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Regional Market-Based Climate Policy in North America: Efficient, Effective, Fair?

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REGIONAL MARKET-BASED CLIMATE POLICY IN NORTH AMERICA: EFFICIENT, EFFECTIVE, FAIR?

CALIFORNIA'S CAP-AND-TRADE SCHEME VS. BRITISH COLUMBIA'S CARBON TAX[1]

Sven Rudolph, Takeshi Kawakatsu, Achim Lerch[2]

Despite President Obama's current interest in climate policy, market-based climate policy on the US federal level still appears to be deadlocked. The same is true for Canada, which has aligned its climate policy to the US. However, regional activities are more promising as British Columbia and California have started using market-based approaches recently. Against this background, the paper asks: Can state level market-based climate policy be a sustainable alternative or supplement to federal action? Which of the two programs does better in terms of fulfilling ambitious sustainability criteria? How can the programs be improved? In order to answer these questions, in a comparative fashion, the paper analyzes the design and the results of the British Columbia Carbon Tax and the California Cap-and-Trade Program and evaluates them based on sustainability criteria. By doing so, the paper provides a comparative evaluation of two North American sub-national level market-based climate policy programs, shows the significance and the challenges of such regional initiatives, identifies best-practice design elements, and provides recommendations for regional market-based climate policy design.

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1 Introduction

„As a President, as a father, and as an American, I'm here to say we need to act" (Obama 2013). With this words and similar statements, US President Barack Obama recently made a clear commitment to climate policy. However, while President Obama even urged Congress to come up with a market-based solution to climate change in his State of the Union speech, taking into consideration the political scars from the 2010 struggle on the Waxman-Markey-Bill (Pooley 2010), at least in the short-run, efficiency standards and additional incentive programs for renewable and nuclear energy appear to be most likely the way to go for the Obama administration. Market-based approaches, in turn, remain most unlikely. The same is true for Canada, which has aligned its climate policy strategy to the US (Bernstein/Brunnée/Duff 2008, GoC 2013). While in both countries the federal level has failed to implement market-based climate policy instruments so far, several US states and Canadian provinces have acted. Besides the US Northeast, British Columbia introduced a carbon tax in 2008 and California has just started its cap-and-trade program.

But can these programs be considered a sustainable alternative or at least a supplement to federal action, and which of the two programs does better under the given circumstances? In order to answer these questions, this paper analyzes the designs and the effects of both programs in a comparative way. The paper defines sustainability criteria for the design of market-based climate policy instruments based on modern environmental economics' and climate justice arguments (Ch. 2) and describes and evaluates the California Carbon Market (Ch. 3) and the British Columbia Carbon Tax (Ch. 4) before drawing comparative conclusions (Ch. 5). By doing so, the paper provides a comparative evaluation of two North American sub-national level market-based climate policy programs based on sustainability criteria, shows the significance and the challenges of such regional initiatives, identifies best-practice design elements, and provides recommendations for regional market-based climate policy design.

2 Design Elements and Criteria for Sustainable Market-Based Climate Policies

Earlier papers have already shown how sustainability criteria and design elements can be specified and how design recommendations for sustainable carbon market can be derived (Rudolph et al. 2012; table 1). However, in the case of climate policy taxes, this task is still to be done.

Taxes as an instrument to internalize externalities were suggested for the first time by Pigou (1920). However, it is well known that a Pigouvian tax is, although pareto-efficient in theory, not feasible in practice, particularly due to the problems of calculating the monetary value of externalities. Therefore, today's discussions on environmental taxes are usually based on the Standard-Price-Approach proposed by Baumol/Oates (1971): Taxes representing a price for emissions are not used to achieve a pareto-efficient allocation but to achieve a pre-set arbitrary environmental goal.

The comparison of environmental taxes and emissions trading has a long history in the environmental economics literature (Tietenberg/Lewis 2010). From a theoretical perspective both instruments are equally efficient and effective if the tax and the permit price equal marginal abatement costs for achieving the given emission target. The main advantage of emissions trading over environmental taxes is certainly is the security in achieving the emission target due to the immediate amount regulation by the emission cap and thus a higher environmental effectiveness, which is achieved even without the knowledge of marginal abatement costs. A tax, on the other hand, might set the wrong price and therefore miss the target if the government estimates these costs incorrectly. However, it is argued, that the right tax can be found in a process of trial and error (Baumol/Oates 1971); still such a process would cause temporary efficiency losses.

One major advantage of an environmental tax compared to emission trading is the possibility of a broader coverage by including small emitters, which in an emissions trading scheme would significantly increase transaction costs; e.g. it seems easier to include the transport sector as a major emitter in a tax scheme than in emission trading. In addition, representing another advantage of taxes over emissions trading, taxes grant more certainty about the marginal control costs, especially when the marginal control cost curve is rather steeply sloped while the marginal damage curve is rather flat. In this case small changes in the degree of control would have little effect on damages but a large effect on abatement costs (Tietenberg/Lewis 2010: 319). From a Public Choice perspective, although taxes necessarily put an additional financial burden on emitters, governments might prefer taxes over emissions trading, because they are used to raising taxes but not to creating markets, because governments can have direct control over costs burdens put on emitters, and because governments are reluctant to leave allocation decisions entirely to markets. Therefore, in terms of political feasibility, taxes might be advantageous.

Still, in climate policy, as in the case of carbon cap-and-trade schemes, carbon or energy taxes' compliance with sustainability criteria largely depends on their concrete design. Major design elements of such taxes are:

- Target: Does the tax pursue a concrete absolute volume emission target (such as the cap in emission trading), and if so which target?
- Coverage: Which emitters have to pay for which emissions?
- Tax base: Has the tax to be paid on emissions or on fuels?
- Tax rate: Is the tax rate fixed or dynamic; does it equal marginal abatement costs for the required target?
- Revenue spending: Are the tax revenues used for ecological purposes, for lowering distortional taxes or for social redistribution?
- Monitoring and penalties

Applying basic arguments on sustainability criteria for climate policy instruments (Rudolph et al. 2012) to the design elements of a carbon or energy tax, the following design recommendations for ecologically effective, economically efficient, and socially just climate policy taxes can be derived.

With respect to the target, as already mentioned above, it seems impossible to implement a pareto-efficient Pigouvian tax, because damage costs cannot be exactly calculated. Applying the Standard-Price-Approach, however, economic efficiency is independent of the concrete target level. Thus, the level of acceptable pollution is not a question of economics, but of environmental as well as of social (particularly intergenerational) justice considerations and can be set by the government. In order to comply with the global 2°C climate policy target with a probability of two thirds, applying the Budget Approach (WBGU 2009) would lead to a total amount of 750 billion tons of CO_2e that can be emitted within the period of 2010 to 2050. If additionally aspects of social justice such as different historic responsibilities for emissions are considered, concrete emission targets for individual countries could be calculated, e.g. based on the concept of Contraction & Convergence (Meyer 2000).

From an efficiency perspective as well as in terms of ecological effectiveness the tax should cover all polluters and pollutants. Thus, all greenhouse gases (GHG) should be taxed, whereat the tax rate could be calculated on the base of global Warming Potentials (GWP), e.g. in carbon dioxide equivalents (CO_2e). However, taxing non-CO_2 GHG can either be difficult due to measurement problems, e.g. for methane from the agricultural sector, or inadequate as in the case of CFC (where rules seems more appropriate because of their destructive effect on the ozone layer). From a social justice perspective two aspects have to be considered: In order to comply with the polluter-pays-principle, all polluters as well as all pollutants should be covered. However, this could lead to a high burden for poor households. especially due to the regressive effect of energy taxes. Such problems of social justice can be dealt with in three ways: tax exemptions, the tax rate, the spending of tax revenue. While reduced tax rates or exemptions would result in significantly weakening the effectiveness, using the revenues for ex post compensation would reduce the effectiveness only with respect to the income effect of the tax while the substitution effect would still remain.

In terms of the tax base, in practice environmental taxes are often paid based on pre-products containing the actual pollutant, because direct emissions are oftentimes difficult to measure. In the case of CO_2, e.g., the tax base could be the carbon-containing fossil such as coal, oil, or natural gas etc. Tax rates should then be calculated based on the different carbon contents of the fuels. In the perspective of efficiency and ecological effectiveness a strong correlation between emissions and the tax base is essential (which applies in the case of carbon content and CO_2-emissions); thus a carbon tax is preferable over a general energy tax, because the latter would also penalize renewable energies.

Ideally the tax rate should be set at a level equal to marginal abatement costs for the emission target. In practice abatement costs are known only to individual emitters, but not to the tax-setting authority. Therefore establishing the adequate tax rate at first try seems impossible, but a trial-and-error process may allow approximating the respective level. However, such a process would not only cause temporary efficiency losses, but also lead to less planning reliability for emitters and to inefficient investments in new technologies (Tietenberg/Lewis 2010: 313). In order to milden negative impacts while also considering the fact, that significant emission reduction may need time (e.g. for technological improvements), the authority should chose a dynamic tax rate starting at a low rate, which will rise over time in pre-fixed steps. This procedure would also give planning reliability to emitters due to the pre-set tax hikes, which in turn could foster the dynamic efficiency in terms of innovation incentives even better than in the case of emissions trading where price developments are uncertain. In addition, such a procedure could also be advantageous with respect to social justice, because it leaves more time for adaptation to households.

In terms of spending the revenues, from the perspective of economic efficiency revenues should be used to reduce other distorting taxes and by that overall inefficiency of the tax system (double dividend). From the environmental perspective the revenues should be used for additional environmental measures, which could increase the ecological effect of the tax. However, from a social justice point of view, redistributing the revenues in order to milden adverse distributional effects seems to be preferable. In addition, due to the substitution effect, such compensations would be less harmful to the environmental effect of the tax than exemptions or low rates. However, in any case there is an obvious tradeoff: The better the tax works in reaching the environmental target of reduced emissions, the lower the tax revenues are. Therefore using tax revenues for other than redistributional or environmental measures such as the lowering of distortional taxes or social security payments might be problematic due to uncertain revenue levels.[3]

[3] In the case of inelastic demand (as for many energy sources) the trade off is minor, however. Thus e.g. the German Ecological Tax Reform has been using revenues for lowering payment to the old age pension fund with some success.

Just as in the case of emission trading, the monitoring system has to be reliable. This includes an accurate measurement or calculation of emissions from the pre-products. Penalties have to be severe and above the tax rate, in order to prevent fines to be considered as quasi prices.

Table 3 in the concluding section summarizes the design recommendations for sustainable market-based climate policy instruments.

3 The California Cap-and-Trade Program

The US is still the strongest economy in the world, the second biggest emitter of GHG, and ranks among the top per-capita emitters of CO_2 (US DoS 2010). In international climate policy, however, the US is not a party to the Kyoto Protocol, but committed to a 17% reduction by 2020 (base 2005) in the Copenhagen Accord. At the national level, the comprehensive, partly market-based American Clean Energy and Security Act (ACESA) failed politically in 2010 (Pooley 2010). Nevertheless, other measures may lead to emission reductions of 16.3% in 2020 (Burtraw/Woerman 2012). Still, due to the political scars of 2010, a federal cap-and-trade program remains very unlikely, despite of the fact that the US can be considered the founding father of cap-and-trade in practice (Stavins 2007). But nowadays, individual US states are more progressive in using markets than the federal level. While the Regional Greenhouse Gas Initiative (RGGI) can be considered widely successful, California has just started the biggest cap-and-trade program in the US so far.

3.1 Design

California is the ninth largest economy and with a share of 2% the fifteenth biggest emitter of GHG in the world (Burtraw et al. 2012, CARB 2013c).

Total emissions summed up to 433 million metric tons of CO_2e in 1990, 482 Mio. t. in 2005, and 486 Mio. t. in 2007, before decreasing after 2008 due to the global economic crisis to 450 Mio. t. in 2010. CO_2 represents a share of 90% of all Californian GHG emissions. The biggest emitter is the transport sector with a share of more than a third, followed by the electric power and the industrial sector, while the commercial and residential as well as the agricultural sector are of lesser importance.

Concerning market-based climate policy, in 2007, California was a co-founder of the Western Climate Initiative (WCI), a joint project of western US and Mexican states as well as Canadian provinces, with the aim of establishing a common North American carbon market to reduce GHG emissions by at least 15%. However, while the WCI is still officially in existence, most of the member states lost interest recently. Only a linkage between California's and Québec's carbon will be established by 2014.

In California, already in 2005 former governor Schwarzenegger issued on official order to his administration to advance policies in order to reduce GHG emissions to the 2000 level by 2010, to the 1990 level by 2020, and 80% below the 1990 level by 2050. In 2006, California passed its Global Warming Solutions Act, the Assembly Bill 32 (AB 32) (California State Assembly 2006). AB 32 made the California Air Resources Board (CARB) responsible for achieving the targets and for implementing policies, naming a cap-and-trade program as one policy option. The CARB made its market-based strategy concrete in the Scoping Plan of 2008 (CARB 2008) and finalized the rules in the Final Order of 2011 (CARB 2011b). California's program was supposed to start in 2012 already, but political struggles created the necessity to postpone the introduction to January 1st, 2013.

California's cap-and-trade program (CARB 2011a) is a mixed up- and downstream scheme, which covers all Kyoto gases (CO_2, CH_4, N_2O, H-FKW/HFC, FKW/PFC, SF_6) and NF_3. It starts downstream with power generation and large industrial facilities with annual emissions above 25,000 tons of CO_2e; it also includes electricity imports. From 2015 onward emissions from liquid and gaseous fossil fuel use in smaller facilities, buildings and the transport sector will also be covered upstream; compliance obligations rests with distributors of transportation, natural gas and other fuels. Altogether the program covers about 360 businesses, representing 600 facilities and 85% of California's GHG emissions. From 2015 onwards, California's cap-and-trade Program will hence be the second biggest carbon market behind the EU Emissions Trading Scheme by twice as big as RGGI.

As 80% of the total targeted emission reductions were supposed to be achieved by measures outside of carbon market,[4] the total emissions budget for the carbon market was calculated to be 163 million tons CO_2e in 2013, which is 2% below the level forecasted for 2012. Again in 2014 the cap declines by 2%. In 2015, due to the broadened coverage, the cap increases to 395 million tons and will be reduced by 3% annually until 2020, when the cap reaches 334 million tons. The total reductions for the covered sectors compared to 2012 levels amount to about 17%.

California hands out a major part of its California Carbon Allowances (CCA), each worth the emission of one metric ton of CO_2e in a given year, for free. Electricity generators receive 90% of average emissions worth 97.7 million allowances in 2013 and 84.9 in 2020. Two thirds of these allowances go to investor-owned utilities (IOU), while only one third goes to publicly-owned utilities (POU). Basically, all electricity generating facilities receive their allowances for free on behalf of their clients. However, while publicly owned generators can directly use allowance for compliance, privately owned facilities have to auction off all their allowances and buy back the amount they need for compliance. The industrial sector receives allowances worth 90% of average emissions. The individual allocation is calculated using three factors: a Product Benchmark, the Cap Decline Factor, which aligns the cap to the reduction roadmap, and the Assistance Factor, taking account of the threat of carbon leakage. Due to competitiveness reasons, the share of auctioning in the industry sector is only 10% in 2013 but will be increased in the future. Auctions are held quarterly from November 14th, 2012, onwards using a well-established format (uniform price, single round, sealed bid) and selling spot and forward allowances. The reserve price is 10 US$ and increases annually by 5% over inflation. Unsold allowances are transferred to the reserve.

Banking of unused allowances is allowed without limits, while borrowing is prohibited. Offsets are allowed up to 8% of individual entity's compliance obligation. Project types are limited to projects within the US – while there exists a framework for international expansion – and to forestry, urban

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[4] Those were e.g. efficiency standards for motor vehicles and buildings as well as a portfolio standard for renewable energy in power production (Burtraw et al. 2012).

forestry, dairy digesters, and the destruction of ozone-depleting substances. Reductions have to be additional, durable, and verifiable, and offsets will be verified by independents agents.

If facilities are shut down, allowances have to be given back and no new allocation will be made. New entrants are provided with allowances free-of-charge from a reserve. This reserve is filled with an increasing (from 1% to 7%) share of total allowances under the cap. The reserve is also used for cost containment. In each case, one third of the available allowances can be bought at a price of 40, 45 and 50 US$; however these prices will be increased by 5% plus inflationary adjustment each year. Thus, California establishes a price collar ranging from the reserve price of 10 US$ to the reserve prices; but it is only binding at the upper limit as long as there are still allowances available from the reserve.

Trading and compliance periods are 2013-2014, 2015-2017 and 2018-2020. Auctions are held by the private company Market Northamerica under on behalf of CARB; the biggest secondary market is expected to be the Intercontinental Exchange. Reserve sales are also held quarterly.

Revenues from allowance auctions, calculated to be at least 1 Billion US$ per year, go to two different uses: At least 85% of the economic value of allowances handed out to public utilities have to inure to the benefit of ratepayers. In the case of private utilities the Public Utility Commission (PUC) decides about the concrete spending, while in the case of public utilities the utilities themselves can make the decision. While the concrete way of refunding is still under discussion, there are proposals on a per-capita-dividend as well as on funding of energy efficiency measures. The revenue form auctioning allowances to industry will be transferred to a Greenhouse Gas Reduction Account within the Air Pollution Control Fund (Burtraw et al. 2012). Again, details are still to be decided. According to two laws, proceeds from auctioning, have to be spend for environmental purposes and at least 25% of program funding must be allocated to projects that benefit disadvantaged communities (CARB 2013a).

The monitoring system includes monitoring, reporting and, verifying of emissions (MRV). Facilities are expected to continue to report GHG emissions annually, while reports have to be verified by independent agents. Industries have to register with CARB in order to participate in the emission trading market. For compliance, Californian facilities have to provide allowances and offsets for 30% of previous year's emissions each year. The remaining 70% have to be covered at the end of the compliance period. Emissions as well as allowances are registered in the Compliance Instrument Tracking System Service (CITSS). In the case of non-compliance, four allowances must be provided for every ton of emissions that was not covered in time. In addition, penalties based on clean air regulations may apply, which can sum up to several thousand dollars per day.

3.2 Design Evaluation, Effects, and Recommendations

As California's cap-and-trade program has just started its operation in 2013, empirical results are limited. Still, as a first step, the design of the program can be evaluated based on criteria for sustainable carbon markets (Rudolph et al. 2012). The mandatory character of the program is fully in line with the design criteria for sustainable emissions trading schemes, as is the combination of a downstream start in 2013 a and an upstream expansion from 2015 onwards, which guarantees a most comprehensive coverage. While the program is still limited geographically, it at least includes electricity imports. The 2020 reduction target of around 17% below 2012 emission levels achieved y a dynamic reduction path is ambitious if compared to other cap-and-trade program, but still too low if compared with the necessities set forth by the Intergovernmental Panel on Climate Change (IPCC) of a 25-40% reduction compared to 1990 levels in industrialized countries. Also, the mostly free-of-charge initial distribution of allowances does not comply with sustainability criteria. The revenue spending scheme, however, fulfils environmental and social criteria, as it lessens burdens for low-income households and invests in additional climate measures; it, however, might not be the most efficient way of using the revenues. Also in compliance with sustainability criteria are the rules for naking and borrowing. While offsets are generously accepted, they are problematic if they deliver reliable emission reductions. In addition, California's cap-and-trade program has implemented a reliable trading and monitoring infrastructure, in line with the sustainability criteria. While the constricted price ceiling may be acceptable from a social justice perspective and the floor price might serve environmental and social aims, a price collar may hamper the efficient allocation; however current price levels indicate that this collar is set a level not to obstruct the market. Altogether, the California Cap-and-Trade Program complies with a large portion of sustainability criteria, while still especially the initial allocation as well as the cap size could be improved.

Despite of the current lack of performance data, some ex ante studies have predicted the effects of California's cap-and-trade program (Burtraw et al. 2012, CARB 2010, Next 10 2012). Depending on how the revenues are spent, the Californian gross domestic product is calculated to change between -1.4 and +0.2%. Price expectations are 15.90 US$ in 2013, 20.92 US$ in 2015 and 36.94 US$ in 2020 (Synapse 2008). Household incomes will only be slightly (<1%) negatively influenced even when all sectors are covered from 2015 onwards; some studies even predict slightly positive effects. Electricity costs could increase by 50 to 80 US$ per customer per month in 2013, if allowance prices reach 15.90 US$ and revenues would not be used to compensate rate payers. The CARB expects fuel prices to increase by 0.18 to 1.45 US$ per gallon for gasoline and between 0.24 and 1.87 US$ for diesel in 2020. The average household could be faced with an increase of heating costs of 4.50 US$ per month from 2015 onwards. As several studies show (Burtraw et al. 2012, Energy Resources Group 2009), increasing energy costs for households can be compensated by a purposeful recycling of auction revenues and measures already planned. Even if allowances prices reach 30 US$, a per capita refund of the total value of allowances from the program would lead to a net benefit for the majority of Californian households. This even holds, when 50% of the total value will go to the state. For compensating low income households even using only 10-20% of the total allowances value would suffice. However, to what extent costs are compensated depends largely on the way of revenue spending, which is not yet decided fully. Still, at an allowance price of 15.90 US$, the economic value generated by the program – and thus the budget available for compensation – sums up to about 3 Billion US$ in 2013 alone. It will increase to 8.7 Billion in 2015 (p=20.92 US$) and 11.7 Billion in 2020 (p=34.09 US$).

Table 1: Auction Results 2012-2013 (US$)

	Reserve Price	Vintage 2013 Clearing Price	Vintage 2015/16 Clearing Price	Revenues
Auction 1 (Nov. 2012)	10,00	10,09	10,00	289.102.450
Auction 2 (Feb. 2013)	10,71	13,62	10,71	223.588.476
Auction 3 (May 2013)	10,71	14,00	10,71	283.794.322
Auction 4 (Aug. 2013)	10,71	12,22	11,10	275.551.457
				1.072.036.705

Source: data from CARB 2013b

Besides ex ante studies, the results from the first allowance auctions can be analyzed (table 1). While prices for current vintage 2013 allowances started low and only slightly above the reserve price level, in later auctions prices increased to a level close to ex ante calculations. Vintage phase II allowances, however, have been sold at the reserve price level at the first three auctions and only outstripped it in August 2013. In terms of amounts, all vintage 2013 allowances on offer were sold, while only parts of vintage phase II allowances were sold up to the third auction; only in August 2013 all vintage phase II allowances were sold. Total revenues of the first four auctions added up to more than 1 Billion US$. Thus, while low prices at the beginning of the program raised fears about a lack of scarcity in the market, the increase in the price level and the repetitive sale of the total amount of vintage 2013 and in August 2013 even of vintage phase II allowances now indicates that there is no over-allocation.

Altogether, the California Cap-and-Trade Program represents a significant step towards ambitious market-based US climate policy. Not only does it comply with major sustainability criteria, but in comparison with other US trading schemes it is by far the most ambitious; and even compared to the EU trading program it excels in many parts. Still, there is enough leeway for improvements. In order to become more sustainable, targets have to be in line with climate protection requirements of a 25-40% reduction (base 1990) by 2020 and the share of auctioning has to be increased soon.

4 British Columbia's Carbon Tax

Among alternative public policies to reduce emissions of CO_2 and other GHG, a carbon tax represents a promising but often under-utilized approach, particularly in North America (Duff 2008). In Canada, however, British Columbia (BC) introduced a carbon tax in 2008, which is making the province one of the most aggressive North American jurisdictions when it comes to addressing climate change. Nevertheless, climate change, in substance, should be addressed globally, because it is global issue. In spite of it, why did BC take action on climate change ambitiously at state government level? Moreover, why did BC take the initiative to introduce a carbon tax although it was not introduced at the federal level as well as in other Canadian provinces?[5]

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[5] In Canada, the Federal Liberal Party made the introduction of a carbon tax a major issue in the federal election in 2008, but, popular support for the Liberal Party fell by 4% and the Party lost 27 seats on the House. Therefore, Canada failed to introduce the first national carbon tax in North America. On

For several reasons, it is not surprising that BC would be national leader in the development of climate policy (Duff 2008). With almost half the province's population concentrated in the metropolitan area of Vancouver, which enjoys a more moderate climate than the rest of Canada, and almost 93% of its electricity currently generated from hydroelectric power, BC CO_2 emissions per capita are among the lowest in Canada at 15.5 tons in 2005 compared to 23.1 tons in the country's average and its total GHG emissions summed up to almost 56 Mio. t. in 1990, 66 Mio. t. in 2005, 65 Mio. t. in 2007, and 62 Mio. t. of CO_2e in 2010. Despite low emissions per capita, however, total emissions increased by 30% between 1990 and 2005, with the biggest growth resulting from fossil fuel production and fugitive emissions from oil and natural gas, which almost doubled during this period. Combustion of fossil fuels is responsible for 79.5% of total BC GHG emissions. At the same time, BC has lost half of its lodgepole pines to the ravages of the mountain pine beetle and has also experienced summer drought and severe winter storms. Therefore, BC launched its "Climate Action Plan" in 2008 with aggressive GHG targets of a 33% reduction from 2007 levels by 2020 and an 80% reduction by 2050. In order to reduce GHG emissions, at the same point of time, the tax on the use of carbon-based fuels was implemented as a crucial component of the province's climate change strategy (GoBC 2008).

4.1 Design

Concerning the tax base, BC's carbon tax applies to GHG emissions in the province from the combustion of fossil fuels that are captured in the National Inventory Report. Thus, the tax base includes all fossil fuels purchased for use in the province, or used by those importing or producing the fuel. However, it is intended that some fuels, or the use of some fuels in certain circumstances, are not to be subject to the carbon tax or the tax is refundable. Because of technical measurement problems, the tax does not apply to CO_2 emissions from industrial process such as the production of oil, gas, aluminum and cement, as well as emissions of other GHGs from landfills and the agricultural sector. Also the tax does not apply to the combustion of biofuels. Fuels exported from BC and fuels used for inter-

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the other hand, in 2007, the province of Quebec became the first jurisdiction in North America to introduce a carbon tax when it imposed a duty of 3C$/t of CO_2 on the bulk sale of specific fossil fuels.

jurisdictional commercial marine and aviation purposes also are excluded. Competitiveness concerns of BC's industries are addressed by implementing such a border tax adjustments

Starting on July 1, 2008, the tax rates are based on 10 C$ per ton of CO_2-equivalent (CO_2e) emissions, increasing by 5 C$/t. each year for the next four years to 30 C$/t. in 2012. The specific tax rates vary for each type of fuel, depending on the amount of CO_2e released in combustion. For example, the tax rate for gasoline is 6.67 Cents per liter. The tax rate for diesel is slightly higher at 7.67 ¢/l. due to the higher carbon content of the fuel, while the tax on propane is lower at 4.62 ¢/l.

In terms of administration, the legislation requires all businesses that make the first sale of fossil fuels in BC to have been appointed collectors like those of the existing motor fuel tax. Collectors remit security to the government equal to the tax payable on the final retail sale and reimburse for the amount they paid as security when they collect security from the wholesale or retail dealer to whom they sell the fuel. The wholesale or retail dealer is likewise reimbursed for the amount they paid as security when they collect security from the retail dealer or tax from the consumer to whom they sell the fuel. Thus, all individuals, businesses and visitors to BC, who purchase or use fossil fuel in the province required to pay the tax at the time of retail purchase or use of fossil fuel in the province.

With respect to revenue spending, every cent generated by the carbon tax is returned to British Columbians through tax reductions and credits. The legislation requires the province to demonstrate how exactly carbon tax revenues flow back to individuals and businesses. In order to ensure this, by law the government must table an annual plan, the "Revenue Neutral Carbon Tax Plan," that clearly outlines how every cent of carbon tax revenue will be returned to taxpayers. According to BCMoF (2013), spendings mentioned in the plan can be differentiated between household tax measures and business tax measures. The former includes Low Income Climate Action Tax Credit, the 5% reductions in the first two personal income tax rates, Northern and Rural Homeowner benefit and so forth. The latter includes the reductions in each of the general and small business corporate income tax rates, the corporate income tax small business threshold increased from 400,000 to 500,000 C$ and so forth.

4.2 Effects, Design Evaluation and Recommendations

Actually, in the past four years, how have this carbon tax and revenue recycling impacted on the environment and economy? While there have been few studies of this kinds so far, Elgie/Mcclay (2012; 2013) have presented some early ex-post study results, the summary of which are given in Table 2.

Table 2: The environmental and economic effects of BC's carbon tax (base 2007/08)

Per capita consumption of petroleum fuels subject to BC's carbon tax					
	2008/09	2009/10	2010/11	2011/12	2008-12 total
British Columbia	-5.4%	-3.6%	-2.4%	-7.1%	-17.4%
Rest of Canada	-3.4%	-0.7%	3.9%	1.7%	1.5%
Difference	-2.1%	-3.0%	-6.3%	-8.8%	-18.8%
GHG emissions per capita from sources subject to BC's carbon tax					
	2008	2009	2010	2011	2008-11 total
British Columbia	-1.5%	-6.7%	-1.1%	-2.4%	-10.0%
Rest of Canada	-3.6%	-3.9%	-0.9%	3.9%	-1.1%
Difference	2.1%	-2.8%	-0.2%	-6.3%	-8.9%
BC and Canada GDP per capita					
	2008/09	2009/10	2010/11	2011/12	2008-12 total
British Columbia	-1.16%	-3.90%	1.64%	1.92%	-0.15%
Rest of Canada	-0.45%	-3.38%	1.91%	1.38%	-0,23%
Difference	-0.71%	-0.52%	-0.27%	0.54%	-0.08%

Note: While the data of per capita consumption of petroleum fuels is expressed by fiscal year (July 1 – June 30), that of GHG emissions per capita is expressed by calendar year, due to data availability.

Source: Elgie/Mcclay (2013): 2

In terms of environmental effects, BC's carbon tax aims at reducing the use of fossil fuels and thus GHG emissions. It is worthwhile to review both of these changes, in order to assess the environmental effectiveness of BC's carbon tax. Table 2 shows that BC's fuel consumption per capita has fallen every year since 2008/09. It declined by 17.4% from the 2007/08 base year to 2011/12. Moreover, it declined 18.8% more than in the rest of Canada during this four year period[6]. BC's per capita GHG emissions associated with carbon taxed fuels declined by 10.0% from 2008 to 2011. During this period, BC's reductions outpaced those in the rest of Canada by almost 9%[7]. These GHG reductions were

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[6] Rivers/Schaufele (2013) specially examines changes in motor vehicle fuel use due to the carbon tax and estimates about 10% reduction in motor fuel use from the carbon tax through to the end of 2011.

[7] However, GoBC (2008) shows, if the carbon tax is maintained at 30 C$/t above 2012/13, it will reduce BC emissions by only 4% of business as usual emissions by 2020.

similar to those seen in fuel use during this same 2008-11 time period. Total GHG emission reductions from the carbon tax alone may add up to three million tons in 2020.

Regarding economic effects, when the carbon tax was brought in, there were predictions that it would harm BC's economy. Therefore, Elgie/Mcclay (2012; 2013) also examined how BC's economy has changed since the introduction of the carbon tax. Table 2 shows that after four years BC's GDP has slightly outperformed the rest of the country over the period the carbon tax has been in place. The difference in GDP change is very small (0.1% in total from 2008-11); moreover, the carbon tax is just one small factor in BC's overall economic picture. While it would be a stretch to claim that the tax shift has had a positive impact on the economy, the data at least appears to indicate it has not had a negative effect. BC has a carbon price that is higher than anywhere else in North America. Yet there is no evidence at this is harming BC's economy.

However, this only means that the economy-wide impact of the tax shift seem to have been neutral or positive. It does not mean that no firms or households have experienced adverse economic impacts. Actually, it is expected in the analysis by BCMoF (2013) that the economic impact of BC's carbon tax varies by industry and that some industries are more impacted than others. Industries with high emissions intensities, e.g. cement production, petroleum refining, oil and gas extraction etc., are most impacted. Other industries, however, are less impacted. Unfortunately, there are yet no studies, which examine the impacts of BC's carbon tax shift on the outputs and jobs differentiating by industry.

In terms of effects on households, some empirical studies exist. As with consumption-based taxes, lower income households will feel the impact of the carbon tax intensely, but distribution is also affected by how the proceeds of the tax, 1.120 Billion C$ in 2012/13, are used. Therefore, Lee/Sanger (2008) estimated the impact of the tax on different income groups on direct and indirect consumption of fossil fuels, and also modeled the distribution of the tax cuts and credits implemented by the government. They found that BC's carbon tax is slightly progressive for 2008/09, with credits exceeding taxes paid, although personal and corporate income tax cuts lead to net gains for the top 20% of households. However, as the tax increases over time, the regime will be moderately regressive from 2010/11 with in increasing trend afterwards. Lee (2011) derives more detailed estimations for the distributional impact of BC's carbon tax and revenue recycling for households in each income decile for

2010 and 2012. The results show, taking into account tax cuts and credits returned to households, the income top 10%, on average, receive net benefits of up to 1% in 2012; while the bottom 10% face net costs of 0.5%. Anyway, the total effect on households is slightly positive. Melton/Peters (2013) expand these previous analyses of BC's carbon tax by providing a comprehensive assessment of its impacts on households. As a result, they find, by lowering corporate taxes, the province is likely to become more competitive relative to other North American jurisdictions, which has a positive impact on the provincial economy and on household income in the long-run. However, it is necessary to note that this results focus on the impact of the carbon tax on the average BC household.

Considering the above described design as well as the effects, BC's carbon tax can be evaluated as follows. First, the tax base is relatively broad. The fossil fuels included in the tax base account for 75% of BC's total GHG emissions (Matt/Partington/Shah 2012). Still, if the tax would additionally cover the non-combustion industry emissions that can be accurately measured, the coverage would increase from 75% to 82% (Pembina Institute 2012). This would not only enhance the environmental effectiveness of the tax but make it more socially just by treating more GHG emissions sources equally. However, it is important to keep in mind that, when the carbon tax was introduced, the BC government committed to replace the tax on large industries by a cap-and-trade scheme via the Western Climate Initiative (WCI). Part of the reason for that commitment was to address a gap in the tax's coverage in that it did not apply to non-combustion GHG emissions. However, BC has not moved forward to implementation and may join in the relatively near term, but the picture is still much less clear.

Second, the tax rate starts low and increases gradually. Allowing this relatively long phase-in up is intended to give people and businesses enough time to adjust their consumption patterns and to respect decisions made prior to the announcement of the tax. Still, it is expected that the impact of the existing tax regime is relatively small. At the end, the carbon tax needs to be high enough to significantly shift technology investments as well as behavior towards cleaner and more efficient energy choices in a way that BC can meet its climate policy commitments. Therefore, e.g. Matt/Partington/Shah (2012) recommend that the government should continue to increase the tax rate in 2013 and beyond.

Third, BC's carbon tax is revenue neutral. While the revenue recycling plan is based on conservative estimates and the actual carbon tax revenues and the recycling costs may deviate from these estimates for a number of reasons, in the event of a revenue surplus, the recycling plan also shows how the government intends to return the surplus to taxpayers via additional tax reductions. This ensures that there is full, transparent, ongoing revenue recycling. However, BC's carbon tax regime has been "revenue negative" for the years 2012 and 2013; tax reductions and credits are expected to return 260 million C$ more to taxpayers than the amount of carbon tax paid, primarily due to corporate income tax cuts. While, as a result, the general corporate income tax rate in BC is among the lowest in North America and BC's income tax rates are presently the lowest in Canada for those earning up to 122,000 C$, there is a need to find mechanisms to deal with this problem.

Fourth, low income households are protected. A refundable Climate Action Tax Credit will ensure that those households with low income are compensated for the tax, and that most will be better off than without the tax scheme. As described above, while the tax credit was large enough to more than offset any potentially negative impacts from the carbon tax on low income individuals and families in the first year, increases in the credit have not kept pace with increases in the carbon tax (Lee/Sanger 2008). To make up for this gap, the province need to examine about increases of the possible protection it provides to low income British Columbians.

Finally, the administration of the tax is simple. The carbon tax is applied and collected at the wholesale level in essentially the same way that motor fuel taxes are applied and collected; this is except of natural gas which is collected at the retail level. Therefore, the government can reduce the number of businesses that need to file a tax return and remit to government. This minimizes administrative costs.

5 Conclusions

Summing up major results of this paper, first, is has to be stated that in the present situation, British Columbia and California can be considered the North American leaders in climate policy, and even on a global scale the British Columbia Carbon Tax and the California Cap-and-Trade Program are best practice models.

Second, as national levels in North America do not seem to move, regional programs are the way to go. Not only can they provide significant emission reductions, but, and even more importantly, they can serve as drivers for the national level and even best practice models for other countries.

Third, both the British Columbia carbon tax and the California Cap-and-Trade Program are well designed, fulfilling a big share of criteria for sustainable market-based climate policy. Coverage is comprehensive, and targets appear ambitious at least compared to similar programs. The generated carbon price level of 30 $ and above, at least for the time being, seems sufficient for generating major emission reductions and innovation. Both programs are fully revenue neutral; they invest each and every cent either in climate protection, redistribution, or the lowering of distortional taxes.

Forth, in comparison, due to its size and its broader coverage, California's Cap-and-Trade Program delivers more emission reductions in total GHG volume, although mid-term targets are more ambitious in British Columbia (-12% by 2020, base 1990) than in California (0% by 2020, base 1990). And even relative program reductions are bigger in California (9%, by 2020, base 2007) than in British Columbia (6% by 2020, base 2007). On the other hand, as expected, carbon price hikes in British Columbia are certain and started earlier (2008) than in California (2012), while the carbon price in 2020 might to be higher in California, if there are no additional tax increases in British Columbia. In terms of distributive results, the British Columbia Carbon Tax makes most polluters fully pay for their resource use, while California hands out major parts of its emission allowances for free, leaving out some opportunities for environmental, economic, or social improvements by revenue spending. Still, both programs have positive net total effects on households, although they might be regressive in later stages.

Fifth, in terms of improvements, for sure, California should lower its cap to be in line with necessary emission reductions of 25-40% by 2020 (base 1990) and accelerate the introduction of auctioning. British Columbia, on the other hand, probably has to increase the rate even further in order to reach its ambitious reduction target; including emissions from production processes other than combustion, in addition, would also foster that goal.

But despite of the few design flaws, both the California Cap-and-Trade Program and even more the British Columbia Carbon Tax might act as groundbreaking examples for sustainable climate policies, and the authors hope that they will act as pioneers especially for their federal level North American governments.

Table 3: Recommendation for Sustainable Climate Policy Instrument Design and (Non-)Compliance of the California Cap-and-Trade Program and the British Columbia Carbon Tax

	GHG Cap-and-Trade (California)	GHG Tax (British Columbia)
bindingness	mandatory	mandatory
coverage		
pollutants	**100% of GHG**; if selective, then most important	**100% of GHG**; if selective, then most important
emitters	**all**; if selective, then most important polluters	**all**; if selective, then most important polluters
up- vs. downstream / tax base	upstream; if downstream, then comprehensive	tax base correlated with emissions
exemptions	**none** (no opt-out)	**none**
target		
overall GHG emission reduction target	**25-40% by 2020, 80-95% by 2020 (2°C-target)**	**25-40% by 2020, 80-95% by 2050 (2°C-target)**
cap	absolute volume; scarce, target oriented, fair; decreasing	
emission right unit	1 ton of CO_2e	1 ton of CO_2e
initial distribution of emission rights	**full auctioning of emission rights** (phase-in)	fixed-price emission rights (tax rate)
pricing		
price	market price	**tax rate equal to MAC**; if need be or trial-and-error
price determinating institutions	market (stock exchange)	government
price control	**no price ceiling**, but price floor	increasing tax rate **up to MAC**
	banking, no borrowing	
	high quality offsets limited in number	
revenue use	per capita dividend or reduction of distortionary taxes or climate mitigation and adaptation or low-income household compensation	per capita dividend or reduction of distortionary taxes or climate mitigation and adaptation or low-income household compensation
MRV	IT-based, continuous, reliable	IT-based, continuous, reliable
	annual reconciliation (via emission, allowance registries)	
penalites	fines > p, discouraging, equal for all	fines > tax rate, discouraging, equal for all
	ex post compensation	

compliance, **non-compliance**

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