Stimulating a Canadian narrative for climate

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Abstract

This perspective documents current thinking around climate actions in Canada by synthesizing scholarly proposals made by Sustainable Canada Dialogues (SCD), an informal network of scholars from all 10 provinces, and by reviewing responses from civil society representatives to the scholars' proposals. Motivated by Canada's recent history of repeatedly missing its emissions reduction targets and failing to produce a coherent plan to address climate change, SCD mobilized more than 60 scholars to identify possible pathways towards a low-carbon economy and sustainable society

and invited civil society to comment on the proposed solutions. This perspective illustrates a range of Canadian ideas coming from many sectors of society and a wealth of existing inspiring initiatives. Solutions discussed include climate change governance, low-carbon transition, energy production, and consumption. This process of knowledge synthesis/creation is novel and important because it provides a working model for making connections across academic fields as well as between academia and civil society. The process produces a holistic set of insights and recommendations for climate change actions and a unique model of engagement. The different voices reported here enrich the scope of possible solutions, showing that Canada is brimming with ideas, possibilities, and the will to act.

Key words: climate change, governance, low-carbon transition, energy production, energy consumption

## Stimulating a Canadian narrative for climate action

Past climate change discourses have been characterized either as alarmist (emphasizing the devastation to come), dismissive (rejecting the alarmist discourse), or based on small actions (every small step counts) (Ereaut and Segnit 2006). None of these have led to worldwide climate action at the scale or pace necessary to prevent dangerous anthropogenic climate change (New et al. 2011). Several authors have therefore argued for a new climate change narrative that fosters accelerated action (Moser and Dilling 2007; Risbey 2008).

For Canada, the 2015 October federal election and the December United Nations Framework Convention on Climate Change COP21 meetings offered key opportunities to shift climate discourse. Motivated by Canada's recent history of repeatedly missing its emissions reduction targets and failing to produce a comprehensive climate action plan, Sustainable Canada Dialogues (SCD) (http://sustainablecanadadialogues.ca/en/scd) mobilized more than 60 scholars from all provinces in 2014–2015 to reach a consensus on possible pathways towards a low-carbon economy and sustainable society. This effort resulted in a position paper, "Acting on Climate Change: Solutions from Canadian Scholars", proposing 10 policy orientations that could be implemented now to begin the transition to low-carbon development pathways (Potvin et al. 2015). Bushell et al. (2015) proposed that new climate narratives must be constructed as an iterative process that fully engages relevant stakeholders. The SCD scholars (hereafter scholars), therefore, broadly invited representatives from diverse civil society perspectives to respond to these proposals. Twenty-eight contributions were received, some invited, and others offered, from an Indigenous institution, non-governmental organizations, businesses, labour groups, and private citizens (Fig. 1). These were compiled in "Acting on Climate Change: Extending the Dialogue Among Canadians" (Sharma and Potvin 2015).

This perspective synthesizes scholars' policy orientations and reviews input from the civil society dialogues, documenting the breadth of current thinking around climate actions in Canada. This process of knowledge synthesis/creation is novel and important because it provides a working model for making connections across academic fields as well as between academia and civil society. The process produces a holistic set of insights and recommendations for climate change actions and a unique model of engagement.

Reaching a scholarly consensus

To reach a consensus on desirable climate actions, scholars used a Delphi survey (see Methods in Supplementary Material) to answer the question "Bearing in mind the upcoming federal elections and the United Nations Climate Change Conference, Paris 2015, what key recommendations or solutions do you think *Sustainable Canada Dialogues* could propose to Canadian policymakers to
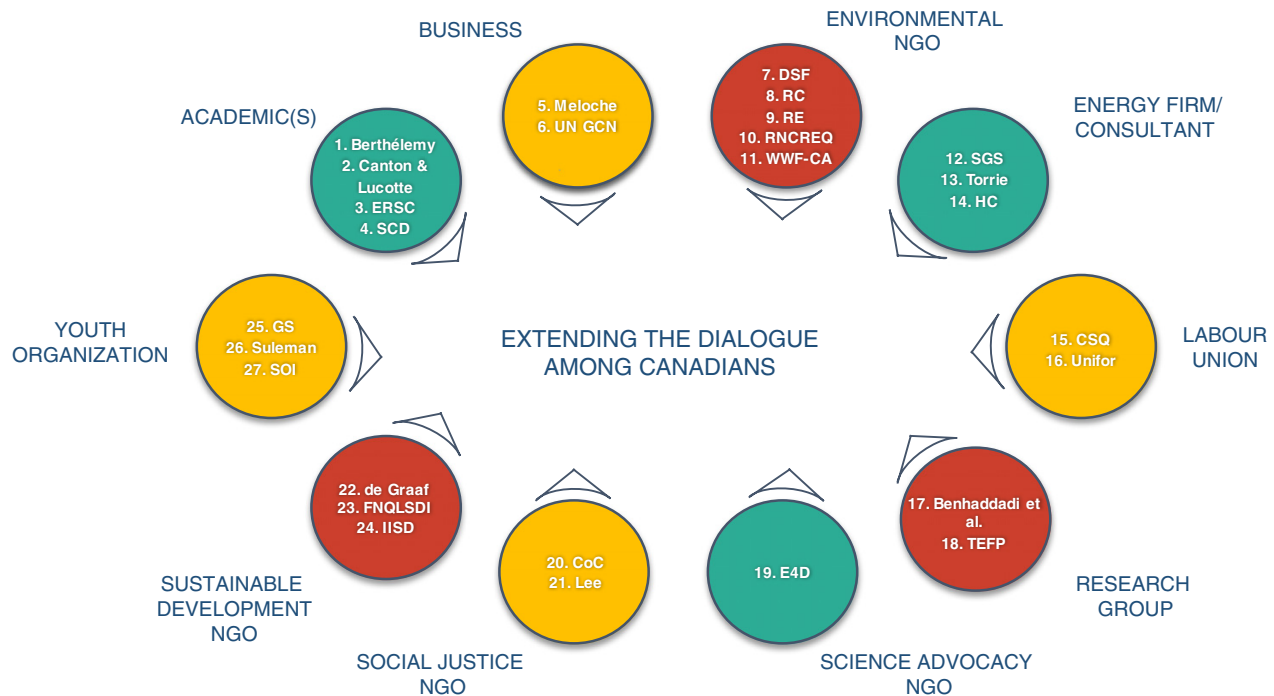
Fig. 1. Contributors to *Acting on Climate Change: Extending the Dialogue Among Canadians*, arranged according to sector of society. 1. Nathalie Berthélemy, 2. Mathieu Canton and Marc Lucotte, Université du Québec à Montréal, 3. Liette Vasseur and Gary Pickering, Environmental Sustainability Research Centre, Brock University, 4. Natalie Richards, Mark Stoddart, Ashlee Cunsolo Willox, Catherine Potvin and the Sustainable Canada Dialogues' Visioning Team, 5. François Meloche, Bâtirente, 6. United Nations Global Compact Network Environment Committee, 7. Ian Bruce and Ryan Kadowaki, David Suzuki Foundation, 8. Michael Small and Claire Havens, Renewable Cities, 9. Caroline Sanchez Valero, Réseau Environnement, 10. Philippe Bourke and Cédric Chaperon, Regroupement national des conseils régionaux de l'environnement du Québec, 11. David Miller, Susan Evans and Farid Sharifi, WWF-Canada, 12. Adam Day and Sean Fleming, Solar Global Solutions, 13. Ralph Torrie, Torrie Smith Associates, 14. Philip Raphals and Rick Hendriks, Helios Centre, 15. Erik Bouchard-Boulianne and Jean Robitaille, la Centrale des syndicats du Québec, 16. Lana Payne and Jim Stanford, Unifor, 17. Mohammed Benhaddadi, Pierre Blanchet, Jean-François Boucher, Jean-François Desgroseilliers, Érick Lachapelle, Isabelle Lessard, Annie Levasseur, Paul Lewis, Valérie Patreau, André Potvin, Johanne Saint-Charles, Juan Torres and Cathy Vaillancourt, Centre interdisciplinaire de recherche en opérationnalisation du développement durable, 18. Alex Boston, Trottier Energy Futures Project, 19. W.R. Peltier, John Stone, Tim Takaro and Alana Westwood, Evidence for Democracy, 20. Andrea Donahue-Harden, Council of Canadians, 21. Marc Lee, Canadian Centre for Policy Alternatives, 22. Megan de Graaf, Fundy Biosphere Reserve, 23. Catherine Béland and Michael Ross, First Nations of Quebec and Labrador Sustainable Development Institute, 24. Scott Vaughan, International Institute for Sustainable Development, 25. Paul Kershaw, Generation Squeeze, 26. Shazeen Suleman, Canadian Commission for UNESCO Youth Advisory Group, and 27. Corinne Cadoret and Noah Picard-Simon, NordMAB's Students On Ice. See http://sustainablecanadadialogues.ca/en/scd/extendingthedialogue.

foster sustainable development in Canada?". The first survey round resulted in 299 statements, many of which were "operational solutions" such as "Compel manufacturers to include their vehicle's greenhouse gas emissions in advertisements"; "Each new urban development project should contribute towards the creation of walkable pedestrian-oriented communities"; "Build an electric train in the Quebec-Windsor corridor"; and "All government purchases should be smart and fair trade". Together, these initial statements represent a wealth of ideas that could serve to stimulate actions (**Table S1**).

The Delphi survey continued for two additional rounds. In round 2, scholars were asked to rate the initial 299 statements according to their perceived importance. The 51 statements receiving a high median score and low interquartile range in round 2 served as input for round 3 in which actions were ranked for achievability and potential impact. The most highly ranked statements focused principally

on energy (seven statements), urban design, and transportation (six statements) (Table S1). It is noteworthy that five of the seven statements pertaining to energy addressed fossil fuel production; for example, "Federal and provincial governments should avoid costly and irrevocable investments in obsolete energy sources (e.g., fossil fuel-based) and technologies in the short term". Transportation was similarly dominant in the selected statements, being the focus of five out of six, including "Integrate sustainable development and climate change into the heart of territorial and urban planning (laws, orientation, etc.), including incentives to reduce reliance on cars, supporting greater expansion of public transportation, tolls in areas with heavier traffic, improving current road infrastructure without creating new roads, etc." (Table 1).

Climate change governance

Scholars' proposal

Canada's failure to meet its emissions reduction targets has been attributed in part to the absence of a cohesive vision across governmental levels (Jones 2014), highlighting again the importance of governance. Long-term low-carbon transition entails application of policies that are most appropriate according to their place and the current state of regional knowledge, then systematically monitoring progress and adjusting efforts over time based on lessons learned (Meadowcroft 2011). Scholars therefore envisioned climate governance as a multi-level process of cooperation and collaboration between citizens and different government levels: municipal, territorial, provincial, federal, and Indigenous.

Many different routes and pathways can be consistent with a low-carbon future in Canada. Decarbonisation priorities in Quebec (with its hydro-based electricity system) will be different from those in Alberta (which relies extensively on coal for electricity and whose hydrocarbon extraction sector constitutes a large component of the provincial economy). Different regions will therefore opt for distinct combinations of these and other technologies depending on their visions, energy portfolio (CESAR 2016), and emissions sectors (Layzell 2014).

Civil society responses

Calls for novel multi-level climate governance were at the heart of 18 out of 28 contributions received. Civil society responses emphasized the need for clear federal leadership (Bruce and Kadowaki 2015; Peltier et al. 2015; Sanchez Valero 2015; GCNCEC 2015). Vaughan (2015) proposed a clear and predictable federal regulatory framework would create opportunities for transition which, according to Canada's Global Compact environment committee (GCNCEC 2015), could stimulate businesses to integrate climate change considerations into their strategies. According to Bruce and Kadowaki (2015), Canada would be on course to meet its emissions reduction target of 17% by 2020 had it adopted, in 2008, the best existing provincial emissions reduction policies in a national framework. Several civil society responses emphasized the crucial role of cities and local government leadership in transitioning to low-carbon (Boston 2015; Bourke and Chaperon 2015; Sanchez Valero 2015; Small and Havens 2015) because they concentrate wealth, innovation, education, consumption, and emissions, as well as poverty and vulnerability.

Civil society contributors also felt climate change governance should be participatory (Benhaddadi et al. 2015; Richards et al. 2015) and evidence-based (Kershaw 2015; Peltier et al. 2015), allowing all Canadians to act on the future at hand by engaging in a transition (de Graaf 2015; Robitaille 2015; Vasseur and Pickering 2015). Some contributors called for inclusion of youth (Cadoret and Picard-Simon 2015; Kershaw 2015; Robitaille 2015; Suleman 2015) and local knowledge (Benhaddadi et al. 2015; de Graaf 2015; Richards et al. 2015; Robitaille 2015; Vasseur and Pickering 2015) in the climate narrative, while acknowledging the jurisdictional status of Indigenous peoples (Béland and Ross 2015).

Table 1. Statements retained in round 3 of the Delphi survey that asked SCD scholars "Bearing in mind the upcoming federal elections and the United Nations Climate Change Conference, Paris 2015, what key recommendations or solutions do you think *Sustainable Canada Dialogues* could propose to Canadian policymakers to foster sustainable development in Canada?".

Topic	Statement
Energy	
	1. Federal and provincial governments should develop a national energy policy and long-term plans, respectively, for transitioning to a mainly renewable energy economy. *Note: One scholar stresses that this statement needs to be fine-tuned. Renewable energy is not the answer to everything and not all renewable energy is sustainable.*
	2. Terminate direct and indirect domestic subsidization of the petroleum industry. Redirect these funds to initiatives aiming to reduce GHG emissions.
	3. Support international efforts to end fossil fuel subsidies globally.
	4. Implement a moratorium on further development of the oil sands.

	5. Immediately embark on a trajectory of ending oil sand extraction in Alberta within 10 years:
	  i. Continuing to do so will put the world on the most aggressive CO_2 growth curve, spelling disaster;
	  ii. Continuing to do so endangers downstream ecosystems in Alberta.

	6. Federal and provincial governments should avoid costly and irrevocable investments in obsolete energy sources, e.g., fossil fuel-based technologies, in the short term.
	7. Novel energy policies should promote renewable energy, low energy consumption, residential insulation, and the use of environmentally sound designs. Environmental performance considerations should be integrated into federal decision-making processes. Aggressive policies need not be expensive (e.g., adding solar hot water to every new house would be ~1% of the house's value.
Low-carbon policy	
	1. Develop a national climate change policy.
	2. Put a price on carbon either by joining the international carbon market or through a carbon tax for all enterprises operating in Canada.
Cities/transportation	
	1. Set national automobile emission standards that match regions with "best practices" (i.e., California within North America).
	2. Introduce more rapid transit within cities. Rapid transit need not be expensive (e.g., no need for subways), but can be facilitated by clever use of buses (see example of Jaime Lerner in Curitiba, Brazil (Adler 2016)).
	3. Support sustainable transportation initiatives at the municipal level, including through federal infrastructure money.
	4. Integrate sustainable development and climate change into the heart of territorial and urban planning (laws, orientation, etc.), including incentives to move away from reliance on cars, support for greater expansion of public transportation, tolls in areas with heavier traffic, improvements to current road infrastructure without creating new roads, etc.
	5. Create "smart cities", which means that all of the systems (water, waste, energy, transportation, buildings, etc.) are made sustainable, clean, accessible, and integrated and connected using clean advanced technologies. In doing so, enforce sustainable sourcing for new building and retrofits.
	6. Develop new building codes that improve housing sector energy efficiency. (Homeowners often weigh the upfront price of a house more heavily than operating costs; this makes it important to use the building code rather than rely on builders and homebuyers to make the best decision independently.)
Land use	
	1. Decrease deforestation practices and increase protection of forests—natural carbon sinks.

(continued)

Table 1. (*concluded*)

Topic	Statement
Information, education, and research	
	1. Inform society on climate change mitigation and adaptation so that everyone can understand the key issues and act on them. Inform the necessary stakeholders and decision makers of the risks and available options linked to climate change and promote dialogue regarding possible measures of mitigation and adaptation.
	2. Promote applied research in the domain of sustainable cities, taking into account mitigation of and adaptation to climate change impacts.

Note: Statements with high feasibility and potential impact (i.e., with median score of 3 and a low dispersion (interquartile range of 0 ($N = 2$) or 1 ($N = 16$)) were retained. A total of 43 scholars answered at least one of the three rounds. For further details, see **Supplementary Methods**.

Furthermore, Vasseur and Pickering (2015) proposed a shift in decision-making and mindset to embrace both adaptive and anticipatory governance as a stepping stone to a more resilient country in the face of climate change, because benefits for public health (Peltier et al. 2015; Suleman 2015), biodiversity (Boston 2015; Miller et al. 2015; GCNCEC 2015), water (de Graaf 2015; Donahue-Harden 2015; GCNCEC 2015), and social equity (Béland and Ross 2015; Donahue-Harden 2015) could emerge from a well-designed low-carbon transition.

Implementation

Scholars indicated that effective climate change governance should (i) favour policy coherence and alignment within governments; (ii) support policy congruence between levels of government; and (iii) enhance participatory policy development to close implementation gaps. Canada has past experience in governance innovations that can be drawn upon to facilitate climate governance. Examples include the Canadian Council of Environment Ministers and the national, provincial, and municipal round tables on environment and economy, and their structural arrangements (Dale 2005).

According to Bourke and Chaperon (2015), fully engaging with municipalities would enable identification of locally appropriate promising climate actions. Sanchez Valero (2015) proposed as initial steps that every municipality have a greenhouse gas inventory and an action plan to reduce emissions and support increased public awareness, as illustrated by the Federation of Canadian Municipalities in *Partners for Climate Protection* (**Table 2**), a guide for municipalities towards climate action. Indeed, creation of such municipal inventories in British Columbia triggered by the 2008 Climate Action Plan (Province of British Columbia 2008) was part of a much wider suite of climate change actions that followed (Burch et al. 2014). In Quebec, the initiative *Par notre propre énergie* provided a platform to showcase innovative projects that reduce fossil fuel consumption, thus favouring knowledge sharing and stimulating the low-carbon transition (**Table 2**).

Climate change awareness will play a key role in implementing efficient climate change governance (Bourke and Chaperon 2015; Sanchez Valero 2015; GCNCEC 2015). Experiences of the Fundy Biosphere Reserve (de Graaf 2015), Brundtland schools (Robitaille 2015), Youth Advisory Group for the Canadian Commission for UNESCO (Suleman 2015), and Students On Ice (Cadoret and Picard-Simon 2015) are examples of tangible initiatives that raise awareness and engage youth in the pursuit of a sustainable society (**Table 2**).

Table 2. Existing Canadian initiatives cited in both *Acting on Climate Change: Solutions from Scholars* and *Extending the Dialogue Among Canadians* reports that reflect proposals of SCD and civil society and provide guidance on how the low-carbon transition can be operationalized.

Contribution	Name of initiative	Description	Link
Energy production			
	Montreal Carbon Pledge	Measures carbon footprint of investment portfolios	http://montrealpledge.org
	Suncor	Invests in technology to reduce environmental impact	http://www.suncor.com/default.aspx
	Par notre propre énergie	Creates conditions to reduce oil dependence in Quebec	http://www.par-notre-propre-energie.com
	High Conservation Value framework of Forest Stewardship Council	Identifies places of high ecological value to avoid in renewable projects	https://ic.fsc.org/en/smallholders/support/technical-materials/high-conservation-values-and-biodiversity
	Investment in wind energy in Paintearth County and Pincher Creek, Alberta	Establishment of wind farms in districts of Alberta	http://canwea.ca/wp-content/uploads/2014/01/canwea-AB-brochure-e-web-v1.pdf
	Ontario feed-in tariff program	Payments for renewable energy use to encourage investment	http://fit.powerauthority.on.ca
	Divest McGill	Campaigns for McGill University to divest its endowment from the fossil fuel industry	http://divestmcgill.com
	Columbia Hydro Constructors	Implemented employment equity programs in the late 1990s that provided training and opportunities for marginalized groups in the province	http://columbiapower.org/about/
	Sustainable Development Technology Canada	Provides venture capital to support precommercialization development of clean technology options	https://www.sdtc.ca/en
	Climate Change and Emissions Management initiative	Provides start-up capital to promising clean technologies	http://ccemc.ca/about/
	Flow-through shares for clean energy modeled after mining industry	—	http://miningtaxcanada.com/flow-through-shares/
Energy consumption			
	Neighbourhood Energy Utility, Vancouver	Recapture of waste water to improve building energy efficiency	http://vancouver.ca/docs/planning/renewable-energy-neighbourhood-utility-factsheet.pdf
	Montreal Transit	Commitment to 100% electrified transit	http://www.stm.info/en/about/major_projects/electrification-surface-system
	ecoENERGY and ENERGY STAR	Programs that improve consumer product efficiency, taking pressure off the grid and helping reduce utility peak energy requirements	http://www.nrcan.gc.ca/energy/funding/current-funding-programs/eii/4985 and http://www.nrcan.gc.ca/energy/products/energystar/12519
	Pay-as-you-save, Manitoba	Manitoba Hydro pays upfront energy upgrade costs and households pay from savings in utility bills	https://www.hydro.mb.ca/NewsReleases/GetDetail?hdnAct=E&hdnTXT='PAYS%20Financing%20Program%20makes%20energy%20efficiency%20more%20accessible'

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Table 2. (*concluded*)

Contribution	Name of initiative	Description	Link
Adaptive governance			
	Établissement vert Brundtland (EVB-CSQ)	Network of institutions to educate public and youth for sustainable development	http://evb.lacsq.org
	Fundy Biosphere Reserve	Enhances communities' and students' climate change adaptation capacity and awareness	http://www.fundy-biosphere.ca/en/
	Canadian Commission for UNESCO Youth Advisory Group	Network of youth to identify youth's concerns, recommendations, and coordinate projects	http://unesco.ca/home-accueil/youth-jeunesse%20new
	NordMAB's Students On Ice	Educational youth expeditions to polar regions	http://studentsonice.com
	Climat municipalités, Quebec	Helps municipalities contribute to climate change mitigation	http://www.mddelcc.gouv.qc.ca/programmes/climat-municipalites/
	Partners for Climate Protection	Promotes GHG reduction initiatives in municipalities	http://www.fcm.ca/home/programs/partners-for-climate-protection.htm

Pricing carbon to begin the transition

Scholars' proposal

Transitioning to a low-carbon economy can be facilitated by climate policies that are (i) environmentally effective, (ii) cost-effective, (iii) administratively feasible, (iv) politically feasible, and (v) equitable. Climate policy analysts widely agree that carbon pricing should be a key component of any comprehensive climate change policy, whether as a carbon tax or cap-and-trade system (Gupta et al. 2014). Carbon pricing is therefore the key enabling policy orientation.

Civil society responses

Several contributors contended the allocated value per tonne of carbon will determine the effect of a carbon price. A low price would have little impact on emissions reduction (Benhaddadi et al. 2015; Torrie 2015; Vaughan 2015), whereas a sufficiently high price could encourage fossil fuel/energy companies to internalize environmental production costs when determining future project viability (Meloche 2015). Vaughan (2015), however, recalled the importance of emissions reductions gained by measures such as efficiency standards, arguing that carbon pricing cannot replace all climate policies, but rather should be one instrument in a climate action toolbox. For GCNCEC (2015), the creation of a more predictable economic or regulatory environment is an advantage of carbon pricing. It envisions that governmental and business sectors working jointly to facilitate the implementation of a carbon pricing strategy could stem from a carbon market working hand-in-hand with renewable energy subsidies and removal of regulatory barriers.

Implementation

Scholars and civil society contributors both recognized that provinces have already invested in different mechanisms to price carbon, and that it will be crucial to coordinate actions among provinces (Benhaddadi et al. 2015; Bruce and Kadowaki 2015). Scholars proposed that any national system would require adaptation by provinces with different existing policy instruments. For example, if a national carbon tax was adopted and Quebec retained its cap-and-trade system, it could either

negotiate an equivalency agreement that ensures its carbon price levels are similar to the rest of Canada or comply with a province-specific emission cap.

Concerns

Pricing carbon raises equity concerns (Benhaddadi et al. 2015; Bouchard-Boulianne 2015; Kershaw 2015; Lee 2015). Because implementation would inevitably raise gasoline and heating oil prices, poor and marginalized households would require support to ensure they do not bear a disproportionate cost of the low-carbon transition (Bouchard-Boulianne 2015). Many Indigenous peoples, for example, live in small, remote, and isolated communities that are off-grid and lack access to public transportation, increasing the proportion of vulnerable households (Béland and Ross 2015). Equity measures associated with carbon pricing such as tax credits or other forms of financial support to lower-income families could increase social acceptability (Benhaddadi et al. 2015; Kershaw 2015), allowing for a higher carbon price that enhances environmental effectiveness while assisting lower-income groups during the transition (Bouchard-Boulianne 2015). Although British Columbia's revenue-neutral carbon tax is often proposed as a model, Lee (2015) suggested using revenue from a carbon tax or market to support climate mitigation and adaptation initiatives that also address social equity.

Energy production

Scholars' proposal

Several policy proposals were geared towards energy production and included favouring low-carbon electricity production, fully integrating the oil and gas sectors in climate policies, and developing a national energy strategy that considers the need for energy efficiency. Wind energy alone could provide several times the existing fossil fuel and nuclear electricity at a competitive cost (Harvey 2013). It could be supplemented by solar photovoltaic, geothermal, ground-based heat recovery, biomass, and biogas to supply a considerable portion of Canada's energy needs (Barrington-Leigh and Ouliaris 2014). Furthermore, diversifying Canada's energy portfolio could improve both energy and economic security (Bridge and Le Billon 2013).

Civil society responses

Many contributions stressed the benefits of clean energy for the Canadian economy and for employment (Bouchard-Boulianne 2015; Bruce and Kadowaki 2015; Day and Fleming 2015; Lee 2015; Miller et al. 2015; Payne and Stanford 2015; Small and Havens 2015; GCNCEC 2015). Small and Havens (2015), however, emphasized the importance of energy efficiency, noting that in North America up to 40% improvement in energy efficiency will be necessary to complete the low-carbon transition they envision. Torrie (2015) observed that all published low-carbon future scenarios require much greater efficiency in electricity and fuel.

Payne and Stanford (2015, p. 71) noted that "Canada's traditional reliance on natural resource industries... complicate[s] the politics and the economics" of low-carbon transitions. Raphals and Hendriks (2015) suggested that natural gas could be used sensibly during the transition. In contrast, Lee (2015) argued that retaining fossil fuel reserves in the ground is necessary to reduce emissions by 80% by 2050. Some expressed unease because expanding oil sands extraction could increase Canada's emissions by an approximated 100 Mt per year, preventing the country from meeting even a low-ambition emissions reduction target (Berthélemy 2015; Donahue-Harden 2015). Because oil extraction and export are interconnected, Donahue-Harden (2015) demands that pipeline expansion be stopped. GCNCEC (2015), however, points to emerging best practices in the Canadian oil industry: for example, Suncor manages risk and takes advantage of opportunity through technological innovations such as reducing tailings, which are byproducts of the bitumen extraction process.

Implementation

Scholars proposed capitalizing on current hydroelectric production and plentiful untapped renewable energy resources by creating east–west intelligent grid connections between provinces. Torrie (2015, p. 61) emphasized the need to consider how the "new electric grid" could accelerate renewable energy deployment by "including an array of information technologies, energy storage techniques, responsive demand technologies, and a transmission and distribution infrastructure". Because a new electrical grid would modulate the shift to renewable energy, Vaughan (2015, p. 38) called for links between "structurally rigid and capital-intensive systems (such as hydro) and more networked and modular energy innovations such as electric vehicles and wind", whereas Day and Fleming (2015) raised the potential for microgrid technologies to take full advantage of solar photovoltaics.

Civil society contributions cited a number of existing renewable energy programs and initiatives such as investment in wind energy in Paintearth County and Pincher Creek, Alberta (**Table 2**).

In an energy-constrained world, regulatory frameworks must stimulate effective energy management (GCNCEC 2015). Potential gains in emissions reduction and fossil fuel displacement could be achieved with efficiency standards and a national energy policy (Benhaddadi et al. 2015; Boston 2015; Bruce and Kadowaki 2015; Donahue-Harden 2015; Torrie 2015). Recognizing that energy decision-making is currently fragmented (with production, transport, consumption, and relevant jurisdictions largely considered in isolation), the adoption of a life-cycle approach to energy and development projects would enable accounting for both upstream and downstream impacts (Benhaddadi et al. 2015; Donahue-Harden 2015).

Finally, several contributions indicated that ceasing fossil fuel subsidies and divesting from high-carbon industries would be vital for stimulating the low-carbon transition (Donahue-Harden 2015; Kershaw 2015; Lee 2015; Meloche 2015; Richards et al. 2015; Small and Havens 2015; Vaughan 2015). Meloche (2015) described fossil fuels as risky investments for two reasons: (i) it is predicted that fuel demand will decrease with expanding electric car markets and (ii) investors will have to deal with future environmental disruption stemming from their own investments. He proposed the Montreal Carbon Pledge (**Table 2**), an international commitment to measure the carbon footprints of investment portfolios, as a possible first step.

Concerns

Civil society contributors suggested specific policy modifications. For example, removal of barriers to connecting renewable energy to grids (Donahue-Harden 2015) and Ontario's feed-in tariffs as a model (Day and Fleming 2015; Small and Havens 2015) (**Table 2**). Others contended new low-carbon electricity utilities should be either publicly- or community-owned, so as not to disenfranchise the least well off (Donahue-Harden 2015; Lee 2015).

Contributions from civil society revealed broad social justice concerns. Several contributors emphasized that energy efficiency programs should ensure social and economic benefits in meeting energy needs such as creating jobs and reducing social inequity (Donahue-Harden 2015; Kershaw 2015; Payne and Stanford 2015) to ensure that poor households and marginalized communities have access to energy-efficient appliances and heating/cooling systems (Donahue-Harden 2015). Columbia Hydro Construction, which implemented employment equity programs in the late 1990s and provided training and opportunities for marginalized groups, is an example that could be emulated (**Table 2**).

Recognizing that natural resource extraction and transportation, including renewable energy projects, often take place on Indigenous territories, deployment of the "new grid" must acknowledge First Nations, Inuit, and Métis as full partners (Béland and Ross 2015; Donahue-Harden 2015). This would

entail not only culturally relevant consultations and free, prior, and informed consent (Donahue-Harden 2015), but also renewable energy project ownership, full partnership or leadership, and fair sharing of benefits derived from electric network restructuring including access to low-carbon electricity (Béland and Ross 2015).

Contributors also expressed concern over potential adverse effects of hydropower expansion (Bourke and Chaperon 2015; Raphals and Hendriks 2015). Hydroelectric dams impact ecosystems and affect local populations by reducing territorial access and potentially altering eating habits and food security due to mercury contamination in the first decades of operation (Canton and Lucotte 2015). Maximizing reservoirs' use—for example, using them to harvest wind as well as hydro energy—could alleviate some concerns (Canton and Lucotte 2015). In addition, negative effects of new hydroelectric dams could be reduced by following existing best practices such as avoiding area-intensive developments in high or sensitive biodiversity zones (Miller et al. 2015). Béland and Ross (2015, p. 15) remarked that "construction of ... new infrastructures will inevitably take place on Aboriginal land. The consultation, collaboration, and prior consent of the affected First Nation communities should therefore be prerequisites to the implementation of an energy policy ...".

Finally, a frequent argument for continued support of the fossil fuel sector is the widespread notion of "no oil, no jobs" (Payne and Stanford 2015; Robitaille 2015). The low-carbon shift would profoundly impact job markets. Workers in shrinking sectors would need to be offered training and re-qualification for new jobs (Bouchard-Boulianne 2015; Donahue-Harden 2015; Lee 2015). These risks led some contributors to call for divestment from fossil fuels and investment in renewable energies (Donahue-Harden 2015; Meloche 2015; Small and Havens 2015). Expanding sectors such as home renovation, energy efficiency, and public transport infrastructure could then benefit from job creation (Bouchard-Boulianne 2015; Lee 2015; Payne and Stanford 2015; Robitaille 2015).

Energy consumption

Scholars' proposal

Realistic visions for a sustainable Canada require new ways of contemplating mobility (Richard and Perl 2010), shifting public attitudes and behaviours, and forward-thinking decision-making that provides access to alternative mobility modes. In Canada, energy consumption centres around two primary areas: (i) transportation (24% of emissions) and (ii) buildings (11% of emissions) (Environment Canada 2013). Despite a 29% countrywide improvement in building energy efficiency between 1990 and 2007, overall energy use jumped 7% due to an increase in number of households and average home size (Office of Energy Efficiency 2010). Cities, home to 81% of Canadians, concentrate emissions and could become foci of mitigation actions. Local governments have control over critical sources of emissions such as those related to transport (Betsill 2001; Bulkeley and Betsill 2005). Furthermore, climate change impacts are often felt at the scale of cities (Wilbanks and Sathaye 2007).

Many factors combine to affect choice of transportation mode, including household structure, age, gender, time and cost of trips on various networks, parking availability and cost at destination, presence of children in the household and their travel needs, level of car ownership, and weather conditions. When rethinking Canada's transportation system, development of new transportation technology and changing behaviour as it relates to mobility are important goals for innovation and could be magnets for research and development. Landscape and open-space planning is tied to mobility; "smart" city planning reduces the need to travel and creates space for active transportation such as bicycling and walking. Throughout Canada, cities are increasing urban density, mixed land uses, and nonautomobile transportation options, while encouraging climate-friendly buildings and reduced energy consumption. Energy, transport, and building infrastructure last several decades and lock

development along specific pathways (Lecocq and Shalizi 2014). Government investment should bear in mind that infrastructures built today must foster and sustain the transition to a low-carbon future (Nilsson and Eckerberg 2007). The Government of Canada's Green Infrastructure Fund could therefore play a key role in the Canadian transition (Infrastructure Canada 2015). By 2035, nearly three quarters of Canada's buildings will be new or renovated, offering the opportunity to promote a less carbon-intensive built environment.

Civil society responses

Low-carbon transportation involving more diverse modes and increased transit options (Benhaddadi et al. 2015; Payne and Stanford 2015; Sanchez Valero 2015) may provide numerous benefits. These could include expansion of the car-sharing economy (Boston 2015), job opportunities vis-à-vis creation of public transportation infrastructure (Bouchard-Boulianne 2015; Payne and Stanford 2015), enhancement of quality of life through reduced noise pollution, commuting time and road accidents (Lee 2015), and improving public health (Boston 2015; Lee 2015; Suleman 2015). According to Benhaddadi et al. (2015), city design supported by principles of functional and social density and diversity must include access points to efficient public transit networks. Similarly, Torrie (2015) envisions mixed-use, high-density cities reducing emissions, fuelled by reduced car dependence and changes in mobility needs. Boston's (2015) ideal future Canadian cities have a mixed-use neighbourhood model where, just like costs of transportation, costs of pollution are internalized. Additionally, for Lee (2015), "complete communities" should reflect social equity across ages, incomes, and abilities, by offering affordable housing, accessible residential homes, and care units.

Implementation

Scholars recognized the need for novel institutional frameworks and financing options that would enable municipalities to play a crucial role in choosing and implementing climate actions related to energy consumption. Land value tax financing alone is insufficient, because it can facilitate developer-led urban sprawl. New financing approaches such as divesting from planned road and highway expenses could be considered. Valuation of natural and constructed landscapes for ecosystem functioning and environmental management benefits (e.g., climate change mitigation via thermal cooling; Hough 2004), would be an important paradigm shift in municipal and provincial planning.

For Small and Havens (2015), electric public transit systems should be a primary focus of action. Diversification and increased availability of urban and interurban transit will help reduce the "single-occupant car" paradigm (Sanchez Valero 2015), whereas regulations could also play a key role in increasing passenger and freight vehicle efficiency (Bruce and Kadowaki 2015). Biofuels are proposed as a potential contribution to low-carbon transportation (Bruce and Kadowaki 2015; Sanchez Valero 2015; Torrie 2015). Benhaddadi et al. (2015) suggested engaging the forestry sector in the low-carbon transition via carbon stock management and biofuel production to help sustain local economies.

Cities could facilitate the adoption of renewable energy through district energy, producing and distributing renewable energy for heating and hot water (Boston 2015; Lee 2015; Small and Havens 2015). Existing buildings could harness local renewable energy such as geothermal power (Small and Havens 2015); however new building codes and efficiency standards are also needed (Benhaddadi et al. 2015; Small and Havens 2015). Building form has an impact on energy efficiency: multiplexes, row houses, and townhouses are more efficient than standalone houses, whereas wood-frame low-rises can be 25% less expensive to build than concrete buildings (Benhaddadi et al. 2015; Teasell, cited in Boston 2015).

Concerns

Béland and Ross (2015) observed that Indigenous communities have a distinct reality; federal funding should aim to collaboratively improve quality of life on and off reserves as well as develop culturally and environmentally appropriate buildings. Donahue-Harden (2015) supported retrofitting programs' incorporation of mechanisms to reduce social inequity. Manitoba's pay-as-you-save program, through which Manitoba Hydro pays upfront energy upgrade costs and households pay from utility bill savings, was cited as an inspiring example (**Table 2**). Boston (2015) called for win-win situations like establishing secondary suites or separate units in low-occupancy homes for additional income during retirement.

A new climate narrative: learning from the past

The first lesson—emphasized by the scholars as well as by several contributors from civil society—is that many past extraction projects did not engage in meaningful consultation and led to little or no benefit sharing with Indigenous peoples (Béland and Ross 2015). Low-carbon pathways must include full nation-to-nation partnerships with Canadian Indigenous peoples, who from the onset should play a key role as full partners in the transition's dialogue and implementation (Béland and Ross 2015; Donahue-Harden 2015; Payne and Stanford 2015). Given Indigenous Title, Indigenous and Treaty Rights of First Nations, Inuit Land Claims, and the special circumstances of Métis and Non-Status Indians, the distinct jurisdictions of Indigenous peoples must be acknowledged in practice (Béland and Ross 2015). It is essential to recognize Indigenous peoples' abilities and rights to manage resources and lands and the role of traditional ecological knowledge for more sustainable community development.

A second lesson, highlighted by Payne and Stanford (2015), concerns the pace at which natural resources, especially, but not only, oil, are extracted. Shifting away from our "boom and bust" mentality (e.g., bulk export of raw bitumen) would facilitate the creation of more sustainable development pathways. This would ensure long-term jobs by increasing Canada's value-added contributions to natural resources both downstream and upstream of the point of extraction. In fact, Canadian energy productivity is one of the lowest of the Organization for Economic Cooperation and Development (OECD) countries (OECD 2016). Torrie (2015) suggested that energy productivity could improve if the service economy and manufacturing expanded at the expense of primary processing.

Torrie (2015) offered a third lesson when he proposed reframing the low-carbon transition challenge to facilitate the emergence of socially attractive solutions. Adoption of green buildings, he argued, is facilitated by their aesthetic, technical, and marketable value, whereas improvements in energy use are often considered secondary co-benefits. "Personal transportation" could likewise be reframed as "access", including all decisions and behaviours that reduce demand for personal mobility such as telecommuting, working from home, and teleshopping.

It has been proposed that in a democracy collaboration between responsible enterprises and engaged civil society is necessary to address global issues such as climate change (Mintzberg 2015). This paper demonstrates the existence of a range of Canadian solutions from diverse sectors of society (**Table S2**) and a wealth of existing inspiring initiatives (**Table 2**). Together with renewed leadership at the federal level (Ayed 2015) and the willingness of provincial governments and Indigenous leaders to engage in dialogue, this suggests that Canada is currently well-positioned to improve its climate action record. Noting the inability of a doom-and-gloom narrative of climate change to evoke concerted action, SCD reframed the issue to one of opportunities and solutions, garnering lavish praise from the media (see e.g., "Un plan Marshall pour le Canada"; Asselin 2015). We hope the iterative process of creating a climate narrative, including the search for consensus, broad engagement, and solution-oriented discourse, could be used to inform discussion on climate change in Canada as the country follows its COP21 commitments.

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Competing interests

The authors have declared that no competing interests exist.

Data accessibility statement

All relevant data are within the paper and in the Supplementary Material.

Supplementary material

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Supplementary Material 1

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