Chaire de gestion
du secteur de l'énergie
HEC MONTRÉAL

Les bénéfices de l'intégration des marchés de l'électricité dans le Nord-Est de l'Amérique

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Deep decarbonization in Northeastern North America: The value of electricity market integration and hydropower

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ARTICLE INFO

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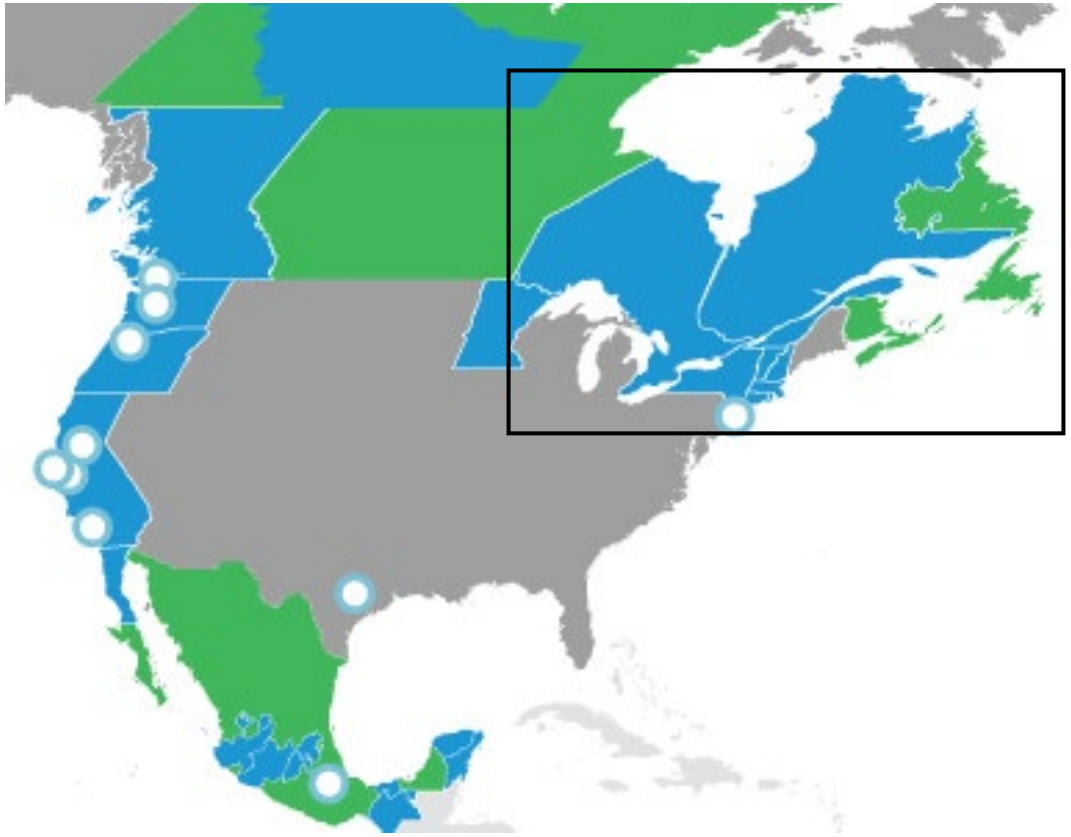
Pierre-Olivier Pineau
avec Jesús A. Rodríguez et Sébastien Debia

29 mars 2021 – 10h30-12h

Le Nord-Est est engagé dans la décarbonation



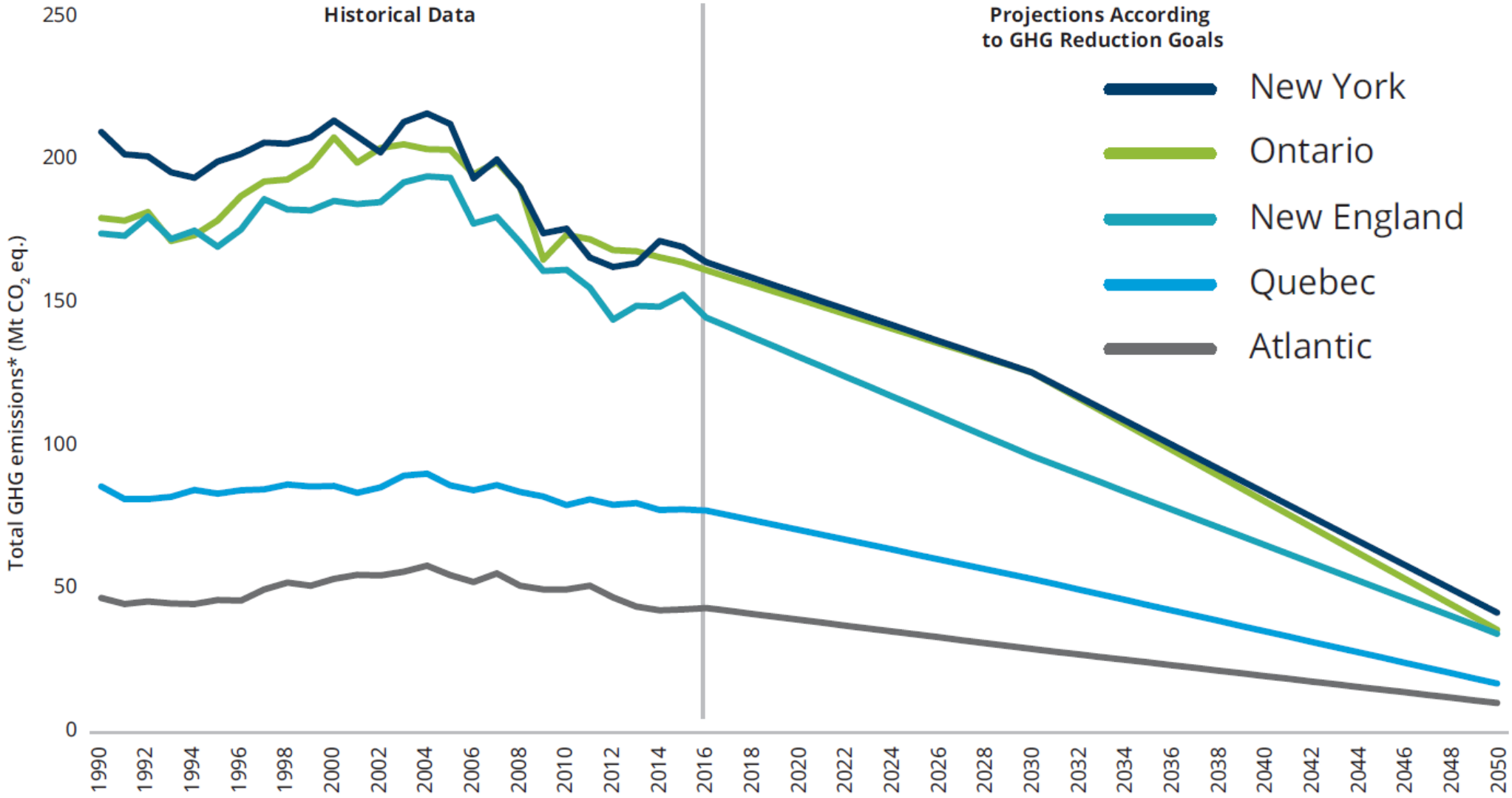
Under 2° Coalition: Réduction de 80-95% des GES sous le niveau de 1990

Des vraies initiatives:

- Renewable Portfolio Standards (RPS)
- Marchés du carbone: RGGI + WCI
- Clean energy funds
- New York's Reforming the Energy Vision (REV)
- Massachusetts Clean Energy RFP
- …

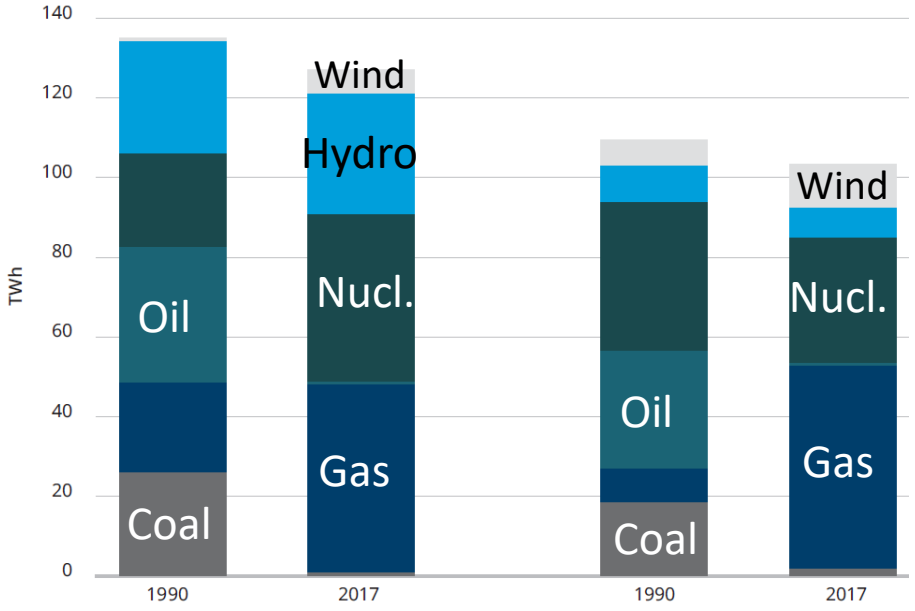
Under2mou (2017)

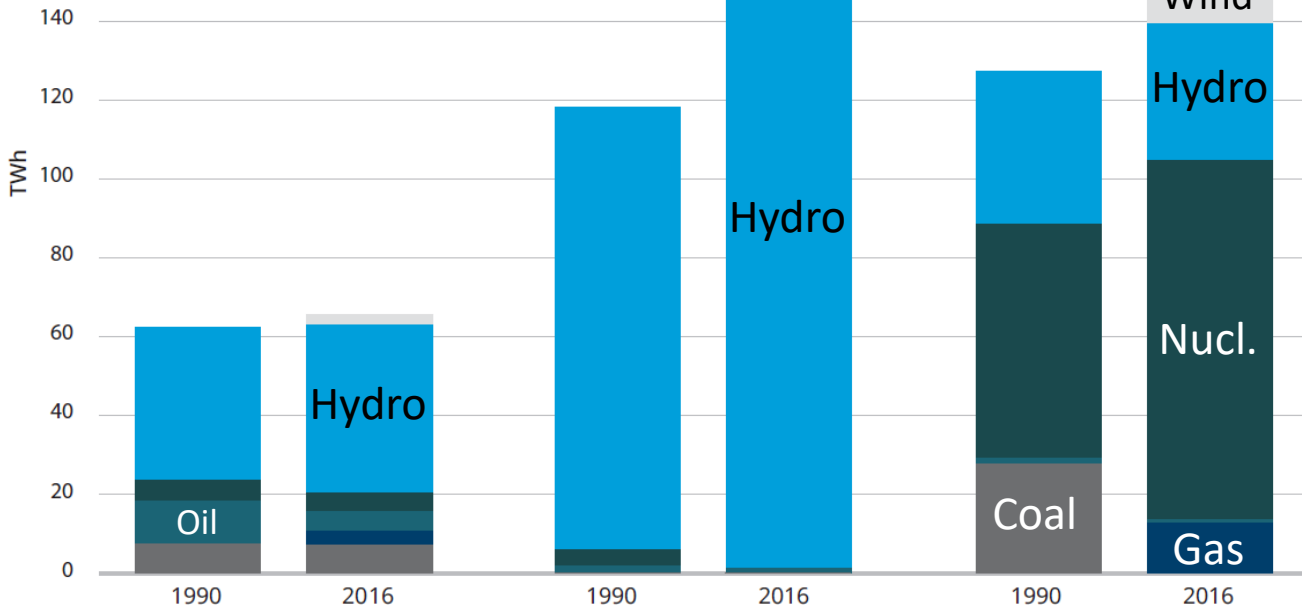
Émissions de GES 1990-2016 avec les cibles de 2050



Complémentarité des parcs de production: Production par Source 1990 and 2017 (or 2016)

Enjeux: 5 régions, 5 marchés,
Pas de planification commune, peu d'intégration





Capacité totale Nord-Est 180 GW

New York 20M

Nouvelle Ang. 15M

Prov. atlantiques 2M

Québec 8M

Ontario 14M

Questions de recherche

1. Quels investissements en capacités de production, de stockage et de transport seraient nécessaires pour atteindre les objectifs de décarbonisation?
2. Quelle est la valeur de l'intégration régionale (coopération) pour parvenir à une décarbonisation?
3. Quelle est la contribution de l'hydroélectricité à l'expansion des énergies renouvelables dans la région?

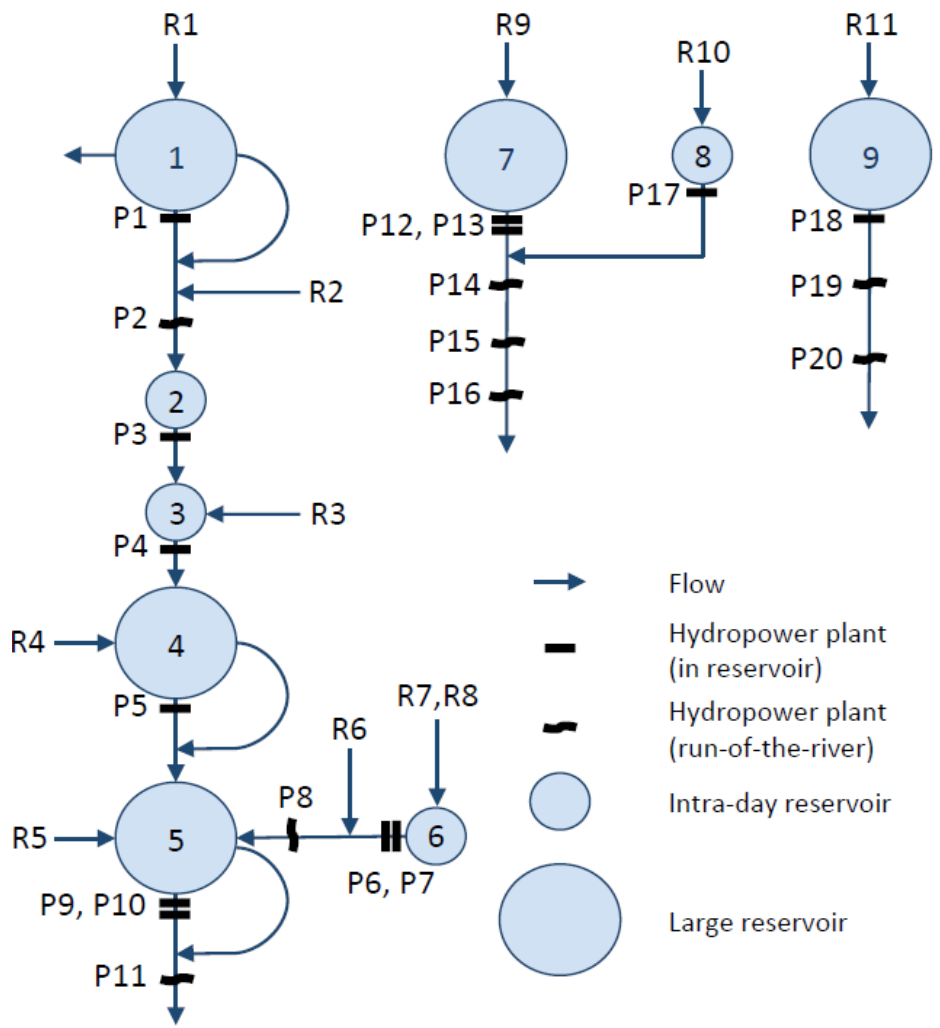
Approche de modélisation (1)

- Modèle d’investissement et de production électrique
- 8,760 heures (1 an)
- Investissement : capacité de production + transmission
- Décisions opérationnelles: production horaire par technologie, échanges d’électricité entre régions, + stockage d’énergie, gestion de la demande

Approche de modélisation (2) – Technologies

- **Renouvelable intermittent** (solaire & éolien) avec des profiles de production régionaux
- **Nucléaire**.
- **Gaz naturel**: CT et CGGT + possibilité de gaz naturel carboneutre
- **Hydro**: Fil-de l'eau + Réservoirs intra-journaliers + Grands réservoirs (cycle de stockage annuel)
- **Stockage d'énergie** (journalier)
- **Transmission**: interconnexions seulement

Approche de modélisation (3) – L'hydro au Quebec



Number	Name	Capacity [Billion m^3]	
		Min.	Max.
1	Caniapiscau	39.0	52.6
4	La Grande 3	25.2	60.0
5	Robert Bourassa	19.4	61.7
7	Manicougan	35.2	137.9
9	Aux Outardes	10.9	24.5

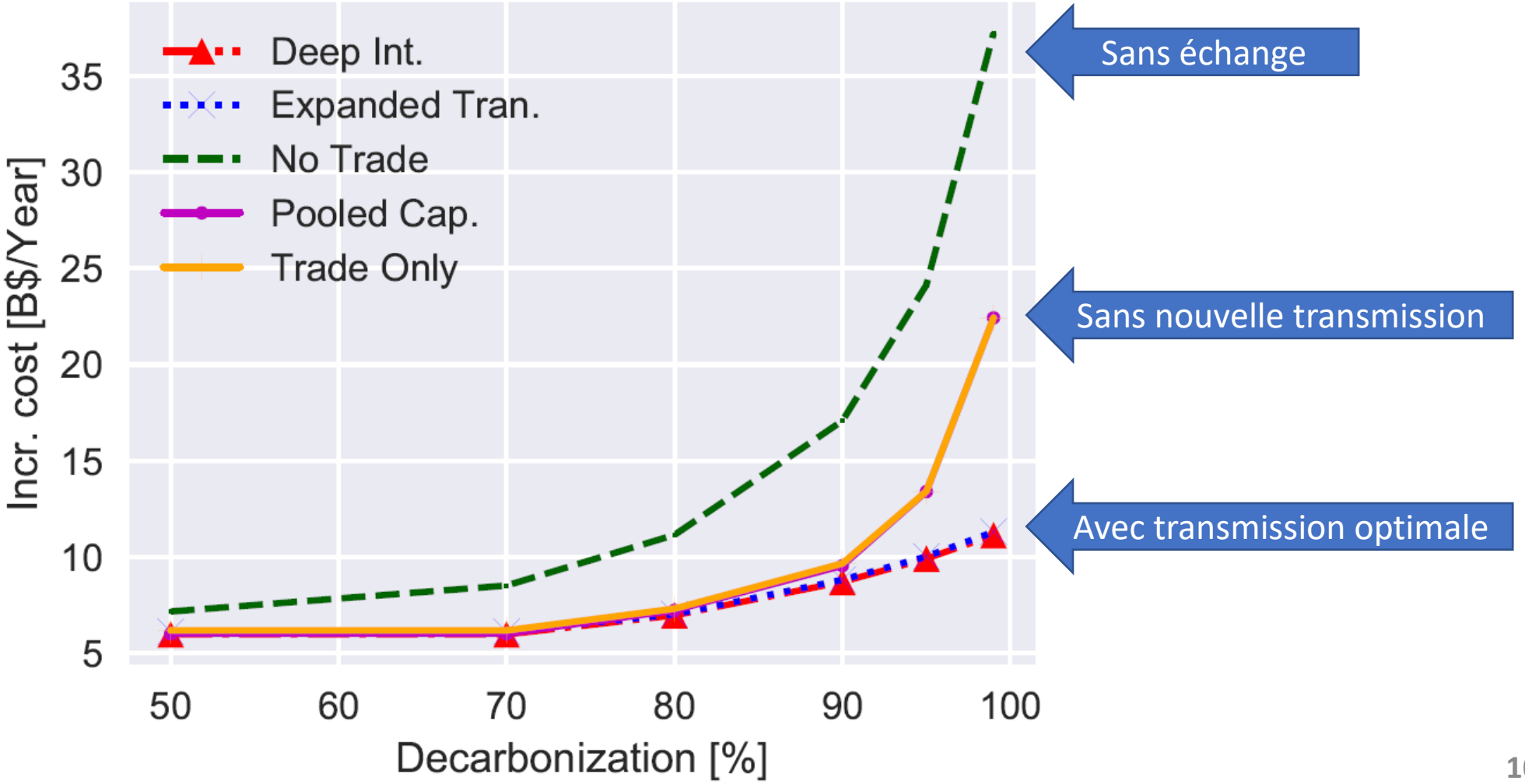
Table 13: Storage capacity of large reservoirs in Quebec

5 modes d'intégration & 3 approches de coopération

	Échanges électriques	Expansion de la transmission	Partage des capacité de prod.
No Trade			
Trade Only	Oui		
Expanded Transmission	Oui	Oui	
Pooled Capacity	Oui		Oui
Deep Integration	Oui	Oui	Oui

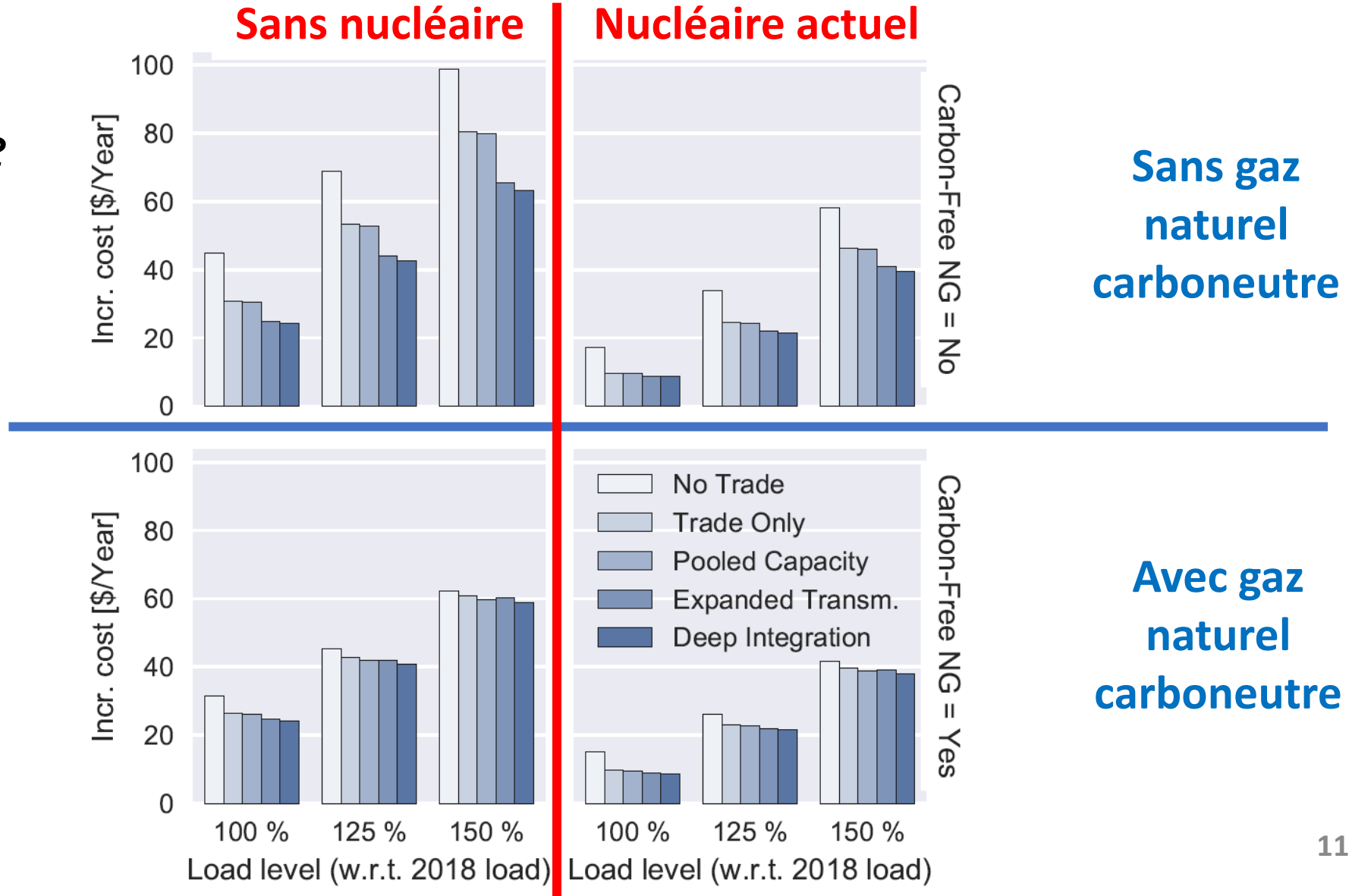
+ Sensibilité au niveau de décarbonation, nucléaire, gaz naturel carboneutre and niveau de demande

Résultats (1): Décarboner sans collaborer est exponentiellement plus cher



Résultats (2): Nucléaire, gaz naturel carboneutre et niveau de demande (100%, 125% et 150%)

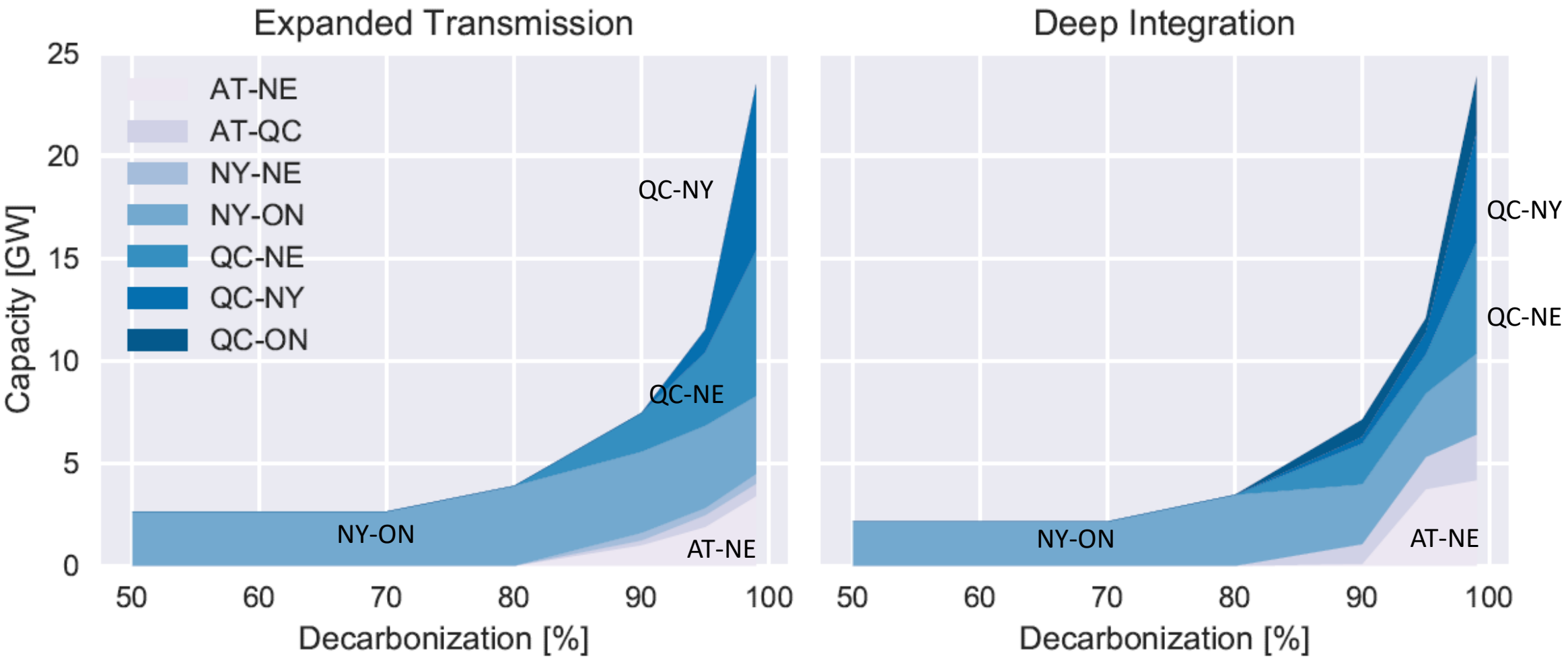
Coût annuel de décarbonation à 90%



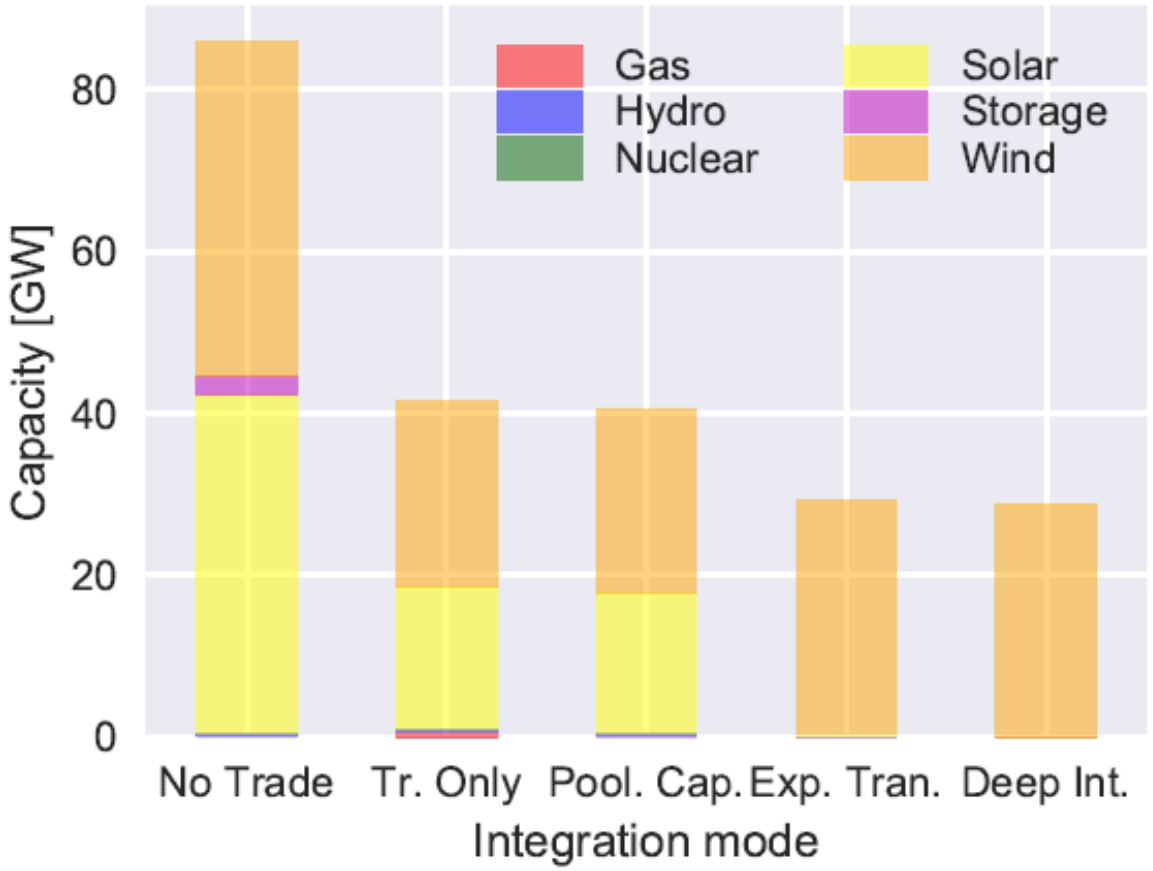
Sans gaz naturel carboneutre

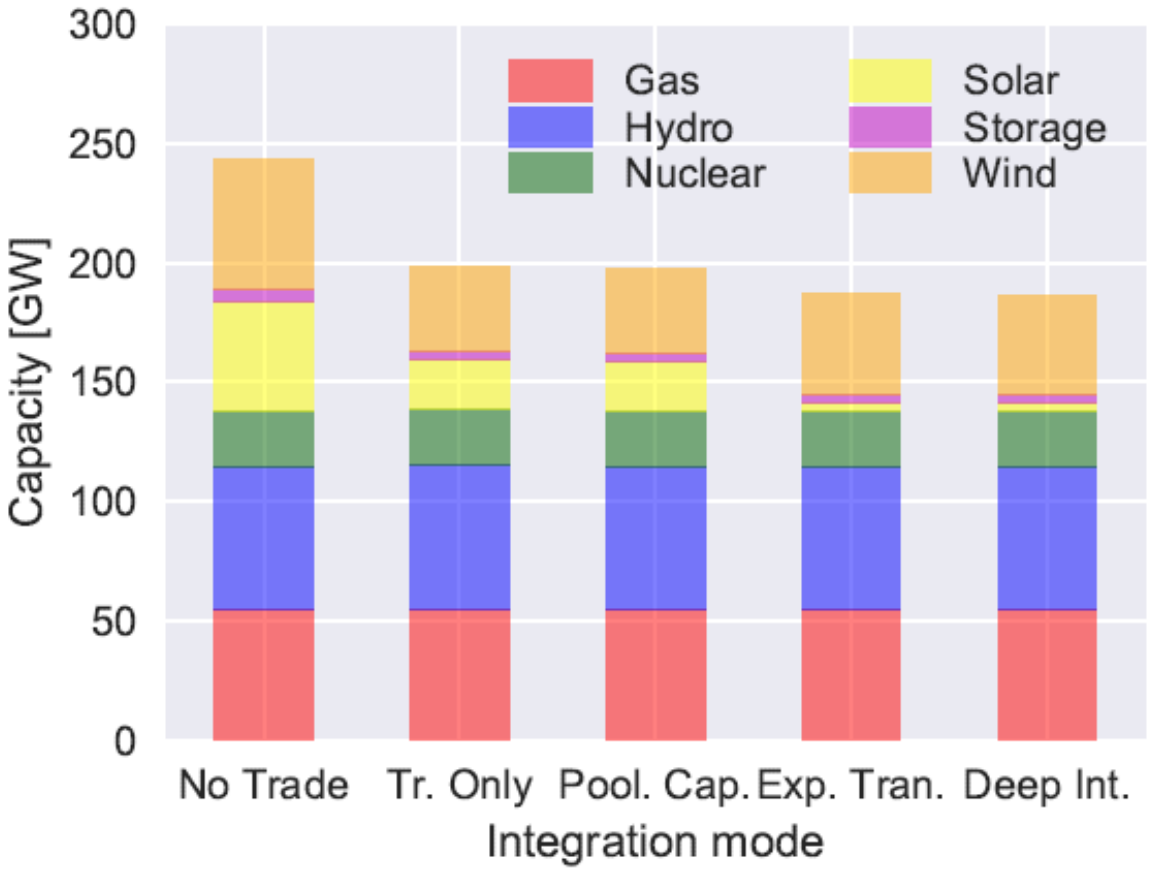
Avec gaz naturel carboneutre

Résultats (3): La transmission régional est clé

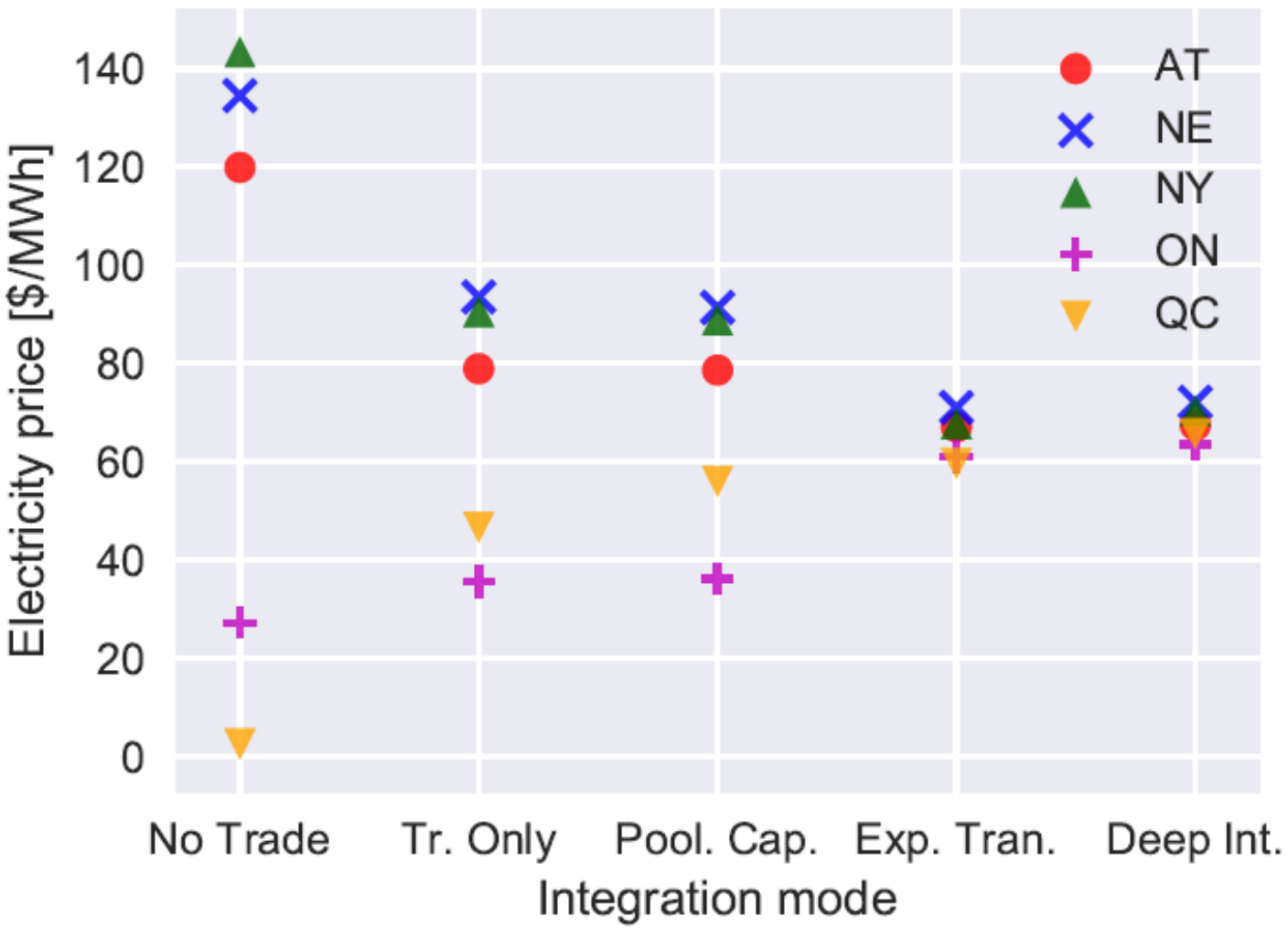


Résultats (4): Nouvelles capacités et totaux



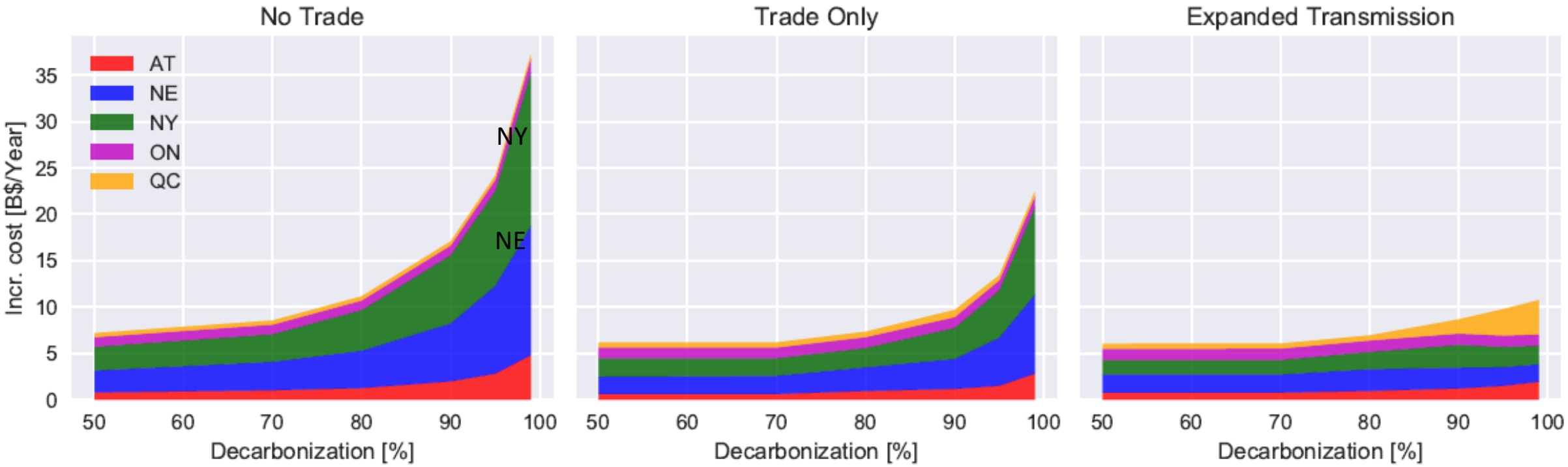


Résultats (5): Convergence des prix (coûts marginaux)



Résultats (6): Impacts régionaux des coûts

Coût annuel d'opération et d'investissements par niveau de décarbonation



Résultats (7): Hydro contribue à la pénétration éolienne

Entre le réseau actuel et un réseau de transmission optimal:

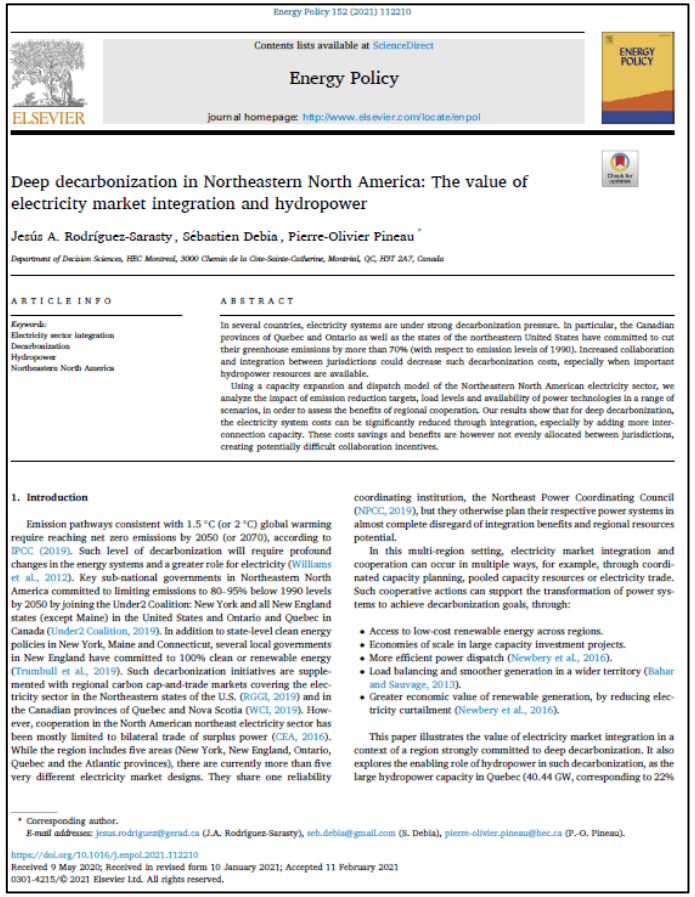
- Corrélation hydro-éolienne: de -0,06 à **-0,28**
- Production éolienne: de 102 à **120 TWh**
- Délestage éolien: de 1,5 % à **0,1 %**

Conclusions

- L'intégration réduit les coûts de décarbonation
- Une décarbonation profonde va requérir une intégration profonde, sinon les coûts explosent exponentiellement
- Les impacts régionaux varient beaucoup (prix, investissements, coûts)

$\Rightarrow$ **des discussions régionales sont nécessaires**

Pour aller plus loin:



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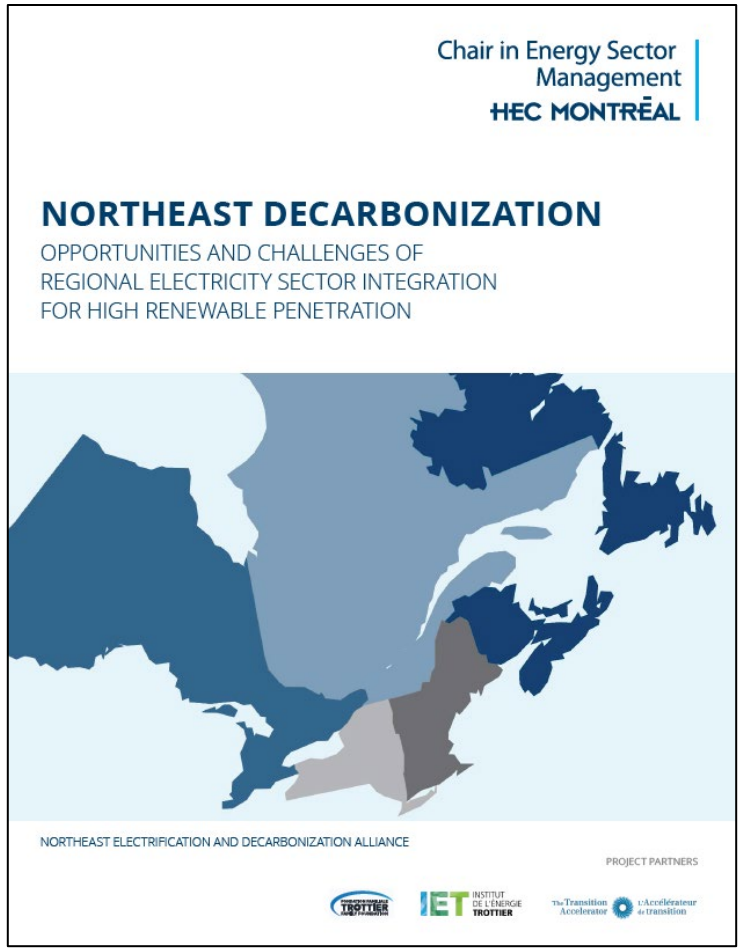

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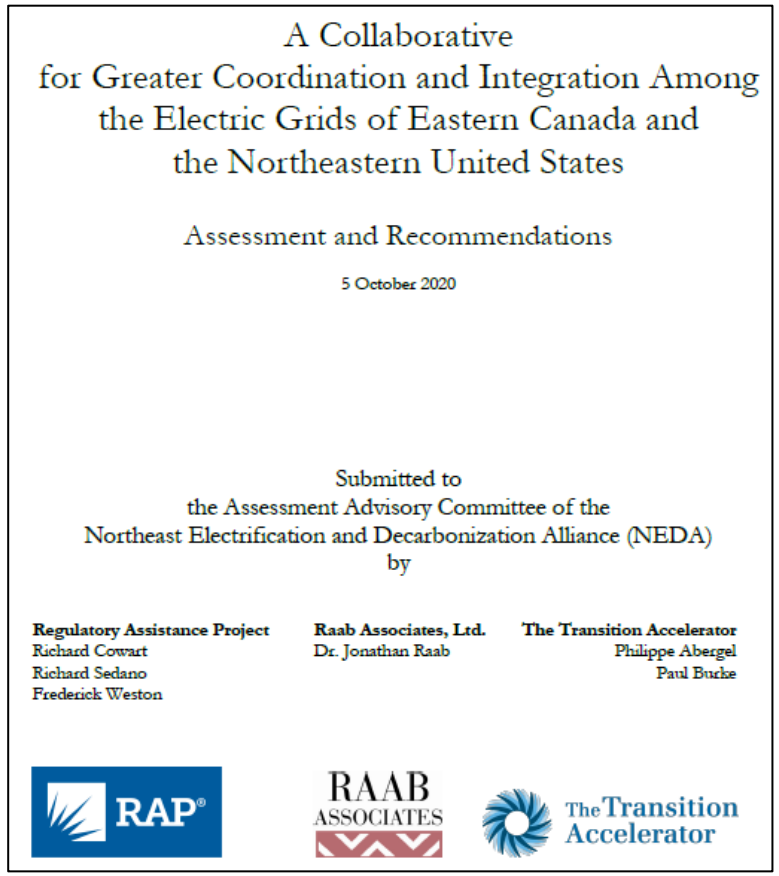
NORTHEAST DECARBONIZATION

OPPORTUNITIES AND CHALLENGES OF REGIONAL ELECTRICITY SECTOR INTEGRATION FOR HIGH RENEWABLE PENETRATION

NORTHEAST ELECTRIFICATION AND DECARBONIZATION ALLIANCE

PROJECT PARTNERS



A Collaborative for Greater Coordination and Integration Among the Electric Grids of Eastern Canada and the Northeastern United States

Assessment and Recommendations

5 October 2020

Submitted to
the Assessment Advisory Committee of the
Northeast Electrification and Decarbonization Alliance (NEDA)
by

Regulatory Assistance Project
Richard Cowart
Richard Sedano
Frederick Weston

Raab Associates, Ltd.
Dr. Jonathan Raab

The Transition Accelerator
Philippe Abergel
Paul Burke

Rapport de consultations de 30 entrevues avec des acteurs du nord-est sur la collaboration régionale

https://transitionaccelerator.ca/northeast_decarbonization/
https://energie.hec.ca/npcc-2/

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