REGIONAL INITIATIVES – EUROPE

ICT for ENERGY
TELECOM AND ENERGY WORKING TOGETHER FOR SUSTAINABLE DEVELOPMENT

Report

Telecommunication Development Sector

ITU

ICT for ENERGY – Telecom and Energy Working Together for Sustainable Development

Acknowledgements

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Executive Summary

Access to affordable, reliable, sustainable and modern energy is essential to people's health, comfort and economic activity around the world. The targets under the Sustainable Development Goal 7 have been set by the United Nations accordingly:

Target

7.1 By 2030, ensure universal access to affordable, reliable and modern energy services.

7.2 By 2030, increase substantially the share of renewable energy in the global energy mix.

7.3 By 2030, double the global rate of improvement in energy efficiency.

Information and Communication Technology (ICT) and in particular connectivity offered by communications services play a critical role for achieving each of the targets. ICTs enable among others pay-as-you-go schemes, support operation and maintenance of power grids, make integration of renewable energy sources into grids possible and improve energy efficiency e.g. by providing consumers with information to reduce consumption. On the other hand, it is important to note that any economy will only be able to reap the full benefits of ICT if access to energy is secured. Also, energy consumption triggered by ICT may pose a challenge in particular to decoupling energy consumption and economic growth.

Incentives for cooperation between energy and ICT actors stem from (emerging) business cases as well as positive framework conditions set by policy makers and competent authorities. For instance, business incentives can be based on additional revenue sources that can be tapped by collaboration such as offering power supply to people in remote areas or developing new products and services e.g. in smart city environments. Incentives created by policy frameworks include infrastructure mapping initiatives as well as relevant directives such as the Cost Reduction Directive in the European Union.

The results of the Horizon2020 Coordination and Support Action ENERGISE indicate that these incentives may however not be enough to achieve the level of cooperation among industry actors that would be necessary to fulfil the ambitious targets set by SDG 7. In fact, the results of the two years EU-wide project point to unclear regulatory frameworks and a persistent lack of trust among industry actors as the two main barriers to cooperation.

This paper suggests that these barriers can be overcome by coordinated regulatory action. This should not be misunderstood as a call for more regulation. Instead, it is a call for better, more balanced and overall more sensible regulatory frameworks on national and international levels. The most important areas to address in cross-sectoral regulatory collaboration are common market definitions, common standards, a balanced approach to data flows in smart energy networks and ensuring their cybersecurity. Furthermore, policy makers should aim to build communities around collaboration of utilities and ICT actors to bridge existing knowledge gaps, develop a common language and resolve persistent misunderstandings.

To achieve these goals, the present paper suggests to develop national digitization strategies that foster cooperation of both competent authorities as well as industry actors. These strategies ought to be based on a comprehensive stocktaking of existing approaches, relevant business cases and corresponding products / services. An analysis of these cases and identification of best practices, which have to be benchmarked against national framework conditions in developing the strategies mentioned above, needs to follow. All these steps can leverage the existing results of ENERGISE. As first step, the identified types of cooperation can be used to structure potential national targets as shown in the table below.

Type of cooperation	Corresponding strategic goals in…	
	Developed countries	Developing countries
Smart metering	Achieve significant take-up of smart meters by private households and businesses alike	Use smart metering technology to promote mini-, micro- and off-grid solutions
Network operation	Set appropriate frameworks that allow data collection and analysis to improve network performance and facilitate predictive maintenance of network infrastructure	Leverage ICT to monitor network performance and identify technical and non-technical losses
Infrastructure sharing	Implement policy measures that facilitate infrastructure sharing to reduce costs and increase speed of deployment e.g. infrastructure mapping, cost reduction directives	Implement policy measures and set standards for infrastructure sharing where this is appropriate
Joint deployment	Implement policy measures that foster the deployment of empty ducts with every other utility	Build common frameworks, coordination capacity and knowledge exchange to foster integrated deployment of ICT and energy infrastructure
Development of new products and services	Support innovation strategies by local enterprises	Build fora to disseminate and exchange knowledge about the advantages of integrated ICT and energy solutions to offer new forms of payments or ownership

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1 Introduction

Energy is essential to people's health, comfort and economic activity. Although affordable and reliable access to energy is essential for economic growth and eradicating poverty, there is also an urgent need to decouple economic growth from energy consumption. Otherwise global climate change will jeopardize any sustainable development efforts. The importance of energy for worldwide sustainable development is reflected in the Sustainable Development Goals (SDGs) set up by the United Nations.[1] Specifically, the Sustainable Development Goal 7 (SDG 7) addresses the issue of affordable and reliable access to energy for everyone. It is linked to SDGs 1 "no poverty", 10 "reduced inequalities", 12 "responsible consumption and production" as well as 13 "climate action". Cross-sector cooperation of all stakeholders including ministries and competent national authorities is essential to achieve the ambitious targets set out for global development.

SDG 7 sets the following targets:

7.1 By 2030, ensure universal access to affordable, reliable and modern energy services

7.2 By 2030, increase substantially the share of renewable energy in the global energy mix

7.3 By 2030, double the global rate of improvement in energy efficiency

The means foreseen to achieve these targets are

7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries (LDCs), and small island developing states (SIDS).

Infrastructure expansion and technology upgrade for supplying and sustainable energy is enabled by the latest information and communication technologies (ICT). ICT will be equally instrumental to the roll-out of renewable energy sources, increasing energy efficiency in current and future networks as well as promoting investment in energy infrastructure and clean energy technology. Consequently, governments and policy makers around the world envision integration of energy and ICT networks as a critical precursor for ensuring access to affordable, reliable, sustainable and modern energy for all.

Access to energy on the other hand is essential for any economy to benefit fully from the positive socio-economic impact of ICTs (R. C. G. Arnold, van Baal, Demary, & Schiffer, 2013). To achieve successful integration of energy and ICT networks, energy and telecommunications providers will have to collaborate just as energy and telecommunications regulations may have to be aligned. This paper seeks to inform policy makers and regulators about the relevance of SDG 7, the role that ICT play for achieving it as well as the targets set out under it and thus the importance of successful cooperation between energy and telecommunications sectors. The paper proceeds to define the requirements for successful collaboration between energy and telecommunications sectors and to give an outlook of how the ITU can support national governments in fulfilling these requirements and facilitate cooperation of the two sectors. To achieve these overarching objectives, the remainder of the paper is structured as follows.

First, the role of ICTs in achieving SDG 7 is presented in section 2 that explains why ICTs are critical in providing access to affordable, reliable, sustainable and modern energy for all. Beyond being necessary for the roll-out of smart grids and smart meter solutions in developed countries, ICTs are a driver for mini-, micro- and off-grid solutions[2] in developing countries, enabling countries to leapfrog

[1] For more information see: www.un.org/sustainabledevelopment/sustainable-development-goals/

[2] Definitions: Micro-grids: grid systems with less than 10kW of power capacity; Mini-grids: grid systems with 10kW-100kW of grid capacity; Off-gird: Individual energy generation using e.g. solar panels or a small wind turbine.

fossil fuels power generation and empowering consumers to make informed choices. This section's findings underscore that ICTs can only be integrated successfully if energy and telecommunications providers collaborate.

Second, this paper investigates current incentives for cooperation of energy and ICT sectors towards the achievement of SDG 7. This entails both business case incentives and external incentives for cooperation reflected in the framework conditions set up by policy makers and regulators worldwide.

Third, a focus on the European Union (EU) experience as regards collaboration between energy and telecommunications providers gives a detailed account of drivers and barriers to collaboration in practice. The presented insights draw on the results of "ENERgy Grid Implementation – Smart and Efficient" (ENERGISE), a Horizon2020 coordination and support action funded by the European Commission (EC). Specifically, the paper will discuss the key results of the project and develop a checklist for Distribution System Operators (DSOs), Transmission System Operators (TSOs) and telecommunications providers that aims to facilitate their decision-making as regards cooperation for smart grid roll-out.

Fourth, the paper extracts requirements for successful collaboration of energy and telecommunications providers based on the insights presented in the preceding section as well as an expert workshop held jointly with the ITU in February 2017.

The paper culminates in an outlook of what countries can do to facilitate access to affordable, reliable, sustainable and modern energy for all by fostering sector and competent authorities collaboration.

2 The Role of ICT for Achieving SDG 7

Section 1 listed the targets formulated as part of SDG 7. This section commences by reprising the targets and highlighting their significance for global development as well as current issues that curb achievement of the targets. Hence, the role that ICT can play in achieving the targets is discussed in detail.

Target 7.1

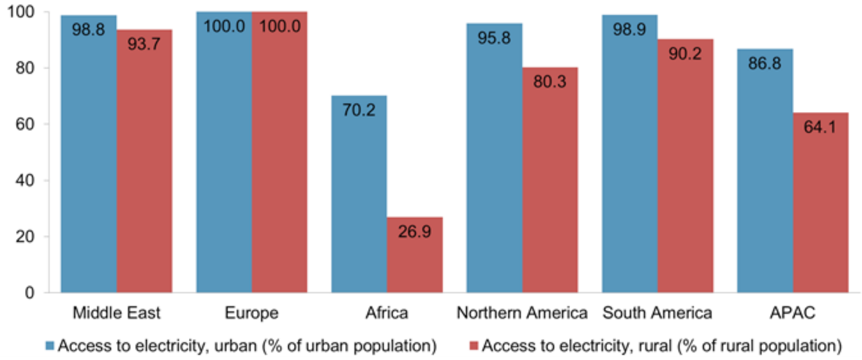
"By 2030, ensure universal access to affordable, reliable and modern energy services"

The first target under SDG 7 foresees to ensure universal access to affordable, reliable and modern energy services by 2030. The use of ICTs can make access to energy service more affordable, reliable and modern.

A substantial part of the cost of access to energy stems from the infrastructure that is necessary to deliver electricity to recipients. As Figure 1 exemplifies, urban populations by and large have access to electricity commonly provided via power grids. This is particularly true in developed countries. In rural and remote areas, costs for infrastructure deployment can be substantial or even prohibitive. Local mini-grids, micro-grids or off-grid architectures can offer a solution due to decreasing costs of solar power panels[3] among other reasons.

[3] According to pv.energytrend.com, the average price in US$ per Watt of PV cells has decreased from US$76 in 1977 to US$0.30 in 2015.

Figure 1: Share of population with access to electricity (urban and rural) in %



Source: World Bank (2017)

ICT can make a positive impact in all contexts for affordability of energy. In most developed countries, even rural areas have reliable access to electricity. Here, ICT solutions can help consumers save money on their energy bills as sensors and actuators enable them to micro-manage their demand or to become prosumers who produce their own power. Furthermore, ICT can be used by energy providers to monitor and manage grids resulting in efficiency improvement and cost savings. In developing countries, urban grids partly can profit from the same impact of ICT. In rural and remote areas that can only be served by solutions not connected to the main power grid network of the country, ICT can help to make a viable business case for energy providers.

An analysis by the Earth Institute and Ericsson (2016) indicates that a substantial share of revenue vanishes along the supply chain of energy providers offering solutions in rural and remote areas in developing countries. Two types of losses occur. Technical losses refer to power dissipation in components along electricity distribution infrastructure. Non-technical losses refer to electricity theft (e.g. the 'hook line'), customers failing to pay their bills and accounting errors (World Bank, 2009). ICT can solve the latter reason for revenue losses by enabling new pay-as-you-go (PAYG) payment models. These new payment models empower people to better manage their cash flow. A recent GSMA (2016) report confirms that this takes away a lot of the pressure usually felt by consumers in developing countries in traditional contractual agreements.

With these new ICT-based solutions, sensors provide real-time metering while mobile phones with payment functions (e.g. M-Pesa) enable direct payment. Successful examples include M-Kopa[4], Mobisol[5] and Simpa Networks[6]. Between them, these services have provided access to energy for over 750,000 households by the end of 2016.[7] In total, GSMA estimates that the pay-as-you-go electricity market in Sub-Saharan Africa is US$10 billion (GSMA, 2016).

Beyond taking away the incentives to steal electricity, ICT can also help to monitor grids identifying and rectifying non-technical revenue losses. For instance, in the Indian state Andhra Prades a comprehensive management system was installed at the state-owned electricity supplier. The system uses a central customer database. It analyses metering, billing and collection performance. Also, staff's performance is tracked in detail against internal targets. Thus, irregularities show up quickly. The success is impressive. Non-technical distribution losses reduced from around 38% in 1999 to 26% in 2003 (World Bank, 2009).

Finally, ICT measurement and payment functions can support empowerment of local consumers. Various business models allow individuals to gain ownership of their power generating equipment after enough payments have been made. Thus, they can become power producers themselves.

4 For more information see www.m-kopa.com/
5 For more information see www.plugintheworld.com/mobisol/
6 For more information see https://goo.gl/1PsiAp
7 WIK research based on press releases

In developed countries, ICT implementation such as smart meters can help to save costs for households by improving their demand cycle. Specifically, smart meters can incentivize consumers to reduce their energy consumption by providing them with real-time clear feedback about how much energy they consume as well as the associated cost. Consumers can furthermore profit from load- and time-sensitive tariffs that motivate them to shift their electricity demand to times when there is a lot of energy available on the grid. Finally, costs may be reduced simply due to remote data collection about electricity consumption and fully automated billing (Frontier Economics, 2011).

Access to energy must be reliable. Otherwise it is hardly going to change the situation of people yet to gain access to electricity. In fact, unreliable access to energy is one of the main barriers to growing economic activity in many developing countries. Most recently, the G20 finance ministers and central bank governors working group (2017) underscore this finding. They state that across Africa unreliable access to utilities is a "major deterrent of private investment, especially in manufacturing, substantially restricting economic growth." (p. 15).

ICT can help to achieve reliability of access to energy. Its implementation in energy grids enables monitoring, error detection or even prevention. Through cellular connectivity, which is usually much more widely available than energy grids today, even rural and remote areas can be reached for remote maintenance. Indeed, mobile base stations can be used as anchor customers[8] to provide access to energy for people yet unable to use electricity regularly. A report by the Earth Institute (2016) indicates the potential power of approaches such as cooperative roll-out strategy. It finds that of "some 3 million mobile phone towers in operation in Africa, about 640,000 are located in rural off-grid areas." (p. 81).

Finally, the target defines that SDG 7 aims to provide access to modern energy sources. 'Modern' in the context of SDG 7 could and should be thought of as leapfrogging from fossil fuels to renewable energy sources. As it has been outlined above, these renewable energy sources play a critical role for sustainable energy access via mini-grid, micro-grid and off-grid solutions. In developed counties, renewable energy sources help to achieve ambitious targets set out as regards limiting the global temperature increase to 2°C. As they introduce new challenges into managing power grids, ICT is an essential enabler for the share of renewable energy sources to grow worldwide. ICT and in particular connectivity, sensors and actuators are necessary to manage power grids with renewable energy sources whose power generation is usually more volatile than that of conventional systems.

Target 7.2

"By 2030, increase substantially the share of renewable energy in the global energy mix"

In the same vein, ICT will thus be essential to achieve target 7.2. Renewable energy requires ICT solutions to be successful, a truly decentralized grid requires ICT support in one way or the other, they all share that measuring consumption in real-time is a key enabler. In developed countries this potentially refers to much more than just smart grids and smart meters. In fact, a future-proof decentralized energy supply is a central piece in any smart city development. Without a comprehensive framework to integrate demand-side management tools such as smart meters, electric cars that can act as flexible electricity storages and local storage capacity in private and business premises, it is hardly imaginable that the visions of smart cities will become reality. ICT and in particular data collection and analytics play a critical role in fulfilling these visions of fully connected cityscapes.

In developing countries, where in many regions there is no legacy infrastructure, ICT can enable leapfrogging to renewable fully decentralized energy supply. As it has been outlined in the above, new business models for mini-grid, micro-grid and off-grid solutions play a critical role in this. Finally, it should be noted that reliable access to electricity is essential in the roll-out of mobile broadband. For instance, in Mexico reaching 80% of the population requires only a third of the investment needed to connect the remaining 20% (Garcia & Kelly, 2016).

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8 Anchor customer usually describes the first relevant customer in an area yet to be covered. Typically, this is an institution or site with relevance to the community i.e. a school, a church or a mobile base station.

Target 7.3

"By 2030, double the global rate of improvement in energy efficiency"

Energy efficiency is an issue for both developed and developing countries. ICT can help to solve this issue on the supply and demand side. At present, some 70% of electricity is wasted before it reaches the end-user – enormous potential for ICT to make the whole supply chain smarter and hence more efficient. For instance, ICT implementation and smart data usage can improve overall productivity for energy providers. For instance, Ausgrid – an Australian electricity infrastructure company – reports an average productivity improvement of 72% by having their field workers use a software enabling better data collection in remote locations (World Economic Forum, 2016). In developing countries, it is often more fundamental issues that need to be resolved. Poor manufacturing quality combined with a lack of standards can cause weak electrical contacts. This results in significant losses during transmission and hence degraded performance, significant maintenance costs and system downtime (Institute for Transformative Technologies, 2016).

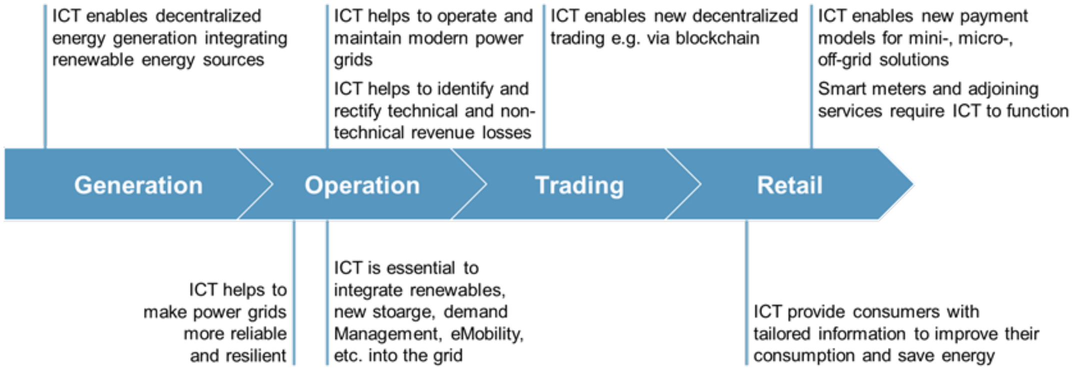
As regards the demand side, we need to decouple economic growth from energy consumption. Overall, the change rate of global energy intensity has to reach-2.6% (CAGR) over 2010 to 2030 to achieve the SDG 7 target. ICT can help consumers to reduce their consumption by automatically monitoring and managing their energy consumption or by providing them with sufficient information to benchmark their own consumption and make appropriate changes. The case study below exemplifies this. Notably, ICTs are a major driver of energy consumption. Thus, understanding how one's energy consumption depends on usage patterns also referring to ICT usage patterns can help to address this challenge.

Making information powerful

The *Me* app developed by Centrica/British Gas enables users to predict bills and split payments with housemates. In the future, add-on services may include the ability to compare the consumption of people residing on the same street, and integrate with remote temperature controls and smart meters. Utilities will be able to move from supplying a commodity to providing an experience, better meeting consumer needs and improving brand "stickiness". Consumers will also be able to determine their electricity mix, reduce usage and drive efficiency. (World Economic Forum, 2016)

In sum, the insights presented here show clearly that a business-as-usual approach will not suffice to achieve SDG 7 nor its specific targets. Given the role that ICT and in particular telecommunications as a major enabling factor play for achieving SDG 7 (see Figure 2) and in light of increasing convergence of energy and telecommunications applications, a step change in the collaboration of telecommunications and energy sectors appears to be necessary. The following section will therefore discuss the current incentives for such a collaboration.

Figure 2: The role of ICT along the energy value chain



3 Incentives for Cooperation Between Energy and ICT towards SDG Achievement

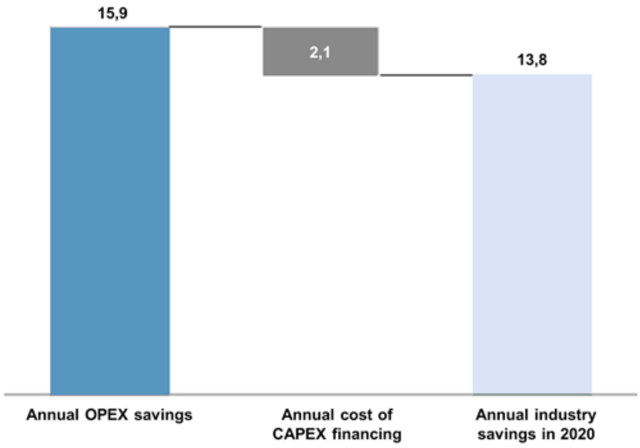
The preceding section has presented cases where there is an obvious incentive for the two sectors to cooperate. For instance, the implementation of ICT in power grids can realize significant cost savings. It can also increase customer satisfaction and retention. However, even when there is a clear incentive to cooperate, energy providers tend to prefer to build and operate their own communications infrastructure.

With regard to achieving SDG 7 as well as most efficient use of existing infrastructures with a view to fast broadband deployment a lack of cooperation can slow down the process. Hence, policy makers and regulators around the world have developed various measures to facilitate cooperation between utilities and telecommunications providers.

Indeed, Garcia and Kelly (2016) in their background paper to the World Bank Digital Dividends Report (2016) highlight that cooperation and infrastructure sharing is a crucial element to maximize social welfare. Within the scope of the present paper, their concept of infrastructure cooperation i.e. when telecommunications is housed or jointly constructed with another infrastructure is most relevant. This kind of cooperation can be particularly relevant in sparsely populated areas where deployment of two infrastructures at the same time can lessen the investment burden somewhat while unlocking a new market to both actors. Cooperation between actors from different sectors is more likely to occur than cooperation between competitors.

There is even a rationale for cooperation in infrastructure in bad and off-grid areas. As shown in the above, ICT and in particular connectivity of power generators can help to provide access to electricity even in remote areas. Connectivity in these areas is only possible with cellular base stations, which also require a reliable supply of power. While many base stations in bad and off-grid locations are still powered by diesel generators, more innovative renewable or hybrid ways to supply energy become increasingly popular. According to research conducted by GSMA (2014), these systems can lead to annual cost savings for telecommunications providers of around US$ 14 billion by 2020 even when accounting for the initial CapEx that is needed (see Figure 3).

Figure 3: Annual industry cost savings due to transition green energy solutions, billion US$ (2020)



- For retrofits, capex refers to additional capex required to convert to green power solutions, while for new sites capex refers to total capex required
- We assume that all off-grid towers under business-as-usual would deploy DG solutions at off-grid sites to ensure uptime and low capex
- A 10% annual cost of financing is used to develop the cost saving estimates

Source: Interviews with MNOs, TowerCos and ESCOs (March-April 2014); Desk research; Dalberg Tower Estimation and Green Power Model (2014); Dalberg analysis; Source: GSMA. (2014)

Cooperation in deployment including the coordination of linear network infrastructure actors can thus be beneficial. Notably, some of these benefits may be offset by differences in the pace of deployment which depending on the specific infrastructures to be co-deployed can be quite substantial. Consequently, policy makers and regulators should also account for the potential opportunity costs for delayed roll-out of mobile connectivity. In situations when various infrastructures need to be (re-) built e.g. due to a recent armed conflict, a holistic approach is likely to be the most efficient (Garcia & Kelly, 2016).

Business incentives for ICT and energy cooperation go even further as Garcia and Kelly (2016) and the OECD (2006) argue. The interdependencies for telecommunications and energy infrastructures are shown below.

Policy makers globally have understood the significant potential for welfare benefits of cooperation between infrastructure providers. Hence they have introduced policy measures that intend to facilitate cooperation. For instance, in Europe the Cost Reduction Directive[9] sets the framework conditions for easier access to existing infrastructure as well as co-deployment of infrastructure with the aim to roll-out high-speed broadband more quickly. Among other steps, the European Commission promotes the use of infrastructure mapping initiatives that help actors intending to deploy new infrastructure to identify already existing assets that can be used for their own deployment.[10] In order to unfold the maximum effectiveness of such measures examples from Europe show that regulatory incentive schemes should take into account the whole framework that affect their impact. E.g. when looking at incentives for joint deployment the attractiveness of joint deployment by the market actors is also very much affected by the relative deployment costs which are in turn widely determined by labour costs and not only by incentives set within a sectoral regulation.

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9 Directive 2014/61 – “Directive on measures to reduce the cost of deploying high-speed electronic communications networks”.

10 For an overview of European broadband and infrastructure mapping projects see: Arnold, René C. G., Marius Kirch, Martin Waldburger, and Andreas Windolph. "Broadband and Infrastructure Mapping Study- a Study of the European Commission Smart 2012/0022." Berlin and Bad Honnef: TÜV-Rheinland Consult and WIK-Consult, 2014. Furthermore, the following website offers up-to-date information on European mapping projects: www.broadbandmapping.eu/

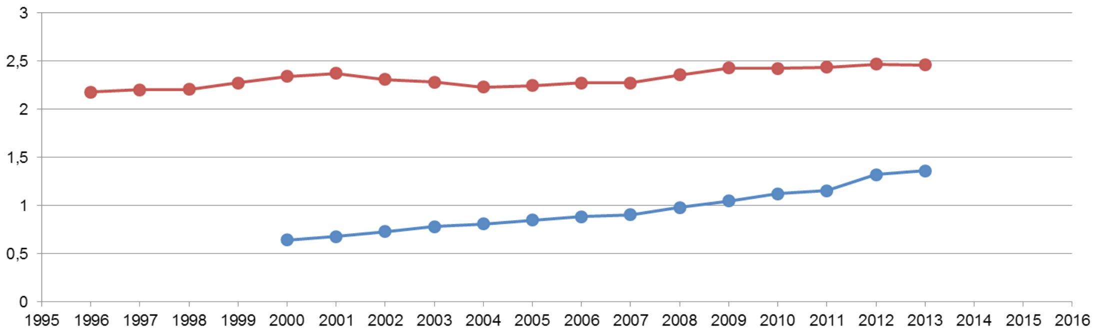
Table 1: Interdependencies for telecommunications and energy infrastructures

Infrastructure	Telecommunications	Electricity
Telecommunications		Intelligent electricity networks, including remote metering (better demand management). Greater efficiency in spot and futures markets for electricity. More dispersed electricity consumption patterns
Electricity	Dependence on electricity, vulnerable to outages and voltage fluctuation. Electricity network can be used for transmission of information.	

Source: OECD (2006)

Equally, innovation policy often seeks to facilitate cross-sector collaboration to develop novel solutions such as innovative ways to organize monitoring and payment of electricity, smart grid and smart city solutions. Gross[11] expenditure on research and development (GERD) has been relatively stable at approximately 2.4% of GDP in high income countries since the late 1990s. In low and middle income countries GERD has increased significantly from around 0.6% in 2000 to 1.4% in 2014. This indicates that even in developing countries more and more funding becomes available to support innovation processes that benefit from cross-sectorial collaboration.

Figure 4: Governmental Expenditure on Research and Development (GERD) in high and low / middle income countries as % of GDP (1996 to 2014)



Series: Research and development expenditure (% of GDP); Source: World Development Indicators; Created on: 04/06/2017

Source: United Nations Development Statistics (2017)

In sum, there are both business and welfare incentives for cooperation between energy and telecommunications providers applying in developed and developing countries. It appears that policy makers have set up framework conditions facilitating collaboration between the two sectors. Surprisingly, little if any investigation of the actual level of cooperation exists. With the coordination and support action (CSA) ENERGISE under the Horizon2020 framework, the European Commission has taken a step to close this gap. The following section presents key results of this project.

[11] Public and private expenditure – notably public investment often triggers private investment and vice versa.

4 Collaboration in Practice – The European Union Experience

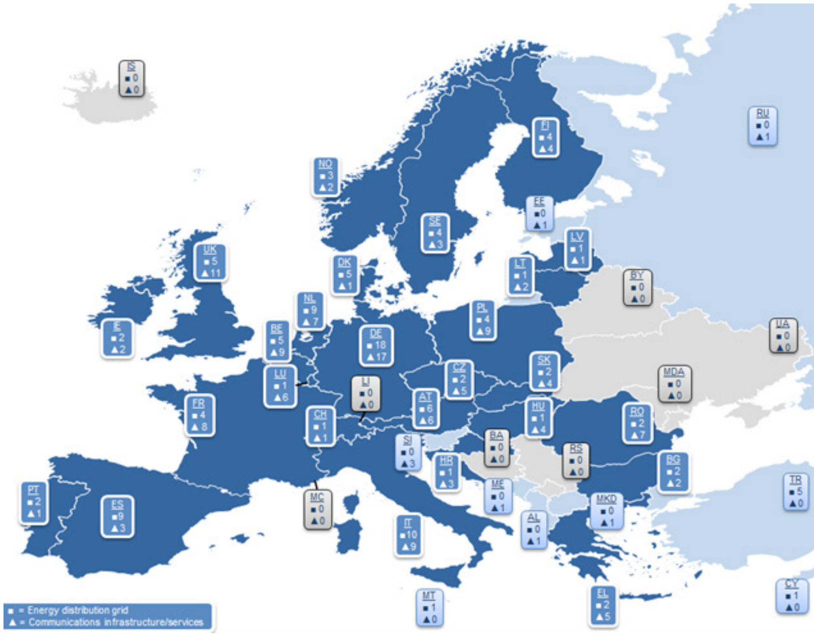
4.1 ENERGISE – Project overview

The preceding sections show that collaboration between energy and ICT sectors can help to achieve SDG 7 as well as both business and policy framework incentives exist to facilitate cooperation. In light of the apparent benefits of such cooperation, policy makers and regulators should be able to monitor the state and progress of cooperation between energy and telecommunications providers. They should furthermore be able to tap the internalized knowledge of the community of industry actors that are engaged in cooperation. By doing so, policy makers and regulators cannot only learn about the impact of their measures, but can also understand in detail the drivers and barriers to cooperation.

To understand in more detail if, how and why energy and telecommunications providers collaborate in Europe, ENERGISE conducted extensive data collection and built a community of stakeholders. The data collection split into a survey phase, more than 40 interviews with actors as well as various expert workshops.

The survey work aimed at understanding smart grid use cases and cooperation models in detail. In total, 294 respondents completed the online questionnaire. Among them were the main target groups of ENERGISE i.e. DSOs, TSOs and telecommunications providers, but also researchers and other industry stakeholders such as equipment manufacturers. The figure below shows that the main target groups cover almost all EU Member States. Nonetheless, it should be noted that the results should be interpreted carefully as they do not necessarily represent a fully representative sample of the survey's main target groups in Europe.

Figure 5: Coverage of the European Member States by DSOs and communications providers



Source: ENERGISE (2017)

While the quantitative evidence gathered for the project provides an overview of the European landscape of cross-sectorial cooperation, the interviews enabled us to compile a data set of 60 application cases. These insights were then condensed into an interactive toolkit that supports energy and telecommunications providers in their decisions to cooperate for smart grid roll-out. The table below illustrates the composition of the application cases as regards the type of cooperation they represent.

The following sections summarize key results of ENERGISE that first help to understand the specific reasons and barriers for cooperation, then describe success stories of cooperation that has been registered and analyzed by ENERGISE leading to presenting a checklist and a toolkit for decisions about cooperation to be used by energy and telecommunications providers. Finally, the following sections provide an outlook based on the survey results about the areas where respondents to the main survey see further potential for cooperation.

Key Learnings from ENERGISE

Blurring and merging of markets leads to significant challenges for regulation

There is an increasing interdependency between infrastructures and the involved sectors

Rising demand for new (m2m) communications solutions

Exchange and cooperation between NRAs from both sectors is perceived as driver for more collaboration

No clear common understanding of what is a critical application / what are the minimum communication requirements

Which ratio of expected outside performance vs. in-house supply

Geospatial dimensions count

5G standards aim to include all stakeholders and requirements, but no major joint input from DSOs yet

Cooperation is hard to achieve but possible and economically viable

Growing number of examples of cooperation that originate in other fields of cross-sectoral cooperation, e.g. joint deployment

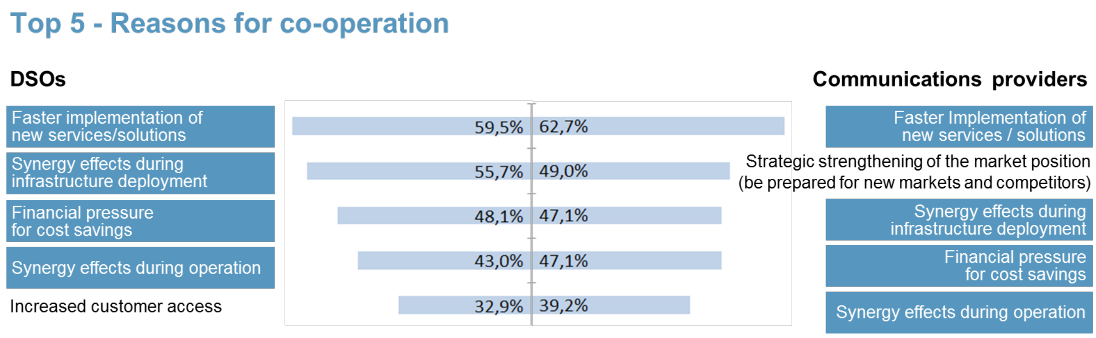
4.2 Reasons and barriers to cooperation in Europe

An important objective of the survey was to understand the reasons and barriers for cooperation. The figures below highlight the most important reasons and barriers for cooperation as ranked by the DSOs and telecommunications providers in the sample.

Figure 6 shows the most important drivers for cooperation. While there is concurrence on four out of five drivers, DSOs hope to gain better i.e. more direct customer access by collaborating with telecommunications providers. On the other hand, telecommunications providers seek to set foot into new strategically relevant fields of business. The most important driver for both groups of stakeholders is to speed up implementation of new services and solutions. Around half of the stakeholders in each group see cost reduction in the deployment of infrastructures as an important driver for cooperation. Also, the other drivers identified by the stakeholders in the sample revolve around costs. They refer to potential synergy in operating power grids and external financial pressure.

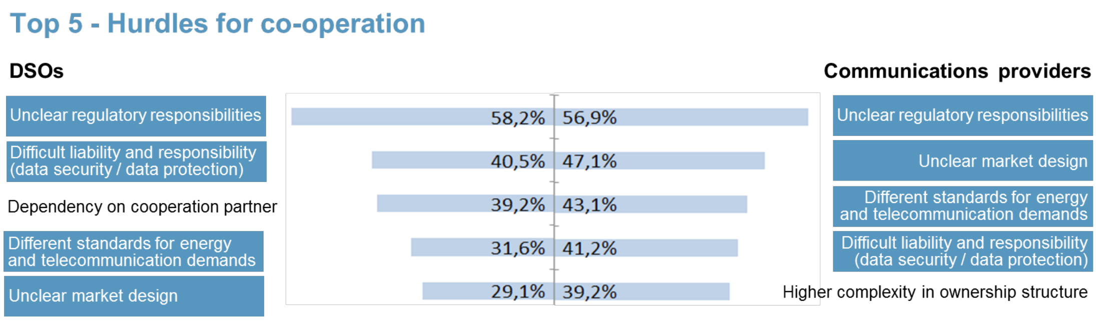
Figure 7 depicts the top five barriers to cooperation as identified by DSOs and telecommunications providers in the sample. Close to 60% of respondents in both groups see unclear regulatory responsibilities as the most important barrier to cooperation. The remaining three top barriers that DSOs and telecommunications providers concur on also revolve around (regulatory) framework conditions and refer to unclear, conflicting or non-existent standards for co-deployment, co-use and other potential collaborative solutions. Beyond these aspects, DSOs clearly see the risk to become dependent upon one telecommunications partner i.e. they are afraid of potential lock-in effects. Telecommunications providers on the other hand fear more difficult contractual relationships due to increasingly complex ownership structure of infrastructure, rights of way and similar issues.

Figure 6:Reasons for cooperation



What are the most important reasons for a cooperation between a DSO and providers of communications infrastructure/solutions when considering smart grids? (n = 294)

Figure 7:Hurdles for cooperation



What are the most important hurdles for a cooperation between DSOs and providers of communications infrastructure/solutions when considering smart grids? n = 294

4.3 Examples of successful cooperation

Across Europe, ENERGISE identified 60 application cases of successful cooperation already happening between energy and telecommunications providers. These application cases were clustered into five relevant types of cooperation (see Table 2). The table below defines the five types of cooperation and provides insights into the main findings of ENERGISE as regards the relevance of this type of cooperation from the perspectives of industry actors and competent authorities.

Table 2: Relevant fields of cooperation

Relevant fields of cooperation	Description of the field	Relevance of collaboration
Smart Metering	Smart meter deployment and operation	**Among industry actors**: • Smart meters by definition require some sort of connectivity – they are a primary area of cross-sector collaboration • In many countries smart meter roll-out is mandatory **Among competent authorities**: • Coordination of standards and regulation applying to energy and telecommunications sectors • Careful consideration of pricing regulation for energy providers
Network Operation	ICT support to operate power grids Monitoring, critical status identification and rectification Increase of grid efficiency Integration	**Among industry actors**: • ICT is required to operate, monitor and maintain modern power grids • ICT can reduce operational expenditure (OpEx) • ICT can reduce technical and non-technical revenue losses • Integration of decentralized energy supply e.g. by renewable energy sources requires ICT support **Among competent authorities**: • Coordination of standards and regulation applying to energy and telecommunications sectors • Setting sensible framework conditions for integration of renewable energy sources • Integrating relevant SDGs in setting targets for the share of energy generation from renewable sources
ICT-infrastructure sharing	Lease or rent energy / telecommunication infrastructure for example in order to save costs	**Among industry actors**: • Business case decides whether infrastructure sharing is sensible **Among competent authorities**: • Setting the right framework conditions and incentives for infrastructure sharing: • Information e.g. Infrastructure mapping • Building communities to exchange knowledge e.g. cross-sector fora, coordination and support actions • Encourage infrastructure sharing by coordinated regulatory frameworks e.g. Cost Reduction Directive
Joint deployment of infrastructure	Joint deployment of energy and telecommunication infrastructure	**Among industry actors**: • Business case decides whether joint deployment is sensible **Among competent authorities**: • Setting the right framework conditions and incentives for infrastructure sharing: • Information e.g. investment mapping • Building communities to exchange knowledge e.g. cross-sector fora, coordination and support actions • Encourage joint deployment by coordinated regulatory frameworks e.g. Cost Reduction Directive

Relevant fields of cooperation	Description of the field	Relevance of collaboration
Development of New Prod-ucts &Services	New products and service such as: • Smart meter services • eMobility solutions • Demand manag-ing services • Smartphone applications • Blockchain grid solutions for energy trading	**Among industry actors**: • New competitors increase external pressure on traditional stakeholders to collaborate for innovative products and services • ICT and in particular data collection and analysis play a critical role in many new products and services • Customers expect tailored, smart and comfortable products and services they can use on their (mobile) ICT devices **Among competent authorities**: • Setting the right framework conditions for data collection and analysis • Unlock significant economic growth potential

Source: ENERGISE (2017)

Among the 60 application cases as part of ENERGISE, the most common type of cooperation is network operation. This is not surprising as ICT today are an essential part of operating and maintaining a modern power grid system. More and more decentralized power generators further increase the need to employ modern ICTs in network operation. Specifically, ICTs and in particular communications services are needed for the operation and the monitoring of electricity networks. With more and more ICT-enabled technologies such as eMobility, demand side management and similar applications becoming available, the relevance of this type of cooperation is likely to grow in the near future.

Smart meter roll-out and infrastructure sharing feature roughly the same number of application cases identified by ENERGISE. While smart meter roll-out in many countries is driven by legal frameworks, infrastructure sharing is driven more strongly by cost considerations. Notably, the Cost Reduction Directive aims to increase infrastructure sharing.

Joint deployment is significantly less common among the 60 application cases. This may simply be due to the different investment cycles of energy and telecommunications infrastructures. Perceived issues of liability may however also prevent a stronger engagement of industry actors in this type of cooperation. Again, the Cost Reduction Directive aims at facilitating and incentivizing the roll-out of high-speed electronic communications networks by reducing its cost through joint deployment.

Equally, new products and services as a field of collaboration feature only in a few application cases identified in the sample. This may be interpreted as a lack of collaboration in this field. This finding is somewhat surprising as this type of cooperation is likely to determine the future of energy providers in Europe as well as other industrial countries where they have come under competitive pressure by companies like Nest (owned by Google) who strategically place themselves close to consumers and thusly in control of the customer relationship. Other companies such as Tesla build on a comprehensive approach to build the electricity grids of the future offering solar power, power storage as well as manageable demand in form of electric cars. While the latter companies have understood and in fact build on the power of data and ICT, energy providers need to make a step towards ICT stakeholders in order to cope with this kind of novel competition. On the other hand, it may also be the case that participants were simply unwilling to share their innovative projects with the project team. When collaboration for innovative products and services was shared with the project team, it underscored the importance and potential of these projects as the following case study illustrates.

Case Study Orange

Telecommunications companies or in this case the subsidiary of the French company Orange in Poland are entering the local energy retail markets. For Orange, the key value of their business is the data and the direct contact to the end customer. DSOs do have access to the energy system but do not have yet access to the end customer (partly restricted by regulatory framework). In contrast, telecommunications companies do have access to both sides and do have the ability to transform "Big Data into Smart Data". This sensitive data is the basis for energy services directed towards the end customer like demand side management or smart home services. In future, Orange is willing to act as connection point between network elements and customers. This could lead to a greater dependence for DSOs on telecommunications companies. (Source: Presentation Orange Polska, Final ENERGISE Workshop in Brussels)

M2M communications for the Energy sector: new technologies alter the market and enable new business models

M2M communications require a stable and cost efficient network. Sigfox is one Low-Power Wide-Area Network (LPWAN) with millions of connected objects already registered across all five continents. The advantage of the LPWAN is the low energy consumption, low cost and a wide range. In the Energy sector, they already As regards the serve utility sector SIGFOX is e.g. already activities in Water Metering. Above that, Sigfox is also active in other industries but it always depends on the application's specific requirements such as safety conditions in order to decide if this network will be suitable. Looking at the overall M2M market and infrastructure operators a huge growth in deployment and number of applications can be observed.

As regards the practical implementation of collaboration between energy and telecommunications providers, ENERGISE identified four major modi operandi to establish a cooperation:

Public tender: a company from the energy or telco sector seeks to acquire, buy goods, services or works from the other sector, often via a tendering or competitive bidding process. This we frequently identified for smart metering and network operation.

Bilateral agreement: an energy and telco company agree on a cooperation. In the application cases infrastructure sharing and joint deployment commercial solutions take this form.

Joint venture: a business entity created by two or more parties from the energy and telco sector, generally characterized by shared ownership, shared returns and risks, and shared governance.

Affiliate: a cooperation of an energy and telco company within the same company group.

Beyond these specific success factors associated with individual types of cooperation, ENERGISE identified three significant success factors for cooperation between energy and telecommunications providers:

Congruence is everything

If the partners seek to build on existing assets then there needs to be geospatial congruence i.e. the connectivity needs of the energy provider need to match with the coverage of the telecommunications provider.

Equality in power

Throughout the application cases analyzed by ENERGISE, collaboration appears to be most successful if the partners are of similar size. This seems to prevent power and information asymmetries building trust among the partners.

An obvious business case

Application cases with a clear perspective to reduce costs significantly, speed up the implementation of new solutions or provide access to a new knowledge pool in the ENERGISE database are the ones that came to full cooperation the quickest. In application cases that developed more slowly business rationales first had to be discovered and argued internally.

4.4 Examples of barriers to cooperation

As described in the above, the survey results already point to most common barriers for cooperation. Here, reasons linked to the regulatory and standardization frameworks ranked the highest. Based on the detailed insights generated by the application cases, the most important barrier to cooperation is however that energy providers do not feel fully understood by telecommunications providers when it comes to the level of criticality that their infrastructure represents and that has to be mirrored in the reliability and resilience of the applied telecommunications solution.

Thus, DSOs often feel they cannot source the services they actually require from telecommunications providers. Consequently, they refrain from collaboration and instead trust only their own infrastructure. However, with increasing data and latency requirements of smart energy solutions and smart city applications, there may evolve a new need to cooperate.

On the other hand, it also has to be noted that providing communications solutions with a high degree of resilience is not necessarily interesting to telecommunications providers since costs are disproportionately high while the returns remain small. Again, new technologies such as 5G or narrowband IoT applications may change the picture.

On top of that, the competitive environment can be a hindrance for successful cooperation. In markets with strong incumbents, DSOs tend to be under the impression that there is little choice as regards whom to collaborate with simply due to the coverage that the incumbent offers. Thus, they feel to pay too much for communications services externally procured. From the perspective of the telecommunication providers, DSOs with their requirements which are difficult to meet are not necessarily the most profitable and strategically interesting customers.

4.5 A checklist for cooperation

Based on the fields of cooperation, ENERGISE also aimed to understand and evaluate the decision criteria that energy and telecommunications providers apply when deciding about the implementation of new infrastructures and services. In order to build a toolkit that can support the industry actors as well as policy makers in their decision-making processes a database comprising all case studies with the mapped existing solutions was compiled. To arrive at detailed insights about cooperation decisions an in-depth analysis of the application cases was conducted[12]; by doing so the crucial decision criteria were investigated and highlighted.

ENERGISE found that there is a limited set of relevant decision criteria for evaluating different infrastructure solutions and implementation of new services that is relevant for all market players (cf. Table 3 below). The relative importance of decision criteria varies with the field of cooperation

[12] Morphologic analysis was used for this since it appeared to be best suited to the task of identifying patterns in a substantial dataset with many variables, but few numeric (quantifiable) values. A more detailed account of the analysis can be found in the deliverables to be published on project-energise.eu.

that is evaluated; i.e. for *Smart Metering* different factors appear to be of outstanding importance, whereas for *Network operation* those are others. In addition to that, different types of stakeholders are differently focused regarding the importance of specific criteria (e.g. for DSOs exerting control on an ICT-network that is used for grid operation is of great importance[13]).

Moreover decisions are strongly affected by the respective country and company context; thus, ENERGISE collected a database that consists also of country and company specific data to illuminate the companies decisions in the relevant regulatory context.

Table 3: List of decision criteria and their characteristics

Typical parameters of a solution evaluation					
Competitive Situation	Not at all	Low competitive	Medium	Competitive	Very competitive
Existing usable assets	-	None	Few	Some	Many
Standardization / Possible applications	Not at all	Low	Kind of	Well	Fully
Risk of Lock-in	Very low	Low	Average	High	Very high
Scalability	Very low	Low	Medium	High	Very high
Envisaged level of ownership	-	None	Few	Some	Many
Investment Cost	Very low	Low	Medium	High	Very high
Operational Cost	Very low	Low	Medium	High	Very high
Velocity of implementation	Very slow	Slow	Medium	Fast	Very fast
Life time	5 years	5-7.5 years	7.5-10 years	10-15 years	> 15 years
Availability (average during a year's period)	Not at all (<80%)	Low (>80%)	Kind of (>90%)	Well (>97%)	Fully (>99%)
Coverage	Not at all (<80%)	Low (>80%)	Kind of (>90%)	Well (>97%)	Fully (>99%)
Spectrum	Not available	low probability	balanced	high probability	Available
Ecosystem	0	1	2-5	6-10	> 10
Reaction time	Too Slow	Slow	Reasonable	Good	Fast

When looking at the example of Smart Metering several criteria are of key importance for the industry actors. First and foremost, potential partners need to consider the competitive situation they find themselves in. If they are immediate competitors, cooperation will be difficult and requires very detailed contractual agreements. Also the perceived relevant competitive environment in the targeted market is of importance here. Second, potential lock-in effects especially on the side of the energy provider need to be considered. If the risk of lock-in is high, a cooperation becomes less attractive. If the parties decide to carry on with the process, existing assets have to be considered. For instance, existing infrastructures may be used to deploy new solutions. Finally, the scalability and applicability

[13] The aspect of exerting control is reflected in the "risk of lock in" criterion.

of the envisioned cooperative solutions have to be considered. The better the chances of scalability the more attractive the business case is likely to become for both parties.

Furthermore, the remaining decision criteria are considered when planning of the cooperation becomes more detailed. These consist of the potential cost and returns of the envisioned solution, the ease and speed of implementation as well as issues revolving around the level of control that remains with the individual parties.

However, the checklist comprises criteria are relevant for almost all stakeholders and fields of cooperation; though it can only serve as an orientation for potential cooperation partners. The decision-making toolkit which is the main results of ENERGISE provides much more detailed insights into specific application cases, potential best practices and business cases that already work. The toolkit will be made available on the project's website soon and can hence be used by any energy or telecommunications provider interested in engaging in a cooperation with the respective other.

5 Requirements for Successful Collaboration of Telecommunications and Energy Providers

This section seeks to develop a list of requirements for successful cooperation of energy and telecommunications providers based on the insights of ENERGISE as well as a joint expert meeting of the ITU and ENERGISE in February 2017. The identified requirements build directly on the most important barriers to cooperation identified in the project and the meeting. The requirements draw on the key results of ENERGISE as outlined in Section 4.1. Table 4 shows them side-by-side.

Table 4: Key barriers to cooperation and corresponding requirements for successful cooperation

Key barrier to cooperation	Requirement for successful cooperation
Unclear regulatory framework and standards	Integration / cooperation of regulatory authorities Clear regulation even across sectors Balanced approach to data flows in smart grids and similar ICT-enabled infrastructures
Lack of trust and mutual understanding of energy and telecommunications providers	Points of knowledge exchange Community building Best practice showcases A common language

The following sections discuss each of the two identified areas and the corresponding requirements for successful cooperation of energy and telecommunications providers.

5.1 Clear and integrated regulatory frameworks

Successful cooperation depends critically on clear and integrated regulatory frameworks. This has emerged from ENERGISE across both the survey and the application cases analyses. The joint expert meeting by the ITU and ENERGISE identified examples for areas where more clarity and integration of regulation is needed.

Despite differences in the specific national regulatory frameworks, interoperability was identified as a common issue in smart grid deployment. For instance, in Romania there is no technical standard allowing the coexistence of power grid lines and fibers for broadband provision in the same duct. This leads to an impractically long initiation process for any business model that requires either sharing of ducts or co-deployment of infrastructure, which is a particularly important concern for broadband and smart grid roll-out in rural areas. A similar situation exist in Albania, where telecommunications providers are keen to use the electricity network to increase their broadband coverage, but face legal issues prohibiting telecommunication lines on electricity poles. In both countries, the issue can be traced down to different laws applying to telecommunications and electricity infrastructure. Integrating these two regulatory strands could solve the issue.

Besides integration of existing regulation, it emerged from the discussions at the joint expert meeting that upcoming fields of regulatory intervention need to account for both sectors. Regulation around the data originating from smart grids was mentioned a prominent example. The decisions made in this area by policy makers and regulators will have a significant impact on future business cases for both telecommunications and energy providers. New rules need to strike a balance between data protection and enabling usage of these data to improve service delivery, offer new services or perhaps even for new business models that allow targeted advertising to take place in exchange for lower energy tariffs. In any of these decisions cyber security has to play a most important role however as data usage must not interfere with the security and reliability of the electricity network.

New regulation should also aim to be consumer centric. Policy makers and regulators need to find new ways to empower consumers in light of the diminishing means they have to understand, monitor and control if and how their data are used in a world with a rapidly increasing number of connected devices (R. Arnold, Waldburger, & Hillebrand, 2015). Consumer empowerment with regard to smart grid deployment starts with their freedom to select any device without the DSO interfering. As the Italian example shows, this can be done without exploding costs for smart grid deployment. Here, the regulator approved a solution using a separated band on powerline communication and later further options for communication between smart meters and devices that sets a common standard independent from the end-user device.

While the Italian example above profited from coordination of the regulators, other countries show that integrated regulators can make a major difference for a country's digitization. For instance, in Switzerland, there is intensive ongoing work between both ministries – telco and energy. A new legislative is coming this year with basic and technical recommendations. This strategy "Digital Switzerland" aims at a common view on the issues across governmental bodies so all actors have a coherent and concurrent approach. Bulgaria plans to build one multisector agency like Luxembourg who plans the full smart meter roll-out till 2020. Smart grid will be deployed in medium and low voltage level. Germany which also has got a multisector regulator has recently released a law for smart meter roll-out and also has got an integrated national strategy to build smart networks covering education, energy, governmental, health and transport sectors.

5.2 Build trust and communities

Telecommunications and energy providers are driven by very different business models, different investment and innovation cycles. Hence, their views on collaboration and joint business activities vary substantially. While the main objective of DSOs is security of supply, the telecommunication business is mainly customer-driven. New entrants such as Nest or Tesla are likely to change the competitive landscape with an integrated and at the same time very customer-centric approach. The potential competitive pressure should be understood as a call to action for both policy makers and regulators as well as the industry itself to communicate more and build a new mutual understanding for the concerns of the respective other party involved.

Community building and developing a common language can be the first steps in this process. The results of ENERGISE which build a community of telecommunications and energy providers around the issue of cooperative smart grid roll-out in Europe show clearly that such actions initiated by policy makers can be successful. Based on the results of ENERGISE, the most pressing issues that should be discussed in such fora are:

- Liability and lack of trust: Service Level Agreements (SLAs) are often not met by telecommunication providers
- Diverging life cycles of telecommunications and energy infrastructure
- Unmet coverage and penetration requirements
- New requirements of M2M communication due to emergence of Internet of Things (IoT)
- Standardisation: joint development of technological solutions by energy and telco sector

The following section provides an outlook of how the ENERGISE results can be leveraged expanding to sustainable energy provision as outlined under SDG 7.

6 An Outlook

The present paper has shown that achieving SDG 7 and its targets will depend critically on ICT integration into energy infrastructure. On the other hand, reaping the socio-economic benefits of ICTs depends critically on access to energy and thus cooperation of ICT and energy sectors. While there are obvious business advantages to cooperate as well as some incentives set by policy makers and regulators in both sectors as well as innovation policy, the results of ENERGISE show that these may not suffice to sustainably drive cross-sector cooperation. The main barriers to successful cooperation as identified for the European context are:

- Unclear cross-sectoral regulatory frameworks
- Lack of trust and a common language

These barriers appear to resonate with issues encountered in other regions of the world. Unclear regulatory frameworks, for instance, often impede quick roll-out of cooperative solutions in many developing countries especially when funding for participating sector actors stems from different sources. Since often more than one competent authority is part of the process, there first and foremost needs to be a coordination among the various regulators that can enable e.g. consistent reporting and monitoring tools for the use of funding as well as processes guiding how overlaps in investment plans and cost can be resolved. An adjoining lack of standards is a much more severe issue in developing countries than in developed countries. In fact, even within one sector this leads to often low quality of products and hence service provision. This is likely to result in a lack of consumer confidence and thus low take-up rates. Also, there are very few if any standards for data exchange among government agencies (Palvia, Baqir, & Nemati, 2015) which curbs cooperation among them.

The advantages of integrating ICT into solutions that will enable access to affordable and reliable energy everywhere as outlined in this paper may not be obvious to energy providers. Also, there may be a lack of trust in ICT. A joint effort by policy makers and regulators can change perceptions and prejudice for the better. Just as in developed countries, it will be paramount to showcase existing solutions and highlight the business advantages. It will furthermore require actions to build a community of stakeholders around these solutions that interact frequently and share their knowledge.

Several steps appear to be necessary. First, stock taking of national strategies for digitization of utilities and among them most prominently energy infrastructure. Second, identification of best practices. Third transfer of these best practices into applicable advice for national governments around the world to push for cooperation among ICT and energy sectors to achieve the ambitious targets set out under SDG 7 through national policies and strategic actions.

The ENERGISE toolkit can serve as a starting point for a comprehensive data collection, structured analysis of the knowledge to be gathered and an information dissemination platform for relevant stakeholders. National strategies to foster cooperation could leverage the five types of cooperation identified based on the application case analysis performed by ENERGISE. The following Table 5 provides an overview of the five types of cooperation and potential corresponding strategic goals.

Table 5: Types of cooperation and corresponding strategic goals

Type of cooperation	Corresponding strategic goals in…	
	Developed countries	**Developing countries**
Smart metering	Achieve significant take-up of smart meters by private households and businesses alike	Use smart metering technology to promote mini-, micro- and off-grid solutions
Network operation	Set appropriate frameworks that allow data collection and analysis to improve network performance and facilitate predictive maintenance of network infrastructure	Leverage ICT to monitor network performance and identify technical and non-technical losses
Infrastructure sharing	Implement policy measures that facilitate infrastructure sharing to reduce costs and increase speed of deployment e.g. infrastructure mapping, cost reduction directives	Implement policy measures and set standards for infrastructure sharing where this is appropriate
Joint deployment	Implement policy measures that foster the deployment of empty ducts with every other utility	Build common frameworks, coordination capacity and knowledge exchange to foster integrated deployment of ICT and energy infrastructure
Development of new products and services	Support innovation strategies by local enterprises	Build fora to disseminate and exchange knowledge about the advantages of integrated ICT and energy solutions to offer new forms of payments or ownership

It should however be noted that this is not a call for more regulation, but one for more coordinated and balanced regulation. Furthermore, it has to be pointed out that regulation cannot force industry to collaborate. Specific decisions will always depend on the viability of the individual business case. Better framework conditions will however make it easier to cooperate.

The final working paper is a call for action for countries to consider a collaborative approach for effective roll out for SDG goal 7 at national level starting with a vision, a comprehensive national strategy back with practical actions. A framework would be elaborated by ITU to that effect and your comments on this paper together with your opinion on such as framework is needed.

An infographic that depicts the several relationships between ICT and ENERGY and possible interventions through regulatory collaboration, national strategizing and deployment of applications and services, is being formulated. Innovative inputs and ideas for this unique diagram is welcome.

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