



ENERGY AND EMPLOYMENT IN A LOW-GREENHOUSE GAS EMITTING ECONOMY

A Review of Job Prospects Predicted for Western Canada, Canada as a Whole,
the United States, and the World

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ABSTRACT

The studies reported in this review, on the employment effects of moving from fossil fuels to renewable energy for electricity generation, predict that the overall net number of jobs would increase. While Canada would lose some fossil fuel related jobs, more jobs would be created in renewable energy and a wide variety of related activities to reduce greenhouse gas emissions. The net effect would be an increase in employment. One recent investigation reported on the possible significant increase in employment in Saskatchewan and Alberta in renewable energy electricity production, hydrogen production and use, energy efficiency, and related activities, by 2030.

The shift to renewable energy would be part of a portfolio of actions involving not only more wind and solar energy generated electricity, but also more energy efficiency, energy storage, and energy demand management.

INTRODUCTION

In 2019, Canada was the fourth largest producer of crude oil in the world (4.7 million barrels per day). The United States was the largest producer.¹ Canada exports a considerable percentage of our crude oil, mostly to the United States. However, our own domestic oil consumption was 2.4 million barrels per day, making us the ninth largest consumer, just after South Korea, and just before Brazil.²

But the scientific evidence is very strong that the world, and individual countries, will need to move quickly to greatly reduce consumption of fossil fuels such as crude oil, natural gas, and coal by 2050. We need to do this if we are to avoid very serious negative effects of the increase in carbon dioxide, methane, and nitrous oxide (all powerful greenhouse gases) in the atmosphere caused by large-scale combustion of fossil fuels. Some of the negative effects on climate are already becoming evident.

So, what will countries like Canada and the United States do? What other sources of energy have low greenhouse gas (GHG) emissions compared to fossil fuels, are cheap enough, and are available enough, to replace crude oil, natural gas, and coal? What would be the effect on employment?

¹ <https://www.nrcan.gc.ca/science-and-data/data-and-analysis/energy-data-and-analysis/energy-facts/crude-oil-facts/20064>

² https://en.wikipedia/wiki/List_of_countries_by_oil_consumption



INTERNATIONAL

Climate change is a global problem and the changes in technology, economics and behavior needed to reduce greenhouse gas emissions, must be worldwide in scope and action, The International Energy Agency (IEA) has just released a report entitled *Net Zero by 2050: a Roadmap for the Global Energy Sector*.³ The news release cited gives access to the whole report and its executive summary.

The news release about this report describes a vision of what the world might be like in the year 2050:

“By 2050 the energy world looks completely different. Global energy demand is around 8% smaller than today, but it serves an economy more than twice as big and a population with 2 billion more people. Almost 90% of electrical generation comes from renewable sources with wind and solar PV accounting for almost 70%. Most of the remainder comes from nuclear power. Solar is the world’s single largest source of total supply. Fossil fuels fall from almost four-fifths of total supply today to slightly over one-fifth. Fossil fuels that remain are used in goods where carbon is embodied in the product such as in plastics, in facilities fitted with carbon capture, and in sectors where low emissions technology options are scarce.”

The big emphasis on electricity and on the technologies used to generate electricity is due to the low greenhouse gas emissions from solar, wind, hydro power and nuclear, compared to fossil fuels (See Table 1).

Technology	Emissions
Coal	820
Natural Gas	490
Solar (PV) Utility Scale	48
Solar (PV) Rooftop Scale	41
Hydro Power	24
Nuclear	12
Wind Onshore	11

Table 1. Greenhouse gas emissions from different methods to produce electricity (Grams of carbon dioxide equivalents per kWh electricity)⁴

The International Energy Agency predicts major increases in spending to achieve these very large changes. These investments would create millions of jobs in installing large amounts of low greenhouse gas emission forms of energy production, in energy efficiency, and in engineering, manufacturing and construction industries.

³ <https://www.iea.org/news/pathway-to-critical-and-formidable-goal-of-net-zero-emissions-by-2050-is-narrow-but-brings-huge-benefits>

⁴ https://en.wikipedia.org/wiki/Life-cycle_greenhouse_gas_emissions-of_energy_sources



Both solar energy and wind energy are intermittent forms of energy. Various strategies, including storage technologies, would be needed to ensure reliable production of electricity in the grid.

One scenario of the world in 2050 emphasized that the present generation of electricity needs to switch from fossil fuel to renewable energy sources, and that everything that can run on electricity must do so (e.g., cars and trucks, trains, heating and cooling buildings, and many industrial processes).

WORLD EMPLOYMENT IN RENEWABLE ENERGY IN 2019

The International Renewable Energy Agency (IRENA) publishes each year an estimate of the world employment in renewable energy. The most recent report outlines employment in 2019.⁵

The total number of jobs in renewable energy was 11.5 million in 2019, slightly more than the number (11 million) in 2018. The largest employment sector was solar (photovoltaic, or PV) electricity generation with 3.8 million jobs, of which 38% were in China.

The second largest number of jobs was in biofuels, such as bioethanol and biodiesel (2.5 million jobs). Many of these jobs were in South America (43%) and southeast Asia (34%) and were associated with raw material crop production (e.g., sugarcane as a raw material for bioethanol production). Most of the biofuels would likely be used as additives to gasoline or diesel fuel employed in internal combustion engines. In the vision of the world in 2050, most vehicles were predicted to have electric motors running on electricity from low GHG emitting sources. Thus, it is unclear what role there would be for biofuels used in internal combustion engines.

The third largest source of renewable energy employment in 2019 was wind energy with 1.17 million jobs. China was estimated to have 518,000 jobs for people employed in wind energy.

UNITED STATES

The E2 organization has tracked annual employment in the clean (low GHG emissions) energy sector since 2015. In 2020, the total number of jobs fell for the first time.⁶ This was ascribed to the effects of the COVID-19 pandemic and the lingering effects of the previous federal administration, which had a policy of encouraging jobs in the fossil fuel industry. In 2020, the clean energy sector employed about 3 million people, down from the 3.36 million in the previous year. There were job losses in the energy efficiency, solar energy and grid modernization areas, but job increases in the wind energy and clean vehicle manufacturing (electric and hybrid vehicles) areas.

⁵ https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Sep/IRENA_RE_Jobs_2020.pdf

⁶ <https://e2.org/reports/clean-jobs-america.2021/>



The whole clean energy sector remained the largest job creator, employing nearly three times the number of people as the fossil fuel extraction and generation sectors. California, Texas, New York, and Florida were the leaders in clean energy jobs.

CANADA

A detailed review of the literature on potential job gains and losses in the process of moving from a world economy with large employment of fossil fuels to one with low fossil fuel consumption and high consumption of renewable energy, was published by H. Carlson of the Saskatchewan Environmental Society in 2017: *Planning for the Transition in a Carbon Constrained World*.⁷ Carlson's review also emphasized the importance of training and financial assistance as the economy loses fossil fuel-related jobs and gains jobs in renewable energy and increased energy efficiency.

A recent study (May 2019) by Clean Energy Canada, a think-tank based at Simon Fraser University in British Columbia, calculated how big the clean energy economy was in Canada. It employed 298,000 people in 2017, about as many as the real estate sector of the economy: *Missing the Bigger Picture*.⁸

Most of the jobs were in clean transport (57.5%) followed by clean energy supply (20.1%), then grid infrastructure and energy storage (15.8%) and clean buildings (6.6%).

This study was followed in October 2019, with a more detailed examination of the clean economy, its size, and likely size in 2030, and its comparison with the fossil fuels economy: *The Fast Lane*.⁹ An accompanying technical report was produced by Navius Research.¹⁰

The calculations in the report used a broader definition of activities which reduce GHG emissions in the economy. This calculation estimated that there were 398,000 people employed in the whole clean energy economy in 2020. This was compared with slightly over 1,000,000 people in the fossil fuel economy in 2020.

Clean Energy Canada and Navius Research used existing and pending GHG reduction legislation in the federal and provincial governments to estimate the likely employment, GDP size and annual investments in the clean energy economy in 2030 (See Tables 2 and 3).

Energy Sector	2020	2030
Clean Energy Low GHG	398,000	559,400
Fossil Fuel	1,039,400	989,700

Table 2. Comparison of the clean energy and fossil fuel energy sectors in employment in 2020 and the estimate in 2030.

⁷ <https://environmentalsociety.ca/wp-content/uploads/2017/11/Planning-for-the-Transition-29-Nov-2017.pdf>

⁸ <https://cleanenergycanada.org/report/missing-the-bigger-picture/>

⁹ <https://cleanenergycanada.org/report/the-fast-lane-tracking-the-energy-revolution-2019/>

¹⁰ <https://cleanenergycanada.org/wp-content/uploads/2019/09/Quantifying-Canadas-Clean-Energy-Economy.pdf>



Economic Indicator	2020	2030
Sector GDP	54.9	77.4
Annual Investments	28.6	38.2

Table 3. Clean energy sector GDP and annual investments in 2020 and estimated size in 2030 (Billions of Canadian Dollars)

1. Many of the jobs in 2030 were calculated to be in manufacturing GHG cleaner vehicles, such as electric cars, trucks, and buses (262,000 estimated jobs).
2. The second largest source of employment was in cleaner buildings, e.g., making existing buildings more energy efficient (167,000 jobs).
3. The third largest employment area was in clean energy supply (80,000) such as in wind, solar, and hydro production of renewable energy.
4. People were also employed in industry (28,000) and grid infrastructure and storage (21,600).

Three of the major vehicle manufacturing companies have recently announced plans for significant production of electric cars and trucks in Canada. This may be a signal that the shift in production of vehicles from fossil fuel powered to renewable electricity powered has started.

NEXT STEPS

FEDERAL GOVERNMENT'S PLAN TO REDUCE GHG EMISSIONS BY 40%, AND JOB EFFECTS

The Canadian federal government announced new regulations in August 2021, designed to reduce greenhouse gas emissions from the economy. The goal was to reduce GHG emissions by 40% by 2030.

Mark Jaccard of Simon Fraser University used these regulations and other GHG reduction goals announced earlier (*A Healthy Environment and a Healthy Economy*, December 2020) by the federal government to calculate the likelihood of achieving the 40 per cent reduction in GHG emissions. Jaccard used the Navius Tech model to estimate the likelihood of the economy meeting the GHG reduction goal. He concluded that there was a good chance of achieving this objective.¹¹

Clean Energy Canada, with Navius Research, employed the December 2020 federal plan to calculate the likely number of jobs in both clean energy and fossil fuel energy in 2020 and 2030. The new report (*The New Reality*¹²) and the accompanying technical report (*Canada's Energy Economy to 2030*¹³) are available from Clean Energy Canada.

¹¹ <https://policyoptions.irpp.org/magazines/septembre-2021/assessing-climate-sincerity-in-the-canadian-2021-election/>

¹² <https://cleanenergycanada.org/report/the-new-reality/>

¹³ https://cleanenergycanada.org/wp-content/uploads/2021/06/TechnicalReport_Navius_CleanEnergyJobs.pdf



Clean energy economy:

- 430,500 jobs in 2020
- 639,200 jobs in 2030
- Gain of clean energy jobs of 208,700 compared to a loss of 125,800 jobs in the fossil fuel sector

The study predicted that the number of clean energy jobs in Alberta by 2030 would have increased by 164% to 71,700 jobs. In Saskatchewan the increase would be 99.3% to 21,000 jobs. Some of the increase could be in hydrogen consumption technologies. (This assumes that hydrogen production would be changed to routes which reduce carbon dioxide emissions; the current route employs natural gas as the feedstock and yields carbon dioxide as a co-product to hydrogen).

EFFECT ON THE BUILDING TRADES

The Columbia Institute did a study in 2017 of the possible job creation possibilities if Canada met its climate goals in 2050:

1. Electrical supply with more wind, solar, tide and wave power, geothermal power, hydro power, nuclear power, and transmission line construction = 1,048,900 jobs;
2. Smart communities with efficient buildings and district energy systems = 1,997,640 jobs;
3. Transportation: Improvements in urban transportation = 245,000 jobs.

The total of direct jobs would be 3.3 million in the building trades by 2050. If indirect jobs were included, the total number would be about 17 million.¹⁴

TRANSITION PLAN FOR WORKERS

The Centre for Future Work conducted a study, commissioned by the Environmental Defence organization, on *Employment Transitions and the Phase-Out of Fossil Fuels*.¹⁵ The study noted that a 20-year phase-out would mean losing about 8,500 jobs per year. This is about the number of jobs created elsewhere in the Canadian economy every ten days. The study discussed a number of issues including support for increased labour mobility, incentives for early retirement, income protection for affected workers, skills training, and stronger representation for workers in negotiating transition jobs.

The study noted that certain communities with high fossil fuel employment (particularly in Alberta and Saskatchewan) would need more assistance in the transition.

The Toronto-Dominion Bank has published a similar discussion of the plans for an employment transition recently: *Don't Let History Repeat: Canada's Energy Sector Transition and the Potential Impact on Workers*.¹⁶

¹⁴ <https://columbiainstitute.eco/wp-content/uploads/2017/09/Columbia-Jobs-for-Tomorrow-web-revised-Oct-26-2017-dft-1.pdf>

¹⁵ <https://centreforfuturework.ca/wp/uploads/2021/01/Employment-transitions-Report-Final.pdf>

¹⁶ <https://economics.td.com/esg-energy-sector>



ALBERTA'S EMERGING ECONOMY

This was the title of a new study by the Pembina Institute (*Alberta's Emerging Economy*¹⁷). The growth in the new economy to 2030 was divided into four activity areas:

1. Renewable electricity = 31,300 jobs
2. Transit and electric vehicle infrastructure = 14,500 jobs
3. Energy efficiency in buildings and industry = 14,500 jobs
4. Environmental cleanup and methane reduction in oil and gas = 6,900 jobs

There are employment possibilities in Saskatchewan in environmental clean up of inactive old oil and gas wells. One estimate was that there might be 1,500 jobs in this province over the next 15-20 years.

ALBERTA AND SASKATCHEWAN ARE EXPECTED TO LEAD THE REST OF CANADA IN GREEN ENERGY GROWTH

Kevin Green of the CTV News Calgary summarized the estimates of renewable energy new growth¹⁸ reported in a new publication of the Canada Energy Regulator entitled *Canada's Renewable Power*.¹⁹ This report will give links to reports on individual provinces.

1. Wind energy capacity = double in Alberta and triple in Saskatchewan.
2. Solar capacity = add 1200 MW capacity by 2023 in Alberta.

The CTV news article listed 15 new projects in Alberta, ranging from 4 MW to over 400 MW capacity size, expected to be completed and generating electricity by 2022 or 2023. Many of these were wind power projects, with three solar power projects also underway.

A recent article on Canada's wind energy industry reported that "a competitive electricity supply auction in Alberta yielded the lowest-ever rate paid for wind energy in the country, a weighted average of \$37 per MWh." The same article noted that the costs for wind energy electricity production are continuing to decline.²⁰

In Saskatchewan, SaskPower has listed a number of new projects, some of which are wind and solar power electricity generating sites. Two of the new wind power projects are 200 MW in size.²¹

WIND AND SOLAR ENERGY POTENTIAL IN WESTERN CANADA

A recent study of the renewable energy resources in Alberta showed maps of the wind energy and solar energy potential in all of Canada.²² These maps indicated that much of

¹⁷ <https://www.pembina.org/pub/albertas-emerging-economy>

¹⁸ <https://calgary.ctvnews.ca/alberta-saskatchewan-set-to-lead-country-in-green-energy-growth-1.5359069>

¹⁹ <https://www.cer-rec.gc.ca/en/data-analysis/energy-commodities/electricity/report/canadas-renewable-power/canadas-renewable-power/index.html>

²⁰ https://canwea.ca/wp-content/uploads/2019/06/Alberta-Wind-Market-Profile_June-2019.pdf

²¹ <https://www.saskpower.com/Our-Power-Future/Infrastructure-Projects/Construction-Projects/Current-Projects>

²² <https://www.pembina.org/reports/renewable-energy-what-you-need-to-know.pdf>



the Prairie Provinces have good resources for wind energy, and parts of Alberta and southern Saskatchewan have excellent resource capabilities. The solar energy map indicated that much of southern Alberta, Saskatchewan and Manitoba had high potential for solar energy development.

Costs of wind and solar energy have declined greatly since 2009 and recent contracts for wind energy-based electricity and solar energy-based electricity in Alberta were very competitive to natural gas-based electricity prices.

The Pembina report²³ stated that a portfolio of renewable energy, energy efficiency, storage and demand-side management could provide the same reliability as a fossil fuel generation system, with considerably lower greenhouse gas emissions.

SUMMARY

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The shift to renewable energy would be part of a *portfolio of actions* involving not only more wind and solar energy generated electricity, but also more energy efficiency, energy storage, and energy demand management.

²³ <https://www.pembina.org/reports/renewable-energy-what-you-need-to-know.pdf>