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**Cross-cutting and inter-sectoral cooperation to integrate renewable energy into energy systems**

## **Energy Transition and the Post-COVID-19 Socioeconomic recovery: Role of women and impact on them**

### **Note by the secretariat**

#### *Summary*

There are several pathways through which energy systems are transitioning to a decarbonised, sustainable economy. The development and implementation of these technologies are being driven by innovation in a wide variety of technologies, from digitalisation, to building energy efficiency, to direct air capture. Now that most economies are emerging, governments are focused on driving a sustainable socioeconomic recovery from the COVID-19 pandemic, but there is an endemic issue which must be addressed.

The energy sector is missing out on the experiences, skills, and talents of much of half the human population, which severely constrains the sustainable energy transition. In addition to a larger skilled workforce, there are several advantages in bridging the gender gap within the energy sector. Gender disparities in the energy sector have been observed around the world. Women are less represented in policymaking, corporate leadership and governance, as entrepreneurs and venture capitalists, and in the labour workforce. Indeed, as it relates to employment, the energy sector is the least gender diverse.

Several possible reasons why women tend not to participate in the energy sector include women's own perceptions of the industry, insufficient access to information, finance, and training, corporate human resources practices, and cultural biases and norms about gender roles. These barriers are surmountable using a two-way complementary approach, which is simultaneously bottom-up - action by women and society to bridge the gap of gender inequality in the energy sector - and top-down - government and policymakers need to develop policy tools to encourage women's participation in the energy sector.

This paper summarises key findings from a report and empirical case studies of five United Nations Economic Commission for Europe (ECE) member States: Albania, Belarus, Ukraine, the United Kingdom, and Uzbekistan.



## I. Introduction

1. The COVID-19 pandemic hit the world suddenly and unexpectedly, at a time when transitioning the global energy system to sustainability was at the forefront of many countries' energy policies. As the global economy slid into a lockdown, the green economy lost importance temporarily. Now that most economies are emerging, governments are developing policies to drive an economic recovery. Society now has the opportunity to simultaneously recover into a greener, more sustainable economy while creating new opportunities for building a more equal society. Gender disparities in the energy sector have been observed around the world. Women are less represented in policymaking, corporate leadership and governance, as entrepreneurs and venture capitalists, in the labour workforce, and as consumers (decision makers). The Albanian National Agency of Natural Resources (AKBN), the Department for Energy Efficiency of the State Standardization Committee of the Republic of Belarus, and the State Agency on Energy Efficiency and Energy Saving (SAEE) of Ukraine have requested the United Nations Economic Commission for Europe (ECE) to conduct a study on the topic of the Energy transition and post-COVID-19 socioeconomic recovery, with a focus on the role of women and impact on them. This report focuses on this aspect of the energy transition and post-COVID-19 socioeconomic recovery.

2. The report covers six major topics: First, transitioning towards sustainable energy with gender equality and women's empowerment. Second, give an overview of the developments in the energy sector and its trends, developments, and innovation. Third, assess the impact of the COVID-19 pandemic on the energy sector, the economy and social well-being and the impact on women. Fourth, participation of women in the economy, and specifically in the energy sector. Fifth, gender equality and diversity in the energy sector and its opportunities and challenges. Sixth, promoting women's participation to ensure a transition to sustainable energy and green post-Covid-19 economic recovery. These six topics are supported by case studies from five countries in the ECE region: Albania, Belarus, Ukraine, the United Kingdom, and Uzbekistan. Recommendations are made for each country individually, and the report culminates in a set of recommendations that will be useful for ECE member States in their decision-making.

3. The methodology of this report entailed extensive desktop-based analysis of a variety of sources, including national policies, government-led programmes, the role of local and international institutions, financial mechanisms, the industrial climate, academic literature, published news articles, market-based reports, and public databases. The research was complemented with the inputs of national and international subject matter experts, who reviewed and provided feedback on the report and case studies.

## II. Transitioning towards sustainable energy with gender equality

4. Energy is an underlying resource that interconnects every aspect of life; it is the most important component which drives the existence of our planet. In addition to renewable forms of energy, society currently requires fossil fuel-based energy to meet our needs. However, the drive to meet our collective insatiable needs and desires has caused immense damage to natural ecosystems, created challenging circumstances for the planet, and paradoxically threatened our own well-being.

5. While a complete transition away from fossil-based energy is not currently possible, there are various potential ways to mitigate the environmental damage and transform the world with a sustainable transition. Driven by the international climate change agenda and the Nationally Determined Contributions (NDCs), countries around the world are pursuing strategies to transition their energy systems away from fossil fuels. The goals of a sustainable energy system transition interlink with a preservation of the natural environment, continuous economic progress, and social well-being - a just use of natural resources, human capital, and international cooperation. In fact, a sustainable energy transition can act as an enabler to achieve many of the United Nations Sustainable Development Goals (SDGs). In addition to the obvious environmental benefits, adopting a low-carbon approach for energy generation

creates new pathways leading countries towards a structural economic shift by driving technological innovation, creating jobs, and developing opportunities to build a greener and sustainable economy. Moreover, a significant co-benefit of transiting towards a low-carbon or carbon-neutral energy system – a green sustainable economy – is that it creates new opportunities for building a more equal society.

6. Despite the many benefits expected, there are substantial risks threatening an effective, sustainable transition. Institutions that enable a coherent approach to transition current economies to green economies are needed to create an enabling environment. Equality of opportunity is an especially important characteristic of the improved “human well-being and social equity” expected of a green and sustainable economy (the International Labour Organization - ILO, 2017). Broad considerations of equity also include relative wages, working hours, the work environment, and even basic needs (clean water, food, shelter, hygiene); these considerations can highlight important differences between labour policies in developing and developed countries. Of particular importance is the availability of a skilled labour force that must be equipped to meet the challenges of the transition and the dynamics of changing production and consumption patterns. In part, this risk can be resolved by a combination of pivoting on existing skillsets towards newer skills and developing entirely new jobs. Substantial investment in education and training programmes will be needed to support existing and new workforce participants. Governments, social partners, and stakeholders must understand all these considerations to ensure social equity concerns are addressed by providing access to relevant training and education, upgrading jobs and wages (based on skills and ability), and encouraging equality of gender participation (ILO, 2018). This latter point is especially true regarding the energy sector.

7. There are several advantages in bridging the gender gap within the energy sector; including wider availability of the skilled labour workforce. Several academic studies have shown that an equal representation of women in the workforce and in management positions has numerous positive impacts, such as more concern for the environment (Liu, 2018; Mavisakalyan & Tarverdi, 2019; World Bank, 2017).

8. There are various energy transition strategies with varying impacts on which resources people will be able to use, how these resources can be used, and for what purposes. Transitioning towards a low-carbon and energy-efficient society will increasingly benefit women around the world; for example, they will be able to access better technology and renewable energy to change household consumption patterns. The transition of the global energy system is leading us towards an innovative future, offering an opportunity to transcend the current global economy in favour of a green and sustainable economy. Equal gender participation in this endeavour can help society leap to a future of technological advancement in the energy sector. It is disappointing to note that the participation of women continues to be low across the spectrum of the sector, from policymaking to the labour workforce.

### **III. Overview: Developments in the energy sector**

9. The current energy transition can be viewed as the fourth in a series of fundamental structural transformations in how energy is generated. According to V. Smil (2018, cited in Hafner & Tagliapietra, 2020), the fourth energy transformation began in 2017, with the increasing share of renewable energy (excluding hydropower) in total primary energy consumption. The rapid increase in the share of renewables can primarily be attributed to the need to counter global climate change and to achieve compulsory energy sector decarbonisation targets agreed upon nationally and internationally. Today, the energy transition is driven by a complex variety of drivers, primarily climate-focused geopolitical agendas and technological progress. The availability of new technologies is dramatically increasing the efficiency of the energy sector and evolving new pathways for economies to become energy efficient. This, in turn, allows countries to ensure the competitiveness of their national economies, boost development with affordable energy, and enhance energy security. The latter, of course, ties back into political agendas.

10. There is significant technological progress across the world in designing innovative solutions for decarbonising the energy generation system. The development of national

policy instruments across economies - including public investments, phased elimination of fossil fuel subsidies, market mechanisms, and regulatory frameworks - are imperative and go hand-in-hand with the development and implementation of technological solutions. A strongly integrated approach between policy instruments and technological innovations is essential for supporting the energy transition and solving climate change issues. Municipal, regional, and national institutions are simultaneously designing pathways around technological innovations to promote sustainable practices.

11. Transitioning to a low-carbon economy requires transformation at multiple levels and must be implemented in system-wide initiatives to simultaneously transform energy supply and demand. Energy supply in terms of renewable and non-renewable sources of energy generation, transmission and distribution systems, short-term and long-term energy storage and energy demand in terms of energy consumption patterns, buildings, transport and infrastructure. For this, an integrated systems perspective is crucial, as it starts with the recognition of the interconnectivity of all the components of the energy system, and the energy sector's linkages with the rest of the economy. The result of a policy instrument or technology implementation may be beneficial to one component or sector, while being detrimental to another. The combined benefits of multiple instruments/technologies could cancel themselves out or amplify their cumulative effects to achieve multiple objectives.

12. To avoid unintended consequences, mitigation measures and complementary instruments/technologies should be considered (Hafner & Tagliapietra, 2020), such as:

- intermittency – wind, solar, and to some extent, seasonal hydropower generation are inherently intermittent; digital systems will fill a crucial role in augmenting the electric utility grid with the requisite flexibility
- zero-carbon technologies – zero-emissions vehicles rely on zero-carbon energy sources and public fueling infrastructure
- natural and engineered systems – the preservation of existing and restoration of degraded, natural habitats will be crucial to achieving net negative emissions; transformation of land use, such as the clearing of natural forest cover for agricultural practices, can lead to carbon emissions while destroying natural carbon sinks
- mitigation and adaptation – some adaptation measures can contribute to mitigation; for example, forest restoration and coastal wetland protection help resist rising sea levels and promote food production while sequestering carbon
- complementary actions across economies – renewable energy source capacity varies geospatially, and the availability of natural resources and land can cause challenges to implement a common practice across countries; however, ingenious local solutions can help meet common global objectives.

13. The case studies presented in this report reflect that there is no one-size-fits-all solution for all countries. Each country varies in terms of energy policies, availability of natural resources, human capital, and existing social infrastructure. These differences lead to different optimal approaches to energy transition policy- and decision-making.

14. Technological pathways to decarbonisation are supported by six primary technology pillars (Sustainable Development Solutions Network -SDSN, and Fondazione Eni Enrico Mattei - FEEM, 2019):

- zero-carbon electricity generation - a shift in electricity generation away from fossil fuel combustion
- electrification of end-use - increasing the penetration of electricity can enable the electrification of economic sectors that currently use fossil fuels
- alternative fuels – are under development for use in sectors that are harder to electrify; examples include hydrogen, fuel from waste, coal and biomass to liquids
- smart power grids – the deployment of smart grids will allow more efficient, economic, and reliable transmission and distribution system operations, especially as the share of intermittent power sources increases

- materials efficiency – waste and emissions can be reduced by better choices of materials and their utilization patterns; the circular concepts of “reduce, reuse, recycle” or “recycle, reuse, remanufacture” are examples
- sustainable land use – this primarily applies to agriculture, which contributes up to a quarter of all greenhouse gas (GHG) emissions.

15. Low-carbon energy (LCE) supply technologies supporting the energy transition include renewable energy (e.g., wind, solar, tidal, hydropower, and geothermal energy), alternative fuels (e.g., biofuels and fuels from waste), nuclear fission, and efficient combustion technologies with the potential to reduce GHG emissions. Examples are in the transportation sector but also of the built environment. The efficiency of lighting, heating, air conditioning, and home appliances – as well as construction methods and materials – continues to advance. Energy efficiency rating systems help consumers choose the most efficient appliances. With the continual and rapid increase of digital computation and communication requirements, there is an acute need to reduce the energy consumption by all types of IT devices and within the Information Communication and Technology (ICT) sector.

16. The development of technologies used for energy supply and demand plays a pivotal role in the energy transition. Many of the newest trends and developments are in cross-cutting technologies such as batteries, hydrogen fuel, smart grids, and carbon capture, usage, and storage (CCUS). These technologies are enabling the deployment of clean energy sources on the supply side, while facilitating their integration (in particular, renewable energy electricity in home use) in end-use sectors (IRENA, 2018). Progress in such enabling technologies is, therefore, a powerful driver of innovation in energy generation and consumption, which are increasingly intertwined.

17. The concepts of energy efficiency and the circular carbon economy are being increasingly adopted and influencing consumption patterns in society. Supported by innovative technologies, energy efficiency measures are promoting generation capacity, while eliminating waste. Improvements in energy generation are not enough, however, as a successful energy transition will require further changes in demand-side consumption patterns. Buildings, for example, still account for more than 35% of the European Union’s (EU) energy-related GHG emissions (SDSN and FEEM, 2019). There are already solutions in place to reduce these emissions: for example, deep renovation and a switch to renewable heat generation. Perhaps the most important barriers, however, are behavioural. Improved awareness and intelligent use of building automation technologies will help to further decrease demand. Regulations and guidance are key in this area.

18. Social behaviours hinder progress in other areas as well. As consumerism continues to increase – especially as much of the world is lifted out of poverty – the production of waste is expected to increase. To combat this worrying trend, many countries are undergoing large-scale transitions to develop circular economies. This new paradigm of consumption, in addition to increasing the productivity of resources, creates economic opportunities, reduces emissions and waste, promotes innovation and generates skilled green jobs (the Organisation for Economic Co-operation and Development - OECD, 2017a). A report by the International Labour Organization (ILO, 2018) estimates that the circular economy could create nearly 6 million new jobs. In addition, the development of the requisite technological and infrastructure capacity is expected to create more indirect jobs. Further, the paradigm of the circular economy should drive beneficial behavioural changes, encouraging the manufacture and use of more durable products, an increase in rentals of some goods, and a stronger emphasis on repair. All of this should create further indirect green jobs.

19. Society must transition to consuming carbon without the associated emissions. CCUS is a critical class of technologies concerned with both capturing carbon dioxide (CO<sub>2</sub>) before it is emitted and removing existing CO<sub>2</sub> from the atmosphere. The captured CO<sub>2</sub> can either be sequestered or used in the manufacture of valuable products. In some uses, captured CO<sub>2</sub> is injected into wells to increase the efficiency with which petroleum products are extracted. However, stringent policies and extensive financial resources are needed to make carbon circularity a thriving economic opportunity.

#### **IV. Assessing the impact of COVID-19 on the energy sector and on women**

20. Since early 2020, the COVID-19 pandemic has had a substantial negative impact across the world, threatening people's livelihoods, ways of living, and their very lives. The high level of risk has caused many governments to dramatically curtail many facets of economic activity and trade, triggering extensive losses. In response to the disruption in international trade, some countries that are largely reliant on imports are considering redeveloping their domestic markets to regain a measure of self-reliance. However, there are risks that they could adopt unsustainable practices. Perhaps a silver lining to the pandemic, international trade links will likely be restructured to safeguard individual nations' economic interests and reduce vulnerability. This restructuring could boost local economies and lead to the creation of local jobs. The COVID-19 pandemic may even have presented countries with opportunities for green economic recovery, employing environmentally friendly, energy-efficient processes. As new investments will be needed to support the adoption of advanced technologies and the development of the requisite skilled workforce, there will be opportunities to create green and decent jobs. COVID-19 mitigation measures, such as working from home, social distancing, or using local products are encouraging investments in innovative and efficient digital technologies. Overall, the current pandemic situation is creating new opportunities for structural economic shifts (World Bank, 2020).

21. The pandemic has also impacted the energy sector. An analysis published by Wood Mackenzie (2020) on the volatility of European power and renewable markets during COVID-19 assessed the impact on electric utilities, distributed solar generation, and energy storage. In the residential sector, maintaining social distancing due to COVID-19 created difficulties in services for rooftop solar installation. Issuing planning permits became a low priority for government organizations, and unemployment and related financial challenges resulted in a decline in renewable energy services. Lockdown restrictions stalled industrial and commercial sectors, leading to substantial cuts in power demand; the resultant oversupply of energy led to financial losses and job reductions for energy companies. The year 2020 was the first when more electricity was generated in the US by nuclear plants than coal-fired power plants (Wood Mackenzie, 2021), largely driven by the reduction in demand. Fossil-fuel based energy generation was already on a decline due to the growing penetration of, and preference for, renewable energy. Across the world, significant reductions in the levels of air pollution have been witnessed, which led to public demand for policy action to reduce dependency on fossil fuels and develop cleaner and greener fuel choices to promote social well-being and protect the environment. Green growth recovery packages are being rolled out across countries to accelerate economic recovery, boost job creation, promote energy security, and drive transition to sustainable energy systems.

22. The COVID-19 pandemic also had a considerable impact on women. Even though women account for 48% of the global workforce, the proportion of women in the energy sector workforce is very low: 22% of the oil and gas workforce are women, and the percentage increases to 32% in renewable energy (the International Energy Agency - IEA, 2020). The recession caused by the COVID-19 pandemic had a disproportionate impact on both unskilled labour and women. As schools closed, women experienced high levels of job losses, as they were either made redundant or had to make a choice to take the role of a career. In the European Union, it is estimated that the poverty rate among women will increase to 1.9% (European Commission, 2020). As governments take advantage of the economic recovery to transition to sustainable energy systems, a Just Transition is needed to support international recovery efforts to rebuild robust economies while supporting gender equality and the economic empowerment of women.

23. Achieving energy transition objectives and pursuing the deployment of low-carbon technologies post-COVID-19 will disproportionately impact the more vulnerable sections of society, due to the initial transition in employment, supply chains, and energy costs. Therefore, a Just Transition is needed to tide over the initial stages of transition. The idea that environmental security should not be compromised to achieve economic prosperity is foundational to Just Transition, introduced by the International Labour Organization (ILO) in the 1970's (ILO, 2011). In 2015, the ILO endorsed and adopted guidelines based on the

shared experience of country's policies and sectoral strategies by putting forward a policy framework for a "Just Transition". Just Transition attempts to address the objectives of climate change, sustainable development, and support for green and decent jobs while securing fairness of existing jobs. Just transition also means ensuring evolution in industrial activities by combining resource efficiency and emission reduction. An effective transition would also require the shift of skillsets by upskilling existing skills to meet the demand for a low carbon future so the current labour force can transfer their skills to meet the needs of new and future sectors, moving from brown to green jobs (ILO, 2015).

## V. Participation of women in economic sectors, focusing on the energy sector

24. Gender participation has recently started to become a pivotal point of concern among corporate sector policymakers, international institutions, and academic researchers (Osunmuyiwa & Ahlborg, 2019; Ryan, 2014). Academic discussions around the confluence of gender, climate change, and energy have typically occurred in two relatively disjoint bodies of literature. The first has focused on developing nations, attempting to characterize the inequalities in energy access and climate change impacts on the lives of rural women. The narratives around the "poverty of women" and the "low quality of energy access and its adverse impact on health and safety" have predominantly taken the focus. This body of literature has largely ignored broader topics such as equal participation in energy sector decision-making, or climate change policy development. Second, the literature analysing the role of women in the energy sector in the developed world has largely focussed on the gender divide in perceptions of climate change (McCright, 2010) and differences in energy sector careers (Pearl-Martinez & Stephens, 2016). Clancy et al. (2017) claims that the analysis of energy poverty vis-à-vis gender reveals a significant effect of gender on energy access.

25. According to Kronsell (2013), there is evidence that organizations and governments behave differently when women are more represented in positions of power. In addition, the rise of women's status in a nation is associated with greater support for environmental protection. However, despite the potential benefits to energy transition efforts, women tend to be underrepresented in political decision-making. Germany, Italy, Finland, and Sweden implemented a joint project in 2003 and 2005 entitled "Climate for Change – Gender Equality and Climate Policy", which aimed to promote the participation of women in climate change-related policymaking. This project found that the participation of women was low across the European Union (EU), with only slight differences between member states. Pearl-Martinez et al. (2016) analysed 72 countries and found that only 6% of ministers accountable for national energy policies and programmes were women. Indeed, as recently as March 2019, only four member states of the EU (Belgium, Bulgaria, Estonia, Germany) had a female energy minister (Clancy & Feenstra, 2019, p.22).

26. In addition to energy policymaking, women participate less in decision-making in energy companies. The IEA (2021b) analysed 2,500 energy and utility firms (38,000 employees), finding that approximately 14% of senior management are women. This is only slightly lower than the 15.5% observed in the 30,000+ non-energy firms sampled. Further, data shows that women have a higher tendency in most countries to hold senior management roles in non-energy firms, as compared to energy companies. While the observed disparities in holding senior management roles could be explained by behavioural, preferential, or sociocultural reasons, they cannot be explained by purely academic qualifications. According to the IEA (2021b), education levels are roughly the same for executives of both genders. The data of studies remain limited, and are generally only reported at highly aggregated levels, constraining the level of analyses that could be performed. The knowledge gap is decreasing, but there is still much to be done to improve the acquisition, reporting, and analysis of relevant data. Most importantly, observational data cannot identify causality; progress to an equitable future does not end with baselining information (GWNET, 2019). Given the environmental benefits that the evidence suggests accrue from having more women in senior management and corporate leadership positions, the observed disparities in gender diversity across the energy sector, including renewables, are disconcerting. The important business of sustainable energy could be missing out on the opportunity to reach its

full potential and drive the energy system transition due to the less diverse workforce. Considering the critical nature of the current green economy transition, governments, businesses, and societies should be doing all they can to ensure it is successful (GWNET, 2019).

27. The current global focus on transitioning to sustainability presents many opportunities to simultaneously transition to a more diverse and inclusive workforce. However, there is much to be done beyond observing disparities, as there could be many reasons for the lack of diversity. Experience shows that the simplest proposed solution – quotas – actually hurts society; diversity solutions need to be more nuanced to be truly effective. A deeper understanding is needed of why women tend not to work and lead in the energy sector. Relevant career paths, the breadth of skills, and opportunities across the sector must be identified and analysed. Together, these two types of analyses can inform efforts to attract more women to the energy sector.

## **VI. Gender equality and diversity in the energy sector to tackle economic and energy challenges**

28. Before any policy changes can be made to drive increased participation of women in the energy sector, policymakers must assess the extent to which the observed gender gaps reflect possible underlying preferences, market dynamics, socio-cultural constraints, or even policy failures.

29. The study identifies the opportunities and challenges facing women's participation in the economy – specifically in the energy sector – and promotes their participation to ensure a successful transition to a sustainable energy system and green economy post-COVID-19. The overall findings from the research and analysis of the national case studies indicate that there are three primary challenges limiting women's participation in the energy sector. First, contextual obstacles – women's own biases are holding them back from realizing their full potential. The career choices women make suggest that women tend to perceive energy careers as highly technical and requiring physical strength. Very little effort has been made by society and the energy industry to eliminate such false perceptions and promote more gender diversity. Even considering energy sector roles that do require a high degree of technical knowledge, there seems to be no reason why more women could not fill those roles. Second, economic obstacles – vary by the type of economy, but limited access to finance and training to enter the formal labour market can be a hindrance to women's participation. In emerging economies and developing countries, the primary barrier is financing and training. It should also be noted that a high proportion of people in developing countries are employed in informal work. This is particularly true for women and may be part of the reason that access to finance and training to enter the formal labour market is the greatest obstacle. These differences should be systematically analyzed to most effectively guide efforts to create more energy sector jobs for women. Third, soft obstacles – lack of information regarding employment opportunities acts as a barrier to women's employment in the energy sector. Limited access to mentors and role models, and low representation of women in senior roles, can strengthen the perception that it is a male-dominated sector, thus discouraging women from considering various opportunities.

30. However, there exist also numerous opportunities. As discussed in Chapter 2, the newest trends and developments across technologies such as batteries, hydrogen fuel, smart grids, and CCUS are set to play a pivotal role in the current energy transition. Cooperation between governments, businesses and society, is needed to capitalize on the development of innovative technologies to encourage women's participation in the energy transition, which is reshaping the sector with advanced solutions. There is a substantial need to develop institutional measures to promote social inclusion.

31. Regarding the energy transition, several opportunities exist. First, for energy generation and storage, increasing the penetration of renewable energy sources is a primary objective of decarbonizing the power sector. A major challenge with this transition is that renewable energy sources tend to be highly intermittent. To mitigate these risks, power generated from sources such as solar and wind must be associated with additional flexibility



technologies (dispatchable generation, electricity storage, grid interconnections, demand-side management, sectoral coupling, and low-carbon electricity sources such as nuclear and CCUS-enabled fossil fuel combustion). With all these technologies, there is an abundance of opportunities in the energy sector for innovation, entrepreneurial investment, and employment (Hafner & Tagliapietra, 2020). Second, carbon capture, utilization and storage present an opportunity. For example, while still relatively immature and expensive, direct air capture (DAC) is an exciting technological advancement, allowing to remove excess CO<sub>2</sub> from past emissions from the atmosphere. Beyond energy generation, CCUS has important applications in energy-intensive sectors. A significant portion of global emissions is from the production of products such as cement, iron, steel, and chemicals. In addition to simply capturing and storing the CO<sub>2</sub>, there are many potential applications for its productive use in a carbon circular economy. Despite the progress already made, investment and innovation are still needed, which could be stimulated with incentive mechanisms such as tax credits. In addition to filling a key role in climate change mitigation, CCUS could create many lucrative entrepreneurial opportunities (SDSN and FEEM, 2019). The third key opportunity is in carbon circularity and material efficiency. In addition to reducing societies' environmental footprint, systematic reuse and recycling has the potential to create a wide variety of jobs, from low-skilled labour for reuse/recycling to medium-skilled jobs. This is in addition to the investments and jobs needed to adapt existing manufacturing and infrastructure assets (Green Alliance, 2015). Applying the circular economy paradigm to carbon will be especially effective in responding to climate change. The CO<sub>2</sub> captured from electricity generation, manufacturing processes, and directly from the air can be used to manufacture products. As this recycled carbon is used more, less carbon will need to be extracted, further reducing environmental degradation. As CCUS technologies mature, carbon circularity has the potential to dramatically leverage and multiply the impact of many innovations. In consideration of the expected economic benefits, several countries – both developed and developing – are promoting the circular economy. Analyzing the potential promised by a circular economy, the European Commission (2015) suggested that EU businesses can save over half a trillion euros (8% of annual turnover) and create approximately 580,000 jobs while reducing CO<sub>2</sub> emissions by nearly half a billion tonnes by 2030.

32. Another area of opportunity is regarding the social context. As the economic recovery from the COVID-19 pandemic progresses, governments and businesses should adopt measures on gender equality in their plans. The COVID-19 crisis made the inequality between men and women more evident such as the wage gap and split of home responsibilities. The Horizon 2021-2027 programme is aimed to integrate gender into research and innovation across all sectors of the economy and political levels. Targeted programmes and policies that preferentially support the empowerment of women are particularly important now – policies providing paid leave, ensuring equal pay, and addressing any gender bias in hiring.

33. Additionally, job creation and diversity in energy entrepreneurship present valuable opportunities. The GWNET (2019) study has demonstrated that the sustainable energy sector, in supporting a green energy transition, can create employment opportunities for people from a diverse array of backgrounds, skillsets, and interests.

34. A shift towards decentralized energy generation is a major component of transitioning the energy sector. In addition to creating opportunities for new actors to enter the energy sector and fill roles that large electric utilities may not be able to, decentralization introduces new forms of governance and influence. According to the Right to Energy (2020), decentralized energy generation is a useful tool to reassess and improve relevant domestic energy policies and involve citizens in climate change issues. For example, local energy initiatives, such as cooperatives, can be developed in conjunction with community members.

## VII. Case studies

35. The report included six case studies to analyze and compare five key topics in each case study. First, Energy and Electricity were analyzed. Second, the economic interlinkages of the energy sector and, third, the challenges and opportunities for women in the energy sector were examined. Fourth, the good practices for gender equality were investigated and,

lastly, recommendations were given. The case studies were performed in the following six countries.

1	Albania
2	Belarus
3	Ukraine
4	United Kingdom
5	Uzbekistan

### **VIII. Drivers of change: Women participation towards a sustainable energy transition and green Post-COVID-19 recovery**

36. The pandemic has taught some lessons specific to women’s role. As such, a lesson learned is that people should have access to information about new employment opportunities if they lose their job. In particular, information regarding possible upskilling learning opportunities is invaluable. This knowledge can help people use their time to learn new skills during a lockdown or similar circumstances. In addition to the clear economic benefits, this can help an individual psychologically by creating a positive learning environment and giving them hope of new employment when things return to normal. Relevant education and training programmes that can boost the economy should be made available on the internet. These programmes could focus on promoting skill development for women, which can be useful in creating opportunities targeted at growing areas of the economy and in non-traditional sectors (such as energy).

37. Data collected by the IEA (2020a) on renewable energy performance during the COVID-19 pandemic shows that energy generation from renewable energy outperformed fossil fuel energy generation. In addition to the benefits of using low-carbon sources, there is evidence that the renewable energy sector is resilient, as it continues to contribute to the functioning of economies and society. However, investments in the low-carbon energy sector are declining due to the economic slowdown. Public spending should continue to be aimed at renewable energy to ensure the continuation of new and existing projects, while creating innovation hubs, new employment opportunities, and developing local supply chains – all of which will contribute to the economic recovery. It is well documented that the healthcare, retail, Information and Communications Technology (ICT), and energy sectors played a vital role in helping economies transition toward a “new normal” during the strict lockdown measures. It is imperative for the energy sector to similarly redefine its contributions to the economy and build capacity through investing in developing a skilled workforce and driving technological innovation for a low-carbon and sustainable transition.

38. This study has discussed the need for gender diversity in the energy sector extensively. Transitioning towards a low-carbon and energy-efficient system will increasingly benefit women around the world. There are multiple benefits of engaging with women in the context of energy. First, women can access technology and renewable sources of energy to change household consumption patterns. Second, the energy transition strategies will impact both men and women; the decisions to adopt one approach or another will have a direct impact on which resources women and men are willing to use, whether as entrepreneurs or consumers. Third, there are several other areas of energy where women can contribute due to their diverse skills and knowledge

39. The policy brief on women’s leadership published by the United Nations (C3E, 2017) notes that the participation of women improves the political decision-making process as women work across party lines to promote gender equality issues. The global energy transition is leading toward an innovative future, offering an opportunity to transcend the current economic structure toward a green and sustainable economy. Equal gender

participation in this endeavour can create future opportunities for technological advancement in the energy sector.

40. Financial institutions can play a pivotal role in promoting investments in the energy sector by implementing complementary fiscal policies and supporting regulatory environments in ways that increase business and investor confidence in the transition. Successful implementations of projects in the energy sector can truly lend confidence to businesses to invest in green jobs, but it will likely need greater coordination and engagement with wider public policy. A good example is the increasing availability of green finance through green bonds and other similar instruments, which are encouraging long-term investments in low-carbon technologies. The banks and financial institutions can benefit from diversifying their investment portfolios, and it will help them show that they are creating green jobs.

41. Evidence from the national case studies in Chapter 6 emphasizes the importance of accessing information and networks that can facilitate women's participation in the energy sector. This entails strengthening labour market information systems and career guidance services - perhaps through public employment offices. Having access to mentors and role models who can advocate equality of opportunity could help women rise above the so-called "glass ceiling" and increase the representation of women in positions of leadership.

42. While there are many prerequisites, a fundamental requirement for transitioning the global energy system to sustainability is a skilled labour workforce. Further, many of the skills used in the energy sector currently will not be useful in a green economy, so an effective green transition will rely on the development of newer skillsets. Whether this need is filled through developing newer skill sets for performing existing jobs or introducing new jobs entirely, investments in education and training programmes will be needed. As the economy changes structurally, demand for some occupations will decrease, and others will go away entirely. However, many of the existing skillsets may be applicable in other contexts, enabling workers to transition to new, greener occupations (WGEO, in press). For example, as some types of energy operations are similar, the fossil fuel industry has many jobs from which it should be relatively easy for employees to transition into cleaner energy jobs.

## IX. Conclusion

43. The five national case studies revealed the stark reality of gender inequality in the energy sector. Most countries have policies and initiatives to address the observed disparities, but implementation is predominantly voluntary. This study proposes a two-way complementary approach to tackle the challenge of gender diversity. First, the bottom-up approach shows the need for action by women and society to bridge the gap of gender inequality in the energy sector. This includes two steps to achieve gender equality. First, a behaviour change meaning to eliminate the stereotype mindset and to pursue non-traditional employment opportunities in energy sectors. Second, to develop the skill sets needed for the energy sector, such as through STEM education and vocational courses. The top-down approach shows the approach for the government and policymakers, who need to develop policy tools to encourage women's participation in the energy sector. In this approach, first, policy directives and regulations must be adapted to ensure access to education. Also, gender-neutral policies must be promoted across the government sector. Second, gender diversity must be promoted in the energy sector, and hiring policies must be adjusted to eliminate stereotypes.

44. Equality of opportunity is an especially important characteristic of the improved "human well-being and social equity" expected of a sustainable economy. Broad considerations of equity also include relative wages, working hours, the work environment, and basic needs (clean water, food, shelter). Of particular importance is the availability of skilled labour which must be equipped to meet the challenges of the transition and the dynamics of changing production and consumption patterns. In part, the challenge of skilled labour availability can be resolved by a combination of pivoting on existing skillsets towards newer skills and developing entirely new jobs. Substantial investments in education and training programmes will be needed to support existing and new workforce participants.

Governments, industries, and society should understand these considerations to ensure gender equality is addressed by providing access to relevant training and education, upgrading jobs and wages based on skills and ability, and encouraging women's participation.

45. The transition of the global energy system is leading us towards an innovative future, offering an opportunity to transcend the current global economy in favour of a more sustainable one. Equal gender participation in this endeavour can help society leap to a future of technological advancement in the energy sector. It is disappointing to note that the participation of women continues to be low across the spectrum of the energy sector, from policymaking to the labour workforce.

## **X. Recommendations**

46. The report identified the following possible recommendations for priority actions that countries and firms can take to encourage the participation of women in the energy sector:

(a) Adoption of a low-carbon energy pathway: This will drive countries towards a structural economic shift by driving technological innovation, creating jobs, and developing opportunities to build a greener and sustainable economy;

(b) Invest in technological development: The development of national policy instruments across economies - including public investments, phased elimination of fossil fuel subsidies, market mechanisms, and regulatory frameworks - is imperative and goes hand-in-hand with the development and implementation of technological solutions;

(c) Promote change on demand-side: Awareness-raising on energy efficiency and automation technologies can help decrease power demand; developing regulations and guidance can support changes in consumption patterns;

(d) Challenge social and cultural perception: Empower women by helping them develop skills to build confidence to address cultural norms that may discourage them from participating in sectors like energy;

(e) Information and data collection: There is a need for the collection, monitoring, evaluation, and publication of data regarding the participation of women in the energy sector. Analyzing such data can help in promoting policies and monitoring trends in the gender gap;

(f) Ensure national energy security: Transitioning towards sustainable energy can create direct and indirect job opportunities in the energy sector and develop opportunities for building new supply chains. This transition can create opportunities for investment, entrepreneurial activities, and the development of a skilled workforce. There may also be significant potential in building local supply chains;

(g) Non-discrimination in property rights and access to finance: Ensure there is no gender-based discrimination in property rights and access to finance;

(h) Networking and mentoring: Promote mentorship platforms to preferentially encourage women professionals and subject matter experts from the energy sector to support connections among the female workforce through networking;

(i) Capacity development: Provide opportunities for women to access training and education programmes that improve entrepreneurship and technical skills; this will increase their opportunities for participation in the energy sector and its subsectors;

(j) Green economic recovery: Financial investments in the energy sector, supporting innovation, green growth, and sustainable development can create multiple opportunities for women to participate in "build back better" and promote low-carbon solutions during the socioeconomic recovery from the COVID-19 pandemic;

(k) Capacity building through upskilling the current workforce: Provide access to training to improve current skillsets; this can help in career development and future opportunities;

- (l) Review gender diversity gaps: Assess human resources policies to review the gender gap and analyze best practices adopted by other industries and organizations;
  - (m) Promote networking and mentoring: Promote networking group platforms for women within the organization and across the industry. A mentorship program can be beneficial for new entrants.
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