

Wind Integration in Ontario

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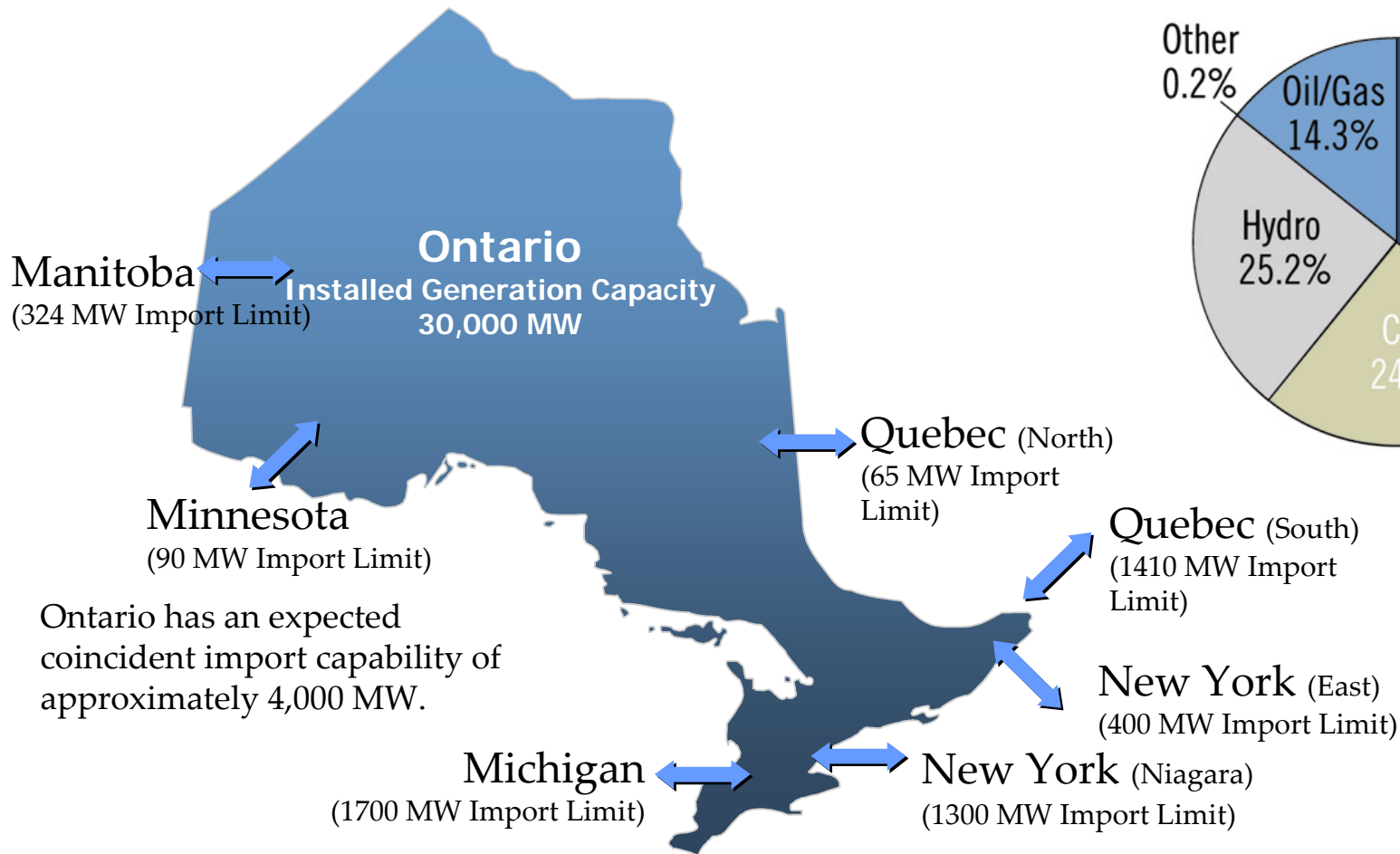
- **Context**
 - current developments in Ontario's electricity sector are favourable to new wind generation
- **Market Design Issues**
 - the rules governing the IMO-administered markets facilitate participation by wind generators
- **Regulatory Requirements**
 - regulatory changes have been made to enable the connection of wind generation to transmission and distribution systems
- **Connecting to the IMO grid**
 - the IMO is considering the modification of its Connection Approval process due to an influx of wind applications
 - transmitters have streamlined and expedited connection processes
- **Operating challenges**
 - significant operating experience is to be gained from the imminent integration of sizable amounts of wind generation

- To date, the development of wind power in Canada has been limited
 - wind makes up less than 1% of Canada's gross generation capacity
 - though small in absolute terms, installed wind generation capacity has grown at an annual rate of about 26% since 2000

Province/Territory	Wind Generation (Total Installed Operating Capacity) (MW)
Nfld & Labrador	0.00
Nova Scotia	4.86
New Brunswick	0.00
PEI	13.56
Québec	113.25
Ontario	15.75
Manitoba	0.00
Saskatchewan	21.78
Alberta	200.67
British Columbia	0.00
Nunavut	0.00
NWT	0.00
Yukon	0.81
Total Canada	370.68

Ontario: Straddles Mid-west and North-east U.S.

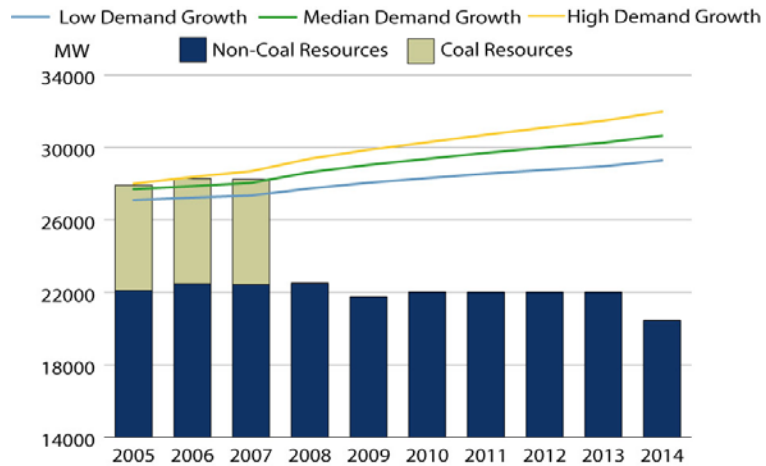
Installed Generation by Fuel Type, Ontario 10-Year Outlook 2004



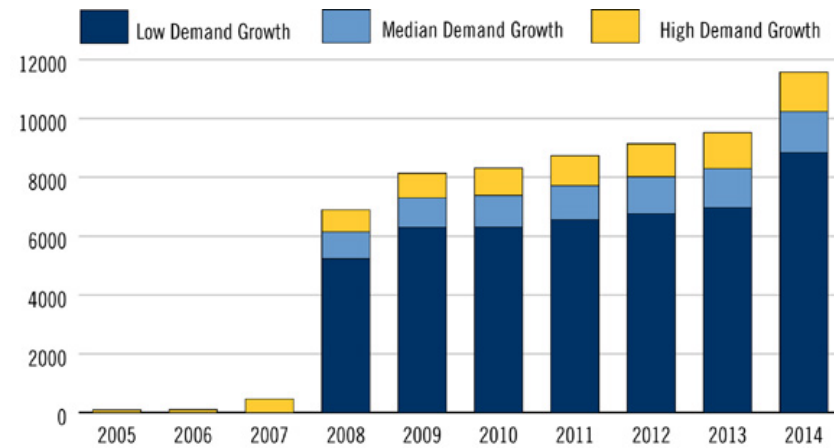


Significant resource needs ahead

Resource Adequacy 10-Year Outlook 2004



Net Requirement for Additional Resources 10-Year Outlook 2004



Targets in place for renewables

- Ontario currently has an emissions trading program for NO_x and SO_x, but not for CO₂
- The development of a Renewable Energy Credit (REC) market is being contemplated
- Ontario does not have a formal RPS, though the government has set targets for renewable generation
 - 5% of generation to be renewable by 2007 (1350 MW)
 - 10% of generation to be renewable by 2010 (2700 MW)
 - the development of an RPS is being contemplated



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Government issued an RFP

- In order to stimulate investment in renewable generation, the government has initiated a Request for Proposal
 - RFP for 300 MW renewables
 - response to RFP totalled 4400 MW
 - Announcement due this fall



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Market design is favourable to renewables

- Open access
 - the IMO allows for non-discriminatory connection and access to the IMO-controlled grid
- Market rules
 - the IMO has made specific accommodation for renewable and intermittent generation in the market rules (largely applicable to wind)
 - A separate “Intermittent Generation” category has been created in the rules, which is largely allowed to operate at will and is settled on the hourly (rather than 5-minute) spot market price
 - the only restriction on operation can arise due to transmission security limits

- Market rules, continued...
 - The IMO recently amended the Market Rules, relaxing the revenue metering and other technical requirements for embedded generation
 - If renewable generators find that any particular rule is creating an unnecessary barrier to participation, they can always seek an exemption from that rule
- Day ahead market
 - the IMO is currently developing a day ahead market, in which intermittent generators will be included



- Distribution System Code
 - recent amendments to the Distribution Code standardized connection requirements for the incorporation of embedded generation
 - four generation categories defined by size
 - connection processes and related time frames for each category prescribed
 - technical requirements standardized
 - contracts standardized



- Transmission System Code
 - Socialization of network costs
 - amendments to the TSC will establish that system enhancement costs are to be borne by all ratepayers
 - TSC allows for more favourable rate treatment of renewable energy projects
 - generation units producing 2 MW or less per unit will be eligible for net billing charges on relevant connection facilities
 - load reduction attributable to energy conservation, energy efficiency and load management will not be considered system bypass



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Connecting to the IMO grid

- Connection Assessment Approval process
 - Applies to all directly-connected generation facilities, and embedded generators rated at ≥ 10 MVA
 - Identifies any negative impacts on the reliability of the integrated power system, and required transmission upgrades
 - Verifies compliance with Market Rules and Transmission system code

- Generator Connection Requirements
 - reactive power capabilities
 - required ability to withstand voltage and frequency variations, allowable phase unbalance
 - requirements for protection systems, monitoring and telemetry
 - performance requirements for generator controls
- Generators should not trip for system faults (need low voltage ride through capability)
- Changes to the connection process are being contemplated in light of large number of proposals



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Connecting the IMO grid

- Hydro One and other transmitters in Ontario have streamlined connection processes
 - expedited processes have been developed to provide preliminary assessments and preliminary cost estimates to proponents making proposals under the RFP



- The IMO has yet to gain operational experience integrating sizable amounts of wind generation into the grid
- Particularly, the IMO has to determine the impact on the need for regulation/AGC, spinning reserve and other ancillary services
- There may also be an impact on how we pay for reactive support/voltage control ancillary service



- The impact of wind integration on the IMO-controlled grid will be determined in part by:
 - the variation in MW output of a wind farm throughout the day and based on changing weather patterns
 - the speed at which this variation occurs (e.g. over minutes, tens of minutes, or hours)
 - the extent to which variations in different locations cancel each other out or are mutually reinforcing
 - the extent to which wind generators contribute to voltage control or aggravate it
 - degree of correlation with load variation

- Variability of wind power for the first several hundred MW...
 - unlikely to affect need for additional AGC generation (regulation)
 - unlikely to create significant “excess generation” during light load periods
 - unlikely to create need for additional operating reserve (currently around 1000 MW)
- Will require timely and accurate hourly production schedules, and outage plans for operational planning and generation dispatch purposes.
 - per Market Rules requirements for “intermittent generators”
- Will need to gain operational experience in Ontario context

- The IMO is confident about the potential for incorporating the first several hundred MW of wind generation in Ontario
 - we have reviewed key studies by other jurisdictions on the topic and appreciate the issues associated with wind integration
 - Ontario has several characteristics that can enable us to compensate for wind variability
 - high inertia capacity with five neighbouring jurisdictions
 - extensive hydroelectric capacity
 - large geographic area with uncorrelated wind sites
 - large spinning reserve requirements
 - The integration of projects arising from the 300 MW RFP will provide a learning opportunity that will inform future expansion of wind generation in Ontario

- The current direction of the electricity sector in Ontario is favourable to wind
- The design of Ontario's market is accommodating of wind and other intermittent generation
- Regulatory instruments have been amended to enable connection of renewable resources to the grid
- The IMO and transmitters have streamlined connection processes
- The IMO is yet to gain operating experience related to the integration of sizable amounts of wind generation, but is optimistic about prospects for increased participation of wind generators in the IMO-controlled grid and market