

General information

The Pathways Explorer is an online tool designed to facilitate the comparison of possible transformation pathways to achieve net-zero GHG emissions in Canada by 2050.

The results presented in the tool come from NATEM, a technoeconomic optimization model developed by ESMIA Consultants. This technology-rich model optimizes the overall cost to transform the energy system according to the assumptions taken and the constraints imposed, for instance on GHG emissions, the cost or penetration of various technologies, the implementation of additional policies, and the evolution of energy demand drivers.

The tool provides two main functionalities, accessible from the welcome page:

- 1) **Open the visualization tool** to explore modelling results and the evolution of indicators across selected scenarios;
- 2) **Browse analyses** of key sensitivities on production, technology, demand, and additional policy measures.

This guide details the tool's functionalities and how to use it to its full potential.

Visualization tool

The Visualisation tool has a number of different views (Figure 1):

- The initial view is the *High-level Comparison*, where scenarios are listed in a heat map to be compared;
- From the High-level Comparison view, scenarios can be filtered to display only those of interest to the user (*Filter Scenarios*);
- A selection of scenarios from the High-level Comparison view can also be displayed in a *Detailed Comparison* view;
- Finally, from the Detailed Comparison view, a specific chart can be selected for more in-depth comparisons in the *Single-chart Zoom* view.

Each of these views and their functionalities are explained below, starting with the initial filtering of scenario

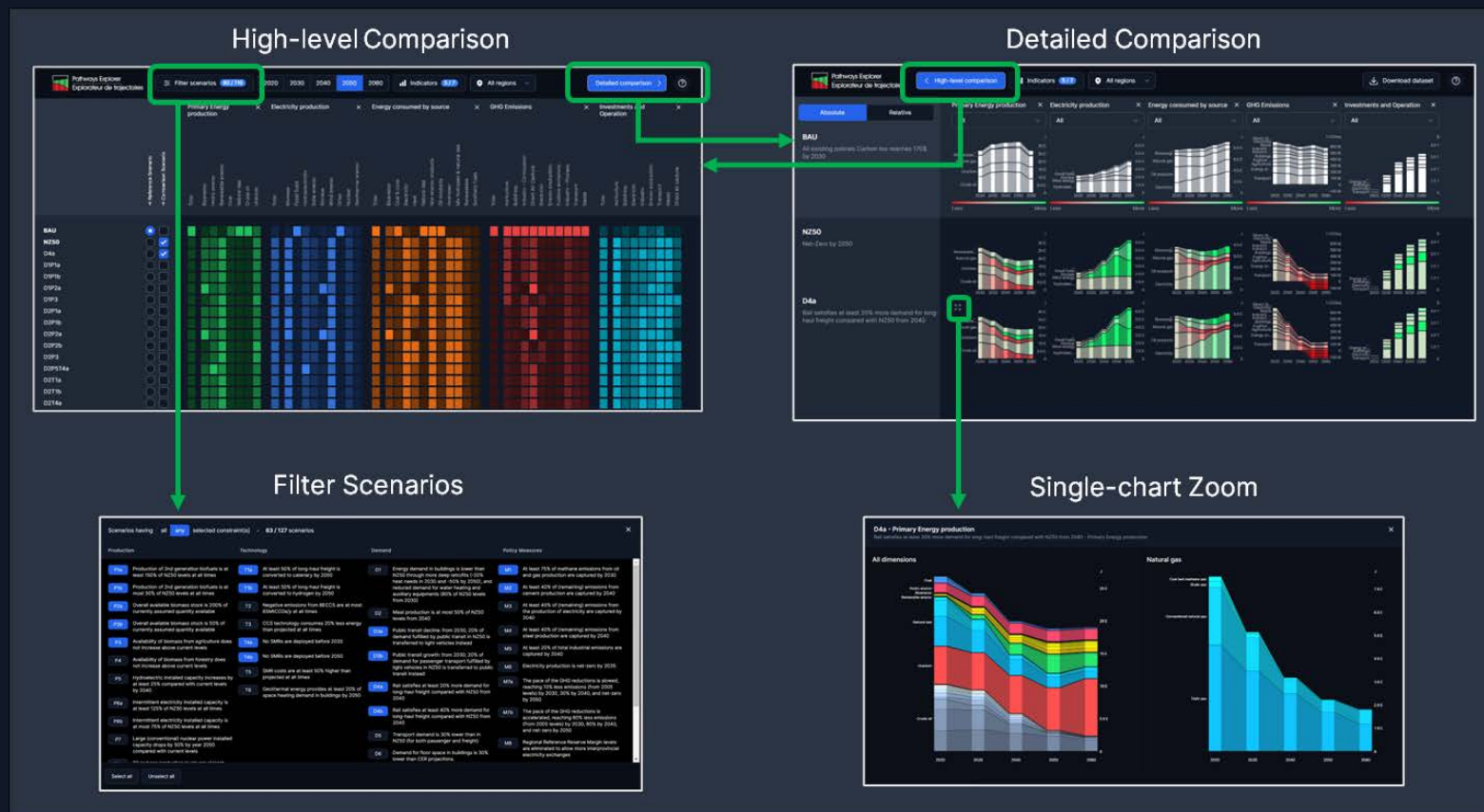


Figure 1 - Pathways Explorer various views

Filter Scenarios

Given the numbers of scenarios modelled, the first step should be to select scenarios of particular relevance or interest to the user. The Pathways Explorer includes numerous scenarios where various additional *constraints* have been added to the main default Net-Zero scenario (named NZ50). It is possible to narrow down the list of scenarios displayed to those which include specific constraints.

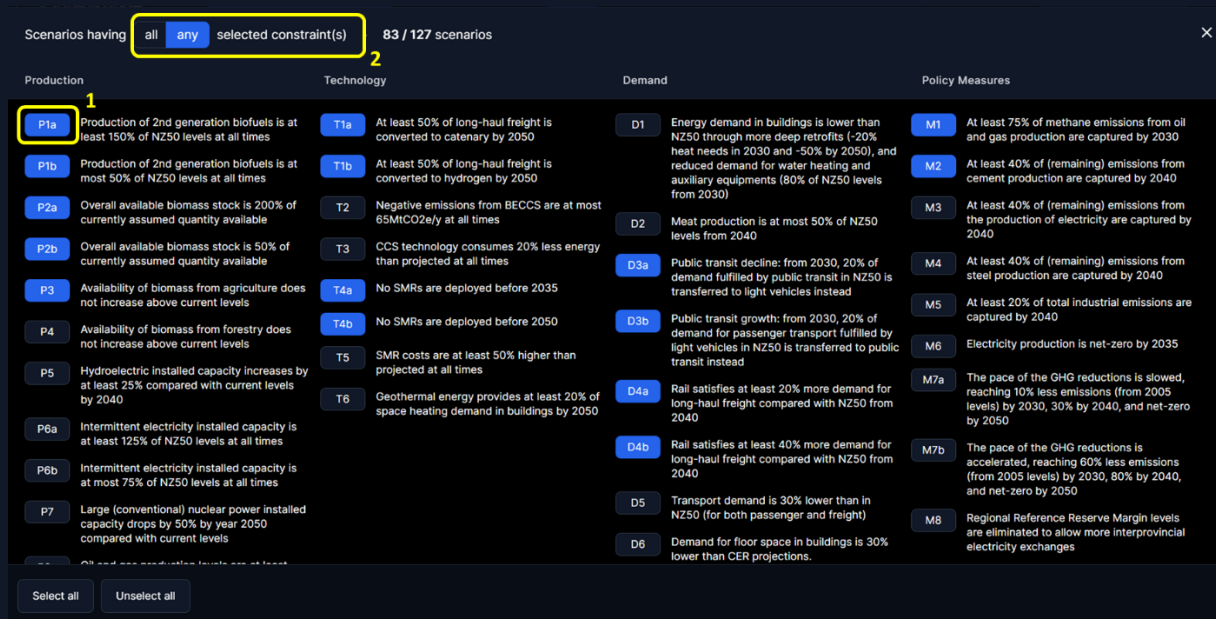


Figure 2 - Filter Scenarios view

A description of what the constraints impose is found next to the constraint's name (1 in Figure 2). Each of the available constraints can be selected by clicking on its name.

Scenarios can be filtered using two methods (2 in Figure 2):

- "Any of": displayed scenarios will be limited to those that contain any of the selected constraints. By default, *all* constraints will be selected.
- "All of": displayed scenarios will be limited to only those which include all of the constraints selected. Once first constraint is selected, the remaining constraints will grey out, except those used in conjunction with the first selection.

The High-level Comparison view will then only list scenarios enforcing the selected constraints, plus the two default scenarios (see next section).

High-level Comparison

The main page in the visualization tool is a heat map of filtered scenarios, allowing for a high-level comparison. By default, all scenarios available in the Pathways Explorer will be displayed.

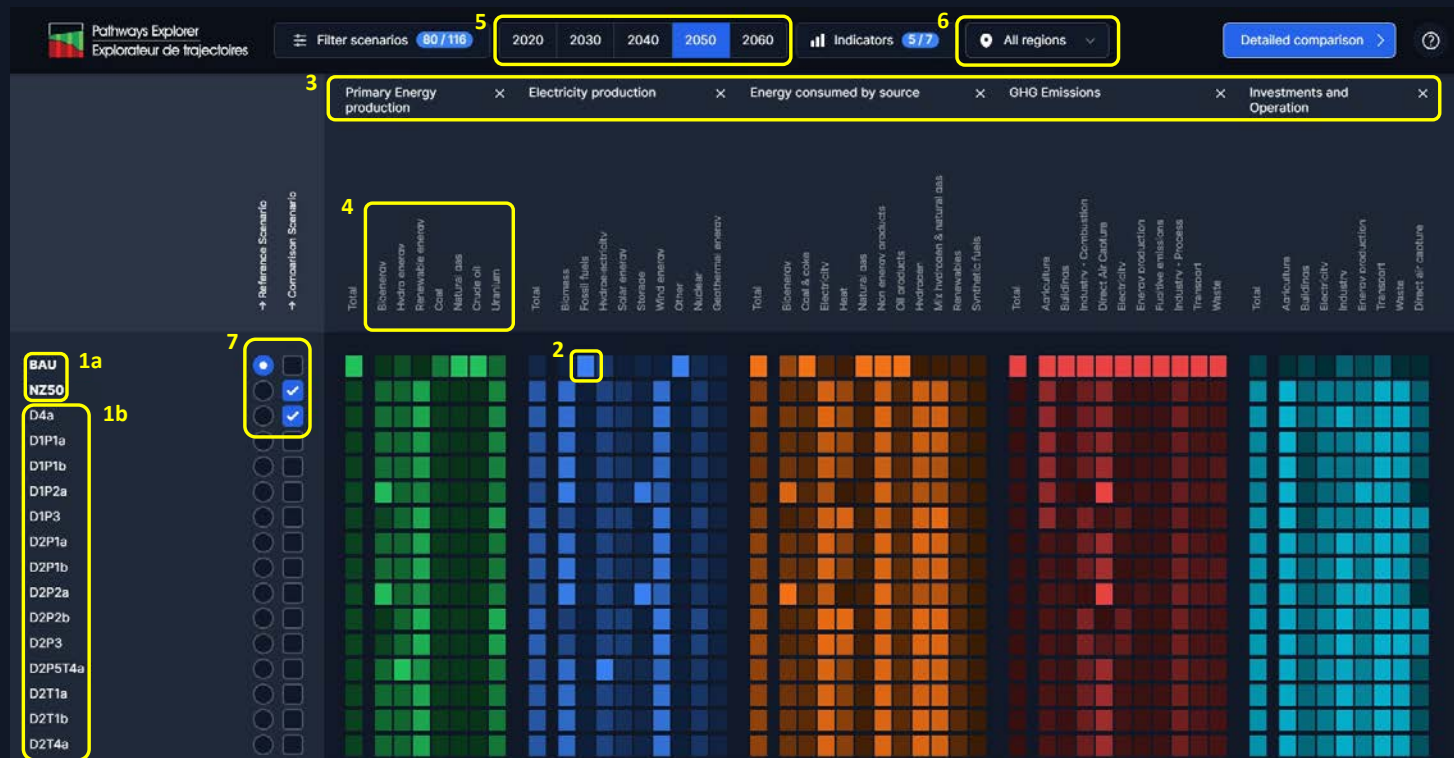


Figure 3 – High-level Comparison view

The Pathways Explorer includes two *default scenarios* (1a in Figure 3): a business-as-usual trajectory (BAU), which includes all policies and measures already in place with a quantifiable impact on emissions; and a scenario that uses identical assumptions, but which is forced to achieve net-zero emissions country-wide by 2050 at the least possible cost (NZ50). The heat map view also displays other *scenarios* (1b in Figure 3) as selected through filtering.

The heat map is composed of *intensity elements* (2 in Figure 3), a color-coded representation of results on various *indicators* (3 in Figure 3). Each *indicator* is in turn broken down in various *dimensions* (4 in Figure 3). (For instance, the Primary Energy Production indicator is composed of following dimensions: Bioenergy, Hydro energy, Renewable energy, Coal, Natural gas, Crude oil and

Uranium.) In that map, results are relative to other scenarios: the brighter the shade of the *intensity element*, the higher the value for that indicator across scenarios.

The results are available for a number of years (5 in Figure 3), with 2050 selected by default and at the Canadian, Provinces and Territories level (6 in Figure 3).

Each *intensity element* represents the modelling result for the selected year for all *indicators* but **Investments and Operation**, where the result is the total for the decade. Also, for that same indicator, results are in 2016 dollars.

Sorting scenarios

The colors in each column allow to visualize the variation, across displayed scenarios, in one specific dimension within a given indicator. Clicking on a dimension's name (4 in Figure 3) will sort scenarios either in increasing, decreasing or default order.

Indicators

To narrow down the list of indicators presented, click on  Indicators  and select/unselect the indicators you want to see appear in the heat map.

Tooltips windows

Additional information on a scenario is provided upon hovering over some items:

- Hovering the mouse pointer over a *scenario name* will display the *assumptions and constraints* applied to that specific scenario.
- Hovering the mouse pointer over a colored area will display the precise numerical value of that dimension for the corresponding scenario.

Selecting scenarios for detailed comparison

It is also possible to select specific scenarios to compare them with more detail. This is done by using one of the two the checkboxes next to each scenario's name (7 in Figure 3).

One scenario must be selected as the Reference Scenario, and at least one must be selected as a Comparison Scenario. Those selected scenarios will be the ones displayed in the Detailed Comparison view.

Detailed Comparison

In this view, the scenarios selected previously are displayed as follows: the chosen reference scenario is in the first row, followed by all scenarios selected for comparison.

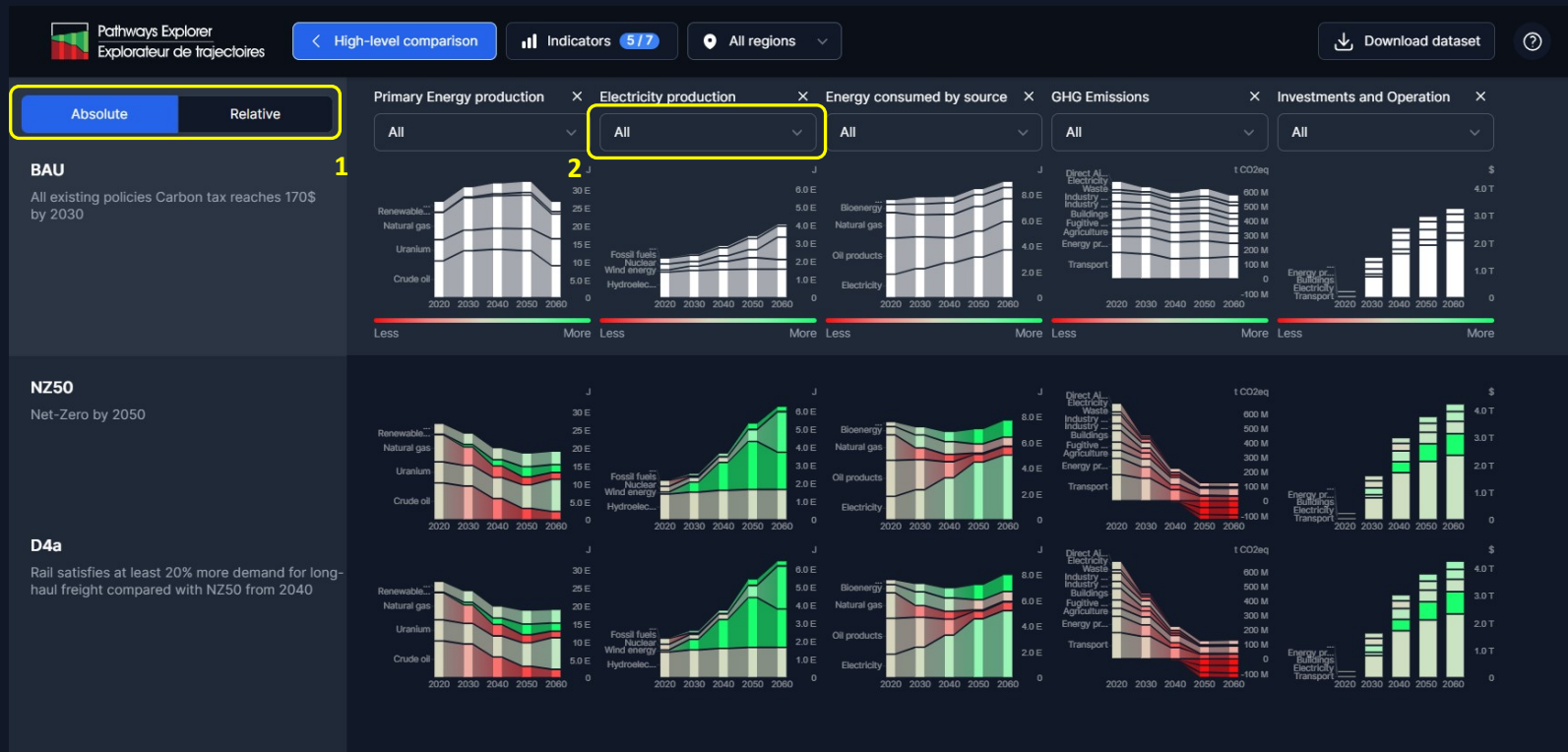


Figure 4 - Detailed comparison view

The view displays the evolution of all dimensions for each indicator over time. For each indicator, the values are presented for each year indicated on the chart (2020, 2030, 2040, 2050, and 2060), and linear interpolation is used to link the values between years. One exception is **Investments and Operation**: for this indicator, the charts show the total cost for each decade.

The charts for the comparison scenarios use **green** to help identify scenarios where a given dimension presents higher levels than in the chosen reference scenario. Similarly, the charts use **red** to help identify scenarios where a given dimension presents lower levels than in the chosen reference scenario.

The user can also toggle (1 in Figure 4) between a view of the results in absolute terms, and a presentation in relative (%) terms, where results from the comparison scenarios are presented relative to the reference scenario's quantities.

Comparisons can be made more specific by selecting a dimension from the dropdown list under a given indicator (2 in Figure 4), or by clicking on that dimension in the graph.

Tooltips window

For more precise comparisons, you can hover the mouse pointer over a given chart area. This displays a tooltip containing the results for the given dimension and year, for instance GHG emissions from buildings in 2040 for scenario NZ50:

2040 Buildings		Commercial, Residential	
	Value (% of total)	Diff. from ref.	Total
BAU	56.9 Mt (10%)		593 Mt
NZ50	17.6 Mt (7%)	-69%	227 Mt
D2	18.6 Mt (7%)	-67%	227 Mt
D3a	17.7 Mt (7%)	-69%	227 Mt

Figure 5 – Tooltip for detailed comparison

In this tooltip, all scenarios in the view are displayed for the chosen dimension and year, with the reference scenario at the top of the list. Moreover, the row in bold is the scenario corresponding to the current location of the mouse pointer.

The information displayed in the tooltip contains the value of the result with the units (in the example above, 17.6 Mt), with the relative importance of this value in the total for that dimension (7%). The second column then shows what difference this represents from the reference scenario's value, in relative terms (in the example above, GHG emissions from buildings are 69% lower in NZ50 than in BAU). Finally, the last column shows the total for the dimension that year (in the example above, total GHG emissions for NZ50 in 2040 are 227 Mt).

Single-chart Zoom


Another way to yield more precise information is selecting to magnify a chart for a given indicator and scenario. For instance, Electricity Production in NZ50 can be magnified by clicking on  that appears when mouse hovers over this chart from the Detailed Comparison view. This opens a zoomed-in view of the chart (Figure 6).



Figure 6 – Single-chart Zoom view

In this view, the chart on the left is a larger-size version of the chart found in the previous view, showing each of the dimensions for the indicator. Then, hovering the mouse pointer over a specific dimension displays a chart on the right with finer detail, showing a second level of dimensions. In the example above, the hydroelectricity dimension is selected on the left, so the chart on the right shows that this is comprised of two elements in the second dimension level, run-of-river and storage dams, with the evolution of each over time in the NZ50 scenario.

Browse analyses

From the welcome page, you can also opt to review analyses produced by the IET experts on key sensibilities by clicking on the Analyses module. The main Analyses page then offers a selection of sensitivity analyses.

After clicking on a given analysis, you will be taken on a step-by-step explanation of the analysis of key results for the selected analysis, in a view similar to the Comparison View, with elements of interest highlighted in the appropriate chart. Clicking on Next or Previous will navigate across the items of the analysis.

In the analysis module, the same options will then be available to explore in finer detail the results presented, either by using the tooltip or by magnifying a given chart.