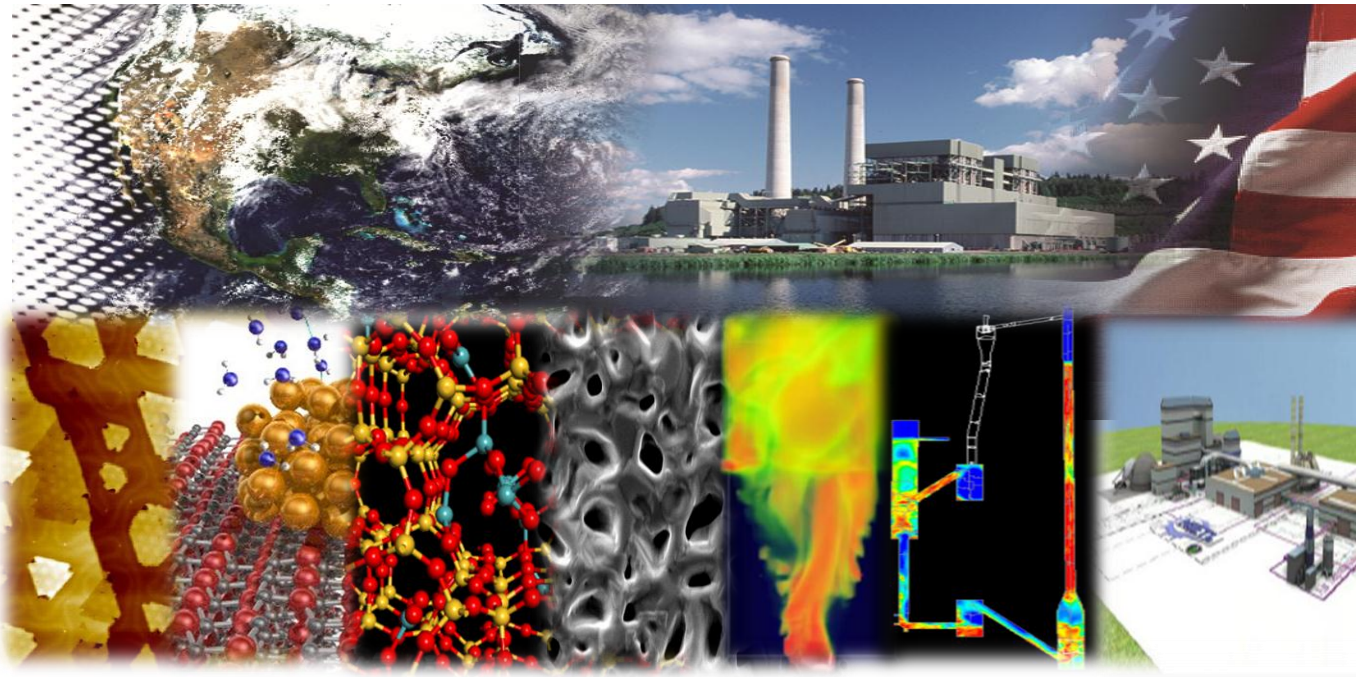
NATIONAL ENERGY TECHNOLOGY LABORATORY



Accelerating Materials Development

Providing Relevant Solutions to Global Challenges

Bryan D. Morreale

Focus Area Lead (Acting)

Materials Science & Engineering

US DOE NETL

U.S. DEPARTMENT OF ENERGY

NETL-RUA Energy & Innovation Conference
November 28-29th, 2012

Global Drivers

Significant global drivers contribute to and/or cause challenges that require innovation of materials across all sectors

GLOBAL DRIVERS

DEMOGRAPHIC CHANGES

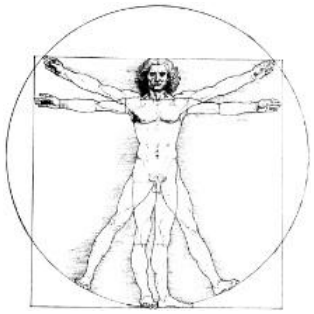
NEW TECHNOLOGY

SUSTAINABILITY

NATIONAL SECURITY

RESOURCE SCARCITY

GLOBALIZATION



HUMAN HEALTH

Public & Private "Manufacturing" Motivation

Competitive Advantage

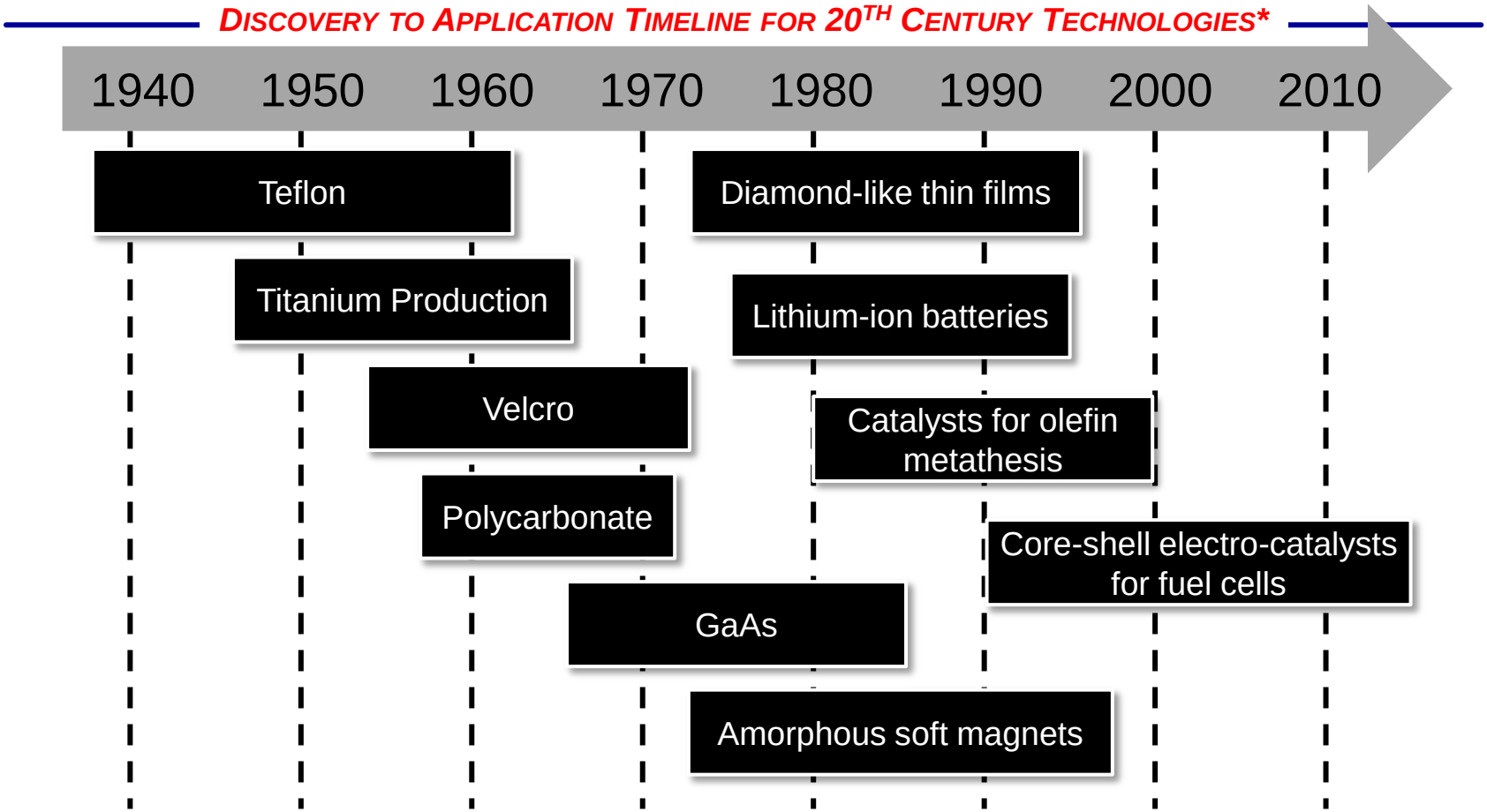
- Speed to market
- Safety
- Sustainability
- Innovation
- Trained workforce
- Stable supplies

- Risks
- Costs
- Inventory

Discovery to Application

Long & Tortuous Road

A new paradigm of development is required in the 21st century to develop technology "twice as fast at a fraction of the cost"



*Wadia, Cyrus; The Materials Genome Initiative MRS Fall Meeting, November 28th, 2011

Materials Development Continuum

"Business as Usual"

Navigating the challenges within each phase of the development continuum are key to accelerating innovation

MATERIALS DEVELOPMENT CONTINUUM[1]

	Material Need Established	Development Plan/Teaming	Materials Design	Process Scale-Up	Design Criteria	Qualification & Implementation	In-Service Support
Objectives	• Applications • Benefits • Timing of Need • Performance Requirements Established • Properties • Product Forms	• Who • Where • Intellectual Property • Funding Secured	• Exploration of Candidate Systems • Matrix Approach • Optimization based on Physical Principles • Chemistry and Process Downselect	• Plant Trials • Intermediate to Full Scale Bathes • Performance Validation • Fabrication Characteristics • Trade Studies, NPV	• Full Scale Product Forms • Establish Production Variability / Stats • Static, Fatigue, DT, Corrosion • Spec Development	• Part Fab and Destructive Testing • Market / Contract Pricing • Production Preparation	• Environmental Effects • Loading / Thermal Fatigue Damage • Notices of Escape/Quality Issues • Repair / Refurbishment • Life Extension
Duration	1-2 Years	1-3 Years	1-3 Years	2-3 Years	2 Years	1-2 Years	Life of Program
Cost	$100K's	$100K's	$100K's	$1,000K's	$1,000K's	$10K's	$100K's

[1] Cotton, James D., "What Boeing Wants from Integrated Computational Materials Engineering for Metallic Materials", Structural Dynamics and Materials Conference, April 2012.

Breaking the Paradigm

Materials Development Continuum

Leveraging multi-disciplinary, multi-scale research accelerates development, increases innovation, reduces risk

Materials Genome Initiative, for Global Competitiveness (2011)

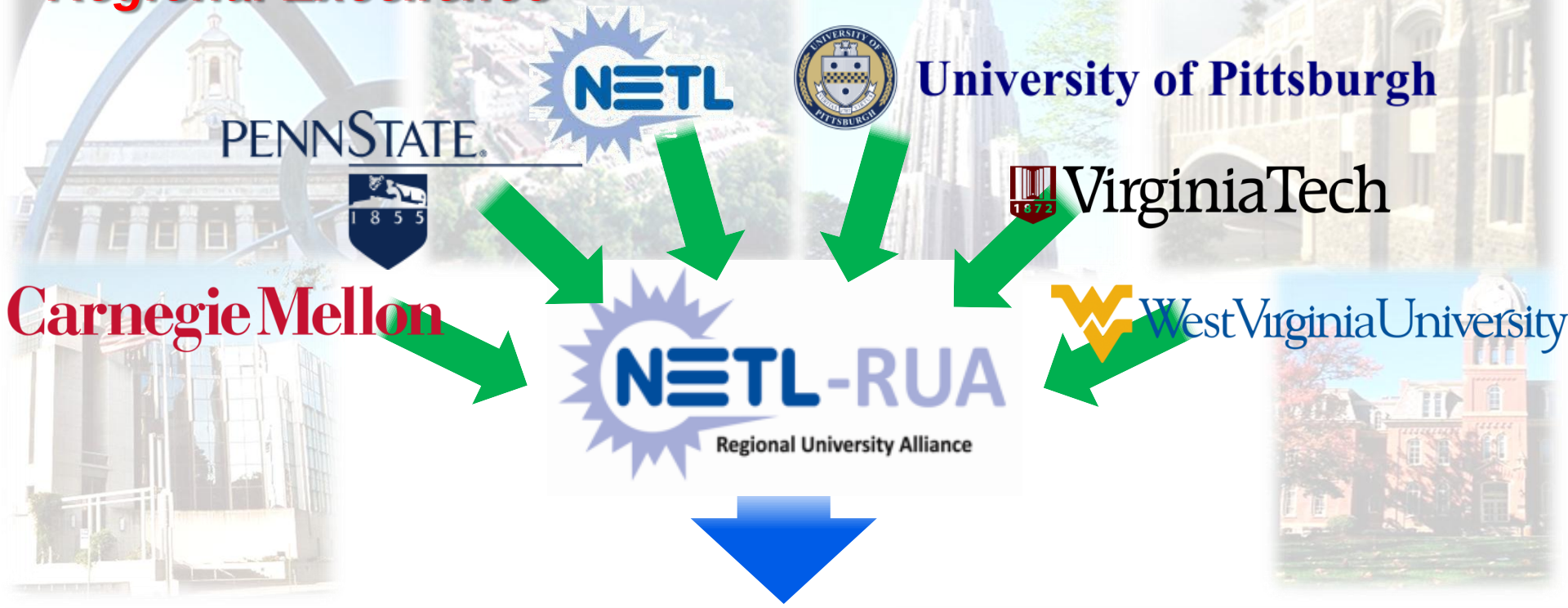
NETL Research & Development

Providing Solutions to National Challenges

- Use-inspired and targeted R&D
- Tens of millions of dollars invested in infrastructure and facilities
- Hundreds of talented & motivated staff
- 100-years of “expertise”
- Technical project management processes
- Targeted collaboration – from discovery through demonstration and deployment

Strategic Partnerships

Regional Excellence



Shared Resources + Shared Intellect = Targeted Innovation

Create and enable dynamic teams to do targeted research that effectively provides solutions to the Nation's most challenging problems

Computational & Basic Sciences - Energy Systems Dynamics - Geological & Environmental Systems - Materials Science & Engineering

Diverse Materials and Applications Expertise

Severe Service Environments

Alloy Manufacturing

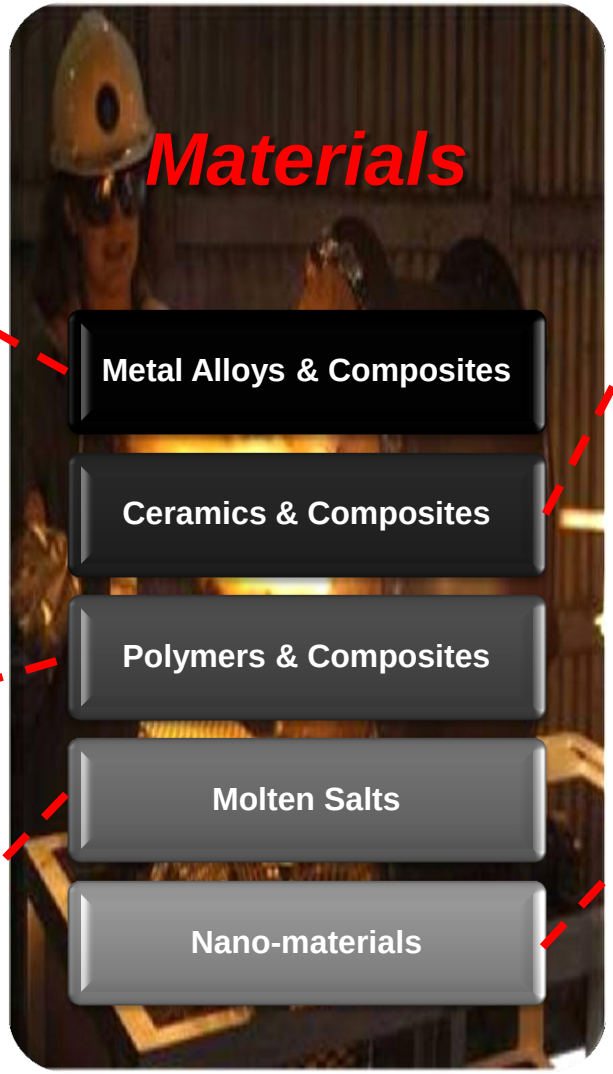
Turbines
Membranes
Sorbents
Medical Alloys
Sensors
Power Electronics
Films & Coatings

Ferrous
Non-ferrous
Refractory
Precious Metals

Membranes
Sorbents
Solvents
Adhesives
Films & Coatings

Catalysts
Electrolytes
Solvents
Transport Media

Ionic Liquids
Eutectics



Fuel Cells
Batteries
Capacitors
Supercapacitors
Semi-conductors
Films & Coatings

Graphene

Sorbents
Membranes
Thermo-catalysts
Photo-catalysts
Electro-catalysts

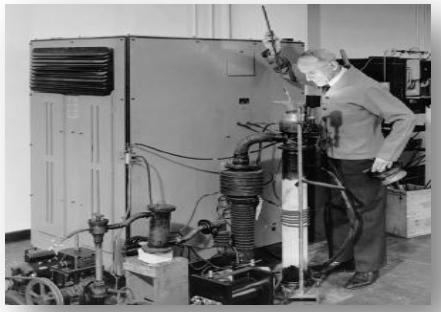
Perovskites
MOFs/ZIFs
Alkali earths
Carbon
Carbides & Oxides

Enabling Technology

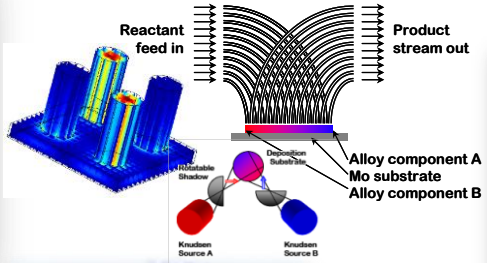
100+ Years of Success

NETL has aided multiple industries in the development of technologies that have had lasting impacts

Kroll Process



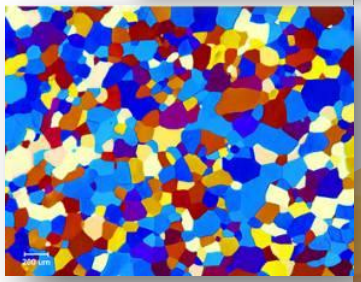
High-Throughput Optimization



Ammonia-based Gas Scrubber

Aurex ®95P

BIAS Sorbents



Armstrong Process

Summary

Leverage investment, collaborations and expertise to provide targeted and innovative solutions to national materials challenges

- **70-years of delivering materials-related solutions**
- **Over $25M in specialized infrastructure and facilities supporting Advanced Materials Development**
- **Mature processes for delivering “products” from the bench to demonstration scale**
- **Innovative approach to materials & technology development**
- **Expertise and capabilities for a variety of materials and applications**
- **Access to thousands of innovative engineers and scientists**

Up Next

Advanced Alloy Fabrication
Jeff Hawk, NETL-ORD

Soft Materials
David Luebke, NETL-ORD

Catalyst Development & Commercialization
David Berry, NETL-ORD

Combinatorial Approaches to Material Optimization
Andrew Gellman, CMU

Partnering for Innovation: Critical Materials
Roe-Hoan Yoon, VT

Additional Information

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