European Union
European Regional
Development Fund

SET-UP
Interreg Europe

SMART GRIDS - EUROPEAN AND HUNGARIAN ANALYSIS, GOOD PRACTICES, DEVELOPMENT POSSIBILITIES

- Governmental background study –

Summary

2019

1. Definition, concept and benefits

In recent decades, we have witnessed significant social changes, as part of and as a result of which, energy demand has altered significantly. Also, today's information dumping and accelerating innovation, convergence and marketization of technical tools to facilitate communication, information processing and transfer, indicate further significant social changes and are foreseen to take place in the future[1].

Changing consumer habits require the development of responsive, high-security grids that are tailored to the demands, and to which continuous innovation provides a reliable technological background. the so-called smart (or intelligent) grids continuously provide data on both consumption and grid quality, which can be evaluated to make operation more efficient and cheaper (and consequently energy efficient), while at the same time increasing operational and security of supply.

According to the relevant European Union legislation[2], a smart metering system or an intelligent metering system is an electronic system for measuring energy consumption that provides more information than a conventional meter as well as can transmit and receive data through some form of electronic communication.

Other available definitions somewhat refine the above general description by emphasizing certain aspects of the concept. The role of stakeholders in the system and the main benefits of using smart grids are highlighted in one, while others add to the objective of developing power grids to be more environmentally neutral (less impact on the environment), whereas others emphasize the importance of two-way digital communication between the user and the power grid extended by intelligent metering and monitoring systems.[3] Also important is the system-based approach (ERGEG), which states that a smart grid is an electrical grid that integrates the behaviour and actions of all connected users (producers, consumers and those belonging to both) in a cost-effective way, in order to provide an economical, sustainable electricity grid with low losses, as well as to provide secure and high-quality power supply.[4]

The main components of smart grids are technology and infrastructure, in other respect, technology (intelligent solutions), communication and target devices, all of which are subdivided into a rather complex system including:

a. renewable energy sources

b. decentralized energy production

[1] Baros, Z.-Németh, S.: The role of information and communication technologies int he widespread use of renewable energy sources: A case study from Finland (In Hungarian). Energiaellátás, energiatakarékosság világszerte, 2006/2. pp. 52-63.
[2] https://eur-lex.europa.eu/legal-content/HU/TXT/?uri=celex%3A32012L0027
[3] Digital Single Market, Glossary – https://ec.europa.eu/digital-single-market/en/glossary
[4] Jászay, T.: The impact of decentralised electricity generation on energy systems (In Hungarian) – METÁR Konferencia, Budapest, 09.06.2016.; https://rekk.hu/downloads/events/MET%C3%81R_20160609_JT_final.pdf

c. transmission grid

d. distribution grid

e. energy storage

f. micro grids

g. smart metering

h. users

As for Hungary, given the current state of smart grid development, the operation of new distribution grid technologies and services, as well as the possibilities of integrating micro-grids into the electricity system can be considered are some of the key aspects and need to be studied during the pilot projects implemented.

There are numerous benefits of setting up and developing smart grids that cover a wide range of features. The most important benefit of using smart grid technologies is to jointly meet the energy efficiency and climate strategy goals set by the European Union, to respond to the current challenges of the electricity sector and to meet the higher demands of consumers.

From the market point of view, the price-improving effect can be emphasized, the application of flexible tariffs takes place at the retail level facilitating the general spread of the former. As a result of the economic benefits, more accurate planning and cheaper operation of the grid capacity is made possible, which results in the improvement of the sustainability and reliability of the energy supply. These benefits impact all stakeholders in the electricity sector - producers, distributors, service providers, consumers, etc.
Other benefits include convenience, such as prepaid card consumption, theft detection, telemetry or remote power on/off.

With regard to smart grid development, the following observations can be made:

- The above cannot be considered as fixed components of smart grids.
- A smart grid is not a predetermined product.
- The selection or use of smart grid solutions depends on the goals to be achieved, the current state of each element and the potential for improvement.
- The content of a smart grid is much larger than what covered by smart metering.
- Smart metering is usually an integral part of smart grids, but smart grids can be built without smart metering.
- Smart metering, smart grid usage can only be implemented with the involvement of consumers.

Despite the initial phase of the roll-out of smart grids, the projects carried out so far provide practices that can be relied on in the future. The main task in spreading the technology is to integrate, complement and operate and standardize the variety of smart grid devices.

Advances due to cost-benefit analyses carried out and in most cases have resulted in positive results, may facilitate the regional diffusion of technology in Europe. Central Europe is lagging far behind in this matter compared to Western Europe. In the region, Romania, Austria, Serbia and Bosnia and Herzegovina have decided to install smart meters by 2020. The large-scale replacement of meters and their manufacture can generate significant export investments throughout Europe in the near future.

The importance of this topic has been recognized in Hungary as well, and smart systems are identified as the Energy Industrial Development and Research Development Innovation Action Plan by the Ministry for National Development (2018) as a priority tool in order to meet the energy efficiency objectives set. The installation of smart meters has also been identified as a tool for intelligent grid development.

Each of the smart city aspects (smart mobility, smart environment, smart people, smart living conditions, quality of life, smart governance and smart economy) that can measure the state of cities and the impact of development, are connected somehow to the topic of smart grids. The way and extent these enforced depends on many factors, including the condition of the settlement to be developed, the technologies to be used for development as well as the relationship and collaboration between stakeholders (representing the local site and smart grid development).

However, it is important to point out that the proliferation of new digital technologies necessarily contributes to the establishment of cities offering a better quality of life that is environmentally, socially and economically sustainable, but itself should not be considered as an exclusive means of urban development.

2. Preconditions

However, to realize the developments and thus to reap the before-mentioned benefits, it is necessary to jointly comply with certain elements of a complex technological-socio-economic-political system, which, in their absence, results in the hindering of the wide-spreading of smart grids.

Of these conditions, the present summary is intended to briefly describe three, primarily to give an overview on the situation in Hungary.

2.1 Legislation

In accordance with the Commission's proposal[5] on the requirements for smart metering and smart grids, they should cover the following areas of regulation:

- technical standards,
- protection of personal data,
- promoting smart grids,
- open and competitive market (for the benefit of consumers) and
- continuous support for technological and system development.

Amongst the driving forces behind smart grid development are policies and initiatives aimed at reducing CO_2 emissions and increasing energy efficiency. The content of these should be reflected in the member states' own objectives, together with the means by which they intend to achieve the above objectives.

There is a relatively limited number of national energy law legislation that directly addresses the issue of smart grids.

Act LXXXVI of 2007 on Electricity lays down the main framework for the preparation and implementation of pilot projects related to smart metering. With regard to the former, the Act authorizes the Government to lay down in regulations the implementation of pilot projects related to the introduction of smart metering:

- smart meters and their equipment,
- the rights and obligations of the participants in the pilot project,
- data management and data processing standards and
- rules for reporting and disseminating information on the results of the pilot project.

[5] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0202:FIN:HU:HTML

By law, grid licensees and Act XL of 2008 on natural gas supply are required to implement smart metering systems may carry out smart metering projects. Such pilot projects may also be carried out by business associations set up for this purpose.

System users are required to cooperate in the implementation of the pilot project and to tolerate the installation of a meter that provides the technical prerequisites for the pilot project.

The grid licensee shall not charge grid users in connection with the implementation of the pilot project and shall not adversely affect the rights and obligations of the grid user arising from the electricity purchase contract of the grid user.

The grid licensee continues the pilot project under the supervision of the Hungarian Energy and Public Utility Regulatory Authority under the smart metering legislation.

The rules, obligations and rights related to the implementation of the Central Pilot Project for smart metering and smart grid implementation, for legal affairs, the Project Owner, the Infrastructure Operator and the Project Member are described in the 26/2016. (II.25.) Governmental Decree, including the installation of measuring instruments, the scope of the information to be provided, the issues of data management and data protection as well as the issues concerning the financing and scheduling of pilot projects.

In addition to the legislative background of the Hungarian pilot project briefly introduced in the ‘Good practices’ section of this study, smart metering is also represented in the implementation decree of the 57/2015. Government Decree on energy efficiency. According to this, the effects of introducing smart metering can also be taken into account when calculating energy savings for consumers due to changes in consumer behaviour.

More legislation, e.g. on the distribution grid operator's obligation to draw up a grid development plan and to report regularly on the development of metering, reading and billing systems is indirectly linked to the issue of smart grids.

Apart from the above, however, there is a significant backlog in the Hungarian legislation, which is partly due to the delayed transposition of the EU Energy Efficiency Directive and the fact that substantive details of the issue’s regulation is not included in the finalized legislation.

2.2 Funding

With regard to smart grid development, the issue of government involvement in subsidies arises. In addition to the previously identified ‘conventional’ incentive schemes (investment grants, investment incentives, fiscal instruments, voluntary schemes, etc.), other sources are also available.

In order to achieve the objectives set by the European Union, besides the above instruments, specific programs have been set up, some of which support R&D activities or international

exchange of experience (Horizon2020, Interreg), while others include demonstration or concrete implementation projects. The sector is witnessing significant innovation activities on the international market, resulting in successful products. The programs of the European Union aim partly at balancing market pressure, at promoting innovation in various regions and at promoting cooperation between the stakeholders.

In addition, there are policy instruments from the Structural and Cohesion Funds available for each Member State.

Among the national policy instruments of the 2014-2020 period for financing smart grids and its certain elements, the priorities of the Economic Development and Innovation Operational Program and the Competitive Central Hungary Operational Program include energy efficiency and intelligent energy use as well as the promotion of renewable energy sources, which affect both the business sector and public infrastructure (residential and public buildings). The Operational Program for Territorial and Urban Development aims at achieving the objectives necessary to meet the above objectives in the municipal sector. In addition, the supported projects include solutions that are in line with approaches to connect urban transport development with smart and sustainable solutions ('smart city' and 'slow city'). This study intends to review and evaluate in detail the funding opportunities offered by the Environment and Energy Efficiency Operational Program (EEEOP).

The document identifies the interventions required to achieve the climate goals set:

- Special attention should be paid to adapting the electricity systems' changed production structure (large-scale, weather-dependent RES, production away from consumption centres, etc.) in order to feed in more renewable energy to the grid,
- Increasing the proportion of electricity-generating power plants using renewable energy sources and decreasing the share of well-controlled power plants negatively impact the controllability of electricity systems. The regulation often requires short-range, high-amplitude interventions, often hundreds of MW in size. Due to the physical limitations of the existing power plants, this is a difficult and costly task.
- The inflexibility of the grid and electricity systems, even now at a lower rate, is already a major barrier to the further spread of renewables. Therefore, in order to facilitate the safe and efficient integration of large-scale renewable production, emphasis should also be placed on the establishment of production units and storage facilities providing the necessary flexibility to facilitate their deployment as part of the smart grid infrastructure.

The investment priority 'Promotion of energy efficiency, smart energy use and renewable energy use in public infrastructures, including public buildings and residential buildings' shall support the production and use of renewable energy for buildings as part of the EEEOP and the installation of district heating systems. In addition, support for the production and distribution of energy generated

from renewable sources and raising energy awareness through the implementation of complex outreach programs will also be identified as an investment priority.

Based on the above, EEEOP potentially supports smart-grid devices and smart-grid developments (including, in a broader sense, programs aimed at influencing consumers) in the 4 measures of Priority 5. One of the aims of this study is to give a review on the position of smart grid developments in the relevant calls of EEEOP Priority 5, thereby the availability of funding opportunities offered by the Operational Program and the extent to which applicants request support through these applications.

After reviewing the scope of eligible activities indicated in the relevant calls, it can be concluded that the financing of complex smart grid developments is not included in these calls. The next step was to review how the relevant calls encourage the use of certain smart grid elements (excluding energy efficiency in general and the renewable energy sources).

The above relevant activities are included in the EEEOP-5.2.2, 5.2.3, 5.2.5, 5.2.8, 5.2.11 and 5.2.12 calls, i.e. the energy management tool to be installed in the project. Based on the 3.4.1.1 a) section of the call (the requirements of the general technical and professional content of the project), such devices must comply with EN 15232 standards and must be capable of active regulation and of comparing the project's indicative commitments with actual, measured data. Its installation is obligatory for EEEOP-5.2.2, 5.2.8 and 5.2.12, calls recommended for EEEOP-5.2.3 call whereas this restriction is not included in the EEEOP-5.2.5 call.

Among the activities independently not eligible for support under the EEEOP-5.3.1 call are the activities of the installation of new controlling, measurement data acquisition, telemechanical and remote monitoring systems optimizing the operation, and the establishment of heat storage facilities.

Table 1 summarizes the number of projects including activities related to smart grid elements based on the applications submitted by the time of writing this study, more specifically, 28.2.2019.

Table 1: Smart grid development projects under the related measures of EEEOP Priority 5 [6]

Call	Number of projects submitted	Number of projects containing smart grid development elements
EEEOP-5.2.2	128	1
EEEOP-5.2.3	88	9
EEEOP-5.3.1	35	8

[6] https://www.palyazat.gov.hu/

As indicated by the table, the activity concerned has a rather low priority in the projects to be implemented. However, at the current stage of implementation of the projects, the specific technical content is in many cases is not known or identified only to a limited extent. The reason for this is due to the specific features of the tendering system, i.e. the content of the project to be implemented will be elaborated only in connection with the public procurement procedure for the main activity (procurement of equipments, construction).

It is also clear that the proportion of related developments is the highest in applications promoting the modernization of the district heating sector. Of the 8 projects involved, the installation of new controlling, measurement data acquisition, telemechanics and remote monitoring systems to optimize operation will affect 6 projects involving the development of district heating systems in Hungarian towns, involving a total of approximately 12,500 residential and 700 other consumers. The two projects to be implemented in Budapest, will include the development of a remote monitoring system for heating centres, including the optimization of the energy consumption of approximately 700 heat heating centres concerned.

It is also important to note, with regard to the figures showing a low preference for the development elements relevant to this study, that they were observed at a relatively high level of allocation of relevant and potentially relevant calls.

The low level of preference for the development of certain smart grid components, along with the predominance of general energy efficiency and/or renewable energy developments can be underlined by several factors.

First of these is the general condition of the buildings at the sites where the developments will take place. In many cases, public sector actors struggling with a lack of resources, and the energy classification of public buildings owned by municipalities is unfavourable due to their obsolescence, thus the main or exclusive goal is the renovation of the mechanical (heating) system, the thermal insulation of the façade, the slabs, installing a heat or power system. As a result of the development, spectacular energy savings of more than 10% can be achieved with regard to the energy consumption of municipally owned public buildings, and a higher level of comfort, environmentally friendly institution is being created which in this form meets the development needs. As a result, due to the significant additional costs involved in other ancillary developments in energy infrastructure, the beneficiaries do not necessarily wish to assume such additional activities.

The ‘Technical and professional requirements’ section of the previously listed calls set out the specific costs that if exceeded make the projects not eligible for funding. Beneficiaries intend to make maximum use of the grants available in the EEEOP primarily for priority actions. Furthermore, the cost of the planned activities would be likely to result in the submission of grant applications or projects already awarded exceeding the limits set out in the relevant calls and therefore the project eventually would not be eligible.

The experiences of the current programming period should be supplemented by the problems caused by the lack of national pilot projects, good practices, the low number of each smart grid element and the overall lack of experience. Such may cause difficulties in planning and implementing the next programming period.

2.3 Consumers

Increasing energy awareness can be achieved through the implementation of complex programs. The target system of such program can cover a very wide spectrum, one segment of which is limited to issues related to the use of smart grid devices.

It is important that consumers represent at the same time the users' side as well as the producer or feed-in side. Their attitudes in these two segments are determined by different aspects. As a user, their decisions regarding energy use are primarily driven by cost effectiveness while environmental and energy awareness is often overlooked. At the same time, power consumption by residential customers is currently inelastic, and the possibility of shifting consumption is very limited due to the nature of the consumption of basic equipment. The approach to consumer input is determined by the size of the investment and the payback period and this latter is influenced by the amount of available funding.

On the national level, government overhead measures will adversely affect smart grid developments and the conditions for introducing smart metering on both sides. E.g. the financial interest of consumers will decrease, thus the economic feasibility of the investment and the level of energy awareness will remain low. There is also an impact on the role of energy suppliers: the so-called energy efficiency obligation scheme as foreseen in the EU Energy Efficiency Directive applies to actors in the energy industry specifically targeting energy savings at consumers. In Hungary, such a system has not been introduced so far, and in the absence of such a system, energy suppliers may not be interested in reducing their consumption (and thus their revenues).

More emphasis should be placed on improving the energy performance of consumers' appliances (such as household appliances and smart meters), as this will enable consumers to monitor and optimize their energy consumption and to save costs. Providing (credible) information is thought to be important, not only because only 47% of consumers are aware of how much energy they are consuming, but also because consumer rights are believed not being properly enforced.

According to a survey conducted a few years ago, about 85% of the Hungarian population does not even know what smart metering means, but the majority are open to the opportunities involved in adjusting their consumer behaviour to the data measured.

3. Good practices – an international and national outlook

As part of the governmental background study on electricity smart grids, this chapter covers the different good practices in order to provide an international and national outlook. The showcased good practices partly come from the research carried out outside of the SET-UP Interreg Europe project, but mostly represent those that were identified in the three years long project experience exchange.

In accordance with the Programme Manual of the Interreg Europe programme, a good practice is "an initiative (e.g. project, project, process, technique) undertaken in one of the programme's priority axes which has proved to be successful in a region and which is of potential interest to other regions. Proved successful is where the good practice has already provided tangible and measurable results in achieving a specific objective." The lessons learnt from these practices serve as hands on experiences for individual, organisational and territorial learning, also being especially useful for governmental learning.

With reference to the Programme Manual[7], "capitalisation is defined as a process of collecting, analysing, disseminating and transferring good practices and policy experience in a particular field of regional policy with the objective of exploiting and deploying in policy the results achieved by the regions in that field. In particular, one of the expected results of this process is the transferral of those practices and experiences into mainstream Structural Funds programmes … within regions seeking to improve their policies." This statement underlines the importance of good practices in capitalisation based governmental policy making and grant programme planning for development projects mobilising the quadruple helix actors equally.

3.1 Electricity Smart Grid Good Practices

1. *eBAGDE[8]: Development of Novel ICT tools for integrated Balancing Market Enabling Aggregated Demand Response and Distributed Generation Capacity*

This 7th Framework Programme project focused on optimal pan-European intelligent balancing mechanism of electricity smart grids. Territorial coverage of eBADGE project was the border area of Austria, Italy and Slovenia. The objective of the project was to integrate virtual power plant systems that can assist in the management of the power transmission and distribution grids in an optimized, controlled and secure manner.

[7] Interreg Europe Programme, Programme Manual: https://www.interregeurope.eu/fileadmin/user_upload/documents/Call_related_documents/Interreg_Europe_Programme_manual.pdf 19 December 2018 (version 6) pp 10. Acceded on 18 March 2019.
[8] Project description of the eBADGE project. https://cordis.europa.eu/project/rcn/105542/factsheet/en Acceded on 21 March 2019.

2. *UPGRID[9]: Real proven solutions to enable active demand and distributed generation flexible integration, through a fully controllable LOW Voltage and medium voltage distribution grid*

This smart grid centred project focused on addressing the constraints and needs:

- arisen from poor observability of low voltage (LV) grid,
- local accumulation of distributed generation,
- risks and difficulties in managing the distribution grid, aging infrastructure and
- social and environmental restrictions that inhibit the grid development.

Regarding the above, the project proposed an open, standardised and integral improvement of the LV grid.

3. *Sustainable Construction Programme in Andalusia[10] (SET-UP good practice)*

The Sustainable Construction Promotion Programme in Andalusia (SCPP) gave a boost to sustainable construction and rehabilitation, reduced the energy bill of households and companies due to investments through incentives in measures of energy efficiency and the use of renewable energies. These are all relevant building blocks of an efficient electricity smart grid.

4. *Catalogue of energy improvement measures to apply for the Incentives Programme for Sustainable Construction in Andalusia[11] (SET-UP good practice)*

Being part of SCPP, the catalogue facilitates the application to sustainable construction grants in Andalusia. It is an inventory of 48 available measures including a wide range of thematic as renewable energies, energy saving and efficiency, smart mobility, etc. Offered examples motivate public and private actors to submit their proposals for SCPP.

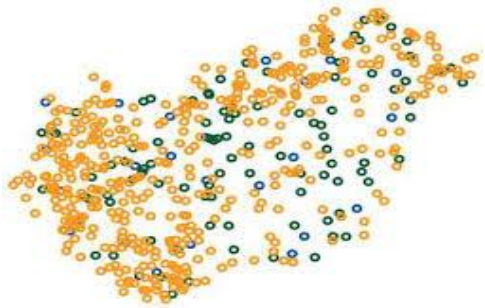
5. *Local Energy Loop[12] (SET-UP good practice)*

Local Energy Loop was launched by the Brittany Region in 2012, to assist local authorities in the definition and implementation of efficient energy policies, based on an integrated territorial approach. Based on action plans established on these policies, concerned local authorities are

[9] Official website of the UPGRID project. Horizon 2020 project: http://upgrid.eu/ Acceded on 22 March 2019.
[10] Official promotion video of SCPP. https://www.youtube.com/watch?v=Ng9qIf8cqGQ&feature=youtu.be Acceded on 19 March 2019.
[11] Official good practice description of the catalogue on the Interreg Europe website. https://www.interregeurope.eu/policylearning/good-practices/item/1783/closed-catalogue-of-energy-improvement-measures-for-the-incentives-programme/ Acceded on 19 March 2019.
[12] Official good practice description of Local Energy Loop on the Interreg Europe website. https://www.interregeurope.eu/policylearning/good-practices/item/224/local-energy-loop/ Acceded on 20 March 2019.

offered financial support that is provided by the Regional Authority in their local project development, focusing on relevant areas, for example in marine energy.

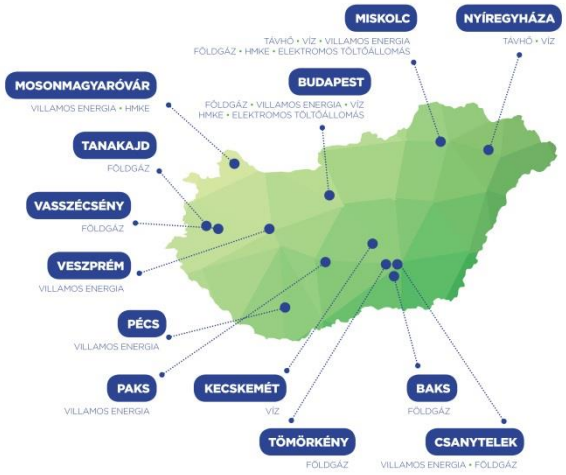
6. *Smart Synergy Project*[13] *(SET-UP good practice)*



Based on Hungarian Act of Electricity, the project was launched to examine the wholeness of smart metering roll-out, also to obtain practical experiences on rolling out and operating the grid. The good practice was delivered and financed by Hungarian Distribution System Operator companies in 2012-2013.

7. *Central Smart Grid Pilot Project*[14] *(SET-UP good practice)*

Good practice initiated by the Hungarian Government – among others – strived for modernisation of infrastructure for data collection, solving system regulation problems, integration of renewable energy sources into the system, and piloting the country wide roll-out of smart metering. Installed electricity smart meters could form a smart grid on the concerned municipalities that took part in the pilot.



[13] Official good practice description of Smart Synergy Project on the Interreg Europe website. https://www.interregeurope.eu/policylearning/good-practices/item/915/smart-synergy-project/ Acceded on 19 March 2019.

[14] Official good practice presentation on the 4-5 July 2017 SET-UP meeting in Paks, Hungary.

4. Development possibilities

The main goal of a concept of smart grid development is its vision, which is conceptualised as 'The widespread use of smart grids in Hungary'. To achieve this, three strategic objectives and three related priorities have been identified as follows:

1. Examining the conditions necessary for the implementation of smart grid projects and solving the existing problems

In terms of priority, the main focus will be on analyzing the main issues and barriers (prerequisites, regulations, funding, task and resource sharing, communication, etc.) for the smart grid development prerequisite system.

2. Implementing research, development, demonstration and deployment projects related to smart grids

After the implementation of Priority 1, they will be implemented in practice.

3. Implementation of programs raising public awareness

They include the transfer of general and specific knowledge related to smart grids, conceptual delineation, the individual system components, the overall benefits of use, the conditions of use and international best practices. The information must be conveyed in such a way that it can be understood by all professional and non-professional target groups.

Here presentation of the practical details of each smart grid development and its components are provided including the use of smart home appliances or electric vehicles, explaining the advantages and disadvantages of implementing them.

The horizontal principles of the concept are represented by the three components of equal importance (environmental, economic and social sustainability), since in our case the concept is aimed at finding the optimal harmony between their implementation. The three components come in the form of energy efficiency and climate goals, cost savings and quality of life.

The concept encompasses a very broad target group of relevant development, including technical professionals, service providers, traders, politicians, municipalities, financial professionals and various groups of the population.

Smart grid development is typically a bottom-up initiative, so stakeholders' willingness to act is a key issue. It is usually difficult to get people's attention, but their background, motivation, sensitivity or over-motivation can also help them get involved. An individual will be more inclined to act if (a) he or she sees a change in behaviour for himself or herself and for society; and if (b) they are emotionally more motivated in their knowledge of the problems of the present and the dangers of the future.

A program of this kind will be feasible if it succeeds in attracting the interest of the stakeholders. This is a function of proper communication, and the other important expectation is to raise awareness of the consequences of the related problems and of taking responsibility. The problem is the way in which consultations are carried out at an early stage and throughout the process.

Communication channels may be selected according to the target groups. In general, the role of television, radio, the (local and regional) press, and the Internet in particular, among young people, cannot be neglected. Occasionally, distribution of leaflets and brochures to the public and using other innovative communication tools can also be useful, as well as the organization of public events (workshops, roundtables, Internet forums, etc.) which also provide a good opportunity for participation.

However, these must always be preceded by information to the public and an assessment of the population's awareness of smart grids/devices in order to select the right target groups. By understanding the views of the general public, we can systematically explore the nature and causes of the problem, thereby identifying our major tasks in smart grid development planning.

5. Conclusions

Based on the government background study, the following main conclusions can be drawn:

- In terms of smart grid development, Central Europe is lagging far behind in Europe, and Hungary is performing poorly within the region. So far, only a few pilot projects have been implemented.
- Several elements of the set of conditions required for the use of smart grids or its elements have serious shortcomings:
    - There is no legislation available regarding the development, deployment and operation of smart grids,
    - Sharing of benefits and costs is unclear,
    - Additional costs / investments related to smart grids are not currently covered by the system usage fee (regulation),
    - Low level of public awareness on relevant issues,
    - Low utilization of available but limited EU funds,
    - Smart grid development projects do not play a prominent role in smart city developments and include mostly renewable energy sources related developments.

Overall, there are currently no reasons or factors for the rapid roll-out of smart grids in Hungary. Even the creation of a smart grid strategy could be considered as a great step forward.

Hungarian actors are actively involved in the work of various international organizations (EURELECTRIC, ERGEG). The national innovation capacity can be one of the main drivers of relevant developments in many respects (e.g. software development). Some national service providers and other stakeholders are interested in such developments.

The main evidence from the Hungarian case study can provide valuable information for the preparation of a call for proposals on smart grid electricity in the 2021-2027 programming period, thus making more efficient use of available EU resources in this respect.