Synergistic Integration of Energy Systems and Closed-Loop Manufacturing Systems

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PORTSFUTURE

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PUBLIC OUTREACH AND APPLIED-ENVIRONMENTAL TASKS FOR THE FORMER PORTSMOUTH GASEOUS DIFFUSION PLANT (PORTS) IN PIKETON, OHIO AND SURROUNDING COUNTIES

The facility at Piketon, Ohio

PORTS FUTURE

Outline

- Premise for Integration
- Integrated Energy System (IES)
- Closed-Loop Manufacturing (CLM)
- Process Heat Applications & Usage
- PORTS IES-CLM Complex Concept
- IES-CLM Potential Benefits
- IES-CLM Challenges
- Summary/Conclusions

Premise for Integration

Systems/processes optimized to work together addresses the Nexus of Energy, Water, Climate, Food, and Waste

- The "whole" is worth more than some of the "parts"
  - Synergy obtained from a "systems of systems" approach
- "Smart Systems" can create "Smart Solutions"
- "Value" as a driver—not absolute "cost"
  - Value Propositions:
    - High Efficiency (i.e., Thermal, Economic)
    - High Reliability and Resiliency
    - Sustainability
    - Minimal water usage
    - Low Emissions/Waste Minimization
    - Acceptable/Low Cost

Integrated Energy System

- Technical definition: Two or more energy resources are utilized as inputs to two or more physically coupled subsystems to produce one or more energy commodities as outputs
- Simpler definition: Multiple energy resources combined together to produce one or more energy related products
- IES is not a technology, but integrated approach to applying technologies, "*systems of systems*"
- Co-locating, combining, interconnecting and/or networking of energy producers and energy users

IES by Different Names

- Cogeneration (Traditional among technical people)
  - Usually thought of as a single energy resource producing two energy commodities
- Combined Heat and Power (CHP)
  - Natural Gas/Coal/Oil/Biomass to produce steam (process heat) for a chemical process and additionally generate electricity
- Hybrid Energy Systems
- Combined Energy Systems
- Polygeneration

China & Polygeneration

Coal chemical recycling economy demonstration park in Wuzhong City in Ningxia Providence

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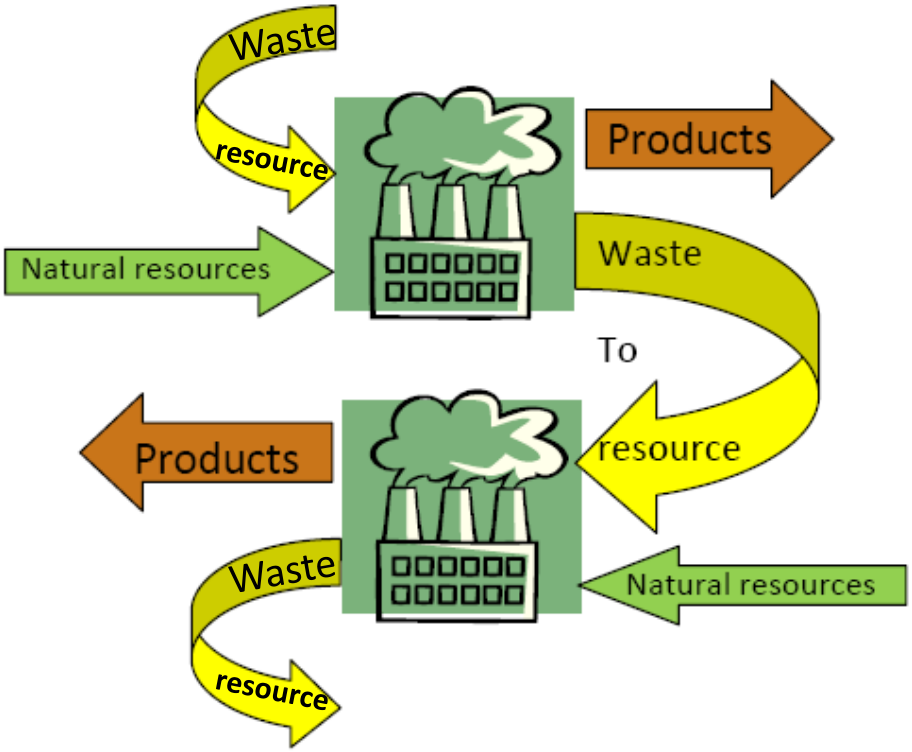
Closed-Loop Manufacturing
(Industrial Symbiosis)

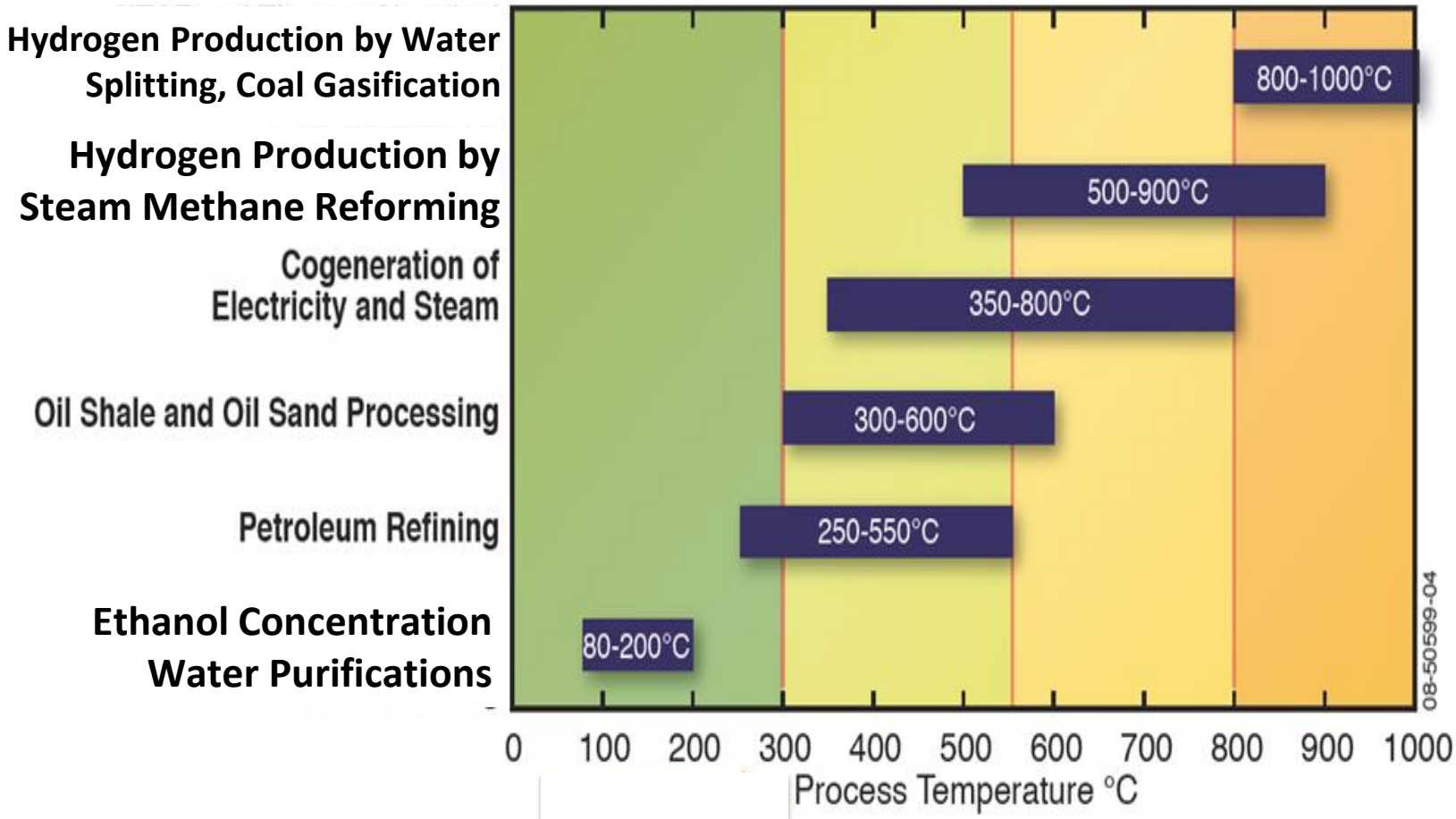
Typical industrial process used today

Linear system

Move toward Circular system

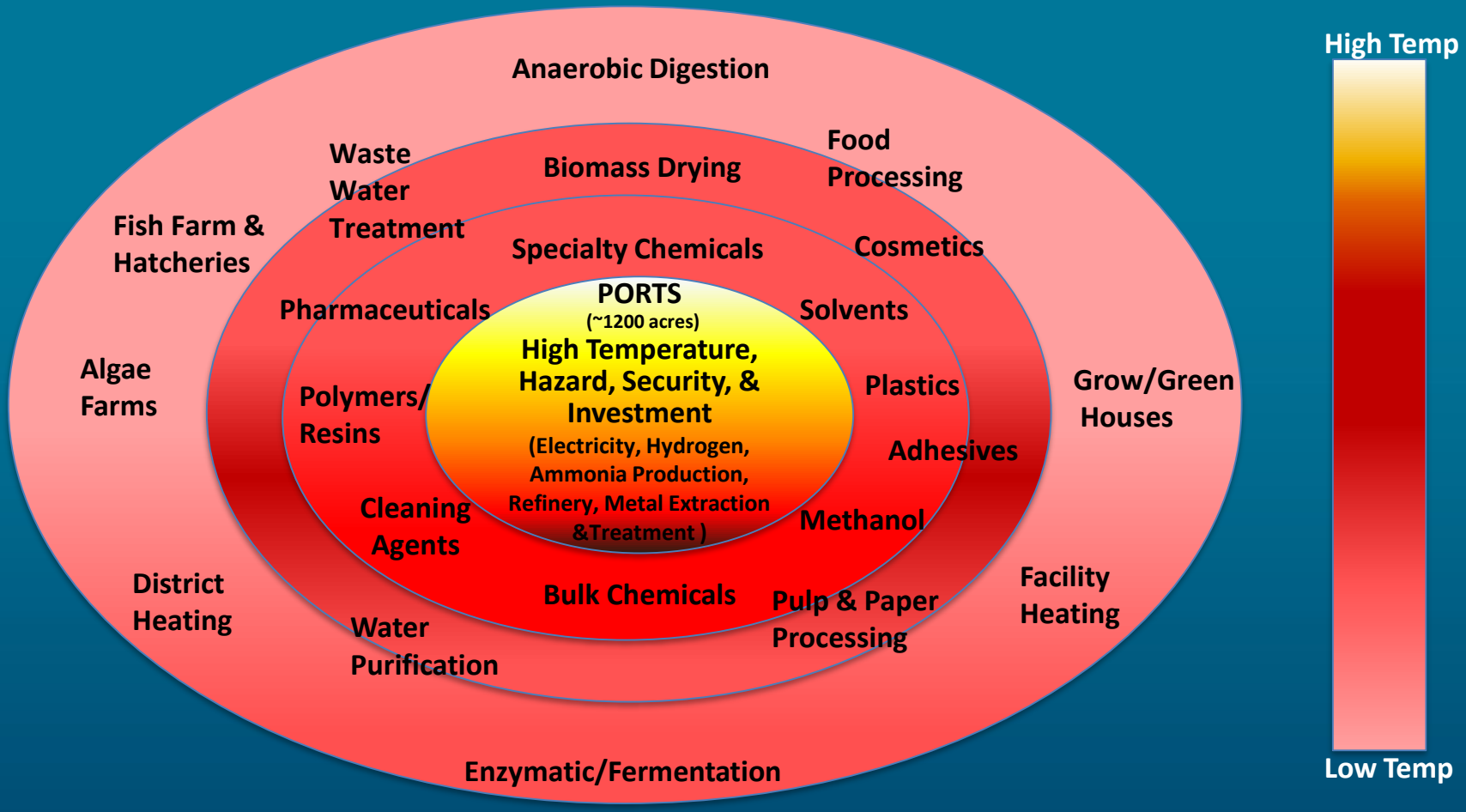


Process Heat Applications



Utilize process heat at every temperature level

Process Heat Usage



Closed-Loop Cooling Water

Anaerobic Digesters

Refinery

CCGT

Fish Hatchery

Water is filtered and treated as it is recycled

Water Treatment

Green Houses

Grow Houses

Algae Ponds

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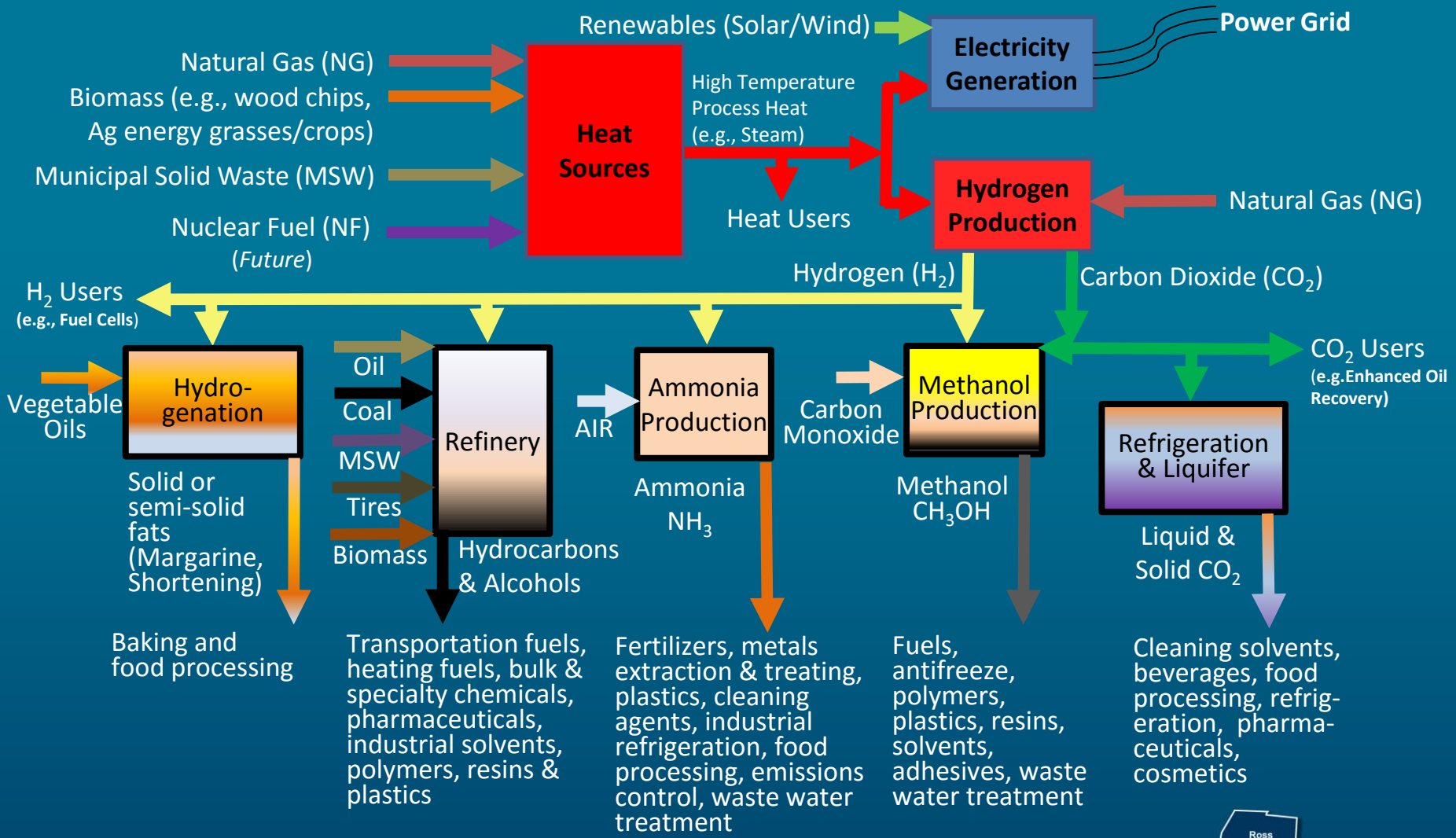
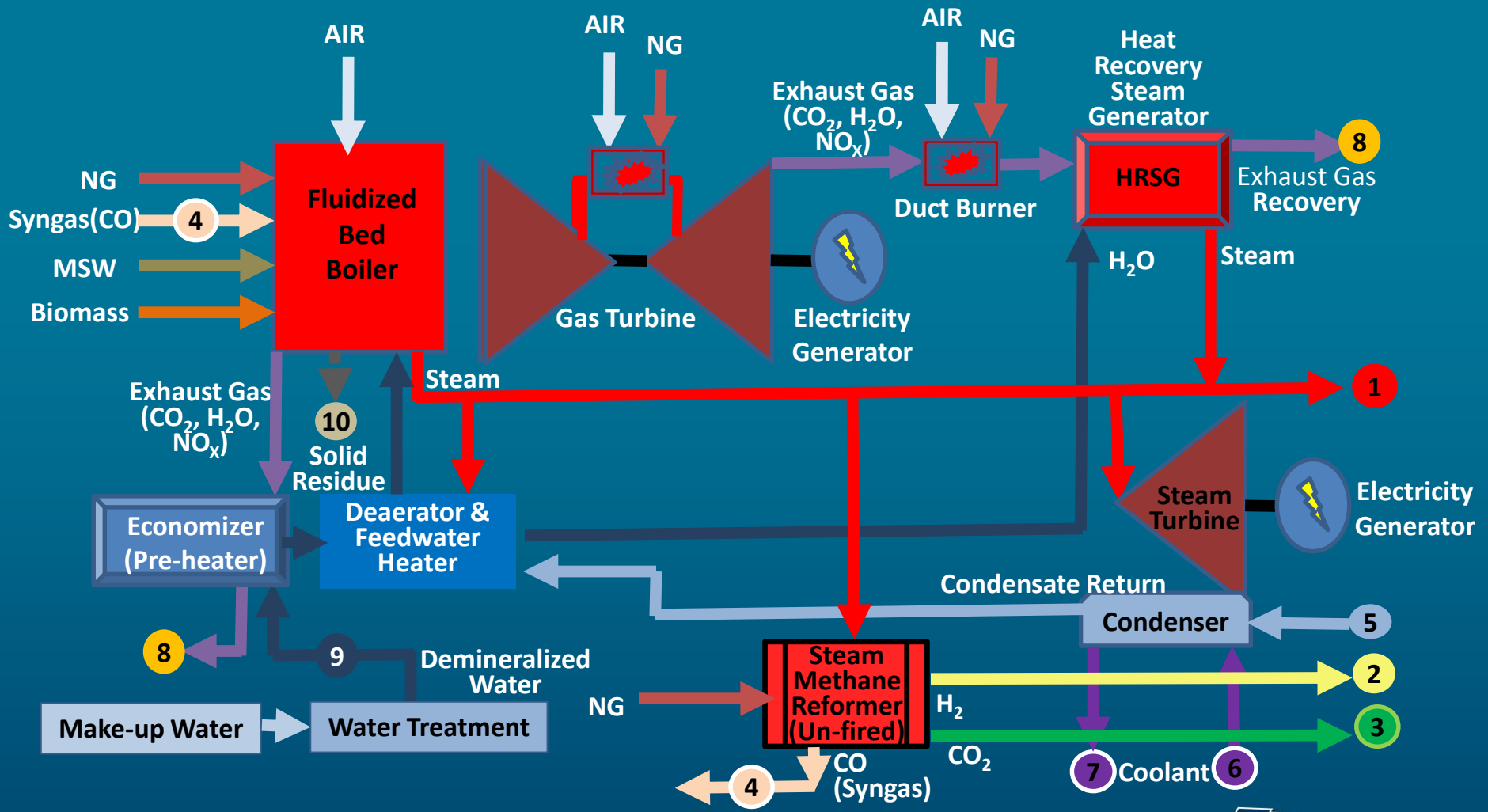
IES-CLM Complex Concept



Initial Phase of IES-CLM



The facility at Piketon, Ohio

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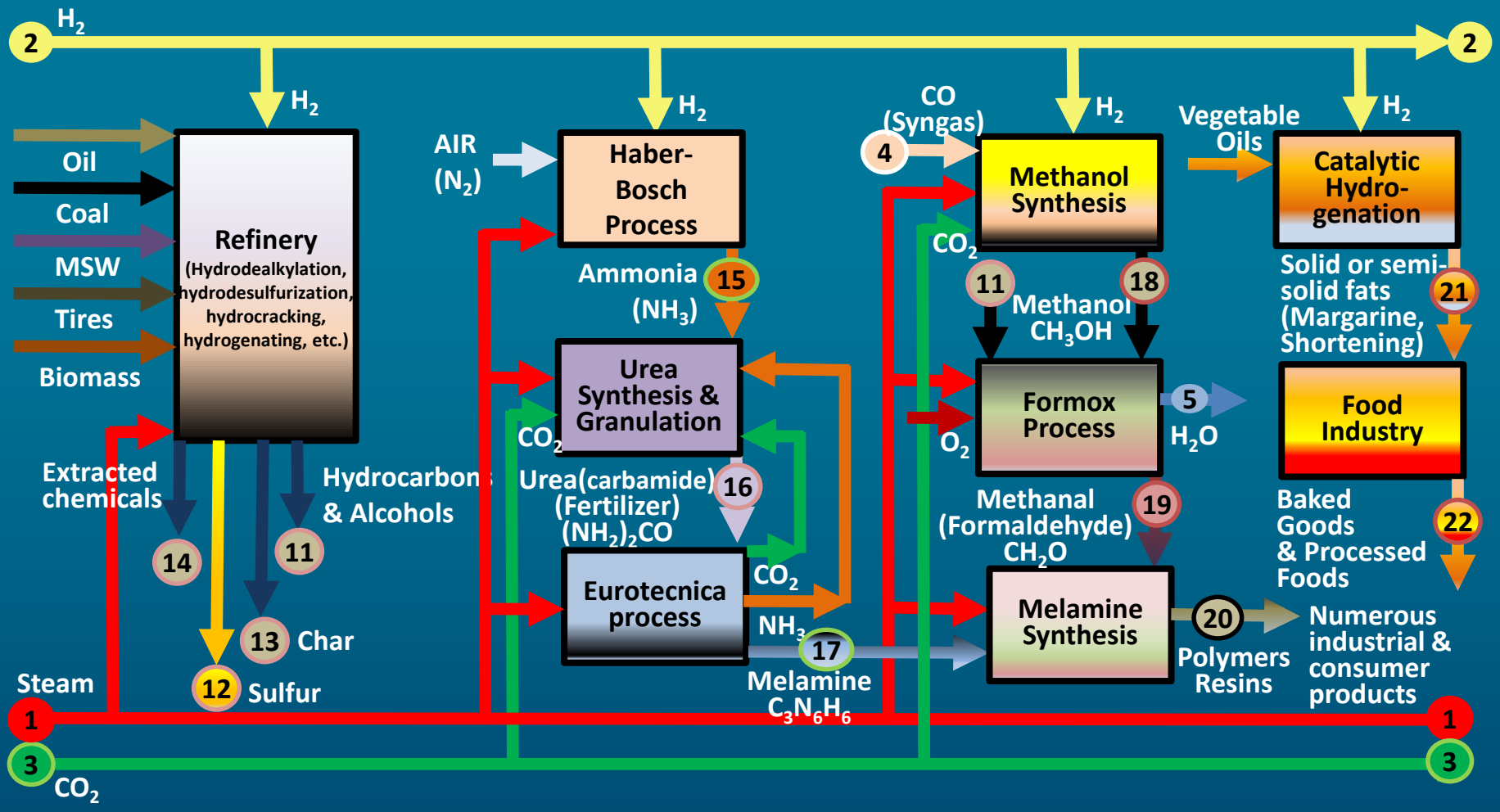
Additional Phases of IES-CLM



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IES-CLM Potential Benefits

- Effective resource management (Cost Savings)
  - Higher overall efficiency
  - Recycling of water and materials, including CO_2
  - Better utilization of capital equipment and lower operating expenses
    - Shared resources (e.g. infrastructure, facilities, personnel)
    - Shared processes (e.g. common/support systems)
- Use of local domestic and renewable resources
- Reduced waste and emissions
- Promotes sustainability on an industrial scale
- Industry collaboration and co-location
- Transformation of brownfield sites

Challenges

- Multiple organizations working together (Planning)
  - Must integrate people before you can integrate systems
- Large Capital Investment ($B's)
- Security (investment protection)
  - Potential terrorist target
- Requires unique sites (Megasites)
  - Near energy and other natural resources
  - Intensive industrial and support infrastructure
- Flexibility and resiliency
  - Dependent and independent operations
- Phased development and incorporation of new technology

Summary

- IES-CLM is not a new concept or technology but an integrated approach for applying technologies
  - "Systems of Systems" approach focused on comprehensive synergistic integration
- IES-CLM provides opportunity to optimize efficiency and effective resource management
  - Minimize cost and impact on the environment
- IES-CLM addresses the nexus of energy, water, climate, food, and waste on an industrial scale

For more information on the project, visit www.portsfuture.com

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