INEST

Institute for Nuclear Energy Science and Technology

Nuclear Hybrid Energy Systems

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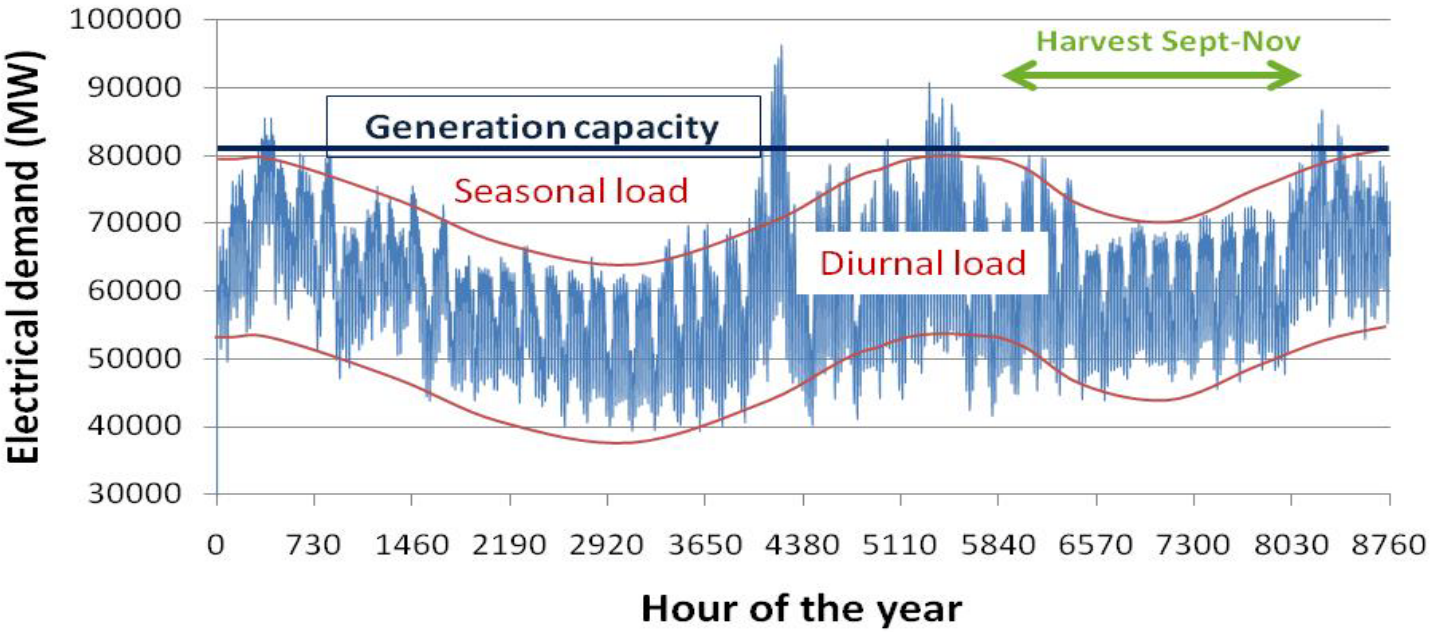
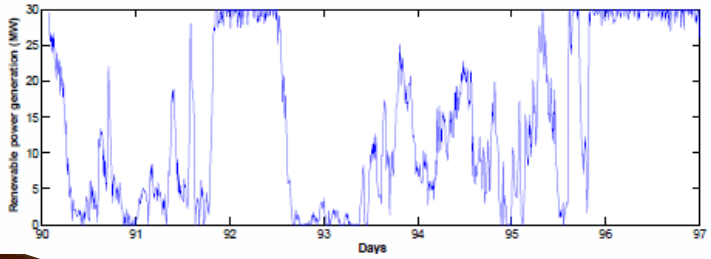
Power dynamics create HES opportunities

- ✓ Generation capacity is a high quality, clean, ubiquitous resource
- ✓ Excess diurnal capacity is available year round
- ✓ Excess seasonal variation is also available for other work

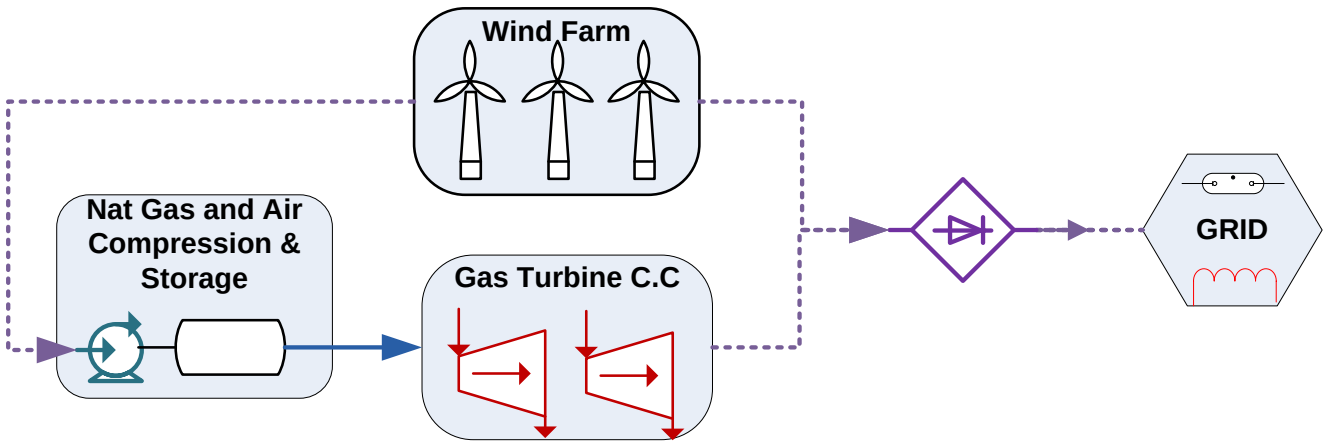


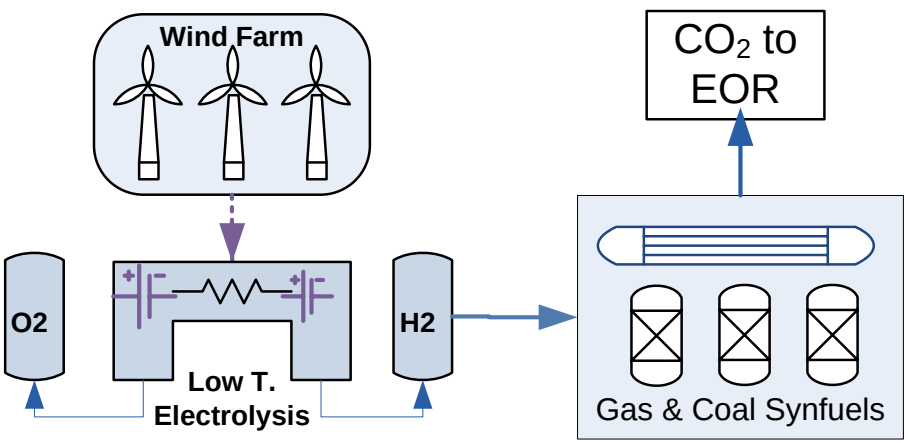


The Problem:

- ✓ Intermediate and Peaking Generation is underutilized
- ✓ Fossil fuel power generates GHG emissions
- ✓ New nuclear reactors are expensive
- ✓ Renewable sources are intermittent but stochastic

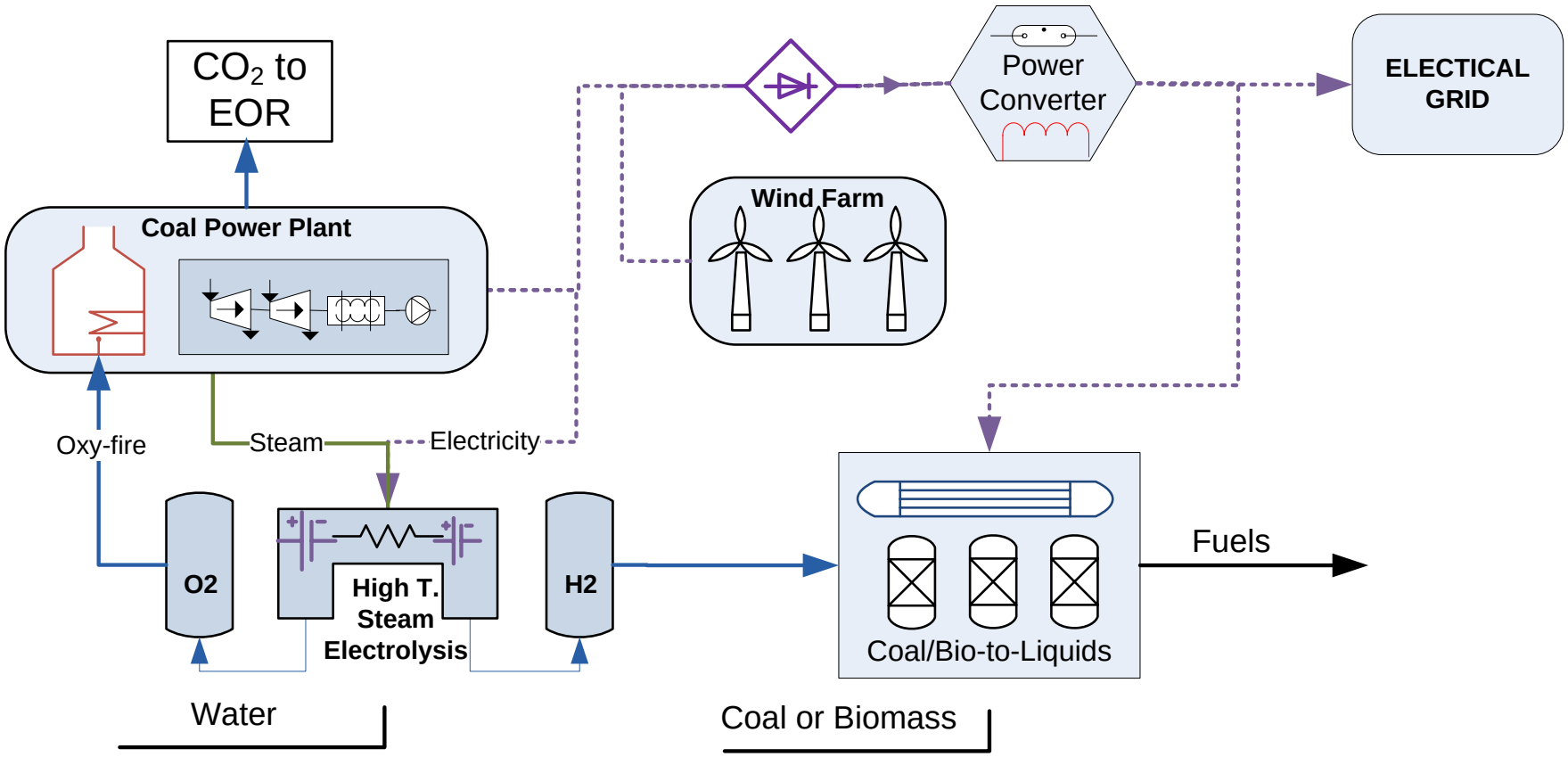
Hybrid System Process Examples 1:





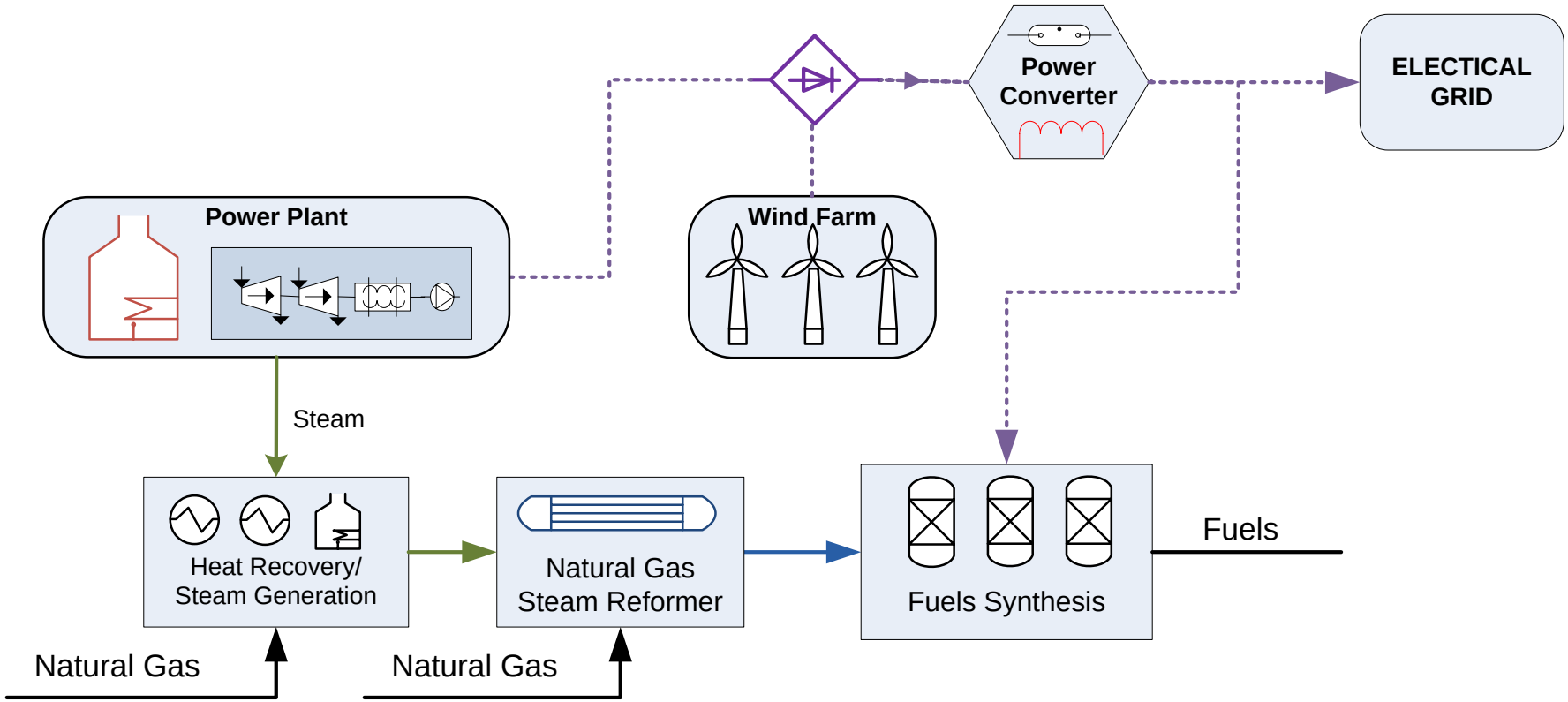
Dispatchable or Non-Dispatchable Wind
Hydrogen and Oxygen Storage
Low CO_2 Fuels

Hybrid System Process Example 2:



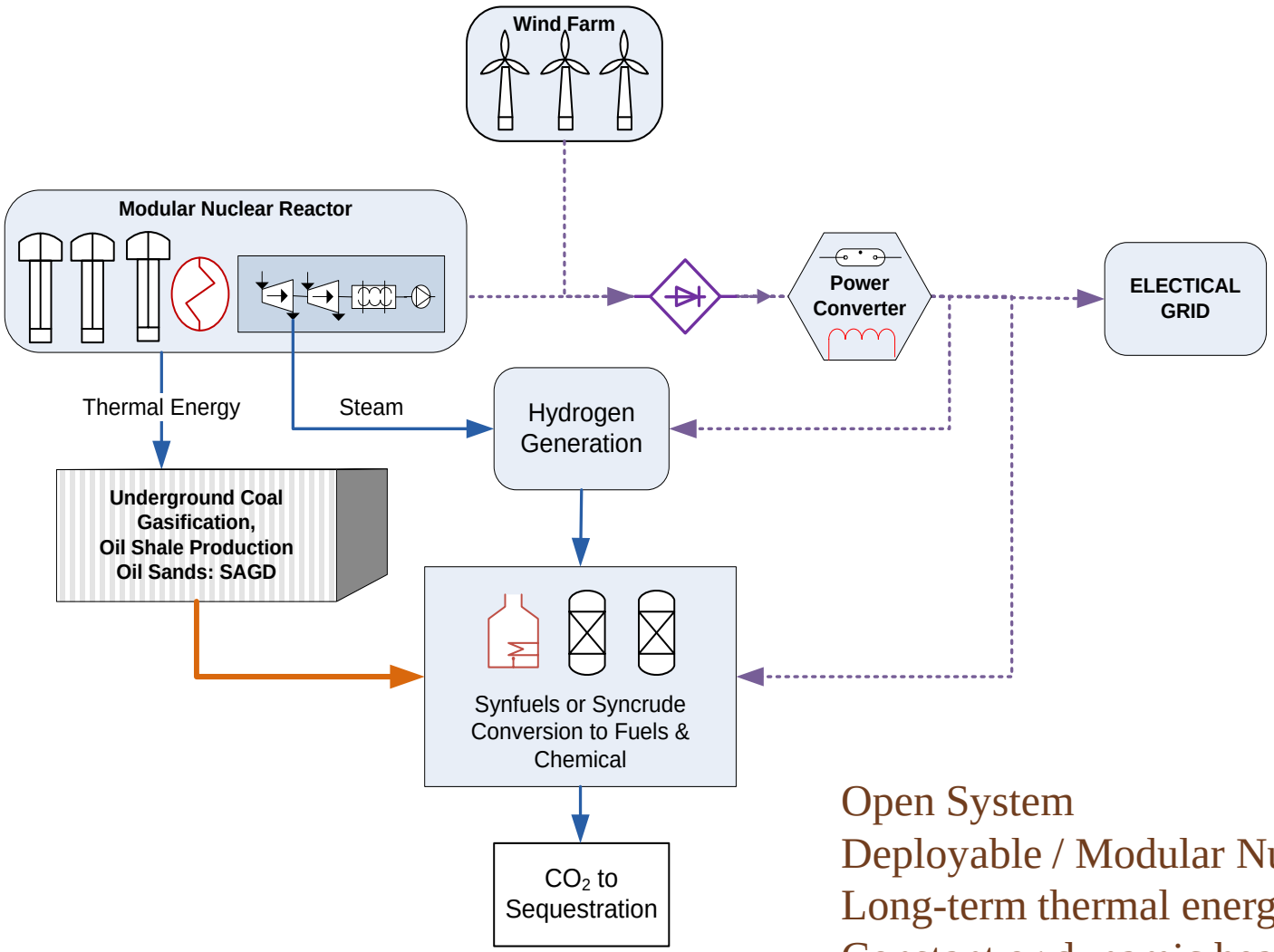
Closed or Open System
Dispatchable or Non-Dispatchable Wind
Hydrogen and Oxygen Storage
Retrofit Coal-Fired Plant (or IGCC)
Gasification or Pyrolysis Conversion
Low CO_2 Fuels

Hybrid System Process Example 3:



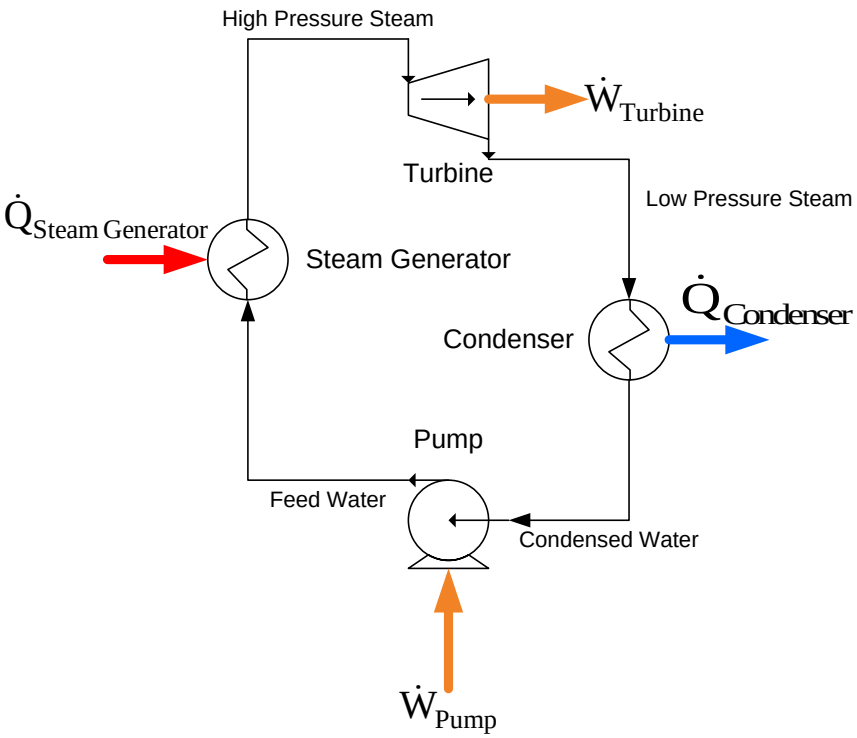
Closed or Open System
General Power Production Plant
Dispatchable or Non-Dispatchable Wind
Indirect-Heated Steam Methane Reforming
Dynamic Natural Gas –Fired Steam Gen.
Constant Fuels Production

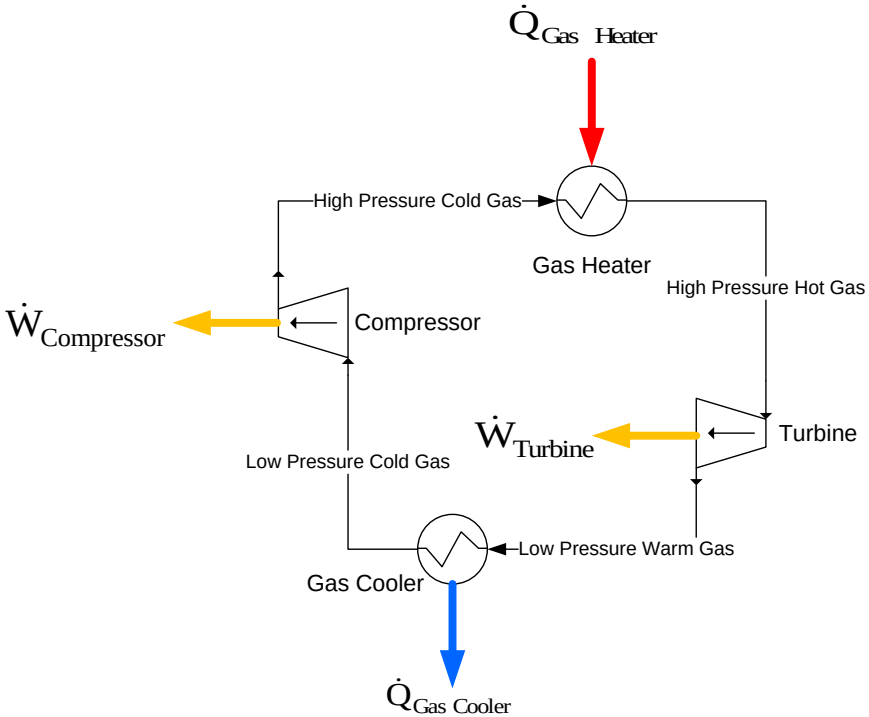
Hybrid System Process Example 4:



Open System
Deployable / Modular Nuclear Reactor
Long-term thermal energy deposition
Constant or dynamic heat maneuvering
Constant Fuels Production

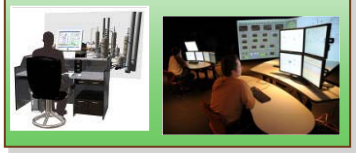
Simple Rankine and Brayton Cycles:





Energy Integration

Hybrid process and systems design; Economic & lifecycle analysis; Advanced monitoring & controls

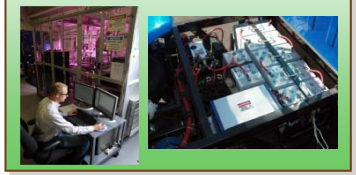


Systems Architecture, Integration, and Control

Thermal hydraulic component development/demonstration; Heat and electromagnetic process energy deposition

Energy Transfer

Dynamic electricity generation & storage; Hydrogen, fuels , & chemicals synthesis



Energy Conversion & Storage

Resource extraction and processing; Feedstock thermal treatment & conversion

Resource Production & Conversion

CO_2 separation & conversion; Solid waste conversion; Low grate heat recovery; Water treatment

Byproduct Management

Thermal Energy Management

- Reactor Design / Modularization
- Heat Generation / Transport
- Thermal Hydraulics
- Heat Exchangers
- Heat Upgrading
- Thermal Energy Storage
- Heat Deposition to Process
- Hydrogen Generation
- Chemical Energy Conversion
- Resource Extraction and Processing
- Materials Fabrication

System Operations

- Technical & Economical Analysis
- Dynamic System Modeling
- System Monitoring & Control
- Instrumentation
- Load-Following Power Generation Cycles
- Power Conditioning / Balancing
- Batteries
- Wind Turbines
- Electrical Power Transmission
- Regulatory / Licensing / Safety
- Human Factors
- Market Challenges