

Hydrogen to Provide Flexibility in The Canadian Energy System

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Motivation

- Save excess renewable energy production
- Storage of hydrogen with Power to Gas (P2G) conversion
- Flexibility of hydroelectricity generation
- Emission reduction
- Cost optimization of electricity generation in Canada

- **OSeMOSYS**

- Open source modelling system
- Develop energy models
- Python program

- **EMI**

- Energy Modelling Initiative
- Transformation of the electricity sector and its contribution to decarbonization of Canada's economy

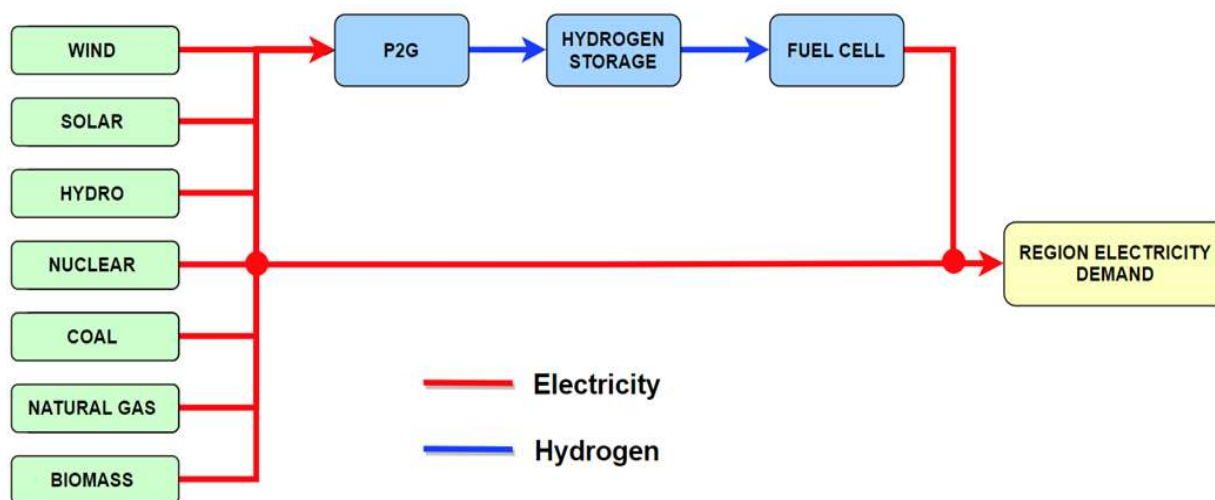
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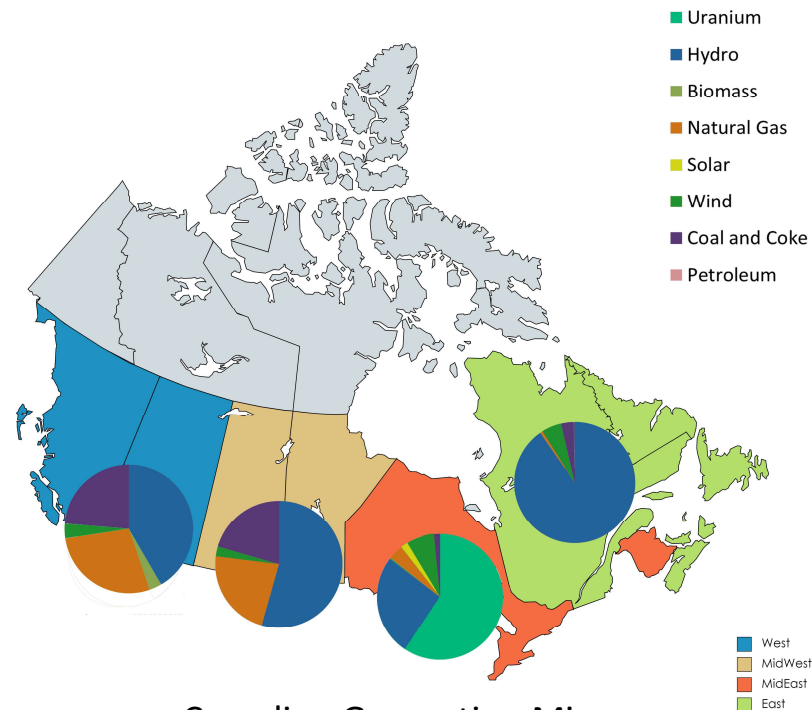
OSeMOSYS
Open Source Energy Modelling System



Power to Gas (P2G)



Canadian Electricity Generation - Energy Inputs (2019)

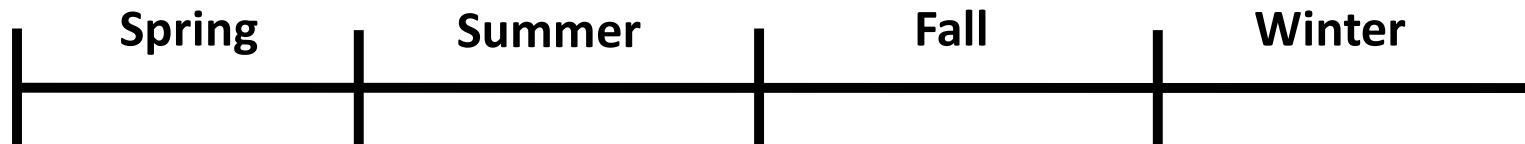


Created with mapchart.net

Canadian Generation Mixes –
Government Website

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Model Data - Timeslices

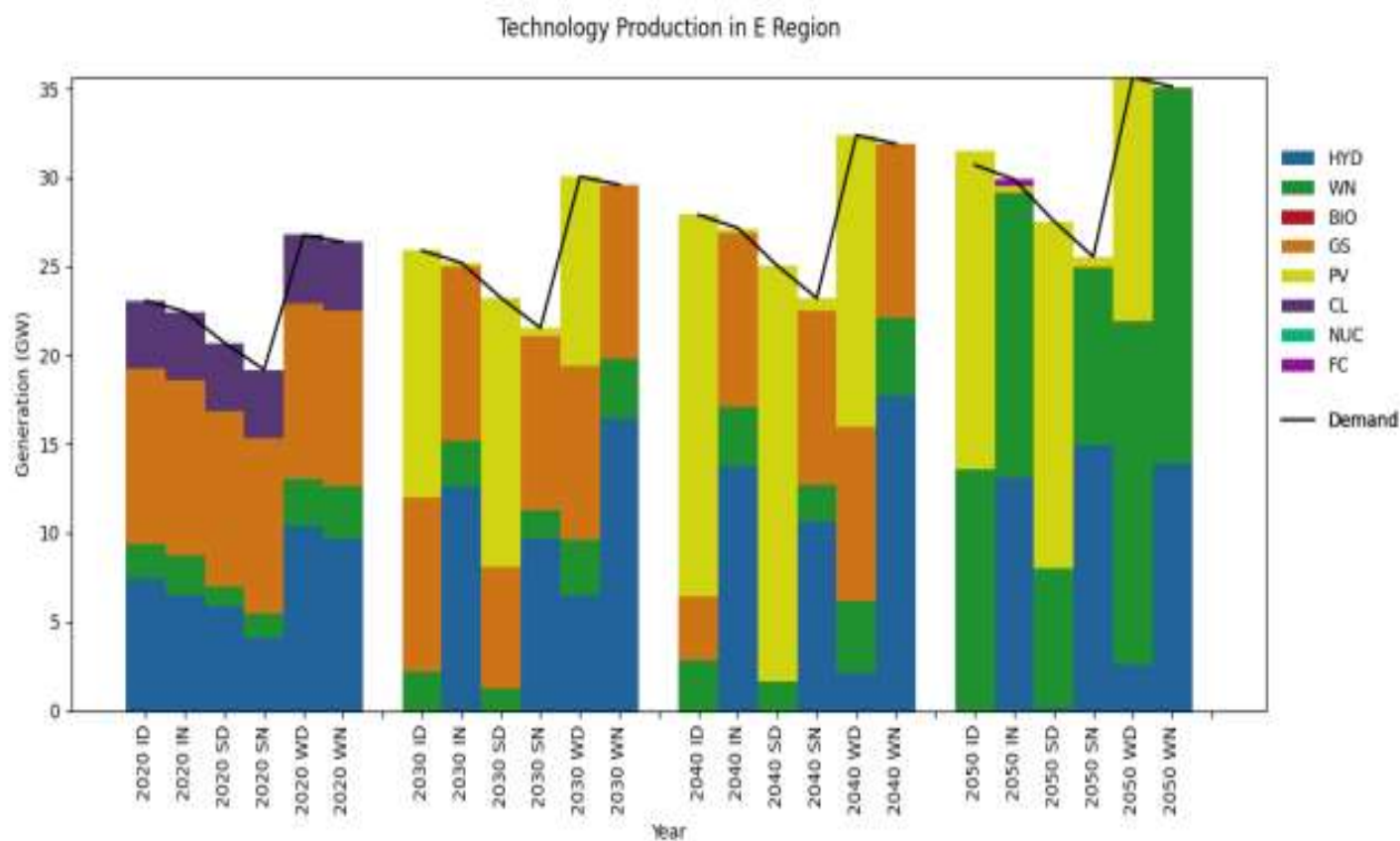


- Days
- Nights

Scenarios

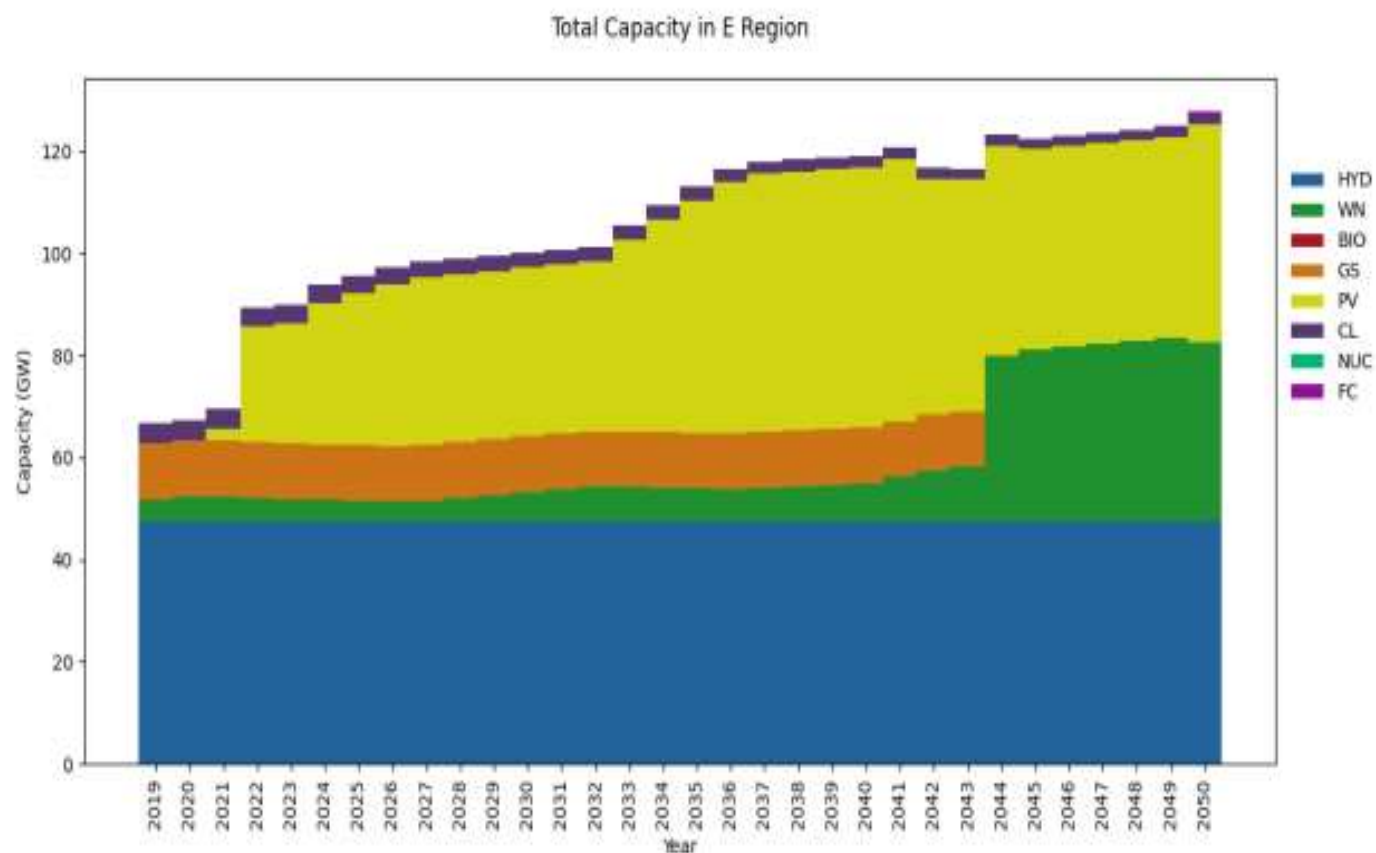
Scenario #	Scenario name	Constraint
-	Base Model	<ul style="list-style-type: none">- Canadian electricity demand data- Constant emission penalty from 2022 (\$50/tonne)- Flexible Hydro generation
1	Increase Emission Penalties	<ul style="list-style-type: none">- Constant emission penalties from 2030 (\$170/tonne)
2	Hydro Restricted	<ul style="list-style-type: none">- Inflexible Hydro generation
3	Hydro Restricted and increased penalties	<ul style="list-style-type: none">- Inflexible Hydro generation- Constant emission penalties from 2030 (\$170/tonne)

Base Model – Energy Production (E)



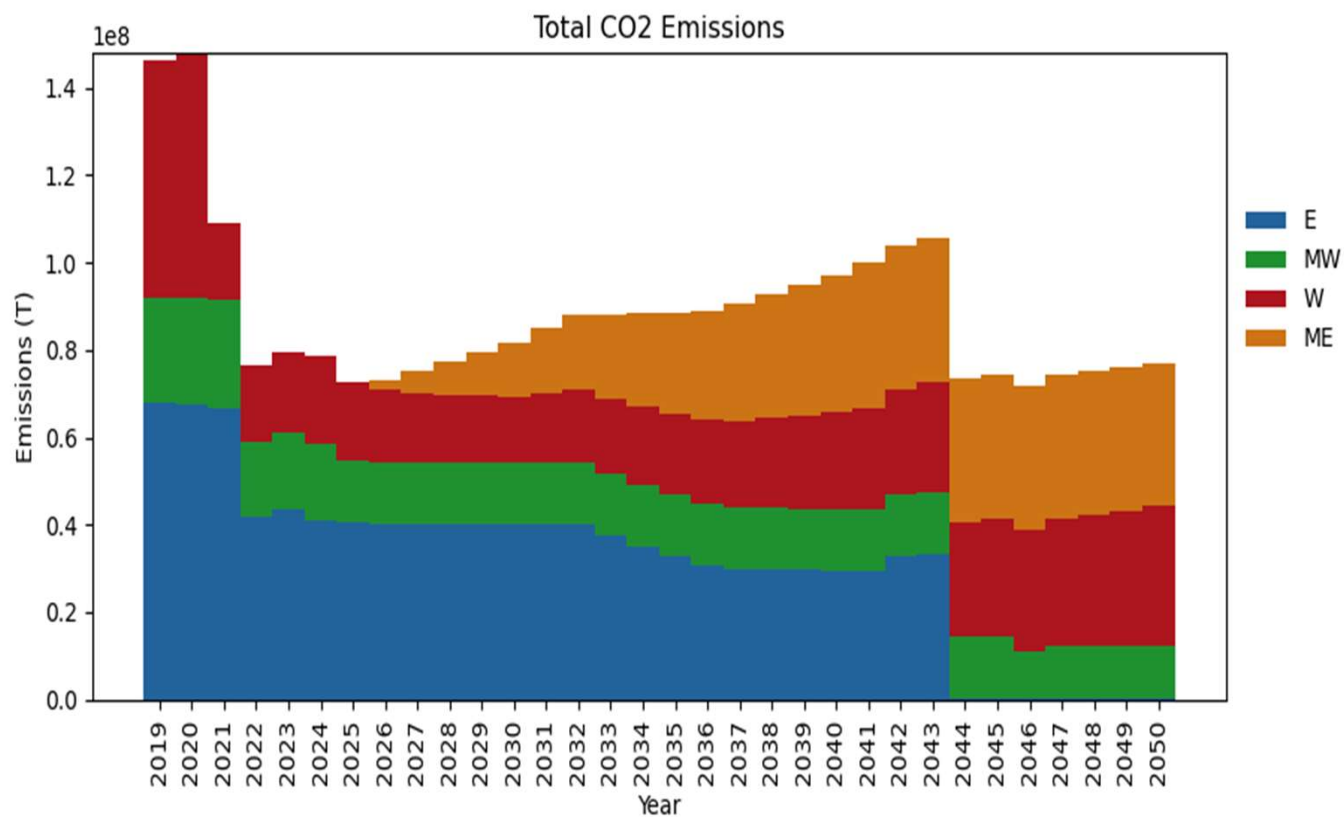
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Base Model – Energy Capacity (E)



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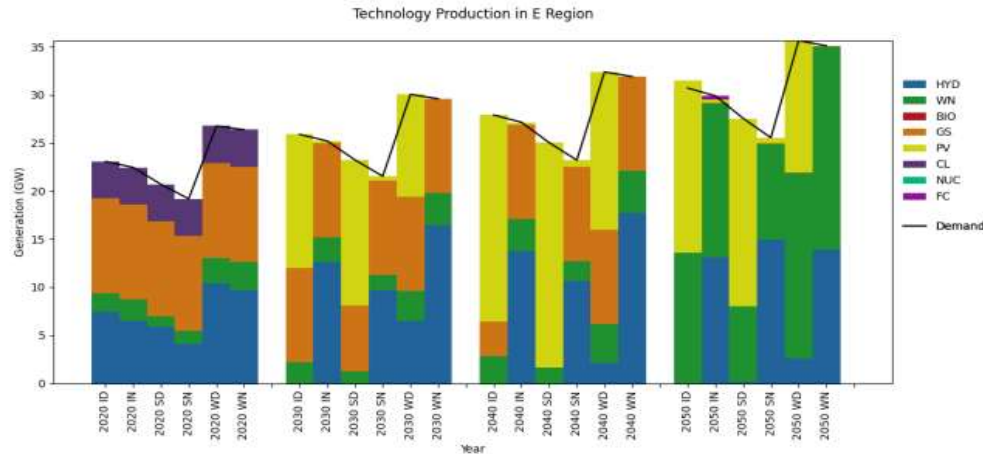
Base Model – Emission Forecast



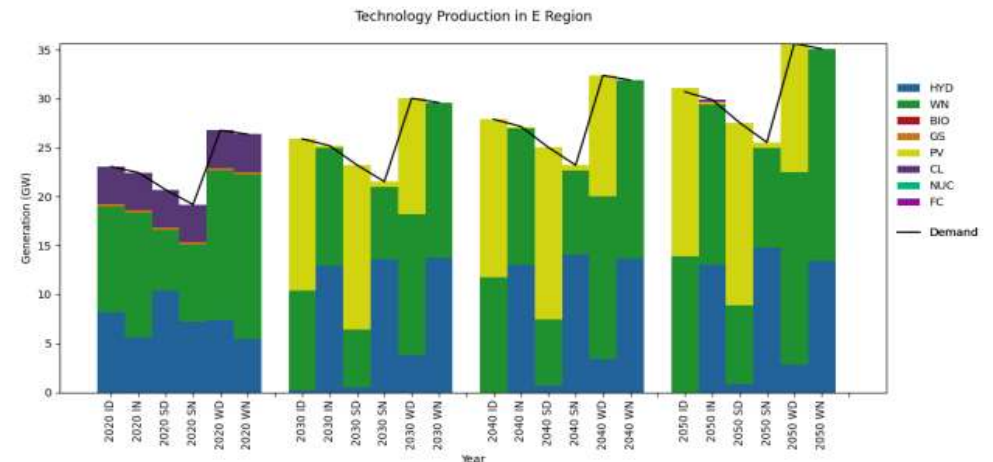
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Increase Emission Penalties (E – Energy Production)

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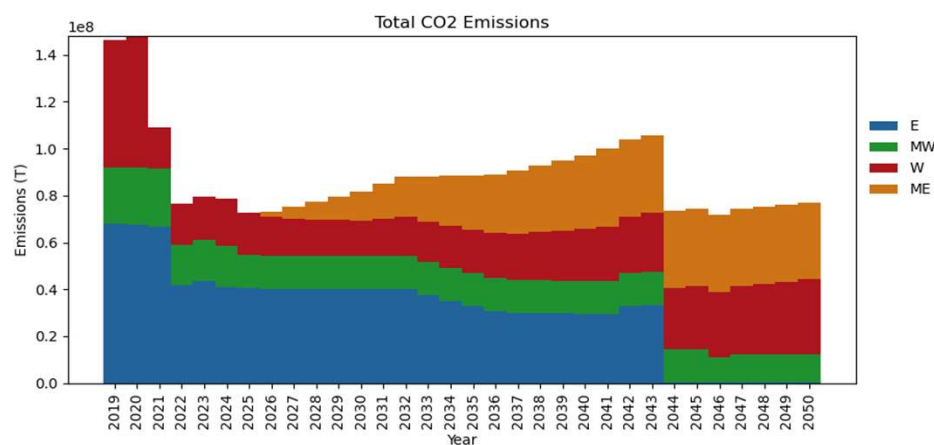
Constant Emission Penalty (\$50/tonne)
from 2022



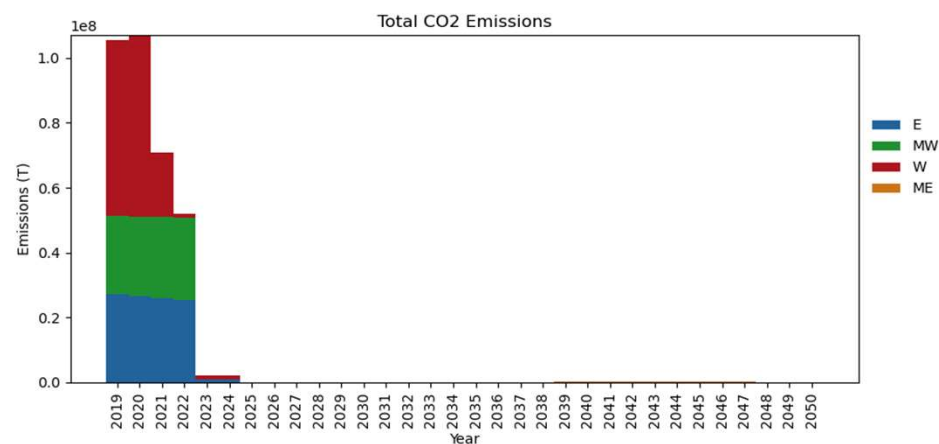
Constant Emission Penalty (\$170/tonne)
from 2030

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Increase Emission Penalties (Emission Forecast)

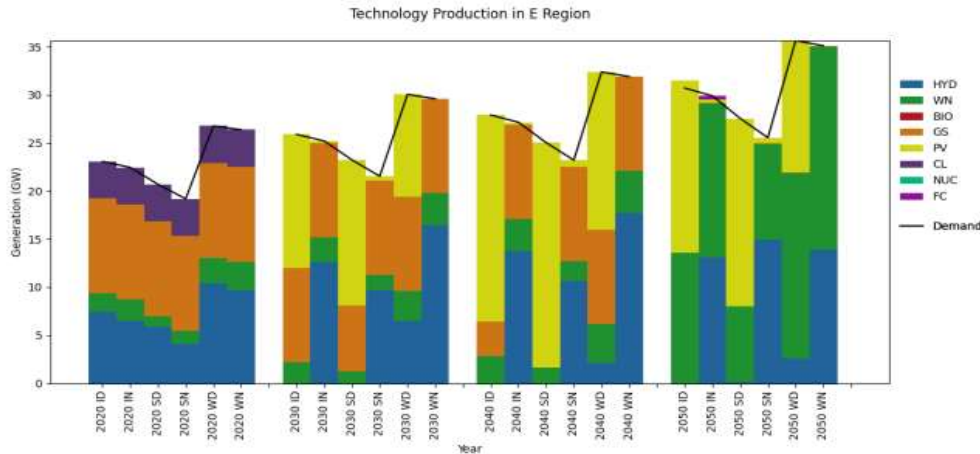


Constant Emission Penalty (\$50/tonne)
from 2022

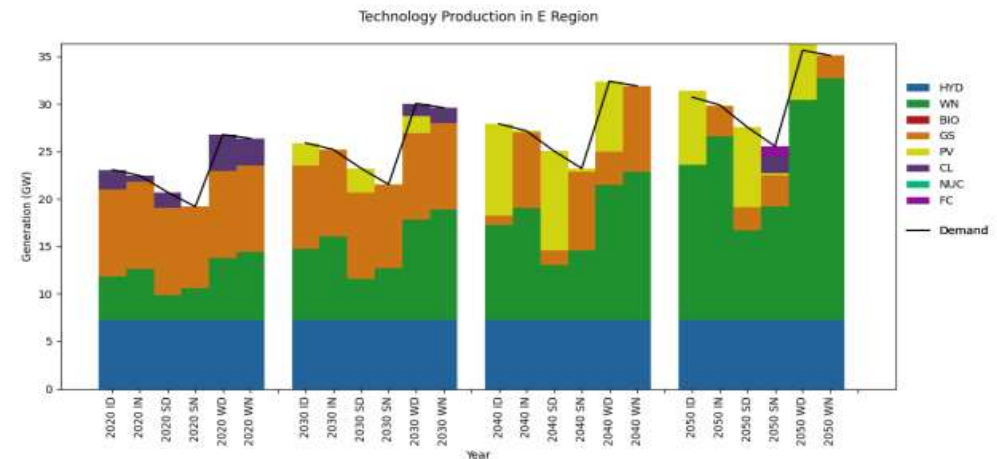


Constant Emission Penalty (\$170/tonne)
from 2030

Hydro at Restricted Operation (E – Energy Production)

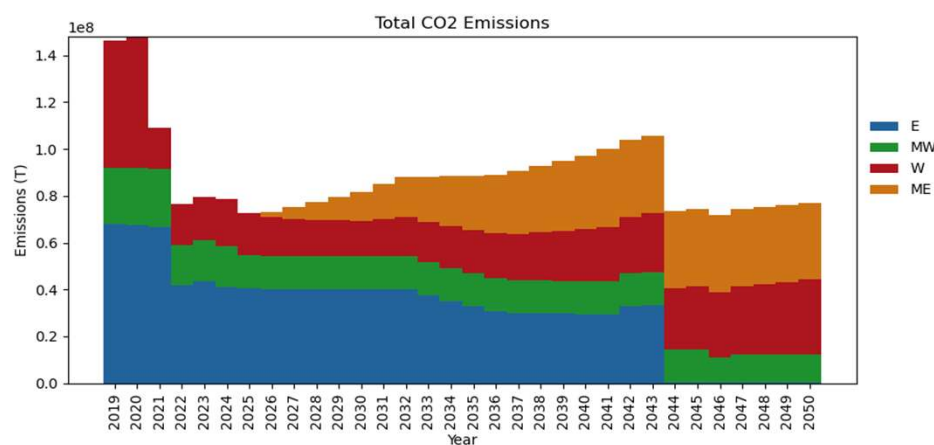


Constant Emission Penalty (\$50/tonne)
from 2022

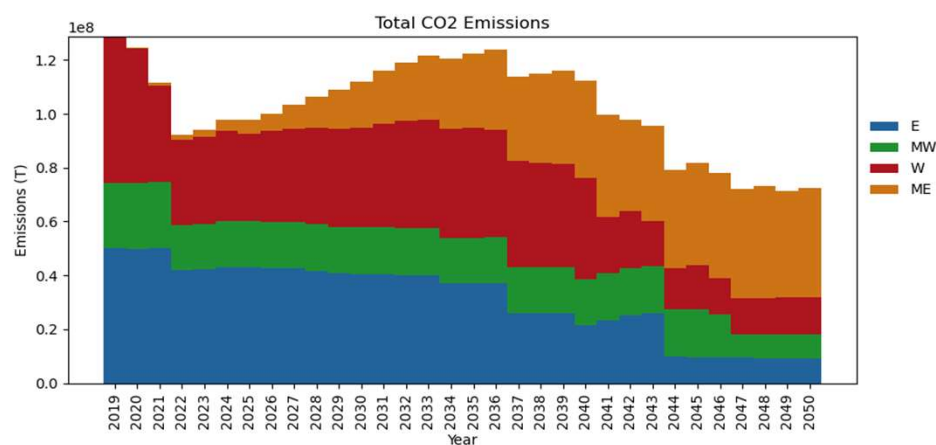


Restricted Hydro and Constant Emission
Penalty (\$50/tonne) from 2022

Hydro at Restricted Operation (Emission Forecast)

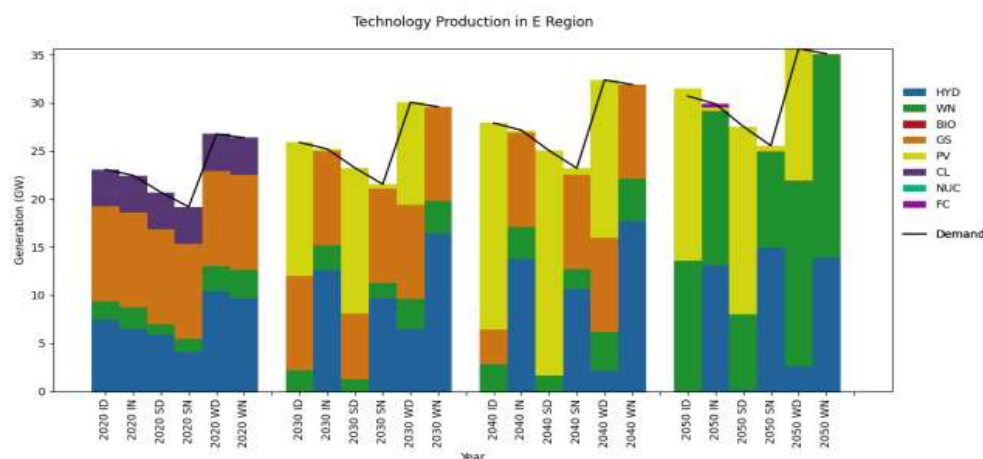


Constant Emission Penalty (\$50/tonne)
from 2022

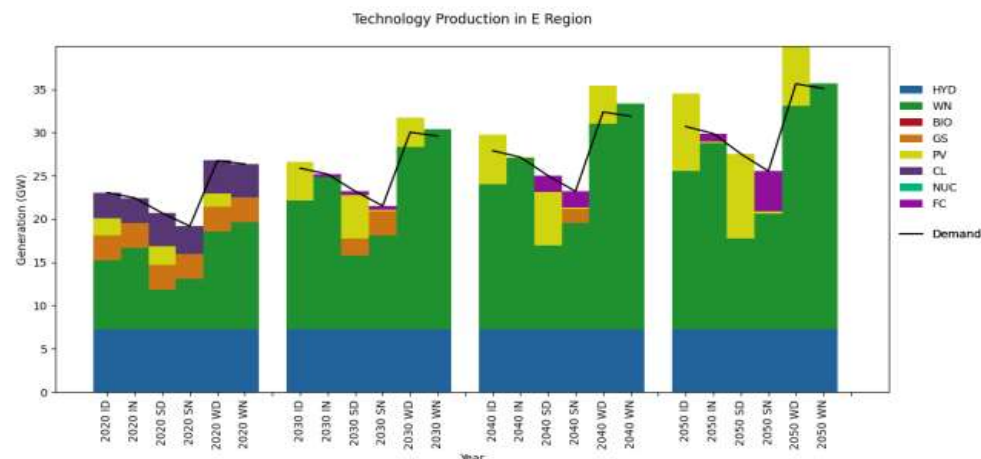


Restricted Hydro and Constant Emission
Penalty (\$50/tonne) from 2022

Hydro at Restricted Operation and Increase Emission Penalties (E – Energy Production)

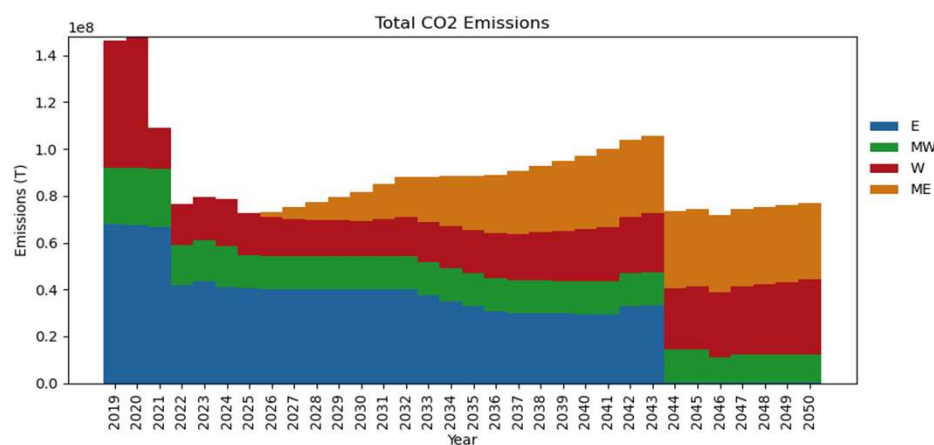


Constant Emission Penalty (\$50/tonne)
from 2022

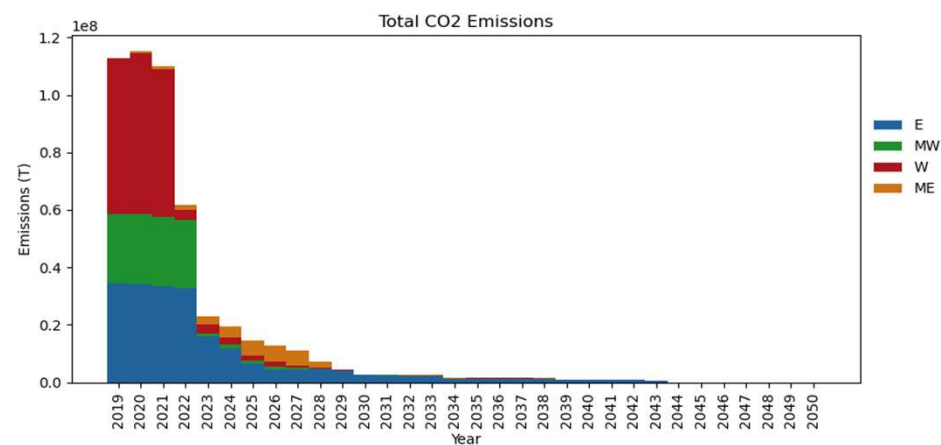


Restricted Hydro and Constant Emission
Penalty (\$170/tonne) from 2030

Hydro at Restricted Operation and Increase Emission Penalties (Emission Forecast)



Constant Emission Penalty (\$50/tonne)
from 2022



Restricted Hydro and Constant Emission
Penalty (\$170/tonne) from 2030

Conclusion

- Carbon Tax requirements (\$170/tonne by 2030)
- Flexibility of Hydro for the electricity system and emission reduction
- P2G's contribution to the electricity system and emission reduction

Discussion/Thank you!



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