Political-institutional barriers to energy efficiency

1. Introduction

Energy efficiency has been touted as a critical component of societies' response to the challenges of climate change, economic development, and energy security [1,2]. Substantial improvements in energy efficiency can "reduce the need for investment in energy infrastructure, cut fuel costs, increase competitiveness, lessen exposure to fuel price volatility, increase energy affordability for low-income households and cut local and global pollutants improving consumer welfare" [3, p. 36]. Energy efficiency is considered a major energy resource, as it can potentially deliver reductions in demand exceeding any other fuel output in several countries. Hence it is not merely a "hidden" fuel, but is in fact the "first fuel" [4].

There are two widely recognized caveats to this potential. First, the Jevons paradox – the tendency for efficiency improvements to lead to increased demand – tells us that energy efficiency gains are followed by a rebound effect, diminishing the overall impact of the measures on energy demand [5]. Real energy efficiency improvements are bound to be smaller than their initial theoretical potential, and the extent of this difference can be substantial. Part of this rebound effect may not be a negative outcome, as it may simply follow from the "taking back" of energy savings in order to achieve health benefits, poverty alleviation, or productivity improvements that were otherwise inaccessible to consumers, for instance [6]. In any event, this effect leads several authors to argue that efficiency improvements need to be governed with care, for instance by being coupled with conservation policies (e.g., [7]).

The second caveat is that energy efficiency remains a puzzle to many analysts because even when they make economic, environmental, cultural, and social sense, improvement measures often do not materialize. For various reasons, there exists an "energy efficiency gap" or "energy paradox" [8-15] (see also [16,17]).

The potential benefits of energy efficiency and these two caveats have led to rich literatures that classify barriers of various forms. These classifications helped feed studies that attempt to comprehend and empirically measure barriers to improved energy efficiency, and consequently provide more specific recommendations as to how these can be overcome. We contribute to these literatures on barriers to the adoption and successful implementation of energy efficiency measures, by focusing on political-institutional barriers. Whereas various scholars looked at barriers of different forms (economic, behavioral, organizational, and cultural, in particular), the attention to political-institutional barriers has been limited, especially in classification efforts. However, as we show in this paper, a specific understanding of these barriers can play a critical role, as efforts to overcome other types of barriers are likely to be insufficient without careful consideration of their political-institutional counterparts, which may prove very difficult to eliminate.

The article follows a straightforward structure. First, we review the relevant literature to situate our contribution. Second, we propose a definition of political-institutional barriers and describe what makes them distinct from other types of

barriers. We then present a classification of political-institutional barriers, which we developed with the objective of facilitating the identification of specific types of political-institutional difficulties or obstacles to the adoption, design, or implementation of energy efficiency measures. Finally, to show the importance that these barriers can have in practice, we illustrate the occurrence of these barriers in three case studies in section 4. The cases were chosen for their illustrative potential, but broad generalizations are avoided. We discuss the factors highlighted by these cases in the conclusion.

2. Methods and literature review

Spanning over more than three decades, rich literatures from various theoretical perspectives now detail barriers to – and, more recently, drivers of – energy efficiency. For our literature review, we covered – from the more general to the more specific – political economy, energy policy, and energy efficiency studies. We looked both at studies that provide classification attempts for barriers, as well as work that discusses different solutions to barriers, including recent reports from international institutions such as the International Energy Agency, the United Nations Environment Programme, and the United Nations Industrial Development Organization.

Moreover, the discussions about conceptual frameworks to understand, analyze, and address barriers to improvements in energy efficiency have been enriched more recently by empirical attempts to provide recommendations depending on firm size, country, type of activity, or sub-sector (for a summary, see [18,19]). Since energy efficiency usually has its place, to varying degrees, in the energy policy of most national governments (see [20]), several studies provide helpful insights into how the governance of energy efficiency can effectively overcome these barriers [4, 21-23]. Throughout the review, we focused on the attention that these contributions have given to barriers related to political actors and institutions.

Many recent studies, including empirical work attempting to measure barriers, start from Sorrell et al.'s classification [13,14,24] which categorize barriers according to different theoretical backgrounds. In the economic category, market failures (e.g., imperfect information, split incentives, adverse selection, principal-agent relationships) are distinguished from market barriers (e.g., heterogeneity, hidden costs, access to capital, risk). The behavioral category regroups barriers such as bounded rationality, inertia, or values, while the organizational type includes power distribution and culture within the firm [17].

Sorrell et al., however, exclude barriers found in earlier empirical studies that stem from political-institutional factors, treating them separately as "contextual factors" [24]. Observing results from empirical studies, the authors mention for instance that "'the government does not give incentive to improve energy efficiency', 'lack of enforcement of government regulations' and 'lack of coordination between different government agencies' fail to explain why cost-effective technologies are being neglected by individual organizations" [24, p. 42]. At first glance, this is surprising: in several earlier classification attempts, part of the discussion on

barriers has revolved around the role of government actors in impeding energy efficiency improvements in various sectors. In a short but oft-cited contribution, Weber, for instance, distinguished four types of barriers: behavioral, organizational, market and institutional. Of these, the latter type refers to barriers "caused by political institutions, i.e. state government and local authorities" [15]. Hirst and Brown had also pointed to "structural" barriers outside the control of the individual end-user, which included codes and standards, as well as government fiscal and regulatory policies [9]. To be sure, Sorrell et al. do argue that these factors can have an important influence, but do not consider them to be barriers, since the focus in the framework is on decisions and behaviors within firms. As a result, the discussion neglects an elaborate development of the actors and institutions external to these organizations. This is an important lack: Reddy [25], for instance, had described a more thorough list of all actors influencing improvements to energy efficiency, which included politicians, government agencies and departments, and international institutions.

Empirical studies and reviews also alternatively list some form or another of barriers linked to governmental actors, for instance insufficient enforcement of standards [26], lack of governance leadership/interest [27], weak legislation [28], limited financial incentives by the government for energy efficiency [28], lack of integration of energy and environmental issues during policy formulation [29], or non-existing labels/standards for energy-efficient products/processes [29]. Other recent studies have also pointed to different government or regulatory barriers, but again merely provide an incomplete list of some examples found in empirical studies (e.g., [30-33]).

To our knowledge, there exists no systematic attempt to conceptualize this type of barrier and categorize the different possibilities. One interesting contribution is Cagno et al. [34], who proposed an expansion of Sorrell et al.'s framework, pointing to shortcomings and empirical difficulties. Cagno et al. introduce the notion of barriers that are "external" vs. "internal" to the firm, and leave a place for "government/politics" barriers, insisting that "regulation and policy may affect the diffusion of technologies and/or energy suppliers imposing standards or particular policies to regulate the market, modifying the price and/or the availability of services/products, as well as influencing a single firm through various policies" [34, p. 295]. However, they not only simplify this category down to either "lack of proper regulation" or "distortion in fiscal policies", but also end up incorporating these two possibilities within internal "information" barriers as part of the empirical framework. The same can be said of Thollander and Palm's comprehensive discussion of barriers [17], which explicitly includes Weber's "institutional" barriers, but remains limited to briefly listing "codes and standards" and "government fiscal and regulatory policies" as "structural barriers", with little development.

Another interesting attempt to provide a more complete framework comes in Reddy's "actor approach" taxonomy [35], which differentiates barriers at the micro (project) level, the meso level (related to the organizations affiliated with the project), and the macro level (state, market or society). This approach provides an important contribution in detailing the causal mechanisms linking barriers to

outcomes. Reddy provides examples of barriers of the political type, which are spread across the meso level (understaffed implementing agencies, for instance) and the macro level (energy policy legislation, for instance), and argues for the identification of actors and institutions having different responsibilities and roles depending on the level of the barriers identified.

This leaves several gaps to address. It is our contention that efforts to identify and suggest ways to remove barriers to improvements in energy efficiency will remain incomplete or prove ineffective without proper consideration for barriers of the political-institutional type. Many of the contributions of these literatures downplay or give little attention to political-institutional barriers, and although some of these barriers are indeed considered by several authors, many issues remain regarding the understanding we have of them. Despite a tacit recognition of their presence and importance by several studies, they are loosely classified (when they are classified at all), alternatively termed regulatory [20,23], institutional [12,19, 29], government-related [25], or contextual [24], often with no specific delimitation, and accompanied with few examples. In our view, these efforts also provide insufficient conceptualization of these barriers, give little attention to the political process behind changes in legislation and regulation – or the absence thereof – and provide us with limited information as to how these "external" barriers affect the decision by firms to invest or not in measures to improve energy efficiency.

There is also some confusion regarding the meaning of "institutional" in this context, as it is sometimes used to refer to plants and producers (e.g., [20,23]) instead of political or administrative institutions. Additionally, it is often not clear whether the discussion about political issues linked to energy efficiency efforts should be part of the debates over solutions to other types of barriers (i.e., policy intervention to resolve barriers), or should be considered as barriers in themselves, to which several solutions may be considered.

We argue that part of this confusion lies in insufficient attention and detail given to the categorization of these types of barriers, and since there seems to be a consensus that policy is key in overcoming several other types of barriers, understanding their political-institutional counterpart is critical in order to prevent or avoid further difficulties in the design and implementation of measures to improve energy efficiency.

3. Framework for political-institutional barriers

3.1 Definition

In this section, we provide a clarification of the concept of political-institutional barrier. This allows us to clearly circumscribe what we include and, by extension, what we exclude from the barriers considered. There are some ambiguities in trying to classify barriers to energy efficiency, and differentiating political-institutional barriers from their economic, organizational, behavioral, or cultural counterparts needs to be done with care. First, following from Weber [15, p. 834] and Sorrell et al. [14, p. 27], we consider that the term *barrier* (to energy

efficiency improvements) itself has in fact three components: an objective obstacle, a subject hindered, and an action hindered. As Weber discusses, this distinction supposes the existence of a variety of specific obstacles (e.g., persons, attitudes, or regulations), subjects hindered (e.g., consumers, managers, or politicians), and actions hindered (e.g., buying more efficient equipment, or decreeing an energy tax) [15, p. 834].

As can be inferred from the classification and aspects discussed below, we use the term "political-institutional" in a broad sense. To differentiate with the other types of barriers identified in the literature reviewed in the previous section, we thus consider political-institutional barriers to be those obstacles that originate from, are controlled by, or are caused by factors directly related to political institutions. This includes characteristics pertaining either to the political-institutional environment (the fundamental political rules that serve as the basis for production, exchange, and distribution) or to political-institutional arrangements (the governance structure and its evolution and interaction with the institutional environment) [36, pp. 132–133; 37, pp. 25–26]. "Political-institutional", in this context, incorporates a variety of macro-level institutions such as political regime type and governance structures (federalism, for instance), meso-level institutions such as public and political organizations and the rules by which they abide (a ministry or a government agency, for instance), as well as micro-level institutions such as behavioral and social expectations towards politicians and members of public and governmental organizations (political leadership, for instance).

3.2 Classification

We classify these political-institutional barriers as one of three different forms: political obstruction, conflicting guidelines in governance structure, and lack of policy coordination. Each of these forms, in turn, presents itself in different variations.

3.2.1 Political obstruction

Political obstruction is a first category of political-institutional barrier, and can take different forms. This represents situations where actions – or lack thereof – by government leaders and key policymakers impede efforts to put on the agenda, elaborate, or successfully implement energy efficiency measures, even despite the absence of particular reluctance from industry or consumer groups. For instance, lack of political backing of measures and legislation to improve energy efficiency, and political opposition or indifference can make a difference in the elaboration of energy efficiency programs and regulations [22], as "government representatives are key to make pressure for energy efficiency" [38, p. 1137] (see also [39,40]).

In some instances, substantial political will – the "extent of committed support among key decision makers for a particular policy solution to a particular problem" [41, p. 659] – becomes a necessary condition for reforms or changes to occur. Opposition can come from various individuals and collective actors having formal and informal veto power on new regulation or legislation. These veto players can be institutional (a legislature requiring the assent of two chambers for a bill to

pass, for instance) or partisan (the party in power's position regarding a given policy option, for instance) [42].

Both categories of veto players have an impact on the potential for the political obstruction barrier to affect progress on energy efficiency measures. For instance, a higher number of veto players may increase the likelihood for policy changes to be incremental rather than major, and may simply reduce the rate of policy adoption, as Madden [43] has shown for climate change policy. This type of barrier is likely to be at its worst when the number of veto players for energy efficiency legislation is high, when the government in place lacks a champion taking charge of energy efficiency efforts, or when the governance structure makes this need for political backing highest (more on this latter point in 3.2.2 below).

Another source of political obstruction comes from high levels of corruption, as well as lack of political stability and effectiveness. These contexts generally impede energy efficiency initiatives, as the result is a higher discount rate for investors in energy efficient technologies. This especially affects investments in long-term capital goods like capital-intensive energy efficiency technologies, which can be particularly problematic in developing countries [12, p. 6] (see also [27]). Even in OECD countries, however, greater corruptibility reduces the stringency of energy efficiency policy [44].

3.2.2 Conflicting guidelines in governance structure

A second category of barriers results from conflicting guidelines within the energy efficiency governance structure. At the national level, conflicting interests between different government departments, for instance a ministry focused on economic growth and another one dealing with the protection of the environment, may result from the departments' different objectives and preferences with regard to the pace, nature, and extent of energy efficiency regulation. Which department has jurisdiction over the energy efficiency governance can have an impact on broader inter-department battles, as can the power distribution between these departments.

Moreover, diverging actions between different agencies having partial authority over energy efficiency can be problematic. In an IEA report, Limaye et al. [20] identified seven different governance models for energy efficiency. Energy efficiency governance can be conducted under: a government agency with broad energy responsibilities, such as the United States Department of Energy; a government agency focusing primarily on clean energy or sustainable energy, such as the Australian Greenhouse Office; a government agency focusing entirely on energy efficiency, such as Canada's Office of Energy Efficiency; an independent authority created by statute to promote energy efficiency and/or clean energy, such as the United Kingdom Energy Saving Trust; an independent corporation owned entirely by the government, such as South Africa's National Energy Efficiency Agency; a corporation through public-private partnership, such as the Polish National Conservation Agency; or a non-profit or non-governmental organization, such as the Austrian Energy Agency [20, pp. 25–33]. These models are represented throughout the world in various forms, and the authors' classification goes to show the important variability in the way that energy efficiency governance is treated in

political and administrative circles. These different approaches to governance can lead to actions framed towards different goals.

Each of these models comes with a different set of advantages and limitations, for instance regarding the ability to secure funds, the political clout within the government, the size of the staff dedicated to energy efficiency, or the flexibility in asking for outside advice (see Appendix). Consequently, given that modifying the structure of government agencies and departments is usually politically cumbersome, these features have an impact on the facility with which energy efficiency measures can be designed and enacted. Many of these difficulties have to do with the effectiveness in the design and implementation of energy efficiency programs and measures; however, they can also prevent initiatives coming from the private sector if, for instance, the regulatory authority resides in an agency traditionally closed to input from industry, or if the authority is perceived by private actors as diffuse and ambiguous.

Another aspect is the relevant agency's inadequate capacity to enforce mandatory measures and regulations. Apart from the structure of authority mentioned above, insufficient funding and staff can lead to lack of enforcement effectiveness [28,45], which may be particularly problematic if the measures are intended to be aggressive, or if they require a substantial change in current consumer or industry practices. Note that this is also affected by which of the governance models is in place, as certain models normally have more difficulty accessing public funds (see Appendix).

3.2.3 *Lack of policy coordination*

A third category of political-institutional barriers regroups policy coordination failures and impediments. While some of these may be closely associated with one or more of the governance structure issues described above (more on this in 3.3 below), they can operate independently and as such are treated as distinct barriers. A first example is the existence of multiple non-harmonized standards internationally. Harmonized international standards for testing, efficiency classifications and labels constitute barriers to international trade and prevent manufacturers from realizing economies of scale [38,46].

A second and related example of a policy coordination barrier is a similar process found at the country level, when different standards exist for sub-national jurisdictions. Codes and standards surrounding energy efficiency can present the same scattered features as internationally, producing similar difficulties at the national level. This is likely to be the case in federations, especially if jurisdictional responsibility is not at the national level (e.g., [30]).

A third and related example is when these codes, standards, and other energy efficiency measures are contradictory, whether between jurisdictions or between sectors (e.g., [17,47]). Building construction codes, for instance, can hinder efforts to streamline the use of new energy technologies that may have energy efficiency advantages [48]. This barrier is especially problematic given that setting and revising codes and standards is often a long process dominated by special interests, and variations in codes cause or contribute to a fragmentation of the market and compounds manufacturing inefficiencies [9, p. 273]. Furthermore, this

type of coordination issue can make it cumbersome to obtain government permits needed to deploy energy efficiency devices and processes [49].

A fourth example is regulation producing an incentive structure hindering energy efficiency measures. This can be particularly problematic with regard to energy providers, when regulation makes the profitability of providers rely on energy sales – for instance, energy tariffs that discourage energy efficiency investments, such as declining block prices [23], thus creating a disincentive to participate in supporting or delivering energy efficiency improvements to customers [20]. This is another version of the "split incentive" barrier, which occurs when the potential adopter of energy efficiency measures is not the party that uses the energy (and thus differs from the one who enjoys the energy savings), for instance in a tenant-owner relationship. In this case, however, the barrier is caused directly by regulation.

3.3 *Links and interactions between barriers*

Table 1 summarizes these categories of barriers. Although the categorization presented above serves to distinguish specific barriers and can be useful to address them, political-institutional barriers rarely appear in an isolated form, and in this section we consider possible interactions between instances.

Possible combinations or interactions are of course not particular to political-institutional barriers. Risk aversion, for instance, may be linked to (or worsened by) imperfect information barriers, if the missing information is the one needed to make proper risk assessments. Other possibilities of overlap and interactions have been pointed out, notably in [13,50], and further developed in [19,51,52], among others. For our purpose here, however, the discussion will remain limited to links between barriers of the three types described above.

Table 1 – Categories of political-institutional barriers to energy efficiency (EE)

Category of barrier	General description	Examples
Political obstruction	Individual actions by political figures – or lack thereof – impede EE efforts	• Lack of political backing to EE measures/veto players opposed to EE • Corruption and lack of political stability and effectiveness increase discount rates for investors
Conflicting guidelines in governance structure	Problems linked to the EE governance structure	• Conflicting interests between different government departments/agencies • Diverging actions from different agencies having partial authority over energy efficiency • Inappropriate administrative capacity/flexibility
Lack of policy coordination	Policy coordination failures and impediments	• Existence of multiple non-harmonized standards internationally • Existence of different standards for sub-national jurisdictions • Contradictory regulation between jurisdictions or sectors • Regulation causing incentive structure that hinders EE measures

As a first example of this, political obstruction may be closely associated with battles within the governance structure. For instance, a clash between different priorities with regard to energy efficiency measures across two or more ministries is often related to more personal political infighting. This combination can take the form of a battle between key figures of the ministries, with the government leadership also taking a role. The aspect we want to highlight is that although the impediments to energy efficiency improvements here would seem be caused by conflicting guidelines in the governance structure (because two different ministries have a say), the barrier can actually be worsened by political obstruction. Put differently, any potential solution to the governance structure problem will be difficult if there is no way to get around the more personal clashes.

Another example is the possible link between conflicting guidelines in the governance structure and contradictory or uneven policies across subnational jurisdictions, a policy coordination problem. In a federation, if jurisdictional power is shared between the national and subnational levels, lack of action at the higher level – and lack of collaboration and coordination between subnational governments – will likely result in scattered measures and regulations across the country. So in this case, even if the direct barrier to energy efficiency is primarily one of lack of policy coordination, it could be prevented or improved by removing the governance structure issue. Similarly, the problem of the incentive structure for energy providers hindering energy efficiency improvements, mentioned in 3.2.3

above, can also be influenced by the governance structure, for instance if the energy providers are publicly owned and have influence over energy efficiency policy. Resolving this situation requires giving attention to the combination of barriers, which may end up differing from considering each one individually.

The point here is that the categorization of barriers laid out above should serve to obtain a detailed understanding of possibly several barriers (including ones not falling under the political-institutional type). The potential interactions and combinations outlined in this section hint that a holistic approach to barriers should be taken when trying to address a given instance.

4. Results and discussion

In this section, we use examples to illustrate certain dimensions of these barriers at play. Three cases are discussed, each highlighting one of the categories mentioned in section 3.2.

4.1 Political obstruction: transport fuel efficiency in the United States

As a first illustration of a political-institutional barrier to more stringent energy efficiency measures, the case of fuel efficiency regulation in the United States is considered. Two main policy tools have been used historically to promote more efficiency in transportation in the United States: fuel taxes, at both the federal and state level; and Corporate Average Fuel Economy (CAFE) standards, initiated following the Arab oil embargo in 1973-74. Both categories of policies have repeatedly shown how political obstruction is a key barrier to higher energy efficiency in the transport sector, and we consider here each of these broad categories of policies.

First, fuel taxes are often considered to be the most effective policy tool to increase fuel efficiency in transport, as they represent a direct means to target a specific product's price (here, gasoline), having in theory the most direct impact on consumer behavior – as well as car manufacturer behavior, in the consumption and fuel efficiency of vehicles offered, as a result [53,54]. In practice, indeed, countries with lower domestic taxes on gasoline tend to have higher consumption rates, and vice-versa [55].

The second main policy tool used in the United States to improve fuel efficiency in the transport sector is the CAFE standards, which target new light-duty vehicles, further differentiating between cars and trucks. Despite much stricter standards in other regions with similar socio-economic conditions, standards have remained very low in the United States [56]. More interesting to us, however, is the fact that they remained virtually unchanged from the mid-1980s to the mid-2000s, despite multiple attempts over the years to increase them or change the rules for how they are applied.

For instance, in 1994, the National Highway Traffic Safety Administration (NHTSA), responsible for writing and enforcing the standards, published a notice stating that it was considering an adjustment to fuel economy standards for trucks before the decade would be out. This awoke lobbying from car manufacturers and opposition in Congress, and the next year, the House of Representatives passed the FY1996 Department of Transportation Appropriation, which explicitly prohibited

the use of funds to change CAFE rules. After it became law, a similar scenario was repeated in each of the following years, with some opposition in the Senate (ultimately unsuccessful), and the standards (as well as their structure) remained unchanged for the rest of the decade [57].

Part of this opposition to raising the standards during the 1990s was certainly attributable to the low prices for gasoline, and when these increased at the turn of the century, support built to both remove this appropriation prohibition and reconsider raising the standards. The former efforts were successful, but multiple propositions for increasing standards in the wake of 9/11-related energy security concerns ultimately failed.

More durable movement finally came when the Energy Independence and Security Act (EISA) 2007 managed to increase the standards on the 2020 horizon, measures defended by the Bush administration in its efforts to reduce dependency on oil. Furthermore, the Obama administration announced in 2009 substantially stricter standards for the 2012-2016 period, along with additional standards for CO_2 emitted by cars. This was followed by an agreement with thirteen large automakers that further increased the target fuel economy standard by model year 2025 [58].

The lack of change in the standards for the 20-year period preceding the EISA 2007, and the substantial modifications since, show how basic political obstruction (here the United States Congress, and mostly the House of Representatives, acted as a major veto point) is an important factor impeding modifications to energy efficiency policy. Although the reasons for this obstruction can be quite varied – asymmetric lobbying, political ideology, and oil prices certainly had an influence in this case – the actions of legislators and leaders from the executive branch play a crucial role in the evolution of these efforts. Without generalizing from this single case, a higher number of veto players, both institutional and partisan, seems to decrease the likelihood of modifications to the status quo (here, in the form of more stringent energy efficiency legislation).

Moreover, it is worth noting that political obstruction is only one dimension of the political-institutional impediments that restrained fuel efficiency improvements. The governance structure was one where the agency responsible for CAFE standards was within the executive branch of the federal government, and clearly did not have the independence required to secure funding and hence full autonomy in its actions. This highlights how the autonomy of an agency with energy efficiency responsibilities is as important as its independence, especially as far as funding is concerned. Nevertheless, this example illustrates how political obstruction can be a particularly important and resilient obstacle.

4.2 Conflicting guidelines in governance structure: energy efficiency in the Quebec, Canada electricity sector

Hydro-Québec is a government-owned public utility overseeing the generation, transmission, and distribution of electricity in the Canadian province of Quebec. Established in 1944, it has undergone several changes to its structure and to the distribution of authority for different aspects of energy production and use over the years, and responsibility for energy efficiency was no exception. We focus here on the period covering the latter half of the 1990s decade, where energy

efficiency objectives have repeatedly been decreased, ignored, or abandoned by Hydro-Quebec. This is meant to illustrate a barrier stemming from conflicting guidelines in the governance structure, where the objectives of a government department, corporation, or agency conflict with authority for designing and implementing energy efficiency measures.

When the Quebec "energy debate" occurred in the mid-1990s regarding the future of Hydro-Québec, the new objectives for energy efficiency put forward a few years earlier by the public monopoly suddenly decreased, and backed away from the targets it had put forward earlier in the decade. Then, despite recommendations from the Economy and Labor Commission (Commission de l'économie et du travail) to put back the old approach in place, Hydro-Québec continued with its reluctance and completely bypassed it when publishing its 1998-2002 action plan [59].

Energy efficiency in Quebec at the time was officially under the jurisdiction of the Energy Efficiency Agency (Agence de l'efficacité énergétique). The Agency was originally created in 1977 as the Office of Energy Savings (Bureau des économies d'énergie), and replaced in 1992 by the Energy Efficiency Management (Direction de l'efficacité énergétique), attached to the Ministry of Natural Resources and Energy. In 1997, it was again renamed and reorganized as the Energy Efficiency Agency to oversee energy efficiency measures. However, with regard to electricity, plans had to be proposed by Hydro-Québec. As a result, responsibility for the size, pace, and nature of improvements rested with the public monopoly.

There was an important if straightforward conflict of interest for Hydro-Québec within this structure. On the one hand, it had to put forward global plans and timelines for improving energy efficiency around electricity production, transmission and consumption. On the other hand, its main source of revenue came from the sale of electricity. Given the political difficulties associated with any proposal to raise electricity prices in Quebec, this implied that at least to a certain extent, Hydro-Quebec revenues were dependent on the volume of sales. This led several groups to point to the inability for Hydro-Québec to realize a substantial energy efficiency program, given these conflicting objectives [60,61].

There are several reasons for this reluctance, which do not lie solely in the conflicts within the governance structure. Political will in the form of leadership from the electricity monopoly, for instance, can partly explain differences between this example and more positive results in the Canadian province of British Columbia, where a largely similar electricity governance structure is in place. Although the Quebec electricity governance represents a somewhat rare institutional arrangement, what we want to highlight with this example is that the governance structure dimension seems to have been a key barrier that prevented more progress on the energy efficiency front during that period. The extraction of full responsibilities for energy efficiency from Hydro-Québec to an independent third party like a more autonomous Energy Efficiency Agency could have prevented or attenuated this type of problem, given the specific situation of the Quebec public monopoly [60,62].

4.3 Lack of policy coordination: minimum efficiency performance standards (MEPS) for electric motors

Electric motors represent 46% of global electricity use [46]. The industrial sector accounts for more than 60% of this consumption, where these can be used for mechanical movement, in pumps, in fans, or in compressors, which means motors used in this sector consume over a quarter of the world's electricity production. Additionally, the efficiency improvement potential is considerable [46]. This situation has made electric motors a target of energy efficiency policy around the world for at least the past two decades. However, for many years these efforts were slowed down because of various barriers, and we focus here on one: a policy coordination barrier at the international level regarding efficiency testing standards.

Although motors and motor-driven equipment have been traded globally for many decades, discrepancies in many different national and regional standards for size, efficiency and verification of energy efficiency hampered a harmonized and transparent market development towards more energy efficient models. In particular, electric motor efficiency testing methods and procedures produced different results and thus did not allow motor manufacturers to compete in a transparent and credible fashion, especially in markets with mandatory energy performance standards [38]. Even after the introduction of minimum efficiency performance standards (MEPS) in the United States in 1992, a major policy development that was accompanied by a similar policy in Canada and that would lead the way for changes much later in the European Union, controversy over testing standards remained in the 1990s.

The main point of contention was a variation in testing methods [38,63], which in turn caused the different grid supply frequencies (60Hz for most of the Americas and Japan vs. 50Hz for Europe, Asia, Africa and Australia) to lead to different claims depending on the region of applicability. The North American prevailing testing method came from the Institute of Electrical and Electronics Engineers (IEEE 112-B), and was based on direct efficiency measurement. The prevailing European standard set by the International Electrotechnical Commission (IEC 60034-2), on the other hand, was based on an indirect measurement, which tended to overestimate efficiency, especially in small motor sizes [64,65].

This relatively simple discrepancy between standards proved to be an important barrier to international trade, and hampered the diffusion of more energy efficient electric motors by preventing manufacturers from being able to realize economies of scale. Different standards meant that comparability of efficiency and energy consumption for similar motors was difficult across regions – notably the North American and European markets – which increased testing costs, especially for manufacturers providing products for global markets [66, p. 82].

Due to the attention given to this problem in the late 1990s [63,65], efforts began to revise the IEC 60034-2 standard so that an efficiency classification of motors at the global level would be possible. This led to the IEC 60034-2-1 standard, published in 2007. This not only made it possible to have a direct correspondence between North American (Epact/NEMA Premium), Chinese (Class 1/2/3), Australian (MEPS 2002 and 2006), and European efficiency classification (the

Eff1/Eff2/Eff3 European MEPS were passed into law shortly after), but also triggered similar developments in other markets, notably India [67].

This shows how the lack of coordination between standards at the global level can prevent a greater and smoother diffusion of more energy efficient technologies, but also that the effectiveness of certain policies intended to increase the use of these technologies (for instance, the MEPS enacted in North America in 1992) can be affected by the lack of coordination with other jurisdictions in the global market. The absence of harmonized standards for entire motor systems has also been identified as an important barrier to eliminate in the future [46,68].

As in the previous two cases, it should be noted that lack of policy coordination was only one dimension of the political-institutional obstacles that slowed progress on electric motors energy efficiency. Leadership from the United States Department of Energy, for instance, helped efforts to legislate more stringent MEPS in 1992, while European efforts came only much later. Moreover, efforts from the Department of Energy were helped by its collaboration with the different industry associations, notably the National Electrical Manufacturer Association (NEMA), the American Council for an Energy Efficiency Economy (ACEEE), and the Consortium for Energy Efficiency (CEE). Moreover, for our purpose, it should further be noted that this type of international policy coordination barrier may be one of the most difficult to resolve, because of the potential unwillingness of certain major countries' agencies to participate and agree on a given standard, or because of the lack of an international body with strong authority to impose such a standard on all participating members.

5. Discussion

These three cases suggest that there are no easy fixes for any of these barriers. On the face of it, an agency independent from political power, especially where competition for the provision of energy is limited, would seem to present the highest potential for minimizing barriers of the first and second types presented above. In theory, this type of governance structure would decrease the number of veto players involved, but as Limaye et al. [20] have shown, in practice the situation is often more complex. Necessary increases in the funding of new programs, for instance, is likely to be at least partly outside of the control of this type of agency, creating a space for obstruction. The CAFE standards example certainly illustrates this, and it is not entirely clear how an agency completely independent from the executive branch would have been shielded from this constraining, which reminds us of the utmost importance of the political obstruction dimension.

Moreover, energy efficiency measures often involve standards of various sorts, and the potential for a lack of policy coordination, whether at the international or national level, is also important. As briefly illustrated through the example of electric motors, this barrier is worst when it impedes the development of international markets for more energy efficient technologies. This is not a difficulty specific to energy efficiency measures, of course, as authors on trade and globalization have pointed out for a long time. Cooperation of individual countries in the establishment of global standards, especially in areas where state intervention

may be seen by many as unnecessary or unwarranted, is always a tall task. Nevertheless, the increased attention given to energy efficiency in policy circles in recent years seems to indicate a push for this cooperation to materialize, as was the case for electric motors.

Some limitations to our classification and definitions are worth mentioning. In particular, the illustrative examples are all from North America, where the context of energy production and consumption may be different from elsewhere, not least because of the abundance of many of the energy resources. Because of this, generalizations based on our classification – and the resulting recommendations to eliminate these barriers, for instance – should be made with care. The categories described above are intended to be general, and cannot substitute for empirical studies that would investigate the details of cases such as the political regime, or the veto players and veto points present at the national level. The same is true for the need to evaluate whether there are trends in how some of these barriers affect different industries, sectors, or firm sizes, as we mentioned in section 2.

Despite these limitations, the cases provide some ideas for further research. Clearly, it seems crucial to consider the actions and decisions of government actors and institutions, as they produce barriers of their own that end up preventing the adoption of cost-effective and energy-efficient technologies by individual firms. This suggests several reasons why it may be misleading to study the barriers too narrowly in terms of what constrains the decision by firms to adopt cost-effective technologies (as Sorrell et al's oft-used definition leads to). Reasons why attention should be paid specifically to political actors and the barriers they control are many.

As recent studies of drivers of energy efficiency have shown (notably [18]), government actors have an important role to play in supporting enterprises in removing or reducing barriers, in other words they are crucial stakeholders in promoting possible drivers to energy efficiency improvements. For instance, as government actors and institutions aim to improve the energy efficiency of entire sectors or industries, they may attempt to put in place rules or programs that will affect these decisions by firms, aiming to remove or reduce information barriers or inertia. However, as the discussion above shows, government actors themselves face barriers in doing so. Giving proper attention to barriers of this type is then essential, and in several cases this is unlikely to come out of surveys of industry actors.

Another example is illustrated in the second case study above: sometimes the firm making the decisions is a public monopoly, which may have an impact on its decisions to pursue aggressive energy efficiency policies – or not. A transfer of responsibilities for energy efficiency objectives and enforcement from the monopoly to an independent agency, for instance, may go a long way to produce improvements in the end result.

More generally, what we want to convey with this contribution is the notion that although increased attention to all types of barriers to energy efficiency in recent years is welcome, efforts in this regard may be futile or severely limited if sufficient attention is not paid to barriers of the political-institutional type. Understanding the dynamics underlying these barriers is essential to the pursuit of energy efficiency, and the correct identification of certain types of barriers as well as combinations and interactions between different instances, are key steps in the

elaboration of solutions to such barriers. A holistic approach to these obstacles remains the only way to ensure that they are properly addressed, as others have also pointed out (e.g., [35,69]).

6. Conclusion

This article presented and categorized barriers to the adoption and successful implementation of energy efficiency measures, where they have their origin in political institutions in a broad sense. Across the three categories of political obstruction, conflicting guidelines in governance structure, and lack of policy coordination, several more specific barriers can prevent progress with regard to energy efficiency.

In addition to the need for further empirical investigation of these barriers, an important next step is to extend this analysis to energy efficiency drivers, as several authors have pointed out in recent studies (e.g., [18,35,47,70,71]). This is particularly relevant to analyses of political-institutional barriers, because these may not merely prevent decisions and behaviors: they may be directly preventing drivers for energy efficiency improvements to be put forward, enacted, or enforced. Future research must look into ways to eliminate or prevent them, so that efforts by all stakeholders to tap into the "first fuel" of energy efficiency produce maximal results.

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9. Appendix

Table 2 – Institutional models for energy efficiency implementation and governance

Model	Examples	Main advantages	Main limitations
(1) Government agency with broad energy responsibilities	U.S. Dept. of Energy Danish Energy authority	Good visibility and credibility; Access to larger parent organization's resources; Greater clout in obtaining government funds; Integration of EE within broad sector objectives.	EE may not get sufficient priority for resources; EE function may not receive adequate attention or resources if top management is not committed; Large bureaucracy may impede decision making
(2) Government agency focusing primarily on clean energy or sustainable energy	Australian Greenhouse Office Mexico: CONAE	Agency focus consistent with EE; Dedicated "clean energy" agency provides greater voice in sector policy and obtaining resources	Narrower focus (size of the agency) provides less clout; The combining of EE with other sustainable energy options, may lead to a decreased emphasis on EE.
(3) Government agency focusing entirely on energy efficiency	Canada: Office of Energy Efficiency Brazil: PROCEL	Focus is entirely on EE: dedicated staff; Opportunity to create a pro-EE agency culture; Possible leveraging of other resources.	Narrower focus (size of the agency) provides less clout; Success highly dependent on effective top management; Agency must compete for resources, and may not be isolated from broader energy policy agenda.
(4) Independent authority created by statute to promote energy efficiency/clean energy	U.K.: Energy Saving Trust Sustainable Energy Ireland	Independence facilitates operational discretion; Flexibility in accessing outside advice and support, in hiring management and staff, and fund raising.	Agency may not be viewed as mainstream by other government agencies and some stakeholders; Potential competition between ISA and public agencies; Less direct access to public funding; Changing scope may require legislation.
(5) Independent corporation owned entirely by the government	South Africa: NEEA Korea Energy Management Corporation	Independence facilitates operational discretion; Access to private-sector talent/technical capacity; Ability to form joint ventures and subsidiaries; Flexibility to obtain external inputs and funds.	Less direct access to public funding; Board composition will determine effectiveness; Agency may not be viewed as mainstream; Potential competition with public agencies.
(6) Corporation through public-private partnership	Polish National Conservation Agency Germany: DENA	Agency can benefit from private sector participation since EE programs need mobilization of the private sector for implementation; Independence allows greater flexibility in decisions.	Potential conflicts may arise due to different objectives and/or perspectives of the private and public partners; Partnerships have less direct access to public funding.
(7) Non-profit or non-governmental organization	Austrian Energy Agency Croatia Energy Institute	NGOs have greater credibility with some stakeholders; EE focus helps build core competencies; Flexibility in obtaining external inputs and funding.	NGOs have less direct access to public funding; Some stakeholders (such as industrial firms) may not find the NGO a credible source for EE information; NGO governance structure may impose other strictures.

Source: Adapted from [20, pp. xii–xiii, pp. 25–33]