

Smart Grid at BChydro: Current Status

Summer - 2009

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July, 2009

BChydro 

Agenda

- Who is BChydro?
- What is a Smart Grid?
 - BChydro's definition
 - Drivers & Benefits
- Smart Grid Application Building Blocks
 - Building Blocks
 - Application Current Status
- BChydro's Smart Grid Program
- BChydro's Smart Grid Experience
- Questions

Who is BChydro?

- Gov't Owned Crown Corp.
- 1.7 Million Customers
- 51,000 GWh Domestic Load
- Serve 94% of British Columbia
- Triple Bottom Line Performance
 - Reliable, Low Cost for Generations
- Distribution Assets: \$5.7B
- 2,200 Field Employees
- F09 Normalized SAIFI=1.7 F09 Normalized
CAIDI=2.5hrs
- CEMI-4=9% CELID-6=12%



What is a Smart Grid?

The BChydro Definition of Smart Grid:

“A modern, intelligent electricity transmission and distribution system that incorporates elements of traditional and **advanced** power engineering, sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional services to customers and the economy.”

In other words:

**Modernization and automation
of the current power delivery system**

There are numerous reasons to pursue a Smart Grid:

- **Internal factors:** BC Energy Plan, Legislation for Smart Meters by 2012, Green energy, Ageing assets, Limited labour resources, Employee safety
- **External factors:** Impending energy shortages, Advanced technology, Reliability of service, Customer service, Public safety, Green energy
- **Benefits:** Reliability, Safety, Conservation & Energy Efficiency, Enhanced Customer Service, Operational Efficiencies.
- **Considered to be the lowest cost option to meet long term system operation requirements**

Smart Grid Benefits

Smart Grid Benefits

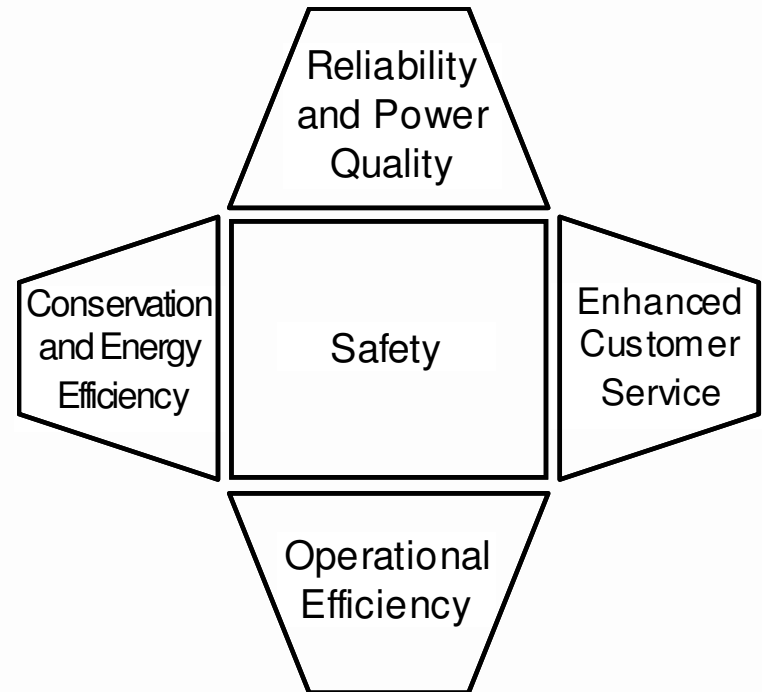
- Reliability and Power Quality
 - SAIDI improvement of 40 % anticipated
- Safety
 - Public and Worker
- Conservation and energy efficiency
 - Behaviour (Peak use and consumption)
 - Energy diversion detection
 - Voltage optimization
- Enhanced Customer Service
 - Two way information flow in real time including outage notification
 - Customer Choice (Reliability, Rates, Generation)
- Operational Efficiencies
 - Asset Optimization
 - Utility Efficiency



Smart Grid Benefits (cont'd)

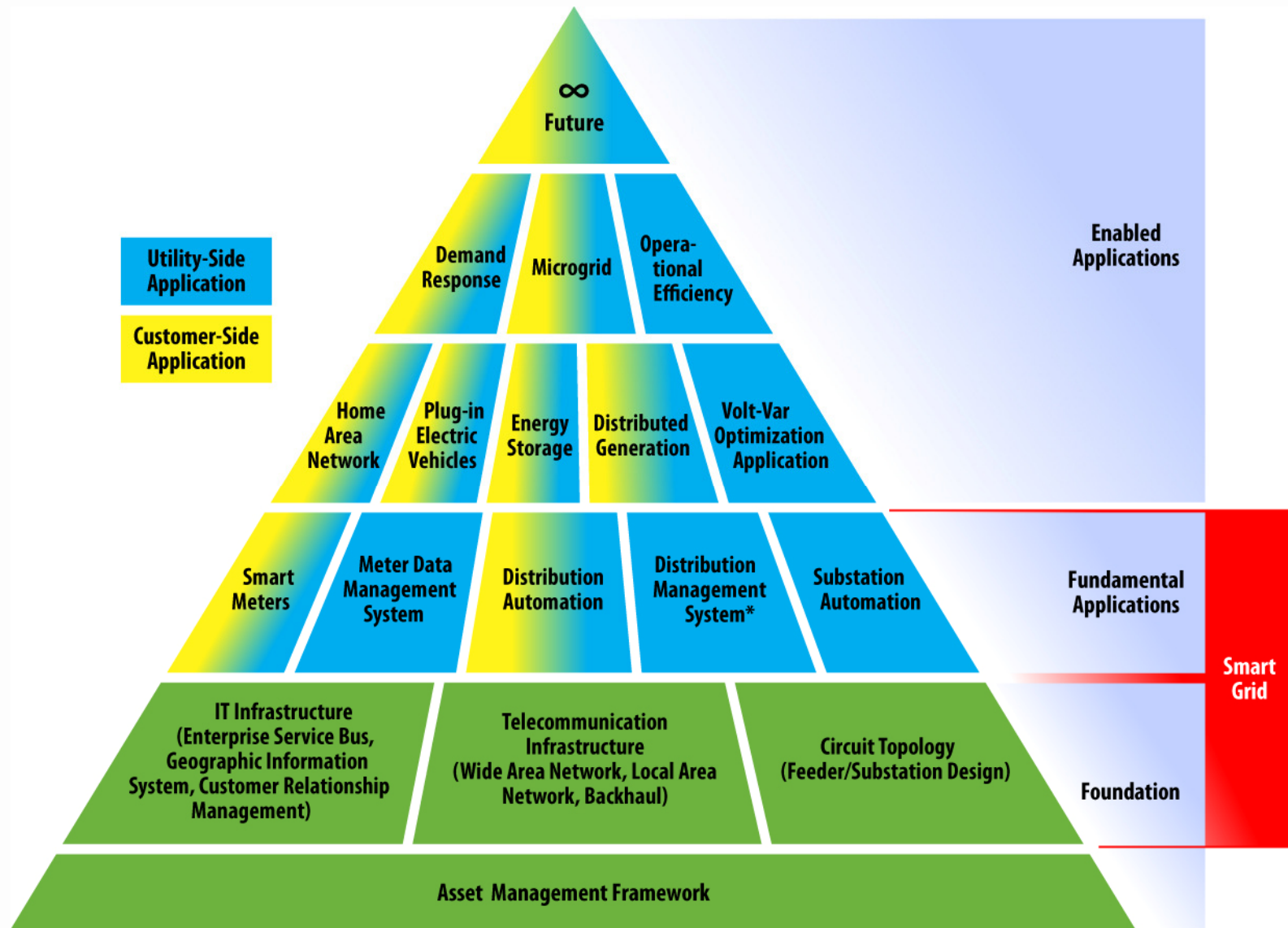
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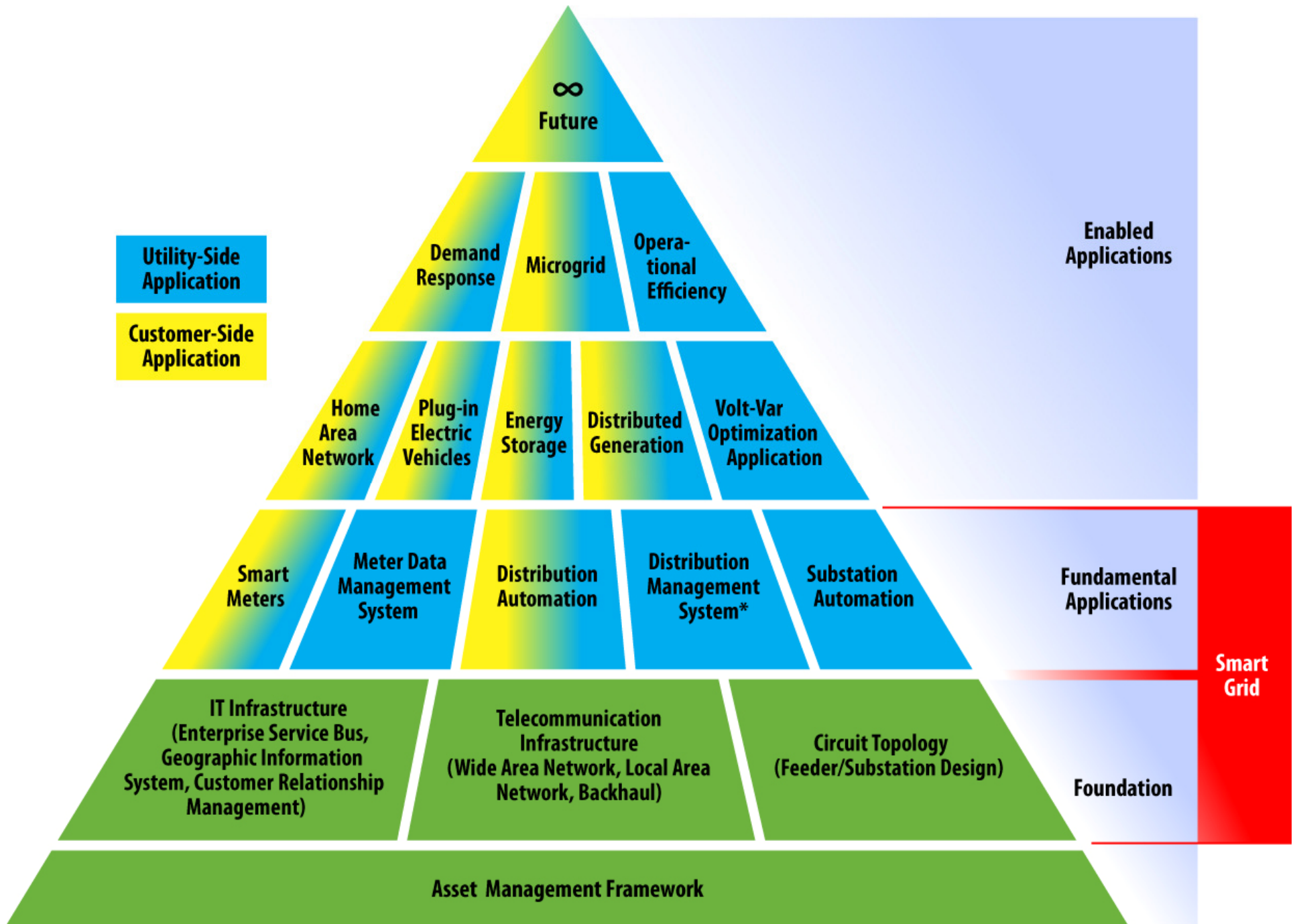


Considered to be the lowest cost option to meet long term system operation requirements

Smart Grid Building Blocks



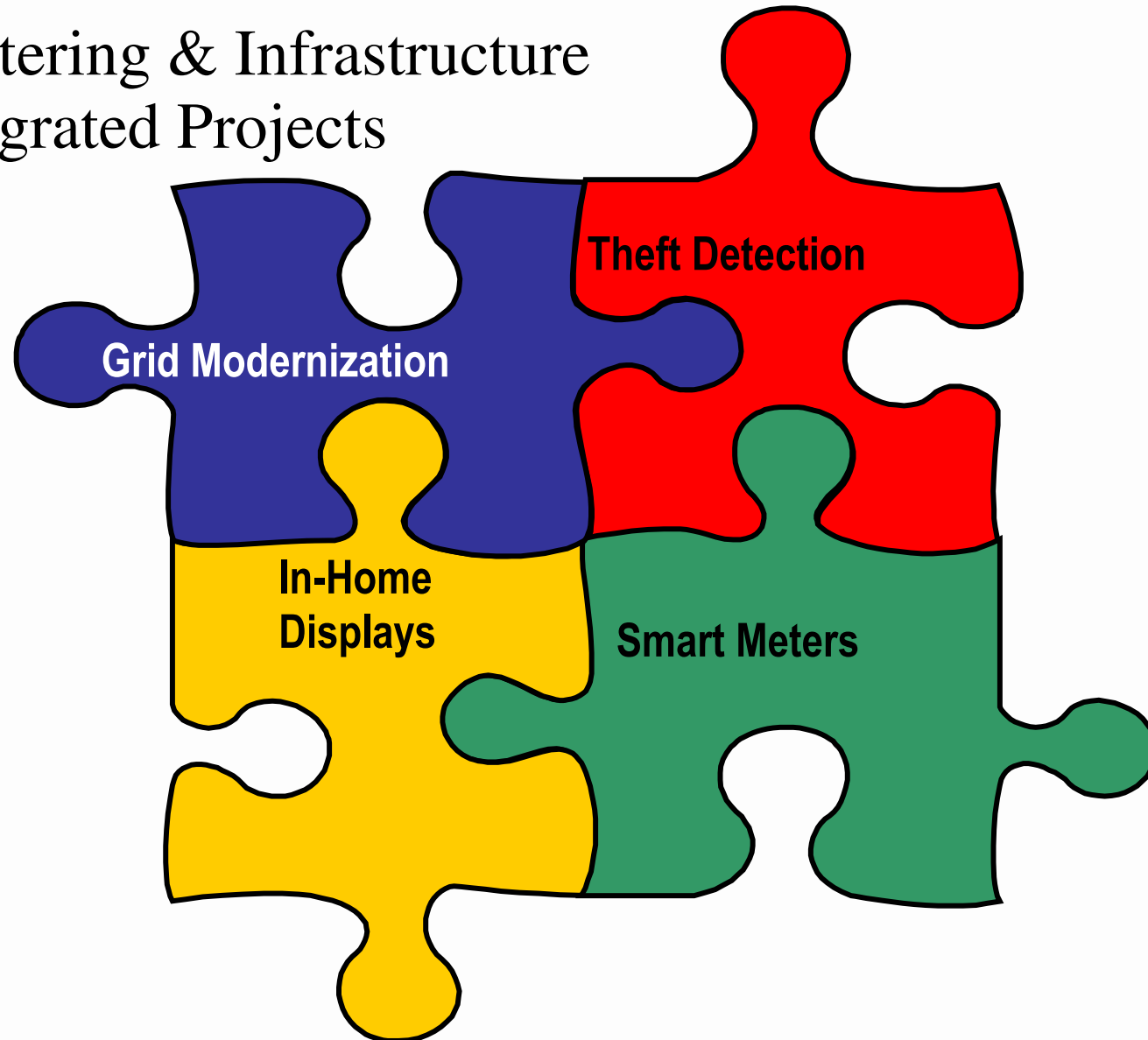
*includes Energy Management System



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Smart Grid Applications - SMI

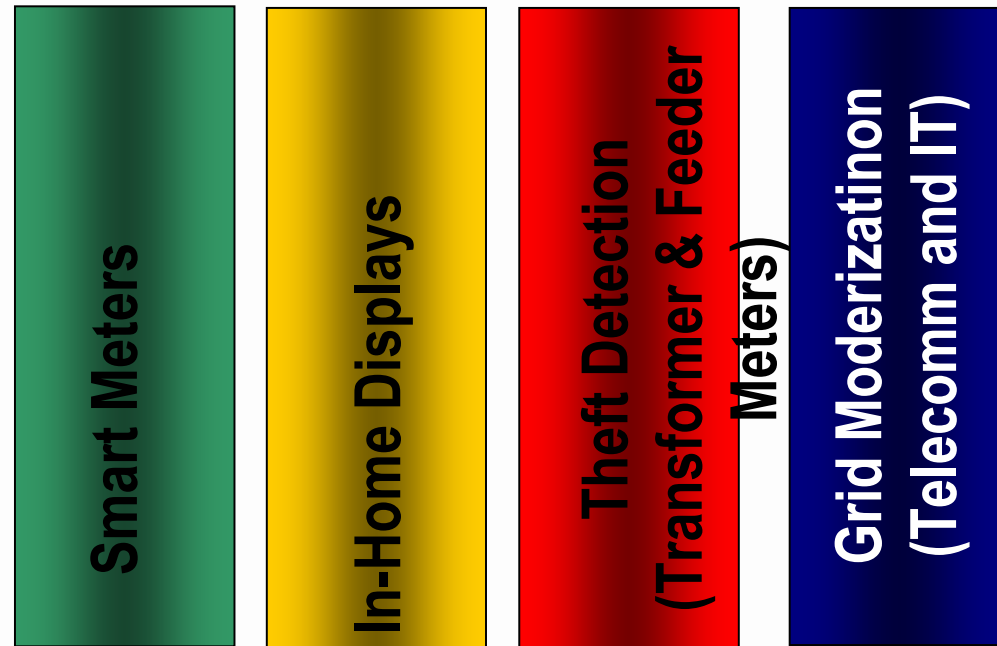
Smart Metering & Infrastructure Four Integrated Projects



Smart Grid Applications - SMI

SMI as a Smart Grid foundation

Smart Metering & Infrastructure as a Foundation



BCHydro's Smart Grid

Metro Reliability

Volt Var Optimization

DMS

Load Tap Changers

Reclosures

Distributed Generation

Plug In Hybrid E-Vehicles

Smart Grid Progress

BCHydro has tangible Smart Grid progress in the following areas:

- Distribution Management System
- Smart Metering and Infrastructure (SMI) Program
- Distribution Automation
- Substation Automation/VVO
- PEV/Microgrids/Distributed Generation
- Other - Industry Forum Participation

Distribution Management System (DMS)

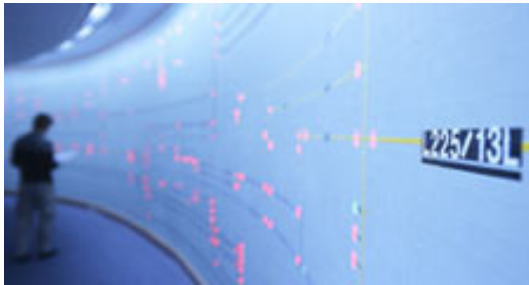
- A Decision Support System to assist the control room and field operating personnel with the monitoring and control of the electric distribution system
- Centralized DMS control with provision for peer-to-peer automation



Smart Grid Applications - DMS

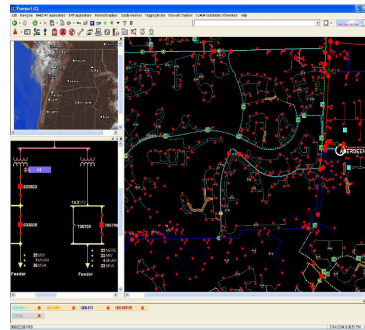
DMS (Cont'd)

Past



Wall Board Mimic

Present



Electronic Mimic



New Energy Management System by Areva

Future



DMS

Little or No Decision Support Capability within the Control Room Environment



Electronic Mimic with Advanced Apps for Decision Support

The Transformation
Current State → Future Vision

Smart Grid Applications – SMI Status

Smart Metering & Infrastructure Status

- Legislated to install ALL customer meters by 2012
- The “I” in SMI is for Infrastructure
 - Communication systems
 - Feeder and various feeder device meters
 - IT systems
- Request For Proposals - Summer/Fall 2008
 - 3 Vendors Shortlisted
 - Decision Was Scheduled For December 2008
 - Decision Currently Pending
- Expect system to be operational by 2012.
- Currently staffed with 150-200 employees

D-Automation Strategy - Status

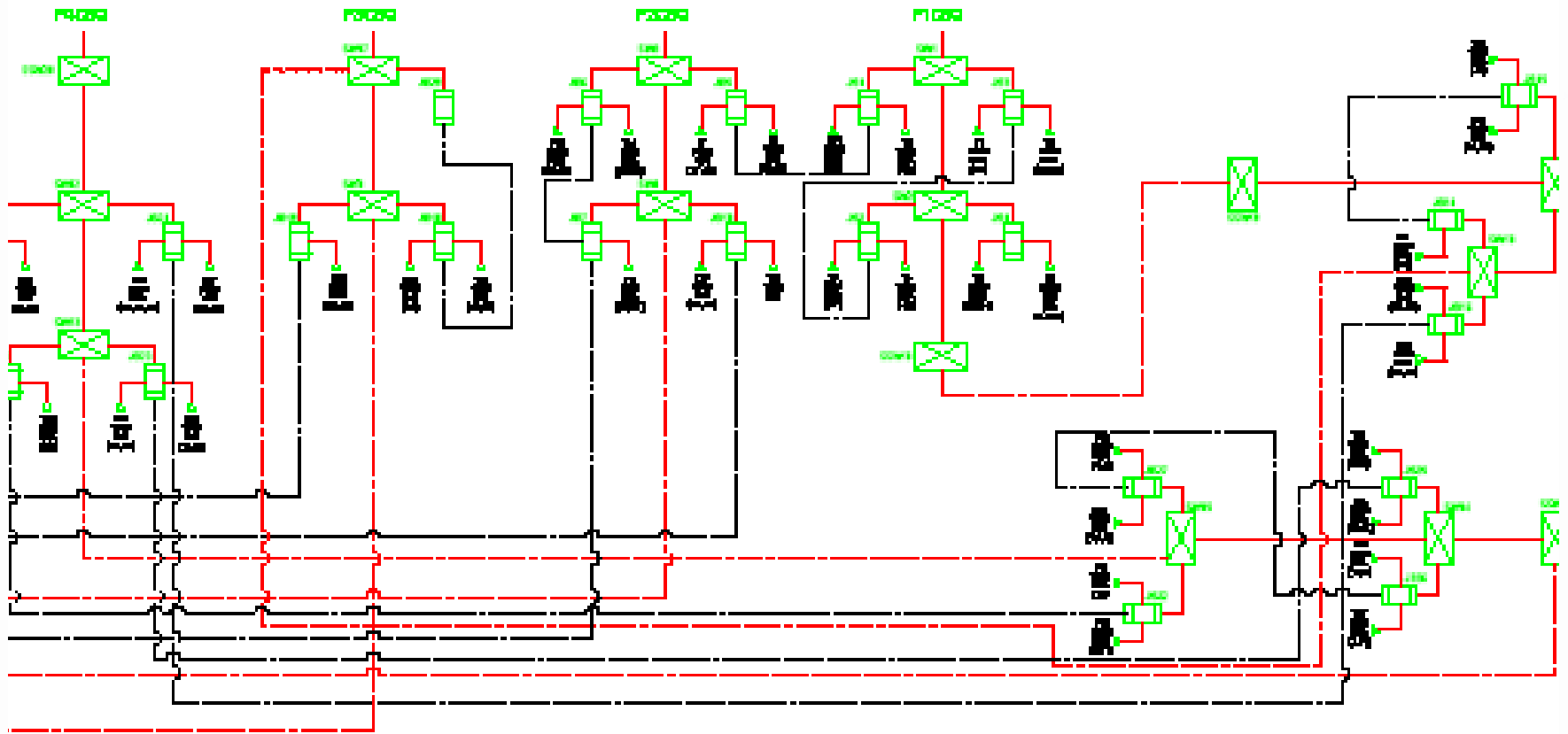
- Circuit Topology
 - Feeder open-loop configuration
- Equipment Standards
 - Supervisory Control and Data Acquisition (SCADA) enabled
 - Secure and IP based communications
- Substation Automation
 - Protection Control and Monitoring (PCM) and Volt-VAR Optimization (VVO) Upgrades
- Distribution Automation
 - Guidelines for Enabling SCADA for Reclosers & Switches

Smart Grid Applications - Topology Status

Distribution Automation/Circuit Topology

- Enabling SCADA (Supervisory Control and Data Acquisition) and other automation technologies to make the distribution network more intelligent.
- Some automation in place currently
 - DV2010 partnered - Park Royal Closed Loop system
 - Recloser project initiated on Vancouver Island this year
 - Vista switches with SCADA being used for 2010 Winter Games
- Metro Vancouver DA/Topology Redevelopment
 - Planning and Justification
 - Open Loop with sub loops as necessary

Metro Vancouver Topology - Open Loop with Sub Loops



FEEDER LINE SCHEMATIC
P.12

Maple Ridge automation project

- Step 1 (F2009 March), is installation of reclosers and switchgear at strategic locations.
- Step 2 (F2010) for the full automation project will involve replacement of all station feeder protection relays from electromechanical to SEL electronics relays (part of VVO project).
- As a final step, we will add communication to the equipment and implement the automation scheme with a target date of June 2010.
- Currently considering piloting Distributed Intelligence approach

Automation Functionality Matrix

Control / Logic					Functionality		
Peer-to-Peer/ Distributed	Supervisory w/ DMS	Supervisory w/o DMS	Local Intelligence	Basic	Fault Interruption & Locating	Restoration Capability	Restoration Success
				X	Yes	Reclose only	Temporary faults only
			X		Avoid nuisance trips	Dual radial or stand-by	Hit-or-miss on capacity
		X		X	Yes	Any alternate feed; Limited visibility	< 5 min (>> 5 min during storms); Educated guess on capacity
		X	X		Avoid nuisance trips; Devices report in	System reconfiguration	< 5 min (>> 5 min during storms); Optimized
	X			X	Yes	Any alternate feed; Limited visibility	< 1 min; Educated guess on capacity
	X		X		Avoid nuisance trips; Devices report in	System reconfiguration	< 1 min; Optimized
X			X		Avoid nuisance trips	Any alternate feed in the Neighbourhood	< 1 min; Optimized
X		X	X		Avoid nuisance trips; Devices report in	Any alternate feed in the Neighbourhood	< 1 min; Optimized; Peer-to-Peer is primary; Supervisory overrides
X	X		X		Avoid nuisance trips; Devices report in	System reconfiguration	< 1 min; Optimized; DMS is primary; Peer-to-Peer is back-up

U/G Switchgear Specifications

- S&C Electric Vista Switchgear (25 kV)
- SEL 351 relays for automation of 600 A fault interrupters on the feeder main
 - allows for zone protection scheme versus always fault clearing with the substation feeder breaker
 - allows for S&C IntelliTEAM II interface module
- 200 A fault interrupters on the load tap positions
- Prefer below ground control enclosures
- Proceed with fibre optic cables for communications to enable centralized SCADA
- Wireless communication for centralized SCADA is being considered, but is not a valid option until a final recommendation is available

Automation Projects & Guides

- Protection, Control & Monitoring (PCM) and Volt VAR Optimization (VVO) Upgrades
- Proceeding on automating 200 sets of reclosers based on Life-Cycle Analysis
- Automation Guide For Switches
 - Feeder open-loop configuration with sufficient switchgear on each circuit to allow for the historical two-thirds rule and the increasing circuit utilization
 - Installed on feeder main to connect to an alternate supply, or where an isolation point is required when a portion of the circuit is connected to alternate supplies
 - Sub loop for loads as necessary
 - Currently Being Implemented in Metro Vancouver
- U/G Switchgear Specifications

Protection, Control & Monitoring (PCM) and Volt VAR Optimization (VVO) Upgrades

- VVO is an effective conservation tool to reduce energy consumption, and has been in operation at one substation since the mid 1990's, and there is a program operational since 2007 to upgrade individual substations
- Substations that do not have VVO savings also benefit from PCM Upgrades as total Life-Cycle Cost of sustaining legacy electro-mechanical feeder-bus and feeder relays is equivalent to replacement with digital relays (or IEDs – Intelligent Electronic Devices)
- Other benefits of providing SCADA to distribution substations include safe & reliable operation of the power system, employee & contractor safety, and operational efficiencies

Automation Guide for Reclosers

- Proceeding on automating 200 sets of reclosers based on Life-Cycle Analysis
- Application of Three-Phase Reclosers
 - At least 300 customers connected downstream
 - Eliminate 3 or more annual sustained outages
 - Reduce annual duration of sustained outages by at least 30 min
- Application of Single-Phase Reclosers
 - At least 100 customers connected downstream
 - Eliminate 2 or more annual sustained outages
 - Reduce annual duration of sustained outages by at least 20 min

Automation Guide for Switches

- Installed on feeder main where there is an ability to connect to an alternate supply, or where an isolation point is required when a portion of the circuit is connected to alternate supplies
- Feeder open-loop configuration with sufficient switchgear on each circuit to allow for the historical two-thirds rule and the increasing circuit utilization
- Sub loop for loads as necessary

Enabled Applications (PEV, DG, Microgrids)

- **Plug In Electric vehicles (PEV)**
 - By end of 2009, BChydro expects to have largest fleet of plug in vehicles in North America (at 10)
- **Distributed Generation (DG)**
 - Existing large penetration of IPPs
 - Existing customer Net metering program (<10kW)
 - Strategy under development for customer based DG
 - Smart Grid is ensuring system will be prepared to accommodate.
- **Microgrids**
 - In partnership with BCIT we are working to develop a demonstration project of a true Microgrid.
 - BChydro is preparing a Microgrid Use Case that defines the term and lays out various scenarios.

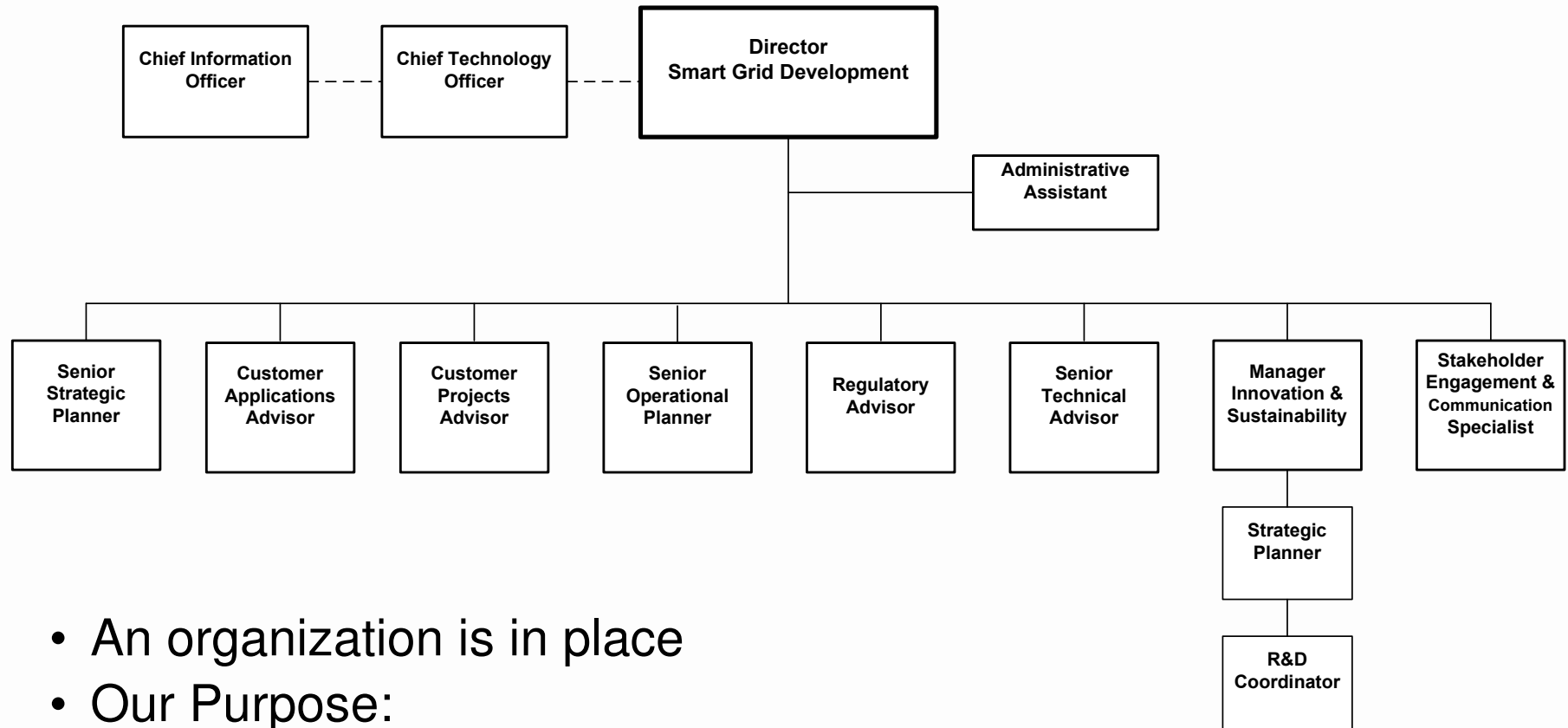
Other - Industry Forum Participation

- Gridwise Alliance
 - Membership and Board Seat
- Grid-Interop
 - Participating in various working groups
- DV2010
- Utility AMI / Open AMI, IEEE, EPRI, CEATI, UTC
- Benefits – Driving open standards, sharing information, common voice, coordinated approaches

BCydro's Smart Grid Program Current Status

- Authorized to form Smart Grid Program team in February 2008
 - Currently Reporting to the Chief Technology Office
 - Currently about 10 people in the Smart Grid group
- Key deliverables:
 - five year strategic vision and roadmap (both imminent)
 - as well as a cost/benefit analysis of Smart Grid and a 20 year vision (proposed)
- Strategic Group intended to align all programs and applications that reside under the Smart Grid governance umbrella
 - Provide a cross-application coordination (for example – DG needs work with SMI needs)

BChydro's Smart Grid Program



- An organization is in place
- Our Purpose:

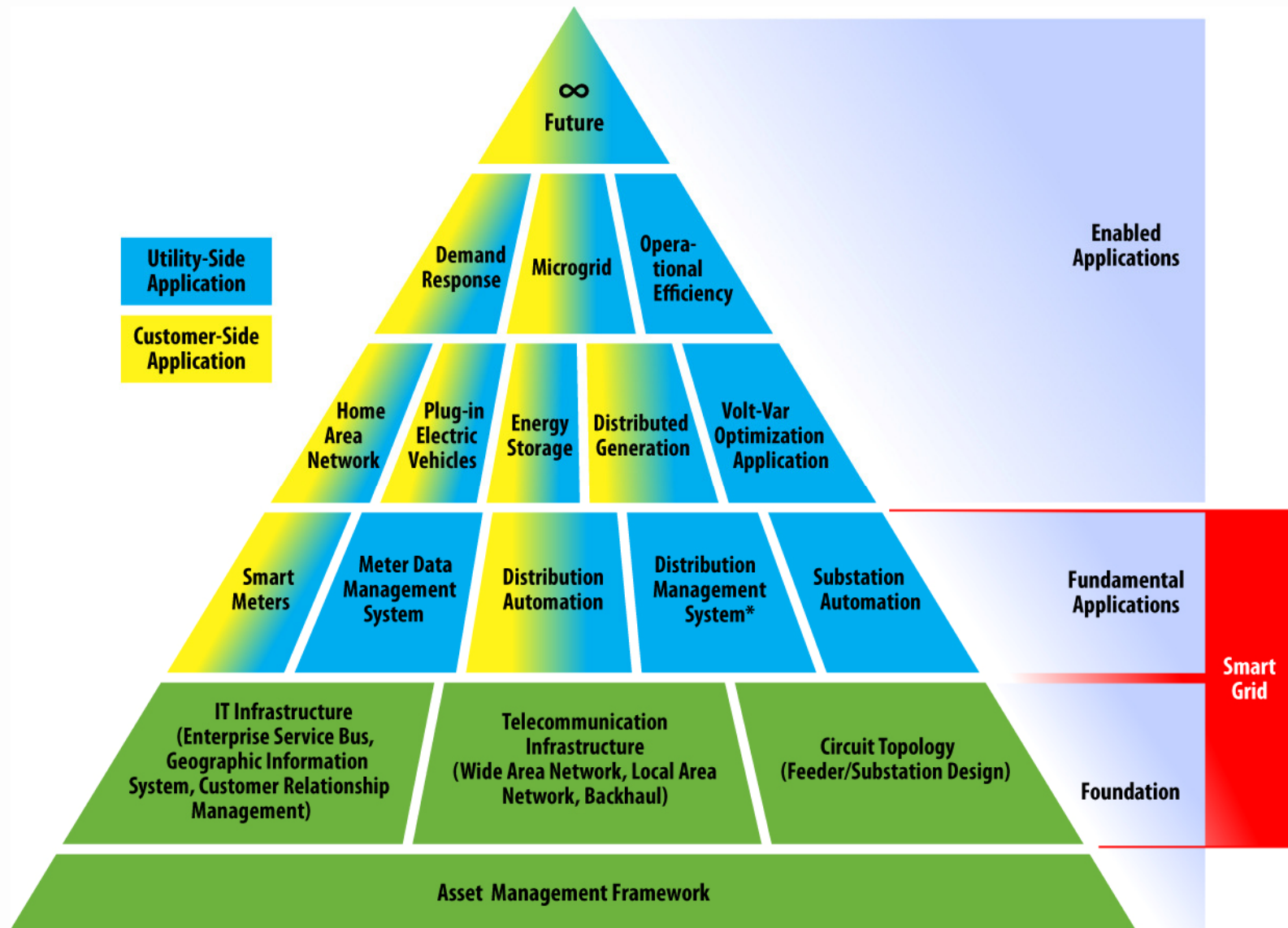
To advance the deployment of Smart Grid applications

BChydro's Experience with Smart Grid

What does this all mean?

- Clarify the inconsistent understanding of what a Smart Grid is (hence the need for the Pyramid diagram) and therefore how it will be achieved.
- BChydro is relatively mature in the Strategic space of Smart Grid (Strategy, Dedicated Team, Interest Group Participation).
- Also a risk averse organization so measurable progress has been slow.

Smart Grid Building Blocks



Utility-Side Application
Customer-Side Application

*includes Energy Management System

Questions



Thank You

Tom Gutwin
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BChydro Distribution Planning