

Hybrid Energy Systems: An Integrated Energy System Scheme

Sustainability:

- Economic
- Environmental
- Social

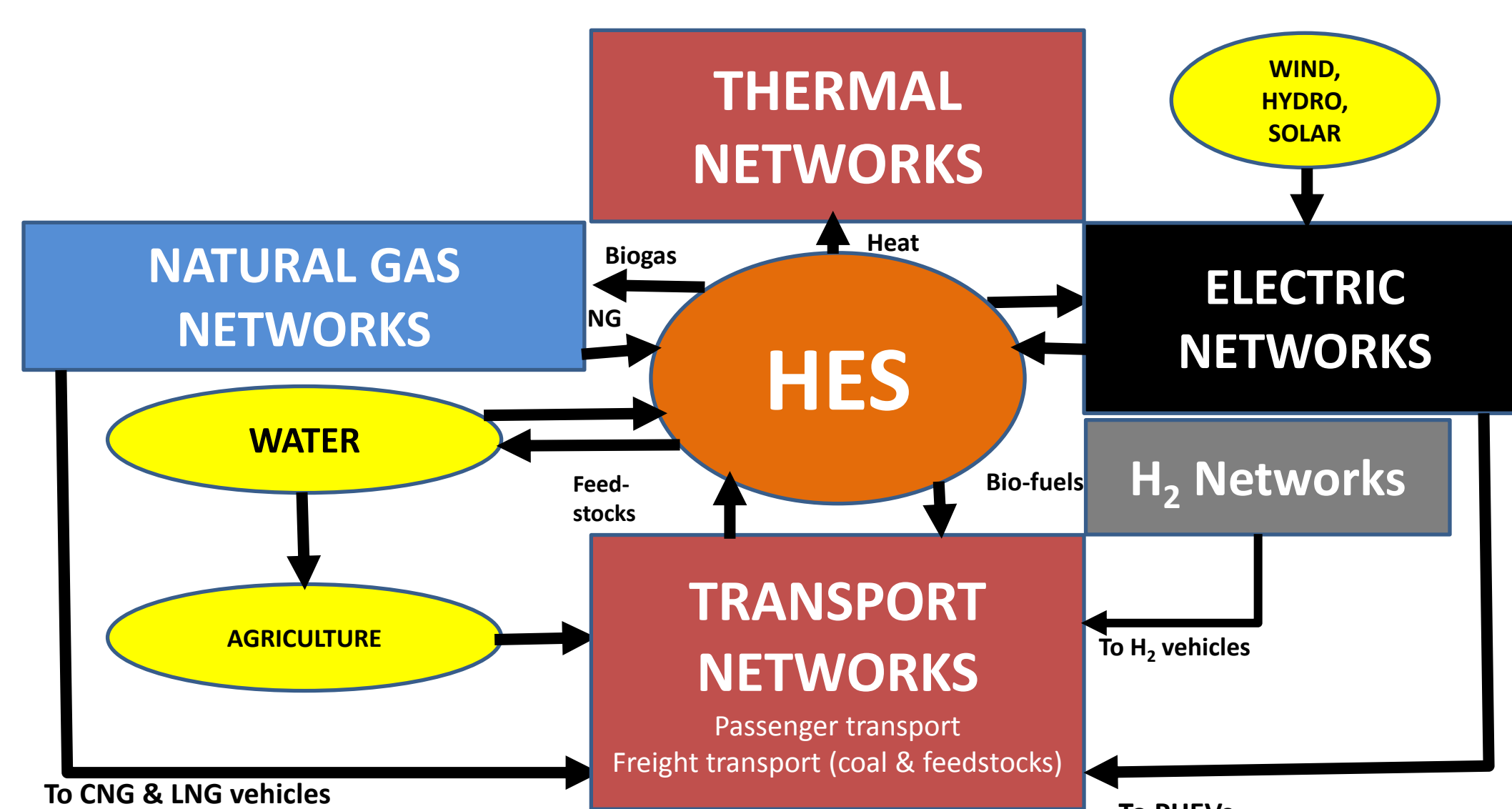
Infrastructure integrity

- Reliability
- Flexibility
- Resilience
- Adaptable

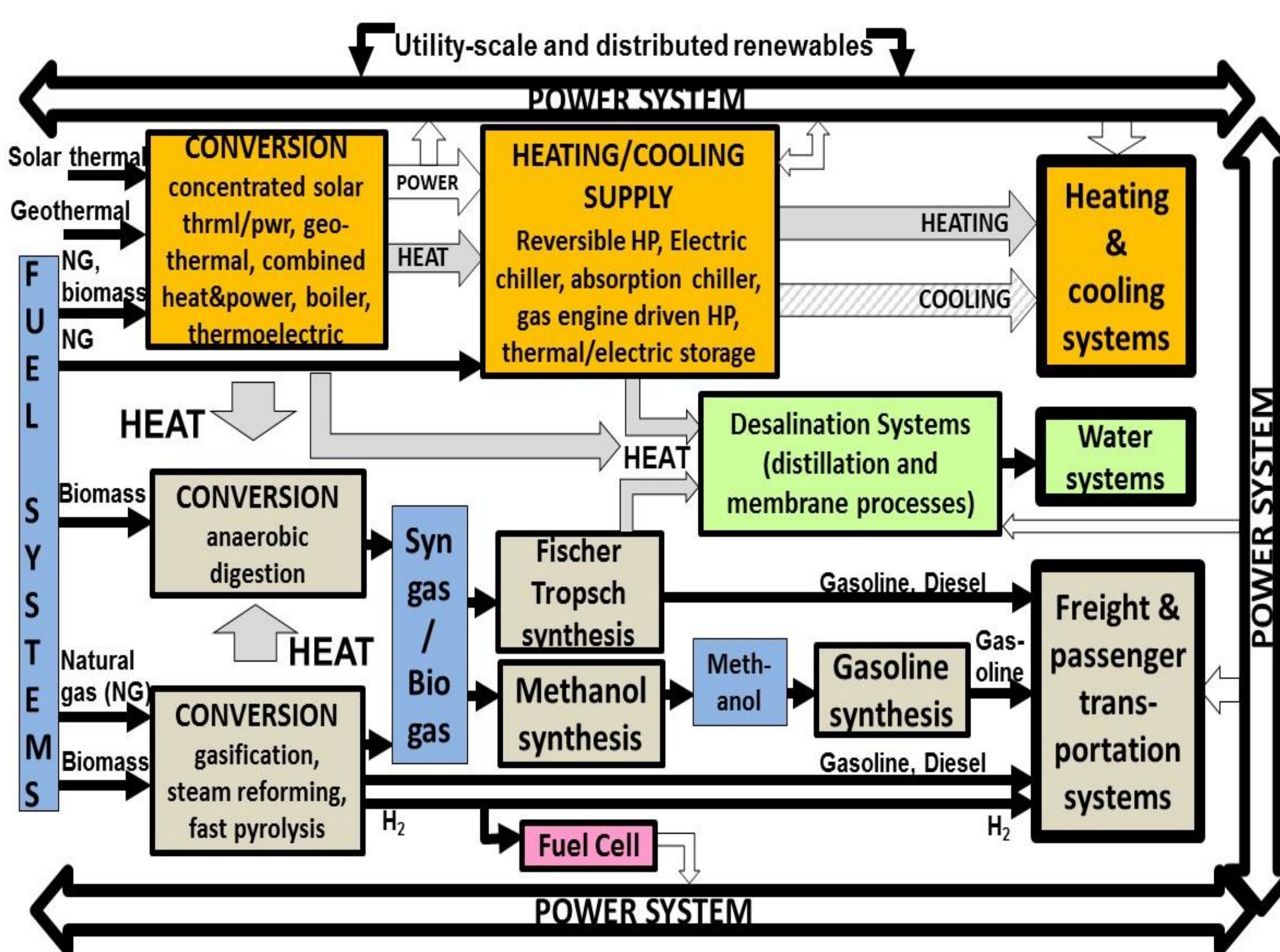
Results

- Case 1: High gas prices (6.2%/yr) with an imposed carbon tax
- Case 2: Low gas prices (3%/yr) with an imposed carbon tax
- Case 3: High gas prices (6.2%/yr) without an imposed carbon tax

Interdependent Infrastructures



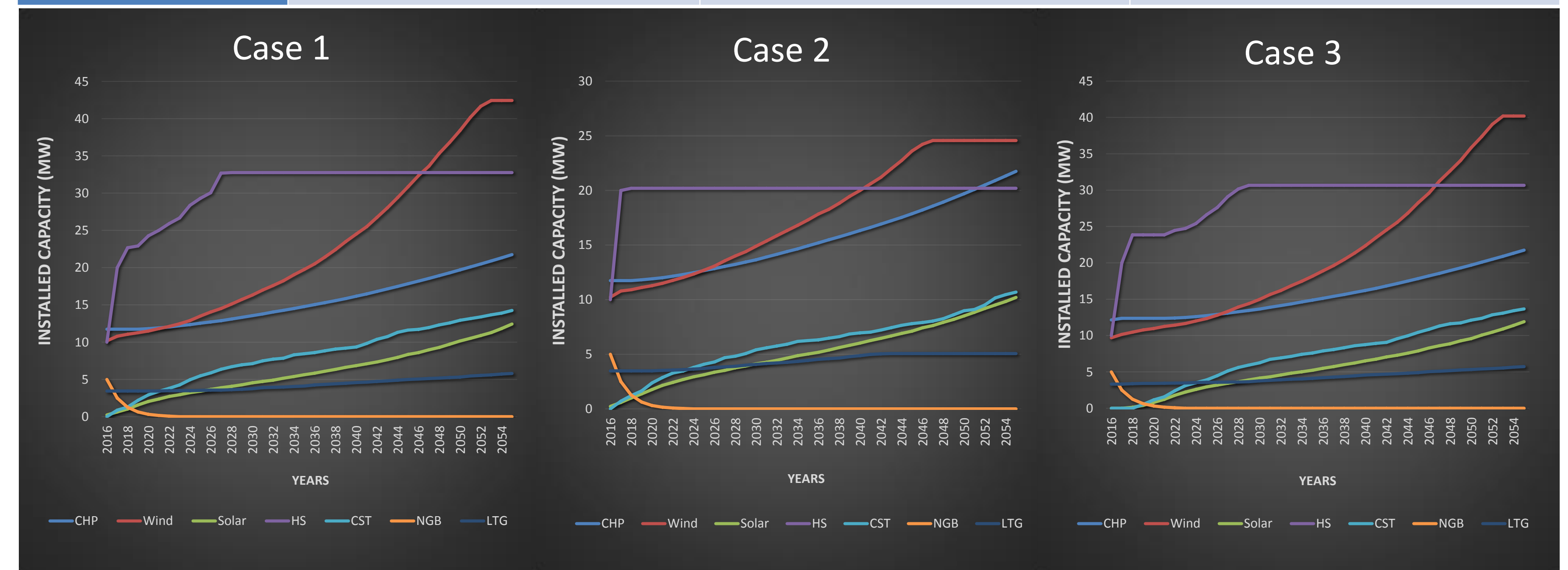
Template for a Hybrid Energy System



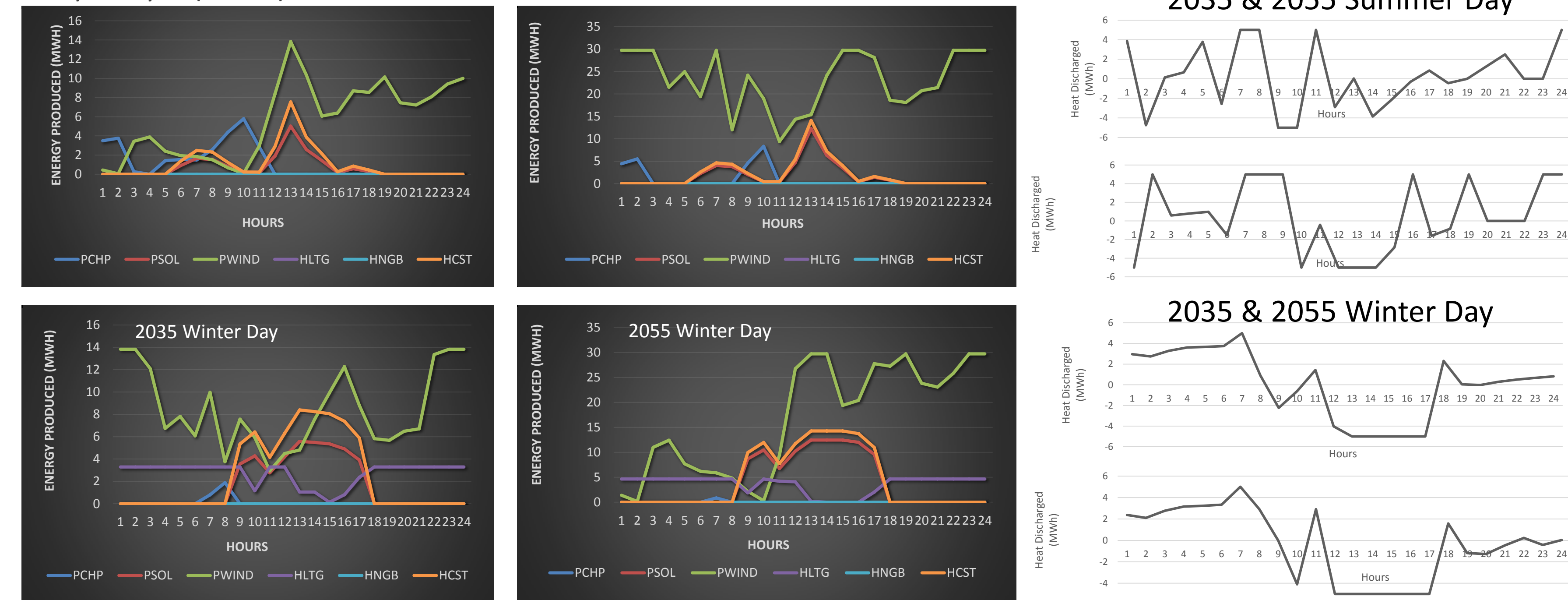
Features:

- A better DG
- At dist sub
- 10-100MW
- Modular
- built quickly
- region-specific configurations
- Efficient
- Flexible
- fast
- storage
- MIMO

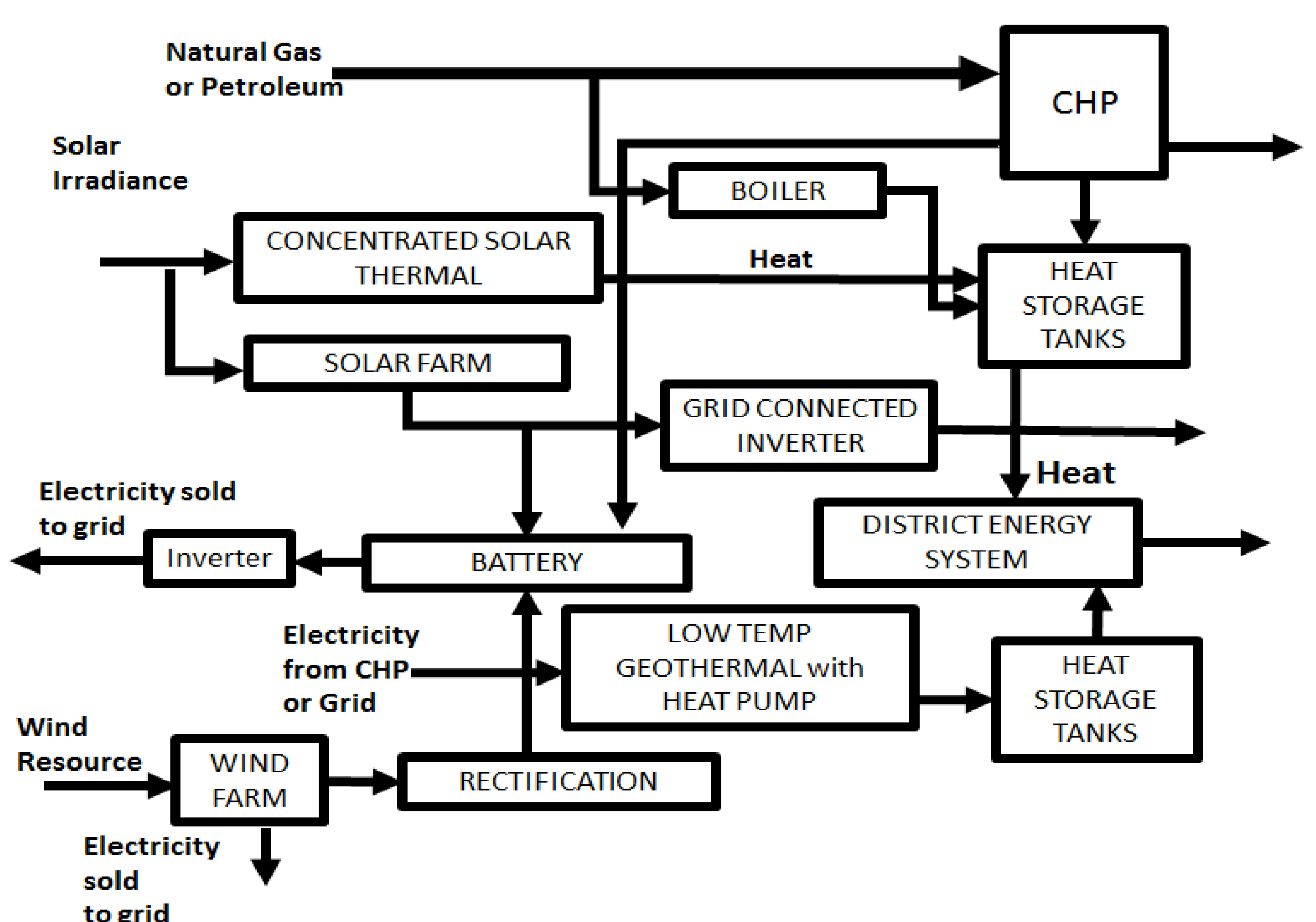
Technology	Energy Produced (MWh)		
	Case 1	Case 2	Case 3
CHP	794,375	1,645,477	1,613,157
Solar	524,857	455,703	482,766
Wind	2,664,404	2,016,707	2,470,422
LTG	133,082	117,868	123,584
CST	720,526	520,584	638,577
NGB	33,716	114,622	85,736



Hourly Analysis (Case 1)

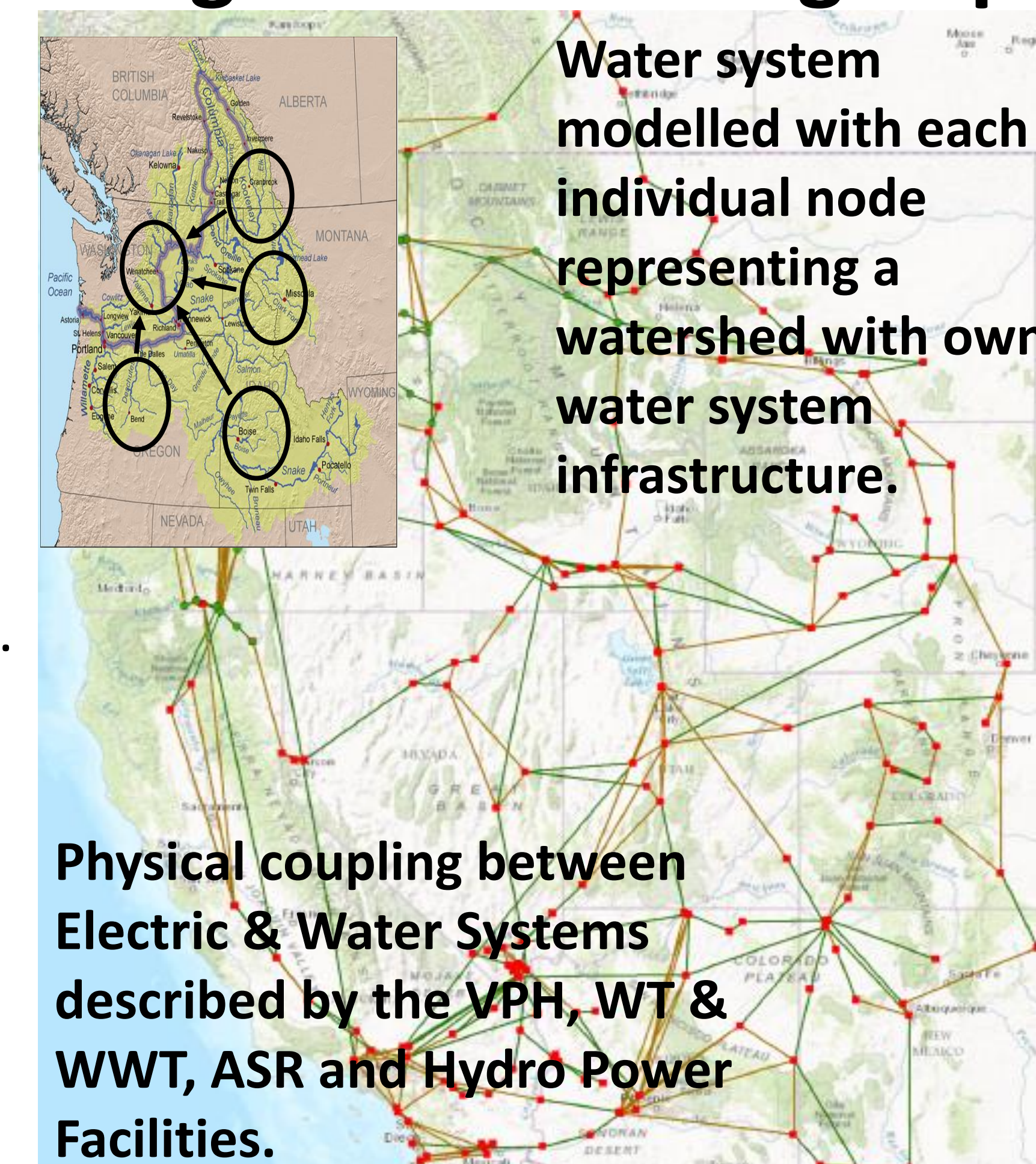


Geographically correct Midwest HES



- Two heat sources
- Two uses of low temperature heat
- Three forms of storage
- Effective configurations may utilize subset of these.

Integrated modeling of power & water systems



MIN NET PRESENT VALUE

G&T&W Investment Costs
+ Fixed O&M Costs
+ Var O&M Costs
+ Fuel Costs
+ Reserve Costs
+ Environmental Costs

SUBJECT TO:
Electric & Water Infrastructure Investment constraints
Electric & Water Operational, planning, environmental constraints
WT & WWT working level limits, Stream Flow Balance, ASR Charge/Discharge, VPH storage & release constraints

Decision Variables:
Investment variables for Electric & Water infrastructure
Operational levels for Electric & Water infrastructure

Year 1 Year 2 Year 20