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# Overview of the Canadian Energy Flow Account

## 18th London Group meeting, Ottawa

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# Overview

- How the Canadian Energy Flow Account is compiled
  - control totals and our account structure
  - data sources used (consumption per industry)
  - compilation method
  - how we fill the gaps when data is missing
  - quality control
  - challenges

# Official Canadian consumption

## Annual Report on Energy Supply and Demand (RESD)

| 2008 revised | Total coal | Crude oil | Natural gas | Gas plant natural gas liquids (NGL's) |
|---|---|---|---|---|
| | Terajoules (TJ) | | | |
| **Supply and demand characteristics** | | | | |
| Production | 1,490,152 | 5,916,116 | 6,660,798 | 627,143 |
| Exports | 802,072 | 4,153,944 | 3,940,791 | 205,573 |
| Imports | 398,549 | 1,919,985 | 596,887 | 9,073 |
| Inter-regional transfers | .. | .. | .. | .. |
| Stock variation | -2,328 | -4,488 | -239,355 | -8,602 |
| Inter-product transfers | . | 264,048 | -79,569 | .. |
| Other adjustments | 120,660 | 131,901 | 176,421 | 86,445 |
| **Availability** | **1,209,351** | **4,218,523** | **3,653,099** | **525,690** |
| **Stock change** | -4,895 | . | . | . |
| Transformed to other fuels | | | | |
| Electricity by utilities | 1,015,342 | . | 342,599 | . |
| Electricity by industry | 21 | .. | 74,358 | . |
| Coke and manufactured gases | 124,510 | . | . | . |
| Refined petroleum products | . | 4,218,523 | 26,705 | 93,500 |
| Steam generation | 3 | | 19,436 | . |
| Net supply | **74,371** | **..** | **3,189,985** | **431,269** |
| Producer consumption | 2,920 | .. | 653,940 | 16,015 |
| Non-energy use | 9,954 | . | 144,925 | 344,566 |
| Energy use, final demand | **61,496** | | **2,391,121** | **130,691** |
| Total industrial | **59,189** | **.** | **1,037,317** | **60,691** |
| Total mining and oil and gas extraction | 11,174 | . | 394,797 | 40,597 |
| Total manufacturing | 48,017 | . | 623,902 | 17,001 |
| Pulp and paper manufacturing | x | . | 55,221 | . |
| Iron and steel manufacturing | x | . | 59,192 | . |
| Aluminum and non-ferrous metal manufacturing | x | . | 26,671 | . |
| Cement manufacturing | x | . | 2,200 | . |
| Refined petroleum products manufacturing | . | . | 55,335 | . |
| Chemicals and fertilizers manufacturing | x | . | 121,648 | . |
| All other manufacturing | x | . | 303,635 | x |
| Forestry and logging and support activities for forestry | . | . | .. | . |
| Construction | . | . | 18,602 | 3,093 |
| Total transportation | **.** | **.** | **148,843** | **12,812** |
| Railways | . | . | . | . |
| Total airlines | . | . | . | . |
| Canadian airlines | . | . | . | . |
| Foreign airlines | . | . | . | . |
| Total marine | . | . | . | . |
| Domestic marine | . | . | . | . |

Energy balance table covers:

- more than 20 fuels
  - refined petroleum products and electricity types are detailed
- more than 40 supply-demand
  - production, trade and inter-regional transfers are listed.
  - energy use consumption by sector is shown.
  - fuel conversion, producer consumption and non-energy use are isolated.

**Net availability is our control total**

TJ available for consumption = "Availability – Stock change"

# Canadian Energy Flow Account –
## energy use and non-energy use tables

Fuel types (11) →

Industries (300) + household (2) ↓

| | | CC0370 | CC0380 | CC0390 | CC3950 | CC3961 | CC3962 | CC3963 | CC3964 | CC3990 | CC5460 | CC5480 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Coal | Crude oi | Natural | Motor g | Aviation | Diesel | Light Fue | Heavy Fu | Liquid Pe | Electric | Coke |
| 111400 | nhouse, Nursery and Floriculture Production | | | | | | | | | | | |
| 111A00 | (except Greenhouse, Nursery and Floriculture Production) | | | | | | | | | | | |
| 112500 | Animal Aquaculture | | | | | | | | | | | |
| 112A00 | mal Production (except Animal Aquaculture) | | | | | | | | | | | |
| 113000 | Forestry and Logging | | | | | | | | | | | |
| 114000 | Fishing, Hunting and Trapping | | | | | | | | | | | |
| 115100 | Support Activities for Crop Production | | | | | | | | | | | |
| 115200 | Support Activities for Animal Production | | | | | | | | | | | |
| 115300 | Support Activities for Forestry | | | | | | | | | | | |
| 211100 | Oil and Gas Extraction | | | | | | | | | | | |
| 212100 | Coal Mining | | | | | | | | | | | |
| 212210 | Iron Ore Mining | | | | | | | | | | | |
| 212220 | Gold and Silver Ore Mining | | | | | | | | | | | |
| 212230 | Copper, Nickel, Lead and Zinc Ore Mining | | | | | | | | | | | |
| 212290 | Other Metal Ore Mining | | | | | | | | | | | |
| 212310 | Stone Mining and Quarrying | | | | | | | | | | | |
| 212320 | and Ceramic and Refractory Minerals Mining and Quarrying | | | | | | | | | | | |
| 212392 | Diamond Mining | | | | | | | | | | | |
| 212393 | Salt Mining | | | | | | | | | | | |
| 212394 | Asbestos Mining | | | | | | | | | | | |
| 212396 | Potash Mining | | | | | | | | | | | |
| 21239A | eous Non-Metallic Mineral Mining and Quarrying | | | | | | | | | | | |
| 213100 | Activities for Mining and Oil and Gas Extraction | | | | | | | | | | | |
| 221100 | Power Generation, Transmission and Distribution | | | | | | | | | | | |
| 221200 | Natural Gas Distribution | | | | | | | | | | | |
| 221300 | Water, Sewage and Other Systems | | | | | | | | | | | |

- share same classifications as IO accounts.
- detail 11 commodities (fuel types).
- compiled at the most detailed industry level.
- focus on energy consumption and not supply.
- allow linkage between energy flow and economic accounts.

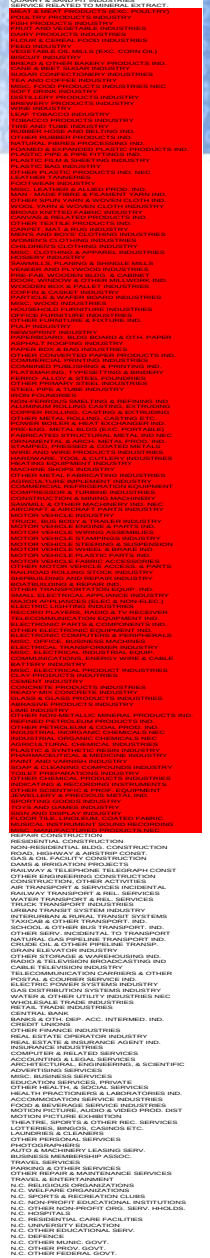
# Discrepancies between our starting point and our final output

- Energy Supply & Demand table does not give enough industry detail.

| Energy supply & demand | Energy flow account |
|---|---|
| Total mining and oil and gas extraction | 14 industries |

- Non-energy, producer consumption and energy conversion amounts are not reported in the industries where it happened.
- Fuels are not reported at the same level of detail.

| Energy supply & demand | | Energy flow account |
|---|---|---|
| Petroleum Coke | Coke | Coke |




# Energy Account data sources

## Manufacturing sector

Industrial consumption of energy survey

- terajoules (TJ) unit and NAICS classification *(~ ISEC)*
- non-energy and energy consumption
- coal, natural gas, electricity, HFO, LPG and coke

Petroleum report (provincial $/litre) and provincial IO expenditure

- derive number of litres bought and transform it into TJ
- diesel, motor gasoline and light fuel oil

**~ 20% of total energy consumption**


# Energy Account data sources

## Mining sector

Annual Census of mines

- conducted by Natural Resources Canada
- census of all mines for various fuel use (except coal)
- physical units and SIC classification

**~ 2% of total energy consumption**


# Energy Account data sources

## Various sectors

Report on Energy Demand and Supply

- TJ units, aggregated demand categories (no NAICS, SIC or IO structure), and energy and non-energy use.
- amounts are moved into their appropriate industries (non-energy, producer consumption and conversion)

Electric Power Thermal Generating Station Fuel Consumption Survey

- Own production of electricity

**~ 40% of total energy consumption**


# Energy Account data sources

## Transportation sector

Annual Air Carrier, Trucking, Passenger Bus and Urban Transit, and Rail surveys

- physical units and NAICS classification

**~ 13% of total energy consumption**

# Compilation method

- Obtain a consumption value in TJ, per IO industry, per fuel.
  - Involves conversion of physical units into terajoules
  - Involves preparation of concordance files
    - Some reported data match 1:1 IO industry
    - Some match many:1 (many source data sum into 1 IO industry)
    - Some match 1:many (1 source data is split amongst many IO industries)
      - Expenditure dollars from Input-Output are used in these cases. TJ amount is shared between the industries based on their purchase ratio.

# Filling the gaps when there is no survey data – example

- After integrating all source data

| | | CC0370 | CC0380 | CC0390 |
|---|---|---|---|---|
| | | Coal | Crude oil | Natural gas |
| 111400 | Greenhouse, Nursery and Floriculture Production | 25 | | |
| 111A00 | Crop Production (except Greenhouse, Nursery and Floriculture Production) | 6 | 35 | |
| 112500 | Animal Aquaculture | 12.3 | | |
| 112A00 | Animal Production (except Animal Aquaculture) | | | |
| 113000 | Forestry and Logging | | 25 | |

- Benchmark to our control totals

| | | | |
|---|---|---|---|
| Net Availability | 100 | 82 | 132 |
| Residual use (Net_avail - surveyed) | 69 | 10 | 132 |
| Total $ IO expenditure of blank industries | 1000 | 150 | 3000 |
| Total $ IO expenditure of 112500 | 178 | 0 | 50 |
| ratio of 112500 | 0.18 | 0 | 0.01667 |
| Amount gave to industry 112500 | 12.3 | 0 | 2.2 |

# Release format of the Energy Flow Account

## Total energy, 1990 - 2008

Industries (117) + household (2) ↓

| Sector | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| Total, all sectors | 10,242,348 | 10,091,416 | 10,266,979 | 10,557,868 | 10,498,742 | 10,470,903 | 10,226,701 | 10,840,945 | 10,612,484 |
| Business sector | 7,638,001 | 7,513,910 | 7,552,989 | 7,764,124 | 7,658,424 | 7,632,322 | 7,442,237 | 7,851,631 | 7,649,385 |
| Crop and animal production | 189,336 | 196,453 | 185,421 | 185,335 | 177,363 | 169,023 | 162,585 | 177,368 | 174,849 |
| Forestry and logging | 62,207 | 32,609 | 37,162 | 42,756 | 41,144 | 44,839 | 38,362 | 31,051 | 30,369 |
| Fishing, hunting and trapping | 19,911 | 16,181 | 15,765 | 16,652 | 16,950 | 13,492 | 11,351 | 11,196 | 11,118 |
| Support activities for agriculture and forestry | 11,804 | 10,766 | 11,748 | 13,211 | 13,468 | 15,955 | 14,049 | 15,295 | 15,837 |
| Oil and gas extraction | 1,001,287 | 960,445 | 1,058,644 | 1,137,990 | 1,074,476 | 1,112,942 | 1,052,099 | 1,104,403 | 1,096,012 |
| Coal mining | 16,733 | 20,257 | 17,077 | 18,165 | 17,916 | 14,919 | 12,498 | 14,162 | 17,921 |
| Metal ore mining | 76,393 | 76,296 | 76,469 | 77,997 | 70,269 | 74,533 | 74,584 | 70,172 | 82,056 |
| Non-metallic mineral mining and quarrying | 54,006 | 51,055 | 48,888 | 55,860 | 55,270 | 53,045 | 58,387 | 58,604 | 58,858 |
| Support activities for mining and oil and gas extraction | 41,867 | 47,940 | 44,423 | 52,426 | 54,195 | 61,830 | 68,896 | 63,791 | 61,170 |
| Electric power generation, transmission and distribution | 1,729,000 | 1,745,122 | 1,665,133 | 1,733,336 | 1,611,069 | 1,623,420 | 1,515,911 | 1,666,580 | 1,657,178 |
| Natural gas distribution, water and other systems | 21,013 | 17,197 | 19,624 | 18,778 | 18,404 | 18,413 | 16,983 | 21,048 | 21,446 |
| Residential building construction | 17,829 | 19,120 | 21,853 | 23,899 | 28,015 | 29,672 | 27,935 | 30,567 | 30,256 |

Statistics Canada. *Table 153-0032 - Energy use, by sector, annual (terajoules),* CANSIM (database).

# Quality control

- % changes in energy use from current year to previous year, per industry, per fuel.
- Implicit price ($ paid/TJ) and intensity (TJ/$ output), per industry, per fuel.
- GHG account output
  - Small changes in energy consumption may reflect in high changes in GHG emissions.
- Bridge tables
  - to explain visually how we go from the total energy consumed to the energy flow account.

# Quality control – bridge table

| MEFA fuel #11 - Coke, 2006p (TJ) | RESD fuel types: Coke | RESD fuel types: Petroleum coke | MEFA fuel type: Coke | Impact of other data sources: ICE (fuel use) | Impact of other data sources: ICE (non-fuel use) | Impact of other data sources: Pet Report and I/O Prov | Impact of other data sources: Thermal Plants Survey | Impact of other data sources: Census of Mines | Impact of other data sources: Transportation Surveys | Impact of other data sources: Input-Output expenditure allocation | Net adjustment due to other data sources | Re-allocation of activities: Energy transformation | Re-allocation of activities: Producer consumption | Re-allocation of activities: Transportation | Accounting adjustments: Foreign use of fuels | Accounting adjustments: Stock change | Accounting adjustments: Other adjustments | Total final adjustment | Benchmark | final MEFA: Energy Use Account |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Production | 92,239 | 115,215 | 207,454 | | | | | | | | | | | | | | | | | |
| Exports | 2,836 | 3,925 | 6,761 | | | | | | | | | | | | | | | | | |
| Imports | 2,879 | 89,172 | 92,051 | | | | | | | | | | | | | | | | | |
| Inter-regional transfers | . | 0 | 0 | | | | | | | | | | | | | | | | | |
| Stock variation | 0 | -60 | -60 | | | | | | | | | | | | | | | | | |
| Inter-product transfers | . | -646 | -646 | | | | | | | | | | | | | | | | | |
| Other adjustments | 10,737 | 9,277 | 20,014 | | | | | | | | | | | | | | | | | |
| Availability | 103,018 | 209,153 | 312,172 | | -62,241 | | | | | -13 | | | | | | 26,925 | | -35,329 | 276,8 | |
| Stock change | -1,317 | -25,608 | -26,925 | | | | | | | | | | | | | | | | | |
| Transformed to electricity by utilities | . | 36,648 | 36,648 | | | | | | | | | | | | | | | | 36,6 | 36,648 |
| Transformed to electricity by industry | 0 | 2,180 | 2,180 | | | | | | | -2,180 | -2,180 | | | | | | | -2,180 | | |
| Transformed to coke and manufactured gase | . | . | 0 | | | | | | | | | | | | | | | | | |
| Transformed to refined petroleum products | . | . | 0 | | | | | | | | | | | | | | | | | |
| Transformed to steam generation | . | . | 0 | | | | | | | | | | | | | | | | | |
| Net supply | 104,335 | 195,933 | 00,268 | | | | | | | | | | | | | | | | | |
| Producer consumption | . | 103,526 | 03,526 | -57,154 | | | | | | | -57,154 | | -46,372 | | | | | -103,526 | | |
| Non-energy use | 464 | 61,777 | 62,241 | | -62,241 | | | | | | -62,241 | | | | | | | -62,241 | | |
| Energy use, final demand | 103,871 | 30,628 | 34,498 | | | | | | | | | | | | | | | | | |
| Total industrial | 103,871 | 30,628 | 34,498 | | | | | | | | | | | | | | | | | |
| Total mining and oil and gas extraction | 3,591 | 854 | 4,445 | | | | | | | | | | 46,372 | | | | | 46,372 | 50,8 | 50,817 |
| Total manufacturing | 100,280 | 29,774 | 130,053 | 57,138 | | | | | | 2,123 | 59,261 | | | | | | | 59,261 | 189,3 | 189,314 |
| Pulp and paper manufacturing | x | . | 0 | | | | | | | | | | | | | | | | | |
| ..... (hided - no data) ..... | | | | | | | | | | | | | | | | | | | | |
| Chemicals and fertilizers manufacturing | x | x | 0 | | | | | | | | | | | | | | | | | |
| All other manufacturing | x | 4,922 | 0 | | | | | | | | | | | | | | | | | |
| Forestry and logging and support activities | . | . | 0 | | | | | | | | | | | | | | | | | |
| Construction | . | . | 0 | | | | | | | | | | | | | | | | | |
| ..... (hided - no data) ..... | | | | | | | | | | | | | | | | | | | | |
| Residential | . | . | 0 | | | | | | | | | | | | | | | | | |
| Public administration | . | . | 0 | | | | | | | | | | | | | | | | | |
| Commercial and other institutional | . | 0 | 0 | | | | | | | | | | | | | | | | | |
| Statistical difference | . | . | 3 | 17 | | | | | | 43 | 60 | | | | | | | 63 | 63 | 63 |
| | | | | | | | | | | | | | | | | | Balanced totals | | 276,842 | 276,842 |

**Notes:**

1 - Because of confidentiality, the **Non-energy use** detail (62,241 TJ) was removed from the **Availability** as too many cells would have been suppressed.

# Challenges

- Integration of data from many sources/providers
  - Concepts and definitions may be different: be careful of double counting.
    - Some data includes foreign purchases of domestic fuel.
    - Some data includes producer consumption, some does not.
  - Source data are not all collected using the same classification systems.
  - Input data are not always in a dataset format.
- Need to find new data sources
  - Improve household and services sectors (less surveyed).
  - Help for decision making when two sources give us different pictures.

# Questions?

## Thank you

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