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North American Natural Gas Market and Infrastructure Developments Under Different Mechanisms of Renewable Policy Coordination

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Disclaimer: *results are currently under review. Analysis and results in this presentation are not to be cited or reproduced in any other way.*

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OUTLINE

- **Motivation**
- Research Question
- Methodology: multi-model, soft-link study
- Results
- Conclusions
- Limitations & Future Research

WHAT ARE RENEWABLE PORTFOLIO STANDARDS?

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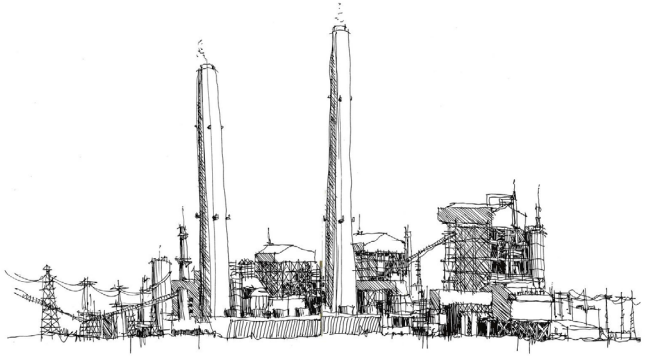
non-emitter

emitter



issue RECs

purchase RECs

Renewable Energy Certificates (RECs) Market Clearing

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WHAT DOES RENEWABLES PENETRATION IMPLY FOR NATURAL GAS CONSUMPTION?

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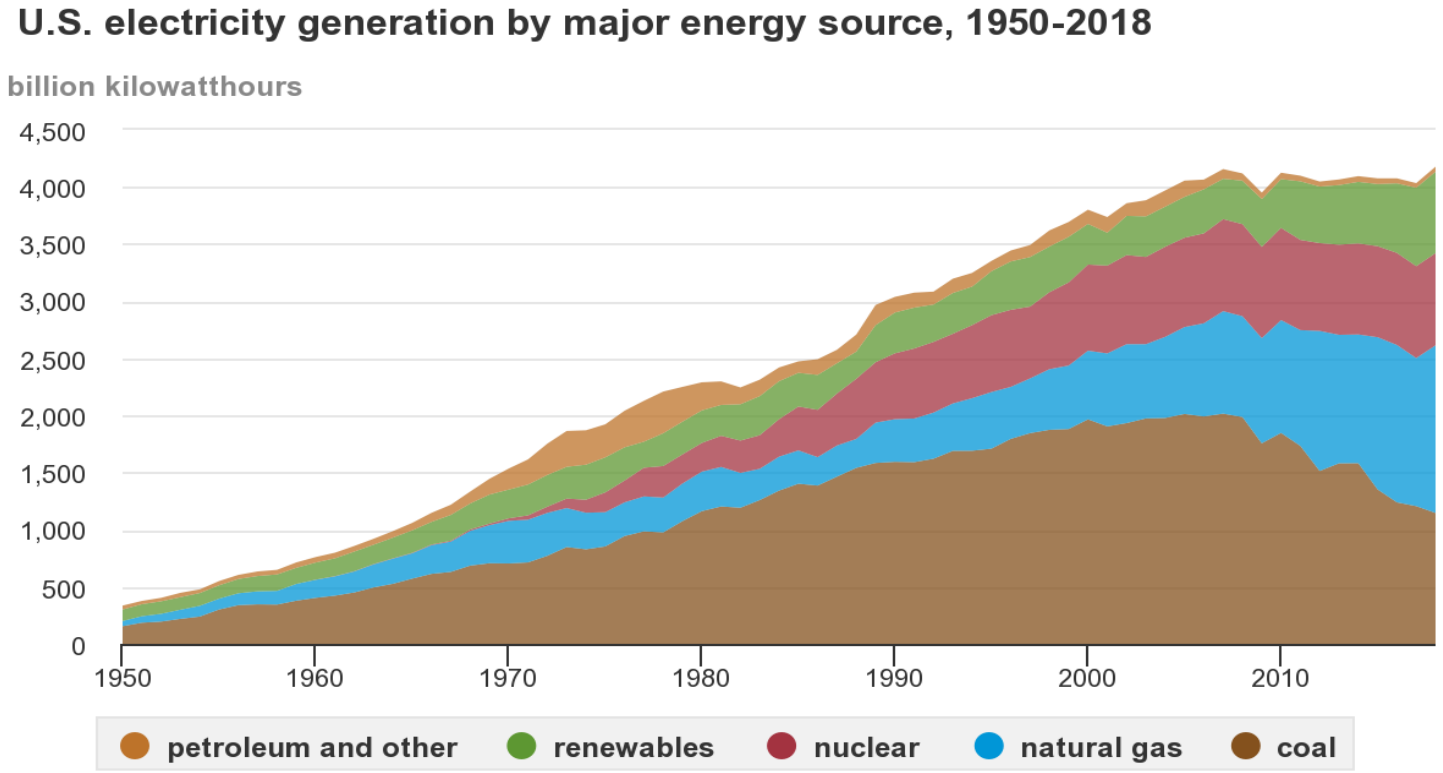

eia

Note: Electricity generation from utility-scale facilities.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, March 2019

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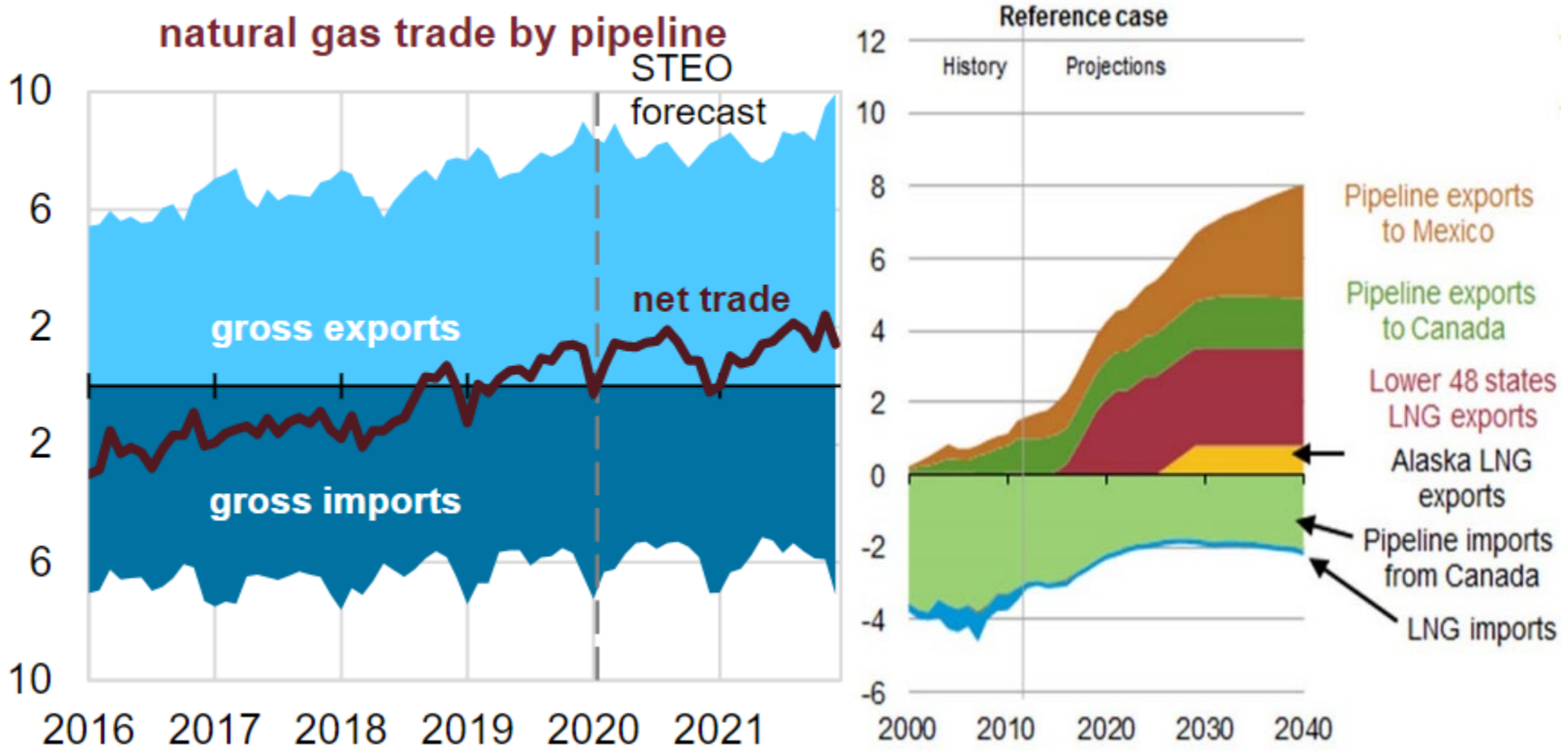
TRENDS IN INTERNATIONAL NATURAL GAS TRADE



Source: U.S. Energy Information Administration

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TRENDS IN NATURAL GAS PIPELINE INFRASTRUCTURE

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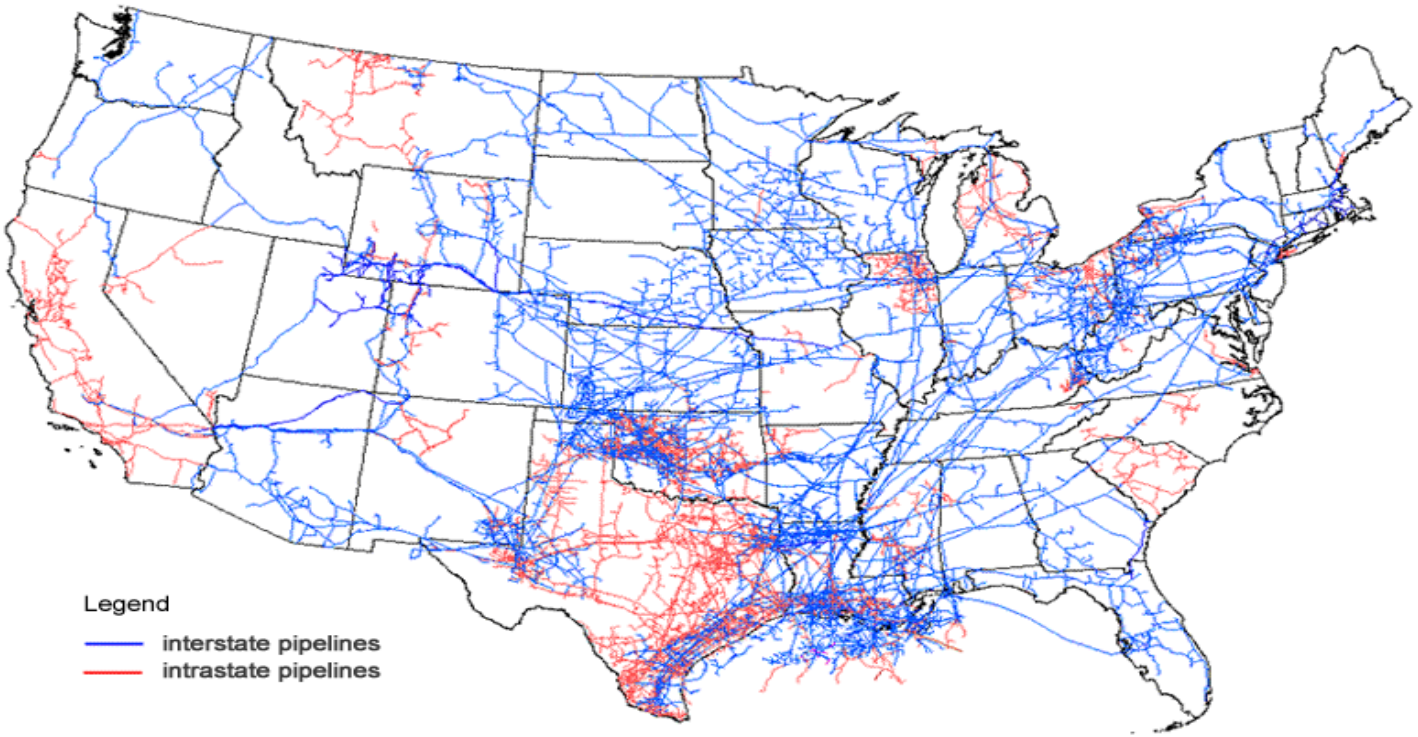
Map of U.S. interstate and intrastate natural gas pipelines



Source: U.S. Energy Information Administration, *About U.S. Natural Gas Pipelines*

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RESEARCH QUESTIONS

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What is the impact of more stringent RPS targets on natural infrastructure and trade? How does the impact change when RECs are allowed to be traded between producers of different states and North American regions?

How sensitive are the results for the natural gas sector to the modeling assumptions of different electricity markets models?

How do the developments in the natural gas market inform policy-making in the electricity sector?

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SCENARIOS DESCRIPTION

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- **Target:** share of retail load in North America covered by eligible sources is set greater or equal to 30% in 2020 and 60% in 2050, with linear increase between years.
  - **International coordination (Scenario 1):** unbundled RECs are traded between the U.S., Canada, and Mexico.
  - **No international coordination (Scenario 2):** unbundled RECs are *only* among electricity producers of the same ***country*** in the U.S., Canada, and Mexico.
  - **No inter-regional coordination (Scenario 3):** unbundled RECs to be traded *only* between producers of the same ***region*** of the U.S., Canada, and Mexico.

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DESCRIPTION OF MODELS

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Model Name	Abbr.	Sectors	Countries	# of Regions	Supporting Organization(s)
North American Natural Gas Model	NANGAM	Natural Gas	U.S., Canada, Mexico	17	Johns Hopkins University
Regional Energy Deployment System	ReEDS2.0	Electricity	U.S., Canada, Mexico	73	National Renewable Energy Laboratory
North American TIMES Energy Model	NATEM	Electricity	Canada	13	ESMIA Consultants Inc.
National Energy Modeling System	NEMS-AEO2019	Electricity, End-Use	U.S.	22	U.S. Energy Information Administration
Global Energy System Model	GENeSYS-MOD	Electricity	Mexico	9	DIW Berlin

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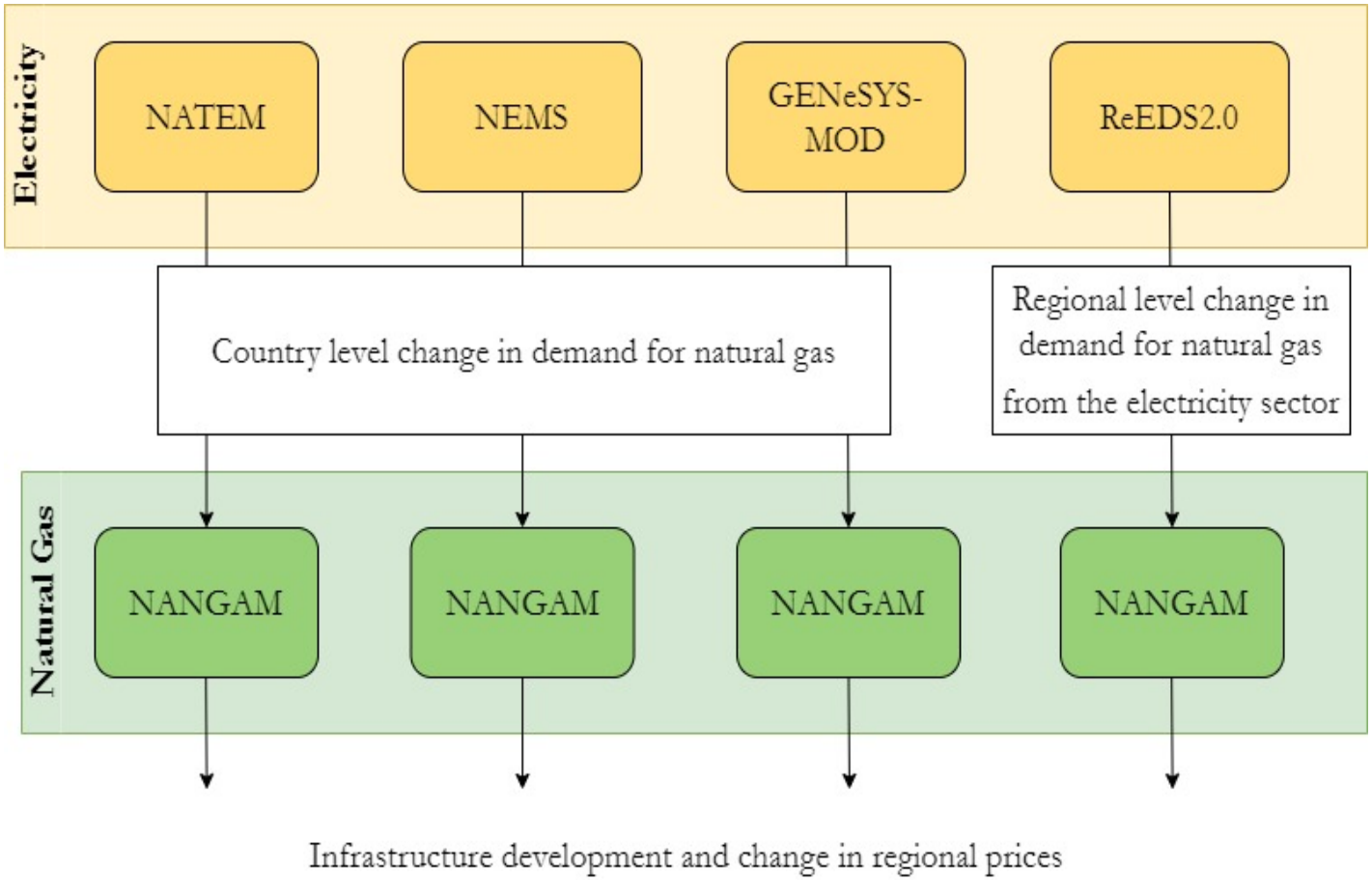
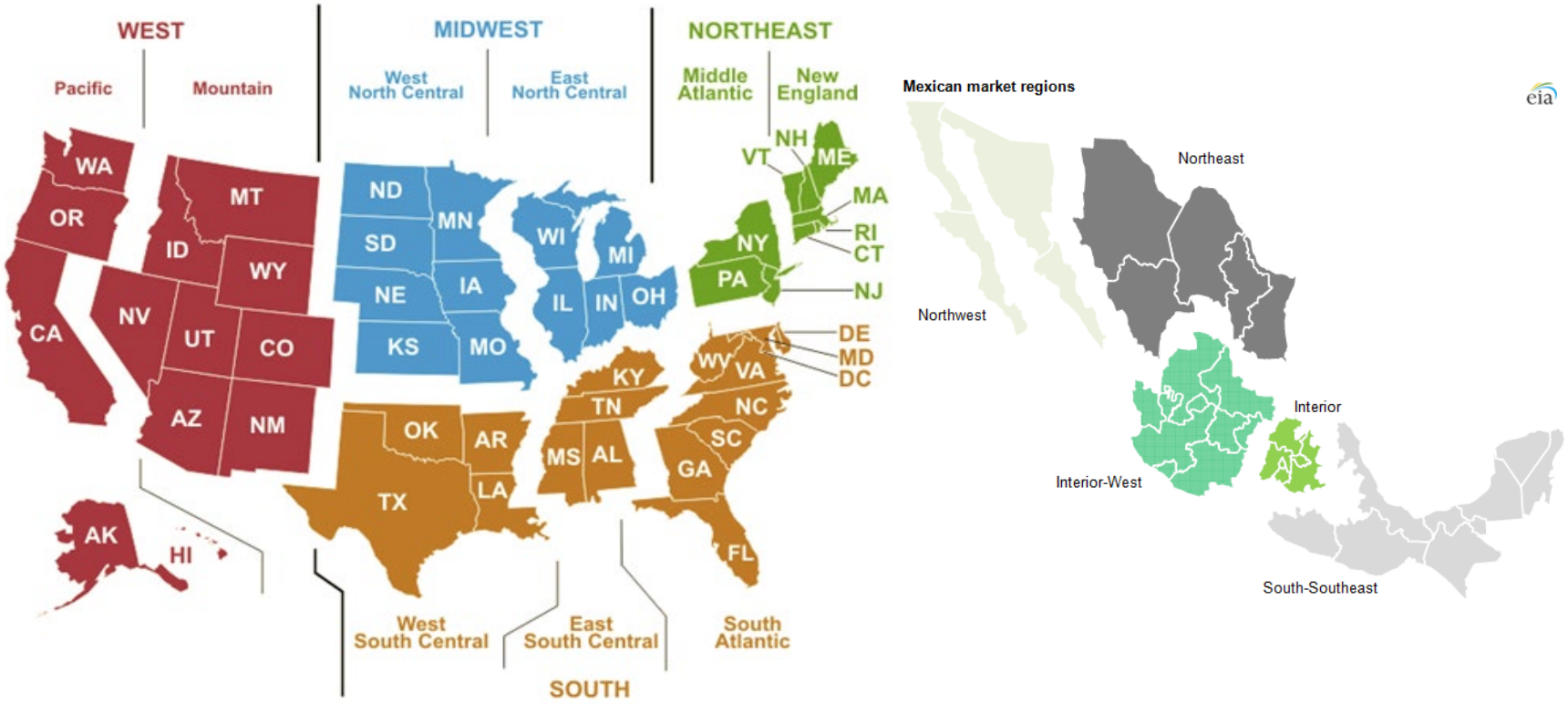
MODEL COUPLING



Description of linkage between NANGAM and all other models.

REGIONAL DISAGGREGATION IN NANGAM



U.S. Census regions (left) and regional disaggregation of Mexico (right) in NANGAM. Source: U.S. Energy Information Administration.

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DECREASE IN U.S. NATURAL GAS PRODUCTION INFRASTRUCTURE INVESTMENT BY 2050

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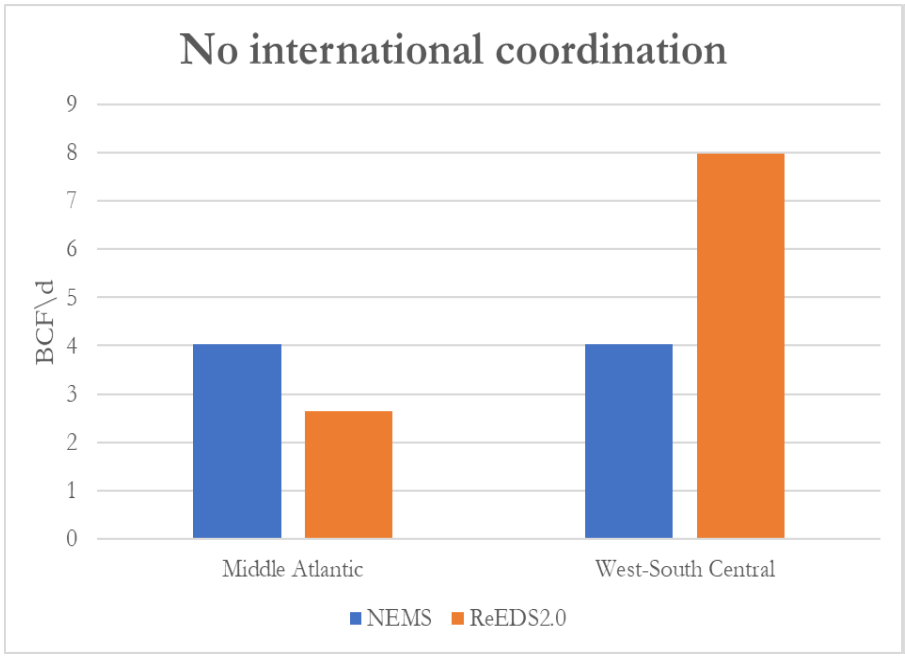

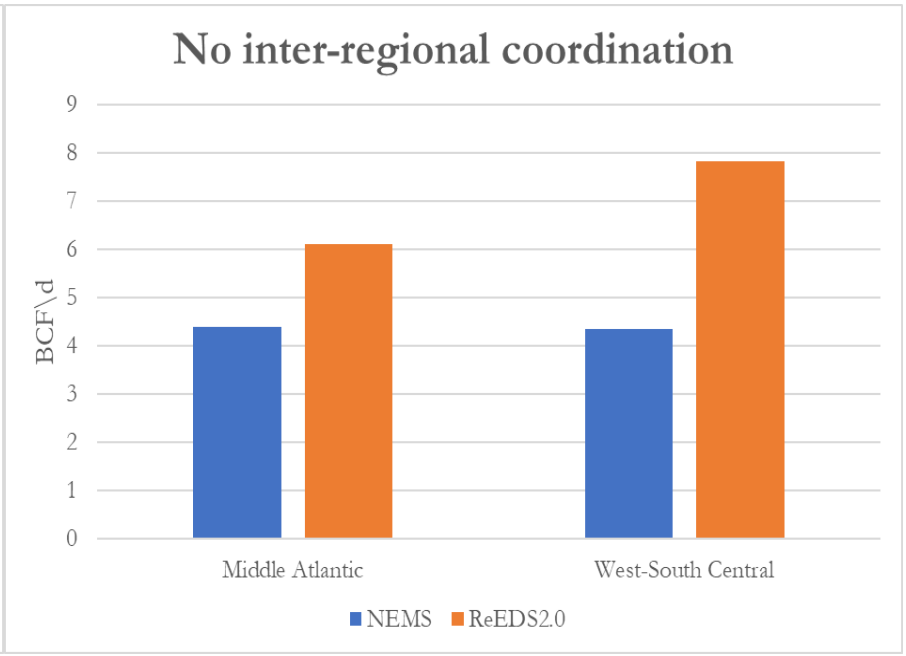

NANGAM results. Regional natural gas production infrastructure investment follows different trajectories, based on the modeling assumptions of the gas consumption-generating model.

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NET CANADIAN NATURAL GAS EXPORTS TO THE U.S.

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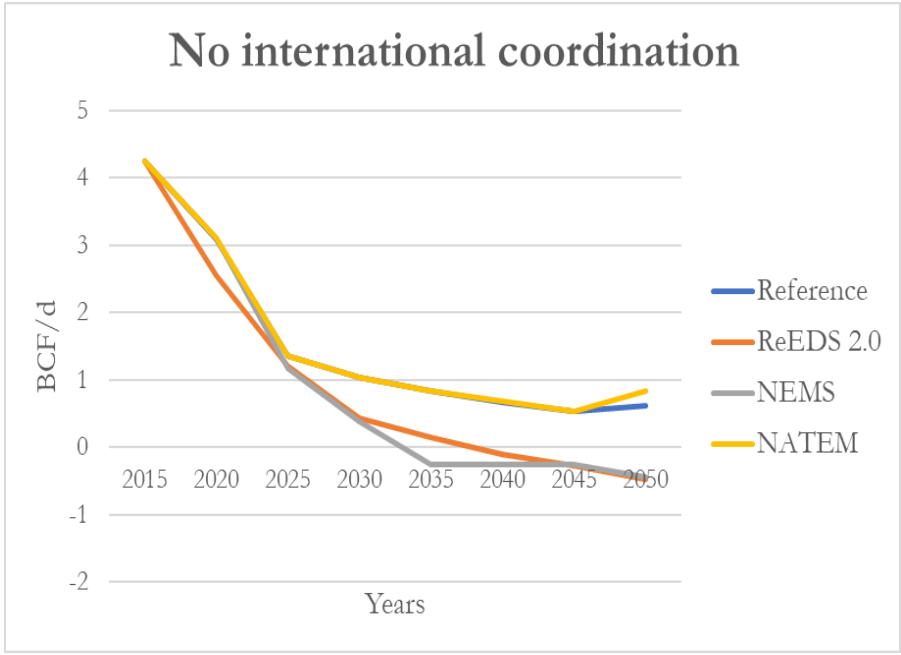

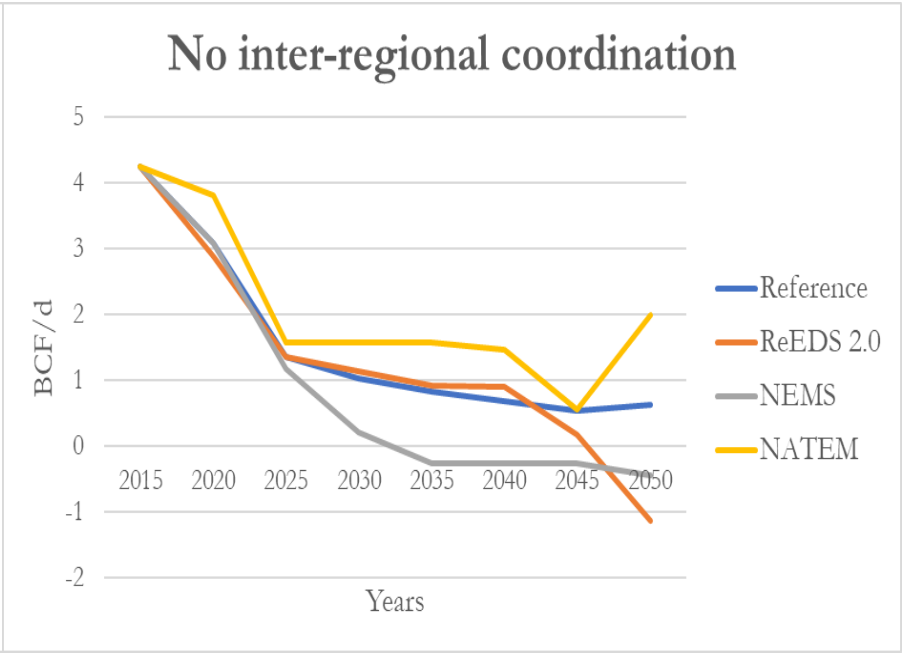

NANGAM results. Results vary depending on the country represented in each model.

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NET U.S. NATURAL GAS EXPORTS TO MEXICO

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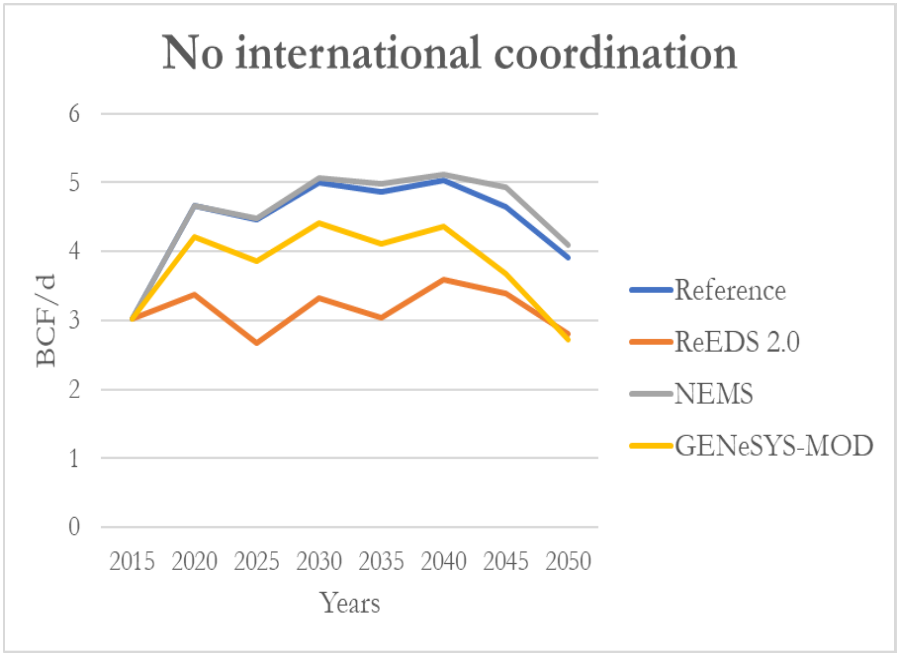

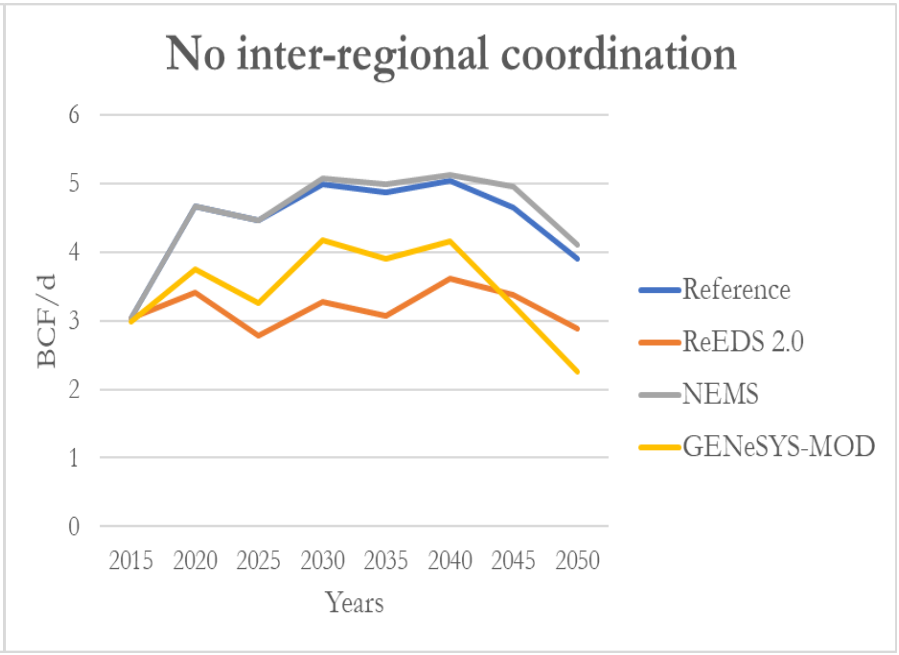

NANGAM results. Results vary depending on the country represented in each model.

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NATURAL GAS PIPELINE USAGE RATE OF MAJOR INTERCONNECTIONS, 2030

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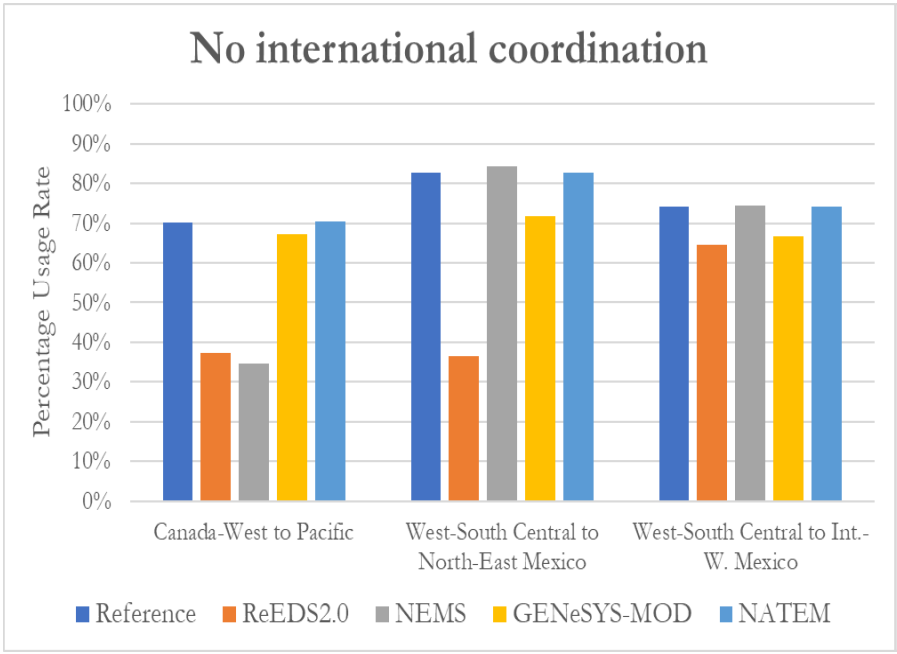

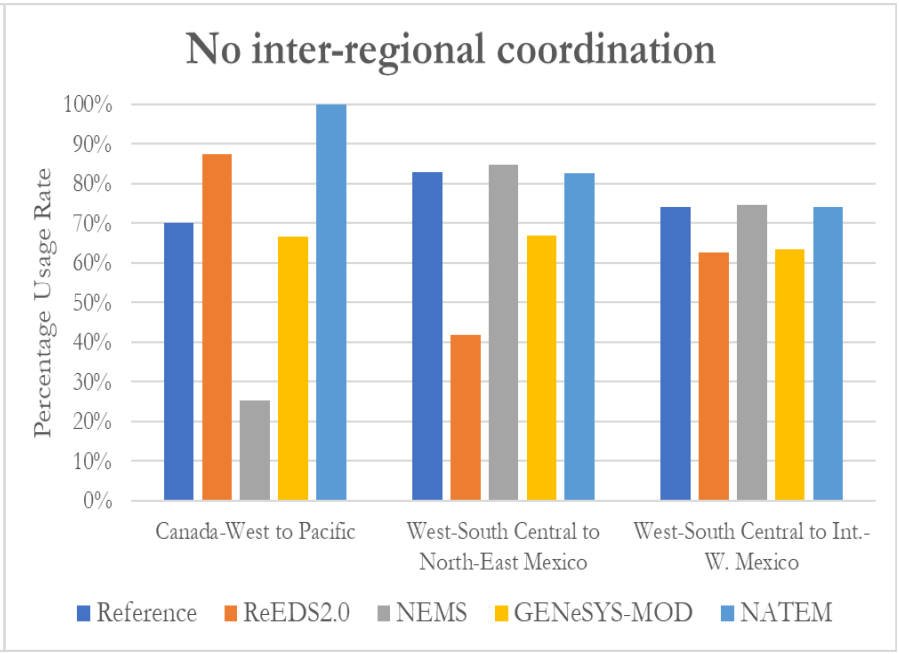

NANGAM results. Pipeline infrastructure suffices and there is no pipeline investment. The usage rate adjusts instead. Results vary depending on model inputs.

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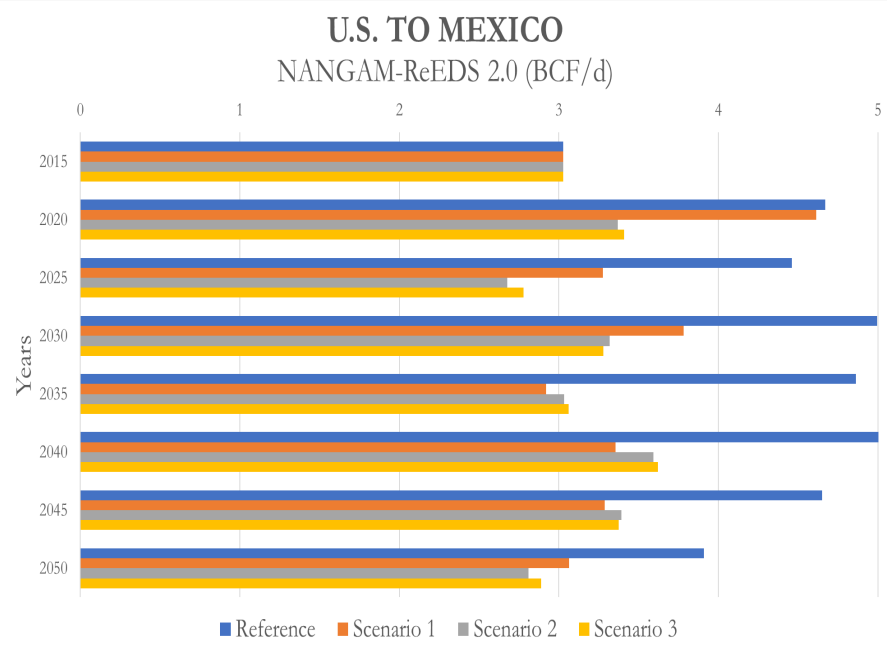
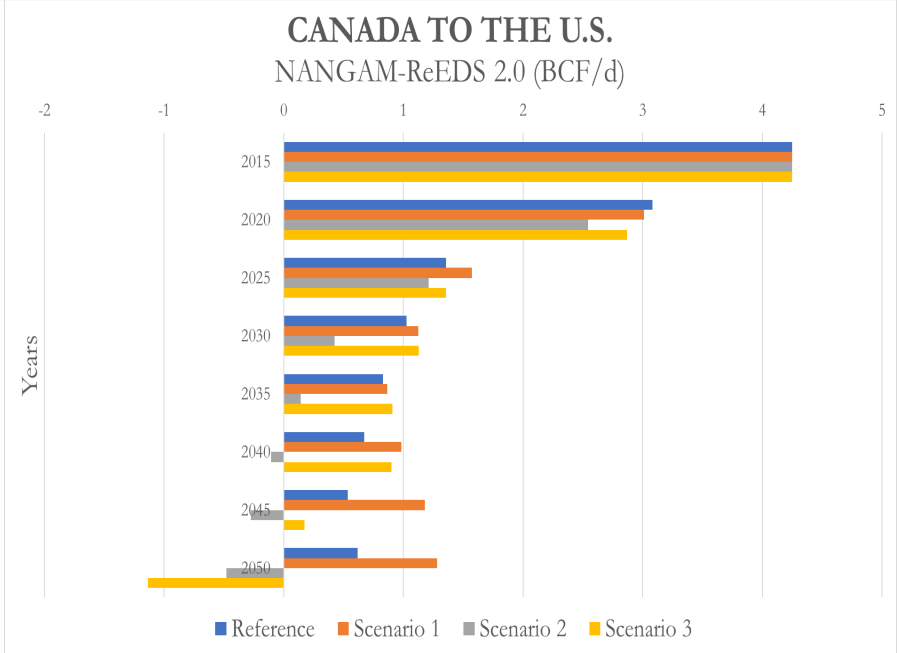
NET U.S. NATURAL GAS IMPORTS AND EXPORTS





NANGAM results. Net Exports of U.S. to Mexico (left) and Canada to the U.S. (right) for all scenarios and years. Inputs from ReEDS2.0.

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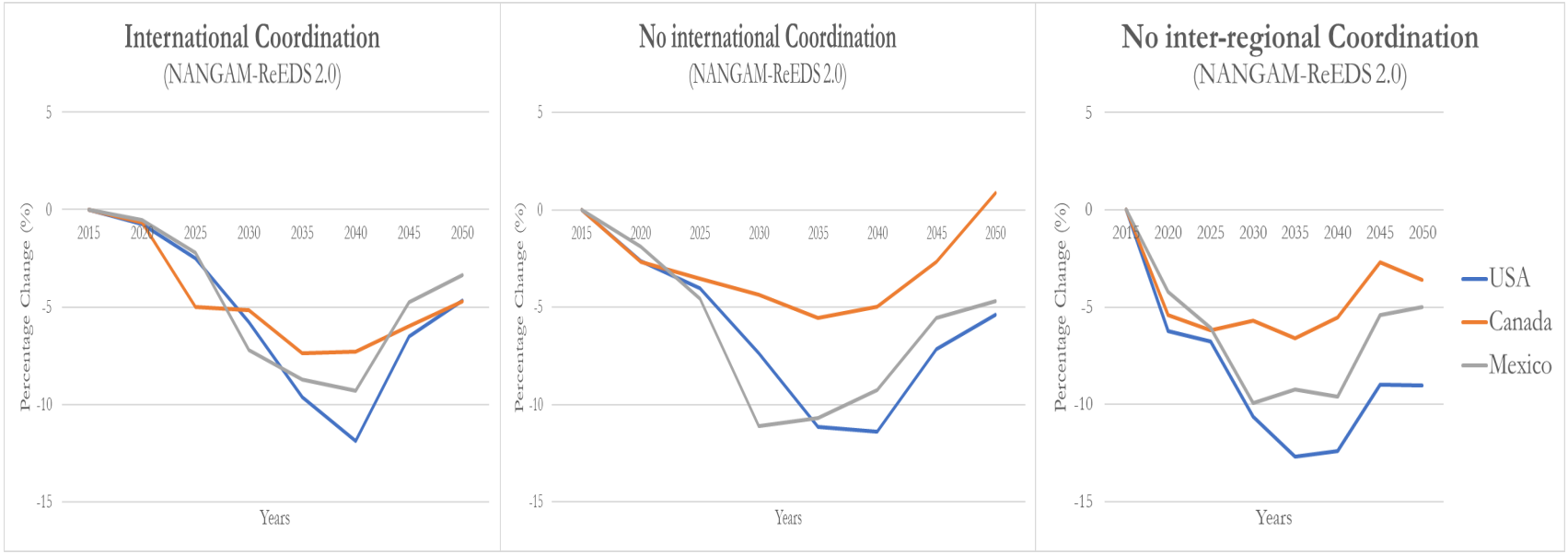
PERCENTAGE CHANGE IN NATURAL GAS PRICES COMPARED TO REFERENCE



International coordination results in smaller variance of natural gas prices when compared to Reference for all three countries.

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CONCLUSIONS

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- Natural gas infrastructure development is sensitive to renewable policy coordination assumptions.

- Investment in inter-country pipeline infrastructure remains unchanged ⇒ *change in pipeline usage rate instead*.

- coordination ⇒ natural gas price variation due to the policy

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LIMITATIONS & FUTURE RESEARCH

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- One-way link between energy-economy/electricity and natural gas model.
- Liquified Natural Gas is treated as exogenous.
- Future research on how changes in lifecycle emissions for the different RPS coordination schemes impact welfare.

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Thank you

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