



PUMPED HYDRO STORAGE (PHS) AND BATTERY ENERGY STORAGE SYSTEMS (BESS): AN ASSESSMENT OF ENERGY 2020 INITIAL RESPONSE AND IDENTIFICATION OF POSSIBLE IMPROVEMENTS

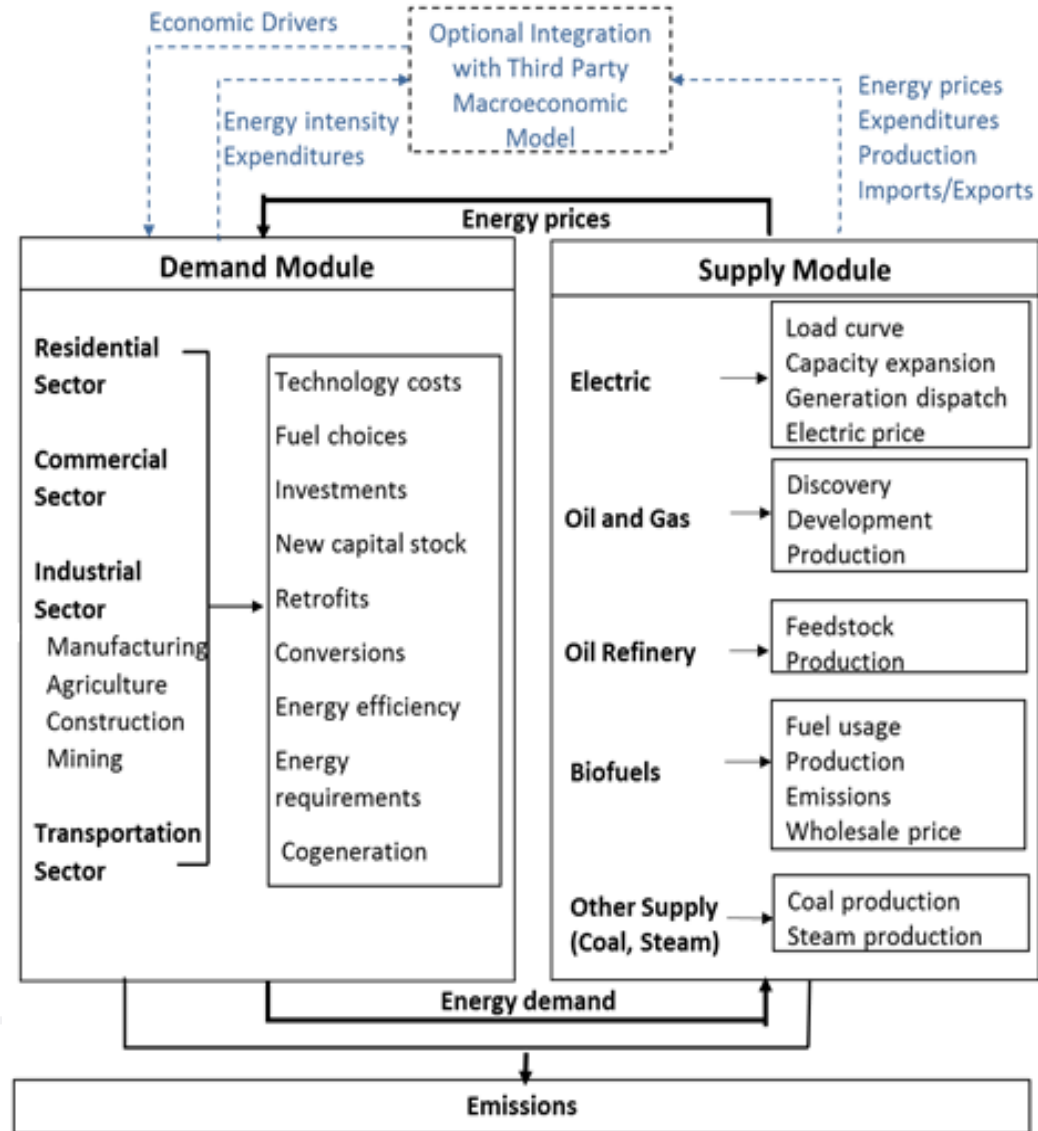
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 - Systematic Solutions, Inc.
 - Jeff Amlin and Ian Beitenhaus
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ENERGY 2020



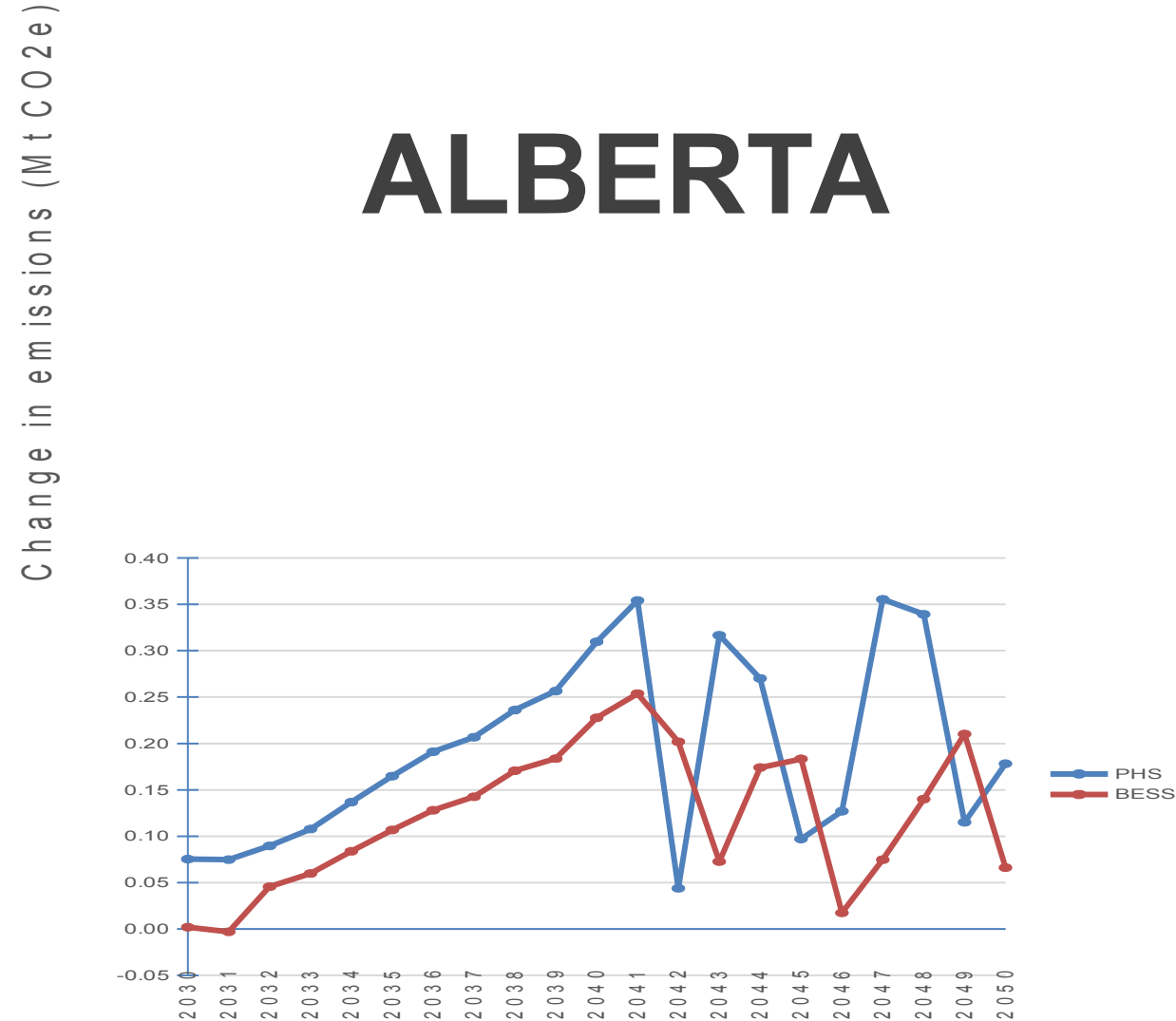
ENERGY 2020

- North America; each Canadian province and territory (PT)
 - Electricity:
 - Individual generating units; over 20 plant types
 - Prices vary by area and by time period (e.g. peak vs. baseload)
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METHODS

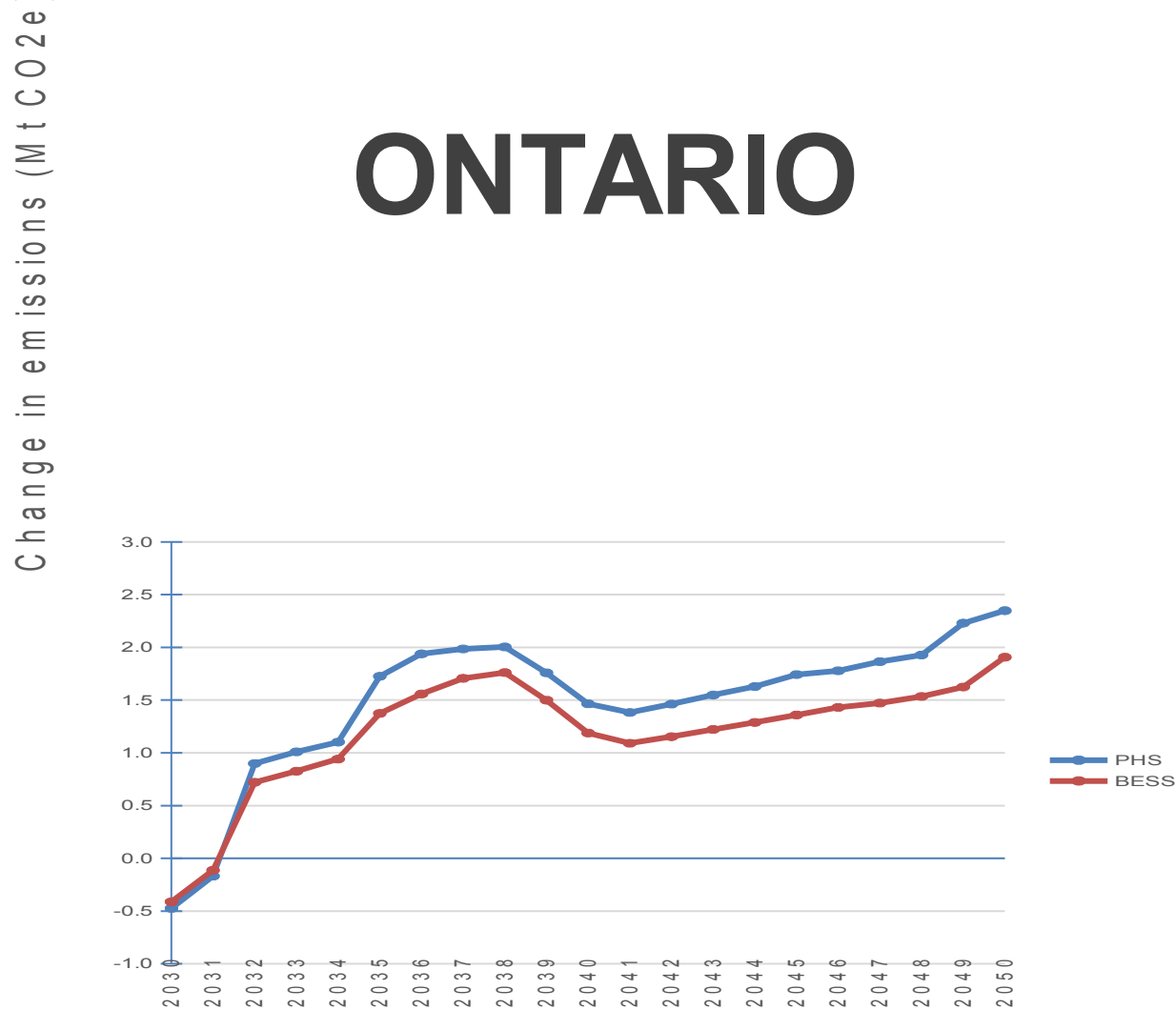
- Add grid-level storage units: Pumped Hydro Storage (PHS) and Battery Energy Storage System (BESS)
 - Three runs:
 - Control  no storage units in Canada
 - PHS  starts in 2030 and increases each year; eight PTs
 - BESS  starts in 2030 and increases each year; all PTs
 - Total capacity: 4.5-5 GW in 2030, 18-19 GW in 2050
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ALBERTA



- Need to recharge the storage units
- Modified flows with neighbouring provinces

ONTARIO



- Similar to Alberta
- Much stronger effect on flows  exports to the U.S.

CANADA

- Values similar to Ontario
 - Changes in total GHG emissions almost equal to changes in electricity-related GHG emissions
 - Reductions in total GHG emissions for Canada and the U.S. (except for three years in PHS)
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DISCUSSION

- Do not simply assume ‘carbon-free recharge electricity’
 - Depends on portfolio of units, contracts, etc.
 - Amount and efficiency of storage units
 - Storage-related changes in electricity prices matter
 - Can impact flows
 - Can affect GHG emissions elsewhere
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FUTURE WORK

- Improve the impact of grid-level storage units on electricity prices
 - Explore links (i.e. constraints) between storage capacity and variable renewable electricity (VRE) units
 - Dispatch of existing VRE units
 - Construction of new VRE units
 - Collaboration with other groups could be helpful
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