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Decision Making and the Energy Path towards Carbon Neutrality
The Case of Costa Rica

Daniela García Sánchez, Doctoral Student
Economics and Social Science Graduate School, Hamburg University
GIGA Institute of Latin American Studies
daniela.garcia@giga-hamburg.de

Abstract

Costa Rica announced its carbon neutrality by 2021; however, the real challenge is in the implementation by means of a national sustainable energy strategy. The possibilities to reach 100 percent of electricity generation expanding hydropower appears as the "dominant" solution, however this approach entails environmental problems and social conflicts that compromise sustainability in the long term. Alternatively, the strategy consisting in a higher diversification of renewable energy sources, i.e. with a relevant role of solar energy, remains relegated.

Even though, some alternative technologies have been introduced in Costa Rica forty years ago, they still play a marginal role in the national strategy for climate change. Within the country energy mix, hydropower is widely used by public and private energy generators. This does not imply that all actors are expecting non-conventional technologies to become the sole or dominant provider of electricity. Nevertheless, sustainability and long term planning entail increasing the share of other renewable sources in future energy policies and strategies.

In this sense, the following questions emerge: what kind of dilemmas stands before the national energy system today and how to create a path based upon alternative renewable sources in order to reach 100 percent renewable electricity generation, foreseeing carbon neutrality by 2021. There is a wide range of explanations in this respect that could be clustered in two groups: governance and people. First, a change in the energy route is a matter of governance with the number of challenges it entails. Second, energy developments are also a matter of strategic actions, from people or actors, oriented to strengthening the position of e.g. solar power into the national energy mix. To be able to answer these questions, a set of theories and approaches will be used from Agency, Governance and Path-dependence frameworks.

Introduction

Along the path towards low carbon economies, new energy policy challenges emerge. This study addresses these challenges in the context of energy transition in developing nations of Latin America. Considering the case of the electricity sector in Costa Rica, the central questions of this paper are what kind of dilemmas stands before the national energy system today and how to create a path based on alternative renewable sources.

The wave of liberalization reforms that started in Latin America and spread all over the world during the 80s and 90s created important transformations in the energy field. In this process private actors start to gain relevance in front of the State. Some reforms were considered positive, such as gains in efficiency, but most assessments refer to the negative consequences, mainly by their one-dimensional perspectives, for instance, the adverse effects reforms have had over social welfare, equity and environmental sustainability in the long run (Pachauri y Spreng, 2012).

More recently, international organizations from the United Nations system and other non-governmental organizations exerted influence towards more social and environmental aspirations. The emphasis on achieving the Millennium Development Goals (MDGs) has reoriented energy goals towards the social and poverty alleviation benefits of electrification. In addition to the challenges of extending the benefits of modern energy to all populations and growing industries, current environmental constrains increasingly amplify difficulties. In fact, in studies of the energy field of governance, energy related challenges are framed in the arenas of energy access and security; climate change and other environmental impacts; as well as economic and social development (Dubash and Florini, 2011; Flüeler et al, 2012). Pressures from the global community on climate change require nations to increase their use of renewable energy sources and to adopt cleaner ways of producing, delivering and consuming energy. Hence, inducing change to low carbon economies and securing development requires special attention towards the corresponding governance level, including national politics and global norms, also who governs and how.

Costa Rica is not a wealthy, industrialized country, but rather a developing nation of middle income[1]. Nevertheless, it is considered a leader in sustainable practice and policy[2].

[1] According to the World Bank's main criterion for classifying economies is gross national income (GNI) per capita. Other Latin American countries in the group are Mexico, Panamá, Colombia, Ecuador, Uruguay, Peru, Chile, Argentina, Suriname, Venezuela and Brazil, and seven Caribbean countries.

[2] 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.).

The political model is defined in terms of "participative democratic[3]" or "socially inclusive capitalist development [4] ", meaning the provision of greater democratic control on environmental resource allocation and economic development, for example through public and non-profit organizations (Martin, 2004).

In effect, 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 Costa Rican Electricity Institute (ICE) performance throughout the course of fifty years leading the sector. However, the electricity trajectory in Costa Rica reveals tensions and conflicts of power between domestic political elites, state institutions and social movements. In the current context of carbon neutrality, the environmental model pursued by Costa Rica is not free from criticism and is confronted by concerns that question the energy path based on hydroelectricity.

The first section of this paper develops an analytical framework of driving factors for institutional transformations around the concepts of global governance and institutional entrepreneurs that will be defined later on, situating the case study in a broader comparative perspective. In addition, the concept of transdisciplinarity developed by Pachauri y Spreng, (2012) will be presented as a tool to approach the study of energy transitions. The second part makes a description of the electricity trajectory in Costa Rica and the environmental policies in the context of low carbon economies. The relevance of hydropower for the development of Costa Rica's energy system and its relationship with over-all economic development, welfare and national identities are highlighted within this section. The third segment describes the current challenges and dilemmas based on the paradigm of carbon neutrality, in which global governance and institutional entrepreneurs interact. Finally, the last section presents concluding remarks and future perspectives.

Concepts explaining energy transitions: institutional entrepreneurs & global governance

Theories studying institutional change (or inertia) such as neoinstitutionalism, neofuntionalism and evolutionary economics have developed explanations to describe stabilization, persistence and loss of flexibility of institutions. Institutionalization (Colomy, 1998) and path dependency (Liebowitz and Margolis, 1995) both refer to this phenomenon where reproduction prevails over transformation to a certain extent. Additionally, to allow for

[3]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).

[4] Often termed "social democratic" or "mixed model", this characterization corresponds with a widespread perception of the country itself (Hoffman, 2008).

new forms of social practice to emerge, aspects of agency and interest in institutional change are incorporated in the analysis based on Giddens and Scharpf's conceptual framework of structuration (Giddens, 1979; Scharpf, 1997).

Following this direction, DiMaggio (1998) introduces the role of entrepreneurship in the formation of institutions (institutional entrepreneurs) to the analysis. The concept of institutional entrepreneurs helps to reduce macro biases of structure over agency and to differentiate between emergent events behind actors, such as external technological development, from strategic behavior of actors perusing their interests and projects through intended and deliberate actions, for instance by creating incentives. These entrepreneurs assume a leadership role in episodes of institutional change but rarely possess the resources, power, and legitimization necessary to implement their program.

The institutionalization of their "entrepreneurial project" or program usually requires the assent of various groups and the use of strategies to enlist support and defuse resistance. According to this theory, successful entrepreneurs, in turn, become overrepresented by elites and secondary elites, powerful state actors, and professional groups. 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 respect, the history of non-conventional technologies is not one of linear technological improvements resulting in social change; but rather a varying and conflicting one (Jørgensen, 2012). Traditionally, transition has occurred as an outcome of individual innovations and spread slowly via the interaction of social groups. However, it is only over the last two centuries that nationalized systems of energy provision have emerged and that governments have assumed a larger role in directing energy transitions through public policy and programs (Pachauri y Spreng, 2012 p.78). In some countries this development has been achieved through centralized planning, in other instances the government functions as a facilitator or regulator providing the conditions for private agencies and/or local agencies or cooperatives to operate.

Independently of the type of institutional arrangement, energy production relies on well-functioning bio-socio-technical systems, but the energy system is developed and operated by people. As part of the scope conditions, the entrepreneurial program is embedded in cultural and symbolic frames of the country, the political context and the prevalent economic model. These conditions change over time because of the interaction of internal elements and the

influences of external institutions and affairs.

The international or global level has been always plaid a role in institutional changes, for instance in the form of ideologies, norms, technologies or funds. In this sense, domestic energy policies are shaped by global energy institutions that directly or indirectly rule or govern the sector, particularly bilateral and multilateral financial institutions in which the impact of private sector investments and climate change mandates prevail (La Viña, Dulce and Saño, 2011; Dubash and Florini, 2011).

In the current era of global imperatives and commitments of climate change, such as reduction of global greenhouse gas (GHG) emissions, a great level of trust has been delegated to global governance and innovation processes. International organizations promoting the incorporation of global norms for climate protection and the reduction of environmental impacts have been progressively integrating new technologies into their strategies. Indeed, a main driving factor of the global renewable energy boom is increasing awareness of climate change.

In recent years, renewable energy has become an important part of mitigation strategies and mechanisms adopted by global institutions and are increasingly considered an effective way to achieve significant reduction in GHG emissions, in compliance with the Kyoto agreements and subsequent negotiations (Never, 2011). Concepts such as "green growth" or "green economy" are conceptualized by international organization to reconcile economic growth and environmental protection, and use, through the promotion of renewable energy sources and other clean technologies (UNEP, 2011).

Moreover, renewable energies become relevant when conditions for predicted institutional change, such as problem-solving dissatisfaction or the process of delegitimization of established units/projects, are present. Additionally, the incorporation of global governance enters into the debate about the role of the 'state' in governance, which has further been enriched by discussions about 'scale and governance' and adjustment levers in the energy field (Dubash and Florini, 2011). Also, scholars affirm that the pro-market ideology, which has transformed the energy sector in many countries, faces new competition from a resurgent model of state capitalism (Florini and Dubash 2011).

According to Pachauri and Spreng (2012), academic empirical research on energy is often disciplinary research that is vital and important, but is rarely suited to furnishing sound policy advice. Applying Max-Neef's matrix[5], the concept of transdisciplinarity to the study of

[5] This matrix is based on a multidisciplinary approach at an empirical level and on a transdisciplinary mode at pragmatic level by means of perspectives from different actors, as well as the incorporation of the levels of norms and values.

energy transitions involves four levels: empirical sciences, pragmatic studies, norms and values. This approach involves multidimensional perspectives, as well as actors' interests and values, which are missing in most cases of energy transitions.

For instance, from a direct monetary cost perspective large hydroelectric power plants are required to match increasing energy demand at competitive prices calls a regional electricity market in Central America, which is an idea regional actors increasingly support[6]. However, following Pachauri and Spreng (2012) even a multidisciplinary perspective with the experience of various pragmatic studies needed to understand the repercussion of the activity; will not provide an adequate characterization or a solid base for formulating recommendations for programs that may have an impact on energy transitions. The analysis necessarily needs to be extended to the level of norms and values.

This research paper in the selected case of Costa Rica is at the level of norms and values. First, it includes the analysis of "politics of policies" as a matter of actors' values and perspectives, also affected by decisions made in the past. Second, the paper refers to energy planning, design, politics and legal challenges as part of the sector governance in the country. The next sections present an overview of the effects of these levels on the electricity trajectory of the country towards carbon neutrality 2021, as well as some challenges and dilemmas which the trajectory entails.

Hydroelectricity as a mean for providing a sustainable energy path in Costa Rica

Costa Rica prides itself for its electricity sector, which is considered to have one of the highest electrification indexes in Latin America, ranking second after Chile (OLADE, 2006 cited in Vargas, 2009). It is also a world leader in renewable electricity use (Wilde-Ramsing and Potter 2008; Vargas 2009) since nearly 93 percent of the national electricity is generated by renewable sources (Molina, 2009).

According to Pachauri and Spreng (2012), successful national electrification efforts can be attributed to: (1) an emphasis multiple, especially productive uses of electricity at an early stage, (2) close coordination between different levels of government and private or cooperative agencies and (3) strong awareness of the development needs and priorities of the benefiting communities. In Costa Rica the main electricity provider since 1949 is the Costa Rican Electricity Institute (ICE), a decentralized vertically integrated public company. The ICE together with municipal and cooperative distributors, along with some private generators

[6] 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).

provide an integrated system with national coverage of electricity and communication networks with an acceptably modern quality of energy access (Vargas, 2009).

It is noteworthy that hydroelectricity has been more than an energy source for Costa Rica, just like the ICE has been more than just the public electricity provider. The electricity model pursued by Costa Rica for the last 50 years was able to reconcile a guarantee for energy access with the development project of domestic political elites such as economic growth and social well-being (Bull, 2005). In the context of electricity production and economic development, hydroelectricity becomes extremely important for two reasons: first, for supplying power to the domestic industrial demand and for continuing electricity network developments; second, for maintaining increased electrification and a social orientation for pricing electricity targeting final residential consumers, rural areas, and some industrial sectors (Vargas, 2002). In this sense, hydroelectric dams appear to possess compelling economics advantages since they provide large quantities of relatively cheap electricity (between 2 cents and 10 cents per kWh, depending on dam location, size and type; Bradford, 2006).

Between the 1950's and 1980's, ICE became an autonomous institution that not only gained good reputation and credibility regarding its efficiency and technical standards, it also provided political results in terms of voters that became beneficiaries of 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).

Local financial resources were limited because of the political mandate to pertain subsidized energy prices for certain groups of society (Vargas, 2002). 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 1980's gradual liberal reforms and especially the ones implemented during 1990's changed the structure of the electricity sector[7]. Private producers got a share in energy generation activities and the autonomy of ICE was reduced as a consequence of re-centralization efforts from political elites, and result of debt crisis and structural adjustment programs. Public companies, along with ICE and its subsidiaries continued to lead energy production and distribution activities. The constellation of secondary actors changed as well. Traditional powerful groups, such as labor unions, reduced their influence, while new lobby groups appeared, including environmentalist and consumer organizations (Vargas, 2002).

[7] Several liberalization attempts were resisted during this period.

Regarding electricity sources, hydropower continued as the major source of electricity, complemented with new geothermal, wind, solar power, and biomass sources in the energy matrix, developed by both public and private entities.

At the beginning of the 21st century the continuation of efforts to liberalize the energy sector were confronted again. Attempts to accelerate the privatization process were curbed in 2000 when a bundle of bills intended to reform ICE and the legislation for the energy and telecommunication sector, labeled the "ICE Combo", were withdrawn. As a consequence, power struggles and large scale social protests arose. From political point of view, a separation between interest of domestic elites and goals of the electricity institute became evident (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).

In the second administration of ex president Arias Sanchez (2006-2010), the issue of telecommunications and electricity liberalization emerged again in the context of a package deal in the Central American Free Trade Agreement (CAFTA). However, this time main line telephony and electricity were separated from mobile telephony and internet services, which in turn were embedded in a broader scheme of the free trade agreement (Hoffman 2007). Not without struggles and a huge media campaign, CAFTA was finally approved in 2007 by means of a public referendum, which was Costa Rica's first in history.

In the same year, Arias announced the "Peace with Nature" initiative 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 launches its carbon neutrality strategy by 2021. Both the Peace with Nature and the carbon neutrality initiatives have been integrated into the national strategy for climate change "as a tool to speed up decision making, definition of priorities and monitor mechanisms to legitimize the carbon neutrality goal 2021" (MINAET, 2009, p.21).

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 electricity is dominated by hydroelectricity and transportation by fossil fuels[8] (MINAET, 2009). From the perspective of all sectors possibly being targeted to achieve carbon neutrality by 2021, the electricity subsector presents the most viable technical possibilities for becoming carbon "neutral", given the fact that over ninety percent of the national electricity is already being generated with renewable sources, namely mainly hydropower. Nevertheless, it must be noted that this

[8] Among alternative sources only a short reference to biofuels, especially for the transport industry, is included.

carbon neutrality approach, which highly relies on hydropower, entails energy-supply risks, environmental problems and social conflicts that compromise sustainability in the long term.

A crucial time for energy transformations

Carbon neutrality by 2021 is primarily a commitment to offset, reduce and/or avoid carbon emissions generated domestically, which is part of the country's intention to become the world's first carbon neutral economy. From arguments presented above, two strategies to reach carbon neutrality in the electricity sector become evident: to either a) strength the relatively inexpensive climate change mitigation path, by aiming at generating 100 percent of the electricity with hydropower, including larger dams, and by fostering reforestation efforts for carbon sequestration, funding projects for emission reduction and pursuing other activities to conserve energy; or b) to implement a substantial transformation of the energy sector in order to fulfill the "renewability gap" by generating 100 percent energy production with a combination of other alternative renewable sources, such as solar energy, wind power or biogas.

On the one hand, the country has gained international recognition for its successful implementation of policies in line with the first strategy, based on off-set emissions and sell carbon certificates in the global carbon market. The first strategy also includes, for instance, promoting economic incentives for environmental protection, which is the idea underlying of Payments for Ecosystem Services (PES)[9] and the mechanism of Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing countries[10]. Under these norms and policies, increasing a given area's potential to fix carbon via photosynthesis process, for example by means of reforestation, or to store natural carbon stocks, for example by the protection of forest or soil threatened by destruction were prioritized over transformations in the energy field.

The main goal of the carbon neutrality framework is to promote the usage of renewable energy that decreases the use of carbon based fuels. Given that the first strategy aiming at generating 100 percent of the electricity production with hydroelectric technology has been followed by Costa Rica during the last five decades, seems to be the dominant path. Hydroelectricity is widely used by public and private electricity suppliers, and the government

[9] By means of national law, this program provides the legal basis for landholders to be compensated for providing ecosystem services. Funds are generated by fuel taxation, grants and loans from national and international institutions, debt relief, agreements with the private sector, and market instruments.

[10] The Rainforest Coalition, led by the governments of Papua New Guinea and Costa Rica, initiated REDD in 2008 and continued to put pressure on the international community to ensure the program fair and equitable way (SF, 2012).

does not have a clear strategy for alternatives technologies. But it should also be noted that both increasing the use of hydroelectricity and promoting forest conservation are compatible with global norms and are in accordance with climate change agreements and national sustainable development principles.

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; Martin, 2004). In 1998 and 2002, Costa Rica signed and ratified the Kyoto Protocol as well as the United Nations Framework Convention on climate Change (UNFCCC) and thereby officially ratified its goal to reduce GHG emissions. Currently, five renewable energy projects as part of the CDM are registered in the Joint Implementation Office of Costa Rica (OCIC) with potential to reduce GHG emissions in the energy sector[11]. This small number of projects is partly explained by a national energy system that is already based predominantly on low carbon energy sources, such as hydropower.

The second strategy, however, which aims at drastically transforming the energy sector to increase the share of other renewable energy sources in the country's energy system, is underestimated. Alternative energy sources were introduced in Costa Rica in the 80s with the use of photovoltaic solar energy generation in isolated territories. Geothermal technologies and wind power became relevant during the 90s (Vargas, 2002). Here the ICE and private generators became institutional entrepreneurs leading those changes[12]. However, according to data on electricity production, their share remains relatively low (see Figure 1).

The renewable electricity generation is almost entirely dominated by hydropower, which makes up 83 percent of the total renewable energy production. Hydroelectricity is followed by geothermal (13 percent), and wind power, biomass and solar energy production, combined accounting for the remaining 4 percent. The national potential for electricity production based on these non-hydro sources is considerable (Alvarado *et al*, 2009), however, particularly in the case of solar energy and biomass, have been lacking strong presence in the energy system mainly because of their high initial cost[13]. Furthermore, in the last years new thermal stations (from oil sources) started operations in order to secure the provision of energy in the short term due to rainfall variability and droughts (Wilde-Ramsing and Potter 2008; Agüero, 2009;

[11] Two hydropower projects and three windmills financed partly by Norway government and IDA (US International Development Agency). The rest projects registered are four in forestry and one on waste water treatment in coffee benefits (OCIC, 2010: http://cdm.unfccc.int/Statistics).

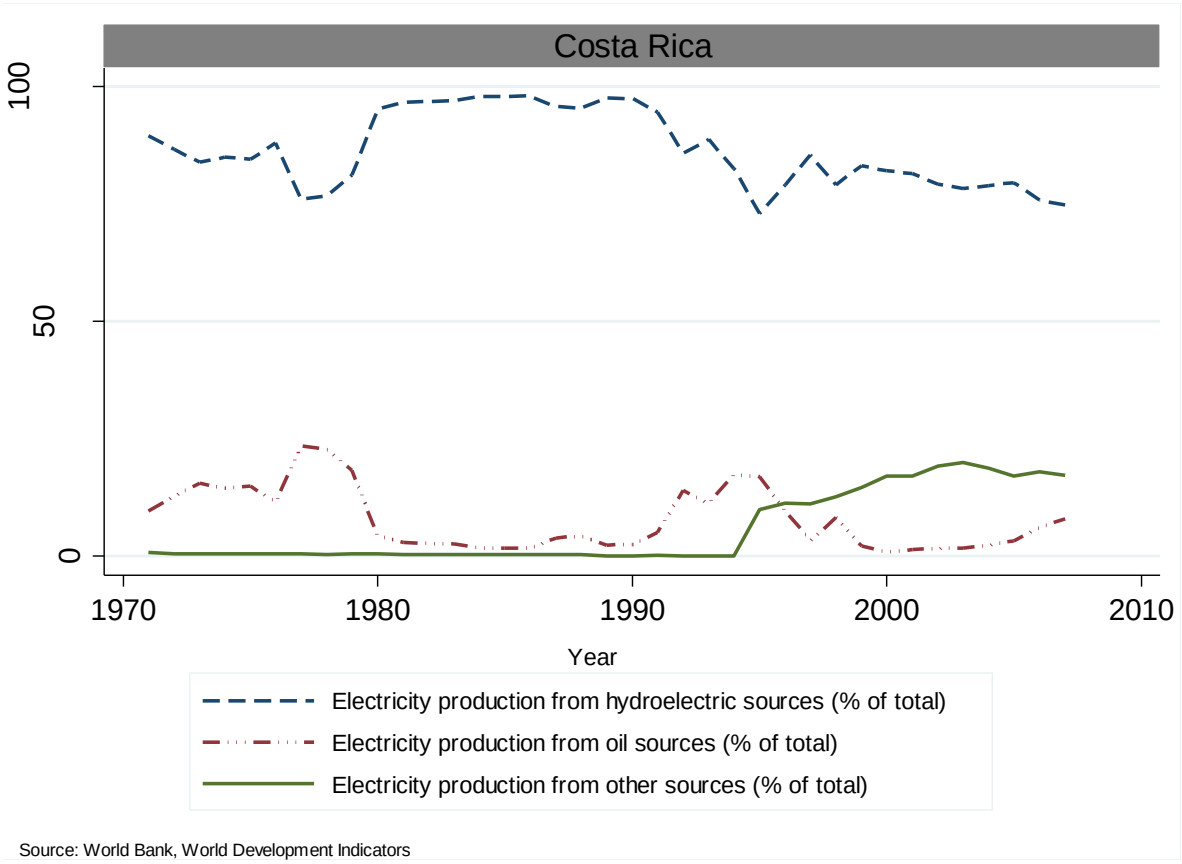
[12] The segmentation and division of projects allowed the private sector to work on small and medium scale projects, while ICE deals mainly with the large projects (Vargas, 2002).

[13] According to respondents from preliminary interviews conducted in the case of solar energy in 2010.

2012).

The last few years, solar energy has gained relevance as a supplementary energy source within the country's electric grid and has been advances with numerous pilot projects developed by ICE [14]. In these cases, institutional entrepreneurs cooperate with foreign companies to pursue development. Regarding solar energy, institutional entrepreneurship is still incipient. Their mobilization of resources has not yet gained support by political parties, but an increasing number of actors in civil society, small solar energy businesses and within state organizations have voiced their interest.

Figure 1 Electricity production by source (% for total)



Source: World Bank, World Development Indicators

Since solar energy still shares less than 1 percent of total electricity production, the institutionalization of an energy path based on solar technology will be a long process. The development could be advanced further by acceleration of transformations in the current context of carbon neutrality that increase the amount of resources and support to institutional entrepreneurs. For instance, the availability of private capital, as well as organizational changes, for instance in ICE that create a strong solar energy department.

[14] Such pilot projects are, for example the 2MW photovoltaic plant currently being developed in cooperation with Samsung since 2011, and other projects in joint efforts with various Japanese cooperations. A pilot project aiming to introduce distributed energy generation (also called on-site generation, meaning the owner or user of a system also feed the energy system with the electricity that produce) for self consumption was initiated by ICE in 2010.

Importantly, this second strategy to create another electricity path does not imply that all actors expect alternative renewable technologies to become the sole or dominant provider of electricity. Nevertheless there are two main criticisms against the first strategy which support the second: first, focusing exclusively in hydropower would lead to environmental, social and economic problems, and second, focusing on only one technology would hinder advancements of other renewable technologies such as solar energy to become more integrated in the national energy strategy for climate change.

Hydropower has been considered and promoted globally as a means for clean, safe, and reliable energy, nonetheless, hydroelectric dams and reservoirs have caused serious problems (Meisen and Krumpel, 2009; International Rivers, 2011). Besides environmental problems, particularly in sensitive regions such as rainforest or aquatic ecosystems, the social impacts associated with hydroelectric projects, exemplified for instance by the enforced reallocation of human populations and its consequential effects on socioeconomic activities, have gained significance in the agenda of project developers.

In addition to these concerns, laws restricting their development in specific territories have increased project confrontation or mediation with different actors (e.g. environmentalist, rural or eco-tourism activities, aboriginal groups). One example in Costa Rica is the conflict resolution process of the Boruca Hydroelectric Project. In this case, ICE was involved for several years in a process of mediation and negotiation with indigenous organizations, among other actors, in the Inter American Court for Human Rights (Carls and Haffar, 2010).

Furthermore, heavy dependency on hydropower has created problems of unstable energy production, which consequently have increased thermal generation. Negative impacts of thermal generation are not only economic, due to growing oil imports, environmental, due to higher CO_2 emissions, and social, due to increasing prices of energy; but also political because it threatens the country's achievements and reputation.

Finally, 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 (MINAET, 2009). The argument is that private investment is necessary, given the ICE's financial limitations to initiate these transformations. To date, the focus of the governmental action have hence been the incorporation of initiatives to promote private investments in to the National Strategy for Climate Change and to thereby to 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 hand (*Ley general de electricidad and Ley de contingenciaeléctrica*;

La Gaceta No.170, 2010).

Concluding remarks

The overview of the trajectory of electricity production in Costa Rica and the current context framed by efforts to promote low carbon economies highlight important elements for the analysis of institutional transformations in today's energy systems.

In accordance with the theory of historical institutionalism, all countries have their own trajectories. Nevertheless, three findings from decisions made in the past could be summarizes. First, the high scores in the performance of Costa Rica's electricity sector can be attributed primarily to the political and economic models adopted by the country in the 40s; these make the country a unique case. Secondly, Costa Rica is characterized by a strong national sentiment sensitive to general social well-being. Third, Costa Rica's trajectory created a strong political actor in the form of state autonomous institutions, today in evident confrontation with domestic political elites.

Considering the question of what kind of dilemmas stands before the Costa Rican electricity system today they could be resumed in: (1) the need to increase the total installed capacity to produce electricity using renewable sources without compromising social orientation of pricing and wellbeing of all members of society (2) while the evidence of climate and social risks that affects the availability of hydroelectricity create negative expectations over this source, and (3) options in the short run to avoid the use of thermal stations during draughts or peak periods are considered costly. These make questionable whether or not target of becoming carbon neutral by 2021 will be met but also securing sustainability in the long term.

To answer the question of how to create a path based on alternative renewable sources foreseeing carbon neutrality by 2021, preliminary factors related to theories of path dependency, institutional entrepreneurs and global norms become apparent.

With reference to path creation, the technical advantages of hydropower and dams are important for development. Complementary advantages from alternative renewable sources need to be exploited, for example, the economic potential to deploy solar energy technologies to supply industrial intermediate and peak load (Bradford, 2006).

The stabilization or institutionalization of hydroelectricity brings important insights to consider for the case of alternative renewable sources. The availability of financing for the construction of dams and other crucial infrastructure through loans from international credit institutions such as the World Bank and the Inter American Development Bank were crucial.

Vested interest in hydroelectricity projects were political, when beneficiaries of electrification become voters, and economic through the direct participation of politicians in projects.

Developments in new directions started already during the 90s. Currently the opportunities of enhancing these developments are present in merging global institutions related to renewable energies. Tensions are growing regarding bill proposals to change the structure of the energy sector in Costa Rica. In this sense, institutional mechanisms that are conducive to fostering institutional entrepreneurial activity are required. At the same time, transformations within the electricity sector require more reflection on the energy sector's trajectory in order to improve an assessment on a transdisciplinary basis. Thus the incorporation of other perspectives, norms and values needs to be redefined. Powerful institutional entrepreneurs have a leading role in defining the route towards carbon neutrality based on an electricity sector in which nature and people are in harmony.

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