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GENDER AND ENERGY: OPPORTUNITIES FOR ALL

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Global Trends Impacting Gender Equality in Energy Access^{*†}

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Abstract Achieving a just and equitable transition to a sustainable energy system will rest on efforts to address gender inequality. Women in developing countries are impacted by energy poverty in far greater numbers than men, and they do not have the same opportunities as men to take advantage of emerging opportunities that can help deliver energy access for marginalised populations. This article, geared to policymakers, brings attention to six global trends – decentralisation of energy services, affordability, mobile payments, women’s entrepreneurship, urbanisation, and humanitarian settings. Achieving energy access for all, as called for under Sustainable Development Goal 7, will require attention to the ways in which these trends drive or hamper gender equality in energy access.

Keywords: energy access, energy poverty, gender equality, decentralisation of energy services, affordability, mobile payments, women’s entrepreneurship, urbanisation, humanitarian settings, Sustainable Development Goals.

1 Introduction

Energy systems are undergoing rapid, significant, and disruptive change. A number of major trends² are under way that could catalyse the closing of energy access gaps around the world. Positive trends include the decentralisation of energy generation and distribution to reach remote areas, rapidly declining technology costs, the proliferation of mobile connectivity for communication and finance, and the increase of women’s business ownership in some developing countries. Trends that are problematic for energy access include the increasing populations in urban informal settlements and in humanitarian settings.

However, gender inequality impedes the leveraging of these trends to expand energy access to those who need it most. Women in developing countries are impacted by energy poverty in greater numbers than men, and they do not have the same opportunities as men to take advantage of emerging opportunities that can help deliver energy access for marginalised populations (ENERGIA 2019). Fewer women than men

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This article is part of *IDS Bulletin* Vol. 51 No. 1 February 2020 ‘Gender and Energy: Opportunities for All’; the Introduction is also recommended reading.

Table 1 Trends carrying gender implications in energy access

Trend	Implications for gender equality
Decentralisation Energy services are increasingly decentralised	The expansion under way of off-grid and mini-grid energy access solutions presents new opportunities to close gender gaps by reaching those not served by the grid
Affordability Energy services are increasingly affordable	With improving technology and increasing scale, energy services are becoming less expensive and consumer financing packages help to put connections within reach
Mobile payments Access to mobile payments is expanding	Mobile money and other digital innovations can be leveraged to propel women's access to off-grid and clean cooking solutions, as well as their entrepreneurship
Entrepreneurship Women's business ownership is on the rise in many countries	The upward trend in women's entrepreneurship is an opportunity to expand energy access by empowering women to help close the access gap at the last mile, reaching those who would not be reached by business-as-usual approaches
Urbanisation The world's population is increasingly urban	Securing reliable electricity and clean cooking access for women and men living in slums and peri-urban areas enables livelihoods, as well as the legitimacy and economic contribution of urban settlements
Humanitarian settings More people live in humanitarian aid settings	Humanitarian agencies should shift away from diesel-generated power towards renewable-powered electricity and provide clean cooking solutions to pre-empt the need for residents to collect firewood

Source Author's own.

own mobile phones (Intel 2013), gain access to financing (World Bank 2017b), or even have a voice in household decision making on energy matters. These realities hinder the potential for achieving universal access to sustainable energy by 2030, as called for under Sustainable Development Goal 7 (SDG 7). Delivering sustainable energy to all women and men and their children requires a greater focus on gender equality in both the delivery of and the beneficiaries of sustainable energy services.

This article brings attention to the ways in which key global trends drive – or hamper – gender equality in delivering sustainable energy solutions. The research was carried out during 2017–18 for the development of the *Levers of Change* report, which was published by Sustainable Energy for All (SEforALL) and ENERGIA, International Network on Gender and Sustainable Energy, and funded by the UK Department for International Development (DFID) (SEforALL 2018). The primary audience of that report, and thus this article, is policymakers and practitioners.

The six selected trends are: (1) decentralisation of energy services, (2) affordability, (3) mobile payments, (4) women's entrepreneurship, (5) urbanisation, and (6) humanitarian settings (see Table 1 for a summary of gender implications). The criteria used to select trends were: global significance and magnitude of the trend, including any evidence of the trend's urgency; availability of evidence to demonstrate correlation to gendered and inclusive access to electricity and clean cooking; balance of trends that are economic, social, or technological in nature; readiness of interventions that could be pursued by policymakers and, secondarily, other actors in the external audience; and potential alignment with the mandates of project partners SEforALL and ENERGIA.

The article first reviews why gender equality is important in energy access. Section 3 follows with a summary of how each trend impacts gender equality in energy access, and Section 4 concludes with suggested policy implications.

2 Why gender equality matters in energy access

Achieving a just and equitable transition to a sustainable energy system will rest on efforts to address gender inequality (ENERGIA 2019). To close the global energy access gap, governments and other actors need to reach the 1.06 billion people worldwide who do not have electricity and the 3.04 billion people who do not have clean cooking solutions (IEA and World Bank 2017).

2.1 The global energy access gap is gendered

Women in developing countries – who make up the majority of those living in extreme poverty – are those most affected by energy deficits. Equally important, or perhaps more important, women are key agents in tackling energy poverty. Women are the primary energy managers in households and are economic actors positioned to drive economic growth (ENERGIA 2019). They are uniquely networked with energy consumers in poor households, a particularly critical role at the 'last mile' where centralised grids are out of reach (Glemarec, Bayat-Renoux and Weissbein 2016; Gray, Boyle and Yu 2016). Yet women face tremendous barriers in accessing land tenure and financial services (World Bank 2017b), and they are more vulnerable to climate-induced weather events. Without access to clean cooking solutions, millions of women and children face significant illness and premature death from indoor air pollution. In addition to the devastating impact on quality of life and wellbeing, women and girls are forced to divert multiple hours per day collecting biomass for cooking, time that could be spent on educational and productive activities (Duflo, Greenstone and Hanna 2008).

2.2 The potential of policy frameworks, and the challenge of implementing them

The global policy frameworks on sustainable development and climate change, which intend to support those most affected by energy poverty, have made headway over time in integrating a gendered response in

policy language. However, the implementation of these goals and plans remains a challenge.

Through the 2030 Agenda for Sustainable Development, governments committed to leave no one behind and to prioritise those furthest behind in achieving the SDGs. Linkages between the SDGs give light to an overall agenda committed to addressing gender inequalities in energy access. Universal access to affordable, reliable, sustainable, and modern energy, SDG 7, is a fundamental component of achieving SDG 1, ending poverty in all its forms everywhere. Both of these goals are linked to SDG 5 on women's rights to economic and natural resources, the enhanced use of enabling technology, and the prevention of violence against women and girls. Other important linkages include SDG 13 on climate change action and the Paris Agreement, which recognised the intersection of climate change and gender equality.

While significant activity is already under way at the intersection of these SDGs, addressing gender equality is not always at the forefront in their implementation. In voluntary reviews of how the SDGs are being implemented, governments report on developing renewable energy sources and connecting households to the energy grid in rural areas, but they encounter challenges in the high upfront cost of modern energy and addressing energy deficits in remote areas. Governments have pointed to legal and institutional mechanisms that exist to support women's rights, and the need to integrate a gender perspective in policy and budgeting, but report that such efforts are stymied by the low level of women in decision-making in the public and private spheres and prevailing social norms that perpetuate gender inequality (UN DESA 2017).

Implementation of the global climate change policy framework (United Nations Framework Convention on Climate Change) also struggles to put women at the centre of access to renewable energy. Following the Paris Agreement, countries outlined post-2020 actions to reduce emissions, many of which charted complementary efforts to enhance energy access. While more than half of the Nationally Determined Contributions (NDCs) submitted by sub-Saharan African countries recognise the importance of affordable and reliable energy access to development, only 40 per cent of the NDC submissions reference gender equality or women. And among these countries only a few highlight the participation of women in energy decision making and in sustainable energy programmes and training (UNDP 2016).

2.3 Leveraging global trends could catalyse action

The context of our rapidly changing world is highly relevant to tackling energy poverty, and in the case of gender equality it may be possible to leverage the trends described in this article. Knowledge of these global trends could influence decisions on how energy is delivered and financed, and the contributions of and impacts on women and men. Changes over time in the global and national context could significantly alter the pathway towards achievement of energy access for all and the

SDGs by 2030. Employing a gender lens helps identify populations that are most in need of targeted support to meet these goals. Policymakers could propel energy access strategies from the perspective of how they would be best designed and deployed to reach both women and men. The trends described herein point to risks that might throw off policy and planning, as well as options for accelerating opportunities and leapfrogging ahead of existing timelines.

2.4 Background of this article

The research was undertaken as part of a scoping study commissioned by SEforALL and ENERGIA and funded by DFID (SEforALL 2018). The intention was to explore and bring visibility among policymakers to the role that select global trends play in achieving gender equality in energy access. While evidence abounds on the ways in which energy access drives economic growth, alleviates poverty, and delivers other socioeconomic benefits, less is known about how trends are impacting gendered energy access. An improved understanding of the gender aspects of these trends could support policymakers in shaping policy and finance decisions to enhance the delivery of the 2030 goals.

Owing to the broad landscape of the six trends studied, the research was designed as a scoping study capturing available evidence on each of the trends. The methodology consisted of: (1) a literature review spanning regions and sub-regions with energy access gaps for electricity and clean cooking, including Africa, Asia, and the Pacific, and Latin America and the Caribbean; (2) interviews with 33 representatives of institutions engaged in research and policy work in this arena; and (3) input and peer review from a Steering Committee.

3 Global trends

It is unlikely that achieving universal energy access will come to fruition using business-as-usual approaches. The strategies employed by governments and organisations to expand energy access will need to keep pace with significant change under way in the energy sector, in national economies, and in local communities. Six global trends affecting the modes by which energy is delivered are presented below, along with implications for gender equality.

3.1 Decentralisation of energy services

The expansion under way of off-grid and mini-grid energy access solutions presents new opportunities to close gender gaps by reaching those not served by the grid.

3.1.1 Trend overview

The way that energy is distributed is changing from centralised grids to a mix of on-grid and off-grid solutions. Off-grid energy service companies, marketing household solar electricity systems that can support varying bundles of light-emitting diode (LED) lights, mobile phone chargers, radios, fans, and/or super-efficient televisions, have emerged as a disruptive force. For households without any access,

these new services can mean additional hours of running a business or studying. But higher levels of electricity supply capacity are also important, as they enable broader use of appliances and other equipment for productive activities (SEforALL and Power for All 2017). Commercially viable mini-grid business models that can supply those levels of electricity have proven more elusive, but enthusiasm for that prospect remains. Mini-grids can provide a higher, more sophisticated level of electricity, supporting income-generating activities such as water pumping or grain milling and threshing for agriculture, or cold storage to keep dairy, meat, fish, and other products chilled and free from spoiling for a longer duration. Mobile communication technology is helping to propel the reach of these decentralised energy systems, as mobile banking and mobile payments unlock new business models. About 634 million people without electricity, or 53 per cent of the global unelectrified population, are already covered by mobile networks (Nique and Smertnik 2015), driving demand for accessible, affordable power-charging facilities – such as those supported by decentralised renewable energy (DRE) systems. Decentralised systems have been shown to increase the possibility of reaching remote populations (Practical Action 2017) and these solutions are expected to provide the majority of new access connections by 2030. Achieving energy for all will require off-grid solar photovoltaic (PV) or mini-grid connections for an estimated 72 per cent of those gaining new access (IEA 2017a).

3.1.2 Gender implications

Growing evidence suggests that decentralised systems can drive women's use of energy for income-generating purposes and, therefore, economic empowerment. Decentralised technologies extend the benefits of modern energy services – including reduced drudgery, time savings, and health and safety – to women and families who live beyond the reach of the central grid. Examples abound of decentralised technologies impacting women's health and wellbeing in remote areas. In Africa, electrifying clinics for lighting and medicine refrigeration has been found to improve maternal health (World Bank 2017a). In Indonesia and India, there is evidence linking television access to reduced family size, less domestic violence, and increased autonomy for women, owing to new norms presented in the media (Grimm, Sparrow and Tasciotti 2015; Jensen and Oster 2009). And the presence of public lighting delivered by stand-alone mini-grid systems has critical benefits for the safety of women and girls (World Bank 2017a). While there are some limitations and unexpected consequences of expanded electricity access, such as non-productive activities being pushed aside (Winther 2008), and it is not clear how access impacts gender relations, there is substantial evidence of a positive impact on women's welfare (Winther *et al.* 2017).

Employment and entrepreneurship in decentralised energy has the potential to become a major source of income generation for women, throughout the energy value chain (Pearl-Martinez 2014). Although there is currently an imbalance in women's representation in the renewables industry, this is slowly changing, and the number of jobs

in solar, bioenergy, hydropower, and wind is growing rapidly, with the potential to reach 15–24 million jobs by 2030. The off-grid sector could create 4.5 million jobs by 2030, particularly in solar PV, and additional indirect jobs will emerge through entrepreneurship (IRENA 2017b). As outlined further in Section 3.4, tapping into women's income-generating opportunities made possible by decentralised power systems (where the alternative would be no power at all) could be a win-win both for access to energy and for gender equality. As women become engaged as sales agents for clean cooking solutions and off-grid service connections, they are also empowered economically. However, the existing barriers that need to be overcome to facilitate women accessing such opportunities cannot be ignored. In rural Kenya, women were found to have less control over decision making about appliances and lighting – regardless of whether electricity came from the grid, mini-grid, or solar home system – because men paid subscription fees and registered as the customer (Winther, Ulsrud and Saini 2018).

3.2 Affordability of energy services

With improving technology and increasing scale, energy services are becoming less expensive and consumer financing packages help to put connections within reach.

3.2.1 Trend overview

Affordability of decentralised options is a key determinant in electrification at the last mile. The least-cost solution for providing energy access to three-quarters of those in sub-Saharan Africa is through decentralised options, particularly solar off-grid and mini-grid systems (Glemarec *et al.* 2016). For those without access to the grid, spending on lighting and mobile phone charging with kerosene, candles, battery flashlights, and similar technologies amounts to US\$27bn per year (Lighting Global and GOGLA 2016). The cost of appliances has an impact on women's economic empowerment and agency. Solar-powered home electricity systems are frequently bundled together with highly efficient appliances by off-grid energy service companies, and consumer financing is available via monthly instalments for the whole package. Affordability is one of the drivers of the expansion of pico-solar. Consisting of a solar panel and battery supplying LED lamps and a mobile phone charging port, and providing up to 15 watts, pico-solar accounted for 94 per cent of all off-grid solar sales in 2016, mostly in South Asia and sub-Saharan Africa. The overall cost of pico-solar units has decreased significantly in recent years, resulting in 59 per cent of all pico-solar units in sub-Saharan Africa priced below US\$20 (Nygaard, Hansen and Larsen 2016).

The uptake of clean cooking technologies is also influenced significantly by cost. The upfront cost of improved cooking appliances, as well as alternative fuels such as liquefied petroleum gas (LPG), has been a major barrier. Clean cooking technologies are not expensive enough to be a cost-effective offering of microfinance institutions or banks (GACC 2015a). Although it is a fossil fuel with environmental drawbacks and not without safety hazards, LPG is a step forward from biomass cooking

for health and climate change outcomes (Rosenthal *et al.* 2018). In urban areas, LPG use has been increasing and its expansion in developing Asia is expected to make up the majority of global expansion through 2030, despite the 2.3 billion people worldwide projected to remain without access (IEA 2017a). In rural areas, poor infrastructure and infrequent delivery of LPG cylinders are part of the equation of low supply and, on the demand side, the prohibitive cost and distribution challenges are compounded by limited awareness at the household level of the benefits of alternative fuels (Cecelski and Matinga 2014).

3.2.2 Gender implications

It is more expensive to provide access to rural areas than to urban areas owing to the need for lengthy transmission infrastructure and technical losses along the way, and rural populations usually have less disposable income than those in urban areas. For remote communities, mini-grid and off-grid systems are often a more cost-effective avenue than grid extension because, in the absence of substantial public subsidies, the connection cost is prohibitively high. In a study of clean cookstoves, the impact on household expenses and attention to the needs of end users was found to be as important as the cost of the cookstove itself (Riley 2014).

The upfront costs of solar home systems have also remained a barrier, but these systems have demonstrated benefits to women through savings on kerosene, better quality light, enhanced child welfare, and increased self-respect and empowerment (Winther *et al.* 2017). For poor energy consumers, affordability is determined by whether there are consumer finance options available, such as pay-as-you-go or lease-to-own. These options, typically financed by the energy service company, spread out repayment of the upfront capital cost over time (SEforALL and Power for All 2017). For many poor women, however, access to consumer finance is constrained by the additional hurdle of being outside the formal financial system, lack of access to mobile payments, and not having control over household decision making (Demirguc-Kunt *et al.* 2014). Pico-solar provides only a basic level of energy services, but it is beneficial to those without access as it displaces kerosene, which produces harmful smoke; enables financial savings once the investment cost has been recouped by what daily outlays to purchase kerosene would have been; and provides a higher quality of light that enhances study time (SEforALL and Power for All 2017).

3.3 Mobile payments

Mobile money and other digital innovations can be leveraged to propel women's access to off-grid and clean cooking solutions, as well as their entrepreneurship.

3.3.1 Trend overview

The energy sector is increasingly digitalised. Appliances, buildings, vehicles and transportation systems, and industry value chains are becoming *smarter* and there is greater connectivity between people and between devices, particularly through the internet and mobile phones (IEA 2017b). The emerging network of devices embedded

with the ability to connect and exchange data is improving efficiency and extending technologies and services to new spheres. For example, cloud-based metering and software platforms can be paired with mini-grids and telecom towers, which require electricity. Together, these digital solutions serve as anchor loads to provide the consistent demand that mini-grids need to operate, and they can support further investment in expanding electricity supply to remote communities. The digital revolution is propelling new modes of financing solar home systems, especially in geographic areas that are too difficult or costly for the grid to reach. When mini-grid and off-grid electricity providers have access to the internet and communications, this can accelerate expansion of energy access, especially as a tool for cashless payments that reduce the cost of many small-scale transactions and improve customers' repayment rates (Modi and Figueroa 2015). Despite these possibilities, digital connectivity is not a panacea, as access to mobile and internet technologies is irrelevant if electricity is not available.

3.3.2 Gender implications

There is emerging evidence that digital connectivity may have a leapfrogging effect in relation to poverty reduction. Between 2008 and 2014, Kenya's mobile payments system lifted 200,000 families out of poverty, equal to about 2 per cent of the country's households. The impact of access to mobile payments was more pronounced for women, whose access to mobile money prompted a switch to business or retail occupations over farming (Suri and Jack 2016). Access to mobile technology by women and those in remote locations is also a key determinant in the expansion of new financial models. Mobile finance can help women access energy products and services, as well as support services for agriculture. For women entrepreneurs in developing economies, digital commerce and other technologies can overcome limited access to finance, time constraints, mobility, and skills and training (UNCTAD 2017). Access to mobile finance also enables women to invest in businesses and pay for their families' education and health needs (Lewis, Villasenor and West 2016). New digital approaches are being used to improve adoption of clean cookstoves, such as in India, where women are paid through a system of climate credits to use stoves and fix them when they break (Ramanathan *et al.* 2017). Other aspects of digitalisation may also be beneficial to women. The declining costs of solar PV and batteries means that greater amounts of energy can be stored 'behind' the household electricity meter (IEA 2017b), which is an opening for women as household energy managers to assume more control.

However, women may remain excluded from the benefits of mobile payments unless the gender divide in access to digital and energy technologies and services is addressed. Women in developing countries have significantly lower rates of digital literacy than men. A study by Intel found that 25 per cent fewer women than men across developing countries had internet access, largely due to the high cost of a connection (Intel 2013). While global access to mobile phones is

increasing, a substantial gender gap remains in low-income and middle-income countries. Women in these countries are 10 per cent less likely than men to own a mobile phone, or 184 million fewer women than men, due to women's lower levels of education and income (GSMA 2018). Social norms are also at play in many communities, as the use of mobile phones is sometimes deemed inappropriate for women and girls.

3.4 Entrepreneurship

The upward trend in women's entrepreneurship is an opportunity to expand energy access by empowering women to help close the access gap at the last mile, reaching those who would not be reached by business-as-usual approaches.

3.4.1 Trend overview

Globally, the number of women engaged in entrepreneurial activities is growing steadily, although some regions are not seeing this increase. The 2018 Mastercard Index of Women Entrepreneurs concludes that, while there is much room for improvement, women's advancement as entrepreneurs is 'adequately healthy' in the majority of regions. While Ghana and Uganda have high proportions of women business owners, sub-Saharan Africa and the Middle East are lagging behind other regions (Mastercard 2018). Similarly, the 2014 Gender Global Entrepreneurship and Development Index finds a high level of 'female entrepreneurial drive' in certain African countries – Ghana, Nigeria, South Africa, and Uganda – but, as a whole, sub-Saharan Africa has fewer female entrepreneurs (GEDI 2014). In developing countries, women's business leadership is more prevalent in smaller firms – just under 40 per cent of small companies compared to half that for medium-sized companies (IFC 2011).

The increase in the rate of women's entrepreneurship parallels a surge in international dialogue and investment in women's economic potential. This is signalled by the establishment of the High-Level Panel on Women's Economic Empowerment by the United Nations (UN) Secretary-General in 2016 (UNHLP 2016), new global investment mechanisms such as the Calvert Foundation's Women Investing in Women Initiative and Goldman Sachs' 10,000 Women initiative, and numerous leadership and award programmes to catalyse women's leadership in business, science, technology, engineering, and mathematics (Stengel 2016). This new wave of support for investing in women draws on analyses correlating gender equality with global economic growth (Mastercard 2017; GEM 2017).

3.4.2 Gender implications

The expansion of sustainable energy, especially to remote areas, may depend on women's engagement as entrepreneurs, owing to the unique relationship they have with female energy consumers. Women's household decisions about energy afford them a nuanced understanding of their customer base and supply chain, which can translate into a minimal business cost in identifying and securing customers. Women entrepreneurs demonstrate an advantage in managing supply

chains and reaching customers in rural areas (Glemarec *et al.* 2016; Gray *et al.* 2016) and there are examples of women outperforming men in selling energy products, including solar lanterns and cookstoves. In these studies, women's success is attributed to their ability to influence members of their community, the broad networks within which they have relationships, and their understanding of women's particular energy needs (Soria, Farley and Glinski 2016; GACC 2015b). Supporting women's businesses may bring greater return on investment, as studies confirm women are a lower credit risk and repay loans more frequently than men (Zelizer 2011). Women's business success also translates into reinvestment in families and communities, as women entrepreneurs are more likely to spend earnings on children's education and health, compared to male entrepreneurs (Pazarbasioglu 2017).

Yet in developing countries, 70 per cent of women with small and medium-sized businesses are not accessing financing, amounting to nearly US\$300bn per year (World Bank 2017b). Women face more bottlenecks to building businesses than men. Existing evidence catalogues the significant and wide-ranging barriers restricting women's business ownership, including lack of access to capital, regulatory restrictions, isolation from business networks and intermediaries, lack of access to market data and information, discriminatory cultural and gender norms, lower levels of education and business experience, limited female role models and mentors, and competing demands of household and family responsibilities without access to childcare (GEM 2017). Studies also show that expansion of women's entrepreneurship requires support beyond the business realm. Tackling broader gender barriers – for example, addressing improvements in health and education, gender-based violence, childcare, land and property rights, and rural electrification – are equally important (Buvinic and O'Donnell 2016). Women were found to be less likely to develop into independent entrepreneurs in the renewable energy sector in the absence of broader skills development, support for entering established renewable energy supply chains, and changes in social norms that designated the installation of solar home systems as a male domain (Glemarec *et al.* 2016).

3.5 Urbanisation

Securing reliable electricity and clean cooking access for women and men living in slums and peri-urban areas enables livelihoods, as well as the legitimacy and economic contribution of urban settlements.

3.5.1 Trend overview

By 2050, about 68 per cent of the world's population will live in cities (UN DESA 2018), and currently one in eight people globally live in slum conditions (UN-Habitat 2016). In the fastest growing cities, electricity generation does not always keep pace with demand, leading to voltage fluctuations, brownouts and blackouts, and unreliable service. Electricity supply often prioritises large-scale commercial and industrial needs, rather than the smaller enterprises of the urban poor. The result is that the urban poor are forced to rely on polluting fuels for cooking,

to the detriment of city air quality, or to install diesel generators to have access to reliable (although dirty and expensive) electricity. In urban areas, grid connections are expected to be the most cost-effective means of expanding electricity access by 2030. However, shifting to cleaner cooking fuels, such as LPG, is also central to expanding energy access and would lead to the most dramatic reduction in both indoor and outdoor air pollution (Westphal *et al.* 2017). LPG is projected to provide access to 90 per cent of those in urban areas gaining access to clean cooking by 2030. While there are success stories in urban areas of China and Indonesia of fuel switching from traditional biomass to LPG, at a global scale, 2.3 billion people are projected to remain without access to clean cooking by 2030 (IEA 2017a).

3.5.2 Gender implications

Urban environments provide economic opportunities and facilitate proximity to energy supplies, yet women and men living in informal urban settlements have a harder time accessing energy. About half of those living in slums depend on unpaid connections to electricity, leaving utilities without revenue (Danielsen 2012). Those without a formal electricity connection may resort to illegal means of connection or use expensive and unsafe fuels, sometimes being charged higher prices by illegal intermediaries. There is some evidence pointing to insecure property tenure preventing female-headed households from accessing energy (Heinrich Boll Stiftung 2016). In urban areas without street lighting, gender-based crime is a major problem, particularly because sanitation facilities are located at a distance from households. Electrification efforts are obstructed by the lack of coordination between housing and energy initiatives, and public subsidies are not sufficient to make energy access adequately affordable. The realities of poor urban households are also missing in national energy policy. Informal settlements in cities may not be recognised by authorities and fall in the gap between national energy ministries, urban energy companies, and rural electrification agencies (Danielsen 2012).

3.6 Humanitarian settings

Humanitarian agencies should shift away from diesel-generated power towards renewable-powered electricity and provide clean cooking solutions to pre-empt the need for residents to collect firewood.

3.6.1 Trend overview

The number of people who are forcibly displaced has nearly doubled in the past two decades – up to 65.6 million people as of 2016, half of which are women (UNHCR 2016). Of these, 8.7 million people live in refugee camps with minimal access to electricity, relying on collected fuelwood for cooking (Lahn and Grafham 2015). The vast majority of refugees are hosted by developing countries, where governments often have less surplus capacity to provide additional energy services (Morales 2017). While many displaced people are housed in camps hosted by countries other than their own, many more are internally displaced and similarly lack modern energy provisions. Humanitarian

relief settlements can range in size from large towns to small cities and while the residents are there – in theory, only temporarily – they require energy for household cooking and lighting and community services such as power to operate schools and health centres, refrigerate medication, pump water, and support administration staff functions.

Decentralised renewable energy options such as solar-powered mini-grids with diesel or batteries for backup, are recognised as options by these humanitarian agencies, but are not yet the go-to solution. When electricity is available, it is typically delivered through diesel generators, at great operational cost due to the expense of fuel deliveries. Humanitarian agencies are short on energy expertise and on systematic long-term energy planning and management. While financing is needed for energy supply solutions that span both emergency and recovery periods, humanitarian funding is often short term and politically oriented, in quick response to emergencies that soon fall off the radar (Lahn and Grafham 2015). In addition, a challenge for humanitarian agencies is that installing more durable energy supply infrastructure in humanitarian settings can signal the potential permanence of these settlements to wary host governments (Morales 2017). Governments grapple with tensions between refugees and host communities caused by competition for fuelwood, as almost 65,000 acres of forest are burned for fuel each year by people living in refugee camps (Lahn and Grafham 2015).

3.6.2 Gender implications

Access to non-traditional energy sources, particularly in humanitarian settings, is a matter of protecting women's and girls' lives. Firewood collection for household energy is often a dangerous task. Reports abound from Chad to Sudan of women experiencing physical aggression, theft of property, or rape during trips outside camps to collect firewood. Women are discouraged from reporting sexual assaults owing to cultural expectations or because firewood collection outside camps is illegal in many countries (Lahn and Grafham 2015). This is compounded by the insecure legal status of people living in camps (Morales 2017). The health impact of cooking with traditional fuels is substantial, especially for women and girls, as an estimated 20,000 forcibly displaced people face premature death from indoor pollution each year (Lahn and Grafham 2015). Not having to collect firewood also facilitates time available for women's economic and educational activities in these camps (UNHCR 2012). The availability of electricity for street lighting can also keep shops and public spaces open later and generally improve the lives of those in humanitarian settings, especially women. In one example from the Goudoubo refugee camp in Burkina Faso, only 3 per cent of those who leave the house after dark are women, due to the lack of public lighting (Vianello 2016).

4 Policy implications

As introduced at the outset of this article, the national roll-out of the international agreements on sustainable development and climate change demonstrate that more attention needs to be directed towards

gender equality. Bridging the gender gap in access to sustainable and modern energy is not primarily a question of technology. Instead it is a question of organising energy delivery in a way that navigates existing inequalities and responds to the central roles played by women as energy managers and consumers. The prevailing investment approach to energy access is not organised to address these realities and thus perpetuates gender inequalities (Ngum 2016). The results of this are palpable – countries experiencing higher levels of gender inequality also have lower levels of electricity access (O'Dell, Peters and Wharton 2014). This article concludes with an overview of policy implications for each of the six trends discussed above.

4.1 Expanding decentralised energy services based on gender gaps

Government decision-making on energy rarely reflects gendered realities, partly because ministries do not collect adequate data on household and income-generating energy usage and needs. Globally, sex-disaggregated and gender-relevant data and evidence is very limited, including on access to and use of energy, decision making, household division of labour, productive uses of energy, and entrepreneurship (SEforALL 2017).³ Greater policy coherence between gender policy and renewable energy planning, as well as gender-disaggregated data collection, would help ensure that decentralised energy services are expanded in a manner that delivers specific benefits to women.

4.2 Leveraging affordability to expand services to women

Policymakers should assess what women and men can afford in specific contexts and address cost barriers, taking advantage of dramatic reductions in technology costs and the integration of technologies and new business models. Targeted mobile phone surveys and other 'lean data' approaches enable vastly better data collection than was previously possible (Acumen 2017). Achieving universal energy access will require policies that address not just the energy sector but also banking, financial, and infrastructure policies that lower the cost of grid and off-grid electricity and clean cooking solutions (Pachauri *et al.* 2013). Improving women's technology choices could be enhanced through access to credit and the collection of data that monitor how they use energy (UNIDO 2015).

4.3 Bridging the digital gender divide

Expanding women's access to mobile finance has the potential to expand local markets and reach more of those without access to electricity and clean cooking solutions (IEA 2017a). First and foremost, mobile money has to be expanded, especially in less-developed countries where a lack of these services persists. Attention should be focused on the gender digital divide when making decisions about how to expand mobile money; for example, by considering the needs of female-headed households. Global technology companies moving to connect rural areas in developing countries to their services should consider women's and men's needs, including energy needs that could benefit from solar home systems and mini-grids, as well as the application of

pay-as-you-go models to finance irrigation pumps, LPG canisters, and biogas systems (GSMA 2017).

4.4 Creating a business and regulatory environment supporting women's entrepreneurship

Given that legal and regulatory structures protect women's business activities as well as men's, countries with stronger rule of law and greater women's political empowerment also have higher rates of women's entrepreneurial activity (Goltz, Buche and Pathak 2015). To propel energy access, policymakers need to create a business and regulatory environment that supports women-owned small and medium-sized enterprises, as well as other aspects of their wellbeing. While financing targeted to the needs of women-led businesses is key, support beyond financing is critical to women's economic empowerment. Employment and entrepreneurship in decentralised energy could become a major source of income generation for women, especially at the base of the energy ladder but also further up the value chain (Pearl-Martinez and Stephens 2016; Glemarec *et al.* 2016). The number of global renewable energy jobs (direct and indirect) could reach 15–24 million by 2030 (IRENA 2017a). The off-grid sector could create 4.5 million jobs by 2030, particularly in solar PV, and additional indirect jobs will emerge through entrepreneurship (IRENA 2013).

4.5 Formalising energy access in informal urban settlements

Policymakers need to circumvent tenure and payment barriers for women and men living in slums and peri-urban areas. Municipalities, national energy ministries, and other agencies responsible for energy supply should be sensitised to the needs of women in informal settlements, collect data on those populations, and address the unique barriers faced by women and men in securing access to energy in these environments. Given the reliance of poor households on cooking fuels that cause indoor (and outdoor) air pollution, solutions should include clean cooking technologies and fuels, in addition to electricity and solar home systems. Subsidised tariffs must be designed to ensure true affordability for those most in need, particularly female-headed households. Alternative payment arrangements to alleviate upfront costs can include monthly instalments and prepaid connections. To facilitate legal connections to electricity and LPG for those without proof of land or property ownership, agencies should accept alternative forms of proof of address.

4.6 Regularising energy services in humanitarian settings

Equitable access to sustainable energy should become a formal – and central – component of humanitarian aid. Sustainable technologies and clean fuels should be prioritised in humanitarian settings, and replacing diesel generators with DRE systems can reduce long-term fuel and other operational costs (UNHCR 2012). To start, international policy frameworks, humanitarian organisations, and national governments need to adopt coordinated energy access goals and guidelines for displaced people, ensuring that women's needs are assessed and clearly

articulated. To deliver on these policies there is a need for increased capacity and funding; coordination among government, UN agencies, and non-governmental organisations that are offering their own divergent solutions in camps; standardised methods for energy-related data collection in camps that reflect the needs of both women and men; and consideration of granting displaced peoples the right to work and access land, which could provide the means for them to pay for energy services, supporting energy delivery solutions (Lahn and Grafham 2015). Both host communities and displaced populations benefit when sustainable energy services are delivered at lower cost and facilitate an integration of these populations (Morales 2017). Host country officials appreciate the benefit of saving scarce natural resources from fuelwood collection. Ideally, refugees entering a humanitarian camp would receive a suitable cookstove and fuel, and a solar lantern, as well as training on any new technology (UNHCR 2012).

Notes

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- 1 Rebecca Pearl-Martinez, Department of Geography, Durham University, UK.
 - 2 The Oxford Dictionary definition of *trend* is 'A general direction in which something is developing or changing', <https://en.oxforddictionaries.com/definition/trend>.
 - 3 For more information on gender data, see SEforALL (2017).

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