

Introduction: Materials for Ultra-Supercritical Steam Turbines

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Need for USC Steam Cycles

The US DOE has several major power generation initiatives that involve materials at high temperatures, some of which rely on a Rankine bottoming cycle as a contributor to overall plant efficiency:

- Vision 21
- Clean Coal Technologies
- FutureGen

Power Generation Roadmaps

- **Vision 21** is aimed at effectively eliminating (at competitive costs) environmental concerns associated with the use of fossil fuels for producing electricity and transportation fuels. The approach is to develop technology modules that address specific functions (e.g. gasification; power generation); these are to be ready in the 2005-2015 timeframe.
- **Clean Coal Technology Roadmap** is a discussion document aimed at integrating the coal programs of DOE, EPRI, and the Coal Utilization Research Council (CURC). Its destinations involve major aiming points for advanced combustion cycles of 1250° F/675° C steam by 2010, and 1400° F/700° C steam by 2020.
- **FutureGen** is a new initiative aimed at demonstrating Vision 21-type technologies, including production of hydrogen, removal of air pollutants, and capture and sequestration of carbon. The demonstration plant a 275 MWe-size unit, and will be ready for initial operation in the 2008-2010 timeframe.

DoE-EPRI-CURC Integrated Clean Coal Technology Roadmap

- Supports all the relevant initiatives: Clear Skies; Clean Coal Power; Climate Change; Homeland Security
- Destinations are based on current DOE and industry performance and cost targets (CURC, EPRI, DOE product lines)

	Reference	2010	2020
Efficiency (HHV)	40	45-50	50-60
Availability	>80	>85	90
Capital \$/kW	1,000-3,000	900-1,000	800-900
COE ¢/kWh	3.5	3.0-3.2	<3.0
<i>Materials Goals</i>			
Steam T, °F/°C	1112/600	1250/675	1400/760

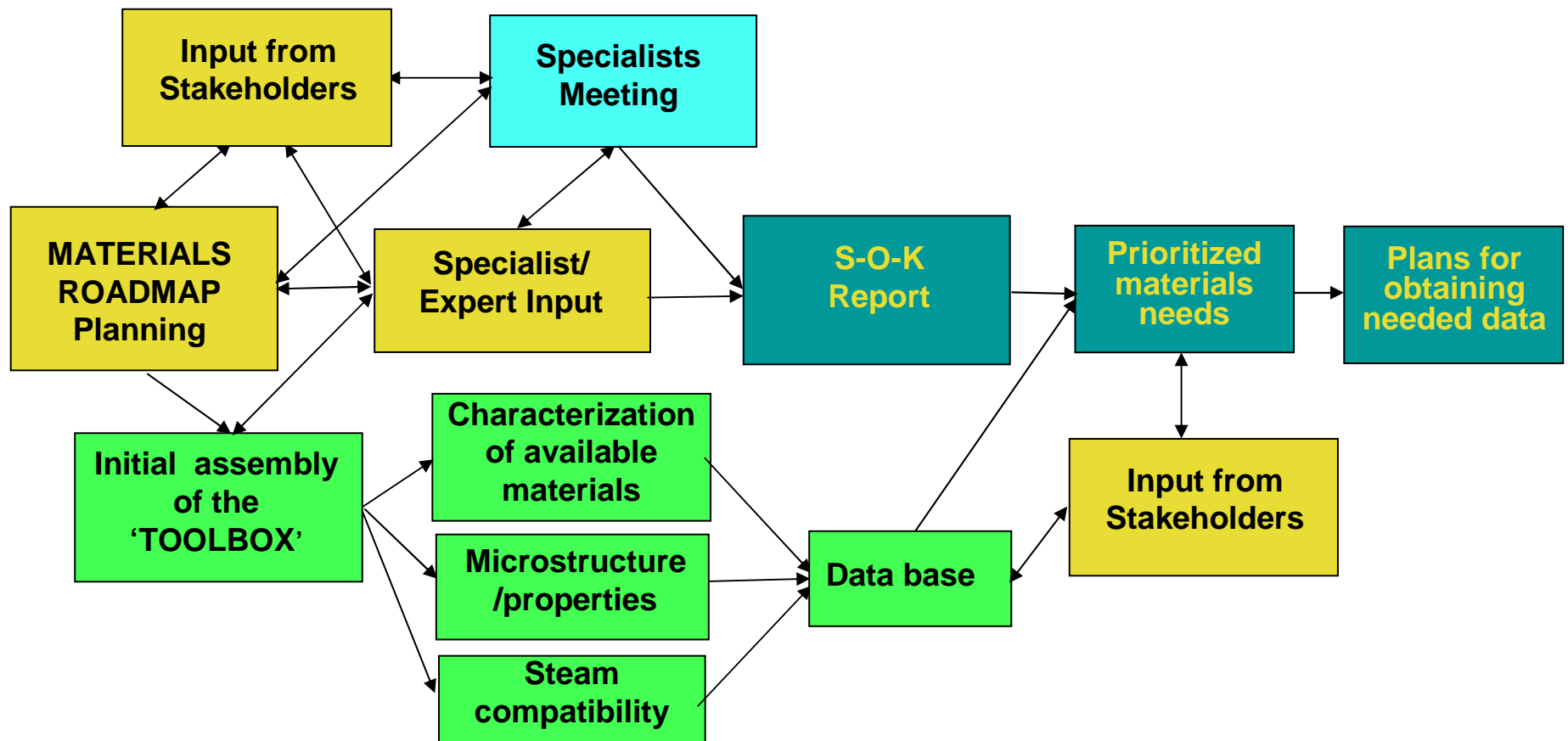
New DoE-ARM Program on USC Steam Turbine Materials

- **Purpose**

- define the materials/components challenges confronting turbines for USC duty
- initiate efforts to address these issues for conditions where:
 - ferritic steels can be used (maximum use temperature?)
 - austenitic alloys will be needed
- identify approaches for addressing the perceived barriers for these alloy classes, and level of effort needed
- initiate selected/strategic efforts

First Year Activities

Organizing the Materials Roadmap



Implementation of the Overall USC Steam Roadmap

- The ability to reach the DOE-CURC-EPRI Product Roadmap destinations is highly dependent on the use of improved materials
- We need to address the availability (or lack) of such materials and the ability to make components to ensure that:
 - the Roadmap continues to address the major market needs
 - the Roadmap Destinations are not jeopardized by:
 - the cost or timing associated with materials development
 - the ability to manufacture the required components