JOINT CLEAN CLIMATE TRANSPORT RESEARCH PARTNERSHIP

JCCTRP Policy Brief on Transport and Climate Policy in California

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Modelling and decision-making for transport and climate policy

Findings from the Phase 1a Workshop of the Joint Clean Climate Transport Research Partnership (JCCTRP)

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INTRODUCTION

Climate change is one of the defining challenges of our time, requiring an unprecedented level of global cooperation to avoid dangerous levels of greenhouse gas emissions (GHG).[1] Despite the recent diplomatic success of the Paris Agreement, climate change politics continues to be characterized by gridlock at the international level.[2] In light of such challenges, coordinated action at the sub-national level has increasingly been seen as a hopeful spur to greater climate action through more “bottom-up” political processes.[3] In North America, Quebec, California and, most recently, Ontario have taken an important leadership role in climate policy through a linked GHG trading system operating under the auspices of the Western Climate Initiative (WCI) - a voluntary cooperative agreement between partner jurisdictions.[4]

In 2015, the WCI was significantly expanded to include transportation-induced emissions, which constitutes the largest source of emissions in all three jurisdictions - 38% California, 42% in Quebec and 34% in Ontario.[5] In this context, it is important that jurisdictions be able to anticipate the effects of various GHG emission reduction measures on emissions trading with WCI partners, notably the effects of measures in the transportation sector. Energy systems modelling allows these issues to be explored by beginning to attempt to quantifying energy and technology pathways. Equally important is to understand the role that modelling plays in policy decision-making.

In order to face this challenge, academics and practitioners from Quebec, California and Ontario as well as the state of Vermont have come together to develop the Joint Clean Climate Transport Research Partnership (JCCTRP). In this policy note, we report on a Phase 1a meeting of the JCCTRP held in early

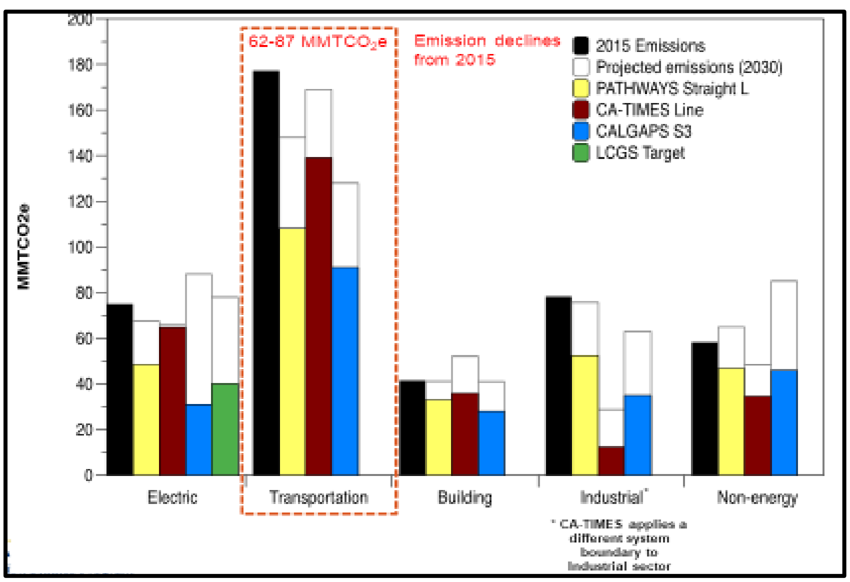
November 2017 in Montreal. The JCCTRP aims to build a network of experts whose objective is to identify best practices, clarify links between modelling and decision-making, and formulate concrete propositions to strengthen modelling capacities across partner jurisdictions.

In this policy brief we report on Californian efforts to reduce emissions in the transportation sector. The state has recently legislated to reduce GHG emissions 40% below 1990 levels by 2030.[6] To achieve this goal, California aims to cut its gasoline consumption by half and raise the amount of power generated from renewable energy sources by 50%.[7] California also aims to add 100,000 zero-emission heavy trucks to the current fleet and to raise the efficiency of freight transportation by 25%.[8] Below we present some of the key modelling tools and policies that California will use in attempting to reach these ambitious goals.

MODELLING CAPACITY IN CALIFORNIA

Many Californian organizations have developed high-level modelling capacities. The Institute of Transportation Studies at University of California Davis (ITS-Davis) is a research institute of global stature with advanced expertise in three core areas: (i) travel behaviour and transport systems modelling; (ii) environmental vehicle technologies and fuels; (iii) climate change, air quality, and other environmental impacts.[9] In terms of modelling, ITS-Davis also leads the California Climate Policy Modelling (CCPM) Dialogue, which brings together policy-makers, modellers, and other stakeholders.[10] Its main objective is to review the current status of energy systems modelling in California and to examine technology and policy pathways for achieving California's climate policy goals.

Figure 1: Projected emissions in 2030 compared to 2015, across CCPM models



Source: Adapted from Yeh, S. (2016) Low Greenhouse Gas Emissions in California by 2030. Presentation to the 22nd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP22); Transport Models and Climate Policy Evaluation Tools: Marrakesh.

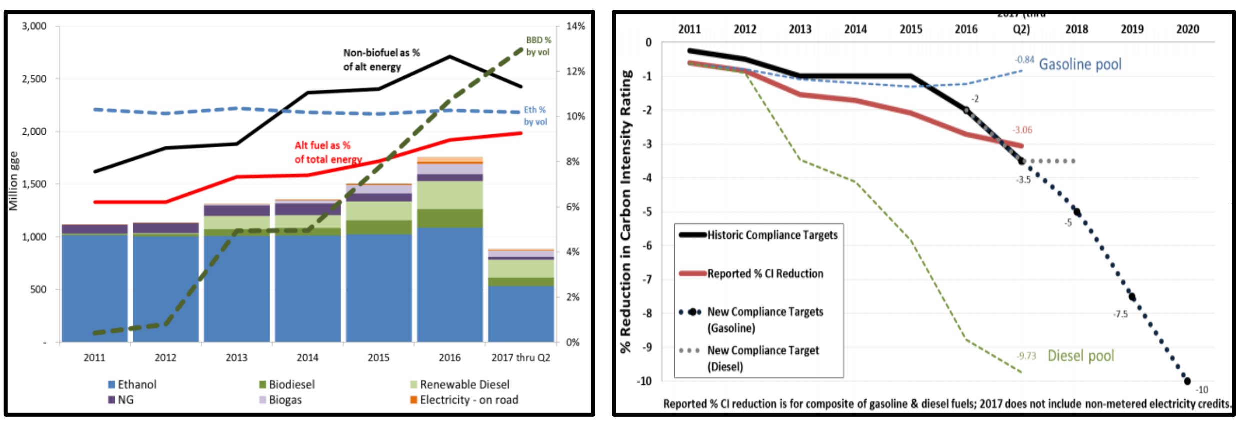
In 2015, the CCPM undertook an inventory of models used in California, identifying three broad categories of models: optimization models (CA-TIMES of UC Davis), equilibrium models (UC BEAR, Berkeley Energy and Resources) and spreadsheet-based scenario development models (E3 Pathways et CALGAPS).[11] Californian modelling expertise also features sectoral and regional models used to model specific areas of the economy, such as the USC REMI PI+ (REMI Policy Insight Plus) macroeconomic model and the NREL LCGS (Low Carbon Grid Study) cost-distribution model.[12] Figure 1 below presents a comparison of projected emissions in 2030 of the different models considered in CCPM for various economic sectors, including transportation—each compared to a 2015 reference scenario. One of the challenges of such dialogues is to understand different modelling results and their implications for policy.

ITS-Davis itself also undertakes important modelling and monitoring efforts of California's transport sector. For example, ITS-Davis regularly produces a review of California's Low Carbon Fuel Standard, one of the key policies of California's climate action plan.[13] This has identified several opportunities and challenges. For example, as demonstrated in Figure 2, while the LCFS has been successful in driving overall reductions in carbon intensity and leading to important increases in the availability of alternative fuels (Figure 2a), such success has largely been due to reductions in the carbon intensity of diesel fuel rather than in gasoline use (Figure 2b). ITS-Davis has pointed to three coming revolutions in transportation, that require careful management and analysis to ensure they lead to a sustainable, low carbon, transportation sector of the future: vehicle electrification, automation, and widespread shared mobility.[14] It is worth stating that ITS-Davis has also been involved in a recent global evaluation of the potential to reduce emissions in the transport sector. This was done by collecting and assessing detailed sectoral studies and comparing these to integrated assessment model (IAM) results.[15]

Figure 2: Some key findings of 2017 Review of California's Low Carbon Fuel Standard

(a) Alternative fuel penetration.

(b) Carbon intensity of fuel pools vis-à-vis LCFS compliance targets.



Source: Witcover, J. (2017) Low Carbon Fuel Standard (LCFS) Update. Presentation to the ITS-Davis Sustainable Transportation Energy Pathways (STEPS) Fall Research Symposium, UC Davis: Davis.

The consulting group Energy Innovation, based in San Francisco, has strong modelling expertise in the energy sector and associated emissions.[16] For example, Energy Innovation has developed the Energy

Policy Simulator, a new model which estimates the relative effect of various emission reduction policies set out in California's *Scoping Plan* in a user-friendly online interface.[17] The Energy Policy Simulator is based on system dynamics which may be contrasted with approaches such as computable general equilibrium (CGE) models or technology-based optimization models. System-dynamics models can contribute significantly to policy-making because they take a feedback approach that captures relatively complex intra-system relationships and focus on aggregate rather than individual dynamics, resulting in relatively simple models that allow for straightforward model runs and policy simulations.[18]

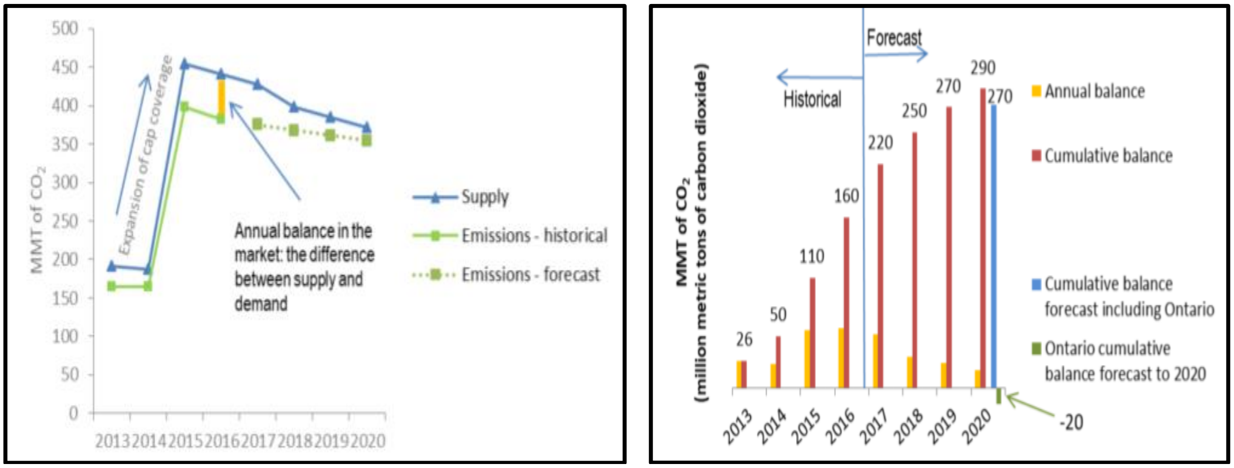
Also important is a recent Energy Innovation analysis of the market balance of the California-Quebec-Ontario carbon market. The concern is that, for a variety of reasons including the inability of models to anticipate accurately the amount of emissions required by firms in the three jurisdictions involved, more emission allowances appear to exist on the market than are necessary. Such oversupply has implications for prices on the carbon market. Energy Innovation estimates that, through 2020, annual oversupply will range between 25-60 MtCO2e, though peaking in 2015-2016 and declining by 2020 (Figure 3). Cumulative oversupply is estimated at 270 MtCO2e for the period 2013-2020 which would, if unaddressed and carried forward towards the 2030 emissions target, possibly render difficult efforts to use the carbon market as a tool to incite emission reductions. While potential oversupply certainly warrants further attention, it is worth pointing out that other observers argue that because of price control mechanisms of the California-Quebec-Ontario carbon market, such as the price floor and price ceiling, oversupply may pose less of a problem that anticipated.[19]

In addition to modelling exercises led by academics and consultants, the California government also possesses considerable in-house modelling capacity. For climate change and energy issues, the two most important are the California Energy Commission (CEC) and the California Air Resources Board (CARB). The CEC collects energy-related data and conducts surveys and assessments of California's energy systems and trends, while also cultivating in-house modelling and analytical capacity for the regular publication of Integrated Energy Policy Reports (IEPRs).[20] CARB is the Californian body responsible for developing climate action plans, most notably in the form of regular *Scoping Plans*. CARB experts use bottom-up and top-down models to evaluate policy options for reducing emissions across all sectors of California's economy, including Energy 2020 and E-DRAM.[21] They also undertake modelling of transportation fuels in its examination of carbon intensity reduction requirements under the Low Carbon Fuel Standard.[22] In addition, CARB has also undertaken modelling exercises of its carbon market linkage with Quebec.[23] Such modelling capacity suggests that modelling has an important impact on policy design and evaluation in California, which we discuss in greater detail below.

Figure 3: Market balance analysis of California-Quebec-Ontario carbon market, 2013-2020

(a) Market balance under trend demand forecast shows oversupply resolving in 2020.

(b) Annual oversupply appears to have peaked in 2016 but cumulative oversupply still climbing. Integrating Ontario does not change the basic dynamic.



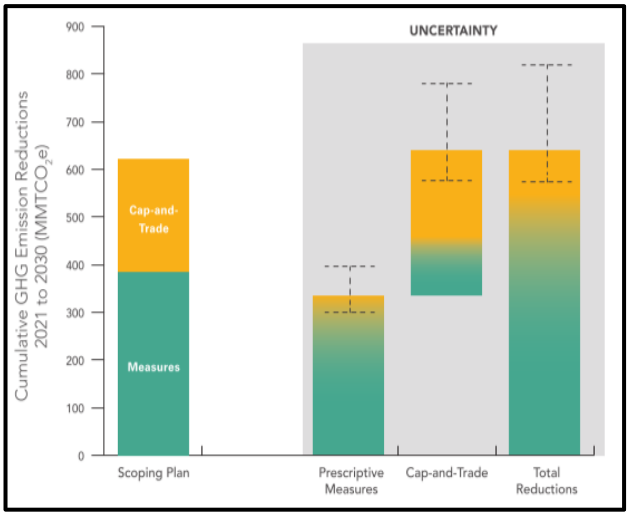
Source: Busch C (2017) Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation, San Francisco, pages 20-21.

MODELLING AND DECISION-MAKING IN CALIFORNIA

The relative autonomy enjoyed by California within the American federal system explains the exceptional capacities of CEC and CARB for energy and climate policy implementation.[24] Ideally, modelling assists policy-makers to identify the appropriate mix and sequencing of various technologies and incentives to reach policy goals. Ideally, this should proceed in a three-step iterative cycle where models help decision makers evaluate and revaluate policy options: (i) technology assessment and sector data collection; (ii) scenario development and modelling; (iii) evaluate results against goals.

The clearest example of the role of modelling in California's climate policy decision-making is found in the *Scoping Plan* outlining the strategy for achieving the state's greenhouse gas target. The Californian administration is required to develop and update every five years a comprehensive *Scoping Plan* to "identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms, and potential monetary and nonmonetary incentives" in order to attain California's emission reduction goal.[25] The 2008 *Scoping Plan* and the 2017 update have been informed by sophisticated economic modelling.[26] Marking a significant increase in modelling sophistication, the 2017 update includes an assessment of uncertainty of the relative effectiveness of the carbon market and related policies and measures (Figure 4). However, it is worth noting that the general strategy in 2017 remains similar to that of 2008: policies and measures such as the Low Carbon Fuel Standard are intended to drive the majority of California's emission reductions, with the carbon market accounting for remaining reductions. To the degree that policies and measures underperform, rising prices on the carbon market are expected to play a larger role in achieving the emission reduction target.

Figure 4: Uncertainty analysis of emission outcomes set out in California's 2017 *Scoping Plan*



Source: CARB (2017) California's 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target, California Air Resources Board, Sacramento, page 29.

However, the manner in which modelling outputs are integrated in the Californian decision-making process is difficult for policy experts to evaluate. For example, models such as those reviewed by the CCPM are not designed to optimize the choice of policies, rather they estimate the costs of policies identified by analysts and are not necessarily those selected by decision makers. Nor do they capture the benefits of switching to other policies if modelled options turn out to be incorrect. Perhaps more significant for the transport sector, most models like those discussed at the most recent CCPM tend to use broad assumptions to characterize local-level policy-making despite the fact that Californian local governments and agencies have a major role to play in climate policy implementation. This is particularly important for transport, where major decisions about infrastructure and land-using planning are made at the local level.

For example, the 2016 California State Freight Action Plan (CSFAP) envisions that sustainable freight system will "Utilize a partnership of federal, State, regional, local, community, and industry stakeholders to move freight in California on a modern, safe, integrated, and resilient system that continues to support California's economy, jobs, and healthy, livable communities."[27] Higher-resolution models appropriate for local-level decision-making and also qualitative approaches will be necessary to implement the CSFAP successfully. METRANS Transportation Center, based at University of Southern California (USC), is an important academic research center focused on mitigation in the transportation sector. Its research combines qualitative and quantitative approaches to assess the impact of climate policies in the transportation sector.[28]

Finally, when discussing the role of energy and transport system modelling in the decision-making process, it is also important to underline the uncertainty surrounding the scenario modelling and cost assumptions, especially of emerging technologies. Conveying findings along with uncertainties to decision-makers is a key challenge. It is particularly at this level where the JCCTRP hopes contribute, by help decision-makers and the public understand what energy and transport system models can and can't tell us.

CONCLUSION

California is a global leader in modelling and their application to climate and transport policies. The state has advanced energy-system modelling capacities in academia, private sector as well as government that are formally integrated into the decision-making process. The economic impact of the carbon market linking Quebec, California and Ontario is also being modelled. The California Climate Policy Modelling (CCPM) Dialogue is a testament to the considerable interest in integrating various modelling expertise and to further informed and critical reflection on the use, evolution and development of models to assist decision-making. To be held in 2018, the next meeting of the CCPM will accord considerable attention to the transportation sector and to the limitations of principal existing models.

The role of energy and transport modelling in California also raises important issues for the political economy of sustainability transitions. The importance given to modelling in California appears to demonstrate how state planning and liberal economic policy can be bridged in an effective manner. It is increasingly recognized that governments can be a key partner in the social and technological innovation process.[29] This role may need to be intensified to transition in an efficient and timely manner to low-carbon energy systems and fight climate change. However, despite the considerable sophistication and effort put into planning Californian climate policy, much of the modelling appears concentrated at the state-level which might overlook local-level challenges with transport policy implementation. We anticipate that the implementation of transport solutions at the regional, municipal and local levels will seek out finer-resolution and spatially-explicit models that aid with infrastructure and land-use planning.

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[1] IPCC (2014) Mitigation of Climate Chang: Summary for Policymakers, in Climate Change 2014: Mitigation of Climate Change Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Edenhofer O, Pichs-Madruga R, Sokona Y, Farahani E, Kadner S, Seyboth K, Adler A, Baum I, Brunner S, Eickemeier P, Kriemann B, Savolainen J, Schlömer S, von Stechow C, Zwickel T and Minx JC eds) pp 1-30, Cambridge University Press, Cambridge, United Kingdom and New York, NY.

[2] Hale T (2016) "All Hands on Deck": The Paris Agreement and Nonstate Climate Action. Global Environmental Politics; Hale T, Held D and Young K (2013) Gridlock: why global cooperation is failing when we need it most, Polity; Victor D (2011) Global Warming Gridlock, Cambridge University Press, Cambridge.

[3] Bulkeley H, Andonova L, Betsill MM, Compagnon D, Hale T, Hoffmann MJ, Newell P, Paterson M, Roger C and VanDeveer SD (2014) Transnational climate change governance, Cambridge University Press; Schreurs MA (2008) From the Bottom Up: Local and Subnational Climate Change Politics. The Journal of Environment & Development 17:343-355; Sabel CF and Victor DG (2017) Governing global problems under uncertainty: making bottom-up climate policy work. Climatic Change 144:15-27.

[4] Bang G, Victor DG and Andresen S (2017) California's Cap-and-Trade System: Diffusion and Lessons. Global Environmental Politics 17:12-30; Houle D, Lachapelle E and Purdon M (2015) The Comparative Politics of Sub-Federal Cap-and-trade: Implementing the Western Climate Initiative. Global Environmental Politics 15:49-73; Klinsky S (2013) Bottom-up Policy Lessons Emerging from the Western Climate Initiative's Development Challenges. Climate Policy 13:143-169; Mazmanian DA, Jurewitz J and Nelson H (2008) California's Climate Change Policy: The Case of a Subnational State Actor Tackling a Global Challenge. The Journal of Environment & Development 17:401-423; Purdon M, Houle D and Lachapelle E (2014) Mapping the Political Economy of California and Quebec's Cap-and-Trade Systems, Sustainable Prosperity, Ottawa; Purdon M and Sinclair-Desgagné N (2015) Les retombées économiques

prévues du marché du carbone conjoint de Californie et du Québec. Notes & Analyses sur les États-Unis/on the USA 29.

[5] OMECC (2014) Ontario's Climate Change Update 2014, Ontario Ministry of the Environment and Climate Change, Toronto, page 7; Purdon M, Houle D and Lachapelle E (2014) Mapping the Political Economy of California and Quebec's Cap-and-Trade Systems, Sustainable Prosperity, Ottawa, page 10.

[6] Siders D (2016) Jerry Brown signs major climate bill: 'This is big, and I hope it sends a message across the country', in The Sacramento Bee, website (accessed October 3, 2016): http://wwwsacbeecom/news/politics-government/capitol-alert/article100651307html, Saramento.

[7] https://www.arb.ca.gov/cc/pillars/pillars.htm

[8] CDOT (2016) California Sustainable Freight Action Plan, California Department of Transportation, Sacramento, page 10.

[9] UC Davis Sustainable Transportation Energy Pathways, site Web : https://steps.ucdavis.edu ; UC Davis Institute of Transportation Studies, site Web : https://its.ucdavis.edu/.

[10] California Climate Policy Modeling Dialogue, site Web : https://policyinstitute.ucdavis.edu/initiatives/ccpm/.

[11] Yeh, S., Yang, C., Gibbs, M., Roland-Holst, D., Greenblatt, J., Mahone, A., Wei, D., Brinkman, G., Cunningham, J., Eggert, A., 2016. A modeling comparison of deep greenhouse gas emissions reduction scenarios by 2030 in California. Energy Strategy Reviews 13, 169-180.

[12] Ibid.

[13] Yeh, S., Witcover, J., 2016. Status Review of California's Low Carbon Fuel Standard, 2011-2015. UC Davis, Institute of Transportation Studies: Davis.

[14] Fulton, L., Mason, J., Meroux, D., 2017. Three Revolutions in Urban Transportation. Institute of Transportation Studies, UC Davis, Davis, California. Institute of Transportation Studies, UC Davis, Davis, California.

[15] Kobayashi, S., Fulton, L., Figueroa, M., 2017. What can Transport Deliver?: Contrasting Scenario Pathways with New Technology Penetration. UC Davis, Institute of Transportation Studies: Davis.

[16] Energy Innovation, site Web: http://energyinnovation.org/.

[17] https://us.energypolicy.solutions/scenarios/home

[18] Ghaffarzadegan, N., Lyneis, J., Richardson, G.P., 2011. How small system dynamics models can help the public policy process. System Dynamics Review 27, 22-44.

[19] Borenstein S and Bushnell J (2018) California's Carbon Cap is Not in Jeopardy, Because It's Not Really a Cap, Energy Institute at Haas, Stanford University. Website (accessed 10 January 2018): https://energyathaas.wordpress.com/2018/01/02/californias-carbon-cap-is-not-in-jeopardy-because-its-not-really-a-cap/, Stanford.

[20] CEC (2017) Energy Assessments Division, California Energy Commission, Sacramento. Website (accessed 24 February 2017): http://www.energy.ca.gov/assessments/.

[21] CARB (2010) Economic Models, California Air Resources Board. Website (accessed February 3, 2017): https://www.arb.ca.gov/cc/scopingplan/economics-sp/models/models.htm, Saramento; E3 (2017) Tools: PATHWAYS Model, E3. Website (accessed February 3, 2017): https://www.ethree.com/tools/pathways-model/#, San Francisco.

[22] CARB (2018) Final 2017 Scoping Plan Update Appendices and Modeling Information, California Air Resources Board. Website (accessed 10 January 2018): https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm, Sacramento.

[23] CARB (2012) 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 Compliance Instruments Issued by Linked Jurisdictions, California Air Resources Board, Sacramento.

[24] Because of California's early e orts to tackle air pollution, the state obtained privileged status under the 1970 Clean Air Act to implement stricter vehicle air pollution regulations than the federal government (Berck P, Braennlund R and Berck CS (2010) Green regulations in California and Sweden. Journal of Natural Resources Policy Research 3:49-61; Hanemann WM (2007) How California Came to Pass AB 32, the Global Warming Solutions Act of 2006. Department of Agricultural & Resource Economics, UCB).

[25] (Núñez, Chapitre 488, Lois de 2006 : §38560, 38561(b))

[26] CARB (2008) Climate Change Scoping Plan: a framework for change, California Air Resources Board, Sacramento. , pages 73-80. To evaluate the economic impacts of the Scoping Plan, the CARB compared estimated economic activity under a business-as-usual (BAU) case to the results obtained when actions recommended in the Plan are implemented. The BAU case represents the forecasted statewide emissions with existing policies and programs, but without any further action to reduce emissions.
[27] CDOT (2016) California Sustainable Freight Action Plan, California Department of Transportation, Sacramento, page 8.
[28] METRANS, site Web : https://www.metrans.org/.
[29] Mazzucato M (2011) The Entrepreneurial State. Soundings 49:131-142.