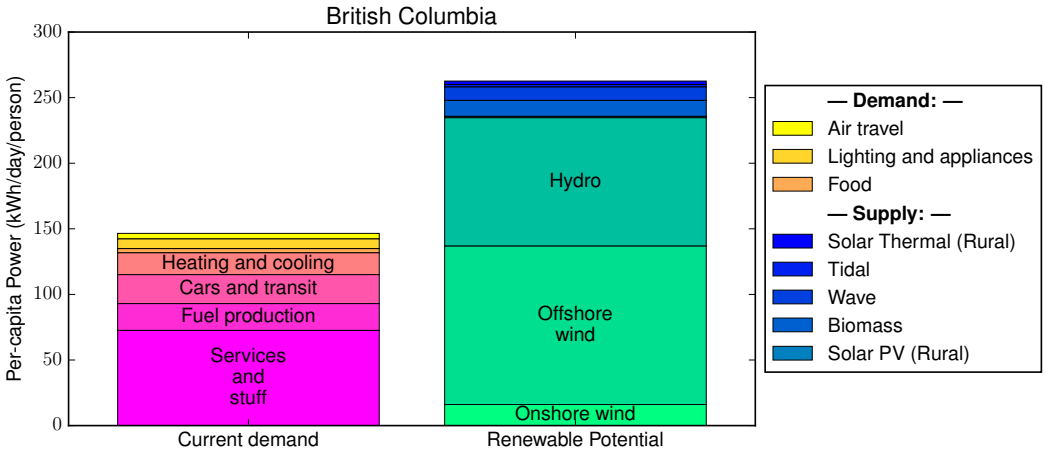
Provincial summaries for "The renewable energy landscape in Canada: a spatial analysis"

C. P. Barrington-Leigh
McGill University

Renewable energy scenario for B.C.

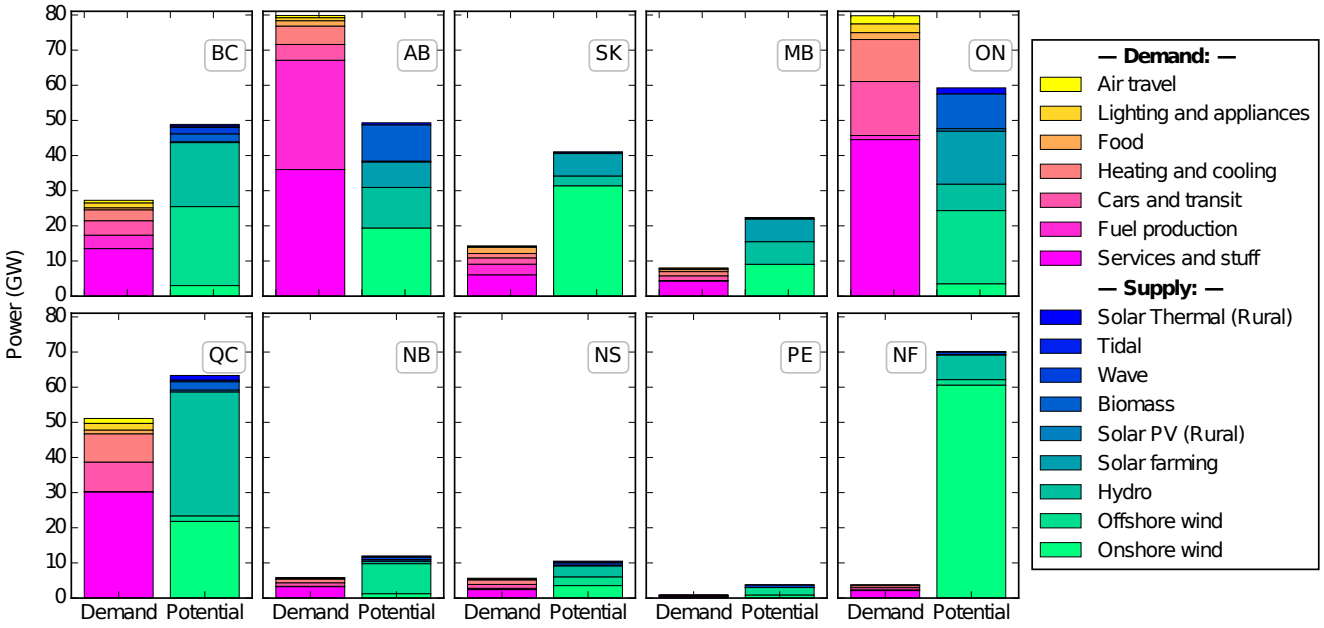
This snapshot is based on "The renewable energy landscape in Canada: a spatial analysis," *Renewable & Sustainable Energy Reviews* (2016), doi:10.1016/j.rser.2016.11.061. Our project assembles all sources of energy use into familiar household categories, and it identifies feasible sites for renewable energy generation across Canada. CONTACT: C. BARRINGTON-LEIGH, MCGILL UNIVERSITY

British Columbia's large existing wealth of hydroelectric power is complemented in our scenario with huge offshore — and some onshore — wind resources, as shown in below. All wind and solar and other intermittent renewable power developed in B.C. will benefit from their complementarity with hydroelectric dams, which can be controlled to flow when other resources aren't. We also count biomass and wave power as significant resources in B.C.'s future renewable portfolio.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in B.C.. On the right is a breakdown of available renewable energy resources.

For maps, methods, sources, and more detailed discussion, see our full paper. We do not carry out an economic analysis, but our criteria for generation siting relate also to economic feasibility. Overall, our analysis shows that all but two provinces in Canada have sufficient renewable energy potential to meet the entire current energy demand.



Renewable energy scenario for Alberta

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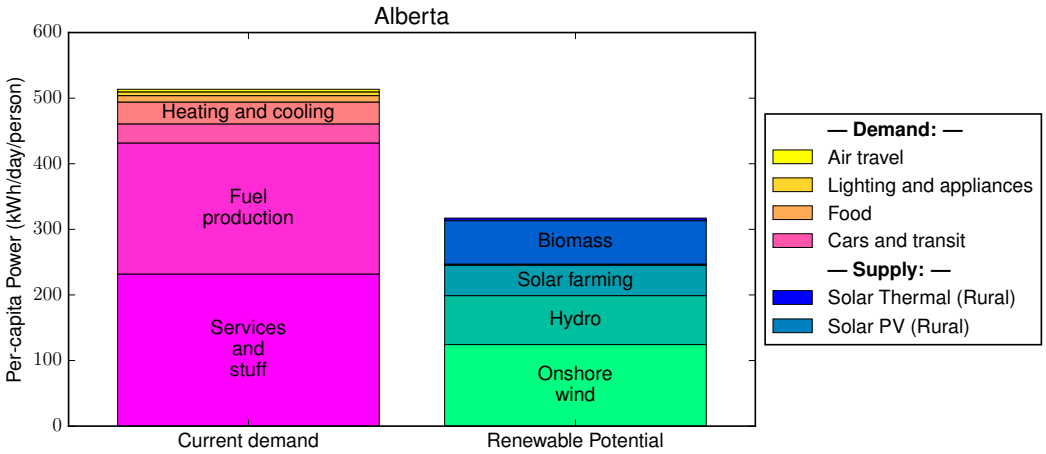
Alberta stands out from other provinces in its current per capita energy requirements, which amount to over 500 kWh/day per person; see below. Unsurprisingly, a large component of this is due to the production of fuel, and a significant proportion of what we list as "Services and stuff" for Alberta is likely also related to the oil industry.

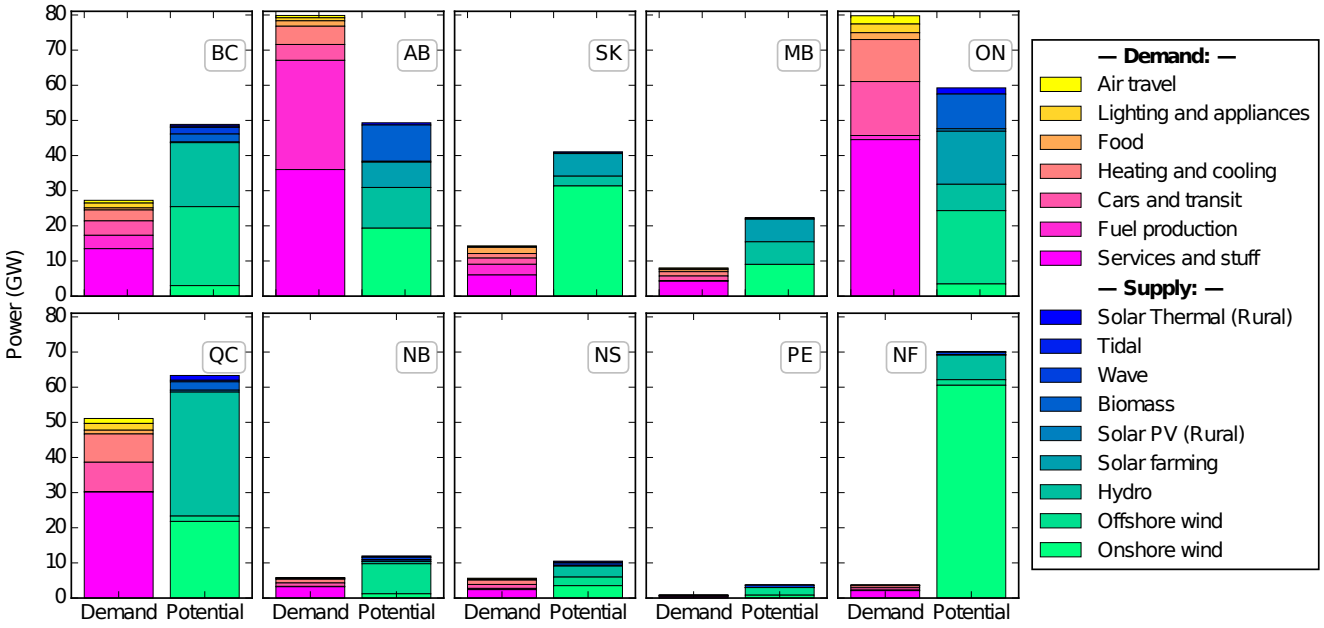
Unlike the other large provinces, Alberta has no offshore wind potential. Its potential renewable resources include wind, hydro, biomass, and solar farming. As has been mentioned, with appropriate distribution systems and a more aggressive embrace of solar, Alberta could exploit considerably more than we have included in the present assessment.

It is worth noting that on a per capita basis, Alberta has more than twice as much renewable power potential as does Ontario, the other province without sufficient renewable resources to cover its demand.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Alberta. On the right is a breakdown of available renewable energy resources.

For maps, methods, sources, and more detailed discussion, see our full paper. We do not carry out an economic analysis, but our criteria for generation siting relate also to economic feasibility. Overall, our analysis shows that all but two provinces in Canada have sufficient renewable energy potential to meet the entire current energy demand.



Renewable energy scenario for Saskatchewan

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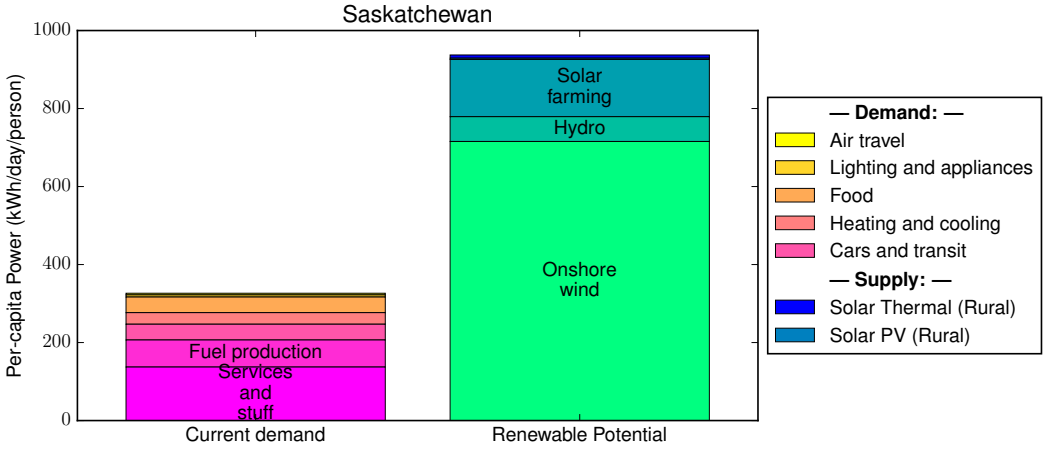
As shown in below, Saskatchewan also has a high per-capita energy use, currently, but with strong wind resources and the possibility of extensive solar farming, its potential renewable portfolio greatly exceeds the demand. This may represent a significant opportunity to export energy to its relatively needy neighbour, Alberta. Once again, it is important to note that, if such export demand exists, there may be even more feasible solar farming than we have allocated.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Saskatchewan. On the right is a breakdown of available renewable energy resources.

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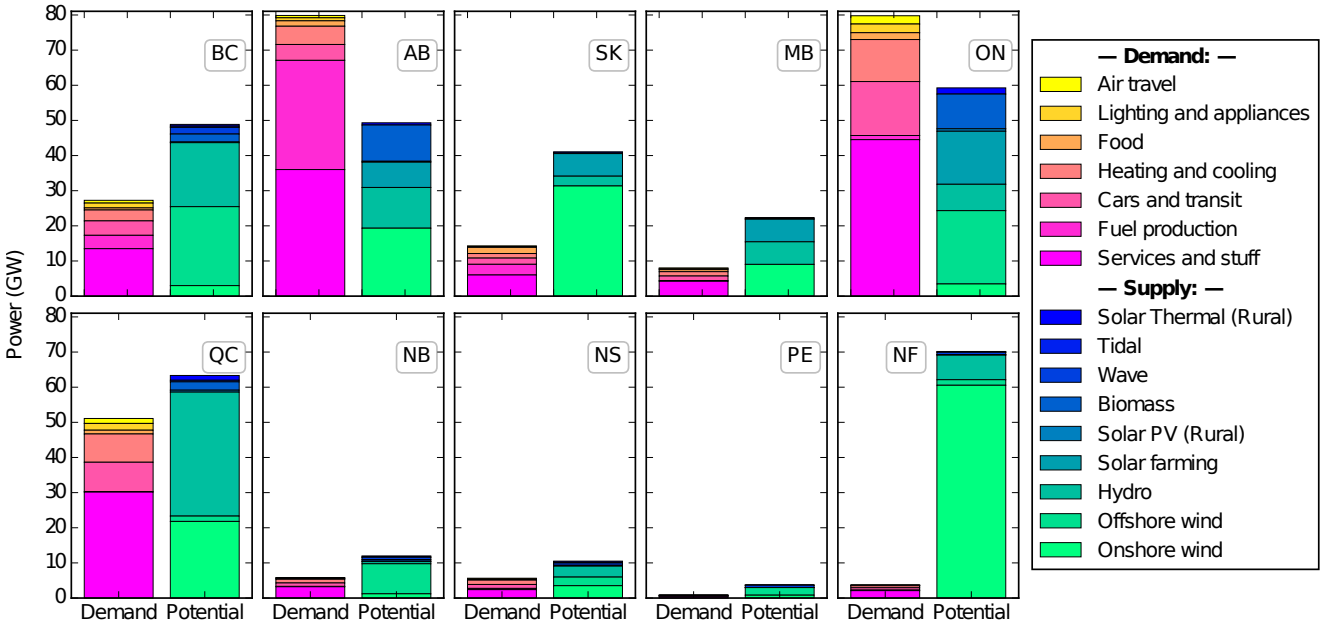

Renewable energy scenario for Manitoba

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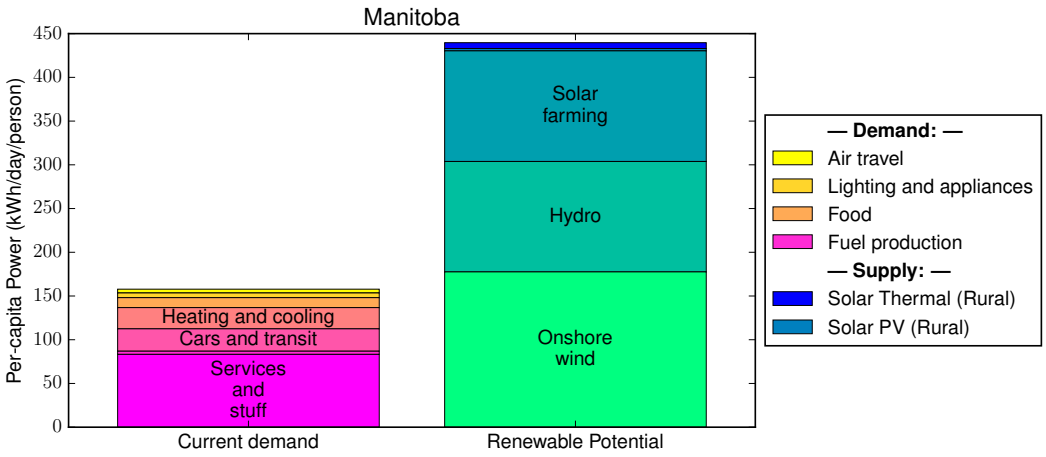
In comparison with Saskatchewan, Manitoba, portrayed in below, has less easily accessible wind power but more hydroelectric potential. Plenty of each of these, along with a deployment of solar farming as in Saskatchewan, would leave Manitoba with a 200% excess of renewable energy over its own (current) needs. In fact, this surplus would be sufficient, through exports, to close the gap between Ontario's demand and potential supply. Moreover, the complementarity of solar and wind power, which tend to peak at different times, and the further complementarity of these intermittent power sources with the throttlable resource of hydroelectricity, give Manitoba a particularly enviable endowment of renewables.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Manitoba. On the right is a breakdown of available renewable energy resources.

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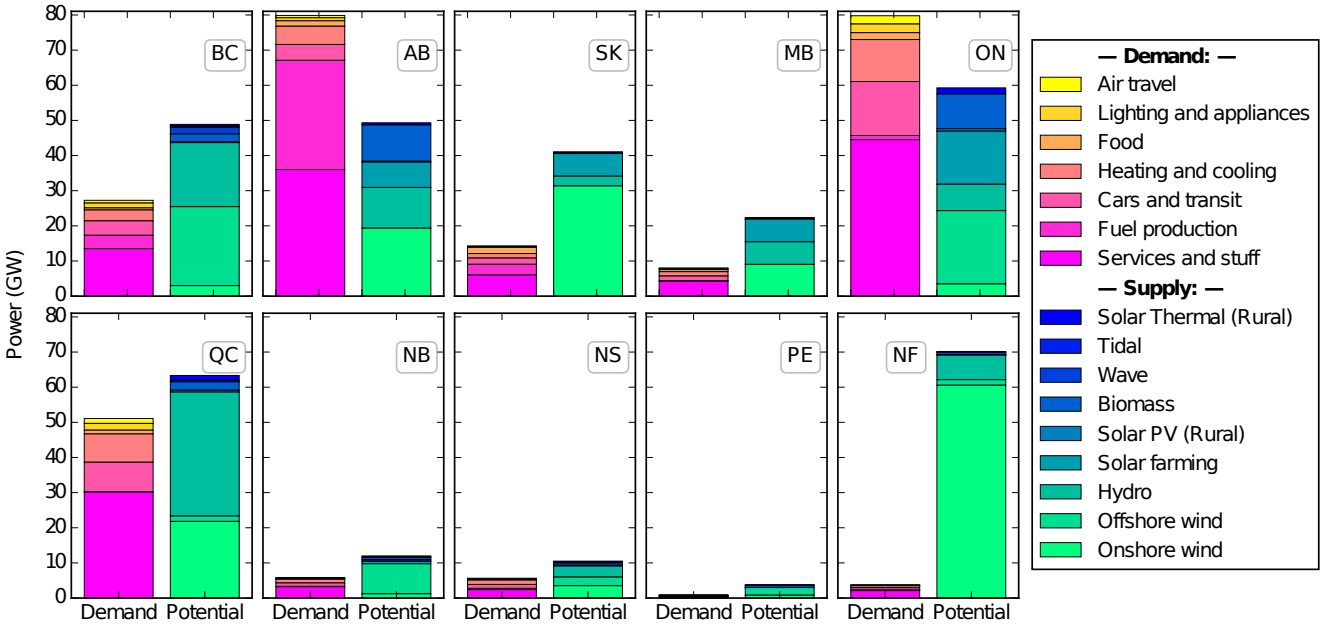

Renewable energy scenario for Ontario

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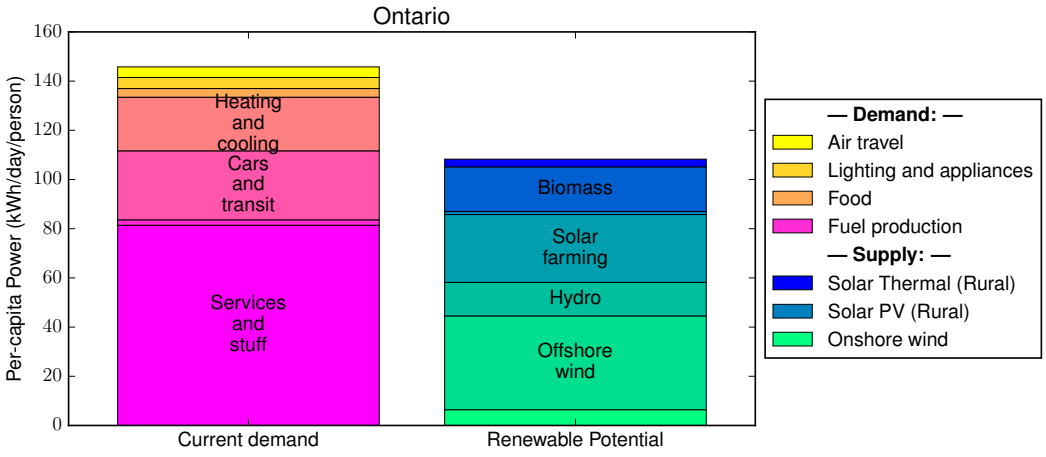
Ontario's dense population and lower fraction of primary extraction industries gives it a relatively low per capita energy usage at present (see below). Nevertheless, in absolute terms it is the second largest consumer of power in Canada, after Alberta. We find a diversified portfolio of available renewable energy for Ontario which amounts to the third largest among the provinces, but it is insufficient to meet Ontario's demand. The largest component of renewable energy potential in our assessment comes from offshore wind, largely on Lake Erie and Georgian Bay, but the portfolio includes also significant bioenergy, solar farming, hydroelectricity, and some onshore wind.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Ontario. On the right is a breakdown of available renewable energy resources.

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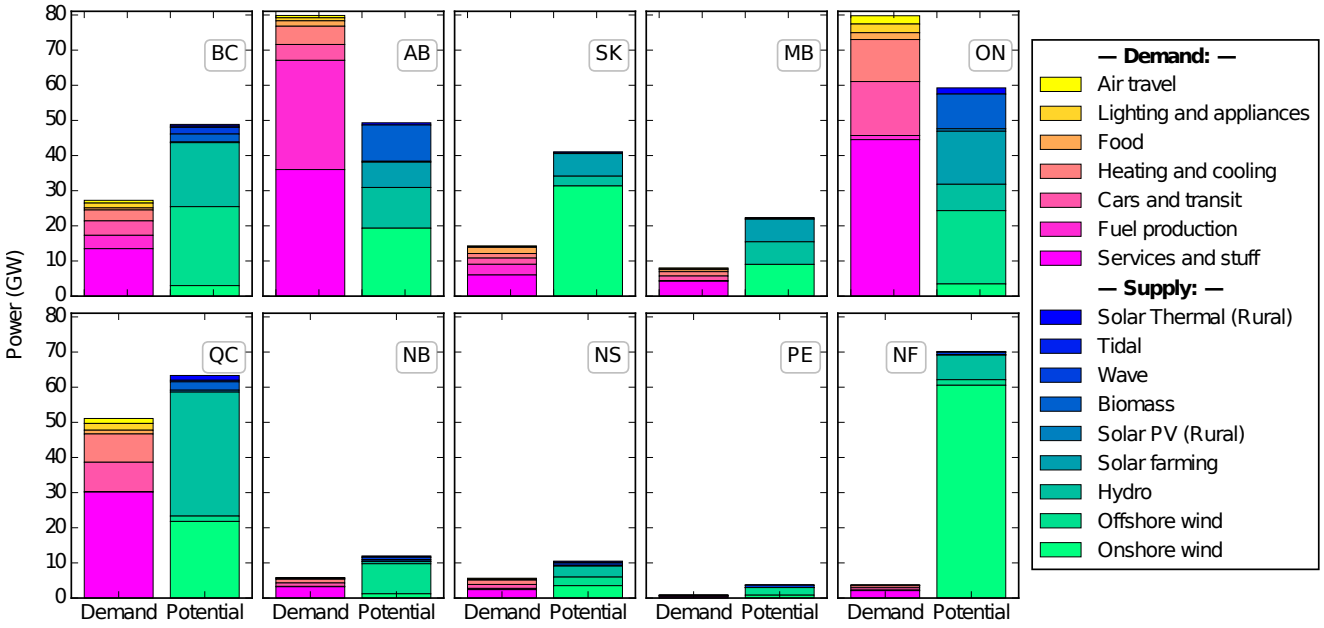

Renewable energy scenario for Quebec

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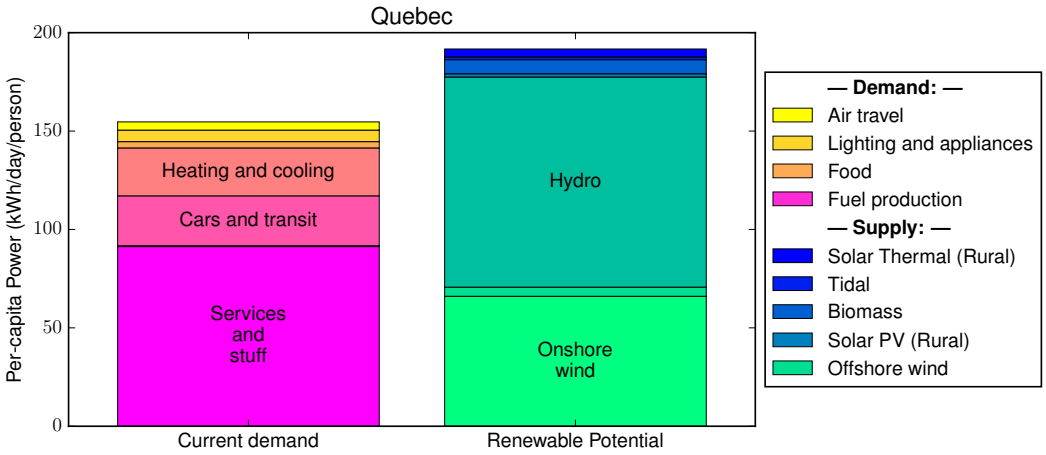
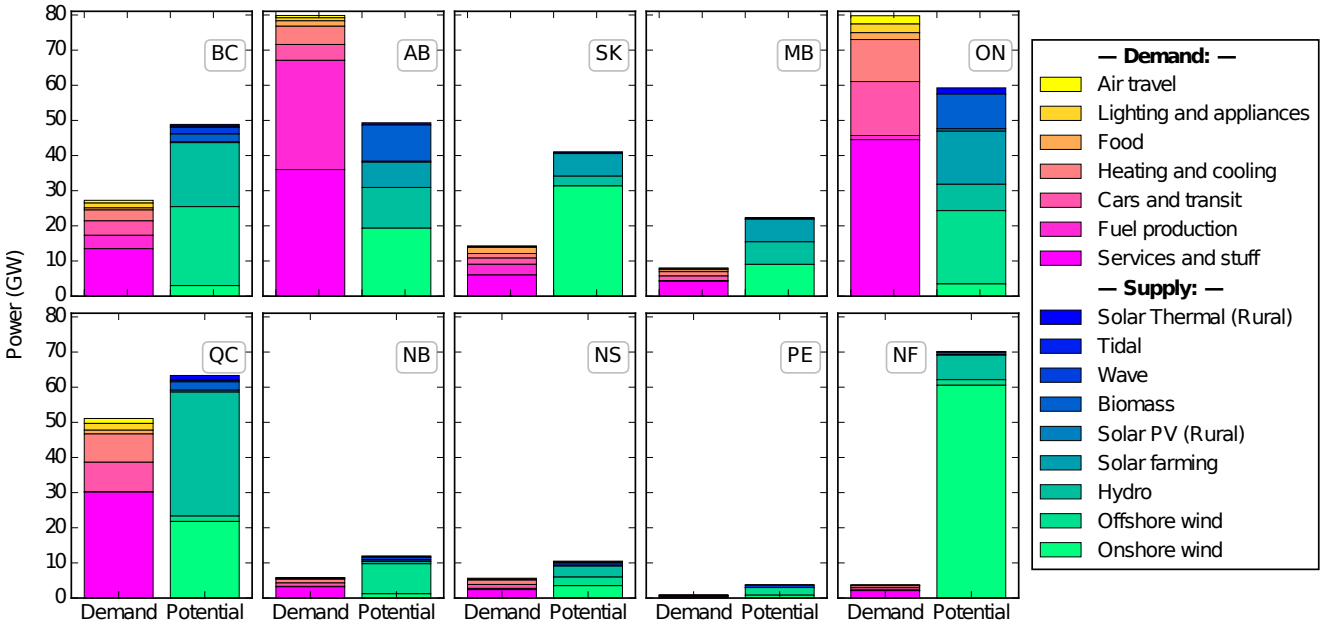
Per capita energy demand in Quebec is typical of other provinces, at around 150 kWh per person, per day. Quebec is already exploiting an enormous hydroelectricity resource but, as shown in below, it has further capacity and in addition a large potential for wind power. Together, these would be more than sufficient to cover all of the existing energy demand of Canada's second largest province. As a reminder, the "Current demand" includes not only existing electricity use, but also all fossil fuel consumption for transportation, heating and cooking, and industry. Moreover, as in British Columbia, Quebec's huge load-stabilizing hydroelectricity capacity gives it a major advantage for developing intermittent renewables such as its onshore wind resources. In addition to these two primary energy sources, Quebec has the potential to generate power from biomass, tides, and offshore wind.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Quebec. On the right is a breakdown of available renewable energy resources.

For maps, methods, sources, and more detailed discussion, see our full paper. We do not carry out an economic analysis, but our criteria for generation siting relate also to economic feasibility. Overall, our analysis shows that all but two provinces in Canada have sufficient renewable energy potential to meet the entire current energy demand.



Renewable energy scenario for New Brunswick

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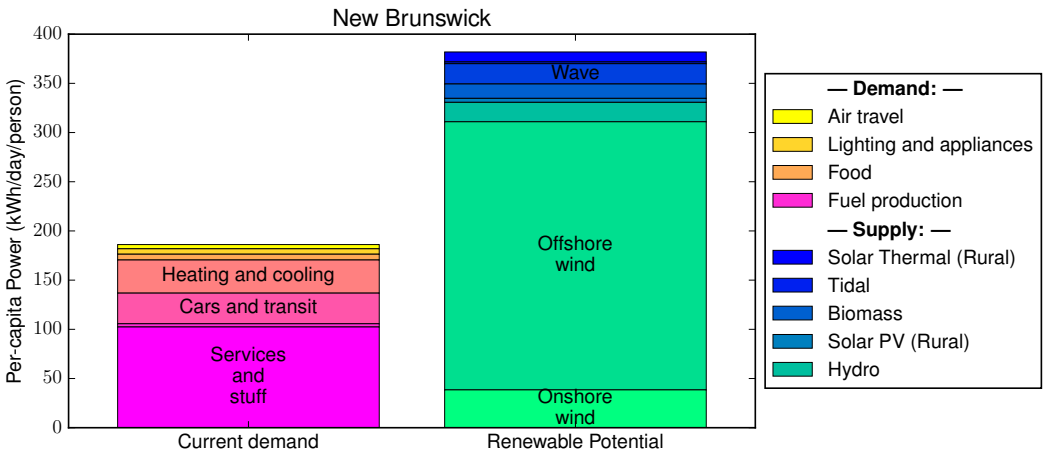
New Brunswick has an average level of current energy consumption for its population but, on a per capita basis, is extremely wealthy in renewable energy potential. As shown in below, the province could supply more than its entire current energy needs with offshore wind power alone, but in addition has biomass, tidal, onshore wind, and hydroelectric resources.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in New Brunswick. On the right is a breakdown of available renewable energy resources.

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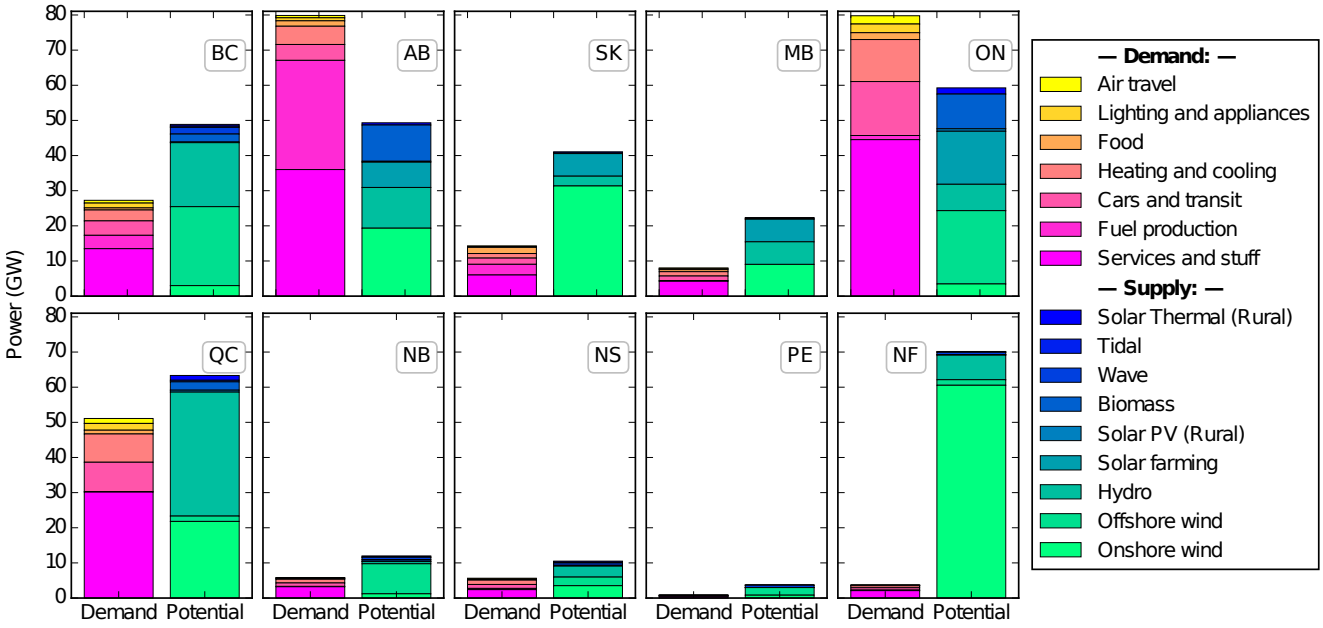

Renewable energy scenario for Nova Scotia

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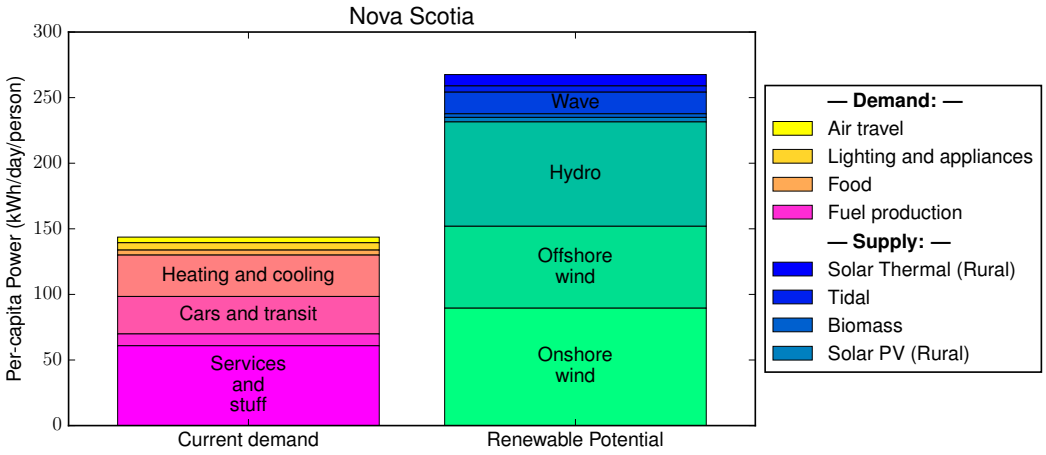
Nova Scotia has a diverse potential portfolio of renewable energy sources, among which hydroelectricity, offshore wind, and onshore wind each could produce enough power to cover a large fraction of the province's current energy demand (below). In addition, wave power figures significantly in Nova Scotia's potential resources. Nova Scotia also stands to benefit from the combination of its intermittent wind power and its complementarity hydroelectric capacity.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Nova Scotia. On the right is a breakdown of available renewable energy resources.

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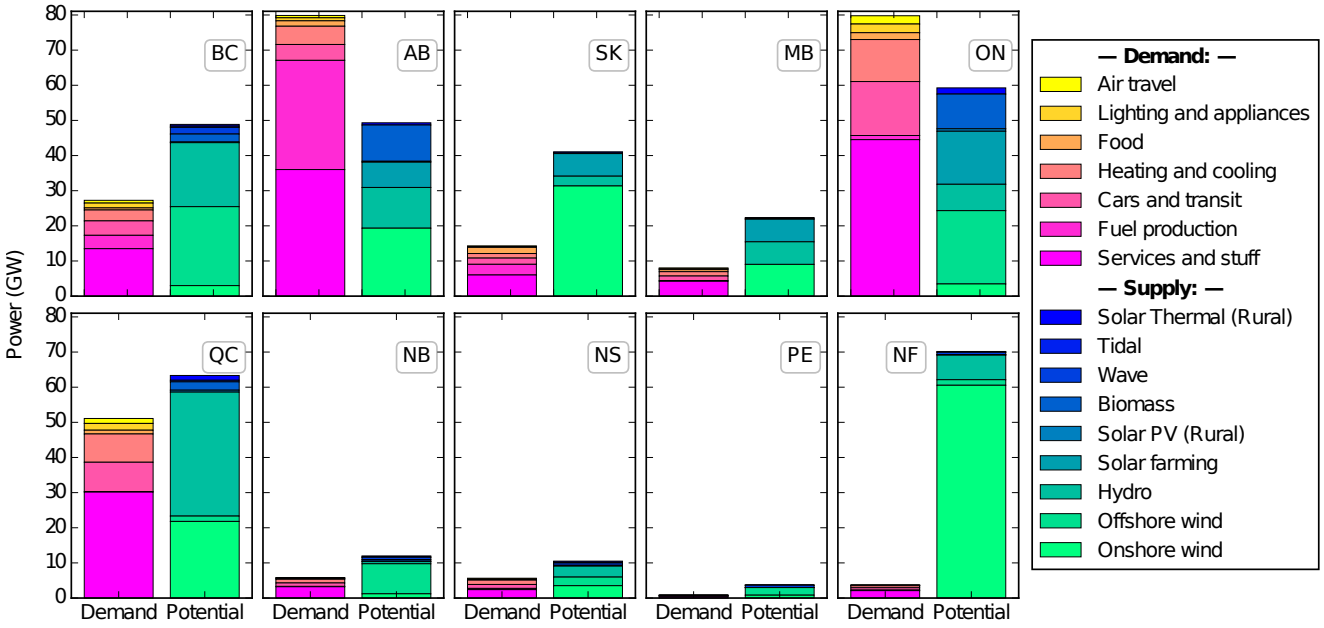

Renewable energy scenario for Prince Edward Island

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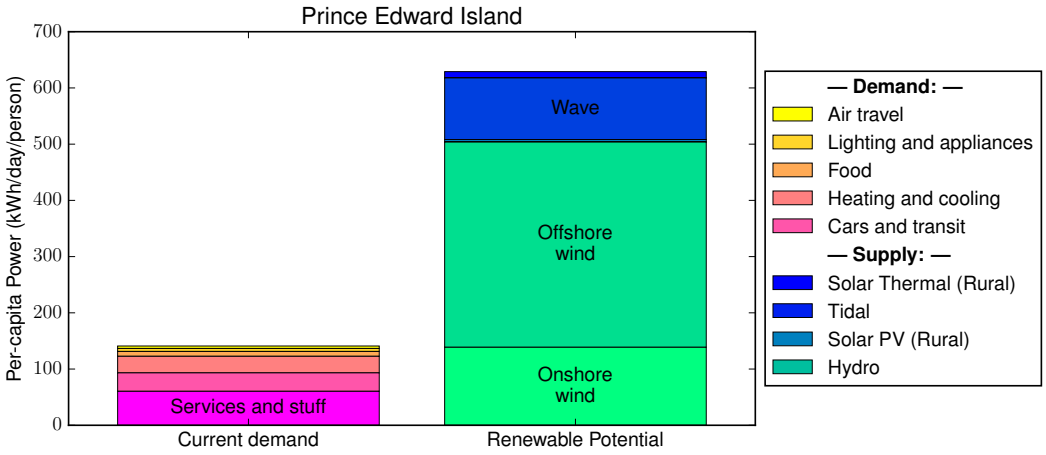
The small population of P.E.I. has a typical per capita energy consumption for Canada; see below. Yet its maritime borders offer it a large surplus of renewable power from offshore wind farms and wave power. In addition, even its onshore wind resources could be sufficient by themselves to supply all current demand for energy, as long as it could be traded with neighbours to cover periods with low local wind velocity.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Prince Edward Island. On the right is a breakdown of available renewable energy resources.

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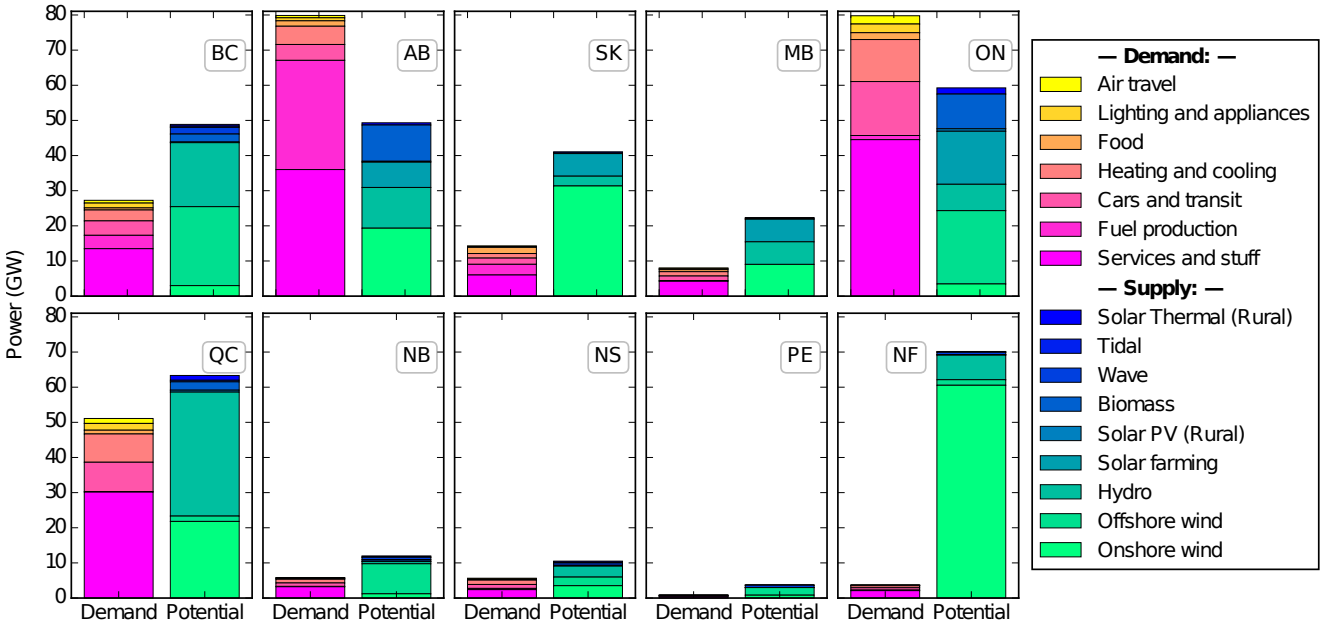

Renewable energy scenario for Newfoundland & Labrador

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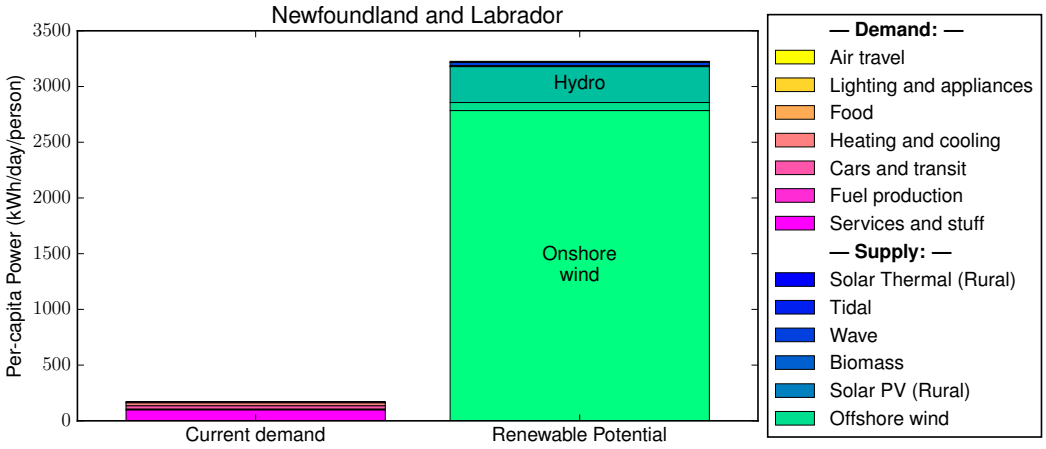
The onshore wind potential for Newfoundland and Labrador, shown in below, is remarkable by any measure. In per capita terms, it dwarfs the province's own needs and at current energy prices could generate $200,000 per household of annual revenue if a market existed for it.[1] In absolute terms, our estimate of Newfoundland and Labrador's renewable energy potential is the largest in the country. Although it includes some hydroelectricity and a dispersed wind catchment area, both of which would help with reliability of power, the resource would clearly be developed only if it was exportable. This might involve new transmission systems such as a direct-current link connecting to Quebec and U.S.A markets. In addition, while we have sited high-potential wind areas only near existing roads and transmission lines, clearly the nature of the transmission infrastructure to these locations would need to change drastically for the exploitation of new energy resources on the scale of those envisioned here for Newfoundland and Labrador, as well as for other provinces. For very large developments, new roads and population centres may be developed to suit the location of the wind, rather than vice versa, in which case the geography of our analysis may be taken as only representative.



The stack on the left shows the sum of all energy currently consumed, as both electricity and combustion, in Newfoundland & Labrador. On the right is a breakdown of available renewable energy resources.

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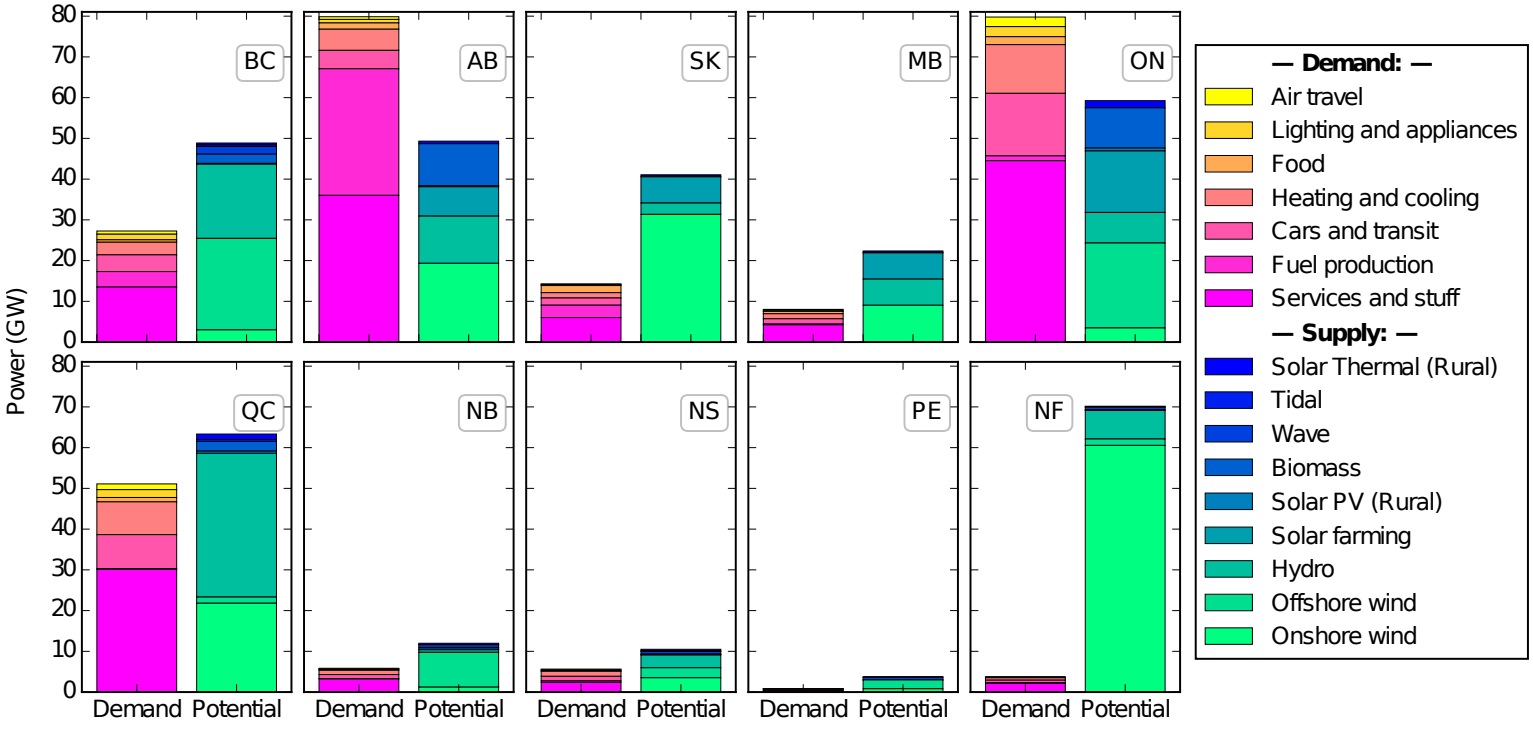

[1] The average household size in Newfoundland and Labrador is 2.4. At a domestic energy price of $0.10/kWh, the value of 3000 kWh/day would be, annually, ∼ $110k per *individual*.