Hybrid Energy Storage

Updates

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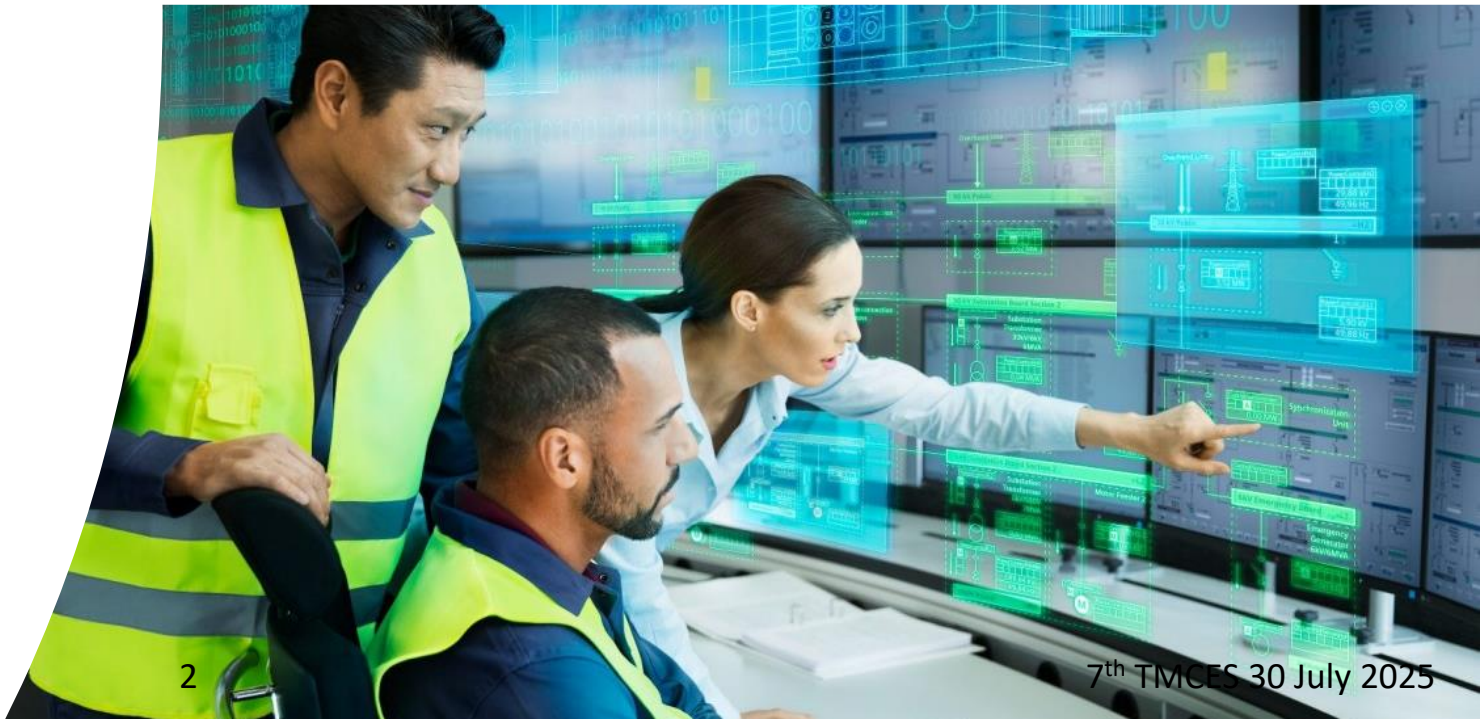
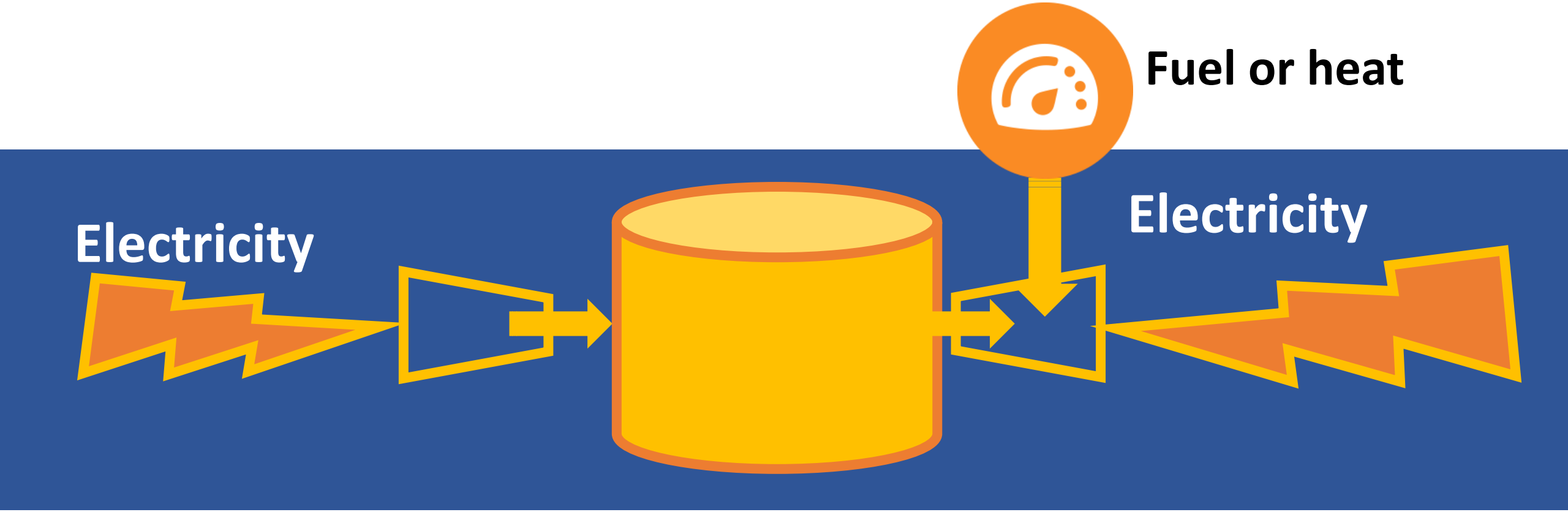
PINTAIL POWER

License and support hybrid energy storage technologies

- Integrated with gas turbines
  - Cryogenic Storage
  - Hot Thermal Storage
- Benefits
  - Cut fuel use
  - Cut storage cost
  - Leverage proven components



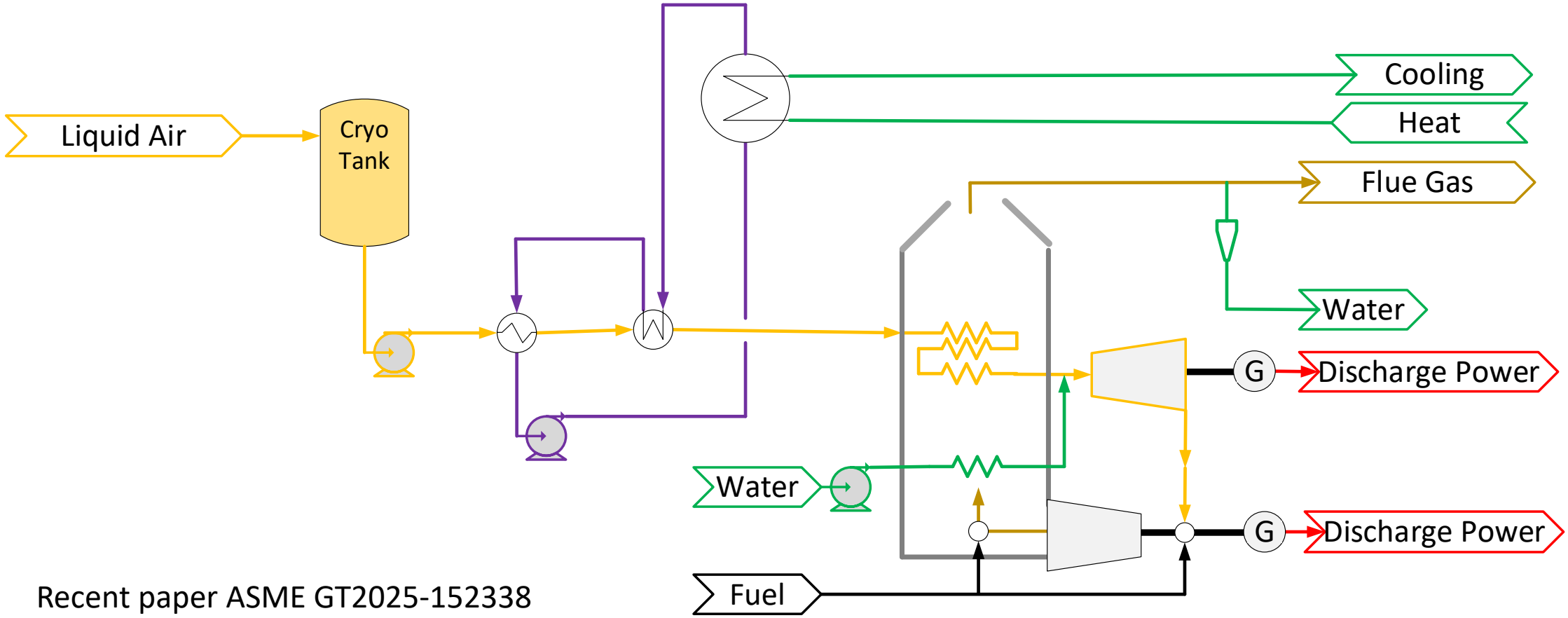
What is Hybrid Energy Storage



Cryogenic Hybrid

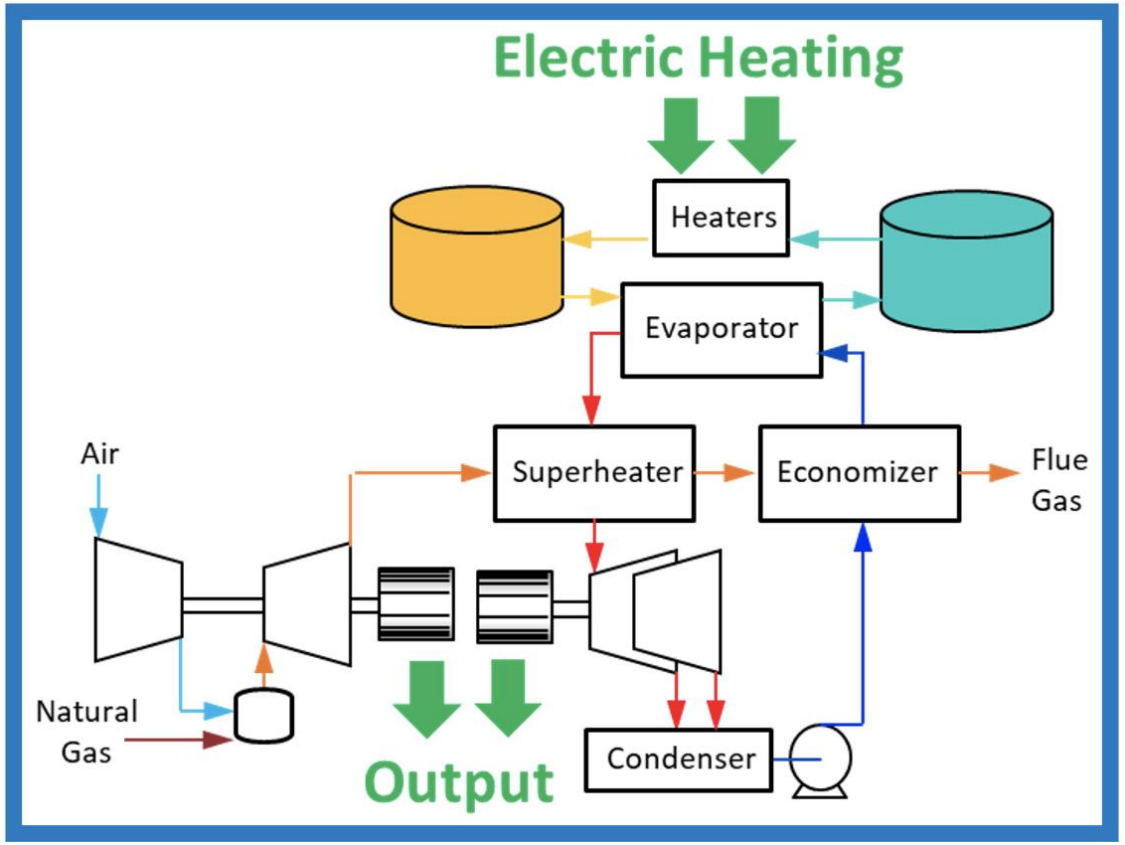
- **Highest storage density**
  - 378,000 kWh-e/m^3
- **Lowest storage cost**
  - <$1/kWh-e
- **Low self-discharge rate**
  - 0.012%/day

Cryo Storage with Data Center Cooling



Recent paper ASME GT2025-152338

Hot Thermal Hybrid: Liquid Salt Combined Cycle



Source: Electric Power Research Institute. 2022. Retiring Fossil Plants: Utilizing Thermal Energy Storage Technology for Longer Duration Energy Storage Deployment

- Peaker flexibility at ½ the fuel heat rate
  - Ready to run via steam cycle preheating
- Intermediate discharge capacity factor
  - Ramp, peak, and overnight operation
- Revenue during charging (w/o fuel)
  - Regulation up/down with variable salt flow and heater temperature control
  - Synchronous inertia and volt/var
  - Frequency regulation with solid state power controller

LSCC hybrid at intersection of key trends

- Load growth from electrification and data centers
- Renewable variability and need for flexibility
- Renewable curtailment and need for low-cost, large-scale storage
- Gas power growth hampered by long gas turbine lead times
- Utility interest in adding LSCC to existing simple cycle gas turbines

Questions?