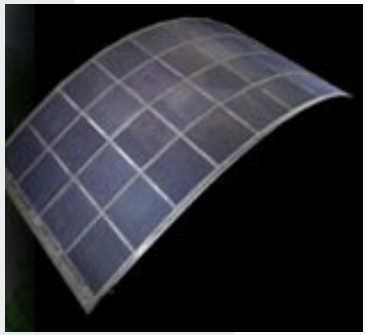
Ontario Centres of Excellence

The Need for Smart Grid Technologies in Ontario

Why we need solutions that enable DG



Robert Stasko

Director, Business Development

OCE - Energy

robert.stasko@oce-ontario.org

Pulling yourself up by your bootstraps

Ontario Centres of Excellence

Classic Electric Trolley in Astoria Oregon pulls its own diesel generator (why is this ironic?)


The Challenge …

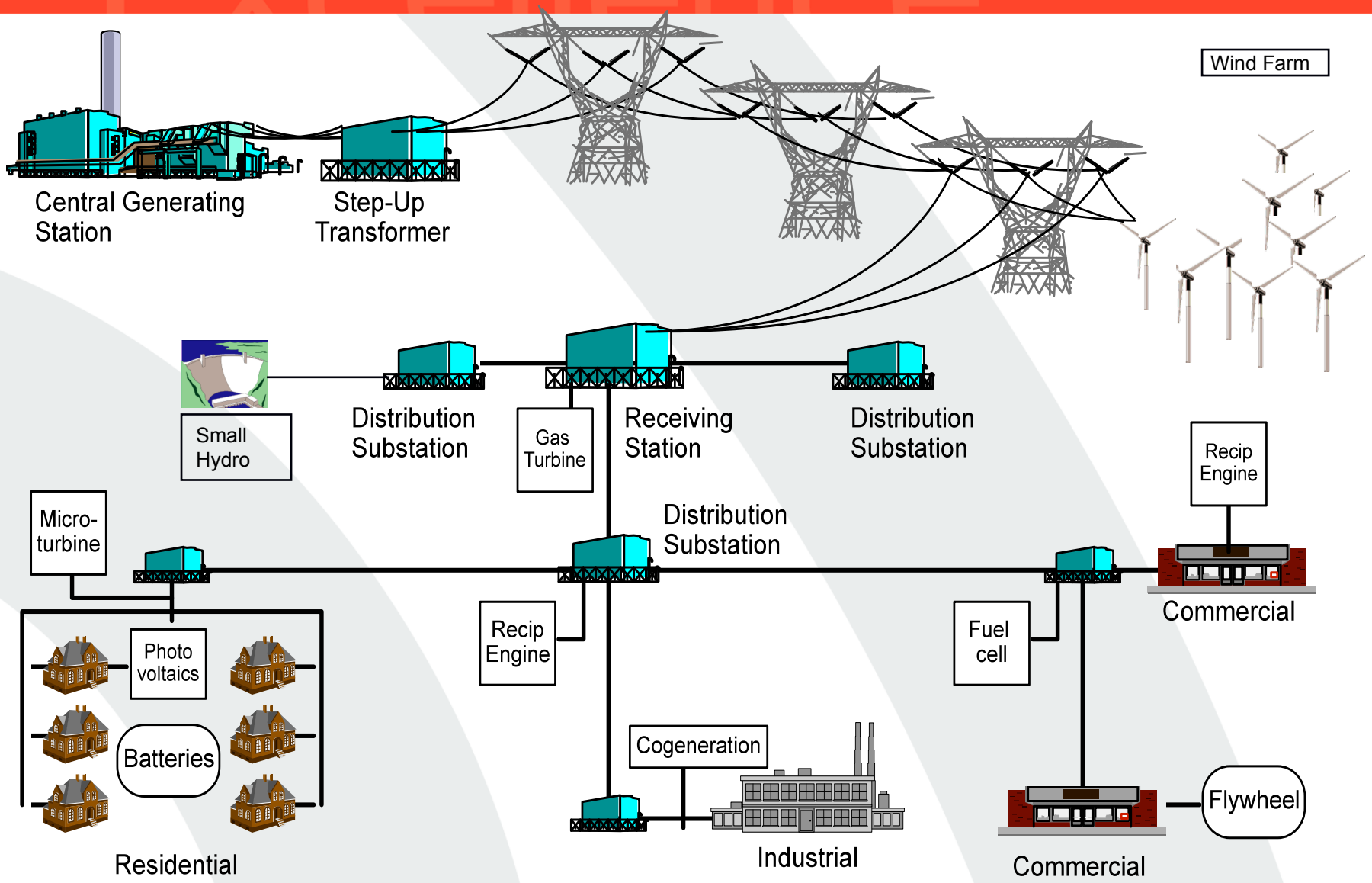
Challenges to the existing grid

Ontario Centres of Excellence

- Aging and dated equipment and infrastructure
- Shifting patterns of load vs generation sources and subsequent system constraints
- Local public resistance to new transmission (and distribution) lines
- rapid increases in renewable generation sources; often in remote or transmission- constrained locations
- Significant increase in ‘self-dispatched’ distributed generation from intermittent sources

ALL THESE CHALLENGES COULD BE ADDRESSED BY SMART GRID SOLUTIONS

The Emerging Electricity Network



What is a 'Smart Grid' ?

Ontario Centres of Excellence

- One that maximizes the capacity of the system via use of sophisticated monitoring, communications and control hardware and software
- One that allows bi-directional electricity flow thereby enabling net metering and local generation
- One that effectively manages intermittent sources of generation such as wind and solar
- One that makes effective use of energy storage and VAR support to reduce line losses and work around system constraints
- One that fully enables a distributed energy solution

How to Implement Smart Grid Solutions

Ontario Centres of Excellence

- Perform a comprehensive technology scan of all promising smart grid solutions, present and future
- Review best operational practices implemented in other jurisdictions, or soon to be implemented
- Develop a plan specific to the needs of the Ontario grid
- Identify needed system changes or upgrades
- Address regulatory barriers to implementation

DEVELOP MADE IN ONTARIO TECHNOLOGY SOLUTIONS THAT ADDRESS THE PROBLEMS AND THAT CREATE ECONOMIC BENEFITS

What is Distributed Generation ?

Ontario Centres of Excellence

- **Distributed Generation (DG) - small-scale, modular, power generation units located close to where the energy is used.**

- **Drivers:**
  - Electricity Price Volatility and Risk
  - Need to generate closer to loads
  - Environmental Concerns
  - New Power Market Entrants
  - Higher Efficiency / Cogeneration
  - Power Quality & Reliability
  - Technology Development

Distributed Energy Technologies

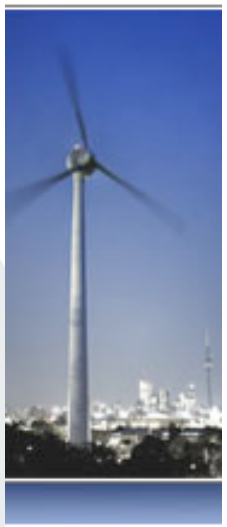
Ontario Centres of Excellence

- Wind Turbines
- Micro-turbines
- Recip. Engines
- Gas Turbines
- ORC Engines
- Mini-Hydro
- Fuel Cells
- PV-Solar
- Biomass Conversion
- On-site Energy Storage

Photovoltaic Technology

- Free-standing **arrays or**
- Building-integrated
- **wall & roof cladding**
- Crystalline silicon
- **(on glass panel) has**
- **highest efficiency**
- Thin-film or amorphous panels
- **laminated to architectural building components**
- **Simple modular** grid-interactive inverters
- Easy, distributed connections **to building wiring**
- **Usually** installed with no battery back-up

Pro's and Con's of Wind Power



- 30% capacity factor
- 70% production factor
- Intermittant generation
- High capital cost
- Zero fuelling cost
- Needs significant wind velocity
- Renewable and non-emitting
- Typically in constrained areas or remote locations (away from grid)
- Has become the darling of many investors
  due to predictable capital, production and maintenance costs!

Microturbine Market Drivers

- Electric Industry Restructuring
- Power when and where it's needed
- Reliability/Integration
- T&D Savings
- Capital costs can be competitive with central station power plants (CHP)
- Lower Emissions/low maintenance
- Resource Recovery Application
- Higher efficiency, especially when heat exhaust is harnessed

Combustion Turbines for CHP & DG

Ontario Centres of Excellence

The OGT2500 from Orenda is an example of smaller aero-derivative technology

2.85 MWe at 28% elec. Efficiency; plus 49% thermal efficiency. Robust, modular & transportable; can run well on biofuels

Organic Rankin Technology Options

Ontario Centres of Excellence

- Makes use of any waste heat source of about 300C or more. Closed cycle working fluid.
- UTC ‘Pure Cycle’ produces 200kW electric

- Uses existing technology and HVAC components

Fuel Cell Energy (FCE)

MCFC 250kW CHP Product

1MW integrated power plant installed at Enbridge HQ in North Toronto

Residential Sterling Engine

Ontario Centres of Excellence

'Whisper Jet' tested at CANMET

Market niche: replacement gas–fired boiler for residential applications: 7kW of domestic space heating or hot water and 1kW of power (while operating).

$800M order placed by PowerGen in UK for placement in early adopter residences

Target Price: $5000 CND

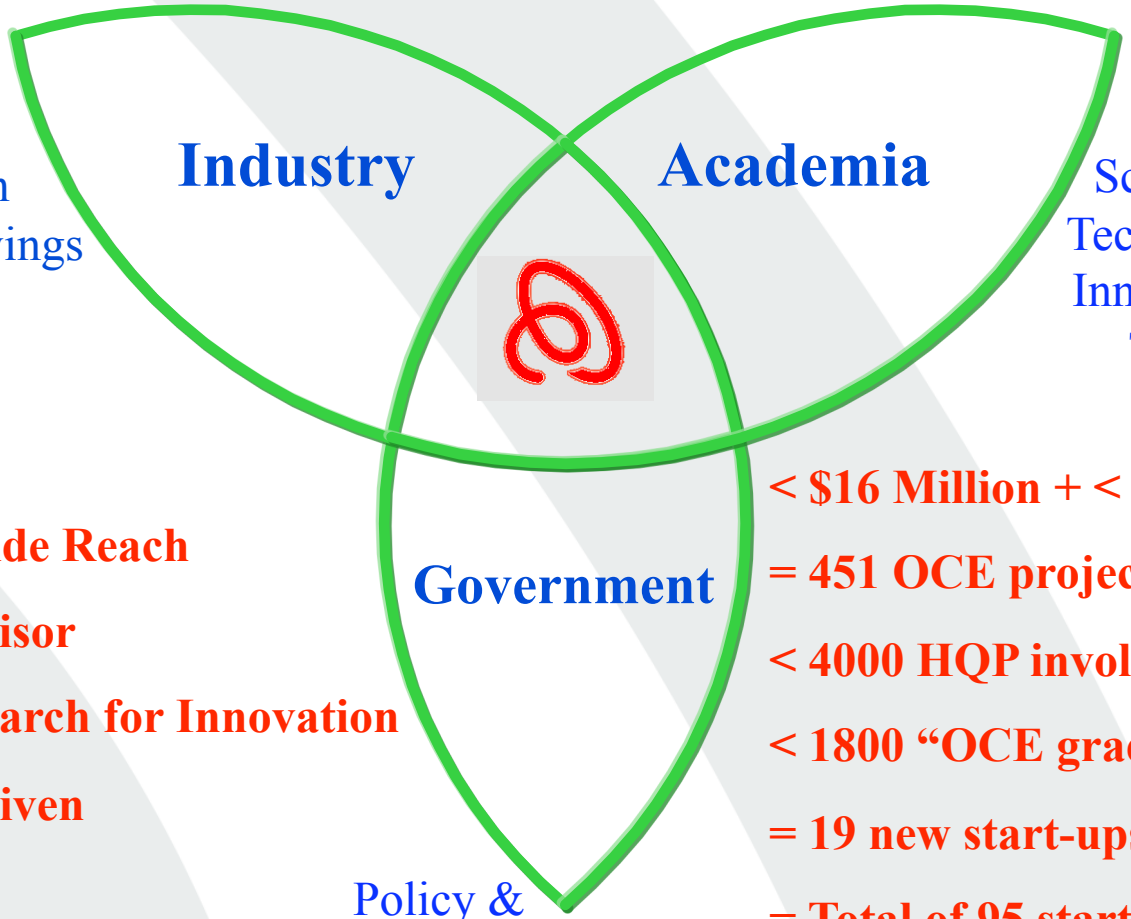
What is OCE's role in advancing DG and Smart Grid Solutions?

Ontario Centres of Excellence

- Continuing to work with Ontario stakeholders to identify and develop the right technology directions
- Bring together the technology experts and the innovators at Ontario universities and in the electricity sector for idea exchange (example: Discovery Event)
- Develop research, development and demonstration projects along with academia (universities & colleges) and sector collaboration partners
- Promote Made in Ontario Solutions!

Ontario Centres of Excellence Inc.

Ontario Centres of Excellence



Jobs & Wealth Creation / Savings

Science & Technology Innovation, Training

Policy & Regulations

Network

Province-Wide Reach

Trusted Advisor

Proactive Search for Innovation

Outcome Driven

< $16 Million + < $33 Million

= 451 OCE projects

< 4000 HQP involved

< 1800 "OCE graduates" - jobs

= 19 new start-ups

= Total of 95 start-ups with

< $85 Million follow-on investments

Centre for Energy

Ontario Centres of Excellence

1. Energy markets

Focused on supply/demand balance and energy pricing, demand response, energy conservation, energy efficiency, consumer behaviour.

2. Energy Systems

Integrating emerging energy technologies into functional systems.

Focused on: interconnection issues, grid operations, transportation networks and distribution of energy.

3. Emerging Energy Technologies

Clean-Tech… Green-Tech…

4. Skills Development

Demographics… Jobs, Jobs, Jobs

5. Technology Convergence

Next-Tech…

Leveraging the intellectual capacity of all of the Centres within OCE's family by promoting projects which respond to sector needs and combine energy technologies with environmental technologies, materials and manufacturing technologies, communications & information technologies and photonics technologies.

What is OCE already doing to advance Smart Grid technologies and solutions?

Ontario Centres of Excellence

- Continuing support of new DG technologies in solar, wind, biomass, CDM, earth energy and hydrogen
- Renewed emphasis on enabling technologies that support Distributed Generation (energy storage, advanced control mechanisms for local grids)
- Exploring the grid impacts of electricity as transportation fuel, and seeking solutions for anticipated problems.

Some examples of OCE co-sponsored projects that support Smart Grid solutions

Ontario Centres of Excellence

- Energy Hub Management System: Communication and Control to empower energy managers (U of Waterloo, Energent, Bell, Milton Hydro, Enerbrite, Lixar, HydroOne)
- Reactive Power Ancillary Service Market for the IESO; Design and Analysis (U of Waterloo, ABB and OPA)
- Hydrogen Economy Research Initiative: economic production of H2 from off-peak emission-free electricity (Bruce Power and U of Waterloo)
- Managing Energy-Related Behaviors: energy consumption in buildings and how to effect demand reductions (U of T, Toronto Atmospheric Fund, OPA, Toronto Hydro, City of Toronto)
- Energy Mediator 'Hydrolyzer': using Thermal and Hydrogen Storage derived from off peak (and constrained) electricity generation to smooth demand on the grid (H2Green. U of T and McMaster)

Meeting the Challenge
Cleanfield Energy Corporation

Ontario Centres of Excellence

Cleaner Energy with Ontario-Grown Turbine

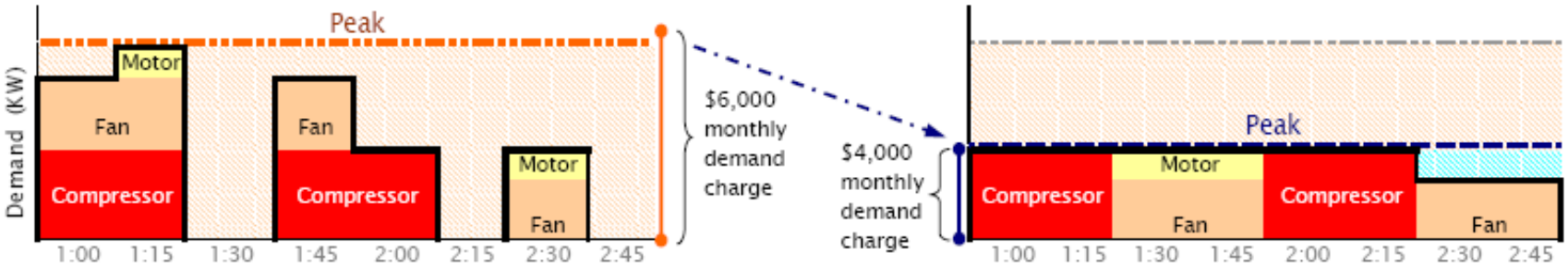
- Vertical-Axis Wind Turbine generating clean, reliable electricity
- Tower and rooftop installation
- Field trials at the McMaster Innovation Park in Hamilton
- Studying urban applications
- Residential and commercial markets

Meeting the Challenge
REGEN Energy Inc

Ontario Centres of Excellence

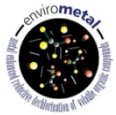
Reducing Peak Consumption for Commercial Users

- Pilot Project with OPA and Herb Sinnock at Centennial College
- Wireless Load Management Controllers
- Applied Testing for College Students



Enabling Innovation

Ontario Centres of Excellence



CPPI

Next

Ontario Centres of Excellence

The three big “S’s”:

SOLAR – the challenge is to drop the price of photovoltaic panels by an order of magnitude (e.g. from $0.80 per KWh to $0.08 per KWh).

STORAGE – the holy grail for electrical energy.

SMART GRIDS – enabling bidirectional energy flow to optimize D-G and cent

Thank you…

Ontario Centres of Excellence

www.oce-ontario.org