

# ONTARIO **POWER** GENERATION

Converting Northwest Thermal  
Atikokan Generating Station  
Thunder Bay Generating Station

*March 5, 2013*





Alberta Biomaterials Development Centre  
*ABDC Biomass – Edmonton, AB*



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## Ontario Hydro's 5 Successor Entities (Apr. 1999)

-  1. Ontario Power Generation (OPG) – electricity generator
-  2. Ontario Hydro Services Company, later renamed Hydro One Inc. with 5 subsidiaries, including Hydro One Networks Inc. - runs most of the transmission and distribution systems for power in Ontario
-  3. Independent Market Operator (IMO) – later renamed Independent Electricity System Operator (IESO) – administers electricity grid
-  4. Electrical Safety Authority - enforces electrical safety across Ontario
- OEFC** 5. Ontario Electricity Financial Corporation - responsible for servicing the debt and liabilities of the former Ontario Hydro, that were not assigned to the successor companies



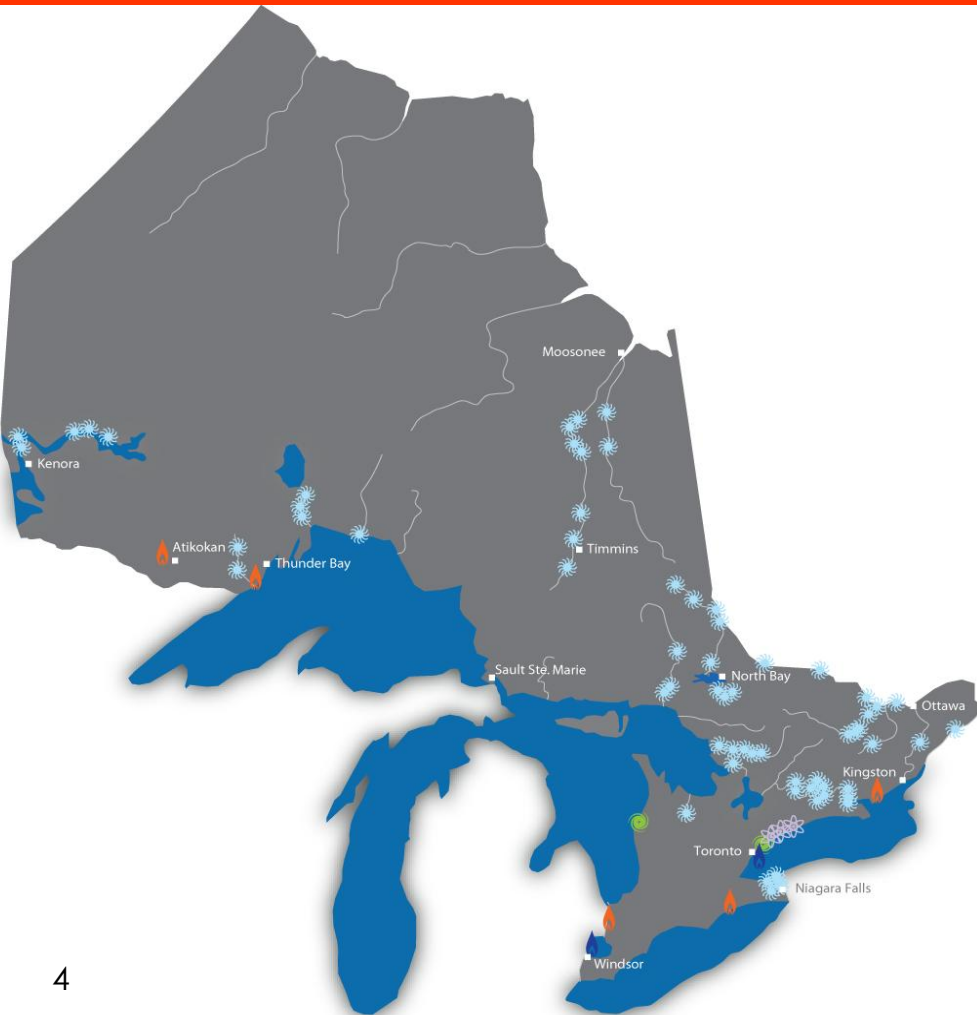
## Ontario Power Generation Profile

- Ontario's public power company.
- Profits stay in Ontario.
- Lowest price generator.
- Generated 84.7 TWh of electricity in 2011 (88.6 in 2010).
- Produces about 60% of Ontario's electricity.
- 11,800 employees.
- Capacity: 19,049 MW.





## Ontario Power Generation Facilities



- Two Nuclear stations (10 units)
- Five Thermal stations (13 units)
- 65 Hydroelectric stations (240 dams)
- 2 Wind Turbines
- 2 Natural Gas stations (co-owned)



## Ontario's Long-Term Energy Plan

### Highlights:

- Nuclear continues to supply 50% of Ontario's electricity.
- Increase hydroelectric generation.
- Expand renewable generation from wind, solar and bioenergy.
- Use natural gas generation for reliability and to meet peak demand.
- Expand supply from high efficiency combined heat and power.
- Continue to grow conservation.



## Ontario's Long-Term Energy Plan

### Implications for OPG's Thermal Business:

- Convert Atikokan GS to biomass.
- Convert Thunder Bay GS to natural gas.
- Eliminate coal generation by end of 2014.
- Close two additional Nanticoke GS coal generators in 2011.
- Initiate natural gas pipeline studies for Nanticoke GS and Lambton GS.
- Potential for biomass co-firing with natural gas in converted coal units in the future.

AGS 211 MW



TBGS 306 MW



Nanticoke GS 2,000 MW



Lambton GS 950 MW





## Powering Northwestern Ontario

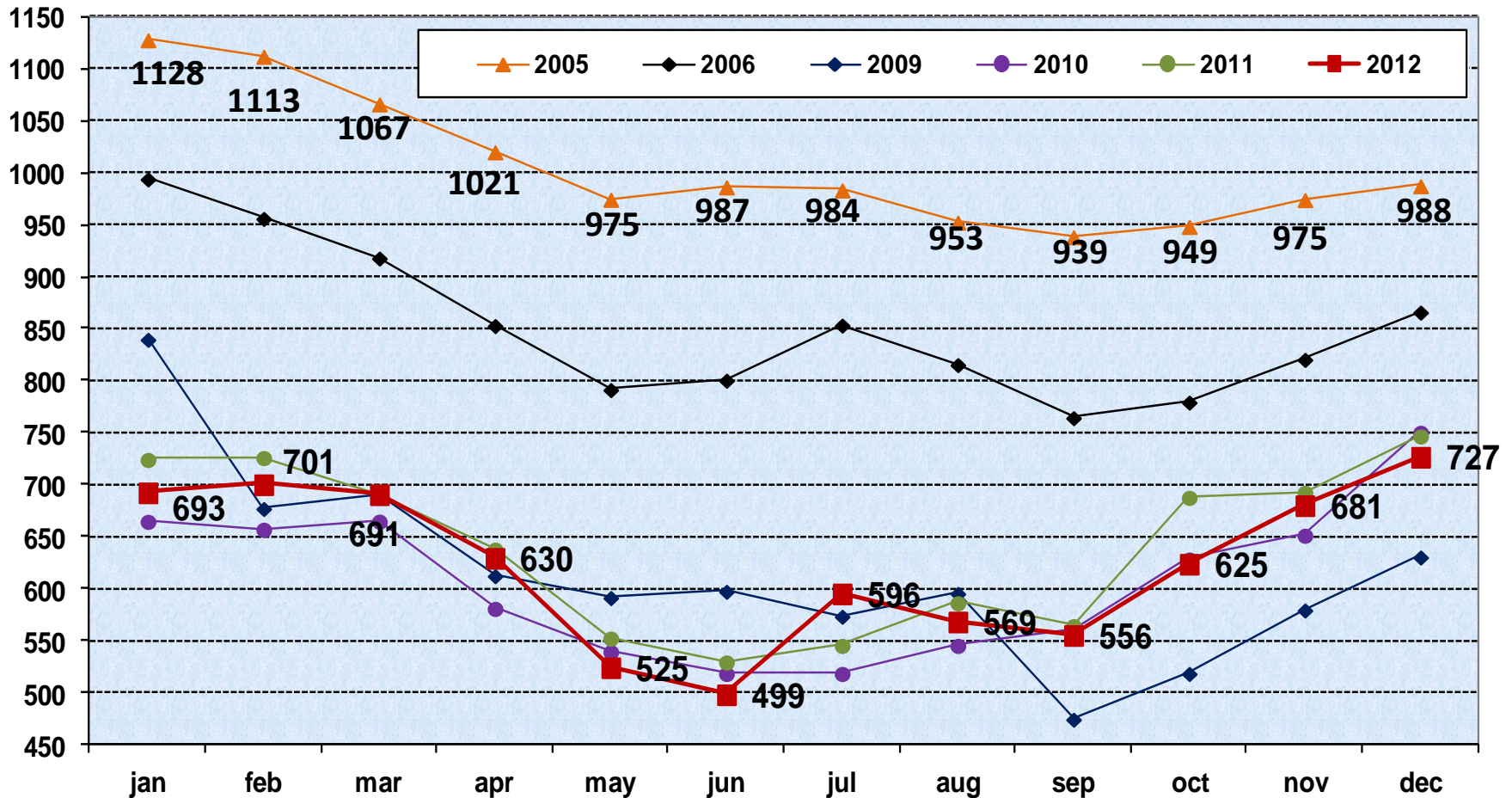
- **CAPACITY** - OPG's generating capacity in northwestern Ontario is just less than 1200 MW (687 MW Hydro and 517 MW Thermal = 1194 MW).
- Hydro plants in the region provide majority of generation for NWO.
- **The converted units at both NW Thermal plants retain their full capacity.**
- Thermal plants cover peaks, low water periods and system stability with reliable, quick response capability.
- **DEMAND** - peaked at just over 1100 MW in 2005 and then decreased through to 2009 at which time it began to stabilize.
- **CURRENT DEMAND** in NWO ranges from 550 to 700 MW.
- **CURRENT EXCESS CAPACITY** in NWO is about 500 MW.
- Excess generation in northwestern Ontario positions the region as a platform for growth and development.





## Northwestern Ontario Peak Electricity Demand

Northwest Peaks (Weather-Corrected, except for May to Sept) - (MW)







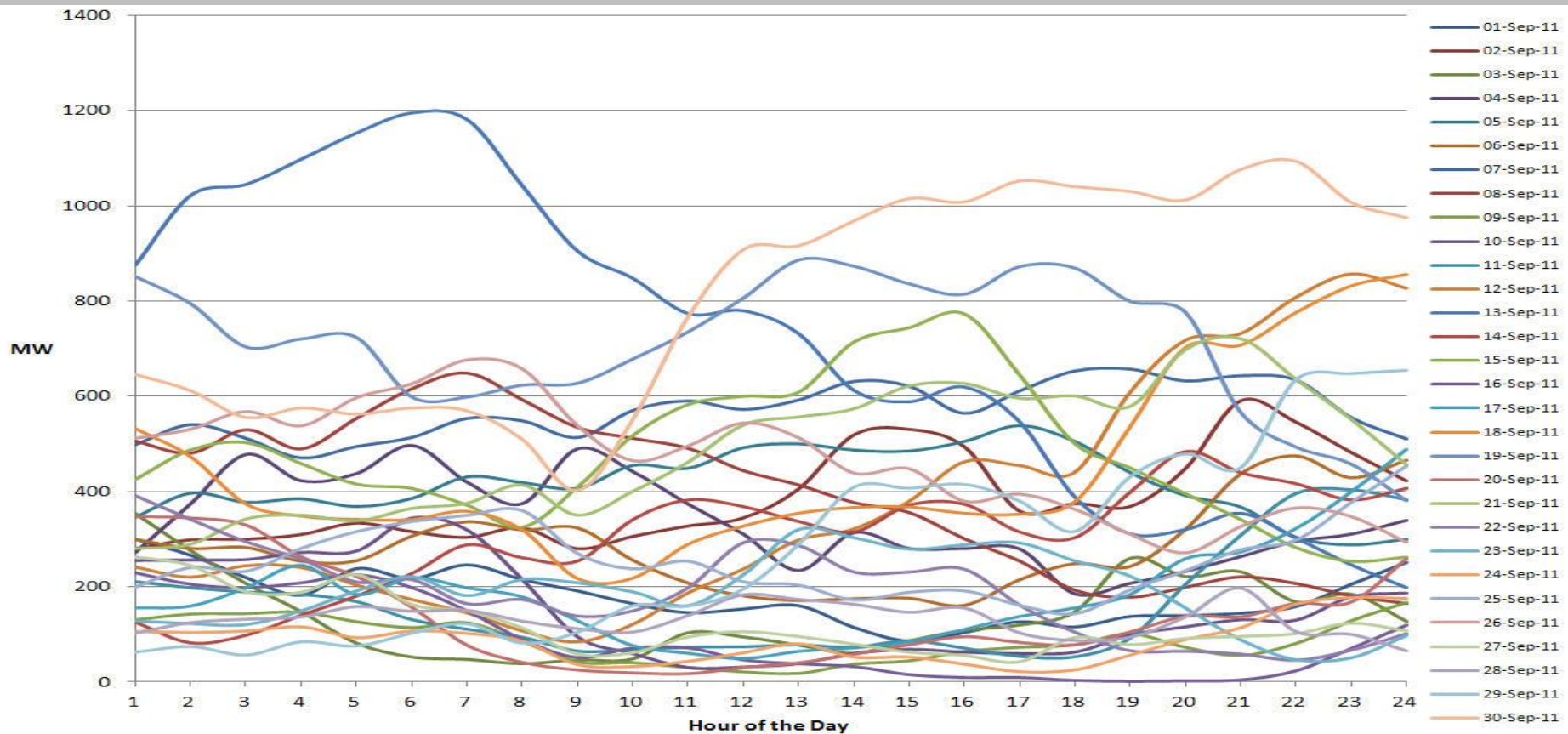
## Nuclear Context

- Nuclear electricity generation provides over 50% of Ontario's power.
- Over the next 10 to 15 years:
  - Pickering Nuclear's reactors will be taken out of service by 2020. Current in-service capacity is 2100 MW.
  - Darlington Nuclear and Bruce Nuclear have a 10,000 MW capacity which will be taken offline for refurbishment creating a short term "valley" in electricity from nuclear over a number of years.
  - 2,000 MW of nuclear new build at Darlington is in the LTEP.



## Wind Generation in Ontario – September 2011

4 hour delta - # of instances greater than 200 MW - 722



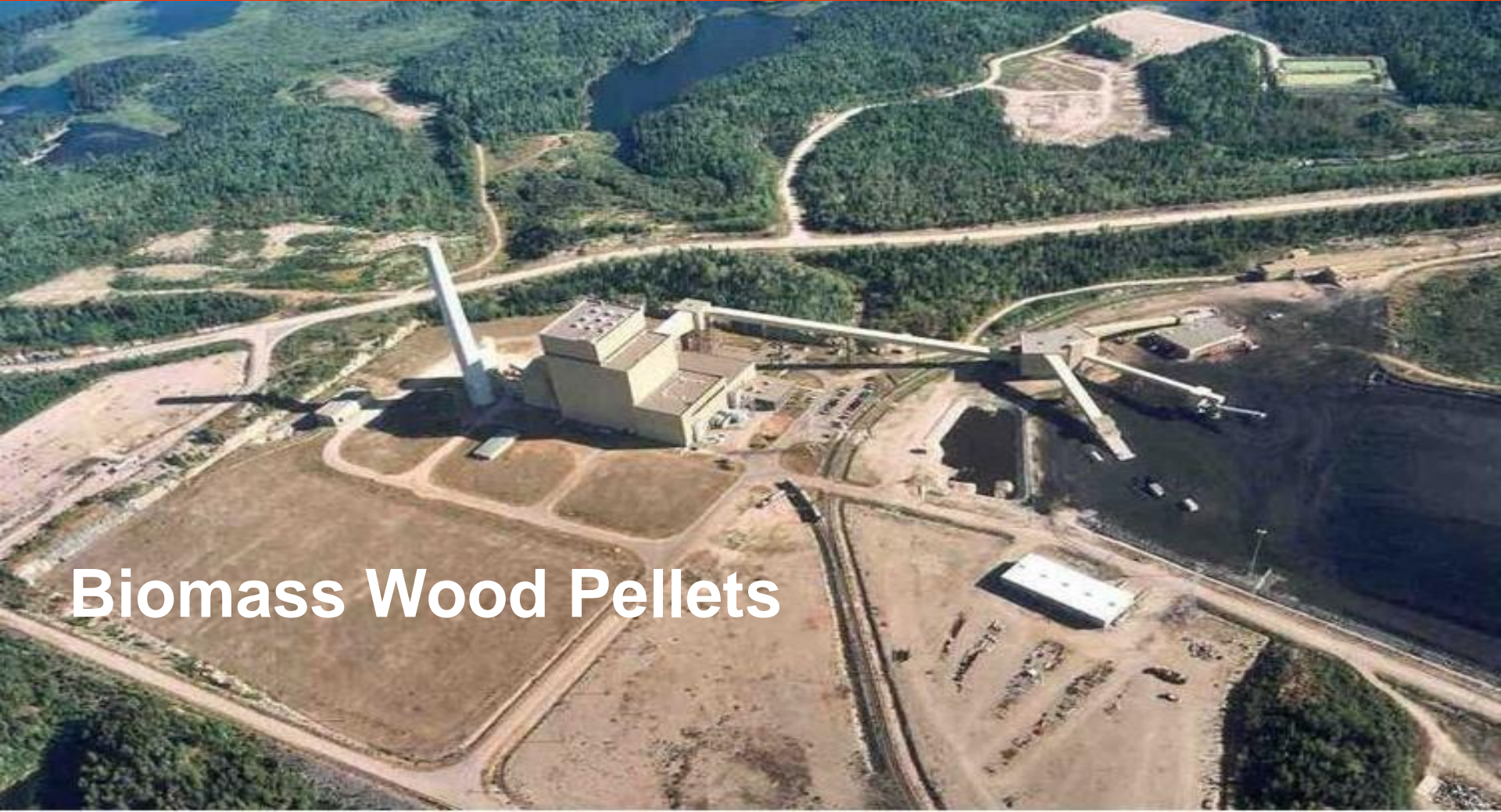
Thermal's ramp rate and flexibility can enable intermittent renewable generation





## Northwest Thermal Conversion – Atikokan GS

**Biomass Wood Pellets**





## Why Biomass Wood Pellets at Atikokan GS?

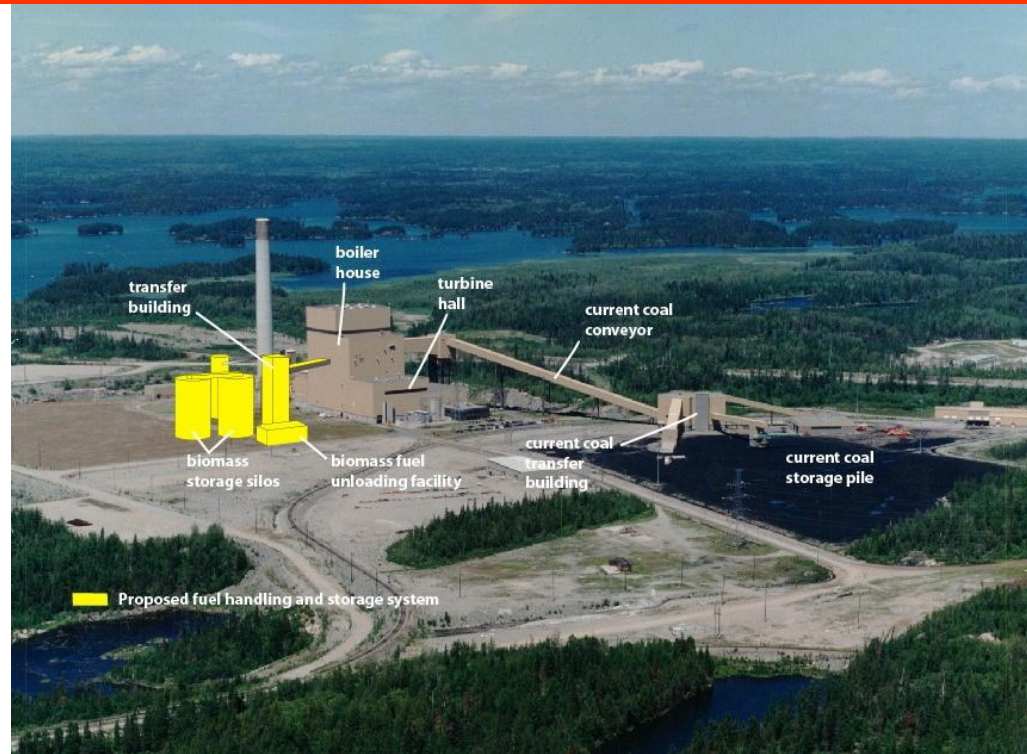
- Coal is not an option after 2014.
- Makes use of existing generating station owned by people of Ontario.
- Conversion costs less than new build.
- Sustainable and environmentally responsible fuel source.
- Available when needed to meet peak demand and back up OPG Hydro in low-water years and intermittent renewables like wind/ solar.
- Synergy with Ontario's forestry sector. Helping to develop Ontario's forest / agriculture biomass fuel supply chain.
- Greenhouse gas benefits compared to fossil fuels.
- Co-firing biomass with natural gas an option for the future.
- OPG will source, biomass fuel that will not impact food supply.





## Atikokan GS Biomass Conversion is underway

- Fuel is being changed from coal to biomass wood pellets.
- Annual demand expected to be 150 million kWh.
- Some modifications to furnace.
- New fuel handling and storage system to ensure safety.
- 10,000 tonnes of storage using two 5000 tonne silos.
- Pellets “first in first out” - minimizes self heating.





## OPG's Biomass History

- **OPG's predecessor, Ontario Hydro, conducted preliminary investigations of biomass potential back in the 1970s.**
- **Successful test burns of waste grain material were conducted at Thunder Bay GS in the 1980s.**
- **Biomass co-firing was already well-established in several European countries at levels up to 20% of the fuel blend.**
- **OPG is taking responsible action to manage greenhouse gas emissions.**
- **As we move to improve our environmental footprint, our biomass-testing program is an important part of the process.**



## Biomass Technical Workshops in 2006

- **Nov. 9 – Ontario Centres of Excellence and Ontario Ministry of Energy led to two Bio-energy Research Technical Workshops to engage experts in the field of bio-energy. OPG was supportive and Atikokan Generating Station was the host site for the first event**
- **Nov. 23 – the second Technical Workshop was held in Toronto and included an overview of Biomass and its potential as a co-firing agent. OPG had the opportunity to talk about recent biomass test burns at Nanticoke and Thunder Bay and to give a presentation on the specifics of Atikokan GS.**



## Test Trials 2006 – 2008

### Nanticoke Generating Station

- **March 2006 – August 2008, a three-phased biomass co-firing testing was undertaken at OPG's Nanticoke Generating Station.**
- **Results of the first short burn (8 tonnes of wheat shorts) served as “proof of concept” for the program.**
- **A series of short duration burns were followed by a longer (~ 2 weeks) engineered test burn that incorporated silos, conveyors and blowers. *We achieved sustained combustion.***
- **By June 2008, we had successfully co-fired milling by-products with coal to produce over 1.3 million kilowatt hours of electricity – *enough to power 1,300 Ontario homes for one month.***
- **By August 2008, a full-scale commercial installation was complete.**





## Atikokan Bio-Energy Research Centre announced

- **Sept. 5, 2007 – Provincial Government announced the investment of the \$4 million in the Atikokan Bio-Energy Research Centre to support six innovative projects that included research and testing.**
- **Atikokan Generating Station would be the host site.**
- **At the Atikokan Generating Station, some of the questions that arose included:**
  - **is a 100% biomass burn achievable?**
  - **If it is in the short term, is it sustainable in the long term?**
  - **If the costs are high, would we be dispatched very often?**
  - **If just to meet peaks, how quickly could we come on and what sort of ramp rates could we achieve?**
  - **What would be the effects of this on boiler operation and reliability?**
- **It quickly became evident that there was much research for the Atikokan Bio-Energy Research Centre.**



## Atikokan GS Biomass Co-firing Trials 2006 - 2007

- Conducted test burns of wheat shorts
- Evaluated strategy to reduce net GHG emissions
  - Phase 1 - proof of concept (Mar. '06)
  - Phase 1b & 2 - engineered test **burn** ('06 - '07)

- ✓ Measured CO / CO<sub>2</sub> / No<sub>x</sub> / O<sub>2</sub> opacity
- ✓ CO<sub>2</sub> (@ 3% energy input) = 80,000 MT/unit/yr
- ✓ SO<sub>2</sub> (@3%) up to 7% reduction
- ✓ NO<sub>x</sub> (@7%) up to 7% reduction
- ✓ potential reduction in metals, Hg





## Biomass Research Projects Announced

### Summary of research projects:

- **Co-firing Peat/Forest Biomass with Coal for Power Generation - Charles Xu, Lakehead University**
- **Environmental Effects of Wet-harvesting Peat as an Alternative Energy Source for the Atikokan Generating Station - Peter Lee, Lakehead University, Mike Waddington, McMaster University**
- **Wood Biomass Procurement and Quality Enhancement for Energy - Reino Pulkki, Lakehead University, Brian Kurrika, Confederation College**
- **Optimizing Ontario-based Wood Pellet Production for Co-firing and Market Development and Penetration - Andrew Pollard, Queen's University**
- **Monitoring Total Mercury Emissions from Atikokan Generating Station - Murray Thomson, University of Toronto**
- **Combustion Optimization Studies – Coal-Only Baseline & Co-fired Biomass Fuels – J. McGregor, McMaster University; M.Thomson, University of Toronto**

## Thunder Bay GS Test Trial August 2006

- A test burn of about 12 tonnes of pelletized grain screenings was conducted.
- The long term objective was to install equipment to minimize handling and burn the raw product.
- The pellets were mixed in the coal yard, fed into the hopper, the mixture was conveyed into the plant and confined to a specific bunker, fed through the pulverizer and burned as normal.
- The percentage was 5% of total fuel eg. 10 tonnes grain/200 tonnes coal.

***Atikokan and Thunder Bay boilers are known to be well suited for biomass firing as they were all built to fire high moisture lignite coal.***





## Atikokan GS – Early Test Burns 2008



- **Jan. 19 – 26 tonnes of softwood pellets were burned in the boiler - 1<sup>3</sup>/<sub>4</sub>-hour test achieved an overall 16% blend with lignite. One-tonne bags of pellets were loaded and flowed through the materials handling system as easily as coal – achieved proof of concept.**
- **Mar. 8 – 180 tonnes of waste wood pellets were blended with 20% lignite. Pellets were delivered in 3 different configurations of grain cars to identify if one was better than another for dumping and handling.**
- **May 30 – testing to optimize primary air flow through the mill, 180 metric tonnes of pellets in 1 mill, 20% energy input from biomass, 8 hours duration.**





## Atikokan GS Biomass Test Burns continue

- **July 8, 2008 – 66% biomass test burn; 180 tonnes of pellets in 2 mills, remainder on coal; achieved 66% of energy input from wood; reached 125 MW gross load.**
- **July 10, 2008 – 100% biomass test burn; 180 tonnes of pellets in 3 mills; back off on coal and gas support; achieved average of 150 MW gross load running on 100% wood in three mills - no natural gas or coal support; peaked at 175 MW for brief period; test was sustained for just over 5 hrs.**







## Groundbreaking News!

*OPG sets record*

*Largest 100% biomass generator in North America!*

- July 17, 2008 – 100% Biomass Test Burn, 180 tonnes of pellets in 3 mills, light off on gas and wood and run to determine load sustainability.
- July 31, 2008 – 100% Biomass Test Burn, 5 more cars of pellets in all five mills. Started up on gas and wood – achieved Maximum Continuous Rating on the unit.
- <sup>23</sup> Biomass testing well underway!





## OPG – Quickly Becoming a Catalyst

- These tests determined how our equipment would function with biomass and helped to gain a greater understanding of the technical requirements.
- OPG was quickly becoming the catalyst for Ontario's biomass industry. Tests using biomass made from sustainable wood sources and non-food agricultural products could produce much cleaner and greener power than coal.
- OPG's biomass program continued to make progress.







## Atikokan GS - An Explosion

- On December 1, 2008, an explosion occurred on the 11<sup>th</sup> floor of the Atikokan Generating Station's powerhouse. No employees were in the area and electricity was not being produced at the time. There were, thankfully, no injuries.
- Biomass testing was put on hold.
- Plant safely returned to service in eight weeks.
- After intensive investigation and analysis, a Safety Study identified procedures ranging from procurement specifications for wood pellets and their handling and storage, to a detailed design to minimize mechanical stress on fuel pellets and dust generation.





## Stakeholder and Community Outreach underway

- By early 2010, people were beginning to rally around the Atikokan biomass project. Drafts for Environmental Approvals were underway. A community outreach program was initiated. Stakeholder support in the form of written resolutions and letters began pouring in.



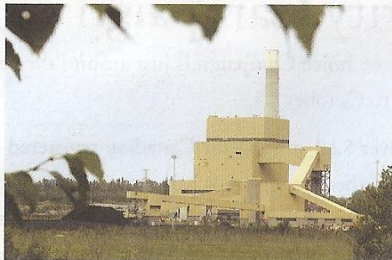




## Energy Minister directed purchase of power

- August, 26, 2010 was a major milestone – The Minister of Energy directed the Ontario Power Authority to negotiate a Power Purchase Agreement with Ontario Power Generation for biomass-generated electricity from Atikokan Generating Station.

### Atikokan Achieves Major Milestone



OPG is one step closer to repowering Atikokan with biomass fuel.

A major milestone was achieved on August 26 as Ontario Minister of Energy Brad Duguid directed the Ontario Power Authority to negotiate a contract with OPG to purchase biomass-generated electricity from the station. Minister Duguid announced, "We are planning for a coal-free future by converting Atikokan to biomass so that Northwestern Ontario will have a stable and clean supply of energy to fuel their economy."

Acquiring fuel and plant modifications at the right price

and a negotiated contract with the OPA will be necessary to demonstrate a solid business case for repowering.

In a message to Thermal staff, Senior Vice President **Frank Chiarotto** noted, "While the directive is specifically for Atikokan, we are continuing our assessments of conversion of Thunder Bay, Lambton and

Nanticoke units to cleaner fuels like natural gas and biomass."

*(Left to right): Dennis Brown, Mayor of Atikokan; Bill Mauro, MPP - Thunder Bay-Atikokan; Ed Enge, Atikokan GS Manager; Jane Todd, Northwest Program Manager; and Al Arnott, Director of the Biomass Conversion Project.*



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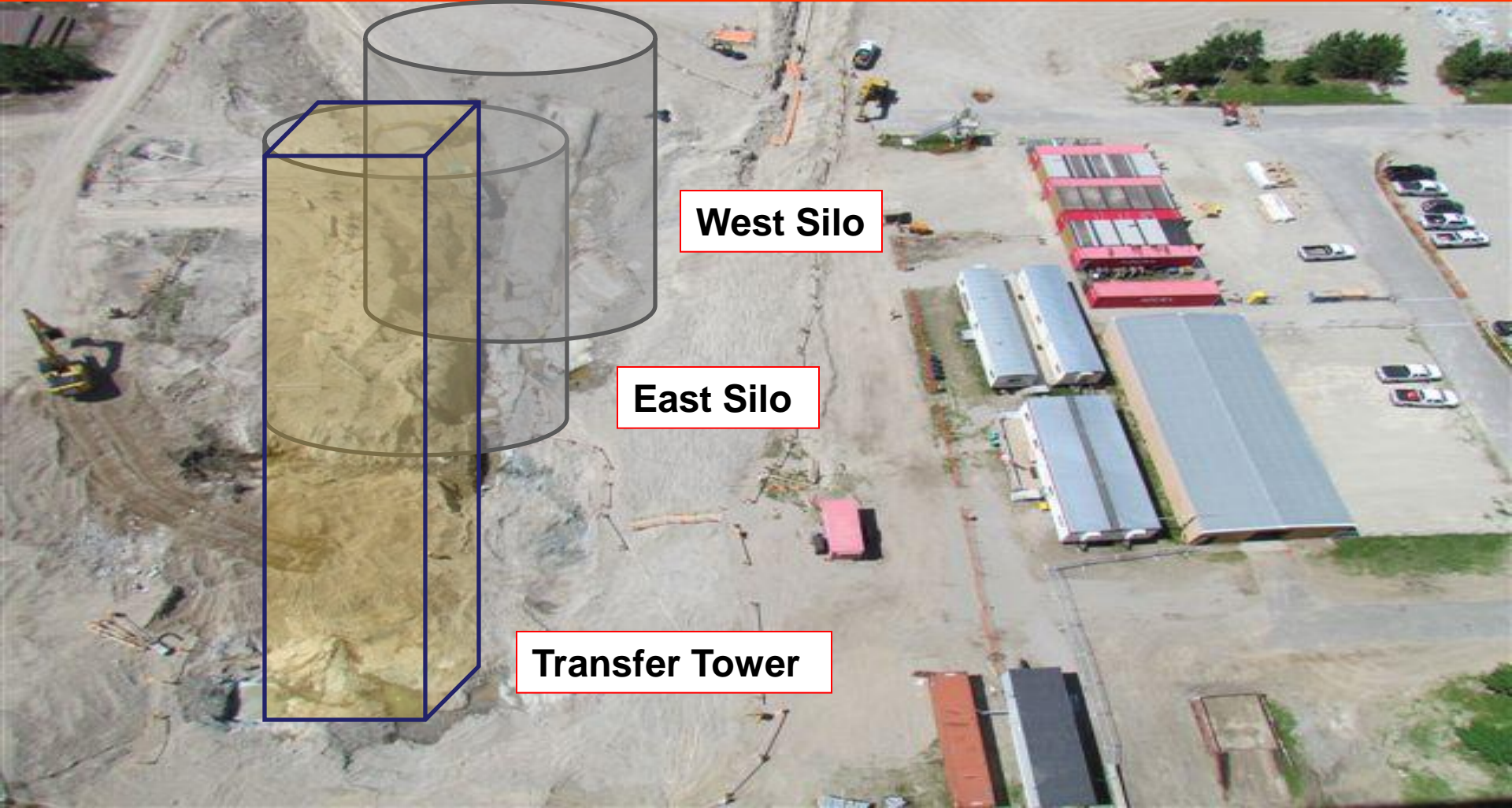
## There was still a long way to go

- **OPG would now contract for detailed engineering and cost estimates for the plant modifications and biomass fuel supply to develop the project business case submission.**
- **Still ahead:**
  - **The Ontario Power Authority to provide the Power Purchase Agreement**
  - **Fuel & Modification contracts to be put in place**
  - **OPG's Board approval of the business case required**
  - **Plant Modifications to be done**
  - **Fuel to be sourced and delivery contracted**





# Atikokan GS – Plan view



**West Silo**

**East Silo**

**Transfer Tower**





## Excavation at Atikokan GS







## Silo Foundation Forming at Atikokan GS







## Silos taking shape







## Truck Receiving and Transfer Tower underway







## Project coming together







## Sustainable Fuel Supply: Atikokan GS

- Fuel must meet the United Nations Framework Convention on Climate Change definition of renewable biomass.



- Atikokan GS: 90,000 tonnes of wood-based fuel per year ... Less than 1% of annual harvest in Ontario.
- Fuel has been sourced and will be processed in northwestern Ontario.





## Biomass Sustainability Analysis

- **Conducted by The Pembina Institute in 2011.**
- **Based on thorough forest carbon life-cycle modeling and socio-economic analysis.**

### **Findings:**

- **A biomass program using wood pellets at a rate of 2 million tonnes per year can be done sustainably with no systemic decline in forest carbon stocks over time.**
- **Significant greenhouse gas benefits over natural gas combined cycle (80% lower GHG emissions).**



## Ontario Power Generation

- **Converting the Atikokan Generating Station to biomass fuel makes business sense. It makes use of an existing generating station owned by the people of Ontario.**
- **Most recently, fuel supply contracts were signed with Atikokan Renewable Fuels and Resolute Forest Products. Both are located in northwestern Ontario and both contracts include an aboriginal involvement component.**
- **The Atikokan Generating Station Conversion Project is well underway and once operating will be the largest 100% capacity biomass fuelled plant in North America.**
- **Biomass is an opportunity that OPG will continue to explore as an option for its other stations.**





## Atikokan GS Repowering Project Schedule

- 2012** Energy Supply agreement with OPG/OPA complete.  
Business case approved by OPG Board of Directors and government support attained in July.
- 2012** Environmental Compliance Approval certification with MOE for finalization.
- 2012** Material handling system construction in progress.
- 2013** Furnace and Combustion system modification to begin.
- 2014** Commission and place in-service.



# Northwest Thermal Conversion – Thunder Bay GS



**Natural Gas Project on hold**



## Thunder Bay GS - Future to be Determined

- **Nov. 1, 2012 – Minister of Energy announced TBGS Natural Gas Conversion Project was placed on hold.**
- **Conversion of TBGS to gas by the end of 2014 no longer possible.**
- **Jan. 10, 2013 - Premier announced Nanticoke and Lambton plants will stop burning coal by end of 2013. Two coal units will remain in the province, scheduled to close by the end of 2014.**
- **Jan. 17, 2013 – City of Thunder Bay, Northwestern Ontario Municipal League and Fort William First Nation representatives met with the Energy Minister and Ontario Power Authority officials to discuss region’s energy needs. Final decision on future of TBGS pending.**
- **TBGS Environmental Compliance Certification submission continues to be under review by the Ministry of Environment.**





## In Summary

- **Atikokan GS Biomass Conversion Project is well underway and on schedule. It is also stimulating economic growth in the region.**
- **Thunder Bay GS Natural Gas Conversion Project is on hold. The project team remains intact. A decision by the Minister of Energy on the future of the project is expected within a few months.**
- **Biomass options are being studied at Thunder Bay GS as a future option to fuel coal plants.**



**ONTARIO** **POWER**  
GENERATION

**Thank you!**