

TECHNO-ECONOMIC MODELLING AND PUBLIC CONFIDENCE: TRUTH AND TRADE-OFFS

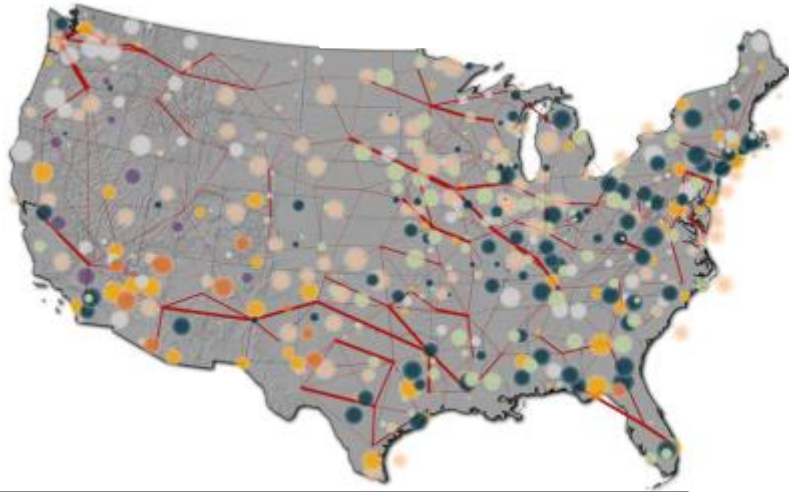
Dr. Bryson Robertson

January 24, 2017

Positive Energy – Trust in Transition

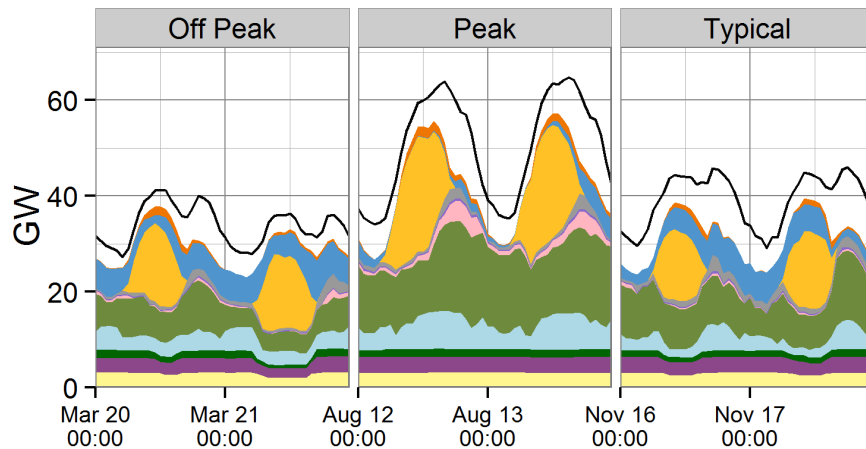


Energy System Models: Apples, Oranges and Pears



- Optimal generation and transmission planning
 - Decadal time scales
 - ReEDS model (NREL)

- Distributed market penetration for solar PV
 - Variety of time scales
 - dGen model (NREL)



- Operational model to understand system balancing
 - Unit commitment and economic dispatch
 - 5-minute resolution
 - PLEXOS model (Energy Exemplar)

Energy System Models: A Perspective

Four observations:

- # 1: Model output is only A prediction, not THE prediction.
- # 2: The past does not represent the future.
- # 3: Models will provide a 'pathway' to any imaginable future; no matter how impossible it may be.
- # 4: If the factor is 'soft' and can't easily be quantified, the model probably doesn't account for it.

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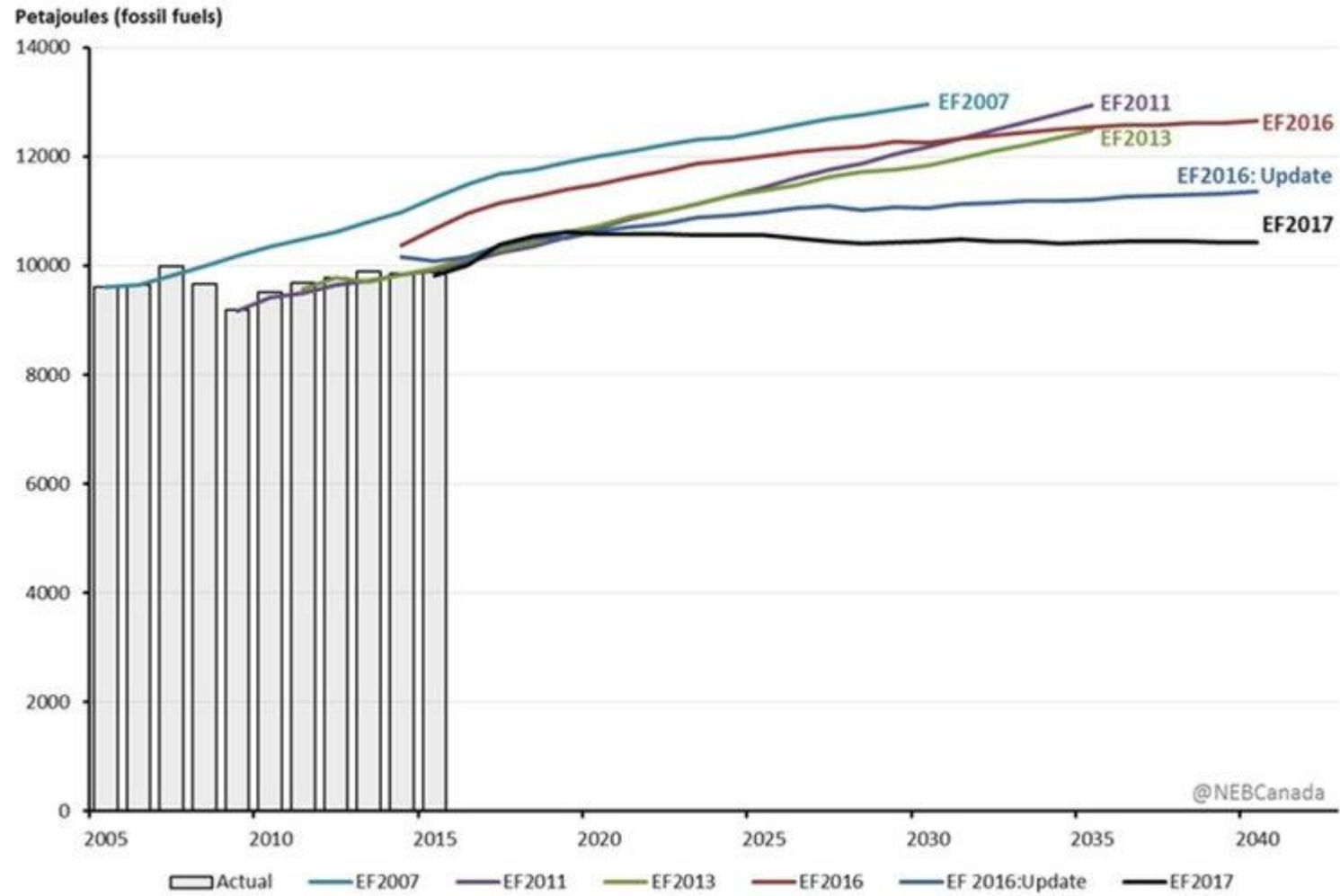
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Energy System Models: 'A' Prediction



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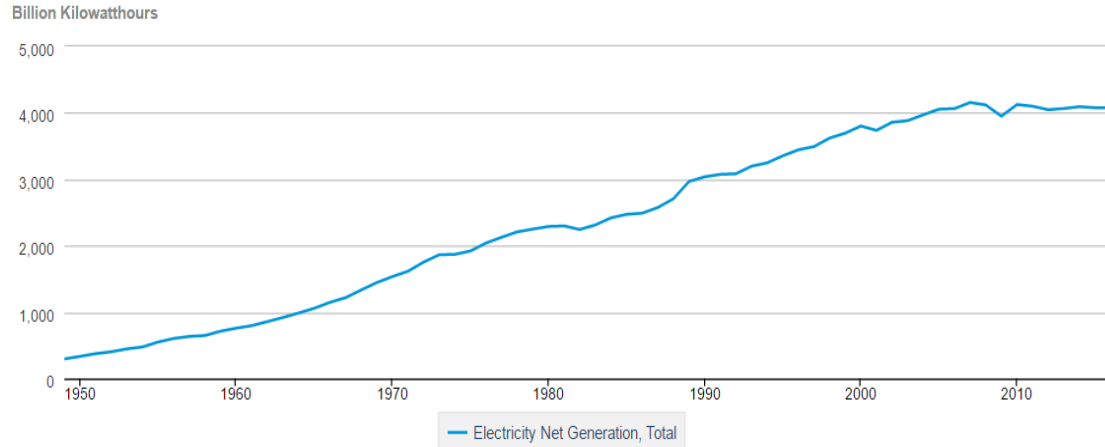
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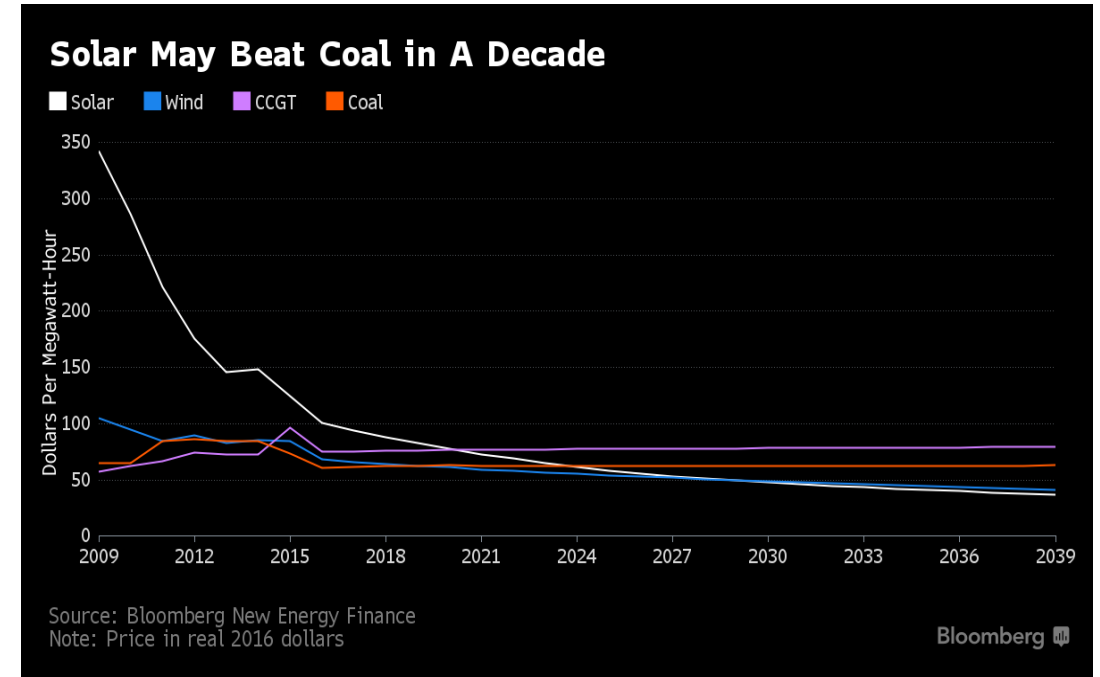
The Past Doesn't Reflect the Future

Flattening Electricity Demand



eia Source: U.S. Energy Information Administration

Technology Innovation



Electrification of Transportation and Heating



Xcel Energy: Colorado

- Wind: \$18.10/MWh
- Solar: \$29.50/MWh
- Wind + Storage: \$21.00/MWh
- Solar + Storage: \$36.00/MWh

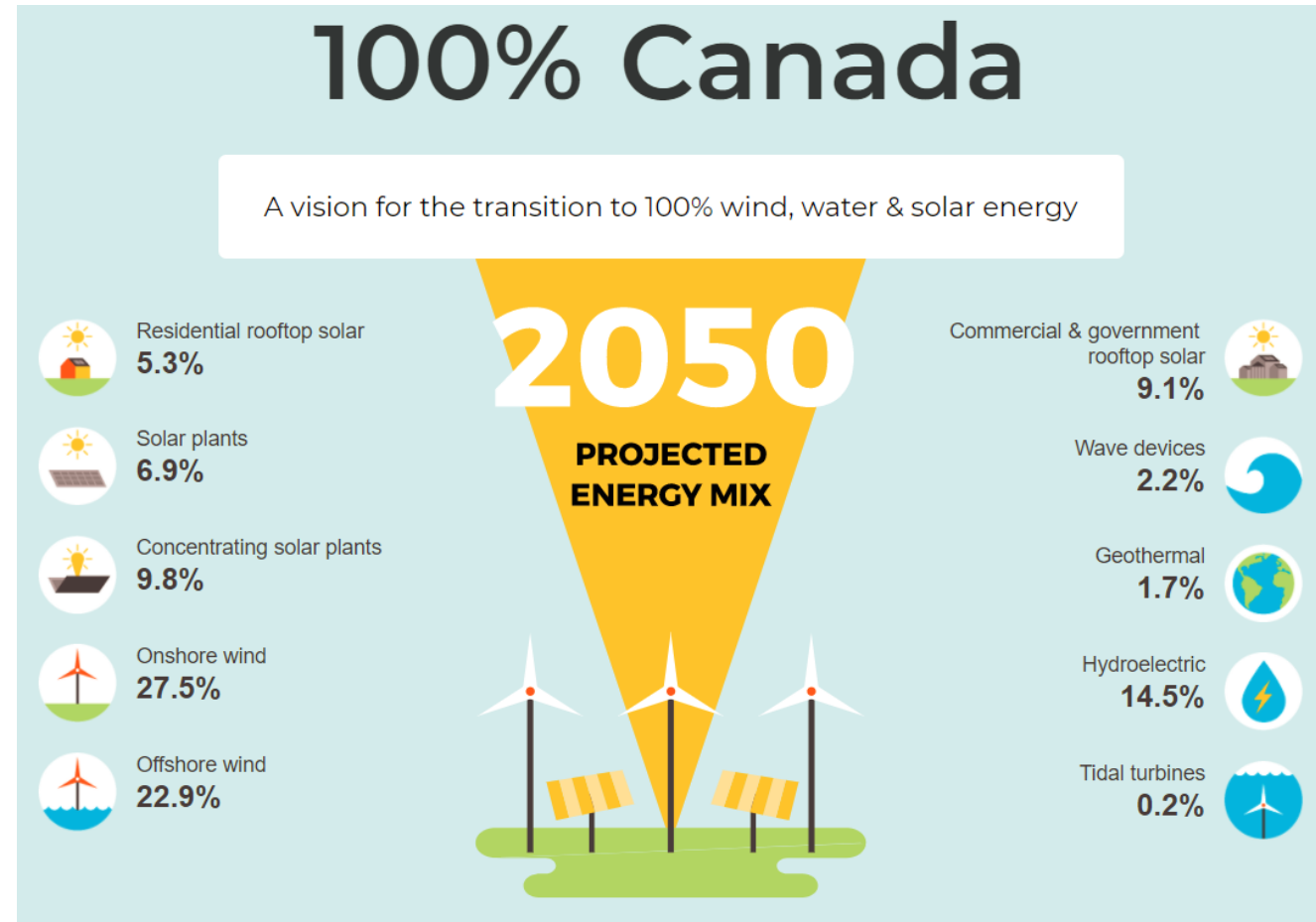
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“The Burden of Truth”: Heard et al. (2017)

- *Constraint 1:* The electricity demand must be realistically projected over the timeframe
- *Constraint 2:* Supply must be simulated to meet real-time demand, together with additional back-up within regulated limits, in all plausible climatic conditions.
- *Constraint 3:* Any transmission requirements must be sufficient to meet projected demand and reliability standards.
- *Constraint 4:* The proposed system must provide critical ancillary services to ensure power quality and reliable operation.



The Burden of Truth: Heard et al. (2017)

“...the push for the 100%-renewable ideal has ironically delayed the identification and implementation of effective decarbonization pathways.”

“We argue that the early exclusion of other forms of technology from plans to decarbonize the global electricity supply is unsupportable, and arguably reckless.”

“...a 100% renewable electricity supply would, at the very least, demand a re-invention of the entire electricity supply-and-demand system to enable renewable supplies to approach the reliability of the current systems.”

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Techno-Economic Models and Social Acceptance Proxies

Techno-economic models provide a technical and economically 'optimum' solution but ... this is only one part of 'the solution'.

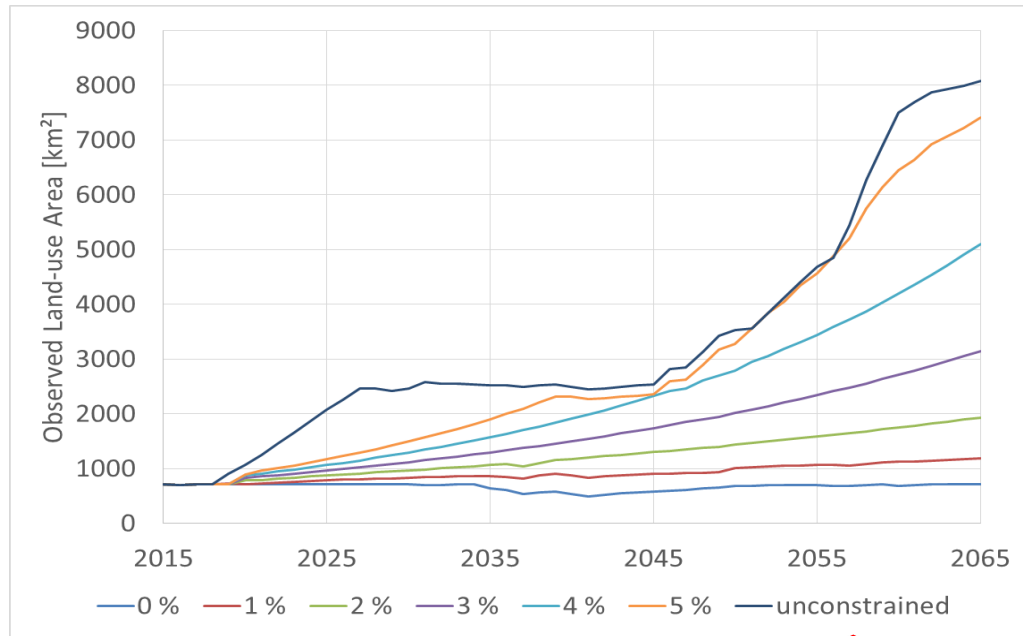
Human responses and interactions change 'the solution' or pathway

An example proxy for social acceptance: Land-use

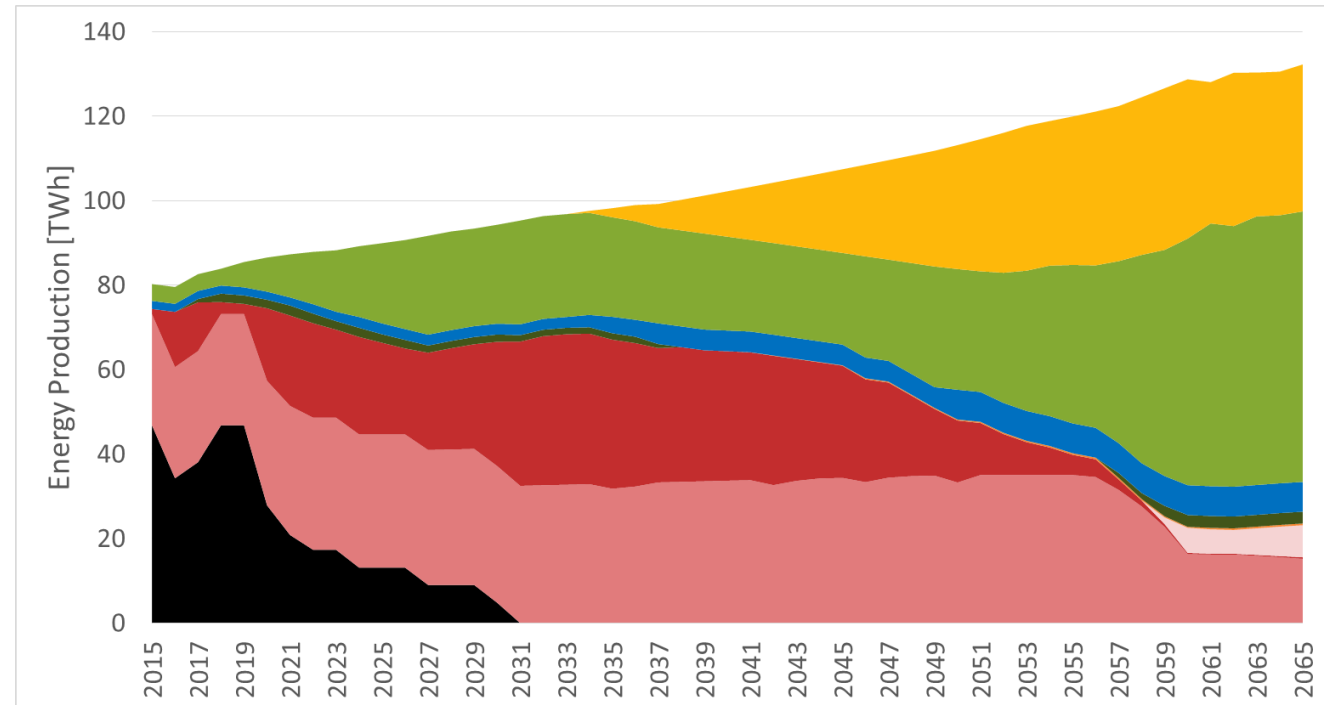


Alberta Land Transformation: Unconstrained

Total Annual Land-Use Area



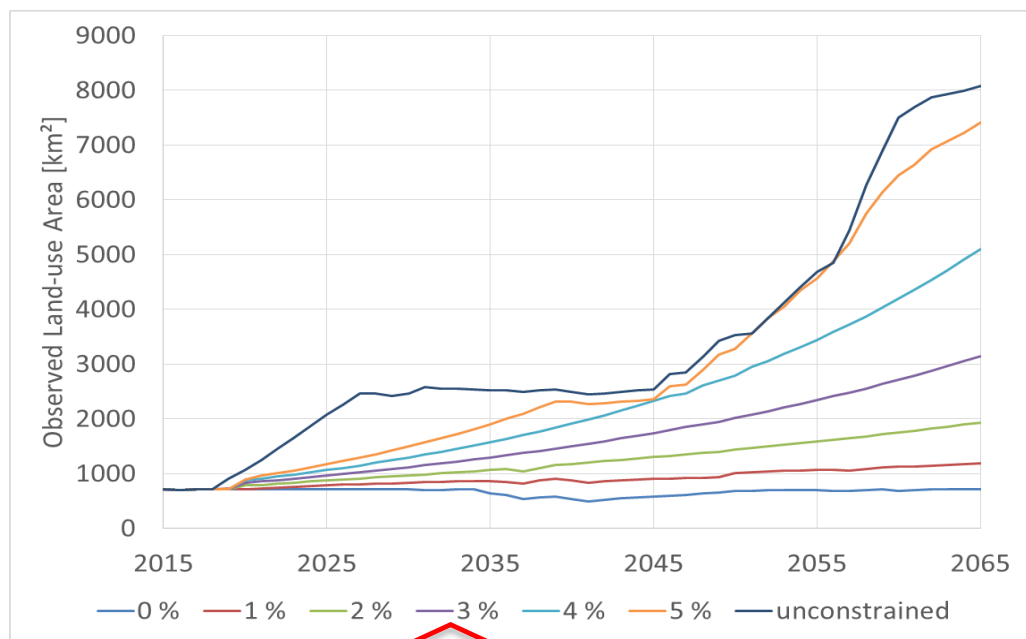
Annual Generation



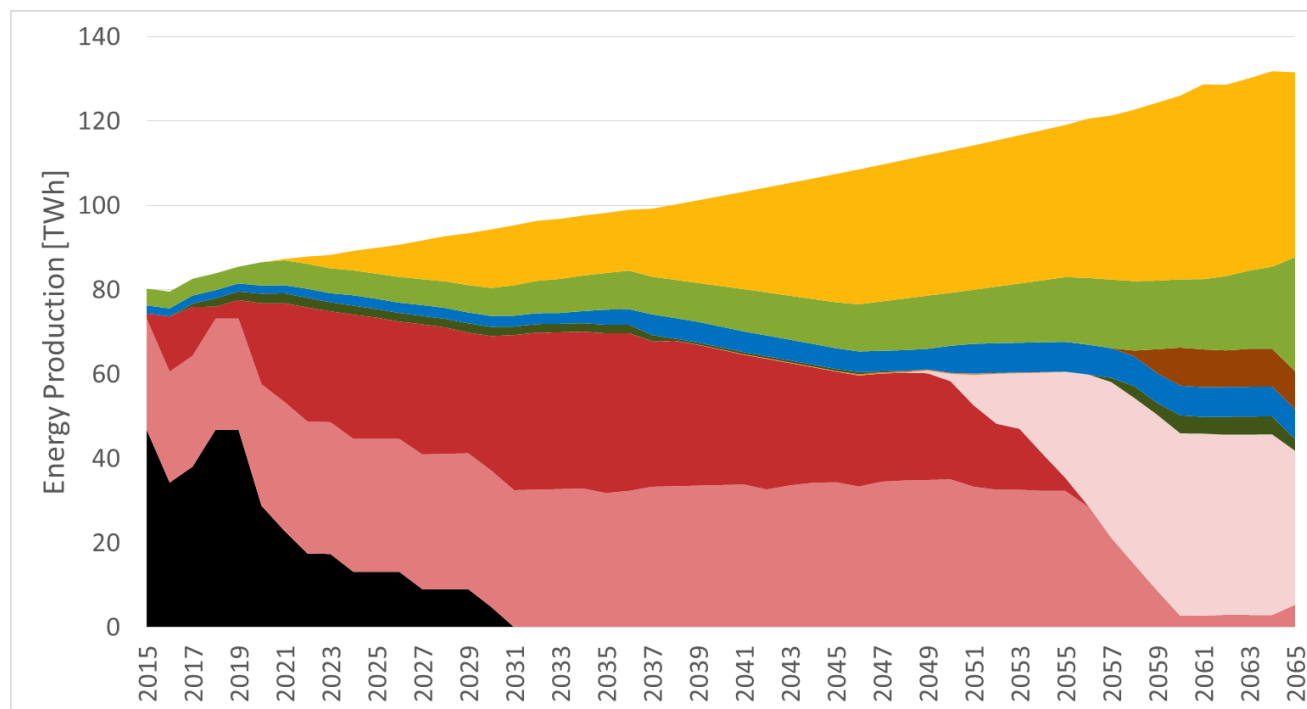
- Solar
- Wind
- Geothermal
- Hydro
- Bio
- RICE
- OCGT
- CCGT-CCS
- CCGT
- CoGen
- Coal-CCS
- Coal
- Nuclear
- Dummy

Land Transformation: 3%/yr.

Total Annual Land-Use Area



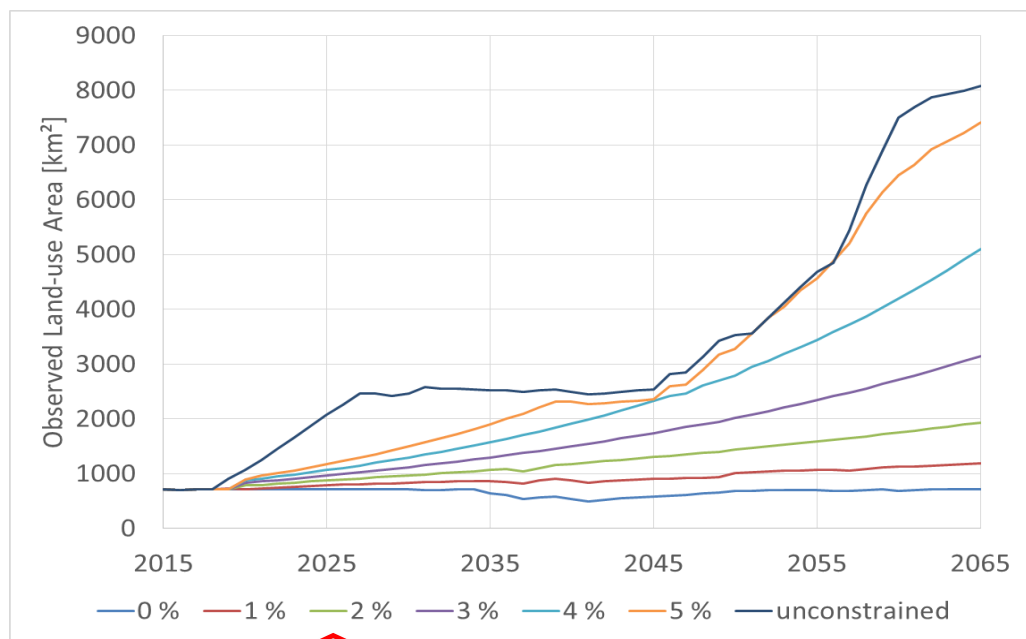
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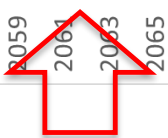
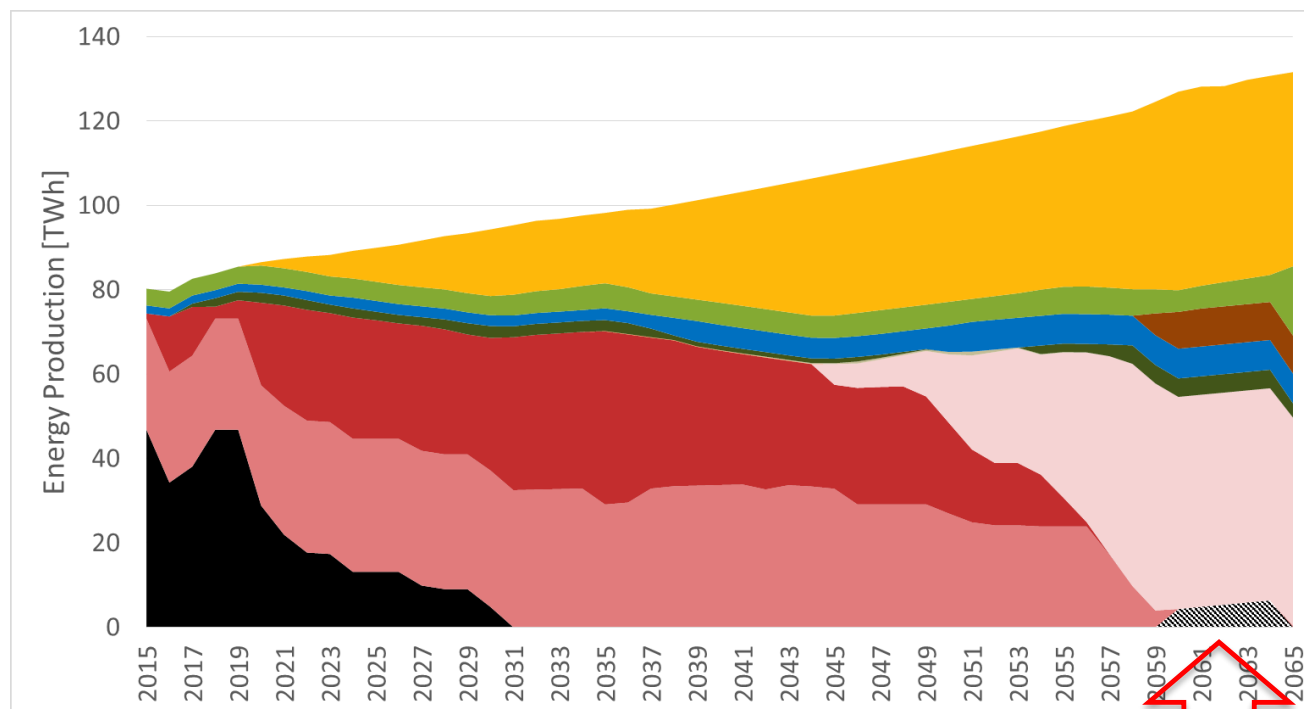
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- Coal
- Nuclear
- ▨ Dummy

Land Transformation: 2%/yr.

Total Annual Land-Use Area



Annual Generation



- Solar
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Opportunities

- Inclusion of Social Acceptance in techno-economic models.
- Assist the development of suitable policies to drive decarbonization with mitigation of possible risks
- Understand trade-offs and sensitivities to decarbonization
- Provide a healthy planet for my grandchildren to live on

Challenges

- Inclusion of Social Acceptance in techno-economic models.
- Ensuring pathways are feasible, AND viable.
- Enhancing awareness of trade-offs between pathways.
- Lack of publically available data Canadian data.

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2060
Project

