



Canadian Bioenergy Association

Economic Impact of Bioenergy in Canada- 2011

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Data based on a CanBio telephone/email survey April-August 2011

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Executive Summary:

Due to the lack of bioenergy-specific data in Canada, CanBio undertook surveys of bioenergy production facilities in 2011 to assess the size and economic impact of bioenergy in Canada.

Similar to Scandinavia and Austria, Canada took considerable time to learn what biomass systems worked best domestically. Having gone through this learning process, often fraught with frustration, the last 2 years has seen substantial growth in bioenergy in Canada.

- Pellet capacity grew from 1.1 MT to 2.1 MT 2006-10, but based on promising market prospects in Europe and Asia, capacity grew an astounding 50% in the last 12 months to 3.2 MT. There are another 336,000 tonnes under construction.
- In the 30 years 1980-2009 only 3 biomass district heat projects were built in Canada, yet in the last 2 years 16 more community heat plants have started up, 12 more are under construction, and 26 more are at various stages of planning.
- Bio-ethanol capacity grew from 1.415 ML (million litres) in 2009 to 1.97 ML in 2011. Two next generation ethanol plants with capacity 41 ML are now under construction.
- Biodiesel capacity grew from 141 ML in 2009 to 210 ML in 2010, with another 116 ML under construction.
- Independent power producers increased biomass power generation from 426 MWe in 2009 to 466 MWe in 2011.

Bioenergy has had a major impact on employment. Including plants under construction, 3,927 are employed directly in bioenergy production and feedstock supply across Canada. 1,658 are employed in the pellet industry nationwide, 1,000 in ethanol and 916 in independent power.

Table: Productions jobs in feedstock supply and in plants, including those under construction

| | <u>BC</u> | <u>NT</u> | <u>AB</u> | <u>SK</u> | <u>MN</u> | <u>ON</u> | <u>QC</u> | <u>NB</u> | <u>NS</u> | <u>PE</u> | <u>NL</u> | <u>Total</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|
| Pellets | 550 | | 23 | 0 | 0 | 386 | 265 | 173 | 138 | 62 | 61 | 1,658 |
| Ethanol | 0 | | 160 | 182 | 40 | 513 | 105 | 0 | 0 | 0 | 0 | 1,000 |
| Biodiesel | 24 | | 14 | 50 | 47 | 40 | 47 | 0 | 0 | 0 | 0 | 222 |
| Cogen-IPP | 56 | | 215 | 0 | 0 | 391 | 224 | 30 | 0 | 0 | 0 | 916 |
| Pyrolysis | 0 | | 16 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 32 |
| Bio-heat | <u>7</u> | <u>1</u> | <u>34</u> | <u>0</u> | <u>1</u> | <u>1</u> | <u>15</u> | <u>0</u> | <u>0</u> | <u>40</u> | <u>0</u> | <u>99</u> |
| Total | 637 | 1 | 462 | 232 | 88 | 1347 | 656 | 203 | 138 | 102 | 61 | 3,927 |

Bioenergy also employs people in non-production jobs, including academia, governments and not-for-profit organizations. It is estimated that nationwide 296 are employed in bioenergy research programs at universities, in industry associations and in governments. Combining production and non production, and including indirect employment, the industry employs an estimated 9,527. Not included in the survey were engineering, retail, algae, consulting, and

manufacturers. Also not included is employment in feedstock supply for ethanol and harvest residue feedstock supply, owing to insufficient consistent data received in the survey.

Importantly, while wind turbines tend to locate in areas with consistent wind patterns irrespective of where people are, bioenergy tends to develop in small communities, many formerly dependent on traditional forest products. Such development brings employment where even a few jobs count. 40-50 jobs in a small community can often make a significant contribution to community survival. As shown below, including production jobs only 3,529 are employed in 62 communities with population less than 5,000 people, an average of 57 jobs per community. 6,236 are employed in 101 communities with less than 25,000 people.

Table: Direct Employment in Production & Indirect Employment by Community Population

| | <u>0-5000</u> | <u>5000-25000</u> | <u>25000 +</u> | <u>Total</u> |
|---------------|---------------|-------------------|----------------|--------------|
| Pellets | 2,013 | 813 | 525 | 3,350 |
| Ethanol | 856 | 1,204 | 1,940 | 4,000 |
| BioDiesel | 197 | 18 | 119 | 333 |
| Cogen Indep | 402 | 642 | 318 | 1,362 |
| Pyrolysis Oil | | 24 | 24 | 48 |
| District Heat | <u>62</u> | <u>6</u> | <u>71</u> | <u>138</u> |
| | 3,529 | 2,707 | 2,996 | 9,231 |

1. Introduction

While bioenergy has been part of the Canadian energy scene for 20 years and more, very little is known about how big the bioenergy industry is, how widespread, and its impact on the Canadian economy, especially at the community level. In 2006 fully 5% of Canada's energy was from biomass, however, much of this was renewable heat and power from cogeneration facilities built at pulp mills to reduce energy costs and enable the mills to be competitive in world markets. The employment impact was negligible, since pulp mill employees could often operate the added cogeneration facility, and most of the feedstock was onsite mill residue that also required little if any new employment. Beginning in 2000 the wood pellet industry began to grow significantly to supply hungry offshore markets, primarily Europe, and a number of ethanol and biodiesel plants were built to enable achievement of domestic targets for renewable transportation fuels.

To shed light on the growing impact of bioenergy, CanBio commissioned a survey of the industry undertaken in 2011. The purpose of the survey was to develop a database for bioenergy to understand the growth and structure of Canada's bioenergy industry, and determine the socio-economic benefits that the industry provided. The study was targeted chiefly at production facilities including ethanol, biodiesel, pellets, bio-heat, bio-power, cogeneration, etc. Key data sought in the survey included capacity, production, exports, type and source of biomass feedstock, purchaser of energy, employment (direct/indirect), wages and salaries, capital investment, etc. This information was primarily sought by way of telephone survey and where possible data was acquired from known databases, online and media sources. The survey was limited and did not include the following sectors: wood chipping, algae producers, retail, equipment manufacturers and construction. To expand the database a mini-study was subsequently undertaken to assessment employment in non-production organizations, such as, academia, governments etc.

As shown in Table 1.1, 147 operational bioenergy production plants were identified, with 26 under construction, and 48 in various stages of planning for a total of 221 plants. Another 21 have been shut down, primarily cogeneration plants at closed pulp mills. Operational means fully complete and operating, but some plants may be operating at below capacity or even shut down temporarily due to market conditions. Planned plants refer to those intended to be operational within 2 years. Since some of the data, such as actual production and employment, is considered confidential by many companies, it was agreed that CanBio would report capacity data by plant. Actual production, employment and other confidential data are reported by region. Some companies did not report all data. For example, 58% of companies provided employment data. For other companies CanBio used interpolation to estimate employment by making comparisons with plants of similar size.

Table 1.1- Surveyed Plants

| | <u>Operating</u> | <u>Constr.</u> | <u>Planned</u> | <u>Shut</u> |
|------------------|------------------|----------------|----------------|-------------|
| Pellets | 39 | 7 | 11 | |
| Ethanol | 19 | 2 | 2 | |
| Biodiesel | 13 | 2 | 7 | |
| Pyrolysis Oil | 2 | | 1 | 2 |
| Cogen (p&p) | 39 | | 1 | 17 |
| Cogen (non p&p) | 16 | 7 | 1 | |
| District Heating | <u>19</u> | <u>8</u> | <u>25</u> | <u>2</u> |
| | 147 | 26 | 48 | 21 |

2. Capacity

2.1. Wood Pellets

In mid 2011, there were 39 operational pellet producers in Canada with a total capacity of 3,222,151 tonnes per year (tpy), as shown in Table 2.1. This capacity represents an astounding 55% growth of over 1 million tonnes, from 2010 when capacity was recorded as 2,082,510 tonnes. Of 1,139,640 tonnes in new capacity, 684,000 tonnes is from new plants, 551,000 tonnes capacity was added to existing plants, and 95,000 tonnes was lost due to plant closures. Not all plants are operating at full capacity due to market conditions. The Enligna plant in Nova Scotia is currently under bankruptcy protection and it is not known whether it will re-open under new management. There are another 7 pellet plants under construction that will add 336,004 tpy of capacity, also shown in Table 2.1. When these are complete, total capacity will be 3,558,144 tpy. Not shown are 11 plants in various stages of planning, 6 in Ontario and one each in BC, Alberta, Saskatchewan, New Brunswick and PEI.

Table 2.1 Pellet Capacity 2011 (continued next page)

| | <u>Plant</u> | <u>Location</u> | <u>Capacity (tonnes pa)</u> | | <u>New</u> |
|----|------------------------------------|-------------------|-----------------------------|-------------|------------|
| | | | <u>2010</u> | <u>2011</u> | |
| 1 | Pacific BioEnergy Corp. | Prince George, BC | 180,000 | 350,000 | 170,000 |
| 2 | Pinnacle Pellet- Burns Lake | Burns Lake, BC | | 320,320 | 320,320 |
| 3 | Pinnacle Pellet- Houston | Houston, BC | 150,000 | 240,240 | 90,240 |
| 4 | Pinnacle Pellet- Meadow Bank | Strathnaver, BC | 200,000 | 220,000 | 20,000 |
| 5 | Pinnacle Pellet- Williams Lake | Williams Lake, BC | 150,000 | 200,200 | 50,200 |
| 6 | Premium Pellet Ltd. | Vanderhoof, BC | 140,000 | 140,000 | |
| 7 | Pinnacle Pellet- Quesnel | Quesnel, BC | 90,000 | 100,000 | 10,000 |
| 8 | Princeton Co-Generation | Princeton, BC | 90,000 | 90,000 | |
| 9 | Tahtsa Pellets Ltd.- Pacific Flame | Burns Lake, BC | | 80,000 | 80,000 |
| 10 | Pinnacle Pellet- Armstrong | Armstrong, BC | 50,000 | 61,880 | 11,880 |

Table 2.1 Pellet Capacity 2011 (continued)

| | Plant | Location | Capacity (tonnes pa) | | New |
|----|----------------------------------|---------------------|----------------------|---------------|-----------|
| | | | 2010 | 2011 | |
| 11 | Woodville Pellet-Highland Plant | Merritt, BC | 29,000 | 60,000 | 31,000 |
| 12 | Okanagan Pellet Company | West Kelowna, BC | 50,000 | 50,000 | |
| 13 | Vanderhoof Speciality Wood Prod. | Vanderhoof, BC | 30,000 | 30,000 | |
| | SBC Firemaster | Kamloops, BC | 30,000 | | -30,000 |
| 14 | Gold Standard Pellet Fuel | Surrey, BC | | 45,000 | 45,000 |
| 15 | Vanderwell Contractors | SlaveLake, AB | 60,000 | 60,000 | |
| 16 | La Crete Sawmills | La Crete, AB | 35,000 | 50,000 | 15,000 |
| 17 | Foothills Forest Products | Grande Catche, AB | 25,000 | 25,000 | |
| 18 | Woodville Pellet Corp. | Kirkfield, ON | | 60,000 | 60,000 |
| 19 | Industries LacWood | Hearst, ON | | 7,000 | 7,000 |
| 20 | Gildale Farms | St.Marys, ON | 4,000 | 4,000 | |
| 21 | Trebio Inc. | Portage-du-Fort, QC | | 130,000 | 130,000 |
| 22 | Energex Pellet Fuel | Lac-Megantic, QC | 120,000 | 120,000 | |
| 23 | Granules LG | St.Felicien, QC | 50,000 | 120,000 | 70,000 |
| 24 | Lauzon Recycled Wood Energy | Papineauville, QC | 40,000 | 60,000 | 20,000 |
| 25 | Granule Boreal | Amos, QC | 50,000 | 50,000 | |
| 26 | Lauzon Recycled Wood Energy | St. Paulin, QC | 30,000 | 30,000 | |
| 27 | Granulco | Sacre-Coeur, QC | | 20,000 | 20,000 |
| 28 | Granules de la Mauricie | Shawinigan-Sud, QC | | 22,000 | 22,000 |
| 29 | Shaw Resources | Belledune, NB | 75,000 | 75,000 | |
| 30 | Groupe Savoie | St-Quentin, NB | 55,000 | 55,000 | |
| 31 | TP Downey | Hillsborough, NB | 40,000 | 40,000 | |
| | Crabbe Lumber | Bristol, NB | 40,000 | | -40,000 |
| 32 | Nashwaak Valley Wood Energy | South Portage, NB | 17,500 | 17,500 | |
| 33 | Marwood | Tracyville, NB | 10,000 | 12,000 | 2,000 |
| 34 | Enligna | Musquodoboit, NS | 105,000 | 100,000 | -5,000 |
| 35 | Shaw Resources | Shubenacadie, NS | 90,000 | 90,000 | |
| 36 | Finewood Flooring | Baddeck, NS | 10,000 | 10,000 | |
| 37 | Holson Forest Products | Roddickton, NL | 10,000 | 50,000 | 40,000 |
| 38 | Exploits Pelletizing | Bishops Falls, NL | 15,000 | 15,000 | |
| 39 | Cottles Island Lumber Company | Summerford, NL | <u>12,000</u> | <u>12,000</u> | |
| | Total Operational: | | 2,084,510 | 3,224,151 | 1,139,640 |

Table 2.1 Pellet Capacity 2011 (continued)

| | Under Construction: | | Capacity (tonnes) |
|---|-----------------------------------|-----------------------|-------------------|
| 1 | Lhtako Energy Corp. | Quesnel, BC | ? |
| 2 | Whitesand First Nations | Armstrong, ON | 60,000 |
| 3 | Atikokan Renewable Fuels | Atikokan, ON | 140,000 |
| 4 | Direct Pellet Industries Inc. | Haliburton, ON | 16,000 |
| 5 | Granules LG International Inc. | Mashteuiatsh, QC | 80,000 |
| 6 | Pellagri Energy | Hartsville, H.R., PEI | 4 |
| 7 | Crabbe Lumber | Bristol, NB | 40,000 |
| | Total Under Construction | | 336,004 |
| | Total Operational & Under Constr. | | 3,558,144 |

Table 2.2 shows pellet capacity by province. At almost 2 million tonnes, BC is clearly the dominant producer. When plants under construction are complete, BC capacity will have 56% of Canada's total capacity, while Quebec will have 18%.

Table 2.2 Pellet Capacity by Province- tonne per annum

| | <u>Operational</u> | <u>Under Constr.</u> | <u>Total</u> | |
|---------------|--------------------|----------------------|--------------|-----|
| BC | 1,987,640 | | 1,987,640 | 56% |
| Alberta | 135,000 | | 135,000 | 4% |
| Ontario | 71,000 | 216,000 | 287,000 | 8% |
| Quebec | 552,000 | 80,000 | 632,000 | 18% |
| New Brunswick | 199,500 | 40,000 | 239,500 | 7% |
| Nova Scotia | 200,000 | | 200,000 | 6% |
| PEI | 0 | 4 | 4 | 0% |
| Nfld | 77,000 | | 77,000 | 2% |
| | 3,222,140 | 336,004 | 3,558,144 | |

Almost all Canadian pellet production is exported. While world demand for pellets is ramping up quickly, the recent opening of large plants in the South East US has created temporarily poor export market conditions for Canada. It is estimated that production in 2010 was 1.4 million tonnes vs. capacity of 2.1 million tonnes, and in 2011 production is projected to be 1.75 million tonnes vs. capacity of 3.2 million tonnes. 90% of exports are to Europe, 5% to Asia and 5% to the US. It is believed that with new renewable energy targets established in 2011 in Korea, that a major proportion of BC pellets may soon be diverted from Europe to Korea.

2.2. Ethanol

In Canada, there are 16 operating 1st generation ethanol plants, 3 demo 2nd generation plants, 2 plants under construction and 2 proposed plants. Total ethanol production for the 19 operating and demo plants is 1,973.575 MI (million litres) or 2,014.575 MI when including plants under construction. A 5 ml Enerkem plant is currently under construction at Westbury Quebec, where the syngas module is operating, using old railway ties as feedstock. The methanol module is in the test phase, and construction on the ethanol module is under way.

Table 2.3 Ethanol Capacity- (Million Litres p.a.)

| | <u>Plant</u> | <u>Location:</u> | <u>Capacity (Mmly):</u> |
|----|-----------------------------|----------------------|-------------------------|
| 1 | CR Fuels | Wheatland County, AB | 140 |
| 2 | Permolex Int., L.P. | Red Deer, AB | 42 |
| 3 | Husky Energy Inc. | Lloydminster, SK | 130 |
| 4 | NorAmera BioEnergy Corp. | Weyburn, SK | 25 |
| 5 | North West Terminal Ltd. | Unity, SK | 25 |
| 6 | Pound-Maker Agventures | Lanigan, SK | 13 |
| 7 | Terra Grain Fuels Inc. | Belle Plaine, SK | 150 |
| 8 | Husky Energy Inc. | Minnedosa, MB | 130 |
| 9 | Amazingly Green Products | Collingwood, ON | 54 |
| 10 | GreenField Ethanol Inc. | Chatham, ON | 195 |
| 11 | GreenField Ethanol Inc. | Johnstown, ON | 155 |
| 12 | GreenField Ethanol Inc. | Tiverton, ON | 27 |
| 13 | IGPC Ethanol Inc. | Aylmer, ON | 162 |
| 14 | Kawartha Ethanol | Havelock, ON | 80 |
| 15 | Iogen Corp. - Demo Facility | Ottawa, ON | 2 |
| 16 | Suncor St. Clair Ethanol | Sarnia, ON | 400 |
| 17 | Enerkem Inc. - Demo | Sherbrooke, QC | 0.475 |
| 18 | GreenField Ethanol Inc. | Varenes, QC | 230 |
| 19 | Atlantec Bioenergy Corp. | Milford, NS | <u>13</u> |
| | Operating Total: | | 1973 |
| | Under Construction: | | |
| 1 | Enerkem Inc. - Demo | Westbury, QC | 5 |
| 2 | Enerkem Alberta Biofuels | Edmonton, AB | 36 |

Table 2.4 illustrates ethanol capacity by province. Almost half of the plants and 60% of capacity are in Ontario. Most plants in the East use corn as feedstock, and most of in West use grain.

Table 2.4 Ethanol Capacity by Province

| <u>Province</u> | <u>#</u> | <u>Capacity</u> | <u>Under Constr.</u> |
|-----------------|----------|-----------------|----------------------|
| Alberta | 2 | 182 | 36 |
| Sask. | 5 | 343 | |
| Manitoba | 1 | 130 | |
| Ontario | 8 | 1,075 | |
| Quebec | 2 | 230 | 5 |
| Nova Scotia | <u>1</u> | <u>13</u> | - |
| | 19 | 1,973 | 41 |

2.3. Biodiesel

There are 13 operating biodiesel plants including one demonstration facility with a total biodiesel production of 209.9 MI, as shown in Table 2.5. 2 plants are under construction that will have capacity of 116 MI, raising the total capacity to 326 MI. Also, 7 plants are proposed, as shown in Table 2.6, with a total capacity of 896 MI. If built, these plants could increase the overall production to 1,222 MI of biodiesel per year.

Table 2.5 Biodiesel Capacity- Million litres p.a.

| | <u>Plant Name</u> | <u>Location</u> | <u>Capacity (Mmly)</u> |
|----|---------------------------------|-------------------------|------------------------|
| 1 | Consolidated Biofuels Ltd. | Delta, BC | 10.9 |
| 2 | City-Farm Biofuel Ltd. | Delta, BC | 10 |
| 3 | FAME Biorefinery - Demo | Airdire, AB | 1 |
| 4 | Milligan Bio-Tech Inc. | Foam Lake, SK | 20 |
| 5 | Speedway International | Winnipeg, MB | 20 |
| 6 | Eastman Bio-Fuels Ltd. | Beausejour, MB | 5 |
| 7 | Bifrost Bio-Blends Ltd. | Arborg, MB | 3 |
| 8 | BIOX Corporation | Hamilton, ON | 66 |
| 9 | Noroxel Energy Ltd. | Springfield, ON | 10 |
| 10 | Methes Energies Canada | Mississauga, ON | 5 |
| 11 | Rothsay Biodiesel | Montreal, QC | 45 |
| 12 | Bio-Lub Canada.com | St-Alexis-des-Monts, QC | 10 |
| 13 | QFI Biodiesel Inc. | St-Jean-d'Iberville, QC | <u>5</u> |
| | Total Operating: | | 209.9 |
| | <u>Under Construction:</u> | | |
| | Methes Energies Canada | Sombra, ON | 50 |
| | Kyoto Fuels Corp | Lethbridge, AB | <u>66</u> |
| | Total Under Construction: | | 116 |
| | Total Operating & Under Constr. | | 325.9 |

Table 2.6 Capacity- Proposed Biodiesel Plants

| <u>Proposed Plants:</u> | | Mlpy |
|--------------------------|----------------------|-----------|
| TRT-ETGO | Bécancour, QC | 100 |
| Bioversel Sarnia | Sarnia, ON | 170 |
| Biocardel Quebec Inc. | Richmond, QC | 40 |
| BIOX Corporation | Hamilton plant 2, ON | 67 |
| BioStreet Canada | Vegreville, AB | 235 |
| Canadian Bioenergy Corp. | Lloydminster, BC | 265 |
| Western Biodiesel Inc. | High River, AB | <u>19</u> |
| Total: | | 896 |

Table 2.7 illustrates biodiesel capacity by province. More than half of national production is in Ontario. Each Western province has production, but there is none in the Atlantic Provinces.

Table 2.7 Biodiesel Capacity by Province

| <u>Province</u> | <u>#</u> | <u>Capacity</u> | <u>Under Constr.</u> | <u>Proposed</u> |
|-----------------|----------|-----------------|----------------------|-----------------|
| BC | 2 | 20.9 | | 265 |
| Alberta | 1 | 1 | 66 | 254 |
| Sask. | 1 | 20 | | |
| Manitoba | 3 | 28 | | |
| Ontario | 3 | 126 | 50 | 237 |
| Quebec | 3 | <u>15</u> | - | <u>140</u> |
| | 13 | 209.9 | 116 | 896 |

2.4. Cogeneration (Pulp & Paper, Sawmills):

39 operating cogeneration plants were identified at pulp & paper mills and sawmills across Canada, as shown in Table 2.8. There were 59 such plants in 2000, but 20 have shut down after the closure of several pulp mills as a result of lack of competitiveness in a new global arena. Total operating capacity is 1,349 MW_e and 5,331 MW_{th}. NewPage has a 60MW cogen project approved, but with the mill in bankruptcy proceedings as of mid 2011 it is uncertain whether a new organization or project will emerge.

Table 2.8 Pulp and Paper Cogen

| | Plant Name: | Location: | | Mwe | MWth |
|----|-----------------------------------|-------------------|----|-------|-------|
| 1 | Conifex | Mackenzie | BC | 14 | 281 |
| 2 | Canfor Northwood Pulp | Prince George | BC | 55 | 663 |
| 3 | Canfor International Pulp Mill | Prince George | BC | 18 | |
| 4 | Canfor Prince George | Prince George | BC | 46 | 14 |
| 5 | Cariboo Pulp & Paper Company | Quesnel | BC | 32 | 388 |
| 6 | Catalyst Paper | Crofton | BC | 39 | 45 |
| 7 | Catalyst Paper | Powell River | BC | 36 | 255 |
| 8 | Domtar Inc. | Kamloops | BC | | |
| 9 | Zellstoff Celgar | Castlegar | BC | 52 | 343 |
| 10 | Howe Sound Pulp & Paper Corp. | Port Mellon | BC | 48 | 178 |
| 11 | Louisiana Pacific EWP Power | Golden | BC | 8 | 19 |
| 12 | Nanaimo Forest Products | Nanaimo | BC | 30 | 292 |
| 13 | Neucel Speciality Cellulose | Port Alice | BC | 15 | 98 |
| 14 | Tembec Industries Inc. | Skookumchuck | BC | 59 | 277 |
| 15 | Tembec Industries Inc. | Cranbrook | BC | 58 | |
| 16 | Tolko Industries Ltd. | Kelowna | BC | 12 | 56 |
| 17 | Mackenzie Pulp Mill Corp. | Golden | BC | 8 | 19 |
| 18 | Western Pulp | Kelowna | BC | 56 | 1 |
| 19 | Alberta Pacific Forest Industries | Boyle | AB | 99 | 695 |
| 20 | DMI Peace River Pulp Division | Peace River | AB | 45 | 425 |
| 21 | West Fraser Timber | Hinton | AB | 51 | ? |
| 22 | Weyerhaeuser | Grande Prairie | AB | 60 | ? |
| 23 | AbitibiBowater | Thunder Bay | ON | 67 | 0 |
| 24 | AbitibiBowater | Fort Frances | ON | 45 | ? |
| 25 | Sonoco Can Corp (closed?) | Brantford | ON | 4 | 14 |
| 26 | Tembec Inc. | Chapleau | ON | 7 | ? |
| 27 | Tembec Inc. | Kapuskasing | ON | 15 | 0 |
| 28 | Fibretek | St. Felicien | QC | 29 | 0 |
| 29 | Domtar Inc. | Windsor | QC | 32 | 309 |
| 30 | Tembec Inc. | Temiscaming | QC | 12 | ? |
| 31 | Borex | Dolbeau | QC | 28 | 126 |
| 32 | AV Cell | Atholville | NB | 21 | ? |
| 33 | AV Nackawic Inc. | St. Anne Nackawic | NB | 25 | 176 |
| 34 | Irving Pulp | Saint John | NB | 33 | 311 |
| 35 | Twin Rivers Paper Company | Edmundston | NB | 46 | 157 |
| 36 | Northern Pulp Nova Scotia | Pictou County | NS | 82 | 26 |
| 37 | AbitibiBowater- Brooklyn | Brooklyn | NS | 45 | 45 |
| 38 | Taylor Lumber | Mid. Musquodoboit | NS | 1.1 | ? |
| 39 | Kruger Corner Brook Pulp & Paper | Corner Brook | NF | 18 | 120 |
| | Total: | | | 1,349 | 5,331 |

Fully half of the nation's 39 cogen installations, and approximately 57% of cogen power capacity (1,064 MWe) are in BC, as shown in Table 2.9. Total energy capacity is 6,680 MWe.

Table 2.9 Pulp & Paper Mill Cogen by Province

| | # | MWe | MWth | Total |
|----|----------|-----------|------------|------------|
| BC | 18 | 585 | 2,928 | 3,512 |
| AB | 4 | 255 | 1,120 | 1,375 |
| ON | 5 | 138 | 14 | 152 |
| QC | 4 | 101 | 435 | 536 |
| NB | 4 | 125 | 644 | 769 |
| NS | 3 | 128 | 71 | 199 |
| NL | <u>1</u> | <u>18</u> | <u>120</u> | <u>138</u> |
| | 39 | 1,349 | 5,331 | 6,680 |

2.5. Cogeneration (Independent)

There are 16 independent power producers with total capacity of 466 MWe and 20 MWth, as shown in Table 2.10. Hydro Quebec signed 6 biomass power contracts for power supply in 2012 and these projects are under construction. A new gasification heat and power plant is under construction at UBC, and one plant is planned for Quesnel, BC.

Table 2.10 Independent Cogeneration Heat and Power Plants

| | Plant Name | Location | MWe | MWth |
|----|-----------------------------------|--------------------|-----------|------|
| 1 | Canadian Gas & Electric | Grande Prairie, AB | 25 | 15 |
| 2 | Drayton Valley Power | Drayton Valley, AB | 16 | 0 |
| 3 | Whitecourt Power Partnership | Whitecourt, AB | 28 | 0 |
| 4 | Verdant Energy Ltd. | Westlock, AB | 16.5 | 0 |
| 5 | Capital Power Income LP | Williams Lake, BC | 68 | 0 |
| 6 | U. Of New Brunswick | Fredricton, NB | | |
| 7 | Capital Power | Hearst, ON | 40 | 0 |
| 8 | Delta Energy Atikokan Cogen | Atikokan, ON | 10 | 0 |
| 9 | Northland Power | Kirkland Lake, ON | 139 | 0 |
| 10 | Northland Power | Cochrane, ON | 42 | 0 |
| 11 | Robert O.Pickard Environment Ctr | Ottawa, ON | 2.4 | 2.5 |
| 12 | Humber Treatment Plant | Etobicoke, ON | 4.7 | 2.9 |
| 13 | Energy+2000 | Ajax, ON | 0.7 | |
| 14 | St. Felicien Cogeneration Project | Saint-Felicien, QC | 21.4 | |
| 15 | Probyn | Chapais, QC | 27 | |
| 16 | Societe en Commandite Gazmont | Montreal, QC | <u>25</u> | - |
| | Total: | | 465.7 | 20.4 |

Table 2.10 Independent Cogeneration Heat and Power Plants (continued)

| | <u>Plant Name</u> | <u>Location</u> | <u>MWe</u> | <u>MWth</u> |
|---|------------------------------|--------------------------|------------|-------------|
| | Under Construction: | | | |
| 1 | Terreau Biogaz | Haute-Yamaska | 3 | |
| 2 | FibreK | Saguenay- Lac St Jean | 9.5 | |
| 3 | WM Québec | Centre-du-Quebec | 7.6 | |
| 4 | Innoventé Inc | St Patrice-de-Beaurivage | 4.6 | |
| 5 | EBI Énergie | St. Thomas | 9.35 | |
| 6 | Fortress Specialty Cellulose | Thurso | 18.8 | |
| 7 | UBC- Nexterra | Vancouver, BC | 2 | |
| | Total: | | 54.85 | |
| | Planned: | | | |
| | Quesnel | Quesnel, BC | 1.7 | 5.5 |

Table 2.11 illustrates capacity by province. Ontario dominates with 7 plants and half of Canada’s productive capacity. While, pulp mills are major heat hosts and cogen operates efficiently with a higher proportion of thermal energy, independents have a much higher proportion of electric energy.

Table 2.11 Independent Heat and Power Capacity by Province

| | | <u>MWe</u> | <u>MWth</u> | <u>Total</u> |
|----|----------|------------|-------------|--------------|
| BC | 1 | 68 | 0 | 68 |
| AB | 4 | 85.5 | 15 | 100.5 |
| ON | 7 | 238.8 | 5.4 | 244.2 |
| QC | 3 | 73.4 | 0 | 73.4 |
| NB | <u>1</u> | <u>0</u> | <u>0</u> | <u>0</u> |
| | 16 | 465.7 | 20.4 | 486.1 |

2.6. Bioheat

The greatest growth in bioenergy in Canada is in bio-heat, many in small communities. In 2000 there were only two systems in Canada, the Charlottetown plant in PEI and the Cree First Nation Plant in Oujebougamou Quebec, both built in the 1980s. Revelstoke BC developed the first new community heat plant in 2005, which was expanded in 2008. But, in the last 2-3 years there has been a proliferation of development, primarily in Quebec and BC. Quebec municipalities joined the CanBio technology missions to Sweden in 2008 and Finland in 2009, and that combined with a new Quebec incentive to convert heavy and light oil heat to biomass, resulted in a number of new bio-heat developments. In BC, the BC Bioenergy Network (BCBN) was established in 2008. BCBN acts as a catalyst for deploying near-term bioenergy technology capital at pilot and full-scale demonstration phases, as well as providing support for bioenergy capacity development, education and advocacy for the sector. By 2011, 10 capital and 11

capacity building projects were supported. Also in BC, the Rural and Remote Communities Green Heat Initiative project supports development of BC's bio-energy heat sector by providing market and industry development assistance, pre-feasibility study assistance, professional education and training. By 2011, over 18 projects were identified or supported for potential deployment. As shown in Table 2.12, there are now 19 community heat plants in operation. Furthermore, 12 additional plants under construction, 14 at the feasibility stage, and 12 more in final stages of planning, as shown in Table 2.13.

Table 2.12 Community Heat Capacity

| | <u>Plant Name:</u> | | <u>MWth</u> |
|----|--|----|--------------|
| 1 | Revelstoke Community Energy Corporation | BC | 1.5 |
| 2 | Cree First Nation Community | QC | 2.7 |
| 3 | PEI Energy Corp. | PE | 22 |
| 4 | UNBC - Nexterra Gasification system | BC | 1.9 |
| 5 | UNBC - Biomass Pellet project | BC | 4.4 |
| 6 | Kruger Products LP | BC | 21 |
| 7 | Tolko Ind. Ltd.- Gasification System- Heffley | BC | 11 |
| 8 | Dockside Green- Residential/Commercial gasification | BC | 2 |
| 9 | False Creek SEFC & Olympic Village | BC | ? |
| 10 | Kluane First Nation | YU | ? |
| 11 | Rosa Flora | ON | 1.044 |
| 12 | Grassy Narrows First Nation | ON | |
| 13 | Chateau-Richer, Abitibi-Bowater | QC | 3 |
| 14 | Domaine-du-Roy, Centre de Sante | QC | 4.5 |
| 15 | CF Matapedia- CSSS Amqui | QC | 0.41 |
| 16 | CF Girardville- Garage Transport Guy Harvey | QC | 0.005 |
| 17 | CF Girardville- Usine d'extraction d'huiles essentielles | QC | 0.015 |
| 18 | CF Girardville- Bureau CFG | QC | 0.007 |
| 19 | CF Girardville- Nettoyeur Net plus | QC | <u>0.027</u> |
| | Operating Total: | | 75.511 |

Table 2.13 Heat Plants under construction and planned

| | <u>Under Construction:</u> | | <u>MWth</u> |
|----|---|----|-------------|
| 1 | Far North Biomass/Lambion Energy Solutions | ON | 2 |
| 2 | Simon Fraser University Campus | BC | 36 |
| 3 | Providence College | MB | |
| 4 | La Cite Verte, SSA Societe immobiliere Inc. | QC | 5 |
| 5 | City of Prince George * | BC | |
| 6 | Lillooet BC * | BC | 0.4 |
| 7 | Williams Lake BC * | BC | 0.22 |
| 8 | Stellat'en First Nation- Fraser Lake BC * | BC | |
| 9 | The Beedie Group | BC | |
| 10 | CF Matapedia- SEREX | QC | 0.074 |
| 11 | CF de Petit Paris- Reseau parc industriel | QC | 0.078 |
| 12 | CF Girardville - Ecole Chanoine-Simard | QC | 0.074 |
| | Total Under Construction: | | 43.846 |

| | <u>Feasibility stage:</u> | |
|----|--|----|
| 1 | CF Matapedia- Causapscal | QC |
| 2 | CF Matapedia- CSSS Mont Joli | QC |
| 3 | CF Matapedia- Reseau Amqui | QC |
| 4 | CF Matapedia- Reseau St-Leon-Le-grand | QC |
| 5 | ACF de St-Elzear- CSSS de Maria | QC |
| 6 | CGFA- CSSS de Montmagny | QC |
| 7 | CF Laterriere/Ste-Rose- Reseau St-Honore | QC |
| 8 | CF Girardville- CHSLD de Normandin | QC |
| 9 | CF Girardville- Ferme experimentale Normandin | QC |
| 10 | CF Girardville- Pavillion du Cegep St-Felicien | QC |
| 11 | CF St-Dominique- Residences de personnes agees | QC |
| 12 | CF St-Dominique- Reseau Macamic | QC |
| 13 | CF St-Dominique- Projet minier | QC |
| 14 | CAF Kinojevis-Abijevis- Reseau CSRN, UQAT, Cegep | QC |

(Continued below)

Table 2.13 Heat Plants under construction and planned (continued)

| | <u>Planned:</u> | |
|----|---|----|
| 1 | Prince Rupert (City) * | BC |
| 2 | Burns Lake Village- (arena) * | BC |
| 3 | Burns Lake Village- (downtown core) * | BC |
| 4 | Tatla Lake School * | BC |
| 5 | Dawson Creek- Northern Lights College * | YK |
| 6 | CF Matapedia- Reseau Matane | QC |
| 7 | CF Matapedia- Reseau Sayabec | QC |
| 8 | CF de Petit Paris- Reseau St-Ludger-de-Milot | QC |
| 9 | CF Laterriere/Ste-Rose- Centrale de chaffage Saguenay | QC |
| 10 | CF Laterriere/CF Ste-Rose- Projet RTA | QC |
| 11 | CF Haut-St-Maurice- Reseau ville de La Tuque | QC |
| 12 | Maria Hospital | QC |

2.7. Pyrolysis Oil

Canada remains the world leader in commercialization of pyrolysis oil. Information is limited on pyrolysis oil producers: Ensyn, Dynamotive and Titan Clean Energy. Ensyn of Ottawa has been producing pyrolysis oil since 1989, with 6 small plants in the US. Its largest plant was built in Renfrew in 2004, with capacity of 100-tpd, and it has been operating since then. All production is sold into the US, some in the food and chemicals market, and some for building heat. The second dominant producer is Dynamotive, which built a 100-tpd pilot plant in West Lorne Ontario in 2005 and subsequently expanded the plant to 130-tpd. A major portion of production was fed into a 2MW Orenda turbine to make power for the Ontario grid under the Feed-In-Tariff (FIT) program. The remainder was sold into the US heat market. The West Lorne mill was shut down in 2008 on loss of feedstock from the neighbouring furniture factory, and unwillingness to undergo a new environmental assessment of 2-year duration simply to change feedstock. Dynamotive built the largest pyrolysis plant in the world, a 200-tpd plant in Guelph that was designed to operate using post-industrial waste from the City of Toronto. Lacking a significant off-take agreement, this plant was shut down before operating fully. Ensyn in 2011 announced a new plant would be built in High Level Alberta, the new largest pyrolysis plant in the world, with capacity of 400-tpd. The entire production will be fed into diesel engines to make power. Titan Clean energy operates a small plant in Saskatchewan targeting the char market.

3. Employment

3.1. Pellets

Employment in the pellet industry is listed by province in Table 3.1 below. Out of the 39 plants, 23 reported actual employment. The missing data was interpolated based on the reasonable

assumption that similar plant sizes have similar employment. There are an estimated 921 directly employed in 39 existing pellet plants in Canada, and 281 in feedstock supply for a total of 1,202. As new plants open, feedstock supply employment is projected to grow substantially. Older plants were supplied chiefly from neighbouring sawmills and feedstock employment was negligible, but many plants now tend to have harvest residues as a significant proportion of feedstock supply, which require more workers. FPInnovations estimates that 14 workers are needed for every 50,000 BDt of harvest residue supply. In many cases, the survey did not expose the proportion of feedstock from harvest residues, so employment is underestimated. 7 plants are under construction and it is estimated that direct employment in the plants and feedstock supply will be 456, for a total of 1,621 in production and supply. Indirect jobs have been estimated at 1,646, including distribution, retail, marketing, ports, etc.

It is important to note that the actual socio-economic benefit of the above jobs is substantial. These jobs are not in cities where the 50-60 jobs per plant would be negligible. They are in small forest communities, many of which have suffered from the decline in the forest products industry in recent years, and the job impact of the plant is often sufficient to ensure ongoing survival of the community.

Table 3.1 Employment in the Wood Pellet Industry

| | Employment | | | Under | Indirect |
|----------|------------|-----------|-------|---------|----------|
| | Plants | Feedstock | Total | Constr. | |
| BC | 350 | 161 | 511 | 39 | 550 |
| Alberta | 10 | 13 | 23 | 0 | 128 |
| Sask. | 0 | 0 | 0 | 0 | 0 |
| Manitoba | 0 | 0 | 0 | 0 | 0 |
| Ontario | 114 | 24 | 138 | 248 | 271 |
| Quebec | 175 | 0 | 175 | 90 | 225 |
| NB | 108 | 48 | 156 | 17 | 243 |
| NS | 108 | 30 | 138 | 0 | 138 |
| PEI | 0 | 0 | 0 | 62 | 5 |
| Nfld & L | 56 | 5 | 61 | 0 | 61 |
| | 921 | 281 | 1,202 | 456 | 1,621 |

3.2. Ethanol

Employment in Ethanol plants is shown in Table 3.2, below. Operational ethanol plants in Canada (including demo plants) employ 940 people in 19 communities, with the greatest concentration in Ontario and Saskatchewan. The 2 ethanol plants under construction will add 60 employees for an overall total of 1,000. All plants reported employment therefore no estimation was required.

Only 5 of 18 plants reported employment in feedstock supply and there was no correlation between the ratio of feedstock supply jobs and plant jobs, so feedstock employment is not included below. Similarly, reported indirect jobs per plant job varied between a multiple of 2 to a multiple of 19, making estimating indirect jobs also difficult.

Table 3.2 Employment in Ethanol Plants

| <u>Operational Plants</u> | <u>Plants</u> | <u>Employment</u> |
|---------------------------|---------------|-------------------|
| Alberta | 2 | 120 |
| Sask. | 5 | 182 |
| Manitoba | 1 | 40 |
| Ontario | 8 | 513 |
| Quebec | 2 | 85 |
| Atlantic | <u>1</u> | - |
| Subtotal: | 19 | 940 |

| <u>Plants Under Construction</u> | | |
|----------------------------------|----------|-----------|
| Quebec and Alta | <u>2</u> | <u>60</u> |
| Total: | 21 | 1,000 |

3.3. Biodiesel

13 biodiesel plants employ an estimated 166 people in plants and 33 in feedstock supply for a total direct employment of 198. Adding plants under construction yields 222 jobs, and indirect adds 111 for a total of 333.

Table 3.3 Employment in Biodiesel Plants.

| | <u>#</u> | <u>Cap'y</u> | <u>In Plants</u> | <u>Feedstock</u> | <u>Total</u> | | <u>Indirect</u> | <u>Total</u> |
|----------|----------|--------------|----------------------|------------------|--------------|--|-----------------|--------------|
| BC | 2 | 21 | 20 | 4 | 24 | | 12 | 36 |
| Alberta | 1 | 1 | 2 | 0 | 2 | | 1 | 4 |
| Sask. | 1 | 20 | 42 | 8 | 50 | | 25 | 75 |
| Manitoba | 3 | 28 | 39 | 8 | 47 | | 23 | 70 |
| Ontario | 3 | 126 | 24 | 5 | 28 | | 14 | 42 |
| Quebec | <u>3</u> | <u>15</u> | <u>39</u> | <u>8</u> | <u>47</u> | | <u>23</u> | <u>70</u> |
| Total | 13 | 210 | 166 | 33 | 198 | | 99 | 297 |

| | | | | | | | | |
|---------------|----------|------------|-----------|----------|-----------|---|-----------|-----|
| Under Constr. | <u>2</u> | <u>116</u> | <u>20</u> | <u>4</u> | <u>24</u> | - | <u>12</u> | 36 |
| Total | 15 | 326 | 186 | 36 | 222 | | 111 | 333 |

| | | | | | | | | |
|----------|----------|------------|------------|-----------|------------|---|-----------|-----|
| Proposed | <u>7</u> | <u>896</u> | <u>150</u> | <u>29</u> | <u>179</u> | - | <u>90</u> | 269 |
| Total | 22 | 1,222 | 336 | 66 | 401 | | 201 | 602 |

3.4. Cogen- Pulp and Paper

In Canada 39 operating pulp mills have onsite cogeneration. In reporting, pulp mills tended to provide all employment at the pulp mill, not just the cogen. These pulp mills employed an estimated 12,779 people in 2011, and it can be assumed that employment of this many people is at least supported by the cogen plant, which reduces energy costs and sustains pulp mill competitiveness.

Table 3.4 Employment- Pulp Mills

| | # | Plant |
|----|----------|------------|
| BC | 18 | 6,620 |
| AB | 4 | 1,620 |
| ON | 5 | 1,541 |
| QC | 4 | 740 |
| NB | 4 | 1,258 |
| NS | 3 | 300 |
| NL | <u>1</u> | <u>700</u> |
| | 39 | 12,779 |

3.5. Cogen- Independent

16 non-pulp and paper power plants employ an estimated 390 people at the plants and 474 in feedstock supply, for a total of 864. None of the 7 plants under construction were surveyed.

Table 3.5 Employment at Independent Power Producers

| Independent Cogen Employment 2011 | | | | |
|-----------------------------------|------------|-----------|-----------|-------|
| | Employment | | | |
| | Plants | In Plants | Feedstock | Total |
| BC | 1 | 28 | 28 | 56 |
| Alberta | 4 | 99 | 116 | 215 |
| Ontario | 7 | 162 | 229 | 391 |
| Quebec | 3 | 86 | 86 | 172 |
| NB | 1 | 15 | 15 | 30 |
| | 16 | 390 | 474 | 864 |

3.6. Bio-heat

Biomass heat projects make use of a renewable resource and increase the energy independence of communities, but such projects tend not to provide a significant number of jobs inside the plant. Of 19 operating community heat plants only 4 reported employment, however a much higher proportion of plants under construction or in planning stages reported employment, which allowed for a fairly accurate assessment of employment in plants. In general community heat plants tend to employ only 0.5 up to 3 people. In Table 3.6.1, direct

employment in operating plants is estimated at 60, largely influenced by 40 recorded by PEI energy corp. Similarly, employment in planned heat plants is shown as 120, but employment of 112 was reported for 2 Quebec jurisdictions alone. Total direct employment in plants that are operating or under construction is 98. CanBio will ensure in a 2012 update that plant employment and feedstock employment is consistent across communities.

Table 3.6.1 Biomass Heat Employment

| | # | # Reporting | Est Jobs |
|--------------------|-----------|-------------|------------|
| Operating | 19 | 4 | 60 |
| Under Construction | 12 | 7 | 38 |
| Feasibility | 14 | 12 | 27 |
| Planned | <u>12</u> | <u>9</u> | <u>120</u> |
| | 57 | 32 | 245 |

Table 3.6.2 illustrates employment in community heat by province.

Table 3.6.2 Employment in Heat Plants by Province

| | Operating | Under Constr. | Feasibility | Planned | Total |
|----|-------------|---------------|-------------|---------|-----------|
| BC | 3.5 | 3.5 | 3.3 | | 10 |
| NT | 0.8 | | | | 1 |
| MB | | 0.8 | | | 1 |
| ON | 3.8 | 30.0 | | | 34 |
| QC | 11.5 | 3.8 | 116.5 | 27.5 | 159 |
| PE | <u>40.0</u> | - | - | - | <u>40</u> |
| | 59.5 | 38.0 | 119.8 | 27.5 | 245 |

3.7. Pyrolysis Oil

Because of the small number of pyrolysis oil plants, companies were reluctant to share employment data. No employment data was officially reported. Generally, 16 people are directly employed in a 200tpd plant.

3.8. Canada Production Plants

An estimated 3,280 are employed directly in bioenergy production plants and feedstock supply in Canada, as shown in Table 3.8.1. Of these, 1,202 or 37% are in pellet plants, and 940, or 29%, are in ethanol plants. Not included is employment in harvest residue feedstock supply at pellet plants, not well enough known, and feedstock supply to ethanol plants, which is unreliable.

Table 3.8.1 Employment in Operational Plants and Feedstock* Supply

| | <u>BC</u> | <u>NT</u> | <u>AB</u> | <u>SK</u> | <u>MN</u> | <u>ON</u> | <u>QC</u> | <u>NB</u> | <u>NS</u> | <u>PE</u> | <u>NL</u> | <u>Total</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|
| Pellets | 511 | | 23 | | | 138 | 175 | 156 | 138 | | 61 | 1,202 |
| Ethanol | | | 120 | 182 | 40 | 513 | 85 | | | | | 940 |
| Biodiesel | 24 | | 2 | 50 | 47 | 28 | 47 | | | | | 198 |
| Cogen-IPP | 56 | | 215 | | | 391 | 172 | 30 | | | | 864 |
| Pyrolysis | | | | | | 16 | | | | | | 16 |
| Bio-heat | <u>4</u> | <u>1</u> | <u>4</u> | - | - | | <u>12</u> | - | - | <u>40</u> | - | <u>60</u> |
| Total | 595 | | 364 | 232 | 87 | 1,086 | 491 | 186 | 138 | 40 | 61 | 3,280 |

* Feedstock supply jobs for ethanol plants are unreliable and not included. Harvest residue supply jobs to pellet plants are not included, as it is not well enough known.

Table 3.8.2 shows direct employment in bioenergy plants and feedstock supply for operational plants, and plants under construction. Total employment on completion will be 3,927.

Table 3.8.2 Employment in Plants (Operational & Under construction) & Feedstock*

| | <u>BC</u> | <u>NT</u> | <u>AB</u> | <u>SK</u> | <u>MN</u> | <u>ON</u> | <u>QC</u> | <u>NB</u> | <u>NS</u> | <u>PE</u> | <u>NL</u> | <u>Total</u> |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|
| Pellets | 550 | | 23 | 0 | 0 | 386 | 265 | 173 | 138 | 62 | 61 | 1,658 |
| Ethanol | 0 | | 160 | 182 | 40 | 513 | 105 | 0 | 0 | 0 | 0 | 1,000 |
| Biodiesel | 24 | | 14 | 50 | 47 | 40 | 47 | 0 | 0 | 0 | 0 | 222 |
| Cogen-IPP | 56 | | 215 | 0 | 0 | 391 | 224 | 30 | 0 | 0 | 0 | 916 |
| Pyrolysis | 0 | | 16 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 32 |
| Bio-heat | <u>7</u> | <u>1</u> | <u>34</u> | <u>0</u> | <u>1</u> | <u>1</u> | <u>15</u> | <u>0</u> | <u>0</u> | <u>40</u> | <u>0</u> | <u>99</u> |
| Total | 637 | 1 | 462 | 232 | 88 | 1347 | 656 | 203 | 138 | 102 | 61 | 3927 |

3.9. Employment in Non-Production Facilities

The study brought to light capacity, production and employment for bioenergy production plants in Canada. However, many non-production sectors have meaningful socioeconomic impacts; engineering firms, industry consultants, manufacturers, biomass transportation, academia, etc. A secondary survey was undertaken to assess employment at universities, in non-profit organizations and governments.

An estimated 155-160 people are employed across Canada at universities, including faculty, PhD students, and other researchers. The following approximates employment at several universities¹:

- U. Of Toronto- approx. 26 (microbiology/algae/life cycle analysis)

¹ Dr. Susan Wood Director of Research Services
Dr. David B. Layzell FRSC, Professor & Executive Director, Institute for Sustainable Energy, Environment and Economy (ISEEE), at the University of Calgary.

- Queens U. - 13 people in three organizations; Institute for Energy and Environmental Policy, Sustainable Bioeconomy Centre, Engineering training module.
- UBC- approx. 6 in Biomass & Bioenergy Research Group (combustion & gasification tech/lifecycle analysis/supply chain logistics)
- UNBC- approx. 4 in Centre for Renewable Energy (biomass heating)
- McMaster U. - approx. 2
- McGill- approx. 12 (feedstock enhancement/harvest & conversion/socioeconomic impacts)
- U. Of Sherbrooke- Cellulosic Ethanol Industrial Research, 7
- U. Of Victoria- approx. 2 (biofuels/ biorefinery/ biochemicals)
- U. Of Calgary- approx. 10 (biomass CHP/ biofuels)
- U. Of Alberta- approx. 15 (forestry/feedstock's)
- U. Of New Brunswick- 9 in the Canadian BioEnergy Centre (CBEC)

No separate survey was done for government. However, Dr. Susan Wood, Queen's University, approximated the number of people working directly on bioenergy in governments as follows; National research Council- 28 people (or 8 person years specific to bioenergy), other Federal government - approximately 48, Provincial governments - approximately 30.

55 people are known to be working in bioenergy in not-for profit organizations, as shown in Table 3.9.1. In some organizations, such as the Canadian Bioenergy Association (CanBio), employees work only in bioenergy. Other organizations such as FPInnovations, the prime research organization for the Canadian forest industry, employs 500 people in four centres across the country, but only 10 man-years would be spent on bioenergy. The Quebec Wood Export Bureau now deals with wood pellets, as well as traditional solid wood products, and employs 18 people of which 1 is dedicated to bioenergy. The Ontario Forest Industries Association (OFIA), Forest Products Association of Nova Scotia (FPANS), New Brunswick Federation of Wood Lot Owners and other such provincial associations might employ 50 people nationwide, with 10-15% of their time dedicated to bioenergy.

Bio Talent Canada is focused on HR and skills development aimed at connecting individuals with professionals in various sectors in the bioenergy industry. It has full-time staff of 3. Bio Talent completed a study focused on the bioenergy, biofuels, and biotechnology subsectors and concluded that R&D is one of the largest areas in which human resources are lacking and needed by firms to ensure the development and long term success of the company. Other areas of employment included in the report that are lacking are in general management, operations, manufacturing and marketing, sales and communications. These are essential positions for companies to develop secondary products and services and create an abundance of jobs. The

Ontario Centre for Research & Innovation in the Bio-Economy (CRIBE) employs 2 full time staff. CRIBE was provided \$25 million in provincial funding to develop a bio-economy. It funded a Sault Ste Marie biomass to syngas project that will enhance existing employment of 20 jobs with an additional 56 jobs. Alberta Innovates Bio Solutions focuses on agricultural, forestry and life science research and technology, employing 18.

Table 3.9.1. Employment in Not-for-Profit Organizations

| | <u>BC</u> | <u>AB</u> | <u>SK</u> | <u>MN</u> | <u>ON</u> | <u>QC</u> | <u>NB</u> | <u>NS</u> | <u>PE</u> | <u>NL</u> | <u>N</u> | <u>Total</u> |
|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|--------------|
| WPAC | 2 | | | | | | | | | | | 2 |
| FPAC | | | | | 1 | | | | | | | 1 |
| CanBio | | | | | 2 | | | | | | | 2 |
| CRFA | | | | | 4 | | | | | | | 4 |
| CRIBE | | | | | 2 | | | | | | | 2 |
| BioTalent | | | | | 3 | | | | | | | 3 |
| Alberta Innovates | | 18 | | | | | | | | | | 18 |
| FPInnovations | 5 | | | | | 5 | | | | | | 10 |
| BCBN | 4 | | | | | | | | | | | 4 |
| QWEB | | | | | | 1 | | | | | | 1 |
| Other | <u>2</u> | <u>1</u> | - | - | <u>2</u> | <u>2</u> | <u>1</u> | - | - | - | - | <u>8</u> |
| Non Profit | 13 | 19 | 0 | 0 | 14 | 8 | 1 | 0 | 0 | 0 | 0 | 55 |

Table 3.9.2 summarizes employment by province in academic research (where known), governments and not-for-profit organizations.

Table 3.9.2 Employment in Academia, governments and not-for-profit organizations

| | <u>BC</u> | <u>AB</u> | <u>SK</u> | <u>MN</u> | <u>ON</u> | <u>QC</u> | <u>NB</u> | <u>NS</u> | <u>PE</u> | <u>NL</u> | <u>N</u> | <u>Total</u> |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|--------------|
| Academic Research | 12 | 25 | 0 | 0 | 41 | 19 | 9 | 0 | 0 | 0 | 0 | 106 |
| Other Research | | | | | | | | | | | | 49 |
| Governments | 26 | 2 | 0 | 0 | 36 | 18 | 3 | 1 | 0 | 0 | 0 | 86 |
| Not-for-profit org. | <u>13</u> | <u>19</u> | <u>0</u> | <u>0</u> | <u>14</u> | <u>8</u> | <u>1</u> | <u>0</u> | <u>0</u> | <u>0</u> | <u>0</u> | <u>55</u> |
| | 51 | 46 | 0 | 0 | 91 | 45 | 13 | 1 | 0 | 0 | 0 | 296 |

Two areas were not fully included in the surveys: biomass supply, and municipalities. Increasingly biomass users are turning to forest residues as a feedstock source. FPInnovations has indicated that 14 workers are required for every 50,000 tonnes forest biomass supplied to bioenergy facilities. Pellet production is approximately 2,000,000 tonnes in Canada, and it is estimated that 35% of pellet feedstock is from harvest residues, or 700,000 tonnes. Estimated labour in biomass supply to pellet plants is thus about 200. Historically cogen units took feedstock from sawmills: some adjacent (requiring no new employment) and some from neighbouring sawmills (requiring transportation, but not chipping). New and planned district

heating facilities, especially in Quebec, are sourcing from the forest. Employment figures for cogen and DH are not estimated in this short study.

Municipalities often have economic development organizations, some focused on bioenergy. For example, the Hearst Economic Development Corporation in Ontario has a staff of 3 (2 developers, 1 support), and 75% of project work is on bioenergy opportunities.

3.10. Impact on Small Communities

Canada was built on the forest industry, with citizens in almost every community in the boreal forest in some way was either employed at or providing services to a local sawmill, pulp mill, board mill, paper mill, etc. With globalization and increasing competitiveness of offshore plants, many pulp and paper mills shut down over the last 20 years. Similarly, the housing crisis in the US has resulted in the collapse of demand for Canadian lumber and subsequent closure of many sawmills. Small communities, formerly dependant on industries with traditional forest products, struggle to survive and seek to reinvent themselves. The bioenergy sector and the bio-economy are stimulating job growth, which is beginning to replace jobs lost to other forest products. While wind farms tend to concentrate in areas of consistent wind patterns, irrespective of population, bioenergy plants tend to be located in small communities where the addition of 30-40 sustainable jobs makes a significant contribution to the survival of the community. Of the 140 bioenergy production plants operating or under construction, 101, or 72%, are in communities of less than 25,000 people, with 62 (44%) in communities less than 5,000 people, as shown in Table 3.10.

Table 3.10.1 Plants by Community Population

| | 0-5000 | 5000-25000 | 25000 + | Total |
|---------------|--------|------------|---------|-------|
| Pellets | 29 | 13 | 4 | 46 |
| Ethanol | 7 | 7 | 7 | 21 |
| BioDiesel | 5 | 2 | 8 | 15 |
| Cogen Indep | 6 | 10 | 7 | 23 |
| Pyrolysis oil | | 2 | 2 | 4 |
| District Heat | 15 | 5 | 11 | 31 |
| | 62 | 39 | 39 | 140 |

Table 3.10.2 illustrates employment by community size. For example, pellet plants provide 990 direct jobs in 29 communities with a population less than 5000, for an average of 34 direct jobs per community. Across all bioenergy production, 2805 (1644+1161) direct jobs have been generated in communities under 25,000, or 72% of total bioenergy jobs created.

Table 3.10.2 Employment by Community Population

| | <u>0-5000</u> | <u>5000-25000</u> | <u>25000 +</u> | <u>Total</u> |
|---------------|---------------|-------------------|----------------|--------------|
| Pellets | 990 | 400 | 258 | 1,648 |
| Ethanol | 214 | 301 | 485 | 1,000 |
| BioDiesel | 131 | 12 | 79 | 222 |
| Cogen Indep | 268 | 428 | 212 | 908 |
| Pyrolysis Oil | | 16 | 16 | 32 |
| District Heat | <u>41</u> | <u>4</u> | <u>47</u> | <u>92</u> |
| | 1,644 | 1,161 | 1,097 | 3,902 |

As shown in Table 3.10.3, 39 pulp & paper mills and solid wood mills in Canada have cogen plants. These mills employ 12,779 people. The cogen plants reduce energy costs and make the mills more competitive, thus indirectly supporting all the mill jobs.

Table 3.10.3 Forest Industry Supported Jobs

| | <u>0-5000</u> | <u>5000-25000</u> | <u>25000 +</u> | <u>Total</u> |
|-------------|---------------|-------------------|----------------|--------------|
| Employment | 3712 | 4478 | 4588 | 12779 |
| Communities | 15 | 12 | 12 | 39 |

Employment in bioenergy production facilities above reflect direct employment in plants and in feedstock supply. Direct employment creates indirect employment, such as engineering, retail and construction. Indirect employment depends on many factors. Pulp mills, major employers, and can generate 5 times as many indirect jobs as direct. Small district heating plants that employ 1 person are unlikely to create indirect jobs. The survey suggests an average of 1 indirect for each direct job for pellets, 3:1 for ethanol, and 0.5:1 for bio-diesel, independent cogen, pyrolysis oil and district heating. On this basis, 9,231 are estimated to be employed in production and feedstock, direct and indirect, as shown in Table 3.10.4. This total yields an average of 57 jobs in each of 62 communities less than 5000. Adding 296 jobs in academia, governments and not-for-profit organizations brings industry employment to 9527. Not included are equipment manufacturing, engineering, consulting, retail, algae etc. As above, 12,779 are employed at pulp, paper and solid wood plants, kept competitive with biomass cogen.

Table 3.10.4 Direct and Indirect Employment in Production

| | <u>0-5000</u> | <u>5000-25000</u> | <u>25000 +</u> | <u>Total</u> |
|---------------|---------------|-------------------|----------------|--------------|
| Pellets | 2,013 | 813 | 525 | 3,350 |
| Ethanol | 856 | 1,204 | 1,940 | 4,000 |
| BioDiesel | 197 | 18 | 119 | 333 |
| Cogen Indep | 402 | 642 | 318 | 1,362 |
| Pyrolysis Oil | | 24 | 24 | 48 |
| District Heat | <u>62</u> | <u>6</u> | <u>71</u> | <u>138</u> |
| | 3,529 | 2,707 | 2,996 | 9,231 |