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Three sides to every story: Gender perspectives in energy transition pathways in Canada, Kenya and Spain

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ABSTRACT

Transitions toward a low-carbon future are not only technical and economical, but also deeply social and gendered. The gendered nature of energy transitions is often implicit and unexplored. As a corrective, this paper explores energy pathways by applying concepts from innovations and gender studies. We examine gender perspectives and niche energy innovations which could disrupt the regime. The regime represents the *mainstream pathway* that includes the dominant gender perspective and energy system. We explore different gender perspectives of energy transition pathways by applying an Alternative Pathways framework that includes: (1) *on-stream pathways* that exist within the mainstream pathway to promote equal opportunities for women and men, as well as niches for energy innovations without challenging the high-carbon energy regime; (2) *off-stream pathways* that depart from the mainstream and promote differences across different genders while creating niches outside the energy regime; and (3) *transformative pathways* that are fundamentally different from the previous mainstream and includes all gender perspectives in a new energy regime. Applying this framing, in Canada, we explored Indigenous perspectives in the oil sands sector; in Kenya, we studied largescale renewable energy impacting Indigenous communities; in Spain, we evaluate the movement away from fossil fuels and towards renewable technologies. The framework helped to identify that mainstream pathways represented the dominant male perspective while woman's perspective were largely left out. Such absence generate energy pathways that are disconnected from local realities, lack public buy-in and slow-down a sustainable energy transition.

1. Introduction

The Paris Agreement has played a pivotal role in setting the global agenda for climate change and has recognised the need to promote gender equality in mitigation actions and support gender-responsive adaptation (see Article 7 in the Paris Agreement [1]). While acknowledging that addressing gender issues in global climate policies is important for agenda setting, implementing actions is significantly more challenging. Indeed, energy transition processes central to climate mitigation efforts are not just a complex technical and economic endeavour, but also a deeply political and gendered one. Part of the

challenge in addressing gender issues in energy transitions is due to entrenched power dynamics of gender, which can lead to exclusion and inequality in resources access and decision making. These are brought about by unquestioned long-standing practices, dominant perspectives, and norms that have reinforced unequal gender and power relations in decision making spaces [2–6].

Energy transitions pathways are constructed from negotiated processes between different actors with their own perspective of how transitions should happen. Dominant perspectives – which often prevail – tend to give limited or no attention to the gender dynamics of energy transition [7,8]. There is limited research on the gender dimensions of

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energy transitions and critical analysis of where these pathways come from and who's perspectives they represent.

This study provides insights by bringing a gender perspective into energy transition and innovation studies. Our research asks the question: "How have gender perspectives been manifested in energy transition pathways?". Our understanding of gender refers to socially constructed roles, responsibilities, expectations and needs of men and women, separate from biologically determined differences [9].

Our study is confined to studying gender in binary terms – that is, an emphasis on women and men. This is largely due to the methodological and empirical limitations of the three case studies that have not focused on the intersectional dimensions of gender. We appreciate this limitation from the outset of our study (see literature review on this issue in Fathallah and Pyakurel [10]). We were drawn into investigating a gender perspective as an ex-post enquiry, that emerged after the design of the research focus. We, however, acknowledge that gender is fundamentally intersectional, interlocking with multiple axes of power and inequality such as class, ethnicity, age and race [11,12]. Our study is a starting point to further discuss issues across the broader gender spectrum and thus we believe that it contributes to missing literature on gender perspectives within energy transition studies to enhance the gender-energy research field. In this paper, when we reference statistics based on sex (i.e. male or female), we are referring to the biological traits of a person [13].

Within our research, we consider energy transition pathways as normative descriptions of how the world could look like over time when realising a common goal. These descriptions may include, but are not limited to, technological choices, policy mixes, institutional set ups, drivers of behaviour change and infrastructure development.¹ In our analysis, we use data on low-carbon transition pathways in Canada, Kenya and Spain gathered in a previous research project and unveil some of the gender biases often underexplored in socio-technical energy transition and innovation studies. The data on energy transition pathways comprise of formal pathways, presented in policy documents and reports, as well as informal pathways gathered through interviews and workshops with key stakeholders (see Hanger-Kopp et al. [14] for details on stakeholder engagement methods). Conceptually, this paper seeks to shed more light on two different gender perspectives, primarily female and male, in energy transition pathways. Methodologically, we seek to identify the extent to which previous empirical research that did not initially consider woman's perspectives, can be analysed ex-post. We do not attempt to carry out a full gender analysis of energy transition pathways in this paper but aim to bring attention to women's perspectives as one of gender perspectives in technological innovations and energy transition studies.

Our paper is structured into the following sections. Section 2 describes the connection between gender and energy transitions. Section 3 presents a framework, the Alternative Pathways Framework, for analysing gender perspectives on energy transitions. In Section 4 we apply this framework to three case studies. In Section 5, we discuss the insights from our analysis and draw more generalisable observations that could be helpful for other energy transitions contexts. Section 6 concludes with overarching insights and reflections on our learning process in writing up this paper.

2. Where are the different gender perspectives in energy transitions?

2.1. Energy transition pathways

Transitions away from current patterns of high-carbon energy

¹ Pathways as defined by the TRANSrisk Horizon 2020 EU project (Grant number: 642260) "Transitions pathways and risk analysis for climate change mitigation and adaptation strategies" – (2015-2018).

production and consumption depend significantly on diffusion of low-carbon innovations into existing *energy systems*. Our understanding of an energy system is based on Carlsson and Stankiewicz's [15] definition of a technological system described as a "dynamic network of agents interacting in a specific economic/industrial area [i.e. energy sector] under a particular institutional infrastructure and involved in the generation, diffusion, and utilisation of [energy] technology." ([15], p 93). Thus, energy systems encompass generation side and demand-side energy technologies as well as the accompanying institutional and physical infrastructure.

Innovation in technological systems can range from incremental changes to radical innovations that cause shifts in society and are supported by institutional innovations in policies, labour relations as well as organisational and research and development structures [16]. Radical innovations can occur outside the 'technological regime', which can be described as "a set of design parameters which embody the principles which will generate both the physical configuration of the product and the process and materials from which it is to be constructed" (Georghiou et al., qtd. in Kemp [17], p 1025). Thus, the regime is the dominant or mainstream configuration. Contrasting the regime, there are special spaces or niches that "act as incubation rooms that protect novelties against the mainstream market selection" ([16], p 22). A technological transition [18,19] where 'green' or low-carbon technologies can be applied within mainstream society requires a shift in the way society values energy resources and prices externalities [20].

The gender dimension is largely absent in this technocratic description of a transition; but, at the same time, energy transitions hold large potential to include a gender perspective particularly when exploring niches space from a societal perspective. Indeed, techno-economic and socio-technical transitions storylines tend to dominate the perspectives of how energy systems might transform [21]. This strong technocratic framing is prevalent in climate scenario modelling within the scientific community as seen in the Fifth Assessment Report where 88% of the top 44 authors responsible for compiling the report were male [22]. Additionally, the well cited "shared socio-economic pathways (SSPs) describing world futures in the 21st century" [23], also included in the Intergovernmental Panel on Climate Change (IPCC) report, were written by 11 male authors and 1 female. It is therefore important that the gendered nature of studies on pathways be more closely explored and interrogated, not only by considering the gender composition of authors but whether they include and address social equity and gender issues.

2.2. Exploring a gender perspective for just energy transitions

Energy transitions is a fertile ground to explore climate justice [24] and equality issues [25], as changes in energy systems are often confronted with power inequalities linked to politics and policy making [26]. Energy policy and policy making processes are often explored through a technocratic perspective, and efforts to include social and economic analysis are often limited to the energy prices, jobs and labour issues [27], as well as energy poverty [28,29]. The limited emphasis on the social dimension could partly be attributed to the fact that "Scientists, Engineers, economists and bureaucrats dominate energy policy design and implementation" ([25], p. 452). There are links drawn between energy justice and broader justice issues [30] as well as energy justice and policy making [31]; but the discussion of gender equality in decision and policy making process for just, transitions is still under explored.

Efforts to bring feminist perspectives into climate debates have initiated alliances between gender studies and the study of natural systems through studying different gendered perspectives of environmental knowledge and practice [32,33], sustainability [34] as well as emerging literature focusing away from women's vulnerabilities to emerging collaborative social action [35]. More forms of inclusiveness, "care-full" science and practices have also been emerging [36] pushing

for societies, such as that of regenerative cultures, which refer to a cultural group's ability to transform in response to change [37].

In much of the literature on gender, energy and climate change, women have been categorised as vulnerable groups, and victims [38] in need protection from climate change risks or associated with the household, see literature review in Osunmuyiwa and Ahlborg [39]), or women in the global south [40] who need access to energy services that impact their livelihoods (see literature review in De Groot [41]). The link to women and household activities is partly due to the “gendered division of labour in which women's lives have generally been linked to unpaid activities within the home, while men have had formal, paid work in public spaces” ([40], p. 1). Additionally, women have been type-casted as nurturers or virtuous caretakers of nature [43] but often without the needed resources [44]. On the other hand, the role of women in technology is largely absent, as men are typically associated with the generation of knowledge and organisation of science and technology [45], and activities essential to solving climate change challenges.

Development of energy systems is often associated with male roles in engineering and technology, partly perpetuated by the ongoing gender gap in the fields of science, technology, engineering and mathematics [46,47]. Additionally, the development of technologies is typically viewed in terms of utility and solutions to current technological system deficits [48,49]. Technology is usually conceived as removed and dis-embedded from society and therefore socially- and gender neutral [50,51,42]. Men are also framed as natural leaders, as evident in male-dominated governments and the policy-making domain where power is exercised [38].

Some future areas of sustainability transitions research include ethical aspects of transitions and politics and power in transitions [52,53]. Positioning a gender perspective in energy transitions can help to explore the dynamics of power and politics from a feminist political ecology tradition [54–56]. Power and politics in action are manifested in processes where authority structures evolve or are reproduced, how certain types of knowledge legitimise emergent authority, and how (gendered) subjectivities are created to embody and carry out the aspirations of both authority and the knowledge [57–59]. This positioning can potentially explain how policies and programs can exclude different gender perspectives (i.e. ‘gender blindness’ [60]²), or present tokenistic gender considerations, or introduce pathways for transformation because there can be struggles around authority and knowledge.

2.3. Gender perspectives for exploring energy policies and transitions

One means of exploring gender perspectives in energy and climate policies is to consider gender equality through gender mainstreaming³ [61], as a generic policy approach [62], with a broader perspective of diversity and democratic processes. Gender equality has a number of definitions and in this study we primarily draw on the understanding of gender equality linked to sustainable development as understood by Leach (2015) 1. ([63], p. 3) as “building more equitable gender relations that support the human rights, dignity and capabilities of all women and men, intersected by differences of class, race, sexuality, age, [marital status], ability and circumstances, is a central requirement

² Gender blindness defined as “The failure to recognise that the roles and responsibilities of men/boys and women/girls are given to them in specific social, cultural, economic and political contexts and backgrounds” UNICEF [60].

³ Office of the United Nations High Commissioner for Human Rights, OHCHR, 2019 defines gender mainstreaming as “the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes so that women and men benefit equally and inequality is not perpetuated” [61].

of an ethical world order”. We see gender equality as the capability to overcome socio-economic disadvantage in the domains of work, well-being and access to resources, such as energy. Gender equality in policy processes also means equal participation in decision making at multiple levels. This includes supporting agency, power and voice in energy planning institutions and building deliberative forms of democracy that can debate energy transition goals and values in inclusive ways; and assuring space for citizen collective action. Gender equality ultimately also requires the realisation of all human rights ([59], p. 7).

Gender equality in policies can be viewed through a “threefold typology of inclusion, reversal, and displacement” ([60], p. 366) or as other scholars interpret it ‘sameness’, ‘difference’ and ‘transformation’ [65]. Sameness includes integrating (Squires, 1999) or constitutionally embedding women's rights [66] in the mainstream decision making process by promoting equality of women to that of men. Another perspective of gender equality is to recognise and tailor to differentiated needs that exist across genders [67] (Felski 1997 qtd. in Walby [65]), for instance, through affirmative action policies. Transformations for gender mainstreaming transcends the binary concepts of male and females and consider all genders and their interests in the decisions making process, as well as taking issues of intersectionality into account [68,64,69,70].

3. Alternative pathways framework to analyse energy transition pathways through different gender perspectives

In order to analyse different gender perspectives on energy transition pathways, we developed an Alternative Pathways framework that draws on the concepts of regimes and niche from innovations literature to describe energy transitions. In our paper, regime refers to the dominant energy system (i.e. energy regime) and the dominant gender perspectives in our pathways while niche represents the non-dominant energy technologies and non-dominant gender perspectives.

3.1. Alternatives pathways framework

The Alternative Pathways framework (see Fig. 1) aims to help identify the dominant and alternative transition pathways and their gender perspectives. It serves to highlight the importance of niche spaces that represents woman's perspective as a non-dominant gender perspective and niches for low-carbon technological innovations. These niche perspectives and technologies may potentially disrupt the current regime of dominant male perspectives and high-carbon energy systems.

The low-carbon pathways in our study have a strong technology and policy focus and were not initially analysed from a gender perspective but from a risk perspective [71]. The Alternative Pathways framework makes explicit the gender bias that remained largely unexplored in our previous research. We recognised that providing another gender perspective in energy transition pathways does not equate to gender equality in the transitions itself or the policy making process; but we believe that one of the very first steps towards a just transition is to present the perspectives of women with the same level of importance and legitimacy as the dominant, male, gender perspective. Our framework conceptualises the three types of energy transition pathways, set out in the following sub-sections.

3.1.1. Mainstream pathway

The mainstream pathway represents the dominant energy pathway and includes policies that promotes high carbon energy technologies central to the energy regime. The policy making process is the mainstream pathway and is primarily a male domain. The positions of power are mainly held by a homogenous demographic in policy making, and the energy system includes the value chain and workforce.

The on-stream transition pathway (sameness) exists in a dedicated niche space within the mainstream and does not disrupt the mainstream dominant perspective. Policies within the on-stream pathway promote

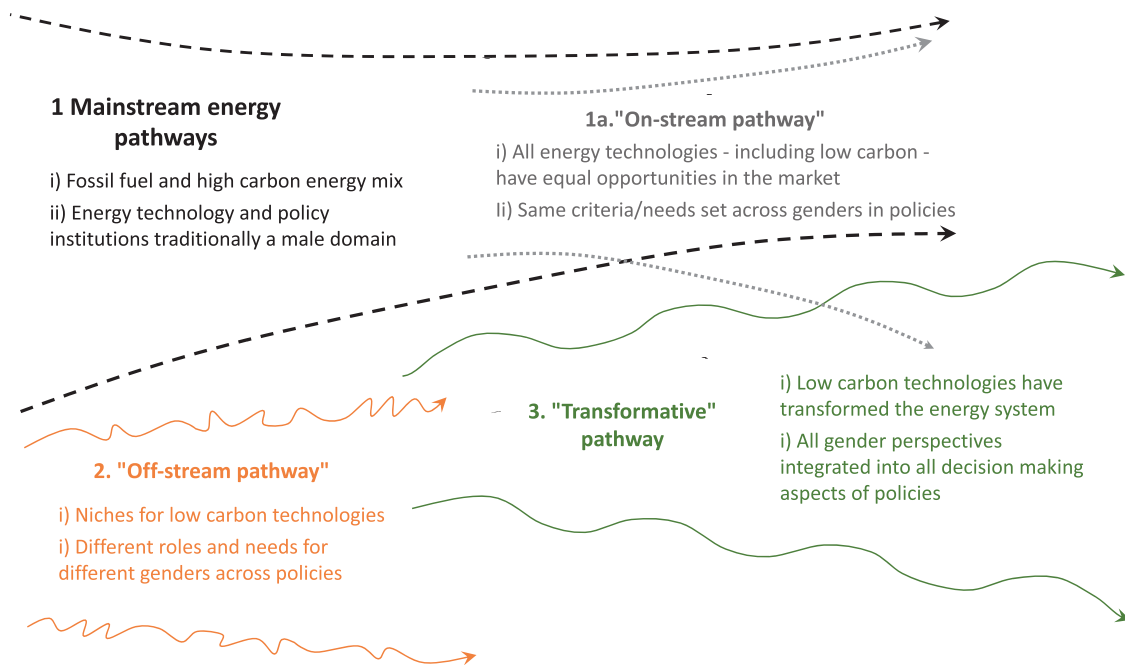


Fig. 1. Alternative Pathways framework to analyse gender perspectives on energy transition. Source: Authors' own and adapted from Squires [64].

niche low-carbon technologies (e.g. renewable energy) but fossil fuel technologies continue to dominate the energy regime. There are dedicated policies that promote niche low-carbon technologies by providing niche players with a level playing field (i.e. equal opportunities) to participate in the energy system regime through sharing energy infrastructure and carving out a niche space in the energy market. There is also an equal treatment of different gender perspectives in energy policies within the on stream pathway. While the largely male-dominated perspectives continues to be accepted, alternative gender perspectives are viewed as equally valid. However, the dominant pathway is not fundamentally questioned and the underrepresented perspective only exists in the niche spaces without challenging the mainstream perspective.

3.1.2. Off-stream transition pathway (differentness)

The off-stream transition pathway values alternative perspectives that depart from the mainstream perspective and challenges the mainstream pathway in a number of ways. Policies within the off-stream pathway promote low-carbon innovations in a dedicated space that is separate from regime technologies. Policies help to create protective niche spaces for low-carbon technologies, which exist outside the mainstream energy regime. For instance, niche technologies may require new infrastructure to be built outside the existing infrastructure. These technologies may be supported through special incentives, programmes, and subsidies. In the off-stream pathway, gender sensitivity exists in unique spaces outside of the mainstream. The off-stream perspectives are viewed as distinct perspectives that do not reinforce the mainstream pathway. On the contrary, synergies of niche technologies supporting alternative voices may emerge in a gender sensitive, off-stream energy transition.

3.1.3. Transformative transition pathways

Transformative transition pathways involve a radical technological innovation and the representation of all gender perspectives becomes a new norm. This new mainstream pathway no longer resembles the previous dominant mainstream pathway. A transformation may occur as a result of on- and/or off-stream pathways leading to a future where all gender perspectives are considered in decision making processes.

This has been referred to as a double transformation, where “two transformations that were contingent upon each other; a socio-technological shift and women’s increased status” ([70], p. 71). Transformation pathways are supported by a mix of policies that lead to a radically changed energy regime dominated by low-carbon energy. The transformation process includes previously marginalised genders and groups. Transformative pathways also consider broadening the discussion of gender beyond women by including gender with other intersecting social identities.

3.2. Application of the alternative pathways framework

This study is an ex-post analysis using the Alternatives Pathways framework of energy transition pathways developed through a previous research project based on existing policies and stakeholder perspectives (see the TRANSrisk⁴ project and Hanger-Kopp et al. [14] each case study details). We selected three case studies from the fourteen country case studies where we could consider different gender perspectives to evaluate existing pathways. These studies include Canada’s oils sands, Kenya’s centralised power sector, and Spain’s energy sector transition from fossil fuels to renewables; all present different geopolitical challenges, and histories with varying trajectories in energy provision and transition. While the case studies are very diverse, there were key commonalities across these pathways. All case studies had a strong presence of vulnerable and marginalised communities due to impacts from large scale energy systems with land use implications. Another commonality was that the researchers leading these case studies identified gender as an emerging issue linked to wider social justice concerns that were not studied as part of the original research design.

Additionally, out of the fourteen country studies that were carried out, only the Spanish study, specifically explored the role of women in energy policy making, which was an additional element included by the researcher and was not part of the original research design. As a result, these findings led researchers on the Canadian and Kenyan case studies

⁴ TRANSrisk: Transitions pathways explored implementation risks (or barriers) and consequential risks (negative outcomes) of the transition pathways. (For more information see: <http://transrisk-project.eu/>)

to question why there was an overwhelming absence of women and underrepresented voices in the decisions making in their own case studies. Based on the identified gap in the TRANSrisk project, we carried out an ex-post analysis by applying an Alternative Pathways framework that considers gender perspective in energy transition pathways.

Each country case study presented in this paper is written by the case study leader in the research project; therefore, the pathways are highly influenced by each researcher's gender experience. The case study leaders first present the core ideas behind the pathways collected in previous research from 2016 to 2018, then the researchers supplemented the pathways with some additional insights from existing research, policies or data until October 2019.

Since each case study is based in a very unique context, we did not attempt to carry out a cross country comparison. Instead our aim was to see if applying the framework to existing pathways could help bring out the dominant and alternative gender perspectives in the pathways and to acknowledge the missing gender perspectives in energy transitions pathways.

4. Evaluation of energy transitions pathways by gender mainstreaming approach

Using our Alternative Pathways framework, we examine mainstream perspectives in Canada, Kenya, and Spain and also discuss potential for energy transition pathways in each country. In Canada, we present examples of niche on-stream perspectives that do not challenge the energy regime and dominant male perspective while the Kenyan pathways include niche on- and off-stream perspectives that could challenge the energy regime and include male and female perspectives. The Spanish pathway includes niche on – and off- stream as well as potential transformation pathways that challenge the existing energy regime and gender roles in policy making.

4.1. Canadian case study transition pathways

4.1.1. Cap the emission hat: mainstream pathway to limit oil-sands emissions while supporting its growth

The energy regime in Alberta, Canada, is strongly dominated by oil sands energy production, which is also one of the biggest fossil fuel energy resources in the world. The sector is ranked as a top ten carbon emissions emitter in the world, contributing to 1.6% of global emissions [72]. At the same time, the oil sands and fossil fuel sector are key economic drivers to the Canadian economy; thus, strong economic interdependencies have been out weighing strong climate protection policies. From the climate policy perspective, Canada agreed to decrease GHG emissions by 30% below 2005 levels by 2030 in its Nationally Determined Contribution (NDC), as a part of the Paris Agreement.

The prevalence of fossil fuel extraction on this mainstream perspective maintains the unequal reality of this sector. The voice of different genders and cultural groups including the Indigenous right holders are largely absent in the official climate policy implementation targets, which take on a technocratic approach focusing on technology innovation as seen in Alberta's Technology innovation and emissions reduction (TIER) fund. Additionally, the Canadian NDC failed to recognise the value of Indigenous knowledge and practices in addressing climate change issue and did not acknowledge the diverse needs of Indigenous communities or any local community. The NDC also did not mention gender and social needs, and rather focused on clean growth to address climate change.

The mainstream perspective for Alberta also includes policies around carbon pricing, emissions capping, electricity generation from renewables, increased efficiency in energy usage. These, were developed by the New Democratic Party elected at that time in 2015 to decrease emissions growth under the "Climate Leadership Plan" [73].

However, the newly elected provincial government in 2019, the United Conservative Party, announced that this plan would be replaced by the TIER fund [74]. The TIER fund requires big emitters, including oil sands producers, to reduce their emission intensity by 10% (increasing by 1% annually) compared to their performance between 2016 and 2018. Additionally, the plan considers emission reductions by paying a rate of \$30/t-CO₂eq to the TIER fund, below the \$30–50/tonne CO₂eq proposed by the previous government, and significantly below prices required to meet IPCC targets [75].

These policies implemented by the provincial government do not challenge the energy fossil fuel regime nor the complex inequalities women and Indigenous communities are subjected to. Under the current mainstream pathways, policy have not provided a legitimate space that considers the diverse needs and priorities of Indigenous peoples; however, the same gender issues are currently acknowledged and explored but is disconnected from wider discussions of inclusion and equality related to Indigenous rights. Previous research by Stienstra et al. [76] found a significant lack of consideration for gender and intersectional issues in resource development in the Canadian north and discussed how policy instruments fall short in incorporating Indigenous gender and intersectional aspects in their assessments. The authors highlighted the importance of incorporating gender-based analysis into decision making and the key role government organisations have in the process. These elements have not yet been addressed appropriately in Alberta's oils sector or the energy mainstream perspective.

Considering the absences of Indigenous perspectives and gender perspectives in the mainstream pathway of the existing study, we decided to further explore the absence of diverse perspectives and look into gender representation in the workplace. The Canadian oil sector has an entrenched regional industrial culture that could be perceived as a "boys club" [77]. The "good jobs" are preserved for white males who represent the frontier cowboy male perspective: the heroes conquering the remote wilderness to find fortune [78]. The "boys club" was a term used by women and Indigenous people working in the industry to reflect unequal hiring practices, barriers to better paid positions, and sexual and racial harassment on the work site [79]. Whereas, the "good jobs" represent full-time, year-round, benefit providing, indefinite, single employer position capable to sustain a family [80]. Additionally, in Alberta, women account for 21.5% of the oil and gas sector while visible minorities only represent 13% of the workforce [81]. Women and other minorities statically remain more prevalent in lower paid, less stable jobs. Also, women in this province make 41% less than men above the national average in earnings gap of 31% [82]. But these numbers alone barely scratch the surface of deeper set inequalities in Canada and do not consider gender income gap which bring longer term challenges such as retirement savings and poverty in senior citizens [83]. Even if the numbers improved in terms of equal representation, this may not necessarily lead to gender equality especially when deeper rooted issues on equality and inclusion are not meaningfully considered in energy and resource decision making in Canada [84].

Beyond underrepresentation, Indigenous workers face discrimination in income, type of eligible positions and education opportunities. Indigenous workers also experience additional challenges that consider the conflictive relationship between dominant capitalist structures and caring for the collective good represented in their world views. Additionally, the ancestral homes of Indigenous communities are located near large natural resource development sites. The communities at large are not equally benefiting from these large economic activities when compared to the gains from the industry. However, Indigenous companies that have been able to gain space in this sector have offered opportunities to Indigenous workers under a more familiar dynamic and the opportunity to maintain a healthier family-work relationship within their community [85]. These changes have also brought internal inequality within Indigenous communities, creating separations between members with access to capitalist structures and members who

do not. Also, perceptions remain amongst some Indigenous workers that consider that the role of the woman is at home and the oil sector is a tough workplace built for men [79].

Our limited snapshot of these perspective does not sufficiently address the intersectional issues of inequalities women, Indigenous communities, as well as Indigenous women face. The strong technical and policy focus in the mainstream pathways highlights the dominance of the male, settler-colonial perspective. This resounding absence of gender and Indigenous perspectives requires further in-depth exploration [86,87] in order to appropriately address the magnitude of inequalities prevalent in the oil sands sector.

4.1.2. *Pace our development: on-stream pathway for oil sands development from indigenous perspectives*

There have been some independent efforts and studies from Indigenous communities to voice their concerns in the energy regime and resource development. The perspectives from an Indigenous perspective is categorised as an on-stream pathway because it does not seek to overthrow the current energy regime but to exist in a protective space within the mainstream.

The community of Fort McKay, consisting of Dene, Cree and Métis community members, commissioned a study that expressed their community needs in relation to the development of oil sands near their reserve and traditional [88]. The study was used to develop the 'pace our development' pathway [89] based on the community's priorities to conserve biodiversity and cultural practices while slowly developing the oil sands. The strong emphasises on land use and biodiversity indicators based on traditional practices (i.e. berries, fish, fisheries, caribou herds) are not typically highlighted in climate policy agendas, nor are the differing gender roles linked to traditional practices and energy resources development. This pathways lies within the mainstream since the assumption is the oil sands sector will continue to grow but within limits. At the same time, there are also resistance to resource exploitation through the court system that threaten the traditional lands [84].

This on-stream pathways, which was developed by an Indigenous community did not specifically highlight issues on gender. Thus, for this paper, we set out to search for other insights to shed more light on gender issues while considering Indigenous perspectives. We found that there was a lack of intersectionality in low-carbon energy pathways at the provincial level, as seen in the Alberta Narratives Projects. The project was a public engagement research initiative that collected insights for Alberta's energy-climate future pathways [90,91]. While gender issues were included in the energy transition pathways, Indigenous perspectives were excluded in the project due to the project's research process. Indigenous communities highlighted problems that energy and climate could not be detached from the Truth and Reconciliation Commission's (TRC) call for action. The TRC was tasked to uncover past injustices linked to residential schools where young girls and boys were systematically abused within the system [92]. Additionally, the history of research and consultation has often been extractive, adding another layer of injustice on top of the resource extraction and colonial history [91]. The colonial history has especially placed Indigenous women at a disadvantage. For instance, The Indian Act of 1876 "abolished traditional forms of governance and inserted laws that brought local government under state control [93]. Leadership roles of women, hereditary chiefs, and elders were replaced with a patriarchal, male-only elective system [94]" (qtd. in University of Alberta [95]).

We also discovered that applying a settler-colonial gender perspective can provide skewed interpretations to the meaning and role of women within the Indigenous world views. Therefore, it is essential to have proper accounts from Indigenous researchers and methodologies on the manifestation of gender inequalities within communities affected by natural resources development, especially driven by dominant groups, and how it can manifest in different energy transition

pathways. For instance, within Indigenous communities there is also a gender perspective that varies significantly between each community [96]. Some communities are matriarchal, where women make the leadership decisions, while in other communities, women take on roles related to education, community management and knowledge holders [97]. Many communities were traditionally egalitarian with different gender roles. Women and men both held positions of power related to spirituality, economics and politics. In the political decision making process, women held a high level of power in land management and in selecting chiefs and in the governance structure [98]. There are also third genders that embody both masculin and feminine spirits, represented by the term "niizh manitoag", the Northern Algonquin word for "Two-Spirit" [99,95]. Two-Spirit acknowledges that gender is fluid and is more complex than the traditional settler-colonial binary perspective of male and female or homosexual and heterosexual. The traditional roles of Indigenous women have changed over time due to the settler-colonial patriarchy governance structures and laws that systematically discriminated Indigenous women. For instance, the Indian Act resulted in unequal power dynamics within Indigenous communities where men dominated the political realm and women were systematically stripped of their positions in society. Women were unable to vote or hold title deeds to land, which significantly reduced their power over distributing goods from the land. This has led to long standing discrimination against Indigenous women, as seen in numerous unresolved cases of missing and murdered Indigenous women, girls, and Two-spirit, a shameful history that the Canadian government is only beginning to acknowledge [95].

This on-stream pathways, supplemented by additional desk research on gender from Indigenous perspectives, can include distribution of benefits more equally and across generations, and challenge the existing power dynamics that lead to unsustainable social and environmental impacts. We also advocate for closer examination of intersectionality issues in low carbon transition in Alberta and for alternative perspectives (e.g. minorities) to be made explicit. An energy transition should represent the diverse needs of different genders and groups and should aim to build trust between various communities and the government.

4.2. *Kenya case study transition pathways*

4.2.1. *A vision for the future: Kenya's mainstream pathway for growth and prosperity*

Kenya's mainstream energy pathway is influenced by a backdrop of policies and laws. In 2007, the Kenyan government established Vision 2030, its roadmap for becoming a newly industrialising, middle-income country by 2030 [100]. Achieving Vision 2030 relies strongly on developing the power sector to expand generation capacity and increase access, security and affordability of energy services for a growing industrial and household customer base [101]. The launch of Vision 2030 provided an opportunity to address persistent social and gender inequalities in Kenya [102], including in the energy sector. In addition, Kenya's new constitution in 2010 set out a range of provisions for improving gender equality: no more than two thirds of all public committees and decision making bodies should be men and 30% of the government's procurement budget had to be dedicated to women, youth and people with disabilities.

Kenya's mainstream pathway focuses on an energy regime characterised by large scale electricity generation to power the nation based upon a diverse generation mix that includes exploitation of domestic coal resources. As electricity access expands, the middle class grows, and industrial activity rises, major electricity demand increases are forecast [103,104]. Since 2011, a number of plans have been established to meet this demand, the latest being the updated Least Cost Power Development Plan 2017–2037 published in 2018. Currently there is no coal-fired power generation in Kenya. However, the Least Cost Power Development Plan 2017–2037 expects coal power to

expand at a similar pace to geothermal power and hydropower, both of which have a well-established history in Kenya.

We found that Kenya's mainstream energy pathway is rather gender-blind; thus, for this paper, we looked into energy policy making spaces and drew on some statistics to assess the representation of women and men in the energy regime. Compared to Kenya's 2004 Energy Policy, the revised 2013 Energy Policy incorporated considerably more gender issues [105]. Yet in formal energy institutions, such as the Ministry of Energy and Petroleum and state-owned electricity utilities, men with engineering backgrounds continue to hold most senior management positions and thus dominate the decision making space [106]. For example, the state-owned distribution company, KenyaPower, has achieved considerable progress in increasing the gender balance within the workforce compared to most other African electricity utilities. Even so, women still make up only 19% of the workforce (10,590), with the majority working in technical field operations (2,190) and customer service (470). Thus, it is perhaps no surprise that large-scale technological solutions in areas of existing expertise (hydro, geothermal and fossil fuels) dominate the response to addressing Kenya's energy challenges. Meanwhile, energy needs beside electrical power, such as biomass energy – which is largely collected and used by women and girls for household cooking and which accounts for up to 70% of energy demand in the country – receives less attention in the mainstream pathway [107].

Like the Canadian mainstream pathway which also drew on statistics as a preliminary, but also limited, indicator to explore representation of women and men in decision making places within the energy regime. There was not only a lack of representation of women in decision making spaces but also a lack of consideration for women's and girls' energy needs; therefore, a dedicated gender analysis for energy policies in Kenya is still needed. A gender analysis could potentially unveil biases against certain genders in government policies [38]. This mainstream energy transition pathway hopes to trigger discussion for further exploration of alternative gender perspectives within decisions making spaces of the Kenyan energy sector.

4.2.2. Low-carbon climate-resilient development: on-stream pathway to power the economy

Within the mainstream, there is an on-stream pathway focused on the potential for large scale, grid-connected renewables that exist within the energy regime to power Kenya's economic development ambitions. Renewable energy has always played a major role in Kenya's electricity supply. For decades, hydropower dominated the electricity mix, but since the turn of the century, when a series of droughts highlighted the climate vulnerability of hydropower, geothermal has begun to represent an increasing share. Although, geothermal is a niche technology, it does not challenge the large scale energy regime but exists in a special space within the mainstream; hence geothermal is considered as part of the on-stream pathway. Indeed, the state-owned generation utility, KenGen, made a strategic decision to invest in more geothermal power in order to diversify its generation assets and reduce risk to future rainfall variability in a changing climate. Added to this, Kenya has positioned itself within the international community as a champion of low-carbon climate-resilient development. In 2015, Kenya submitted its NDC to the UNFCCC, setting out a number of mitigation and adaptation actions to abate its GHG emissions by 30% compared to a business-as-usual scenario [108]. Expansion of renewable sources of energy was a core mitigation priority, with geothermal being the focus of a recent proposed Nationally Appropriate Mitigation Actions for Kenya submitted to the UNFCCC [109]. Also, in 2018, the government announced its third Medium-Term Plan (2018–2022) giving great priority to expanding the renewable energy sector.

In many ways, we found that this on-stream pathway maintains a strong technological perspective and the same male-dominated decision space and gender-blind policy perspective. But when we carried out some additional research, we found that the on-stream pathway does

appear to be accompanied by growing momentum around changing gender dynamics in the centralised energy system. For instance, in 2017, the state-owned generation company, KenGen, appointed its first ever female CEO, Rebecca Miano [110] and the KenGen board has transformed its board to ensure one third are women [111]. Meanwhile, the Pink Energy in KenGen and Women in Geothermal (WING) Africa are networks established to promote women in the power sector [112] [113] and women are starting to work in roles traditionally dominated by men, such as geothermal drilling engineers [110].

It remains to be seen how on-stream policies that promote gender representation impact women on a day to day basis or how women will be able to impact decisions making in energy and policy. These company initiatives consider both women and men based on the same metrics as defined by the position (e.g. CEO) but may not necessarily consider the different needs and challenges women face. Therefore off-stream pathways are needed to account for the diverse interests and issues women and other genders face.

4.2.3. Political and technological decentralisation: off-stream pathway to improve local livelihoods

For this study, we carried out additional research to compile off-stream pathways that highlighted niches spaces for women and Indigenous communities for energy systems. Despite the dominance of the mainstream and on-stream pathways around large scale centralised grid-based power development, there are several niches for energy technologies and opportunities for women and Indigenous communities.

One off-stream pathway lies around decentralised power generation through off-grid solar home systems and renewable energy mini-grids. Decentralised solar power has witnessed strong growth over the past decade, with innovative pay-as-you-go solutions utilising Kenya's well-established mobile money services. This new market has opened opportunities for women-led enterprises in solar, steam, briquettes and biogas to champion the benefits of adopting renewable energy [114,115,105]. Opening up niche space for women entrepreneurs provides one avenue for increasing the decision making power of women within the sector. However, Marshall and Bennett [90] argue that the focus on private sector entrepreneurship only serves to reinforce gender power imbalances through social norms associating business entrepreneurship with male-dominated behaviour. Nevertheless, decentralised power can be an interesting off-stream pathway to closely explore and to bring a spotlight to opportunities for women entrepreneurs.

Another aspect of the off-stream pathway looks at issues of intersectionality on local governance of energy resources and benefit-sharing. Even though geothermal energy was described as part of the on-stream pathway, we are focusing on the energy governance aspect more broadly, which happens to cover renewable energy including geothermal energy technologies. Here, the off-stream pathway refers to the new ways of governance, rather than focusing on the energy technology itself. In recent years, decisions around how to manage geothermal power generation have also been heavily influenced by the changing political landscape associated with the devolved county government system established in the new Kenyan constitution in 2010 [116]. The social and environmental risks of largescale renewable energy development – such as geothermal, hydro and wind – are largely borne by Indigenous communities, which are rights holders of the land where the activities generally occur. Kenya's strong land rights mean that Indigenous communities maintain some access rights on privately-owned lands. Since the livelihoods of these communities are closely tied to the land, the national and county governments – as duty bearers for the citizens they govern – have a responsibility to uphold these rights. This is particularly the case where the capacity of rights holders to manage social and environmental impacts is limited. Environmental and social impact assessments, with associated resettlement action plans for displaced communities, are the typical tools used by duty

bearers to hold private economic interests accountable for minimising risks to local and Indigenous communities. But there is potentially a greater role for monitoring by local citizens, including opportunities for women, who might be better placed to identify changes in their local communities and environment.

With energy planning and development mandates, county governments in Kenya have a substantial role to play with regard to shaping energy development priorities and politics according to their local resources [117]. For instance, most geothermal steam fields lie within the Rift Valley – an area spreading across Turkana, Baringo, Nakuru and Kajiado counties. Local governments in these counties want a role in decision making over geothermal development in their constituencies to embrace its benefits, rather than risk disruptions in the county and local community [118]. Already, in December 2017, land disputes and public participation concerns led to the collapse of the Kinangop Wind Power Project, highlighting the sensitivity of land issues and community engagement.

The passing of the Energy Act in 2019 has given legal clarity to what local-level governance will mean within the counties when it comes to energy issues [119]. For example, each county government is now expected to develop a county energy master plan that will be used to formulate an integrated national energy master plan. Debate continues over how governance of the energy sector at county and central governments will be managed in practice. The devolved system in Kenya is still new, hence a lot of learning and adaptation still needs to take place before effective means of ensuring citizen participation, including women who have been historically marginalised, are established. Moreover, it is not clear how this will address gender power dynamics in relation to energy decision making in the home and community, where men often make the major purchasing decisions related to energy in the household [120].

The changes in energy policy making present in this off-stream pathway reveals that there are emerging niche spaces that exist outside the mainstream energy regime and new energy governance practices that differ from the current policy regime and may lead to more equitable policy outcomes.

4.3. Spanish case study transitions pathway

4.3.1. Old wine in new bottles: mainstream to the on-stream pathway

In Spain, we discussed the mainstream along with the on-stream pathway as the country has been on an oscillating trend regarding its energy transition moving toward and away from the fossil fuel regime until recently. Around 80% of primary energy (in 2016) depended on imports [121], GHG emissions increased to 340 million tonnes (in 2016 for all sectors excluding land use, land-use change, and forestry (LU-LUCF), including international aviation [122]), as well as, the halt to new renewable power installations (since 2013). These changes were due to political impositions and administrative barriers such as the sun tax and fees on self-consumption (i.e. electricity production for own use). These factors have been seen as a lack of commitment in terms of political will fostering a renewable energy transition agenda and a weak ambition in complying with the Paris Agreement.

Yet, in 2017, an expert commission was gathered to provide a roadmap for decarbonisation proposals and analyses for designing a new Law on Climate Change and Energy Transitions for Spain [123]. Despite its ambition and goodwill, the expert commission summoned by the Government, the opposition and several trade unions were composed of 14 male experts. The commission of experts in fact was and currently is a true reflection of actor-dynamics in the energy sector, not only exclusive to Spain but as a general trend world-wide. This consequentially sparked outcry by the public that not only had women been excluded in energy policy and decision making, there was a general overall lack in gender diversity in energy companies as well [124]. Porter (2016) points to the potential perspectives agencies in conveying or withholding perspectives, such that when a certain

group's voices "...[a]re suppressed, silenced, excluded or ignored; agency is undermined" ([125], p 36). Spain's case of an all-male expert panel, or exclusion to certain positions in companies accentuates attention to a particular set of storytellers and their perspectives; while ignoring how different gender conscious energy transitions can be manifested. Similar agencies might be inhibited when disputing voices of vulnerable, (under)represented and/or marginalised communities on this path for responding to current energy predicaments of our time.

This mainstream pathway has been useful for highlighting structural problems. Critiques claimed that the current energy model focusing on centralised and often polluting infrastructure and oligopolistic actor agglomerations was unjust and becoming obsolete [126]. Also, the unequal gender representation is not a matter questioning numbers or the capabilities of men but are issues of plurality of visions and actors and that of overall justice. The mainstream structure not only perpetuated a lack of diversity and equality - failing to achieve the basics of the sameness criteria in the on-stream pathway for gender representation - but was ignorant of the power and agency of different pathways, undermining voices of women.

The government at that time was also compiling a strategy of just transitions in collaboration with unions within the energy regime on the future role of coal workers all contributing to more ambitious plans for the overarching goals in complying with the Paris Agreement [127,128]. The just transitions strategy emerges from the on-stream pathway and is a solidarity strategy that aspires to ensure that people and territories take advantage of the opportunities of this energy transition away from the current high carbon regime and that nobody is left behind, promising inclusivity [129]. Although inclusivity is captured through the sameness criteria (i.e. both women and men are viewed as the same), integrating rights of all vulnerable groups with the just transitions strategy; capturing gender specific needs should be a part of the off stream pathway (discussed in the next section) and including women's visions into decision making spaces is also vital. This can be seen in the results of a survey conducted in 2017 when asked regarding the perception of women in energy decision making in Spain [130]. While 26% of male participants believed that there is gender equality in energy decision making, more than half of women believed that they were systematically excluded in the current energy transition model.

As with the numbers presented in the Canadian and Kenyan case study, the lack of representation of women only begins to highlight a symptom of a gender inequality problem and equal representation is not a intended to be a blanket solution.

4.3.2. The new ministry of ecological transitions and off-stream pathway

The off-stream pathway focuses on new government institutions created outside of the energy policy regime and presents an opportunity to explore niches for clean energy and woman's perspective in a protective niche. The new government in Spain, taking over in June 2018, (and re-elected in April 2019) has created a new Ministry for Ecological Transition. The Ministry is the first of its kind merging the former Ministries for Environment and for Energy, and also led by a female minister. The new ministry has an ambitious outlook on energy transitions with a central focus on the National Integrated Energy and Climate Plan (PNIEC) 2021–2030 [131], a guiding roadmap toward EU's 2030 climate and energy goals as well as opting for carbon neutrality by 2050. The national plan, ranked highest of the 28 European Union Member States National Energy and Climate Plans, evaluated by the European Climate Foundation based on the adequacy of national targets, the comprehensiveness of the policy descriptions as well as the quality and inclusiveness and participation [132]. Another positive outcome has been regarding the removal of the controversial sun tax [133] that had hindered the development of solar PV in the recent history of Spanish renewables rollout. This tax removal helped to reinstate the protective off-stream niches for the solar power sector. These special niches provide opportunities that could potentially lead to

transformations in energy systems and where all gender perspectives, beyond just women, become part of the energy decision making process.

4.3.3. Transcending off-stream toward transformative pathway: consumers at the heart of the energy system for “care-full” and gender sensitive pathway

In this study, we developed a transformative pathway as we believe there is evidence in the on- and off-stream pathway that could lead to radical changes in Spain's energy sector. There is general consensus that renewables will be deeply embedded in the future of energy transitions [134]; thus the potential transformative pathway would be to include the possible benefits of a more equal representation and decision making on an already changing energy system. Not only are systems transitioning for more decentral modes of production, bringing people closer to nodes of production, but they also serve as a tool for empowering more diverse and gender aware, grassroots participation in a new form of energy production. Prosumers, consumers generating their own power in this sense, has been a being a crucial step in for the democratisation of energy [135–137]. This leap has finally been supported in April 2019, when the Spanish Government approved the final regulation on self-consumption (BOE, 2019, Royal Decree 244/2019)-tr [138], freeing the pathway for citizen participation in Spain.

Although not a new concept in Europe [139], the decree is to accelerate the energy transition in Spain, since it opens up producing and consuming renewable energies both as individual users or in the forms of community production through shared renewable installations. This not only gives access to people who do not have access to a roof owned renewable electricity production/supply system, but also opens space to transition toward an economy based on the commons where resources are taken care of by a community [140] rather than private appropriation or dispossession of communal assets [141]. Although adhering to the mainstream energy regime infrastructure for grid connection (i.e. the “sameness” criteria) the new legislation lifts administrative barriers in grid connecting. This provides basic rights to the remuneration of electricity for everyone, which previously was considered as an economic activity only allowed through fees. This can be seen as a temporary emancipation towards transformative change, particularly if all gender perspectives are considered.

Restoring the right to self-production and creating an accessible space for the average person can act as an open platform where gender mainstreaming can systematically be reinforced. Many energy cooperatives, already in action in Spain, have equality plans set out in their statutes; however, there is always a wide gap between formal intentions and reality [142]. The change of the regulation may, in fact, serve as a promoter to seek for more gender equality in practices and applications. Such gender-targeted policies can also be combined with the idea that the supply and the consumption chain are not cut-off but are rather brought closer together for a gender equality agenda in energy action and decision making processes. Applying a gender-conscious perspective for transformative action can also tackle larger issues of energy poverty: a very relevant intersectional issue bringing together gender, socio-economic and marital status in Spain, highlighting the burden falling on the invisible workforce of women in the household [143,144].

A new indicator referred to as the “feminisation of energy poverty” is recently being used to disaggregate poverty statistics not only by gender but also via a hypothetical assumption of men and women as autonomous entities in the household as if each individual lived on his/her own income. The use of such an alternative measure accentuates invisible displays of power inequalities present in the home that otherwise would be disguised if energy poverty data were collected as a household. In Catalonia for example, when every poverty levels are disaggregated by gender only: 18.8% of men and 19% of women were at risk of poverty. However, when disaggregated with the assumption of autonomy, 25.7% of men and 49.7% of women were shown to being at risk. This indicator therefore brings to the surface the hidden female

share of energy poverty in the household [143] as an intersectional element across the gender dimension, income and autonomy. The adoption and use of alternative indicators as such, can elevate the debate of gender discussions beyond numbers of representations across men and women but rather surface the invisible consequences of unequal distribution of energy services. This in turn, can serve as a step forward in recognising priority areas of action for more inclusive energy policies.

The new regulation that give rights to self-production can be seen to foster energy democracy, combat energy poverty, organise grassroots initiatives with the inclusion of gender sensitive visions and applications from the ground up. The fruits of such initiatives can be seen for example with the emerging Network of Women for an Ecofeminist Energy Transition (La Red de Mujeres por una Transición Energética Ecofeminista (RMx1TEE) [145]). Similar organisations and niche spaces, in due course will encourage principles of solidarity and a care economy based on core principles of inclusion across age, status, class, income, race and gender.

5. Discussion

Applying our Alternative Pathways framework in energy transition pathways in Canada, Kenya and Spain unveiled the many gender layers that can manifest within transition pathways. Initially we found that pathways were easily differentiated by their energy technology: mainstream energy pathways were primarily fossil fuel energy systems or large-scale energy systems. On-stream energy pathways provided niche spaces within the dominant fossil regime; off-stream promoted low-carbon innovations separate from regime technologies: while on the other end of the spectrum, transformative energy pathways implied a new radical technological innovation. Like many other contexts of change, energy transitions show us how values and resources are governed and accessed. The kind of resources, groups of people, regions targeted and who is considered knowledgeable and competent to undertake planned energy transition activities are contested and negotiated.

But when we applied a gender perspective to the on-and off-stream pathways, we found it far more challenging to meaningfully include both women and men's perspectives. We started off by discussing the current energy regime and searched for numerical indicators- as lowest hanging fruit – to give some insights to gender representation of women and men in the energy sector. But we also realised that gender representation of women does not equate to gender equality in decisions making process and much more research is needed to explore different gender perspectives. In fact, a gender perspective focusing on women as well as the wider gender spectrum should have been applied ex-ante and not ex-post where there is limited or no research resources to carry out the in-depth research needed for this area.

We also see from the pathways that energy transitions proceed with authority. The institutions (rules and rulers of the game) and organisations guiding energy transitions are usually governments, their energy agencies and their institutional instruments that legitimise the decision making about particular trajectories of transition. Power operates within and between these different formal and informal organisations and institutions, as well as between actors at different levels and scales to also shape who is authorised to steer the transition. In all three case studies, we see that authority is gendered.

5.1. Gender voices across pathways

The *mainstream* pathways were predominately technical and male-dominated raising the question: “Where are the different gender perspectives?”. Each pathway has a resounding absence of diverse gender perspectives (e.g. woman) or very limited representations of alternative perspectives. Additionally, all three mainstream pathways focused on the top down decision making of large centralised energy systems. The

mainstream pathway demonstrate a lack of awareness for diverse voices, especially woman's voice, and may perhaps be a deliberate systemic exclusion of alternative perspectives.

The *on- and off-stream* pathways generally explored: "What were the (potential) approaches for including different gender perspectives?". These pathway are a starting point to thinking about gender, more specifically a woman's perspectives. The on- and off-stream pathways demonstrate niche incremental changes that raise awareness to bring in different gender perspectives and voices. Many of these pathways have a starting point from the community, a more local and bottom up approach, which can begin to consider multiple gender perspectives and more inclusive space for decision making. This space allows for reflection and acknowledges the need for different gender approaches, within the smaller scale energy systems. But efforts cannot only be limited to representation and acknowledging differences.

The *transformative* pathways raised a question of "How can different gender perspectives be active agents of change?". A transformation is not the end point but a process of radical change that disrupts the existing unsustainable technologies and social practices that exclude different genders (not only woman) and underrepresented groups. While the pathways are not yet in the transformative phase (but the Spanish pathway was the closest to potential transformative change), transformation can be viewed as a *process that* can enable agents of change. Women, and underrepresented groups need to be viewed as enablers as change rather than as vulnerable, marginalised groups at the mercy of powerful (male) actors. This means real agency in participation, recognition and decision making in innovation and policy practices by bringing the voices to desired directions of transformation to set policy agendas, develop and implement policies.

5.2. Reflections on the alternative pathways framework

We would like to reflect on how we applied the Alternative Pathways framework in analysing gender perspectives in energy transition pathways. All researchers (who identify as women and men) found it difficult to balance the technological and policy perspective while simultaneously bringing in a balanced perspective of women and men as well as the issues of intersectionality.

First, we were aware that technocratic discussions dominated the pathways. The heavy emphasis on technology and policy was due to our research training background and experience, which stood out in the pathways. Having a technocratic focus may not have been problematic in itself if we had been able to appropriately include a balanced gender perspective in the pathway. But we found it difficult to depart from the male-dominated perspective. This alone shows how highly gendered our own research training and experiences are, and this could be an interesting to study further.

Second, we found it challenging to bring out the women's perspective when it was missing from the original research study. Thus, we resorted to quantitative data that was most readily available. The lack of in-depth qualitative data on women's perspectives highlights a strong need for further empirical research in the case study countries. We believe there is still value in a binary gender perspective, despite its limitations, because there still remains limited inclusion of women's perspectives in decision making around energy transitions, let alone inclusion of other alternative perspectives from marginalised groups.

Third, even though we only focused on a binary gender perspective, we found that by attempting to bring out women's perspectives, we had an opportunity to begin searching for alternative gendered perspectives and to re-evaluate the preconceived roles of women and men. For instance, when exploring the role of gender within Indigenous communities for the Canadian case study, we were presented with another world view of women's role in society and decision making. Unlike the dominant Canadian settler-colonial perspective which historically has taken a view of gender as a binary construct, some Indigenous communities acknowledge non-binary genders or Two Spirit. Additionally,

Indigenous women traditionally held position of power and respect in society. But due to colonisation and a complex history, Indigenous women have become one of the most vulnerable groups in Canada. There is also a danger that if women's and other gender perspectives – as well as issues of intersectionality – are not included in energy pathways by design, we will likely see the patriarchal governance structures of dominant groups continue to dominate in energy transition pathways.

Fourth, the added element of intersectionality was even more challenging as there were fewer studies in this area and little or no empirical evidence of these issues in our previous research. We felt it was important to include issues of intersectionality as we wanted to go beyond the binary issues of gender. But we realised that we could not tackle the intersectionality issues sufficiently in this study without carrying out further transdisciplinary research. Thus, transdisciplinary research methods are needed to study gender beyond a binary gender perspective and explore issues that intersect with other social dimensions in energy transition. This includes the co-design of research questions with stakeholders representing different genders and expertise, as well as the co-development of knowledge and research outputs (see Pohl et al. [146] for transdisciplinary research methods).

Overall, we consider that it was very important to document our learning experience as this study changed the way we have viewed energy transition pathways. Our most important take-home message was that we cannot simply ignore the glaring absence of woman's and other missing gender perspectives in energy transition pathways. The findings in itself were not surprising to us but the process of trying to bring out woman's voice made us acutely aware of how we had ignored the power dynamics of those developing energy transition pathways. We did not examine in-depth the "who" in the pathway development of our original research, but mostly the "what" (i.e. technology and policy). In our previous research, we also assumed that if we spoke to stakeholders [147] or tried to include a gender perspective, then we could appropriately include diverse perspectives and this would translate to promoting gender equality. This was clearly not the case, but applying a framing, like the Alternative Pathways framework, was a start to rethinking how we should approach research in just energy transitions. Moving forward, we would like to build from this experience and thoughtfully include alternative gender perspectives as well as collaborate with more gender experts in future studies in order to meaningfully study gender equality in energy transitions pathways.

6. Conclusions

Energy transition pathways, as manifested in Canada, Kenya and Spain, present very different degrees of gender consciousness. The pathways served to explain the absence of the equal representation and voices of women and other minority groups in decision making. This not only perpetuates the technical culture that shapes and constrains the energy sectors in these countries, it excludes social and different gender perspectives in decision making, and prioritises knowledge that lies in the hands of male technical experts.

The Alternative Pathways framework for analysing gender perspectives in energy policy making was developed to explore the very important issue of why there appears to be an overwhelming absence of not only female but empowered gender voices in energy transition pathways. Including gender perspectives can challenge energy transition researchers and practitioners to rethink dominant energy transition pathways, and the value of including women, other genders and groups as *influencers* of just energy decision making processes.

Our study highlighted the challenge of linking gender issues to technology- and policy-focused perspectives of energy transitions. Considering two different groups (women and Indigenous communities) that are often marginalised in decision making for energy and resource sectors was found to be even more difficult. Tackling intersectionality clearly adds further layers of complexity especially when

addressing exploring female and male perspectives along with systematic discrimination experienced by Indigenous communities, as seen in the Canadian case study or tensions between Indigenous communities and higher level of decision making in Kenya. The Spanish case study had a strong focus on gender and policy making since these aspects were explicitly considered within the case study. It was also the only study that began to explore issues of gender equality on top of the discussions on gender representation. The Canadian and Kenyan case study, on the other hand, did not explicitly explore gender equality but focused on woman's perspectives and highlighted some issues related to intersectionality in relation to need of Indigenous communities.

All case studies demonstrated that some efforts have been attempted to improve the *representation* of diversity through *on-stream* pathways to *broaden* the discussion to include different genders and to create spaces for different pathways to potentially include minority groups. The off-stream pathways, on the other hand *deepened* the discussion of gender and wider inequalities by recognising the diverse needs of different genders and other social groups through a bottom up approach to energy planning and policy. New emerging spaces for transition can be regarded as positive drivers toward transformational change. We argue that different energy systems - whether on-stream or off-stream-emerging in very different energy transition pathways can be seen as steps towards change for a more gender equal and just energy system.

When evaluating energy transitions in different contexts, we also urge researchers and decision makers to consider multiple gender perspectives to make explicit the power dynamics and inequalities within the mainstream perspectives. When we recognise the unequal power dynamics, we can make dedicated efforts to search for alternative pathways - on-stream, off-stream and/or transformative pathways - to give us (at least three) more perspectives of what sustainable potential energy transition pathways could look like. Incorporating comprehensive energy pathways will increase the likelihood for implementation and engagement with the public to construct a more just low-carbon future.

Declaration of Competing Interest

The authors declare that they have no conflict of interest with the sectors evaluated in this investigation.

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