

# Hydrogen-Hybrid Microgrid Developments 2024



**Resilient Power Works, LLC**  
**Hagerstown MD**



# Hydrogen-Hybrid Microgrids “HHM” 2024

*REVOLUTIONIZING THE GRID OF TODAY... AND TOMORROW:*

## *KEY HHM FEATURES*

### **CLEAN, DISTRIBUTED, DISPATCHABLE BASE-LOAD POWER**

- Produces its own Hydrogen on-site (Gray and Green) AT ONLY 50 PSI –
- Eliminates Fuel Storage and Transportation concerns
- Exceptional Fuel Efficiency (2 ½ times better than using only a NG Turbine)
- Produces less than 1/100<sup>th</sup> the CO<sub>2</sub> of a coal-burning generator  
while producing the same electrical power
- Extends the useful life of its SOFC by more than 7-times

# Hydrogen-Hybrid Microgrids “HHM” 2024

## UTILITY BENEFITS:

- **LOW-COST SPINNING RESERVES**
- **Capable of Load Following = Greater Efficiency**
- **Fuel Composition Flexibility:**
  - Can run on Gray, Blue and/or Green Hydrogen produced on-site with Natural Gas, Methane, Propane, and/or Renewables
- **Provides optimum power solutions for US Military Installations and other Critical Infrastructure**

# Hydrogen Hybrid Microgrids “HHM” 2024

## Optimal Location for Installing the Hydrogen Hybrid Microgrid

- Low-voltage Bus --Distribution Substation  
*(utility-side or behind-the-meter)*
- **Point of Common Coupling:**  
Each Feeder (as needed).
- Does not replace the “bulk power grid;”  
*it stabilizes, enhances and buttresses*

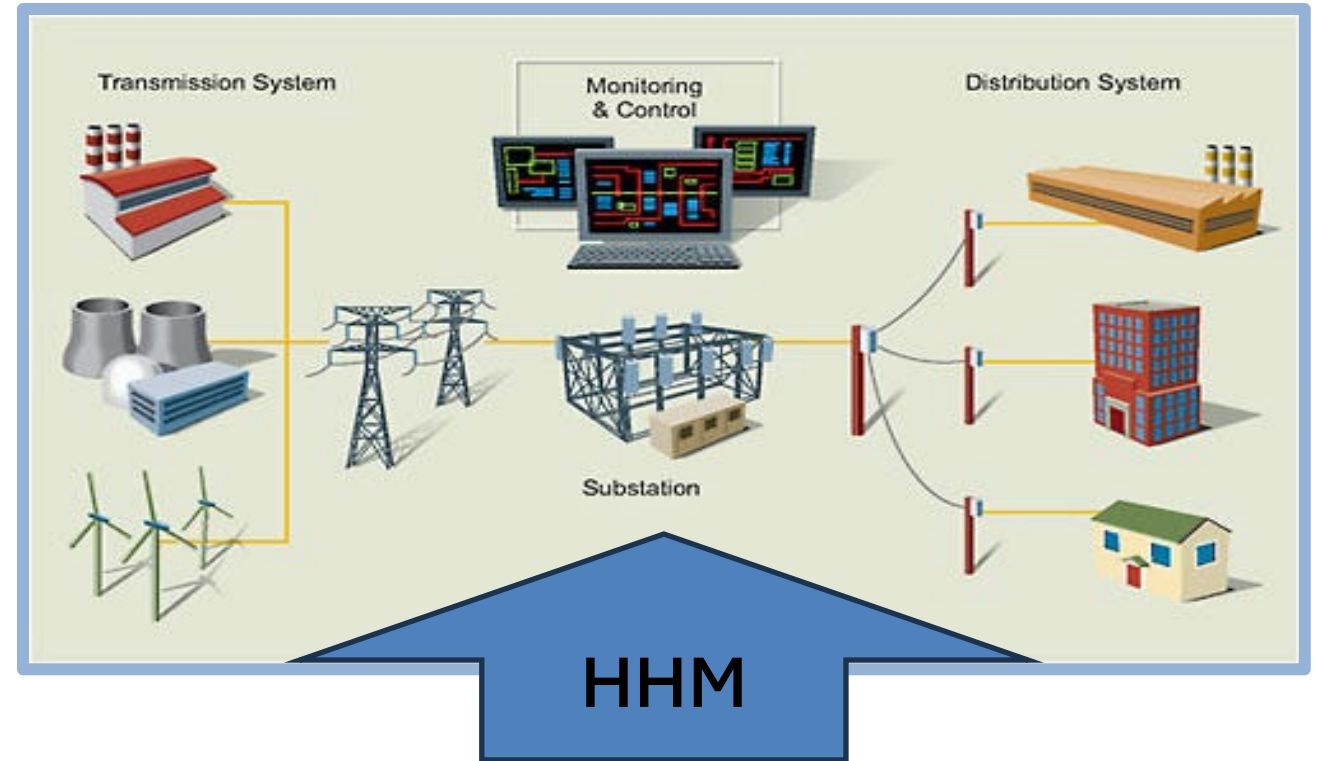




# Hydrogen Hybrid Microgrids “HHM” 2024

Designed to Be:

- Dispatchable
- Load-Following
- Scalable
- Resilient
- Spinning-Reserve  
Balancing Capacity
- A Unique Distributed-  
Generation Resource



**Strategically Commissioned at  
Distribution Substations**

# Hydrogen-Hybrid Microgrids “HHM” 2024

- **SCALABLE & ADAPTABLE**  
DISTRIBUTED ENERGY RESOURCE
- DISPATCHABLE BASE-LOAD POWER 24/7
- MINIMAL NORMAL CO2 PRODUCTION or  
CARBON CAPTURE OPTIONS
- SUPPORTS LONG-TERM RELIABILITY  
OBJECTIVES (NERC 2023)



# ***Spinning reserves within the NE ISO will need to increase “by an order of magnitude” by 2040.***



Image of utility control room above and excerpt from July 2023 article in [Utility Dive](#).

***Wide-spread adoption and commissioning of the HHM at critical Nodes in the nation’s distribution system can help utilities meet critical demand, provide baseload, dispatchable power as a Distributed Generation asset as the Grid demands it.***



# *LOCATIONAL BENEFITS: Hydrogen-to-Power (H2POWER) Toolkit For facilities and utility managers*



Workforce Development Programs Planned



# ***HHM PILOT UNDER CONSTRUCTION*** ***at National Energy Technology Lab – Morgantown, WV***



**HHM PILOT UNIT  
to be completed  
September 2024**



# Control Development for Hybrid Systems



**Resilient Power Works, LLC.**

**Rick Lank**

**Rebecca Rush**

**U.S. DOE**

**National Energy  
Technology Laboratory**

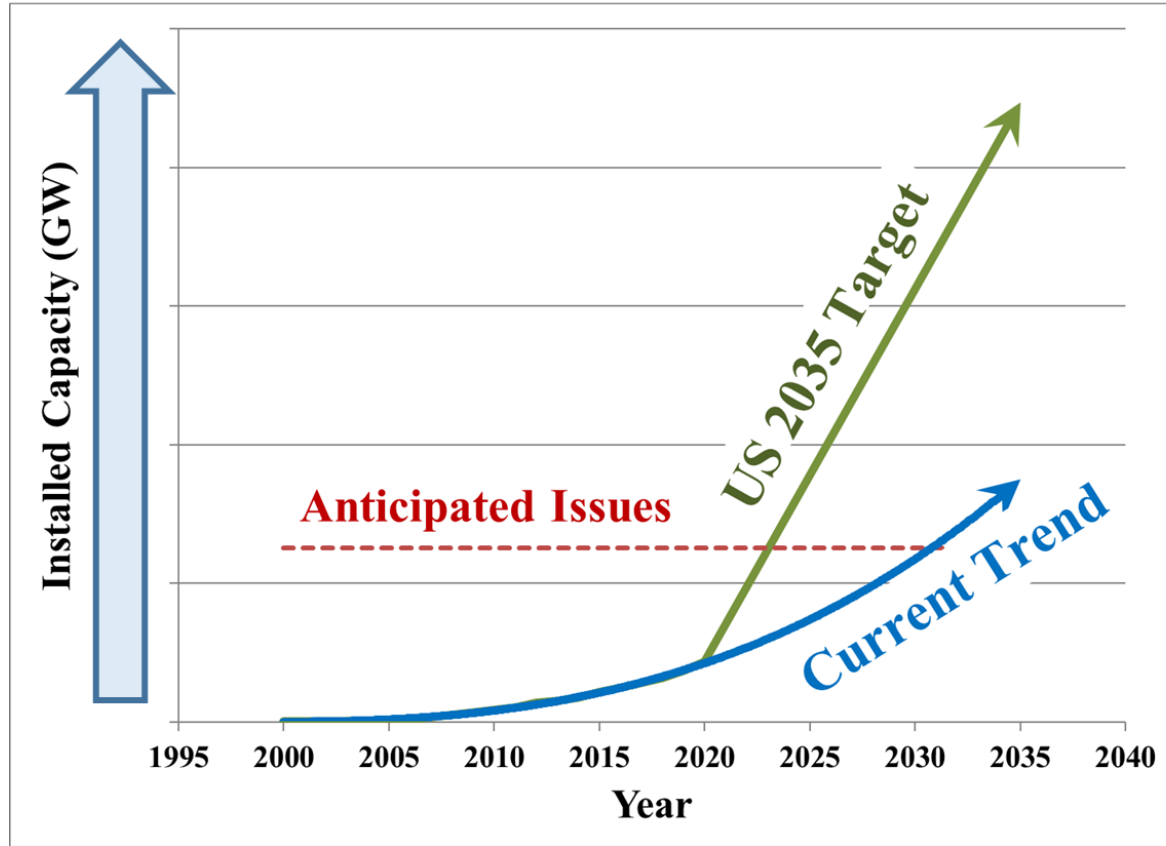
**David Tucker**

**Farida Harun**

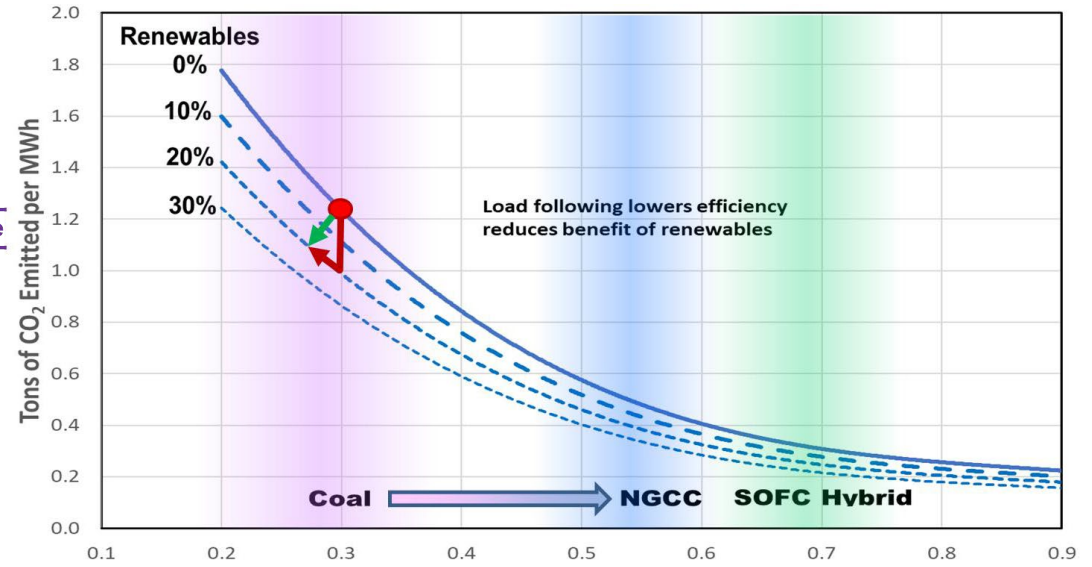
**Nana Zhou**

# Motivation

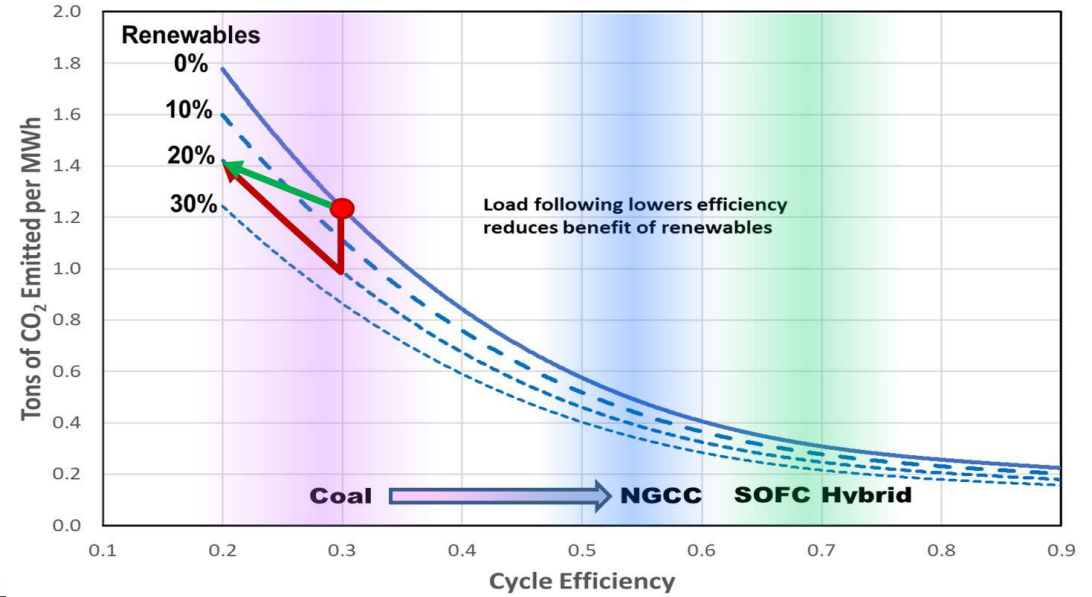
## Combined Solar and Wind



Net Decrease



Net Increase

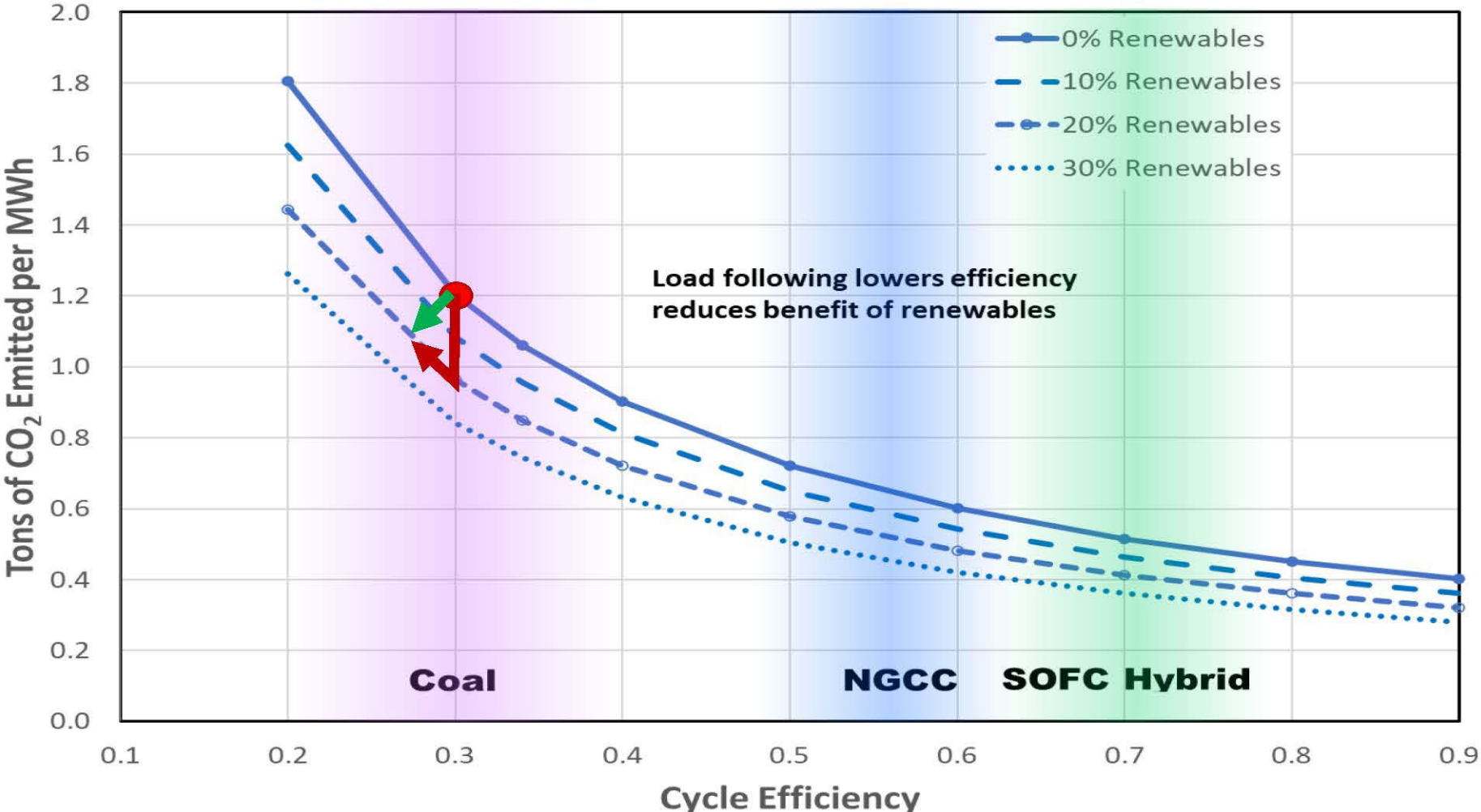




# Motivation

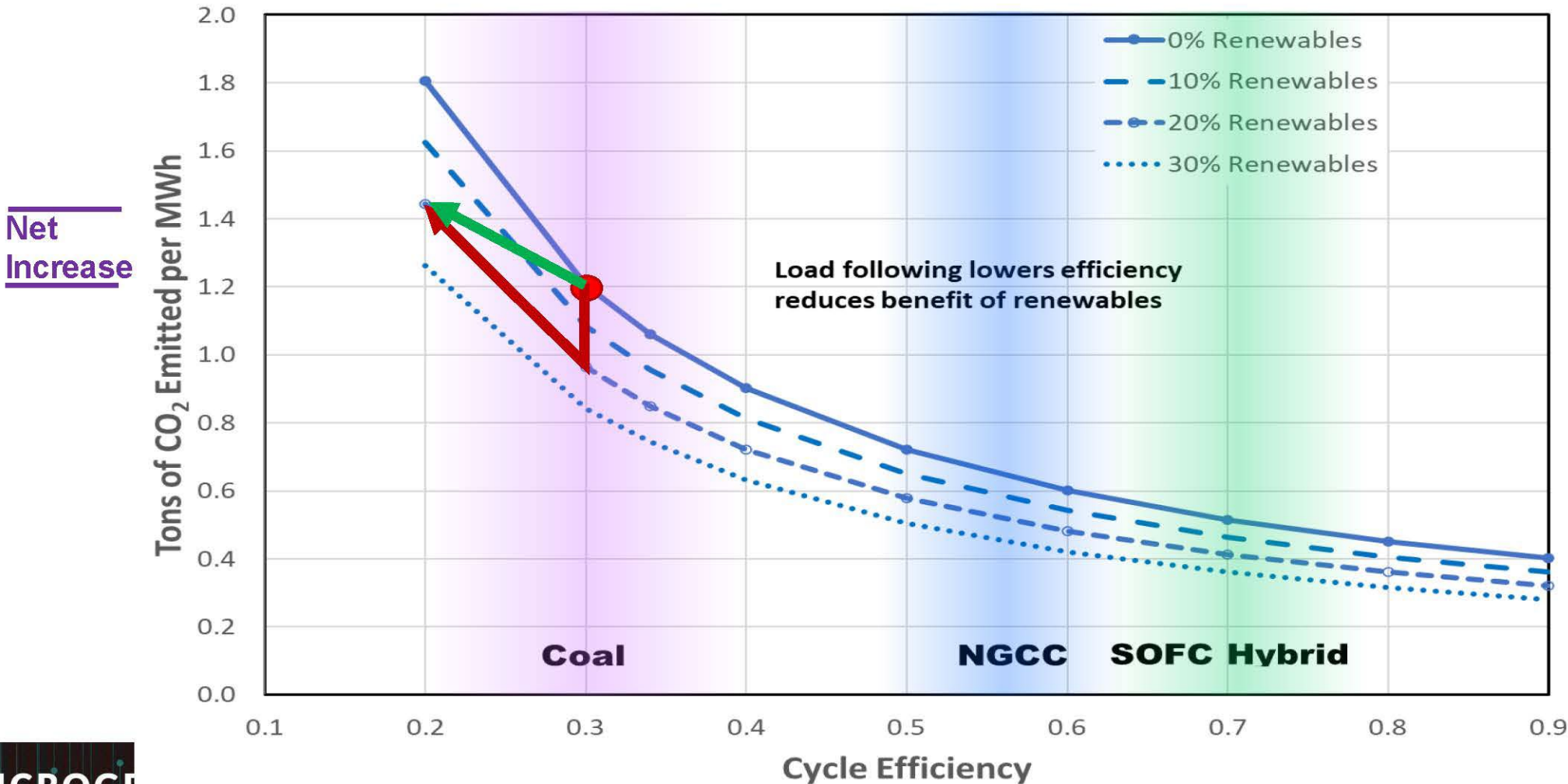
## Impact of Efficiency and Renewables on CO<sub>2</sub> Emissions

Net Decrease



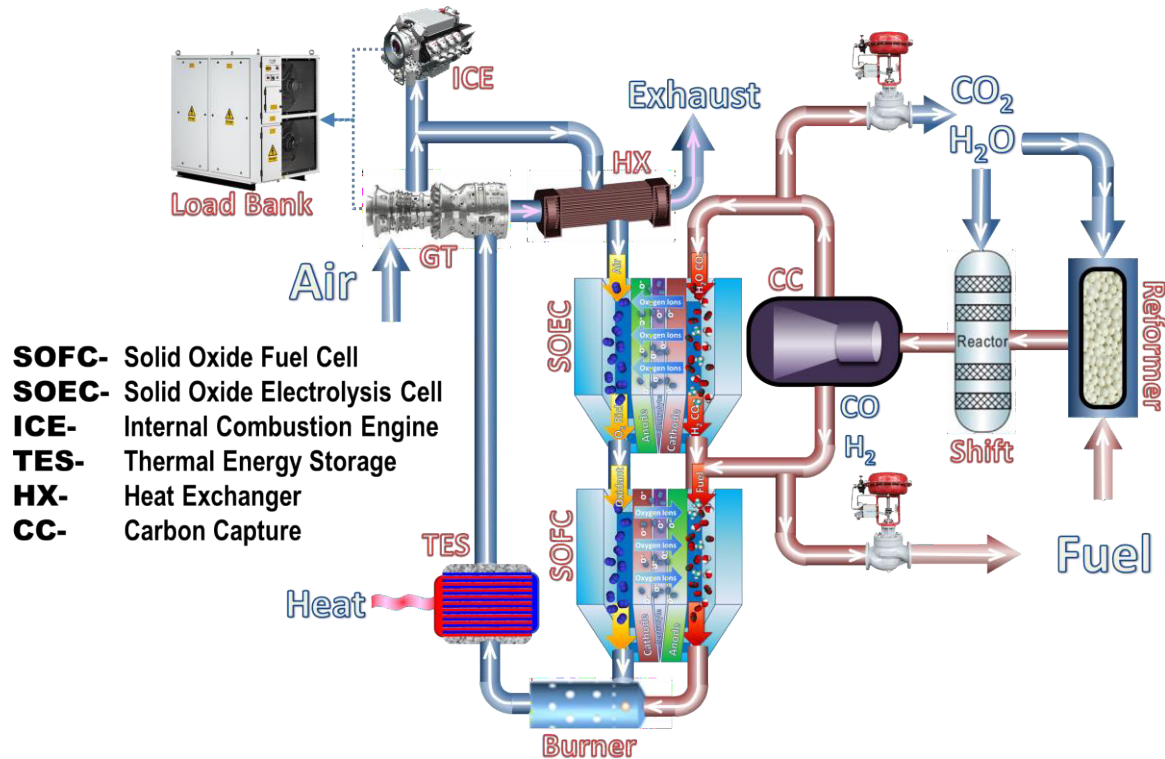
# Motivation

## Impact of Efficiency and Renewables on CO<sub>2</sub> Emissions





# Novel Hybrid Concepts Needed

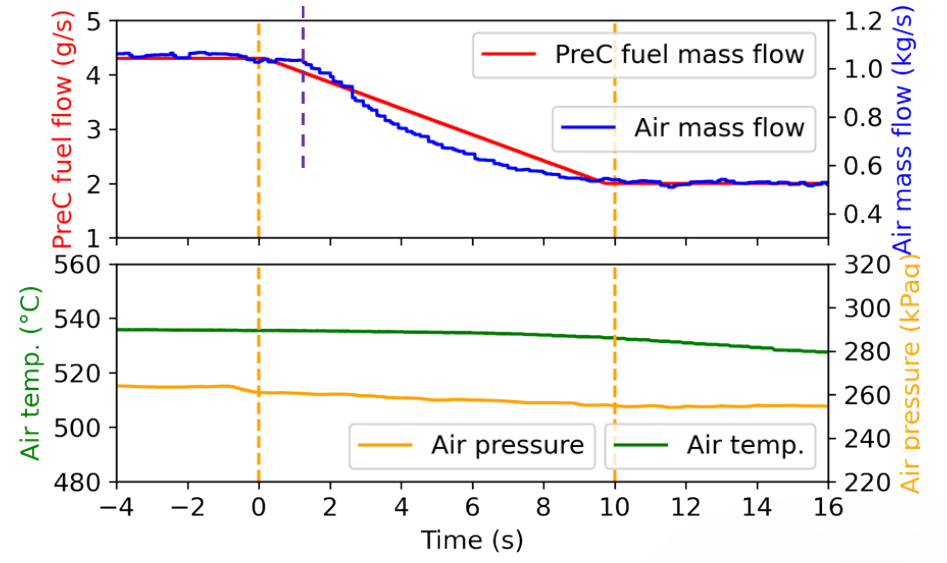
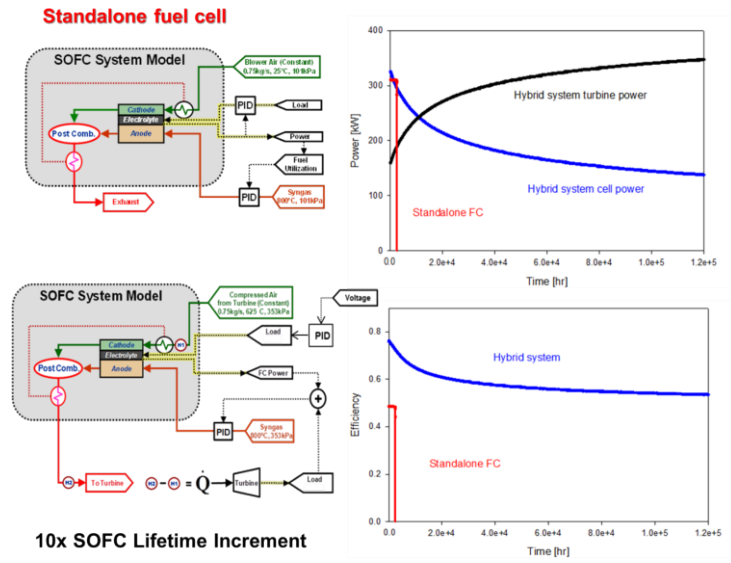
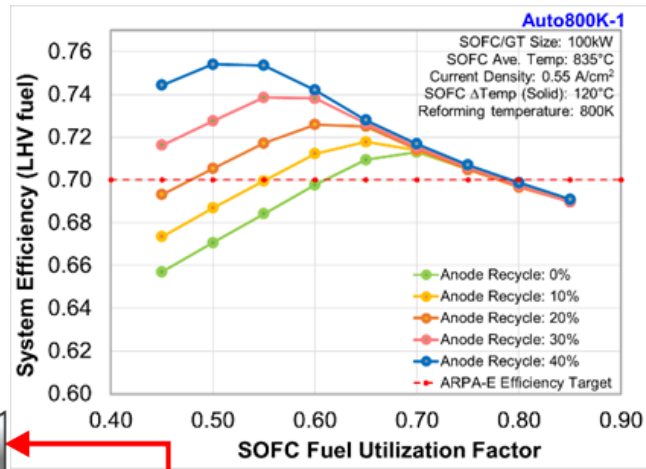
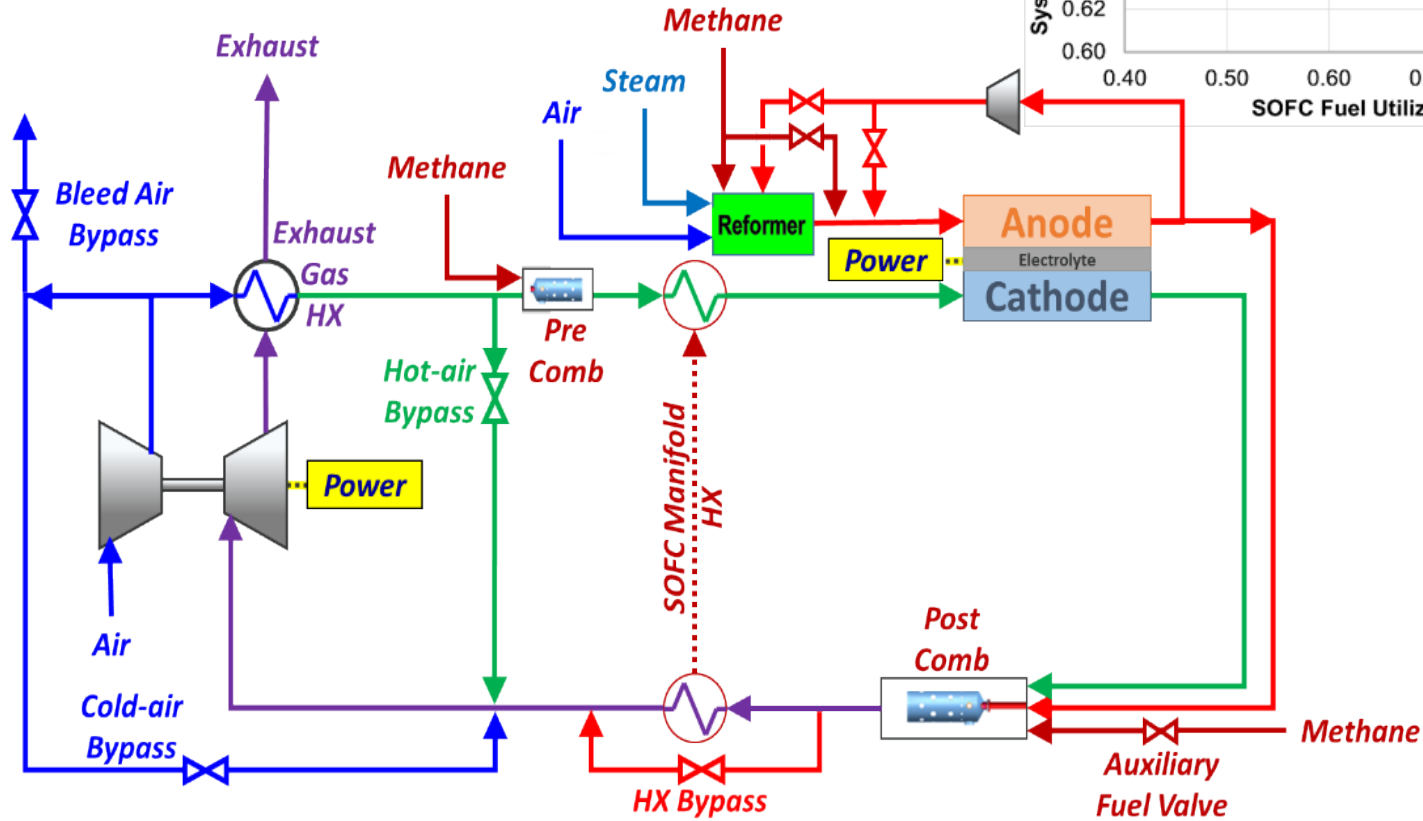


Achieving the highest efficiency and flexibility with the lowest emissions with Integrated Energy Systems





# Hybrid Systems





# Control Development for Hybrid Systems



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#### Collaborators on the HHM Proposal to ESTCP (DoD)

- **Sandia National Labs** (Locational Benefits, Energy Forecasting, Environmental Impact)
- **Pacific Northwest National Labs (PNNL)** – (Human Factors; Utility Operator Training)
- **University of Texas – Arlington (UTA)** – (Load-following, Grid Integration; Engineering Trng, Workforce Development)

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**THE REVOLUTION IN  
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