ADVANCED METERING INFRASTRUCTURE FOR SLOVENIA

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ABSTRACT

In the paper results of a cost benefit analysis for investment in the Advanced Metering Infrastructure (AMI) in Slovenia are presented. The impact of an AMI adoption on attaining the goals of energy policy, particularly in terms of energy end-use efficiency and greenhouse gas emission reductions are shown, too. Some information of Elektro Gorenjska’s AMI pilot projects and their plans for a complete roll out in 2009 are shortly discussed in the final section.

INTRODUCTION

Advanced Metering Infrastructure (AMI) systems offer much more than just metering and remote reading of consumption of electric energy, gas, water, etc. With their additional functions, they represent one of the basic energy information infrastructure technologies, which, among others, allows for:

- operation of truly competitive and transparent energy markets,
- efficient use of energy,
- development of innovative energy services, and
- construction and operation of electricity networks of the future (SmartGrids).

The AMI systems are predominantly designed for metering and management of household and light industry consumption, however, certain functionalities may also be used with other customers.

The European Union (EU) sets strategic goals with regard to energy end-use efficiency and greenhouse effect gases emissions reductions. Especially due to climate changes, in March 2007, the EU ministers appealed to the realization of the »3x20« goal, which comprises:

- energy consumption reduction of 20 % by the year 2020;
- greenhouse gas emission reduction of 20% by the year 2020, and
- increasing the shares of renewable energy sources of 20% by the year 2020.

Investment is sensible when the benefits acquired by it are greater than the investment costs. AMI systems require on one hand a considerable investment costs, but bring a number of benefits to all players in the electric power market. Evaluation of benefits represents the core part of the analysis.

ADVANCED METERING INFRASTRUCTURE SYSTEMS

The AMI system architecture (Figure 1) may roughly be divided into the following three levels:

- smart meters,
- communication network,
- data center.

Figure 1. Design of a typical AMI system

Nowadays, the smart meter is becoming more and more an energy information entry point into households, i.e. a contact point between the users and their home appliances on the one hand, and the grid operators, suppliers and other participants in the energy market, on the other hand.

In the current situation communication via low-voltage power lines (PLC) is most often used for the local coverage. Wireless networks, such as ZigBee, are also becoming increasingly popular. For the wide area network, mostly the networks of mobile telephony operators (e.g. GSM, GPRS, UMTS, WiMax) are used. Wired M-bus or wireless communication systems (e.g. wireless M-bus, ZigBee) are mostly used for multi-utility meters (gas, heat, water) connections.

The AMM systems offer various functionalities, which are also continuously developed and improved, since one of the driving forces in introducing these systems is stimulating innovations, for instance:

- efficient remote meter reading and more accurate billing,
- local data display – continuous informing of the user,
- demand side management (DSM),
- distribution network supervision and control,
informatics support for a fast and efficient switch of the supplier,
multi-utility – remote reading and managing of consumption of gas, water and heat, etc.

Functionalities must be supported by data center applications. Investments in realisation of various functionalities must be justified and – of course - technically possible (e.g. taking into account all communication bottlenecks, etc.).

COST BENEFIT ANALYSIS

The aim of the cost benefit analysis is to evaluate all the costs and benefits resulting from adoption of the AMI system for the household and small business consumers and to investigate whether the additional benefits would compensate for additional costs. The analysis was made for the overall area of Slovenia (almost 890,000 measuring sites) under assumption that the AMI system adoption has been harmonised among all the five Slovenian distribution utilities. In second half of 2008 the analysis was made even in more detail for Elektro Gorenjska, one of Slovenia’s five distribution utilities.

Main assumption was, that it would altogether take five years to have the AMI system completely adopted, this meaning that each year one fifth of the total number of consumption sites would be adequately equipped. The meter life expectancy was assessed at fifteen years, which is also the period covered by our economic analysis. We paid due regard to the current state in the area of applicable legislation binding distribution utilities to do meter reading just once a year.

Investment costs

Investment costs represent main costs of the AMI system investment. Meters have to be purchased, old meters removed, new ones installed, also communication equipment and data center has to be purchased and installed. Besides that employees have to be educated to work with the new center. Also some additional transition costs were assessed.

The total investment costs, evenly distributed over the period of the five observed years, was assessed at some 235 million €, which is 266 € per a consumption site. The major part of this investment is the purchase value of the system meters themselves (with the assembly included) [1].

AMI system operational and maintenance costs

Three main cost categories were defined during the operational lifetime of the AMI system:

- Material costs of system maintenance and operation,
- Labor costs and
- Communication costs.

Besides basic costs categories additional costs for new functionalities DSM and multi-utility were evaluated. Total yearly O&M costs were evaluated at some 6 million € [1].

Costs are divided more or less equally between all five categories with material costs being highest with 29,4 % share of all O&M costs and multi-utility with the lowest share of 7,4 % (figure 3).
Benefits

Adoption of the AMM system assures a series of benefits for all of the electricity market participants, from distribution and transmission system utilities, electric power providers, producers and customers.

The basic benefit of the AMI system for distribution utilities are lower costs of meter reading, which derive from the remote reading functionality. In Slovenian legislation there is currently mandatory only yearly reading of household and light industry meters. The savings have potential for a vast increase, if mandatory monthly reading takes into effect.

Demand side management has the potential for main benefits of the AMI system. Distribution and transmission utilities, energy providers as well as customers can benefit from DSM. In the analysis, we have concentrated just on the electric power system benefits, which come from lowering of the critical peak demand. Top 10 % megawatts of the yearly peak demand are reached in less than 10 hours per year. If we concentrate on lowering demand in just this hours, great savings of investments both in transmission and distribution system as well as peak production units can be achieved. The potential has been evaluated at 5 % of the yearly peak demand and the investment savings were evaluated at 200 € per kW per year.

Commercial losses (losses from inaccurate meter readings and theft) in Slovenia are estimated at some 2 % of the total households consumption. AMI system will first of all give the possibility for accurate assessment of commercial losses and identification of individual problems. Estimations are made, that 50 % of commercial losses could be avoided, which represent an important benefit of the system.

AMI system enables to combine readings of electricity, gas, water and heat at one place, thus considerably lowering costs of all utilities and providing another benefit.

By installing local data displays, consumers can be continuously informed about their consumption, which can help building their ecological awareness. There is a lot of discussion of potentials of such data displays and some pilot projects with different results are already in progress around the world. We have used a very conservative assumption of 1 % savings potential, which results in annual savings of 55.000 tons of CO2.

Figure 4: Shares of the AMI system benefits

A number of other benefits were also identified:

- AMI systems give more accurate monthly bills, thus reducing costs of distribution utilities call centers because of fewer complaints,
- accurate data enables more cost efficient distribution system planning,
- faster detection of power outages,
- AMI system is the core element for the "smartgrids" vision,
- easier integration of distributed generation,
- lower administrative costs in case of supplier switch,
- more accurate consumption planning,
- etc.

The overall discounted benefits calculated for the observed period of 15 years are above half a billion €.

Economic justification

After evaluating investment and O&M costs and benefits of the AMI system for Slovenia economic justification of the investment can be calculated.

Judging from the social perspective, argumentation in favour of investing in the AMI system is economically eligible. This is being proven by the analysis of all the basic indicators. The net present value is positive, precisely on the level of approximately 115 million €. The internal rate of return is 10.4 percents and the payback period is slightly above 11 years.
To avoid the possibility of any incorrect assessment, we also made a complex sensitivity analysis. In any of the investigated cases, the investment was found economically justifiable. It was found as such even when the approach we took was more pessimistic. The investment is the most justifiable if we opt for monthly data reading, which is also the long-term target of the EU.

### ROLL OUT PLANS

On the base of the detailed cost benefit analyses and positive experience with realized pilots, Elektro Gorenjska – electric distribution utility serving more than 80,000 residential customers, decided for a full scale roll out starting in a year 2009. After successful realization of the first multi-utility AMI pilot project, where 60 smart meters were integrated into the system providing also data from water and heat meters to other utilities, they succeed to motivate these utilities to support the project. Another multi-utility pilot has been followed soon - cca. 500 smart meters are being installed in city of Kranj (water and gas meters are connected to smart meters using wireless M-Bus).

The Elektro Gorenjska utility is also opened for advanced technologies oriented towards SmartGrids and is participating in Alpine Space Programme named AlpEnery on the field of virtual power systems.

Other Slovenian distribution utilities have not decided for a complete roll out yet.

### CONCLUSION

By using the existing functionalities, the AMI systems may be an efficient instrument for attaining the highly set goals of the EU energy policy. These systems actually represent the energy information infrastructure, which, besides the above mentioned positive effects in terms of efficient use of end energy, reduction of CO₂ emissions, increase in the security of supply, improvement of the competitiveness of economy, etc., offer a great potential also for the development of new innovative energy services.

The cost benefit analysis for the case of introduction of the AMI system in Slovenia shows that investment into the AMI system is justified. By reasonably exploiting the system functionalities, the annual consumption may be reduced by 31 GWh and the CO₂ emissions by 55,000 tons annually.

### REFERENCES
