Chapter 1
Energy Challenges in the Global South

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Abstract Energy needs at the global level are gigantic and steadily increasing while the need to reduce carbon emissions is vital if catastrophic climate change is to be avoided. In the Global South, a large part of the population still lacks access to energy, which is crucial for poverty alleviation via the creation of employment and better health and education systems. A great deal of hope is placed on sustainable energy to connect economic growth to increased social equity while preserving the environment. At the same time, energy efficiency and the share of renewable energies in the global energy mix needs to increase unceasingly. This book discusses the challenges of solving complex social and environmental problems with technology in the Global South. While encouraging technology interventions are presented, the limits of technology and the untapped potential of involving women as key stakeholders for energy initiatives constitute also a key focus of this publication. Providing sustainable, reliable, and affordable energy to all will require successful coordination and integration between sectors, stakeholders, policies, infrastructures, and technologies. Promoting renewables, increasing energy efficiency, determinedly addressing the challenges of tailoring solutions to unique socioeconomic contexts, creating local ownership, and aiming for massive upscaling remain the key issues.

1.1 Introduction

In 2014, 1.3 billion people worldwide still lack access to reliable and affordable energy (IEA 2014). At the same time, energy needs will increase by 45 % within the next 15 years (UN 2012). The global electricity demand is growing almost twice as fast as the total energy consumption—a demand that is difficult to meet, even

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more so in view of the missing and aging power sector infrastructure (IEA 2012). A great deal of hope is placed on sustainable energy to connect economic growth to increased social equity while preserving our natural resources. Electricity can empower communities by enabling children to study after dark and clinics to store vaccines and perform life-saving operations. It can improve access to information, security at night, and support the growth of local businesses. The United Nations (UN) launched the Sustainable Energy for All initiative to build the clean energy economies of the future.[1] However, taking into account all new developments and policies, the world still does not have a more sustainable global energy system. Demand will grow by at least one-third until 2035, with India, China, and the Middle East driving 60 % of the increase (IEA 2012) while the world economy might grow threefold in this time (IEA 2012). It will be a formidable challenge to decarbonize the world energy system while also safeguarding that electricity and energy services are accessible to all. Meeting this objective will require a much faster transition to low-carbon energy than what has been achieved thus far (Sachs 2014).

The UN has declared 2014–2024 the decade of Sustainable Energy for All, inciting governments to renew their commitments toward this goal. However, much more needs to be done. The International Energy Agency (IEA) estimates that by 2030, one billion people will still be without electricity and 2.6 billion without clean cooking facilities (2012). In sub-Saharan Africa alone, 600 million people lack access to energy, which is crucial for economic growth. For instance, this region represents 13 % of the world population but only 4 % of the global energy demand (IEA 2014). Only seven countries have electricity access rates over 50 %. The remaining countries in Africa have an average grid access rate of just 20 % (Castellano et al. 2015). Sub-Saharan Africa has significant potential power sources such as solar, wind, and hydropower; however, most effort is concentrated on centralized, large-scale, and grid-based approaches, and few resources are dedicated to providing energy to low-income families.

1.2 The Need for More Efficiency

The challenges of providing access to reliable and affordable energy to all are manifold, intertwined, and highly complex. Increased energy efficiency has great potential to lower energy needs and reduce carbon emissions. It is therefore fundamental that policy makers from different sectors integrate energy efficiency as a key measure to positively influence global energy and climate trends. There are encouraging signs, such as China targeting a 16 % reduction in energy intensity, the European Union (EU) planning for a 20 % cut in energy demand, and Japan aiming to reduce electricity consumption by 10 % by 2030 (IEA 2012). Policy makers

[1](www.se4all.org) accessed 7 April 2015.

increasingly realize that energy efficiency is critical to ensure energy security and sustainable development. However, despite new policies, a large share of the potential to improve the energy efficiency is linked to the construction sector and remains untapped (IEA 2014). Energy efficiency needs more visibility by promoting the economic gains to be made. This must be supported by making energy efficiency more affordable by creating appropriate business models and incentives. Governments have a decisive role to play in the mainstream implementation of energy-efficient technologies, which is central to reducing the carbon emissions and avoiding catastrophic climate change. Nonetheless, the fact that considerable reserves of fossil fuels are still available hinders the willingness to give sufficient importance to improve energy efficiency. Fossil fuels receive six times more in subsidies than renewable energies (IEA 2012). In emerging economies such as China, India, and countries in the Middle East, growth in oil consumption, very much linked to the transport sector, more than outweighs the reduced demand in the OECD countries, steadily increasing oil use (IEA 2012). At the same time, technological progress leads to high-efficiency, coal-fired technologies, and efficient carbon capture and storage mechanisms might allow for a gradual transition to a low-carbon power system (IEA 2014).

The IEA (2012) defines access to modern energy services as a household having access to electricity and to a relatively clean, safe means of cooking. The IEA also considers consumption of a specified minimum level of electricity in its definition; the amount varies based on whether the household is in a rural or an urban area. The source of the electricity can be a grid, a mini-grid, or from an off-grid electricity generating system. This book on sustainable access to energy in the Global South illuminates many of the challenges of providing energy at the household and community level.

1.3 The Potential of Renewables

The importance of renewable energy such as hydro, wind, and solar power is steadily increasing, reinforced by rising fuel prices, falling technology costs, and subsidies (IEA 2012). Emerging and developing countries in particular have the chance to leapfrog to renewable energy sources, jumping the phase of the fixed network and leapfrogging ahead to a flexible system of multiple, interconnected mini-grids. In many emerging countries, renewables already provide the most affordable source of energy for off-grid and mini-grid systems (IRENA 2014). Brazil, for instance, remains one of the least carbon-intensive energy sectors in the world and has become a world leader in renewable energy (IEA 2013). Power generation from renewable sources is growing twice as fast in non-OECD countries and continents, led by China, India, Latin America, and Africa. The largest share of growth in renewable-based power generation at the global level comes from wind power (34 %), followed by hydropower (30 %) and solar technologies (18 %) (IEA 2014). Even though this is a very positive sign, the combination and integration of

different energy sources from a market and technical point of view is becoming more challenging and requires targeted training and capacity building as suggested by MacLeod and Rosei (Chap. 20). Promising new technologies will only be successfully deployed if the expertise to implement, monitor, and maintain sustainable energy infrastructures exists at the global level. Pache et al. (Chap. 21) report on successful capacity-building strategies on environmental monitoring allowing for sustainable energy extraction in Lake Kivu in Africa.

Creating a renewable-based energy system in developing and emerging economies would be a prodigious leap. Renewable energy technologies such as large-scale hydro, geothermal, wind, and solar energy are already providing 30 % of the world's energy needs (IRENA 2014). Wind and solar power are able to compete with non-renewable energy sources while subsidies are decreased. Solar photovoltaic prices have decreased by 80 % since 2008, and onshore wind electricity has decreased by 18 % (IRENA 2014). Total investment in renewable energy has more than quadrupled, from US$55 billion in 2004 to US$214 billion in 2013. This will not be enough to avert serious climate change, which will require investments of at least US$550 billion per year (IRENA 2014), but it shows that a significant change over a relatively short period of time is possible.

1.4 Socioeconomic Benefits of Energy Access

Providing low-income families access to energy is considered central to poverty alleviation. In Chap. 3, Leopold et al. argue that despite a substantial political effort at the global level, low-income families might not be the ones to benefit. In an effort to change this, the nongovernmental organization *Practical Action* has developed an Energy Market System Framework to support the creation and maintenance of sustainable energy markets that enable access for the world's poorest people. However, providing access to energy is not enough. As Attigah et al. describe in Chap. 4, electrification needs to be coupled with productive uses in order to achieve socioeconomic benefits for the target population. In order to evaluate the impact of projects on the livelihoods of the intended beneficiaries, Mattarolo et al. have developed an energy-specific, people-oriented monitoring and evaluation approach (Chap. 5). Reckerzügel describes a social enterprise in Bali that was founded to transform the used cooking oil into biodiesel, simultaneously creating income, substituting fossil fuel, and contributing to climate change mitigation (Chap. 22). This project, based on an integrated approach, has the potential to become a best practice for used cooking oil transformation in emerging market countries. This will require persuasive political support to create a legal framework oriented toward recycling, a sustainable business model, and continued financial support for further capacity building. Sinha et al. (Chap. 15) discuss the complexity but also the opportunities such projects offer in the context of the large-scale diffusion of biomass thermal gasifiers in India. Klaiber (Chap. 2) argues for integrated approaches that build profitability along the whole value chain, including the development,

implementation, exploitation, and maintenance of appropriate technologies leading to energy security.

1.5 Upscaling

Successful upscaling and ensuring long-term sustainability of improved energy solutions remains at the same time a key challenge and a key necessity. Many improved energy projects are overstating the technical solution and do not survive the end of the financial support ensured during their projects' duration. Others never go beyond the successful prototype stage. Yet others are met with resistance by local governments, as was the case with solar photovoltaics (PV) in South Africa despite the fact that PV technology is able to stimulate economic growth, create employment, and reduce inequalities, as Walwyn's study shows (Chap. 13). Ehrensperger and Wymann von Dach (Chap. 7) discuss several key obstacles to long-term sustainability related to project design, management, implementation, and stakeholder participation. For instance, a case study by Mirza (Chap. 10) on Pakistani solar PV systems illustrates how an exclusive focus on technological aspects that neglects a thorough analysis of the energy needs in the community may result in low local ownership of the project. Similarly, local power dynamics and inappropriate subsidies can hinder project implementation and upscaling. Zalengera et al. (Chap. 9) found that while main grid electricity was too expensive for households on Likoma Island in Malawi, the proposed cheaper energy alternatives were not adapted to local energy needs. This illustrates once again the unavoidable trade-offs that need to be made between tailoring energy solutions to specific local contexts and identifying solutions that can be massively upscaled to the regional or even national level. Certain authors, such as Ngounou et al. (Chap. 6), are convinced that there are no standard solutions and that the key to success lies in developing holistic approaches. In their study of decentralized rural electrification systems, Jain and Kattuman (Chap. 11) share the same view and argue that proper management of socioeconomic, operational, environmental, and economic challenges remains crucial. Based on their findings, they recommend that the transition from success stories to upscaling should be based on standardizing the planning approach while customizing the solution.

1.6 Gender-Blind Technology

Much hope is placed on technology to solve the worlds' most pressing problems; it is very tempting to overstate the potential of technical solutions. However, beside technology, taking the socioeconomic dynamics of a given context into account will be equally if not more important regarding the success of an intervention (Baruah 2015). Technology by itself will not be able to solve complex social and

environmental problems. Baruah and Govindan (Chap. 16) point out that women have less access to new technologies almost everywhere in the world. Nonetheless, the gender implications of promoting new technologies, in particular in the transition to low-carbon economies, remain largely unquestioned. Baruah and Govindan highlight the fact women in science, technology, and energy hold few ministerial positions, and women are rarely considered to be key stakeholders for energy initiatives. They conclude that gender-blind projects and programs by governments, civil society, private sector, or international aid organizations still tend to marginalize women. Fernández-Baldor et al. (Chap. 17) show in their study in Peru how even well-intended technical interventions can reinforce traditional gender roles and entrench intra-household gender inequalities if they do not take into account the fact that technology can contribute unequally to the expansion of people's capabilities. However, gender inclusiveness in the renewable energy sector has considerable potential to support women's empowerment, which technological innovation alone does not guarantee. Skutch (2005) argues that the manner in which an energy service is planned, implemented, and maintained might yield even more positive effects for women than the technology itself.

It is therefore crucial to foster constructive exchange regarding the limits of technology, particularly with respect to the complex problems they are supposed to solve, as Abdelnour points out in Chap. 18. At the same time, using women's empowerment as a pretext and marketing/advocacy platform without rigorously addressing gender inequalities lacks the needed effectiveness in attaining the goal of poverty alleviation. "The unwillingness to fundamentally question the suitability to solve complex problems enables their repackaging as solutions to impending crisis" (Abdelnour 2011).

1.7 Conclusion

Providing sustainable, reliable, and affordable energy to all will require successful coordination and integration between sectors, stakeholders, policies, infrastructures, and technologies. Current climate scenarios predict a long-term average global temperature increase of 3.6 °C (IEA 2014). This will lead to a range of very alarming global changes such as rising sea levels, species extinction, food production crises, and an increase in storms and droughts. However, there are also some positive developments. For instance, the costs of solar PV fell by two-thirds between the end of 2009 and 2013 which has been compared to the speed of change in the information technology revolution. In Denmark, wind has become the cheapest energy source of all. In Germany, almost half of all renewable generation is now owned by households and farmers, marking a profound shift in control (IRENA 2014). Progress in energy efficiency and technology gives some cause for hope, as long as political efforts are sustained—a combination of multiple technologies might offer the most potential. Renewable energy is increasingly seen as the affordable solution to meeting the world's rising energy demand while

mitigating climate change. For instance, Bharadwaj and Bhattacharjee (Chap. 14) investigated the potential of renewable energy-based mini-grids for rural electrification in India and Africa. Many green mini-grid projects have successfully dealt with the challenges of large-scale deployment and led to effective poverty reduction with the help of smart decision tools.

A sustainable future requires making the best choices aiming simultaneously for energy access for all while achieving economic and environmental objectives. As can be seen in the many chapters of this book, renewable energy also has the potential to provide communities currently left off the grid with electric power, opening up a range of new opportunities for socioeconomic development in the fields of education, health, and access to information and communication technology. The International Renewable Energy Agency (IEA 2014) puts forward the most optimistic scenarios, estimating that doubling the share of renewables in the global energy mix, reinforced by greater energy efficiency, could keep atmospheric carbon below the 450 ppm and thereby below the level at which catastrophic climate change would occur. Let us hope that this is indeed still possible. Promoting renewables, increasing energy efficiency, and determinedly addressing the challenges of tailoring solutions to unique socioeconomic contexts while at the same time aiming for massive upscaling, creating local ownership, and including women in posts of responsibility are the key issues to address.

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