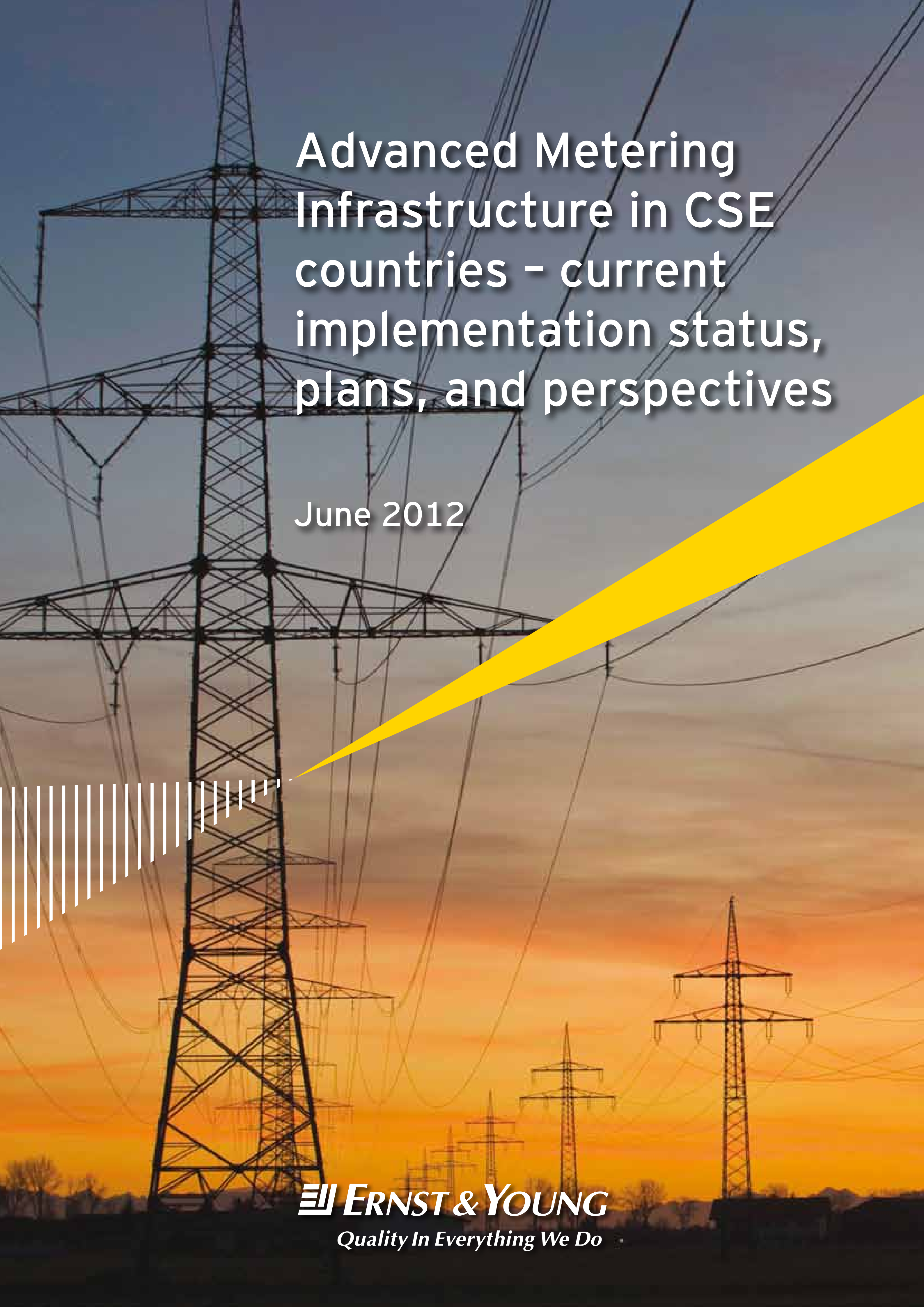

Advanced Metering Infrastructure in CSE countries - current implementation status, plans, and perspectives

June 2012

Ernst & Young
Quality In Everything We Do

Foreword

Pursuant to the Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009, the European Union's member states are conducting cost-benefit analyses regarding the economic viability of a country-wide smart metering implementation. In general, according to the aforementioned Directive, if the outcome of the analysis states that the implementation of smart metering in particular country is beneficial to the economy or such analysis is not prepared, a member state is obliged to implement Advanced Metering Infrastructure covering at least 80% of electricity consumers until the year of 2020. As such undertaking requires significant investment, it is necessary to conduct in-depth analysis of potential costs and benefits of the implementation to ensure the maximum value both for consumers and the whole economy.

The Report, prepared by Ernst & Young, summarizes key findings from the analysis of particular CSE countries' smart metering implementation status. The research shows that so far only Hungary has conducted a country-wide cost-benefit analysis and three other countries from the CSE region have started a CBA, which is to be completed by 3 September 2012. In our view, the country-wide CBA should be the most important source of information regarding factors that influence the profitability of the project and on the most crucial aspects of AMI deployment. Unfortunately, as each country has its own specifics determining possible benefits deriving from smart metering implementation, it is impossible for one country to simply adopt assumptions regarding costs and benefits of AMI implementation from another, which makes a CBA so important in the first place.

Apart from the status of AMI implementation, the Report focuses on each CSE country's potential regarding possible benefits according to a set of specific factors, presenting the ranking of the analysed countries based on points for each identified factor influencing smart metering implementation potential.

Being aware of the complexity of smart metering concept, Ernst & Young may help market regulators and energy enterprises to effectively utilize benefits and adopt new smart reality.

Last but not least, we would like to acknowledge and thank everyone who participated in the preparation of this Report for their time and effort.

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Acronyms and abbreviations

The following table provides information on acronyms and abbreviations used throughout this paper.

AMI	advanced metering infrastructure
AMM	advanced metering management
AMR	advanced meter reading
CAPEX	capital expenditures
CBA	cost-benefit analysis
CSE	Central and Southern Europe
DSO	distribution system operator
DSR	demand side response
ERO	energy regulatory office
HAN	home area network
IHD	in-home display
MDM	meter data management
OPEX	operating expenditures
RES	renewable energy sources
SM	smart metering
SME	small and medium enterprises
TSO	transmission system operator

1. Introduction

This report was prepared by the Performance Improvement team of Ernst & Young Business Advisory. The purpose of this report is to analyze the current state of AMI implementation in chosen Central and Southern European countries (CSE countries) as well as to identify key issues in this respect.

The report covers the following CSE countries: **Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey**.

The main report is divided into four parts (chapters 3-6).

Chapter 3 presents the background and the objective of the report.

Chapter 4 describes the current state of electric energy markets in the CSE countries and includes such information as the size and structure of the market, average energy consumption and general quality of energy supply. The chapter is concluded with a ranking of the analyzed CSE electric energy markets evaluating the individual countries' potential for AMI implementation.

In chapter 5 the current state of AMI implementation in the CSE countries is described, including the information on the results of cost-benefit analyses and plans regarding pilot projects and country-wide roll-out. In addition, key stakeholders' attitude to smart metering and regulatory approach towards AMI are presented. The chapter is concluded with a comparison of the CSE countries' potential for AMI implementation estimated in chapter three and their actual activities in the field of AMI.

Chapter 6 is devoted to the detailed analysis of the state of AMI implementation in the CSE countries. The results of the analyses of individual countries covered by the report are presented according to the following structure:

- general description of the electricity market,
- information on electricity distribution system and share of RES in energy production,
- potential for AMI implementation,
- presentation of the regulatory approach and key stakeholders approach to AMI,
- information on pilot projects already carried out and plans regarding a country-wide roll-out,
- additional information on AMI implementation in the given country.

Resources used for this report include:

- surveys carried out by Ernst & Young in the CSE countries in January and February 2012,
- Eurostat and the national statistical databases,
- S. Renner et al., *European Smart Metering Landscape Report*, SmartRegions, Vienna, February 2011,
- P. Capros et al., *EU energy trends to 2030 – update 2009,* European Commission – Directorate-General for Energy, Luxembourg, 2010,
- *5th CEER Benchmarking Report on the Quality of Electricity Supply*, CEER, Brussels, 2011,
- *The Global Competitiveness Report 2009–2010*, World Economic Forum, 2009,
- *Electricity prices – price systems 2010*, Eurostat, 2011,
- annual reports of energy companies,
- information available on public offices websites,
- other publications.

2. Executive summary

2.1 Smart metering definition and associated capital expenditure

The most common and widespread definition of smart metering, also called AMI, is the one developed by the European Commission in its interpretative note on Directive 2009/72/EC which states that the "ability to provide bidirectional communication between the consumer and the supplier/operator" and to "promote services that facilitate energy efficiency within the home" are the key features of smart metering.

More complex definition of smart metering was developed during the preparation of Implementation Study of Smart Metering in Poland issued by the Institute of Power Engineering and Ernst & Young Warsaw. The study defines smart metering in its two aspects: a technical and a functional one. This definition is illustrated by the drawing below.

Drawing 1: AMI definition

Advanced Metering Infrastructure (AMI)

Technical aspect of AMI

- Complete infrastructure comprising metering devices (meters), networks, software and communication protocols.
- **Metering devices** are able to exchange the data with the concentrator or the metering system by using the defined transmission media. The most basic functionality of the meter in AMI system is to register the electricity consumption in the predefined time intervals (e.g. hourly) and transmit the data bi-directionally: to and from the meter.
- **Transmission infrastructure** is the communication network using various transmission technologies (PLC, radio, telephone network, LAN, WAN) to send data between the meter and concentrator / MDM and between the concentrator and MDM.
- **MDM (Meter Data Management)** is the IT system responsible for data acquisition from the concentrators or / and from the metering systems; its purpose is also to process and store the data as well as to make them accessible for the different entities under the particular conditions.

Functional aspect of AMI

- AMI has the purpose of **acquiring the data** regarding energy consumption and other energy parameters from end-users.
- AMI should enable to **influence the level of end-users' consumption** using management measures that are acceptable for the consumer.
- The metering data should be acquired in a secure and reliable way, in the predefined time intervals.
- AMI should enable the utilities to diversify energy tariffs, implement Demand Side Management (DSM) programs, detect theft and power failures. It should also support the network investment optimization and sourcing and balancing of electricity.

Source: „Smart Metering in Poland – Implementation Study", Institute of Power Engineering, Research and Development Unit, Gdańsk Division, Ernst & Young, 2010.

The estimated total costs of AMI implementation are significant and vary in the analysis conducted in different countries from above EUR 102 to as much as EUR 162 per each metering device (for details please refer to page 20 of this Report). The differences in CAPEX result mainly from different assumptions regarding chosen meter functionalities, number of substations and IT systems' cost.

As a consequence of high investment costs it is necessary to prepare deep cost-benefit analysis, which would take into consideration not only long-term costs of the AMI implementation, but would also cover such specific aspects of each CSE's country energy market as:

- the size and structure of the market,
- average energy consumption and its price constituting the potential for consumer behavior change,
- level of network losses,
- other market factors such as share of RES and actual electricity delivery quality.

These factors are crucial for the analysis of each market's potential regarding the implementation of AMI and potential benefits attributed to it, and are further discussed in this executive summary and the Report.

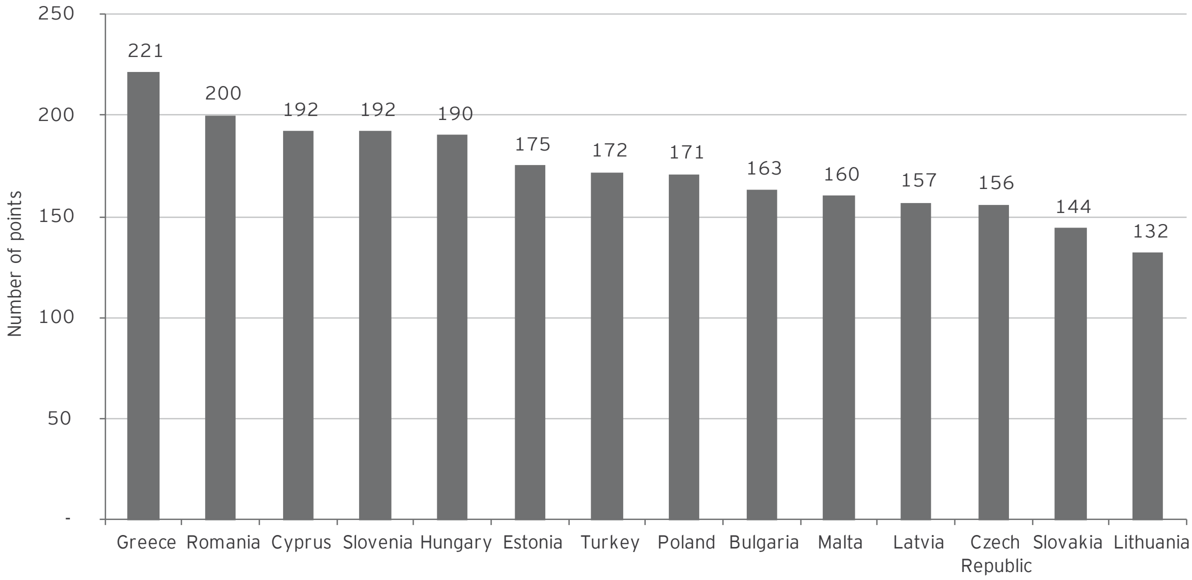
2.2 CSE markets' potential for AMI implementation

Based on the described market features criteria of the analysed CSE countries, a ranking of their potential regarding AMI implementation has been prepared. Every criteria has been assigned a weight:

- market size (2 points),
- average electricity consumption (2 points),
- average electricity bill (5 points),
- network losses reduction potential (3 points),
- quality of supply (4 points),
- planned share of RES in electricity production in 2030 (5 points),
- implementation complexity level – based on the number of DSOs (1 point).

A country could obtain a maximum of 308 points. The results of the assessment of the potential for AMI implementation in each CSE country are summarized in the graph below (the detailed points calculation is shown on page 29).

Chart 1: Results of the ranking of the CSE countries



Source: Ernst & Young.

The ranking suggests that Greece has the highest potential for AMI implementation, while Lithuania is least likely to implement smart metering. The countries with the second highest AMI implementation potential are Romania, Cyprus, Slovenia and Hungary with a similar number of points.

In the case of Greece, it is the market size, the electricity consumption, and the average annual cost of electricity for residential customers, as well as the future share of RES in electricity production, which have the greatest influence on the country's high score in the ranking.

What matters most in the case of Romania is the market size, significant distribution network losses, low quality of energy supply, and high future share of RES in electricity production. Cyprus, Slovenia and Hungary are countries, where the average electricity bill and consumption build the AMI potential.

Lithuania is the country with one of the lowest average annual electricity price for residential customers, consumption per household and, in the same time average level of network losses and quality of supply metrics. That is why we assess Lithuania's potential for AMI implementation as low.

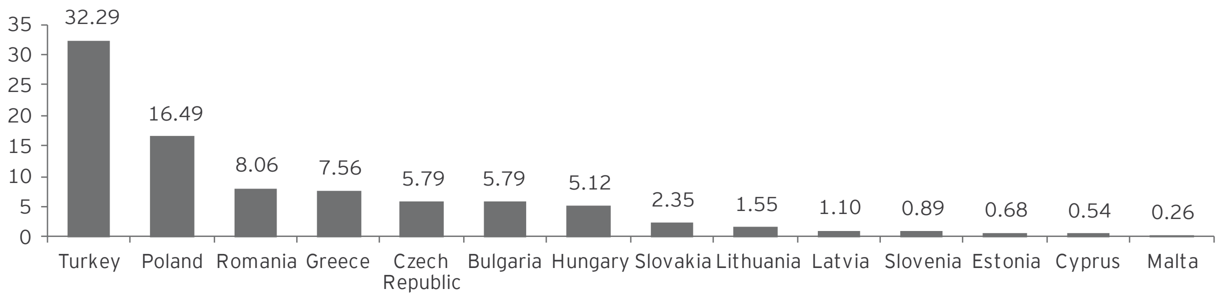
For the other countries not commented above, different drivers affect AMI implementation potential.

The size and structure of the market

The size and structure of the market – mainly the number of consumers – drive the level of necessary CAPEX per metering device. It can be assumed that the higher the number of customers, the stronger is the economy of scale, therefore the lower CAPEX per metering device.

The following chart presents the size of selected CSE countries' energy markets – the overall number of electricity consumers. In the CSE countries households constitute over 80% of customers and this group is mostly considered when analysing AMI benefits.

Chart 2: The number of electric energy customers in the CSE countries (in millions)



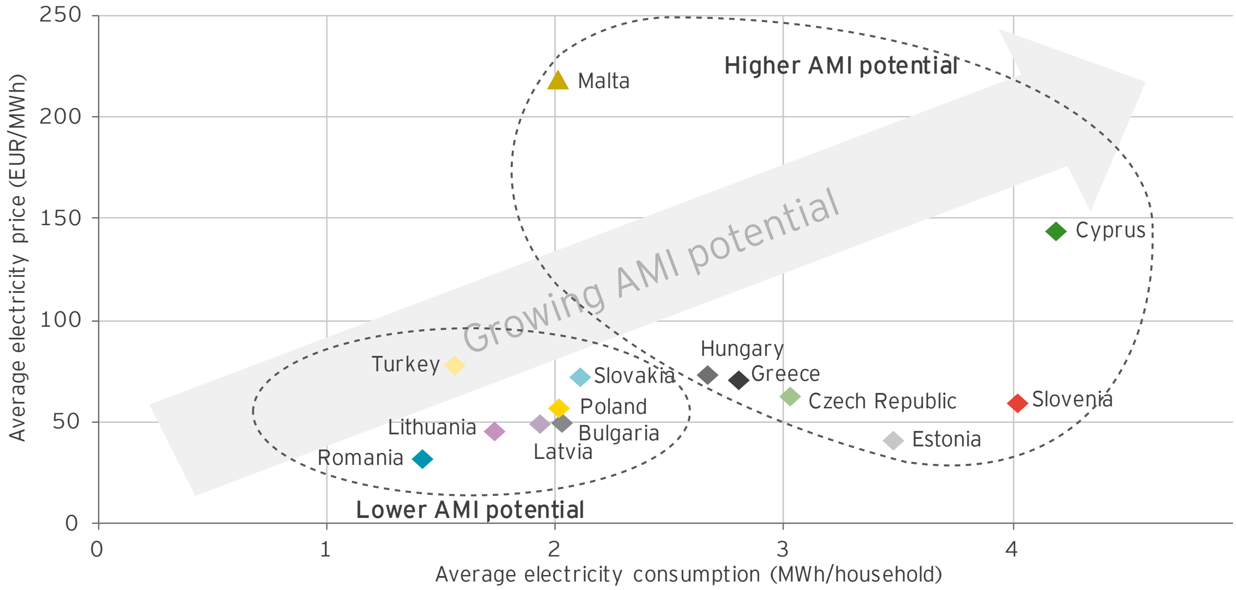
Sources: Eurostat, the national statistical databases, the annual reports of energy companies.

As far as the size and the structure of the energy market are concerned, it is clear that the biggest potential lies in Turkey and Poland. As a consequence, it may be expected that these countries may mostly benefit from the economy of scale during massive AMI roll-out.

Potential consumer benefits associated with the average energy consumption level

According to most analyses performed by CSE countries, the AMI feature will enable residential consumers to constantly monitor their energy consumption, and as a result to decrease their energy bill as the most important consumer benefit. Hence, it may be assumed that the countries that both have the highest average electricity consumpiton and the highest price of electricity, will have the highest potential to benefit from AMI implementation. The following chart summarizes these relations.

Chart 3: Average electricity consumption per residential customer vs. average electricity price (without distribution charges and VAT) in 2010



Source: Eurostat.

As presented above, the highest average electricity consumption in the household sector of the energy market is in Cyprus and Slovenia, with respectively an average of 4.2 MWh and 4.0 MWh consumption of electricity per household per year. When it comes to the electricity price (without distribution charges and VAT), the highest can be observed in Malta and Cyprus - approx. 219 EUR/MWh and 145 EUR/MWh respectively.

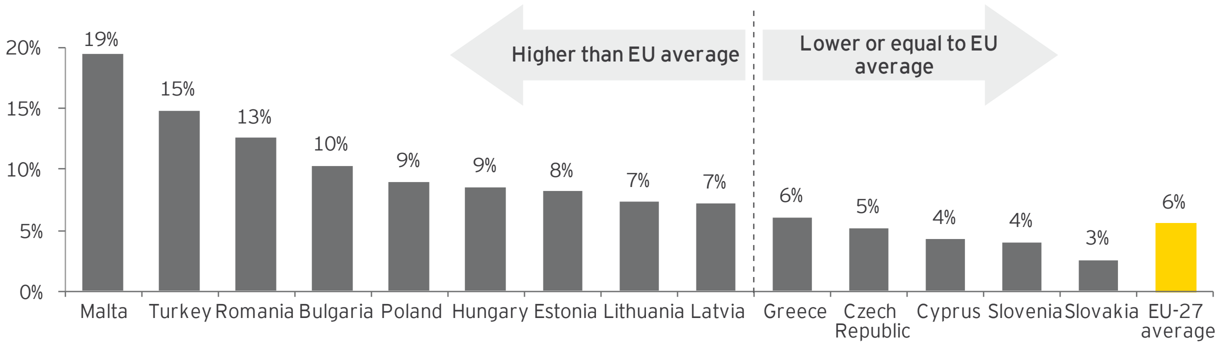
As a consequence, the highest average electricity bills in 2010, thus the highest potential of electricity bill reduction, were observed in Cyprus (approx. 605 EUR/household/year) and in Malta (approx 440 EUR/household/year). Romania, Lithuania and Turkey have the lowest AMI potential when potential for electricity bill reduction is considered.

Potential DSO benefits associated with the average network losses level

If electricity bill reduction is the biggest benefit for electricity consumers, the decrease in the level of network losses would be the highest benefit for distribution system operators. Network losses can be split into two groups: commercial and technical. Commercial losses are defined as losses related to energy that was delivered but not metered, billed or paid for and can be split into the following categories: theft, meter reading fraud, meter tampering, inaccurate metering. Technical losses are losses, which are the result of physical phenomena accompanying the energy flow in the grid. Smart metering impementation will mainly enable DSOs to constantly monitor electricity consumption, thus will enable them to be informed of any unauthorized connection or of meter tampering, which is the main source of commercial network losses. On the other hand, constant network flow monitoring may enable DSOs to reduce technical network losses.

The following chart presents the average network losses level in the analysed CSE countries, calculated as a percentage of electricity input to the grid.

Chart 4: Network losses (as % of electricity input)



Source: Eurostat.

As far as the potential to reduce network losses is concerned, the highest level of losses in 2010 could be observed in Malta, Turkey and Romania at the level of 19%, 15% and 13% respectively. On the other hand Cyprus, Slovenia and Slovakia have the lowest potential to reduce network losses.

Other factors that influence country's potential regarding AMI implementation

The analysis also covers other aspects of CSE countries' electricity markets that may be the source of potential benefits or additional costs such as:

- quality of electricity supply – the level of unplanned interruptions of electricity supply and their length, which may be avoided thanks to the implementation of AMI and Smart Grid functionalities,
- Renewable Energy Sources (RES) share in the "fuel-mix" – the rapid development of RES will trigger faster development of AMI as the first step towards Smart Grid implementation,
- complexity of AMI implementation – it may be assumed that higher costs of smart metering deployment will have to be borne by countries with a high level of market complexity understood as a high number of entities (DSOs) involved, which may cause additional costs regarding i.e. IT systems.

For detailed information on Smart Grid functionalities and the analysis of the above factor's impact on AMI implementation potential, please refer to the appropriate sections of the Report.

2.3 Status of AMI implementation in CSE countries compared to their potential

Greece, Romania, Hungary, Cyprus and Slovenia have the highest potential for AMI implementation among the CSE countries; therefore, in theory, these countries should be the leaders in the deployment of smart meters in the CSE region.

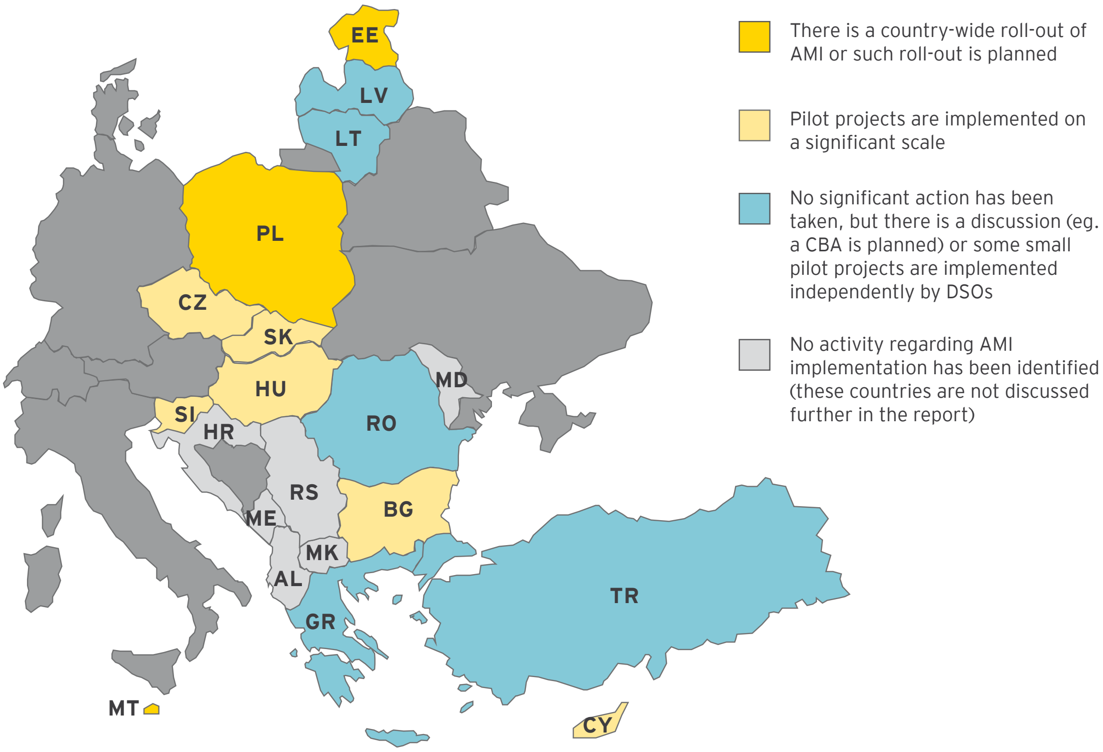
Gathered information regarding Smart Metering diffusion in the CSE region indicates, however, that quite different countries (except for Slovenia where big scale implementation covering nearly 50% of metering points is confirmed) are the most ambitious players in the market. While Malta is the undisputed leader of AMI implementation due to the almost finished country-wide roll-out, it is followed by Estonia where utilities themselves started a roll-out that should cover most of the electricity consumers in the next five years.

The other significant players in the field of SM are Bulgaria, Poland and Slovakia, where the DSOs carry out some big scale pilot projects and implementations. For instance, there is a country-wide roll-out planned in Poland.

Status of AMI implementation in the CSE countries

The following drawing presents the status of AMI implementation in analysed CSE countries divided into four groups.

Drawing 2: Status of AMI implementation in the CSE countries



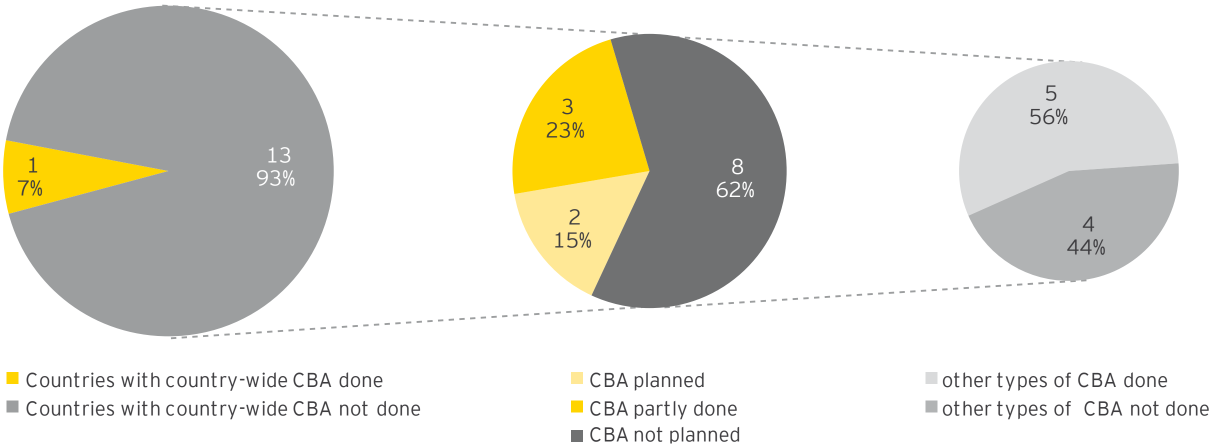
Source: Ernst & Young.

The summary of the most important elements constituting status of AMI implementation are analysed on the following pages.

CBAs' results and regulatory approach towards AMI implementation

The chart below shows the status of CBAs in the analysed countries:

Chart 5: Status of CBAs in CSE



Source: Ernst & Young.

Hungary is the only country, which has so far conducted a country-wide CBA. Its results proved the economic viability of AMI implementation. On the other hand, it is very likely that another CBA study will be conducted, which will verify the outcomes of the first one and may have significant impact on Hungarian plans regarding AMI implementation.

Among the rest of the CSE countries three have already started carrying out CBAs: Cyprus, where the results of the analysis are to be published by July 2012, the Czech Republic, where the country-wide analysis is to be finalized by September 2012, and Lithuania, where the CBA is being developed by Ernst & Young. In addition, Romania and Slovakia are planning to carry out a CBA.

The remaining eight countries are not planning to carry out CBAs that fulfil the requirements of the Directive 2009/72/EC. However, in four of them (Malta, Poland, Slovenia, and Turkey) some other types of cost-effectiveness studies have been performed, as well as in Slovakia. Usually those studies have been carried out by DSOs interested in installing smart meters in selected customer groups. According to available data most of those studies gave positive macroeconomic results.

Despite the fact that only one country conducted CBA to date, some countries have already adopted some legal provisions towards implementation of AMI and these include: the Czech Republic, Estonia, Greece, and Turkey.

Additionally, five other CSE countries are planning to adopt some regulations regarding AMI: Bulgaria, Hungary (at this stage only for pilot projects), Poland, Romania, and Slovakia.

When it comes to the question whether the implementation of AMI is going to be mandatory or optional, only in seven CSE countries the roll-out will be mandatory (for all customers or only for some groups of consumers – eg. in case of Turkey). These are seven out of the nine countries where there already exist regulations regarding SM or some legal provisions are on their way.

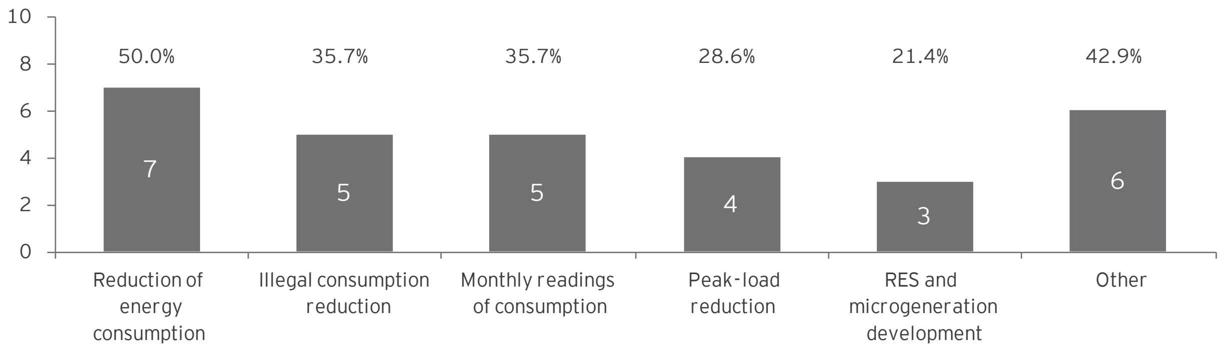
The Czech Republic and Slovakia, the remaining two countries from the group of those that already have legal provisions regarding AMI or that have plans to adopt such provisions soon decided to make AMI implementation optional (the Czech Republic - however, after EU approval of SM implementation plans, the implementation will become mandatory) or postponed the decision until the results of the CBA are revealed (Slovakia).

Other CSE countries lacking regulatory provisions make AMI implementation optional. Pilot SM projects are realized voluntarily by energy companies or distribution system operators. The adoption of smart metering technology and services is therefore dependent solely on the activity of the utilities.

Key reasons for AMI implementation in the CSE countries

The following chart presents the outcome of the survey on key reasons for AMI implementation in the CSE countries. It can be noticed that reduction of energy consumption is the most popular factor for AMI implementation in the CSE region – in the survey seven, out of 14 countries indicated consumption reduction as the main reason for SM deployment.

Chart 6: Key reasons for AMI implementation in the CSE countries



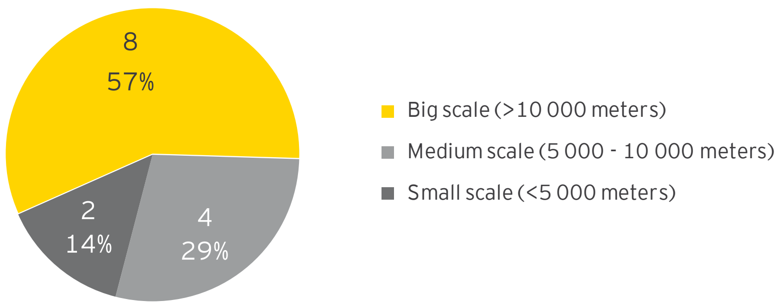
Source: Ernst & Young.

Apart from the above mentioned key objectives of AMI implementation, some countries listed additional reasons. In Bulgaria, for example, one of major problems in energy supply and a significant cause for SM diffusion is the high rate of errors in metering and bills calculation, which is a ground for a lot of customer complaints. In Turkey implementation of smart meters is supposed to bring improvement of settlements between energy suppliers and customers. In Slovenia implementation of AMI is expected to support competition in the energy supply market and to be one of the mechanisms to strengthen consumer rights. In Malta installation of smart meters is supposed to help reduce the costs of bi-monthly billing.

Pilot projects and country-wide roll-out

The chart below presents the share of CSE countries, where pilot projects are or have already been carried out. It can be seen that countries with pilot projects conducted on a big scale dominate (these are: Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia, and Slovenia). Three countries (Greece, Latvia, Malta) carried out and one (Lithuania) is currently carrying medium scale pilot projects. Small pilot projects are being run by Cyprus and Turkey.

Chart 7: Share of CSE countries with pilot projects carried on a big, medium, and small scale



Source: Ernst & Young.

The available data shows that, among CSE countries, Poland is planning to install the greatest number of smart meters. So far the installation of a total of 3.29 million meters (which is 20% of the total number of electricity customers) by 2018 is confirmed.

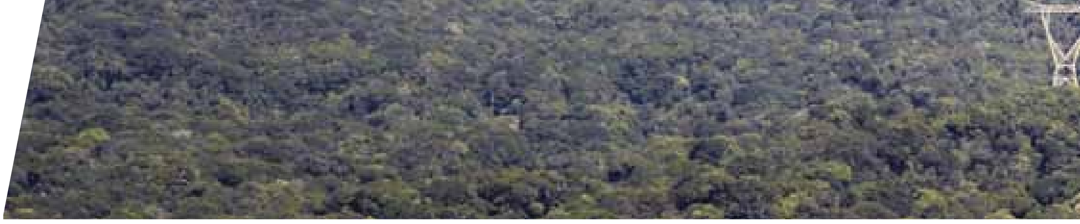
Apart from Poland, three other countries can also be distinguished because of the number of smart meters to be installed: Bulgaria (planning to deploy 0.9 million of smart meters by 2020), Estonia (planning to install almost 0.5 million smart meters by 2017), and Slovenia (planning to install 0.4 million smart meters by 2020).

When it comes to the share of installed smart meters in the total number of metering points, Malta is clearly the leader in AMI implementation. By May 2012, 82% of all Maltese electricity consumers will be equipped with smart meters. According to the plans announced by Enemalta – the Maltese national electricity provider which is running a country-wide roll-out – by the end of 2012, 98% of the consumers are to be provided with smart meters.

Apart from Malta, two other countries clearly stand out: Estonia and Slovenia. By May 2012, Estonia equipped 20% of its electricity consumers with SM but the plan is to install smart meters for 73% of customers by 2017. This country-wide roll-out is run by the individual DSOs, without any significant governmental or regulatory support. Slovenia, on the other hand, installed smart meters for 19% of its electricity consumers, and by 2020 the rate of SM deployment is expected to be 47%.

The remaining 8 countries (Cyprus, Czech Republic, Greece, Hungary, Latvia, Lithuania, Romania, and Turkey) are running some pilot projects, but the scale of those activities is significantly smaller than in the countries mentioned above. In all of these countries the planned share of smart meters in the total number of electricity customers is supposed to be less than 1%.

3. Report objective



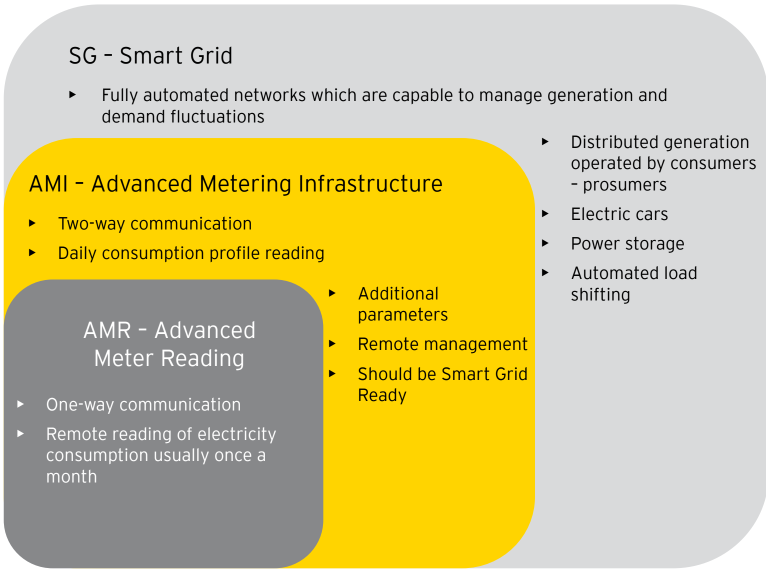
The main objective of this Report is to depict the current status of conducted analyses and developments in the field of AMI in some countries of Central and Eastern Europe (see map on page 21), as well as to elaborate on plans of the analyzed countries in this regard. The analysis is performed in the context of the CSE countries' potential for AMI implementation and activities they undertake in this direction in order to point out the ones with the best perspectives for successful roll-out of smart metering systems. The countries are compared on the basis of the potential drivers and barriers to the AMI implementation.

3.1 The buzz around "smart" – AMI and Smart Grid: definitions

For years the energy industry has neither been a headliner for media nor the "it topic" for politicians and scientists. Changing rather slowly, relatively stable, and too complicated to go into details in the daily news, it hardly ever rose excitement and passionate discussions. However, one can observe there has been a change in this regard recently – it seems that the energy sector finally is becoming something interesting enough to spare it a few pages in the newspapers, and spend hours to discuss it during the numerous conferences, panels and events.

"Intelligent" is the crucial word here and the "hot topic" is how to smarten the electric grid and why countries should spend millions of euros replacing the meters they have been using so far for the new, "smart" ones. The increased interest in the topic of Smart Grid and smart metering may be observed in many countries across the globe – USA, Australia and most of the European countries have conducted pilot implementations and are hoping for triggering energy efficiency among consumers, reduction of peak load, improving the energy system security, and many other benefits to which the meters with bidirectional communication may open the door.

Drawing 3: AMI is more than AMR and is a starting point for Smart Grid



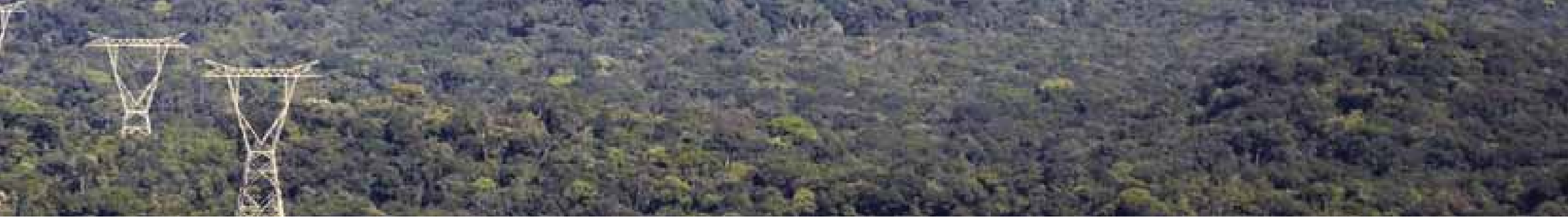
Source: Ernst & Young.

When it comes to the definition of smart metering, also called AMI, the European Commission, in its interpretative note on Directive 2009/72/EC states that the above mentioned "ability to provide bidirectional communication between the consumer and the supplier/operator" and to "promote services that facilitate energy efficiency within the home" are the key requirements of smart metering[1]. Also the ERGEG Status Review on Regulatory Aspects of Smart Metering, issued in 2009, confirms this conclusion[2].

More comprehensive definition of AMI, or an Advanced Metering Infrastructure, may be found in the Implementation Study of Smart Metering in Poland issued by the Institute of Power Engineering and Ernst & Young. The study defines smart metering in its two aspects: a technical and a functional one. This definition is illustrated in the following drawing.

1 Interpretative Note on Directive 2009/72/EC Concerning Common Rules for the Internal Market in Electricity and Directive2009/73/EC Concerning Common Rules for the Internal Market in Natural Gas – Retail Markets, Commission StaffWorking Paper, Brussels, 22 January 2010, p. 7

2 EREGEG, Status Review on Regulatory Aspects of Smart Metering (Electricity and Gas) as of May 2009, Ref: E09-RMF-17-03, Brussels, 19 October 2009



Drawing 4: AMI definition

Advanced Metering Infrastructure (AMI)

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- **Metering devices** are able to exchange the data with the concentrator or the metering system by using the defined transmission media. The most basic functionality of the meter in AMI system is to register the electricity consumption in the predefined time intervals (e.g. hourly) and transmit the data bi-directionally: to and from the meter.
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Functional aspect of AMI

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- AMI should enable the utilities to diversify energy tariffs, implement Demand Side Management (DSM) programs, detect theft and power failures. It should also support the network investment optimization and sourcing and balancing of electricity.

Source: „Smart Metering in Poland – Implementation Study", Institute of Power Engineering, Research and Development Unit, Gdańsk Division, Ernst & Young, 2010.

Also the United States Federal Energy Regulation Commission (FERC) has developed its own definition. It describes AMI as "the communications hardware and software and associated system software that creates a network between advanced meters and utility business systems and which allows collection and distribution of information to customers and other parties, such as competitive retail providers, in addition to providing information to the utility itself."[3]

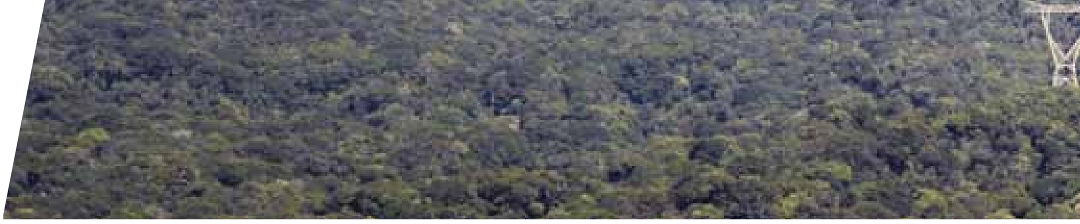
Although in many publications the terms "smart metering" (AMI) and Smart Grid are used synonymously, one must not forget that AMI is an element and, as many sources state, "the door-opener" for a much more complex concept. The concept mentioned is Smart Grid and it is defined as "an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end-users. Smart Grids co-ordinate the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders to operate all parts of the system as efficiently as possible, minimizing costs and environmental impacts while maximizing system reliability, resilience and stability".[4]

As for the benefits that can be obtained from "smartening" the country's electric grid, one can list the following major ones:

- Smart Grid will be self-healing: sophisticated grid monitors and controls will anticipate and respond instantly to system problems or interruptions in order to avoid or mitigate power outages and power quality deficiencies;
- It will be more secure from physical and cyber threats: deployment of new technology will allow better identification and response to manmade and natural disruptions;
- It will support widespread use of distributed generation: standardized power and communications interfaces will allow customers to interconnect fuel cells, renewable generation, and other distributed generation on a simple plug and play basis;
- It will enable customers to better control the appliances and equipment in their homes and businesses:

3 Federal Energy Regulatory Commission Survey on Demand Response, Time-Based Rate Programs/Tariffs and AdvancedMetering Infrastructure – Glossary, 2008, p.1

4 Source:"Technology Roadmap. Smart Grids"; International Energy Agency



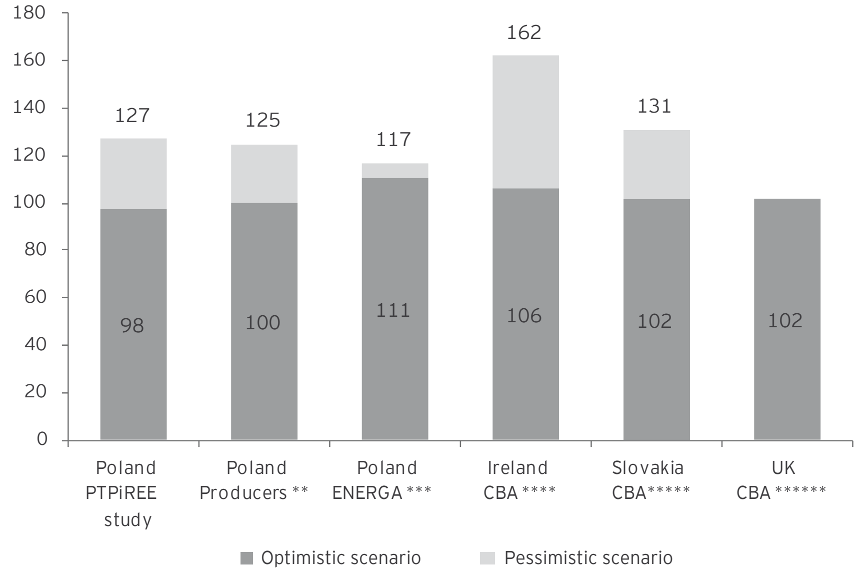
the grid will interconnect with energy management systems in smart buildings to allow customers to manage their energy use and reduce their energy costs[5].

The Report is dealing mainly with the issues of AMI, but some Smart Grid aspects are considered as well. In particular, it has been investigated how and to what extend AMI implementation is a part of a wider Smart Grid deployment plan in different countries.

3.2 Why spend – the motivation of CSE countries for AMI implementation

When it comes to estimations, countries tend to focus rather on the benefits that can be obtained from AMI implementation, than on analyzing the investment cost. Nevertheless, one must know the expenditure is expected to be rather significant.

Chart 8: Cost of AMI implementation – CAPEX per metering device (EUR)*



*) *Without the cost of IT systems integration.*

**) *The numbers obtained during a conference „Metering Billing CRM Europe 2011": CAPEX for a massive turnkey implementation (including MDM).*

***) *The actual implementation costs on the basis of presentation given by ENERGA-OPERATOR on 8 March 2011 "Experience in the implementation of Smart Grid".*

****) *Without the cost of IHD, which is obligatory in Ireland.*

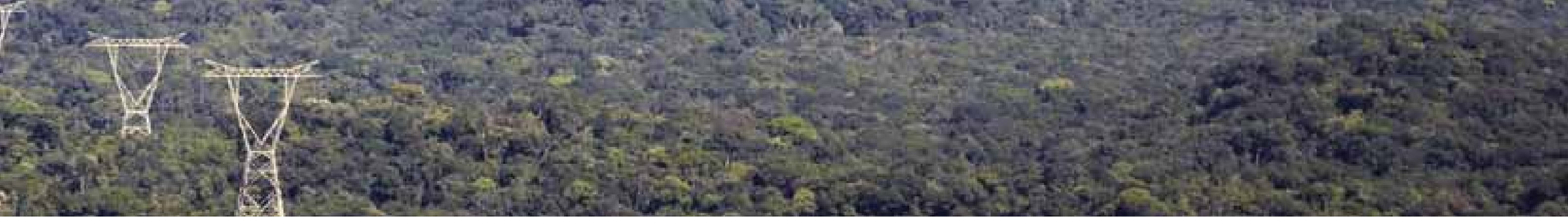
*****) *Depending on meter functionality and communication technology prices ranged from EUR 101.6 to EUR 131 per metering point.*

******) *Without the cost of IHD and the cost of educational campaigns for consumers – in the UK the retailers are responsible for implementing AMI and AMI costs incurrence.*

Source: PTPiREE Study, materials from a conference „Metering Billing CRM Europe 2011", "Experience in the implementation of Smart Grid" by ENERGA-OPERATOR, data from CBAs done by Ireland, Slovakia, and the UK.

Presented graph summarizes the expected AMI implementation CAPEX level per metering device. One can see that it varies quite significantly between the countries and studies, ranging from 102 € (a result of CBA done in the UK) to 162 € (CAPEX estimation for the most advanced installation option – a result of CBA done in Ireland). The differences in CAPEX level result from varying assumptions regarding projected meter functionalities, density of concentrators and other auxiliary devices as well as expected IT costs. Nevertheless, the structure of costs stays rather similar, with cost of meters and auxiliary devices posing the most significant element of projected expenditures (71% to 77%) and installation costs equal to 15 to 20% of the overall expenditures. Logistics and project management systems were estimated to account for ca. 5% of the entire investment, the rest is cost of the IT systems.

5 Source: „Smart Grid: Gaining Customer Buy-In", EnergyBusinessReports.com



As one can see, the financial assumptions of studies carried out in individual countries varied but the expenditure per metering device always stayed quite high, ranging between 102 € in the UK and Slovakia and 162 € in Ireland. This shows that "blind" investment may not turn out feasible and that a thorough cost-benefit analysis ought to be performed before a decision in regard to SM implementation is taken.

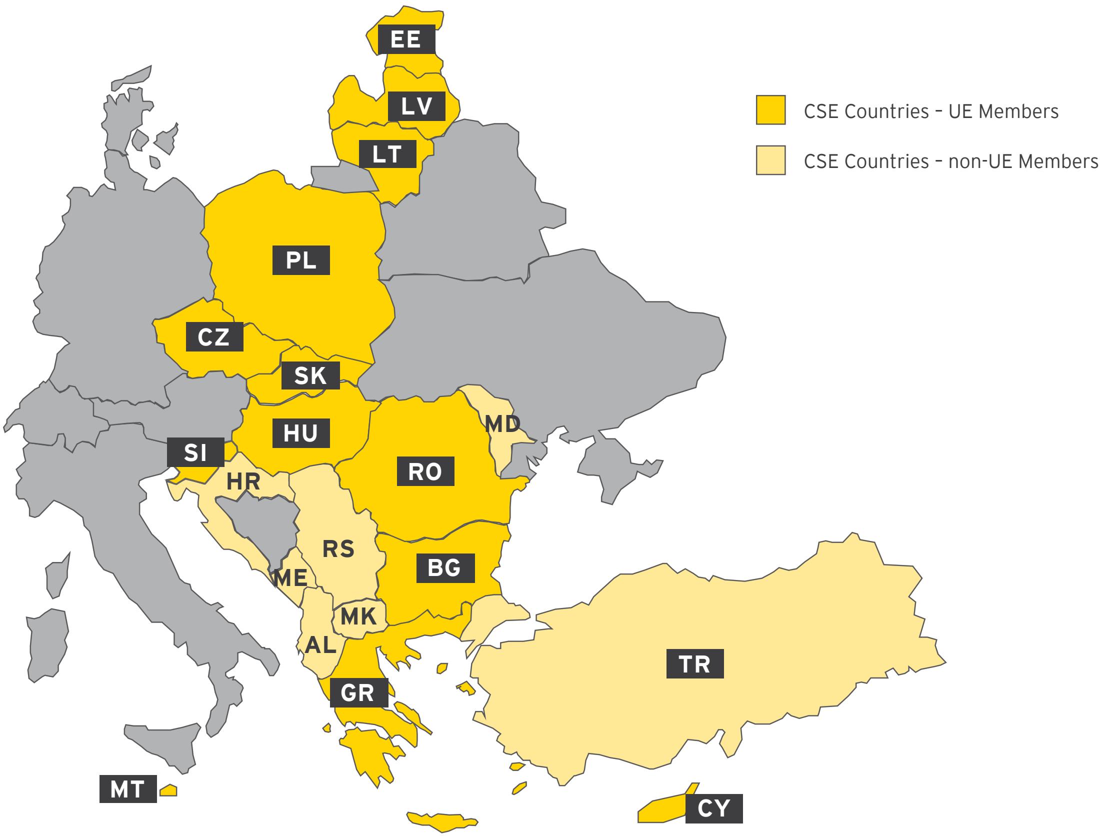
A cost-benefit analysis is also required by the European Union's Directive on internal markets (2009/72/EC) stating that the implementation of the intelligent metering systems "may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution." According to the Directive, the feasibility of implementation should be assessed in the cost-benefit analysis that in turn shall be prepared before 3rd September 2012. Subject to that assessment, a country-wide roll-out plan with a timeframe of up to 10 years for the implementation of smart meters shall be prepared. In case the CBA proves the roll-out to be economically reasonable, there is the requirement that at least 80% of consumers shall be equipped with intelligent metering systems by 2020.

The Directive on internal markets is part of the so-called Third Energy Package being the major driver for the EU Members to implement AMI. Also under the so-called Energy Services Directive (2006/32/EC) the EU Member States, which represent the majority of the countries analyzed in this report, have the obligation to implement smart meters in the new buildings and the ones that undergo major renovation and to replace the old "dumb" meters with the new "intelligent" ones where feasible.

In the following map 20 countries that belong to the CSE region are marked. Initially, all of them were supposed to be included in the analyses. However, in the course of the Report preparation it appeared that in some of these countries no activities regarding AMI implementation could be identified. As a result of this finding, the scope of the Report has been reduced to fourteen countries: Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey.

Despite the fact, that the EU Members are the majority, among the analyzed countries there is also Turkey which stays outside the EU and hence is not bound by the above discussed Directives. One can ask what its motivation for incurring millions of euro for implementation of the intelligent metering systems is, but the answer is quite simple and seems reasonable: the motivation are the expected benefits of SM implementation.

Drawing 5: CSE countries in and outside European Union



Source: Ernst & Young

The USA's National Assessment of Demand Response Potential carried out for the Federal Energy Regulatory Commission[6] is an example of benefits quantification. Demand Response programs discussed in the paper can be implemented provided that there is a smart metering system deployed in the given area (so there is no need for further investment – in case of other countries, where AMI is not yet implemented, the additional expenditures resulting from its deployment must be taken into account). Benefits were estimated and the results seem quite promising. The study examined several scenarios the results of which varied quite significantly, as presented in the following drawing.

Drawing 6: Scenarios of Demand Response Potential analysis carried out in USA

Scenario	Business-as-Usual Scenario	Achievable Participation Scenario	Full Participation Scenario
Assumptions	• existing and planned demand response programs continue unchanged over the next ten years	• advanced metering infrastructure is universally deployed • dynamic pricing tariffs are the default • other DR programs, such as direct load control, are available to those who decide to opt out of dynamic pricing	• advanced metering infrastructure is universally deployed • dynamic pricing is the default tariff and offered with proven enabling technologies
Results	4% reduction in peak demand for 2019 compared to a scenario with no demand response program	14% reduction in peak demand for 2019 compared to a scenario with no demand response program	20% reduction in peak demand for 2019 compared to a scenario with no demand response program

Source: „A National Assessment of Demand Response Potential" Staff Report for the Federal Energy Regulatory Commission prepared by The Brattle Group, Freeman, Sullivan & Co., Global Energy Partners LLC

In 2010 the Ofgem's Department of Energy and Climate Change has conducted an impact assessment study regarding implementation of AMI in SMEs[7]. Numerous benefits are listed in the paper, starting with the avoidance of manual meter reading costs and reduced customer service costs, through elimination of estimated bills, to 25% reduction in theft as a result of more sophisticated antitampering mechanisms, avoidance of peak load investment as a result of customer response to time-of-use price signals (assuming 2,5% reduction in peak demand), reduced energy use resulting from provision of real time consumption and pricing data (5-10% is estimated), to carbon benefits gained through consumption reduction.

Also the Australian assessment built on the results of 18 months' Home Energy Efficiency Trial (HEET) looks promising: one of the potential scenarios assumes peak demand reduction of 12-30% (which is an equivalent to ~500-2 000 MW of virtual capacity), energy conservation level of ~5%, which means also the equivalent to ~5MT reduction in CO2 emissions and the overall reduction in consumption of ~5%.

For all the above stated reasons some of the CSE countries, analyzed in this paper, have already started an implementation for some customer groups or have plans in place regarding roll-out of the smart metering systems. However, one must remember that various projections or even benefits proven by experiences of one group of countries shall not necessarily turn out similar for the others. For each country the specific consumption patterns, end-users that are best motivated by different stimuli, and other characteristics distinguishing its market determine the potential for achieving benefits from implementation of the intelligent metering systems. The general development directions pointed out by the countries performing studies, pilots and roll-outs should not prevent the ones being on the stage of planning from performing their own cost-benefit analyses that would examine their own benefit potential with their market's peculiarities taken into account. Pilot implementations performed in the country-specific environment should contribute to rationalizing the spending decisions as well.

Nevertheless, taking advantage from the other countries' experiences is surely a good starting point for planning own AMI implementation and so the aim of this report is to ensure knowledge and best-practices sharing between the CSE countries regarding the topic in question.

6 „A National Assessment of Demand Response Potential" Staff Report for the Federal Energy Regulatory Commission prepared by The Brattle Group, Freeman, Sullivan & Co., Global Energy Partners LLC.

7 „GB wide advanced / smart meter roll-out to small and medium non-domestic sites", Ofgem, Department of Energy and Climate Change, Impact Assessment no DECC0010, 2010

4. Overview of the electric energy market in CSE countries

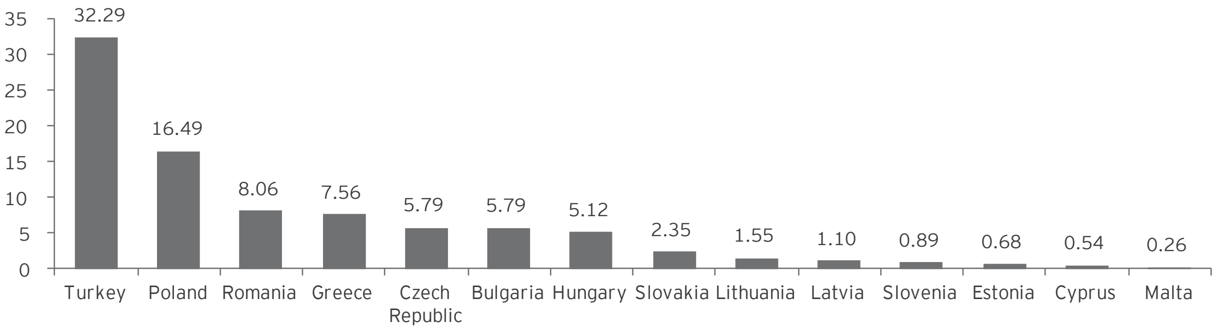
In this chapter the current state of electric energy markets in CSE countries is described, including information on the size and structure of the market, average energy consumption, average network losses, general quality of energy supply, plans regarding development of RES, and a number of distribution system operators present in each market. The chapter is concluded with a ranking of the CSE electric energy markets that evaluates the individual countries' potential for AMI implementation.

4.1 The size and structure of the electric energy market

One of the major factors that may affect the profitability of investment in AMI is the size and structure of the electric energy market, i.e. the number and type of electricity consumers. Generally, it can be assumed that the greater the number of customers (so called metering points), the lower the CAPEX per customer, hence the stronger the economies of scale.

In the chart below information on the market size in the selected CSE countries is presented. Two countries clearly stand out: Turkey with its 32.29 million customers and Poland with 16.49 million customers. The third biggest market is Romania – 8 million customers, which is only half the size of the Polish market. On the opposite side of the scale are Slovenia, Estonia, Cyprus, and Malta – each with less than 1 million customers.

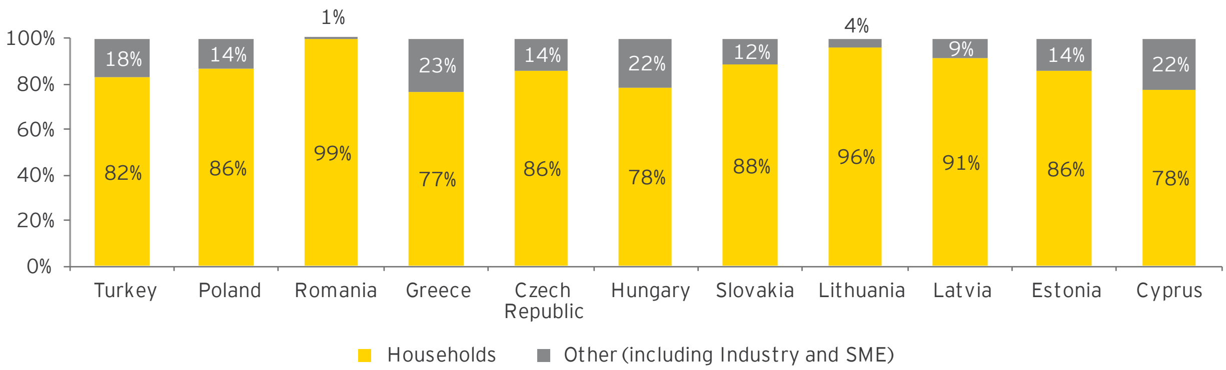
Chart 9: The number of electric energy customers in the CSE countries (in millions)



Sources: Eurostat, the national statistical databases, the annual reports of energy companies.

The structure of the market in some of the CSE countries is shown in the next chart (for the remaining countries the data is not available). As expected, in all countries the residential customers (households) dominate – they constitute between 77% and 99% of all electricity consumers. The other consumer groups – including the industry and small and medium enterprises – constitute between 1% and 23% of the total number of customers.

Chart 10: The structure of electricity customers in the CSE countries (number of residential and other customers in total number of electricity consumers)



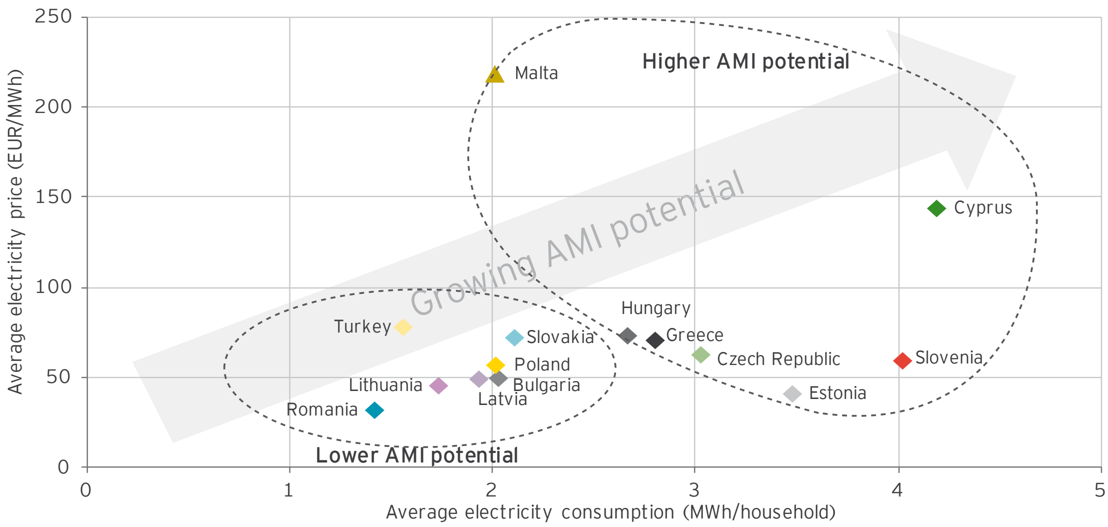
Sources: Eurostat, the national statistical databases, the annual reports of energy companies.

4.2 Potential consumer benefits associated with the implementation of AMI

The most important consumer benefit and one of the main drivers of smart metering implementation is the feature of AMI that enables residential customers to constantly control their energy consumption and, as a result, to influence their energy bill. It can then be deduced that the highest potential for AMI implementation have those countries where increasing energy efficiency is most needed, i.e. those with the highest average electricity price and the greatest average energy consumption per household.

Among the analyzed CSE countries the highest average electricity price (without distribution charges and VAT) for residential customers is in Malta (approx. 219 EUR/MWh) and Cyprus (approx. 145 EUR/MWh) while the lowest price is in Romania (approx. 33 EUR/MWh). When it comes to energy consumption, the residents in Cyprus and Slovenia use the most electricity (4.2 MWh/household/year and 4.0 MWh/household/year, respectively), whereas the Romanian residents use the least electricity (only 1.4 MWh/household/year). Detailed information regarding electricity consumption and prices in the CSE region is shown in chart below.

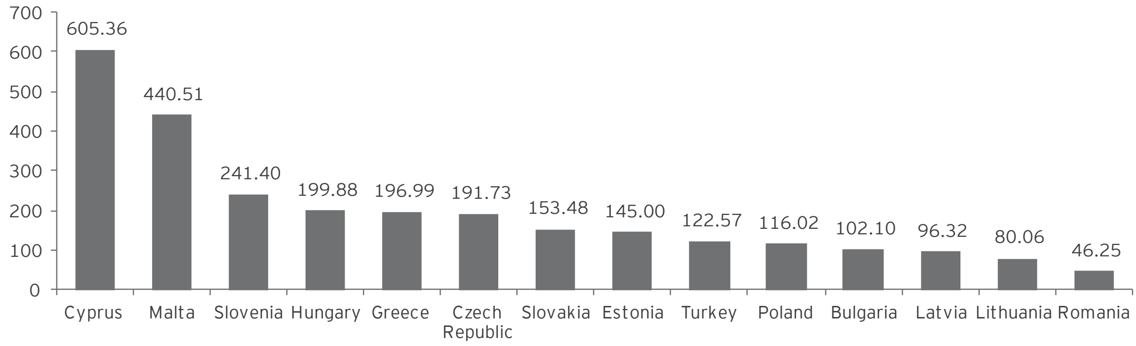
Chart 11: Average electricity consumption per residential customer vs. average electricity price in the CSE countries (without distribution charges and VAT) in 2010



Source: Eurostat.

On the basis of the information on the average energy consumption per household and the average energy price (without distribution charges and VAT), the average electricity bill in each CSE country can be estimated. In 2010 the citizens of Cyprus and Malta received the highest energy bills – 605 EUR/household/year, and 441 EUR/household/year, respectively. Romanians, on the other hand, paid the least – only 46 EUR/household/year.

Chart 12: Average electricity bill in CSE countries (EUR/domestic customer) in 2010*



** The amount of electricity bill does not include fees for distribution (grid fees). It includes only electricity price (no distribution charges and VAT are included).*

Source: Eurostat.

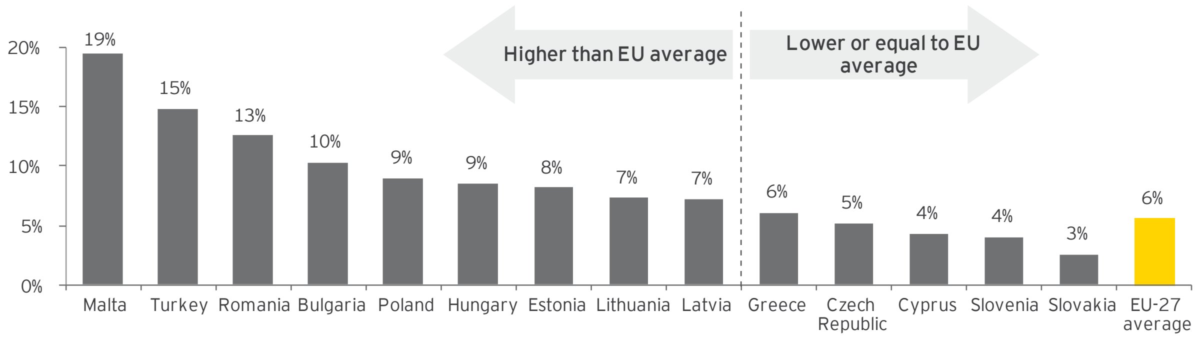
4.3 Potential DSO benefits associated with the implementation of AMI

In the case of the energy consumers the most important benefit associated with AMI is the possibility to save electricity and lower the amount on the energy bill. In turn, the main benefit for distribution system operators is the possibility to lower the cost of operation by reducing network losses (mainly losses associated with electricity thefts).

In the next chart the share of distribution losses in total electricity input in each CSE country is shown. It can be noticed that Malta, Turkey, and Romania have the highest network losses – in 2010 as much as, respectively, 19%, 15%, and 13% of electricity input was lost. The best situation was in Slovakia, where network losses reached only 3% of total energy input. It is worth noting that in the whole European Union the average network losses reached around 6% of the total energy input.

Network losses can be split into two groups: commercial and technical. Commercial losses are defined as losses relating to energy that was delivered but not metered, billed or paid for and can be split into following categories: theft, meter reading fraud, meter tampering, inaccurate metering. Technical losses are losses which are the result of physical phenomena accompanying the energy flow in the grid. Implementation of smart meters with a feature that enables alarming DSO whenever there is an attempt to connect to the grid in an unauthorized manner or there is a case of meter tampering and that gives a possibility to analyse network flows in detail, should enable DSO to reduce both commercial and technical network losses.

Chart 13: Network losses (as % of electricity input)



Source: Eurostat.

4.4 Quality of electricity supply

There are two main indicators that are used to measure the quality of electricity supply: number of interruptions per year per customer (SAIFI – System Average Interruption Frequency Index) and minutes lost per year per customer (SAIDI – System Average Interruption Duration Index). The first shows how often breaks in electricity supply occur, hence, what the level of distribution network reliability is. The second indicates how quickly and efficiently interruptions in electricity distribution are removed.

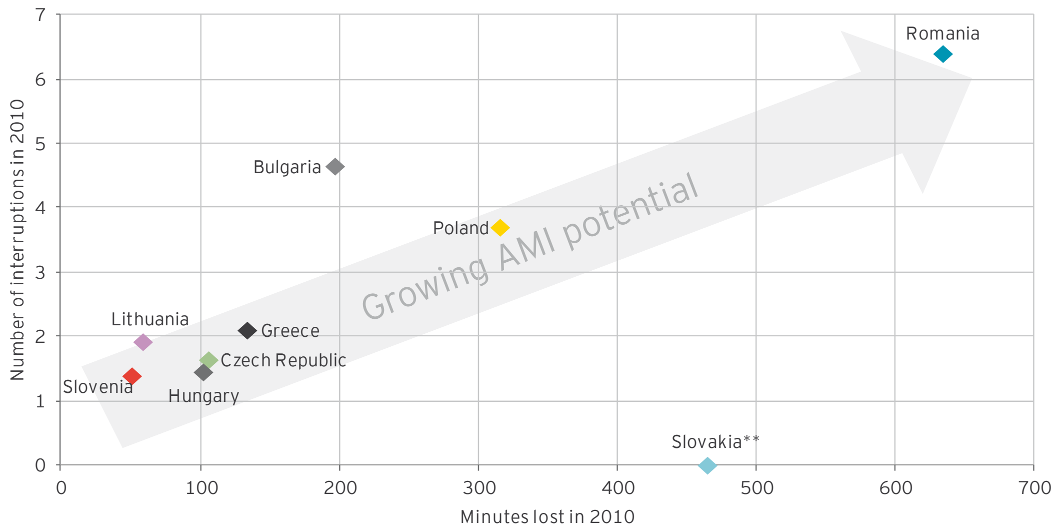
Implementation of SM gives a DSO detailed and up-to-date knowledge about electricity flows and electricity quality in every network segment, which enables better planning of investments and maintenance. It can then be assumed that the lower is the current quality of energy supply in a given country, the higher the country's potential for AMI implementation.

Detailed information regarding quality of energy supply in the CSE region is shown in the next chart.

Among the analyzed CSE countries, in 2010 the most unplanned interruptions in electricity supply occurred in Romania – on average 6.4 breaks per customer. The most reliable distribution network, on the other hand, was in Slovenia, where on average only 1.4 interruptions per customer happened. When it comes to the total length of breaks in electricity supply in 2010, the worst situation was, again, in Romania where the total time without electricity was 635 minutes per customer (over 10 hours). In Slovenia, where the efficiency of troubleshooting is the highest, the total time of breaks in 2010 was only 51 minutes per customer.

Generally it can be said that – with regard to the quality of electricity supply – Romania has the highest potential for AMI implementation.

Chart 14: Quality of electricity supply*



* *No data for Cyprus, Estonia, Latvia, Malta, and Turkey.*

** *No data regarding number of interruptions.*

Source: „5th CEER Benchmarking Report on the Quality of Electricity Supply", CEER, Brussels, 2011.

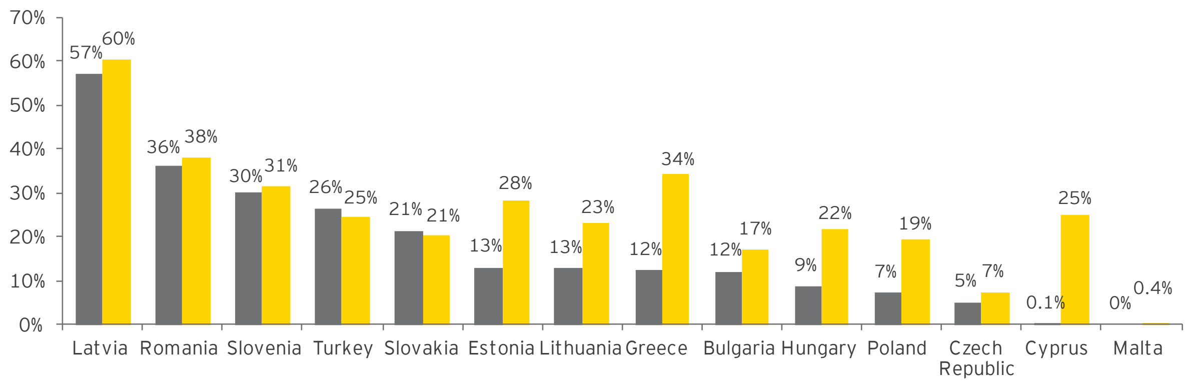
4.5 RES integration into distribution networks

The factor that may increase the pace of smart metering implementation in the CSE region is the development of renewable energy sources. This is because implementation of Smart Grid is required to accomodate a growing share of RES in electricity production since, as mentioned before, Smart Grid can anticipate and respond instantly to problems or interruptions in energy supply in order to avoid or mitigate power outages and power quality deficiencies.

It shall be assumed that countries with particularly ambitious plans regarding the development of RES in the next 20 years will have a strong drive to deploy smart metering (which is a first step to implement Smart Grid). In order to estimate the potential of each country to implement AMI we, therefore, looked at their current and planned future share of renewables in electricity production.

In 2010, of all the CSE countries, Latvia had the biggest share of RES in electricity generation (57%). The worst situation was in Malta, where RES was not at all used for electricity production, and in Cyprus, where only 0.1% electricity was produced from RES. However, it is worth noting that Cyprus has very ambitious plans in this regard. By 2030 as much as 25% of its electricity is supposed to be generated from RES. Among the remaining countries Estonia, Greece, Lithuania, Hungary, and Poland have the most ambitious plans to invest in RES.

Chart 15: Share of RES in gross energy production in 2010 and in 2030

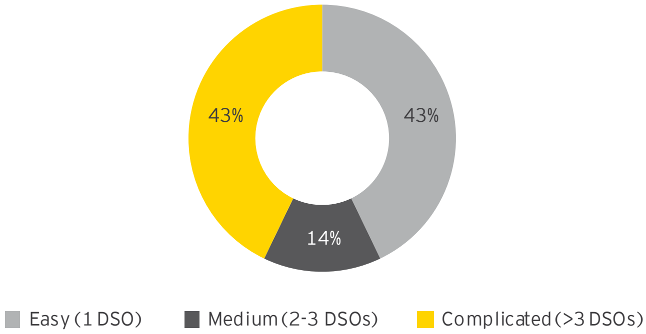


Source: The national statistical databases, the national energy plans, PRIMES - EU energy trends to 2030.

4.6 Complexity of AMI implementation

One of the factors that may slow AMI implementation is the fragmentation of the electricity distribution market - the number of entities providing electricity distribution services in a country. It can be assumed that the more DSOs are in a market, the more complicated the smart metering implementation will be. In 43% of the analyzed CSE countries AMI implementation should be easy due to the fact that only 1 DSO is present on each market. In 14% of the CSE countries the situation is slightly more complicated because the number of DSOs is between 2 and 3. In as much as 43% of CSE countries the process of smart metering implementation will most likely be difficult due to a high number of DSOs.

Chart 16: Share of countries with certain level of complexity of AMI implementation – based on DSO number



Source: Ernst & Young.

Summary: Evaluation of electric energy markets and potential for AMI implementation in CSE

A ranking of the analyzed CSE countries has been developed based on the analysis of the state of the electricity market in each country. The potential for AMI implementation was assessed on the basis of 7 criteria (each criterion was assigned a weight):

- market size (2 points),
- average electricity consumption (2 points),
- average electricity bill (5 points),
- network losses reduction potential (3 points),
- quality of supply (4 points),
- planned share of RES in electricity production in 2030 (5 points),
- implementation complexity level – based on the number of DSOs (1 point).

In each category the countries were sorted by the value of the criterion (from largest to smallest). Then the position of the country on the list was multiplied by the weight of the criterion (this means that the scale of assessments was relative, i.e. the highest mark was given to the country that had the highest value of a given criterion). A country could obtain a maximum of 308 points.

In our view, selected criteria are the most important ones for the assessment of AMI implementation potential. Moreover the assessment scope was limited by data availability. If more data was available, other criteria could have been introduced to the analysis. Nevertheless, in our opinion, the criteria with the biggest influence on the implementation potential have been included and we believe that adding more criteria would not affect the ranking significantly.

The results of the assessment of the potential for AMI implementation in each CSE country are summarized in the table below.

Table 1: CSE countries potential regarding AMI implementation

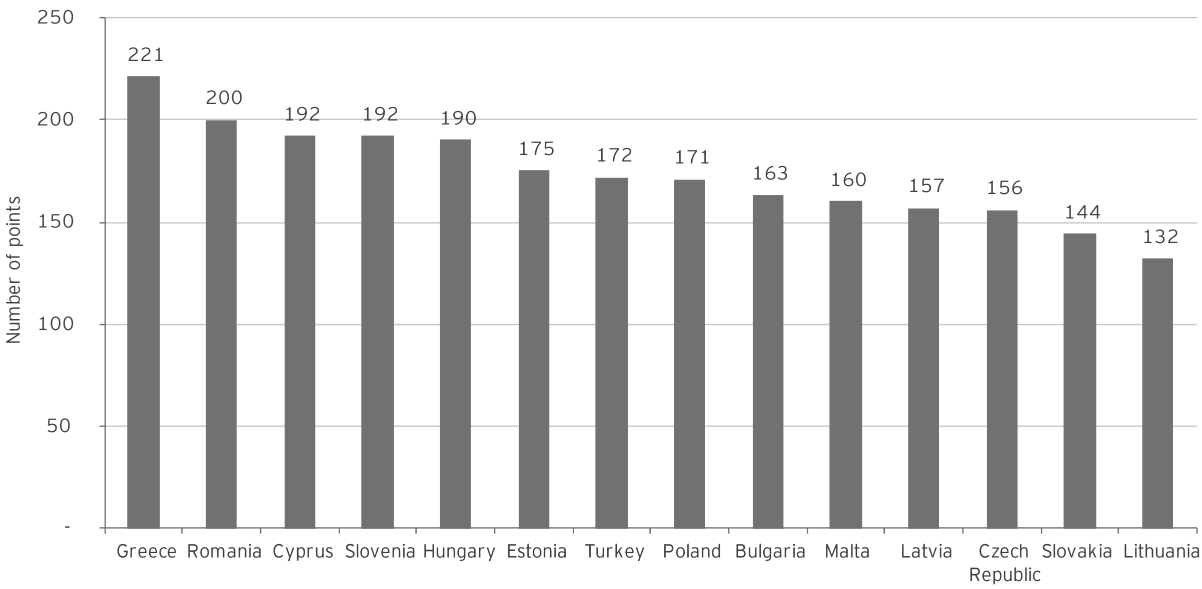
No.	Country	Market size	Average electricity consump-tion	Electricity bill	Network losses reduction potential	Quality of electricity supply	Share of RES in 2030	Implemen-tation complexity level	No. of points
1	Greece	22	18	50	15	42	60	14	221
2	Romania	24	2	5	36	56	65	12	200
3	Cyprus	4	28	70	9	22	45	14	192
4	Slovenia	8	26	60	6	26	55	11	192
5	Hungary	16	20	55	27	32	30	10	190
6	Estonia	6	24	35	24	22	50	14	175
7	Turkey	28	4	30	39	22	40	9	172
8	Poland	26	12	25	30	48	20	10	171
9	Bulgaria	20	14	20	33	48	15	13	163
10	Malta	2	10	65	42	22	5	14	160
11	Latvia	10	8	15	18	22	70	14	157
12	Czech Republic	18	22	45	12	36	10	13	156
13	Slovakia	14	16	40	3	38	25	8	144
14	Lithuania	12	6	10	21	34	35	14	132

The ranking suggests that Greece (221 points) and Romania (200 points) have the highest potential for AMI implementation while Lithuania (132 points) is least likely to implement smart metering.

In the case of Greece it is the market size, the electricity consumption, the electricity bill, as well as the future share of RES in electricity production which have the greatest influence on the country's high score in the ranking.

What matters most in case of Romania are the market size, significant distribution network losses, low quality of energy supply, and high future share of RES in electricity production.

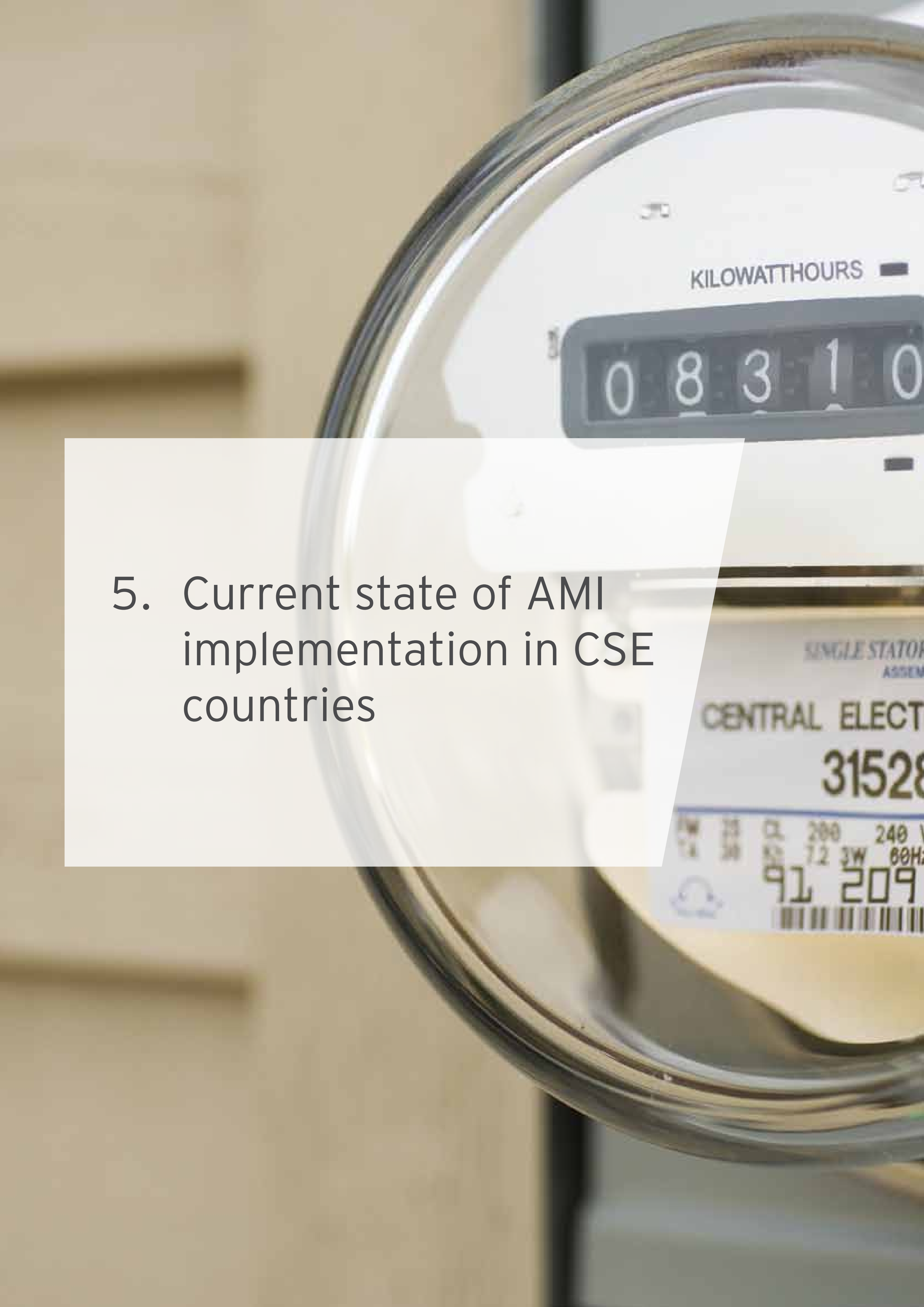
Chart 17: Results of the ranking of the CSE countries



Source: Ernst & Young.

The countries with second highest AMI implementation potential are Cyprus, Slovenia and Hungary with 192, 192 and 190 points respectively. Cyprus, Slovenia and Hungary are countries where average electricity bill and consumption build the AMI potential.

Lithuania is the country with one of the lowest average electricity bill, consumption per household and at the same time, average level of network losses and quality of supply metrics. That is why we assess Lithuania's potential for AMI implementation as low.



5. Current state of AMI implementation in CSE countries

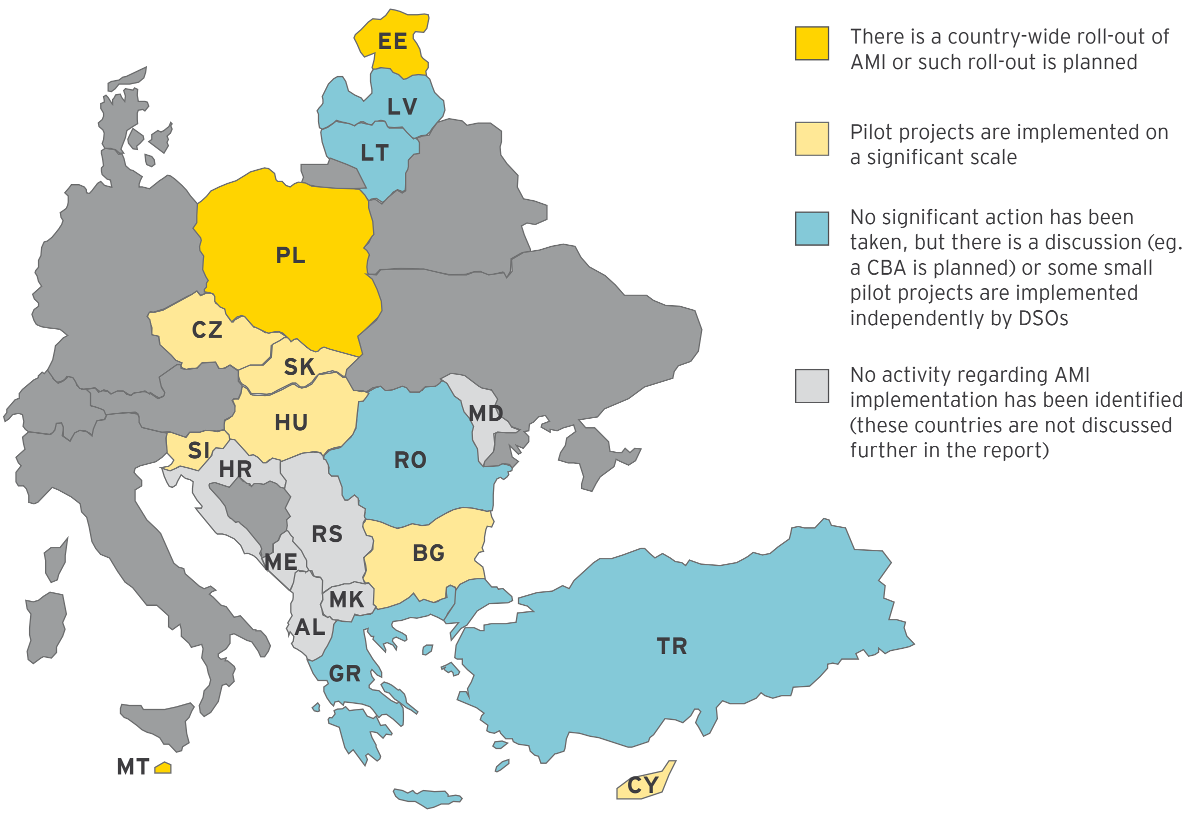
In this chapter the current state of AMI implementation in the CSE countries is described, including the information on the results of cost-benefit analyses and plans regarding pilot projects and country-wide roll-out. In addition key stakeholders' attitude to SM and regulatory approach towards AMI are presented. The chapter is concluded with a comparison of the CSE countries' potential for AMI implementation estimated in the previous chapter and the countries' actual activities in the field of AMI.

5.1 Status of AMI implementation in the CSE countries

The CSE countries have been divided into 4 groups:

- countries where no activity regarding AMI can be identified (Albania, Croatia, Macedonia, Moldova, Montenegro, Serbia) – these countries are not analyzed further in this report,
- countries with a small degree of AMI implementation, where efforts are focused on discussions or some small-scale pilot projects conducted independently by DSOs (Greece, Latvia, Lithuania, Romania, Slovakia, Turkey),
- countries where some serious steps toward AMI implementation have been taken and where pilot projects have been carried out on a significant scale (Bulgaria, Cyprus, Czech Republic, Hungary, Slovenia),
- countries that are planning or have already started to carry out a country-wide roll-out of smart meters (Estonia, Malta, Poland).

Drawing 7: Status of AMI implementation in CSE countries

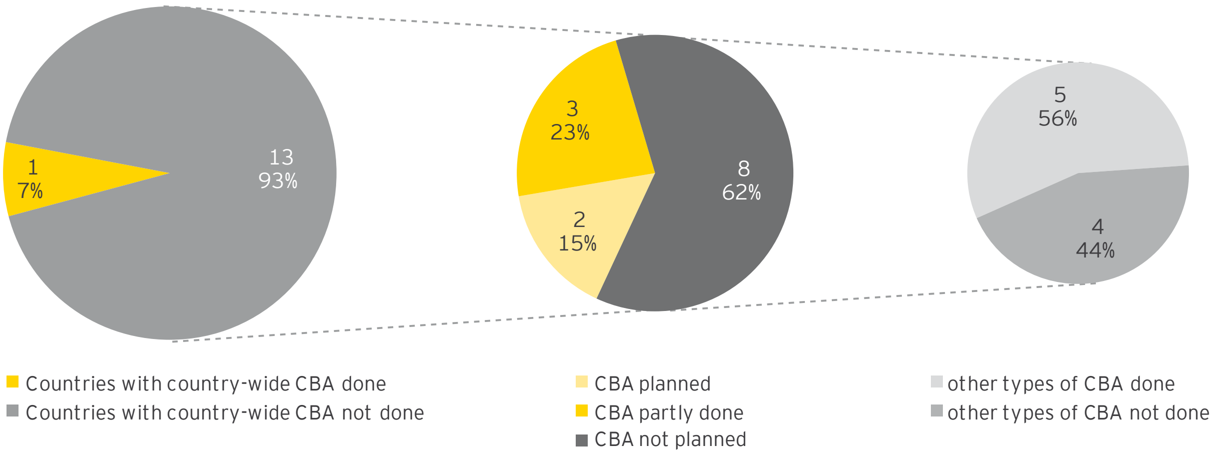


Source: Ernst & Young.

5.2 Results of cost-benefit analyses

In the chart below the status of CBAs in the CSE region is shown. Only one out of 14 analyzed countries – Hungary – has carried out a cost-benefit analysis as is required by Directive 2009/72/EC[8]. The analysis proved the economic viability of AMI implementation, but Hungary has not made an official decision regarding a country-wide roll out and it is probable that another CBA study in line with European Commission Recommendation from 9th March 2012 will be conducted. Before making the final decision, the government is to organize several pilot projects, including a pilot of 20 000 meters, which will be a country-wide pilot project, with all Hungarian distributors and Hungarian Energy Office involved. The requirements regarding pilot projects are defined in a draft government decree, which, however, has not gone into force yet. Apart from the above, a few pilot projects have already been started by some DSOs.

Chart 18: Status of CBAs in CSE



Source: Ernst & Young.

Among the remaining CSE countries, three have already started carrying out CBAs: Cyprus, where the results of the analysis are to be published by July 2012, the Czech Republic, where the country-wide analysis is to be finalized by September 2012, and Lithuania, where the CBA is being developed by Ernst & Young. In addition, two countries – Romania and Slovakia – are planning to carry out a CBA in the future.

The remaining eight countries are not planning to carry out CBAs that fulfil the requirements of Directive 2009/72/EC. However, four countries (Malta, Poland, Slovenia, and Turkey) have conducted some form cost-effectiveness studies. Usually those studies were carried out by DSOs interested in installing smart meters in selected customer groups. According to available data, most of those studies gave positive macroeconomic results.

What is interesting is the fact that in the majority of CSE countries, the lack of a CBA, which fulfils the requirements of the EU directive, does not necessarily mean that AMI will not be implemented. As it is explained in the next sections of this chapter, in most of the CSE countries, there are plans to implement AMI at least in some groups of customers. The best example is Estonia where no official cost-benefit analysis has been carried out but at the same time it is a country with the most ambitious plan regarding SM deployment among the described CSE countries.

8 Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

5.3 Key stakeholders' approach to AMI implementation

Information provided in this section comes from a survey conducted by Ernst & Young in the CSE countries.

To key stakeholders of AMI implementation in a given country belong:

- distribution system operators (DSO),
- transmission system operators (TSO),
- retailers,
- commercial energy consumers,
- residential energy consumers,
- the energy regulatory office (ERO),
- the government.

It should be noted, only information regarding the DSOs and the governments approach towards AMI was available for all CSE countries. Information regarding the remaining stakeholders was available selectively and only in some CSE countries.

In the following charts the DSOs' and the governments' approach to AMI implementation in CSE countries is presented. In most of the countries (Bulgaria, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Latvia, Malta, Romania, Slovenia, and Turkey) DSOs support the implementation of AMI. However Czech DSOs will support AMI implementation only if its benefits exceed corresponding costs or if there is an obligation from the government or the ERO and if costs of AMI implementation are included in the tariff. In two countries (Lithuania, Poland) DSOs have no opinion. For example in Poland DSOs think that their benefits from AMI will not exceed the implementation and operation costs; as a result, they are willing to implement SM only if there is such obligation from the government or the ERO and if the costs are included in the tariff.

In Slovakia major DSOs tend to be against full-scale AMI deployment because the expected costs exceed the benefits.

When it comes to the governments' approach, it seems that the governments are generally less engaged in the project than the DSOs. Only half of the governments in the analyzed CSE countries openly support AMI (the governments of Bulgaria, Estonia, Greece, Hungary, Malta, Poland, Romania, Turkey). The other do not express their opinion or simply have no opinion (in Lithuania and Latvia the governments are pretty much indifferent to SM).

Chart 19: DSOs' approach

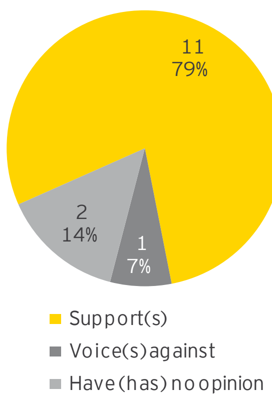
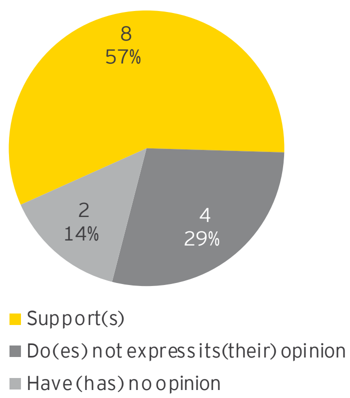


Chart 20: Governments' approach



Source: Ernst & Young.

As mentioned before, information regarding other stakeholders' attitudes to AMI is not available for many of the CSE countries. However, it can be noticed that the energy regulatory offices usually have the same opinion as the governments: they either support AMI, or have no opinion or do not express their opinion.

The transmission system operators (TSO) either support (Poland, Romania, Slovakia, Turkey) or do not have any opinion. It is worth mentioning that no case of TSO opposition to SM has been identified.

The residential customers in the CSE region generally have no opinion on the topic. This is mainly a result of lack of knowledge about what AMI is and how it should be used. It is therefore necessary to educate this group about the potential benefits of SM implementation.

5.4 Regulatory approach to AMI implementation

The chart on the next page presents the status of legal regulation regarding SM in the CSE countries. So far only four countries adopted legal provisions regarding AMI: the Czech Republic, Estonia, Greece, and Turkey.

In the Czech Republic several existing regulations were updated in the course of the last years, so as to cover the area of Smart Metering.

In Estonia a governmental decree on grid operation was amended (last amendment in 2010) in order to cover the objectives of AMI. However, there is no legal requirement for a country-wide SM roll-out.

In Greece the legal act "Measures to improve energy efficiency in end-use, energy services and other provisions", which includes articles regarding SM was adopted in 2010. This law has been defined as a step towards a roll-out of electricity smart meters.

Turkey has issued some guidelines regarding AMI. However, in this country SM is mandatory only for some groups of consumers, and currently there are no plans for a mandatory roll-out for residential customers.

Apart from the countries mentioned above, five other CSE countries are planning to adopt some regulations regarding AMI: Bulgaria, Hungary (but only in regard to pilot projects), Poland, Romania, and Slovakia.

In Bulgaria the authorities vaguely express intention of adopting some regulation regarding AMI. In future policy, the construction of intelligent networks shall be set as one of Bulgaria's priorities and the electricity transmission and distribution networks operators shall be encouraged to construct and develop intelligent networks. No detailed information regarding the timeline is available.

In Hungary a draft governmental order regarding SM pilot projects implementation is expected to be adopted in September 2012.

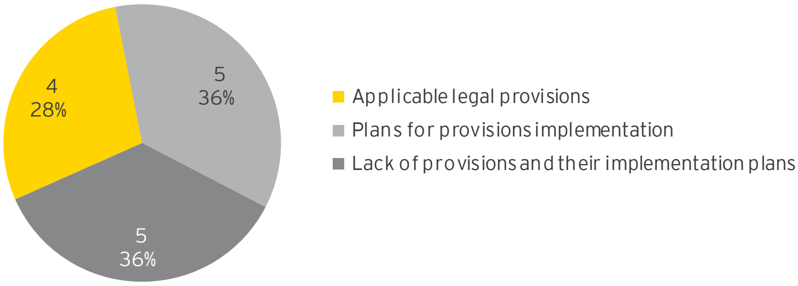
In Poland a draft energy law is currently being prepared. The Ministry of the Economy would like the new law to be in force in Autumn 2012. However, it should be noted that this schedule is very optimistic given many controversies surrounding the document. The main controversy is that the new law requires a 100% SM diffusion rate without preparation of a comprehensive CBA, whereas the EU requires only 80% of smart meters to be installed until 2020 and only if the CBA proves economic viability of such a project.

In Romania some type of policy or strategy regarding roll-out of smart meters is expected in 2012, after the final decision on massive deployment of SM is taken.

In Slovakia the new regulation regarding AMI can be expected no earlier than the second half of 2012.

The rest of the countries either have not implemented any legal provisions or the information on such regulations cannot be retrieved. In Malta, for example, the government openly expressed its support for SM in 2009 in a proposal for a national energy policy. However, no legal provision regarding AMI can be retrieved from the Maltese Energy Law.

Chart 21: Status of legal regulation of AMI in the CSE countries

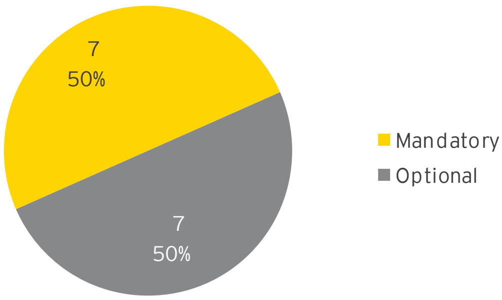


Source: Ernst & Young.

The next chart presents information on the share of CSE countries where AMI implementation is mandatory. The SM diffusion shall be mandatory (for all customers or only for some groups of consumers – eg. in the case of Turkey) in seven CSE countries only. These are seven out of the nine countries where there already exist regulations regarding SM or some legal provisions are on their way.

The Czech Republic and Slovakia, the remaining two countries from the group of those that already have legal provisions regarding AMI or that have plans to adopt such provisions have decided to make AMI implementation optional (the Czech Republic - however, after EU approval of SM implementation plans, the implementation will become mandatory) or postponed the decision after the results of the CBA are revealed (Slovakia).

Chart 22: AMI – mandatory or optional?



** For the purpose of the Report, Slovakia has been presented as a country, where AMI implementation is optional due to the lack of official decision, which will be made after the CBA study finalization.*

Source: Ernst & Young.

In the remaining CSE countries lack of provisions makes AMI implementation optional. Any pilot SM projects are realized voluntarily by energy companies or distribution system operators. The adoption of smart metering technology and services is therefore dependent solely on the activity of the utilities.

5.5 Key reasons for AMI implementation in the CSE countries

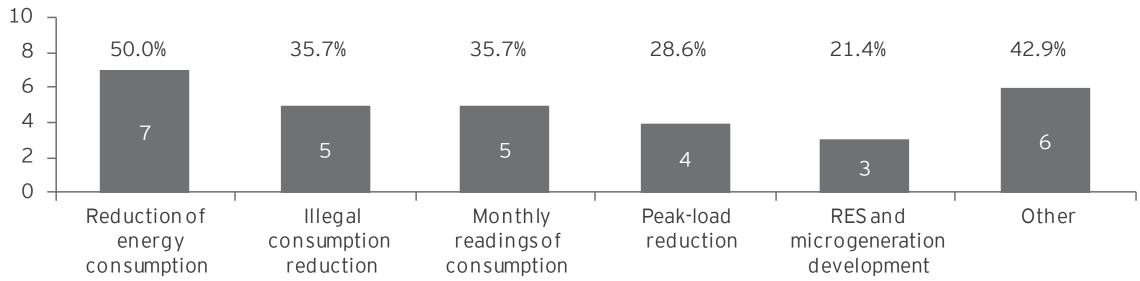
Information provided in this section comes from a survey conducted by Ernst & Young in the CSE countries.

In the next chart information on the key reasons for AMI implementation in CSE countries is presented. According to available sources, there are five most common objectives of AMI implementation in the CSE countries:

- peak-load reduction,
- reduction of energy consumption,
- RES and microgeneration development,
- reduction of illegal electricity usage,
- possibility to provide monthly readings of consumption.

It can be noticed that reduction of energy consumption is most popular in the CSE region – in the survey, seven out of 14 countries indicated consumption reduction as the main reason for SM deployment.

Chart 23: Key reasons for AMI implementation in the CSE countries

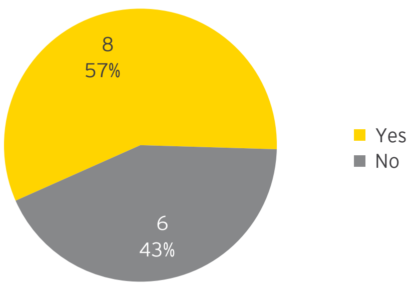


Source: Ernst & Young.

Apart from the above mentioned key objectives of AMI implementation, some countries listed additional reasons. In Bulgaria, for example, one of major problems in energy supply and a significant cause for SM diffusion is the high rate of errors in metering and bills calculation which is a ground for a lot of customer complaints. In Turkey, similarly, implementation of smart meters is intended to improve settlements between energy suppliers and customers. In Slovenia implementation of AMI is expected to support competition in the energy supply market and to be one of the mechanisms that strengthens consumer rights. In Malta, installation of smart meters is supposed to help reduce the costs of bi-monthly billing.

As it is shown in chart below, in eight out of 14 CSE countries (Cyprus, Czech Republic, Hungary, Malta, Poland, Romania, Slovakia, and Turkey) AMI is to be part of a wider plan to implement Smart Grid.

Chart 24: AMI implementation as the element of Smart Grid plans?



Source: Ernst & Young.

Only three out of the above mentioned eight countries provided detailed information regarding the functionality or the elements of the Smart Grid, which are to be implemented.

In Hungary, the Smart Grid is to have the following elements: prosumer/ distributed generation, development of the electric car, and development of ‘intelligent building’ technologies.

In Poland, the Smart Grid shall support prosumer/ distributed generation, energy storage, development of ‘intelligent building’ technologies, and implementation of DSR programs.

In Romania, the Smart Grid shall support energy storage and development of ‘intelligent building’ technologies.

5.6 Incentives and financing of roll-out projects

Two important issues that have been investigated in this report are: the system of incentives for DSO’s to implement AMI and the system of financing the roll-out projects.

According to the available information, so far, only in Poland a system of incentives for SM implementation is planned to be introduced. The Polish ERO decided to grant the additional return on investments in AMI to those DSOs which decide to implement SM for all electricity customers.

In the remaining CSE countries, no system of incentives or a plan to implement such a system has been identified.

When it comes to the financing of roll-out projects, data is available for only six out of the 14 countries. In the case of four countries (Estonia, Lithuania, Poland, Romania) roll-out projects are to be financed through tariffs. In Poland, however, some additional financing from the National Fund of Environmental Protection is available.

In two remaining countries for which information is available – Hungary and Turkey – the roll out is supposed to be done with DSOs’ own financing (bank loans), but in Hungary a grant from Science, Technology and Innovations Strategy Program is available for pilot projects.

5.7 Market model

When it comes to the management of data gathered through smart meters, a country that decides to implement AMI can choose between the following market models.

Drawing 8: Metering market models

Model	SME (Smart Metering Entity) model	DSO model	Retailer model
Description	▸ An entity independent from the DSO and retailer (smart metering market operator) gathers measuring data from the DSOs and manages and shares the data.	▸ Each DSO gathers and manages the measuring data from its customers, and when it is necessary, shares the data with other market players.	▸ Each retailer gathers and manages the measuring data from its customers, and when it is necessary, shares the data with other market players.

Source: Ernst & Young

Information regarding the planned market model in the CSE countries has been obtained through the survey conducted by Ernst & Young and from available publications. Nevertheless, data was available only for nine countries: the Czech Republic, Estonia, Hungary, Lithuania, Malta, Poland, Romania, Slovakia, and Turkey.

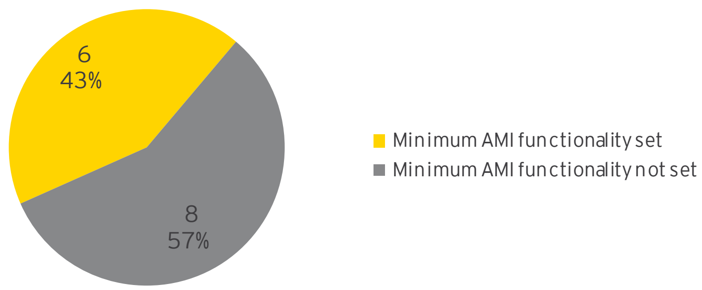
The metering market in six of these countries will be SME model i.e. in each country a single entity independent from the DSOs will be responsible for collecting, managing, and sharing the data. In these countries the activity of this market operator will be regulated by law or by decisions issued by Regulator (regulated model). In Hungary the coexistence of four regional market operators is assumed when in the other countries the model will be centralised.

In Estonia, Lithuania and Turkey the role of the metering data operator will be performed by the DSO. As a result, these three will also be regulated markets and in case of Lithuania and Estonia centralised (one DSO on the market).

5.8 Functionality of smart meters and smart tariffs

As it is shown in the next chart, only in six CSE countries (the Czech Republic, Greece, Hungary, Malta, Poland, and Turkey) a minimum functionality of AMI has been set in adopted or soon-to-be-adopted regulations regarding SM.

Chart 25: Has minimum functionality of AMI been set?



Source: Ernst & Young.

Detailed information on proposed functionality of smart meters is available only for three of these countries: Hungary, Poland, and Turkey. Below information on minimum SM functionality in each of these countries is presented.

In Hungary the following minimum functionality of AMI has been specified in a draft governmental order regarding SM which is soon-to-be-adopted:

- time of supply interruptions logging,
- voltage deviation beyond acceptable (defined by the law) levels logging,
- remote electricity supply connection / disconnection,
- remote limitation of available maximum power for customers (for demand side response programs or social tariffs purposes),
- communication with other media metering devices through installed interface,
- pre-paid settlement method.

In Poland the following minimum functionality of AMI has been specified in a document published by Polish ERO:

- active energy consumption measurement in 15-minute intervals,
- reactive energy consumption measurement in 15-minute intervals,
- energy input into the network measurement in 15-minute intervals,
- maximum power measurement in each hour,
- time of supply interruptions logging,
- voltage deviation beyond acceptable (defined by the law) levels logging,
- remote electricity supply connection / disconnection,

- remote limitation of available maximum power for customers (for demand side response programs or social tariffs purposes),
- communication with other media metering devices through installed interface,
- communication with HAN (Home Area Network) through installed interface,
- pre-paid settlement method.

In Turkey the following minimum functionality of AMI has been specified in the legal provisions regarding SM:

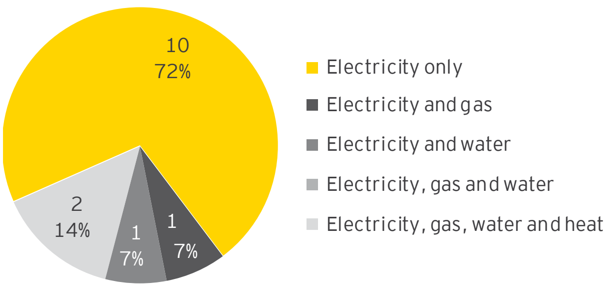
- active energy consumption measurement in 1-hour intervals,
- reactive energy consumption measurement in 1-hour intervals,
- energy input into the network measurement in 1-hour intervals,
- maximum power measurement in each hour,
- voltage deviation beyond acceptable (defined by the law) levels logging.

Most CSE countries will set the minimum requirements when the legal acts regarding AMI are adopted.

5.9 Pilot projects and country-wide roll-out

Even though in many of the CSE countries no regulations regarding SM have been adopted and no minimum functionality of AMI has been set, in all of those countries some AMI pilot projects are being carried out. According to information presented in the following chart, in most of the discussed countries the pilot projects cover only electricity metering. However, in the Czech Republic SM covers electricity and gas metering, in Malta pilot projects encompass electricity and water metering, in Hungary and Bulgaria in addition to electricity some pilot projects also include gas, water and heat metering.

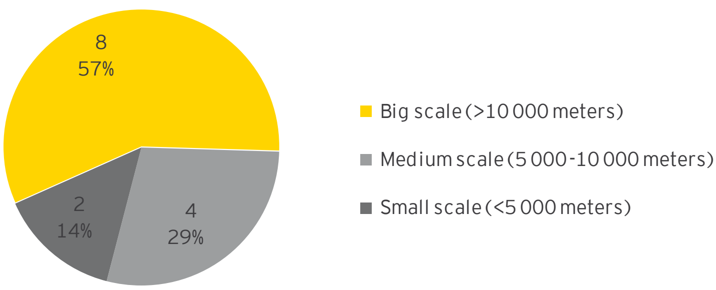
Chart 26: AMI pilot projects scope



Source: Ernst & Young.

In many countries pilot projects are carried by the utilities independently from governments. The next chart presents the share of CSE countries, where pilot projects are or have already been carried out on a big scale (installation of more than 10 000 meters), medium scale (installation of 5 000 – 10 000 meters), and small scale (installation of less than 5 000 meters). It can be seen that countries with pilot projects conducted on a big scale dominate (these are: Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia, and Slovenia). Three countries (Greece, Latvia, Malta) carried and one (Lithuania) is currently carrying medium scale pilot projects. Small pilot projects are being run by Cyprus and Turkey.

Chart 27: Share of CSE countries with pilot projects carried on a big, medium, and small scale

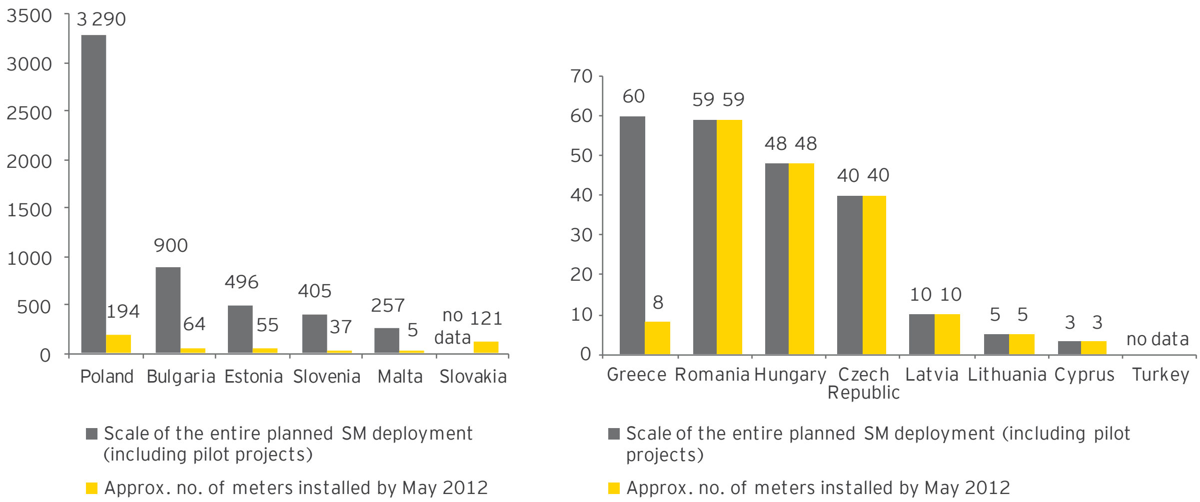


Source: Ernst & Young.

In the charts below more detailed information regarding the scale of AMI implementation activities in the individual CSE countries has been shown. Grey bars in the charts represent the scale of planned AMI implementation (only confirmed projects) – either the total number of smart meters (first chart) or the share of smart meters in the total number of electricity customers/ number of metering points (second chart). Yellow bars in the charts represent the number of smart meters already deployed (including pilot projects) in each country (first chart) or the share of installed smart meters in the total number of electricity customers/ number of metering points (second chart).

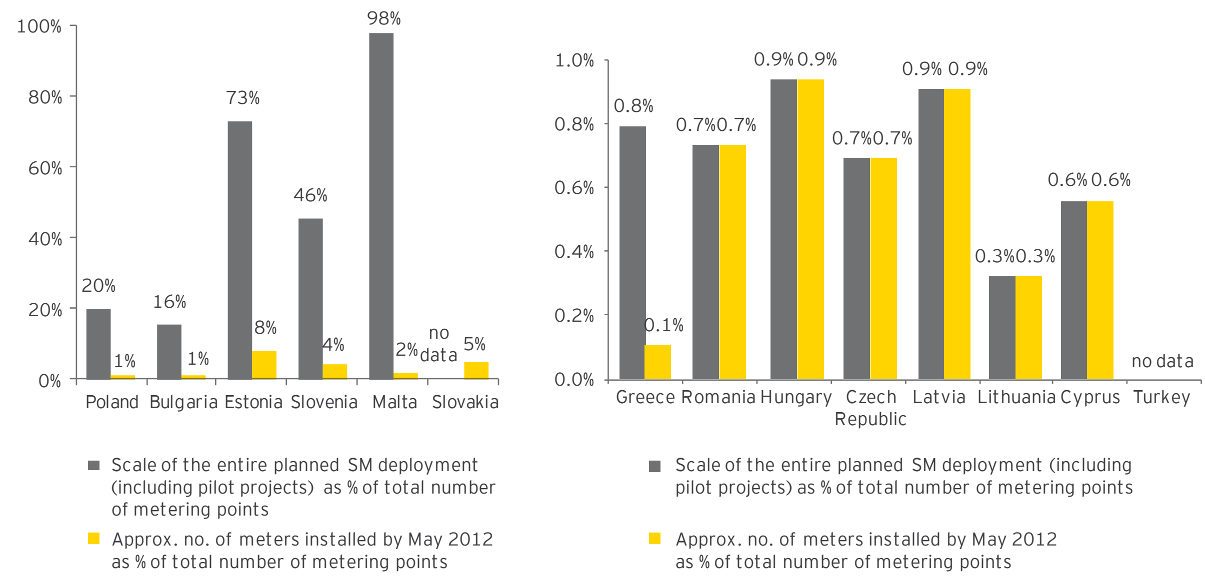
As it can be deduced, for the majority of countries, the grey bars indicate only the pilot projects to be carried out before the final decision regarding country-wide roll-out is made. In a few countries however, the grey bars already show the scale of planned country-wide roll-outs. The pilot projects considered include the pilot projects carried out on behalf of the governments (as part of CBA), as well as the pilot projects carried out individually by DSOs.

Chart 28: Scale of AMI implementation activities in the CSE countries (in thousands of smart meters)



Source: Ernst & Young.

Chart 29: Scale of AMI implementation activities in the CSE countries (share of smart meters in total number of metering points)



Source: Ernst & Young.

The available data shows that Poland is planning to install the greatest number of smart meters among CSE countries. So far the installation of a total of 3.29 million meters by 2018 (which is 20% of total number of electricity customers) is confirmed and this information is shown on both charts above. This is the implementation of smart meters by ENERGA-OPERATOR, one of the Polish DSOs, which has decided to implement AMI for all its customers. However, it is important to note that if the new energy law is adopted (which is still under discussion), a full country-wide roll-out of SM shall be mandatory (which means installation of 16.5 million smart meters).

Apart from Poland, three other countries can also be distinguished for the number of smart meters to be installed: Bulgaria (planning to deploy 0.9 million of smart meters by 2020), Estonia (planning to install almost 0.5 million smart meters by 2017), and Slovenia (planning to install 0.4 million smart meters by 2020). No data is available regarding SM plans in Slovakia where so far 121 000 smart meters have been installed. However, there is information available that in 2009, one of the Slovakian DSOs – Stredoslovenska Energetika a.s., a member of EdF Group – started to buy and deploy 40 thousand smart meters annually.

When it comes to the share of installed smart meters in the total number of metering points, Malta is clearly the leader in AMI implementation. By May 2012, 82% of all Maltese electricity consumers will be equipped with SM. According to the plans announced by Enemalta – the Maltese national electricity provider which is running a country-wide roll-out – by the end of 2012, 98% of the consumers are to have smart meters.

Apart from Malta, two other countries clearly stand out: Estonia and Slovenia. By May 2012, Estonia equipped 20% of its electricity consumers with SM but the plan is to install smart meters for 73% of customers by 2017. This country-wide roll-out is run by the individual DSOs, without any significant governmental or regulatory support. Slovenia, on the other hand, installed smart meters for 19% of its electricity consumers, and by 2020 the rate of SM deployment is expected to be 47%. As mentioned before, if the new energy law is adopted, Poland will be another country to carry out a country-wide roll-out.

The remaining 8 countries (Cyprus, Czech Republic, Greece, Hungary, Latvia, Lithuania, Romania, and Turkey) are running some pilot projects, but the scale of those activities is significantly smaller than in the countries mentioned above. In all of these countries the planned share of smart meters in the total number of electricity customers is supposed to be less than 1%.

Summary

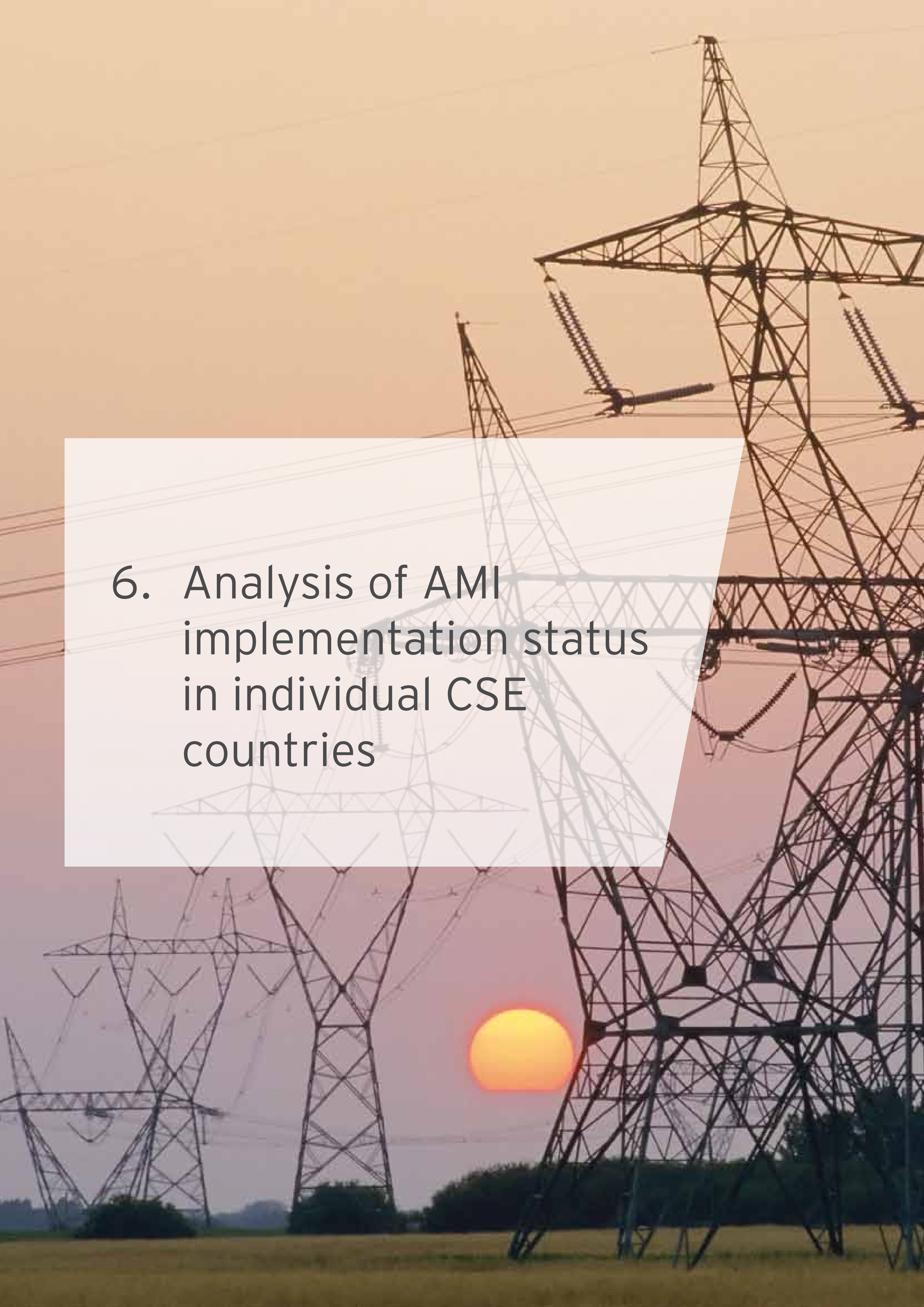
According to the analyses presented in the previous chapter, among the CSE countries, Greece, Romania, Hungary, Cyprus and Slovenia have the highest potential for AMI implementation. Therefore, in theory, these countries should be the leaders in the deployment of smart meters in the CSE region.

The gathered information regarding Smart Metering diffusion in the CSE region indicates, however, that quite different countries (except for Slovenia where big scale implementation covering nearly 50% of metering points is confirmed) are the most ambitious players in the market. While Malta is the undisputed leader of AMI implementation due to the almost finished country-wide roll-out, it is followed by Estonia, where the utilities themselves started a roll-out that should cover most of the electricity consumers in the next five years.

The other significant players in the field of SM are Bulgaria, Poland and Slovakia, where the DSOs carry out some big scale pilot projects and implementations.

Going back to Greece and Romania, the first one has already adopted some legal framework but is very slowly starting to carry out some pilot projects; the second one has already done some pilot SM implementation but has not made a final decision regarding a massive roll-out of smart meters and has not adopted any regulations regarding SM yet.

Hungary prepared a CBA analysis which proved AMI is feasible. Still, no final implementation decision has been made and it is possible that another CBA study will be conducted, which may significantly influence final decisions regarding the shape and range of smart metering implementation in Hungary. Cyprus conducted only small-scale pilot implementations.



6. Analysis of AMI implementation status in individual CSE countries

This chapter presents the current state of AMI implementation in the fourteen CSE countries – Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, and Turkey.

Information regarding every country is presented according to the following structure:

- general description of the electricity market,
- information on electricity distribution system and share of RES in energy production,
- potential for AMI implementation,
- presentation of the regulatory approach and key stakeholders approach to AMI,
- information on pilot projects already carried out and plans regarding a country-wide roll-out,
- any additional information on AMI implementation in a given country.

6.1 Bulgaria

Electricity market in Bulgaria

The electricity market in Bulgaria is the sixth largest among the CSE countries discussed in this Report. According to the Bulgarian DSOs (EVN, E.ON, CEZ) and available publications, currently there are 5.79 million electricity customers in the entire country. No detailed information regarding the structure of the market is available, however it should be assumed that similarly to the other countries, in Bulgaria the residential consumers dominate.

In 2010, total electricity consumption in Bulgaria was 27 103 GWh, of which residential consumers used 10 559 GWh. If we assume that the share of residential customers in the total number of electricity customers is 90%, we can calculate that the average annual energy consumption of a household is 2.0 MWh. This is the same as the average annual energy consumption of all analysed CSE countries, which also equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Bulgaria is 50 EUR/MWh, which is much less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 102 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are three major distribution system operators in Bulgaria:

- EVN – with 28% market share (1.6 million customers),
- E.ON – with 19% market share (1.1 million customers),
- CEZ – with 33% market share (1.9 million customers).

The infrastructure of the distribution system is quite inefficient – as much as 10% of energy input is lost (in 2010 the network losses amounted to 4 480 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Bulgaria is also an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 4.65, and the total duration of interruptions (SAIDI) was 197.24 minutes (nearly 3.5 hours). At the same time in the ranking regarding the quality of electricity

supply prepared by the World Economic Forum, Bulgaria ranked 95 among 133 analyzed countries (and last among the CSE countries).

Currently about 12% of electricity generated in Bulgaria comes from renewable energy sources, and Bulgaria is planning on increasing the share of RES in the fuel-mix to 16.9% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Bulgaria ranked 9th among the 14 countries. The key factors that increase Bulgaria's potential for SM deployment are big market size, significant distribution network losses, and low quality of electricity supply.

On the other hand, the factors that could potentially impede SM diffusion are relatively low energy consumption, quite low future share of RES in electricity production and an increased complexity of SM implementation due to the large number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

So far in Bulgaria neither legislation or policy framework regarding the implementation of smart metering has been adopted, nor has the national cost and benefit analysis been carried out. Nevertheless, from some vague information provided by the authorities, it can be derived that the government supports AMI implementation and it has some plans for adopting a regulation regarding AMI and Smart Grid. In the planned policy the construction of intelligent networks shall be set as one of Bulgaria's priorities and the electricity transmission and distribution networks operators shall be encouraged – by recognition of the costs related to the development and implementation of such projects – to construct and develop intelligent networks.

Among the other key stakeholders, only the distribution system operators support AMI implementation in Bulgaria. The other parties (TSO, ERO, retailers, and consumers) do not have an opinion or do not express their opinion on the topic.

AMI pilot projects and country-wide roll-out plans

There are no official plans for a country-wide roll-out in Bulgaria. However, the DSOs show some activity in regard to smart meters diffusion. According to available publications, in 2009 CEZ Bulgaria, together with ADD Bulgaria, deployed an AMM system for 30 thousand smart meters.

A more spectacular project is the one to be carried out by E.ON. The company is planning on installing 850 000 smart meters over the period of 2011-2020. The estimated project cost is EUR 65.5 million.

The two main objectives of SM diffusion in Bulgaria are in all cases reduction of illegal energy consumption and lowering the rate of error in metering and bill calculation.

6.2 Cyprus

Electricity market in Cyprus

The electricity market in Cyprus is the second smallest among the CSE countries discussed in this Report. According to the Electricity Authority of Cyprus, currently there are 0.54 million electricity customers in the entire country. In Cyprus the residential consumers dominate – they constitute 78% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 22%.

In 2010, total electricity consumption in Cyprus was 4 889 GWh, of which residential consumers used 1 738 GWh. Since there were 0.42 million residential customers in 2010, the average annual energy consumption of a household was 4.2 MWh. This is very high compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Cyprus is approx. 145 EUR/MWh, which is much more than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 600 EUR/household/year.

Electricity distribution system and share of RES in energy production

The electricity distribution network in Cyprus belongs to Electricity Authority of Cyprus which is the only distribution system operator in the country. The infrastructure of the distribution system is relatively efficient – only 4% of energy input is lost (in 2010 the network losses amounted to 220 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The detailed information regarding the quality of energy supply in the country is not available. However, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Cyprus ranked 23rd among 133 analyzed countries (and 2nd among the CSE countries, after the Czech Republic).

Currently barely 0.1% of electricity generated in Cyprus comes from renewable energy sources. However, Cyprus has a very ambitious plan regarding RES development. It is assumed that the share of RES in the fuel-mix will reach 25% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Cyprus ranked 3rd among the 14 countries (together with Slovenia). The key factors that increase Cyprus's potential for SM deployment are high energy consumption, extremely high energy bills for residential consumers, high future share of RES in electricity production, and low level of complexity of SM implementation due to a very simple distribution system (only one DSO).

On the other hand, the factors that could potentially impede SM diffusion are small market size with very little economies of scale, relatively little network losses, and quite high quality of electricity supply.

Regulatory approach to AMI

Currently, there is no legal framework regarding intelligent networks in Cyprus and no plans have been identified regarding future development of such regulation. Nevertheless, according to SmartRegions, "the current legislation does not hinder the evolution of smart meters or Smart Grids on the island".

There is no much information available regarding the key stakeholders approach to AMI in Cyprus. From available sources it can only be derived that the DSO support AMI implementation. The government of Cyprus does not express its opinion on the topic.

AMI pilot projects and country-wide roll-out plans

According to available data, the only SM activity that is presently going on in Cyprus is a pilot project run by the DSO. The project is to install 3 000 smart meters with all related technologies and, by July 2012, to carry out a cost-benefit analysis based on the findings from this undertaking. After the CBA is published, the strategy for the full roll-out of AMI is expected. It can be assumed that if a decision is taken on the country-wide roll-out, the diffusion of smart meters shall be a part of wider Smart Grid plans.

The main objectives of potential future AMI implementation would most likely be reduction of energy consumption and, especially, peak-load reduction, as well as the development of RES.

6.3 Czech Republic

Electricity market in the Czech Republic

The electricity market in the Czech Republic is the fifth largest among the CSE countries discussed in this Report. According to the energy regulatory office, currently there are 5.79 million electricity customers in the entire country. In the Czech Republic the residential consumers dominate – they constitute 86% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 14%.

In 2010, total electricity consumption in the Czech Republic was 57 213 GWh, of which residential consumers used 15 028 GWh. Since there were 4.97 million residential customers in 2010, the average annual energy consumption of a household was 3.0 MWh. This is high compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in the Czech Republic is approx. 63 EUR/MWh, which is less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 190 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are three major distribution system operators in the Czech Republic with a 97% total market share:

- CEZ – with 61% market share (3.54 million customers),
- E.ON – with 22% market share (1.3 million customers),
- PRE – with 13% market share (0.75 million customers).

The infrastructure of the distribution system is quite efficient in comparison to the other CSE countries – only 5% of energy input is lost (in 2010 the network losses amounted to 4 466 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in the Czech Republic is somewhat an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 1.64, and the total duration of interruptions (SAIDI) was 106.24 minutes. Nevertheless, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, the Czech Republic ranked 19th among 133 analyzed countries (and 1st among the CSE countries).

Currently about 5% of electricity generated in the Czech Republic comes from renewable energy sources, and the country is planning on increasing the share of RES in the fuel-mix to 7.3% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation, the Czech Republic ranked 12th among the 14 countries. The key factors that increase its potential for SM deployment are big market size, quite high energy consumption, and high energy bills for residential consumers.

On the other hand, the factors that could potentially impede SM diffusion are relatively low network losses level, low future share of RES in electricity production, and an increased complexity of SM implementation due to the large number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

So far in the Czech Republic no legislation forcing the implementation of smart metering has been adopted. Nevertheless, in the course of the last years several existing regulations were updated, so as to cover the area of SM.

In 2006 a first cost-benefit analysis of AMI was carried out. That feasibility study gave a negative result regarding SM implementation. Currently another CBA, which is a part of a larger AMI project, is under development and the assumed completion date is before 3 September 2012.

The AMI situation in the Czech Republic is rather specific: all electricity low voltage networks are equipped with smart metering devices that enable tariff switching and load management (it covers 60% of low voltage consumption of households and SMEs). Furthermore, approximately 60% of total electricity consumption goes through continuing metering. That is why the AMI implementation is evaluated so carefully and with such hesitation.

In general it can be said, that while the DSOs support SM deployment subject to certain conditions only and carry out some pilot projects, the government does not express its opinion on the topic. Information on the other stakeholders' approach to AMI is not available.

AMI pilot projects and country-wide roll-out plans

Whereas a country-wide roll-out plan in the Czech Republic is still under discussion, various pilot project are carried out by the DSOs.

The first pilot project was done already in 2006 by E.ON, which installed 4 000 smart meters in South Moravia. The aim of the project "was to investigate technical issues and evaluate various technology manufacturers"[9].

The second project was carried out by PRE in years 2009-2010. The company installed 2 500 smart meters in the region of Prague.

The last two pilot projects are being carried out by CEZ. The company plans to deploy 4 900 smart meters in Vrchlabi city and additional 40 000 smart meters in other region in years 2010-2015. The aim

9 P. Spodniak, Diffusion of smart meters in Central East Europe, Lappeenranta University of Technology, Saint-Petersburg, 2011.

of the first undertaking is to evaluate the whole Smart Grid solution. The system in Vrchlabi city shall be equipped with "charging stations for electronic vehicles, possibilities to micro-generate and redistribute renewable energy, and monitor and plan consumption of electricity, water, and gas via home displays".

The second undertaking shall be a large scale test of SM. If that project gives a positive result, CEZ plans to carry out a mass roll-out of Smart Grid solutions in a specific region with 1 million inhabitants by 2015.

There are multiple objectives of SM diffusion in the Czech Republic: reduction of electricity consumption and possibility of tariff switching, peak load reduction, reduction of energy thefts, 15-minute readings of actual consumption, RES and microgeneration development, remote load management and possibility to disconnect during crisis situations, detailed load curves analysis and segmentation, monitoring of non-standard situations (over/under voltage, non-standard frequency etc.), better identification of outages, etc.

6.4 Estonia

Electricity market in Estonia

The electricity market in Estonia is the third smallest among the CSE countries discussed in this Report. According to SmartRegions and other sources, currently there are 0.68 million electricity customers in the entire country. In Estonia the residential consumers (0.58 million) dominate – they constitute 86% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 14%.

In 2010, total electricity consumption in Estonia was 6 895 GWh, of which residential consumers used 2 023 GWh. The average annual energy consumption of a household was therefore 3.5 MWh. This is very high compared to the average annual energy consumption in all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Estonia is approx. 40 EUR/MWh, which is much less than the average of the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 145 EUR/household/year.

Electricity distribution system and share of RES in energy production

The distribution market in Estonia is dominated by one company – Jaotusvõrk OÜ, a subsidy of state owned Eesti Energia – which serves 73% of electricity customers. The infrastructure of the distribution system is rather inefficient – as much as 8% of energy input is lost (in 2010 the network losses amounted to 1 047 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The detailed information regarding the quality of energy supply in Estonia is not available. However, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Estonia ranked 38th among 133 analyzed countries (and 5th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, and Slovenia).

Currently about 13% of electricity generated in Estonia comes from renewable energy sources, and the country is planning on increasing the share of RES in the fuel-mix to 28.4% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Estonia ranked 6th among the 14 countries. The key factors that increase Estonia's potential for SM deployment are high electricity consumption, high distribution network losses, high future share of RES in electricity production, and low level of complexity of SM implementation due to a simple distribution system (market is dominated by one DSO).

On the other hand, the factor that could potentially impede SM diffusion is a small market size with little economies of scale.

Regulatory approach to AMI and key stakeholders approach

In Estonia the regulatory approach to AMI is unclear. On one hand, a governmental decree on the grid operation was amended (last amendment in 2010) in order to cover the objectives of AMI. On the other hand, there is no legal requirement for a country-wide SM roll-out and there are no regulatory incentives for the DSOs to deploy SM. A cost-benefit analysis of AMI, as required by Directive 2009/72/EC, or any other type of financial analysis have not been performed.

However, it is worth to notice in Estonia that the lack of clear regulatory approach does not impede AMI implementation. In fact a situation can be observed in which the government, which supports AMI, "exercises its policy objectives via a stock company [a state owned Eesti Energia] without the need of codifying the legal environment".

Naturally, since the government supports SM diffusion, the state owned DSO also supports the implementation of SM. The support is also expressed by the energy regulatory office. The Estonian TSO – Elering – is only interested in that functionality of AMI that allows to reduce the peak load. The other stakeholders' attitude to AMI is unknown.

AMI pilot projects and country-wide roll-out plans

In Estonia no official roll out schedule has been adopted. Nevertheless, the dominating DSO, Jaotusvõrk OÜ, the subsidy of state owned Eesti Energia, has a plan to install 220 000 smart meters by 2013, and to equip with smart meters 100% of its electricity consumers (496 000) by the end of 2017 (Jaotusvõrk OÜ already installed 55 000 smart meters during the period 1995-2010). This means that by 2017, 85% of all Estonian electricity consumers will be covered with SM.

Another DSO that shows some activity in the field of AMI is VKG Elektrivõrgud OÜ. Apparently the company equipped at least some of its consumers with SM. Unfortunately, no reliable data regarding the exact number of installed smart meters is available.

The main objectives of implementation of SM in Estonia are ensuring monthly reading of electricity consumption and reduction of peak-load.

6.5 Greece

Electricity market in Greece

The electricity market in Greece is the fourth largest among the CSE countries discussed in this Report. According to the Public Power Corporation, currently there are 7.56 million electricity customers in the entire country. In Greece the residential consumers dominate - they constitute 77% of all electricity customers (around 5.8 million). The share of non-residential consumers (such as industry and SMEs) is 23%.

In 2010, total electricity consumption in Greece was 53 120 GWh, of which residential consumers used 18 130 GWh. If we assume that the share of residential customers in the total number of electricity customers is 90%, we can calculate that the average annual energy consumption of a household is 2.7 MWh. This is almost 50% higher than the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Greece is approx. 74 EUR/MWh, which almost equals the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 200 EUR/household/year.

Electricity distribution system and share of RES in energy production

The electricity distribution network in Greece belongs to Public Power Corporation (PPC), a publicly owned company, which is the only distribution system operator in the country. The efficiency of the distribution system infrastructure is the same as the average efficiency in the entire EU – only 6% of energy input is lost (in 2010 the network losses amounted to 3 783 GWh).

The quality of energy supply in Greece is an issue. According to CEER, in 2010, the number of interruption per year (SAIFI) was 2.1, and the total duration of interruptions (SAIDI) was 134 minutes. At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Greece ranked 68th among 133 countries (and 11th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Lithuania, Poland, Latvia, Hungary, Malta).

Currently about 12.3% of electricity generated in Greece comes from renewable energy sources. However, the country has a very ambitious plan regarding RES development. It is assumed that the share of RES in the fuel-mix will reach 34.5% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Greece ranked 1st among the 14 countries. The key factors that increase Greece's potential for SM deployment are large market size, high energy consumption, high energy bills for residential consumers, low quality of electricity supply, high future share of RES in electricity production, and low level of complexity of SM implementation due to a simple distribution system (only one DSO).

On the other hand, the factor that could potentially impede SM diffusion is a relatively low level of distribution network losses.

Regulatory approach to AMI and key stakeholders approach

According to SmartRegions, Greece is slowly proceeding towards a country-wide roll-out of smart meters and it has already adopted some legal provisions regarding the implementation of AMI. The energy supply companies are obliged to supply smart meters to any new connections of new buildings, to replace old meters in the refurbished buildings and to install smart meters whenever the grid is refurbished. Moreover, in any other case the energy suppliers are supposed to replace old meters with smart meters whenever it is economically reasonable.

In Greece the government and DSO fully support AMI implementation. The other key stakeholders do not express their opinion on this topic.

It is however worth mentioning that a cost-benefit analysis of AMI, as required by Directive 2009/72/EC, or any other type of financial analysis have not been performed.

AMI pilot projects and country-wide roll-out plans

So far only about 8 000 electricity consumers (the medium voltage consumers) have been equipped with smart meters. Currently PPC is planning a pilot project to install additional 60 000 smart meters in large end customers of low voltage connections (these include some residential customers). After this project is finalized, as much as 30% of the total final energy consumption in Greece will be measured with SM.

Eventually, all electricity customers shall be covered with AMI. However, no official schedule of the country-wide roll-out has been adopted yet.

The main objectives of future implementation of SM in Greece are: reduction of energy consumption and reduction of electricity thefts, as well as ensuring monthly reading of electricity consumption.

Additional information

It is worth to mention that PPC is also "examining the possibilities of extending the electricity metering system to include metering the water and the natural gas consumption".

6.6 Hungary

Electricity market in Hungary

The electricity market in Hungary is the seventh largest among the CSE countries discussed in this Report. According to the distribution system operators, currently there are 5.1 million residential electricity customers in the entire country. In Hungary the residential consumers dominate – they constitute 78% of all electricity customers (around 4 million). The share of non-residential consumers (such as industry and SMEs) is 22%.

In 2010, total electricity consumption in Hungary was 34 207 GWh, of which residential consumers used 11 202 GWh. The average annual energy consumption of a household was therefore 2.8 MWh. This is almost 50% higher than the average annual energy consumption of all analysed CSE countries, which equals to 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Hungary is 71 EUR/MWh, which is just a bit less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 200 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are six distribution system operators in Hungary:

- E.ON Dél-dunántúli Áramhálózati – with 13.7% market share (0.7 million customers),
- E.ON Észak-dunántúli Áramhálózati – with 17.6% market share (0.9 million customers),
- E.ON Tiszántúli Áramhálózati – with 14.8% market share (0.76 million customers),
- ELMŰ Hálózati Kft – with 25.4% market share (1.3 million customers),
- ÉMÁSZ Hálózati Kft. – with 13.7% market share (0.7 million customers),
- EDF DÉMÁSZ Hálózati Elosztó Kft. – with 14.8% market share (0.76 million customers).

The infrastructure of the distribution system is quite inefficient – as much as 9% of energy input is lost (in 2010 the network losses amounted to 3 801 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Hungary is somewhat an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 1.45, and the total duration of interruptions (SAIDI) was 102.38 minutes. At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Hungary ranked 52nd among 133 countries (and 9th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Lithuania, Poland, and Latvia).

Currently about 8.6% of electricity generated in Hungary comes from renewable energy sources, and the country is planning on increasing the share of RES in the fuel-mix to 21.7% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Hungary ranked 5th among the 14 countries. The key factors that increase Hungary's potential for SM deployment are big market size, high energy consumption, high energy bills for residential consumers, relatively high distribution network losses, unsatisfactory quality of electricity supply, and quite high future share of RES in electricity production.

On the other hand, the factor that could potentially impede SM diffusion is a high level of complexity of SM implementation due to the high number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

So far in Hungary no legislation or policy framework regarding the implementation of smart metering has been adopted. Nevertheless, the government and the Energy Regulatory Office are actively proceeding towards preparing a regulation on SM.

Hungary is in fact the only CSE country to carry out a comprehensive cost-benefit analysis as required by Directive 2009/72/EC. The CBA, which was developed in 2010 on behalf of the Hungarian ERO, proved economic viability of AMI implementation and included recommendations for the method and timeframe of the introduction of SM. On the other hand, it is possible that another CBA analysis will be conducted in Hungary, which will be in line with the European Commission Recommendation from 9th March 2012. The results of the second CBA study may have great influence both on Hungarian plans regarding SM implementation and the regulator's approach towards AMI roll-out.

When it comes to the key stakeholders' approach to AMI, apart from the government and the ERO, only the distribution system operators support AMI implementation in Hungary. The other parties (TSO, retailers, and consumers) do not express their opinion on the topic.

AMI pilot projects and country-wide roll-out plans

As mentioned above, the CBA proved economic viability of AMI implementation, but Hungary has not made an official decision regarding a country-wide roll out and another CBA study may be conducted. Additionally, before the final decision, the government is to organize several pilot projects. The requirements regarding pilot projects are defined in a draft government decree, which, however, has not gone into force yet. Nevertheless, two pilot projects have already been done or have been started by the DSOs from the E.ON Group and another one has been launched including 20 000 meters, which involves both all the Hungarian DSOs and Hungarian Energy Office. The goal of this project is to test the technical and economic effects of smart metering (especially the changes in consumer habits will be examined) and possible integration of smart metering technology with other systems.

The first pilot project that included installation of 19 000 smart meters was done in years 2006-2008. The second project that includes installation of 9 000 smart meters started in 2011 and should be finalized in 2012. The latest, including 20 000 meters will start this June so that the installation will be finalized in October and after that a one-year monitoring period will follow. This pilot project includes not only, as mentioned above 20 000 electricity meters but also includes about 3 000 gas meters, 1 000 water meters and about 1 000 remote heat meters.

6.7 Latvia

Electricity market in Latvia

The electricity market in Latvia is the fifth smallest among the CSE countries discussed in this Report. According to AS Sadales Tikls – a Latvian DSO, currently there are 1.1 million electricity customers in the entire country. In Latvia the residential consumers dominate – they constitute 91% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 9%.

In 2010, total electricity consumption in Latvia was 6 215 GWh, of which residential consumers used 1 938 GWh. Since there were 1 million residential customers in 2010, the average annual energy consumption of a household was 1.9 MWh. This is lower than the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Latvia is 50 EUR/MWh, which is much less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 100 EUR/household/year.

Electricity distribution system and share of RES in energy production

The electricity distribution network in Latvia belongs to AS Sadales Tikls, a fully owned subsidiary of AS Latvenergo, which is the only distribution system operator in the country.

The infrastructure of the distribution system is quite inefficient – as much as 7% of energy input is lost (in 2010 the network losses amounted to 725 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The detailed information regarding the quality of energy supply in Latvia is not available. However, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Latvia ranked 50th among 133 analyzed countries (and 8th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Lithuania, and Poland).

Today in Latvia already 57% of generated electricity comes from renewable energy sources (mostly hydroelectric power plants). Nevertheless, Latvia is still planning to slightly increase the share of RES in the fuel-mix by 2030 (the use of RES should rise to 60.2%).

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Latvia ranked 11th among the 14 countries. The key factors that increase Latvia's potential for SM deployment are relatively high network losses, very high future share of RES in electricity production, and low level of complexity of SM implementation due to a simple distribution system (only one DSO).

On the other hand, the factors that could potentially impede SM diffusion are small market size with little economies of scale, low electricity consumption and low energy bills for residential consumers.

Regulatory approach to AMI and key stakeholders approach

In Latvia neither legislation or policy framework regarding the implementation of smart metering has been adopted, nor has the official cost-benefit analysis of AMI been carried out. The only key stakeholders that support AMI implementation are the DSOs. The other parties, including the government and the ERO, do not express their opinion on the topic.

AMI pilot projects and country-wide roll-out plans

Currently in Latvia no mass roll-out of smart meters is planned. However, the dominant distribution system operator AS Sadales Tikls shows some activity in the field of AMI. According to available sources, during the years 2004-2010 the DSO run a pilot project to equip 10 000 customers (including 7 000 industrial customers) with smart meters connected with AMR system. The purpose of the project is to gather data on possible technologies, Smart Grid applications and to analyze some business cases.

6.8 Lithuania

Electricity market in Lithuania

The electricity market in Lithuania is the sixth smallest among the CSE countries discussed in this Report. According to LESTO – a Lithuanian DSO, currently there are 1.56 million electricity customers in the entire country. In Lithuania the residential consumers dominate – they constitute 96% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 4%.

In 2010, total electricity consumption in Lithuania was 8 332 GWh, of which residential consumers used 2 590 GWh. Since there were 1.56 million residential customers in 2010, the average annual energy consumption of a household was 1.7 MWh. This is low compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Lithuania is 46 EUR/MWh, which is much less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 80 EUR/household/year.

Electricity distribution system and share of RES in energy production

The electricity distribution network in Lithuania belongs to LESTO which is the only distribution system operator in the country.

The infrastructure of the distribution system is quite inefficient – as much as 7% of energy input is lost (in 2010 the network losses amounted to 989 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Lithuania is somewhat an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 1.92, and the total duration of interruptions (SAIDI) was 58.92 minutes. At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Lithuania ranked 44th among 133 analyzed countries (and 6th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, and Estonia).

Currently about 12.7% of electricity generated in Lithuania comes from renewable energy sources, and Lithuania is planning on increasing the share of RES in the fuel-mix to approx. 23% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Lithuania ranked last among the 14 countries. The key factors that increase Lithuania's potential for SM deployment are relatively high distribution network losses, some issues with quality of electricity supply, and low level of complexity of SM implementation due to a simple distribution system (only one DSO).

The factors that could potentially impede SM diffusion are small market size with little economies of scale, low electricity consumption and low energy bills for residential consumers.

Regulatory approach to AMI and key stakeholder approach

In Lithuania none of the key stakeholders expresses their opinion on the AMI implementation and so far no regulatory framework regarding SM has been adopted. However, a cost-benefit analysis is currently being carried out, the results of which shall be available in August 2012. Based on this study further decisions regarding the implementation of AMI will be made by the government.

AMI pilot projects and country-wide roll-out plans

So far in Lithuania only one pilot project has been started. The project is run by the Lithuanian TSO (Lietuvos Energija) and the UK based company (Enica), which plan to install 5 000 smart meters during years 2011-2014.

According to available information, a schedule for a country-wide roll-out of SM shall be announced by the government after the official cost-benefit analysis is developed.

6.9 Malta

Electricity market in Malta

The electricity market in Malta is the smallest among the CSE countries discussed in this Report. According to Enemalta, currently there are 263 thousand electricity customers in the entire country. No detailed information regarding the structure of the market is available, however it should be assumed that similarly to the other countries, in Malta the residential consumers dominate.

In 2010, total electricity consumption in Malta was 1 606 GWh, of which residential consumers used 475 GWh. If we assume that the share of residential customers in the total number of electricity customers is 90%, we can calculate that the average annual energy consumption of a household is 2.0 MWh. This is the same as the average annual energy consumption of all analysed CSE countries, which also equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Malta is 219 EUR/MWh which is the highest electricity price in the entire CSE region and which is much more than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 440 EUR/household/year.

Electricity distribution system and share of RES in energy production

The electricity distribution network in Malta belongs to Enemalta which is the only distribution system operator in the country. The infrastructure of the distribution system is inefficient – as much as 19% of energy input is lost (in 2010 the network losses amounted to 386 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The detailed information regarding the quality of energy supply in the country is not available. However, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Malta ranked 67th among 133 countries (and 10th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Lithuania, Poland, Latvia, and Hungary).

Currently Malta uses no renewable energy sources and the only source of energy is crude oil imported from other countries. Although Malta is seeking to reduce its total dependency on imported fuels (by exploring for petroleum and examining possibilities of exploitation of renewable energy sources), according to the information provided in the report on EU energy trends to 2030, there is a little chance that this situation will change in the next years. According to the energy projections, by 2030 only 0.4% of Maltese electricity will be generated by RES.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Malta ranked 10th among the 14 countries. The key factors that increased Malta's potential were high energy bills for residential consumers, high distribution network losses, low quality of electricity supply, and, at the same time, low level of complexity of SM implementation due to a very simple distribution system (only one DSO).

On the other hand, the factors that could potentially impede SM diffusion were small market size with very little economies of scale, low energy consumption by residential consumers, and a very low future share of RES in electricity production.

Regulatory approach to AMI

In 2009 the government of Malta issued a proposal for a national energy policy in which it pointed out the importance of demand-side management in raising the general quality of energy supply and energy efficiency. The information whether any legal provisions regarding AMI have ever been implemented cannot be retrieved from the Energy Law. Nor is the information available whether Malta carried out a comprehensive cost-benefit analysis of AMI. Nevertheless, the fact is that since 2009, with the support of the government, Enemalta has been quickly proceeding with a country-wide roll out of smart meters.

AMI pilot projects and country-wide roll-out plans

In the recent years Malta has become the most active player in the field of AMI implementation among the CSE countries. The key motives for SM deployment were very high losses on electricity grid and water network, low quality of energy supply, and the need to reduce the peak load and generally to lower the energy consumption.

In 2009 the first phase of a 4-year country-wide roll-out of smart meters started. After a pilot project was successfully carried out, in which 5 000 of smart meters where installed (measuring both electricity and water consumption), the full roll-out of smart meters began. Each year during the last three years (2010-2012) 84 000 electricity meters have been replaced and AMR modules for the same number of water meters have been installed.

According to IBM, which is building the Smart Grid in Malta, by the end of 2012 Malta is to become "the world's first "Smart Grid" country" with over 250 000 smart meters and a Smart Grid "integrating both water and power systems".[10]

The market model in Malta will be centralized and regulated. The customer services and billing functions will be managed by Automated Revenue Management Services (ARMS) Ltd., which is a private limited liability company jointly owned by Enemalta Corporation and Water Services Corporation.

Additional information

According to information provided in the report by SmartRegions, during the first two years of the project some serious problems with electricity bills occurred: more than 5% of issued bills were incorrect. Many customers did not receive their bills or received estimated bills instead of bills of their actual consumption. The investigation of the billing system run in 2010 revealed a software failure.

6.10 Poland

Electricity market in Poland

The electricity market in Poland is the second largest among the CSE countries discussed in this Report. According to PTPiREE (Polish DSOs Association), there are currently 16.5 million electricity customers in the entire country. In Poland the residential consumers dominate – they constitute 86% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 14%.

In 2010, total electricity consumption in Poland was 118 490 GWh, of which residential consumers used 28 615 GWh. Since there were 14.2 million residential customers in 2010, the average annual energy consumption of a household was 2.0 MWh. This is the same as the average annual energy consumption of all analysed CSE countries, which also equals 2.0 MWh/household.

10 IBM: http://www.ibm.com/smarterplanet/ie/en/smart_grid/examples/index.html

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Poland is 58 EUR/MWh, which is much less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 116 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are six major distribution system operators in Poland:

- PGE Dystrybucja S.A. – with 31% market share (5 million customers),
- TAURON Dystrybucja S.A. – with 25% market share (4.1 million customers),
- ENERGA-OPERATOR S.A. – with 17% market share (2.9 million customers),
- ENEA Operator Sp. z o.o. – with 14% market share (2.4 million customers),
- TAURON Dystrybucja GZE S.A. (former Vattenfall Distribution Poland) – with 8% market share (1.2 million customers),
- RWE Stoen Operator Sp. z o.o. – with 5% market share (0.9 million customers).

The infrastructure of the distribution system is quite inefficient – as much as 9% of energy input is lost (in 2010 the network losses amounted to 12 247 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Poland is also an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 3.7, and the total duration of interruptions (SAIDI) was 316.1 minutes (over 5 hours). At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Poland ranked 48th among 133 analyzed countries (and 7th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, and Lithuania).

Currently about 7.1% of electricity generated in Poland comes from renewable energy sources, however the country is planning to increase the share of RES in the fuel-mix to 19.2% by 2030.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Poland ranked 8th among the 14 countries. The key factors that increase Poland's potential for SM deployment are large market size, high distribution network losses, low quality of electricity supply, and intensively growing share of RES in electricity production.

On the other hand, the factors that could potentially impede SM diffusion are relatively low energy consumption and energy bills for residential consumers, as well as a high level of complexity of SM implementation due to the high number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

Even though the government and the energy regulatory office, as well as the TSO and commercial energy consumers show a strong support for AMI implementation, so far in Poland neither legislation regarding the implementation of smart metering has been adopted, nor the national cost-benefit analysis as required by Directive 2009/72/EC has been carried out.

Nevertheless some activity in the field of AMI needs to be recognized. In 2008 on behalf of the ERO a feasibility study assessing technical aspects of SM and costs of the implementation, as well as legal and socioeconomic issues was conducted. In 2010 the Energy Institute of Gdansk and Ernst & Young carried out another study on implementation of smart metering in Poland. Meanwhile two declarations "concerning introduction of smart metering in Poland" were signed by multiple bodies, including the ERO, and an organization devoted to the development of Smart Grid in Poland was established.

Currently a draft energy law that includes some legal provisions regarding AMI is being prepared and the Ministry of the Economy responsible for the development of the regulation would like the new law to be in force in Autumn 2012. It should be noted, however, that this schedule is very optimistic given the many controversies surrounding the document. The main controversy is that the new law requires a 100% SM diffusion rate without preparation of a comprehensive cost-benefit analysis, whereas the EU requires only 80% of smart meters to be installed until 2020 and only if the CBA proves economic viability of such project.

It is important to note that, as opposed to the other countries in the CSE region, the DSOs in Poland do not show much interest in AMI implementation. They think that they will not benefit from AMI and, as a result, they are willing to implement SM only if there is such obligation from the government or the ERO and if the costs are included in the tariff.

AMI pilot projects and country-wide roll-out plans

When it comes to SM pilot projects, Poland is one of the most active CSE countries – all DSOs have already carried out or are planning to conduct such projects.

The pilot project led by ENERGA-OPERATOR, which in fact is a first phase of a full roll-out in the region operated by ENERGA-OPERATOR, started in 2010. By June 2012 the company plans to install 100 000 smart meters. The full roll-out is supposed to be completed by 2018.

Another pilot project is carried out by ENEA Operator. In 2010 the company equipped with smart meters 5 500 industrial clients and 1 000 residential customers.

The third entity to carry out pilot projects is TAURON Dystrybucja. In January 2012 the company started an installation of 20 000 smart meters. The first results of this undertaking, which purpose is to verify the logistics and organisation of mass roll-out, are expected in mid-2012.

Earlier on the company carried two other, smaller-scale pilot projects, both to install ca. 1 500 smart meters. The purpose of the first project was to verify the PLC technology in difficult areas of the network, i.e. rural, long linear segments of the grid and old areas of the network. The purpose of the second project was to verify the radio technology in difficult areas of the network. According to SmartRegions, in years 2013-2015 the company is planning to equip additional 320 000 of its customers with smart meters.

TAURON Dystrybucja GZE S.A. (former Vattenfall Distribution Poland) is a company currently conducting a pilot project. By January 2012 the utility installed 10 000 smart meters in order to verify the interoperability of IDIS system (Landis & Gyr and Iskraemeco meters were installed mixed on the same concentrators from L&G) and to verify the cooperation of MDM system with other IT systems of the DSO, such as SCADA, GIS, etc.

The last utility planning to conduct a pilot project is PGE Dystrybucja. According to information provided by the company, about 54 000 smart meters are to be installed in two pilot areas. The purpose of the project is to verify the logistics and organisation of mass roll-out and the benefits for the DSO.

The main objectives of future implementation of SM in Poland are: reduction of peak load and development of RES and microgeneration.

Additional information

The main drivers for the implementation of AMI in Poland are the market specificity and the need for further expansion into Smart Grid, including implementation of DSR and DSM (which are cheaper than building traditional generation) and development of distributed generation. Firstly, Polish electricity generation is mainly based on coal, which means that with the increase of CO_2 emission costs, the prices of electricity will go up. Secondly, the generation assets in Poland, as well as the transmission and distribution network, are old and need to be highly modernized or replaced in the near future, which means that there is a high need for significant investments.

The implementation of SM in Poland is supposed to be an element of wider plan for the deployment of the following Smart Grid solutions in the country: prosumer/distributed generation, energy storage, development of 'intelligent building' technologies, and implementation of DSR programs.

6.11 Romania

Electricity market in Romania

The electricity market in Romania is the third largest among the CSE countries discussed in this Report. According to the Romanian DSOs, currently there are 8.06 million electricity customers in the entire country. In Romania the residential consumers completely dominate – they constitute 99% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 1%.

In 2010, total electricity consumption in Romania was 41 317 GWh, of which residential consumers used 11 329 GWh. Since there were 8 million residential customers in 2010, the average annual energy consumption of a household was 1.4 MWh. This is low compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Romania is 33 EUR/MWh, which is the lowest price in the CSE region and which is less than half of the average price for all analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 46 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are four distribution system operators in Romania:

- Electrica S.A. – with 37% market share (3 million customers),
- Enel – with 32% market share (2.6 million customers),
- CEZ – with 17% market share (1.4 million customers),
- E.ON – with 14% market share (1.1 million customers).

The infrastructure of the distribution system is inefficient – as much as 13% of energy input is lost (in 2010 the network losses amounted to 7 058 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Romania is very low. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 6.4 and the total duration of interruptions (SAIDI) was 635 minutes (10.5 hours). At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Romania ranked 78th among 133 analyzed countries (and 12th among the CSE countries, after the Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Lithuania, Poland, Latvia, Hungary, Malta, and Greece).

Today in Romania already 36% of generated electricity comes from renewable energy sources (mostly hydroelectric power plants). Hence, Romania is not planning to significantly increase the share of RES in the fuel-mix by 2030 (the use of RES should rise to 37.8%).

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Romania ranked 2nd among the 14 countries. The key factors that increase Romania's potential for SM deployment are large market size, high distribution network losses, low quality of electricity supply, and intensively growing share of RES in electricity production.

On the other hand, the factors that could potentially impede SM diffusion are low energy consumption, very low electricity prices and, as a result, the lowest energy bills for residential consumers in the CSE region, as well as quite high level of complexity of SM implementation due to the high number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

In Romania neither legislation regarding the implementation of smart metering has been adopted, nor has the official cost-benefit analysis of AMI as required by Directive 2009/72/EC been carried out. In November 2010 a SM roadmap was approved as a part of "Action Plan for implementation in the national power system of the Smart Grid concept", but until now it has not been followed appropriately.

However, there is a chance that the SM landscape in Romania will soon change, since a decision on a massive deployment of intelligent metering systems is expected in 2012.

The Ministry of Economy, Trade and Business Environment is currently working on transposition of Directives 2009/72/EC and 2009/73/EC to Romanian law. The drafted document has a chapter dedicated to the implementation of SM system, in which the following schedule is defined:

- first step – the Romanian Electricity, Heat and Gas Regulatory Authority (ANRE) has to evaluate the effects of implementation of smart metering systems on the electricity and natural gas market (cost-benefit analyses) – third quarter of 2012,
- second step – if the results of the cost-benefit analyses are positive, ANRE will propose a schedule for smart metering implementation, taking into consideration the best practices, latest technology, appropriate standards and the importance of the electricity and natural gas market development.

Implementation of AMI in Romania has a strong support of the DSOs, the TSO, the government, and the regulatory office – ANRE. The DSOs are hoping that the implementation of intelligent network solutions will help increase the efficiency and quality of energy supply.

For the TSO the implementation of online monitoring and diagnosis systems for high voltage stations is a chance to reduce the maintenance costs.

According to ANRE „Smart Grids are required in order to ensure the coexistence of centralized production with centralized distribution, promoting efficient technologies, with low carbon emissions, cost optimization and improved tariffing, and, lastly, the integration of end consumers in energy trading, ensuring bi-directional communication and availability of information on different levels".

The other key stakeholders – the retailers and the customers – do not express their opinion on the topic.

AMI pilot projects and country-wide roll-out plans

So far only one pilot project has been conducted in Romania. The project, carried out by Electrica, was to install 59 000 smart meters in several regions of the country.

No official schedule on the country-wide roll-out has been announced yet, but as stated above, a decision is expected in 2012.

The main objective of future implementation of SM in Romania is reduction of electricity consumption.

6.12 Slovakia

Electricity market in Slovakia

The electricity market in Slovakia is the eight largest among the CSE countries discussed in this Report. According to the Slovakian energy regulatory office, currently there are 2.35 million electricity customers in the entire country. In Slovakia the residential consumers dominate – they constitute 88% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 12%.

In 2010, total electricity consumption in Slovakia was 24 118 GWh, of which residential consumers used 4 362 GWh. Since there were 2.07 million residential customers in 2010, the average annual energy consumption of a household was 2,1 MWh. This is just a bit higher than the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Slovakia is 73 EUR/MWh, which is a little bit less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to 153 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are 3 major distribution system operators in Slovakia:

- Západoslovenská energetika – ZSE Distribúcia – with 43% market share (1 million customers),
- Stredoslovenska energetika – Distribúcia – with 30% market share (0.7 million customers),
- Vychodoslovenska distribucna – with 26% market share (0.6 million customers).

Although these three major distribution companies have dominant position regarding the number of customers, according to Slovak regulatory authority they distributed ca. 52.1% of the total electricity consumption in Slovakia in 2010. The rest of the market is shared by 162 small DSOs which are the operators of the local distribution systems – they together own less than 100 000 distribution points.

The infrastructure of the distribution system is quite efficient in comparison to the other CSE countries – only 3% of energy input is lost (in 2010 the network losses amounted to 856 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Slovakia is an issue. According to CEER, in 2010, the total duration of interruptions (SAIDI) was 465.4 minutes (nearly 8 hours). The number of interruptions per year (SAIFI) is unfortunately not available. At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Slovakia ranked 27th among 133 analyzed countries (and 3rd among the CSE countries, after the Czech Republic and Cyprus).

Currently already 21.3% of electricity generated in Slovakia comes from renewable energy sources, but with increasing energy demand and generation, the share of RES in the fuel-mix will decrease by 2030 to 20.5%.

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Slovakia ranked 13th among the 14 countries. The key factors that increase Slovakia's potential for SM deployment are quite high electricity prices and, as a result, high energy bills for residential consumers, as well as some issues with ensuring proper quality of electricity supply.

On the other hand, the factors that could potentially impede SM diffusion are relatively small market size, low electricity consumption by residential customers, very little distribution network losses and high level of complexity of SM implementation due to the large number of DSOs present on the market.

Regulatory approach to AMI

So far no legislation or policy framework regarding AMI implementation has been adopted in Slovakia.

A cost-benefit analysis as required by Directive 2009/72/EC has not been performed, as well. However, two other feasibility studies of SM have recently been conducted. The first study, which was carried out by Vychodoslovenska Distribucna, proved SM diffusion to be "highly uneconomical and counterproductive for customers due to high initial cost of meters and communication systems which strongly outweighed the benefits". The second study, which was carried out by Zapadoslovenska Energetika, on the contrary proved AMI implementation to be feasible.

What is interesting it is the fact that in Slovakia, as opposed to the other CSE countries, the key stakeholders that support SM are the TSO, retailers, and customers. The government, the ERO, and the market operator have no opinion or do not express their views on the topic, and the Slovakian DSOs voice strongly against the implementation of AMI.

AMI pilot projects and country-wide roll-out plans

Only one of the Slovakian DSOs – Stredoslovenska energetika – distribucia – started to conduct pilot projects. Since 2009 the company has been installing 40 000 smart meters yearly.

Currently in Slovakia there is no official schedule of a country-wide roll-out. However, according to available sources there is a plan to carry out a massive deployment of smart meters by 2020 as required by Directive 2009/72/EC.

6.13 Slovenia

Electricity market in Slovenia

The electricity market in Slovenia is the fourth smallest among the CSE countries discussed in this Report. According to SmartRegions, currently there are approx. 0.89 million electricity customers in the entire country. No detailed information regarding the structure of the market is available, however it should be assumed that similarly to the other countries, in Slovenia the residential consumers dominate.

In 2010, total electricity consumption in Slovenia was 11 966 GWh, of which residential consumers used 3 219 GWh. If we assume that the share of residential customers in the total number of electricity customers is 90%, we can calculate that the average annual energy consumption of a household is 4.0 MWh. This is very high compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Slovenia is 60 EUR/MWh, which is less than the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 240 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are five distribution system operators in Slovenia:

- Elektro Celje – with a 15.7% market share (140 000 customers),
- Elektro Gorenjska – with a 9.0% market share (80 000 customers),
- Elektro Ljubljana – with a 36.5% market share (325 000 customers),
- Elektro Maribor – with a 24.2% market share (212 000 customers),
- Elektro Primorska – with a 14.6% market share (130 000 customers).

The infrastructure of the distribution system is quite efficient in comparison to the other CSE countries – only 4% of energy input is lost (in 2010 the network losses amounted to 952 GWh), whereas the average network losses in the entire EU amount to 6% of total electricity input.

The quality of energy supply in Slovenia is an issue. According to CEER, in 2010, the number of interruptions per year (SAIFI) was 1.39 and the total duration of interruptions (SAIDI) was 51 minutes. At the same time in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Slovenia ranked 31st among 133 analyzed countries (and 4th among the CSE countries, after the Czech Republic, Cyprus, and Slovakia).

Today in Slovenia already 30% of generated electricity comes from renewable energy sources. Hence, Slovenia is not planning to significantly increase the share of RES in the fuel-mix by 2030 (the use of RES should rise to 31.3%).

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Slovenia ranked 4th among the 14 countries (together with Cyprus). The key factors that increase Slovenia's potential for SM deployment are high electricity consumption by residential customers, quite high electricity prices and, as a result, high energy bills for residential consumers, some problems with ensuring proper quality of electricity supply, and high future share of RES in electricity production.

On the other hand, the factors that could potentially impede SM diffusion are small market size with little economies of scale, little distribution network losses, and high level of complexity of SM implementation due to the high number of DSOs present on the market.

Regulatory approach to AMI and key stakeholders approach

So far no legislation or policy framework regarding AMI implementation has been adopted in Slovenia and, according to SmartRegions, "there have been no serious discussions between the Slovenian stakeholders about the benefits of smart metering for different stakeholders".

A cost-benefit analysis as required by Directive 2009/72/EC has not been performed, as well. However, two other cost-benefit analyses were carried out by EIMV (Milan Vidmar Electric Power Research Institute) in 2008 and 2010. The first study, which examined the roll-out of AMI for all 890 000 measuring sites in Slovenia and included both household and small business customers, proved AMI implementation to be economically viable. The second study, which was conducted on behalf of SODO (a central Slovenian DSO), showed even better results than the first one due to a reduction of costs for smart meters.

AMI pilot projects and country-wide roll-out plans

In Slovenia some of the DSOs run small pilot projects in order to assess costs and benefits of SM deployment. Detailed information regarding the scale of these pilot projects is available only for Elektro Ljubljana. In 2008 the company successfully deployed smart meters for 6 600 customers, and, due to positive results of that first project, in 2010 it equipped with smart meters additional 30 000 electricity consumers.

Despite the positive outcome of both CBAs and despite the success of the pilot projects, so far only two of the Slovenian DSOs – Elektro Gorenjska and Elektro Ljubljana – decided to start a full roll-out of AMI for all of their customers. According to information provided by both companies, Elektro Gorenjska planned to equip with SM all 80 000 customers in 2011 and Elektro Ljubljana plans to complete the full roll-out (installation of 325 000 meters) by 2020.

Additional information

According to SmartRegions, since January 2008, AMR systems with meters that measure the daily load profiles in 15-minute intervals are mandatory for industrial and other customers with a contracted power of more than 41 kW.

6.14 Turkey

Electricity market in Turkey

The electricity market in Turkey is the largest among the CSE countries discussed in this Report. Currently there are 32.3 million electricity customers in the entire country. In Turkey the residential consumers dominate – they constitute 82% of all electricity customers. The share of non-residential consumers (such as industry and SMEs) is 18%.

In 2010, total electricity consumption in Turkey was 169 884 GWh, of which residential consumers used 41 410 GWh. Since there were 26.6 million residential customers in 2010, the average annual energy consumption of a household was 1.6 MWh. This is low compared to the average annual energy consumption of all analysed CSE countries, which equals 2.0 MWh/household.

According to the Eurostat report on electricity price systems in 2010, the average energy price (without distribution charges and VAT) for residential customers in Turkey is 79 EUR/MWh, which almost equals the average for the analyzed CSE countries: 76 EUR/MWh.

Based on the household average annual energy consumption and the average electricity price (without distribution charges and VAT), the average electricity bill can be estimated to amount to approx. 125 EUR/household/year.

Electricity distribution system and share of RES in energy production

There are 21 distribution system operators in Turkey. The infrastructure of the distribution system is very inefficient – as much as 15% of energy input is lost (in 2010 the network losses amounted to 30 222 GWh), whereas the average network losses in EU-27 amount to 6% of total electricity input.

The detailed information regarding the quality of energy supply in Turkey is not available. However, it is worth to mention that in the ranking regarding the quality of electricity supply prepared by the World Economic Forum, Turkey ranked 84 among 133 analyzed countries (and 13th among the CSE countries, just before Bulgaria).

Currently about 26.3% of electricity generated in Turkey comes from renewable energy sources, and, what is interesting, Turkey is planning to decrease the share of RES in the fuel-mix to 24.5% by 2030 (by decreasing the use of hydro energy in favour of gas fuel).

Potential for AMI implementation

In the ranking of CSE countries regarding the potential for AMI implementation Turkey ranked 7th among the 14 countries. The key factors that increase Turkey's potential for SM deployment are large market size, high distribution network losses, low quality of electricity supply, and high share of RES in electricity production.

On the other hand, the factors that could potentially impede SM diffusion are low electricity consumption and, as a result, relatively low energy bills for residential consumers, as well as high level of complexity of SM implementation due to the high number of DSOs present on the market.

Regulatory approach to AMI

In April 2011 Turkey issued some guidelines regarding AMI. However, in this country SM is mandatory only for certain companies such as autoproducers and autoproducer groups, generation companies etc., which buy and sell electricity in the market.

So far no policy has been adopted regarding the implementation of AMI for residential customers and there are no plans for adopting such regulation. Nevertheless, it is worth to mention that most of the key stakeholders in the country support the idea of SM. These are the DSOs, the TSO, retailers, the ERO, and the government.

AMI pilot projects and country-wide roll-out plans

Currently in Turkey there are no plans for a mandatory roll-out of AMI for residential customers.

According to available information, in the last few years one pilot project was carried out. It was carried out in the municipality of Adana and its goal was to reduce electricity thefts.

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