Hungarian Energy Office
Electricity Licensing and Supervision Department

Terms of Reference for the "Smart Metering Study" Call for Tender

According to Section (1) 19, Article 170 of the Act LVIII of 2007 on **electricity (VET),** the Government shall provide a Decree to define "**the rules on equipping electronic consumption meters at users** as defined in Article 13, Directive 2006/32/EC of the European Parliament and of the Council of 5 April, 2006 on energy end-use efficiency and energy services repealing Council Directive 93/76/EEC".

According to Section (4) Article 100 of the Act XL. of 2008 on **natural gas (GET)**: "The installation, operation, maintenance, periodical authentication of gas meters, providing transmitter for meters above 100 m3/hour, installing and operating the signal forwarding telemechanic devices – in absence of other agreement – are the duty of the natural gas distributor."

The Articles 43.-48. and Section (2) and (3) of Article 57 of the Act XVIII. of 2005 regulate District Heating, the Articles 13. and 14. of the Act LXVII. of 2008 regulates the metering and billing the district heat.

The preparation of the Governmental Decrees on smart metering the electric energy and natural gas are being performed by the Hungarian Energy Office (hereinafter: the Office). To utilize it for preparing the decrees the Office wants to have a study made by an expert company to be selected through tender.

The invitation for tender will be issued by the Office. The Office will take care of the project for the preparation of the study with the co-financing of the World Bank Energy Sector Management Assistance Program (ESMAP). ESMAP's financial support is provided with the understanding that the results of the study will be available for wider circulation given considerable interest in best practice approaches to "smart energy metering" among other clients of the Bank.

The Office hereby calls for tenders on preparing the study. This document contains **terms of reference** for the tasks of the Applicant.

Professional Background, Considerations, and Conditions of the Study

I. Introduction

Smart metering is an issue addressed intensively throughout the world. The United States has the most experience in the introduction of the method, but Canada, Australia, and New Zealand are also pioneering. **Directives 2006/32/EC and 2005/89/EC** stipulating the general introduction of smart metering have significantly accelerated the process in Europe. During the past one or two years, this issue has

become the focus of attention, regulatory authorities, research and development institutes, suppliers, and consumers are addressing it on a wide scope, studies, reports, and experience based papers are being published, numerous conferences are being organized.

However, the provisions of the Directives mentioned are completely general, without providing any details of principle or technology. One frequent complaint is that this deficiency greatly hinders the selection of the solution to be applied and harmonization not only on an international, but also on a national scale. According to the unofficial information provided by ERGEG, there is no such regulation to be expected on a European scale for the time being, and **the specification of minimum requirements is the task of member state regulatory authorities**. A number of international standards are available or being developed for the devices, interfaces, and protocols to be applied, but general regulation is specific to each country, location, and what more, consumer group.

The general observation is that – although directives only address the metering of energy consumption and related activities – smart metering offers many more possibilities. Almost all documents list **another** 5 to 10 **features** (from the detection of electricity theft to the identification of line faults) that are worth exploiting. The metering of the electricity fed in by small (primarily household sized) power plants is of key significance, which is also one of the preconditions for the establishment of a SmartGrid.

Literature places high importance on **integrated metering**, that is a system of data for electricity, line gas, district heating, and water metered according to similar principles and forwarded on common communication channels.

Little is spoken of the application of **radio frequency ripple control** (RKV) and smart metering implemented in certain countries (especially in the field of E.ON operations). RKV is beyond doubt no replacement for smart metering (due to the one-way flow of information), but it is possible to also apply RKV for remote control in addition to smart metering.

There are many who address the **cost/benefit analysis** of smart metering systems, since – due to high investment amounts – the issue of returns is of key significance.

II. Basic Information

Main directives, laws, and documents.

a) Directive 2006/32/EC on energy end-use efficiency and energy services. Provisions regarding the subject can be found in the following sections: Introduction (28), (29); Article 11 (1); Article 13; Cross-sectoral measures r), 2.0. of Annex IV (See the annex for complete quotes from the text).

b) Directive 2005/89/EC concerning measures to safeguard security of electricity supply and infrastructure investment. Article 5, Maintaining balance between supply and demand.

c) Proposal for the amendment of Directive 2003/54/EC (energy package 3). Introduction (21), Article 22c 1 m), 15 h), i), and CEER remarks for (15) i).

d) COMMISSION COMMUNICATION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on the future opportunities of the internal market of natural gas and electricity;

e) ERGEG documents (especially ”Smart Metering with a Focus on Electricity Regulation” and ”Supplier Switching Process Best Practice Proposition”);

The detailed processing and aggregation of the high number of studies, reports, conference documentations, and reports on experiences addressing the issue – many times in different or even conflicting ways – is impossible. The following sources were used in addition to the above mentioned documents:

a) The presentations and comments voiced at the “*Intelligent consumption metering*” workshop of the office;

b) Materials of the ”Smart Metering European Opportunities and Solutions” conference (Amsterdam);

c) Materials from the „2008 Intelligent Metering” 4th annual conference of European Utilities (network providers and metering providers) (Barcelona);

d) The NRRI study titled „Advanced Metering Infrastructure: What Regulators Need to Know”, the study „Zukunft des innovativen Messwesens in Österreich” received from E-Control;

e) Experiences of EU member states.

III. Definition

The immaturity of the topic and method are characterized by a lack of standardization even on the level of definition and terminology. “Smart metering” is a term used on a wide scope with various contents. European literature mostly contains the expressions Automated Meter Management (**AMM**) or Automated Meter Reading (**AMR**), while American literature refers to Advanced Metering Infrastructure (**AMI**). Similarly, the Hungarian attempts at translation also vary (for example, the translation of 2006/32/EC contains the consumption meter names “*electronic*”, “*unique*”, and “*intelligent*”). Domestic literature mostly uses the terms “*intelligent*” and “*smart*”. On behalf of the HEO, we recommend the use of the term “**smart metering**”. To the best of our knowledge, the terms AMM and AMR do not yet have an official Hungarian counterpart.

AMR generally represents the remote reading of the meter, but does not necessarily refer to a bidirectional flow of information. AMM or AMI represents the **central management** of remotely read data (also including AMR), these are defined as a complete system which provides many other information in several directions in addition to consumption metering data, including meters, implementers, the communication network, central data management and distribution, remote operation, software, and the protocols.

Direct Load Control (DLC) should be mentioned at this point, which may be treated as a separate function, and may also feature sound-frecvency ripple control (HKV) or radio-

frecvency ripple control (RKV) as a tool of communication, or – if otherwise applied – AMM as an obvious choice (which may have special significance in Hungary).

IV. Smart Metering Objective

The **primary objective** of smart metering is defined in Directive 2006/32/EC: it describes a metering/invoicing system which is capable of providing transparent **support to consumers in saving energy**. According to Article 13, consumers must receive information **for self-regulation through invoicing based on actual consumption; the following information must be made available**:

a) Current actual prices and actual consumption of energy;

b) Comparisons of the final customer's current energy consumption with consumption for the same period in the previous year, preferably in graphic form;

c) Wherever possible and useful, comparisons with an average normalized or benchmarked user of energy in the same user category;

d) contact information for consumers' organizations, energy agencies or similar bodies.

V. Presumed Expectations of the Consumer

Costs should decrease:

- the consumer should consume less: energy saving devices, disciplined and conscious use,
- the consumer should consume differently: discount tariffs (e.g. controlled, off-peak, week-end), timed connection
- the consumer should receive information regarding its consumption, that is consumption of the previous year in a monthly breakdown: consumption meter display, actual or estimated monthly consumption should be on the display and the invoice.
- Displaying other useful consumer information on the meter.
- It should be possible to plan for his/her payments:
- Monthly actual consumption: Monthly reading or call-in, profile based invoicing, pre-payment meter, or
- Same invoice amount: invoicing in equal monthly installments (this does not represent any progress compared to the current system).

VI. Minimum Functional Requirements

Possible functions of smart metering have been defined by many in different ways:

a) In its study mentioned above, **ERGEG** describes the following minimum functions:

   - Remote meter reading
   - Load profile data
   - Consumer access to required metering data

- Third party access to required metering data
- Ensuring tariffs for changing time dependant use
- Meter remote management
- Price feedback to the consumer.

b) According to the **Dutch** Netherland Technical Agreement NTA 8130, basic requirements regarding the smart metering system are:

- It must provide actual metering data to improve administration processes, generated periodically or upon request by remote reading;
- It must make it possible for the supplier to promote the energy consumption sensitivity of the consumer and support energy efficiency;
- It must be capable of switching electricity and gas off and on with safe remote switching, in groups or individually (by consumers);
- It must be capable of changing the level of energy available by remote switching in groups or individually;
- It must make it possible for the supplier of energy and/or water to work using various tariffs;
- It must make prepaid services possible;
- It must ensure the supervision of the distribution network;
- It must provide opportunity for technical development and apply open protocols.

c) According to the **Austrian** study mentioned, smart metering must be capable of the following:

- load metering
- two-way communication (transmission and reception)
- storage of metered data
- suitability for managing several tariffs
- import and export metering
- recording of voltage quality parameters
- recording of supply interruptions
- centrally controllable supply interruption and supply limitation
- LCD information display
- communication port for further connections, e.g. further counters, household devices, etc.

d) The **NRRI** study concludes that there is no single best and final list of functions and requirements. AMI technologies and applications are developing and entering the market at a fast pace. Some analysts state that AMI applications can be expected which were formerly unimaginable, and these will significantly improve the usefulness of AMI.

VII. Smart Metering Benefits and Drawbacks

The **advantages** of smart metering are just as difficult to take into account as its functions. Take the Austrian study for example:

a) On the end user side:

- real time data on current consumption
- promoting the emergence of energy conscious behavior
- better alignment with consumption during times with better tariffs[1]
- application of unique tariff providing an incentive for energy saving
- better invoicing
- easier switching of supplier
- improved customer service.

The United Kingdom has gathered several years of experience on smart metering. A report issued in 2007 investigating the result of electricity and gas energy savings achieved primarily at household consumers had the following conclusions:

- Direct electricity savings resulting from the incentives provided by smart metering amount to 1 to 3%, which may reach 8% by 2010 as far as carbon dioxide emissions are concerned; and in the case of gas, a 1 C° decrease in internal building temperatures reduces gas use by 10%.
- Smart metering provides incentives for choosing the time of consumption. The application of a time-of-use tariff can help move 20 to 25% of total consumption from peak to off-peak periods, thereby achieving significant savings.

b) On the side of the electricity supplier:

- cost optimization by shifting metered, actual consumption peaks
- the reduction of the amount of required balancing energy by better prognosis
- products suited to special consumer requirements may be offered (e.g. special tariffs for singles, families, etc.)
- suppliers applying special meters[2] may establish a profile better suited to consumer requirements, thereby better attracting consumers willing to switch
- metered data accessible to third parties, and thereby discrimination free treatment of all market stakeholders.

c) On the network operator side:

- improved network management and control
- cost reduction by automating workforce intensive processes (reading, settlement, etc.)
- automatic limitation of consumption and disconnection of non-payers.
- electricity losses may be easily covered at consumers, targeted fault repair

[1] Remark: Tariff means the price of market products that has evolved on the wholesale and retail markets depending on the time-of-use.

[2] Remark: The Austrian example presumably refers to the fact that the trader/supplier assuming the costs of the smart meter may gain an advantage by using this meter. Or, wherever the distributor uses a smart meter, the supplier/trader is in a better situation.

- analysis of voltage quality data provided by the meter, quality management
- integration of decentralized production, movement in the direction of active and intelligent electricity distribution networks
- individual load metering with low costs.

The **drawbacks** of smart metering are rarely mentioned. It is beyond doubt that there are those who oppose the system, who mainly fear for vulnarable small consumers with low consumption. One conclusion is that these consumers must definitely be of special consideration.

VIII. Economic Impact

Most authors pay a great deal of attention to economic analysis. International experience shows that as a result of the high amount of investment required, it is not sufficient to oblige network operators to implement smart metering, the opportunity must also be provided for the analysis and taking into account of expected costs and assumed benefits. The task of the regulator is to define the objectives to be achieved and the requirements, as well as to highlight the advantages of implementation.

Experience frequently shows that expected costs are much easier to quantify than assumed benefits. **Costs** may be assigned to three categories: capital costs, operating and management costs, and stranded costs (basically the costs of old meters that had been removed). Each cost component may significantly differ from one country to the next.

Taking possible **benefits** into account is required on a much wider scope and is much more difficult. Main components of these benefits are related to the benefits listed in the section above. Consequently, the following classification may be considered as typical: system benefit, consumer benefit, network and metering operating benefits, and the opportunities of the energy supplier. One part of benefit components are indirect benefits which are difficult to quantify.

Several studies address cost/benefit calculations, including the quoted ERGEG study, which also provides a methodological recommendation.

IX. Return of Investments

The evaluation of the acceptability of each cost component, the verification of the calculation of returns on investment, and the specification of the sources of returns are one of the most important and most difficult **tasks** of the **regulator**. In theory, the reimbursement of cost components which benefit the consumer are borne by the consumer, but the increased consumer tariffs resulting from this must be at least in balance with the benefits arising on the consumer side. The cost ratio which may be assigned to the impact resulting in general energy savings and decreased environmental load must not necessarily burden household consumers impacted by smart metering, but may also be spread on a wider scope. There are several cost components which yield benefits for network operators, meter service providers, or

energy suppliers. These latter must obviously be taken into account as cost reduction factors.

The method of **transferring** the costs accepted for reimbursement and decreased by savings to the **consumers** also varies. Within the Italian electricity system, metering tariffs are separated from network tariffs, are only taken into account for low voltage consumers, and are received by only those DSOs (Distribution System Operator) which are already applying smart metering. In other countries, such as in Ireland, network usage tariffs are increased in line with the amount required for the reimbursement of the costs reduced by the savings.

Therefore, during the impact analyses performed prior to the introduction of the use of smart meters, various forms of direct and indirect impact must be taken into account with due consideration and circumspection, as well as their cost impact and estimated benefit. In this work of analysis, stakeholders (distributors, traders, consumers, the authority) are not necessarily driven by the same interests!

X. Technical Considerations

Technologies already implemented show a great deal of difference, and meters, as well as smart metering systems, are constantly evolving. The (distribution) supplier implementing and operating a smart metering system should preferably have the opportunity to **decide** the hardware and software architecture of smart metering and the telecommunication system **itself**. At the same time, it may happen that (distribution) operators scale the system to its specific components too low or unnecessarily high. The task of the regulator is to verify that the infrastructure planned complies with the objectives set, and does not hinder technological development.

A number of key technical requirements:

- The smart metering system must provide the same functions and results **for all consumers**;
- Minimum requirements must be met on a **system level** as opposed to a device level, so that these are independent of the architecture applied by the (distribution) operator or the recommendations of the supplier of the device, and that these can be consequently aligned with different other solutions;
- Smart metering systems must be evaluated on the **level of results** as opposed to the level of the architecture or sizes;
- Smart metering should provide for **cooperation** between systems of various structures, various system users, and various applications.

The latter requirement leads to **standardization**. A number of standards already exits for the exchange of data (e.g. Electronic Data Interchange – **EDI**, International Organization for Standardization – **ISO**), while others are currently being implemented. Specific manufacturers must apply standards on a national, and in addition, on a EU level, especially on the level of the **interfaces** of the communication architecture.

Fundamental requirement is ensuring that

- consumers may **switch suppliers** without changing the meter,
- **communication** with a meter installed by a **competing** network operator or meter service providers should not cause a problem for the competing energy supplier or meter service provider,
- **competition** should evolve on the market of meters, thereby decreasing prices.

The extension and implementation of the smart metering system leads to the conclusion that the provision of the Directive which stipulates that smart metering must be installed if the meter is replaced can only be fulfilled economically for the group of consumers belonging to the same data concentration. This conclusion can also be interpreted in a way so that if a meter needs to be replaced somewhere, the data concentrator of the given area must be equipped, and all relevant meters replaced.

XI. Regulatory Trends and Model in Europe

The solutions described in European literature and at conferences outline two regulatory trends:

a) **Italian** version of smart metering: following lengthy preparations, the regulating authority issued decrees providing detailed and accurate provisions for the requirements and parameters of meters, interfaces, protocols, and the metering system, the costs accepted by it, the implementation schedule, and the requirements related to consumers. These requirements were met by DSOs (primarily ENEL) by installing meters with a standard technology and standard parameters according to standard principles. This practically provided one device manufacturer with a monopoly, which naturally may result in significant extra costs.

b) **Dutch** version: “open platform” approach. In this solution, the smart meter becomes a “central hub”, to which various meters (electricity, gas, heating, water), as well as remote switching, quality and fault detector, etc. devices may be/are connected on the metering side, while the outbound transmission channel is an independent interface. The development of this system into a so-called multi-vendor, multi-utility, multi-platform remote data collection and management system is in progress, which makes cooperation and compatibility between various systems possible.

Based on other considerations, classification leads to two types of metering policy models throughout Europe:

a) In case of the **standardized** metering market model, the network license holder has a monopoly for providing metering services, while at the same time the regulating authority may accelerate the introduction of smart metering with obligations or financial incentives,

b) In case of the **liberalized** market model, metering services are activities of the competitive market, but in this case, the authority may also prescribe compliance with minimum requirements. In this case, smart metering may be provided by

contractors independent of the network licensee – selected by market competition or the regulator. The advantage of this solution is that integrated metering, that is the smart metering of gas, district heating, and water in addition to electricity is easier to implement.

XII. The Hungarian Situation

Impacted network licensees, as well as a few universities and independent research & development institutes are addressing the issue of smart metering on the level of studies, and in some cases, pilot project preparation. The following description may be given of the information gathered, primarily based on what had been said at the workshop organized by the Office:

The preparation of network licensees greatly depends on the practice and strategy of their foreign owner.

a) **DÉMÁSZ** seems like the most committed to the introduction of smart metering. It has created a study together with BMF EKI, is planning a pilot project from 2008 to 2010, and has indicated that it will launch actual implementation by 2010. It is waiting for the decision and instructions provided by the EDF center.

b) The situation of **E.ON** is special from the point of view that they decided to apply RKV years ago. This is currently in progress in both Germany and in Hungary involving significant investments, especially in the field of DÉDÁSZ on our side. According to their opinion, RKV is more beneficial in the field of direct load management (faster and more reliable), but they are not disputing the advantages of smart metering, either. They are waiting for the decision of German E.ON. However, they have launched the preparation of a pilot project at TITÁSZ, with the cooperation of BME-VET.

c) **ELMŰ and ÉMÁSZ** are also addressing the issue of smart metering, and have also created a study together with BMF EKI. They are waiting for the decision of RWE.

It is known that network distributors have already equipped all consumers in excess of 3x80 A with electronic consumption meters and a remote metering communication line. It should be investigated whether these existing systems comply with the requirements of smart metering, whether these may be developed or are in need of replacement.

There is currently no sign (or no intention on behalf of distributors) that the meter service provider would be unbundled from the electricity network operator. However, companies that have gas supplier division as well are also considering the smart metering of gas.

Other stakeholders of the electricity market, such as consumers, universal suppliers, traders, and generators have yet to establish and voice their positions.

XIII. Conclusion

There is no tried and tested, single best method for the introduction and use of smart metering systems. Several of the **EU member states** are conducting studies, and launching or operating pilot projects. What is needed is for the techniques and technology which are undergoing revolutionary progress to somewhat mature, for standards to appear, and for experiences to be put to use. This description of tasks is mainly based on the evaluation of the situation as of 2007, which may change significantly by the end of 2008 based on the results of feasibility studies conducted in parallel by many European countries.

ERGEG is recommending that the issue of applying smart metering be investigated **subject to the national environment**, taking into account the unique characteristics of the national market and the regulatory environment. Requirements and technical standards pertaining to smart metering must be investigated independently of the market model, so that minimum service can be provided to consumers and a mitigation of investment risk to network operators.

Considering that the smart metering system acts as a link between consumers and other stakeholders on the market, and as such, plays a key role in the operation of the market, **it is the task of the regulator and legislator** to select the optimum solution from amongst a number of options available to the given country.

The conference held in Barcelona in May 2008 showed that the development of smart metering and its application is booming. It is typical of this conference that remote energy metering was only addressed as an evident basic task, and attention was primarily concentrated on the following:

- Present status, experiences
- beyond meter reading
- open systems, open standards, interoperability of components of different origin
- future-proof smart metering
- multi-utilities metering – the joint metering of several suppliers (electricity, gas, water, heat)
- general roll-out strategies of smart metering
- policy and regulatory developments
- smart grids

Similarly quick development can be detected on the supply market of manufacturers and solution providers; during the past few years, a number of companies entered into this business. The conference was accompanied by more than two dozen manufacturers and solution suppliers showcasing their offering.

XIV. Tasks

The selected winner of the tender shall perform the **following tasks**:

General requirements:

- Analyzing the feasibility and conditions of the introduction of the smart metering in Hungary; preparing proposal for improving legal background of the introduction, the method and scheduling the introduction;
- elaboration those results which can be utilized in broader circle (not Hungary specific) for the World Bank.

Requirements for electric energy and natural gas

a) Processing of the high volume of – primarily European – literature as well as theoretical and practical solutions and experiences;

b) Investigation of the Hungarian national market and the regulatory background;

c) An assessment of the metering systems currently in operation in Hungary, cognition of the intentions of network operators;

d) Development of recommendation (scenarios) for the functions and requirements of smart metering, also including the requirements of standardization, integrated metering, and later development;

e) Investigation of the conditions of the introduction of smart metering; impact analysis; demonstration of expected requirements; cost/benefit analysis; recommendation for scheduling the introduction;

f) Organization of workshops under the guidance of the Office with the involvement of stakeholders and experts of the industry, processing of the remarks received.

Requirements for district heating

g) Analyzing the possibility of measuring the produced and/or supplied (sold) heating energy parallel with measuring the produced and/or supplied (sold) electric energy in case of co-generating plants;

h) Analyzing the possibility of metering at the delivery point between the heat producer and heat supplier;

i) Analyzing the possibility of measuring the heat supply for communal bodies;

j) Analyzing the possibility of measuring the heat supply residential heat centers;

k) Analyzing the feasibility of introducing the smart metering for heat metering.

Further aspect for the preparation of the study:

During various phases of the study under preparation, the contractor must provide for an active and possibly open consultation process on the home page of the Office so that the study submitted to the contracting authority provides an introduction to the opinion of stakeholders and its assessment by the contractor (as early as prior to the closing workshop).

During the performance of the task, a realistically foreseeable development in the next 3 years must be taken into account, since any laws following the closing of the study in 2009 may not be prescribed obligations to distributors prior to 2010-2011.

In February 2009 the European Commission Enterprise and Industry Directorate-General mandates CEN-CENELEC-ETSI: *„Standardisation mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability".* The contractor shall apply the results of this mandate.

It should be taken into consideration that smart metering is also one component of smart energy networks. The work aimed at the development of smart networks on behalf of EU DG Research (Fp 5-7 Smart Grid) is currently in progress.

XV. Expected activity, deliverables

List of expected intermediate end final results of the work

a) Based on the initial information an **inception report** (first schematic edition of the study) shall presented. The **first workshop** shall be organized and managed;

b) Utilizing the comments of Office and the expert stakeholders the **preliminary report** shall be elaborated and submitted;

c) Utilizing the comments of Office and the expert stakeholders the **final report** shall be elaborated and submitted. The **second workshop** shall be organized and managed;

d) Utilizing the information collected from the experts of the Office, the World Bank, and other concerned experts the **improved final report** shall be elaborated and submitted;

e) **Summarizing report** for the World Bank shall be elaborated and submitted;

f) Taking over the work, **termination** the project.

Deliverables

g) **inception report;**

h) **preliminary report;**

i) **final report, improved final report;**

j) Summarizing report for the World Bank;

The study, all reports and documents (with the exception of technical background documentation) shall be submitted both in **Hungarian and English** language.