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A historical analysis of US climate change policy in the Pan-American context

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Abstract
The problem that climate change poses globally is being addressed locally through the use of diverse policy responses in many countries. Following its five-decade history of environmental policy making in the USA, the country has employed a particular mix of different renewable energy policy instruments, or tools, in order to reduce its greenhouse gas emissions and replace fossil fuels with renewably sourced energy. We analyze and compare renewable energy policies and policy instruments from 2000 to 2016 for Argentina, Brazil, Canada, and Mexico with the USA, to determine what makes the USA unique in its robust approach to climate policy and reflect on the time periods when policy making has been the most active. We found that the most often used regulatory instruments in the USA to achieve its climate policy goals have been Renewable Portfolio Standard requirements implemented at the state level, with federal climate mitigation policy being contested.

Keywords Renewable energy · Climate change policy · Historical policy analysis · Pan-America

Introduction

By January 2018, 174 countries had ratified the Paris Agreement, an historical achievement in the sense that there was global consensus that all countries are responsible for tackling the problem of climate change. In light of many countries' environmental track records, the Agreement was also unique in that it required them to identify ways to reduce their greenhouse gas (GHG) emissions from multiple sectors, identify ways to improve energy efficiency, and create plans to support renewable energy development. Renewable energy policies can be one of the most efficient and widest-ranging options for reducing GHGs and moving away from burning fossil fuels in order to meet overarching climate policy goals.

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Renewable energy policies have emerged as key tools to address climate change mitigation. Consequently, the goal of this paper is to present a historical review of the policy instruments used in renewable energy policy making in the USA from 2000 to 2016 and compare them to those used during the same time period by the neighboring countries of Canada and Mexico, as well as Argentina and Brazil to show renewable energy policy making trends over time. This paper will briefly review the history of the US climate policy, provide a regional context of Canada and the three Latin American countries included in our analysis, discuss the policy instruments the countries use to promote renewable energy, and conduct a comparative analysis of the scope of the instruments used from 2000 to 2016 for the policies included in the study.

Renewable energy policies use many different policy instruments, or tools. They range from policy makers gathering information, regulating behavior, incentivizing action through resource provision or funding organizations that do (or not do) something as a way to resolve a problem, or institute change (Hood and Margetts 2007; Howlett 2009). Each country has a unique history of using policy mixes to respond to environmental problems. Analyzing the policies can help reveal how countries may respond to future environmental challenges through policy making and to provide broader insight on how countries might achieve climate change mitigation by considering key hemispheric trading partners.

This study speaks to the symposium's goal of putting the current state of American environmental politics in its historical context, with an additional focus on providing a concrete quantitative measure of how the USA is responding to climate change. We chose five countries in the Americas for our study, because they are readily comparable: they all have federal systems of government, are major trading partners, and each country is working on finding solutions to the problem of climate change. These countries also individually have the highest gross domestic products (GDP) in the Americas (IMF 2017); GDP has long been closely linked with economic growth and GHG emissions, although this relationship has been questioned recently (Schandl et al. 2016; York and McGee 2017). Furthermore, all five countries are among the top 30 with the largest GHG emissions globally (Boden et al. 2017). The International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA) databases provided information on current and past renewable energy policy instruments. Five broad categories of instruments were compared, namely research, development and deployment (RD&D); economic instruments; information and education; policy support; and regulatory instruments.

We conclude that more than other Pan-American countries, the USA relies on regulatory instruments in its climate policy making, though its policy objectives and scope are weaker than that of other countries. The most active policy making period coincides with state level focus on the Renewable (Energy) Portfolio Standard (RPS) in the USA. In the current political climate, sub-national climate policy has become especially important.

Policy instruments promoting renewable energy

Managing complex multi-dimensional renewable energy policies requires a mix of policy instruments to address multiple long-term goals and objectives (Klassert and Moeckel 2013). These policy mixes, or portfolios, feature the use of combinations of different kinds of policy tools—market based, hierarchical, network, and others—whose exact configuration changes from location to location. One important step in comprehending how policy mixes originate, change, and develop concerns understanding the combination of elements required in order to assemble a mix (Wellstead and Howlett 2017). These elements are policy tools or "instruments" that have settings and calibrations, both of which have been the subject of enquiry in the policy sciences for many years. Policy mixes include policy goals and means across several levels of specificity (Howlett 2009; Kern and Howlett 2009; Cashore and Howlett 2007). In the policy literature, it is unclear which mix of policy instruments is most optimal in renewable energy policy deployment or for meeting policy goals (Mir-Artigues and Del Río 2014). Multiple policy instruments can help address multiple issues, but they can also lead to conflict or "double coverage" (Mir-Artigues and Del Río 2014).

Tied closely to policy mixes are the density and intensity of policy instruments. Density is measured by an accounting of the number of policies and instruments employed within a policy field, whereas intensity refers to the "strictness or generosity" of policies (Bauer et al. 2012). Intensity includes such factors as the level of involvement, scope of the enforcement, and formal aspects such as the conditions of enforcement, the administration capacity, and the procedural features for participation (Schaffrin et al. 2015; Bauer et al. 2012).

A brief history of US climate policy

In principle, sound environmental policy, including climate policy, should be based on sound science. In the case of the USA, starting in the 1980s, there was a concerted effort to promote climate science at the international level to provide the basis for climate policy in the USA as well as globally. Most of the decade was spent by the international community focused on the 1984 discovery of the hole in the stratospheric ozone layer and efforts to reduce the production of and eventually ban ozone-depleting substances such as chlorofluorocarbons. These efforts resulted in the Vienna Convention for the Protection of the Ozone Layer in 1985 and the Montreal Protocol in 1987 (Hecht and Tirpak 1995). Policy instruments to implement the Montreal Protocol in the USA included direct regulation, cap and trade, and a tax under the 1990 Amendments to the Clean Air Act (Cook 1996). The United Nations Environment Programme among others promoted quick adoption of a climate change convention, though the most immediate outcome of these efforts was establishment in 1988 of the Intergovernmental Panel on Climate Change (IPCC) (Zaelke and Cameron 1989–1990). The secretariat was initially based in Washington, D.C. The IPCC was divided into three main working groups: science, impacts, and response strategies. It has integrated the work of thousands of scientists worldwide, with extensive peer review, seeking consensus on the many dimensions of climate change. The main assessment reports of the IPCC, issued every 5 or 6 years, are intended to inform policy debates at both national and international levels. The most recent IPCC report was issued in 2013–2014 (IPCC 2014).

The release of the first IPCC assessment report helped to increase momentum for negotiation of a climate change treaty. This treaty was completed during the Earth Summit held in Rio de Janeiro in June 1992, formally the United Nations Framework Convention on Climate Change (UNFCCC). The objective of the UNFCCC, which achieved near universal participation, was "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"

(Hecht and Tirpak 1995, p. 372). The focus on stabilization of atmospheric concentrations would require substantial emissions reductions. However, then, US President George H.W. Bush successfully argued that the treaty should not have binding limits and enforcement mechanisms for GHG reduction, which led to a much weaker treaty. As a result, this framework climate treaty accomplished little and is best seen as a climate change agreement parallel to the Vienna Convention. Former President Bill Clinton and his Vice President Al Gore did commission a federal Climate Change Action Plan in 1993, but it focused on voluntary measures and lacked adequate funding and legislative support, so it too accomplished little (Clinton and Gore 1993). A modest Btu/energy tax increase was proposed that was defeated by Congress (Harrison 2007, p. 99).

International negotiators developed the Kyoto Protocol to the UNFCCC in 1997 during tense meetings in Japan's former Imperial capital. The USA was originally on board and agreed to modest reductions in GHG emissions from 1990 to 2008–2012 as part of the accord. The Kyoto Protocol and the UNFCCC applied to six GHGs (not covered by the Montreal Protocol) and overall would have cut emissions by 5.2% among industrialized countries. While the USA signed the agreement, its Senate never ratified it. President Clinton in fact never submitted the Kyoto Protocol for ratification, since a unanimous Senate resolution indicated that it would not be ratified as written. In 2001, the new President George W. Bush stated that because of domestic economic concerns, he had no interest in abiding by the agreement and would withdraw the USA from the Kyoto Protocol (Harrison 2007). In its place, that Administration committed to a modest 18% reduction in GHG emissions intensity (the ratio of emissions to real gross national product) over a decade (Goulder 2002).

The Presidency of Barack Obama was an active time for climate policy. While Congress failed to approve comprehensive climate legislation, Obama turned to executive and regulatory approaches to address climate change. First, proposals for a strong follow-up treaty to the expiring Kyoto Protocol fell short at the international conference in Copenhagen in December 2009. A Copenhagen "Accord" was agreed to, which for the first time included significant GHG emissions reduction commitments from large developing countries though the document is not a treaty and lacked binding commitments. The US Environmental Protection Agency (EPA) concomitantly issued an "endangerment finding" that GHGs threaten the public health and welfare. This formed the basis for the position of the USA during the Copenhagen negotiations, along with climate change mitigation legislation that had been proposed, though not approved, by Congress. Following the Copenhagen Conference, Obama released a Climate Action Plan in 2013 while EPA issued a series of regulations to reduce GHG emissions, most notably the Clean Power Plan in 2014–2015. This Plan aimed to reduce carbon dioxide emissions from electric power plants by 32% over 25 years, with varying state targets and flexible options available to states for implementation (Konisky and Woods 2016). Finally, with strong US involvement, the Paris Agreement was concluded in December 2015 as the long-awaited follow-up to Kyoto. While not a binding treaty, the Paris Agreement included near universal international participation and does not require domestic ratification. The US Nationally Determined Contribution (NDC) was 26–28% below GHG emissions in 2005 by 2025, including land use, land use change, and forestry measures (UNFCCC 2017).

In a stark reversal, new US President Donald Trump announced in June 2017 that he would withdraw the USA from the Paris Agreement (a process that will take several years). Nevertheless, the US federal system means that states can keep developing renewable energy and other policies with or without the federal government's leadership or action to reduce GHG emissions. For example, 20 of 50 states have signed pledges to abide by the Paris Agreement (America's Pledge 2017). Additionally, 398 US city's mayors have committed to make stronger GHG emission-reduction policies because of the federal government's decision to withdraw from the Paris Agreement (see the Mayors National Climate Action Agenda, www.climate-mayors.org).

Pan-American regional context

Canada, along with the USA, has among the highest per capital GHG emissions in the world and arguably has special responsibility to lead by example in cutting emissions. From initial discussions in the 1990s, Canada played a leading role in the formulation of international climate policy similar to the USA (to which it is highly sensitive to events and policies, especially on trade) (Liftin 2000, p. 249). In terms of natural resources policy, Canadian provinces have constitutional authority complicating federal policy development where the federal government has jurisdiction. Nonetheless, Canada was an international leader on climate change until around 1997, when both North American countries began to lag (Liftin 2000, p. 242). While both countries went on to sign the Kyoto Protocol, only Canada ratified it. During the first commitment period, emissions actually grew faster than in the USA. In December 2011, the Conservative government led by Stephen Harper formally withdrew from the Protocol (Hu and Monroy 2012, p. 3244). A new Liberal government under Prime Minister Trudeau was elected in October 2015 and Canada sought to become a supporter of international climate change cooperation. This is reflected by its Paris Agreement's NDC, which is 30% below GHG emissions in 2005 by 2030 (UNFCCC 2017).

Brazil has long received attention as a critical country in climate change policy because of the high rate of deforestation in the Amazon in the twentieth century. Protection of the Amazon forest has been a highly sensitive issue. Forestry measures were only included in general terms as mitigation options in the UNFCCC, negotiated in Rio de Janeiro. One of the country's objectives was to retain sovereignty over its forestry sector and to highlight its high rate of renewable energy use, at around 33% (BP 2016). This is largely because of its major reliance on hydroelectricity for power production and the major role of biofuels in the transportation sector. The Kyoto Protocol, which greatly enhanced the use of forestry and land use measures to reduce GHGs, was not mandatory for developing countries such as Brazil. Brazil released a comprehensive National Policy on Climate Change in 2008, which sought to greatly reduce deforestation and expand the use of renewable energy sources through a combination of direct regulation and voluntary measures. Nonetheless, the Policy faces challenges such as expanded hydropower leading to flooded forests and a rapidly growing oil sector (Trennepohl 2010).

Argentina along with Kazakhstan gained international attention at a 1998 meeting in Buenos Aires by announcing that they would voluntarily abide by the Kyoto Protocol, although the intent was to limit GHG emissions growth not reduce them (Stevens 1998). The Argentine plan was to link its emissions to GDP, similar to the US emissions intensity policy under President George W. Bush. Argentina's plan was controversial and died after President Carlos Menem left office in late 1999 (Below 2015, pp. 61–89). However, Argentina did have 44 projects achieve registration under the Clean Development Mechanism of Kyoto (Blanco et al. 2016). Additionally, the City and Provincial Governments of Buenos Aires adopted a Climate Change Action Plan in 2009 (updated in 2015), which was followed by the City's approval of the Adaptation and Mitigation Climate Change Law in 2011. The Plan details numerous regulatory and voluntary measures to reduce GHG emissions (Buenos Aires Ciudad 2015).

Mexico is a third major developing country in Latin America that has become active in climate change mitigation policy and plans. For example, it has expanded the use of natural gas while decreasing reliance on oil, with coal use in Mexico under 10% of its total energy consumption. It has also promoted energy efficiency improvements and reforestation. A *National Strategy on Climate Change* was released in 2007, which while initially relying on voluntary measures foresees development of a GHG cap and trade system (GOM 2007). A very ambitious goal was announced in climate talks in Poznan, Poland, in 2008, which would reduce GHG emissions 50% below 2002 levels by 2050. Mexico committed at Copenhagen in 2009 to a 30% emissions reduction for 2020 compared to business as usual levels (Pong 2010).

Data and methods

A key challenge was identifying hundreds of renewable policies and their contents from the five case study countries. The International Renewable Energy Agency (IRENA) is a treaty organization representing 150 states and tasked with promoting renewable energy across the globe. As part of its mandate to advice and support to governments, IRENA developed and maintains databases including policy profiles for renewable energy. Policy relevant information is regularly provided and updated by member countries in a database maintained by IRENA policy analysts. Information is categorized in a systematic fashion according to instrument type (e.g., economic instruments, policy support). During the analysis, the authors of this paper consulted with renewable energy policy experts in the five countries for confirmation of the selected policies.

We selected and analyzed both the number of national and sub-national (provincial and state) policies and types of renewable energy policies and policy instruments created between 2000 and 2016. This comprehensive and regularly updated database ensured that the instruments were all labeled consistently across countries and within countries (e.g., among states or provinces). This database enabled us to tally the total number of renewable energy policies from each country in our study and their states or provinces across the specified time period. The five instrument categories the online database used include RD&D, economic instruments, information and education, policy support, and regulatory instruments. We also measured the intensity, or strength, of the scope of each country's renewable energy policies using a modified version of Schaffrin et al.'s (2015) methodology. One of the key intensity scores for a Pan-American-US comparison was the determination if renewable energy policies were committed to reducing GHG emissions (measuring the countries' policy objectives). Scores ranged from 0 = no GHG emission reduction target given; .5 = indirect target given, such as a percentage of wind power production; .75 = directly targets climate, but no specific percentage is given; to 1 = any percentage reduction in GHG emissions was determined through a deliberative approach by two of the authors. These scores were summed and averaged across the respective countries. The scope score measures the policy's reach, taking account of whether the policies address both the supply and the demand side of the renewable energy development (the households' and companies' demand or supply) and gives credit for all renewables included in the policy's scope (e.g., solar, wind, hydro, biomass). Possible scores range from 0 to 1.25 (0 = only one group targeted; .16 = for each target group; .5 = all groups targeted; 0 = only one renewable energy source targeted; 0.05 = for each additional renewable energy targeted). Scores for each individual policy were tallied, and mean scores for each country were calculated, resulting in standardized policy intensity scores that could be directly compared across countries.

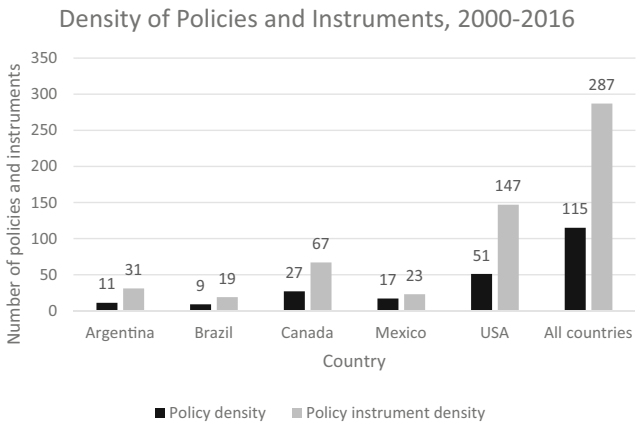


Fig. 1 Density of policies and instruments, 2000–2016

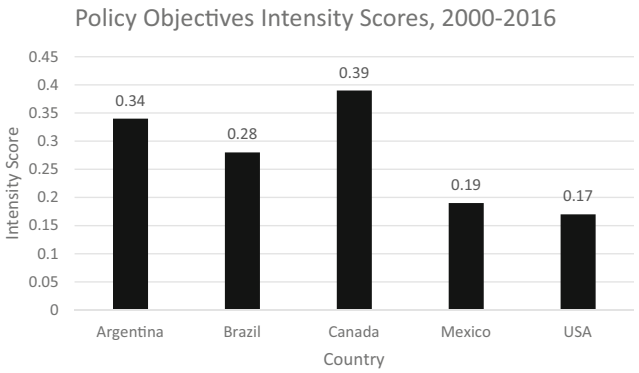


Fig. 3 Policy objective intensity scores, 2000–2016

Results and discussion

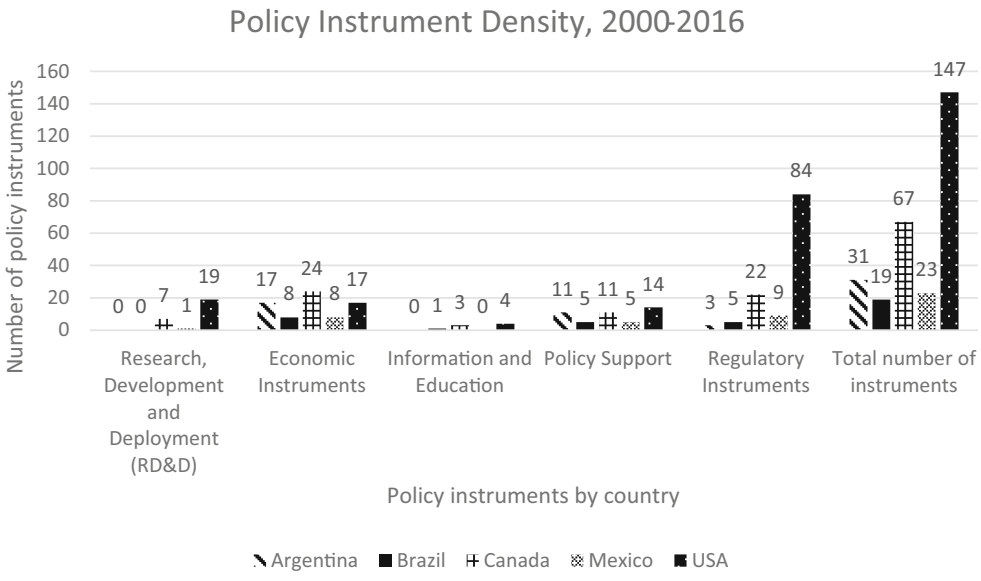
Comparative analysis: policy density and scope intensity

In the countries included in our analysis, each renewable energy policy was constructed using multiple instruments (Fig. 1). Overall, the USA used the most policies and instruments, as shown by its policy density and instrument density; a total of 147 instruments comprised the 51 renewable energy policies at the federal and state levels. Not surprisingly, almost twice as many policies and instruments were employed in the USA compared to the other four countries. The large number of states (50) contributed to this high score. However, as analysis of policy intensity illustrates, policy density alone only tells part of the story of measuring policy output.

Any individual policy was commonly composed of several instruments. For example, the USA's Energy Policy Act of 2005 (a single policy) was made up of regulatory instruments, economic instruments, policy support, and RD&D. In total, 123 regulatory instruments were used, making it the most often-used tool for renewable energy development. Economic instruments were the second-most used (74 times), followed by 46 policy support instruments, 27 RD&D, and finally eight information and education instruments (Fig. 2). The frequency with which regulatory instruments were used in the USA was greater than all other types of instruments that were used combined. RD&D instruments were the next most commonly used (19 times), followed by economic instruments (17 times). The least commonly used instruments were those related to information and education.

Argentina's 11 renewable energy policies from the 17-year period outlined in this paper were composed of 31 policy instruments. There were no RD&D instruments used, and regulatory instruments were the most commonly used. Compared to other countries in this analysis, Brazil had the fewest renewable energy policies and policy instruments. It had no RD&D instruments, one information and education instrument, and few regulatory instruments. Economic instruments were the most commonly used. Canada used the second highest number of most

Fig. 2 Policy instrument density 2000–2016



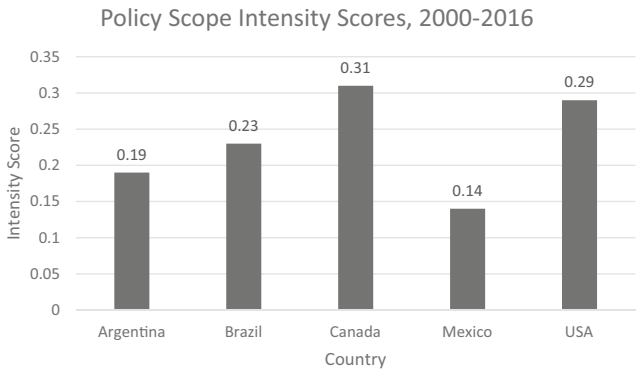


Fig. 4 Policy scope intensity scores, 2000–2016

instruments (and the second highest number of policies) over time compared to the other four countries included in our analysis. Economic instruments were most commonly used, while information and education instruments were least common. Mexican renewable energy policies were often composed of a limited number of instruments. Of the 17 renewable energy policies across the outlined time period, 23 total instruments were used. Regulatory instruments were used most often and information and education instruments were used the least often.

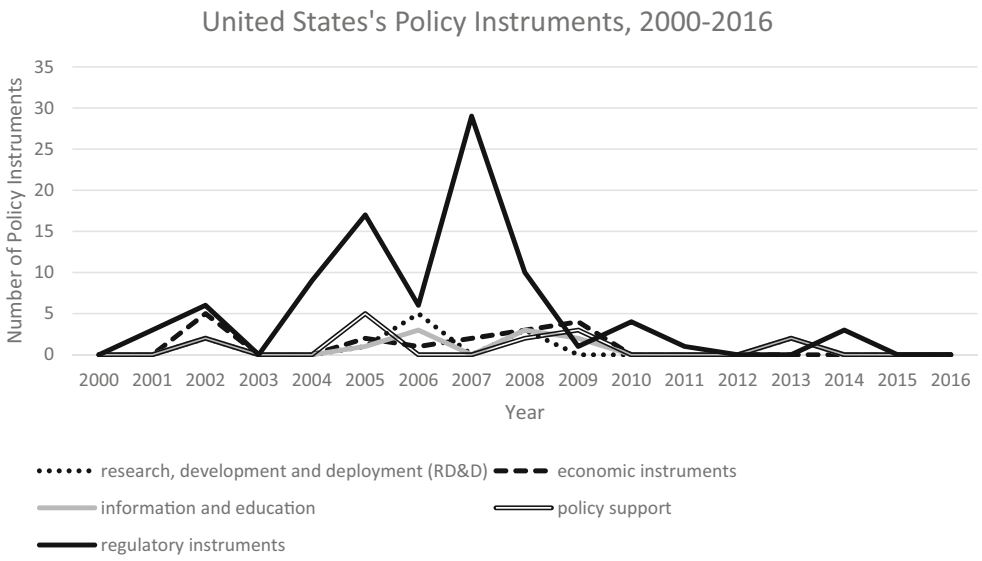
Despite the high policy density scores, the intensity scores of the policies' objectives are all well below the maximum possible score of one, where the policy explicitly states a percentage reduction in GHG remissions as an objective (Fig. 3). They are also below the less ambitious 0.5 score policies could receive if they state a percentage for a specific amount of a renewable energy to produce as an objective. Canada had the highest mean score for policy objectives, followed by Argentina's policies, then Brazil's, Mexico's, and, finally, the USA's. This indicates that the USA's policies either are very general in their climate change goals (i.e., they do not specify a percentage reduction of GHG emissions or increase in production of renewables), targeting many different types of outcomes instead and allowing for flexibility in what the policy achieves, or it means that the policies are weak with outcomes that are difficult to measure.

In terms of the intensity, or strength, of the policies' scope, the scores are low for all the countries analyzed (Fig. 4). All scores given are out of a total score of 1.25. The US policies ranked second strongest, just behind Canada's. This means that Canada's policies were the broadest, guiding more supply and demand activities and targeting more types of renewable energy than other countries did. Compared to Canada and the USA, Brazil's policies were weaker, followed by Argentina's, and finally Mexico's. The USA's scope score aligns with its objectives score, with many different types of outcomes targeted and a broad range of potentially flexible ways to meet its objectives.

We also tracked policies and policy instruments used each year by each country (Fig. 5). The RD&D instrument was used the most often (six times) in the USA in 2006. Its usage coincided with the creation of the Global Bioenergy Partnership, which outlined future research, technology development, voluntary research schemes, and demonstration projects. Other countries used the instrument less often, but when they did, used it to jump-start renewable and clean energy systems demonstration projects. In the USA, economic instruments were used five times in 2002 for the Rural Energy for America Program (REAP) and Biomass Research and Development Initiative (BRDI). Similarly, other countries used economic instruments, such as infrastructure investments, financial incentives (grants and subsidies), and loans, to establish federal renewable energy programs and funds.

Information and education tools were rarely used in any country except the USA where they were used three times in each 2006 and 2008. These types of instruments were used for information provision and advice and aid in implementation in such programs as the Wind & Water Power Program. Such

Fig. 5 US policy instruments, 2000–2016



instruments were also used in the USA throughout the time period considered in this paper for projects such as the State Climate and Energy Program, Solar Decathlon, and National Biodiesel Education Program. All case study countries used policy support tools between 2002 and 2016, with the Latin American countries most often using them to create policies from 2008 to 2010. Unlike the Latin American countries and Canada, which used such instruments to create general climate change-related policies, the USA used policy support tools (five times) more generally in 2005 in its State Climate and Energy Program and Energy Policy Act of 2005 (EPAct). Only Canada and the USA regularly used regulatory instruments; the Latin American countries used them once or twice a year across the 17-year time period considered here. The USA used regulatory instruments 29 times in 2007 alone, as well as 17 times in 2005 and 10 times in 2008. The instruments were used during the 4-year time span from 2005 to 2008 for such policies as the EPAct, the Energy Independence and Security Act of 2007 (EISA, specifically the Renewable Fuel Standard for motor vehicles), and the state-specific RPSs in 29 states.

The majority of state level RPSs were created in 2005, 2007, or later, accounting for the spikes in policy making activity in these years. The focus of the EISA and RPSs was to create greater energy independence and security by developing clean energy. Since then, the use of myriad renewable energy policies and policy instruments has become less common, perhaps because of low oil and gas prices. There has been a shift toward policies such as former President Obama's Clean Power Plan (which has started to be dismantled by President Trump) that regulate and mitigate GHG emissions from electric power plants and focus on climate change directly rather than support alternative sources of energy, which is what our analysis focused on. Besides one Canadian provincial plan (in Ontario) that uses a feed-in tariff to promote renewable energy and something similar to an RPS in Argentine, the RPSs are what make the USA unique: more than half of the states have one and each is unique to the state's resources.

Conclusions

Measuring a country's renewable energy policy making activity through time can demonstrate its priorities for addressing climate change. Comparing that country's policy objectives and scope with those of others can show its strengths and weaknesses, or at the least, what is possible. In this paper, we sought to review and compare the history of renewable energy policies and instruments used from 2000 to 2016 in the USA and Argentina, Brazil, Canada, and Mexico to uncover the diverse approaches to climate change mitigation in the region. We analyzed the following policy instruments employed by each country: research, development and deployment (RD&D); economic instruments; information and education; policy support; and regulatory instruments.

Our analysis shows that while the USA has a prolific renewable energy portfolio composed of a majority of regulatory instruments, its individual policies are not as specific in its goals as those of other countries included in this analysis. Its policies had the weakest climate change objectives of any of the countries in our analysis, and the USA's policy scope was weaker than Canada's. However, the flurry of activity with the creation of Renewable Portfolio Standards at the state level can be credited for the USA's high level of policy making activity in the mid-2000s. This type of policy and a diverse mix of flexible instruments used by multiple states shows the unique approach that the USA has taken for making renewable energy policy. Such policy output and use of multiple instruments demonstrate how the USA may be able to achieve its climate change goals under the Paris Agreement.

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