Smart Metering for Households: Cost and Benefits for the Netherlands

Hans-Paul Siderius, Aldo Dijkstra

SenterNovem

Abstract

It is taken for granted that a smart metering infrastructure is beneficial for small electricity and gas customers (households), energy and distribution companies and society as a whole. However, business cases done by individual companies only in special situations, e.g. Italy, show a positive outcome of smart metering. In other countries, e.g. Sweden, regulation was put in place to introduce smart metering.

This paper describes the results of a societal cost benefit analysis, demonstrating that the Netherlands society would profit from installing a smart metering infrastructure. The largest benefits are energy savings for consumers, reduced costs because of more transparency in the market and less costs for handling complaints at the energy suppliers. The largest costs are costs of the smart meters and infrastructure and the cost for the (monthly) feedback to consumers. The study also included a sensitivity analysis. Furthermore, the results show why smart metering does not take off automatically, even if it provides benefits to the consumer.

Attention is paid to the role of standardisation, the process of the cost benefit analysis, the consultation of stakeholders and other qualitative aspects, including the place of smart metering within the EU energy services directive. Recommendations are provided regarding the role of the government to introduce smart metering to all households in the Netherlands.

Introduction; background and set-up of the study

Based on an earlier study on demand response by small-scale custormers in the Netherlands [1] establishing a smart metering infrastructure was considered to ba a basic requirement for implementing demand response. Furthermore, from (consumer) behaviour theory it is known that feedback on energy consumption can result in energy savings [2]; however, the theory provides no clue about the actual costs and benefits of large-scale implementation of feedback systems. Also the EU directive on energy services acknowledges the role of smart metering with respect to energy savings and says in Article 13 (Metering and informative billing of energy consumption):

"1. Member States shall ensure that, in so far it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricty, natural gas, district heating and/or cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on the actual time of use."

Insight into the (societal) costs and benefits of large-scale implementation of a smart metering infrastructure is crucial when deciding on (mandatory) implementation as a policy instrument. Also large-scale implementation is not possible without standardisation. Results of cost-benefit studies from other EU countries, e.g. Italy or Sweden [3], are only partially useful for the Netherlands because of differences in consumption and market situation. Therefore in the Netherlands a study was carried out with the following aims:

1. To clarify if and how a (European) standard for smart metering devices (gas/electricity) can play a role in accelerating the implementation of smart metering devices at small-scale customers.
2. To acquire clarity about the costs and benefits of large-scale implementation of smart meters at small-scale customers.
3. To involve players in the energy market so that they will be both well informed and able to help shape the potential process of implementation.

These objectives were further detailed in the three main parts of the study, as listed in the following sections.

Investigation on the role of standardisation in (accelerating) the implementation of smart meters
The purpose of the investigation carried out by NNI[1] was to answer the following questions:

- Is developing a standard for smart electricity and/or gas meters an appropriate strategy for accelerating innovation among market players and thereby stimulating the introduction of smart meters into the Dutch market?
- How do the players in this sector view the issue of standard development and how is this topic handled within the current standard committees?
- Will market players handle the developing of standards themselves or are there causes for the Dutch government to play a role? If so, what type of role?
- Which players should be involved in standard development? And how is this process perceived on the whole?

In order to answer these questions NNI took a number of actions, including an information day with workshops for stakeholders and 12 in-depth interviews with market parties.

Cost-benefit analysis of smart metering infrastructure at small-scale customers
The purpose of the cost-benefit analysis was to weight the *costs* of large-scale introduction of smart metering infrastructure (electricity and gas) at small-scale customers in the Netherlands against the *impacts and benefits*. Impacts and benefits for example could affect the security of supply, market operation (simplification of administrative processes, increased choices, increased transparency), environmental awareness, energy conservation and efficient energy provisions as a whole. The cost-benefit analysis was carried out by KEMA.

Involving the market players
In addition to the cost-benefit analysis, it was important to attain insight into the *process* necessary for a large-scale introduction of a new metering infrastructure. This concerned questions such as: who assumes which role, where are the responsibilities and interests, who takes initiative, how are the costs and benefits divided among the various players, etc.
Involving players from the energy market is necessary so that from the start they will be both well informed and able to help shape the process of potential implementation of smart meters at small-scale customers.

Results of investigation on standardisation [4]

Developing standards is a necessary condition for implementing a smart metering infrastructure. However, it is not a sufficient condition in the sense that standardisation is the primary activating force for this innovation. In addition to market organisation and regulation, standardisation is a type of support needed for the required innovation on the part of the market players, predominately with regard to guaranteeing interchangeability of devices and data.
The views and positions of players in the sector with regard to standard development are dependent on their market position and relationship in the chain. Grid administrators that have to maintain their operations and reliability at minimal costs view the development of standards as a necessary market instrument, characterised by Dutch and/or European consensus of market players, enabling – among other things – the realisation of upsizing and interchangeability. Grid administrators would like to assume an active role and provide input in the needed development of standards.
The other players, such as the metering companies, suppliers and meter manufacturers prefer to observe further, steer or follow developments. Depending on the position of the meter and the market organisation with regard to meter responsibility, it may well be possible that the companies responsible for metering will also want to assume a more participating role and to provide more input. The interest of meter manufacturers is channelled from the requirement of grid administrators and metering companies to achieve interchangeability of devices and data. Players that want to develop new options for their buyers (such as on-line and real-time applications) want to utilise their market edge in order to focus on subsequent innovations.
Development of standards is not automatically adopted by all the players in the market. Government will have to play the role of a regulator and thereby facilitate the required development of standards. In order to motivate the players (the chain of service providers) a clear indication will have to be given to prevent the energy distribution infrastructure from ending at the connection register, but rather to

[1] NNI: Dutch Standardisation Institute

expand it to metering data, data collection, data retrieval and communication, including the meter code. This means that government indicates the required (minimum) functionalities for this purpose, while the market players complete this with realising these functionalities.
There is no unequivocal conclusion to be drawn about how these agreements should come about, as long as they do emerge. The preference is for an adjustment in the regulation (metering codes) or a European/Dutch standard. Whether or not the parties prefer standards is usually dependent on their knowledge about standardisation. Manufacturers, TSOs and metering companies indicate in general that they would want to tackle standardisation without the adjustment in the metering codes, while the other parties would first prefer a clear regulation.

Grid administrator, companies responsible for metering, suppliers and meter manufacturers will have to become involved in standard development. In general, the process of developing standards is seen as follows:

- Determining a standardisation project
- Putting together participants/authors and observers
- Establishing a draft and presenting it for comments
- Processing the comments and presenting it to a vote with regard to publication
- Declaring the implementation of the project.

Results of cost-benefit analysis [5]

Set-up and basic assumptions

Definition of situation zero (base case) and situation one
The cost-benefit analysis makes a distinction between the 'situation zero' and 'situation one' (also see figure 1).

- ***Situation zero*** is the current situation in which – barring a few exceptions – small-scale customers (in the Netherlands in essence consisting of 6.7 million households) do not have a smart meter and are not connected to a smart metering infrastructure. The legal framework (gas and electricity acts), activities of government and market players remain as they are. The market dynamics (what market parties are planning to do) are not considered in this case.
- ***Situation one*** is the situation in which all small-scale customers are connected to a smart metering infrastructure by means of smart meters for gas and electricity, in any case, and these households receive minimal a monthly feedback about their actual consumption.

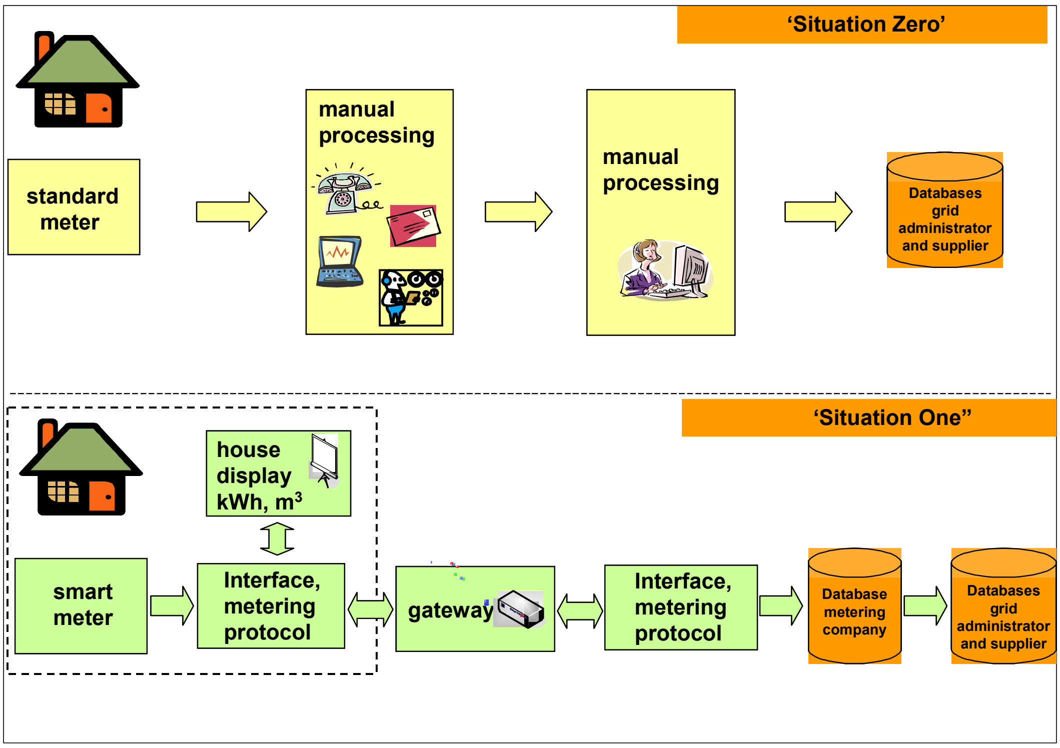

Figure 1 Situation Zero and Situation One

The transition phase from ‘situation zero’ to ‘situation one’ will be realised by the market players. They will ensure that meters and smart metering infrastructure will have an ‘open’ structure so that consumers can change suppliers easily without any problems.
The option to describe ‘situation one’ as the situation in which *all* small-scale customers are connected to a smart metering infrastructure is dictated by the fact that certain benefits can be achieved only if all small-scale customers are connected (i.e., benefits of scale). Not only is the choice for situation one vital for the results of the cost-benefit analysis, but equally important is the choice of situation zero. An overly negative zero situation provides a rosy picture while an overly positive zero situation give a pessimistic one. Situation zero is not automatically equal to ‘doing nothing’ or ‘existing policy’. The choice for a zero situation as described above is a conscious choice based on the following reasoning. Alternatives for situation zero (such as the fact that market players already have concrete plans for installing smart meters) do not materialise sufficiently without a clear framework by the government[2]. In this context, smart meters are not the only factors that play a role, but mainly the metering infrastructure. Replacing all dumb meters with smart meters does not deliver the targeted aims of energy conservation, market operation and security of supply. Every governmental intervention, for example, adapting legal regulations to create a clear framework, requires a foundation; at the present moment the cost-benefit analysis is what provides the foundation whether government takes action or not.

The consequences of the above is that even if the results of the cost-benefit analysis are positive, this does not decisively answer the issue, for example, of what type of infrastructure needs to be installed and how this should be organised. The costs of employing governmental instruments that could possibly be needed to achieve ‘situation one’ are also not included in the cost-benefit analysis. In conclusion, we want to stress that this is a differential study. Only the cost-benefit that differ from ‘situation zero’ are examined.

Societal character of the study
Furthermore, the study considers the situation throughout the Netherlands. This societal cost-benefit analysis is therefore not comparable to a survey by an individual market player that includes in it’s business case, for example, impacts such as bonding of existing customers and acquisition of new customers by implementing smart meters. For an individual group, the profits for these types of internal impacts can make the difference between an attractive or a non-attractive project. Companies often employ profits as a simple manner for accounting the costs of the organisation to separate products, processes and projects. For society, profits as a whole are only a conveyance that should make no difference in terms of social appeal. From a societal point of view, the number of customers is anyway fixed and this does not affect the cost-benefit analysis.

What is a smart meter?
A smart meter is a meter that determines and stores in real-time or near real-time energy consumption, provides the possibility to read consumption both locally and remotely and – with regard to electricity – can also be utilised remotely to limit the consumption by the consumer or to switch it off (figure 2).

[2] This assumption is based on the research of demand response among small-scale consumers [1], the research of the NNI [4], and discussions with market players.

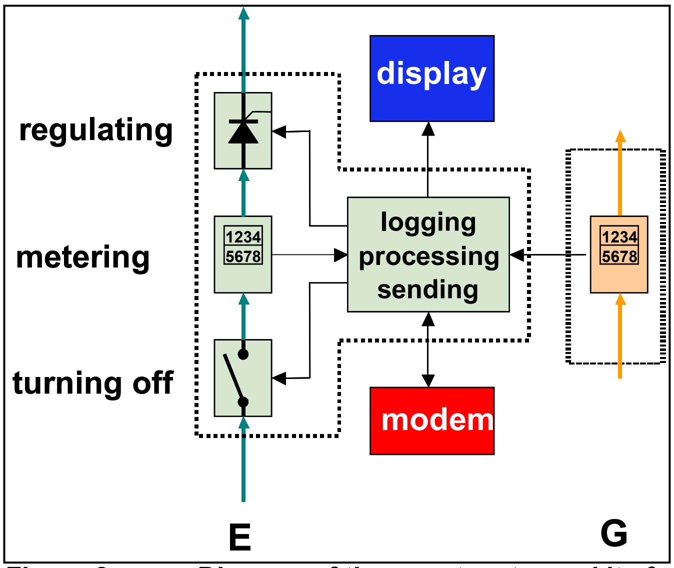

Figure 2 Diagram of the smart meter and its functions

The study dealt with electricity and gas meters, whereas the same unit is used for data communication. As figure 2 indicates, there is a difference between electricity (E) and gas (G) meters: with regard to safety aspects, a gas meter does not have a control and switching off function. Furthermore, the calculating capacity of the electricity meter is used for logging and processing gas consumption. The meter has a display on the device itself with an instantaneous reading of the consumption, as required in the Measurement Instrument Directive. In any case, the smart meter uses bi-directional communication and has a switch-off and switch-back function.
A basic assumption is that the *price* of smart meters will be determined by the European market. The scope of the Dutch market (in other words, the demand for smart meters) will be too limited to lead to a substantial drop of prices of smart meters. Therefore, the financial model does not include the relation between price and the number of smart meters that will be installed.
It is assumed that the *data communication infrastructure* has sufficient capacity and is available at marginal costs. Quantifying technologies are PowerLine Communications (PLC, via the existing electricity grid), communication via wireless modem (GSM or GPRS) and Internet via ADSL modem (existing Internet connections). Furthermore, it is assumed that the metering data without transaction costs will be available to the relevant market parties.

Legislation and regulations
Legislation and regulations are continuously being developed, both in the Netherlands and in the European Union. In this project the assumption is that legislation (gas and electricity acts) will not change significantly during the transition from ‘situation zero’ to ‘situation one’ and that government regulations and activities of market players will remain comparable to the current situation. At the present time there is a free meter market for small-scale customers, in other words, consumers can select their own metering company. This project therefore assumes that the free meter market remains in ‘situation one’. Should this change, then only the cost division between the mutual players change in the results of the financial model, not the total costs.

Results of the cost-benefit analysis

Scenarios
Scenarios are connected with important choices such as the rate of implementing smart meters, implementing smart meters only for electricity or for gas and electricity, choosing the type of data infrastructure (PLC, GSM or Internet), choosing the financial parameters (running period and interest percentage), how the impacts of market dominance are taken into account and how the impacts of the return (taxes and net rates) are taken into account.
The ‘reference alternative’ contains choices that lead to ‘situation one’ and in which all cost-benefit entries are represented in a reasonable manner (see Table 1 for the basic assumptions of the reference alternative).

Table 1 Basic assumptions of the reference alternative

	Scenario value
Transition speed	10 years
Type of meters	Gas and electricity
Type of data infrastructure	40% PLC, 40% Internet and 20% GSM (expert estimate)
Financial parameters	Period of 30 years at 7% negotiable interest
Market dominance	No market dominance impacts, efficiency benefits are completely returned to the consumer
Return	Loss of tax proceeds and net income is not recuperated from the consumer.

After calculating the results of the reference alternative, a sensitivity analysis was carried out in order to further examine the impacts of the uncertainties. Whereas in the scenarios fundamental choices for implementing smart meters are examined, in the uncertainties a variety of common generic parameters were examined. The impacts of the uncertainties in these generic parameters emerge in the sensitivity analysis by varying them in the reference alternative.

Results of the reference alternative and sensitivity analysis
The net cash value of the entire project amounts favourably to € 1.2 billion. It should be mentioned once more that this societal cost-benefit analysis is not comparable with a survey by an individual market player. This study investigates the situation for Dutch society and looks only at the cost and benefits that differ from a zero situation.
From figure 3 it emerges that in the reference alternative the entries of energy conservation by households, the more efficient business processes in companies, and the competition, which results from easier switching, result in significant benefits. Purchasing and installing smart meters, the metering infrastructure and the monthly invoicing are the largest cost entries.

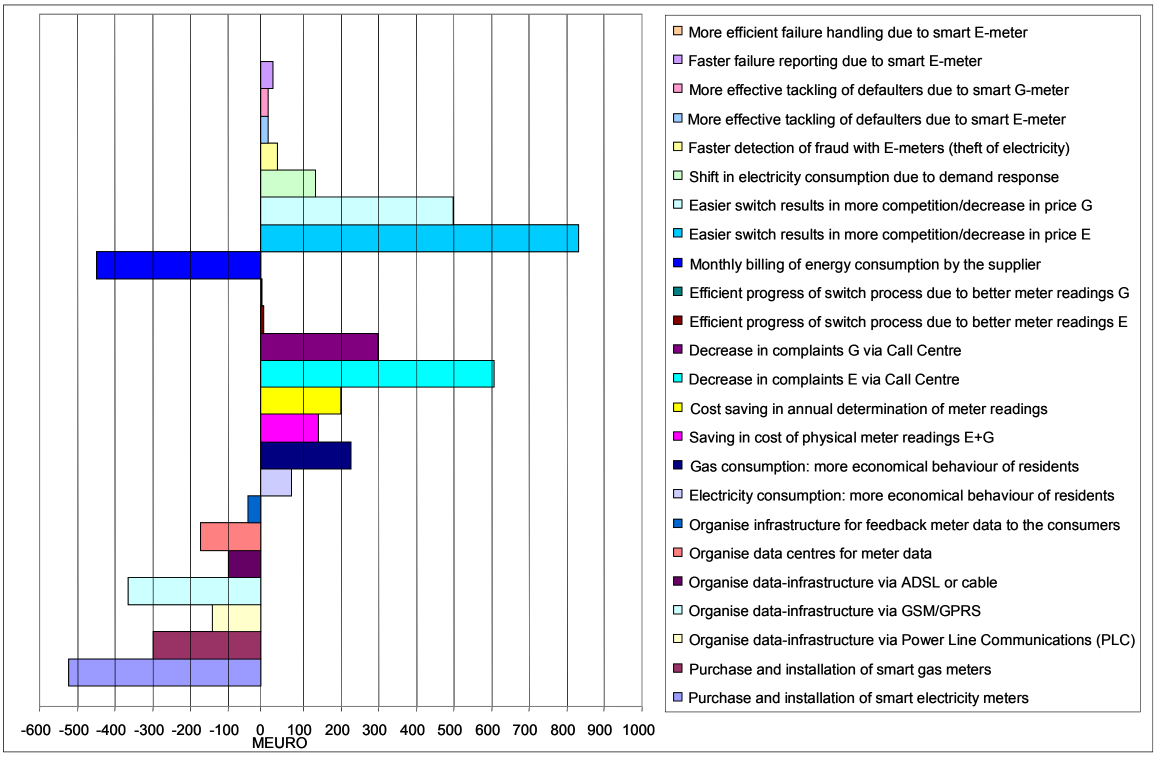

Figure 3 Overview of contribution per cost-benefit entry (reference alternative)

The division among the players is shown in Figure 4. Households in particular profit from implementing smart meters in the Netherlands. In the reference alternative, the costs are borne by the other market players.

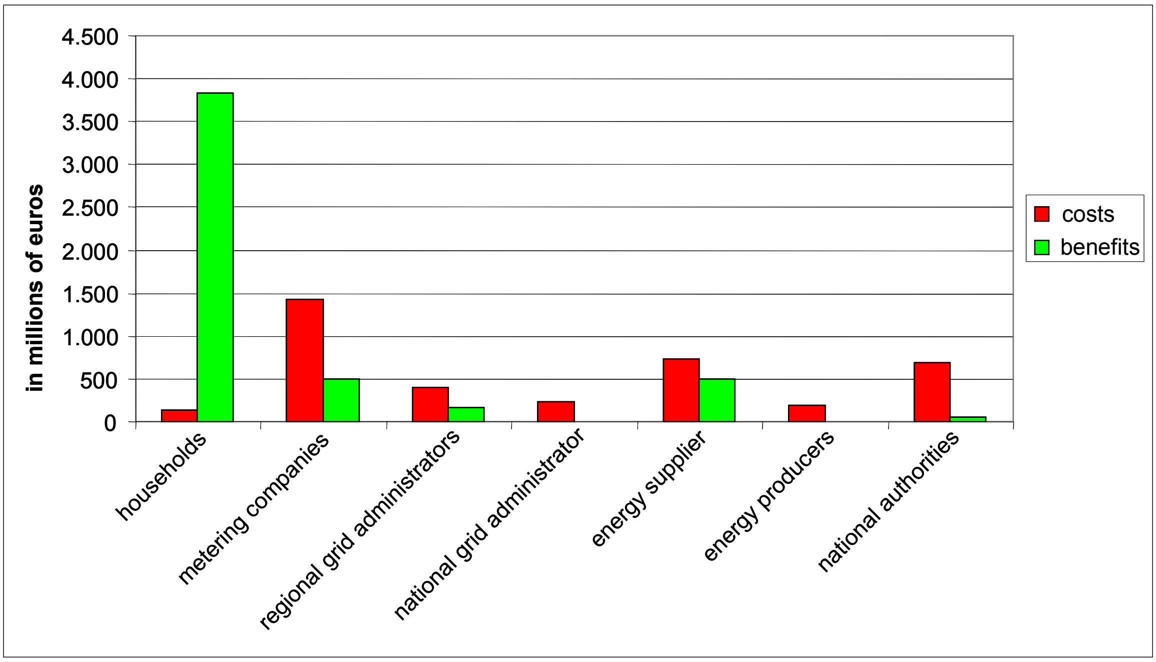

Figure 4 Overview of costs and benefits per player (reference alternative)

Which factors are the most uncertain or have the greatest impact on the financial result emerges from the sensitivity analysis (see Figure 5). Should a number of these factors be estimated differently (according to the left value in the figure), then the net cash value of the project might become negative.

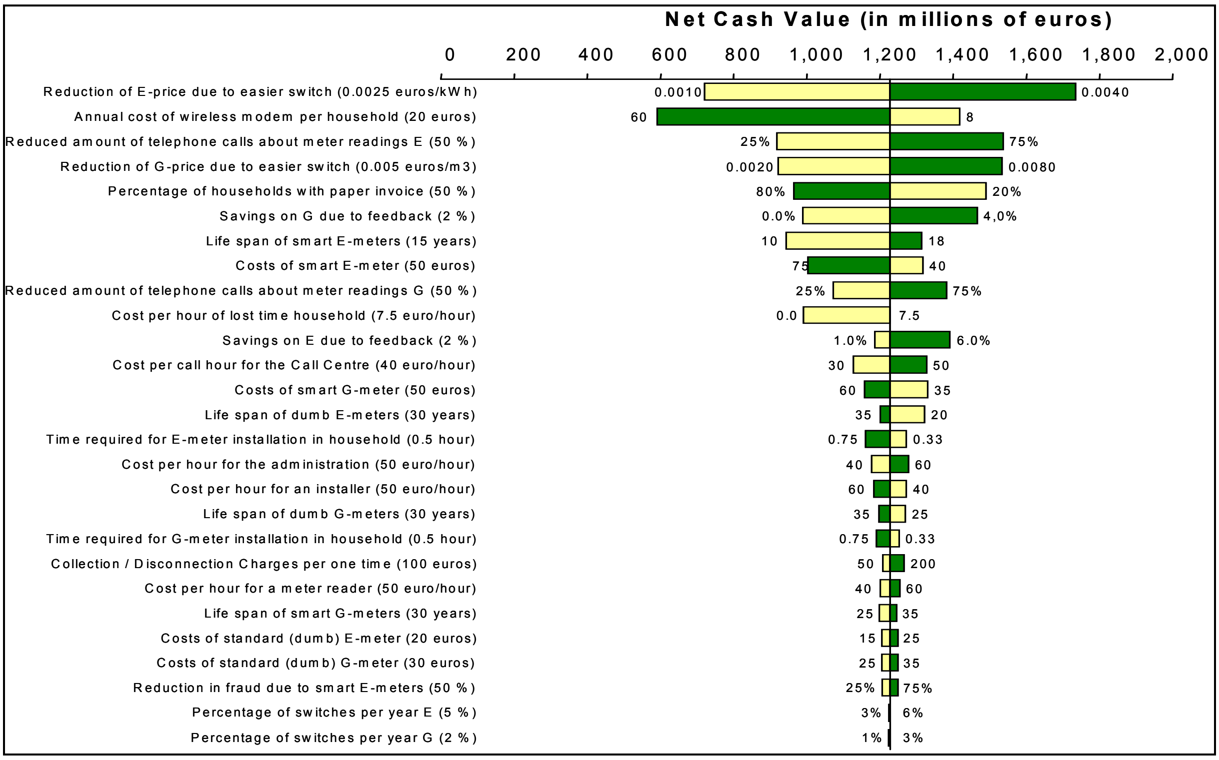

Figure 5 Results of the sensitivity analysis (reference alternative)

The study further examined the sensitivity per player for a number of important variables, such as energy conservation in households, the decrease of energy prices as a result of easier switching, and the reduction of the number of telephone calls. In terms of benefits, households are the most sensitive: variation is approximately € 6 billion (from € 1.5 billion to € 7.5 billion). For energy suppliers variation is approximately € 0.4 billion and for metering companies € 0.2 billion. In term of costs, the energy suppliers are the most sensitive: the variation is approximately € 2 billion. The variation for government is approximately € 1 billion and for regional grid administrators it is € 0.5 billion.

Results of other scenarios
By using scenarios, a number of variants in the net cash value of implementing smart meters can be calculated in the financial model. Table 2 sums up a number of variants that have an impact on the Net Cash Value. The results of the reference alternative have a grey background.

Table 2 The impact of variants on the Net Cash Value (NCV)

Variant		NCV (in M €)
Transition speed	5 years	1,400
	10 years	1,200
	20 years	1,000
	30 years	800
Type of meter	Only 100% electricity meters	400
	5% of electricity meters and gas meters	50
Type of data infrastructure	40% PLC, 20% GSM, 40% Internet	1,200
	100% PLC, 0% GSM, 0% Internet	1,500
	0% PLC, 100% GSM, 0% Internet	0
	0% PLC, 0% GSM, 100% Internet	1,600
Less systematic roll out	Transition speed of 15 years, installation period of 1 hour, cost of adjustment per household € 3	900

The basic assumption for the reference alternative is a large-scale, systematic roll out. With a less systematic roll out, for example if the meter is installed only after a consumer request, the Net Cash Value drops to € 900 million. In that case, the assumption is a longer transition period, higher installation costs and higher costs of adjustment per household.

Results of involving the market players

Introduction; overview of the market players
Figure 6 provides an overview of the relevant market players in the Netherlands.

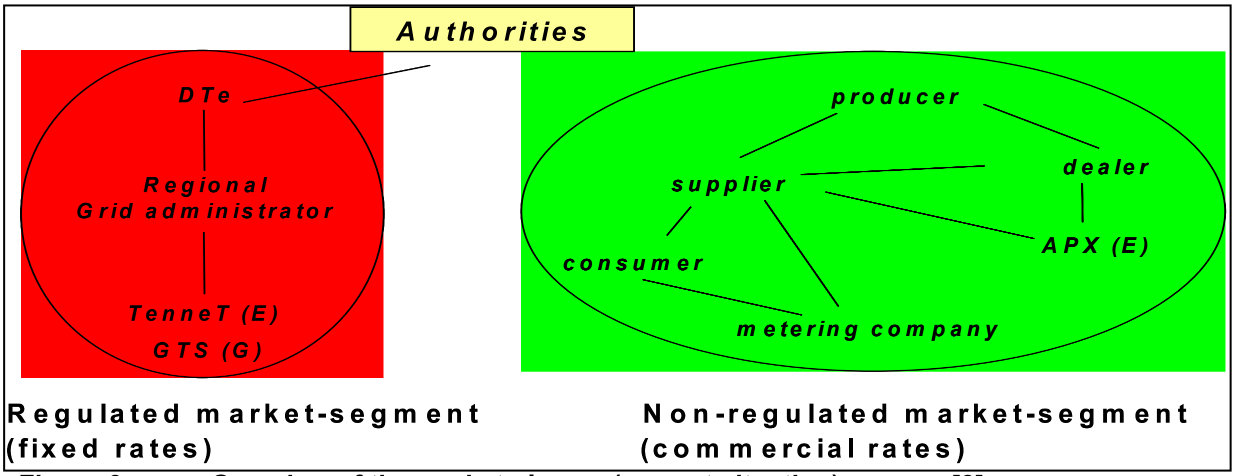

Figure 6 Overview of the market players (current situation); source [3]

All the concerned market players view the discussion about implementing smart metering infrastructure for small-scale customers in light of the regulated/non-regulated meter market, the unbundling discussion, and the total rearrangement of the liberalised energy market. These parties perceive that smart metering infrastructure offers the current market certain efficiency benefits and furthermore, future innovations in the area of energy services and Home Automation and market development of decentralised energy production
The market players very much appreciated the fact that the government makes the effort to invest in carrying out (or enable) a cost-benefit analysis. Major players were genuinely willing to participate in

this study. These parties have ideas and sometimes have concrete plans for implementing smart meters.

Obstacles to the large-scale implementation of smart meters
Market players mentioned the following obstacles to the large-scale implementation of smart meters and infrastructure for small-size customers.

Regulated or non-regulated meter market
For the time being, obscurity about the future of the meter market blocks the implementation of smart metering infrastructure. Major players are biding their time.
The fact that households do not purchase new/smart meters demonstrates that somewhere there is something wrong in the way the current free market operates. According to one player, this is further substantiated by the fact that current metering companies do not merge into one or more stronger companies, but rather remain close to their mother companies.

Development in the supporting data infrastructure
An additional obstacle is the fact that the supporting data infrastructure is still largely on the move. While one player has opted for the PLC technique, other players prefer Internet and GSM or in combination with PLC. PLC requires a needs a high degree of coverage and consequently, demands that agreements are made between the area of operations of the grid administrators.

Ownership issues
A number of parties have indicated that it is important to re-establish who will be the future owner of the meter. This will prevent a situation in which a meter will have to be changed when changing a supplier. In view of the new market model that will be created, property rights of the metering data will also need to be reviewed.

Standardisation of meters
The parties agree about the need to determine the basic functionality of the smart meter. The initial specifications are described in Table 3. Standardisation will go through the existing standardisation committees.

Table 3 Basic functionalities of the smart meter, initial specifications

Basic functionalities of the smart meter
Counter (kWh)
Log consumption per period (minimum per quarter)
Outages (recordings of disturbance/failure)
Internal clock
Bi-directional transmission/communication:
• Remote reading (standard data format)
• Remote switching off and switching back
Return delivery of electricity (e.g. produced by PV)
Standard data outlet

Since a meter has a standard outlet and the data is in a standard format, it is easy to link other devices to the meter. These could use the meter data to transmit information to residents, drive household equipment, etc.

The role of government (as seen by market players)
The market players see a clear role for government in removing the obstacles. By and large they are of the opinion that the government's role is to create a level playing field for improving market operations as well as for promoting a base for innovations in the energy services. The role of government is chiefly seen as a regulating and promoting role.
A *regulating role* entails determining the framework in which smart metering infrastructures could be built and deciding whether or not to regulate the meter market. This will clarify where the regulated public tasks lie and where the non-regulated commercial tasks lie. The regulating role is also expected in terms of determining the basic functionalities of the smart meter, perhaps guidelines concerning the supporting data infrastructure, and the aforementioned ownership issues.

To conclude, it was stated that if government would adopt a guideline (similar to the situation in Sweden) that small customers should receive invoices regularly (and possibly based on actual consumption), it could accelerate developments in the area of smart meters.
Furthermore, according to the market players, government can also *act as a promoter* by contributing to pilot projects and exchange of knowledge, for example in the area of feedback of consumer data to households. According to these parties – if the government would apply subsidies for smart meters – the implementation process would accelerate, but this is not a required pre-condition.
It could be useful for government to provide public information (as a neutral sender), alongside specific communication from suppliers to their customers. These undertakings would have to emerge from a wider vision of government on energy consumption, energy conservation and sustainable energy.

Conclusions and recommendations

Framework for conclusions
In general, a smart metering infrastructure can contribute favourably to demand response, security of supply, market operation, energy conservation, environment awareness, and efficiency of energy provisions in general [4]. Based on this the following framework for potential roles for the government was formulated for the process involved in implementing a smart metering infrastructure:

Table 4 Framework for conclusions

		Obstacles viewed by market players	
		Large	*Small*
Cost-benefit analysis	*Positive result*	1. Steps by government	2. Steps by the market
	Negative result	3. No steps	4. ?

This framework assumes four possibilities with regard to steps that would be or would not be taken:

1. Cost-benefit analysis is positive and market players perceive large obstacles: steps by the government are required.
2. Cost-benefit analysis is positive and market players hardly perceive any obstacles (or only small ones): steps will be taken by the market players themselves.
3. Cost-benefit analysis is negative and market players perceive large obstacles: government and market players take no steps because implementing smart infrastructure is not attractive.
4. Cost-benefit analysis is negative and market players hardly perceive any obstacles (or only small ones): status quo, until the cost-benefit analysis becomes positive (i.e., by changing the parameters).

The conclusion of this investigation is that the cost-benefit analysis is positive, but the obstacles perceived by market players are that great that a large-scale implementation will not get off the ground by itself. Certain market players will probably take some initiatives to implement small-scale smart metering infrastructure. In order to accelerate the desired large-scale implementation (100%) of smart metering infrastructure – which in terms of costs and benefits is the most optimal one – steps are required by the government.

Further analysis of the cost-benefit analysis
Although the result of the cost-benefit analysis is positive, we anticipate that the perceived obstacles in the market are that great that smart metering infrastructure will not be realised in the short-term in all households in the Netherlands. The reason for this is a combination of the points below.
First of all, what clearly emerges from the cost-benefit analysis is the problem of ‘split incentive’. The balance of the costs and benefits of a smart metering infrastructure is only positive for households: the benefits (€ 3.8 billion) exceed the costs abundantly (€ 0.14 billion). For all the other parties the costs exceed the benefits; this applies especially to the metering companies: they have to invest € 1.0 billion more than they earn back. In combination with the unclear direction (for the time being) of the meter market, this explains why the metering companies are not taking any steps.
However, households are also not taking any steps. Although the return for all 6.7 million households over the duration of the project is significant, the return *per* household *per* year is so low that we do not expect that households would spontaneously buy smart meters by themselves.
In the most favourable case, energy suppliers will take steps to get a smart metering infrastructure off the ground on a limited scale, even without government support. Suppliers will offer smart meters i.e., to enhance their own image. However, there are disadvantages to this: in order to recuperate the

investment[3] the customer will most likely be tied to the supplier for a longer period of time or will have to pay a penalty in case of changing suppliers prematurely. The consequences of changing suppliers after the minimal contract term are also obscure: Does the new supplier have to use the old meter or will it be replaced? A long-term contract and the obscurity regarding use of the meter in case of changing suppliers hampers the option of changing supplier. This means reduced market operation on the energy market.
The expectation is that in this manner, smart meters will never reach all households in the Netherlands. Furthermore, a significant role is also played by another aspect, which did not emerge in this investigation, but did come up in the group interviews of consumers in the demand response survey [1]: The consumer above all does not want any 'fuss'. Many consumers already find the liberalised energy market a great deal of fuss, let alone having to select a special meter.
In conclusion, we hereby state that steps by government are required for removing the obstacles mentioned by the market players (see Section 5.1.3) and for the purpose of launching a large-scale, systematic roll-out of a smart metering infrastructure for small-scale customers (the most optimal one in terms of costs versus benefits) with equal opportunities for all players.

Consequences for the implementation of Article 13 of the Energy Services Directive
The main objective of the Energy Services directive is the realisation of additional energy conservation in the member states and the development of a market for energy services. One of the pre-conditions, stated in article 13 of the directive for realising the objectives of the directive, is the requirement for meters and settlements. Article 13, paragraph 1 states that Member States must ensure that end users are provided with (smart) meters that show the exact actual consumption and indicate the time of consumption, for as far as this is technically possible, financially reasonable and proportional to the potential saving. Article 13, paragraph 2 states that Member States must ensure that energy billing is based on actual consumption and that, depending on the amount of decreased energy used, the frequency of settlement must be such that consumers are in a position to regulate their own consumption.
There is no automatic obligation to implement smart metering infrastructure at small consumers ensuing from either one of these two articles. After all, both articles make the topic dependent on proportional saving (paragraph 1) and decreased amount of energy (paragraph 2). Both paragraphs in article 13 are closely related. If the assumption is that a decreased amount of energy justifies a more frequent settlement in which the end consumer can regulate consumption, then the frequency should be at least 4 times per year and preferably every month. According to the first sentence in article 13, each settlement must be based on the actual consumption. This is economically feasible only with a smart metering infrastructure. Given that a smart metering infrastructure is technically feasible, compliance with the condition of paragraph 1 is hereby obtained and consequently, Member States have to ensure that end users are provisioned with smart meters.

Recommendations to the government
From the cost-benefit analysis it is clear that a fast, systematic, large-scale implementation of a smart metering infrastructure at small-scale customers delivers the optimal result in terms of costs versus benefits. From discussions with market players it is clear that some measure of regulation of the market will be necessary in any case, to prevent undesirable impacts in the steps towards the implementing a smart metering infrastructure.
All this combined with the 'split-incentive' issue in implementing a smart metering infrastructure, a low return per household per year, and taking into account that the consumer wants it 'as simple as possible' and is not interested in meters, our recommendations to the government are as follows:

- Oblige suppliers to invoice regularly (at least 4 times per year) based on actual consumption and to provide on-line inspection of the consumption data. In the current situation (manual reading of meters), this means a substantial increase of costs for reading the meters by the metering companies. Various market players have indicated that such an obligation constitutes a sufficient reason to shift to a large-scale implementing of a smart metering infrastructure.
  This is similar to the obligation used in Sweden to implement a smart metering infrastructure. Furthermore, this obligation awaits the Energy Services Directive. In principle, this obligation already ensures that implementing of a smart metering infrastructure is cost-effective for the metering companies. The experience in Sweden, however, demonstrates that based on such

[3] The cost of installation and infrastructure at individual installation are (at least) 25% higher compared to these cost used in the cost-benefit analysis, which are based on large-scale and systematic rollout.

obligations, installed meters can also differ in functionality and are far from being future proof. Therefore, the following point is also vital.

- Prescribe the basic functionalities of a smart metering infrastructure (see Table 5 for the initial specifications). This functionality also makes the meter suitable for demand response functions. The data communication infrastructure (PLC, ADSL, GSM etc.) is *not* prescribed.

Table 5 Basic functionalities of smart metering infrastructure, initial specifications

Counter and display (kWh, m3)
Log consumption (gas, electricity) and return delivery (electricity) per period (minimum per quarter)
Outages (failure to supply)
Internal clock
Standard data outlet
Bi-directional transmission/communication (standard data format and protocols): Remote reading and remote switching off and switching back (only for electricity)

- Prescribe the implementation period (the period of time by which all households in the Netherlands should be connected to a smart metering infrastructure): between minimum 5 years and maximum 10 years. Ensure that the obligation of small-scale customers to have their meters replaced in clearly established.
  From the cost-benefit analysis it follows that the shorter the implementation period, the higher the returns. On the one hand, implementation should be done carefully with using sufficient installation capacity, for example. Prescribing the implementation timeframe creates equal market opportunities and contributes to clarity and peace in the market.
- Review via the Office of Energy Regulation (DTe) the establishment of the fixed charges for households from the perspective of the cost-benefit analysis data on the split-incentive issue. This could perhaps bring about a more equally divided allocation of costs and benefits.

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