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ROBERT SCHUMAN CENTRE FOR ADVANCED STUDIES

FLORENCE SCHOOL OF REGULATION

WAME World Access to Modern Energy

REPORT

Public regulation to facilitate implementation of access-to-energy projects

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1. Introduction

Currently, nearly 1.2 billion people, 17% of the world's population, have no access to electricity and around 2.7 billion people, 38% of people on earth, are without clean cooking facilities.

In accordance with the International Energy Agency, we define lack of access to electricity and to clean cooking facilities as a lack of **access to "modern energy"**, the term "modern" refers to the simultaneous presence of two aspects: maximum environmental sustainability and minimum possibility of health damage. Over 95% of the people without access to modern energy are concentrated in sub-Saharan Africa or developing Asia and 84% of them live in rural areas. The distribution of this energy poverty largely coincides with the world's distribution of the overall extreme poverty.

In 2015, the United Nations adopted the **2030 Sustainable Development Agenda**, which includes a set of 17 sustainable development goals (UN SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030. Goal number 7 calls for the global community to "Ensure access to affordable, reliable, sustainable and modern energy for all", a significant challenge that requires a great collective commitment from governments, the energy industry, NGOs and funding organizations.

Within the framework of the newly adopted UN Sustainable Development Goals, the G20 Energy Access Action Plan and COP21 on Climate Change, the Florence School of Regulation (FSR) and the World Access to Modern Energy (WAME) Association have agreed to form a partnership to contribute to the process of ensuring affordable, reliable, and modern energy for all, combining the FSR's long expertise in energy regulation and in teaching with WAME's institutional focus on world access to modern energy.

2. The current situation

Access to energy provides a fundamental basis for economic growth and well-being. Without sufficient access to energy in homes and schools or for trade and commerce, the poor regions will remain at a disadvantage in keeping up with the developed world.

Over the last decade, many developing countries have experienced rapid economic growth and a rise in energy demand. Their governments have made a great effort to eliminate barriers to investments in order to meet increasing demands as well as assuring universal access to energy.

Most developing regions are very rich in both fossil fuel and renewable energy sources, but access to these resources is unevenly distributed and under-developed. Many people without access to energy live in remote areas that will not be reached by expansion of the grid by 2030 and hence other viable solutions have to be implemented. Others live close to the existing power grid ("under the grid", as opposite to "far from the grid"), and yet they live without an electricity connection. The fact that people living close to a low-voltage electricity distribution grid[1] are not connected to it may be attributed to either the lack of resources or interest by the incumbent distribution utility to provide the connection, or the lack of economic resources of the potential beneficiaries to pay for the initial connection and the monthly fees that follow. Off-grid technologies can provide a temporary bridge to a future permanent connection to the grid for both remote and "under the grid" poor customers.

[1] We mention areas where low-voltage electricity distribution grids exist, because people living near a high-voltage line built for long-distance transmission of electricity cannot technically connect to it, so they are in the same position of people living far from any network.

Meeting the increase in demand and the objective of universal access to energy will require a combination of grid extension and off-grid solutions. Large-scale power projects have been and are being designed to meet increasing energy demands and are gradually being built in a number of developing countries, supporting on-grid electrification. Simultaneously, it is becoming clear that the recent cost declines in solar photovoltaic and storage technologies provide cost-effective options for addressing energy needs in remote areas, where on-grid electrification is technically or economically unfeasible.

Increased connection through grid extension and off-grid solutions are furthermore being facilitated by innovative business models and management technologies such as *pay-as-you-go* models, and use of mobile money. This is enabling a vast range of initiatives to offer affordable energy solutions to people who would otherwise not have been connected. Many of these projects are however still in pilot phases and need to scale up the delivery of their services rapidly in order to keep the pace with population growth and to meet the ambitious energy access goals.

Public-private partnerships, domestic policy reforms and creative policy and financing structures are helping spur increased international investment and project development. Despite many such positive signs, stakeholders from all sectors raise the fact that strong regulatory reform and increased transparency remain critical elements to be tackled to ensure the necessary investments are being made in the future and the goal of providing energy to all is being met.

3. The present and the possible role of regulation

In a developing country, as in any developed country, it is the responsibility of the Government to provide universal access to energy. Governments must make difficult choices, region by region, between extending the national grid or investing in local isolated systems. Depending on geographic conditions and population density, the latest available technology and business models, the best solution may vary. Governments must therefore aim to design and implement the optimal pattern of grid expansion and complementary development of off-grid systems.

Regulators have a role in this task. Electrification by grid extension can, in principle, be addressed with the customary regulatory approaches. When establishing the remuneration of the distribution companies and the tariffs for the end consumers, regulators should be aware that the cost of distribution in areas with low and dispersed demand is several times higher than the cost of distribution in a dense urban area. Urban consumers routinely subsidize rural consumers in every country in the world, since the same tariff is typically used for all consumers. Distribution system operators may therefore need to be incentivized to invest into extensions and connections in cases that do not present a prospective short-term net return. The most common instrument in the hands of the regulators is the definition of the tariff system, which starts by establishing the cost of the investments to be included into the regulatory asset base to which the operational cost is added. With these numbers in place it is possible to calculate the remuneration, which shall be covered by the entire population of customers.

Access to energy by the population not served by the national grid is generally not mentioned in the regulator's mandate. One of the key questions to address regarding assuring universal access to energy is whether the national regulatory authorities should play an active role in setting rules that address off-grid systems. In other words, should the task of regulation be limited to safeguarding consumers served by an electric system and maintaining competition among the operators of the same system, or should it also contribute to the extension of the existing service to the population presently excluded from it?

There are good reasons to support the opinion that regulators can play an important role in the general effort towards achieving world access to energy in the next 15 years. The current state of the challenge is the background against which the present Enquiry has been run. Consequently, the current situation is worth describing briefly, distinguishing (a) the role of regulators in extending access where the grid exists, (b) the diffusion of off-grid solutions such as isolated mini-grids or individual home systems, and (c) the development of isolated solutions and their possible merger into the large grid if and when it reaches the area.

What are the proportions of grid extension and of other solutions (mini-grids and off-grid isolated systems) in the plans for universal access? Scenarios 2010-2030 can be found in the International Energy Agency's World Energy Outlook 2013, chapter 13: "In the Energy for All Case, mini-grid and off-grid solutions account for the greater part of the additional investment …. The annual level of investment is expected to increase over time … This growth over time reflects the escalating number of additional connections being made annually in the Energy for All Case … and the increasing shift in focus to mini-grid and off-grid connections"(page 483).

This shift in focus is inevitable. Since urban areas have been served first, the focus must be placed on the population living in rural areas, where grid extension is substantially more expensive. The interest in rural electrification, and off-grid solutions in particular, has grown dramatically during the last decade and is continuing to accelerate.

Regulation can serve a useful purpose in assuring access to energy to the most vulnerable consumers, both where the grid exists and where it does not yet exist. However, the obstacles it needs to address in these two cases are rather different. Regulation in areas where the grid is absent is typically very recent and it may be incomplete or unclear, because of the lack of sufficient time to implement it and to get experience from it.

(a) **The role which regulation can play in areas served by the national distribution grid**

The fact that a grid is present does not ensure universal access to the population of the area.

When the cost of connection is an obstacle to access by the poor, some improvement can be achieved by merging the connection charge and the energy tariff into a pay-as-you-go system. This is affordable by poor people while preserving the economic equilibrium of the electricity company. Such arrangements can be introduced on a contractual basis proposed by the supplying company within the existing regulatory framework, provided this is not too rigid, or even promoted by the regulator itself.

Integration of illegal connections into a legal and safe system can be promoted by combining an accurate monitoring of the area, easier bureaucratic procedures, repression of illegality, and affordable service contracts, as shown in Ahmedabad, India (for a description of an interesting case see http://www.wame2015.org/case-study/990/ahmedabad-slum-electrification-project).

Areas not yet served by the grid may be served if the grid is extended. Wherever the networks can be extended by private operators or by state-owned operators subject to budget constraints, good regulation can improve the conditions for new investment. In general, uncertainty raises the cost of capital and hinders investment decisions, otherwise profitable at normal levels of risk. Uncertainty may regard the duration of concessions if it is too short, or possible decisions to modify it; changes in the level of tariffs and of other conditions imposed on business by the institution in charge of regulation; or possible political decisions to change the ownership of industrial assets (nationalisation). Consequently, a stable and sound regulatory framework makes investment more attractive while protecting consumers.

(b) **The role of regulation where access to electricity is based on the diffusion of off-grid solutions such as isolated mini-grids or individual home systems.**

Access to electricity is possible even outside the reach of large, national or regional networks, as an increasing share of the electricity supply is provided by stand-alone systems or by isolated mini-grids connecting consumers with local generation, often based on renewable sources of energy. Any plan to provide access to the people excluded today has to rely on such systems, since these people generally live in rural areas with very low population density.

When considering possible regulation of rural electrification, and in particular off-grid electrification, three fundamental facts should be kept in mind. Each of them raises issues, and issues are interlinked. Yet, it is useful to mention each of them individually.

First, the value of the first kWhs that meet the very basic needs is very high for all consumers. People without access are willing to devote their entire current spending on kerosene for lamps and candles, in exchange for a basic electricity service that allows them to switch on a couple of lamps and charge their mobile phone. The price they are willing to pay for these first few, high-value, kWhs of electricity is much higher than what they are willing to pay for the subsequent kWhs, and this behaviour corresponds perfectly to the shape of an electricity utility function.

It is indeed this willingness to pay a relatively high price for the first kWhs that small local entrepreneurs build their business case upon, when making their offer of an elementary service. There may be no abuse on behalf of the entrepreneur: the offer may reflect the real cost and the poor people are willing to pay the set price.

Second, the provider of this service holds a monopolistic power. There is a possibility of abuse in this de facto monopolistic position of the provider of such a basic and valuable service. Therefore, the regulator should protect the consumer against the monopolistic power of the entrepreneur.

Presently, in some countries in South Asia and Sub-Saharan Africa, off-grid systems are the fruit of initiatives by local private entrepreneurs who freely negotiate with the inhabitants of the villages. In absence of any regulation or even monitoring, local, and often poor, consumers end up paying very high prices per kWh for a service that is just capable of satisfying their primary needs and to replace unhealthy and technically inferior devices such as kerosene lamps. Since competition for the provision of these basic services is absent or very weak, introducing some kind of tariff control would be justified.

Suppliers may justify high prices with the need of recovering the capital invested under conditions of uncertainty regarding future revenues. Adequate regulation should therefore be designed to protect consumers, possibly through setting an upper limit to tariffs, while protecting investors by reducing uncertainty on future market conditions.

Third, the cost of the electricity service is higher where the population is dispersed, a cross-subsidy between urban and rural areas is normal in a grid-connected area to keep the tariff uniform, and a similar subsidy is justified in the case of off-grid systems serving poor people.

Once these three facts are made clear, it becomes possible to look at possible developments in areas where the people have no access, or very limited access, to electricity, and design a progressive path approaching the goal of universal access.

Isolated systems can grow, link up, be reached by the large distribution grid one day.

(c) **The role of regulation in supporting the development of isolated systems and their possible merger into the large grid if and when it reaches the area**

In developing countries, under a properly designed regulatory framework, local systems can withstand integration into a national grid. Currently, similarly local systems are mushrooming

even in rich countries, where a national electricity system exists and serves the whole territory, typically supported by policy measures that seek to exploit the environmental advantages of small-scale decentralised generation. A converging trend can be seen.

An important technical task of off-grid electrification is therefore to assure that local systems are compatible with one another and with the existing grid, even if they are not presently connected to it. This ensures that future interconnections are viable, and creates a common market for spare parts. Compatible systems and standardised components can help prevent locally dominant operator from thwarting competition and will allow efficient markets to develop.

This is not what generally happens. Due to the nature of the very simple technology used, a basic service is usually not compatible with the existing national grid, and will have to be discarded if the grid arrives one day. It is important to reduce the uncertainly regarding unexpected arrival of grid extension, which most often makes the micro grid obsolete, by encouraging clear national planning of grid-extension. This will allow entrepreneurs to develop business models that do not have to push for recovery of the investment cost in a very short period of time. Regulation should help in incentivizing the entrepreneurs to install micro grids that are compatible with future connection to the national grid instead of the micro grids that are less expensive and more affordable by the poor people, but are not compatible with connection to the grid.

Financial support will be needed to cover the difference between the efficient costs of supply and what consumers can afford to pay, which could be estimated as equal to the tariff available to grid-connected consumers. In the case of very poor consumers, the reference level can be identified in the "social" tariff, if such a tariff has been introduced to the benefit of poor consumers in the areas connected to the national grid, as it is the case in some countries.

In general, existence of a clear and fair regulatory environment can persuade the operators of aid programmes such as the NGOs to go beyond the mere distribution of stand-alone devices (solar panel, bulb and plug) and favour the setting up of a local enterprise that will build and operate an integrated system at the village level and assure the training of local people in maintenance and replacement when needed. Birth of local companies or associations under local control and management can be the final result of an off-grid project initiated as an exercise in aid; much more effectively than a project consisting in a simple dissemination of stand-alone devices.

In countries like India, where the national electricity system largely relies on generation from abundant inexpensive coal, there is a risk that, when the national grid arrives and provides the local community with coal-generated electricity at a national tariff that is typically subsidized, a local off-grid system based on solar energy will be abandoned, with an effect that implies waste of previous investment, negatively affecting the energy mix with respect to GHG emissions. The increase in public expenditure created by additional customers benefitting from the administered price of electricity could have been accompanied by better economic and environmental results.

4. The Enquiry

The FSR and WAME have conducted an enquiry in order to get feedback from the field on some of the issues related to the role of regulation in providing universal modern energy to all.

It is clear that the responsibility of providing universal access to energy lies with governments, and that large energy companies, mostly privately owned, as well as small innovative enterprises, will be playing an important role in actually delivering on this commitment. What is less clear is the role that the regulatory authorities should play, and the regulatory approaches that could most effectively promote sustainable and efficient universal access to modern energy.

The enquiry was divided into three main parts:

1. Determining the extent of access to electricity;
2. Determining the current role of technical regulation;
3. Determining the current role of economic regulation.

The questionnaire and the report have been drafted by Pia Lovengreen Alessi, FSR Advisor on Universal Access to Energy, under supervision by the FSR/WAME Expert Group, composed of:

- Jean-Michel Glachant, FSR Director

- Pippo Ranci, WAME President, FSR Advisor

- Ignacio Pérez-Arriaga, FSR Training Director, Professor at MIT and Comillas University

- Franco Becchis, Turin School of Local Regulation Director

- Sergio Ascari, FSR Gas Advisor.

The enquiry period ran from December 2015 to March 2016. The questionnaire (see Annex) was circulated partly through personalised e-mails and letters and partly through mass-mailing to over 4000 contacts within the fields of energy regulation, plus repeated mailings to representatives and members of the following institutions:

<u>Regional and National Representatives of Energy Regulators including:</u>

- International Confederation of Energy Regulators (ICER)
- Council of European Energy Regulators (CEER)
- Mediterranean Energy Regulators (MedReg)
- Energy Regulators Regional Association (ERRA)
- African Forum for Utility Regulators (AFURNET)
- Asociación Iberoamericana de Entidades Reguladoras de la Energía (ARIAE)
- East Asia and Pacific Infrastructure Regulatory Forum (EAPIRF)
- Organisation of Caribbean Utility Regulators (OOCUR)
- Regional Electricity Regulators Association of Southern Africa (RERA)
- ECOWAS Regional Electricity Regulatory Authority (ERERA)

<u>Representatives of Energy Industry</u>

- Representatives of over 100 companies working in the energy industry
- 25 donor companies of the FSR
- 7 founding companies of WAME

Academics and Non Governmental Organisations

- Representatives of over 150 academic institutions
- Representatives of over 50 NGOs and associations
- The network of the Turin School of Local Regulation

Despite great efforts to disseminate the questionnaire, a limited number of responses were received. Perhaps this is in itself an indication of limited involvement and knowledge of issues related to the regulation of access to energy.

A total of 28 responses were received, representing 22 different countries and 5 continents. 16 responses were received from representatives of Regulatory Authorities and the rest from academics and non-governmental organisations.

Responses were received from the following countries: Bulgaria, Burkina Faso, Columbia, Czech Republic, Denmark, Georgia, India, Israel, Italy, Kenya, Lithuania, Macedonia, Mexico, Montenegro, Netherlands, Peru, Portugal, Rwanda, Slovenia, Turkey, Ukraine, United States.

Special attention has been given to respondents from Africa, Asia and South America, the three continents with the vast majority of persons without access to energy.

In addition to the written enquiry, personal meetings were held with representatives of two Associations of regulators: CEER and MEDREG.

Two documents have provided great input in the drafting of the present Report:

a. The G20 Energy Access Action Plan: Voluntary Collaboration on Energy Access

b. Energy access as a key factor for human development: the view of Mediterranean regulators (paper prepared by MEDREG).

The following section outlines the general points raised by respondents in relation to national electricity planning, the role of technical regulation and the role of economic regulation respectively. No statistical significance may be attributed to these statements, however we still believe these points can serve as useful information for further discussion and examination.

As a general comment, it is worth mentioning that we found that in many developing countries there is not yet a clear picture of the technical and economic regulatory situation regarding off-grid systems. We have been informed that specific technical or economic regulatory aspects are currently up for discussion or that pilot experiments are currently being conducted, which will hopefully shed some light on where the regulation should be oriented. The interest in rural electrification, and off-grid solutions in particular, has grown dramatically during the last decade and is continuing to accelerate. Therefore, a corresponding regulation is typically very recent, if in place at all. This may explain why we have found that in many cases it is still incomplete or unclear.

5. Results of Enquiry

Measurement

The country data on the percentage of population without access to electricity, collected by the International Energy Agency (IEA)[2], are generally reliable where they are available. The estimates indicated in the IEA correspond to the figures estimated by the institution that supplies them the figures, accuracy of these figures is however sometimes disagreed upon between national public institutions.

While these numbers reflect the number of households that do not have access to energy at all, they do not take into account the households that do not have access to reliable forms of electricity. Reliability can be measured by indicators of frequency and duration of interruptions (SAIFI and SAIDI are the usual indicators of yearly averages), yet many of the least developed countries do not yet use indicators to measure the effective availability and quality of service. Some are currently implementing them. Where they are in use, they seem to be a good instrument to track progress and to make comparisons between regions within the same country and even between countries.

National Planning

The degree of electrification and the need for further action vary greatly in the developing world, and so does the planning to meet the UN SDG number 7 of providing universal access to electricity by 2030. While most countries do have short, medium and long-term planning in place, the level of ambition and transparency varies greatly and often reflects the level of poverty in the country. Some countries are able to explain how they intend to meet their stated objectives, usually through a combination of grid extension, reduction in connection charges, and maintenance of the current grid to reduce losses etc., while others only have a political statement declaring certain objectives with little explanation on how they intend to achieve them.

As countries are getting closer to reaching total, or near total coverage of electrification, their attention increasingly turns to focus on demand, and how they can plan to meet increasing demand.

Off-grid solutions are currently included in very few governments national planning. In most places they are being promoted by third parties, such as international NGOs or local entrepreneurs; and often they are still in a testing/pilot phase. Few governments, like Peru, India and Rwanda, have taken a proactive stance to rural electrification and while the results of their actions are yet to be quantified, it is indeed a step in the right direction. As positive results of the pilot phases and other initiatives are made public, increasing interest in including off-grid expansion into the national electrification planning is being observed. However, while the Government holds the responsibility to provide universal access to energy, off-grid development is usually not within the mandate of public authorities, and hence, they have till now been relying on a laissez-faire strategy which has been unquantifiable and hence not included in the national planning strategy.

Off-grid development will for sure play a crucial role in delivering global and national electrification objectives. Many of the countries realising the important role it will play, are

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2 http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/. See also http://www.wame2015.org/world-map/1.

currently discussing how best to allow for off-grid to develop in a co-ordinated manner that will protect the users while allowing for a market to develop.

In order to allow off-grid development, it is important to be aware that an unexpected grid extension may undermine investments in off-grid projects. Transparency about short, medium and long-term grid extension plans is, therefore, important as the lack of it is a barrier to building the necessary off-grid systems. Furthermore, open and transparent dialogue with all stakeholders about grid-extension plans is essential. All too often it is only the big leading power companies that are given the opportunity to influence the policy process and as such they have a clear advantage at the expense of small and often more sustainable solutions.

To meet the objective of providing energy access to all, it is important to have reliable and transparent short, medium and long-term power grid extension plans available so that all stakeholders can plan accordingly. It is also important to differentiate and measure availability and quality of services in order to monitor and steer improved access on all fronts simultaneously. Finally, it is important to introduce the right regulatory conditions that will allow scaling up both grid expansions and off-grid systems in the most remote areas and often allow off-grid investments to act as a bridge, in places closer to the existing distribution network, until grid extension comes.

The role of technical regulation

Role of regulation for off-grid

While in most countries there are still no precise minimum technical standards for off-grid investments, there seem to be vast support for the regulatory body to set such standards. Minimum standards are not only important for safety and compatibility, but also for the well-functioning of the system installed in the long-term, for making its maintenance and upgrading easier, and for integrating it into the grid when appropriate. Standards should be well defined and clear, as this will facilitate compliance.

Compliance to sound technical regulations is also very important to identify the investments that are needed to scale-up the off-grid systems and enable them to meet the international and national goals for access to energy. Without minimum technical standards and guidelines, it is difficult to prevent unsafe cost-reductions, which compromise safety for the user and future compatibility of the installation.

Introducing minimum technical standards help preventing the investments in mini-grid solutions from being spoiled or made wasteful. While there is a call for regulators to introduce robust technical standards for reasons of safety and compatibility, such standards should not be so stringent as to create unnecessary bottlenecks and lengthy delays for granting building permission. Standards should be put in place to allow for flexibility and innovation without compromising the quality of the end product, especially for vulnerable customers.

Appropriate technical standards depend on the given situation. Requirements for individual household solar panel installations will be less stringent than in a mini-hydro power installation aimed to power several villages: standards should be less stringent (without compromising safety) in installations of low demand and voltage. Furthermore, they should be allowed to evolve together with the evolution of the service provided.

In some places, incentives are being put in place in order to attract private investors in off-grid solutions. Incentives may include exemption from license for mini grids <50kW and easier licensing process for larger off-grid solutions. While it is of course important to encourage

development of off-grid solutions and attract the needed investments, it is important to do so without compromising the safety of the users of the installation.

Where technical standards are introduced there will be an increase in demand for skilled installers and technicians. It is important to have adequate national and regional institutions that can meet the increased demand of qualified technicians in order not to hinder the growth of the enterprises and not to compromise the safety of the installations.

It would be wise to steer the evolution of off-grid in the direction of minimum standards with an increasing harmonisation of standards, at least at a regional level. In response to rapid growth of off-grid systems it will be important to have sufficient qualified technicians in order not to block or compromise development.

Role of regulation of the grid

Regarding technical regulation of the national grid, there seem to be an overall concern that more could be done in terms of increasing the standards for maintenance and efficiency. As noted earlier, in many poor countries, the minority that has a grid connection has access to a service, which is all too often both unreliable and inefficient. Frequent blackouts are the norm and poorly maintained transmission and distribution networks result in high losses (both technical and as a result of illegal connections), which result in an unreliable service and higher tariffs. It is, therefore, important to put rules and monitoring in place, to promote regular maintenance of the system and improved efficiency. If this problem is not addressed, it will be difficult to build a solid business case, which is needed to attract the investments for future expansion of the networks.

The role of economic regulation

Tariff setting

In most cases, prices for electricity supply in off-grid systems are currently not being set by the regulator and are therefore freely set by the local enterprise, undertaking the necessary investments under monopolistic conditions.

Beyond allowing excessive price levels, an unregulated system prevents the introduction of cross-subsidization among urban and rural consumers, which is routinely applied everywhere in the world. Yet it is this cross-subsidization that makes rural electrification possible, since placing the burden of the actual costs on tariffs would often render rural electrification an impossible task.

When the cost of connection is an obstacle to access by the poor, some improvement can be achieved by merging the connection charge and the energy tariff into a pay-as-you-go system, which is affordable by poor people while preserving the economic equilibrium of the electricity company.

Support mechanisms

Support mechanisms can have a significant role to play in reaching the most vulnerable customers in both urban and rural settings.

Subsidies can be shaped in different ways and many countries have one or several such mechanisms in place. In some cases, they are paid by the national government, in other cases

they are charged on the general tariffs, while some apply a combination of both. In many countries, great efforts are being made to substantially reduce the connection charge, as this initial investment cost has been a real deterrent to connection for consumers. Many countries have some form of social tariff, paid either by the Government or being charged on the generality of customers. Other mechanisms are used in order to allow customers to gain access such as step, or "block- tariffs", where a minimum monthly consumption is very cheap and the price increases with each extra step of consumption.

In many cases, off-grid systems are still excluded from official tariff-setting, and consequently from cross-subsidization in favour of rural areas and from application of social tariffs. When the tariffs for grid-connected electricity are subsidized, while off-grid electricity is not, the latter encounters an additional barrier, and the customers of off-grid solutions are subject to a heavier burden, which may be further increased by the lack of competition among suppliers.

In very few cases did we observe that the social tariffs have been extended to the off-grid.

Where support mechanisms are not yet in place, financial and technical support from NGOs and other agencies may ease the burden in a similar way.

While support mechanisms can be very useful indeed, one must be careful with their design, since they influence the choice of different technologies and business models. A support mechanism may fail in its design and as a result not achieve the desired outcome. It may even be an obstacle to the flexibility and innovation that is needed for the introduction of new models based on new technologies when they become economically viable and may be scaled up. Complicated subsidy procedures and heavy red tape can also prove to be an obstacle to smooth implementation.

Support mechanisms should, therefore, be designed to reflect the specific reality of the given area, as one-fits-all solutions are unlikely to be adequate. It is also important that subsidies are continuously revised to make sure they are fit for purpose, and do not hinder technological or business developments or improvements.

In a future world where externalities are duly internalised, for instance once a CO2 price really reflects the cost of emissions, support mechanisms may no longer be needed and a self-sustaining market may be expected to develop.

Institutional aspects

In some countries there seems to be an excessive level of regulatory complexity as responsibilities for overlapping issues, such as renewable energy, rural electrification, technical standards etc., lie within different government ministries or agencies. This may result in conflicting regulations or lead to a regulatory vacuum, which may stall progress altogether. Clarity of mandates and institutional arrangements among institutions is therefore recommended.

Furthermore, a well-functioning electricity service involves many players (government, regulators, TSO, DSO, investors, local entrepreneurs etc.). Conflict may arise among these actors and it is therefore very important to have efficient and independent settlement and dispute resolution services in place to settle rising problems fast and efficiently so as to avoid unnecessary suspension of services.

Finally, in order to attract the large-scale funding needed to build large regional infrastructure projects, it is important to establish the necessary regional cooperation to make such projects a reality. This is true both for cross-border expansion of the grid, as well as for large-scale renewable energy projects, such as large hydro-power projects.

6. Conclusions

There is vast global recognition of the need to provide universal access to energy. This has been highlighted by the United Nations by introducing, among the Sustainable Development Goals, a distinct goal number 7: "Ensure access to affordable, reliable, sustainable and modern energy for all".

Yet, it is not generally recognised or understood that in the wide-ranging effort to achieve the goal, regulatory institutions may have a significant role. This is confirmed by the low response rate to our enquiry. However, the answers collected do provide positive arguments in favour of an engagement of regulators in various directions.

The first direction is a promotion of more accurate measurement of the current situation, i.e. the degree of exclusion from the electricity services or the frequency of very low level of continuity and quality of such services.

The second direction is the continued development and enforcement of technical standards in general, and particularly in the case of off-grid systems.

A final direction is an attention to the economic aspects of access. This includes developing a framework that allows for innovative contractual solutions to be implemented, that lower the initial cost of access to electricity, such as pay-as-you-go solutions, and includes subsidies where necessary.

The conditions and the opportunities are different in each region of the world: there is no one-size-fits-all type of regulation. Innovation is key to meeting the challenge of providing universal access to energy, and the regulator has the task of easing innovation while protecting the most vulnerable customers.

Increased capacity building and cooperation of all stakeholders (regulators, policy makers, entrepreneurs etc) will be key to make universal access to energy a reality by 2030.

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  http://www.nrel.gov/docs/fy15osti/64460-ES.pdf

ANNEX 1: ENQUIRY

<u>Administration</u>
Name:
Surname:
Function:
Organisation:
Country:
E-mail:
Name of Regulatory Authority of your country:

Please provide as much detail as possible and attach files and links where relevant.

1. The limit of access to electricity

1.1 Is the country data collected by the IEA (http://www.wame2015.org/world-map/1) considered representative of the country situation as known by you?
1.2 Please provide, if possible, indicators of the effective availability and quality of the service. (i.e. approximate duration of service, of interruptions [the widely used indicators are: the System Average Interruption Frequency Index (SAIFI) and the System Average Interruption Duration Index (SAIDI)])
1.3 Are there any plans or estimates predicting the number or share of the excluded people that may be reached by the extension of the existing grid by 2020? Or by 2030?
1.4 Are there any plans for electricity supply with off-grid solutions (micro-grids or stand-alone systems for individual households) for isolated rural communities or for those that are not expected to be connected to the grid soon?
1.5 Do you have any other feedback you may consider appropriate regarding the limits of access to electricity in your country?

2. The role of technical regulation

2.1 Are precise minimum standards for off-grid investments, such as the choice between AC and DC micro-grids, the levels of voltage and frequency, currently being set by the regulator in your country?
2.2 In the case of off-grid solutions for electricity supply, is there any established approach to take into account the preferences of the beneficiaries in the electrification plans?
2.3 Do you have any other feedback you may consider appropriate regarding the role of technical regulation of the electricity grid in your country?

Opinion on technical regulation (optional: answers are not required, yet welcome)

- In case technical minimum standards described above are not present in your country, do you think they should be set?
- Do you think standards should be less stringent (without compromising safety) in areas of low density of demand?
- In such cases, should such lower standards be temporary or permanent?

3. The role of economic regulation

3.1 Are tariffs or price caps for electricity supply in off-grid systems currently being set by the regulator?
3.2 Are any subsidies being provided to suppliers in order to keep the tariff of off-grid systems low?
3.3 In case subsidies are in place, are they paid by the national Government or charged on the generality of all customers?
3.4 Is any "social" tariff provided to specific households, such as those in weak economic conditions? In case it exists, is it extended to the off-grid systems?
3.5 Do you have any other feedback you may consider appropriate regarding the role of economic regulation of the electricity grid in your country?

Opinion on economic regulation (optional: answers are not required, yet welcome)

- Do you think tariffs or prices in off-grid systems should be capped by the regulatory authority?
- Could you share any successful experience of business models established in your country to supply electricity with off-grid solutions?