

The CODERS API: A How-to Guide

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Introduction

CODERS is an open-source database of the Canadian energy system that is used by modelers and researchers nation-wide. The database is hosted on a specific data server of the Digital Research Alliance, Canada called [Arbutus](#) and located at the University of Victoria. CODERS itself was developed by research teams at the University of Victoria (Sustainable Energy Systems Integration and Transition Group, SESIT) and at the University of Toronto (Dept. of Civil and Mineral Engineering).

1.1 Structure

The database is stored as a SQL database. There are tables for data variables and each table has multiple unique attributes (column names). As an example: The generators table has attributes including generation type (generation technology), province where generation facility is located and its year of establishment.

1.2 Access mechanism

While it is possible to access the data by downloading tables through the user interface of the CODERS website, it is generally faster to access the tables stored in the database programmatically via an Application Programming Interface (API) which provides a communication layer between the user and the database. Users do not have direct access to the MySQL database.

Instead, users (through a scripting/programming language such as Python) will send HTTP requests to the API, and the requested data will be returned in JavaScript Object Notation (JSON) format. The JSON format data can be converted to, eg, a dataframe which can then be easily exported to a CSV (or similar) file for use in your models. For CODERS, as with most APIs generally, access to the API service is made possible through obtaining an “API key” which operates as a unique identifier for the user so that they can access the data, essentially like a password in this case.

1.2.1 New user sign up

The process of signing up and creating new accounts has recently (September, 2025) changed on the CODERS website and database. Previously, users were given a single “API key” which they used like a password to access the website as well as the key for their API access for programmatic access to the database.

Every individual user should create their own API key. As part of the process of signing up, we require every individual who accesses CODERS to accept an end-user license agreement

(EULA) which ensures ethical use of the data. Please note that acceptance of the EULA is a required step in the process of setting up an account to use CODERS as otherwise you will only be able to view a small subset of the tables. Once a user signs up on the page, the API key will be momentarily available so that the

Database walk-through

2.1 Calling the data via the API

When using the API, users send a “request” and, if successful, the database will return a “HTTP response”. We strongly encourage users to ensure that they have Python installed. Users may elect to use a language different from Python, for example R, but technical support from our team assumes that you are using Python.

With Python installed, users should install the following libraries and also make sure to include (or “import”) them into the script file you are using to call the CODERS database:

1. “requests”: the library to handle HTTP requests
2. “pandas”: used for data manipulation, you can find this useful to structure the data you queried or to export to Excel, for example
3. “os”: might be useful for some users, for example who want to store the API key in a separate file from the script

Following that, you should be able to request data straight away by copying and pasting the lines of code below into a Python script (can be made in a simple text editor). Note that you should be comfortable declaring variables in Python to run these scripts, but this is very simple. For example, on a line before you put in the API request, you can include variable declarations like “provincecode = ‘BC’” so that you can then use “provincecode” in place of “BC” when you want to download data for British Columbia, or for example declare “Year = ‘2022’” so that you can download data for that year.

When carrying out any of the below examples, please fill in the API key provided by our team.

1. Check your connection by running the following request. It should give you a “Welcome to CODERS” message. If not either you need to install the dependencies (Python and requests library) or ask us for a new API key

<https://api.sesit.ca/?key={yourapikey}>

2. To get a list of all tables in the database, include the following

<https://api.sesit.ca/tables?key={yourapikey}>

3. To know which filters can be applied to each of these tables

<https://api.sesit.ca/filters?key={yourapikey}>

2.2 Data tables available via the CODERS API

While CODERS includes many data tables relevant to the Canadian energy system, we highlight some of the most important tables below.

Use https://api.sesit.ca/{table_name_as_highlighted_below}?key={yourapikey} to get any of the following tables.

- [Generators](#): generators
- [Transmission Lines](#): transmission_lines
- [Storage](#): storage
- [Provincial demand](#): provincial_demand
- [Generation generic](#): generation_generic
- [Interface capacity](#): interface_capacities
- [Inter-jurisdictional](#): intertie_capacity

Details on Specific Data Tables

Generators Table: This table gives data on all generation facilities in Canada. For this table, users are currently able to filter for province (province) and generation type (gen_type). Province filter codes are [AB, BC, MB, NB, NL, NS, ON, PE, QC, SK]. Generation type filter codes are [wind, gas, biomass, coal, solar, hydro_run, hydro_pump, hydro_daily, hydro_monthly, diesel, nuclear]

To apply filtering use the following command:

[https://api.sesit.ca/generators?
province={provincecode}&gen_type={type_of_generator}&key={yourAPIKey}](https://api.sesit.ca/generators?province={provincecode}&gen_type={type_of_generator}&key={yourAPIKey})

A brief overview on all attributes of the table is given below. Detailed definitions for each attribute can be found on our [database glossary](#).

GENERATORS (STORAGE)		
Data guide name	API Pathname	Units
Generation Unit Name	generation_unit_name	
Gen Unit Code	generation_unit_code	
Generation Facility Name	generation_facility_name	
Generation Facility Code	generation_facility_code	
Owner	owner	
Province	province	
Location	location	
Latitude	latitude	(dd.ddd)
Longitude	longitude	(dd.ddd)
Elevation	elevation	(m)
Balancing Area - COPPER	copper_balancing_area	
Operating Region	operating_region	
Connecting Node Name	connecting_node_name	
Connecting Node Code	connecting_node_code	
Connecting Voltage	connecting_voltage	(kV)
Start Year	start_year	
Previous Renewal Year	previous_renewal_year	
Possible Renewal Year	possible_renewal_year	
Closure Year	closure_year	
Generation Type	gen_type	
Generation Type - COPPER	gen_type_copper	
Unit Installed Capacity	unit_installed_capacity	(MW)
Facility Installed Capacity	facility_installed_capacity	(MW)

Capacity Adjustment	capacity_adjustment	(%)
Unit Effective Capacity	unit_effective_capacity	(MW)
Facility Effective Capacity	facility_effective_capacity	(MW)
Capacity Factor	capacity_factor	(%)
Unit Average Annual Energy	unit_average_annual_energy	(GWh/year)
Facility Average Annual Energy	facility_average_annual_energy	(GWh/year)
Total Number of Generation Units Represented	generation_units_represented	
Total Number of Facility Generation Units	total_facility_generation_units	

Transmission Lines Table: This table gives data on all transmission lines in Canada. Please note that each transmission line has a starting node and an ending node, and both these nodes can be found on the (separate) Nodes table. One filter is applicable on this table currently for province. Province filter codes are [AB, BC, MB, NB, NL, NS, ON, PE, QC, SK].

To apply filtering use the following command:

https://api.sesit.ca/transmission_lines?province={provincecode}&key={yourAPIKey}

A brief on all attributes of the table is given below. Detailed definitions for each attribute can be found on the [database glossary](#).

TRANSMISSION (TRANSMISSION_LINES)		
Data guide name	API Pathname	Units
Unique line ID	transmission_line_id	
Transmission Circuit ID	transmission_circuit_id	
Owner	owner	
Province	province	
Operating Region	operating_region	
Number of Circuits	number_of_circuits	
Current	current_type	(aC/dc)
Transmission Line Segment Length	line_segment_length_km	(km)
Transmission Line Segment Length	line_segment_length_mi	(miles)
Transmission Line Length	line_length_km	(km)
Transmission Line Length	line_length_mi	(miles)
Voltage	voltage	(kV)
Reactance	reactance	(ohm)
Summer Capacity	summer_capacity	(MW)
Winter Capacity	winter_capacity	(MW)
Starting Node Name	starting_node_name	
Starting Node Code	starting_node_code	
Ending Node Name	ending_node_name	
Ending Node Code	ending_node_code	

Notes	notes	
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Storage Table: This table gives data on all storage facilities in Canada. One filter is applicable on this table for province. Province filter codes are [AB, BC, MB, NB, NL, NS, ON, PE, QC, SK].

To get the attributes list for this table run:

<https://api.sesit.ca/storage/attributes?key={yourapikey}>

A brief on all attributes of the table is given below. Detailed definitions for each attribute can be found on the [database glossary](#).

STORAGE (STORAGE)		
Data guide name	API Pathname	Units
Storage Facility Name	storage_facility_name	
Storage Facility Code	storage_code	
Owner	owner	
Province	province	
Location	location	
Latitude	latitude	(dd.dddd)
Longitude	longitude	(dd.dddd)
Elevation	elevation	(m)
Balancing Area - COPPER	copper_balancing_area	
Operating Region	operating_region	
Connecting Node Name	connecting_node_name	
Connecting Node Code	connecting_node_code	
Connecting Voltage	connecting_voltage_in_kv	(kV)
Start Year	start_year	

Previous Renewal Year	previous_renewal_year	
Possible Renewal Year	possible_renewal_year	
Closure Year	closure_year	
Storage Type	storage_type	
Storage Type - COPPER	storage_type_copper	
Storage Capacity	storage_capacity	(MW)
Storage Energy	storage_energy	(MWh)
Storage Duration	storage_duration	(Hours)
Associated Generation	associated_generation	

Provincial Demand Table: This table gives data on hourly electricity demand in each province over the years. This API implicitly asks for province and year to return the results and would give an error when any of these parameters are missing.

[https://api.sesit.ca/provincial_demand?
year={year}&province={provincecode}&key={yourapikey}](https://api.sesit.ca/provincial_demand?year={year}&province={provincecode}&key={yourapikey})

The above endpoint returns the rows within the Provincial Transfers table filtered by the year and province. If an error code is returned, there exists no data on the demand of the specified province during the given year.

Below is a list of the current provincial demand data:

- AB: 2018, 2019, 2020,2021,2022
- BC: 2018, 2019, 2020,2021,2022, 2023
- NB: 2018, 2019, 2020,2021,2022
- NL: 2018, 2019, 2020,2021
- NS: 2018, 2019, 2020,2021,2022
- ON: 2018, 2019, 2020,2021,2022
- QC: 2018, 2019, 2020,2021,2022
- SK: 2020,2021,2022
- PE: 2018,2019,2020,2021,2022

- MB: 2018,2019,2020,2021,2022

A brief on all attributes of the table is given below. Detailed definitions for each attribute can be found on the [database glossary](#).

PROVINCIAL HOURLY DEMAND (PROVINCIAL_DEMAND)		
Attribute	API Pathname	Units
Local Time	local_time	
Province	province	
Daily Hour Ending	daily_hour_ending	
Annual Hour Ending	annual_hour_ending	
Demand	demand_MWh	(MW)

Generation Generic Table: This table gives common data points on average generation type.

GENERATION – GENERIC (GENERATION_GENERIC)		
Attribute	API Pathname	Units
Generation Type	gen_type	
Generation Type - COPPER	gen_type_copper	
Description	generation_type_description	
Typical Plant Size	generic_generation_size_MW	(MW)
Capital Costs	capital_cost_CAD_per_kW	(\$CAD/kW)
Total Project Costs (2020)	total_project_cost_CAD_per_kW	(\$CAD/kW)
Economic Life (years)	economic_life	(years)
Service Life	service_life	(years)
Annualized Capital Cost	annualized_capital_cost_CAD_per_kwyear	(\$CAD/kW-year)

Fixed O&M Costs	fixed_om_cost	(\$CAD/MW-year)
Variable O&M Costs	variable_om_cost	(\$CAD/MWh)
Construction Time	construction_time	(years)
Development Time	development_time	(years)
Average Fuel Price	average_fuel_price_CAD_per_MMBtu	(\$CAD/GJ)
Carbon Emissions	average_fuel_price_CAD_per_GJ	(lbs/MMBtu)
Carbon Emissions	carbon_emissions	(tCO ₂ eq/MWh)
Heat Rate	heat_rate	(MMBtu/MWh)
Generation Efficiency	efficiency	(%)
Minimum Plant Load	min_plant_load	(%)
Minimum Capacity Factor	min_capacity_factor	(%)
Maximum Capacity Factor	max_capacity_factor	(%)
Time to Full Capacity	time_to_full_capacity	(minutes)
Minimum Up Time	min_up_time_hours	(hours)
Minimum Down Time	min_down_time_hours	(hours)
Ramp Rate	ramp_rate_percent_per_min	(%/min)
Spinning Reserve Capability	spinning_reserve_capability	(%)
Forced Outage Rate	forced_outage_rate	(%)
Planned Outage Rate	planned_outage_rate	(%)
Cold Start Up Costs	startup_cost	(\$/MWcap)
Shut Down Costs	shutdown_cost	(\$/MWcap)
Notes	notes	

Interface Capacity Table: This table gives data on energy capacity from and within Canada to other countries (US).

TRANSFER CAPACITIES – JURISDICTIONS (INTERFACE_CAPACITIES)		
Data guide name	API Pathname	Units
From Country	from_country	
To Country	to_country	
From Province or State	from_province_state	
To Province or State	to_province_state	
Current	current_type	
Summer Capacity	ttc_summer	(MW)
Winter Capacity	ttc_winter	(MW)
Associated Interties	associated_interties	
Notes	notes	

Inter-jurisdictional Capacity Table: This table gives data on inter-provincial/international line capacity, showing how much electricity can be transferred across boundaries.

TRANSFER CAPACITIES – INTERJURISDICTIONAL LINES (INTERJURISDICTIONAL)		
Data guide name	API Pathname	Units
Node Name	border_point_name	
Node Code	border_point_code	
Transmission Circuit ID	transmission_circuit_id	

Owner	owner	
From Country	from_country	
To Country	to_country	
To Province or State	from_province_state	
From Province or State	to_province_state	
Latitude	latitude	(dd.dddd)
Longitude	longitude	(dd.dddd)
Elevation	elevation	(m)
Intertie Status	intertie_status	
Number of Circuits	number_of_circuits	
Current	current_type	
Line Length	line_length_km	(km)
Line Length	line_length_mi	(miles)
Voltage	voltage	(kV)
Reactance	reactance	
Summer Total Transfer Capacity	ttc_summer	(MW)
Winter Total Transfer Capacity	ttc_winter	(MW)
Starting Node Name	network_node_name_starting	
Starting Node Code	network_node_code_starting	
Ending Node Name	network_node_name_ending	
Ending Node Code	network_node_code_ending	
Notes	notes	

VRE Energy Data

Grid Cell Info Table: This table gives data on onshore and offshore surface area, distance to grid and grid cell location mapping of all the 2984 grid cells in Canada.

To get the table data use the following command:

http://api.sesit.ca/grid_cell_info?key={yourapikey}

A brief overview of all attributes of the table is given below. Detailed definitions for each attribute can be found on our [database glossary](#).

GRID CELL INFO		
Data guide name	API Pathname	Units
Surface Area Onshore	surface_area_onshore	
Surface Area Offshore	surface_area_offshore	
Population	population	
Distance to Grid	distance_to_grid	
riverBalance Area	balancing_area	
Province	province	
Grid Cell	grid_cell	
Latitude	latitude	(dd.dddd)
Longitude	longitude	(dd.dddd)

Hydro Capacity Data Table: The hydro capacity factor data table consists of hourly capacity factor data by province. These data are derived from monthly hydroelectric generation data.

To get the table data use the following command:

https://api.sesit.ca/hydro_capacity_factor?key={yourAPIkey}

The above endpoint gives you an index list of all provinces and years for which the hydro capacity data is available. To access the data for a particular province and year apply the data filtering as follows:

[https://api.sesit.ca/hydro_capacity_factor?
province={provincecode}&year={Year}&key={yourAPIkey}](https://api.sesit.ca/hydro_capacity_factor?province={provincecode}&year={Year}&key={yourAPIkey})

Province Codes: AB, BC, MB, NB, NL, NS, ON, QC, SK

Years: 2013, 2021

A brief on all attributes of the table is given below.

HYDRO CAPACITY FACTOR		
Data guide name	API Pathname	Units
Local Time	local_time	(yyyy-mm-dd hh-mm-ss)
Province	province	
Annual Hour Starting	annual_hour_starting	
Local Hour Starting	local_hour_starting	
Capacity Factor	capacity_factor	

Annual Hour Starting: It is the 1-hour indexed window in the whole year index for which the data in the row pertains to.

Local Hour Starting: It is the 1-hour indexed window applied for that row entry. It is the local time against the capacity factor data.

Example: When annual_hour_starting is 1 that means that the local time will be {year}-01-01 00:00:00, which is the first hour of the year. Similarly, annual_hour_starting of 100 means that it is the start of the 100th hour of the year

Calculation and Assumptions:

- The monthly hydroelectric (hydraulic) generation data is divided by the installed capacity of all hydroelectric generation in CODERS generating for the number of hours in each month, by province for the year 2021
- The resulting capacity factors for each month for each province are presumed to be the same for each hour in each month

Limitations:

- Statistics Canada installed capacity was not available for 2021 at the time of our calculations, so we used CODERS installed capacities

- Statistics Canada includes generation down to 500 kW for wind and 100 kW for solar, whereas CODERS data is down to 1,000 kW (1 MW)
- CODERS (in 2021) did not include distribution-connected facilities that meet transmission-level demand; this will be changed for the 2023 update with distribution-connected generation meeting transmission-level demand to be included in CODERS

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<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510001501>

VREs: Solar PV and Wind Power Capacity Data Tables

CODERS provides capacity factor data for ~3,000 grid cells which together cover all of Canada's 10 provinces (each grid cell being 0.5 degrees latitude by 0.625 degrees longitude). Note that these grid cells cover some offshore territories which fall under Canada's marine spatial planning zones, as well as some grid cells within large lakes which would be classified as offshore (only offshore wind turbines would work at these sites).

API Endpoint for wind power: http://api.sesit.ca/wind_capacity_factor?year=2021&key={yourAPIkey}

API Endpoint for solar power: http://api.sesit.ca/solar_capacity_factor?year=2021&key={yourAPIkey}

Note that the above requests would give you 8,760 hours of data for each of the ~3,000 grid cells, for each of the two tables. You should download the data as local csv files on your device since repeatedly downloading such huge volumes of data would cause the API response time to lag.

Calculation and Assumptions related to VREs:

- In our most release of CODERS (October, 2025), capacity factors for VREs are computed using the CoRES tool. This means that meteorological data is obtained for cross-sections and using the Copernicus/ERA5 dataset made available through an API service published by the European Center for Medium-term Weather Forecasting.

Both tables have the same structure as is shown below:

[SOLAR/WIND] CAPACITY FACTOR		
	Grid Cell Number	Grid Cell Number
Annual Hour Starting	Capacity Factor	Capacity Factor
Annual Hour Starting	Capacity Factor	Capacity Factor

Please see the definition of “Annual Hour” provided elsewhere in this document.

- **Sources Links:**

[GES DISC Dataset: MERRA-2 tavg1_2d_slv_Nx: 2d,1-Hourly,Time-Averaged,Single-Level,Assimilation,Single-Level Diagnostics V5.12.4 \(M2T1NXSLV 5.12.4\) \(nasa.gov\)](#)

[Global estimations of wind energy potential considering seasonal air density changes – ScienceDirect](#)

[ECMWF weather data through the “Climate Store” managed through the European Center for Medium-term Weather Forecasts](#)

[Correlations in Renewable Energy Sources](#)

Appendix: Data Glossary

Annualized Project Costs (\$/year)	
Definition	The Total Project Costs of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility annualized over the facility's economic life (70 years) at a real discount rate of 7%.
Clarifications	None.
Calculations	Annualized Project Costs = (Total Project Costs*Interest Rate)/(1-(1+Interest Rate)^-Economic Life), where Interest Rate = 7% Economic Life = 70 years
Limitations	Interest rates and economic life may vary from values assumed.
Sources	See Capital Costs

Annualized Project Costs per kW (\$/kW-year)	
Definition	The Total Project Costs of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility annualized over the facility's economic life (70 years) at a real discount rate of 7% in terms of kW of installed capacity.
Clarifications	None.
Calculations	Annualized Project Costs per kW = Annualized Project Costs*1000/Installed Capacity
Limitations	Interest rates and economic life may vary from values assumed.
Sources	See Capital Costs

Associated Generation	
Definition	The generation, usually wind or solar, that is developed in conjunction with or ,associated with charging a hybrid storage facility.
Clarifications	With exception of Summerview 1 (AB_SUM01_STO), all Storage Facilities are grid supplied. This attribute is included in CODERS as more Associated Generation is currently planned for future Storage Facilities
Calculations	No calculations.
Limitations	None.
Sources	N/A

Associated Interties	
Definition	Transmission interties composing the total transfer capacity between jurisdictions (e.g., Province to Province).
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	37

Available Transfer Capacity (MW)	
Definition	The transfer capacity of a transmission line after deducting firm reservations from Total Transfer Capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	N/A

Average Fuel Price (\$/GJ)	
Definition	The annual average price of a fuel required to power a thermal Generation Facility.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	9, 45, 49, 50

Balancing Area – COPPER	
Definition	The balancing area within the COPPER model in which a generation, storage, transmission, or other facilities operate.
Clarifications	Some facilities are physically located in one province but interconnected to and operating within a neighbouring province.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	62, 244

Capacity Adjustment (%)				
Definition	The percent by which the Installed Capacity of a generation unit or facility is derated based on its electric load carrying capability or forced outage rates to obtain its Effective Capacity.			
Clarifications	None.			
Calculations	This is data directly obtained or derived from sources. Where derived, the Capacity Adjustment is obtained by dividing the Effective Capacity by the Installed Capacity.			
Limitations	The Capacity Adjustment for variable renewable energy resources (e.g., wind and solar) and energy storage is system specific and changes with the addition (removal) of generation assets.			
Sources	AB	28, 98, 192	NS	28, 98, 192, 205
	BC	28, 98, 192	ON	28, 98, 102
	MB	28, 98, 140, 192	PE	28, 98, 130, 192
	NB	28, 98, 192, 198	QC	28, 87, 98, 192
	NL	165, 212	SK	28, 87, 140, 192

Capacity Factor (%)				
Definition	The ratio of actual electrical energy output of a generation unit or facility over a year to the theoretical maximum electrical energy output resulting from its continuous operation at full installed capacity over that year.			
Clarifications	None			
Calculations	Capacity Factor = Average Annual Energy / Installed Capacity*365*24*1000			
Limitations	Average annual energy can and does vary substantially from year to year due to environmental, system operating and demand factors.			
Sources	AB	4, 12, 28	NS	176, 189, 205
	BC	28, 29, 243, 244	ON	101
	MB	109, 113, 117, 120	PE	53, 128, 130, 192
	NB	44, 53, 105, 150, 152	QC	79, 158, 192, 214
	NL	161, 165, 168, 212	SK	220

Capital Costs (\$)				
Definition	The estimated capital cost of a generation facility including contingency and project management costs, but excluding interest during construction (IDC), corporate overhead, future inflation, and transmission costs.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	Estimates of capital costs are obtained from sources which vary in their use of cost estimation methodologies and estimation class. The level of uncertainty varies between capital cost estimates for different projects.			
Sources	AB	3, 11, 38, 238	NS	N/A
	BC	28	ON	74
	MB	113	PE	N/A
	NB	148, 154	QC	N/A
	NL	165	SK	232

Capital Overhead (\$)	
Definition	The estimated cost of “supporting functions” which are capitalized and charged to a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation capital projects.
Clarifications	Supporting functions typically include: corporate services, senior management oversight, supervision, project governance, accounting, post-employment benefits, and dedicated health and safety resources.
Calculations	A value of 2% of Capital Cost is used based on BC Hydro’s standard rate for capital overhead costs.
Limitations	Since the capital overhead rate is typically calculated by dividing the capital overhead cost pool by the total direct labour transfers made to capital projects, actual capital overhead costs for specific projects may vary somewhat from those estimated.
Sources	See Capital Costs

Carbon Emissions (tCO₂eq/MWh)	
Definition	The carbon dioxide equivalent emissions of the operations of Generation Facilities.
Clarifications	Carbon Emissions does not include embedded emissions from construction or materials related to Generation Facilities.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	201

Closure Year				
Definition	The year a generation or storage facility was closed or is scheduled to be closed, or the year a contract for import/export terminated or is scheduled to terminate.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	5, 10	NS	177, 187, 191
	BC	28, 29	ON	103, 206
	MB	120	PE	130
	NB	148, 149, 156	QC	33, 236
	NL	165	SK	220, 226

Cold Start Up Costs (\$/MW Cap)	
Definition	The cost for a Generation Facility to ramp from idle (cold) conditions to full installed generation capacity, expressed as a ratio of total costs divided by installed capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	202, 243

Connecting Node Name				
Definition	Transmission system node (substation) to which a facility is interconnected. In the case of a distribution-connected facility, the proximal transmission system node to the distribution-connected facility.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	Distribution-connected generation facilities may connect to the system such that their generation enters the transmission system at more than one node.			
Sources	AB	3	NS	180, 191
	BC	30, 55, 65	ON	77
	MB	108	PE	130
	NB	150, 151, 231	QC	88

	NL	144, 160, 166	SK	226, 227
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Connecting Node Code	
Definition	The unique CODERS asset identification code defining each transmission system node and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter generation facility code A three-digit code defining the node
Clarifications	Transmission system nodes are defined as one of the following: CSS = AC/DC Converter Station DSS = Distribution Substation GSS = Generation Substation INT = International Intertie IPT = Interprovincial Intertie ISS = Industrial Customer Substation JCT = Junction SWS = Switching Station TSS = Terminal Station
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	N/A

Connecting Voltage (kV)				
Definition	The voltage at which a Generation Facility, Generation Unit or Storage Facility is known or assumed to be interconnected to the transmission network.			
Clarifications	None			
Calculations	None			
Limitations	The connecting voltage is not known in all instances and is sometimes presumed based on the known voltage of nearest transmission line.			
Sources	AB	3	NS	191
	BC	30, 55, 65	ON	77
	MB	108	PE	130
	NB	150, 151, 231	QC	88, 89
	NL	144, 160, 166	SK	226, 227

Construction Time (Years)				
Definition	The duration (in years) for completion of construction of a Generation Facility, Storage Facility or Transmission Facility beginning with the start of construction and ending with commissioning of the final generation unit.			
Clarifications	Construction Time is reported to the nearest higher year where a range of estimates is provided from a source (e.g., 8 to 9 years is reported in CODERS as 9 years).			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	Actual construction periods, particularly for capital intensive projects such as hydroelectric and nuclear, often exceed estimated Construction Time.			
Sources	AB	28	NS	N/A
	BC	15, 18, 28	ON	74
	MB	113	PE	N/A
	NB	148, 154	QC	N/A
	NL	141, 165	SK	232

Contract Name				
Definition	The CODERS name given to a contract for capacity (and in some instances energy) sales between provinces or between a province and the United States.			
Clarifications	None.			
Calculations	No calculations.			
Limitations	Contracts for seasonal capacity exchanges are not included in CODERS.			
Sources	AB	N/A	NS	186
	BC	N/A	ON	83
	MB	123	PE	148
	NB	148	QC	83, 88
	NL	186, 212	SK	123

Contract Code	
Definition	The unique CODERS asset identification code defining each Contract and consisting of the following separated by an underscore: A two-letter provincial code indicating sales between provinces (“PP”) or exports to the United States (“XX”) A six-letter code consisting of the two-digit code of the exporting province, the two-digit code of the importing province and a two-digit numerical code numbering the contracts between jurisdictions A three digit “CON” defining this as a contract
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Contracts for seasonal capacity exchanges are not included in CODERS.
Sources	N/A

Current Type				
Definition	The type of current (alternating current or direct current) associated with a transmission line or transmission line segment.			
Clarifications	All lines are presumed to be alternating current unless specific information is located to indicate they are direct current.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	3	NS	180, 184
	BC	30, 55	ON	78
	MB	109, 111, 112, 114, 115, 116, 118, 121, 122, 138	PE	130
	NB	105, 150, 231	QC	88
	NL	144, 166, 212	SK	216

Cycle Type				
Definition	The type of cycle (open or closed) used in a pumped hydroelectric Storage Facility.			
Clarifications	An open cycle contains at least one reservoir that discharges or receives water to or from the environment.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	238, 240	NS	N/A
	BC	19	ON	174, 233
	MB	N/A	PE	N/A
	NB	148	QC	N/A
	NL	N/A	SK	N/A

Design Flow – Generation (m³/s)				
Definition	The maximum water flow rate of the total installed generation capacity of a pumped hydroelectric Storage Facility.			
Clarifications	The design flow is inclusive of all Generation Units in a pumped hydroelectric Storage Facility.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	238, 240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Design Flow – Pumping (m³/s)				
Definition	The maximum water flow rate of the total installed pumping capacity of a pumped hydroelectric Storage Facility.			
Clarifications	The design flow is inclusive of all pumping units in a pumped hydroelectric Storage Facility.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	238, 240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Development Time (Years)				
Definition	The duration (in years) for completion of development of a Generation Facility, Storage Facility or Transmission Facility beginning with the submission of a project description to regulatory bodies and ending with commissioning of the final generation unit.			
Clarifications	Development Time is reported to the nearest higher year where a range of estimates is provided from a source (e.g., 8 to 9 years is reported in CODERS as 9 years).			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	Actual development periods, particularly for capital intensive projects such as hydroelectric and nuclear, often exceed estimated Development Time.			
Sources	AB	28	NS	N/A
	BC	15, 18, 28	ON	74
	MB	113	PE	N/A
	NB	148, 154	QC	N/A
	NL	141, 165	SK	232

Distance to Market Grid (km)	
Definition	The estimated distance of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility to a feasible transmission interconnection point on the interconnected transmission grid.
Clarifications	Unless already included in total capital costs, 25 km is added to Distance to Market Grid to account for potential grid interconnection costs.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Distance to Market Grid does not currently include specific estimates of costs for grid interconnection, including substation development.
Sources	62

Economic Life (years)	
Definition	The time that a Generation Facility, Storage Facility, or other asset is anticipated to provide economic benefits to the facility owner.
Clarifications	Economic benefits refer to the net benefits of revenues less operation, maintenance, and other costs.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	17, 203, 205, 237

Elevation (m)	
Definition	The physical elevation above sea level in which a generation, storage, transmission, or other facility is physical located.
Clarifications	None.
Calculations	Latitude and longitude are used to sample elevations from a digital elevation model (DEM) using GIS software.
Limitations	Minor errors in latitude and longitude coupled with limitations in the accuracy of the DEM may result in some discrepancy (est. +/- 10 m) between actual and estimated elevations.
Sources	181

	Facility Average Annual Energy (GWh/year)				
	Definition	The actual annual electrical energy output of a Generation Facility averaged over more than one year depending on data availability.			
	Clarifications	Some values of average annual energy are estimated from the expected capacity factor for the given Generation Type within a given provincial electricity system.			
	Calculations	Average Annual Energy = Capacity Factor * Installed Capacity*365*24*1000			
	Limitations	Average annual energy can and does vary substantially from year to year due to environmental, system operating and demand factors.			
Sources	AB	1, 4, 12, 28, 42, 242, 244	NS	176, 189, 205	
	BC	28, 29, 243, 244	ON	101	
	MB	28, 109, 113, 117, 120	PE	53, 128, 130	
	NB	44, 53, 105, 150, 152	QC	79, 158, 192, 214	
	NL	159, 161, 165, 168, 212	SK	220, 226, 227	

Facility Effective Capacity (MW)				
Definition	The capacity of a Generation Facility available at peak demand after derating based on the Capacity Adjustment.			
Clarifications	None			
Calculations	Unit Effective Capacity = Unit Installed Capacity * Capacity Adjustment			
Limitations	The Facility Effective Capacity depends upon the Capacity Adjustment, which changes with the addition (removal) of generation assets.			
Sources	AB	1, 28, 42, 192, 242, 244	NS	28, 187, 192, 195, 205
	BC	23, 24, 28, 29, 98, 192, 243, 244	ON	28, 98, 101, 102, 103, 244
	MB	28, 113, 120, 140, 146, 192	PE	28, 98, 130, 192, 196
	NB	28, 53, 150, 152, 156, 192	QC	28, 84, 87, 90, 98, 192, 214, 215, 244
	NL	165, 172, 212	SK	28, 87, 140, 192, 220, 226, 227, 230

Facility Installed Capacity (MW)				
Definition	Installed generation capacity of a Generation Facility.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	1, 42, 242, 244	NS	187, 195
	BC	24, 28, 29, 243, 244	ON	101, 103, 244
	MB	113, 120, 146	PE	130, 196
	NB	150, 152, 156, 198	QC	84, 90, 214, 215, 244
	NL	165, 172, 212	SK	220, 226, 227, 230

Fixed O&M Costs (\$/MW-year)	
Definition	Operations and maintenance costs of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility that do not vary with changes in energy generation.
Clarifications	Fixed operations and maintenance costs typically include labour costs associated with baseline staff, administration, dam maintenance, equipment and parts. They exclude costs that effect a substantial betterment of the generation facility.
Calculations	Where known, Fixed O&M Costs are directly obtained from sources. Where unknown, costs are estimated based on the known Fixed O&M Costs of other similar facilities. The current formula used in CODERS is as follows: Fixed O&M Costs = $139832 * (\text{Installed Capacity in MW})^{-0.246}$ (hydro_run) Fixed O&M Costs = $573555 * (\text{Installed Capacity in MW})^{-0.4}$ (hydro_daily) Fixed O&M Costs = $2 * 10^8 * (\text{Installed Capacity in MW})^{1.372}$ (hydro_monthly) Fixed O&M Costs = $-13516 \ln(\text{Installed Capacity in MW}) + 113199$ (storage_PH) Where known, Fixed O&M Costs for renewed hydroelectric projects vary substantially showing no pattern. Only the relevant costs (estimated to be 40% of all Fixed O&M costs based on Muskrat Falls O&M costs) associated with the renewal are considered. The current approach to hydroelectric renewal Fixed O&M Costs in CODERS is as follows: Fixed O&M Costs = (Fixed Costs for the renewed project - Fixed Costs for the existing project)/(Installed Capacity of the renewed project), where (using a hydro_daily example): Fixed Costs for the existing project = $573555 * (\text{Existing Installed Capacity in MW})^{-0.4} * (\text{Existing Installed Capacity in MW})$ Fixed Costs for the renewed project = (Fixed Costs for the existing project)*(Existing Installed Capacity+(0.4)*(Additional Installed Capacity))/(Existing Installed Capacity)
Limitations	Estimates of Fixed O&M Costs may differ materially from actual Fixed O&M Costs.
Sources	19, 28, 113, 142, 148, 245

Forced Outage Rate (%)	
Definition	The hours a Generation Facility, Storage Facility, Transmission Line or other facility is removed from service due to an unplanned condition divided by the total number of hours that the facility was removed from service plus the hours the facility was connected to the electricity system expressed as a percent.
Clarifications	The forced outage rate excludes consideration of the hours of planned outage.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	41, 203

Generation Duration at Peak Output (h)				
Definition	The total time that a pumped hydroelectric Storage Facility can continuously generate at its maximum generation capacity.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Generation Efficiency (%)	
Definition	The ratio of total electrical energy produced by a thermal Generation Facility to the total fuel energy available.
Clarifications	The Generation Efficiency is an alternative means of expressing the heat rate of thermal Generation Facility.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	9, 51, 203

Generation Facility Code	
Definition	The unique CODERS asset identification code defining each generation facility and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter generation facility code A three digit “GEN” defining this as a Generation Facility
Clarifications	Generation Facilities that consist of phases are presumed to be distinct Generation Facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Efforts are made to utilize the generation asset identification codes used by the utilities and system operators within the Gen Unit Code.
Sources	N/A

Generation Facility Name				
Definition	The given name of a generation facility.			
Clarifications	Generation facilities that consist of development phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	A commonly used Generation Facility Name may differ from the legal name. Generation Unit Name may differ between sources. Alternative names are provided in the notes to each generation unit. Generation facilities < 1 MW installed capacity are not included in CODERS.			
Sources	AB	42	NS	137, 187, 195
	BC	23, 29, 57, 244	ON	101, 103, 244
	MB	113, 120	PE	69, 130, 196
	NB	44, 150, 152, 156, 244	QC	33, 84, 90, 214, 215, 244
	NL	165, 172, 212	SK	220, 226, 227

Generation Type		
Definition	The type of electricity generation of a given generation unit, generation facility or generation contracted for import/export.	
Clarifications	Generation types defined in CODERS include:	
	Short Name	Description
	biogas	biogas
	biomass	biomass
	biomass_CG	biomass cogeneration
	coal	coal combined cycle
	coal_CCS	coal carbon capture and storage
	diesel_CT	diesel combustion turbine
	diesel_ST	diesel steam turbine
	gasoline_CT	gasoline combustion turbine
	geothermal	geothermal binary cycle
	hydro_daily	hydroelectric daily storage
	hydro_storage	hydroelectric monthly storage
	hydro_run	hydroelectric non-storage
	h2blue_CT	hydrogen combustion turbine
	h2green_CT	hydrogen combustion turbine
	MSW	municipal solid waste
	NG_CC	natural gas combined cycle
	NG_CG	natural gas cogeneration
	nuclear	nuclear light water reactor
	nuclear_SMR	nuclear small modular reactor
	oil_CT	oil combustion turbine
	oil_ST	oil steam turbine
	solar_PV	solar photovoltaic
	solar_recon	recontracted solar photovoltaic
	storage_lithium	lithium ion battery storage
	storage_pump	hydroelectric pumped storage
	wind_ons	onshore wind
	wind_recon	recontracted onshore wind
	wind_ofs	offshore wind
Calculations	This is data directly obtained from sources. No calculations.	
Limitations	None.	

Sources	AB	1, 238, 243, 244	NS	72, 184, 195
	BC	23, 29, 57, 244	ON	101, 103, 244
	MB	113, 120	PE	130, 196
	NB	148, 150, 152	QC	33, 84, 90, 214, 215, 244
	NL	165, 172, 212	SK	220, 226, 227

Generation Type – COPPER		
Definition	The type of electricity generation of a given generation unit, generation facility or generation contracted for import/export as used in the COPPER model.	
Clarifications	Generation types defined in COPPER include:	
	Type	Generation Types Included
	biomass	biogas, biomass, biomass co-generation, municipal solid waste
	coal	coal
	coal_CCS	coal with carbon capture
	diesel	diesel combustion turbine, diesel steam turbine, gasoline combustion turbine, oil combustion turbine, steam combustion turbine
	geothermal	geothermal
	hydro_daily	hydro_daily
	hydro_storage	hydro_storage
	hydro_run	hydro_run
	h2blue_CT	blue hydrogen combustion turbine
	h2green_CT	green hydrogen combustion turbine
	NG_CC	natural gas combined cycle
	NG_CG	natural gas co-generation
	nuclear	nuclear light water reactor
	nuclear_SMR	nuclear small modular reactor
	solar_PV	solar photovoltaic
	solar_recon	recontracted solar photovoltaic
	wind_ons	onshore wind
	wind_recon	recontracted onshore wind
	wind_ofs	offshore wind
Calculations	This is data directly obtained from sources. No calculations.	
Limitations	None.	

Sources	See Generation Type
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Generation Unit Code	
Definition	The unique CODERS asset identification code defining each generation unit and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter generation facility code appended to a two-digit unit number A three digit “GEN” defining this as a Generation Unit
Clarifications	Generation Facilities that consist of phases are presumed to be distinct Generation Facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Efforts are made to utilize the generation asset identification codes used by the utilities and system operators within the Gen Unit Code.
Sources	N/A

Generation Unit Name	
Definition	Given name of a generation unit, consisting of the Generation Facility Name and the unit number.
Clarifications	Generation facilities that consist of development phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility. A generation unit may represent a single physical generation unit where data is available to characterize that specific generation unit or may consist of all the generation units within a generation facility where unit-specific information is unavailable. Onshore wind, offshore wind and solar facilities are always characterized as single generation units.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	A commonly used Generation Facility Name may differ from the legal name. Generation Unit Name may differ between sources. Alternative names are provided in the notes to each generation unit. Generation facilities < 1 MW installed capacity are not included in CODERS.
Sources	See Generation Facility Name

Greenfield Code	
Definition	The unique CODERS asset identification code defining each Greenfield Project and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter Generation Facility code A three digit “GRF” defining this as a Greenfield Project
Clarifications	Renewal Projects that consist of more than one capacity expansion are presumed to be distinct Generation Units in CODERS.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Efforts are made to utilize the generation asset identification codes used by the utilities and system operators within the Renewal Code.
Sources	N/A

Greenfield Project Name	
Definition	Given name of a future potential hydroelectric development project that entails development of a new Generation Facility.
Clarifications	Generation facilities that consist of development phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility. A generation unit may represent a single physical Generation Unit where data is available to characterize that specific generation unit or may consist of all the generation units within a generation facility where unit-specific information is unavailable.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	A commonly used Generation Facility Name may differ from the legal name. Generation Unit Name may differ between sources. Alternative names are provided in the notes to each generation unit. Generation Facilities < 1 MW installed capacity are not included in CODERS.
Sources	See Capital Costs

Gross Head (m)				
Definition	The total available head in a pumped hydroelectric Storage Facility.			
Clarifications	Gross Head is the elevation difference between the surface of the upper reservoir and lower reservoir before consideration of losses.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Heat Rate (MMBtu/MWh)	
Definition	The ratio of the total fuel energy available to the total electrical energy produced by a thermal Generation Facility.
Clarifications	The Generation Efficiency is an alternative means of expressing the heat rate of thermal Generation Facility.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	9, 51, 203

Implementation Costs (\$M)	
Definition	The loaded capital costs of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility inclusive of Capital Overhead and Interest During Construction costs.
Clarifications	None.
Calculations	Implementation Costs = Capital Costs + Capital Overhead + Interest During Construction
Limitations	See limitations related to Capital Costs, Capital Overhead and Interest During Construction.
Sources	See Capital Costs

Import Export Capacity (MW)				
Definition	The firm capacity imported/exported between jurisdictions, or the amount (in MW) by which the total transfer capacity is reduced on the transmission lines between the jurisdictions that are party to the contract.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	Contracts for seasonal capacity exchanges are not included in CODERS.			
Sources	AB	N/A	NS	186
	BC	N/A	ON	83
	MB	125	PE	130
	NB	198	QC	83, 88
	NL	165, 212	SK	125

Interest During Construction (\$M)	
Definition	Interest on debt accumulated during the construction period of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility and added to the cost of that facility.
Clarifications	None.
Calculations	Interest During Construction (IDC) = $PV \cdot (1+i)^n$ (Excel FV(rate,nper,pmt)), where Present value (PV) = Capital Cost Interest rate (i) = 5% Number of periods (n) = Construction Time (years)
Limitations	Actual IDC rates may vary from 5% during the construction period. Capital costs are presumed to be expended equally throughout the construction period, which may overestimate or underestimate actual interest costs.
Sources	See Capital Costs

Latitude / Longitude (dd.dddd)	
Definition	The latitude and longitude at which a generation, storage, transmission, or other facility is physical located.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	The coordinate reference system differs between various sources and may result in slight differences in latitude and longitude between sources.
Sources	62, 244

Location				
Definition	The geographical location (town, city, river, etc.) in which a generation, storage, transmission, or other facility is physical located.			
Clarifications	Some facilities are physically located in one province but interconnected to and operating within a neighbouring province.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	42	NS	137, 184, 185, 188
	BC	23, 29, 57	ON	103, 206
	MB	120	PE	69, 196
	NB	44, 150, 152, 156, 244	QC	33, 84, 90, 214, 215, 244
	NL	165, 172, 212	SK	220, 226, 227

Maximum Capacity Factor (%)	
Definition	The maximum annual energy production of a Generation Facility as a proportion of the total potential annual energy production.
Clarifications	The total potential annual energy production reflects the installed capacity multiplied by the annual hours the facility is available for generation.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	47, 48, 205

Minimum Capacity Factor (%)	
Definition	The minimum annual energy production of a Generation Facility as a proportion of the total potential annual energy production.
Clarifications	The total potential annual energy production reflects the installed capacity multiplied by the annual hours the facility is available for generation.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	47, 48, 205

Minimum Down Time (hours)	
Definition	The minimum time following ramping to zero generation capacity that a Generation Facility must remain before restarting.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	61, 104

Minimum Generation (%)	
Definition	The minimum generation of existing hydroelectric, hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facilities designed to account for requirements for minimum daily and seasonal downstream environmental flow requirements present at most hydroelectric facilities.
Clarifications	The Minimum Generation of existing hydroelectric, hydroelectric renewal and greenfield hydroelectric is presumed to be 10% of installed capacity, while the Minimum Generation of pumped storage hydroelectric is presumed to be 0% of installed capacity.
Calculations	This data is estimated. No calculations.
Limitations	The use of a generic 10% minimum generation for hydroelectric facilities may vary annually, seasonally, or daily compared to actual conditions.
Sources	N/A

Minimum Plant Load (%)	
Definition	The minimum instantaneous operating capacity of a Generation Facility expressed as a proportion of the total installed capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	201

Minimum Up Time (hours)	
Definition	The minimum time following ramping to desired generation capacity that a Generation Facility must operate.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	61, 104

Number of Circuits				
Definition	The number of transmission circuits on a given transmission line or line segment.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	3	NS	180, 184
	BC	30, 55	ON	78
	MB	109, 111, 112, 114, 115, 116, 118, 121, 122, 138	PE	130
	NB	150, 151, 231	QC	88
	NL	144, 166, 173, 212	SK	216

Number of Generation Units Represented				
Definition	The physical number of generation units represented in the data respecting a generation unit or generation facility.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	42, 146	NS	146, 191
	BC	28, 29, 146, 243, 244	ON	101, 146, 206
	MB	120, 146	PE	130, 146
	NB	44, 146, 152	QC	84, 146, 214, 215
	NL	146, 172, 212	SK	146, 226

Operating Region				
Definition	The Province served by the operation of a generation, storage, transmission, or other facility.			
Clarifications	Some facilities are physically located in one province but interconnected to and operating within a neighbouring province.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	3	NS	137, 184, 185, 188
	BC	23, 29, 57	ON	103, 206
	MB	120	PE	69, 196
	NB	150, 151, 231	QC	82, 90
	NL	165, 172, 212	SK	220, 226, 227

Owner				
Definition	The legal owner(s) of a generation, storage, transmission, or other facility.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	42	NS	137, 184, 187, 194
	BC	23, 29, 57	ON	103, 244
	MB	120, 146	PE	69, 196
	NB	44, 150, 152, 156, 244	QC	84, 146, 214, 215, 236
	NL	165, 172, 212	SK	

Penstock Length (m)				
Definition	The total length of the water conduit used in a pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A

	NL	N/A	SK	N/A
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Planned Outage Rate (%)	
Definition	The ratio of annual unserved energy (MWh) due to planned work either on a Generation Facility, Storage Facility or transmission facility unit or component, to the installed plant capacity (MW) multiplied by 8760 hours.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	41, 203

Possible Renewal Year				
Definition	The year a generation or storage facility is scheduled for major refurbishment or contract renewal, or a contract for import/export is scheduled for renewal.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	5, 10, 239, 243	NS	177, 186, 187, 191, 192
	BC	23, 29, 40, 58, 242	ON	103, 206
	MB	121, 123	PE	43, 69, 130, 211
	NB	148, 149, 156	QC	33, 90, 236
	NL	157, 165, 173, 212	SK	220, 226, 227, 230

Previous Renewal Year				
Definition	The year when a generation or storage facility most recently underwent a major refurbishment or turbine-generator replacement, or a contract for import/export was last renewed.			
Clarifications	The Previous Renewal Year may be the same as the Start Year if the facility or contract has yet to be renewed.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	5, 10, 239, 243, 244	NS	137, 186, 187, 191, 192, 195
	BC	29, 58	ON	103, 206
	MB	113, 120, 121	PE	69, 130, 211

	NB	44, 149, 150, 156	QC	33, 79, 84, 136, 214, 215, 236
	NL	157, 165, 173, 212	SK	220, 226, 227, 228, 230

Project Definition Costs (\$)	
Definition	Costs associated with the planning, environmental assessment, and regulatory approval of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility
Clarifications	Project Definition Costs are typically deferred for inclusion in the rate base following commissioning of a Generation facility.
Calculations	Where known, Project Definition Costs are directly obtained from sources. Where unknown, costs are estimated based on the known Project Definition Costs of other similar facilities. The current formula used in CODERS is as follows: $\text{Project Definition Costs} = 0.9539 * (\text{Implementation Costs})^{0.6784}$
Limitations	Estimates of Project Definition Costs may differ materially from actual Project Definition Costs.
Sources	See Capital Costs

Project Footprint (ha)				
Definition	The total land area of the components of a pumped hydro Storage Facility			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	18, 19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Province	
Definition	The Province in which a generation, storage, transmission, or other facility is physical located.
Clarifications	Some facilities are physically located in one province but interconnected to and operating within a neighbouring province.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	62, 244

Pump Type				
Definition	The type of pump or pump-turbine (e.g., single-stage, multi-stage) used in a pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	18, 19, 240			
Sources	AB	240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Pumping Duration and Peak Output (h)				
Definition	The total continuous time that a pumped hydroelectric Storage Facility can continuously pump at its maximum pump capacity.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Ramp Rate (%/minute)	
Definition	The rate at which a Generation Facility can increase generation expressed as a proportion of the maximum increase in generating capacity per minute to the total installed generation capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	61

Reactance (ohm)	
Definition	The opposition, essentially inertia, against the flow of alternating current by inductance (L) and capacitance (C). Along with resistance, it is one of the two elements of impedance.
Clarifications	Impedance is a comprehensive expression of all forms of opposition to current flow, including both resistance and reactance.
Calculations	Surge impedance (Z_c) = $(L/C)^{0.5}$ Surge impedance loading (SIL) = $\text{Voltage} * \text{Voltage} / Z_c / 10^6$
Limitations	None.
Sources	14, 71, 209

Renewal Project Name				
Definition	Given name of a future potential hydroelectric development project that entails capacity expansion at an existing Generation Facility.			
Clarifications	Generation facilities that consist of development phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility. A generation unit may represent a single physical Generation Unit where data is available to characterize that specific generation unit or may consist of all the generation units within a generation facility where unit-specific information is unavailable. Renewal Projects are given a Generation Unit name consistent with the naming of existing units at the Generation Facility.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	A commonly used Generation Facility Name may differ from the legal name. Generation Unit Name may differ between sources. Alternative names are provided in the notes to each generation unit. Generation facilities < 1 MW installed capacity are not included in CODERS.			
Sources	AB	3	NS	N/A
	BC	28	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	80
	NL	165	SK	N/A

Renewal Code	
Definition	The unique CODERS asset identification code defining each Renewal Project and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter Generation Facility code A three digit “REN” defining this as a Renewal Project
Clarifications	Renewal Projects that consist of more than one capacity expansion are presumed to be distinct Generation Units in CODERS.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Efforts are made to utilize the generation asset identification codes used by the utilities and system operators within the Renewal Code.
Sources	N/A

Reservoir Storage (m³)				
Definition	The storage volume of the limiting (usually upper) reservoir in a pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	18, 19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Reservoir Type				
Definition	The type of reservoir arrangement (lake to lake, lake to reservoir, reservoir to lake, reservoir to reservoir) used in a pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A

	BC	18, 19	ON	N/A
	MB	N/A	PE	N/A
	NB	148	QC	N/A
	NL	N/A	SK	N/A

Round Trip Efficiency (%)

Definition	The ratio of energy (in MWh) obtained from storage to the energy (in MWh) placed into storage.
Clarifications	The round-trip efficiency of pumped hydroelectric storage is assumed to be 80% unless it is otherwise known.
Calculations	No calculations.
Limitations	Estimates of Round Trip Efficiency may differ materially from actual Round Trip Efficiency.
Sources	N/A

Service Life (years)

Definition	The operational life of a Generation Facility, Storage Facility or other asset from the date of commissioning until replacement or retirement.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	17, 203, 205, 237

Shut Down Costs (\$/MW Cap)

Definition	The cost for a Generation Facility to ramp from operating conditions to shutdown (cold) conditions, expressed as a ratio of total costs divided by installed capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	202, 243

Spinning Reserve Capability (%)

Definition	The proportion of a Generation Facility installed capacity available for use as spinning
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	reserve.
Clarifications	Spinning Reserve capacity is not available for energy production other than when it is called on to meet reserve requirements.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	41, 201

Start Year				
Definition	The year when a generation or storage facility was commissioned or a contract for import/export was initiated.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	5, 42, 242, 243	NS	137, 186, 187, 191, 192, 195
	BC	23, 29, 40, 57, 242	ON	103, 206
	MB	113, 120	PE	69, 130, 211
	NB	44, 149, 150, 156	QC	33, 79, 84, 136, 214, 215, 236
	NL	165, 212	SK	220, 226, 227, 230

Storage Capacity (MW)	
Definition	The total possible instantaneous discharge capability of the energy storage facility.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	See Storage Facility Name

Storage Code	
Definition	The unique CODERS asset identification code defining each Storage Facility and consisting of the following separated by an underscore: A two-letter provincial code A three-letter to five-letter storage facility code A three digit “STO” defining this as a Storage Facility
Clarifications	Generation facilities that consist of phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	Efforts are made to utilize the generation asset identification codes used by the utilities and system operators within the Gen Unit Code.
Sources	N/A

Storage Duration (hours)	
Definition	The amount of time a storage facility can discharge at its storage capacity before depleting its storage energy.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	See Storage Facility Name

Storage Energy (MWh)	
Definition	The maximum amount of storage energy in a storage facility.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	See Storage Facility Name

Storage Facility Name				
Definition	Given name of a Storage Facility.			
Clarifications	Generation facilities that consist of development phases are presumed to be distinct generation facilities in CODERS unless they are interconnected to the same node and known to operate as a single facility. A generation unit may represent a single physical generation unit where data is available to characterize that specific generation unit or may consist of all the generation units within a generation facility where unit-specific information is unavailable. Onshore wind, offshore wind and solar facilities are always characterized as single generation units.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	A commonly used Generation Facility Name may differ from the legal name. Generation Unit Name may differ between sources. Alternative names are provided in the notes to each generation unit. Storage facilities < 1 MW installed capacity are not included in CODERS.			
Sources	AB	246	NS	N/A
	BC	N/A	ON	94, 244
	MB	N/A	PE	130
	NB	N/A	QC	N/A
	NL	N/A	SK	227

Storage Type		
Definition	The type of electricity generation of a given generation unit, generation facility or generation contracted for import/export.	
Clarifications	Storage types defined in CODERS include:	
	Short Name	Description
	storage_air	compressed air energy storage
	storage_lithium	lithium-ion battery storage
	storage_pump	hydroelectric pumped storage
	storage_solid	solid-state energy storage
Calculations	This is data directly obtained from sources. No calculations.	
Limitations	Detailed technical information is not currently developed in CODERS for compressed air and solid-state energy storage.	
Sources	See Storage Facility Name	

Storage Type – COPPER		
Definition	The type of Storage Facility as used in the COPPER model.	
Clarifications	Storage types defined in COPPER include:	
	Type	Storage Types Included
	storage_lithium	lithium-ion battery storage, solid-state energy storage, compressed air energy storage
	storage_pump	hydroelectric pumped storage
Calculations	This is data directly obtained from sources. No calculations.	
Limitations	Detailed technical information is not currently developed in CODERS for compressed air and solid-state energy storage.	
Sources	See Storage Facility Name	

Transmission Line Segment Length (km)				
Definition	The physical length of a portion of a transmission line between to nodes			
Clarifications	Transmission Line Segment Length may be sourced, measured using available maps where the routing is known or estimated based on the distance between nodes.			
Calculations	This is data directly obtained from sources and maps. No calculations.			
Limitations	None.			
Sources	AB	3, 62	NS	179, 194
	BC	30, 55, 65	ON	62
	MB	62, 110, 111, 112, 121, 122, 138	PE	130
	NB	62, 231	QC	88
	NL	157, 160, 173	SK	62

Time to Full Capacity (minutes)	
Definition	The time required for a Generation Facility to ramp from idle (cold) conditions to full installed generation capacity.
Clarifications	
Calculations	This is data directly obtained from sources. No calculations.
Limitations	These are generic values and may differ considerably from actual values.
Sources	46

Total Number of Facility Generation Units				
Definition	The aggregate physical number of generation units in a Generation Facility.			
Clarifications	Not all generation units may be currently operational but are still included in the dataset. Decommissioned units are identified by their Closure Year.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	42, 146	NS	146, 191
	BC	28, 29, 146, 243, 244	ON	101, 146, 206
	MB	120, 146	PE	130, 146
	NB	44, 146, 152	QC	84, 146, 214, 215
	NL	146, 172, 212	SK	146

Total Project Costs (\$)	
Definition	The sum of Capital Costs, Capital Overhead, Interest During Construction and Project Definition Costs of a hydroelectric renewal, greenfield hydroelectric or pumped storage hydroelectric generation facility.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	See limitations related to Capital Costs, Capital Overhead, Interest During Construction and Project Definition Costs.
Sources	See Capital Costs

Total Transfer Capacity (MW)				
Definition	The capacity of a transmission line to carry electricity, in MW.			
Clarifications	The Total Transfer Capacity of a transmission line varies with ambient temperature and is higher in winter compared to summer.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	8	NS	199
	BC	27	ON	93
	MB	126	PE	199
	NB	199	QC	197
	NL	199	SK	219
	CA	37		

Transmission Circuit ID				
Definition	The unique utility issued identification associated with a transmission line.			
Clarifications	None.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	3	NS	180, 184
	BC	30, 55, 60	ON	78
	MB	109, 111, 112, 114, 115, 116, 118, 121, 122, 138	PE	130
	NB	106, 150	QC	85
	NL	144, 166, 173, 212	SK	216

Transmission Line Length (km)	
Definition	The physical length of a transmission line, including all line segments between two nodes demarcating the end points of the line.
Clarifications	Transmission Line Length may be sourced, measured using available maps where the routing is known or estimated based on the distance between nodes.
Calculations	This is data directly obtained from sources and maps. No calculations.
Limitations	None.
Sources	See Transmission Line Segment Length

Turbine Type				
Definition	The type of turbine (e.g., Francis, Kaplan, Pelton) used in a hydroelectric facility or pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	240	NS	N/A
	BC	18, 19	ON	N/A
	MB	N/A	PE	N/A
	NB	N/A	QC	N/A
	NL	N/A	SK	N/A

Unit Average Annual Energy (GWh/year)	
Definition	The actual annual electrical energy output of a generation unit averaged over more than one year depending on data availability.
Clarifications	Some values of average annual energy are estimated from the expected capacity factor for the given Generation Type within a given provincial electricity system.
Calculations	Average Annual Energy = Capacity Factor * Installed Capacity*365*24*1000
Limitations	Average annual energy can and does vary substantially from year to year due to environmental, system operating and demand factors.
Sources	See Facility Annual Average Energy

Unit Effective Capacity (MW)	
Definition	The capacity of a generation unit available at peak demand after derating based on the Capacity Adjustment.
Clarifications	None
Calculations	Unit Effective Capacity = Unit Installed Capacity * Capacity Adjustment
Limitations	The Unit Effective Capacity depends upon the Capacity Adjustment, which changes with the addition (removal) of generation assets.
Sources	See Facility Effective Capacity

Unit Installed Capacity (MW)	
Definition	Installed generation capacity of a generation unit.
Clarifications	A “unit” reflects the number of generation units represented by the data, which may mean a single unit where unit-level data is available or all units where unit-level data is unavailable.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	See Facility Installed Capacity

Variable O&M Costs (\$/MWh)	
Definition	Operations and maintenance costs, excluding water rentals, of a Generation Facility that vary with changes in energy generation.
Clarifications	Variable operations and maintenance costs typically include labour costs associated with operations, consumable materials, production costs, and costs associated with cooling the facility. They exclude costs that affect a substantial betterment of the generation facility.
Calculations	
Limitations	Estimates of Variable Costs may differ materially from actual Variable Costs.
Sources	19, 28, 245

Voltage (kV)				
Definition	The electromotive force, also known as the electric pressure, or electric potential difference between two points.			
Clarifications	Transmission line Voltages vary from 63 kV to 765 kV in CODERS.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	3	NS	180, 184
	BC	30, 55	ON	247
	MB	109, 111, 112, 114, 115, 116, 118, 121, 122, 138	PE	130
	NB	106	QC	85
	NL	144, 166, 173, 212	SK	216

Water Rentals (\$/MWh)				
Definition	A form of variable operations and maintenance costs potentially levied as a tax on hydroelectric renewals, greenfield hydroelectric or pumped storage hydroelectric generation facilities based on energy production.			
Clarifications	Only variable water rentals are included in CODERS, as fixed charges (e.g., land taxes) are not included separately for other types of generation. Not all provinces charge water rentals.			
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	N/A	NS	N/A
	BC	241	ON	67
	MB	234	PE	N/A
	NB	N/A	QC	70
	NL	66	SK	235

Water Type				
Definition	The type of water (fresh or salt) used in a pumped hydroelectric Storage Facility.			
Clarifications				
Calculations	This is data directly obtained from sources. No calculations.			
Limitations	None.			
Sources	AB	238, 240	NS	N/A
	BC	18, 19	ON	174, 233
	MB	N/A	PE	N/A
	NB	148	QC	N/A
	NL	N/A	SK	N/A

Wind Project Area (km²)	
Definition	The permitted land use area of a wind project.
Clarifications	Where source data is not available, the Wind Project Area is visually estimated using Google Maps.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	62

Wind Project Density (MW/km²)	
Definition	The spatial density of the installed capacity of a wind Generation Facility.
Clarifications	None.
Calculations	Wind Project Density = Facility Installed Capacity / Wind Project Area
Limitations	None.
Sources	N/A

Wind Turbine Capacity (MW)	
Definition	The installed capacity of individual wind turbines within a wind Generation Facility.
Clarifications	None.
Calculations	This is data directly obtained from sources. No calculations.
Limitations	None.
Sources	146

