

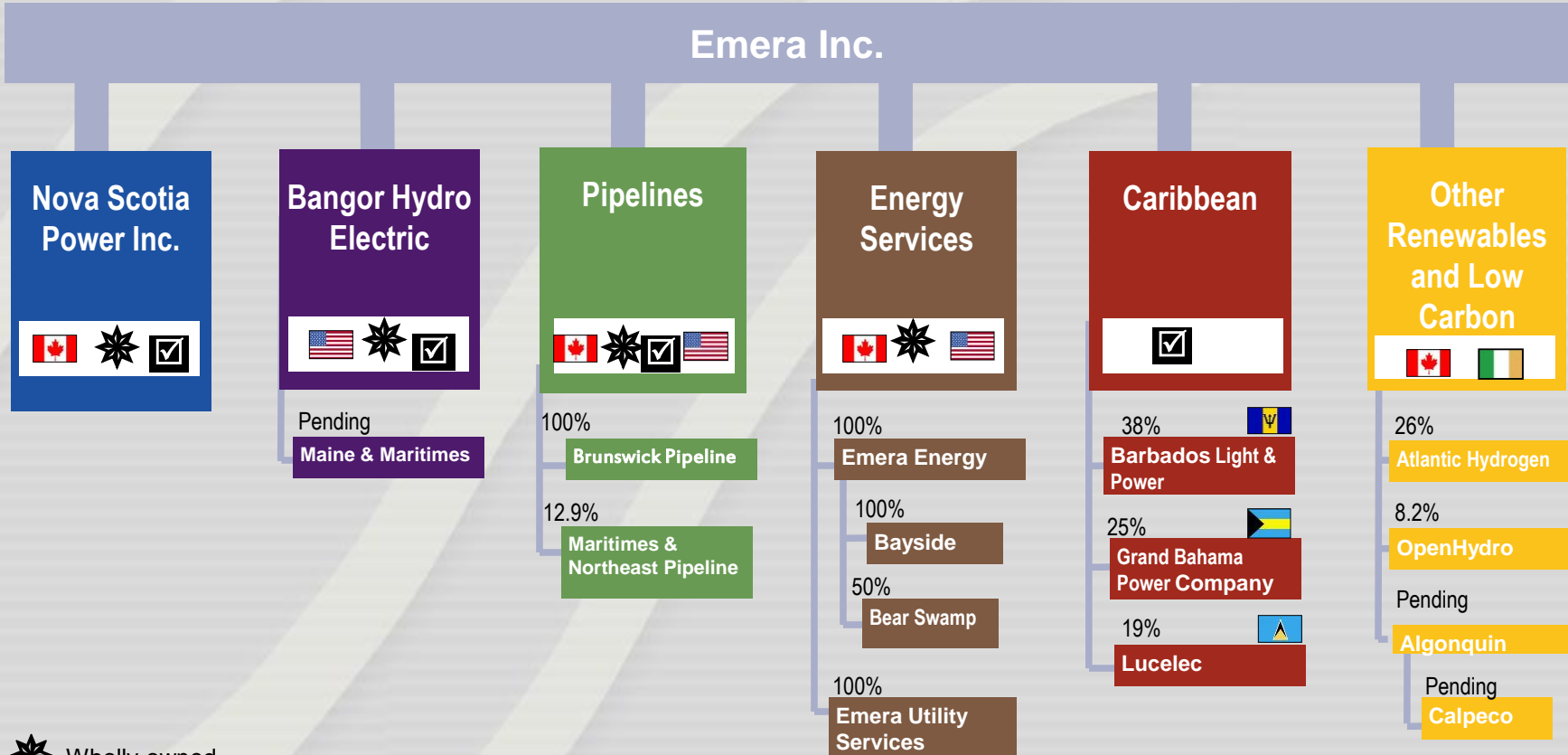
# The Challenges of Connecting Renewable Energy to the Grid

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September 24, 2010

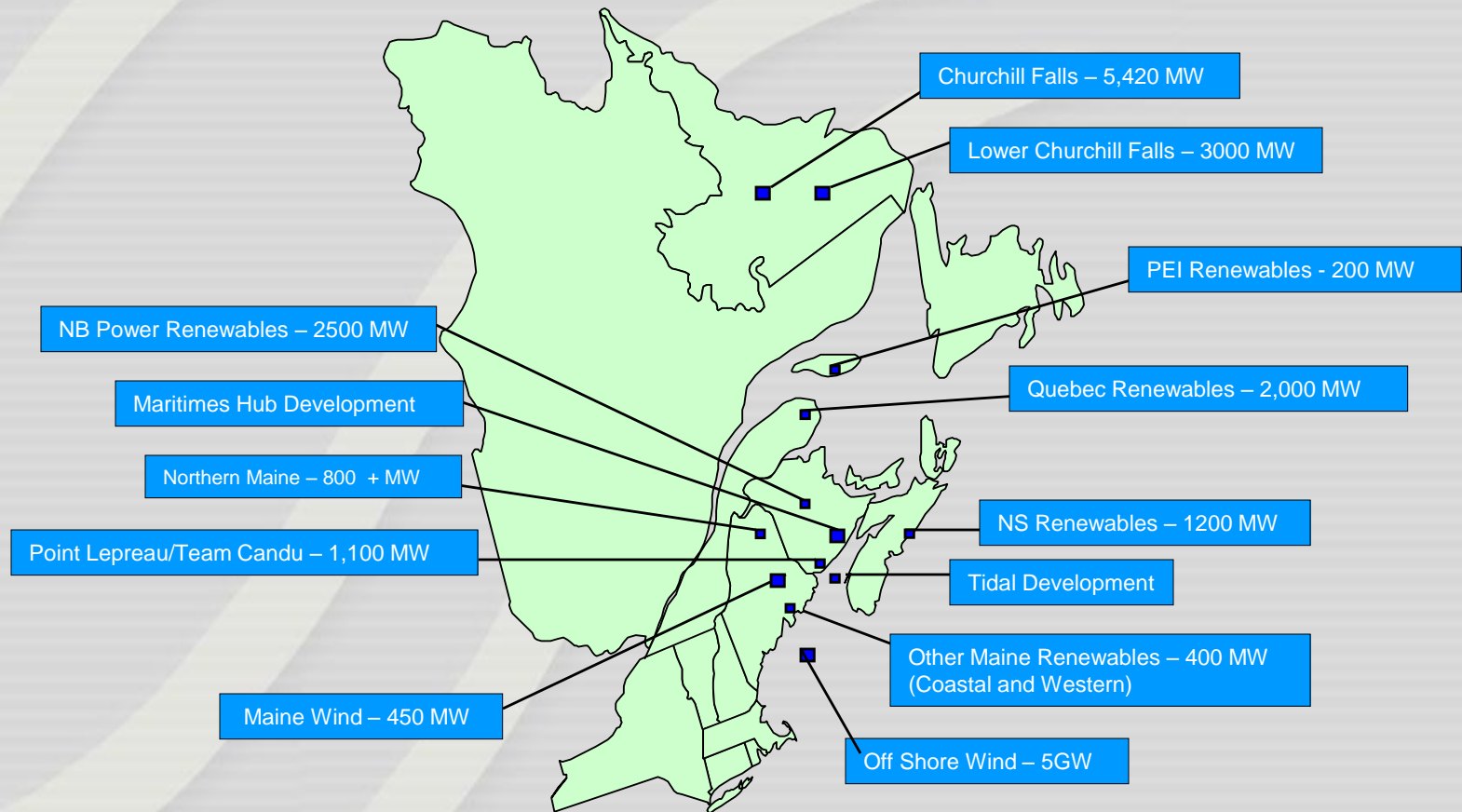


# Emera Overview



Wholly-owned  
 Regulated business

# Regional Renewable Possibilities



# The Challenges...

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- Political and Policy Matters
- Environmental Factors
- Transmission Considerations
- Economic Drivers
- Technical Considerations
- Technology Advancements

# Political and Policy Matters

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- Market
  - Renewable energy credits +
  - Energy market –
  - Capacity Market –
  - Demand –
- Tax law
  - Tax credits +

# Political and Policy Matters

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- Governmental Policy
  - Renewable portfolio standards (RPS) +
  - Long Term Contracts +
  - Carbon legislation/compacts +
  - FERC siting policy (NIETC) +
  - Stimulus Funding -
  - Midwest wind concept +
  - Global instability and drive to energy independence +
  - Rates +/-
  - Economic Development +
  - Compliance w/ NERC Standards +

# Environmental Factors

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- Environmental Policies and Pressures
  - NIMBYism -/+?
  - Streamlining Permitting -
  - State/local siting -
  - Pressures to reduce carbon emissions +

# Transmission (Reliability) Considerations

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- RTO Policies (Transmission Tariff)
  - Reliability Upgrades +
  - Transmission cost allocation –
  - Interconnection –
- Fuel Diversity
- Aging infrastructure +
  - No significant transmission built in New England between 1970 and 2006 +
  - Significant generation changes and load changes +
- FERC Incentives – EPACT 2005
- Integration (Grid operations) +
- Integration (Smart Grid) +

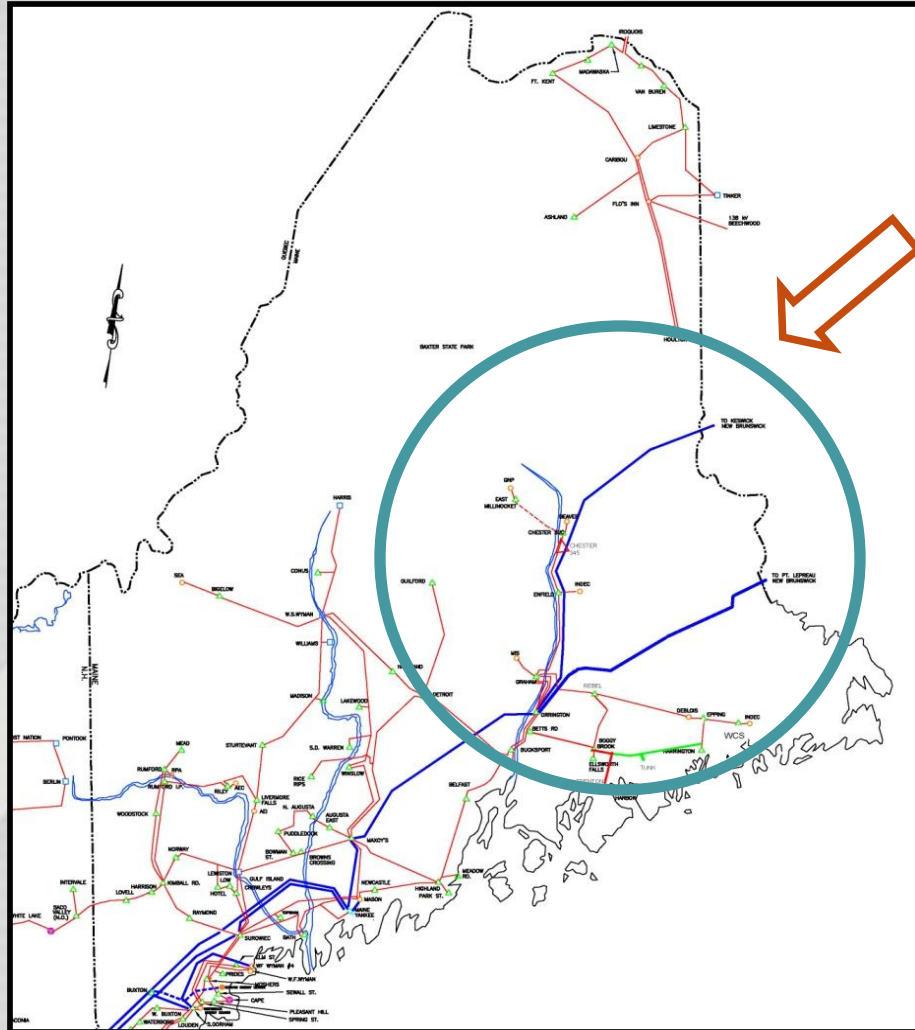


# Economic Drivers

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- Economic Drivers
  - Supplier offerings -
  - Availability of capital -
  - Fuel price stability +

# Overview of Northern Maine



# Technical Considerations

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- Case Study – Northern Maine
  - Electrically weak system
  - Generation in significant excess of load
  - Islanding a small system in the Maritimes (5,500 MW's of load)
  - Static Var Compensator
- Traditional Power System Studies include:
  - Short Circuit analysis
  - Steady State Load Flows
  - Electrical stability testing
  - Using traditional machine electrical parameters

# Technical Considerations

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- Issues for wind include:
  - Not located electrically close to load
  - Over-frequency issues for islands
  - Little inertia
  - Intermittency
  - Voltage control
  - Interactions with solid state voltage control devices
    - Subsynchronous electrical stability
    - Subsynchronous Torsional interaction
    - Subsynchronous Resonance
  - Systems with excessive transient recovery voltages
  - Complex studies using control system models and more sophisticated tools such as PSCAD
  - Harmonics

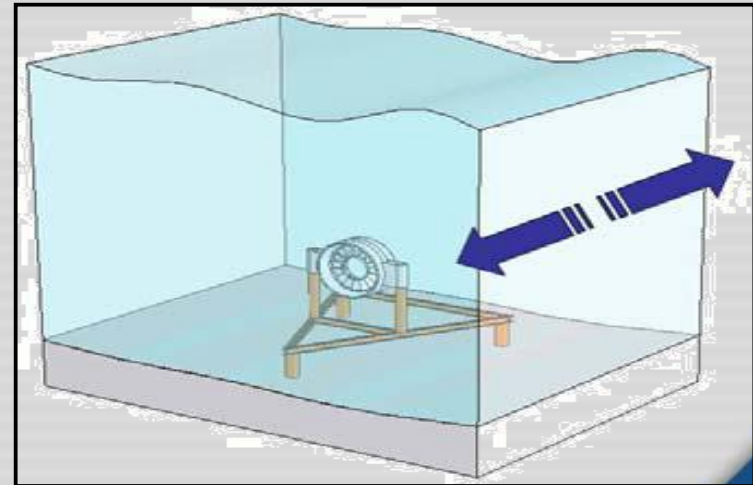
# Technology Advancements

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- Technology
  - Onshore Wind +
  - Offshore Wind -
  - Tidal -
  - Biomass +
  - Solar -
  - Hydro -

# One Example: OpenHydro

- OpenHydro designs and manufactures marine turbines for harnessing energy from tidal currents under the world's oceans
- OpenHydro's commercial scale 250 kW test turbine has been being tested at the European Energy Marine Centre ("EMEC") in Scotland
- NSPI selected this technology, with a triangular subsea base, for deployment in a demonstration project in the Bay of Fundy in the Fall of 2009





# OpenHydro: Major Components

- **Duct:** Simple construction and clean hydrodynamic lines minimize the locations where sea life could be come entangled. The shaped inlet duct improves turbine performance.
- **Generator:** highly efficient integrated permanent magnet generator.
- **Rotor:** the single piece rotor is the only moving component in the turbine unit. Retention of the blade tips within the outer housing clearly defines the swept area and eliminates the danger of fast rotating blade tips.
- **Open Center:** increases the efficiency as well as providing and exit route for marine life
- **Stator:** Stationary component of the turbine which houses the generator system components.









# openhidro

tidal technology

# Questions...