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Biomass at OPG: Growing Opportunity for Ontario

November 2009

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Outline

OPG

OPG's Biomass Project

Fuel and Supply Chain Considerations

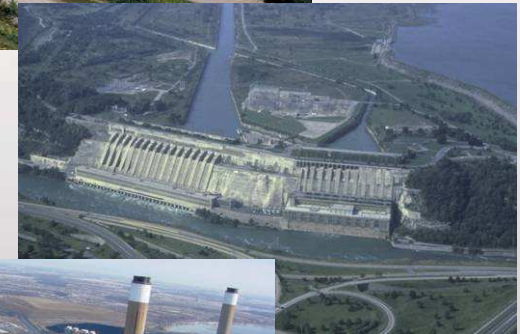
Moving Agricultural Potential Ahead

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Ontario Power Generation Profile

- Owned by the Province of Ontario
- Generated 107.8 billion kwh in 2008
- Produces two-thirds of Ontario's electricity
- No transmission or retail functions
- 11,000 employees
- Capacity: 21,000 MW
- Gross Revenue: \$6 billion



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Nanticoke 3,640 MW



Atikokan 211 MW



Lambton 1,920 MW



Thunder Bay 306 MW

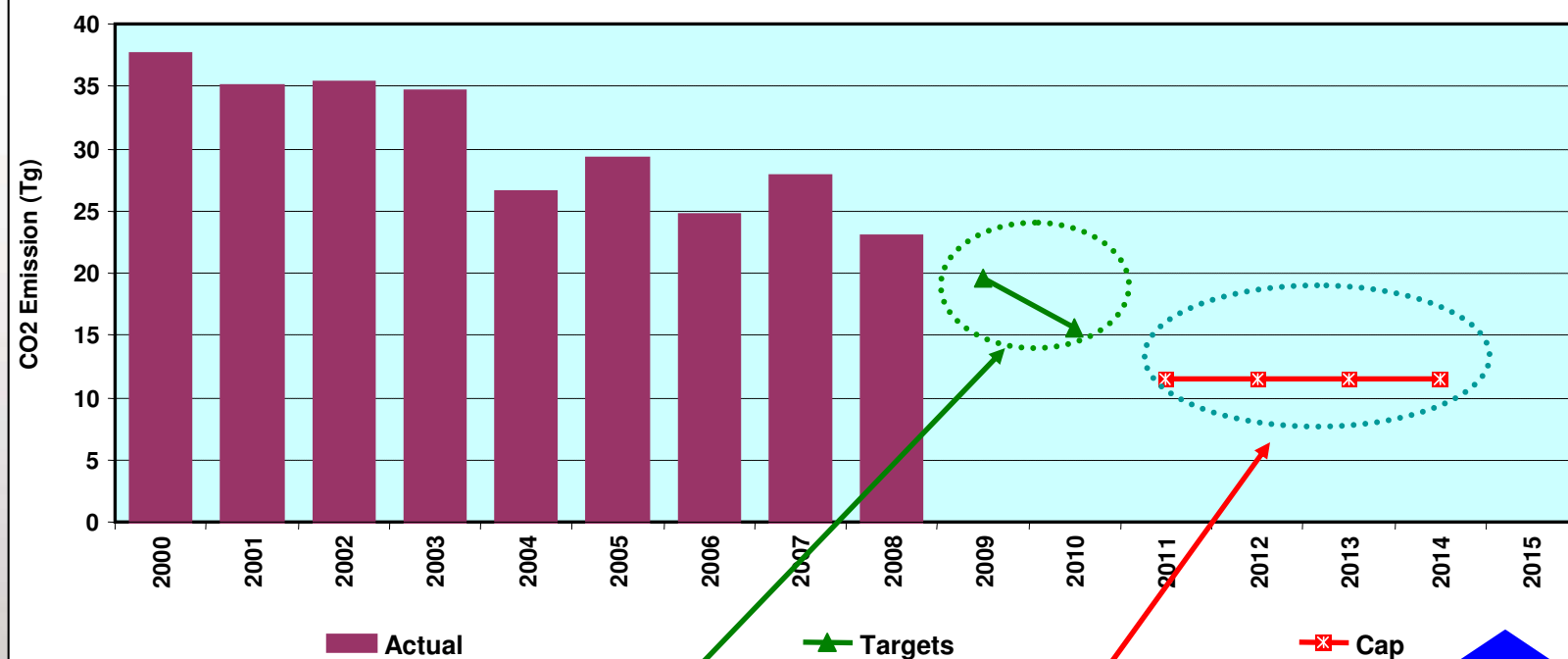


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CO2 Emissions from OPG Coal Plants



Target based on
*Shareholder
Declaration and
Resolution*

Proposed hard cap
based on *Ontario
Regulation O.Reg
496/07 Amendment*

Use of coal ends
under *Ontario
Regulation
O. Reg 496/07*

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Why Biomass at OPG Coal Plants ?



Thunder Bay GS



Atikokan GS

- Renewable energy
- On demand when you need it
- Greenhouse gas benefits
- Synergy with agriculture and forestry – made in Ontario industry
- Makes use of existing plants – lower capital costs

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Biomass – Public Considerations

Biomass has some key positive attributes:

- Renewable
- Greenhouse gas emissions/climate change benefits
- Is an alternative to coal
- Ontario economic benefits

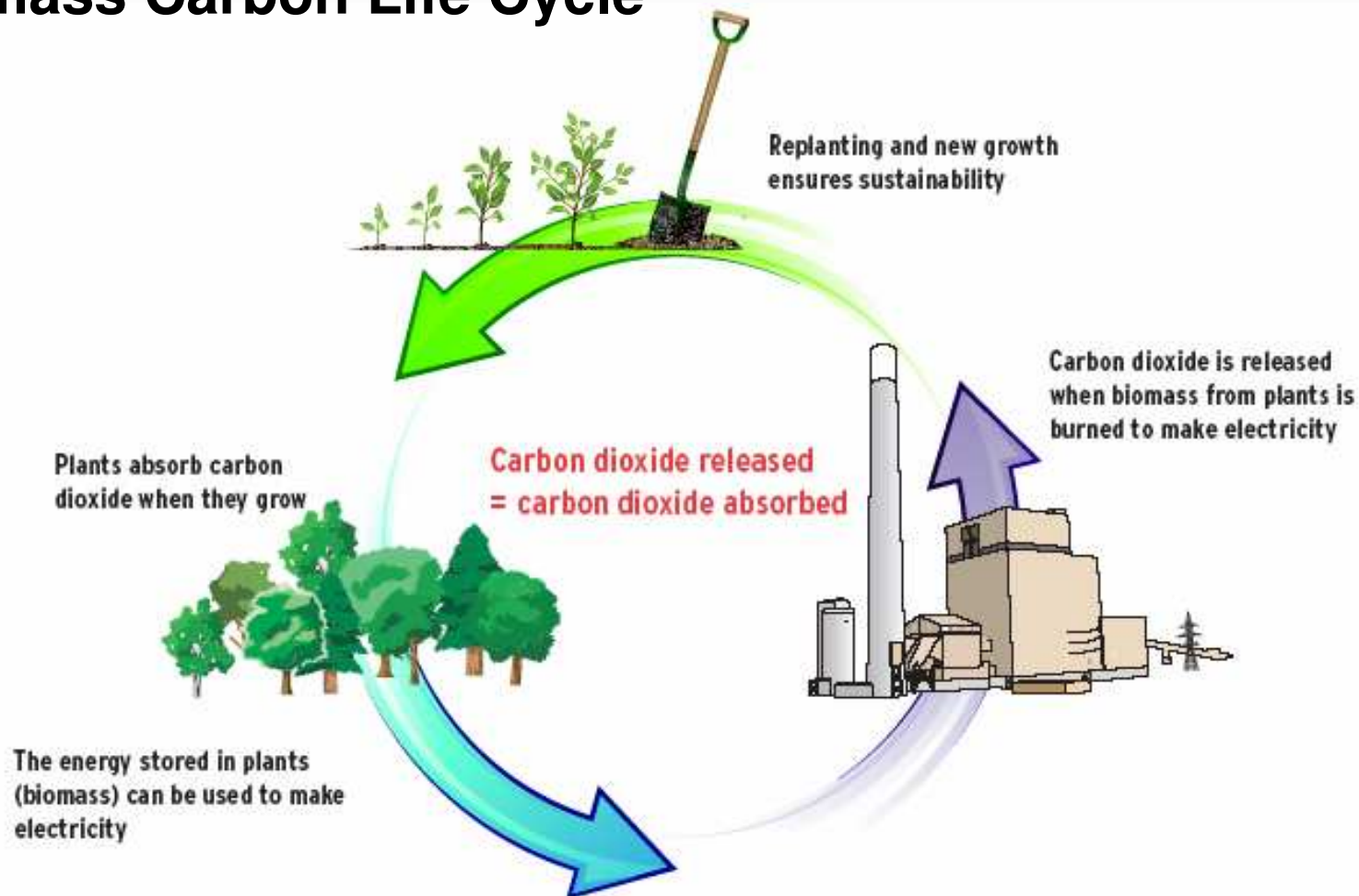
But the public will demand:

- Sustainability and environmental responsibility
- No impact on food supply

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Biomass Carbon Life Cycle



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GHG Assessment: Agriculture-Based Fuels

- Diversity in potential biomass feedstocks, soil types and inputs complicates GHG life-cycle analysis for agricultural biomass.
- Will examine one representative by-product and one representative fuel crop: corn cobs & miscanthus.
 - additional feedstocks could be considered such as: switchgrass, corn stover, soybean stover, dried distiller's grain.
- Anticipated schedule for initial study:
 - Study initiated late 2009.
 - completion in 2010.

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OPG's Biomass Project

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Project Scope

- Assess biomass option for 17 coal fired units at four generating stations – not all will be converted
- Much lower electricity production per unit
- Potential for up to 1,000 MW of biomass generation capacity & total of up to 5 terawatt-hours of electricity
- Develop forest and agriculture based fuel channels

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Biomass Test-Firing Experience

Atikokan GS

- Achieved full load on 100% wood pellets

Nanticoke GS

- “No-coal” wood pellet test complete
- Seasonal co-firing with wheat shorts
- 4 million kwh of renewable production in 2008 – enough to power more than 300 homes

Thunder Bay GS

- Co-fired grain screenings with coal

Lambton GS

- Co-fired wheat shorts with coal



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Current Biomass Project Activities

- Safe handling and storage analysis
- Engineering concept studies:
 - Atikokan (complete)
 - Nanticoke (underway)
 - Thunder Bay (underway)
 - Lambton (will follow)
- Combustion and ash studies
- Fuel specification development
- Environmental permitting

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OPG's Current Focus - Atikokan

- Conversion to wood-fibre biomass
- Expect full electrical output capability
- Anticipated annual production of around 150 million kilowatt-hours
- Annual fuel requirements approximately 100,000 tonnes dried wood pellets
 - less than 5% of 2005/2006 harvest in Northwest Ontario
- Engineering work underway

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Reviewing Potential at Other Plants

Thunder Bay:

- Similar plant design to Atikokan
- Potential conversion of one unit
- Wood-fibre fuel likely

Lambton and Nanticoke:

- Preliminary engineering concept work
- Likely combination of wood and agriculture-based fuel

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Challenges

- Fuel cost – more expensive than coal
- Fuel supply infrastructure does not exist
- Requires supply and handling huge volumes of fuel – low energy density
- Covered shipping and storage is required
- Potential combustion/boiler issues
- Ash re-use considerations
- Avoid competition for resources
- Many by-products defined as wastes
- Public perceptions



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What has to happen?

- Minister's directive to OPA to proceed
- Fuels specification for wood and agricultural products developed and contracts let
- Power Purchase Agreement
- Plant modifications engineered and contracts let
- Fuel suppliers and aggregators in place

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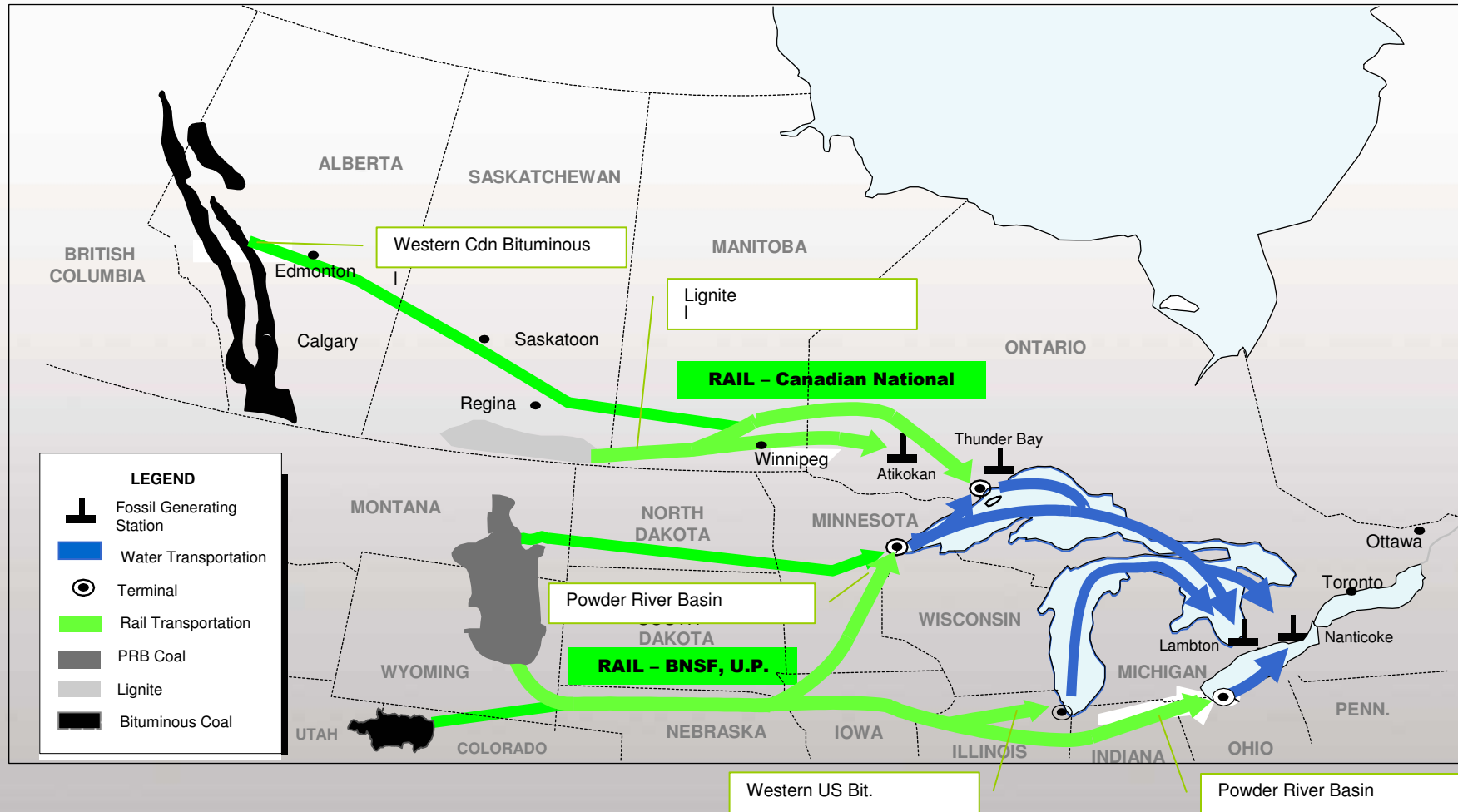
Fuel and Supply Chain Considerations

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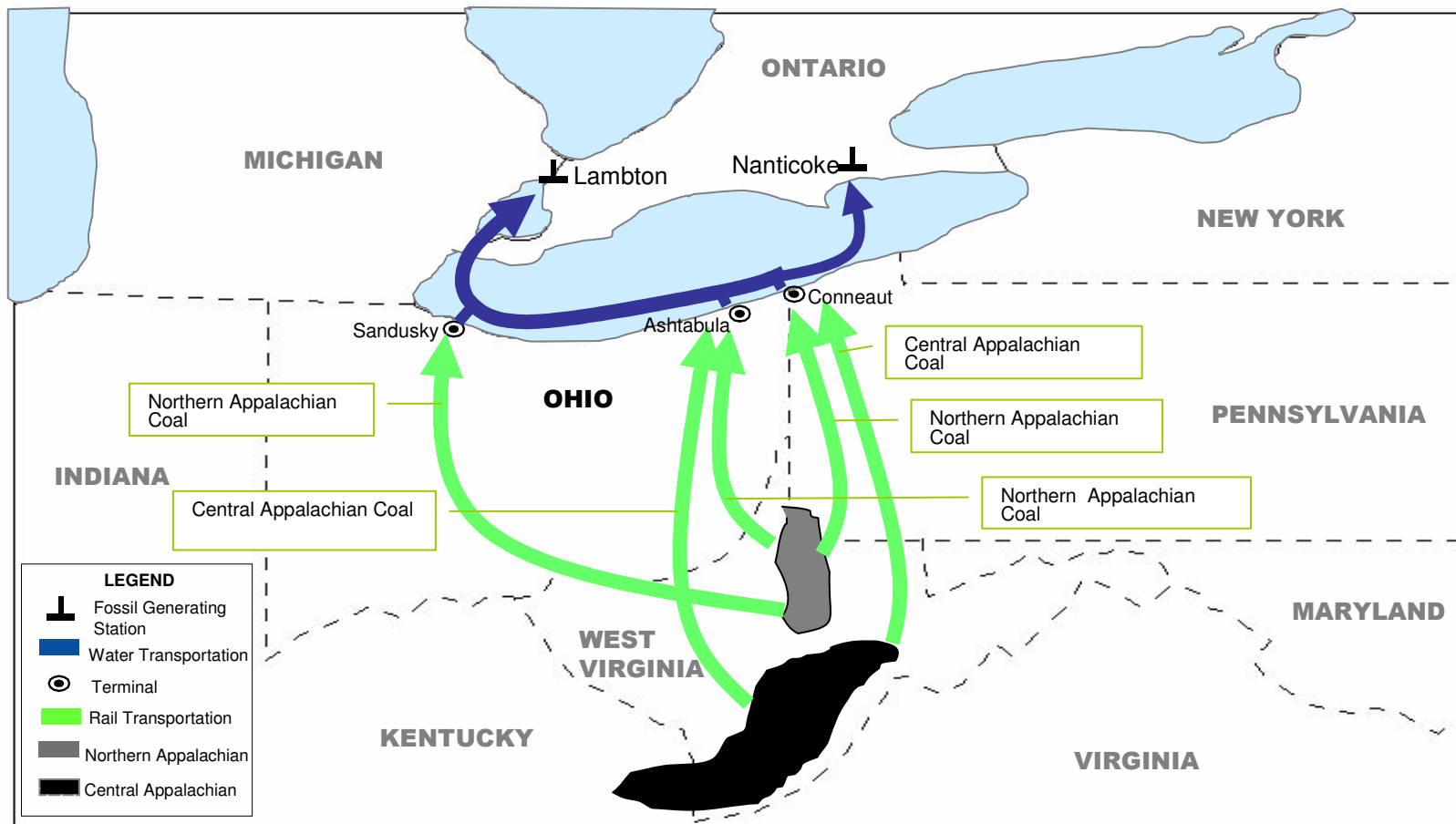


- Managing Supply Risk
- Price Risk
- Delivery Risk
- Storage
 - Source , Transload, Station
- In the context of phased in Plant Conversions

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Vessel

Seaway Marine Transport, Interlake, Canadian Steamship Lines

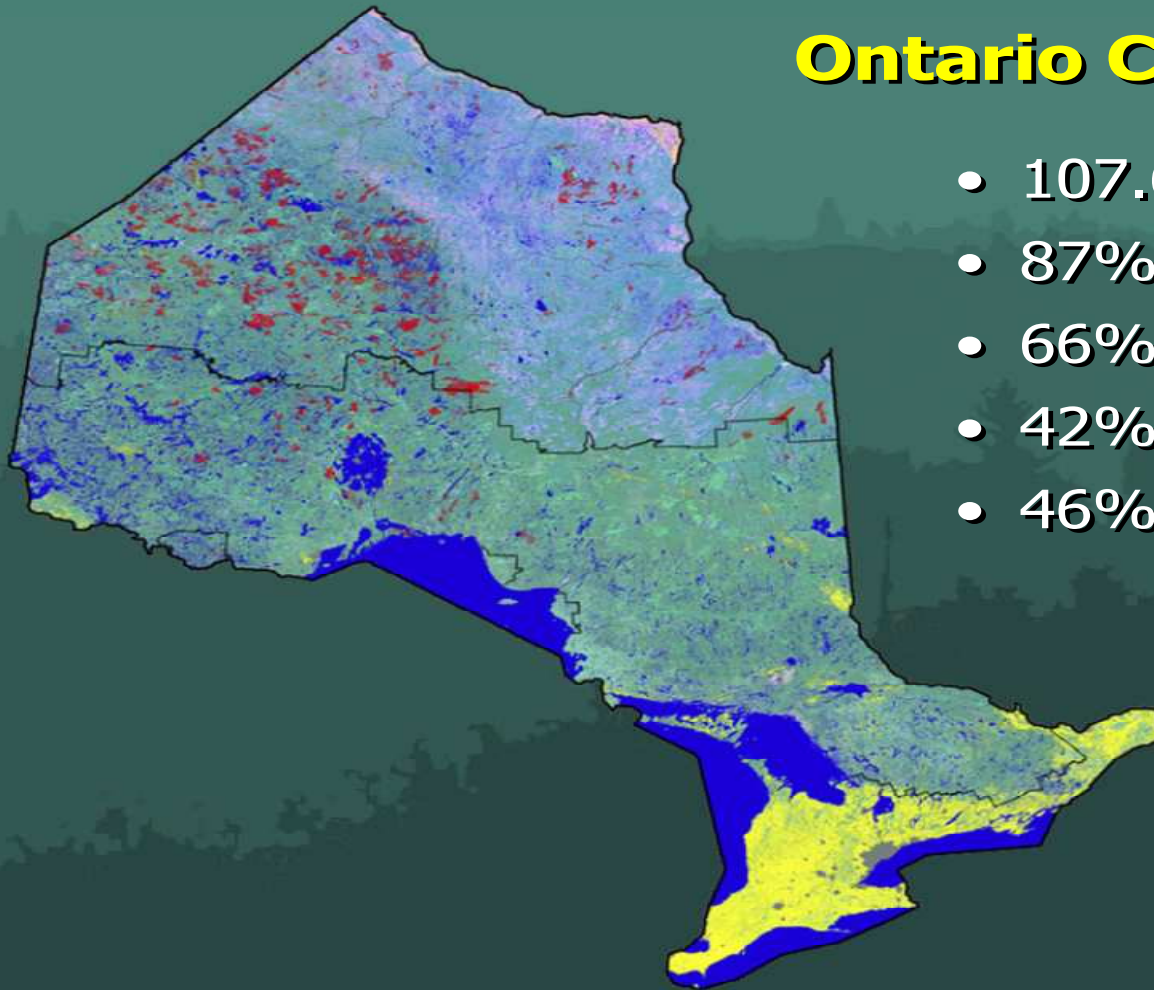
Rail

Norfolk Southern, CSX, CN

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Ontario Context



- 107.6 million ha
- 87% public land
- 66% forested
- 42% managed
- 46% natural state



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Basic Fuel Requirements

- Pelletized fuel
- Ontario sourced and processed
- Biomass fuel must not be defined as a waste under Ontario regulation
- Life-cycle greenhouse gas impact known and minimized
- Sustainability standards will be applied



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Challenges – Pellet Plant

- Need access to 4 – 5 M tonnes of green fibre.
- Optimal Pellet plant size 100 – 200 k tonnes of Pellets, optimal draw size .
- Likely plants will locate on rail lines/ road access on or near existing sawmills/pulp & paper mills
- Clearly a distribution across the province embedded within the resource
- Pellet plants anticipated to operate essentially 365 , 7/24

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Challenges - Fuel Characteristics

- Product must stay dry , we currently put solid fuel to ground.
 - Next generation of processed Fuel may address
- Product decomposes
- Heat Content ~7,500 btu/lb
- Product Density .. Lighter than coal
- Durability ... dusting ... Natural binder
- Grindability... resistance to crushing .. Particle size

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Challenges – Bulk transport

- Customized Rolling Stock , Customized Truck Trailers .. current equipment configured for different product
- Contamination ... an issue
- Current infrastructure to support not in place
 - Port, Rail , Truck ... receiving storage loading
- Nanticoke and Lambton vessel delivery

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Challenges – Delivery

- Moving 2 – 2.5 M tonnes of pelletized product
 - 1.5 – 2.0 M tonnes moving from North to South
- Timing mismatch between Pellet plant production and electricity production
- Leverage current delivery infrastructure and or combination of new receiving facilities.
- Storage ... rolling , floating, fixed at pellet plant , fixed at GS , fixed at port, fixed at transloading facility

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Supply Chain Business Model

OPG will:

- buy pelletized biomass fuel from technically and financially capable counterparties who aggregate raw biomass materials and produce processed fuel.
- arrange transportation of processed fuel.
- purchase fuel through competitive RFPs on the basis of well defined technical specifications for pelletized wood biomass and pelletized agricultural biomass.
- enter into long term fuel contracts.

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Supply Chain Business Model

- Fuel processor / aggregators to arrange for the required supply and transportation of raw material (e.g., by entering into contracts with producers).
- Some conditions of OPG contracts with fuel aggregators are expected to “flow through” to primary producers (e.g., requirements for sustainability)

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Developing Agricultural Potential

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Crop Identification

- Selection of appropriate crop to grow:
 - Soil types
 - Climate
 - Harvesting
 - Environmental benefit (including ecological)
 - GHG benefits (to be studied)
 - Technical suitability (combustion)

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Crop Identification

- Combustion studies to determine:
 - Combustion characteristics
 - Ash composition
 - Air emissions
- Crops included in combustion studies are miscanthus, switchgrass, willow, corn stover and soy bean stover.

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Summary - The Opportunity

OPG's biomass program has the potential to:

- Increase the supply of renewable electricity
- Reduce net greenhouse gas emissions
- Benefit Ontario's forestry and agricultural sectors
- Make use of OPG's public assets for years to come

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