2025 Integrated Resource Plan

Technical Advisory Committee Meeting #2

Supporting Materials

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Manitoba Hydro
energy for life

Outline

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Proposed Load Projections

Proposed Load Projections

Overview

- Load projections are the energy demand that Manitoba Hydro might be required to serve for both electricity and natural gas.
- Planning assumptions that underpin each load projection ensure they are common across both electric and natural gas (i.e. customer choosing to electrify a natural gas process would see an increase in electric consumption and a decrease in natural gas usage.)
- A net-zero economy brings into consideration greenhouse gas emissions. The concept of net-zero economy by 2050 is becoming more prevalent for Manitobans, as it is:
  - included in Manitoba Hydro's mandate;
  - introduced in Manitoba's Affordable Energy Plan; and
  - within Federal policy.
- There is significant uncertainty about how Manitobans achieve a net-zero economy by 2050 in Manitoba. Different customer actions (whether its residential, commercial or industrial) may affect the amount and pace of change to both the electric and natural gas consumption.
- It is important within the 2025 IRP to evaluate a broad range of potential load projections for electricity and natural gas required to be served by Manitoba Hydro.
- Three load projections are proposed, recognizing different combinations of policy actions and customer decisions which will drive different electrical and natural gas energy demand.

Proposed Load Projections

Guiding principles for developing the 2025 IRP load projections

- Capture a broad range of potential futures for both electricity and natural gas.
- Leverage key learnings from 2023 IRP in developing planning assumptions for each load projection.
- Limit the premature removal of existing systems (i.e. systems that are still within their planned service life).
- Develop a baseline projection with limited changes to how Manitobans use electricity and natural gas.
- Ensure two load projections support achieving a net-zero economy by 2050, highlighting different pathways to net-zero economy by 2050.

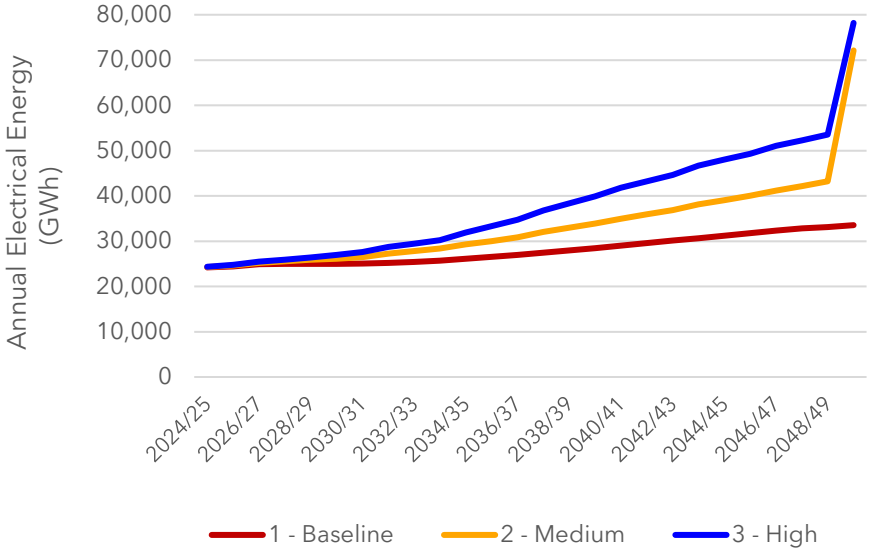
Proposed Load Projections

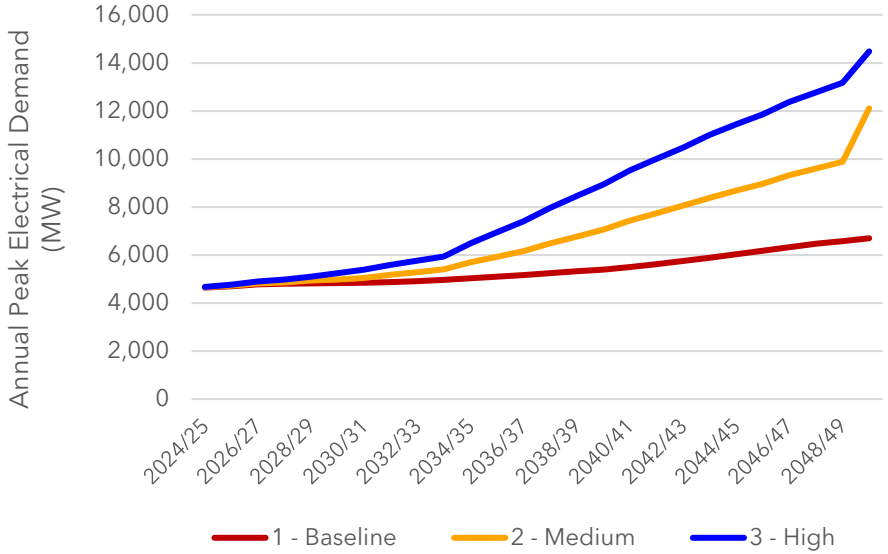
Electric energy and demand

- The subsequent slides provides the preliminary estimates for each of the three proposed load projections, which are each based on a theme in the planning assumptions.
- The **baseline load projection** (depicted in red) assumes lower economic growth and that there is little change from what Manitobans are currently doing today, where customers continue to select the most economic decisions when it comes to their energy needs.
- The **high load projection** (depicted in blue) represents accelerated actions towards a net-zero economy by 2050 and assumes that much of the electric demand will need to be served by Manitoba Hydro. This will include:
  - planning assumptions that skew toward electrification as a means of decarbonization; and,
  - policy assumptions to phase out natural gas, leveraging an approach to electrify as existing systems reach end of life.
- As shown on the energy and demand charts, Load Projection 3 includes assumptions on carbon capture technology to offset any remaining emissions by 2050. Conversely the higher focus on electrification leads to the largest reduction from the natural gas system.
- The **medium load projection (**depicted in yellow) also assumes actions towards a net-zero economy by 2050 and recognizes a different pathway to achieve net-zero. This includes planning assumptions where alternatives to full electrification are explored, such as dual fuel heating and slightly more aggressive carbon capture projections in 2049/50.

Proposed Load Projections

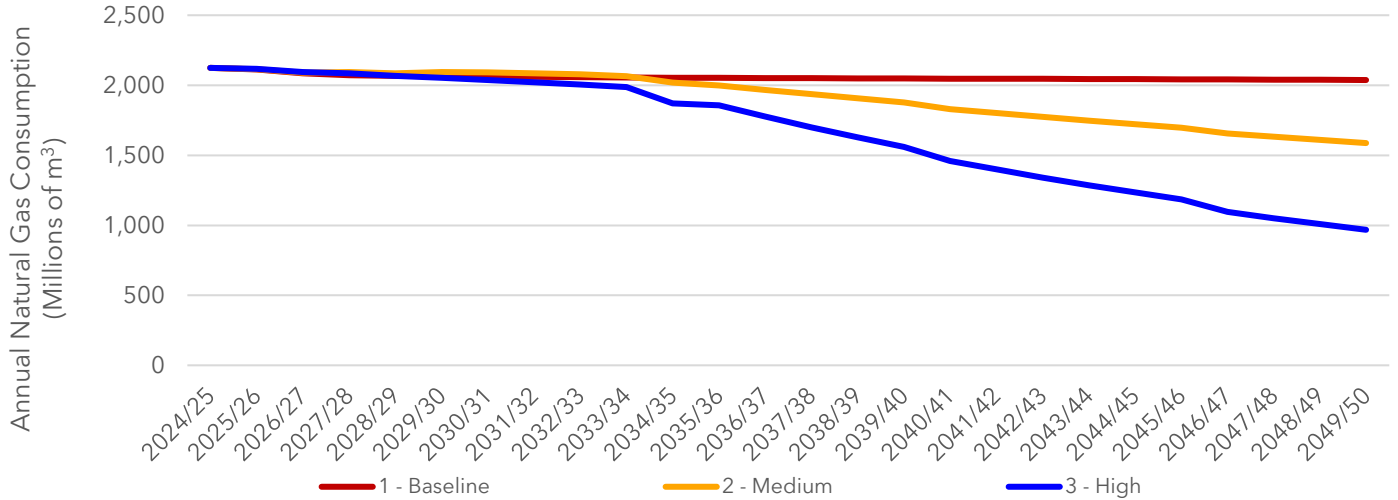
Electric energy and demand (net of Efficiency Manitoba Plan)





Proposed Load Projections

Natural gas (net of Efficiency Manitoba Plan)



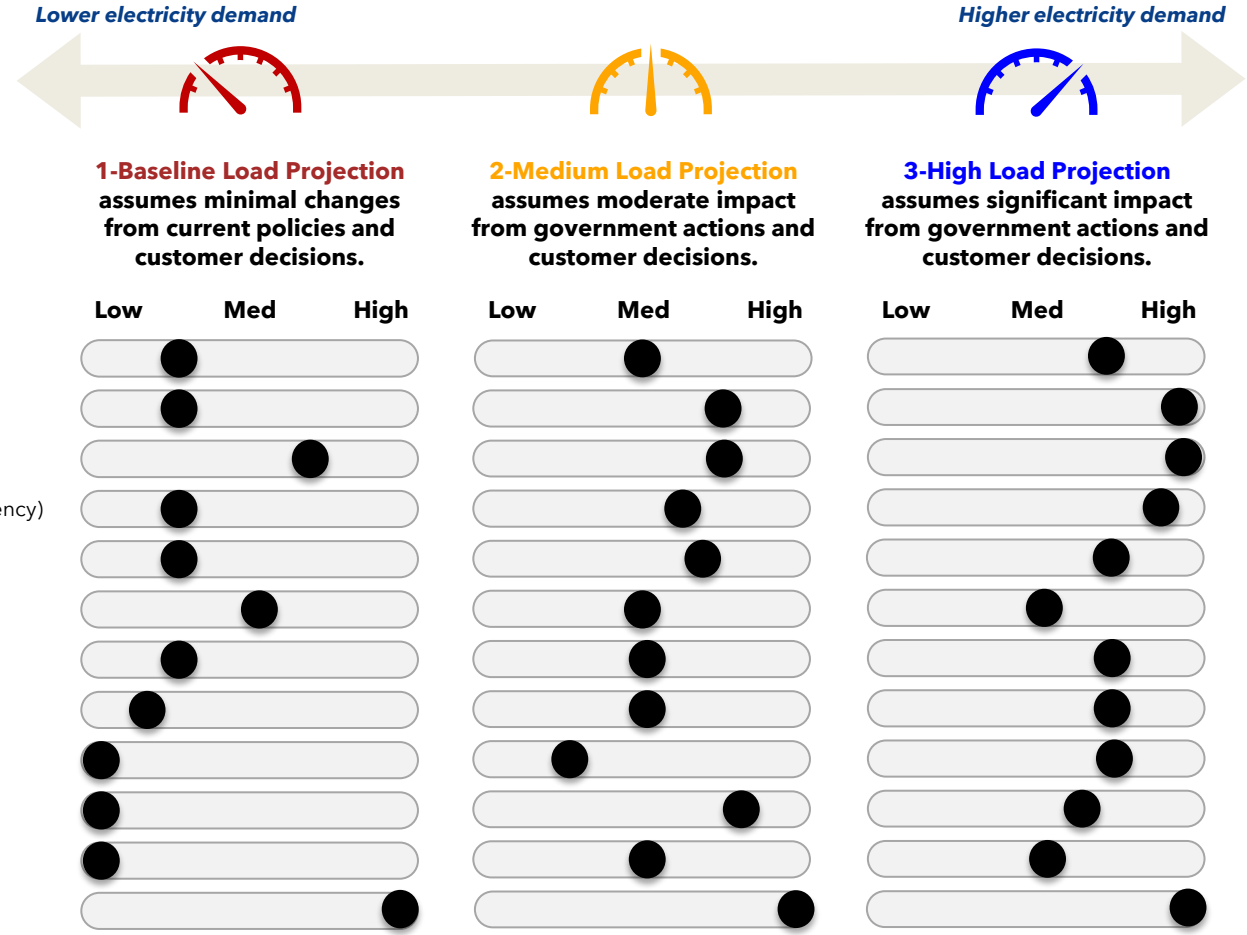
- This chart displays the natural gas volumes associated with each of the three proposed load projections shown on the previous slide. The natural gas system plays an important role across all three load projections.
- It is important to note that a net-zero economy by 2050 in Manitoba may still result in greenhouse gas emissions within Manitoba and, as highlighted in both load projection 2 and 3, there are negative emission technologies in place to offset the emissions like a Direct Air Capture system.

Proposed Load Projections

Planning assumptions

- Included in the next slide are the planning assumptions with the greatest potential impact each of the proposed load projections. The three proposed load projections are across the top, along with the key planning assumptions on the left-hand side.
- This slide illustrates the range of decisions for each of the different planning assumptions across each of the proposed load projections.
- A few key points to identify:
  - there are numerous assumptions that are included;
  - some have greater level of uncertainty; and
  - all the inputs are independent, though there are some correlations (e.g., energy policy and electrification of transportation).
- Descriptions of the planning assumption categories are provided on the following slides.

Proposed assumptions for the load projections



Proposed Load Projections

Planning assumption descriptions (1 of 4)

Economic Growth includes assumptions relating to Manitoba population, real Manitoba disposable income, real Manitoba gross domestic product, consumer price index, and electric and natural gas price projections.

Energy Policy refers to the implementation of policy at all levels of government that has an overarching governance on several of the key planning assumptions, and that impacts, or is anticipated to impact, decisions on energy use.

Electrification of Transportation refers to replacing fossil fuels in transportation with electricity as the means of powering light-duty vehicles, medium- and heavy-duty trucks, and buses which includes battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV). This may include the electrification of aviation, rail and shipping.

Customer Self-Generation & Storage refers to behind the meter (BTM) generation technologies that generate electricity on site behind our customers' meter. Energy produced could be completely utilized by the customer, or with the use of bi-directional meters, send excess production back to Manitoba Hydro's integrated system. Storage refers to customer's ability to store energy being produced for use at a different time (i.e. battery).

Proposed Load Projections

Planning assumption descriptions (2 of 4)

Space Heating refers to the heating of indoor spaces by any means (such as natural gas, electricity, or solar radiation) with the heater either within the space or external to it. Examples of technologies include, but are not limited to, electric/natural gas central forced air furnaces, electric baseboards, electric/natural gas boilers, air source heat pumps (ASHP), cold climate air source heat pumps (ccASHP), ground source heat pumps (GSHP), and gas absorption heat pumps. The technologies are grouped into the following categories:

- **All Electric** – A heating system that utilizes electricity, such as an electric central forced air furnace, electric baseboards and/or electric boilers.
- **Dual Electric System** – A heating system that utilizes an ASHP or a CCASHP in combination with an electric central forced air furnace.
- **Geothermal** – A heating system that utilizes a GSHP to draw energy from the ground to provide heating and cooling.
- **Dual Fuel System** – A heating system that utilizes a combination of fuels, typically an ASHP or a ccASHP in combination with a natural gas furnace.
- **Natural Gas** – A heating system that uses natural gas, such as a forced air furnace or boiler.
- **Other** – A heating system that uses alternate fuel sources, such as wood, propane or oil.

Proposed Load Projections

Planning assumption descriptions (3 of 4)

Energy Efficiency means using less energy to do the same things. For example, energy-efficient homes and buildings need less energy to heat, cool, and operate appliances and electronics. Similarly, energy-efficient factories use less energy to make products. Includes both energy efficiency programs and codes and standards.

Industrial Decarbonization means making changes to industrial processes to reduce carbon emissions. This can involve using energy sources that produce fewer emissions or improving existing processes.

Industrial Economic Development includes both the expansion of current industrial facilities or the addition of new ones in the province.

Proposed Load Projections

Planning assumption descriptions (4 of 4)

Hydrogen Production includes the impact on our systems related to the production of hydrogen, primarily through electrolysis.

CO_2 Capture refers to both direct air CO_2 capture technologies (that extract CO_2 emissions directly from the atmosphere at any location) and industrial CO_2 capture (that extract CO_2 directly from exhaust plumes). The CO_2 can be permanently stored in deep geological formations or used for a variety of applications.

Biomethane & Hydrogen Blending refers to the blending of biomethane (typically sourced from animal or agricultural waste) or the blending of hydrogen that can be injected into natural gas pipelines or onsite at industrial facilities, often with the intention of reducing net GHG emissions. The resulting blends can also potentially be used to generate heat and power.

Demand Response refers to the temporary reduction of customer electrical demand by the customer or directly by a utility in response to a signal. A utility may contract with customers with large electrical loads to provide demand response as a resource to manage peak electrical demand. A signal may include a request from the utility due to high demand or reliability, a change in price, or an incentive.

Greenhouse Gas Emissions

Greenhouse Gas Emissions

Overview

- The following slides provide background information on greenhouse gas (GHG) emissions in Manitoba and potential technology options for reducing or removing emissions.
- The *Manitoba Emissions* graph highlights emissions by sector and indicates if they are from combustion or non-combustion sources. This information provides context for discussions around how to reduce emissions in Manitoba, including which emission sources can or cannot be impacted by energy choices.
- Achieving net-zero economy by 2050 could require reducing and/or removing GHG emissions. Two potential technologies considered (carbon capture and sequestration and direct air capture) are described in this section.

Greenhouse Gas Emissions

Assumptions to achieve a net-zero economy by 2050 in Manitoba

Assumed that a net-zero economy by 2050 in Manitoba will:

1. Have lower fossil fuel use than current levels.
2. Have lower non-combustion emissions than current levels.
3. Rely on Manitoba produced biofuels and hydrogen.
4. Rely on Manitoba based offsets and CO_2 removals.
5. Net any remaining fossil fuel combustion emissions, and non-combustion emissions, to zero in 2050.

Manitoba Emissions (2018-2022 Average)

Description of *Combustion* emission in *Manitoba Emissions* graph

Combustion Emissions (58%, or 13 Mt): Emissions occurring as the result of burning fossil fuels (e.g., gasoline, natural gas, diesel).

- **Vehicles (39%):** Also referred to as **Transportation**.
  - Includes all emissions that occur in Manitoba when fuel is combusted to move vehicles.
  - Manitoba's largest GHG emissions category.
- **Stationary Combustion (19%):**
  - Includes all emissions that occur in Manitoba when fuel is combusted for purposes other than **Transportation**.
  - Includes space heating and industrial heating (e.g., boilers, furnaces, and heaters), customer owned electricity generation, some industrial processes, and miscellaneous equipment (e.g., pumps, air compressors).

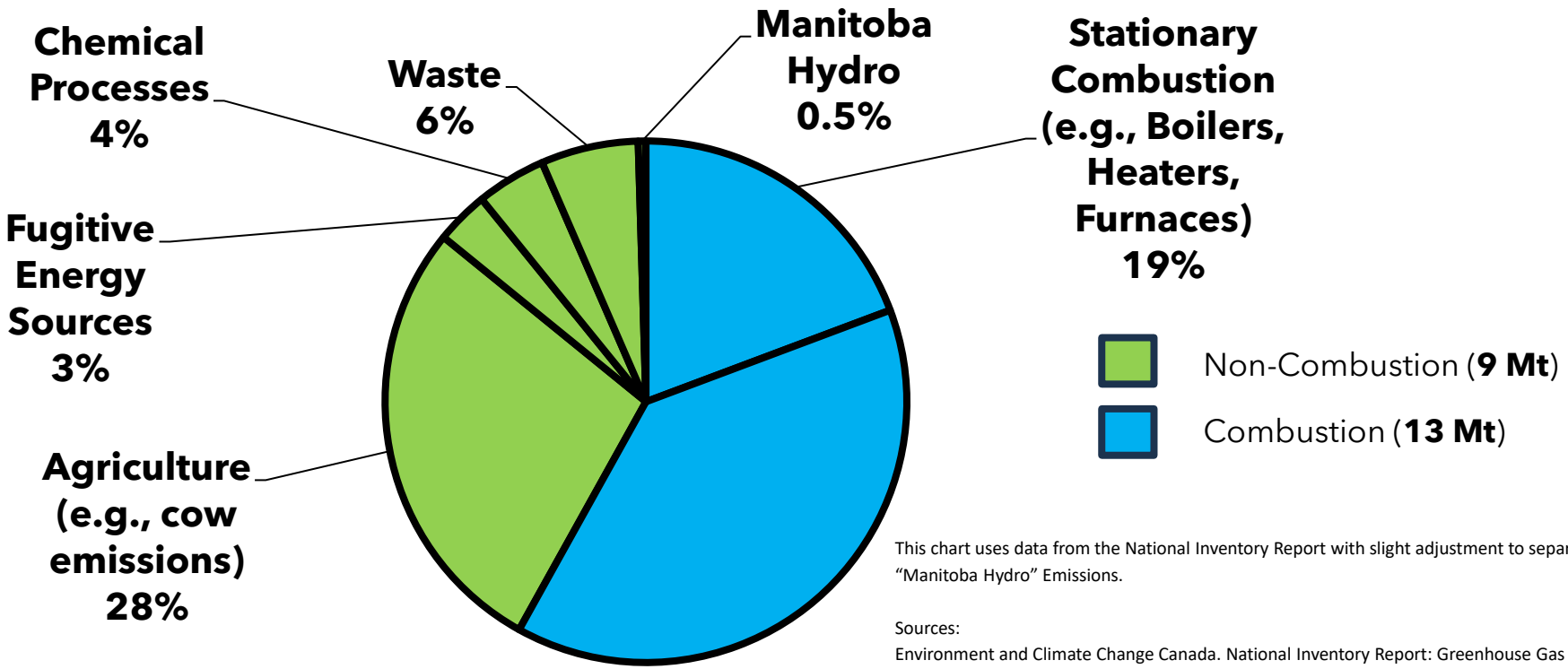
Manitoba Emissions (2018-2022 Average)

Description of *Non-Combustion* emission in *Manitoba Emissions* graph

Non-Combustion Emissions (41%, or 9 Mt): Emissions occurring as the result of causes unrelated to combustion.

- **Agriculture (28%):**
  - Includes all agriculture emissions that do not fall under **Vehicles** or **Stationary Combustion**.
  - Contributors are: methane emissions from livestock and soil related emissions; manure and fertilizer use.
- **Waste (6%):**
  - Mostly methane emissions occurring from landfills.
  - Includes smaller amounts from wastewater treatment and similar sources.
- **Chemical Processes (4%):** Also referred to as **Industrial Processes**
  - Result from chemical reactions that occur during manufacturing or industrial processes (such as steel and fertilizer production) but that are not **Stationary Combustion**.
- **Fugitive Energy Sources (3%):**
  - Occur during the production, processing, and transportation of oil and natural gas.

Manitoba Emissions (2018-2022 Average)



This chart uses data from the National Inventory Report with slight adjustment to separate out "Manitoba Hydro" Emissions.

Sources:

Environment and Climate Change Canada. National Inventory Report: Greenhouse Gas Sources and Sinks in Canada (1990-2022). 2024, https://publications.gc.ca/site/eng/9.506002/publication.html
https://www.hydro.mb.ca/environment/greenhouse-gas/
https://www.hydro.mb.ca/corporate/operations/generation/#brandon

Carbon Capture and Storage (CCS)

Also referred to as carbon capture and sequestration

- Process where carbon dioxide (CO_2) is separated from other emissions before it is released into the atmosphere and then transported to a long-term storage location/product.
  - Currently only practical on large industrial based emissions.
- There are a variety of existing and proposed technologies to separate the CO_2 with various energy efficiencies.
- Natural gas combustion combined with CCS can reduce emissions - a CO_2 reduction technology.
- Bio-energy combustion combined with CCS can produce negative emissions as it removes CO_2 from the atmosphere.

Direct Air Capture (DAC)

- Extracts CO_2 directly from the atmosphere, rather than from specific sources like with CCS.
- Generally more energy-intensive and costly than CCS.
  - Primarily because the concentration of CO_2 in the air is much lower than in emissions from industrial sources.
- Can be designed to operate using either heat or electricity, providing flexibility in implementation.
- Permanent removal of CO_2 from the atmosphere.

Source: https://www.iea.org/energy-system/carbon-captureutilisation-and-storage/direct-air-capture

Resource Options Inventory

Resource Options Inventory

Overview

- Manitoba Hydro monitors and maintains an inventory of electricity generation resource options that have potential to meet Manitoba's future electricity needs.
- Each of these resources have unique characteristics that are included in the model. Characteristics define how each resource can operate within the energy supply system.
- Each characteristic is defined on the following slides.

Description of Resource Characteristics (1 of 2)

Rated Capacity – The maximum amount of electricity that a generating station can produce under specific conditions designated by the manufacturer. Alternative terms include installed capacity and nameplate capacity.

Firm Capacity – A guaranteed level of capacity that is intended to be available at all times during the timeframe being planned for.

Operating Parameters – The specific conditions and settings under which power generation systems operate. Includes but not limited to: efficiency curves, minimum generation, minimum run times, maintenance schedules, etc.

Dependable Energy – The amount of electrical energy supplied during the equivalent of the lowest system flows on record.

Development Timelines – The lead time necessary to plan, license, and construct a resource, including any new transmission needed to connect the resource to the grid.

Asset Life – Represents the weighted average life of the various components of a resource. This does not necessarily indicate the maximum life as a resource may last longer with additional major capital investment in component refurbishment or replacement. In the case of energy efficiency, this is the average of each of the various individual measures.

GHG Emissions – The greenhouse gas emissions produced during the operation phase of a resource.

Description of Resource Characteristics (2 of 2)

Capital Costs – The upfront expenses required to construct and put a new resource into operation.

Transmission Costs – The cost of associated transmission required to interconnect a new resource to the existing electrical system.

Fixed Operating Costs – The fixed cost of operating and maintaining a resource that does not vary significantly with electrical generation levels such as general and administration expenses, staffing expenditures, plant support equipment, and routine maintenance.

Variable Operating Costs – Variable cost of operating and maintaining a resource that includes costs that vary with electrical generation levels such as water treatment, disposal of waste, chemicals, catalysts, lubricants, and other consumables. This does not include fuel costs.

Fuel Costs – The costs associated with the procurement and consumption of fuel used to generate electricity.

Dispatchable – A resource with an assured fuel or input energy supply which can be started or stopped on command and whose output can be increased or decreased on demand to follow load. Examples include hydropower units, thermal generators, and batteries.

Intermittent – A generating resource that is not dispatchable due to the fluctuating nature of the energy source. This term typically applies to wind and solar resources. An alternative term is Variable Renewable Resource.

Optional Information

If you're eager to learn more, we encourage you to review the appendices from the 2023 Integrated Resource Plan (IRP). While some minor data changes have occurred since their publishing, much of the information remains highly relevant and valuable.

- Appendix 1 - Existing System and Load (Including GHG and energy breakdowns in Manitoba)
  - https://www.hydro.mb.ca/docs/corporate/irp/irp-2023-a1-existing-system-and-load.pdf
- Appendix 2 – New Resource Options (Resource Inventory)
  - https://www.hydro.mb.ca/docs/corporate/irp/irp-2023-a2-new-resource-options.pdf

Thank you!

Hydro.mb.ca/future

Email us at: IRP@hydro.mb.ca

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