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A Green Industrial Revolution

Climate Justice, Green Jobs and Sustainable Production in Canada

Marc Lee and Amanda Card

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Summary

TO FIGHT AGAINST catastrophic climate change, Canada needs to reduce greenhouse gas (GHG) emissions to near zero by mid-century at the latest. This amounts to a new, green industrial revolution that will have transformative impacts on the nature of work. In addition, there are important employment implications as to how we respond or adapt to climate change itself.

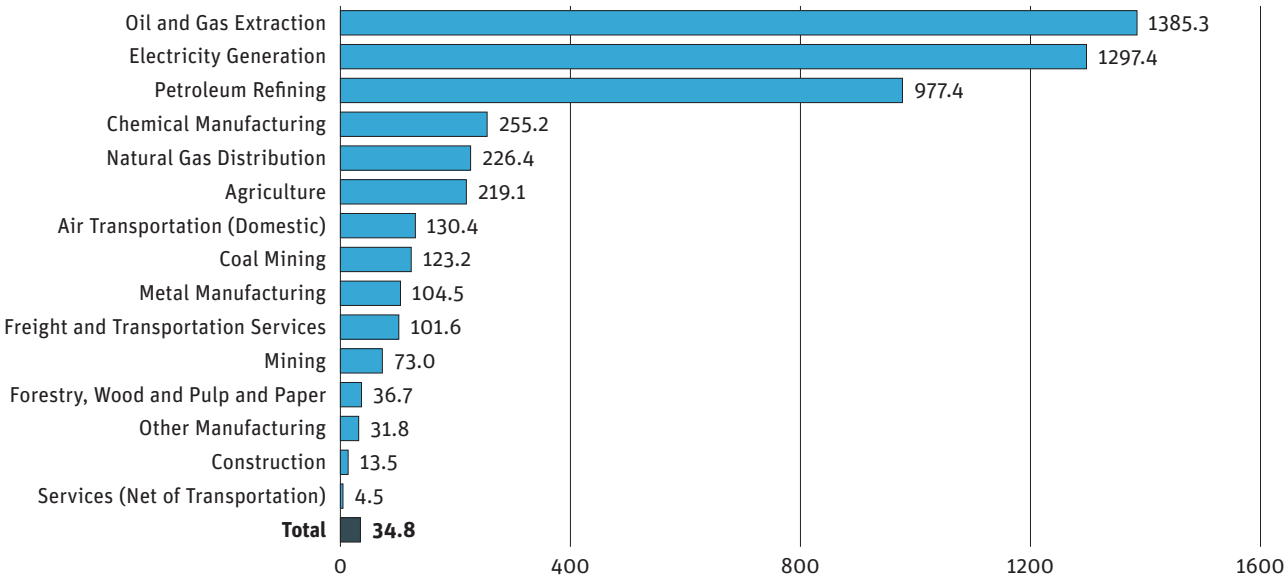
With this report, we hope to contribute to a growing conversation about industrial and employment strategies the federal government can use to transition to a sustainable economy and create a new generation of well-paying green jobs.

Past industrial revolutions have caused great upheaval and hardship, with some sectors of society bearing a terrible burden. If this green industrial revolution is to occur in a just manner, we need to help workers make the transition to new employment, and provide economically marginalized people with new opportunities to secure decent work and economic security. Creating green jobs allows us not only to confront climate change, but also to achieve *climate justice*.

Green Jobs: The Canadian Context

At the broadest level, green jobs are the work done in a sustainable economy. That is, at the end of a successful green industrial revolution, all jobs would be inherently green. For our purposes here, green jobs are well-paid,

FIGURE 1 GHG Emissions per Worker, Canada, 2008



Source Authors' calculation based on Table 1.

meaningful jobs that contribute to a reduction in greenhouse gas emissions, produce no or low environmental impact, and/or help the economy or society adapt to the impacts of climate change.

Currently, three-fifths of Canada's commercial and industrial GHG emissions (that is, non-household emissions) come from a handful of sectors: fossil fuel production, electricity generation, and agriculture. A few hot spots stand out for having high levels of GHG emissions *per worker*: fossil fuel production, electricity generation, chemical manufacturing and agriculture. The two biggest culprits are the oil and gas industry and electricity generation, each of which provides very little direct employment in return for their substantial emissions. Electricity generation facilities make up two-fifths of the top 522 CO_2 emitting facilities in the country, while oil and gas facilities make up one-third.

Canada's emissions profile is driven by the extraction of fossil fuels that are either exported or used for electricity generation. The federal government's industrial policies to support the resource sector include substantial subsidies and tax breaks. Such practices have been extremely successful in economic terms, but are increasingly in conflict with climate policies.

Another key challenge is that many of the jobs that have high levels of GHG emissions per employee are highly paid unionized jobs. At the same

time, many service sector jobs have a small carbon footprint, but are low paying and provide little job satisfaction. This must be addressed with "just transition" plans that support workers as they change to sustainable careers. For a green industrial revolution to truly fulfill its potential, green jobs must be synonymous with decent work.

Leadership from the federal government is needed to implement more coherent and integrated climate, industrial and labour market policies if a green industrial revolution that decarbonizes Canada's economy is to occur.

Investing in Green Jobs

A focal point for green jobs is in rebuilding Canada's physical infrastructure: the buildings in which we live and work, how those buildings connect together as communities, the ways in which we move ourselves, and how we get and use energy. The more robust a green jobs program in delivering new employment opportunities, the smoother will be the transition. Importantly, investments in fossil fuel industries create far fewer jobs than green economy investments.

Many public service jobs (civil service, health care work or early childhood education, for example) could be considered a major source of inherently green jobs. Green jobs should also be actively linked to gains for traditionally disadvantaged populations, including women, visible minorities, immigrants and aboriginal people, as well as low-income households in general. Commitments to support households in the transition will also be required to create the demand for low-carbon investments, while guarding against adverse equity impacts on low-income households.

New Building Construction and Retrofits

The concept of net zero energy buildings is considered an ideal for green residential, commercial and institutional buildings in the future. A major gap, however, is a need for funding of coordinated education and training programs to develop Canada's knowledge capital in this area and ensure a supply of skilled workers. There are also opportunities to develop local green jobs in the supply of equipment like hyper-efficient windows, heat pumps and other parts currently imported from Europe and Asia.

While net zero is an ideal for new buildings and housing development, the reality is that housing stock takes a very long time to turn over. A key

green jobs strategy, therefore, is to start with retrofits of existing buildings. Because so many buildings need energy efficiency upgrades, and this is local, labour-intensive work, building retrofits are the low-hanging fruit of green job development. Specific policy actions will stimulate the demand for retrofits and increase the supply of skilled workers: home and business financing reform, rising marketplace standards, and coordination with post-secondary institutions and apprenticeship and training programs.

A bold apprenticeship program could provide an excellent opportunity to train economically disadvantaged groups (such as women, aboriginal people and recent immigrants) in the skills that will be in high demand when the country undertakes a large-scale green capital plan.

Clean and Efficient Energy

Electricity generation has major emission implications for those provinces that still rely on coal and other fossil fuel. Improving transmission infrastructure and efficiency between regions could facilitate the sharing of clean energy, such as hydro, across provinces. As well, investments in renewable energy can help us move closer to a zero carbon future while providing new green jobs in the sector.

Investments in infrastructure efficiency across the country would also improve the flow and reliability of power for all Canadians in a sustainable manner. Regulations in energy efficiency for equipment will not only reduce emissions from operation, but could potentially provide incentives for green jobs in manufacturing low-energy products wherever Canada might have a competitive advantage.

Zero-Emission Transportation

A massive expansion of public transit should form a major part of a green jobs plan. Expansion of transit capacity is directly linked to new green jobs: the creation of new railway corridors and transit lines will produce employment gains in construction and green manufacturing.

Over the long run, a zero-emissions transportation system must be rooted in more complete communities, where high-density housing is located close to public and private services and amenities. Without the need for long commutes, walking and biking could eventually encompass half of all trips,

supplemented by transit, taxis and car-sharing, all of which would be powered by clean electricity.

Similar strategies are relevant to freight movement. Reducing GHG emissions from freight transportation requires shifting from high-GHG transportation modes like airplanes and trucks to low-emissions modes like trains and ships. Technological developments such as electric engines (and perhaps biofuel or hydrogen fuel cell) for trucks will eventually enable switching away from fossil fuels. Perhaps more importantly, freight emissions would be reduced by decreased consumption and less resource extraction for export.

Green Manufacturing

Canada needs a strategic framework to make existing manufacturing operations more environmentally friendly, develop new green manufacturing capacity, and work toward "closed-loop" production processes that recycle and reuse wastes. Opportunities to green existing manufacturing operations can be realized through carbon pricing and other incentive mechanisms, but also by encouraging ideas for changes in workflow and production processes from the shop floor.

Research into New Technologies

Long-term economic and employment strategies must also consider the development of new technologies. The future path of any technology is impossible to predict, of course, but the decades to come offer the potential for major breakthroughs in areas like biotechnology, nanotechnology and quantum computing, all of which have massive potential for implementation in a green industrial production system. For example, advances in nanotechnology could support the development of hydrogen-powered vehicles and more efficient solar power generation. Canada should be positioned to adopt and adapt green applications of these technologies.

Adaptation Planning

Beyond mitigation of GHG emissions, there will be new work related to adapting to a warmer Canada. We can develop strategies that improve our resilience to climate change in a way that creates green jobs, builds physic-

al infrastructure and reinvigorates social networks. Adaptation-related jobs could include reinforcing dykes in low-lying areas, planting trees in areas decimated by forest fires and mountain pine beetle, and upgrading storm sewers and water treatment facilities.

Climate impacts on provinces, territories and individual communities will be diverse and variable, and require planning processes that identify major risks — e.g., fires, floods, droughts and landslides. The development of more localized, sustainable food systems is a key aspect of resilience planning, as climate change may affect global food supply chains, and conventional agriculture is highly dependent on fossil fuels. Beyond food, a planning framework that focuses on ensuring basic needs should also address water, housing and electricity at national, regional and community levels.

A Green Social Contract

The term "social contract" is generally used to describe the agreement — written or assumed — between a government and the citizens it governs. A "green social contract" would guide a government to prioritize both the environment and the well-being of its citizens in any decision-making process.

Fear of job loss could have a paralyzing impact on progress towards GHG emissions mitigation. With the development of new green jobs in Canada, there are likely to be job losses within certain industries like oil and gas. But on balance, there will be a net increase in jobs — if public and private investments can be leveraged to develop green jobs.

A green social contract would include strategies for helping workers transition to green jobs and protect against widespread unemployment. In the vast majority of cases, skills will be readily transitioned to other needed work that will be created in green industries. "Just transition" packages should include education and training, income support and mobility allowances for workers who need assistance in changing careers. Coordination with secondary, post-secondary and training/apprenticeship programs to ensure appropriate skills development will be necessary.

A Carbon Transfer

The principle that prices should tell the truth about costs of production (e.g. that environmental costs should be factored in) is fundamental to the shift to a sustainable economy, but doing so poses a huge transitional problem

for low- to middle-income families who spend a higher percentage of their incomes on energy and necessities. Ensuring that carbon pricing or higher energy prices do not have net detrimental impacts on low-income households is important to ensuring sufficient demand for green goods, services and investments. We propose a "carbon transfer" system that would be designed similarly to the income transfers for Old Age Security and the Canada Child Tax Benefit. These transfers have a maximum amount for the lowest income families, and phase out slowly over the income distribution, so that a very high proportion of families get something.

Recommendations

In the near term, we recommend the following steps be taken by the federal government:

1. **Commit to zero fossil fuels** by 2040 at the latest, with all energy requirements met by clean electric sources, plus some biofuels and hydrogen fuel cells where alternatives are required. All remaining non-fossil-fuel GHG emissions should be eliminated by 2050.

2. **Enact a moratorium on new fossil fuel extraction** unless 100% of emissions can be captured and stored underground permanently.

3. **Put a price on carbon** through a national carbon tax and/or a cap-and-trade system. Revenues should be put towards further emissions reductions and reducing carbon price impacts on low- to middle-income families.

4. **Establish a rapid action plan on climate change** to approach our 2020 target, funded by a mix of carbon revenues, increased royalties and eliminated subsidies from fossil fuel industries, and reallocated expenditures from unsustainable activities (e.g. highway expansion).

5. **Develop a comprehensive national green industrial strategy,** including green jobs and capital plans, with priority focus on the following areas: green building construction and retrofitting; transportation; green manufacturing and waste management; and adaptation planning. The strategy must be coordinated across business, trade unions, secondary and post-secondary institutions and all levels of government, and should actively engage traditionally disadvantaged populations.

6. **Increase national model regulations to "net zero" new buildings** as quickly as possible. An expansion of the ecoEnergy program for building retrofits is also in order, with special attention paid to low- to middle-income households, older housing stock and coverage of multi-unit buildings.

7. **Implement a national transportation planning framework** that focuses on building regional rail corridors, complete communities and shifting to more sustainable modes of transportation (such walking, biking and transit, rather than just on electric vehicles).

8. **Create a national green energy framework** that includes investments in infrastructure to improve regional transmission of clean energy (e.g. hydro) and efficiency.

9. **Increase support for research and development of new technologies** with green economy applications through direct government funding, direct or indirect support for commercialization and production, and support for learning and diffusion of knowledge and technology.

10. **Develop adaptation plans** for all regions of the country, focused on the security of basic needs in areas such as food, water, electricity and housing.

11. **Launch a broad-based participatory exercise** aimed at defining the parameters of a new "green social contract" that ensures no one is left behind in the transition to a sustainable economy.

12. **Develop a framework for a new "climate transfer" grant to households** that would, minimally, be equivalent to existing energy expenditures (and ideally more) to insulate low- to middle-income households from increases in energy and carbon prices, funded by revenues from those sources

Introduction

From Business-as-Usual to Green Industrial Revolution

CLIMATE CHANGE IS a by-product of a global economic system based on the extraction of fossil fuels to power our vehicles, homes, offices and factories. An altered climate is already evident in retreating glaciers, shrinking polar ice, and floods, droughts, and extreme weather events world-wide. Impacts are observable in every region of Canada, from the loss of viability of ice roads in the North, to pine beetle outbreaks in the Western forests, to water shortages across Canada. Summaries of climate science and modeling, such as those undertaken by the International Panel on Climate Change, tell us that a business-as-usual trajectory of rising greenhouse gas emissions (or even maintaining emissions at current levels) will have profound impacts on the natural systems that underpin human well-being, and over the longer term threatens the very survival of humans, not to mention countless other animals and plants.

In spite of this, political willingness to support climate action has, if anything, weakened. The federal government has ignored the growing evidence of climate impacts and the increasingly dire predictions from climate models in favour of championing expansion of the very industries at the root of the problem, notably the Alberta oil sands. Ottawa ended 2011 by pulling out of the Kyoto Accord, the legally binding international treaty for commit-

ments to reducing greenhouse gas (GHG) emissions. Ostensibly, the federal government is awaiting a new international treaty that includes the United States and China, to be negotiated by 2015 and in force by 2020. Meanwhile, a top economic priority for the feds is expanding the infrastructure of pipelines to better sell oil sands bitumen to the U.S. and China. Critics of new pipelines have been dismissed as radicals and demonized as opposing Canada's national interest. The 2012 federal budget announced a significant streamlining of environmental assessment for major new mines, pipelines, and oil and gas extraction activities.

In the absence of federal leadership, a range of climate actions have occurred at the provincial level. According a recent report on provincial actions by the David Suzuki Foundation, British Columbia, Ontario and Quebec are the leaders in Canada, although the report notes that "no province is doing as much as it could, and provincial targets remain below what the science says is necessary."[1] Even in provinces like BC that have legislated GHG reduction targets and set out a wide range of actions, including a carbon tax, government interest in climate policy has been on the wane. In its recent Jobs Plan, the BC government narrowly focused on new coal mines and shale gas fracking as economic drivers. Ontario's *Green Energy and Green Economy Act*, modeled on Germany's support for renewable power supply, has come under fire as electricity prices have gone up.

Too often, shifts away from good climate policies are made on economic grounds — that accelerated mining and oil and gas extraction is needed to support job creation and Canadian economic growth, and that climate action will adversely affect economic development and prosperity. In our view, a strategic and systemic approach to green job creation that integrates climate and industrial and employment policies is vital to the political success of climate action. In this paper we seek to construct a preliminary, integrated framework for analysis of a sustainable economy, and to launch a dialogue about strategies the federal government can undertake to accelerate the transition to such an economy by creating a new generation of well-paying "green jobs." We assemble some baseline information about green jobs in the Canadian context, and associated social justice dimensions, including decent work and the development of a green social contract that ensures no one is left behind.

Fully responding to the climate challenge will require changes in how we live, work and play. This means rethinking and questioning "business as usual" practices and our assumptions about how our economy works. There is no national policy framework to coordinate climate action, and to

ensure good climate policies are not contradicted by industrial policies that subsidize natural resources extraction, or transportation policies to expand ports, bridges and highways. The federal government cannot meet is stated target of a 17% reduction in greenhouse gas emissions below 2005 levels by 2020 in the absence of a comprehensive plan. In fact, federal documents openly admit that existing measures will only provide one quarter of the necessary deductions.[2] And this does not even take into consideration the carbon footprint of Canadian exports (particularly fossil fuels) and imports. Resolving the contradictions between climate and industrial policies is central to breaking from "business as usual."

The principal challenge for Canada and other countries around the world is to de-couple the economy from fossil fuels. This amounts to a new, green industrial revolution that will have transformative impacts on the nature of work and employment. In addition, there are important employment implications as to how we respond or adapt to climate change itself. Strategic thinking about employment and industrial policies is thus required to guide a transition that supports a high level of employment in jobs that are intrinsically green, while creating others that directly facilitate the move to a zero-carbon Canada.

Canada's federated structure means that certain policy levers are within the jurisdiction of the provinces, though there are a number of policies that will be best implemented, or at least coordinated, on a national basis. We further recognize that Canada's transition to a sustainable economy must be accompanied by climate action in other countries around the world. Some "no regrets" policies can be pursued that are beneficial irrespective of this broader context (conservation programs, for example) but we assume that international cooperation on climate action (eventually) will occur. Canada stands to benefit from acting now rather than waiting, and as a wealthy nation needs to demonstrate leadership.

Sustainable Production and Green Jobs

THE TERM "GREEN jobs" or "green-collar jobs" has been increasingly used in recent years to describe a new generation of employment opportunities that are sustainable, well-paid and secure. In this section, we seek to better understand what makes a job green, then in subsequent sections turn to the Canadian context, the role of "green jobs" as a core theme of a coordinated national economic strategy, and what this means for integrated and effective industrial, climate and labour market policies.

The production of goods and services and their consumption by households are ultimately anchored in, and dependent on, ecological systems. Ecological economics recognizes that the economy is a sub-set of the biosphere, and places its emphasis on the inflows of materials and energy, and the outflow of wastes, into production and consumption activities. To be sustainable, (1) materials and energy inputs must be harvested in a way that does not deprive future generations, meaning use of resources that are renewable (e.g. wood from trees, energy from sun and wind) and recyclable (e.g. metals, paper); and (2) wastes (pollutants in the water, land and air, including greenhouse gases) must be within the "sink" functions of the Earth to process them naturally. A sustainability framework includes two cycles of production — organic and technological — that are closed-loop systems in which "waste is food." That is, in the organic cycle all wastes are biodegradable

(and become soil or fuel) while in the technological cycle non-organic, non-biodegradable, man-made items are re-used, re-manufactured or recycled.[3]

Unfortunately, the scale and form of modern production and consumption have vastly exceeded ecological limits. In the case of climate change, the primary concern is the emission of greenhouse gases (GHGs) as a by-product of production processes and a wide range of energy services (heating, mobility, powering gadgets) demanded by consumers. Climate change is arguably one planet-wide symptom of extensive environmental degradation — to make matters worse, the problem is global and systemic. A transformational shift towards sustainable systems of production and consumption is urgent, and this requires collective action led by governments.

Fossil fuels burned in homes, businesses and factories, plus those combusted in various forms of transportation, account for about three-quarters of Canada's GHG emissions.[4] Achieving a clean energy system means phasing out fossil fuels entirely, unless 100% of emissions can be captured and stored underground permanently (the intuition behind carbon capture and storage, or CCS). Reducing the use of fossil fuels, and eventually eliminating them, is no small challenge because they have underwritten a high standard of living; fossil fuels have high concentrations of energy per unit of mass, and when processed into purer forms, are highly portable. In addition to emissions from the combustion of fossil fuels, there are GHG emissions associated with certain industrial processes (e.g., production of aluminum and cement) and emissions from agricultural practices, waste disposal (landfills) and deforestation.

Mitigation efforts — the reduction of emissions over time — should ultimately lead to something close to zero emissions by mid-century. The last few per cent of emissions may be very difficult to eliminate, and may challenge our ability to get completely to zero, although much will depend on the evolution of technology in the coming decades. Some very small amount of emissions that can be absorbed by oceans, forests and soils is compatible with a sustainable economy. But for all intents and purposes, a green industrial revolution seeks to reduce emissions to near-zero. Based on the work of NASA scientist James Hansen, a long-term target for global CO_2 levels is 350 parts per million, but current CO_2 levels are 395 ppm, much higher than a sustainable level — and they will continue to rise in the transition period. Actions like restoring forest cover would also be greatly needed to pull CO_2 out of the atmosphere (some future technology could possibly also attain this goal but no current examples exist that would be able to capture tens of billions of tonnes).

This generalized understanding of a green industrial revolution is picked up in research on sustainable production and green jobs.[5] *Aggressive conservation efforts* to reduce energy demand are generally less costly than building new supply. These can include efforts to improve the energy efficiency of vehicles and appliances, but also absolute reductions in the consumption of GHG-intensive goods and services. Dramatic improvements in the energy efficiency of residential and commercial buildings are currently possible, including new construction and retrofitting existing structures. Beyond efficiency measures, conservation also requires changes in the amount and composition of consumption.

Fuel switching from fossil fuels to alternatives, such as electricity, hydrogen and biofuels, will also be required. Hydrogen and biofuels are both inefficient from an energy-use perspective, and have challenges that limit their use over the whole economy. Biofuels, or fuels derived from organic matter, have proven problematic due to conflicts with other potential land uses, in particular agricultural land needed for food production. Hydrogen faces the critical problems of a lack of supportive infrastructure, and because it does not exist in raw form, how it can be produced cleanly. Use of hydrogen and biofuels will likely be restricted to niche applications. Instead, zero-emission electricity will likely be the principal source of energy in a zero-carbon economy. This includes hydro, solar, wind, geothermal and tidal energy, although all new supply options have some environmental cost, including GHG emissions in manufacture and construction.[6] In addition, capture of waste heat and energy (for example, in district heating systems) can also displace fossil fuels.

Over a longer period of time, *land use and urban form changes* are key to deep, long-run emission reductions, in particular shifts to lower emission modes of transportation and more complete communities. In transportation this means shorter trips, greater transit use, and more biking and walking, rather than just replacing internal combustion engines with electric ones. For buildings this means hyper-efficient design, increases in density, and mixed-use, mixed-income neighbourhoods where homes are closer to transit, jobs, stores and public services. These areas are also where important co-benefits are to be found that address a number of other equity and environmental objectives (such as reductions in other pollutants, health improvements and community economic development). Outside of these more compact urban areas, land must be preserved for farming and for natural ecosystems.

Green manufacturing efforts seek to reduce the footprint of all industries through a mix of electrification (from clean energy resources), technology substitution and changes in processes. Concepts such as zero waste and closed-loop systems embody this idea of sustainable production, much of which is already viable with existing (or near-term) technologies. These would lead to major reductions in the throughput of materials in the economy (and their embodied energy content) by reducing consumption, increasing efficiency and emphasizing re-use and remanufacturing. In addition, research into *new fundamental technologies* can lead to innovations in energy and production practices that may be hard to envision today.

The shift to a zero-carbon economy is facilitated by *capital stock turnover* — the ongoing replacement of appliances, vehicles and buildings over time — if accompanied by minimum emissions standards and increases in the cost of emitting greenhouse gases (carbon pricing). However, given the urgency of the climate challenge, a more aggressive approach than relying on natural rates of capital stock turnover is appropriate. Efforts to accelerate this turnover should be made, for example, through accelerated capital cost allowances, and investment tax credits for new capital investments that meet thresholds for emission reductions (the type of credits routinely provided to the oil and gas industry).

Green Jobs and Decent Work

In the face of climate change, the concept of "green jobs" or "green-collar jobs" has become a major focus for policy makers, albeit a vaguely defined one. The importance of putting forward a coherent jobs agenda as part of a green industrial revolution cannot be understated. Few workers will go along with a radical transformation to de-carbonize the economy and achieve sustainable production systems if they fear they will lose their livelihood in the process. A green jobs framework that aggressively ensures new employment in "sunrise" sectors, a program of advanced skills upgrading and training, and a guarantee that no one will be left behind inform a "green social contract" that is a prerequisite for change (more on this in the final section).

At the broadest level, green jobs are the work done in a sustainable economy. That is, if we undertake a green industrial revolution, by mid-century (or earlier) all jobs would be inherently green. There are two general or "in principle" definitions of green jobs that are useful in moving forward. In a detailed study, the United Nations defines green jobs as:

> [W]ork in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; decarbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution.[7]

From a more activist perspective, the U.S.-based Apollo Alliance, a coalition of labour, business, environmental and community leaders working to catalyze a clean energy revolution, builds on this definition to include a notion of decent work:

> Green-collar jobs…are well-paid, career track jobs that contribute directly to preserving or enhancing environmental quality. Like traditional blue-collar jobs, green-collar jobs range from low-skill, entry-level positions to high-skill, higher-paid jobs, and include opportunities for advancement in both skills and wages. Green-collar jobs tend to be local because many involve work transforming and upgrading the immediate built and natural environment — work such as retrofitting buildings, installing solar panels, constructing transit lines, and landscaping. Green-collar jobs are in construction, manufacturing, installation, maintenance, agriculture, and many other sectors of the economy.[8]

Interestingly, many service sector jobs that have a small carbon footprint would not fit a modified definition of green jobs that includes some concept of "decent work." While "services" covers a vast range or work, many service sector jobs in Canada are those less desirable food service, cleaning, trash removal and other forms of service that pay low wages and have less desirable working conditions. Inclusion of decent work, along with low or no environmental impact, is, in our view, a fundamental justice and equity dimension to a "green job."

Low income among workers is not a trivial concern. Based on Labour Force Survey data, the Canadian Labour Congress calculated that 23.8% of Canadian were "low wage" in 2011; for women, this figure was 28.4%, while it was 19.2% for men.[9] Incidence of low wage work was substantially lower for those in unionized jobs, with only 8.4% in low wage work overall (8.9% for women, 7.9% for men). The intuition that working full time should put one above the poverty line has been taken up by Living Wage campaigns across North America.

In a broad sense "decent work" is a well-paying job that is secure and safe, with some measure of personal autonomy and flexibility that enable one to raise a family, and to save for retirement — although there may be trade-offs among these characteristics (some may take on risk for the reward of far-above-average wages). From research on life satisfaction, we know that in addition to the income to purchase goods and services, work also provides people with a means for contributing to wider society, which has a value above and beyond income. There are large and negative well-being implications of unemployment; thus, work is also central to social cohesion in advanced societies.[10]

Decent work is thus facilitated by the private and public creation of stimulating work, with supportive labour market institutions, such as employment standards, minimum wages, hours of work provisions and health and safety regulations. Decent work is also more likely to be found in an environment that is an outcome of the collective bargaining process that leads to higher wages, greater non-wage compensation (employer-provided benefits packages), expansive pension plans, and better job security and working conditions.[11]

Thus, green jobs, for the purpose of this paper, are those that provide decent work while either contributing to a reduction in greenhouse gas emissions or producing no or at least low environmental impact, and jobs that specifically help the economy or society adapt to the impacts of climate change. For a green industrial revolution to truly fulfill its potential, it must incorporate decent work into the transition, and consider that work to be a core part of a new middle class.

Greenhouse Gas Emissions and Green Jobs in Canada

PUTTING NUMBERS TO existing and future green jobs is no small challenge, as data collected at the industry or occupational level generally do not distinguish between work that is green and that is not. A study by ECO Canada, the sector council for environment industry in Canada, estimated the number of "environmental employees," defined as "individuals who spend 50% or more of their work time on activities associated with environmental protection, resource management, or environmental sustainability". According to their 2010 survey results, Canada had over 682,000 environmental employees, equivalent to 4% of total employment.[12] For comparison, employment for mining, quarrying and oil & gas extraction in the same period accounted for only 1.5% of total Canadian employment.

In the remainder of the section, we look more closely at green jobs as they relate to climate change by looking at Canada's industrial mix in terms of both GHG emissions and employment. The results in *Table 1* include all industrial and commercial domestic emissions (80% of total emissions) — we do not include household emissions (personal transportation or residential emissions), nor do we count emissions embodied in exports. Data limitations mean the analysis is for broad industry categories only. *Figure 1* puts

TABLE 1 Industrial GHG Emissions and Employment, 2008

Industry	GHG Emissions (Mt CO_2e)	% of GHG	Employment (thousands)	% of total employment
Fossil Fuel Industries				
Oil and gas extraction	137.5	23.1%	99	0.6%
Petroleum refining	17.5	2.9%	18	0.1%
Coal mining	1.4	0.2%	11	0.1%
Natural gas distribution	3.6	0.6%	16	0.1%
Commercial Transportation				
Freight and ground transportation	63.8	10.7%	628	3.7%
Domestic air transportation	8.6	1.4%	66	0.4%
Manufacturing and Heavy Industry				
Chemical manufacturing	22.6	3.8%	89	0.5%
Metal manufacturing	25.1	4.2%	240	1.4%
Forestry, wood and pulp and paper	8.5	1.4%	231	1.4%
Other manufacturing	36.3	6.1%	1143	6.7%
Mining	6.7	1.1%	92	0.5%
Other Industry				
Electricity generation	121	20.4%	93	0.5%
Agriculture	70.9	11.9%	324	1.9%
Construction	11.2	1.9%	830	4.9%
Service industries	59.4	10.0%	13207	77.3%
Total	**594.1**	**100.0%**	**17087**	**100.0%**

Notes 2008 data were used, as emissions by sector were not included in the 2009 National Inventory Report. Under manufacturing and heavy industry, mining includes minerals, metal, gems, etc. while coal extraction falls under fossil fuel industries. Cement production emissions were split between construction (70% of cement production consumed domestically) and manufacturing (30% exported). Employment data for agriculture came from the Labour Force survey, as agriculture is not included in the Survey of Employment, Payroll and Hours.

Sources Environment Canada, *National Inventory Report 1990–2008: Greenhouse Gas Sources and Sinks in Canada* (2010), Table 2-16: Detail of trends in GHG emissions by sector, www.ec.gc.ca/Publications/default.asp?lang=En&xml=492D914C-2EAB-47AB-A045-C62B2CDACC29; Statistics Canada, *Survey of Employment, Payrolls and Hours,* Table 281-0024, and *Labour Force Survey,* Table 282-0008.

the GHG and employment data together into a measure of emissions per worker, or the carbon footprint associated with various industries.

Table 1 shows that more than one-quarter of Canada's commercial and industrial GHG emissions come from the oil and gas sector, including extraction, processing and distribution. Conversely, these areas employ less than 1% of Canadian workers. Moreover, although conventional oil production is expected to decline, production from the oil sands is anticipated to more than double between 2008 and 2020 from 1.3 million barrels per day

The Heart of Canada's GHG Dilemma

The most GHG-intensive industrial area in Canada exists in Alberta's north. The tar sands is the greatest barrier to Canada's carbon neutral future. In 2009, emissions from Canada's oil sands industry increased 20% over 2008, and made up 6.5% of total national emissions.[15] And the development continues, with plans to ship even greater volumes of bitumen south or west if the Keystone XL or Northern Gateway pipelines go ahead. Canada's proved oil reserves are now the third largest in the world (after Saudi Arabia and Venezuela), and bitumen from the oil sands makes up 97% of these reserves.[16]

The proved reserves of the oil sands alone represents 73 Gt (gigatonnes or billion tonnes) of CO_2, with the potential for almost double that amount with future discoveries and developments in the area. These emissions will mostly be counted in the GHG inventories of other nations over the years that they are emitted, as most bitumen and resultant products are exported and combusted elsewhere. However, these Canadian exports stand to contribute more than double the amount of global GHGs emitted in 2007 (29.5 Gt) to the atmosphere. And as we have seen, fossil fuel industries in total (including coal and natural gas production) employ only 0.9% of Canadians, while undermining our opportunity to move towards a sustainable future. Consider what potential the billions invested in continued expansion of the tar sands could have for developing green jobs across Canada, supporting decent careers while mitigating climate change.

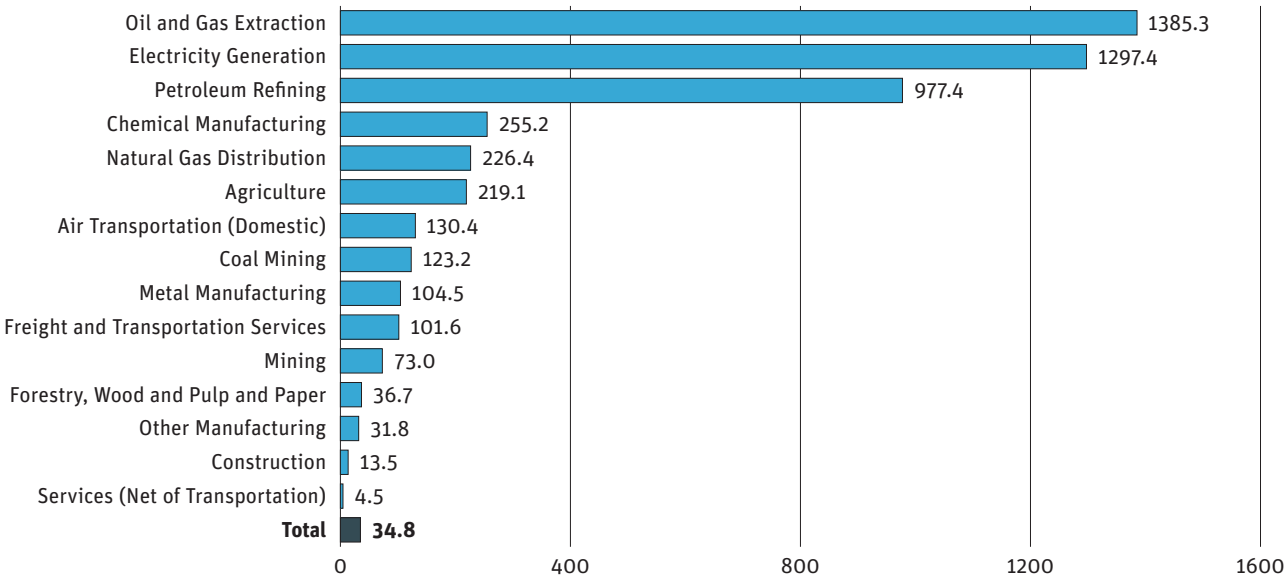
to just over 3 million, driving an overall increase in Canadian oil production of almost 50% over that time frame.[13]

The emissions profile of both coal mining and oil and gas extraction and processing is even worse when we consider the Canada is a major net exporter of fossil fuels. By accounting convention, only emissions within Canada are counted in the national GHG inventory, so exported fuels and their emissions are counted in the inventories of other nations, and do not appear in *Table 1*. But emissions from Canadian coal, oil and gas combusted in other jurisdictions (primarily, the U.S., China and Japan) are about 1.2 times Canada's own domestic emissions from combusting fossil fuels.[14]

Other "hot spots" include electricity generation, freight transportation (and other transportation services), chemical manufacturing, metal manufacturing and agriculture. Including fossil fuels, these sectors employ 9% of Canadian workers, but comprise almost four-fifths (78%) of industrial and commercial emissions.

Electricity generation emissions are significant, 20% of the total, and are associated with coal and natural gas generation, particularly in Alberta, New Brunswick, Nova Scotia and Saskatchewan. Conversely, Quebec and B.C. draw significantly from hydroelectric resources, while Ontario uses 50%

FIGURE 1 GHG Emissions per Worker, Canada, 2008



Source Authors' calculation based on Table 1.

nuclear energy (low on emissions, but with environmental implications of its own). But even with these contributions, electricity generation in Canada results in high overall emissions per worker.

In contrast, the *service sector* employs over three-quarters of Canadians while producing only 10% of GHGs, and therefore has a very small GHG footprint per worker. Emissions for the service industries are related to heating and cooling buildings as well as energy for lighting, computers and other equipment. This calculation does not include transportation services, which we include under freight and transportation services. While the operations of many service sector jobs are low in carbon intensity, they also rely on imported machinery and equipment that have embodied GHG emissions (related to production abroad and transportation to the domestic market). A full life-cycle approach would count these emissions. Commuting to work is another large source of emissions not captured in the above analysis (these, along with residential emissions, are considered to be household direct emissions).

A key challenge for decent work is that many of the goods-producing jobs that have high levels of GHG emissions per employee also tend to be high-paying unionized jobs. In contrast, the greenest jobs in the service sector comprise many low-paying jobs that are not decent work. Thus, as we

TABLE 2 Canada's Top Point Source Emitters (>50 kt CO_2e), 2009, Summarized By Industry

	Number of facilities	Greenhouse gas emissions (kt CO_2e)	Share of top emitters
Electricity Generation	108	100,294	40.1%
Fossil Fuel Industries	151	83,630	33.3%
Primary Metal Manufacturing	35	21,239	8.5%
Chemical Manufacturing	43	16,977	6.8%
Cement and Lime	28	11,224	4.5%
Other Manufacturing	82	6,068	2.4%
Mining	34	5,754	2.3%
Services	36	4,770	1.9%
Other Utilities	5	497	0.2%
Total	**522**	**250,454**	**100.00%**

Notes "Other Manufacturing" includes food, wood products, pulp & paper, plastics and rubber products, non-metallic mineral products, and transportation equipment. "Services" includes airports, waste management facilities, and universities. "Other Utilities" includes sewage treatment and steam plants.
Source Authors' calculations based on Environment Canada, *2009 Facilities Greenhouse Gas Emissions* (2010), www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1.

move forward there may be some conflicts between work that is "decent" and work that is "green", which speaks to the need for a "green social contract" or "just transition" programs (a topic we return to later in the paper).

Some finer details about Canada's industrial emissions profile are available from data on emissions by specific facilities. *Table 2* includes 552 facilities that exceeded 50 kt CO_2e in 2009, grouped by industry. These facilities together accounted for 53% of Canada's industrial GHG emissions.[17] While it is helpful to identify the largest emitters for the purposes of strategic mitigation of GHG emissions, this also tells us that more than half of non-household emissions stem from a wide range of smaller sources. This finding implies limits on proposed solutions like carbon capture and storage (CCS), which is primarily applicable to large point sources of emissions rather than more decentralized sources (more on CCS in the next section).

Notably, two-fifths of the emissions on this list of top emitters derive from electricity generation facilities, including the top emitter (in Alberta) and seven of the top 10 emitters (five in Alberta, one in Saskatchewan, one in Ontario). Fossil fuel processing facilities make up over one-third of reported emissions. The facilities listed as the second, fourth and twelfth highest emitters are all categorized under non-conventional oil extraction. This highlights the increased emissions associated with non-conventional fossil fuels, such as bitumen (and shale gas), which are prominent current (and future) exports for Canada.[18] For other industries, large point-source emit-

ters are also notable for their contribution to Canada's overall emissions inventory. Besides electricity generation and non-conventional oil extraction, the top 25 emitters include two iron and steel manufacturing plants in Ontario, and two chemical manufacture facilities, one in Alberta and one in New Brunswick.[19]

Overcoming Carbon-Intensive Industrial Policies

CANADA WAS FOUNDED as a "staples economy," a term Canadian economic historian Harold Innis coined to describe the country's economic development, driven by the extraction and export of unprocessed or semi-processed raw materials. Canada has historically been a country on the margin of global industrialization and innovation, and has developed tendencies towards falling into a "staples trap" that locks in this pattern of development. While some progress was made in developing value-added industries and services in the post-WW2 era, including development of public services and Crown corporations, the role of oil sands bitumen in the early 21st century has arguably shifted Canada back to a focus on resource extraction — towards a new "carbon trap", in the words of economist Brendan Haley.[20] In Canada's carbon trap, capital investments by public and private sectors, policy frameworks, development of supportive institutions, and vested interests in the political system serve as bulwarks to change.

Moreover, the Canadian case demonstrates that dependence on resource extraction for export, GHG emissions notwithstanding, is not necessarily a negative. While Canadian history demonstrates the legacy of booms and busts due to developments in export markets, over the long term, Canada's resources have produced wealth and a modicum of international power, par-

ticularly in the context of diminishing conventional oil supplies. Of note, the "terms of trade" have shifted in Canada's favour, with higher global prices for Canadian mining and oil and gas exports leading to gains in real income that exceed gains in real GDP (which only counts production, and neglects gains from higher global commodity prices).[21]

Development of natural resources is primarily within the jurisdiction of provincial governments, and as regional economies developed they greatly expanded north-south patterns of trade. The federal government is involved in territorial and coastal resource development, and has still done much to encourage resource extraction, with a recent emphasis on expanding oil and gas trade with Asian markets. Expansion of oil sands production is a top priority for the Conservative government, evident in the promotion of pipeline projects, including Trans-Canada's Keystone XL pipeline proposal to pump Alberta bitumen straight to the Gulf Coast (capacity: 700,000 barrels a day) and Enbridge's Northern Gateway project to the West Coast to access Asian markets (capacity: 500,000 barrels a day).[22] To further tap Asian demand, BC is also planning up to four Liquid Natural Gas (LNG) terminals in Kitimat that would be supplied by Northeast BC's vast reserves of shale gas — at their peak these LNG actions would add 112 Mt CO_2e per year to the atmosphere.[23]

Environmental Deregulation

The 2012 federal budget (framed as an Economic Action Plan rather than merely a budget) committed to a streamlining of approval processes for major projects, and about one-third of the budget bill is dedicated to dismantling federal environmental laws.[24] The federal government anticipates 500 new projects worth $500 billion over the coming decade, and the changes are aimed at ensuring a rapid approval process, now capped at two years from the time of application (18 months for National Energy Board hearings).[25] Centred around the Major Projects Office, which currently has 70 projects on file, the new framework will facilitate putting hundreds of millions of tonnes of CO_2 into the atmosphere, as well as other environmental damages from air and water-borne pollutants. Six projects highlighted as "major economic projects" that will benefit from consolidated review — three oil and gas pipelines, a gold mine and a uranium mine — are indicative of the government's priorities.

While previously existing environmental assessment was already inadequate — for example, due to failure to fully consider greenhouse gas emissions — the new framework further undermines the public interest in several ways.[26] Environmental impacts will be lumped in among many other technical and regulatory considerations, another move away from ensuring that sustainability be a core objective of the approval process. The new regime's focus gives priority to corporate profits, and fails to commit to a thorough evaluation of economic costs and benefits for projects.[27] Public participation is deliberately curtailed, with environmental groups and concerned citizens sidelined by the perceived need to speed up approvals. To achieve these goals, project approvals will delegated to provincial governments that may have weaker assessment processes and a greater incentive to push forward projects to access resource royalty revenues.[28] In any event, the federal cabinet can over-ride any decision made by regulatory bodies.

Altogether, this is the opposite of the "responsible resource development" claimed by the federal government, and more of a colonial vision of the economy as a quarry for foreign interests. Instead of ensuring development of resources in a manner consistent with real long-term policy objectives such as energy security and climate action, the country is to open to any foreign investor who wants resources. While there will be some Canadian jobs in all of this, most of them will be of short duration in the construction phase, while permanent jobs will be few due to the capital intensive nature of these industries. The new process drops any pretence of evaluating projects in a neutral manner against the broader public interest, rather than narrow corporate interests.

Supports to Resource Development

Consistent with the notion of a "carbon trap", government subsidies and tax breaks for resource industries are deeply embedded in Canada's political culture, and spur increased production, and emissions, than would otherwise be the case. Federal and provincial subsidies for the oil and gas sector, in terms of direct spending, loan guarantees, insurance, post-closure environmental costs, tax breaks, royalty reductions and other measures amounted to $2.8 billion in 2008 (or $87 for every Canadian).[29] Federal subsidies were about half the total, and a disproportionate share of federal and provincial subsidies went to Alberta.

In 2009, G-20 members pledged to phase out fossil fuel subsidies, but Canada's "implementation" has been misleading at best. The 2012 federal budget states a commitment to "rationalizing inefficient fossil fuel subsidies by phasing out tax preferences for resource industries." In Budget 2012, an investment tax credit for oil and gas development specific to Atlantic Canada is being phased out and the 2011 federal budget committed to phasing out a preferential tax break offered for oil sands development, but only to match the rate for conventional oil. These are token gestures compared to the grand commitment on "rationalizing fossil fuel subsidies."

As it stands, oil sands exploration costs can be deducted in full for the year incurred. This will be reduced to a 30% rate, but the shift will not be complete until 2016.[30] A leaked briefing note from the Department of Finance prior to Toronto G-20 meetings indicated that top bureaucrats agree that preferential incentives for the fossil fuel industry are no longer warranted.[31] And yet, many subsidies remain in place.

Similarly, the mining sector benefits from preferential tax policies, such as the Canadian Exploration Expense and the Canadian Development Expense. Natural Resources Canada comments that: "federal and provincial income tax systems, as well as provincial mining taxes, provide a generous treatment of exploration and other intangible expenses, and allow mining companies to recover most of their initial capital investment before paying a significant amount of taxes"[32].

Another form of subsidization comes in the form of low-cost electricity to industrial customers. Economist Pierre-Olivier Pineau argues that the difference between the market price of electricity (average North American price) and the price paid in a low-cost Canadian jurisdiction should also be considered to be a subsidy.[33] For example, large industrial customers in BC paid 2.34 cents per kWh less than the average North American price in 2011, which implies a subsidy of $308 million.[34]

It is also the case that these subsidies prime the pump of economic activity, that leads to billions of dollars in royalties and corporate income taxes paid by the mining and oil and gas sectors.[35] At a time when governments are reluctant to raise taxes, government budget expenditures on social programs are supported by such royalty revenues and corporate income taxes. The "carbon trap" is further reinforced by a growing reliance on these revenues that weave resource interests into the economic and social fabric of the country. What *has* changed is the nature of the social contract vis-a-vis resource industries. In the past, resource investments were less capital intensive and created more jobs that supported small towns and urban cen-

tres across the country, while governments historically implemented labour market policies tied to industrial development in the resource sectors.

Climate Policies vs Industrial Policies

To date, climate action in Canada has been dismal, from failing to live up to Kyoto Protocol commitments (then abandoning the framework altogether) to not making concrete plans to meet our newer Copenhagen Agreement target. Environment Canada estimates that existing provincial and federal plans to reduce emission will only get one-quarter of the way to the (weakened) target affirmed in the Copenhagen accord to produce 607 Mt of CO_2 equivalent or less by 2020. This target was set at 17% below 2005 levels by 2020 in alignment with the target set simultaneously by the U.S. It has been indicated that a plan to meet this target will rely on a sector-by-sector regulatory approach, though no plan has yet been published.[36]

While there are some smaller federal investments in clean energy projects and green infrastructure, and energy efficiency subsidies, Canada has been a laggard at spurring green alternatives with the same effort reserved for oil and gas. In response to the economic downturn, Canada invested only 8% of stimulus spending on green initiatives, according to global analysis by HSBC in 2009, a lesser amount than recovery plans in the U.S. (12%), China (34%) or the EU (64%).[37]

Thus far, there has been no political willingness federally to put a price on carbon emissions, in terms of either a carbon tax or cap-and-trade system, although federal and provincial governments levy fuel taxes that put a de facto price on a narrower range of emissions (these have not been implemented with climate in mind). BC's carbon tax was implemented in July 2008, and will reach $30 per tonne (approx 7.2 cents per litre at the pump) in July 2012, although no further increases have been scheduled and the provincial government that brought in the tax is in the process of reconsidering it.[38] Alberta and Quebec also have very modest variants of a carbon tax, although neither is as comprehensive as the BC version.[39] Quebec is also the only province to continue forward with the Western Climate Initiative cap-and-trade system, in which BC, Manitoba and Ontario have been part of the negotiations. However, none of these programs have been implemented aggressively enough to have a significant impacts nationally. A recent study determined that a national carbon price would need to reach $200 per tonne by 2020 to enable reductions that will keep the planet from

reaching the critical threshold of increasing more than 2 degrees Celsius (assuming other countries do their part).[40]

Canada's carbon trap is also reinforced by existing trade relationships and international trade agreements. Canada has aggressively pursued new trade agreements in order to expand markets for exports but also to enhance protections and market access for Canadian corporations, most notably in the mining sector (such as insurance provided for overseas investments against foreign political turmoil or nationalization). Transportation investments to facilitate trade, such as highway expansion and gateways (ports and border crossings) are a high priority for the federal government, including the Northern Gateway. While a full review of trade law as it relates to existing industries and climate policy is beyond the scope of this paper, some key aspects of trade agreements are very problematic, and would need to be renegotiated or abandoned in order for Canada to pursue an activist green industrial revolution. In particular, the NAFTA includes provisions for "proportional sharing" of energy resources that limit Canada's ability to restrict exports, and aggressive environmental efforts would likely be met by investor-to-state dispute settlement (NAFTA's notorious Chapter 11 that allows foreign corporations to sue governments for interventions that affect their economic interests).

The trend in industrial policy in recent years has been to emphasize passive, supply-side policy measures that seek to reduce operating costs for businesses in order to make them more "competitive" and to attract new foreign investment. Such policies include corporate income tax reductions, reductions in royalties, deregulation, and weakening of employment standards. These policies have arguably had a negative impact on decent work in Canada's industrial sectors, and have contributed to entrenching a low-value-chain resource mindset that dominates provincial and national economic policy-making. This is particularly puzzling in oil production, where some 80% of the world's remaining oil reserves are held by state-owned companies. Canada is one of the only jurisdictions in the world that allow private, foreign ownership, leading some state-owned companies (from China and Norway, for example) to make investments in the oil sands.

Moreover, Canada has developed what economists call "Dutch disease", where foreign investment flows into oil and gas have driven up the value of the Canadian dollar, making manufacturing less competitive and further reinforcing resource extraction as the dominant economic model.[41] While resource exports are booming, non-resource goods and services exports have declined by a greater margin due to an over-valued currency. Canada has

CCS: Burying the Evidence?

Given the need for GHG emissions to fall dramatically over the coming decades, carbon capture and storage (or CCS) technology has been proposed as a solution that would allow for continued use of fossil fuels but without the GHG emissions. CCS is based on separating out CO_2 from fossil fuel processing or combustion, and pumping it deep underground where it will stay, forever. If CCS technologies can be successfully implemented — and this is a big "if" — there might be a case to be made for the development of "sustainable fossil fuels."[44]

First, there are long-term risks associated with sequestration. For example, concerns about leaks from Canada's largest CCS demonstration site in Weyburn, Saskatchewan challenge the viability of this solution.[45] Beyond leaks, CCS would probably not be able to contain anything close to 100% of emissions on a life-cycle basis. There are already substantial emissions associated with extraction even if a single processing facility can sequester all of its emissions. At the facility level, Mark Jaccard estimates that "most CO_2 capture technologies currently under serious consideration prevent 85–90% of the carbon in the fuel from reaching the atmosphere."[46] And while this may be applicable in power stations and large industrial plants, there are no foreseeable technologies that would capture and sequester emissions from small-scale combustion in homes or businesses.

Second, the economics are not favourable. A pro-CCS task force reporting to the Alberta government commented that:

> *CCS is expensive and currently uneconomic. CCS costs are site-specific and vary widely. They range from $70 to more than $150/tonne. Over and above any potential compensation available to industry, deploying CCS currently carries a financial disadvantage of up to $100/tonne.*[47] *Those carbon prices seem unlikely to appear out of current political processes — whether in BC, Canada or the US — any time soon.*

The report additionally notes that development and implementation of CCS is complex and will take time. It recommends large public subsidies in the early stages to bridge the cost gap.

The Pioneer CCS demonstration project in Alberta, which had $779 million in federal and provincial funding for a $1.4 billion project, was recently shelved as uneconomic.[48] Another, Shell's Quest CCS project, is expected to cost over $1.35 billion, including $865 million in federal and Alberta government support.[49] The federal government has thus far committed $1.3 billion to CCS development, adding to the $2 billion the Alberta government has set aside to encourage CCS. Public funds are subsidizing projects for some of the most profitable companies in Canada, and there is pressure for more government funding.

BC has required that any coal-fired electricity generation use CCS, and draft federal regulations could require new coal-fired electricity plants after 2015 to implement CCS.[50] Even if we are generous about the potential of CCS as a technology, it should be regulated as a mandatory requirement, where applicable. Developing CCS would be expensive, however, and it would be less costly (especially if governments are expected to pick up the tab in the short- to medium-term) and less risky to spearhead aggressive conservation efforts and shifts to truly renewable sources of energy.

shifted from having current account surpluses, due to broad-based manufacturing and resource industry exports, to large current account deficits (about 3% of GDP in recent years) that are a drag on the domestic economy.[42]

Given the above, it is no surprise that climate action sits in direct conflict with expansion of capital-intensive resource industries that are important contributors to our national inventory of GHG emissions, and fossil fuel exports that extend Canada's carbon footprint in unsustainable ways.[43] Leadership from the federal government is needed to implement more coherent and integrated climate, industrial and labour market policies if a green industrial revolution that decarbonizes Canada's economy is to occur. While almost everyone agrees business-as-usual is not acceptable from a GHG perspective, most policy work does not think beyond business-as-usual, and may also be compromised due to vested interests.

Growing Green Jobs

CANADA WILL EVENTUALLY need to shift from a policy of official denial about climate change to a commitment to significant action. Pressure will likely emerge from the international arena, and action could be swift in the wake of one or more major climate disasters that affect major population centres. Rather than throwing a tantrum, we argue that Canada can derive substantial economic advantages — from the development of new green jobs to innovation and technology growth to improved health outcomes — via aggressive climate action.

A key barrier to change is the legitimate concern that a shift away from fossil fuels will lead to recession and massive job losses. As pointed out earlier, the total number of jobs in mining and oil and gas is relatively small compared to the entire Canadian economy. There is also good reason to believe that the green industrial revolution we envision will require lots of new work. Below we highlight areas where employment opportunities can be created through public policy or investments that move Canada closer to a zero-carbon economy. The discussion draws on a number of more detailed research papers for the CCPA-BC's Climate Justice Project.

A key focal point for green jobs is in rebuilding Canada's physical infrastructure: the buildings in which we live and work, how those buildings connect together as communities, the ways in which we move ourselves, and how we get and use energy. These actions will cost money, and the most obvious source of revenues for such a transition is a steadily rising carbon tax. We review the key features of fair and effective carbon pricing later in

the section. We also focus on some key elements of a new social infrastructure for a green economy that supports the demand side of Canada's economy with purchasing power, through incentives and a "green social contract" to facilitate change.

The more robust a green jobs program in delivering new employment opportunities, the smoother will be the transition. A study of green jobs in the U.S. context notes that they are already "in the same areas of employment that people already work in today, in every region and state of the country. For example, constructing wind farms creates jobs for sheet metal workers, machinists and truck drivers, among many others. Increasing the energy efficiency of buildings through retrofitting relies, among others, on roofers, insulators and building inspectors."[51]

We recognize that there is an important difference between existing jobs and potential jobs, however dirty the former and green the latter. That real people in real communities may be adversely affected by climate policies may politically trump promises of new, green jobs that do not currently exist. Planning for a smooth transition must include a vision for new initiatives that create jobs, and a commitment of proactive public investments and industrial policies to create new employment opportunities in public and private sectors.

Clean Electricity

Renewable sources of power, accompanied by large gains in energy efficiency, are central to achieving a zero-carbon economy.[53] Mark Jacobson and Mark Delucci of Stanford University argue that it would be technically possible to provide all of the world's energy with renewable sources (wind, water and solar technologies, with no nuclear and biomass) by 2030.[54] A commitment to clean electricity on a national basis could begin with shifting of existing subsidies for fossil fuels to renewables. BlueGreen Canada estimates that compared to the United States on a per capita basis, Canada's lower investments in renewable energy for 2009 and 2010 has resulted in the loss of 66,000 direct and indirect jobs.[55]

The concept of developing a robust east-west electricity grid in Canada is not new, but based the shift to clean energy to reduce emissions, especially for provinces currently dependent on coal and other fossil fuels, could be a catalyst for this vision. Transmission infrastructure to enable the transfer of hydro power from Newfoundland to the Maritimes, Manitoba to Alberta and

Employment Impacts of Green Investments

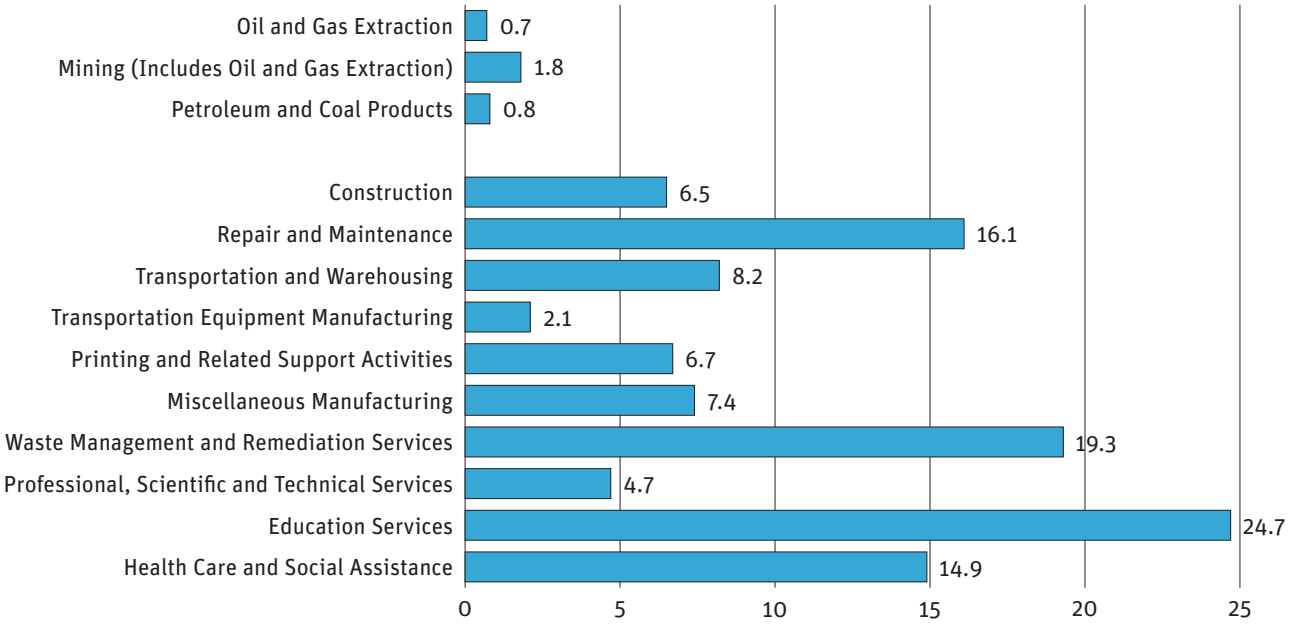
Estimates of employment (and GDP) impacts of new investments are typically based on input-output models that map the flow of materials, labour and income through the economy. On this basis, studies often estimate that an additional $1 million invested in a particular sector of the economy leads to a certain number of jobs. Those jobs are broken down into *direct jobs* in the sector where the investment is made, *indirect jobs* as part of the supply chain, and *induced jobs*, those created when workers spend their incomes in the local economy.

Making predictions based on I-O models can be challenging and lead to over-estimates of job creation.[52] Estimates are gross figures, meaning they do not account for alternative investments that would also create jobs. One notable assumption made in these models is that new investments lead to new jobs for unemployed workers, whereas in practice there will be gaps in certain areas due to labour supply and skills shortages that must be addressed through education and training programs. Thus, estimates should be considered potential jobs that can be realized only through good labour market (including "just transition") policies. In addition, making estimates of induced job creation arising from new investments is very challenging.

In *Figure 2*, we show estimates of direct jobs per million dollars of output, based on standard input-output tables. This comparison of employment (standardized for output) across industries shows that not all investments are equal. Some industries are very capital intensive, and require a large outlay in order to generate the same number of jobs as a smaller investment in another sector. Oil and gas extraction, for example, creates relatively few jobs in Canada in spite of billions of investment, whereas service sectors that are much more labour-intensive can generate far more jobs per dollar of investment. Categories in the input-output tables do not neatly align with green jobs (due to measurement issues, and for confidentiality reasons some industry sub-areas are suppressed). However, we note:

- For building retrofits, $1 million of construction output supports 6.5 direct jobs, but because retrofitting is arguably more labour intensive, repair and maintenance, which supports 16 direct jobs per million dollars may be more relevant.
- In transportation, data are not available for "urban transit systems" but $1 million of output supports 8.2 direct jobs in transportation and warehousing, and 2.1 jobs in transportation equipment manufacturing.
- Green manufacturing and alternative energy investments are harder to assess, but we include some categories that are more closely related to the type of investments we envision: waste management; miscellaneous manufacturing; printing and related activities. Each supports several times the jobs as an equivalent fossil fuel investment.
- Many public service jobs — civil service, health care or education — could be considered a major source of inherently green jobs, and show a very high employment impact of investments in that area (note of caution: the structure of the input-output analysis means that both education and health impacts pertain to 'private' organizations, and the public organizations have been excluded).

FIGURE 2 Direct Jobs Per $1 Million of Output



Source Informetrica Limited, based on Statistics Canada's 2002 w-level public-use Input-Output tables.

Saskatchewan, and improved transmission capacity between Ontario and Quebec, could result in significant emission reductions if able to displace coal-fired generation. New investments in hydropower capacity could support and enable other renewable technologies such as wind, geothermal, solar, and tidal energy, tied into a national clean electricity grid while displacing existing thermal generation plants that include some of Canada's top point-source emitters. Development of new high-voltage transmission infrastructure would also be a source of green jobs.

Renewable energy also contributes to a greater number of direct jobs than fossil fuels per unit of energy delivered. A study in the U.S. found the number of jobs created can be almost three times that of fossil fuels per MW of wind or biomass power, and 7–10 times for photovoltaics.[56] A study by the Pembina Institute found that comparing investments in carbon capture and storage (maintaining fossil fuel reliance) and wind power (renewable alternatives), public money spent on the wind project produced more than twice as many job-years per dollar than funding Project Pioneer (CSS).[57] There are additional green manufacturing jobs to be generated in the fabrication of products such as wind turbines and solar panels that can prove to be more economically viable to manufacture domestically than import

(in part due to size). And in order to capitalize on job growth, a national clean energy plan needs to include training and transition programs to ensure that clean energy skills are developed in the labour force, as well as investments in research and innovation to make Canada competitive internationally in clean energy.

Buildings: Retrofits and New Construction

The concept of "net zero" and "Passiv haus" buildings is considered an ideal for green residential, commercial and institutional buildings in the future. In practice, it means siting the building to take better advantage of the winter sun, along with improvements to building envelopes to better facilitate lighting, heating and cooling, and the use of more energy efficient equipment and appliances within homes — with on-site clean electricity generation (such as solar panels) and/or neighbourhood-scale energy systems (including waste heat recapture) supplying any energy gaps. Such buildings would greatly reduce reliance on fossil fuels.

GHG emissions for commercial and institutional buildings amounted to 36 Mt of CO_2e in 2009, 5% of Canada's overall emissions. That same year residential homes in Canada contributed 41 Mt of CO_2e in emissions, a further 6% of the national emissions total. While building codes and standards are a provincial responsibility, the federal government provides a model establishing a baseline for energy efficiency of new buildings. In 2011, the Model National Energy Code for Buildings establishes a standard that is 25% more energy efficient than the previous code.[58] This sets the minimum energy efficiency standard across Canada. Five provinces have already committed to bettering this baseline, planning to require an EnerGuide for Homes rating level of 80 in their building codes by 2012 including Nova Scotia, New Brunswick, Quebec, Ontario and BC.[59] Scheduling increasing energy efficiency standards for the near future could encourage green construction and housing markets, creating jobs and put Canada on a path towards zero emissions buildings.

There is also interest in low-energy buildings from consumers, and this is reflected to some extent in market demand for green construction (LEED standards have become increasingly widespread as an indicator of green building). Canada-wide, there have been many buildings certified by LEED, including over 50 homes and buildings rated as LEED Gold Standard, and 18 at the Platinum level. LEED Platinum certified in 2009, SC3 Smith Carter Head Office in Winnipeg, Manitoba was able to cut its energy consumption

to less than 50% of the Model National Energy Code baseline. And Vancouver's Southeast False Creek is home to the first net zero multi-unit residential building, as well as a Neighbourhood Energy Utility that meets 70% of the energy needs of all the housing developments by capturing waste heat from sewers. The capacity to make these energy savings can be developed across the country.

A major gap, however, is a need for funding of coordinated education and training programs to develop Canada's knowledge capital in this area and ensure a supply of skilled workers. There are also opportunities to develop green jobs in manufacturing to supply the equipment that will be needed for net zero buildings locally, such as hyper-efficient windows, heat pumps and other parts currently imported from Europe and Asia. In addition, independent analysis of on-site performance is required; its absence can be a shortcoming of programs like LEED (which is not an explicit energy performance standard). Installation of components needs to be monitored, enforced and performed by certified, skilled workers, or buyers may be faced with problems due to shoddy work.

While net zero is an ideal for new buildings and housing development, the reality is that housing stock takes a very long time to turn over. A key green jobs strategy, therefore, is to start with retrofits of existing buildings. Because so many buildings could use energy efficiency upgrades, and this is local, labour-intensive work, building retrofits are essentially the low-hanging fruit of green job development. Policy actions are required to stimulate the demand for retrofits by homeowners and the supply of skilled workers.

The Government has provided incentives with the Economic Action Plan to Canadians through the ecoENERGY Retrofit — Homes program. Like provincial programs, the federal program has experienced on-again off-again funding, with the latest tranche of $400 million in funding in the 2011 federal budget. The window for new applications was closed in January, with less than half of these funds expended,[60] nor was any additional funding announced in the 2012 budget. The national program for commercial and institutional organizations wrapped up in March 2011 due to low uptake. Regulation may prove to be a better policy instrument for effecting change in commercial buildings.

A next generation ecoENERGY program could build on its success by focusing on older housing stock, rental housing and multi-unit buildings. Low-income energy efficiency programs are "low-hanging fruit" that can yield relatively greater energy savings than mainstream energy efficiency programs because low-income households live in less energy-efficient homes

than the average household. But rethinking the program to make it more effective for low- to middle-income households is also needed, considering multiple barriers such as information gaps, complexity, financing, eligibility and tenure[61]. Additional challenges apply to retrofits for multi-unit buildings, which are not covered by the existing program. An upgraded program should aim for other multi-unit buildings, including non-profit housing, rental properties and condos, where retrofitting must grapple with multiple owners and/or residents.

A smooth transition to zero-emissions housing requires more attention be paid to impacts on low-income households and other vulnerable populations, alongside the goal of green job creation and skills development:[62]

- **Accelerate financing reform.** Financing through the public sector can also ensure credit is available to low-income households, landlords and others. A key dimension of this is for governments to pay for cost-effective upgrades up front and link repayment to the property rather than the occupant.

- **Establish dedicated funding for retrofits and reduce complexity across programs.** The current model of periodic funding from federal and provincial governments, plus independent programs from electricity and gas utilities, could be replaced with a "one window" approach, including multi-year funding, as part of a national energy efficiency strategy.

- **Support mandatory energy audits and focus on older housing stock.** The federal government can encourage a complete energy audit of housing, starting with the oldest housing stock. Such a program could be coordinated federally and, similar to the facilities reporting required for the highest emitting corporations in Canada, the results could be made available in the public domain and help set regulations for energy performance to meet GHG emission targets.

- **Establish progressively higher minimum standards for appliances and buildings.** Progressively higher marketplace standards for energy efficiency of appliances should be set. And the federal government must push minimum standards for buildings that lead, over time, to net-zero targets.

- **Invest in skills development for green jobs.** An aggressive approach to zero-emissions housing would require planning and se-

quencing of retrofits in accordance with the availability of skilled labour. The associated need for training, apprenticeships, etc. should be also co-ordinated with post-secondary institutions and include vulnerable populations.

Zero-Emission Transportation

Transportation is another area where there are large gains to be had in green job creation and in GHG reductions, with over one-quarter of Canada's emissions generated from transportation. Even if climate change were not cause for urgent action, Canada's reliance on fossil fuels for transportation leaves it vulnerable to price shocks of the type seen in 2007–08 and likely to occur again. Economist Jeff Rubin's peak oil scenario points to oil prices of $200 per barrel in the next economic expansion, a development that would drive economies back into recession, then perhaps $300 to $400 a barrel oil in the subsequent expansion.[63] It would be prudent to plan for such risks, and such dynamics may just be a matter of time.

Almost seventy percent of transportation emissions in Canada come from road transportation. As with buildings and equipment, the federal government has a role in setting energy efficiency requirements for vehicles that need to be significantly increased to reduce the emissions generated by an ever-increasing number of cars on the road. Canada's ailing auto sector has much to gain in research and development investments that could help make the sector more competitive and bring back well-paying union jobs with a green approach.

However, to make real inroads to a sustainable future, we need to move towards other less harmful modes of transportation. Considering the size of our nation and the necessity in moving goods and people throughout, one low-emission mode of transport that needs reviving is rail. Acting not only as an alternative to highway travel, high speed rail corridors between major centres could also reduce GHG-intensive short-distance air travel. The federal government has made some investments in the busy Toronto to Montreal rail route through the Economic Action Plan, but a much more visionary approach is needed, to provide a service that can create and meet a high demand for low-carbon transport.

New high-speed rail corridors should be considered, such as the often mentioned Quebec City to Windsor corridor,[64] and Vancouver to Calgary to make necessary business and personal travel sustainable. A full coast-to-

coast high-speed rail network could eventually emerge out of these first developments, powered by clean energy sources along the route. The jobs associated with such expansion would span across research and development, domestic production, maintenance and other necessary services, all of which could provide decent careers for Canadians while decreasing overall transportation emissions.

A national transit policy framework to guide a massive expansion of public transit should form a major part of a green jobs plan. In 2009, there were over 119,000 jobs in transit and ground passenger transportation in Canada. Expansion of transit capacity is directly linked to new green jobs, and creation of new transit lines and transit vehicles point to large potential gains in construction and green manufacturing. The Canadian Urban Transit Association reports that 1.9 billion transit trips were taken in 2010, a 4% increase from 2009.[65] The untapped potential of existing transit infrastructure could be realized if funding is made available and accompanied by measures to discourage private vehicles by reducing available road and parking space. And while transit ridership has increased across Canada, there is much room for performance improvement by investing in new infrastructure to speed up transit connections. If existing funding to expand roads and bridges were instead put to transit expansion, more efficient, much higher capacity transit networks could be built throughout Canada within a decade,

In the longer term, large reductions in emissions from transportation will stem from changes in land use patterns toward more complete communities where increases in density, mix of use, proximity of public and private services and amenities act as structural factors that make the behavioural change required easier. Complete communities are equally amenable to large urban areas, suburbs and small town, though opportunities and barriers will be particular to each location. In the 2011 Climate Justice Project report *Transportation Transformation*, key strategies are outlined for driving the transition to a sustainable transportation system as efficient and enjoyable to use as a private car, based on the following objectives:

- Shortening the average trip length for all modes of transportation;
- Shift auto trips to more efficient modes, such as bike trips or public transit;
- Switch to clean fuels, primarily zero-emission electricity;
- Make transportation connections seamless; and

- Integrate actions to maximize other benefits (such as improved health and safety).

In redesigned urban places walking and biking could eventually encompass half of all trips, supplemented by transit, taxis and car-sharing, all of which would be powered by clean electricity (although a limited amount of biofuels and hydrogen may need to play a role in transportation). And while these transitions are locally-based, there is much the federal government could do to support and invest in such shifts, including providing funds for transformative transit and transportation infrastructure, and the promotion of complete community demonstration projects in each province. This vision of complete communities supports both serious climate change action and the need for more equitable community and mobility options for all Canadians.[66]

Suburban development patterns are defined by auto-dependency. However, there are great retrofit opportunities to transform suburbs into complete communities with alternative transportation options. Three major strategies to get there include: 1) redevelop main streets and neighbourhood/city centres, 2) create transit networks, and 3) give priority to more-efficient, low-carbon modes of transportation.[67] One possible example is the redevelopment of suburban malls into town centres, replacing mall parking with housing, offices and other services.

Outside of major metropolitan cities, larger centres would also benefit from greater transit service, especially if accompanied by urban redevelopment at key nodes and high streets. Expansion of inter-city transport within provinces should also take place along the main corridors connecting larger urban centres. Revived and more affordable passenger rail and bus services would facilitate reduced automobile ownership and use for those in smaller cities and rural areas, improving emissions outputs, options for travellers of all incomes as well as safety benefits in reducing highway traffic.

More than half of transportation emissions in 2008 were from personal transportation (57%), with the remainder from the movement of goods and freight.[68] Similar strategies around fuel-switching to clean electricity are relevant to goods movement. Technological developments, such as the application of electric engines (and perhaps biofuel or hydrogen fuel cell) to trucking, will eventually enable fuel-switching away from fossil fuels. Reducing GHG emissions from freight transportation includes shifting from high-GHG transportation modes, like air and trucks to use of low-emissions transportation modes such as rail and ships. Expansion and electrification

of rail in particular has great promise as rail freight has declined in recent decades while trucking has increased.

Perhaps more importantly, freight emissions would be reduced by reductions in consumption and resource extraction. Additional operations that source more goods locally, from food to manufactured goods, will also reduce emissions associated with large global supply chains.

Greening Manufacturing

Manufacturing has been on the decline in Canada due to the shift to oil and gas production. Meanwhile, Canada has outsourced carbon emissions associated with imported manufactured goods from China (in addition to carbon-intensive production, Canadians also benefit from the exploitation of workers in terms of wages and working conditions). Moving to zero carbon economy offers new possibilities to re-invigorate domestic manufacturing by making the price of imports reflect the true costs of production (carbon tariffs on imports would be needed to level the playing field for any carbon pricing that occurs in Canada). Canada needs an industrial strategy that: (1) develops new green manufacturing capacity, (2) dramatically improves energy efficiency and use of renewable power in existing manufacturing operations, and (3) closes the loop on materials in the economy through aggressive reuse and recycling.

Zero waste policies emphasize shifting from generating wastes to recovering resources, building on recycling and composting policies to divert materials from landfills and incineration. In this framework, products are designed as part of closed loops with a stronger emphasis on re-use (e.g. bottles and packaging) and re-manufacturing (i.e. disassembly of consumer electronics) before recycling of materials for subsequent generations of products. Organic materials are composted. Reducing the material throughput of our "throw-away culture" is also desired. A rethink of waste thus strives to dramatically shrink the ecological footprint of society, and requires a significant absolute reduction in energy and material flows through the economy. While it is necessary to recycle or compost materials, more importantly a rethink of waste seeks to *dematerialize consumption* (e.g. iTunes sales in place of CDs), extend the useful lives of products, and reduce excessive and wasteful consumption.

The shift to "upstream" proactive solutions — aggressive reduction, redesign, re-use, recycling and composting — has great potential to save energy and reduce the carbon emissions associated with consumption. Developing

and sustaining closed-loop markets for materials simultaneously creates domestic green job opportunities—serving a social justice agenda of generating employment opportunities that are sustainable, well-paid and secure—while reducing GHG emissions.

Ontario has fostered green manufacturing start-ups through domestic content requirements in the Green Energy Act. Several international solar manufacturers established contracts for production in Ontario in 2010 and 2011, creating green manufacturing jobs in a sector and region that has been adversely hit by the recession.[69] A national clean energy plan could similarly motivate investments across Canada for the production of equipment necessary to renewable energy generation. Joint ventures or strategic partnerships could link to Canada's needs for alternative energy (e.g. Danish wind turbine manufacturers) and transportation infrastructure (Bombardier was induced to manufacture cars in BC for the Millennium Skytrain line).

The Canadian government is able to help stimulate green manufacturing in a number of ways. For example, in the automotive sector, federal regulation of vehicle emissions could be substantially increased to ensure that auto manufacturers are compelled to increase fuel efficiency and pursue alternative energy sources. Recent federal contributions to support green innovation in the auto sector have helped stimulate green manufacture, including support for Toyota Canada's Project Green Light to improve the environmental efficiency of manufacturing facilities in Ontario.[70] Such actions help both in maintaining decent jobs in the auto sector, and support the transition from "brown" to green jobs in auto manufacturing.

Opportunities to green existing manufacturing operations are already being realized where economic considerations are favourable. The pulp and paper sector in BC, for example, now generates a large share of its electricity needs by burning its wood waste. A steadily rising carbon tax that increases the costs of burning fossil fuels is an example of a policy that creates economic incentives for change over time, and could be accompanied by targeted tax credits and accelerated capital cost allowances for energy efficient investments (as opposed to across the board corporate income tax cuts favoured by BC's current carbon tax recycling regime). Changes in pricing and regulatory standards for industrial customers would also drive major improvements in energy efficiency.

Innovative climate policies should also look to create spaces where ideas for changes in workflow and production processes can come from within. Research on technological innovation finds that half of the gains of innovation are from gradual improvements in the application and use of technol-

ogies, as opposed to the development of new technology itself. By tapping the knowledge of workers on the shop floor, operations could be reorganized to reduce GHGs and energy. This requires working closely with unions and implementing safety net provisions that guard against job losses.

To shape a closed-loop manufacturing strategy will require a more aggressive public sector presence. Public agencies can drive the demand side through regulatory initiatives (for example, banning single use plastic beverage containers and requiring re-usable bottles), and minimum recycled content requirements in public procurement and through marketplace standards. In addition, the development of a "middleman" public enterprise or Crown corporation to connect materials supply and demand would help overcome various market failures and stop the export of recyclable materials. This supply management framework could include significant sorting, processing and manufacturing infrastructure, including smelters and pulp and paper mills. Emerging small-scale manufacturing technologies (fabrication labs or 3D printing) could also play a role in localizing value-added production for domestic markets.[71]

In addition, long-term economic and employment strategies must also consider the development of new advanced technologies. New technology developments occur under much greater uncertainty, and because of spillovers there is a strong case for federal leadership on technology research and development. The federal government can scale up existing programs that have potential to make some significant contributions. Sustainable Development Technology Canada (SDTC) is an arms-length federal initiative supports Canadian clean technology projects, with an emphasis on financing pre-commercial research and development. SDTC is a foundation with just over $1 billion in capital (half for clean technologies, half for biofuels), meaning only a portion of this funding can be awarded each year. This is a fairly small piece compared to the $2.8 billion in subsidies and tax breaks for fossil fuel industries (and some SDTC money currently supports projects like CCS, of benefit to the oil and gas industry). Nonetheless, SDTC could readily be supported with additional funding and a more focused mandate in support of green economic development and job creation for a zero carbon future.

That said, the future path of any technology is impossible to predict, and technologies also have negative applications and unintended consequences, but the decades to come offer the potential for major breakthroughs in biotechnology, nanotechnology, and quantum computing technologies, all of which have massive potential for implementation in a green industrial production system. Nanotechnology is regarded as a "platform" technology

that will help support and improve the development of other green technologies such as efficient hydrogen-powered vehicles, enhanced and cheaper solar photovoltaics, and the development of a new generation of batteries and super-capacitors.[72] It is possible that nanotechnologies will also serve a fundamental platform for developing green materials, smart buildings and clean water systems. Canada will want to be positioned to adopt and adapt green applications of these technologies. To do so will require a strategic framework to coordinate the complex inter-relations and develop the required complementary innovations to make the technologies productive, including technology policy tools at three levels — direct government funding of R&D, direct or indirect support for commercialization and production, and support for learning and diffusion of knowledge and technology.[73]

Adaptation Planning

Beyond mitigation of GHG emissions in Canada, there will increasingly be new work related to adaptation to a warmer climate. Climate impacts on regions and communities will be diverse and variable, and require planning processes that identify major risks (e.g. fires, floods, droughts, landslides). Developing and implementing a coordinated national strategy for climate adaptation will lead to green jobs that build physical infrastructure and reinvigorate social networks.

A wide spectrum of work is possible, from reinforcing dykes in low-lying and flood prone areas, planting trees to accelerate forest recovery after forest fires and mountain pine beetle, and implementing other infrastructure upgrades to storm sewers and water treatment facilities. On the social side, adaptation may include reinforcing the role of social agencies, supporting non-profit service providers, and developing various engagement processes. Less well-understood are the social networks that bind a community together and ultimately matter most from the perspective of resilience.

The development of more localized, sustainable food systems is a key aspect of resilience planning, as climate change may affect global food supply chains, while at the same time conventional agriculture is highly dependent on fossil fuels, and is a contributor to a warming planet. Revitalizing a local, sustainable food system can be developed by building on farmers' markets to expand the linkages between local farmers and urban institutional buyers such as schools, universities, hospitals, non-profit housing units and hunger programs, as recommended by another Climate Justice

study on BC's food system.[74] Moreover, sustainable agriculture is generally thought to be more labour-intensive than conventional practices. While most people do not think of agriculture as a green job, training programs to assist potential new farmers get started (especially young urbanites) are also part of a green jobs strategy.

Beyond food, a planning framework that focuses on ensuring basic needs should also address water, housing and electricity at provincial, regional and community levels. These core areas will require public coordination that integrates sustainability, security and equity objectives. A spectrum of possible interventions is possible, ranging from: direct delivery of services (through Crown corporations or other public agencies); public insurance models (especially for agriculture and extreme weather events); developing buffer stocks; other complementary regulation; provision of infrastructure; and finally, engaging citizens to ensure support for climate policies and that effective interventions are made.

A Green Social Contract with Workers

We have argued that there are substantial green job gains in traditional sectors that are already considered "green," from bus drivers to engineers, and positive impacts on total labour demand in some areas. To the extent that full employment is an objective, strategies that promote job creation in areas like health care, child care, education and other public services may be contributions to the "greening" of work.

On the other hand, there are likely to be job losses within certain industries or because certain industries are so inherently unsustainable or vulnerable to climate impacts themselves (irrespective of mitigation strategies), including forestry, fisheries, and tourism. On balance it is not obvious whether jobs gained will be larger than jobs lost, and certainly policy actions will have some bearing on this outcome. Overall, there is no reason to believe that the transition will have large, negative impacts on employment, although there will likely be redistribution of employment across and within jurisdictions, and across sectors of the economy.

Nonetheless, fear of job loss could have a paralyzing impact on progress toward, and acceptance of, GHG emissions mitigation. We thus propose a new social contract based on the concept of "just transition" programs that deal fairly with workers in industrial areas that cannot be greened. The term "social contract" is generally used to describe the agreement — written or

assumed — between a government and the citizens it governs. A "green social contract" would guide a government to prioritize both the environment and the well-being of its citizens in any decision-making process.

In the vast majority of cases, we believe that skills will be readily transitioned to other needed work that will be created in green industries. However, a just transition package should include education and training, income support and mobility allowances. Coordination with secondary, post-secondary and training/apprenticeship programs to ensure appropriate "green" skills development will be necessary.

The concept of green jobs has often been linked to potential gains for traditionally disadvantaged populations, including women, visible minorities, immigrants and aboriginal people, as well as low-income households in general. The work of Van Jones (and his organization, Green for All) shows the power of bridging the greening of the economy with pathways out of poverty for groups who need economic opportunities (in his case, young people in Oakland, California leaving prison).[75] Across Canada, apprenticeships and training programs already exist upon which green jobs can be developed, but explicit policy attention must be paid to the creation of opportunities for disadvantaged groups, leading to new well-paying jobs. ECO Canada has been delivering an Environmental Monitoring training program for Aboriginal learners across Canada that are short-term, community based, and integrate local knowledge and the participation of Elders. There have been 750 program graduates since the program was developed in 2006, with an estimated 70% employment rate for those who have completed the program.[76] Programs for low-income youth, recent immigrants, and other marginalized groups could be built with similar emphasis on community relevance and green employment focus.

Denmark's "flexicurity" model offers a real-world case study for what a just transition program could look like. Flexicurity began in the mid-1990s as a model for labour markets that accepts change in the nature and types of work, but promotes income security and active retraining through large public investments. That is, in a dynamic economy sometimes workers will lose work, and the state underwrites the transition to new work with time, income and skills training. As a result, Denmark spends substantially more than Canada on income support, education and training (and is notably more advanced in greening its workforce and economy). This is a direction very much opposite to that the federal government has taken in its recent Employment Insurance reforms, which make the system more punitive, and the large increase in the Temporary Foreign Worker program.

Carbon Pricing and Transfer

The principle that prices should tell the truth about costs of production is fundamental to the shift to a sustainable economy. Carbon pricing is typically discussed in the context of reducing the gap between market prices and the full costs associated with combusting fossil fuels. But carbon pricing is also the key ingredient to financing the green industrial revolution we envisage. Carbon taxes have already been implemented in BC, and a federal carbon tax regime could build on such programs, with improvements such as those emphasized in another Climate Justice report on the BC carbon tax.[77] These measures include: aiming for a $200 per tonne tax by 2020 (a science-based target consistent with 2 degrees maximum global temperature increase[78]); expanding the tax to cover all industrial emissions, not just those from fossil fuel combustion; applying the tax to imports and exports; and using the revenues to support climate action.

Carbon pricing poses a huge transitional problem for low- to middle-income families who spend a higher percentage of their incomes on energy and necessities. And as a matter of fairness, people with low incomes already have smaller carbon footprints. In 2009, the average Canadian is responsible for 13 tonnes of CO_2e in household GHG emissions (direct and indirect emissions from electricity, heating and transportation). When divided by income quintiles (where households are grouped in 20% increments, ranked from lowest to highest), those in the lowest quintile only emit 8.6 tonnes per capita, while those in the highest 20% emit 15.5 tonnes per capita.[79] It is important to develop an approach that does not have an unequal impact on families with lower incomes who have lower emissions to begin with.

We propose a more coherent "carbon transfer" system that would instead be designed more like the income transfers for Old Age Security and the Canada Child Tax Benefit. These transfers have a maximum amount for the lowest income families, and phase out slowly over the income distribution, so that a very high proportion of families get something. Such a design will also likely lead to a better political outcome for aggressive climate policies, and will have positive economic and employment impacts to the extent that additional spending incomes from the bottom of the distribution. In the BC case, Climate Justice modeling developed a scenario where half of the revenues from a $200 per tonne carbon tax were allocated toward a carbon transfer, in a manner that the bottom half of households received more in credits on average than paid out in carbon tax, and 80% of households received a credit.[80]

Cap-and-trade systems are sometimes perceived to be more politically palatable (as they do not specify "tax"). However, details around design of such a system matter a great deal. One major design concern, with major implications for fairness, in cap-and-trade systems is the potential for windfall profits to particular companies or sectors. This is because new rules may confer an implicit advantage (a private hydropower generator, for example), but also by deliberate gaming of the system to boost profits. Another source of windfall profits is from the free allocation of permits. If permits are auctioned, governments receive revenues that can be used (like a carbon tax) to address adverse distributional outcomes or to finance other climate action. But where allowances are given away for free, as in the European Union Emissions Trading System, companies have passed forward the economic value of the permits (the opportunity cost of selling them) to consumers, leading to windfall profits.[81]

In the case of a carbon tax or auctioned permits under a cap-and-trade system, a revenue source is readily available to fund both climate action initiatives and a carbon transfer to households. There are many possible variations on this theme. A twist on a cap-and-trade system known as "cap-and-dividend" could also be implemented, where upstream producers of fossil fuels must buy permits for their emissions, with the proceeds redistributed to households. They would also have to contend with higher prices passed on from those sources, but would experience a net saving if they reduced their consumption of fossil fuels.[82] At a household level, authors like George Monbiot argue for a similar rationing system; a form of per capita *carbon quotas*.[83] In such a system, emission rights are allocated as equal per capita amounts. Redistribution is inherent in this model, as intensive emitters (primarily the rich) would have to pay low emitters (mainly the poor) in order to emit more than their allocated share. Elaborate versions of this idea exist that essentially create a new quasi-currency based on GHG emission rights, with a digital infrastructure similar to debit card transactions.

Finally, a related fiscal move to make prices tell the truth should be to remove implicit subsidies for sectors that are GHG intensive. This includes subsidies and tax breaks, and cheap electricity for the oil and gas and mining sectors.

Conclusion

Wrestling with Industry

THE PRIMARY CHALLENGE facing a sustainable production and green jobs strategy in Canada is the dominance of GHG-intensive industries, particularly resource extraction driven by energy demand in export markets. Canada needs to decouple from an economic strategy that has been extremely successful for generating wealth. Our economy is being tied to relentless extraction of oil and gas resources, yet this activity represents a climate disaster for the world. Canada's established reserves of fossil fuels have the potential to contribute six times the amount of GHG emissions that are generated annually by the entire globe.[84] No amount of climate change action proposed by federal or provincial governments could succeed in bring down Canada's overall emissions if oil and gas development continues as projected, without major technological advances to capture the emissions generated.

Climate change poses challenges to Canada's industrial production structure in several key areas, including the secure, sustainable and equitable provision of food and agricultural products, transportation and energy. Indeed, climate change itself could be considered a massive economic threat that could destabilize a wide range of ecosystem services we take for granted. The Stern Review on the Economics of Climate Change estimates that the cost of such disruptions could rise to 20% of GDP or more, and recommends expenditures on 1% of GDP going forward on mitigation measures.[85]

In Canada's case, 1% would amount to $16 billion per year, though higher expenditures would be justified for a more rapid transition.

It is critical to articulate in advance a set of desired objectives that we seek to achieve with industrial and employment policy. For example, if technological substitution is sought there may be tension created because of reductions in consumption and demand for traditional products. In the process of mitigating and transitioning to climate change, jobs and even communities will be created and lost with the usual social friction that accompanies such processes. Because of these tensions it is also critical to place desired objectives in the appropriate hierarchy of importance so that the objectives do not conflict with each other.[86] For example, economic growth and wealth creation must be accomplished via carbon neutral, sustainable practices; income equity and decent work must occur via green jobs; etc. In some cases we might choose a model of full public provision of these goods and services (as we currently do with health care); in others we may wish to set the infrastructure and regulatory incentives such that private firms and individuals are willing to provide them.

The framework proposed here can help with the creation and implementation of industrial and employment policy changes designed to mitigate and adapt to climate change. In our assessment there are many more inherently green jobs relative to the smaller share of dirty jobs that account for a large share of emissions. In addition there are desirable jobs that could be created in the public sector, such as in the expansion of early childhood development programs or not-for-profit housing development, that would not normally be considered as part of a green job package.

The Canadian government needs to take a leading role in coordinating climate, industrial and labour market policies that are integrated, coherent and consistent. While much of the emphasis of climate action has been at the individual level, in fact many of the broad changes that dramatically reduce emissions are structural in nature, and thus requires collective action. To pull off an industrial revolution in the span of decades will require careful planning and clarity of the ultimate objective of eliminating fossil fuels in the Canadian economy. The single largest barrier to achieving this is not technology, but the embeddedness of vested interests from Canada's resource extraction sector in government decision-making.

Recommendations

In the near term, we recommend the following steps be taken by the federal government:

1. **Commit to zero fossil fuels** by 2040 at the latest, with all energy requirements met by clean electric sources, plus some biofuels and hydrogen fuel cells where alternatives are required. All remaining non-fossil-fuel GHG emissions should be eliminated by 2050.

2. **Enact a moratorium on new fossil fuel extraction** unless 100% of emissions can be captured and stored underground permanently.

3. **Put a price on carbon** through a national carbon tax and/or a cap-and-trade system. Revenues should be put towards further emissions reductions and reducing carbon price impacts on low- to middle-income families.

4. **Establish a rapid action plan on climate change** to approach our 2020 target, funded by a mix of carbon revenues, increased royalties and eliminated subsidies from fossil fuel industries, and reallocated expenditures from unsustainable activities (e.g. highway expansion).

5. **Develop a comprehensive national green industrial strategy,** including green jobs and capital plans, with priority focus on the following areas: green building construction and retrofitting; transportation; green manufacturing and waste management; and adaptation planning. The strategy must be coordinated across business, trade unions, secondary and post-secondary institutions and all levels of government, and should actively engage traditionally disadvantaged populations.

6. **Increase national model regulations to "net zero" new buildings** as quickly as possible. An expansion of the ecoEnergy program for building retrofits is also in order, with special attention paid to low- to middle-income households, older housing stock and coverage of multi-unit buildings.

7. **Implement a national transportation planning framework** that focuses on building regional rail corridors, complete communities and shifting to more sustainable modes of transportation (such walking, biking and transit, rather than just on electric vehicles).

8. **Create a national green energy framework** that includes investments in infrastructure to improve regional transmission of clean energy (e.g. hydro) and efficiency.

9. **Increase support for research and development of new technologies** with green economy applications through direct government funding, direct or indirect support for commercialization and production, and support for learning and diffusion of knowledge and technology.

10. **Develop adaptation plans** for all regions of the country, focused on the security of basic needs in areas such as food, water, electricity and housing.

11. **Launch a broad-based participatory exercise** aimed at defining the parameters of a new "green social contract" that ensures no one is left behind in the transition to a sustainable economy.

12. **Develop a framework for a new carbon transfer to households** that would, minimally, be equivalent to existing energy expenditures (and ideally more) to insulate low- to middle-income households from increases in energy and carbon prices, funded by revenues from those sources.

Notes

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