The policies for the large-scale deployment of smart gas meters in some European countries and draw policy implications, in particular for Italy

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Abstract

ABSTRACT

In this article we assess existing policies, at both European and at national level, for the large-scale deployment of smart gas meters in Italy. In particular we focus on the cost-benefit analyses which, as required by the Third Package, have been carried out in a few countries so far, including Italy, UK and France. We find substantial differences in both the value and the type of expected benefits, which have been identified in these analyses.

We conclude that the “business case” for a large-scale deployment of smart gas meters still appears unclear, especially when it is not done in combination with smart electricity meters. Therefore, we suggest that a more thorough review of the costs and benefits yielded by smart gas meters should be conducted at both Italian and European level and that other options (e.g. new regulation), should be investigated prior to committing businesses and consumers to such a massive investment plan.

I. ONCE INTRODUCTION

The introduction of smart metering is one of the core elements in recent European policies targeting the environmental sustainability and the competitiveness of gas and electricity markets. As part of the Third Energy Package adopted on 13 July 2009, EU Member States are obliged to "ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas and electricity markets" [1, 2]. That is, all EU Members must roll out some form of smart metering, subject to the results of an economic assessment.

In recent years the European Commission has issued several guidance documents [1-6] which are sometimes characterized by a different approach between electricity and gas, corresponding to different degrees of maturity in the policies of these two sectors: e.g. in those countries where the economic assessment results in a positive outcome, at least 80% of consumers must be equipped with smart electricity meters by 2020; on the contrary, a similar target has not been imposed upon the gas sector yet.

The aim for implementing smart meters in the Third Energy Package is twofold: first, to boost energy efficiency and demand side management; secondly, to ensure active participation of customers in the market. Moreover adopting smart meters is in line with another objective in the Third Package, i.e. developing smart grids.

At present it does not seem clear whether the difference between the benefits and the costs of adopting smart meters on a national scale is a positive one. There is indeed a high degree of uncertainty – more so in the gas sector than in the electricity one – concerning both the smart metering technology (including its costs) that should be adopted and the actual values of these benefits.

This article addresses a few issues of introducing smart meters in the gas sector. In particular, the Italian smart gas metering program, having the most ambitious deployment targets, is analyzed, by comparing the latter with similar European initiatives and focusing on the corresponding cost-benefit analysis (or CBA), as required by the 2009 Directive on the internal market in natural gas [1]. It should be noted that only six out of twenty-seven EU countries have so far completed the required CBA for the gas sector [7].

II. THE EUROPEAN POLICY DEBATE ON SMART GAS METERING

The economic policy debate has identified several areas where smart gas meters (or SGMs) are expected to yield relevant benefits, which are summarized in Table I.

TABLE I
TYPE OF BENEFITS ATTACHED TO SMART GAS METERING

Macro area	Benefits
(1) Energy efficiency	• Consumers' awareness • Consumption flexibility
(2) Industrial processes	• Quality of service • Relationships among stakeholders in the gas supply chain • Metering costs
(3) Defaulting consumers	• Remote disablement of supply • Accurate bills
(4) Network's operation, maintenance and development	• Information on network flows
(5) Safety	• Detection of network leaks

First of all, SGMs can contribute to making consumers' behaviour more energy efficient via two mechanisms. On the one hand, thanks to more frequent and accurate information on energy consumption and cost provided by SGMs, consumers become more aware of the economic and environmental impact caused by their energy uses and, thus, they may reduce and/or shift their gas consumption [8]. On the other hand, thanks to more accurate billing, SGMs send correct price signals to consumers, which are then expected to make more efficient choices in their energy uses. It should be highlighted that the energy saving one is the largest among the financial benefits considered by most CBAs recently carried out in Europe: e.g. the Dutch CBA for both gas and electricity smart meters presents a positive result (=net present value or NPV) of almost €800 million, which corresponds to a benefit from energy saving of almost €1,500 million [9].

Secondly, SGMs can contribute to improving industrial processes in the gas supply chain. More accurate and timely information on gas withdrawals of each consumer from the network allows a quick estimate of suppliers and shippers' actual balances. Also, using SGMs leads to meter reading savings for all suppliers because site visits are no longer required. Consumers benefit too as switching procedures would improve thanks to timely availability of metering data. Moreover, better industrial processes should reflect in a better quality of service of gas supply: more accurate information on gas use and costs should help consumers better manage their energy expenditure, thereby reducing also suppliers' costs in managing consumers' debts. Finally, the possibility of using SGM to remotely enable/disable gas supply should reduce suppliers' operating costs for non-simultaneous taking over contracts. The exact magnitude of this type of benefits largely depends on the effectiveness of those regulatory mechanisms (e.g. load profiling) which are currently being used to make up for the lack of timely and accurate metering data.

Thirdly, SGMs can make defaulting consumers' management both more effective and less significant. On the one hand, remote disablement (via an electric valve within the SGM) allows interrupting gas supply to defaulting consumers in a quick and economic manner. Also, this represents a better deterrent for consumers who are considering not paying their gas bills and, thus, reduces the number of defaulting consumers. On the other hand, more accurate billing lowers the risk of having consumers defaulting because of surprisingly high balances to pay. Not surprisingly, among all industry stakeholders, it is the suppliers who often consider this particular benefit as the most valuable one [10].

Finally, it has sometimes been suggested that SGMs would yield benefits with regards to operating, maintaining and developing gas distribution networks (i.e. by providing more detailed information on network flows), as well as improving safety within consumers' premises (i.e. by detecting gas leaks on the network). However the current debate has not clarified yet under which conditions these benefits would materialize and at what cost. Based on the information provided by Italian distributors, it appears that most decisions concerning network's operation and maintenance currently rely on data provided by sensors spread across the grid. In this respect, Italian distributors consider highly unlikely that SGMs could replace or greatly improve the current decision making process.

With regards to safety, our analysis suggests that this benefit would require sharing access between distributors and consumers to a series of infrastructures and devices (e.g. sensors to detect gas leaks) within every consumer's premises. This shared access would imply a reshuffle of distributor's roles and responsibilities towards final consumers, which would substantially raise operating and management costs. Our analysis of several European CBAs [9, 11-17] could not find "detecting gas leaks" among the expected benefits. Thus this type of benefit does not seem particularly significant.

The economic literature on smart metering mostly addresses its application to the sole electricity sector and has so far ignored to investigate how this technology might impact upon the gas supply chain. Therefore, our analysis identifies a few key differences between gas and electricity regarding the costs and benefits which arise from the introduction of smart meters on a large scale. Overall the evidence from a few European cases suggests that any smart gas metering program is characterized by higher costs and lower benefits compared to those of its equivalent in the electricity sector (e.g. [11]).

With regards to benefits, most studies [9, 18, 19] assume a much greater potential for reducing and shifting consumption over time in electricity than in gas: e.g. the British CBA assumes 2.8% and 2% of energy saving for electricity and gas respectively. Such difference is strictly correlated to higher price elasticity in electricity consumption. It is widely believed that load shifting is less valuable for gas systems since gas prices are generally less volatile than electricity prices mainly because of greater storage opportunities. Also, the benefit from remote disablement may not actually materialize in the gas sector because of bigger safety, communication and cost constraints as opposed to those implied by the corresponding functionality in electricity.

As far as smart gas metering costs are concerned, information is very limited. However there is general consensus that SGMs are more expensive than their electricity counterparts especially because they cannot rely on the low-voltage power network for either powering the SGM itself (a battery must be used instead) or communicating with supply (or distribution) companies. An example of the different costs involved by the two smart metering systems is presented in the British CBA, as illustrated in Fig.2 [20]. In this respect it should be stressed that those deployment programs, where both gas and electricity are rolled-out simultaneously (e.g. the Netherlands and Great Britain) rather than separately (e.g France and Italy), are assumed to be more cost effective than otherwise, due to economies of scope but also to the possibility of sharing part of the communication infrastructures.

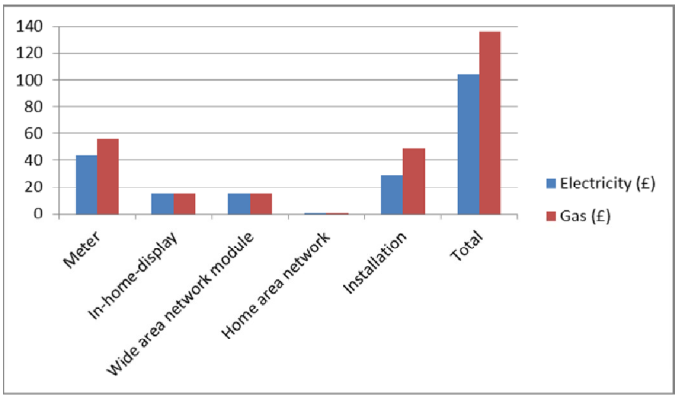

Fig. 1. Estimated unit cost of key components of the smart metering system for Great Britain

III. A COMPARISON BETWEEN ITALY AND OTHER EUROPEAN COUNTRIES

When analyzing smart gas metering policies, the Italian case appears as a particularly relevant one for at least three reasons. First, Italy was the first country to introduce and almost complete in 2006 a national roll-out of a smart meters in the electricity market [21]. Secondly, Italy was the first country to set up a national smart metering program for the gas sector [7]. Lastly the Italian smart gas metering program appears to be as one of the most ambitious ones in Europe in terms of deployment targets, i.e. tight timetable and complete replacement of gas meters for all types of consumers [22, 23]: e.g. Italian distributors must install SGMs at 100% of all non-domestic consumers by 31 December 2012 and at 80% of domestic consumers by 31 December 2016[1].

[1] In comparison, British suppliers (instead of distributors) must install smart meters for both gas and electricity at 100% of domestic and small non-domestic consumers by 2019.

However, it should be noted that our assessment of the Italian case, in spite of its high relevance, has been largely affected by the limited available information. For instance, AEEG, the Italian energy regulator, has only published a synthesis of the sole CBA published so far [22]. The latter considers costs and benefits of distributors only, which are those responsible for all metering activities in Italy, and, contrary to other European CBAs, ignores those of other stakeholders, such as suppliers and consumers [8].

Following a critical review of the relevant literature, our analysis suggests that the Italian policy for SGMs differs from that of other European countries (e.g. Great Britain, France and Netherlands) in at least two key elements: the objectives to be achieved through SGMs and the timing of the investment program.

With regards to the first element, while the Italian smart gas metering program mostly aims at improving industrial processes in the gas sector, in other European countries priority is given to improving sustainability, especially energy efficiency. Indeed, neither the Italian policy nor its CBA considers the obligation to couple every newly installed SGM with an In-House-Display (or IHD), inside consumers' premises. The latter, which is included in the British program, is often considered a rather crucial requirement for a successful implementation of a smart metering system. That is because the IHD allows a direct form of feedback[2] (= real-time information on consumption and costs), which, in pilot projects, has proved to be the most effective solution for improving consumers' awareness of their energy use, which may trigger behavioural changes and, thus, energy savings at household level [18, 24-26].

Overall energy saving represents the largest benefit in CBAs carried out in other European countries. For instance, in the British CBA, which considers smart meters for both gas and electricity, the NPV, which amounts to £5.1 billion, corresponds to a reduction in energy consumption equal to around 42% of all benefits, as shown in Table II (calculations based on [11, 12]).

TABLE II
BENEFITS OF SMART METERING IN THE BRITISH CBA (£ M)

	DOMESTIC	NON-DOMESTIC	TOTAL
ALL BENEFITS	15,825	2,823	18,648
BENEFITS ONLY FROM ENERGY EFFICIENCY (=% OF ALL BENEFITS	5,623 (=36%)	2,140 (=76%)	7,763 (=42%)

Such an assumption on energy saving implies that a CBA focusing on SGMs only, which are characterized by higher costs and lower benefits compared to its electricity equivalent, is very likely to yield a negative NPV if energy efficiency is not considered in the list of benefits, as illustrated in Fig 2[3] (calculations based on [11, 12]). Similarly, in the French CBA on SGMs, energy saving plays a crucial role in ensuring a positive NPV (= €312 million), as shown in Fig.3 (calculations based on [15]).

[2] On the other hand, access to a web portal with information on actual and historical consumption is a typical example of indirect feedback.

[3] The figure shows also the results with or without (the benefit of) the avoided cost for maintaining pre-payment meters, since these are currently not allowed in the Italian system.

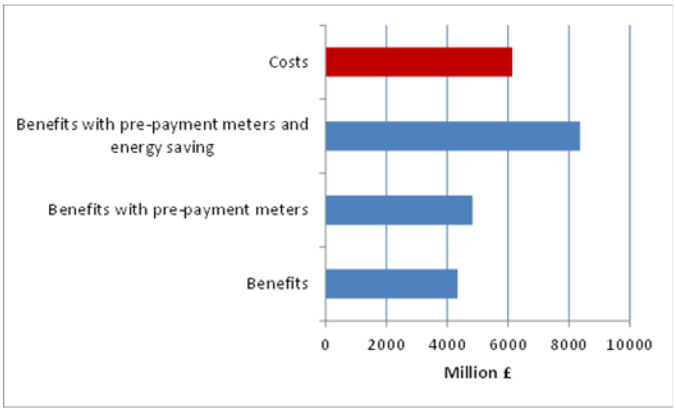

Fig. 2. British CBA's key results for SGMs

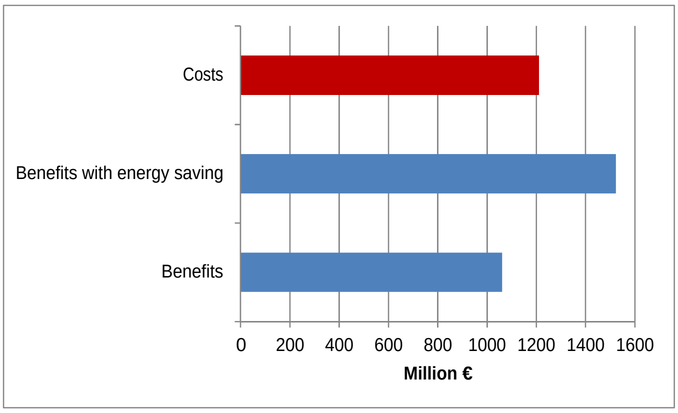

Fig. 3. French CBA's key results for SGMs

Moreover, as to the net value of improving industrial processes in the gas sector, the Italian CBA does not take into consideration alternative solutions to SGMs, which may yield similar benefits but with lower costs: e.g. a more effective load profiling which makes financial settlement among suppliers, shippers and distributors more efficient. Overall it is believed that improvements in the organizational and regulatory framework could significantly reduce the incremental benefits which could arise from introducing a smart gas metering system.

Finally, it should be noted that requiring that SGMS should measure consumption in standard cubic meters – i.e. adjusted for pressure and temperature – is a unique feature of the Italian program only, since no other smart metering policy provides for such a functional requirement. While measuring consumption volumes in standard cubic meters may be a desirable feature of having a more advanced metering system, the corresponding technology is still immature, especially for domestic consumers. Thus it appears highly uncertain whether it is currently cost effective to introduce this particular functional requirement in any national smart metering program.

With regards to the timing for the roll-out of SGMs, the Italian policy introduces deployment targets which are more ambitious than those set by other European policies. In the light of information currently available, it does not seem clear how Italy would benefit in economic terms for being the "prime mover" in the European landscape, for a series of reasons.

First of all, it can be expected that in the foreseeable future "spontaneous" trend in technological research will produce a new generation of smart meters, with better functionalities and lower costs. Also, learning economies are generally greater in the initial stage of introducing a new technology. Therefore, later projects will benefit from learning that was gained in early projects by all relevant actors. Lastly, if technology becomes more mature, it can be expected that competition in supplying these new technologies will increase, thus reducing the overall cost of the investment program [27].

IV. CONCLUSIONS

The analysis of different European policies suggests that adopting SGMs is expected to bring relevant benefits, which may differ in magnitude depending on the stakeholders under consideration in the gas sector. It should be noted that this conclusion appears consistent with the results of another recent analysis of the Italian smart gas metering programme [28].

The net benefit (=benefits minus costs brought about by SGMs) for distributors is likely to be moderately positive or even negative if distributors themselves (e.g. France and Italy) are in charge of the roll-out and are not allowed to pass on all investment costs to final users. Suppliers, on the other hand, are likely to be the largest beneficiaries thanks to a series of avoided costs (e.g. fewer complaints for inaccurate billing to deal with) that SGMs are expected to yield in the area of “industrial processes” and of “defaulting consumers”.

With regards to consumers, it is expected that they will be able to benefit from smart meters through reduced bills from the lower costs borne by energy companies and reduced energy use. However there are at least three necessary (but not sufficient) conditions that need to be met for this benefit to materialize. First, consumers must be able to receive some form of feedback on their actual consumption (e.g. IHD). Secondly, consumers must be able to understand the opportunity to reduce their energy bills. Finally, consumers decide to change their energy behaviour: so far the evidence on whether they will do so has been inconclusive (e.g. [24], [18] [25]). In particular, as highlighted by [20], there is still much uncertainty surrounding the extent to which householders would change their behaviour when the new meters are introduced. Thus it is suggested that every smart metering programme should clearly set out what energy companies' (both distributors and suppliers) responsibilities will be for engaging with consumers to deliver the benefits of smart meters.

Otherwise, the only people who will benefit are the energy companies. Consumers will have to pay energy companies (e.g. distributors in Italy and suppliers in Great Britain) for the costs of installing and operating smart meters through their energy bills but no transparent mechanism presently exists for ensuring savings to energy companies are passed on to consumers. Also consumers may not be willing to cooperate during the roll-out of smart meters: therefore an effective educational campaign appears as absolutely crucial to help consumers use smart meters to reduce consumption.

After investigating several European experiences, it is believed that any policy on smart gas metering, including the Italian one, should also take into consideration a few existing uncertainties, besides the expected benefits. First of all, at present smart meters for gas are characterized by higher costs and lower benefits than their correspondents for electricity, especially where the two technologies are not deployed simultaneously. Because of this, any policy on smart metering should carefully assess whether certain objectives could be pursued with cheaper instruments, like regulatory and organizational changes, before rolling out more expensive SGMs: e.g. requiring a more sophisticated load profiling for achieving more accurate bills; moving gas meters outside the home, for making it easier to interrupt defaulting consumers, etc.

Furthermore, the optimal technological solution for implementing a smart gas metering system is not obvious yet, mostly because of an immature technology, as previously explained. Also, significant practical difficulties may arise in procuring and installing the required data communications service (e.g. an estimated cost of £3 billion in Great Britain) before the planned roll-out. This is especially true in those cases where SGMs cannot rely on the communication infrastructures of the smart electricity system. Such difficulties may be mitigated by conducting a relevant number of pilot projects prior to the national roll-out.

Moreover, because the introduction of smart metering is one of the core elements in recent European policies on the sustainability and the competitiveness of gas markets [1], national policies for SGMs should be designed in a way which is consistent with the European framework: e.g. adding energy efficiency among the benefits to be pursued by deploying SGMs.

Finally, in spite of its controversies (e.g. questionable assumptions on consumer behaviour) it is believed that a CBA is still a rather powerful tool for assessing public policies which involve large investment programmes, like those related to smart metering. However, in order for a CBA to be transparent and comprehensive, all stakeholders affected by the policy under consideration, rather than just those in charge of the deployment (e.g. distributors in Italy) should be included in the economic assessment.

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VII. Biographies

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