Smart Micro-Grid Project Update: Hartley Bay, BC, Canada

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- Innovative Clean Energy Fund, BC (ICE)
- Natural Resources Canada (NRCan Canmet ENERGY)
- Indian and Northern Affairs Canada (INAC)
- Sustainable Development Tech. Canada (STDC)
- Western Economic Diversification Canada (WD)
- Village of Hartley Bay and Gitga'at Nation

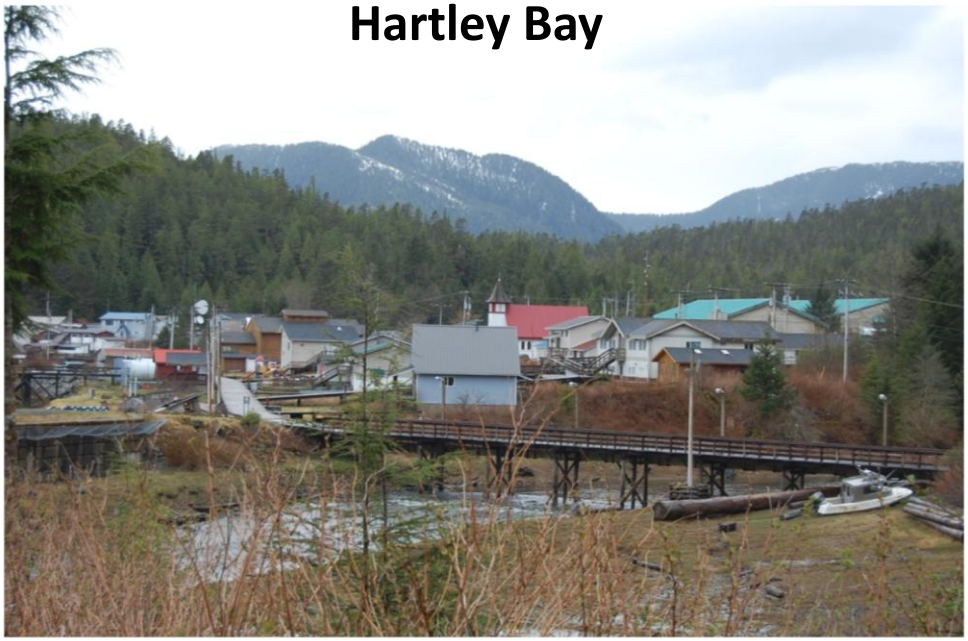
Natural Resources Canada

www.nrcan.gc.ca

Agenda

- An Introduction to Hartley Bay's Micro-grid
- System Design Features
- Project Milestones
- Results and Benefits
- Challenges
- Next Steps
- Questions

Hartley Bay



Introduction to Hartley Bay

The Hartley Bay Micro-grid:

- Hartley Bay Quick Facts:
  - Gitga'at First Nation
  - 170 Residents
  - Off Grid
  - 450 kW max demand
  - $500,000 Fuel Costs
  - $0.67/kWh, 2GWh/yr
  - 25 kV Distribution
  - Fuel is barged in regularly

A Network With True Living Conditions

Objectives of Smart Microgrid Project:

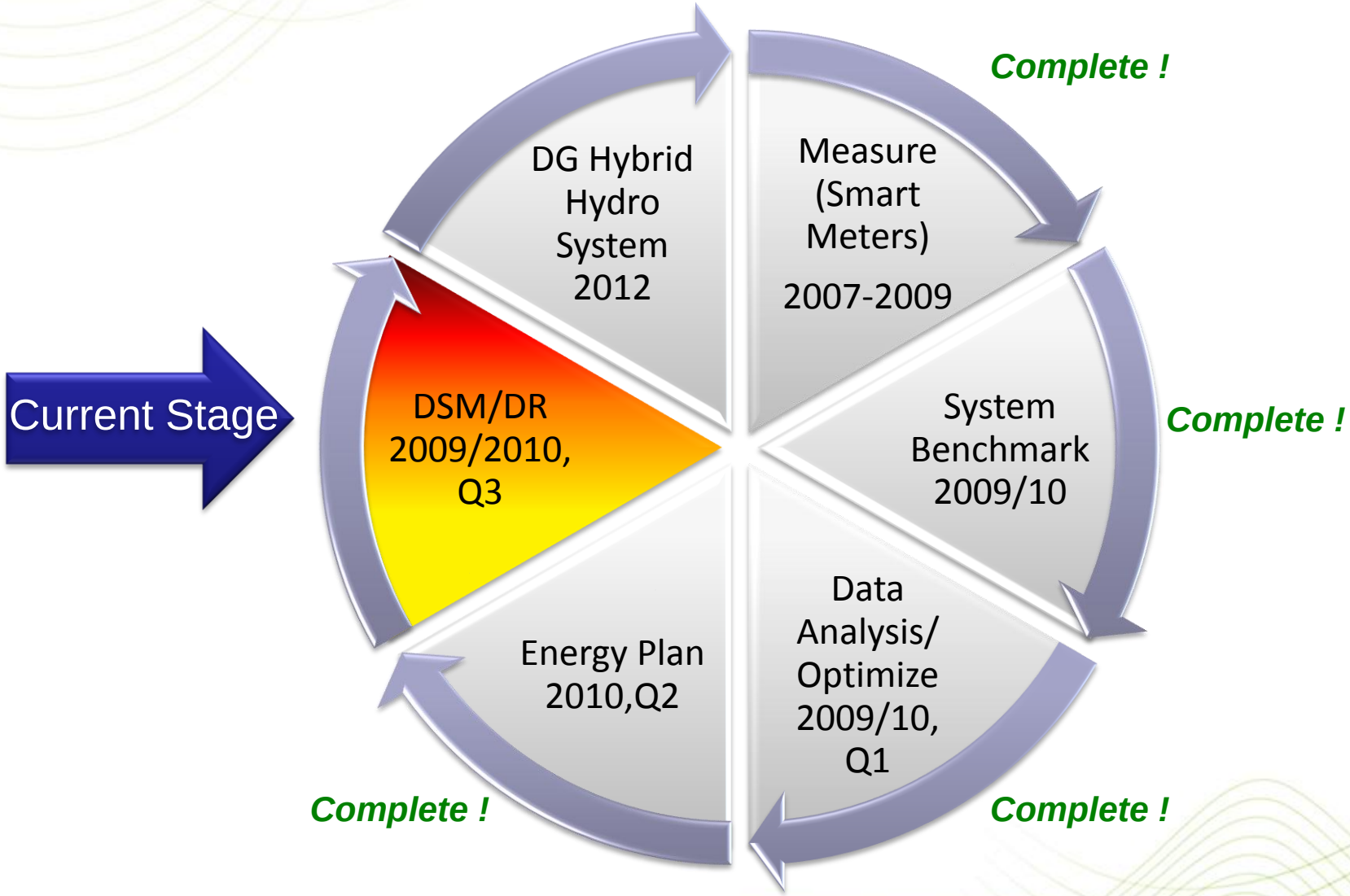
Social/Environmental:

1. To be the Greenest First Nation Village in Canada.
2. To change the way the residents consume power.
3. Reduce: GHGs, Diesel Spill Potential

Economical:

4. Production and Energy Costs, Regulatory Impacts (booms)
5. Integrate Hydro/Diesel Combined Generation
6. Increase Reliability, Maintainability, Usability

Milestones and Process



System Overview

- Smart Meters (1 and 15 minute min intervals)
  - 62 Residences, 20 Commercial, kWh, kW, V, A
  - 3 Generators, L of Diesel/min, kWh, kW, V, A, GHGs
  - 3 Internal Temperature monitoring points and Weather
- Communications Platforms
  - Monitoring - IEEE 802.11 5GHz Wireless
  - Monitoring - 900 MHz Mesh Modbus
  - Monitoring – 900 MHz Meshed Smart Meters (EKA)
  - Control - 900 MHz Paging Dispatcher (PAGENET)
  - Backbone – Microwave/Wired TCPIP/Cellular (Telus)

System Overview

- Security
  - Proprietary Communications Protocols
  - Default privacy for users
- Central Collector and Analytics
  - Pulse Energy Management System
  - EKA/Cooper Smart Metering
  - Cooper Yukon Load Controller
- Direct Control *(Q3, 2010)*
  - Hot Water Heaters, Freezers (Switches)
  - Thermostats (Commercial and Residential)
  - Commercial building automation set points

Smart Micro Grid - Architecture

Pulse Energy Servers

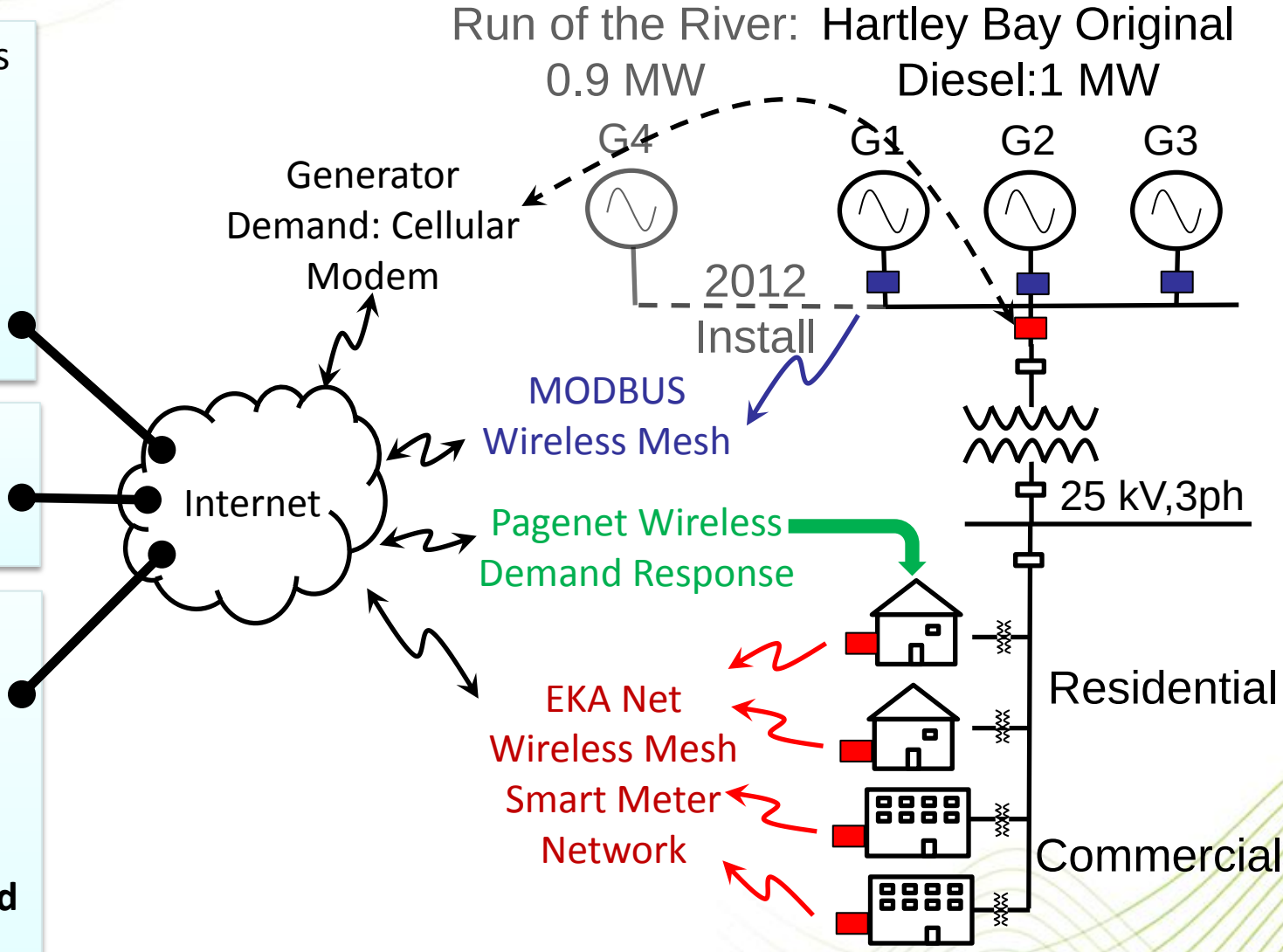
Energy Monitoring, Alerts and

Demand-response dispatch Logic

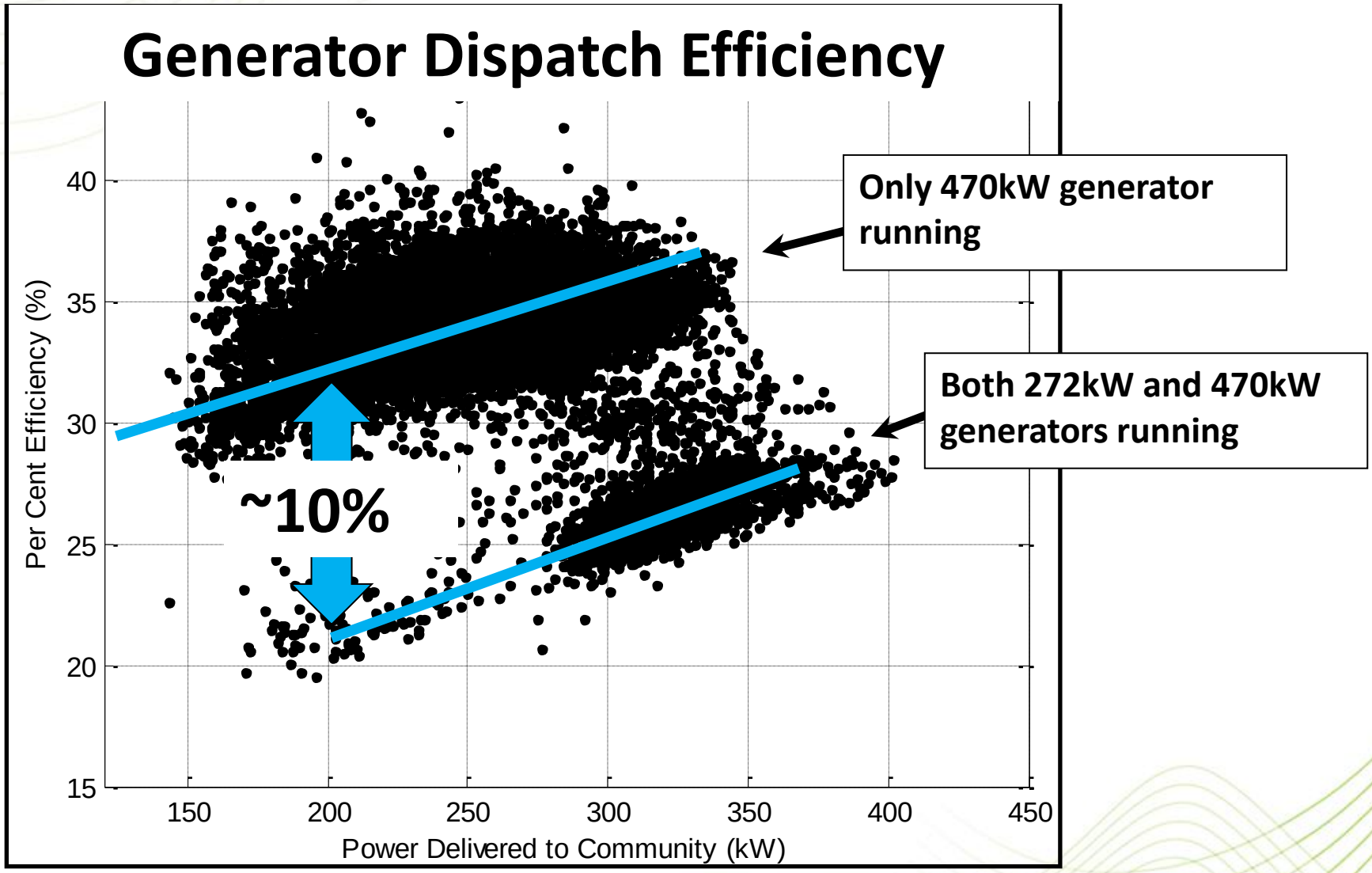
Cooper / YUKON Demand Response Direct Control

Hartley Bay Admin Office Server

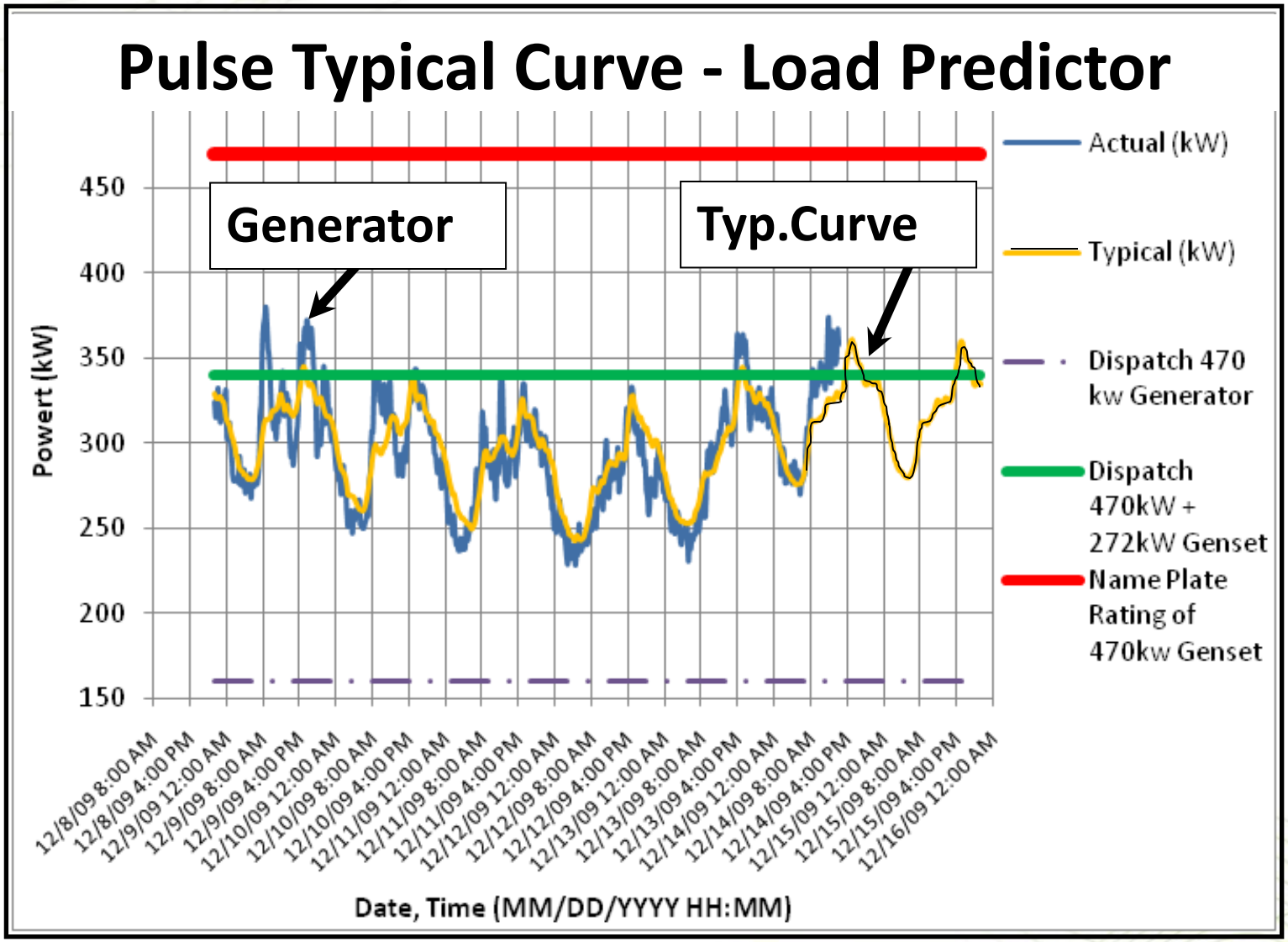
Data Aggregator and DR Dispatcher



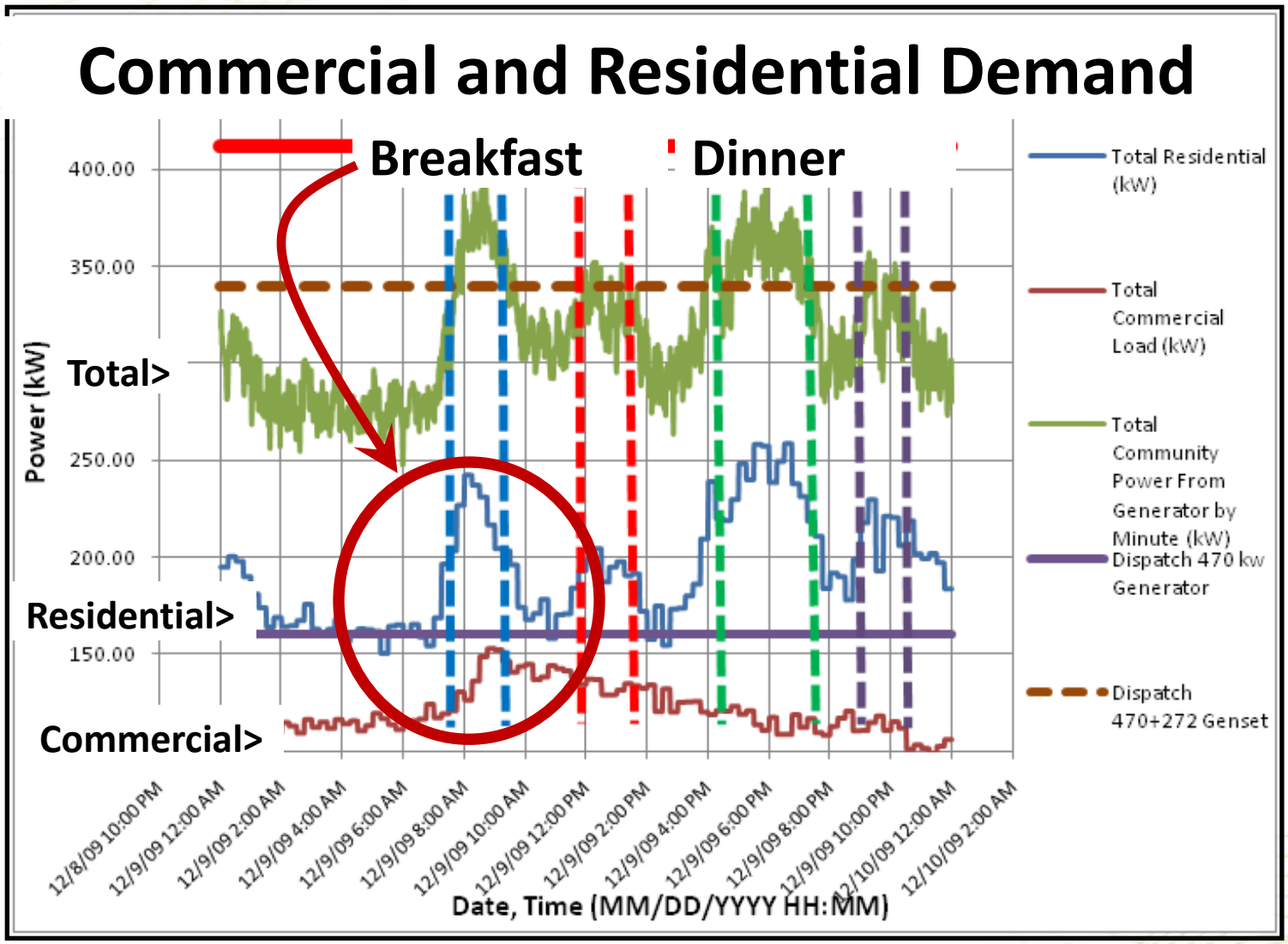
Results:


Generator Dispatch Efficiency
Per Cent Efficiency (%)
40
35
30
25
20
15
150
200
250
300
350
400
450
Power Delivered to Community (kW)
~10%
Only 470kW generator running
Both 272kW and 470kW generators running

Results:


Pulse Typical Curve - Load Predictor
Generator
Typ.Curve
Actual (kW)
Typical (kW)
Dispatch 470 kw Generator
Dispatch 470kW + 272kW Genset
Name Plate Rating of 470kw Genset
Powert (kW)
450
400
350
300
250
200
150
12/8/09 8:00 AM
12/8/09 4:00 PM
12/9/09 12:00 AM
12/9/09 8:00 AM
12/9/09 4:00 PM
12/10/09 12:00 AM
12/10/09 8:00 AM
12/10/09 4:00 PM
12/11/09 12:00 AM
12/11/09 8:00 AM
12/11/09 4:00 PM
12/12/09 12:00 AM
12/12/09 8:00 AM
12/12/09 4:00 PM
12/13/09 12:00 AM
12/13/09 8:00 AM
12/13/09 4:00 PM
12/14/09 12:00 AM
12/14/09 8:00 AM
12/14/09 4:00 PM
12/15/09 12:00 AM
12/15/09 8:00 AM
12/15/09 4:00 PM
12/16/09 12:00 AM
Date, Time (MM/DD/YYYY HH:MM)

Results:


Commercial and Residential Demand
Breakfast
Dinner
Total>
Residential>
Commercial>
Power (kW)
400.00
350.00
250.00
200.00
150.00
12/8/09 10:00 PM
12/9/09 12:00 AM
12/9/09 2:00 AM
12/9/09 4:00 AM
12/9/09 6:00 AM
12/9/09 8:00 AM
12/9/09 10:00 AM
12/9/09 12:00 PM
12/9/09 2:00 PM
12/9/09 4:00 PM
12/9/09 6:00 PM
12/9/09 8:00 PM
12/9/09 10:00 PM
12/10/09 12:00 AM
12/10/09 2:00 AM
Date, Time (MM/DD/YYYY HH:MM)
Total Residential (kW)
Total Commercial Load (kW)
Total Community Power From Generator by Minute (kW)
Dispatch 470 kw Generator
Dispatch 470+272 Genset

Real Time Asset Management

Innovative Thinking

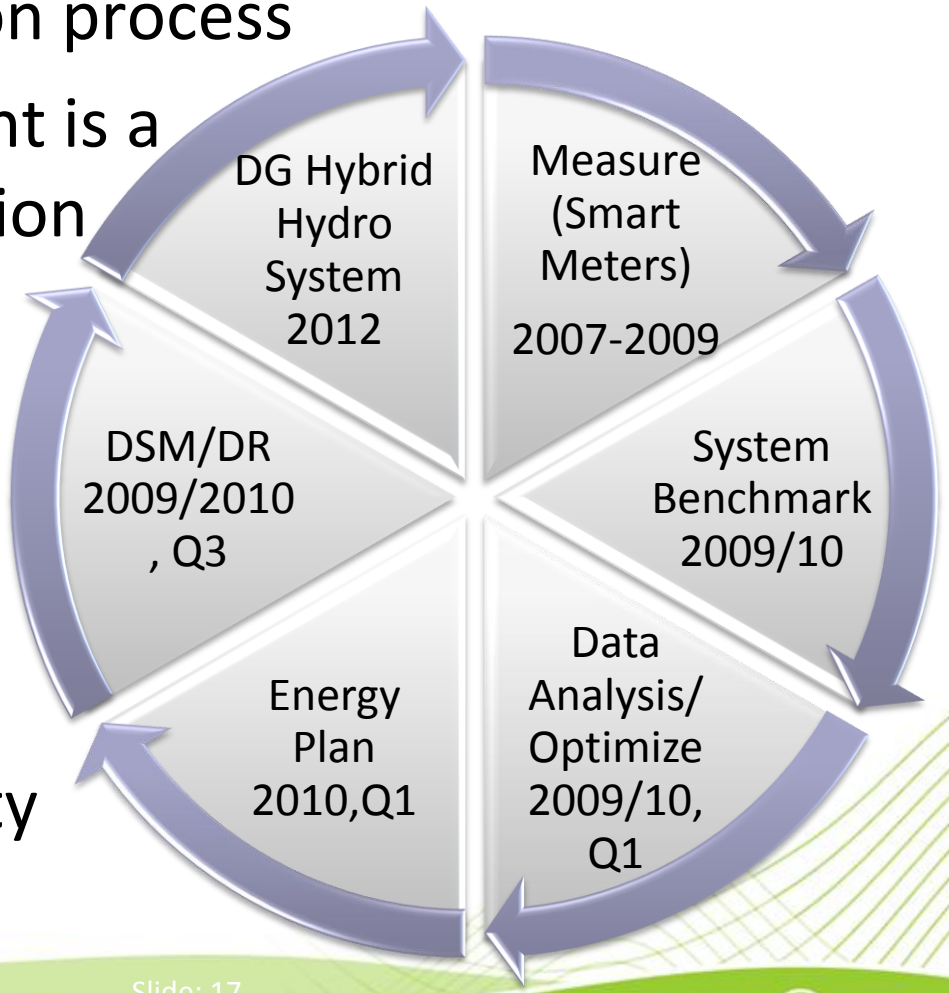
- Real world user data
- “Pulse Typical Curve” Demand Predictor
- Generator efficiency and dispatching efficiency
- Advanced community energy plan
  - Top 1% demand occurs for 2 minutes (525k min in a yr)
  - Top 10% of demand occurs for less than 3hrs per year (8.7k hr in a year) - can it be prevented? Why size a generator to support 3 hrs?
- Smart Microgrid business case exists (3yr est.payback)
- Remote “Energy Coordinator”/Community Engagement

Challenges

- Supply Chain
  - Selecting suitable suppliers during technology flux
- Engineering
  - Matching the system spec to the area
  - Software Support (local and remote)
  - Security and integrity of data and control
  - Telecom is Central
- Management
  - Configuration, Analytics, Training
  - Physical Cataloging and Verification
  - Upgradability

Final Thoughts and Next Steps

- Developed Business Case
- Follow stepwise installation process
- Better Energy Management is a Technological-Social Solution
- Demand Response Installation and Hardware Availability
- Use of NRCAN “Off-Grid Optimization Tool”
- Meter Costs and Availabilty



~Questions~

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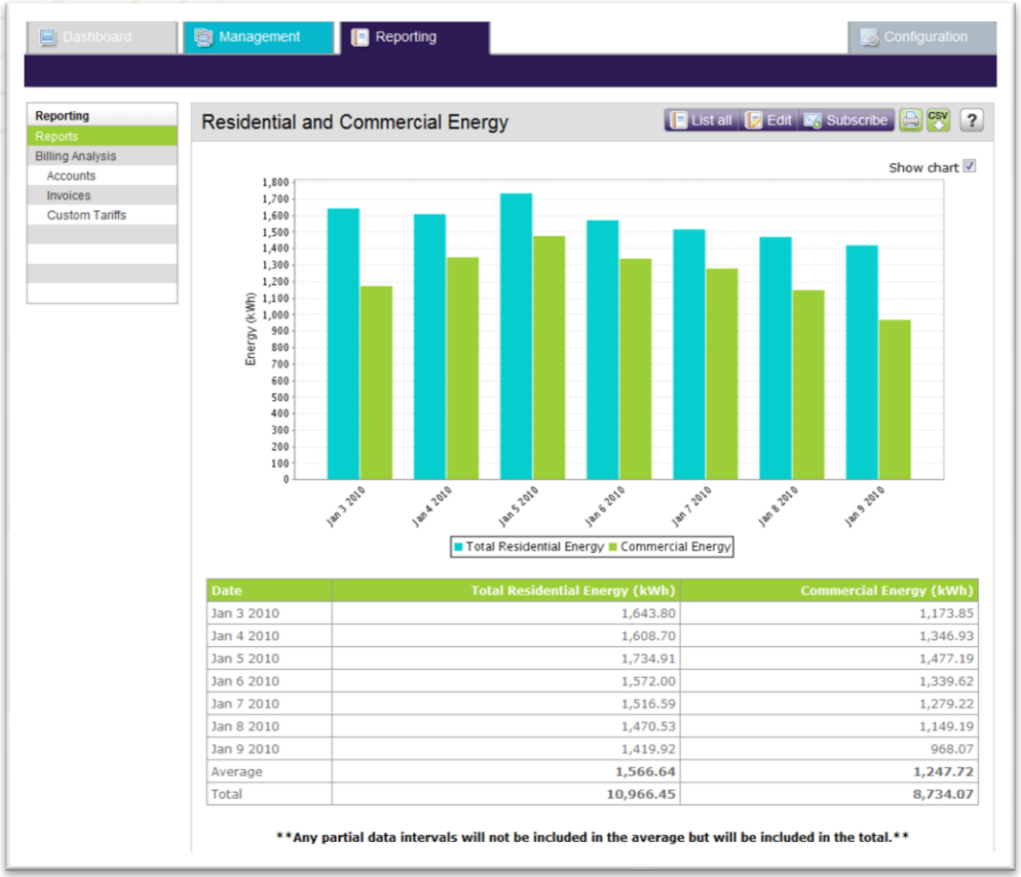
Pulse Applications



Date	Total Residential Energy (kWh)	Commercial Energy (kWh)
Jan 3 2010	1,643.80	1,173.85
Jan 4 2010	1,608.70	1,346.93
Jan 5 2010	1,734.91	1,477.19
Jan 6 2010	1,572.00	1,339.62
Jan 7 2010	1,516.59	1,279.22
Jan 8 2010	1,470.53	1,149.19
Jan 9 2010	1,419.92	968.07
Average	1,566.64	1,247.72
Total	10,966.45	8,734.07

Any partial data intervals will not be included in the average but will be included in the total.

Reporting and Benchmarking

Real Time Operator

User Dashboard

www.pulseenergy.com