

Community Energy Storage

Linchpin of the New Energy Era

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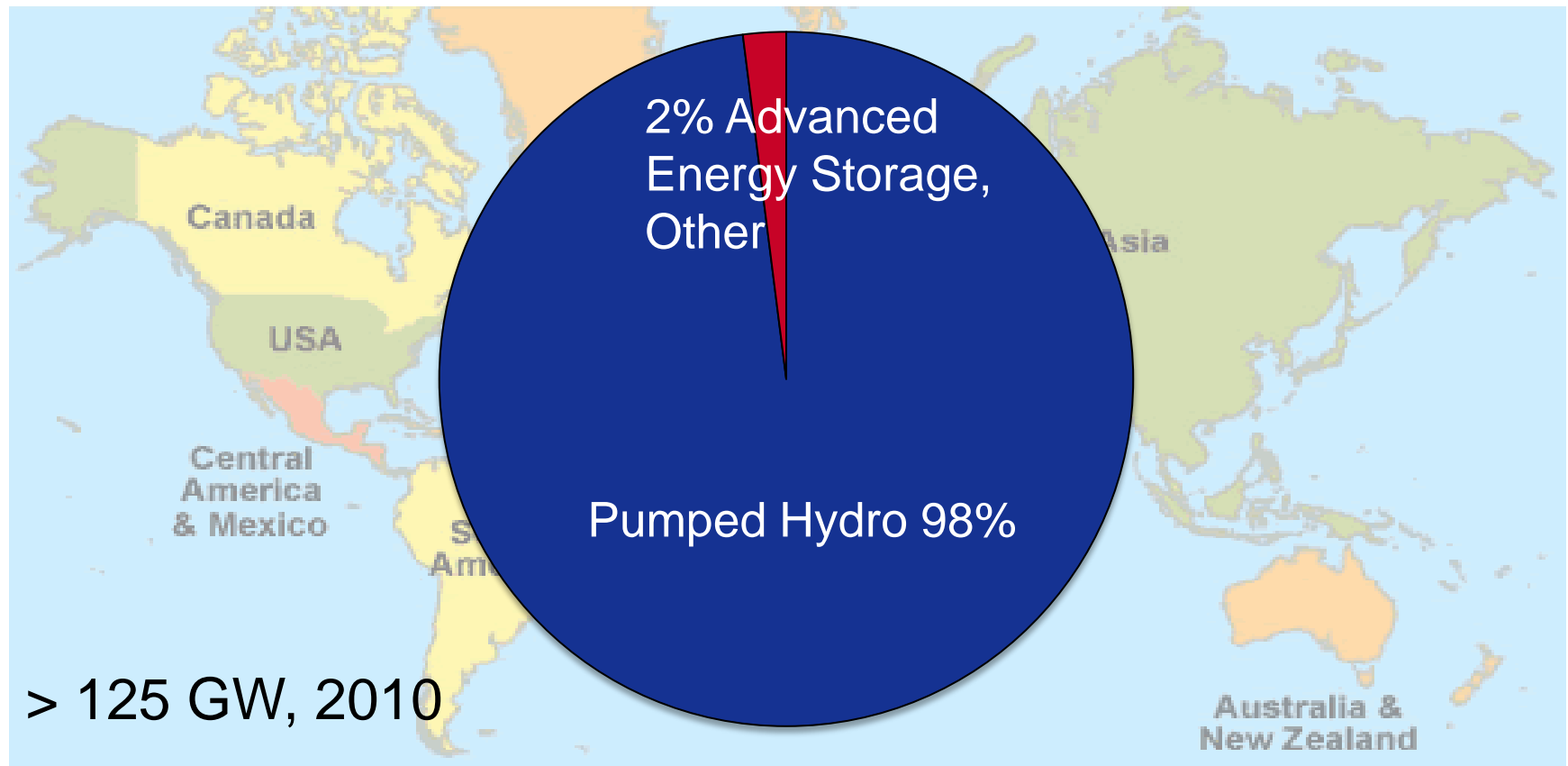


Grid Modernization 2006 - 2012

Value
Intelligence
Integration
Component



Energy Storage Globally



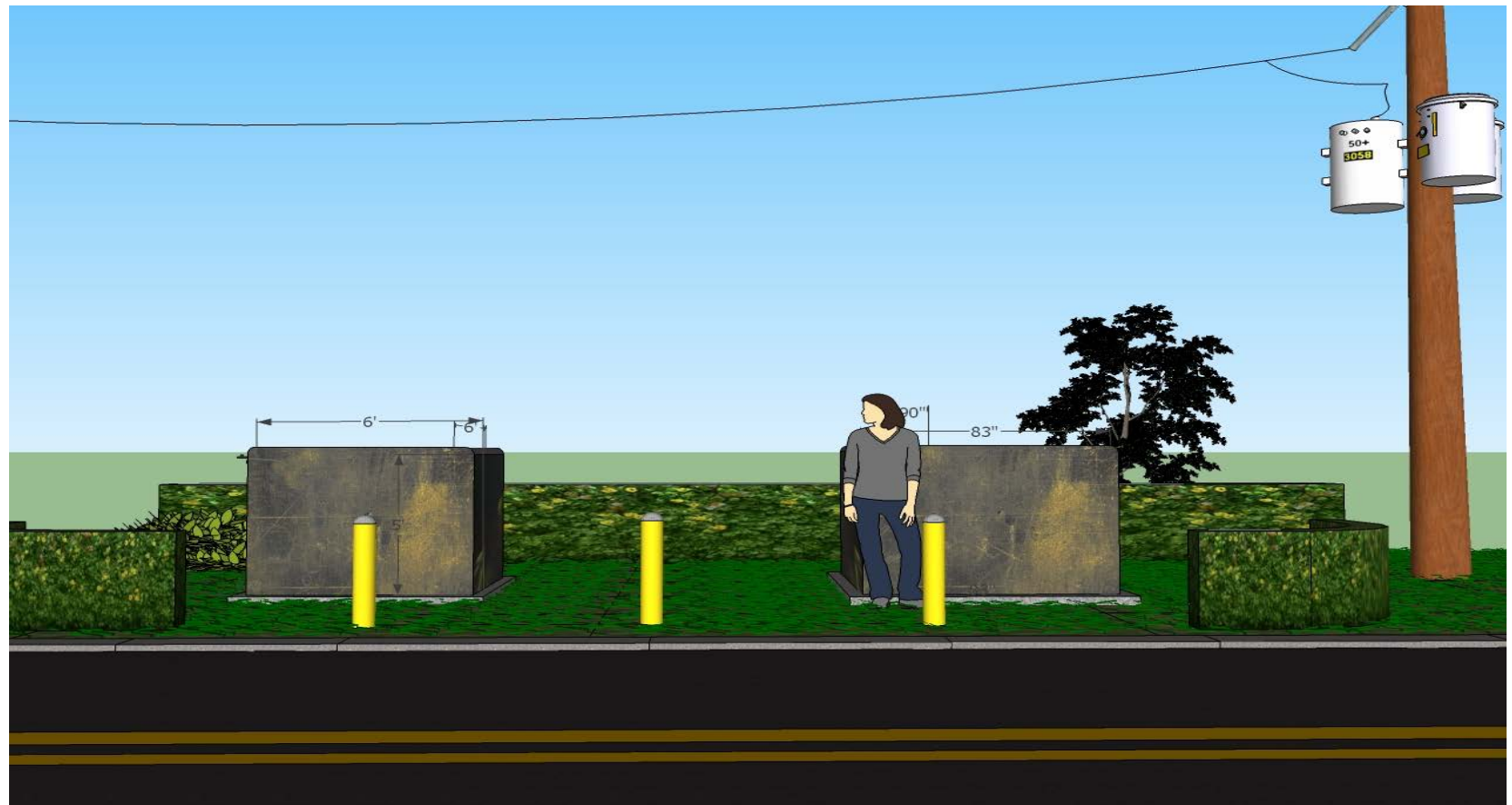
Source: Electric Advisory Committee, May 2011



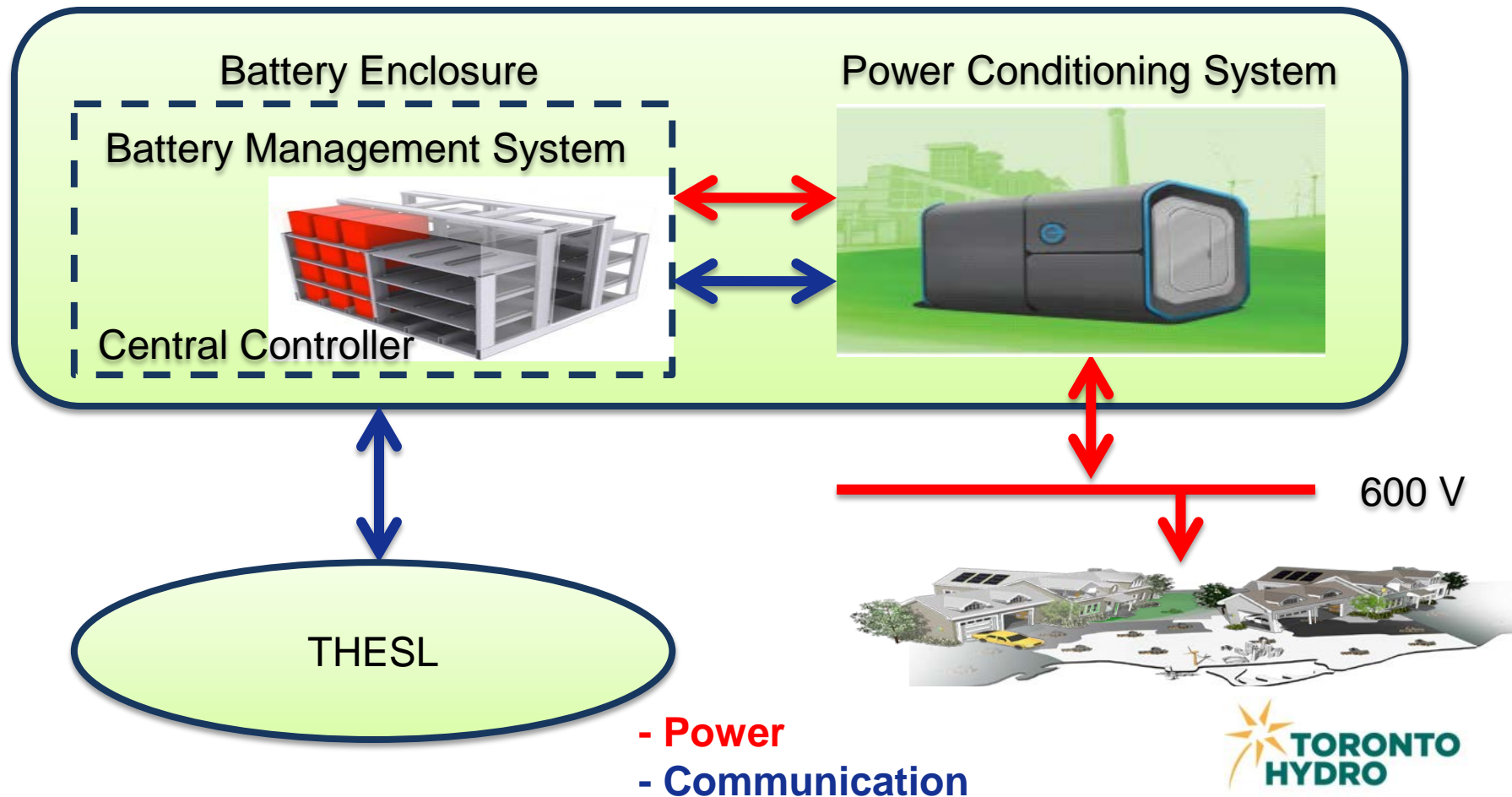
Energy Storage Helps ...



Community Energy Storage



Community Energy Storage Implementation





What is 750 kW going to do ? What is Next ?



“... to steer the world towards a cleaner, cleverer and more competitive energy system” – World Energy Organization, 2008





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Centralized Energy

Black Box Model

Aging, Constrained Black Box

Trends Stressing Black Box

Power Management Model

Green Power

Centralized Intelligence

Digital On/Off Management

Supply/Demand Side Management

**ENERGY
STORAGE**
AS LINCHPIN

Decentralized Energy

Advanced Sensing and Monitoring

Extra Variable of Control: Storage

Renewable Energy and EV as Base

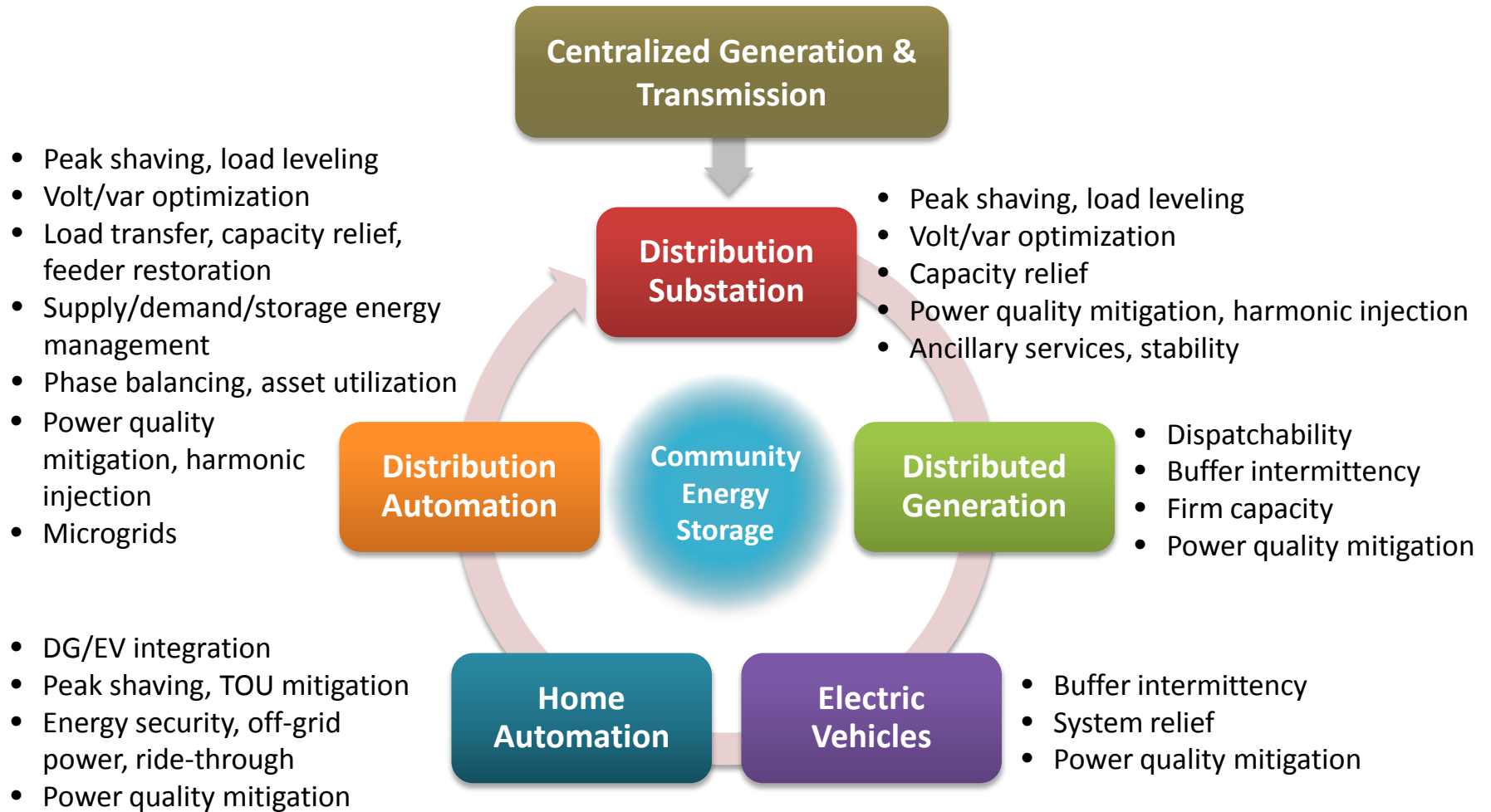
Energy Management Model

Green Electrons

Decentralized Intelligence

Analog Active Energy
(Supply/Demand/Storage)
Management and Microgrid

Uses of Storage in the Smart Energy Ecosystem



Community Energy Storage: Toronto Smart Grid Community Demonstration



Design, development, and deployment of three 250kWh/250kW community energy storage units to be demonstrated in Toronto Hydro's Smart Grid Community



Grid Objectives

- Peak shaving and valley filling
- Capital deferral
- Reliability improvements
- Buffering intermittency between new generation and loads (e.g. EV)
- Optimal management of supply/storage/demand resources
- System loss reduction
- Power quality improvement
- Support potential microgrid and backup power applications

Development Objectives

- Battery performance optimization
- Battery management system
- Thermal and battery life management
- Smart inverter technology
- Control, Protection, Power Management (CPPM) technology
- Distributed intelligence
- Grid-aware charging/discharging
- Standards-driven communications with the grid

Production Objectives

- Storage technology agnostic
- Optimized manufacturing process
- Reduced \$/kWh
- Modularity and scalability
- Safety, reliability, robustness

Project Innovations

Battery Array

- State-of-the-art lithium polymer cells by Dow Kokam
- Cells key characteristics: safety, reliability, cycle life, power/ energy design temperature performance
- Expected 5000+ cycle under planned operational scheme
- Discharge temperature range -30°C to 60°C
- Multi-level protection
- Patented thermal management scheme, built into module pack design, ability to operate in utility outdoor applications
- Innovative construction to reduce \$/kWh
- Flexible, modular design for scaling

Battery Management System

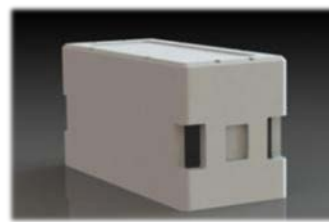
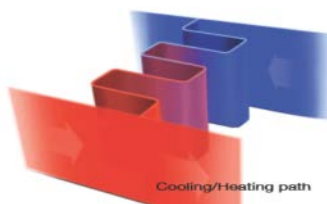
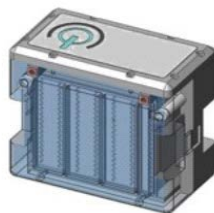
- Distributed logic
- Electrical and environmental controls
- Protection, cell optimization, communications
- Controller redundancy

Control, Protection, Power Management

- Grid-aware” storage unit operation
- Optimization engine
- Adaptive control functions
- Scalable to a 1MWh+ unit operation
- Data logging and processing functions, ultra-high speed decision making
- Key enabler for microgrid and other transformative grid applications
- Substation automation-like LAN technology

Power Conversation System

- NPT-IGBT, PWM, direct DC-AC bidirectional inverter/converter
- Smart inverter, capable of harmonic and unbalanced current injection, LV and LF ride-through, essentially a distribution feeder DSTATCOM
- Active/reactive power injection, selected P/Q priority
- Grid-connected, standalone, standby operating modes with black-start capabilities, anti/intentional islanding
- Configuration grid interface, controllable fault-contribution
- Relay-driven system protection
- Local human-machine interface (HMI)
- Scalable to multi-MW units (e.g. wind/solar farms, industrial applications)



QUESTIONS?



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