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What do we know about the study of distributed generation policies and regulations in the Americas? A systematic review of literature

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ABSTRACT

Policy-makers are increasingly in search for evidence-based solutions for meeting contemporary challenges of energy services that are both low carbon and sustainable. One of the emerging trends are policies and regulations that incent distributed electricity generation, DG. The question that this article addresses is: what is the current state of the study of these policies or regulations in the Americas? The focus on the Americas was chosen because the article is part of a larger research project that explores regulations for DG in Brazil and Canada. This article uses a non-traditional means for synthesizing academic work; systematic literature review to explore the current state of peer-reviewed publications on the subject. It is a means of transparently locating, evaluating and synthesizing information to avoid bias in data collection. In total, 87 articles were included in the review. Climate Change is the main driving force for DG, as identified in the articles. Job creation or the green economy was cited as a motivating factor more strongly in North America. While in the southern countries, the issue of diversifying the energy mix and avoiding infrastructure costs was more pronounced. Many articles dealt with the issue of mechanisms for incenting DG and over half of these focused on aspects of Feed-in-tariffs. Incentive mechanisms vary depending on policy goals of the jurisdictions, with Renewable Portfolio Standards being more popular in the U.S. The review showed that there is little emphasis on the social impacts and benefits of the regulations or policies and that specific urban challenges and local governance is not widely investigated, pointing to a need for future study in these areas.

1. Introduction

> If the emergence of the mass politics of the early twentieth century, out of which certain sites and episodes of welfare democracy were achieved, should be understood in relation to coal, the limits of contemporary democratic politics can be traced in relation to oil. The possibility of more democratic futures, in turn, depends on the political tools with which we address the passing of the era of fossil fuel [1].

A transition to a low-carbon energy system and, therefore, the ‘passing of the era of fossil fuel’ has received much attention by academics in the last decades; not just because the technical challenges are considerable, but also because a new energy system configuration will affect the way our societies function as a whole. If coal and the steam engine can be considered as fundamental attributes of the First Industrial Revolution (beginning in 18th century Britain, later expanding to western Europe and the USA in the 19th century); then the Second Industrial Revolution of the 20th was made possible by petroleum, the internal combustion engine and mass electrification. Rifkin, as the title of his book denotes, is concerned with what is to come afterwards, *The Third Industrial Revolution*. He asserts that it will be supported by five pillars; renewable energy; distributed generation electricity via micro-scale power plants; electricity storage technologies; integration of information technology and electricity i.e. smart grids; electrification of transportation [2].

The dominant configuration of the current electricity sector was consolidated in the 21st century and is based on the notion of a natural monopoly [3]. This means that centralized generating stations (nuclear, hydroelectric or thermoelectric) produce electricity in large-scales, which are then transported over long distances via high-voltage transmission lines to industrial consumers and to urban centers, where distribution companies then deliver the electricity to various commercial and residential consumers via medium or low-voltage distribution lines. Rumpala [4] (2013) affirms that electricity generation and distribution are centralized not only in scale, but also in terms of power and decision-making capacity, and are therefore oligopolistic

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Table 1
Keyword searches and results, per academic database.

Number of Results per phase				
Database	**Keyword and other search criteria**	**1**	**2**	**3**
Web of Science (English)	TOPIC: ("distributed electricity generation" OR "distributed generation")*OR*TOPIC: ("decentrali* electricity generation" OR "decentrali* generation")*OR*TOPIC: ("net meter*")*OR*TOPIC: ("feed in tariff" OR "feed-in tariff")[a]. Results then refined by country and research areas[b]	375	107	75
Proquest (English)	All (distributed generation) AND all ((electricity OR electrical energy)) Additional limits Date: From 2000–2014; Source type: Scholarly Journals, Working Papers; Language: English, French, Portuguese, Spanish	12	2	2
CAPES portal (Portuguese)	("geração distribuída" OR "geração descentralizada") AND ("energia elétrica" OR eletricidade) AND (regulação OR incentivo OR regulamentação OR política)	13	0	0
Scielo (Portuguese)	1."geração distribuída"; 2. "geração descentralizada"; 3. microgeração OR micro-geração; 4. minigeração OR mini-geração	44	4	3
CAPES portal (Spanish)	1. ("generación distribuída" OR "generación descentralizada" OR "generación energética distribuída" OR, generación energética descentralizada") AND energia electrica AND (regulacion OR incentivo OR reglamentación OR política) 2. ("produccion distribuída" OR "produccion descentralizada" OR "produccion energética distribuída" OR "produccion energética descentralizada") AND energia electrica AND (regulacion OR incentivo OR reglamentación OR política)	31	5[c]	3
CAPES portal (French)	"production décentralisée" AND (énergie OR électricité OR politique OR régulation OR réglementation OR incitative)	8	0	0
CAIRN (French)	Votre recherche: "production décentralisée" AND (énergie OR électricité OR politique OR régulation OR réglementation OR incitative) 69 résultats	69	6	4
Total		552	124	87

[a] The "*" was used to avoid discrepancies between American or British spelling.
[b] Search refinement specifications; **Document Type**: (Article OR Abstract OR Review) AND **Publication Years**: (2014 OR 2007 OR 2001 OR 2013 OR 2006 OR 2000 OR 2012 OR 2011 OR 2005 OR 2010 OR 2004 OR 2009 OR 2003 OR 2008 OR 2002) AND**Countries/Territories**: (USA OR Uruguay OR Canada OR Argentina OR Chile OR Colombia OR Brazil OR Venezuela OR Mexico OR Trinid Tobago OR Cuba OR Ecuador) AND **Research Areas**: (Science Technology other topics OR Energy Fuels OR Operations Research Management Science OR Sociology OR Environmental Sciences Ecology OR Social Work OR Behavioral Science OR Social Sciences other topics OR Government Law OR Public Administration or Public Environmental Occupational Health).
[c] One duplicate journal from Web of Science search.

configurations.

The technical, economic and social challenges associated with integrating distributed or decentralized generation, DG into our electricity sector are equally numerous and complex. Policy-makers and electricity regulators have a plethora of issues to deal with, which will require adapting or bridging existing tools as well as thinking of new ones to ensure that electricity is generated in a sustainable and reliable manner [5].

What is the current state of academic work regarding policies and regulations for DG in the Americas? What are the analyses focused on? How do they frame the issues at hand? What motivating factors are identified for DG? Is there consistency between studies concentrating on developed or developing countries? What issues need further academic attention? This article will explore the abovementioned questions through a systematic review of peer-reviewed academic literature published from 2000 to 2014. This study only considered peer-reviewed publications, in keeping with the intent to reduce bias in data collection. However, the study could expand to include grey literature, which is considered in Section 4, but would require the modification of the inclusion/exclusion criteria adopted in this study.

The geographical focus of this article is the Americas, specifically looking for works that consider the socio-political and regulatory aspects of DG as a new configuration for the electricity sector. Studies focused on European policies and regulations are purposely not included, nor are works that looed at Asian countries, such as China and Japan. The application of distributed generation in Africa (mainly associated with the issue of energy access) has also been excluded. The rationale is that the present investigation is part of a larger research design, which will focus on DG in Brazil and Canada, two large countries in the Americas that have very different geography, resource base, political arrangements, technical capacities and historical trajectories with renewable energy when compared to the European, Asian and African contexts. In addition to these factors, countries of the Americas, by in large, do not suffer from the same spatial constrictions or resource scarcities for electricity generation as in the European or even in some Asian contexts, which can be considered drivers at the fore of the respective distributed electricity policies in those continents.

The following section; Methodology includes a description of the design of the systematic review, data collection procedures as well as the document inclusion and exclusion criteria. Section 3 includes an analysis of the data extracted from the manuscripts, namely; general attributes of the articles, motivating factors identified for DG, the document focus on polices or incentive mechanisms. The final considerations section elaborates on future possibilities for investigation into DG policies and regulations.

2. Methodology: systematic review design

A systematic review, SR is a methodological tool that employs clearly formulated questions and explicit methods of locating and analyzing literature, which are usually summarized quantitatively. It can be understood as a meta-analysis and is a way of tracking the evolution of contemporary social phenomena and understanding variables leading to policy deployment [6–8]. Furthermore, SR is not merely an expanded form of an ordinary literature review; "systematic reviews are not just big literature reviews, and their main aim is not simply to be 'comprehensive'… but to answer a specific question, to reduce bias in the selection and inclusion of studies, to appraise the quality of the included studies, and to summarize them objectively" [9].

The work by King et al. *Designing Social Inquiry* (1994) insists that one of the keys of a research plan is the consideration given to data quality, recording and reporting the process of data gathering and data generation, as well as using existing data to generate unbiased inferences [10]. For this reason, a systematic review avoids bias by explicitly stating and explaining why certain works are included or excluded in the analysis, which is not the case of a traditional literature review. Moreover, the social sciences are increasingly looking to issues of generalizability, consistency, reproducibility, precision and verification in research procedures such that "qualitative methods like their quantitative cousins, can be systematically evaluated only if there canons and procedures are made explicit" [11].

Systematic reviews have a been employed more prominently in health sciences or medical sciences for their ability to support evidence based approaches to decision making [12]. However, Pettigrew states the tool has been gaining legitimacy in the social sciences since the 1960's. In the context of climate change and environmental issues in particular, systematic reviews are increasingly viewed as a means of synthesized and unbiased scientific information to support evidence-based policy interventions [13].

2.1. Data collection procedures

Several keyword searches were performed to locate peer-reviewed journals in the following search engines; Web of Science, ProQuest; Scielo; CAPES Foundation journals portal; and Cairn.info (see summary in Table 1). Web of Science was selected because it is recognized as one of the "most powerful, current, comprehensive, and widely used search engines available for analysis of interdisciplinary, peer-reviewed literature" [14]. The main weakness is that searches are limited to English-language terms, which, if used as the sole document source may result in an Anglophone bias.

In order to expand the data collection to include works published in Portuguese, Spanish and French, keyword searches were also conducted in the following databases: Scielo and the CAPES Foundation journals portal. In addition, Cairn.info offers a very comprehensive database of French-language literature in the social sciences and humanities, as shown in Table 1.

The timeframe selected is 2000–2014. This range was chosen because the upper limit; 2000 corresponds to the year that Germany introduced the well known *Erneuerbare-Energien-Geset, EEG* (German Renewable Energy Sources Act), which sparked much interest in sustainable energy transitions and mechanisms to incent decentralized electricity generation.

2.2. Document "Inclusion or Exclusion" procedure

The documents located via the keyword searches were then reviewed based on their titles and abstracts. Papers that were written with authors from countries in the Americas, but that had European or Asian policies and regulations as their object of study were excluded, as well as book reviews, book chapters, and theses (even though peer-reviewed material was stipulated in the keyword search some of these documents appeared in the initial results).

Finally, papers were read in their entirety. Works that were exclusively concerned with technical aspects of DG, such as grid-interconnection issues, sizing, technological innovation, etc. were excluded since the objective of this paper is to decipher the state of research into policy and regulation considerations for DG. Papers that focused on rural electrification were also excluded since there already exist systematic reviews and analysis of these types of isolated energy access projects [15–17]. Rural electrification presents a different set of policy challenges involving the expansion or creation of infrastructure, while distributed generation, as understood in this study, are projects that can connect to existing distribution networks.

The three phases of data collection are represented in Fig. 1. The remaining pool of 87 articles (listed in the Appendix A) were analyzed to identify the focuses of the articles and assign characteristics, as shown in Table 2. The articles were coded, tabulated and analyzed using Microsoft Excel.

3. Data analysis

Data collection and analysis are interrelated processes, therefore, open coding was performed and some codes needed to be modified as the analysis proceeded [18]. The final set of categories and codes are listed in Table 2. In order to achieve consistent results, a sample of 14 articles was reviewed at the end of the analysis to verify that the interpretations did not change as a sort of quality control mechanism.

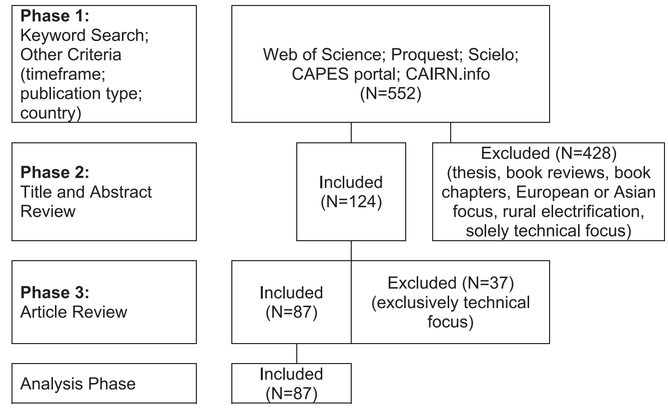

Fig. 1. Flowchart of document selection (modified schematic from Berrang-Ford et al. [7,14,61]).

Table 2
Categorization and coding of articles.

Language of Publication
Country(ies) of Authors` Institution(s)
Country(ies) corresponding to the Object(s) of Study
Definition of DG (attributes). The values of this variable were not pre-determined and open coding was applied. The results were later grouped as perFig. 6.
Type of Technology Considered (Solar PV, Wind, biomass, Hybrid, etc.)
Factors Motivating DG. The values of this variable were not pre-determined and open coding was applied. The results were later grouped as perFig. 8.
Type of Study: 1. Modeling for Policy Considerations; 2. Analysis of Policy Design and Regulations; 3. Analysis Policy Impact or Evaluation; 4. Analytical Framework Formulation
Focus: primary and secondary foci were assigned for each document from the list below:

- Comparison for policy/incentives refinement
- Economic competitiveness, financing considerations
- Environmental Benefits and Impacts
- Grid Integration
- Incentive Mechanisms (other)
- Incentive Mechanisms (capital incentives and FIT)
- Incentive Mechanisms (NM and FIT)
- Incentive Mechanisms (NM)
- Incentive Mechanisms (RPS, FIT)
- Incentive Mechanisms (RPS, NM, Tax, Energy Efficiency Standards)
- Incentive Mechanisms (Tax rebates)
- Incentive Mechanisms (FIT)
- Innovation (tech and organizational)
- Institutional Analysis
- Policy or Regulation Adoption Factors
- Proposal of technology/efficiency measures
- Social Benefits and Impacts
- Technology Adoption/ Penetration Factors

Scale of Focus: International, Regional, State/Provincial, Local/City

In other systematic reviews involving more than one researcher there are other techniques to maintain coding consistency.

3.1. General attributes of the articles

The timeframe for articles included in the analysis 2000–2014. As previously mentioned, this range was chosen because the German Renewable Energy Sources Act was introduced in 2000, an event which sparked much attention in renewable energy incentive mechanisms (such as in Feed-In-tariffs, FIT), even though FITs had been offered in Germany since 1990 [19]. Indeed, in their bibliometric analysis of distributed generation publications, Woon et al. [20] note that interest in Solar PV, micro-grids/smart-grids all grow rapidly post-2000. Fig. 2 shows the number of articles in this study (total number=87) per publication year. It is evident that there is a growing interest in the theme of DG in the Americas. However, over the entire period, the rate of growth in the number of articles is almost flat. Yet, if we look at the period post-2008, (i.e. post sub-prime economic crisis) the annual

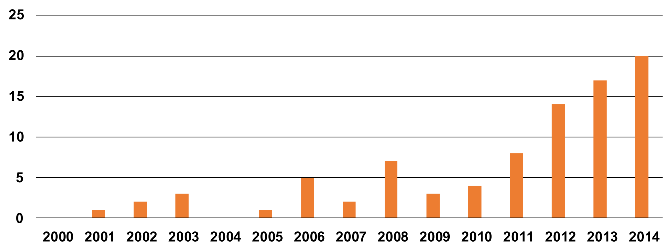

Fig. 2. Date of publication of articles (Elaborated by C.A.G. Garcez).

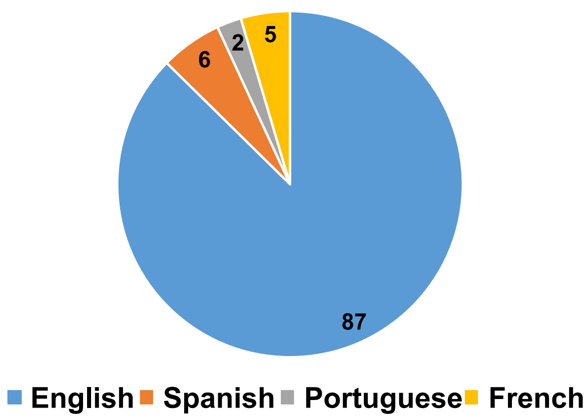

Fig. 3. Language of publication (% of total) (Elaborated by C.A.G. Garcez).

growth rate in the number of publications increases more than two-fold.[1]

The vast majority of the documents considered were published in the English-language (87%, as shown in Fig. 3). This is not surprising, as the United States dominates the country ranking in scientific publications, both in the general category but also in the category of energy research [21]. Interestingly, while the number of articles included in the final analysis that are published in Portuguese was low,[2] while the number of articles published with Brazil as the corresponding author's affiliation was 13 (or 15% of total articles, see Fig. 4), showing that the language of publication is not necessarily representative of the object of study.

The jurisdiction under analysis is another general characterization of the documents. It is shown graphically in Fig. 5. Canada as an object of study on a national level is not present in the analysis. This was to be expected, as electricity policy is an exclusively provincial matter according to the Canadian Constitution. Of the 18 journals that consider this most northern country of the Americas, 14 focus on the province of Ontario (78%), three on Quebec and one on the province of Prince Edward Island. Moore et al. (2012) [22] suggest the deficient role occupied by the federal government in promoting renewables negatively affects provinces that are being proactive and innovative, such as in the case of the Province of Ontario. Parker [23] compares the Japanese and Australian policies and incentives for Solar PV to that of Canada. However, due to an absence of federal-level policies or incentives, the article only considers the province of Ontario. In contrast, the majority of articles that focus on the United States of America, which also has a decentralized electricity policy arrangement, do consider in some form or another the national scenario, either through the comparison of multiple state-led initiatives or federal tax incentives. Carley and Andrews argue that the challenges facing DG in the US are “not so much technological or even economic as institutional” [24]. This necessarily means that the federal government must

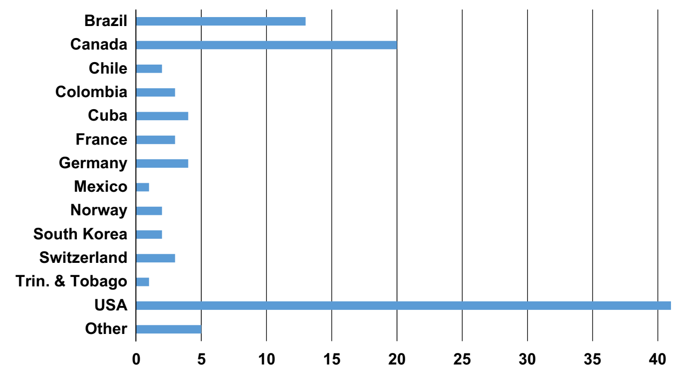

Fig. 4. Author affiliation, country (Elaborated by C.A.G. Garcez).

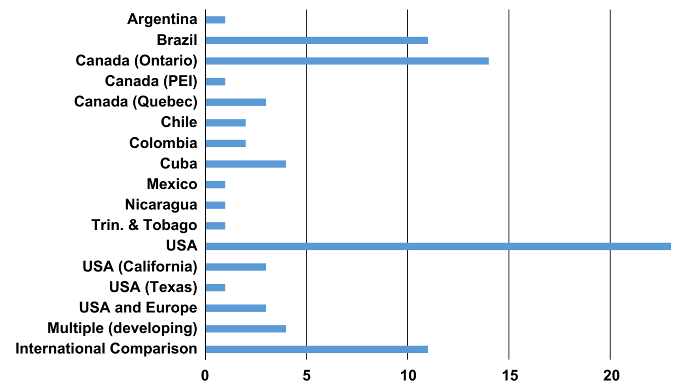

Fig. 5. Object of Study, Jurisdiction (Elaborated by C.A.G. Garcez).

play a role in the establishment of standards to minimize leakage of carbon from states with innovative policies to those with high-polluting energy mixes, establishing overarching policies such as a carbon tax, renewable portfolio standards, etc.

3.2. *Definition of distributed generation*

The National Renewable Energy Laboratory, NREL of the U.S. Department of Energy, DOE/US defines DG in general as; “an electric power source that is located at or near the point of consumption” [25]. Academic literature assigns various attributes to DG, which were captured through open coding. This means pre-determined values were not assigned for this variable. The responses were later grouped into related categories, as can be seen in Fig. 6. Many of the articles used the term distributed or decentralized generation without providing any further detail or attributes (34 of the 87 articles or 39%). As previously described in the data collection methodology, rural electrification was omitted from the analysis, so it is expected that related terms such as isolated systems or battery-back-up are not identified. The term that was observed with the largest frequency was “small-scale” generation, followed by “renewable/low-carbon” and “near consumption load”, which attests to the idea that traditional, diesel generators, which use a fossil fuel derivative for back-up power or for isolated communities, does not fit the overall conception of distributed generation.

Furthermore, Fig. 7 displays the type of technology that was considered in the documents. The majority of articles (65) specified one or more type of generation technology in their analysis, while the remainder considered DG in general terms. Again, traditional diesel generators were not mentioned, nor was mini-hydro.

3.3. *Motivating factors for distributed Generation*

The objective for this item was to extract the motivating factors for

[1] Trend line for period 2000–2014; Y=0.003X, R^2=0.003. Trend line for period 2008–2014; Y=2.6X; R^2=0.8073

[2] 57 articles were located in the initial Portuguese-language keyword search, but only 2 were included in the final analysis

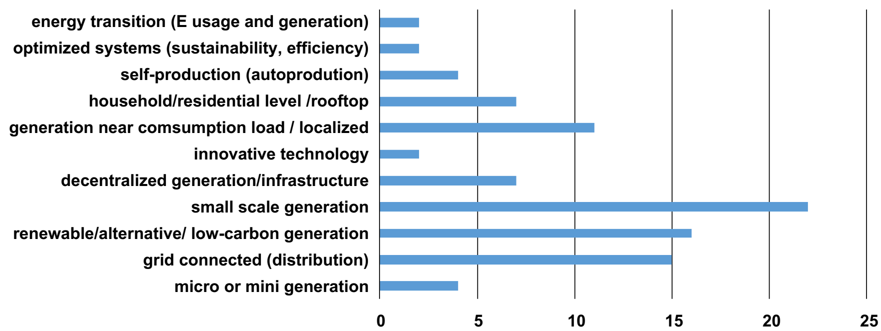

Fig. 6. Attributes of distributed generation, frequency of responses (Elaborated by C.A.G. Garcez).

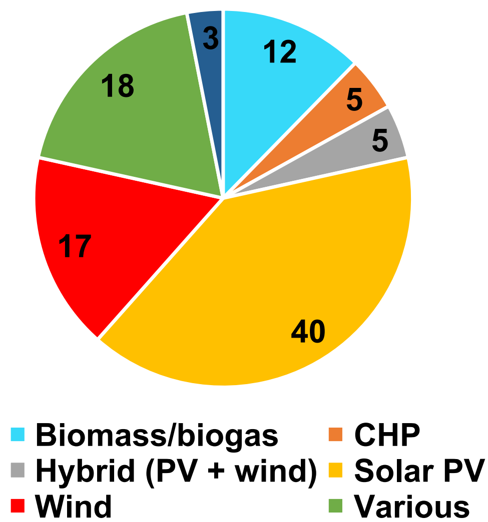

Fig. 7. Technology considered, percentage of total (Elaborated by C.A.G. Garcez).

DG that are articulated in the publications, as well as to identify if there are differences between the factors identified in works that analyze countries in South versus North America. It is important to understand the motivating factors that spur the policy-making context for DG policies and regulations as an initial point of departure for policy evaluation [26].

Fig. 8 is a radial diagram that displays the frequency of factors identified in the documents. The factors were grouped into three main categories; Environmental; Economic and Energy Systems. It is evident that Climate Change (freq=39) and Environmental pollution (freq=27) are the dominant motivating factors. In the economic sub-set of factors, "job creation/green growth" is the most noted (freq=13), "avoided infrastructure investment costs" and "avoided fossil fuel costs" follow (freq=12; 10, respectively). The two most popular responses in the energy systems category were "energy security" (freq=14) and "efficiency", which includes avoided distribution system losses (freq=12).

The responses do vary somewhat when analyzed by geographic perspective, i.e. articles that have Canada and/or the USA as their object of study versus Latin American or Caribbean countries. Fig. 9. displays the same motivation factors that were plotted in the previous radial figure by their proportional frequency (percentage of total responses) for each of these two groups. Environmental concerns and Climate Change continue to be the two most cited reasons for the growth of DG. However, the theme of "job creation/green growth" represents a larger priority for journals concerned with policies in Canada and the USA (11%), while journals that focused on countries in South America only identified this motivating factor in 3% of the cases. This is an interesting difference, which shows how energy and economic priorities (i.e. the green economy) have been incorporated into some jurisdictions in North America, most notably California and Ontario, while it seems fewer South American countries have prioritized the link between jobs and the renewable energy sector.

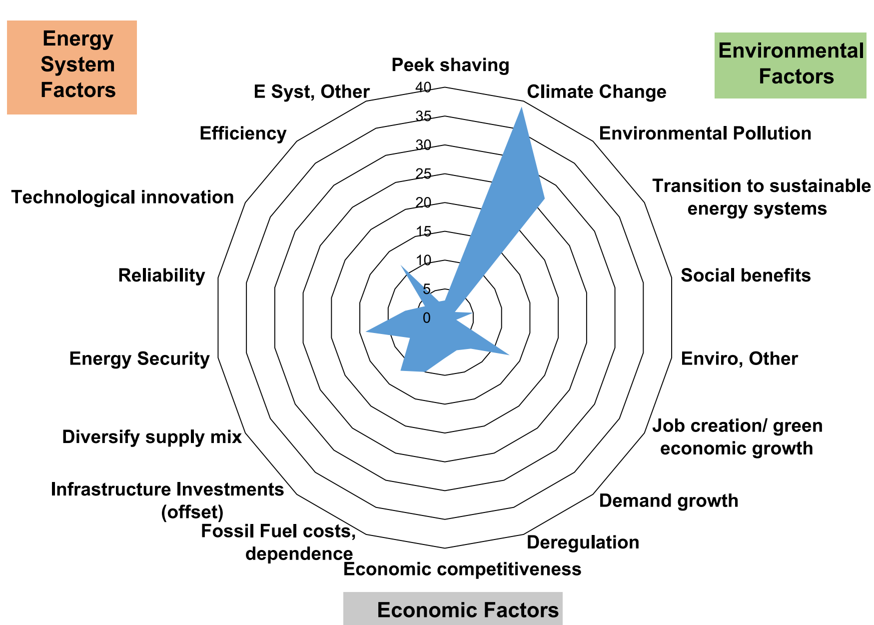

Fig. 8. Motivating Factors for distributed generation, frequency of response (Elaborated by C.A.G.Garcez).

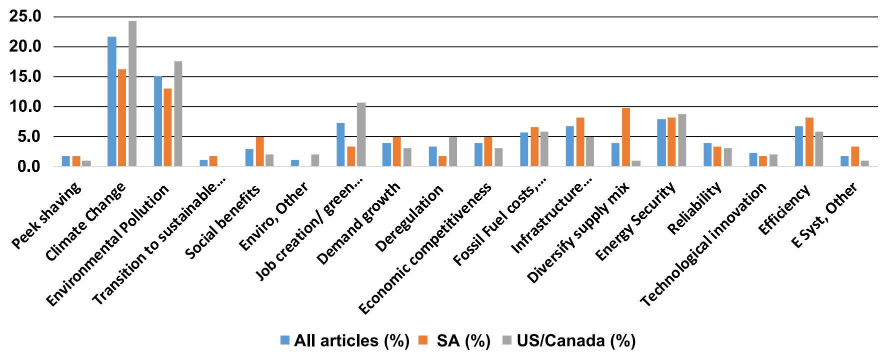

Fig. 9. Motivating factors for distributed generation, by region (% of total responses), (Elaborated by C.A.G. Garcez).

The diversification of the energy supply mix occupies a larger place of importance in South American studies (10%), while in articles from Canada and the USA, this item was mentioned in a small portion (4%) of the cases. A plausible explanation for this difference is that some countries in Latin America (especially those in Central America and the Caribbean) have a more pressing need to diversity their energy mixes and avoid operational costs associated with fossil fuel price volatility as well as offset infrastructure investments.

3.4. Document focus

For each article, the primary and (in some cases) secondary foci are identified, as per the set of values shown in Table 2. The list of foci ware established after Phase 2 of data collection, in which the abstracts of the articles had been read. New categories were included during the analysis to capture more accurately the intent of the documents. The results of the analysis are shown in Fig. 10.

More than a quarter of the articles had either a primary or secondary focus associated with the category "Incentive Mechanisms for Distributed Generation" (27% or freq=41). Of these documents, more than half (54%) analyzed the mechanism referred to as Feed-in-Tariffs, FITs, either stand alone or in comparison to other mechanisms, as per Fig. 11.

It is not surprising that such attention is given to FIT mechanisms, their design, optimization and effectiveness. FITs vary in their features, but most have the following characteristics, they combine long-term contracts with fixed-prices per unit of generation (usually differentiated by generation type), along with guaranteed grid-access. Many of the articles point to the FITs as one of the most efficient mechanisms for encouraging renewable energy deployment. According to a report prepared by the United Nations Development Program, UNDP 66 countries have adopted some sort of FIT mechanism [27].

Huenteler's [28] article focuses on options for international support (i.e. NGOs, banks and donor countries) to cover part of the cost FITs in developing countries. While other articles propose new economic formulations to optimize FIT designs [29–31], such as that of Kim and Lee) [32], whose intention is to optimize the uptake of renewable

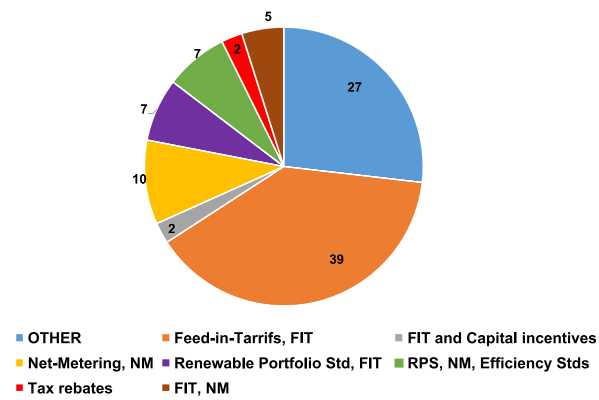

Fig. 11. Incentive mechanisms subset, types considered (Elaborated by C.A.G. Garcez).

energy while minimizing burden on rate-payers. Couture and Gagnon compare market-dependent vs. market-independent FIT models and concludes that those operating independently from the market (i.e. fixed price models) "create greater investment security and lead to lower-cost renewable energy deployment than market-dependent models" [33]. Other articles, focus on using FIT options to increase the economic viability of certain DG technologies [34,35]. Kulatilaka et al.'s analysis [36] argues that FITs, as implemented in the USA for Solar PV, place too much risk onto the homeowner/consumer. They advocate for changes in contractual arrangements toward leasing options, which would aid in scaling-up DG deployment.

The effect of FIT policies is also the topic of several articles, Smith and Urpelainen [37] conduct a causal analysis of the effects of FITs on renewable electricity generation in 26 industrialized countries. They concluded that national shares of renewable electricity increase by a factor larger than the sample mean for every cent (0.01US$) per KWh increase in FIT offer prices.

Various articles (especially in the USA) are concerned with the comparison of different types of mechanisms, such as Renewable Portfolio Standards, RPS, tax incentives and FITs. Schmalensee [38] identifies RPS as the mechanism of choice in the USA because the

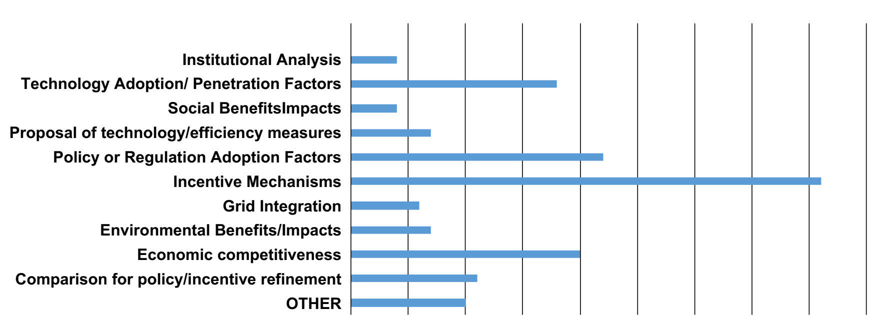

Fig. 10. Focus of document, frequency of responses (Elaborated by C.A.G. Garcez).

“quantity goal” seems more attractive to states, while the FIT mechanism is more widely adopted outside of the USA because it removes investment risk for renewables. Carley and Brown reiterate this policy choice, stating that RPS seem to be more politically palatable and provide symbolic legitimacy for the state legislature, “even if the renewable energy mandate or goal is small, this policy can still indicate that states are in favor of renewable energy development” [39]. The authors also indicate net metering, NM and interconnection standards are one of the most common incentive mechanism in the USA, which they consider crucial to removing market barriers for DG.

The present analysis shows that the choice of incentive mechanisms varies and is dependent on the policy goal or landscape in the jurisdiction. In the USA, Renewable Portfolio Standards have been favored, while in many other contexts, Feed in Tariffs, first introduced in Europe have been implemented with the intention of rapidly increasing the uptake of decentralized and renewable generation. However, there is increased concern on designing or modifying FITs in such as to reduce the burden on the overall market or ratepayers, while reducing the risk on the residential or small-scale investor through leasing options.

Another category of articles included in the coding was “comparison for policy/incentives refinement”. For example Mabee et al. [40] compare Ontario and German FIT (introduced in 2008 and 2000, respectively), with the intention of identifying points Ontario could refine based on learning from the German experience (for instance decreasing rates over time). The German policy is often used as a reference in comparisons; Kissel et al. recognize that the German FIT resulting from EEG spurred interest in South America, first in Brazil in 2002 with PROINFA, the Electric Energy Renewable Sources Incentive Program (which has since expired) [41]. They consider that FIT mechanisms can be effectively applied in the case of emerging markets that have higher degrees of macroeconomic instability if modified accordingly. Some of the points raised in their article are nationalization targets and special financing conditions through national development banks. In an earlier publication, Kissel and Krauter (2006) [42] also compared German and Brazilian FIT (PROINFA) rates. They assert that large capital investment in wind, along with high interest and inflation rates need to be taken into account in the design of the incentives, especially looking and the reduction in rates when capital repayments have been amortized in the Brazilian case.

3.5. Urban or local focus

Nine of the articles included in the study focus specifically on urban or local scale, however their research objectives are quite heterogeneous. Howard et al. [44] analyze the potential of a mature technology, Combined Heat and Power, CHP in the context of New York City. As a member of the C40 (an initiative promoting the role of municipal governments to achieve GHG emission reductions) the city has committed to reduce its emissions by 30% by 2030 and have established targets for distributed generation, including CHP [43]. According to Howard et al.’s analysis, applications of CHP at the building level and micro-grid (block scale) would result in 2.3 million metric tons and 5.0 million metric tons, respectively. This corresponds to a GHG reduction of 4% and 9% for the city as a whole [44]. One of the main hurdles that they cite is financial burden associated with navigating various permitting processes and recommend the city assist in this process by providing guidance via a handbook to facilitate the implementation of the technology. Siler-Evans et al. [45] are also concerned with CHP in the neighboring city of Newark, New Jersey. Their focus is economic competitiveness evaluation under various scenarios of carbon pricing, net metering and well as Feed-in-Tariff design to reduce investor risk.

In the context of Latin America, Caballero et al.’s article [46] aims at providing policy recommendations for designing a small, grid-connected Hybrid (Solar PV and Wind) system for a block of homes in Hanga Roa city of Easter Island, Chile. The case they analyze is serviced by utility generation via six diesel generators, which is an expensive operation due to volatile fossil fuel prices. Their analysis presents various scenarios for reducing the life cycle cost, including the options of net billing and net metering. Casillas and Kammen's work (2011) is concerned with providing an alternative power system to two communities in Nicaragua that are connected to a utility grid currently served with diesel generators. The overarching goal in the two articles that consider the Latin American countries of Chile and Nicaragua is to question the current configuration or regime paradigm for electricity provision (i.e. diesel), while contemplating economically viable ecological alternatives. Indeed Casillas and Kammen summarize this:

> Cheap capital costs and the prevalence of well developed supply chains make diesel generators a common choice for providing power to isolated communities. However, the long-term volatility of diesel prices and the negative environmental externalities resulting from the production of carbon dioxide provide two important reasons for reducing diesel dependency in these electric systems. This study demonstrates that there are many currently available opportunities for rapidly and cost effectively transitioning to the delivery of low-carbon energy services in rural communities. In order to make the persuasive case to policy makers, government officials, and funders, it is critical to present the costs and benefits of the decisions in consistent and rigorous manners [47].

A third article with a similar theme was prepared by Rodrígues Gámez et al. [48] for the city of Havana, Cuba. Theirs is also a feasibility study for Solar PV generation connected to the distribution system, with the objective of providing solutions for energy policy and planning. They consider factors such as solar radiance optimized with respect to proximity to the existing distribution grid in Cuba, which covers 97% of consumers in the island-country. The benefits that Rodrígues Gámez et al. considered are directly related to the GHG reductions associated with displacement of thermoelectric generation. Currently, Cuba's electricity mix is dominated by thermoelectric stations using both imported and domestically produced petroleum derivatives, i.e. 79% oil-fired or fuel oil; 13% gas-fired; 6% diesel-fired [49].

Two Brazilian papers also focused on local/municipal applications for DG. Urbanetz et al. [50] analyzed the grid integration of solar PV. Although it is one of the more technical papers, it was included in the analysis, because its objective was to guide policy in understanding if PV in a city such as Florianopolis could be integrated in a strategically sited manner and lead to the efficient operation of a distribution grid. The results of their modeling showed that Solar PV could result better voltage profile and loss reductions, which they conclude could result in the postponement of distribution system upgrades. The other Brazilian paper authored by Mitscher and Ruther [51] present an economic competitiveness analysis of five Brazilian State capitals. They show that rooftop Solar PV has reached grid parity in Belo Horizonte (due to high residential tariffs) and they affirm that if lower interest rates became available for this technology, Solar PV would also be economically attractive in other capitals such as Brasília, São Paulo and Florianópolis.

The three papers that study DG applications in Cuba, Nicaragua and Chile focus on the displacement of diesel, both for cost reduction (due to dependence on volatile fossil fuel generation), but also GHG reductions. While the Brazilian examples do not point to the low-carbon potential of the technologies as a priority, but rather to the optimization of the distribution system and economic considerations such as offsetting infrastructure costs. This is to be expected as Brazil's energy mix involves a higher participation of large, hydroelectric stations and is considerably lower in carbon content.

In contrast to the articles explored above, that have focused on providing models of technically and economically feasible solutions for DG development, the remaining two documents focus on institutional aspects of the energy transition within an urban scale. Both of the articles are fruit of a project that was led by S. Jaglin entitled Energy Trajectories in Metropolitan Regions in the Global South (*Trajectoires Énergétiques dans les Régions MétrOpolitaines des Suds, TERMOS*) from 2011 to 2013.

The first article [52] explains how urban energy issues in emerging countries are evolving and how local actors and governments are influencing the transitions towards sustainable energy systems. Common amongst the cities considered (Buenos Aires, Argentina; New Delhi, India; Cape-Town, South Africa; Istanbul, Turkey; and Sfax, Tunisia) are the following characteristics: growing demographics, a strong increase in energy consumption, significant social contrast and high rates of poverty in their urban population. They depart from a broad literature on socio-technical transitions and seek to show how local and national interest play out within this urban scale transition. The authors conclude that although a discourse in favor of low-carbon and sustainable energy system is identified, there were no real urban "green" coalitions observed between economic and political actors. Their research did not find organized civil society groups that could push the low-carbon energy agenda forward. They did observe urban energy issues being given increased interest at the national governance level; however, there is an increased politicization of energy issues at the city level.

The second article of the TERMOS project, describes specifically the case of Buenos Aires [53]. The authors assert that the term "energy transition" does not have a place in public policy in Argentina; only the related term of energy efficiency is identified.[3] The main concern in the Argentinian capital is to control electricity rates for political advantages, but the authors question the sustainability of such a practice. The artificially low tariff stipulated for the city, the authors argue, does not allow for improvements in service delivery to be made, nor for efficiencies or the development of new generating sources.

3.6. Social aspects

It is clear that environmental factors are the main driving force for DG, but in a continent with large regional inequalities, the question remains, how do these articles address social or socio-economic benefits of the technologies? We have already seen that the driving force or "green economic growth" or job creation is much stronger in the articles that deal with Canada and US than in South America. In the larger body of documents included in the analysis, there are only five articles that were coded as having "social benefits/impacts" as either their primary or secondary focus.

Schelly [54] is concerned with the practices or behaviors of residents that adopted solar energy in the States of Wisconsin and Colorado. Her objective is to identify the accrued social and environmental benefits beyond that of policy adoption. In the case of Wisconsin, homeowners who adopted Solar PV through the State's FIT policies pointed toward the impetus for energy conservation. The increased savings translated into increased income via energy generation (paid out at higher FIT rates). What is interesting is that although the majority of the respondents did not declare environmental motives for joining the FIT program, the incentive mechanisms in the policies induced energy conservation as a result. In comparison, Colorado has a larger PRS but it does not apply to all utilities and there is a strict sizing limit to solar PV. This policy inconsistency, as well as unfavorable rates (wholesale rates are offered, rather than retail or premium rates, such as FITs) caused unintended consequences for that State's policy. The sizing restrictions in Colorado (based on household consumption) caused respondents to increase their consumption prior to applying for the program so that they could justify either installing a larger system, with the intention of purchasing electric vehicles or heating appliances, to offset natural gas. The result was less electricity conservation than in the case of Wisconsin. Ironically, in comparison to Wisconsin, almost all Colorado interviewees cited environmental reasons for adopting Solar.

Krupa's article [55] provides suggestions for improving a mechanism incorporated into the Canadian province of Ontario's FIT offer prices for decentralized renewables; the Aboriginal Adder. The Ontario Green Energy Act (2009) includes an additional $0.015 per kWh price adder for renewable energy projects that included Aboriginal economic participation. Krupa argues that the current "Aboriginal Adder" is a first step in promoting the participation of this historically marginalized and vulnerable population in the energy sector. However, if Ontario and Canada are to truly engage in a sustainable energy trajectory, Aboriginal involvement should be further expanded. An example Krupa offers is the creation of a price adder for transmission project in Ontario, as well for this approach to be emulated by other Canadian provinces.

The analysis of Ontario's Green Energy Act, GEA by Yatchew and Baziliaukas [56] also points out that the Province was strongly motivated by socio-economic factors when designing the policy. The authors assert that the GEA and the FIT program were designed to be the "cornerstone of the Ontario government's Green Economy plan. The government has indicated that the new Act will create 50,000 well-paying jobs in the first three years" [56]. The authors also elaborate on the sense of urgency in Ontario at the time of policy design to adopt aggressive incentive measures, as a means of securing itself as a leader in the renewable energy industry in North America. One could consider this an example of "competition amongst states" inducing the diffusion and adoption of DG policy in the case of Ontario [57].

Juárez-Hernández and León are concerned with wind development in the Isthmus of Tehuantepec in the State of Oaxaca, Mexico. Their analysis concludes that the current development model contains significant information asymmetries, both concerning the local indigenous communities, but also involving the landholders that are directly affected by developments. In addition, little benefit is materialized in terms of generating skilled, local employment, seeing that the majority of components are manufactured abroad [58]. These factors, the authors assert, have resulted in a development paradigm for wind generation that is receiving increased social resistance by local communities in Mexico.

Rumpala [59] has a very different focus than the others concerned with social benefits of DG. His work is not empirically based, as in the case of the others dealing with social benefits/impacts of DG. The focus of Rumpala's article is to provide a theoretical framework for dealing with the central question of how technological changes will also induce social reconfigurations. The author affirms that in the current configuration of the energy sector, electricity generation is centralized not only in scale, but also in terms of power (oligopolistic) and decision-making capacity. He maintains that DG opens is the possibility of increased community cooperation through smaller-scale and renewable projects.

3.7. Brazil and Canada in comparison

The present analysis, as previously mentioned, is part of a larger research project regarding DG in Brazil and Canada. These two large and resource rich nations of the Americas will be further compared with relation to their historical and institutional trends of electricity generation and the context in which distributed generation emerges. For this reason, some of the characteristics of the documents included in the analysis that deal with these two jurisdictions will be highlighted here. There are 11 articles have Brazil as their object of study, while 14 articles deal specifically with the Canadian province of Ontario.

The motivating factors for DG that the two sets of articles identified

[3] Original citation in French, "En Argentine, le terme de "transition énergétique" n'appartient pas au vocabulaire des politiques publiques, à la différence de celui d' "efficience énergétique"".

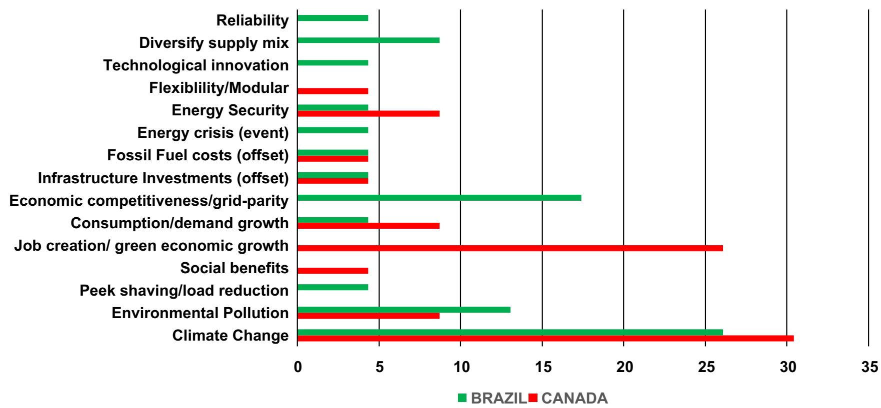

Fig. 12. Motivating factors for DG (% of responses), Canada (Ontario) and Brazil (Elaborated by C.A.G. Garcez).

are shown in Fig. 12. It is quite evident that there are contrasting motivating factors for the deployment of DG in the two cases. In Ontario, socioeconomic factors such as job creation and social benefits are quite strong, while they are completely absent in the Brazilian sub-set. By contrast, the Brazilian articles point to issues of energy system optimization and economic competitiveness as the main driving forces (which are absent for the Ontario sub-set).

The Ontario policy and regulations designed to incent distributed generation were introduced in 2009, while the current regulation in Brazil that applies to mini and micro generation was published in 2012. For this reason, the types of articles are also quite different; two thirds of the articles in the Brazilian sub-set are concerned with modeling for policy considerations, while only four articles (36%) deal with policy analysis (one of which deals with a policy that is no longer active: PROINFA). In the case of Ontario, four articles are characterized as "modeling for policy considerations", while five papers deal with policy evaluation and another five are focused on aspects of policy design. This analysis shows that there is void in peer-reviewed literature and therefore a need to research the policy design aspects of the Brazilian regulation for distributed generation.

4. Final considerations

The objective of a systematic review is to answer certain questions via meta-analysis of a body of peer-reviewed works in an unbiased and transparent manner. This present analysis was guided by a specific question: What is the state of study on regulations and policies for distributed generation? Systematic reviews are not "infallible approach[es] to discerning broad findings from a body of scientific work" [60], as there are instances for error due to interpretation inconsistencies.

With regards to improving the meta-analysis, a possible solution is to include "grey literature" into the review. This would allow for a comparison between data extracted from peer-reviewed documents and other sources. In this case, certain precautions would need to be taken. This study was limited to peer-reviewed literature because it is considered to be "a widely accepted and scientifically rigorous source" [61]. Reports prepared by international organizations such as the International Energy Agency, IEA of the OECD, the International Renewable Energy Agency, IRENA of the United Nations, and other renewable energy organizations or research institutions would certainly enrich the analysis. However, caution would be warranted since they are not scrutinized through the peer-review process and may present preferences associated with the institution [62]. DG is a relatively new policy, especially in the case of some jurisdictions in the Americas. Peer-reviewed studies, being subject to rigorous review can also involve lag-times up to 2 years, for this reason grey-literature could, therefore enhance the present analysis.

The results of this paper will be useful as a springboard for future study. The larger research plan with a comparison of Canada and Brazil as objects of study will benefit from the characteristics identified, such as a large discrepancy in motivating factors in the two cases for DG.

Overall, the findings of the systematic review show that there is little emphasis given in previously published works to understand social impacts and benefits of distributed technologies, an issue that policy makers will have to address if policy interventions to mitigate climate change can be fully realized. Additionally, specific urban challenges and governance at the local scale for distributed generation is not widely investigated, pointing to a need for future study that considers such institutional considerations.

The systematic review is a promising technique for conducting a literature review, one that avoids bias in data collection and analysis but also lends itself to comparison. The methodology could be easily applied to another geographical region, such as Africa, Asia or Europe allowing for comparison and therefore, global insights into the problematic of policies and regulations for distributed, small-scale electricity generation.

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Appendix A

	Authors	Title	Year	Publication
1	Huenteler, Joern	International support for feed-in tariffs in developing countries-A review and analysis of proposed mechanisms	2014	RENEWABLE & SUSTAINABLE ENERGY REVIEWS

2	Mallikarjun, Sreekanth; Lewis, Herbert F.	Energy technology allocation for distributed energy resources: A strategic technology-policy framework	2014	ENERGY
3	Taha, Ahmad F.; Hachem, Nadim A.; Panchal, Jitesh H.	A Quasi-Feed-In-Tariff policy formulation in micro-grids: A bi-level multi-period approach	2014	ENERGY POLICY
4	Giraudy Arafet, et al.	Factibilidad de instalación de sistemas fotovoltaicos conectados a red	2014	Ingeniería Energética
5	Rowlands, Ian H.; Kemery, Briana Paige; Beausoleil-Morrison, Ian	Managing solar-PV variability with geographical dispersion: An Ontario (Canada) case-study	2014	RENEWABLE ENERGY
6	Hawthorne, Bryant; Panchal, Jitesh H.	Bilevel formulation of a policy design problem considering multiple objectives and incomplete preferences	2014	ENGINEERING OPTIMIZATION
7	Borchers, Allison M.; Xiarchos, Irene; Beckman, Jayson	Determinants of wind and solar energy system adoption by U.S. farms: A multilevel modeling approach	2014	ENERGY POLICY
8	Kulatilaka, Nalin; Santiago, Leonardo; Vakili, Pirooz	Reallocating risks and returns to scale up adoption of distributed electricity resources	2014	ENERGY POLICY
9	Schelly, Chelsea	Implementing renewable energy portfolio standards: The good, the bad, and the ugly in a two state comparison	2014	ENERGY POLICY
10	Holdermann, Claudius; Kissel, Johannes; Beigel, Juergen	Distributed photovoltaic generation in Brazil: An economic viability analysis of small-scale photovoltaic systems in the residential and commercial sectors	2014	ENERGY POLICY
11	Pal, Rajib	Has the Appellate Body's Decision in Canada - Renewable Energy/Canada - Feed-in Tariff Program Opened the Door for Production Subsidies?	2014	JOURNAL OF INTERNATIONAL ECONOMIC LAW
12	Smith, Michael G.; Urpelainen, Johannes	The Effect of Feed-in Tariffs on Renewable Electricity Generation: An Instrumental Variables Approach	2014	ENVIRONMENTAL & RESOURCE ECONOMICS
13	Fernando Yanine, Franco; Caballero, Federico I.; Sauma, Enzo E.; Cordova, Felisa M.	Building sustainable energy systems: Homeostatic control of grid-connected microgrids, as a means to reconcile power supply and energy demand response management	2014	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
14	Choi, Hyundo; Anadon, Laura Diaz	The role of the complementary sector and its relationship with network formation and government policies in emerging sectors: The case of solar photovoltaics between 2001 and 2009	2014	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
15	Howard, Bianca; Saba, Alexis; Gerrard, Michael; Modi, Vijay	Combined heat and power's potential to meet New York City's sustainability goals	2014	ENERGY POLICY
16	Pinto, Aime; Zilles, Roberto	Reactive power excess charging in grid-connected PV systems in Brazil	2014	RENEWABLE ENERGY
17	Zhang, Xianjun; Karady, George G.; Ariaratnam, Samuel T.	Optimal Allocation of CHP-Based Distributed Generation on Urban Energy Distribution Networks	2014	IEEE TRANSACTIONS ON SUSTAINABLE ENERGY
18	Sergio Juárez-Hernández y Gabriel León	Energía eólica en el istmo de Tehuantepec: desarrollo, actores y oposición social	2014	Revista Problemas del Desarrollo: Revista Latinoamericana de Economía
19	Elisabeth Graffy, Steven Kihm	DOES DISRUPTIVE COMPETITION MEAN A DEATH SPIRAL FOR ELECTRIC UTILITIES?	2014	ENERGY LAW JOURNAL
20	ABRAMOVAY, RICARDO	INOVAÇÕES PARA QUE SE DEMOCRATIZE O ACESSO À ENERGIA, SEM AMPLIAR AS EMISSÕES	2014	Ambiente & Sociedade
21	Rodríguez Gámez, María; et al.	Sistemas fotovoltaicos y la ordenación territorial	2013	Ingeniería Energética
22	Moore, Steven; Durant, Vincent; Mabee, Warren E.	Determining appropriate feed-in tariff rates to promote biomass-to-electricity generation in Eastern Ontario, Canada	2013	ENERGY POLICY
23	Caballero, F.; Sauma, E.; Yanine, F.	Business optimal design of a grid-connected hybrid PV (photovoltaic)-wind energy system without energy storage for an Easter Island's block	2013	ENERGY
24	Vahl, Fabricio Peter; Ruether, Ricardo; Casarotto Filho, Nelson	The influence of distributed generation penetration levels on energy markets	2013	ENERGY POLICY
25	White, William; Lunnan, Anders; Nybakk, Erlend; Kulisic, Biljana	The role of governments in renewable energy: The importance of policy consistency	2013	BIOMASS & BIOENERGY
26	Krupa, Joel	Realizing truly sustainable development: A proposal to expand Aboriginal 'price adders' beyond Ontario electricity generation projects	2013	UTILITIES POLICY
27	Carley, Sanya; Browne, Tyler R.	Innovative US energy policy: a review of states ' policy experiences	2013	WILEY INTERDISCIPLINARY REVIEWS-ENERGY AND ENVIRONMENT
28	Krasko, Vitaliy A.; Doris, Elizabeth	State distributed PV policies: Can low cost (to government) policies have a market impact?	2013	ENERGY POLICY
29	Stokes, Leah C.	The politics of renewable energy policies: The case of feed-in tariffs in Ontario, Canada	2013	ENERGY POLICY
30	Islam, Towhidul; Meade, Nigel	The impact of attribute preferences on adoption timing: The case of photo-voltaic (PV) solar cells for household electricity	2013	ENERGY POLICY

		generation		
31	Cowart, Richard; Neme, Chris	CAN COMPETITION ACCELERATE ENERGY SAVINGS? OPTIONS AND CHALLENGES FOR EFFICIENCY FEED-IN TARIFFS.	2013	ENERGY & ENVIRONMENT
32	Jannuzzi, Gilberto de Martino; de Melo, Conrado Augustus	Grid-connected photovoltaic in Brazil: Policies and potential impacts for 2030	2013	ENERGY FOR SUSTAINABLE DEVELOPMENT
33	Rai, Varun; Robinson, Scott A.	Effective information channels for reducing costs of environmentally-friendly technologies: evidence from residential PV markets	2013	ENVIRONMENTAL RESEARCH LETTERS
34	Avaci, Angelica B., et. Al.	Avaliação econômico-financeira da microgeração de energia elétrica proveniente de biogás da suinocultura	2013	Revista Brasileira de Engenharia Agrícola e Ambiental
35	Jaglin, S; Verdeil, E	Énergie et villes des pays émergents: des transitions en question. Introduction	2013	Flux
36	Marie-Hélène Zérah, Gautier Kohler	Buenos Aires: l'introuvable transition énergétique d'une métropole fragmentée	2013	Flux
37	Yannick Rumpala	Formes alternatives de production énergétique et reconfigurations politiques. La sociologie des énergies alternatives comme étude des potentialités de réorganisation du collectif	2013	Flux
38	Filgueiras Sainz de Rozas, Miriam L.; Castro Fernández, Miguel	La capacidad de absorción para la innovación: estudio de caso en la Generación Distribuida Cubana	2012	Ingeniería Energética
39	Urbanetz, Jair; Braun, Priscila; Ruether, Ricardo	Power quality analysis of grid-connected solar photovoltaic generators in Brazil	2012	ENERGY CONVERSION AND MANAGEMENT
40	Schmalensee, Richard	Evaluating Policies to Increase Electricity Generation from Renewable Energy	2012	REVIEW OF ENVIRONMENTAL ECONOMICS AND POLICY
41	Ben Amor, Mourad; Pineau, Pierre-Olivier; Gaudreault, Caroline; Samson, R.	Assessing the economic value of renewable distributed generation in the Northeastern American market	2012	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
42	Kim, Kyoung-Kuk; Lee, Chi-Guhn	Evaluation and optimization of feed-in tariffs	2012	ENERGY POLICY
43	Mitscher, Martin; Ruether, Ricardo	Economic performance and policies for grid-connected residential solar photovoltaic systems in Brazil	2012	ENERGY POLICY
44	Mosher, J. N.; Corscadden, K. W.	Agriculture's contribution to the renewable energy sector: Policy and economics - Do they add up?	2012	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
45	Wiener, Joshua G.; Koontz, Tomas M.	Extent and types of small-scale wind policies in the U.S. states: Adoption and effectiveness	2012	ENERGY POLICY
46	Antonio Suarez, J.; Anibal Beaton, P.; Faxas Escalona, R.; Perez Montero, O.	Energy, environment and development in Cuba	2012	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
47	Carley, Sanya; Andrews, Richard N.	Creating a sustainable U.S. electricity sector: the question of scale	2012	POLICY SCIENCES
48	Lieben, Ivan; Boisvert, Ian	Making Renewable Energy FiT: A Feed-in-Tariff Certifying Body Could Accelerate Renewable Energy Deployment in the United States	2012	NATURAL RESOURCES JOURNAL
49	Dong, C. G.	Feed-in tariff vs. renewable portfolio standard: An empirical test of their relative effectiveness in promoting wind capacity development	2012	ENERGY POLICY
50	Siler-Evans, Kyle; Morgan, M. Granger; Azevedo, Ines Lima	Distributed cogeneration for commercial buildings: Can we make the economics work?	2012	ENERGY POLICY
51	Mabee, Warren E.; Mannion, Justine; Carpenter, Tom	Comparing the feed-in tariff incentives for renewable electricity in Ontario and Germany	2012	ENERGY POLICY
52	Blechinger, Philipp Friedrich Heinrich; Shah, Kalim U.	A multi-criteria evaluation of policy instruments for climate change mitigation in the power generation sector of Trinidad and Tobago	2011	ENERGY POLICY
53	Alagappan, L.; Orans, R.; Woo, C. K.	What drives renewable energy development?	2011	ENERGY POLICY
54	Darghouth, Naim R.; Barbose, Galen; Wiser, Ryan	The impact of rate design and net metering on the bill savings from distributed PV for residential customers in California	2011	ENERGY POLICY
55	Casillas, Christian E.; Kammen, Daniel M.	The delivery of low-cost, low-carbon rural energy services	2011	ENERGY POLICY
56	Yatchew, Adonis; Baziliauskas, Andy	Ontario feed-in-tariff programs	2011	ENERGY POLICY
57	Hernandez, J. A.; Velasco, D.; Trujillo, C. L.	Analysis of the effect of the implementation of photovoltaic systems like option of distributed generation in Colombia	2011	RENEWABLE & SUSTAINABLE ENERGY REVIEWS

58	Carley, Sanya	The Era of State Energy Policy Innovation: A Review of Policy Instruments	2011	REVIEW OF POLICY RESEARCH
59	White, Andrew J.; Kirk, Donald W.; Graydon, John W.	Analysis of small-scale biogas utilization systems on Ontario cattle farms	2011	RENEWABLE ENERGY
60	Ben Amor, Mourad; Lesage, Pascal; Pineau, Pierre-Olivier; Samson, Rejean	Can distributed generation offer substantial benefits in a Northeastern American context? A case study of small-scale renewable technologies using a life cycle methodology	2010	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
61	Wiginton, L. K.; Nguyen, H. T.; Pearce, J. M.	Quantifying rooftop solar photovoltaic potential for regional renewable energy policy	2010	COMPUTERS ENVIRONMENT AND URBAN SYSTEMS
62	Couture, Toby; Gagnon, Yves	An analysis of feed-in tariff remuneration models: Implications for renewable energy investment	2010	ENERGY POLICY
63	Barin, A.; Canha, Luciane N.; Magnago, Karine F.; Abaide, A.da Rosa	SELECAO DE FONTES ALTERNATIVAS DE GERACAO DISTRIBUDA UTILIZANDO UMA AN ALISE MULTICRITERIAL BASEADA NOM ETODO AHP E NA LOGICA FUZZY	2010	Revista Controle & Automacao
64	Albadi, M. H.; EI-Saadany, E. F.	The role of taxation policy and incentives in wind-based distributed generation projects viability: Ontario case study	2009	RENEWABLE ENERGY
65	Kissel, Johannes M.; Hanitsch, Rolf; Krauter, Stefan C. W.	Cornerstones of a renewable energy law for emerging markets in South America	2009	ENERGY POLICY
66	Carley, Sanya	Distributed generation: An empirical analysis of primary motivators	2009	ENERGY POLICY
67	Stoutenborough, James W.; Beverlin, Matthew	Encouraging pollution-free energy: The diffusion of state net metering policies	2008	SOCIAL SCIENCE QUARTERLY
68	Mills, Andrew; Wiser, Ryan; Barbose, Galen; Golove, William	The impact of retail rate structures on the economics of commercial photovoltaic systems in California	2008	ENERGY POLICY
69	Parker, Paul	Residential solar photovoltaic market stimulation: Japanese and Australian lessons for Canada	2008	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
70	Felder, Frank A.; Haut, Ruthanne	Balancing alternatives and avoiding false dichotomies to make informed US electricity policy	2008	POLICY SCIENCES
71	Lesser, Jonathan A.; Su, Xuejuan	Design of an economically efficient feed-in tariff structure for renewable energy development	2008	ENERGY POLICY
72	Cadena, Angela Ines	Regulacion para incentivar las energias alternas y la generacion distribuida en Colombia	2008	Revista de Ingenieria
73	Orrego, Lina María Bastidas; Montoya, Santiago F.; Henao, Juan D. V.	¿Hacia dónde irán los sectores eléctricos de los países de la región Andina?	2008	Cuad. Adm.
74	Sovacool, Benjamin K.	Coal and nuclear technologies: creating a false dichotomy for American energy policy	2007	POLICY SCIENCES
75	Coll-Mayor, Debora; Paget, Mia; Lightner, Eric	Future intelligent power grids: Analysis of the vision in the European Union and the United States	2007	ENERGY POLICY
76	Kissel, Johannes M.; Krauter, Stefan C. W.	Adaptations of renewable energy policies to unstable macroeconomic situations - Case study: Wind power in Brazil	2006	ENERGY POLICY
77	Mueller, Steffen	Missing the spark: An investigation into the low adoption paradox of combined heat and power technologies	2006	ENERGY POLICY
78	Vachon, Stephan; Menz, Fredric C.	The role of social, political, and economic interests in promoting state green electricity policies	2006	ENVIRONMENTAL SCIENCE & POLICY
79	Hughes, L; Bell, J	Compensating customer-generators: a taxonomy describing methods of compensating customer-generators for electricity supplied to the grid	2006	ENERGY POLICY
80	Stuart, EK	Energizing the island community: a review of policy standpoints for energy in small island states and territories	2006	SUSTAINABLE DEVELOPMENT
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