

# Liquid Air Combined Cycle (LACC) for Power and Storage

Thermal-Mechanical-Chemical  
Energy Storage (TMCES) Workshop  
10-11 Aug 2021



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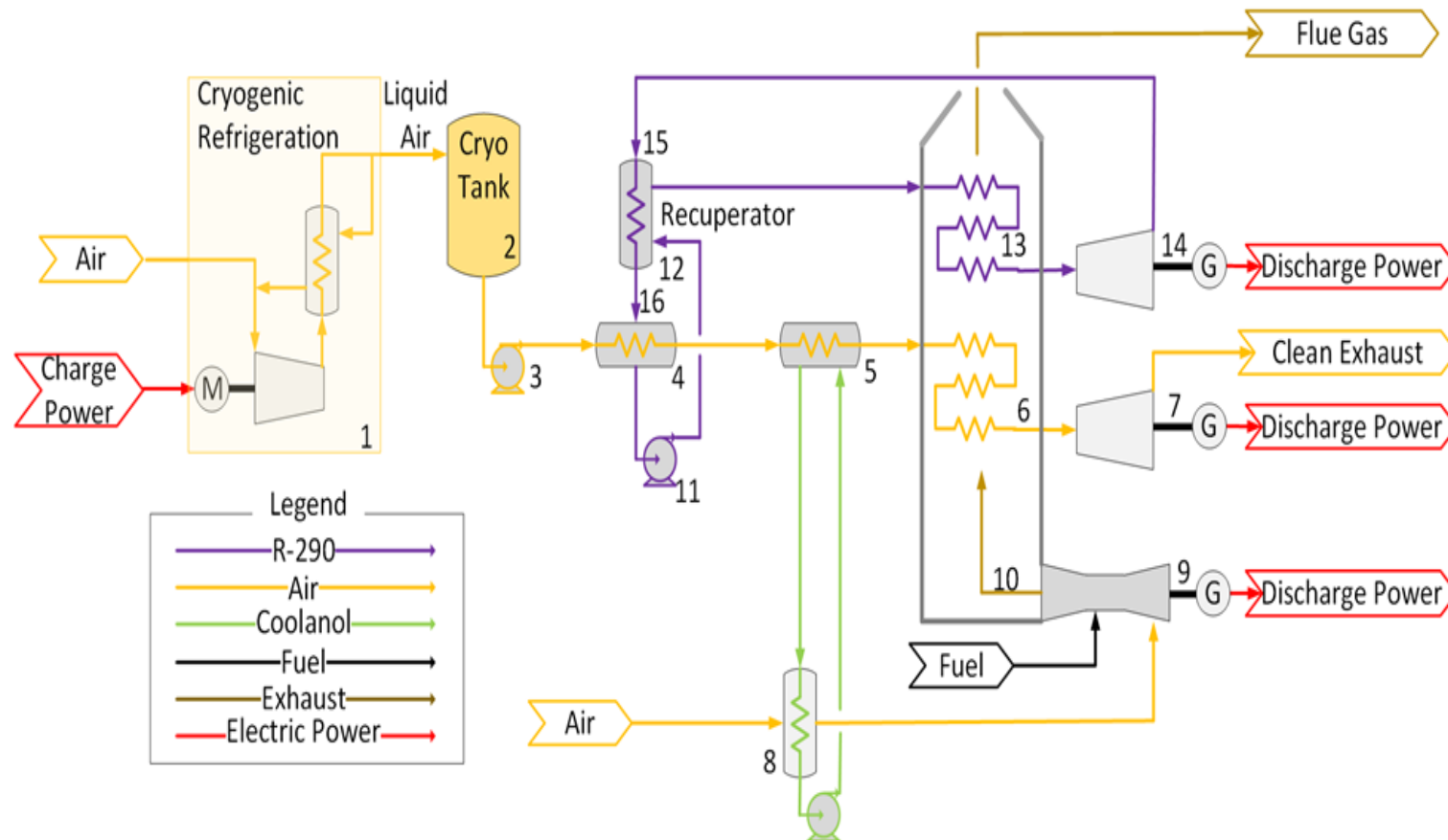
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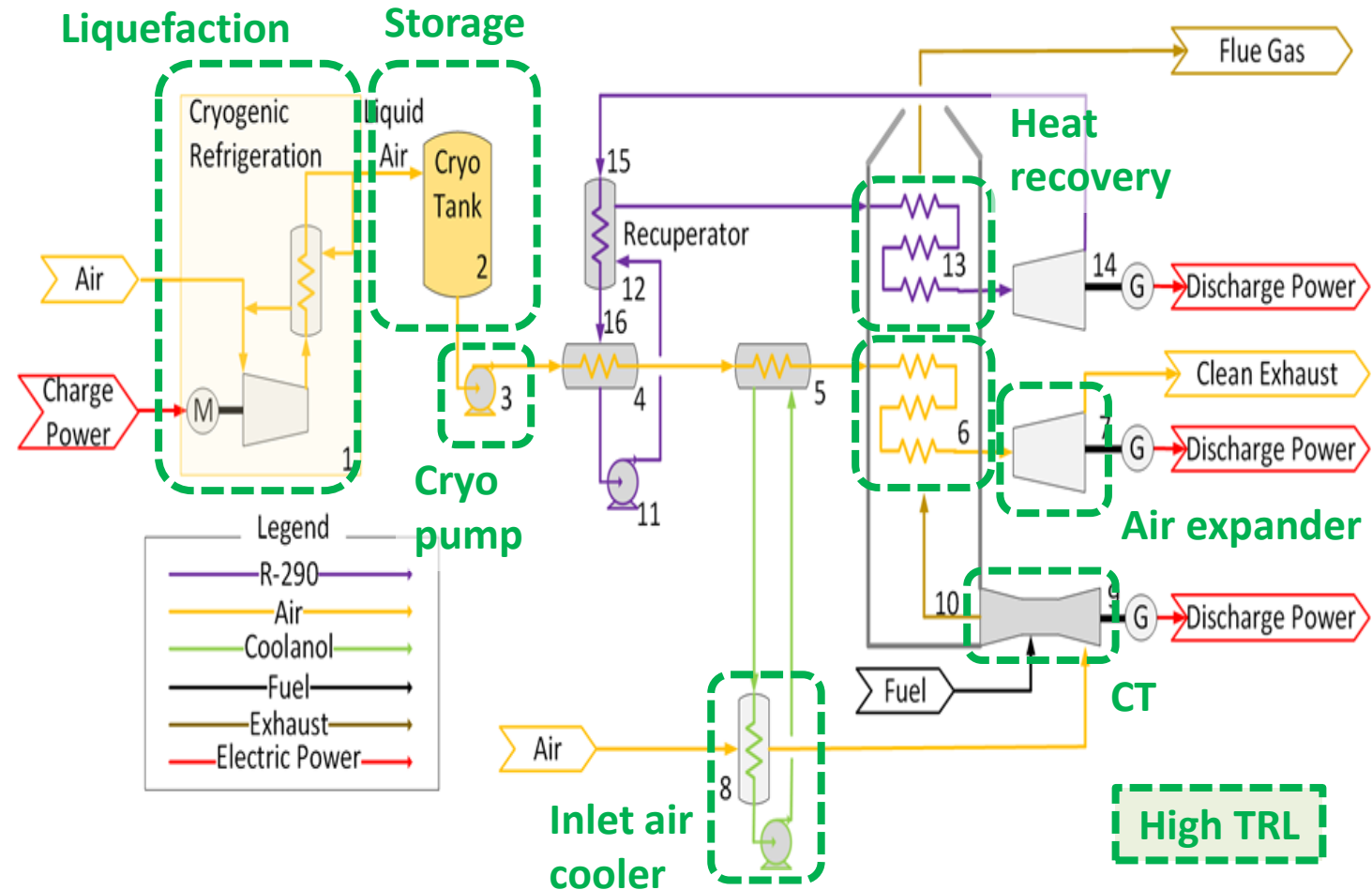
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Palo Alto, CA

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Mr. Milton Venetos



# LACC can be applied to existing or new combustion turbine assets

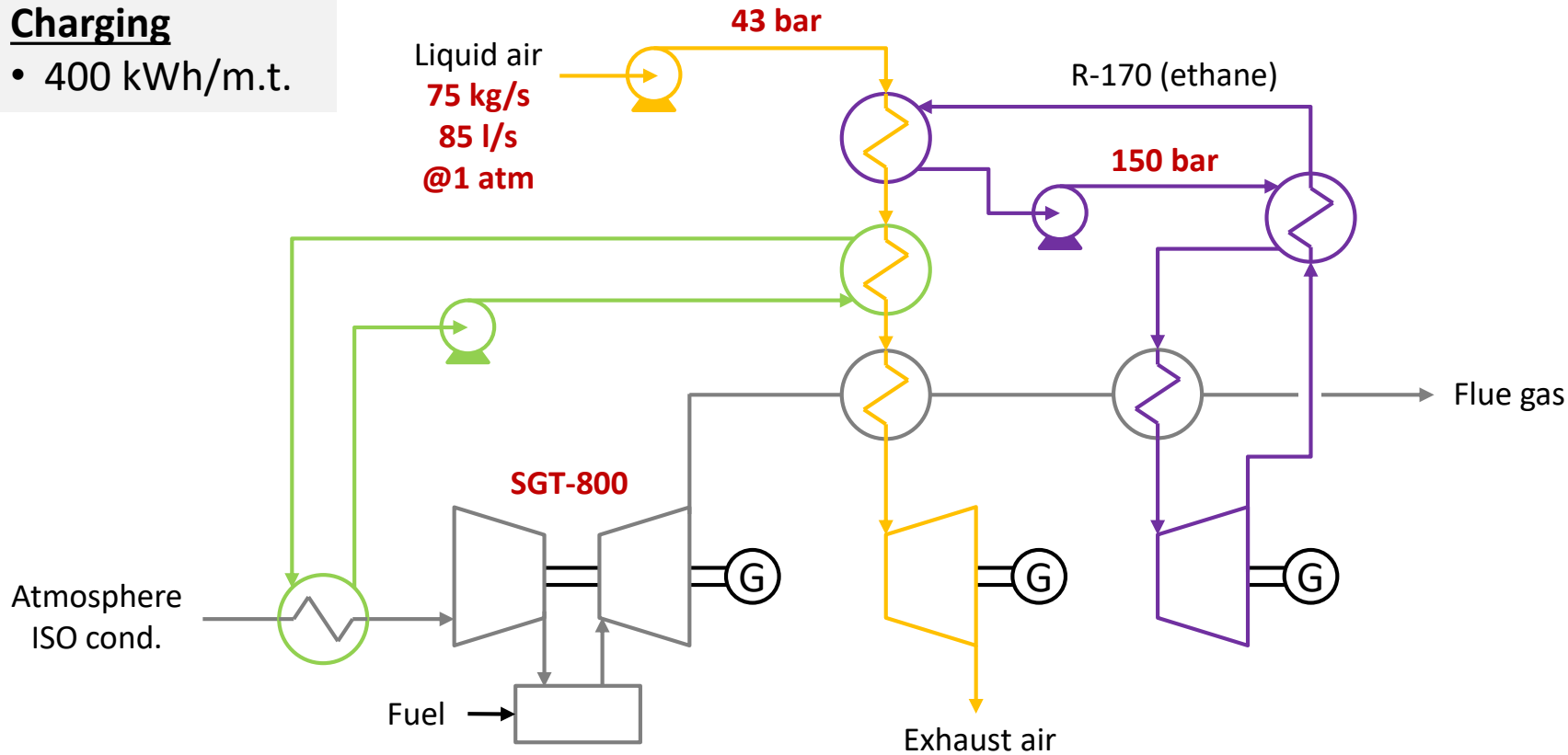
- Advantages
  - Any CT
  - Site anywhere
  - High-TRL components
  - Valuable at large scale
  - Lower CAPEX
- DOE project objectives
  - Identify application
  - LACC conceptual design
  - Demo-scale LACC



# Feasibility calculations have demonstrated preliminary performance

## Charging

- 400 kWh/m.t.



## Discharging

- Net power
  - SC: 54 MW
  - CC: 77 MW
  - **LACC: 104 MW**
- Fuel heat rate
  - SC: 8,725 Btu/kWh
  - CC: 5,993 Btu/kWh
  - **LACC: 4,532 Btu/kWh**
- Primary (electric) energy rate
$$\frac{\text{Charge energy}}{\text{Discharge energy}} = \mathbf{1.04}$$
- Liquid air rate = **2.6 kg/kWh**

# Commercialization/market considerations

- Cryo liquefaction is capital intensive
  - Reducing liquid air consumption key cost reducer
  - Zero-cost storage medium offsets CAPEX
  - Benefits from economy of scale
- Coupling opportunities
  - Fuel security (co-liquefy natural gas)
  - H<sub>2</sub>, Renewable fuel cost savings via low heat rate
  - Oxy combustion for carbon capture



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## *Questions?*



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