PEMBINA institute

British Columbia Green Buildings Map

Methodology backgrounder, 2017 edition

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Summary

The second phase of the Clean Energy Jobs Map focuses on quantifying and locating employment in B.C.'s energy-efficient building sector, including jobs from the construction of high-performance buildings, the energy renovation of existing buildings, and the manufacturing and supply of high-performance components.

The map aims to capture a snapshot of B.C.'s "green" construction industry, capturing the number and distribution of jobs in 2016. For market segments for which 2016 data was not available, we used averages representing a "typical" recent year. The numbers of direct and indirect jobs are estimated for the province as a whole by multiplying the total costs of projects by established jobs factors. The locations of projects and manufacturing plants are mapped to indicate geographic distribution.

This analysis has been updated for 2017 and now gives a total of 31,700 direct and indirect jobs; Table 1 indicates the breakdown by sector.

View the map: www.pembina.org/pub/bc-green-buildings-2017

Table 1. Jobs supported by energy-efficient buildings in B.C. for a recent representative year (rounded to the nearest 100)*

	Residential	Commercial, Institutional & Mixed Use	Manufacturing and Supply	Total
Retrofit	**2100**	**3500**	**1300**	**6800**
BC Hydro	700	1500	500	2700
FortisBC	500	400	200	1000
Non-program	1000	1600	600	3100
Construction	**6100**	**8800**	**10000**	**24900**
Part 3	2500	8800	7500	18800
Part 9	3700	0	2400	6100

Total	**8200**	**12300**	**11200**	**31700**

* We chose to focus on a recent representative year, as the various data sources were not available for one particular recent year. Note: totals do not add due to rounding.

Estimating and locating jobs from high-performance new construction

For this exercise, we consider as "high performance building" any building that meets one of the following certifications: LEED, Passive House, Living Building Challenge, BOMA BEST, Green Globes, BUILT GREEN, ENERGY STAR for New Homes, R-2000, houses rated at or above EnerGuide 80 (for the old EnerGuide rating system), and homes rated better than the reference house (for the new EnerGuide rating system, v15). The inclusion of BUILT GREEN, ENERGY STAR, R-2000, and EnerGuide v15 data is new for the 2017 update.

Building information and location was collated from the LEED Project Profiles database[1], the BOMA BEST Certified Buildings database[2], the Green Globes Certified Buildings database[3], the International Passive House Institute Database[4], the Passive House Canada database[5], the Registered Living Building Challenge Projects map[6], the B.C. Major Projects Inventory[7], Built Green Canada's database[8], and Natural Resources Canada's EnerGuide, ENERGY STAR, and R-2000 databases[9].

Homes certified by NRCan (EnerGuide, ENERGY STAR, and R-2000), or Built Green Canada, are not geolocated to respect confidentiality of the data; instead, the location of these projects is mapped approximately based on their forward sortation area (the first three digits of the postal code).

Estimating jobs from new construction

Job estimates for Part 3 buildings are derived from taking cost information for buildings marked as 'in construction' in the December 2016 B.C. Major Projects Inventory, and which qualify with one of the above-described certifications. These costs are then multiplied by the job factors described below. Job resulting from green Part 9 construction jobs are estimated by averaging over the last six years the number of houses certified by NRCan as EnerGuide 80+, above reference house, ENERGY STAR, or R-2000, and the number of BUILT GREEN certified homes. An estimate of typical 'green' home construction costs is used for these certified homes, and jobs are then inferred using the multiplying factors described below.

Estimating jobs from energy retrofits

Retrofit job numbers are based on recent expenditures under BC Hydro's[10] and FortisBC's[1112] demand-side management programs. The total cost of the retrofit (include funds provided by the building owner) was estimated as slightly less than double the value of the grant, based on survey data from similar programs.[13] In addition, we estimated retrofit investments that occur without incentive programs, based on previous findings by BC Hydro during the LiveSmartBC program.[14]

Estimating and locating jobs from manufacturing of high-performance components

The jobs in this sector are not quantified explicitly; rather, they are represented by the indirect job estimates from construction and renovation projects (Table 2).

A list of high-efficiency manufacturers in B.C. was provided by the Ministry of Energy and Mines and supplemented by a scan of insulated panel producers. The map shows the location of known manufacturing facilities of efficient windows and doors, high-efficiency insulation and structurally insulated panels, and high-efficiency HVAC equipment.

Table 2. Job Factors (Jobs / $1 Million)

	Direct	Indirect	Combined
Construction	6.0	4.0	10.0
Retrofit	15.9	3.6	19.5

Source: Statistics Canada (for new construction)[15]; Green Jobs BC (for retrofits)[16]

Discussion and Methodology

Scope

Whenever possible we used cost data and location for projects in construction in 2016. When this was not possible, we used data averaged out over several recent years. As such, our job estimates represent jobs supported over a typical recent year. We include direct jobs for construction and retrofit, and indirect for manufacturing and suppliers.

As we attempt to quantify jobs related to energy efficiency in the building sector, there are two possible approaches (and some hybrids of the two):

1. Try to quantify jobs resulting from projects targeting “beyond code” energy efficiency;
2. Try to quantify the segment of the construction industry that works on energy systems, irrespective of the level of performance of the building.

We opted for option (1) because we want to emphasize the economic benefits occurring due to beyond mandated energy performance in buildings. We use certification as one proxy for “beyond code” performance. However, we should note that since the code is by definition the worst acceptable buildings, most buildings will include elements that go beyond minimum prescriptive code performance, even if they are not pursuing a certification. We should also note that only a portion of the total construction cost for certified buildings is related to the energy systems of the building. We did not attempt to isolate the costs of the energy systems alone; thus, these job numbers are illustrative of the size of the industry working in leading green buildings, or in the retrofit market, not just the building energy portion of this industry.

Job factors

The job factors are based on the B.C. Stats Input-Output Multipliers for 2006 and 2008 as cited by the Federation of Canadian Municipalities and Green Jobs B.C.[17] These numbers were cross-referenced against a wide range of job factors found for construction and retrofit, available in Appendix 1.

Construction job numbers

Construction jobs for simple buildings (Part 9) are based on data provided by NRCan and Built Green Canada, which lists all buildings that were certified (or had an EnerGuide score of 80+ or beyond reference house) and what year they were built in. We averaged out the data for the last six years that we had full access of data to (2011-2016).[18] This is multiplied by the average cost of constructing an energy-efficient Part 9 home in B.C., estimated at $340,000[19], to get total investment dollars.

The above described job factors for construction are then applied to get annual job numbers.

Construction job numbers for larger buildings (Part 3) are calculated from building projects in the B.C. Major Project Inventory (MPI) that had the status of "Construction Started" and were identified as targeting one of the above energy-efficiency certifications. To represent the typical spend over the course of a year, we average out the project costs over the duration of the construction. To smooth some of the high variability in reported project duration, we use the average construction duration for projects within a certain cost bracket (as calculated from the MPI durations and summarized in Table 3) to give an annual estimate. Each project's average annual cost is then multiplied by the direct and indirect job factors for construction.

Because the MPI only includes projects over $15 million, our methodology does not capture construction jobs from lower-cost Part 3 buildings. As such, our construction jobs are likely underestimated.

Table 3: Construction length for Part 3 building by cost bracket (years)

Cost Bracket (Million $)	Average Construction duration (Yrs)	Number of Projects
<50	3.80	11
50-99	3.80	10
100-199	4.38	2
200-299	3.42	1
300-399	8	3
500-599	3.92	3
600-699	4.89	3
1000-1999	8.88	2
>2000	21	2

Retrofit job numbers

Retrofit job numbers are based on recent historical expenditures under BC Hydro's[20] and FortisBC's[21, 22] demand-side management (DSM) programs. Only spending allocated for residential and commercial projects was considered; program spending on industrial, low income, conservation and education, admin, innovation and advertisement and supporting initiatives was not included. Where applicable, program total costs were divided into residential and commercial spending based on the cost numbers provided in program reports. Detailed info for BC Hydro and FortisBC data can be found in Appendix 2 and 3. Table 4 below summarizes total spending by the programs considered in this project.

For each program, the average yearly grant totals were increased by 92% to include homeowner and commercial contributions, based on survey results by the Acadia Centre.[23] Detailed info for the private contribution factor used can be found in Appendix 4.

Table 4: Annual spending considered in-scope from B.C. based retrofit programs ($million)

Program	Total yearly program DSM spending	Residential	Commercial	Total in-scope for this project	Total including private contribution*
BC Hydro	172.6	22.3	48.6	71.0	136.1
FortisBC	37.5	15.0	13.0	28.0	53.8

* In-scope program spending is multiplied by 1.92 to account for private contribution (Acadia Centre)

We can use DSM expenditures as a general proxy for retrofit spending, including an estimate of the proportion of retrofit activity that happens outside of DSM programs. Interviews with homeowners conducted by BC Hydro to quantify free ridership and spill effect of the residential LiveSmartBC program showed that between F2009 and F2011, the LiveSmart program had a spillover rate of 12% from participants, and an estimate spillover of 84% outside of program participants. That is, for each unit of energy saved as a result of grants provided, 0.84 units of energy were saved due to retrofits conducted without incentives. We use this 84% spillover estimate as a lower bound for the additional retrofits investments conducted outside of the grant program.[24] The investments by the retrofit programs, private contribution to the programs, and the out of program retrofits together gives the total investments in retrofits in B.C.

The total investment is then multiplied by the job factors for renovation to estimate job creation from energy retrofits.

Manufacturing & supply job numbers

Jobs from manufacturing and supply are calculated from the indirect job numbers for construction and retrofit described above.

By estimating the jobs from investments in energy retrofits and high performance buildings, we are not capturing the manufacturing and supply jobs related to investments in regular code construction. However, high-energy performance building products may still be used in regular code buildings/non-certified buildings (for example, most Passive House-compliant windows are not used in Passive House projects).

Furthermore, there are products that naturally fit into energy efficiency — all insulation products, for example, whether for code or beyond-code buildings. Therefore, we are certainly underestimating this sector.

On the other hand, not all high-performance building materials used in B.C. buildings are actually produced in B.C. The two effects balance each other, but we estimate that the former would dominate the latter and therefore the total number of manufacturing jobs attributable to energy efficiency is probably greater than the value provided here.

On the additionality of green buildings jobs

Lastly, we want to address the additionality of jobs related to the green building industry. One can argue that the jobs associated with the construction of these green buildings would have existed, regardless of whether the building was green or not. The "additional" jobs resulting from a higher investment in energy efficiency (which generally increases material and design costs) could be estimated, but this was not our objective. Rather, we want to highlight that the clean tech sector in general and the high-performance buildings sector in particular are already a vibrant economic driver in B.C., and showcase that rapidly growing sector.

In many ways, this is an underestimation of the "energy efficient building" industry and its economic benefits. Most importantly, we have not included the induced jobs resulting from energy savings. Studies have shown that the re-spending in the economy of money saved form energy efficiency is the largest economic and employment driver from energy efficiency.[25]

Because of the difficulty of quantifying employment associated with energy management, we also have not included this portion of the building energy efficiency labour force. We expect that the energy management sector is much smaller than the construction and renovation sector, but it nevertheless represents a non-negligible and growing source of employment.

Summary of findings

Our analysis gives a total of 31,700 direct and indirect jobs[26]. New construction of high performance buildings generates 24,900 jobs; 6,200 in the residential sector, 8,800 in the commercial & institutional sector, and 9,900 indirect jobs, mostly in the manufacturing and supply sector. Retrofits account for 6,800 jobs, with 2,100, 3,500, and 1,300 for residential, commercial & institutional, and indirect/manufacturing respectively. Table 5 gives the detailed job numbers.

Table 5: Jobs supported by energy efficient buildings in B.C. (unrounded numbers)

	Residential	Commercial, Institutional & Mixed Use	Manufacturing and Supply	Total
Retrofit jobs	**2098**	**3458**	**1258**	**6814**
BCH	681	1483	490	2655
Fortis	459	396	194	1048

Non-program	958	1579	574	3111
Construction jobs	**6136**	**8815**	**9968**	**24919**
Part 3	2472	8815	7524	18811
Part 9	3665		2443	6108
Total jobs	**8234**	**12273**	**11226**	**31733**

Review Process

The external review is currently ongoing.

Appendix 1. Comparison of job factors

Sector	Organization	Study/Report	Region	Job Factor
Construction Industry	Green Jobs BC	Buildings, Energy Efficiency Retrofits and Green Jobs in BC	BC	6.46 jobs/$1M (direct), 10 jobs/$1M (direct and indirect)
	American Council for an EE Economy	How Does EE Create Jobs? Fact Sheet	US	20.3 jobs/$1M US (direct, indirect, induced). For overall US economy: 17 jobs/$1M US (direct, indirect, induced).
		Understanding the True Benefits of Both Energy Efficiency and Job Creation		
	Federation of Canadian Municipalities	Building Canada's Green Economy: The Municipal Rule	Can	6 jobs/$1M (direct), 10 jobs/$1M (direct and indirect)
Retrofit	Green Jobs BC	Buildings, Energy Efficiency Retrofits and Green Jobs in BC	BC	15.93 jobs/$1M (direct), 18.51 jobs/$1M (direct and indirect)
	Sundquist, E.	Estimating Jobs from Building Energy Efficiency	US	4.3 jobs/$1M for large industrial retrofits; 7.4 jobs/$1M for multifamiliy EE retrofits; 9.1 jobs/$1M for single family EE retrofits (All direct)
	Columbia Institute	Building Fast Action for Climate Change and Green Jobs: This Green House	Can	20 jobs/$1M; 16.7jobs/$1M in USA

	Institute for Market Transformation and Political Economy Research Institute	Analysis Job Creations and Energy Cost Savings	US	12.1/$1M Operational Improvements 9.58/$1M Multifamily Capital Upgrade 9.24/$1M Commercial Capital Upgrade (Direct and Indirect)
	HR&A / Living Cities	The Benefits of Energy Efficiency in MultiFamily Affordable Housing	US	10 jobs/$1M

Appendix 2. Overview of BC Hydro DSM expenditures in the building sector

Here we describe the methodology we used to estimate investment dollars in retrofits stimulated by BC Hydro's programs. We use past BC Hydro DSM spending over a three-year period (2014-2016) to take a yearly average. This gives an average DSM expenditure of $173 million/year, based on documents filed with the BCUC. Not all of the $173 million was spent on areas we consider in scope: for retrofits, we include the residential and commercial incentives, but exclude spending on industrial and portfolio-level programs. In this period, 13% of total DSM expenditures went to residential and 28% to commercial programs. 59% of the spending was out of scope (see Table A2-1).[27]

Table A2-1. BC Hydro past DSM expenditures broken down by sector ($millions)

Sector	3-year total (2014-2016)	1 year average	% of total spend
Residential	67	22	13%
Commercial	146	49	28%
Industrial	209	70	40%
Portfolio-Level	96	32	19%
Total	518	173	100%

Source: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/revenue-requirements/RRRA-2015-2016-main.pdf

This gives average annual DSM investments on residential and commercial of $22 and $49 million respectively (see Table A2-2).

Table A2-2. BCH DSM expenditures assumed for Green Buildings Map

Group	Total DSM ($millions)	Residential	Commercial	Total for Pembina study

BC Hydro	173	22	49	71

Please note: not all expenditures from the residential and commercial programs are for retrofits. Some of the money will go towards equipment rebates, such as the purchase and installation of high efficiency electric heat pumps. While this is still an energy efficiency 'retrofit', it may not be representative of the job factors we are using. Direct retrofit jobs will likely be lower for equipment retrofits than suggested by our job factors. However, in equipment retrofit scenarios, the indirect job factors likely underestimate the job creation by manufacturing of high efficiency building materials/components/equipment and other suppliers, which we consider in scope. As such we assume that, on balance, these factors balance each other out. We are constrained by the level of detail in the data available to us, and are therefore forced to make this assumption.

Considering the above paragraph, we want to re-emphasize that we make conservative assumptions throughout the project (not including Part 9 construction projects below $15 million, underestimating manufacturing and supplier jobs in B.C. etc.). The one exception is the above-described assumption that DSM program spending will primarily go towards retrofits.

Appendix 3. Overview of FortisBC DSM expenditures in the building sector

FortisBC has two different DSM programs for its electric and natural gas businesses. Each is described below.

Fortis Electric information is from Fortis Inc. submissions to the BCUC on DSM expenditures for its electric business in 2016. Fortis spent $6.5 million on electricity DSM in total in 2016, of which 39% and 36% are for residential and commercial programs respectively. 25% of the spending is out of scope (see Table A3-1).[28]

Table A3-1. Fortis Electric DSM spending for 2016

Sector	Money spent ($ millions)	Ratio
Residential	2.5182	39%
Commercial	2.3394	36%
Industrial	0.3001	5%
Program Total	5.1577	79%
Supporting initiatives	0.6573	10%
Planning & Evaluation	0.7184	11%
Total	6.5334	100%

Fortis Natural Gas information is from Fortis Inc. submissions to the BCUC on DSM expenditures for its natural gas business in 2016. Fortis spent $31 million on gas DSM in total in 2016, of which 40% and

34% are for residential and commercial programs respectively. 26% of the spending is out of scope (see Table A3-2).[29]

Table A3-2. Fortis Natural Gas DSM spending for 2016

Sector	Money spent ($ millions)	Ratio
Residential	12.531	40%
Commercial	10.637	34%
Industrial	1.003	3%
Low Income	2.277	7%
Conservation, Education and Outreach	2.415	8%
Innovative Technologies	0.757	2%
Enabling activities	1.378	4%
Total	30.998	100%

Fortis' electric and natural gas DSM expenditures are combined to inform the residential and commercial program expenditures used in our project. Total DSM expenditures for Fortis' electric and natural gas business is $37.5 million/yr. Of this, $15 million is for residential programs, and $13 million is for commercial programs. 25% of Fortis' DSM expenditure is out of scope (see Table A-3-3).

Table A3-3. Fortis' electric and natural gas combined DSM expenditures used in our project ($million)

Program	Total DSM expenditure	Residential	Commercial
FortisBC	37.5	15.0	13.0

Appendix 4. Private contribution

Utility DSM programs only fund a portion of the cost of retrofit projects. The rest is funded privately (or publically for public buildings). We refer to this private contribution to retrofit projects simply as "private contribution". Data on private contribution was difficult to obtain. We base our factor on a 2014 study by the Acadia Center, which used surveys from Manitoba that break down energy efficiency retrofits by program spending, private spending and total expenditures on retrofit projects, and apply them to other provinces.[30] The private contribution for British Columbia is estimated at 0.92 times the program spending. Total spending therefore is 1.92 (see table A4-1). This was cross-referenced to the expected contribution factor from BC Hydro.[31]

Table A4-1. Program and private contribution to energy efficiency initiatives for British Columbia

British Columbia	Electric (c/kwh)	NG (c/m3)
Unit Program Costs	2.8	9.3
Unit Participant Costs	1.5	12.1
Total Costs	4.3	21.4
Private contribution	0.92	
Total contribution	1.92	

[1] http://leed.cagbc.org/LEED/projectprofile_EN.aspx

[2] http://bomacanada.ca/bomabest/certifiedbuildings/

[3] http://www.greenglobes.com/newconstruction/certified.aspx

[4] http://www.passivhausprojekte.de/index.php#s_bf18546217c0e02b1e69a4a4aec42556

[5] http://www.passivehousecanada.com/projects/

[6] https://living-future.org/lbc/basics/

[7] http://www2.gov.bc.ca/gov/content/employment-business/economic-development/industry/bc-major-projects-inventory

[8] Data request (May 15, 2017) for Built Green Canada certified projects in B.C.

[9] Data request (May 8, 2017) for EnerGuide, ENERGY STAR, R-2000, and corresponding three digit postal codes.

[10] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/revenue-requirements/RRRA-2015-2016-main.pdf

[11] http://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/140924_FBC%202015-2016%20DSM%20Expenditures%20-%20ICG%20IR1%20Response_FF.pdf

[12] https://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/170331_FEI_2016_DSM_Annual_Report_FF.PDF

[13] Factor for participant spending based on a business as usual scenario for British Columbia (Appendix 6). Acadia Centre, Energy Efficiency: Engine of Economic Growth in Canada (March 2014) http://acadiacenter.org/wp-content/uploads/2014/11/ENEAcadiaCenter_EnergyEfficiencyEngineofEconomicGrowthinCanada_EN_FINAL_2014_1114.pdf Cross referenced against expected contribution factor in: BC Hydro, Power Smart Employment Impacts (2010).

[14] "The evaluated average free-ridership and participant spillover was 44 and 12 per cent respectively. The evaluation also estimated non-participant spillover of 543 TJ e per year or 84 per cent of program gross savings. "BC Hydro. "Evaluation of the LiveSmart BC Efficiency Incentive Program," 2012.

[15] Statistics Canada "National Input-Output Multipliers" 2006, M-level aggregation, cited in Federation of Canadian Municipalities, Building Canada's Green Economy: The Municipal Role (2011). https://fcm.ca/Documents/reports/Building_Canadas_green_economy_the_municipal_role_EN.pdf

[16] Green Jobs BC, Buildings, Energy Efficient Retrofits, and Green Jobs in BC (Jan 2013). http://greenjobsbc.org/wp-content/uploads/2012/01/GJBC-building-retrofits.pdf

[17] Building Canada's Green Economy: The Municipal Role.

[18] We assume that the average construction time for energy efficient Part 9 building in BC is 1 year.

[19] We took the average of two cost estimates per square footage and multiplied this by the size of an average BC new home, which we define at 2,000 ft^2. Cost estimates from: http://canphi.ca/wp-content/uploads/2015/07/Passive-House_BusinessCase_2015.pdf

[20] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/revenue-requirements/RRRA-2015-2016-main.pdf

[21] http://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/140924_FBC%202015-2016%20DSM%20Expenditures%20-%20ICG%20IR1%20Response_FF.pdf

[22] https://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/170331_FEI_2016_DSM_Annual_Report_FF.PDF

[23] Factor for participant spending based on a business as usual scenario for British Columbia. See Energy Efficiency: Engine of Economic Growth in Canada. Cross referenced against expected contribution factor in: BC Hydro, Power Smart Employment Impacts (2010).

[24] "The evaluated average free-ridership and participant spillover was 44 and 12 per cent respectively. The evaluation also estimated non-participant spillover of 543 TJ e per year or 84 per cent of program gross savings." BC Hydro. "Evaluation of the LiveSmart BC Efficiency Incentive Program," 2012.

[25] Energy Efficiency: Engine of Economic Growth in Canada.

[26] Note: all numbers are rounded to the nearest 100

[27] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/revenue-requirements/RRRA-2015-2016-main.pdf

[28] http://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/140924_FBC%202015-2016%20DSM%20Expenditures%20-%20ICG%20IR1%20Response_FF.pdf

[29] https://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/170331_FEI_2016_DSM_Annual_Report_FF.PDF

[30] Energy Efficiency: Engine of Economic Growth in Canada.

[31] BC Hydro, Power Smart Employment Impacts (2010).