



**ARCHITECTURE  
OF TERRITORY**

**HINTERLAND**

ETH Zurich DArch  
FCL Singapore

Assistant Professorship of  
Architecture and Territorial Planning  
Project 1, 2012–2013

Milica Topalovic  
Martin Knüsel, Marcel Jäggi

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Singapore, Johor, Riau





Riau Archipelago with Batam's Baniang Bridge in the background



Singapore Strait as seen from the Marina Bay Sands



Pasar Gudang, Johor with the Johor Strait and the skyline of Singapore in the background



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## Research Project

During two semesters in 2012 the research on the tri-national region of Singapore, Johor and Riau was carried out with students from the ETH Zurich, collaborators, experts and guests.

### Teaching Team

Asst. Prof. Milica Topalovic, Martin Knüsel, Marcel Jäggi

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### Special Thanks to Experts,

#### Collaborators and Guests

BAPPEDA BATAM (Municipal Planning Authority of Batam): Wan Darussalam, Rahmat Kurniawan, Agung Aidil Sahalo, Azril Apriansyah  
UNRIKA BATAM (University of the Riau Archipelago): Hanung Nugroho, Disha Nuralmer, Rino Purna Irawan, Tri Sutrisno, Purwono Budi Santoso, Sigit Wardoyo, Yuga She Uchul, Rozaini Zai, Andri Aan Sofian, Agus, Hadi, Rino Gade  
UTM (University of Technology Malaysia)  
FACULTY OF BUILT ENVIRONMENT: Ho Siong, Chau Loon Wai, Abdul Rahim Bin Ramli, Ibrahim Ngah  
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AND: Joshua Bolchover, Goda Budvytyte, Paolo Cuochi, Cuthbert Choo, ChemGallery

Jurong Island, Andy Hauw, Lee Chee Hock and Lee Chee Wee of the Hock Wee Nurseries,

Poison Ivy, Sree Kumar, Marie Laverre, Charles Lim, Patricia Lim Pui Huen, Gordon Mathews,

Mary Ann O'Donnell, Till Paasche, Bas Princen, Colin See, Sharon Siddique, Edgar Tang, Henrik Tieben, Marc Westhof, Jolovan Wham

## Book Colophone

Eight different works on the hinterland were prepared by the students and are brought together in this book.

### Editors

Milica Topalovic, Martin Knüsel, Marcel Jäggi, Stefanie Krautzig

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### Graphical Revision

Stefanie Krautzig

### English Lectorate

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The Strait of Singapore, downtown skyline on the horizon, 2011, Bas Princen

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## Introduction

### Riau Province - Indonesia: Batam Industrial Island

Livio De Maria & Stephanie Schenk

### Singapore Strait - Malaysia, Singapore, Indonesia: The City in Front of a City

Martin Garcia & Magnus Nickl

### Johor State - Malaysia: Hinterland vs. Capital

Giulia Luraschi & Karl Wruck

### Sand: Construction of Territory - Singapore's Expansion into the Sea

Lino Moser & Gabriela Schär

### Water: The Water Scarce - A Record of Dependencies

Pascal Deschenaux & Simon Zemp

### Food and Agriculture: Growing Out - Singapore's Food Supply

Desirée Dampont & Caroline Schillinger

### Human Resources: Conducting Human Resources - Migrant Workers in Singapore

Ahmed Belkhdja & Saskja Odermatt

### Energy and Oil: The Extended Strait - Singapore's Oil Hub

Martin Garcia & Magnus Nickl





Throughout history, cities have functioned as centres of political and economic power, from which the agricultural and resource-rich hinterlands were controlled. From the nineteenth century onward, new technologies, transportation modes and the opening of trades have introduced a remarkable complexity to the relationship between cities and hinterlands. Today, it is often thought that cities rely decreasingly on surrounding territories for supply and subsistence. Instead, they seem emancipated from the constraints of geography, operating in a global web of dependencies. By contrast, the research presented in this book is based on a hypothesis that an understanding of the city-hinterland relationship, the ability to conceptualize it in qualitative terms, and to influence it by means of planning and design strategies, is central in addressing urban sustainability.

Singapore's hinterland in the tri-national region of Singapore, Malaysian State of Johor and Indonesian Riau Archipelago has served as the paradigmatic research case. At first glance, the island city-state is the city without a hinterland. Certainly, it is a city whose production grounds and access to resources lie beyond national borders. The economic incorporation of proximate areas in Malaysia and Indonesia has remained both a necessity and a profitable opportunity for Singapore.

The book is an extensive, well-documented and illustrated report on field investigations and studio work carried out with fourteen students of the ETH Department of Architecture in 2012. Our cross-border expeditions in the tri-national space of Singapore-Johor-Riau enabled a collection of many original case studies, which together give an alternative portrait of the city-state. The book does not represent the accustomed view of Singapore as an island developed on the paradigm of a global city, but as a city whose present and future are tightly connected to its metropolitan region. Beyond the specific case, the book is a rich source for redefining the notion of the hinterland at the start of the twenty-first century.

### Architecture of Territory

Set up as a long-term research, Architecture of Territory is an investigation of processes and phenomena of territorial urbanization. Though already in the 1970s, Henry Lefebvre was one of the first to introduce a thesis on an all-encompassing and complete urbanization of the world, within the disciplines of architecture and urbanism urbanization was generally understood as equivalent to the growth of cities. According to the UN population statistics, since 2008, for the first time in history, more than half of the world's population lives in cities. Correspondingly, concerns with the management and the consequences of urban growth have become a commonplace, even a cliché, both in the academic community and among policymakers. The feeling of urgency regarding the urban has been instrumental in channelling vast amounts of research energy and ample amounts of public and corporate funding into seeking urban solutions and technologies for the "future cities," "smart cities," etc. Indeed, the Future Cities Laboratory in Singapore where this book is being made, is part of this trend.

At the same time, another strand of research within architecture and urban disciplines is gaining in importance. It comprises a shift of interest from cities to what was once considered the non-urban realm or the city's "constitutive outside:" the hinterlands, rural countryside and "nature," including alpine zones, jungles, deserts and oceans. Recent publications and new research initiatives (such as the Architecture Workroom Brussels and the Urban Theory Lab at the Harvard GSD) speak of increasing interest among architects to work in larger scales and beyond the limits of a city. Following this line of inquiry, the Architecture of Territory looks beyond the areas of "concentrated urbanization" that comprise various forms of contemporary urban agglomerations, and investigates urban transformation processes characteristic of the counter space, the field of "extended urbanization."

### Singapore's Hinterlands

In mid 2011, the start of the program was marked by the launch of the first research theme, The Hinterland, with the tri-national region of Singapore serving as the case study. The project focused on Singapore's urban impact beyond its national borders, through economic incorporation of territory and labour of the neighbouring provinces of Riau Archipelago and the State of Johor. The research was linked together with teaching and intensive fieldwork in the format of design research studios. During the ETH spring semester 2012, the investigation of Singapore's hinterland focused on the theme of Productive Territories. These are the territories and corresponding organisational forms of economy that function in the fragmented tri-national situation, thriving on the wealth gap and other socio-economic and political differences among the neighbouring cities. During the autumn semester 2012, the hinterland investigation was shaped through the lens of Resources. The origin, the flows, "the map" and other territorial dimensions of the five key resources for Singapore - soil, water, food, energy and human labour - were studied in depth.

The research on the metropolis-hinterland phenomenon can be roughly divided into two strands addressing different territorial scales. The first concerns "the geographical hinterland," the continuous but differentiated urban surface surrounding the metropolitan core. The second, the discontinuous hinterland, is generally understood less as a spatial phenomenon, and more as a system of transnational flows. Thus it can also be termed "the socio-metabolist hinterland."

### SiJoRi, the tri-national Region

During the course of work the hinterland notion was broadened to include the concept of the cross-border region. It became clear for example that Singapore-centric view implied by the hinterland investigation is not precise, and that the space of Singapore, Riau and Johor comprises multiple centres and requires multiple views. The concept of the cross-border region is projective, it allows for multiple viewpoints

of the cross-border region is projective, it allows for multiple viewpoints and for interaction with various existing actors, plans and projects. Singapore's relationship with its immediate, geographical hinterland is manifest in the cross border region, popularly SiJoRi, now counting more than eight million legal residents and an unspecified migrant population. In the late 1980s, SiJoRi emerged as a political construct among Singaporean, Malaysian and Indonesian governments to acknowledge the process in which Singapore's economy had begun to expand over its borders. Today, despite the high degree of economical synchronization in the region, the political articulations of common interests in form of cross-border governance bodies, joint development plans, or even maps, remain scarce or non-existent. The tri-national logic of separation in which the territory is presently organized obscures the logics of cross-border continuities and dependencies, which are vital for each of the sides involved. The political fragmentation of territory stands in contradiction with the underlying economic interests. As part of the research, the patterns of production in the region (Productive Territories) were in focus, especially the electronic manufacturing, shipping and petrochemical industries. Several case studies (notably the Batamindo Industrial Park located on the Indonesian side of the border in Batam, a home to around 70 global corporations and over 70,000 employees) have shown the role of Singapore as the regional managerial centre and regional and global distribution hub. Similarly, case studies of food and water production and trade have revealed Singapore's close ties with both Riau and Johor.

#### Global City Frontiers

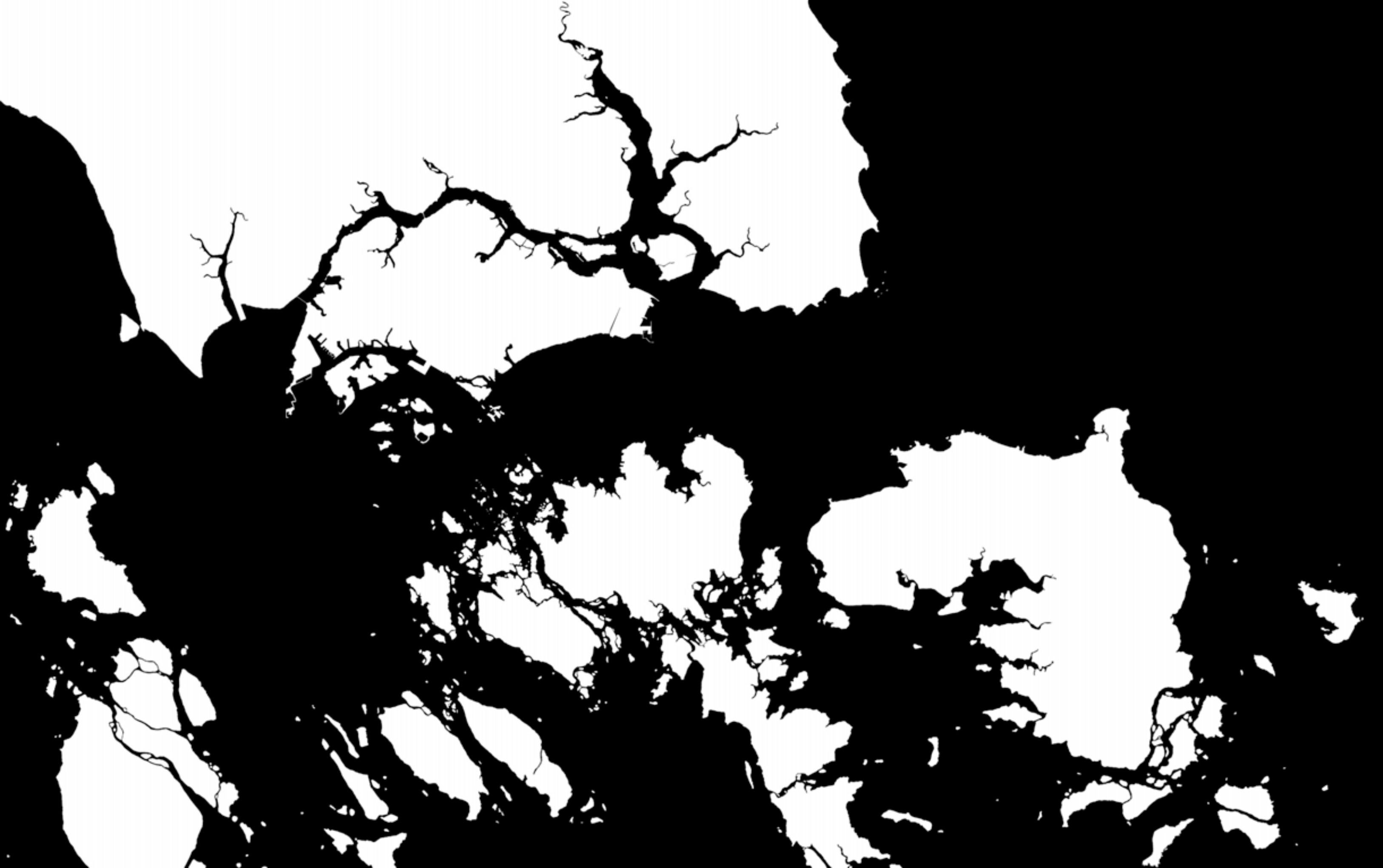
Different realities occur in geopolitical context, where some of the resource flows to and from Singapore were sketched out. Though in 1965 after the independence it had looked like Singapore had near-zero chance of survival, being a state without natural resources and raw materials, a paradigm shift in thinking about the country's external relations had already occurred by the early 1970s. The shift was registered in the words of the first foreign minister of Singapore, Sinnathamby Rajaratnam:

"Once you see Singapore as a global city, the problem of hinterland becomes unimportant, the world is the hinterland." He thus foreshadowed Singapore's growing emphasis on connectivity and on being a hub. The flows of sand, energy and labour shown in the study can be seen as key examples that locate Singapore as the centre in global exchange networks.

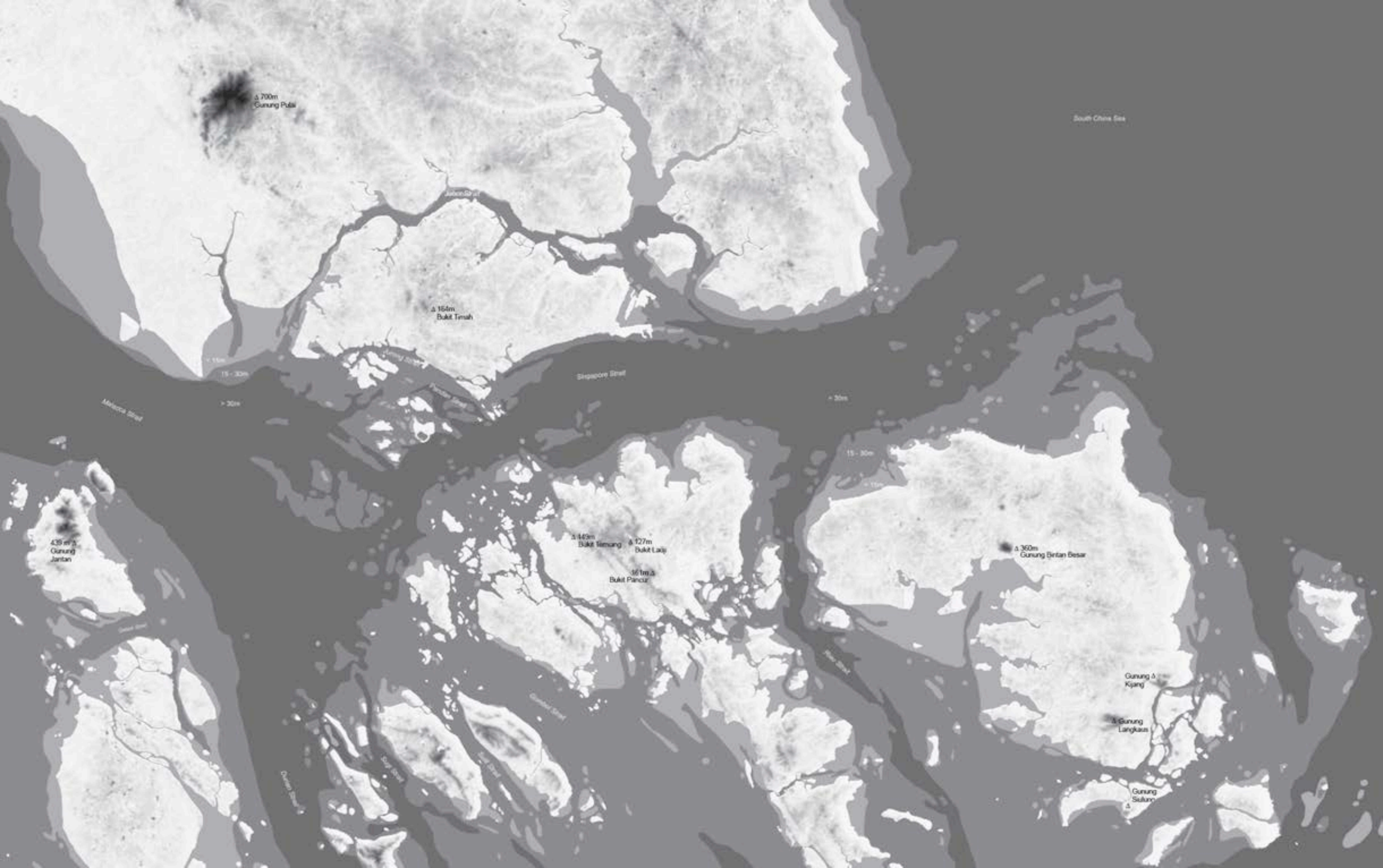
Clearly, the hinterland of Singapore is a tangible phenomenon that can be observed in various territorial scales. The city-state is the driving force behind the industrialization and urbanization of the neighbouring territories of Malaysia and Indonesia, forming its geographical hinterland. Substantial resources that cannot be secured in the immediate geographical frame are being supplied to the city from larger distances, owing to the elaborate networks and infrastructures of exchange. Several unexpected and highly interesting observations have surfaced during the research. We learnt for example how the growth of the city's economy, population and political influence led to enlarging its hinterland radiuses. The central role of Singaporean government in planning and securing the different hinterlands became apparent. It surfaced also that sustenance and commodity agriculture productions have different roles - commodity paradoxically being the only local form of agriculture in Singapore. It became clear that the importance of the immediate regional context for Singapore is often overlooked, in favour of the global city myth.

One of the most important insights concerns our revised understanding of sustainability as a fundamentally territorialized concept. Throughout the work, our team repeatedly observed and documented a lack of instruments and efforts with which sustainable practices could transgress national and other territorial boundaries, and become viable not only locally but across various transnational platforms. Finding paths for moving beyond the Nimby politics towards transnational sustainable systems appears crucial.

Milica Topalovic, August 2013









**Special Economic Zones**  
 Singapore is surrounded by various special economic zones in Johor and in the Riau Islands. Economical and other regulatory incentives have been created within these zones to foster cross-border exchange with Singapore and to attract foreign investment.  
 Special Economic Zones can be understood as territorial devices that maintain Singapore both as the centre of a large industrial region, and as a node in the borderless networks of global economy.





**Industrial Parks**  
Together with other infrastructures, industrial parks are being set up within the Special Economic Zones as facilities for electronic manufacturing and other productive activities. The headquarters of multinational companies are based in Singapore, while the production is carried out on Indonesian or Malaysian territory. Singapore also functions as the supply and distribution hub for resources, material components and final products.









**Water Reservoirs**

There are only few natural water sources within the region around Singapore.

The history of the region's urban growth can be traced back in parallel with the evolution of techniques of water management, which are best articulated in Singapore. The collection of rainwater and water reservoirs for example, present an evolving infrastructure now covering around 70 percent of the island's surface

To avoid water scarcity, Singapore invested vast efforts in building catchment infrastructures also on Malaysian territory. The largest reservoir is the Lingui Dam in a distance of around 100 kilometres to the city.

As much as 40 percent of the water consumed in Singapore is thought to come from the state of Johor, which still complexifies neighbourly relations. Since the early twentieth century, water issues have been in the centre of regional geopolitics.





**Tourist Resorts**  
The region is becoming increasingly touristic. The proximity and competitive prices generate tourist flows from Singapore to popular destinations in Johor as well as in the Riau Archipelago.





#### Golf Courses

Golfing is important for the region. Many tourist resorts are successful because they offer an attached golf course. An astonishing 17 golf courses can be found in the state of Johor Bahru, 11 in the Riau Archipelago and 18 in Singapore.

These numbers indicate that the lower prices offered in Johor, Batam and Bintan attract golfers to cross regional borders.



**Starbucks**  
Global food and beverage chains such as Starbucks Coffee have developed a dense network of coffee shops within Singapore and the presence of Starbucks in the map of the region serves as an indicator for globalisation. The regional success of the brand has encouraged Starbucks' gradual expansions beyond Singapore and into Johor as well as in the Riau Archipelago. In 2012, two Starbucks cafes operated in Batam.



#### Pirate Attacks

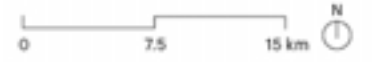
From 2002 until 2007, there have been 258 pirate attacks reported in the Malacca and the Singapore Straits. This vast density made an insurance branch classify the strait as a war zone in 2005, which was later cancelled when surrounding countries increased their security apparatuses.

Compared to Singaporean territory where only one attack happened, the vast majority were executed in Indonesian waters.



**Military Zones**

Singapore is known a highly militarized country. Within its limited national territory, the areas occupied by the military are significant and larger than the areas currently occupied by agriculture for example.









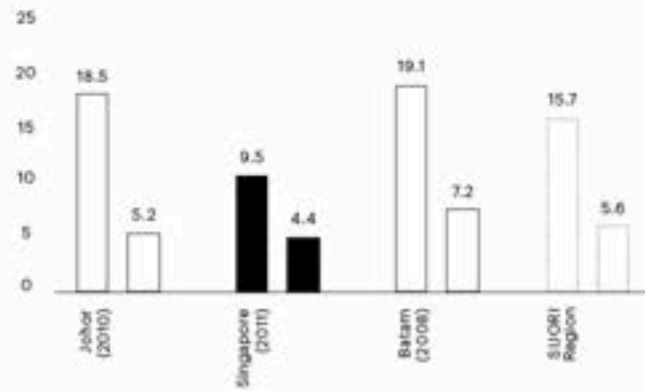
### SIJORI Statistics: Population

Throughout centuries, the Singapore-Johor-Riau region formed a continuous and borderless part of the Malay world. From the early nineteenth century onwards, in the colonial period, different migration dynamics transformed Singapore into a multicultural city with majority Chinese population, and into a multireligious society within the Muslim hemisphere. Today, more than 40 percent of Singapore's resi-

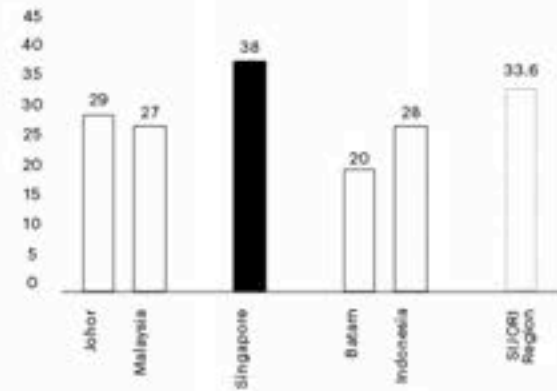
dents are foreign nationals, one of the highest percentages worldwide. Cross-border linkages are still strong between the different parts of the region and among the different communities and ethnic groups.

Due to recent economic growth around Singapore, Johor and especially Batam have experienced an important influx of domestic workforce leading to massive transformation of their respective demographics.

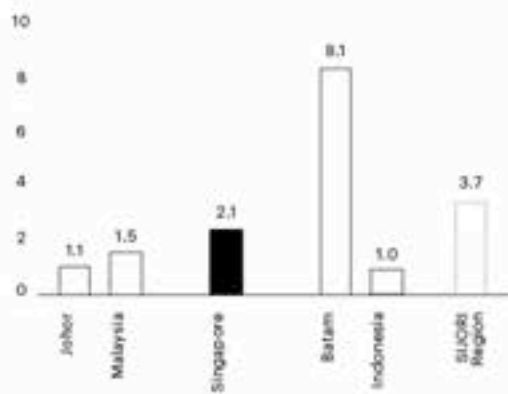
Birth / Mortality Rate



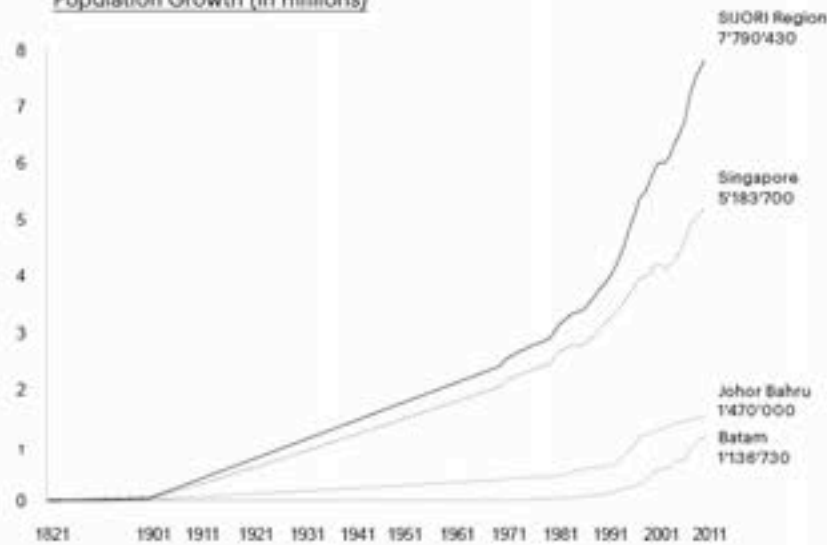
Median Age (in years)



Population Growth (in %)



Population Growth (in millions)

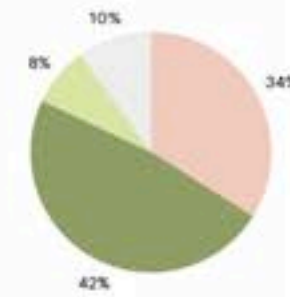


### Ethnic Diversity



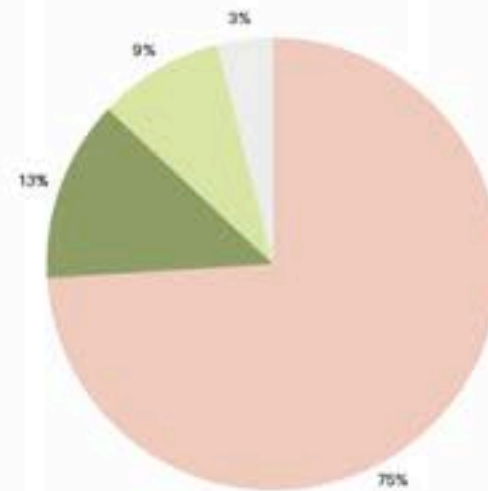
Johor Bahru (2010)

Total Population: 1'470'000



Singapore (2011)

Total Population: 5'183'700



Batam (2008)

Total Population: 1'136'730

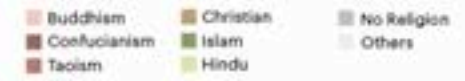


SIJORI Region

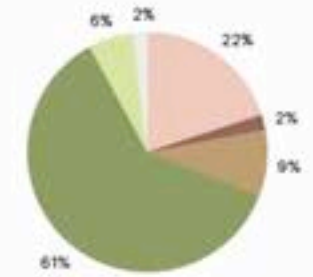
Total Population 7'790'434



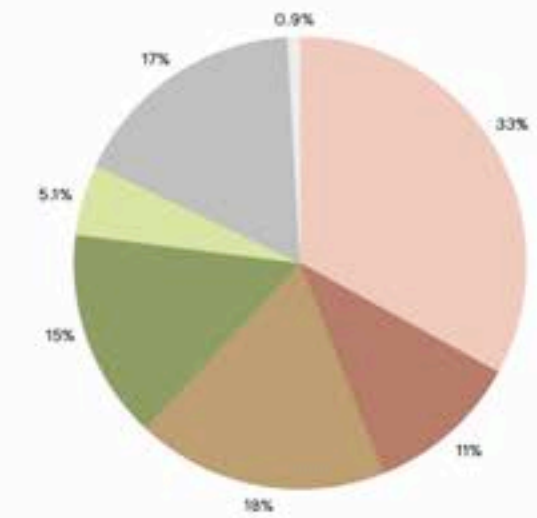
### Religious Diversity



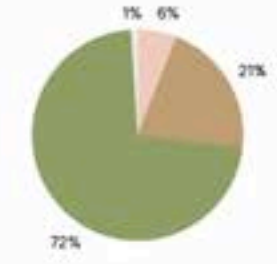
Johor Bahru (2010)



Singapore (2011)



Riau Archipelago (2008)



SIJORI Region

Total Population 7'790'434

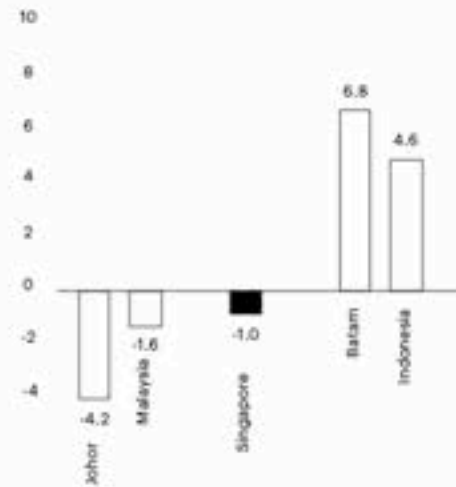


### SIJORI Statistics: Economy

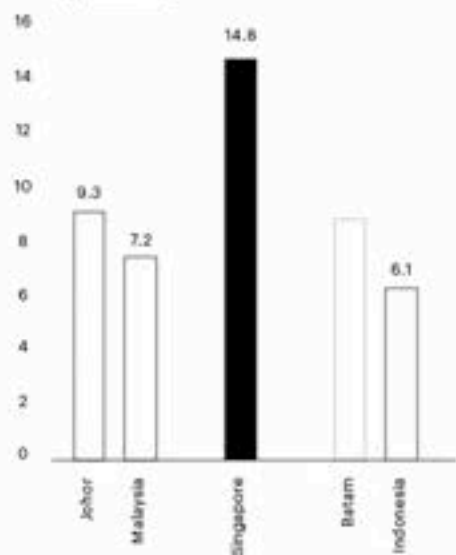
Formerly known as one of the four Asian tiger states, Singapore has updated and reinvented its economical structure at a tremendous speed since its independence in 1965. Its primary location enabled the city-state its positioning as a hub for large scale functions such as container ports, petro-chemical plants, international airport services as well as for financial services.

Since the 1980s, industrial production has been phased out from Singapore and transferred to the neighbouring Johor State and Riau Island Province. The proximity to the global hub as well as the availability of comparatively cheap land and labour attracts investment from Singapore and beyond. The economic activities within these areas can be described as complementary to Singapore.

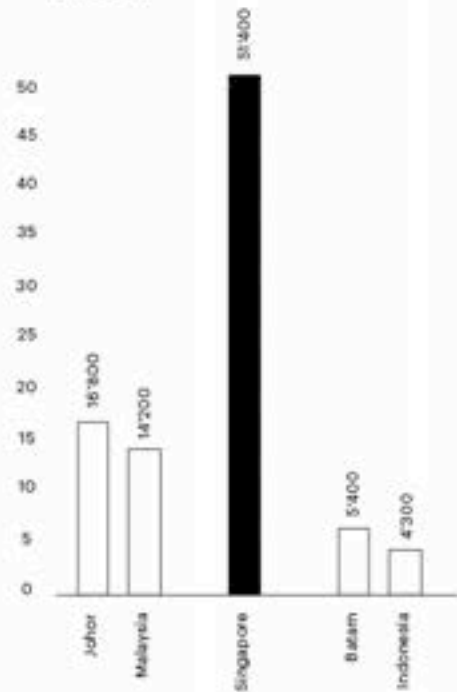
GDP Growth Rate, 2009 (in percent)



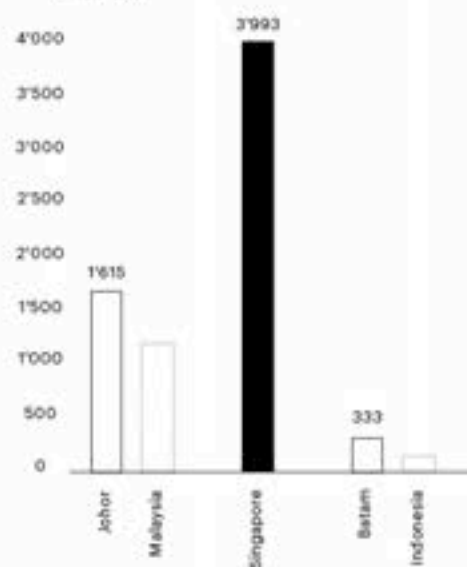
GDP Growth Rate, 2010 (in percent)



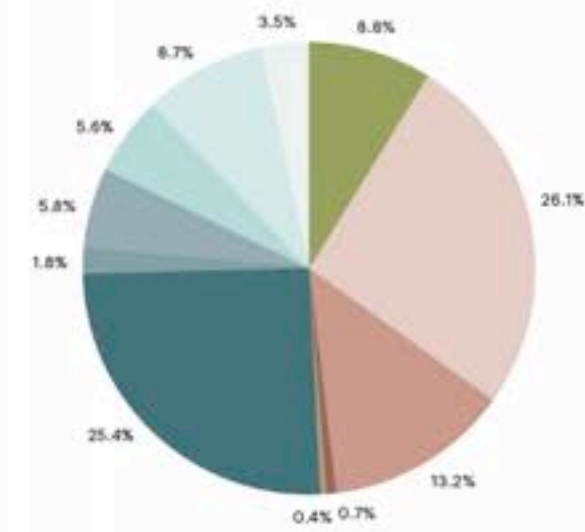
GDP per Capita, 2009 (in USD)



Average Monthly Income, 2010 (in USD)

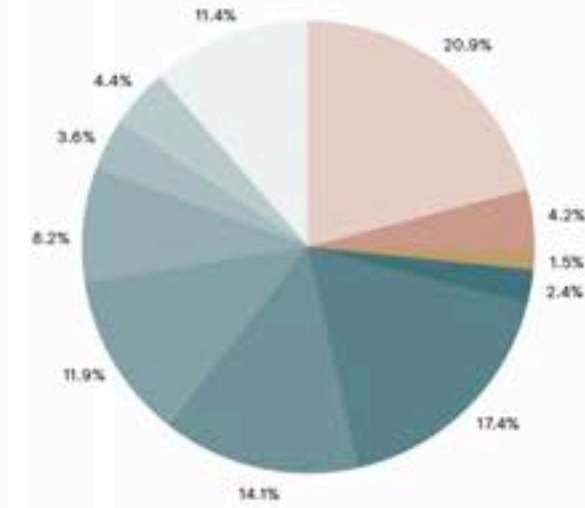


### Sectors and GDP's in the SIJORI Region



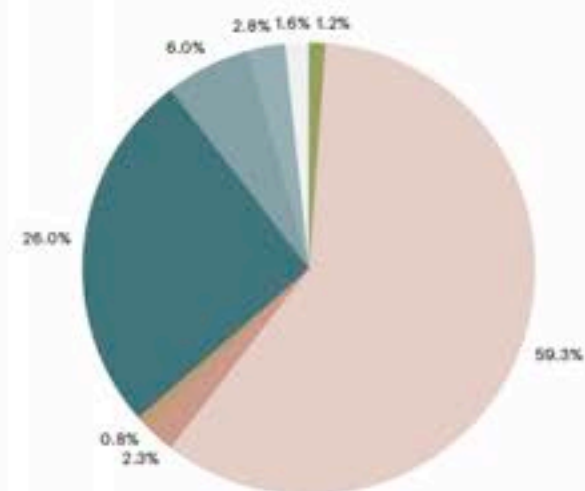
Economic Sectors in Johor (2010)

Agriculture	8.8%
Industry	26.1%
Construction & Building	13.2%
Mining	0.7%
Electricity, Gas & Water	0.4%
Trade, Hotels and Restaurants	25.4%
Financial Service Companies	1.8%
Transport & Communications	5.8%
Public Administration	5.6%
Education, Health & Social Work	6.7%
Other Services	3.5%



Economic Sectors in Singapore (2010)

Agriculture	0.03%
(not represented in the graphic)	
Manufacturing	20.9%
Construction	4.2%
Electricity, Gas & Water	1.5%
Accommodation & Food Services	2.4%
Wholesale & Retail Trade	17.4%
Business Services	14.1%
Finance & Insurance	11.9%
Transportation & Storage	8.2%
Information & Communications	3.6%
Ownership of Dwellings	4.4%
Other Services	11.4%



Economic Sectors in Batam (2010)

Agriculture	1.2%
Industry	59.3%
Construction & Building	2.3%
Electricity, Gas & Water	0.8%
Trade, Hotels & Restaurants	26.0%
Financial Service Companies	6.0%
Transportation & Communication	2.8%
Other Services	1.6%

### Singapore's Resource Suppliers Beyond the National Border

Owing to Singapore's open economy and function as an entrepôt, vital resources including sand, water, food, labour and energy are being supplied from abroad. Every resource has its own strategic hinterlands, which can be found anywhere from the neighbouring sites in Malaysia and Indonesia, over sites within the ASEAN, up to regions in different parts of the world.



## Productive Territories

At first glance, Singapore is a wealthy metropolis with a sparkling urban organization, impeccable social order and a world-class skyline. But this image is anything but complete. For decades, the city-state's expanding economy has required more space and labour beyond its 680 square kilometres territorial limits. Mirroring the growth of Singapore, fast growing "support cities" within the Malaysian and Indonesian borders are characterised by young populations of migrant workers, vast sites of global manufacturing industries, by dynamism and by uncertain futures.

During the ETH spring semester 2012, the investigation

of Singapore's hinterland was conducted under the theme of Productive Territories. These are the territories and corresponding organisational forms of economy that function in the fragmented three-national situation, thriving on the wealth gap and other socio-economic and political differences among the neighbouring countries.

The investigations describe and contest the forms and the rules of urbanism in Singapore's productive hinterlands on three different territories: The Riau Islands Province (Indonesia), the Strait of Singapore (Indonesia, Singapore, Malaysia) and Johor State (Malaysia).



### Riau Islands Province - Indonesia

The island of Batam in Riau Archipelago was designated as Indonesia's first industrial zone in 1971 in order to benefit from the proximity to Singapore. At the beginning of the 1990, Batam remained scarcely inhabited and covered with rainforest. Two years later, several companies had begun manufacturing activities on the Indonesian island and thirty-five more had already agreed to set up activities in an industrial park. At the same time, a second island, Bintan, was added to the scheme and designed to operate as a planned resort. Since then, Singaporean investments have been decisive for the rapid industrialization and urbanization of the two major islands in Riau Archipelago.

The emerging metropolitan region Singapore-Johor-Riau is fast growing, both in terms of population and economy, with a population of around 8 million today. The region is dominated by a strong centre and is profoundly asymmetric: the large landmass of Johor extends to the North, while Riau Archipelago is dispersed to the South; Johor is economically wealthier, it has a longer history and tighter connections to Singapore than Riau. It is estimated that 300,000 residents of Johor Bahru are based in Singapore for work while 150,000 more commute daily to work in the city-state. On the other hand, seasonal workers and maids from Riau work in both Singapore and Johor. Riau Archipelago is dominated by industrial manufacturing (Batam) and tourism (Bintan), while Johor Bahru seems to be transforming into a service economy extending from Singapore. Culturally, the region is unified and part of the Malay world, with the exception of the Chinese dominated city-state.

After its independence in 1965, Singa-

pore rapidly transformed from a relatively undeveloped colonial outpost into one of the most developed nations in Asia. Within three decades, the city-state joined the First World economy, despite its small population, limited land area and lack of natural resources. From early on, it focused on offering cheap labour and welcoming foreign direct investments and Western multinationals. This allowed Singapore to rapidly establish itself, as one of the four Asian Tigers with one of the highest GDP growth rates in the world through the 1970s. Gradually, policymakers sought to switch from the low profit manufacturing of low cost products, toward a production with increased wages, requiring higher skill and higher productivity. During the 1980s, it became clear that the continuing growth of Singapore's economy required more space and workers beyond the limits of the city-state. At the same time, changing political circumstances allowed for an onset of regional economic cooperation. Through the so-called Growth Triangle agreement among the three countries, Singapore offered to provide management expertise, technology, telecommunications and transportation in exchange for land and labour offered by Johor and Riau. As a result, vast tracts of land have been opened up for development, mainly industrial production, dominated by Singaporean investment. Particularly since the early 1990s, the phenomenon of migration of the manufacturing sector from Singapore and the formation of the productive hinterlands in Johor Bahru and Riau became apparent.

Since 2006, the legal format of the cross border cooperation has been refined through the establishment of special economic zones (SEZs) and the free trade zones (FTZs) that have been set up on the Malay-

sian and Indonesian sides in order to further capitalize on the relationship with Singapore. Owing to various incentives, involving tax reduction, abolition of customs duties, possibility of ownership, and certainly the access to land and labour, "the zones" now represent a warm pool for both Singaporean firms and the multinationals.

The study attempts to analyse and describe the productive territory of Batam and Riau Archipelago, the Indonesian side of the metropolitan hinterland.



#### Straits of Singapore - Indonesia, Singapore, Malaysia

The Singapore Strait (Selat Singapura in Malay) is a 105 kilometres long and 6 kilometres wide sea passage linking to the Straits of Malacca in the West and the South China Sea in the East. The Singapore Strait is the most constricted and shallow part of the Malacca Straits, and one of the most strategic global shipping routes, next to the Suez and the Panama Canals. The strategic importance of the Malacca and the Singapore Straits is enormous. More than 50,000 vessels pass through the Strait each year, carrying around one quarter of the world's traded goods, including oil travelling to China from the middle East, Chinese manufactured goods and Indonesian coffee. Experts recognise that if the Straits were to close for just a few days, there would be a major impact on the global economy and the European economy would be paralyzed within a few weeks.

The maritime trade along the Straits has a long history as it has been part of the Maritime Silk Route linking the Mediterranean basin, the Indian Ocean and the Pacific Ocean. From the early fifteenth to the early nineteenth century, the port of Malacca dominated the Straits when its role gradually diminished after the founding of Singapore in 1819. The Straits have not only brought exotic goods and trading opportunities to the region, but also new populations, cultures and religions. As a kind of a middle point between India and China, the Singapore region includes people of Chinese, Malay, and Indian descents, from Muslim, Buddhist and Hindu religions.

The Singapore Straits is maintained and managed by three countries, each responsible for providing security, ensuring safety and protecting the environment. The inde-

pendence of Singapore in 1965 was followed by its economic rise as one of the world's busiest ports, leading to the region's growing economic asymmetry. At the same time, political relationships among the three countries have remained strained and difficult; for example several border disputes along the Straits still remain unresolved. As a result of these complex influences, the space of the Straits is remarkably complex and intricate too; it is highly regulated, criss-crossed by hard borders, and fragmented into various restricted zones. The Indonesia-Singapore border lies along the Straits, thus the busiest shipping route overlaps with a national border, and cross traffic of people and goods from one country to another constantly interferes with the through traffic of international shipping. By contrast, the space of the Straits has been much more open for local travel in the past and the fragmentation is a novel and arguably a strengthening phenomenon.

The Straits is also a microcosm of local activities, where next to ports, shipyards, and bunkering stations (fuel stations for ships), one finds petroleum, sand and stone extraction sites, waste disposal sites and military installations as well as tourist resorts, heritage locations and uninhabited islands covered by mangrove forests. In the past, the area was notorious for piracy. Today, this is also an area where the strict national laws in Muslim countries (against gambling and drinking in particular), are diluted in the free zone provided by the Singaporean waters.



#### Johor State - Malaysia

Johor Bahru is a city of nearly two million people developed along the Straits of Johor and the Causeway leading to Singapore. It was founded in 1855 in response to the growing demand by the Singapore port for jungle timber, and for cultivation of rubber and pepper. Throughout the nineteenth and the twentieth centuries until today, the relationship between the two cities has remained close and complex, showing a combination of political rivalry and economic integration. Johor Bahru is today a fast growing city on Singapore's periphery, with a dual character as a productive hinterland and a suburban area linked to the metropolitan core.

The emerging metropolitan region Singapore-Johor-Riau, is fast growing both in terms of population and economy, with a present population of around 8 million. Though dominated by a strong centre, the region is profoundly asymmetric: the large land mass of Johor extends to the North, while Riau Archipelago is dispersed to the South; Johor is economically wealthier, it has a longer history and tighter connections to Singapore than Riau. It is estimated that 300,000 residents of Johor Bahru work and live in Singapore, and 150,000 commute daily to work in Singapore. On the other hand, seasonal workers and maids from Riau work in both Singapore and Johor. The Riau Archipelago is dominated by industrial manufacturing (Batam) and tourism (Bintan), while Johor Bahru is transforming into a service economy extending from Singapore. Culturally, the region is unified and part of the Malay world, with the exception of the Chinese dominated city-state of Singapore.

After its independence in 1965, Singa-

pore rapidly transformed from a relatively undeveloped colonial outpost into one of the most developed nations in Asia. Within three decades, the city-state joined the First World economy, despite its small population, limited land area and lack of natural resources. From early on, it focused on offering cheap labour and welcoming foreign direct investments and Western multinationals. This allowed Singapore to rapidly establish itself, as one of the four Asian Tigers with one of the highest GDP growth rates in the world through the 1970s. Gradually, policymakers sought to switch from the low profit manufacturing of low cost products, toward a production with increased wages, requiring higher skill and higher productivity. During the 1980s, it became clear that the continuing growth of Singapore's economy required more space and workers beyond the limits of the city-state. At the same time, changing political circumstances allowed for an onset of regional economic cooperation. Through the so-called Growth Triangle agreement among the three countries, Singapore offered to provide management expertise, technology, telecommunications and transportation in exchange for land and labour offered by Johor and Riau. As a result, vast tracts of land have been opened up for development, mainly industrial production, dominated by Singaporean investment. Particularly since the early 1990s, the phenomenon of migration of the manufacturing sector from Singapore and the formation of the productive hinterlands in Johor Bahru and Riau became apparent.

Since 2006, the legal format of the cross border cooperation has been refined through the establishment of special economic zones (SEZs) and the free trade zones (FTZs) that have been set up on the Malay-

sian and Indonesian sides in order to further capitalize on the relationship with Singapore. Owing to various incentives, involving tax reduction, abolition of customs duties, possibility of ownership, and certainly the access to land and labour, the 'zones' now represent a warm pool for both Singaporean firms and the multinationals.

The study attempts to analyse and describe the productive territory of Batam and Riau Archipelago, the Indonesian side of the metropolitan hinterland.

## Resources

After its independence in the early 1960s, it looked like Singapore had low chances of survival because of its lack of natural hinterland and material resources. But today, on the surface at least, the city appears to defy limitations.

Owing to its open economy and function as an entrepôt, vital resources including labour, energy and food are being supplied from the outside. No doubt, Singapore's excessively controlled and technologically oriented urban model represents a specific answer to its restricted context. Looking further, across the city-state's borders, it is apparent that Singapore's economy uses land and labour far beyond its territorial limits. Its strategic hinterlands (agri-

culture zones, water sources, sand quarries, etc) are found anywhere from the neighbouring areas of Malaysia and Indonesia, to sites in Cambodia, China and the Middle East.

During the ETH autumn semester 2012, the hinterland was described through the thematic lens of Resources. The origin, the flows, "the map" and other territorial dimensions of the five key resources for Singapore – sand, water, food, energy and human labour – were the focus of the study.

The investigations have shown the manner in which each of the vital resources is increasingly sought by the city-state in a geopolitical frame in the ASEAN countries and beyond.



### Sand - Creation of Wealth by Expanding Territory

The reclamation of land is a long-standing practice in Singapore that had its first imprints in the island's coastline in the 1820s, during the colonial period.

Efforts to reclaim land have increased significantly since Singapore's independence in 1965; the land area of Singapore has grown from 581 square kilometres in 1957 to 775 square kilometres today, adding 25 per cent to the original land area. For 2030, a goal to create an additional 100 square kilometres of land has already been set by the government.

The urban use of the reclaimed areas is extremely diverse: large expanses of reclaimed industrial land are located in the area of Jurong; in the downtown, the most attractive business and commercial areas are reclaimed, too. Strategic infrastructures and facilities, such as large parts of the Port, the Changi Airport and the military zone of Pulau Tekong are constructed on reclaimed land. In the end, land reclamation is also a tool for increasing the housing density: along the East coast, housing and recreation areas are built on a wide strip of land, which did not exist before.

In the past, the common strategy for providing material for the new land was by flattening the hills in Singapore's inland areas. This particular phenomenon known as the 'cut and fill' method contributed to a complete, tridimensional transformation of Singapore's topography: in order for new land to be built, the old land had to be demolished and built from scratch as well. In the process, numerous coastline villages, mangroves and marine habitats have vanished. While in economical terms, the radical

treatment of Singapore's urban surface was a success and presented a mechanism for generating wealth, culturally, the island and the city have been transformed through a *tabula rasa*: a place without history.

An important feature of the land reclamation process is that over time, it becomes technically more difficult, more costly and requires more and more sand. The older reclamation projects were carried out in the zone in the coastal zones with depths between 5 to 10 meters, but as the coastline moves further and further into deeper waters, going to zones with the depth of 15 meters or more is now required. Singapore has not been able to meet its needs for sand for some years and therefore imports from other countries in the region. Topping the list of exporters to Singapore today are Malaysia, Cambodia and Vietnam with 3.8 to 5.8 million tons (in 2008).

Overshadowing Singapore's reputation as the single biggest importer of sand in the world are the detrimental aspects of sand trade. Due to environmental and political impacts of vanishing lands, nearly all countries in the region with the exception of Myanmar and China have placed official bans on sand trade with Singapore. In spite of this, the trade seems to continue in an informal manner, with a silent approval by local governments and authorities, helped by corruption.

Major protagonists of the land reclamation projects in Singapore are state agencies, in particular the Housing Development Board (HDB), the Port of Singapore Authority (PSA), and the Jurong Town Corporation (JTC); the state is thus the designer and the creator of its new territories. The production of the new land is a necessity in view of the high population density and the limited surface for growth. While the newly built sites

generate high revenues for the state due to their prime locations, the production of land can be seen as one of the most lucrative businesses for the entrepreneurial state. As long as the territorial boundaries are not violated, and despite all the misgivings, it appears that Singapore will continue to rely on land reclamation as the key mechanism for an ongoing reinvention of its urban environment and for the creation of wealth.

The goal of the work was to investigate and describe the phenomena of sand trade and land reclamation in Singapore and the region. The study represents the architectural, urbanistic, economical and cultural characteristics of the artificial landscapes reclaimed from the sea.



#### Water - Controlling the Territory with Water

Singapore has no natural water sources, and the history of its urban growth can be traced in parallel with the evolution of techniques of water management. The first reservoir in Singapore, the MacRitchie Reservoir, was completed in 1868 to supply the booming new port under the British. Two similar waterworks, The Lower Pierce Reservoir, and the Upper Seletar Reservoir were completed in the early twentieth century. In the 1930s, Singapore also began to look for water sources in the neighbouring Sultanate of Johor. From rented land properties in Johor, a strategic supply for the city was then created via a pipeline that was laid along the Causeway on the Johor Straits.

In 1961 and 1962, in the eve of its independence, Singapore had managed to secure two vital, long term water contracts with its northern neighbour: the first contract valid until 2011 allowed the leasing of nearly 3000 hectares of land for the purpose of harvesting water, while the second contract valid until 2061, still guarantees Singapore an access to 250 million gallons per day from the Johor river. At the time of the independence, 80 percent of Singapore's fresh water came from Malaysia, underscoring Singapore's extreme vulnerability and the political dimension of water in the neighbourly relations. Malaysian Prime Minister Tunku Abdul Rahman had expressed this in great clarity in 1965, when he said: "If Singapore's foreign policy is prejudicial to Malaysia's interests, we could always bring pressure to bear on them by threatening to turn off the water in Johor."

In the years to follow, this vulnerability became a motive for Singapore to develop its local water resources. The Public Utilities Board, created in 1963, embarked on the

construction of more water schemes inside Singapore. They included the damming of river estuaries to allow for greater storage volumes. After a series of political twists and turns over the year in negotiations with Malaysia, the city-state had decided to achieve a complete self-sufficiency in its water supply before 2061.

In the past ten years, two new technologically sophisticated strategies for saving and providing water were added to Singapore's water management repertoire: water reuse (the so called creation of NEWater by reclamation) and desalination of sea water. New facilities including the reclaimed water plants and the seawater desalinations plant were built in the early 2000s.

With this, Singapore's current national water policy called the "4 Taps" was put to effect. The first and second taps refer to local water catchments and water imports. The "Third Tap" is reclaimed water, while the "Fourth Tap" represents desalination. In 2010, the "largest taps" were the imported water with providing the 40 percent of the total supply, and reclaimed water with 30 percent. In the future, as the demand to water grows, Singapore expects to reduce its dependency on water imports.

Perhaps the most impressive among the water management strategies in Singapore has been the increasing efficiency of use and conservation of water, leading to the reduction of water consumption per capita since the mid 1990s. For example, through public education and campaigns urging people to conserve water, consumption has been reduced from 165 liters per person per day in 2003 to 155 liters in 2009. The target is to lower it to 140 liters by 2030. The level of water losses is also one of the lowest in the world at only 5 percent.

Water management strategies are the most important influence determining the shape and form of Singaporean territory: water is collected from more than two thirds of the island's surface. This is a physical image of completely designed and engineered territory and a powerful illustration of "total control:" a planning and development system fully in the hands of the state.

The goal of the work was to shed light on the complex process of shaping Singaporean territory through its water strategies.



#### Food & Agriculture - Between Local and Global Hinterlands

Being a land-scarce nation devoid of any natural resources, Singapore imports around 90 percent of the food it consumes. The almost complete absence of agriculture, livestock farming and aquaculture, combined with the need to feed the population of over 5 million together with some 13 million tourists per year has stimulated the food imports from neighbouring Malaysia, Indonesia and other countries. As Singapore plans to grow in the next decades, the dependency on foreign food sources will only increase.

Half a century ago, nearly a quarter of the country's territory (then 140 square kilometres) was still devoted to agriculture. After the independence in 1965, the city-state in cooperation with the United Nations Development Programme (UNDP) and other international agencies, undertook huge efforts in order to increase its food production. Shortly after, the local food production was able to fully meet the demand for eggs, poultry, pork and half of the leafy vegetable.

By the mid 1980s however, less than 50 square kilometres of the agricultural land remained in use, which represented 1,6 percent of Singapore's total land area. Today agriculture contributes to 0,2 percent of the GDP in Singapore and provides employment for only 0,2 percent of the total workforce. These low-cost foreign labourers work on Singapore's 200 farms.

Two major features characterize the extreme transformation of Singapore's agriculture sector. On one hand, due to the rapid growth of the built-up area and industries, agricultural land was reorganized and moved further away from the urban core to the so-called hinterlands of the island. For instance pig farmers were grouped and resettled to

Punggol District in the central north tip of Singapore, before being totally phased out in the late 1980s. On the other hand, agriculture activities were partially regrouped in two specific areas of the island, Lim Chu Kang District and Mandai hills, where flower cultivation and fish farming were developed over the time.

Most of agriculture and fishing was outsourced abroad to the proximate hinterlands in Malaysia and Indonesia, as it has also been done with the manufacturing sector. A growing number of Singaporean companies, such as the supermarket chains are active in the region, contracting out or investing in food production for Singapore.

Singapore allows free import of food supplies and products but as a country reputed for safety and hygiene, it has strict regulations ensuring safety of food imports. The major governmental bodies controlling the food trade are the Agri-Food and Veterinary Authority of Singapore (AVA) and the Food Control Department.





#### Human Resources - Transnational Work Migration to Singapore and the Region

The mixing of ethnicities and the high proportion of migrant labour among Singapore's population is a historical phenomenon. When Singapore became independent from the United Kingdom in 1963, most of the new Singaporean citizens were uneducated workers from China, Malaysia and India. Many of them were seeking to earn some money in Singapore and had no intentions of staying for good. After the independence, the process of crafting a Singaporean identity and culture began. Both the former Prime Ministers of Singapore, Lee Kuan Yew and Goh Chok Tong, have stated that Singapore does not fit the traditional description of a nation, calling it a society in transition. Certainly, the highly mobile, multiethnic and global character of Singapore's population continue to be the main social characteristics of the city-state. According to the recent government census, Singapore's population consists of 74.2 percent Chinese residents, 13.4 percent Malay, 9.2 percent Indian descent residents, while Eurasians and other groups form 3.2 percent. The present population of Singapore is around 5.18 million people, of whom 3.25 million (63 percent) are citizens while the rest (37 percent) are permanent residents or foreign workers.

While Singapore is historically marked by the influx of migrant population, it is fascinating that its economy today, more than ever, depends on import of both labour and inhabitants. Nearly half (47.9 percent) of the Singaporean workforce today is comprised of foreigners, and this number is expected to increase in the future, due to the decline and ageing of Singaporean citizens. Singaporean government estimates that 30,000 migrants

per year are needed in order to maintain the constant size of the workforce in Singapore; the actual immigration statistics in the past decade confirm these projections.

More than one million foreign workers currently in Singapore are from a relatively heterogeneous group. A smaller proportion belongs to elite high skilled professionals, the so-called ex-pats, but the majority (nearly 900,000) consists of low-skilled workers, especially the construction workers, domestic helpers, etc. The workforce originates from countries in the region, such as Malaysia, Indonesia, China, Bangladesh, the Philippines, Thailand and Vietnam.

Elaborate transnational systems of workers' recruitment form an invisible structure behind the presence of thousands of foreign workers in Singapore. Various protagonists play a role in this system, starting with local recruitment and training agencies, to employment agencies in Singapore.

The temporary working contracts (usually 2-year duration) and high commissions that workers pay in order to enter the process, are just two among many different rules with which the foreign workers employment is regulated in order to provide high security and lower risk both for the Singaporean state and the employing firms.

The political consequences of foreign labour are not to be underestimated. While attracting foreign talent has been important for Singapore's position as a global city, immigration and income inequality have also emerged as pressing issues. The need to strike a balance between openness and local concerns presents one of the most critical political challenges for Singapore. The sensitive problematic of the foreign labour is perhaps best understood by looking at urban spaces of foreign workers and their relation

with the rest of the city. Even at first glance, a separation of spaces of resident and low skill foreign worker populations is noticeable. In the case of foreign construction workers, a separation of living, working and socializing spaces, along with exclusive means of transport and various services, such as the ATM machines, reinforce a perception of parallel urban spaces, carefully kept at a distance from the rest of the city through planning and regulatory instruments.

The goal of the work was to shed light on the complex phenomenon of transnational work migration in Singapore, and to investigate and describe the architectural, urbanistic and social characteristics of spaces in the city used and adapted by the foreign workers.



#### Energy & Oil - Towards a Global Energy Hub

Ever since its independence in 1965, Singapore has been importing nearly all the energy it consumes. Today, its electricity is generated from around 80 percent of natural gas and 20 percent of petroleum imports.

Not only is Singapore completely dependent on imported energy sources; the city-state actually imports more than double the amount of energy it spends for consumption. The reason behind this surprising strategy is the booming petrochemical sector on the island, developed since the 1970s and strongly expanding since the mid 1990s. At the time when electronic manufacturing in Singapore was beginning to lose its international competitiveness, the Singaporean government identified existing potentials for developing the export oriented petrochemical industry. Being one of the biggest harbours in the world, having strong banking and insurance sectors, political and economical stability and China as a fast emerging market in the region, have proven to be the key factors in establishing a strong oil industry on the island.

Today, Singapore is developing toward one of the biggest oil and gas hubs in the world. It is considered to be the world's top bunkering port and the third largest oil-trading centre with more than 800 professional oil traders working on the island. Besides, Singapore is also one of the major oil refinery centres in the world. In total, the oil sector creates nearly 20 percent of Singapore's exports and represents one of the strongest pillars of the economy for the city-state, paradoxically, without sourcing a single drop of oil within its territory.

The history of the oil industry in Singapore began in 1891 with Shell as an oil bun-

king pioneer, supplying shipping companies with fuel oil. Around the steadily growing oil trade on the island, various oil related spin-off sectors emerged in the last decades, such as the petrochemical industry, oil and gas equipment manufacturing and rig manufacturing. Singapore for example now owns 60 percent of the world's oilrig market.

On the one hand, Singapore's development toward a diversified and complex oil hub appears as an imported construct; on the other hand, the ideal local conditions have made it attractive and prosperous.

The goal of the work was to describe the character of the energy system in Singapore and the region, and to speculate its implications on the global scale. Is Singapore becoming a global petrochemical hub? Secondly, the study investigated the urban impact of petrochemical facilities and infrastructures in Singapore.

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Unless stated otherwise, all diagrams and photographs are original to this book. Original photographs are the work of instructors and students of Architecture of Territory during spring and autumn semester 2012. All satellite images are taken from Google Maps and Google Earth.

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Masterplan data are provided by the Urban Redevelopment Authority (URA) Singapore; the Batam Masterplan data and statistical data are provided by the Municipal Planning Authority Batam (Bappeda Batam); all information on the sea is derived from nautical charts purchased through DPM Singapore, United Kingdom Hydrographic Office and the Maritime and Port Authority (MPA) Singapore.

We apologize for missing credits, which were not submitted by the authors of respective chapters by the date this book was printed.

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Architecture of Territory  
ETH Zurich  
FCL Future Cities Laboratory

Hinterland  
Singapore, Indonesia, Malaysia  
Project 1, part 1

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# BATAM INDUSTRIAL ISLAND

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## Conclusion

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Batam is located on the south of Singapore separated only by the Singapore Straits, one of the most important shipping lanes in the world. The strait is the main shipping channel between the Indian Ocean and the Pacific Ocean linking major Asian economies such as China, Japan and South Korea with the western world. More than 72'000 vessels pass through the strait every year, carrying about one-quarter of the world's traded goods.

The Indonesian Riau Archipelago consists of a total of 1248 islands that are divided in to three municipalities Karimun, Bintan and Batam. With a distance of only 20 kilometers, Batam is one of the closest Indonesian island to Singapore. Batam is the largest city in the Riau Island Province and consists more than 370 islands. It has been developing rapidly, attracting many international firms and factories, followed by large migration inflows from people from all over Indonesia. Many young Indonesians come to Batam looking for work, mainly in the industry sector. Both Karimun and Bintan have a population of around 200'000 people, however Batam stands out with 1.3 million inhabitants.

Through its early economic efforts since the 70's and its early trading agreements to achieve a cooperation with Singapore, Batam now holds the most industrial companies in the Riau province. According to the research focus on productive hinterlands of Singapore, the geographical focus within our work has been set on Batam.

# Fields of Gravity

Since the beginning of its extensive industrialization, Batam's identity has been strongly influenced by its dependency on Singapore as well as its political affiliation to Jakarta. Recognizing Singapore not only as a hub, but also as a doorway to global markets, Batam and Indonesia's government have been developing various forms of Special Economic Zones in the last 40 years in order to profit from its relative location.

Batam's character has been affected by its fast growth and conflictive aspiration to meet the needs and interests of both Jakarta and Singapore. This bipolarity is visible on different levels, like in Batam's local government, who has two planning authorities, which obscures their fields of responsibility. Also the retrieval of an its own identity remains difficult due to the constantly changing body of residents, which depends on the current

economy driven mainly by Singapore. All this gives Batam a particular character, which differs from the rest of Indonesia.



## Crossing the Gap

Crossing the mere 20 kilometres that separate Singapore from Batam allows travellers to enter completely different worlds.

Leaving the Singapore Harbour Front Ferry Terminal, travellers arrive at one of Batam's three International Ferry Terminals after a one-hour ferry ride. The short journey takes you across a time zone, one hour back in time, and into a significantly different environment. While Singapore is extreme humid, Batam is dryer and more breezy.

As the majority of Batam is associated to the Muslim faith, the streetscape is also quite different than Singapore with most women wearing the hijab. Batam's population

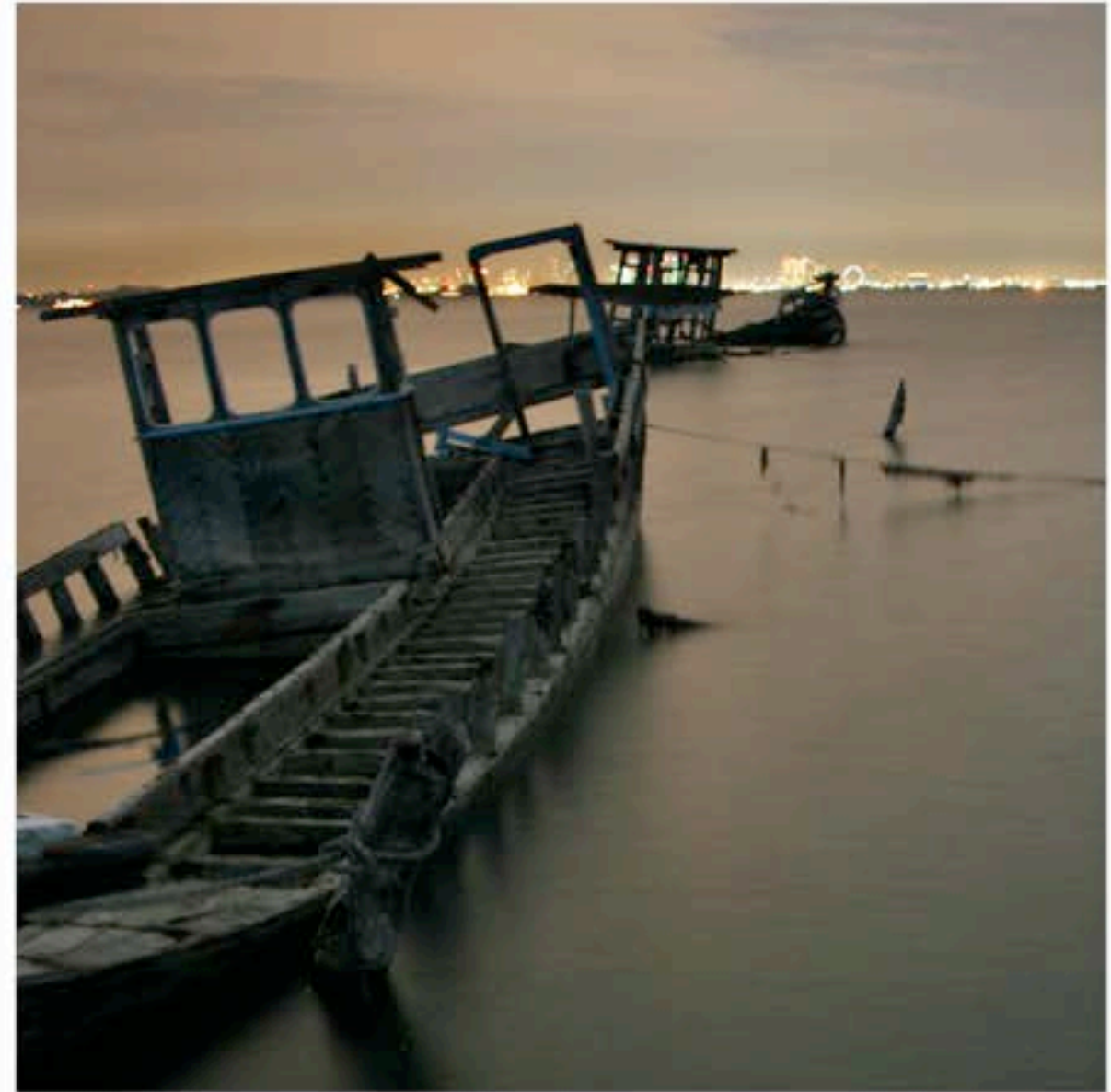
mainly has ethnic Malay roots, while the majority in Singapore has Chinese roots.

The fast economic development of Singapore results in huge price differences in every sector compared to Batam. This attracts many Singaporeans to the Indonesian archipelago for shopping sprees on weekends.

The hectic traffic is dominated by motorcycles. As a visitor, the only way to get around is by taxi since foreigners would have problems trying to figure out the unwritten traffic laws and a street system with no marked street names. Taxis in Batam do not have meters. Instead, fares are negotiated before the beginning of the ride.



Ferry lines between Singapore, Johor and Riau.



A night view from Pulau Belakang Padang, north east of Batam, over the Strait towards Singapore.

### The Shiny World

Easily visible at night, Singapore gleams into the night, perhaps more than any other islands of the archipelago.

The city-state has become known as an international and booming hub, with extremely high land prices, reputed international schools and for its economic dominance. Despite its geographic proximity, Singapore

remains out of reach for most Indonesians as a result of the economic disparity between the high-income city-state and Batam, which remains a transitional economy. On the other hand, numerous visitors from Singapore make use of the cheap labor, shopping facilities and sex tourism in Batam, despite common fears of becoming a victim of robbery.



Check in 30min before leaving  
Harbour Front, Singapore

15'  
Waiting Hall

30'  
Ferry boarding

40'  
Departure



45'  
Passing Sentosa coastline

50'  
Singapore skyline



55'  
Looking back

60'  
Along a world trading route



70'  
Crossing the Strait

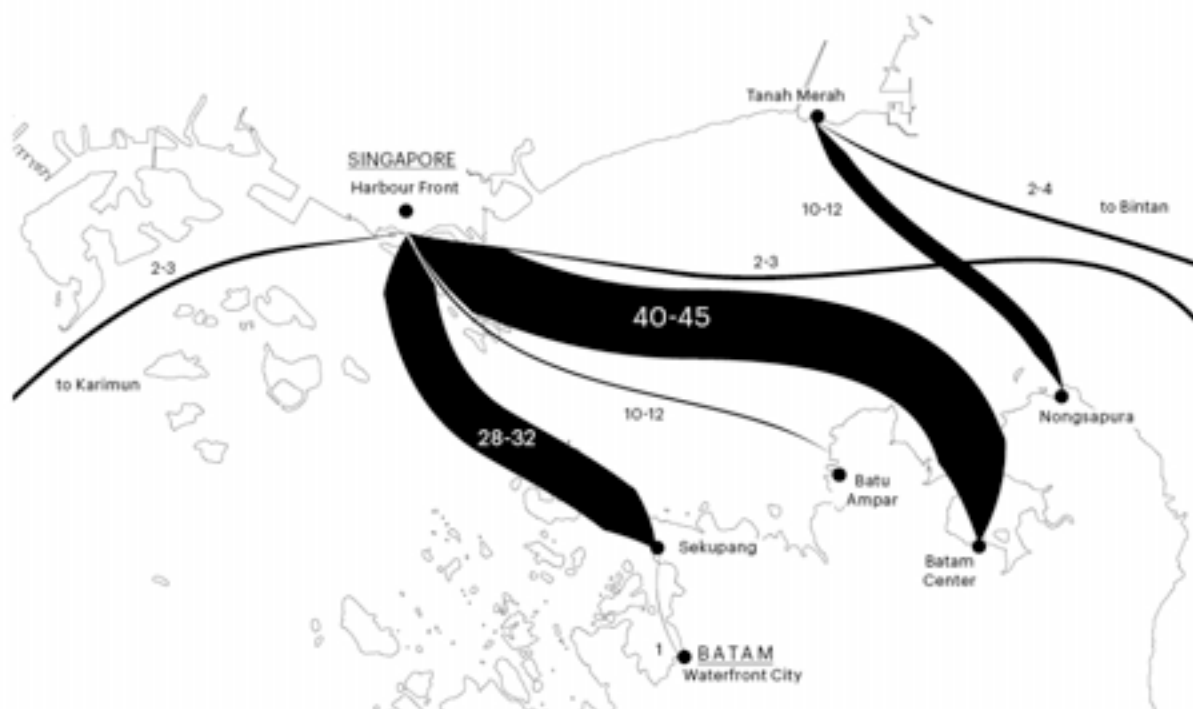
85'  
Batam in sight



95'  
Entering Batam's main harbour

100'  
Arrival at Batam Center

110'  
Customs



#### Ferry Connections

##### Between Singapore and Batam

Singapore's main passenger seaport is Harbour Front, where six providers offer ferries bound to Karimun, Bintan and Batam. With ferries departing every 10 to 20 minutes, around 90 to 110 ferries leave Harbour Front for Batam each day. One ferry can hold between 200 and 250 passenger, potentially carrying over 600'000 travellers from Singapore to Batam per year.

Crossing the border is made easy and affordable. An adult two-way ticket costs 34 S\$ and for frequent passengers there are special offers. For example text messages booking or e-cards shorten the boarding time by allowing you to directly enter to pre-immigration gate and boarding gate. On the other hand, the waiting times at the immigration for infrequent travellers can be long.

Batam has four main seaports, each accessible from Singapore and designed for different functions.

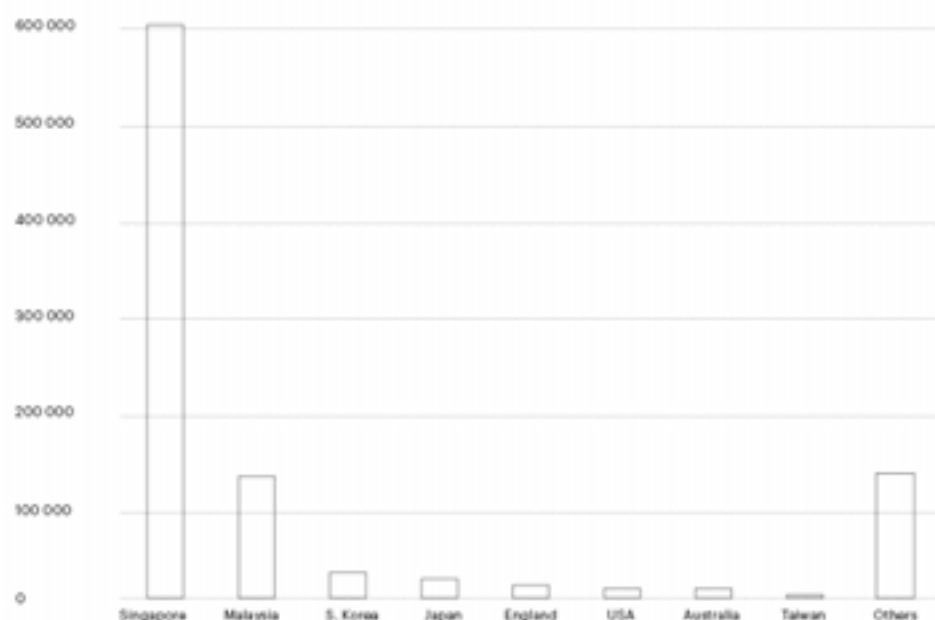
Sekupang is the domestic port. From here ferries head to Karimun and to different ports in Sumatra.

Penguin ferries offers the fastest connection between Singapore and Batam as its vessels can reach Batu Ampar in 45 minutes, which is the main freight port. Most goods and raw material coming and going to Singapore pass through this seaport. This explains why this port is so well connected with industrial parks and factories as many community businessmen make use of this ferry route.

Port Nongsapura is located in the most northern point of Batam and is surrounded by large golf courses and beach resorts. Its main users are tourists. Ferry crossings to Singapore increase by up to 10 per day on weekends at this port.

Another form of tourism is found at Batam Center. On weekends many tourist come to Batam for cheap shopping and other leisure activities such as sex tourism. Accordingly, ferries leave Singapore every 10 minutes. A direct connection by footbridge offers a convenient access between the ferry terminal and the city's largest mall.

Foreign Visitors by Nation (2009)



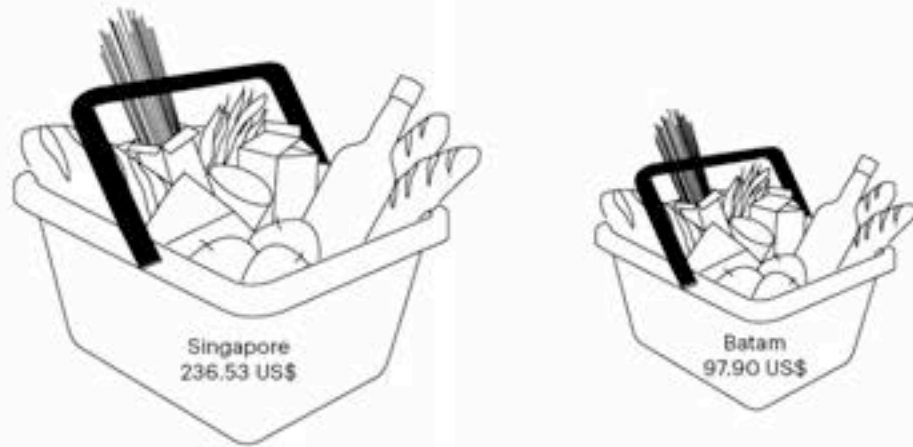
#### Visa

Travellers must have a valid passport to enter Indonesia. Most visitors must purchase a visa for either seven days for 10 US\$ or 30 days for 25 US\$, with the possibility to extend once for another 30 days. Not all nationalities are required a visa. For example Singaporeans and Malays are exempt from this requirement. This in combination with the general low prices in Indonesia attracts many Singaporeans and Malays to visit Batam on weekends for shopping and recreation.

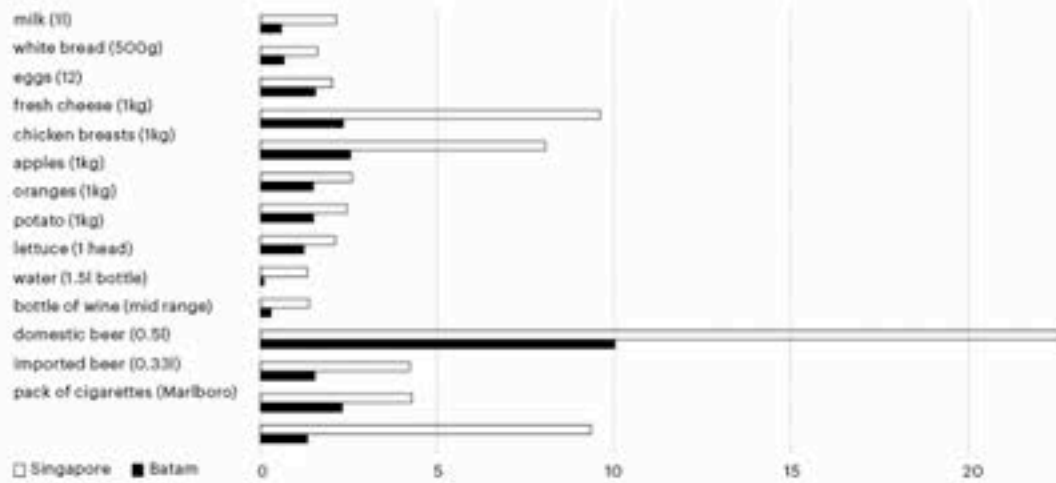
#### Countries with no Visa Requirement:

- Brunei Darussalam
- Chile
- Hong Kong
- Macau
- Malaysia
- Morocco
- Peru
- Philippines
- Singapore
- Thailand
- Vietnam

Monthly Costs for Food per Person



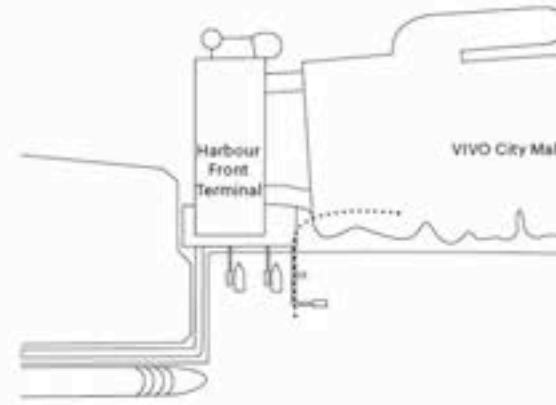
Prices for Market Products on Both Sides of the Strait (in US\$)



Shopping Tourism

Many Singaporeans go to Batam for shopping, especially on weekends. The price difference alone makes it a worthy journey. A Singaporean needs more than twice as much money each month for food than somebody living in Batam. Many market products and especially addictive substances such as wine and cigarettes are less than half the price in Batam compared with Singapore. This is because of the high taxes in Singapore. Clothing, accessories and services like beauty treatments are also much more affordable in Batam.

In order to manage the big tourist flow on weekends, the frequency of ferry rides is increased. The island's largest mall is conveniently located across the ferry terminal and fitted to meet the needs and expectations of the Singaporean clientele by offering many international brands and restaurants, such as the only Starbucks in Batam.



**Singaporean Standards**  
Batam's Mega Mall, located in Batam Center. The ferry terminal is conveniently connected by a footbridge with the mall, which fits the Singaporean standards.



# Magnet of Migration

Batam was designated as an industrial zone over forty years ago. The rising economy led to an increasing demand for cheap labour, making Batam a magnet for people from different parts of Indonesia seeking work opportunities.

With a population growth rate of 9 per cent in the last 10 years (two per cent is attributed to natural increase), Batam has the highest rate of population growth in Indonesia. Since 1971, the population has increased from 6'000 to 1.3 million.

Two principal phenomena have contributed to the immigration waves in Batam. For one, Batam's industries recruit new workers from schools all over Indonesia. A two-year contract is generally offered, which includes housing arrangements, salary and transportation back to the hometown.

In other cases, many families follow friends or other family members already working in Batam with the hope to find work, settle down and start a new life.

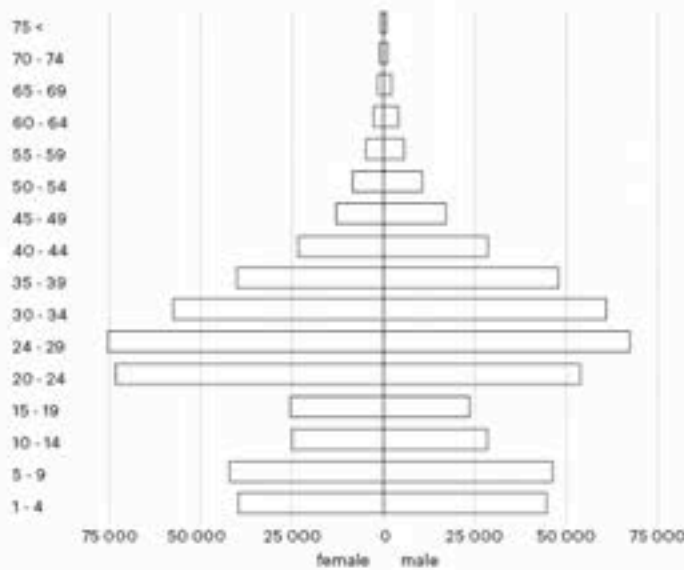
Batam's industry mostly requests young women and fit men, which explains the relatively young population body, with a

median age of 20 years.

The production of electronic devices is Batam's leading industrial sector. This sector demands high levels of concentration and fine motor skills. For these requirements, female workers with good eyesight are usually preferred. Here, most women work on short-term contracts before returning home or switching companies every couple of years.

Another major industry sector is shipbuilding, which hires large numbers of men. Here, short-term contracts are also standard. The duration of the contract depends on the amount of work and the particular shipyard's standards.

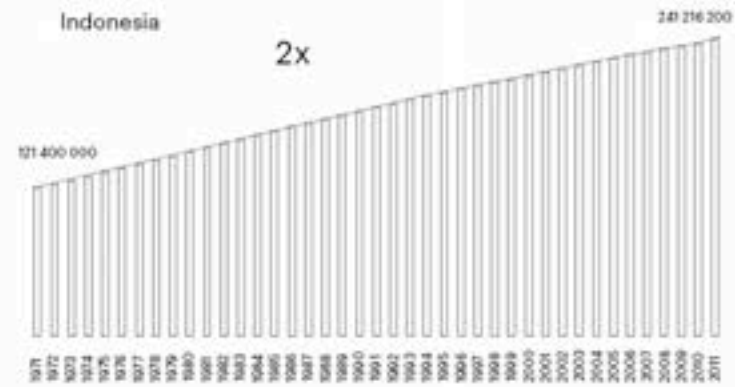
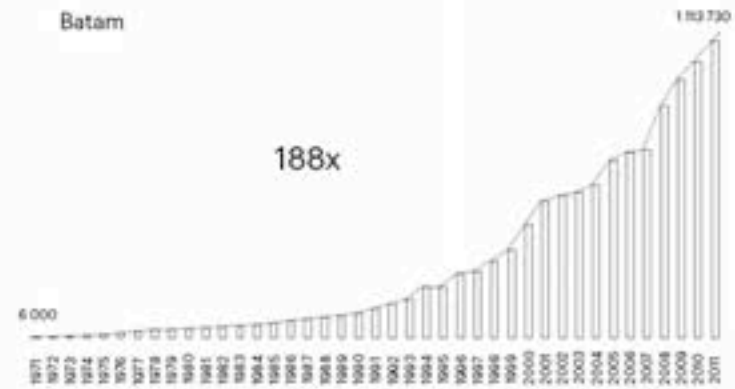
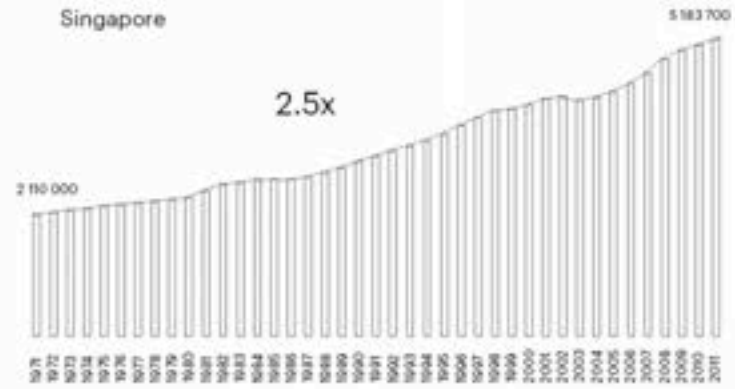
Batam Population Pyramid (2008)



Origins of the Population of Batam

A map from the project "Tropical Town" (by Stephen Cairns et al.) - a work looking at the inhabitants of different housing types in Batam - can give a rough idea of the places of origin of Batam's population. It shows that the majority is originally from Sumatra and Java.

## Annual Population Figures



## Population Growth in Singapore, Batam &amp; Indonesia

Before the potential of Batam as an industrial production site was recognized, around 6'000 people populated the island's traditional villages. As soon as the strategic importance given by its proximity to Singapore was discovered and first attempts were made to develop industries, the population started growing. In the 1980s a law was introduced that allowed private companies to manage

industrial estates on Batam. As a response to the sudden demand of labour force the population grew rapidly. Another significant increase appeared in recent years since the Free Trade Zone was expanded to the whole BBK in 2007. Over the last 40 years, the population has increased by 188 folds.



## Portrait of an Immigrated Family

Ratih (35), is a housewife and runs a small kiosk from her house. She came from South Java to Batam four years ago with her entire family. Her brother worked in the Batamindo Industrial Park for two years and today is employed at a shipyard.

Also in the picture, Ratih's husband Banyu (39), who repairs houses in the kampung. Her mother Mawar (57), daughter Ria (9) and son Lemah (2).



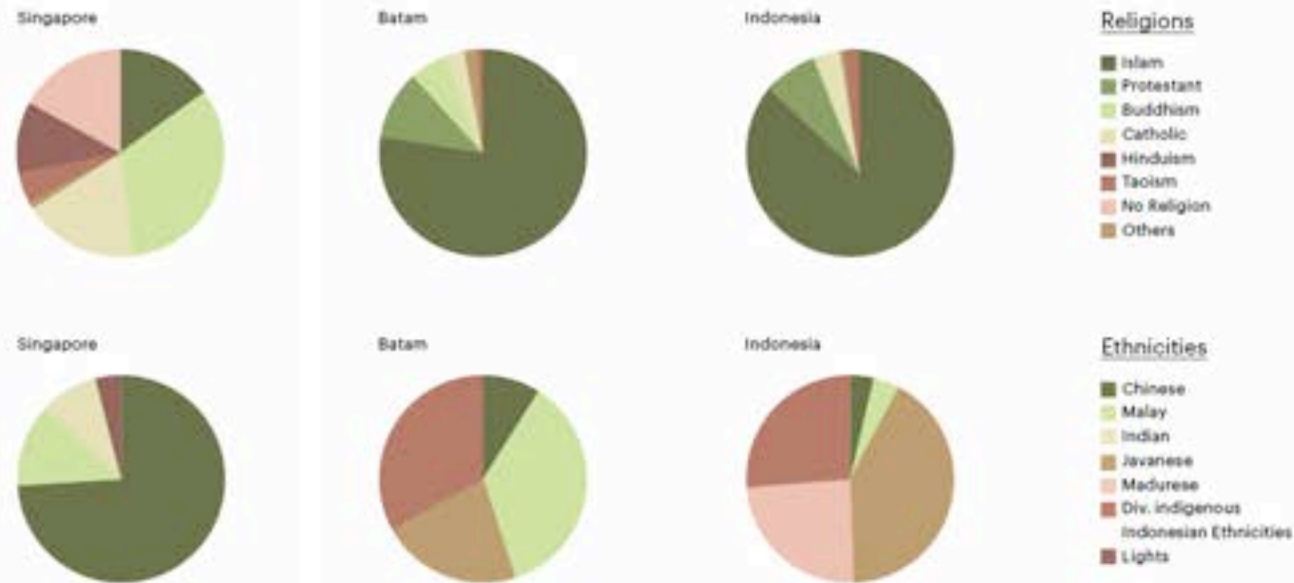
## Differences

Singapore has a wider diversity in terms of religion compared to Indonesia and Batam, where the majority is Muslim. There is, however, a greater mix of ethnicity in Indonesia than in Singapore where the population is dominated by people of Chinese origins. In Batam and Indonesia a mix is found of Malay, Chinese, Javanese, Madurese and diverse indigenous Indonesian ethnicities.

Batam's GDP per capita is higher than that of Indonesia, yet, it remains significantly lower than in Singapore. In Singapore the average age is 38 years old, which marks the existence of an ageing problem. While in Batam, important migration flows of young workers have flooded the island with a thriving population with a median age of

only 23. Batam's average income is higher than in the rest of Indonesia, but still very low in comparison to Singapore.

Due to Singapore's high population density, firms are forced to relocate their production sites to surrounding areas such as Batam. As a result, extensive demand for labour force has encouraged migration in Batam and elevated the population density.



### GDP in US\$



### Median Age



### Average Income in US\$



### Population



### Population per km<sup>2</sup>



# Productive Sites

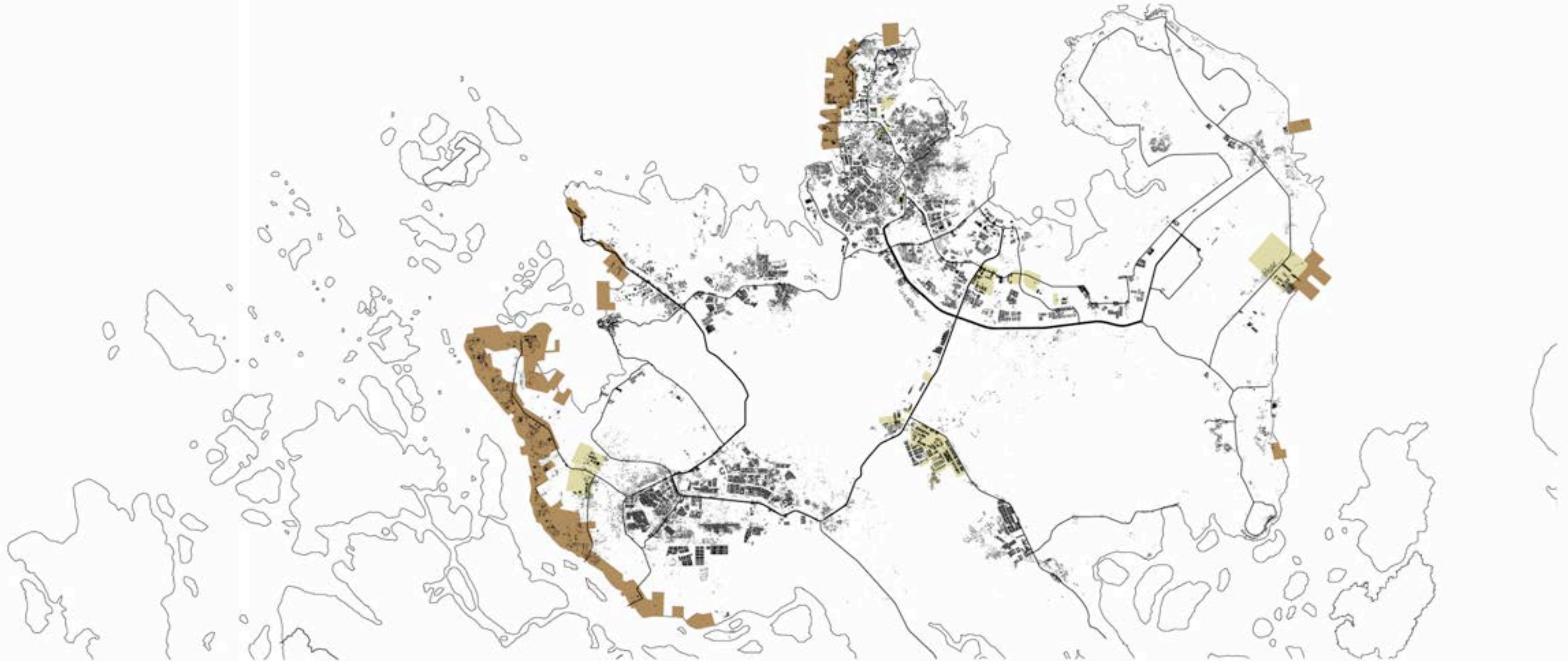
Looking at Batam's economic structure it can be observed that 59 per cent of the economy derives from industries. The economy is divided across three main sectors: shipyards, industrial parks and small scale and traditional production. Each of these sectors has its own characteristics and influence on the island.

An important impulse for Batam's economy is the industrial parks. Strategically located inland, they nonetheless re-

main close and well connected to the main seaports as well as the airport.

Along the coastline two conditions can be observed. On the one hand there are traditional kampongs, on the other hand, the shipyards. While both are highly dependent on the water, they each make a totally different use of it. The traditional villagers depend on fishing and small hand-crafts. More intense labour is found in the shipyards, where

the coast is re-formed according to their needs - a process called "cut and fill" - in order to build and repair ships. This is clearly noticeable in the angular appearing coastline.



Industrial Sites (2009)

■ Shipyard  
■ Industrial Park

0 1 2 km



Agriculture, 1%  
Mining, 1%  
Electricity, Gas, Water, 1%  
Industry, 59%  
Construction, 2%  
Trading, 26%  
Transport, 2%  
Finance, 6%  
Public Service, 2%

## Traditional and Small Scale Production

A glance over the map shows that the Kampongs are roughly located along the north and the south coastlines of Batam Island and its surrounding islands. It is interesting to notice that when visiting the Kampongs, a different atmosphere in the northern and southern villages can be experienced. It seems to be that the northern Kampongs are more vivid with bars and restaurants than their southern counterpart. This contrast is likely to be a result of the urbanization of the Straits.

Before the industry boom the traditional trade was fishing, which is still practiced today, though threatened due to the degrading water quality.



Existing Kampongs in the district of Batam

The kampongs on the small islands are well connected to each other by private boats and internally organized boat ferries guarantying the connection to Batam island. Also the villages on Batam island are well connected to the main city districts and work possibilities. The most used mode of transportation remains the motorcycle, which is sometimes used by entire families at once.

Electricity is usually provided by the government for twelve hours a day starting at noon. If this is not the case, the villages have their own generators running on diesel.



Kampong Tanjung Riau  
Google satellite image

### What is a Kampong?

In its original use, the Indonesian word "kampong" means "village", usually the home village or birthplace of an individual. "Kampong" should not be confused with "slum", since most Kampongs actually contain a mix of lower, lower-middle class and middle class families living in mostly permanent dwellings. Kampongs are mostly located along the coastline since the traditional trade is fishing. This dependence and close relationship to the water is clearly shown by the approachability of the housing. The stilt houses are arranged along simple wooden piers, which reach out into the water like arms, coming from a single path going along

the coastline. Moving around within the Kampong is mostly done by boat, motorcycles or on foot; no cars can be found. Only few houses, mostly schools, places of worship and wash stalls are located onshore. Fish processing factories, fish farms and illegal wood trading are mostly operating in this form of Kampong.

Another form of Kampong appears inland, where small factories such as tofu and tempeh (traditional soya cheese) and other forms of handcrafts can be found. Most housings are built on a single story and arranged along dirt roads. Scooters are the preferred mode of transportation as the use of cars remains infrequent.



Footbridge, 2012  
Kasu Island

#### Kampong

The wooden boardwalk connects the stilt houses with the main land. Boats are the main transportation between the island and the stilt houses on water. Electricity is a new feature in the Kampongs and is either provided by the government or privately owned generators.



#### Traditional Shipbuilding

Boats are very important for transportation between the islands and within the Kampongs. In Batam's province many traditional shipbuilding companies can be found. Wooden boats are built out of illegal timber cut down on surrounding islands. Traditionally the boats are between 10 and 15 meters long. First the boat's body is produced by the shipbuilding company, then another firm builds the motor in, which is selected by the customer. Around 3 to 6 boats are finished each year per firm with 10 workers. The boat bodies are sold for around 300 Mio. Rupiah (31 000 US\$), to Singapore, Indonesia and Malaysia. Depending on the ability of the worker, each can earn between 1 to 3 Mio. Rupiah (100 to 300 US\$) per month.



#### Tempeh Production Kampung Tua Belian

Soy is found in many typical Indonesian dishes in forms of tofu and tempeh (soy cheese), which is produced on small sites in inland Kampongs. Soybeans are shipped from Malaysia to Batam, where they are processed in small dwellings. Every day round 550kg of soybeans are chopped, cooked and put aside to rest for two days, by five employees of Batam's biggest soy cheese producer. It provides the whole of Batam with tofu and tempeh. Here a worker earns a salary of 1.5 million Rupiah (155 US\$) per month.

## Shipyards

Driving in a boat along the coast of Batam Island, you can experience an impressive landscape of ships and hear the hammering and welding of the shipbuilders.

Over 58 shipyards build, converse and repair ships in Batam. Most shipyards are located on the west coast, where they are protected by small islands from currents coming from the Strait of Malacca. Here the coastline is built up very densely.

The shallow water – only 10 meters in depth – and large swamp can only accommodate ships up to 160 meters in length. Complex efforts to carry out land reclamation and desludging are carried out, which affect the environment. Ideal shipyards are reclaimed so that more workspace with more edges for ships to dock and deeper waters can be reached. The surrounding of the artificial shipyard must be desludged every 2 to 3 months.



Shipyards in Batam



Kabil Industrial Estate  
Google satellite image

### What is a Shipyard?

Shipyards and dockyards are places where ships are repaired, disassembled and built. These can include yachts, military vessels, cruise liners or other cargo or passenger ships. Dockyards are generally associated with maintenance and basing activities whereas shipyards designate the space for the initial construction. The terms, however, are used interchangeably, in part because the evolution of dockyards and shipyards has often caused them to change or merge roles.



Drydocks Shipyard, 2012  
Batam West Coast

**Occupation of the Coastline**  
Traveling by boat along the coast of Batam Island, an impressive skyline of ships can be observed and the hammering and welding of shipbuilders can clearly be heard.



Plan of the Nexus Shipyard, 2012  
Google satellite image

Plan of a Shipyard

Nexus is located on the east coast of Batam and is owned by the Beng Kuang Group, a Singapore based company with vast experiences in the marine, offshore and oil & gas industries. The Beng Kuang Group has several shipyards in Singapore and Batam. As Singapore provides the knowledge and Batam the cheap labour and benefits of the Free Trade Zones, the company allows both of its shipyards to be used complementarily.

In 1998 seven hectares of land were rented and five years later the plot was extended through a "cut and fill" process to thirty-two hectares.

Raw material, such as steel is imported from China, but due to the shallow water around Batam the steel must be loaded onto smaller vessels in Singapore. This steel (2) is then cut out (4, 5), bent and moulded in

particular workshops (6). Single parts are assembled in the middle of the lot (7) until the basic body is floatable. From here it goes from the slipway into the water. While floating in the water (9) the boat is built together piece by piece.

Today around 315 workers are employed at Nexus in Batam. Nexus makes use of so-called worker pools, where workers are hired depending on the amount of work that needs to be done. Their contract ends with the completion of the job.



Nexus Shipyard



Import to Singapore

For its large deliveries from China, Nexus has to send the steel imports, transported on huge carriers over to Singapore where the loads are transhipped to smaller carriers that are able to access the shallow water of Batam's shorelines.

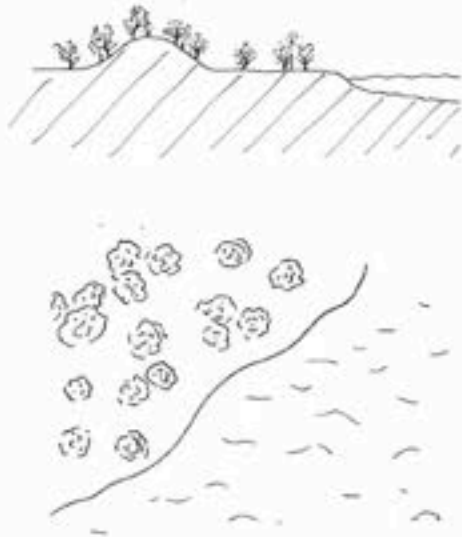




#### Cut

Large areas of land are constantly being reclaimed along the coastlines of the Riau islands for shipyard building, real estate developments (such as Costarina) and for the general expansion of territory (new streets, etc.).

To satisfy the demand of soil, a strategy was developed called "cut and fill". This approach causes an enormous impact on the environment and influences the visual appearance of the landscape. Throughout the island, hills are being slowly flattened out as their soil is being used as infill. It seems that the strategy of cut and fill is being carried out throughout the island, every elevation is being cut, leaving exposed significant patches of bright red earth as evidence of the operation.



#### Fill

Investors buy plots of land on the waterfront in order to build shipyards.

Batam's land belongs to BIDA. This agency decides where soil can be removed. In this case, they cut and sell soil by cubic meter, for the price of 3000 Rupiah (0.32US\$) per unit. The investor is responsible for the filling process. When the land reclamation is completed, the area created through infill is easily recognizable thanks to the distinct redness of the added soil.

Transformation of the Landscape  
As a consequence of the 'cut & fill' practice, Batam's landscape (and many others of the Riau Archipelago islands) is being transformed immensely. The redness of the soil is left exposed following cut and fill programmes, and has come to reshape the landscape of Batam.



# Industrial Parks

Over the years, 26 industrial estates and 1'274 multinational companies in nine different business sectors have settled in Batam. Industry is the biggest production sector in Batam. Many different products are manufactured, from sports equipment to plastic, with electronics as the leading sector. This sector tends to prefer to hire women workers due to their fine motor skills.

Batam's government provides good infrastructure to support the island's industrial parks. The industrial estates are mostly located along Batam's main road connecting Batu Ampar seaport and Hang Nadim airport. The size of

the industrial parks varies, from small areas of 9 x 25 meters to large plots of up to 420 hectares.

Batamindo is the oldest industrial estate in Batam, which was founded in 1989 in collaboration with Singapore. The industrial park located in the heart of the island led to Batam's success story and remains is a showpiece for other industrial parks today.



Industrial Parks in Batam



Kara and CAMMO Industrial Park  
Google satellite image

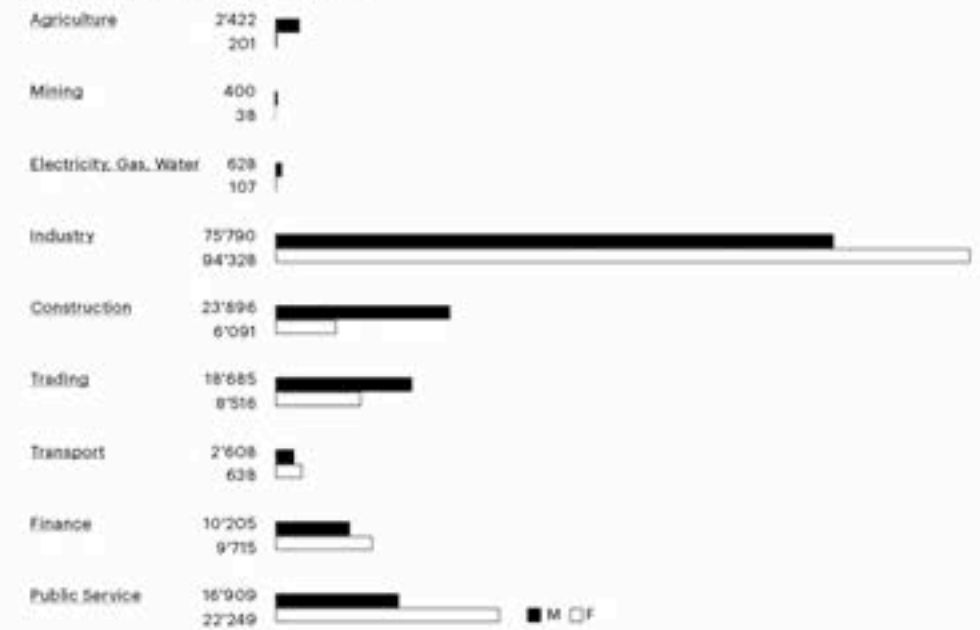
### What is an Industrial Park?

An industrial park (or also known as industrial estate) is an area zoned and planned for the purpose of industrial development. Industrial parks are usually located outside the main residential area of a city and normally well connected with transportation routes. These parks may contain oil refineries, ports, warehouses, distribution centres, chemical plants, plastics manufacturers or food and beverage processors, to name just a few examples. Some industrial parks offer tax incentives for businesses to locate there, such as tax increment financing.

### Gender Based Production

The production of electronic devices is Batam's leading industrial sector. This sector demands high levels of concentration and fine motor skills. For these requirements female workers with good eyesight are most suitable.

### Workforce per Sector and Gender



# Construction of a Hinterland

"Batam was previously nothing. Shall I tell you why Batam exists, and whose idea it was? It was the idea of Mister Soeharto (Indonesia's second President). Pak Harto was once the commander of troops against a militia force in Malaysia (during the celebrated confrontation-konfrontasi Indonesia had with Malay and British forces from 1962 to 1966). He was a young man and he was a commander, and he was instructed to prepare all of his troops for a clash against the Singapore militia and the British. And as a young man, as the commander, he was maybe at that time a one-star general, or maybe two-star, I don't know ya, but he made

his headquarters on the island of Batam because Batam is so close to Singapore. So there he was watching, and he saw the movement of all of the ships [in the Strait of Singapore] and he could see that he could look right down to Singapore. And Batam was nothing at that time, and he came there, didn't show anything to the British or anybody, he showed nothing to the people over there, and then he said 'My goodness, this is a very strategic place.' And he planned from there how he could destroy and attack Singapore and whatever during this confrontation - [which was] not with Singapore because Singapore was not yet there [it

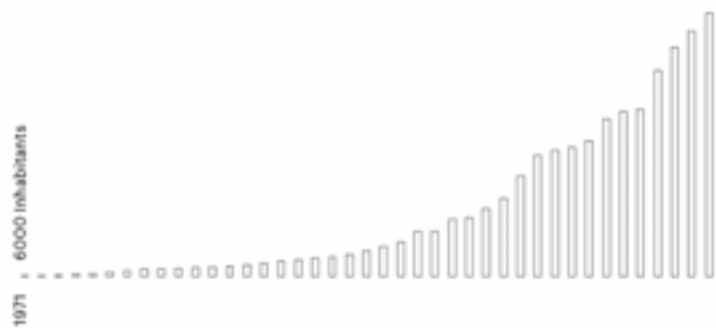
did not officially exist as the Republic of Singapore]. [The confrontation] was against the British. And at that time he didn't know that he would someday be a president [of The Republic of Indonesia]. And so I mention all of this, I tell you this, because I know the story from Soeharto. He told me the story..." Bachharrudin Jusuf Habibie, President of Indonesia 1998-1999.



Overflight over Batam's  
urbanised center Nagoya,  
2012



Sekupang, 1959

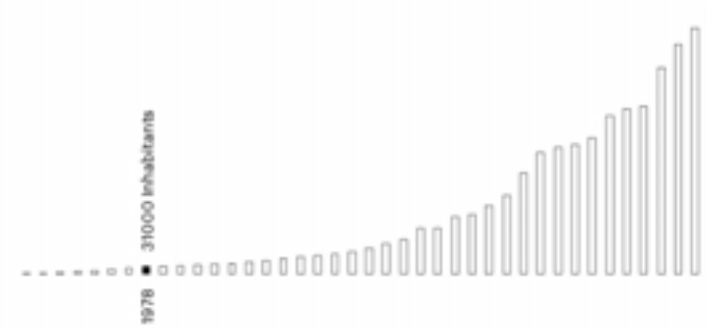


**Balloon Theory**

The development of Batam dates back to 1970s. Initially, Batam was developed to compete with Singapore. Over the years, the Indonesian authority observed that it would be more beneficial to develop Batam's industrial potential so as to complement Singapore's distinctive and performing economy and existing infrastructures. The former aide to former President Suharto and his successor, Dr Habibie have put forward the 'balloon theory' of development for Batam. They suggested that Singapore is like a balloon filling up with air. If the air does not find a second balloon, the first balloon will burst. Indonesia can benefit from Singapore's 'excessive growth' due to its proximity to Singapore and can be positioned as an extension of Singapore's production base.



First factory of Citra Tubindo, 1984



**From the Oil Period (1971) to a Center of Industry, Commerce and Tourism (1978)**

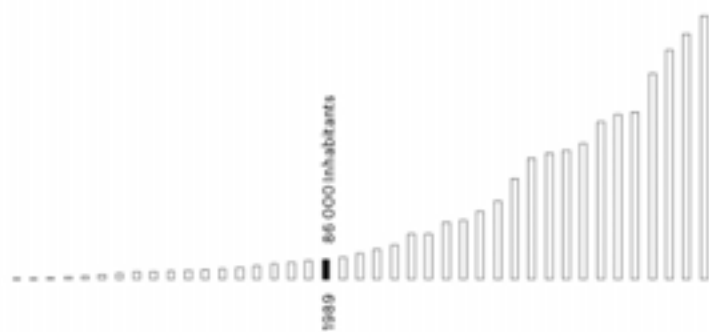
In 1971 Batam Island was designated as an industrial zone by the Indonesian presidential decree. To facilitate the industrial development, the Batam Industrial Development Authority (BIDA) was established. In support of the industrialization plan, the state-owned oil company, Pertamina, was a key player in starting activities ranging from infrastructure, light manufacturing, industrial real estates, gas and chemicals industries to offshore drilling. The 1976-1978 period was the consolidation phase focusing on the strengthening and maintenance of existing structures, infrastructure and assets amidst Pertamina's crisis.

In another presidential decree in November 1978, Batam Island was declared as a bonded zone to support the development of export oriented industries. At the end of 1970s, a master development plan was devised for Batam Island to be developed as an industrial, commercial, and tourism center in Indonesia.



Left: Lee Kuan Yew (Prime Minister of Singapore) signing the consortium to build the Batamindo Industrial Park, 1989.

Right: laying the first stone in Batamindo, 28.2.1990

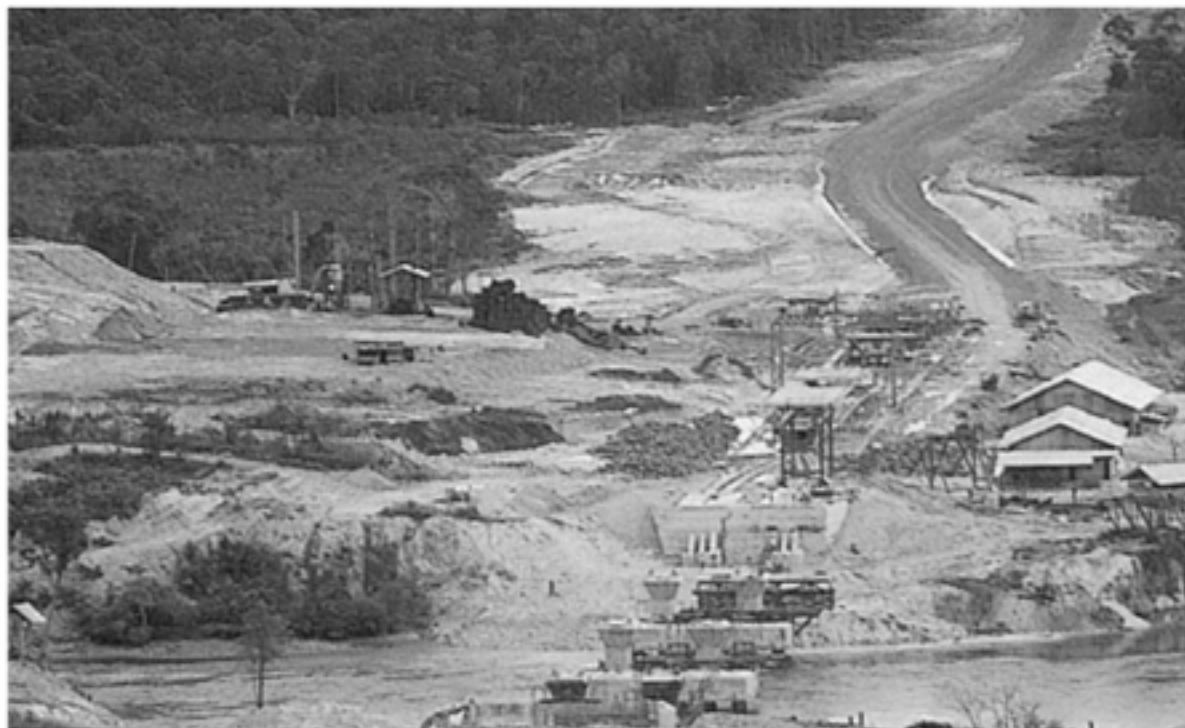


**Batamindo, 1989**

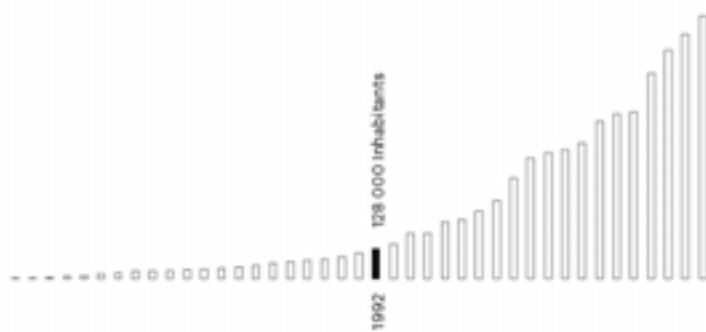
On October 29 1989, the law on the management of industrial estates by private companies was passed. That move received favourable comments from private enterprises as well as political leaders in Singapore.

Singapore's companies that are affiliated with its government partnered with private Indonesian enterprise to develop Batam's Industrial Park (Batamindo), an industrial estate to take advantage of its status as a duty-free export processing zone (EPZ), and of the business generated when industries move over from Singapore.

In 1990, Singapore and Indonesia signed an agreement to cooperate in the development of the Riau Province and the promotion and protection of investment between the two countries. The 1990 agreement also includes provisions to simplify exit and entry procedures; to simplify tax systems to facilitate investment; to promote the tourism industry; to cooperate in water supply, transportation and infrastructure development and maintenance.



Construction of one of the six Trans-Barelang Bridges, 1995



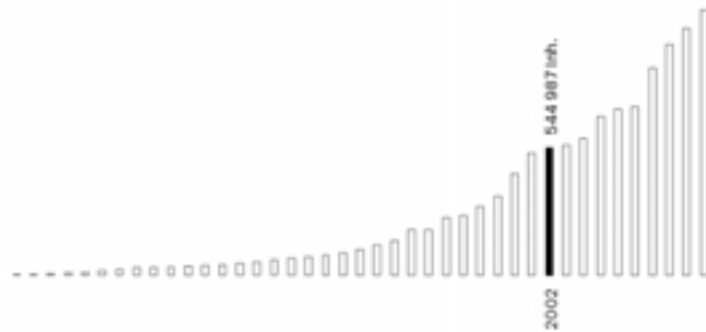
**Expanding the Special Economic Zone**

Batam islands have been declared a Bonded Zone in 1992. From then on, goods could be imported into a bonded zone and then re-exported without tariffs, unless the goods are to be sent into the regular customs territory of Indonesia. Bonded zones are intended for the processing of goods and materials, including their design, engineering, sorting, initial inspections and packaging.

Companies in bonded zones must export at least two-thirds of their production, excluding components, which may be sold on the domestic market if such sales do not exceed 50% of realised export value. The advantages of a bonded zone include permission for foreign nationals to own 100% of their businesses and an exemption on import duties of spare parts and material for production purposes. A drawback on duties and surcharges is available on imports into the Indonesian customs zone that are subsequently shipped to bonded zones for later export.



Batam Center, location of the administrative offices of BIDA and Bappeda



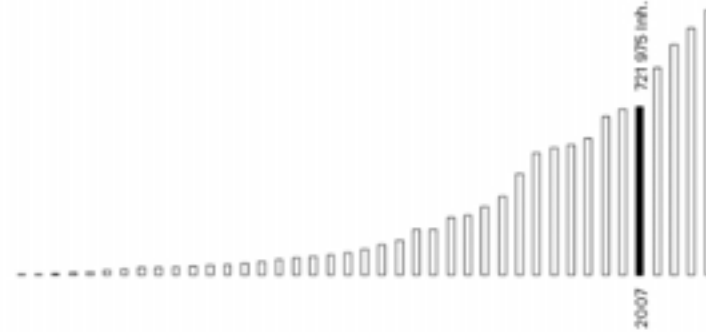
**"Bonded Zone Plus"**

In 1999 Batam was declared a self-governing city. This triggered many discussions concerning responsibilities between two authorities: BIDA established in Jakarta in 1971 and the newly formed Bappeda.

Batam's status has been upgraded from 'Bonded Zone Plus' in 2002, downgraded to 'Bonded Zone' in 2004, and restored to 'Bonded Zone Plus' in 2005. In July 2005, the status of the Batam Industrial Bonded zone, together with Bintan's Industrial Estate and Karimun's Industrial Cooperation zone, have been upgraded to 'Bonded Zone Plus' to give investors more legal certainty. The Minister of Finance confirmed Batam's status as a 'Bonded Zone Plus' and issued a package of reforms to improve the island's investment climate. The package simplifies customs procedures, liberalizes the import of used capital goods, reduces some taxes and allows for the movement of goods between bonded zones. It stopped short of making Batam an entirely free-trade area.



The Barelang Bridge, the island's emblem and symbol of progress



**The Free Trade Zone Today**

The signing of Framework Agreement 5 between Singapore and Indonesia on Economic Cooperation in the islands of Batam, Bintan and Karimun (BBK) was done on 25 June 2006. A key feature of the agreement was that Singapore would assist the development of the three islands as a Special Economic Zone (SEZ). (...) Batam was granted a Free Trade Zone status while Bintan and Karimun were granted enclave status. (...) BBK was officially designated as FTZs for 70 years, and would be run by a new supervisory council and each zone by a separate management body (Toh & Ng, 2009). The status abolishes import taxes, customs and exempts duties, value-added tax and luxury-goods sales taxes. The move was part of a government plan to establish eight special economic zones (SEZs) in partnership with the government of Singapore. A Special Economic Zones law, which the parliament was considering in early 2008, will stipulate separate business incentives involving tax holidays or land-ownership issues.

# Batamindo "One Location Global Markets"

The Batamindo Industrial Park is located in the heart of Batam and is the pioneer industrial park with an area of 320 hectares. It is located in a natural reserve and in proximity to two important water reservoirs. This artificial conglomerate originated from an economic cooperation agreement in 1989 between the Indonesian and Singaporean governments, more precisely a joint venture between PT. Batamindo investment corp. (sub Salim group, Indonesian) and

Batamindo management (Singaporean with governmental participation) was signed. This cooperation shows the different role allocations very clearly. Firms located in Singapore have growth restrictions, therefore Singapore must find ways to remain attractive to foreign investors and offer them alternative areas to expand. Singapore brings its management and technical expertise to Batam, but also serves as a distribution hub

and allows Batam's global market access. Batam on the other hand offers Singapore competitively priced labour and land. The park is strategically connected by Batam's main road with the main cargo port Batu Ampar used for delivery of raw materials and the airport Hang Nadim, which is important for the transportation of electronic devices. Both destinations are reachable in 15 minutes by road.



Park Model  
Batamindo, 2012



## Urban Plan of the Industrial Park

On this platform 74 companies manufacture products that are later sent all over the world. This production cluster is surrounded by a natural reserve and somehow appears as a foreign body clearly outlined by its fence. A rather large

settlement with both illegal and legal housing has developed along the main road near the entrance to the park. Also noticeable are small dwellings clinging to the south part of Batamindo.



Batamindo Industrial Park, 2010  
Google satellite image



### Productive Capsule

The industrial park is economically autonomous; it is a productive capsule.

The infrastructure is planned to provide the park and its tenants a high-level of independence from the remaining of the island. The industrial estate includes roadwork, a town centre, water supplies and distribution, telecommunication facilities, drainage and sewage system, residential quarters for workers along with commercial, recreational and medical buildings. Nevertheless this artificial conglomerate is in interdependency with other structures, primarily on social levels. Thus both illegal and legal housing appears around the park, which compensates for some of the missing infrastructure for the inhabitants living in the dormitories, which are located quite far from the town centre.



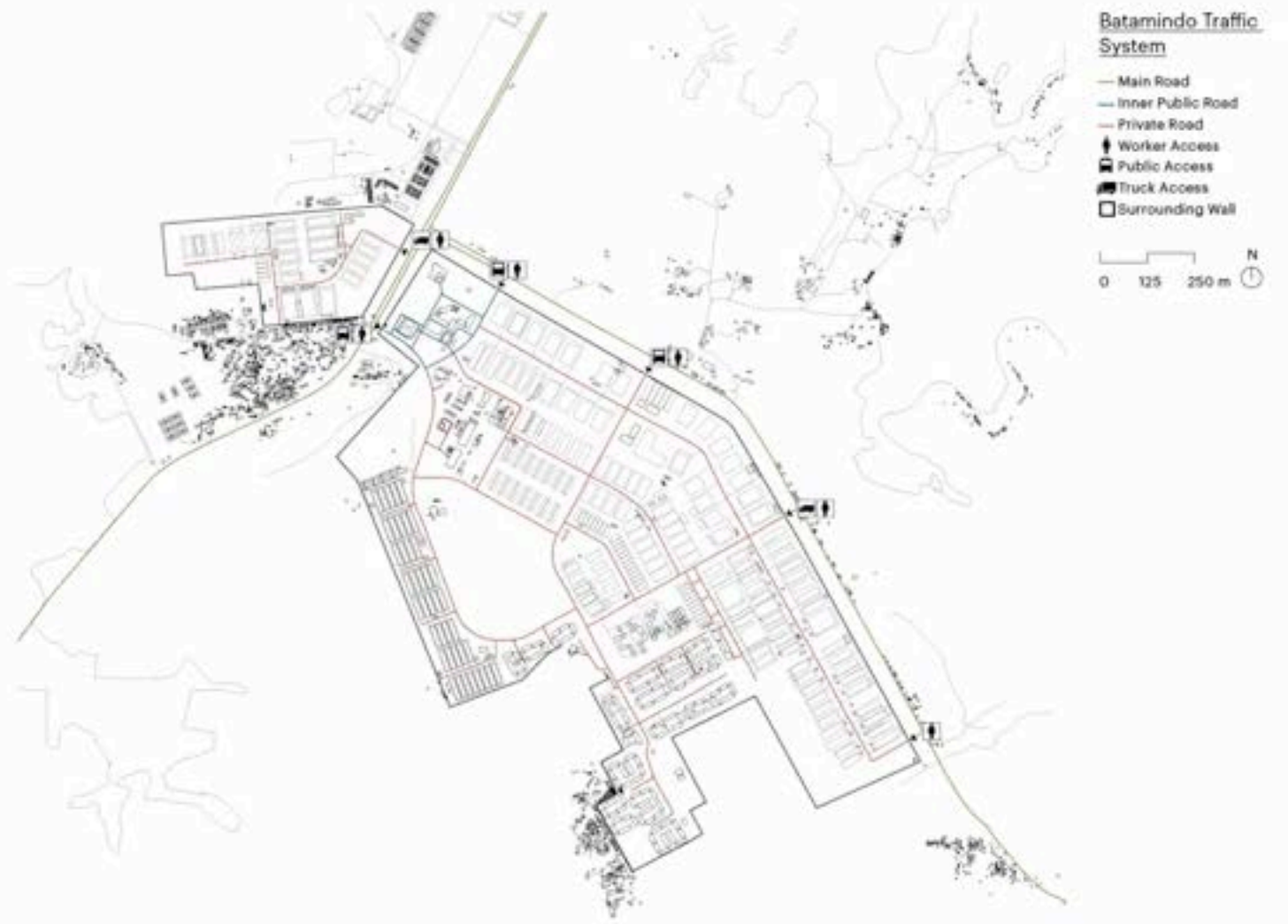


#### Manufacturing Spectrum

Over 74 multinational companies manufacture their products in 11 different sectors. Batamindo is a place of assembly since high technology pieces are produced elsewhere and are then sent Batam via Singapore. Products are assembled and finalized before being once again sent out via Singapore to other markets.

The majority of the firms located in Batamindo produce electronics. In this field the production process can be split up very between high-tech production and labour-intensive assembly work.

Batamindo provides a brochure with four factory types with ground floors sizes of 1800 - 3000 square meters, which facilitates the set-up up new facilities. Due to the free trade agreement, foreign landownership is allowed.



#### Permeability

The park has five gates, which all have different functions. All gates are open to the workers, but not all for visitors. The two gates and roads by the town centre are open to the public, but in order to enter into the park, you must use the internally organized green mini buses. One particular gate is for delivery. The workers can go in and out as they please, however the gates close at 10 pm for all visitors.



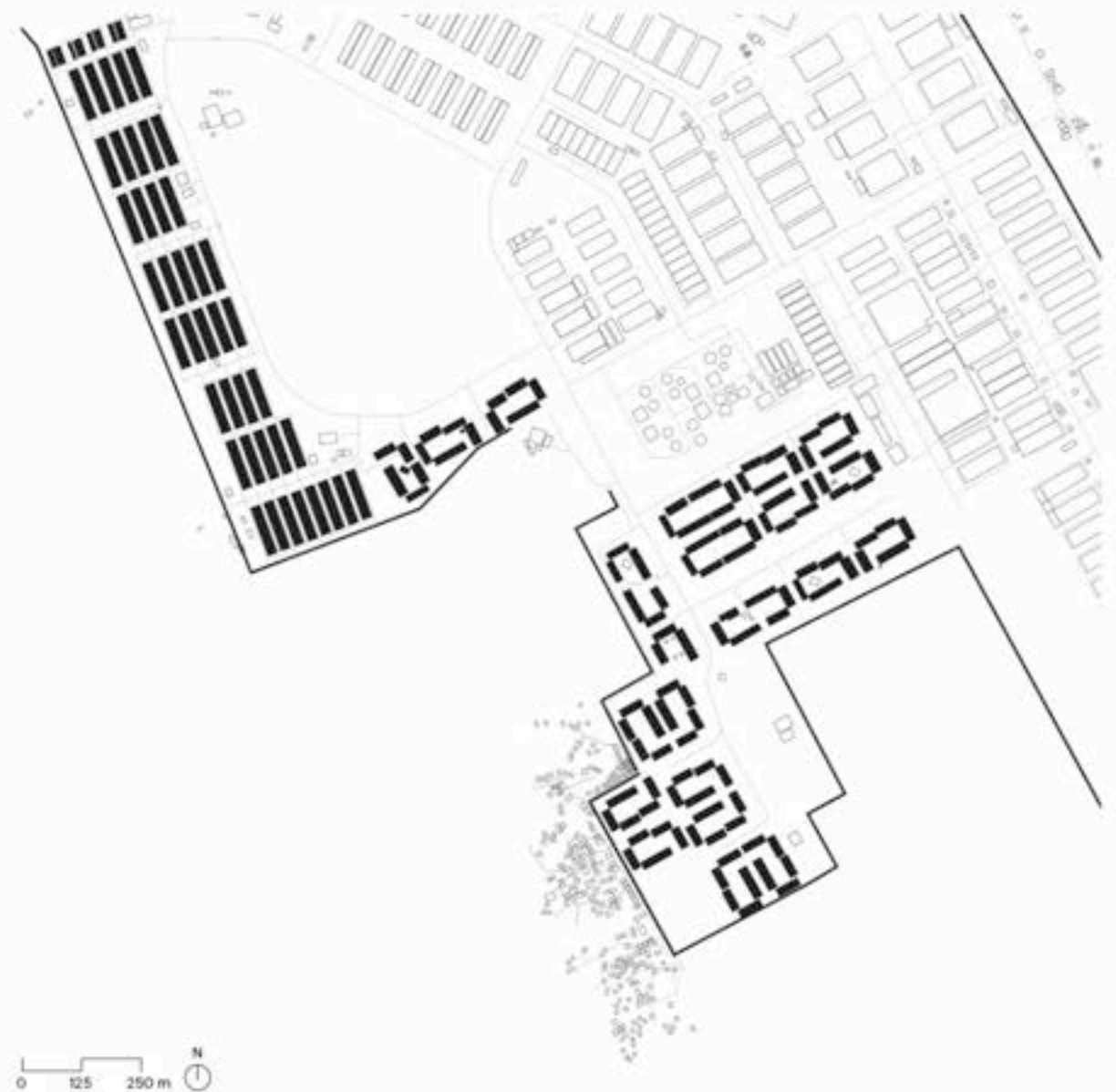
**Segregation of Housing Types**  
The Batamindo Industrial parks provide housing for its workers and the management.

The managers' housing is located in the south link country club. With these resort-style bungalows and executive apartments accommodations, other features such as night golfing, tennis courts are also offered.

On the other hand around 150 buildings located in the park's grounds are designed to accommodate the workers. These come with a set of specific conditions. Only singles are allowed to live in the gender-segregated apartments. Around eight to ten people live in one sparsely furnished apartment.

These dormitories are very popular among young women from other parts of Indonesia working on short-term contracts. Here they can relate with other workers going through the same experience and share memories of their home. So these dormitories also have a social supporting function.

In the past years, dormitories have been knocked down to make more room for factory buildings, since the park area is limited.





- 1. courtyard of a dormitory block
- 2. 4-member-household kitchen
- 3. TV and ventilation in the living room

Workers' Housing

The dormitories provided by Batamindo are four stories high and divided into apartments designed for eight to ten people. The floor plans are reduced to a minimum and generally have only one bedroom furnished with four bunk beds, a living room, a kitchen and a washroom. Personal belongings are sparse. The workers in Batamindo cherish these dormitories for their affordable prices and because they make it easy to connect with other workers.



2.



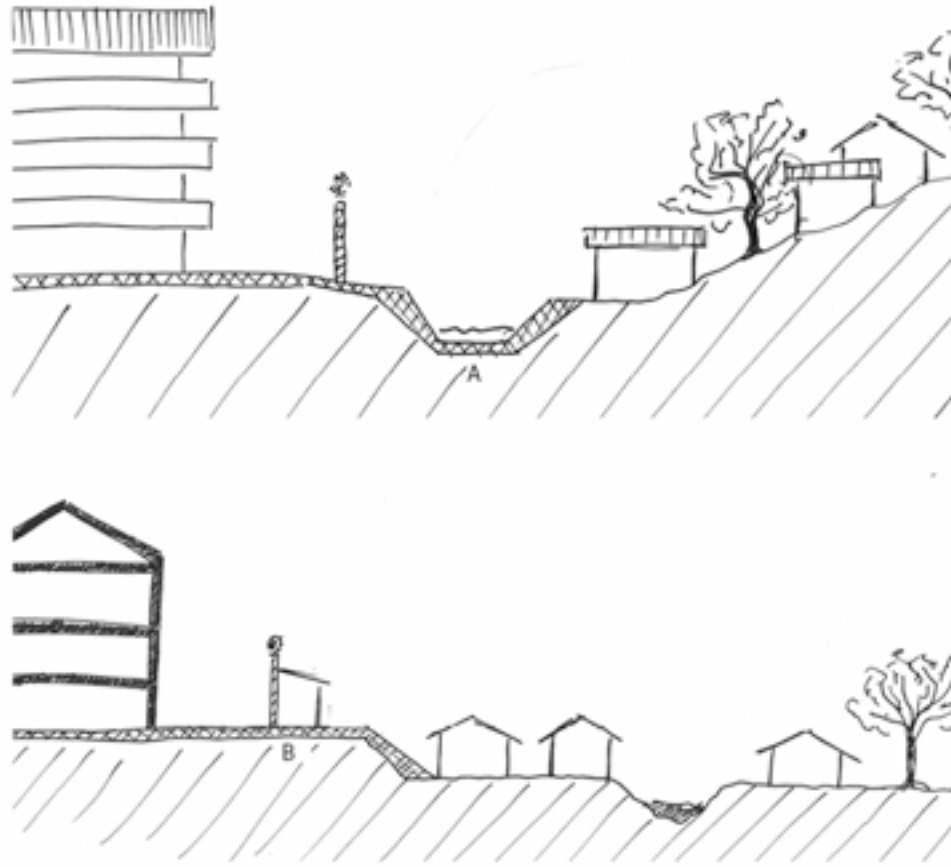
3.



Portrait of Batamindo Workers, 2012  
Batamindo Dormitories

Recruited in School

The two young women Soreia (21) & Nairi (23), both work for CIBA Vision in Batamindo. Sorei was recruited from high school in Jakarta and Nairi came to Batamindo following a friend's recommendation. Both young women work on short-term two-year contracts, which include compensation for their travels back home. They earn a minimum wage of 1.4 million Rupiah (150 US\$) per month. Both young women are glad to be able to work in Batamindo as this allows them to put money aside for a better future and to support their family back home.



Sections showing how the Kampong is built on Batamindo's foundation

#### Kampong Selayang

The informal settlement Kampong Selayang is docked on to the south tip of Batamindo's walls like a parasite. The village is interdependent with the industrial estate in many ways. It profits from Batamindo's channelled sewage system (A) and fundament so that the dwelling structure is directly built onto the extended concrete (B). Even its electricity is tapped from Batamindo. The only way to enter the kampong is through a 1.2 metre wide gate (1) built into Batamindo's fence, since it is completely embedded in the natural reserve.

The market (2) is right by the entrance, with many different food stands and small shops, meeting the needs of the people living in the dormitories, since the park's town centre is beyond walking distance.

Also a church (3) and a Muslim school with a mosque (4) can be found in the Kam-

pong. The Islamic school supports and educates young woman working in the park and the church community also provides housing in the village for their students. In this kampong the housing sprawls into the woods and are connected by dirt roads.

Over 500 households (5) have been set up here, with an especially high rate of families since Batamindo's dormitories reserved for singles only are out of bound. In these families most men work in shipyards and the women work in Batamindo. Since they have settled down with their family, they rotate companies periodically as they are hired based on short-term contracts.



#### Urban Plan of Kampong Selayang

A Sewage system  
B Extended concrete

1 Gate  
2 Market  
3 Church  
4 Muslim school and Mosque  
5 Houses



Gate to the Village at Kampong Selezang, 2012 Batamindo

**Pasar Rakyat**

In English "pasar rakyat" means people's market. The kampongs serves different needs that cannot be fulfilled within the organized park structure, such as stalls repairing worker's clothes or food markets. Many signs are hung up around the entrance gate announcing the different church services.

A great example of how the industrial park and the kampong benefit from each other is the portrait of Revianita. She runs a small sewing shop in the market where she mostly repairs workers' clothes from the park.

Revianita and her husband came to Batam from Sumatra four years ago (1998). He works in a shipyard and her daughter works for Venturindo in Batamindo.



1. Market street
2. View towards the dormitories over the roofs of the market
3. Housing scattered in the woods

**A Walk Through**

The market is located by the entrance and has many different food stands and small shops selling a wide range of goods, from mobile phones, fresh vegetables, tools, to stalls offering house repair services. Since the market is built inside Bataminodo's foundation, the street is paved. The market street is a preferred hangout since the food courts offered by the park are out of walking distance.

Once in a while motorcycles make their way through the market's narrow street where all traffic is forced to pass through. Housings are scattered into the woods and connected by narrow dirt roads. When the rain comes, these paths are flooded and very slippery. The houses are all well maintained and homely, with small decorated porches.



2.



3.

## Creating Conditions for Global Manufacturing

The establishment of Special Economic Zones sets the basis for Batam's growing attractiveness as an industrial manufacturing hub providing tax incentives and other assets for importing and exporting companies. The law for the management of industrial estates by private companies passed in 1989 has made these location accessible to foreign investors.

The foundation of the Industrial Park Batamindo is a joint venture by Indonesian and Singaporean partners realized to combine the advantages of global management. This provides the highest quality conditions for production through the provision of cheap labour force and cheaply

priced land. All this is located just a few kilometres away from a hub with premium global connections, which assures the success of this venture.

In order to facilitate foreign private investments, a 'one stop service' was established to accelerate all kinds of administrative clarifications and interactions with authorities. Factories can be ready for production only three months after the signing of the initial contract thanks to this simple and efficient set up process.



Origin of the 74 Batamindo tenants



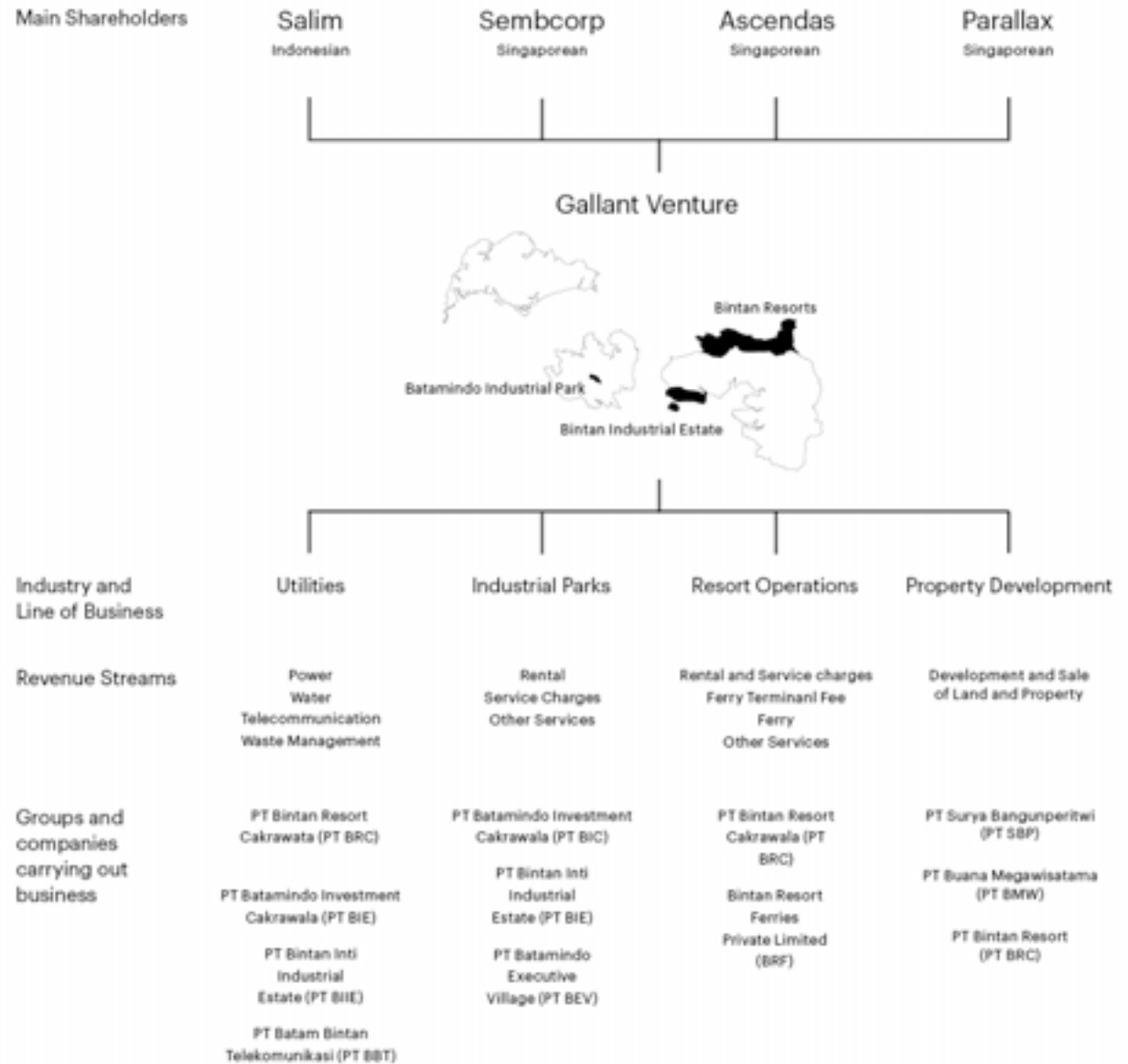
- 1 Alteo Chemical Indonesia, PT
- 2 Brotika Semesta (DHL Express), PT
- 3 Casio Electronics Indonesia, PT
- 4 CIBA Vision Batam, PT
- 5 Daihan Labtech, PT
- 6 Eminent Plastics Batam Indonesia, PT
- 7 E-tech Manufacturing Indonesia, PT
- 8 Epson Batam, PT Scanner Assembly
- 9 Epson Toyocom Indonesia
- 10 ESG Panatec, PT
- 11 Esqarada / BSW, PT
- 12 Evox Rifa Indonesia, PT
- 13 Exas Batam, PT
- 14 EX Batam Indonesia, PT
- 15 Fluid Sciences Batam, PT
- 16 Foster Electric Indonesia, PT
- 17 Fujitec Indonesia, PT
- 18 Heng Huat Plastic Industries Ind, PT
- 19 HLN Batam, PT
- 20 Hymold Batam, PT
- 21 Honfoong Plastic Industries, PT
- 22 Infineon Technologies Batam, PT
- 23 JMS Batam, PT
- 24 Japan Servo Batam, PT
- 25 Leo Industries Batam, PT
- 26 Minamoto Indonesia, PT
- 27 Nactec Batam, PT
- 28 Nagano Driube Indonesia, PT
- 29 Nissin Kogyo Batam, PT
- 30 Noble Batam, PT
- 31 NOK Asia Batam, PT
- 32 NOK Precision Component, PT
- 33 NXP Semiconductors, PT
- 34 Panasonic Battery Batam(PBB), PT

- 35 Panasonic Shikoku Electronics Batam( PSECB), PT
- 36 Patlite Indonesia, PT
- 37 PCI Electronic International, PT
- 38 Perkin Elmer Batam, PT
- 39 Petrolog Harapan Abadi Semesta, PT
- 40 Philips Industries Batam, PT
- 41 Polestar Plastic Batam, PT
- 42 Primo Micropones Indonesia, PT
- 43 Risis Indonesia, PT
- 44 Rubycon Indonesia, PT
- 45 Sanipak Indonesia, PT
- 46 Sanmina-SCI Batam, PT
- 47 Sansyu Precision Batam, PT
- 48 Sanwa Engineering Batam, PT
- 49 Sanyo Precision Batam, PT
- 50 Schneider Electric Manufacturing, PT
- 51 Shimano Batam, PT
- 52 Shin-Etsu Magnetics Indonesia, PT
- 53 Siemens Hearing Instruments, PT
- 54 Surya Teknologi Batam, PT
- 55 Takamori Indonesia, PT
- 56 TEAC Electronics Indonesia, PT
- 57 TEC Indonesia, PT DOT Printers Head
- 58 Teckwah Paper Products Indonesia, PT
- 59 Thomson Batam, PT
- 60 Top Foam, PT
- 61 Tunas Karya Indoswasta, PT
- 62 Unisem, PT
- 63 Uwatec Batam, PT
- 64 Varta Microbattery Indonesia, PT
- 65 Wireforms Batam Indonesia, PT
- 66 Yeakin Plastic Industry, PT
- 67 Yokogawa Manufacturing Batam, PT



**One Stop Service**

Batamindo's management offers a so-called "one-stop service". This is an integrated service by the 'under one-roof policy' designed to simplify investment licenses and permits, which facilitates investments and the set up of industrial facilities in Batam. This service extends at different levels in the operation, such as security and maintenance, business license applications, immigration, manpower management as well as recruitment and logistics.



**What is Gallant Venture?**

"Gallant Venture Ltd. is an investment holding company with focus on regional growth opportunities. We are a commercial development and management group in Riau Archipelago and an integrated master planner for industrial parks and resorts in Batam and Bintan. Since the early 1990s, we have operated in four key areas; utilities, industrial parks, resort operations and property developments. In 2004, our operating revenues totalled approximately S\$202.0 million while our total assets were valued at approximately S\$1.5 billion. Our principal shareholders include the Salim Group, the Parallax Group, SembCorp Industries Ltd and the Ascendas Group.

Our businesses take advantage of the strategic proximity of Singapore and the

close economic cooperation between the Singapore and Indonesian governments to promote investment in the Riau Province. Headquartered in Singapore, our location is one of our key assets given Singapore's reputation for multinational management due to its infrastructure, proven legal system and good corporate governance environment. Our investment portfolio is a good mix between stable cash flow in the utility and industrial park businesses, promising growth potential in the resort and property development businesses in Bintan, and strong balance sheet with low gearing." (www.gallantventure.com)

**MEEC Tai Sin**  
POWER CONTROL & INSTRUMENTATION LABS  
SRI LMKO 178  
**PT. SRI BATAM BAYA**

GUCCI  
LENSA SINGLE VISIOMY  
Rp. 75.000  
TERMASUK CRYSA  
240.000  
LENSA PROGRESSIVE  
270.000  
Rp. 80.000 - Rp. 37.000  
**OPTIK MELAWAI**

**SAMSUNG**  
ARTHA KENCANA

**OPTIK MELAWAI**

KETAYU MOP  
**BAHAGIA**  
**Tiger**



# Infineon: Portrait of a Global Player

Looking for a tenant in Batamindo that makes use of the park's many locational advantages, Infineon proved to be the perfect find and offered to give us an insight in its complex production process and global distribution.

Infineon is a German semiconductor company headquartered in Munich and employs over 26'000 people worldwide. In the 2011 fiscal year (ending September 2011), the company reported sales of 3.997 billion Euros. "Infineon Technologies focuses on the three central chal-

lenges facing modern society: Energy Efficiency, Mobility and Security and offers semi-conductors and system solutions for automotive and industrial electronics and chip card and security applications.

Infineon's products stand out for their reliability, their quality excellence and their innovative and leading-edge technology in analogue and mixed signal, RF and power as well as embedded control." (from www.infineon.com)

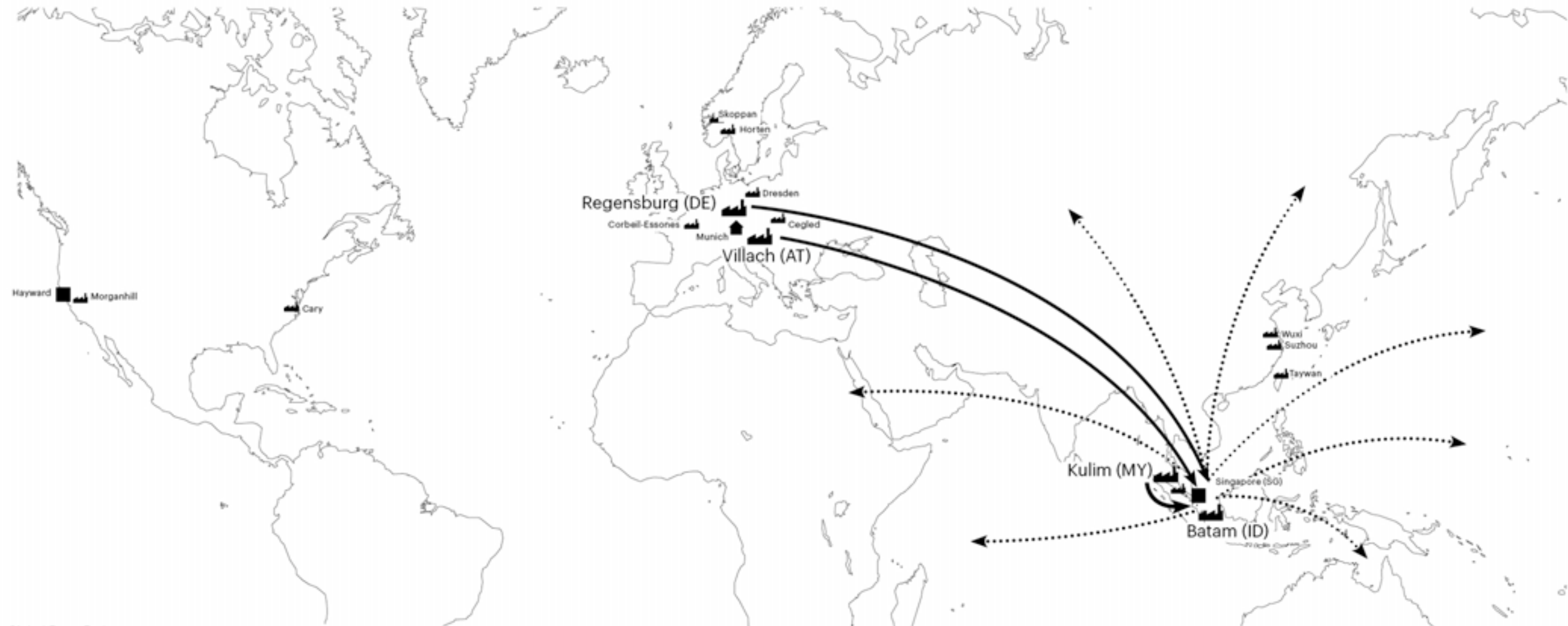
### A Model of Global Production

The microchip production process is divided into two steps: front-end and back-end. Due to the different technical requirements the two steps can be carried out in different locations.

The front-end step, in which silicon wafers are fabricated is very demanding from a technical point and special facilities are required. In the more labour intensive back-end process, the semiconductor chips are

put together with different components to form mountable microchips.

The back-end production used to be set-up in Singapore and was moved to Batamindo in 1996. This decision was made with the help of Singapore's toll, which also advises firms located in Singapore. This strategic decision combines Batamindo's locational advantages of cheap production and proximity to Singapore as a global distribution hub.



**Global Front-End Production**

- Delivery to Batam over Singapore
- Distribution from Singapore
- Infineon headquarter (Munich)
- Infineon distribution center
- ▲ Infineon production sites



#### Back-End Steps

- Front-end delivery to Batam
- Material from independent suppliers
- Container transport to Batamindo
- Finished products Distribution Center
- Singapore
- Factory Batamindo

**Linking Singapore and Batam in the Production and Distribution Chain**  
Infineon's distribution centre in Singapore is responsible for the supply to its Asian customers.

The front-end process of the microchips finalized in Batamindo is carried out in Regensburg, Villach and Kulim. The wafers are flown (—) to Singapore and then directly transferred to Batam's Hang Nadim airport.

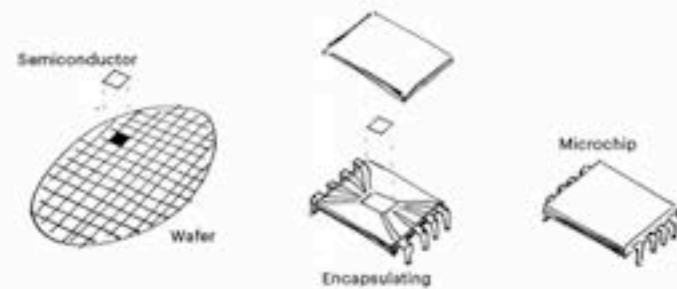
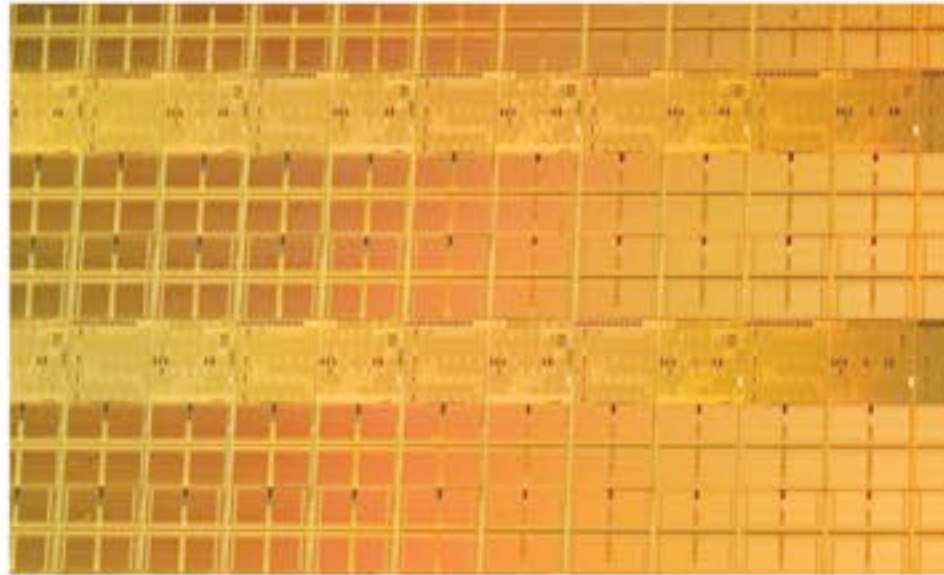
In parallel, other raw materials needed for the back-end production in Batamindo are shipped by independent suppliers to Singapore using large container sea vessels (- -). The deliveries are divided into small pallets according to the need of individual firms.



Boat customized for a single container, Batu Ampar, 2012

#### Container Shipping

Raw materials find their ways to the Infineon's distribution center. Here everything is repacked for the production of specific microchips and loaded into a single container for Batamindo (—). A small boat fitted to carry one container travels from Singapore's harbor to Batu Ampar in Batam. From here the container is loaded onto a truck and driven to Batamindo. Good road infrastructure allows the transfer from the port to Batamindo in only 15 minutes.



### Production

Since the wafer surface is extremely fragile the whole workspace must be kept perfectly clean so that no particles get in contact and ruin the chips. Workers must wear a full body suit with mouth masks and air brush their whole body holding their hands up before entering the room.

As a first step in the back-end process, rectangles are cut out using a diamond blade. The small pieces are placed on copper and wires are bonded, brazed and then finally encapsulated. After a series of testing the microchips are marked, scanned and packed.

Boxes are then loaded into a container and driven to Batu Ampar. From here they are carried to Singapore by wooden ships. The finished product is either picked up by the customer directly from the warehouse or flown out.

### Front-End Product: The Wafer

Simply said, a wafer is a thin disc of semiconductors, which is the base material for microchips. The semiconductor consists of material with electrical conductivity for a conductor and an insulator. Silicon is the main material used to produce semiconductors, which is accumulated with argon and melted so that pure silicon is gained. The silicon rolling is cut into thin slices and the newly formed disc undergoes many micro fabrication process steps such as deposition of various materials and photolithographic patterning; a process that uses light to transfer a geometric pattern. In other words information is printed, as a result, a pattern or design becomes visible.



### Employees

It is typical for electronic industries to have more female than male employees. The same is true at Infineon. Most young women work as operators. Around a third of the workers live in the dormitories provided by the park.

Infineon is a 24-hour, seven days a week operation, divided into three eight hour shifts per day.

Infineon trains its employees through various classes and seminars. All these efforts are reflected in the low affiliation rate of six per cent, compared to other firms where rates of fifteen to twenty per cent can be observed.

Today, other functions such as technician, site management and top management are still dominated by men, which will most likely change due to the high women

quota. The lack of higher educated workforce is a growing problem in Batam. Infineon's site management, for instance, is mostly run by Malays, Filipinos and Singaporeans. The top managers of Infineon's Batamindo industries usually work in Batam during the week, but live with their families in Singapore because of the higher living standards and international schools.

# Conclusion

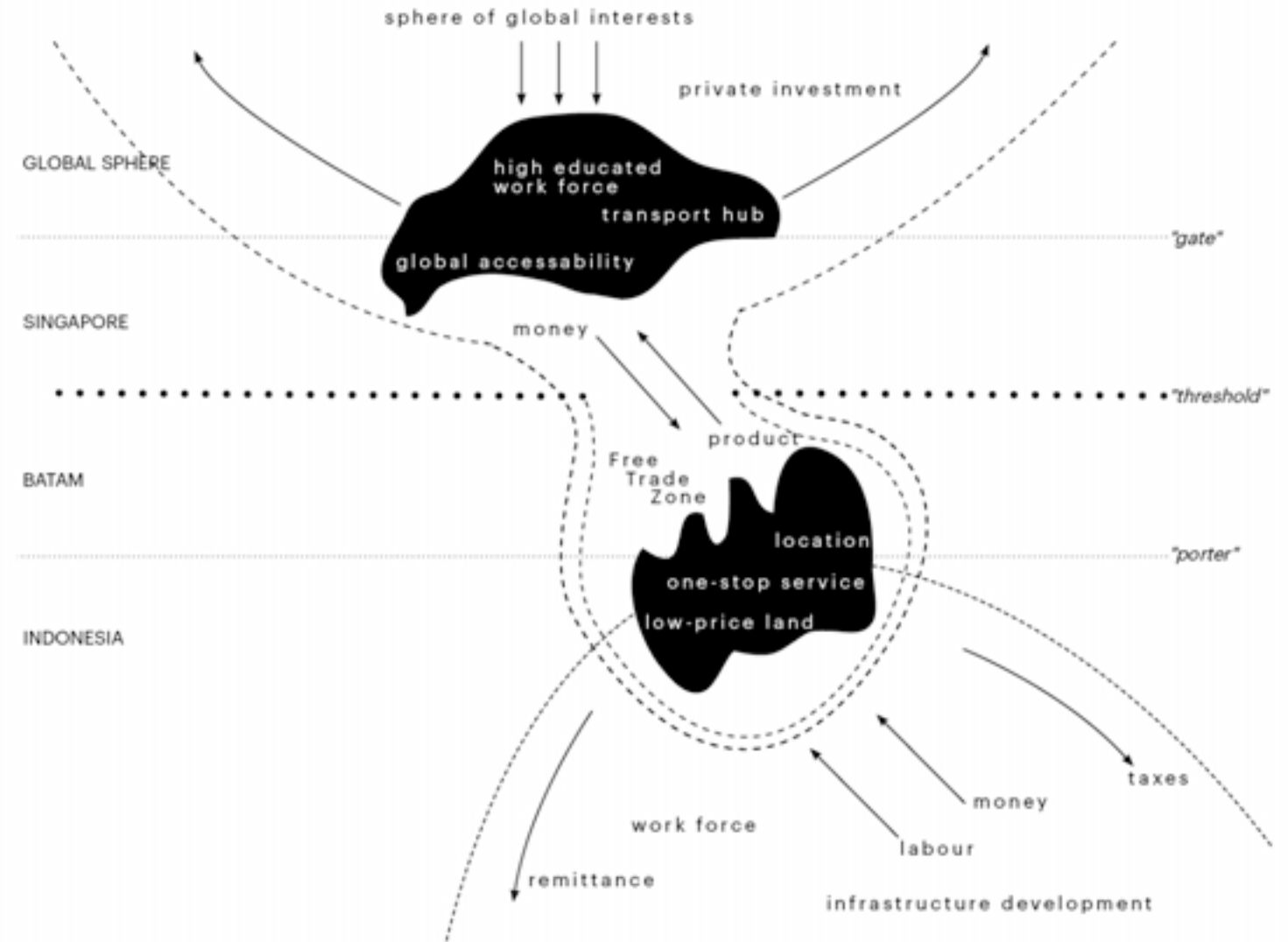
An ocean of social, economical and cultural differences separates Batam from Singapore. These disparities, however, have allowed waves of opportunities to brush from one shoreline to the other. As a result of the cooperation between Singapore and Indonesia, special economic agreements have been set up so that this gap of differences can be overcome and capitalized upon. Through this new constellation Batam

Values being exchanged

labour	land	investment	regulatory framework	distribution
managerial level		investment in production		
managerial level		investment in facilities & services	Free Trade Zone	●
	●		influence since 1999	
predominantly low skilled labour		investment in infrastructure through BIFZA & FTZ	Free Trade Zone	

has occupied a new role in relation to the rest of Indonesia to become a great point of interest. As a 'porter' towards Singapore, Batam has achieved accessibility to the global market for Indonesia. Simultaneously, it has accommodated Singapore's now world-renown market. These new conditions have shifted Batam's dependencies from Jakarta to Singapore in many ways. From another point of view this bridging of the threshold

does not only decrease Singapore's land scarcity problem due to the city-state's extremely high population density, but also serves the interests of investors worldwide for low price land and cheap labour in a global-gated location. All in all Batam seems to have much more potential than only being a hinterland. Due to the condition that has been created on the island, two completely different worlds of interests come to equal terms on this very Island.



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- Wan Darussalam, Chairman Bappeda Batam.
- Andy Hauw, Batamindo Industrial Park Manager.
- Farida Li, General Manager VJB.
- Nada Fasa Soraya, Chairwomen KADIN Batam.
- Hans-Martin Stech, CFO Infineon South-east Asia.
- Thomas Wevelsiep, Director Infineon Batamindo.
- Jürgen Potoradi, Director Infineon Batamindo.
- Suri Teo, Admin Manager Nexus Engineering.
- Hanung Nugroho, Student.
- Raith, Kampung inhabitant.
- Soraya, Dormitory inhabitant.
- Names unknown, owners of the Tofu production and the traditional shipyard.

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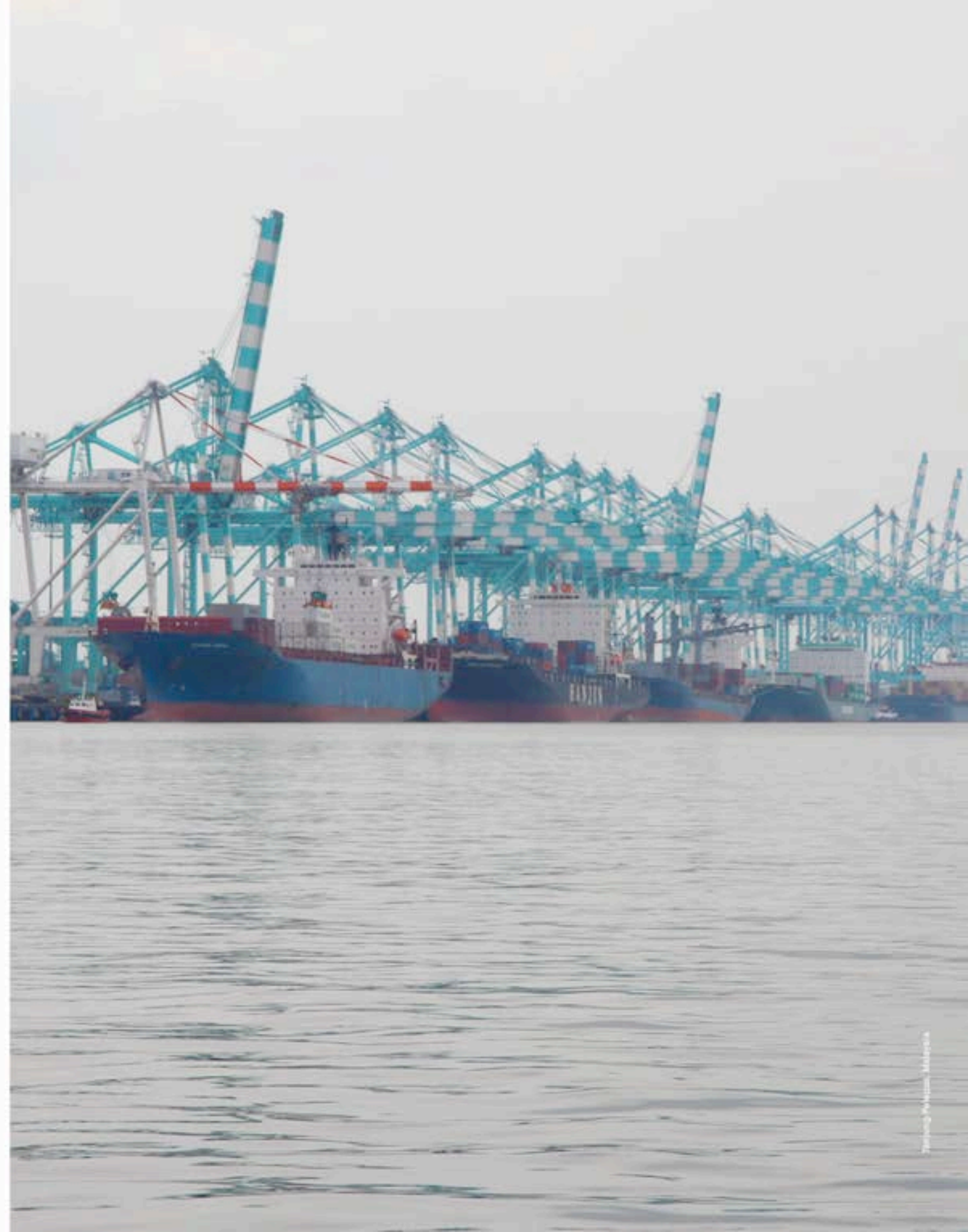
Thanks to Milica Topalovic, our Professor. The participation in this project was a unique possibility, not only to get an understanding of urban territories but also for having a unforgettable time in Southeast Asia.

Also to the assistants Marcel Jaeggi and Martin Knuesel who made a big effort in supporting the whole team of students during the semester. Thank you for the pleasant teamwork.

Special thanks go to Bappeda Batam, especially Bobbie Rahmat Kurinawan. He showed us the many beautiful sides of this fascinating island. We appreciated his support in every way.

Thanks to the management of Infineon Technologies, esp. Hans Martin Stech, Thomas Wevelsiep and Juergen Potoradi, for giving lots of background information about their business structures and for having the great possibility to get an insight in the globally linked manufacturing processes. Magnus Nickl for his support to get in contact with Infineon Technologies, and all the other fellow students, namely Giulia Luraschi, Martin Garcia and Karl Wruck, who made these long working hours and nightly sessions more than pleasant. We had hell of a time!

Thank you, Mom and Dad, for everything.













CHINA SHIPPING LINE



# SINGAPORE STRAIT - THE CITY IN FRONT OF A CITY

by  
Martin Garcia  
Magnus Nickl

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## The Global Shipping Corridor

Global Shipping Highways (p.24)  
Malacca and Singapore Strait (p.28)

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## History of 'The Port City'

Singapore as a Strategic Location  
within the British Empire (p.34)  
Strait Settlements (p.36)  
Transformation of the Singaporean Harbor (p.38)  
The Container Revolution (p.40)

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## The Strait as an Urban Territory?

Influence of the Depths (p.44)  
Border Regimes (p.50)  
Submarine Infrastructures (p.54)  
Space of Shipping (p.56)  
Space of Passengers (p.66)  
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Fishing Territory (p.70)  
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The Urban Plan of the Strait of Singapore (p.76)

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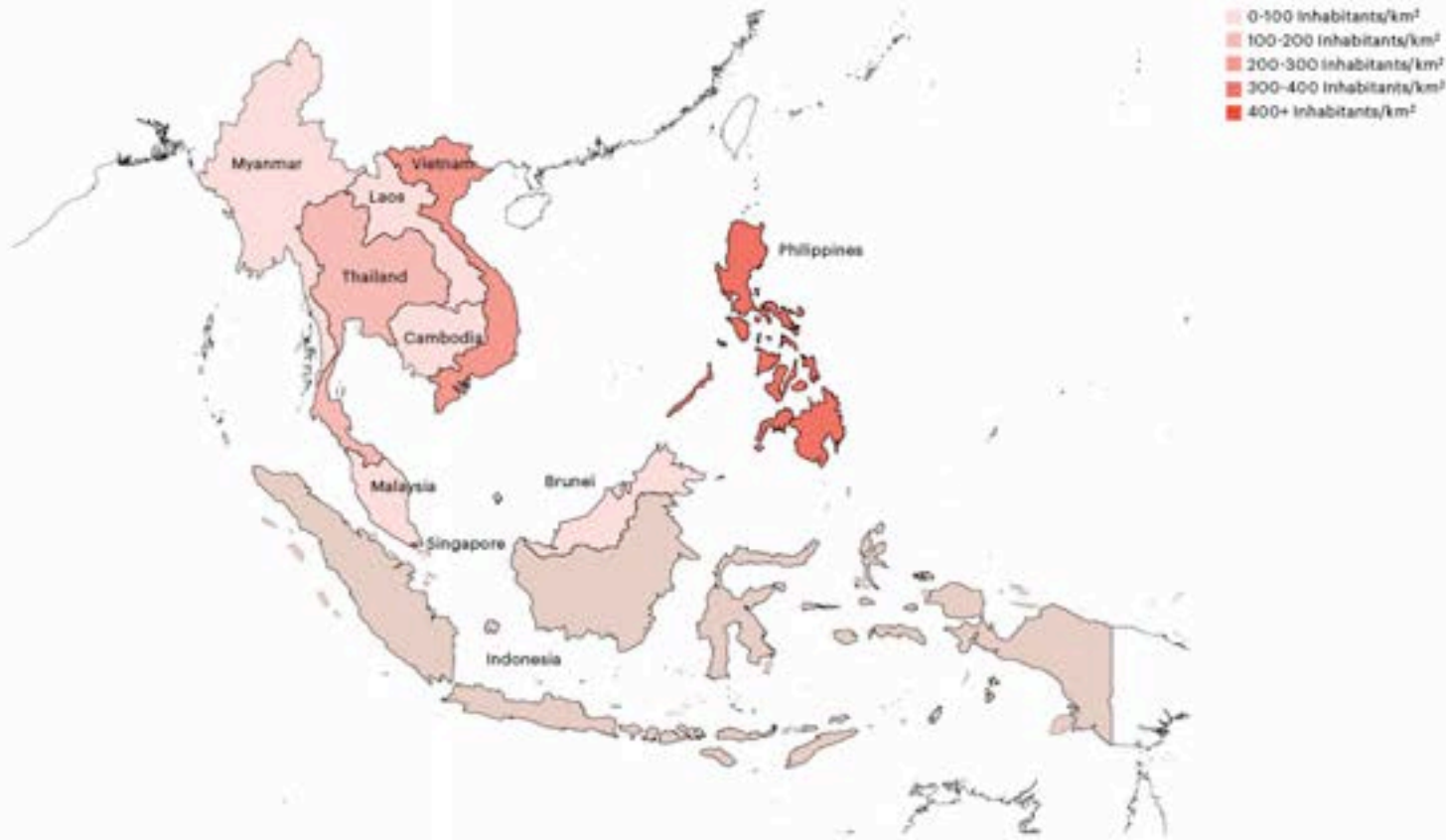
The Singapore Strait is a major Shipping route of South East Asia. With a width of about 16 Kilometers and a length of approximately 105 Kilometers the Singapore Strait is located between the Singapore Island and the Riau Archipelago, Indonesia. The Singapore Strait also connects the Strait of Malacca in the west and the South China Sea in the east. The biggest virtue of the Singapore Strait is that it provides a deep water passage to the Singapore Port making it one of the busiest in the world. In this work we describe the Strait of Singapore with the tools provided by traditional urban research. Does a water way have patterns assimilable to urban spaces and what can we learn by deploying this knowledge? The results is a novel view associated with a global waterway.

# The Global Shipping Corridor

An analysis of global ship movements requires detailed knowledge of ships' arrival and departure times at their ports of call. Such data have become available in recent years. Starting in 2001, ships and ports have begun installing Automatic Identification System (AIS) equipment. AIS transmitters on board of the ships automatically report the arrival and departure times to the port authorities. This technology is primarily used to avoid collisions and in-

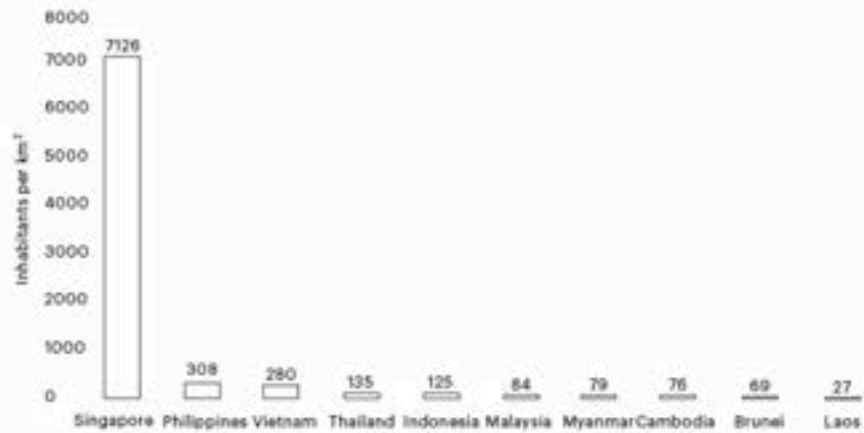
creases port security, but arrival and departure records are also made available by Lloyd's Register Fairplay for commercial purposes as part of its sea-web data base ([www.seaweb.com](http://www.seaweb.com)). The same approach is used to track ships on the open sea and the result can be seen by looking at the graphics below.





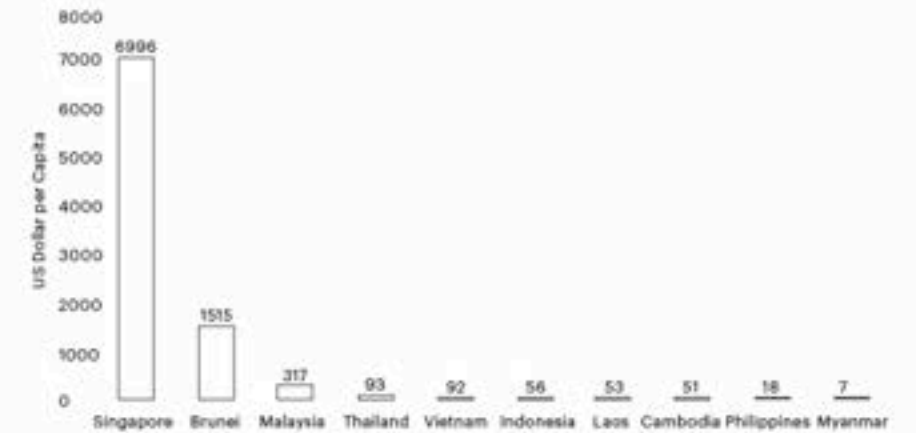
Population Density in ASEAN Countries

ASEAN covers a land area of 4.46 million km<sup>2</sup>, which is 3% of the total land area of Earth, and has a population of approximately 600 million people, which is 8.8% of the world's population (numbers from 2011). The sea area of ASEAN is about three times larger than its land counterpart. Due to its small size, Singapore has a very high population density forcing the Government to use land in a frugal manner. In order to meet this maxim all shipping facilities, traditionally using a lot of space, are relatively small in size.

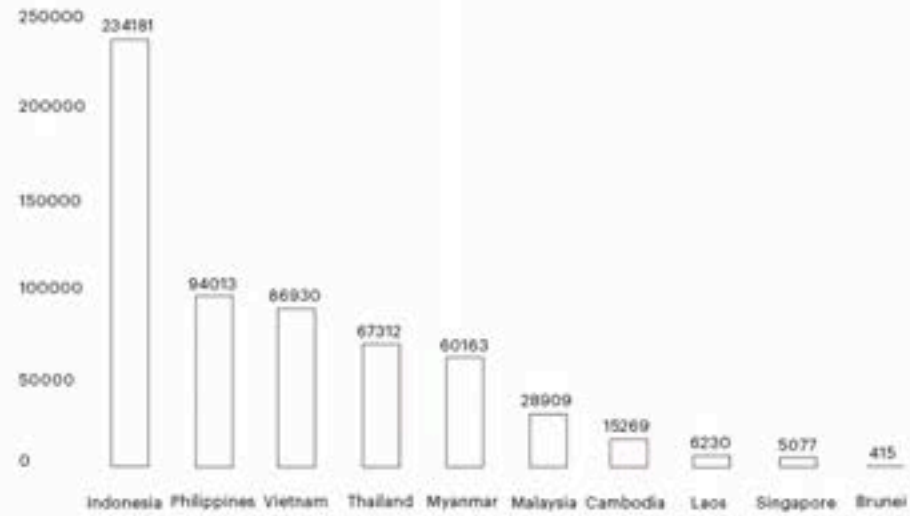


Foreign Direct Investment (FDI) per Capita in ASEAN Countries

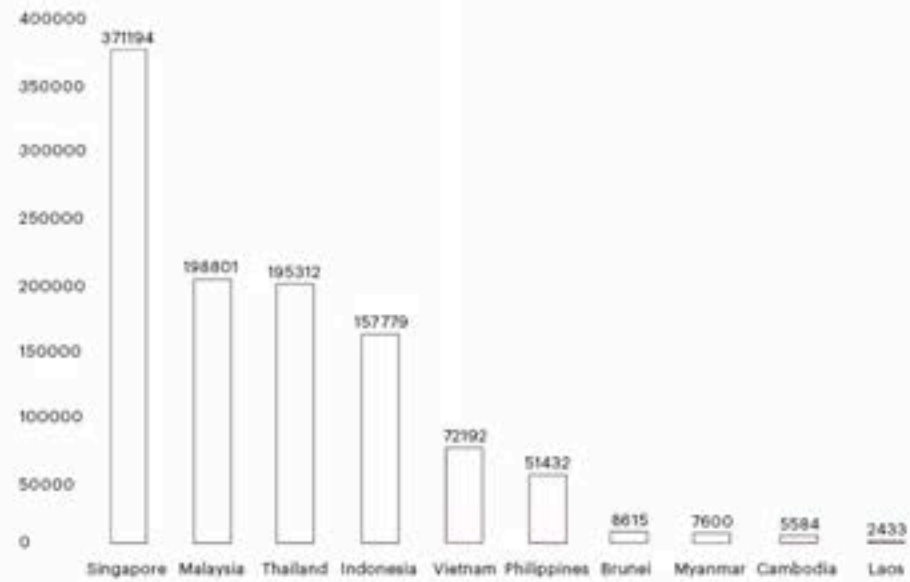
The Foreign Direct Investment (FDI) that was achieved in 2009 accumulated to \$37.9 billion and increased in 2010 to \$75.8 billion. 22% of FDI came from the European Union, followed by ASEAN countries themselves with 16% (numbers from 2011). Due to the debt issues in the European Union and the US, while Japan is still recovering from the tsunami, the forecast for the FDI development in the Asean member countries is slightly negative.



Inhabitants (in thousands)



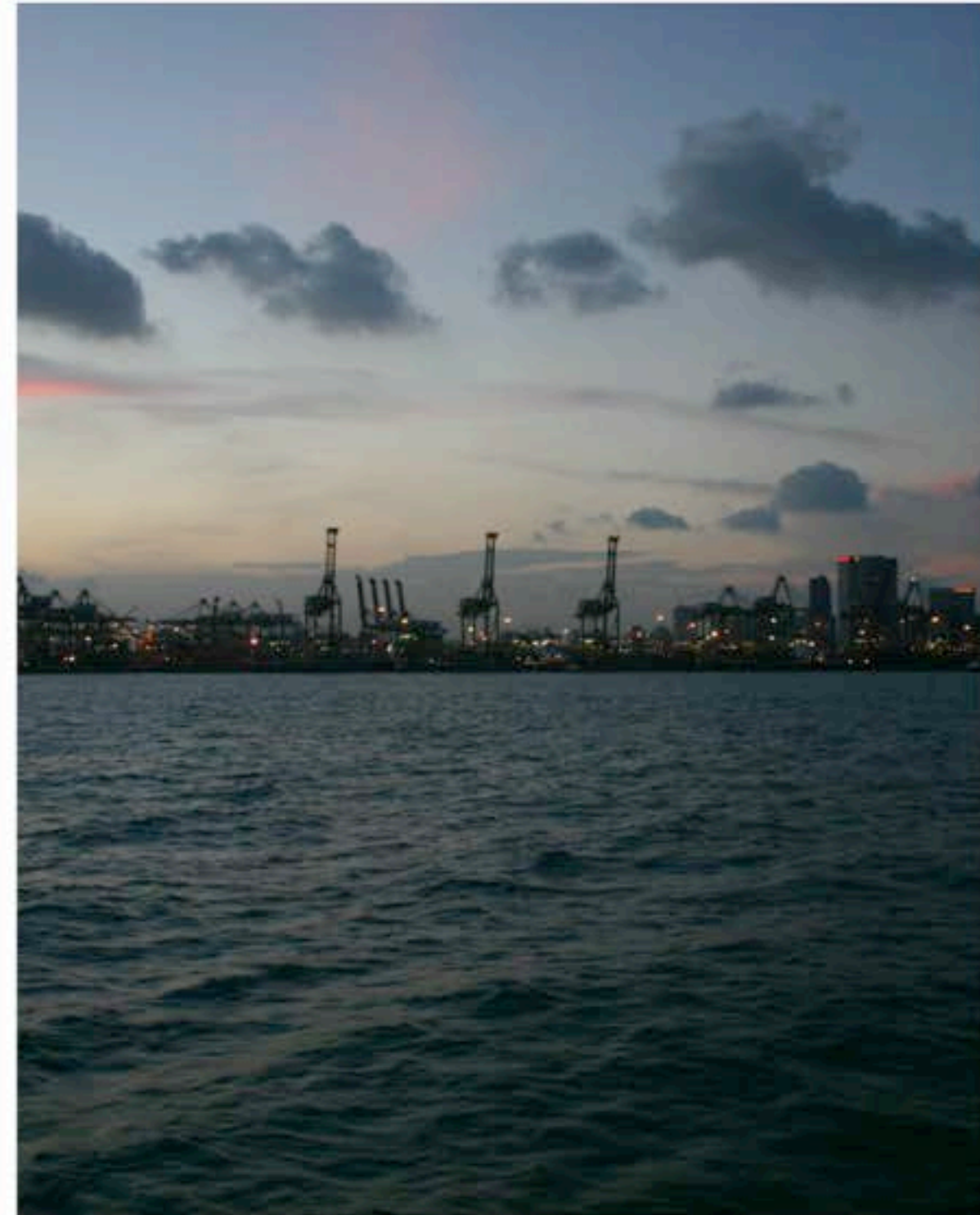
Exports (in Million US \$)



#### International Shipping and Global Trade

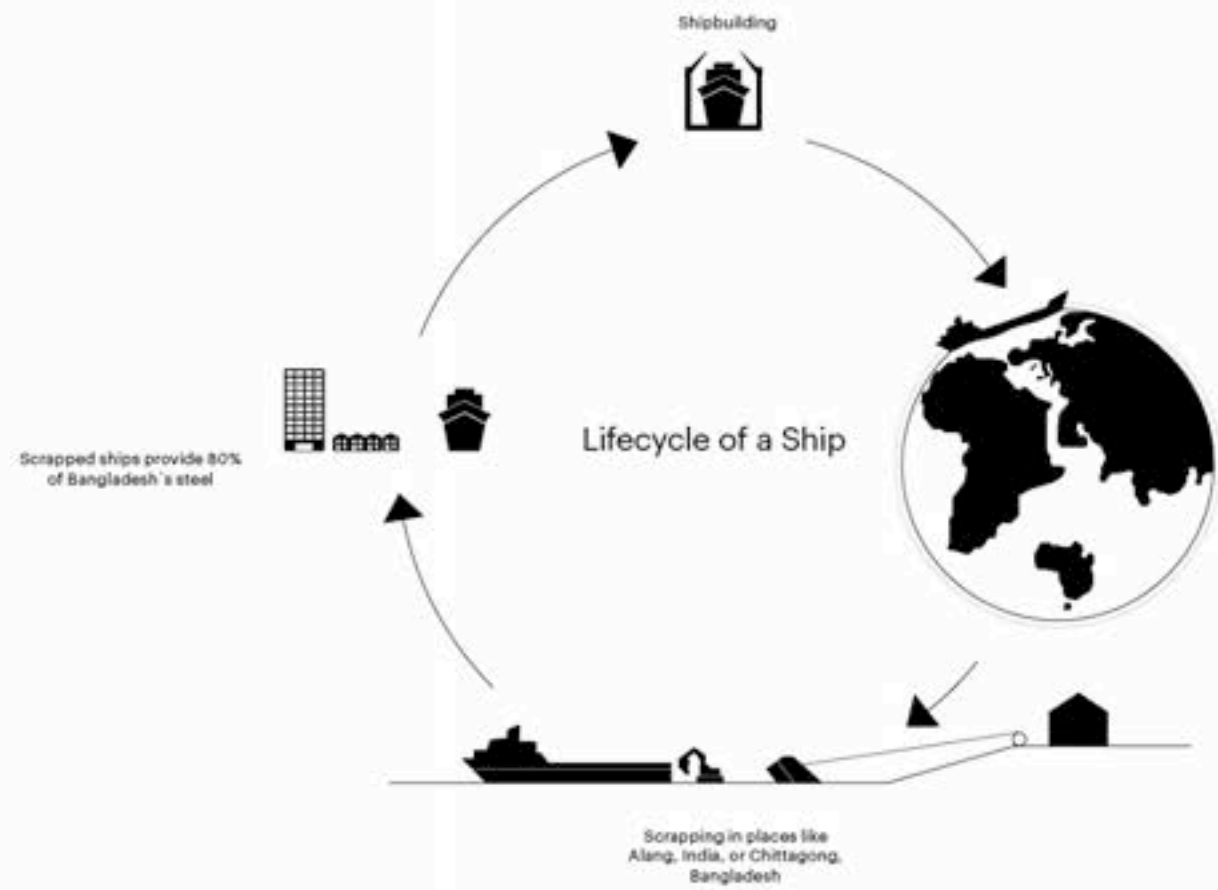
As the world became more developed, proximity to raw materials and to markets became the factors that, above all others, shaped the world's economy and, in particular, the major trade patterns and shipping routes. Eventually, the great seaborne trades became established: coal from Australia, Southern Africa and North America to Europe and the Far East; grain from North and South America to Asia, Africa and the Far East; iron from South America and Australia to Europe and the Far East; oil from the Middle East, West Africa, South America and the

Caribbean to Europe, North America and Asia; and now we must add to this list containerized goods from the People's Republic of China, Japan and Southeast Asia to the consumer markets of the Western world. Global trade has permitted an enormous variety of resources to be widely accessible and thus facilitated the widespread distribution of our planet's wealth.



Tanjong Pagar Container Terminal





Average time in service 26.9 - 31.5 years for oil tankers

### Lifecycle of a Ship

Most ships used in today's world are built in Japan, China, South Korea and in the Philippines. After a certain lifespan, ships will be removed from the fleet. For oil tankers, this span is currently between 26.9 to 31.5 year.

As soon as the ship is no longer used, it will be removed through a process called scrapping. Oil tankers have accounted for between 56.5% and 90.5% of the world's total scrapped ship tonnage. Most of these processes are done in Pakistan, India, and in Chittagong, Bangladesh, which we had the opportunity to visit.



1.



2.



3.



4.

- 1. Ship repair yard, Batam
- 2. Ship construction yard, Batam
- 3. Shipbreaking coast, Bangladesh
- 4. Ship breaking yard, Chittagong, Bangladesh

# Global Shipping Highways

The compound annual growth rate for global container trade volumes from 2002 to 2015 is estimated to be 6.6%, compared to 8.5% per annum during 1980-2002. The average growth rate through to 2010 has been estimated at 7.5% per annum, while for the following five years, the growth rate is expected to decline to 5.0%.

The world's busiest port is contested by several ports around the world, as there is as yet no standardised means of evaluating port performance and traffic. For the past decade, the distinction has been claimed by both the Port of Rotterdam and the Port of Singapore. The former based its measurement on cargo tonnage handled (total weight of goods loaded and discharged), while the latter ranked in terms of shipping tonnage handled (total volume of ships handled).

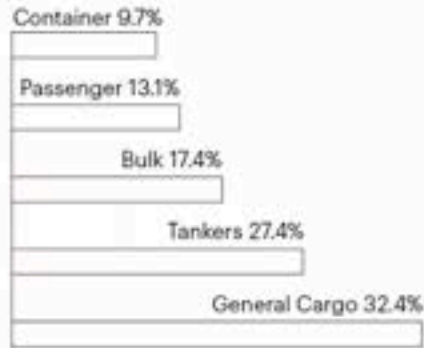
Exports from North Asia are expected to grow more slowly than exports for the world as a whole, due largely to subdued growth in containerized exports from Japan. North Asia's share of imports is also expected to fall over

the forecast period, but to a less significant extent.

Container traffic to and from other parts of Asia is expected to grow more rapidly than the world average. Expansion is expected to be particularly rapid in China, continuing the trend of the last five years, and solid growth is expected in South Asia. South-East Asia is also expected to increase its share of world container traffic over the forecast period.

The intra-Asian trade will continue to outperform global container growth by some percentage points, recording an average of 8.3% per annum over the forecast period.

Intra-Asian trade enjoyed spectacular growth in the decade prior to the 1997 currency crisis, with growth average well in excess of 10% per annum for a decade. The crisis brought a sharp reversal of this pattern, with an absolute decline in cargo volumes in the following year. Growth in the trade has now resumed, and the prospects for the next decade appear solid.

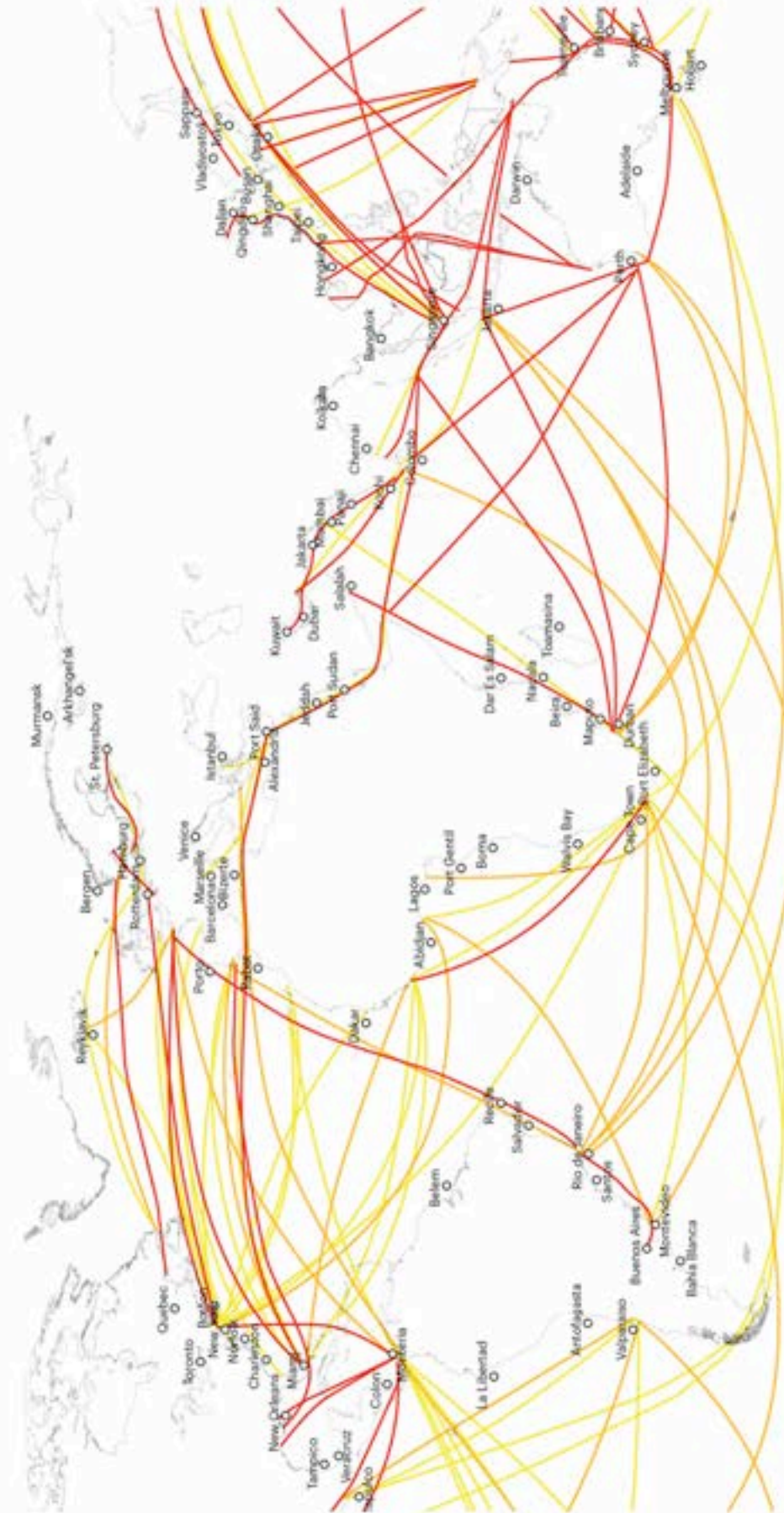


### International Commercial Ship Fleet and Seafarer Supply

Around 90% of world trade is carried by the international shipping industry. There are over 50'000 merchant ships trading internationally, transporting every kind of cargo. The world fleet is registered in over 150 nations, and manned by over one million seafarers of virtually every nationality.

The initial demand estimate combines fleet size and information on manning scales. This is then calibrated to be consistent with supply estimates. The calibration is

based on estimates of the overall supply/demand balance derived from comprehensive data supplied by over 100 major companies, and information from national administrations and a crewing experts' survey. Based on this evidence, the current estimate of worldwide demand for seafarers in 2010 is 637'000 officers and 747'000 ratings.



Major Trade Routes (2012)

- 100 journeys
- 1000 journeys
- 1000+ journeys



Panama Channel



Gibraltar Strait



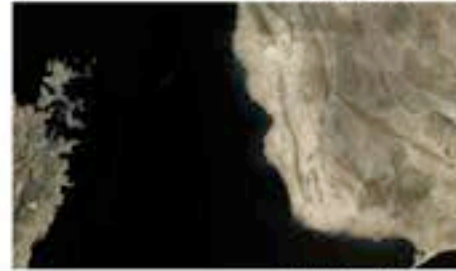
Suez Channel



Bosphorus Strait



Cape of Good Hope



Bab Al-Mandab Strait



Cape Horn



Denmark-Sweden



Hormus Strait

Important Features for Shipping

A strait or straits is a narrow, typically navigable channel of water that connects two larger navigable bodies of water. It most commonly refers to a channel of water that lies between two landmasses. Straits used for international navigation between two high seas or exclusive economic zones are subject to the legal regime of transit passage. The regime of innocent passage applies in straits used for international navigation that connect a part of high seas or an exclusive economic zone with the territorial sea of coastal nations. The same regime also applies in straits formed by an island of a state that borders it and the state's mainland if there exists a route through the high seas or through an exclusive economic zone of similar convenience with respect to navigational and hydrographical characteristics. There may be no suspension of innocent passage through such straits.



#01 Shanghai



#02 Singapore



#03 Hong Kong



#04 Shenzhen



#05 Busan



#07 Guangzhou



#08 Dubai



#10 Rotterdam



#7 Basel

Ports

It is to note that the list of largest ports in the world is subject to constant alteration. This is mainly because of the development taking place in each and every country across the globe, with respect to marine cargo transportation and commercial networking. China is the frontrunner in this race to have a stronghold in the marine ports sector.

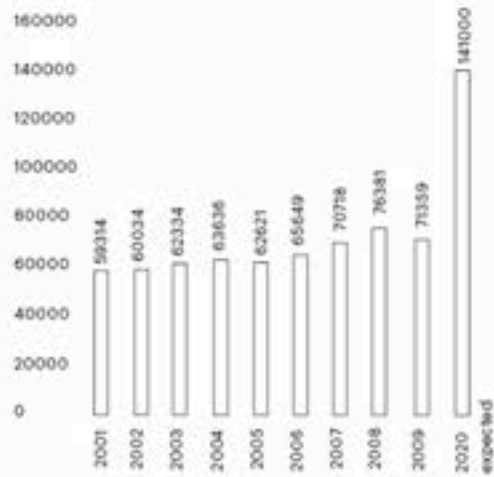
## Malacca and Singapore Straits

From an economic and strategic perspective, the Strait of Malacca is one of the most important shipping lanes in the world.

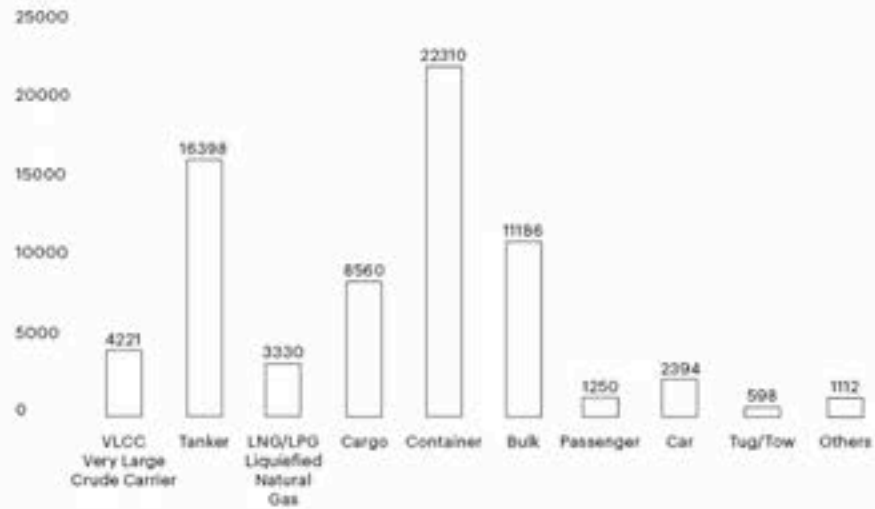
The strait is the main shipping channel between the Indian Ocean and the Pacific Ocean, linking major Asian economies such as India, China, Japan and South Korea.

Over 70'000 vessels pass through the strait each year, carrying about one-quarter of the world's traded goods including oil, Chinese manufactured goods and Indonesian coffee.

Number of Vessels in the Strait of Malacca

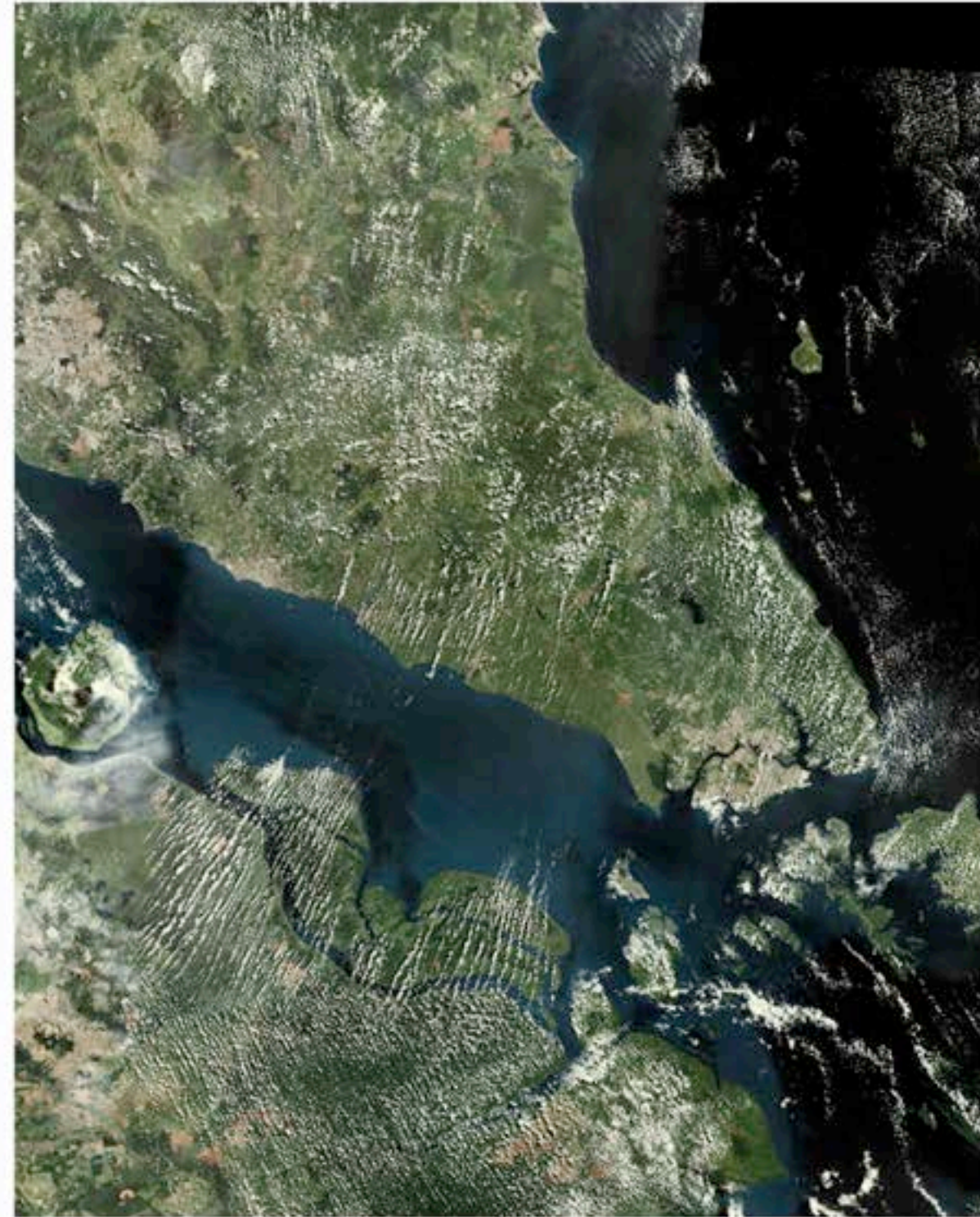


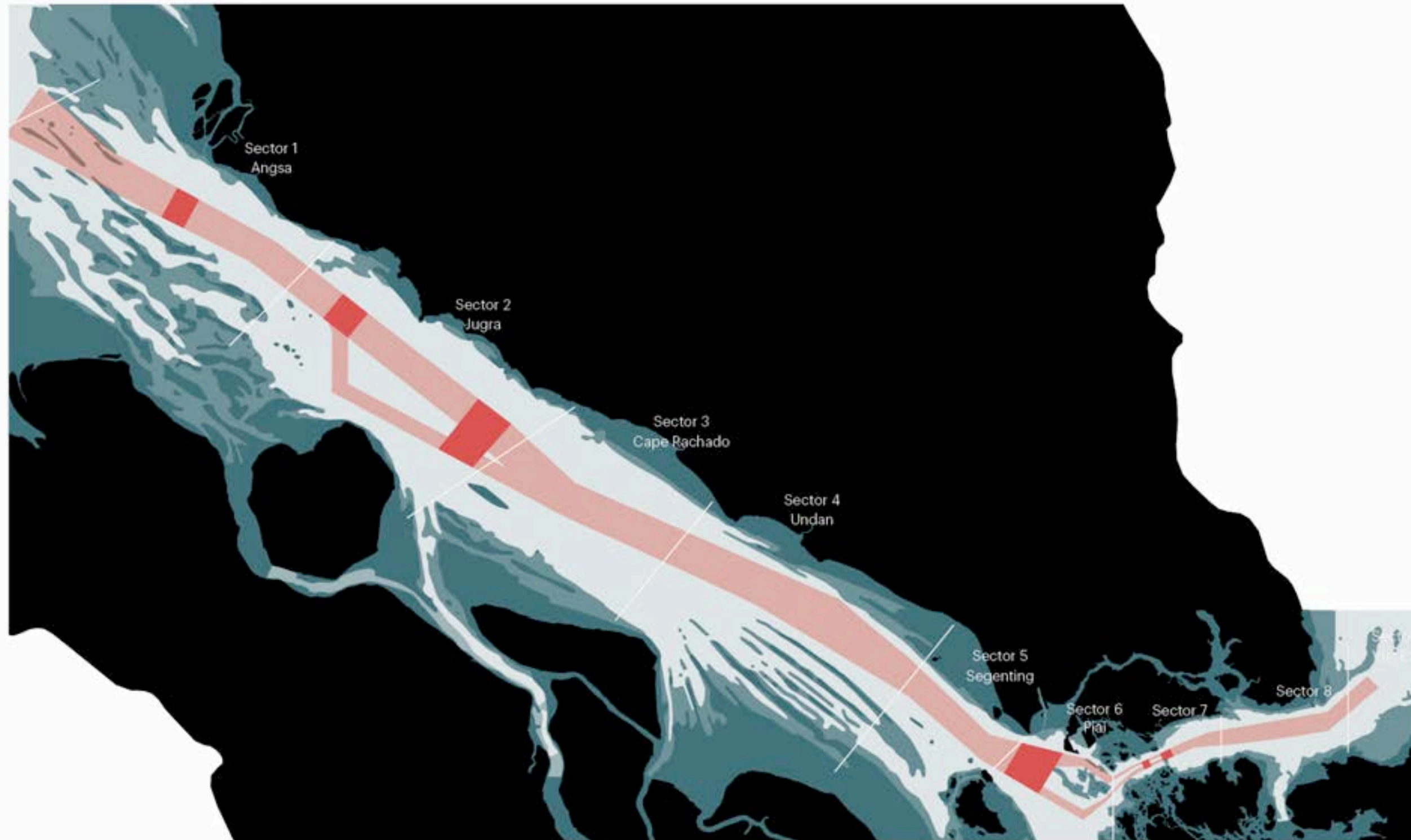
Type of Vessels in the Strait of Malacca (2009)



### Vessels in the Strait of Malacca

About a quarter of all oil carried by sea passes through the strait, mainly from Persian Gulf suppliers to Asian markets such as China, Japan, and South Korea. In 2006, an estimated 15 million barrels per day (2'400'000 m<sup>3</sup>/d) were transported through the strait. The maximum size of a vessel that can pass through the Strait is referred to as Malaccamax. The strait is not deep enough (at 25 metres or 82 feet) to permit some of the largest ships (mostly oil tankers) to use it. A ship that exceeds Malaccamax will typically use the Lombok Strait, Makassar Strait, Sibutu Passage and Mindoro Strait instead. At Phillips Channel close to the south of Singapore, the Strait of Malacca narrows to 2.8 km (1.5 nautical miles) wide, creating one of the world's most significant traffic choke points.





The Strait of Malacca and the Strait of Singapore (2012)

- 0-10 meters
- 10-20 meters
- +20 meters
- Main Fairway
- Turning and Crossing Areas

# History of the Port City

The British Empire comprised the dominions, colonies, protectorates, mandates and other territories ruled or administered by the United Kingdom. It originated with the overseas colonies and trading posts established by England in the late 16th and early 17th centuries. At its height, it was the largest empire in history and, for over a century, was the foremost global power. By 1922 the British Empire held sway over about 458 million people, one-fifth of the world's

population at the time, covered more than 33'700'000 km<sup>2</sup>, almost a quarter of the Earth's total land area. As a result, its political, linguistic and cultural legacy is widespread. At the peak of its power, it was often said that "the sun never sets on the British Empire".

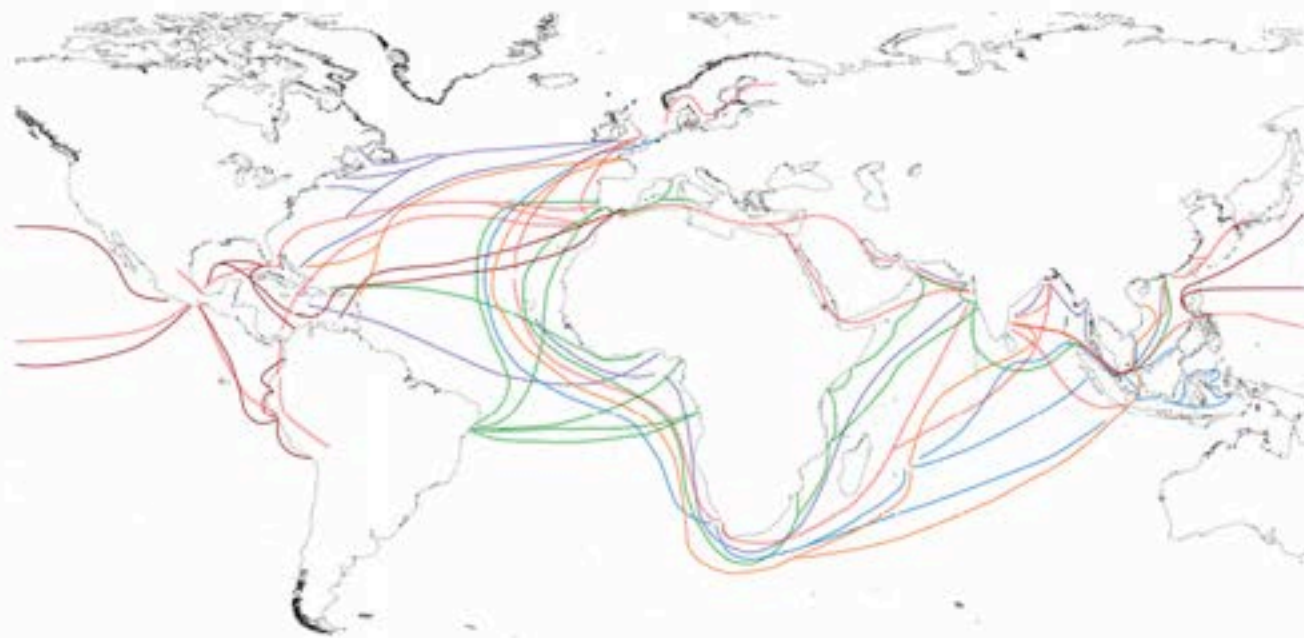


## Singapore as Strategic Location within the British Empire

In late 1818, Lord Hastings – the British Governor General of India – appointed Lieutenant General Sir Stamford Raffles to establish a trading station at the southern tip of the Malay peninsula. The British were extending their dominion over India and their trade with China was expanding. They saw the need for a port of call to “refit, revitalize and protect their merchant fleet” as well as to prevent any advances made by the Dutch in the East Indies.

After surveying other nearby islands in 1819, Sir Stamford Raffles and the rest of the British East India Company landed on Singapore, which was to become their strategic

trading post along the spice route. Eventually Singapore became one of the most important commercial and military centers of the British Empire. The island was the third British acquisition in the Malay Peninsula after Penang (1786) and Malacca (1795). These three British Settlements (Singapore, Penang and Malacca) became the Strait Settlements in 1826, under the control of British India. By 1832, Singapore became the center of government of the three areas. On 1 April 1867, the Strait Settlements became a Crown Colony and was ruled by a governor under the jurisdiction of the Colonial Office in London.



Colonial Maritime Trade Routes, 16-20th Century

- Dutch Trade Route
- Portuguese Trade Route
- French Trade Route
- English Trade Route
- Spanish Trade Route



Colonial Territories in Southeast Asia 19th Century

### Singapore Region: Borders and Connections throughout History

The territory of the Maritime Southeast Asia, or the Malay Archipelago as it is most commonly referred to, comprises Brunei, East Malaysia, Singapore, East Timor, the Philippines and Indonesia. For centuries, the Malay Archipelago has been a unified territory. Through colonial occupation, political borders have been introduced.

The first Malay empire, the thalassocratic Srivijaya, embraced the Malay Peninsula, Sumatra and parts of Java and Borneo, and reigned from the VII to XIII century. Through the appropriation of territorial waters, especially the Strait of Malacca located in the centre of the empire, the Srivijaya built a long and successful history of maritime trade with the Middle East, India, Southeast Asia and China. Srivijaya's domination of both the Straits of Malacca and the Strait of Sunda gave them control over local trade and the traffic of the maritime Silk Road.

In the XV century, the relations with the Arab world brought Islam to the Malay. A power shift took place in around 1400 with the outset of the Islamic period, covering the territory of the Malay Peninsula, the Riau islands and parts of Sumatra. The Srivijayan prince and king of Singapura, Parameswara, was the founder of the new empire, transforming Srivijaya into Malacca. The sultan actively supported the spread of Islam by sending Muslim missionaries throughout the Hindu archipelago.

Shortly after, the fall of the Sultanate of Malacca and the Portuguese occupation in 1511 marked a crucial turning point for the area, ushering the period of colonization and parcelling of the once united territory. The religious rivalry prevented a peaceful agreement between the sultanate and the Portuguese: shortly after the occupation, a new sultanate was founded in Johor, side-by-side with the Portuguese Malacca.

With the increasing European colonization of Southeast Asia, the Malay territory was becoming increasingly fragmented. Through the Anglo-Dutch Treaty of 1824, the British and the Dutch dominions were established in the north and south. In this manner, the once unified region was irrevocably fragmented, following the lines drawn by the British in 1819. The independence of Indonesia in 1945, Malaysia in 1957 and Singapore in 1963, could not renew the weakened political ties between each geopolitical entities. The fragmented territory surrounding Singapore today represents a complex and paradoxical context marked by cultural unity, the need for economic alliance, and political rivalry.

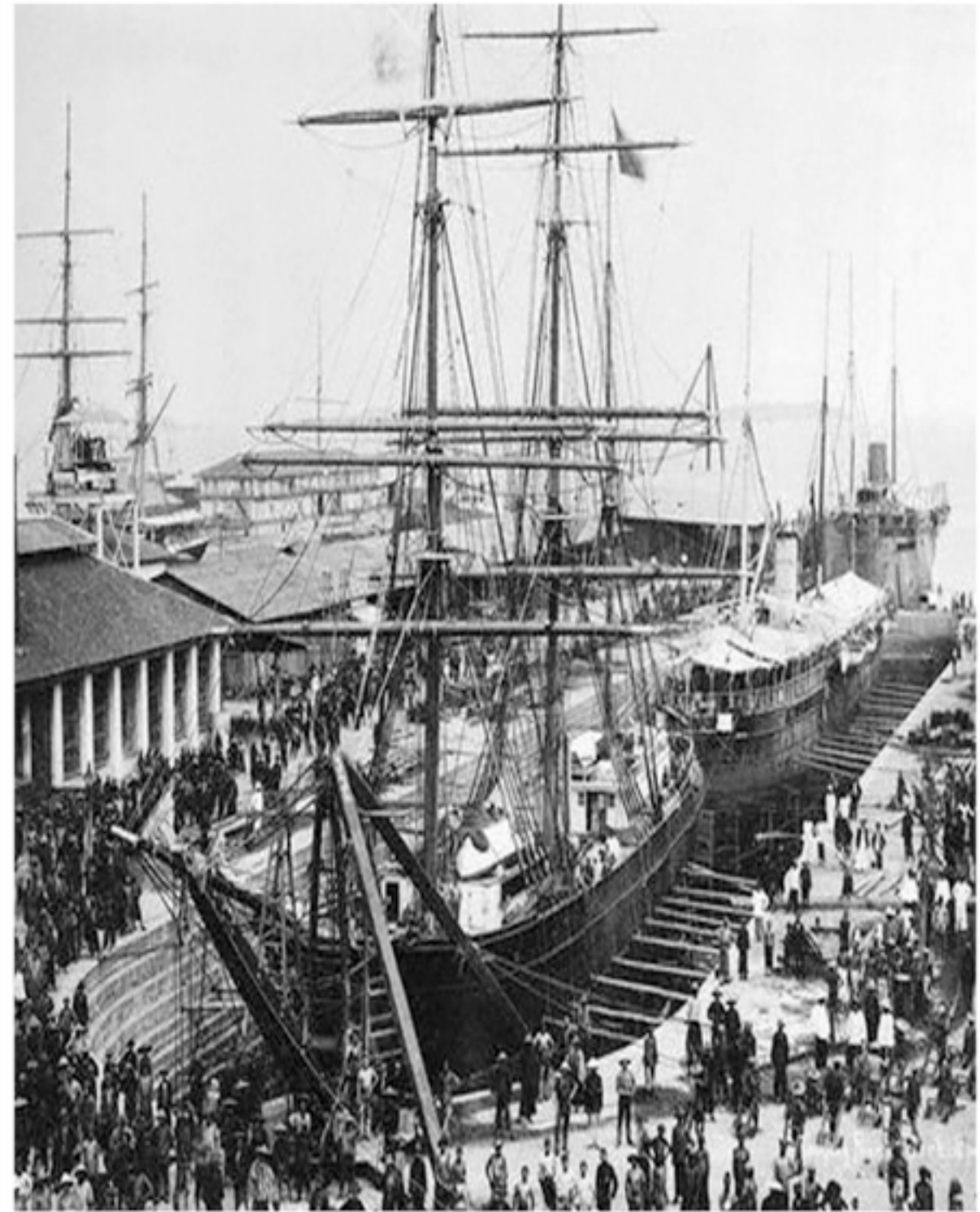
## Strait Settlements

During the subsequent decades, Singapore grew to become one of the most important ports in the world. Several events during this period contributed to its success. British intervention in the Malay peninsula from the 1820s onwards culminated, during the 1870s, in the formation of British

Malaya. During this period, Malaya became an increasingly important producer of rubber and tin, much of which was shipped out through Singapore. Singapore also served as the administrative center for Malaya until the 1880s, when the capital was shifted to Kuala Lumpur.



Main Ports along the Strait  
of Malacca  
Colonial Period



Opening of King's Dock  
1913



## Transformation of the Singaporean Harbour

Raffles made landing on the north bank of the river and discovered favourable conditions for the setting up of a colony. The area on the side of the river's north bank was leveled and firm, but the southern bank was swampy. The settlers found abundant fresh water, and the river itself was a sheltered body of water protected by the curved river mouth. The river was to become the nexus from which the new colony would thrive, and the immediate surrounding areas would form the core of the island's business and civic areas. As the settlement grew, many better-off fami-

lies moved to the East Coast, where they often operated plantations and maintained large sea-side homes near the beach at Katong.

The current planning policy of Singapore's Urban Redevelopment Authority (URA) is to create partially self-sufficient towns and districts, which are each related to one of four regional centres, or to Singapore Central Business District (CBD). These regional centres reduce traffic strain on Singapore's CBD by replacing some of the commercial otherwise fulfilled within the Central Area.



Settlements and Harbours



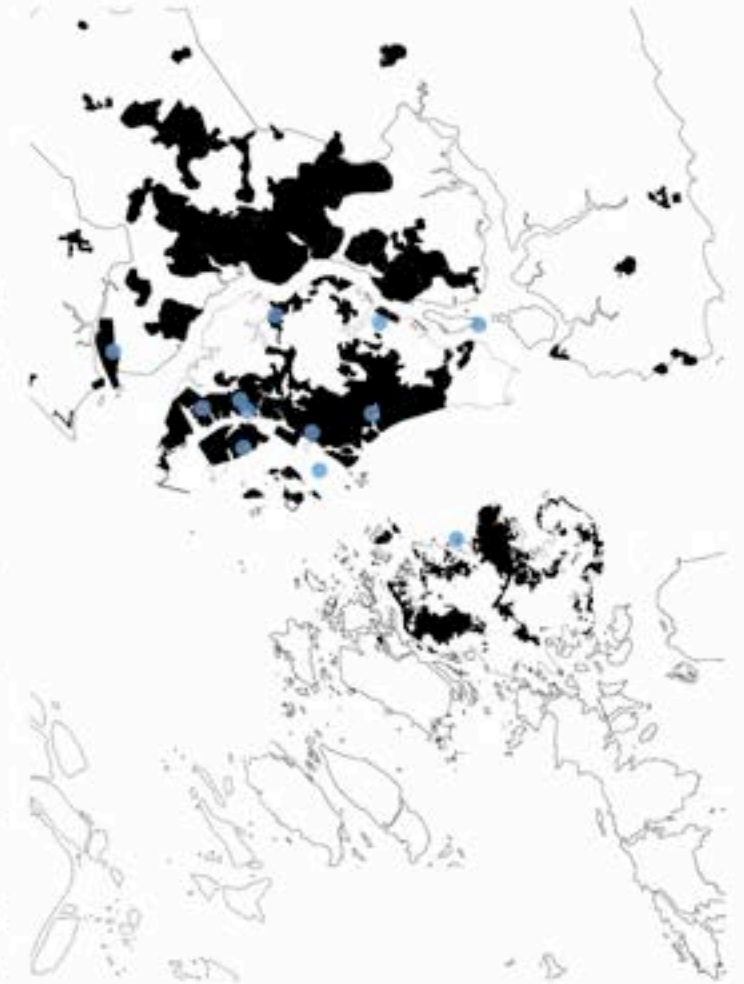
1900



1950



1990



2011

## The Container Revolution

In 1955, a North Carolina trucking entrepreneur, Malcolm McLean, acquired the Pan-American Steamship Company from Mobile, Alabama, a subsidiary of Waterman Steamship. Using a concept developed by Seatrain Lines in the 1930s, he initially favored the construction of 'trailerships'—taking trailers from large trucks and stowing them in a ship's cargo hold. This method of stowage, referred to as roll-on/roll-off, was not adopted because of the large waste in potential cargo space onboard the vessel, known as broken stowage. Instead, he modified his original concept into loading just the containers, not the chassis, onto the ships, hence the designation containership, or "box" ship. In January 1956, he purchased three T-2 tankers and oversaw the construction of wooden shelter decks, known as Mechano decking. This was a common practice in World War II for the carriage of oversized cargo, such as aircrafts. The first ship with containers, SS Ideal X, sailed from Port Newark, New Jersey, to Houston, Texas, on 26 April 1956 and opened a new age in cargo transportation. Shipping firms were slow to embrace McLean's concept. The conversion of existing ships provided the first generation of containerships. Many of these vessels, such as the C-3 freighters altered by Matson Lines in the Pacific, merely added lashings on deck for the securing of containers. The existing booms served as the means to load and unload the boxes. Yet, the addition of containers did not solve the problem of cargo throughput. A lack of standardization in container length and height persisted and forced dedicated service between trucking firms and shippers, precluding the introduction of true intermodalism—the seamless movement of cargo from shore to ship to shore. McLean's new company, Sea-Land, based on the East Coast, preferred thirty-five-foot-long containers, while Matson on the West Coast used twenty-four-footers. Not until 1961 did the International Standards Committee set up formal sizes: the twenty-foot equivalent unit (TEU = 20' length x 8' width x 8.5' height) and the forty-foot equivalent unit (FEU = 40' x 8' x 8.5').

A major technological improvement in the transportation of containers came with the introduction of cellular construction. The installation of vertical rails in the holds of ships, known as cell guides, in conjunction with high-speed shore cranes, made container handling quicker and more efficient. Yet, the transition to containerships did not always proceed smoothly. Grace Lines suffered a severe setback in their trade with the west coast of South America by introducing containers before the market could sustain them. In addition, they incurred the wrath of local labor when stevedores and longshoremen refused to move the containers for fear of losing their jobs. Many companies also faced the challenge of vessel replacement. As their war-built fleets were nearing the end of their service lives, many firms had to choose what type of ships to build. Some companies went with larger freighters, others preferred with barge carrying vessels, others with roll-on/roll-off ships. Even containerships did not prove to be the right choice initially. In 1960, American President Lines constructed two ships that represented a transition point from break-bulk stick freighters to true containerships. The Searacers provided for a mix of container transport and break-bulk cargo. The two conflicting systems of cargo transportation proved inefficient and incompatible, but, nevertheless, symbolic of the crossroads that the shipping industry faced in terms of technology. It was the Vietnam War that demonstrated the true value of the containership. To deliver the mountains of supplies needed to support the armed services, the Military Sea Transportation Service (today known as the Military Sealift Command) contracted with Malcolm McLean. In April 1966, Sea-Land initiated container service between the east coast of the United States and Bordeaux, France, and Hamburg, Germany, laying the foundation for modern trade.



Malcolm McLean

# The Strait as an Urban Territory?

Methods from urban planning are applied to analyze the Strait of Singapore. In a first step, natural conditions, external influences and spatial regulations are identified and possible impacts are taken into consideration. Besides the

obvious users, the shipping industry, several additional layers are introduced. The final result will be a complex structure, which follows similar patterns than an urban plan.





### Influence of the Depths

Compared to the neighbouring coasts, Singapore's natural conditions are optimal for port activities. On the western part of the south west coast the depths allow for the harbouring of vessels with a considerable draft. There are large zones with more than 30 meters depth, but the fact that they are disconnected limits the size of ships which can pass through the strait.

On the other side the Indonesian Islands Karimun, Batam and Bintan have wide swamps and areas with maximum depth of 10 meters, which is inconvenient for a harbour.

A similar situation occurs on the Malaysian parts of the strait. However, Malaysia made significant efforts to remedy to this situation by digging a channel that grants access to the port of Pelepas. The depths in the Strait of Johor in the north of Singapore does not allow the development of container harbour.



### Natural Conditions Define the Location of the Harbour

The most important factors to place a harbour were and still are natural conditions. When favourable natural conditions occur in a given space, significant savings can be achieved for the construction and maintenance of a port. Disregarding natural conditions when building of a harbour may lead to continuous submarine excavations and the need for dams to be constructed.

In Batam where most of the coastal areas are shallow, extensive constructions are providing constant access to areas with sufficient depth of the sea where boats can land.

AccessibilitiesSmall Crafts

A small craft is a boat used for personal, family, and sometimes sportsmanlike recreation. Typically such watercraft are motorized and are used for holidays, for example on a river, lake, canal or waterway. Pleasure craft are normally kept at a marina. They may include accommodation for use while moored to the bank.

Ferries

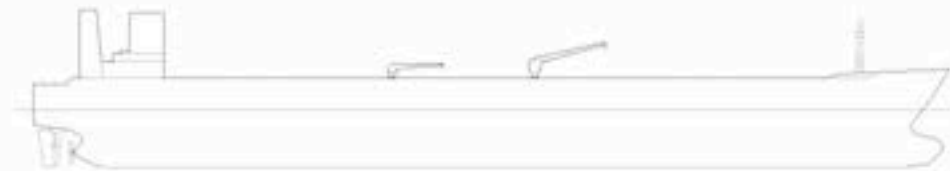
A ferry is a boat or ship used to carry primarily passengers, and sometimes vehicles and cargo as well, across a body of water. Most ferries operate on regular, frequent, return services. A passenger ferry with many stops, such as in Venice, is sometimes called a water bus or water taxi.

Container Vessels

Container ships are cargo ships that carry all of their load in truck-size intermodal containers, in a technique called containerization. They form a common means of commercial intermodal freight transport.

Very Large Crude Carriers

"Supertanker" is an informal term used to describe the largest tankers. Today it is applied to very large crude carriers (VLCC) with capacity over 250'000 DWT. These ships can transport 2'000'000 barrels (320'000 m<sup>3</sup>) of oil/318'000 metric tons.





▶ Current Measurements

#### Weak Currents around Singapore

One of the most important factors for a successful harbour is the possibility for a slow approach of the vessels to Jetties or anchorage points. Even if there is sufficient depth, a strong current can hinder the proper operation of a harbour.

The strait of Malacca has many points with sufficient depth for a harbour but only few of these points are protected enough from the strong current coming down from north. As the strait of Singapore is a turning point for the currents coming from the Strait of Malacca and the South China Sea, currents are slowed down considerably at this point. The currents coming from the Strait of Malacca continues passing between Karimun and Batam, while the currents coming from the South China Sea joins to two other currents; a slower one passing through the Strait and a faster one

flowing southward between Batam and Bintan.

In the case of Singapore the islands in front of the southwestern coast helps to maintain acceptable current velocities. To improve these favourable conditions, Singapore started the reclamation of Tuas. This new terminal provides calm waters to the western coast of Jurong island.

#### Moderate Tidal Conditions

After considering depths and currents, the most important requirements for efficient harbours are favourable tidal conditions. This means slow tidal changes and a small range of difference in terms of water spring. With a water level change of four meters in a time of five hours, the north entrance has the worst values concerning tidal variances.

In these aspects Singapore has a change interval of eleven hours between low tide and high tide, which means that the harbour has enough time to react to unforeseeable phenomena from the sea.

The main spring range in front of Singapore is around 2.2 meters, which compares to the Strait of Malacca. This makes the draft planning of the harbour more precise and allows more conveniences during the construction because the obligatory inclusion of many security factors decreases.



— Main High Water Interval (h)  
— Main Spring Range (m)



### Border Management

The Strait is a water space managed by Singapore, Indonesia and Malaysia. The management of the water space does not correspond to national borders. The fairway contains water space belonging to the three countries and is regulated by the international water laws. So the actual management of the national waters starts at the borderline of the fairway. Malaysia has three ports on the Strait and an authority agency for each of them. The harbours are Tanjung Kukup, Tanjung Pelepas and the Johor Bahru Port which frontiers directly the borderline to Singapore.

The Maritime Port Authority (MPA) is the only instance for the management of the water space. The fact that this space overlays with the spaces managed by the port operator (PSA), the Jurong Town Corporation (JTC), the Police Coast Guard (PCG), the National Environment Agency (NEA) and the Ministry of Defense (MINDEF) adds a great complexity to this country's small water territory.



#### Spaces of Control

The strait of Singapore is a very small space in comparison to its global importance. The interests of the three countries which are placed on it are represented in its strong regulation and deployment of security forces. Because of its harbour, Singapore is the most organized area on the strait. But Malaysia also has a very regimented and differentiated regulation of its waters.



#### Pulau Nipa

Pulau Nipa is a military island from Indonesia that is situated inside of the Fairway. Originally it was a swamp area with two peaks, but the Indonesian armed forces reclaimed it to two islands which are connected by a street.

Its strategic value lies on how close the island is to Singapore and also on its position inside of the Fairway. The closeness to Singapore gives the Indonesian military a clear visibility to the Singaporean islands, specially to Pulau Sudong, Pawai and Senang which are themselves military islands. So the primary task of the operators resides clearly in observation. There are often spectacular live firing tests in the water space of Pulau Pawai and Sudong which can easily be watched.

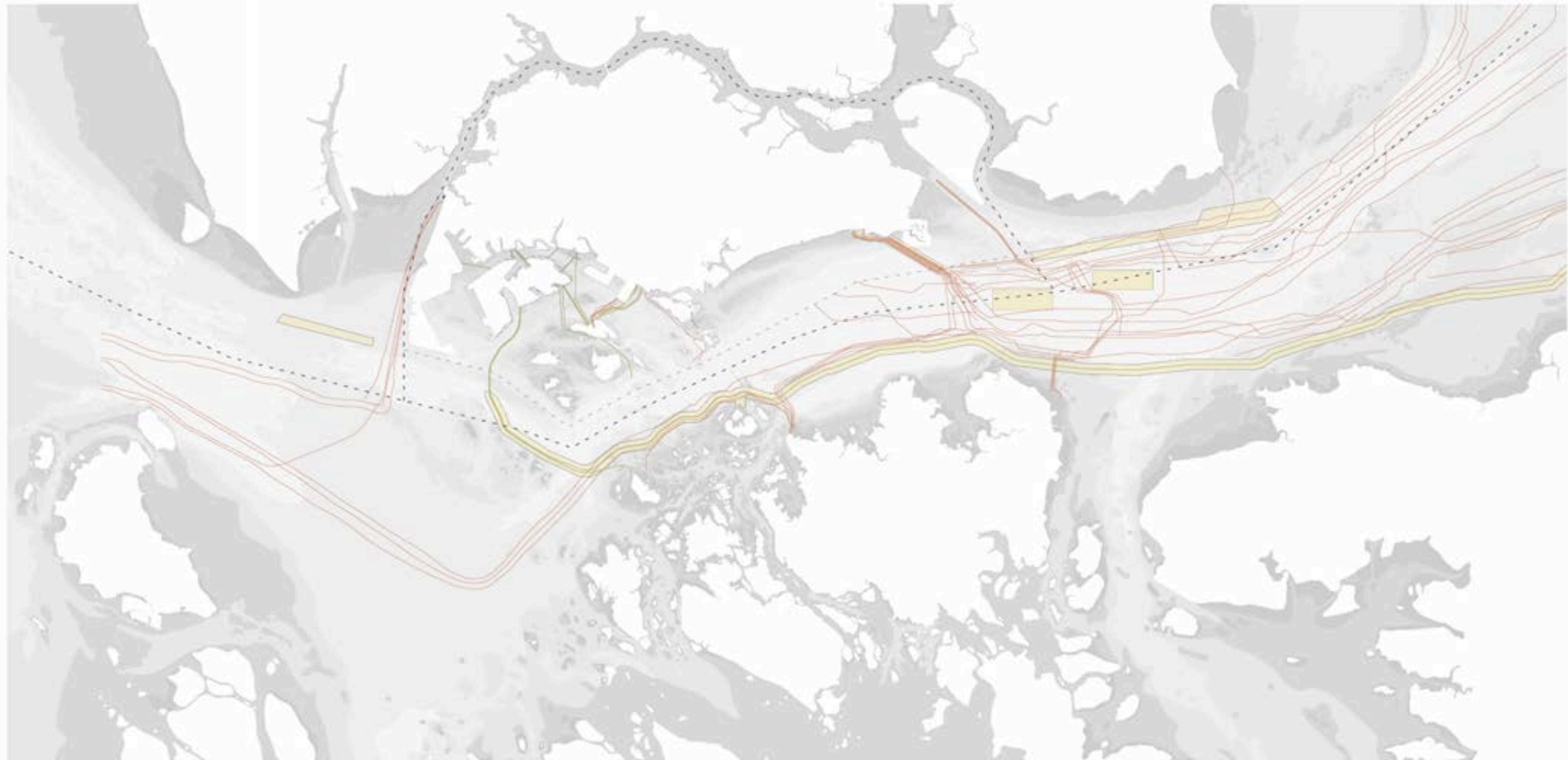
The situation on the Fairway also give considerable importance to Pulau Nipa. Every vessel that passes through the strait of Singapore has also to pass quite near to Nipa. The Nipa transit which is a big zone dividing the Fair in two parts is an area controlled by Indonesia which is officially meant for anchorage of accidented vessels. Still the space is clearly controlled by the military. In any case the Island of Nipa gives a certain control of a crucial segment of the strait of Singapore to Indonesia.



#### Pedra Branca

In their letter of July 24, 2003 to the registrar of the International Court of Justice, Malaysia and Singapore requested a decision that would determine sovereignty over several small features in the eastern entrance of the Singapore Strait: Pedra Branca/Pulau Batu Puteh, Middle Rocks, and South Ledge. In assessing the history of this region, the Court concluded in its judgment of May 23, 2008, that as of 1844, Pedra Branca/Pulau Batu Puteh "was under the sovereignty of the Sultan of Johor", the predecessor over Malaysia, but that by 1980 sovereignty over Pedra Branca/Pulau Batu Puteh had passed to Singapore". Taking this history and other factors into account, the Court found "that sovereignty over Pedra Branca/Pulau Batu Puteh belongs to the Republic of Singapore" (twelve votes to four), "that sovereignty over Middle Rocks belongs to Malaysia" (fifteen votes to one), and "that sovereignty over South Ledge belongs to the State in the territorial waters of which it is located" (fifteen votes to one).





### Submarine Infrastructure

The Strait of Singapore evokes the image of a water space overpopulated with ships that separates the Riau Archipelago from Singapore. Rarely someone thinks of a submarine space connecting Singapore to its surrounding more than separating it. The submarine space also contains information about the tidying efforts of different nations.



### Submarine Pipelines and Cables

The pipelines mainly connect Singapore with the oil and gas islands of Jurong and Bukom. There is a gas pipeline going out from Pulau Jurong along Indonesia to Borneo and along Batam to the south. The other special pipeline is the going out of Pulau Bukom to a much deeper area. This is buoys bunker point provided by Shell.

Most of visible cables are communication cables. They are bundled on the areas managed by the MPA and fairly dispersed on the fairway. Most of the cables going out of Singapore go through a channel in Changi, which is specially assigned for them by the

MPA. The internal cables connect the southwestern Singaporean archipelago with the main island.

There are many anchoring and fishing prohibition zones on the Strait. The most visible are least regulated and located on the zone of gas pipeline in Indonesian waters. The rectangles on the borderlines of Indonesia are disused explosive dumping grounds. The two zones on the Malaysian side are there to keep the entrances of the Port of Johor Bahru and Tanjung Pelepas clear.



### Space of Shipping

The main users of Strait of Singapore are container ships, oil and gas vessels. Once on the Strait the ships have to consider some regulations such as the assignment of anchorage zones or a jetty. At night, they should consider the guiding lights which mark the way to the different zones.

The huge amount of ships passing through the strait continuously is very difficult to perceive. But there are different applications which can help to track nearly all vessels which are on the waters of the strait. On the google satellite image dated the 25.5.2010 there are 728 vessels on the strait. Of course there are many more small craft vessels which are very difficult to locate because of their size on this scale.

By locating these ships and contrasting them to the water somehow a kind of figure ground appears. The vessel can be read as inhabitants or as buildings of the urban territory of the strait.





#### Anchorage Space

The anchorage zones have different uses. There are some general uses that most of the harbours have like holding areas.

Of course in the case of Singapore there are special anchoring points for Petroleum ships as well as for gas ships, which are mostly situated at the western part of Jurong island. Bunkering zones are meant as waiting space for ships which need to be provided with fuel until a bunkering ship comes.

The special use zones are used for unforeseeable difficulties like lack of anchoring points or dangerous goods, but gener-

ally port master directly guides the ships in this zones.

Ships with particular sizes have determined anchoring zones. The Very Large Crude Carriers have an assigned zone at the end of the Tuas reclamation. The small craft vessels have their zones in front of the East Coast beach.

The spaces specifically meant for the traffic of vessels inside the borders of the MPA never frontier directly any land area and have strict velocity limitations.

In general the port master is oversees all the ships which are within the borders of the MPA.

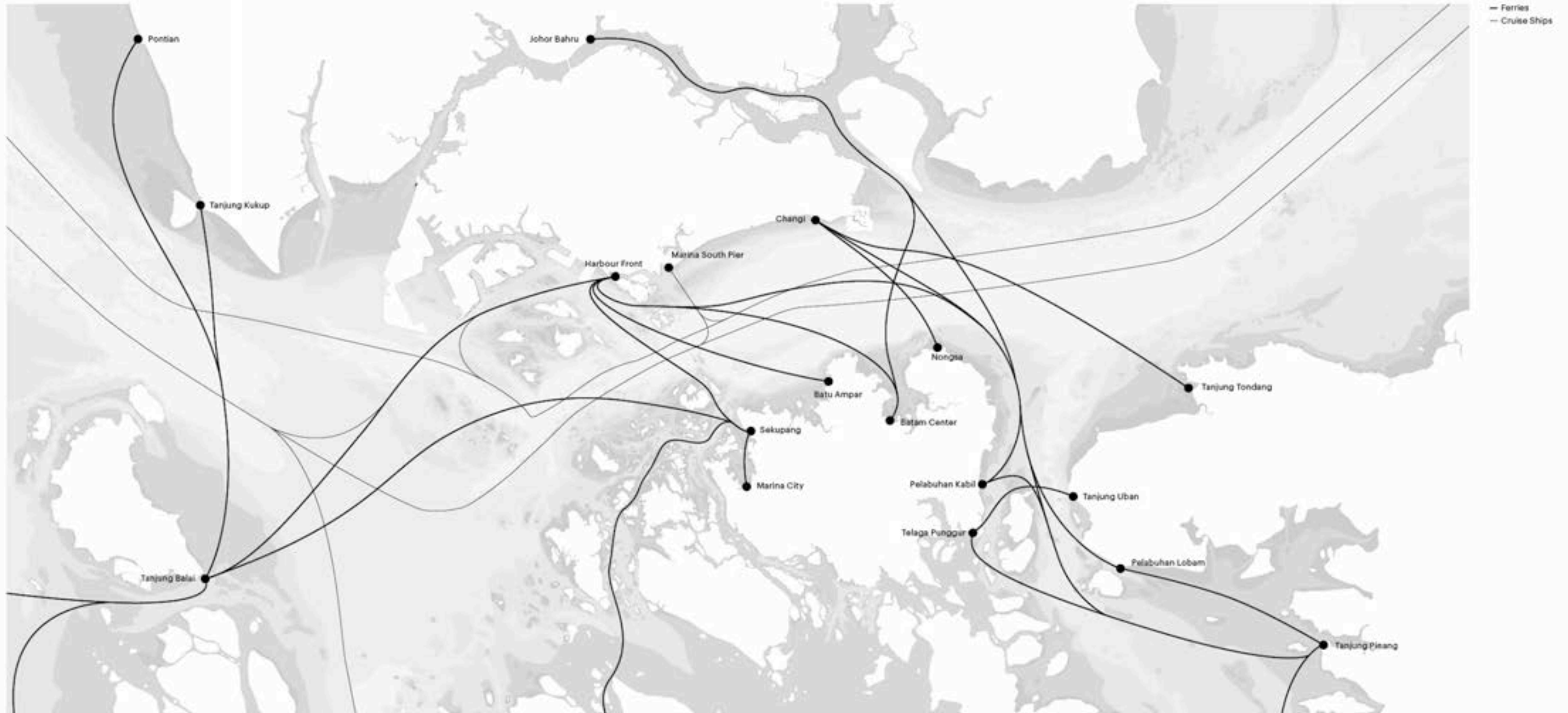




#### Illumination of the Straits

At night the visibility of the harbour routes is obstructed, so lights have to take the task of guiding the ships securely through the changing depths of the harbours.

Like night satellite views where the intensity of illumination of a territory correlates with grade of urbanisation, satellite images of the Strait of Singapore clearly show the areas with the most activities. The illumination in the port of Singapore has also to do with the small space in which a vast amount of ships have to be guided, which also means that more light correlates with more organisations.



### Space of Passengers

Opposite to the commercial shipping traffic there is also a crossborder traffic. The ships have to use specific ways on the fairway, which are meant for them to cross without any dangerous interference with the main traffic. Some passenger ships are following the main traffic but stop at the same spots as the cross border ships.

Due to the fact that Singapore is a popular tourist destination and the continuous growth of the cruise ship industry, the arrival figures in this ship category are increasing. The docking point is located at Harbour Front, although a new cruise ship terminal is currently under construction near South Pier.

Most of the ferries to Batam are going from Harbor Front and the Changi ferry terminal to the harbours of Batu Ampar and Batam Center. The points to cross the fairway are in front of Sentosa that means very near to Harbor Front and in front of Changi. The other connections also have fix departing times despite having much less passengers.



### Leisure Zones

Being such a regulated zone it is quite surprising that the Strait of Singapore has spaces for leisure activities. Even more surprising is that some of these activities take place in the already overpopulated and very restricted areas of the MPA. This coexistence of leisure, military and commercial affected zone so near to each other shows a specific grade of interaction of different intention in this territory.

### The Strait's Leisure Activities

The diving points in front of Singapore lie very near to the live firing areas of the ministry of defense and are also object of various boats driving over them. The special experience a diver can get here is a dive very near to industries and industry affected diving sites.

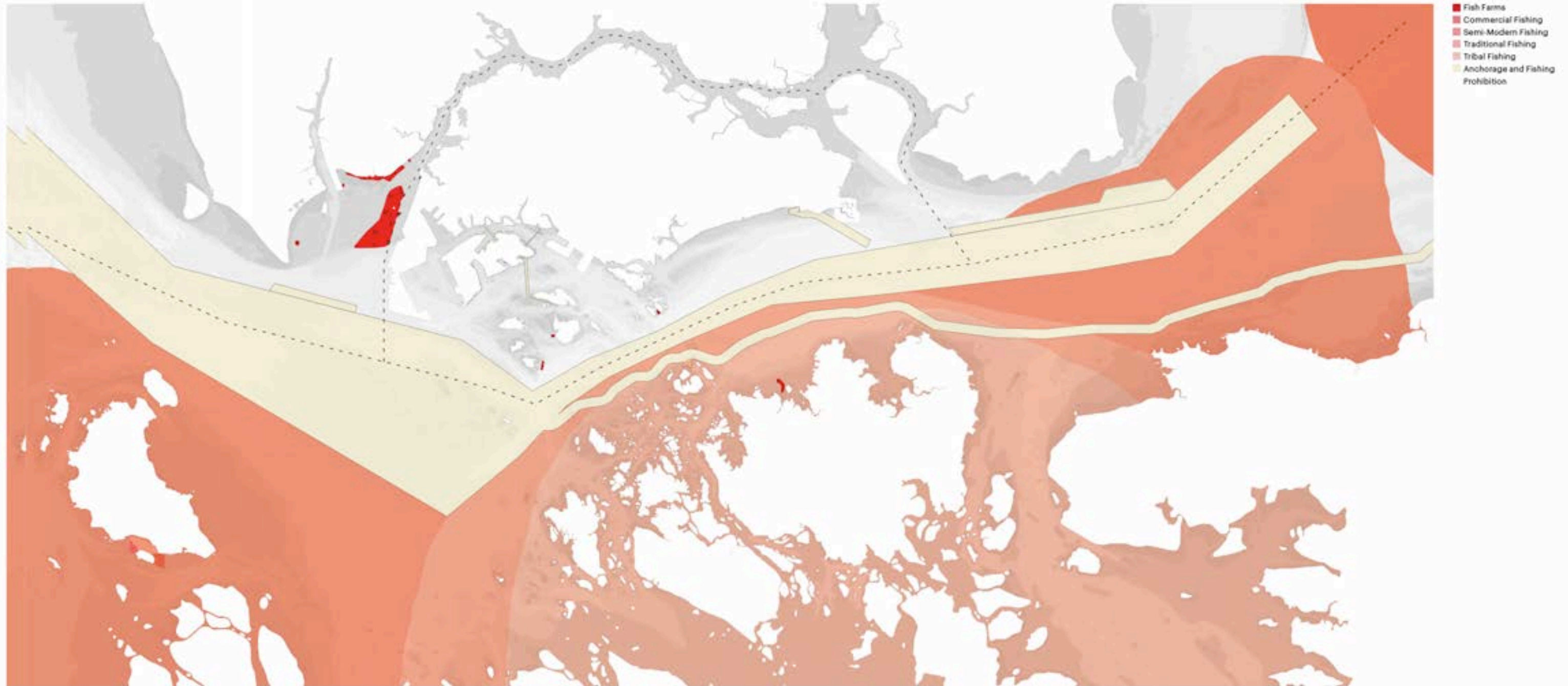
Leisure World is a casino ship which goes from Pasir Gudang through the borderline of Singapore and Malaysia to international waters with the idea of evading the Malaysian laws of gambling prohibition. The ship has everyday more than 200 customers on board. There is a ferry coming from Changi which brings people from Singapore first to Nongsa where Indone-

sian people are joining and then to the Leisure World already on international water.

The sport fishing sites are mainly situated on Singaporian natural reservoirs along the coast. The idea is enjoying the art of fishing without killing the animals. So after catching a fish the fisher normally take a picture and releases it to its freedom. There are some sport fisher spot on Batam and Bintan but they are to informal to locate them precisely.

Singapore has some important Yacht harbors on its coast. The biggest of them is situated on the eastern part of Sentosa.





### Fishing Territory

Indigenous people of Malaysia, Singapore and Indonesia have always used the water of the Strait as a fishing ground. Nowadays this use has decreased specially on the Singaporean and Malaysian side due to the fast growth of the port of Singapore and the pollution that ensued. Batam, Bintan and Karimun did not develop as much as its neighbours and therefore traditional fishing prevails to this day.

Fishing Grounds in the Strait of Singapore is divided into different categories: Tribal and traditional fishing grounds serve as a primary nutrition source for the local community, relying on an undistracted accessibility towards the sea.

This does result in conflicts with other users of the Straits, for example the professional shipping industry and commercial fisherman. Professional fishing is characterized by the use of large vessels and a large capital expenditure.



— South Seasonal Route  
 — East Seasonal Route  
 — West Seasonal Route  
 — North Seasonal Route

### Aquatic Living Space

The strait of Singapore is often seen as a zone that is purely about commerce. But the water space in the north of Batam is used from time to time as a living space by people living on their boats and following their traditional routes.

### The Sea Gypsies

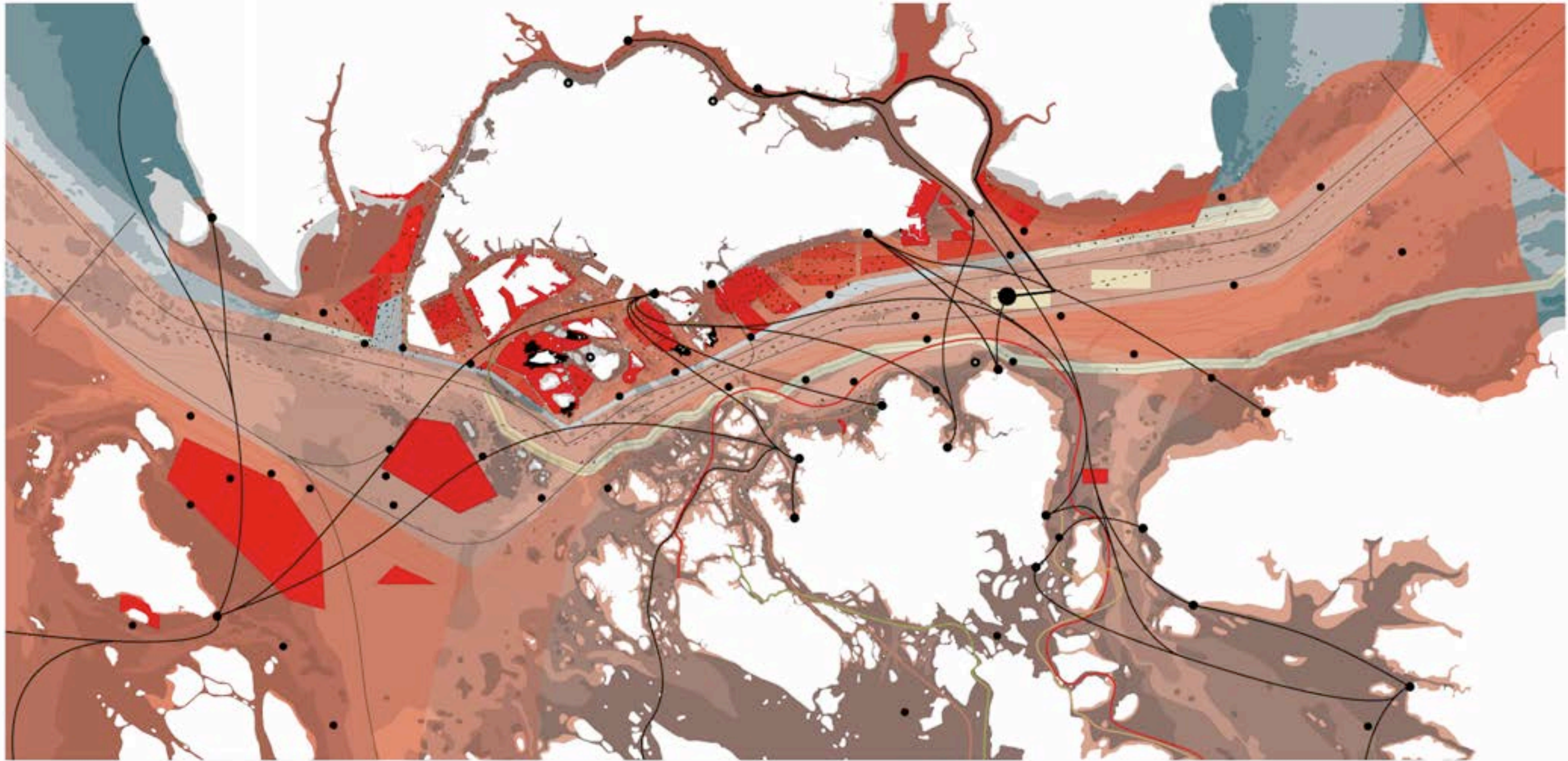
The tribal Malay, the "Suku Laut" (the sea people) or more commonly known as the sea gypsies, usually move amidst the unpopulated islands of the archipelago. Entire families share a canoe as their home. Their trajectories are related to the seasonal winds, that influencing the sea currents and the fish stocks. The Suku Laut is the poorest and the less respected group among indigenous inhabitants. Governmental attempts to settle the nomadic tribes have all failed.

The 'Rumah-Rumah Terapung' are sea-based houses built like a pontoon with four strong and adjustable chains hooked on the seabed. Those houses have the ability to float on the water following the movement of the tides. Floating houses that can serve as fishing boats are also built. They can move individually or assemble with others on the coast.



### Piracy

Despite heavy control on the Singapore Strait, acts of piracy have been recorded on these waters. As the authority noticed that most of the pirates were Indonesian, their government was under pressure to invest more money in counter-piracy naval operations. Nowadays there are still some single attacks on the Strait.



### The Urban Plan of the Strait of Singapore

The urban plan combines all the different layers that were introduced in the previous sub-chapters. As a result we get a complex structure of different functions and organisation patterns forming a certain tension against each other but also creating a high diversification of the territory.

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View of the Singapore skyline from the Fair Gudang Municipal Tower, Johor, Malaysia









Architecture of Territory  
ETH Zurich  
FCL Future Cities Laboratory

Hinterland  
Singapore, Indonesia, Malaysia  
Project 1, part 1

Asst. Prof. Milica Topalovic  
Martin Knüsel  
Marcel Jäggi

# JOHOR HINTERLAND VS. CAPITAL

by  
Giulia Luraschi  
Karl Wruck

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## One Bridge, Two Nations

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## Global Hinterland

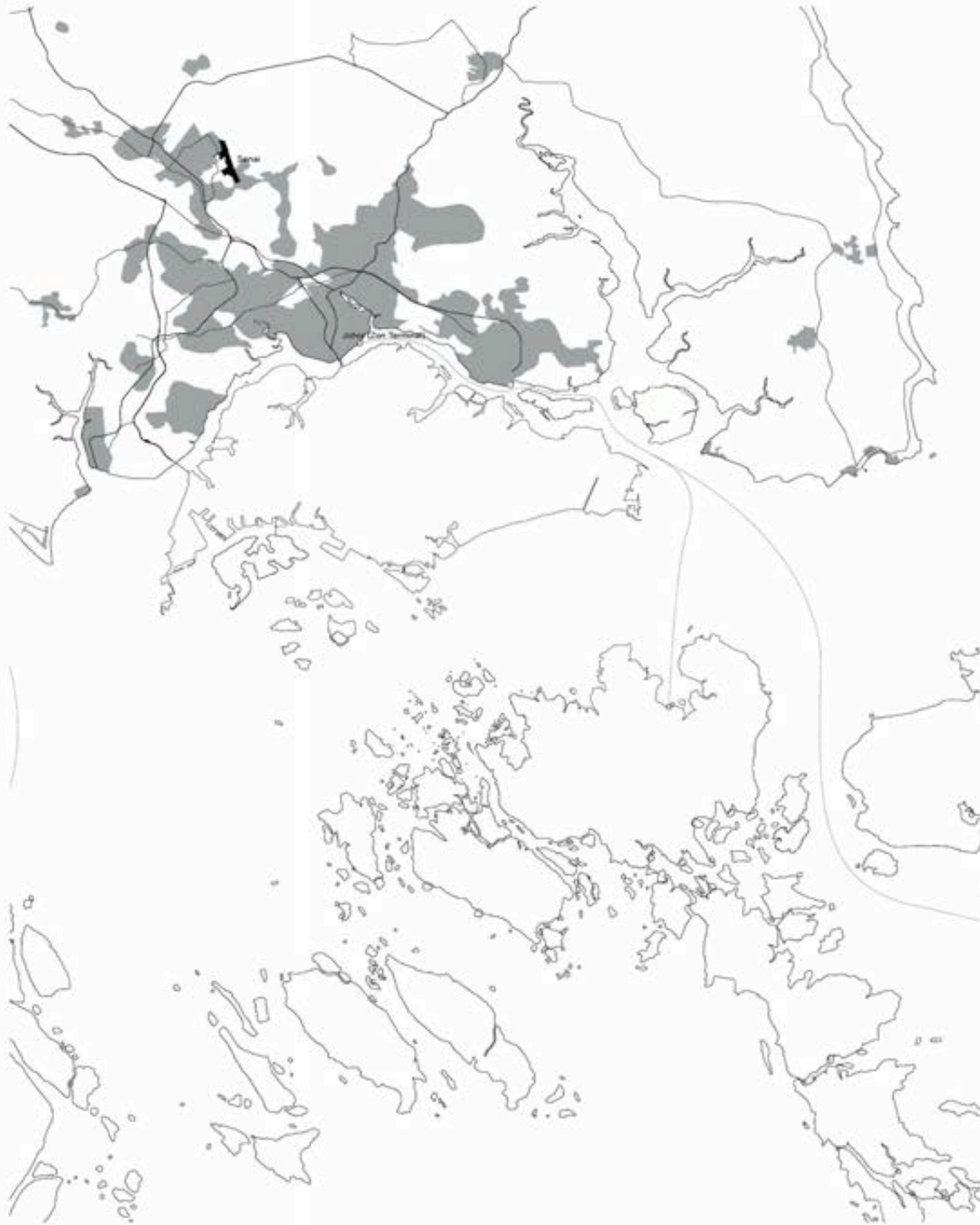
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Looking at the Southern Johor region, one is tempted to think of it as being another Shenzhen; a huge industrial park like the Indonesian islands to the south of Singapore. As the tight relation between Singapore and its hinterlands has grown to become unquestioned – in Johor like in the Riau archipelago – the national border between these geopolitical entities has lost in importance. This has given credence to an unspoken question: has Johor been turned into a mere suburb of Singapore?

Traditionally, the Southern Malaysian territory has been the productive hinterland that helped sustain the prosperous city-state of Singapore. At the same time, Johor's history as a sultanate stretches back over five hundred years and continues to contribute to the region's identity. Finally, the formation of a federal Malaysian Nation has left lasting traces in Johor, and also in Kuala Lumpur, the national centre of power. This territorial investigation focuses on the former, Johor, which continues to drive its national economy while fuelling on the economic energy of Singapore. Johor denies easy assessment, its multi-layered complexity adds to the challenge of its analysis. Yet, this project strives to dissect the region's prevailing phenomena and, wherever possible, tries to link the parts together to form an understandable whole.

This is the setting in which the following territorial investigation is placed. Johor denies easy assessment and is multi-layered up to the point of complete incomprehensibility. Yet, this project strives to analyze the region's prevailing phenomena and, wherever possible, tries to link the parts together to form an understandable whole.

# One Bridge, Two Nations

The Johor-Singapore Causeway is a 1.1 kilometre slice of land that represents the only physical contact point between Peninsular Malaysia and the city-state of Singapore. There are many cultural, economical and political differences between these two nations and the way they are managed affects the life of about 60 to 100 thousand people who cross this bridge everyday.



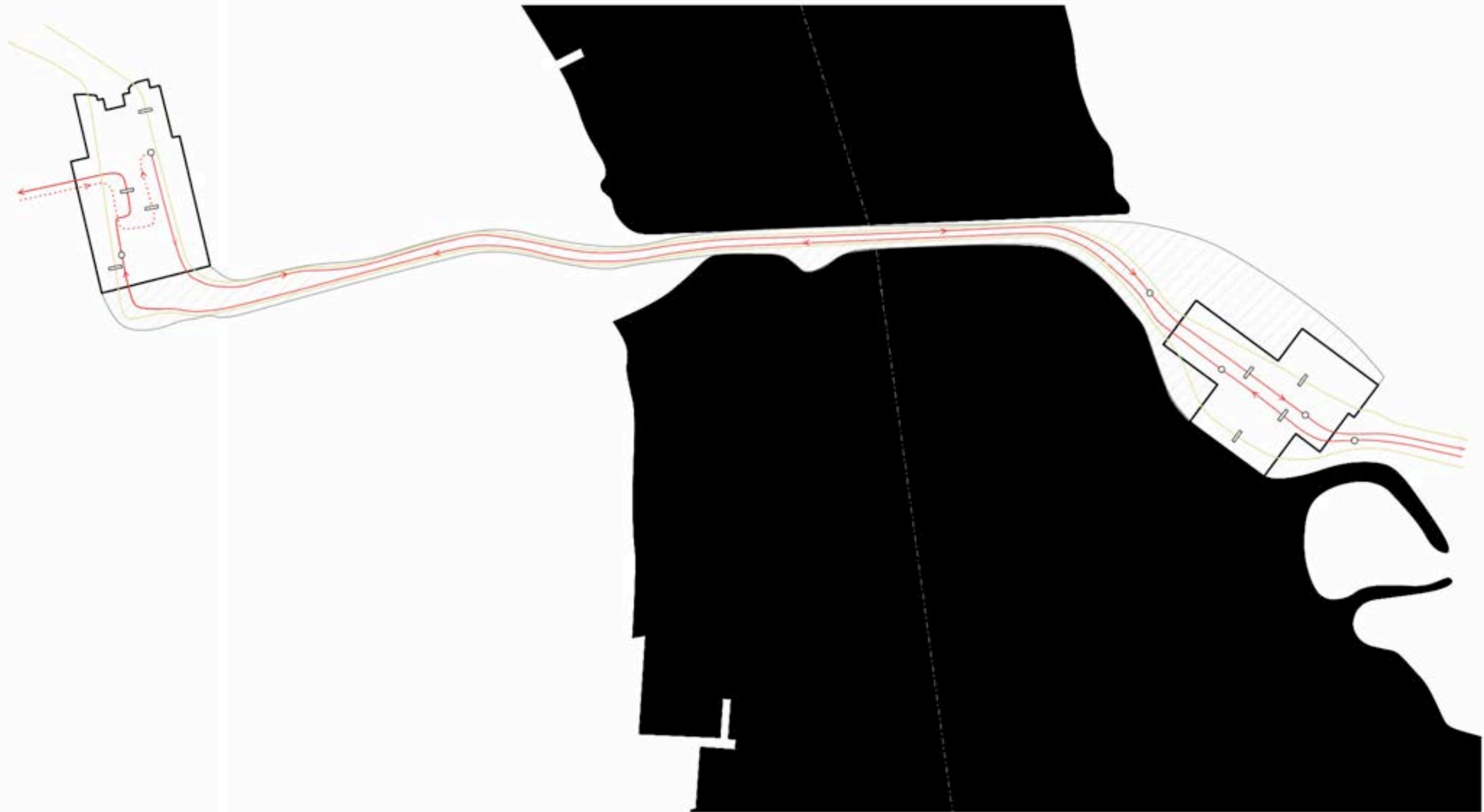
Singapore's territory in the background, nearing complete urbanization. The natural reservoir is one of the few remaining green spaces on the island.

## The Causeway

The Johor–Singapore Causeway was the first strip of land linking Peninsular Malaysia and Singapore. It was completed in 1923. It encouraged the development of the two cities in significant ways, which has led to increased pressures over the control of this infrastructure. The causeway

is the most direct way to move between Johor Bahru and Singapore. In 1998 a 1920 meter-long bridge called 'Tuas Second Link' was built on the western side of the Johor Straits to tackle growing traffic jams on the causeway.





Crossing the Border over the Causeway

- Bus stop
- - Custom control
- by Bus
- by Taxi, Car and Motorcycle

## Means of Crossing

The construction of the new Singaporean (the Woodlands, 1999) and Malaysian (Immigration and Quarantine Center, 2008) customs changed the way people could commute between the two countries. People coming from Singapore are now forced to move up to the Custom & Immigration Quarantine Complex CIQ of Johor before being able to

freely walk along the Malaysian coast. Nevertheless, this proceeding facilitates the control and the movement of the traffic, which is organised in different lanes (motorcycles, cars and taxis, buses, trucks and lorries).freely walk along the Malaysian coast side.



### Car

Many trucks cross the causeway every-day. We had no access to the facilities but we saw that every one of them has to pass through an X-Ray scanner.

Time: 35 min  
Price: 1.20 SGD  
Users: businessmen, families



### Motorcycle

Clearly the favourite mean of crossing for the daily commuters residing in Malaysia. It is faster than cars, especially at rush hour.

Time: 25 min  
Price: no toll charge  
Users: daily commuters



### Swimming

Approaching Singapore's shore swimming or by boat is strictly forbidden, and one can hear many stories about Malay people having problems with Singapore's Work Permits who try to swim back to Malaysia.

Time: 40 min  
Prohibited



### Pedestrian

Since the new Malaysian CIQ was built, it is no longer possible to cross the causeway by foot. Before that, people coming from Singapore could reach Johor directly after the immigration centre that stood by the seaside. The picture shows the pipelines that transport water from Malaysia to Singapore.

Time: 15 min  
Prohibited



### Bus

It is one of the cheapest ways to cross the border. From Singapore, one can take it either from Bugis MRT Station (in the city centre) or Kranji MRT station (in the Woodlands). One arrives at JB Sentral Station in the centre of Johor Bahru. The main drawback of this mean of transport is that the passenger must get off twice to cross both customs by foot.

Time: 45 min  
Price: 2.20 SGD  
Users: students, retired and housewives



### Taxi

Crossing the causeway by taxi is easy but pricier. Since not every taxi can cross the border, one usually has to get to the Singapore-Johor Taxi Terminal at Bugis. After crossing the two CIQ centres and without having to get out of the car, one can exit around JB Sentral.

Time: 35 min  
Price: 40 SGD  
Users: businessmen and groups of Singaporeans on a shopping trip



## A Worthy Trip

About 60'000 Malaysian vehicles cross the border to enter Singapore every day. The price difference between goods bought in Malaysia versus Singapore is remarkable, partly because of the currency exchange (1 Singapore Dollar (SGD) is worth around 2.4 Malaysian Ringitt (MYR)).

Many Singaporeans go to Malaysia to profit from these cheaper prices. On the other hand the Malaysian profit from Singapore's higher wages and education quality, and in general from the better choice of low cost companies in Singapore.

### MALAYSIA

1 Liter 	MYR 2 = SGD 0.81 - 51%
1 pair 	MYR 70 = SGD 28 - 44%
1 km 	MYR 3 = SGD 1.20 - 63%
Woman haircut 	MYR 80 = SGD 33 - 49%
18 Holes 	MYR 250 = SGD 102 - 49%

### SINGAPORE

Engineer wage 	SGD 51'945 + 46%
Low Cost Flights 	Offers + 70%
Cosmetics 	SGD 90 - 25%

#### Singaporean Customs Restrictions

- Tobacco products: one package of cigarettes per person is allowed when entering Singapore, but it has to be already opened and the package cannot be full. The custom officer will control how many cigarettes are being imported and importers will be taxed on tobacco goods.
- No alcohol import is allowed for daily commuters from Malaysia.
- Three Quarter Tank Rule: Singapore cars has got to have a 3/4 full tank before entering Malaysia.



#### Meeting

Mr Ruben is project leader at Bahru Stainless. He lives and works in Johor Bahru, and commutes to Singapore every 2-3 weeks to attend meetings with international clients, and also on the weekends when he travels for leisure with his family.



#### Shopping

The two Singaporean teachers Nurul and Nur commute to Johor one or two times every month to do some shopping. They remember that they used to go to Johor already with their parents to buy food and other cheaper household goods.



#### Working

The construction sector generates many daily commutes as to take advantage of price differences between Johor and the city-state. Singapore is a growing market and the wages are higher than in Johor, but in Johor the construction material is cheaper, so it is an advantage for Singaporean to hire Malay building firms.



#### Studying

Mr Kian is a Malaysian Chinese from Johor. He has been commuting between Johor and Singapore since he was 7 years old, when he started attending a Singaporean Chinese school. In his first university years in Singapore he also used to live in Johor with his parents and traveled daily to Singapore by bus. The travel cost (about SG\$ 200 per month) were much cheaper than the cost of a student room in Singapore (about SG\$550 per month).



#### Racing

Nizim and Rashid are landscape architects from Singapore. In their free time they ride on the Johor Circuit in Pasir Gudang because there are no such circuits in Singapore.



#### Golfing

Johor is a dreamland for golfers because the prices and the courses available are much better. These two Singaporean friends drive to the Tanjong Puteri Golf Resort one or two times every week to practice their favourite sport.

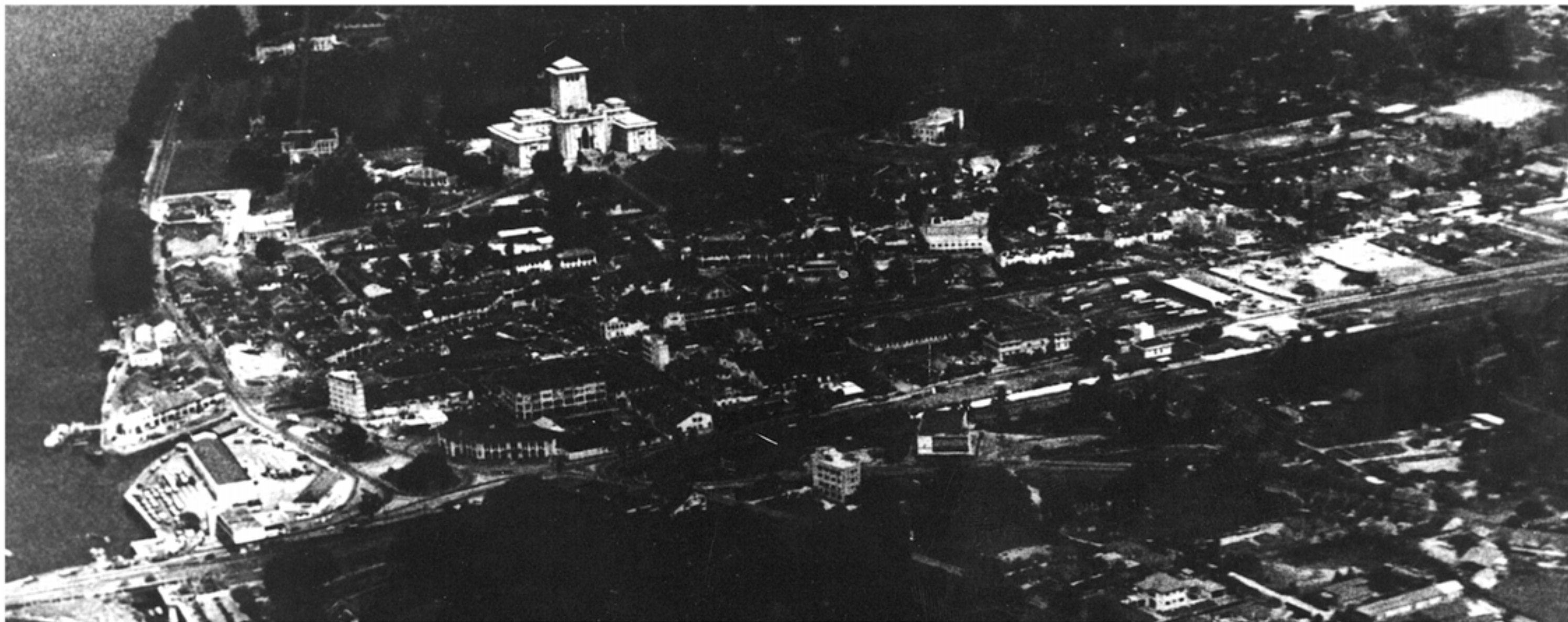
# History of the Island and its Hinterland

The territory of Johor has oscillated throughout modern history between being agricultural hinterland and the seat of the Sultan. Over the past 200 years, the region from the southern tip of the Malaysian peninsula to Singapore and the Riau archipelago has undergone a multitude of political affiliations. These affiliations have included the rule of the Temengongs up to the 18th century and have split into two or more political entities thereafter.

The starting point of this overview of geopolitical history in Johor and Singapore starts off around 1800 with the Malay Sultanate, covering almost the entire region. It is proposed that the essence of the region's modus operandum

had already been laid out in that time but continued development up to the present day. In short, the whole Johor-Singapore area seems to strive for a reading as one entity, where its two main parts, the island and the hinterland, perform different but inherently interdependent roles. The one, Johor, with its fertile, even and vast land, seems to be ideal for agricultural production. The other, Singapore, located along one of the most important global shipping routes of all time, appears to be the dream version of every farmer's market. Within 20 kilometres from the mainland lies a harbour that easily sells and ships agricultural produce to the world.

In reality, the harbour market has long discovered that there is much more to trade than farmer's products, and the mainland has been trading (and governing) on its own. Within this balance of interests lies a history to be told.



Johor Bahru in 1932: The Istana Besar, seat of the sultan, throned over the city

## From Pepper to Rubber: Agricultural Territory until 1957

In around 1800, the Sultanate of Johor-Riau, which had been existing in the region for more than 200 years was experiencing internal power struggles; the rule of the Malay Temenggongs was challenged by the Bugis of Sumatra. When Sir Stamford Raffles arrived in 1819, he was able to negotiate an agreement to split the empire into a Bugis

kingdom on the Riau archipelago and a Johor sultanate on the northern territories. Drawing on his diplomatic skills and the unsteady situation, he also obtained permission from the sultan to set up a trading port on the southern tip of Singapore Island for the East India Company.



"A tiger takes a stroll near the shoreline", National Archives Malaysia

Top:  
The first British Straits settlements

Bottom:  
The empire of the Temenggongs before the agreement of 1819



### 1820: "Endless Wood"

After travelling along the Johor Strait in 1825, John Crawford reported an 'unruffled sea' and 'endless wood of the most magnificent timber'. Together with Raffles, he was involved in the negotiations local rivalries in around 1820. Colonial administrator, diplomat and physician, he pointedly observed what was going to become Johor's most valuable resource: its vast land area. Apart from some Kampung along the shore, the land area was covered with jungle and was uninhabitable. The Temenggongs themselves had their seat on the southern tip of Singapore Island.



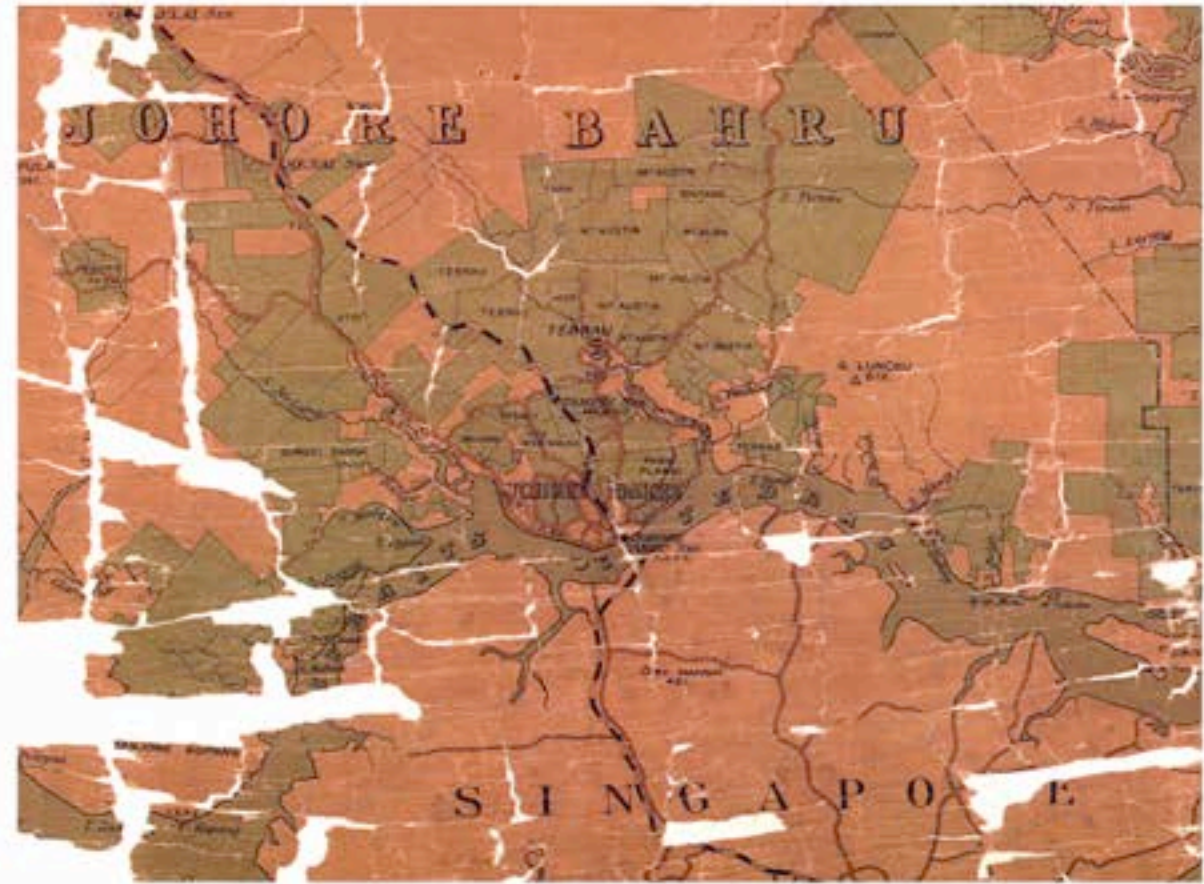


Top:  
Spreading "Surat Sungai"  
concession villages in the  
Johor territory - and a  
growing Singapore

Bottom:  
Singapore is an  
independent Straits  
Settlement, with the  
sultanate of Johor to its  
North

#### 1860: Shifting Powers and the Surat Sungai

Towards the middle of the nineteenth century, the power balance in the region fundamentally shifted. Already in 1824, the British obtained full sovereignty over the whole island of Singapore from the sultanate of Johor. Simultaneously, persisting power struggles in the Temengong's empire lead to continuing negotiations. In 1855, the power balance had turned upside down. The British gave sovereignty to the Temengong's rule over the Johor territory. With the backing of the region's ever more dominant colonial power, the Temengongs quickly moved to putting their Johor land to use. Starting from 1857, concessions were issued for the setup of small plantations along the many rivers of Johor. The Surat Sungai, or 'concession to the master of the river', was a success especially among ethnic Chinese Singapore residents. Between 1855 and 1862, 70'000 Chinese were employed on those plantations. At the high time of this form of agricultural production, 9'000 tons of pepper and 21'000 tons of gambier were produced in 1890, all of which was shipped through the port of Singapore.



1.  
Johor estates in 1940,  
founded largely in the 18th  
century

2.  
Singapore in 1860, Fort  
Canning Hill

3.  
Johor Bahru in 1860,  
Developing into a  
plantation village

4.  
Jetty of the causeway  
railway ferry



2.



3.



4.

#### From Gambier to Rubber: Establishment of Large Estates

From the turn of the eighteenth century on, European firms discovered Johor as plantation grounds for coffee. They were issued new kinds of concessions by the sultan, making huge plots of land available to them. For half a century, the smaller Surat Sungai plantations existed scattered in between the new estates. A government act in 1917 finally consolidated the new, larger grouping of territory and ended the time of the Surat Sungai concessions.

Already in the nineteenth century, rubber became the most important produce in Johor and continued to be so until long

in the twentieth century. Equally, the established land ownership structure of large-scale estates continues to persist to this day. Lee 'the rubber and pineapple king' Kong Chian set up his plantation company around the turn of the twentieth century - a firm that is still operating in Johor today. Following on the success of agricultural endeavours in the region, Johor Bahru steadily developed into a plantation village.

Since all goods that were produced in the mainland were shipped through Singapore's harbour, the causeway crossing became a crucial bottleneck for the region's economy early on. For transportation reasons and in face of a lack of roads through

the Johor jungle, the Surat Sungai concessions had already been set up along the rivers. They were easily accessible from the northern Singaporean shore, which around 1850, was already well connected to the harbour settlements on the south by roads. The system of local transportation experienced huge enhancements when the Malaysian railroad network was extended into the Johor area and continued on the other side of the Causeway all the way to the city of Singapore. In the beginning of the twentieth century, a train ferry ran across the causeway making it possible for train cars to pass through without unloading.



#### 1923: Construction of the Causeway

With the expansion of rubber estates in the twentieth century and increased traffic across the Causeway, a permanent crossing was erected and opened in 1923. It connected the road and railway network terminals of Johor Bahru in the north with the ones at Woodlands in the south. The causeway was a huge success and saw a steady increase in traffic. It was a crucial piece within the plantation-harbour system of Johor and Singapore. During the 1930's, it also became part of the developing leisure culture. Car rallies were held there and newly established tour busses took Singaporean citizens on comfortable weekend getaways to the Johor countryside.

Meanwhile, the power balance in the region continued to shift in favour of the colonial rulers. The sultanate of Johor adopted a new administration modelled after the British system and had to accept a British adviser in 1904. The suggestions from his office were, as in other countries within the 'British resident system', mostly binding and significantly reduced the Sultan's sovereignty.

With this background in mind, the construction of the Istana Besar in the 1860's as the new seat for the Sultan in Johor Bahru appears more as a cosmetic measure rather than as a demonstration of actual power.



Top:  
1923: the newly constructed causeway enables a continuous railway connection between Johor and Singapore

Bottom:  
The sultanate of Johor is gradually losing its sovereignty



Causeway railroad in Johor Bahru

## From Rubber to Industrial Estates: Developing Territory after 1957

After the Second World War, the Malaysian government initiated a thorough transformation of the country that introduced new highways, ports and industrial areas to Johor. Separated from Singapore by an international border, the



Johor's first industrial harbor in Pasir Gudang, 1975

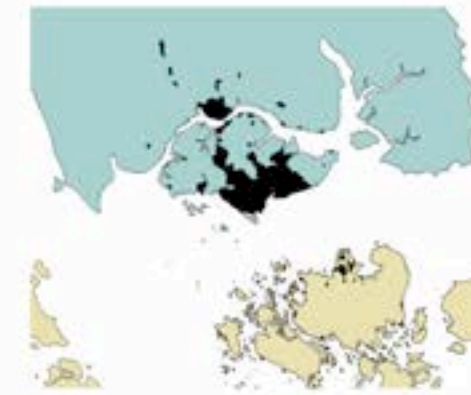
Southern Malay state, suspended between cooperation and competition, entered a phase of ambivalent relations with Singapore that continues today. relations with Singapore that continues until today.



Top:  
Beginning of industrial  
Developments  
Bottom:  
Singapore as part of  
Malaysia

### 1964: Singapore's Merger with and Separation from Malaysia

In 1963, Singapore merged with the Malaysian states in the north to form Malaysia. Seen as an economic and political solution to rising unemployment and the threat of revolutionary tendencies in the population, the merger was seen by the governments as a way to bring stability to Malaya and Singapore at the aftermath of the Second world war. However, the union was short-lived as intensifying racial tensions brought on by federal policies of affirmative actions ("bumiputera policy") that preferentially favoured Malays resulted in disputes between racial groups, primarily the Chinese and Malays. This was further exacerbated by the failure to establish a common market, hence undermining the major economic purpose of the merger. The combination of the need to prevent widespread bloodshed due to brewing racial tensions and the breakdown of the economic promise of the merger resulted in the expulsion of Singapore from Malaysia in 1965.





Top:  
1980 spreading urban area  
over Singapore and the  
start of industrial  
development in Johor  
Bahru

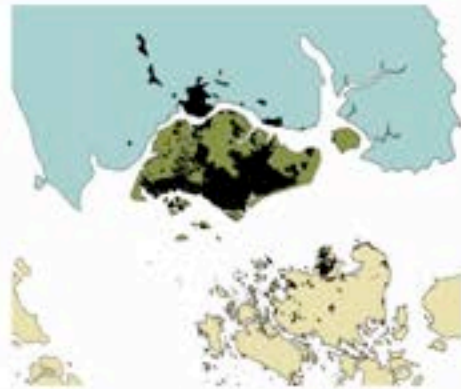
Bottom:  
The three nations in the  
region

1980: Two Nations

Continuing Industrial Development

Starting from the 1960's, Singapore saw an increase in industrial development with the creation of large industrial and housing estates throughout its territory. For the first time in its history, the problem of a restricted land area became eminent. As a result, reclamation work began on the Southwest coast of the island and companies began relocating land intensive industries to Johor.

The Malaysian government immensely fostered direct investment from Singapore starting from the 1970's. New road and port infrastructure were created and the first agricultural estates around Johor Bahru were converted into industrial parks.



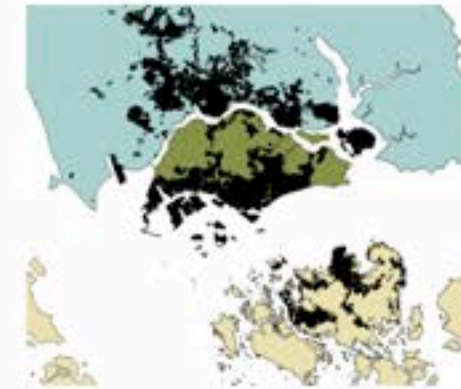
Top:  
Johor's urban sprawl vs.  
Singaporean density

Bottom:  
The tri-national  
metropolitan region of  
Singapore

2012: Metropolis Region

Spanning Across Three Nations

Since 2006, Johor's administration has been emphasising the establishment of service related developments in its territories. This initiated a growth of suburban sprawl within the persisting structure of plantations. Owned by large Malaysian or multinational corporations, estates of all sizes have been transformed into mostly private and gated living quarters. The growth of an urban middle-class occupying semi-detached houses and villas has resulted in the inevitable adoption of various characteristics positioning Johor as a suburban hinterland to Singapore. At the same time, steady economic development in the manufacturing and service sectors have resulted in further growth of industrial estates, which can be attributed to significant Singaporean investment in the area. Johor too complements this development with continued emphasis on structural industrial development in the hope to rival Singapore, in the cargo, hospitality and leisure sectors.



# Towards a Service Economy

2020 is perceived as a very special year for Johor and all of Malaysia. Government officials, investors and the general population do little to hide their excitement in regards to the prospects and hopes expected in Malaysia by the year 2020. The year 2020 marks the target time of Malaysia's development goals.

In 2020, Malaysia's economic and social indexes are expected to reach the status of a 'developed nations'. Rooted

in agricultural production and boosted further through manufacturing activities, the country aspires to lift its economy once again through an active development of the service sector.

For decades, Johor has been at the forefront of development thanks to its direct exposure to Singapore, which has served as a role model for Johor's economic development and a source of direct investment. Culturally, Johor remains

separated from its southern neighbour, where ethnic, religious and cultural landscapes take a heterogenous form that could never be mirrored in Johor. Still, the odd couple of Singapore-Johor has come from far and managed to form a region that is truly unique in its complex structure and balance of powers. The following chapter aims to highlight some of these phenomena and their backgrounds.



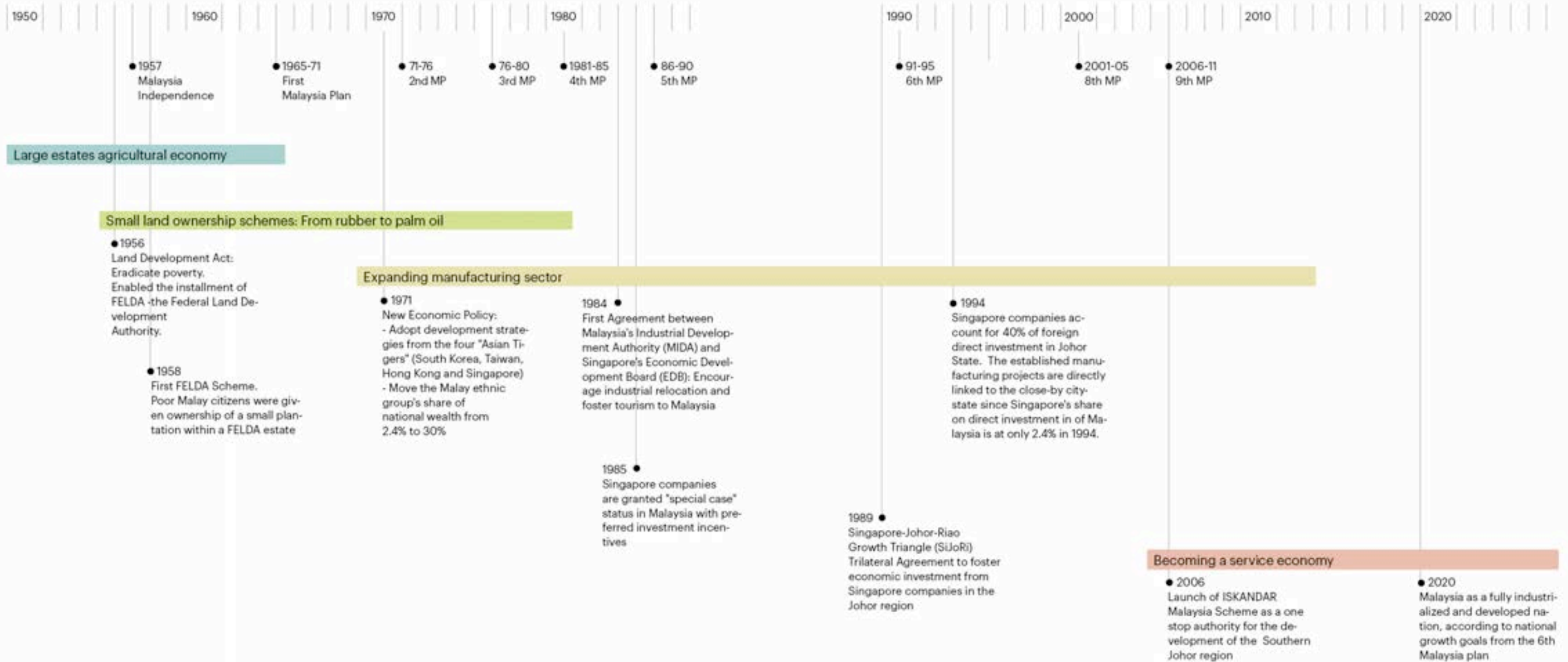
Pasir Gudang. Rowhouses and a field waiting to be developed

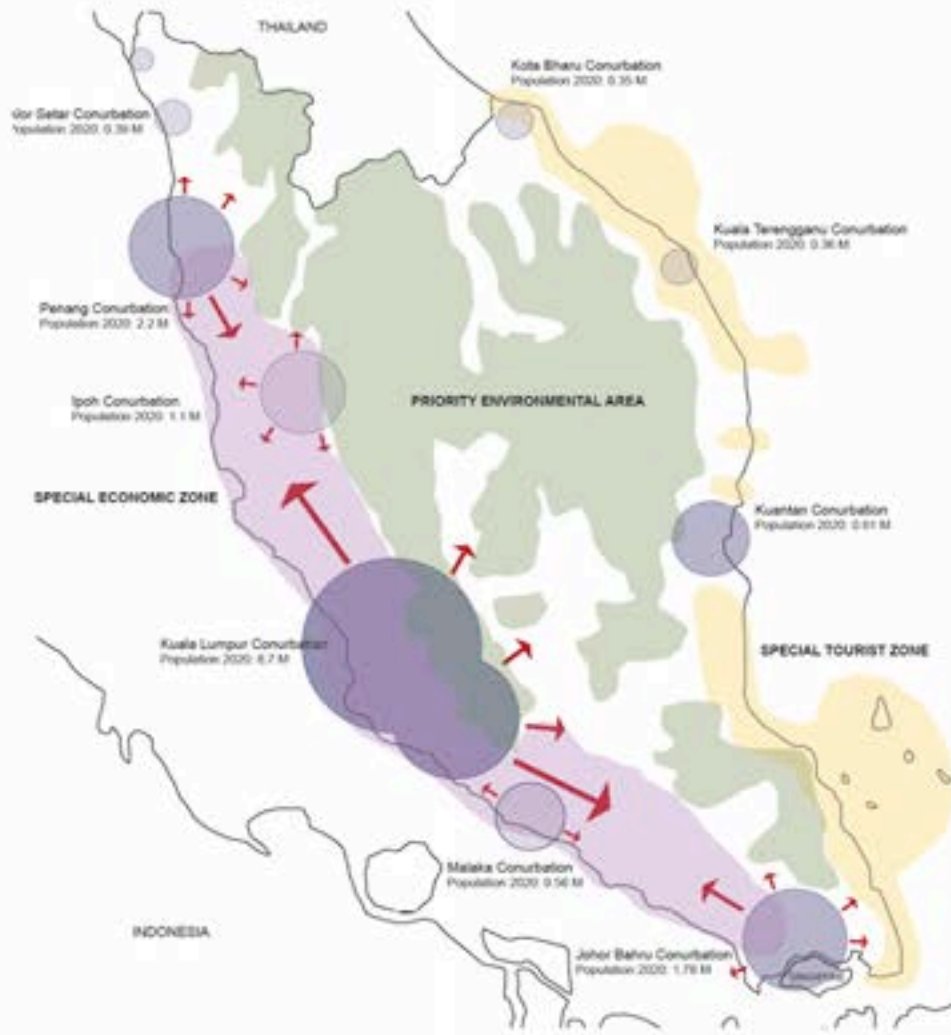


## Planning Change: Economic Development in Malaysia

Since its independence in 1957, Malaysia has developed from a territory centring on agricultural production to a manufacturing and service based economy. This transfor-

mation of the economy was fostered by succeeding 'Malaysia Plans'. As a federal instrument, they covered administrative, territorial and economical policies.





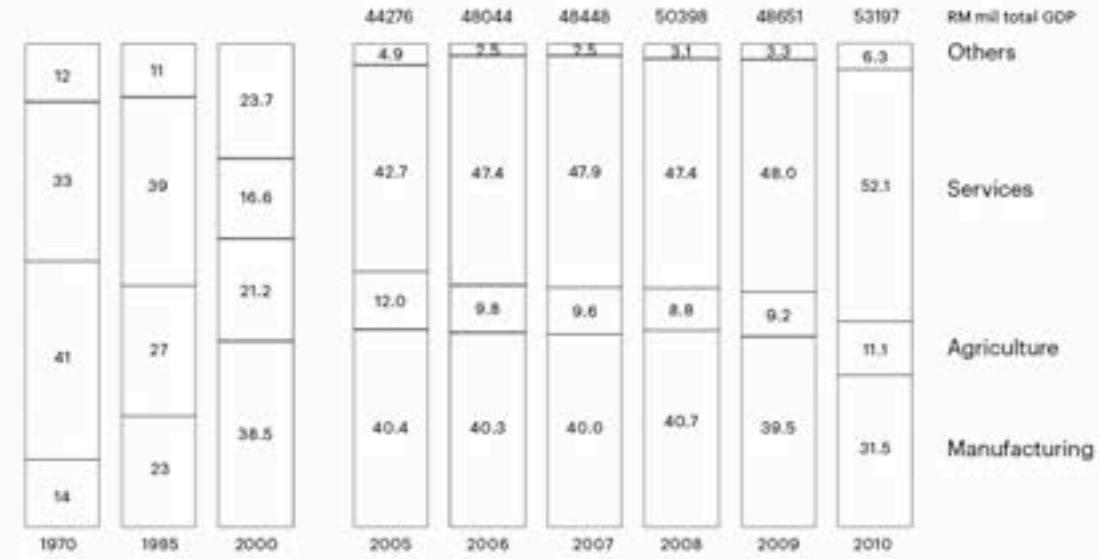
**Physical Development Strategy**

The ninth Malaysia Plan was set up in 2006 at the time of the Asian financial crisis, a period also characterised by an unsettled world economy rattled partly by rising oil prices. It proposed to maintain the same national budget until 2010 and to continue the post World War II sequence of federal economic development plans. Envisioning an annual GDP growth of 6%, the plan highlighted five goals:

1. Moving the Malaysian economy up the value chain
2. Raising capacities for innovation and knowledge and nurturing a 'first class mentality'
3. Addressing socio-economic inequalities
4. Improving living standards
5. Strengthening institutional capacities to implement changes.

At the core of physical development strategies was the introduction of national growth corridors. Stretching between the existing urban centres on the West coast, they were meant to spread economic development beyond Kuala Lumpur. At the same time, the establishment of an environmental area in the central and eastern parts of the Malaysian peninsula was supposed to prevent the urban development from uncontrolled destruction of natural areas.

**Johor State: Transformation of the Economic Sector**



**Johor State Economy: on the Forefront of Change**

How successful has the Malaysian development strategy been in the Johor region? Available indicators show that the share of service and manufacturing related industries has been growing significantly in this state over the past forty years.

The massive support and fostering of both local and foreign investment in manufacturing projects has resulted in a rise of the manufacturing sector's contribution to the GDP from 14% in 1970 to almost 40% in 2000. Telling from these numbers, the Malaysian growth strategy has been a success on the economic level in Johor State.

A surprising outcome can be observed in the numbers quantifying changes in service related industries. The service sector contributed to 40% of the GDP in 1985, before shrinking in importance in 2000 when it only accounted for less than 20%. At the same time, other industries besides the aforementioned

three expanded from around 10% in 1985 to almost a quarter of the GDP in 2000.

This can be interpreted as a relocation of services into the informal sector, possibly as an aftermath of the 1997 Asian financial crisis, which devastated the service sector.

Up to the present day, the Southern Johor region counts at least three abandoned shopping malls. Planned around the turn of the millennium, their present derelicts exemplify the struggle of the region's service sector in the aftermath of the global crisis.

Starting from 2005, the service sector showed a slower but steady increase in its contribution to the GDP in Johor state. The establishment of the Iskandar special administrative region in 2006 presented the prospect of more sound development of the service sector in recent years.



Abandoned Pacific Mall building close to Johor Bahru city center

## Political Meets Economic Power

Johor is one of Malaysia's thirteen states and one of the nine states with a hereditary ruler as its titular head. The Sultanate of Johor joined the Federation of Malaysia in 1948 and has been the first state to adopt a constitutional monarchy. Traditionally, the sultan as the head of the state has had to be a member of the Johor royal family.

Today, Johor is the only state in Malaysia to employ its own military: The Royal Johor Military Force. Formed



The State of Johor's Ten Districts

— State  
— District

in 1885, it is the private army of the Sultan. Although the state government is headed by its chief minister, important political decisions and strategies are laid out by the Sultan. Among other issues, his assessment and advice have culminated in the project for a third crossing between Johor and Singapore. Like him, many representatives of Johor's elite are members of the 'Johor Civil Service', a club that surrounds the Sultan.



Administration Levels in the Southern Johor Region

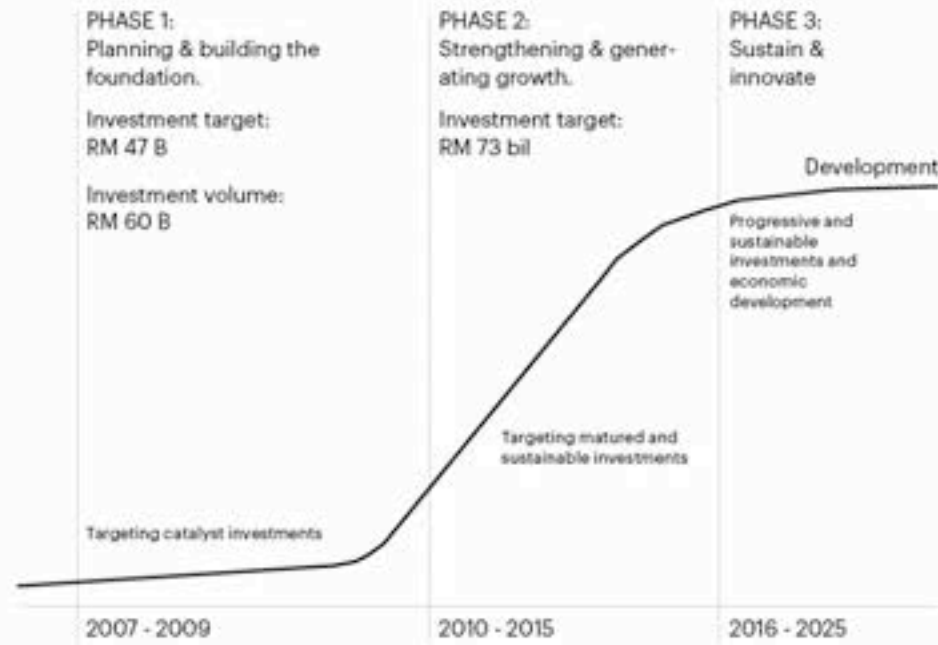
The State of Johor consists of ten Districts. Closest to Singapore is the district of Johor Bahru, which is also the location of Johor's state capital.

Within the district of Johor Bahru, the local administration is divided among three municipalities. Together with the municipality of Kulajaya, neighbouring to the north, these territories are central to the Southern Johor special economic region, which later became the Iskandar Malaysia region.

The Municipalities Neighbouring Singapore

— District  
— Municipality

**Economic Development Strategy of the Iskandar Region Over the First Three Decades**



**Iskandar Malaysia - One Stop Investment Region**

From 2006 to 2011, the ninth Malaysia Plan gave special attention to the newly formed Iskandar special administration region at the southern tip of the growth corridor. Its political body, the Iskandar Region Development Authority (IRDA), was provided with RM 101'111 billions to boost the urban, economic and social development of the region.

Named after the line of the Sultans of Iskandar, the declared region strives to equip Southern Johor with a unique selling point, especially targeted at its southern neighbour.

Planning started in 2005 on the initiative of Malaysia's then prime minister for the feasibility of such a territorial construct. Once considered as having potential, actual planning started in the same year and led to the publication of a comprehensive development plan (CDP) in 2006. It included seemingly all possible implications for the future region, from urban planning, economic incentives, to cultural and social actions.

Modelled after the Pearl River Delta Economic Zone in China, Iskandar Malaysia predominantly aims at providing potential investors with an attractive ground for the setup of

new projects in all possible fields, including manufacturing, hospitality, leisure, education, and finance.

Incentives, such as tax exemptions for flagship projects can be negotiated comprehensively with the IRDA, which also assists with permits and regulations. Within Malaysia, only in the Iskandar region can investors enjoy full foreign ownership of property and companies, as well as full foreign staffing.

According to the CDP, development is channeled into five flagship zones: A to E. Allowing investments in a variety of projects, they are meant to channel developments into urbanistically reasonable and sustainable paths. Officially, it is a declared aim of the Iskandar plan to realise a social and economic development in a manner that is most beneficial to both the local population, as well as for natural resources. Concentration of heavy industrial activities in zone D, for example, or the accumulation of land intensive service related projects in zone B, speak of this strategy.

Time wise, the CDP proposes a three part vision of the near future until 2025. In a first phase, signature projects are meant to stimulated efforts in raising capital. From the

government side, they either lay out basic infrastructure, such as highways, or put up architectonic signs of the region's ambitions. The relocation of the state administration into its new representative home within the Nusajaya flagship zone (B) can be interpreted within this strategy, as to reaffirm a picture of both a shining and stable regional governance. From the private site, flagship projects, such as fashion outlets and entertainment parks are meant to attract follow-up projects.

As of 2012, the financial goal of raising RM 47 billions in investment had been reached and exceeded as incoming capital had reached RM 60 billions. At this point, however, the region is just encountering its biggest tipping point that will most likely determine if the project moves forward.

Why is that so? According to the proposed vision, as well as to a broad consensus among politicians, investors and observers in 2012, a broad audience of possible investors has been watching the progress in Southern Johor. They are asking, whether the realised catalyst investments are economically sound past their introductory phase and whether other large scale companies are setting up businesses in Iskandar. At this point,



1. Zones within a zone: The five flagship areas and the Iskandar Malaysia outline
2. The unilaterally declared "Singapore-Johor Bahru" ring road - Iskandar trying to connect to Singapore at eye level (without becoming a suburb, that is)
3. Downtown Nusajaya in an "artist's impression": Opening competition with Southeast Asia's finance-Goliath Singapore

no sound assessment can be given regarding the success or failure of Iskandar. What can be observed right now, is that the new economic framework and massive infrastructure upgrading has immensely transformed the Southern Johor landscape. Even if the vision of a skyscraper riddled financial downtown in Nusajaya seems to be far away from realisation within the next few years, other urban phenomena have spread wide across the region. Either introduced or boosted by the new planning, they are all showing a reading of the Johor territory that may after all not be what Iskandar intended: Johor as a suburb of Singapore.



2.



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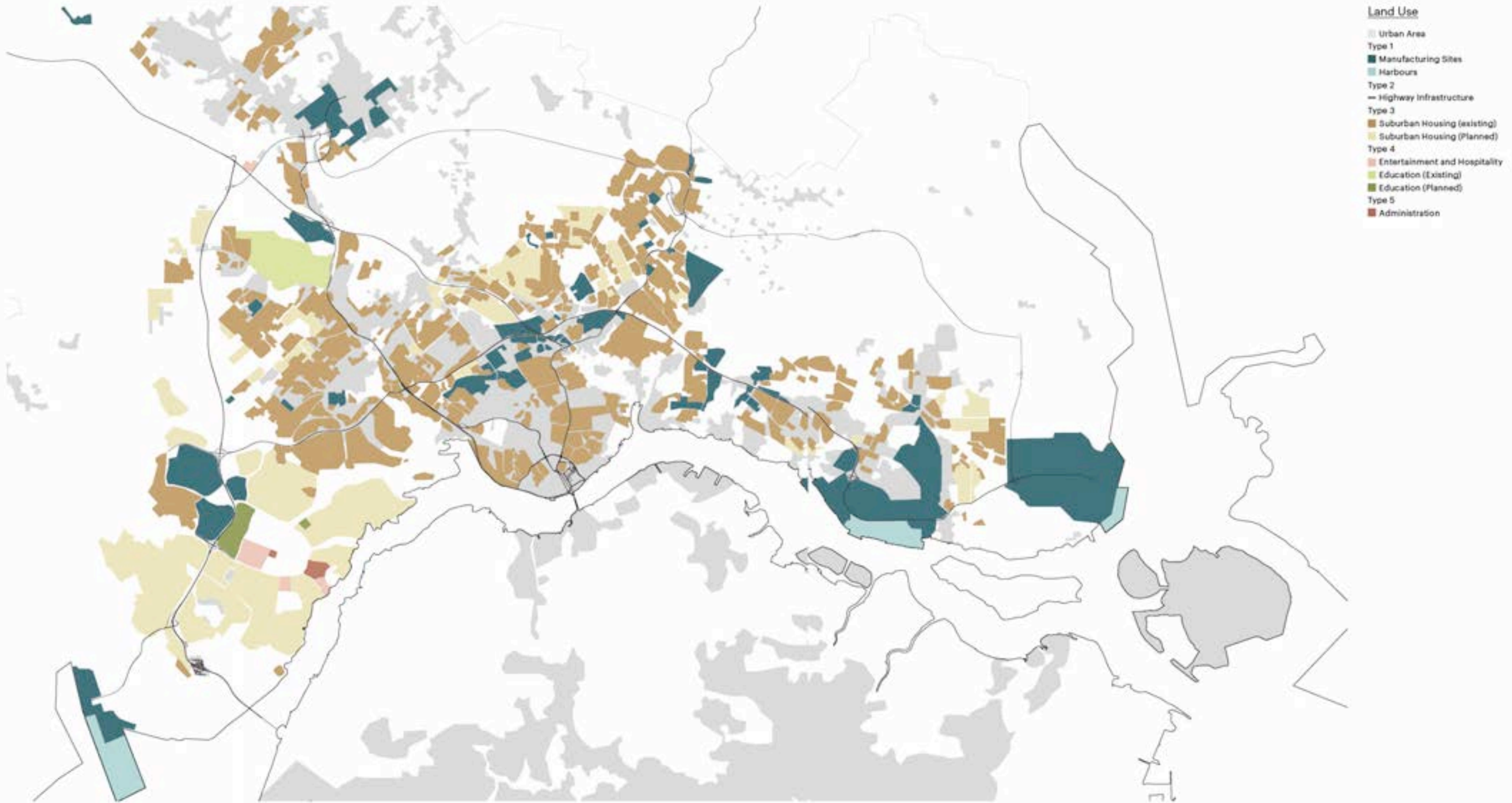
## Morphology of the Hinterland

Travelling to Johor from Singapore, one will observe a number of urban phenomena that are greatly different in the city-state. Vast lots of heavy industrial land, almost randomly sprinkled with some greened vacancies and dormitory housing, palm oil estates of all sizes and endless rows

of suburban semi-detached houses. Travelling itself can be demanding in a grid that seems to mainly consist of cul-de-sacs and private roads. This section proposes to catalogue prevailing urban phenomena of the Iskandar region while questioning how far they are driven by Singapore.



Compilation of uses:  
Fragmented urban  
landscape in Pasir Gudang



### The Map of the Hinterland

Starting with the outline of the Iskandar region, this map gathers all those phenomena, which have appeared to the authors as most striking in both shaping the territory and being an expression of a hinterland relationship with Singapore.



**TYPE 1: Manufacturing Sites**

Johor's true bread and butter business has been the manufacturing sector for over forty years. Furthermore, most of this business has traditionally been closely linked to Singapore. Carpenters for instance seem to have made a united migration to Johor long ago, as have most of the heavy and 'dirty' industries.

Today, traces of production sites are scattered all across the territory, spanning over an impressive variety of scales. Small scale domestic manufacturing businesses still run in the traditional Kampung along the river deltas of the eastern and Western areas. Shophouses industries, sometimes informal, are producing metal and wood parts. They line up along arterial roads, for example on the way to Kota Tinggi in the north-east or Senai. These production businesses are integrated into the urban fabric, otherwise characterised by the presence of residential dwellings. Finally, Johor also offers a respectable number of industrial estates catering to medium and large size firms, all the way up to multi-national corporations. Bahru Stain-

less from Spain is setting up Asia's biggest stainless steel production plant in Tanjung Langsat in the eastern end of the Iskandar region. The project is scheduled to be operating at full capacity in 2020.

In terms of scale, Johor seems to offer every kind of production site imaginable. If Singapore's core effort centres around high-tech industries, with neighbouring Indonesia trying to absorb the spillover, then Johor seems to remain a territory for the more rough production processes at the lower end of the value chain. Corporations are running light to medium size productions in Johor, but high-end dust-free laboratories are still waiting to make their way into the Johor production landscape.

plant in Tanjung Langsat in the Eastern end of the Iskandar region until 2020.

In terms of scale, Johor seems to offer every kind of production site imaginable - only, if it comes to the areas of production, there is less of a variety. If Singapore's core effort centers around high-tech industries, with neighboring Indonesia trying to absorb the spillover, then Johor seems to remain

as a territory for the more rough production processes at the lower end of the value chain. Corporations are running light to medium size productions in Johor, but high-end dust-free laboratories are yet waiting to make their way into the Johor production landscape.



- 1. Medium industry production site in Pasir Gudang
- 2. Contemporary shop houses within a residential development in Johor Bahru
- 3. Vacant plots among light industrial buildings in Senai

1.

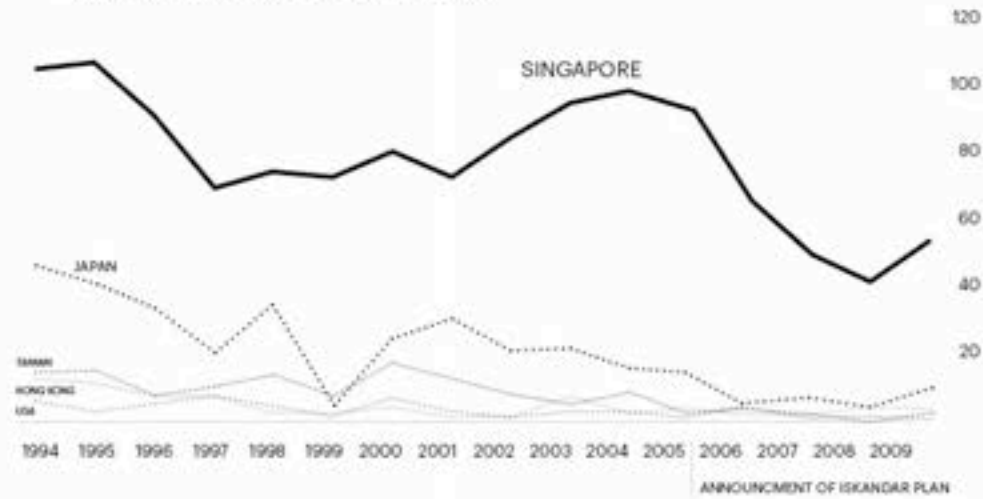
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3.

Foreign Direct Investment in Johor State by Country of Origin



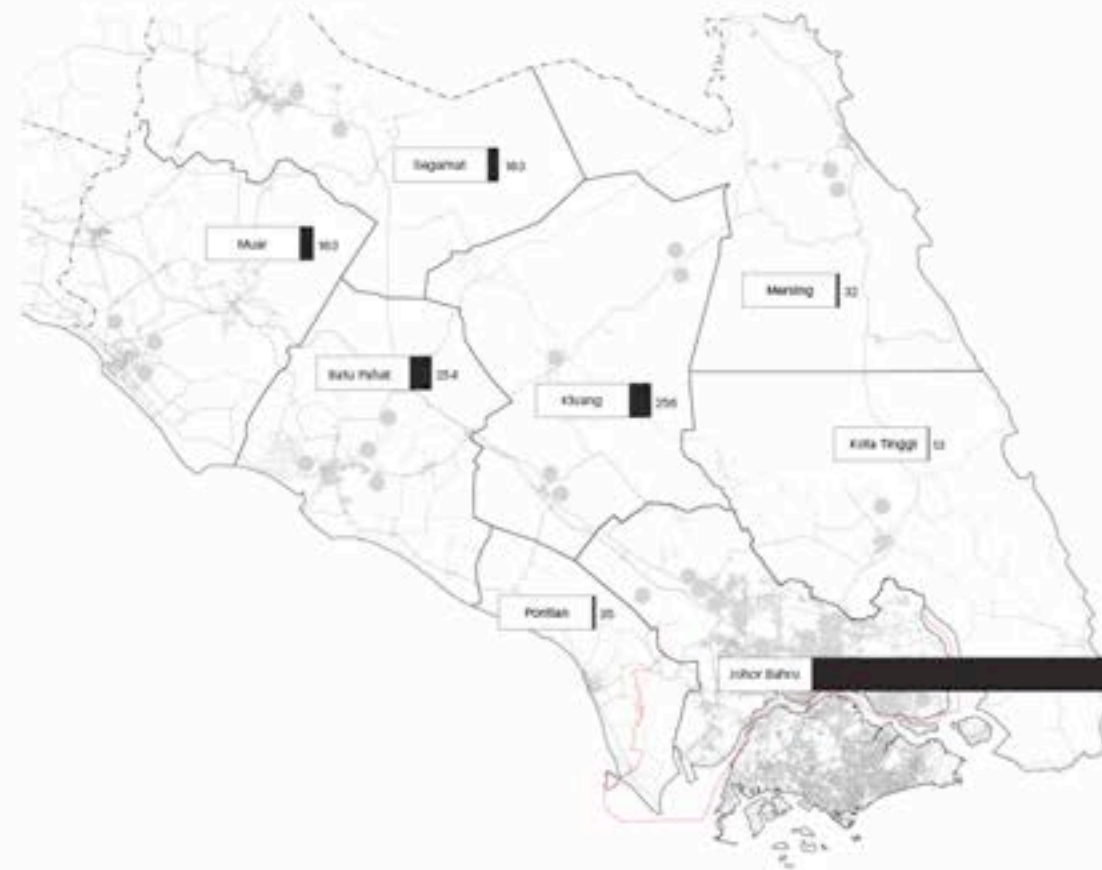
Number of Approved Manufacturing Projects in Johor State by Foreign Parties



**In Focus: Government-related Industrial Development in Johor**

Malaysia's national strategy of the 1970's to develop the country after the role models of the so-called Asian Tigers has been particularly successful in Johor. Being only 1 kilometre of water apart from Southeast Asia's rising tiger city, the state has attracted all kinds of Singaporean investment in Malaysia over the years. And, it has since strived to provide foreign companies with a fertile and easy ground. In 1977, the Johor Economic Development Corporation (PKENJ) was founded. As a 'government linked company', it leased large land plots from the state in order to

develop them into future industrial parks. Pasir Gudang in the east of Johor Bahru and Tebrau, north of the city centre were the first parks to be established. Johor's PKENJ laid out the street grid and basic infrastructure and started sub-leasing plots of all sizes to interested investors. Foreign companies would found a local branch to run their business in Malaysia and were guided through the regulations by PKENJ.







#### TYPE 2: Building Proximity: Highway Infrastructure

Travelling along the Southern Johor highways, most traffic conditions can fit into two very distinct categories: streets are either fully congested, with cars and motorcycles sneaking through even the tightest of spaces, or the streets are completely empty, seemingly vacant until a lonesome horizon.

Especially for visitors from Singapore, used to intelligent traffic control systems, Johor's conditions might appear as striking. They cast a light on the current state of infrastructure in Johor. Public bus transport is available, but is in best case rudimentary and slow. The Iskandar CDP highlights the importance of a future monorail and tram system, but its realisation is not part of the region's initial phases. Hence, the overwhelming majority of the working population relies on individual modes of transport to commute. Gas is subsidised in Malaysia, making driving an affordable mode of transportation for even lower income individuals.

On a second note, there seems to be an unfortunate relation between road conditions and traffic conditions. New roads are empty, whereas the old highways remain over-used throughout the entire day. Singaporean sports car owners have discovered this relation and established the popular habit of going racing on new Malaysian highways.

This, too, is telling of another characteristic of Johor's infrastructure. Although the whole region is laid out in a decentralised manner, road construction has been heavily focussing on the region's western side around Nusajaya. While this newly created part of the city is now ready for development, in the east, with its existing large industrial cluster around Pasir Gudang, traffic has been almost collapsing in the last years. Individual commuters often depend on the Pasir Gudang highway, but are also partly dependent on cargo traffic between the industrial estates in the east, and the region's biggest container harbour in the west – Tanjung Pelepas – a passage that constitutes a bottleneck.

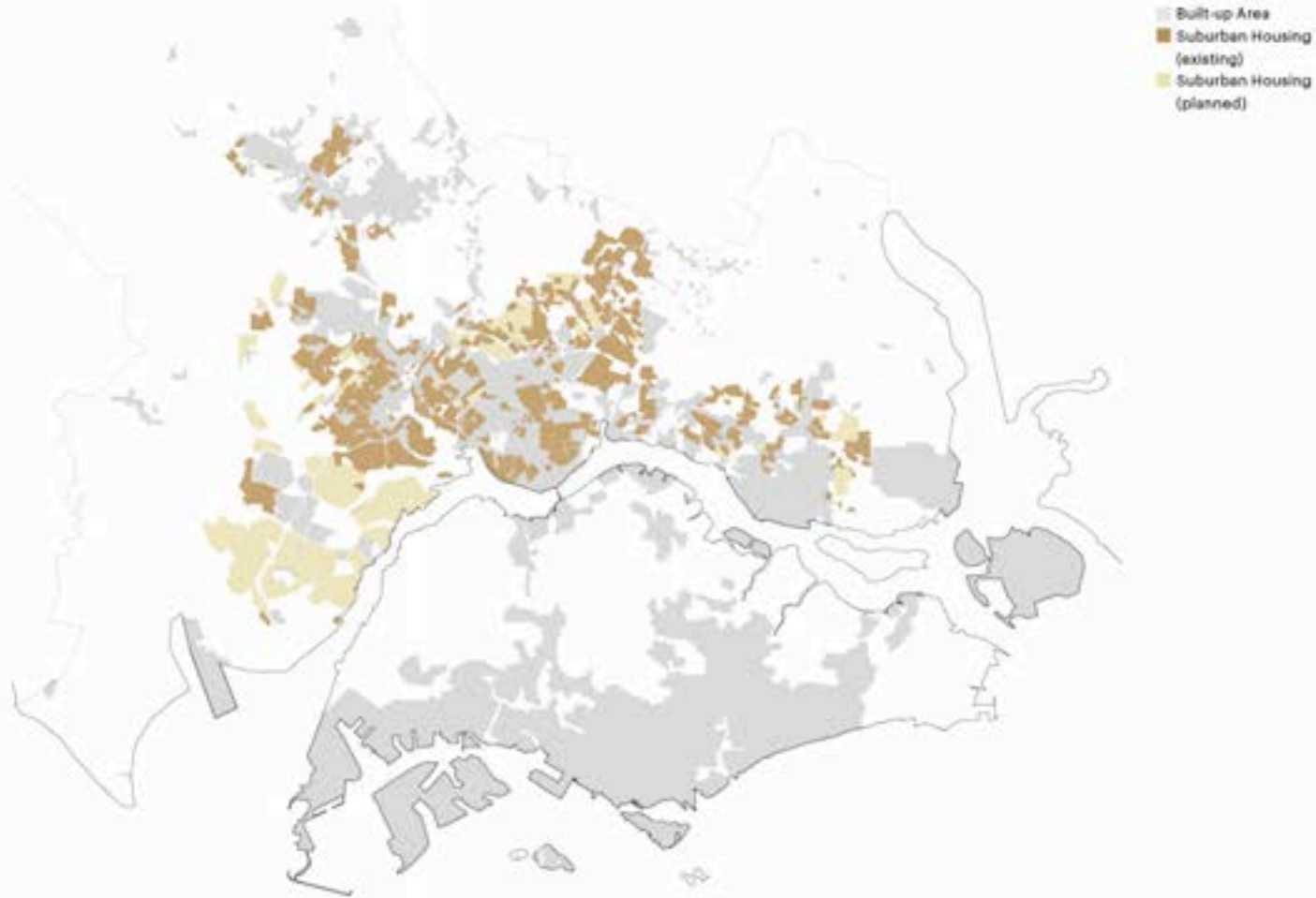
Although an upgrade of the Pasir Gudang highway was included in the budget of the ninth Malaysia Plan, this has not happened yet and is again subject to political decision making.

Thus, the current traffic infrastructure in the Iskandar region can be considered as imbalanced. It appears as an absurd thought to imagine that the expat staff of a newly established company in the Iskandar region would ask for public transportation, since the suburban lifestyle has been one of the main reasons to relocate here in the first place.

The IRDA, on the other side, seems to be catering mainly to international investors and employees, at least for the initial Iskandar phase, where road infrastructure is also the easiest way to enable flows of people and goods. If the DCP lives up to its own goals in the future, a railway and tram complement seems to be indispensable in order to ease traffic on the streets.



1. Elevated part of the new highway to Kuala Lumpur
2. City Center Mall in Pasir Gudang. Private vehicles are the prevailing modes of transportation
3. Congested traffic in Pasir Gudang
4. New highway in Nusajaya, West Iskandar



### TYPE 3: Villa for the Price of a Flat: Building Suburbs

If manufacturing is the sector that continues to bring most revenue to Southern Johor, then middle class housing estates are the region's backbone. The dream of a suburban home is appealing to locals and expats alike, including Singaporeans. Privately developed estates cover more than half of the built up area in Iskandar. They are by far the most widespread popular types of dwellings. Seemingly endless rows of semi-detached houses, villas and row houses line up along the main arterial roads. If one has ever needed a demonstration ad oculos to render valid the reading that Johor is a suburb to Singapore, it is nowhere clearer than on the drive from Johor Bahru to Nusajaya.

The land ownership structure of large privately owned estates benefited the middle class' conquest of this territory. Countless firms have developed their plantations into gated housing communities. Up to the 1990's, the majority of developments centred around the city centre of Johor Bahru. With the opening of the Second Link in the

West between Malaysia and Singapore in 1998, the focus shifted towards the West. The Iskandar CDP has further emphasised this development through the declaration of its Nusajaya flagship zone B.

The life of this zone has been marked by persistent ambivalence. Proclaimed as the region's new shining centre of governance, finance and attractions, it is at the same time Singapore's most ideal suburb in Malaysia. The brochures of real estate developers put it forth explicitly: It's only 15 minutes from this spacious 'paradise' to Singapore's crowded and busy territory. Even if the vision of a financial centre in Nusajaya will be realised in the future, the region's current development phase depends on money coming in from Singapore. For the money that could only buy a HDB flat in the city-state, one can afford a single family house with a garden in Johor.

In the end, the urban fabric seems to be the most negatively affected. The suburbs in Johor barely have a continuous street network, reducing accessibility enormously to one or two entry points of a private com-

munity and to the means of entering by car. Proposed as planning for 'security' - which, to the Singaporean eyes is one of the major concern in Johor - this strategy sets social and economical segregation in stone.



2.



3.



#### TYPE 4: Building Stability: a new Administrative Center

After its first few years in existence, Nusajaya and its proposed development into a centre for service-related economies still seem like fairly fragile construction. Every support is needed - and it comes from Johor's highest level; The state administration has moved in 2008 from its old seat in Johor Bahru to the new 'Nusajaya' in the Western flagship B.

This represents an ambitious move as government offices used to play a major function within the city life of Johor Bahru, the region's traditional centre, which now has an even harder time to sustain itself. Nusajaya's success is not clearly visible yet. What is more, Iskandar Malaysia's vision of five distinct flagships depends on a critical mass of people that live and work in the new metropolis. In 2012, such an explosion of population numbers is not in sight yet, leaving the current projects somewhat stranded in a large, empty landscape.

Perhaps it does need a bold move to reaffirm the feasibility of the Iskandar plans. Taking this economic and marketing background

into account, the relocation of state administration offices serves this purpose. It is the built manifestation of the region's ambitions and confidence (and of its hope that this attitude radiates towards possible investors.)

A further piece within this mosaic of planning is the architecture of the new state administration building. It emphasises Malay-Islamic roots and creates a virtual history of the place that has actually never been there.



New administrative building in Nusajaya. The architectural decoration evokes Malay and Islamic traditions



**TYPE 5: Building Attraction: Leisure, Education and Hospitality**

During the ongoing initial phase of Iskandar Malaysia's development, the government has invested in catalyst projects, and private initiatives have been launched.

Of them, most are situated in Nusajaya, the western flagship B. Out of the biggest projects, the Johor Premium Outlets shopping centre has touched down in Senai to take advantage of the town's good highway accessibility from all other parts of the Iskandar region. Even though Johor Bahru, which officially serves as flagship A, is more centrally located geographically, getting into the city is a nightmare by car, which may be one reason why the old downtown has not yet seen any catalyst investments. Like the relocated state offices, all other major developments are located around flagship B.

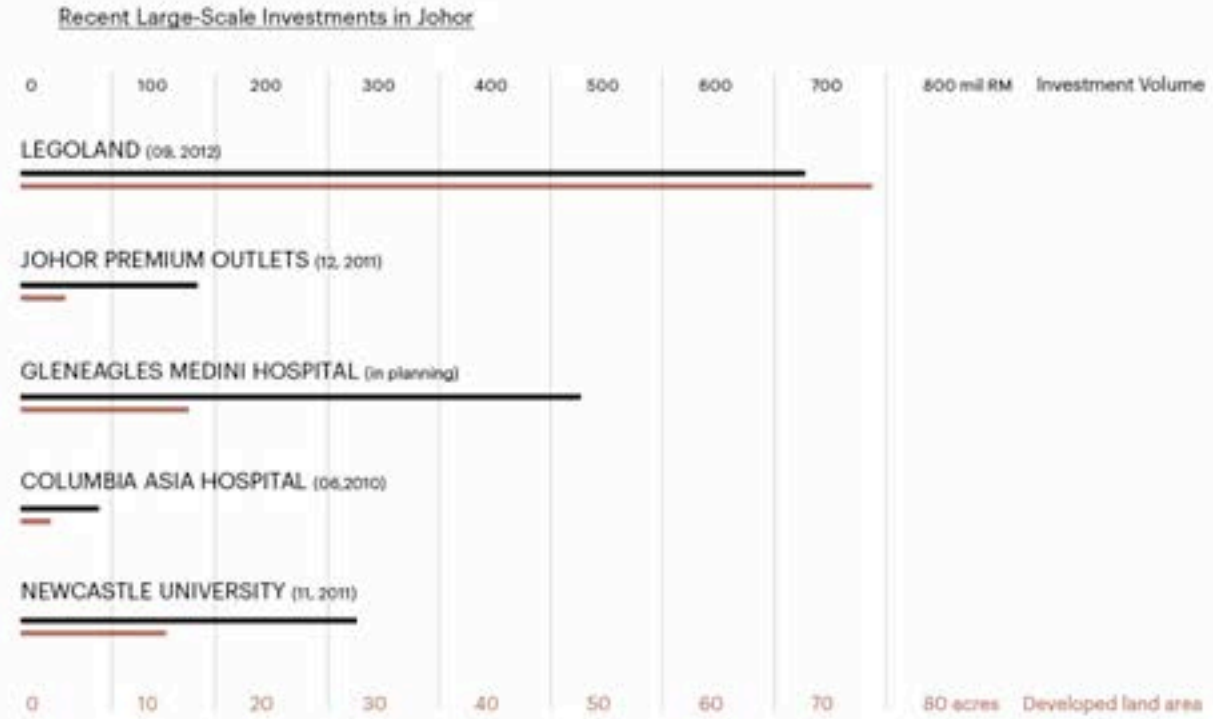
One of the most interesting changes takes place in the educational sector. At least eight higher education institutions have signed contacts to establish branches in or around the so called 'EduCity'. Among them are Carnegie-Mellon University from

the United States, Raffles University from Singapore, the Netherlands's Maritime Institute of Technology and UK's Newcastle University Medicine, which has already moved into its facilities. The confidence of these institutions can be considered as a very optimistic sign of the future success of the Iskandar Region, at least in economic terms.

Apart from these flagship projects, the vast majority of investment happens in large real estate projects, for example, the Puteri Harbor Project, which covers an enormous 688 acres. It combines living, working and amusement park facilities with waterfront access. If realised as planned, it will bring RM 2.3 billion into the region. The Medini development, within which the Gleneagles Hospital from Singapore is going to erect its private health clinic for a wealthier clientele, totals 2'225 acres and is scheduled to require RM 4.2 billion to be completed. Three real estate investment companies have stakes in this project and all are involved in the current planning process.

Yet the question remains whether these developments are going to be able

to amount to a lively, sustainable and accessibly city. Telling from past experiences with private housing developments and the state's seemingly limited intervention in the planning processes, this is more than doubtful from the present perspective.





1.



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Old Attraction:

1. The ZON, duty free shopping mall and ferry terminal
2. Inside the ZON: Visitor traffic is low. Products offered are cheaper than in Singapore, but the variety is smaller.



1.



2.



3.

New Attractions:

1. Legoland's construction site
2. Fenced-off campus of NU/med
3. Johor Premium Outlets, not particularly popular among targeted Singaporeans ("we can have the same discounts in Singapore if we wait")

# Homegrown Industries

Oil palms were introduced to the British colony of Malaya in 1910 by Scotsman William Sime and English banker Henry Darby. The British owned and managed the first few plantations and their companies (e.g. Sime Darby, Boustead) remained listed in London until the 1960's - 1970's. The autonomous industrialisation of Malaysia started in those years based on the agricultural sector inherited from the British. The politicians of the time tried successfully to

fight the poverty of the former colony. Millions of hectares of palm oil plantations continue to contribute to the welfare of Malaysia.



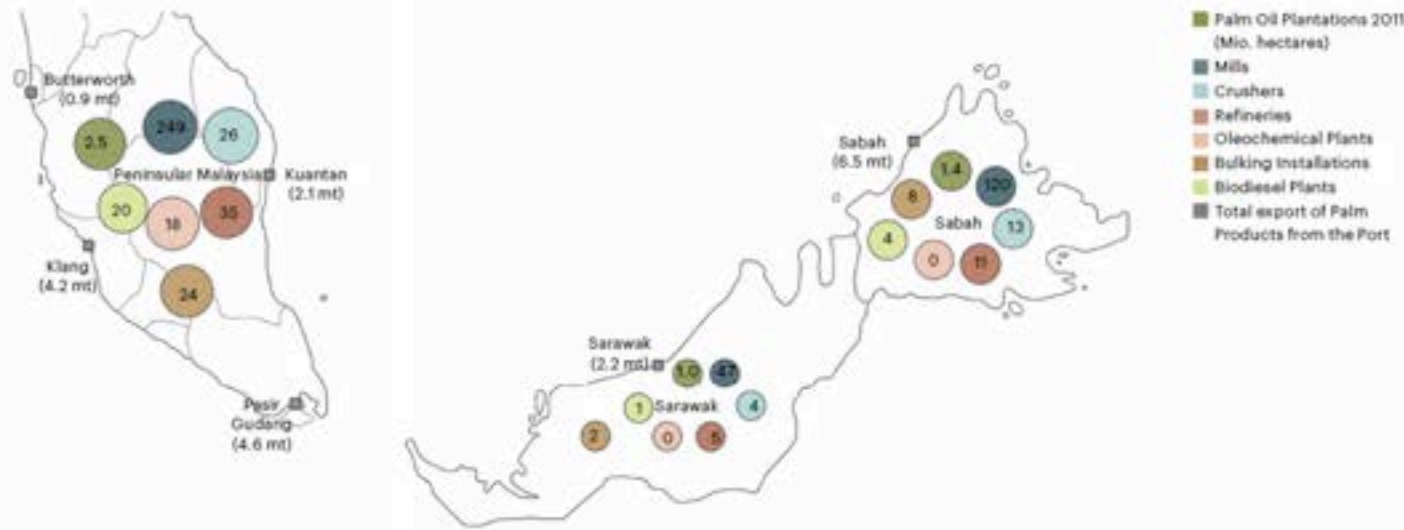
# Palm Oil Industry in Malaysia

In 2011, Malaysia produced 18.9 million tonnes of crude palm oil on 5 million hectares of land. The sector employs more than 570'000 people.

Malaysia is the largest exporter of palm oil in the world; whereas China is the largest importer for the tenth consecutive year, with off-take amounting to 3.98 million tonnes or 22.1% of total Malaysian palm oil exports, followed by the

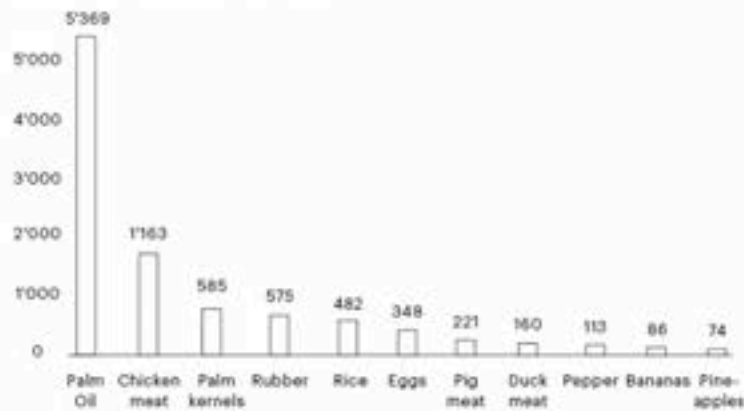
European Union (11.2%), Pakistan (10.1%), India (9.3%), USA (5.8%), Egypt (3.9%) and Japan (3.0%). These seven markets combined accounted for 11.78 million tonnes or 65.4% of the total Malaysian palm oil exports in 2011.

Extracted from the fruit of the oil palm, the oil is used in foods, cosmetics, detergents and biofuel.



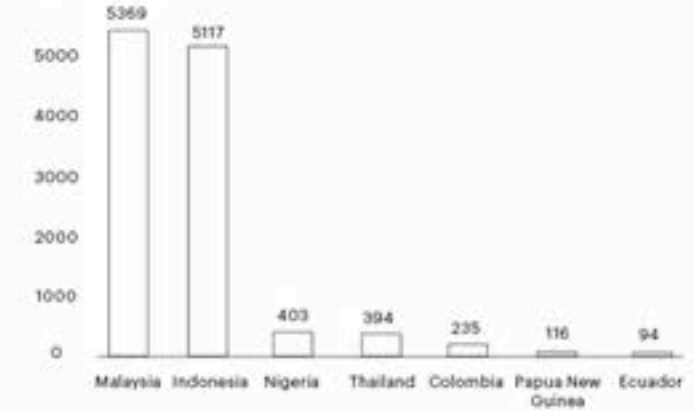
**The Malay Golden Goose**  
Palm oil is the most profitable product of the Malaysian agriculture and it dominates the sector with a productive yearly output of 5'369 USD millions.

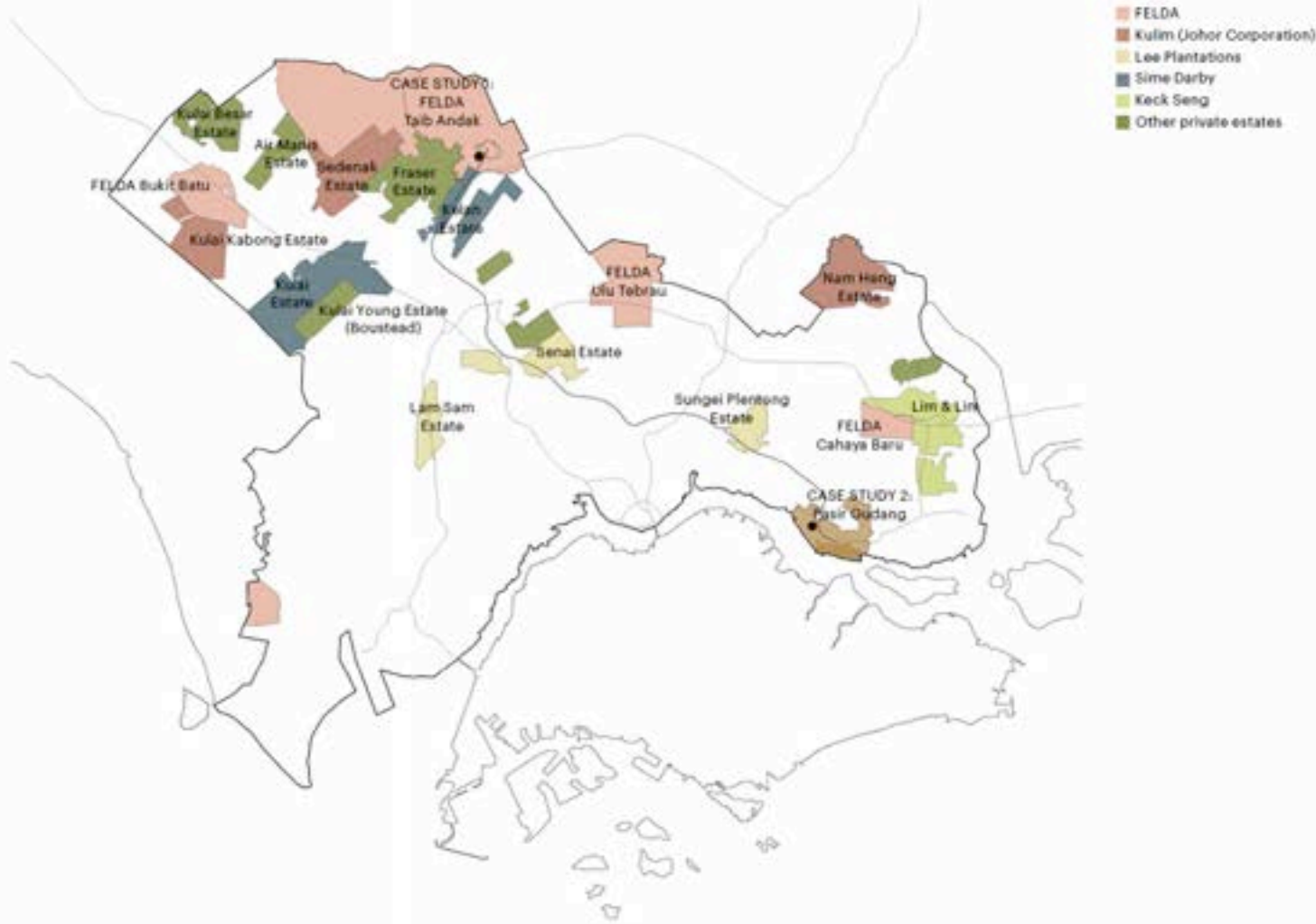
Yearly Agriculture Production Volume in Malaysia, 2011 (in 1 Mio. Dollar)



**Malaysia vs. Indonesia**  
Indonesia and Malaysia dominate the global palm oil market. In 2007 Indonesia became the world top producer of palm oil, surpassing Malaysia in quantity but not in quality. Thanks to developed downstream production plants, Malaysia can sell processed palm oil at higher prices.

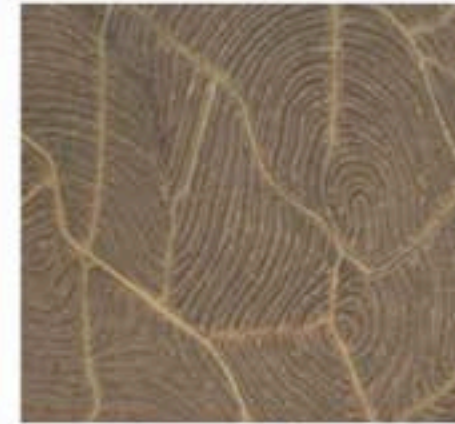
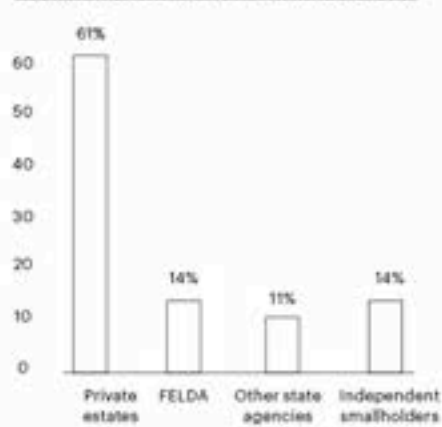
World Palm Oil Production 2011 (in 1 Mio. Dollar)





**Palm Oil Production Sites in Iskandar**  
 The map shows an overview of the biggest palm oil plantations in the Iskandar region. Private owners such as Sime Darby and Boustead have been present in Malaysia since the beginning of the 20th century. Since Johor Bahru has grown as a metropolis many palm oil plantations have been transformed into industrial parks, golf courses or housing developments in the past 30-40 years; now, they appear as randomly leftover plots.

Plantation Ownership in Johor State (%)



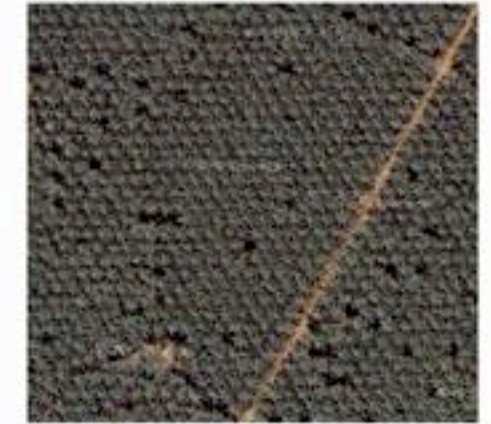
**Land Preparation**

Access roads and terraced fields replaced the tropical forest. The productiveness (5000 kg oil per hectare) and profitability of palm oil is very high in comparison to coconut (2260 kg/ha) or sunflower (800 kg/ha).



**3-Year-Old Palms**

Oil palms are planted in a 30 foot grid so that passages can be easily integrated into plantations. After 2 or 3 years the first fresh fruit bunches can be harvested.

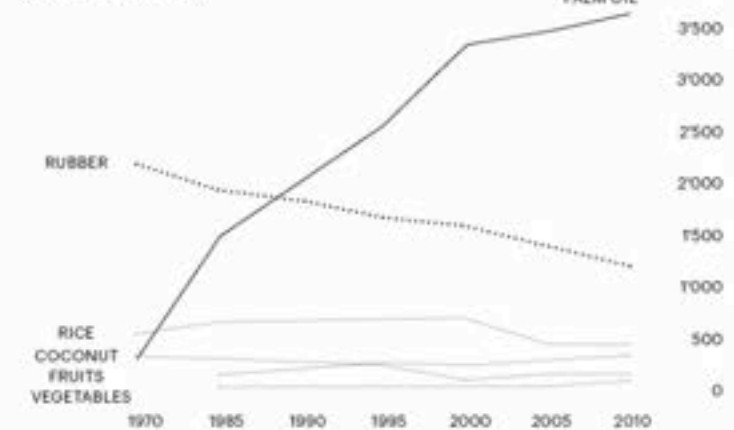


**20-Year-Old Palms**

After 20-25 years the palms are old and stop to be productive. They are then cropped and a new planting cycle begins.

**Palm Oil as a Successful Alternative**  
 The palm oil plantations' importance begins in the 1960's, when the world prices of tin and rubber plunged. The palm oil's use and demand have increased steadily since then. In Malaysia, its proliferation was promoted by the Federal Land Development Authority (FELDA), which opened its first palm oil settlement in 1960 and is nowadays the world's biggest palm oil planter.

Agriculture Production Area in Malaysia, 2011 (in 1000 Ha)





## FELDA: Village Cooperatives for Palm Oil Production

The Federal Land Development Authority was formed on 1 July 1956 when the Malaysian Land Development Act came into force with the main aim of eradicating poverty. Settlers were each allocated 10 acres of land (about 4 hectares) planted either with oil palm or rubber, and given 20 years to pay off the debt for the land. After Malaysia achieved independence in 1957, the government focused on value added of rubber planting, boosting exports, and alleviating poverty through land schemes. In the 1960's and 1970's, the government encouraged planting of other crops to

hedge the economy when world prices of tin and rubber plunged. Rubber estates gave way to oil palm plantations.

In 1961, FELDA's first oil palm settlement opened, measuring only 375 hectares of land. As of 2000, 685'520 hectares of the land under FELDA's programmes were devoted to oil palms. By 2008, FELDA's resettlement broadened to 112'635 families working on 853'313 hectares of agricultural land throughout Malaysia. Oil palm planting took up 84% of FELDA's plantation land bank.



### FELDA Sites in Malaysia

The map shows that Johor is an important spot for the production of the palm oil managed by the state. The reallocation of the poor population happened mostly in the Southern Peninsular states of Malaysia. In the most urbanised state, Selangor, FELDAis involved in only four villages. Plantations need much land and human resources to work the fields.

STATE	SETTLERS   SCHEMES	FELDA Settlers per State, 2011
Pahang (1)	43'123   115	> 40'001
Johor (2)	27'641   73	20'001 - 40'000
Negeri Sembilan (3)	16'429   49	10'001 - 20'000
Terengganu (4)	7'463   21	3'001 - 5'000
Perak (5)	5'914   17	2'001 - 3'000
Kedah (6)	3'185   10	0 - 2'000
Kelantan (7)	3'115   11	
Selangor (8)	1'929   4	
Sabah (9)	1'649   64	
Melaka (10)	1'330   5	
Perlis (11)	857   3	
<b>MALAYSIA</b>	<b>112'635   372</b>	



Palm oil fruits ready for the mill



#### Poverty Alleviation Schemes

FELDA was established on July 1st 1956 by Tun Abdul Razak, Malaysia's second Prime Minister. The goal of the program was to eradicate poverty by giving land to the landless in order to generate income and to prevent social conflicts. Only Malay people could join the program. Minister Tun Abdul Razak hoped to reduce the socioeconomic

disparity between the Chinese minority and Malay majority via the 1971 Malaysian New Economic Policy, which lasted until 1990. The initial target was to move the ratio of economic ownership in Malaysia from a 24:33:63 ratio of Bumiputra (ethnic Malay people), Other Malaysian and Foreign ownership to a 30:40:30 ratio.



1956-1970



1971



1971-1988



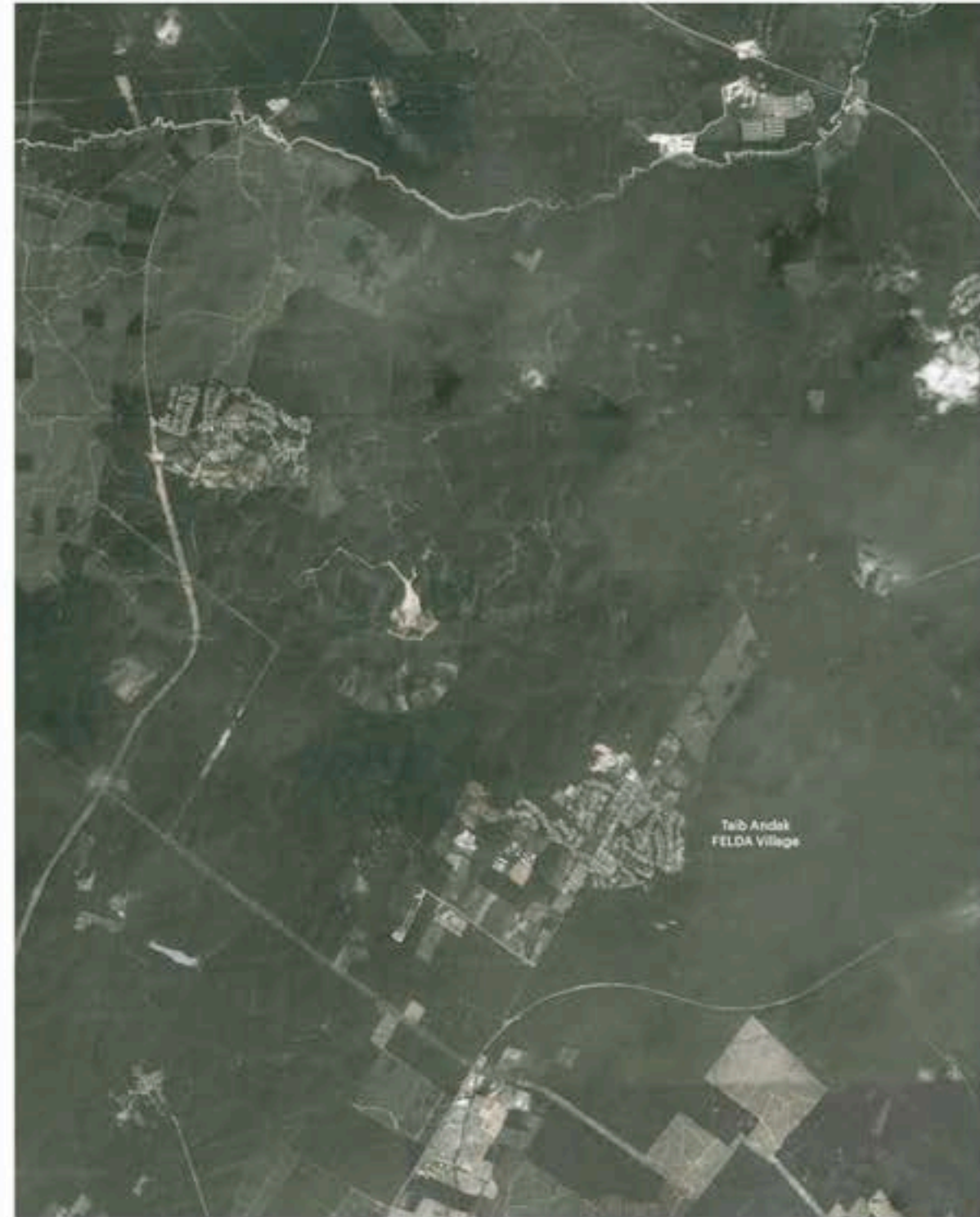
1989-1994



1995-today

#### From Rubber to Palm Oil

The FELDA logos show three important moments in the Malaysian history: in the beginning the logo was green and shows peninsular Malaysia, where began the plantations, then based on rubber. In 1971 the logo changed according to the Malaysian New Economic Policy. The successive logos are orange because of the success of the palm oil plantations which, as we can observe, really improved the welfare of the farmers. In fact the government stopped to build new FELDA schemes in 1996.



#### Income from the Field

The field work is the main source of income for the settlers, so they strive to increase the farm productivity and quality. Complementary non-farm activities include a mini-market, aquaculture and livestock.



**The New Productive Village**  
 FELDA Taib Andak was named after the first chairman of FELDA, Mr Tan Sri Taib Bin Hj. Andak. It is situated 42 kilometres north of Johor Bahru and was established in 1960. This was the sixth scheme opened in the country and the first in Johor. It is significant because this was the first scheme with palm oil as a main crop. The village expanded in eight phases and counts 620 settlers today. The village grew around a central axis that connects the entrance with the palm oil mill. A mosque lays at the centre.

- Staff Houses
- Worker Houses
- Office
- Multi-purpose Hall
- Oil Station
- School
- Park

0 100 200 m

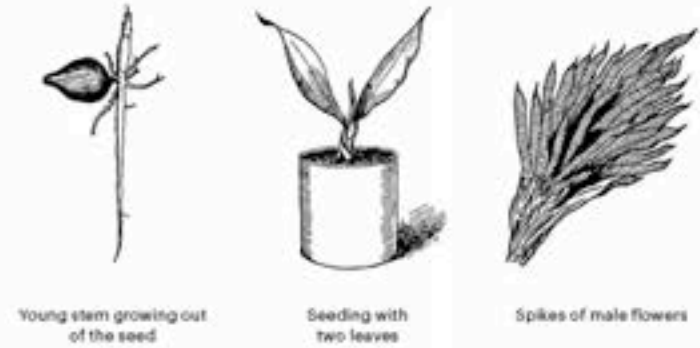


**FELDA Evolution**  
 Most of the FELDA settlers are now between 60 and 70 years old. They came to the villages as landless poor and thanks to the State's initiative, they reached over the years a remarkable livelihood: they earn between RM 3'500 and 5'000 (US \$1'096 to \$1'565 per month). The children of the first settlers can take over the father's land if they are married, but most of them choose to work in factories or in the services sector outside the village. The FELDA community is very proud of their children becoming doctors, lecturers, bank managers, lawyers and so on.  
 Mr. Haji Tukimin Bin Mohshed, 63 years old, widower, lives and works in FELDA Taib Andak since he was 13. He has got three sons. The oldest is 43: two of them work outside the plantation.

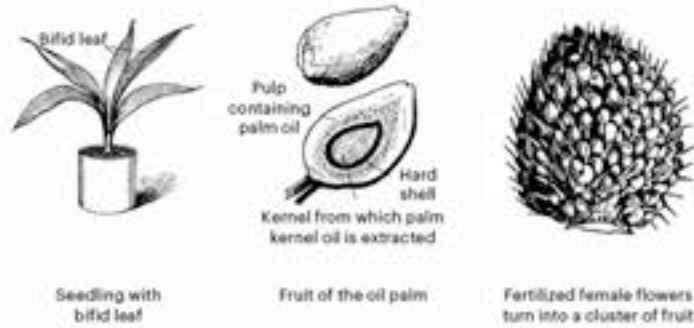




Harvesting activity, Eeck Seng Plantation, Pasir Gudang.



Young stem growing out of the seed      Seedling with two leaves      Spikes of male flowers

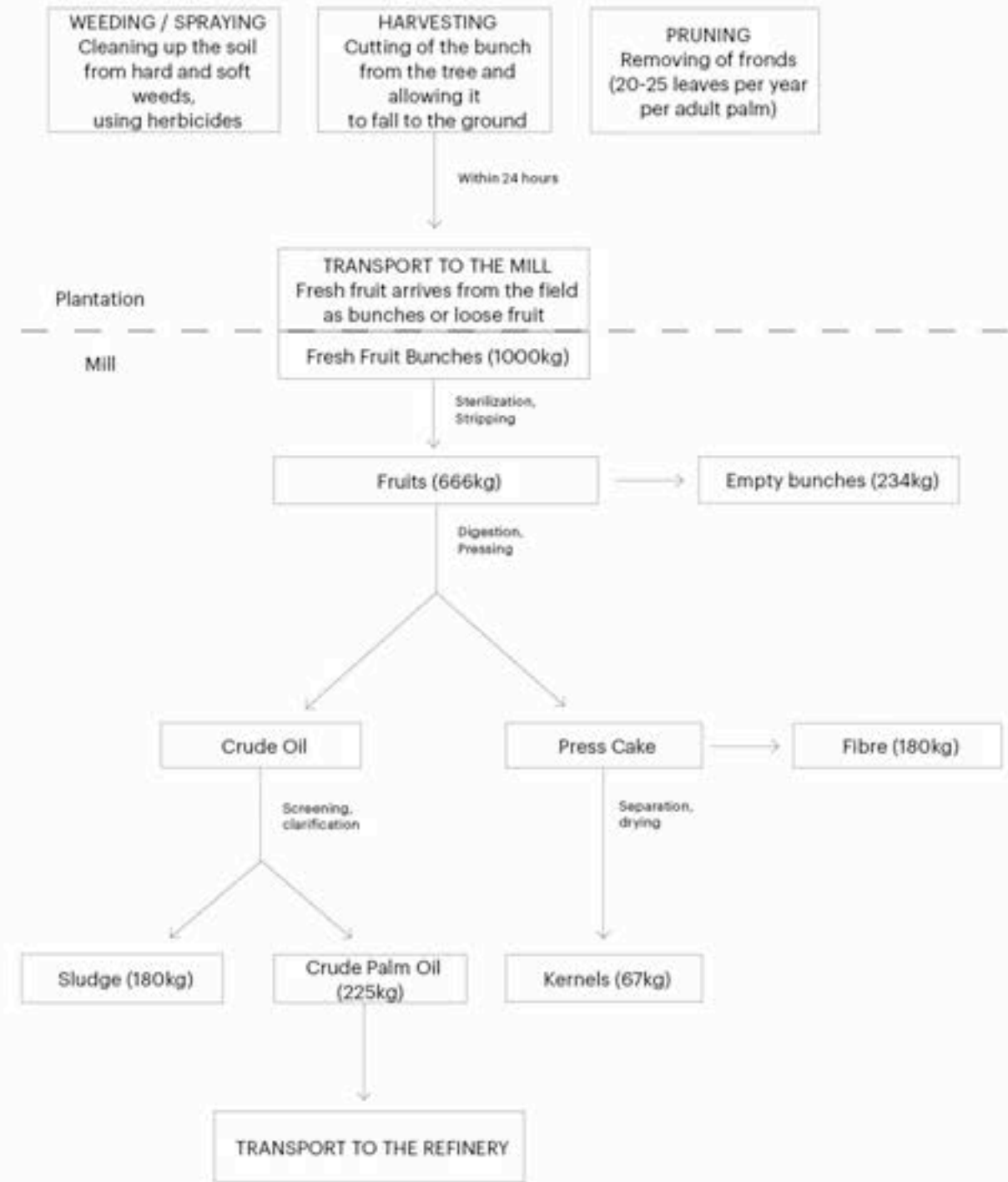


Bifid leaf      Pulp containing palm oil      Hard shell      Kernel from which palm kernel oil is extracted      Fertilized female flowers turn into a cluster of fruit

Production Process in the Palm Oil Plantation

The main activities in the plantation are manuring, harvesting, spraying, weeding and pest control. It takes about six months for the oil palm to produce a fruit bunch out of a flower.

The fresh fruit bunches weight between 30 kilograms and 60 kilograms and are normally harvested 2 times per month.



## Pasir Gudang: A Palm Oil City

Pasir Gudang began to develop from a palm oil plantation into an industrial area after the establishment of the Johor Port in 1977. In the 1960's the government already founded three FELDA schemes in this region 35 kilometres east of Johor Bahru, so the decision to transform the area in an industrial town was an important step for its development.

The most characteristic industries of Pasir Gudang developed near the port and are huge palm oil refineries which operate day and night. In this chapter we will investigate them and their relation to the local population of around 65'000 inhabitants.



FELDA Refinery



**Nationalism and Competition**

The industrial township Pasir Gudang was built at the beginning of the Malaysian industrialisation in the 1970's. Its strategical proximity to the Straits of Singapore was used to build a successful spot for the manufacturing and shipping of goods. The FELDA plantations as well as the private palm oil plantations in the surroundings use this industrial site to refine and ship the palm oil to importing countries.



Palm Oil Business	Healthcare	Property and Logistic Services	Restaurants	Property	Hospitality	Entrepreneur Venture
Kulm (Malaysia) Bhd	KPJ Healthcare Bhd	Damansara Realty Bhd	TPM Technopark Sdn Bhd	QSR Brands Bhd	Johor Land Bhd	Puteri Hotels Sdn Bhd
New Britain Palm Oil Ltd	Al-Aqar KPJ REIT	Healthcare Technical Services Sdn Bhd	Tanjung Lingsat Port Sdn Bhd	KFC Holdings (Malaysia) Bhd	Damansara Assets Sdn Bhd	Kumpulan Hotel Selesa
			Johor Logistic			Sibu Islands Resort Sdn Bhd
			Langsat Marine Base Sdn Bhd			

**Johor Corporation**

Johor Corporation, formerly known as the 'Johor State Economic Development Corporation' (JSEDC), was formed in 1968 as part of the Malaysian government's programs to restructure its multi-ethnic society by eradicating the economic imbalance between Malays and non-Malays.

Malaysian state economic development corporations were designed to break away from the bureaucratic binds of a regular government department and to become a commercially-oriented investment arm of the respective state governments. In 1977 JSEDC was appointed administrator of the industrial township Pasir Gudang, and managed its

land until 2009, when a new independent Municipality was established.

Johor Corporation continues to be one of Malaysia's leading business conglomerates, comprising more than 280 member companies and employing over 65,000 employees in Malaysia as well as regionally. In 2010, the Johor Corporation Group's turnover exceeded RM 7.5 billion and profit before tax of RM 962 million.

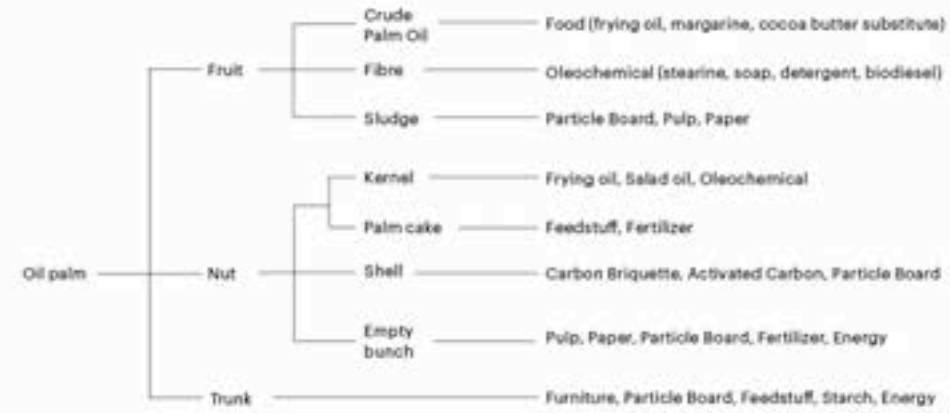
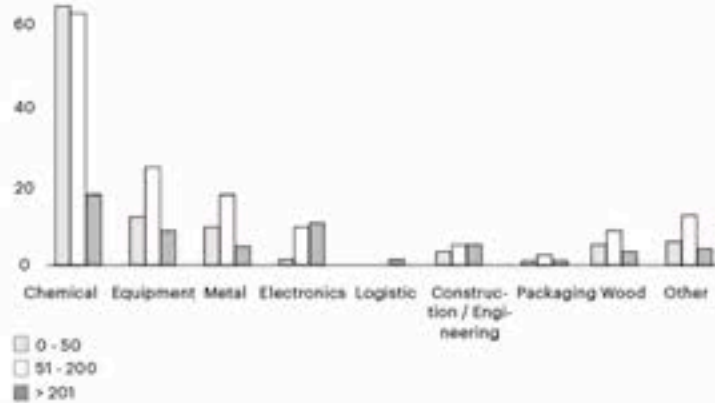


**A Mix of Heavy, Medium and Light Industry**

The industrial land is subdivided into 15 areas, but in each one the lease conditions are the same: from 30 to 60 years for a locked and cheap rate. In the late 1970's and early 1980's there were no regulations about environmental issues, so every company that applied received the land, without the need for planning or regulating its activities.

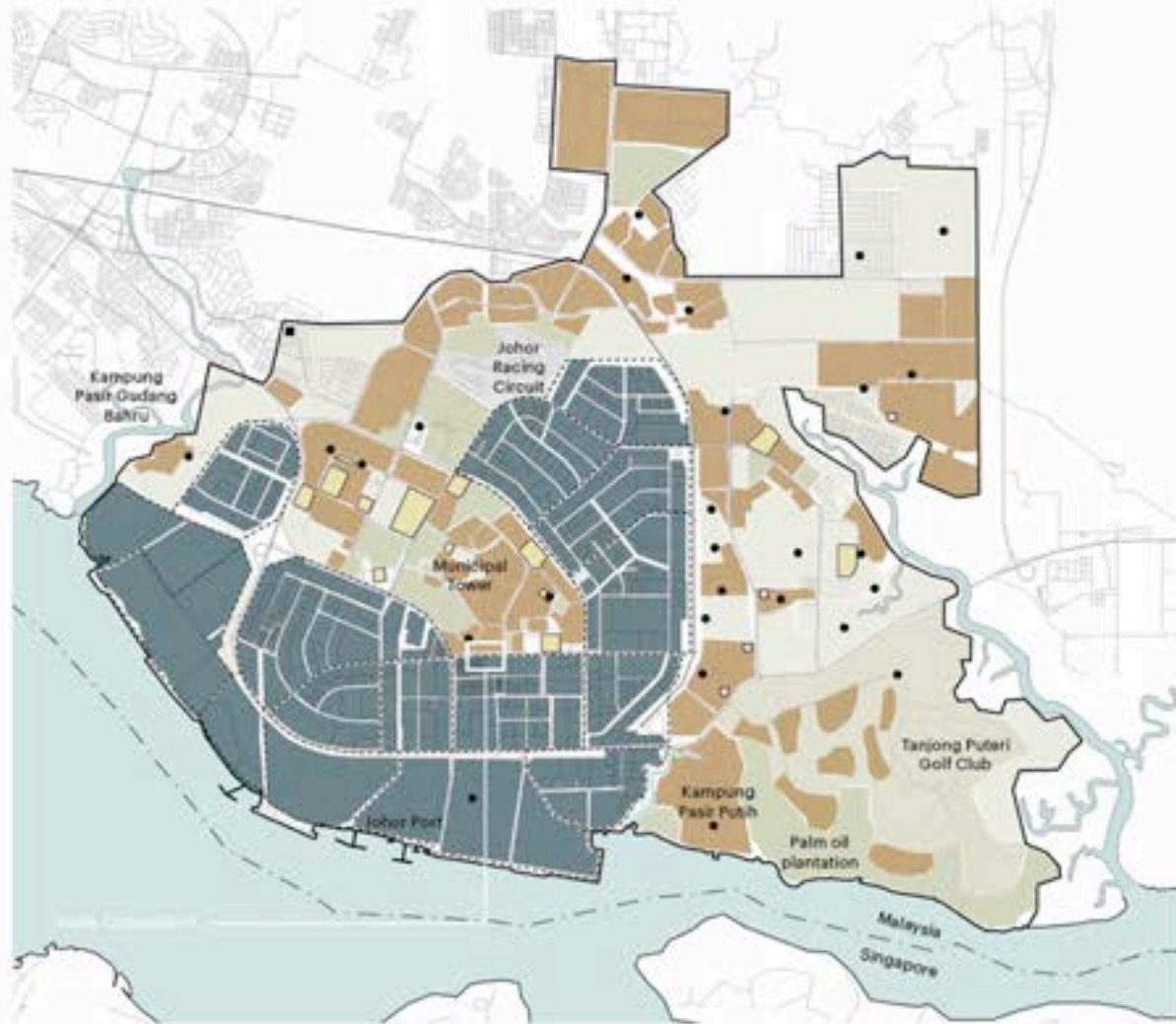
Industrial Park Name	Distance to Johor Bahru (km)	Total Area (Hec)	Still available (Hec)	Price (RM/m <sup>2</sup> )	Lease Period (years)	For Industry Type
Pasir Gudang	36	936	6.7	13.0 - 16.7	30 - 60	Light/Medium/Heavy

**Industries in Pasir Gudang by Number of Employees**



**Oleochemical Sector**

The refineries grew in the Pasir Gudang area because of the big amount of palm oil production achieved thanks to the FELDA program and the economical incentives of the Malaysian State. The downstream of the crude palm oil produces many other chemical products that can be transformed from other industries (for example soaps or cooking oil producers). We can observe that the biggest and most common companies of Pasir Gudang are related to this important and successful sector.



## Pasir Gudang

- Industries
- Housing
- Community Centres
- Park / Natural Area
- River / Straits
- Mosque
- Chinese Temple
- Church

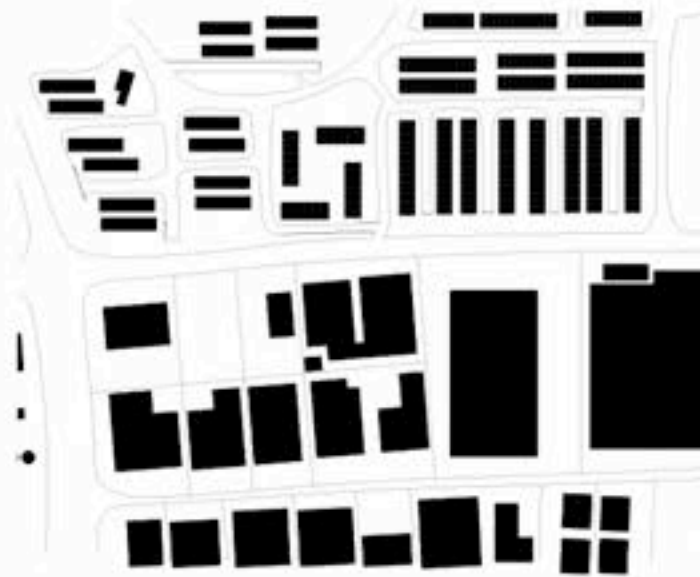
0 0.5 1 km

An Industrial Town

The name Pasir Gudang originated from the existence of a sand mine at Kampung Ulu. Sand ('pasir' in Malay) was dug and stocked in sand pits/stores ('gudang' in Malay) to then be exported to Singapore.

The oldest settlements of Pasir Gudang are the Kampung Pasir Gudang Bahru and Pasir Putih, which were founded in the 1920's. The surroundings were occupied with rubber and palm oil plantations until the government decided to build a new industrial city at this location in 1977.

The industries grew step by step starting from the port, without any kind of zoning: the result is a village area as a leftover spaces. Nowadays the heavy industry have to be placed 250 meters away from housing areas.

Scale Comparison

The zone between housing and industry are characterised by wide truck-friendly streets. Rows of trees are planted along these streets. In the kampungs and near to the

palm oil plantation we can still find traditional Malay houses. The cheapest apartments are in mass housing developments, where many foreign temporary workers from Myanmar, Bangladesh and Indonesia live.

From Industrial Township to Municipality

The Pasir Gudang Municipal Council (MPPG) was established on 1st July 2008 to replace the Johor Corporation that administrated the city since its foundation in 1977.

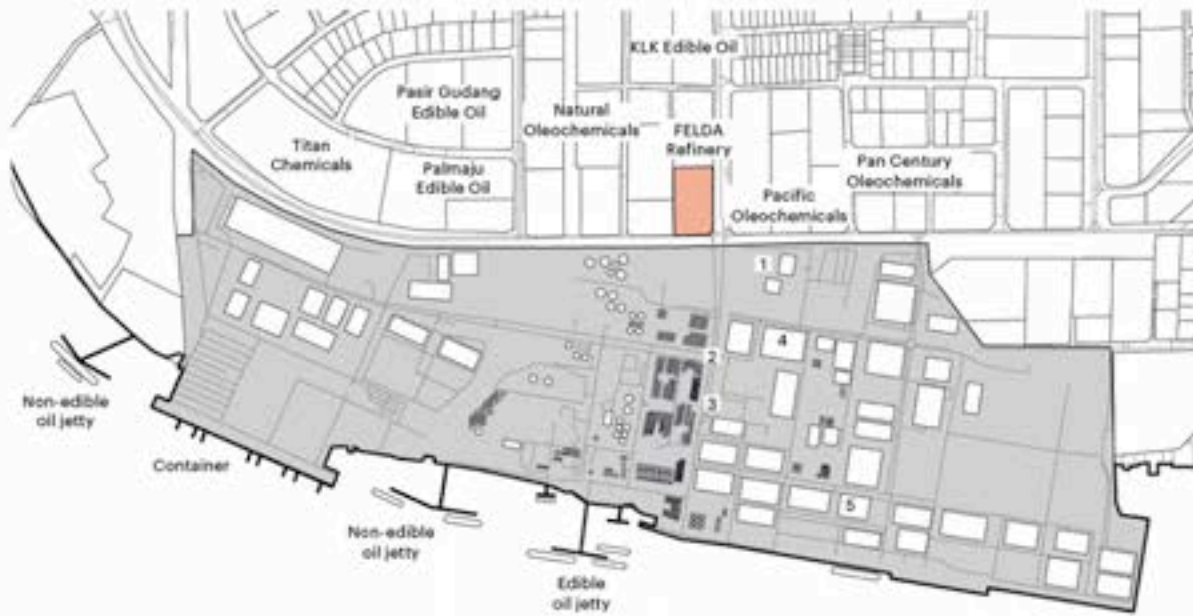
From September 2009, MPPG's management migrated to the new municipal tower. After 31 years of development and with a population of about 65'000, the former industrial park could begin to manage its own political power and finances.





### Endangered Life

45 years after its opening, the Pasir Gudang industrial park remains a successful economic model. In fact, it is already being expanded in the Tanjung Langsat area (see Flagship Zone map). On the downside, air, water and soil pollution have steadily increased since the 1970's. Up to 80% of the industries of Pasir Gudang own water treatment plants, but the volume of polluted water thrown into the rivers is so much that it can not be controlled. As a result, the two Pasir Gudang rivers (Sungai Masai and Sungai Laloh) are consistently amongst the top 10 most polluted in Malaysia.



**Johor Port Infrastructure**

1. Customs Checkpoint
2. Security Checkpoint
3. Wisma JP Logistic
4. Security Service Center
5. Marine Center

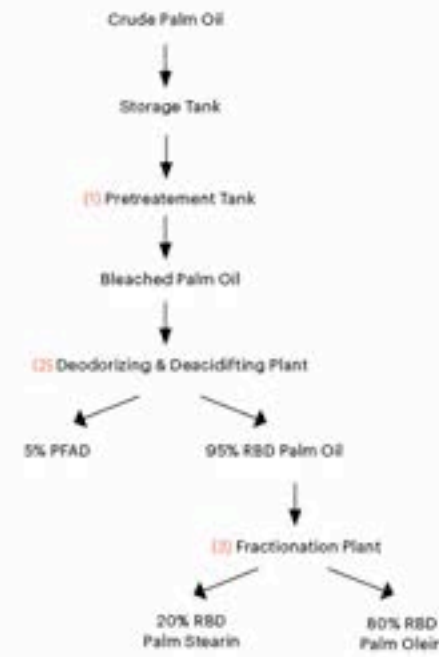
0 0.5 1 km

**Johor Port**

Johor Port is the largest palm oil terminal in the world. In 2011, 3'299'944 tonnes of palm oil were exported from it, which corresponds to the 18% of all Malaysian palm oil port exports. Founded with Pasir Gudang in 1977, it obtained the status of free zone in 1984 and was fully privatised in 1995. Johor Port is a logistical hub for Iskandar Malaysia and a part of the triangle formed by the poles of Tanjung Pelepas Port, Senai Airport and Johor Port.

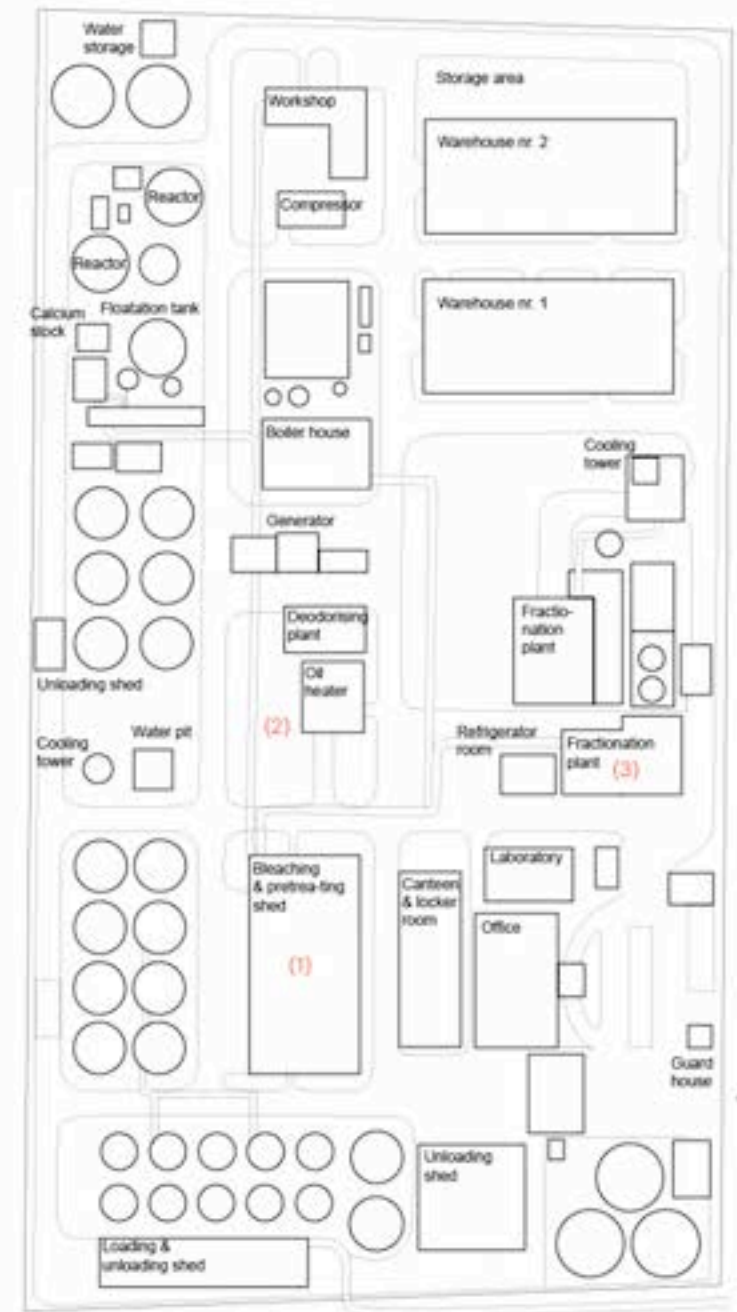


**Palm Oil Refining Process**



**The Felda Refinery in Pasir Gudang**

Palm oil products are made using milling and refining processes: first using fractionation, with crystallisation and separation processes to obtain solid (stearin), and liquid (olein) fractions. Then by melting and degumming, impurities can be removed, and then the oil is filtered and bleached. Next, physical refining removes smells and coloration to produce refined bleached deodorised palm oil, or RBDPO, and free sheer fatty acids, which are used as an important raw material in the manufacture of soaps, washing powder and other hygiene and personal care products. RBDPO is the basic oil product which can be sold on the world's commodity markets, although many companies fractionate it further into palm olein, for cooking oil or other products.



0 25 50 m

# Global Hinterland

Until 2006, Johor used to be Singapore's playground for foreign direct investment. Companies from Japan and Hong Kong invested in the region as well but its international significance remained fairly limited. All this changed with the intense marketing and regulatory efforts brought by the Iskandar project. Other players have entered the arena and the investment volumes seem to have blown up. In 2000, Singapore was the largest inves-

tor with 100 approved manufacturing projects and a total volume of RM 1 billion. In 2008, a single project from Spain was established with over four times as much investment volume, making it by far the biggest project ever realised in the region. This is the most extreme example of an overall trend that sees Iskandar opening up to international corporations who are able to raise huge sums of money. For the territory, this has mixed implications, which this

chapter aims to trace. After a brief introduction over Spain's mega-investment, the focus of the following pages is going to be on the Senai industrial area. Located within the Iskandar flagship zone E, it shows a telling mixture of industrial developments.



## Bahru: Asia's Biggest Stainless Steel Production Plant

This RM 4.4 billion project spreading over 350 acres is scheduled for completion in 2020. The plant is expected to generate 1'600 jobs in other companies throughout the region. Approximately 30% of its production will be sold in Malaysia, giving local companies that require stainless steel a boost as they will no longer have to import this material.

In 2012, production had already begun in the first phase and the project seems to be on track.

The plant occupies a vast plot in the Tanjung Langsat area, which serves as an extended development to Pasir Gudang.



Location of Tanjung  
Langsat



Johor Technology Park:  
large scale industrial  
development on a former  
agricultural estate,  
surrounded by palm oil  
plantations

## Endless Possibilities: High Tech in Senai

The Senai area is intended as a hub for new high technology industries that support Johor's efforts to move its manufacturing sector up the value chain. Located north of Johor Bahru, the area is well connected to other regions of Iskandar through the highway network.

Senai itself shows a broad mix of different industries, from informal shophouses over medium-sized manufactur-

ing firms, to large production estates of international companies. The built-up area sprawls far into the countryside, with industrial estates being surrounded by palm oil plantations. The different types of industries, as well as living areas and other built phenomena are distinctly scattered throughout the landscape and hardly interact or interfere with each other.



Location of Senai within  
the Iskandar outline



Light industry factory in  
Senai

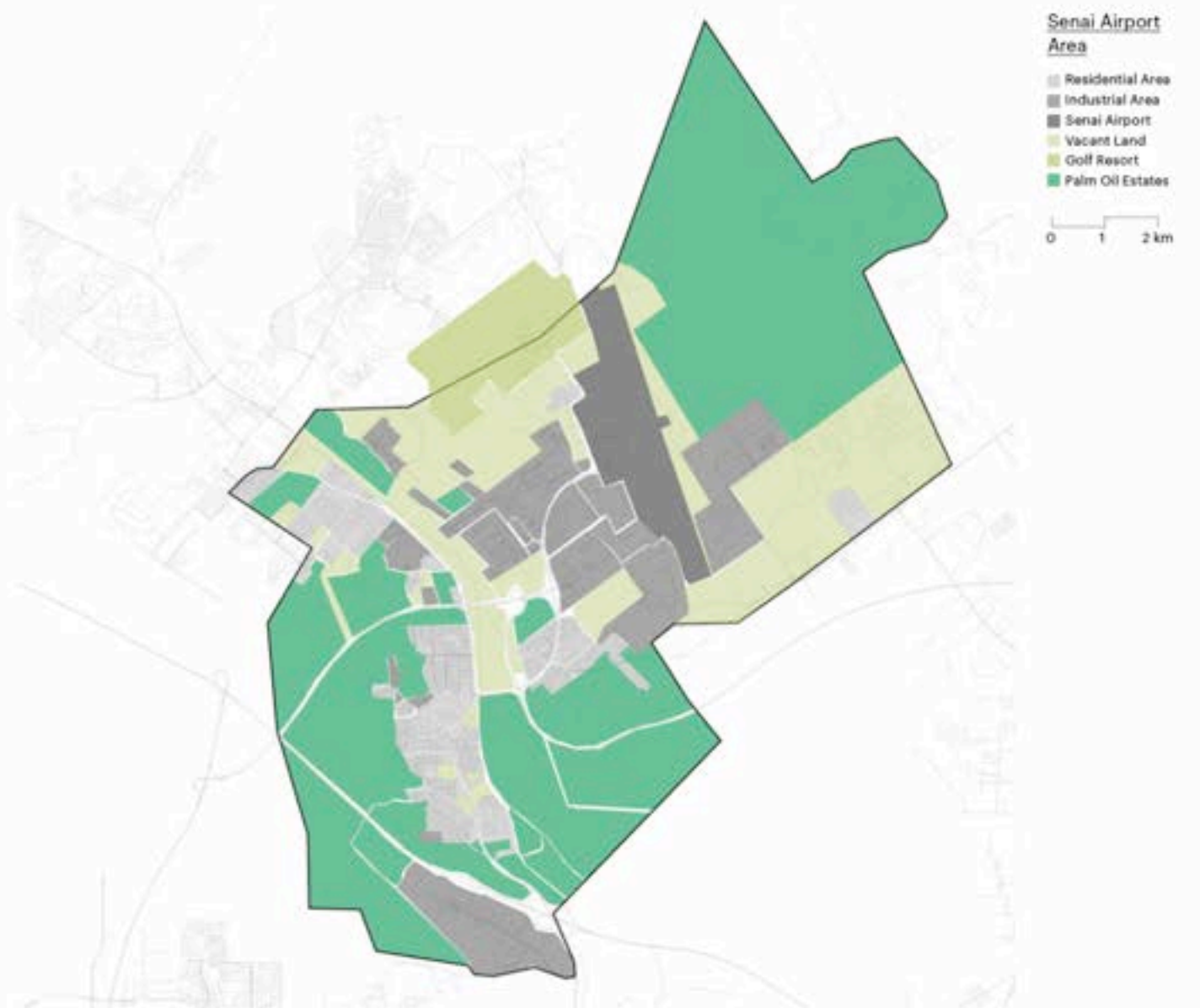


#### Senai Town and Estates: Location and Borders

The town of Senai is part of the larger Iskandar flagship zone E. As such, it is meant to develop into the region's high technology manufacturing cluster as it is a well connected air cargo hub. The flagship outline stretches far to the south and reaches into the campus of Universiti Teknologi Malaysia (UTM), southern Johor's main higher education institution. Southeast of Senai's airport, it also includes a triangular land area to be developed into a 'High Technology Park' in the future. Plans for this project are already under way and the current palm oil plantation of Lee Corporation is supposed to disappear soon. Connectivity is the key to the flagship E concept: Senai has direct access to the new highway leading from Johor Bahru to Kuala Lumpur, as well as to Iskandar's new lateral connection, stretching from Nusajaya in the west past Pasir Gudang to Desaru on the Malaysian east coast. The availability of easy access to national roads and international air and sea ports, together with the presence of UTM, is meant to establish a fertile cluster for up-and-coming manufacturing spin-offs.



Top:  
Map of Senai  
  
Bottom:  
Senai Highway - the town's  
traditional main road,  
lined by shop houses



#### Zoning and Urban Development

The old nucleus of Senai is a linear town that stretches along the old artery of the 'Senai Highway': a double lane main street lined by shop houses. The new Kuala Lumpur expressway passes by on the south eastern side and has absorbed much of the traffic. Outside the old settlements, plantations used to stretch into the landscape with farm villages scattered in between them. In the 1970's, a transformation process began to develop some of those lands into industrial parks. The first ones were developed by Johor Corporation to the northeast of the old town, up to the airport and beyond it.

Since the 1990's the Johor Technology park - south of the Kuala Lumpur expressway - has been available, also managed by Johor Corporation. This estate, as well as the future 'Johor High Technology Park' in the southeast sit on grounds leased from the Lee Corporation - a private Malaysian Palmoil and real estate investment company. Therefore, any new investment within those parks has to be ratified by both JCorp and Lee Corp.

Industrial Park Name	Distance to Johor Bahru (km)	Total Area (Hec)	Still Available (Hec)	Price (RM/m <sup>2</sup> )	Lease Period (years)	For Industry Type
Senai I	30	40.5	0	3.7	60	Light/Medium
Senai II	30	70.2	0	5.6	60	Light/Medium
Senai III	30	136	0.25	11.1	60	Light/Medium
Senai IV	32	51	0.86	13.0 - 18.6	30 - 60	Light/Medium
Johor Technology Park	21	184.6	41.7	14.9 - 20.4	30 - 60	Hi-Tech/R&D

**Johor Corporation's Industrial Parks**  
 The majority of businesses have settled down in one of the industrial parks that are managed by Johor Corporation. Out of a total of five, the four older ones are almost completely occupied. They stretch between the airport and the old town centre. They are aimed at light and medium industries, like Dyson, manufacturing vacuum cleaners, or Panasonic, producing electronic products. According to industry estimates, Senai is an unofficial hub for the production of remote controls.

The industrial areas in Senai seems to be a success and have indeed added value to the local economy. According to the Iskandar Comprehensive Development Plan (CDP), Senai is also the proclaimed centre for high-tech developments. Flagship E is marketed as a Malaysian silicon valley, with a stimulating cluster of innovative firms and research institutions not far from UTM. Johor Corporation's Technology Park was seen as the first step towards this vision. After the first six years since these plans were announced, their realisation has no yet picked

up the same speed as the medium or heavy industry sectors. Companies producing semiconductor related products have been reluctant to move to Senai or Johor in general. For most of these firms, the setup of a new plant is a huge investment.

The current cluster of companies in Senai lacks two major characteristics of other high-tech conglomerations. In Senai, the companies are generally foreign. They don't have their research & development divisions in the region and are subsidiaries of large international corporations. These circumstances lead to a situation where the important decisions and discoveries are made elsewhere, with only routine production done in Senai.

Johor Corporation is currently planning another high technology park to cater especially to the desired medium-scale industries with a locally rooted clientele. The success of this attempt will depend on how open and accessible the environment is for young, up-and-coming firms.



**Senai Industrial Sectors**

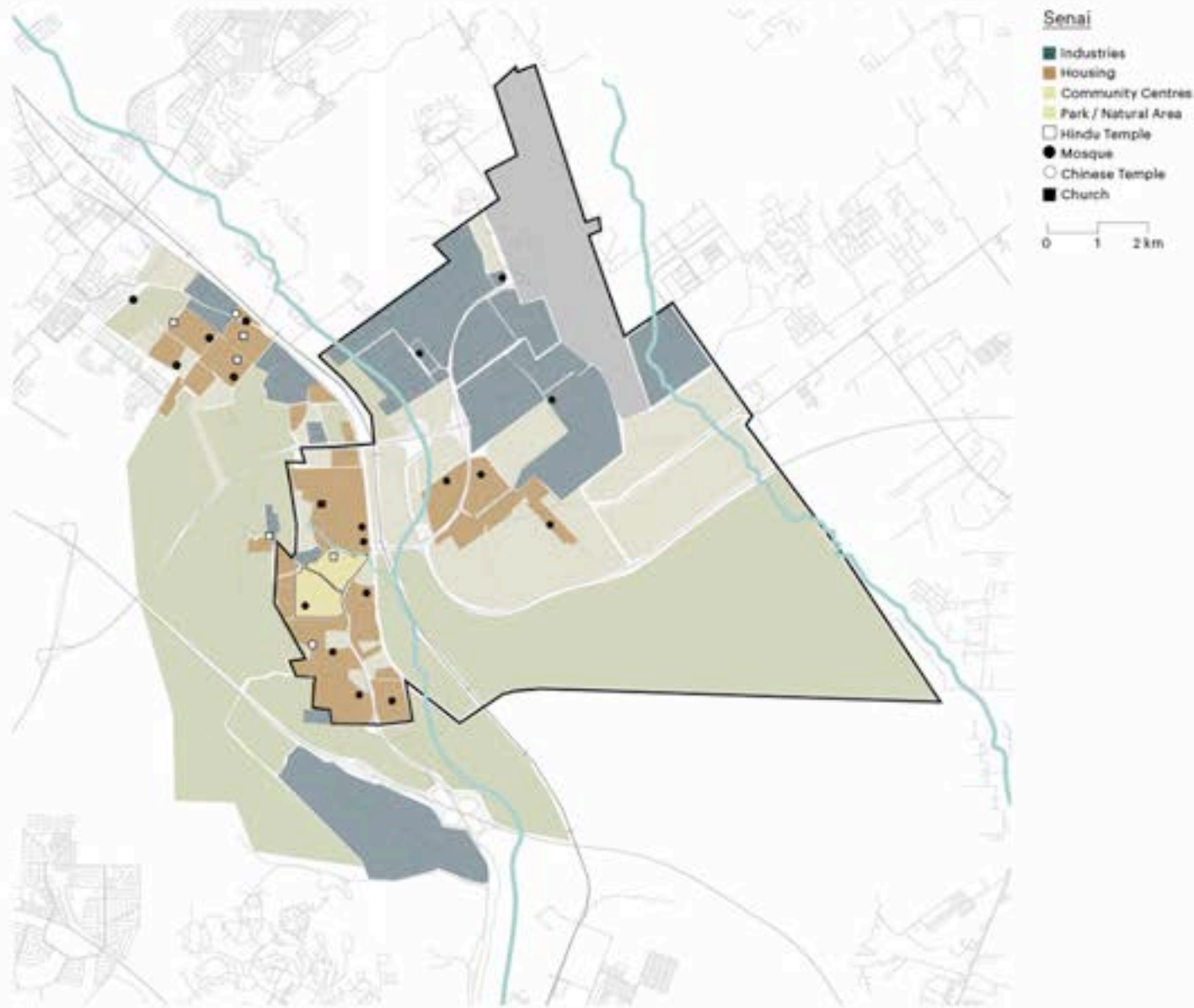
- Chemical
- Metal
- Electronics
- Logistic
- Engineering
- Construction
- Wood
- Others
- Plots still available
- Johor Corporation Industrial Parks

0 250 500 m

Senai IV Industrial Park

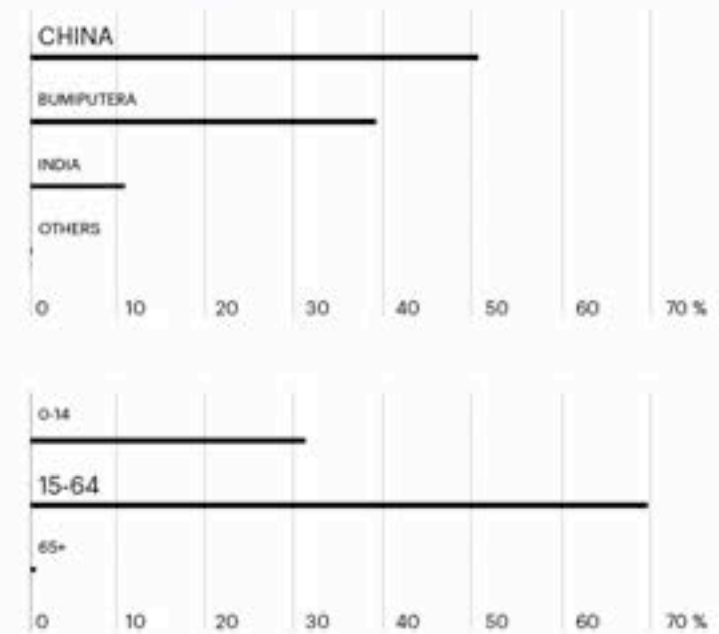
Johor Technology Park





Chinese shophouses along Senai Highway

**Chinese Roots vs. Global Investors**  
 Remarkably, the state's effort for industrialisation has persistently overlooked an old part of Johor's economy, especially the Chinese ethnic group, which was already involved in small manufacturing businesses in the 1960's. Senai, for example, was an old centre for these types of small scale and often informal production. Still today, the majority of the population is of Chinese ethnic origin and Chinese signs are omnipresent around Senai Highway.





## Malay Brain-Drain to Singapore

When asked about their thoughts on investment in Johor, the officials of a large German semiconductor company replied that infrastructure is the actual problem, even though it is far from being ideal for the sensitive, dust-free environment needed for production. Instead, companies identified the shortage of a qualified workforce in Johor as the major shortcoming.

One of the main reasons for this seems to be Johor's proximity to Singapore. With salaries usually twice higher in the city-state, many people prefer working across the border. Singapore aims to encourage this movement by loosening work permit requirement for Malaysians. In order to hire Malays, companies do not need to deposit a S\$5'000 security bond, which normally is the case when hiring foreign labor. Furthermore, work pass holders can re-apply for a new work permit after a job change without having to leave the country.

Not surprisingly, almost 60% of Malays abroad live in Singapore, and almost all of them are very well educated, according to official statistics. No domestic helpers migrate to Singapore from Malaysia. Instead, the typical migrant is the kind of person that seems to be missing in the Senai area to form an inspiring setting for high-tech startups. Secondly, of those Malays going abroad, well over 80% are of Chinese origin. Taking all those facts together, it is



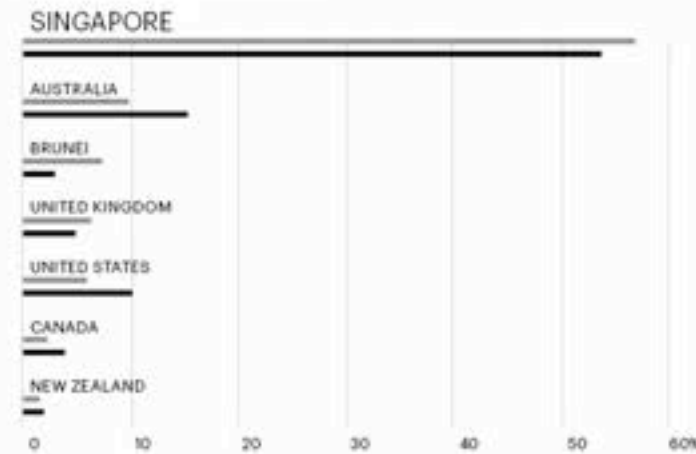
Approx. 250'000 Malays live in Singapore. That is 2.5 times the population of Senai and Pasir Gudang together.

incomprehensible how the Iskandar CDP is not making any integration attempts towards the Chinese community, especially in Senai. Education for most Chinese ethnics happens either in non-accredited private schools in Johor or Singaporean schools from early on. All this reflects Malaysia's ethnic issues and how they necessarily make an imprint on the Iskandar Malaysia development.

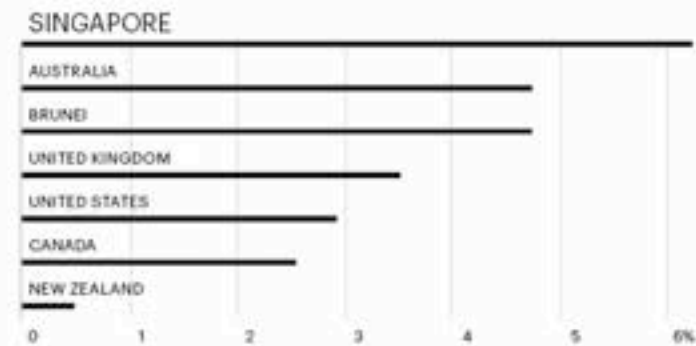
Two remarkable observation, however, can be made, when looking closer at the Malay diaspora. Not surprisingly, almost 60% of Malays abroad live in Singapore, but almost all of them are very well educated, according to official statistics. Not domestic helpers migrate to Singapore, but especially those people that seem to be missing in the Senai area to form an inspiring setting for high tech start-ups.

Secondly, of those Malays going abroad, well over 80% are of Chinese origin. Taking all those facts together, it is incomprehensible how the Iskandar CDP is not making any moves whatsoever towards the Chinese community, especially in Senai. Even more, education for most Chinese ethnics happens either in not-accredited private or Singaporean schools from early on, making it a dire necessity for those people to seek work abroad. All this reflects Malaysia's ethnic issues in a nutshell - and how they necessarily make an imprint on the Iskandar Malaysia development.

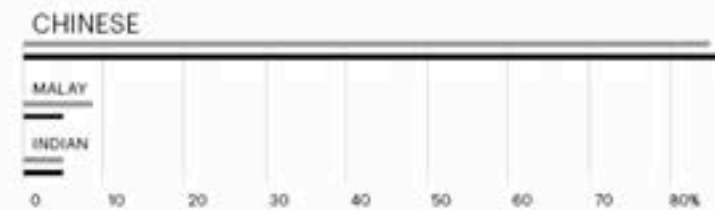
Malay Diaspora (gray) and Brain Drain (black) with Countries of Residence



Increase of Diaspora Individuals from 2000 to 2010



Ethnic Group's Share of the Diaspora (gray) and Brain Drain (black)



## Johor: Hinterland vs. Capital

This territorial study of Singapore's northern hinterland comes at a particularly meaningful time as 2012 is commonly seen as a turning point for Iskandar Malaysia's feasibility in the future.

Loaded with hopes and expectations, Iskandar Malaysia has already made a firm imprint on the territory. Its new economic and administrative framework has boosted the region's development. Interestingly enough, the development plan oscillated between proposing the Southern Johor region as a global metropolis and integrating it into the region as a de facto suburb of Singapore. Thus the present ambivalent state of Johor suspended between the power centres of Kuala Lumpur and Singapore, its own state administration and the impact of multinational corporations' investments continues.

Expecting something like a production park for Sin-

gapore's over-performing high-tech manufacturing sector, Johor has presented itself as much more; a multi-layered, multi-faceted and self-contradictory territory. Seemingly, an important achievement of Iskandar Malaysia is to try to bring a direction, hope and an identity to the region. Its success in providing an alternative to Singapore will probably depend on two main factors. First, the development within the Iskandar territory has been driven so far by huge private estate companies that have no interest in creating an open, accessible city. The second aspect concerns the region's relation to Singapore. Although it is not likely for the two neighbours to get together as close and supportive partners any time soon - their cooperation and open as possible communication will probably be the second factor in sustaining Johor's success.



View of Johor Bahru from  
One Raffles Place,  
Singapore

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## Acknowledgements

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- Norfakaruddin Razi Bin Sa'ari, Pasir Gudang Municipal Council.
- Udayaman Kutty Amboo, Tanjong Puteri Golf Resort Berhad.
- Francis Hutchinson, Institute of Southeast Asian Studies, Singapore.
- Ruben Lara, Bahru Stainless.
- Mohd Yusof Bin Abd Wahab, Pasir Gudang Environment and Health Department.
- Ho Chin Siong, Universiti Teknologi Malaysia.
- Loon Wai Chau, Universiti Teknologi Malaysia.
- Muhamad Hafidz, UTM Architecture Student.





Marina South & East, Singapore - Infrastructures made possible by land reclamations





City of Singapore - Strategic sand reserve







Marina Bay Sands - iconic development built on reclaimed land

Architecture of Territory  
ETH Zurich  
FCL Future Cities Laboratory

Hinterland  
Singapore, Indonesia, Malaysia  
Project 1, part 2

Asst. Prof. Milica Topalovic  
Martin Knüsel  
Marcel Jäggi

# CONSTRUCTION OF TERRITORY

Singapore's Expansion  
into the Sea

by  
Lino Moser  
Gabriela Schär

p.16

## Claiming Land from the Sea

Shaping Colonial Shores (p.18)  
Tabula Rasa (p.20)  
Sites for the Global City (p.22)  
Updating the Global Hub (p.24)  
Pushing the Limits (p.26)  
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## Soil Extraction & Trade

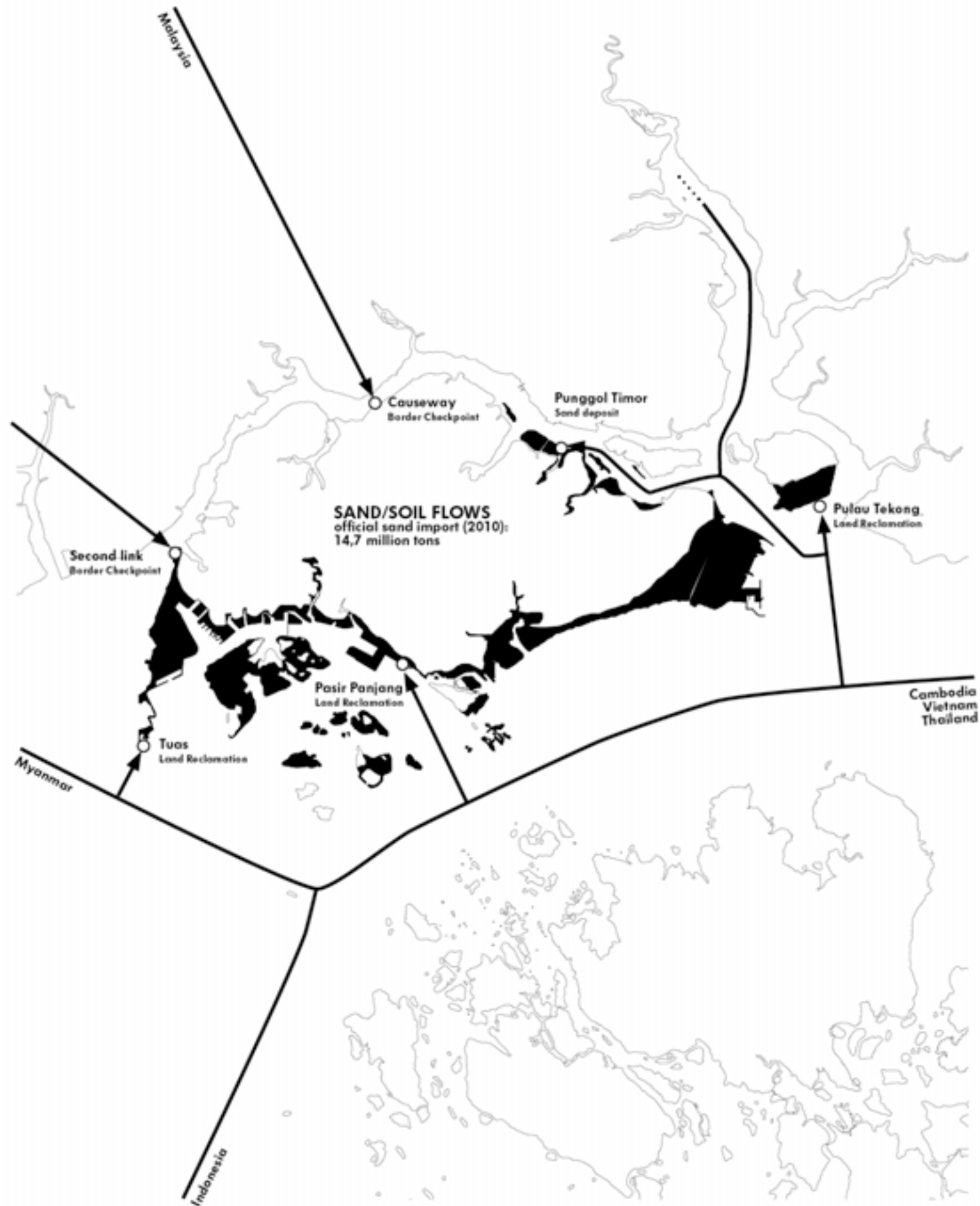
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Singapore has expanded its land territory by 25 percent since its founding. Land reclamation took place under British colonial rule and increased exponentially after Singapore became an independent state.

Since Singapore has long run out of sand, fill material for land construction has to be imported. The staggering volume of this soil trade has caused environmental, social and political problems.

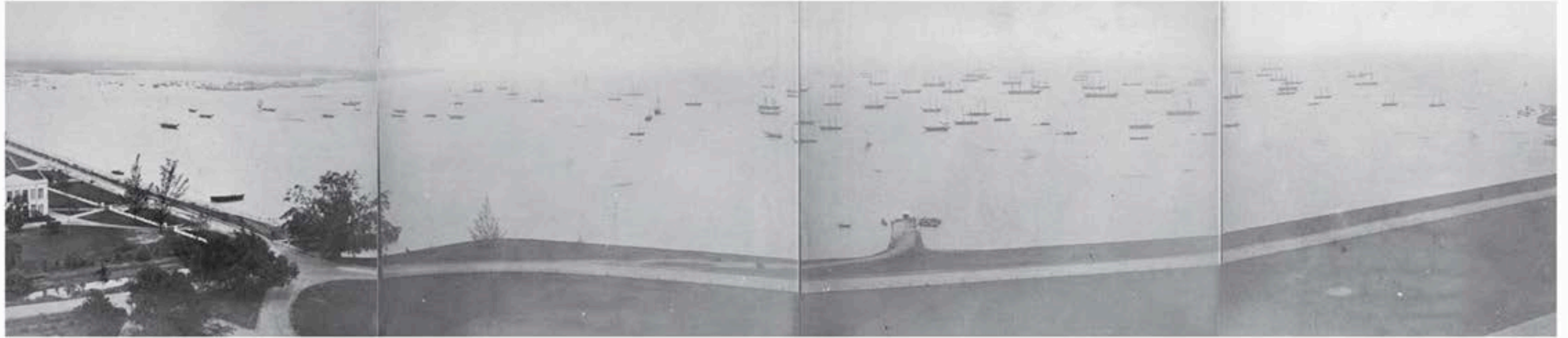
The Singaporean government controls the entire land reclamation process from start to finish. Artificial land in strategic locations is valued very highly by the real estate market, which allows Singapore to make large profits from its constructed territory.

# Claiming Land from the Sea

Singapore's land area has continuously been extended and the successive coastlines form a historical record of this process, similar to the way annual rings document the growth of a tree.

The first land reclamations took place soon after the founding of colonial Singapore in 1819, and by the beginning of the 20th century adding large patches of land to the existing city was commonplace.

Until this day, Singapore has continued to expand into the sea at an unparalleled pace. The government still refers to the process as "land reclamation", although the new land is built where none existed previously.



Top:  
Panorama from St.  
Andrew's cathedral, 1863

Bottom:  
Panorama from Peninsula  
Excelsior Hotel, 2012

## Shaping Colonial Shores 1820-1958

The first reported land reclamation project was the correction of the Singapore river's shoreline in order to facilitate the landing of trading boats. Optimizing harbor operations remained a major motivating factor for large-scale changes to the waterfront throughout the colonial period.

Starting in 1879, a considerable amount of land was added to the waterfront on both sides of the mouth of the Singapore river. To the south, a deep stretch of land was built into the sea, extending the area of the city designated for the mostly Chinese and Indian immigrant population. A

new harbor basin was also constructed in front of this area. To the north, the new land on the coastal side of Beach Road was used for government institutions, a market, and as recreational and leisure space for the European colonial population centered on that side of the river.

On the eve of World War II, the colonial government carried out the first major land reclamation for infrastructure purposes. Kallang airport was built just north of the city in 1937. This became the model for later expansions by an independent Singapore.



### Telok Ayer Basin

The area east of Telok Ayer street, which follows the original coastline, was built to expand both port and trading operations. The rapidly growing Asian immigrant population was responsible for most of the city's economic activities, and more space for shophouses was desperately needed.

The number of boats calling at the trading post also outgrew the Singapore river. Telok Ayer basin and the adjoining shophouse district were built to relieve these pressures.

### Right: Kallang Airport

With air travel becoming more important, the swampy Kallang Basin northeast of the colonial city was drained in order to build the city's first airport.

Rapid technological advances meant the runway was soon too short for jet propelled planes, and Kallang Airport ceased operations in 1955.



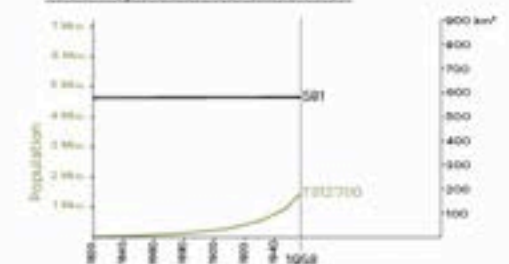
### Transformation of Territory

- Original Land
- Constructed Land 1820-1958
- Maritime Territory

- 1 Telok Ayer Basin & King's Dock
- 2 Kallang Basin
- 3 Beach Road Strip
- 4 Causeway



### 1958 Population vs. Land Area



# Tabula Rasa 1958-1974

After being defeated in Singapore during World War II, British rule in the region was coming to an end. Singapore was granted self-governance in 1958, and eventually became an independent nation in 1965.

The war had left the colonial city unable to handle the rapidly growing population. The new government set out to combat the concerning sanitary and living conditions in the improvised settlements around the formal city, but eventually destroyed the traditional village culture of the

Malay population along with the urban slums.

The Housing Development Board (HDB) was formed in 1960 to initiate and carry out a government housing program. The sheer scale of this operation meant planners had to look to modernist production, assembly and configuration methods. Inland swamps were filled, hills were cut down, and new land was built into the sea to create the flat land on which the new nation was to grow; the ideal tabula rasa of modernist theory.



### Marine Parade Housing Estate

The first phase of the East Coast reclamation scheme was built for a large public housing estate, and Marine Parade remains the only HDB housing project on new coastal land. A 12 km stretch of public beach was built along the new coast as well.

### Infrastructures on the Waterfront

The Nicoll Highway replaced civic and leisure institutions along the shore parallel to Beach Road.

1958



1987



### Tabula Rasa

This sketch from Rem Koolhaas's article, "Singapore Songlines", illustrates the all-out transformation of territory during this period.



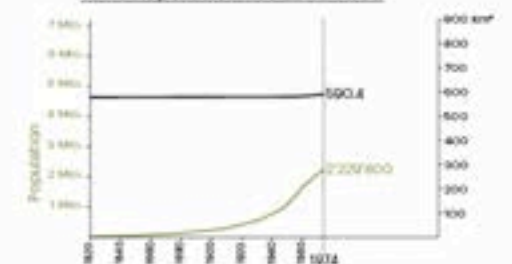
### Transformation of Territory

- Original Land
- Constructed Land 1920-1958
- Constructed Land 1958-1974
- Maritime Territory

- 1 East Coast
- 2 Marine Parade
- 3 Marina Center
- 4 Jurong Industrial Waterfront



### 1974 Population vs. Land Area



## Sites for the Global City 1974-1987

The rate of new land construction increased rapidly in the late 1970s, along with the size of new projects. The motive was no longer sheer survival, but instead to join the ranks of first-world nations and develop a global city economy.

The first terminal of Changi International Airport was built on new land at the Eastern end of the main island. By the time it became operational in 1981, the new East Coast Parkway (ECP) was already linking the new airport to the city center. This new highway assures a smooth transit to the city, but it separates the dense residential areas of East-

ern Singapore from the island's popular beaches.

With the shipping industry relying on bigger ships, the Telok Ayer Basin became outdated. Large expanses of land were added onto the central area and the economy was transformed into office based activities rather than industrial trades related to the docks of Singapore.

In this period, Pulau Tekong was enlarged exclusively for defense purposes, which freed-up the former military base of Sentosa to be developed into a resort island.



Marina City

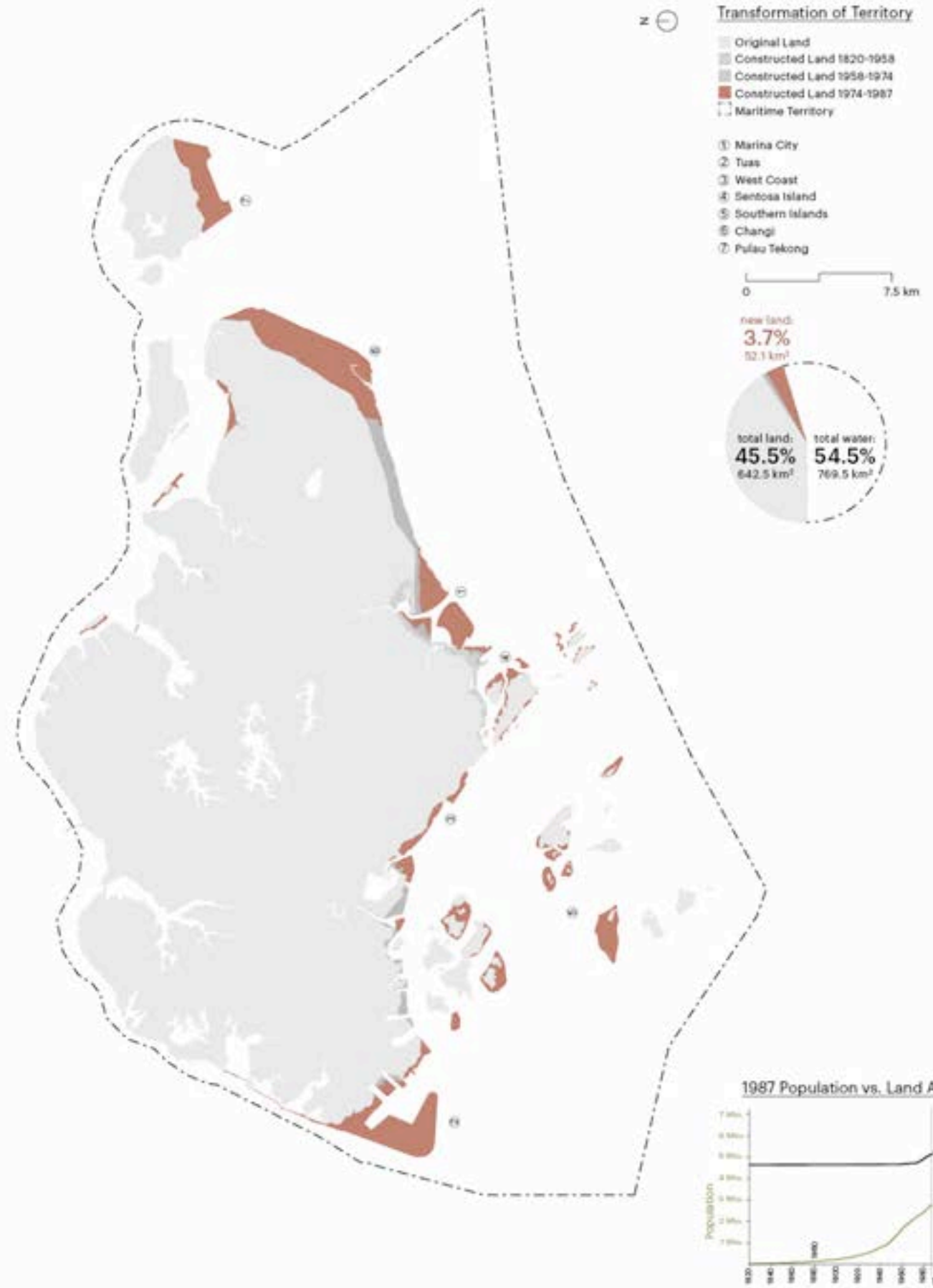
The 660 hectares of new land added onto the existing city center were divided between three parcels: Marina South (pictured above), Marina East, and Marina Center, the first of the three projects to be built.

These areas were planned for future extensions of the booming Central Business District (CDB), and eased real estate pressure on the remaining central area neighborhoods. Conservation efforts in the historic shophouse districts of Chinatown, Kampong Glam and Little India were now taken seriously because business demands could be satisfied elsewhere.



Tuas

This entirely man-made peninsula on Singapore's Western end was built for light industries and manufacturing businesses.



## Updating the Global Hub 1987-2011

The most recent (and still ongoing) phase of land construction in Singapore is concentrated away from the city center, and driven by an intensified and scaled-up version of the global city strategy of the 1980s.

Singapore is building the sites and facilities to become a hub for many of the economic activities it engages in. It is a hub for air travel in the region, a hub for the oil trade and petrochemical industries, and a hub for container shipping. The expanding CBD is an international banking and finance center, and with two integrated casino resorts recently completed (both at least partially on artificial land), Singa-

pore is working to become more of a tourist destination in its own right.

Even the land creation efforts in Northeastern Singapore, which are for housing and military use, play into this 21st century global city strategy. Singapore's defense spending is supposed to guarantee stability in order to attract businesses. In Punggol an existing HDB housing estate is being extended to include a large waterfront housing district, which will be made up mostly of condominiums catering to the upper class of the global city workforce.



**Air Hub: Changi**

Currently operating three terminals, and with an additional 2'000 hectares of land to grown on built during the 1990s, Changi Airport has already outlasted its colonial ancestor at Kallang and looks positioned for intense future growth.

31 years after its opening it is the third busiest airport in South East Asia, just behind Soekarno-Hatta in Jakarta and Suvarnabhumi in Bangkok.



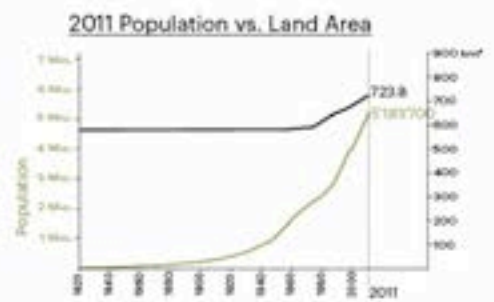
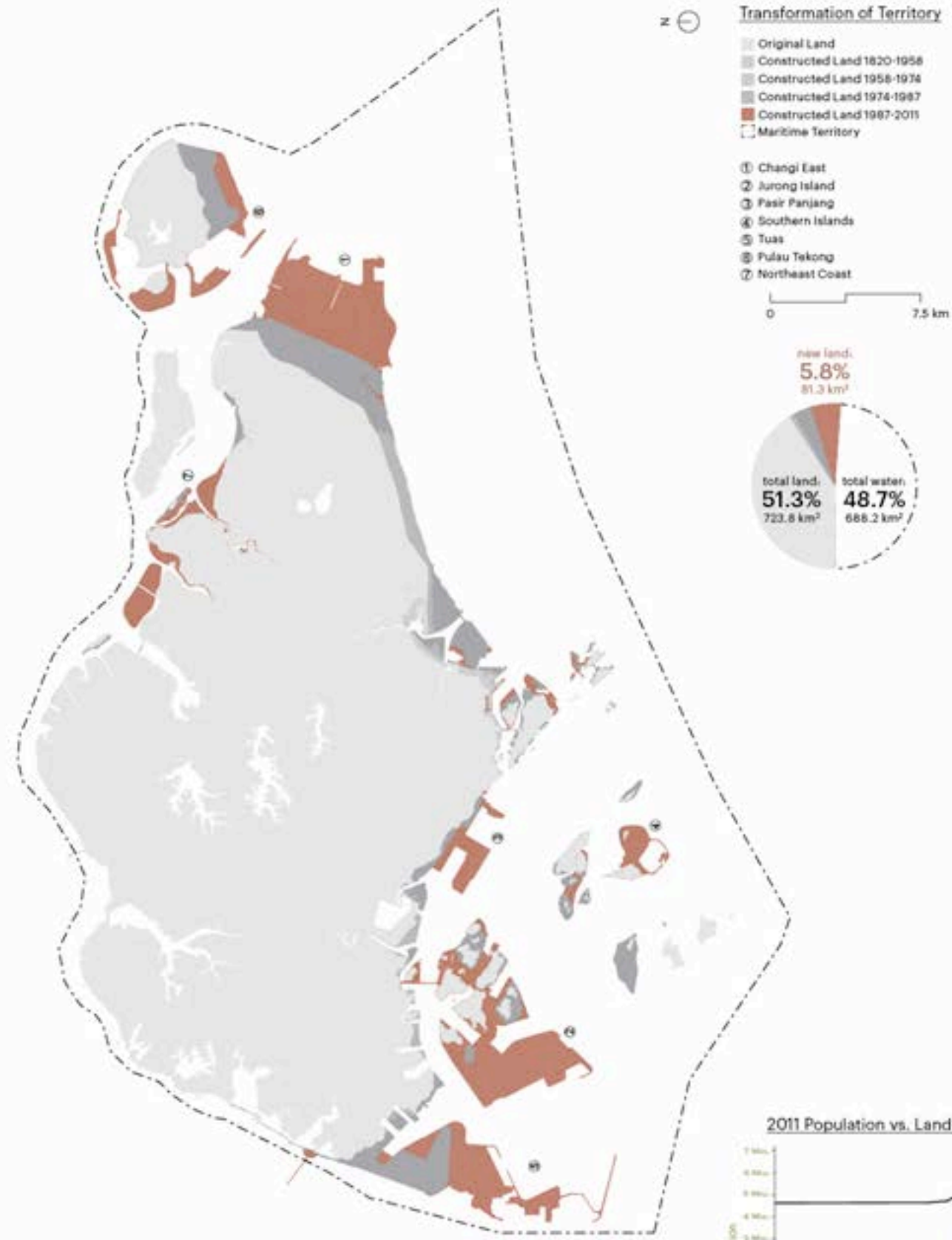
**Petrochemical Hub: Jurong Island**

Some of the islands south of industrial Jurong district have been used by oil companies since the early 1970s. Since 1995 they have all been combined and further enlarged to form the highly secured petrochemical industry site renamed Jurong Island.



**Container Hub: Pasir Panjang**

The ongoing expansion of the container terminals at Pasir Panjang will allow Singapore to redevelop the Keppel Harbor site for downtown waterfront condominiums.





## Pushing the Limits 2011-2050

The Urban Redevelopment Authority (URA) Masterplan of 2008 and the 2001 Concept plan show extensive future additions to Singapore's land area.

While some of these projects are already under construction, or are a continuation of trends visible today (such as enlarging and combining industrial offshore islands), the Concept Plan also deals with the projected increase of the population to 6.5 million inhabitants.

In this scenario, new land behind the military installations on Pulau Tekong and Changi airport is planned for housing and industrial purposes. The Northeastern island of

Pulau Ubin is also scheduled for enlargement, for the first time. Today it is preserved as a remnant of a fishing-oriented island culture that has been almost completely wiped out in Singapore, but taking into account future population growth the planning authorities seem willing to sacrifice it.

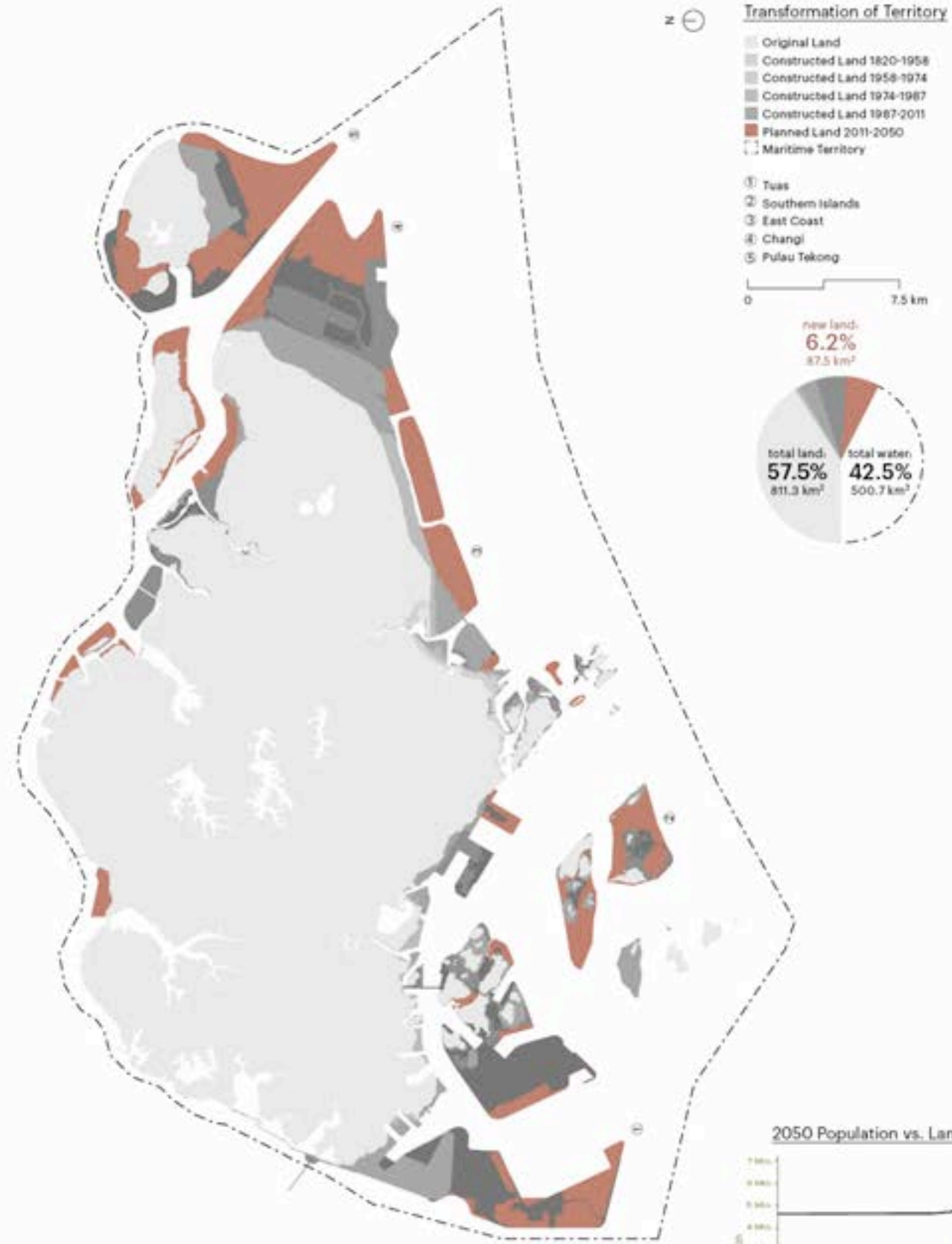
Another addition to the east coast is also planned. A strip of up to 1.5 km wide built in front of the existing beach would produce prime new residential real estate, but a considerable amount of value would also be lost on the current beach-front properties.



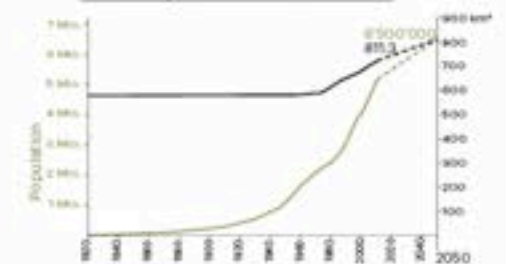
### Regional Conflicts

This caricature from a Malaysian newspaper illustrates the concerns Singapore's closest neighbors have about the small island nation expanding its territory.

From the point of view of Malaysia, the physical expansion of Singapore threatens to literally clog up the Strait of Johor, which is crucial to Johor's own port industry.



2050 Population vs. Land Area



# Land Construction Techniques

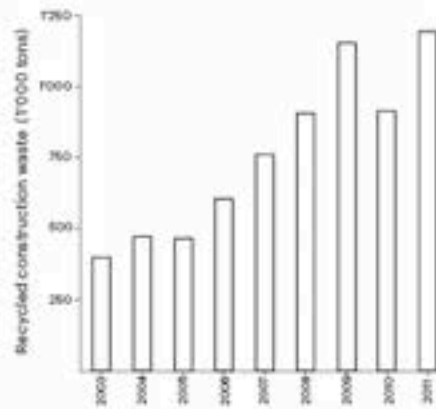
Land construction projects have gotten larger, are carried out in deeper waters, and involve different fill materials depending on their availability. New techniques and technologies are constantly developed to tackle this ever more difficult process.

Initially, land reclamation was done entirely with soil cut from hills and sand dredged from the sea bed. Settling and stability issues were manageable as these materials are firm and porous enough to allow for easy draining.

When these materials were no longer available locally, sand had to be imported and consequently paid for. To

ease the economic impact of intensified land building efforts, testing began on dredged clay mixed in with sand.

As Singapore's hunger for land pushed construction into deeper waters, the demand for sand increased exponentially, driving prices higher. At the same time, expanding port operations and the larger shipping vessels necessitate deeper dredging of the shipping lanes. This process produces large clay lumps of up to 8m<sup>3</sup>, which are now also used.



Large clay lumps are taken from the seabed and dumped into construction sites by bottom opening barges.

### Construction Waste Recycling

As Singapore excavates more underground tunnels for public transport, storage and military purposes, the resulting construction waste is simultaneously too expensive to dump in the offshore landfill and too valuable as a fill material to throw away. Recycling rates have consequently reached 99%.

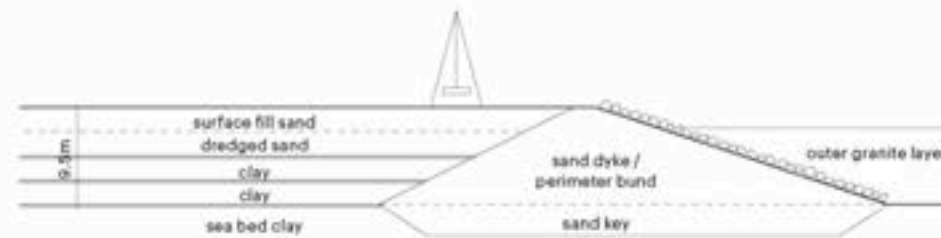
### Layered Clay Scheme

The Changi East project of the early 1990s created 2'000 hectares of land, almost three times that of the earlier phase. The amount of fill material needed, however, increased by a factor of eight.

The use of dredged clay was therefore extensively tested. Since the particles making up clay are smaller than sand, water is

more difficult to remove from the mixture.

The idea of the layered clay scheme is to place 20 cm of sand between the clay layers to help facilitate water run off. The method proved to be too time consuming to apply on a large scale, and Changi East was carried out using sand as the sole fill material.



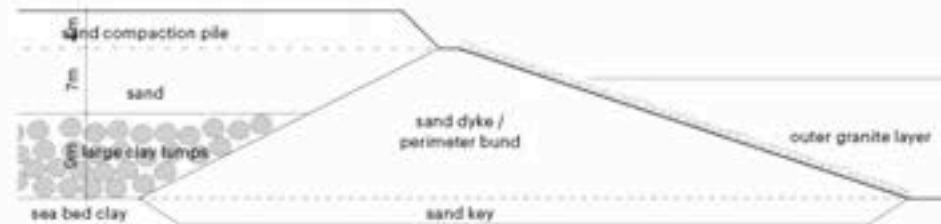
### Large Clay Lumps

The first tests using large clay lumps as fill material started in 2001 at the 2'500 hectare construction site of Pulau Tekong.

Because of the sizeable voids between the large lumps, the upper part of the fill still needs to be made of sand. Additional sand is then piled on top to create enough pressure for the voids to close.

### Cement Mixed Slurry

The most recent methods studied, also at Tekong, involve mixing cement in with dredged slurry, but so far only for the perimeter bund.





1.



2.



3.



4.

1. Dynamic Compaction
2. Installation of prefabricated vertical drains at Changi East
3. Vibro Compaction
4. Vibro replacement columns installed offshore using a gravel jet system

## Land Improvement Technologies

Retroactive and land improvement has become crucial since a rising number of construction projects have chosen the alternatives to sand as a filling material. These are constructed on less suitable seabed or soil and pressed into service before the natural settling process can occur.

The oldest technique is referred to as "dynamic compaction" and involves repeatedly dropping a heavy weight onto the new land from a considerable height. Prefabricated vertical drains have also been used.

More recently, vibro floatation has become widespread. This technique comprises sticking a vibrating shaft into the land at short intervals to shift the fill material particles into open gaps.

Increased stability can be achieved by installing vibro replacement columns to act as a foundation. VRCs are basically vertical holes all the way to the firm seabed layers, filled with tightly packed gravel.

### Vibro Replacement Columns

Jurong Island, Singapore's artificial petrochemical hub, is booming to the point where sites are sold even before they are built. The expanded island has come to cover some very soft sea bed conditions, where the typical vibro compaction method cannot stabilize the ground enough to support the huge oil storage tanks that are built on it.

Vibro replacement columns are installed in these cases, because they are much cheaper than conventional concrete support pillars.



### Offshore Vibro Replacement

Traditionally sand keys are dredged from the soft clay seabed to support the perimeter bunds of land construction projects.

At one stretch of the bund at Pulau Tekong the sea bed is unable to support dredging without subsequent loss of stability, so instead offshore vibro replacement columns have been installed by pumping gravel into underwater holes through a long tube.





18.10.2012 / 11.15



25.10.2012 / 13.08



02.11.2012 / 14.23



21.11.2012 / 12.21



30.11.2012 / 11.07



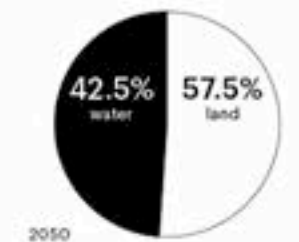
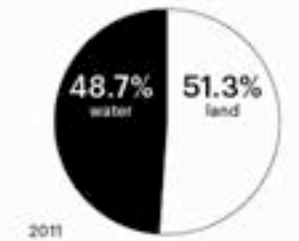
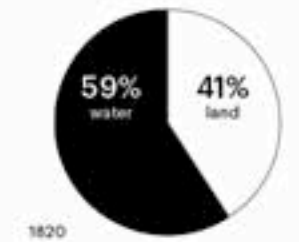
07.12.2012 / 15.03

**Pasir Panjang Land Construction**  
 Work on container terminals 3 & 4 at Pasir Panjang port was well under way at the time of writing. The photo series covers a period of about two months.





## Land and Maritime Territory



## Maximizing Territory

While Singapore has never ceased to extend its territorial area, this practice will eventually reach its limits. Even such a rich and technologically advanced nation cannot overcome all the challenges presented by the deeper waters and the scarcity of fill materials. Theoretically, the national borders and the 20 meter seabed contour define the limits of Singapore's potential expansion.

## Depth of the Straits

According to the Singaporean Urban Redevelopment Authority (URA), constructing land in waters more than 20m deep is financially unfeasible. This still leaves Singapore sizeable potential territory beyond the already planned projects, but most of these areas are crucial to port operations as they are currently organized.

## Political Relations with the Neighbors

Another limiting factor is the close proximity of the maritime borders with Malaysia and Indonesia. Singapore has already transformed its territory to the point where it is only 48.7% maritime, down from 59% before reclamation works began. Quite literally, Singapore is inching closer and closer to its neighbors.

## Scarcity of Fill Materials

The most immediate concern for Singapore's land expansion is the scarcity of fill materials. Even with the most advanced reclamation schemes currently being tested, the amount of soil needed to fill the deeper sea bed is staggering and securing supply is becoming more and more difficult.

# Soil Extraction & Trade

Singaporean demand for soil is at an all time high. Land reclamation projects are being carried out in deeper waters which requires increasing quantities of fill material, and high quality local sources have long been depleted. Singapore's strong economic growth has gone hand in hand with rapid development. Sand is imported for building construction as well as for land reclamation purposes, and this high demand coupled with a lack of local supply

has raised prices. This growing disparity between the value of sand in Singapore and its cost in the region has made the soil trade a very lucrative business. Profits are high and restrictions are poorly enforced, so environmental concerns have mostly been ignored.



Imported sand arriving at the Pulau Ponggol Timor sand depot by barge

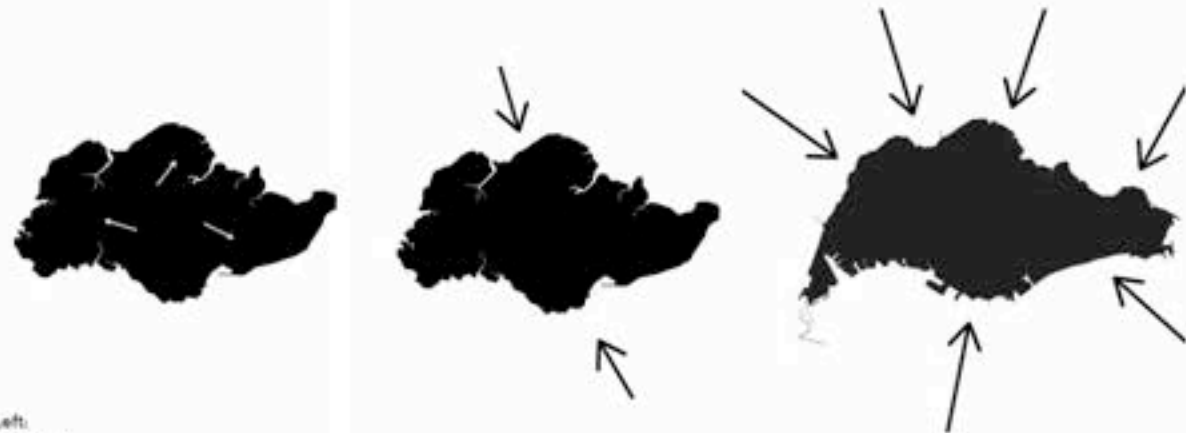
## The Expanding Radius of Sand Sourcing

Since the pace of building new land sped up dramatically after the mid-1970s, the issue of sand exploitation has gone from a very local to a regional scale, and now concerns all of Southeast Asia.

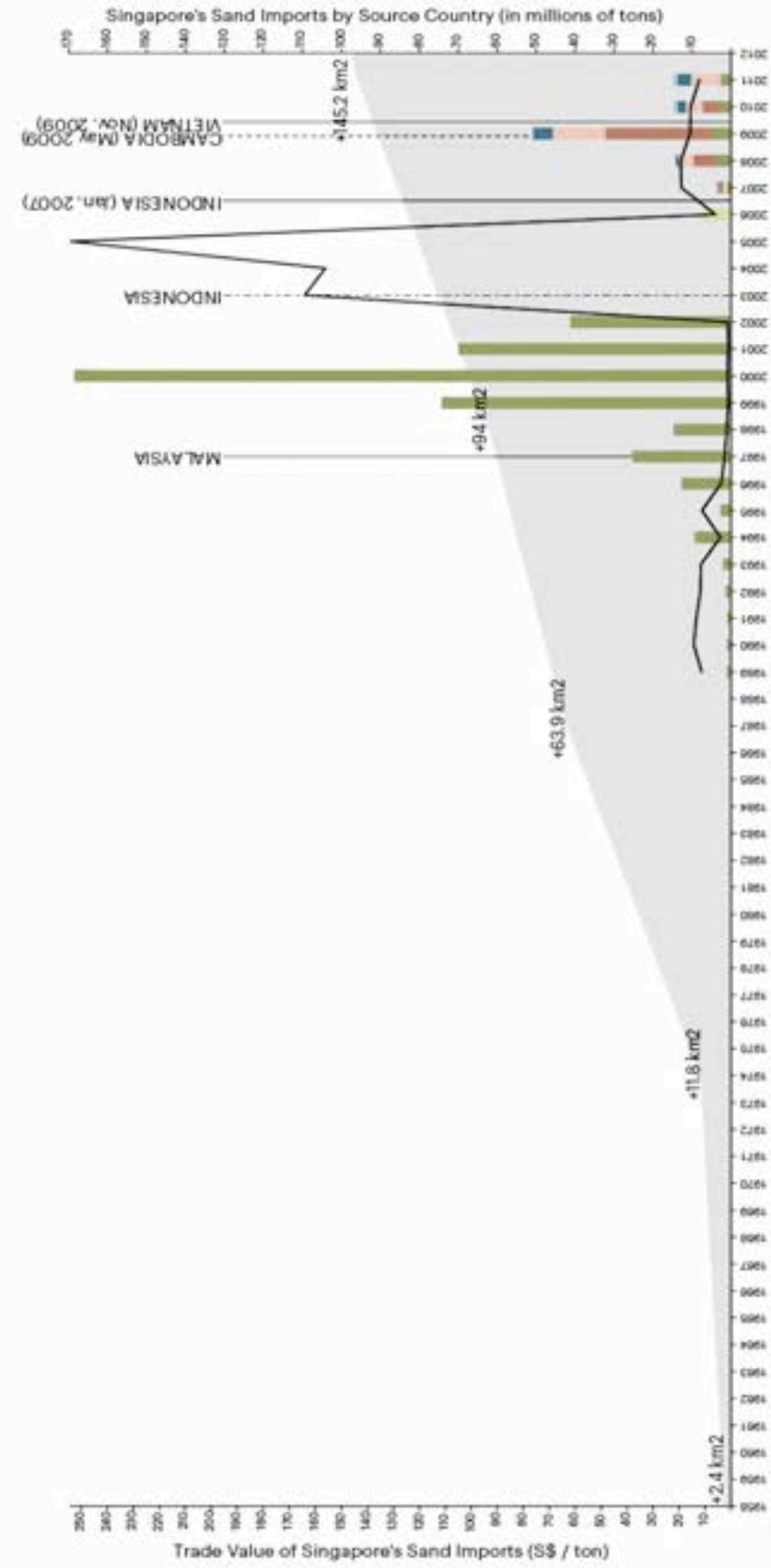
Early land reclamations in Singapore were carried out in shallow foreshore and swampy inland areas close to the hills that were cut down to provide the fill material. As a result, new flat land was created both where a hill was leveled and at the site where the soil was dumped into the water. Dredging sand from foreshore areas had a very similar, if inverse, effect.

As local sources were depleted, dredging operations expanded into the Straits around Singapore. This informal trade with neighboring Indonesia and Malaysia reached such a magnitude that entire islands began to disappear due to massive erosion. Both countries have banned the export of natural sands to Singapore, with mixed results.

In order to replace these regional suppliers, Singapore has had to look to the wider region for willing trading partners, some of which have in turn banned sand exports after a few years of rampant exploitation.



Left: Local sourcing - out and fill  
 Middle: Regional scale - depleting the Straits  
 Right: Southeast Asian trade - diversified & distant sourcing



**Soil Trade Statistics**  
 Imports and exports of natural sands in the region have been reported to the United Nations global trade statistics division (UN COMTRADE) starting in 1989. The import figures reported by Singapore do not cover the informal trade, but they do give a sense of the scale of these operations. Graphing the imports against the export bans and the reported yearly value of the trade reveals which bans have been effective, and how the trade has shifted to partners farther away.

**Added Land Area**  
 Total of added Land Area

**Source Countries**  
 Malaysia  
 Indonesia  
 Vietnam  
 Cambodia  
 Myanmar  
 Philippines

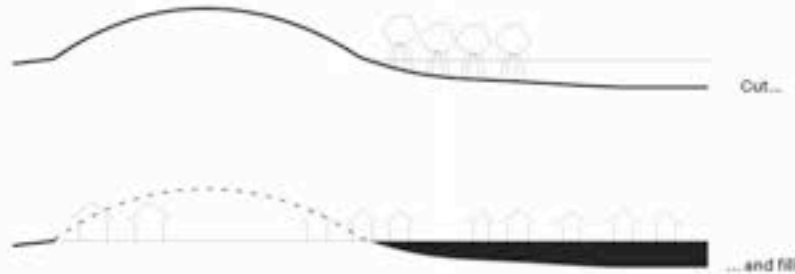
**Export Bans**  
 All natural sand  
 Sea sand  
 River sand

Trade value / ton



Left:  
Housing land (foreground) was created by partially filling a mangrove swamp (middle left) with material cut from a nearby hill (background left)

Right:  
Google satellite image of Batam, showing the scale of territorial transformation



### Cut and Fill: Batam Time Capsule

A 45-minute ferry ride from Singapore, the Indonesian island of Batam allows a glimpse into Singapore's past.

Being one of Singapore's industrial hinterland, Batam has experienced rapid development and large-scale transformations of its territory. Much like in Singapore after independence, sites for development are created by cutting hills and using the soil to fill up mangrove swamps inside the island.

More recently, new land has also been built onto the sea, and it will be interesting to see how Batam deals with sourcing fill materials when it has flattened its hills and mountains.





Left:  
Pulau Nipah in July 2003  
Google Earth

Right:  
Pulau Nipah in May 2008  
Google Earth



Dredging the sea bed



Erosion, destruction of mangroves, corals and fish spawning grounds

### Nipah Case: Shifting the Border

Massive dredging in the straits around the Indonesian Riau Archipelago has seriously diminished sea bed stability and caused some smaller islands to crumble into the sea.

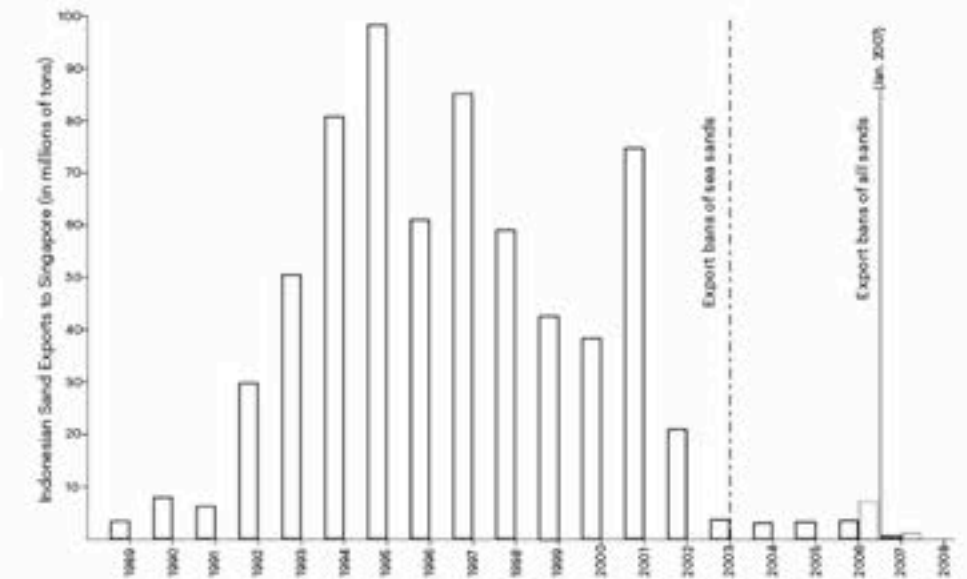
The most famous of these is Pulau Nipah, one of the Indonesian islands used to calculate the international border with Singapore. By 2003 it was so depleted that it barely broke the water surface at high tide. Indonesia, fearing that the border could be recalibrated to Singapore's advantage rebuilt the island over the next years.



**Indonesia's Contribution to Singapore**  
The UN COMTRADE database shows that Indonesia reported considerable exports of natural sand to Singapore starting in 1989. The export peaked at almost 100 million tons in 1996. Singapore only started reporting sand imports from Indonesia in 2006, just before Indonesia banned all export of natural sands to Singapore.

Since Singapore reported imports of a comparably large scale from Malaysia during the same period, it seems that Singapore does not consider the Straits in and around the Riau Archipelago as sovereign Indonesian territory.

### Bans of Sand Exports to Singapore



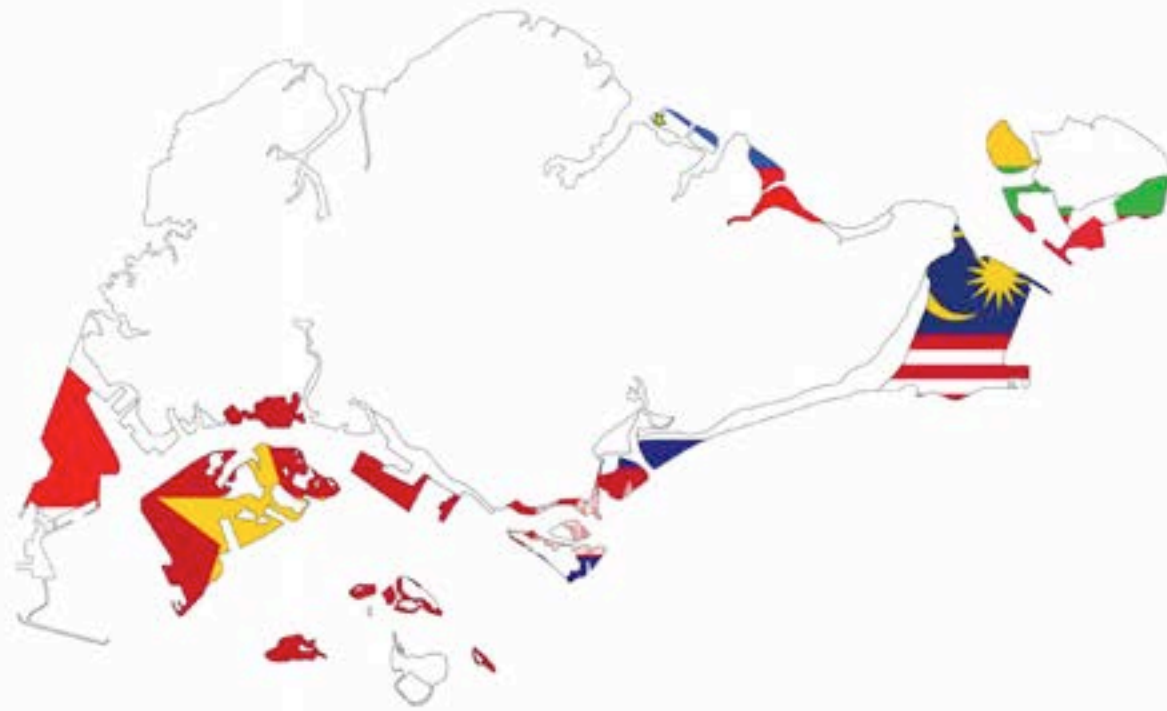
# Trade Bans & Territory

Singapore's construction of territory has an impact on a subcontinental scale. Sand sourcing reaches more than 2'000 km across Southeast Asia and every large coastal country in the region besides Thailand has contributed to Singapore's expanded land mass.

As each source runs out or is cut off, Singaporean importers look for a new, unspoiled sources one step further out. After a few years of rampant exploitation, these new source countries become aware of the negative impacts large scale sand extraction has on their coastal and river-based ecosystems and societies. Exports to Singapore be-

came banned, and the whole process starts over again.

Export bans are passed for different reasons, as each nation has a different relationship to Singapore and specific internal dynamics. The early Malaysian and Indonesian bans were largely expressions of political disputes, while the recent ban in Cambodia is a result of public pressure over environmental concerns.



### A Global City Built on Foreign Soil

For all of its defensive nationalist rhetoric about being a small, surrounded island, the story of its land construction shows a very clear regional hierarchy of economic power.

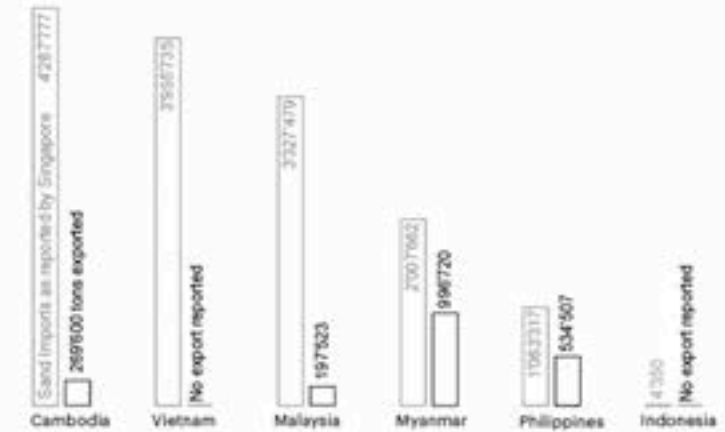
Although individual contributions are difficult to quantify, about three quarters of Singapore's constructed land area is built from foreign sand (Lee et al).



### Trade Bans in Effect (2010)

The three largest sources of natural sand Singapore reported to UN COMTRADE for 2010 had at least partial bans in effect.

Existing contracts are usually allowed to be concluded past a ban taking effect, but the discrepancy between Singapore's reported imports and the source countries' reported exports is striking.





A sand barge in the strait of Johor, on its way to the Punggol Timor sand depot



Dredging the river bed

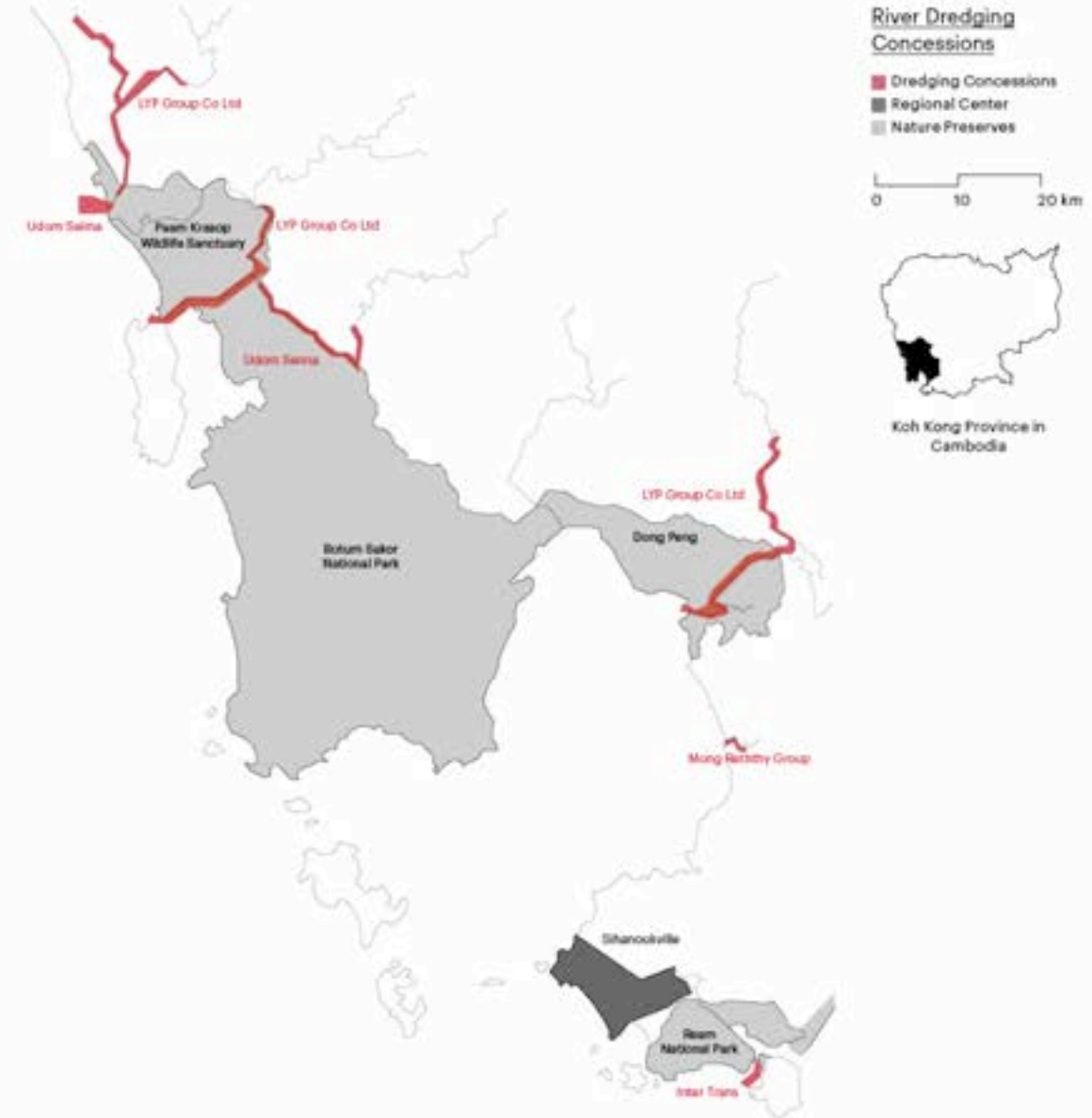


Erosion, destruction of mangroves and fish populations

### Cambodian Case: Circumventing the Ban

Despite a May 2009 ban on the export of river sand, the Cambodian government issues concessions for the dredging of both sea and river beds.

Two of the three major sand mining corporations are run by sitting Cambodian senators, Ly Yong Phat and Mong Reththy. The NGO Global Witness estimates that LYG Group Co Ltd and Mong Reththy Group together export 8.1 million tons of sand to Singapore per year. In 2009, the year the Global Witness report was written, Cambodia reported less than 1 million tons of natural sand exported to Singapore.

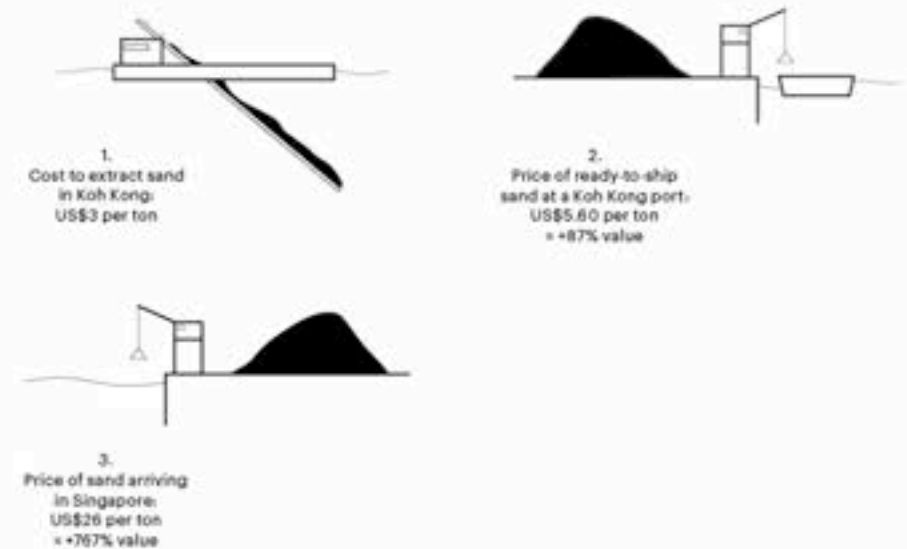


### Environmental Preservation vs Profit

Sand mining operations are concentrated in Koh Kong province, home to large rivers and the majority of the country's coastline.

The concessions for river dredging are in or upriver of national parks and wildlife sanctuaries. Smaller companies are subcontracted by the concession holders to do the actual dredging.

Sea bed sand is the primary fill material used for land reclamation, while the construction industry needs finer river sand mainly for mixing concrete. The cost to extract a ton of sand in Koh Kong province is less than 12% of what that same ton of sand is worth in Singapore. The profits being made in this business are so high that those involved in it are not very concerned about environmental preservation efforts and agreements. (Global Witness, "Shifting Sands")



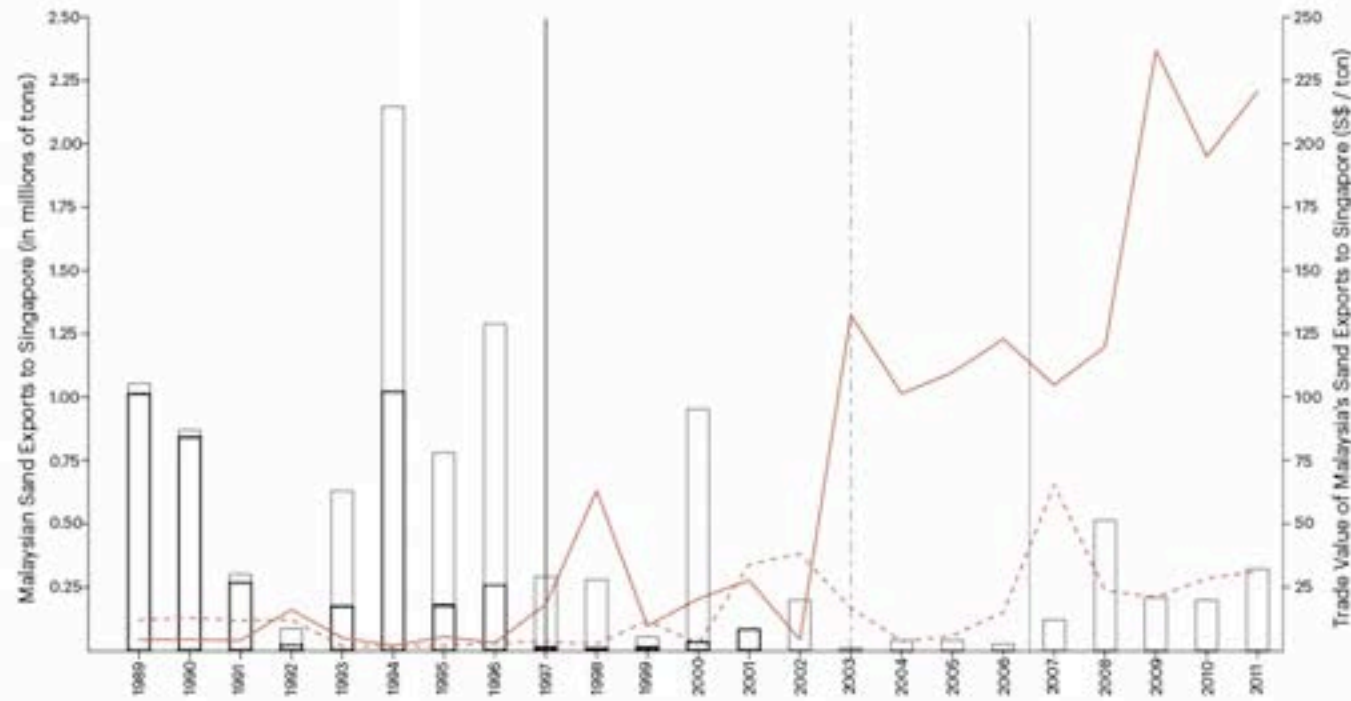
# Sand Gates & Strategic Reserves

Sand is brought to Singapore by land and by sea. Malaysian trucks full of sand cross the Causeway and the Second Link at Tuas. Barges carrying sand arrive at Pulau Punggol Timor.

At these sand gates, the loads are transferred to trucks that deliver them either to a sand depot or directly to a construction or reclamation site.

The Singaporean government keeps strategic sand reserves, in order to react to extreme fluctuations in the price and availability of such a crucial, locally not available resource.

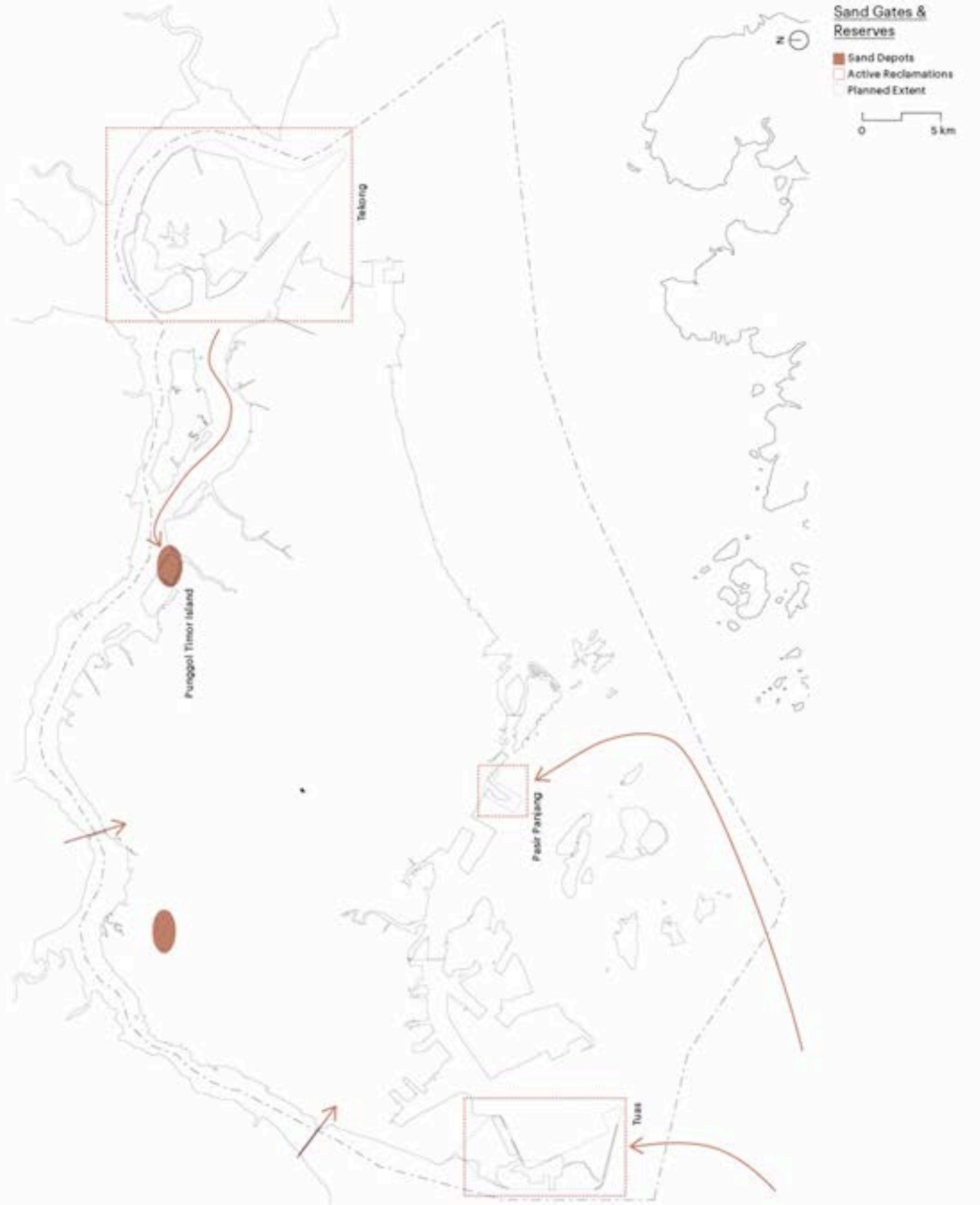
For example, if a major supply country institutes an export ban and sand prices skyrocket until new sources can be tapped, the government can release a certain amount of sand at a fixed price. This allows the government to practically guarantee that land and building construction projects can continue on schedule without major delays or cost overruns.



**False Declaration**  
 Malaysia still exports natural sand to Singapore on a yearly basis, even though it passed a ban on doing just that in 1997. Since the early 1990s, more than half of the exports reported have been quartz and silica sands. Former Malaysian MP Mahathir Mohamad famously stated that these exports are surely falsely declared.

**Malaysian Sand Exports to Singapore**

Exports	Export Ban
□ silica & quartz sand	— sand
□ other natural sand	- - sea sand (Indonesia)
	- - sand (Indonesia)
Trade Value	
— silica & quartz sands	
- - other natural sands	



**Sand Gates & Reserves**

- Sand Depots
- - Active Reclamations
- · · Planned Extent

0 5 km



1.



2.



3.



4.



5.



6.

**Pulau Punggol Timor Sand Depot**  
 The gate for barges bringing sand into Singapore by sea occupies an artificial island in Northeastern Singapore. Sand is stored on two separate plots, one of which has a high daily turnover while the other appears to be a strategic sand reserve where multicolored mountains of sand lie for long periods of time.  
 The site also has an industrial area where several concrete premixing companies are located, as well as one concrete precasting operation that produces the elements for HDB construction.



- 1. Strategic sand reserve - the sand piles are fitted with drainage elements, which adds to the militarized aesthetic of the site
- 2. Strategic sand reserve - unpopulated but equipped with basic infrastructure
- 3. Strategic sand reserve - closely guarded and devoid of life
- 4. The high-turnover part of the site is full of machines ready to transfer sand
- 5. SinMix - one of the concrete mixing plants on the site
- 6. G & W Precast Pte Ltd - the biggest and newest of the company's three plants in Singapore. 90% of production is for HDB construction projects

# Decoding the Constructed Territory

The construction of territory in Singapore is an extremely controlled, entirely top down process. It involves the highest levels of government, and depends on precise execution from the initial planning phase until the new land is developed and integrated into the city. Projecting developments decades in advance requires not only careful planning, but also a high level of control over the population and economic strategy.

Looking at the entirety of Singapore's constructed territory instead of concentrating on the individual phases reveals a complex system of networks and dependencies.



## Actors, Processes & Profits

The hierarchical structure of colonial society was replaced with a paternalistic one party system whose success is based on getting results. Priorities have changed over time but the success of the government in achieving its planning goals has been constant.

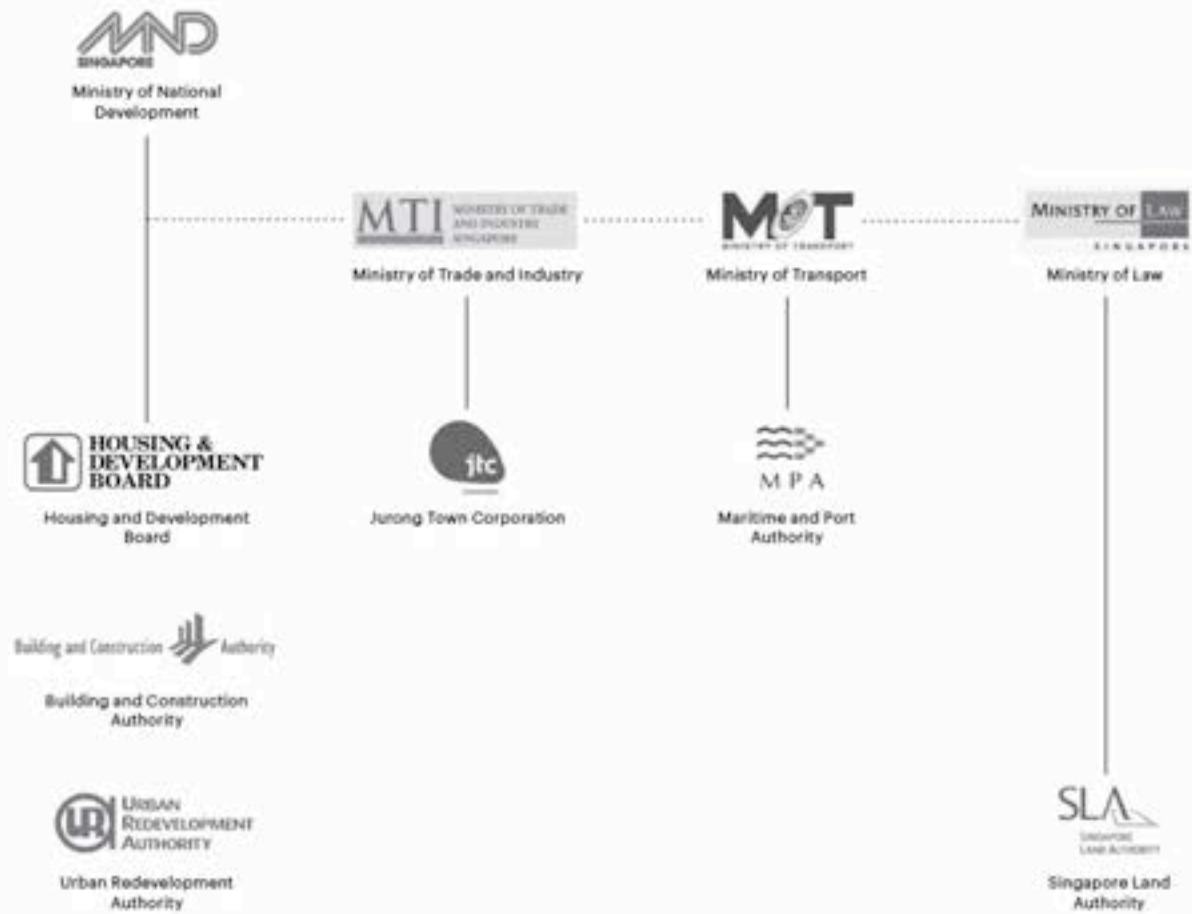
Creating and distributing new land is the most effective way the government can steer Singapore's evolution and therefore it never relinquishes control over the process. At every step a government agency is directly or indirectly involved, and if something is not to their liking the



Singapore's defining first prime minister, Lee Kuan Yew, going over plans for the original east coast reclamation scheme.

Land Aquisition Act of 1967 allows them to take over private property and decide on the appropriate compensation.

In the early days of independent Singapore, the goal was to create land for economic development and to build housing for the population. In more recent years, the process has become a money making operation in itself. Where the government used to have to build the pieces of their planned city themselves, they now make large profits letting private developers do it for them.



### Obscure Hierarchy

The web of government agencies, subsidiary boards and ministries involved in land reclamation is difficult to untangle, but in the end the Ministry of National Development seems to be pulling all the strings.

**Land Reclamation Process:**

**1. Planning Phase**

The general development strategy for Singapore comes from the Ministry of National Development (MND). The semi-autonomous HDB then takes care of the specific site planning while the JTC and the MPA plan for their respective purposes.



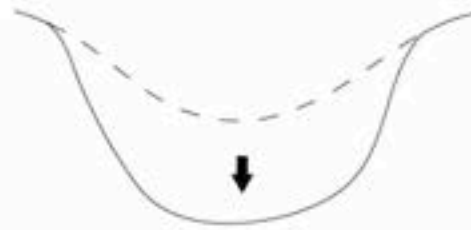
**2. Implementation**

The actual building of new land is done by private contractors chosen by the respective subsidiary boards through an open tender process. Smaller subcontractors are brought in for specific phases of the reclamation works.



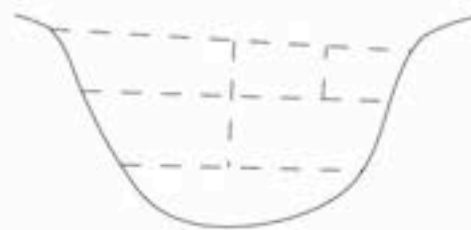
**3. Settling**

While the new land settles, it is officially handed over to the contracting government agency and ownership is transferred to the government. The SLA and the URA are in charge of planning for the sites' development.



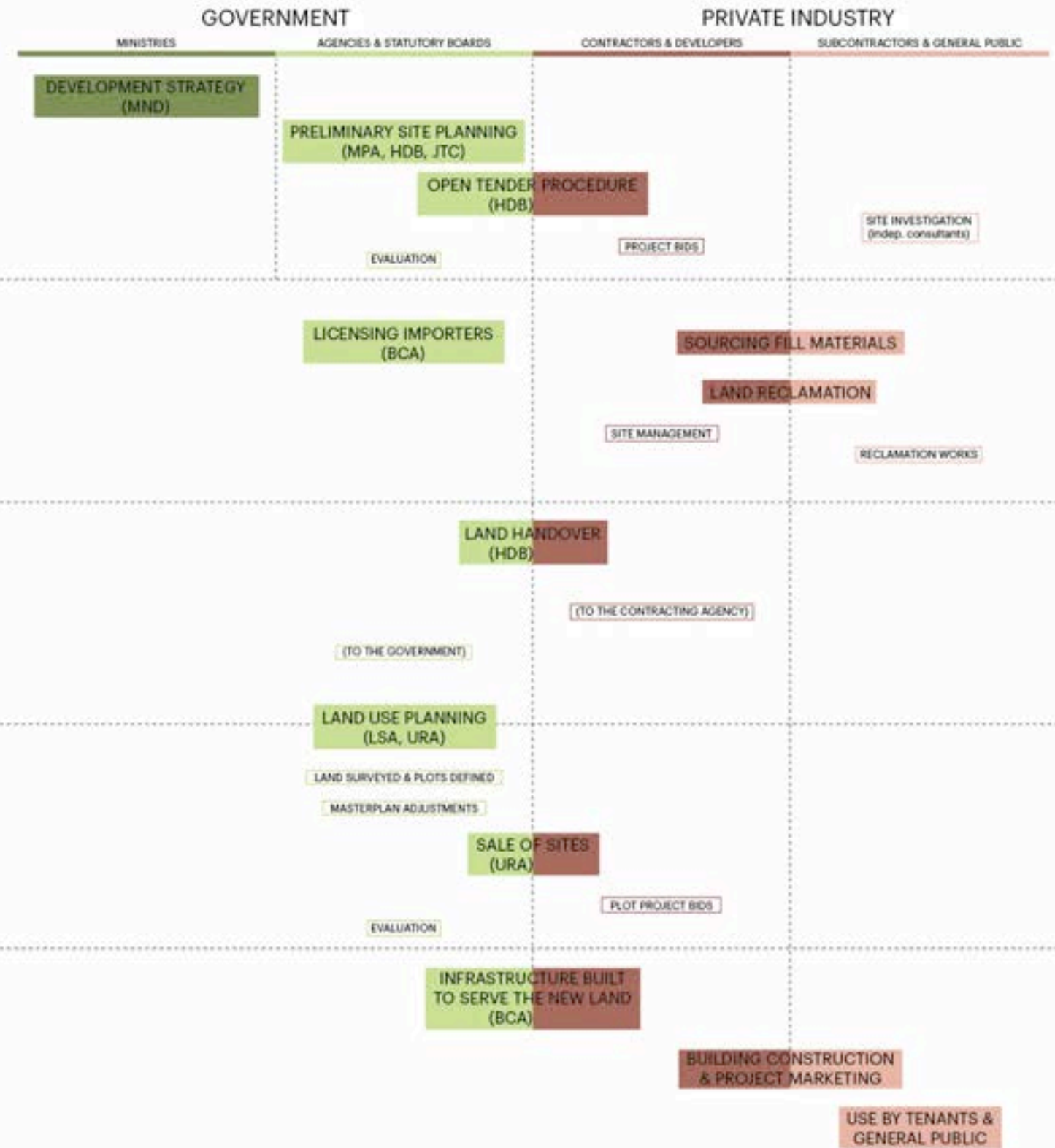
**4. Parcellation**

Plots are defined in adjustments to the URA Masterplan, and most of the land leasing is also done through the URA Sale of Sites program.



**5. Exploitation**

Private developers, having paid a premium price for a finite lease on the land, still have to follow strict guidelines for the development of the sites. However, the JTC, MPA and often also the HDB end up developing the land for their purposes.





## The Extra 25 Percent

The 145.2 km<sup>2</sup> that have been added onto Singapore's islands since 1820 represent a 25% increase in the total land area. Having analyzed the successive phases of this growth, it makes sense to also look at the entire constructed territory as a whole.

The different hubs of the Singaporean global city economy are all located on artificial land, as are some of the infrastructures linking them. The reclaimed land seems to form a sort of linear city, but it is in not self sufficient by any

means. In fact, it relies heavily on the original island to house and serve the population and to supply the workforce.

In many ways, the original island at the center of Singapore serves as the hinterland for the economic engines of the constructed territory. The workforce being channeled in from the dormitory suburb that is the middle 75% of Singapore is like an intravenous fluid for the coastal city wrapped around it.



Left:  
Singapore in 1820

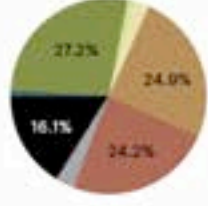
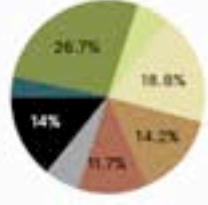
Right:  
Singapore in 2011



Raffles Quay in 1890, after the Telok Ayer reclamation



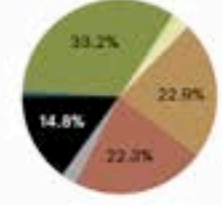
Raffles Quay in 2012



URA Masterplan 2008 (eight categories)



**Space for the Global City Economy**  
 The transition from a quai- and dock- to an office economy has profoundly transformed the territory of Singapore, but interestingly enough the same location is still absolutely central.





**Built up Area on the Original Land**

- Building footprint
- Land area

**22.8%**  
built up  
area

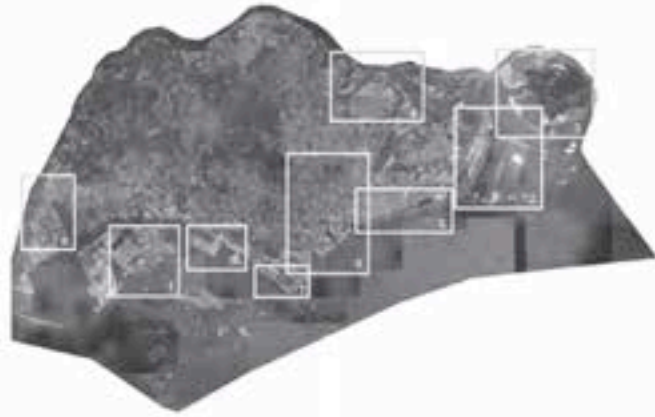


**Built up Area on the Constructed Land**

- Building footprint
- Land area

**9.5%**  
built up  
area





#### Ingredients of a Global City

There are two basic types of sites to zoom on: the purpose-built ones with a specialized use, and the mixed use areas.

There is a clear difference in scale between the two. Special use sites are generally created so as to provide maximum land area, while mixed use sites tend to focus on generating more waterfront spaces.



1. Jurong Island is visibly in a state of transition. The booming petrochemical industry is buying land before it is even built.



2. Changi illustrates the long term planning when creating land for strategic industries. Most of the site is unused, awaiting future airport growth.



3. Pulau Tekong is undeveloped because it is used exclusively for military training.



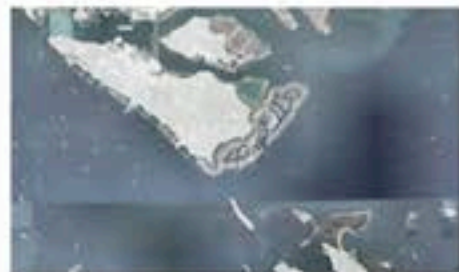
4.



5.



6.



7.



8.

4. Punggol shows the redesigning of the shore to create reservoirs and waterfront areas.

5. The East Coast is a linear arrangement of large scale projects parallel to the older city.

6. Pasir Panjang is shaped only to efficiently process shipping containers.

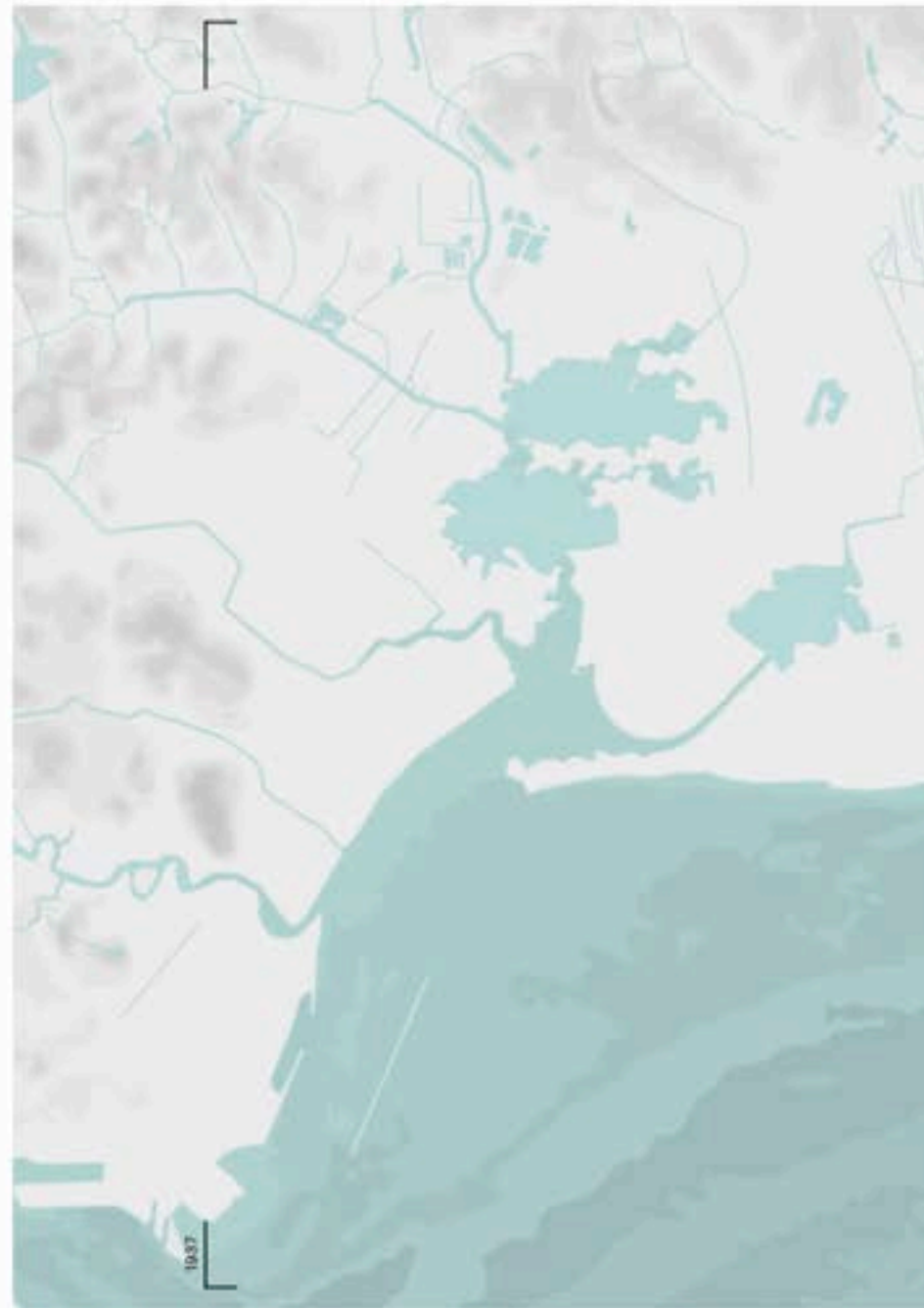
7. Sentosa Island wants to maximize waterfront properties like Dubai.

8. Tuas is organized on a grid but has to allow ship access to industrial Jurong.

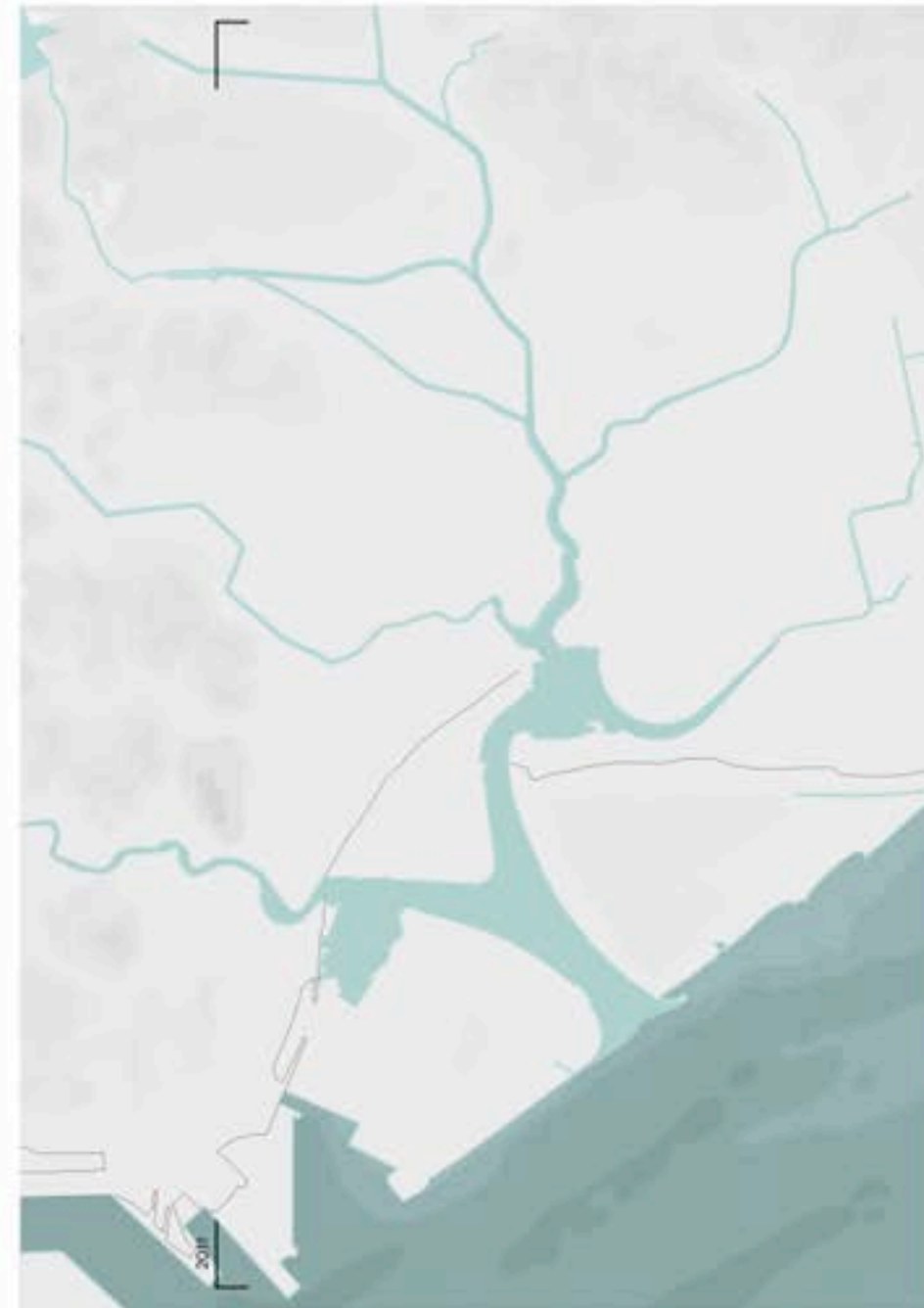
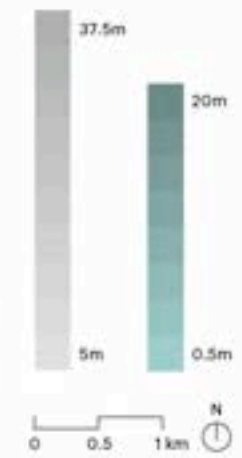


#### 9. The Mixed Use Central Area

All the various strategies come together here. The constructed land is shaped to expand the shoreline and create a reservoir. Like Tuas, it is adjacent to an existing economically productive area that wants to expand. Port facilities are present, as is the large golf club, which temporarily uses the new land.

Land and Water  
Topography**1937: Natural Topography**

The central area was still defined by hills and an extensive canal system as well as by the waterfront. The underwater topography was shallow and quite complex at this time.

Land and Water  
Topography**2011: Transformation to meet Expenses**

By 2011, the hills have been flattened considerably, the canals to the east filled, and the rivers have been straightened.

Large land areas have also been built out into the sea, which is much deeper than it used to be.

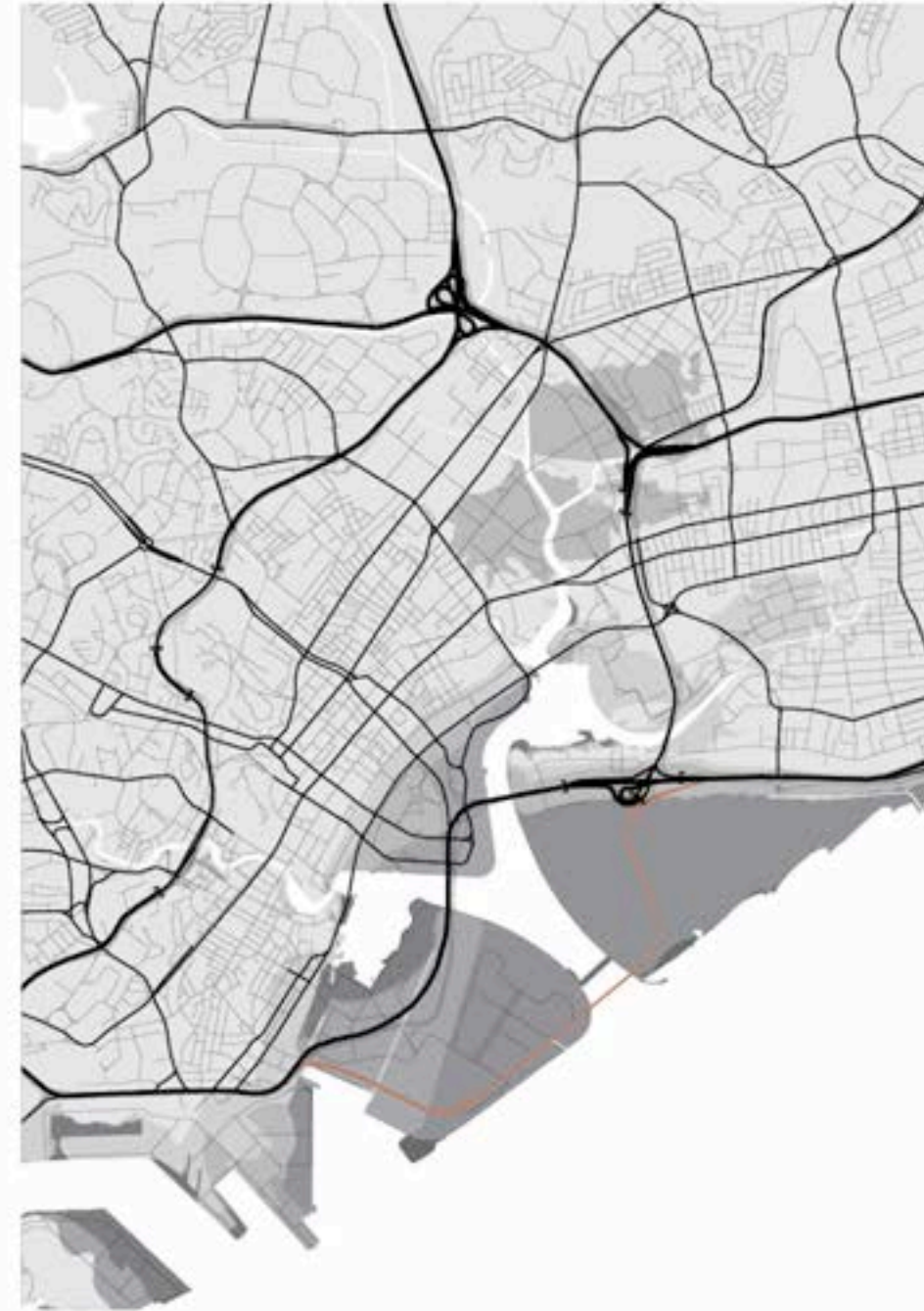


#### Road Network 1937

- Original land
- Reclaimed land 1820-1937
- Main roads
- Secondary roads



**Centrality of the Historical Structure**  
The road network in 1937 was a grid along which the colonial city was organized, with country roads connecting the rural back-country with the city.



#### Road network 2011

- Expressways
- Underground
- Main roads
- Secondary roads
- New Expressway
- Underground

- Original land
- Reclaimed 1820-1937
- Reclaimed 1937-1958
- Reclaimed 1958-1974
- Reclaimed 1974-1987
- Reclaimed 1987-1998
- Reclaimed 1998-2011



**Multi-Centered-City**  
The road network in 2011 is much more complex, with an expressway system overlapping the main and secondary roads. These expressways actually circumvent the inner-city as they link the entire island around the central area.



## MRT Network 1990

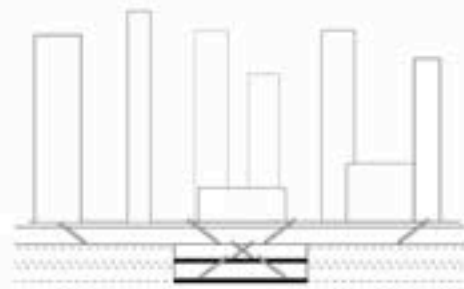
- North South Line, 1988
- Underground
- East West Line, 1990
- Underground

- Original land
- Reclaimed 1820-1937
- Reclaimed 1937-1958
- Reclaimed 1958-1974
- Reclaimed 1974-1987



## Connection to Suburbs

The original two lines of the MRT system built at the end of the 1980s connect the main axes of the island with the central area. Stations were built near central nodes, retrofitting the existing city.



## MRT Network 2013

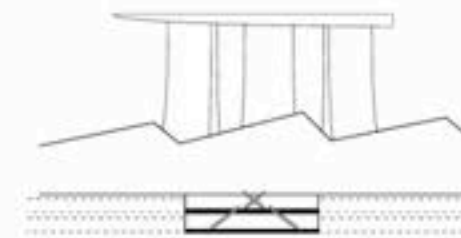
- North South Line, 1988
- Underground
- East West Line, 1990
- Underground
- North East Line, 2003
- Circle Line, 2009
- NS Line Extension, 2014
- Downtown Line, 2013-17

- Original land
- Reclaimed 1820-1937
- Reclaimed 1937-1958
- Reclaimed 1958-1974
- Reclaimed 1974-1987
- Reclaimed 1987-1998
- Reclaimed 1998-2011



## Interconnection as Upgrade

More recent MRT construction has focused on interconnecting the existing structure, as well as driving new development by making specific sites on the constructed territory more attractive.







1.



2.



3.



4.



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6.

Cross Section of the City's Layers  
 Stills from the video short, "Coral City", shot  
 along Boon Tat street as it crosses the suc-  
 cessive historic coastlines in the city center.



## Coral City Case Study

Singapore's growth can be compared to that of corals. From a solid base it grew outward continuously, and upward as well. Studying this process in the Telok Ayer / CBD part of the city is especially rewarding since this is a site on which land and buildings have been rebuilt multiple times.

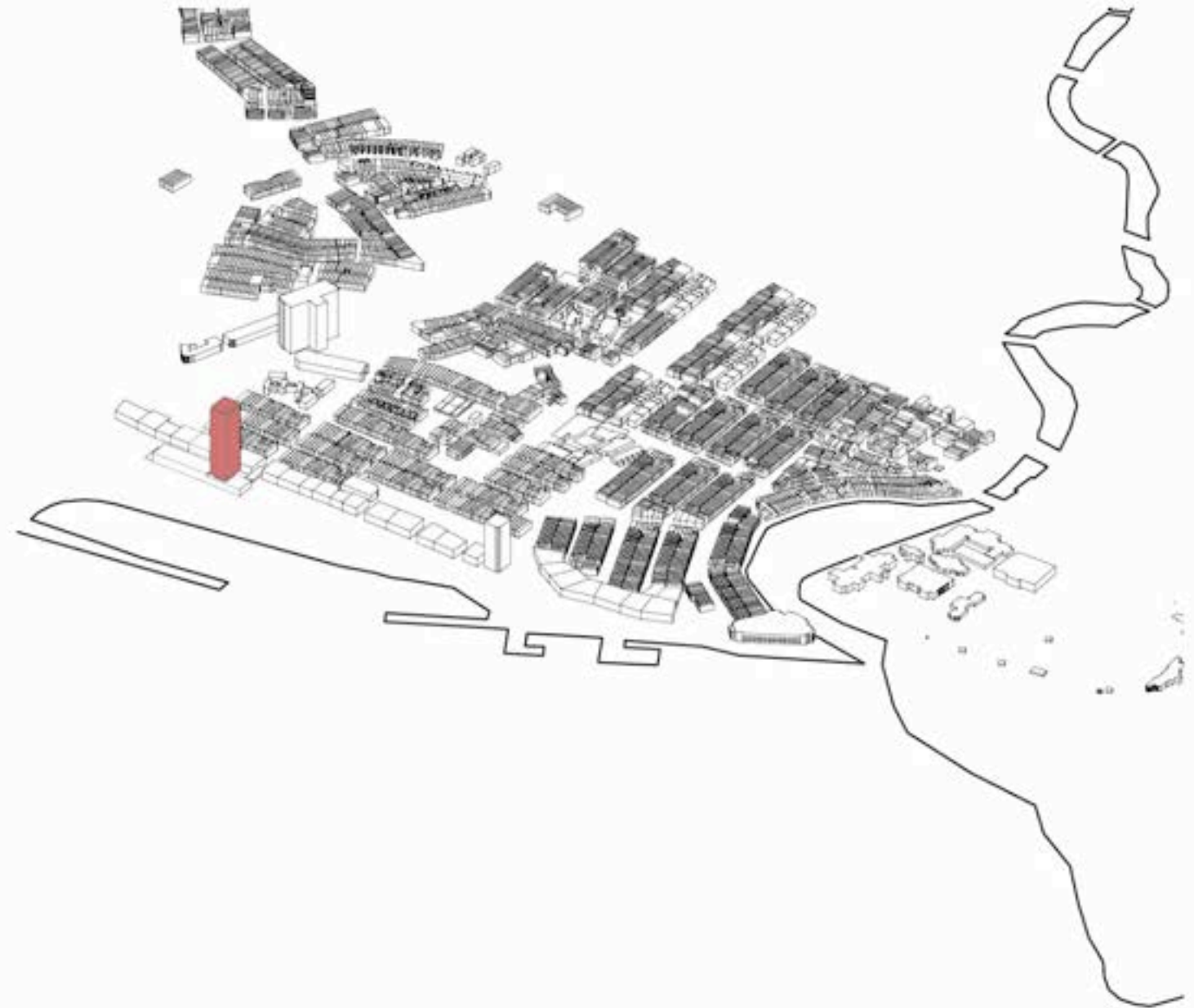
The Singaporean government has steered this process starting with the development of the Golden Shoe at the end of the 1960s. Through the URA's Sale of Sites program, the government has control over what gets built where,



The dock-based and the office economy in the area around the CBD

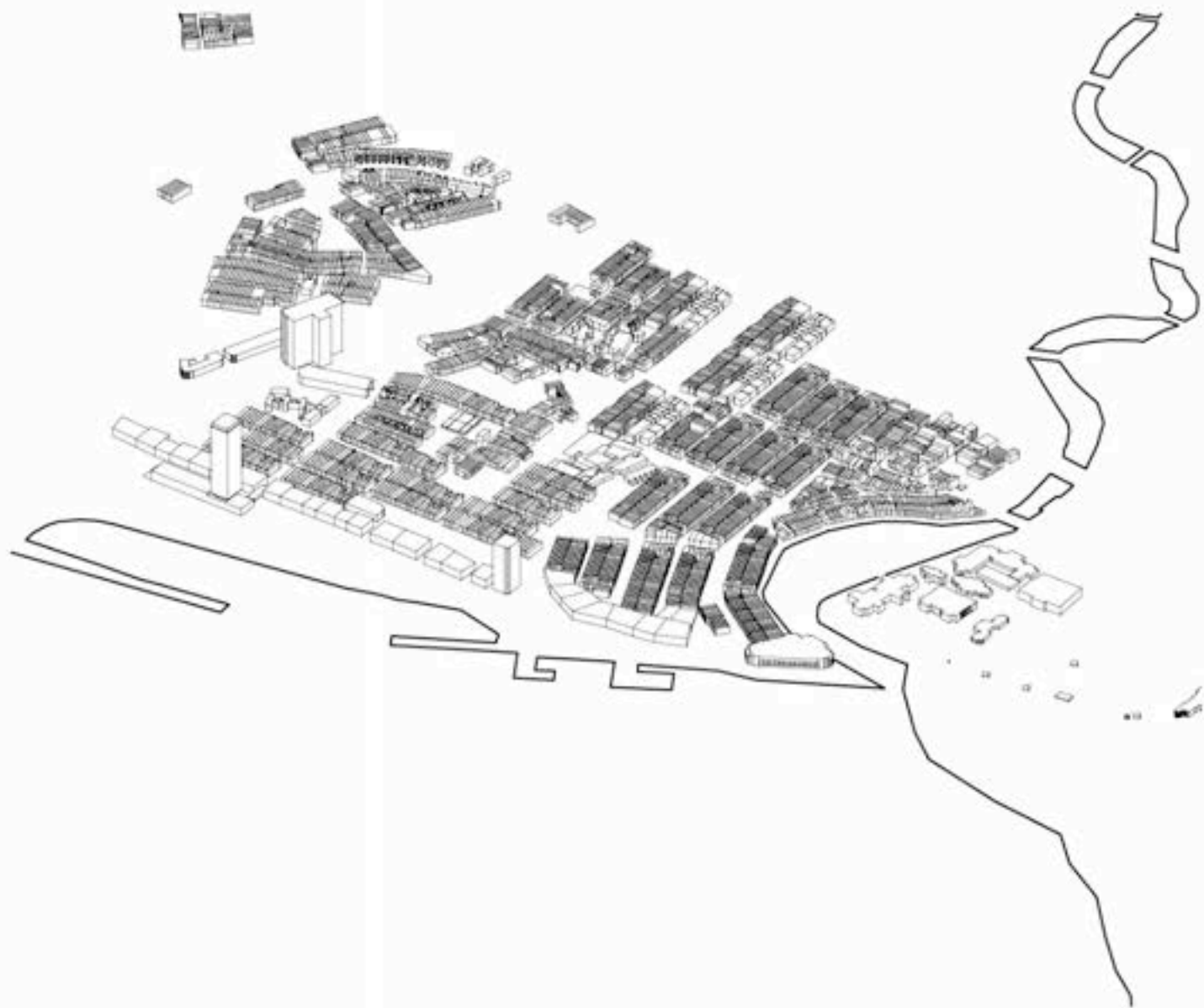
and which program mix is achieved in a certain neighborhood. The Golden Shoe, adjacent to the Telok Ayer Basin in the economic heart of the city, was planned as the Central Business District from the beginning.

What is interesting is that although the nature of the economy has changed completely, and the territory has been totally transformed, this part of the city has retained its economic centrality.



Transaction Price ca. 1958  
Shenton House:  
S\$ 624/m<sup>2</sup>

**1958: The Post-War Harborfront**  
On the eve of self-governance the area between the Singapore river and Telok Ayer basin was still a major trading and business center. Shophouses dominated the district, with larger representative buildings lining Raffles Quay. The first modern tower had already been built in the area; a sign of things to come.



**1974: Starting the Golden Shoe**  
By the mid-1970s the first signs of increased investment in the city center are visible. A couple more towers have been built, the Marina Center reclamation scheme is under way, and many sites in the Golden Shoe area around Robinson Road and Shenton Way had been sold.



Transaction Price ca. 1990  
UOB Centre:  
S\$ 22'217/m<sup>2</sup>

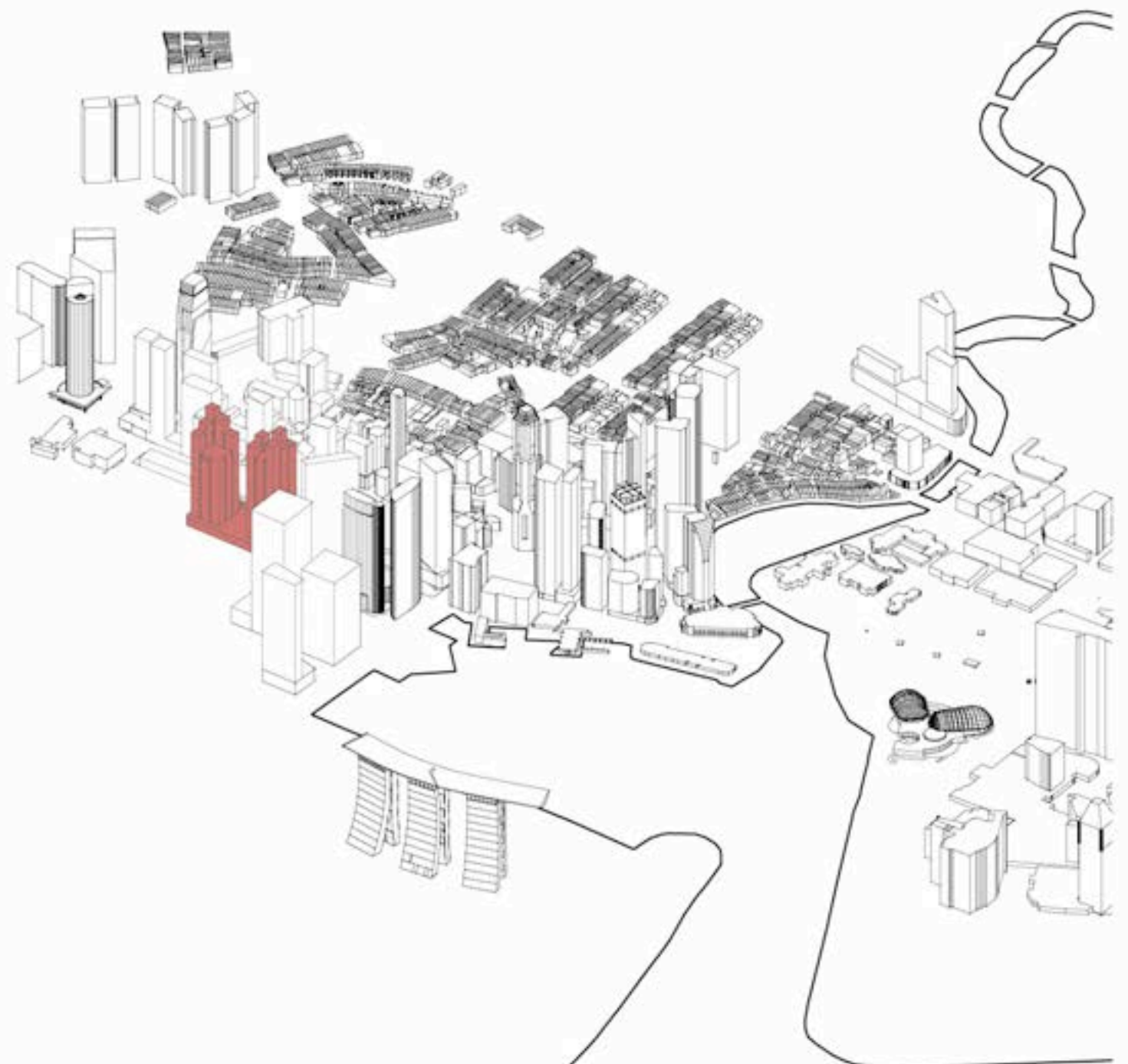
**1990: Rediscovering the River**  
The Central Business District really got going in the late 1970s. A large number of office towers were built behind Telok Ayer Basin and the area around Raffles Place was redeveloped as well. At the same time, with the construction of Marina South and Center, a huge amount of land was added to the area.



Transaction Price ca. 2000  
One Raffles Quay  
S\$ 108'721/m<sup>2</sup>

#### 2000: Filling in the Gaps

The 1990s saw significant densification of the area around Shenton Way and Robinson Road. The city center was obviously an attractive location, but development stopped short of the adjacent Marina South. The last part of Telok Ayer Basin was filled up to better connect the existing CBD and the new land targeted for development.



Transaction Price ca. 2012  
Asia Square:  
1. S\$ 197'188/m<sup>2</sup>  
2. S\$ 109'080/m<sup>2</sup>

#### 2012: The Run on Marina Bay

As the first new towers started to break the plane of the older waterfront to venture out onto Marina South, the government cleverly situated the Marina Bay Sands project. By placing the new integrated resort and MRT station at the edge of the reclaimed land, the URA sent a signal that the entire area up to there would be integrated into the city.

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WATER TOWN



Architecture of Territory  
ETH Zurich  
FCL Future Cities Laboratory

Hinterland  
Singapore, Indonesia, Malaysia  
Project 1, part 2

Asst. Prof. Milica Topalovic  
Martin Knüsel  
Marcel Jäggi

# WATER SCARCE

A Record  
of Dependencies

by  
Pascal Deschenaux  
Simon Zemp

p.16

## Bilateral Relationships

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Flowing through Territories (p.26)

p.34

## Mechanics of Control

Engineered Territory (p.36)  
Centralised Power (p.42)

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A Change in Value (p.48)  
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## A Driving Fear

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Water is omnipresent on the island state of Singapore. As this resource is present in insufficient amounts, islanders are required to save as much of the precious liquid as possible and keep the channels clean.

Water resources are subject to economic, geopolitical and everyday life preoccupations in Singapore. Although the country strives for independence, between thirty to fifty percent of Singapore's water continues to be imported from Malaysia.

Singapore's rainwater is being collected and stored in a variety of reservoirs where it is valued differently depending on its location. To be able to manage such a complex water system, an incredibly efficient and opaque authority has unilateral choice on all the issues concerning this resource.

# Bilateral Relationships

Singapore is a first world country that lies in between transitional economies striving through their industrial sectors. Singapore's strong economy grants access to technological strategies that remain out of reach to its neighbours. The management of the country's water system is a strong example of the advantage that Singapore holds over Indonesia and Malaysia.

Drinkable water comes from four different sources, the so-

called 'four taps': rain catchment, treated sewage water, desalinated water and imports from Malaysia. Because of its high population compared to its small surface (5.35M inhabitants on 714 km<sup>2</sup> in 2012), the amount of fresh water needed each day is considerably more than what is available locally. On the other hand, locally available resources in Malaysia and Indonesia are enough to meet the need of these countries' respective populations.





1. Johor river, one of the main water source for Johor state
2. River with fresh water in the natural reserve of Gunung Pulai
3. Boats for firefly sightseeing on the Johor river
4. Water intake from the Johor river for the Kota Tinggi treatment plant
5. Pipelines coming out of the Kota Tinggi treatment plant

1.

**Johor State, Malaysia**

The state of Johor is economically dependent on the plantations of palm trees to produce oil. This type of agriculture requires a tropical climate and a high amount of water. Coming from the mountain regions in the North, water flows through the territory mostly by rivers where the palm farmers directly take water free of charge.

With its economical growth in the last thirty years, Johor state has been able to upgrade its water treatment to potable standards, making tap water drinkable.

Although the quality of water has improved due to treatment technologies, water resources remain underappreciated: rivers and lakes are polluted by garbage and human waste. In Johor Bahru, the capital of the state of Johor, the river that flows through the center of the city has been covered by a parking lot in the 1960s.



2.



3.



4.



5.



1. Dam at the Muka Kuning reservoir
2. Hole in a fence protecting the reservoir where people pass through to reach the body of water
3. Child jumping from the dam
4. Children in the reservoir's water
5. Locals fishing on the shores of Batam's reservoir water

1.

**Muka Kuning Reservoir Batam, Indonesia**

Contrasting to its northern neighbours of Singapore and Malaysia, Indonesia's economical condition does not allow it to acquire a potable water network. Households need to boil tap water before drinking it to avoid contamination. Rivers and streams are still commonly used as a sewage system.

Batam's reservoirs provide enough tap water for its region. Although these structures are supposed to be protected, the neighbouring population uses them informally for swimming, fishing and weekend strolls.



2.



3.



4.



5.



1. Singapore's skyline surrounding the Marina Bay reservoir
2. NEWater plant near Kranji reservoir
3. Channel restricted to the public near Kranji reservoir
4. Water flowing out of a gutter with Pearl's hill restricted service reservoir in the background
5. Public PUB sign mentioning bans and sanctions

Singapore

Singapore administers its water management in a way that differs from its neighbours. Its world ranking water management facilities are strictly off access to the general public. Water reservoirs, channels and gutters are a defining characteristic of the city-state's landscape.

The country teaches its population to save water through an education program given to every child in primary school. If somebody is caught polluting the water system in any way, costly fines are imposed. Singapore's water technologies have become world famous and it is now a world leader in the water industry.



4.

5.

A Geographical Paradox

Although Singapore is situated in a tropical region where rain precipitations are far over the world average, it does not possess enough natural water for its own population.

This phenomenon is due to the high density of population. This puts Singapore in a similar condition of water scarcity to Qatar or Dubai.

The only solutions to solve water scarcity are through new technologies (treatment of sewage water and desalination of seawater) or importing water from other countries.

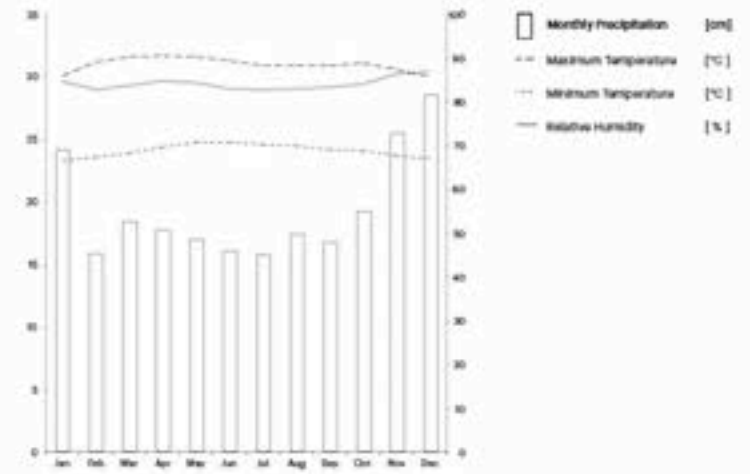
Until recently, Singapore was mostly dependent on Malaysia. In the last thirty years, Singapore has also been investing a considerable amount of money into research and futuristic infrastructures in an attempt to lower its dependency on foreign sources.

Relation in Water: Mesures Usage and Renewable Sources

The total renewable water resources represent how much water a country can gather and is calculated as the sum of surface runoff water and groundwater.

Indonesia and Malaysia have large amounts of water available due to their extensive land area. Singapore by contrast can not satisfy its needs with natural resources due to its small surface.

The comparison also shows that the withdrawal per capita is much higher in the neighbouring countries than in Singapore. This is mainly due to the prevalent agriculture sector which takes 81% of the water withdrawal in Indonesia and 22% in Malaysia. source: Aquestat (FAO)



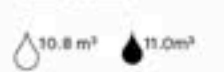
Malaysia



Indonesia



Singapore



Annual water withdrawal (per capita)  
 Annual renewable water source (per capita)



# Water Politics

Water became a political issue at the beginning of the twentieth century when Singapore turned into one of the central trading ports in Southeast Asia. Basic rain catchment reservoirs were formerly sufficient to supply local needs. With its rapid growth, Singapore needed to sign an agreement with the neighbouring state of Johor to allow the import water for consumption. At the time of the contract in 1927, both regions were under British rule, making the bilateral implications insignificant. Water was imported without charge and the amounts were unregulated.

In 1942, British troops fleeing Singapore from Japanese invasion blew up the causeway linking the island to Johor state, which lead to a dramatic water shortage during the Japanese occupation. Only then did Singaporeans realise the implication of their dependence on foreign resources.

In 1961 and 1962, Singapore signed two major contracts with Johor stipulating the quantity limits and prices of water imports. At that point, Singapore was going to be-

come part of Malaysia, making the process relatively easy. Only when Singapore declared independence from Malaysia three years later did the contracts become a source of tensions. Even though the UN approved the agreements, Singapore still feared its complete dependence on another country. This granted upon Malaysia a tactical advantage and negotiation leverage, which it maintains to this day.

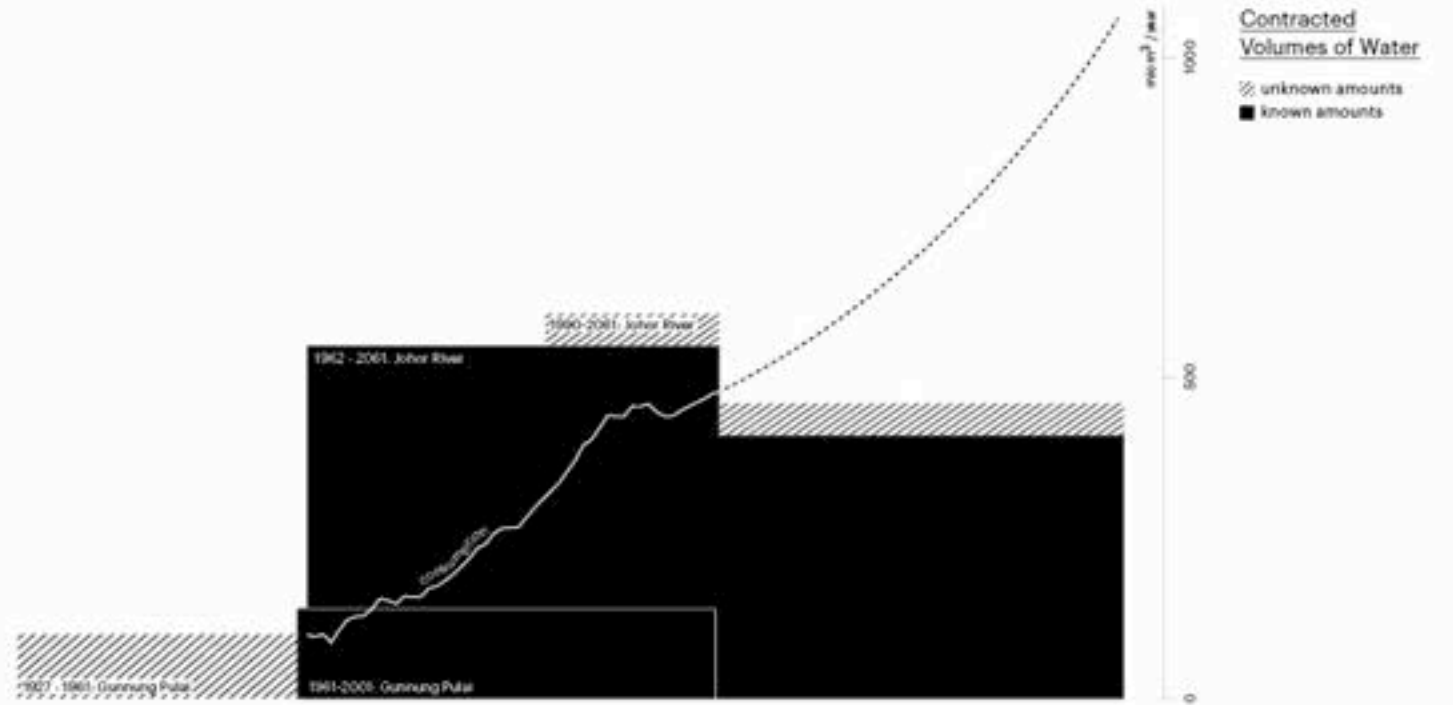
Ever since its independence, Singapore has tried to develop new technologies allowing it to become less dependent on its neighbour.

Tensions amplified by the media and the government of each country became so high that both governments agreed to decide on all water-related issues under 'quiet diplomacy' at the beginning of the 2000s. From then on, information regarding water agreements became out of reach to the public. Basic information and geographical knowledge has been lacking ever since.



Left:  
Geographical map of the 1961 and 1962 agreements between Malaysia and Singapore

Right:  
Newly built dam of the Gunung Pulai reservoir





### Locating the Agreements

Placing the different water agreements on a map makes the geographical implications of politics visible.

Singapore used to take water from three different rivers: the Scudai, the Tebrau and the Johor river. It then treated the water and gave back part of it to Malaysia at a higher price.

In 1990, pipeline technology and new negotiations allowed Singapore to build a new reservoir in Pahang state, north of Johor in the middle of the jungle.

At the end of 2011, the 1961 agreement allowing Singapore to take water from Gunong Pulai ended, marking the end of a chapter in the bilateral relationship.

#### 1961 - 2011 Tebrau and Scudai Rivers

The 1927 agreement was declared void when the British empire signed a new contract with independent Malaysia. This contract gave Singapore the right to take up to 390'000 m<sup>3</sup>/day from the Gunong Pulai reservoir, Tebrau river and Scudai river. The contract ended after fifty years in 2011 and the installations were handed over to Johor state.

#### 1927 - 2011 Gunong Pulai

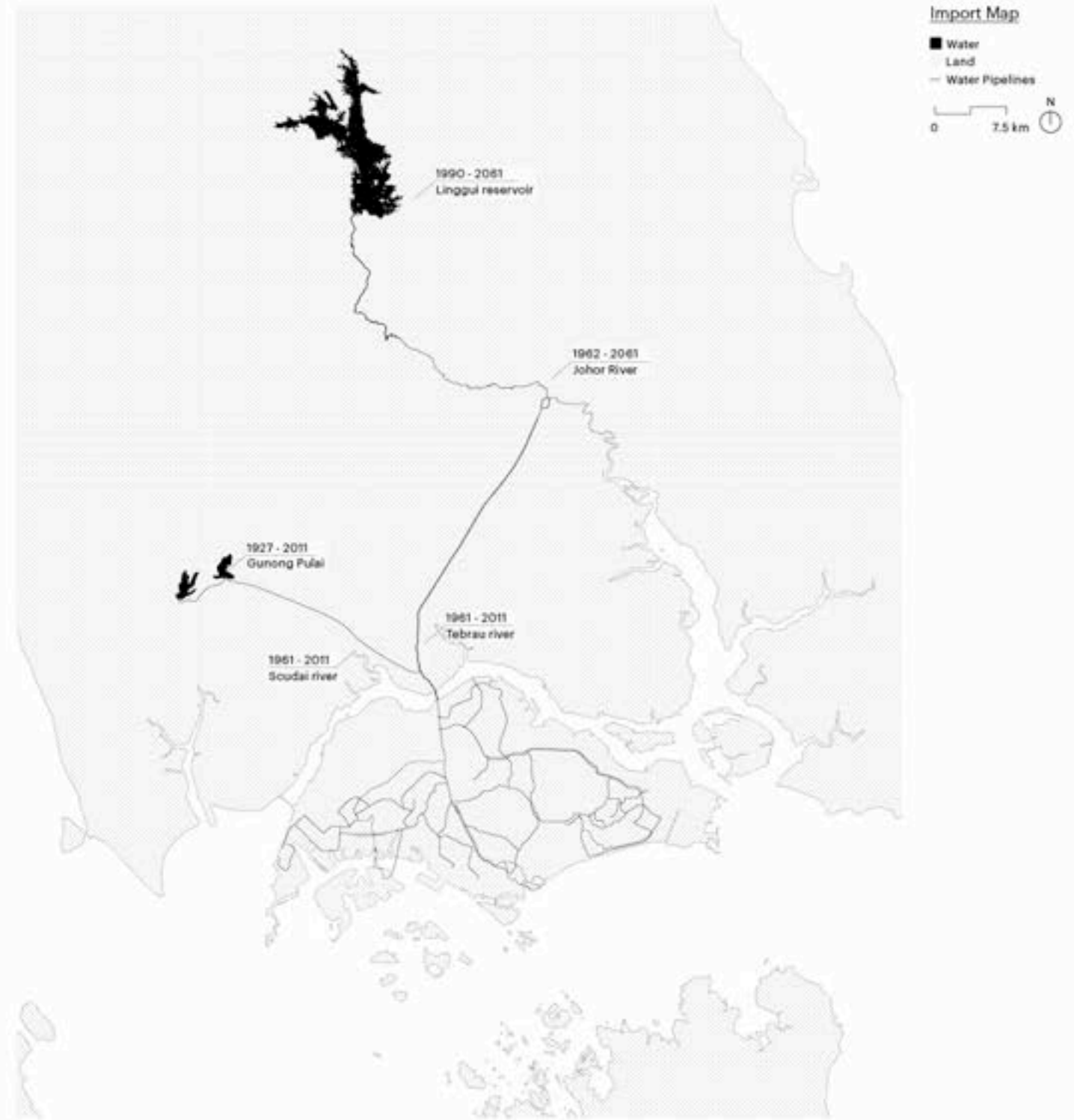
The first agreement between the Singapore state and Sultan Ibrahim of Johor state allowed Singapore to rent an area of 8.5 km<sup>2</sup> and to collect and withdraw the rainwater in the newly constructed reservoir. Together with a dam the first pipeline to Singapore was built.

#### 1962 - 2061 Johor River

Valid for 99 years, this agreement allowed Singapore to take up to 1.14 mio. m<sup>3</sup>/day of water from the Johor river to Singapore. In exchange, Singapore had to give back up to 2% of treated water from the total amount of water it imported.

#### 1990 - 2061 Linggui Reservoir

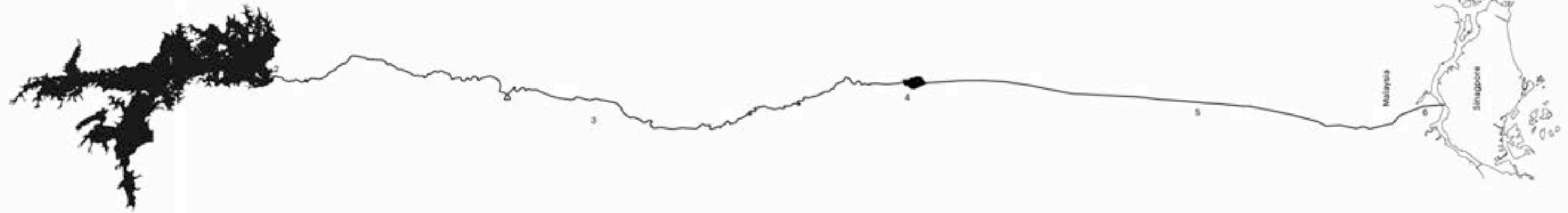
A complementary contract was signed between both governments in 1990. This gave Singapore the right to build the Linggui reservoir and dam, allowing the island state to import more volume. The precise amounts were not given, Singapore must pay a monthly rent and assume the cost of maintenance.



## Flowing through Territories

Singapore's water supply flows through different territories and installations which each have their own rules and security levels. Starting far up in Pandang state, water is stocked in a gigantic reservoir inaccessible to the public, located in the middle of a rain forest. After being released at the Linggui dam, fishermen and farmers use the water of the river for sustenance and leisure. The water then gets pumped into a high-security treatment plant in the Kota

Tinggi area where it is processed and brought to drinking standards. The water is then released into three pipelines buried underground that cut through Johor state. It finally crosses the boarder on the causeway linking Malaysia to Singapore to be redistributed in the island's water system. This infrastructure represents a physical manifestation of Singapore's relation with its hinterlands.



PUB facility protected by Malaysian military

River freely accessible

PUB facility protected by Malaysian military

Pipelines freely accessible

Causeway - Singapore border guards



### 1. Linggui Reservoir

The reservoir exists since the agreement of 1990. It is fenced and restricted to the public despite its gigantic surface. A rich wildlife exists along its shores. Twenty Malaysian soldiers constantly guard the reservoir.



### 2. Linggui Dam

The dam creates the artificial lake and allows control on the stream flowing out of it. It is highly guarded and twelve PUB workers tend to the installations.



### 3. Johor River

The water of the river is freely accessible and used by farmers to water palm forests and orchid farms. Tourists appreciate the fireflies sightseeing at night whilst fishers use the water for sustenance.



### 4. Kota Tinggi Water Treatment Plant

The PUB's Kota Tinggi plant is highly guarded by Malaysian army. The fact that a Singaporean facility is guarded by a Malaysian authority is surprising knowing the tense relationship between both countries.



### 5. Pipelines

The pipelines coming out of the treatment plant are mostly buried underground but the land covering them stays untouched by constructions or farmland, like a green scar in the middle of a palm forest landscape. They are freely accessible.



### 6. Causeway

The pipelines reappear out of the ground when crossing the boarder, placed next to the bridge. The whole causeway is guarded by both Singaporean and Malaysian border guards.



1.

1. The Linggui dam
2. Rocky road leading to the dam
3. Securised arrival to the facilities' checkpoint
4. Malaysian soldiers guarding the dam

Heart of the Island

The Linggui reservoir and its dam are highly restricted areas placed in an uninhabited region of Johor state. A single rocky and unmaintained road leads to the facilities where armed soldiers guard the dam against unwelcomed visitors. The dam is controlled by the Public Utility board, Singapore's water agency. The fact that the area is concealed from the public eye has been explained by a PUB official as an "insurance against Malaysians frustration".

Singapore's water is released from this artificial lake and into the country's water infrastructure system, making it the heart of the island.



2.



3.



4.



Linggui Dam

- Water
- ▨ Dam
- Vegetation
- - - Fence

0 100 200m N

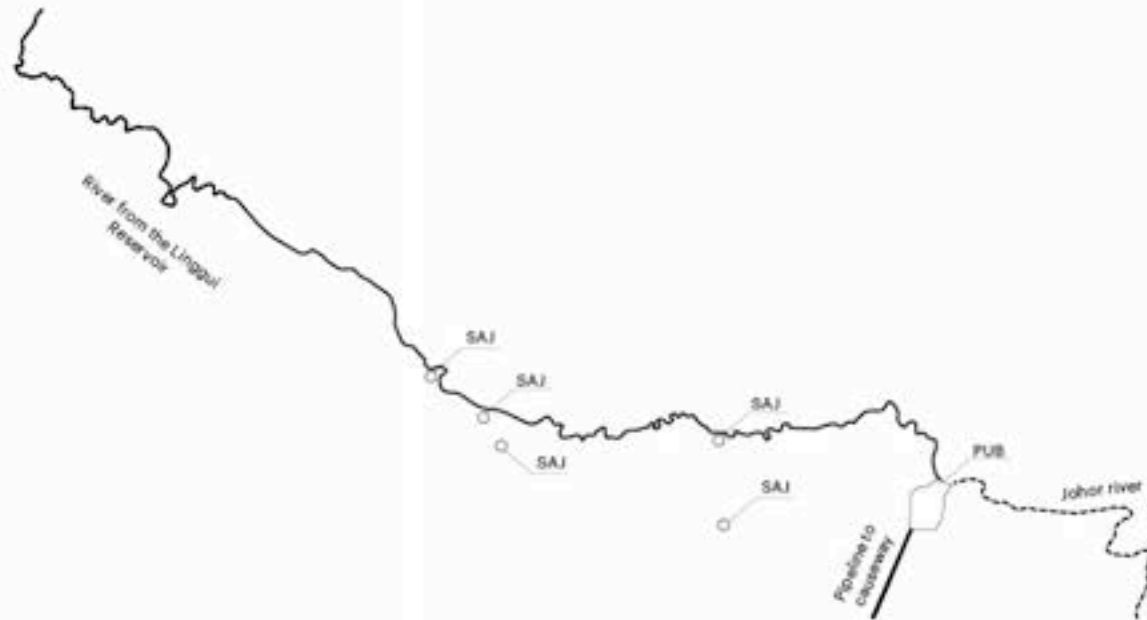


Negotiating Control

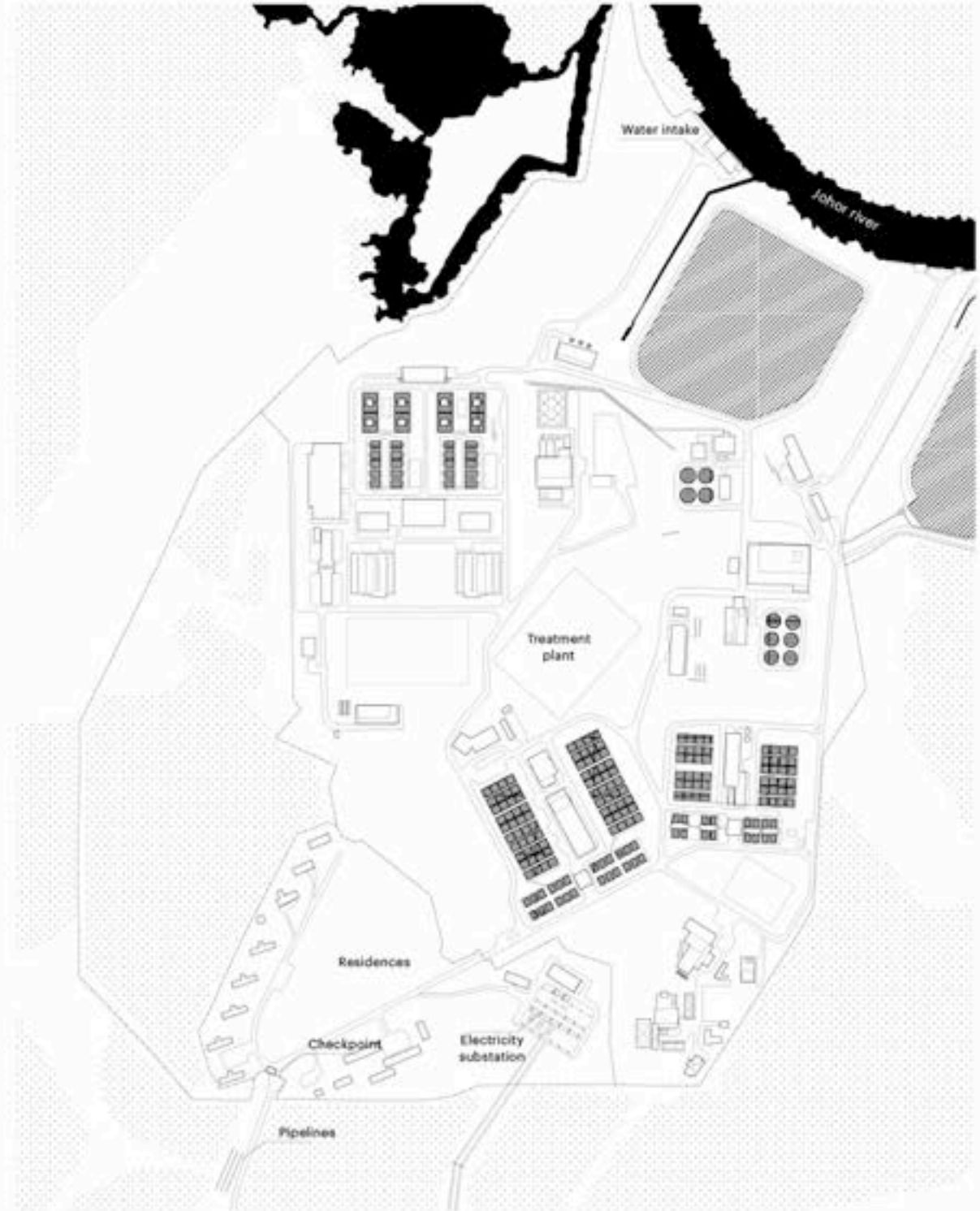
To keep control on Singapore's water supply, the SAJ (Johor's water agency) has first take on the river's water coming from the Lingguit dam. There are ten SAJ plants located along the river shores before Singapore's Kotta Tinggi plant.

The plant is built like a small town; a part

of "contemporary Singapore" in "industrial Johor". A residential and office area is built at the south of the actual treatment plant. An electricity substation finds itself at the southern tip of the facilities, providing enough energy for the whole installation. Like many other water infrastructure facilities, the area is heavily guarded by Malaysian soldiers.



Kota Tinggi treatment plant's checkpoint with pipelines heading to Singapore



Water Treatment Plant Kota Tinggi

■ Water  
 ▨ Dam  
 ▨ Vegetation  
 — Fence

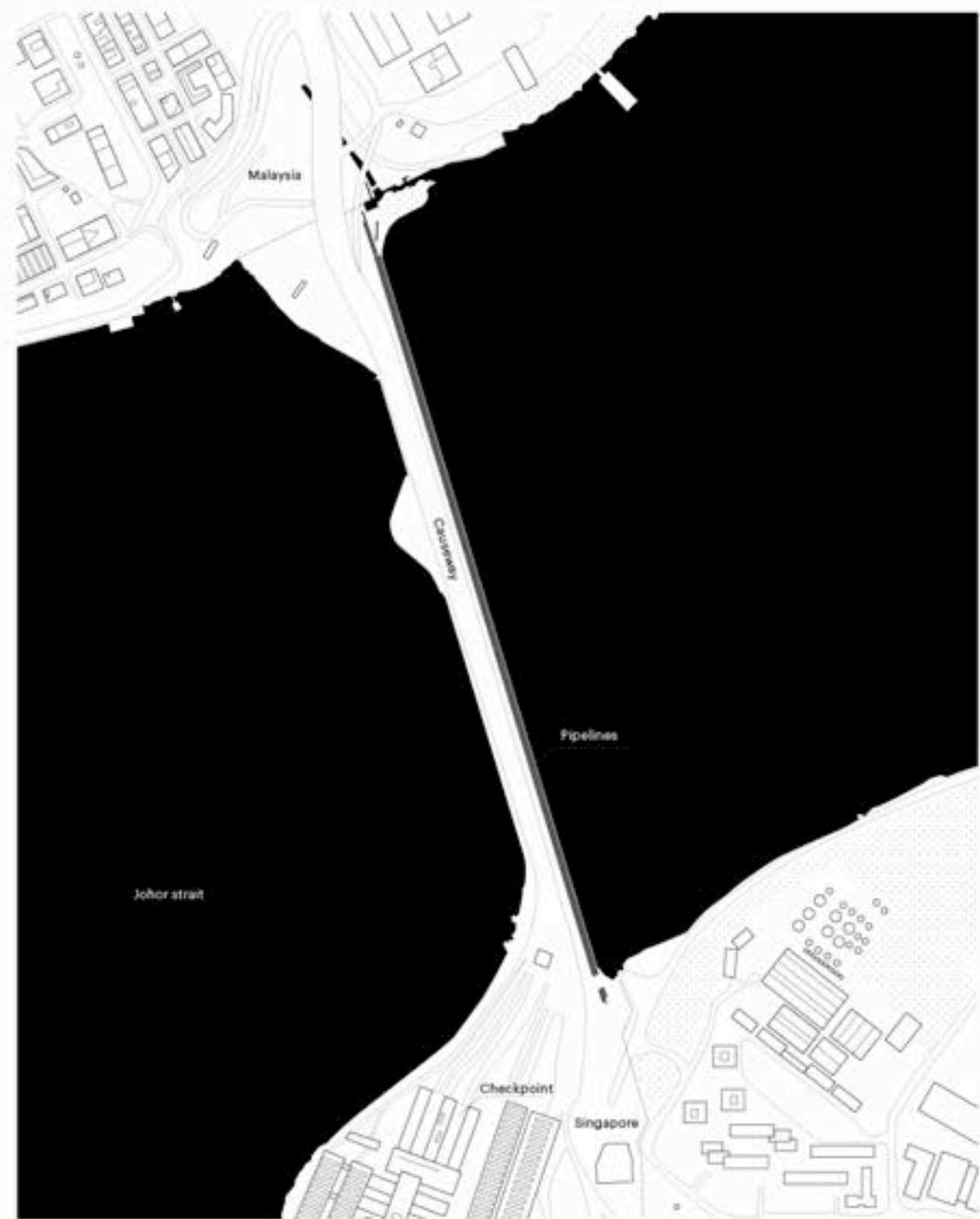
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**Water Gate**  
 Pipelines spring out of the ground when they cross over bodies of water to connect with Singapore. They are linked to the causeway. The causeway can be seen as the physical incarnation of Singapore's fear; an artery feeding the island. Since the British made it explode whilst facing the Japanese invasion, it has always been highly guarded.



Left:  
 Pipelines crossing the causeway  
 Bottom:  
 Japanese soldiers imprisoning British troops in 1942



**Causeway Between Johor and Singapore**

■ Water  
 ▨ Vegetation  
 - - - Fence  
 0 50 100m N

# Mechanics of Control

Being a scarce and precious resource, water stocks are managed with efficiency and preciseness in Singapore. The whole territory is planned for water catchment and protection against pollution through a network of infrastructures. Although some parts of the island's surface still look untouched – mainly the natural parks – even these apparently natural territories have been rebuilt to collect rain water. Together with reservoirs, treatment plants, service

reservoirs and flood control facilities, the cycle of water is artificially managed. The public utilities board oversees all water operations in a exceptionally competent but also opaque approach. Moreover, they have the monopoly over the water resources in Singapore. By depending on Malaysian water import, the resource became a topic of national security. Because of this, information about water management has been considered

sensitive. Reliable information for topics such as the capacity of treatment plants and basic information about water imports remains inaccessible.



Tide control facility at the dam of the Kranj reservoir

# Engineered Territory

Singapore's water shortage and excess at precipitation peaks is managed through a vast network of channels and drains. Its territory is engineered to catch water on sixty six percent of its surface, which represents a technological

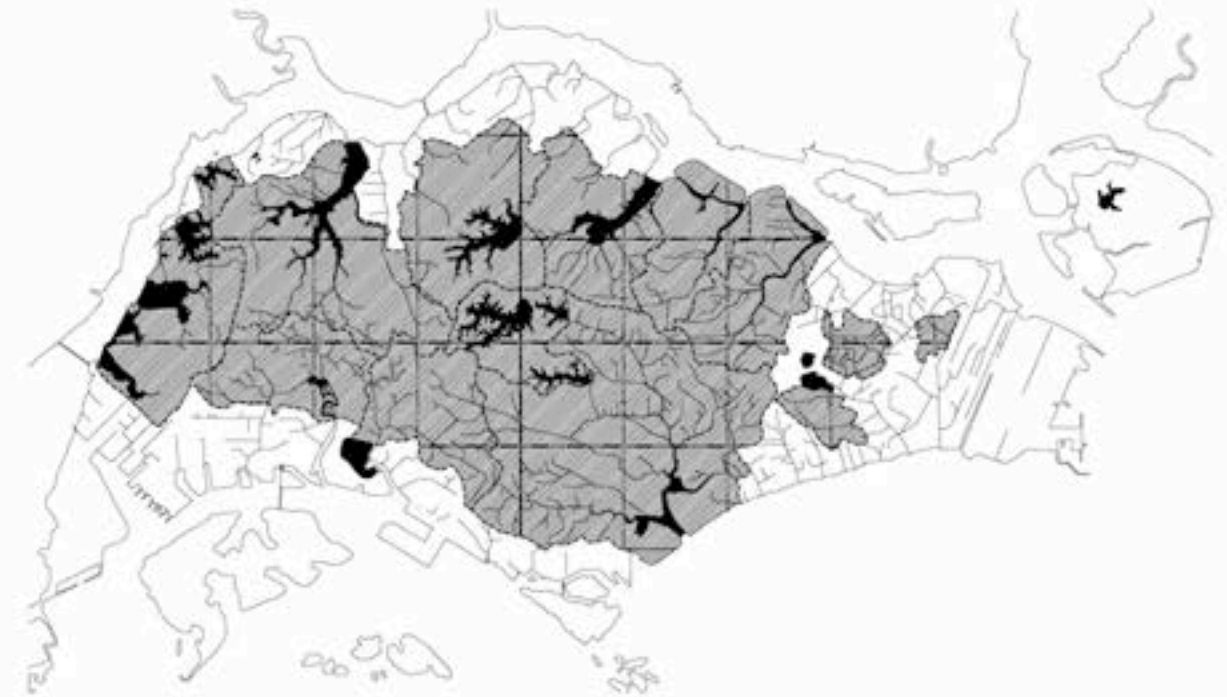
prowess. This area includes different kinds of territories, from natural environments to highly dense residential and business districts.

Annual Average Rainfall (mm)

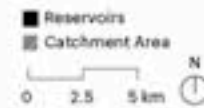


### History

Singapore started to use catchment technology ever since it became a trading port at the turn of the last century; a time when the country stored water in reservoirs to cope with draughts. It only started to shape its territory for catchment purposes in the 1970s. Existing reservoirs were enlarged in order to store more water and new ones were created by damming rivers from the sea. In the future, Singapore intends to collect water on up to ninety percent of its terrain by also damming smaller streams.



Water Catchment Area





## Infrastructure of Control

Beside the channel network, operating buildings are also a part of Singapore's water harvesting machine. Their uncommon architecture enriches the otherwise monotonous Singaporean landscape.



Service Reservoir - Asmara

Service reservoirs can be found all over the island. After the treatment process, potable water is stored in these structures to supply large amounts of water during peak hours. The specific shape of the Asmara service reservoir is due to static considerations and can be found in Singapore's older water constructions.



Flood Control - Pandan

Flash floods remain a considerable problem in tropical environments. Singapore also experiences water flow problems when precipitations are too high. The drainage network that was developed over the last decades allowed to decrease the flood prone areas from 3'200 ha in 1960 to 48 ha in 2012.



Water Towers - Tampines

These specific water towers stock NEWater, distributing it to high-tech industries. NEWater is sent into a different system of pipes specially built for this ultra-clean resource.



Tide Control - Kranji

Estuary reservoirs were rivers that have been dammed where they rejoined the sea. During high tide, powerful pumps are needed to prevent floodings in the interior of the country and not contaminate the fresh water with salt.



NEWater Plant - Changi

At the moment, four NEWater plants clean sewage water to ultra-clean water used mostly in high-tech industries and airconditioning. Only a minor part of its production is redistributed into reservoirs.



Residential Area as Catchment Area

- Buildings
- Roads
- Vegetation



Singapore's dense residential areas have all become catchment areas.



Drainage System

- Sungai Ulu Pandan
- Drains



The drainage network splits up into the smallest of drains, redrawing the built environment with a new water layer.



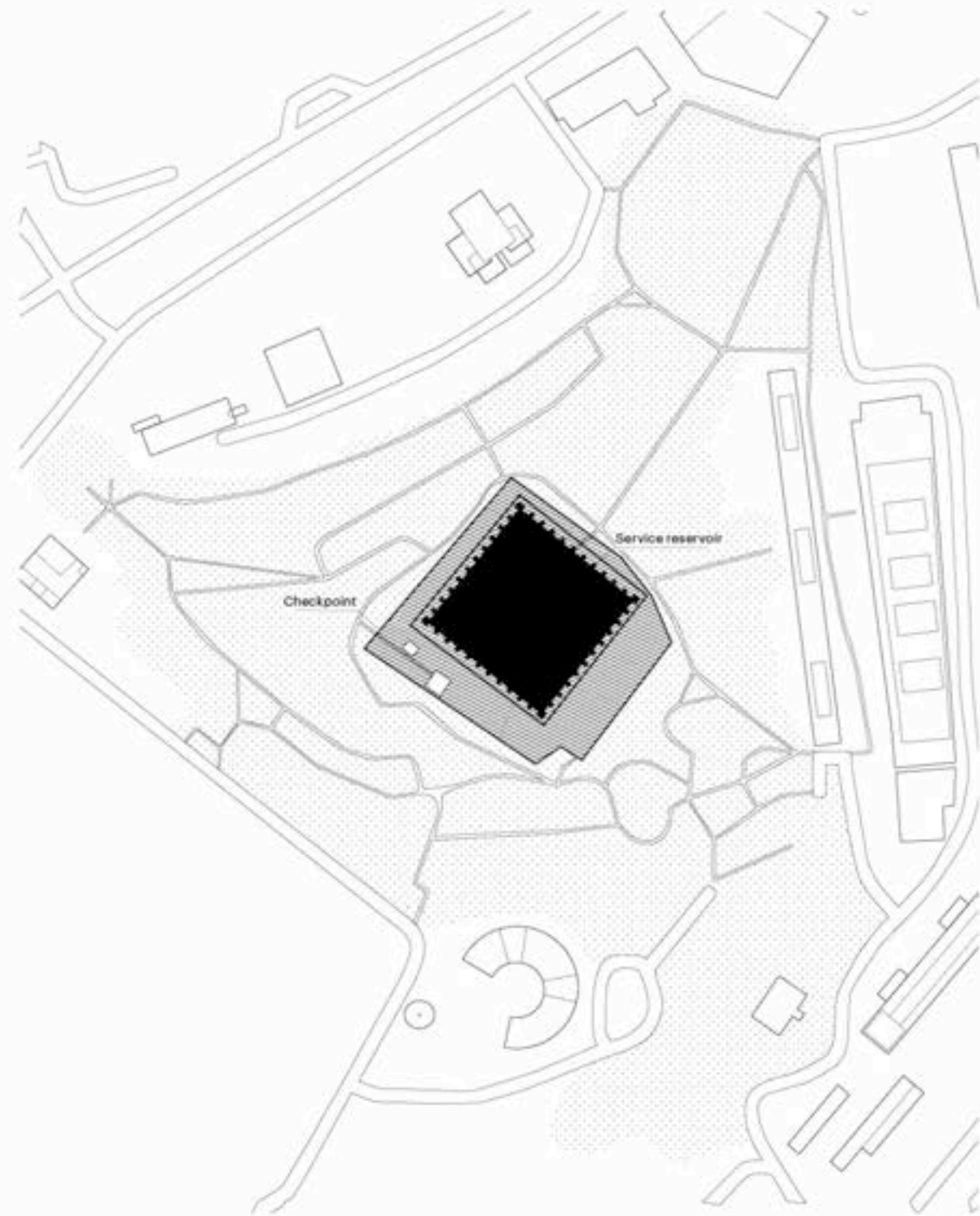
Top:  
The double fence in front  
of Pearl's Hill's reservoir

Bottom:  
Aerial view of Pearl's Hill's  
reservoir

**Fortress in CBD:  
Pearl's Hill Service Reservoir**

Service reservoirs are highly protected because they contain the water that is directly piped to the fresh water network. For the same reasons, they are often located close to residential areas or within the city centre.

The proximity of parks and residential areas to a double fenced security facility creates an uncommon visual clash in the urban landscape. Pearl's hill is a radical example of a military protected zone set in the middle of a park.



**Pearl's Hill Service  
Reservoir**

- Service Reservoir
- ▨ Restricted Zone
- ▨ Vegetation
- Fence



Pearl's Hill Reservoir lies in the middle of Singapore's downtown, with residential areas in the north and bustling Chinatown to the south.

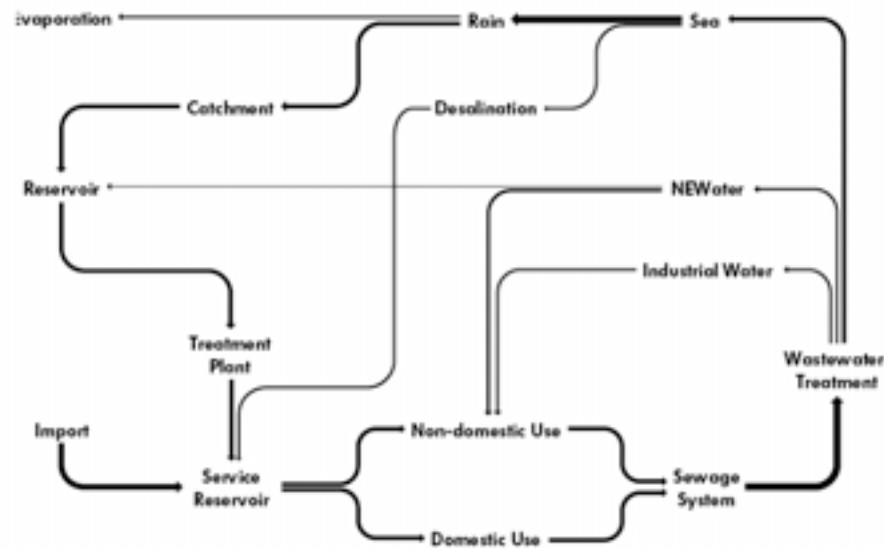
## Centralised Power

Founded in 1963 as the agency responsible for gas, electricity and water affairs, the influential Public Utilities Board only focuses on water. Over time, all water issues were integrated to the Board, from import relationships to public education.

The widespread catchment network, the sophisticated new technologies or the successful decrease of domestic water use demonstrate the power and determination of the Board as well as the Singaporean government.

In 2004, the PUB started a new strategy that would broaden its authority even more. Under the concept of

3P (people, private, public), the Board started to include semi-private companies into the water cycle: competitions for NEWater and desalination plants were held and the lowest priced submissions were selected. The two most known participants are the Hyflux group and the Keppel Corporation, both are Singaporean companies with strong ties to the government. By dominating both public and private sectors and supervising all water affairs, the PUB has become an impressive machine of control: a centralised power.



### PUB's Water Cycle

The Public Utilities Board is directly in charge of all elements of the water cycle. Potable water is produced and supplied by four different sources: imported water from Malaysia, rain catchment, treated sewage water ("NEWater") and desalinated water.

The two first ones are still the most important supplies of potable water. Industrial water and "NEWater" are mainly used in in-

dustries to satisfy their special needs. Yet a small part of "NEWater" (3.5% of Singaporeans' daily consumption of drinkable water) is introduced into the potable water cycle by releasing it into reservoirs.

Desalination plays a small role in 2012 (only producing 10% of the total daily consumption) but it will increase its capacity with the opening of the Tuaspring seawater plant in 2013.



### Education

The PUB has established an efficient education program. Using cartoons (notably Bobo the water saving elephant or Wally the friendly drop), children focus on the problematic of water and learn how to save it. Other notable events are the Singapore water week or water shortage days to prepare against a possible water crisis.



### Import

The PUB imports between thirty to fifty percent (depending on different sources) of its drinkable water from Malaysia. It possesses reservoirs out of its own territory and is always searching for new possibilities to import water from foreign ground. At the end of the 1990s, it signed an important water contract with Riau (Indonesia), allowing Singapore to import up to 4.5 M m<sup>3</sup>/day for one century starting from 2005. This contract was never put into practise due to technical difficulties and insufficient amounts of water on the archipelago.



### Collection

Though Singapore is in a tropical zone and receives twice the world average rainfall on its territory, it remains one of the most water scarce country in the world because of its high population density. Through an ingenious catchment system that covers 66 percent of its territory, it is able to stock a large part of its rain into reservoirs.



### Reclamation

After potable water is used, an ingenious new system of pipes brings back wastewater to be treated. Most of it is then poured in the sea after having been partly cleaned. The other part is used for the production of "NEWater" or industrial water, a non-drinkable water used for cooling.



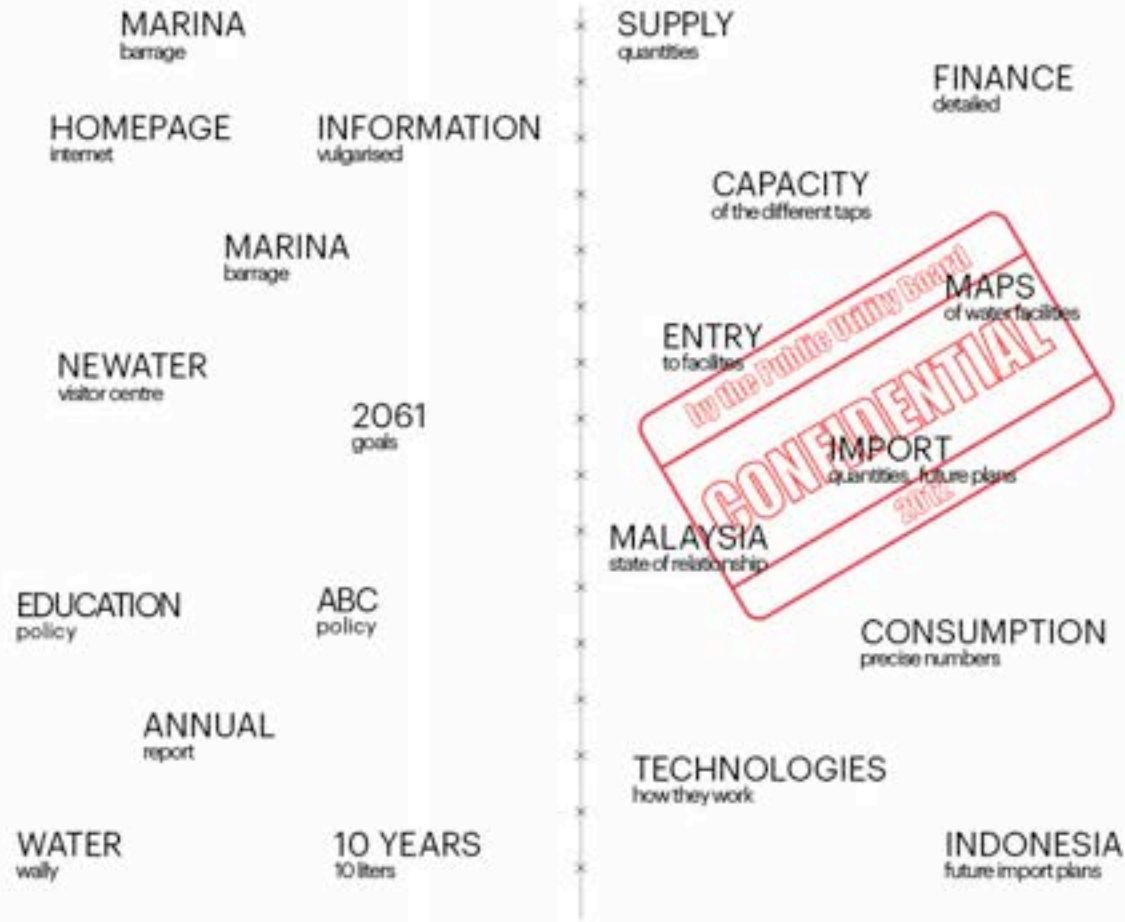
### Production

Singapore produces drinkable water for its population from rainwater. It also uses two major new technologies: "NEWater", that is recycled waste water, the purest form of water available in Singapore and desalinated water which still is a costly and a highly energy consuming production method.



### Planning

The PUB is in charge of planning for every issue concerning water: it distributes it, takes it back, cleans it, but also makes urban plans. The new ABC model for reservoirs and waterways has been put in place by the Board.



### Information Firewall

PUB's Public Relations is twofold. On the one hand it advertises the ideal of Singapore as a blue city that presents itself with nice river shores and fantastic technologies. With enormous promotional expenditure and labels like "ABC" (active, beautiful and clean) or the "3P" approach, people shall be brought closer to the water to enjoy, value and save the resource.

On the other hand, there is a reluctance to share precise information about water resources and the technologies it promotes. Numbers, locations and prices are considered strategically sensitive and are not shared with the public.



Left: Restricted service reservoir in Fort Canning Park

Bottom: Picture from the PUB's annual report of 2011 promoting interaction with waterbodies

### Public Image

Part of the PUB's public relations strategy is to promote Singapore's water bodies as places of recreation. This is part of the new "ABC" strategy where new star projects have been successfully implemented and used as objects for marketing purposes. However most of the existing facilities defy this image as reservoirs are seldom used and the direct contact with water is prohibited and penalised.



# Miscellaneous Interactions

Water infrastructures are present throughout the territory, from small gutters along the roads to lake reservoirs, channels and parks. At present, Singapore's water can be found in between two different government planning strategies; two periods in time that now contradict themselves. The newly implemented strategy is trying to create water-friendly interactions whilst the effect of the ulterior one established a complete separation from water with the rest

of the city, making it inaccessible and unattractive. By describing these different strategies through case studies, a broad overview over a complex multiplicity of urban interactions with waterscapes can be achieved.



Marina bay reservoir with the construction of the stadium in the background and kayaks in the foreground

# A Change in Value

During the last fifty years, Singapore's urban landscape changed dramatically. The economic boom turned the island from a low-income economy into a metropolitan city and financial hub. This change can be demonstrated by contrasting the way people perceived and dealt with water bodies before and today.

In the first half of the 20th century people used to live with and around the water. Life and economy were organised along its shores, inducing its pollution. After realising the strategic importance of water, the Singaporean government decided that water was no longer a natural resource

that everyone should have access to but a precious good that had to be protected. In the 1980s, the authorities restructured a whole area of the city going from Singapore river to the Kallang basins, relocating and reorganising all sources of pollution. The same process also took place less intensely all over the island. The positive results of this catharsis became tangible immediately but at the same time prevented any direct interaction with water. This downside still remains today although attempts are made to re-stimulate interconnection between the city and its water fabric.

### Cleaning the River

A major source of pollution was generated by pig and duck farming further upstream. Their high water demand reinforced the decision to abandon animal farming in Singapore and rely on imports. For instance, Pulau Bulau, better known as "pig island", now exports 1'100 pigs every day exclusively for Singapore.

Before the cleaning of the river took place, Boat quay was a bustling dock where boats shipped goods and people. The harbour trade with its shipyards and bumboats were relocated to Pasir Panjang, on seawater, where soiling was less of an issue.

### Hawker Centers and HDBs

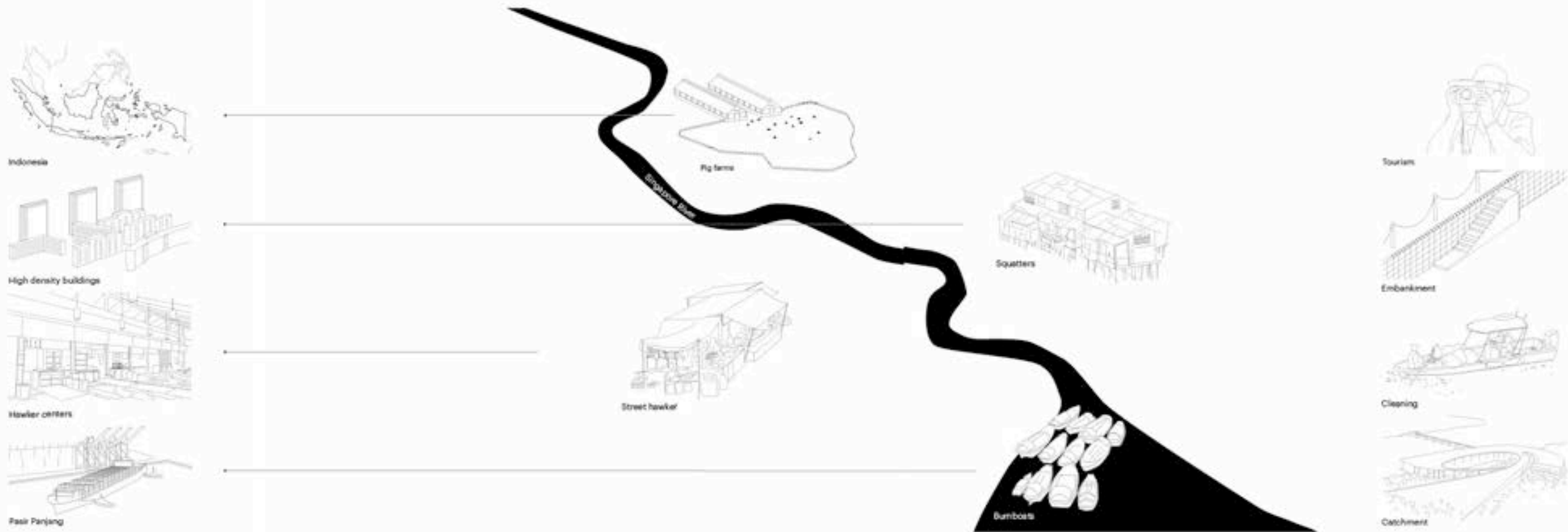
Informal settlements along the riverbanks remained a concern because of lacking basic sanitation infrastructures. Sewage was directly discharged into the river. Unauthorised market-stands generated the same problems as unsold food would be thrown into the water.

The government decided to relocate squat residents into "High Density Buildings" which were firstly built in the 1960s and now characterise the city's architectural landscape. Food stalls were transferred to hawker centres where basic infrastructures are provided.

### The New Wave of Tourism

After restructuring the city area, the riverbanks were converted into touristic hotspots. Boat Quay, once a murky port, became one of the most coveted neighbourhoods for clubs and restaurants.

Water is now regularly cleaned and tourist boats allow sightseeing for Singapore's tourists.



Indonesia



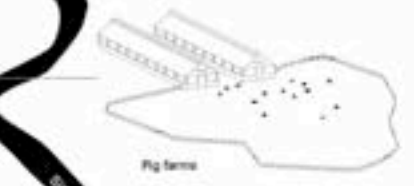
High density buildings



Hawker centers



Pasir Panjang



Pig farms



Squatters



Street hawkler



Tourism



Embankment



Cleaning



Catchment



Bumboats

# Reservoir Typologies

Singapore reservoirs differ not only by function, but also by form. Some are clearly rivers that have been dammed whilst others are lakes that have been upsized. This morphological diversity brings richness to the landscape of

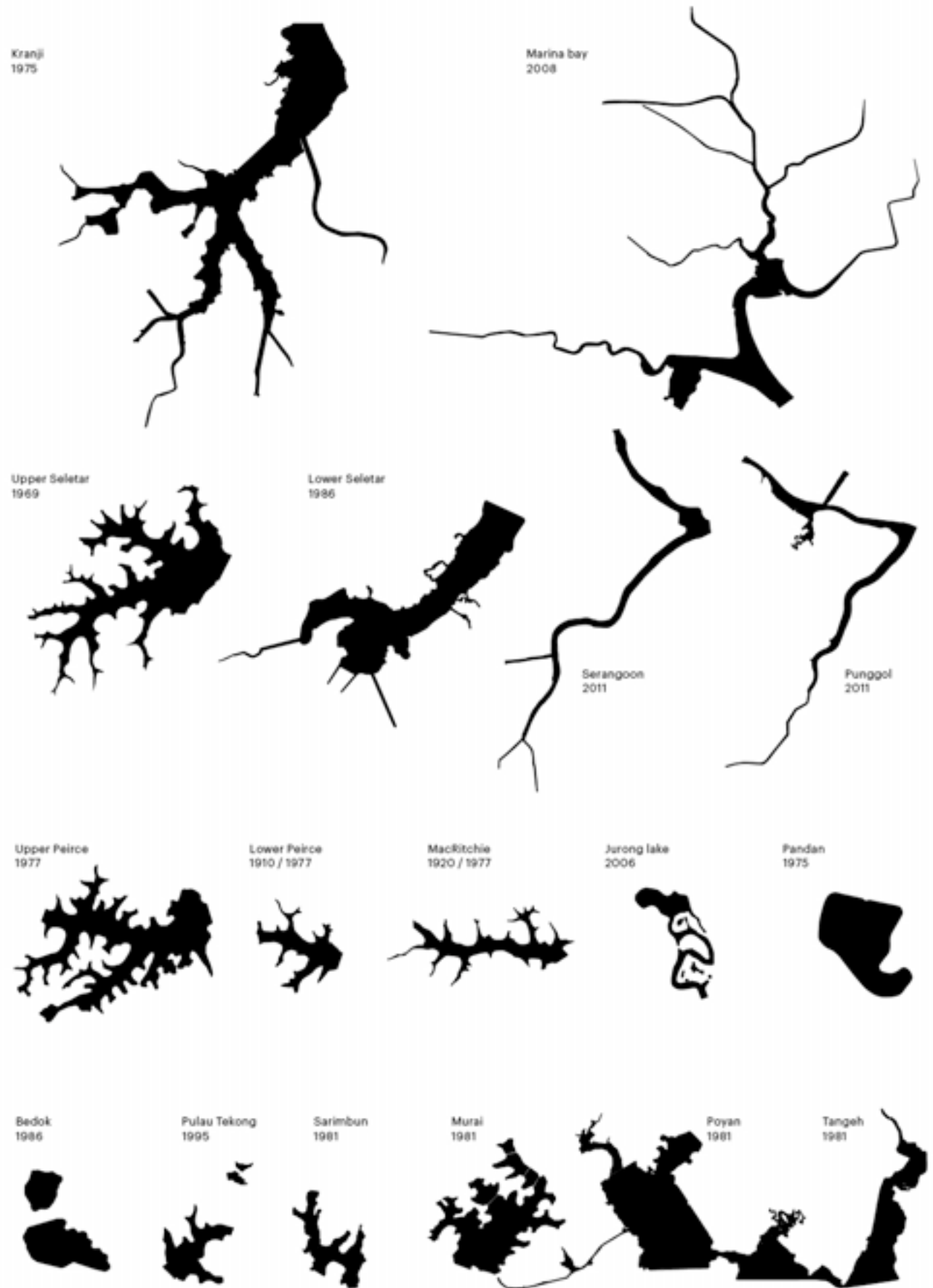
the island. Unfortunately Singapore's authorities are very slow to exploit this grandeur. Most of them continue to be seen as mere reservoirs instead of urban artefacts.



Linggui 1990

### Singapore's Reservoirs

The Linggui Reservoir in Malaysia (this side) covers a surface double the size of all national reservoirs of Singapore (right side).



Kranji 1975

Marina bay 2008

Upper Seletar 1969

Lower Seletar 1986

Serangoon 2011

Punggol 2011

Upper Peirce 1977

Lower Peirce 1910 / 1977

MacRitchie 1920 / 1977

Jurong lake 2006

Pandan 1975

Bedok 1986

Pulau Tekong 1995

Sarimbun 1981

Mural 1981

Poyan 1981

Tangah 1981



### Forgotten in the Jungle

When water became a concern, Singapore started stocking it in reservoirs it placed in the middle of the forest. With the MacRitchie reservoir built in the middle of the eighteenth century, the island was able to provide enough water for its port and the numerous boats that stopped there. This phenomenon continued with the Lower Peirce reservoir, the Upper Seletar reservoir and the Upper Peirce reservoir. In those times, water was not considered as an urban artefact but more as a commodity. Thus the access to these geographical spaces was not seen as a necessity.

When Singapore experienced a surge in its population growth in the 1970s, a new generation of reservoirs was built. Exploiting the last space in the jungle, the reservoirs were built in military zones, making them absolutely inaccessible to the island's population. In 2013, this type of water reservoirs remains essentially closed to the public even though an evolution in the PUB's mentality created a more interactive future for these waterscapes.



### Upper Peirce

Except for a golf course on one of its sides and a few picnickers on Sundays, the Upper Peirce reservoir remains hardly used by the Singaporean population. It is unconnected to the public transport system and can only be reached by car. Water treatment plants and storage facilities as well as military zones can be found along the shoreline. A few remote paths leading through the jungle allows users to appreciate the rich wildlife still present on the island, free from human interference.



2.



3.

1. Upper Peirce reservoir
2. Military zone next to the reservoir
3. A small part of the shore close to the dam makes an picnic area.





#### The Zoo Reservoir

The Upper Seletar reservoir is another example of a body of water difficult to access. The only exception is its dam and the Singapore zoo that is situated on a part of the reservoir. There, people use the view to take souvenir photos and feel as though they landed in the middle of primary nature, while actually being in an artificially recreated landscape. A single boat is allowed on the lake: a tourist attraction offered by the zoo.

A tourist boat that transports zoo visitors around the facility



#### Apparent Wilderness

One could think that these jungle reservoirs are the last remains of Singapore's natural landscape. The truth is very different: although the nature is primarily rainforest, its ground is engineered to catch every drop, leading the water to the reservoirs.

The reservoirs were upsized in the 1970s to store as much water as possible. Because no fishermen are allowed, the fishes there are especially large.



**In-Between Zones**

In the 1970s, a new generation of reservoirs appeared. Located outside the city to prevent the pollution of its water, these reservoirs remain difficult to access. A common character of these reservoirs is expressed through the multiplicity of different land use around its shores: military grounds, industrial zones, forests, parks and golf courses. They are also set far away from residential zones to prevent interaction.

Although these reservoirs are underused and located outside urban centres, they could be reintegrated if the city continues to expand around them.



- 1. Pandan's industrial surroundings
- 2. Flood control building
- 3. Industries on the shores of the reservoir
- 4. Pipeline pumping water out of the reservoir

**Jurong's Shores**

The Pandan reservoir is set in one of Singapore's industrial zones in the south of Jurong. Although residential areas are not in direct proximity to its waters, the reservoir became more user-friendly when a rowing club and a park were established on its shores. In spite of this evolution, the surrounding environment remains morose with industries and containers making a clear contrast to more integrated reservoirs like Marina Bay or Punggol.

"In-between" reservoirs stay largely undefined spaces due to a lack of a clear vision and the heterogeneous areas around them.



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#### An Industrial Paradox

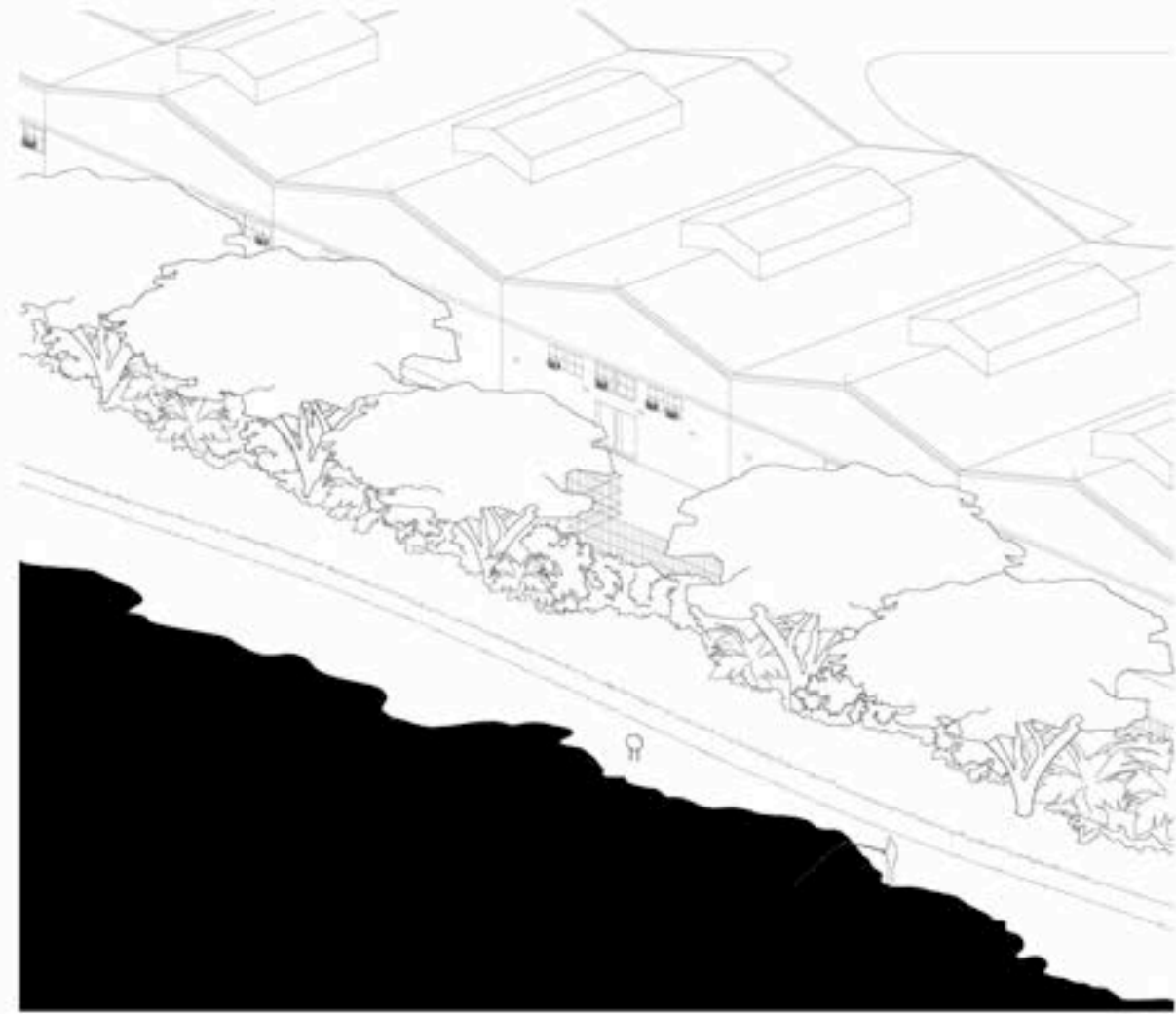
Industries as well as military zones and nature reserves encircle the shores of the Kranji reservoir. A few people fish near the dam, far from the control of the Public Utility Board. Fishermen risk a fine up to five hundred Singapore dollars if they get caught.

This attitude of forbidding direct contact with water is meant as an extra safety against water pollution: no fishing, no swimming, no dogs. In contradiction with these bans, the fact that numerous middle-sized industries are in close proximity to the water does not seem to be a problem.



Left:  
The reservoir seen from  
the dam

Bottom:  
Illegal fishing on Kranji's  
shores



#### Beautified Shore

The industries set along Kranji reservoir's shores are separated by a green belt made out of trees and bushes. This is meant as a reservoir beautification as well as a buffer against possible pollution.



**Urban Integration**

In around 2005, the Public Utility Board realised that waterscapes and channels could actually serve the city more than by just stocking water as a basic resource. It created a new policy called "ABC" (active, beautiful and clean) and started integrating water infrastructures to the city.

With this, water came to be seen as multifunctional in the newly built reservoirs and other selected sites were carefully picked for renovation and re-naturalisation. In this new policy, carefully selected activities are permitted in certain locations. For example, the Punggol reservoir has a defined area where the population can go kayaking.

Although this evolution allows more interactions, it is only focused on certain areas of water infrastructures. Thus most of the city stays in the old system where the infrastructures are completely separated from the island's population. Only a few "ABC" projects have already been built. The location choices for such redevelopment favour new residential areas and touristic hotspots.



1. Chinese gardens at Jurong lake
2. ABC aims to promote reservoirs for pedestrians and bird watchers
3. View of the landscaping of Jurong lake
4. Jurong lake at dusk

**"ABC": A New Policy**

When one talks about interactions, one expects to actually be able to touch the water. The "ABC" policy however does not allow any direct contact. It is more meant as a dialogue between land and water - people jogging and sitting at its sides, view towers and bridges, kayaking and bird watching. In this manner a more distant relationship is created: an indirect interaction.

The official explanation for the ban of direct interaction is related to concerns with pollution. However, given the fact that high-tech cleaning processes remove contamination created by roads and industrial areas after the water has passed through reservoirs, the ratio of pollution created through direct human contact is rather negligible.



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#### CBD's Luxury

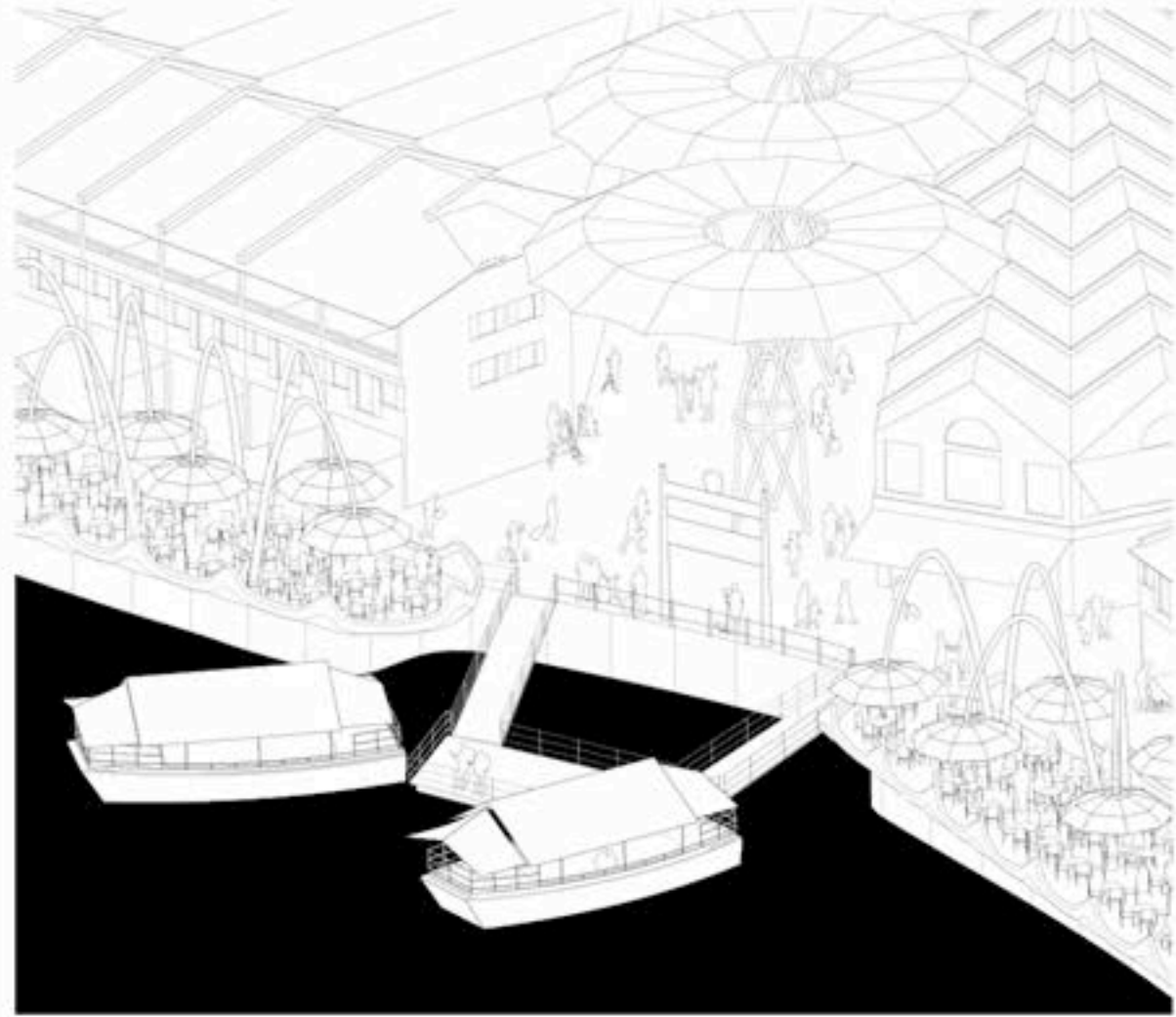
Marina bay differs from all other reservoirs by the sheer density of the city around it: from the towers of downtown to the nightclub neighbourhood of Clarke quay, from the harbour front of Marina Bay Sands to the high-ways passing over it. This proximity to water enriches the landscape, attracting tourists and business. Hence the reservoir is in perfect contradiction to Singapore's old policy of protecting and shutting off its waters.

A new phenomenon establishes itself in these new urban reservoirs: the trade off between the limited surface and the shortage of water. This leads to stronger interconnectivity between the city and the water. It also creates new problems, such as higher water pollution levels due to urban surroundings.



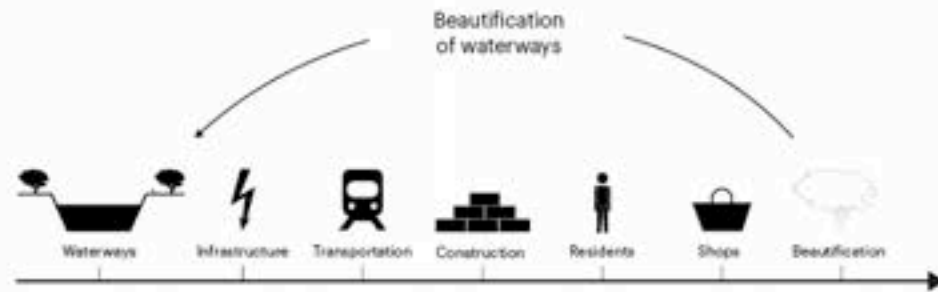
Left:  
Singapore's iconic Marina Bay Sands on the shore of the Marina reservoir

Bottom:  
Jogger on the Marina barrage



#### A Tourist Attraction

Whereas almost all direct interaction with water is prohibited, tourist boats provide an exception to allow tourists to admire the skyline. Cleaning boats patrol the channels.



**A City in the Making**

More than a million new citizens have been added to Singapore's population in the last ten years and this number is expected to rise even more reaching a total of six million people in 2017. To meet the rising demand of living space, new residential areas are being developed. Watertown, a new residential project situated in Punggol in the Northeast region of the island adds five thousand new living unites to try to satisfy demand pressure.

The centrepiece of the urban plan consists of a waterway connecting Punggol and Serangoon reservoirs. PUB's new interaction strategy permitted to build an attractive waterway, referred to as the "Venice of Punggol", instead of a cost effective pipeline.

The newly acquired significance attached to the waterway as an attraction for investors and residents can be shown chronologically; the waterway, instead of being reshaped when the city would already exist around it, was beautified when only roads and basic infrastructures were being built.

This shows that a new purpose has been added to Singapore's water system besides the one of being functional. It is now used as an urban artefact capable of generating a more attractive neighbourhood with higher rents.



1. Bare field in wait of investors  
2-4. City in construction with the green belt already built in the foreground



2.



3.



4.

# Lines through the Island

Singapore's channels spread all over the island, like a highway for water. Their presence in the city landscape cannot be overseen and their appearance could not be more diverse. The vast majority of channels are designed as mono-functional infrastructure elements made out of concrete. Their features were designed in order to receive large amounts of water, assure a constant flow and keep the precious good free from pollution. This type of channel is inaccessible, each side being closed by railings. Despite

their unattractive appearance, people are found using the paths along the ducts for strolls and jogging.

But channels are now being renovated as integrated urban artefacts. Some projects simply try to beautify the existing infrastructure with vegetation to make it more user-friendly. Others are entirely rebuilt, creating spaces for people to enjoy and interact.



Primary Drainage Network

■ Reservoirs  
 ▨ Urban footprint  
 — Channels

0 2.5 5 km N



- 1. Channel in the Ang Mo Kio neighbourhood
- 2. Channel near the Pandan reservoir
- 3. "River plains" in Bishan Park

### Scars and Connectors

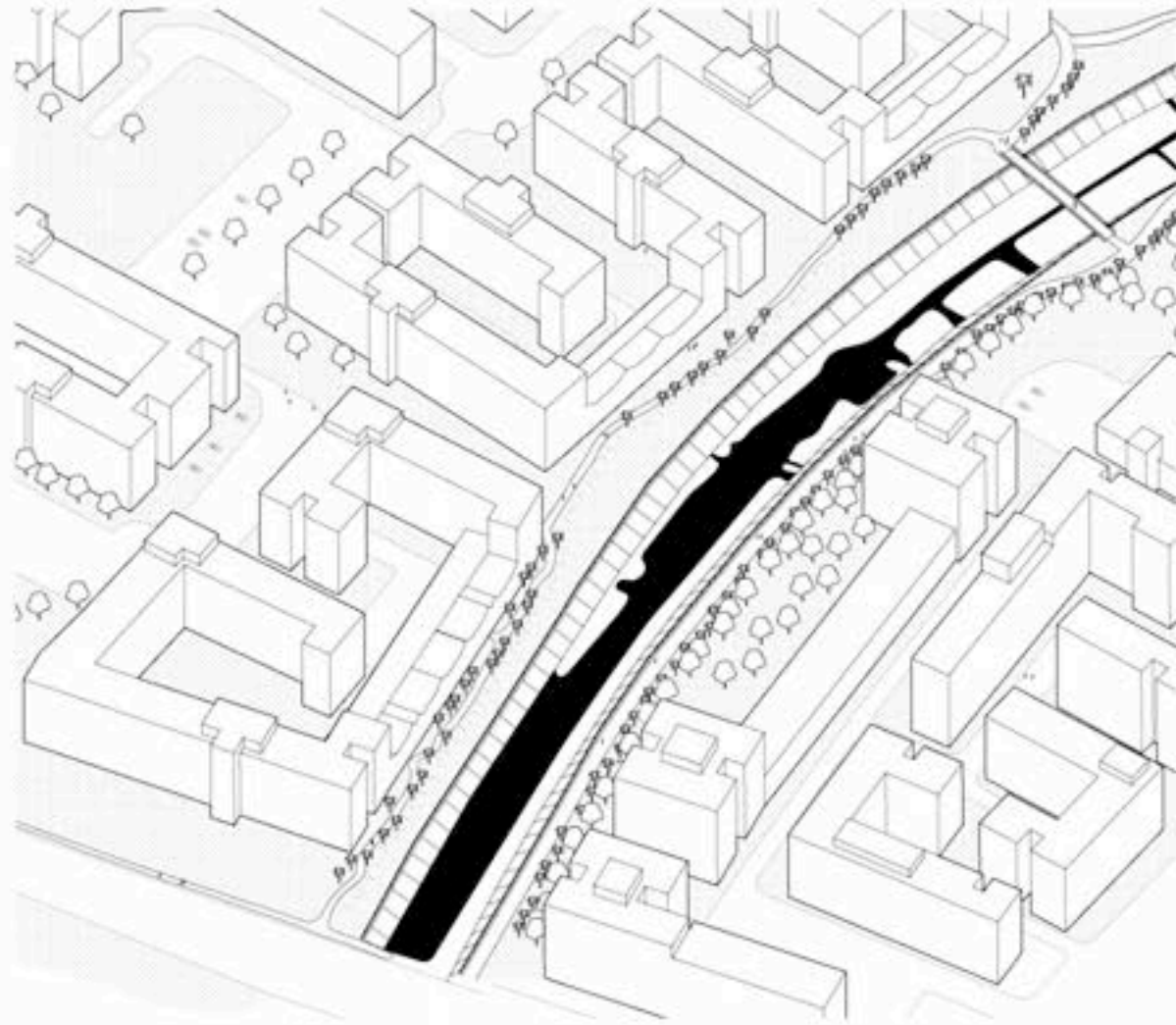
Similar to roads, the majority of channels create boundaries between different urban parcels. A few star projects show how park landscapes can be combined with channels to create neighbourhood centres instead.



2.



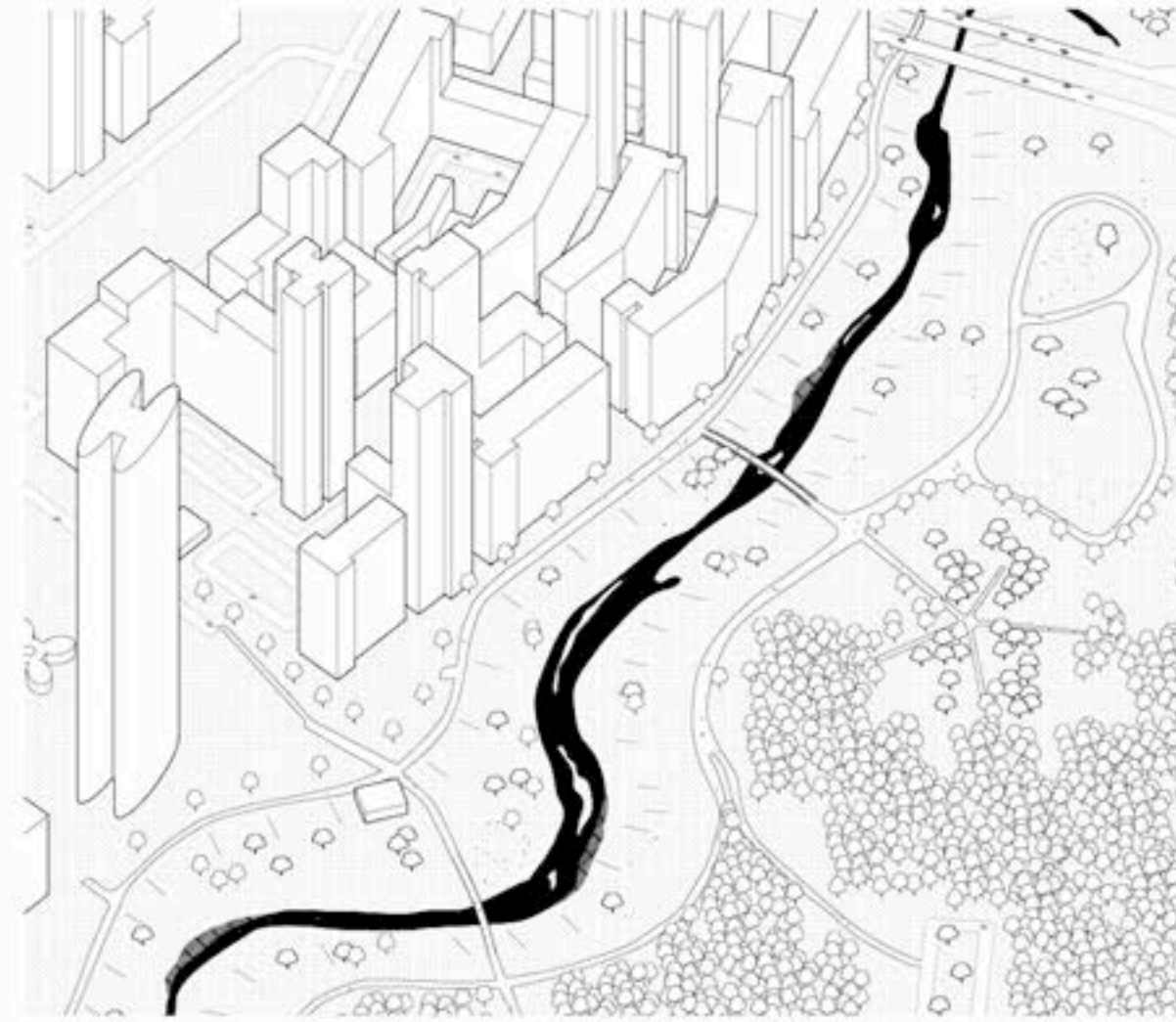
3.



#### 1970-80s - Engineered Channel

In those years, urban planning was dominated by direct functionality, with each urban artefact having a precise function. Hence channels were only meant to direct water from one part of the island to another. Basic security and anti-pollution rules fenced the channels from their surroundings. The downside of this approach is the separation of territory into different areas.

Pasir Ris channel separating neighbourhoods



Bishan Park connecting neighbourhoods

#### 2010s - Renaturalisation

With its new "ABC" policy, the PUB is not only making waterways friendlier but also having an effect on the island's connectivity. Instead of separating neighbourhoods, it creates new urban centres, making the city's environment livelier. Although these new waterways seem to be part of nature at first sight, they are in fact a highly controlled apparatus of water regulation, designed vegetation and flood warning systems.





Kallang River

■ Water  
 ▨ Urban footprint



### Following Kallang

Channels cannot be classified by type seeing that they pass through diverse urban areas and change their appearance accordingly.

1 - 3: Kallang river begins as an overflow outlet at the Lower Peirce reservoir, constructed during British occupation and originally known as Kallang reservoir.

4 - 6: Further downstream the channel enters Bishan park where it flows into a re-naturalised shape, one of the "ABC" policy's star projects.

7 - 8: The park is followed by the old design of channels. The water is led by wide concrete basins towards its destination.

10 - 12: After six kilometres the channel transforms itself into a river, becoming part of the Marina reservoir.

13 - 15: The water goes through residential areas, separating the neighbourhoods.

16 - 18: The water arrives into the Kallang basin. There it is blocked from entering the sea by the Marina barrage and will instead be pumped and processed into drinkable standards.



1



2



3



4



5



6



7



8



9



10



11



12



13



14



15



16



17



18



1-4. Different types of drains

**Capillary Veins**  
 Upstream, channels split up into infrastructures that create a network of pipes and drains, some not larger than 30 cm. Water is collected from every surface, therefore the system is created like capillary veins bringing rainfall to the reservoirs.  
 During heavy precipitations, drains instantly get filled up but during dry spells they appear oversized. Except for the newest development projects, these drains are uncovered and hence are part of the Singaporean landscape.



2.

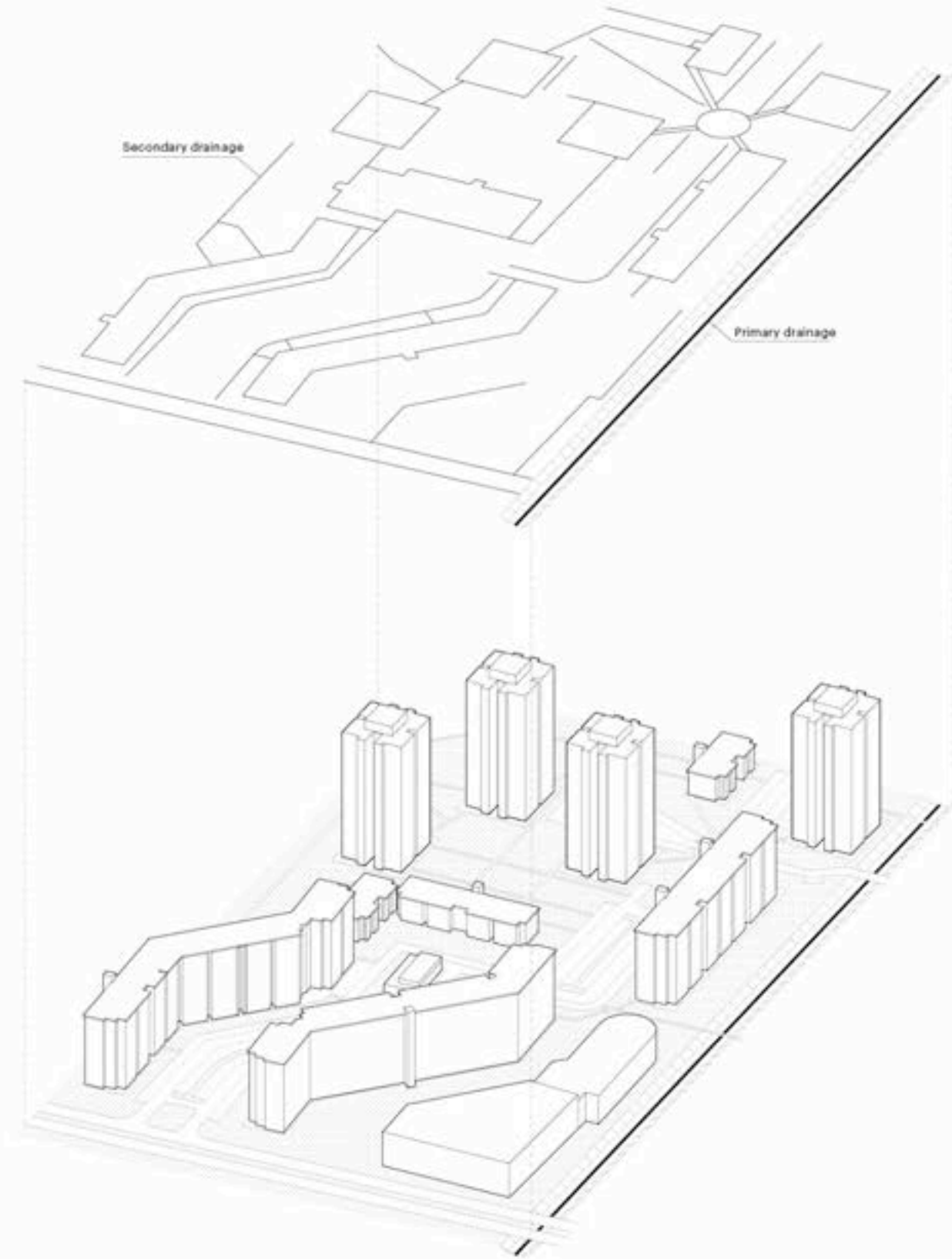


3.



4.

Neighbourhood Clementi West Street 1



# A Driving Fear

Since the very beginning of the Republic of Singapore in 1965, water was a vulnerable issue and a topic of national security. The fear of being at the mercy of Malaysia led to an unprecedented struggle for resource independence. Only with this historical background can Singapore's water strategies be understood. After more than half a century of fear, Singapore claims today to be able to satisfy its daily needs with domestic water productions. It also presents it-

self as a leader in water management and water production technologies.



June 1988, Singapore's and Malaysia's prime ministers sign the agreement to build the Lingui dam



**Water Scarcie**

Singapore realised early that water scarcity would lead to some significant problems. Since as early as 1824, it has been trying to keep up providing enough water to its growing population and industries. Even with imported water from Johor, draughts still affected the vulnerable city-state. In 1963, the situation became so bad it had to cut supply for periods of twelve hours to be able to make the whole nation survive. Water became a matter of life and death.



**Singapore's Fear**

Singapore's dependence on Malaysian goodwill became tangible the moment it declared independence. After Malaysian Prime Minister Tunku Abdul Rahman threatened to cut the water supply if the young nation's foreign policy would interfere with Malaysia, tensions between both countries reached a new high. Singapore also feared shortages like in 1963 due to draughts or war like in 1942 during the Japanese occupation.



**Reforming the Territory**

After deciding to become more water self-sufficient, the first step was to increase the domestic catchment capacity. The three existing reservoirs were heavily enlarged and complemented by eleven new ones, increasing the storage capacities within 20 years by a factor of eighteen. The catchment territory was first enlarged to 50 percent of the territory and reaches now over sixty six percent.



**Turn of the Century**

From the beginning on, Singapore knew that it could not solve its water supply problem only with rainfall, its own territory not being big enough to catch as much water as demand required. Therefore the government invested large amounts in researching new technologies. After the turn of the millennium, lower prices allowed to introduce NE-Water (2003) and desalination (2005) plants into the water cycle. The only limit to these new technologies was their cost.



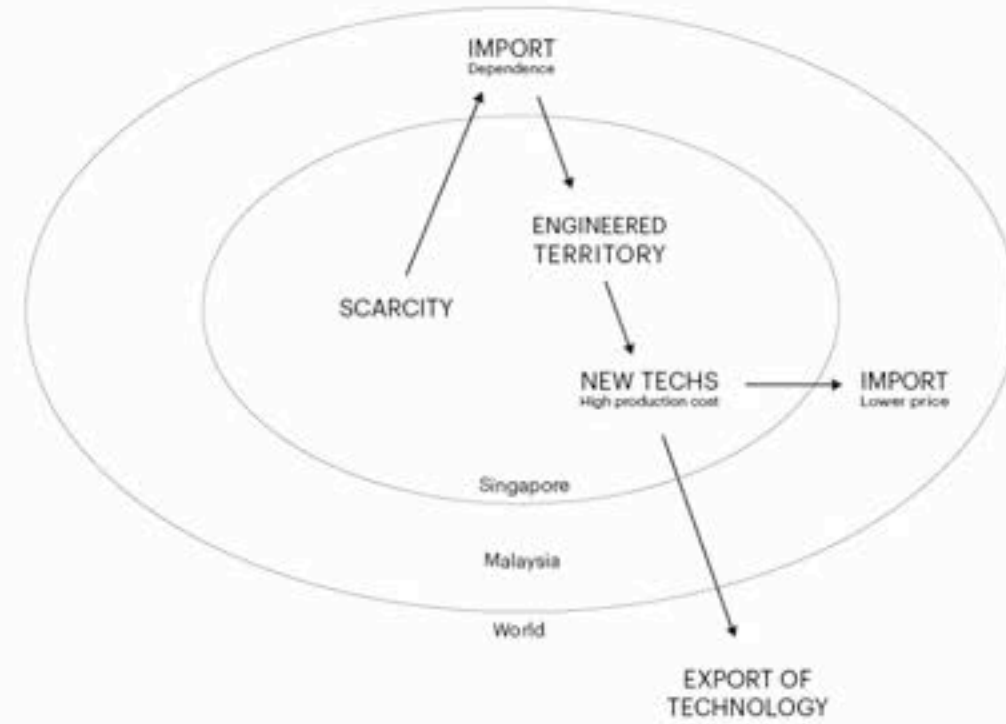
**From Dependence to Chance**

On the 30th of July 2012, PUB's chief executive Chew Men Leong declared: "If you're asking me this question about when will we ever get self-sufficiency, I will put it this way that we can be self-sufficient if need be". Whilst the 1962 import agreement with Malaysia stays the same, Singapore's position in negotiations changed completely. Import remains the first choice because of price more than need.



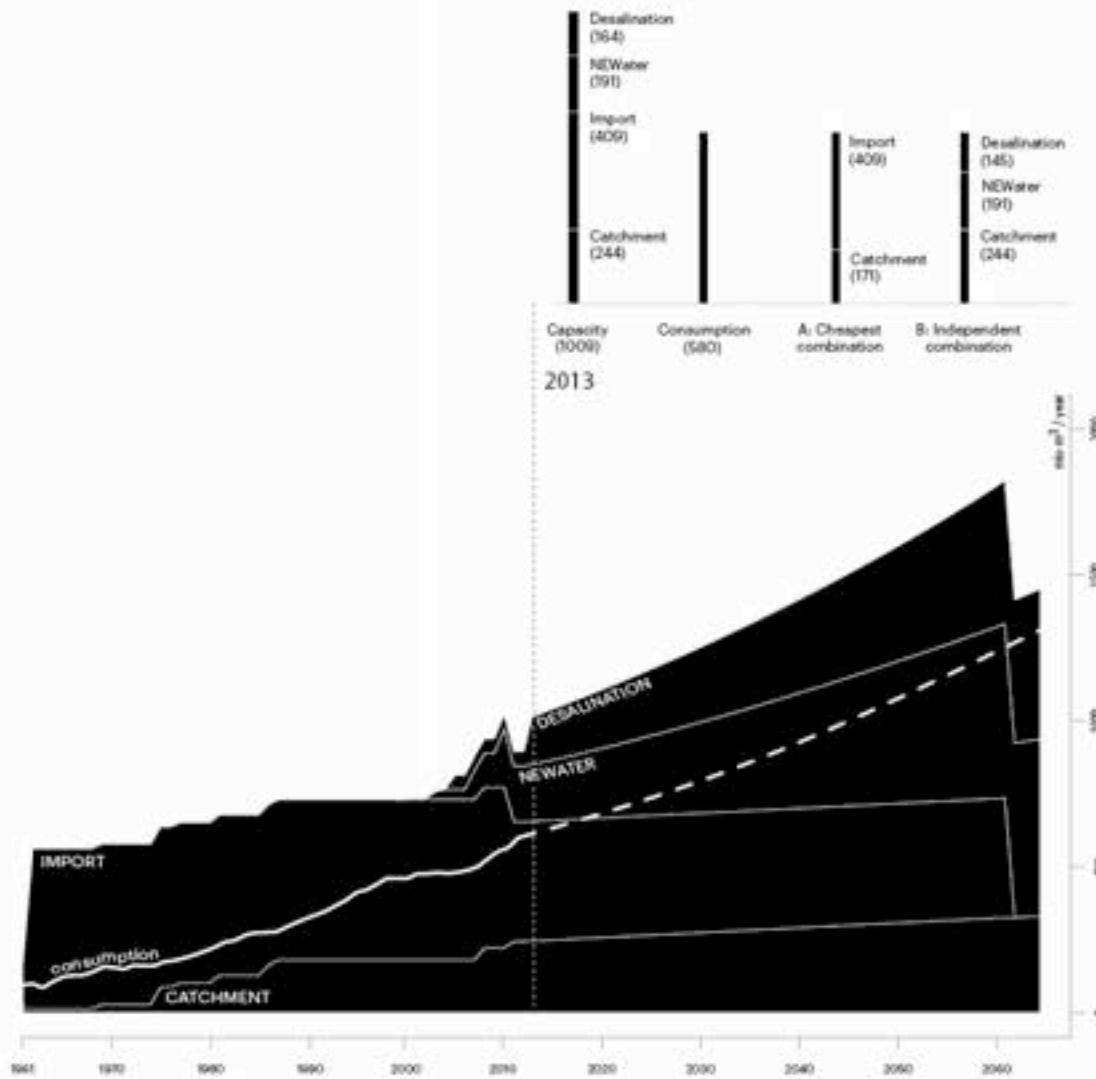
**Exporting Know-How**

Research is still a big element of expenditure for Singapore's government and its companies gather profit from past investments. In 2013, the Singaporean water industry counts more than 100 companies and is estimated to be worth 9 billion Singapore dollars.



**A Chronological Strategy**

In the last decades Singapore introduced different strategies to solve the problem of water scarcity in bilateral contracts and within its own territory.



The Possibility of Choice

Singapore aims to be self-sufficient in the year 2061 when the second import contract with Malaysia will expire. But by comparing the maximal capacity of new technologies to the national consumption, it becomes apparent that Singapore already has the capacity to produce enough water.

Importing water from Malaysia remains the cheapest solution, followed by rainfall catchment, NEWater and desalination. The last became more accessible in recent years but the costs of production are still double the ones of imported water from Johor.

Meeting the Demand throughout Time

Development of demand and supply over 100 years: Since 1965 Singapore tried to become less dependent on water imports by increasing the catchment areas in the 1970s and 1980s and by introducing new technologies in more recent years.

The situation in 2013 (numbers in M m<sup>3</sup>/year): The combined capacity of natural sources, water factories and international contracts results in an oversupply. Variation A and B show possible combinations based on financial and political interests.



"Both and" Strategy

Given the fact that the island state is now able to be water independent, it can continue to import cheap water from Johor without fearing to be at the mercy of the Malaysian government. Instead of taking a clear position, one of total independence or one of financial necessity, it chooses a "both and" strategy, benefiting of the advantages offered by both sides.

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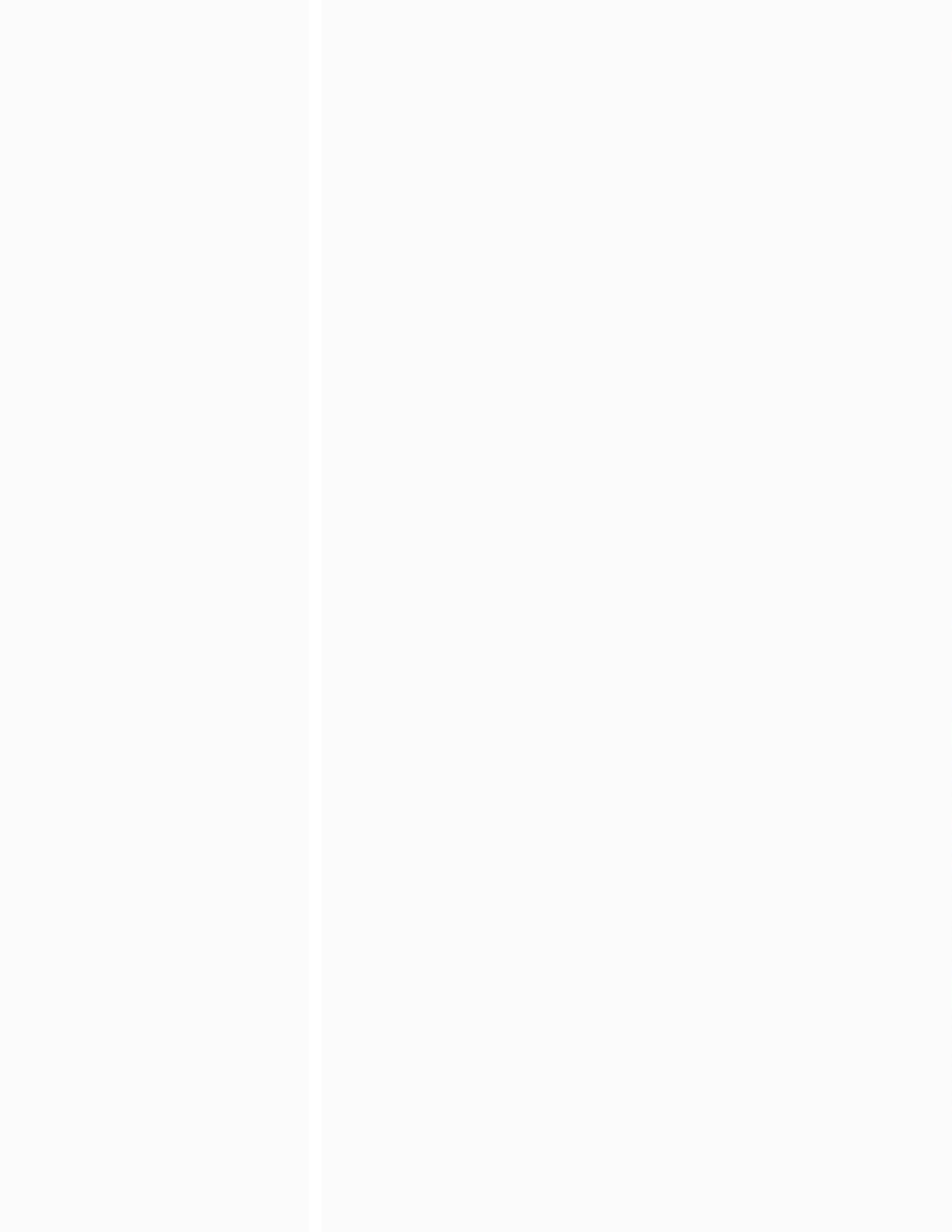
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Traditional fishing village, Tanjung Pagar Laut, Batam



Fish market at Jurong Fishery Port, Singapore

益  
YAK ANN

家魚源  
HONG GUAN FISHERY CO

廣  
廣

ALIAN  
112



Vessel arriving at a fishery port, Batam

# GROWING OUT

Food Supply of Singapore



One of the last fishing villages in Selat, Singapore

by  
Desirée Amport  
Caroline Schillinger

p.16

## Agricultural Pathways

Agrarian Change (p.22)

p.50

## A Region of Fish and Fishermen

p.32

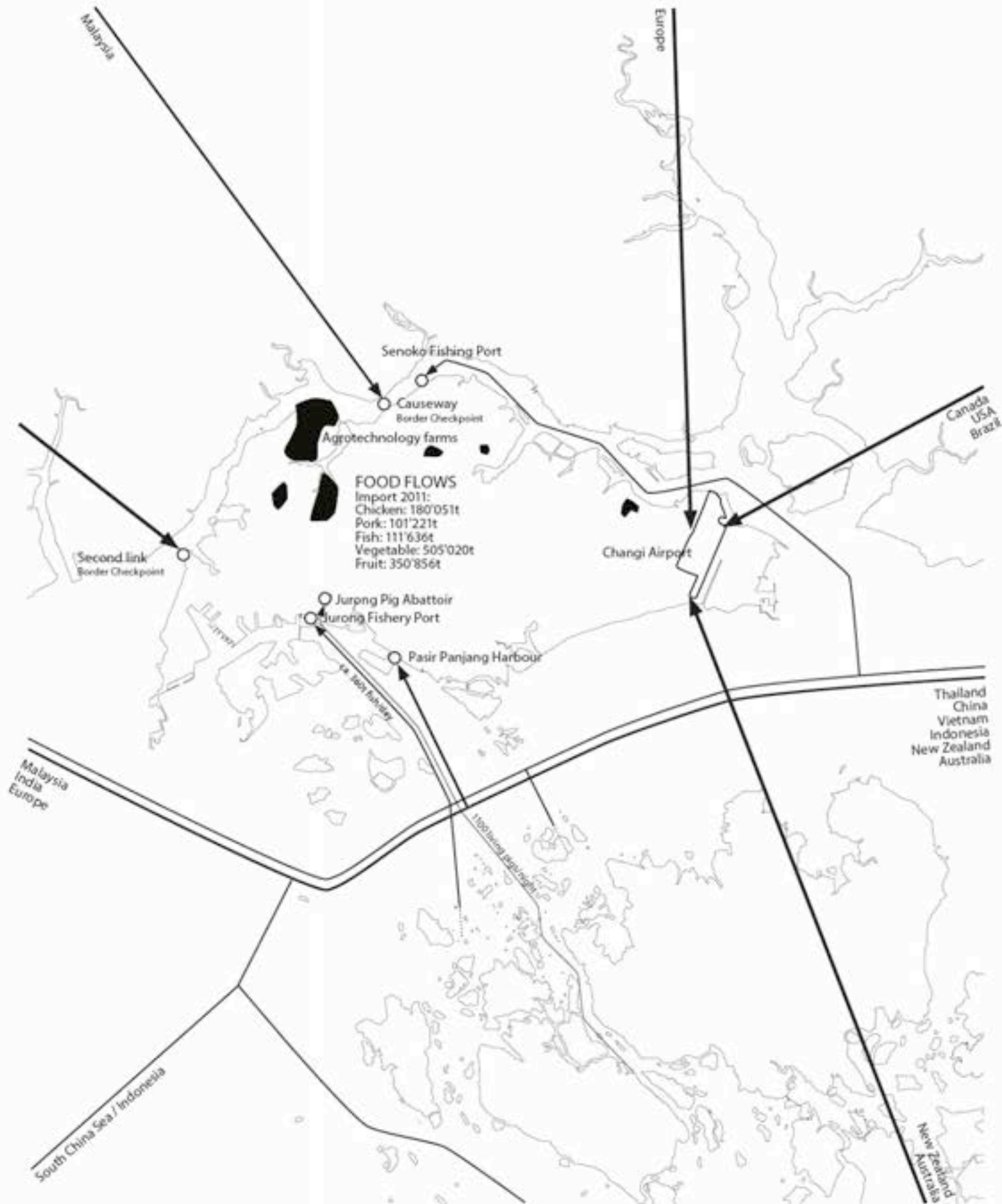
## Outsourced Farming

Case 1: Ornamental Farming (p.36)  
Case 2: Contract Farming (p.46)

p.72

## An Agriculture of Technology

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Once a nation with a lively farming sector, Singapore has reduced its agricultural land to only 1% of its total territory.

In the 1970 many farmers were displaced to provide land for housing and industry. Pig farmers were completely phased out, primarily for environmental reasons. With the urban renewal and industrial estate development, agricultural land became restricted to Agrotechnology Parks and Agro-Bio Parks where intensive farming is practiced, yet productions remain small as a result of the scale of the operations. Singapore is investing a lot in research and development, as it is pre-occupied for only producing a low amount of the food its growing population consumes; the land-scarce nation is highly dependent on its hinterlands.

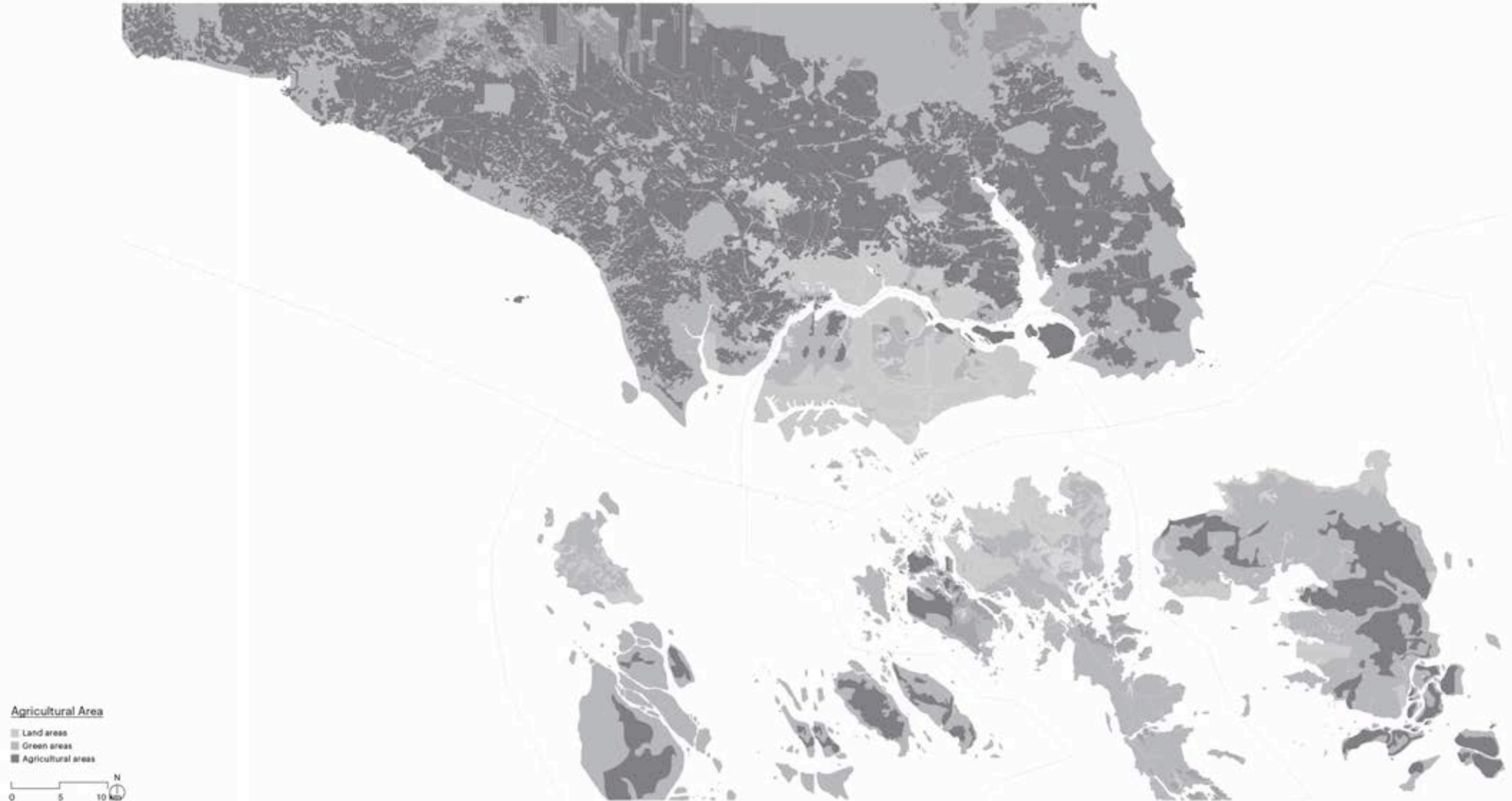
Singapore receives most of its food from five locations: two fishery ports (one in Senoko and one Jurong), the Malaysian Causeway and Second Link are transport routes for the trucks coming from Malaysia, Thailand and Vietnam. Changi Airport trades with world scale businesses.

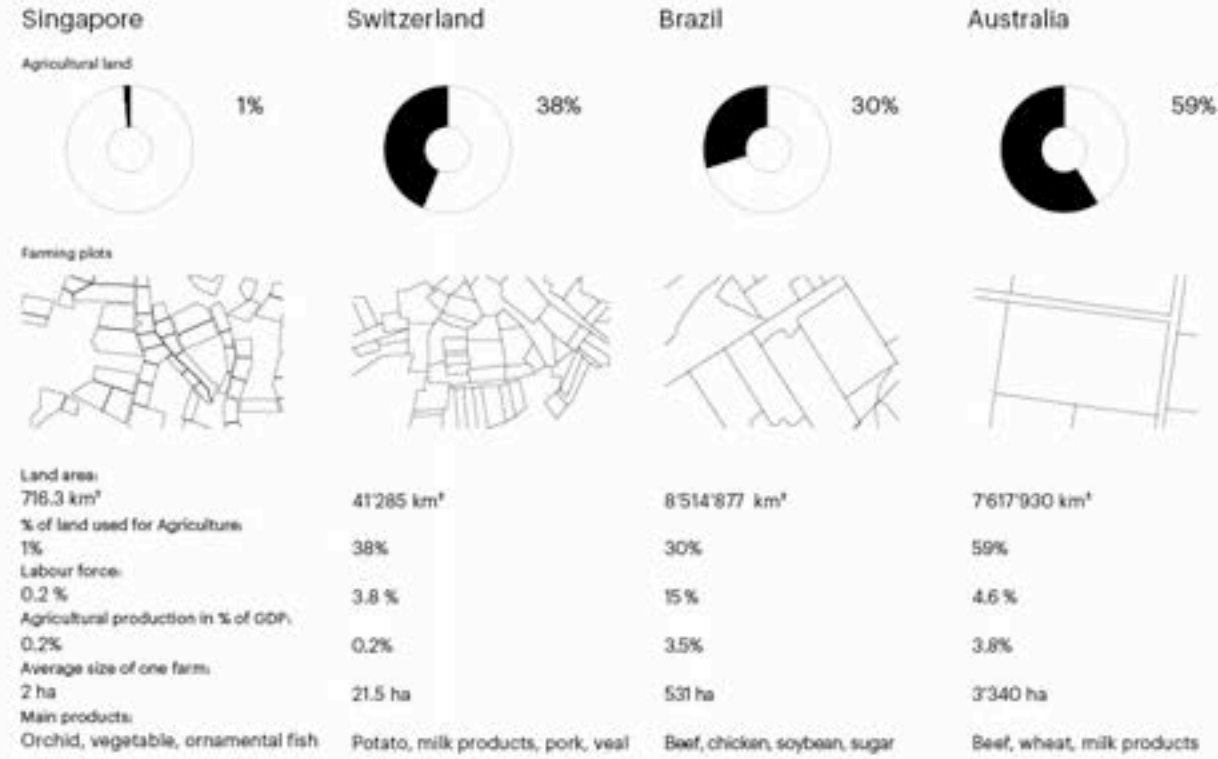
Malaysia and Indonesia are important agricultural regions and crucial trading partners for Singapore. In the 1980s, many entrepreneurs relocated their businesses to neighbouring countries where land prices are favourable and started with contract farming or just production abroad, while the output continues to be intended for the Singapore market.

# Agricultural Pathways

Surrounded by countries with a high quotient of agricultural area, Singapore stands out with its tiny arable territory. The limited land resources was a consequence of the industrialization, urbanization and water conservation strategies, which significantly increased the demand for land. Malaysia, Singapore's closest neighbour, has large areas of agricultural land. Divided only by the Singapore Causeway, the two countries are each other's primary trading part-

ners. Malaysia therefore plays an important role in providing Singapore with agricultural goods. Singapore is connected to its southern neighbour, Indonesia, mainly through the fishing trade.





Limited Agriculture

The agricultural area of Singapore accounts for only 1% of its total land and falls under strict governmental regulations. These areas are mostly located in Agrotechnology Parks, where plot sizes and functions are regulated. As a result of this, this sector is negligible in Singapore and only represents 0.2% of the total GDP.

The small agriculture activities mainly include two types of production: flower cultivation, particularly orchids, and ornamental fish rearing. The highly productive farms in the Agrotechnology Parks provide Singapore with rare varieties of fresh leafy vegetables, too.



Ornamental flower cultivation at the Agrotechnology Park, Lim Chu Kang



Vegetable farm at the Agrotechnology Park, Lim Chu Kang

Intensity and High Quality

The landscape is divided in several zones, which shows the range of agricultural activities regulated by the government. The ornamental flower and the vegetable farm are examples of efficient use of plots and the high cultivation standard on local farms. Cultivation under protective netting for high-quality production is widely practiced.



Food Import

	% Farm production	Tonnes	Dollars \$
Vegetable	4%	497,069	510,160
Fruit		350,856	519,340
Chicken	2%	180,051	536,311
Fish	3%	145,678	800,019
Pork		101,221	426,132
Beef		36,659	238,044
Duck		13,532	55,825
Mutton		9,260	74,689

Food Consumption

	Tonnes
Vegetable	505,020
Fruit	350,856
Chicken	175,428
Pork	101,004
Fish	111,636
Beef	26,580
Duck	15,948
Mutton	10,636

95% of Food is Imported

Singapore being a land-scarce nation imports 95% of its total food consumption. The huge foodstuff demand make Singapore highly dependent on its supplying countries. The Singaporean diet contains large amounts of fish and meat. Yet, vegetable and fruits are the most important products in terms of quantity.



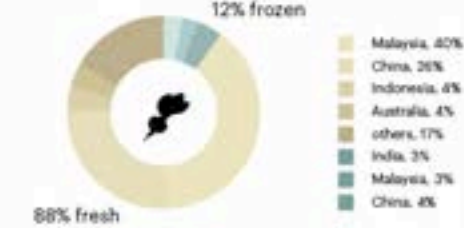
Food Sources

Most of the fresh products coming from neighbouring nations such as Malaysia, Indonesia and Thailand and are transported by truck or ship. Livestock imports come primarily from Malaysia and Indonesia. Singapore imports most of its live pigs from Indonesia. China is an important supplier of fresh and frozen vegetables and fruits for Singapore.

Since the transportation and the processing condition improved, it is favourable to import frozen food from China and countries even further out.

The frozen food sources expand the supply circle to a world scale. Large amounts of frozen pork and chicken are being imported from Brazil to Singapore.

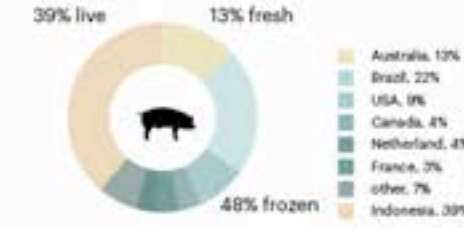
Vegetable  
497,069 tonnes  
510,160,000 dollar



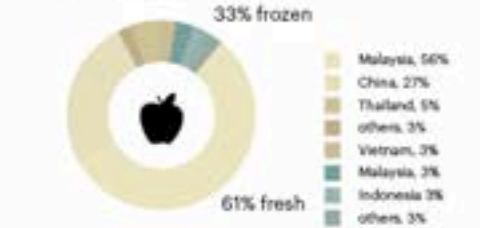
Poultry  
13,583 tonnes  
591,936,000 dollar



Pork  
101,221 tonnes  
426,132,000 dollar



Fruit  
350,856 tonnes  
519,340,000 dollar



# Agrarian Change

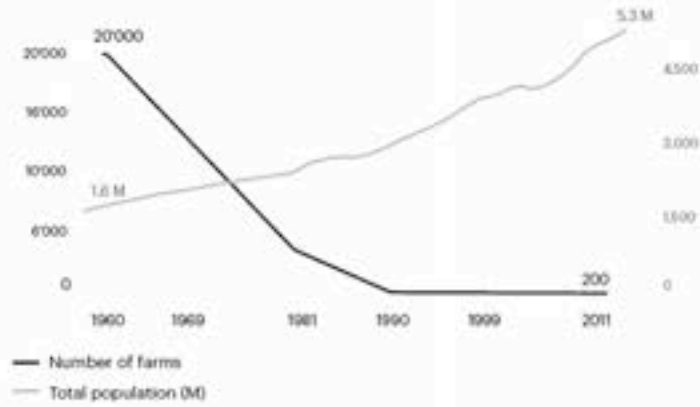
Singapore's agricultural sector has shown significant changes on the business front in the last century. After Singapore's independence, the population increased rapidly while the number of farms decreased.

Whereas in the beginning of the 20th century Singapore's agricultural sector was lively, farming has nearly been phased-out in recent years. In the 1980s the agricultural sector accounted for about 2.25% of the country's

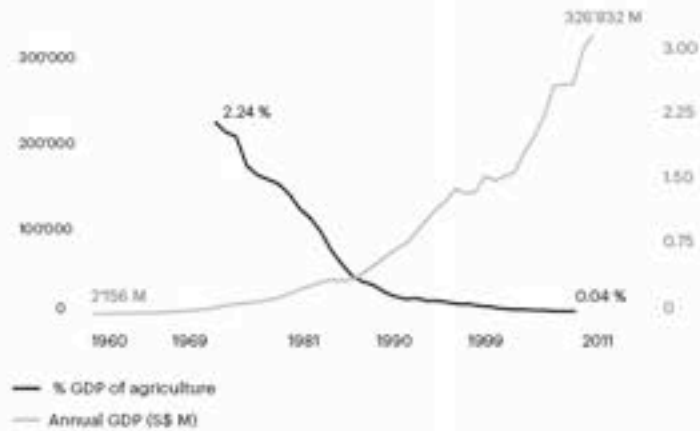
GDP. This has been reduced to 0.004% today. In contrast, the total national GDP increased from about 2 million to up to 326 million.

Singapore has limited the agricultural sector strict zoning regulations and through a shift in focus towards tertiary industries that have allowed for the impressive economic growth nationwide.

Population Growth Compared with Number of Farms in Singapore



Singapore's GDP and its Agricultural Percentage



## Development of Singapore's Agriculture Sector

1959  
Primary Production Department (PPD) was formed

Most farmers and fishermen were poorly educated and they used traditional farming methods



1965  
Independence of Singapore

Provision of essential data allows the government to formulate policies and plans to further develop intensive farming to ensure optimal use of limited land resources

Larger commercial farms subsistence type farms and laboratory techniques were upgrading

1968  
Farm Licensing

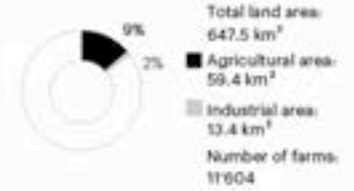
Resettlement of many farmers to provide land for housing and industry

1972  
Resettlement Policy

Self-sufficiency in the production of poultry, egg and pork

1984  
Phasing Out of Pig Farms

Drastic decline in agricultural land is shown



1998  
Development of Agrotechnology Parks

There were 2'075 licensed farms occupying only 2'037 hectares of land total output of some S\$362 million worth of farm produce

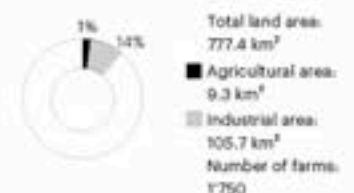
1998  
Pig Farm in Pulau Bulan established

All pig- and duck farm activities were phased out

The Agrotechnology Park in Lim Chu Kang became fully operational.

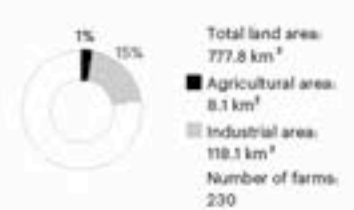
2000  
Agri-Food and Veterinary Authority (AVA) was formed

Farming abroad now seen as new food supply strategy by import-dependent governments



2008  
Global Food Crisis

Beacause of the food insufficiency food import is more than 90% of the consumption



2009  
Contract Farming

FairPrice chain brings in 170 products under contract. A farmer agrees to provide a set amount of produce in accordance with the delivery schedule and standards set by the buyer



#### 1985 Masterplan with Agricultural Land Areas

Total land area:  
545.1 km<sup>2</sup>  
 Agricultural area:  
110.2 km<sup>2</sup>  
 Industrial area:  
13.1 km<sup>2</sup>  
 Number of farms:  
17663



### Rural Singapore

Nearly one quarter of the country's territory used to be reserved for agricultural activities. The country hosted as many as 17663 farms when a great proportion of locals were involved in the agrarian trade. Singapore was almost self-sufficient for poultry and pork and produced about half of the vegetables it consumed. Most farmers and fishermen were poorly educated and they used traditional farming methods.

The farm areas were mainly located in Lim Chu Kang Farming Estate and Ponggol Farming Estate. Ponggol was intensively used as a pig farming area with large-scale practices on small plots of land.

The government planned to convert small farms into large ones concentrated mainly in Ponggol. Due to the lack of land, these were located in close proximity to densely populated residential housing areas.



1. A pig farm in Lim Chu Kang, 1955
2. The vegetable farm in Potong Pasir, 1950
3. The dairy farm in Kranji, 1951



Top:  
Dairy farm in Bukit  
Panjang, 1951

Bottom:  
The vegetable farm at  
Fotong Pasir, 1951



Top:  
A vegetable farm in Jalan  
Kayu, 1950

Bottom:  
The vegetable farm in  
Jalan Kayu, 1950





#### 1985 Masterplan with Agricultural Land Areas

Total land area:  
647.5 km<sup>2</sup>  
 ■ Agricultural area:  
59.4 km<sup>2</sup>  
 ■ Industrial area:  
13.4 km<sup>2</sup>  
 Number of farms:  
11,604



### Resettlement and Phasing-Out of Farmers

The government began phasing-out pig farming in 1984 because of the odour and the pollution it caused. Farm owners were reallocated other land on the island through short-term leases and under strict conditions; they were only to take part in farming practices with minimal environmental after-effects, such as vegetable farming. The land zoned for agricultural practices was reduced drastically in the process. Many farmers were resettled to provide land for housing and industry. Because of the rapid urbanisation of Singapore, hundreds of villages were demolished and the land was made free for redevelopment. The agriculture production decreased rapidly and Singapore's dependence on imported foodstuff increased. At this point, the Primary Production Department (PPD) began to develop farmlands into Agrotechnology Parks to optimise the outputs of the few patches of agricultural lands remaining.



Top:  
The Ama Keng vegetable  
farming villages, 1986

Bottom:  
Duck farm at Yew Tee  
village, 1986





### High Technology

Traditional ways of farming disappeared almost completely from Singapore. There remains a few fishing villages in the northeast part of Singapore. These, however, are no longer economically viable.

PPD began with the agro-technology programme in 1986. Agro-technology is defined as the application of biological science and technology to intensive farming systems. Agro-technology parks are intensive high-technology farms and were established to maximise the output from Singapore's limited agricultural land.

In 2002 the Agri-Food and Veterinary Authority of Singapore (AVA) was formed with the aim of providing safe food, healthy animals and plants for Singapore with highly regulated import and export conditions. Today, Singapore's remaining agricultural land makes out for 1% of its total territory.



Top:  
Ornamental flower breeders,  
Agrotechnology Park in  
Lim Chu Kang

Bottom:  
Goatfarm Hay Dairies,  
Agrotechnology Park Lim  
Chu Kang



# Outsourced Farming

Since the development of Agrotechnology Parks, the plot sizes have become highly regulated and the price of land has been rising rapidly. A growing number of farmers are subcontracting or investing in food production carried out in Malaysia or Indonesia. The output is still intended for Singapore's population. Contract farming and farming abroad is supported through governmental incentive, such as low import taxes. The Malaysian Investment Development Au-

thority (MIDA) even invited Singaporean farms to resettle their business on its territory.

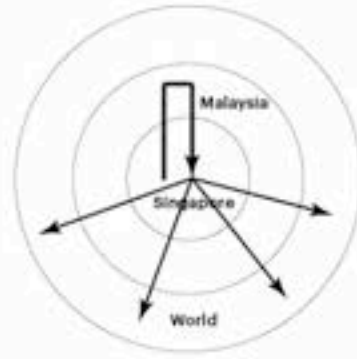


Orchid plantation in Johor,  
Malaysia



Mr. Lee Chee Hock and Mr. Lee Chee Wee Chinese brothers, living in Singapore

**Case 1: Ornamental Farming**  
**Hock Wee Nurseries Sdn Bhd**  
 The Orchid farm started in 1979 and is located in Malaysia since 1988.  
 "There was no possibility to continue the orchid business only with the fathers farm in Singapore therefore we ventured into Malaysia. Our farm in Singapore is sedimentally important for us because our family business started there. We do research in vertical farming to follow the High Technology standard of orchid industry to remain competitive."



**Case 2: Contract Farming**  
**Bright Floriculture Sdn Bhd**  
 The vegetable farm started in 1979 and is located in Malaysia since 1989.  
 "Malaysia invited us in the 1986 for resettlement of the farm business. We wanted to keep the farm in Singapore but we couldn't resist against the government. They took our land in 1989. Since we are staying in contract business with FairPrice we have to deliver a certain amount per month direct to Singapore."



Mr. Ong Hock Beng Singaporean, living in Singapore

Two Cases

The orchid farm Hock Wee Nurseries and the vegetable farm Bright Floriculture are both owned by entrepreneurs who started their businesses in Singapore before relocating to Malaysia in the late 1980s. Both are now Malaysian-based companies and continue to operate in Singapore.

Almost all of the production of the Hock Wee Nurseries is being transported from Malaysia to Singapore's Changi international airport before being dispatched to a range of overseas markets. They are exempt from import taxes into Singapore. Bright Floriculture is under contract with the supermarket chain FairPrice. Every month the company needs to deliver a fixed amount of their production to this steady buyer. Most of the leafy vegetables are being transported over the border to one of the 230 FairPrice supermarket stores. These products taxed at a rate of 7 percent.



Top: The orchid farm of Hock Wee Nurseries, Malaysia

Bottom: The vegetable farm Bright Floriculture, Malaysia





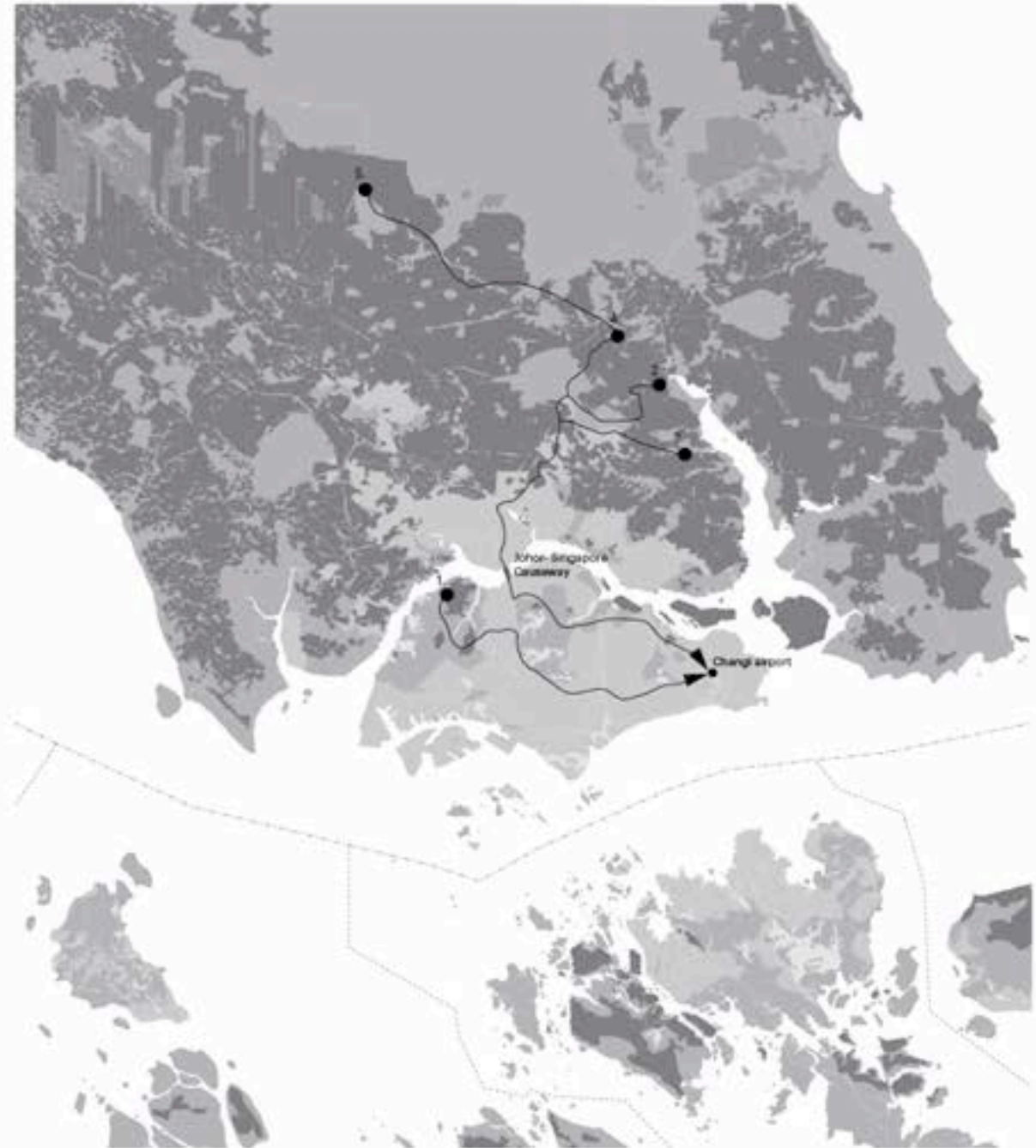
# Case 1: Ornamental Farming

Hock Wee Nurseries Sdn Bhd is managed by two Chinese brothers, Lee Chee Hock and Lee Chee Wee. After inheriting the family business founded by their father in 1979, they ventured to Malaysia in 1988 where Hock Wee Nurseries was founded. They have since established four more farms in Malaysia. They continue to live with their family in Singa-

pore near Zion Orchids, the original family farm. The orchid industry is a flourishing business in Malaysia and through the use of new inventive technologies, the two brothers manage to maintain a competitive place in the market.



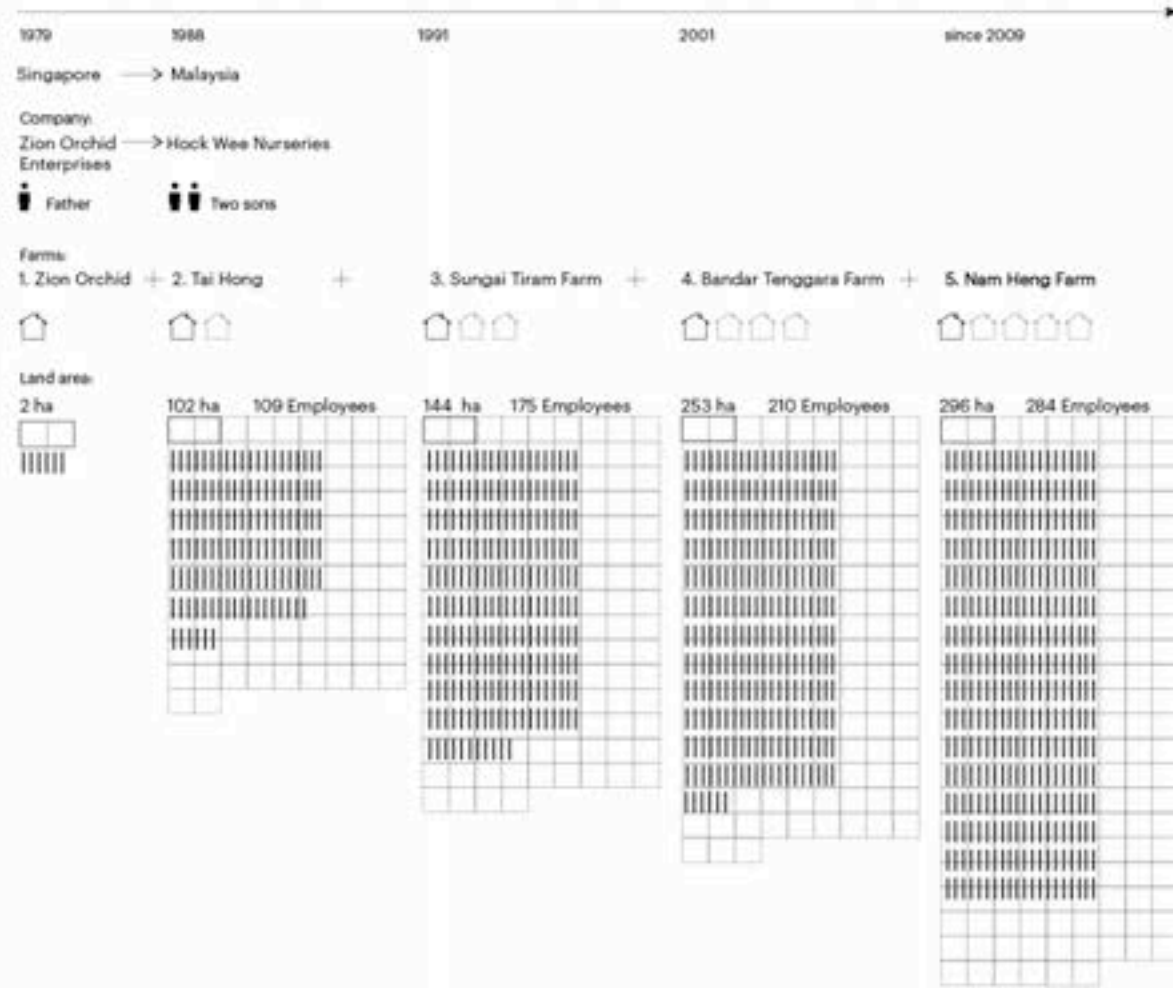
Tai Hong  
The main farm of Hock Wee Nurseries in Johor, Malaysia



From Hock Wee Nurseries to Changi Airport

- 1. Zion Orchids
- 2. Tai Hong farm
- 3. Sungai Tiram farm
- 4. Bandar Tenggara farm
- 5. Nam Heng farm

Company Development



Singapore Roots

In 1979, father Lee Teng Koon founded the Zion Orchid Enterprise; a Singapore-based farm in Lim Chu Kang with 2 hectares of land leased from the government. With the start of Hock Wee Nursery in Tai Hong they could expand their land areas to 102 hectares. Now Malaysian based company, the farm continues to extend and improve its facilities. The farm in Sungai Tiram started operation in 1991 where they already had about 140 employees. Bandar Tenggara and finally Nam Heng meant the extension of their practices by 62 hectares. They continue to keep the farm in Singapore where the production pales in comparison to their Malaysian ventures. The family continues to be emotionally involved with their first farm.

1. Zion Orchid Enterprises

Lim Chu Kang, Singapore  
Since 1979  
2 ha  
Founded farm of the father and living place of Hock Wee family



2. Tai Hong

Johor, Malaysia  
Since 1988  
100 ha  
Main farm



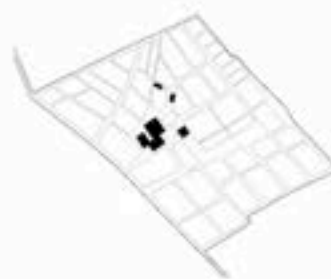
3. Sungai Tiram Farm

Johor, Malaysia  
Since 1991  
43 ha



4. Bandar Tenggara

Johor, Malaysia  
Since 2001  
19 ha

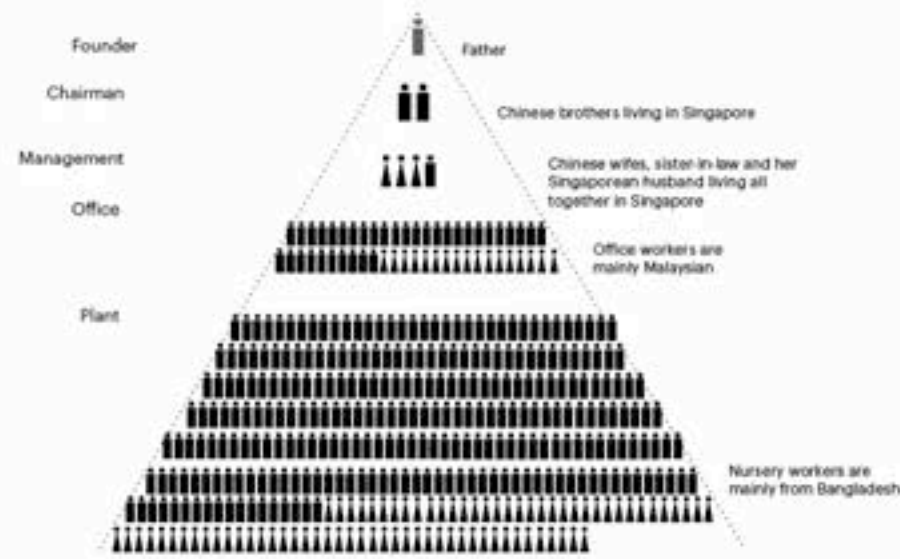


5. Nam Heng Farm

Johor, Malaysia  
Since 2009  
42 ha



Labour Composition of Hock Wee Nurseries

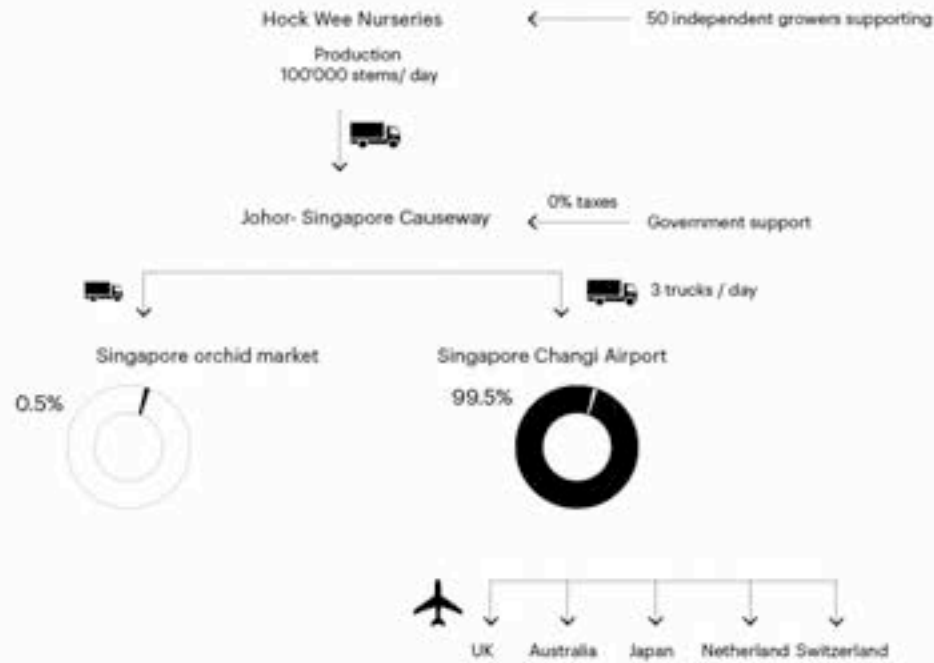


Family Business

The two brothers are being supported by their wives and employees. They work 6 days a week on the farms in Malaysia whereas their wives are responsible for the administration side of the business. Around 16 percent of the staff works from the office, most of which are originally from Singapore. In contrast, the majority of the workforce in the field come from Bangladesh.

Worldwide Demand

The farm is able to bundle up to 1'000'000 stems each day, seven days per week. They have over 45 independent growers supporting them. From Tai Hong they are delivering 3 trucks per day to Changi Airport in Singapore, all tax-free. From there, the products are redistributed across the globe to various markets.



Farm facilities in Tai Hong

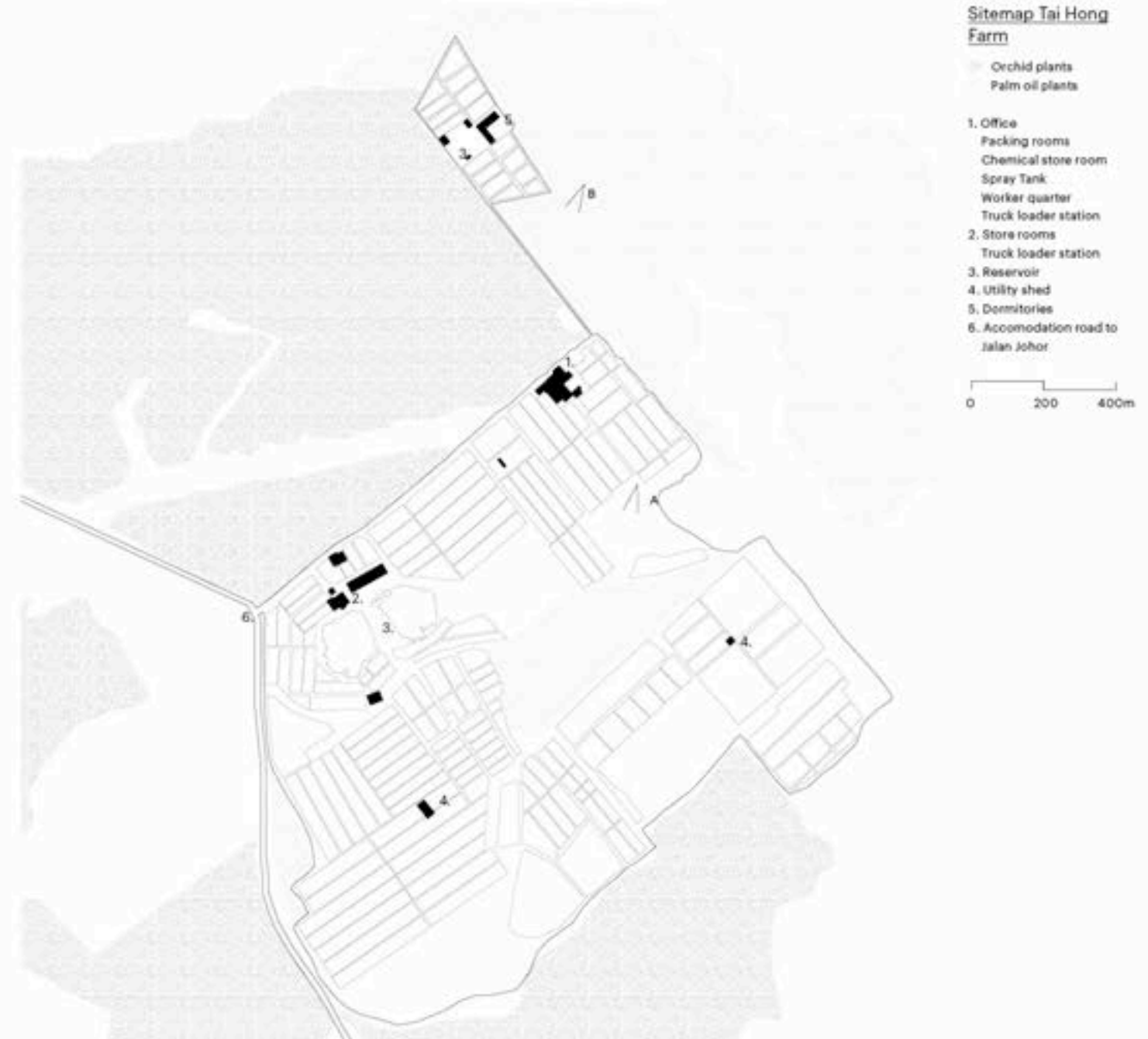




**Thai Hong Farm**  
 Thai Hong is the main farm and located in Kota Tinggi is occupying about 100 ha and is herewith the biggest farm of the company. The chairmen have their office next to the working center and are mostly operating in this farm. But each evening they return back to Singapore.



Top:  
Viewpoint A  
 Bottom:  
Viewpoint B





Top: Some orchids and greeneries produced by the company  
Left: Workers are bundling the fresh cut orchids

**Supply**  
The firm produces fresh cut orchids as well as several other types of flowers and foliage. The products fall under the quality-control audited by the AVA.



1. Office Mr. Lee Chee Wee in his office with his secretary  
2. - 5. Packaging



3.



4.



5.

1. Office Mr. Lee Chee Wee in his office with his secretary  
2. - 5. Packaging

## Case 2: Contract Farming

The first farm of Bright Floriculture started in Singapore. They have been contracted by Singapore's FairPrice Supermarket from the very beginning of their operations. In contrast to Hock Wee Nurseries, the government took their land in 1989 and the company now only has farms in Malaysia.

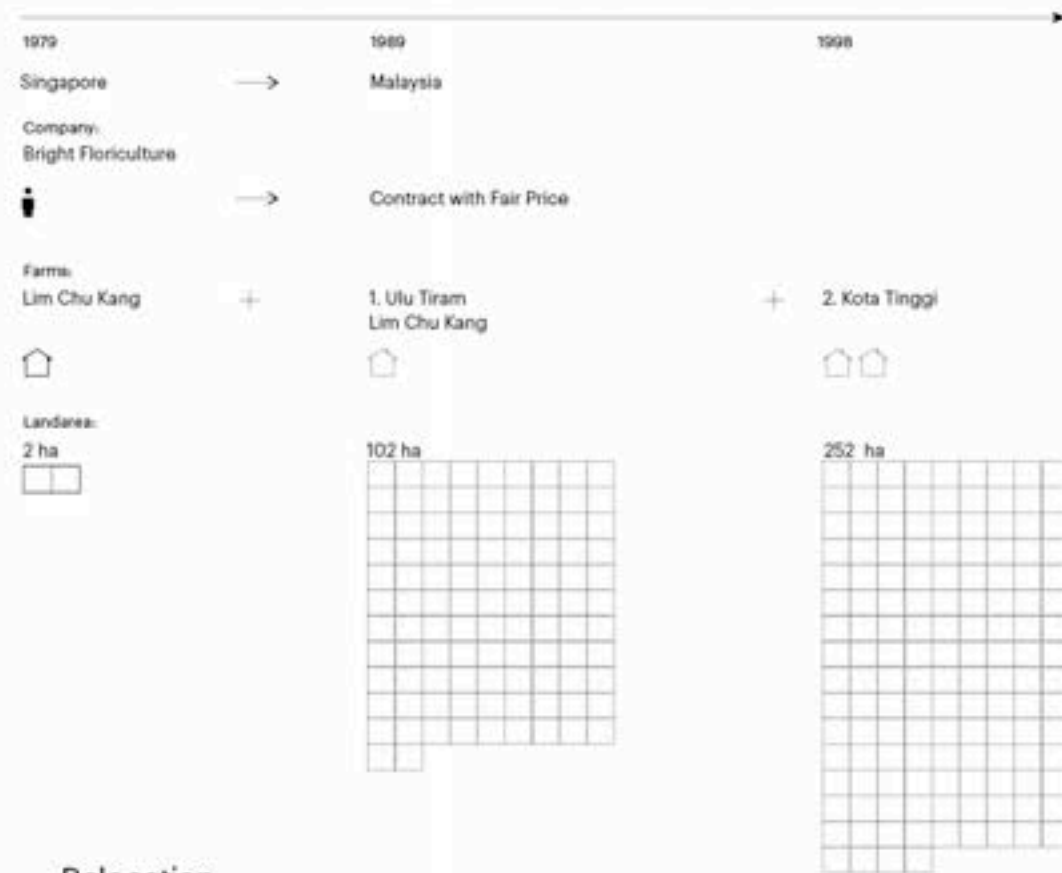
Still, the great majority of production is destined to Singapore's market. They are also supported by the Singaporean government by means of tax exemption and must comply with the AVA license for its imports.



Farming area of the vegetable farm in Ulu Tiram



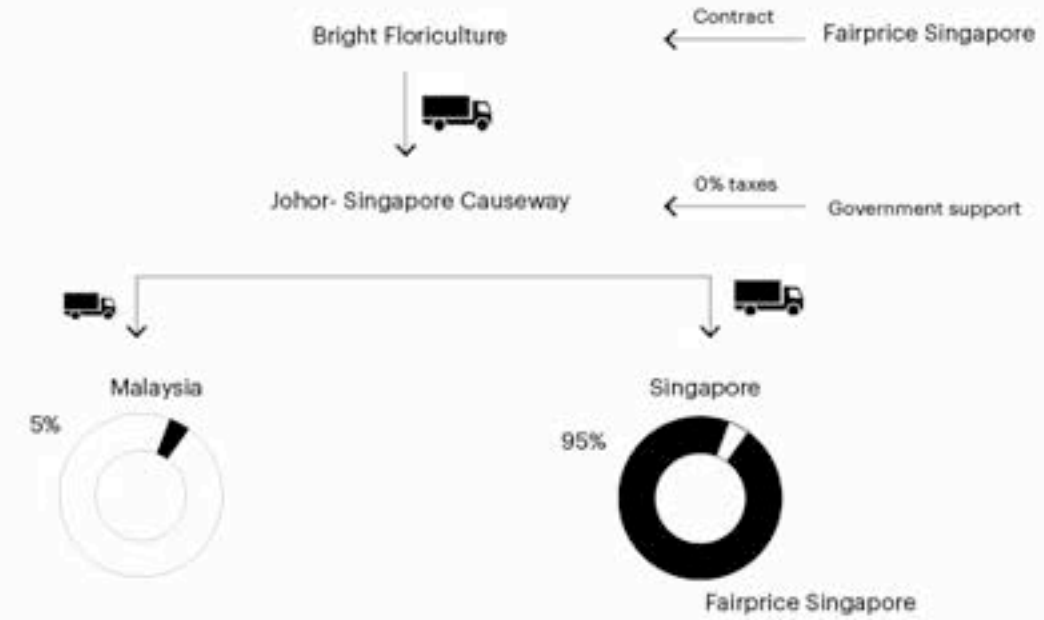
Company Development



Relocation

The first farm located in Lim Chu Kang was moved to Malaysia after the lease expired in Singapore. Bright Floriculture was invited by the Malaysian Investment Development Authority (MIDA) to relocate its farm on its territory, where it could continue to supply FairPrice. Their first farm in Malaysia opened in Ulu Tiram. They expanded further with the opening of their second farm, which opened in Kota Tinggi in 1989. Their contract with FairPrice assures them steady prices as well as a reliable buyer.

Bright Floriculture Distribution Structure



# A Region of Fish and Fishermen

Fishing occupies an important role in the local economy in the Riau Archipelago. It is the main activity for a large part of the population.

Fishing has for long been the main source of income in the region. The soil on the islands of Batam, Rempang, Galang and the smaller islands surrounding them is unsuited for cultivation. In fact, agriculture has not been at all present on the islands of Batam until 1970. Nowadays

the production is small in size and includes mainly fruits and vegetables.

Today's fishing industry is divided between deep-water and traditional practices. Deep-water fishing requires larger vessels, ports, cold storages and it implies a bureaucratic dimension concerned with things such as taxation. On the other hand, traditional fishing uses the simplest of technologies and exists outside the world of international

trades. It exists in parallel to modern reality and manages to interact in a subtle, self-governed and sometimes invisible way.



View of Barelang



### Households Active in the Sector, Batam Regency 2010



### Production per Sector (tons), Batam Regency, 2010



### Fish Production per District (tons), Batam Regency, 2010



### A Society of Fishermen

As much as 99 percent of The Riau Archipelago consists of water. The soil is not fertile. This explains the discrepancy between agricultural establishments and households involved in the fishing sector.

Depending on the districts, the fishing production varies. There is a big production on the northeast coast, in the area of Barel-ang. In fact, the majority of the kampungs are located in those areas. The quantity of fish production close to the islands of Bulan and Belakang Padang are especially impressive. This is due to good fishing possibilities in the waters at Barel-ang and to an informal trade being exercised in the underground, which sees Belakang Padang as main base.



Top:  
Island of the Riau  
Archipelago

Bottom:  
Map of the Riau  
Archipelago

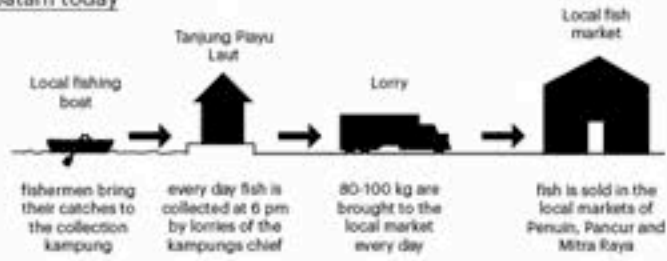
### The Landscape of an Archipelago

The Riau Archipelago has an innumerable quantity of small islands. The municipality of Batam alone counts 400 islands, 270 of those are named. Many islands are too small for practicing any sort of long-term activity. Batam's planning authority considers renting some of these islands to Singapore to be used as cemeteries.

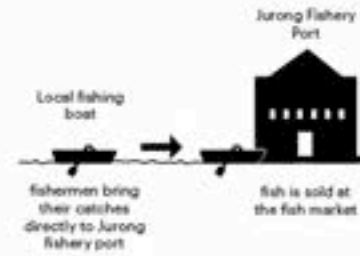
In contrast, it is not unusual to find small islands completely settled and covered by traditional houses with wooden stages and jetties.



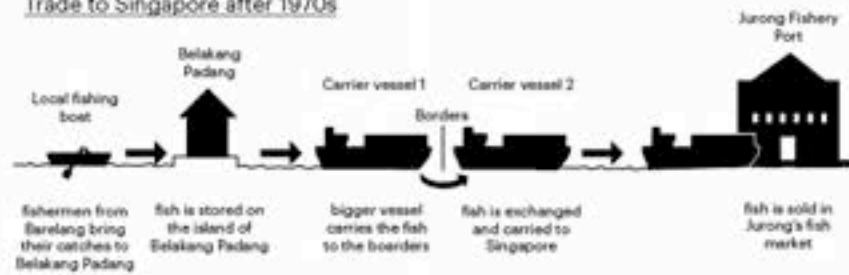
## Local Trade on Batam today



## Trade to Singapore before 1970s



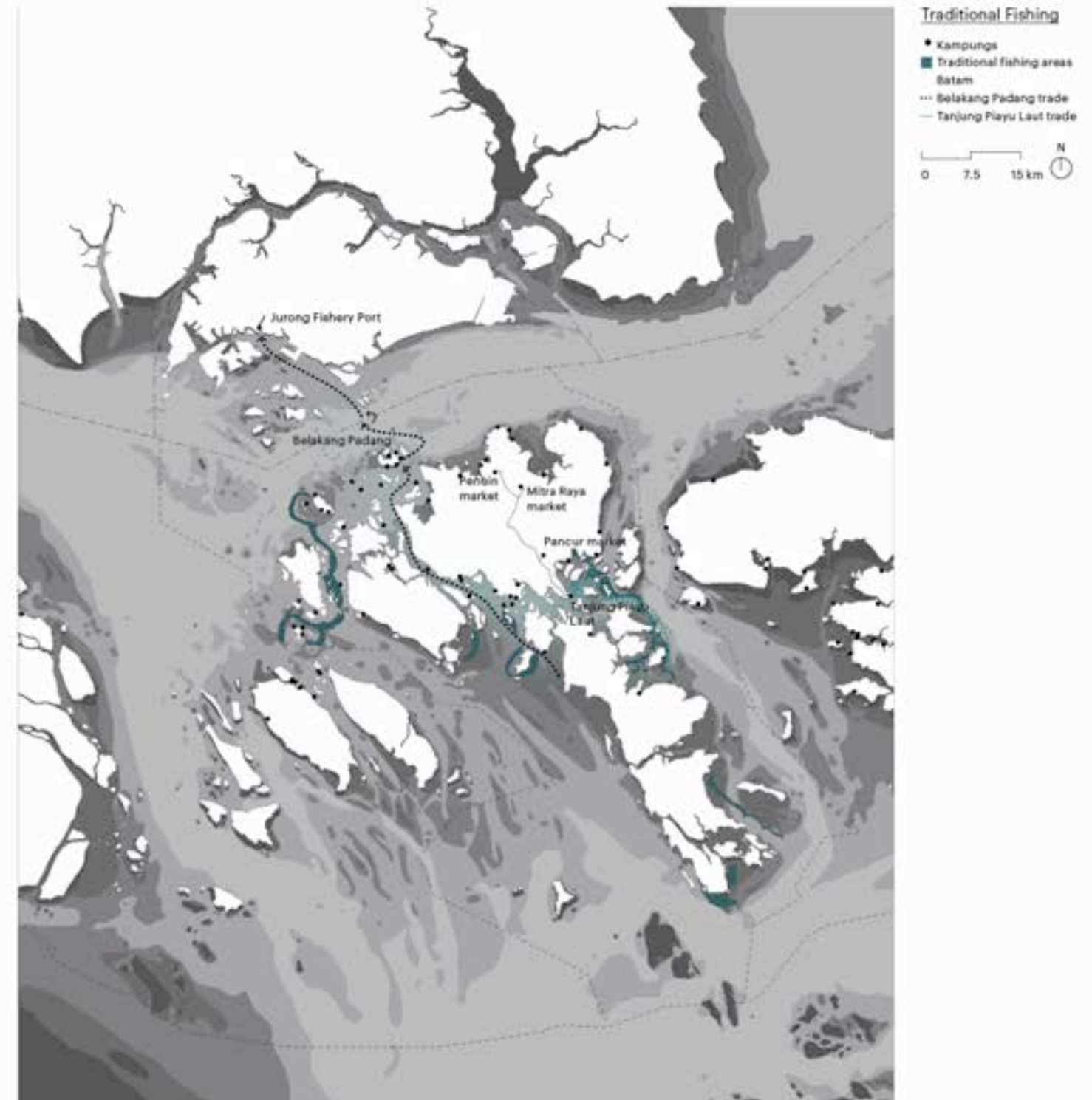
## Trade to Singapore after 1970s



## (Trans-)National Trade of Local Fish

Local fishermen are part of a network, which has a very simple structure. For fish destined to local markets, the economic network rotates around collection kampungs. Fishermen bring their catches once or twice a week to one of the collection kampungs, from where the fish is then carried by lorries to the local markets of Mitra Raya, Pancur and Penuin.

Before the 1970s it was allowed for fishermen from Indonesia to bring their catches directly to the fish market in Singapore. These exchange routes remained tax-free for some years. After the 1970s the situation changed. Fishermen cannot afford to pay the taxes imposed for crossing into Singapore. It is more profitable for them to let their catches be collected by a ship from Belakang Padang. The fish is stored somewhere on the island and then brought to the borders of Singapore where an exchange happens with another vessel which carries the fish to the Jurong fishery port under a false declaration. A similar case was happening with vessels from Hong Kong collecting fish in Bareleng from local fishermen and taking them to the Chinese city.





Tanjung Playu Laut

Tanjung Playu Laut is a kampung of relative importance. It is the place where fish is collected everyday and brought to the market. The fishermen of the surrounding area bring their catches to the village once they have accumulated a certain amount of fish. The kampung chief runs the business of buying the fish from the local fishermen and selling them to merchants at the local markets of Pancur, Mitra Raya and Penuin. The collector arrives either by lorry or by motorbike. Every day the collector manages to carry around 80 to 100 kilograms of fish to the market. A small fisherman can usually bring 10 to 15 kilograms one or twice a week while a fisherman with employees manages to catch around 80 to 100 kilograms.

Kampung Structure



A Customary Hierarchy

A kampung counts on average 60 dwellers. The chief of the village runs the collection. He buys the fish from local fishermen. If for 1 kilogram of crabs he pays 30,000 Rupiah to the fisherman, he then sells it for 40,000 Rupiah to the merchants. Even among the fishermen there is a distribution of wealth. There are fishermen that can afford having more boats and employees in order to catch bigger quantities of fish.

Relation between Boat and Income



Kelong



Traditional fishing boat

A Customary World

Fishermen in Batam regency use traditional fishing methods. The Kelongs are small platforms built on the water without any use of nails and are still a common fishing infrastructure in the kampungs. Also, the boats used are very simple even if nowadays most of the fishermen have motorboats. Fishermen have the possibility to store fish on ice at their houses before bringing them to the collection kampungs.



### Barelang

Barelang is an area South of Batam Island. With six bridges, those islands are connected between them and to Batam. A big road crosses them. Driving down those islands, it is easy to observe many kampongs in this area. Many have a small restaurants where locally caught fish is served.



1.



2.



3.



4.



5.

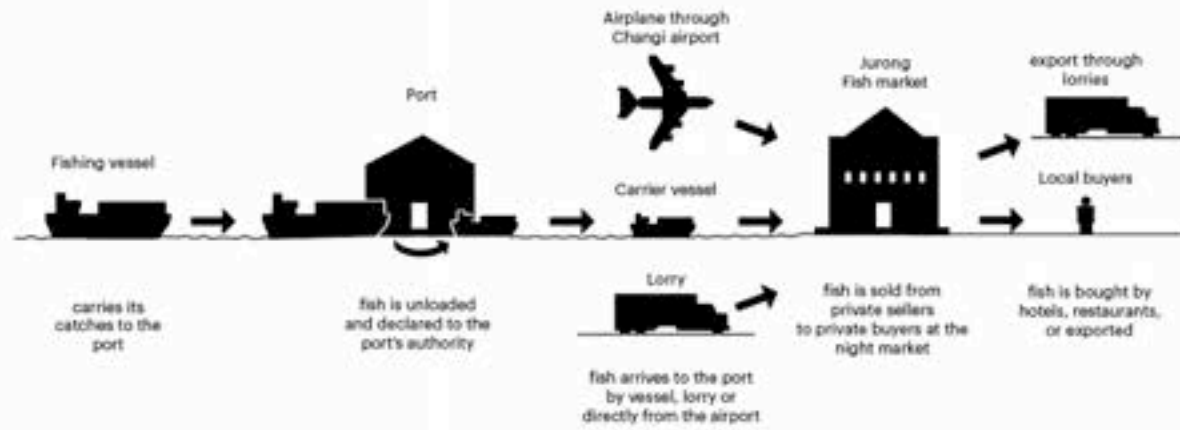
1.  
Kampung on the island of  
Rempang

2.  
Fisherman catching a fish  
from a net on a Kelong

3. & 4.  
Kampung Impressions

5.  
Boat waiting for the high  
tide

## Fish Landing and Trade to Singapore

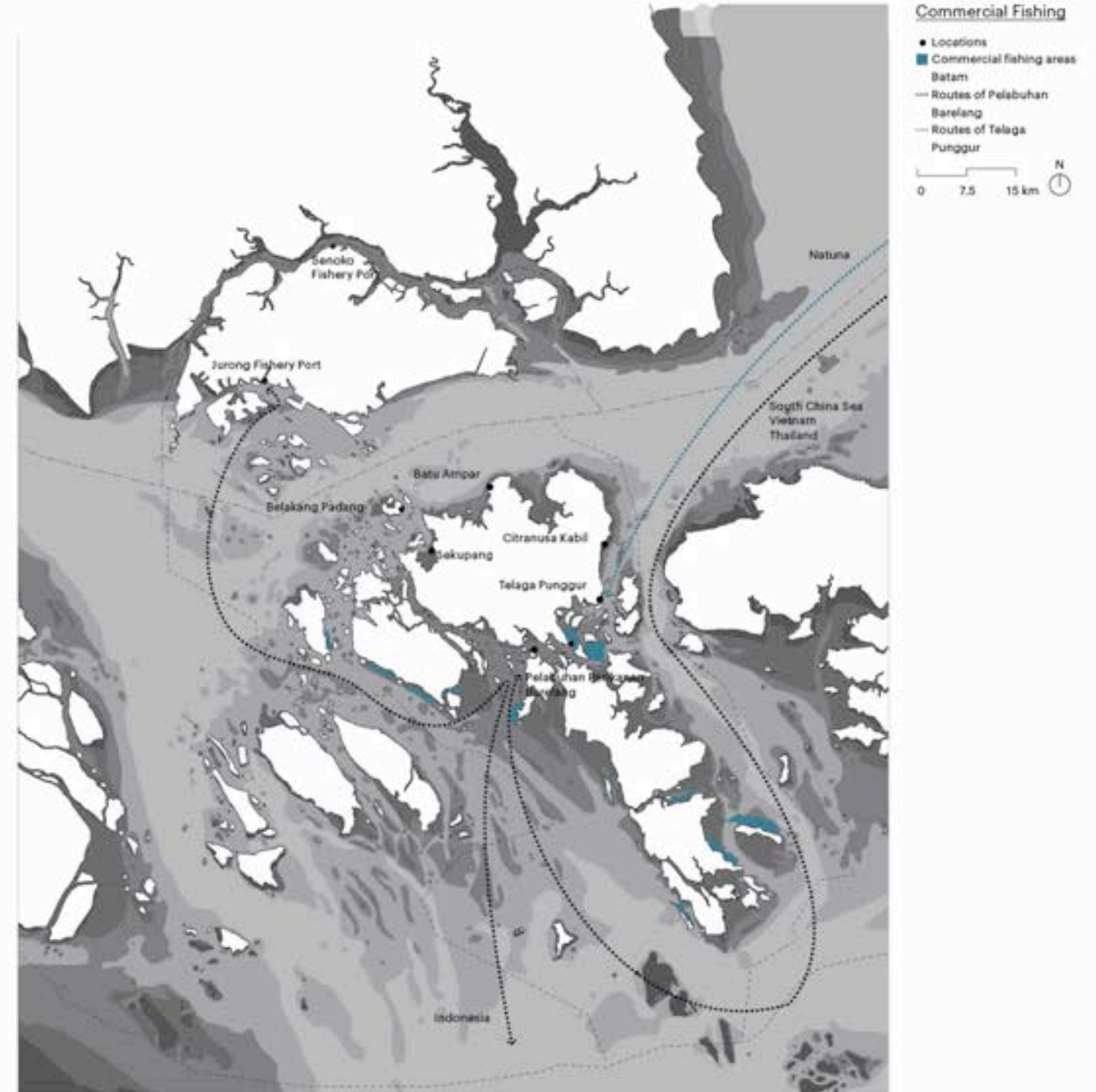


## About Landing and Declaring

The bureaucracy of the ports consists in the act of landing the catches. The expression 'landing' refers to declaring the quantities caught. A fishing vessel needs the permission to fish. Every fishing vessel is allowed to fish in the waters of its country. The catches have to be landed on the territory of that country. This means that the first time that the fish touches the land has to happen in that country. The practise of landing is comparable to a declaration of taxes.

The fishing vessel can also be allowed to fish in foreign waters. In this case the fish has to be landed on the territory of the foreign country that owns the waters where the vessel fished. In both cases, once the fish has been landed it can be brought to any destination in order to be sold. Fishermen often sell the catches to traders directly in the port. Those traders inform themselves about the prices of fish and the demand in different ports in order to decide where to sell the fish.

It also often happens that the fishing vessels fish in international waters where no permission is required. In these cases, the fishermen can bring his catches to any port within reach.



### Telaga Punggur Fishing Port

Pelabuhan Perikanan Swasta Telaga Punggur

first  
private port  
in Batam

Since 1981

13 own vessels

Port: 50

Crew: 400-500

Trade - Local market

### Barelang Fishing Port

Pelabuhan Perikanan Batam

biggest  
private port  
in Indonesia

Since 2007

100 own vessels

Port: 150

Crew: 3,000

Trade  
- Singapore  
- Indonesia  
(Java and others)  
- Local market  
(processed fish)

#### Two Private Ports

The first private ports in Batam were set up in the 1980s. The first private fishery port on the island of Batam is the Pelabuhan Perikanan Swasta Telaga Punggur founded in 1981. It is now a small port with only thirteen vessels. Fishing is not possible in the waters of Batam regency, even if it is the only place where the port is actually allowed to fish. This is due to the fact that the port catches mainly mackerels and cannot find this fish in the local waters. Therefore the port fishes in the waters close to the island of Natuna

where control from the authorities is not frequent because of Natuna's proximity to international waters.

A port on a bigger scale for what concerns the dimensions and especially the international importance is to find on the island of Nipah. Many infrastructures are set up across an area of 30 hectares. Aside from local vessels, others using this port come from Thailand, Vietnam and other parts of Indonesia. They fish in international waters and are therefore allowed to land their catches in a foreign country.



#### Pelabuhan Perikanan Barelang

The port is an attractive destination for foreign vessels since it provides all the needed infrastructures: fuel stations, ice factory, cold storage, and governmental office for landing. It was established out of a private initiative welcomed by the government since it covers an area where there was no

such port before. Fresh fish is brought directly to Singapore's fish market in Jurong or processed. The processing can be of different kinds: packaging, freezing, extracting the bones and freezing, making surimi. Fish bones are used as animal food. The quantity of fish brought to Singapore is around 60 tons per week.



1. Port's hall
2. Vessel from Thailand docking at the port
3. Weighting of the catches
4. Unloaded fish is put into baskets and then into ice containers
5. Ice containers

**Barelang Fishing Port**

Landing means unloading the catches from the vessel and putting them in smaller baskets. Every basket has to be weighed at 30 kilograms. Weighing happens in front of two officers that mark the number of baskets in order to get the total amount of kilograms. The baskets that are already weighed are carried to ice containers and brought to storage or reloaded on the vessel.

The fish that is not brought to the markets is processed. It is packaged in smaller quantities and frozen. In the cold storage the fish is stored in packages of 100 kilograms each. Normally it is tuna or baby tuna that is brought to the port and sold fresh or frozen. With mixed fish the port produces surimi in the factory situated on the plot.



2.



3.



4.



5.



1. Unloading the catches in the port's hall
2. Packaging room
3. Packaging infrastructure
4. Cold storage
5. Ice factory

1.



2.



3.



4.



5.



### Jurong Fishery Port

1. Vessels Arrival
2. Market Hall
3. AVA Office
4. Cold Storage
5. Entrance



transit of 50% of Singapore's fish consumption

103 sellers

2'000-3'000 buyers every night

13 vessels belonging to the port

12 vessels arriving per day carrying 30 tons each

250 tons sold per night

### Fish Imports through Jurong Fishery Port

Indonesia	20%
Malaysia	20%
Thailand	7%
Singapore	7%
Others	6%

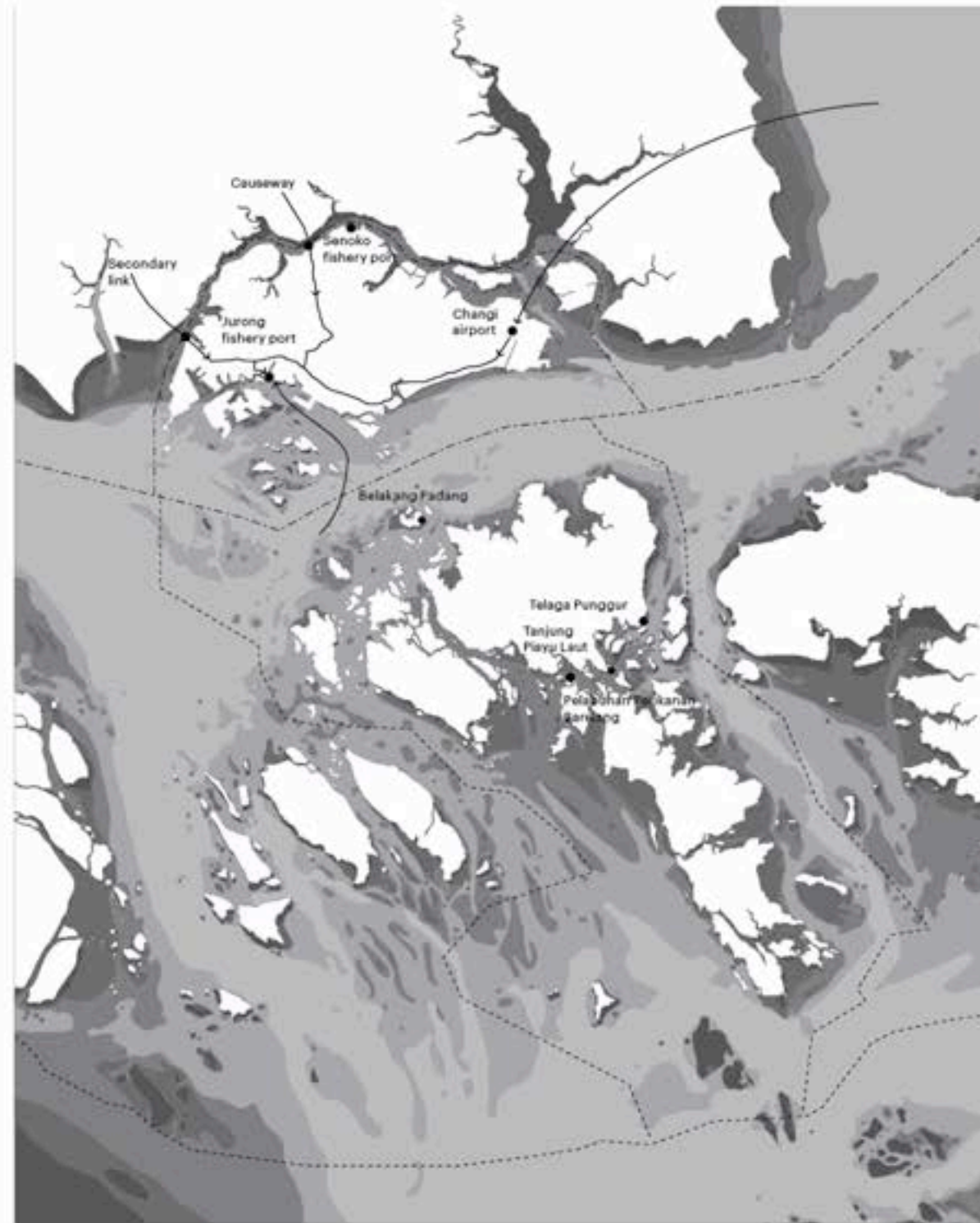
### An Urban Port

Jurong Fishery Port is integrated in the urban structure. Its proximity to the highway makes it ideal for lorries to arrive or to depart with fish ready for export.

The port is surrounded by the Jurong Harbour and occupies only a small area compared to the remaining Jurong port facilities that deal with other goods than fish and seafood.

Fish does not only arrive by vessel to the Jurong Fishery Port. There are other ways for fish to be transported to the Jurong fishery port: fish from Indonesia arrives by carrier vessels, from Malaysia and Thailand it sometimes comes by lorries. From countries further out such as Norway, the fish arrives by plane directly from the airport to the port without being distributed. Singapore itself has thirteen vessels with which it fishes.

The market hall of Jurong Fishery Port is 900 square meters. In this area there are around 100 sellers. Each of them has an area of 50 square meters where he can sell fishes. The site also includes a cold storage and the AVA office. The vessels arriving are mainly carrier vessels. They unload the fish and leave again. The fish might not all be exposed on the 50 square meters but kept in container with ice right outside the hall and brought when needed. There is no infrastructure for processing the fish on the site, apart from a cold storage. Despite that, processing happens in Singapore, even if in small scale. In the market only fresh fish is sold, yet, frozen fish is also imported and arrives to Jurong on vessels that process the catches directly on-board.

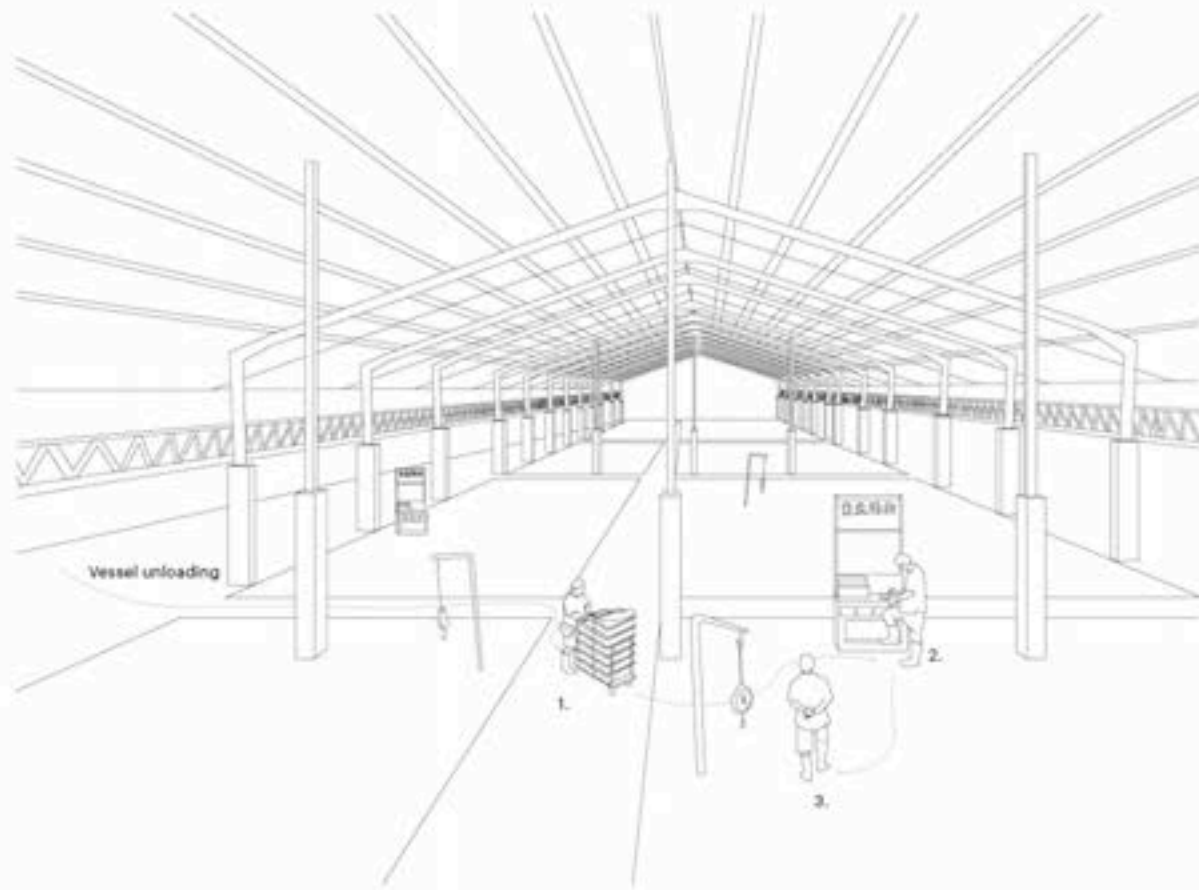


### Fish Routes to Jurong Fishery Port

- Locations
- Routes







### Jurong Market Hall

1. Fish from the carrier vessel
2. Seller
3. Buyer

### The Night Market

From 2 am until 6 am it is rush hour in the market hall of Jurong Fishery Port. The fish that was unloaded from the vessels or lorries are carried into the hall and exposed on the single areas of the merchants. Carriers usually have agreements with buyers, selling to one taker his entire stock. The buyers include hotels, restaurants or private individuals. There are also buyers that have the assignment from third parties to buy fish for them at the market. Expert buyers are able to recognize how many days before a fish was caught and can consequently select fish carefully.





The Market Hall



1.



2.



3.

- 1. Buyers choosing their fish
- 2. Fish exposed on the 50 sqm of a merchant
- 3. Outside the hall, containers to store and transport the fish

# Agriculture of Technology

The drastic resettlement and outsourcing of Singapore's farms that took place in the last fifty years changed the agricultural panorama on the island. Nowadays, agricultural land is integrated in the urban structure. Even though farming areas are in the north of Singapore, they are in proximity to industrial, residential and even military zones. The appearance of agricultural areas is also urban. The six existing sites where agricultural activities are settled are the so-

called 'Agrotechnology Parks'. The plot sizes are incredibly small for the function they have: on average, each plot is of 2 to 3 hectares. The use of the space is completely optimized. As one might guess from the name, the focus is on technology. This is Singapore's solution for assuring maximal agricultural production on only very few hectares of land. The focus on technology increased significantly after the 2008 food crises.



## Agro-Technology Parks

1. Lim Chu Kang
2. Mural
3. Sungai Tengah
4. Mandai
5. Nee Soon
6. Seletar West Farmway
7. Loyang

## Farmable Land in Singapore



1% Agricultural area  
729 ha  
Total land area  
70'400 ha

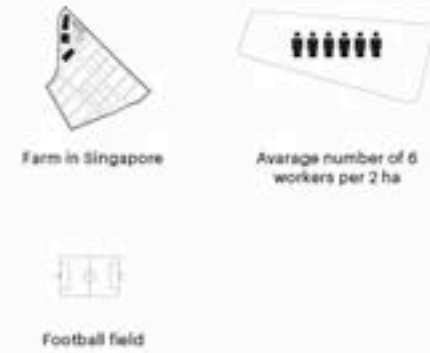


**No Production for Sustenance**  
 The production in the agro-technology parks is varied and overall, it pales in comparison to Singapore's foodstuff needs. The amount produced covers an insignificant part of the local consumption. Furthermore, in some cases the production does not stay in the country but is instead exported.  
 The landscape of Singapore's agricultural land is characterized by fragmentation. It is a landscape of industrial agriculture ruled by efficient use of the land. There are around 250 farms on the island spread between six agro-technology parks and one more area called the Seletar West Farmway. All farming land is rented from the government. The leasing contracts range between 2 and 20 years.

**Singaporean Farm Production**



Lim Chu Kang, excerpt



**Two Hectares**  
 Plots are generally small. Historical developments and shifts in priority led to the division of agricultural plot of about 2 hectare per farm. Actually the length of the large agro-technology park, Lim Chu Kang, measures a bit more than half of the length of Changi airport. Singapore's strategy uses many small-scale farms instead of a smaller number of large farms. The reasons for this include the will to keep a wide variety of products and producers and allowing a certain economical freedom and competition.

A glance on a satellite picture reveals that the sizes of Singaporean farms are relatively balanced: the contrast between the largest and the smallest farm is not of great significance.

Looking towards Malaysia, it becomes immediately obvious that plot sizes in Singapore are much smaller than in most other agricultural settings. A Singaporean farm might be as small as three football fields only, and maybe forty times smaller than a Malaysian farm.

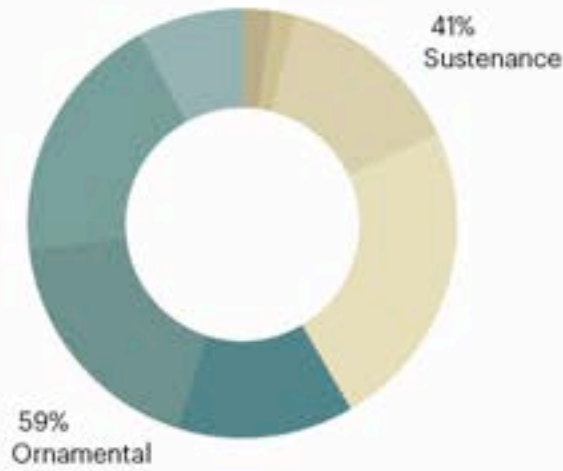


### An Ornamental Output

The farm production in Singapore focuses mainly on 'ornamental' agricultural production. More than half of what is produced on Singaporean farms is not edible. Such products include orchids and aquarium fishes.

Out of a total of around 250 farms, sixty percent of them are involved in the production of ornamental goods.

Percentage of Ornamental and Sustenance Production



Farm Output by Agro Technology Park



### Export-Oriented Production

Singapore is not the main consumer of those ornamental products, which are the main agricultural production of the island. Orchids or aquarium fishes are exported all over the world. Small plants, orchids or decorative fishes arrive to Singapore in an advanced growth state. They are fed and grown on Singaporean land for some weeks before they

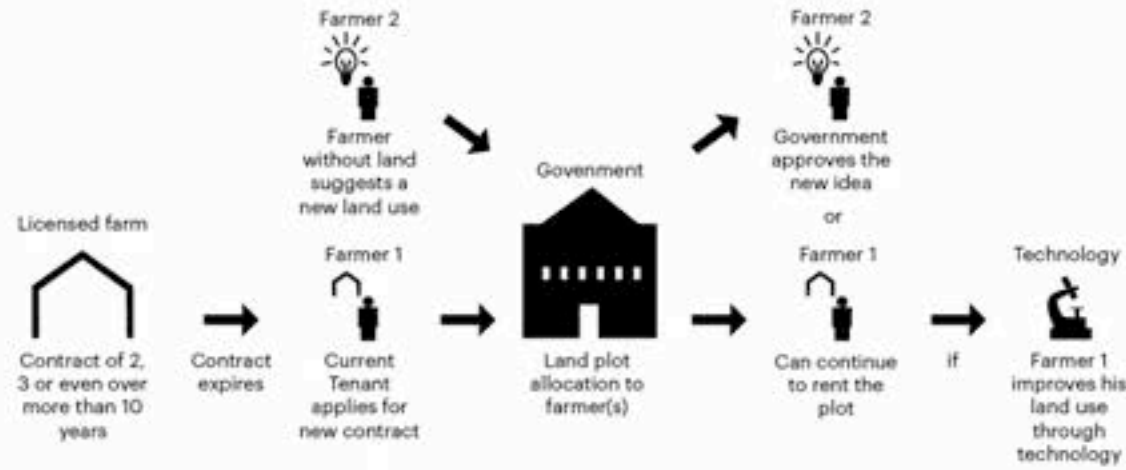
leave the farm towards the open market as Singaporean products, which confers upon them a plus value in international market. This is also the case of ornamental plants, although many of them are actually dedicated to the Singaporean market.



Farm's Production



Rental Renewal and Competition for Technological Renewal



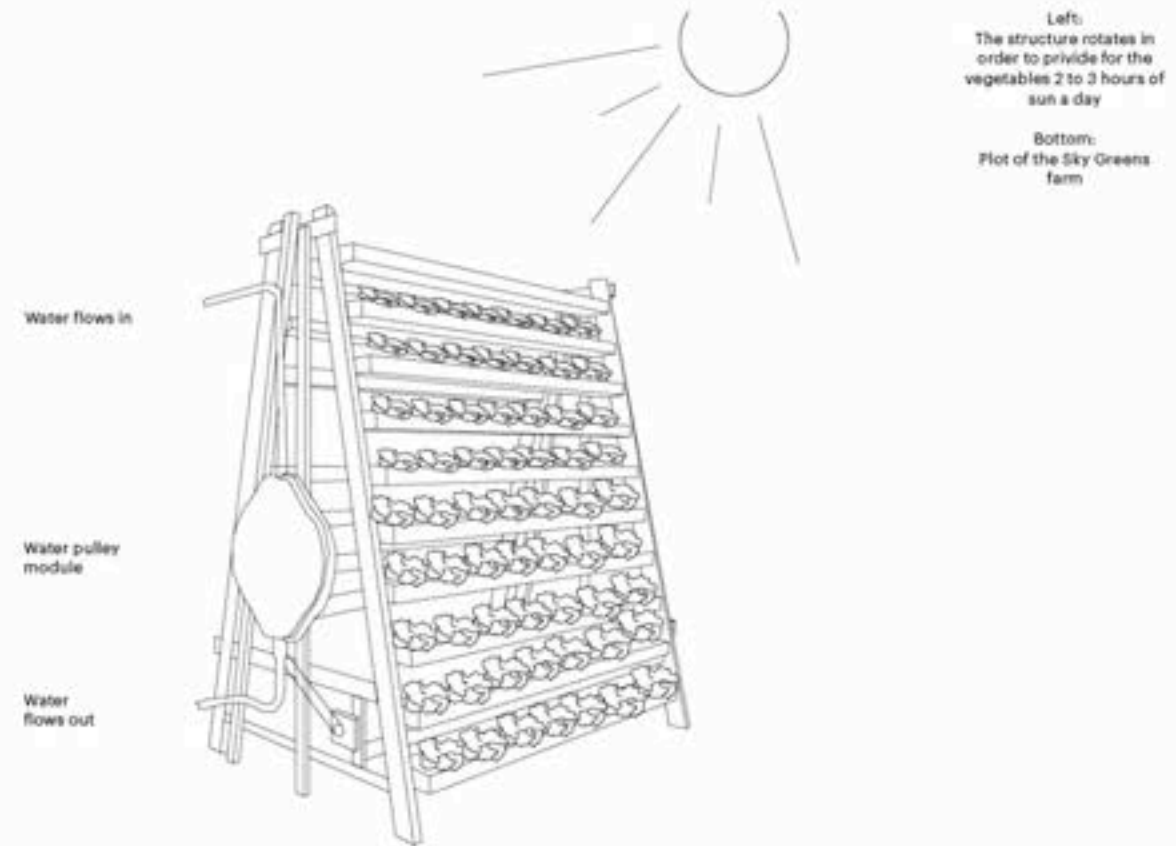
Promoting Technology

The impossibility to dedicate more space to agriculture is the cause of an agricultural development towards technology. This corresponds also to the aim of the government, which looks for help in the part of the population involved in the sector. As a matter of fact the government prefers a technological land-use and tends to promote development processes that align with such ideals. When a rental contract expires the old tenant is often afraid that a competitor might overtake him by using superior technologies allowing for a more efficient land-use. The old tenant is likely to lose the rented land to the competition if he fails to adapt to evolving technologies.

This is a problem for many farmers since their leasing contracts are short. The time is not sufficient for them to see the results of an investment in research in order for the government to see the potential of their land-use.

Singapore itself practices research and it is possible for the farmers to have informative visits at the research and development centres in order to get a glance into the possibilities of investments for them.

The research concerns mainly vacuum packaging and matters such as seeding and the use of so-called non-soil.



Vertical Farming

Sky Greens is the name of the farm that adapted the technology of vertical farming. This technology was developed by a Singaporean researcher and tested in the Research and Development centre. The first vertical farm opened its doors. The invention consists in pyramid shelves where vegetables are grown; a pipe system waters them at intervals; the structure rotates in order for all the vegetables to get the right amount of sun exposure. Such farm is marketed as being 5 to 10 times more efficient than its conventional counterpart.



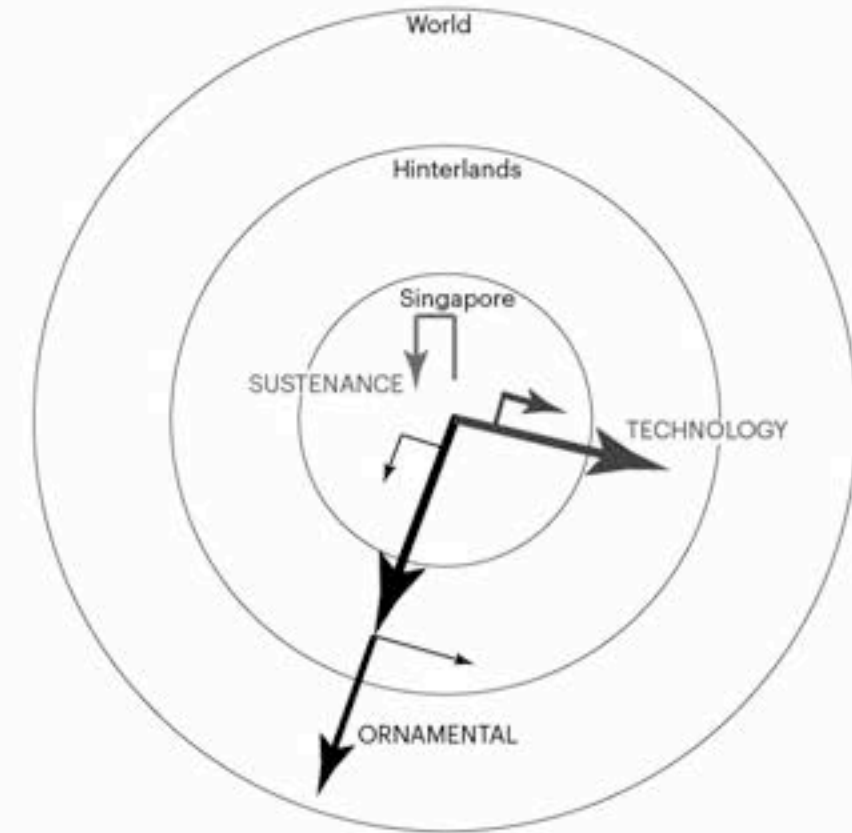


### Technological Agriculture

Singapore's reliance on neighbouring countries also extends to food supplies. Agriculture was a victim of Singapore's success as a nation with a rapidly expanding population and a rising tertiary sector; the downscaling of its agricultural sector was inevitable. Due to Singapore's limited dimensions, the surrounding countries became the periphery of a metropolitan island, a periphery with one important feature: borders. As much as 99 percent of the food consumed in Singapore must pass through these borders. The denial of food production on Singaporean land reaches an incredible extent and results in issues such as the maintenance of steady supplies and its inability to assure the quality and methods of production of the food it imports. Furthermore since the food crisis of 2008, Singapore is

more and more aware of the danger of such an acute dependence. New strategies are developed, which focus on technology in a context where land is in short supply. The agriculture that Singapore aims at is far from the conventional idea of farming. Efficiency is certainly improved. In the past there have been many transformation in the agrarian world and Singapore is definitely building on these advances. Considering that land is a limited and extremely profitable resource, agriculture is the casualty of economically more advantageous activities. It seems as if outsourcing agricultural production might be a symbol of the will for growth.

The example of Singapore shows a tendency in the primary sector towards a technological agriculture and opens the discussion of progress, environment and ethic.



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Sarana Yeoman Sembada, Pelabuhan Perikanan Swasta Telaga Punggur, Batam.  
Fishermen, Batam.  
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Kihua Teh, AVA Singapore.  
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## Image Credits

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# CONDUCTING HUMAN RESOURCES

Migrant Workers  
in Singapore

by  
Ahmed Belkhdja  
Saskja Odermatt



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Financial Attraction of Foreign Workers (p.24)  
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Commercial Dormitories: An Emerging Business (p.74)

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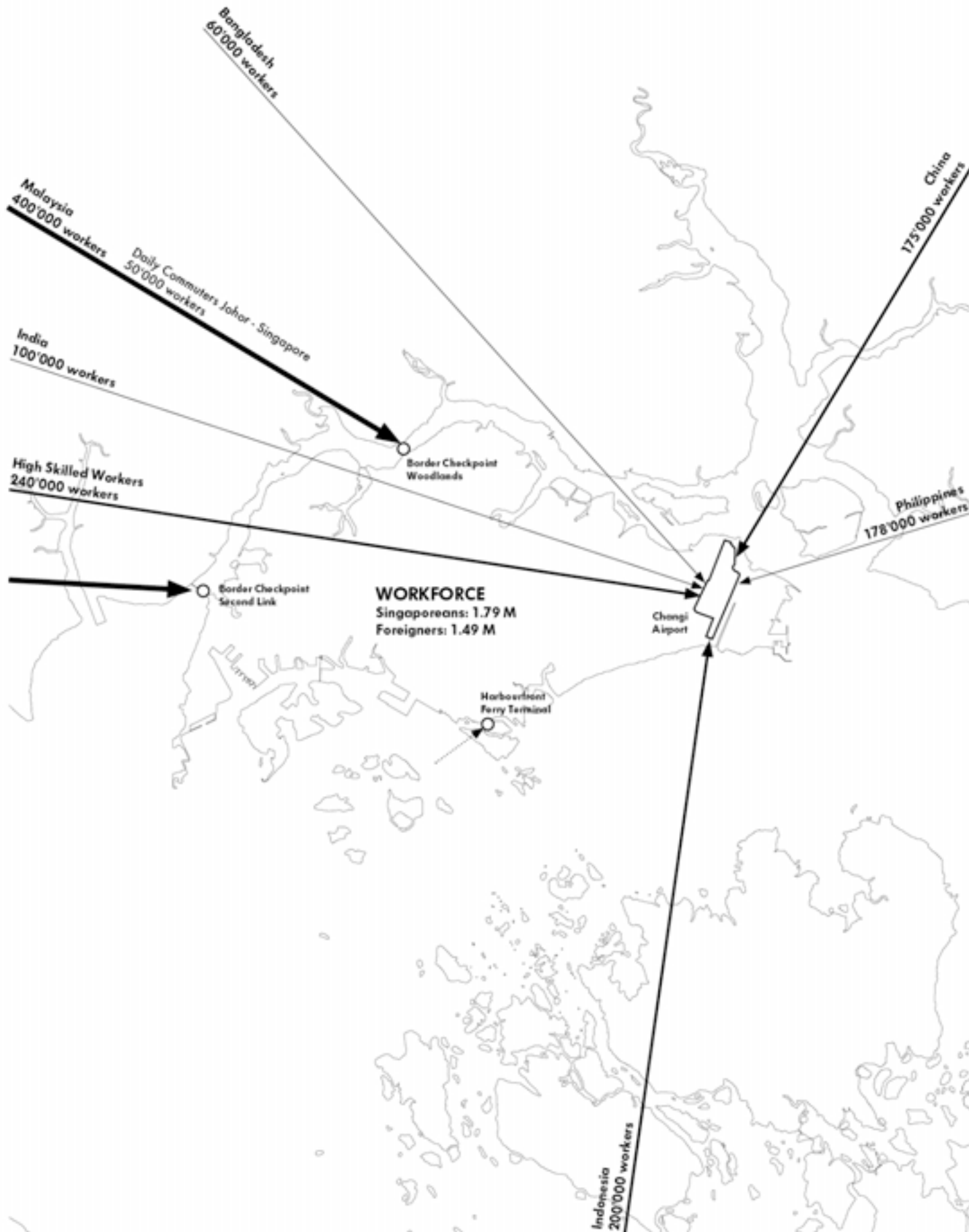
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## Two Fields Of Control

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Foreigners form about forty-five percent of Singapore's workforce and this ratio has been constantly rising in the last fifty years. The mutual dependency between this population of workers and the economy of the Island-State is well known, but its translations into "Singaporean realities" are often overshadowed by geopolitical and/or ethnical considerations.

This research is an examination of some of the processes related to the employment of those foreigners, both on the administrative and territorial levels. For instance, a focus is put on the organisation of the influx of workers and their placement in different regimes of employment, as well as on the way the urban seclusion of some of those foreigners is planned and executed.

This artful conduction of workforce constitutes a comprehensive prototype of manpower management on a national level.



# An Employment Framework

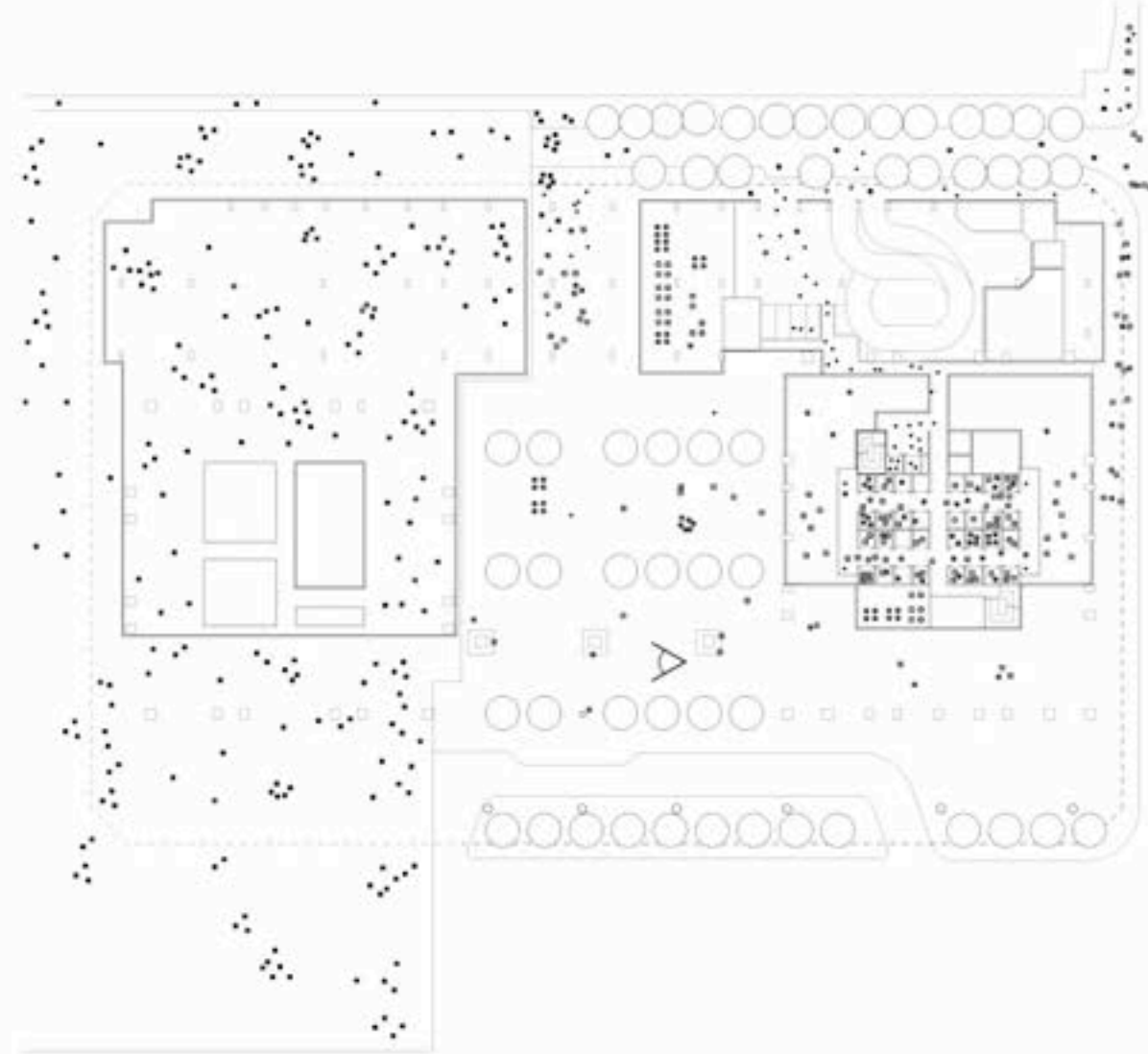
Our exploration of Singapore's human resources began on a Monday morning in the most central district of the city. Flocks of businessmen were going in and out of a brand new complex of offices called Asia Square, which consists of two towers separated by a covered plaza. The plaza and the first tower had just been opened at the time of our visit, while the second tower was still under construction. Thus, a temporary partition was splitting the complex and hiding



Trompe-l'oeil of upcoming tower in Asia Square

the ongoing construction from the plaza. A trompe-l'oeil was printed on this whole partition wall, trying to give the illusion that the other office tower was already standing. We noticed that Asia square was largely occupied by foreigners from first world ('expats') and developing countries (construction workers and cleaning staff), with each group having its own entrances to the complex. This first chapter is a study on those layers of foreign work-

force residing in Singapore, on the nature of the dependencies towards them, and on the Island-State's intent and means to rationalize and control those influxes of people.



Asia Square,  
October 2012

- Singaporeans
- "Expats"
- Cleaning Ladies
- Construction Workers





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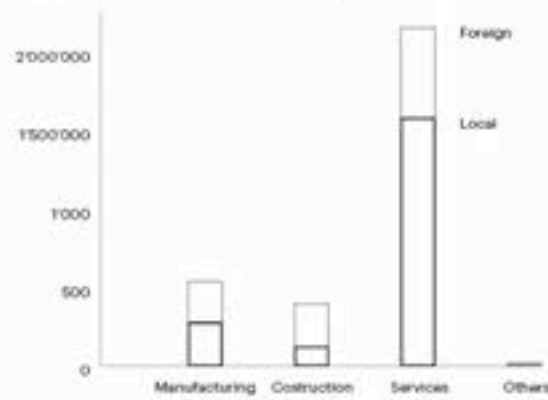
- 1. Main lobby
- 2. Front street
- 3. Smoking area
- 4. Back entrance
- 5. Separation wall
- 6. Break plaza
- 7. Lau Pa Sat Hawker, cleaning lady
- 8. Lau Pa Sat Hawker, financial workers
- 9. Lau Pa Sat Hawker, construction workers

# Singapore's Workforce Structure

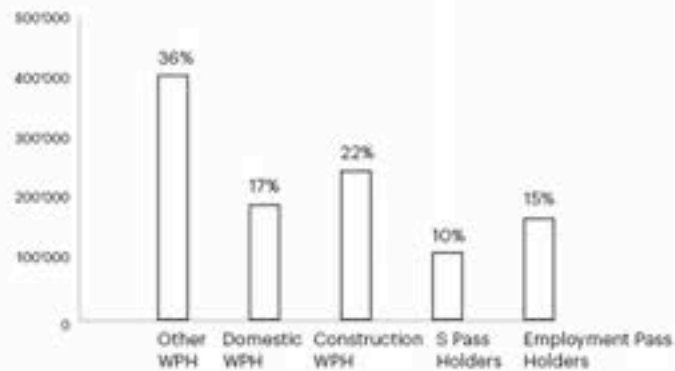
As a secular place of immigration, Singapore's population is mostly an assemblage of people that either came to the island to find work opportunities, or whose ancestors did so. Since the 1960s, the Ministry of Manpower keeps the foreign workforce organised into a clear hierarchy based on income levels.

This hierarchy mainly consists of three categories which all have different sets of rules to follow and different requirements for their employers to comply with. Each employer is allowed to hire a certain number of foreign workers, which varies depending on net revenues and on the amount of local workers they hire.

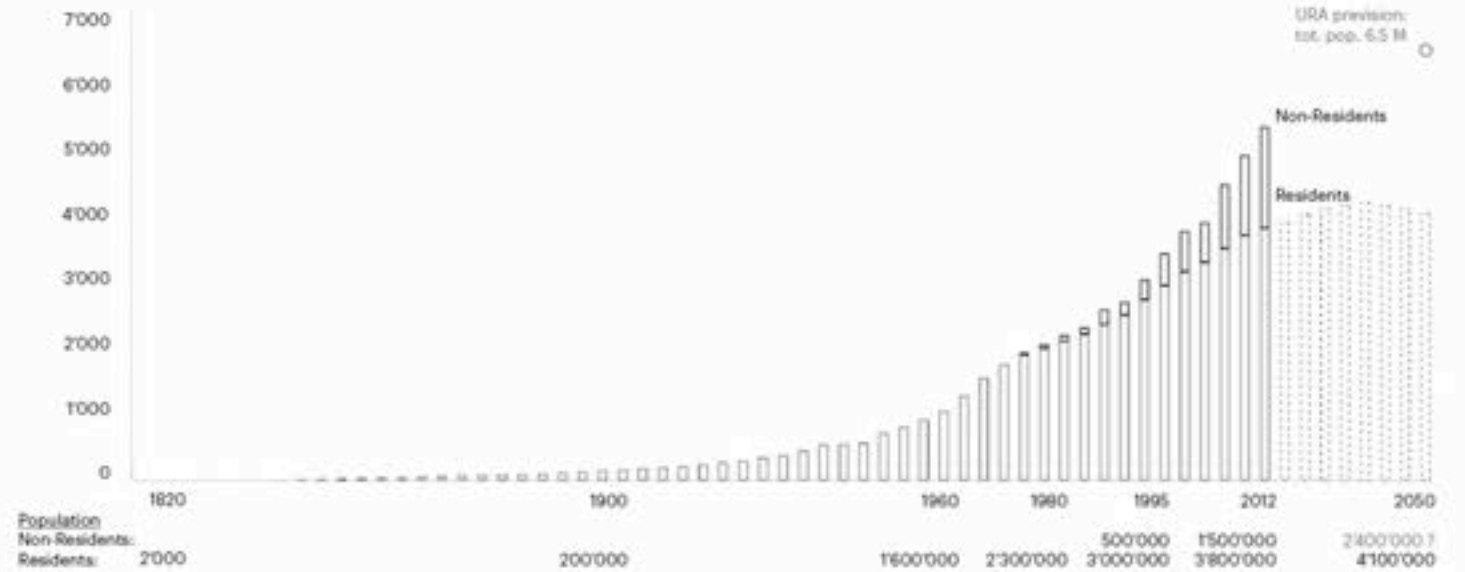
Workforce per Sector (2011)



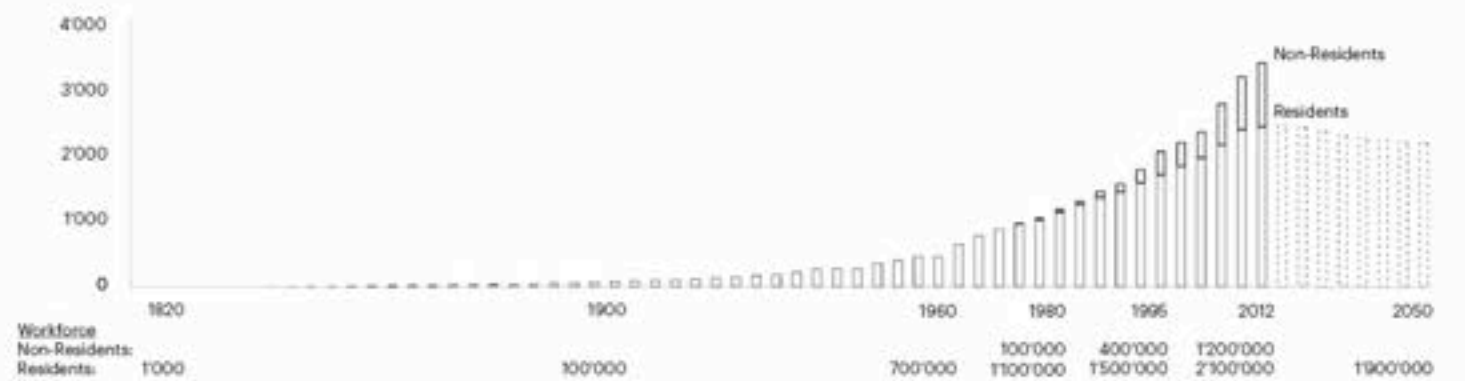
Non-Residential Workforce per Status (2011)



Population per Residency Status



Workforce per Residency Status



### Population and Workforce Evolution

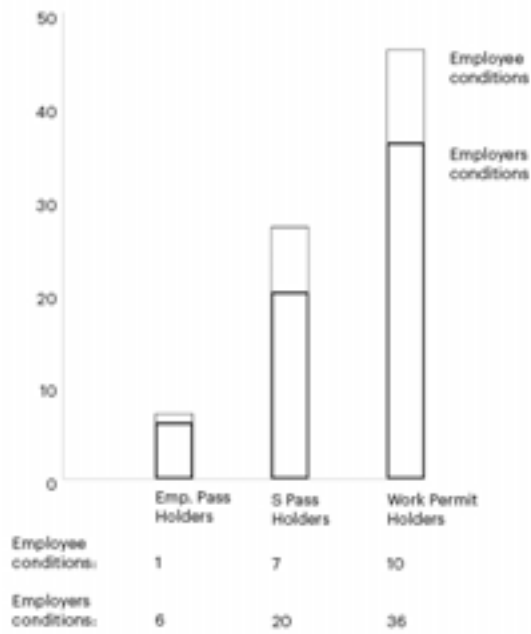
Since the founding of the Republic of Singapore in 1965, statistics split the population into two groups: 'residents' and 'non-residents'.

The resident population comprises Singaporean citizens and 'permanent residents', while the non-resident population consists mostly of foreigners on a temporary residency status. The major trend is for the percentage of non-resident population and workforce to increase rapidly. In addition to the economic advantages of hiring foreign workers, specialists link this trend to the fact

that Singapore's resident population is aging at an alarming rate. And this fact will probably get even more problematic in the coming years, since the generation that was born during the 'baby-boom' of the 1950s is now starting to enter retirement age.

To sum up, Singapore now needs to find strategies to compensate this shrinking of the local workforce, either by opening permanent residency status to more foreigners or by an even more extensive usage of 'non-resident' labour.

Employment Act Conditions

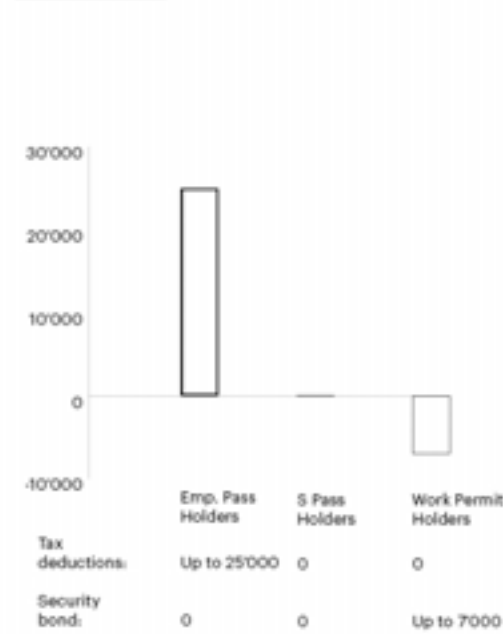


Hierarchy of Treatment

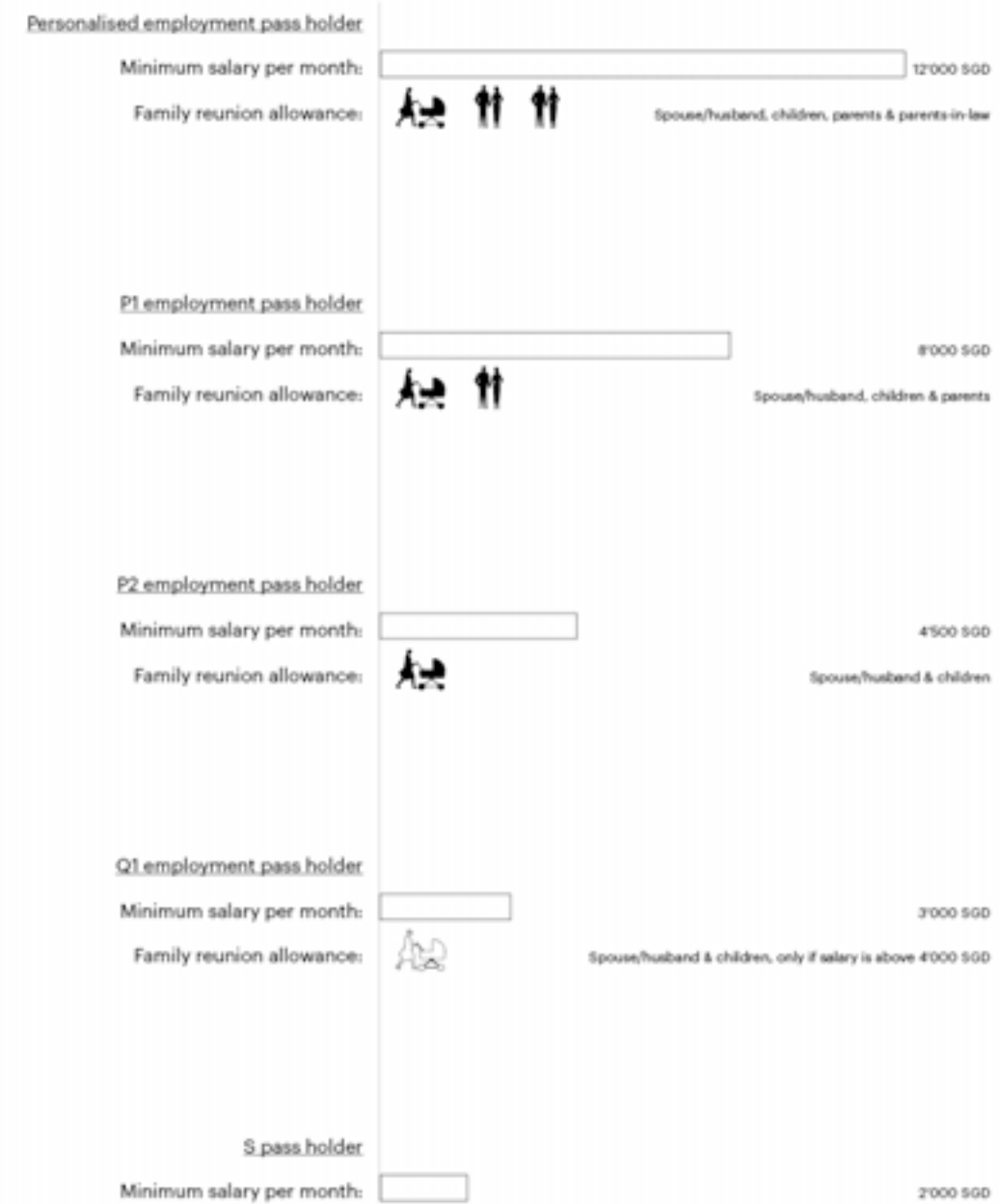
Each of the three categories of non-resident workers has a different level of constraint set up by the 'Employment of Foreign Manpower Act'. It mostly concerns their administrative regime, their allowance to bring their family from their home country to Singapore, and their (lack of) permission to change job while in Singapore.

For this representation, we just counted those conditions that are imposed to both the workers and their employers, regardless of their content. The most peculiar of those them include for example the prohibition of pregnancy and the interdiction to 'break up families in Singapore', both of which only apply to work permit holders.

Potential Gain/Loss for Employer at Recruitment



Benefits per Type of Work Permit



Incentives & Guarantees

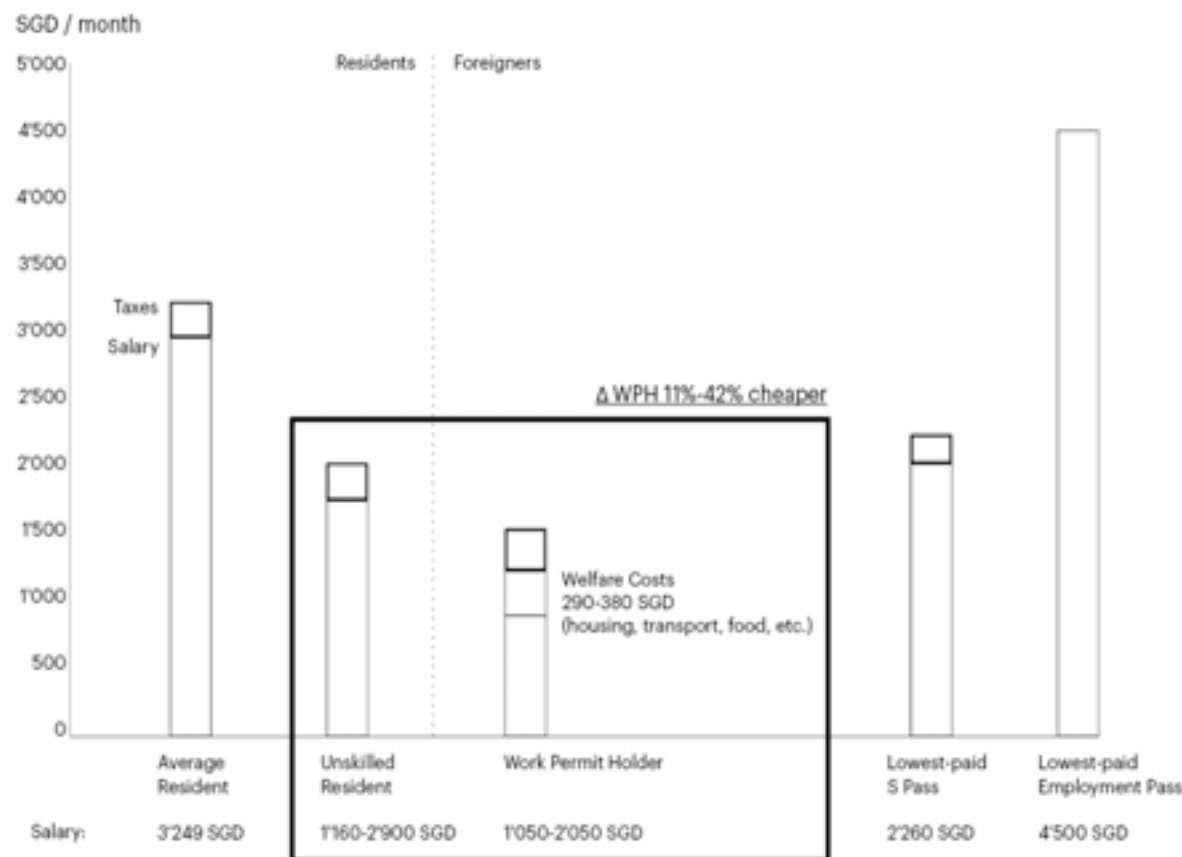
The Ministry of Manpower applies different types of financial interference in the recruitment process. An employer willing to hire a work permit holder has to deposit a 'security bond' of up to 7'000SGD, while hiring an employment pass holder can earn him a tax deduction of up to 25'000SGD to cover the relocation expenses.

# Financial Attraction of Foreign Workers

The main drive of the extensive recourse to foreign workforce is obviously financial. The average salary of an unskilled Singaporean remains significantly higher than what is usually offered to an equivalently-skilled worker coming from another country in Southeast Asia. Singapore's authorities have two means to control the ratio of foreigners in each sector.

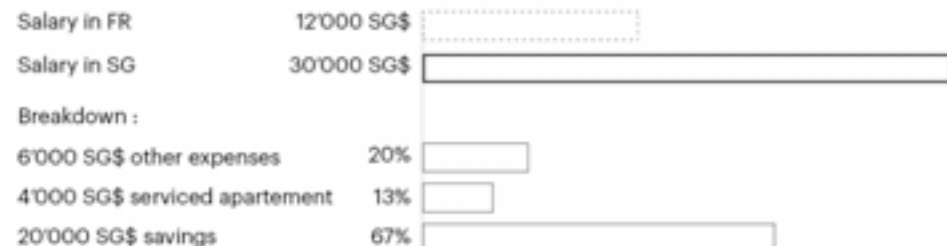
First, each sector has a "dependency ceiling" which allows for a certain number of foreigners for each local worker. The second mean is the control on the "foreign worker levy" that employers have to pay on a monthly basis for each work permit holder they hire.

Monthly Expenses for the Employer, for each Type of Employee



**Robert**

Age : 42 years old  
 Pass & Sector : Employment Pass, Pharmaceuticals  
 Relocation Expenses : Fees paid by his company and gets 10% bonus to come in Singapore.  
 Status : Single  
 Children : -  
 Previous Job Location : Lyon, FR  
 Planning to Stay : 10 Months, but would like a long term job in Singapore



**May**

Age : 26 years old  
 Pass & Sector : Training Work Permit, Cleaning service  
 Relocation Expenses : 2'200 SGD  
 Status : Single  
 Children : -  
 Family Location : Manila, PH  
 Previous Job Loc. : Manila, PH  
 Planning to Stay : 2 years



**Mukul**

Age : 42 years old  
 Pass & Sector : Work Permit, Construction  
 Relocation Expenses : 6'000 SGD  
 Status : Married  
 Partner Salary : None  
 Children : 2  
 Family Location : Tangail, BH  
 Previous Job Loc. : Dubai  
 Planning to Stay : Since he made enough money



# Impacts on Two Scales

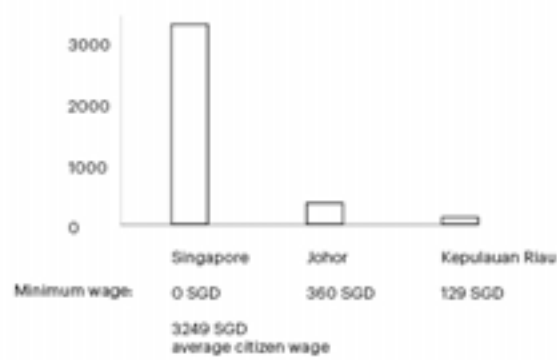
The regional 'triangle of growth', which has officially become a political intention in 1989, relies partly on the idea that each end of the tri-national agreement possesses a different kind of workforce in abundance. Specifically, Singapore would provide the highest-skilled workers, Malaysia the mid-skilled ones, and Indonesia the lower-skilled workers.

In actual terms, this mostly translates into Singaporean

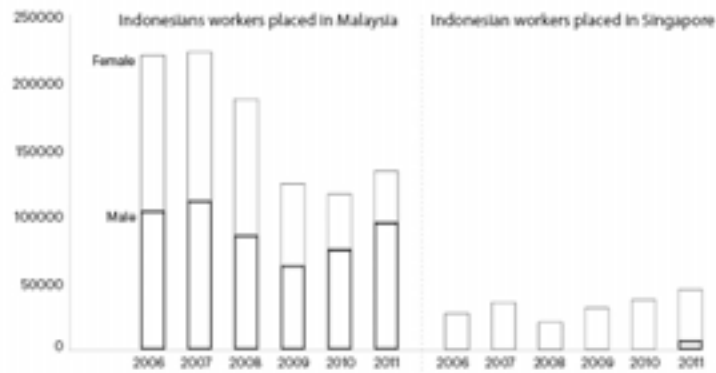
companies opening factories in both Batam and Johor, which in turn brings both domestic and international workforce migration to these regions.

On the other hand, thousands of Malaysian commuters cross the border each day to work and earn a Singaporean salary.

Regional Ratio of Foreign Workforce (2009)



Minimum Wages in the Region (2012)



### Gender Differences

Indonesia's flows of work-related formal emigration show that Malaysia and Singapore are very important destinations for Indonesian "overseas workers" (respectively second and fourth most common).

One should also note how migration of male workers to Singapore seems to have just started in 2011.

Regional Workforce Movements

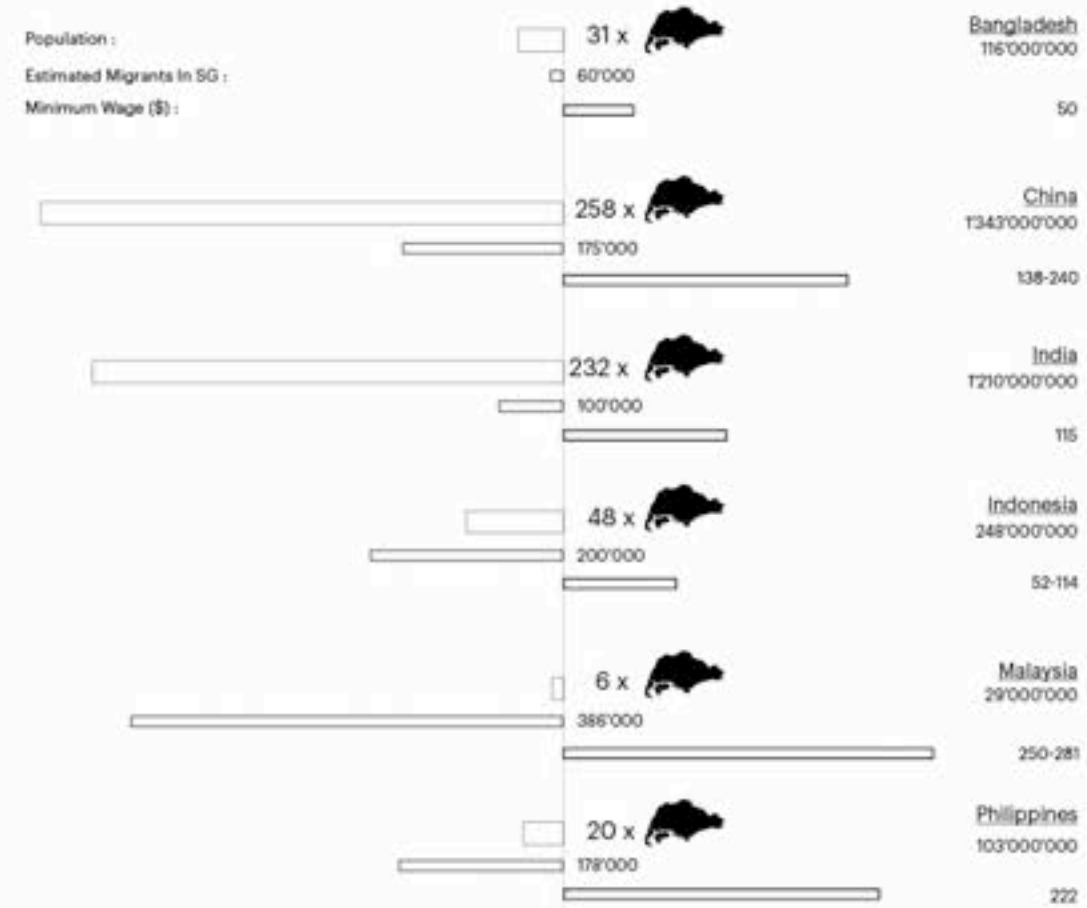




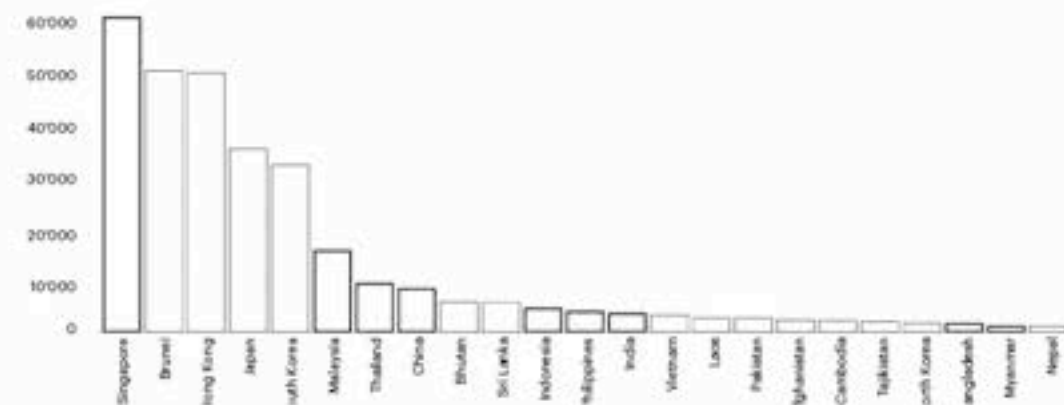
**Differentiated Workforce Fluxes**

Each country in the region provides very specific types of unskilled workers. Indonesia and Philippines are the main sources of domestic workers while India and Bangladesh are the main sources of construction and marine industry workers. China and Malaysia have more diversified flow of emigrants to Singapore.

**Comparing Different Origins and Wages**



**GDP per Capita in the Region**





Foreign construction workers, in a dormitory in Bukit Batok. Photographs were taken with a disposable camera given to one of them.



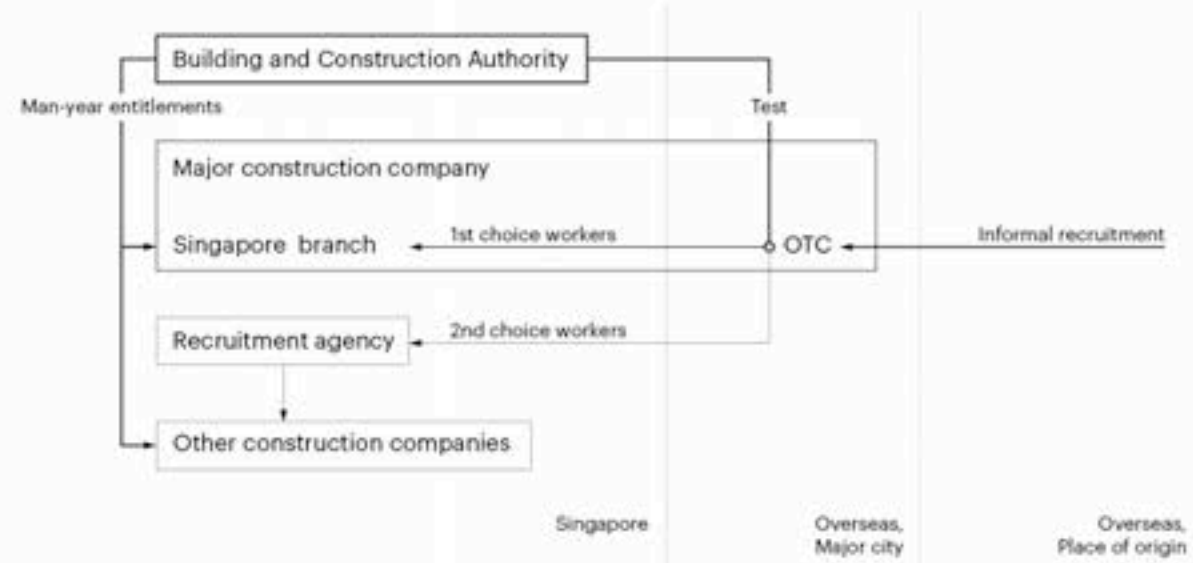


# An Exogenous Construction

Singapore's construction sector is the country's first employer of non-resident workforce. Its 'dependency ceiling' is currently set at 7 foreign workers for each full-time local worker. But as there is no segmentation in this ratio, Singaporean workers usually hold the highest positions in each company, while the foreign workforce is generally carrying out work on the ground.

Since February 2000, the Building Construction Authority (BCA) has required of each foreign worker to train and pass a test in his home country prior coming to Singapore. As a result, 'overseas training centres' (OTC) were opened in each home country of the construction workforce. Those OTCs are generally run by Singaporean construction companies on behalf of Singapore's BCA.

## Ensuring Foreign Workforce



Structural



Architectural



Civil Engineering



Mechanical & Electrical



Construction Plant Operation



Monthly Total per Country



Overseas Training Centres

Each overseas training centre provides training and testing paths according to the profile of workers that are desired in Singapore.

According to a range of employers that we interviewed, the higher-skilled, most technical workers come mostly from China and Thailand, while the more physically demanding jobs are mainly fulfilled by workers from Bangladesh, India and Myanmar.

Nevertheless, the concurrence from other employing places such as Hong Kong and Mainland China is reducing the number of Chinese construction workers coming to Singapore. This explains the will to expand the reach of the OTCs in new places such as the Philippines and Sri Lanka.



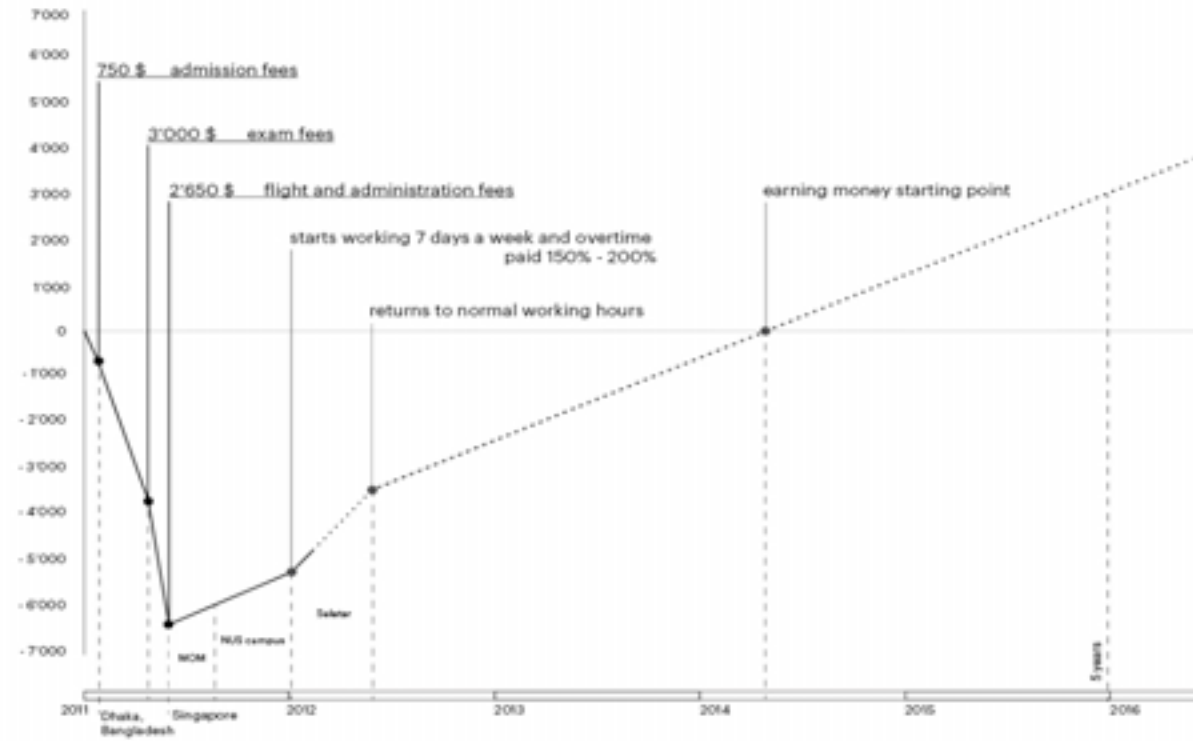
Hyttech Goodwill - Training and Testing Centre, Dhaka, Bangladesh

1. Pipe fitting
2. Plastering
3. Electrical wiring
4. Enhanced construction safety Orientation course (ECSOC)



**Abdur Raut Ahamed Haji Abdur aka Mukul**

Type of work : Electrician  
 Age : 42 years old  
 Status : Married  
 Children : 2  
 Previous Position : Similar, in Dubai



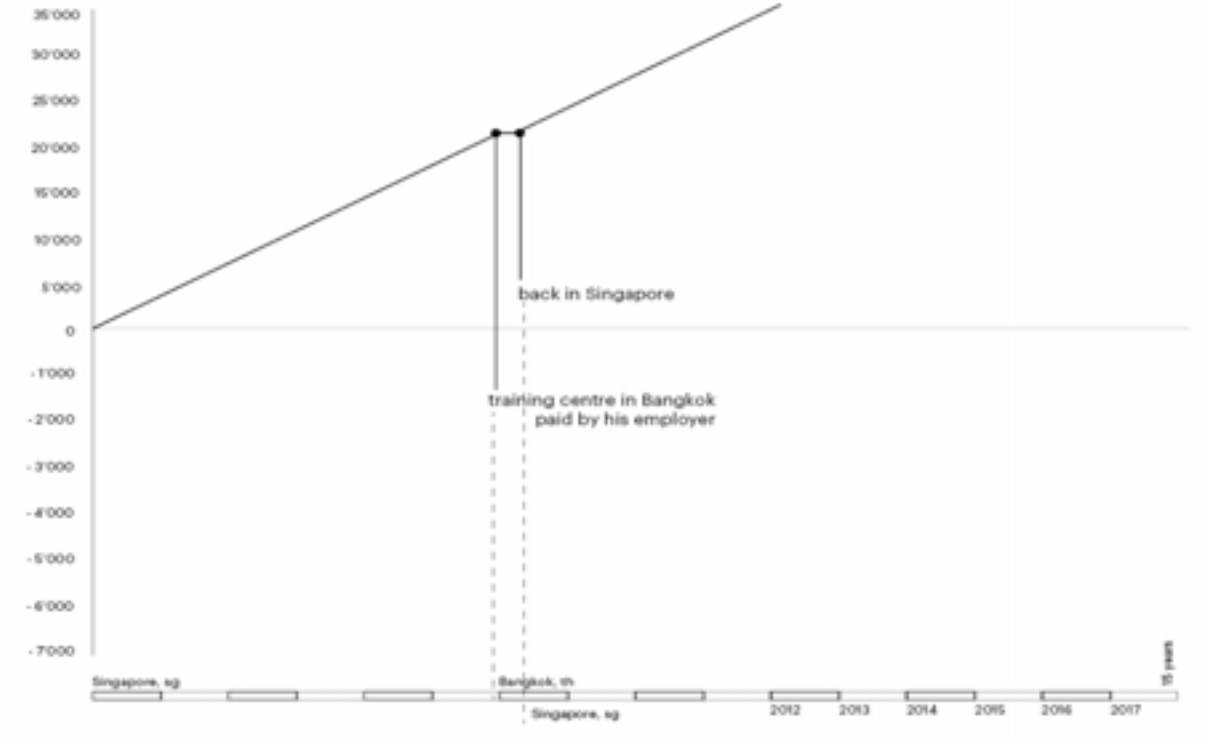
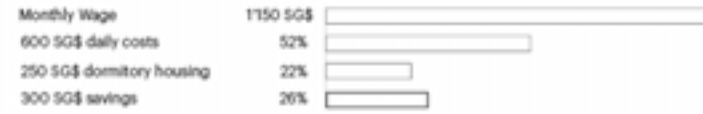
**National Differences**

The financial trajectory of each worker is unique. However, we noted that a lot Bangladeshi and Indian workers had earned large debts in the process of getting from their hometown to their OTC and then to Singapore. They thus need to spend a certain amount of time working in Singapore before actually gaining anything.



**Pongpat Wachirabunjong aka Warat**

Type of work : Painter  
 Age : 34 years old  
 Status : Single  
 Children : -  
 Previous position : None, in TH



# An Invisible City

Our exploration of Singapore's human resources was continued on a Sunday afternoon, in a sleeping industrial area in the southwest of the island. A couple of Bangladeshis were offering haircuts on a grass slope, surrounded by the main road and an almost dry canal.

Thus, as we assumed that one usually goes to a hairdresser either close to home or in a commercial neighborhood, the following question was raised:



Near Pioneer MRT, on the edge of the residential zone

Who are the people going through the hassle of traveling to a remote industrial area for a haircut on a Sunday?

We then discovered that at least twenty-five thousand foreign workers are living in dormitories confined in the middle of the nearby industrial settlements. And that a large part of those workers was working in other areas of the island, in diverse work sectors.

Islands of communal housing and 'recreation centers' in

parts of the city which are designated for industries, activities that are kept away from view in the most dynamic neighborhoods. This chapter is a study on this second city, and on the way in which it cohabits with the Singapore that most of us know.





**A Neighborhood Named Pioneer**

Pioneer is split in two by a major road called Boon Lay Way. The northern half comprises the most western expansion of Singapore's large-scale social housing program (HDB), while the southern half is part of Singapore's largest industrial estate, Jurong.

In the last years, this southern half has also become a sort of grouping area for foreign worker dormitories. Six complexes of dormitories and a 'recreation centre for foreign migrants' were built as enclaves amid the industries.



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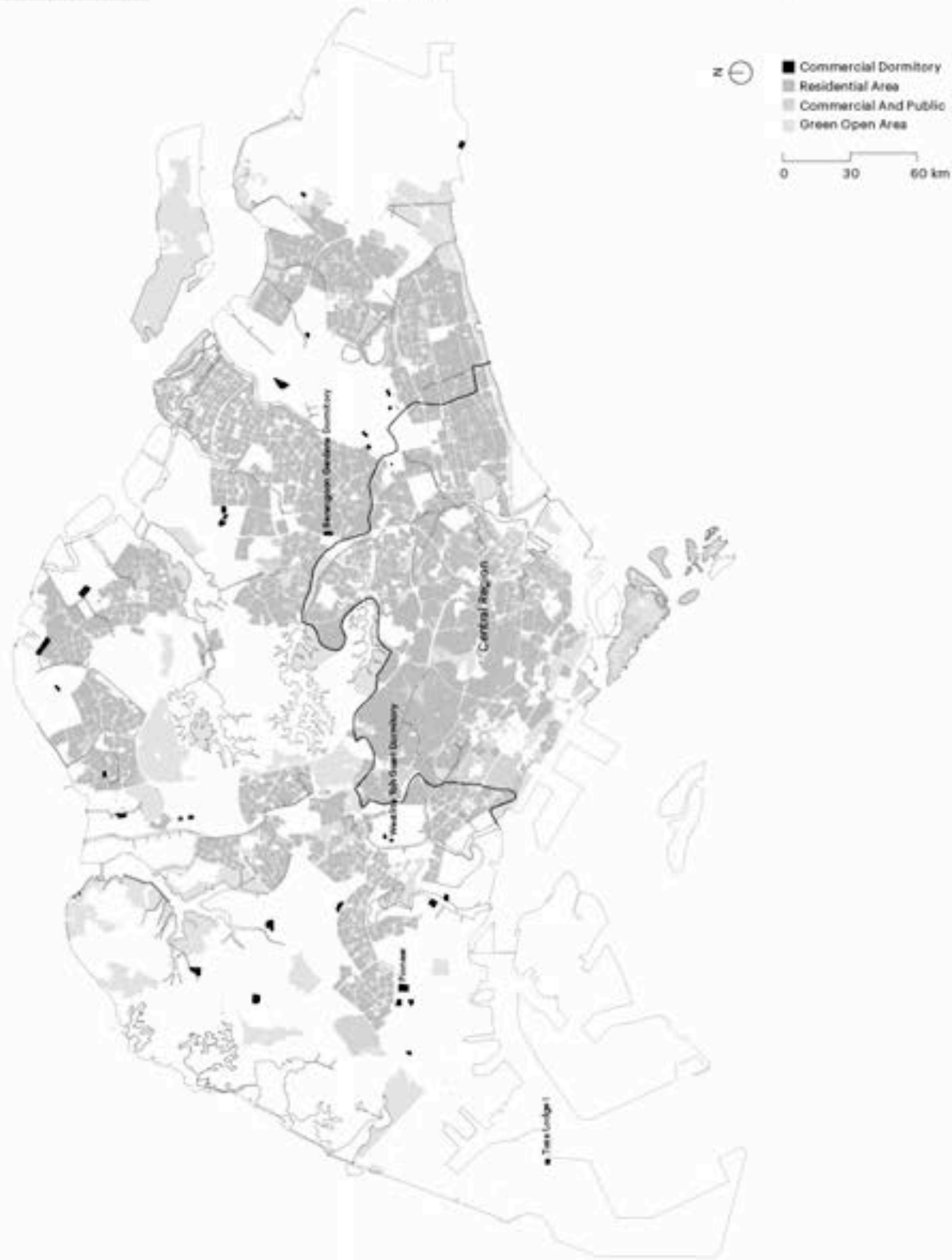


4.



5.

- 1. SCAL Soon Lee Dormitory
- 2. Kian Teck Dormitory
- 3. SCAL Recreation Center
- 4. Kian Teck Dormitory
- 5. Soon Lee Lodge  
Kian Teck Dormitory



#### Planning Repulsion

Singapore's Urban Redevelopment Authority (URA) is the governmental agency in charge of planning the use of the national territory. At first glance, one can observe that sites selected for foreign workers' dormitories are spread on the outskirts of the island. Most of them are also outside of the residential and

commercial areas which constitute the core of the city's expansion:

Dorms inside of central region:	1
Dorms inside of res./com.:	1
Dorms on the edge of res./com.:	4
Dorms outside of res./com.:	34



#### Planning Enclaves

The repulsion from the main cores of the city implies that dormitories are usually set up within functional areas that are kept on the outskirts of the island. Those areas are usually of three categories; industrial zones, 'reserve sites' (plots kept vacant for further planning), and 'special uses' (military functions, reservoirs, cemeteries, etc.). Most

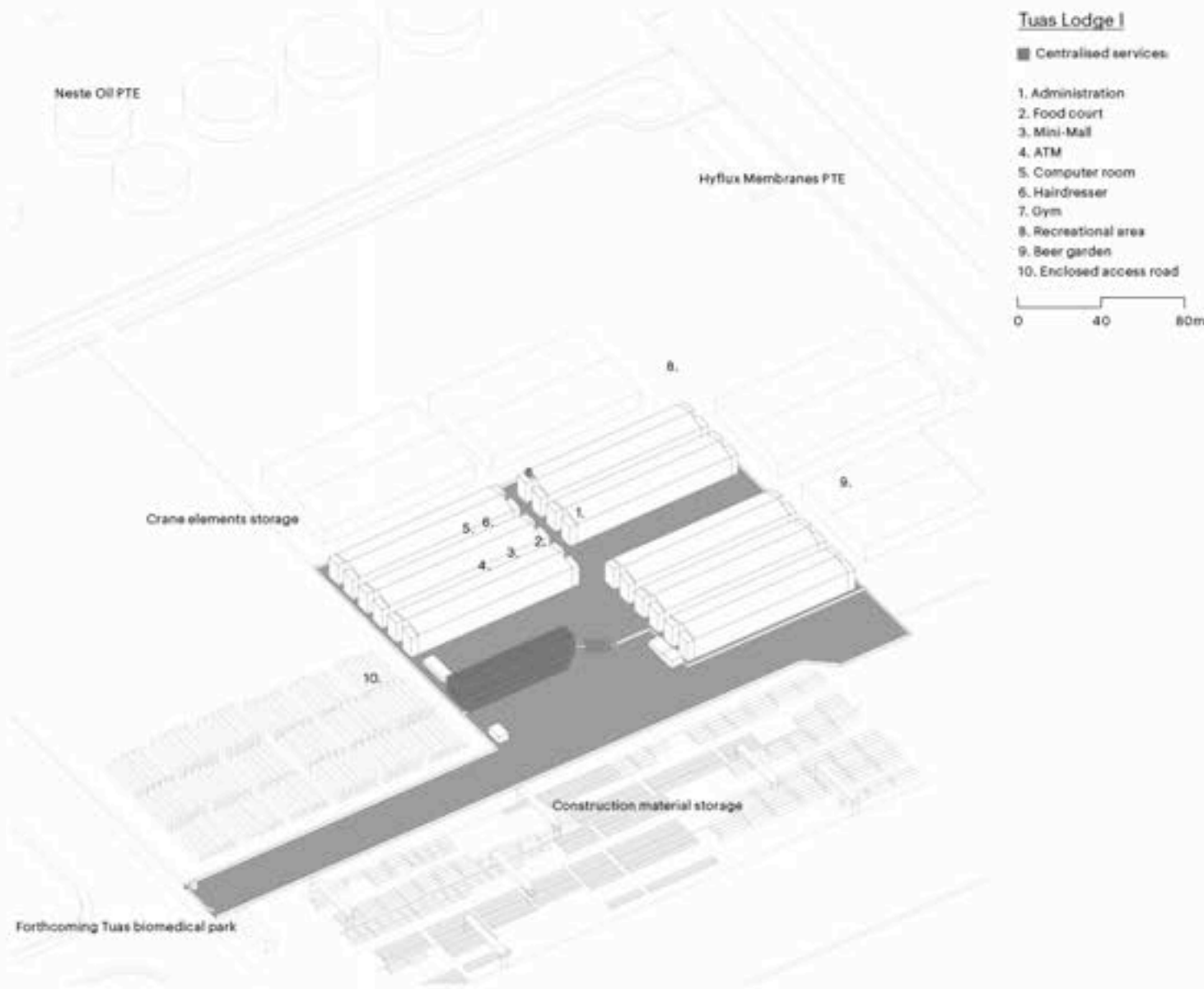
dormitories are either set up as enclaves in those functional areas or exist between them:

Dorms in or next to industrial zones:	29
Dorms in or next to "reserve sites":	6
Dorms in or next to "special uses":	3
Dorms not in those three categories:	1

# Enclaving

Dormitories are the most common option to accommodate work permit holders in Singapore. However, their situation as islands of housing remote from the main residential areas implies that as opposed to other types of housing, they need to be able to function independently from the rest of the city. Or, in the words of a dormitory manager, they must be "self-sufficient enclaves".

Therefore, each of the settlements needs to have in-house offers of food and basic supplies, an ATM along with other essential services. Some even have their own remittance office and hairdresser.



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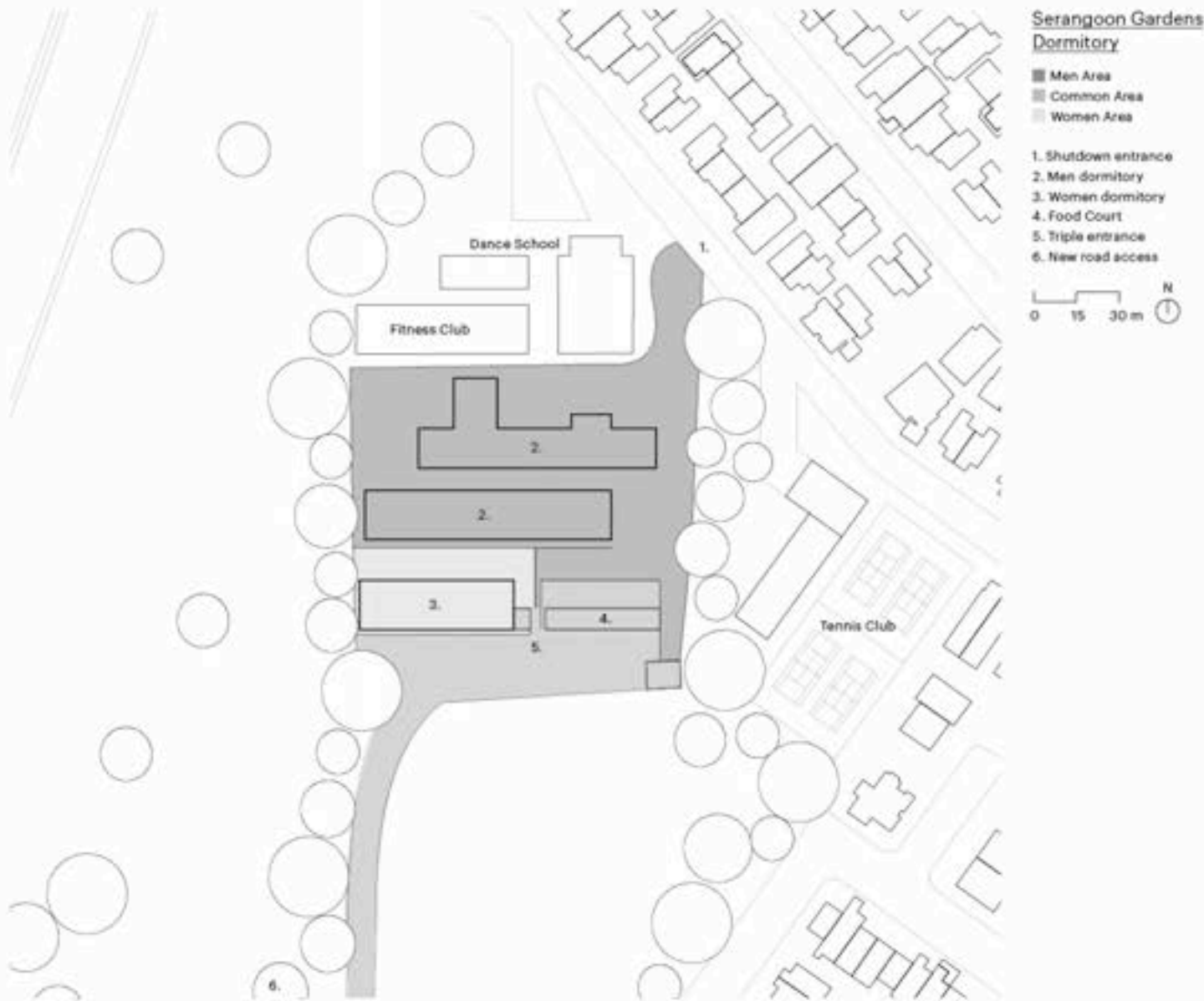
1. Enclosed access to the dormitory in Tuas
2. Covered walkway to the dormitory in Tuas
3. ATM in Blue Stars Dormitory
4. Private Hawker in Soon Lee Lodge
5. Map of the area

# Hiding & Splitting

Considering the fact that most dormitories are extremely dense enclaves of housing, one of the main concerns for their managers is to reduce the potential for conflictual relationships both with their surroundings and inside the settlements.

Therefore, various means of separation are put in place: Men and women occupy separate buildings, out-

door areas and entrances. Men of different origins are separated when possible. Biometrics checkpoints are mandatory at each entrance. Curtains and panels are blocking the rare vis-à-vis with the exterior world.



1.



2.



3.



4.

**Serangoon Gardens Dormitory**  
 In 2008, the Singapore Land Authority announced the intention to convert an abandoned school, which sat next to a housing area, into a foreign worker dormitory. Contestations rose from the neighboring residents, which led to the following compromises:  
 a. The school's entrance was shut down and a new entrance was built from the highway, on the other side of the plot.  
 b. The number of expected beds was lowered, but it seems like the initial number is currently applied.

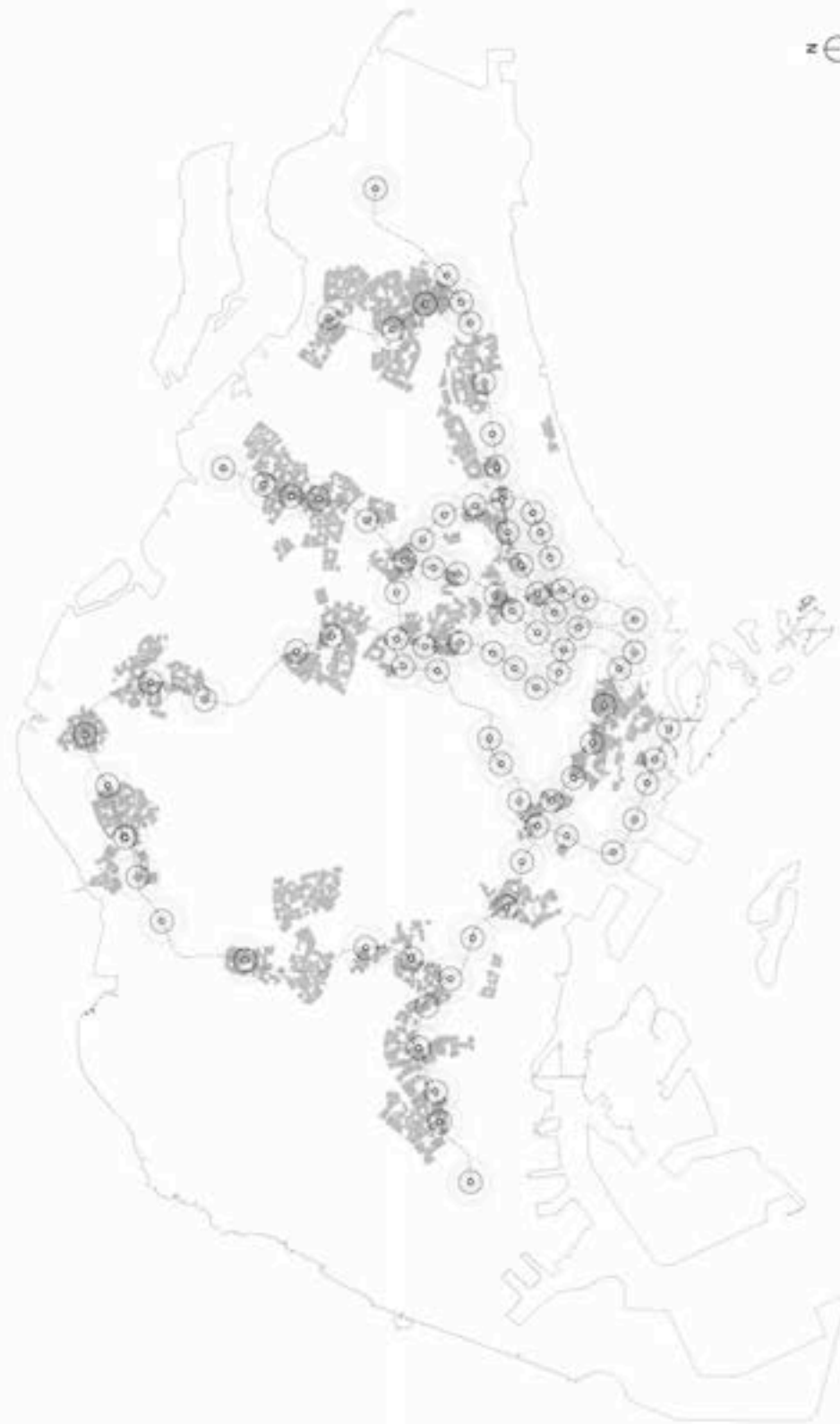


5.

Photographs taken during a clandestine visit.

1. Only entrance to the dormitory (no entry-sign)
2. Guard's office (left), separated entrances for men and women (middle), third entrance to the food court (right).
3. Additional panels to reduce vis-à-vis
4. Additional curtains to reduce vis-à-vis
5. Map of the area





**Public Transport Supply**  
In Singapore, living far from the residential areas often means living far from public transport stations. The new lines of Mass Rapid Transport (MRT) are planned together with the new Housing Development Board (HDB) neighborhoods.

As a result, most of the foreign workers

dormitories are out of reach from the MRT lines, which creates dependencies on buses and private types of transport.

HDBs in 400m MRT catchment area: 18%  
HDBs in 800m MRT catchment area: 70%  
Dorms in 400m MRT catchment area: 7%  
Dorms in 800m MRT catchment area: 23%



■ Commercial Dormitory  
 ■ HDB  
 ○ MRT station  
 ○ 400m catchment area  
 ○ 800m catchment area

0 30 60 km

# Foreign Workers Transport: a Secluded Network

Work permit holders are generally provided with transportation between their residence and workplace by their employers. In most cases, workers of each company are grouped in the same dormitory in order to ease their transport.

Lorries are the most common option for the journey of construction workers as they can accommodate relatively

large groups of individuals and allow to carry some equipment along with the staff. This mode of transportation is always treated as an exception in road safety regulations. On the other hand, some dormitories arrange low-priced bus rides to their temporary residents on their days off.



### Transportation Networks

- Commercial Dormitory
- MET
- ~ Buses from Tuas Lodge I



1.



2.

1. Storyboard of a lorry ride for construction workers, from Marina Bay to Changi

2. Stickers showing capacity and security regulation on the back of a lorry

## Gathering Points: Merging with the City

While most of them live on the outskirts of the island, work permit holders tend to gather in a few places on their free time, usually on Sundays.

Each community of migrants in Singapore tends to have its own preferred gathering places, such as Little India for the Indians and Bangladeshis, or the Golden Mile Complex for the Thais. But we noted that foreign workers

also gather in other, less ethnically-oriented places, such as Jurong Point Mall or Chinese Garden, which can probably be explained based on their strategic location in relation to dormitories. Those places, together with bathing opportunities such as East Beach and Sentosa Island, are the ones where migrant workers can mingle the most with the rest of the population of Singapore.



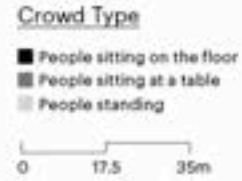
### Gathering Points

- Commercial Dormitory
- Important Gathering Points

0 40 80 km



1. Chinese Garden
2. Sentosa Beach
3. Little India, Tamil community
4. Lucky Plaza, Filipino community
5. Golden Mile Complex, Thai community



**Little India, Sunday**

Being the main gathering area of the Indian and Bangladeshi communities in Singapore, this neighbourhood sees dozens of busses and lorries bringing in flocks of migrant workers each Sunday. They mainly come here to be with friends, buy things and remit money.

Remittance is done either through formal offices or through 'friends', who travel with money on a regular basis and charge a lower rate.



1.



2.



3.



4.

1. Gholia's Village
2. Farrer Park
3. Western Union
4. Northumberland Road

# A Lucrative Subsistence Dwelling

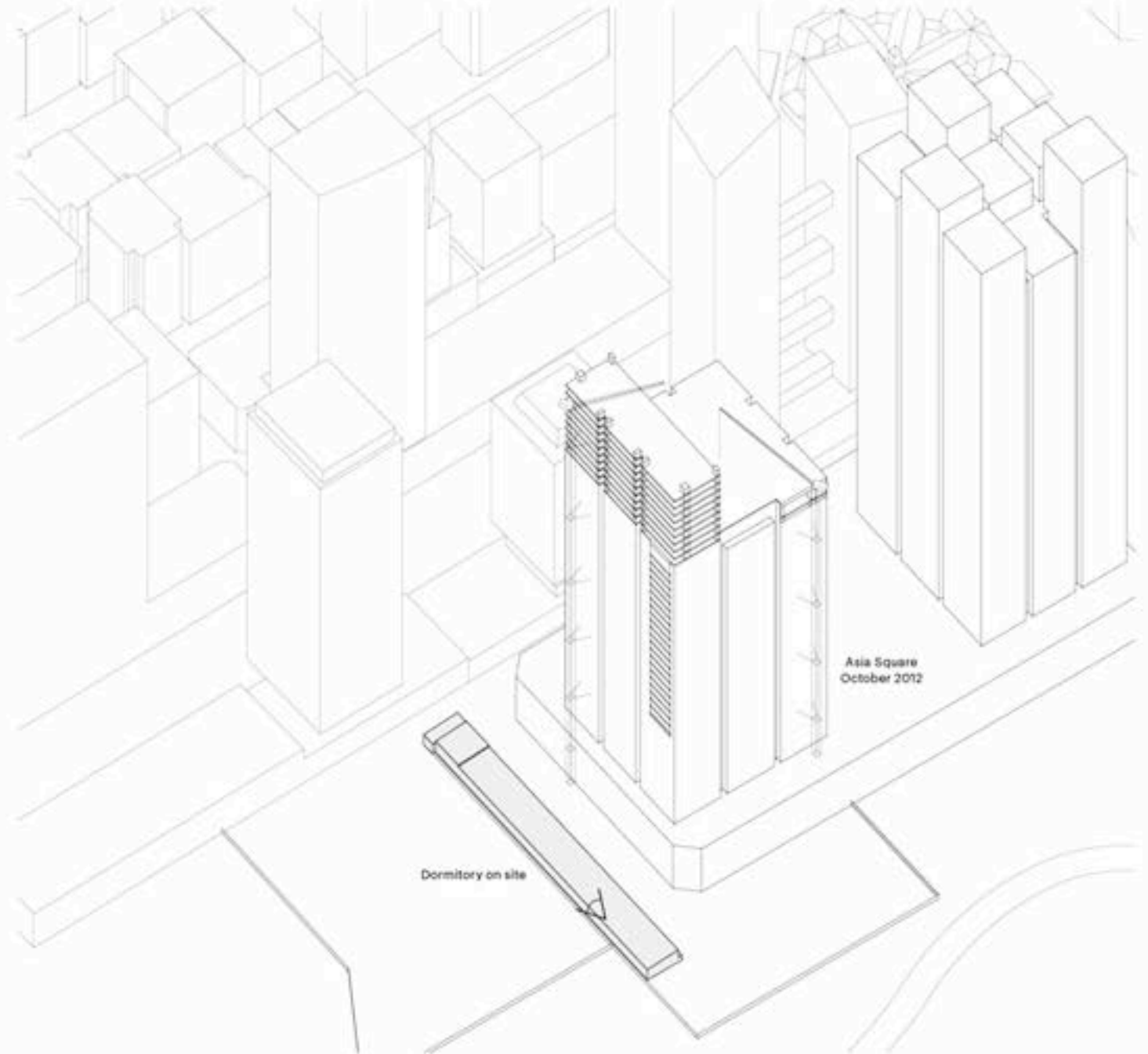
Going back for further explorations of Asia Square in the city center, we focused on the trompe-l'oeil partition wall and what the construction site it aimed to conceal. There, we realized that a hundred-and-twenty-meter-long monolith of metal and fabric was sitting next to the forthcoming tower. On closer look, we understood that it was a building made of containers and scaffolding elements, and that it was meant to house about four or five hundred con-



Container dormitory on Asia Square construction site

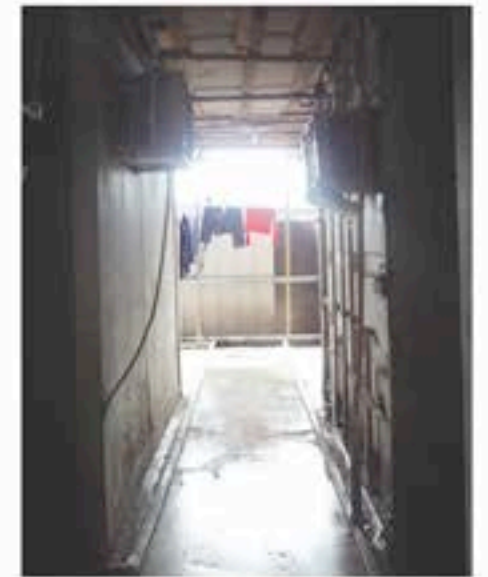
struction workers of the different companies which were occupying the site. Each container is designated to a company and can house about ten to twelve workers. Singapore is now in a difficult transitory period concerning foreign workers accommodation. On the one hand, there seems to be a political intention to convert to more gratifying solutions in terms of image, such as commercial dormitories. On the other hand, the offer for such dormitories is

struggling to expand because of the very little amount of land that is released for this use. This chapter is a study on this evolution of the housing offer through case studies. Going from informal but regulated options, to more systematic, commercial ones.





Dormitory on a construction site in Asia Square. Photographs taken during a clandestine visit.



**NOTICE TO ALL FOREIGN WORKERS**

ALL FOREIGN WORKERS ARE TO PRODUCE THEIR ORIGINAL WORK PERMITS WITHOUT DEMAND. FOREIGN WORKERS WITHOUT PERMITS ARE NOT ALLOWED ON THIS SITE.

所有外地勞工必須隨時出示工作准証  
沒持有工作准証的外地工人不准進入及逗留在地內

SEMUA PEKERJA LUAR NEGERI HENDAKLAH MENUNJUKKAN PERMIT ASLI TANPA DIMINTA. PEKERJA LUAR NEGERI TANPA PERMIT TIDAK DIBENARKAN.

අනෙකුත් සියලුම විදේශීය සේවකයන්ට තමන්ගේ මුල් කාර්ය ධර්ම පත්‍ර ඉදිරිපත් කිරීමට අනුමැතිය ඇත. විදේශීය සේවකයන්ට තමන්ගේ මුල් කාර්ය ධර්ම පත්‍ර ඉදිරිපත් කිරීමට අනුමැතිය ඇත.

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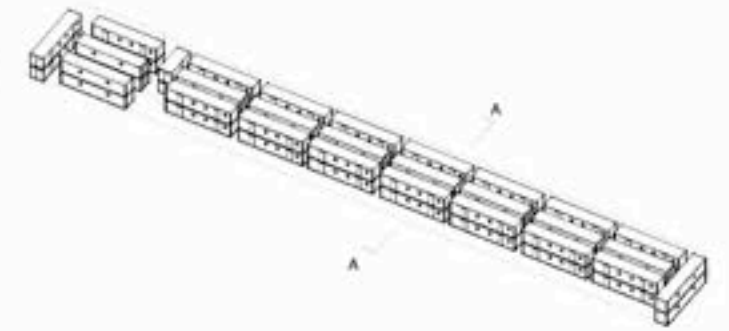
## Asia Square: Dormitory as Mobile Inset

The construction site is enclosed and a security guard controls its entrances. The dormitory inserted in this compound is a purely functional device meant to serve for a set amount of time before being moved to the next construction site.

It is therefore precarious, yet, very efficient. It allows savings on the cost and time of commuting.

**A Prefabricated Housing Model**  
Two layers of containers are placed on the site. A scaffolding-like structure is then constructed around the containers in order to give access to the second level and to create an enclosed habitat, complete with sheet metal as roof and fabric as façade.

A few containers on each end are reserved for communal bathrooms and storage.



## Foreign Workers Housing: Restrained Options

According to Singapore's Employment of Foreign Manpower Act, all employers of work permit holders "shall ensure that the foreign employee has acceptable accommodation. Such accommodation must be consistent with any written law, regulation, directive, guideline, circular or other similar instrument issued by the Government". Domestic workers usually live in their employer's house, but other work permit holders require different solutions.

This situation is put in perspective by the fact that, thanks to its HDB program, Singapore has one of the highest rates of residents living in public housing in the world (83%), as well as one of the highest home-ownership rates for its resident population (89%).

### Accommodation Types



**Permanent Commercial Dormitories**  
These are commercial dormitories sitting on a 30-year-lease plot of land. The current rental price of a bed is about 200 to 250 SGD per month, and there are about 85'000 beds available.

**Temporary Commercial Dormitories**  
These are commercial dormitories sitting on a 9-year-lease plot of land. The current rental price of a bed is about 200 to 250 SGD, and there are about 90'000 beds available.

**Short-Term Quarters**  
According to governmental guidelines, temporary dormitories can be built on construction sites or "temporary occupation licence" land, in order to house the needed workforce of a certain activity, such as construction work.

**Industrial Quarters**  
40% of each industrial estate can be converted into dormitories, following governmental guidelines. Depending on their zoning situation, the beds of those dormitories are either open to be rented by any employer, or exclusively dedicated to workers of the said industrial estate.

**Private Residences**  
This comprises shophouses, semi or fully detached houses, condominiums and other private estates, which are owned or rent by the employer or the worker. Primarily concerns employment pass holders who live in condominiums and domestic workers, who are generally housed in their workplace.

**HDB Flats**  
About 5% of the inhabitants of HDB flats are foreigners who subrent rooms or flats to Singaporean tenants. Most of them are either S pass or employment pass holders, but some are work permit holders. Nevertheless, "foreign construction workers (non-Malaysian) are not allowed to be sub-tenants of HDB flats".





Tuas Lodge 1

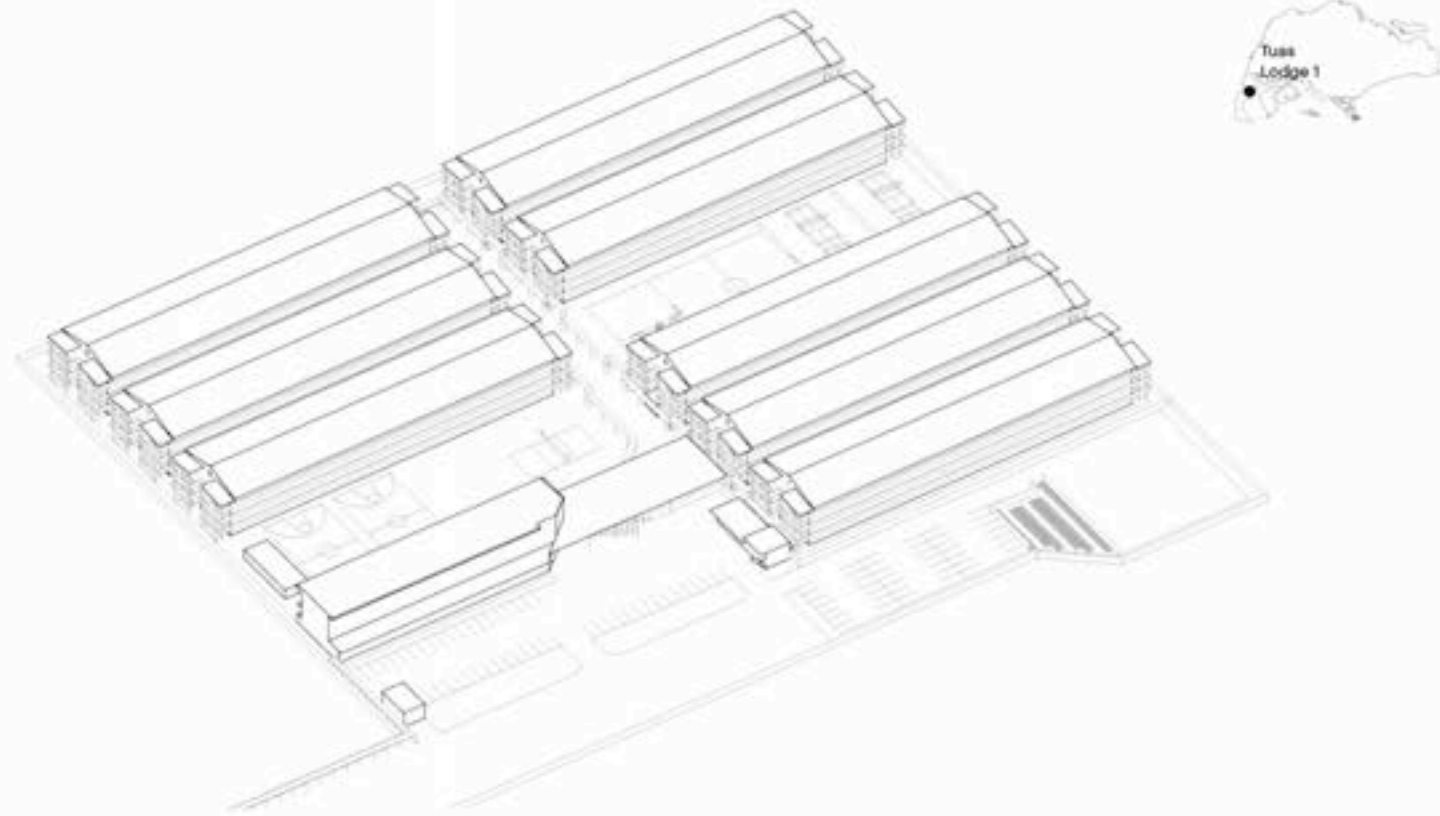


## Tuas Lodge 1: Dormitory as Satellite

Tuas Lodge 1 is a commercial dormitory, which means that several dozens of employers rent rooms there in order to house their foreign workers. In total, about eight thousand six hundred construction workers are living on this thirty-

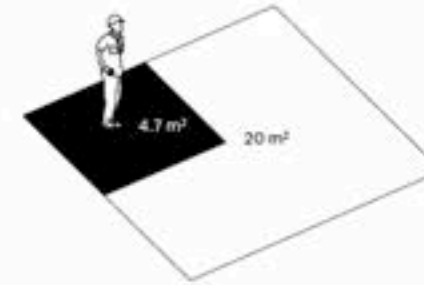
thousand-square-meter piece of land.

The plot is situated in Tuas, arguably the most remote piece of reclaimed land in Singapore's territory.



**Another Prefabricated Housing Model**  
On top of a concrete slab, an assemblage of steel structural elements and sandwich panels is mounted. The whole construction process takes about a week and the total price of the building material is about sixty Singapore dollars per square meter, which comes to about three million dollars for the whole complex.

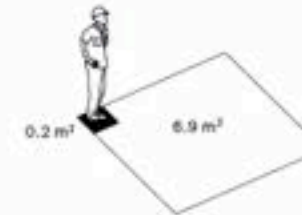
Residential Land Area



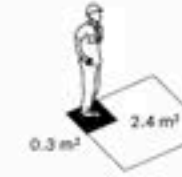
Outdoor Recreational Area



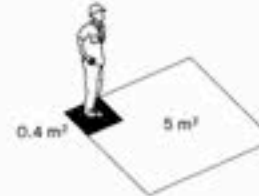
Dining/Living Area



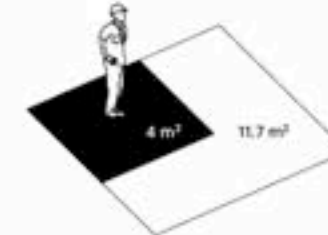
Bathroom Area



Kitchen Area



Bedroom Area

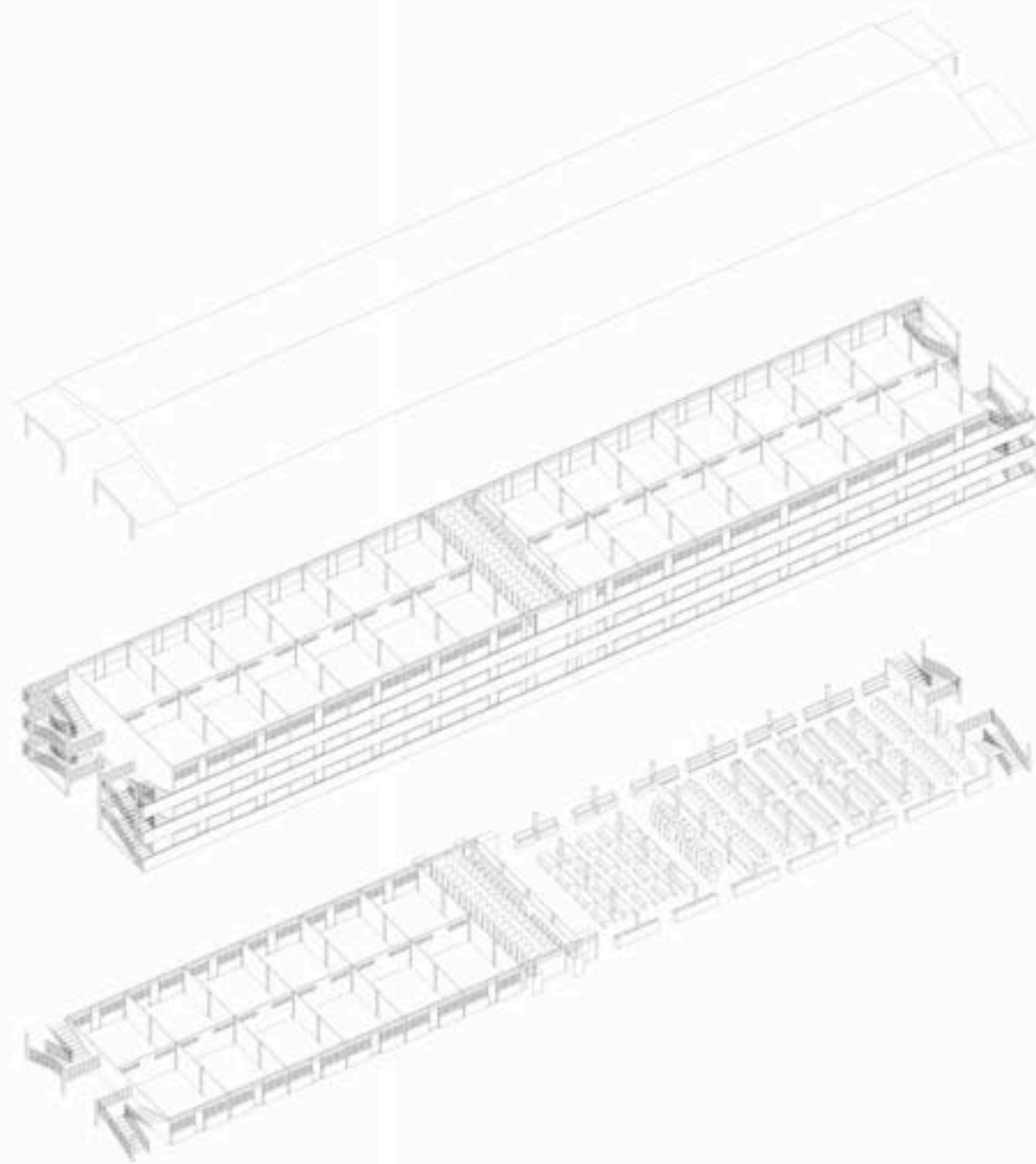


■ Dormitory  
□ HDB

### A New Housing Standard

Several governmental agencies dictate guidelines for foreign workers dormitories in terms of square meters per inhabitant. Altogether, those regulations led to a new standard of housing in the last few years with its distinctive typologies.

We compared this standard with HDB flats, which house 83% of the resident population.



Block Breakdown

Each block consists of 4 floors of bedrooms. The only exceptions are the bathrooms on each floor and the cooking-and-dining areas, which takes up half of the ground floor.

18 Washbasins



18 Urinals



18 Toilets



18 Showers



312 Men



Floor Breakdown

Each typical floor is divided in 26 identical rooms. Each room houses 12 workers. In the middle of the floor, an aisle leads to a common bathroom. There is approximately one set of washbasins, toilet, urinal and shower for 17 inhabitants.

## One Bedroom

- 1 Ceiling fan
- 12 Lockers
- 1 TV



## One Bedroom

- 12 Men
- 1 Ceiling fan
- 12 Lockers
- 1 TV

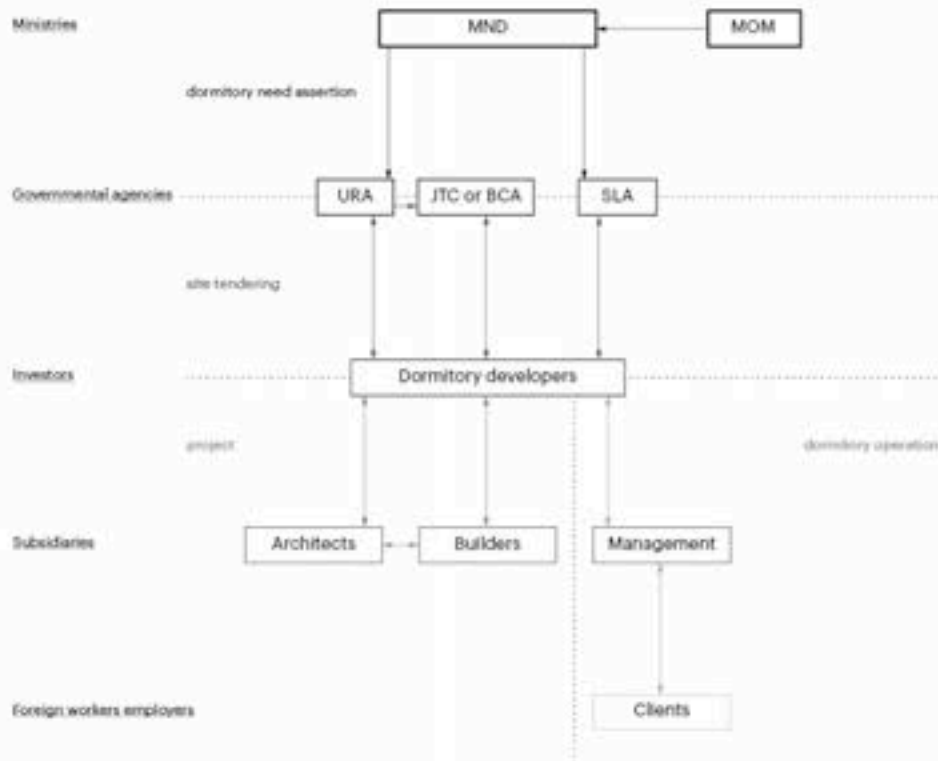


## Commercial Dormitories: An Emerging Business

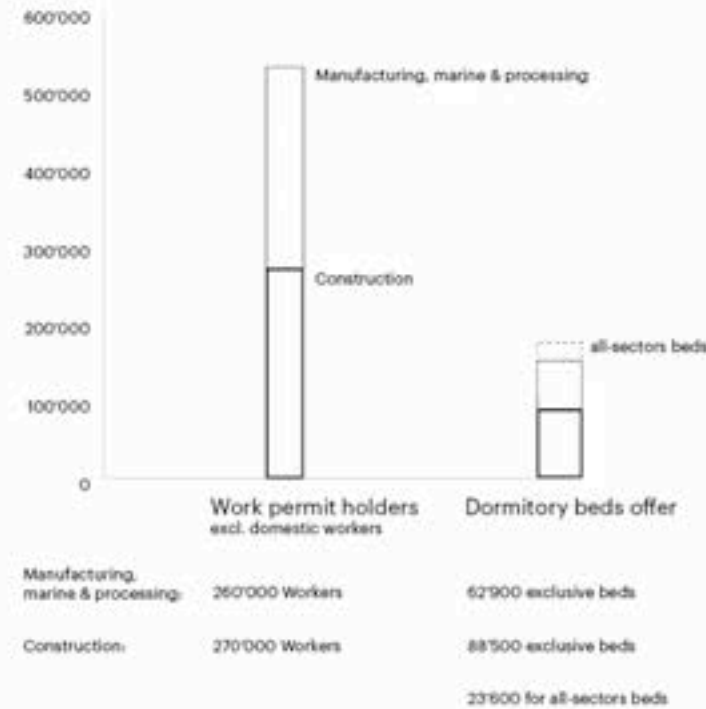
The ownership and management of dormitories is proving to be a very lucrative business in Singapore for two main reasons.

First, the extreme density of those dormitories allows for an inflated leasing market, where rooms can rent out for as high as three thousand dollars per month, for situations where these are occupied by as many as twelve people.

Secondly, the gap between offer and demand drives the rental prices higher every year. This shortage of beds is once again a consequence of the very small number of plots given up by the governmental agencies for this use (recently about one or two sites per year).



- BCA Building and Construction Authority
- JTC Jurong Town Corporation Authority
- MND Ministry of National Development
- MOM Ministry of Manpower
- SLA Singapore Land Authority
- URA Urban Redevelopment Authority



### Supply & Demand

Singapore now has more than a half million foreign workers that would ideally be placed in dormitories. However, due to the land planning constraint, less than two hundred thousand beds are currently available.

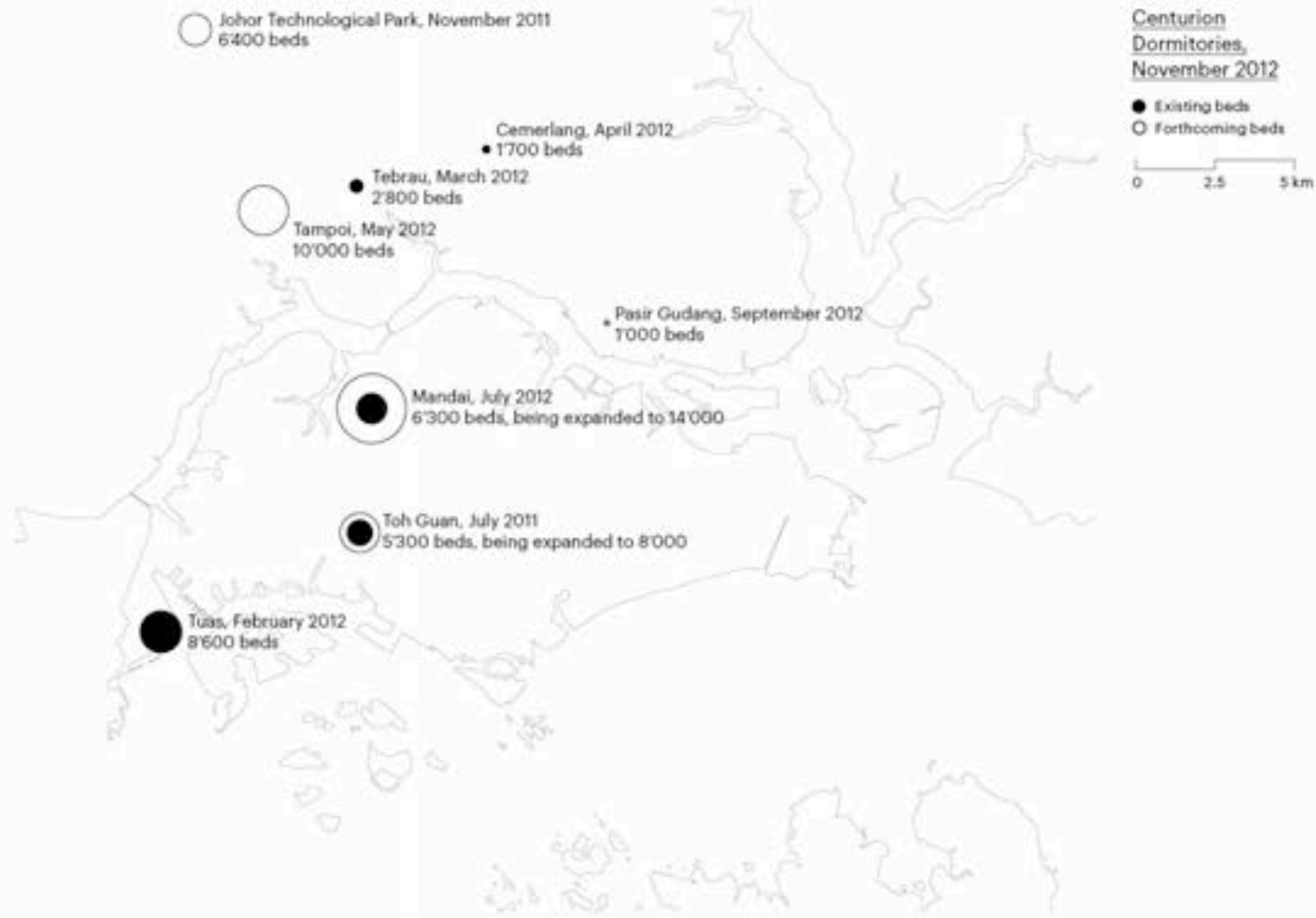
Other constraints exist: When a plot of land is leased for dormitories by the Building Construction Authority, it is generally reserved for workers of the construction sector, while the JTC applies the same kind of exclusivity to the industrial sector. Aside from commercial constraint, this adds to the segmentation of the population of foreign workers in Singapore.

### Commercial Dormitory Ownership

In recent years, several actors have entered the dormitory business, either through calculated financial strategies or 'by chance'.

Indeed, some construction and marine sector companies in need of beds for their own workers have been at the front-row of this nascent market. For example, TTJ, "one the largest structural steel fabricators in Singapore", now earns about 14 percent of its revenue from the operation of two dormitories.

On the other hand, real estate investment funds are buying and selling permanent dormitories at enormous profit.

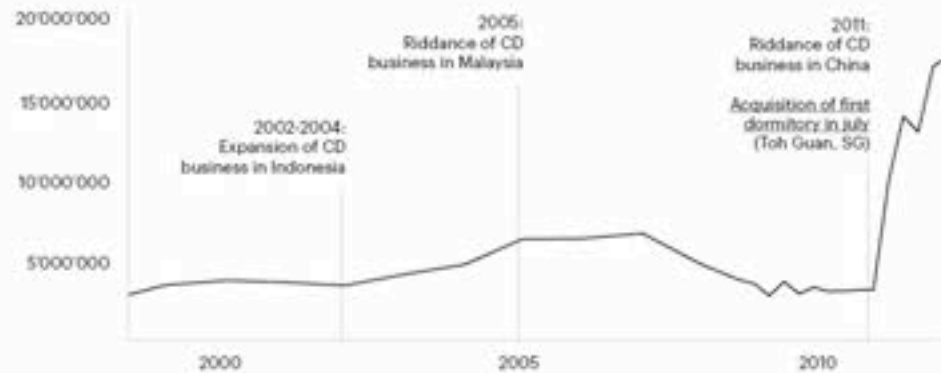


**Centurion**

Centurion is one of those companies that entered the dormitory business 'by chance'. As one of the main CD fabricators in Southeast Asia, it had to find ways to diversify when the concurrence from online markets became too important.

After the acquisition of a dormitory in 2011, they have seized every opportunity to acquire other ones. They are now heading towards the total conversion of their business priorities to refocus on dormitories. The shortage of land for new dormitories in Singapore is now making them expand overseas.

**Revenue Timeline**



The Condominium:  
The Nexus

Capacity:  
242 units for about 800 inhabitants

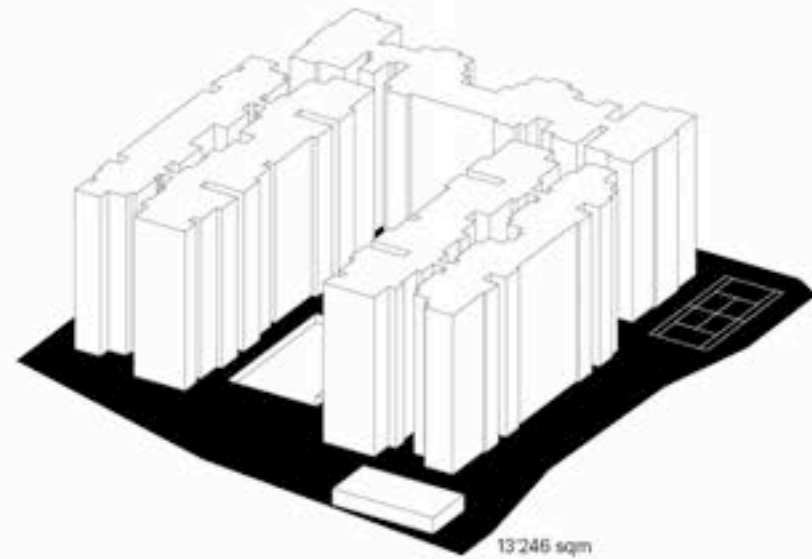


Construction cost:  
45'000'000 SGD

Estimated total revenue  
from unit sales:  
194'000'000 SGD

Construction period:  
2 years and 7 months  
3 years

Average unit pricing at completion: 800'000 SGD



The Workers' Dormitory:  
Toh Guan Westlite

Capacity:  
448 units for about 5'300 inhabitants

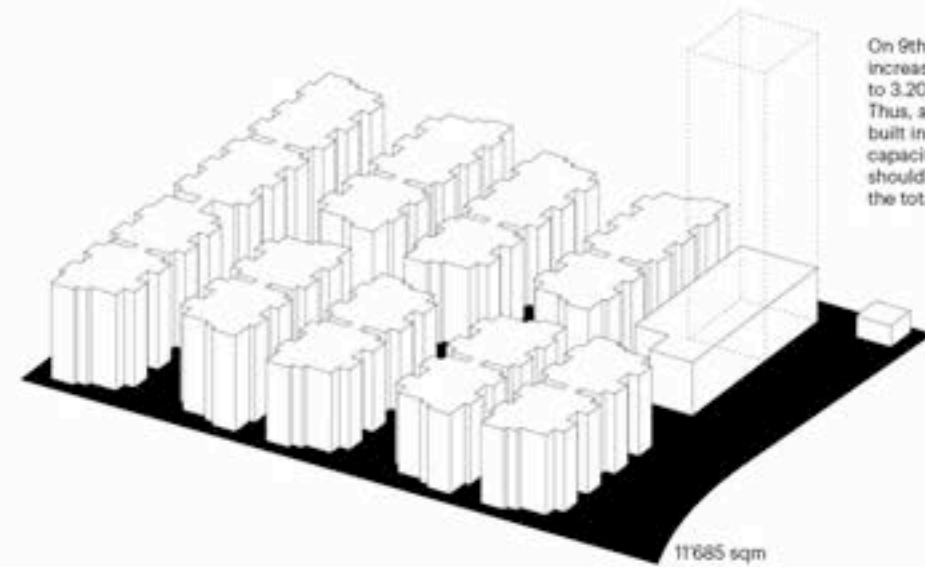


Construction cost:  
15'000'000 SGD

Estimated total revenue  
from 30 years of service:  
477'000'000 SGD

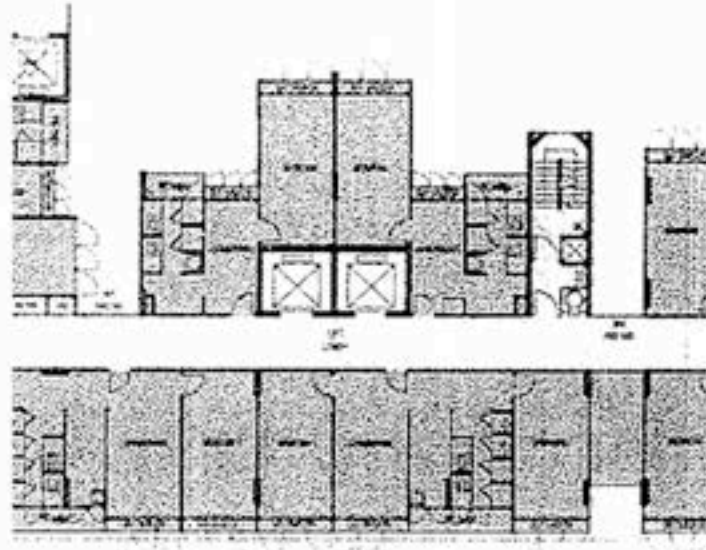
Construction period:  
less than a year  
3 years

Monthly price per bed: 250 SGD



On 9th March 2011, permission to increase the plot ratio from 2.00 to 3.20 was granted by the URA. Thus, an 18-storey tower is being built in order to expand the capacity to 8'000 beds, which should add about 150M SGD to the total revenue.





Toh Guan Westsite

**Condominium**  
 con-do-min-i-um *noun* (kən-də-'mi-nē-əm)  
*plural* con-do-min-i-ums *also* con-do-min-ia

- 1  
 a: joint dominion; *especially*: joint sovereignty by two or more nations  
 b: a government operating under joint rule
- 2  
 a politically dependent territory under condominium
- 3  
 a: individual ownership of a unit in a multiunit structure (as an apartment building) or on land owned in common (as a town house complex); *also*: a unit so owned  
 b: a building containing condominiums



The Nexus condominium



Speculative typology

### Addendum: A Speculative Typology

One could imagine various strategies to increase Singapore's supply of dormitories without compromising the rest of its residential share.

Our speculative scenario consists in reducing the river that separates the two ends of the housing spectrum in Singapore: foreign worker housings and condominiums. One can observe that those two types employ very similar means to create a secured environment, as well as to increase the housing density (and the subsequent real-estate profit). For efficiency in construction, the common choice for both typologies is to use the same plan on each storey of the building.

Thus, the two types of housing could be disposed back to back, each facing a different part of the city. The resulting two-faced typology then offers the opportunity of being used as an urban device: In each situation, the areas on each side of the system would be provided with a horizon of housing, which could perhaps alter the relationship between them.



Left:  
 "Traditional" situation reinvented: condos facing residential area, dormitories facing industrial area.



Right:  
 Housing as frontier: condos facing inland, dormitories facing the open sea.

# Two Fields of Control

## The Art Of Delegation

For both fields of action, the private sector serves as a convenient mediator between the Singaporean state and its foreign workforce. Regulations are applied to employers and service-providers, which in turn have the responsibility of dealing with the migrant workers. The consequence of this situation is twofold:

On the one hand, as opposed to traditional welfare systems, it sustains the illusion that the living and employment conditions of foreign workers are resulting from the economical imperatives and good will of a few private companies.

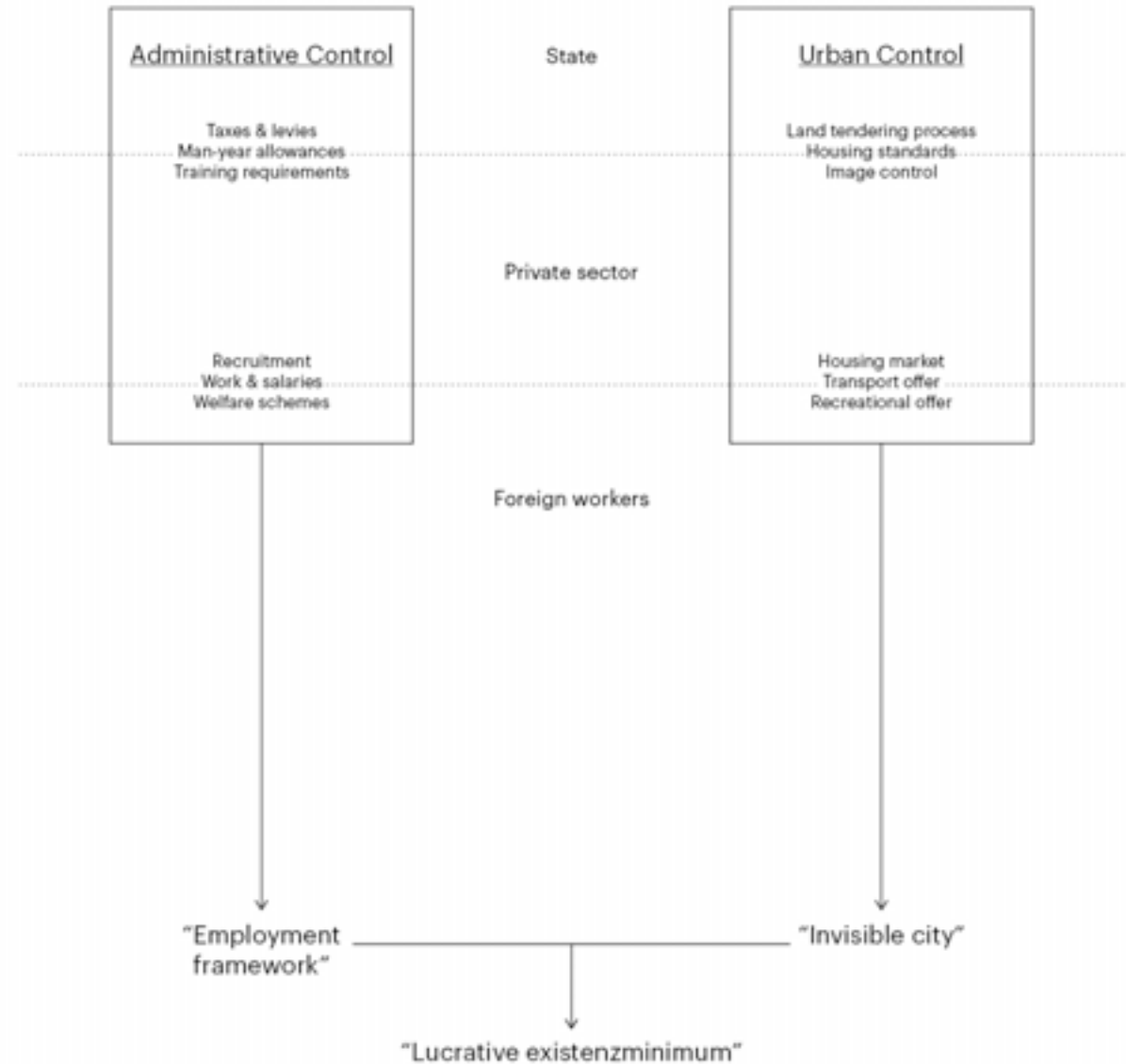
On the other hand, it creates a strong mutual dependency between the employers and their foreign employees: The employers need their workers to comply to the regulations in order to avoid fines. And the workers can only count on their employer to fulfil some of their most basic needs.

## Administrative Control

A system of classification and rationing of the foreign workforce creates a strong hierarchy in the human resources of the country.

## Urban Control

Precise management of land planning and housing regulations is used in ways which tend to seclude the foreign workforce in the Singaporean territory.



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Also, we wish to thank the various migrant workers, company officials, researchers and activists who let us get a peek at their world. Finally, a special thank you to Stamford Raffles.







Oil tanker bypassing in Chittagong, Bangladesh



Architecture of Territory  
ETH Zurich  
FCL Future Cities Laboratory

Hinterland  
Singapore, Indonesia, Malaysia  
Project 1, part 2

Asst. Prof. Milica Topalovic  
Martin Knüsel  
Marcel Jäggi

# THE EXTENDED STRAIT

Singapore's Oil Hub

by  
Martin Garcia  
Magnus Nickl

p.12

## Dependent Island

Global Primary Energy Demand (p.14)

Gas Powered Island (p.18)

Energy Reserves (p.22)

Singapore's Gas Demand (p.24)

Singapore's Oil Demand (p.28)

Minerals and Chemicals as Pillars of the Economy (p.32)

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## Chemical Island

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## Petrochemopolis

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## Liquid Hub

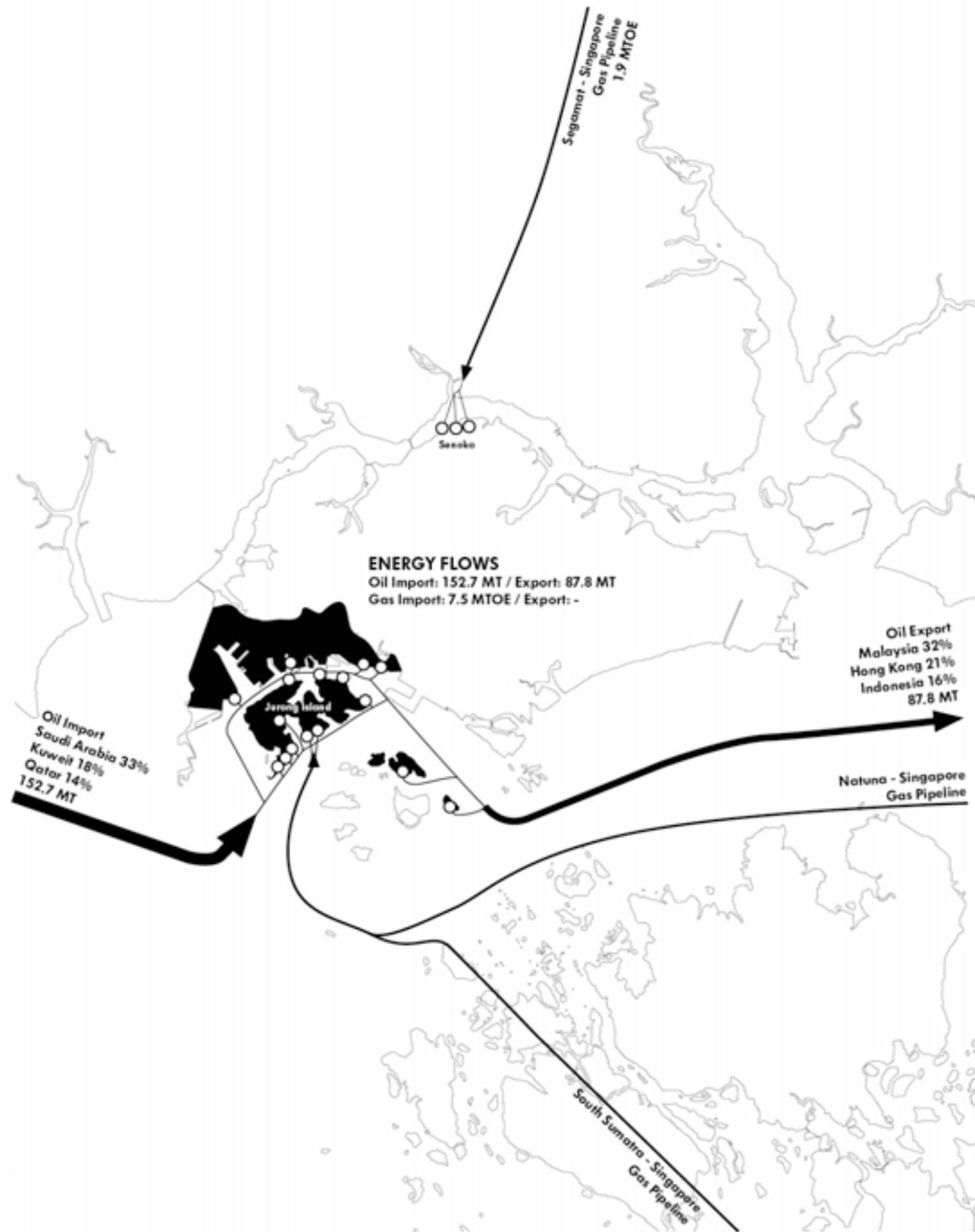
History of the Oil Hub (p.38)

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This work investigates ways by which energy sources shape the space of the global city of Singapore. High electricity demand, the strategic location as a petroleum hub and a highly specialized ship building industry serving the demands of modern oil explorations are major topics that will be discussed. The oil industry, which is prominently located on Singapore's Jurong Island represents a major case study showing the importance of this industry. More importantly, petroleum products are used by many other industries in the chemical sector as a raw material creating a network, which is visible within the urban fabric.

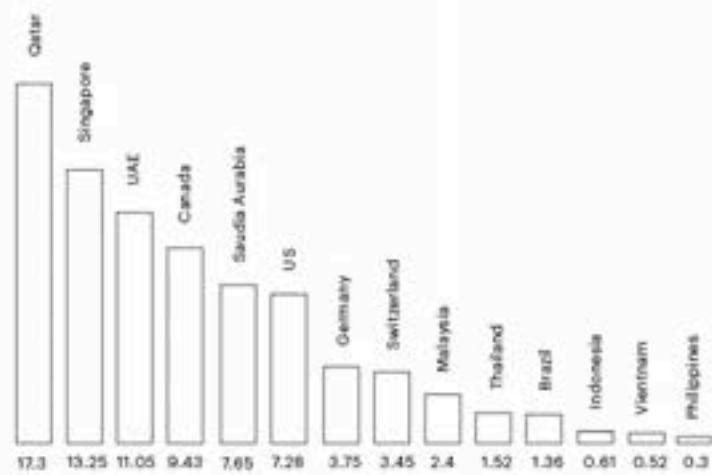
# Dependent Island

As Singapore does not have renewable energy sources, it relies intensively on imports. To improve this situation, renewable sources like solar power, wind energy and others could be a solution. However, the spatial limitations of the island restrict the extent to which these partial solutions could contribute to Singapore's consumption.

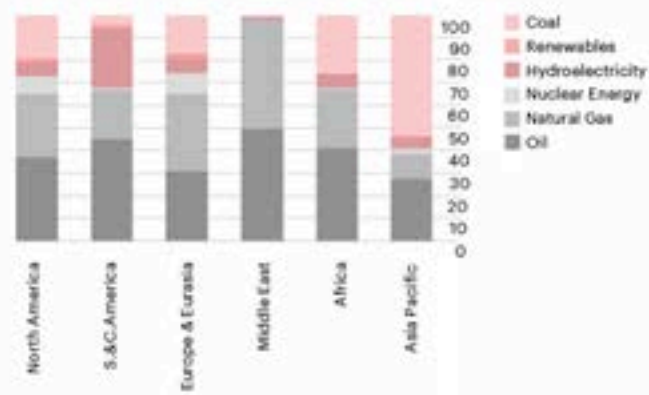


Singapore at night

**Total Energy Consumption per Capita**  
(oil tonnes equivalent per year)



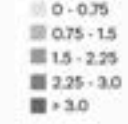
**Regional Consumption Pattern, 2011**



**Energy Consumption per Capita, 2011**  
(Oil tonnes equivalent)



**Oil Consumption per Capita, 2011**  
(Oil tonnes equivalent)



**Gas Consumption per Capita, 2011**  
(Oil tonnes equivalent)



**Coal Consumption per Capita, 2011**  
(Oil tonnes equivalent)



**Renewable Energy Consumption\* per Capita, 2011**  
(Oil tonnes equivalent)



\*Based on gross generation from renewable sources including wind, geothermal, solar, biomass and waste, and not accounting for cross-border electricity supply. Converted on the basis of thermal equivalence assuming 38% conversion efficiency in a modern thermal power station.

## Gas-Powered Island

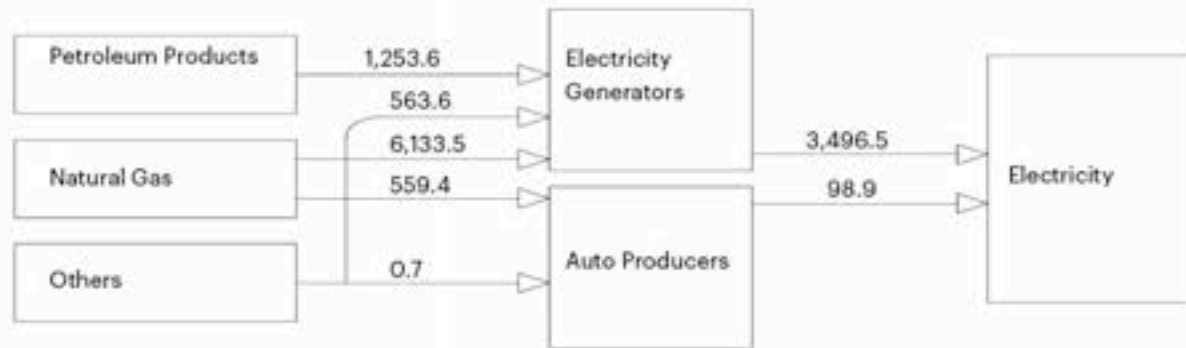
Singapore's energy demand has risen dramatically since its independence in 1965. Energy played a key role for the nation's ambition to join the ranks of 'developed countries'. All of Singapore's electricity was generated through the burning of fuel until recently. Singapore changed its supply system and added gas as a source of electricity due to increasing prices and environmental issues. This gas is imported from Indonesia and Malaysia.

Until today, Singapore sources of electricity are hardly diversified; a situation similar to that of Switzerland.

land. The Swiss rely mostly on hydropower and nuclear power for its electricity.

As prices of natural gas are relatively high compared to coal, Singapore is investigating the possibility of building a coal-fired plant for the production of electricity.

The renewable proportion of Singaporean produced electricity is generated through several incineration plants where household and commercial waste is turned into energy.



**Electricity Generation Singapore**  
Singapore has one of the least diversified energy sources worldwide.

\*Auto Producers are defined as companies whose main business is not electricity generation and the electricity produced is mainly for the companies' own use.



View on HDB housing by night from the Future Cities Laboratory

### Comparison of Electricity Generation by Energy Source

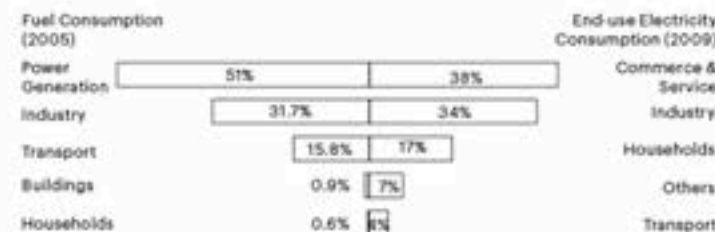


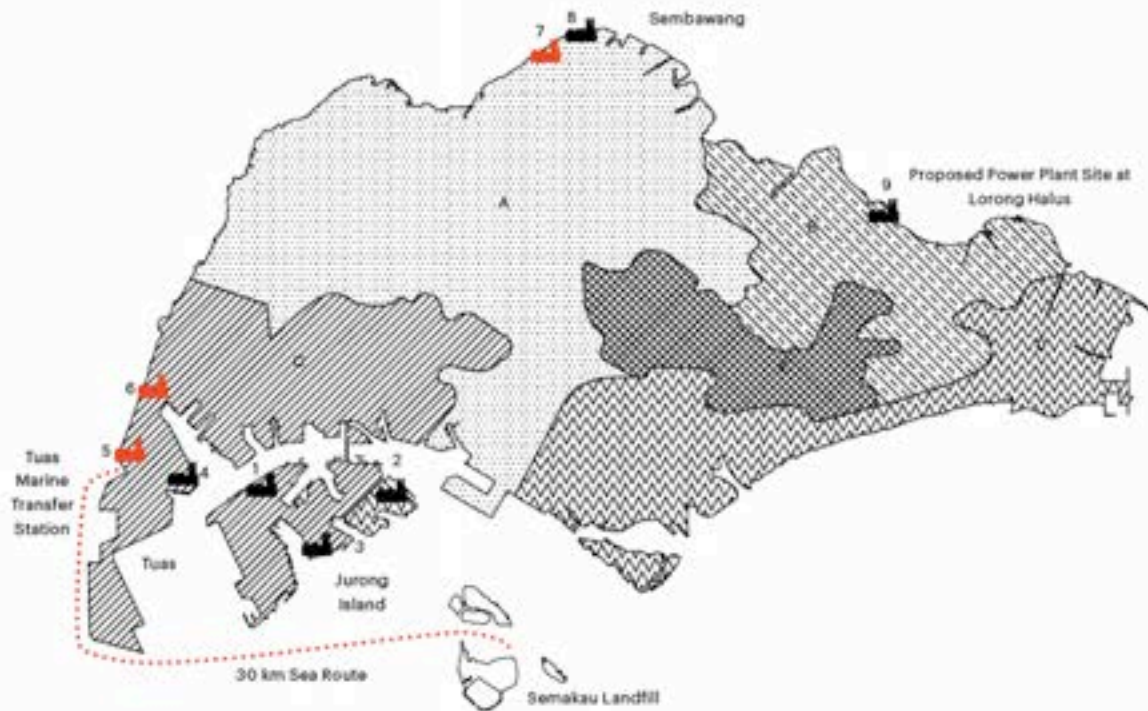
### Fuel Oil Prices in Relation to Electricity Tariff

Singapore's electricity mix is largely dependent on natural gas. As the natural gas price is linked to fuel oil, electricity in Singapore is much more expensive than in the US. This results in a disadvantageous situation for Singapore.



### Fuel Consumption Compared to Electricity Consumption



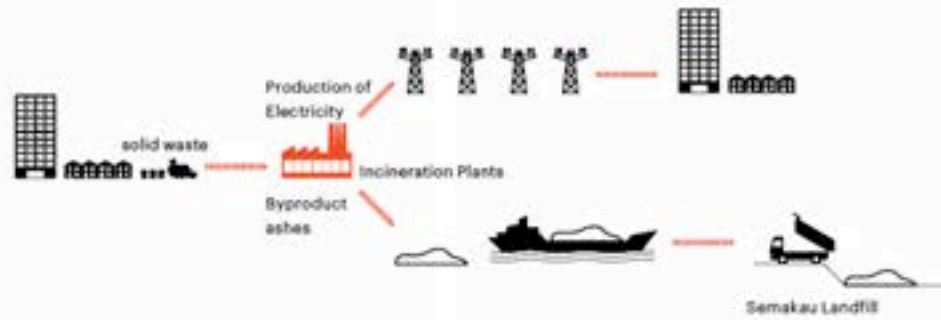


**Transmission Planning Zones**

- Zone A - North-West Block
- Zone B - North-East Block
- Zone C - South-West Block
- Zone D - South-East Block
- Zone E - Central Block

Power Plants  
Incineration Plants

1. Keppel Merlimau Cogen
2. PowerSeraya
3. SembCorp Power
4. Tuas Power Generation
5. Tuas South Incineration Plant
6. Tuas Incineration Plant
7. Senoko Incineration
8. Senoko Energy

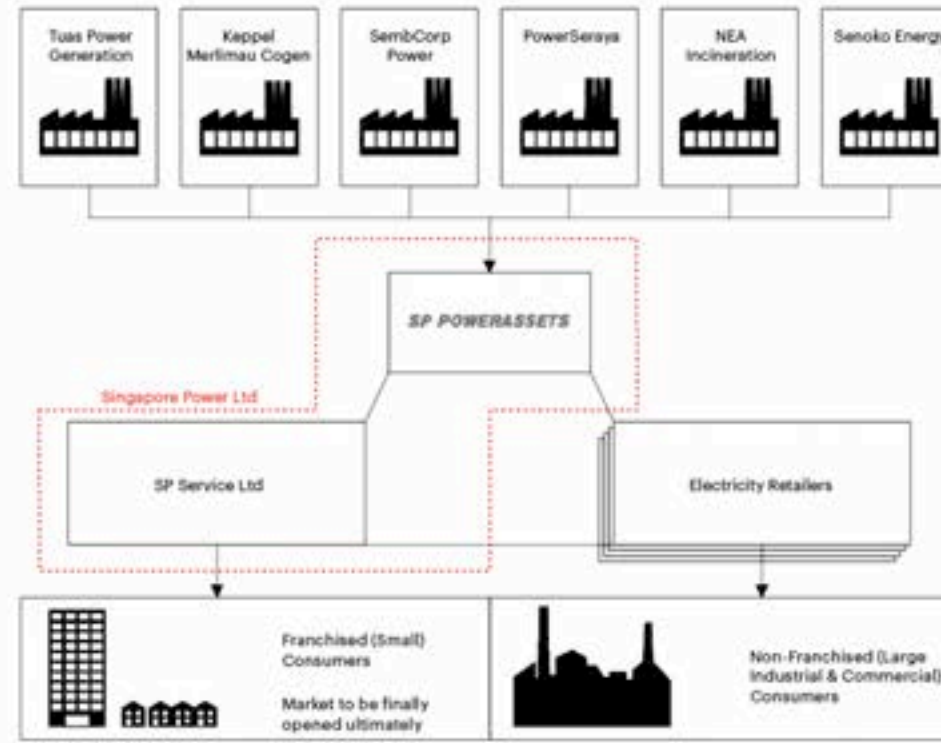


**Solid Waste Management in Singapore**  
The byproduct of the incineration plants is used to fill-up Semakau island. Waste (byproduct of the incineration plants) is unloaded from the ships at the landfill's transfer building. Lorries then transport the waste to landfill cells where it is discharged and compacted.

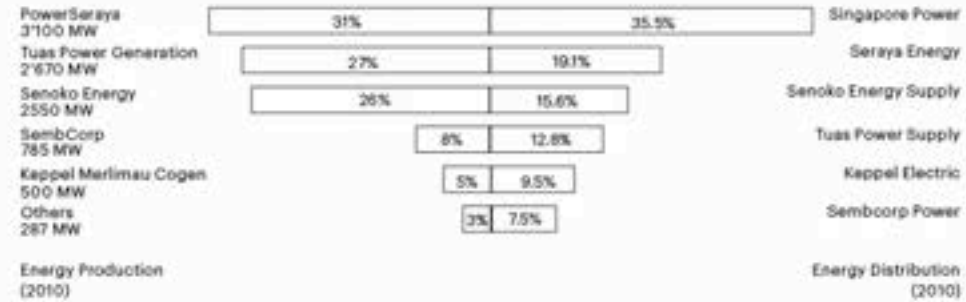


**Semakau Landfill**

Commenced operation	2009
Incineration ash	1'400 t/day
Non-incinerable waste	600 t/day
Capacity	63'000'000 m <sup>3</sup>
Area	350 ha
Cost	610'000'000 S\$
Expected Lifespan	25-45 years



- Milestones in the Singapore electricity market**
- 1995 OCTOBER: Corporatisation of PUB's gas and electricity undertakings. Formation of Singapore Power.
  - 1998 APRIL: Singapore Electricity Pool commenced operation.
  - 1999 SEPTEMBER: Government review of electricity industry.
  - 2000 MARCH: Government decision on further deregulation.
  - 2001 APRIL: Energy Market Authority formed.
  - 2001 JULY: 2MW Consumers become contestable.
  - 2003 JANUARY: The National Electricity Market of Singapore (NEMS) commencement.
  - 2003 JUNE: Commencement of 'Phase 1' Retail Market Liberalisation.
  - 2003 DECEMBER: Commencement of 'Phase 2' Retail Market Liberalisation.
  - 2004 JANUARY: Vesting Contract & Interruptible Load scheme introduce in the electrical market.



# Energy Reserves

The ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei, Burma, Cambodia, Laos, and Vietnam) possess a fair amount of oil and gas reserves, especially in Brunei, Malaysia and Indonesia.

The coal industry is most active in Vietnam, Thailand and Indonesia. Renewable energy sources are already present or could be developed in Brunei, Laos and Cambodia due to geographic circumstances and large rivers. Other

renewable sources are present, though most of them are underdeveloped due to the lack of funding and political backing.

Singapore does not own any natural resources except biomass obtained through municipal waste. Nevertheless, many Singaporean companies are involved in energy related enterprises all over Asia where they secure the country's needs in these matters.



### Proved Energy Reserves, 2008

**SINGAPORE**  
Biomass  
Municipal solid waste 2994 Tj/yr

**INDONESIA**  
Coal 5 529 Million Tonnes  
Crude Oil 497 Million Tonnes  
Natural Gas 3 186 Billion Cubic Meter  
Hydropower 2 147 TWh/yr  
Biomass 70 953 Tj/yr  
Geothermal Energy:  
Electricity generation 8 213 GWh  
Direct use 43 Tj  
Wind energy 2 GWh

**THAILAND**  
Coal 1 239 Million Tonnes  
Crude Oil 50 Million Tonnes  
Shale Oil 916 Million Tonnes  
Natural Gas 340 Billion Cubic Meter  
Hydropower 18 TWh/yr  
Biomass 2 438 Tj/yr  
Solar Energy 34 MWp  
Geothermal Energy:  
Electricity generation 10Wh  
Direct use 79 Tj  
Wind energy 2 GWh

**VIETNAM**  
Coal 150 Million Tonnes  
Crude Oil 626 Million Tonnes  
Natural Gas 217 Billion Cubic Meter  
Hydropower 300 TWh/yr  
Geothermal Energy:  
Direct use 92 Tj  
Wind energy 3 GWh

**MALAYSIA**  
Coal 4 Million Tonnes  
Crude Oil 701 Million Tonnes  
Natural Gas 2 330 Billion Cubic Meter  
Hydropower 230 TWh/yr  
Solar Energy 9.8 MWp

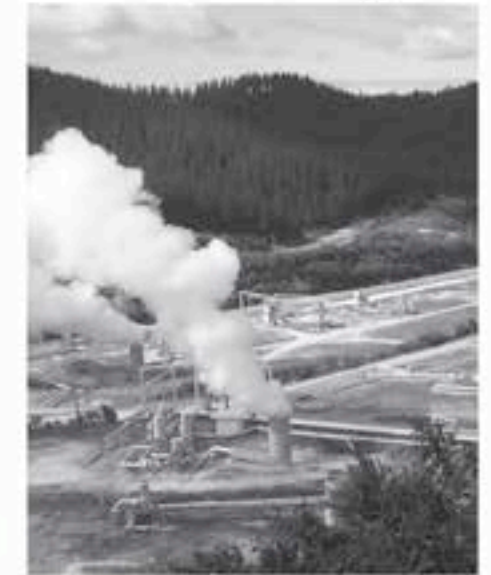
**PHILIPPINES**  
Coal 316 Million Tonnes  
Crude Oil 15 Million Tonnes  
Natural Gas 93 Billion Cubic Meter  
Hydropower 47 TWh/yr  
Wind energy 3 GWh

**BRUNEI**  
Crude Oil 160 Million Tonnes  
Natural Gas 350 Billion Cubic Meter

**LAOS**  
Coal 503 Million Tonnes  
Hydropower 233 TWh/yr

**MYANMAR**  
Coal 2 Million Tonnes  
Crude Oil 7 Million Tonnes  
Shale Oil 286 Million Tonnes  
Natural Gas 590 Billion Cubic Meter  
Hydropower 348 TWh/yr

**CAMBODIA**  
Hydropower 88 TWh/yr



1. Offshore oil field, Brunei

2. Gas field, Natuna, Indonesia

3. Coal mining, East Kalimantan Indonesia

4. Sudirman (Mrica), Central Java, Indonesia

5. Puetro Galera wind farm, Philippines

6. Geothermal Infrastructure, West Java, Indonesia

# Singapore's Gas Demand

Gas used mainly for the generation on electricity plays a key role in many ASEAN countries, especially in Singapore and Brunei, where this is the primary source of electric energy.

In addition, gas is sufficiently available in most countries in Southeast Asia. However, there will be challenges in the future as the demand grows.

"Increasing energy demand in the region is mainly driven by a rapid level of urbanization and industrialization. The region has one of the fastest urbanization trends in the world. It is predicted that, by the year 2025, more than 50

percent of the region's population will reside in urban areas, as compared with 39 percent in 2000." (Energy and environment in the ASEAN: Challenges and opportunities; Shankar, Mann, Salehfar).

Singapore will face challenges in the future to diversify its electricity generation further as the reliance on gas is not sustainable. Furthermore, as Singapore's gas's resources all arrive via pipelines coming form Indonesia and Malaysia, there is a need to reduce the dependence on these countries by diversifying sources of energy imports.

Import from ASEAN: 100%

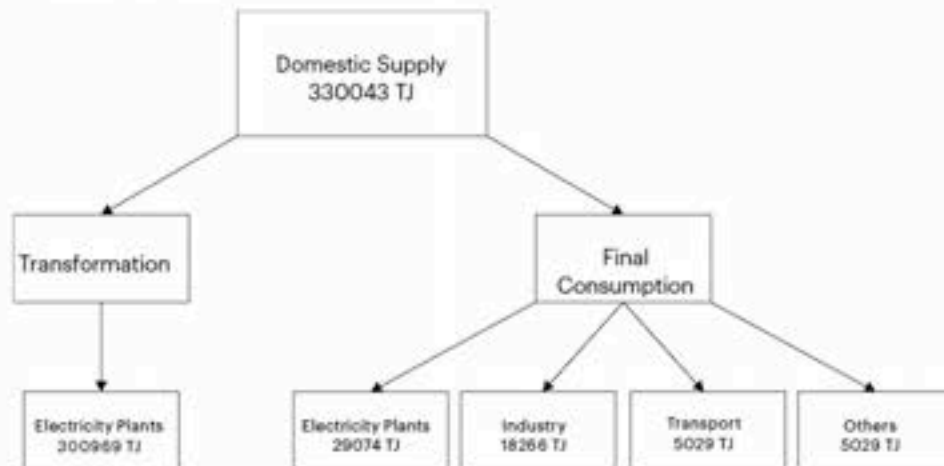
Piped Natural Gas 100%



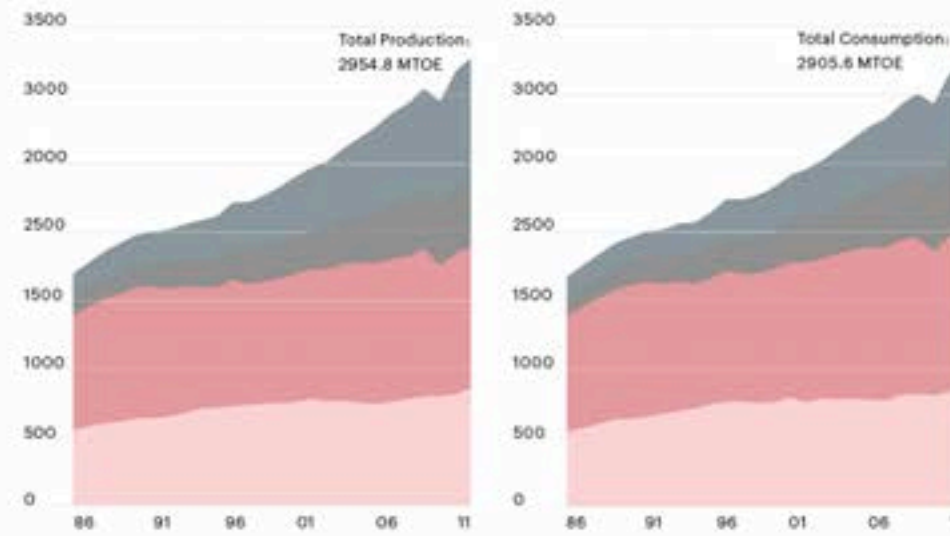
LNG 0%

Domestic gas reserves 0%

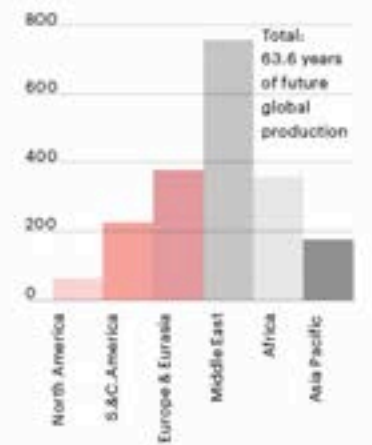
Distribution of Gas within Singapore, 2009



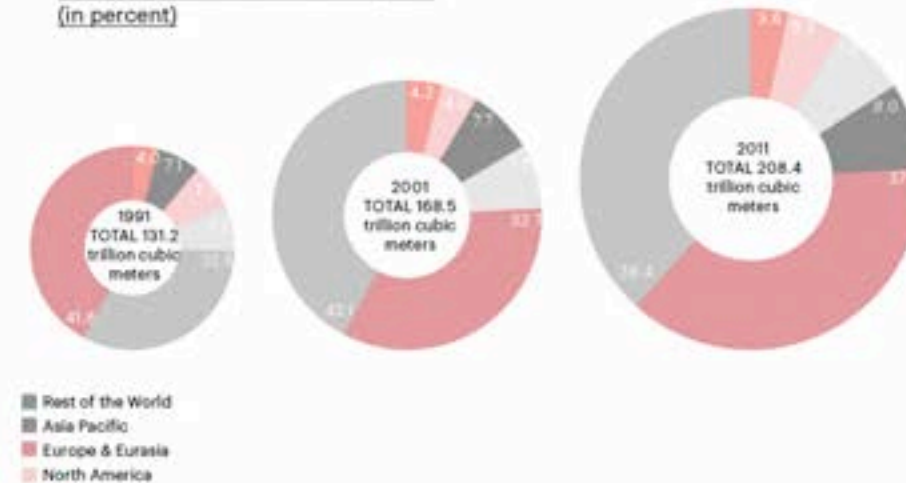
Production and Consumption by Region, 2011 (mtoe)



Reserves to Production Ratio, 2011 (years)



Distribution of Proved Reserves, 2011 (in percent)



**1922 BEGIN AMERICAN PRICE RECORD**  
Beginning of the American wellhead price record by the U.S. Energy Information Administration.



**Wellhead price:**  
The price less transportation costs charged by the producer for petroleum or natural gas.

**1925 FIRST LONG-DISTANCE ALL-WELDED STEEL GAS PIPELINE**  
The first long-distance all-welded steel gas pipeline was laid by Magnolia Gas of Dallas. The line, from northern Louisiana to Beaumont, Texas, was 217 miles in length and comprises 14-, 16- and 18-inch diameter pipes.



**1939 FIRST GAS-POWERED TURBINE TO GENERATE ELECTRICITY**  
The first gas-powered turbine to generate electricity for public use is operated at a power station in Switzerland.



**1947 NEW TYPE OF CAST IRON**  
A new type of cast iron, which is twice as strong and three times as resistant to shock, is introduced in Britain by Harold Hartley.

**1951 NATURAL GAS PRODUCED FROM COAL**  
For the first time in the Western world, natural gas is produced from coal, while it is still underground in the coal seam, at a colliery at Newman Spinney, England.



**1959 LNG**  
LNG is produced for the first time on an industrial scale in Los Angeles. It will be transported to Britain for the first by the vessel Methane Pioneer.

**TRANS-CONTINENTAL GAS PIPELINE**  
Trans-Continental Gas Pipeline completed an 1840 mile long and 30-in diameter gas pipeline from the vast reserves on the Texas-Louisiana Gulf Coast to the high demand area around Philadelphia, New Jersey and New York. It worked at a pressure of 800 psi maintained by 19 compressor stations. It was of welded steel construction throughout.

**1989 AMERICAN GAS INDEX**  
The American Gas Index Fund was introduced.



**1990 TRADE OF NATURAL GAS**  
On April 3rd, trading on natural gas futures began at the New York Mercantile Exchange (NYMEX).

**HENRY HUB**  
The Henry hub is a distribution hub on the natural gas pipeline system in Erath, Louisiana, owned by Sabine Pipe Line LLC. Due to its importance, it lends its name to the pricing point for natural gas futures contracts traded on the New York Mercantile Exchange (NYMEX) and the OTC swaps traded on IntercontinentalExchange (ICE).

**1996 NATIONAL BALANCING POINT**  
The National Balancing Point, commonly referred to as the NBP, is a virtual trading location for the sale and purchase and exchange of UK natural gas. It is the most liquid gas trading point in Europe. It is similar in concept to the Henry Hub in the United States - but differs in that it is not an actual physical location.



**2008 BANKRUPTCY LEHMAN BROTHERS**  
Bankruptcy of Lehman Brothers in September 2008. In the following months, many other banks had to be rescued by government bailouts. Lehman Brother's bankruptcy marked the beginning of a global economic downturn.

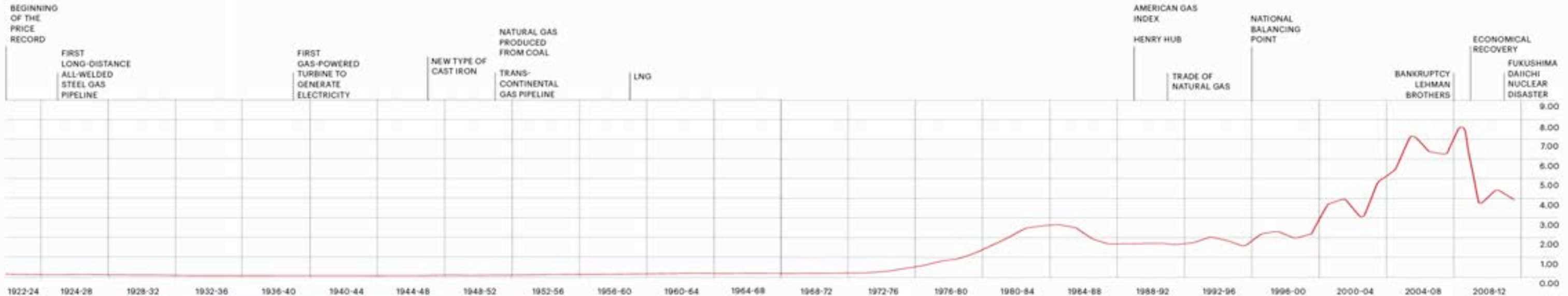


**2010 ECONOMICAL RECOVERY**  
American economy recovers slowly, production increased.



**2011 FUKUSHIMA DAIICHI NUCLEAR DISASTER**  
The Fukushima Daiichi nuclear disaster was a series of equipment failures, nuclear meltdowns, and releases of radioactive materials at the Fukushima I Nuclear Power Plant, following the Tōhoku earthquake and tsunami on March 11, 2011. It is the largest nuclear disaster since the Chernobyl disaster of 1986. In the following months after the accident in Japan, the German government decided to shut down its nuclear power plants by 2022.

Development of US Gas Wellhead Price (Dollars per Thousand Cubic Feet)



Gas Japan CIF

The situation in Japan is similar to that in many Asian countries, where there is only a limited spot market. Prevailing prices reported in the graph are averages of all supplies and largely reflect long-term contracts for natural gas in terms of their linkages to crude oil. Japanese natural gas prices have been rising over the past year, even before the catastrophe of Fukushima.

Gas UK (Heren NBP Index)

Northwestern Europe has also developed strong spot markets, starting in the United Kingdom and now in Belgium, the Netherlands, and Germany. Spot prices at the United Kingdom's National Balancing Point (NBP) generally track other northwestern European pricing points. Spot prices in northwest Europe are influenced by the limited number of suppliers and a relative lack of local production. Key suppliers (Russia and Qatar) supply much of their gas under long-term contracts, which is not directly reflected in the spot market, and gas deliveries from Norway can vary.

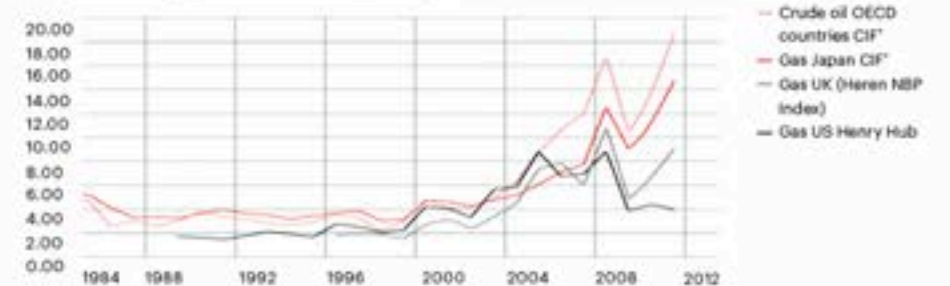
Gas US Henry Hub

North American natural gas markets are highly competitive, with many buyers and sellers. They have seen considerable production growth in recent years; according to EIA, US dry natural gas production rose 20 percent between 2005 and 2010. Henry Hub spot prices are the reference prices for North America and have averaged about \$4.17 per million British thermal units since January 2009. Prices at Henry Hub have been modest by global standards since the financial crisis of 2008-09.



American: "Hey, it's cheaper and you get bigger portions!"  
Singaporean: "Groaning!"

Development of Gas Trading Price (US Dollars per Million British Pound)





# Singapore's Oil Demand

The situation regarding oil demand in Singapore is different than with gas. Singapore harbor is an important gas station for ships.

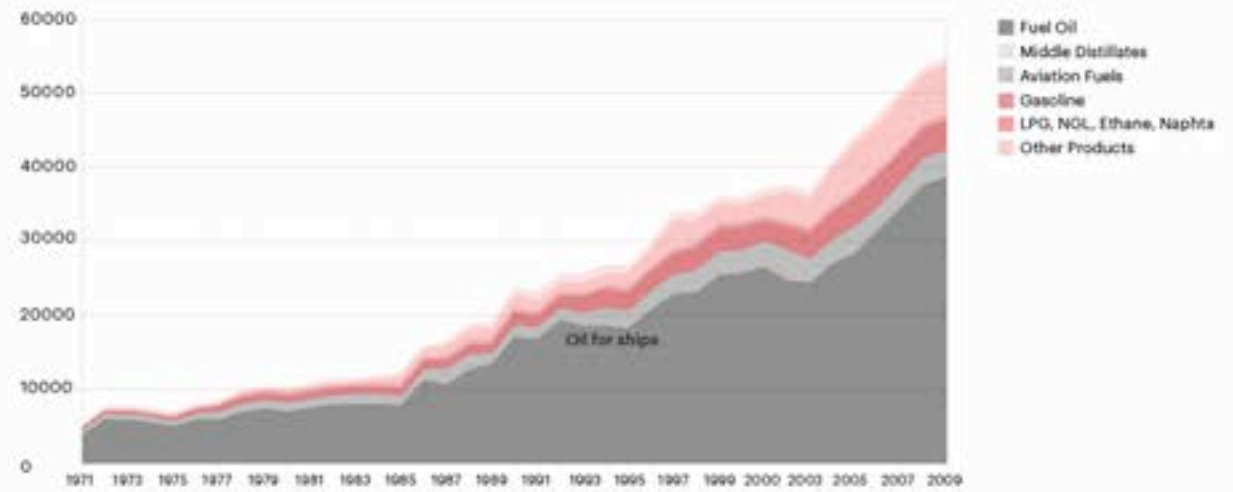
"Although Singapore does not produce any oil, it is one of the top bunkering (ship refuelling) ports in the world. In 2010, about 43 million tonnes of bunkers were lifted in Singapore. This is enough to fill over 17,000 Olympic-sized pools." (MPA Singapore)

In addition, the four refineries located in Singapore produce important raw materials, distributed all over the world. The incoming raw oil is therefore transformed into products with a much higher value. As there is no pipeline, all the oil arrives into Singapore by ships and leaves the same way.

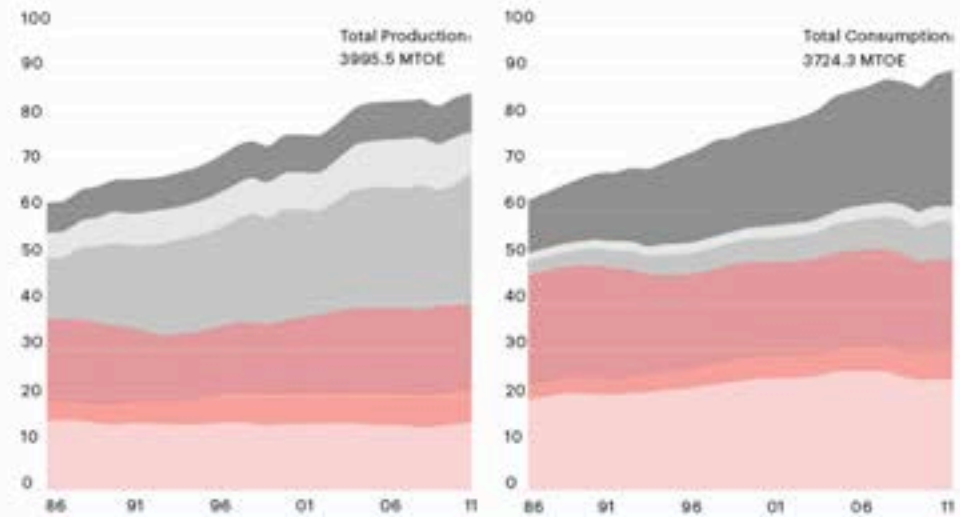
Import from ASEAN = 8.1%



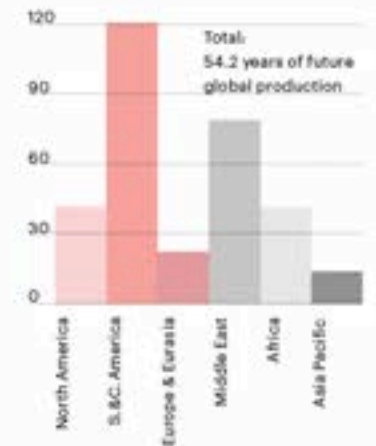
Consumption of Oil Products in Singapore, 2011



Production and Consumption by Region, 2011 (mtoe)



Reserves to Production Ratio, 2011 (years)

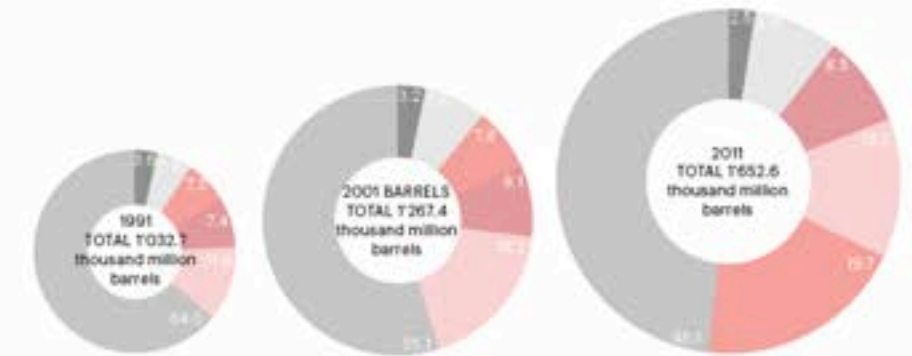


Distribution of Proved Reserves, 2011 (in percent)

Despite very little oil reserves of their own, the emerging economies in Asia Pacific consume large amounts of oil.

There is a need to import oil from the Middle East to Asia. This fact puts Singapore into a strategic position as a distributor of oil and oil-related products.

- Asia Pacific
- Africa
- Middle East
- Europe & Eurasia
- South- & Central America
- North America





**PENNSYLVANIAN OIL BOOM**  
The Pennsylvania oil rush was a "boom" in petroleum production, which occurred in northwestern Pennsylvania from 1859 to about 1870. It was the first oil boom in the United States.



**RUSSIAN OIL BOOM**  
Meanwhile, the Russian oil industry was not organized competitive as it was a state-run monopoly. The policies, however, changed in 1870s, and a private competitive industry emerged leading to explosive entrepreneurship and oil drilling based on American discoveries instead of hand-dug oil. The first wells were drilled in 1871-72, and by 1873 many producers and refiners (more than 20) had sprung up, but many were still inefficient and technologically backward by 1873.



**SUMATRA OIL PRODUCTION AND THE FOUNDING OF SHELL**  
The discovery of commercial quantities of crude oil in Sumatra just over 100 years ago led directly to the formation of Royal-Dutch Petroleum.

**FEARS OF SHORTAGE IN US**  
The vital role of oil in a modern industrial economy had vividly been brought home to the American people by World War I. Immediately thereafter, the US developed a deep-seated fear of oil shortages.



**EAST TEXAS FIELD DISCOVERED**  
On October 5, 1930, Columbus Marion (Dad) Joiners Daisy Bradford No. 3 well hit oil at 1,078 m below ground surface. This well is located near the southeastern boundary of the oil field. Shortly after the Daisy Bradford find, and after another two smaller wells were drilled near the original hole, another new well, this one on the Crim family farm about nine miles (14 km) north of the Bradford farm, reached oil, producing a gusher with a spectacular initial daily flow of 22,000

**POST-WAR RECONSTRUCTION**  
The war increased the demand for oil dramatically and increased the awareness of how dependent a modern society is on oil.



**SUEZ CRISIS**  
The Suez Crisis erupted in July 1956, when Nasser, denied economic assistance by the United States and Britain, retaliated by nationalizing the Suez Canal Company. Nasser seized the British- and French-owned firm to demonstrate his independence from the European colonial powers, to avenge the Anglo-U.S. denial of economic aid, and to garner the profits the company earned in his country.



**OIL CRISIS**  
The 1973 oil crisis started in October, when the members of the Organization of Arab Petroleum Exporting Countries or the OAPEC proclaimed an oil embargo. Prior to the embargo, the geo-political competition between the Soviet Union and the United States, in combination with low oil prices that hindered the necessity and feasibility for the West to seek alternative energy sources, presented the Arab States with financial security, moderate economic growth, and disproportionate international bargaining.

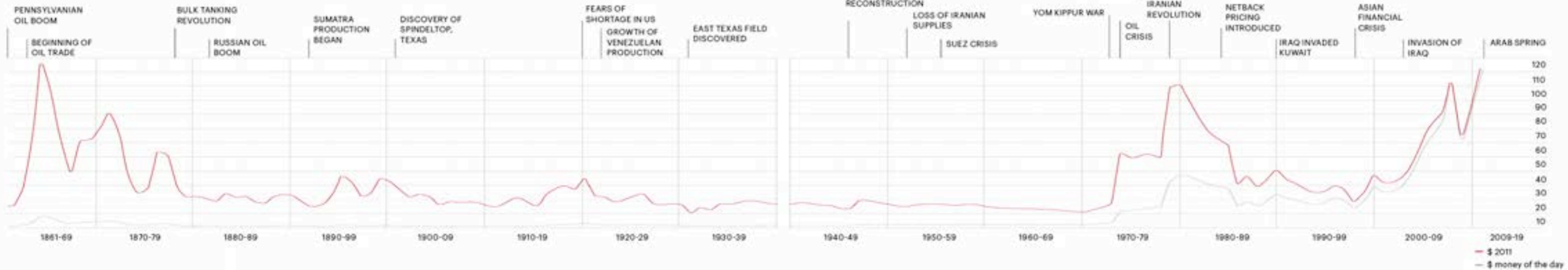
**NETBACK PRICING INTRODUCED**  
A pricing assessment or pricing formula based on the effective price to the producer or seller at a specific location or defined point.



**ASIAN FINANCIAL CRISIS**  
The Asian financial crisis was a period of financial crisis that gripped much of Asia beginning in July 1997, and raised fears of a worldwide economic meltdown due to financial contagion. As a result the demand of oil was decreased.



**ARAB SPRING**  
The Arab Spring is a revolutionary wave of demonstrations, protests, and civil wars occurring in the Arab world.



Development of Oil Price



**BEGINNING OF OIL TRADE**  
America exports petroleum for the first time when the Elizabeth Watts departs Philadelphia's docks bound for London with a cargo of 901 barrels of Pennsylvania oil and 428 barrels of refined kerosene.



**BULK TANKING REVOLUTION**  
To overcome the high handling cost and transportation difficulties, Ludwig Nobel conceived the idea of shipping the oil in bulk tankers (instead of shipped wooden barrels) launching a major revolution in oil transport. The first successful bulk tanker, Zoroaster, was put in service on the Caspian in 1878.



**DISCOVERY OF SPINDELTOP, TEXAS**  
On January 10, 1901, a well at Spindletop struck oil ("came in"). The new oil field soon produced more than 100,000 barrels (16,000 m<sup>3</sup>) of oil per day. Gulf Oil and Texaco, now part of Chevron Corporation, were formed to develop production at Spindletop.



**GROWTH OF VENEZUELAN PRODUCTION**  
After about twenty years from the installment of the first oil drill (1910), Venezuela had become the largest oil exporter in the world and the second largest oil producer, after the United States. Exportation of oil boomed from 1.9% to 91.2% between 1920 and 1935.



**LOSS OF IRANIAN SUPPLIES**  
Under the nationalist government of Mossadegh, the Iranian Leadership decided to put control over the Iranian oil into the hands of the government. This resulted in an armed conflict between Iran and the U.S. and Great Britain.



**YOM KIPPUR WAR**  
During the Yom Kippur War, the accessibility of the Suez canal was not given. This resulted in longer transport routes and costs.



**IRANIAN REVOLUTION**  
The oil boom of the 1970s produced "alarming" increase in inflation and waste and an "accelerating gap" between the rich and poor, the city and the country.



**IRAQ INVADED KUWAIT**  
In 1990, Iraq accused Kuwait of stealing Iraqi petroleum through slant drilling, although some Iraqi sources indicated Saddam Hussein's decision to attack Kuwait was made only a few months before the actual invasion.



**INVASION OF IRAQ**  
Securing American influence over oil resources.

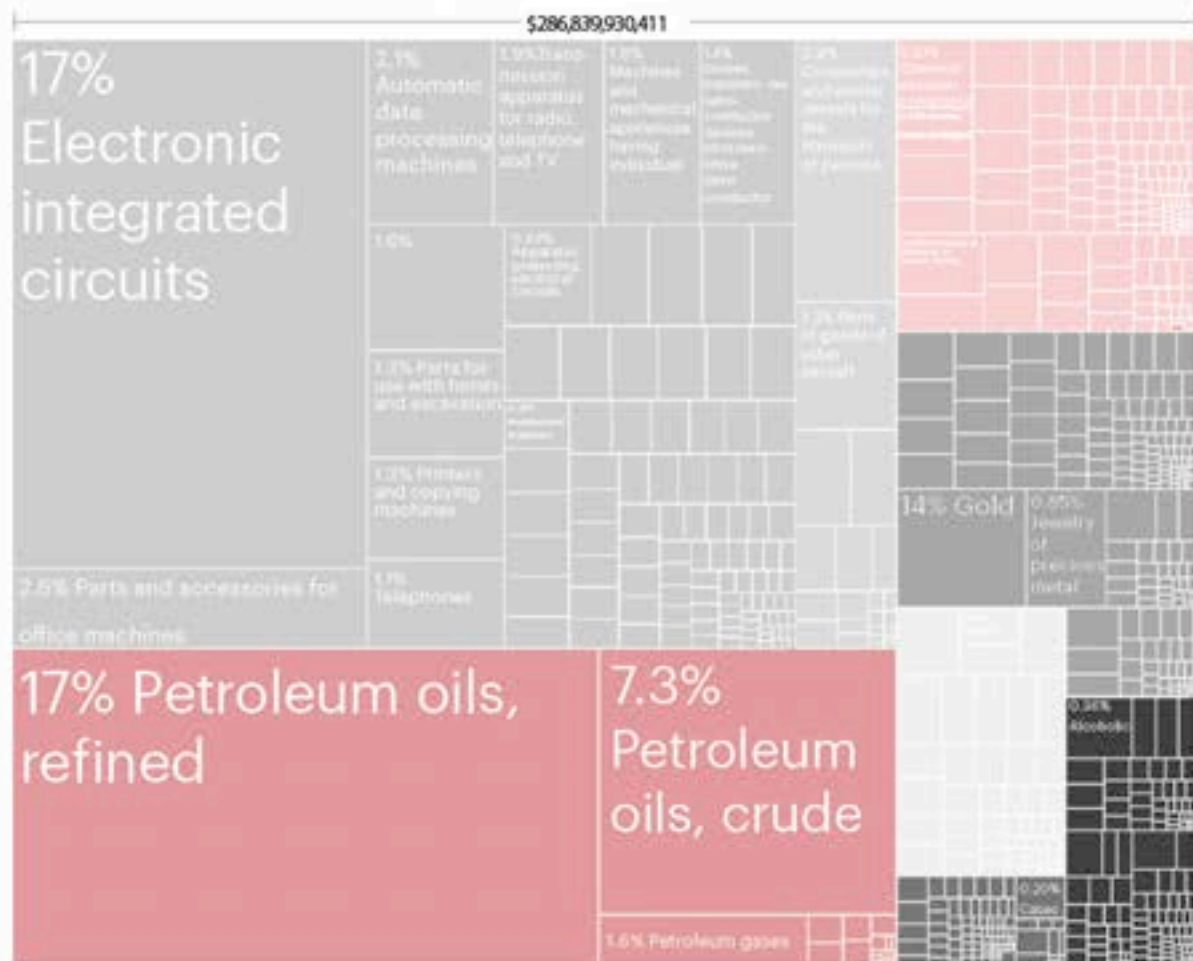
# Minerals and Chemicals as Pillars of the Economy

Besides machinery and electrical products, minerals are a major imported product in Singapore. This is due to the high demand by ships, as the Singapore harbor is a bunkering center, the strong presence of refineries and allied industries and the demand for chemical products, which are generated from crude oil within Asia.

Singapore has been a location for oil storage since the beginning of the 20th century. In the 1960s, refineries

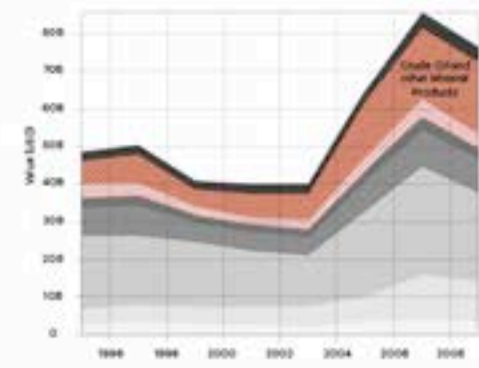
opened up in Singapore due to its strategic location, the proximity to major markets and the political stability.

In recent years, the chemical companies in Singapore have increased in number and size and are expected to increase even further resulting in a growing demand for minerals. This development is, nevertheless, threatened by high electricity prices.

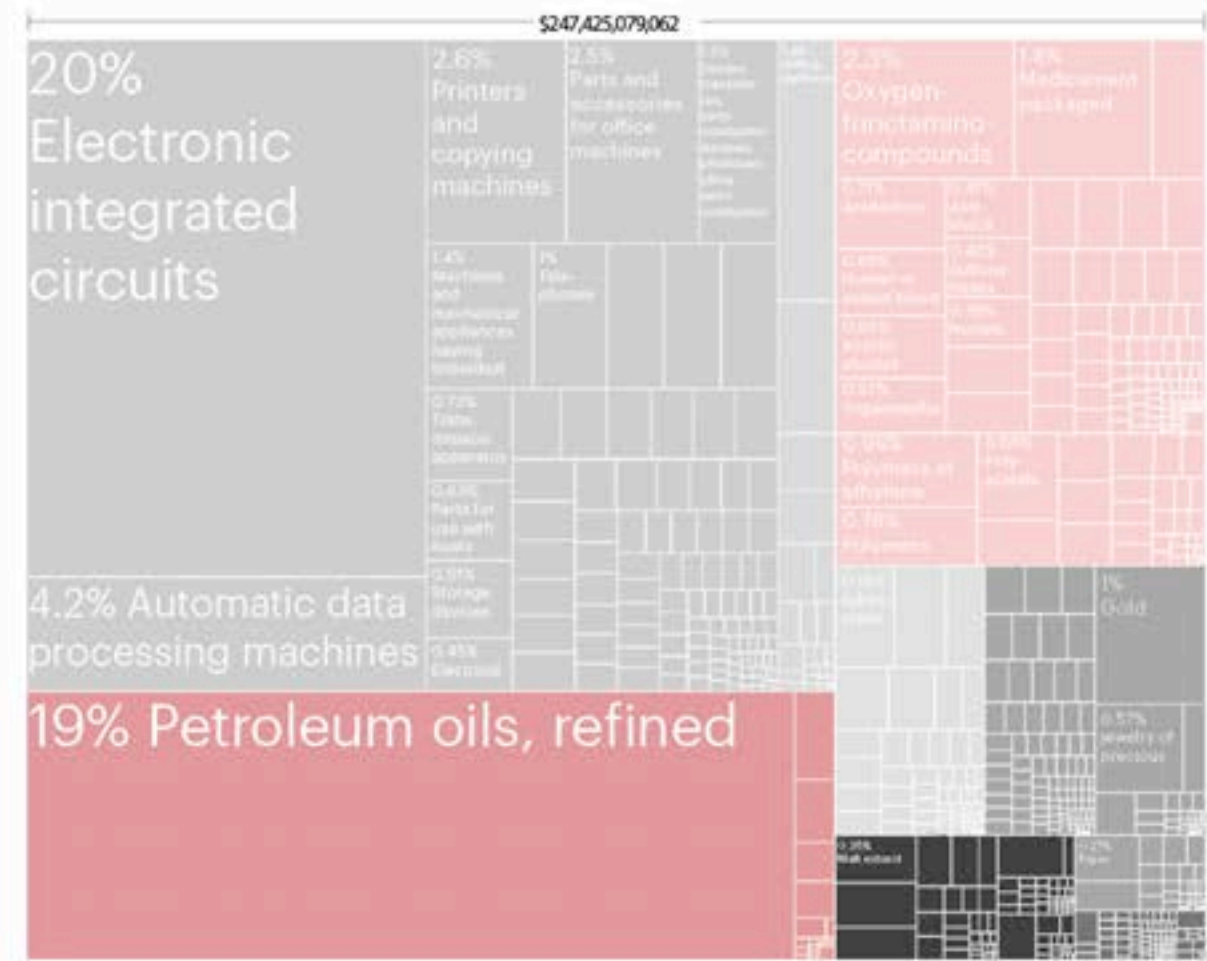


Net Import Singapore, 2009  
Import of mineral products mainly for the transformation into other, more refined, products for the chemical industry.

- Mineral Products
- Chemicals & Allied industries; Plastics/Rubber
- Agricultural Products; Animal & Animal Products; Foodstuffs
- Textile; Footwear & Headgear; Raw hides, Skins, Leathers, Furs
- Wood & Wood Products; Metals; Stone/Glass
- Machinery & Electrical
- Transportation
- Others

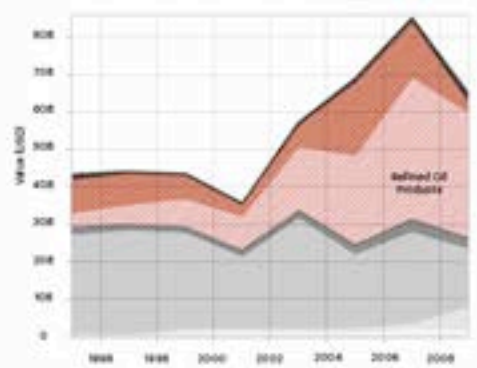


- INDONESIA
- 13.65% Petroleum oils, refined
  - 2.79% Aircraft, spacecraft & launch vehicles
  - 2.69% Petroleum oils, crude
  - 2.04% Parts and accessories of the motor vehicles
  - 1.83% Automatic data processing machines
- MALAYSIA
- 15.05% Electronic integrated circuits
  - 5.84% Petroleum oils, refined
  - 2.93% Petroleum oils, crude
  - 2.88% Parts and accessories for office machines
  - 2.00% Automatic data processing machines



Net Export Singapore, 2009  
Singapore is increasingly becoming a centered on the chemical industry in Asia. With high demand in the emerging regions like China, but also from South Korea and Japan, this sector is expected to grow even further.

It is attracting foreign investment because of political stability, the strategic location of its harbour between the Middle East and Asia and lastly, because of its superior infrastructures. In addition, companies enjoy tax incentives as well as receiving support by the economic development board.



- INDONESIA
- 10.16% Coal, briquettes
  - 7.60% Petroleum gases
  - 6.62% Palm oil, crude
  - 5.77% Petroleum oils, crude
  - 4.39% Natural rubber
- MALAYSIA
- 13.80% Electronic integrated circuits
  - 5.81% Petroleum oils, refined
  - 5.57% Petroleum gases
  - 5.48% Palm oil, crude
  - 5.32% Parts and accessories for office machines

# Liquid Hub

The Liquid Hub of Singapore incorporates the harbor and its facilities, Jurong Island especially, and the surrounding region of Johor Municipality in Indonesia and the Islands of Bintan, Batam and Karimun in Indonesia.

As Singapore is one of the three major oil trading hubs in the world, many companies are keen to have a certain volume of oil stored in the region to be able to react fast to market changes. Therefore, oil storage plays a vital role.

Space limitations in Singapore are forcing more and more storage companies to move away from the island-state and to set up in the surrounding area, creating a truly tri-national hub.



Jurong island skyline



### Competition or Complementation

There are only few oil facilities in the Strait of Malacca. The globally important terminals are in Malaysia. The Port of Singapore is still the most important location for bunkering as well as for the petrochemical industries. It is a very discussed issue if the fast growing oil and petrochemical sector in the region is going to result in stronger competition or if there will be a complementation to the point where a supranational hub is congregated.

### Strait of Malacca



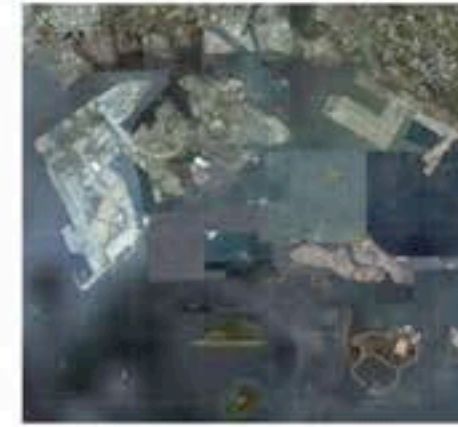
1.



2.



3.



4.

#### 1. Port Klang

Port Klang is divided mainly in two ports, each one with its own operator. These are called the North Port and the West Port.

Both have oil tank facilities of considerable dimensions. Port Klang is the biggest oil storage harbour in the Strait of Malacca.

#### 2. Port Dickson

Port Dickson is one of the locations of Royal Dutch Shell in Southeast Asia and ExxonMobil, each of them running a refinery at this location.

#### 3. Malacca Oil Storage Terminal

Very near Malacca in Sungai Udang petronas erected a refinery taking a large part of the terrain. Through one major jetty the tankers that brings the crude oil and takes the refining products can dock perfectly even if the depth are quite small.

#### 4. Jurong Island in Singapore

Jurong Island of Singapore is the biggest oil and petrochemical hub in the region and is the preferred location for bunkering of both tankers and cargo vessels because a lot of their main operative actions take place in Singapore.

# History of the Oil Hub

The growth of the port's petroleum trade has been spectacular. In the mid 1930s, a traveller returning after a 25 year leave exclaimed, "the numerous islands with which the entrance to Singapore is studded... an indication of the new Singapore. Large patches of hard yellow soil disfigured by huge oil tanks replaced the green spaces of yesteryear."

Oil did not enter Singapore physically except for the island's own use. Since the product was not owned by Singaporean residents, there was no petroleum market in Singapore.

The oil companies used it as a place where petroleum produced in Netherlands India and British Borneo could be collected, blended and distributed. In contrast to Singapore's importance as a merchant and financier in other commerce for petroleum, its principal trade function were handling, storage and shipment. These activities generated a relatively low number of employment opportunities. Petroleum had its greatest effect on economic development through volume and the large demand for ship repair facilities.

The petroleum trade consisted of three main products, namely kerosene, liquid fuel (fuel oil) and motor spirit (petrol, gasoline).

At the beginning of the century the main constituent of the petroleum trade was kerosene, used primarily as an illuminant by the poorer sections of the population.

But the phenomenal expansion in petroleum exports during the inter-war period resulted almost entirely from the new products of liquid fuel and motor spirit. Liquid fuel was required chiefly for the bunkering of oil-fired ships and to a lesser extent to run industrial machinery, while motor spirit was needed for automobiles.

The story of Singapore's petroleum trade was - and remained - the use which multinational oil companies found for the port in their worldwide operations. Apart from some kerosene imported from the west coast of the

United States, petroleum distribution via Singapore was in the hands of two subsidiaries serving three oil majors by 1939: The Asiatic Petroleum Company, established by Royal Dutch Shell, and the Standard Vacuum Company associated with Standard Oil of New Jersey and Standard Oil of New York.

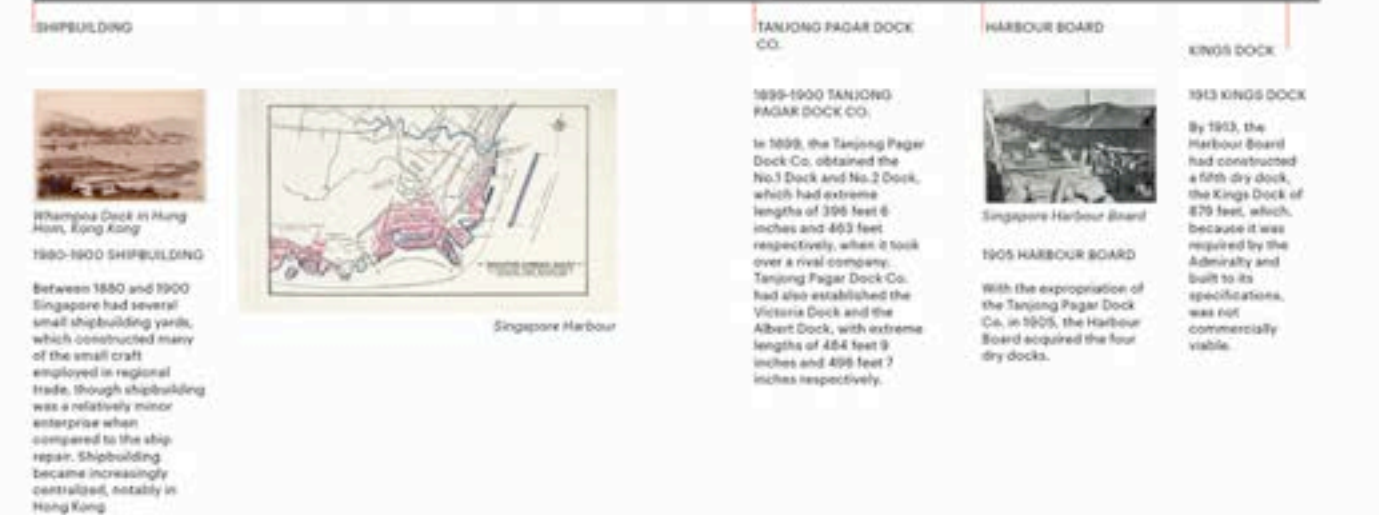
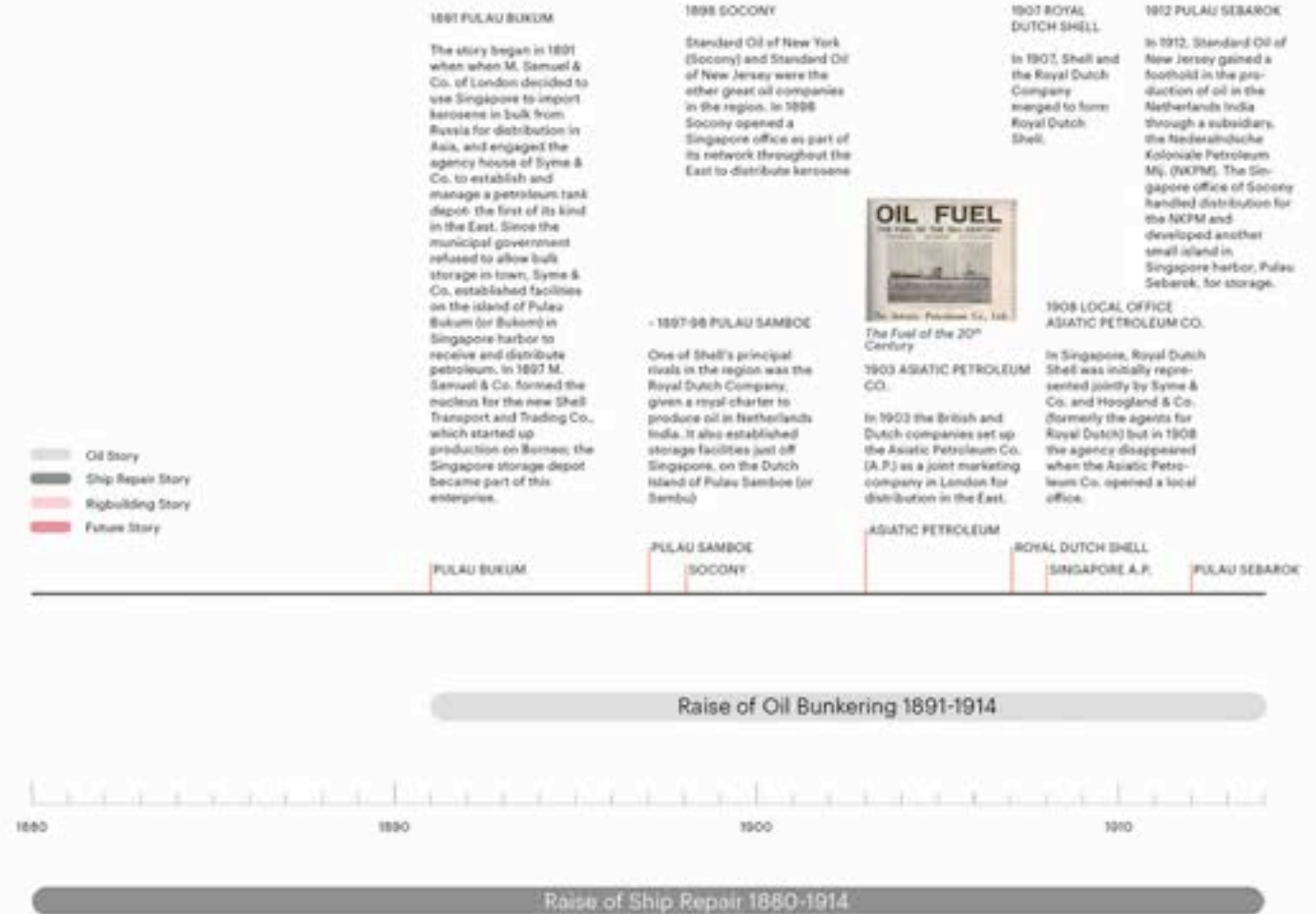
Oil companies were drawn to Singapore because of its geographical advantages - both local and international - and freedom from regulations. Offshore islands afforded a deep-water anchorage adjacent to Singapore harbor, while at the same time allowing safe storage of large quantities of petroleum.

The export of petroleum did not give rise to a merchant class in Singapore, nor did it make it an international petroleum market. The Straits Settlement Commission observed that "Singapore is not a market for the oil, there are no middleman's or dealer's profits involved and oil is merely distributed from here for the sake of convenience."

During the inter war period, unlike the period after 1959, there was no question of government intervention through tax concessions, infrastructure provisions or joint ventures to try to increase the role of oil companies in Singapore or linkages arising from the petroleum trade.

The important linkage of dry dock facilities, which oil tankers created in Singapore, is normally associated with a terminal port, where the longer stay of vessels affords the most economically viable place to obtain repairs.

In largely supporting the dry docks, tanker repair contributed to Singapore's economic development in two important respects. One was to add substantially to Singapore's attractiveness as a port. Second, the dry docks helped Singapore to develop a major engineering industry. The docks were judged "one of the most modern ship-repairing establishments in the East" by an "expert and highly critical" witness: "I do not think there is a place in the world in which you can get to work as solid or as sound or as good a job as you can get in Singapore."



1921 OIL BUNKERING

By 1921 the port had a "large oil bunkering business... providing facilities for the berthing of large ocean-going vessels at Pulau Bukom and Pulau Sembor", and made the port largest British station for the storage and sale of oil bunkers in the East.



Singapore harbour

1926 OIL BUNKERING AT THE WHARVES

In 1926 Singapore's convenience for oil-fired ships was further increased when the Asiatic Petroleum Co. began to supply oil bunkers at the wharves. The Company erected storage tanks and a central pumping station at the northern end of the wharves on land leased to it by the Singapore Harbour Board. Pipelines connected the tanks with most of the wharves, allowing the simultaneous transfer of fuel and cargo.

OIL BUNKERING AT THE WHARVES

1914-18 SUPPLYING ALLIED VESSELS

The sale of oil bunkers developed by the Asiatic Petroleum Co. made Singapore a pioneer in their provision and helped to attract the new oil burning vessels there. During World War I the Company gained experience in the bunkering trade through supplying Allied vessels.

ALLIED VESSELS

OIL BUNKERING

1931 PULAU BINTANG

In 1931 the NKM shifted most of the international distribution of petroleum which had been undertaken from Pulau Sebanik to the nearby Dutch island of Pulau Bintang. After 1931 Pulau Sebanik became almost exclusively a centre for distribution to British Malaya.

PULAU BINTANG

1930s LOST ADVANTAGE

By the 1930s Singapore had lost much of its advantage as an early leader in the provision of oil bunkers; other ports had obtained good bunkering facilities, and the trade in bunkers had become competitive because ships could go further without re-fuelling in

LOST ADVANTAGE

1942 LOWERING OF UNION JACK

"When the Union Jack was lowered on Fort Canning, in Singapore, on that Sunday morning it marked the sudden and dramatic end of an epoch in our Colonial Empire (Letter to The Times, 24. Feb. 1942)

LOWERING OF UNION JACK

1939 VENT FOR SURPLUS

Before World War 2, Singapore grew as an integral of a "vent for surplus" region centred on Malaya and, even more, Netherlands India (Indonesia). Singapore as a port, market and financier provided the essential services component in the venting process which underlay rapid regional growth.

VENT FOR SURPLUS

1945 RECOVERY

It was largely the pre-World War 2 economy and society with which Singapore started the 1950s. World War 2 and the Japanese occupation had made surprisingly little difference in a strictly economic sense.

RECOVERY

World War I Bunkering Port 1918-1930 Years of Decline 1930-1940 World War II



Interaction Oil Storage/Ship Repair 1914-1930 Competition and Decline 1930-1956

1930s TANKERS FLEET

Larger fleet of oil tankers based in Singapore

1930s SLUMP DEMAND

In the 1930s slump demand for ship repair contracted sharply, and dry dock gross revenue fell

SHIP REPAIR

1914-18 SHIP REPAIR

Singapore did benefit from an increased demand for ship repairs arising from World War I.

OIL TANKERS

1920s OIL TANKERS

By the time the demand for ship repair arising from World War I began to subside, the upsurge in the petroleum trade multiplied the number of oil tankers based in Singapore. In this, Singapore was fortunate that tankers "are always expensive in upkeep" and "require reconstructing after 12 years, and again when 20 to 22 years old."

ASIATIC SINGAPORE NAVAL BASE



Floating Dock

1926 SINGAPORE NAVAL BASE

Between 1880 and 1900? The Singapore Naval Base was established on the north side of the island. Here, in 1926, the Admiralty installed a floating dock of 857 feet brought from England.

1930 ASIATIC PETROLEUM CO.

Over 1930 most oil tankers of the Asiatic Petroleum Co. docked in Singapore.

DECLINE

1933 DECLINE

By 1933 many Asiatic Petroleum Co. tankers were repaired outside Singapore.

RECOVERY GRAVING DOCK



Graving Dock

1938 GRAVING DOCK

In 1938, the Admiralty completed a large graving dock at the Singapore Naval Base.

1938-39 RECOVERY

In 1938/39 the dry dock business, probably with increased repair of oil tankers, reached an annual average of 3.2 million.

Caltex gets ready for retail trade



Straits Times, 24 November 1959

1959 CALTEX

In 1959, Caltex began marketing operations in Singapore.

1965 SEPARATION

After its separation from the Federation of Malaysia in 1965, Singapore adopted an export-oriented industrialization program to stimulate industrial growth.

1979 SECOND INDUSTRIAL REVOLUTION

After nearly two decades of strong growth based on a liberal policy of attracting all kinds of foreign investments, the "revolution" was aimed at raising the value-added content of the country's economic activity.



Oil tanker in the 1950s

1950s EXPANDED PETROLEUM EXPORTS

Petroleum exports expanded substantially during the 1950s, and by mid-decade were four times greater in volume than in 1937/38. The Royal Dutch Shell group maintained the Far East headquarters of its tanker fleet at Singapore.

PETROLEUM EXPORTS

1961 1ST REFINERY AT PULAU BUKOM

Royal Dutch Shell opened the country's first refinery in 1961 on the island of Pulau Bukom. Singapore's geographical location and the worldwide trend among international oil companies to locate refineries near rapidly growing markets were the major reasons determined.

INDUSTRIAL PROMOTION BOARD

CALTEX

PULAU BUKOM

SEPARATION



Singapore Refining Company (SRC) located on Pulau Merluu

1977 PETROCHEMICAL CORPORATION OF SINGAPORE

23 Japanese companies and the Singapore government established a 50-50 joint venture, the Petrochemical Corporation of Singapore. The Singapore government offered Pulau Ayer Merbau, as a site for the construction of the petrochemical complex.

JOINT VENTURE

SECOND INDUSTRIAL REVOLUTION

Governmental Action 1945-1961 Initial Phase Export Oriented Industrialization 1965-1979 Transformation



Competition and Decline Transformation Path to Global Leadership 1963-1983

Boom in Rigbuilding 1969-1981

QUEEN'S DOCK



View of Clifford Pier, the Inner Roads and the Breakwater in the 1950s

1956 QUEEN'S DOCK

Queen's Dock, completed in 1956, brought the total number of dry docks to six.

JURONG SHIPYARD



Jurong Shipyard, 1963

1963 JURONG SHIPYARD

The first commercial shipyard, Jurong Shipyard, was set up as a joint venture with the Japan in 1963. Today, Jurong Shipyard is a wholly owned subsidiary of Sembcorp Marine Ltd.

RIGBUILDING



JW McLean

1969 RIGBUILDING

Singapore was launched into rigbuilding by the fledgling Far East Shipbuilding Industries Ltd. The company completed the first jack-up, JW McLean, in 1969.

VLCC



The first Very Large Crude Carrier (VLCC), ST Buford, drydocked at Jurong Shipyard, propelling Singapore into the supertanker league.

1972 VLCC

The first Very Large Crude Carrier (VLCC), ST Buford, drydocked at Jurong Shipyard, propelling Singapore into the supertanker league.

PALMSTAR ORCHID



Palmstar Orchid

1976 PALMSTAR ORCHID

Singapore delivered its first and largest oil tanker, the 95,000-dwt Palmstar Orchid, in 1976.


**1991 JURONG ISLAND PROJECT**  
 In 1991, JTC Corporation (formerly Jurong Town Corporation) was appointed the agent of the Jurong Island project. JTC planned and coordinated with various government agencies in providing the necessary infrastructure and services to the island.

**1997 COMPLEX II**  
 The Complex II was started up in the 2nd quarter of 1997.

**1984 PETROCHEMICAL COMPLEX I**  
 After more than a decade of planning and preparation, Singapore's and Southeast Asia's first petrochemical complex (PCS I) finally came on-stream on Pulau Ayer Merbau in February 1984. The establishment of PCS I provided a key link to the integrated process among the subsectors of the chemical industry.

**1980s CHEMICAL ISLAND COMPLEX**  
 Committed to nurturing Singapore as a regional chemical hub, the government has invested \$57.2 billion to build a chemical island complex. This infrastructural project involves combining seven southern offshore islands of Singapore into a single landmass, known as the Jurong Island Chemical Complex.

**1994 PETROCHEMICAL COMPLEX II**  
 In March 1994, the partners of PCS I to announce a \$53.4 billion investment to build PCS II. As related and interdependent activities, these diverse petrochemical investments have contributed to the cluster-development strategy.

**Jurong Island Reclamation**  
  
 2000 OPENING OF JURONG ISLAND  
 Jurong Island was officially opened on October 14, 2000 by then Prime Minister Goh Chok Tong.

**COMPLEX I**   **CHEMICAL ISLAND JURONG ISLAND**   **CLUSTER**   **COMPLEX II**   **OPENING JURONG ISLAND**

**Transformation**   **Petrochemical Complex 1984-1995**   **Jurong Island 1995-2009**



**Restructuring 1983-1997**   **New Technologies 1997-2009**

**Collapse 1981-1989**   **A New Beginning**

**1981 DOWNTURN**  
 Over 300 rigs were built between 1980 and 1982 in response to global concerns over future oil supply. But when the downturn came, it was so severe that some rigbuilders never recovered. Worldwide orders trickled to 27 in 1984. Starved of new orders, Marathon LeTourneau and Ruben Shipbuilders decided to close.

**1983 GLOBAL LEADERSHIP**  
 Singapore became the largest shiprepair centre in the world in terms of capacity with an aggregate deadweight of 2.82 million tonnes.



**1986 NEW WAYS**  
 As new projects were rare, FELS began work on a harsh environment jack-up which can drill in water depths of 90 to 105 metres. The Monarch was the first one to be built.

**1989 REHABILITATION**  
 Only specialised units are in demand, for deep-sea or shallow-draft operation. Rigbuilders have had to redefine their roles.


**1997 RESTRUCTURING**  
 Restructuring within marine industry saw the first major merger between industry majors, Sembawang Shipyard and Jurong Shipyard.

**2001 FLOATING POWERPLANT**  
 Jurong Shipyard delivered Sultana Del Este, the world's largest floating power plant to Wärtsilä NSD of Finland.


**GLOBAL LEADERSHIP**   **NEW WAYS**   **REHABILITATION**   **RESTRUCTURING**   **FLOATING POWERPLANT**

**UNKNOWN SINOPEC**  
 China's Sinopec, has started work to build Southeast Asia's largest oil storage terminal at the Batam free trade zone.

**Jurong Island Completion**  


**2009 COMPLETION OF JURONG ISLAND**  
 From the 9.91 km² land area of the original seven islets, as of completion of the land reclamation on September 25, 2009, Jurong Island currently has a total land area of 30 km².

**Pengerang Terminal**  


**2015 Pengerang Oil Terminal**  
 By January 2015, a joint venture between the Dutch oil and chemicals provider Vopak and the Malaysian terminal operator Daling, plans to finished the first phase of the Pengerang oil terminal at a cost of \$420 million.


**UNKNOWN TANJUNG PAI**  
 In Tanjung Piai on the most southern point of the west Malaysia Peninsular Sdn Bhd is planning to reclaim 2485 acres. This reclaimed area is meant to be the ground for the Tanjung Piai Integrated Petroleum and Petrochemical Hub.

**COMPLETION**   **SINOPEC**   **PENGERANG**   **TANJUNG PAI**



**Current Extensions**   **The Future Triangle 2014-2040**



**NEW WAYS**

**Roll-on/Roll-off**  


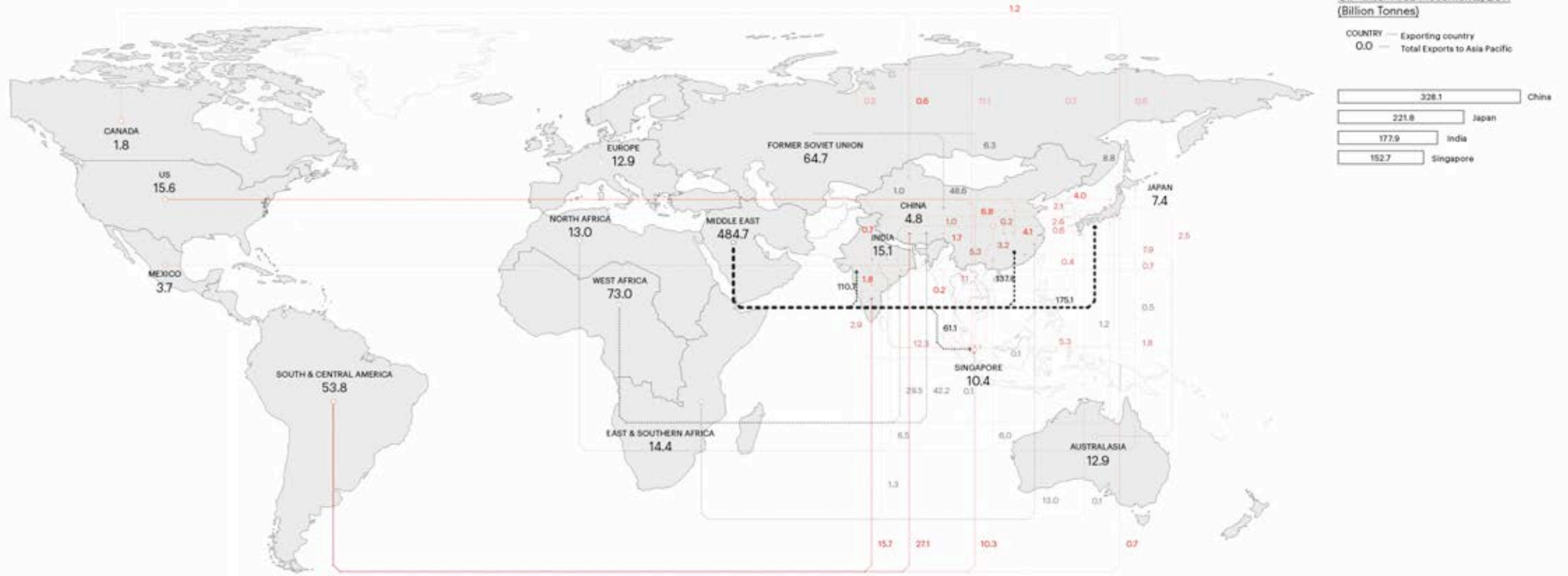
**2009 NEW WAYS**  
 Singapore Technologies Marine delivered the first rebuild Roll-on/Roll-off vessel for transportation of large aircraft components, City of Hamburg.

Panoramic View of Singapore, 1863  
 Panoramic View of Singapore, 2017





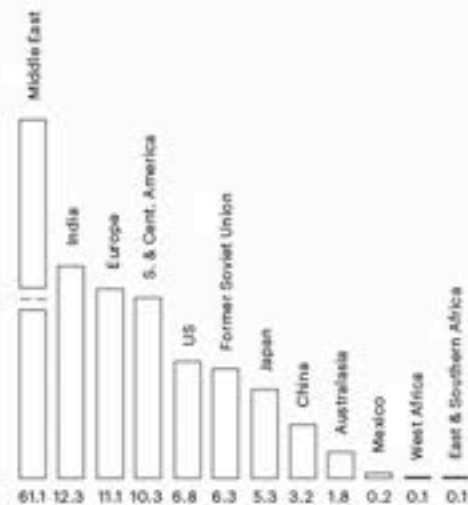


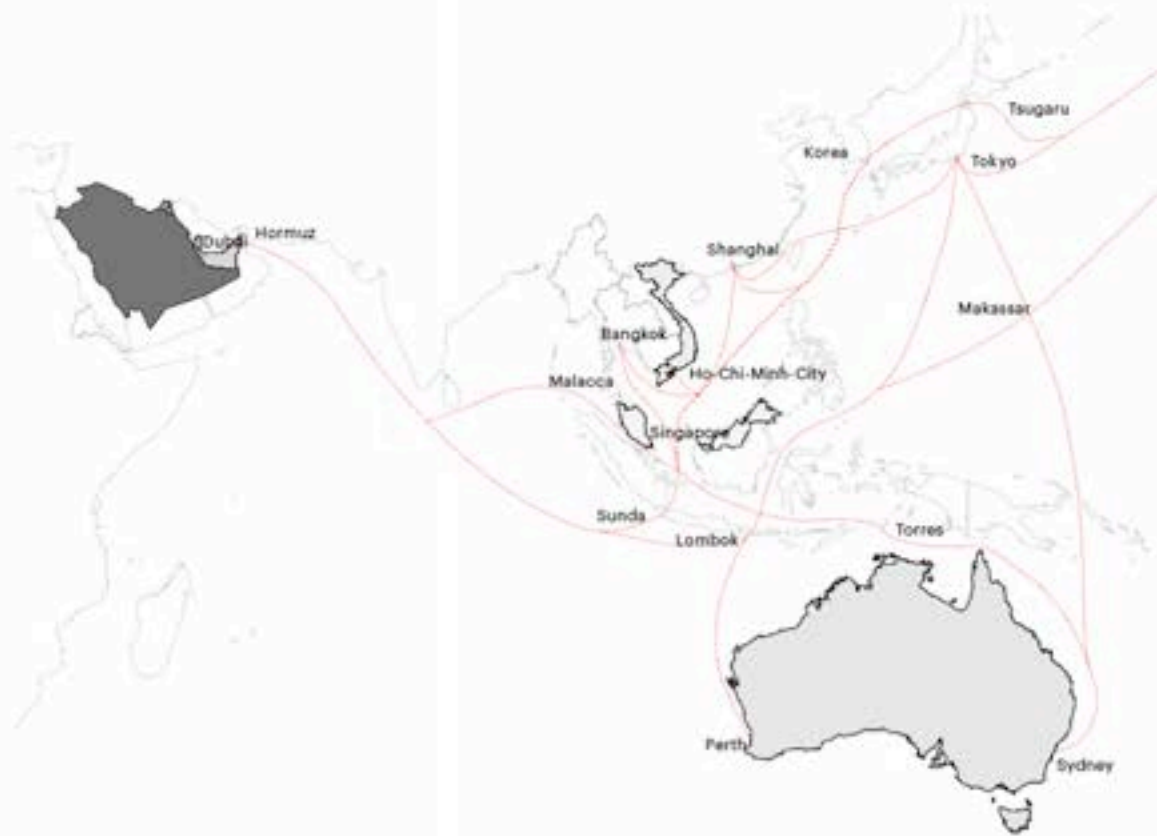
### Worldwide Oil Imports to Asia

The largest oil exporters are the Middle East, the former Soviet Union and West Africa.

Singapore receives a total of 152.7 billion tones of oil per year, which makes it the fourth largest importer of oil in Asia. Singapore's imports are largely diversified, making it more independent than in the gas sector. The island state receives the largest portion of its oil imports from the Middle East, followed by India, Europe and South and Central America.

**Singapore's Oil Importers, 2011 (Billion tonnes)**





Major Oil Shipping Routes  
 --- Main Oil Shipping Route

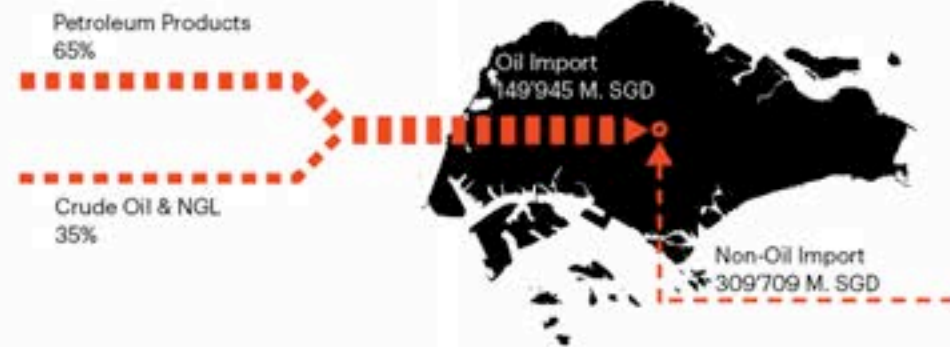
- Saudi Arabia
- Kuwait
- 13.5% Qatar
- 10.5% UAE
- 4.5% Australia
- 4.4% Vietnam
- 3.7% Malaysia



Major Oil Shipping Routes  
 --- Main Oil Shipping Route

- Malaysia
- Hong Kong
- 16.0% Indonesia
- 14.0% Australia
- 13.0% China
- 2.0% Japan
- 1.0% South Korea
- 0.8% Taiwan

Singapore's Oil Import



Singapore's Oil Export





### Oil Facilities

1. Tanjung Bin Terminal
2. Tanjung Piai Terminal (Future)
3. Idemitsu Petrochemical Complex
4. Titan Terminal
5. Pasir Gudang Terminals (Vopak & Felida)
6. Tanjung Langsat Terminals
7. RAPID Terminal (Future)
8. Jurong ExxonMobil Refinery
9. Panjuru Vopak Terminal
10. Panjuru Chevron Terminal
11. Jurong Island
12. Pulau Bukom
13. Pulau Sebarok
14. Pulau Karimun Oiltanking Terminal (Future)
15. Pulau Sambu Pertamina Terminal
16. Pulau Janda Berias Sinopec Terminal (Future)
17. Batam Pelabuhan CPO Terminal
18. Bintan Tanjung Uban Terminal

### Oil Anchorage Zones

19. Tanjung Pelepas Petroleum Anchorage
20. Tuas Petroleum Holding
21. Very Large Crude Carrier
22. Sudong Bunkering
23. Western Petroleum
24. Eastern Petroleum
25. Eastern Bunkering
26. Johor Petroleum
27. Karimun Offloading Zone to Improve Accessibility of VLCC Vessels into Singapore

- "Gates to the City": Pilot Boarding Point
- Offloading Points: Jetties



### Oiltanker

Singapore receives all of its mineral products by ship. The harbor and its accessibility therefore plays a crucial role.

## Gas: A Regional Network

In comparison to Singapore's oil import, the import situation of natural gas is different. Instead of a global oil chain, the gas import structure is based on a regional network.

Neighboring countries like Malaysia or Indonesia are providing the gas security for Singapore so far. Due to growing demand in the home countries, Singapore could face a serious shortage of supplies in the near future. Therefore new gas import options like LNG are currently under construction, securing Singapore's independence in future times.

The new Singaporean LNG terminal is located on Jurong Island and will be operational by the beginning of 2013, opening a new field of markets for growing energy demand. This could benefit companies, which rely heavily on electricity, especially in the chemical industry.

In addition, trading opportunities could develop through the storage of LNG within Singapore, reinforcing Singapore's position as a global hub for liquid energy.



### Dependence on Gas for Energy Consumption in Southeast Asia

Brunei and Singapore are both largely dependent countries on natural gas for electricity generation.

Other than Singapore, Brunei has major gas reserves and is energetically self-sufficient. The same is true with other ASEAN countries.

The independence of Singapore is a certain risk for economic development, due to the tendency towards electricity prices, because of these circumstances.

The opening of Singapore towards a larger LNG market is a first step, though alternatives like coal or renewables sources should be kept in mind.



World LNG Trade (2015)  
Total Sales = 337mt  
(13% of global gas consumption)



ASEAN Pipeline Network

As Singapore relies entirely on piped natural gas, it wants to diversify its sources of gas by building a new LNG terminal, which will be operational by 2013.

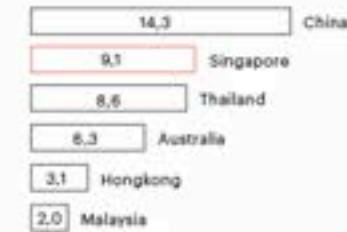
Even though Indonesia and Malaysia were the second and third largest LNG exporters last year, these countries are now looking to import LNG as a result of their decreasing productivity and increasing demands.



Pipeline Trade Movements to Asia Pacific

**Trade Movements by Pipeline**  
 China is the largest recipient of piped natural gas in Asia. Singapore follows at second place, receiving 6.7 billion cubic meters from Indonesia and 2.3 billion cubic meters from Malaysia.  
 The problem concerning pipeline trade is the high dependence on other countries, not providing any alternatives in case of conflict.  
 The advantage of pipelines on the other hand is the constant flow of gas, which enables a precise production, so that storage can be reduced to a minimum.  
 The alternative to piped natural gas is LNG, which requires costly liquefaction and regasification as well as large storage facilities as the incoming flow of gas is constantly changing.  
 The drive for Singapore in reducing its dependence is understandable, but it has to prove to be economical feasible.

Total Imports (Billion Cubic Meters)



Total 9,1 Billion Cubic Meters imported to Singapore



# Global Primary Energy Demand

Global demand for energy has risen inexorably in the last 150 years along with industrial development and population growth. Hunger for energy is predicted to continue to rise by at least 50% by 2030, as developing countries like China and India seek to fuel their rapid economic growth. The lion's share of global energy (about 84% at present) is

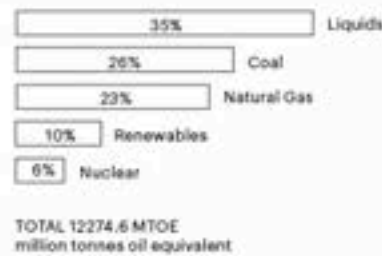
supplied by coal, oil and gas - the fossil fuels." (BBC News) Singapore relies almost entirely on these fuels for its primary energy demand. Today, around 88 percent of the energy consumed comes from oil products, 11 percent comes from gas and an small portion from renewable sources.



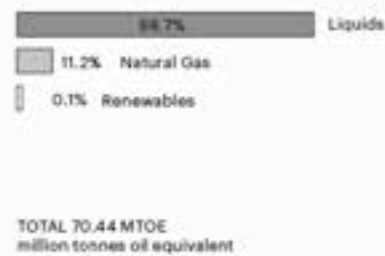
## Primary Energy Consumption, 2011 (million tones oil equivalent)

Emerging economies in Asia Pacific consume large amounts of oil. However, oil reserves in this part of the globe are relatively small. Oil imports from the Middle East is therefore necessary to meet the demand of local Asian Pacific markets. Singapore occupies a strategic position in this network as it operates as a distributor of oil and oil-related services.

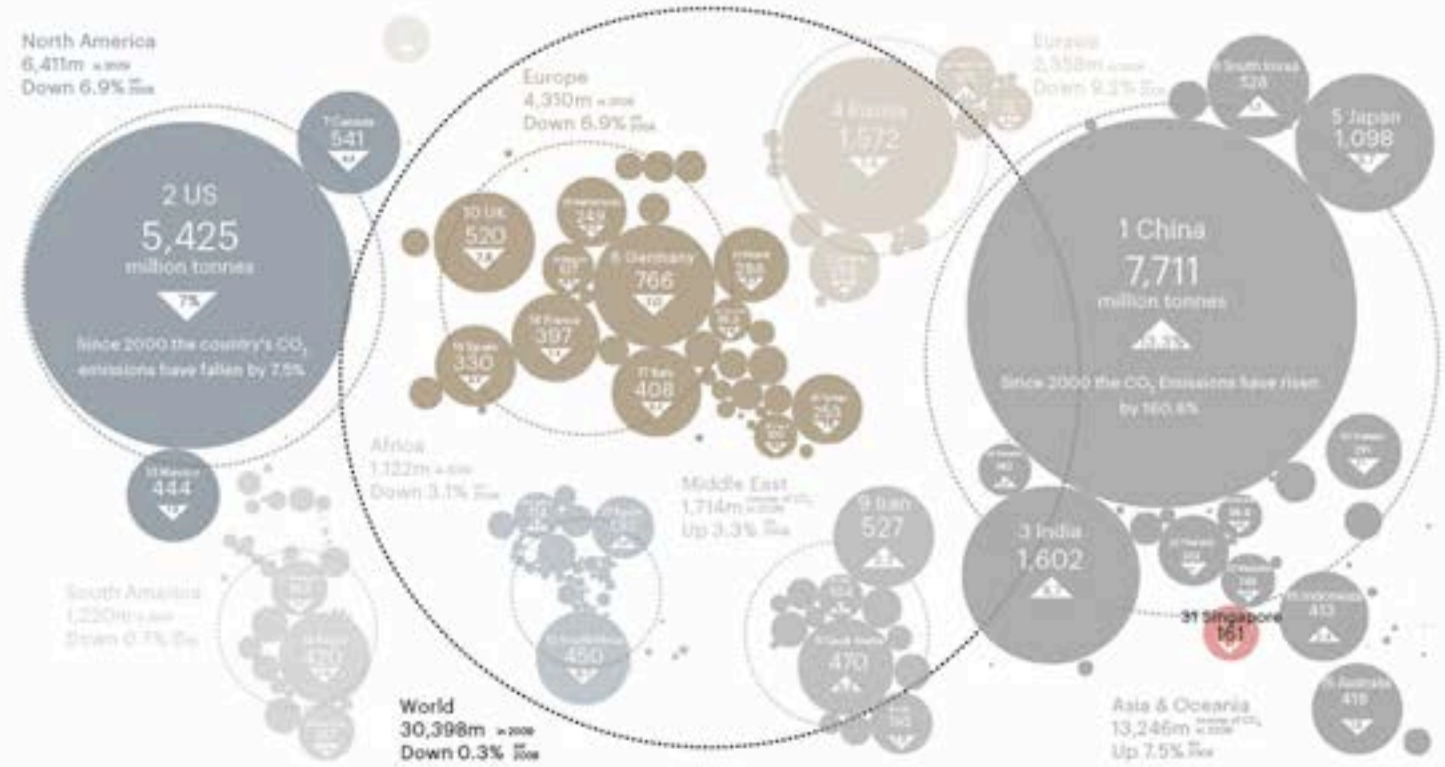
## World Market Energy Use, 2010



## Singapore Energy Use, 2011

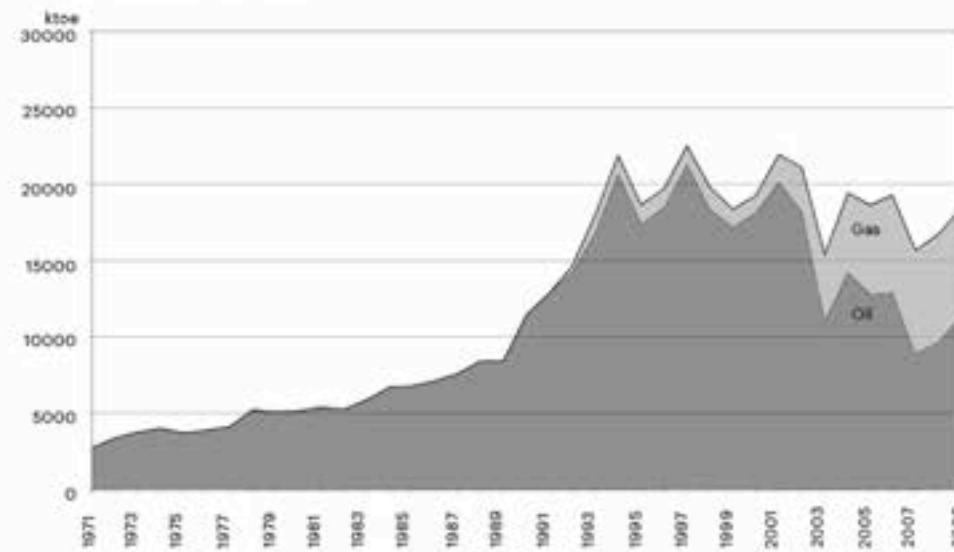


# An Atlas of Pollution: the World in Carbon Dioxide Emissions



Emissions, 2009  
 Emissions ranking and country  
 Million tonnes of CO<sub>2</sub>  
 Change of emissions 2008 - 2009

## Total primary Energy Supply, Singapore, 2009 (ktoe)





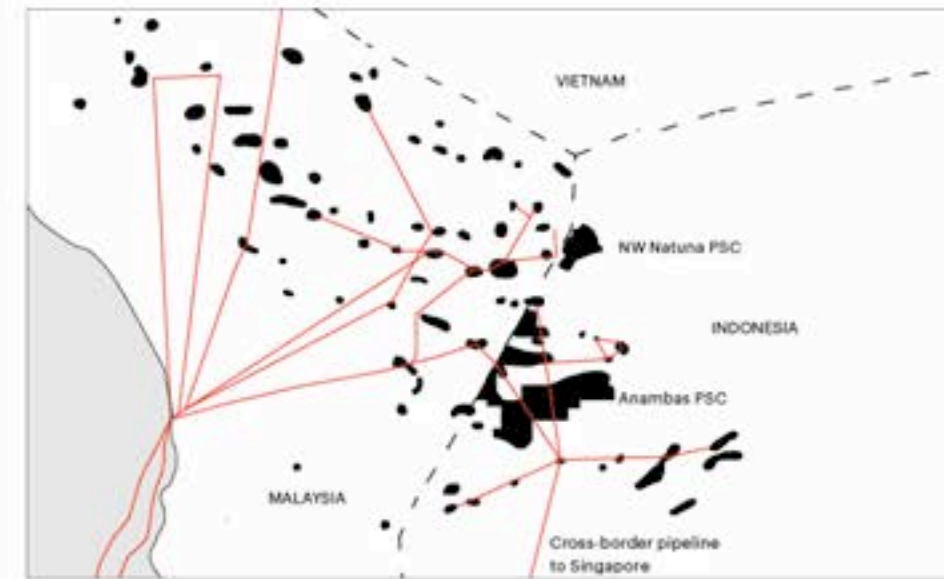
South-East Asia Pipelines Map 2011  
 Gas Pipeline

**Natuna Gas Field**

"Natuna gas field is in the Greater Sarawak Basin about 1,100km (700 miles) north of Jakarta and 225km (140 miles) northeast of the Natuna Islands, Indonesia's northernmost territory in the South China sea.

Discovered in 1970 by Italy's Agip, the field is the biggest in Southeast Asia with an estimated 46 trillion cubic feet (tcf) of recoverable reserves, but has been developed only recently.

The 640km Natuna transportation system is one of the world's longest subsea gas pipelines, delivering to Singapore."

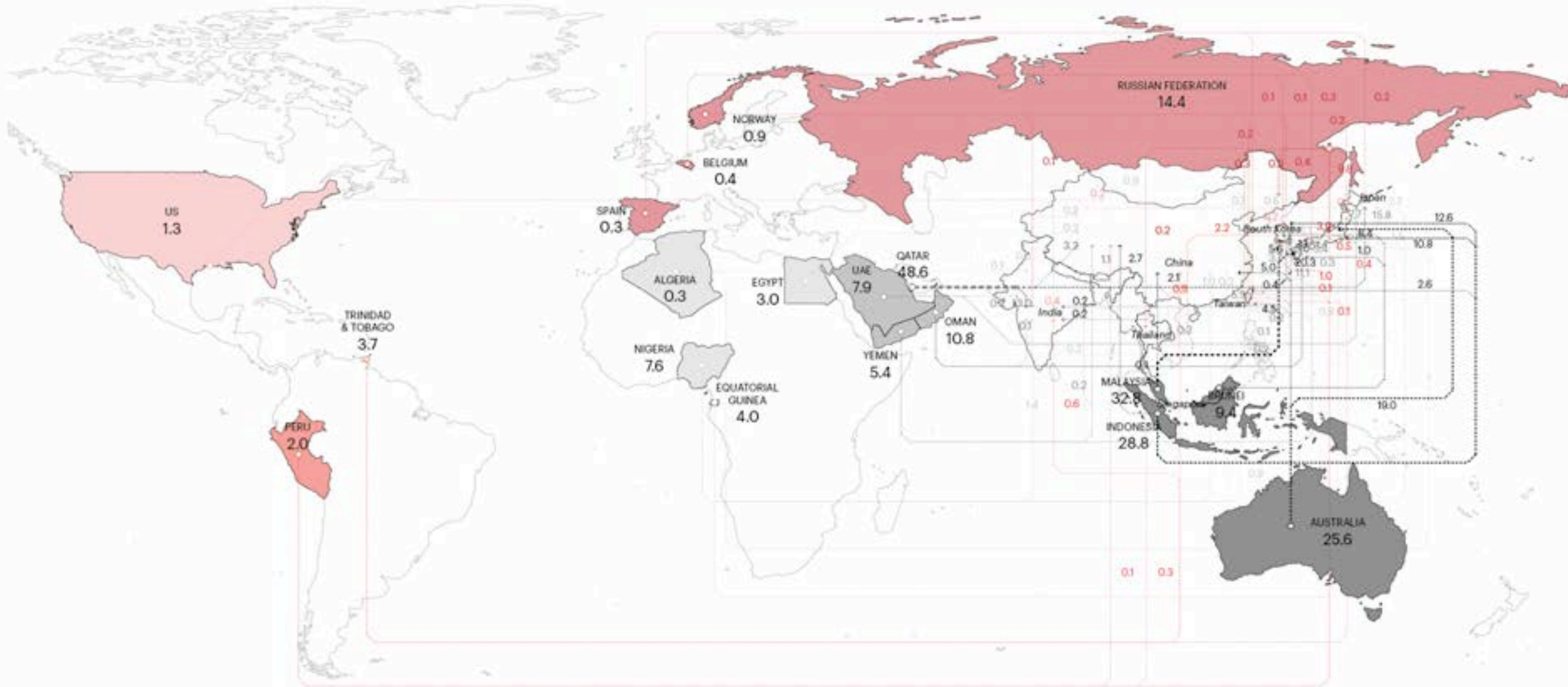


Zoom-in Natuna Gas Field

**Cross-Border Pipelines**

- Indonesia - Singapore
  - 0431 W. Natuna Sea fields - Singapore
- Malaysia - Philippines
  - 0444 Bintulu - Manila
- Malaysia - Singapore
  - 0502 Segamat - Singapore
- Myanmar - Thailand
  - 0608 Yadana field - Ratchaburi
  - 0799 Yadana field - Ratchaburi
- Thailand - Malaysia
  - 0445 Thailand-Malaysia
- Brunei
  - 0900 Offshore fields - Lumut
- Indonesia
  - 0437 Muaraenim fields - Palembang
  - 0439 Rantau-Belawan
  - 0440 Talang Akar fields - Palembang
- Malaysia
  - 0446 Kerteh - Kuala Lumpur
  - 0447 Kuala Lumpur - Melaka
  - 0448 Penang - Kota Bharu
  - 0449 Sarawak offshore fields - Bintulu
  - 0500 Sarawak offshore fields - Lutong
  - 0501 Sarawak offshore fields - Labuan Island
  - 0503 W. Malaysia offshore fields - Kerteh
- Thailand
  - 0604 Erawan - Khanom GSP/PP
  - 0605 Gulf of Thailand - Map Ta Phut GSP
  - 0606 Link from G65 - Ratchaburi



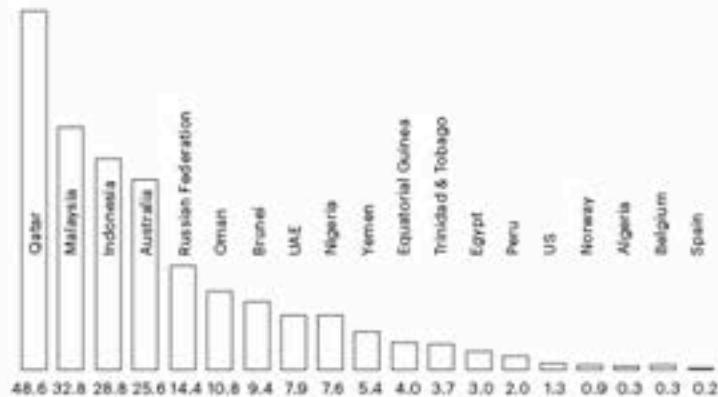


### Liquefied Natural Gas (LNG) Trade

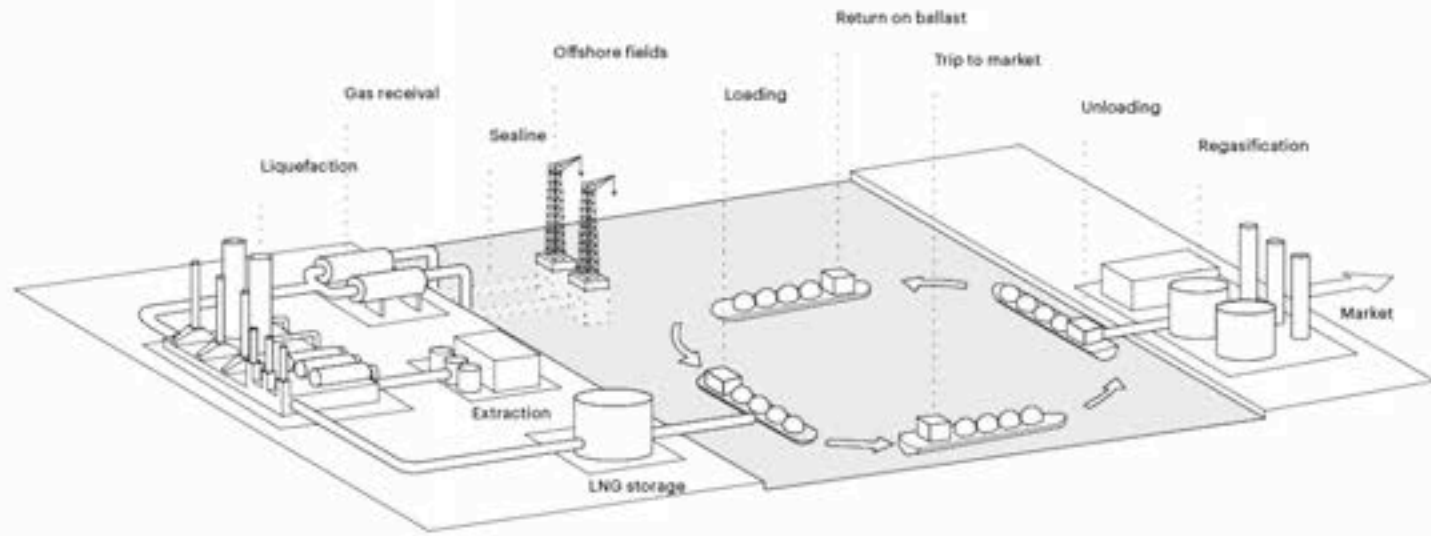
"The cost of transporting natural gas per unit of energy to distant markets is much higher compared to oil because of its volume-pressure behavior, and currently usually occurs by pipeline on-land, or, increasingly, via liquefied natural gas (LNG) for overseas." (Review of Ways to Transport Natural Gas Energy from Countries which do not need the Gas for Domestic Use; Thomas, Dawe; Energy; Elsevier; 2003)

"The biggest obstacle for the LNG trade, which allows the transport of gas over long distances is that, many importing countries do not have the capital to build the huge storage and regeneration facilities." (Review of Ways to Transport Natural Gas Energy from Countries which do not need the Gas for Domestic Use; Thomas, Dawe; Energy; Elsevier; 2003)

**LNG Trade Movements 2011**  
**Total Exports to Asia Pacific**  
**(Billion Cubic Meters)**



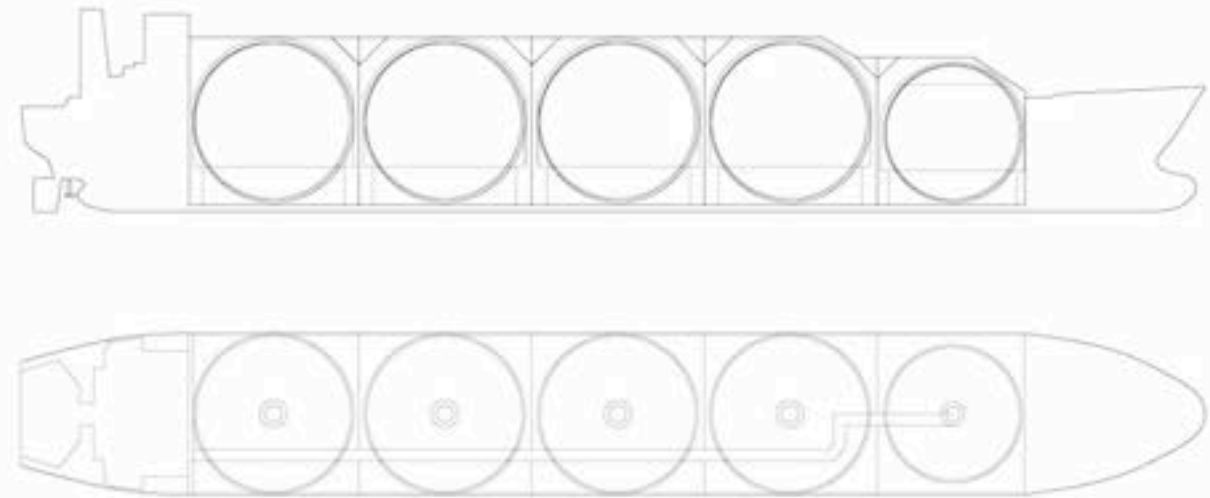
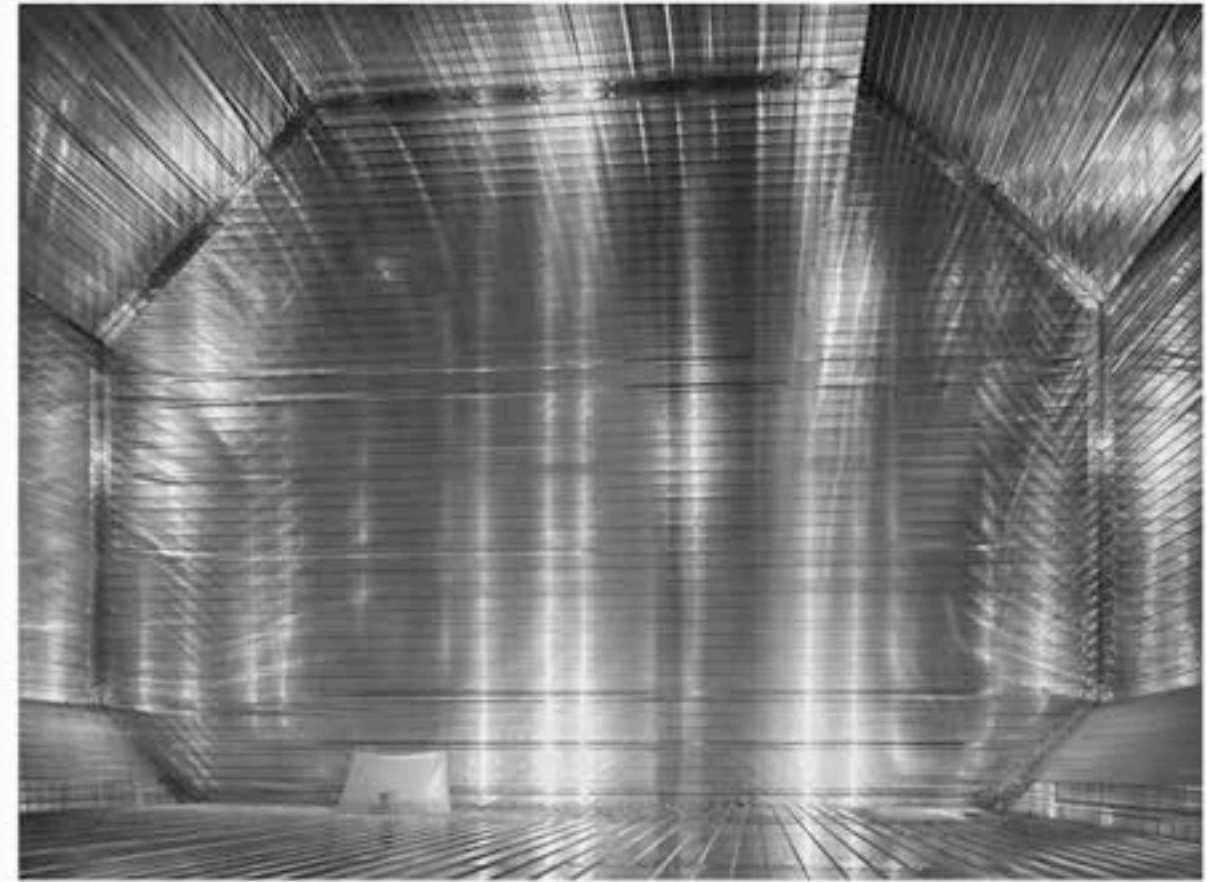
The LNG Value Chain

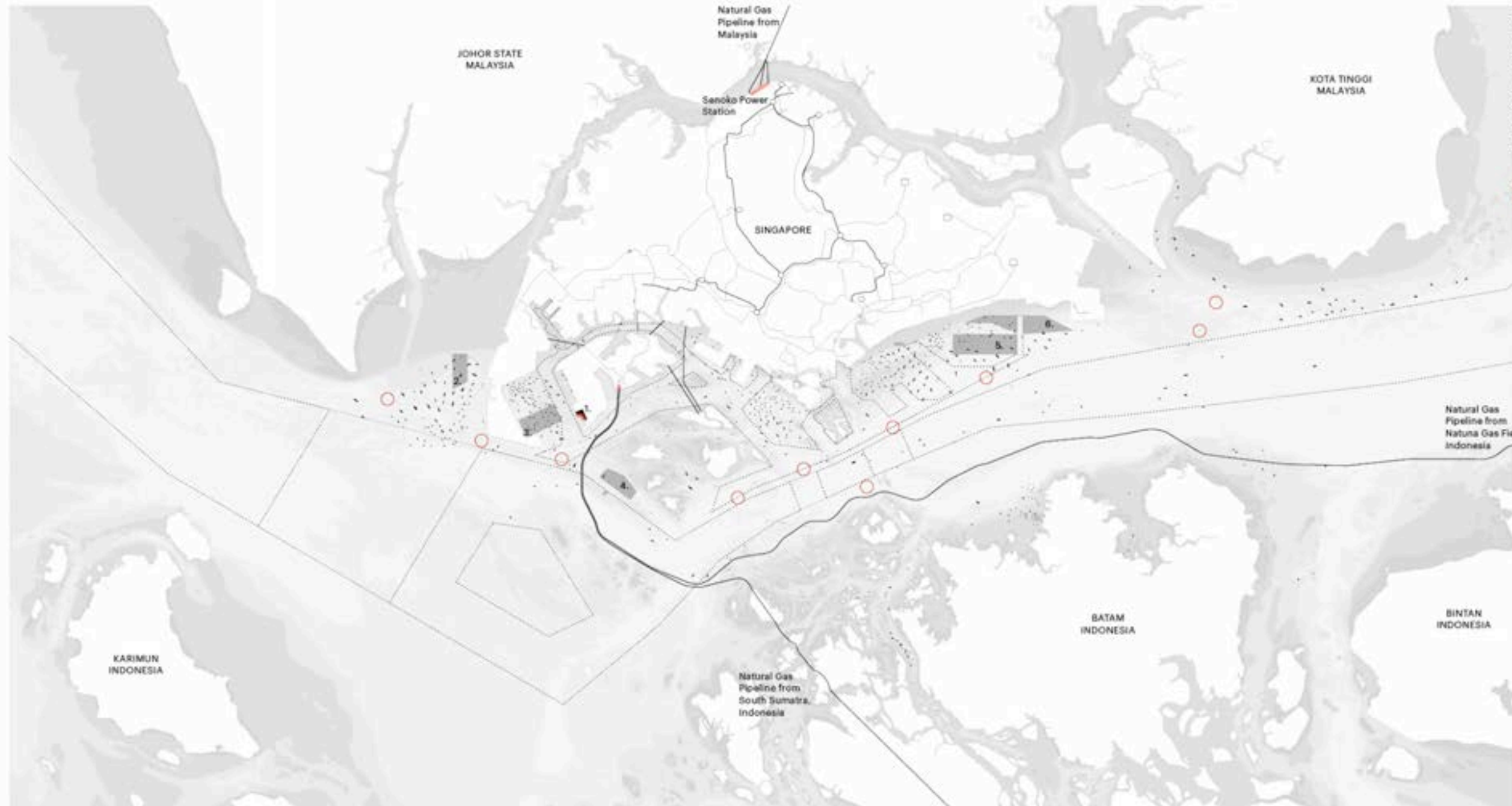


**Singapore's Future: LNG**  
 "Singapore's new liquefied natural gas (LNG) terminal will be able to handle sufficient imports of the fuel to cover all of the country's power needs, even if piped gas supply contracts with Malaysia and Indonesia are not renewed.  
 Supply will come under pressure because of growing domestic gas demand in

Malaysia and Indonesia. What we will do is ensure sufficient capacity to import LNG to meet all of our gas demand," said Chee Hong Tat, the chief executive of Singapore's Energy Market Authority.  
 Singapore officials have previously said the new terminal was designed to supplement piped gas.

LNG carrier from inside





- Gas Facilities**
1. LNG Terminal Singapore (2013)
- Gas Anchorage Zones**
2. Tanjung Pelepas Explosives
  3. LNG/LPG/Chemical Gas Carriers
  4. Sudong Explosive
  5. Eastern Special Purpose
  6. Eastern Special Purpose
- "Gates to the City", Pilot Boarding Point  
 ● Offloading Points, Jetties



**Natural Gas by Pipeline**

Advantage for Singapore:  
 Constant flow of gas, Fixed prices

Disadvantage:  
 Reliance on Indonesia and Malaysia



**LNG Carrier**

Advantage for Singapore:  
 Global market, probably lower prices due to competition

Disadvantage:  
 High investment costs, unsteady flow



- 1. ATB Tanjung Bin
- 2. Pulau Sembu
- 3. Karimun
- 4. Jurong Island area
- 5. Plan for RAPID LNG Terminal, Penggeran
- 6. Pasir Gudang
- 7. Tanjung Lingsat



7.



**Oil Facilities**

1. Tanjung Bin Terminal
2. Tanjung Piai Terminal (Future)
3. Idemitsu Petrochemical Complex
4. Titan Terminal
5. Pasir Gudang Terminals (Vopak & Felida)
6. Tanjung Langsat Terminals
7. RAPID Terminal (Future)
8. Jurong ExxonMobil Refinery
9. Panjuru Vopak Terminal
10. Panjuru Chevron Terminal
11. Jurong Island
12. Pulau Bukom
13. Pulau Sebarok
14. Pulau Karimun Offtanking Terminal (Future)
15. Pulau Sambu Pertamina Terminal
16. Pulau Janda Berias Sinopec Terminal (Future)
17. Batam Pelabuhan CPO Terminal
18. Bintan Tanjung Uban Terminal

**Oil Anchorage Zones**

19. Tanjung Pelepas Petroleum Anchorage
20. Tuas Petroleum Holding
21. Very Large Crude Carrier
22. Sudong Bunkering
23. Western Petroleum
24. Eastern Petroleum
25. Eastern Bunkering
26. Johor Petroleum
27. Karimun Offloading Zone to Improve Accessibility of VLCC Vessels into Singapore

**Gas Anchorage Zones**

21. LNG/LPG/Chemical Gas Carriers
24. Sudong Explosive
27. Eastern Special Purpose
28. Eastern Special Purpose

**Gas Facilities**

32. LNG Terminal Singapore

- "Gates to the City": Pilot Boarding Point
- Offloading Points, Jetties



# Chemical Island

If Singapore is the petrochemical center of the region, then Jurong Island could be called the petrochemical heart of Singapore. Often referred as Houston of the East, Singapore's Jurong Island is already often taken as a model of how to organize a petrochemical sector densely and efficiently. The whole petrochemical industry in Singapore can be considered as a maritime enclave with an intended separation from the mainland. These two islands artificially

created to hold this specific sector are highly organized and have special regulations. If the mainland was not so dependent on them it could be said that Jurong Island and Pulau Bukom are not really part of Singapore.



View to Jurong Island from the Vopak jetty in Singapore mainland

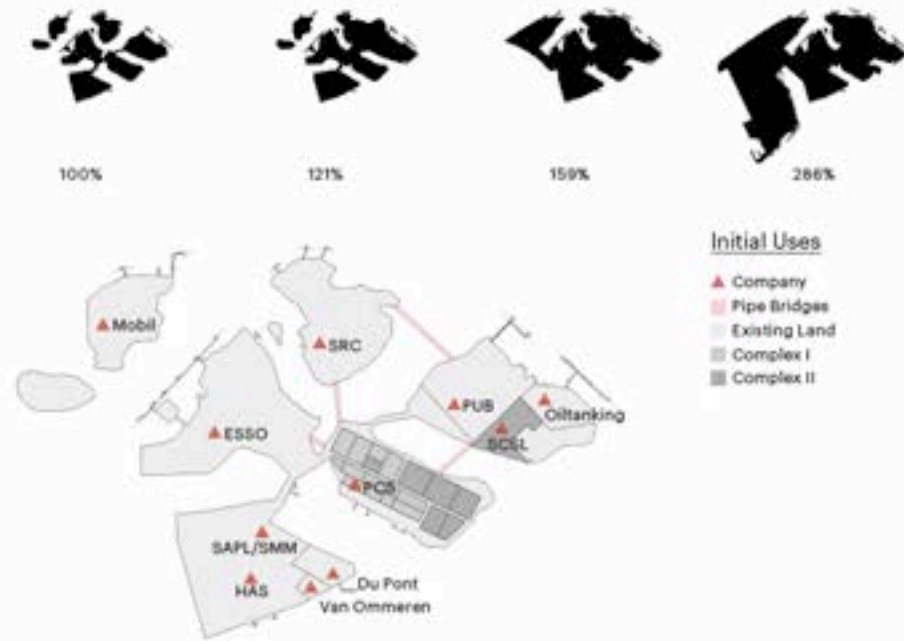


Land Reclamation Process

- Former Islands
- First Joining
- Second Joining
- Island Expansion

**The Construction of Jurong Island**  
 Until the 1960s the former islands of Pulau Seraya, Merlimau, Ayer Merbau and Ayer Chawan contained small fishermen kampungs. With the arrival of the Singapore Refining Company, Esso and Mobil to Pulau Merlimau, Ayer Chawan and Pesek, the environment of these former islands would rapidly change.

The fast industrialization of Singapore and the government pushing the petrochemical sector resulted in a growing lack of industrial land. From this came the idea of joining the 7 islands into an immense new island. With the formation of the JTC Corporation, a main institution was formed for the management of the island.



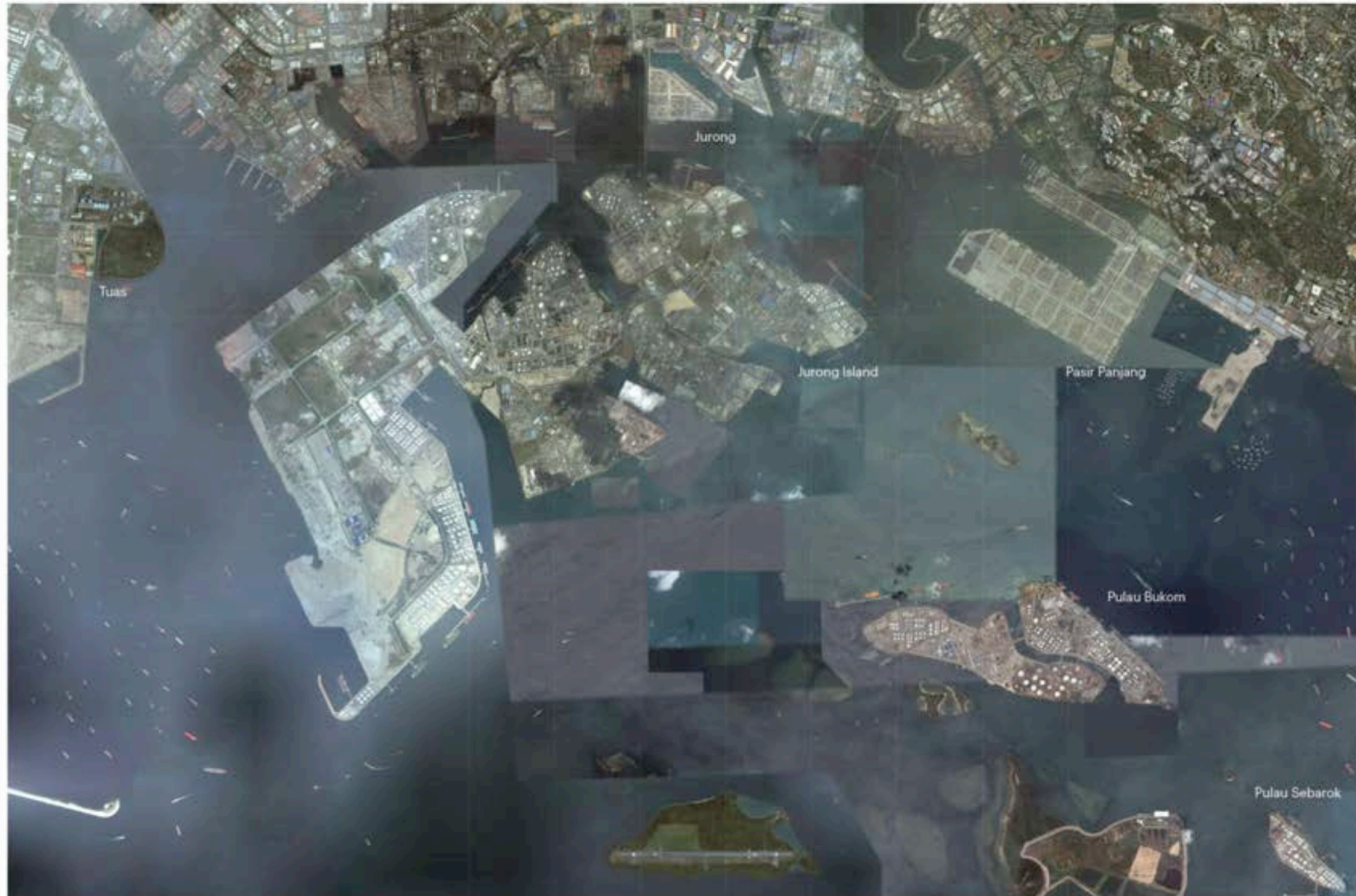
1. View from Taman Jurong to Pulau Seraya
2. Natural coastline of Taman Jurong
3. Urbanized coastline of Taman Jurong



2.



3.



### Center of Petrochemical Industries

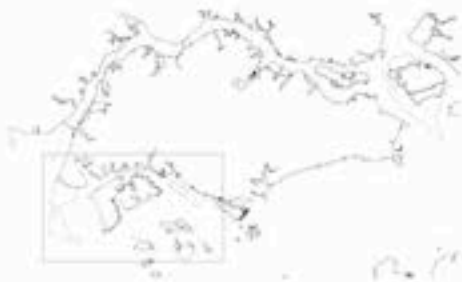
Jurong Island is right in front of the Pasir Panjang Container Terminal. As visible on the satellite image, Jurong Island and Pulau Bukom gather all the facilities which are meant for primary petrochemical production. The ongoing reclamation on the south eastern part will offer even more space for this sector.





#### Built Structures

There are two important types of built structures on Jurong Island. The main typologies are the oil tanks and the chemical plants. Most of the structures are visibly connected by pipes of several sizes and give an impression of being one giant structure. These typologies are also visible on the Pulau Bukom and Pulau Sebarok islands.

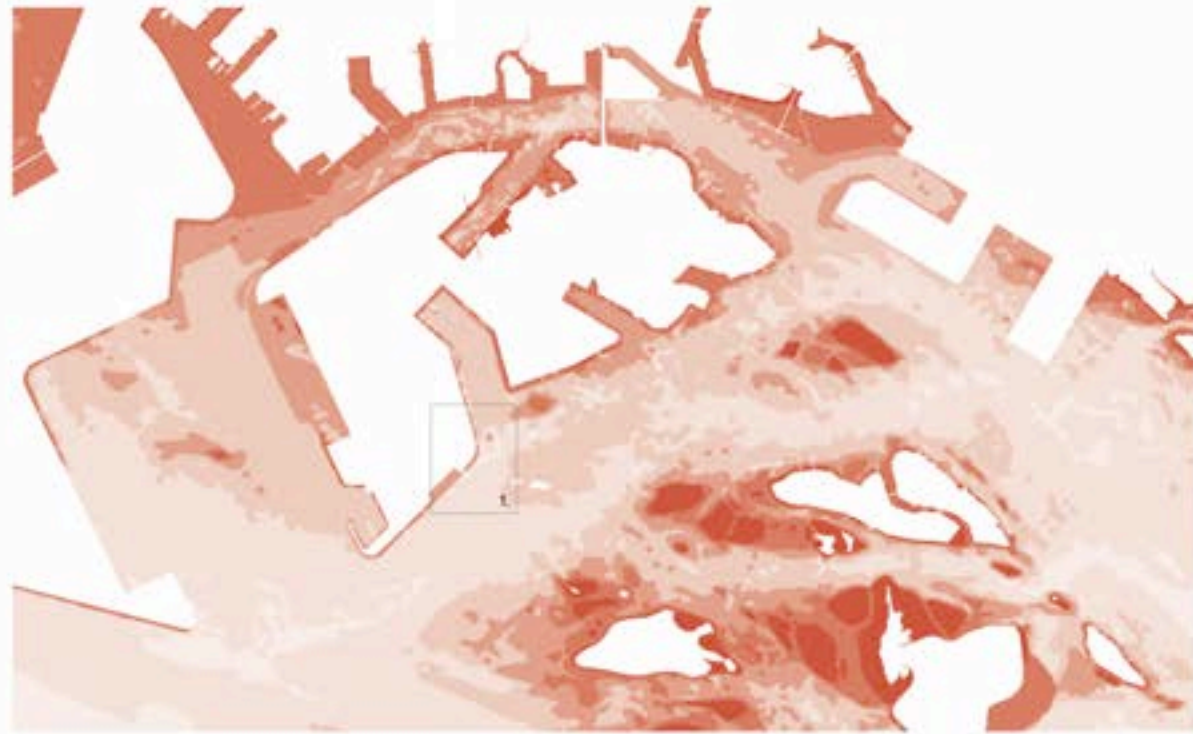


#### Reconstructing the Map

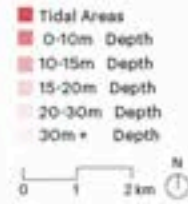
The first step in mapping Jurong Island would be to acquire maps with the footprint and the street network. But in the case of Jurong Island, such information remain scarce. The corresponding data with the exact information are categorized as sensitive since the events of 9/11. In order to understand the island better we used satellite pictures of different sources and years to reconstruct maps of the built structure of Jurong island and specially to get information of the characteristics of petrochemical plants.

Data provided by URA





**Maritime Depths**



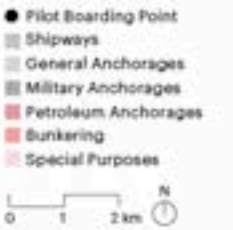
**Maritime Accessibility**

The natural conditions of the maritime territory of Singapore are one of the main reasons for the success of its port. The depths allow vessels of the Malaccamax class (very large crude carriers) to be served at the Port of Singapore.

The new reclamations, for example in Tuas, allow an even greater access to deep water zones in the land area granting more berths for large vessels.



**Maritime Zones**

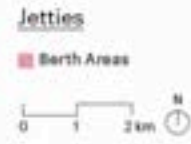
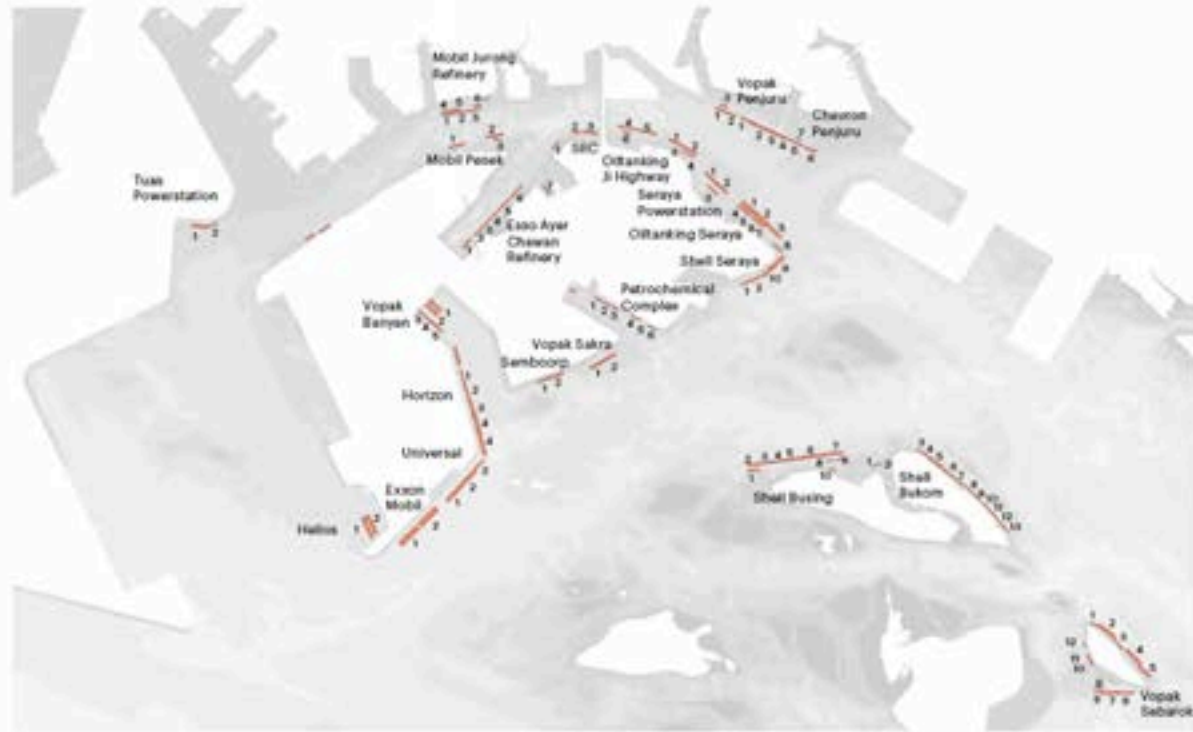


**Maritime Service Zones**

The space around Jurong Island is not void. It is a highly organised space, which is mainly used for transiting and anchoring. To enter the Port of Singapore a vessel coming from the strait has to stop at a pilot boarding point. Once the pilot arrives, the vessel is under the control and supervision of the Maritime Port Authority of Singapore and guided by the port master. Because the Port of Singapore is so busy, there are several different anchorage zones for different sizes of vessels and different loads.



Zonings of Jurong & Tuas

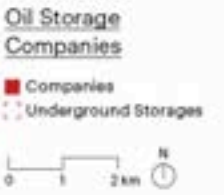


**Jetties & Berths**

Jetties are needed to transfer crude oil and oil products from a vessel to a terminal and vice-versa. Every storage and refining company needs jetties to get their crude oil, while value adding downstream companies can acquire their feedstock from the refineries and the terminals. A Jetty provides a pipeline connection between the tanks of the vessel and the terminal tanks. The engine of the terminal is used to pump the oil to the ship, while to get oil from the ship the engine of the ship is used. The depths of the berths are the most crucial quality of a jetty because they define exactly what ships can dock to the jetty and what specific amount of load they are permitted to carry.

**Depths**

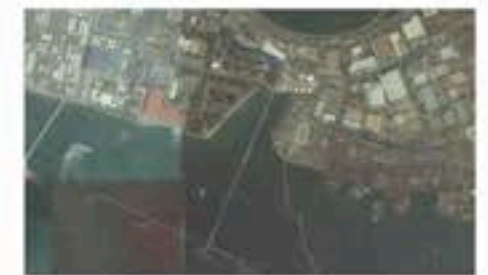
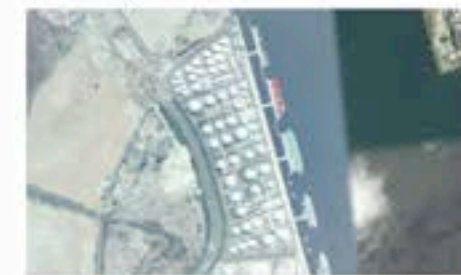
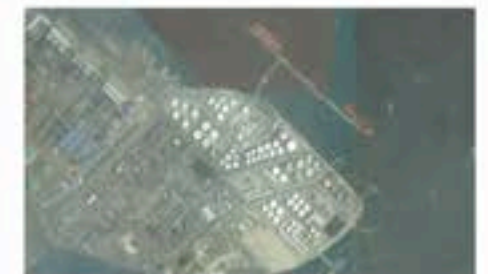
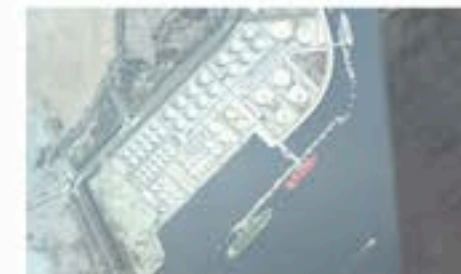
<b>Tuas Powerstation</b> Berth 1 - 13.0m Berth 2 - 10.3m	<b>Mobil Jurong Refinery</b> Berth 1 - 13.9m Berth 2 - 12.9m Berth 3 - 13.0m Berth 4 - 12.3m Berth 5 - 11.6m Berth 6 - 8.6m	<b>Mobil Pesak</b> Berth 1 - 14.7m Berth 2 - 14.6m Berth 3 - 9.0m	<b>Esso A. Chawan Refinery</b> Berth 1 - 13.6m Berth 2 - 8.5m Berth 3 - 12.6m Berth 4 - 12.6m Berth 5 - 15.5m Berth 6 - 15.2m Berth 7 - 10.0m	<b>SKC</b> Berth 1 - 10.7m Berth 2 - 11.4m Berth 3 - 12.4m Berth 4 - 15.3m Berth 5 - 15.5m Berth 6 - 10.6m	<b>Vopak Penjuru Terminal</b> Berth 1 - 14.1m Berth 2 - 13.7m Berth 3 - 12.0m	<b>Chevron Penjuru Terminal</b> Berth 1 - 13.3m	<b>Berth 2 - 13.9m Berth 3 - 14.3m Berth 4 - 11.6m Berth 5 - 12.1m Berth 6 - 10.3m Berth 7 - 2.9m</b>	<b>Seraya Powerstation</b> Berth 1 - 16.3m Berth 2 - 15.2m Berth 3 - 15.4m	<b>Oiltanking Seraya Terminal</b> Berth 1 - 14.3m Berth 2 - 14.5m Berth 3 - 16.1m Berth 4 - 12.3m Berth 5 - 12.8m Berth 6 - 14.5m Berth 7 - 14.6m Berth 8 - 12.4m Berth 9 - 14.8m Berth 10 - 13.9m	<b>Shell Seraya Chemical</b> Berth 1 - 15.2m Berth 2 - 15.7m	<b>S. Petrochemical Complex</b> Berth 1 - 12.0m Berth 2 - 12.1m Berth 3 - 10.0m Berth 4 - 6.8m Berth 5 - 1.8m Berth 6 - 3.0m	<b>Vopak Banyan Terminal</b> Berth 1 - 16.5m Berth 2 - 16.8m Berth 3 - 11.5m Berth 4 - 15.8m Berth 5 - 15.2m	<b>Horizon Terminal</b> Berth 1 - 16.5m Berth 2 - 16.5m Berth 3 - 16.5m Berth 4 - 16.8m	<b>Universal Terminal</b> Berth 1 - 23.7m Berth 2 - 23.5m Berth 3 - 22.8m Berth 4 - 17.7m Berth 5 - 23.4m Berth 6 - 17.3m Berth 7 - 18.7m Berth 8 - 10.6m Berth 9 - 10.8m Berth 10 - 10.8m	<b>ExxonMobil</b> Berth 1 - 24.5m Berth 2 - 23.5m	<b>Helios Terminal</b> Berth 1 - 18.3m Berth 2 - 18.5m	<b>Shell Busing</b> Berth 1 - 15.9m Berth 2 - 17.5m Berth 3 - 17.1m Berth 4 - 15.3m Berth 5 - 14.7m Berth 6 - 16.9m	<b>Berth 7 - 17.0m Berth 8 - 14.7m Berth 9 - 13.5m Berth 10 - 8.5m</b>	<b>Shell Bukom</b> Berth 1 - 11.2m Berth 2 - 5.7m Berth 3 - 13.2m Berth 4 - 13.0m Berth 5 - 16.2m Berth 6 - 13.5m Berth 7 - 15.6m Berth 8 - 12.9m Berth 9 - 11.8m Berth 10 - 11.3m Berth 11 - 11.3m Berth 12 - 12.3m Berth 13 - 15.8m	<b>Vopak Sebarok</b> Berth 1 - 9.6m Berth 2 - 17.1m Berth 3 - 10.3m Berth 4 - 16.9m Berth 5 - 12.9m Berth 6 - 17.7m Berth 7 - 17.0m Berth 8 - 17.0m Berth 9 - 11.7m Berth 10 - 11.2m Berth 11 - 12.5m Berth 12 - 5.5m	<b>Chevron Oronite</b> Berth 1 - 14.5m
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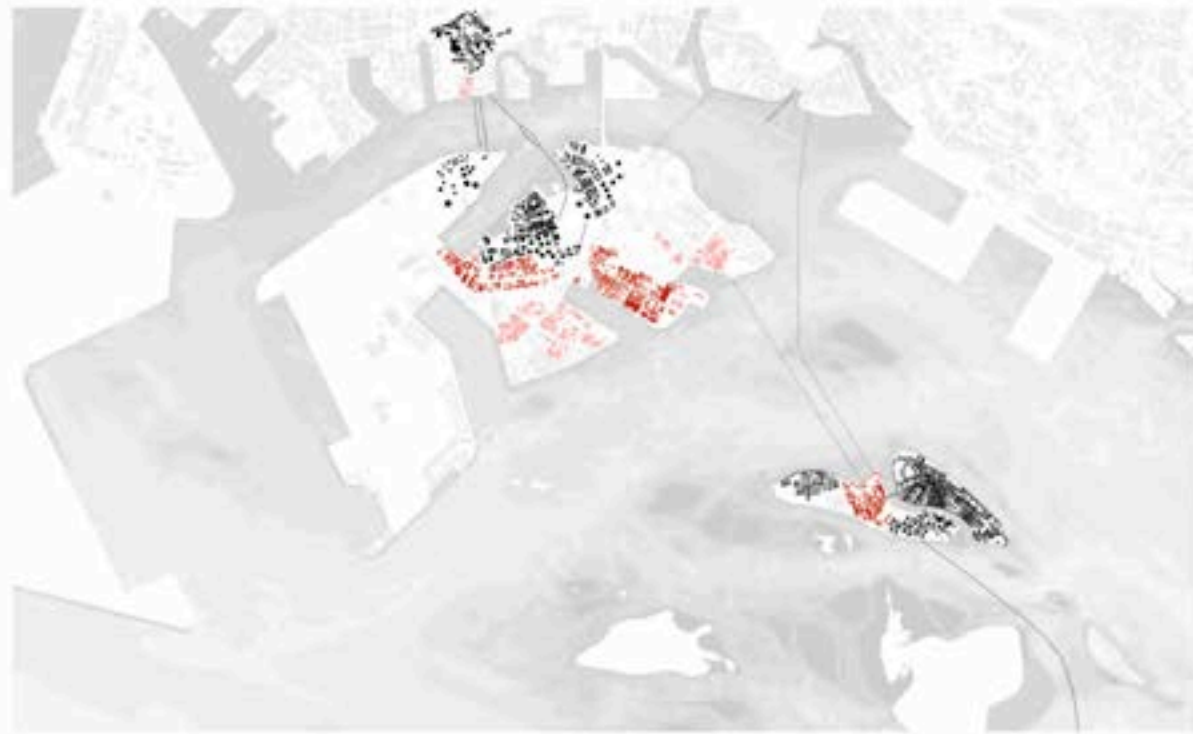


**Storage**

The storage of oil and its products require a relatively large amount of space compared to the other functions of the Island. In order to save the surface space of Jurong Island for the more specialized processes, JTC Corporation is currently building an underground crude storage facility (Jurong Rock Cavern) with a capacity of 2'940'000 cbm.

<b>Vopak (1.+2.)</b> TOTAL CAPACITY: 3'048'297 cbm Banyan: 1'261'319 cbm Sebarok: 1'260'958 cbm Sakra: 288'070 cbm Penjuru: 237'950 cbm	<b>Universal (3.)</b> TOTAL CAPACITY: 2'300'000 cbm	<b>Oiltanking (4.)</b> TOTAL CAPACITY: 1'815'072 cbm Seraya: 717,500 cbm Ji Highway: 649,572 cbm Helios: 448'000 cbm	<b>Horizon (5.)</b> TOTAL CAPACITY: 1'237'400 cbm	<b>Chevron (6.)</b> TOTAL CAPACITY: 238'480 cbm
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**Petrochemical Structures**  
 — Oil Pipelines  
 ■ Refineries  
 ■ Cracking Plants  
 ■ Value Adding Plants

0 1 2 km N

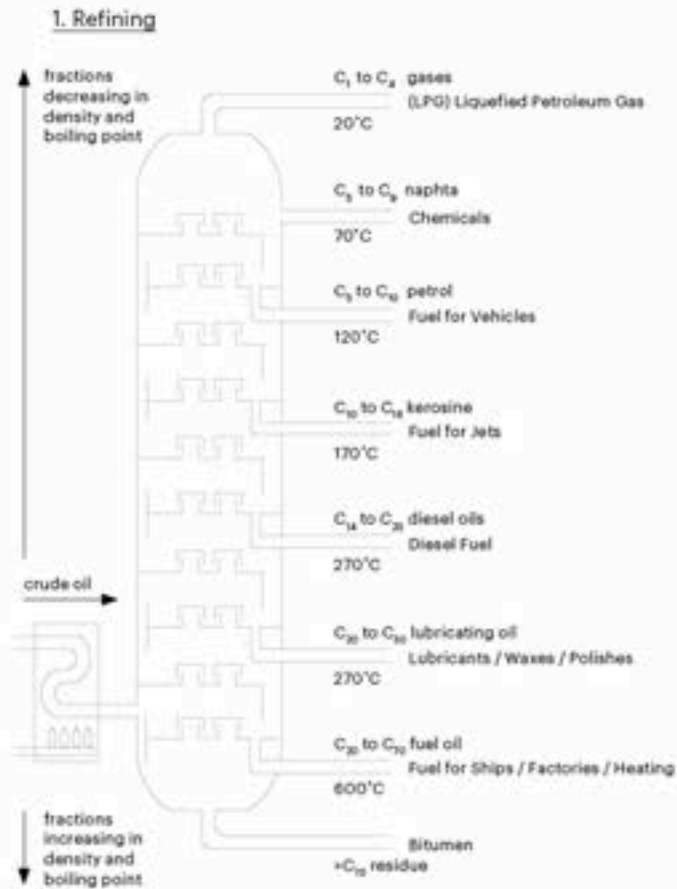


**Largest Refineries, 2012**  
 ○ Refineries in Thousand Barrels per Day

**Refineries**

Crude oil reveals its real qualities when it is divided in its components. This process is called refining and the main instrument for understanding this procedure is the refining column.

Each product of this process has own qualities, but for the petrochemical sector three refining products are relevant. Liquefied petroleum gas, naphtha and gasoil are the main components that continue their way on Jurong Island for example from ExxonMobil to the Petrochemical Corporation of Singapore (PCS).

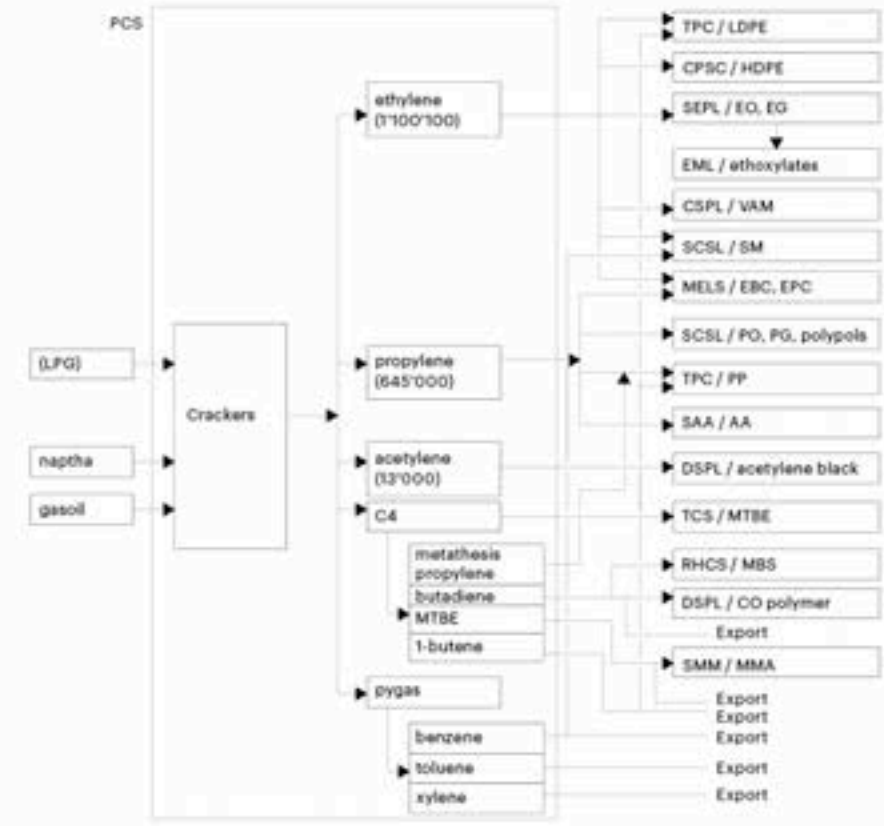


**Petrochemicals and Products**

The main purpose of PCS is to provide the downstream companies high quality ethylene, propylene, acetylene, butadiene etc. It functions as the upstream company of the petrochemical complex on Pulau Ayer Merbau and coordinates all the supporting activities for the downstream companies.

The downstream companies take these products and produce monomers or further products but already with much higher value than the crude oil that came to Singapore by tankers. These other downstream companies complement and compete with each other. There are cases where the same two companies are competitors in one field and have supply contracts on the other side. In any case most of the products leave Singapore again by a tanker.

**2. Cracking**



**3. Value Adding**



**Gas Network**  
 — Gas Pipeline  
 ■ Support Companies  
 ■ Gas Facilities  
 0 1 2 km N

**Gas Network**  
 Jurong Island together with Senoko are the main influx point of natural gas in Singapore. Because of the presence of the pipelines at this entry point of gas, there are also some Powerstations in the area.  
 When the submarine pipelines arrive to Jurong, the gas is transformed from high pressure to low pressure. The gas is transferred through the main pipe rack of Jurong Island to its destinations. Many companies on Jurong Island have their own power generators.  
 Sembcorp is the operator of the main pipe rack called the service corridor.



Left: Main pipe rack surrounding a plot



Right: Main pipe rack along the main street.

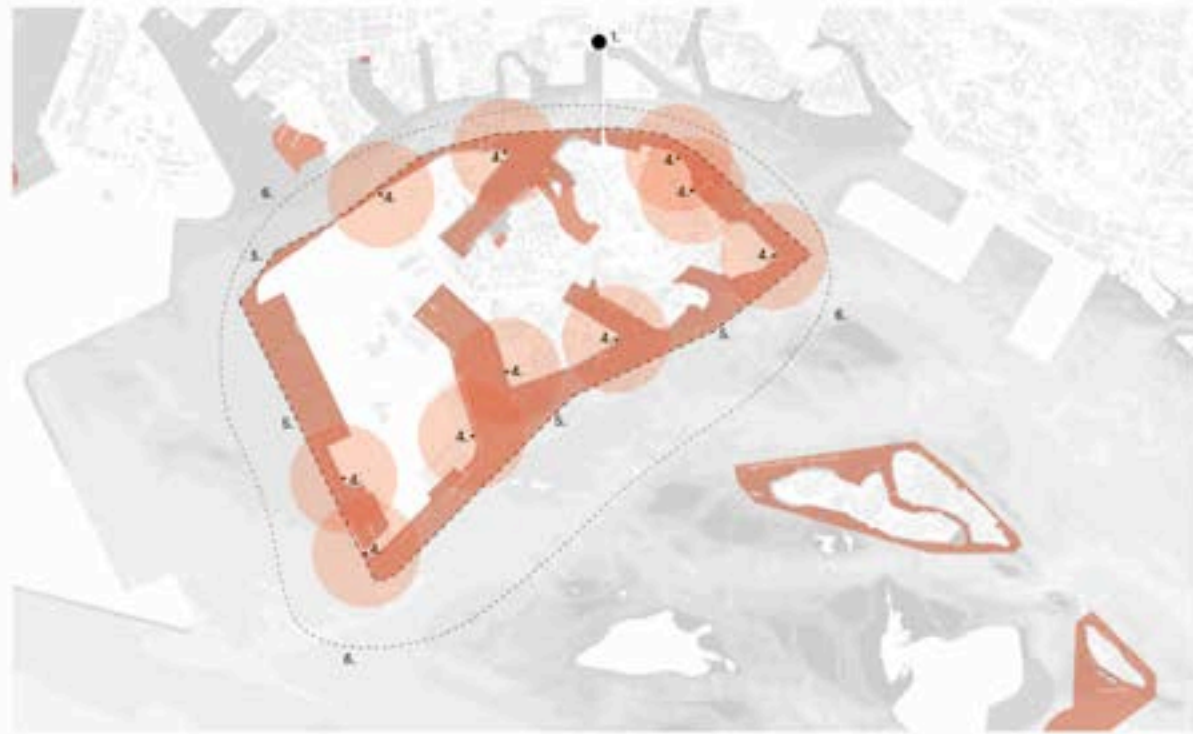


**Companies**  
 ■ Area of Company  
 0 1 2 km N

**Companies**  
 The JTC Corporation is putting a lot of effort to conceal the precise location of the individual companies on Jurong Island. The sites of the major companies such as refineries, storage companies and the historically relevant companies are known generally. But there are a lot of the small downstream plants and supporting companies which are difficult to identify without the help of JTC Corporation.  
 Pulau Bukom and Pulau Sebarok are managed by Shell and Vopak respectively.



- |                  |                   |
|------------------|-------------------|
| 1. ExxonMobil    | 17. Akzo          |
| 2. Shell         | 18. Continental   |
| 3. SRC           | 19. Rotary        |
| 4. Tuas Power    | 20. Huntsman      |
| 5. Keppel Energy | 21. Denka         |
| 6. Sembcorp      | 22. Eastman       |
| 7. Seraya Energy | 23. Perstop       |
| 8. SLNO          | 24. Sumitomo      |
| 9. Oiltanking    | 25. Kurry         |
| 10. Universal    | 26. Invista       |
| 11. Horizon      | 27. Asahi Kasei   |
| 12. Vopak        | 28. Chem. Indust. |
| 13. Chevron      | 29. Air Products  |
| 14. PCS          | 30. Lucite        |
| 15. BASF         | 31. Celanese      |
| 16. Linde Gas    | 32. TPS           |
|                  | 33. MPS           |



Security Aspects

- Check Point
  - Watch Tower
  - Prohibition Zones
- 0 1 2 km N

Security Aspects

Since 9/11, Jurong Island is closed to the public. As the petrochemical sector became more important for Singapore, its facilities are being secured very strictly.

The maritime Prohibition Zone surrounding the island grants a separation space between the shipway and the land. This zone is secured by the Singaporean Coast Guard and watchtowers manned by a private security company.

The air space is controlled by the Singapore Air force that patrols over Jurong Island, which can change depending on the amount of risk. The use of jets for this task is more common. Sometimes there is an interval of less than 10 minutes between each jet, which means either that there is an exercise or that a special event is happening in Singapore. But even if the jets' primary task would be to guard an event, it will always fly over Jurong Island.



1.



2.



3.



4.



5.



6.

1. Checkpoint at Jurong Island Connection
2. Checkpoint at Jurong Island Connection Satellite Image
3. The Helios Terminal surveilled by a watch tower and a patrol boat
4. Watch Tower
5. Patrol Boat
6. RSAF (Republic of Singapore Airforce)



**Urban Uses**

Since Jurong Island is a highly privatized and strongly secured area, there are not many urban uses present. But because there is an amount of 30'000 workers coming in on every day, there are a few uses which seem very obvious and others which are quite surprising. The expected facilities like a food court, shop or medical service are all combined in the visitor centre. Most of the companies don't have their own canteens and have to order their food from outside of Jurong Island.

More informal uses like resting space during work breaks are found next to every bigger construction site in Jurong Island.

The most unexpected facility in Jurong Island as well as in Pulau Bukom are the dormitories for some of these workers. The dormitories on Jurong Island are quite far from the petrochemical plants while in Pulau Bukom they are right next to the facility.



1.



2.



3.

1 & 2. Workers resting in front of tanks under construction

3. Dormitories near oil storage facilities



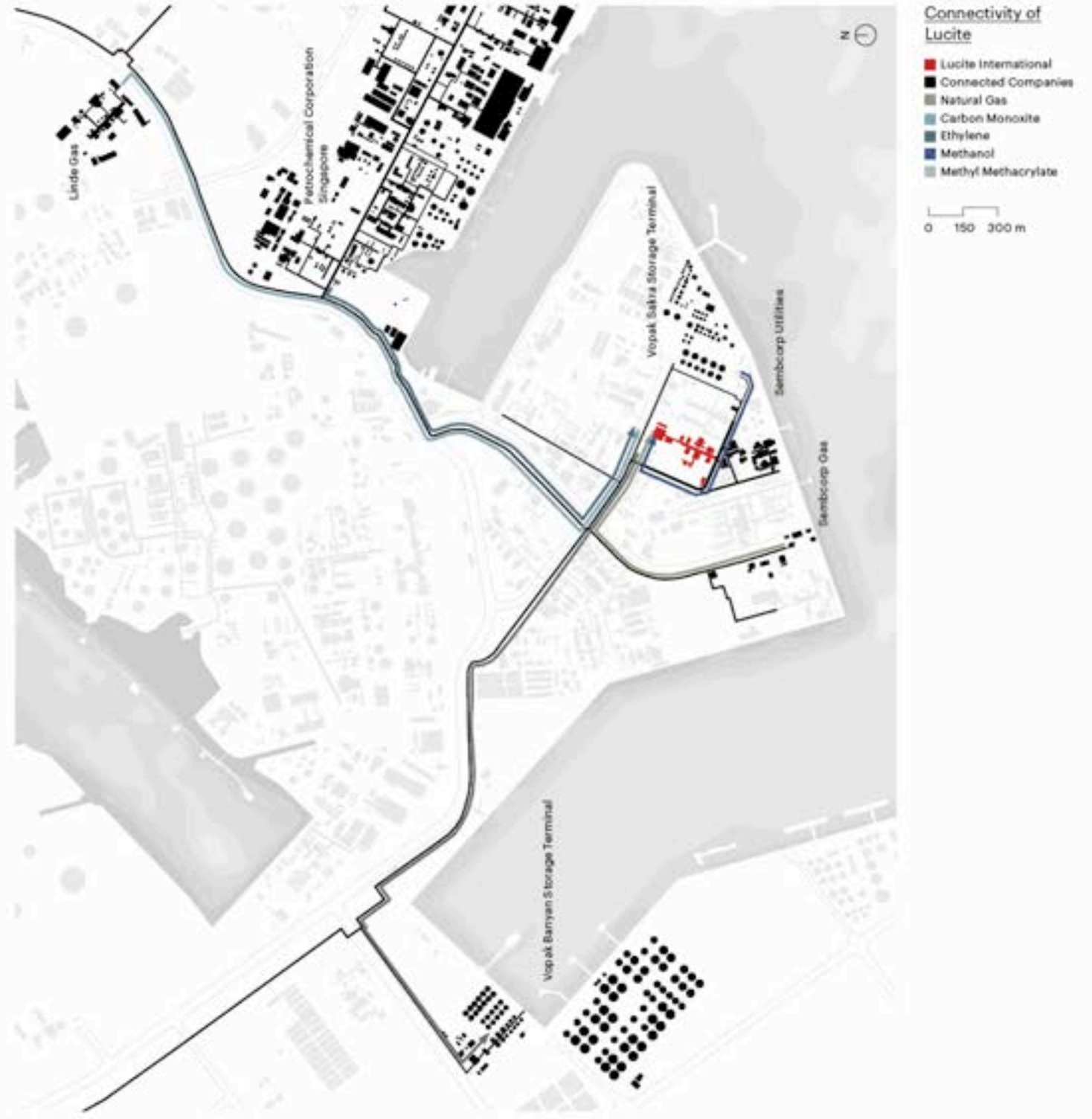


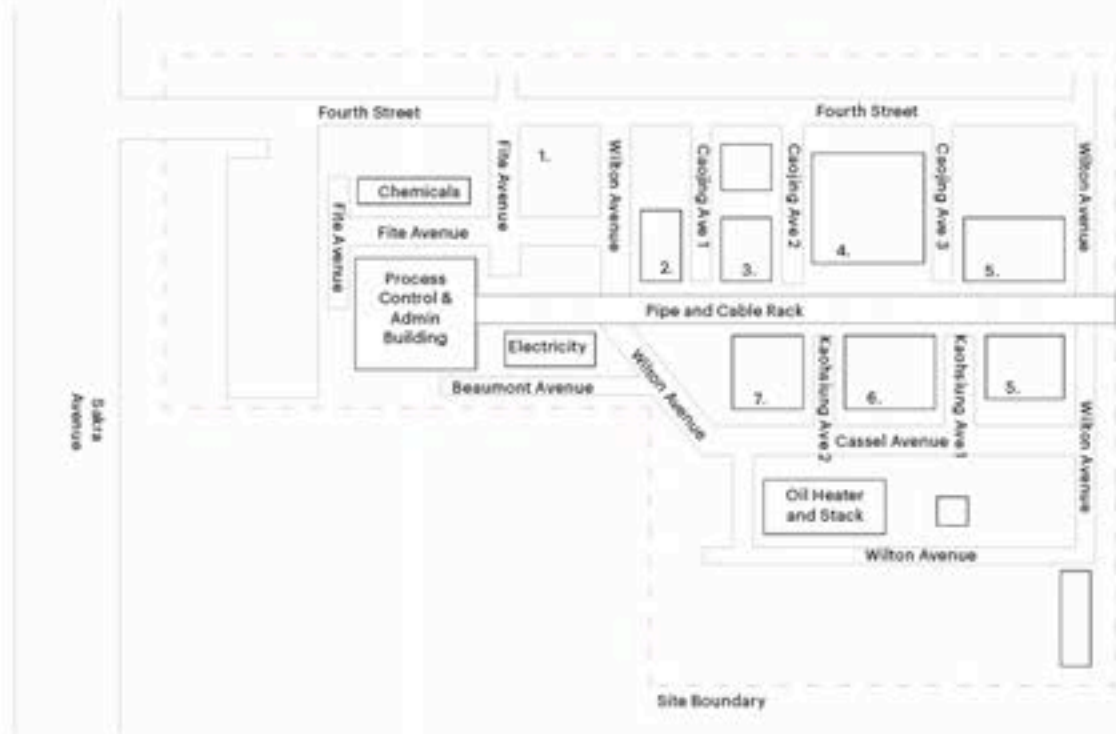
Lucite International Alpha 1 MMA Plant  
Lucite International is a company specializing in the design, development and manufacture of acrylic-based products.

2009 Lucite was acquired by Mitsubishi Rayon Co Ltd and have strengthened the position as the world's largest supplier of Methyl Methacrylate (MMA), which is the essential building substance for all acrylics.

On Jurong Island, Lucite is using a new kind of MMA production with their Alpha 1 MMA Plant.

MMA Refining Column





**MMA Production Process**

The feedstock for the production of MMA consists mainly of ethylene, methanol and carbonmonoxide. In a first step the two intermediate products MeP and formaldehyde have to be created. Together they will react to crude MMA. With heat the MMA is refined and finally stored in the Vopak Banyan Terminal.

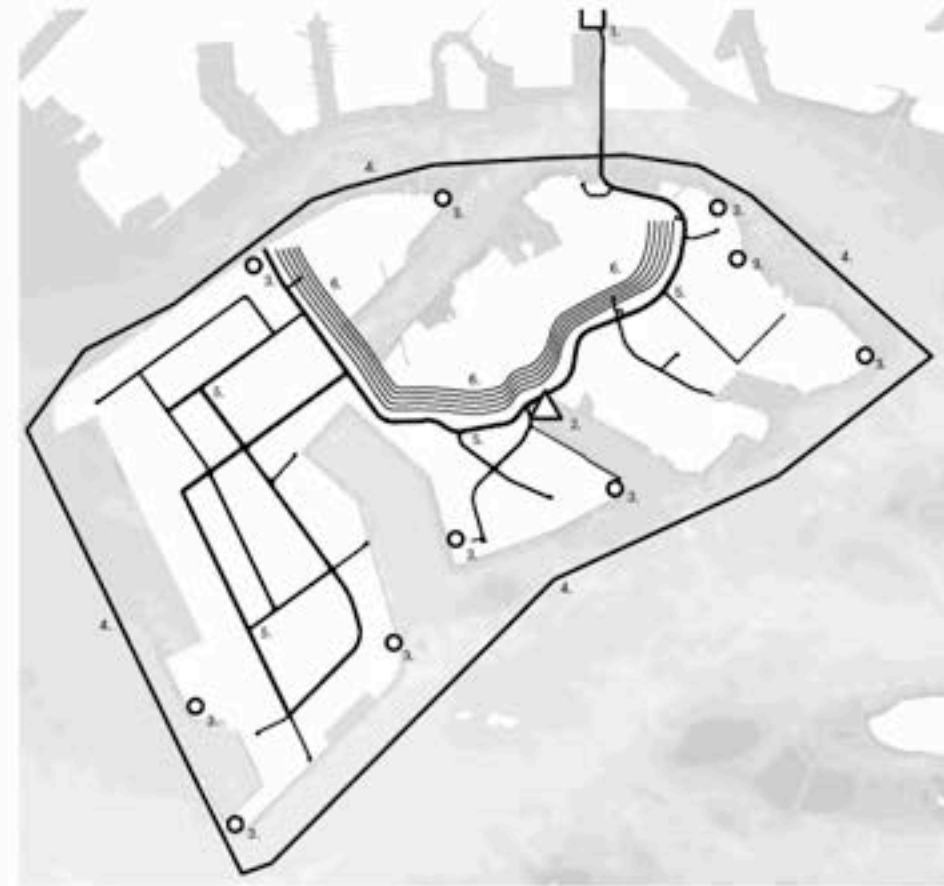


Left: Semboorp Pipeline

Right: Lucite's Pipe Rack

**Internal Pipeline Corridor**

The different reactors are all connected together by a pipe rack, which conducts the feedstock and the product, but also natural gas for the energy demand of the plant and nitrogen for fire outbreaks and explosions.



- 1. Check Point
- 2. Jurong Island Visitor Center
- 3. Watch Tower
- 4. Prohibition Zone
- 5. Street Network
- 6. Service Corridor

**Services Provided in Jurong Island**

If a company wants to rent a plot in Jurong Island, it will get 30-days rental with certain services included in the price.

The aspects that Jurong Island provides are specially the security, the pipeline service corridor and a street network based on the needs of each subsector. Of course the visitor centre contains food facilities.



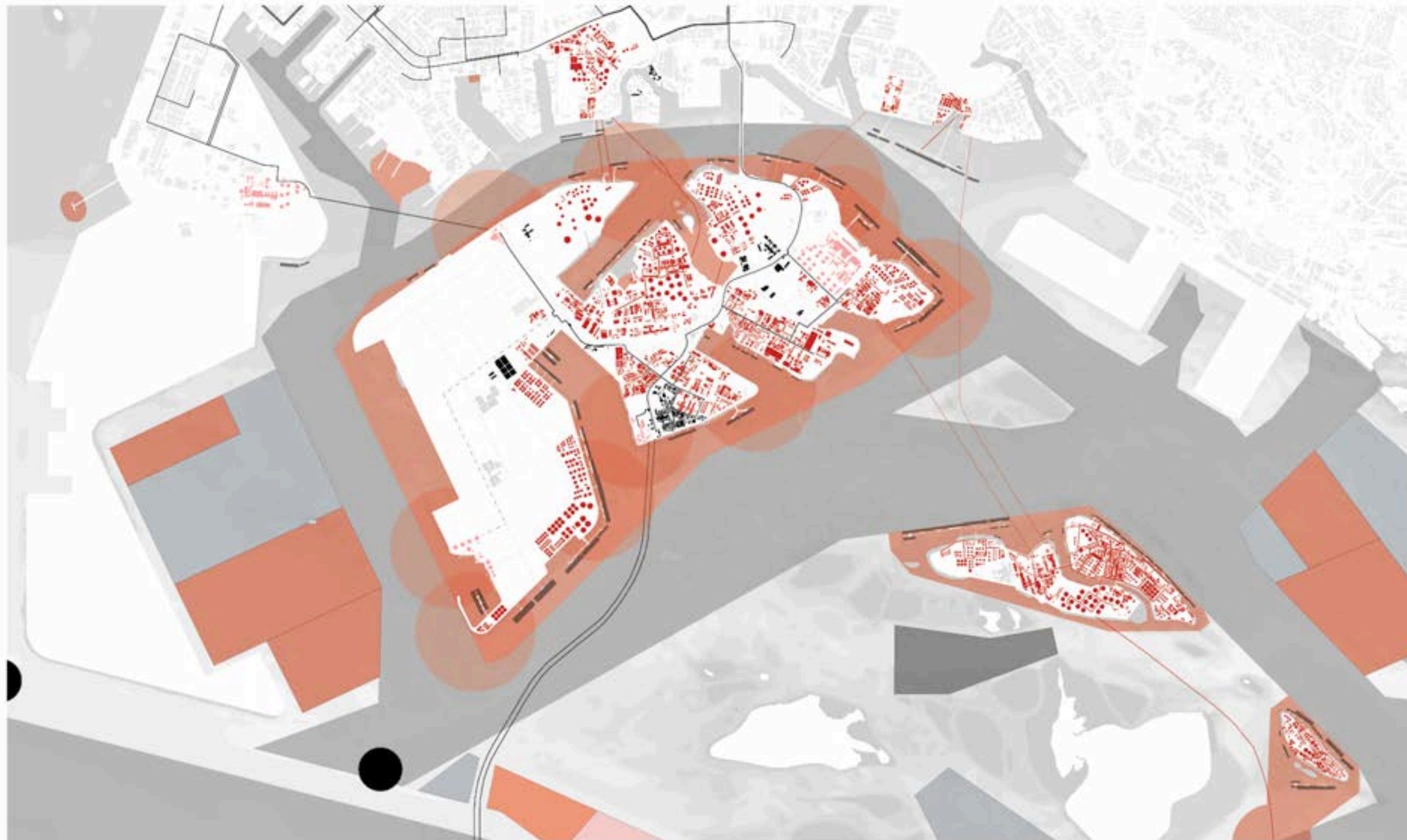
- 1. Incoming Pipes
- 2. MEP Reactor
- 3. Storage Tank Area

4. Left: Formaldehyde Reactor, Right: MMA ROG



3.

4.



#### Combined Layers of Infrastructures

By overlaying the main organisational aspects of Jurong Island, one can see how small the footprint of the gas facilities is compared to the oil and petrochemical sector. Nevertheless the gas remains crucial for running the plants. So the strict separation of functions like we did it on the layers remains questionable.

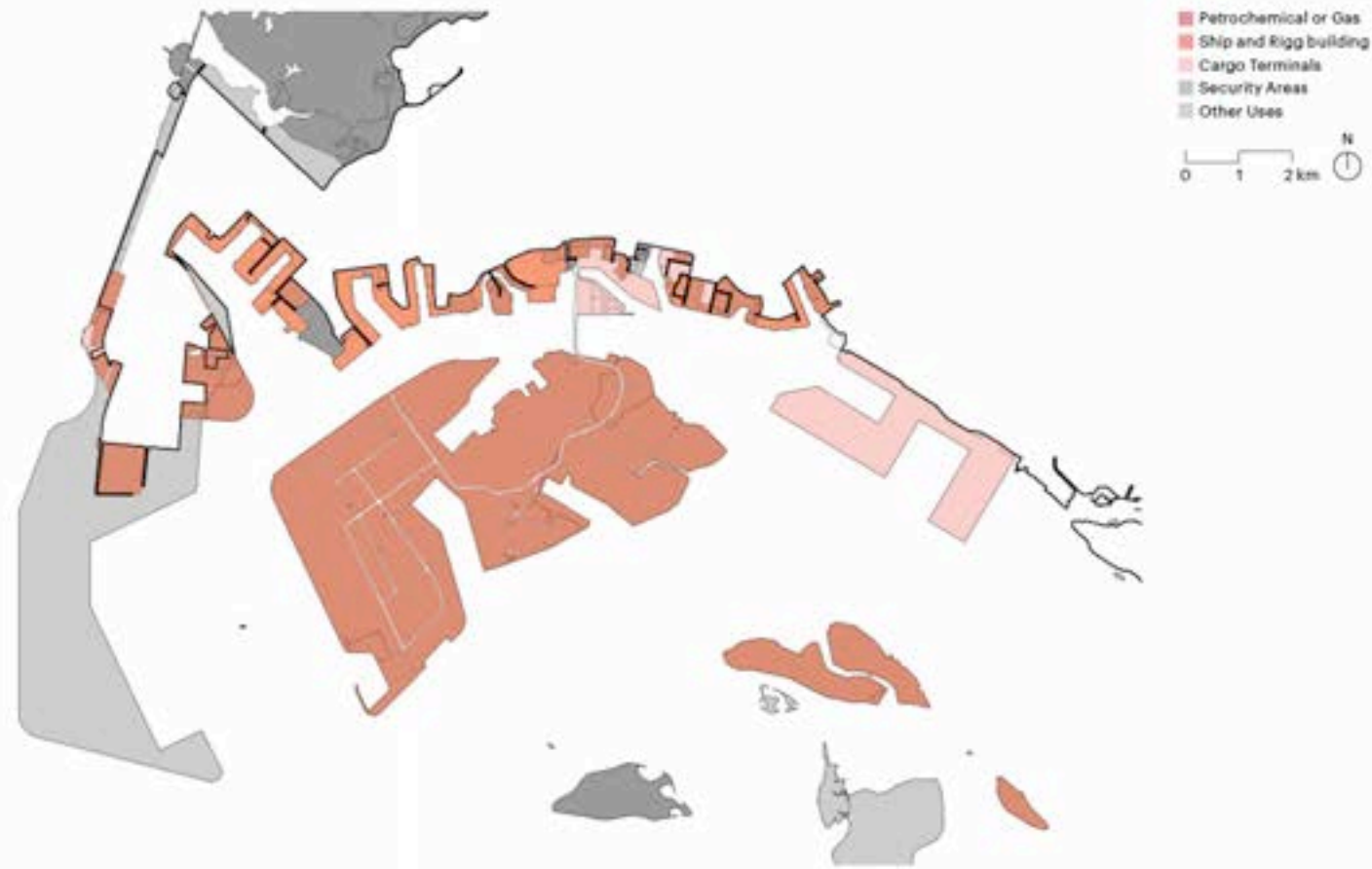


# Petrochemopolis

As we have analysed Jurong Island thoroughly in the previous chapter, we will now focus on the whole islands-state. How is the interconnectivity between the facilities located on Jurong Island and the processing industry, support companies, logistics providers and headquarters located on the main island organized? How is this connectivity expressed spatially within the city fabric?



ExxonMobil Jurong  
Refinery and Surroundings



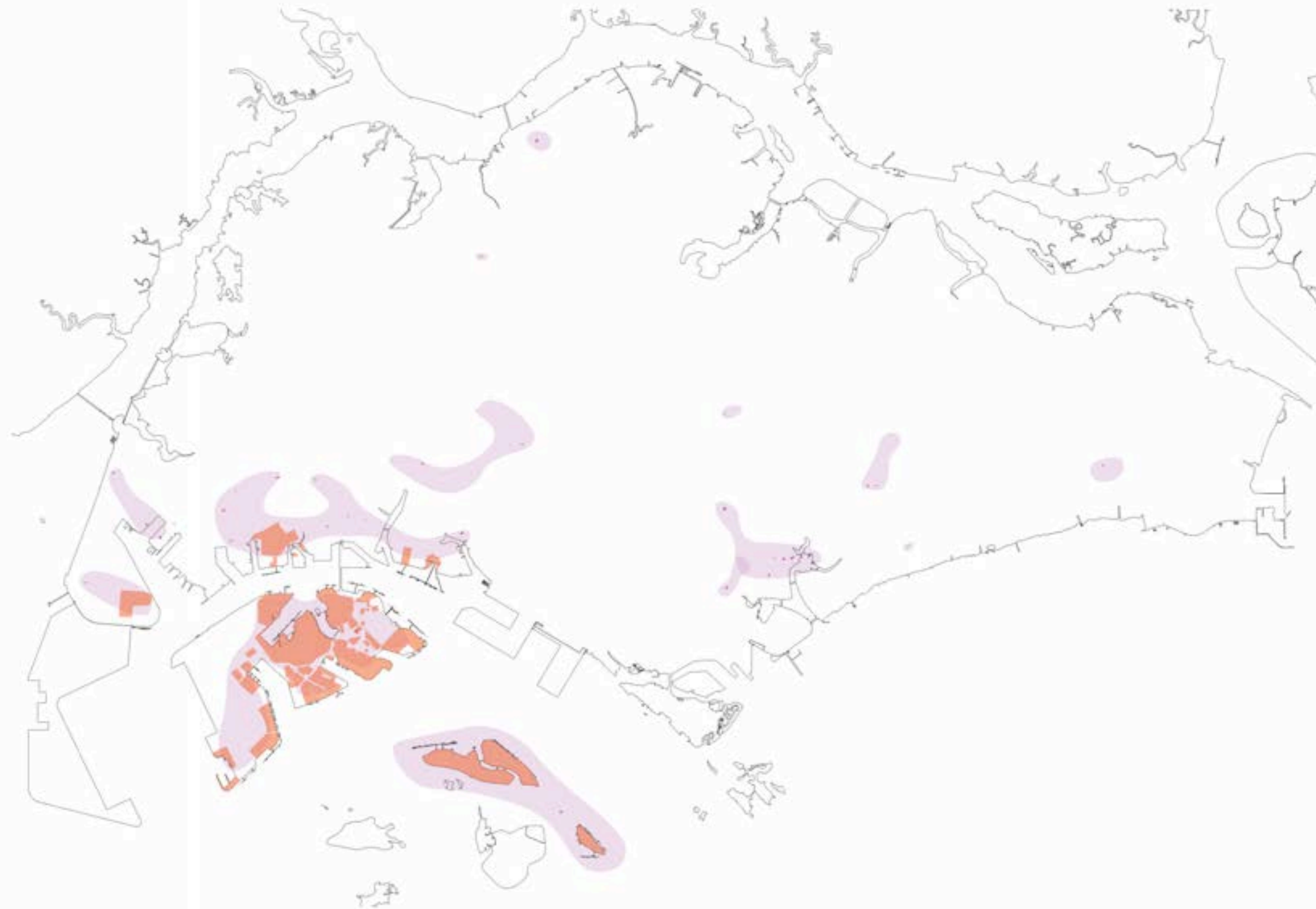
#### The Extended Enclave

Jurong Island and its affiliated petrochemical sector can be seen, together with the container storage facilities and the shipbuilding sector, as an enclosed spatial entity which has a security border towards the city. Together with other non public functions such as the military and privatized areas (airport, housing) this extended enclave establishes a border that seems to surround Singapore, introducing an inland border on the island.



#### The Supporting Cluster

The extended enclave needs a supporting cluster, which provides special services and material that are not necessarily linked to the water. One part of the cluster is situated next to the enclave and is mainly industrial. The other part contains the office buildings and headquarters of the companies which are located next to the water.



### Petroleum Cluster

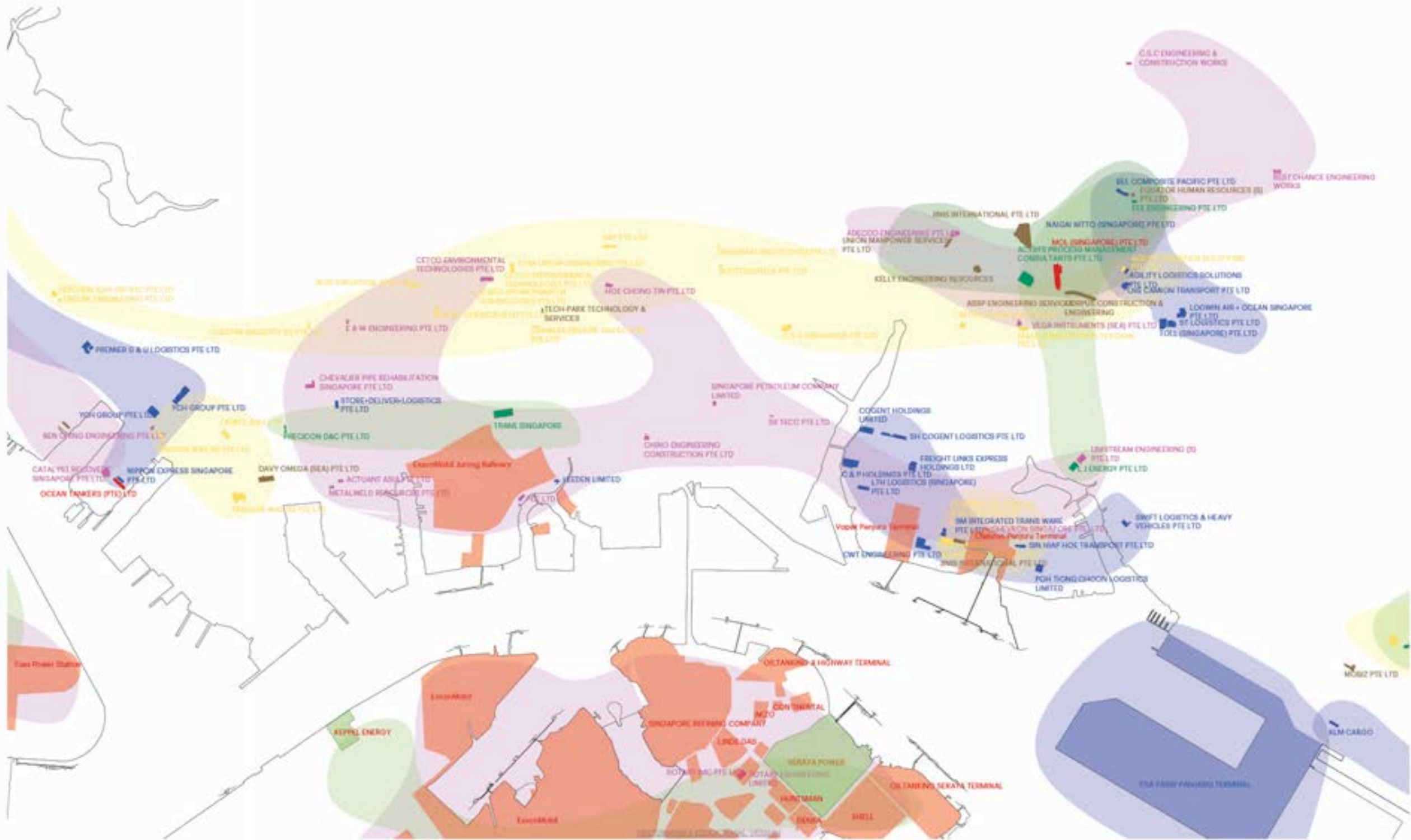
The concentration of this cluster lies in the Jurong area and specially in Jurong Island, while its headquarters are within the financial center.



### Chemical Clusters

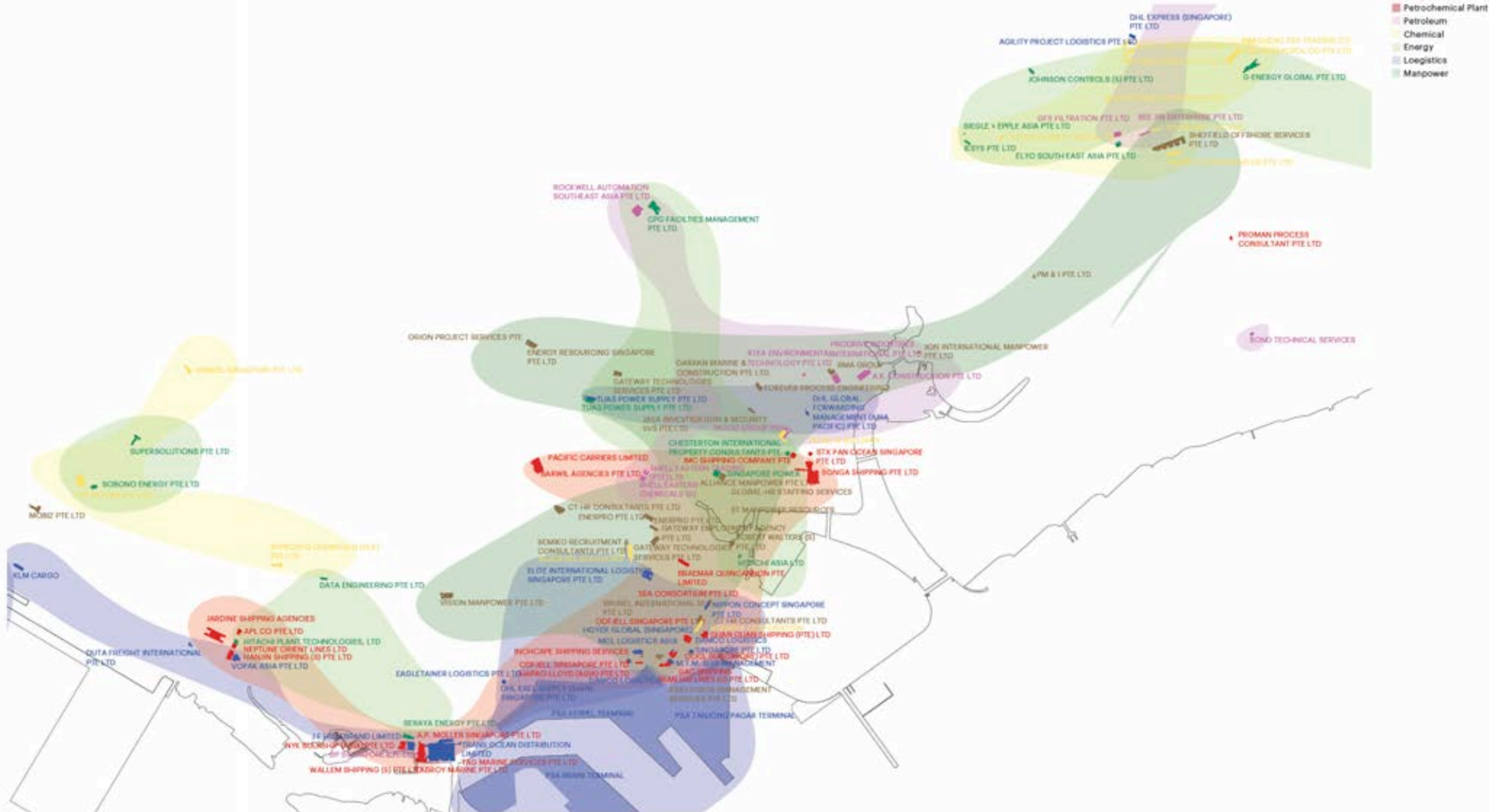
These clusters are formed by the subclusters of petroleum, chemical, energy, logistics and manpower. It is defined as a highly interconnected conglomeration of companies.





### The Cluster in Jurong Industrial Estate

This cluster is influenced mainly by Jurong Island, the shipyards and the logistics facilities of the container terminal and Jurong Port. More on the north there is a strip of chemical companies which is mainly composed by the Jurong Business Park where most of the important companies of this sector have offices.



- Petrochemical Plant
- Petroleum
- Chemical
- Energy
- Logistics
- Manpower

**Central Business District**

The central business district happens to be the major site of communication between the companies and the different sectors. Being some companies of the different sub-cluster in the same office buildings the way of communication often keeps being by telephone.

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