Bio-based/Natural Gas Hybrids: New Power Systems Options for the Distributed Generation Market

Art Lilley

Community Power Corporation

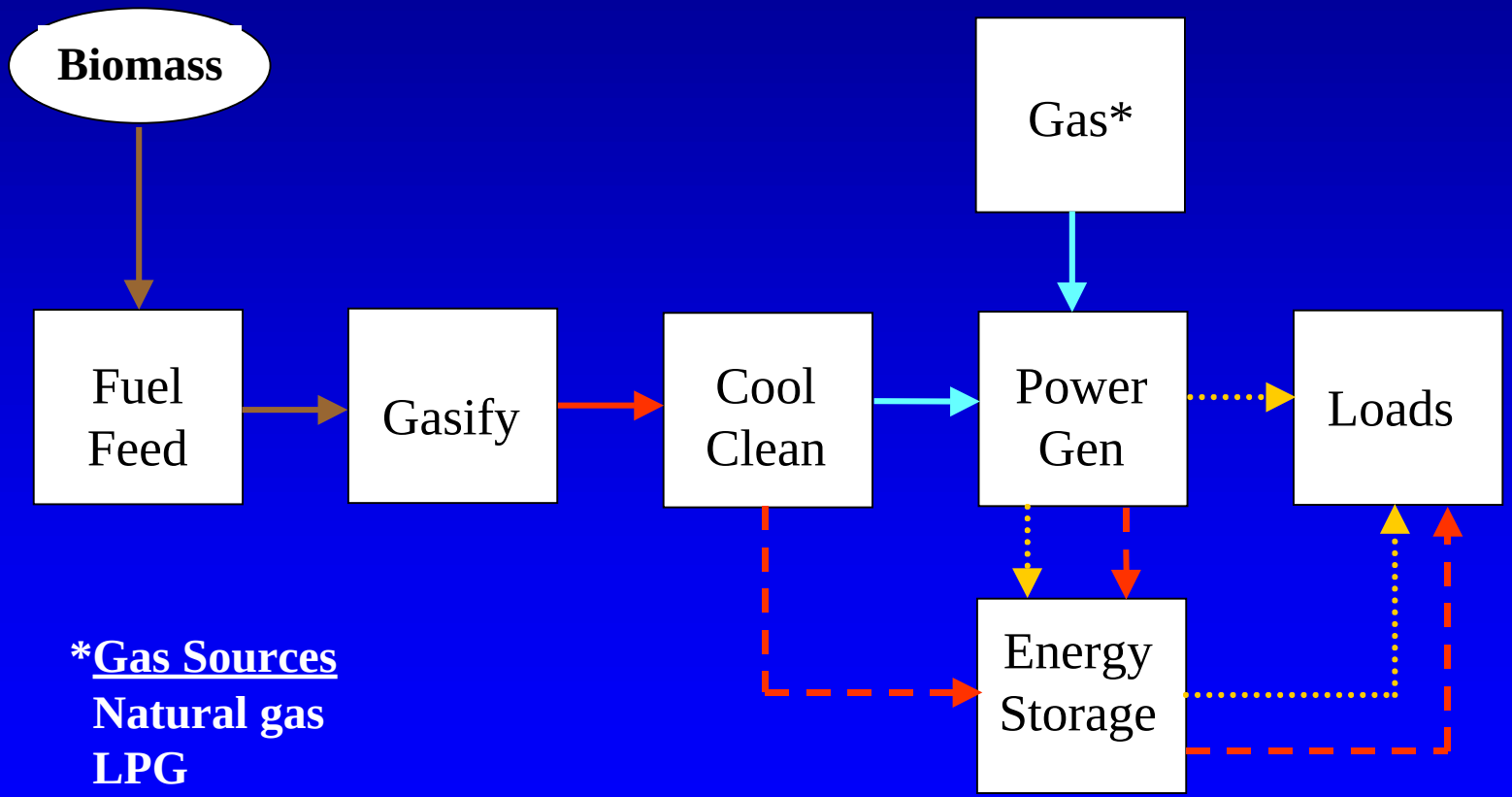
DOE Natural Gas/Renewable Energy Hybrids Workshops

August 21 and 22, 2001

Golden, CO

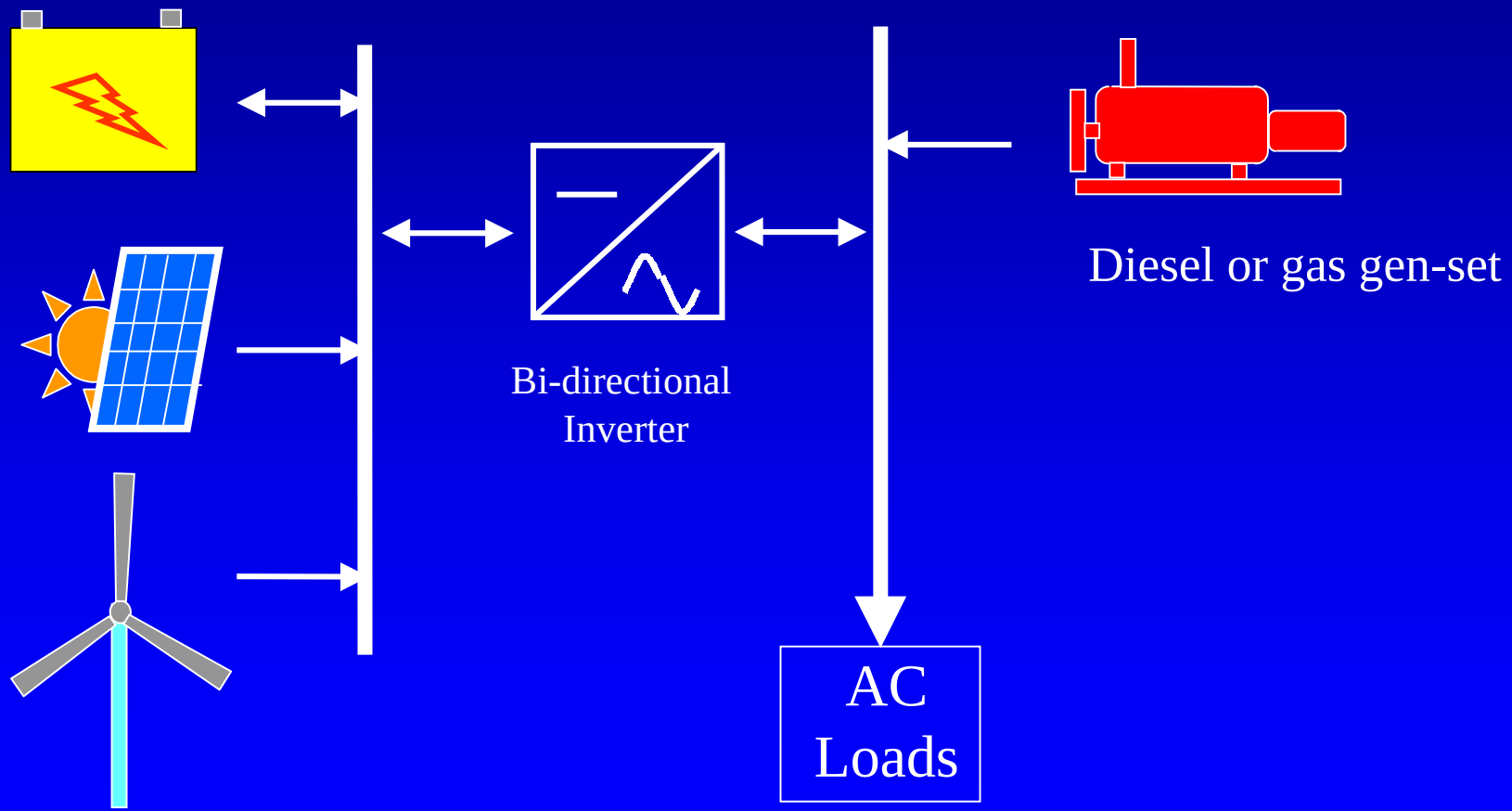
Bio-based Hybrids?

Bio-hybrid System Configuration



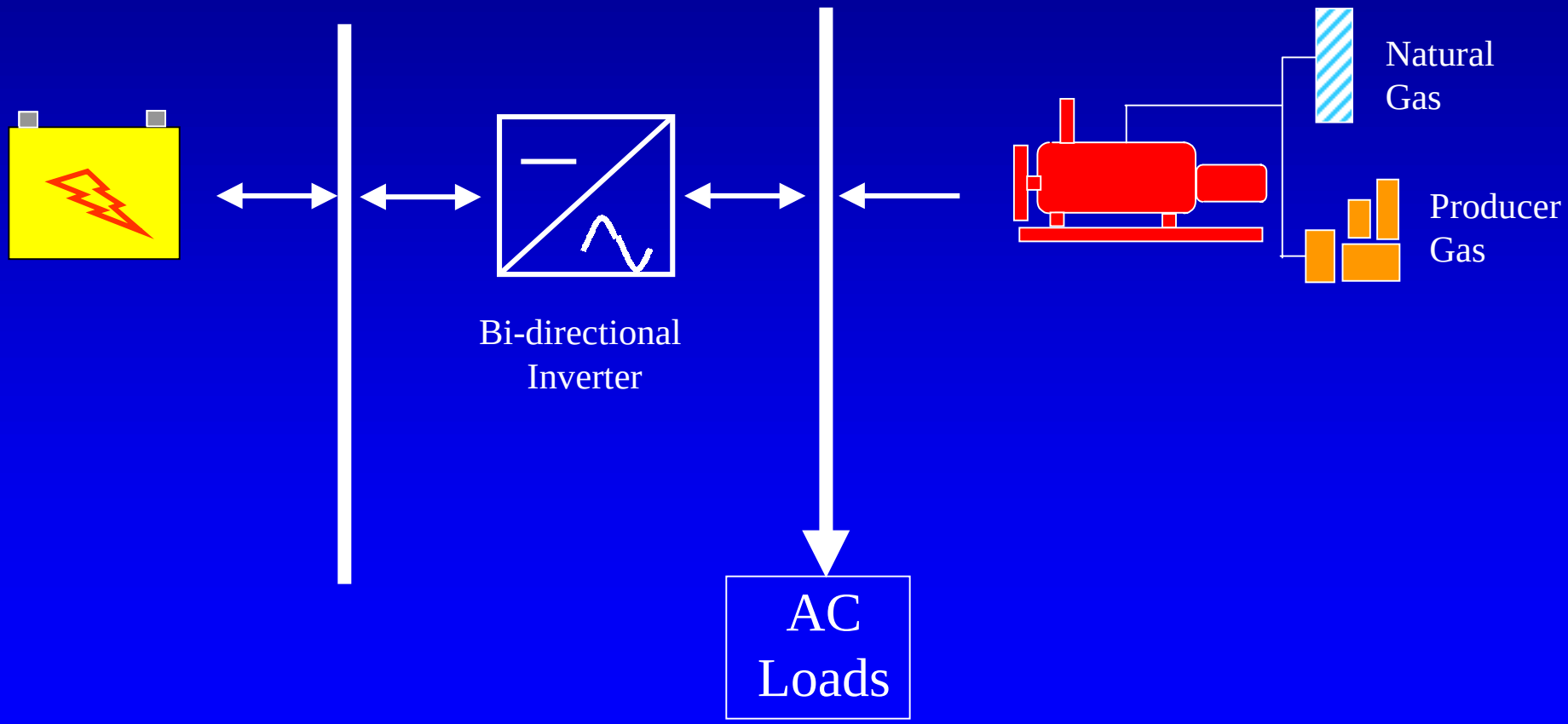
Typical Hybrid Schematic

(Fossil/mixed renewable hybrid)



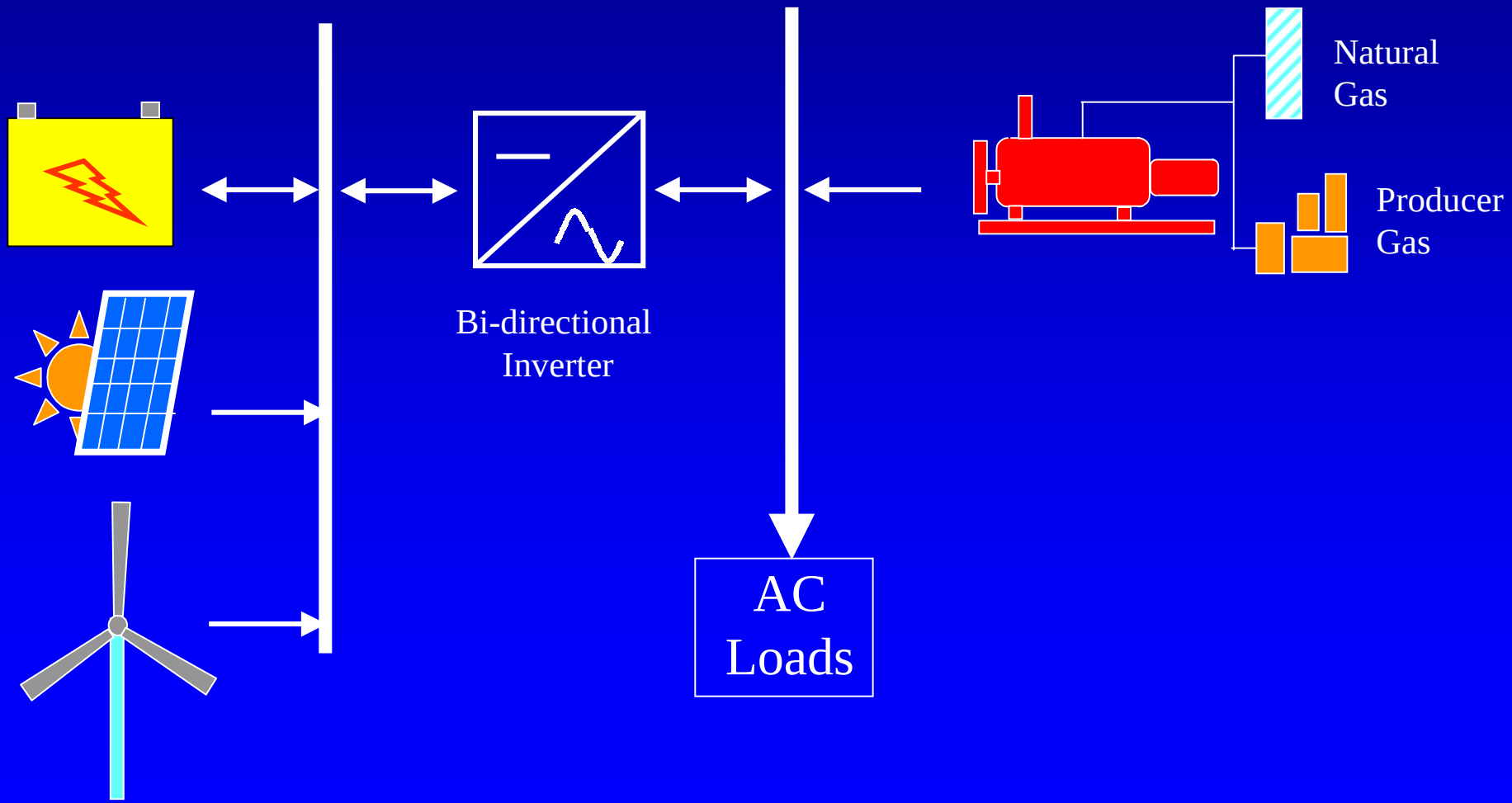
Bio-hybrid Variation #1

(Fossil/renewable hybrid)



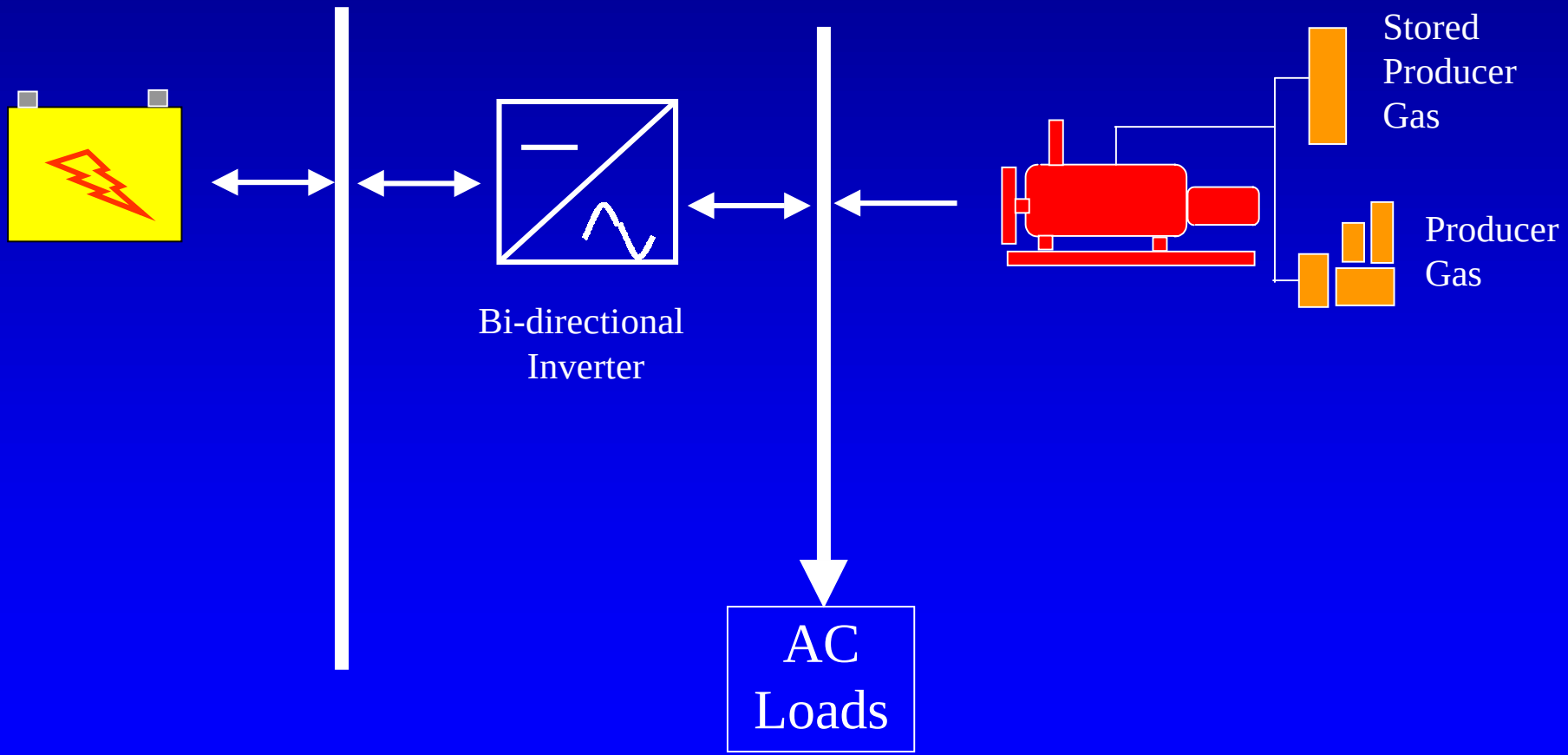
Bio-hybrid Variation #2

(Fossil/mixed renewable hybrid)



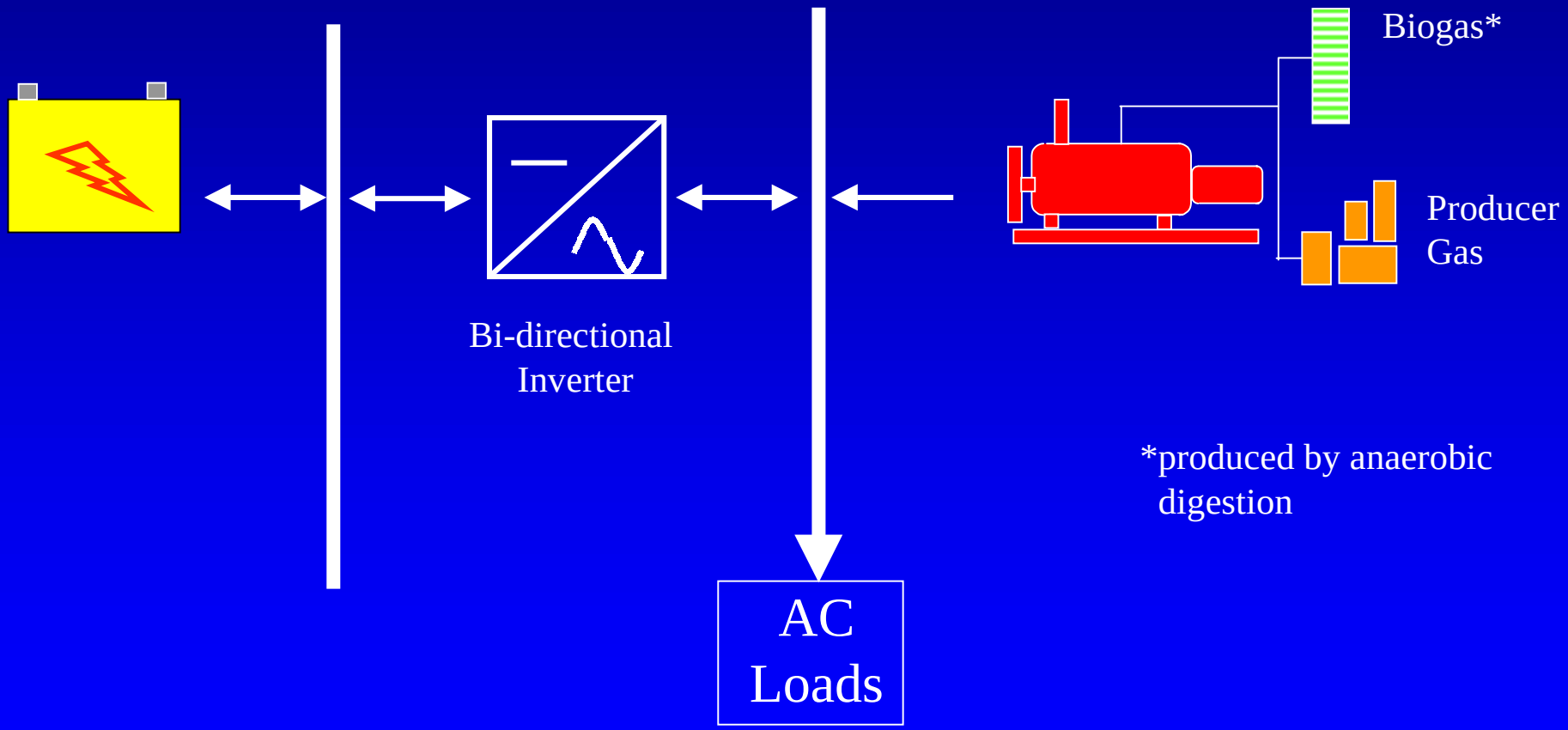
Bio-hybrid Variation #3

(All biomass renewable hybrid)



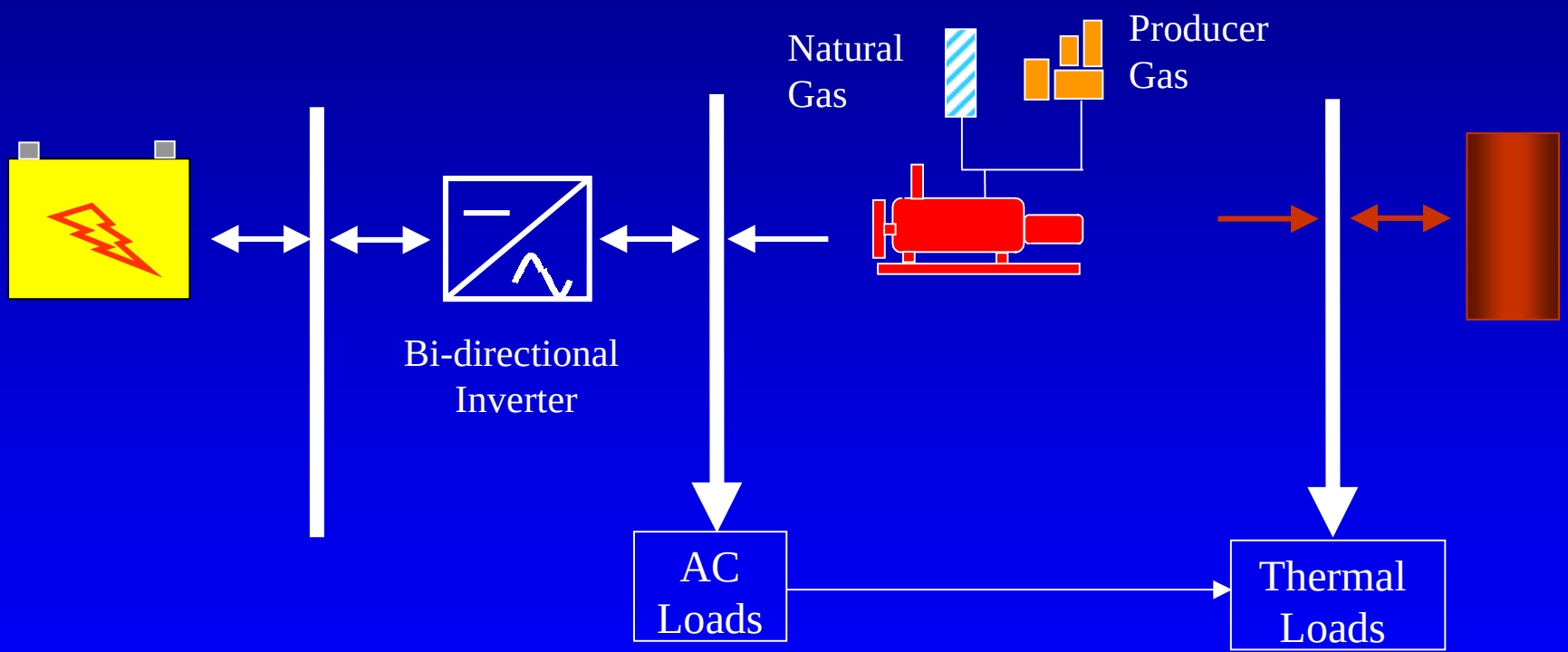
Bio-hybrid Variation #4

(All biomass renewable hybrid)



Bio-hybrid Variation #5

(Fossil/renewable hybrid with thermal storage)



- Space heating
- Space cooling
- Drying
- Ice making

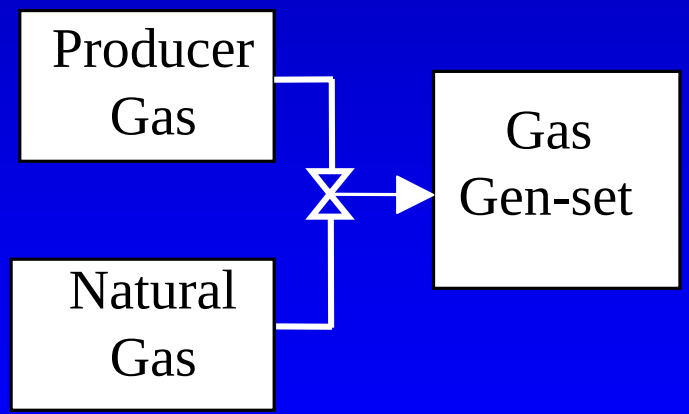
The Heart of the Bio-power Hybrid Has Already Been Developed

- Developed under DOE Phase 2 Small Modular Biopower Program
- BioMax-15 operating in the Philippines
  - coconut shells
  - village power
  - productive use

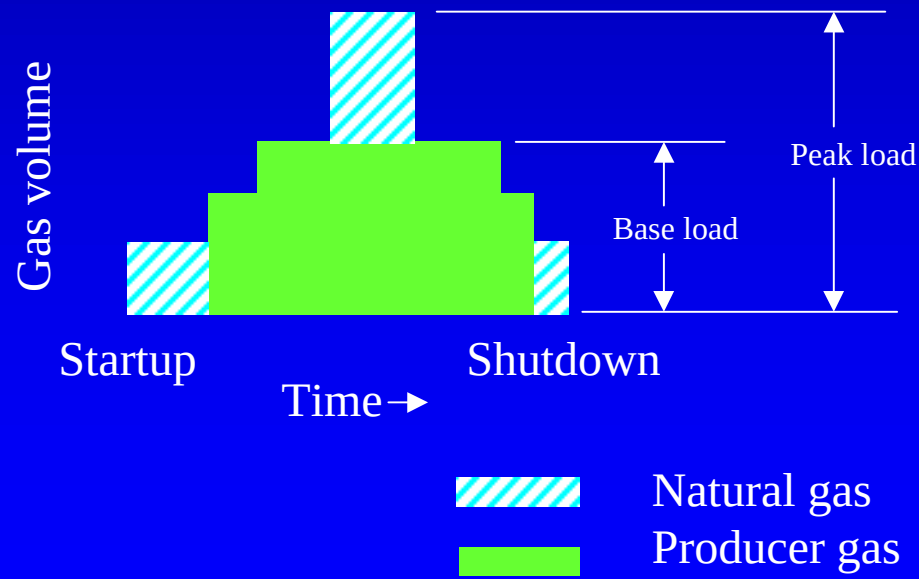
Endurance testing in Alaminos

Bio-hybrid Gas Usage Flexibility Provides System Benefits

Valve mixes gases in any proportion...



...to meet operational and load requirements



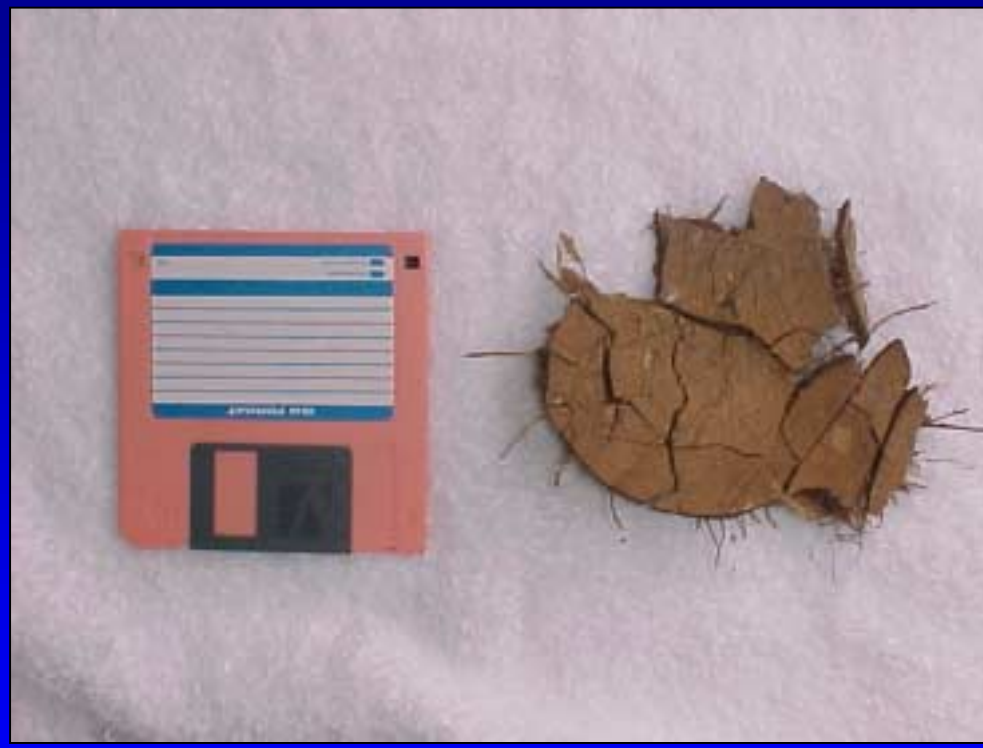
Bio-hybrid Plans

- CPC to develop and demonstrate a micro-modular biopower hybrid (MMBH) for WRBEP
  - Trailer-mounted
  - Based on CEC system
- "Road Show"
  - NREL Hybrid Test Facility
  - California sites
  - Battery charging demo for Army

BioMax 15 - CEC System

MMBH Design Requirements

- Fuels:
  - Wood chips or coconut shells (~.5” to 1”, <20% moisture)
  - Bottled gas
- Electrical:
  - Capacity - 15 kWh/day, 24-hr power
  - Peak power
    - 4 kWe - inverter
    - 7 kWe - inverter/generator in parallel
  - Power quality
    - Domestic: 110 VAC; 60 Hz
    - Export: 220 VAC, 50/60 Hz
- Operation:
  - fully automated
  - 3 to 5 hours per day operation



Shown above are “hairy” coconut shells after grinding. The grinding process was modified to result in smaller, more uniform pieces.

Producer Gas-Natural Gas Hybrids Offer Unique Advantages

- Seamless integration
- Many different design configurations
- Low capital cost
- Dispatchable
- Small footprint = high energy density
- Max opportunity for Combined Heat and Power applications
- Minimal affects of resource variability