The Economics of Smart Metering Across the European Countries. a First Assessment

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Abstract. Research on sustainability transitions and regional diversification remains one of the main green issues in the Digital Era, with a large variety in terms of topics, geographical applications, related theories and methods. Thus, *ad hoc* policy measures need in order to enhance the regional abilities in supporting the acceleration of ongoing green transition. This paper provides evidence that, in a specific region, green activities could be positively attracted and correlated with each other only if green culture and capabilities exist, since previous studies showed a U-shaped relationship among entry regions for sustainable technologies and 'relatedness' to green knowledge.

Moreover, the diversification of sustainable activities depends on the introduction and applications of green environmental technologies. In this perspective, smart meters well represent the potential of digital infrastructure capturing the environmental capacity of a region to apply green technologies for a better future. We investigate the policy effects for smart meter rollout in European countries starting from the idea that this green policy tool helps to satisfy different economic literature strands. A theoretical model is introduced showing that a sustainable and efficient policy instrument will reinforce and develop local green culture. The spatial unit of investigation is the EU-28, and it offers the opportunity to verify the effectiveness of smart meters as a valid tool of analysis for sustainable policies.

Keywords: Smart Meters; Environmental Ecosystems; Sustainability Goals; Europe

1 Introduction

In last decades, among the Sustainable Development Goals for a better and more viable future, 'Green Issues', with a large variety in terms of topics, geographical applications, related theories and methods, have attracted a significant research activity, mainly on sustainability transitions and regional diversification. Thus, *ad hoc* policy measures occur in order to enhance the regional abilities in supporting the acceleration of the ongoing green transition.

The growing interest on renewable energy responds to the increasing global energy and gas demand overtime, especially in emerging market economies, producing potential negative environmental impacts, particularly on the long-term, on nature and climate changes. Thus, in order to protect the environment and to improve people welfare, the introduction of green environmental technologies is crucial for the diversification of local sustainable activities. Promoting smart meters is a robust policy action in world energy-based economies, a real revolution, since they expose some of the potential of infrastructure we develop for a more sustainable world. Smart meters measure consumption with a higher temporal granularity than previous meters. They are both an emerging green technological system that limits the high degree of *inertia* and inefficiency of the old power grids, and an opportunity for consumers to save if they schedule their consumption at certain times of the day, reducing grid losses and operational costs.

From the point of view of environmental design, and in line with the 'four orders of design' model [1], smart meters are a digital infrastructure that make known what was previously unknown, tangible what was previously intangible, flexible what was previously inflexible.

Current European policies adopt a market driven approach for a valid smart meter deployment, but for reaching a sustainable goal, a deep green culture diffusion is still missing. In Europe, policy makers can influence green diversification through political support at regional level, moderating and reinforcing the importance of countries' capabilities [2]. Several studies highlight that the likelihood of developing new eco-technologies in a specific area strongly depends on the past and present activities enforced in the local green expansion [3-6]. Nevertheless, regions differ in their ability to diversify and adapt to technological change and to develop new green activities. In fact, European regions show different capacity to create and develop new sustainable products, as there is an uneven distribution of specialisations [3, 7].

The first step is to identify the determinants that favour green diversification and drive inter-regional differences. Regions' capacities play a crucial role in the local diversification process, whereby new economic activities tend to develop more easily in industrial or technological sectors closely related to those already existing in an area [8-9]. Moreover, green technologies tend to exhibit higher levels of complexity compared to non-green ones [10]. New green technologies emerge from innovations involving non-green knowledge often embedded in a core sector of the economy [11-12], showing that the correlation between the various political and economic interests has a strong role[1].

In this work we investigate whether the introduction and adoption of new green technologies present different development either at a meso-regional level (Europe) or at a micro level (single country). The cognitive proximity and complementarity between the new sustainable technologies that regions can potentially develop are powerful to determine regional policies; if the new green technologies can be based on cognitively close local knowledge, it is more likely that this green technology will emerge and endure in a specific region. We use the Benchmarking smart metering deployment in the EU-28 database [14]. The aim is the attempt to reconcile, through the analysis on the adoption of a green instrument (smart meter), the different strands of interpretation implementing a theoretical model. The paper proceeds as follows. Section 2 presents a critical review of the literature. Section 3 shows the conceptual model that highlights both the opportunity of finding the right policy-green-instrument and the necessity of driving people towards a more massive and aware culture and usage of green technologies. Section 4 offers a critical overview of the smart meters' penetration in Europe, Section 5 the methodological approach, and Section 6 concludes with some policy recommendations.

2 Theoretical Background

In environmental innovations, economic policies are related to the double positive externality that characterises sustainable improvements through knowledge spillovers and adaptation to the green technological changes [2]. In the regional diversification literature, the growing interest in green activities has a high level of past and place dependence: new and green activities arise more easily in technological sectors and industries closely related to those that already exist in a place [14, 9]. Research in this field shows that this driving force is also at the base of the green diversification of regions [15]. This result provides new and further insights into the transition literature that usually underestimate the addictive processes of past dependence, and tends to overlook the role of regional capabilities.

The literature on sustainable transition focuses on policy initiatives at regional and local level, revealing how urban and regional policies matter for

[1] Green technologies rely on ecosystems theory [13] for the development of decision-making methods at the micro level, promoting sustainable development and greater corporate environmental responsibility.

sustainability transitions, being often ahead of national and supranational policies. The presence and nature of environmental policies differ widely among regions and within countries, but little attention is still paid on the effect of regional capacities (and correlation) on green culture and related results on economies [16]. The transition literature states that new environmental technologies are also disruptive because they are subject to fundamental uncertainty (and high risk of failure) as they face many obstacles on both the supply and demand sides. Moreover, this strand suggests that unrelated diversification would be more common in sustainable transition processes. On the other hand, a correlated diversification is the rule [17], where unrelated diversification is only an exception.

The diversification literature evaluates the role of regional capabilities essentially referring to quantitative terms, while the other one, using a geographic approach that emphasizes human-environment relationships, stresses the importance of policies in transformation processes in individual cases. The synthesis of two literatures that have attempted to explain large-scale and long-term socio-technical change shows that new green technologies are radical innovations, and refers to the need for transformative changes doing things differently enabling the greening of economies[2] [18].

Environmental policy influences the development of new green specialisations in some regions but not by default in others. A possible explanation is in the single policy implemented by each regions and in the local capacities of some areas to transform national aids and local incentives into higher investments on new green activities, since regional political support for environmental policies might enhance countries to develop new regional and local sustainable activities.

Through a strong environmental sustainability campaign, it is possible to reconcile the meso and micro levels of policy applicability. Thus, the introduction of peculiar, new techno-green instruments (smart meters), if well sustained, could be the way to satisfy economic actions at meso (Europe) and micro (region) policy-level. In order to investigate regional and European capacities, we use as a tool of analysis smart meters' penetration. Public intervention provides incentives to facilitate green transitions to overcome the initial lack of performance and cost competitiveness of new environmental technologies and to mitigate barriers to their development and adoption. Green innovations require the implementation of a series of policy measures related to the peculiar (hybrid) nature of green knowledge that brings uncertainty and changes in social attitudes.

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[2] Transformative change is change that becomes sweeping, enabling towards sustainability, with a role for everyone in each of these, whether you are an individual, an organization, or a policymaker. It often starts small, but it is strategic. It includes individual decisions to help start or build new social norms, and the legal changes that unlock all kinds of other changes [18].

3 A Sustainable Model on Green Culture

Technological innovation is a powerful mechanism for the transition towards more sustainable societies as it tries to correct market failures [19-20]. Green growth policies seek to increase returns on investments in green innovation by reducing disparities between private returns from economic activity and benefits for society. Sustainable policy measures tend to develop payoffs that enhance natural resources through policies of green innovation or supporting specific technologies; they 'strengthen entrepreneurship and local firm absorptive capacity, support new knowledge creation and commercialization, and support diffusion and adaptation of existing knowledge to new local contexts'[21, p. 72].

Intelligent energy feedbacks would be an effective driver of energy-related behaviour change; in the smart meters' case it is necessary an emerging technological system, for which implementation requires solutions not only related to the engineering of the grid, but also policies and regulation from governments and agencies [22]. Green technologies, in the energy industry in particular, have experienced in the last decades high technological development by integrating smart technologies [23]. However, green growth strategies are not able to solve *per se* structural constraints on economic growth and job creation, as market distortions and an unattractive business environment require a very efficient solution before introducing them. The opportunity for a new and smart specialisation policy framework involves European countries (regional policy) to re-innovate each state policy (local) in order to identify new general sustainable green opportunities for all European countries.

The future technological analysis (FTA) [24] might be a good solution. It integrates both theories, the diversification literature (DL) that underlines the existence of a link between past and place, so that new activities present a positive correlation with the local technological sectors, and the sustainable transition literature (TL) which considers disruptive green technologies not correlated. FTA underlines the importance of bringing together technical and commercial knowledge on potential new products and processes in the early stages of development, as it is the most appropriate time to model the innovation path. In FTA, we assume the existence of a theoretical mechanism for coordinating these two strands of literature introducing the social element through a strong green culture. It addresses directly the longer-term future through the active and continuous development of visions, and pathways to realise them. It is a valuable management and policy tool reinforcing classical strategy, planning, and decision-making approaches in the post-industrial society (Figure 1).

Regional policies on green technologies influence the creation of new sustainable opportunities but not by default everywhere else. Even if a guide policy at regional level should adopt this rule, countries that have already supported green projects would find it easier to introduce it (relatedness) only if they had successfully adopted the latest green policy, too(diversification strand). In these countries, regional green capabilities represent the core of the effectiveness. Obstacles emerge when local green policy is not well supported. Countries with this limit will interpret the introduction of regional green policy primarily as disruptive (complexity).

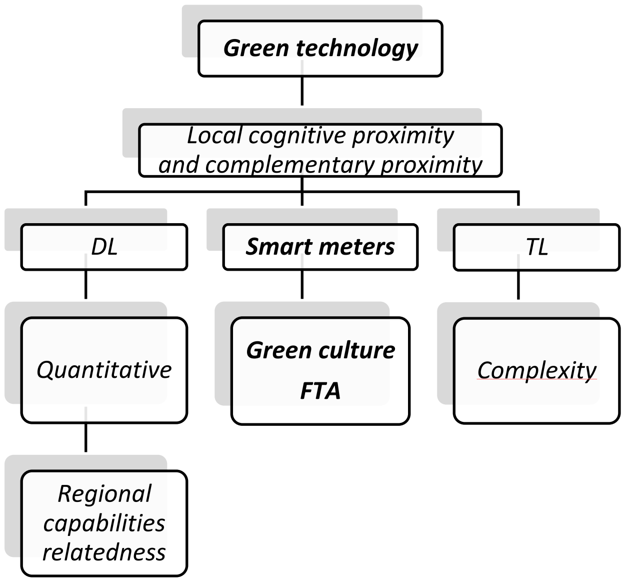

Fig.1 A sustainable model

According to [25], managing four areas of uncertainty application (technological, commercial, organisational and social) requires the introduction of different theoretical elements; technological and commercial uncertainties [26] can be used following a scientific methodological approach of error elimination [27], while organisational uncertainty recalls organisations profit from innovation [28-29]. About social uncertainty, a fragmented approach to social engineering is often used [30] because socio-cultural factors and all unwritten rules play an important role in the adoption of green policies [31]. Socio-cultural support for the population is essential to offset uncertainty, taking place both through the creation of cognitive legitimacy by the formation of a specific knowledge for a successful 'new' green industry, and through socio-political legitimacy so that all the stakeholders will accept the 'new' business idea.

In the green economy, the socio-cultural aspect heavily depends on the placement, and it pushes for a multidimensional vision of well-being, recalling concepts such as equity, inclusive development and sustainability in which the common thread produces a collective cultural change. The social value system is crucial in the behavioural tendency of the individual and the organisation. It emerges from institutions' behaviours and choices, families and individuals, such as codes, tangible or intangible, on which society relies.

Nevertheless, the point is if these positions might converge to a common vision, although they not clearly mention nor investigate from an economic point of view as well the presence, everywhere, of local cognitive proximity and complementarities. These two elements act simultaneously on regional policy. Cognitive proximity is considered 'a part of organizational proximity, since it is also based on the notion that sharing routines facilitates the interaction of actors over geographical distances' [32, p. 77]. The local element helps to confine the involved area, so that it is possible to use only the needed specific local capabilities. The greater the level of local cognitive proximity, the higher the probability of introducing and supporting a new sustainable green policy.

Moreover, advancing from interregional links (complementarities), all countries could control the real effect of a new technology. A complementarity in this sense 'is the same as a comparison of how economic processes in contiguous and more distant regions influence one another' [33, p. 49]. Thus, regional institutions of every single country are influenced. Supporting and evaluating smart meter adoption could be a fair example of how local cognitive proximity, and the complementary, interact and mutually enhance each other.

In the design process, smart meters are the finest technological instrument, disruptive and with a green diversification capability. This is also a good regional policy measure active to determine sustainable changes at a local institutional level. The introduction and adoption of smart meters should drive energy saving, although incentivising savings through social comparison and competition it has not been always successful [34-35][3]. Several problems from financial obstacles to isolated citizens, and an incapacity to change social practices in deep also emerged. Most likely, many 'black holes' related to the different cultural levels of the population and to changes in routines remain due to a lack of credibility and trust in radical innovations. In fact, it is necessary to strengthen the public culture so that all citizens would accept green policies more simply.

An accurate identification of the obstacles to green technology adoption and of the potential barriers to the strategic process' implementation would increase the amount of successful green policy, although the cost and convenience advantage remain the core value message in advertising and in social media, dimming green solutions and sustainable utility. Green technologies' adoption requires high entry costs facing social resistance because of the opposition of the typical consumer behaviour to change habits due to social influence. Thus,

[3] It allows the 'boomerang effect' to operate; when families realise they are using less energy than their average class, they start consuming more [36].

it is necessary to develop a specific proactive culture to facilitate the introduction of these new technologies. People must be attracted: it is essential to create the necessity first, and then the related tool as it happened with the mass customization based on the flexibility and personalization of custom-made products with the low unit costs associated with mass production.

4 Smart Meter Penetration in Europe

New technologies often face barriers because of traditional rules and values, finding resistance from social groups that slow their application [37]. A determinant for the successful implementation of initiatives is the level of their perception and acceptance, an issue carefully analysed in literature, since values drive change, progress and innovation. Among the others, the most relevant aspects are the perceived attitude toward technology (technology acceptance model [38-39]), the importance of trusting the agency providing services (government trust model [40-41]), and the characteristics of product and process (innovation diffusion model [42]).

European countries support smart meters in the introduction of renewable energy, a non-conventional energy source constantly replaced by nature. It is grabbed from the sun, directly and indirectly, or from other natural features of the environment, and advantage environmental sustainability towards a more desirable nature-climate equilibrium.

Renewables include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, and ocean currents, temperature differences in the oceans and the energy of the tides, via technological applications, producing power, heat or mechanical energy by converting them, either to electricity or to transportation power. They will bring considerable benefits from a consumer perspective, an environmental perspective, and an economic perspective, too. Promoting renewables appear to be the one of the most efficient and effective solutions for the future, very attractive in world energy-based economies [43].

However, also in Europe these measures found some social resistance; the lower the social resistance in the adoption of digital infrastructures, capturing the environmental capacity of a region to apply green technologies for a better future, the greater the potential comparative advantage of it over others. Smart metering is suitable more than others are, because it relates to the management of users' private information and data. The introduction of new grid technology faces also specific technical problems for each country: the increase in smart meters, which corresponds to a rise in the connected technology's usage, races the risks of violating consumer day life. Therefore, it is important to build up a 'sustainable consumer' culture. Energy smart meters are linked to a smart grid that, thanks to innovation technologies, permits a radical change of information among operators [44]. Their diffusion is strictly connected with a smart metering information system platform [45] that presumes a strong motivation (such as saving energy) for its use by intelligent consumers.

In Europe, individuals and firms show immaturity and lack of knowledge about the energy market structure and its operability. Thus, policy makers might not only support smart meters with regulation, but also educate people, instilling new cultural skills through hourly rates, complete information on the change of supplier, strong legislation on privacy and data protection, thus favouring social acceptance.

5 Methodology

We refer to a spatial analysis unit based on the EU-28 regions using data from the Benchmarking smart metering deployment [14]. In order to reach a greener and more sustainable Europe, the EU and national governments have set clear objectives to guide European environment policy until 2020 and a vision beyond that, of where to be by 2050, with the support of dedicated research programmes, legislation and funding, fixing some EU environmental priorities. Work is ongoing on many fronts to create new business and employment opportunities, which stimulate further investments. Each regional government have still direct responsibility for issues related to environmental protection, so that local policies on green technology (smart meters) could be used as a comparative indicator of the governmental support of each region for environmental protection.

Smart meters are electronic devices that collect data on household and firms' electricity and gas consumption in real time and offer consumers the opportunity of monitoring their energy consumption both locally and remotely. The idea is that through feedback, it is possible to gain consumption information in real time and change the behavioural attitudes. Smart meters reduce operational costs associated with meter reading, network monitoring and maintenance, improving billing accuracy and management, and enabling other important smart grid functions (time variant pricing and distributed renewable generation). Conversely, smart metering social acceptance is slowed by fears about privacy violations, rising electric and gas bills and loss of control over energy use [46][4].

In the EU-28, smart meters' penetration distinguishes electricity and gas supply. In order to achieve the European energy targets, in the last decades made people becoming familiar with this tool in the electricity sector, while,

[4] The collection and transmission of energy consumption data via smart meters cause privacy risks violating personal freedom opening to difficult jurisdictional and legislation issues among EU countries.

the situation is very different for gas meters. Their slow implementation is due to the cross-cutting nature that requires to involve different stakeholders (collaboration of national regulators, energy companies, technology providers, and consumers) [47]. Thus, smart meters' effectiveness is strongly influenced by policy coordination and implementation.

Electricity

Increasing evidence of climate change and growing dependence on energy has stressed the European Union's determination to become a low-energy economy and to ensure that energy consumed is secure, safe, competitive, locally produced and sustainable. In this view, since the Electricity Directive 2009b (2009/72/EC) EU countries have been forced to introduce smart meters by 2020.

European (regional) policy aims to have an 80% rollout by the end of the period, planning a saving target of at least 9% in household energy consumption. Previously, conventional electromechanical meters were used for measuring electricity flows: data were displayed on an analogic meter and recorded manually. Instead, smart meters measure energy consumption and bi-directionally communicate energy use, billing information, real-time price and power grid status [48-49]. The bi-directional communication capability is the most important difference that distinguishes them from the conventional system.

However, even if the positive impact of smart meters on energy efficiency is widely recognised, their diffusion is still lagging (Figure 2).

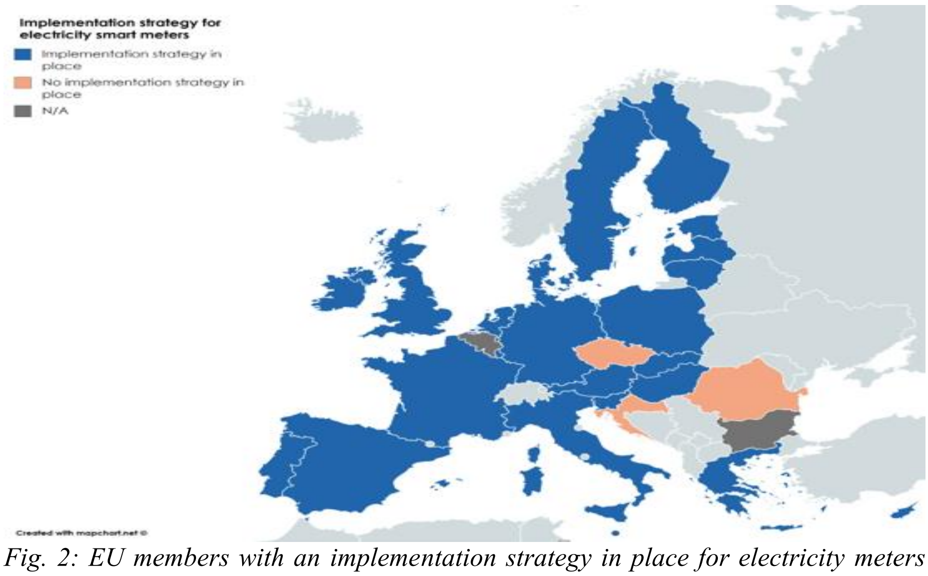

Fig. 2: EU members with an implementation strategy in place for electricity meters (legal provisions)
Source: [14, page 39]

The accessibility of different types of decentralised power generation has made information on production and consumption available, positively contributing to save energy supply and to decrease distribution costs, with evident improvements in efficiency and reliability.

For the power grid of the future, as the number of energy meters increases, an efficient maintenance technique able to query data from devices is essential. Through digital technologies, it is possible to construct and control the intelligent power grid in real time. IoT technology might share data across the network to improve the performance, transferring them to a remote location. In other words, digital technologies are shaping the paradigms of production and business models taking into account the needs of consumers as well of the social and environmental ecosystems. Smart meters share data only with the remote centre of the electric company with the aim of billing the real amount of user's energy consumption.

The smart metering rollout programme is part of the Third Energy Package, a legislative package for an internal gas and electricity market in the European Union with the purpose to further open up these industries within the area. It entered into force on 3 September 2009, and among other features, it includes ownership unbundling, which stipulates the separation of companies' generation and sale operations from their transmission networks, and requires each member to schedule verification of the real diffusion of this technological instrument.

From a legislative perspective, all countries that have complied with the Directive introducing smart meters are obliged to *ad hoc* legislative directions[5].

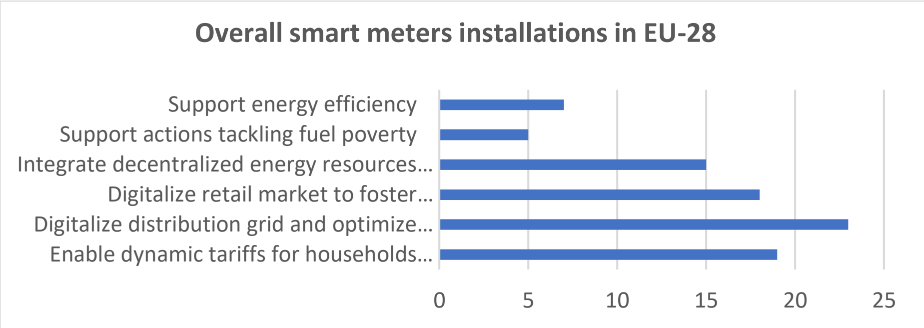

Fig. 3: EU members' motivations for introducing electricity smart meters
Source: Own elaboration on [14]

[5] Belgium introduced smart metering legislation in 2001, where Italy complied with the Legislative Decree 102/2014, approved on 4 July 2014. In the same year, most of EU member states showed a smart meter penetration rate below 10%.

Among the most relevant motivations that support the introduction of smart meters in Europe, more than 20 countries sustain this new technology for 'digitalizing distribution grid and optimizing network operations', while at the second level there are 'enabling dynamic tariffs for households and SMEs' (Figure 3). These two elements are in line with the global digitalised process and with the transition of Industry 4.0 [50].
At the beginnings, most EU member states showed a smart meter penetration rates very low, including United Kingdom, France, Germany and the Netherlands. Only recently, Sweden, Italy and Finland have achieved a market share of over 90%, ranking among the highest (Figure 4).

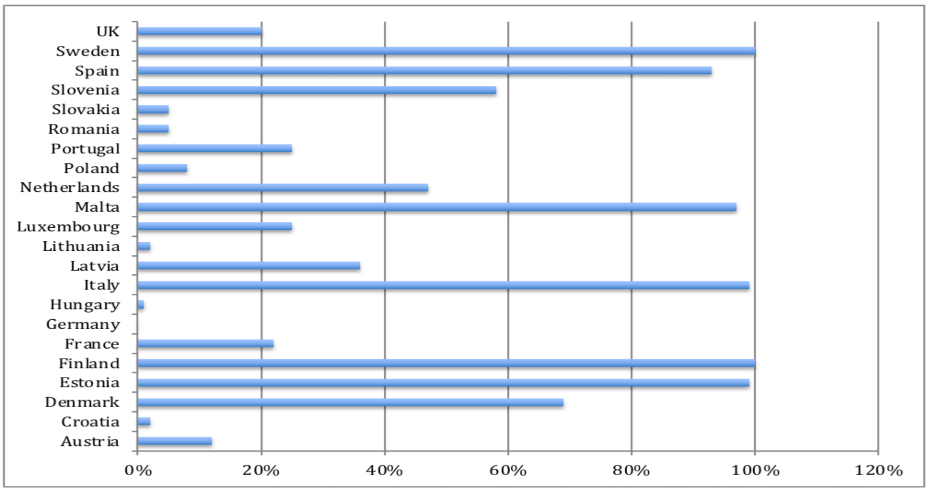

Fig. 4: Total smart meters penetration in Europe in 2019 (in percentage)
Source: Own elaboration on [14]

The case of Sweden is peculiar: it has been among the first European countries to implement and introduce large-scale smart meter reform, aiming to increase consumer awareness with more accurate electric bills to improve responsible energy consumption. Consumer demand for timely and accurate electric billing, low population density and the high cost of manual meter reading are the main drivers of smart meter implementation.

Denmark, Germany and Finland believe smart meters a useful technology for reducing carbon emissions, although Germany is lagging behind in adopting them. For Denmark, in particular, it is the best strategy to benefit from significant changes in electricity consumption and production. It aims to have 50% of electricity consumption from wind power by 2020 and 100% of total energy consumption covered by renewable sources by 2050.

Among the other countries, 22 have introduced electricity smart meters mainly from 2017, but are still left out Belgium, Bulgaria, Cyprus, the Czech Republic, Greece and Ireland.

Natural Gas

The progressive enlargement of the EU up to 28 Member States in the last decade (2013) is likely to suggest a new energy policy entrepreneurship in Europe, strong of considering newer member states' greater dependence on Russian gas imports and historically derived geopolitical suspicion of Russian foreign and energy policy. It became in short a real priority on the EU's agenda, based on the idea to implement policy actions for a 'self-sustaining dynamic'.

Focusing on gas, a large number of EC members tried to duplicate the same legal framework adopted for electricity meters, although they are still at an early stage. Some of them, with the implementation of the Third Energy Package, have managed to introduce specific measures and their own smart meters. The main limits rely to the higher investment connected to the IT infrastructure on which gas meters are potentially based on, smart meters introduction-adoption, maintenance costs and network management.

Directives 2009/72-73/EC and related regulations on electricity and gas attempt to push smart meters as a consumer participation's distinguished element in the internal market. In particular, these measures aim at a sustainable, competitive and secure energy supply. A cost-benefit analysis at the European level [14], based only on pilot projects, allows the European countries to be categorised into four groups[6].

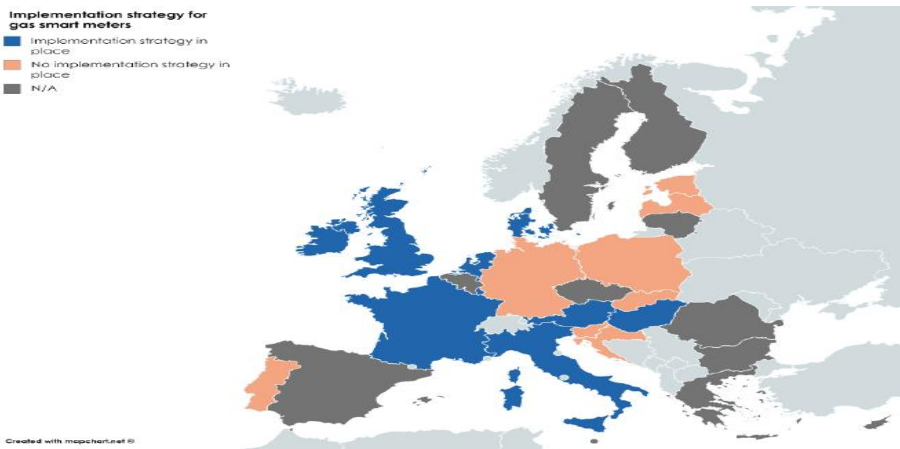

Fig. 5: EU members with an implementation strategy in place for gas meters (legal provisions)
Source: [14, page 75]

[6] They are: 1. Austria, Italy, the Czech Republic, Denmark, Finland, Germany, Lithuania, the Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden, with a cost benefit analysis; 2. Estonia, Greece, Bulgaria, Croatia, Hungary, Poland and Portugal, without any pilot projects; 3. Malta and Cyprus don't have a natural gas network; 4. France, Belgium, Latvia, Ireland, Luxembourg and the United Kingdom register two gas analyses.

Specific gas laws favouring smart meter penetration are recorded in several member states, but only Estonia, France, Luxembourg, the Netherlands and the United Kingdom have introduced gas meters (Figure 5). Belgium has been dealing with gas law since 2004, Hungary since 2008, Ireland and Italy since 2014 in response of the EU Directive on Energy Efficiency 2012/27/EU.

Gas shows more limits than electricity, since not all EU-28 countries have a natural gas network, and the associated costs and investments are higher than electricity. About meter installation in Europe, only France, Hungary, the Netherlands and the United Kingdom, both for SMEs and for households, have installed gas meters (Figure 6).

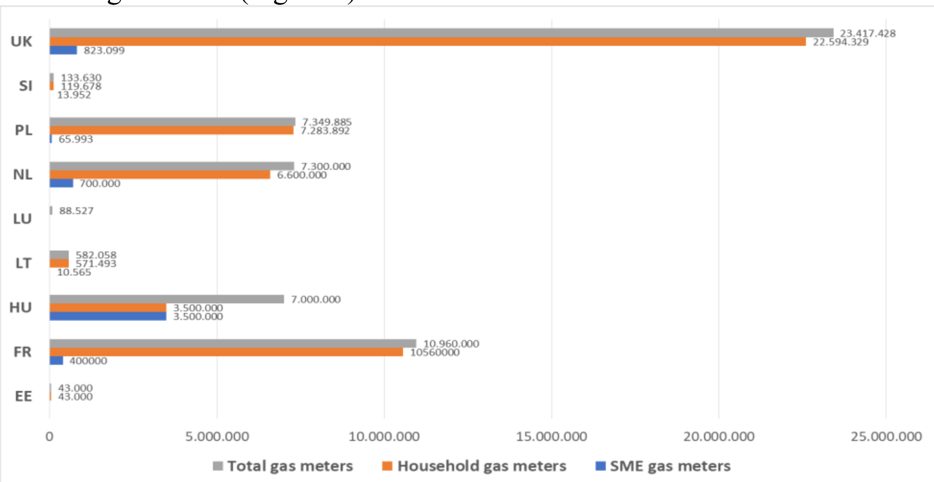

Fig. 6: Gas meters in EU-28
Source: own elaboration on [14]

The Hungarian case is very peculiar since its transmission system operator has interconnection points with Slovakia, Ukraine, Romania and Croatia, a unidirectional inlet point from Austria, and a unidirectional exit point to Serbia, serving a large part of Central Europe via a natural gas pipeline. Their SMEs register the highest number of installed meters (3,500,000), also because the primary law that enables smart metering for gas are the Natural Gas Act XL of 2008.

For household gas meters, the United Kingdom is the first European country (22.594.329) where – and from a legislative point of view – electricity and gas go at the same path. In Italy, the first legislative mandate was Law 99/2009, although the legislation enabling smart metering was the Legislative Decree 102/2014 when a smart meters roll-out national plan has been set by the Italian Regulatory Authority for Electricity and Gas in compliance with the 2020 deadline imposed by the European Union.

6 Conclusions

Environmental quality is central to our health, our economy and our well-being. However, it faces several serious challenges, not least those of climate change, unsustainable consumption and production, as well as various forms of pollution. According to the Third Energy Package, 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. It is also the effect of the research activities on sustainability transitions and regional diversification in the Digital Era due to the digitisation and standardisation of some services (internet, e-mail, etc.).

The vision for a green economy still ask high goals to be achieved. They largely depend on governments' willingness to fully embrace and implement the tools of a green economy. Sustainability can help to transform the current system of unsustainable economic activities into a future with a healthy environment and a more inclusive economy. Traditional indicators of economic growth (GDP) exclude externalities connected to the use of natural resources (among which are pollution and the loss of ecosystems) and the pricing of natural capital [51]. Therefore, it is necessary to find a mechanism through which each country can sustain green technological activities in a self-sustaining dynamic.

The economic policy debate has identified several areas where smart meters are expected to yield relevant benefits. They offer advantages for countries since they can lead to energy saving and can accomplish efficiency objectives: for the network operators who want to compete in digital, they allow for an improvement in the free market processes in terms of efficiency and effectiveness as well as for the users. However, the design, implementation and maintenance of the smart meter system present many problems, mainly related to the high initial investment. In a regulated market, it is presumed that there are no incentives to take risks. The situation is different in a liberalised market where the risks are calculated and weighed. The adoption of common national and international policies, laws and standards would make it possible to exceed the established limits. At present, it does not seem clear whether the difference between the benefits and the costs of adopting smart meters on a European scale is a positive one.

This work is pioneering since the implementation and adoption of smart meters is quite recent. The main limit of the analysis concerns the lack of detailed statistical information that would help in defining and tracing new business models. Data information could be useful to verify the proposed theoretical model and they can drive Governments in a common managerial sustainable vision. The adoption of green technologies desired by each country requires an information dissemination system useful for understanding the trajectories of sustainable development.

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