Coal R&D
Requirements for Sustainability

2007 University Coal Research (UCR)

Historically Black Colleges and Universities and

Other Minority Institutions (HBCU/OMI)

Contractors Review Conference

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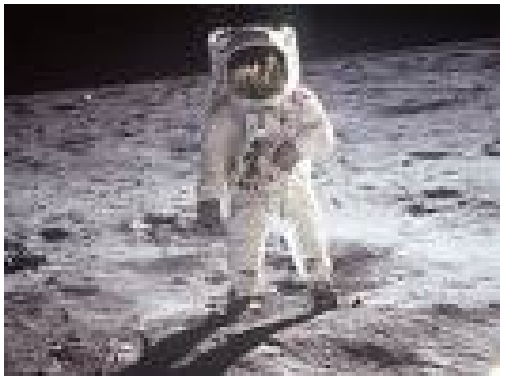
Past Grand Challenge Illustrations

- Longitude Act of 1714
- Infectious Disease – 1800s
- Manhattan Project – 1940s
- Man on the Moon – 1960s
- Project Independence – 1970s
- War on Cancer - 1971
- Strategic Defense Initiative – 1983-1991
- Human Genome Project – 1990-2003

Past R&D Grand Challenges

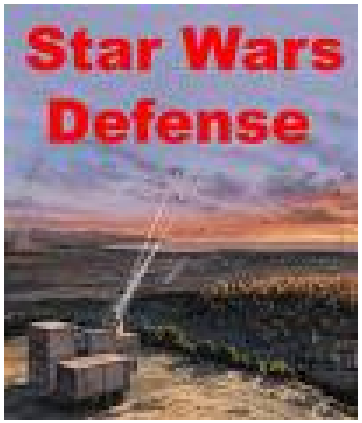
Manhattan Project
(1940s)

~ $25 billion



Apollo Project
(1960s)

~ $91 billion



Strategic Defense
Initiative (1980s)

~ $450 billion

Characteristics

Complex - Large Scale - Multi-disciplinary - Capture the imagination

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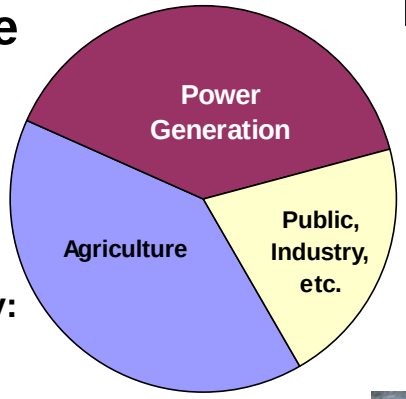
Today's Grand Challenges

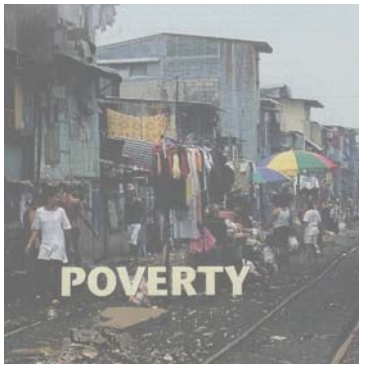
Disaster Resilience

Energy

Water

350 billion gal fresh water/day: U. S.





Terrorism

Global Warming

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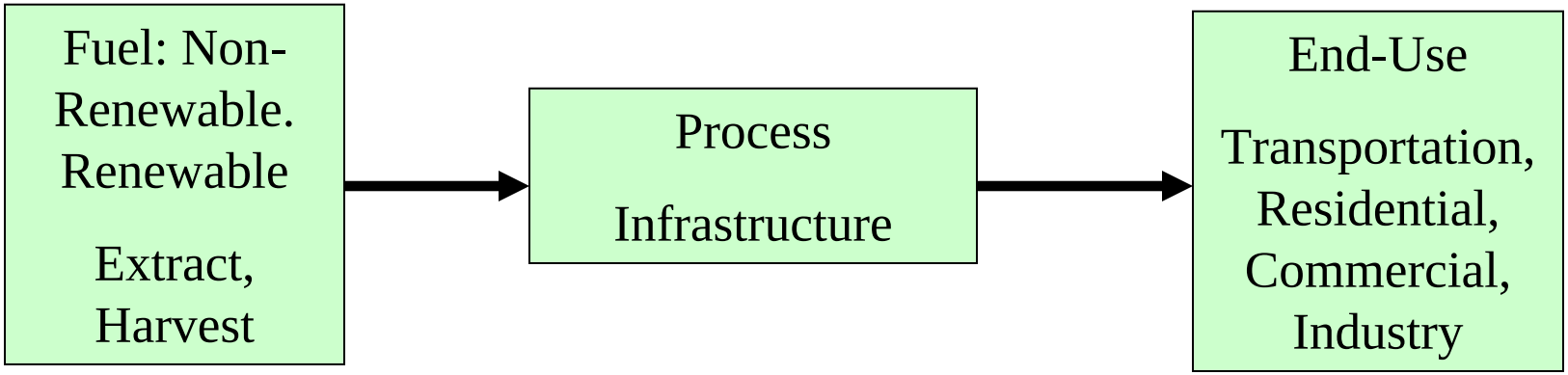
Characteristics of Grand Challenges

	Historic Grand Challenges	Today's Grand Challenges
Boundaries	Isolated Activities	Interdependence
Implementation	Technical Community	Diverse Stakeholders - International
Funding	Government	Multiple Sources

Need for new team, organization, communication concepts.

Energy Challenge



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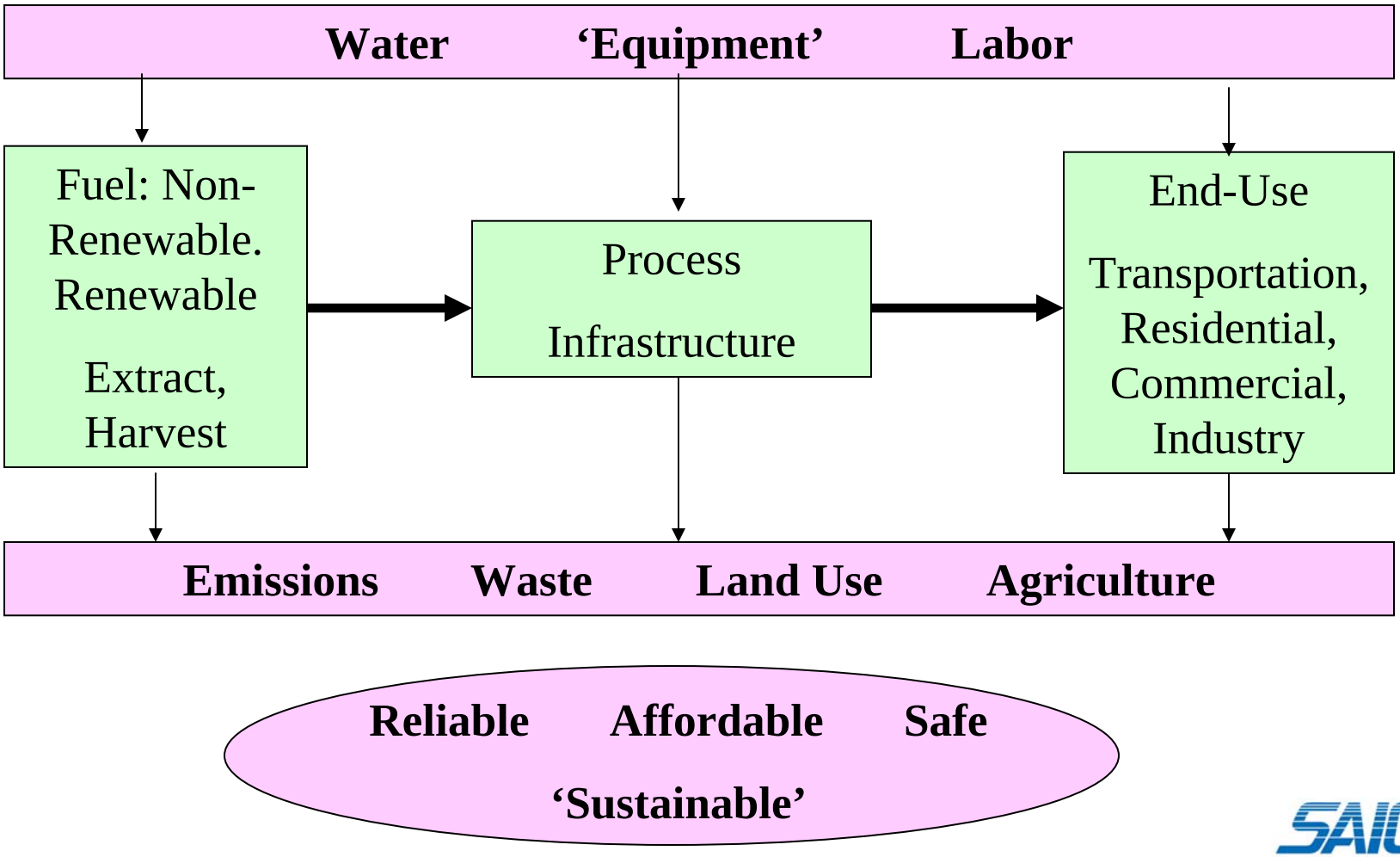
Today's Energy System Challenge



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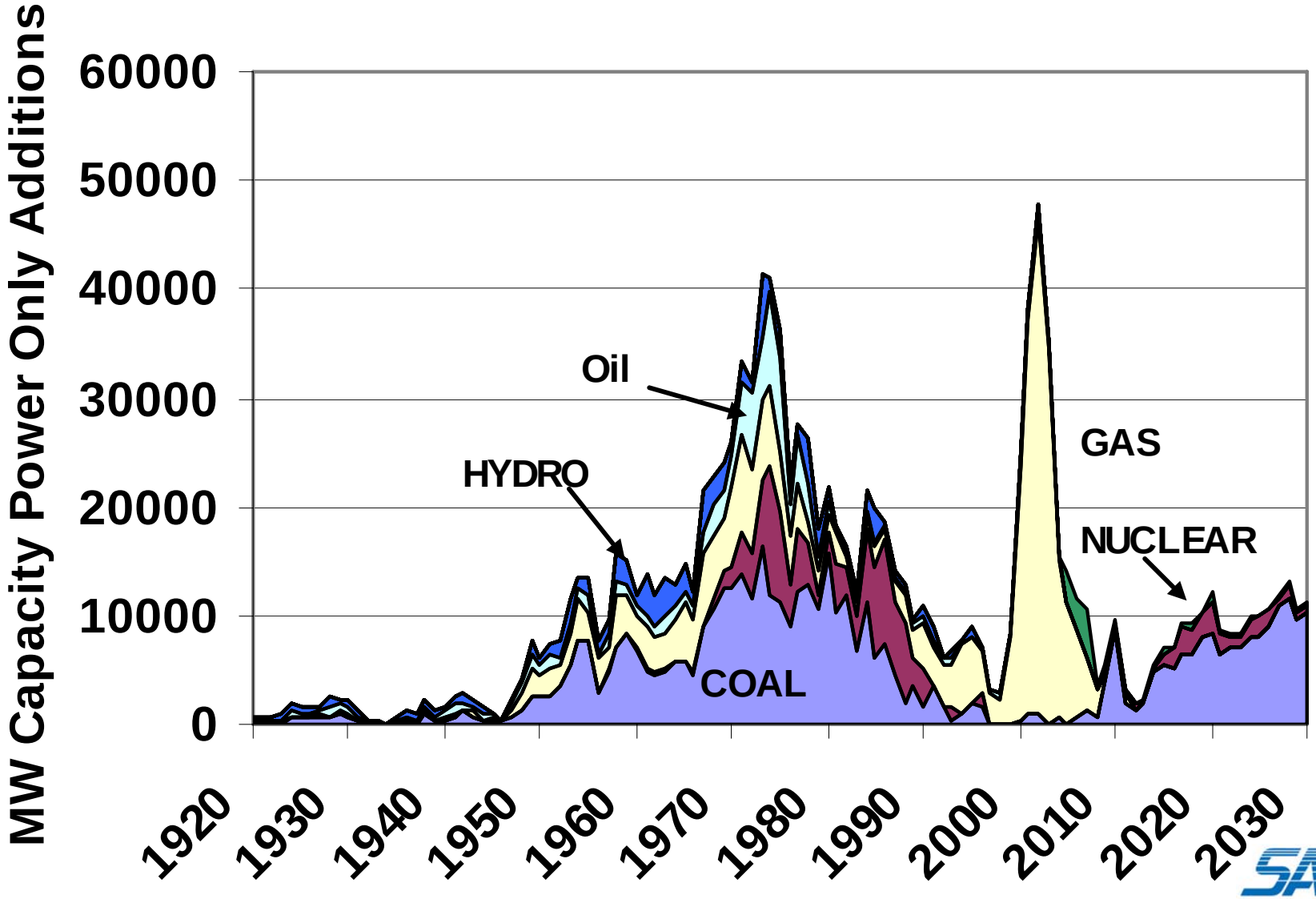
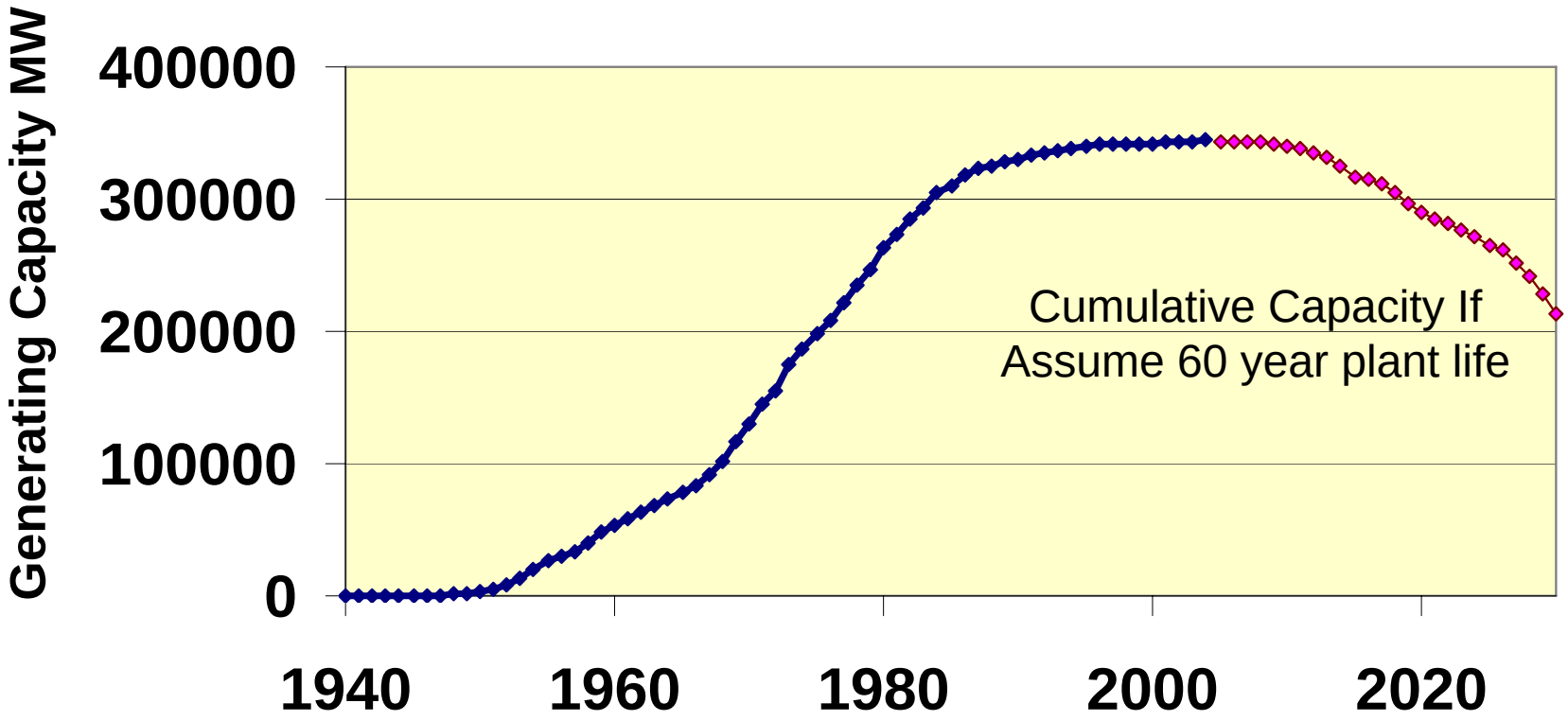
U.S. Electric Power Capacity Perspective



EIA AEO 07 Reference Case Forecast

U.S. Coal Plant Capacity



What is coal plant life extension?

What are the trade-offs?

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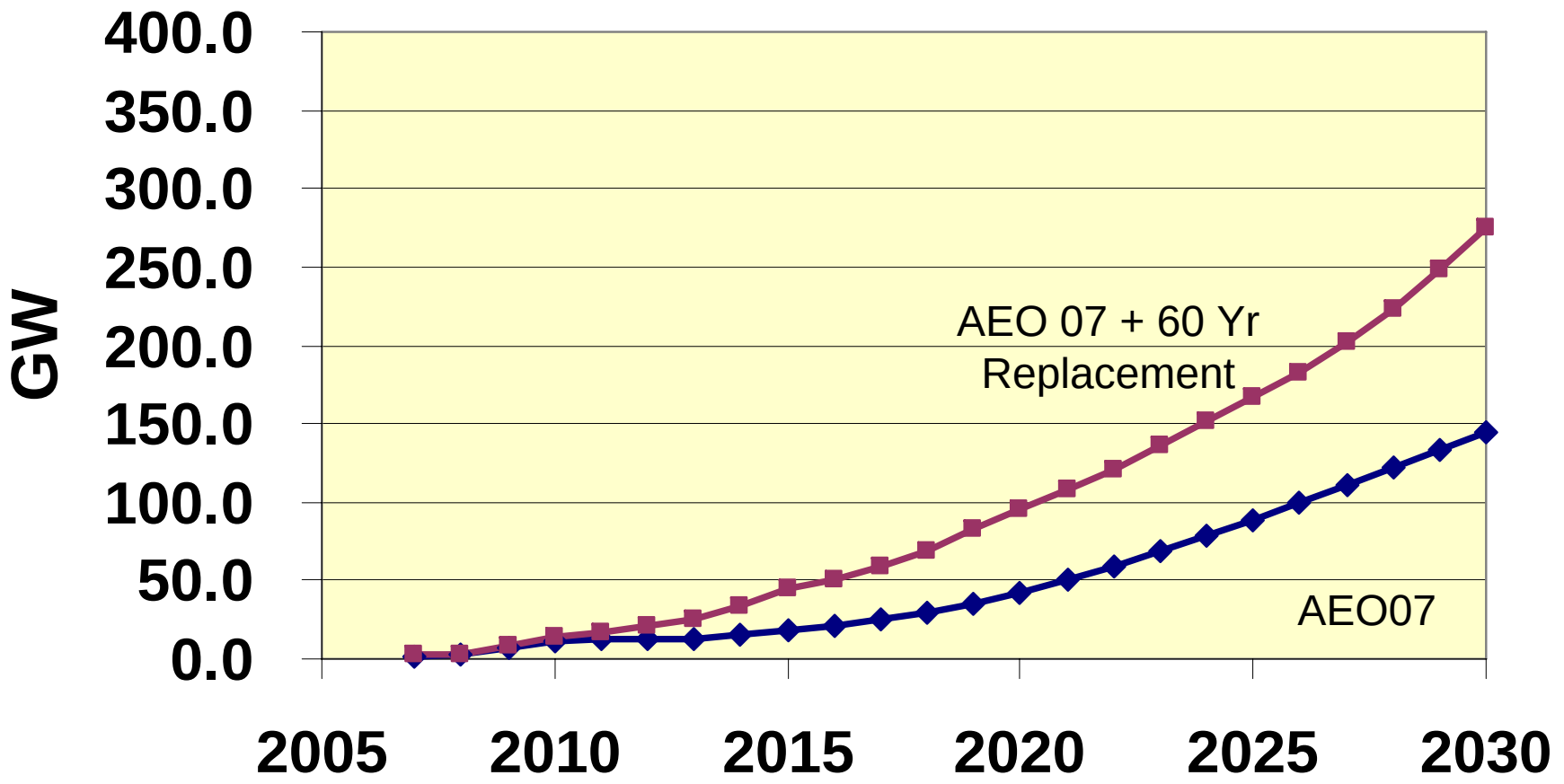
U.S. Coal Capacity Implications



What technology will be available?

Will the skilled workforce be available?

How will we meet electric power needs?

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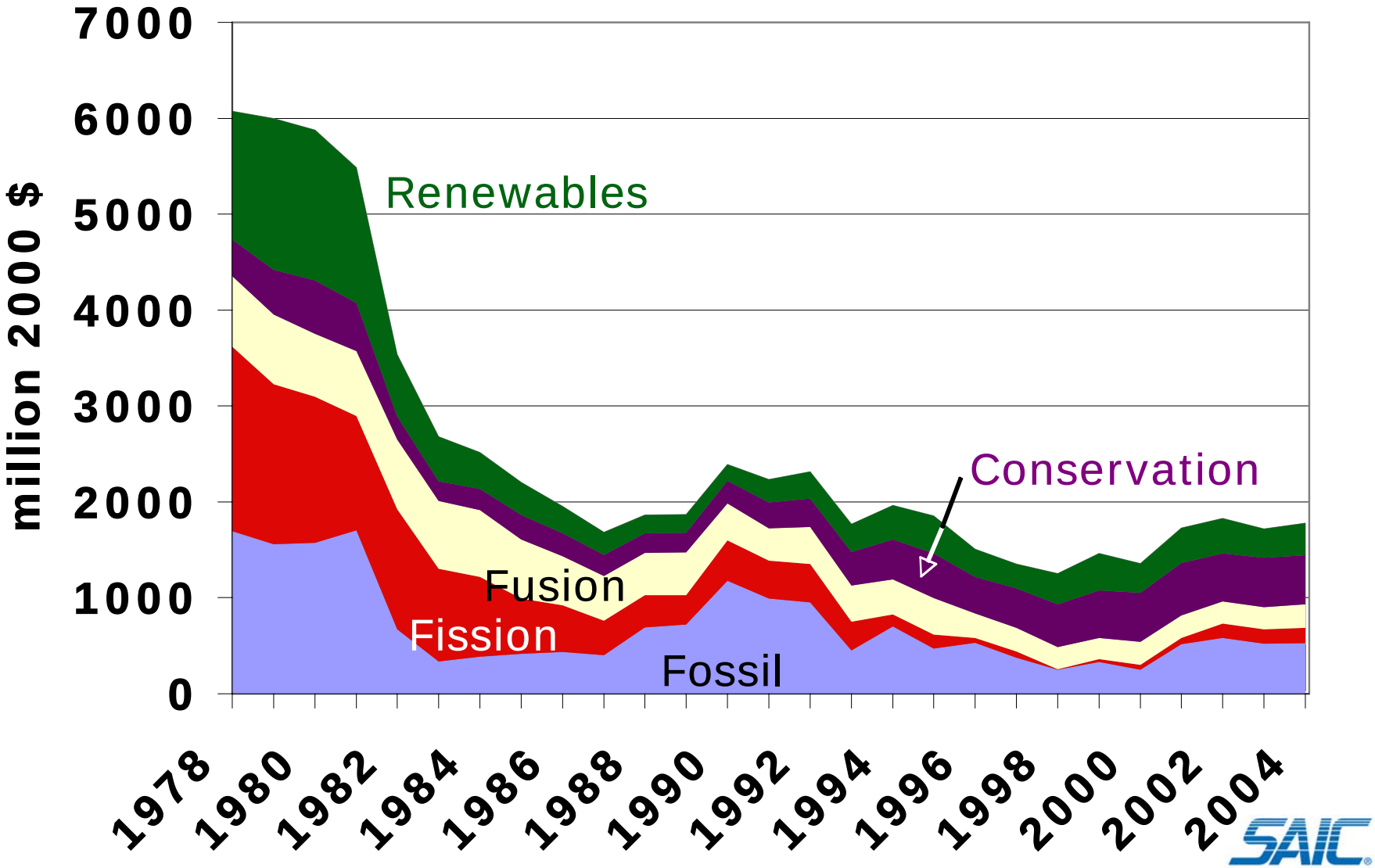
U. S. DOE RD&D



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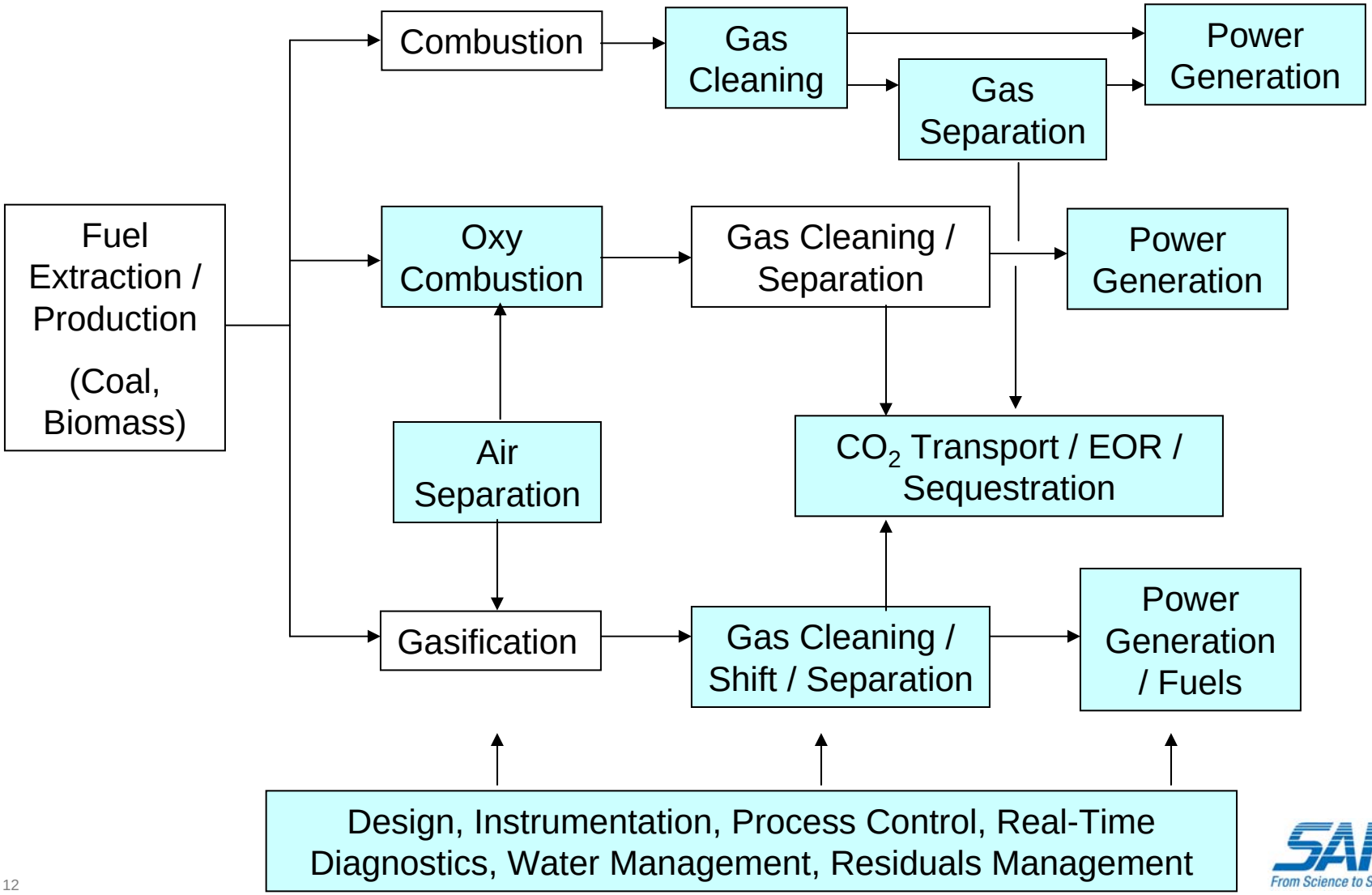
UCR/HBCU/OMI Application Perspective



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Time and Resource Constraints

Concept	Laboratory	Slip Stream	Prototype	Demonstration	Integrated Plant
	(variable time)	< 1 MW (2-4 years) ($1 – 10 million)	1 -20 MW (4-6 years) ($5 – 100 million)	50 – 200 MW (5-10 years) (> $100 million)	Demonstration (7-10 years) (> $300 million)

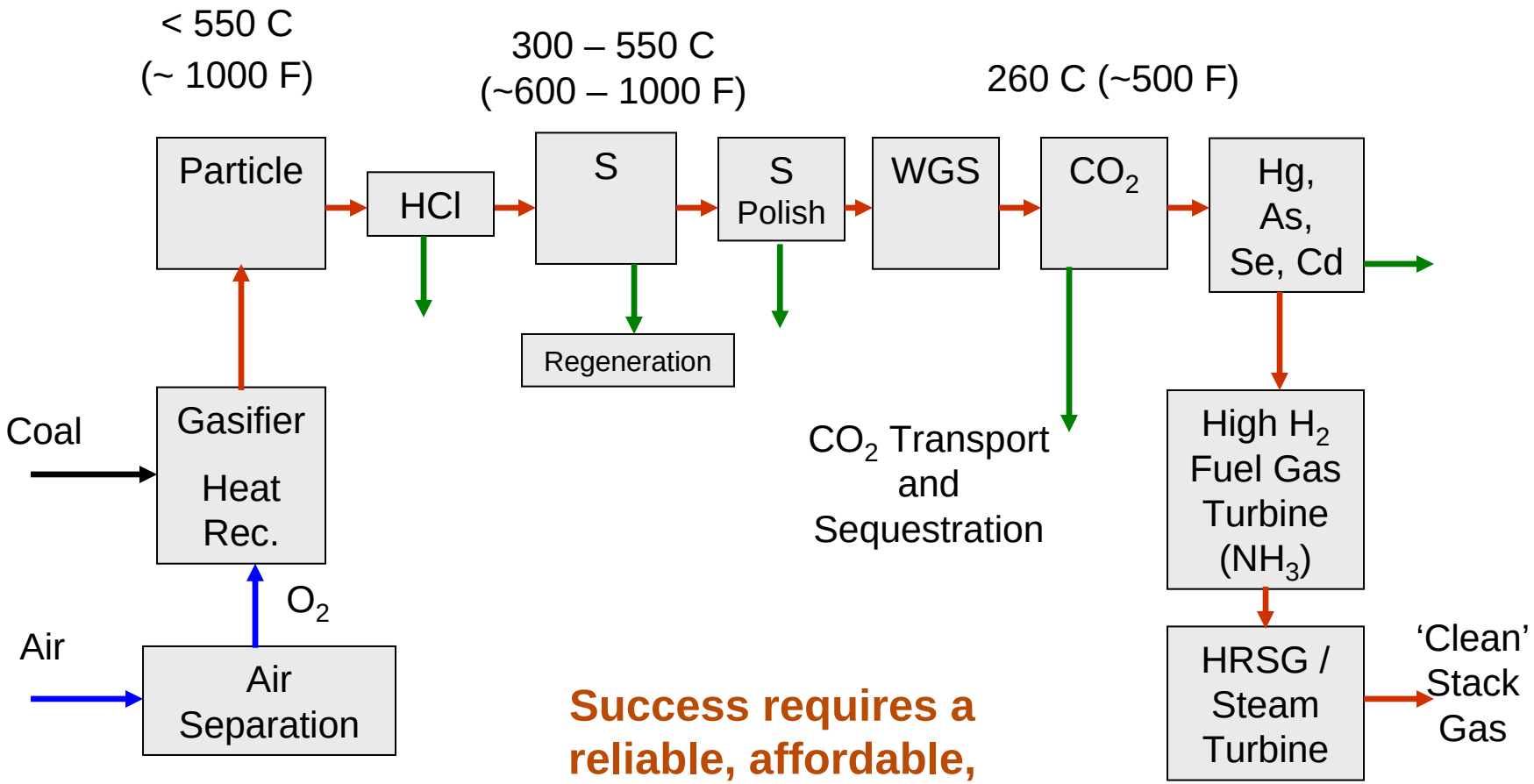
Technology development decisions depend on

- Potential benefit
- When the technology will be needed
- Current technology status / technology challenge

Development Time Varies:

- A new sub-system technology: 10 – 20 years to reach commercial scale demonstration
- Multiple technology integration: additional 5 – 10 years
- Advances in a commercial concepts: < 10 years

IGCC Plant Configuration
Humid Gas Cleaning



Success requires a reliable, affordable, integrated system.

Technology Development Perspective

Plant Section	Major Development Goal
Gasification and Air Separation	Increase efficiency; minimum CH_4; availability; maintenance / Reduce power consumption and cost
Heat Recovery	Improved plant efficiency; improved availability
Particulate Removal	Improved availability
Halide Removal	Reduced sorbent use; demonstrate operability
Sulfur Removal	Demonstrate performance and operability; sorbent cost
Trace Metals Removal	Demonstrate performance and operability; sorbent cost
CO-Shift	Commercial technology
CO_2 Removal	Develop efficient, reliable, affordable process
Power Generation	Demonstrate availability, efficient low-NOx turbine

Commercial technology

Commercial technology; advances required to meet goal

Technology Required

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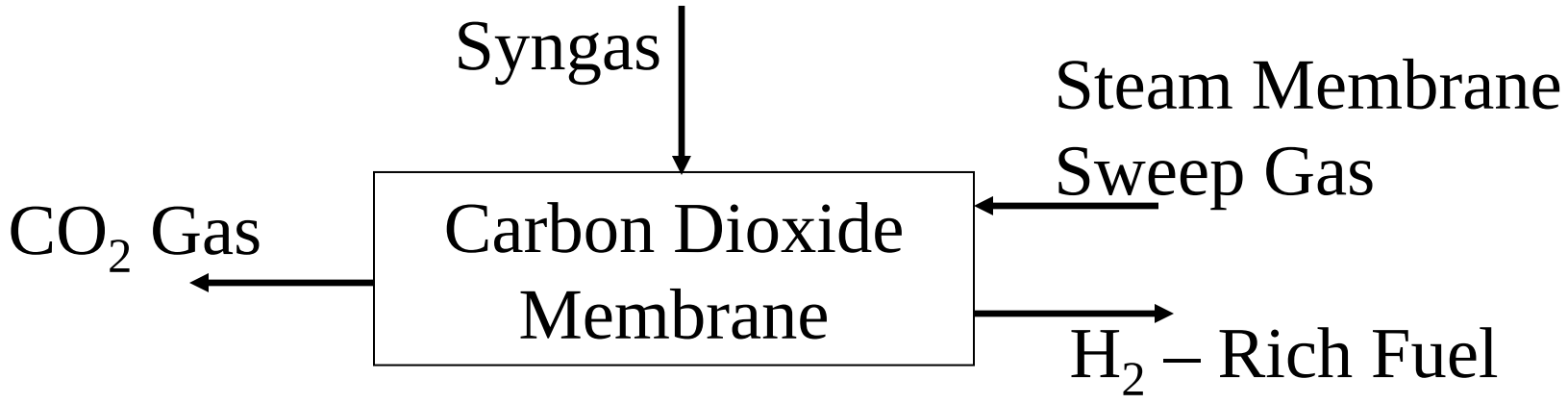
Integrated System Performance Drives Requirements



Requirements (Humid Gas Cleaning IGCC Plant Illustration)

Temperature 250 – 450 C
Pressure 460 – 1000 psia
Hydrogen permeation < 2%
Water permeation - nil
CO_2 Removal 92-97%
Membrane system cost < $150/kW nominal 500 MW scale

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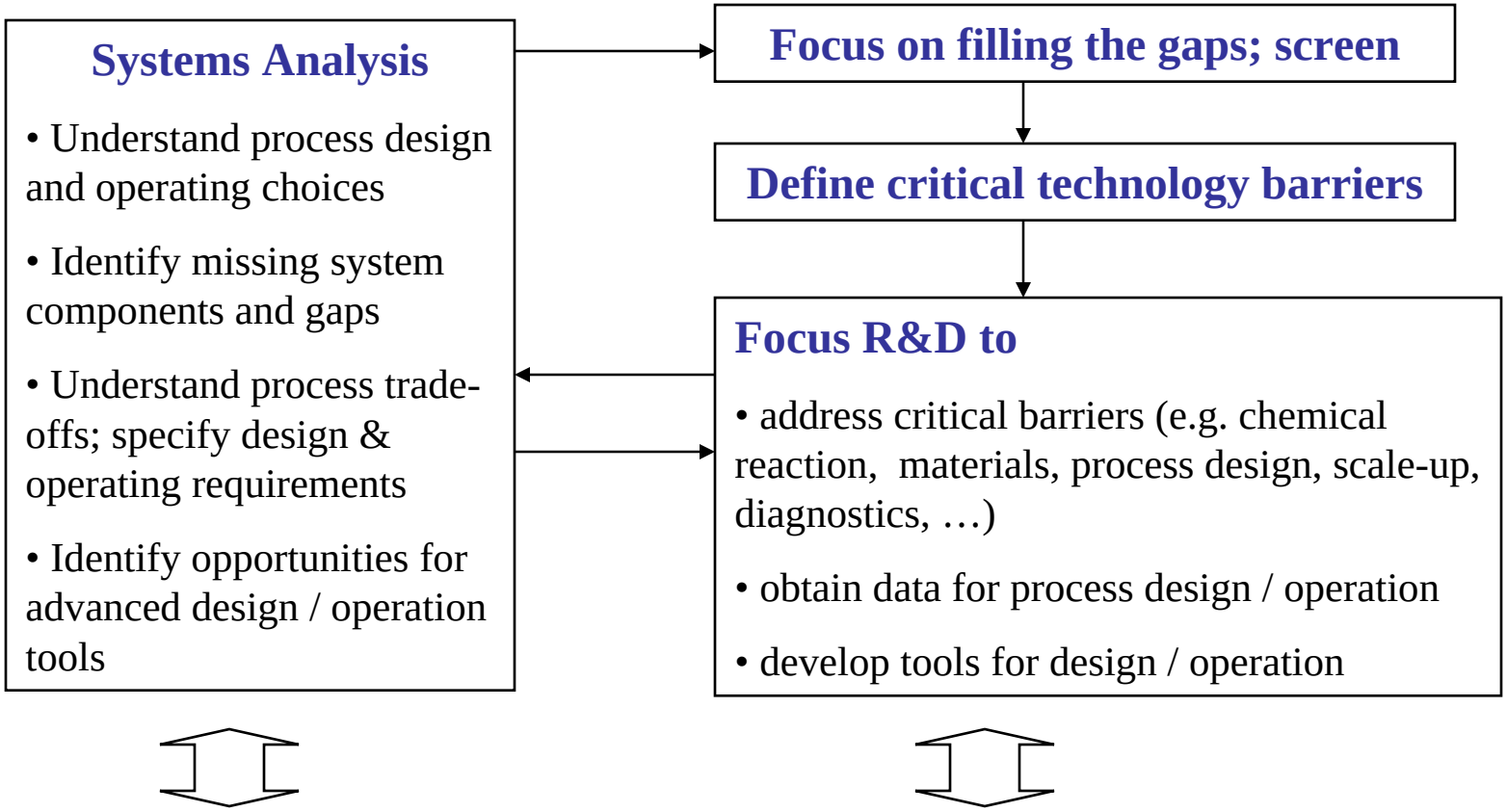
Continuous R&D Project Screening

- Sound theoretical basis
- Understand benefit
- Understand competition
- Compatibility with system configuration(s)
- Potential to meet performance and cost targets
- Does R&D address technology gaps
- Quality of experimental results to support performance targets
- Compatibility with system development schedule and market opportunities

Achieving the Goal

Objective: Economic, reliable integrated system that meets target performance



Technology Supplier – System Designer/Constructor – Technology User

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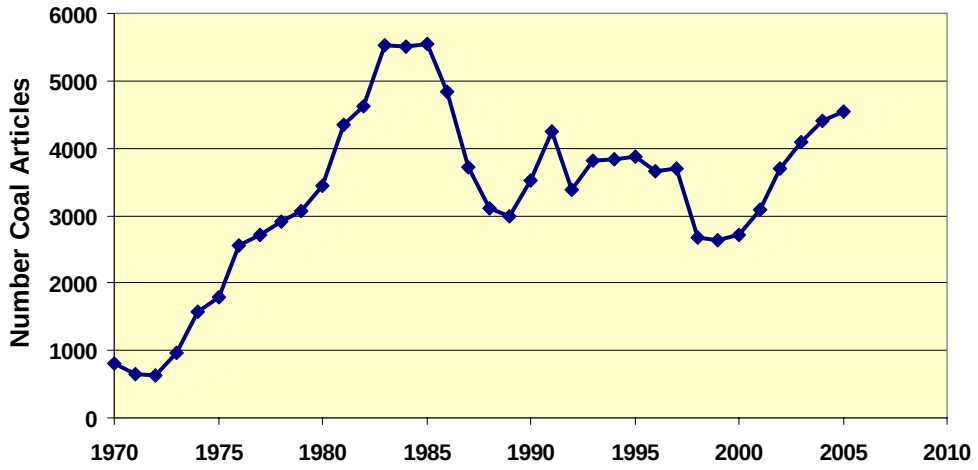
Challenges

- Energy – a grand challenge / different boundaries
- Technology – holistic systems view
- Business-as-usual: not acceptable
- R&D resource limitations
- Concept to Application Time
- R&D Decisions
- Education – skilled workforce



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