A clean electricity power generator, which is part of the investment in new tech energy. ABB photo

Energy Innovation and COP21

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While the general public may have seen the COP21 agreement in Paris in late 2015 as a beginning, it was actually a culmination of years of painstaking policy transitioning aimed at mainstreaming clean energy development. In Canada, much of the economic infrastructure to that end was already in place by last year, with energy innovations in a diverse array of fields now ready for scale-up. And the firms commercializing these solutions are already substantial employers.

On the first day of COP21 in Paris, Mission Innovation (MI), was launched by Bill Gates with US President Barack Obama, French President François Hollande and Indian Prime Minister Narendra Modi. MI's state-level participants pledged to double investments in clean energy research by 2020, to attain the de-carbonization goals contemplated beyond 2030. In addition, 28 wealthy investors started the Breakthrough Energy Coalition, a fund whose intent is to spur private and public sector cooperation and to raise investment in clean energy innovation. These energy innovation

initiatives follow on from the New Climate Economy's proposals for policy action to support low carbon innovation (Global Commission on the Economy and Climate 2015).

Global governance entities made reference to innovation in the lead-up to Paris, but generally with a post-2030 focus. For example, the Organization for Economic Co-operation and Development (OECD) made no mention of the potential impact of innovation in the pre-2020 period, but rather made proposals for quadrupling green infrastructure investment to US$1 trillion; stopping fossil fuel subsidies; making carbon markets more effective; decarbonizing transportation; and increasing development assistance through climate finance. The OECD continued to call for global emissions peaking by 2030 and zero net emissions by 2100—a goal adopted by the G7 in 2015.

For its part, the International Energy Agency (IEA) proposals, to contribute half of the GHG reductions needed to achieve peak global emissions around 2020, had innovation and clean technology shouldering a greater share of the GHG-reduction burden in the future, but did not make it an immediate priority .

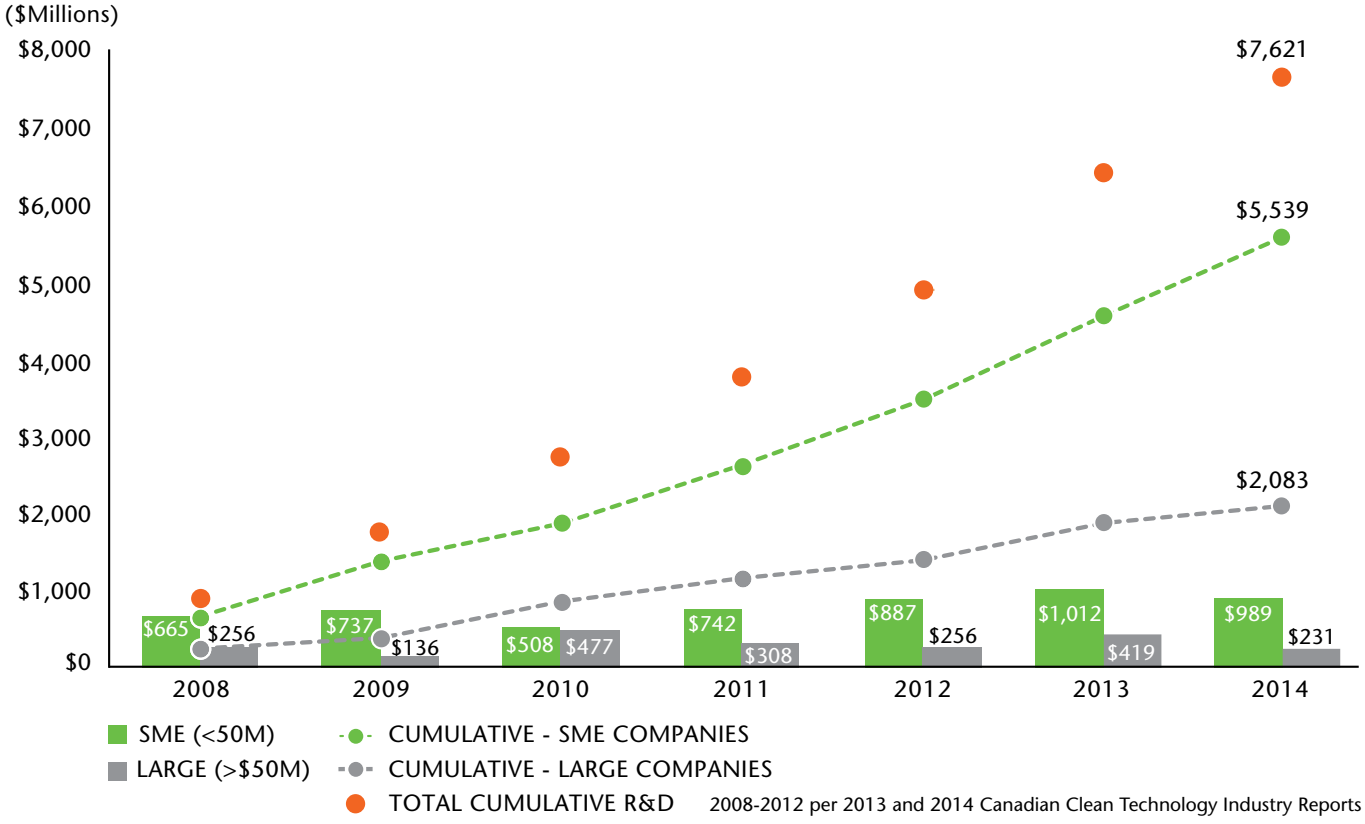
The United Nations itself advanced the Lima-Paris Action Agenda (LPAA) as a framework for non-state actors to track, coordinate and leverage efforts. Under the LPAA, non-state actors translate 'Intended Nationally Determined Contributions' into cooperative or individual initiatives, under seven differentiated areas in which innovation is implied but not explicitly addressed.

Policy leaders will need multiple policy interventions in order to enable scale-up of energy innovations within electricity, built environment, transportation and fuel systems. Coordinated policy implementation will facilitate GHG reductions and emergence of sectors with growing numbers of high quality jobs.

A Canadian case study, based on five years of firm-level research, suggests that first-generation energy innovation policies have succeeded in spurring private sector investment at scale and have produced solutions that could contribute to achieving global GHG peaking, if the capital costs for first-in-kind demonstration projects can be reduced through the same fiscal measures that have enabled wind and solar technologies to commercialize and compete with fossil fuels such as coal, natural gas and petroleum.

Based on a cohort of 814 firms, annual investment in R&D by Canada's clean technology industry was C$1.2 billion in 2014. This was equivalent to private sector R&D investment in the aerospace industry and to 9 per cent of total national private sector R&D. These R&D investments represented 10 percent of industry revenues or about 2.5 times the Canadian phar-

Annual and Cumulative R&D Investments by Canadian Clean Technology Companies—SME Versus Large Companies (2008 To 2014)



Source: Canadian Clean Technology Industry Report (Bak 2015a).

maceutical industry's R&D intensity. To translate these R&D projects into practice, 250 demonstration projects worth $2.9 billion in combined private and public sector investments have been funded over 14 years by Sustainable Development Technology Canada (SDTC).

In the Canadian case study, historical energy innovation policies, including fiscal measures for accelerated depreciation of capital costs, fiscal R&D credits for labour and program-based grants for technical demonstration projects have spurred private-sector energy innovation investments. They have also created firms with the potential for significant positive climate impacts sooner rather than later, and notably, the potential for significant employment growth.

A closer look at the Canadian cohort of clean technology companies reveals more about the profile of innovators. From 2008 to 2014, 70 per cent of Canadian clean technology R&D investment (three-quarters of which were energy related) was made by firms with less than $50 million in annual revenue. What's more, firms have been operating well in advance of the implementation of carbon regulation, having been founded, on average, 17 years ago. While still an emerging industry, these firms have simultaneously created much needed energy innovation and well paid middle class employment.

Here are some take-aways for policy makers:

Energy innovation firms face two valleys of death. The first for first technical demonstration (technical valley of death). The second for commercial demonstration (commercial valley of death.)

- To have the benefit of these innovations for GHG reductions, policy makers must implement policies that address these gaps.
- New investment in low carbon infrastructure should take account of energy innovation in the form of best-in-class technology classifications for both regulatory and fiscal policy design.

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- Risk pooling among both sellers and buyers of energy innovation will be needed to scale up markets. Examples of risk pooling might include performance bonding funds available to public entities that make investments in innovative procurement and infrastructure.
- Climate finance will need to evolve to enable access to a full array of energy innovation by developing countries. Development finance entities can assist by supporting procurement risk pooling across developing countries.

Because energy systems are so complex and because they are made up, in part, of physical plants, energy innovators are capital-intensive. In addition to inventing new technologies, these firms must also instantiate their innovations within manufactured environmental goods and within energy systems including electricity, fuel and transportation infrastructure. Their business models combine investing a significant percentage of revenue into R&D and operating complex manufacturing. These business models are not normally associated with small firms.

As a result, these firms find themselves in a policy no-man's-land, needing industrial-scale capital rather than the venture capital normally associated with innovators. This differs from some other innovative sectors where open-source software has vastly reduced the transaction costs associated with bringing innovations to market and where intellectual property and global internet governance are important policy concerns.

Energy innovators are akin to early baby boomers who were born before health and education infrastructures were put in place. They've had to adapt while they wait for scale-up and finance policies to be designed and implemented. This focus on adaptation is also evident in firm-level findings on human resource (HR) gaps. Their recruiting priorities are squarely focused on sales and capital-raising abilities. When scale-up and finance policies are in place, engineers and scientists will replace sales and finance professionals as the primary HR focus, which will drive significant growth in well-paid jobs.

With regard to innovation, global governance entities could be more ambitious for the 2020-to-2030 period. Beyond wind and solar, clean technology firms have innovations that are ready to be scaled up commercially. As countries grapple with how to resolve tensions between growth goals and climate commitments, these firms are ready to grow employment and contribute to attaining 2020-to-2030 climate targets, thereby contributing to shifting global and national GHG to GDP ratios.

In sum, policy makers can be confident that first-generation energy innovation firms are ready for coordinated finance and infrastructure investment policies to enable the move from demonstration to scale-up impact on the environment and the economy. P

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