Funding, Coordination, and Public Opinion:
Political Obstacles to Electrical Grid Modernization in the Americas

Robert Strickling
Macalester College
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Abstract: *Legislation in Argentina, Brazil, and the United States has prioritized electrical grid modernization. In Brazil and the United States, legislation has even allocated significant funding for such projects. Because of its status as a technological and economic powerhouse, the United States might be expected to lead the Americas with respect to electrical grid modernization. Through a comparative analysis of Argentina, Brazil, and the United States, I argue that the United States can learn from the structure of national regulatory actors although Brazil and Argentina still need to address funding and public opinion deficiencies. Despite significant funding, progress in the United States has been constrained by lack of coordination among a staggering number of government actors at the national level. In Argentina and Brazil, government structure is more conducive to coordination and modernization progress because there are fewer actors and the roles are more clearly delineated. Although not in the same league, the United States could learn from its South American neighbors. However, lack of public political support has already impacted government and private financial backing in Argentina and rises in residential electricity prices is threatening to do the same in Brazil.*

Introduction

The United States was the first nation to put a man on the moon and revolutionized the world by ushering in the Internet Age. Like these landmark events, new electrical grid technology is now on the cusp of revolutionizing the world once again. The New York Times has called new electrical grid technology implementation "crucial" to ushering in new energy models and it has been dubbed the "new space race" by PricewaterhouseCoopers (Kulatilaka 2011). This race is not just for the global economic elites; Argentina and Brazil have also made pledges to develop their electrical grid infrastructure. New electrical transmission infrastructure will provide savings through energy efficiency, increase energy security, and better allow for the incorporation of new energy sources such as wind and solar. Despite the promise of this new technology, however, Argentina, Brazil, and the United States continue to rely on electrical grid transmission networks built with fifty-year old technology.

As of 2011, only six countries in the hemisphere had made a significant move towards modernizing their electricity infrastructure based on renewable energy targets and/or plans to explicitly modernize their electricity grids.[1] Of these countries, the United States and Brazil were the only ones in the top ten globally in terms of national investment in new grid technologies (KEMA). While not world-class in investment terms, Argentina faced similar transmission challenges that require new electrical grid technology like Brazil and the United States. These three countries were trying to connect sources of energy that remain distant from traditional electricity consumption centers. Both Argentina and the United States have a large capacity for wind energy generation but the windy areas of the country are not where the people live, creating the need to transport that electricity longer distances. Similarly, Brazil would like to deliver

[1] These countries are Argentina, Brazil, Canada, Chile, Mexico, and the United States.

hydroelectric power from the south and interior of the country more efficiently to the São Paulo-Rio de Janeiro corridor.

This paper addresses the question of why these countries have not had success modernizing their electrical grids through a political lens by analyzing: 1) access to funding for grid projects; 2) the coordination of a national plan for grid development; and 3) public support for the plans. This paper argues that in Argentina and Brazil, government structure is more conducive to coordination and modernization progress because there are fewer actors and roles are more clearly delineated than in the United States. In Argentina, lack of public political support has already impacted government and private financial backing and similarly rising residential electricity prices are threatening to do the same in Brazil. For now however Brazil, remains better positioned financially than Argentina and has benefitted from government investment, which is notably absent in Argentina.

This paper will engage the theoretical literature on the role of developing countries in new technology deployment (IMF 2011, 170).[2] Breaking down the structure of the electricity transmission sector and regulatory framework for each country illustrates the shortsighted monopolistic transmission firm in Argentina, an ambitious, well-designed, but unproven system in Brazil and a gridlock of government actors in the United States. With this in mind, this paper draws on government publications, testimonies of experts in and outside the government, and independent research firms to illustrate how the three core political obstacles affect each country.

[2] This paper uses the International Monetary Fund's classification, an industry standard, which denotes Argentina and Brazil as emerging economies and the United States as a Major Advanced Economy, the highest classification in their framework. Regardless of controversy surrounding the use of such labels, it is useful for generalizing the type, strength, and behavior of institutions present in the developing world although Brazil and Argentina's favored position in terms of government coordination vis-á-vis the United States, challenges these norms.

Theoretical Framework

Scholars who focus on the developing world and specifically Latin America often focus on what differentiates those countries because of their assigned status as a "developing country" or "emerging economy." Specifically, concerns over government stability and reliability changes the game on policies, there is a more difficult path to capital in order to invest in these projects, and government stability creates greater risk for companies.

In developing countries, issues around deploying new technology, improving energy efficiency, and combating climate change do not always make national agendas because there are more immediate concerns that do not affect countries like the United States as much. Popp (2010) proposes that in such countries, the policies that actually come to fruition to help encourage new technology deployment tend to be smaller regulations rather than game changing restructuring or large funding projects that have been highlighted as good motivators for the United States case. Alcañiz (2010, 151) proposes that the solution to this problem and to the problem of effectiveness of incentive programs is a strong government presence that strictly regulates standards that continually increase with new technology developments to mandate their deployment. This approach will give firms no choice but to invest, although it may represent a step on the path towards the de-privatization of the electricity sector.

Because the combination of unwillingness and inability to invest in the deployment of new more energy efficient technology, governments have turned to international organizations like the World Bank and the Inter-American Development Bank to promote these projects through grants and loans. In addition to solving the government's problem, it helps firms who in many cases have difficulty finding capital for new projects because of concerns beyond their control such as the country's credit rating and concerns over the stability of the regulation of the

electricity sector (Martinot et al. 2002, 335). Unfortunately, these grants and programs are limited in number and cannot be relied on solely for the deployment of new technology across the country. They can only function in concert with effective policy-making by the governments concerned.

Modernizing the Electrical Grid

With any fifty-year-old technology, there are elements that can be improved upon to modernize for a new era. This paper examines the implementation of new electrical grid transmission technology that addresses energy efficiency, energy security, or the incorporation of more renewable energy sources in the grid. This technology could still take a number of forms. One segment of this technology would fall under the "smart grid" label. Depending on the circle smart grid could mean anything from a very specific set of metering technologies to being used as a buzzword without any clear definition.[3] This paper will avoid using this phrase when possible and focus on all technologies (many of which are in fact smart) that work towards the modernization of the system as addressed in the subsequent paragraphs.

With the current electrical transmission infrastructure, energy generators are required to produce significantly more energy than is being consumed because so much energy is lost on aging power lines. In the United States, an Energy and Policy Research Institute study (EPRI 2011, 23) estimated that updating the national grid could reduce its carbon emissions by as much as 58 percent. By increasing the efficiency of power lines, energy generators will be able to produce less electricity in order to meet demands, ultimately saving electrical utilities money.

[3] The U.S. Department of Energy defines smart grid technology as: "a class of technology people are using to bring utility electricity delivery systems into the 21st century, using computer-based remote control and automation. These systems are made possible by two-way communication technology and computer processing that has been used for decades in other industries" (USDOE).

New electrical grid technology implementation would also make long distance transmission more feasible and cost competitive. For instance, despite having some of the best potential for wind energy implementation in the world in southern Patagonia, the vast majority of Argentina's energy demand in the country originates in the distant capital of Buenos Aires. Brazil also has more than 50 percent of their consumption located along the coast connecting Sao Paulo and Rio de Janeiro but their electricity primarily comes from hydroelectric plants to the south or to the west in the Amazon. Similarly, the United States has significant wind potential along the Great Plains in the Dakotas and Iowa, but the population density is low in those areas. By making long distance transmission more cost competitive through the deployment of newer and more efficient electrical lines, it would be easier for countries to encourage the use of cleaner sources of energy for their electricity needs.

Aside from the lines themselves, sensors on the electrical lines can also identify inefficiencies by relaying information on electricity loss. Information from these sensors could identify problems in the electrical transmission lines and help grid operators make informed decisions on the replacement, updating, or patching of lines. With the current grid infrastructure, it is prohibitively difficult for electrical grid operators to locate problems in the system, even those large enough to create blackouts.

The steady increase in business and civilian electricity needs has made the system's ability to meet those demands more inconsistent, especially during peak energy usage. Blackouts such as the Northeast blackout of 2003 in the United States and the 2001 and 2009 blackouts in Brazil that left 18 of 26 states without power have resulted from this inconsistency. Modernizing the electrical transmission network can lead to the implementation of dynamic pricing, which would reduce peak energy usage and allow energy generators to better plan their energy

production and avoid potential blackouts.[4] The sensors or meters that can be placed on transmission would also help electricity providers find problems with the system and fix them before they become a high risk for network failures, like blackouts.

Current electrical grids have also made it difficult to incorporate many renewable energy technologies. The grids are built on the assumption that power generators will be sending constant streams of electricity. Without this constant stream of energy, there is significantly higher risk of the electrical grid being overloaded, causing a blackout (Randall 2011). Many sources of renewable energy are sporadic by nature, making them unreliable as large-scale alternatives for the current generation infrastructure. For instance, solar cells and wind turbines only function when it is sunny or windy, failing to produce a constant stream of energy. Additionally, electrical grids are not currently set up to incorporate small generators of electricity, which is the ideal scale of many new renewable energy sources.

Electricity Industry Structure

Politics is at the heart of understanding the electrical sector because the study of political actors reveals the mechanisms that obstruct deployment of new electrical transmission technology, which is a heavily regulated industry. All three countries, however, have different regulatory circumstances and political structures in place that provides an interesting contrast. [5] One state-held monopolistic firm with shortsighted objectives dominates the Argentine transmission sector whereas Brazilian transmission firms are becoming increasingly more private and more competitive to fit in with ambitious long-term goals to use electricity as a driving

[4] Currently, electrical system operators have no way of relaying information to customers about the supply and demand of electricity in a given moment. By installing smart meters, electricity providers will be able to transmit real-time supply and demand information that allows for price fluctuations throughout the day. For instance, currently there is no financial incentive for a user to try to avoid using electricity during peak hours.
[5] Refer to Appendix 1 for reference on these structures across the country cases.

economic force. While the United States is most defined by the mess that is the interaction of government actors. It is unclear even for the policymakers to decipher which agencies should be responsible for what

State Monopoly in Argentina

In the 1990s, Argentina began a process to reform in their electricity sector that is considered a textbook example of electricity reform and regulation because it experienced success in: 1) promoting competition; 2) bringing in foreign investment; and 3) keeping prices low for consumers (Manzetti 2000, 96). This reform also separated the generation, transmission and distribution sectors, creating three different regulatory regimes for each one. The National Electricity Regulator (ENRE) was established to oversee this process.

In order to ensure fair access and reasonable tariffs for transmission services, transmission was established as a state controlled monopoly. The state controlled monopoly, TRANSENER, controls over 95% of the transmission market in the country. Additionally, though they own and operate the transmission grid, they are not financially responsible for its expansion. Costs and planning associated with electrical grid transmission expansion are the burden of the beneficiaries, although these initiatives are overseen by ENRE with the technical support of Cammesa.

In this institutional framework, Argentina's Congress does not have a direct role in the development of regulatory policy but they are able to direct ENRE through legislation. They did this most notably with a 2007 law that directed ENRE to increase Argentine electricity generation from renewable sources to 8% of the national total capacity by 2017. Congress has the authority to direct the transmission sector as well and could introduce directions for ENRE and TRANSENER's future development if it so chose.

On the whole, the Argentine system is very successful at maintaining cheap and open access to transmission services. On average, Argentine citizens pay up to 30% less for their electricity needs than their Chilean neighbors, a direct product of Argentina's regulations promoting access to transmission and distribution networks (Estache and Rodríguez-Pardina 2000, 184).

Successive Brazilian Reforms

The first major electricity restructuring began in 1996 as President Fernando Henrique Cardoso began privatizing the electricity sector as part of his countrywide implementation of neoliberal policies. The privatization movement was focused on the generation and distribution sectors but the transmission assets however remained state owned. These reforms also included the creation of the Brazilian Electricity Regulatory Agency (ANEEL) to regulate and control the generation, transmission, and distribution of electricity. This agency is charged with finding the balance between consumer and electricity firm interests that is socially optimal which includes mediating any conflicts. ANEEL is also responsible for establishing fair rates that ensure quality service, incentivizing investment (when applicable) and stimulating competition between operators. It is an autonomous organization but was established under the auspices of the Ministry of Energy and Mines (MME), and defers to legislative and executive authority for their policymaking. In addition to its regulatory authority, it is an instrument for the execution of MME's policies.

Under ANEEL, a private independent National Electric System Operator (ONS) was established in 1998 to operate the National Interconnected Electrical System[6] in order to ensure

[6] The National Interconnected Electrical System is the 96.6% of the Brazil's electricity generation and transmission that is interconnected although owned by a variety of different firms. The 3.4% that is not part of this network is primarily made up of small isolated networks located in isolated regions of the Amazon.

security, continuity, and the cost of electricity in the country. ONS operates as a private non-profit with oversight from ANEEL, run by representatives from all areas of the electrical sector as well as large consumers. The creation of the ONS and the CCEE allowed for the virtual integration of the electrical grid that exists today.

After his election in 2003, President Luiz Inácio "Lula" da Silva blocked the privatization of some state electricity firms slated to occur. Despite this shift, Lula ushered in the so-called "New Model" for the electric system. He was able to enact, with the support of Congress, measures to encourage long-term private investment in 2004. These measures focused on the distribution sector but had implications for the transmission sector as well, most notably in the creation of the Energy Research Company (EPE). The EPE is in charge of researching and making recommendations on the future development and planning of the energy sector.

Additionally, the President has at their disposal the National Energy Policy Council (CNPE), made up of representatives from different areas of government to promote cooperation and discussion across ministries on energy issues. Specifically, they are tasked with advising the President on energy policy. Because of the diverse actors who contribute to this body, they are the primary source of energy policy formulation in the executive branch.[7]

Although electrical transmission assets were not privatized like generation and distribution, Cardoso's restructuring of the system and movement towards establishing fair rates for companies spurred private investment. While Electrobrás and other state-owned enterprises remain big players in the auctions for transmission contracts, private firms have won a significant number of contracts in the last decade increasing their presence in the market. After the reforms of the late 1990s, private firms have been very successful in electrical transmission auctions. Taking into account the size of the contracts issued, private firms hold 76.5% of the

[7] Appendix 2 illustrates the current structure of government actors.

transmission market that was auctioned out between 1999 and 2007 while partnerships between public and private entities hold an additional 14% (Serrato 2010, 19).

The Bureaucratic Jungle of the United States

Since the advent of electricity as a major industry in the United States, the industry has been subject to federal regulation. State public utility commissions have retained authority over some of the distribution and retail aspects of the industry but because of the interstate nature of electrical transmission, the Federal Energy Regulatory Commission (FERC) has regulated it. FERC is responsible for setting prices for electrical transmission firms and monitoring the market for electrical transmission firms. It is one of a staggering number of federal entities with their hand in the electrical transmission industry in one way or another. The Department of Energy sets policy relating to energy security and is instrumental in research and development projects. Across the cabinet, the Department of Justice's antitrust division, the Federal Trade Commission, the Securities and Exchange Commission, and the Environmental Protection Agency are a selection of the agencies with a stake in the electrical grid on environmental issues.

The current system for transmission firms is set up principally to allow fair access to transmission networks for all generation and distribution firms. Transmission firms are regulated as regional monopolies. In 1996, FERC issued Order 888, which suggested that these firms be independent from other electrical sector actors such as distribution and generation firms and that they form Regional Transmission Organizations (RTOs). Since that point, FERC has continued to encourage the decentralizing of regulation, through Order 1000 which gives the RTOs the authority to set their own planning objectives (FERC 2011, 6). Over two-thirds of the country's electricity transmission needs are handled by these RTOs.

Regulators in the transmission sector use two types of pricing: at-cost pricing and incentive-based pricing. With at-cost pricing, prices are set at the costs of the transmission firm but this system does not encourage energy efficiency because firms will not reap the benefits of reducing their costs, as the price will change with the energy efficiency. With incentive-based pricing, the price is determined ahead of time for a set period time, giving transmission firms the incentive to cut costs to render their services at a lower price level because they can profit from their energy efficiency. Some policymakers however feel that this leads to a reduction in the quality of service rather than truly improved efficiency (Brennan et al. 2002).

Funding

With any major infrastructure project, like electrical grid modernization, one of the first questions to answer is: how will it be funded? Traditional economics suggest that with competition, firms will innovate on their own without outside impetus. In the case of regulated electricity, there are market failures that prevent this type of investment from the firms themselves unless the regulatory circumstances are just right. Often, it becomes a game of attracting outside investment from the government, international organizations, or companies new to the sector. After an analysis of the nature of market failures, this section will analyze how funding obstacles affect Argentina, Brazil, and the United States.

Argentina's regulatory framework does not promote private investment and a lack of funding from the federal government force the country to rely on the support of international organizations to fund electricity grid modernization efforts, limiting their control of the process. Brazil uses international funding like Argentina but is able to use national funding to support the majority of their electrical grid investment and is able to attract limited private investment that has been constricted by the large state involvement in the transmission sector. The United States

lacks the funding from international organizations but Congress is able to invest significantly more of their own capital than Argentina and Brazil but the direction of this money is not optimal because of Congress's focus on other factors such as job creation.

Market Failures in Regulated Electricity

Within the academic literature, opinions on what is the driving the force behind market failures can generally be classified into three general forces: the Energy Efficiency Paradox, price fixing, and the lack of competition in heavily regulated industries. While all of these are competing claims, their arguments contribute to the development of a consensus within the literature that a policy response is indeed needed in order to encourage the deployment of new technology.

The Energy Efficiency Paradox consists of the idea that cost-effective energy-efficient technologies diffuse slowly and are not as widely adopted as might be expected given the cost-effectiveness. Popp (2010, 289) traces the origin of the paradox to work done in the early 1990s by Jaffe and Stavins (1994), which has continued to be developed since then by other researchers including Anderson and Newell (2004). They found that the cost of new energy efficiency investment had a significantly higher effect on financing than the opportunity to reduce costs does. Furthermore, they observed that nearly all firms that they researched had a payback threshold of less than five years and the median threshold was a mere 1.2 years. While this was a study completed with firms, behavioral economic theory would suggest a similar result if a study were done at the level of the individual, although Gillingham et al. (2009, 610) notes that there are not many empirical studies from which to draw from.

Gillingham et al. (2009, 600) goes on to suggest that firms may not have adequate information on new technologies to make an accurate prediction of the returns on their

investment. As part of this insecurity, firms may also be concerned about whether they can really count on new technologies to deliver the results promised in terms of reliability. Gallagher (2006, 203) argues that a major factor in explaining this insecurity is the diverse sources from which new research and development may come from. These different sources can vary wildly in credibility and never come with guarantees or protections.

Other areas of scholarship claim that the price fixing nature of regulated electricity markets is the main culprit of why there is a lack of new technology development. Brennan et al. (2002, 85) discusses how the mentality behind price fixing in regulatory environments has largely been based on protecting the consumer and forcing firms to cut costs. As a result, firms may not be making enough of a profit to feel comfortable investing limited profits into new technology given the large upfront capital costs that this would require. Clastres (2011, 5403) agrees that a sweeping change in the pricing structure is needed but instead draws from behavioral theory to explain it. He suggest that firms are concerned that if they create cost savings the regulatory structure will force the price down and so they will not see the profits.

Other authors would suggest that this increase in competition would not be enough to stimulate investment and deployment of new technologies but that instead governments need to take into account the positive externalities that this new technology may create for society and incentivize them (Simon, 2007, 25). By taking these factors into account, the government can take an aggressive stance to encourage the deployment of new technologies. In order to combat the Energy Efficiency Paradox, the US Department of Energy has begun investing in demonstration projects and working on the research and development side to make the deployment of new technologies more predictable for firms (Gallagher et al. 2006, 203). Congress has supported these projects as well through the allocation of money and plays a strong

role in the development of the technology. The technical capacity of the federal researchers at the US Department of Energy is very important in dispelling some of the concerns that may arise regarding the reliability of a given technology and whether the projections on returns can be trusted.

A crucial segment of the scholarship on policy responses to these market failures follows the work of Kenneth Arrow (1962). Arrow argues that the implementation of new technology into an industry may not be profitable, at least initially, because the technology requires you to learn by doing in order to be fully developed and financially competitive. Therefore, in a heavily regulated industry, policies to promote the deployment of new technology that require learning by doing are needed because there is no incentive for the utilities themselves given pricing competition structures. Following Arrow's thesis, the implementation of new technologies will allow the costs to decline as a result of experience. Maloney (2002) is careful to emphasize how this learn by doing approach should only be encouraged with particular technologies that produce lots of positive externalities.

In terms of incentivization, other authors believe the appropriate policy response is an effective way of internalizing of the positive externalities of a modernized grid, with the firms (Pollitt 2008, 79). Gillingham et al. (2009, 613) studied the literature on tax incentives and finds that in the 1990s, tax credits were much more effective in encouraging firms to continuing investments in new more energy efficient technology but had a low success rate with getting firms to begin these sorts of investments for the first time. Hassett and Metcalf (1995) present a notable exception to this rule. In their study, they found that a 10% change in the tax price on energy investments, increased the probability of making an energy efficiency investment by 24%

(Gillingham et al. 2009, 613). It is clear that further research is needed in the study of what specific policy incentives are effective in encouraging investment in new energy technology.

Argentina: Beholden to International Organizations

In Argentina, funding a modernization of the electrical grid principally is stymied by two core problems. First, the regulatory frameworks and pricing mechanisms do not encourage private investment in the grid. Second, shortsighted leadership at the national level has left funding for electrical grid projects off the table forcing Argentina to turn to international organizations like the World Bank to get new transmission efforts off the ground. Thirdly, this reliance does not give Argentina full control over its planning agenda, which detrimentally affects the government's ability to guide the development of the network as a whole.

Because of strict regulation to ensure low prices and ease of access to transmission networks, there are not incentives for TRANSENER to invest heavily in its network unless mandated by the government. The pricing structure is such that the cost of any new investment in the grid will be held by those that benefit directly from the lines and not the transmission firms who would need to carry it out (Estache and Rodríguez-Pardina 2000, 184). This takes the power out of the hands of the actual transmission firm, as they have no incentive to plan the grid nor do they have the power if those who benefit are unwilling or unable to bear the financial burden.

Without government financial support for firms in the electricity sector, funding is hard to come by even with a government contract in hand. As a result, they have turned to organizations like the Inter-American Development Bank (BID) to help finance their projects. In March of 2011, BID signed a loan agreement worth $120 million to help Argentina with their Federal Electricity Transmission Plan (BID 2011). This loan program came on the heels of the removal of subsidies and rise in in electricity prices–requirements of BID for the loan service.

International organizations can have impacts such as these, which may interfere with the best interests of the country, but they also can direct which elements of the electrical grid they want to fund. In general, they have a tendency to issue loans or grants for more proven technology because it is a safer risk for them which can make it harder for countries like Argentina to incorporate cutting edge technology.

Energy Finance on the Rise in Brazil

Recently, the Brazilian government has risen to be the 10th biggest investor in the world in ne electrical grid development. In the last decade, Brazil's economy has exploded which has caused a parallel increase in the country's electricity needs. Between 2007 and 2017, energy consumption is expected to increase by over 60% and the government recognizes the need for the grid to grow at a faster rate so as to allow for economic growth (ZPryme 2011, 8). Brazil also dabbles in the international organizations to secure additional funding for projects but in general does not rely on them as a primary source, as opposed to Argentina.

In general, companies do not have significant problems finding credit or funding for new projects in Brazil. However, some concerns over Brazil's future policies and electrical grid have cut into investor security. For instance, reliance on hydroelectric power and frequent electrical grid disturbances are bad omens for long-term investors. While Brazil has been successful in attracting foreign investors, they also have a much more diverse set of domestic companies to serve their infrastructural technology needs than Argentina which certainly helps private investment (Serrato 2008). The more competitive regulatory framework in Brazil also contributes to a better investment environment for the modernization of the electrical grid.

United States and Misguided Congressional Funding

Unlike the cases of Argentina and Brazil, firms in the United States have little-to-no problem finding credit to finance new infrastructure projects and similarly the US government has invested significantly more than these other two cases. At the national level, the United States is second only to China in terms of government investment in new electrical grid technology with almost $7.1 billion (KEMA 2011).[8] The problem with this money is its efficacy towards modernizing the electrical grid.

The problem is that the primary purpose of this legislation was not to modernize the electrical grid. This legislation was passed to set up the United States to recover from a recession and in the process create jobs. The focus of the $7 billion allotted for electrical grid modernization while being spent on like-minded projects is being spent more based on how many jobs it will create rather than how it will help modernize the electrical grid.

To date, the problem with private investment in the electrical grid has not primarily had to do with the regulatory framework or access to capital like in Argentina and Brazil. Problems with private investment have instead been tied to a lack of a clear regulatory and government message on the future of the electrical grid.

Construction of a Coordinated National Plan

In order for a government to enact change to encourage the modernization of the grid aside from funding they have to have a set of policy objectives agreed on. Depending on the number of competing actors in government alone, this can prove quite difficult even if all are working towards the same goal of modernizing the electrical grid. In order to get over this obstacle, countries need to have either an institution in place that can effectively manage and direct these competing agencies or have a coherent national plan with buy-in from the necessary

[8] China came in first on this measure with $7.3 billion. Brazil was tenth with $204 million and Argentina did not make the list.

institutions. The simpler the structure of the government actors is the easier it is to accomplish either of these goals.

In Argentina, the simplicity of the network of government institutions encourages easy coordination on national projects and the Argentine Congress has had success in the past legislating national electricity objectives. Whereas, in Brazil, the situation is murkier than in Argentina and it is not always clear which actors have jurisdiction over what things but the structure has a clear top-down structure, which opens the door for effective coordination. The roles of government agencies are clearly delineated on many issues in the United States but the sheer volume of involved parties makes it difficult to coordinate on a national level.

Clear Argentine Institutions

In Argentina, there are fewer governmental institutions involved in the electricity sector, which makes navigating bureaucratic networks significantly easier to accomplish to develop national policy. Estache and Rodríguez-Pardina (2000, 184) contest that it is the simplicity of the system that has allowed Argentina to be successful in developing national plans regarding their electrical grid. The monopolistic nature of the transmission sector makes regulation and policymaking easier as many efforts only have to be directed at one organization, which is state-owned.

In addition to the simplicity of the Argentine system, Congress has played an important role in setting national energy policy. Although Congress has not been helpful when it comes to funding, they have a track record of legislating key objectives for the regulatory agency, ENRE. The most notable example of this is the 2006 legislation to increase Argentina's renewable energy generation to 8% of the national total by 2016. The legislation set clear goals and steps for particular agencies. For instance, to increase win power generation, ENRE began creating

auctions for the contracts to supply wind energy specifically to the electrical grid. Despite their ability to develop a national plan, Argentina's struggles with funding as noted in the preceding section negatively affect the success of this plan as companies with guaranteed government contracts in hand to supply wind energy still cannot find the capital to build those wind farms. While the process is sound, it is clear there are still many more items that need to be incorporated into Argentina's nation plan which could potentially jeopardize the simplicity of the system as more actors are brought in to address specific problems such as the financing of new energy projects.

Brazil: A Model of Top-Down Coordination

In Brazil, roles of government actors in the electricity sector are clearly delineated with top-down authority.[9] This makes for a likely environment in which to have cohesive, sensible, useful national planning initiatives form. Of the institutions that contribute to this climate the EPE and the CNPE[10] are of particular interest. The EPE is a planning and research commission that does not have a vested stake in the regulatory process and is technically independent of the government. This impartiality makes them a perfect body to develop recommendations on strategic planning objectives. The CNPE is incredibly useful as a tool for generating consensus and delivering a single message within the government. By having everybody on the same page, individual agency policies can be more effective by working as part of a larger national plan with other cogs in other agencies, all part of one big machine.

Alternatively, Woolf et al. (2010) suggests that the roles of different government organizations in auctions are unclear at best. While this may be true and get in the way for some

[9] Refer to Appendix 2 for a diagram of Brazilian government actors in the electricity sector.
[10] The CNPE is made up of officials from throughout the government and can act as a tool for the President to gather these actors and work with them to either develop national policy or to dictate it and be able to work through any potential conflicts or differences of opinion that might occur between organizations.

circumstances, it has not been a major inhibiting factor in the formulation and construction of a coordinated national plan so far. However, the PT party has enjoyed widespread popularity and has not had to deal with a particularly strong active opposition because of the country's economic successes during the administration. With more party conflict, the harmonious Brazilian coordination system may be brought under more scrutiny or be stressed. Additionally, Congress could try to legislate around CNPE's policies as an override mechanism over presidential power in the electrical grid which until this point has gone relatively unchecked.

Internal Government Competition in the United States

Currently, there are no less than 10 federal government agencies that are involved in electrical grid not to mention state public utility commissions. The staggering number of actors involved jointly presents a disjointed view with conflicting visions for what the electrical grid of the future looks like. In order for the federal government to be a driving force in electrical grid modernization, they must present a unified direction. This is especially important to encourage investment in the electricity sector and allow utilities and state agencies to invest comfortably because they face the risk of different technologies or standards becoming pre-eminent without the work of government agencies to create these standards.

Congress has made significant steps, with bipartisan support, to support a National Grid Modernization Road Map. In the last decade they passed three major pieces of legislation to help move grid modernization forward that, while very helpful, have been necessary but not sufficient for the federal government's coordinating needs.[11] These three congressional acts provided crucial money for grid development in the country and gave mandates to federal agencies but lacked a comprehensive, unifying vision for its development.

[11] The three bills referenced included the Energy Policy Act (2005), the Energy Independence and Security Act (2007), and the American Recovery and Reinvestment Act (2009).

In 2005, Congress passed the Energy Policy Act with a Republican-controlled House, Senate and Presidency, though the measure had significant bipartisan support. This bill included a mandate for FERC to use its powers to "encourage the deployment of advanced transmission technologies" (USCENR 2009, 5). It is understood that in this case the "deployment of advanced transmission technologies" is equivalent with what has been described in this paper as the modernization of the electrical grid. The FERC would be able to provide some rate incentives to utility companies who are deploying new electrical grid technologies and could assist them with rate recovery.

In 2009, as part of the American Recovery and Reinvestment Act, over $4 billion was set aside for electrical grid transmission projects. While this is a great step in the right direction with the democrat-controlled senate and house as well as the presidency, there appeared to be great collaboration on the issue to ensure that the legislative will was on the agenda of the executive branch. However, since this bill there has been a lot of debate over how effectively the money is being spent. Furthermore, without a national electrical grid development plan or road map in place, any money being spent would be undirected and may not fit into what turns out to be the long-term goals of the country.

Although, the bills above were passed with bipartisan support Liebrich (2011) argues that the lack of a comprehensive climate or energy bill in the United States is one of the largest impediments to electrical grid modernization.[12] Such a bill would make clearer the division of responsibilities and act as a coordinating document to introduce the steps needed for electrical

[12] In addition to the lack of a climate/energy bill in the United States and the 2010 congressional midterm elections, Liebrich (2011) highlights regulatory pushback over "smart grid" programs in the US, Retrospective changes to tariff regimes in Czech Republic and Spain, and Tariff reductions in other EU countries as global impediments to electrical grid modernization.

grid modernization. Currently, the Executive Branch has its mandate (and funding) from congress but there are too many actors in the Executive Branch for this to be sufficient.

Public Opinion

Public opinion is essential to modernizing the electrical grid as both a political and economic tool. Although much of the political power in all three countries is in the hands of bureaucrats, the legislatures and executives in all three countries have the power to direct policy even if they are not always successful at coordinating it. In addition to the political momentum or stopping power that public opinion has, it is also essential when it comes to price fluctuations in electricity services. Depending on how it is accomplished, modernizing the electrical grid can cause a short-term (or in some cases long-term) rise in the price of electricity to both residential and industrial consumers. This willingness can affect the dynamics of both funding mechanisms as well as hurting political will.

In Argentina, public opinion is focused on shortsighted objectives and the public is extremely price sensitive. Brazil has already begun to see the beginnings of public backlash from residential electricity price increases but in many sectors of society electrical grid modernization is recognized as an important national priority. This dissatisfaction has the potential to grow and rival the Argentines. In the United States, the public is aware of electrical grid modernization but in very different ways and in terms of different objectives but in the face of a prolonged economic recession, that political support is giving way to other interests.

Living in the Moment: Short-Term Vision in Argentina

Even though preceding section demonstrated how institutionally Argentina is in a great position to plan and coordinate a national electrical grid modernization plan, when it comes to

the money or incentivization plans, where it really matters Congress and the Public have balked. Despite well-developed plans, Congress has not put forth any significant funding because it is not a priority. Argentine voters have not indicated they want it to be a priority because there is not the same level of public concept of the importance of the electrical grid as a development tool as it is framed in Brazil. There is only room in the and at the forefront of the national agenda for so many items and the people would prefer to see education, poverty, and trade among others in the limelight. As part of the shortsightedness, Argentines are especially sensitive to price fluctuations which hurt firms' ability to employ new technology.

Energy Efficiency and Rising Electricity Prices in Brazil

As a response to the 2001 energy crisis that introduced electricity quotas, businesses and residents became more conscious of energy efficiency issues. For residents, this meant consuming less and investing in energy efficiency appliances. So far, that sentiment has translated into support for energy efficiency on a system-wide scale because the public is conscious and understanding about that the financial and system benefits would be of new electrical grid technology. There is a much higher awareness in Brazil surrounding the grid because of the 2001 crisis and because blackouts due to system strain are not uncommon although the vast majority do not last very long. This hyper awareness helps politicians put the electrical grid on the national agenda which helped with funding.

While the hyperawareness can be a productive tool for electrical grid development by gathering support, it has also made Brazilians very sensitive to residential electricity price fluctuations. Already there have been residential electricity price increases because of the introduction of more private firms. This may normalize as competition kicks in but is a classic case of short term costs having a shock effect regardless of the potential long term benefits or

monetary savings. Currently, the dissatisfaction with the rising electricity prices especially in lower sectors of society has the potential to derail the political support that has made Brazil so successful up to this point. Some of the concerns echo a rising voice in Brazil to focus on the poor ahead of broad economic development for the country. Currently this however remains a minority movement, especially in comparison to the Argentina case.

United States: A Stubborn Populace in a Recession

Voters and electricity consumers stand in the way of electrical grid modernization both by not demonstrating the political will to make grid development a priority and an unwillingness to pay upfront costs for long-term cost savings. As this paper has illustrated, political actors are at the heart of national grid development but without a mandate from the electorate, grid development has slipped through the cracks. A study completed by the National Energy Technology Lab (2007, 9) indicated that the American public does not fully understand the benefits that the modernization of the electrical grid can bring and so are not willing to make the short-term investment. The Electric Power Research Institute (EPRI) estimates that modernizing the U.S. electrical grid could come at a cost of between $337-476 billion over the next twenty years but with a potential benefit of $1.2-2 trillion (EPRI 2011, 29).

Of the savings estimated by EPRI, many of them will not necessarily reach the consumer. According to EPRI, some of the biggest savings will come to the environment as well as in energy reliability and security. These are savings that will not necessarily reach the household consumer but may be positive public externalities. A report by the Federal Energy Regulatory Commission (FERC) indicated that household savings (after factoring in the increased costs to pay for the modernization of the grid) might only range from $0-10 per month (Miller 2009).

Because these savings are modest and deferred, utilities companies are assuming that the American consumer will not be willing to pay the upfront costs needed for electrical grid.

As a result of the unwillingness (or perceived unwillingness) to shoulder any of the costs, it would put the burden on government to incentivize its development. Given how many of the benefits can be chalked up as positive externalities such as the benefits to CO2 emissions reduction, incorporation of more renewable energy sources as well as energy security, it would be natural fit to see government play a significant role in covering the costs associated with these benefits. Frederick F. Butler, the former President of the National Association of Regulatory Utilities Commissioners (NARUC) put it as: "we must be sure that we move deliberately and in stages so that the costs of rolling out the necessary infrastructure are borne by those who will benefit" (USCENR 2009, 35). For much of the modernization efforts that would mean the government working hand in hand with utility companies using loan or subsidy programs.

Conclusion

It is clear that though the United States might have at one time been the front runner to win this "new space race" of electrical grid modernization, Argentina and Brazil face similar obstacles in broad terms but Argentina and Brazil are better situated to deal with the coordination between actors because of their regulatory and government structures. On paper, the United States remains the clear frontrunner when it comes to funding as Argentina continues to struggle in this regard because of shortsighted leadership. However, Brazil may be beginning to challenge the United States' funding when taking into account how well the government is spending the money. In Argentina, voters and electricity consumers exhibit the same shortsightedness as their political leaders, which may severely hamper their ability to be a leader in electrical grid modernization. Notably absent in Argentina in comparison to the other cases is also the lack of

significant public investment in the electrical grid outside of the state-owned transmission firm. Whereas between Brazil and the United States, whoever can overcome their public opinion issues and win public favor should have the inside track to having a fully functional 21st century electrical grid.

Argentina's inability to find public and private financing is a classic example of the Martinot et al. (2002) argument that a country in their situation would have trouble finding capital. He argues that this is because of the country's credit rating and concerns over the stability of the government regulation. Both Brazil and the United States have demonstrated a willingness to spend large sums of money on their energy sectors but neither has tackled the issue of where the burden of the cost should be placed. The distribution of the benefits of a modernized grid is complex and following the work of Clastres (2011), neither the consumer nor the firms have been willing to bear this cost which would limit the effectiveness of incentive-based regulation.

In all three of these countries, the modernization of the electrical grid is a process still in its infancy. By its nature, this paper has presented a lot of background on each of the cases and really serves as an introduction to the issue in each of the countries while offering an analysis of the contrasting obstacles that they face at this early stage. In the future, when these countries have experienced more tangible success (or failure) in their electrical grid modernization, a more empirical study should be done to assess the results of that process and be able to more adequately assess the impact of and solutions to the key political obstacles as well as what policies turned out to be most successful.

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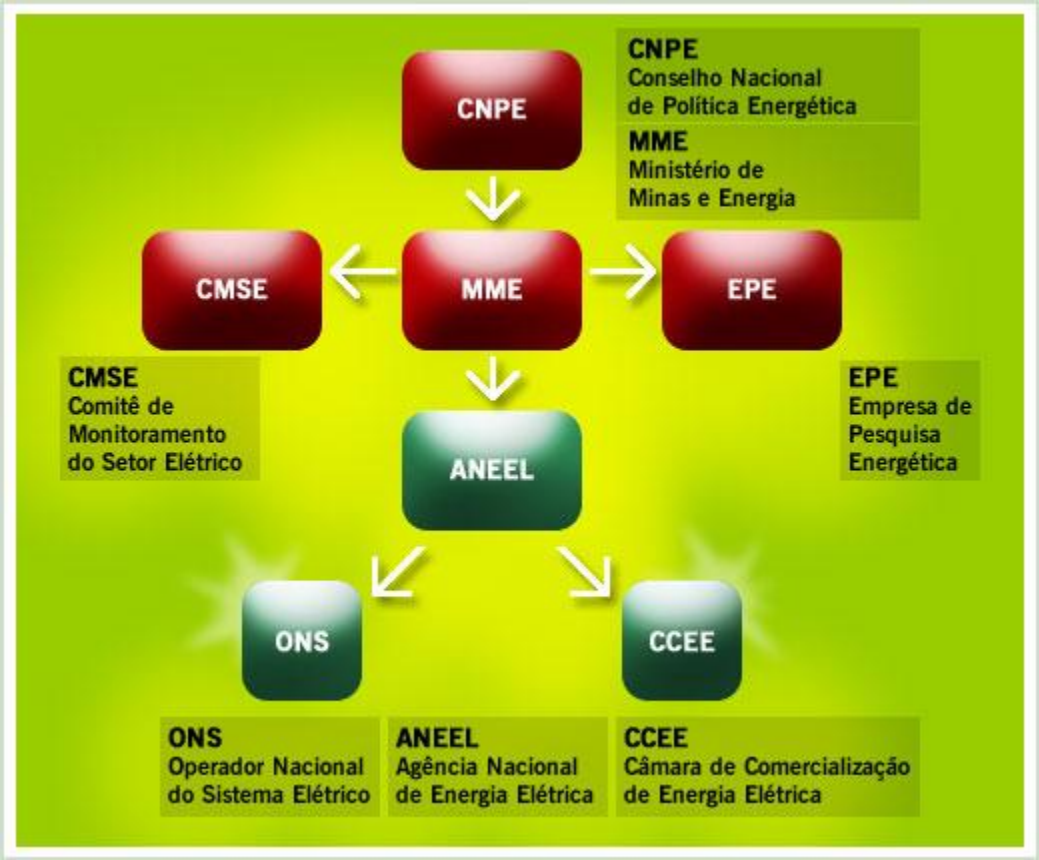
Appendix 1

Electrical Transmission Industry Actors

	Argentina	Brazil	United States
Transmission Firms	Dominated by Single State-Owned Monopoly (TRANSENER)	State-Owned Firms Hold Large Market Share --- Private Firms Winning Most Auctions Post-Reforms	Regional Regulated Monopolies
Regulatory Bodies	Close Working Relationship with State-Owned Monopoly	Clear Regulatory Role at National Level	Federal Commission (FERC) with Strong Regional Councils (RTOs)
Executive Branch	Moderate Number of Actors But Defer to Legislature	Moderate Number of Federal Actors with Clear Top-Down Structure (CNPE, EPE, MEM)	Large Number of Departments with Different Interests in the Electrical Grid (DOE, DOJ, FTC, EPA, SEC, NIST)
Legislative Branch	Large Role in Setting Electricity Sector Policy	Large Role in Funding but Small Role in Setting of Policy	Moderate Role in Setting Electricity Sector Policy/ Priorities- Large Role for Funding
International Organizations	High Reliance on International Organizations	Benefits from Support of International Organizations	Acts Unilaterally in Electricity Sector

Appendix 2

Brazilian Government Institutions Involved in the Electricity Sector



Source: Operador Nacional do Sistema Elétrico (2011)