

# **Grid-scale Storage Technologies**

## **Regulatory Barriers and Policy Instruments**

**Hydrogen Energy Storage for Grid and Transportation Services**  
**May 15<sup>th</sup>, 2014**

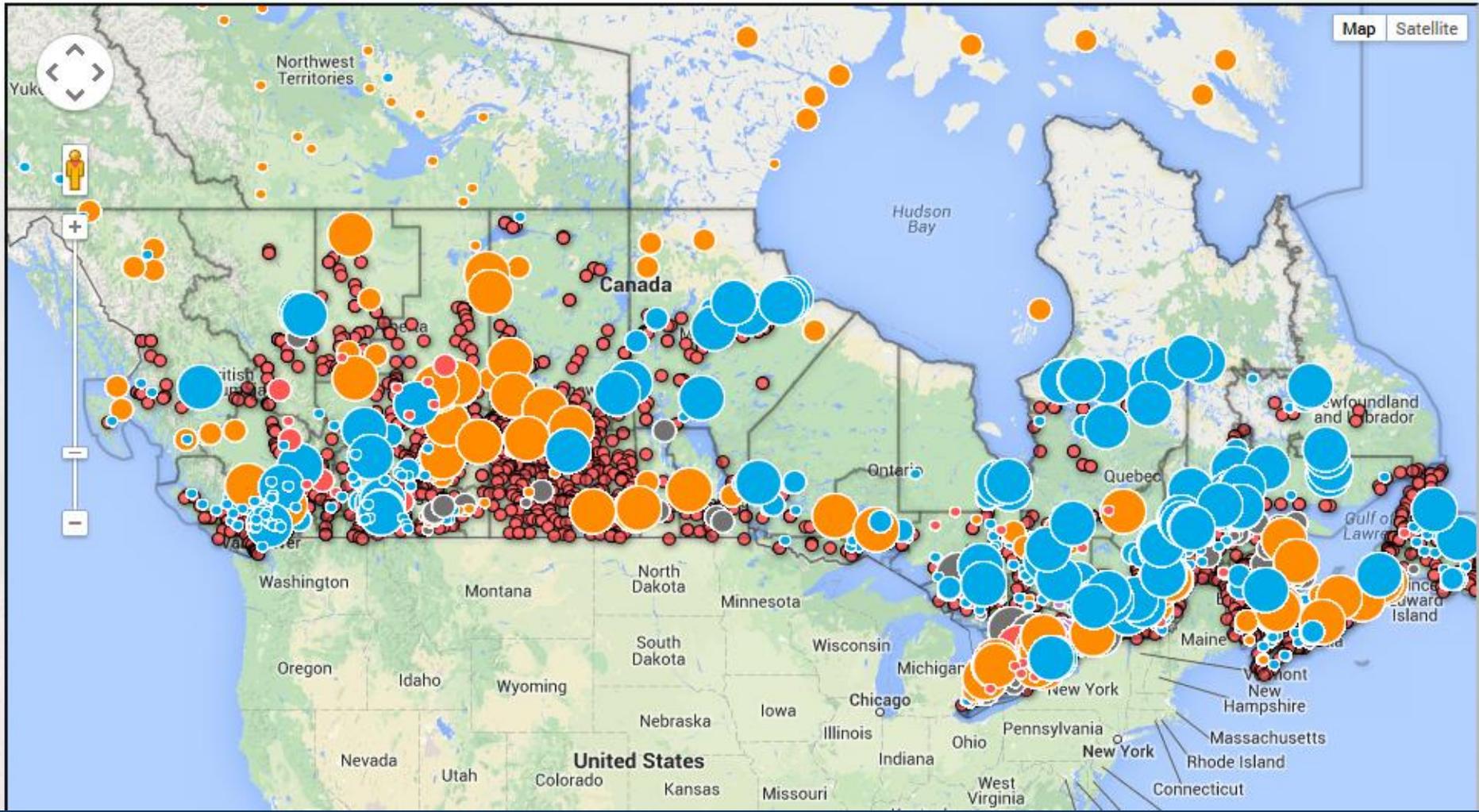
**Sacramento, CA**



# Electricity Map

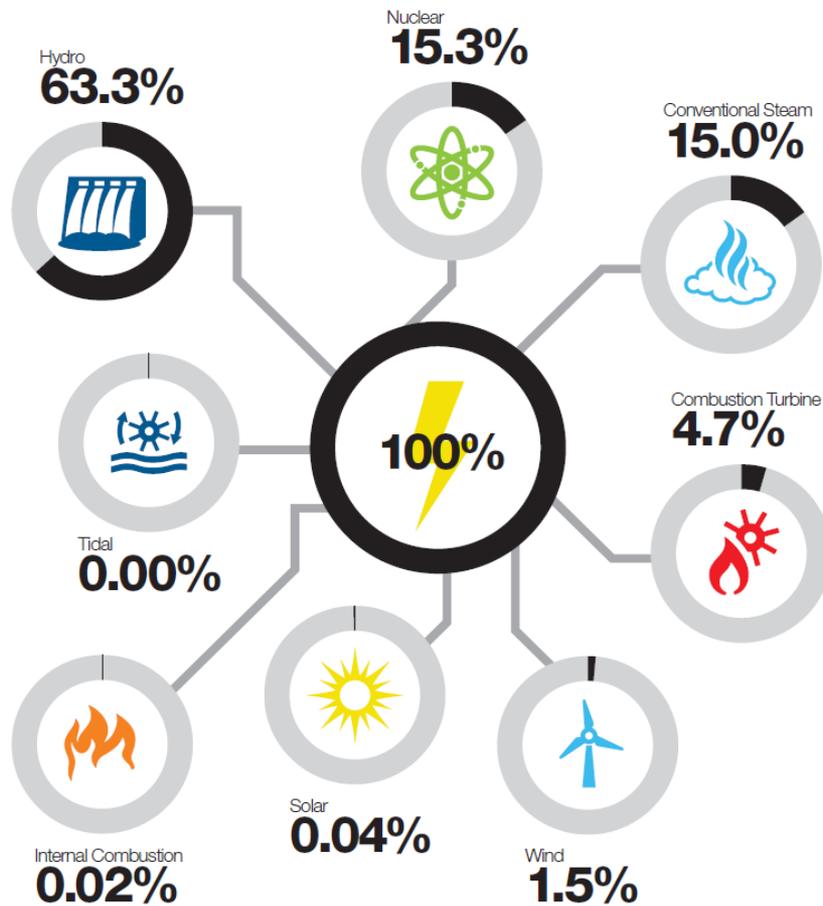
Demand 599 TWh

Generation 595 TWh

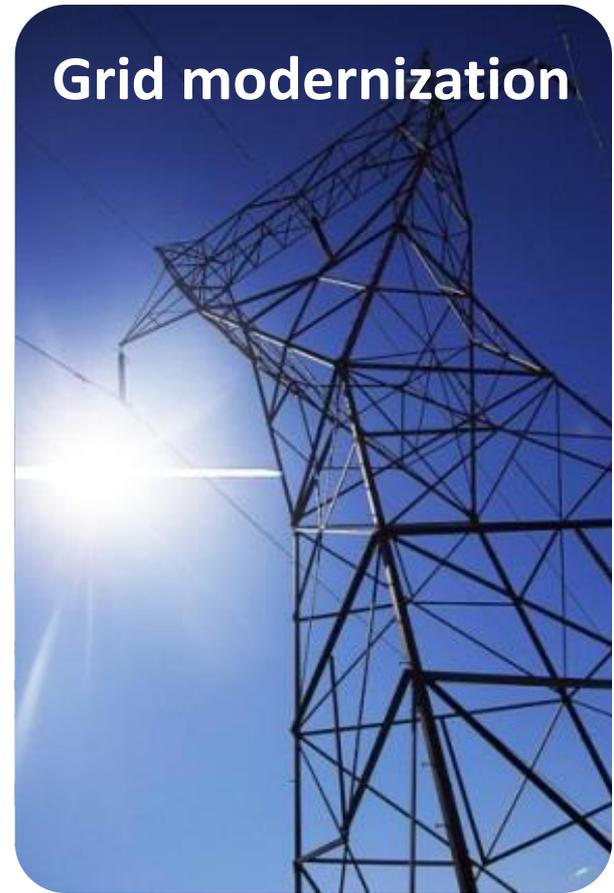


# Electricity Generation in Canada

already clean ...



## Grid modernization



CEA, 2013

# Energy Storage for Grid Security and Modernization

## *Program Overview*





## About NRC

- 2012-13 budget: \$774M
- Over **4,000** employees
- World-class technical expertise and facilities

# Transforming NRC

## MANDATE

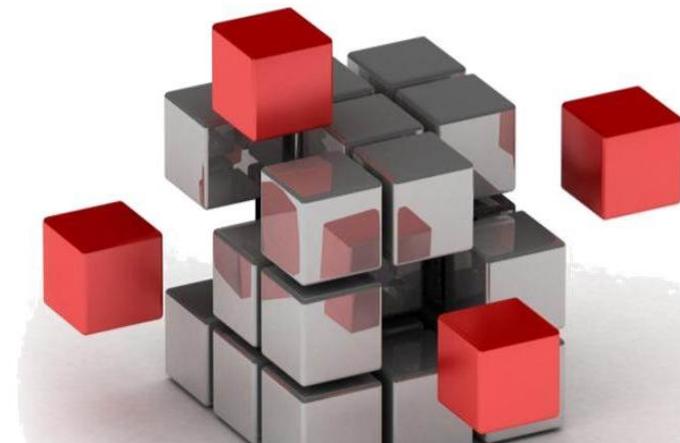
Economic development by providing industrial technology development programs and national laboratories to facilitate industrial R&D

## OLD APPROACH

- ❌ Geographically-based institutes
- ❌ Discrete strategies and business practices
- ❌ Specialized local facilities and expertise
- ❌ Individual project activities

## NEW APPROACH

- ✅ Focused: industry-driven, needs-based
- ✅ Collaborative: internally and externally
- ✅ Multi-disciplinary: build national capabilities
- ✅ Strategic: alignment of project outputs



# NRC Transformation: Strategic Program Approach

- Focused in areas where we *should* rather than *could*
- Building strategic core-competencies that are managed nationally
- Leads to better, more focused investment decisions in projects and infrastructure
- Enables more deliberate positioning vis-à-vis other innovation players in the Canadian innovation system

## GREATER IMPACT



Strategic R&D



Technical Services



Industrial Research  
Assistance Program



Science  
Infrastructure

# Organizational Structure

## DIVISIONS

**Emerging Technologies**

**Engineering**

**Life Sciences**

**Industrial Research Assistance Program**

## PORTFOLIOS

Information and Communications Technologies

Measurement Science and Standards

National Science Infrastructure

Security and Disruptive Technologies

Aerospace

Automotive and Surface Transportation

Construction

Energy, Mining and Environment

Ocean, Coastal and River Engineering

Aquatic and Crop Resource Development

Human Health Therapeutics

Medical Devices

Pacific Region

West Region

Ontario Region

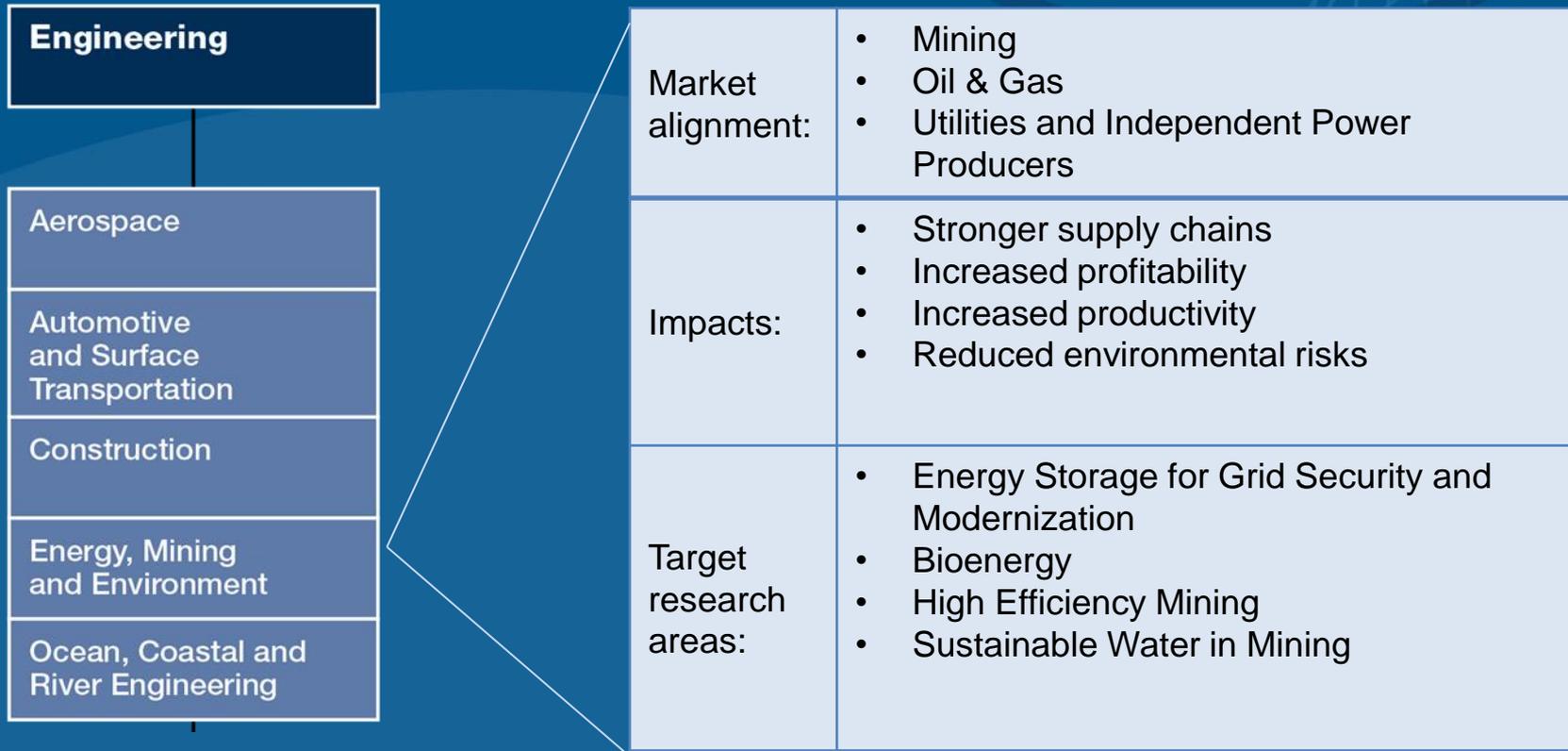
Quebec Region

Atlantic & Nunavut

National Office

Common Services to support portfolios and IRAP

# Portfolio Overview



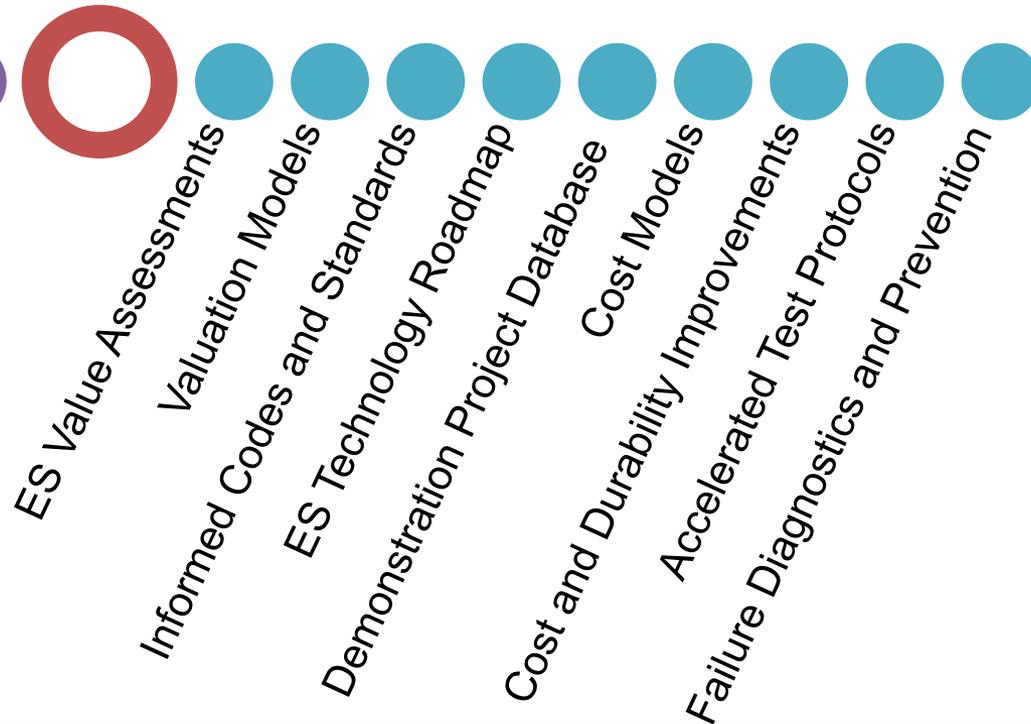
# Program Value Proposition

*To support utilities & industry in modernizing the electricity grid by strengthening the Canadian energy storage technology value chain & reducing risks for utilities to adopt energy storage technologies.*

## Activities



## Outputs



## Outcomes



# Program Scope

## Strategic Support and Analysis

- Techno-Economic Assessments
- Technical Support of Codes & Standards
- Technology Roadmaps

## Demonstration & Validation

- Technical Support of Demo Projects
- System Integration
- Component Validation

## Client Driven R&D

- Manufacturability
- Material Improvement
- Accelerated Testing

✓ **Cost**

✓ **Durability**

✓ **Market Acceptance**



Defer infrastructure investment



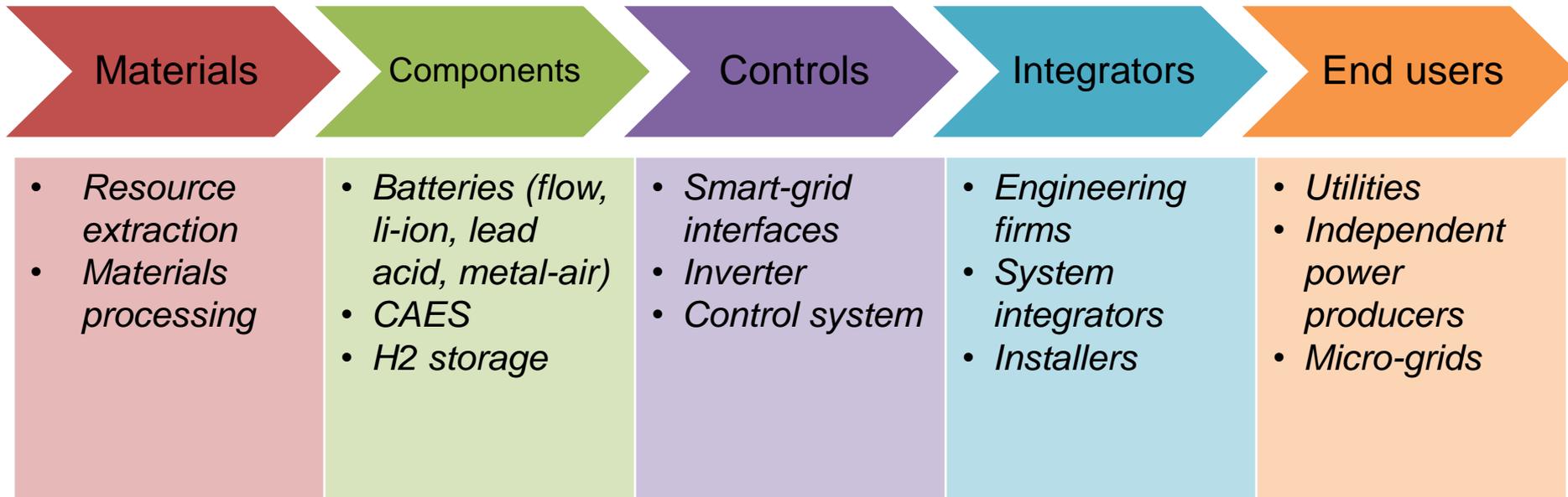
Peak shaving & arbitrage



Integrate renewables

# Program Goals

To demonstrate at TRL7, an installed **cost reduction** from the current ~\$1000/kWh to under \$500/kWh and from the current ~\$2500/kW to less than \$1250/kW, while increasing the **operating lifetime** to >15 years from today's 5-7 years and strengthening the Canadian Energy Storage supply chain.



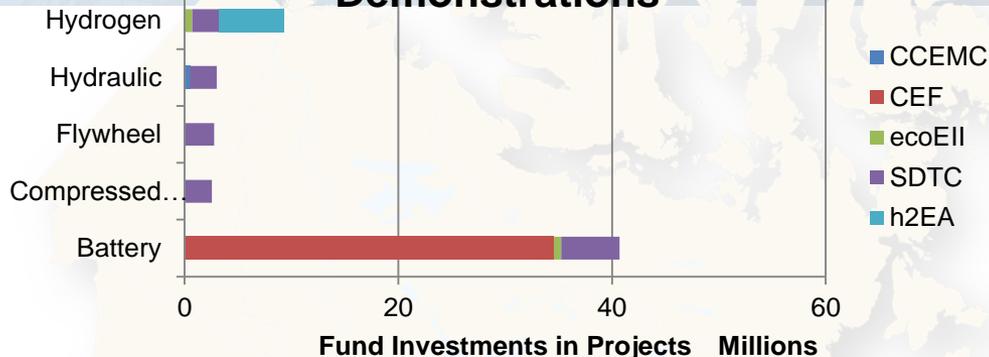
ENABLERS: capital, business / technology experts, incubators, regulators, gov't



# Sample Projects and Results

# Publicly Funded Storage Demonstrations & Pilots in Canada

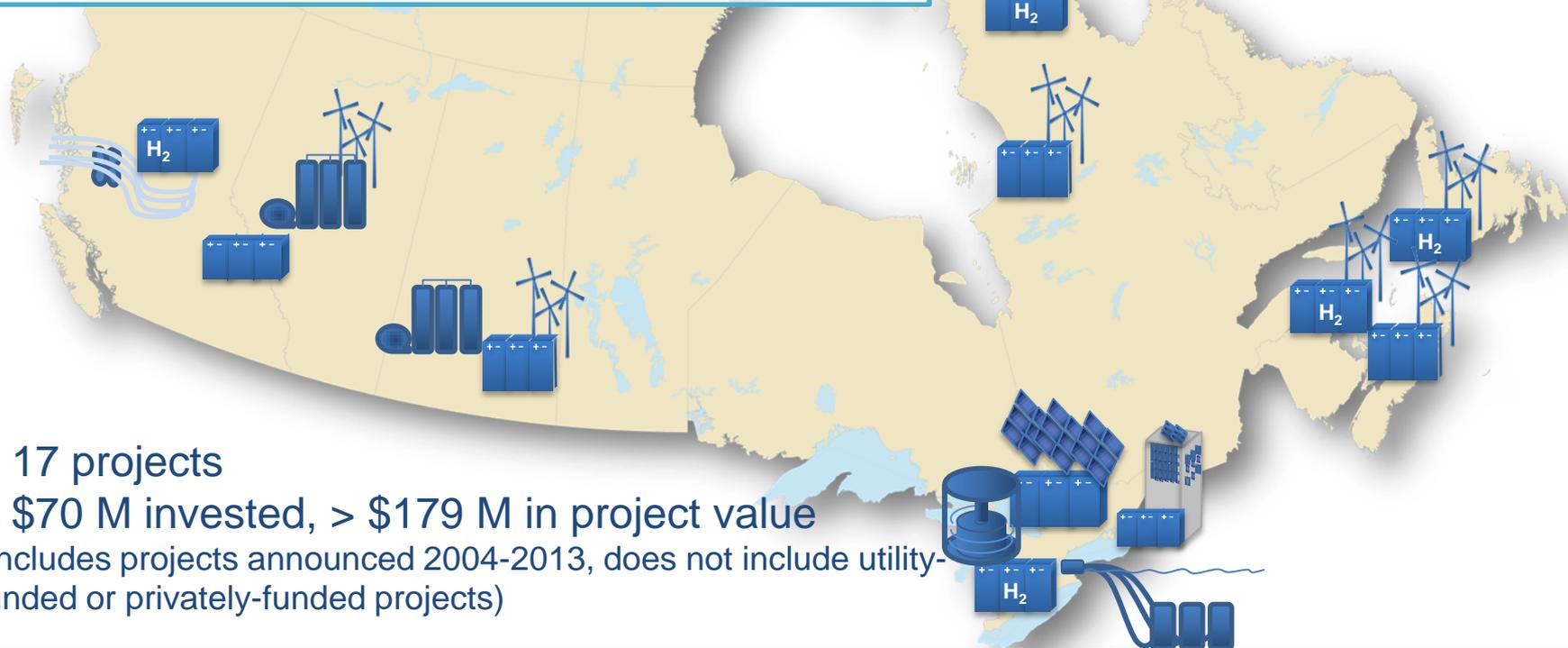
## Publicly Funded Grid Storage Demonstrations



## Smart Grid in Canada

2012-2013:

[www.nrcan.gc.ca/smart-grid-in-canada-201213](http://www.nrcan.gc.ca/smart-grid-in-canada-201213)



> 17 projects

> \$70 M invested, > \$179 M in project value

(Includes projects announced 2004-2013, does not include utility-funded or privately-funded projects)

# Active/Upcoming Projects

## SELECTED PROJECTS

- ES performance evaluation in ramping reserve applications
- ES Technology Roadmap (Li-ion)
- **Integrating P2G Module To Existing Storage Valuation Tools**
- Code and safety standards for LiB shipping & delivery
- Framework for data collection and analysis in ES demonstration projects
- Customization of valuation tools to include Canadian jurisdictional data
- Integration of dynamic ES models in power planning & analysis tools
- Evaluation of the secondary usage of vehicle battery packs

# Electrochemical Energy Storage for the Integration of Renewables

- **Timeline:** Apr 1<sup>st</sup>, 2012 to Mar 31, 2015
- **Scope:** Assist NRCan in the evaluation of CEF funded ES demonstration projects by:
  - Gathering real-time operational data
  - Proposing operational scenarios
  - TEA to assess ES projects under specific operating conditions
  - Estimating the cost and reliability of the demonstrated ES technologies
- **Status:** NRC/NRCan Joint Demonstration Project Workshop May 13-14<sup>th</sup>, 2014, Vancouver BC
- Feasibility ranking and valuation
- Standardizing ES Performance / Application Matrices



# Development of failure diagnostic tools and testing protocols

## Testing protocols

- Failure diagnostics tools
- Dynamic testing protocols for PEM electrolyzers

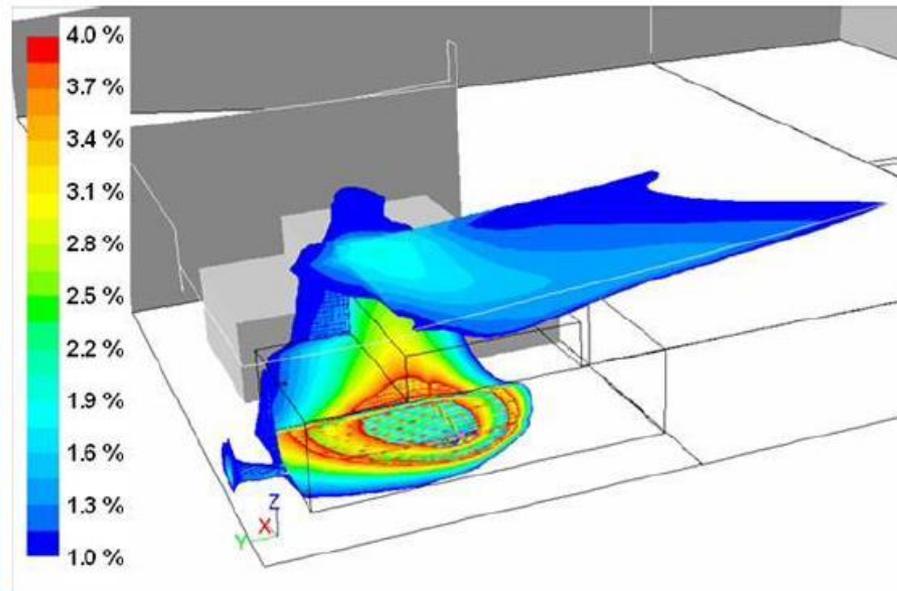
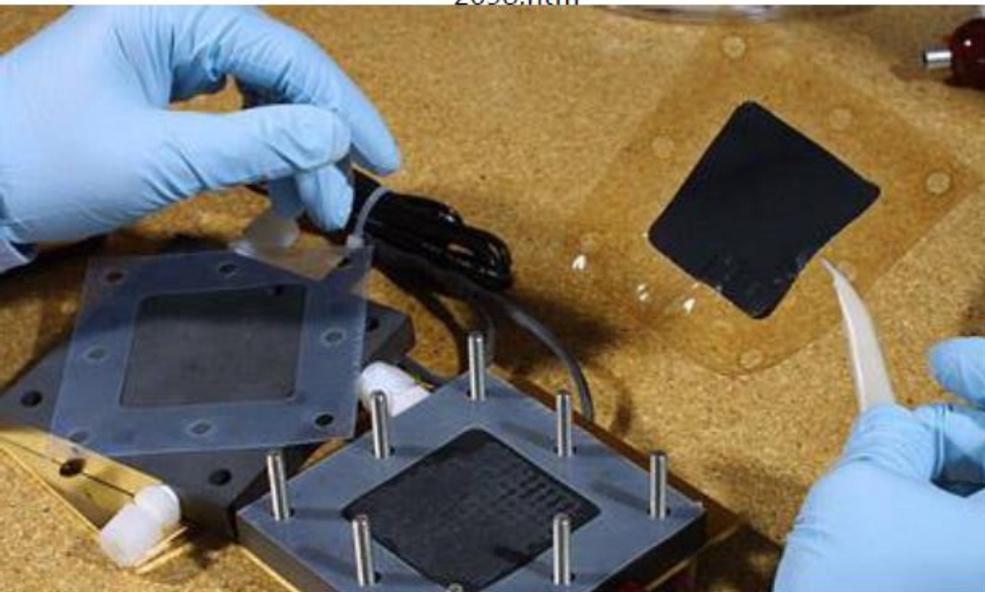
## Codes & standards

- Hydrogen Release in an Underground Parking Facility
- Gap Analysis on the Codes and Standards Related to the Storage of Hydrogen-Fuelled Vehicles

CAN/BNQ1784000  
(Hydrogen installation)

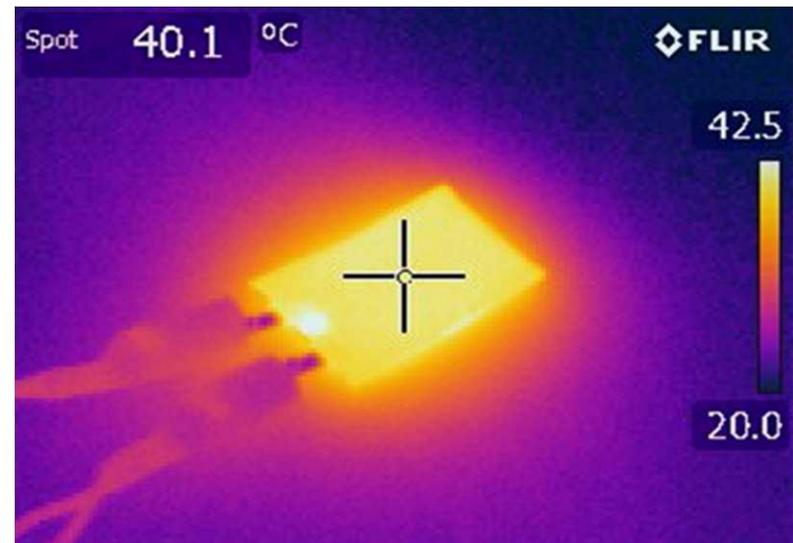
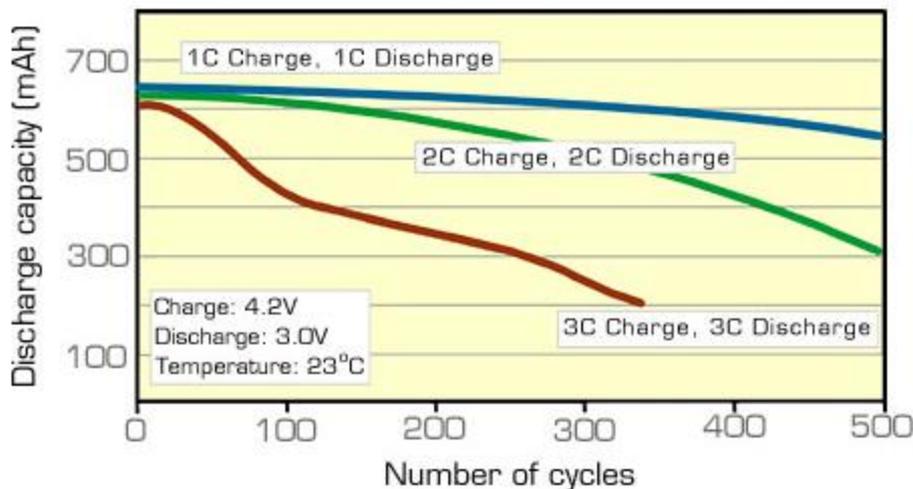


<http://www.tc.gc.ca/eng/programs/environment-etv-menu-eng-2698.htm>



# DND Power Sources for the Canadian Forces

- **Timeline:** Apr 1, 2011 to Mar 31, 2014
- **Scope:** Support the Canadian Forces in the deployment of energy storage devices by carrying out evaluation studies on the latest battery and fuel cell developments from industry. The primary focus is to identify new battery of performance, safety, reliability and state-of-health. Secondary focuses are the development of new operating procedures and performing expert evaluation of field deployment issues.
- **Status:** Completed



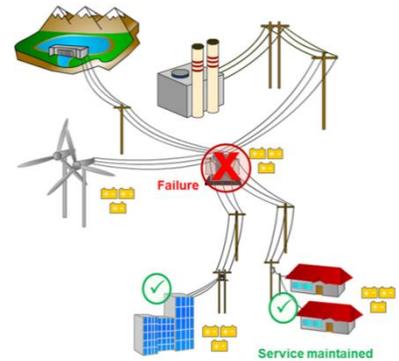
# Policy Instruments

- Feed-In Tariff (FIT) is “technology specific”
- FIT advocates for various types of available technology options on the market. FIT may kill competition among energy storage technology developers
- FIT is “dis-incentivizing deployment of energy storage technologies in the grid”.

## Ontario

- Ontario’s current FIT scheme prevents a multi-level scheme for FIT implementation
- Storage technologies added in energy procurement process ( 50 MW).
- Former feed-in-tariff procurement process for renewable generation projects (>500 kW) will be replaced with a competitive procurement model.
- Time of use pricing
- Enabling value stacking
- Ownership structure and eligibility

# Strategic collaboration and co-investment opportunities



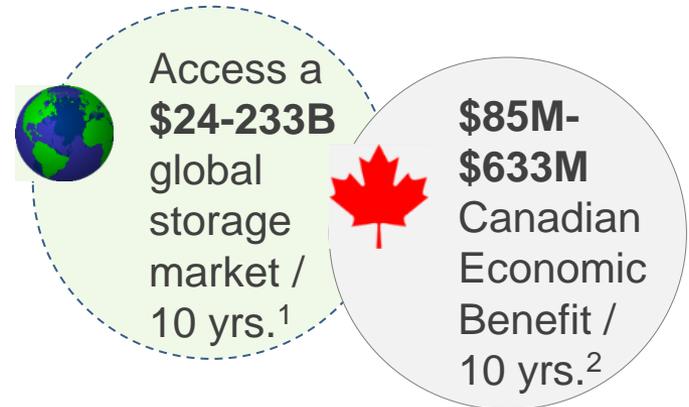
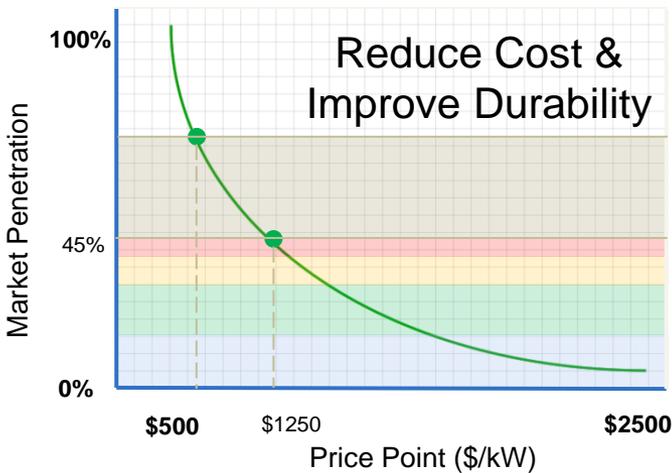
ES Market Opportunity



NRC Investment



Value Chain Co-investment



# Questions?

**Kourosh Malek**

Program Technical Lead, Energy Storage for Grid Security and Modernization

T: 604-221-3000

[Kourosh.Malek@nrc-cnrc.gc.ca](mailto:Kourosh.Malek@nrc-cnrc.gc.ca)

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