



HAL
open science

“Hands off my meter!” when municipalities resist smart meters: Linking arguments and degrees of resistance

Cécile Chamaret, Véronique Steyer, Julie C. Mayer

► To cite this version:

Cécile Chamaret, Véronique Steyer, Julie C. Mayer. “Hands off my meter!” when municipalities resist smart meters: Linking arguments and degrees of resistance. *Energy Policy*, 2020, 144, pp.111556 -. 10.1016/j.enpol.2020.111556 . hal-03490513

HAL Id: hal-03490513

<https://hal.science/hal-03490513>

Submitted on 22 Aug 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

“Hands off my meter!” When municipalities resist smart meters: linking arguments and degrees of resistance

Cécile Chamaret¹

Associate professor

i3-CRG, École polytechnique, CNRS, IP Paris
828 boulevard des Marechaux, 91128 Palaiseau Cedex, FRANCE
+33 1 81 87 21 83
cecile.chamaret@polytechnique.edu

Véronique Steyer

Associate professor

i3-CRG, École polytechnique, CNRS, IP Paris
828 boulevard des Marechaux, 91128 Palaiseau Cedex, FRANCE
+33 1 81 87 21 75
Veronique.steyer@polytechnique.edu

Julie C. Mayer

Assistant Professor

Université Paris-Dauphine, PSL Research University, CNRS, UMR 7088, DRM, Management &
Organisation, 75016 PARIS, France
Julie.mayer@dauphine.fr

¹ Corresponding author: cecile.chamaret@polytechnique.edu

“Hands off my meter!” When municipalities resist smart meters: linking arguments and degrees of resistance

Abstract

Despite smart meters are depicted as a core innovative device to support the clean energy transition, their roll-out is facing a growing resistance, not only from final users but also from an unexpected intermediary actor, such as municipalities in France. While previous research has considered intermediaries as a trigger for implementing new technologies, this article examines intermediary resistance. We study the case of municipalities’ resistance in France by using a quantitative clustering analysis on 444 municipalities’ reports, which detail their decision to reject smart meters. Findings reveal five argumentative strategies of resistance, which are associated to distinct degrees of resistance. Those results challenge previous research by inviting to study resisting actors as a heterogeneous group, and to further explore the particularities of the intermediary level of resisting actors. Our study also shed light on a trigger for resistance that has been neglected in the existing literature: the installation process itself and its potential flaws. Finally, we provide insights to overcome resistance for smart-meters in a context of “forced adoption”, by involving intermediary actors in all stages of the roll-out and adopting a differentiated strategy of communication toward them and also by reducing the imbalance between costs and benefits for end-consumers.

Keywords

Resistance; smart meters, intermediary actors; energy transition; innovation adoption

1. Introduction

In the 2000s, the European Parliament adopted two directives (2001/77/EC and 2009/72/EC) to promote the clean energy transition. The objectives were to reduce electricity consumption, empower consumers, and enable electricity producers and distributors to better manage their business. In 2009, the second directive introduced smart meters as one aspect of this policy. This directive notes that “[i]t should be possible to base the introduction of intelligent metering systems on an economic assessment. Should that assessment conclude that the introduction of such metering systems is economically reasonable and cost-effective only for consumers with a certain amount of electricity consumption, Member States should be able to take this into account when implementing intelligent metering systems”. It also sets a quantitative objective for European countries: “[w]here roll-out of smart meters is assessed positively, at least 80 % of consumers shall be equipped with intelligent metering systems by 2020”. This directive was transposed into French law through France’s August 17, 2015 “energy transition” law, which included the objective of replacing 90% of existing electricity meters with a new smart meter called Linky. The roll-out of Linky started in 2016. It is being managed in a top-down perspective by Enedis, the firm that operates the electricity distribution network across 95% of mainland France, with installation outsourced to a network of partners across the country. Enedis plans to have changed 35 million meters by 2021.

A smart meter is innovative as it uses new technologies but also modifies consumer habits. It is presented as providing numerous benefits for energy users, but also for utilities and energy providers, and society at large (Sovacool et al. 2017). The introduction of smart meters is acknowledged to be a critical tool for the transition towards intermittent renewable energies.

¹ <https://www.enedis.fr/linky-un-projet-industriel>

Some European countries are already starting a second large-scale roll-out of smart meters. However, in other countries there has been strong resistance to the new meters (e.g. the UK; Sovacool et al., 2017; Balta-Ozkan et al, 2014) which has sometimes caused their roll-out to be restricted to large consumers. In Germany, for example, only users (both households and companies) with average annual consumption above 10,000 kWh are currently required to have smart meters. This threshold will be lowered to 6,000 kWh in 2020.

Resistance to smart meters takes various forms, both individual (people preventing installers from gaining access to their traditional meter) and collective (forming groups or associations). Surprisingly, an unusual resisting actor has emerged at the intermediary level in France: French municipalities. Indeed, France is the only state within the European Union where municipalities are the official owners of the electricity meters. As they are bound by a public service delegation contract with Enedis, the French Distribution system operator (DSO), are not the users, nor the adopters of the new electrical meters. However, in most of the member states, the meter is owned by the Distribution system operator (DSO), although it can also be owned by the energy supplier (in the United Kingdom), the metering point operator (which can be the DSO, in Germany) or the consumer (in Spain) (Ergeg, 2007; European commission, 2014).

In 2019, more than 700 French municipalities, urged by local citizens to adopt a strategic stance in the smart meter roll-out, took steps to show their unease, concerns about or rejection of smart meter installations. In some cases the pressure from mayors (who are directly elected by inhabitants of their municipality) was so strong that Enedis postponed the roll-out, or allowed people to decide for themselves whether they wanted a new meter.

While extensive research on resistance to innovation has been conducted at the level of individual final users, very few studies examine such “intermediary” levels of resistance.

French municipalities' reactions to Linky therefore provide a novel case that can shed light on the overlooked resisting role of intermediaries in a new technology diffusion. The literature defines intermediaries as organizations at the interface between firms and other actors such as final users, whose role is to contribute to the innovation process (Howells, 2006). Intermediary actors are generally acknowledged to bring added value to innovation processes and technology diffusion, through knowledge sharing or federation for instance (Stadtler and Probst, 2012). Yet while the extensive literature on innovation resistance identifies various drivers (Ram & Sheth, 1989; Sovacool et al., 2017), it focuses exclusively on final users. Also, the research on intermediary actors has overlooked their potential to resist an new technology: this may differ from final users' resistance due to their specific role, place and power within the innovation process. Little is known about the drivers of such resistance, the correlation between the types of arguments used and the strength of resistance, and how they may differ from the case of individual actors' resistance. By exploring municipalities' stated arguments for resisting the French smart meter Linky, this article aims at answering the two following research questions:

How do intermediary actors express resistance to smart meters?

What is the relationship between intermediaries' expression of the arguments underlying their resistance, and the degree of resistance?

To answer those questions, this study uses a quantitative design. We performed a cluster analysis based on the decision reports by municipalities which resisted the roll-out of smart meters in France from 2016 to 2018. Our findings reveal five different resistance profiles, which are associated with three degrees of resistance. We show that beyond traditional perceived risks related to the technology, arguments such as meter ownership and data

sensitivity are likely to cause the strongest forms of intermediaries' resistance. Our results also highlight geographic patterns of resistance.

The main contribution of this article is that it unfolds an under-studied phenomenon, intermediaries' resistance to innovation, exploring the expression of resistance by municipalities and challenging the traditional view that intermediaries (only) act as a positive trigger for a new technology diffusion. Furthermore, our study highlights that resisting actors, in our case municipalities which are intermediary actors, do not constitute a homogeneous group, but respond to different sets of risks and aspects of the roll-out process. Finally, our results shed light on a new trigger for resistance that is not identified in previous literature on smart meters: the installation process itself and its potential flaws. We therefore provide insights for future roll-outs of new devices that may be perceived as undesirable.

2. Literature review: understanding resistance to innovation in the case of smart meters

2.1. Resisting smart meters

Smart meters differ from traditional meters in three main ways. Through their Automated Meter Reading (AMR) Technology, they accurately measure electricity (or water or gas) consumption on a potentially real-time basis. They communicate data at a higher frequency and enable two-way communication between the consumer and the supplier. They cannot themselves be considered as smart grids, but they constitute an innovative tool to regulate and monitor the electricity network (Gungor et al., 2011). A smart meter can thus be described as triggering a disruptive innovation process, as it involves a new technology, changes ways of interacting with the product, with stronger customer involvement and digitalization of

interactions with the supplier, and finally, it operates in a business environment that may be challenged by the development of smart grids (Marvin et al., 1999).

Since the beginning of their roll-out, smart meters have increasingly attracted scholars' attention. In the UK alone, Sovacool et al. (2017) identified 47 articles dealing with the National Smart Meter Implementation Program. A plethora of studies also explore the roll-out of smart meters in other European countries, such as Germany and Portugal (Pereira et al., 2018), Switzerland (Kaufmann et al. 2013), Norway (Inderberg, 2015), and non-European countries, such as Australia (McHenry, 2013) or the USA (Krishnamurti et al., 2012). While their focus ranges from deployment strategies (Jennings, 2013) to technology concerns (Pereira et al., 2018), very few of these studies address the resistance shown to the technology itself (Sovacool et al. 2017).

Resistance, despite its recurrent emergence in several countries, thus remains an overlooked aspect of smart meter roll-outs, even though it generates critical challenges. As Krishnamurti et al. (2012:792) observe, most of the analyses “assume smooth, rapid dissemination of smart grid technologies with full consumer understanding and little consumer resistance”. Nonetheless, some scholars point out growing problems resulting from resistance, which tends to slow down, complexify, and sometimes even halt the roll-out of smart meters (Sovacool et al. 2017). Dealing with resistance to smart meters is challenging for two reasons. First, while resistance is likely to happen when new technologies are introduced, its manifestation is rather counterintuitive – if not paradoxical – in the case of smart meters, a technology designed with the aim of addressing major societal challenges while providing added value for consumers. Second, as resistance to smart meters emerges from heterogeneous actors and takes various forms (Mela et al., 2018), it cannot be addressed

through a one-size-fits-all solution. To further explore these aspects, we draw on the existing literature on resistance to innovation.

2.2. Drivers and degrees of resistance

Resistance is a common response to new devices or practices. It is not limited to late adopters and can arise at earlier stages of a new product's arrival on the market. Following the call by Gatignon & Robertson (1989) for studies to consider resistance as based on specific variables, which are not necessarily identical to the central variables in innovation adoption, Ram & Sheth (1989) were the first to conceptualize resistance to innovation and brought out five barriers that consumers can erect when resisting innovations. They identified functional barriers and psychological barriers. These psychological barriers consist of tradition and image barriers. Tradition barriers relate to the cultural changes that an innovation can trigger, while image barriers are associated with product identity (category, brand, country of origin for example). These barriers vary according to the nature of the products concerned. Functional barriers encompass usage, value and risk. Usage barriers exist when an innovation requires dramatic changes in habits and practices. Value barriers challenge the performance-to-price value compared with potential substitutes. Risk barriers arise when consumers perceive risks related to the innovation, whether they are proven or unproven. An extensive body of literature examines resistance to innovation through the unique but extensive lens of risk perception. The perceived risks may be functional, social, physical, or psychological (Jacoby & Kaplan, 1972) and help to understand and predict consumer behavior (Featherman & Pavlou, 2003).

Returning to the specific case of electricity smart meters, previous research has shown that they can encompass various drivers of resistance, not limited to risks. Table 1 provides a summary of those drivers. For instance, Wilson et al. (2017) show that consumers in the UK

question the value of the new technology (perception of the object as a non-essential luxury) and perceive different kinds of risks (related to their privacy). Sovacool et al. (2017), reviewing research on the UK case, add health risks to the other perceived risks, as well as concerns about the robustness of data security, and possible acts of cyberterrorism or hacking. While Wilson et al. (2017) report that few of their survey participants saw the smart meter as a disrupter of their daily usage, other respondents were concerned about a potential loss of control over their electricity consumption, which could reduce comfort and disrupt household routines (see also Balta-Ozkan et al., 2014; Buchanan, et al., 2016; Sovacool et al., 2017). These risks are accompanied by mistrust of the electricity suppliers (Buchanan et al., 2016). McHenry (2013) and Khrishnamurti et al. (2012) also underline other types of risks associated with smart meters perceived by Australian and American consumers (specifically financial and functional risks). Beyond those drivers specifically associated to smart meter, the literature on innovation adoption outlines further drivers of resistance, such as psychological risk and image. Studying the case of medical artificial intelligence, Longoni et al. (2019) observe that the resistance to a new uncertain technology is stronger for consumers who perceive themselves to be more unique. Antón et al. (2013) highlight the role of self-image as a determinant of adoption of new devices such as e-books. Consequently, we also consider those two additional drivers as potentially relevant to explain resistance to smart meters.

Table 1: Research-identified drivers of resistance in the case of smart meters

Resistance comes in varying degrees. Previous research identifies three different attitudes when resisting innovation: postponement, rejection and opposition (Szmigin and Foxall, 1998). Following Kleijnen et al. (2009), we consider that postponement is the decision not to adopt an innovation yet. Rejection is a “strong inclination not to adopt the innovation” (Rogers, 2003) at all. Finally, opposition appears when consumers object to the innovation

and decide to fight it². Kleijnen and her colleagues (2009) empirically investigate the antecedents of resistance and highlight a recurring pattern of connection between the nature of antecedents and the form of resistance observed. For example, they found that economic risk and situational factors are more likely to trigger postponement, whereas the perception of physical risk coupled with a perceived conflict with society's existing traditions and norms will more often result in opposition. However, there is no evidence that the same arguments would lead to the same degrees of resistance for different types of actors - especially actors which are supposed to be positive contributors to innovation diffusion.

2.3. Intermediary actors resisting innovation

The literature on innovation process frequently mentions the role of intermediary actors in the diffusion of a new technology (Hodson and Marvin 2010). Intermediaries can be defined as “[a]n organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties” (Howells, 2006: 720). The term encompasses a range of different actors who influence all aspects and stages of the innovation process, such as suppliers, consultants, governmental organizations or development agencies. Intermediaries' roles are defined by the nature of the activities they perform and the mechanisms of value creation in which they participate (Sunday & Wilson-Prangle, 2018).

Despite a diversity of typologies (e.g., Agogue et al., 2013; Kivimaa, & Martiskainen, 2018), scholars generally acknowledge three roles for intermediaries (Stewart & Hyysalo, 2008) in the diffusion of a new device. First, intermediaries play a facilitation role by providing a favourable physical, social, cultural, economic and regulatory environment for the innovation process. Second, through a configuration role, they create technological and symbolic content to influence user adoption. Third, they have a brokering role, which is essential to negotiate with and gain support from other actors such as suppliers or sponsors. Intermediaries can also create value by reducing costs or enhancing scopes of the innovation process (Lin et al., 2016). These roles vary depending on the actor's profile (e.g., public or private partner),

² We follow the typology of Kleijnen et al. (2009), not Szmigin and Foxall (1998), who consider opposition the most extreme case of resistance.

capacities (e.g. their ability to capture and retain knowledge), and position in the innovation network, and the innovative stage in which they intervene (Weber & Heidenreich, 2018). All these roles suggest that intermediaries systematically have a positive influence on the diffusion of a new technology [\[JM1\]](#) .

However, considering intermediaries' willingness to cooperate as a "taken-for-granted" condition is a questionable assumption [\[JM2\]](#) . In some contexts, the diffusion of a new technology needs inputs from actors who may be unwilling to play an active part, or even show resistance. Some would argue that actors who see no point in cooperating with the organization behind a new technology can be discarded from the innovation process, or managed through control and incentive mechanisms (Lichtenthaler, 2013). But some innovation processes rely on actors that are obligatory "passage points" (Boon et al., 2011), if their development or diffusion relies on a given actor's key resources, knowledge or strategic position in the innovation network (Huxham & Vangen, 2000). Those "inescapable" actors may consider that they are enforced to adopt the new technology, feel uncomfortable or even jeopardized by the related changes. In addition, in contexts of public-private innovation processes such as a smart meter roll-out, in which businesses have dealings with local authorities at different levels (Hyysalo et al., 2018), their role as intermediaries are not always clearly defined. This can lead to a variety of interpretations and forms of involvement, that may either foster or block the diffusion of the innovation.

In those situations, we argue that intermediaries may also threaten the success of an innovation process, or at least constitute a serious obstacle. Indeed, by definition, intermediaries benefit from a mediating position and key resources (Howells, 2006; Agogue et al., 2017), which can both accelerate or restrain the development and diffusion of a new technology. First, instead of helping to involve users, intermediaries can rely on their privileged connections to spread a negative perception or to encourage final users not to commit into the technology. Second, they can use their intermediary position to build formal or informal networks of resistance, by reaching and connecting final users and other intermediaries. Third, the relation between the innovating firm and its intermediaries can face classical "agency problems" (Jensen & Meckling, 1976): while firms often rely on intermediaries to help them mitigating conflicts of interest (Agogue et al., 2017),

intermediaries can take advantage to defend their own stakes. If the firm does not have a high level of control on them, intermediaries can easily distort messages or instructions toward final users for the benefit of their own interests.

Only few studies explore intermediaries' willingness or unwillingness to cooperate with the organization behind the technology (Lauritzen, 2017). While there is ample knowledge from previous research on what intermediaries do and how they contribute to create value, less is known about why they decide, agree, or alternatively refuse, to play an intermediary's role. Consequently, there is a need to better understand why and how intermediaries come to put up resistance when intermediary actors take a negative view of a new device, or are unwilling to support it, a singular form of resistance may emerge. We argue that intermediaries' resistance may differ from final users' resistance, due to the intermediaries' specific interface role, position and power in the process of innovation, as previously described. We thus formulate the two following research questions: how do intermediary actors express their resistance to smart meters? What is the relationship between intermediaries' expression of the arguments underlying their resistance and the degree of resistance?

3. Methodology

3.1. Data collection

In France, if municipalities are the legal owners of the electrical meters, they are not the users of these devices: they have transferred the use right of the object through the public service delegation contracts they signed with the Distribution system operator (in France Enedis). As a result, the data collected by the meter is traditionally intended for Enedis to meter the electrical consumption of the end user, and the devices are located within the end consumers' home. To seduce the end consumers and make them accept to have these new devices within their home, Enedis has largely communicated about new services that would be offered to them, notably saving money and contributing to energetical transition through being able to monitor their own consumption in real time. As such, smart meters in France are intended to

have two users: both Enedis (remotely), and the end consumers ; and the technology to be deployed must convince two adopters: both Enedis, as traditional recipient from the metering capacity, and the primary adopter, and the end users that should accept the device at home and are intended to become a key user of the technology. Being in charge of the national roll-out of the new smart meters, Enedis is also acting as the innovative agent trying to convince the end consumers to adopt it. In this paper, we specifically focus on this part of the story. In this configuration, municipalities appear to be an intermediary, at first neglected by Enedis : they are not the users, nor the adopters (because of the public service delegation and because the device is within the consumers' homes), but have still the possibility to (try to) reject the new meters, having the legal ownership of the device.

The data were collected from municipalities' reports detailing their decision to reject Linky smart meters. In France, municipalities' resistance to electricity smart meters is reflected in the decision made by 7933 municipalities to refuse installation of Linky meters. This decision is made by a municipal council vote. Reports of the relevant council meetings (including the nature of the decision, the number of votes, and the reasons given for the decision) are public and published online. We collected a total of 542 such reports published from April 2017 to May 2018. We discarded all reports with insufficient detail, leading to a final sample of 444 reports. This sample encompasses villages, towns and cities from all regions of France. Their sizes vary from 6 to 142,700 inhabitants, with a mean of 5,526. 50 of them are considered "very urban" by France's National Institute of Statistics, and 237 as "very rural". In between are towns with 1,000 to 10,000 inhabitants.

³ As of April 2019.

3.2. Dataset creation

From the reports in our sample we constructed a database, using a coding grid derived from prolific literature on innovation resistance, which we supplemented during the coding process with emerging insights from the municipalities' discourses. For example, when they expressed reasons which were not documented by previous research, we added a new coding variable. At the end we kept only variables with several occurrences. Operating in such an inductive way has two main benefits: we are able to test and compare resistance variables with previous research and we can potentially discover new drivers of resistance specific to the case or not. Examples of our coding scheme are available in the appendix. To limit potential bias, three researchers took part in the coding. A first coding sample of 50 reports and a coordination meeting helped to clarify, compare and homogenize the coding protocol. The researchers also limited bias through a double-check procedure. For each municipality we coded three dimensions, corresponding to the key points of divergence between municipalities' discourses: the nature of the decision, the perceived risks and the arguments indicating the reasons for the decision.

The first dimension, the nature of the decision, relates to the degree of resistance (coded as NivOpp). Following previous research, we distinguished different degrees of resistance, from a desire to leave the choice up to the final consumer, to postponement of the smart meter roll-out, to rejection of smart meters.

Table 2: Degrees of resistance observed in the reports

We then coded the second dimension, the perceived risks. We distinguished seven types of risk perceived by municipalities. They comprise both the perceived risks traditionally identified in the literature (economic, functional, health, ethical) and emerging risks specific

to the Linky case study (relating to privacy, terrorism and hacking). Coding of those risks was based on their presence (1) or absence (0). Regarding the third dimension, the arguments underlying the decision, we highlighted twelve emerging arguments used to justify municipalities' decisions, such as the fact that they owned the electric meters, or that Enedis was forcibly installing Linky meters. Appendix 1 provides an explanation and examples of the coding.

Beside the municipalities' discourses on risks and the arguments given to justify their decision, we also gathered data on municipalities' attributes, such as their geographical location, their population size and the date of their decision. This database made it possible to standardize the data for the analysis.

3.3. Cluster analysis

We undertook a hierarchical clustering analysis to find homogeneous groups of municipalities in terms of arguments. This method is intended to create groups with maximum internal cohesion and maximum external isolation. We performed the analysis using the technique employed by Ward (1963), which generates a classification hierarchy with minimum variance within each of the groups. We also used Sokal & Sneath's coefficient of similarity. The analysis was carried out using R software. The clusters were identified from 20 binary variables (1: presence; 0: absence) reflecting the arguments or perceived risks leading the municipalities to resist the new technology of Linky smart meters. The dendrogram resulting from the analysis drove us to keep five different groups. As figure 1 shows, this is the optimal number of groups in terms of distance (i.e homogeneity) separating the groups. More groups would mean more homogeneity between groups.

Figure 1: The dendrogram resulting from the statistical analysis

4. Results

4.1. Emergent perceived risks and a lower degree of resistance in the case of forced adoption

Our research first revealed emergent risks perceived specific to the case studied. We specifically recorded a significant fear of the potential use of data generated by electricity users. This perceived risk is divided between piracy, terrorism but also potential commercial use by third parties. Our data also show that forcing the adoption is an argument which is often used against Enedis. Also, in line with rising ecological concerns, a new argument emerged questioning the need to replace a working device by a new one. This new argument is interesting as it questions the social role of innovation.

Considering that the roll-out of smart meters results from a European Union decision, it produced different degrees of resistance at different levels. We identified the individual level of resistance (consumers trying to prevent replacement of their own meter), ad hoc groups fighting against the roll-out, consumer associations highlighting the pointlessness of the replacement etc. More surprisingly, municipalities emerged as an important level of resistance against the Linky. Urged on by local citizens, who felt they were too small to fight the introduction of smart meters, municipalities took official decisions about the roll-out on their territories. Those decisions (see table 2) range from letting people decide for themselves whether they want a new meter, to a total ban on installation of smart meters. Between the two is the intermediate decision to postpone the roll-out until more information is provided by the authorities.

Table 3: Degrees of resistance to innovations in the literature and against Linky smart meters (at municipality level)

4.2. Five different groups of resisting municipalities

The first aim of our analysis was to see if different argument strategies were followed by the French municipalities expressing resistance to the Linky smart meter roll-out. Our cluster analysis revealed five different clusters of municipalities, each using different arguments to support their decision to resist the mandatory roll-out of Linky on their territory (see figure 2).

Figure 2: Five different argument strategies used by the resisting French municipalities

We then wanted to see if those argument strategies were associated with specific degrees of resistance to the Linky smart meter, as revealed through the nature of the decision taken by the municipalities. From the weakest to the strongest degree, that resistance consisted of leaving the choice up to individual citizens, postponing the roll-out across the whole municipality, and refusing the roll-out.

The first cluster (in green in figure 2) consists of municipalities we labelled “risk averse”, because they use only arguments related to perceived risks and uncertainties attached to smart meter installation in private homes. This group specifically puts forward three types of risks and uncertainties: the functional risk of the chosen technology (risk of smart meter dysfunctions and potential impacts on households’ electrical equipment, fire hazards due to faulty installation, or incompatibility with existing electrical appliances), the health risks (notably the fear of negative health effects from radio frequency waves) and potential misuse of private data by commercial organizations or public authorities⁴.

Interestingly, the municipalities in this cluster almost unanimously opted for postponement of the smart meter roll-out (calling for a moratorium). This is consistent with applying the

⁴ NB: the risks of cyber terrorism and illegal uses of data by hackers were coded separately (respectively RISQ_DATA_TERR and RISQ_DATA_PIR)

precautionary principle when confronted with uncertainties and perceived risks that are considered to require further scientific studies.

The second cluster (in red in figure 2) consists of municipalities that use a specific kind of legal argument to prevent the smart meter roll-out. As that roll-out was defined as a requirement in the national French energy transition law, local authorities would not normally be able to oppose it. An increasing number of municipalities are well aware of such difficulties, as a growing number of local council bylaws have recently been overruled by national Administrative Courts. But in France, the distribution of electricity is a public service that falls under the responsibility of local authorities, which are the owners of the local electricity meters – explaining the label given to this cluster, “owners”. The ownership argument strategy they use can be interpreted as municipalities looking for loopholes in French law. The distribution network belongs to the State, which then subcontracts network operation to Enedis through a public service delegation. Enedis thus carries out public service duties related to electricity distribution. But as the meters are the property of the municipalities, in this interpretation of the public service delegation, Enedis would require local council authorization to replace the current meters. By refusing to give such authorization, those municipalities thus hope to prevent the roll-out on their territories. This position indicates a stronger degree of resistance than in the previous cluster, as it demonstrates more active involvement by local councils, looking for legal solutions to achieve their ends. However, the arguments debated during the council meetings in the lead-up to their decision cannot be inferred from the text of the bylaws adopted.

The third cluster of municipalities (in blue in figure 2) combines arguments relative to ownership of the meters with arguments relative to perceived risks and uncertainty about the

health effects of the technology deployed and potential violations of privacy, while also questioning the necessity and ethics of the smart meter roll-out. Stressing the fact that the current meters work perfectly well⁵, they question the economic and ecological cost/benefit balance of replacing them, arguing that the roll-out is at odds with the official “green” aims of the law. We name this cluster the “ecologists”. At a deeper level, they seem to be challenging and opposing what they call the “neo-liberal” logic underlying the smart meter roll-out. They express concern at the volume of unskilled job losses resulting from the end of on-site meter reading. As a local authority, they refuse to support what they see as a measure that promotes commercial interests over the interests of ordinary citizens. Not surprisingly, this cluster resists by rejecting the Linky roll-out on their territories, showing the strongest degree of resistance observed.

The fourth cluster (in yellow in figure 2) follows a comparable argument strategy, combining concerns about perceived risks and uncertainty (related to health, and privacy) with two arguments that can be interpreted as an attempt to ground their decision in areas under their jurisdiction: ownership of the meters, and fear of public disorder engendered by citizens obstructing smart meter installers. Maintaining public order and safety is an important duty of French mayors. These arguments are accompanied by complaints about the poor management of the new meter installation campaign, which is using underskilled installers with an unprofessional attitude. This cluster appears to consist of municipalities concerned by the uncertainties and risks attached to the smart meter product, but less worried about societal change. Recognizing that it is difficult for local councils to adopt bylaws on this matter that cannot be overruled by the Administrative Court, they are particularly distinguishable by their search for arguments relating to jurisdiction. We name this cluster the “guardians of public

⁵ In this respect the French case is quite different from the UK case, where many electricity meters dated back to the Victorian era and significant inaccuracy was a concern (Sovacool et al., 2017).

order and property”. Their arguments are more dispassionate, and these municipalities are less homogeneous than the previous cluster in terms of decisions taken, covering the whole spectrum of resistance degrees.

The fifth and last cluster (in purple in figure 2) claims that the new smart meters offer no benefits for individual consumers, and also perceives more diversified risks relating to their installation in private homes: beside the health, privacy and functional risks, they emphasize the risk of higher bills for the consumer, the risks of cyber-terrorism and data hacking, and risks to do with flaws in the insurance system, as smart meter-related dysfunctions and fire hazards are not covered by private home insurance, yet Enedis’ terms and conditions disclaim all liability. This cluster also justifies its position by emphasizing failures or limitations of smart meter roll-outs in other countries or municipalities. Like some of the other clusters, they put forward arguments supporting their right to issue bylaws on the topics (ownership of the meters, maintaining public order), highlighting the local council’s legal liability in the event of any incident resulting from the smart meters, by virtue of their ownership of the meters, to justify their right to issue bylaws. Like the “ecologists”, their discourse reflects a more dissenting stance, contesting the necessity and the economic and ecological costs of the Linky roll-out. They also denounce the mandatory nature of smart meter adoption, considering it as a denial of democracy. Most municipalities in this cluster take a rejection stance, with a minority opting for postponement, and a few for citizen’s choice. Their use of numerous arguments led us to name them the “pragmatists”, as they appear to have sought far and wide for arguments to strengthen their position.

Figure 3: Linking clusters and degrees of resistance

4.3. A geographically-determined phenomenon

The analysis reveals that the discourses of resistance are geographically determined.

The distribution of resistance profiles differs by region. In particular, the "risk averse" profiles are exclusively concentrated in one very small part of France (see Figure 4). Owners are also very concentrated in the South-East part of France. The concentration of other profiles of resistance is more widespread but we can interestingly spot bastions of resistance: in the north-west part of the country for the guardians, in the south-west for the ecologists and in one particular department for the pragmatists (Lot et Garonne). This suggests the existence of a mimicry phenomenon in the discourse of resistance (partly confirmed by the observation of word-for-word identical arguments in some decision reports).

Figure 4: geographical concentration of resistance by groups

The distribution of resistance profiles differs by type of municipality. Although the majority of our sample municipalities are rural (60%), the resistance profiles vary. For example, risk averse towns are exclusively rural. Urban populations are more likely to fit the "guardian" and "pragmatist" profiles. This suggests location-related specificities which drive differentiated perceptions of the new technology.

5. Discussion

This study aimed to unfold the resistance shown by intermediary actors – villages, towns, and cities, referred to collectively as municipalities – to the adoption of smart meters. Through a quantitative analysis of French municipalities' arguments for resisting the roll-out of Linky smart meters, we shed light on distinctive profiles that are associated with specific forms of resistance. We find that a high degree of resistance, i.e., rejection, is closely linked with

arguments of local electricity meter ownership or the lack of any benefit. Rejection is also supported by arguments related to risk, but we observe that risk averse municipalities which use only risk-based arguments opted for postponement of the roll-out rather than rejection. We observe an exception in the “ecologist” cluster, which mainly justifies its rejection of smart meters by risk-related arguments. This ambivalent role of risk can be interpreted as a resistance driver: on the one hand, the “ecologist” cluster refers to risk to support an irrevocable ideological protest against the capitalist system in general; on the other hand, the “risk averse” cluster refers to risk to justify a prudent response to a situation of temporary uncertainty. Furthermore, we find that lower degrees of resistance, i.e. postponement or leaving the choice to citizens, are related to arguments concerning the actual installation of Linky smart meters and municipalities’ roles (such as maintaining order or protecting their citizens’ health and privacy). These results have several theoretical implications.

First, this study provides additional evidence of innovation resistance from a specific case of forced adoption. It helps to see which arguments underlie the strongest forms of resistance. We challenge the results of Kleijnen et al. (2009) who link opposition to the perception of physical risks and a disruption of traditions and norms. In the case of French smart meters, arguments relating to ownership of the meters combined with the claimed absence of benefits, perceived macroeconomic and ethical risks, and arguments that the current meters are working perfectly well, are the arguments that are associated with the highest degree of resistance, rejection (95,7% of the “owners” cluster opted for the rejection of Linky). Conversely, the combination of perceived health, functional, and data risks and ownership arguments are associated with the weakest form of resistance. It seems that municipalities using only the ownership argument (and resisting through rejection) use legal arguments as a strategy for the most effective resistance. Analysing official local council reports only is a

limitation in this case study, as it is possible that many other arguments, not stated in the reports, may have driven them to resist.

Second, this research challenges the general assumption that resisting actors are homogeneous (Wilson et al., 2017). The case of resistance to smart meters suggests that a distinction should be made between final users and intermediary actors, such as municipalities, which can also engage in resistance. While municipalities' resistance can reflect final users' concerns, in many cases it also directly expresses local councils' opinions. Within this category of actors, we highlight five types of resistance, each supported by a specific argument strategy. While we find similar categories of arguments to justify resistance, either related to risk (i.e., physical 71,2%, functional 30% and economical 30,4%) or value (lack of benefit and necessity 29,1%) compared to previous literature, we show that those arguments are used in heterogeneous ways. These considerations indicate a need to further explore different individual and collective reactions to introduction of a new technology, and better understand how the underlying context of change and processes could explain them (Oreg et al., 2018). In our case, the variety of arguments used and of the decisions taken by the "Guardians" cluster is a topic that specifically deserves further investigations, using more in-depth methodologies, e.g. interviews of the municipal council's members of a sample of "guardians" municipalities. Overall, a future research avenue could be to explore how the diversity of arguments used by French municipalities might be the symptom of the widespread defiance the citizens are nowadays displaying against its political ruling class. This growing tendency, which does not only touch France but also other democratic countries (Armingeon & Guthmann 2014; Norris 2011), recently culminated in the country during the "yellow vests" movement, a popular response to an "intense crisis of political trust" (Grossman, 2019). Third, our results suggest that part of the resistance observed is not directed at the technology itself, but rather to the attitude of the people imposing or installing it, echoing Ford and colleagues' findings on

organizational change management (2008). In the Linky case, a significant share of municipalities' arguments consisted of criticisms of Enedis' commercial intentions (30%), or of how Enedis (or its subcontractors) were forcing the public to adopt the new meter (13,3%). This calls for further studies to explore dimensions of resistance that relate to the nature of the relationship between innovation-supportive agents and users (Thomas et al., 2011), and the process of new technology implementation.

6. Conclusion and policy implications

Finally, our findings have practical implications for policymakers.

First, electricity meters concern several stakeholders, including actors that play an intermediary role between the installers and the final users. The French case singles out as the only exemplar within the European Union of an actor outside of the energy value chain and owning electric meters. This kind of configuration enables such intermediaries to take part in resistance movements' emergence and inflation, by bringing back to the debate pre-existing defiance and larger issues of concerns, sometimes loosely related to the new technological device. As such, our analysis drives to recommend to secure ownership of the meters with a stakeholder who could directly benefit from the roll-out (whether the customer, the DSO or the energy supplier). This could help overcome the potential blockage of such "in-between" actor by transforming it into a "user", so as to align interests by making it benefit from the advantages of the new object. This could however be not possible. In all cases, and most importantly, our analysis highlights the need for proactive, differentiated communication during the roll-out of smart meters. As local councils can be a trigger or an obstacle to the roll-out of smart meters, a specific communication strategy should be defined for them. This includes not only reassuring them about the risks for electricity meter users, but also convincing them that the new technology does not jeopardize their particular objectives and

duties, such as protecting the local population or maintaining public order. Furthermore, companies using subcontractors to install their smart meters should ensure that they are properly trained to communicate with potentially reluctant users. They should also be careful about how they incentivize them. Some of the problems encountered in the French smart meter roll-out seem to relate to the fact that the installers are paid on a piecework basis. This gives them no incentive to take time to fully inform final users and make sure they give explicit consent. In addition, our results suggest that municipalities' resistance profiles are geographically determined due to resistance contagion and specific local circumstances. These small regional clusters show that local networks (friendships, local media) remain important players in the adoption of a new technology, or - conversely - in the emergence of a resistance movement against it. Our results thus invite national players to set up a differentiated watch, in particular by monitoring the local press and media to spot as soon as possible "weak signals": local officials, media or municipalities who could feed a negative posture and influence their neighbourhood. This should nourish a decentralized response: for instance, regional division could be in charge of geographically differentiating communication and implementation strategies, while national level would keep coordination between these regions in the response to be adopted, to ensure a consistency essential in this age of Internet. This could limit the risks for policy makers of getting the strategy wrong by being unaware of local specificities and networks.

Second, the policy makers should better balance the cost-benefits analysis for end users. Our data proved a lack of perceived benefits and strong data sensitivity. The roll-out strategy is therefore caught in a vicious circle: to conceive and offer benefits (e.g. advanced off-peak tariffs to end customers, algorithms to better monitor the network state) it requires technical specifications (Sanchez-Sutil et al., 2019) but also customers to agree to give access to their

data with a high degree of accuracy and frequency (on an hourly basis instead of a daily basis). The technical specifications of the Linky⁶ enable such services to be properly offered to customers. But on the customer side, the French Data Protection Authority authorizes the meter to transmit a daily average of electrical consumption by default. Detailed data cannot be collected and transmitted without the express consent of the consumer. Customers could be ready to give their consent if they perceived benefits (McKenna, Richardson & Thomson, 2012). To overcome such limitations, the period of voluntary installation could especially target techno-enthusiastic customers, providing them with better support for self-usage of the data locally produced by the smart meter and a reinforced communication of what data is needed for what kind of services. This could be further the opportunity to highlight the 'privacy friendly' alternatives techniques (McKenna, Richardson & Thomson, 2012) deployed by the third parties (DSO, energy suppliers, etc.) allowing to minimize the amount of data needed and collected, as signs of care and marks of trustworthiness.

Finally, the French case offers lessons concerning the forced adoption of smart meters. Instead of making the installation of smart meters mandatory, a compromise solution could be to temporarily leave the decision up to consumers, as has been done in the UK (Sovacool et al., 2017), or up to the municipalities in view of their intermediary role. After a successful period of voluntary installation in some areas, other areas may be more easily convinced.

To conclude, our research sheds light on resistance to innovation from an original level of analysis: the intermediary level of municipalities. To deepen this perspective, interviews

⁶ Technical specifications of measuring instruments are regulated and available following this link : <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0032&from=EN>. Note that according to the latest information and classifications, Linky is class b. More technical information on Linky are available for readers with this link « Sorties de télé-information client des appareils de comptage Linky utilisés en généralisation par Enedis » [archive] [PDF], sur enedis.fr, Enedis, 15 octobre 2014 – mise à jour 1^{er} février 2017 (consulté le 18 mars 2017), p. 14-28/32.

could be conducted with the mayors engaged in resistance against smart meters, to identify any difference between the official discourse (analysed in this article through reports of local council decisions) and the actual underlying reasons why actors are refusing the smart meter. Finally, our data suggest a geographical concentration of the type of resistance. It looks promising to tackle the potential contagion effect or the spread of resistance using longitudinal data in future research especially considering the still increasing number of resisting municipalities.

Bibliography

Antón, C., Camarero, C., & Rodríguez, J. (2013). Usefulness, enjoyment, and self-image congruence: the adoption of e-book readers. *Psychology & Marketing*, 30(4), 372-384.

Agogué, M., Yström, A., & Le Masson, P. (2013). Rethinking the role of intermediaries as an architect of collective exploration and creation of knowledge in open innovation. *International Journal of Innovation Management*, 17(02), 1-24.

Agogué, M., Berthet, E., Fredberg, T., Le Masson, P., Segrestin, B., Stoetzel, M., Wiener, M., and Yström, A. (2017). Explicating the role of innovation intermediaries in the “unknown”: a contingency approach.” *Journal of Strategy and Management*, 10, (1), 19-39.

Armingeon, K., & Guthmann, K. (2014). Democracy in crisis? The declining support for national democracy in European countries, 2007–2011. *European Journal of Political Research*, 53(3), 423-442.

Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Social barriers to the adoption of smart homes. *Energy Policy*, 63, 363-374.

- Balta-Ozkan, N., Boteler, B., & Amerighi, O. (2014). European smart home market development: Public views on technical and economic aspects across the United Kingdom, Germany and Italy. *Energy Research & Social Science*, 3, 65-77.
- Boon, W. P. C., Moors, E. H. M., Kuhlmann, S., & Smits, R. E. H. M. (2011). Demand articulation in emerging technologies: Intermediary user organisations as co-producers? *Research Policy*, 40(2), 242–252.
- Buchanan, K., Banks, N., Preston, I., & Russo, R. (2016). The British public's perception of the UK smart metering initiative: Threats and opportunities. *Energy Policy*, 91, 87-97.
- Ergeg (2007). *Smart metering with a focus on electricity regulation. European Regulators' Group for Electricity and Gas*. Ref: E07-RMF-04-03. 31 October 2007. Brussels.
- European Commission, (2014) Commission Staff Working Document, *Cost-benefit analyses & state of play of smart metering deployment in the EU-27. Accompanying the document Report from the Commission Benchmarking smart metering deployment in the EU-27 with a focus on electricity*. SWD(2014) 189
- Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International journal of human-computer studies*, 59(4), 451-474.
- Ford, J. D., Ford, L. W., & D'Amelio, A. (2008). Resistance to change: The rest of the story. *Academy of management Review*, 33(2), 362-377.
- Gatignon, H., & Robertson, T. S. (1989). Technology diffusion: an empirical test of competitive effects. *The Journal of Marketing*, 35-49.
- Grossman, E. (2019). France's Yellow Vests—Symptom of a Chronic Disease. *Political Insight*, 10(1), 30-34.

- Gungor, V. C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., & Hancke, G. P. (2011). Smart grid technologies: Communication technologies and standards. *IEEE transactions on Industrial informatics*, 7(4), 529-539
- Hodson, M., & Marvin, S. (2010). Can cities shape socio-technical transitions and how would we know if they were? *Research Policy*, 39(4), 477–485.
- Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research policy*, 35(5), 715-728.
- Huxham, C., & Vangen, S. (2000). Ambiguity, complexity and dynamics in the membership of collaboration. *Human relations*, 53(6), 771-806.
- Hyysalo, S., Juntunen, J. K., & Martiskainen, M. (2018). Energy Internet forums as acceleration phase transition intermediaries. *Research Policy*, 47(5), 872-885.
- Inderberg, T. H. (2015). Advanced metering policy development and influence structures: The case of Norway. *Energy Policy*, 81, 98-105.
- Jacoby, J., & Kaplan, L. B. (1972). The components of perceived risk. *ACR Special Volumes*.
- Jennings, M. G. (2013). A smarter plan? A policy comparison between Great Britain and Ireland's deployment strategies for rolling out new metering technologies. *Energy policy*, 57, 462-468.
- Kaufmann, S., Künzel, K., & Loock, M. (2013). Customer value of smart metering: Explorative evidence from a choice-based conjoint study in Switzerland. *Energy Policy*, 53, 229-239.
- Kivimaa, P., & Martiskainen, M. (2018). Innovation, low energy buildings and intermediaries in Europe: systematic case study review. *Energy Efficiency*, 11(1), 31-51.

- Kleijnen, M., Lee, N., & Wetzels, M. (2009). An exploration of consumer resistance to innovation and its antecedents. *Journal of economic psychology*, 30(3), 344-357.
- Krishnamurti, T., Schwartz, D., Davis, A., Fischhoff, B., de Bruin, W. B., Lave, L., & Wang, J. (2012). Preparing for smart grid technologies: A behavioral decision research approach to understanding consumer expectations about smart meters. *Energy Policy*, 41, 790-797.
- Lauritzen, G. D. (2017). The role of innovation intermediaries in firm-innovation community collaboration: Navigating the membership paradox. *Journal of Product Innovation Management*, 34(3), 289-314.
- Lichtenthaler, U. (2013). The collaboration of innovation intermediaries and manufacturing firms in the markets for technology. *Journal of Product Innovation Management*, 30, 142-158.
- Lin, H., Zeng, S., Liu, H., & Li, C. (2016). How do intermediaries drive corporate innovation? A moderated mediating examination. *Journal of Business Research*, 69(11), 4831-4836.
- Longoni, C., Bonezzi, A., & Morewedge, C. (2019). Resistance to Medical Artificial Intelligence. *Journal of Consumer Research*, Forthcoming.
- Marvin, S., Chappells, H., & Guy, S. (1999). Pathways of smart metering development: shaping environmental innovation. *Computers, Environment and Urban Systems*, 23(2), 109-126.
- McHenry, M. P. (2013). Technical and governance considerations for advanced metering infrastructure/smart meters: Technology, security, uncertainty, costs, benefits, and risks. *Energy Policy*, 59, 834-842.
- McKenna, E., Richardson, I., & Thomson, M. (2012). Smart meter data: Balancing consumer privacy concerns with legitimate applications. *Energy Policy*, 41, 807-814.

- Mela, H., Peltomaa, J., Salo, M., Mäkinen, K., & Hildén, M. (2018). Framing smart meter feedback in relation to practice theory. *Sustainability*, 10(10), 3553.
- Norris, P. (2011). *Democratic deficit: Critical citizens revisited*. Cambridge University Press.
- Oreg, S., Bartunek, J. M., Lee, G., & Do, B. (2018). An affect-based model of recipients' responses to organizational change events. *Academy of Management Review*, 43(1), 65-86.
- Pereira, G. I., Specht, J. M., Silva, P. P., & Madlener, R. (2018). Technology, business model, and market design adaptation toward smart electricity distribution: Insights for policy making. *Energy Policy*, 121, 426-440.
- Ram, S., & Sheth, J. N. (1989). Consumer resistance to innovations: the marketing problem and its solutions. *Journal of consumer marketing*, 6(2), 5-14.
- Rogers, E. M. (2003). *The diffusion of innovation* 5th edition.
- Sanchez-Sutil, F., Cano-Ortega, A., Hernandez, J. C., & Rus-Casas, C. (2019). Development and calibration of an open source, low-cost power smart meter prototype for PV household-prosumers. *Electronics*, 8(8), 878.
- Sneath, P. H., & Sokal, R. R. (1973). *Numerical taxonomy. The principles and practice of numerical classification*.
- Sunday, S. M., & Wilson-Prangley, A. (2018). Intermediary Capabilities in the Context of Challenging State Dynamics. *Journal of Business Ethics*, 152(3), 667-682.
- Sovacool, B. K., Burke, M., Baker, L., Kotikalapudi, C. K., & Wlokas, H. (2017). New frontiers and conceptual frameworks for energy justice. *Energy Policy*, 105, 677-691.
- Stewart, J., & Hyysalo, S. (2008). Intermediaries, users and social learning in technological innovation. *International Journal of Innovation Management*, 12(03), 295-325.

Szmigin, I., & Foxall, G. (1998). Three forms of innovation resistance: the case of retail payment methods. *Technovation*, 18(6-7), 459-468.

Thomas, R., Sargent, L. D., & Hardy, C. (2011). Managing organizational change: Negotiating meaning and power-resistance relations. *Organization Science*, 22(1), 22-41.

Ward Jr, J. H. (1963). Hierarchical grouping to optimize an objective function. *Journal of the American statistical association*, 58(301), 236-244.

Weber, B., & Heidenreich, S. (2018). When and with whom to cooperate? Investigating effects of cooperation stage and type on innovation capabilities and success. *Long Range Planning*, 51(2), 334-350.

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2017). Benefits and risks of smart home technologies. *Energy Policy*, 103, 72-83.

Appendix 1: Explanation and examples of arguments coded in the research.

Translated from French by the authors

	Explanation	Example 1 of verbatim
RISK_ECO	Individual economic risk incurred if invoices increase	"Consumers could be forced to change for a more expensive subscription and they might apply dynamic pricing"
RISK_DATA_Eth	Data collected could be used for commercial purpose	"This new technology could allow to collect data that might be used for commercial purpose and challenge civil liberties"
RISK_DATA_Terr	Data could be hacked and used for terrorist purpose	"The national electrical network will be vulnerable to spying or even cyber-terrorism"
RISK_DATA_Pir	Risk of data leaks	"Smart meters are more easily hackable"
RISK_Funct	Potential problem of electric tension and problem with electric home appliance	"The electricity producer will be able to impose power cuts during peaks in consumption"
RISK_Health	Risk related to unknown consequences of electromagnetic waves	"There are potential risks for health as Linky uses power line communication and emits radiofrequency those are known by WHO as potentially carcinogenic"
RISK_DATA_PrivLife	Risk of being spied by companies dealing with data	"The smart meters will allow a collection of countless data on personal habits and private life. This profiling is worrying"
ARG_Property	The meter is the property of the city	Local communities own the electrical meters according to art. L322-4 from Energy code
ARG_Macro	the replacement is not economically viable from a macroeconomic point of view	The global cost of the project is not acceptable when at the same time all citizens are asked to make financial efforts for the country
ARG_Ecolo	Changing millions of working meters is against ecological principles	"This operation consisting in replacing more than 80 millions of working meters by smart meters with a shorter lifespan is an ecological disaster"
ARG_Forced	People refuse to be forced to adopt the new meter	This technological project which implies a profound change in society has never been discussed
ARG_RespCity	Responsibility of the city would be engaged in case of functional problems (and fires)	"Elected officials and especially the mayors are at risk of being prosecuted in case of damages caused by the linky"

ARG_IndIns	The individual insurance does not cover risks linked to the new generation meters	"Insurance companies exclude damages linked to electromagnetic waves"
ARG_Failed	The rollout failed in other countries/Some countries gave up the rollout	"We are forced to have the new meters where Germany has abandoned the idea"
ARG_NoBenef	There is not enough benefits with adopting smart meters	The reality of energy savings through the smart meters is highly questionable
ARG_MetersWork	Current meters fulfill their mission	"The current meters work perfectly and their non-replacement is not a problem at all."
ARG_FearMob	The rollout created problem of public safety with violence between resisting people and installers	"Considering that public order and respect of the law justify the rollout to be regulated by the city council..."
ARG_Rollout	Rollout was performed badly so far	"city council ask ENEDIS to reinforce their communication toward citizens"

	Explanation	Example 1 of verbatim	Example 2 of verbatim
RISK_ECO	Individual economic risk incurred if invoices increase	"Consumers could be forced to change for a more expensive subscription and they might apply dynamic pricing"	"The deployment implies a cost that will be reported to the future invoices"
RISK_DATA_Eth	Data collected could be used for commercial purpose	"This new technology could allow to collect data that might be used for commercial purpose and challenge civil liberties"	"City council should serve general interest and not commercial interests"
RISK_DATA_Terr	Data could be hacked and used for terrorist purpose	"The national electrical network will be vulnerable to spying or even cyber-terrorism"	"France will be more vulnerable: hackers and cyber-terrorists will be able to watch the population and to trigger a black-out"
RISK_DATA_Pir	Risk of data leaks	"Smaty meters are more easily hackable"	There are risks linked to piracy
RISK_Funct	Potential problem of electric tension and problem with electric home appliance	"The electricity producer will be able to impose power cuts during peaks in consumption"	"Power cuts will be performed without any agent intervention"
RISK_Health	Risk related to unknown consequences of electromagnetic waves	"There are potential risks for health as Linky uses power line communication and emits radiofrequency those are known by WHO as potentially carcinogen"	"Important potential health consequences linked to electrosensitive people"
RISK_DATA_PrivLife	Risk of being spied by companies dealing with data	"The smart meters will allow a collection of countless data on personal habits and private life. This profiling is worrying"	"There are not enough guarantees on the nature of the collected data"
ARG_Property	The meter is the property of the city	Local communities owe the electrical meters according to art. L322-4 from Energy code	The city as owner of the meters can refuse the new meters
ARG_Macro	the replacement is not economically viable from a macroeconomic point of view	The global cost of the project is not acceptable when at the same time all citizens are asked to make financial efforts for the country	This project will lead to major job losses
ARG_Ecolo	Changing millions of working meters is against ecological principles	"This operation consisting in replacing more than 80 millions of working meters by smart meters with a shorter lifespan is an ecological disaster"	"The destruction of the old meter has an ecological impact"
ARG_Forced	People refuse to be forced to adopt the new meter	This technological project which implies a profound change in society has never been discussed	The main concern is the mandatory character of the adoption of the Linky inside households
ARG_RespCity	Responsibility of the city would be engaged in case of functional problems (and fires)	"Elected officials and especially the mayors are at risk of being prosecuted in case of damages caused by the linky"	"The question of whom is responsible in case of an accident or a sanitary risk is not clear"
ARG_IndIns	The individual insurance does not cover risks linked to the new generation meters	"Insurance companies exclude damages linked to electromagnetic waves"	
ARG_Failed	The rollout failed in other countries/Some countries gave up the rollout	"We are forced to have the new meters whereas Germany has abandoned the idea"	"Austria, Belgium and Germany (for subscription under 6kVa meaning the majority of households) decided not to follow the European directive"
ARG_NoBenef	There is not enough benefits with adopting smart meters	The reality of energy savings through the smart meters is highly questionable	"The benefits won't be real for households, only for commercial companies in charge of distributing electricity"
ARG_MetersWork	Current meters fulfill their mission	"The current meters work perfectly and their non-replacement is not a problem at all."	"Current meters work perfectly and have a long lifespan"
ARG_FearMob	The rollout created problem of public safety with violence between resisting people and installers	"Considering that public order and respect of the law justify the rollout to be regulated by the city council..."	"Rejection and public protests are huge, even toward the city council"
ARG_Rollout	Rollout was performed badly so far	"city council ask ENEDIS to reinforce their communication toward citizens"	"Whereas implementation decrees have not yet been issued, EDF is contacting clients to propose the Linky and hiring non-electricians to train them to installation"

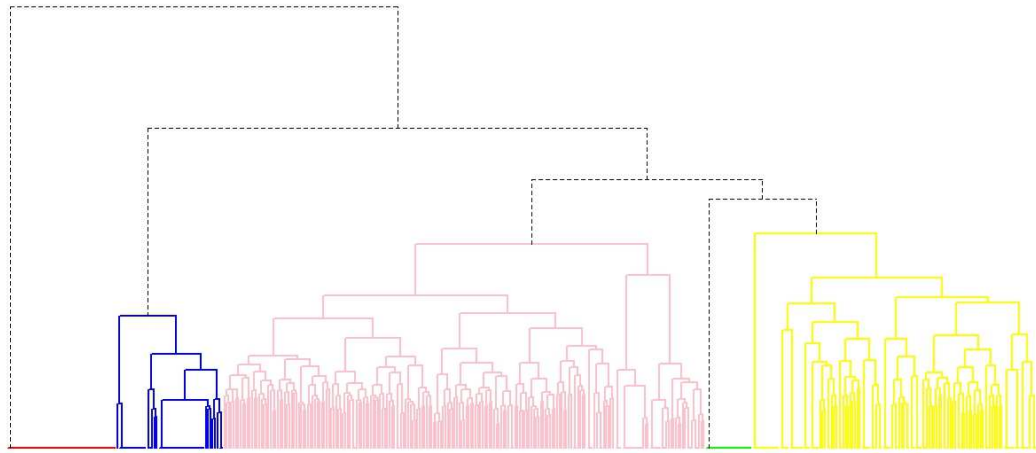


Figure 1: The dendrogram resulting from the statistical analysis

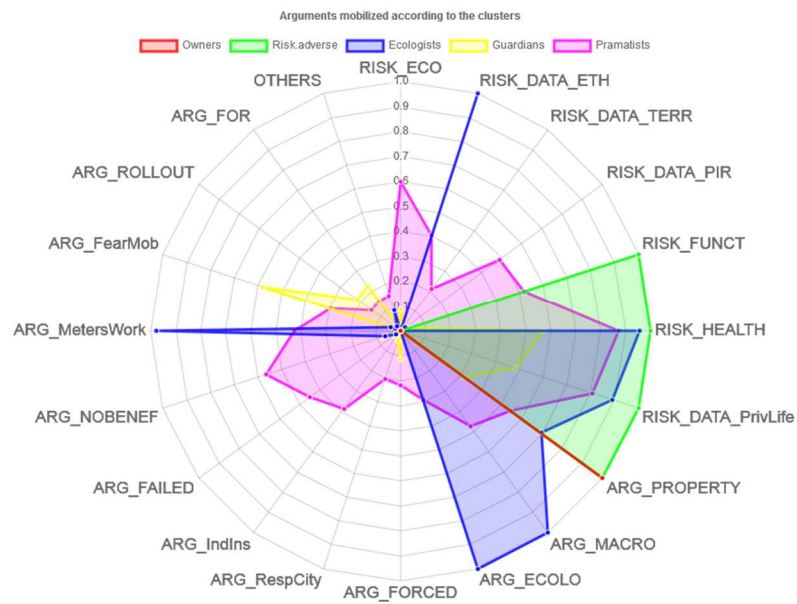


Figure 2: Five different argument strategies used by the resisting French municipalities

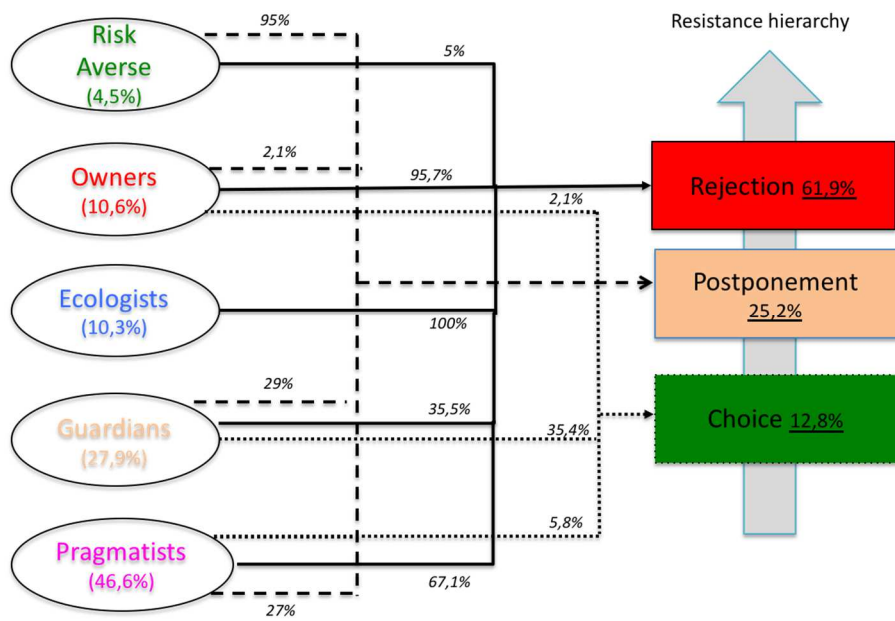
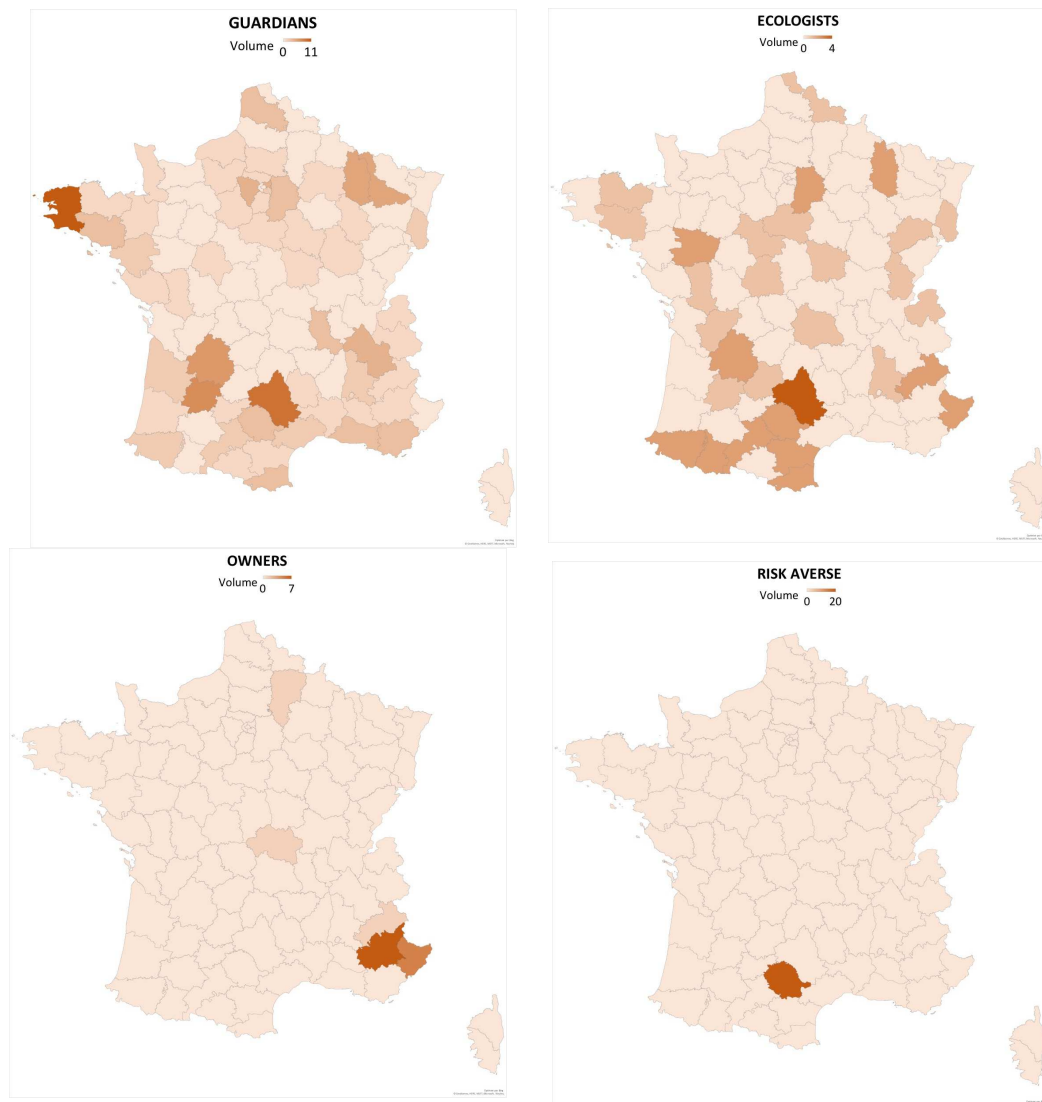


Figure 3: Linking clusters and degrees of resistance



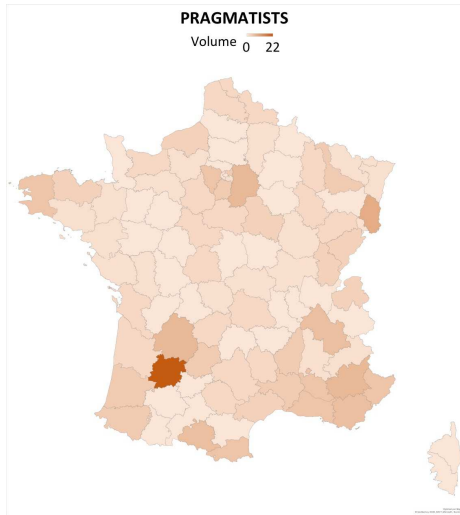


Figure 4: geographical concentration of resistance by groups

Drivers of resistance in innovation adoption		Drivers of resistance studied in the case of smart meters
Usage		Balta-Ozkan et al. (2014) ; Buchanan, et al. (2016) ; Sovacool et al. (2017)
Value		Wilson et al. (2017)
Risks	Functional	Wilson et al. (2017) ; Sovacool et al. (2017) ; McHenry (2013) ; Khrishnamurti et al. (2012)
	Social	Balta-Ozkan et al. (2013)
	Physical	Sovacool et al. (2017)
	Psychological	
	Financial	McHenry (2013) ; Khrishnamurti et al. (2012)
Tradition		Chilvers & Longhurst (2016) ; Balta-Ozcan et al. (2014)
Image		

Table 1: Research-identified drivers of resistance in the case of smart meters

Degree of resistance	Nature of the decision
Low	Leave the choice to the consumer
↓	Postponement
High	Rejection

Table 2: Degrees of resistance observed in the reports


Degree of resistance	Type of resistance	
<p style="text-align: center;">low</p>  <p style="text-align: center;">high</p>	Kleijnen et al. 2009	Municipalities resisting smart-meters
		Leave the choice to the individual citizens
	postponement	postponement
	rejection	rejection
	opposition	

Table 3: Degrees of resistance to innovations in the literature and against Linky smart meters (at municipality level)