



**ENERGY & STRUCTURED FINANCE**

The Benefits of Cogeneration  
Case Study: Upper Chesapeake Medical Center



DistribuGen Conference &  
Trade Show for Cogeneration/CHP 2015

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Houston, Texas


# Energy & Structured Finance

Development Group within Clark Construction Group

- Develops alternative energy systems
- Evaluates existing systems and recommend **custom-designed, clean energy solutions** across multiple technologies with recommendations that:
  - Address existing usage and growth potential at site
  - Are technology neutral
- Serves as **developer/designer/contractor/financier/equity/owner/ operations & maintenance** provider of system
- Sells power to Client via long-term Power Purchase Agreements (PPAs) with equipment turnover options mid-term

# Overview of Clark Construction Group

- 108 years of experience in building and civil construction
- One of the nation's top healthcare builders
- Delivered nearly:
  - 27 Million sq ft of medical facilities
  - 10,000 Hospital beds
  - \$9 Billion for healthcare projects
- Works in partnership with:
  - Private Healthcare Systems
  - Academic Medical Centers
  - Public Providers



# **Case Study For CHP:** Upper Chesapeake Medical Center

# Upper Chesapeake Medical Center

Bel Air, Maryland

- Part of University of Maryland Medical System
- Contains a 200 bed state-of-the-art general medical, surgical hospital and medical complex including:
  - Hospital
  - Two medical office buildings
  - Parking garage
  - Klein Ambulatory Care Center
  - Administrative offices
  - Cancer Center



# Campus Overview





# Challenges Led UCMC to Consider CHP

- Single point of failure in backup power system design
  - One existing 1.5MW diesel generator
- Need for additional thermal capacity and backup power
- Limited space to install new CHP system components
- Concerns over prolonged hospital power outages after Hurricanes Sandy and Katrina led to depletion of diesel fuel
- Potential for new DHHS rule (Federal Register Vol. 78 No. 249) requiring hospitals provide emergency power to heating and cooling systems

# Electrical Distribution Hurdles

- Electrical service to the campus is delivered to a service station via a pair of 33KV feeders:
  - Fed to six (6) substations
  - Three (3) of the six (6) substations feed the “healthcare” uses
- Cancer Center is serviced by a separate feeder
- 1,500KW diesel generator insufficient to provide power to greater than the critical care and a few other connected loads



# Healthcare Operational Challenges

- Hospital functioning under all conditions
- Do no harm
- Ongoing operational management responsibilities
- Integration of new system
  - Complexity
  - Need to minimize shutdowns / system outages

# UCMC Was Unable to Get Funding

- Limited capital available for system upgrades
  - Capital budget favored other revenue generating investments (e.g., MRI, CT-Scan)
  - Previous CHP capital budget requests denied
- Shortage of resources to oversee the design/construction/permitting and operation and maintenance of the CHP system

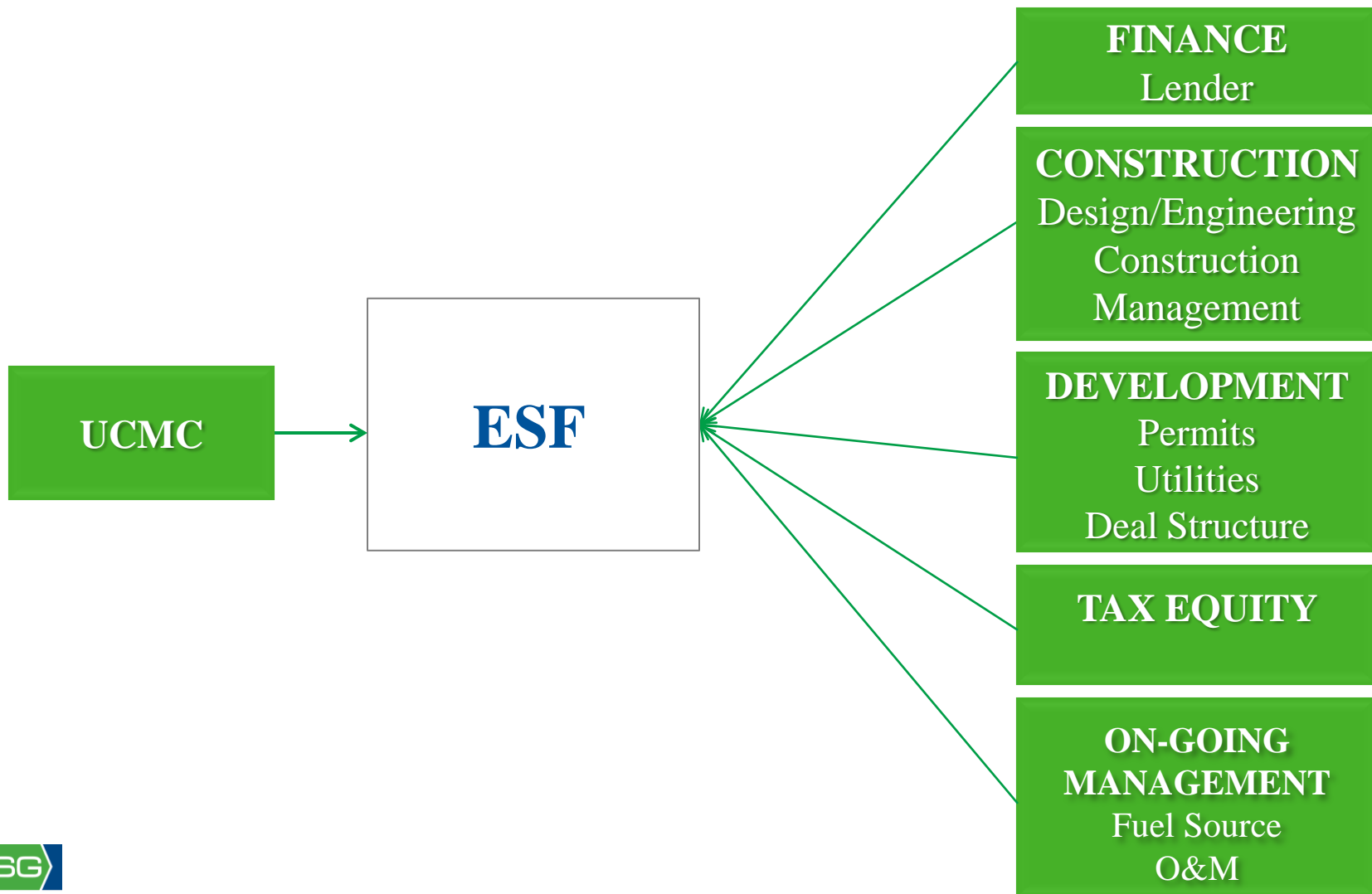
# UCMC Selected Turnkey Solution

## Power Purchase Agreement with ESF

- ESF owns, operated and maintains the system and sells power to the hospital
  - Hospital purchase balance of power needs from Grid
- ESF provided upfront capital for UCMC's CHP system
- 20 year contract yet UCMC has the opportunity to buy out the system at a Fair Market Value early in life-cycle
- Custom-designed CHP system provides hospital with electricity, heating, cooling and steam
- In Island Mode system will serves 95% of hospital loads and 65% of campus loads

# ESF Managed Delivery of UCMC CHP Project

Project Involved Multiple Disciplines and Risk



# UCMC Benefited From CHP Delivery Via PPA

- PPA allowed hospital to avoid capital spend on system – paying for system largely through purchases of energy
- \$1.5M in utility incentive funds used to substantially reduce the PPA rate
- Private ownership of system allowed non-profit hospital to benefit from key Federal Tax Programs
  - Investment Tax Credit at 10% of eligible basis
  - Bonus and accelerated depreciation
- Historically-low natural gas prices and significant domestic availability added to call to action

# System Layout

- The CHP is located within a single story, 705 sq ft building in existing mechanical pit
- The building houses:
  - Generator
  - HRSG
  - Feed water pumps
  - HT heat exchanger
  - LT and HT radiators
- Other components located in or adjacent to the existing central plant include:
  - Absorption chiller
  - Cooling tower
  - Electrical gear
  - Control panels



# ESF Custom CHP Solution for UCMC

- ESF developed custom-designed solution for hospital:
  - 2.0 MW Cat recip engine; 350 T Broad Absorption Chiller; HRSG, Cooling Tower, Radiators
- UCMC System:
  - Generates electricity, steam, chilled water and hot water
  - Parallels the utility and provides baseload power






# Chiller & HRSG Make Tri-Gen System

Absorption Chiller  
(350 Ton)



Heat Recovery Steam Generator  
(2,245 lbs/hour )

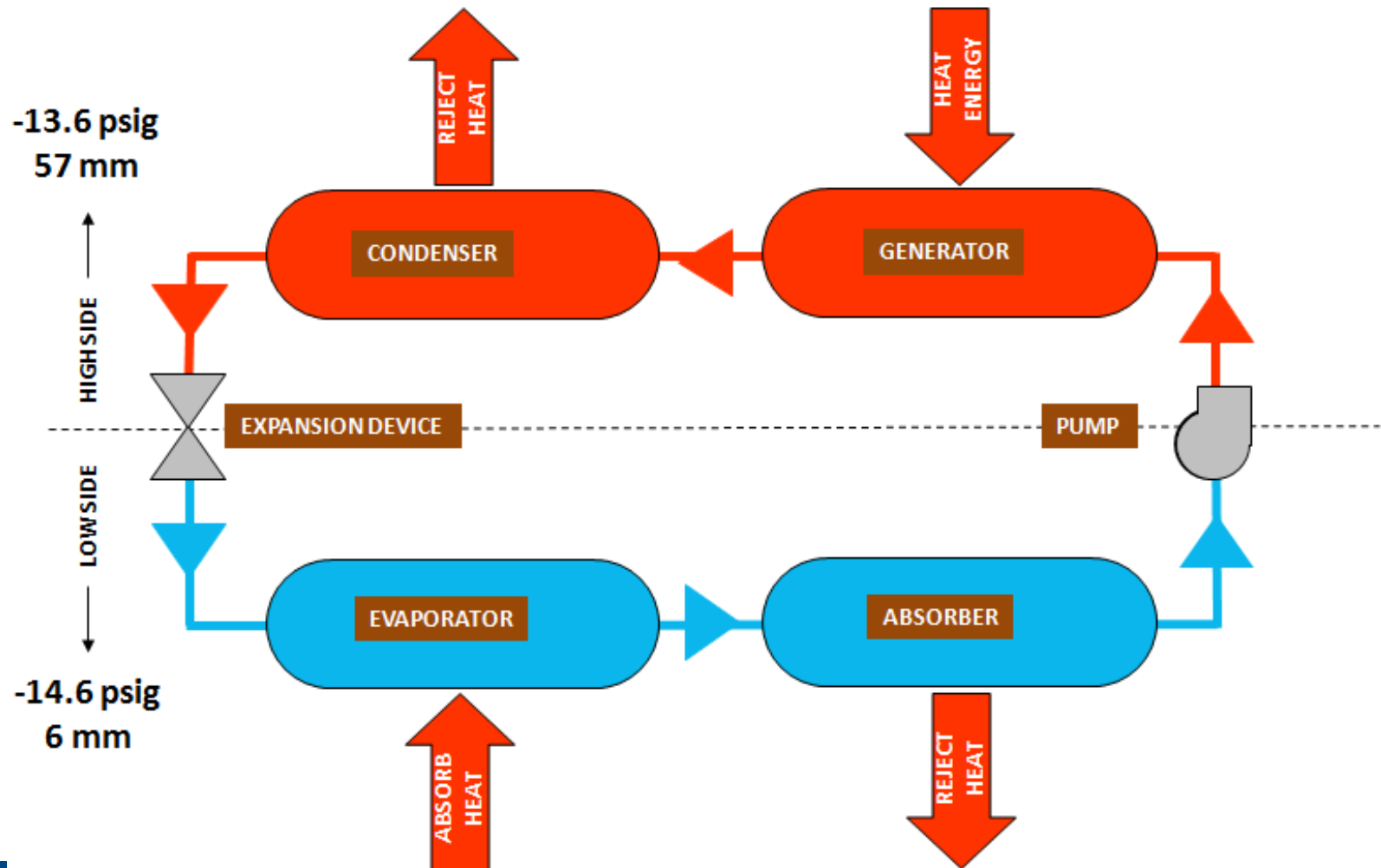




# **Broad Absorption Chiller Overview**

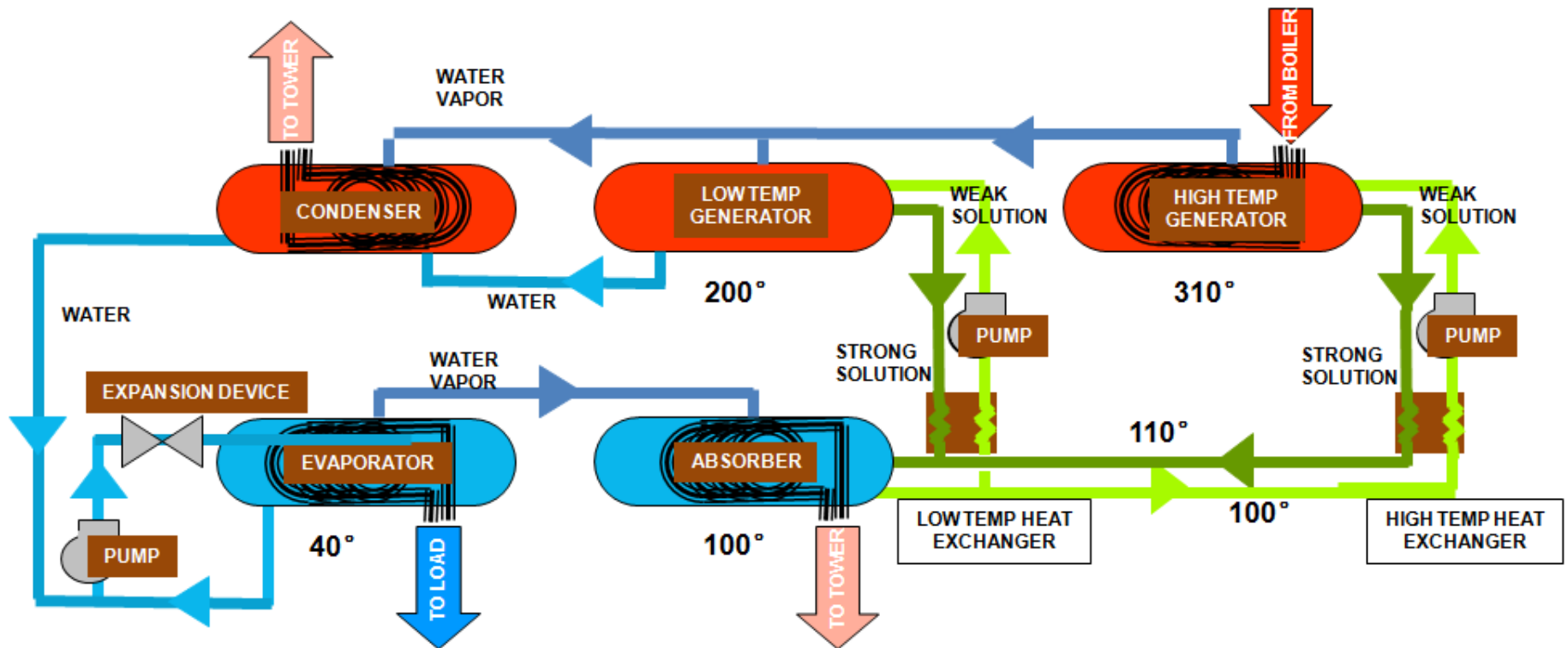
# Single Stage Absorption Cycle

.78 = COP



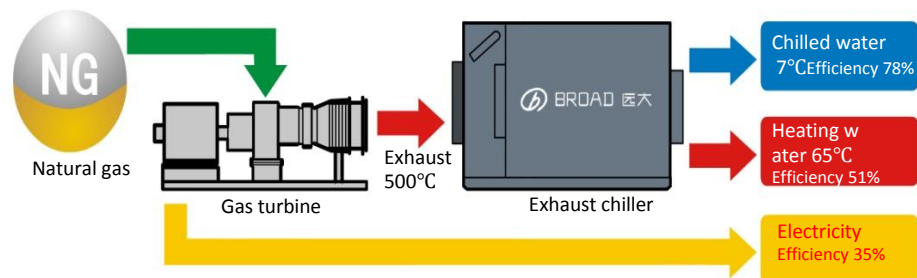
# Two Stage Absorption Cycle

1.4 = COP “Double Effect”



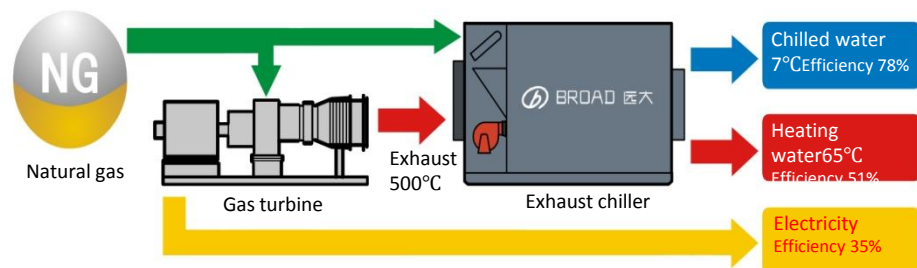
# Modern CCHP Systems

## High Grade Heat Maximizes Cooling



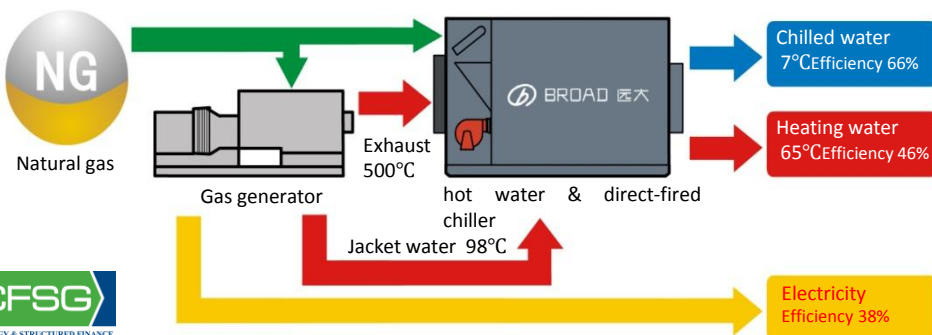
### Mode 1: Exhaust

- E&C: 113%
- E&H: 86%



### Mode 2: Exhaust & direct-fire

- E&C: 113%
- E&H: 86%



### Mode 3: Exhaust, hot water & direct-fire

- E&C: 104%
- E&H: 84%

# Rapid Evolution of Technology



Over 25 years of R&D Evolution of Absorption chillers 10 models  
Generation 11 will ship later this year!



# Rapid Evolution of Technology

## Multi Energy Absorption Delivers

- Smaller Mechanical Equipment Room
- Lowers cost to recover heat streams
- Simple sequence of operation
- Lower Maintenance costs
- Increases Up-time via higher reliability with less moving parts







# Upper Chesapeake Medical Center Project Results

# CHP Solution for UCMC

- Project operational since July 2014
- UCMC avoided any upfront capital outlay for CHP through PPA structure
  - May choose to purchase system based on proven track record
  - Transferred performance, delivery, O&M and other risks to able third party
  - Facilities staff trained in operations and ready to take over system in future
- UCMC will purchase balance of electricity for normal operations from utility and when CHP is offline
  - Provides 45% of the existing electricity for the main interconnected loads
  - Supplies more than 65% of campus electricity with existing diesel generator
  - Provides 95% of hospital loads with diesel when grid unavailable
  - Qualified for over \$1.5M in Empower Maryland

# CHP Solution for UCMC

- Hospital buys all electricity generated by system from ESF
- Byproduct of waste heat is “free” and used to calculate “effective price of power”
- Minimum monthly payments from hospital
- Minimum performance guarantees by ESF
- 20 year contract with fixed escalation, allows for budgeting of utility expense
- Operations and maintenance cost of system including all rebuilds incorporated into cost for 20 years
- Buy-out options for hospital to purchase system early
- Hospital supplies natural gas – cost of this embedded into economic analysis and savings

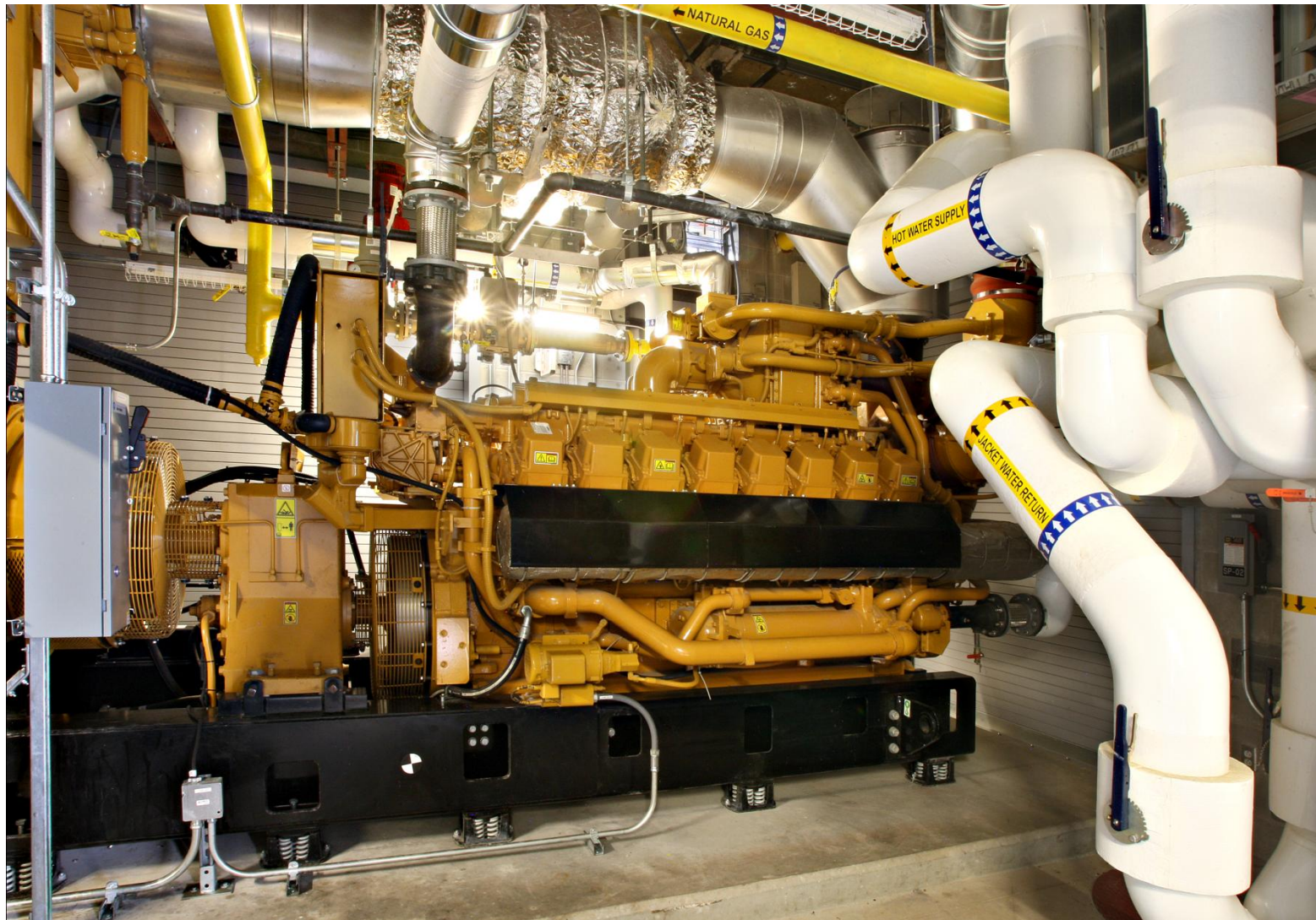
# Rational to Use PPA from Hospital Perspective

- Use of Federal tax credits and depreciation cannot access as non-profit hospital
- Ability to lock in future electric rates
- Access to funding source
- Ability to have turnkey delivery of all aspects system
  - Development
  - Permitting
  - Design
  - Construction
  - O&M
  - Financing
  - Incentive management
- Risk transference from hospital
- Complexity of project coordination
- Any cost overages borne by ESF

# Summary

- CHP system a “home run” for UCMC
- PPA structure facilitated delivery of vital infrastructure which would not have otherwise received funding
- Hospital able to operate during storm/prolonged outage
  - Improved reliability when combined with diesel generator (approximately 65% of campus and 95% of hospital electrical load)
  - Serve as a vital community resource during emergencies
- Environmentally friendly solution
  - 2.0MW system equivalent of taking 2,200 cars permanently off our roads!
- Hospital projected to save over \$9 million over 20 years (savings likely even greater as system operational 30-35 years with regular maintenance)

# CHP System Today



# For More Information

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