U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

Department of Energy's Advanced Energy Storage Program

2020 UCR HBCU Joint Meeting Review | October 29, 2020

Briggs White

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Agenda

PROGRAM OVERVIEW & CURRENT INITIATIVES

QUESTIONS & ANSWERS

DOE Energy Storage Grand Challenge

VISION

By 2030, the U.S. will be the **world leader** in energy storage utilization and exports, with a secure **domestic manufacturing supply chain** independent of foreign sources of critical materials.

MISSION

The ESGC will focus resources from across the DOE to create a comprehensive program to accelerate the **development and commercialization** of next-generation energy storage technologies and sustain U.S. global leadership in energy storage.

KEY OBJECTIVES

- Bidirectional Storage
- Flexible Generation and Controllable Loads
- Chemical and Thermal Storage

FIVE TRACKS OF ACTIVITY

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

DOE Energy Storage Grand Challenge

U.S. leadership in Energy Storage requires a strategy that leverages a range of federal government tools and resources to enable U.S. firms to compete in markets around the world.

DEPLOY EVERYWHERE

Varying use cases each with their own technical and cost requirements

Domestic and International markets

Multi-pronged approach to maximize chance of success

Numerous decision markers such as customers, investors, manufacturers, and policymakers

SIX USE CASES

- *Facilitating an Evolving Grid*
- *Serving Remove Communities*
- *Electrified Mobility*
- *Interdependent Network Infrastructure*
- *Critical Service Resilience*
- *Facility Flexibility, Efficiency & Value*

DOE Office Scope

Energy Storage Application Spaces

Power Generation | **T&D** | **Load Demand**

Fossil Energy

- Large-scale coal & gas assets
  - Existing plants
  - New plants
- Small-scale assets
- Natural gas DG
  - microgrids
  - DOD bases

OE

- Transmission and distribution
- Energy management

EERE – BTO

Residential

EERE – AMO

Industrial

FE

Industrial

Fossil Energy Program Mission

Asset Flexibility | Grid Reliability | Environmental Performance

Thermal

Mechanical

Chemical

Innovative

Image Sources: Adobe Stock

Energy Storage for FE Benefits

Align to NETL & Crosscutting Mission

Reliable & Affordable

RELIABILITY IN A CHANGING GRID
Enables greater grid stability and fossil power plant flexibility to accommodate growth of variable renewable energy and expansion of electrified transportation systems

RESILIENCY IN UNPLANNED EVENTS
Fossil power plants can continue to operate during grid outages and provide robust supply during storms and other natural disasters, aiding response and recovery efforts

SECURE ENERGY SUPPLY
Keeps power plants and the grid functioning in times of physical and cyber-security threats

REDUCED DEPLOYMENT & CUSTOMER COST
Leverages otherwise wasted plant heat energy and underutilized supply system investments

Cleaner Environment

CLEANER ELECTRCITY
Enables greater amounts of renewable energy integration into the electricity supply while keeping the grid resilient

SMALLER REAL-WORLD FOOTPRINT
Realizes the benefit of optimal environment footprint of base-load power plants with fewer new site development demands and lower carbon emissions

REDUCTION IN IDLING
Provides an opportunity to recover heat wasted during turndown operations, improving efficiencies and economics

Stronger Infrastructure

INCREASED FLEXIBILITY
Quickly accommodates unexpected changes in generation and load, maintaining balance among variable renewable energy availability and baseload generator operating conditions

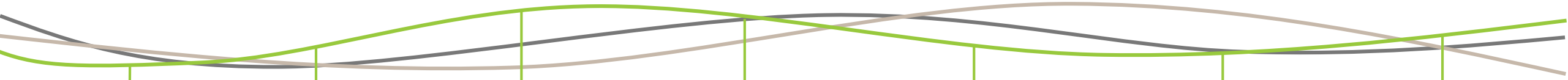
IMPROVED ASSET MANAGEMENT
Optimizes power plant operation, transmission, sub-transmission and electricity distribution infrastructure reduces local and regional socio-economic disruptions

EFFICIENTLY SERVE NEW MARKETS
Stored energy can be made available to affordably satisfy energy demands for new ancillary services

Energy Storage Opportunity Areas

The Energy Storage market is quite complex and faces many challenges

Fossil Energy Generation Key Challenges



FAST RAMPING to support renewables and load following

GRID SCALE ENEGY STORAGE to sell electricity at more favorable prices

ANCILLARY SERVICES to provide grid stability support

GRID RELIABILITY AND RESILIENCY

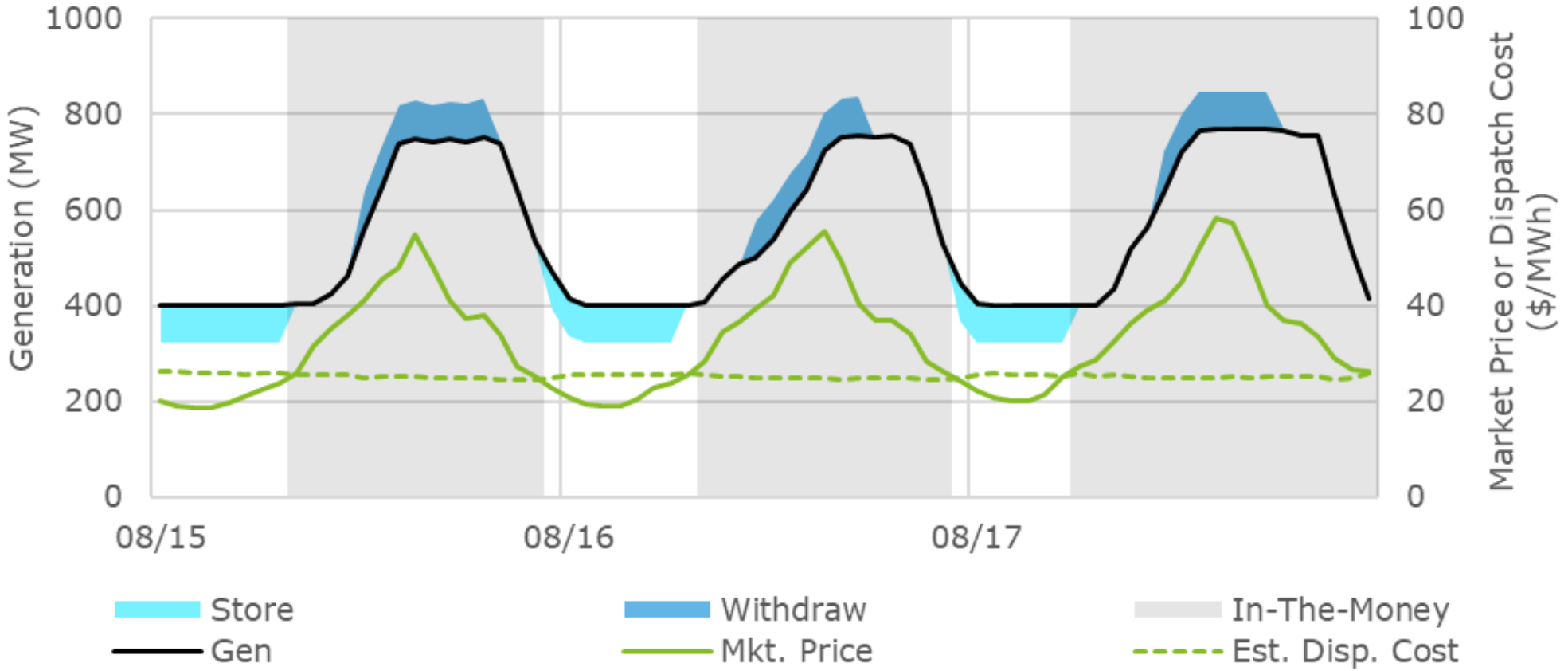
REPURPOSING ABANDONED ASSETS including coal power stations and mines

PEAK SHIFTING to reduce capital costs to overall systems

ENABLING STEADY LOAD to reduce burden of cycling on both capture and non-capture plants

Energy Storage for FE Benefits cont.

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



STORAGE BENEFITS

- **Example:** 8-hour energy storage option
- **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 Actual unit data for generation, market price and estimated dispatch cost

U.S. 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

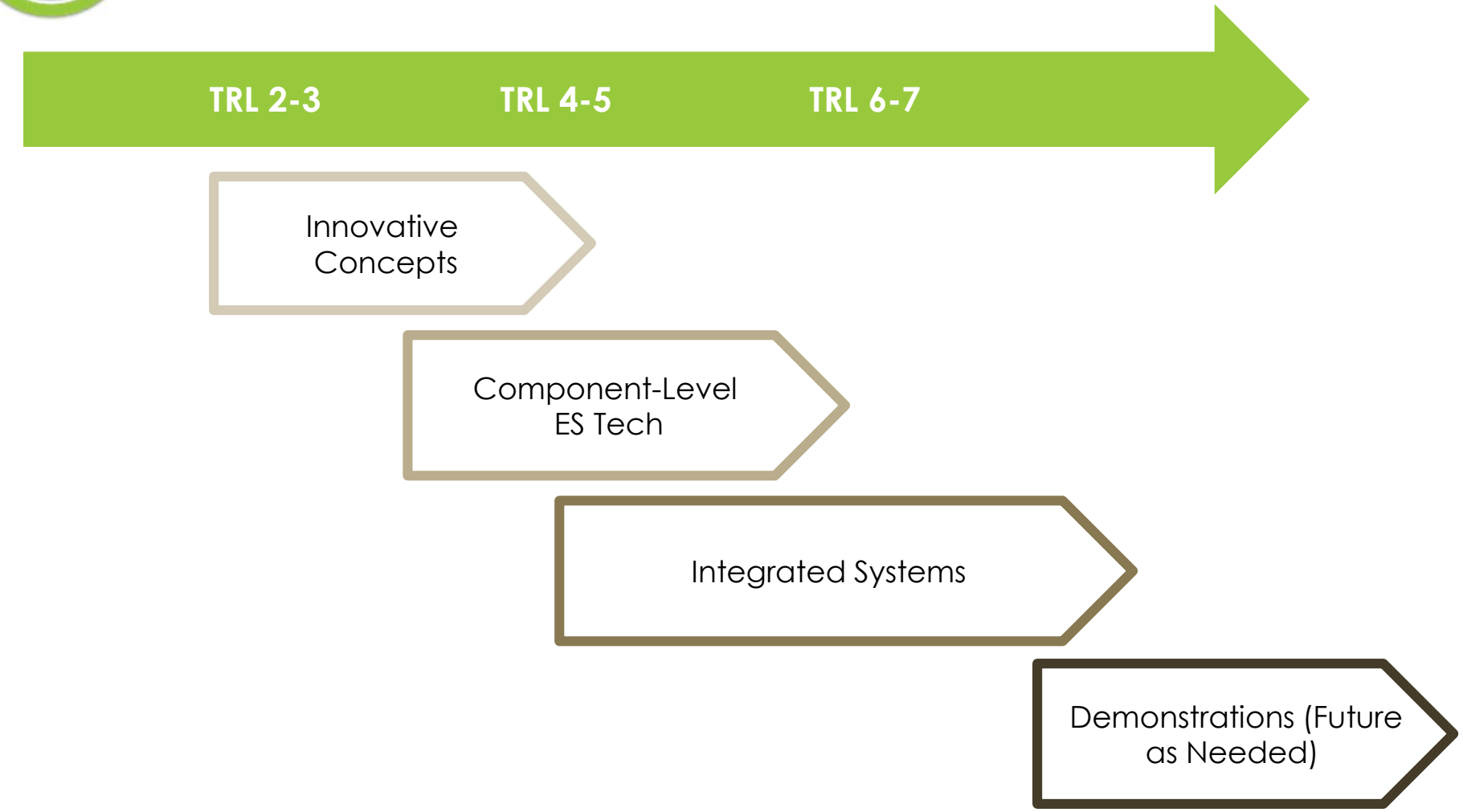
Technology Landscape

TRL 2-3 Basic Technology Research	TRL 4-5 Components Tested	TRL 6-8 System Tested	TRL 9 Commercialized
Advanced Sensible Heat Storage	Geothermal	Latent Heat: Liquid Air Energy Storage (LAES)	Compressed Air Energy Storage
Latent Heat: Other Phase Change Materials	Advanced Chemical Energy		Redox Flow Battery
Forest Waste Wood	Formic Acid Production		Molten Salt
Thermal-chemical Hybrid (TCES)			Chemical Energy (H_2, NH_3, SNG, etc.)
Electro-thermal Hybrid			

Key

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

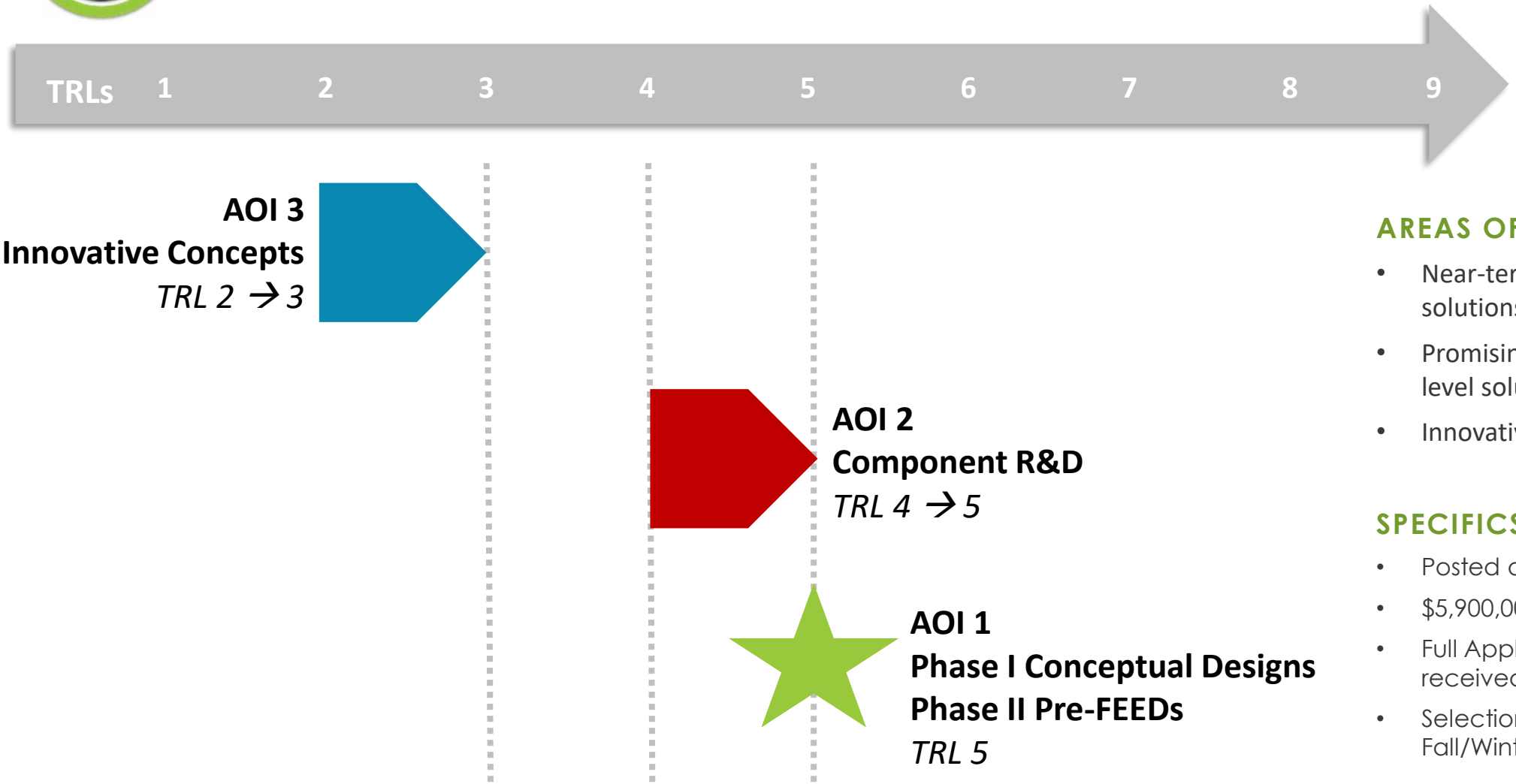
Technology Maturation & Development Vision



OUTCOMES

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

FOA Goals and Focus Areas



AREAS OF INTEREST

- Near-term, system integrated solutions
- Promising mid-TRL component-level solutions
- Innovative, low-TRL concepts

SPECIFICS

- Posted on May 1, 2020
- $5,900,000 DOE funding available
- Full Applications have been received
- Selections to be announced in Fall/Winter 2020

Current Energy Storage Projects

Align to NETL & Crosscutting Mission

ACTIVE PROJECTS FUNDED OUTSIDE OF NETL

EPRI: testing a pilot-scale concrete thermal energy storage system to demonstrate the energy storage potential of the technology when applied to coal-fired power units.

IDAES: seeks to be the premier resource for identification, synthesis, optimization, and analysis of innovative advanced energy systems including the integration of energy storage systems.

Lehigh University: developing an optimized prototype of a solid media thermal energy storage concept for thermal management applications in coal-fired power plants.

West Virginia University Research Corporation: evaluating the transient response to various system concepts that minimize the levelized cost of electricity of thermal, chemical, mechanical, and electro-chemical storage technologies.

NETL PROGRAM

NETL Crosscutting Program:

- Planning to award first cohort of projects from FY2020 FOA

Transformative Power Generation:

- 3 active SBIR Phase 1 Projects modeling the impacts of energy storage on fossil energy assets

CROSSCUTTING TECHNOLOGY RESEARCH

NETL Program

NATIONAL ENERGY TECHNOLOGY LABORATORY

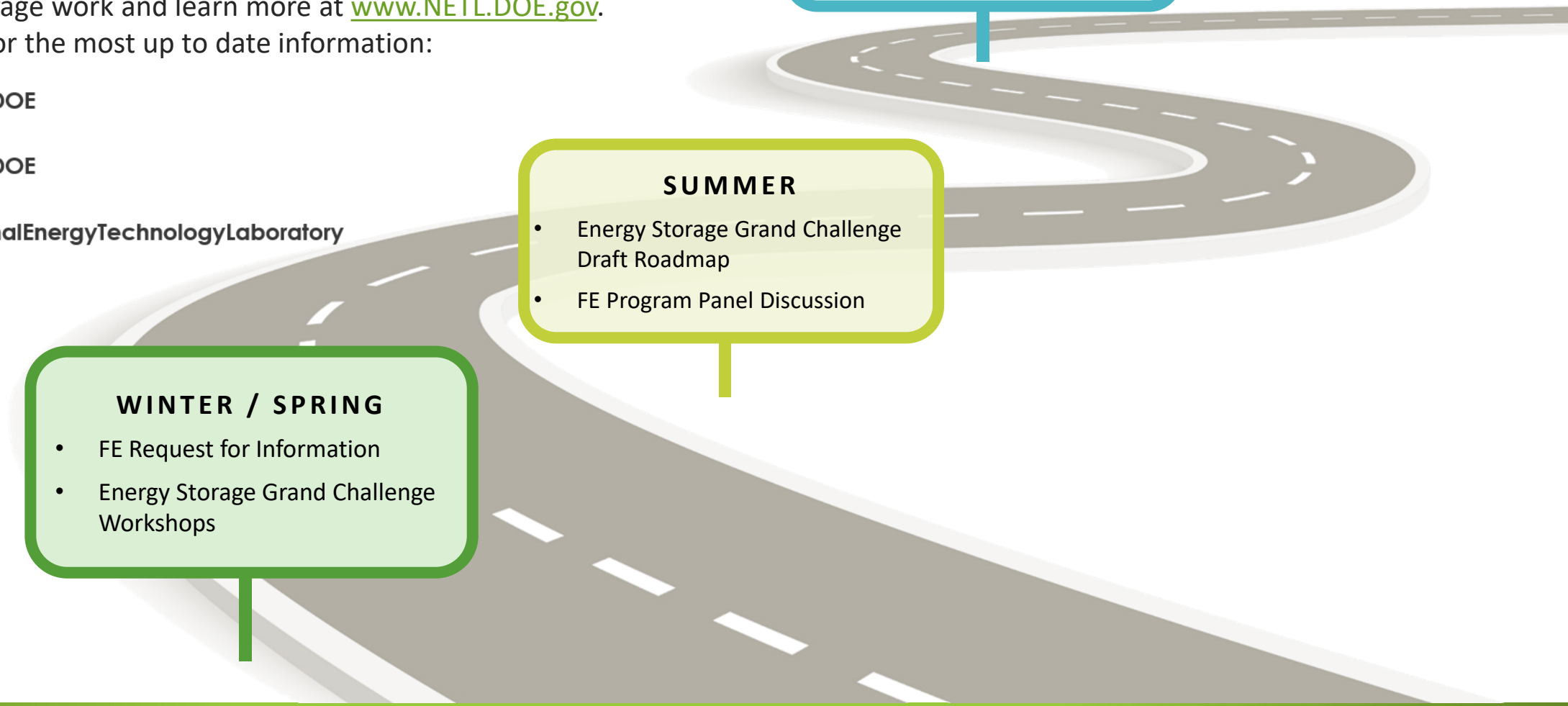
PROGRAM ACTIVITIES

- **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 & Engagement**
  - Educational outreach
  - Stakeholder engagement

Engage with NETL

We have a lot planned for the future! Keep up with our Energy Storage work and learn more at www.NETL.DOE.gov. Follow us for the most up to date information:

- @NETL_DOE
- @NETL_DOE
- @NationalEnergyTechnologyLaboratory



FALL / WINTER

- Announce FOA Selections, November
- New FOA Award Webinar, January

SUMMER

- Energy Storage Grand Challenge Draft Roadmap
- FE Program Panel Discussion

WINTER / SPRING

- FE Request for Information
- Energy Storage Grand Challenge Workshops

Thank you!

ENERGY STORAGE KEY CONTACTS

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INTERESTED IN LEARNING MORE?

Check out our resources available on our webpage!

https://netl.doe.gov/coal/crosscutting/energy-storage

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