June 30, 2015

Energy Storage Subcommittee Report

Activities and Plans

Presented by the Subcommittee Chair, Merwin Brown, CIEE

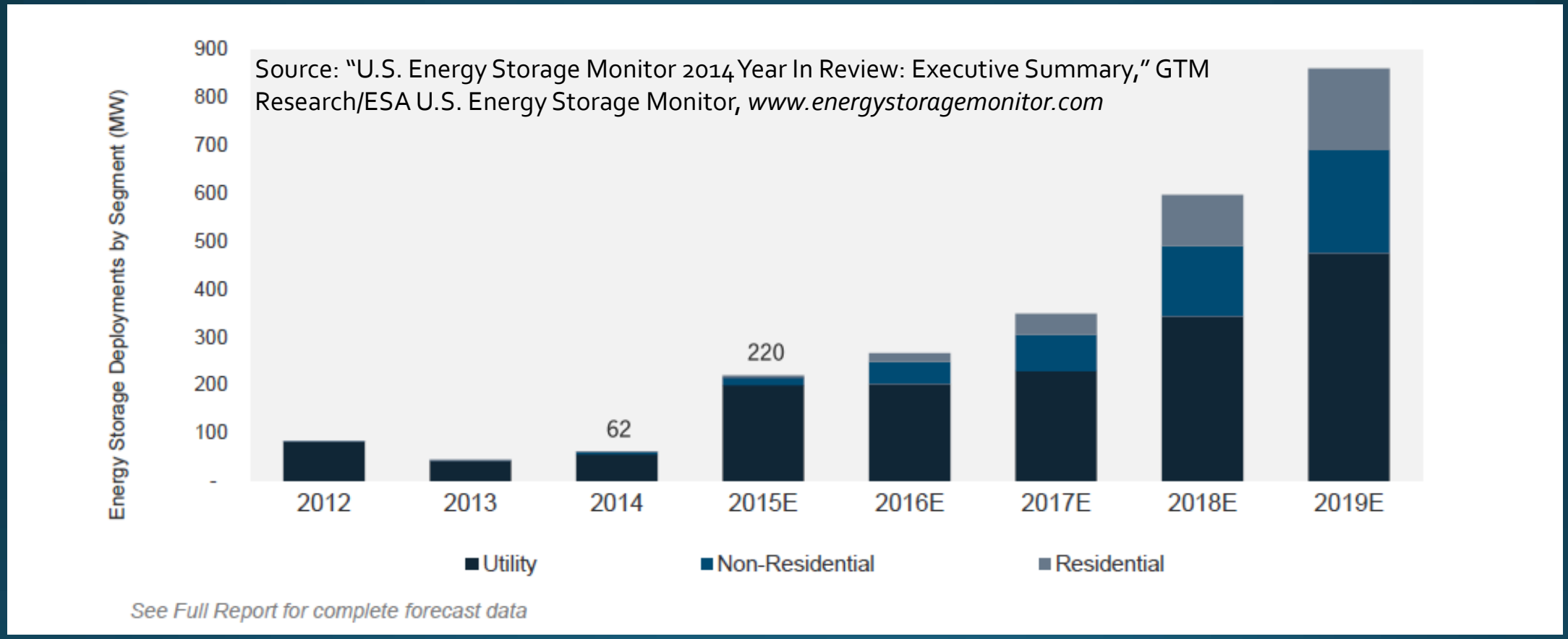
Energy Storage Subcommittee 2015-2016 Plans

a. "National Strategy for Distributed Energy Storage in the Electric Grid " White Paper – a joint effort by the EAC Smart Grid (lead) and Energy Storage Subcommittees. – *Finish in 2015*

b. "Implications of High Penetrations of Energy Storage into Electric Transmission and Distribution Systems" White Paper – *Finish 2016*

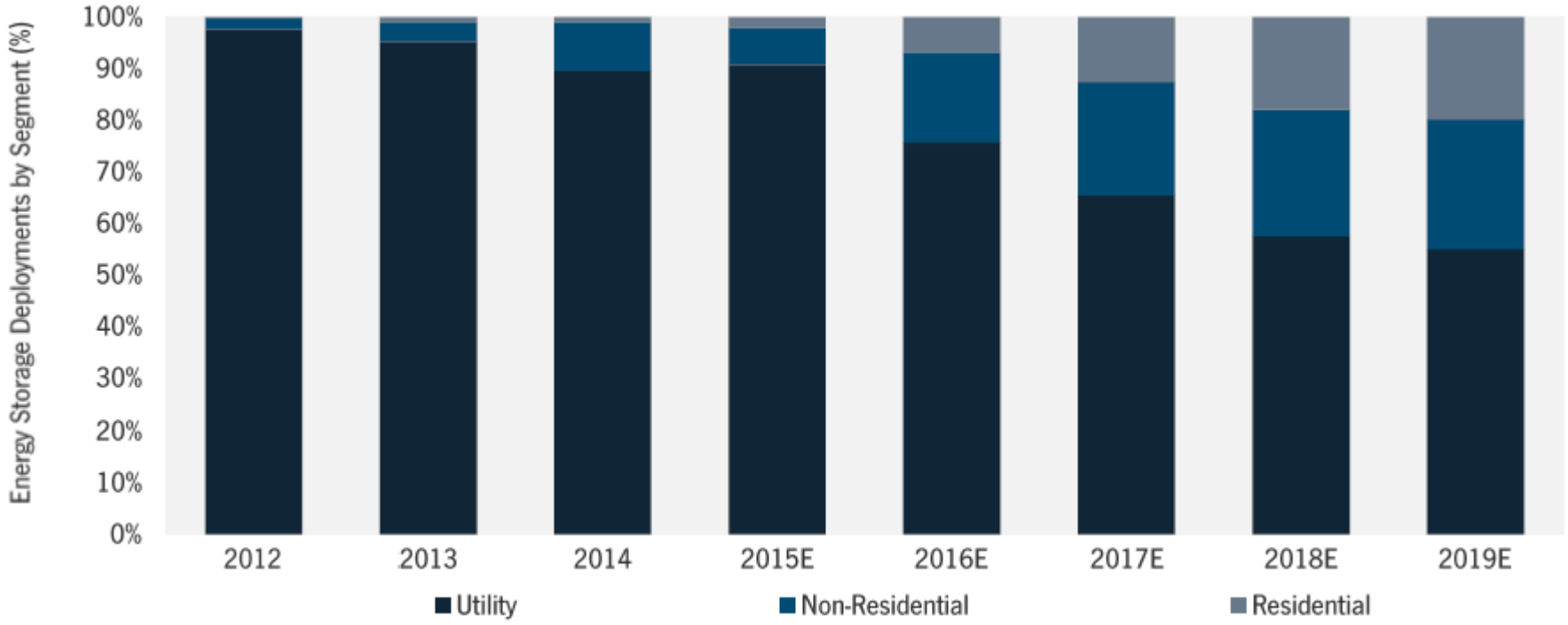
c. Biennial Storage Program Assessment – *Finish 2016*

Proposed Work Product: "Implications of High Penetrations of Energy Storage into Electric Transmission and Distribution Systems" White Paper



U.S. energy storage deployment projections show exponential growth, so penetrations could be high.

Behind-the-Meter energy storage projected to gain in market share.



See Full Report for complete forecast data

Source: "U.S. Energy Storage Monitor 2014 Year In Review: Executive Summary," GTM Research/ESA U.S. Energy Storage Monitor, *www.energystoragemonitor.com*

So high penetrations of energy storage could become ubiquitous throughout the electricity service value chain.

If high penetration of energy storage deployments occur as expected, what would be the electric grid consequences?

- High penetrations of energy storage are expected to bring substantial benefits to the production, delivery and use of electricity.
- Energy storage might be…
  - just another competing technology providing traditional grid service, and/or
  - a disruptive technology for the grid, i.e., electric delivery temporal power flow capability, including "product warehousing."
- High penetrations of energy storage also could result in dislocations and difficulties for the function, operation, form and critical success factors of the electric grid.

Grid needs better understanding of the potential benefits vs. dislocations of high penetrations of energy storage.

Purpose of white paper, "*Implications of High Penetrations of Energy Storage into Electric Transmission and Distribution Systems*," is to:

1. Examine qualitatively the implications of high penetrations of energy storage into electric transmission and distribution systems.
2. Provide a framework for …
   a. Identifying quantitative measures to more thoroughly characterize the vision of energy storage as an agent in the grid, both physically and institutionally, and
   b. Defining a grid technology R&D program that would enhance the benefits and mitigate the dislocations of high penetrations of energy storage.

The DOE is assumed to be the focal audience for white paper.

Challenge: How to analyze the future implications of high penetrations of energy storage given the complexity and uncertainty facing the electric grid?

1. What policy, planning and investment decisions shaping the future electric grid will be made?
2. What electric grid business models, goals and strategies will dominate the future?
3. How do you characterize the future so that decision makers can identify future opportunities and not foreclose options, and handle surprises gracefully?

Scenario Planning

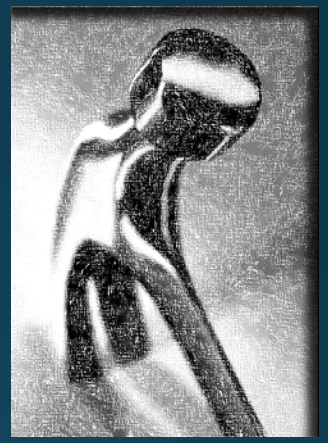
Scenarios are not about predicting the future; they are perceiving futures in the present.

Scenarios:

- Are plausible narratives of alternative environments.
- Are hypotheses of different futures.
- Highlight the risks and opportunities of strategic issues

Scenarios are not:

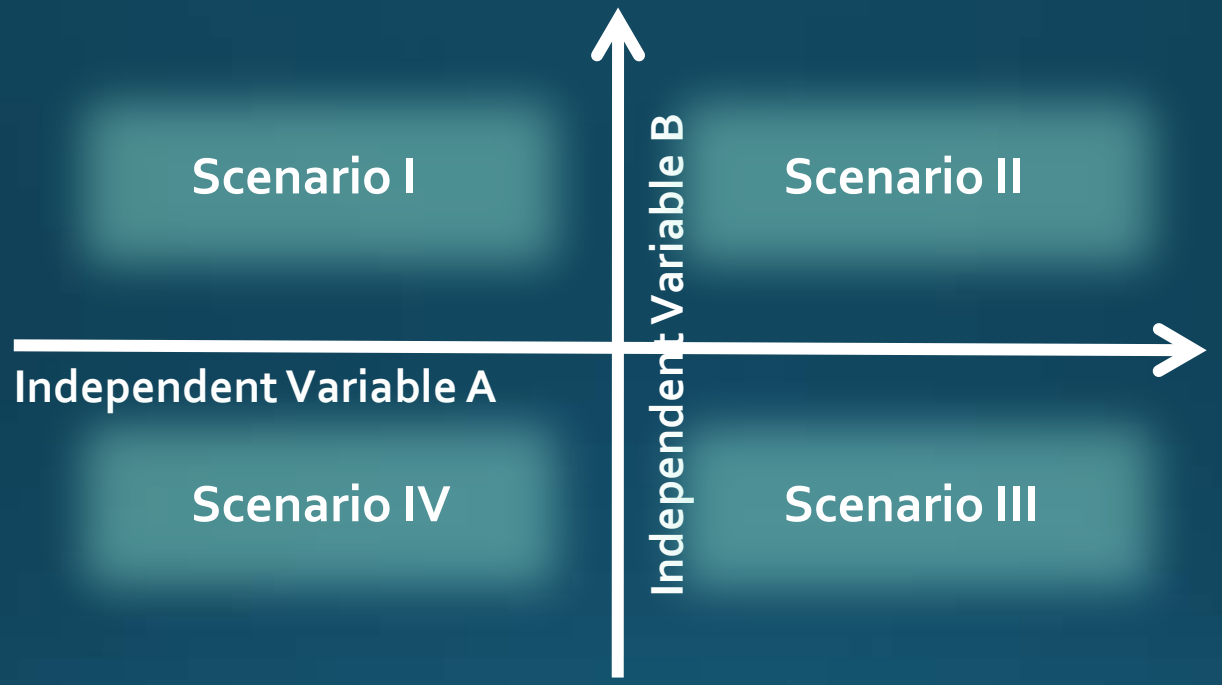
- Predictions
- Strategies



"A scenario is a tool for ordering one's perceptions about alternative future environments in which one's decisions might be played out." Schwartz

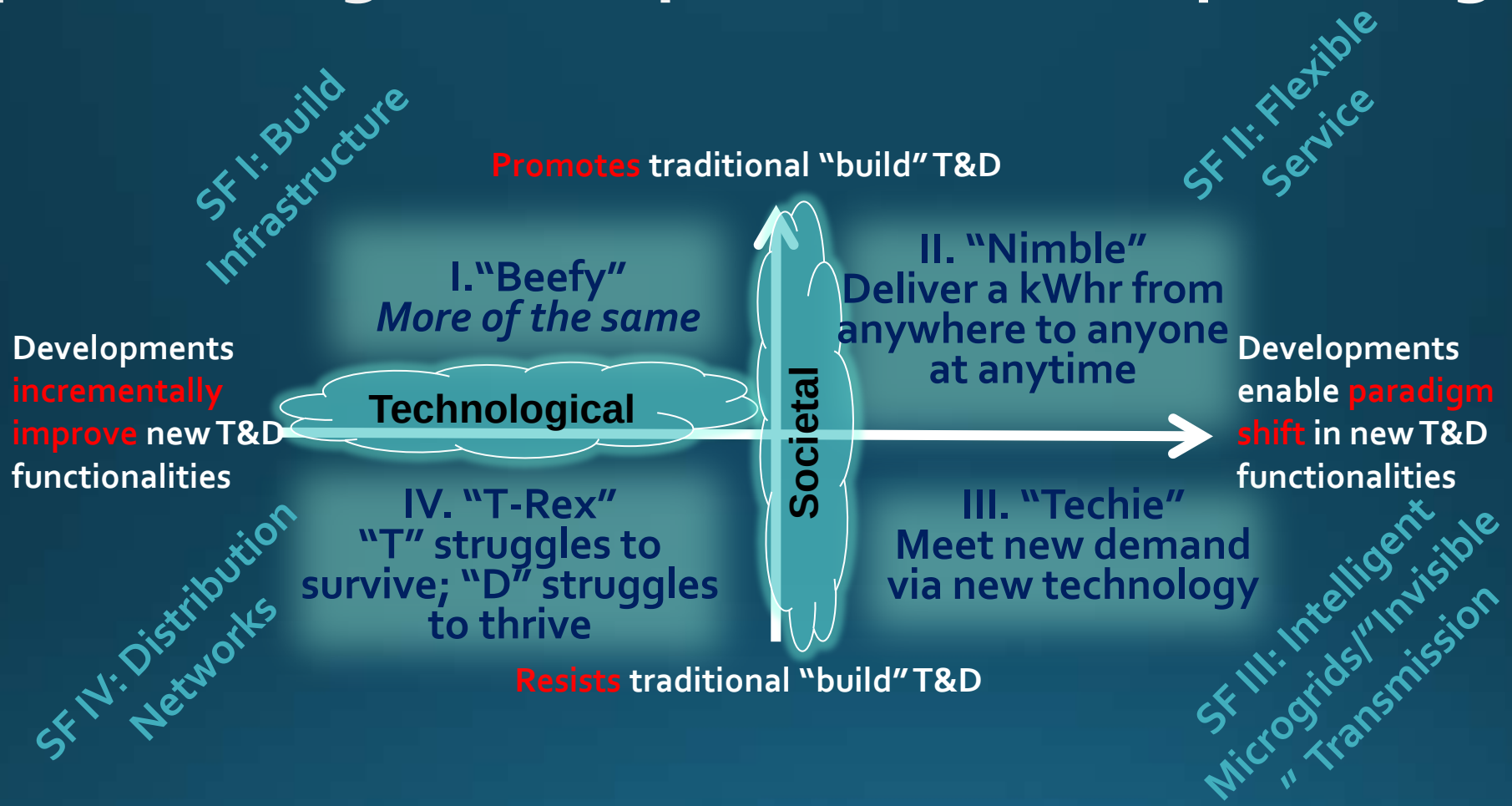
Source: "Plotting Your Scenarios," Jay Ogilvy and Peter Schwartz, Global Business Network (GBN) a Member of the Monitor Group, 2004.

The Energy Storage Subcommittee is using a simplified scenario planning process.



Different plausible futures, i.e., scenarios, are the logical implications of cause & effect interactions in each quadrant between two highly uncertain variables.

Example of using the simplified scenario planning process.



Four future scenarios for T&D result for various degrees of uses of "traditional build" and "technology innovation".

Subcommittee Work in Progress

Step 1: Identify focal Issue or decision, i.e., question.

- Alt #1 How would the function, operation, form and critical success factors of the T&D system be impacted …
- Alt #2 What technology R&D should DOE do to help prepare the electric grid …
- Alt #3 What electric grid technology developments are needed …

… to maximize benefits and mitigate difficulties for the electric grid of high penetrations of energy storage?

Tentatively, alternative #3 is the candidate focal question chosen.

Step 2: Key Factors Influencing the Success or Failure in Addressing an Issue: Example Candidates:

High ES

- Transactive mechanism for pricing electricity.
- Ownership of the energy storage asset.
- Technology sophistication in the grid and the energy storage.
- How much other factors, e.g., integration of renewables, generation mix and location in T&D, demand response, etc., influence (think: drive) function, operation, form and critical success factors of the electric grid.
- How high penetration of energy storage was achieved, e.g., market pull or policy driven.
- The ability and cost to build traditional, e.g., wires, poles, towers.
- What business models dominate for T&D owners.

Uncertainty and importance?

EAC Discussion and Suggestions