

# NETL's Materials Research Program



*17<sup>th</sup> Annual Conference on  
Fossil Energy Materials*

*April 22-24, 2003*

National Energy Technology Laboratory



[www.netl.doe.gov](http://www.netl.doe.gov)



# Goal of FE Materials Program

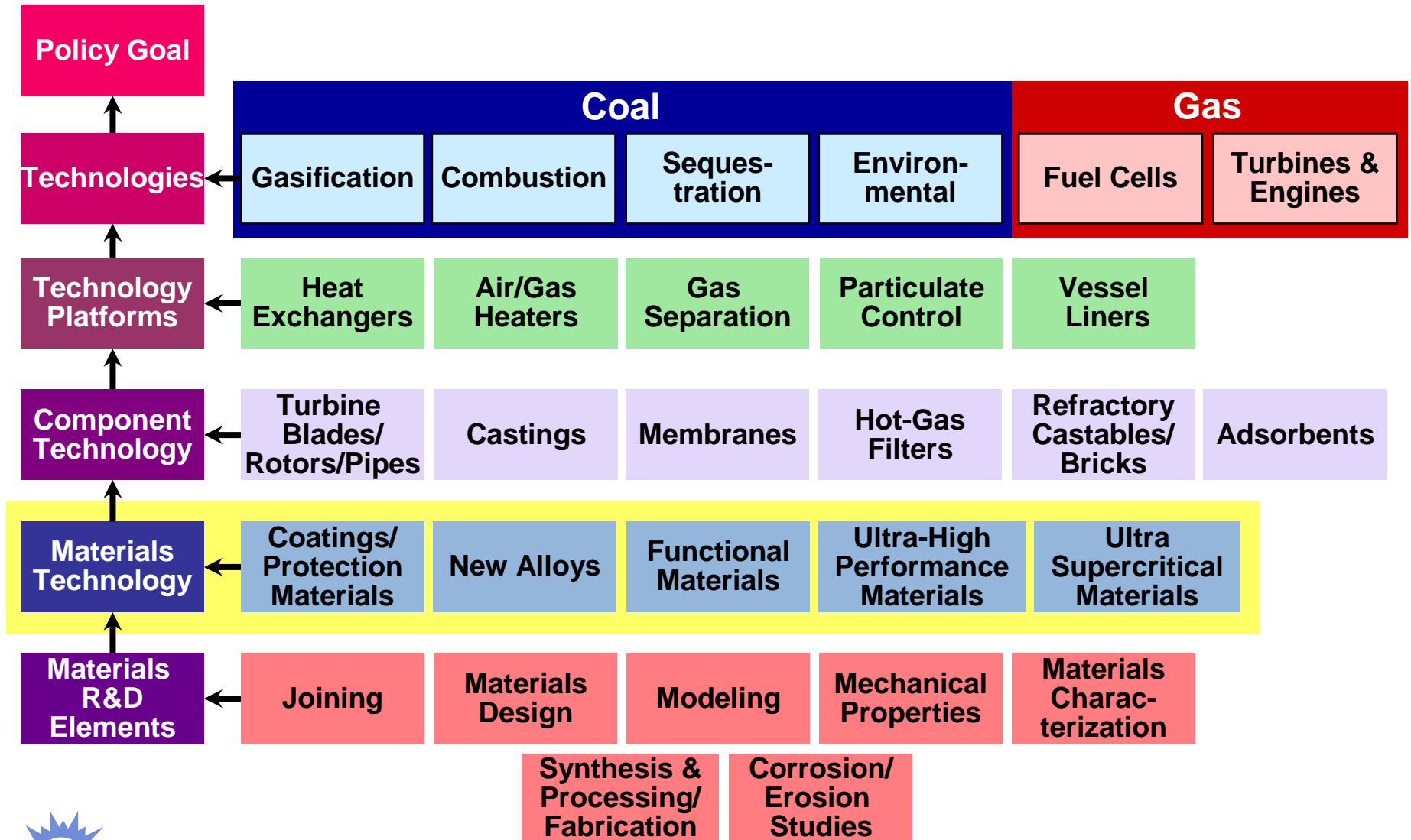
## *Focus on Advanced Research*

Provide a materials technology base to assure success of

- Advanced power generation systems
- Coal fuels systems



# Program Roadmap



# Vision 21

## *Ultra-Clean Energy Plant of Future*

### *Energy Plants for Post-2015*

- **Use available feeds**
  - Coal, gas, biomass, waste
- **Electricity primary product**
  - May co-produce fuels, chemicals, steam, heat



### *Goal*

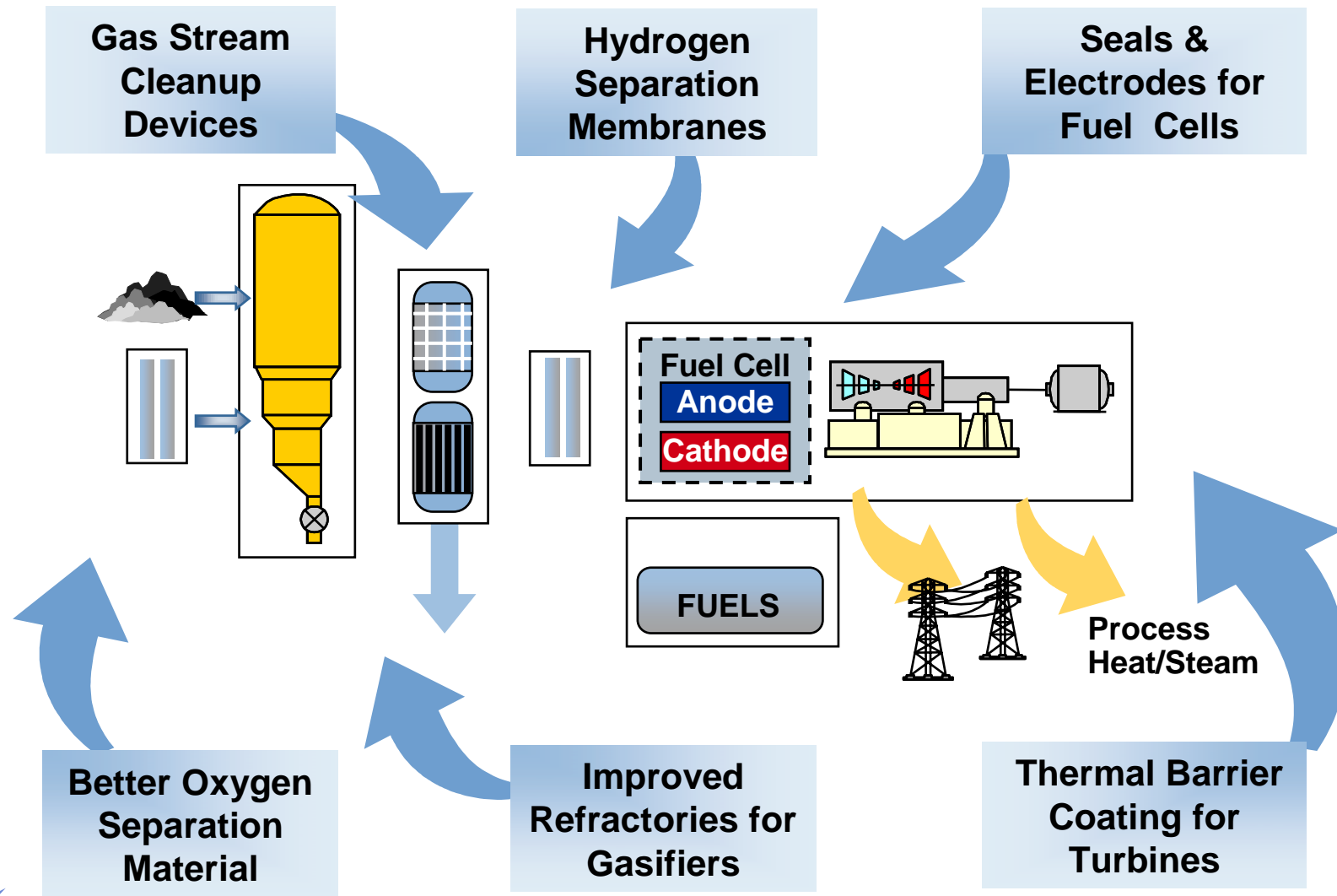
**Absolutely Minimize  
Environmental  
Implications of  
Fossil Energy Use**

### *Approach*

- **Maximize efficiency**
  - 60% coal-to-electric
- **Near-zero emissions**
  - Option for carbon sequestration



# Vision 21 Materials Research Area



CCPI Project

Sutton  $\eta = 32.0\%$



# Coal-Fired Generation Time Line



L.V. Sutton electric generating station

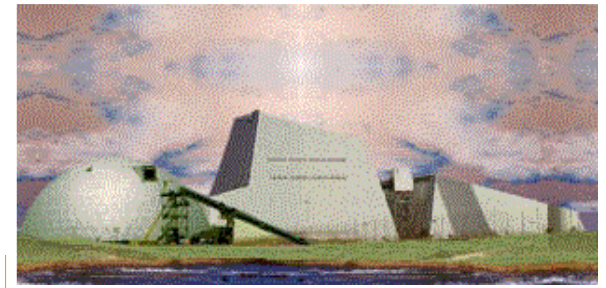


Demo

$\eta = 42.4\%$



Combustion Technology Repowering



DOE Vision 21 Energy Plex

existing...

1950

fleet avg.  $\eta_{HHV} = 33.1\%$

ready in time...

Now

repowering  $\eta_{HHV} = 43.5\%$

greenfield  $\eta_{HHV} = 47.1\%$

the future...

$\eta_{HHV} = 60+ \% \rightarrow$

but when ???

$\leftarrow ?$

Mercury Reduction?

CO<sub>2</sub> Reduction Deadline?

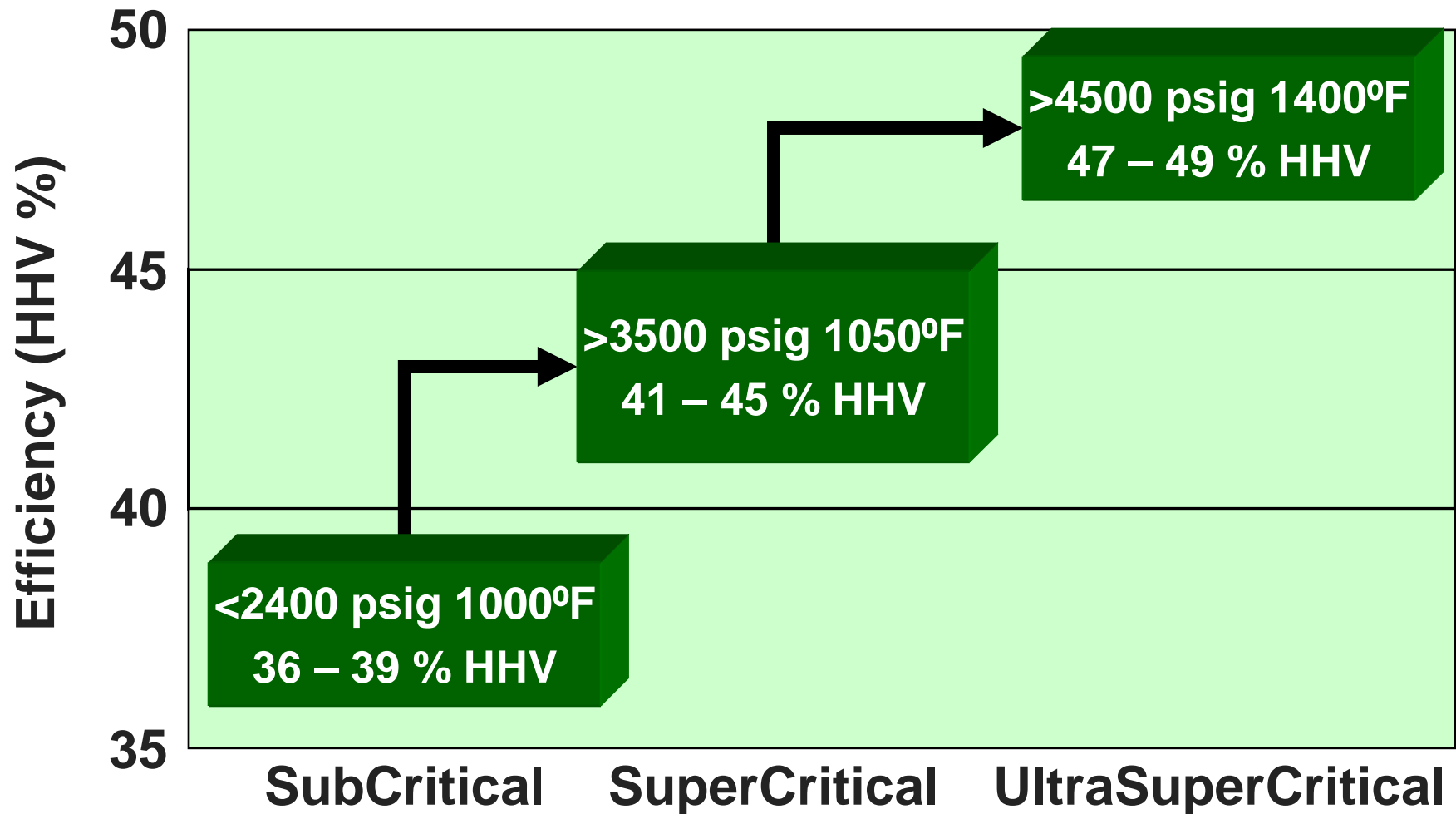


# Why Ultra-Supercritical Materials?

- **1,400° F / 5,300 psi cycles**
  - Efficiencies > 50% HHV
- **Near-term**
  - Solve problems on existing plants
- **Long-term**
  - Enable U.S. manufacturers to compete worldwide



# Pulverized Coal Efficiency





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# Ultrasupercritical (USC) Materials Program

- **Alloys evaluated and/or developed in this program will have direct application to all advanced coal technologies.**
- **USC program not only supports materials that provide mid-term improvements for boilers, but also it provides higher efficiency steam cycle potential for portions of Vision 21 plants**



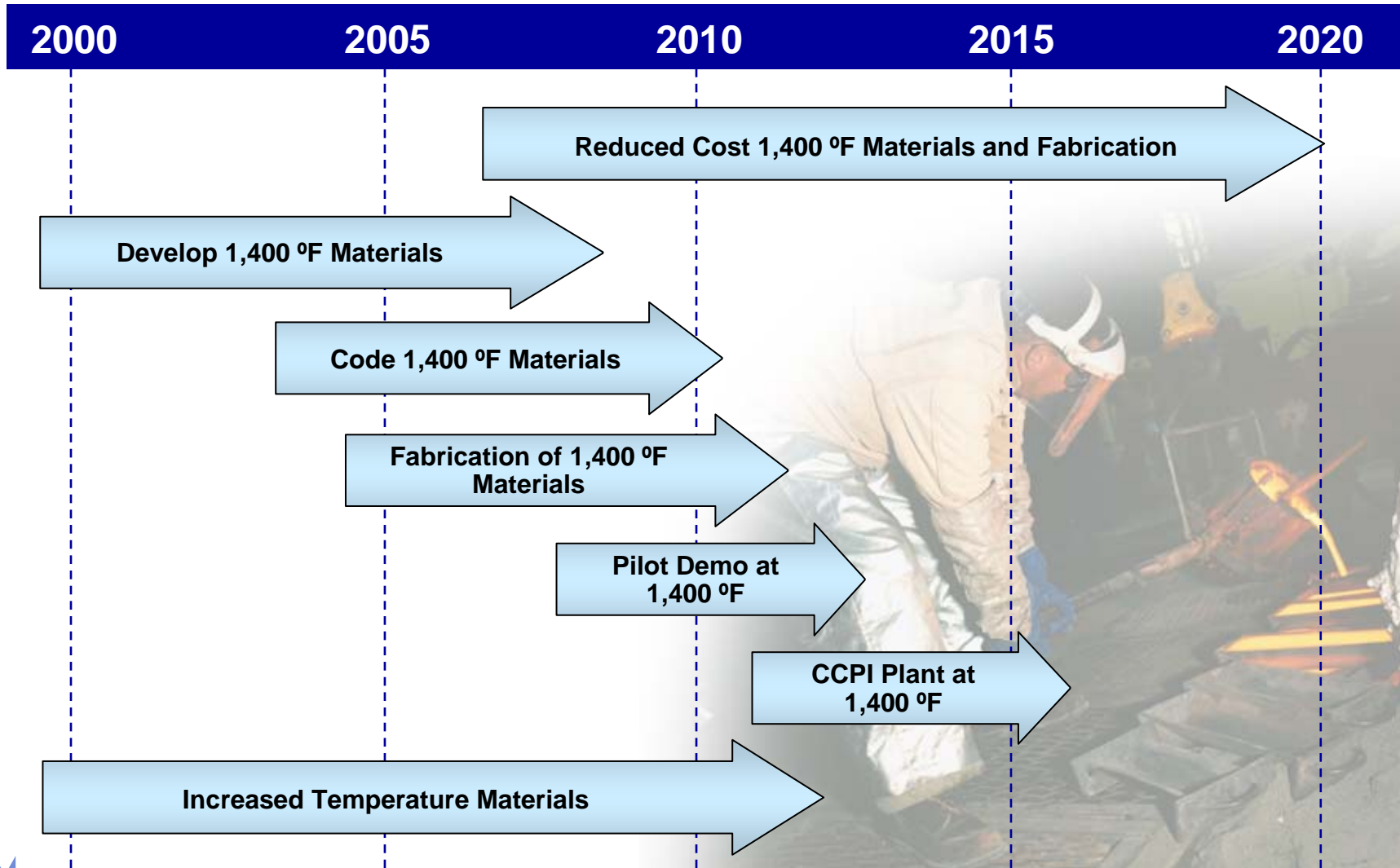
# Advanced Research

## Ultrasupercritical Materials Program

- **Current Status of Technology**
  - Ultrasupercritical Program initiated and projects are proceeding.
- **Remaining Issues and Barriers**
  - Identify the materials performance issues that limit the operating temperature
  - Define and implement a research program to evaluate existing alloys for service at higher temperatures 760°C (1400°F).
- **Commercialization time-frame**
  - Ultrasupercritical power system ready for commercial demo by 2010-2012 timeframe
  - Work with alloy developers and fabricators, equipment vendors, and power generating companies to develop cost targets and promote the commercial deployment of the alloys and processes developed in this project.
- **Key Participants**
  - NETL, Ohio Coal Development Office, Alstom Power, Babcock and Wilcox, Foster Wheeler Development Corp., Babcock Borsig Power, Energy Industries of Ohio, EPRI, Oak Ridge National Lab



# Ultra-Supercritical Materials



# Ultra-Supercritical Materials

## *Addressing Materials Requirements with Partnerships*

**The Team: All boiler manufacturers in the U.S.  
and specialized firms**

Participant
Alstom Power
Babcock Borsig Power
Babcock & Wilcox / McDermott Technology
Energy Industries of Ohio
Electric Power Research Institute
Foster Wheeler
Oak Ridge National Laboratory
Other Specialized Contractors for Testing and Analysis
Haynes International Inc., Allegheny Ludlum, Special Metals



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## Conclusions

- **A new US effort is underway to advance steam cycle materials sponsored by USDOE and OCDO**
- **A strong team has been assembled to test new materials and fabrication methods in the lab and field**
- **This will lead to a long-term goal of advanced, highly-efficient cycles capable of competing on the world market for coal-fired power plants**



# Near-Term Procurement Opportunities

- **University Coal Research – Fall 2003**
- **Small Business Innovative Research – Fall 2003**
- **Development of Technologies & Capabilities for Developing Coal, Oil, and Gas Energy Resources – October 2003**

