Ontario Smart Grid Forum

Toronto Hydro and the Emerging Smart Grid Infrastructure

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System Reliability Planning
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Agenda

- ***Toronto Hydro's Smart Grid Vision***
- Our Initiatives
- Challenges and Next Steps

Convergence of Risks

- Distribution System Architecture
- Aging Assets
- System Security
- Aging Workforce
- Generation and Transmission
- Customers and Regulator
- Conservation and Environment

RISKS INTO 21st CENTURY

Certain?

Manageable?

Sustainable?

"It becomes clear that the industry as a whole could not survive if it chose to remain on the traditional, "Business as Usual" path."

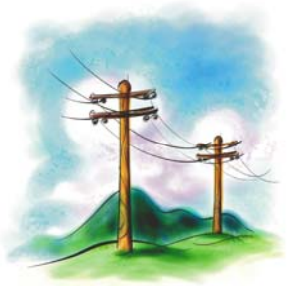
(CEATII Electric Distribution Utility Roadmap, Phase II: Common Infrastructure)

Current and Future Scenario

20th Century Grid	21st Century Smart Grid
Electromechanical	Digital
One-way communication (if any)	Two-way communication
Built for centralized generation	Accommodates distributed generation
Radial topology	Network topology
Few sensors	Monitors and sensors throughout
“Blind”	Self-monitoring
Manual restoration	Semi-automated restoration, and eventually self-healing
Prone to failures and blackouts	Adaptive protection and islanding
Check equipment manually	Monitor equipment remotely
Emergency decisions by committee and phone	Decision support systems, predictive reliability
Limited control over power flows	Pervasive control systems
Limited price information	Full price information
Few customer choices	Many customer choices

Source: The Emerging Smart Grid

Toronto Hydro's Smart Grid Vision



"The best way to predict the future is to create it" (Peter Ducker)

Definition:

A Smart Grid can be defined as the application of modern "cutting edge" information, communications, and electrical/electronics technology to optimize the electric infrastructure, its operation, and its management.

10 Key Attributes:

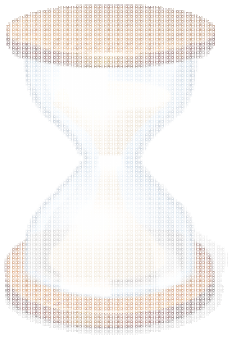
Dynamic, adaptable, anticipatory, self healing, sensitive, low cost, flexible, fast, intelligent, living

(CEATI's *Electric Distribution Utility Roadmap, Phase II: The Case for Change)*

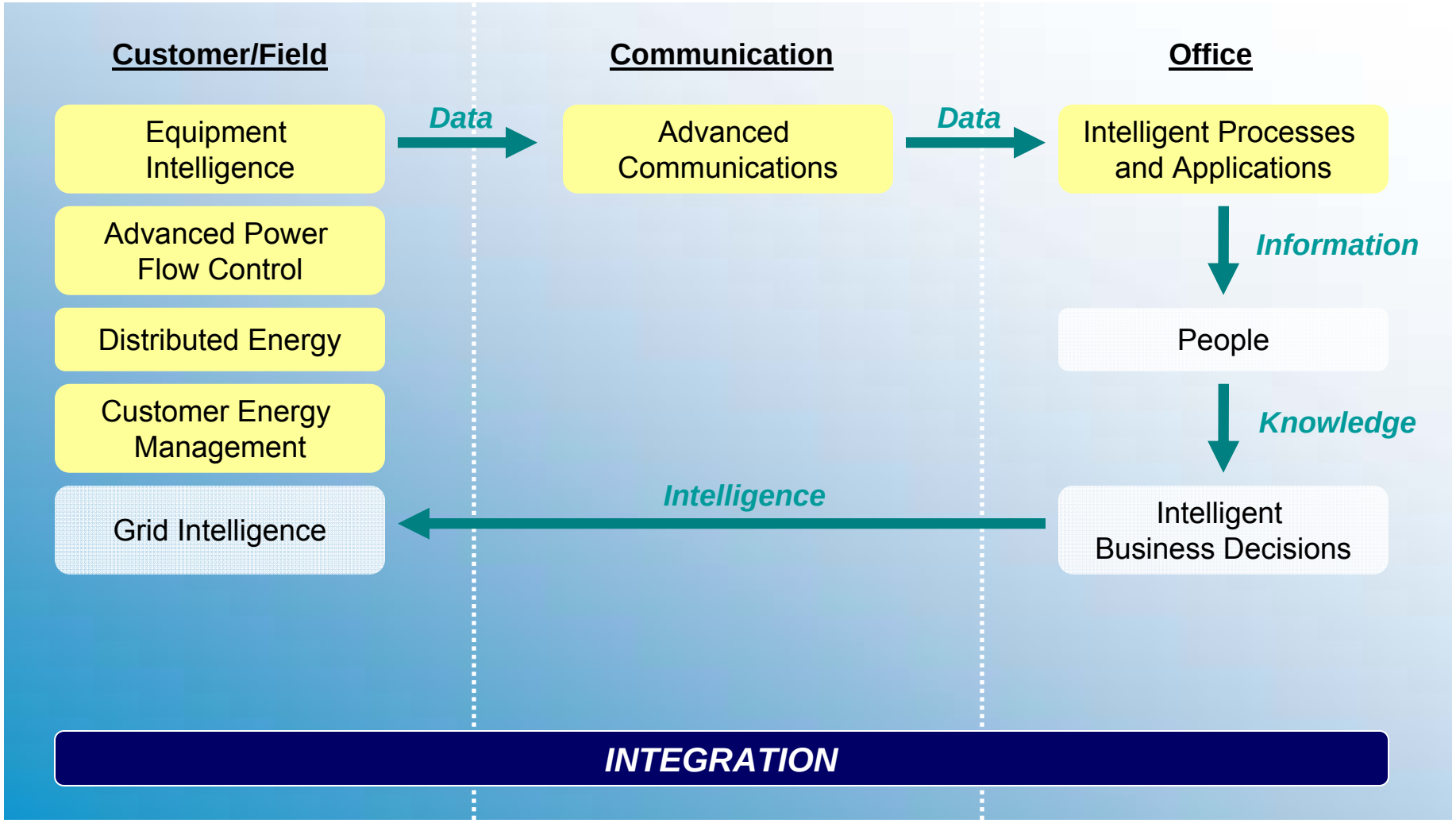
Involvement in the Smart Grid Vision

Background:

- September 2006, Forum for Canadian Business Opportunities for Smart Grid Architecture (NRCan and Industry Canada)
- 2006-2007, IT&S Strategic Plan
- September 2007, Toronto Hydro's first "Roadmap to Smart Grid Infrastructure"
- March 2008, conference on Implementation of the Smart Grid for Canadian Electric Utilities (NRCan and EUCI)
- May 2008, Ontario Smart Grid Forum
- August 2008, CEATI Smart Grid Taskforce



Smart Grid Infrastructure



Drivers Toward a Smart Grid

- Safety
- Customer Satisfaction
- Reliability
- Power Quality
- Aging Assets
- Aging Workforce

SMART GRID

- System Capacity
- Regulatory Requirements
- System Losses
- Distributed Energy
- Environmental Awareness

Aligns with Toronto Hydro's four-pillars:

- ✓ Health and Safety – "My Goal is Zero"
- ✓ Invest in Infrastructure – "Modernize Our Assets"
- ✓ Customer Service and Leadership – "Make a Promise, Keep a Promise"
- ✓ Business Operations – "Financial Performance"

Benefits of Smart Grid Infrastructure

The Smart Grid evolution is a continual transformation that adds value to the entire power delivery chain, yielding real, measureable and tangible benefits.

Planning

✓ Modernize asset base
✓ Improved life cycle analysis
✓ Optimized investments
✓ Achieve stakeholder expectations
✓ Reduced peak demand
✓ Facilitate DG
✓Better decision making

Operations

✓ Better safety control
✓ Improved reliability, security, power quality
✓ Hardened against system hits
✓ Observability of grid status
✓ Operational flexibility

Design, Constructions, Maintenance

✓ Better safety control
✓ Reduced costs
✓ Quick response for needs
✓ Improved workforce productivity and efficiency
✓ Increase process efficiency
✓ Empowered with information

Human Resources

✓ Manage aging workforce
✓ New technologies can attract competent workers

Finance

✓ Improved long term financial control and sustainability

Socioeconomic/Customers

✓ Customer service and satisfaction
✓ Improved reliability and power quality
✓ Extended knowledge, options, and control
✓ Improved participation with utility
✓ Social and environmental footprint
✓ Job creation

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Toronto Hydro's Portfolio of Smart Grid Initiatives

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Customer/Field	Communication	Office
Smart Meters	Advanced Metering Infrastructure (AMI)	Service Oriented Architecture (SOA)
Distribution Transformer Monitoring	WAN	Business Intelligence (BI)
Distribution Automation	SCADA	OMS/DMS
Mobile Computing		GIS
Distributed Generation		CIS
PeakSaver		ERP
PowerShift		Operational Data Store (ODS)
TOU Data Presentment Website		Advanced Asset Management
Conservation Programs		

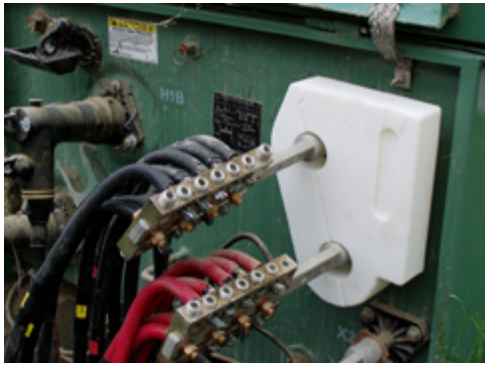
INTEGRATION

Advanced Metering Infrastructure

Smart Meters/Advanced Metering Infrastructure

- Installed over 500,000 smart meters as of July 2008.
- Considerations for strategic deployment of next generation meters.
- Assessing intelligent electronic devices (IEDs) to leverage on AMI's communication backbone.
- Assessing ways to leverage AMI and ODS for outage and asset management
- Plans for WAN upgrades.

Distribution Transformer Monitoring (DTM)



- Pilot to install load monitors at distribution transformers, communicate back to data collector through Powerline Carrier (PLC).
- Monitor transformer losses, theft of power, condition monitoring, etc.

Distribution Automation and Mobile Computing

Distribution Automation

- Conversion of over 50 automated switches per year, “self-healing” ready.
- Automating 6 stations per year with electronic relays and extended SCADA.
- Presently over 400 SCADAMate switches.
- Plans for IntelliTEAM pilot.

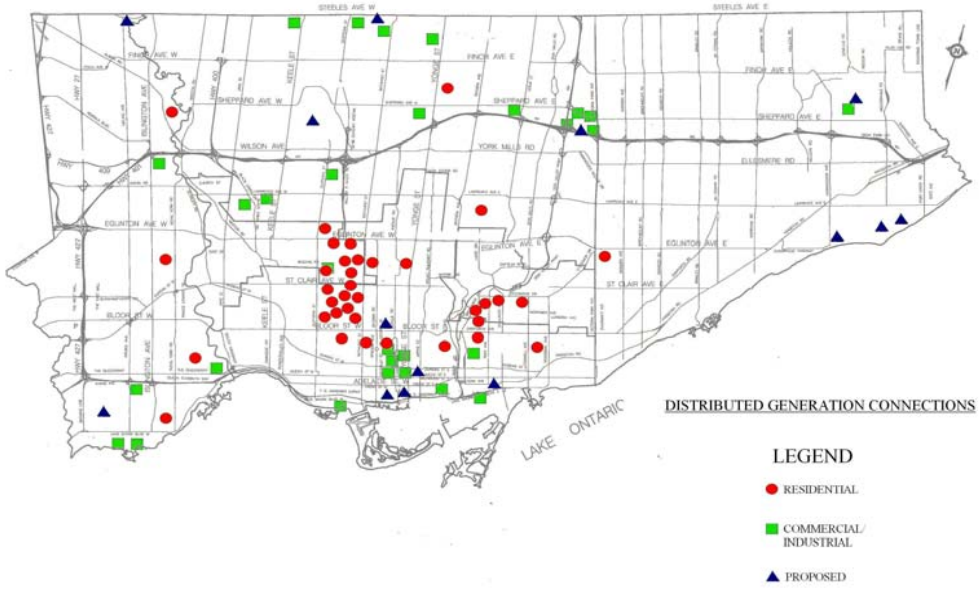
Mobile Computing

- Bar code labelling system.
- GPS coordinates for field equipments.
- Further mobile conversions for maintenance inspections and system response.

Distributed Generation

- Facilitation of net metering, Standard Offer Program (SOP), and Clean Energy Standard Offer Program (CESOP).
- Study with the University of Toronto to evaluate the permissible depth of penetration of DG in the Toronto Hydro distribution system.
- Incentives such as *peaksaver® DE*, for remotely dispatchable generators connected to Toronto Hydro.

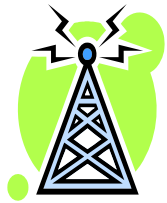
Size of DG	Number	Power Output (kW)
Micro (≤ 10kW)	57	106
Small (≤ 1MW)	13	2817
Medium (≤ 10 MW)	20	75,000
Large (>10 MW)	1	11,000
Total	91	88,923



Expansion of Communications

Wide Area Network (WAN)

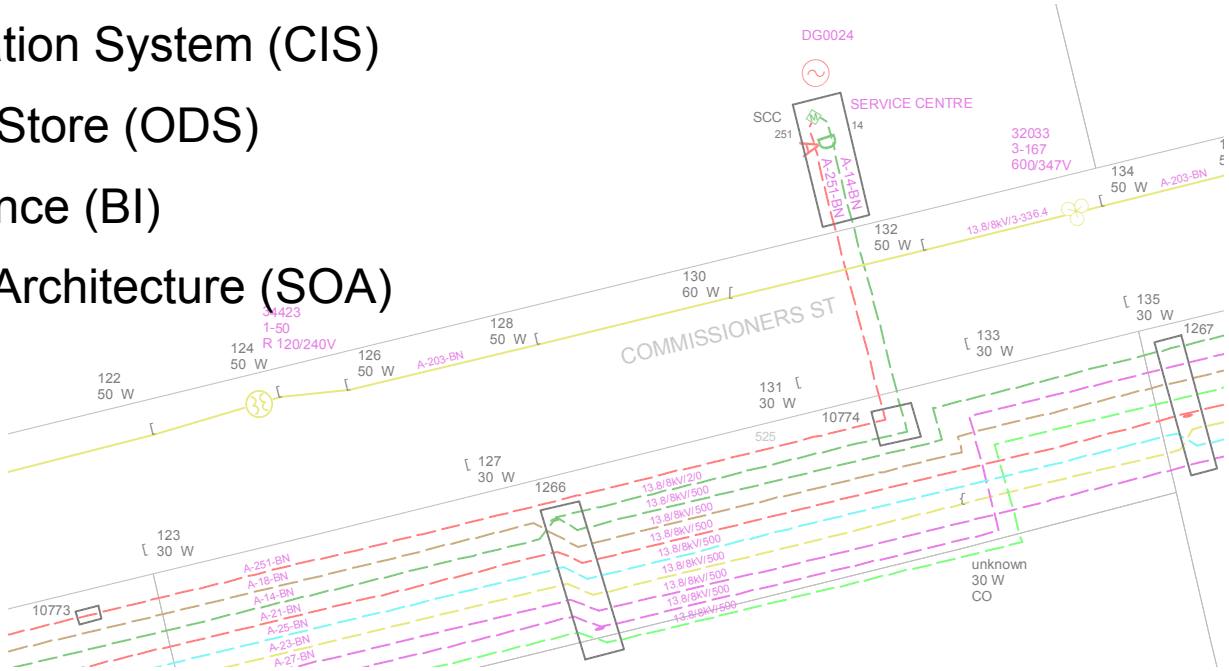
- WAN designed to reach from back office to Local Area Networks (LAN), not to end devices.
- Need additional wide area network capability to reach Smart Meter LAN.
- Exploring options, with emphasis on private wireless technology.
- Communications consolidation opportunities exists for Smart Meter, Smart Grid and Distribution Automation needs
- Co-location of Smart Meter and Smart Grid data collectors at Distribution Automation installations may provide economies and increased network robustness



Enterprise Intelligence

Enterprise Applications

- Enterprise Resource Planning (ERP)
- Geographical Information System (GIS)
- Distribution Management System (DMS)
- Outage Management System (OMS)
- Customer Information System (CIS)
- Operational Data Store (ODS)
- Business Intelligence (BI)
- Service Oriented Architecture (SOA)



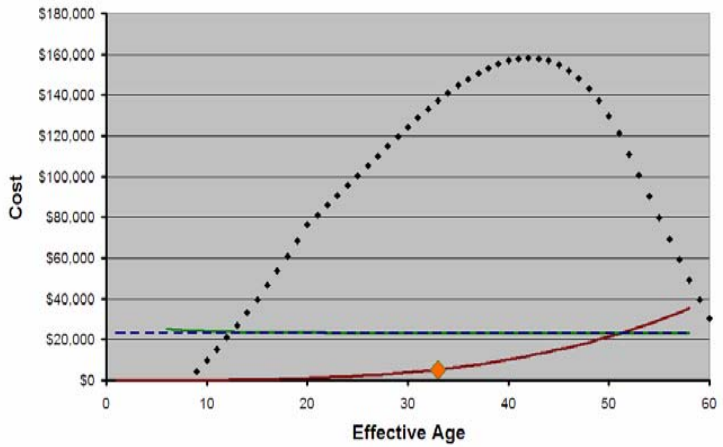
Intelligent Asset Management

Intelligent Asset Management

- System, feeder, and component based planning.
- Asset Conditions Assessment (ACA) and health indexing.
- Asset failure rate analysis and failure investigations.
- Economic and risk analyses.
- Strategically assess options and opportunities for modernization.
- Predictive reliability assessments.
- Incorporation of linear asset management (LAM).
- Enablement from metering data.
- Strategic planning in times of uncertainty.

Underground Primary Cable Risk Based Optimization

Risk costs, minimum life cycle costs, and benefits of injection

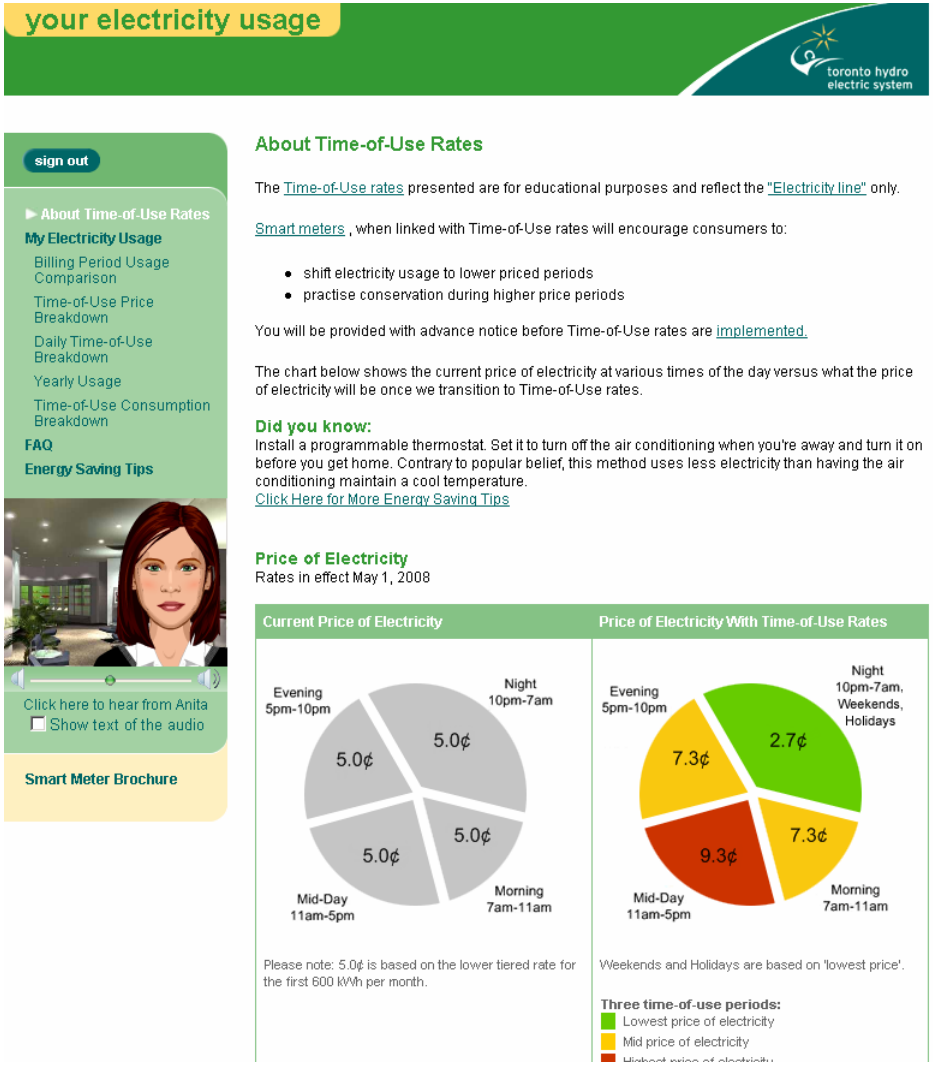


Conservation and Demand Management (CDM)

Conservation and Demand Response

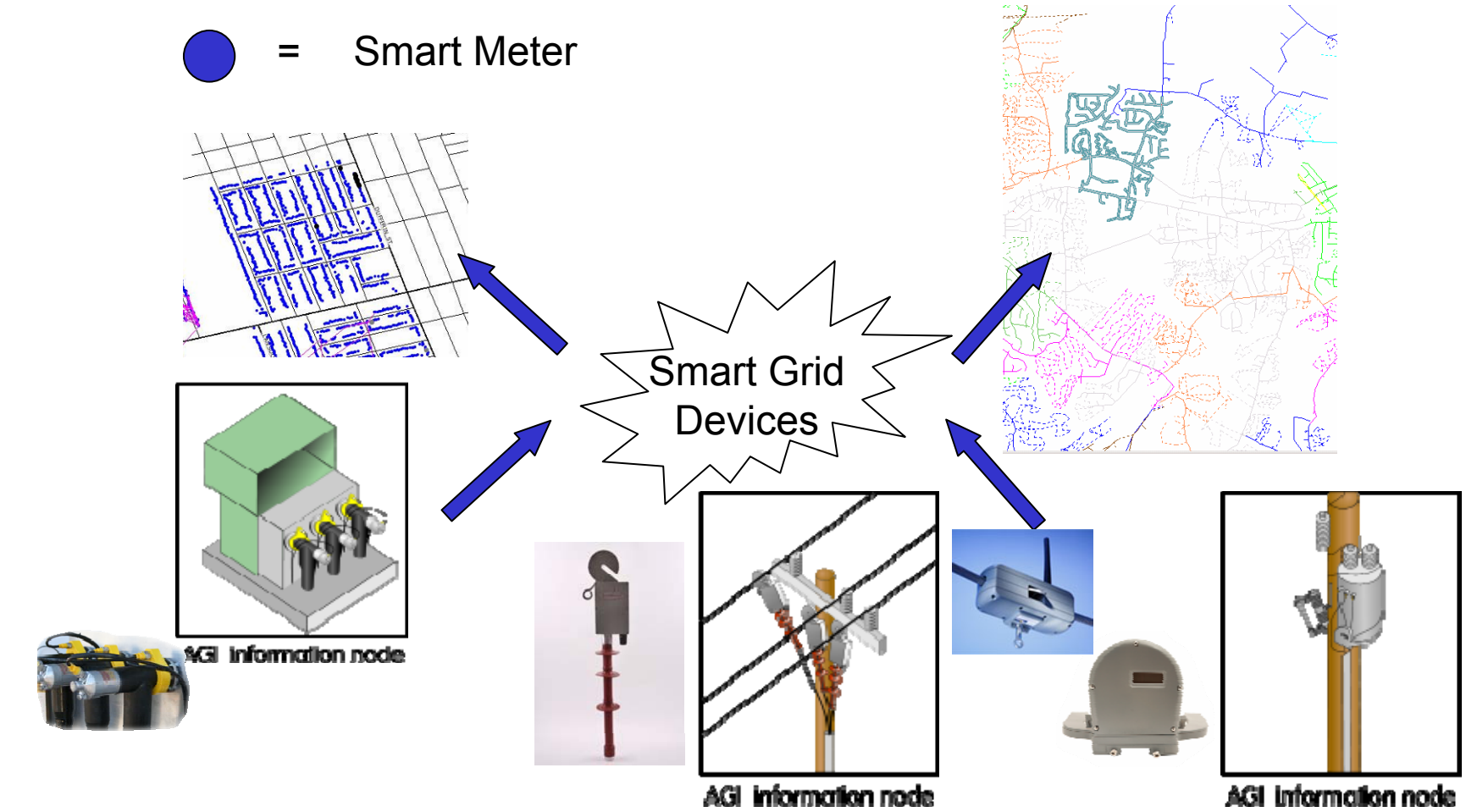
- peaksaver® AC, for Residential remote AC load control. Over 45,000 participants and 45MW Demand Response capacity as of July 2008.
- PowerShift, combines access to Smart Meter information with Peaksaver energy controls to maximize conservation potential
- Summer Savings – 10% credit reward for 140,000 Residential and Commercial customers who reduce their electricity usage more than 10%. 88,000MWh and 83MW reduced in 2007.
- BIP, or Business Incentive Program – Incentive for businesses to install energy efficient equipment. 8MWh and 2MW reduced in 2007.

Customer Participation



https://www.torontohydro.com/tou

The Power of Integration



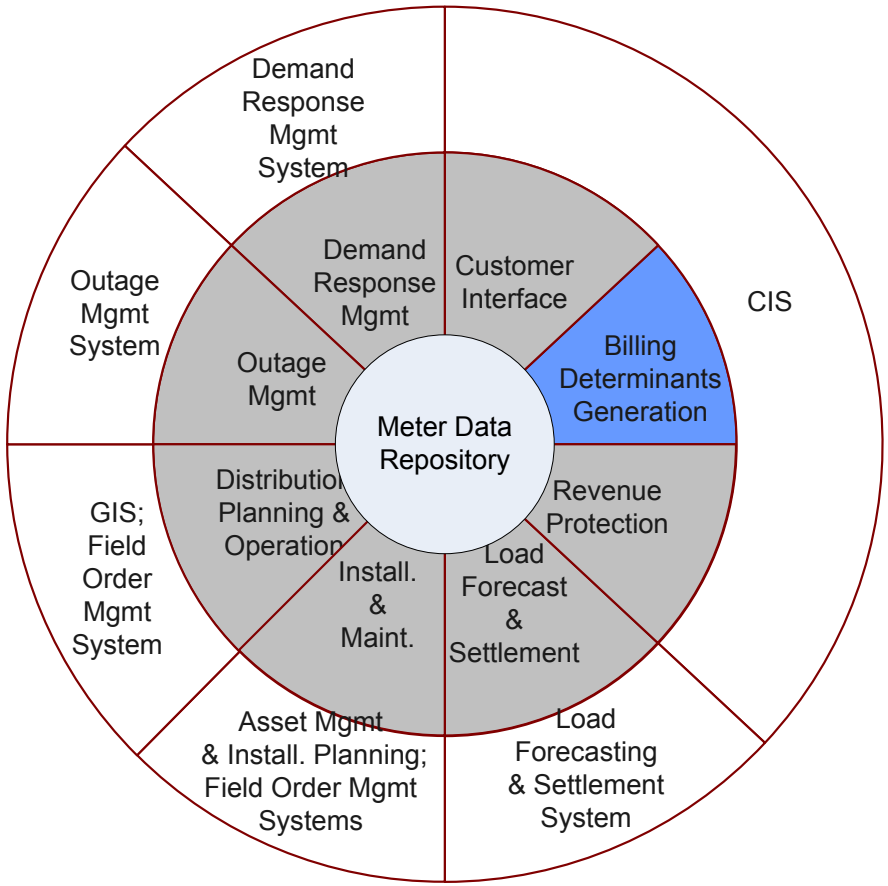
Padmount transformer load, voltage & temperature

Feeder load & voltage

Feeder fault sensor

Overhead transformer load, voltage & temperature

The Power of Integration



- Energy measurement data management
- Device configuration management
- Information integration
- Event management
- Information analysis & presentation

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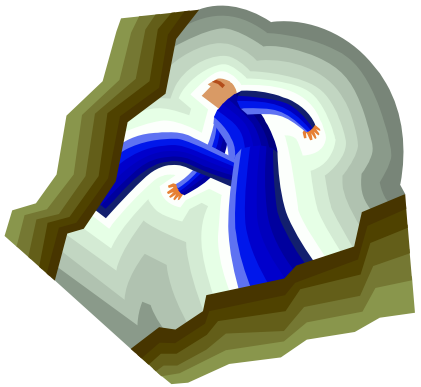
Challenges

1. Understanding the Vision
2. Budget Allocation
3. Changing Business Model
4. New Technology and Standards Development
5. Resources and Stakeholder Collaboration
6. Regulatory and Market Framework
7. Customer Participation



Next Steps

- Collaborative visioning and commitment for change
- Policy framework and incentives
- Regulator Approval
- Roadmap and strategy development
- Strategic research agenda
- Integration, integration, integration
- Technology pilots and deployments
  - Selective technology deployments
  - Greenfield application
- Understanding customer behaviour
- Fostering culture for modernization

Collaborative Approach to Change

UTILITIES

Adoption, investment, deployment and management

ACADEMIC INSTITUTIONS, INTEREST GROUPS & STANDARDS COMMITTEES

Lead research, develop standards

CONSUMERS

Conscious of energy use
Active role in energy management

VENDORS

Advance technologies
Maintain interoperability
Ensure reliability

GOVERNMENT & REGULATORS

Policy and regulatory framework
Direction and Incentives

Leader in Smart Grid Deployment

We can be a leader in Smart Grid Deployment.

It is now a time of strong and definite commitment, collaboration, and change.