The Political Economy of California and Québec's Cap-and-Trade Systems

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RESEARCH REPORT

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Introduction

This report aims to improve understanding of the political and economic factors that have led to the adoption of a linked cap-and-trade system in California and Québec. California has committed to reducing its emissions to 1990 levels by 2020 while Québec has committed to reducing emissions 20% below 1990 levels in the same time period. In their electoral programme the *Parti québécois*, which has formed a minority government in Québec since the 2012 provincial election, expressed a commitment to a 25% reduction. Though very much the product of state and provincial legislation, the cap-and-trade systems of California and Québec operate under guidelines of the Western Climate Initiative (WCI), a voluntary subnational intergovernmental organization initiated in 2007. There is hope that if the linked cap-and-trade system being established between California and Québec is demonstrated to be effective in allowing these jurisdictions to reduce their aggregate emissions more cost-effectively, other states and provinces will commit to the WCI. Successful implementation of a linked cap-and-trade system in California and Québec could also provide a blueprint for an eventual federal or even continental carbon pricing mechanism.

In what follows, we describe emissions trends in each jurisdiction and the evolution of California and Québec's cap-and-trade systems under the WCI. We then undertake a review of the design of California and Québec's climate policy—looking at similarities and differences in their respective cap-and-trade systems but also at complementary policies. Indeed, one of the key findings of this study is that in both California and Québec, cap-and-trade is but one piece of a much more comprehensive package of policies designed to address climate change. The striking feature of California's strategy is that the state expects to attain 85% of its 2020 emission reduction through complementary policies, with the cap-and-trade system serving as a backstop measure to make the system more robust and link its different components. If a complimentary policy does not deliver its intended results, the cap ensures that incentives to reduce emissions remain. Though similar estimates about the role of Québec's complementary policies are not known, it is safe to assume they will also play an important role. In other words, the cap-and-trade systems in both jurisdictions serve as a support measure to enhance the effectiveness of other programs by putting a price on carbon. In turn, complementary policies allow government to retain an important degree of control over climate policy while also targeting emission sources that are generally unresponsive to prices. After exploring existing research on the expected costs of compliance as well as the direction of gains from emissions trading between California and Québec, we explore the political conditions under which the two jurisdictions have come to implement carbon pricing in general, and emissions trading in particular. We conclude with thoughts on opportunities for expansion and linkage to other jurisdictions in North America and beyond.

Empirically, this study draws upon recent research, including a series of interviews conducted between March and October 2013 in California and Québec with key actors across the public, private, civil society and academic sectors. These semi-structured interviews were conducted on a snow-ball sample involving questions ranging from the history and development of each jurisdiction's cap-and-trade system to others regarding political will and processes. See Appendix 1 for a copy of the questionnaire. Where appropriate, we also draw from official and secondary documentation on the cap and trade systems in both jurisdictions, as well as on recent polling on public attitudes toward climate policy in the US and Canada.

Emission Trends in California and Québec

Given the overarching goal of reducing emissions of greenhouse gases, any analysis of carbon policy should begin with a portrait of emission trends. In absolute terms, emission levels in California and Québec are very different. With one of the world's largest economies, California's emissions are nearly six times those in Québec. Indeed, the most recent data available for comparison date from 2010 and indicate that California's gross emissions stood at 452 MtCO2e compared to 83 MtCO2e in Québec (Figure 1a). On a per capita basis, however, California's levels are only slightly greater than Québec's. Moreover; both jurisdictions have seen significant reductions since 2000 (Figure 1b). California's per capita emissions have shrunk from 14.5 to 12.1 tCO2e while Québec's have fallen from 12.0 to 10.4 tCO2e. While these trends refer to economy-wide emissions in California and Québec, and not specifically to only those emissions covered under each jurisdiction's respective cap-and-trade systems, the data provides a picture of initial conditions in both jurisdictions. Note that emissions covered under the cap-and-trade system are discussed under the section on *Emission Reduction Commitments* at page 9 below.

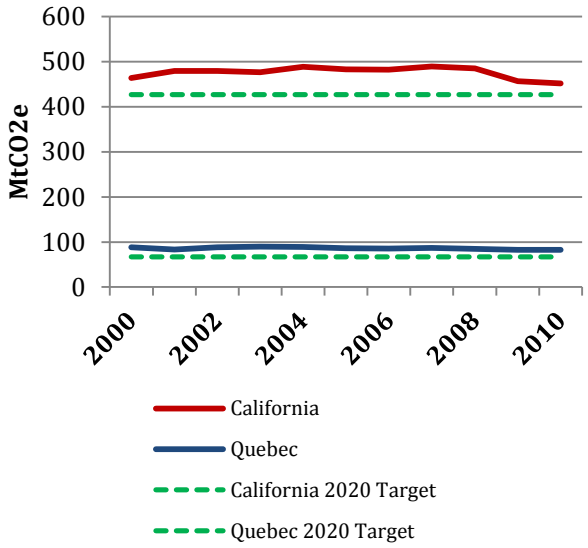
Further analysis of emissions trends in California and Québec suggests that both jurisdictions are becoming more efficient with regard to measures related to climate change (Figure 1c). In terms of emissions intensity of the economy (tCO2e per unit of gross domestic product, GDP), California produced 346 tCO2e per USD million of GDP in 2000, which fell to 245 tCO2e per USD million of GDP in 2010. In Québec, similar trends are found when accounting in Canadian dollars: 369 tCO2e per CDN million of GDP in 2000, which had fallen to 279 tCO2e per CDN million of GDP in 2010.[1] Finally, emissions in both California and Québec have grown slower than their respective national averages relative to 1990 baseline levels (Figure 1d). California's emissions trends are just below US national ones. Relative to 1990 levels, Québec's historical emissions trends are significantly below Canadian national averages, which can be explained in part by the growth of emissions in oil producing regions of Western Canada, and also by hydroelectric power's dominant share in Québec's energy supply mix.

[1] When reported in USD dollars, the Quebec's emissions intensity is significantly lower over the period 2000-2005, but this is largely due to a lower exchange rate. In the year 2000, the Canadian dollar was at a historic low relative to the US dollar.

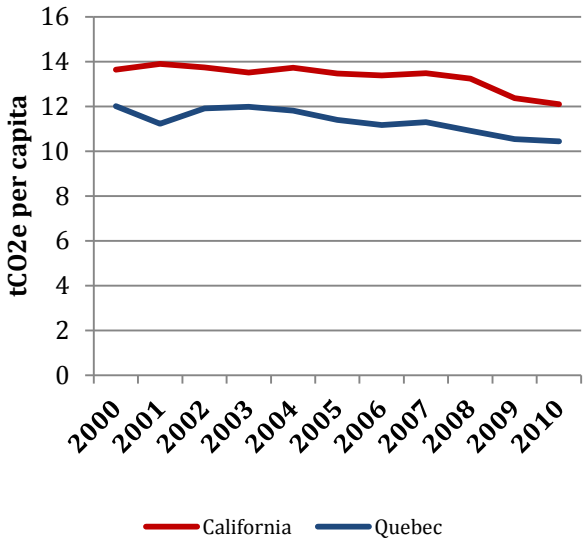
California and Québec differ significantly in terms of emissions by sector (Figure 2). While transport is the largest source of emissions in both jurisdictions, electricity generation is the second largest source of emissions in California while it is almost insignificant in Québec. This is due, again, to Québec's large hydroelectric resources, which dominate the province's energy supply mix (MDDEFPQ, 2006). On the other hand, industrial gases account for a larger share of emissions in Québec than in California, largely due to the significant contribution of Québec's aluminum industry where such gases are generated (Houle, 2007: 83). On its own, the aluminum sector constituted 4% of Québec's GDP in 2012 (Deloitte, 2013: 16).

Figure 1: Historical emission trends in California and Québec, 2000-2010

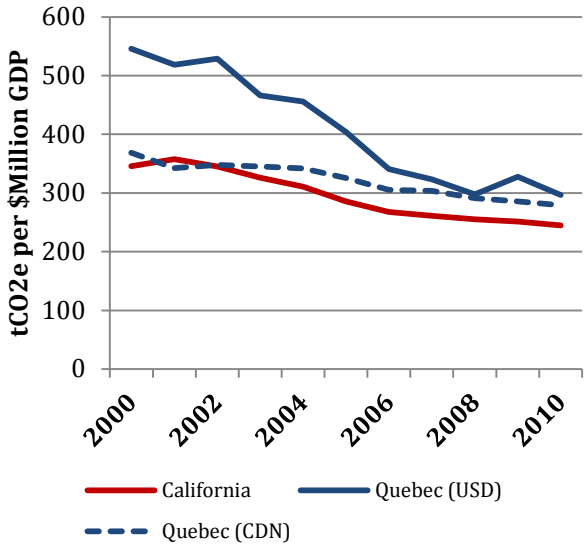
(a) Absolute emissions (no sinks)



(b) Per capita emissions (no sinks)

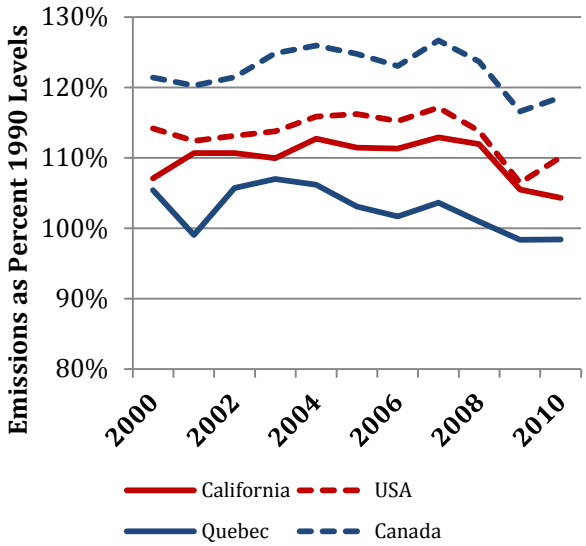


(c) Emissions per million dollars GDP*



Constant 2007 US or Canadian dollars

(d) Emissions trends in California and Québec relative to national trends*



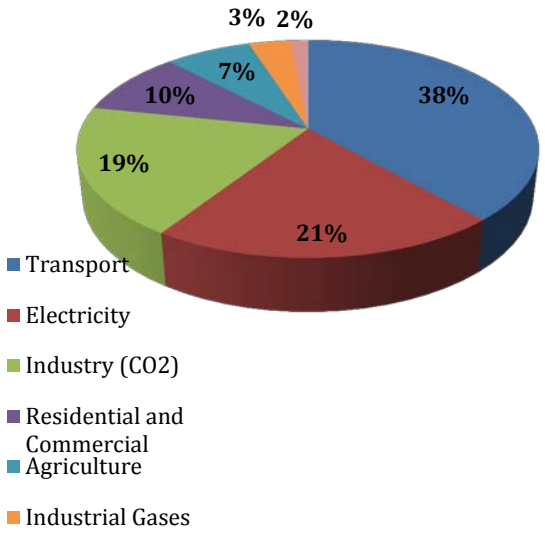
Expressed as a percentage of 1990 emissions levels: 83.8 MtCO2e (Québec) ; 427 MtCO2e (California)

Sources: Figures adapted from (i) Québec - emissions (MDDEFPQ, 2013a; MDDEPQ, 2006; 2007; 2008; MEQ, 2002), population (Statistics Canada, 2014a), GDP (Statistics Canada, 2014b); Exchange rates (Bank of Canada, 2014); Canada emissions, excluding LULUCF (UNFCCC, 2014); (ii) California – emissions (CARB, 2013a), population (US

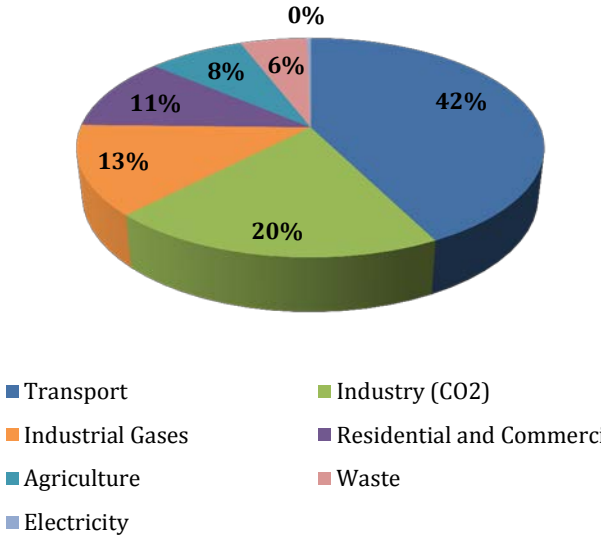
Census Bureau, 2012), GDP (California Department of Finance, 2014), US emissions, excluding LULUCF (UNFCCC, 2014).

Figure 2: Percent Emissions by Sector, 2010 ($MtCO_2e$)

(a) California



(b) Québec



Sources: Québec (MDDEFPQ, 2013a); California (CARB, 2013a).

The WCI and the cap-and-trade systems of California and Québec

In order to understand California and Québec's climate policy it is helpful to review how they have coevolved with the WCI. The WCI is a voluntary coalition of US states and Canadian provinces that have developed a common set of guidelines to facilitate mutual cooperation in order to reduce their collective emissions to 15% below 2005 levels by 2020 (WCI, 2010a). By setting targets and timetables on emission reductions, the WCI bears many similarities to the European Union's Emissions Trading System as well as the Kyoto Protocol. However, the key difference is that the WCI is a non-binding voluntary agreement designed by participating jurisdictions for their mutual benefit. Political authority for such cooperation remains firmly with the individual jurisdictions involved. Neither California or Québec are compelled by a higher authority to establish a cap-and-trade system—each has done so voluntarily because of the expected advantages of cooperation while the non-binding nature of the WCI allows jurisdictions to maintain their autonomy. Yet the WCI framework is more comprehensive and stringent than other subnational efforts to reduce emissions in North America. For instance, the WCI framework will extend an emissions cap over a number of economic sectors instead of only power generation (c.f. RGGI), will not exempt industrial emissions (c.f. BC carbon tax) and will require absolute reductions as opposed to per-capita emissions performance improvements (c.f. Alberta's Specified Gas Emitters Regulation).

The origins of the WCI can be traced back to 2003, but the framework was formally constituted in February 2007 when the Governors of California, Arizona, New Mexico, Oregon, and Washington agreed to collectively tackle climate change through a regional emissions reduction target and related emissions-trading programme. Shortly thereafter, two Canadian provinces joined, British Columbia and Manitoba. In 2008, the states of Montana and Utah as well as Canadian provinces Ontario and Québec became members of the WCI. However, despite the early success of the WCI, new challenges have emerged. Most importantly, six states withdrew in 2011 while three Canadian provincial partners (Ontario, British Columbia, and Manitoba) have yet to complete the enabling legislation required of the WCI emissions trading system. While Ontario has subsequently moved towards a strict regulatory approach for reducing emissions (notably by action to close its coal-fired power plants), British Columbia was successful in implementing a carbon tax as well as a commitment to carbon neutrality for the public sector and a carbon offset market (Houle, Forthcoming; Sustainable Prosperity, 2012). Though still officially a partner, British Columbia has remained largely removed from the emissions trading framework provided by the WCI. Consequently, California and Québec are the only two WCI partners pursuing an integrated cap-and-trade system (for a more complete history of the WCI, see Klinsky, 2013).

Figure 3: Map of Western Climate Initiative, 2013

**GREEN: WCI partner jurisdictions with cap-and-trade legislation; GOLD: WCI partner jurisdictions without cap-and-trade legislation; BLUE: Former WCI Partners; PINK: WCI observers*

Graph made with Google Earth. Sources: WCI (2010a: 4); Klinsky (2013)

Table 1: Milestones in the establishment of the Western Climate Initiative

Year	Event
1995	
	Québec adopts its first *Climate Change Action Plan*
2003	
	California, Oregon and Washington initiate *West Coast Global Warming Initiative*
2005	
	Québec announces *2006-2012 Climate Change Action Plan*
2006	
	California passes *Assembly Bill 32 Global Warming Solutions Act*
2007	
	Establishment of WCI - Originally formed by Arizona, California, New Mexico, Oregon, and Washington to which British Columba and Manitoba subsequently join
2008	
	Québec, Ontario, Montana and Utah join WCI
	Québec and Ontario sign a memorandum of understanding to create a regional cap-and-trade system
	California releases its *Climate Change Scoping Plan*
2009	
	Québec adopts *Bill 42 An Act to Amend the Environment Quality Act and Other Legislative Provisions in Relation to Climate Change*
2010	
	WCI completes its *Design for the WCI Regional Programme* which serves as a roadmap to inform partner jurisdictions in their development of implementing regulations
	California proposition to suspend AB32 (Proposition 23) defeated, with 62% of the vote in favour of the *Global Warming Solutions Act*
2011	
	Withdrawal of all US states except for California (Arizona, Montana, New Mexico, Oregon, and Washington)
	California passes *California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation*
	Québec passes *Regulation respecting a cap-and-trade system for greenhouse gas emission allowances*
2012	
-Feb	California court case regarding local pollutant reductions and AB32
-May	CARB releases a staff report considering the economic and environmental reasons for linking
-June	Québec announces 2013-2020 Climate Change Action Plan
-Nov	California holds first auction for emission allowances
-Dec	Québec approves regulations to allow linkage with other jurisdictions: *Regulation respecting the delegation of management of certain parts of a cap-and-trade system for greenhouse gas emission allowances*
2013	
-Jan	California and Québec cap-and-trade systems come into force
-April	California Governor approves linkage with Québec
-Dec	First Québec allowance auction to be held
2015	
	Expansion of WCI to transport sector

Though participating WCI jurisdictions have voluntarily agreed to cooperate on reducing their collective emissions by 15% below 2005 levels, each is responsible for developing its own targets and regulations independently. To the extent that the WCI is based on state and provincial legislation and regulation, it is thus important to look to subnational laws, regulations and government bodies for information regarding specific measures to reach the respective goals set out in each jurisdiction.

California's climate change legislation, *Assembly Bill 32 Global Warming Solutions Act* ("AB32"), was passed in 2006.[2] In 2008, the state released its *Climate Change Scoping Plan: A Framework for Change,* hereafter referred to as the "Scoping Plan", which outlined the state's strategy for achieving the goals of AB32 (CARB, 2008). The provisions of the Scoping Plan were enacted through the *California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation*, hereafter referred to as the "California Cap Regulation", which was approved in final form in October 2011.[3]

Across the continent, Québec adopted *Bill 42 An Act to Amend the Environment Quality Act and Other Legislative Provisions in Relation to Climate Change* in 2009 ("Bill 42").[4] This was followed by regulations for implementing the emissions trading system—the most important being the *Regulation Respecting a Cap-and-Trade System for Greenhouse Gas Emission Allowances* in 2011 ("Québec Cap-and-Trade Regulation"),[5] *Regulation Respecting the Delegation of Management of Certain Parts of a Cap-and-Trade System for Greenhouse Gas Emission Allowances* adopted in 2012 ("Québec Cap-and-Trade Management Regulation")[6] and *Regulation respecting the determination of annual caps on greenhouse gas emission units relating to the cap-and-trade system for greenhouse gas emission allowances for the 2013-2020 period* ("Québec Allowance Determination Regulation").[7] That same year, Québec launched its *2013-2020 Climate Change Action Plan* (MDDEFPQ, 2012), which is the latest in a series of such plans that were first initiated in 1995.

[2] *Assembly Bill 32 (Núñez). Chapter 488, California Statutes of 2006, codified at California Health & Safety Code,* §38500 et seq.
[3] *California Air Resources Board, Final Regulation Order, Subchapter 10 Climate Change, Article 5, Sections 95800 to 96023, Title 17, California Code of Regulations, §95841.* Accessed October 14, 2013 at http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf. (This version incorporates amendments that were in effect in September 2012, changes to some definitions that were in effect in January 2013, and the linkage with Quebec amendments that will be in effect starting October 1, 2013.)
[4] *Environment Quality Act*, CQLR c Q-2, *as amended by Bill 42, SQ 2009, c 33, An Act to amend the Environment Quality Act and Other Legislative Provisions in Relation to Climate Change.*
[5] *Regulation respecting a cap-and-trade system for greenhouse gas emission allowances, CQLR c Q-2, r 46.1.*
[6] *Regulation respecting the delegation of management of certain parts of a cap-and-trade system for greenhouse gas emission allowances*, CQLR c Q-2, r 15.1.
[7] *Regulation respecting the determination of annual caps on greenhouse gas emission units relating to the cap-and-trade system for greenhouse gas emission allowances for the 2013-2020 period*, CQLR c Q-2, r 15.2.

The lead government body responsible for administering California's climate change policy is the California Air Resources Board (CARB), which is an independent body under California's Environmental Protection Agency. However, other government bodies are clearly important for climate policy in California, including the California Public Utilities Commission and the California Energy Commission. In contrast, the lead government agency responsible for administering Québec's climate change policy is the Ministry of Sustainable Development, Environment, Fauna and Parks (whose acronym in French is MDDEFPQ). Thus one important difference between the two jurisdictions is that California's climate policy is implemented by an agency that is relatively insulated from day-to-day politics and whose leader is a political appointee. In Québec, the MDDEFPQ is led by a Minister who is an elected member of Québec's National Assembly.

Design of Climate Policy in California and Québec

As a decentralized institution, the WCI allows for variation in the application of its rules. But partner jurisdictions have an incentive to harmonize their official regulations with one another in order to facilitate emissions trading. In this section, we consider the specific design of the cap-and-trade systems in California and Québec, identifying similarities and differences. In doing so, we have combined our independent review of the legal frameworks in each jurisdiction with information presented in various independent reports (EDF and IETA, 2012; IETA, 2012a; b). Largely due to harmonization via the WCI, most elements of each jurisdiction's cap-and-trade programs are similar, though a number of important yet subtle differences exist. In both instances, it is important to emphasize that cap-and-trade is but one element of a broader climate policy package being implemented in each jurisdiction and, arguably, not the most important. Thus, this section concludes with a brief, yet important review of "complementary policies" created in each jurisdiction to drive emission reductions in specific sectors.

Emission Reduction Commitments

California has committed itself to reducing its emissions to 1990 levels by 2020, while Québec has committed to reducing emissions 20% below 1990 levels in the same time period. In their electoral programme the *Parti québécois*, which has formed a minority government in Québec since the 2012 provincial election, Québec expressed a commitment to a 25% reduction. It is useful to breakdown these commitments into more comparable units by using the 2005 base year common to the WCI. As illustrated in Table 2, California has committed to reducing its net emissions to 427 MtCO2e by 2020, representing a 10.8% reduction from 2005 levels. Québec's 2020 emission reduction target of 67.1 MtCO2e is actually more ambitious than in California, as it represents a reduction of 22.4% from 2005 levels.

Crucially, only a fraction of these emission reductions are to be achieved through each jurisdiction's cap-and-trade programme, which is divided into three commitment periods (see Figure 4). During the first commitment period, from 2013-2014, the emissions cap will address only emissions in the energy and industrial sectors—accounting for approximately 36% and 29% of total emissions in California and Québec, respectively.[8] From 2013 through 2014, the cap decreases by about 2% annually in both jurisdictions. At the beginning of the second compliance period, coverage expands to include the transport sector in 2015, at which point approximately 87% and 77% of emissions will be covered in each respective jurisdiction. Between 2015 and 2020, the cap reduces at a rate of approximately 3% and 4% per year in California and Québec, respectively.

[8] Emissions under the cap are compared to 2010 gross emissions in California and Quebec, respectively.

Table 2: Comparison of Basic Elements of California and Québec's Cap-and-Trade System

Issue	Units	California	Québec
Emissions Target			
-Net Emissions 2005*	$MtCO_2e$	478.5	*NA*
-Gross Emissions 2005	$MtCO_2e$	482.5	86.4
-Sinks 2005*	$MtCO_2e$	4.0	*NA*
2020 Net Emissions Target	$MtCO_2e$	427.0	67.1
2020 Emission Reduction Target Relative to 2005 Emissions	% Reduction	10.8%	22.4%
2020 Busines-as-Usual (BAU) Emissions Forecast**	$MtCO_2e$	506.8	109.6
2020 Emission Reduction Relative to 2020 BAU Emissions	$MtCO_2e$	79.8	42.5
Scope of Emissions Registry* **			
First Commitment Period			
- Capped emissions 2013	MtCO2e	162.8	23.7
- Inclusion Threshold for Covered Entities (2013-2014)	tCO_2e/yr	Emitters producing 25,000 tCO2e/yr (including imported electricity)	
- Number of establishments covered		NA	78
- Percentage of 2010 gross emissions	%	36%	29%
Second and Third Commitment Periods			
- Capped emissions 2015	MtCO2e	394.5	63.6
- Threshold for inclusion (2015-2020)		• Emitters producing 25,000 tCO2e/yr (including imported electricity) • Emitters distributing gasoline, diesel fuel, propane, natural gas and heating oil	
- Number of establishments covered		NA	NA
- Percentage of 2010 gross emissions	%	87%	77%
Use of Offsets			
Domestic Offsets		8%	8%
International Offsets		Limited to Canada, US and Mexico	Limited to Canada, US and Mexico
Complementary Policies** **			
Expected 2020 Emission Reductions		146.7 MtCO2e	NA
Percent Total Emission Reductions		84%	NA

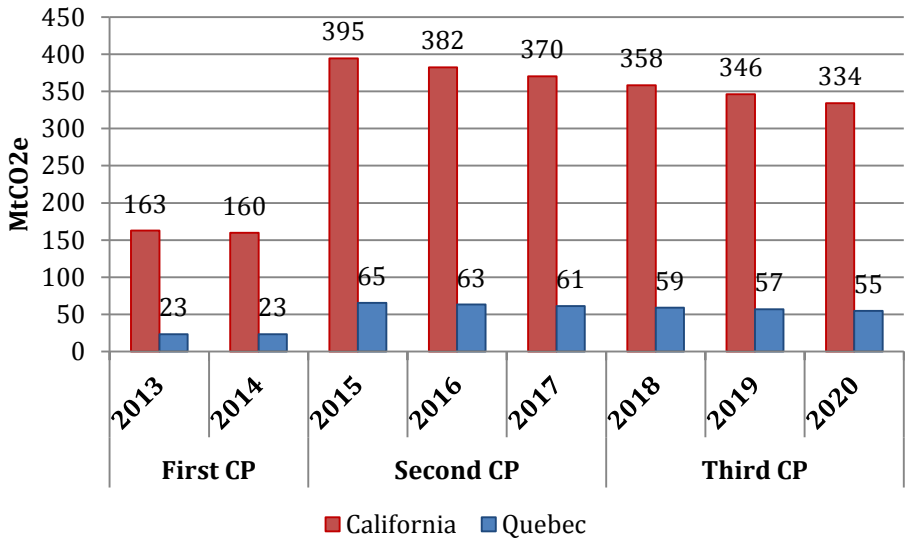
**Québec (and Canada) have elected not to account for carbon sinks under the UNFCCC*

*** NRCan (2006: 174), CARB (2013h)*

****Blais (2012)*

***** CARB (2008: 17)*

Figure 4: Annual size of regulated emissions cap in California and Québec during first three compliance periods, 2013-2020



Sources: California Cap Regulations (Table 6-1); Québec Allowance Determination Regulation (s.1).

Emissions Sources and Sinks

Emissions sources included under the cap-and-trade systems in California and Québec are largely similar; however, the two jurisdictions differ in the role that land-use and forest carbon sinks are permitted to play in achieving emissions reductions (see Table 3). Sustainable forest management in California is expected to generate 5.0 MtCO2e of emission removals by 2020, though the emission removals in the sector are not permitted in the state's cap-and-trade system. However, forestry measures feature prominently amongst California's existing offset protocols, the carbon credits of which can be used in California's cap-and-trade system. In contrast, Québec (and Canada) have elected not to account for carbon sinks given concerns that forests will become net sources of emissions as climate change proceeds (Ali et al., 2009; Le Goff et al., 2009; NRCan, 2007).

Table 3: Emissions sources and sinks of California and Québec's cap-and-trade systems*

Emissions Sources	
Included Sources	
2013-2014	• Mining, Quarrying, and Oil and Natural Gas Extraction • Electric Power Generation, Transmission and Distribution • Natural Gas Distribution • Steam and Air-Conditioning Supply • Manufacturing • Pipeline Transportation of Natural Gas
2015-2020	• Fuel distributers including gasoline, diesel fuel, propane, natural gas and heating oil • CH_4 from operations of a petroleum refinery • CH_4 and N_2O from anaerobic wastewater treatment, petroleum refineries, pulp and paper mills, and production of petrochemical products • CO_2, CH_4, and N_2O emissions from transportation and distribution of natural gas
Excluded Sources	
	• Emissions associated with aviation and shipping fuels • Hydrocarbons used as raw material in the chemical and petrochemical industries • CO_2 from biomass combustion or fermentation • CH_4 from coal storage • CO_2, CH_4, and N_2O emitted from mobile equipment on the site of an establishment
Emission Sinks	
California: Included Sinks	
2013-2020	• Forests in California are now a carbon sink. However, several factors, such as wildfires and forest land conversion, may cause a decline in the carbon sink. California will establish a mechanism to help ensure that current carbon stocks are, at a minimum, maintained and do not diminish over time.
Québec: Excluded Sinks	
	• Québec (and Canada) have elected not to account for carbon sinks

Sources: CARB (2008); NRCan (2007); Ali et al. (2009); Le Goff (2009)

Allowance Allocation

Rules for the Allocation of Free Allowances

One of the political advantages of cap-and-trade is the ability to build flexibility through the allocation of free allowances to address competitiveness concerns, especially for the emissions intensive, trade exposed sectors of the economy. As a result, both governments in Québec and California have elected to allocate allowances freely, especially at the start of the cap-and-trade systems, with more to be auctioned over time. Because allowances have a real value and confer a competitive advantage, they must be allocated in a transparent manner.
Rules for the allocation of free allowances are detailed in Subarticles 8 and 9 of the California Cap Regulation. In the first compliance period 2013-2014, California will freely allocate most allowances to regulated entities. Between 2015 and 2020, the percent of freely allocated allowances will gradually decrease as more and more are auctioned off. For each industrial facility, except for refineries and the electricity sector, allowance allocations are determined by the equation below:

California Free Allowances =	**(1) Total product output or energy consumed * (2) emissions benchmark * (3) cap adjustment factor * (4) industry assistance factor**

First, for emitters using a product-based methodology, CARB will use the facility's annual output and emissions benchmark from the previous 2-4 years to determine annual allowance allocation in a specific year. For a facility using an energy-based methodology, CARB will use the facility's historical annual arithmetic mean for fuel, electricity and/or steam consumed to determine initial allowance allocation. Second, CARB determines two types of benchmarks. For a product-based benchmark, CARB calculates an emissions allowance per unit produced, using an emissions efficiency benchmark identified for specific industries in the regulations (Table 9-1 of the *California Cap Regulation*). For energy-based benchmarks, CARB calculates an emissions allowance per unit of fuel, electricity and steam over historical baseline period. Third, the cap adjustment factor is a fraction that decreases to reflect a tightening emissions cap. Finally, an industry assistance factor is a percentage of free allowances an emitter is provided based on the industry's leakage risk (Table 4). CARB divides the industrial sector into three leakage classifications: High, Medium and Low. While all three leakage classifications are allocated 100% free allowances in the first commitment period, those in the Medium and Low classes will see their free allowances decrease over the remaining two compliance periods. California has special rules for allocating allowances for refineries which are slightly more complicated.

Table 4: California's Industrial Assistance Factors

Leakage Classification	First Compliance	Second Compliance	Third Compliance
High Leakage			
Such as oil and gas extraction, paper mills, and chemical and cement manufacturing	100%	100%	100%
Medium Leakage			
Such as petroleum refineries and food manufacturing	100%	75%	50%
Low Leakage			
Such as pharmaceutical manufacturing	100%	50%	30%

Source: Adapted from California Cap Regulations, Table 8-1.
Note: CARB has recently proposed amendments to the regulation that would extend the transition assistance from the first compliance period into the second compliance period for the industrial sector. What would have been the allocation scheme for the second compliance period would then become allocation in the third compliance period.

Allocating emission allowances in California's electricity sector has proven particularly challenging because of the need to balance electricity prices with climate policy. Note that electricity is the second largest source of emissions in California, while Québec's power is quite clean given the province's large hydroelectric capacity. But given California's size and reliance on fossil fuel generation as well as electricity imports, electricity is also more expensive—two to three times prices paid in Québec.[9] There have also been very active state efforts in California to make electricity accessible to all segments of the population. As one Californian respondent, intimate with California's energy policy, explained "No one wants electricity prices to rise." The respondent continued, "This does lead to the odd tension...In some ways we want the price to change, but then there are these other constituencies whose whole job is to keep the price from going up."

[9] Average prices in the residential sector in 2012 have been estimated at 6.78₵/kWh in Montreal and 22.34₵/kWh in San Francisco; amongst large-power consumers the differences are less 4.78₵/kWh versus 8.92₵/kWh (HydroQuebec, 2012: 4-5). Estimated for a monthly consumption of 1,000 kWh in the residential sector and 3,060,000 kWh and power demand of 5,000 kW amongst large-power customers.

The need to balance emission reductions with affordable electricity has resulted in a considerably more complex system for allocating emission allowances in California. Here free allocations are also awarded to publicly and privately owned electricity distribution utilities. However, these freely allocated allowances must actually be re-auctioned, which in the words of one respondent meant that "essentially [we] buy them back." The auction proceeds generated in this manner are used to compensate electricity customers for increased electricity prices resulting from the cap-and-trade programme. As of 2013, all utility-held allowances for current and previous years must be offered at each auction. Yearly allocations to individual utilities are based primarily on the estimated consumer cost burden for each utility. Such a complex system was adopted by CARB, one respondent explained, because CARB "want[s] liquidity, they want [utilities] there as a buyer. And they want there to be a price placed on those allowances. They don't want [utilities] to just sit out and for there to be a much thinner market."

In Québec, the MDDEFPQ determines each year the number of emissions units that will be allocated without charge to each emitter, based on efficiency benchmarks that are calculated using criteria elaborated in the climate policy regulations. Between 2013 and 2014, allowances will be freely allocated based upon an emitter's average historic emissions intensity between 2007 and 2011 and adjusted for production output.[10] Over the period 2015 to 2020, allocations will be established through an emissions intensity target, tailored for different industrial sectors. Hence, different industrial activities will face different levels of stringency. As emissions intensity targets decrease, fewer allowances will be available for allocation and more allowances will be auctioned. Overall, the number of freely allocated units will gradually drop by between 1% and 2% each year, beginning in 2015 (MDDEFPQ, 2013c). Furthermore, MDDEFPQ will retain 25% of allowances until the following year for which they are to be used, allowing the emitter's emissions to be verified. The MDDEFPQ then adjusts the allocation amount accordingly. Safeguards such as an intensity-based allowance allocation and the 25% retention of allowances by the MDDEFPQ were considered by at least one of those interviewed as a significant improvement over the system in the EU-ETS, which has been bedevilled by issues of perceived over-allocation attributed to a reliance on historical emissions data in setting firm-level allowances (Ellerman and Buchner, 2008).

[10] 100% allocation for process emissions, 80% for combustion emissions, and 100% for emissions from other sources

Given its significant hydroelectric resources and in light of comparatively lower electricity rates, the complexities in the allocation rules for the electricity sector are not found in Québec. Nonetheless, the Québec government has also tailored emission allowances to accommodate specific sectors. For instance, the aluminum sector represents a large source of emissions, particularly due to its use of industrial gases and other process emissions. Yet the industry in Québec has one of the lowest carbon intensities in the world, while also facing intense global competition (Deloitte, 2013). Consequently, the Québec government has allocated free allowances to the sector as a whole rather than to individual companies (as is the case in other manufacturing sectors in Québec).

Allowance Auctioning

The auctioning of allowances is an important step in revealing a carbon price but also in generating revenue from the cap-and-trade system. Allowances can be bid upon and held by emitters who are subject to the cap but also by other market participants who may not have any emissions. This category essentially refers to those financial firms in California or Québec who are permitted to trade in the system, in an effort to provide liquidity in the market.

In what constitutes an important difference with the EU-ETS, both California and Québec have agreed to an auction floor price. It starts at $10/tCO2e for 2013 allowances, rising annually by 5% plus the rate of inflation. Significantly, the floor price in Québec was changed from a $15/tCO2e originally set in its draft rules, presumably to match California's programme and facilitate linking (IETA, 2012b). CARB ran its first auction for the 2013 allowance vintage in November 2012. Allowances initially saw a settlement price of $10.09 USD, though this rose to $14.00 USD in May 2013 before dropping to $11.48 during the most recent two auctions (Table 5). This is notably higher than the prices of allowances on the EU-ETS as well as RGGI (Navarro, 2013). All allowances auctioned in California were purchased; nonetheless, it should be borne in mind that 2013 allowances auctioned only amount to about 40% of those issued by California (64.4 MtCO2e of 162.8 MtCO2e), the rest being freely allocated.

The first auction in Québec took place in December 2013 and the second in February 2014 (Table 6). The first observation is that the settlement price matches the floor price in both auctions. Second, given current exchange rates, Québec allowance prices are lower than California's ($11.39 CDN ≈ $10.13 USD). However, third, there has been a significant increase in the relative amount of available allowances purchased, rising from 34% to almost 100%. This matches the situation in California, suggesting that the market is becoming more mature and buyers paying greater attention.

Table 5: Auction Prices and Purchases in California

Auction Metric	California Auction					
	November 2012	February 2013	May 2013	August 2013	November 2013	February 2014
Vintage 2013						
Settlement Price (USD)	$10.09	$13.62	$14.00	$12.22	$11.48	$11.48
Floor Price (USD)	$10.00	$10.71	$10.71	$10.71	$10.71	$11.34
Allowances Purchased	23,126,110	12,924,822	14,522,048	13,865,422	16,614,526	19,538,695
Percent Available Allowances Purchased	100%	100%	100%	100%	100%	100%
Vintage 2015/2016/2017						
Settlement Price (USD)	$10.00	$10.71	$10.71	$11.10	$11.10	$11.48
Floor Price (USD)	$10.00	$10.71	$10.71	$10.71	$10.71	$11.34
Allowances Purchased	5,576,000	4,440,000	7,515,000	9,560,000	9,560,000	9,260,000
Percent Available Allowances Purchased	14%	46%	79%	100%	100%	100%
Vintage	2015	2016	2016	2016	2016	2017

Sources: CARB (2012a; 2013b; c; d; e; 2014)

Table 6: Auction Prices and Purchases in Québec

Auction Metric	Québec Auction					
	December 2013	February 2014				
Vintage 2013						
Settlement Price (CDN)	$10.75	$11.39				
Floor Price (CDN)	$10.75	$11.39				
Allowances Purchased	2,971,676	1,035,000				
Percent Available Allowances Purchased	34%	99%				
Vintage 2015/2016/2017						
Settlement Price (CDN)	$10.75	$11.39				
Floor Price (CDN)	$10.75	$11.39				
Allowances Purchased	1,708,000	1,285,000				
Percent Available Allowances Purchased	27%	84%				
Vintage	2016	2017				

Source: MDDEFPQ (2013d; 2014)

Price Control Mechanisms (except offsets)

The WCI permits partner jurisdictions to use a number of price control mechanisms to allow for governments to prevent a too high or low price for carbon (WCI, 2010a: 11-13). These include the auction floor price discussed above but also a price ceiling, allowance banking, holding limits, multi-year compliance periods as well as offsets. Rules governing these mechanisms have been adopted in the same manner in California and Québec, except for offsets, which we discuss separately in the following section (see Table 7). As suggested earlier, the extent of price control mechanisms associated with California and Québec's carbon market distinguish it from the EU-ETS.

First, as discussed above, an **auction floor price** keeps allowances off the market in the event that demand were to result in a price that would be below an acceptable level. This feature helps correct an inadvertent over-allocation of allowances. Second, a **price ceiling** has also been adopted under the WCI. Here a so-called Allowance Price Containment Reserve, administered independently by each jurisdiction, is used to collect a portion of allowances from auction each year for release if a certain predetermined price is reached. Alternatively, reserve allowances may be used to adjust the amount of free allowances allocated to emitters. The amount of allowances

withheld from auction to fill each jurisdiction's Allowance Price Containment Reserve is: 1% for years 2013-2014, 4% for years 2015-2017, and 7% for years 2018-2020. Allowances from the reserve are divided into three equal-sized tiers. For the first tier in 2013, reserve allowances will be available at $40, $45 and $50. After 2013, the price of reserve allowances increases by 5% annually plus inflation.

Third, **allowance banking** allows compliance entities to decide how best to use emission allowances over time. Under the WCI, unlimited banking is permitted, although emitters and market participants are subject to holding limits. **Holding limits** are a limit on the amount of allowances that are not destined for the current compliance period and which an emitter or market participant can hold to bank for future use. Holding limits are calculated in the same manner in California and Québec for each entity or market participant. Notably, offsets are not included in the holding limit. Fourth, **multi-year compliance periods** provide flexibility for compliance entities, and recognize that emission reductions efforts may take time to phase in (particularly in the early years of the programme). California and Québec include both annual and triennial compliance obligations for covered entities.

Offsets

The most important issue regarding offsets is the limitation on their use: in both California and Québec, offsets are set to an 8% usage limit. That is, no more than 8% of an entity's total compliance obligation in any given compliance period can be met through the use of offsets. This is much lower than is permitted under the WCI. The WCI permits that offsets be limited to no more than 49% of total emission reductions from 2012 to 2020 and also that a common offset limit be used across partner jurisdictions (WCI, 2010b: 2-3). However, there are important concerns about whether offset credits represent genuine emission reductions and are therefore fully fungible with domestic emissions reductions against which the are traded (Purdon, 2012; Purdon and Lokina, 2014; Wara, 2008; Zhang and Wang, 2011). There are also concerns that offsets present a "moral hazard", offering jurisdictions using them a disincentive to make the more costly structural changes at home to reduce emissions (Neuhoff and Vasa, 2010; Simpson et al., 2007). California and Québec appear to have taken these concerns very seriously.

There are a number of differences between the use of offsets between California and Québec. Most important is the type of protocols available. Given restrictions on the role of forest carbon sinks in Canadian climate policy, these types of offset protocols are absent amongst Québec's carbon offsets. On the other hand, they feature prominently in California. When discussing forest carbon offsets, it is also important to consider California's leadership in The Governors' Forest and Climate Task Force (GCF), which is an important subnational effort for reducing

emissions from deforestation and forest degradation (REDD+) in developed and developing countries. An initiative of several subnational governments across the US, Brazil, Indonesia, Mexico, Peru, Spain and Nigeria, its goal is to build jurisdictional approaches to REDD+ and low emissions development and integrate forest protection into climate policy (GCF, 2013). California is quite active in the GCF while Québec is not involved.

Another difference between offset programmes between California and Québec lies in the way that liability is assigned between buyers and sellers of offsets. In California, this was addressed by creating "buyer liability" rules, meaning that entities purchasing credits would be responsible if the carbon credits would be found bogus. The Québec system is arguably more flexible. Here the government has developed an Environmental Integrity Account. A small percentage of all offset credits are allocated to this account in order to create a buffer, based on an assumption that some of the offset credits are less credible.

Interviewees suggested that California has been more cautious in its use of offsets than Québec would have preferred. California's concern about whether Québec's carbon offsets represent genuine emission reductions has been one of the main issues when negotiating linkage between the jurisdictions. Yet interviews also suggested that there was a concern amongst some that the current rules surrounding offsets are too conservative. There was a sentiment that CARB's focus on environmental integrity has come at the expense of cost containment. As carbon prices rise, some of those interviewed predicted that CARB's current stringency on offsets may become more relaxed.

Table 7: Offset Protocols in California and Québec

	California	Québec
Compliance Offsets		
-Protocols	1) U.S. Forest Projects 2) Urban Forest Projects 3) Livestock Projects 4) Ozone Depleting Substances Projects	1) Manure storage facilities (methane) 2) Waste disposal sites (methane) 3) Ozone Depleting Substances Projects
- Potential New Protocols	1) Rice Cultivation Projects 2) Mine Methane Capture Projects	*NA*
-Standard Bodies	California Air Resources Board	Ministry of Sustainable Development, Environment, Wildlife, and Parks
Early Action Offsets *		
-Protocols	1) U.S. Forest Projects 2) Urban Forest Projects 3) Livestock Projects 4) Ozone Depleting Substances Projects	1) Manure storage facilities (methane) 2) Waste disposal sites (methane) 3) Ozone Depleting Substances Projects
-Standard Bodies	Climate Action Reserve American Carbon Registry	
Liability		
	Strict Buyer Liability	Environmental Integrity Account (EIA), which is a pool of offset credits that the Minister accumulates by withholding 3% of the offset credits awarded to successful projects.

**Early Action Offset Credits may not be used to meet a compliance obligation; however, they may be eligible for transition to CARB Offset Credits to be used for compliance in the Cap-and-Trade Programme.*

Sources: CARB (2013g), MDDEFPQ (2013b)

Revenue Generation and Spending

Through the auctioning of allowances, the cap-and-trade programmes in California and Québec are expected to generate considerable amounts of revenue. The use of such revenue has proven complex and controversial in California, though relatively more straightforward in Québec. We discuss Québec first. According the Québec Ministry of Finance, the cap-and-trade programme in conjunction with the Green Fund duty[11] will generate $2.7 billion of additional revenues by 2020 and over $1 billion by 2017 (Table 8). Most of these funds will be derived from the auctioning of emission allowances (MFQ, 2012: 10). It should be noted that Québec will be phasing out the Green Fund duty completely in the fiscal year 2015-2016. Except for $220 million that will finance some remaining initiatives of the 2006-2012 Climate Action Plan, all forecasted funds will be entirely allocated to the initiatives described in the *2013-2020 Climate Change Action Plan* (MFQ, 2012: 13).

Table 8: Forecast Revenue from Climate Policy in Québec ($billions)

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	TOTAL	
						5 Years	By 2020
Cap-and-Trade	0.010	0.030	0.120	0.425	0.425	1.010	2.445
Green Fund Duty		0.090	0.130			0.220	0.220
TOTAL	0.010	0.120	0.250	0.425	0.425	1.230	2.665

Source: MFQ (2012: 10)

In contrast to Québec, it is more difficult to paint an accurate portrait of revenue generation and spending in California. First, there is a legal debate about whether revenue generated can only be spent on the goals of AB32 or whether it can contribute to general state spending (Horowitz et al., 2012; Lambe and Farber, 2012). Most studies have concluded that it is unlikely that the state's collection of revenue through allowance auctioning will be able to be challenged in court if proceeds are spent on the regulatory objectives of AB32 (the mitigation of emissions) and/or meets all four components of the so-called Sinclair nexus test.[12] Because of an amendment to

[11] Also known as the "duty on gasoline and fossil fuels," Quebec's Green Fund duty refers to the annual levy that is payable to Quebec's Green Fund. The duty applies upstream to importers and distributors of fossil fuels in the province. Funds raised from the duty are used to pay for specific environmental programs and measures aimed at promoting sustainable development in the province.

[12] Nexus Requirement: there is a causal connection or nexus between the product regulated and its adverse effects; Reasonable Cost Requirement: the amount of money raised is limited to the "amounts necessary to carry out the regulation's purpose; Fair

California's Constitution (Proposition 13), a two-thirds vote of the state legislature is required for "…any changes in States taxes enacted for the purpose of increasing revenues" (Lambe and Farber, 2012: 4). However, AB32 was not passed with a two-thirds majority; consequently, the government is limited in how it can use auction proceeds and the general consensus is that this means auction revenues cannot be used towards California's fiscal challenges.

Second, to the best of our knowledge, there are few studies of the amount of revenue that will be generated in California through the cap-and-trade system. Because auction proceeds are determined by how the government allocates free allowances and the legal framework described above, there is the possibility of considerable variation over the long-term. The most concrete revenue projections and spending plan is found in the recently released *Cap-and-Trade Auction Proceeds Investment Plan: Fiscal Years 2013-14 through 2015-16* (State of California, 2012). In this document, the state government proposed investing $500 million from auction proceeds in programmes supporting emission reductions that were currently or could be funded by California's General Fund. Notably, *Senate Bill 535* further requires that 25% of auction proceeds benefit disadvantaged communities and at least 10% of auction proceeds be invested in projects located within those communities (CARB, 2013f). California recently established the *Greenhouse Gas Reduction Fund* in order to receive auction proceeds and to provide the framework for how the auction proceeds will be administered (CARB, 2013f). Thus, based on the minimum $500 million per year generated during California's first compliance period, we expect that approximately $1.1 billion will be collected per year in subsequent compliance periods. A back of the envelope calculation is that the cap-and-trade system in California will generate $7.7 billion in state revenue from 2013-2020.

Allocation Requirement: there is a "fair or reasonable" relationship between the allocation of costs among payers and the benefits received or the burdens imposed by the payer; No Unrelated Spending Requirement: the fees may not be used for "unrelated revenue purposes."

Complementary Policies

The focus of the above sections has been on the rules surrounding the cap-and-trade systems in California and Québec; however, both jurisdictions are similar in that they also have a host of other complementary climate policies in place. The striking feature of California's strategy is that the state expects to attain 85% of its 2020 emission reduction through complementary policies. Cap-and-trade is only part of the broader climate policy picture.

The most important policies in California are the *California Light-Duty Vehicle Greenhouse Gas Standards*, *Energy Efficiency Regulations*, *Renewables Portfolio Standard* and *Low Carbon Fuel Standard* (see Table 9). An estimate of emission reductions associated with each of these complementary measures is available only for California. Schwarzenegger's team urged the adoption of the Low Carbon Fuel Standard (LCFS) as an integral part of California's cap-and-trade system because it was the most reliable market-oriented regulatory approach politically viable for reducing emissions in the transport sector. As one insider explained, "We wanted a competitive environment, a boxing match where you'd have all these people in the ring fighting each other for the consumer's attention, but without government directing one outcome or another." Currently two obstacles have held up the LCFS. First was a court challenge regarding the federal government's so-called dormant Commerce Clause—a case which has recently been decided in California's favour (Hull, 2013). Second, and perhaps more importantly, is the problem of resolving the science of cellulosic biofuels, the technology that many had thought would allow for the LCFS to be attained (see Youngs and Somerville, 2013). At the time of writing in early 2014, we do not know if there have been any breakthroughs that would render cellulosic biofuels feasible.

In Québec, important complementary policies have been the annual Green Fund levy, which is part of the *2006-2012 Action Plan* but has been extended until 2015, as well as elements of the most recent *Action Plan* including the promotion of public transit and alternative transportation and creation of a greener car fleet (Table 10). The effect these policies are expected to have on Québec's emissions is not clear. The most recent *2013-2020 Action Plan* does not include an estimation of the emission reductions expected with each programme. However, we assume such estimates will be available soon and that they will demonstrate that Québec's complementary policies will also play an important role in driving emission reductions.

Table 9: Complementary measures in California

Recommended Reduction Measures	Reductions Counted Towards 2020 Target (MtCO2e)	Percent Total Emissions Reductions
CALIFORNIA		
Estimated Reductions Resulting from the Combination of Cap-and-Trade Programme and Complementary Measures	**146.7**	**84.3%**
• California Light-Duty Vehicle Greenhouse Gas Standards	31.7	18.2%
• Energy Efficiency	26.3	15.1%
• Renewables Portfolio Standard (33% by 2020)	21.3	12.2%
• Low Carbon Fuel Standard	15.0	8.6%
• Regional Transportation-Related GHG Targets	5.0	2.9%
• Vehicle Efficiency Measures	4.5	2.6%
• Goods Movement	3.7	2.1%
• Million Solar Roofs	2.1	1.2%
• Medium/Heavy Duty Vehicles	1.4	0.8%
• High Speed Rail	1.0	0.6%
• Industrial Measures	0.3	0.2%
• Additional Reductions Necessary to Achieve the Cap 34.4	34.4	19.8%
Estimated Reductions from Uncapped Sources	**27.3**	**15.7%**
• High Global Warming Potential Gas Measures	20.2	11.6%
• Sustainable Forests	5.0	2.9%
• Industrial Measures (for sources not covered under cap and trade programme)	1.1	0.6%
• Recycling and Waste (landfill methane capture)	1.0	0.6%
TOTAL REDUCTIONS COUNTED TOWARDS 2020 TARGET	**174**	

Sources: CARB (2008: 17)

Table 10: Complementary measures in Québec

Recommended Reduction Measures
QUÉBEC
• Foster sustainable land-use planning of the territory in a perspective of combating climate change
• Support municipal and community initiatives to reduce GHG, adapt to climate change, and engage in sustainable land-use planning
• Promoting risk management that minimizes vulnerability of communities
• Support innovation and research and the development, demonstration and marketing of technologies aimed at reducing GHG emissions
• Pursue the development of climatological monitoring networks
• Support research in adaptation
• Disseminate knowledge, know-how and solutions pertaining to GHG reduction and adaptation to climate change
• Mobilize Québec by supporting initiatives in civil society and in communities
• Raise Québec's profile in Canada and on the international scene
• Integrate the concern for climate change into the public administration
• Foster a reduction of GHG generated by the operations of the public administration
• Send a carbon price signal by establishing a GHG emission cap-and-trade system
• Promote public transit and alternative transportation by enhancing their availability, developing infrastructure and facilitating sustainable choices
• Create a greener car fleet through more fuel-efficient and better maintained vehicles
• Invest in intermodality and logistics to optimize freight and passenger transportation
• Enhance the efficiency of maritime, rail, air and off-road transportation
• Reduce the environmental footprint of road freight transport
• Enhance the carbon balance and energy efficiency of Québec firms
• Adopt greener building standards
• Promote renewable energies and energy efficiency in residential, commercial and institutional buildings
• Reduce the use of halocarbons
• Equip farmers to better manage GHG emissions from crop and livestock production
• Support GHG emission reduction linked to the management of residual material
• Foster the emergence of bioenergy
• Enhance the energy efficiency of commonly used devices
• Prevent and limit diseases, injuries, mortality and psychosocial impacts
• Support vulnerable economic players
• Revise infrastructure design criteria and management and maintenance methods
• Update biodiversity and ecosystem evaluation, protection and management tools
• Update knowledge and adapt water resource management tools

Sources: MDDEFPQ (2012: 54-55). Emission reductions have not yet been estimated for complementary measures listed in the 2013-2020 Action Plan. Complementary measures associated with the 2006-2012 Action Plan were estimated at 14.6 MtCO2e (MDDEFPQ, 2005).

Expected Costs and Benefits of Reducing Emissions and Emissions Trading

Trading via a linked market should be beneficial to both California and Québec: one jurisdiction can buy allowances at prices lower than it costs to make reductions, while the other jurisdiction can sell excess allowances thereby reducing its overall costs. However, it is important to consider the magnitude and direction of emissions trading against the costs that California and Québec would face if they chose not to link their cap-and-trade systems.

Below we summarize the costs that California and Québec are expected to face in terms of reducing emissions and also the anticipated impacts of emissions trading. In reporting on these cost estimates, it is important to emphasize that these are economic forecasts based on assumptions about California and Québec's economies. The use of economic models to forecast the expected effects of climate policy is highly complicated. To the best of our knowledge, the economic impact of linking California and Québec's cap-and-trade systems has only been studied by the California Air Resources Board (CARB, 2012b) as well as the WCI (WCI Economic Modeling Team, 2012). Independent studies comparing the costs of California and Québec reducing emissions independently and effects of linking are scarce. Furthermore, the results presented here should not be taken as definitive. General experience with economic models in advance of policy implementation is that they tend to over-estimate the costs of meeting emissions reductions relative to what actually transpires. Nonetheless, these models offer insight into the costs and benefits of emissions trading, and inform decision-makers' policy views. For these reasons, we discuss them here.

Effects of Linking on Economic Growth

The expected costs of reducing emissions can be considered in terms of its effects on economic growth. A number of Californian studies suggest an average reduction of 0.43% of business-as-usual GDP by 2020, though effects in individual studies range from +0.15% to -1.40% (Busch, 2009: 9). We do not know of similar studies for Québec though, because estimated marginal abatement costs in the province are higher, a similar effect on GDP growth would be expected. It would be interesting to learn if other studies of costs of implementing climate policy in California and Québec expect to GDP growth to be affected in a similar manner.

In relation to the unlinked scenario, the effects of linking carbon markets appear to have little effect on economic growth. In California, CARB has estimated that California's GDP would actually be slightly greater as a result of linking, actually increasing GDP by 0.04% (CARB, 2012b: 93). This outcome is expected as a result of purchases of Californian allowances by Québec firms. Again, this is because the cost of reducing emissions is expected to remain higher in Québec, resulting in the purchase of Californian allowances. Because of the lack of studies forecasting the effect of climate policy on Québec's economic growth, we are unable to report similar findings for Québec.

Effects of Linking on Allowances Prices

Because opportunities to reduce emissions among Québec industries are expected to be more difficult to find than amongst those in California, the cost of complying with climate policy is higher in Québec (Table 11). Because of Québec's hydroelectric resources, the emissions intensity of its economy is lower than that of California and, consequently, current economic models anticipate that opportunities to reduce further are generally more costly relative to California. Economic modeling of allowance prices in Québec in the absence of a linked cap-and-trade system range from $37-43 per tCO2e in 2013, increasing to $59-69 per tCO2e for 2020 vintages. The range of allowance price estimates is influenced by the use of offsets: maximal use of offsets dampens allowance prices while low offset use would see allowance prices rise. In California, the separate WCI and CARB models estimate that an unlinked cap-and-trade system will see 2013 allowance prices of between $17-36 and $15-30 per tCO2e, respectively. By 2020, allowance prices on unlinked markets in California are expected at $27-54 per tCO2e.

Because emissions in California are nearly six times that of Québec, a linked price would be predominantly determined by the larger Californian market. In terms of 2013 vintages, the likely range of allowance prices of $15.8-$34.5 moves up only slightly from California's perspective. In contrast, allowance prices under a linked system are much lower for Québec relative to its unlinked allowance price. At a range of between $31-55 per tCO2e for linked allowance prices, the same is true for 2020 vintages. Put another way, the linked price represents a marginal increase for California (between 0 and 15%), but represents a substantial reduction for Québec at between 21-57% off of unlinked allowance prices.

Table 11: Estimated Impacts of Linking California and Québec's Cap-and-Trade Systems

	California Unlinked Allowance Price	Québec Unlinked Allowance Price	Cal-Qc Linked		
			Allowance Price	Percent Cal Unlinked	Percent Qc Unlinked
	$/tCO2e	$/tCO2e	$/tCO2e	%	%
2013 Prices	$15.0-34.0	$37.0-43.0	$15.8-34.5	100-105%	43-79%
2020 Prices	$27.0-54.0	$59.0-69.0	$31.0-55.0	102-115%	53-80%

Sources: (CARB, 2012b: 84-86, 91-93; WCI Economic Modeling Team, 2012: 7)

Gains from Trade under a Linked Carbon Market

Linking markets is expected to allow Québec to save between $387-532 million over what it would have cost if it sought to reduce emissions independently—bringing down compliance costs by 52-59% (Table 12). Because of the price differential of allowances between California and Québec described above, economic modeling indicates that Québec will purchase between 14.4-18.3 million of excess allowances produced in California. This would result in a net flow of revenue into California of about $287-498 million through 2020 (CARB, 2012b: 92).

We estimate that the costs of reducing 14.4-18.3 million tCO2e of emissions would be much greater for Québec if its cap-and-trade system were not linked to California: at between $694-1030 million based on prices in the table above. Thus, Québec gains between $34-110 million from trading with California. For California, due to the slight rise over unlinked prices, the linked price would increase the cost of reducing 14.4-18.3 million tCO2e by about $13-56 million. Nonetheless, inflows from Québec would more than compensate for these additional costs and California's net gain from trade would be $284-442 million. To summarize, both California and Québec gain from trading in comparison to a situation where their cap-and-trade systems remain unlinked, but California gains more.

Table 12: Gains from Trade Between California and Québec

Value	Unit	California	Québec
Trade Allowances	MtCO2e	sells 14.4-18.3	buys 14.4-18.3
Costs Unlinked	$Million	$317-810	$684-1030
Costs Linked	$Million	$373-823	$297-498
Cost Difference (Unlinked - Linked)	$Million	minus $13-56	$387-532
Net Gains from Trade	$Million	plus $284-442	plus $34-110

Sources: (CARB, 2012b: 91-93; WCI Economic Modeling Team, 2012: 3-7)

Explaining Climate Policy in California and Québec

In order to understand why California and Québec have adopted the cap-and-trade systems and complementary policies described above, we find it necessary to first explain why these jurisdictions were propelled to take action on climate change in the first place before moving on to explore why a cap-and-trade system was selected in particular as a backstop measure to complement a suite of other climate policies. Moreover, to ask why cap-and-trade succeeded in Québec and California is to implicitly ask why similar proposals failed in other states and provinces similarly engaged with the WCI. Here we offer the beginnings of a framework for the analysis of North American climate policy. Our conclusions should thus be treated as hypotheses that need to be verified through future research.

Why Climate Action in California and Québec?

A causal map of the political and economic factors influencing the adoption and form of climate policy in California and Québec is found in the matrix below (Table 13). We make a distinction between external and internal political and economic factors to be considered. Overall, we find that California and Québec have both taken ambitious commitments on climate change because of strong leadership encouraged by a favourable public opinion buttressed by a technical capacity and understanding of climate policy both inside and outside of government.

Table 13: Mapping the Political Economy of Climate Policy in California and Québec

	Political	***Economic***
Internal	• Leadership and Policy Entrepreneurship • Public Opinion • Political Cohesion and Nationalism	• Prospects for Economic Innovation • Structure of the Economy/Lack of Fossil Fuel Lobby
External	• Prospect of Federal Action • Lack of Federal Action on Climate Change	• Linkage unessential in short-term (California) but essential in short-term (Québec)

Internal Political Factors

Leadership and Policy Entrepreneurship: In terms of motivation for tackling climate change, interviewees cited the strong leadership and policy entrepreneurship on the part of Governor Schwarzenegger (2003-2011) and Premier Charest (2003-2012) in driving the issue forward. In explaining Schwarzenegger's motivations, one respondent explained that he "really liked the environment" and was able to drive policy implementation because he "has a very powerful personality and really wanted it to happen." In explaining Charest's leadership on the issue, one Québec respondent suggested that his experience as Canadian federal Minister of Environment from 1991-1993, during the Rio Earth Summit, enabled him to exert leadership on this issue. But Charest was also a "policy entrepreneur" who insisted that Québec push on with the cap-and-trade system even while other states and provinces showed a lack of enthusiasm. However, perhaps more important in the case of Québec has been the opportunity to promote itself on the international stage. Québec's stature and branding in North America and internationally have been enhanced by its progressive climate policy stance and association with California. As one interviewee pointed out, Premier Charest was eager to show not just Canada but also the rest of the world just how far a sub-federal entity could go in implementing aggressive targets and policies to reduce emissions of greenhouse gases.

Public Opinion: While leadership has been important, the preferences of the political elite in California and Québec for climate action have also been driven by strong public support. A 2007 poll comparing public opinion in California and the US at large found that Californians attached higher significance to climate change (70% versus 52%) and supported taking action (75% versus 64%) (Field Poll, 2007: 2-3). In perhaps one of the biggest public shows of support, AB32 survived a challenge under a 2010 state referendum known as Proposition 23.[13] It asked that the state suspend AB32 until California's unemployment dropped to 5.5 %--despite the fact that unemployment rates in California have been in double-digits for decades. In an important show of support for climate action, the proposition was defeated with 62% of the vote in favour of retaining AB32. However, popular support for climate policy in California should not be taken for granted. The most recent polling suggest that support for climate action has declined slightly from 75% in 2007 to 64% in 2013 (Field Poll, 2013: 3).

[13] In California, a ballot proposition may be put forward by the legislature or by a petition signed by members of the public.

In contrast, perhaps to much of North America, climate policy has never been a controversial political issue in Québec. Public opinion polls have consistently demonstrated that Québeckers accept climate science, prefer taking action now, are more concerned about the impacts of climate change, look to government to spur action on climate change, and believe in the feasibility of shifting to renewable energy moreso than in any other province in Canada (Environics Institute and David Suzuki Foundation, 2012; 2013). As one interviewee explained, the need to act on climate policy runs deep amongst Québeckers, to such an extent that it has become accepted truth in the political landscape. In general, all political parties in Québec, from right to left, have supported climate action, though not necessarily a cap-and-trade system. In Québec, opposition to market-based instruments has come from a few specific industries such as cement, oil refineries and gas distributors. But according to those interviewed, this dissent was never able to find expression in the context of partisan politics and elections.

Political Cohesion and Nationalism: In explaining the reasons behind climate action in California and Québec, political cohesion and nationalism were suggested by a number of those interviewed. One respondent in California explained, "in a way it's easier [in California] because this is a Blue state. There is more political cohesion in this state compared to the nation as a whole so it is easier for us to move forward. It's kind of more of a West Coast kind of an attitude. The California Dream. There is still a lot people who have that basic mindset." Similar politics play out in Québec. For instance, sovereignists and federalists alike in Québec have long advocated the adoption of a national emissions trading system based on the "territorial approach", which would see each province distributed its share of Canada's emissions reduction commitment under the Kyoto Protocol. However, faced with the fact that the federal government has not made progress in adopting such a system, the Québec government in 2007-2008 seized the opportunity to move forward with the development of an emissions trading system, not expecting progress at the national level for the foreseeable future.

Internal Economic Factors

Incentives for Economic Innovation: Another important factor in explaining why California and Québec chose to act on climate change was the promise that such action would have in spurring economic innovation. Those interviewed in California were quite clear that the government believed that "the things we can do for climate change are things that are good for the state—because it's creating a new technological base." Such a view was prominent both inside and outside government, with one California respondent stating that there is an assumption that if a clean technology industry were to exist, it would probably exist in California.

This was felt to be a similar motivation for adopting climate policy in Québec. As one interviewee explained: "The basic driver is to put the Québec economy at the right place, by having a greener economy that would be more competitive towards others in a future where carbon will be regulated." There has also been a feeling in Québec that the province would make money with cap-and-trade—"that Québec has a lot to sell". The economic models presented above which estimate the costs and benefits of cap-and-trade question this view. Québec is amongst the least carbon intensive jurisdictions in North America and has also taken on an ambitious emissions reduction target—meaning that trading is more likely to reduce the costs of reaching this ambitious target than see carbon finance flowing into Québec. But then again, economic models cannot foresee the future and perhaps opportunities for rapid decarbonization of the economy are around the corner. The electrification of Québec's transport sector—currently the largest source of emissions—is amongst the most promising. Recently the government committed $516 million to a programme to electrify Québec's transport system (MCEQ, 2013).

Structure of the Economy/Lack of Fossil Fuel Lobby: In explaining climate action in both California and Québec, another common element was the relative independence of each jurisdiction from the fossil fuel industry. As one California respondent described it, "We do not have coal within the state…we do have oil and gas extraction in the south, but we import almost all of our natural gas, we important all of our oil. So we're kind of a resource poor state." The fact that the oil and gas industry have experienced only limited success in Québec might also explain the surprising lack of opposition from Québec's private sector (though noting certain exceptions).

The lack of effective opposition from the private sector should not be taken for granted. A recent report by the Québec Commission for Energy Issues under Québec's Ministry of Natural Resources has raised concerns about the cap-and-trade system (Lanoue and Mousseau, 2014). In particular, it points to a wariness amongst some of Québec's business community about the effects of climate regulation in the absence of meaningful participation of its major economic partners, notably Ontario and the Northeastern states, particularly with regard to energy prices (p. 98). The report also points to a lack of real information or awareness campaigns, independent of government efforts, about cap-and-trade, the WCI partnership and its effects on energy prices (*Ibid.*). We are sympathetic to these concerns, especially given that we have found no independent estimate of the cost-and-benefits of cap-and-trade nor of linking with California other that reports commissioned for the WCI and Californian government (CARB, 2012b; WCI Economic Modeling Team, 2012).

External Political Factors

Prospect of Federal Climate Action: While many political factors explaining climate action in California and Québec appear to be internal to these jurisdictions, other political factors may be considered external, like the prospect of federal climate action. As one Californian respondent explained, "California likes to get out ahead of the federal government because if you already have a programme in place then you are better able to negotiate exceptions from federal rules or be able to make a better deal in Washington because you already have standing in that area."

Similarly in Québec, by 2007-2008, the government concluded that the Canadian federal government would not establish a cap-and-trade system or that, if a federal system was established, it would not be in Québec's interests. Each Canadian federal plan was complicated by concessions that were required for the oil and gas industries. The leadership in Québec interpreted this as implying that the manufacturing sector in Canada—which is highly concentrated in Ontario and Québec—would be responsible for the majority of reductions. Concluding that climate policy under the federal government would not be in Québec's interests, Québec decided to find alternative partners to establish an emissions trading system.

Lack of Federal Climate Action: But just as much as the prospect of losing the initiative to the federal government was a spur to action in California and Québec, the lack of meaningful federal action was also a factor. Respondents in California observed that AB32 was passed when there was a general expectation that the federal government would take action on climate change. In Québec, the Canadian federal government actually played the role of a foil, galvanizing disparate political actors in Québec against each Canadian federal government climate policy proposal. In the end, Québec decided to develop its own cap-and-trade system where Québec "would control the rules of the game" in order to retain its autonomy.

External Economic Factors

Intergovernmental Cooperation: Interestingly, those interviewed in California placed less importance on cooperation with Québec than Québeckers did on cooperating with California. While there was no consensus amongst those interviewed about whether California would want to "go it alone," some thought California would be able to fulfil its commitments under AB32 without any partnership. Consequently, California has been cautious about linking its cap-and-trade systems with other jurisdictions, including Québec. As one respondent explained, "CARB was ready to link last year [2012] and the legislature said 'wait a minute', they wanted to be sure there is no adverse impact on California businesses from this and that we're not subsidizing things in Québec. And it's not that it's Québec, it's just that it's someplace else."

Some of those interviewed in California thought that linkage with Québec would have very little economic impact on California and that linkage was "largely symbolic." Others in California saw linkage with Québec as "an opportunity to demonstrate that they can link these cap-and-trade systems." However partnering with a state or province closer to California would have been preferred. As we have seen in our review of the expected economic impact of linking, Québec is unlikely to offer cheap credits that California can buy to reduce its costs. One respondent saw little significant price differentials: "It's like trading baseball cards when everyone has the same cards." Finally, some interviewed suggested that linkage to Québec was perhaps contrary to California's interests. Nonetheless, if the economic models of presented earlier about the costs and benefits of linking cap-and-trade systems are correct, linking with Québec will lead to considerable gains than if California acted alone.

In contrast to California, those interviewed in Québec were quite clear that it was unlikely that the province would have proceeded with an aggressive cap-and-trade system without California. In the words of one respondent, "It was indispensable that California was there." As he continued, "The Québec market is simply too small… it is important that we are linked to another market. The bigger the market, the better it is for everyone." One respondent explained that Québec would have simply maintained the annual Green Fund duty, itself insufficiently high to change consumer behaviour. Similarly, the success of Québec's cap-and-trade programme is highly dependent on California: "Am I confident that the carbon market will continue? Wait and see. It will depend a lot on California" remarked one Québec respondent.

Why the Specific Form of Climate Action: Cap-and-Trade Plus Regulation?

One of the larger debates in climate policy circles is about the virtues of various approaches to reducing emissions: cap-and-trade, carbon tax or regulation. In selecting the specific form of climate action, four themes common to both California and Québec were the need for political viability, flexibility, control as well as policy capacity to implement such a complex system. These four characteristics were best offered through a cap-and-trade programme backstopping an array of government policies to reduce emissions.

First, political viability explains why cap-and-trade was the selected policy for pricing emissions. In California, Schwarzenegger had detailed discussions about a carbon tax, which was his personal preference. And relative to other parts of the US, California is rather progressive on taxes. Nonetheless, as others interviewed in California asserted, a tax "has a lot of baggage"—it would have been very difficult to get through." Or as another respondent explained, "In AB32 you won't find cap-and-trade in the law. It just says that after you've done all these other things and shown that these other things aren't sufficient, then you can look at a market-based approach. Well everyone was thinking cap-and-trade. Because the alternative was a carbon tax and the political belief was that a carbon tax would go nowhere. So cap-and-trade was clearly the default."

Similarly in Québec, cap-and-trade appeared politically more viable than a carbon tax. Respondents explained that it was very hard to create a new tax, especially one that would have really changed economic behaviour such as the one implemented in British Columbia (Sustainable Prosperity, 2012). It would have been "political suicide" as one respondent explained. One of the best demonstrations of this is the limited scope of the annual Green Fund duty, which is effectively a limited carbon tax on large emitters. However, as one interviewee observed, "nobody is talking about it." The tax itself is designed not to reduce emissions but to raise $200 million in annual revenue for the Green Fund (which itself is intended to help fund reductions in greenhouse gas emissions and improvements to public transportation in Québec). This leads to some counterintuitive results: if consumption of fossil fuels goes up during the year, the value of the tax actually goes down because its goal is to raise a fixed amount of revenue.

Québec's carbon levy averaged approximately $3.5/tCO2e in 2013, which is insufficient to drive behavioural change. In contrast, the British Columbia carbon tax was initiated at $10 in 2008 and has risen to $30 in 2012 (Sustainable Prosperity, 2012: 5). But others interviewed in Québec confided that, because of the annual Green Fund levy, the current climate strategy actually includes elements of both cap-and-trade and carbon tax—a stark

debate never took place between proponents of cap-and-trade and carbon tax. Finally, other reasons that government adopted cap-and-trade in Québec were a belief that this would facilitate cooperation with other jurisdictions. At least one respondent in both California and Québec found that opportunities for coordinating with other jurisdictions were greater under a cap-and-trade system than under a carbon tax. As it was explained, "When you put a tax in place, it is difficult to commit with other jurisdictions."

Second, a number of those interviewed believed that cap-and-trade offered significant flexibility over a carbon tax. As a respondent in California explained, "A tax is something of a blunt instrument, whereas with allowance allocations [CARB] can actually dampen competitiveness concerns on a very individual basis with the cap-and-trade approach." The architects of California's cap-and-trade system were very conscious about the complex effects of climate policy on the economy and the need for flexibility. In explaining the design of California's climate policy, one respondent explained, "They were thinking about the big picture. How do you do this? How do you prevent a consumer backlash because it costs too much money? Because there's leakage? Or there's business backlash because they're losing trade to somewhere else or moving out of state?" The cost of all this flexibility however has been to add significant complexity to the administration of the cap-and-trade system. It is beyond the scope of this paper to evaluate whether cap-and-trade is really more flexible than other carbon pricing approaches. This would require further research into the experience of jurisdictions adopting cap-and-trade and a carbon tax.

Third, in explaining the significance of complementary regulations in California and Québec's cap-and-trade systems, the picture emerging is that such regulation allows government to retain considerable control over the costs of climate policy. As explained by one California respondent, "climate policy is evolving. There has been a mantra of "markets, markets, markets" but now there is a push back. EU and others are moving towards regulation and this is what California has been doing…California started with all these other policies and took on the cap later, which is contrary to the EU-ETS. Ultimately, politicians don't want to give up control." Regulatory efforts towards environmental issues that have bearing on climate change have a long history in California. As another respondent explained: "We were already doing things that had a climate change consequence because of the long-standing air pollution problems that we have…So things like pushing renewables, pushing vehicles, building standards, appliance standards those have been true for 20 years." Consequently, the cap-and-trade system is only a backstop for these other complementary regulations.

A final political factor that can help explain the adoption of a cap-and-trade system in particular is a growing community of experts, consultants, ENGOs, and businesses who have seized upon the many opportunities offered by emissions trading. In doing so they have expanded the constituency behind these instruments and are building momentum for their successful implementation, despite the uncertain future created by the lack of federal action and international agreement on the climate mitigation. Pro-active governments in California and Québec could rely on an extraordinary policy capacity for climate change action which is lacking in many other states and provinces.

Policy capacity was most clearly identified during Québec interviews. A number of those interviewed stated that the Québec government has been endowed with highly competent and civil servants who have been able to understand the complex set of rules associated with the cap-and-trade system but also anticipate their effects on the provincial economy. Not every province in Canada has this capacity. Furthermore, partnership with WCI has permitted Québec to reduce some of the technical costs of a cap-and-trade system. For example, Québec has been able to outsource certain technical issues to "WCI Inc.", a private-entity established by WCI partners to handle administrative tasks.

Transferability to Other Jurisdictions

When considering why California and Québec have taken climate action and why this has taken the form of a cap-and-trade system backstopping a suite of complementary climate policies we are of course tempted to consider the degree to which such a system might be adopted by other jurisdictions. It is worth repeating that the cap-and-trade systems adopted in California and Québec are not mandated by any international convention while the agreement to link schemes remains voluntary and subject to each jurisdiction's political process and legal system. A full assessment of the prospects of climate policy like that in California and Québec to be established elsewhere in North America requires the proper assessment of the political economy of other states and provinces. Nonetheless, if the cap-and-trade system implemented by California and Québec is to be adopted elsewhere, we venture that three important challenges that will need to be overcome.

The first is related to the political context. Recent polarization of the debate over climate change policy can be observed among progressive and conservative voters in both the US and Canada, with the gap between the two increasing (Lachapelle et al., 2012). However, recent public opinion surveys conducted in both countries paint contrasting pictures of the social acceptability of both climate science and market-based instruments (Borick and Lachapelle, 2013). These observations are supported by recent survey results indicating that US voters are generally more sceptical than Canadian voters of the basic findings of climate science (Université de Montréal and Canada 2020; 2013).

These dynamics point to the conclusion that the adoption and implementation of climate change policy is a bigger challenge in the US than compared to Canada. The difference in political context could explain the difficulty encountered by the WCI, especially in US states traditionally more conservative or with recent changes in political leadership (Rabe, 2013). However, in some Canadian provinces, an unfavourable political context also explains the lack of success in implementing emissions trading. During Ontario's 2011 provincial election, the issue of market-based instruments became extremely sensitive and politicized (Houle, Forthcoming). Framing cap-and-trade as a tax, efforts in Ontario to implement cap-and-trade stalled given that this was also a period of increasing energy prices.

Second, the commitment of leaders is important in order to implement comprehensive policy, such as cap-and-trade systems. There are three reasons why. First, political leadership is necessary for inter-jurisdictional cooperation to take place. Second, cap-and-trade necessitates the adoption of a comprehensive legislative and regulatory framework, which requires the consent of the subnational legislature, which governors and premiers are generally able to control. Third, leaders are able to mobilize resources to achieve their priorities and to foster inter-departmental cooperation. Finally, the policy capacity of the public administration for climate change appears important. Both California and Québec have extensive experience in climate change policy. Québec adopted its first *Climate Change Action Plan* in 1995 and has adopted three more plans since.

The final challenge relates to the political economies of each jurisdiction, especially with the fundamental transformation associated with the development of non-conventional energy resources such as shale oil and gas. California and Québec are heterogeneous economies, relying on a variety of sectors to create economic opportunities. Furthermore, in both jurisdictions, the oil and gas sector represents only a marginal economic activity. Other Canadian provinces such as British Columbia, Alberta, and Saskatchewan have all experienced significant development of their energy sectors, which is difficult to reconcile with the hard cap on emissions proposed by the WCI. Alberta has operated according to its own unique climate policy for the past decade, adopting the *Climate Change and Emissions Management Act* in 2003 and amending it in 2007 to include emission intensity reductions. In the case of British Columbia, it was once thought that the province's highly effective carbon tax could be complemented by a cap-and-trade system proposed by the WCI. However, British Columbia's carbon tax remains the primary carbon pricing mechanism currently implemented in the province and linkages with WCI cap-and-trade systems remain highly uncertain. We venture that the structure of state economies in the US would also explain the political appetite for climate action, which what can be perceived as costly policies.

Conclusion

California and Québec have adopted an innovative mix of climate policy instruments, which includes cap-and-trade system and a broad range of complementary measures, providing a viable option for moving forward on climate change in North America. These efforts effectively sow the seeds for a progressive North American carbon market, and it is our hope that this report will help promote a better understanding between political and economic actors in both jurisdictions about how these respective cap-and-trade systems work, as well as about the political conditions that may facilitate the potential transferability to other jurisdictions in North America. Yet this is only an initial report. It is clear that Californians and Québeckers need additional, independent information about the impact that climate policy will have—both on the global environment and their local economies.

In terms of design of their cap-and-trade systems, California and Québec are largely similar. Efforts to harmonize emissions trading systems through the mutual cooperation framework provided by the WCI appear successful. The few points of divergence include the need for flexibility in different economic sectors (especially the electricity sector in California), in the role of forest carbon sinks and offsets (forests are part of the climate mitigation solution in California but not used in Québec), and finally, in the allocation of revenue use (more complicated in California than Québec). However, cap-and-trade is not the only instrument of California and Québec's climate policy. Arguably the most important similarity between California and Québec is the important role that complementary climate regulations play. Linking cap-and-trade systems between California and Québec is likely to significantly bring down the total costs of reducing emissions, resulting in considerable reduction in allowance prices in Québec and only a very minor increase in California. Nonetheless, given an expected higher price for reducing emissions in Québec, it is likely that California will receive investment into its climate activities as a result of the purchase of allowance credits by Québec emitters.

Relative to a situation where cap-and-trade systems were unlinked, both California and Québec reduce their compliance costs—though the net gains to California appear to be greater than those to Québec. In this case, linking the two cap-and-trade systems appears to be a win-win scenario, while also allowing for more flexible arrangements to be tailored to the political and economic specificities of the two jurisdictions through other complementary types of climate regulation.

When explaining why California and Québec have taken meaningful action on climate change, the most important political and economic factors appear to be internal to each jurisdiction. Within each, politically important factors include leadership, public opinion, political cohesion and nationalism. In order to explain the choice of cap-and-trade specifically, policy capacity specific to these two jurisdictions appears to have played a key role. Economically, the prospect for economic innovation and the structure of the economy, most notably the marginal position occupied by the oil and gas sector in both jurisdictions, appear important. By comparison, external political factors appear less determining, though the prospect and ultimate lack of federal action may in some cases be important, particularly for motivating early action. In explaining why cap-and-trade emerges as a key pillar in their respective strategy, opportunities for flexibility and control appear to be important elements in Québec and California's calculation. As for the prospect of linkage itself, the ability of smaller economies to link with California, and the potential gains from increased liquidity and opportunities for trade, appear to offer smaller jurisdictions an incentive to join larger markets. From California's perspective, linkage is seen as an opportunity to demonstrate that trading works, thus increasing the appeal of this policy moving forward. In both cases, linkage facilitates the adoption of a more ambitious climate policy. The prospects for other states and provinces to join the cap-and-trade system established by California and Québec under the WCI will likely be informed by these factors. Indeed, while the future remains uncertain, the experience of Québec and California suggests one possible way of reducing greenhouse gases as part of a broader policy mix, and point to some incentives and criteria for further linkage with other units. As this report, however, represents only a preliminary study of these issues, we urge caution in extrapolating these early results.

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References

Ali AA, Carcaillet C and Bergeron Y (2009) Long-term fire frequency variability in the eastern Canadian boreal forest: the influences of climate vs. local factors. *Global Change Biology* **15**:1230-1241.

Bank of Canada (2014) *CAN$/US$ exchange rate lookup*, Bank of Canada. Website (accessed October 12, 2013): http://www.bankofcanada.ca/rates/exchange/can-us-rate-lookup/, Ottawa.

Blais M (2012) *Système de plafonnement et d'échange de droits d'émissions*, Québec, Ministère des Finances et de l'Économie.

Borick C and Lachapelle E (2013) *The Politics of Climate and the Climate of Politics. Website (accessed 7 November 2013): http://canada2020.ca/event/the-politics-of-climate-and-the-climate-of-politics-in-canada/*, Canada 2020, Ottawa.

Busch C (2009) *Climate Policy and Economic Growth in California: A Comparative Analysis of Different Economic Impact Projections*, Center for Resource Solutions San Francisco.

California Department of Finance (2014) *California State Gross Domestic Product (GDP), 1963 to 2011*, California Department of Finance, Sacramento.

CARB (2008) *Climate Change Scoping Plan: a framework for change*, California Air Resources Board, Sacramento.

CARB (2012a) *California Air Resources Board Quarterly Auction 1*, California Air Resources Board, Sacramento.

CARB (2012b) *Staff Report: Initial Statement of Reasons for Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms to Allow for the Use of Complianace Instruments Issued by Linked Jurisdictions*, California Air Resources Board, Sacramento.

CARB (2013a) *2000-2011 Inventory by IPCC category - Full Detail, Sixth Edition*, California Air Resources Board. Website (accessed 10 October 2013):

http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_by_ipcc_00-11_2013-08-01.xlsx, Sacramento.

CARB (2013b) *California Air Resources Board Quarterly Auction 2*, California Air Resources Board, Sacramento.

CARB (2013c) *California Air Resources Board Quarterly Auction 3, May 2013* California Air Resources Board, Sacramento.

CARB (2013d) *California Air Resources Board Quarterly Auction 4, August 2013* California Air Resources Board, Sacramento.

CARB (2013e) *California Air Resources Board Quarterly Auction 5, November 2013 - Summary Results Report*, California Air Resources Board, Sacramento.

CARB (2013f) *Cap-and-Trade Auction Proceeds*, California Air Resources Board. Website (accessed 10 October 2013): http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/auctionproceeds.htm, Sacramento.

CARB (2013g) *Compliance Offset Program*, California Air Resources Board. Website (accessed 10 October 2013): http://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm, Sacramento.

CARB (2013h) *Greenhouse Gas Inventory - 2020 Emissions Forecast*, California Air Resources Board, Sacramento.

CARB (2014) *California Air Resources Board Quarterly Auction 6, February 2014* California Air Resources Board, Sacramento.

Deloitte (2013) *Étude sur l'empreinte économique des alumineries à contrats spéciaux*, Deloitte, Montreal.

EDF and IETA (2012) *Québec - The World's Carbon Markets: A Case Study Guide to Emissions Trading*, EDF and IETA, Washington and Geneva.

Ellerman AD and Buchner BK (2008) Over-allocation or abatement? A preliminary analysis of the EU ETS based on the 2005-06 emissions data. *Environmental & Resource Economics* **41**:267-287.

Environics Institute and David Suzuki Foundation (2012) *Focus Canada 2012: Climate change - Do Canadians still care?*, The Environics Institute, Toronto.

Environics Institute and David Suzuki Foundation (2013) *Focus Canada 2013: Canadian public opinion about climate change*, The Environics Institute, Toronto.

Field Poll (2007) *November 2007 California Opinion Index: A Digest Summarizing the California Public's Views about Global Warming.*, Field Research Corporation, San Francisco.

Field Poll (2013) *Two in Three Californias Support Action to Combat Global Warming. Seven in ten back the state's greenhouse gas reduction law.*, Field Research Corporation, San Francisco.

GCF (2013) *Background*, Boulder, CO., Governors' Climate and Forests Task Force.

Horowitz C, Enion MR, Hecht SB and Carlson A (2012) *Spending California's Cap-and-Trade Auction Revenue: Understanding the Sinclair Paint Risk Spectrum* Emmett Center on Climate Change and the Environment, Los Angeles.

Houle D (2007) *Le Choix des Instruments de la Politique Environmentale Québécoise: les cas des précipitations acides, de l'appauvrissement de la couche d'ozone et des changements climatiques.*, Mémoire présenté à la Faculté des études supérieures de l'Université Laval dans le cadre du programme de maîtrise en analyse des politiques pour l'obtention du grade de maître es arts (M.A.), Département de science politique, Faculté des sciences sociales, Université Laval, Québec.

Houle D (Forthcoming) *Obstacles to Carbon Pricing in Canadian Provinces*, Sustainable Prosperity, Ottawa.

Hull D (2013) Ninth Circuit upholds California's Low Carbon Fuel Standard, in *San Jose Mercury News*, 18 September 2013, Website (accessed 10 October 2013): http://www.mercurynews.com/business/ci_24123259/ninth-circuit-upholds-californias-low-carbon-fuel-standard, San Jose.

IETA (2012a) *Summary of Final Rules for California's Cap-and-Trade Program*, IETA, Geneva.

IETA (2012b) *Summary of Québec's Regulation Respecting a Cap-and-Trade System for Greenhouse Gas Emission Allowance*, IETA, Geneva.

Klinsky S (2013) Bottom-up Policy Lessons Emerging from the Western Climate Initiative's Development Challenges. *Climate Policy* **13**:143-169.

Lachapelle E, Borick CP and Rabe B (2012) Public Attitudes toward Climate Science and Climate Policy in Federal Systems: Canada and the United States Compared. *Reviw of Policy Research* **29**:334-357.

Lambe D and Farber D (2012) *California's Cap-and-Trade Auction Proceeds: Taxes, Fees, or Something Else?*, Center for Law, Energy & the Environment, University of California, Berkeley, Berkeley.

Lanoue R and Mousseau N (2014) *Maîtriser notre avenir énergétque: Pour le bénéfice économique, environnemental et social de tous*, Commission sur les enjeux énergétiques du Québec, Ministre des Ressources naturelles, Québec.

Le Goff H, Flannigan M and Bergeron Y (2009) Potential changes in monthly fire risk in the eastern Canadian boreal forest under future climate change. *Canadian Journal of Forest Research* **39**:2369–2380.

MCEQ (2013) *Priorité Emploi: Stratégie d'Électrification des Transports, 2013-2017*, Ministère du Conseil exécutif du Québec, Québec.

MDDEFPQ (2005) *The New 2006-2012 Climate Change Action Plan: Québec and Climate Change - a challenge for the future*, Ministry of Sustainable Development, Environment, Wildlife, and Parks, Québec.

MDDEFPQ (2006) *Inventaire québécois des émissions de gaz à effet de serre en 2004 et évolution depuis 1990*, Ministry of Sustainable Development, Environment, Wildlife, and Parks, Quebec.

MDDEFPQ (2012) *Québec in Action: 2013-2020 Climate Change Action Plan*, Ministry of Sustainable Development, Environment, Wildlife, and Parks, Québec.

MDDEFPQ (2013a) *Inventaire québécois des émissions de gaz a effet de serre en 2010 et leur évolution depuis 1990* Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs, Québec.

MDDEFPQ (2013b) *Offset Credits*, Ministry of Sustainable Development, Environment, Wildlife, and Parks. Website (accessed 10 July 2013): http://www.mddefp.gouv.qc.ca/changements/carbone/credits-compensatoires/index-en.htm, Québec.

MDDEFPQ (2013c) *The Québec Cap and Trade System for Greenhouse Gas Emissions Allowances*, Ministry of Sustainable Development, Environment, Wildlife, and Parks. Website (accessed 10 July 2013): http://www.mddefp.gouv.qc.ca/changements/carbone/Systeme-plafonnement-droits-GES-en.htm#regulatory, Québec.

MDDEFPQ (2013d) *Vente aux enchères d'unités d'émission de gaz à effet de serre du Québec du 3 décembre 2013 - Rapport sommaire des résultats*, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs, Québec.

MDDEFPQ (2014) *Vente aux enchères d'unités d'émission de gaz à effet de serre du Québec du 4 mars 2014 - Rapport sommaire des résultats*, Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs, Québec.

MDDEPQ (2006) *Inventaire québécois des émissions de gaz à effet de serre en 2003 et évolution depuis 1990*, Ministère du Développement durable, de l'Environnement et des Parcs, Quebec.

MDDEPQ (2007) *Inventaire québécois des émissions de gaz a effet de serre en 2005 et leur évolution depuis 1990* Ministère du Développement durable, de l'Environnement et des Parcs, Québec.

MDDEPQ (2008) *Inventaire québécois des émissions de gaz a effet de serre en 2006 et leur évolution depuis 1990* Ministère du Développement durable, de l'Environnement et des Parcs, Québec.

MEQ (2002) *Inventaire québécois des gaz à effet de serre 1990-2000*, Ministère de l'Environnement du Québec, Québec.

MFQ (2012) *Québec and Climate Change: A Greener Environment*, Quebec, Ministry of Finance of Quebec.

Navarro KP (2013) *An Assessment of California's Cap-and-Trade Revenue Options & Free Allowance Allocation Methods*, A Thesis Presented to the faculty of the Department of Public Policy and Administration, California State University, Sacramento, Sacramento.

Neuhoff K and Vasa A (2010) The role of CDM post-2012, in *Carbon Pricing and Investment Response Roundtable Berlin, 5 February 2010*, Climate Policy Initiative and DIW Berlin Berlin.

NRCan (2006) *Canada's Energy Outlook: the reference case 2006*, Natural Resources Canada, Ottawa.

NRCan (2007) *Is Canada's Forest a Carbon Sink or Source?*, Natural Resources Canada, Ottawa.

Purdon M (2012) *State and Carbon Market in Least Developed Countries: Carbon Finance in the Land-Use Sector and State Power in Tanzania, Uganda and Moldova*, Prepared for delivery at the 2012 Annual Meeting of the American Political Science Association, August 30-September 2, 2012, New Orleans.

Purdon M and Lokina R (2014) *Ex-post Evaluation of the Additionality of Clean Development Mechanism Afforestation Projects in Tanzania, Uganda and Moldova - Working Paper 149*, Grantham Research Institute on Climate Change and the Environment Working Paper, London.

Rabe B (2013) *Reverse Diffusion and the Durability of State Cap-and-Trade Policy*, 2013 Annual Meeting of the American Association of Political Science, Chicago, IL.

Simpson J, Jaccard M and Rivers N (2007) *Hot Air: fixing Canada's climate change challenge*, McClelland & Stewart, Toronto.

State of California (2012) *Cap-and-Trade Auction Proceeds Investment Plan: Fiscal Years 2013-14 through 2015-16*, State of California, Sacramento.

Statistics Canada (2014a) Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories, Statistics Canada, Ottawa.

Statistics Canada (2014b) Table 384-0038: Gross domestic product, expenditure-based, provincial and territorial, Statistics Canada, Ottawa.

Sustainable Prosperity (2012) *British Columbia's Carbon Shift: the first four years*, Sustainable Prosperity, Ottawa.

UNFCCC (2014) *Greenhouse Gas Inventory Data - Detailed data by Party*, UNFCCC. Website (accessed 23 October 2013): http://unfccc.int/di/DetailedByParty/Event.do?event=go, Bonn.

US Census Bureau (2012) *Population Estimates*, US Census Bureau, Washington, DC.

Wara M (2008) Measuring the Clean Development Mechanism's Performance and Potential. *UCLA Law Review* **55**:1759-1803.

WCI (2010a) *Design for the WCI Regional Program*, Western Climate Initiative, Sacramento.

WCI (2010b) *WCI Recommendations for Implementing the Offset Limit*, Western Climate Initiative, Sacramento.

WCI Economic Modeling Team (2012) *Discussion Draft Economic Analysis Supporting the Cap-and-Trade Program - California and Québec*, Western Climate Initiative, Sacramento.

Youngs H and Somerville CR (2013) *California's Energy Future – The Potential for Biofuels*, California Council on Science and Technology, Sacramento.

Zhang JJ and Wang C (2011) Co-benefits and additionality of the clean development mechanism: An empirical analysis. *Journal of Environmental Economics and Management* **62**:140-154.

Appendices

Guiding Questions

1) From your perspective, how high a priority would you assign climate change amongst the various issues in California/Québec?

2) Why has California/Québec adopted a cap-and-trade system? What are the advantages and disadvantages of such a policy relative to others?

3) What have been the key milestones in the adoption of California's/Québec's cap-and-trade system? Can you describe its history?

4) Which political actors have been driving/obstructing the adoption of the cap-and-trade system in California/Québec? Have there been any surprises?

5) Is skepticism about climate science a factor in California's/Québec's politics? Why or why not?

6) What have been the main challenges in implementing California's/Québec's cap-and-trade system? Are these challenges concentrated differently at the local, state, federal or international levels?

7) How would you describe the capacity of California Air Resources Board (CARB) to implement the cap-and-trade system? Does it have sufficient resources for the task? Is the authority for climate policy in California appropriately vested in the CARB? // How would you describe the capacity of Québec Ministry of Sustainable Development, Environment and Parks to implement the cap-and-trade system? Does it have sufficient resources for the task? Is the authority for climate policy in Québec appropriately vested in the Ministry of Sustainable Development, Environment and Parks?

8) How would you describe the relationship between the California Air Resources Board/ Ministry of Sustainable Development, Environment and Parks and the Western Climate Initiative (WCI)? How important is it for California/Québec that other states/provinces are engaged with the WCI? Or are engaged with other climate change efforts?

9) What have been the effects of the cap-and-trade system on California's/Québec's economy? How do you expect the relationship between climate policy and economic growth and innovation will evolve?

10) How confident are you that California's/Québec's cap-and-trade system will move forward? How resilient is it to a change in government?

11) How confident are you that California's/Québec's cap-and-trade system will actually work to reduce emissions?