Solutions for Today | Options for Tomorrow

High Performance Materials

Annual Program Review Meeting

Briggs White | June 2021

In today's power system, materials are…

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At the heart of flexibility

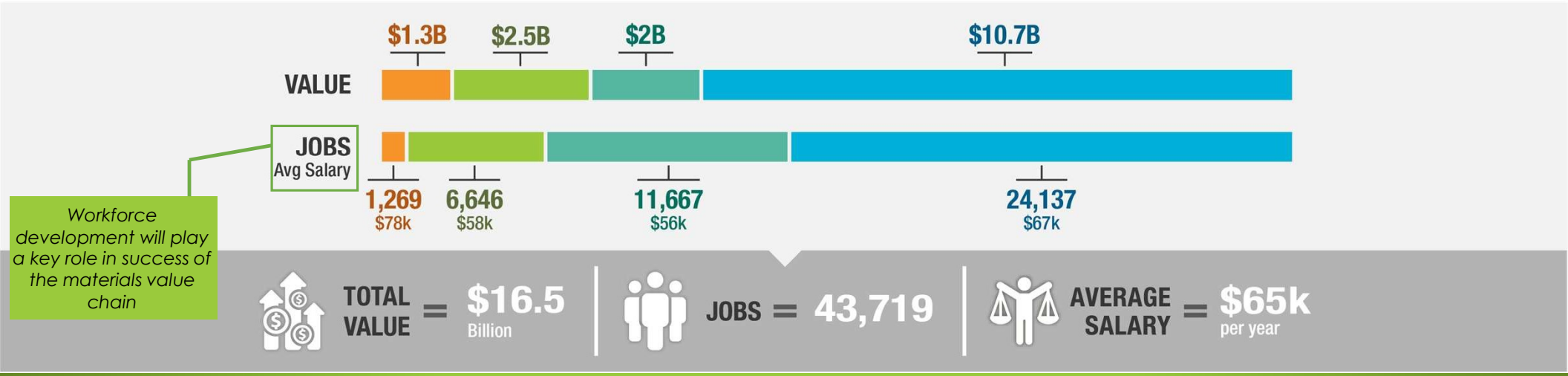
Dispatchable generation can reduce electricity cost to the consumer by a factor of **4** as CO_2 emissions limits approach zero.

BUT these assets will be stressed by requirements of flexible operation, which exacerbate numerous materials-related challenges

Source: The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation - ScienceDirect

In today's power system, materials are…

An important sector of the economy

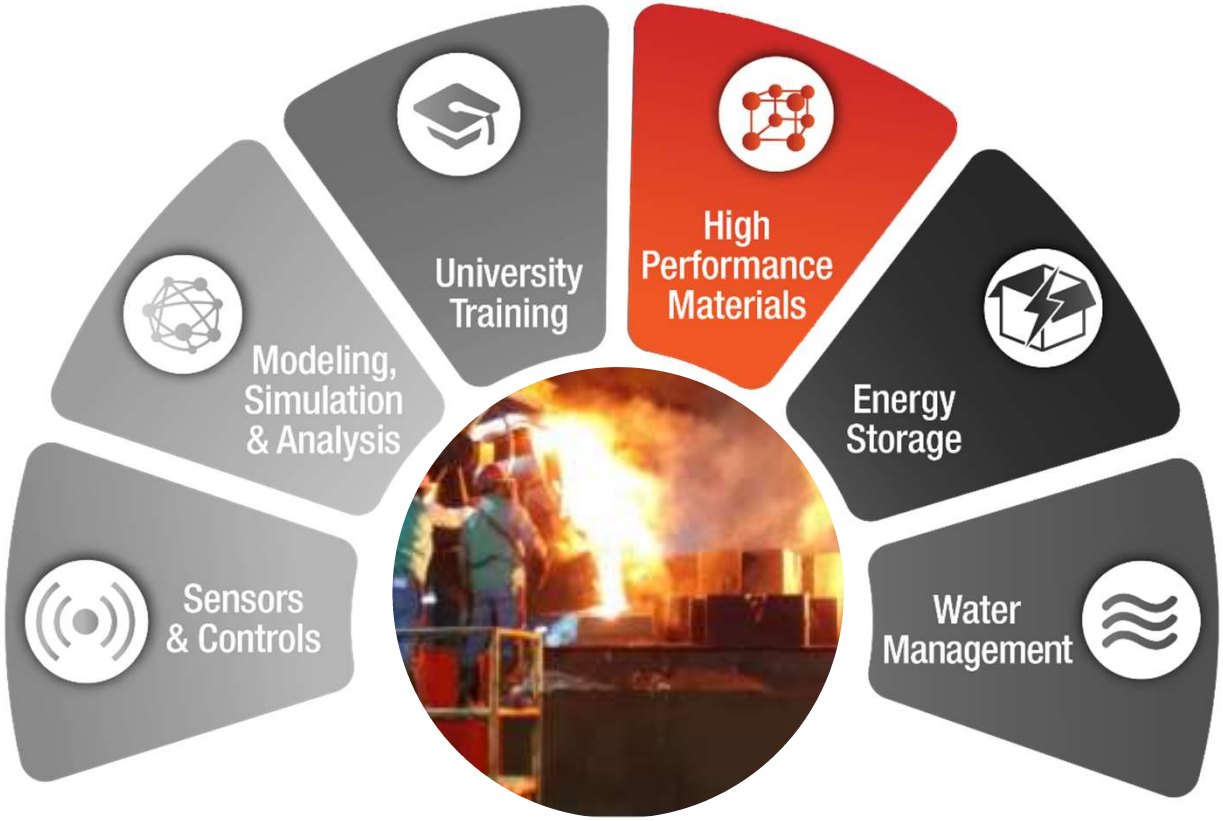


Workforce development will play a key role in success of the materials value chain

The NETL Crosscutting program is organized to…

The NETL crosscutting program is organized to…

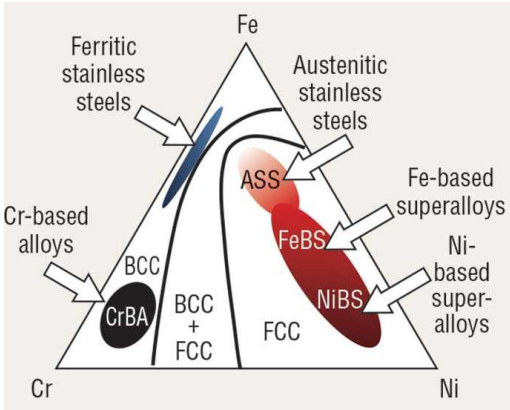
Develop diverse solution



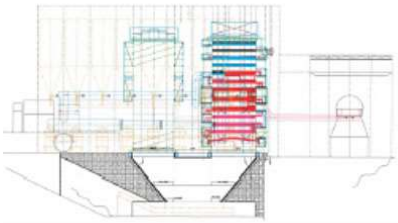
The NETL crosscutting program is organized to…

Meet challenges of today & the future

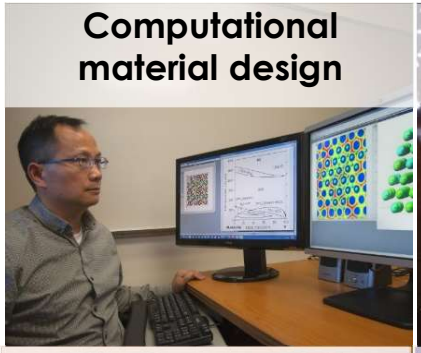
Innovating the production and use of advanced alloys…



in Advanced Energy Systems…



with diverse technical approaches.



The NETL crosscutting program is organized to…

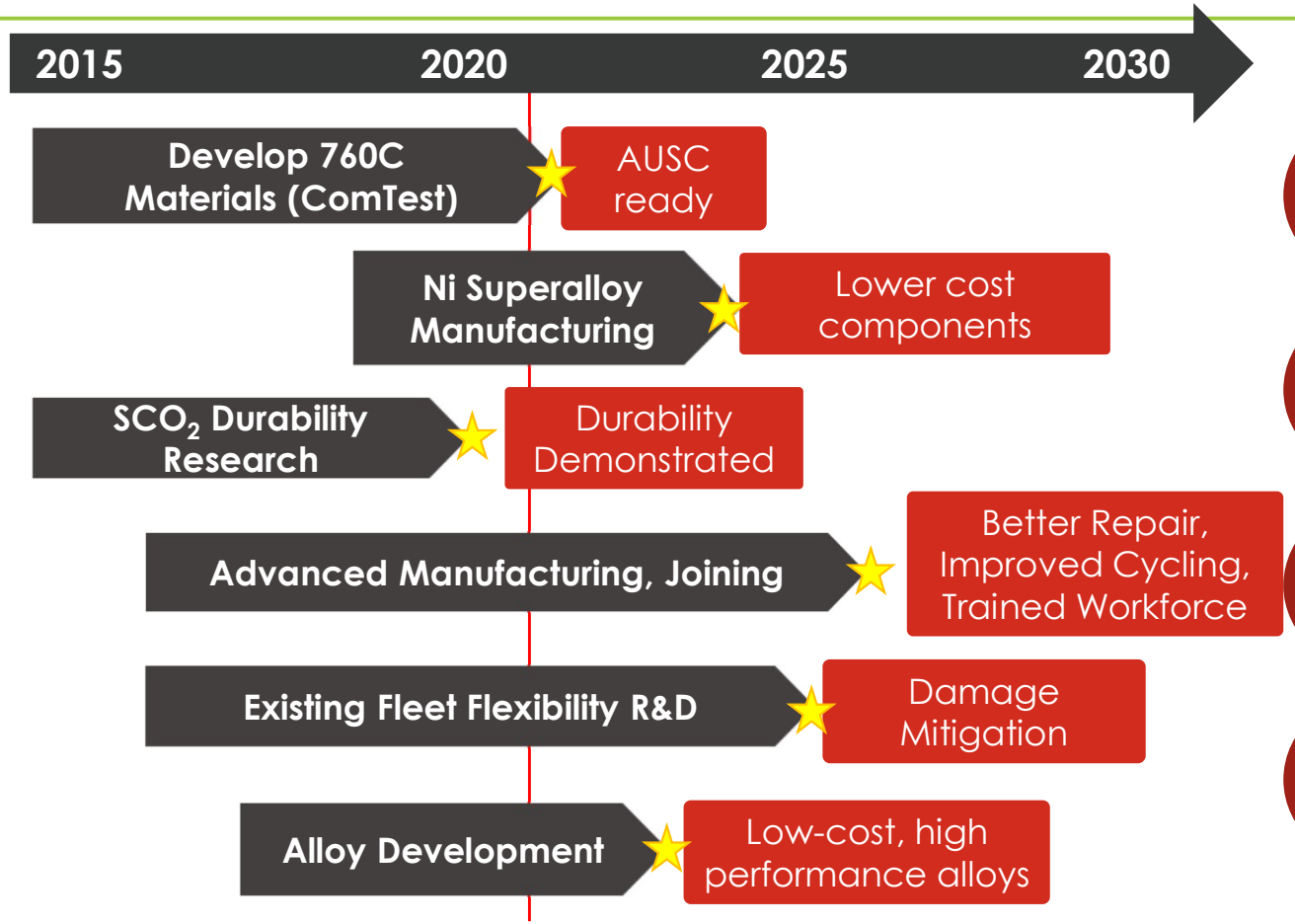
Increase Flexibility and Decarbonize

	Existing fleet		Next Gen.				
SEGMENTS	Coal	Gas	AUSC	sCO2	Hydrogen		
NEEDS	Reliability	Efficiency	Flexibility	Decarbonization	Upkeep	Competitiveness	
CHALLENGES	Asset management	Supply chain	Emissions	Water use	Cybersecurity	Workforce	RUL

SOLUTIONS

Alloy development		Manufacturing		Repair		Life-prediction	
Computational	Experimental	Additive	Novel	Joining	Coatings	Materials	Components
		Assembly	Convent.	FGM	High Nickel		
Ferritic	Austenitic	Components	Intermediates				
High Nickel	High Entropy	FGM	High Nickel				
Coatings		DMW					

TECHNOLOGY DEVELOPMENT SCHEDULE



- Enable High Efficiency Power Cycles (NGCC, steam, SCO_2)
- Facilitate hydrogen, biomass, and CCS
- Enhance Flexibility of Existing and Future Fleet
- Competitive Supply Chain (GDP/Jobs)

Our program impacts stakeholders with…

Our program impacts stakeholders with…

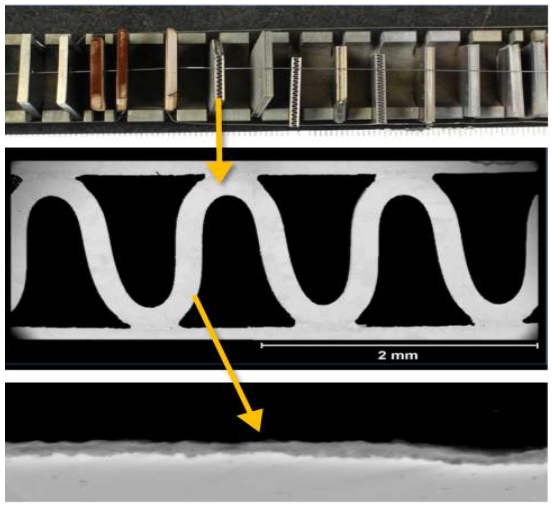
Operationally meaningful outcomes

Improve Cycling

Advanced Ultra-Supercritical (AUSC) Materials
Thick-Walled Cycling Header Development

Courtesy: Alstom Power, Inc.

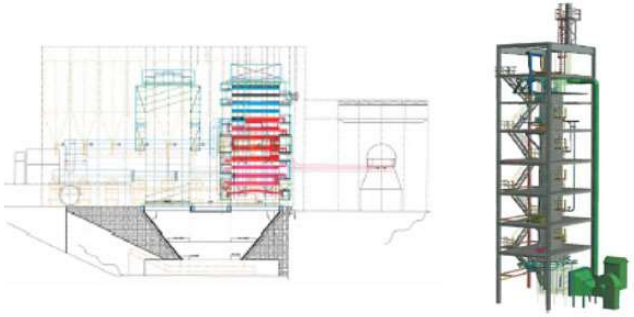
Enable High-Efficiency Cycles



Predicting the oxidation/corrosion Performance of Structural Alloys

Courtesy of: EPRI

Reduce Manufacturing Costs



Advanced Ultra-Supercritical Component Manufacturing

Courtesy of: Energy Industries of Ohio, Inc.

Our program impacts stakeholders with…

Benefits to the workforce

Advanced
Welding
Workforce
Initiative

IN COLLABORATION WITH:

Appalachian Regional Commission

Our program impacts stakeholders with…

Opportunities to develop solutions

Extreme Environmental Materials for Power Generation

Phase I: $6M, Phase II: $TBD

Improving cyclic durability and reducing the costs of next-gen plants

Addressing material failure and repair in the existing fleet

$10M total funding

Cost-effective solutions to most prevalent causes of forced outages

Advanced Welding Workforce Initiative

$1M total funding

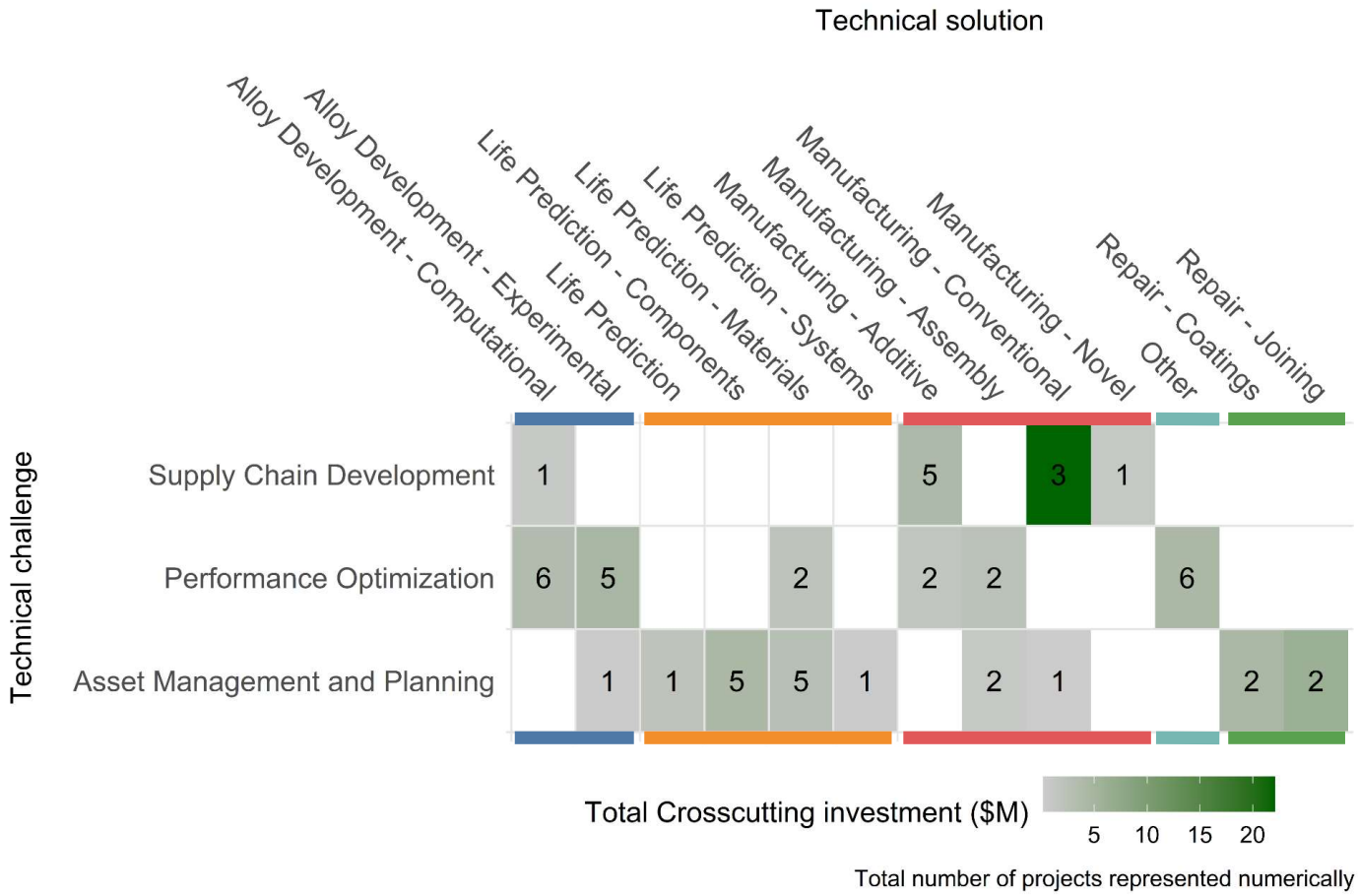
Forging a path forward to fill gaps in skills and jobs for welding

HPC4 MATERIALS Spring 2021 Solicitation

The current portfolio is…

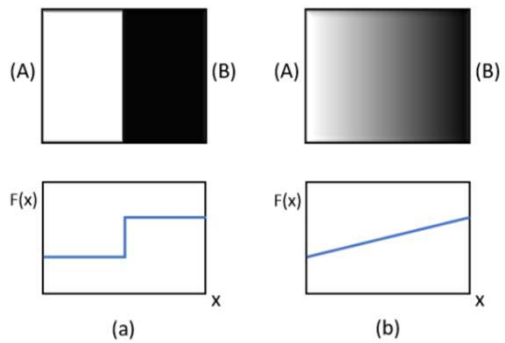
The current portfolio is…

Balanced across challenges/solutions



The current portfolio is…

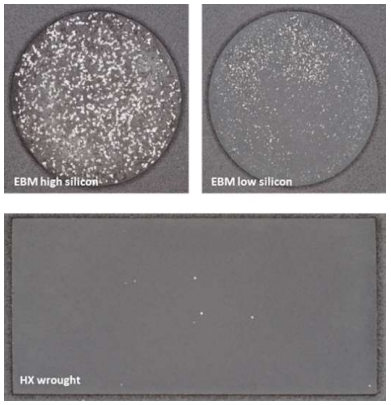
Advancing existing & future fleets



The current portfolio is…

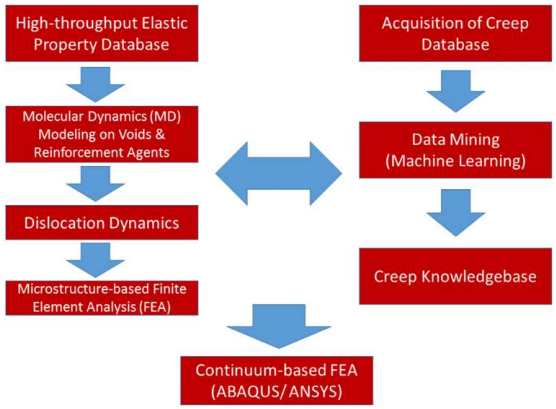
Developing power plants of the future

Ni-Based Alloy/Superalloy Projects



Microstructure and Properties of Ni-based Components fabricated by Additive Manufacturing

Multi-modal Approach to Modeling Creep Deformation In Ni-Base Superalloys



ComTest Consortium
Readying Materials for Advanced Power Cycles

We move
forward, together, as…

We move forward, together, as…

A complete innovation ecosystem

Roles in the Ecosystem

- Objectives & aspirations
- Systems-level planning
- Policy & impact analysis

- Problem definition
- Product specifications
- Scale-up

- Transformational tech
- Workforce development
- Vision for the future

S T A K E H O L D E R S

Government and Regulatory

Commercial value chain

External Innovators
Academia, Small businesses, Research Institutes, National Labs

Collaboration Opportunities

- **Many ways to partner:**
  - Directly with lab
  - Through funded competitions
- **Engage with RFIs, Workshops**
- **Attend Project Review Meeting**
  - Learn about program
  - Network to propose ideas in response to FOAs
  - Provide feedback

High Performance Materials Program Contacts

https://www.netl.doe.gov/research/coal/crosscutting

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