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Carolyn J. Hatch, Diane-Gabrielle Tremblay, Laurence Cazabon-Sansfaçon

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THE ROLE OF SOCIAL ACTORS IN ADVANCING A GREEN TRANSITION: THE CASE OF QUÉBEC'S CLEANTECH CLUSTER

Carolyn J. HATCH

*TÉLUQ, Université du Québec, Canada
hatch.carolyn@gmail.com*

Diane-Gabrielle TREMBLAY

*TÉLUQ, Université du Québec, Canada
dgtrembl@teluq.ca*

Laurence CAZABON-SANSFAÇON

*University of Québec at Montréal, Canada
cazabon-sansfacon.laurence@uqam.ca*

ABSTRACT

This article investigates the role of a local cluster as a mechanism for addressing the institutional challenges of the green transition, with a focus on how local cluster dynamics shape the position and mobilization of social actors. It involves a case study of Québec's cleantech industry cluster and twenty-five interviews with leading industry, intermediary and union stakeholders representing the diversity of the local industry. We found that in addition to the conventional role of enhancing innovation and commercialization in the local industry, the cluster also plays a formative role in shaping the position and collective mobilization of actors vis-à-vis the green transition, a global social movement toward a greener and healthier world.

Keywords: Innovation, Clusters, Actors, Intermediaries, Green Transition, Cleantech, Unions.

JEL Codes: L10, O35, O30, P40

The COP21 negotiations highlighted the critical need for economic actors at all levels to mobilize in the transition to a green economy, defined by the United Nations (UN) as a low carbon, resource-efficient, and socially-inclusive economy. Much of the research aimed at understanding the impacts of climate change and customizing policy to promote green growth has focused on the national and/or sectoral levels, even though the impacts and activities geared to reducing greenhouse gas emissions are highly localized. However, there are exceptions, as some authors have studied the construction and role of local strategies, pointing to the importance of strengthening local innovation capacities such as knowledge flows, networks and institutions in order to facilitate adaptation (Smith *et al.*, 2010; Grin *et al.*, 2010; Rosenzweig, Wilbanks, 2010; Smit, Wandel, 2006). This perspective fits with the extensive research on the role of local industry clusters in advancing local and regional innovation (Porter, 1990; Spencer *et al.*, 2009), yet addressing issues other than climate change.

The purpose of this paper is to investigate the role of a local cleantech cluster as a mechanism in addressing the institutional challenges of a green transition, with a focus on how local cluster dynamics and intermediaries shape the position and collective mobilization of actors. The empirical analysis involves a case study of Québec's cleantech industry cluster, Écotech Québec, founded in 2008 by three entrepreneurs in the local industry. Today, the cluster brings together the key decision makers of the cleantech industry in Québec.

This paper proceeds as follows. We begin by considering the current literature on clusters and the green transition. We then outline the details of the Écotech case study and the qualitative methods employed. In the next section, we discuss the empirical findings in reference to the position of actors on key questions about climate change and the green transition, as well as the role of actors, their degree of agency, and collective mobilization towards green growth efforts. We then investigate the way in which the local cleantech cluster shapes these positions and actions, and we conclude by considering questions for further research.

CLUSTERS AND THE GREEN TRANSITION

The Institutional Foundations of a Transition to a Green Economy

For the past three decades, the international community has been increasingly aware of the seriousness of climate change and its potential impact on human populations. As demonstrated by the Intergovernmental Panel on

Climate Change (IPCC) in its 2014 synthesis report, “*Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems*” (IPCC, 2014:8). Global efforts have since been made to tackle this growing phenomenon, from the Kyoto Protocol of 1997 to the Paris Agreement of 2015. During the 1990s, two concepts dominated the environmental discourse: sustainable development and ecological modernization (Berger *et al.*, 2001). Sustainable development, which slowly made an impact on the economy during the 1990s, revolves around social, economic and environmental dimensions, each given equal measure to achieve an equitable, sustainable economic development (ILO, 2015; Audet, 2017). The concept of ecological modernization emerged to identify a shift in industrial production, suggesting climate change can be tackled within the existing political, economic and social structures (Audet, 2017). In other words, the solution to a greener future lies with technological innovations and market mechanisms.

In the early 2000s, the concept of ‘green transition,’ or ‘transition to a green economy,’ was introduced into the public discourse by a variety of political and economic actors (UNEP, 2011), calling for a fundamental shift to an economic system that is less damaging to the environment. This discourse on transition has taken root in the research community (Boulanger, 2008; Kemp, Loorbach, 2006; Geels, Schot, 2010), as well as among environmental social movements (Switch in Québec, for example) and international organizations (UNEP, OECD, ILO). UNEP (2011) defines the green economy as ‘low carbon, resource efficient and socially inclusive,’ thereby addressing the combined forces of global economic recession, humanly-induced climate change, and socio-economic inequalities (Davies, 2013).

As many have highlighted, transformation into a greener economy as defined by UNEP calls for a fundamental transformation of existing development practices to meet the complex bundling of policy goals: social, economic and environmental. These multiple dimensions blend technological innovation, traditionally seen as disruptive, with social and environmental progress, prompting calls for a new ‘global social contract,’ and a ‘global remodeling of economy and society towards sustainability’ (WBGU, 2011), often through a ‘new technological revolution’ (UNDESA, 2011).

Since action happens extremely locally, among municipalities, firms and local intermediaries and organizations on the ground, we consider the institutional characteristics of the local scale as critically important in shaping the position and collective mobilization of social actors in the transition to a greener and healthier economy. We highlight two important considerations regarding the local institutional arrangements that support a transformation

of this nature. First, there is a need to broaden the traditional (i.e. mainstream economics) sphere of cluster actors to encompass nontraditional parties like activist coalitions, environmental NGOs, trade unions and the like in order to meet the social justice and environmental dimensions of green growth. As Davies (2013) points out, despite strong neoliberal forces that are inherently at play, the open and inclusive nature of cleantech cluster actors can constitute a viable transition pathway. Second, given the diverse (and often conflicting) array of actors in the environmental arena, there is a need to establish forms of economic organization and governance geared to a high degree of collaboration and consensus on the goals and pathways to green growth.

To this end, the emerging global cleantech industry has been quick to brand itself as the source of technological solutions and fixes for the climate crisis (Caprotti, 2011). The Cleantech Group, a US-based industry body, describes cleantech not as a sector, but as an 'ecosystem' of firms, technologies and service providers that can drive societal adaptation to climate change (Cleantech Group, 2009), thus serving as a nexus between technological innovation and capitalist growth, on the one hand, and a socio-environmental project, on the other.

Adaptation and the Role of Industry Clusters

This paper is concerned with the role of a local industry cluster as a mechanism for green growth. In Canada and in Québec, the concept of industrial cluster has proven advantageous for several economic sectors and has attracted foreign investment, and the city of Montréal adopted a strategy of industrial clusters in the late 1990s.

A broad body of literature in regional economic development has focused on the role of clusters in promoting firm productivity, innovation and economic prosperity (Porter, 1990, 1998, 2003; Krugman, 1991; Martin, Sunley, 2003; Gertler, Wolfe, 2006; Wolfe, Gertler, 2004; Asheim *et al.*, 2006; Spencer *et al.*, 2009). Inspired by the thinking of Marshall (1927) on the nature of agglomeration economies, the origins of the cluster concept can be traced to the influential work of Porter (1990, 1998), who has defined the term as follows:

Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, trade associations) in a particular field that compete but also cooperate. (1998, pp. 197-198).

The crux of this literature is that the co-location of economic actors contributes to mutual learning and knowledge exchange, and that these conditions ultimately support innovation and its commercialization.

As in the Montréal cleantech case, outside of academia, clusters have been widely adopted as a policy tool for local economic development based on the argument that they provide the foundation for economic prosperity for local and regional economies (OECD, 2010). The central idea of this approach is that institutions and regulations can directly shape cluster dynamics, and thereby strengthen the competitiveness of local (and therefore national) economies (OECD, 1999; Porter *et al.*, 2001; Anderson *et al.*, 2004). Though the purpose of the different policy instruments will vary depending on the type of cluster and specific regional needs, commonly used investments tend to support the engagement of actors, business linkages, collective services and common projects (OECD, 2010).

The governance of clusters is based on intermediary actors (such as the organization, Écotech) that facilitate the conditions of knowledge sharing, linkages and collective action between stakeholders, in certain contexts creating the conditions for a democratic, multi-stakeholder governance. Intermediaries are defined in the literature as entities (organizations or individuals) that enable economic actors (such as firms) to access the external sources needed for innovation (Tremblay *et al.*, 2012; Julien, 2005; Smedlund, 2006). This is said to be achieved by both direct and indirect means: either by explicitly making resources available, or acting as a broker to facilitate linkages with other actors who hold the resources.

Though there has been a large body of literature on the role of clusters (and intermediaries) in advancing knowledge exchange and innovation, the idea of clusters as transformative agents of change towards a green economy is a relatively new field. In their study of a sustainable energy cluster in the Northeastern US, McCauley and Stephens (2012) examine the potential of a cluster to contribute to a socio-technical transition. The crux of this work is the role of local institutions and 'buzz' in fostering trust between actors towards sustainable energy solutions, and is one we have seen before in the mainstream theory. Yet this work also goes beyond the traditional cluster approach by recognizing the inclusive and open nature of stakeholder participation in a local cluster strategy, which includes non-traditional partners such as activists and the local citizenry alongside classic industry, government and university players.

Picking up on this very idea, Yang *et al.* (2012) discuss the multiplicity of actors involved in the environmental sector, acknowledging the important role for a wide array of participants and local communities within

enviro-innovation spaces. In a similar vein, others have stressed the increasingly pluralistic nature of environmental eco-innovation (Davies, 2013; Carayannis, Campbell, 2010; Leydesdorff, 2012; Horwitch, Mulloth, 2010). Extending this line of thought further, Bulkeley and Schroeder (2012) identify the ways in which boundaries between spheres (public, private and civil society) of governance are being blurred in the environmental arena, bringing about the emergence of new forms of collaborative engagement such as public-private alliances, business- NGO relationships and other so-called 'hybrid' governing partnerships.

Beyond both the environmental sector and the notion of stakeholder participation, Torre and Zimmerman (2015) discuss the growing complexity of local clusters (in all sectors) given their integration into the global evolution of contemporary economies. Borrowing from the natural environment and evolutionary ecology, they propose the notion of 'ecosystem' to capture the true complexity of localized industrial systems in a context of intensified globalization.

The increased complexity of cluster dynamics in a global economy along with the heightened plurality of stakeholder involvement in the environmental realm remain clear, as distinctly outlined in the above literature. Yet given these new and emerging forms of economic partnerships and governance arrangements, how do cluster dynamics shape the position and collective mobilization of social actors with respect to a transition to a more sustainable, equitable economy? This topic has not been fully explored in the existing literature, and constitutes the focus of this article.

CASE STUDY AND METHODS

Montréal Metropolitan Community (MMC)

The Montréal Metropolitan Community (MMC) describes clusters as a model designed to stimulate the creation of conditions in which new ideas and processes can pass the embryo stages to be marketed and provide a return to stakeholders (Communauté métropolitaine de Montréal, 2008a). In 2002, Montréal International worked with industry to develop an action plan for positioning the metropolitan area, and in 2005, the Communauté métropolitaine de Montréal (CMM) included in its development plan a strategy for metropolitan clusters and a fund providing financial support. In its economic development plan for 2011–2017, Montréal strengthened the cluster strategy. There were 15 clusters planned in 2004, of which Écotech is a part, and nine are currently structured and have their own governance body (Montréal, 2011).

The CMM is responsible for the planning and coordination of clusters, but does not substitute for local actors. Stakeholders should be part of a governance body, a non-profit organization under the auspices of a board of professionals. This organization must develop a business plan with goals of growth, value, performance indicators and operate in a consensual approach. Clusters should also develop a strategy for development over ten years. The funding is then provided by the three levels of government (municipal, provincial, federal), once the private sector has made its contribution, which should be equivalent to that of other partners (25%) (Tremblay *et al.*, 2012). These clusters are therefore institutions that foster collective action between stakeholders. Mobilization towards a green transition is therefore very much developed through collective action achieved through the involvement of local actors in the Écotech cluster.

Écotech Québec: The Cleantech Industry Cluster

In the above context of political support at all levels, the cleantech cluster Écotech was founded by local entrepreneurs who set up the initial governance structure, formalized in 2009. Écotech brings together all the key decision makers of the cleantech sector of Québec, including innovative technology producers, research and tech transfer organizations, end-users, the finance community, the sectoral committee, trade unions, and industry organizations. Today, Québec's cleantech ecosystem represents about 500 innovative exporting companies (94% are SMEs, with 70% active on international markets), over 30,000 jobs, a total revenue of \$10.7 billion, and over 200 research centers and associations.

As its mission suggests, Écotech has the dual (and complementary) goal to grow the cleantech sector and promote a greener Québec. To do so, it mobilizes the key players in the green economy to create the most favorable conditions for the development and growth of companies, and encourages end-users to increase the adoption and deployment of clean technologies. It achieves its mandate through four actions: knowledge, networking, positioning and public policy. In partnership with key players from Québec, Canada and the world, the cluster is said to contribute to the development of clean technologies from all of Québec's regions.

Methodology and Research Approach

This research focuses on understanding how the institutional characteristics of a local cluster strategy shape the position and mobilization of social actors in addressing the challenges of a green transition. In order to address

this broad question, we conducted an in-depth study of Québec’s cleantech industry cluster, Écotech Québec. Research is based on a review of the literature as well as detailed semi-structured interviews with Écotech actors representing the full diversity of the cleantech industry, conducted in 2016 and 2017. This includes end-user companies and organizations, innovative cleantech companies, R&D, education and professional development organizations, industry associations, risk capital and finance, cleantech influencers (engineering firms) and labour unions. In total, we conducted twenty-five interviews in French or English of between thirty minutes and 1.5 hours in length. For purposes of the analysis, we grouped interview participants in three groups to distinguish between 1: industry actors, 2: intermediary actors, and 3: labour unions (see Table 1).

Table 1: List of interview participants	
Interview participant	Reference
enterprise developing clean technology	Industry 1
enterprise developing clean technology	Industry 2
enterprise using clean technology	Industry 3
industry association promoting clean technology	Industry 3
enterprise developing clean technology	Industry 5
engineering firm promoting clean technology adoption	Industry 6
enterprise developing clean technology	Industry 7
enterprise developing clean technology	Industry 8
industry association general	Industry 9
industry association promoting clean technology	Industry 10
sectoral committee	Intermediary 1
industrial cluster	Intermediary 2
research and development	Intermediary 3
risk capital and finance	Intermediary 4
coalition for green economy	Intermediary 5
risk capital and finance	Intermediary 6
regional development organization	Intermediary 7
Québec union representing manufacturing and services sectors	Union 1
Québec union representing manufacturing and services sectors	Union 2.1
Québec union representing manufacturing and services sectors	Union 2.2
Québec’s branch of Canada’s biggest private sector union	Union 3.1
Québec’s branch of Canada’s biggest private sector union	Union 3.2
union affiliated with the United Steelworkers	Union 4
small Montréal branch of Québec’s largest trade union	Union 5
public sector union in Québec	Union 6

We interviewed ten cleantech industry actors, highly specialized and technologically sophisticated companies or business groups at the forefront

of their respective fields and pushing the boundaries of a green economy. These actors (typically SMEs) represent various positions along the value chain: upstream technology producers, downstream users, as well as important influencers promoting the use and adoption of innovative clean technologies across many different industry sectors. We also interviewed seven intermediary actors including the cluster, the sectoral committee, research, development and training organizations, economic development entities, an activist coalition, and venture capital/ finance entities.

In addition to industry and intermediary actors, we interviewed eight union actors. Québec is one of Canada's most unionized provinces, with a 37% unionization rate in 2012 (Statistics Canada, 2013). Although the cleantech industry sector is hardly unionized (8%, interviews), unions are involved in the cluster and represented on the Board of Governors of Écotech Québec. They however have their own perspective on the green transition, since their role and goals are quite different from those of the other cluster stakeholders.

The interview guide was designed to address the research question directly. It focused on the position of actors vis-à-vis climate change, the carbon market and the green transition, their degree of action, and collective mobilization (with other social actors) in addressing the challenges of a transition to a greener economy. All interviews were transcribed, translated if necessary, coded and analyzed by theme. The coding themes were: positions and perceptions (of actors) on the green transition; positions and perceptions on the carbon market; positions and perceptions on the economic impacts (of climate change and the transition) on work / employment; public positions on these questions; actions and mobilizations; knowledge of key concepts; influence of cluster dynamics on positions and actions. In the next section, we draw on interview and research findings in order to address our key questions.

FINDINGS

Q1: What are actors' positions on climate change, the green transition, the carbon market, and the impact of these changes on work and employment in Québec?

Industry and Intermediaries

Our research finds that cluster participation and the knowledge sharing and mutual learning between Écotech actors has produced (and reproduced) common positions on these questions, such that the perspectives of both industry

and intermediary actors are similar. As a result, in the following analysis, we combine the perspectives of industry and intermediary interviewees.

On the industry side, many companies have the dual mandate of reducing greenhouse gas emissions while at the same time capitalizing on the business and innovation opportunities cleantech provides. In other words, the firms we interviewed recognize that growth and development are compatible with environmental sustainability, acknowledging the profit opportunities inherent in clean technology development. These companies put environmental sustainability at the center of their competitive goals. This is exemplified by one of the respondents, a systems engineering firm that consults on engineering projects in many different sectors. He says *“For us the environment is not just a matter of dealing with pollutants at the end of the process, but rather is a matter of re-doing the processes so that they generate less pollutants.”* (Industry 6) When asked about their position on climate change and the green transition, responses ranged from *“We are very conscious about climate change,”* on the one hand, to *“Green growth is part of our DNA, it’s why we exist,”* and *“We are part of the solution to a greener and more dynamic economy,”* on the other.

Though these perspectives align with much conventional discourse on cleantech and the green transition, they are given credibility by a representative from Switch, a Québec activist coalition for the green economy and important local partner. Making a link between a green shift and enhanced productivity and competitiveness, he weighs in with a similar perspective to those of his cleantech industry counterparts by saying *“We strongly believe that an economy that espouses a green economy shift will become more efficient and more competitive.”* (Intermediary 5)

We then asked participants about their position on the carbon market and Québec’s cap and trade system, and the economic impacts of climate change and the green transition on employment and work. In our interview sample, virtually all respondents value a price on carbon and view the initiative of the Government of Québec to establish the carbon market along with California as positive, a needed incentive to spur cleantech solutions, foster the adoption of eco-innovations, and promote GHG reduction. Over the years, Switch has intervened publicly and privately in support of the carbon market. However, several concerns were raised, specifically among industry representatives. Some companies suggested there are sector-specific challenges in an effective implementation that need to be addressed. Others argued that it has been frustratingly slow to put in place by the provincial government, thus placing constraints on the pace of cleantech growth. Finally, many voiced a concern that cap and trade needs to expand to other jurisdictions because by leading, Québec is exposing its companies and industries to competitive fragilities.

When asked about the impact of climate change, industry and intermediary actors largely viewed Québec as an area of the planet that will benefit. In the words of one interviewee: *"We know that what's at stake is that climate change has the potential to strengthen Canada's ecosystem, communities and economy. But we see the transition toward a cleaner growth through the adoption of clean technologies."* (Intermediary 2)

Though many acknowledged a warming climate brings serious hardship, mass migration, even war to much of humanity, many respondents felt the environmental effects here would enhance opportunities for biomass and other types of production, presenting economic opportunities. One industry actor said that as companies and individuals learn to adapt, climate change will promote new areas of technological development, such as harnessing new ways to use CO₂. An intermediary argued that even traditional sectors like oil and gas will learn to diversify their portfolios and invest in renewable energies by becoming developers of solar, wind and biomass technologies. One respondent representing a large industry association discussed the impact of an inevitable increased demand for Hydro Québec's clean power to Ontario and the US, which will create wealth and jobs here. He goes on to suggest that:

I think our system is extremely stable so we're going to see more of those Google, Microsoft and other companies that want to have a cloud farm, installing those cloud farms in Québec. They want to have cooler weather but stable electric sources but clean energy because they want to be seen as carbon neutral. So, it's all positive for us. (Industry 9)

When asked about their positions regarding the impact of the green transition on jobs and work, responses were overwhelmingly positive. Most agreed that everybody can gain from the transition. Several suggested that the net impacts on jobs and work will offset the losses, and that an economy that espouses a green shift will be more efficient and competitive, which will in turn create an indirect, positive impact on the rest of the workforce. Several respondents suggested that people will transfer their skills to new industries and eventually adapt, one interviewee comparing the transition to the way people adapted in the information age following the introduction of computers. For Québec and Canada, most agreed that industries and companies doing innovation will prosper, that there will be new products, processes and business models, and that it is an opportunity to create new and high level jobs in both emergent and traditional industries. The skilled environmental and technical specialist and engineering-type jobs that are rapidly in demand will in turn spur dynamism in the local training system as local workforce development aligns with industry need.

So too will there be a substantial impact on the demand for skills and the nature of work, a reality not always construed by industry and intermediary

actors in a positive light. The CEO of a local technology firm discusses in detail the monumental shift in jobs and work that is occurring in the construction industry as society shifts from conventional construction to a greener model involving prefabrication, where standard units are constructed in a factory, shipped and assembled on site. With prefab, as he points out, you can build an 18-story building in three months with nine people, and unlike conventional construction, there is no garbage, no noise, no highway traffic nor impact on the environment. He describes in detail the substantial shift and impact on the nature of skills required and work that this greener model requires:

Obviously, the people that are there are not carpenters or electricians because the flooring and walls are prefabricated. Instead of cutting wood and putting cement, they just snap the floors to the previous ceiling. It's a totally different type of person doing the work. But the salary is much lower than the skilled trades that used to be there. (Industry 5)

In other words, this shift to a more environmentally sustainable building solution can bring both positive and negative impacts upon the world of work. Though most respondents argued that the shift to a greener economy brings quality, skilled jobs, in this construction example, though the product is greener, the process more efficient, the accuracy and quality higher, it comes at the cost of a significantly reduced workforce. As well, the more automated process requires sufficiently lesser skills than a traditional workforce, with the resultant salaries being substantially lower.

Unions

Unions' perspective on these questions differed slightly from that of industry and cluster actors. When asked about their positions towards climate change, union respondents emphasized that union organizations are well aware of the challenges of the fight against climate change, and are willing to play their part in this fight. Some Québec unions took public positions regarding specific environmental issues, for example positioning themselves in favor of a moratorium on oil fracking on Anticosti Island, or expressing doubts regarding the construction of the Énergie Est pipeline. As for the carbon market, most respondents said that unions approve of this initiative, as long as it is not the only tool in place to fight climate change in Québec.

Union respondents had most to say when asked about the impacts of the green transition on jobs. Although they are aware of the impacts of work on the environment, they are also worried about the impacts of the fight against climate change on the future of workers, especially those employed

in traditional sectors such as fossil fuels, where many jobs will be lost, or deeply transformed. Most respondents referred to the concept of *just transition* in relation to this question, meaning that in order to be fair for all, the transition to a greener economy must be planned with the active participation of workers (ILO, 2015):

People working in these polluting industries, if there are to be changes in the next decades, in the next years, first, they need to be consulted, second, they need to be involved, and third we need to find solutions to ensure that these people aren't alone in bearing the costs of this transition. (Union 1)

The planning of the transition was a recurrent topic amongst union respondents. They feel that, at the moment, policies are implemented, laws are passed and economic incentives are put in place, without taking the impacts on workers into consideration. According to one of the respondents, there is a major lack of knowledge regarding which jobs, in which sectors will be impacted by the transition, therefore making it impossible to see the larger picture of relocation and training needs for workers:

It's easy to say, you're making parts for pipelines, now you'll make parts for wind turbines. So instead of working in Montréal, you'll be working in Gaspé. So it's easy to say that green industries will create a lot of jobs, but these jobs need to be adapted to the workers who'll lose their jobs. [...] So we're looking at job creation, and then at jobs that'll be lost, but separately, and I think we need to look at both aspects together if we are to succeed (Union 2.1)

Although most union respondents insisted on their concerns about the future of workers from traditional production sectors, many also admitted that the green transition could be an opportunity for growth and economic development, as it creates new jobs and revitalizes some traditional industrial sectors through technological innovations. Their position is thus more ambiguous than that of the other cleantech industry actors, since they are still closely linked to traditional production sectors potentially on the 'losing side' of the transition.

Q2: What is the role of social actors, their degree of action and collective mobilization in driving a green growth agenda?

Role of Social Actors

In order to investigate the degree of action and collective mobilization of actors, a preliminary step is to understand the role of individual actors

in addressing the challenges of a green transition. We asked our research participants who the important actors are in the transformation to a green economy. Our research shows that the scientific and research community, along with activist organizations and environmental groups, are at the forefront of the green transition. These actors are proactive and play a fundamental role in identifying the impact of climate change, raising the profile and awareness of the issue, raising the intelligence of international organizations, governments and others, and pushing the process forward.

Directly shaped by the knowledge produced and shared by these groups, international organizations like the UN, OECD and ILO, set objectives and put pressure on individual countries, who then translate these policies and recommendations at home.

Because the environmental business is a largely regulation-driven activity, many cited the government as the most important actor, or at least the leading one, in putting policies in place that foster technological innovation and action at the local level. In Canada, this is primarily a provincial mandate (which is why Québec entered the carbon market with California, not Ottawa). As one interviewee puts it, once the provincial government leads by setting those regulations, new markets are created and “*everything else follows.*”

Though the government leads through policy, decisions are made and action is taken extremely locally, within firms, municipalities and institutions and actors on the ground at the local level. In Québec, the local cluster Écotech is very effective in pulling local actors together, acting as a bridge between the different stakeholders and shaping their position and mobilization through common projects, knowledge sharing, and joint taskforces.

Local companies and industry actors capitalize on new market opportunities following the implementation of environmental policies such as cap and trade. One entrepreneur describes it as such:

Montréal in 1981 decided to have a regulation on air pollution control for the manufacturer. And at that time there was not even a Minister of Environment in QC. So, they make a regulation with penalties. It's why we exist today! There was a small local market here in Montréal. I sold my first unit in Montréal in 1990 and we began to develop the technologies, a very small market. At that time, we were driven by governmental regulation. (Industry 2)

Business groups and trade unions are also important stakeholder partners, particularly those representing incumbent industries in a more traditional energy role that will be potentially impacted negatively by the transition. They are critical in fostering awareness of the impacts of a green transition,

identifying the companies and workers that will be disrupted (potentially on the losing end), and in highlighting the costs if that transition does not go well. Moreover, these actors play a role to foster a well-planned and orderly transition, in the best interest of their constituents.

Other important players cited by our respondents are: the sectoral committee (which develops the skills in demand by the environmental value chain), municipal governments (both a critical market for cleantech adoption, and in the vulnerable position of being hardest hit by the impact of climate change), and the finance market and investment community (providers of 'patient capital' required to support innovation and commercialization).

Level of Action: Industry and Intermediary Actors

Industry and intermediary respondents view growth not only as compatible with environmental sustainability, but consider the concepts to be inextricably linked and part of a common innovation framework. Because of this dual-mandate, we found that industry actors in the research sample move beyond their traditional market role of innovating to develop new technologies, commercializing those technologies, and promoting their adoption and use. Virtually all the respondents in the interview sample are also committed to making an environmental and social impact to contribute to the reduction of GHG emissions and a greener and healthier world.

Their level of action, or degree to which they are involved in promoting environmental sustainability and a green transition, is categorized in three levels, from low to high, in the following table (there is some overlap, with social actors taking on multiple levels of action in some cases):

Degree of action	Action	Pathway/tool	Number of actors
low	raise awareness among employees/members, peers and general public; local	knowledge dissemination: shared research and best practice	15
medium	work in collaboration and coalition with partners; local and non-local	policy development	9
high	activist coalition lobbying to raise intelligence, awareness of industry and society; multi-scalar	collective mobilization	2

In the first level, fifteen out of seventeen firms and intermediary partners in our sample are involved to some degree in initiatives geared primarily to raising awareness amongst their employees and/or members, within their

peer communities, and the broader public. These companies and business associations take action through various pathways, the most common being via shared research and best practices.

At a higher level of involvement, nine industry and intermediary actors in the research sample work in coalition and collaboration with their peers along with government agencies and other partners to develop targeted policies aimed at enhancing the transition to a lower GHG emissions economy. Seven are working at the international level alongside the UN and other global players, some in an advisory role to these organizations.

At the highest level of action, we found that two leading industry and intermediary actors have been centrally involved in the creation of Switch, an activist coalition for the green economy in Québec. Switch is a unique organization that is part militant NGO and part business community, with (diverse) members united in the just belief that there is everything to gain out of a transition to a lower carbon economy. Created in 2013, Switch is a Québec alliance of actors from economic, financial, environmental and associative sectors working together towards creating a green economy in the province. The organization stems from the challenges posed by both the environmental and financial crises, and sees this context as an opportunity for Québec's economy to be innovative in order to maintain its competitiveness on the international markets, while being an active protagonist of the transition to a green economy. To this end, it is against pipeline projects and is a powerful advocate for the carbon market in Québec, contributing to the province staying in the market despite pressures from oil lobbies to pull out. Bringing actors from very different backgrounds and set of interests, the alliance created by Switch has worked to serve the goal of boosting the green transition in Québec, independently from those divergent interests.

One of Switch's main goals was to foster public dialogue on a green economy in order to support the elaboration of public policies by the government of Québec, while encouraging public consensus on these issues. To accomplish that goal, Switch published reports and government recommendations, used media platforms to make these recommendations widely available, and got involved in debates about environmental issues in Québec, including the province's participation in the carbon market. Highly successful during a three-year period, Switch has been dormant for a year, opening space for new alliances and similar organizations to emerge to assist the transition of Québec's economy. One of these organizations, Copticom, works with many actors from the environmental and economic sectors, also contributing to creating new alliances between these stakeholders.

One participating firm in the research sample was involved in the founding and governance of Switch and is a member organization, along with

one of the intermediaries we interviewed. As such, these actors are part of global lobbying efforts to raise the intelligence and awareness of government officials, international organizations and the broader public, both local and global, to advocate for a lower GHG emissions economy.

Collective Mobilization of Actors towards a Green Transition

To achieve a greener and cleaner economy, these actors network and interact with large institutions, individuals and key players in a position of agency to advance a cleantech agenda and the green transition movement. The following quote from a leader in the venture capital and finance community exemplifies the degree to which organizations partner and mobilize collectively in pursuit of these broader efforts:

We make concrete actions. We support the green transition cause and we're involved with many other partners, we're a part of the ecosystem. We talk to everybody, from venture capitalists and banks to finance the transition and the solutions to the non-for profits or associations. We speak to the province of QC, to our federal partners. (Intermediary 4)

As this example shows, cluster actors are working in many different coalitions and partnerships with their peers, various entities and organizations, from the local to the global. This includes activist coalitions such as Switch, the R&D community, environmental groups, large international organizations like the UN, government agencies involved in policy-making efforts, and local municipalities and citizens. Moreover, these collaborations are constantly evolving as new organizations form and dismantle to meet specific targets related to the green economy, and as new relationships, priorities and projects arise. Such is the case with Switch, which was very active for years following its founding, yet more recently has become dormant, with activities centered on other organizations such as Copticom.

Role and Involvement of Unions

In the context of the green transition, one of unions' main challenges is to address their members' concerns about their future in a greener economy. Therefore, their main active contribution to the green transition is awareness, by sharing knowledge with their members about climate change, renewable energies, environmental regulations, for example, or by providing tools to assist workers in creating an environmental committee in their workplace. Respondents from different unions emphasized the importance of sharing "success stories" with workers, that is stories of industries that adapted to cleaner energy or production practices without involving major job losses. Unions also invest in green industries and initiatives through

their pension funds, and these investments are one of their most powerful tools available, since these development capital funds are major economic actors in Québec.

Unions work with environmental groups on specific issues and mobilizations, either locally, nationally or internationally. For instance, most Québec unions were represented in a coalition of various social groups at the December 2015 COP21. Through their public positions and mobilizations, unions appear as an important voice in the fight against climate change, at least in the public sphere. They have a high potential for collective mobilization, since unions are historically closely tied to progressive social movements, and they are usually associated with major event such as Earth Days. They however hardly collaborate with the cleantech cluster actors (only one union sits on the board of Écotech). This seems paradoxical since this dynamic sector is probably the best relocation pathway for workers from traditional industrial sectors who might lose their jobs.

Most union respondents argued that the leadership of the fight against climate change must be assumed by governments. Since this leadership is currently still hesitant, unions are lobbying to bring the issue of a just transition to the government's attention. As a result, unions seem to be at a standstill in regards to the fight against climate change, torn between a progressive take on environmental issues and the protection of jobs, and waiting for others to take the lead.

DISCUSSION

The Role of Cluster Dynamics in Shaping the Position and Mobilization of Social Actors

Our research finds that Écotech as a cleantech cluster intermediary plays a fundamental role in creating the local institutional conditions that foster the multi-dimensional aspects of a transformation to a green economy: economic, social and environmental. First, we consider its role in the conventional economic sense of supporting innovation through proximity and knowledge sharing. Then, we discuss a broader role geared to the social justice and sustainability dimensions, as Davies (2013) puts it, its capacity in creating an open institutional space for alternative voices and practices to engage and influence developments. By convening and uniting the manifold array of actors involved in the environmental sphere, it fosters hybrid collaborative alliances and new kinds of economic organization geared to meeting the social justice and environmental components of the green

transition, thereby blurring the boundaries between public, private and civil society sectors (Bulkeley, Schroeder, 2012).

Traditional Innovation Role

Research from the Montréal case study reveals that Écotech plays an important traditional innovation role in engaging social actors and advancing growth in the local industry. This is evident by the development of the local industry to over 450 innovative companies, 1000 organizations and 200 public research groups since its founding in 2009. According to the organization, *"We are a bridge between the different stakeholders. We help the different actors not work in silos."*

By pulling all the actors together around the table, including industry, intermediary and union actors, Écotech creates the social and institutional dynamics that enhance cleantech innovation and knowledge sharing, in three ways. First, by working together on one of five of Écotech's joint taskforces (Regulatory Framework & Taxation, Financing, Innovation & Commercialization, Branding & Internationalization, Skills & Expertise), firms and their innovation partners develop relations and build trust among one another that can lead to the co-creation of future projects and partnerships (beyond the formal cluster). In this way, the cluster fosters inter-firm organization and collaboration between actors. Relationships and trust evolve, and knowledge is shared and circulated via shared best practices and innovation strategies, and through common projects.

Going beyond this knowledge sharing role, Écotech also mobilizes stakeholders to create the best innovation framework for the industry, to ensure the funding value chain is in place, the best talent is available, and the right set of taxation measures and regulations are implemented to provide the appropriate conditions for economic growth.

Finally, research from the interviews shows that Écotech supports the commercialization of cleantech by linking producer firms with the end-user market and promoting its adoption and use. This is a significant aspect of the organization's mandate, not only because cleantech is largely emergent (and thus inherently risky), but also because these technologies have a universal application for use virtually across the economy (in infrastructure, agriculture, the energy sector, mining, and many other areas). Thus, Écotech takes on a critical outreach, awareness and match-making role to leverage cleantech adoption and use among municipalities and corporations across Québec. This role is described by the Écotech interviewee as follows:

We do a lot of match making between cities and clean technology innovators. For example, next week we're going to have a discussion with the

Agri-food and agriculture business sector. And we are going to present them Québec companies that have been developing intellectual property in clean technologies that can have a very good impact on reducing their emissions. So, we want to address the environmental problems of corporations, industry and municipalities. And then when we have identified those challenges, we've bridged the gap between those people having challenges, and the innovators, the SMEs that have the solutions.

Nontraditional Role

As the case study analysis suggests, Écotech also goes well beyond the typical economic role, a role that is associated in the cluster literature with enhancing local and regional economic competitiveness (Porter, 1998; Andersson *et al.*, 2004; Asheim *et al.*, 2006). By convening local social actors and promoting knowledge exchange and collaborative engagement, the cluster also produces (and reproduces) the positionality of actors vis-à-vis the green transition, promoting their active and often highly politicized participation in a global social movement. This explains why we find the perspectives of industry and intermediary actors on key questions (concerning the impact of climate change, the carbon market, and how the green transition impacts work and employment) to be similar, despite the fact that many represent opposite poles on a spectrum, from the finance entities and technology producers on the one end, to activist organizations and the unions representing workers, on the other. As our research finds, Écotech not only shapes the positionality of cluster actors, it also facilitates their collective mobilization in the fight against climate change, and fosters their participation in the transformation of production processes towards a greener world.

Interestingly, we find that historically apolitical industry and corporate actors like the technology producers and their partners have assumed a growing political role, as demonstrated by their deep outreach and engagement efforts to foster awareness about climate issues, culminating in their involvement in the highly activist, militant coalition in Québec, Switch.

CONCLUSION

By creating a common voice, Écotech is a transformative agent of change, bringing the manifold actors and agents involved in the local environmental sector together to affect change through collaboration and association. As an intermediary organization, it facilitates alignment between often divergent and conflicting interests, creating the institutional conditions whereby power and influence ebb and flow within local governance arrangements

through the capacity to convene parties, and create and disseminate knowledge, practices and environmental values. Thus, Écotech makes change through the creation of relationships and new institutional spaces and shared-decision-making processes, bringing together multiple actors from different spheres of activity, and blending hybrid governance arrangements (Bulkeley, Schroeder (2012)). In this way, the cluster fosters the interplay of forces where an array of actors mobilize, coordinate, collaborate, broker and bridge in ways that make new kinds of economic organization possible (Allen, Cochrane, 2007), providing a nexus between disparate groups to unite, organize and make progress. In so doing it shapes the position and collective mobilization of social actors in the transformation to a greener and more equitable economy.

According to Davies (2013), the means and mechanisms of transiting towards a greener economy have led to the expansion of more grounded coalitions involving not only NGOs but also trade unions and workers keen to ensure that such transitions will be fair and sustainable (Swelling, Annecke, 2012). Often presented under the banner of a 'Just Transition', these coalitions support a movement towards a de-carbonized world yet seek to avoid the unorderly transitions of the past, such as during periods of de-industrialization in the US and UK during the 20th century, which negatively impacted entire communities dependent on those industries. Such politicized actors argue for social justice and the fair distribution of costs as well as economic benefits that may occur.

Yet interestingly, the historically politicized actors in our sample, the unions, have assumed an uncharacteristically low profile in Québec. Québec unions are mostly linked to traditional industrial sectors, hence complicating their participation, and there is a preoccupation about the future of the unions themselves, since the green industries are traditionally less unionized. Despite the potential threat the transition poses to jobs and work of their member base, the labour unions have not been strong allies in the green transition effort of the industrial sector in Québec, nor have they dedicated significant resources to it in the past.

Organizations like Switch, on the other hand, realize they need labour on their side to progress towards their policy goals, well aware that workers are asking vital questions regarding the transition, like "will I lose my job?" Yet only one of Québec's major unions was involved in specific Switch activities. In this way, our findings in Québec show that the workers, unions and organizations such as Switch share the same goal: a transition with minimum impact on workers, but for the most part, are acting separately. Although Switch's activities were directly geared towards facilitating an orderly, well

planned and well executed transition for workers and communities, we do not find evidence of a strong partnership between the parties.

However, research also suggests that though unions have come late to the issue of the fight against climate change, in the past few years they have gained some momentum and increasingly see climate change and the energy transition as significant issues that need to be tackled, particularly concerning industrial occupations like the pipe liners and refiners, where there is a great deal of uncertainty about the future of jobs and work. These constitute important considerations for future research.

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