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Solar Energy and the Problem of Path Dependency in Costa Rica's Energy System

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Abstract

A 'case-centric' case study is framed over the base of alternative renewable energy transitions that are challenging the electricity sub-sector of Costa Rica considered to be a country leader in sustainable practice and policy. There is evidence of the progressive exhaustion of Costa Rica's renewable energy model largely based on hydroelectricity. Despite an increasing perception of problems and limitations of conventional technologies, other technologies such as those based on solar energy, have repeatedly been considered unsuccessful and without a future within energy system. Liberalization reforms from the late 1990s in the sector is a critical juncture which have sent the country down a path that has since been reproduced, thus creating a path dependent trajectory. Following the tradition of the neoinstitutionalist school of thought, the main concepts for the analysis are path dependency and institutional entrepreneurs looking at the mechanisms that operate in the interaction between actors, interests and institutions. Based on information from secondary sources, the article sketches actor's interactions based on different forms of mechanisms of path dependency, respectively: power, utilitarian, legitimation and functional explanations.

1. Introduction

Costa Rica is considered to be a leader in renewable energy use, particularly since nearly 90% of its electricity is produced with renewable sources, mainly hydroelectricity. Alternative renewable sources, like geothermal and wind power, were introduced in the national energy system as a result of previous experimental projects and sector liberalization reforms during the late 1990s. However, fifteen years after these episodes, alternative renewable technologies remain limited and solar energy has been almost absent.

In contrast, the installed capacity of conventional energy, particularly large hydroelectric projects and thermal stations, kept growing during the last decades, even in contexts where alternative energy sources would perform better in terms of efficiency. Solar energy is one example of a technology that has been relegated in the trajectory of the national energy system, even though at present it possesses competing advantages. On a global level technological development has improved the efficiency and cost of solar energy. Photovoltaic is the world's fastest growing power-generation technology and is gaining support by multiple and diverse actors (REN21, 2011). Within the national context, other opportunities arise, e.g. the use of solar energy avoids the controversial incursion of hydropower, as well as the exploitation of geothermal energy affecting the conservation of natural protected-areas.

In 2007, Costa Rica announced its Carbon Neutrality Initiative by the year 2021. This commitment raises expectations for the implementation of 100 percent renewable energy in the electricity sector by taking advantage of the solar energy potential, hence opening a window of opportunities for creative and/or radical changes to take place. Besides a new larger solar energy project and a pilot project for distributed generation including solar technologies, no relevant changes are foreseen in the national energy policy. Hydroelectricity projects have been priority in the national installed capacity and projections (ICE, 2009), despite the problems that it entails for Costa Rica's almost iconic status as a "green republic".

This investigation uses Costa Rica as a crucial case and the path dependency theory developed by the neoinstitutionalist school of thought as an overarching approach to explain the processes of stabilization and change within a political context. Based on secondary literature and some preliminary interviews, the purpose of this paper is to analyze the national energy development identifying critical junctures and framing preliminary strategies and interests of actors and institutions supporting different energy options. In the verges of carbon neutrality, the country faces patterns of path dependency; a pathway that, despite the problems it entails, is difficult to reverse.

In terms of the marginal use of solar energy, the Costa Rican case is far from unique in Latin America but presents characteristics that make this a particular intriguing case for theory testing. In addition, any insights made by exploring the case specifically could also open up for possibilities of understanding why energy governance remains such a challenging issue in the region. By asserting the critical juncture for solar industry the question without a reply is whether there is a new path of solar energy or a breaking attempt in the path of hydropower? In order to answer this question the paper approaches the following particular questions:

- Under which conditions has the renewable energy model of Costa Rica, based on hydropower, developed a trajectory that included other renewable sources for electricity generation to a limited extent? What are the mechanisms that activated the reproduction of the energy pathway? In which aspects does solar energy development differ from these processes; which actors and institutions are involved; and what are the mechanisms of change?

To answer these questions, this research combines theoretical concepts of path dependence and institutional change looking at the role of institutional entrepreneurs actors who serve as a central factor in the stabilization of a technological development.

The next part of the paper introduces the case of renewable electricity in Costa Rica, highlighting some figures and intriguing aspects of the case. Secondly, it briefly discusses main theories and analytical concepts. The fourth section of the paper makes a preliminary analysis of critical junctures, institutions and actors, discussing the possible mechanisms that produce the development of a path dependent trajectory and the interactions in a changing context. Finally it summarizes concluding remarks.

2. Renewable electricity in Costa Rica and the governance challenge

2.1. Costa Rica: a leader in renewable electricity use

In 2009 the world's three nations committed to carbon neutral were Costa Rica by 2021, Maldives by 2020 and Norway by 2030 (Merchant, 2009). Maldives' small electricity market (310 000 people) completely relies on oil sources, while Costa Rica and Norway have a head start because they already generate almost all of their electricity from renewable sources, mainly hydroelectricity. In 2010, Costa Rica's renewable electricity supply was divided among hydropower (81 percent), geothermal (13.3 percent), wind power (4 percent), and biomass (1.7) (EIA, 2013). Due to its marginal share, solar energy technologies, including thermal and photovoltaic power, are not present within the data.

In terms of renewable energy use, the Costa Rican case is noticeable because, in contrast to other developing nations with limited amount of resources necessary to invest in capital intensive renewables and small energy markets or with higher exploitable hydroelectric potential, it does not rely completely on hydroelectricity. Moreover, the sector is commanded by a state-owned firm, which in developing countries are considered to be inefficient and prone to risk; and despite the fact that the country has proven oil reserves, it has refused this kind of investments (Wilde-Ramsing and Potter, 2008). Alternative renewable sources, such as geothermal and wind power, were introduced in the national energy system as result of previous experimental projects and sectorial liberalization reforms during the late 1990s which changed the configuration of the national energy system in the verges of the 21st century. Since then, the country is ranking among the top renewable electricity users in the world (The World Bank, World Development Indicators 2013).

In the political economic context, Costa Rica is not a wealthy, industrialized country, but rather a developing nation of middle income. Nevertheless, it is considered a leader in sustainable practices

and policies[1]. Moreover, the country is among the oldest consolidated uninterrupted democracies since the 1950s, a rarity in Latin America (O'Donnell et al, 2004). The political model is defined in terms of "participative democracy"[2] or "socially inclusive capitalist development"[3] meaning the provision of greater democratic control on environmental resource allocation and economic development, for example through public and non-profit organizations (Martin, 2004).

However, the renewable energy model of this "green republic"[4] has been questioned by several actors. In the midst of gradual economic recovery under the umbrella of a "green economy" and at the verges of carbon neutrality by 2021, the national energy system retains its grip on an unchanged transport system based on oil imports, and on a renewable electricity pathway that is at crossroads. Heavy dependency on hydropower has created problems of unstable energy production due to rainfall variability and droughts, which have consequently increased oil-thermal generation to secure the provision of energy in the short term (Wilde-Ramsing and Potter 2008; Agüero, 2009; 2012).

This research has a focus on the electricity sub-sector because it has been the platform of important struggles in the last decades and currently the closer one to achieve the goal of 100% renewable electricity generation, thus the center of attention of political actors in the energy field. The use of different electricity sources has impacts that are not only economic, due to growing oil imports, environmental, due to higher CO2 emissions, and social, due to increasing prices of electricity; but also political because it threatens the country's international reputation and national legitimation, and it exposes actors interests. In Costa Rica, as well as all over Latin America, political conflicts and social confrontations about electricity projects evidence how an initial sustainable energy development based on renewable sources like hydropower or other abundant natural resources have become the new constraints of the national energy system. For these reasons, the changing conditions of the context are important factors to be considered. The question emerging from this scenario is why did the country not stay true to its renewable energy model and develop an alternative energy path based on the renewable option of solar energy?

[1] Costa Rica has demonstrated that a country can implement environmentally stringent policies, while simultaneously 1) sustainably manage and recover forests, 2) achieving economic growth, and 3) receiving recognition as a leader in sustainable development (UNEP, n.d.).

[2] Participative democracy is broadly defined as the inclusion of diverse perspectives in the policy-making process (Prugh, Costanza and Daily, 2000 cited in Martin, 2004).

[3] Often termed "social democratic" or "mixed model", this characterization corresponds with a widespread perception of the country itself (Hoffman, 2007).

[4] Term used by Evans, Sterling (1999) in his analysis of the Costa Rican conservation history.

Following the argument of path dependency appears to be a reasonable way to analyze the pathway of energy development. Hydropower is an established technology for electricity generation in Costa Rica that upholds a dominant position in the national energy system and this might not change in the following years. Moreover, its development becomes predictable or even irreversible given the institutional structure and planning in the electricity sector.

New renewable technologies are of high relevance for national energy systems; however, established and considered long lasting energy institutions uphold their active incorporation. Still, antagonizing sector interests might also make the emergence of a new solar energy pathway difficult. On the other hand, Costa Rica, a consolidated democracy and a leader in sustainable policy, is a least likely case for the classical theory of path dependency based on power claims of elite groups. Therefore, which alternative processes might cause the emergence of solar energy?

2.2. Energy governance challenge

Radical change is not the rule in the development of energy systems. Technologies that become conventional start to dominate despite an increasing perception of problems and limitations, whereas other technologies, such as those based on solar energy, wind power, biogas, and other non-conventional renewable sources, have repeatedly been considered unsuccessful and without a future within energy systems (Flüeler et al, 2012; Jørgensen, 2012). Why does this happen and how can it be explained?

In the last decades, two transformation waves in the energy field have been identified by literature regarding energy transitions in developing countries. One resulted from the liberalization reforms that started in Latin America and spread all over the world during the 1980s and 1990s (Pachauri y Spreng, 2012). During these processes, private actors started to gain relevance in front of the State, and despite efficiency improvements, most assessments refer to the negative consequences of these reforms in terms of social and environmental sustainability on the long run. The second transformation is related to climate change and its related risks, shaping domestic energy policies. Some authors highlight climate change as the main factor having stronger influence over the shifting global energy landscape in the last two decades (Dubash and Florini, 2011; Newell, 2011).

Scholars and academic argue that energy governance, similar to climate governance, is identified and conceptualized as multi-actor, multi-level and multi-challenge governance (Dubash and Florini 2011; Flüeler et al, 2012; Hein et al, 2011). Academic empirical research on energy tends to focus on barriers restraining alternative renewable sources that are either technical, economic, or

institutional. Though important, in most cases they lack multidimensional perspectives as well as actors' interests and values (Pachauri and Spreng, 2012).

3. Theoretical Framework

3.1. Neoinstitutionalism and Historical Institutionalism

Neoinstitutionalims is a school of thought developed in reaction to the behavioral perspectives of institutionalism that were influential during the 1960s and 1970s (Hall and Taylor, 1996). Within neoinsititutionalism there are different schools of thought, including historical institutionalism, rational choice institutionalism and sociological institutionalism (Pierson, 1996; Hall and Taylor, 1996). Although they have developed quite independently, all seek to study the role of institutions in the determination of social and political outcome, but using a different analytical approach.

The rational choice institutionalism assumes the calculus approach of individuals as 'utility maximizers' in which strategic interaction clearly plays a key role. Sociological institutionalism goes beyond the considerations of efficiency toward an appreciation for the role that have collective processes of interpretation and concerns for social legitimacy. While historical institutionalists are eclectic, combining the 'calculus approach' and the 'cultural approach', they emphasize the asymmetries of power over institutions, the role of ideas and their institutionalization over time. (Hall and Taylor, 1996).

Institutionalization (Colomy, 1998) and path dependency (Liebowitz and Margolis, 1995) refer to processes where reproduction prevails over transformation to a certain extent. Path dependence is one feature of historical institutionalism that has emphasized the ways in which initial institutional or policy decisions, even suboptimal ones, can become self-reinforcing over time. But why does this happen?

3.2. Path Dependency

Path dependency within historical institutionalism explains why particular historical junctures have endurance consequences. Many scholars within this theoretical approach have developed the idea of 'policy legacies' that impact on subsequent policy choices in the concept of 'critical junctures' (Pierson, 1996). The notion of critical junctures is used to divide the flow of historical events into periods of continuity, punctuated by moments when substantial institutional change takes place thereby creating a 'branching point' from which historical development moves onto a new

institutional formation and developmental pathways (Thelen, 1999; Hall and Taylor, 1996). As a consequence, institutions continue to evolve in tandem with changing political environments at the hands of political agents but in ways that are constraint by past trajectories (Thelen, 1999).

The principal problem here is to explain what precipitates such critical junctures, and, although historical institutionalists generally stress the impact of economic crisis and military conflict, many do not have a well-developed response to this question (Hall and Taylor, 1996: 942). Additionally, the idea of self reinforcing sequences being the mechanisms that help understanding why a specific institutional pattern or system is reproduced still needs further specification and theoretical development (Thelen, 1999). It is therefore important to explore key issues of who exactly is investing in particular institutions and what dynamically sustains these institutions over time. This allows for an approach that includes both actors and structures (Meyer and Schubert, 2007; Thelen, 1999).

In the classical version of path dependency, historical institutionalists direct the attention to the way in which the power relations present in existing institutions give some actors or interests more power than others in regards to the creation of new institutions; and they tend to stress the way in which some groups lose out while others gain (Hall and Taylor, 1996). Historical sociologist James Mahoney has attempted to categorize four possible forms of mechanisms of reproduction: Utilitarian, Functional, Power and Legitimation (Mahoney, 2000). For the purpose of this investigation all of them are framed as useful competing hypotheses to explain the reproduction of the Costa Rican energy system and its marginal use of solar energy. However, even though Mahoney's more general theories regarding reproductive mechanisms carry explanatory power, the analysis here attempts to explore mechanisms which are arguably specific to the Costa Rican case that enforce and maintain institutional reproduction.

3.3. Institutional Entrepreneurs

Theories studying institutional change are considered to suffer macro biases that impair the recognition of human agencies and interests within institutional change (Colomy, 1998; Fu-Lai Yu, 2001). DiMaggio (1998) introduces the role of entrepreneurship in the formation of institutions to the analysis. In this sense, institutional entrepreneurs become actors who assume a leadership role in episodes of institutional change but rarely possess the resources, power, and legitimization necessary to implement their program. For this reason, the institutionalization of their

"entrepreneurial project" usually requires the assent of various groups and the use of strategies to enlist support and defuse resistance.

Actors distinguish three main characteristics of institutional entrepreneurs. First, their moves or actions can be strategic or action orientated towards communication and mutual comprehension (Breit and Troja, 2003). Second, their responses can be creative (radical) or adaptive from namely extraordinary and ordinary entrepreneurs (Fu-Lai Yu, 2001); and third, their projects are totalizing, reconstructive or elaborative, depending on the level of institutional alterations (Colomy, 1998).

Scholars attempt to explain why institutions look the way they do since successful entrepreneurs are overrepresented by elites and secondary elites, powerful state actors and professional groups. Furthermore, they argue that resource-poor entrepreneurs, however, can serve as effective change agents vis-à-vis mass defiance under exceptional circumstances, for example, when rapid economic and social transformations undermine political stability and render uncertain relationships between political leaders and their constituencies (DiMaggio, 1998). In this sense, differences exist between states which might also account for the variations in energy systems and transformations across regions.

4. Liberalization Reforms in the Electricity Sector as Critical Juncture

For the purpose of this path dependent study of Costa Rica electricity sector, I argue that the liberalization reforms from the late 1990s in the sector is a critical juncture which have sent the country down a path that has since been reproduced, thus creating a path dependent trajectory. Although the starting point, during which parts of the current energy development pathway were institutionalized, can be traced back to previous phases, it is by the result of those reforms that new sources and new actors were incorporated in the electricity sector.

I also argue that at present Costa Rica is facing institutional transformations driven by climate change concerns that crystalized in the announcement of the commitment of carbon neutrality by 2021 and consequent institutional changes since 2010. Still, self reinforcing mechanisms from the past are strong and institutional entrepreneurs supporting a new electricity trajectory such as solar energy are weak as discussed at the end of this section.

4.1. Past trajectories (1950-1980)

A decade of reforms that ended with a civil war in 1948, initiated the 'Developmental State' era between 1950 and 1980 of state involvement within the national economy and welfare, including electricity (Bull, 2005; Vargas, 2002). Since then, the Costa Rican society began to move towards

market, more intensively since mid-1990s (Rovira, 2007). The Costa Rican Electricity Institute (ICE), a decentralized vertically integrated public company was created in 1949, which still, despite actions for re-centralization and versions of gradual liberalization reforms, is the main electricity provider in Costa Rica. In fact, as pointed out by Bull (2005), by the beginning of 21st Century it was considered "the last refuge of state ownership in Latin American" (p.82).

According to Vargas (2002), historically increased electrification, social orientation of electricity pricing and network development were very important for the State. During the 1960s other public companies, such as municipal and cooperative distributors were integrated into the model together with ICE in order to include the electrification of rural and isolated territories of the country. In addition, during the import substitution era, the main goal was to serve the industrial demand for electricity. Hence, hydroelectricity became extremely important for these developmental and wellbeing orientation, especially hydroelectric dams, since it appeared to possess compelling economics since they provided large quantities of electricity at a reasonably cheap price compared with many other forms of energy (Bradford, 2006). In fact, thermal generation (fossil fuel) was practically unused until the 1990's (Wilde-Ramsing and Potter, 2008).

ICE introduced solar energy (photovoltaic) in telecommunication and grid operation since the 1980s in the first applications of experimental projects for indigenous households (ICE, n.d). The projects were later included in the program for rural electrification and extended to national parks and isolated communities with difficult accessibility and low population density, thus attending elementary energy demands with solar panels. During the same period, geothermal resources were studied mainly in preliminary stages, as well as wind potential (Vargas 2002). Other international actors, such as financing institutions, were important for electricity developments. Nevertheless, the development of infrastructure was the result of public investments financed by local institutions and external creditors such as the World Bank (WB) and the International Development Bank (IDB) (Bull, 2005; Vargas, 2002).

The relation with elite groups in the period previous to liberalization reforms favored ICE's autonomy. As pointed out by Bull (2005), the entity became an autonomous institution that not only gained good reputation and credibility regarding its efficiency and technical standards, it also provided political results to the governing elite in terms of content voters that benefit from the electricity services. However, the autonomy granted to ICE not only strengthened the institution, but also created a new political actor with great significance for shaping future policies (Bull, 2005).

4.2. Liberalization reforms of the 1990s

There are two main reasons to consider the liberalization reforms of the 1990s, which promoted private electricity generation as the critical juncture for a technological pathway based on hydropower and oil-thermal, largely underestimating solar energy.[5] Firstly, liberalization reforms were a branching point in the electricity sector, and secondly, solar energy was relegated from main developments ever since (except for rural electrification projects).

Accordingly to past trajectories, the process of liberalization reforms in the electricity sector has been gradual and attempts towards its acceleration affronted opposition from a large part of the public (Hoffmann, 2007; Bull, 2005). The reforms implemented during the administrations of ex presidents Rafael Angel Calderón Fournier (1990-1994) and Jose María Figueres Olsen (1994-1998) were the most significant in the sector, incorporating private participation or co-generation with renewable resources for up to 20MW (1990) and 50MW (1994). They introduced a price system which created competition in terms of electricity generators as well as their coordination by means of a regulator responsible for pricing, quality control and technical norms in providing the service. But they also affected negatively the finance of ICE (Merino, 2003).

In the year 2000, during ex president Miguel Angel Rodríguez Echeverría's administration (1998-2002), a bundle of bills labeled the "ICE Combo", intending to reform the ICE and the energy and telecommunication sector legislation, resulted in power struggles and large scale social protests, obligating its withdrawal. As pointed by different authors, from a political point of view these episodes gave evidence of a separation between domestic elite interests and the goals of the electricity institute (Bull, 2005). The ICE Combo is also an example of policy implementation failure, highlighting the gap between intra-elite arrangements and public support (Hoffmann, 2007).

According to Vargas (2002), by 2000 mayor impacts of these reforms could be summarized in a diversification of the production structure, regarding not only the nature of the producer (14% of installed capacity is owned by private producers), but also new sources of electricity (wind, biomass co-generation, and geothermal projects). Private producers got a share in energy generation activities, which they did not have before, and the autonomy of the ICE was reduced as a consequence of re-centralization efforts from political elites, the debt crisis and structural adjustment programs (Bull, 2005; Vargas, 2002). Environmentalists and consumers' role has been increased; meanwhile the power of labor unions was reduced.

[5] This reforms were included in Law 7200, 1990; Law 7447; 1994; and Law 7508, 1995.

The segmentation and division of projects allowed the private sector to work on small and medium scale projects, while ICE continued working mainly with the implementation of large projects (Vargas, 2002). In terms of renewable sources hydropower continues to be the major source of electricity for both private and public producers, while geothermal and wind energy became part of the energy system to a limited extent, where private actors became important. Whereas solar technologies are still invisible in the energy matrix, limited to small or niche applications.

4.3. Towards Carbon Neutrality: Energy Transformation or Inertia?

The figures of renewable sources accounted for more than 90 percent of total electricity supply; the remaining percentage corresponded to thermal/fossil fuel (7.1 percent). Within the renewable energies, photovoltaic sources represented a 0.003 percent, an insignificant proportion compared with the theoretical estimated potential.[6] The country continues to be a leader in the implementation of renewable energy for electricity generation, even though the use of fossil fuels has increased from 3 percent in 2003 to more than 7 percent in 2008 (MINAET, 2009b).

Given the country's advantages in electrification goals, it became particular active incorporating norms related to environmental commitments.[7] The Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC), signed and ratified by Costa Rica between 1998 and 2002, promoting the goal to offset greenhouse gas (GHG) emissions (Landreau, 2006; Martin, 2004). In the national energy system these implied increasing consideration of CO2 emission reduction within the main goals of electricity projects (e.g. rural electrification program, MINAE, 2005); as well as the consideration of environmental problems and social impacts in the agenda of project developers (e.g. strategic environmental assessment, ICE, 2010).

In the second administration of ex president Arias Sanchez (2006-2010), the "Peace with Nature" initiative was announced, aiming at "strengthening political actions and commitments to reverse the alarming trends of human impacts over ecosystems at global, national and local level" (MREC, 2008). Furthermore, during the Bali United Nation Climate Change Conference in December 2007, Costa Rica launched its carbon neutrality strategy by 2021. During the same year, the issue of telecommunications and electricity liberalization emerged again in the context of a package deal included in the Central American Free Trade Agreement (CAFTA) with the United States. Not

[6] Based on data from the energy sector administration (MINAE, 2009a; 2009b).

[7] By participating in join implementation (JI) strategies and by partaking in clean development mechanisms (CDM), Costa Rica was the first country to join industrialized countries to offset greenhouse gas (GHG) emissions (Landreau, 2006).

without struggles and a huge influential media campaign, CAFTA was finally approved in 2007 by means of a public referendum, Costa Rica's first in history.

In the route towards carbon neutrality by 2021, the Costa Rican Ministry of Environment declared the need to diversify the country's energy mix since the electricity sector is dominated by hydroelectricity and the transportation sector by fossil fuels (MINAET, 2009c). So far, the focus of the governmental action of president Chinchilla Miranda (2010-2014) has consequently been the incorporation of initiatives to promote private investments in to the National Strategy for Climate Change and to thereby legitimize the carbon neutral goal on the one hand, and the promotion of bills within Congress to increase the share of private energy producers in the national electricity generation on the other.[8]

In terms of electrification, ICE, municipal and rural cooperatives, along with some private generators, provide an integrated electricity system and communication network of national coverage with an acceptably modern quality of energy access (Vargas, 2009). Although, some of the ICE projects have faced resistance for decades, such as the conflict resolution process of the Boruca Hydroelectric Project in the indigenous territories of Brunca Region (South) as documented by Carls and Haffar (2010). In the last years, the complete model has been questioned not only by those who openly advocate in favor of more private inclusion using efficiency claims, but also by those who question the sustainability of the current pathway of electricity development.

4.4. Actor's Interaction and self reinforcing mechanisms

Based on information from secondary sources, this section sketches actor's interactions based on different forms of mechanisms of path dependency, respectively: power, utilitarian, legitimation and functional explanations (Mahoney, 2000). These are used as insights for the analysis of critical junctures and electricity developments in Costa Rica.

4.4.1. Power Claims

According to power claims of path dependency, an institution is reproduced because it is supported by an elite group of actors (Mahoney, 2000). Despite the democratic trajectory of Costa Rica, power relations that reproduce the electricity trajectory are more likely than expected. After liberalization

[8] Bill proposals No. 17.811 and No. 17.812 (2010).

reforms interest of political and economic elites has been also in private investments for electricity generation, as some studies from Vargas (2009) and the media reveals.[9]

Though less investigated, vested interests institutionalized over time in the electricity sector might also stall a more active policy towards incorporating new technologies and creating a genuine innovative energy pathway (Vargas, 2009). In the initial experimental stages of non-conventional energy sources the Costa Rican Electricity Institute (ICE) was the institutional entrepreneur that impelled those new developments. Since 2010, new possibilities for solar energy have been opened up by new pilot projects developed by small energy business and partnerships between domestic actors, mainly departments inside ICE, foreign governments and/or transnational global corporations who diversify their investments including solar energy.[10] Regarding solar energy, domestic institutional entrepreneurship is still incipient. Their mobilization of resources has not yet gained support by political parties, though an increasing number of actors within the civil society, small solar energy businesses, and within state organizations have voiced their interest.

4.4.2. Utilitarian Rational Calculations

On the other hand, rational cost benefit assessments of actors are related to efficiency or utilitarian explanations (Mahoney, 2000). This position is likely as has been evidenced in documents of the electricity planning sector. For example, statistical documents of the energy sector 1989- 2008 states that the national potential for electricity production based on alternative renewable sources is considerable; however, the cases of solar energy and biomass have been lacking strong presence in the energy system mainly because of their high initial cost (MINAE, 2009a).

As indicated in the National Strategy for Climate Change, from the government's perspective the promotion of alternative renewable sources in the electricity sector is directly connected to financial incentives and other policies to encourage participation of the private sector. The argument is that private investment is necessary, given ICE's financial limitations to initiate these transformations (Castro et al, 2009).

The global context is also creating these opportunities. First, through the global energy industry development, especially since the significant drop in costs experienced in 2008, particularly photovoltaic power (PV), the most expensive among them on a large scale. From 1995 to 2005 the

[9] Articles from Semanario Universidad (Córdoba, 2012) and elpais.cr (Francia F, 2012).

[10] For example the 1MW photovoltaic plant developed with Japanese cooperation, or the project proposed by Samsung C&T Corporation to ICE to generate over 1MW, and the ICE's pilot project of Distributed Energy Generation for Self Consumption.

cost of producing PV systems has dropped from $11 per watt to as low as $5 per watt, and fallen to less than $2 in 2011 (Bradford, 2006; Mateu, 2011). Second, parallel to mitigation strategies and mechanisms adopted by global institutions in compliance with the Kyoto agreements and subsequent negotiations, concepts such as "green growth" or "green economy" are conceptualized by international organizations to reconcile economic growth and environmental protection or use, through the promotion of renewable energy sources and other clean technologies (UNEP, 2011).

4.4.3. Legitimation Claims

On the side of legitimation explanations, liberalization reforms and discourses of appropriateness are largely interlinked. According to legitimation claims, an institution is reproduced because actors believe it is morally just or appropriate (Mahoney, 2000). Different actors have been using the logic of rules or appropriate to support some forms of renewable energies. For example, in order to diversify the energy system the government claims that more private investments are needed. However this argument is less likely than expected given the risk of "cheap talk", meaning that the different actors could have other claims behind their environmentalist and renewable energies discourses.

Another example is related with the country's gained international recognition for its successful implementation of policies in line with the global climate change strategy based on off-set emissions and sell carbon certificates in the global carbon market. Hence, diversification of renewable sources is not really urgent since the current institutional pathway of electricity based on hydropower is already low carbon based.

In spite of these triggering conditions, including national environmental commitments and the global promotion of solar energy, there are still a reduced number of solar energy projects within the national energy system. According to different actors this relative reduced number of projects is partly explained by a national energy system that is already based predominantly on low carbon energy sources, such as hydropower (Landreau, 2006).

4.4.4. Functional Explanations

Finally, in accordance to functional claims of path dependency, institutions are reproduced over time because it serves a function for an overall system (Mahoney, 2010). In the previous context of a "developmentalist state", hydroelectricity dams possessed compelling economic advantages since

they provided large quantities of relatively cheap electricity (Bradford, 2006). This characteristic was important for supplying power to the domestic industry and continuing electricity network developments (Vargas, 2002). Nowadays, this claim is likely from the government perspective because large hydroelectric projects are required to match increasing energy demand at competitive prices, mainly in the context of a regional electricity market in Central America.[11]

On the other hand, the negative effect of climate change over ecosystems and water reservoirs, as well as the increased competing uses of water (e.g. rural or eco-tourism activities), increase the complexity of the problem (Agüero and Hernández, 2012). In addition, those claiming for the overall sustainability of the energy system argue that the continuation and expansion of large hydroelectric projects and geothermal developments put at risk natural protected areas, confront indigenous human rights, and contradict carbon neutrality (Durán, 2012a; 2012b).

5. Concluding Remarks

Solar energy still contributes to less than 1 percent of the total electricity production and the current electricity pathway has its own reinforcing processes that hinder advancements of other renewable technologies. Hence, understanding the processes of path dependency, as well as clarifying the conditions and actors' interactions, is an important part of the analytical approach used in this research for the determination of a political outcome. In this direction, neoinstitutionalist and historical institutionalist theories have developed explanations to describe stabilization, persistence, and loss of flexibility of institutions. Thereby, they use the concept of critical junctures to explain specific development pathways driven by the impact of historical events.

Towards the end of 1990s, liberalization reforms gradually applied in Costa Rica gave birth to a new pathway of energy production, although limited in extent; it was a branching point for other renewable technologies to be developed beyond hydroelectricity. These changes in the configuration of the national energy system resulted from the interaction of domestic state and private actors, as well as the involvement of global institutions. Reforms in the sector allowed private participation or co-generation with renewable resources.

On the other hand, the country has promoted a civil discourse and a sense of national ownership and pride in its sustainable development policies and institutions. The electricity sector is one example, in part based on the performance of the Costa Rican Electricity Institute (ICE) throughout the

[11] The Framework Treaty of Central American Electricity Market (SIEPAC) and the first protocol were ratified in 1997-1998; its main objectives are to create the institutional and physical infrastructure to facilitate private production and trade among participants in the regional market (REDCA).

course of time. However, the electricity trajectory in Costa Rica reveals tensions, cooperative and antagonistic interactions between actors, including domestic political elites, state institutions, social movements and international organizations. In the current context of carbon neutrality, the environmental model pursued by Costa Rica is not free from criticism and is confronted by domestic concerns that question the current energy pathway.

Preliminary insights of self reinforcing mechanisms that restrain the emergence of a new development path based on solar energy are introduced in the last part of the paper using a theory-guided analysis of causal mechanisms and evidence of secondary sources. Power relations mechanisms are more likely than expected since there is evidence of interest from politicians on investment in private electricity projects, except solar energy. Legitimating claims are less likely than expected since there is a risk of "cheap talk" for the diversification of renewable sources as "appropriate" but is not translated directly into policies. Efficiency arguments are likely because for the electricity planning sector this is one argument behind the marginal use of solar energy, but still needs more in detail analysis. Functional claims are also likely since in order to meet growing energy demand and regional electricity market more large hydroelectricity projects are needed. A further analysis of these actors' interaction is needed. In a step further of the research, these mechanisms will be combined with case-specific evidence from the empirical level.

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