



Biomass Testing at Ontario Power Generation

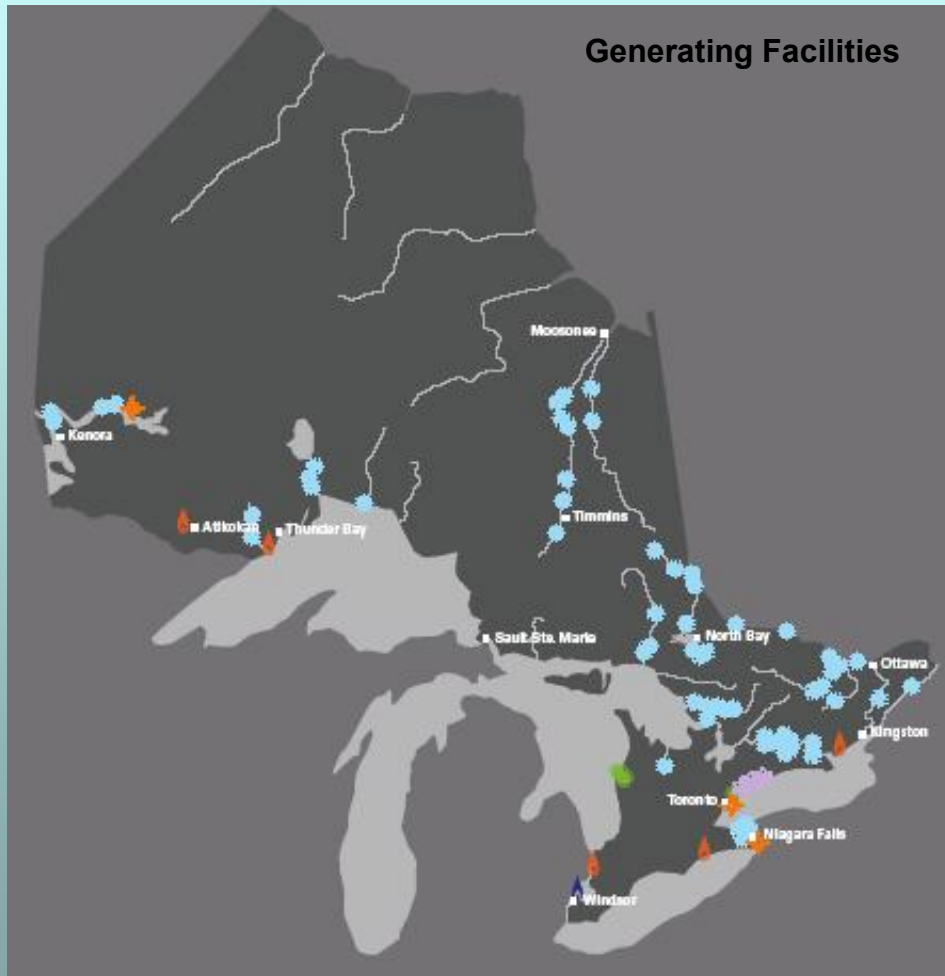
Jim Twomey
Executive Vice President, Fossil

Conference on Biomass and Energy for the Great Lakes Economy
Queen's University

Kingston, Ontario
June 9, 2008

ONTARIO**POWER**
GENERATION

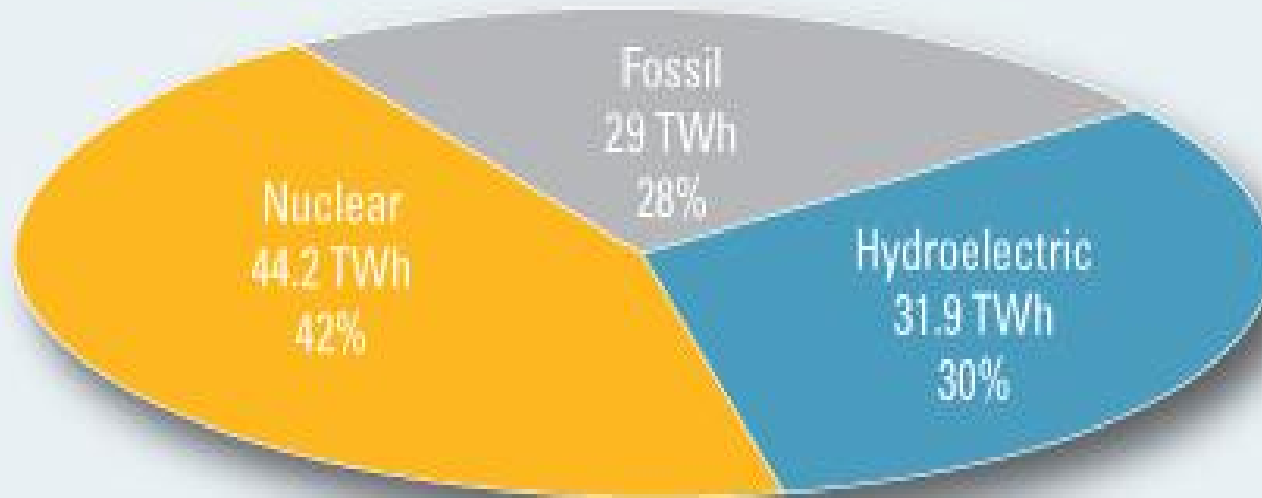
OPG Profile



- Owned by Province of Ontario
- Produces about 70% of electricity consumed in Ontario
- In-service capacity: 22,158W*
 - 64 Hydroelectric stations: 6,972 MW
 - 10 Nuclear Units: 6,606 MW
 - 5 Fossil Stations: 8,573 MW
- Approximately 11,700 employees
- We moderate prices for the people of Ontario

OPG's Generation Mix 2007

2007 OPG Energy Production - 105.1 TWh



OPG's Fossil Fleet

Lambton



Nanticoke



Atikokan

Thunder Bay



Lennox

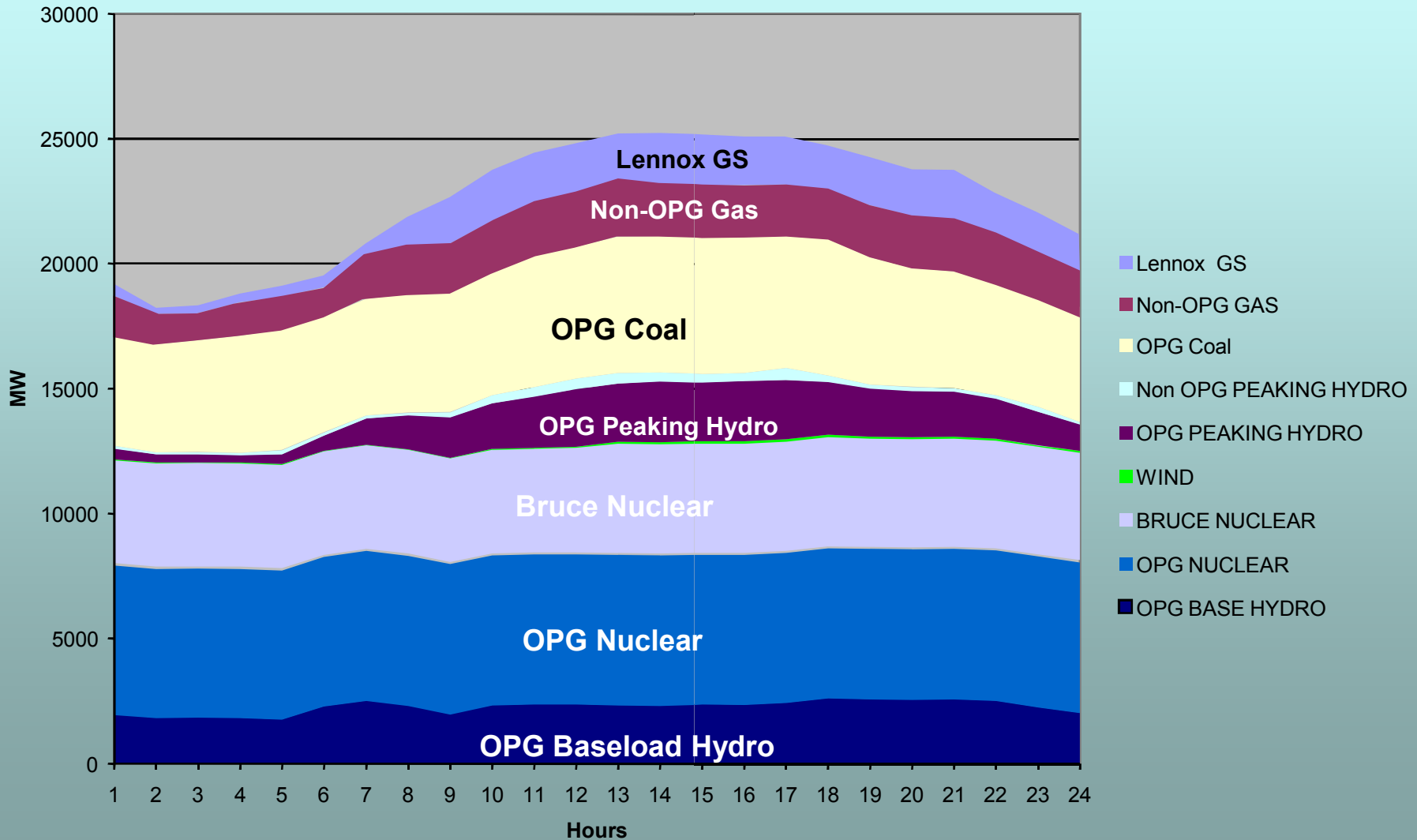


**Portlands Energy Centre
(partnership with
TransCanada Energy)**



Brighton Beach (partnership with ATCO Power)

Supplying Ontario Peak-Demand (Aug 1, 2006)

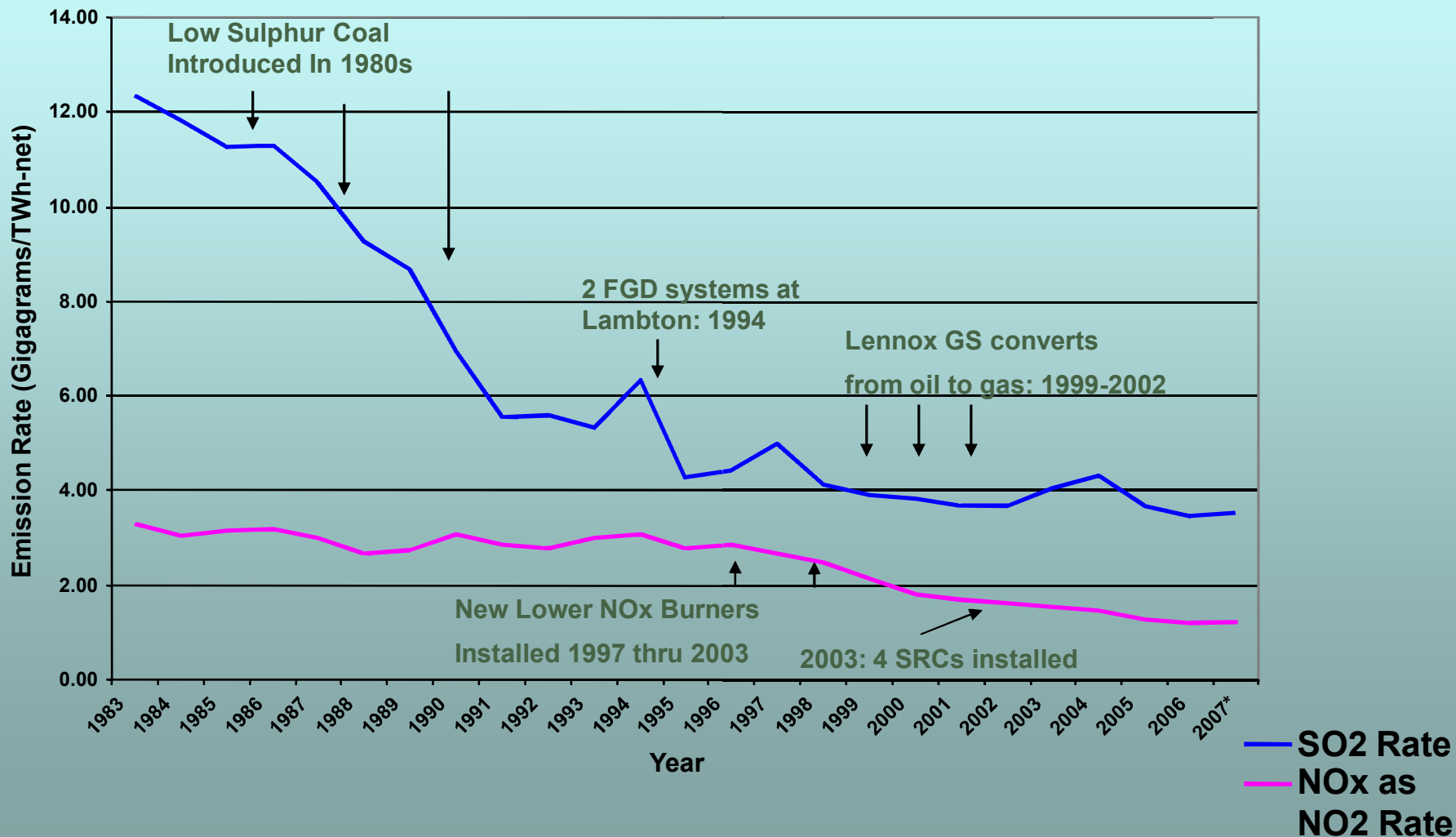


2007 Fossil Performance



- ⦿ **29.3 TWh -- 15% increase in generation from 2006**
- ⦿ **Fossil accounted for almost 30% of provincial peak summer demand on August 2**
- ⦿ **Fourth lowest total acid gas emissions**
- ⦿ **Second best year for acid gas emission rate – 18% reduction over past four years**
- ⦿ **Greenhouse gas emissions slightly above 1990 level**

OPG's Environmental Performance: SO₂ and NO_x Fossil Emission Rates -- 1983-2007



*approximate estimate for 2007

OPG's Biomass Strategy

Continue test program until all coal plants have a biomass option:

- ⦿ Understand fuel availability
- ⦿ Understand fuel handling and storage investment
- ⦿ Understand combustion modifications required
- ⦿ Understand production potential
- ⦿ Understand all costs

OPG Biomass Test Program

- ◉ Focus on co-firing with coal
- ◉ Option to reduce net GHG emissions while coal plants in operation
- ◉ Contributes to the transition to lower carbon future
- ◉ All OPG coal plants involved
- ◉ Test program uses wood pellets and surplus agricultural by-products and dried distillers grain – not food crops
- ◉ Sensitive to potential impacts on competing markets for fuels
- ◉ Host for provincial Atikokan Bio-Energy Research Centre



Thunder Bay GS



Atikokan GS

Why Co-fire Biomass with Coal?



Thunder Bay GS



- Dispatchable green energy
- Option for GHG management
 - lower SO₂ emissions and lower mercury emissions
- Makes use of existing assets – lower capital costs
- Takes advantage of higher efficiency utility boilers
- Established bulk fuel handling systems
- Timely implementation
- Synergy with other sectors – forestry, agriculture,
- Fuel supply potential

Co-firing Biomass with Coal - Challenges

- ⊙ Fuel cost – more expensive than coal – similar to natural gas
- ⊙ Fuel supply infrastructure does not exist
- ⊙ Requires supply and handling huge volumes of fuel – low energy density
- ⊙ Covered shipping and storage is required
- ⊙ Potential boiler issues – slagging, fouling, capacity
- ⊙ Ash re-use considerations
- ⊙ Avoid competition for food and feed resources

Co-firing – European Experience

- ⊙ Renewable energy standards
- ⊙ Renewable energy premiums
- ⊙ Ash re-use standards modified
- ⊙ Supply infrastructure – import fuels worldwide
- ⊙ Strong research support community



Avedøre, Denmark – 70% wood + 30% gas/oil)



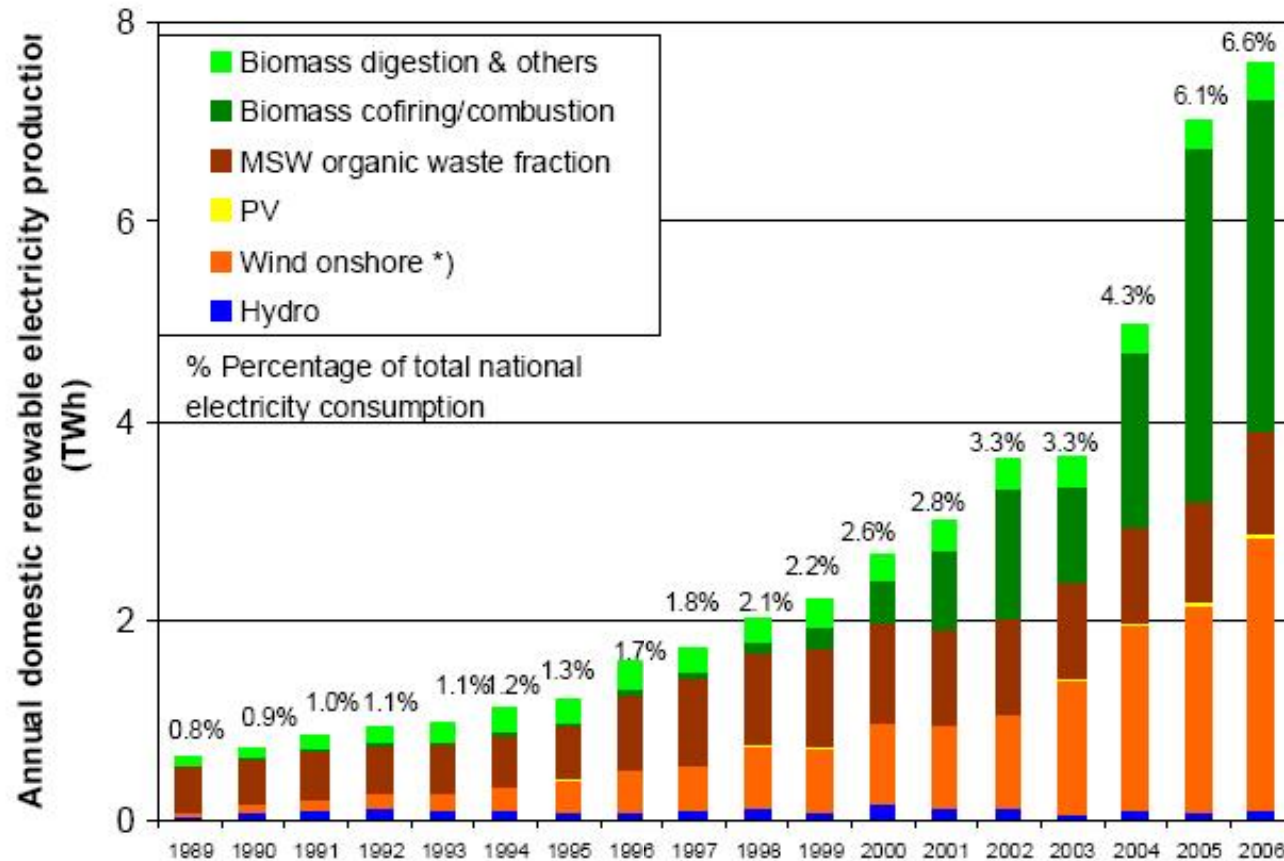
Amer, Netherlands – 20% wood + 80% coal



Fiddlers Ferry, UK – 20% biomass + 80% coal

The Dutch Experience

Annual renewable electricity production in the Netherlands and contributions per technology- 1989 until 2006.



*) Wind offshore 2006: unknown

Source: Sikkema R., Junginger, M., Faaij, A., IEA Bioenergy Task 40 – Country Report for the Netherlands 2007. Universiteit Utrecht, Report NWS-E-2007-197, December 2007

Nanticoke Experience

- Approached by OMAFRA and Ontario Millers Association
- Focus on wood pellets and surplus agricultural by-products - wheat shorts
- Minimal investment in fuel handling means firing is not sustainable
- Have achieved 10% heat input = 50 MW
- 1,376 MWh production (100 homes for a year)
- Moving to longer duration tests this year



Atikokan Experience

- ⊙ Lignite boiler design may be adaptable to biomass – potential for 100%
- ⊙ Focus on wood pellets
- ⊙ Tested at 20% heat input
- ⊙ Moving towards 100% test
- ⊙ Supporting Atikokan Bioenergy Research Centre



Commercial Scale Co-firing

- ⊙ Requires pelletized fuel
 - 600,000 t of wood pellets = 1 billion kwh
 - Lower heat content biomass requires more shipping, handling and storage
- ⊙ Bituminous boilers (Nanticoke/Lambton)
 - Maximum potential = 20%
 - Fuel handling investments
 - Boiler modifications
 - Ash disposal
- ⊙ Lignite boilers (Atikokan/Thunder Bay)
 - Maximum potential = very high %
 - Fuel handling investments
 - Ash disposal
 - Boiler modifications



Great Lakes – St. Lawrence Forest Initiative

- OPG and the Ministries of Energy and Natural Resources are assessing the opportunity that co-firing presents.
- Until 2014, take advantage of the existing coal plant infrastructure to meet renewable energy and forest management objectives.
 - Establish sustainable, renewable wood pellet fuel manufacturing and delivery infrastructure
 - Enable possible 100% biomass energy production post-2014
 - Generate up to 2.5 TWh of dispatchable, renewable energy per year
 - Equal to Dutch biomass co-firing production
 - 2.5 times 2007 wind generation in Ontario
 - Enough to supply Kingston for more than 3 years



Great Lakes – St. Lawrence Forest Initiative

⊙ Next Steps

- Environmental impacts and carbon balance requires further investigation
- Feasibility studies underway & wood pellet fuel costs to be determined



Going Forward

- ⊙ Opportunity to integrate policies
 - Ethanol – Dried Distillers Grain – Electricity
 - Forest Management – Wood Pellets - Electricity
- ⊙ Determine how biomass electricity enters the market
 - biomass costs > electricity market price
- ⊙ Fuel supply infrastructure
- ⊙ Plant modifications required
- ⊙ Collective effort from all sectors to address the policy, technical and social issues



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