DOE FE's Advanced Energy Storage Program

NETL | September 21st, 2020

Bhima Sastri & Briggs White

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DOE Energy Storage Grand Challenge

Enhance US Energy Storage Competitiveness

NATIONAL ENERGY TECHNOLOGY LABORATORY

5 Tracks of Activity

1. Technology Development
2. Technology Transition
3. Policy & Valuation
4. Manufacturing & Supply Chain
5. Workforce & Technical Assistance

6 Use Cases

- Facilitating an Evolving Grid
- Serving Remote Communities
- Electrified Mobility
- Interdependent Network Infrastructure
- Critical Service Resilience
- Facility Flexibility, Efficiency and Value Enhancement

DOE ESGC Key Collaborators

Science

ARPA-E

EERE

OE

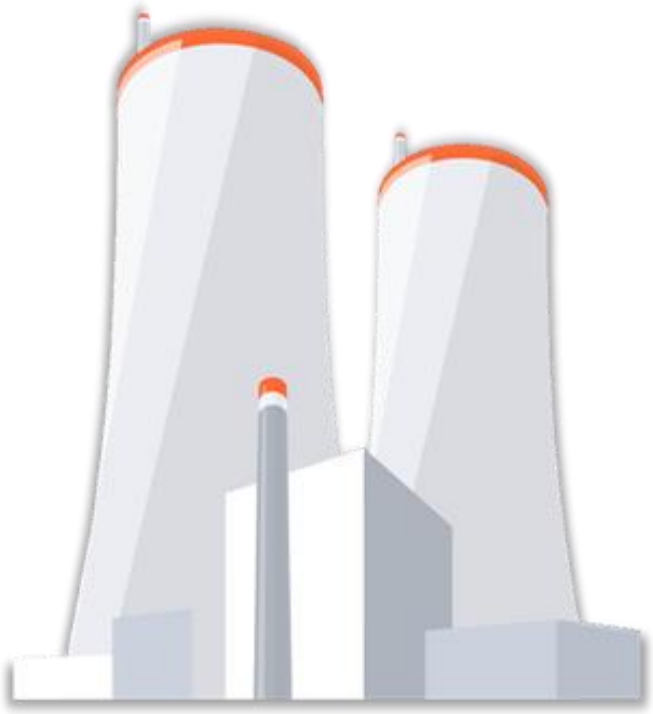
NE

FE

OTT

LPO

Premium on Reliability, Flexibility



Built for steady predictable demand

Reliable, secure power flexibly dispatched

FE Program

Asset Flexibility | Grid Reliability | Environmental Performance

Thermal

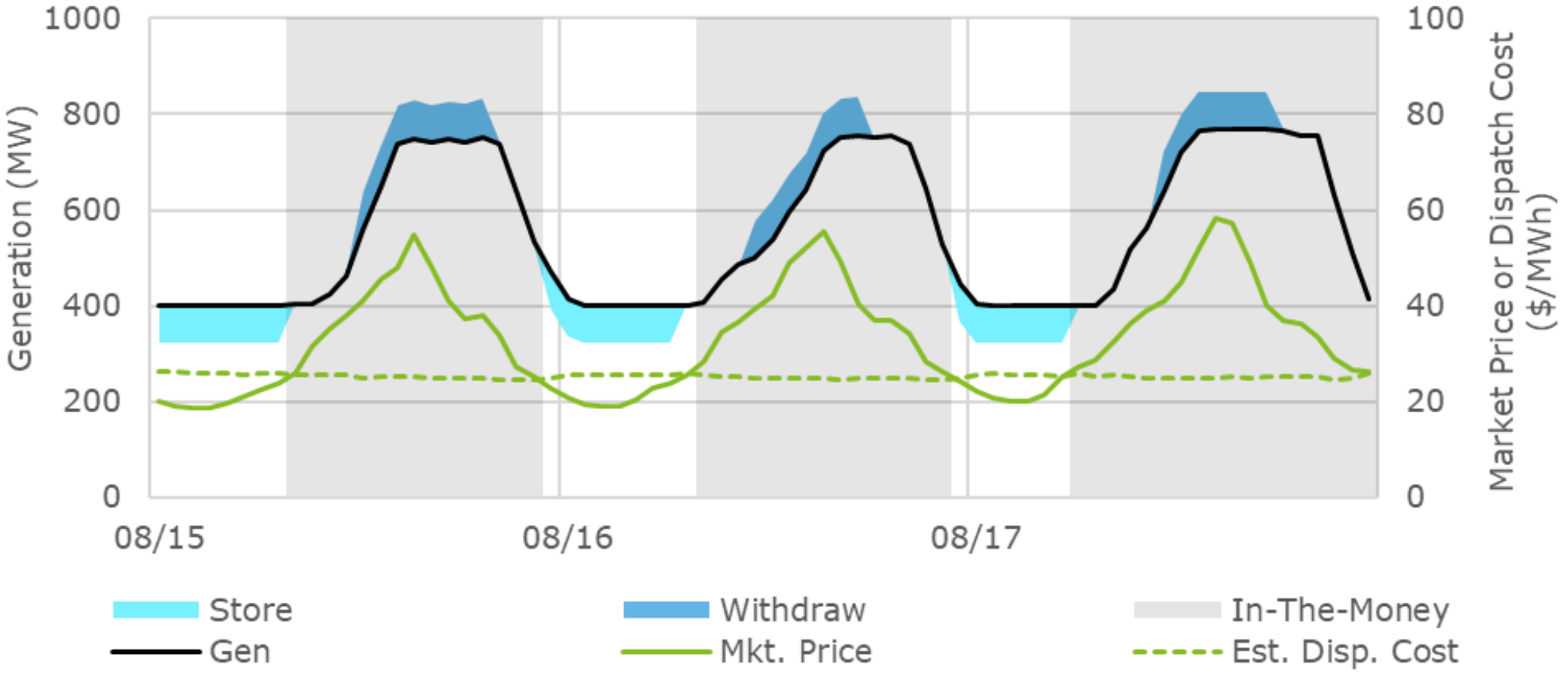
Mechanical

Chemical

Innovative

Fossil Plant Energy Storage Benefit

Illustration of Energy Storage Enabling Financial Benefit (Plant and 'Grid')



Storage Benefit

- Actual unit data for generation, market price and estimated dispatch cost
- Simulation illustrates 8-hour energy storage option (store, withdraw)
- Day 1: higher morning ramp rate to increase revenue and capture peak power
- Day 2: running out of storage due to design capacity

Source: NETL

US Fossil Power Market

Fuel	Prime Mover	Dispatch Type Category	No. of Units	Summer Capacity (GW)
NG	GT	Peaking	2,332	127
NG	CC	Peaking	32	0.3
NG	CC	Cycling	150	15.5
NG	CC	Must Run	547	254
Coal	all	Peaking	10	0.08
Coal	all	Cycling	18	2.2
Coal	all	Must Run	475	221
Coal	all	Baseload	278	6
Gas	IC	Peaking	1,250	5.2
Gas	IC	Cycling	14	0.37
Petro	IC	Peaking	3,308	5.9
Renew	IC	Peaking	1,866	2

Renew IC fuels include Landfill gas, Biogas, Bioliquids, Agriculture byproducts

Fossil power will be in the mix through 2050

ES hybridization with thermal power reduces fossil impacts

NATIONAL ENERGY TECHNOLOGY LABORATORY

TRL 2-3
Basic Technology Research

- Advanced Sensible Heat Storage
- Latent Heat: Other Phase Change Materials
- Forest Waste Wood
- Formic Acid Production
- Thermal-chemical Hybrid (TCES)
- Electro-thermal Hybrid

TRL 4-5
Components Tested

- Geothermal
- Advanced Chemical Energy

TRL 6-8
System Tested

- Latent Heat: Liquid Air Energy Storage (LAES)

TRL 9
Commercialized

- Compressed Air Energy Storage
- Redox Flow Battery
- Molten Salt
- Chemical Energy (H_2, NH_3, SNG, etc.)

Key

- *Thermal Energy Storage*
- *Chemical Energy Storage*
- *Mechanical Energy Storage*
- *Other Technology Type*

US Markets and Policy Evolving

Revenue, tax, value propositions

- Values for services market dependent
- Significant non-revenue benefits need quantified
  - Assets
  - Environment
- Defining terms in the market:
  - Co-location
  - Hybrid

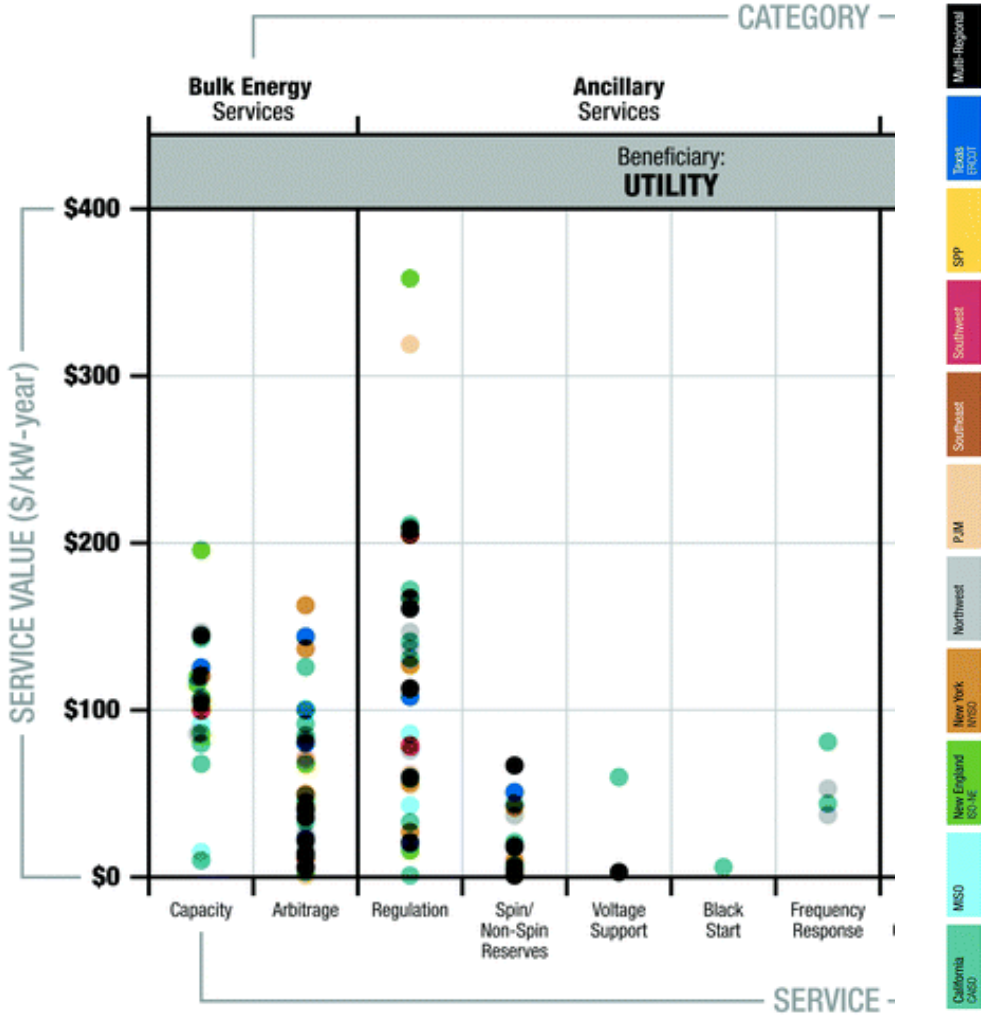


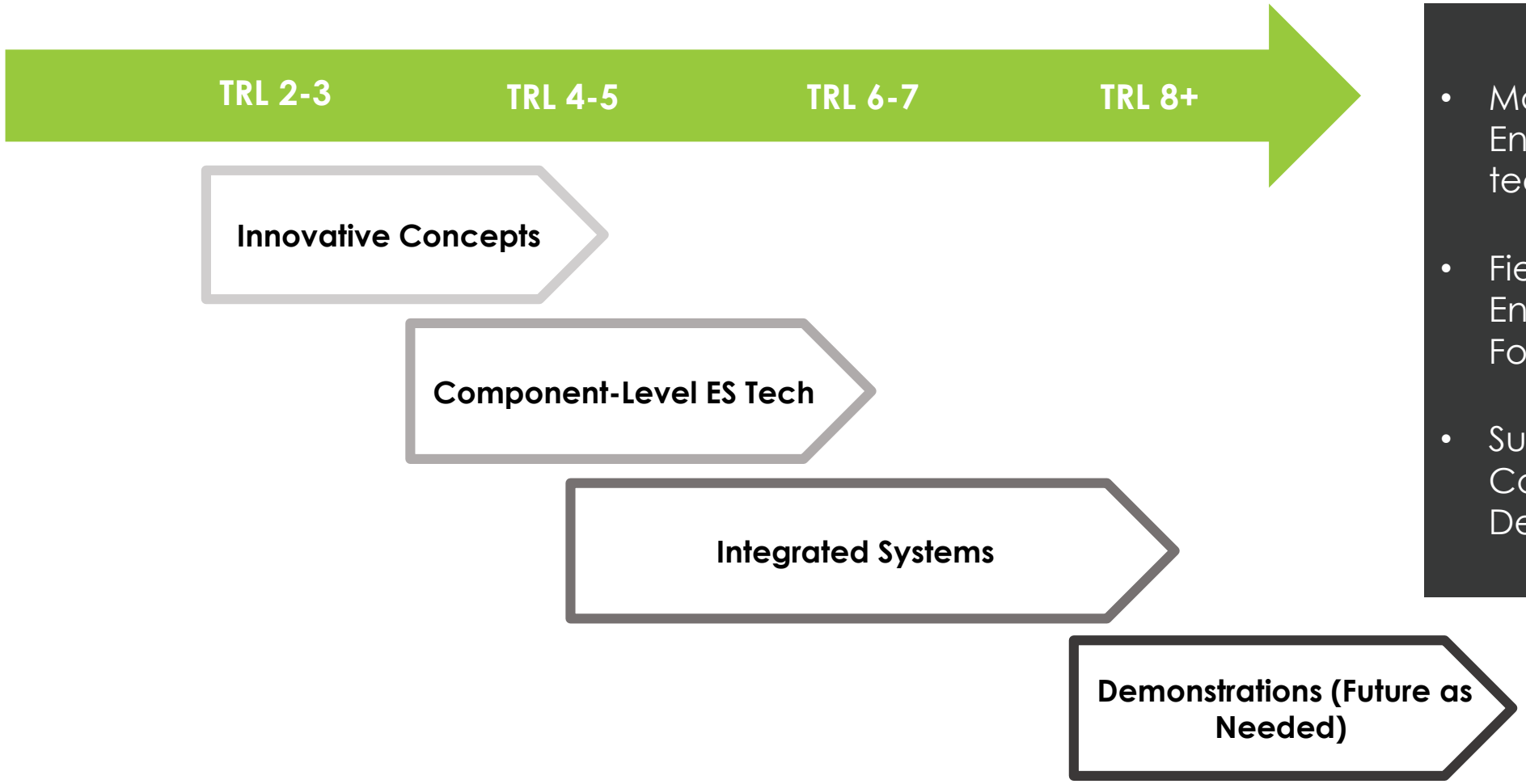
Figure sourced from: Balducci et al.
https://pubs.rsc.org/en/content/articlelanding/2018/EE/C8EE00569A#!divAbstract

Energy Storage: There is More to Do

- **Monetize** technical benefits
- **Leverage** capital
- **Address** technical risk
- **Scale up** pilot projects
- **Demonstrate** social benefits

Image Source: Adobe Stock

Technology Development Vision



Outcomes

- Mature Long-Duration Energy Storage technologies
- Field Test Near-term Energy Storage Tech with Fossil Assets
- Support Commercialization and Deployment

Program Activities

- **Component level R&D**
- **Feasibility studies/Pre-FEEDs**
  - Market studies
  - Economic assessments
  - Technology reviews
  - Integration challenges
- **Technology Demos/Pilots**
- **Energy Storage Tracking**
- **Roadmaps**
  - Integration challenges
  - Manufacturing needs
  - Control systems
- **Webinars**
  - Educational outreach
  - Stakeholder engagement

Image Source: Adobe Photostock

Engagement

Winter/Spring

FE Request For Information

Energy Storage Grand Challenge workshops

Summer

Energy Storage Grand Challenge draft roadmap

FE Program panel discussion

Fall/Winter

October - Announce FOA selections

January - New FOA award webinar

Today's Objectives

1. **Update** you on FE's Energy Storage program
2. **Share** useful information
3. **Refine** hybrid Use Cases
4. **Hear** and **learn** from you

Image Source: Adobe Stock

Thank You!

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