Session 2: Stationary Fuel Cells

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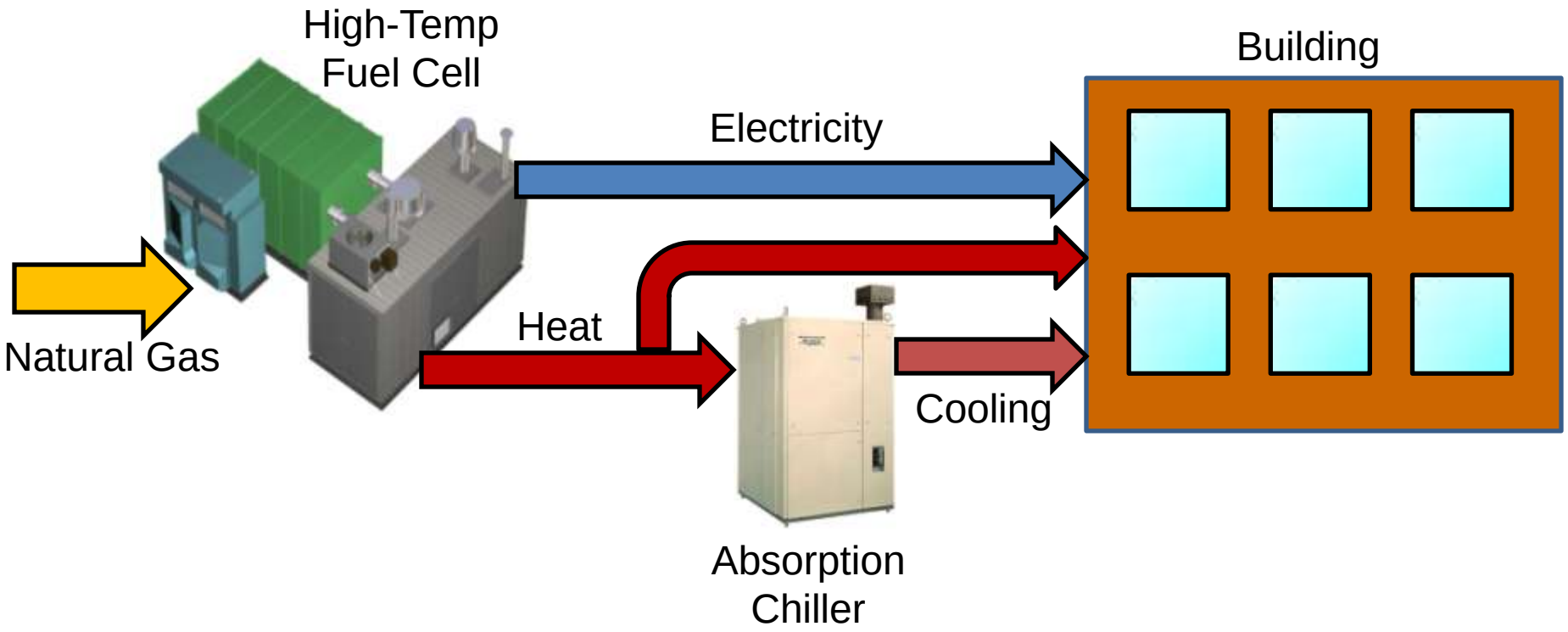
Stationary Fuel Cells Presentation

- UCI Fuel Cell Demonstration
- AQMD Fuel Cell Demonstration
- Discussion Questions

UCI Fuel Cell Demonstration

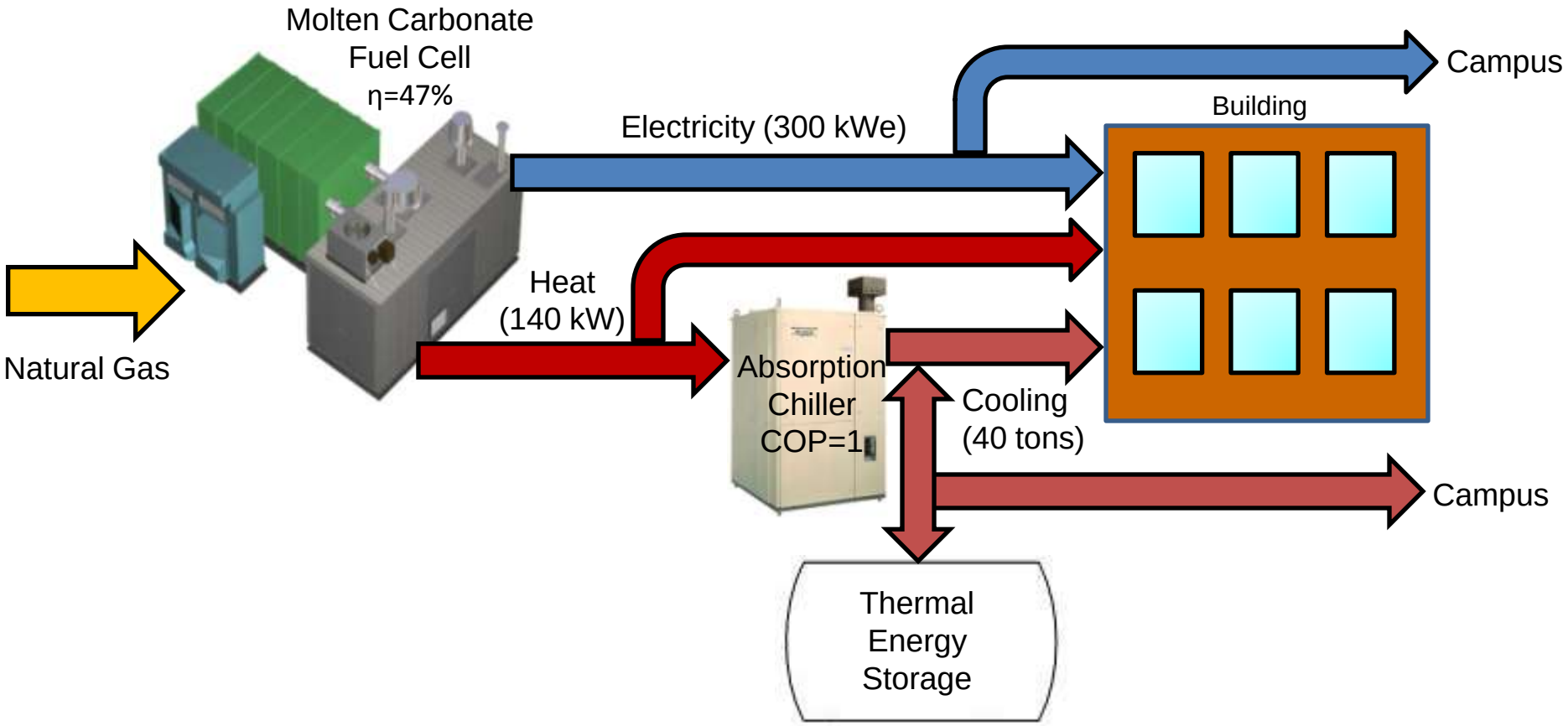
- UC Irvine will install a 300 kW fuel cell at its Science and Technology Building
- Project combines a high temperature fuel cell with absorption chiller using waste heat from the fuel cell to generate cooling
- Project will showcase a combined cooling, heat and power fuel cell system

Concept


High-Temp
Fuel Cell
Building
Electricity
Natural Gas
Heat
Cooling
Absorption
Chiller

System Design

- Project will capitalize on…
  - Distributed generation
  - High temperature fuel cells
  - Absorption chilling
  - *Demonstration of two modes of operation: commercial and institutional



Motivation

- Buildings in the U.S. account for…
  - 40% of total energy consumption
  - 30% of total greenhouse gas emissions
  - 65% of total electricity consumption
    - Cooling uses 15% of that electricity (on average) in the U.S.

- In California, cooling accounts for 17% of the electricity use
- Absorption chillers operate on heat in place of electricity
- High Temperature Fuel Cells…
  - Are more energy efficient than conventional power plants (~50%)
  - Produce virtually zero criteria pollutants
  - Provide distributed, reliable power and avoid transportation losses
  - Are fuel flexible (natural gas, digester gas, landfill gas)
  - Have a small physical and acoustic footprint
  - Exhaust high-quality thermal energy

Project Overview

Goals

- **Development**: Develop, deploy, evaluate, and optimize a high temperature fuel cell (HTFC)-absorption chiller CCHP technology for the California market
- **Demonstration**: Showcase and proactively accelerate the deployment of HTFC-chiller CCHP technology into the California market

Partners

XNERGY

FuelCell Energy
Ultra-Clean, Efficient, Reliable Power

Key Subcontractors

GOSS ENGINEERING

Empowered Energy

Funding Sources

AQMD

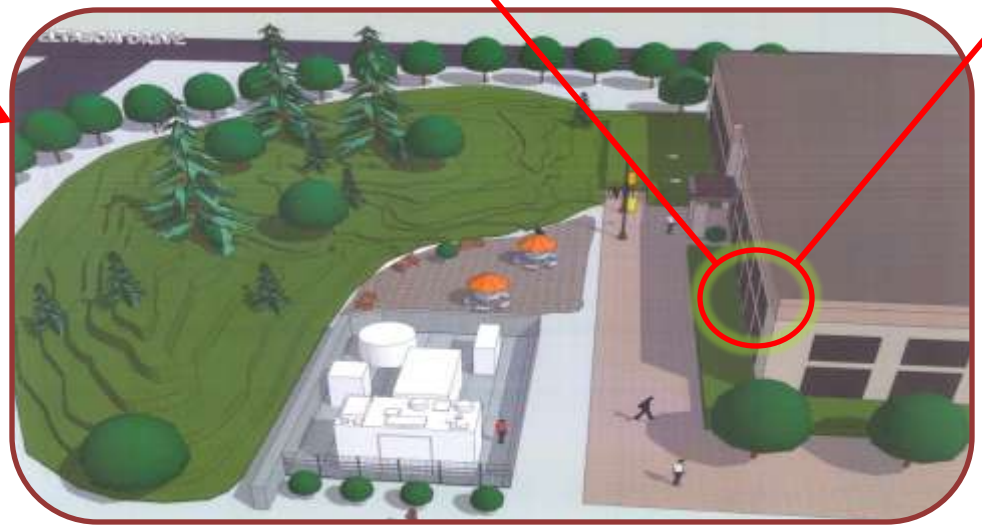
Advanced Power & Energy Program
University of California Irvine

SGiP

Southern California Edison
An Edison International Company

Project Overview

Multipurpose Science & Technology Building (MSTB)
at the University of California, Irvine



- **Near NFCRC**
- **Highly visible**
- **Flex-Tech building design**
  - Standard for the Irvine Co.
  - Copied by other developers
  - Commercial/Institutional

Project Cost

Source	Amount	Percentage
Fuel Cell Energy	$100K	2%
Yazaki	$261K	6%
SGIP	$690K	16%
SoCalGas	$200K	5%
Xnergy	$988K	24%
UC Irvine	$37K	1%
CEC	$1.48M	35%
AQMD	$257.5K	11%
Total	$4.01M	100%

Demonstrate Large Fuel Cell CCHP System At AQMD

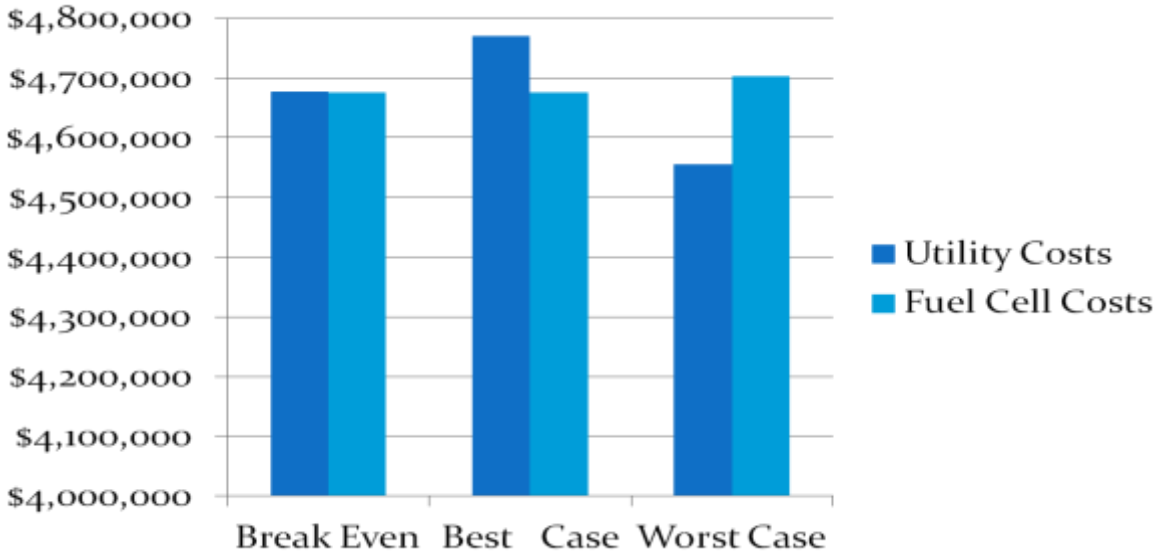
- October 2010 RFP to solicit proposals to install a natural gas, stationary fuel cell unit in the power range of 250-300kW
- Focus of the project: accelerate commercialization, operational experience, develop database, and public awareness

AQMD Fuel Cell Demonstration

- UTC Power was chosen to install a 400 kW fuel cell at AQMD Headquarters
- Electricity generated from natural gas will provide 37% of AQMD's base electrical load
- Waste heat will be used to heat water for the facilities boiler system

Cost Analysis

- AQMD Is Entering An Energy Service And Supply Agreement With UTC – UTC Owns The Equipment AQMD Purchases Power
- The Difference Between The Price Of Natural Gas And Utility Costs Determines Cost Benefit Of Onsite Generation
- Break Even, Best And Worst Case Are Based On Predictions Of Natural Gas And Utility Rate Increases



Project Benefits

- AQMD Cost Savings
- Energy Self Sufficiency
- Promoting Clean Distributed Power Generation
- Increased System Efficiency Through Use of Combined Heat and Power
- Emissions Lower than Local Utility Grid Power Content

Project Cost

Source	Amount	
SGIP	$900,000	19%
AQMD Requested	$3,802,732	81%
Total	$4,702,732	100%

Creating a Value Proposition

- Stationary fuel cells contribute significant value to ratepayers and the State of California… A representative fuel cell 300-1400 kilowatts in size, fueled 100% with natural gas, and operated in CCHP mode 75% of the time ***today contributes up to 20.1 cents of value per kilowatt-hour ("kWh") of fuel cell electricity generated based on the avoided costs of central station electricity generation.***

(NFCRC, 2011)

Questions For TAC Members

- **How can the government and industry stakeholders help create a value proposition for the potential businesses to employ fuel cells for self generation?**
- **What design or technological improvements need to occur to reduce the cost of fuel cells and to make them more applicable to a wider market of users?**