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Remote

# An open-access integrated platform for visualizing Canadian's transition to a low-carbon energy system

# Agenda

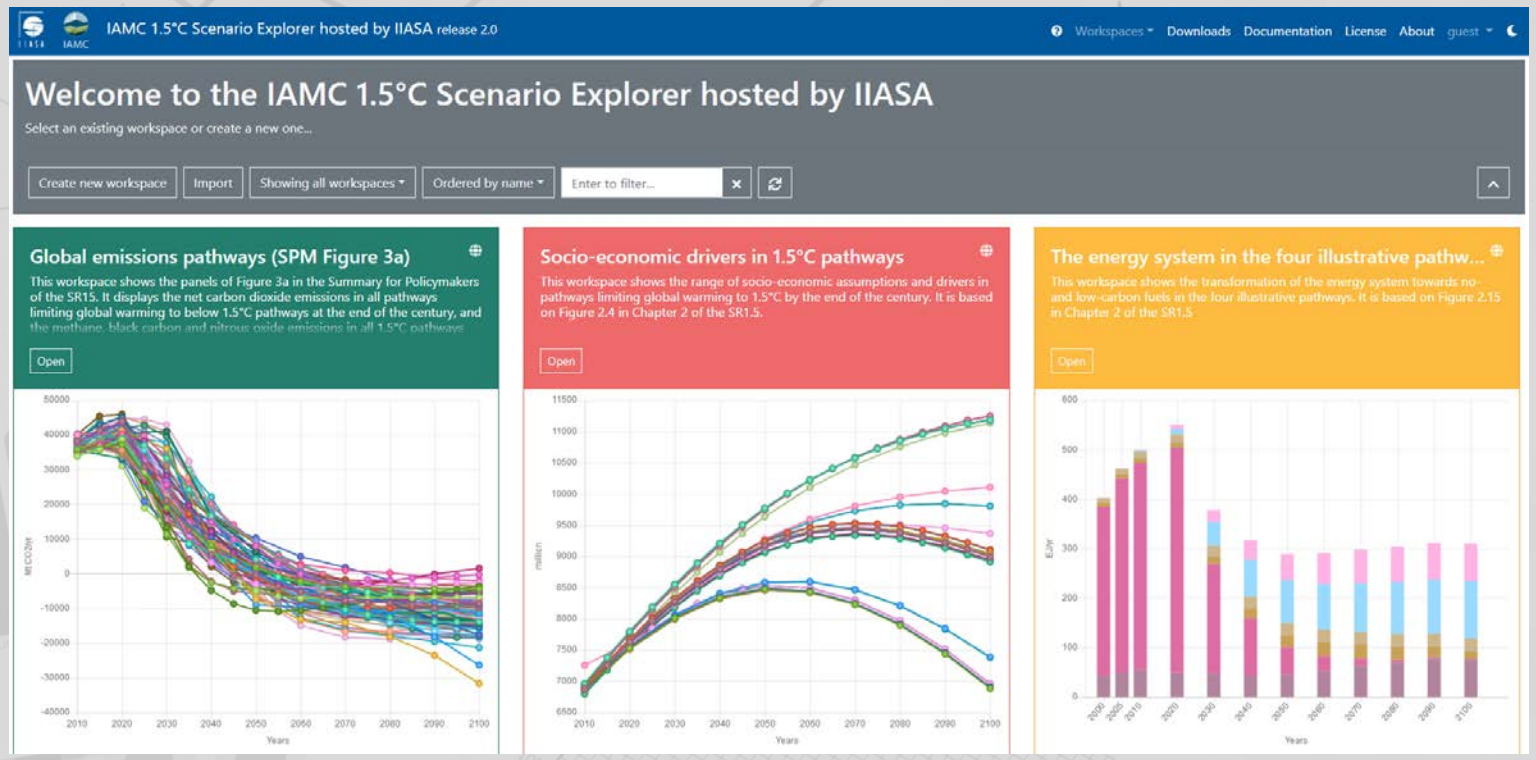
- Background
- Research objectives
- Methods and Models
- Results
- Discussion
- Future works and limitations

# Background

- Canada's commitment to the Paris agreement
  - Modeling platforms to give insights to policies
  - Have various output data
  - Presenting insights in a coherent way
- Visualization options
  - Plotting scripts
  - Proprietary visualization formats
  - Visualization dashboards

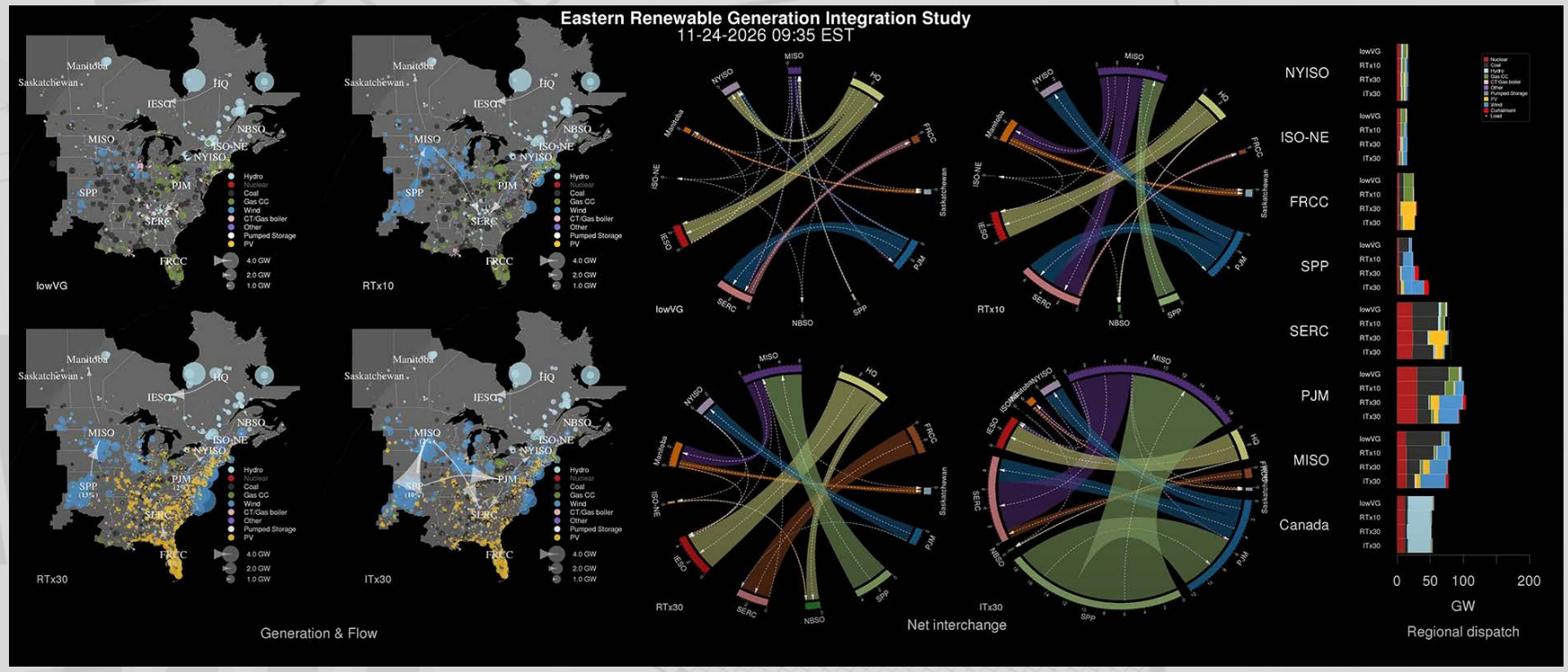
# Visualization platforms

- Visualization platforms:
  - IIASA's Scenario explorer



# Visualization platforms

- Visualization platforms:
  - NREL's MAGMA and KALEIDOSCOPE



# Visualization platforms

- Visualization platforms:
  - IIASA's Scenario explorer
  - NREL's MAGMA and KALEIDOSCOPE
- Limitations:
  - Mainly involve the IAMs
  - Model specific
  - Sectoral and high-resolution models are not still communicated to the stakeholders efficiently

# Objectives

- Develops a process flow to convert the results of the models into a standard data format
- Develops a set of plotting functions that use the standardized results to create figures with interactive widgets that allow for quick multi-platform comparisons
- Accommodating a standardized but flexible format for reporting model outputs
- Publishes the code in an open, accessible, and transparent manner, complete with appropriate documentation.

# Adapting standard data templates

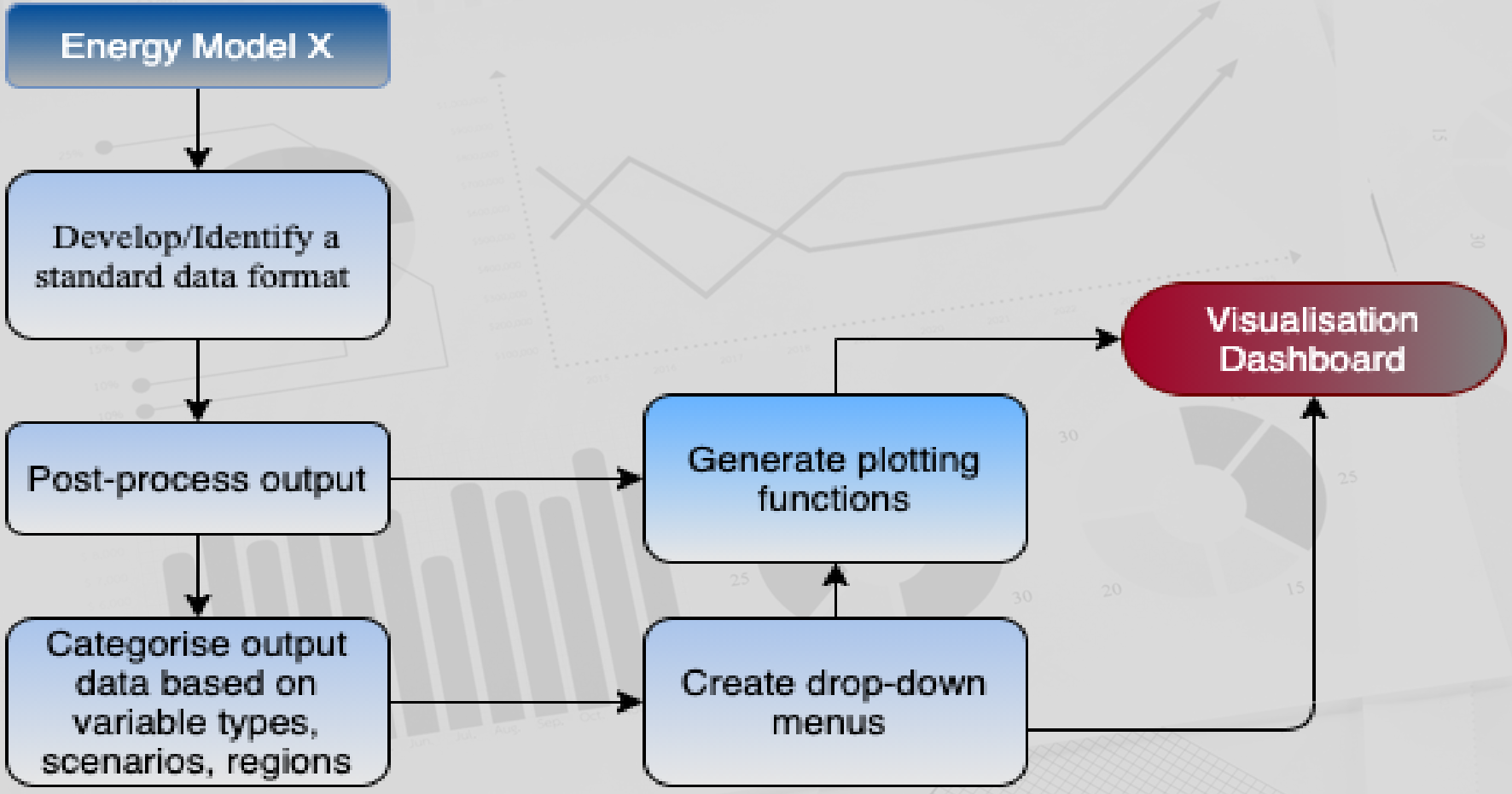
**IAMC Standard Data Template**

| Model | Scenario | Region | Variable | Unit | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|---|---|
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|biomass\|land_use_biomass\|M1 | Gwa | 120.837941 | 130.907769 | 140.977598 | 151.047426 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|hydro\|hydro_hc\|M1 | Gwa | 0 | 0 | 0 | 0 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|hydro\|hydro_lc\|M1 | Gwa | 422.895829 | 422.895829 | 422.895829 | 422.895827 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|solar_csp\|csp_sm1_ppl\|M1 | Gwa | 0 | 0 | 0 | 0 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|solar_csp\|csp_sm3_ppl\|M1 | Gwa | 0 | 0 | 0 | 0 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|solar_pv\|solar_pv_ppl\|M1 | Gwa | 2.8951755 | 2.8951755 | 4.27351384 | 8.92562522 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|solar_th\|solar_rc\|M1 | Gwa | 16.6429236 | 37.4560259 | 78.0134177 | 107.725266 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|wind_offshore\|wind_ppf\|M1 | Gwa | 0 | 0 | 0 | 0 |
| MESSAGEix_ | baseline | Canada\|Can | in\|renewable\|wind_onshore\|wind_ppl\|M1 | Gwa | 38.6989644 | 38.2878891 | 36.3581487 | 25.1503595 |

**Hourly time-series template**

| 1 | Hour | Biomass | Coal | NG | Fuel Oil | Hydro | Imported | Wind | Demand |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 1/1/2012 0:00 | 37.89 | 431.2 | 97.5 | 113.5 | 158.9878 | 696.9894 | 37.932786 | 1574 |
| 3 | 1/1/2012 1:00 | 33.18 | 323.4 | 106.52777 | 0 | 0 | 1113.333 | 61.559197 | 1638 |
| 4 | 1/1/2012 2:00 | 28.47 | 215.6 | 69.02777 | 0 | 0 | 1085.299 | 81.603261 | 1480 |
| 5 | 1/1/2012 3:00 | 33.18 | 135.692284 | 106.52777 | 0 | 0 | 1074.342 | 54.257786 | 1404 |
| 6 | 1/1/2012 4:00 | 37.89 | 94.681465 | 144.02777 | 0 | 0 | 1134.078 | 35.322847 | 1446 |
| 7 | 1/1/2012 5:00 | 42.28 | 164.7819746 | 145.4301984 | 0 | 0 | 1085.521 | 47.986943 | 1486 |
| 8 | 1/1/2012 6:00 | 46.99 | 272.5819746 | 150 | 0 | 0 | 979.3956 | 63.032448 | 1512 |

# Methodological workflow



# Models – IAMC data template

**Integrated assessment models**

- Multi-sector and multi-vector frameworks
- Assessing the costs and benefits of climate change and mitigation policies
- Answer ambitious global warming goals at least possible costs
- Case: Message-ix Canada

**Capacity expansion models**

- Electricity system long-term planning model
- Investigating the least possible cost option
- Address and assess impact of polies and their relevant scenarios on the electricity system
- ReEDS, IESD5, and SWITCH
- Case: COPPER

# Models – Hourly time-series data template

**Electricity system operational models**

- Electricity systems operation in a short span and in presence of network constraints and technical requirements
- To find the least possible cost that balances demand and supply
- Answer questions on a given generation fleet's adequacy and reliability
- Case: SILVER

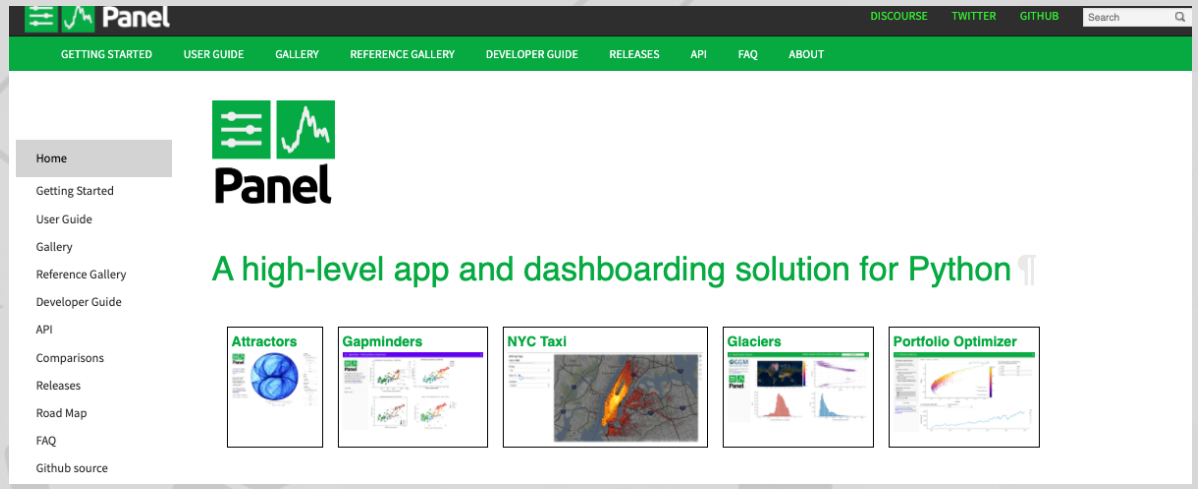
**Transportation models**

- Simulate and predicts the transportation load in various energy sectors
- Electrification of the transportations system
- Contribution to Canada's carbon mitigation
- Case: SESIT's transportation model based on TASHA

**Building energy models**

- Simulate energy demands with given physical characteristics
- Energy efficiency and demand response potential
- Contribution to Canada's carbon mitigation
- Case: SESIT's building model

# Software Development


- Open-source package
- Interactive web-apps
- Detailed documentations & tutorials
- Seamless integration of widely used plotting libraries such as matplolib & Bokeh

## Plotting Libraries

bokeh

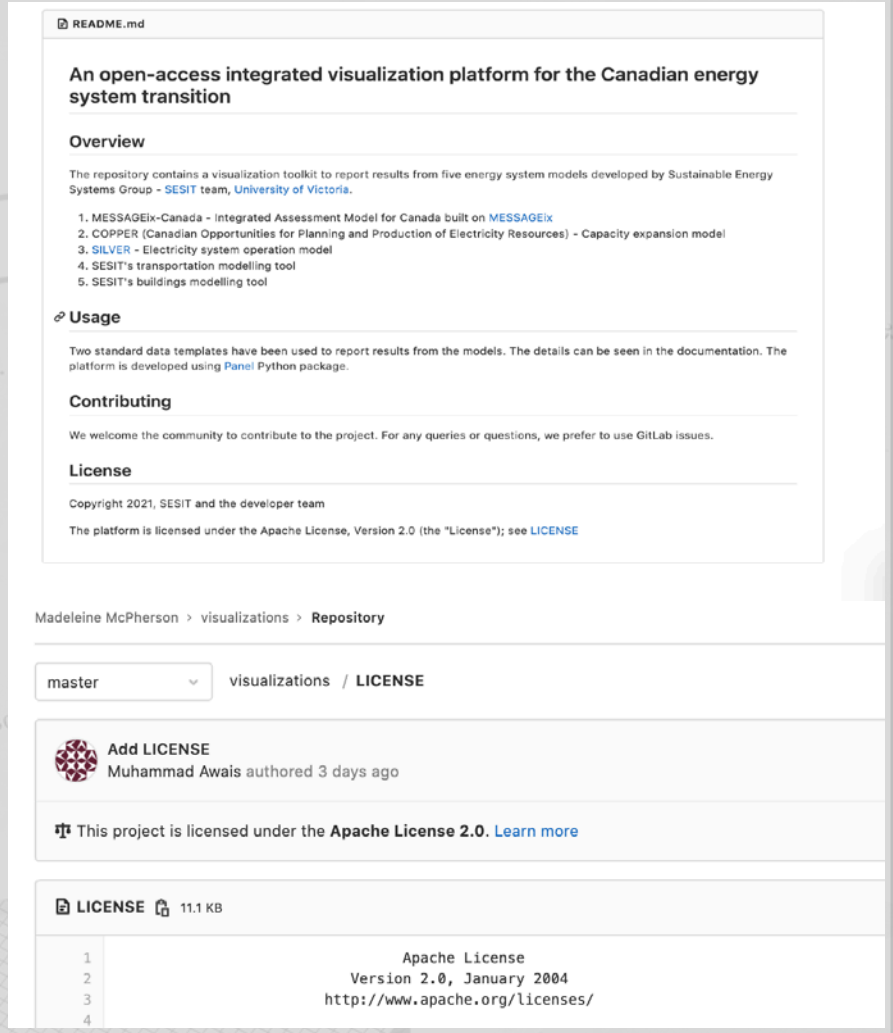
matplotlib

# Results

- Video tour of the platform

# Acessability, re-usability & transparency

- The project code is made accessible at https://gitlab.com/McPherson/visualizations
- Uses open-source libraries
- Invites contributors to build their own case studies for visualizing energy system model results.
- The detailed report of the project will be publicly available at https://emi-ime.ca/



# Limitations

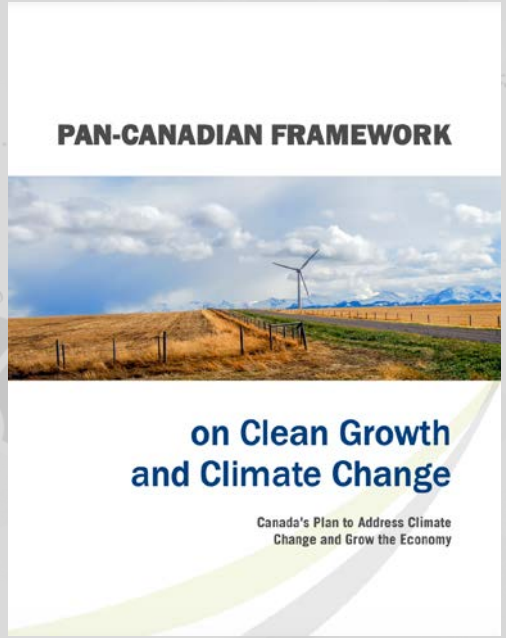
- Only integrates selected models and their examples
- Limited plotting options
- The results from models needs post-processing
- Basic undertsanding of python to visualize results

# Future Work

- Flexible platform
- Include an uploading feature where use can upload a csv file to visualize the results
- Host the platform on web-page
- Build model documentation on open-source documentation pages such as read the docs.

# Towards decarbonization pathways

- Capability to visualize decarbonization pathways from various models, scenarios
- Helps regional & national stakeholders for better policy analysis
- Motivates the community to develop standardized data formats for their models and integrated platform
- Pathway towards model comparison studies.
- Decision choices to energy transition for policy makers



# Thank you!