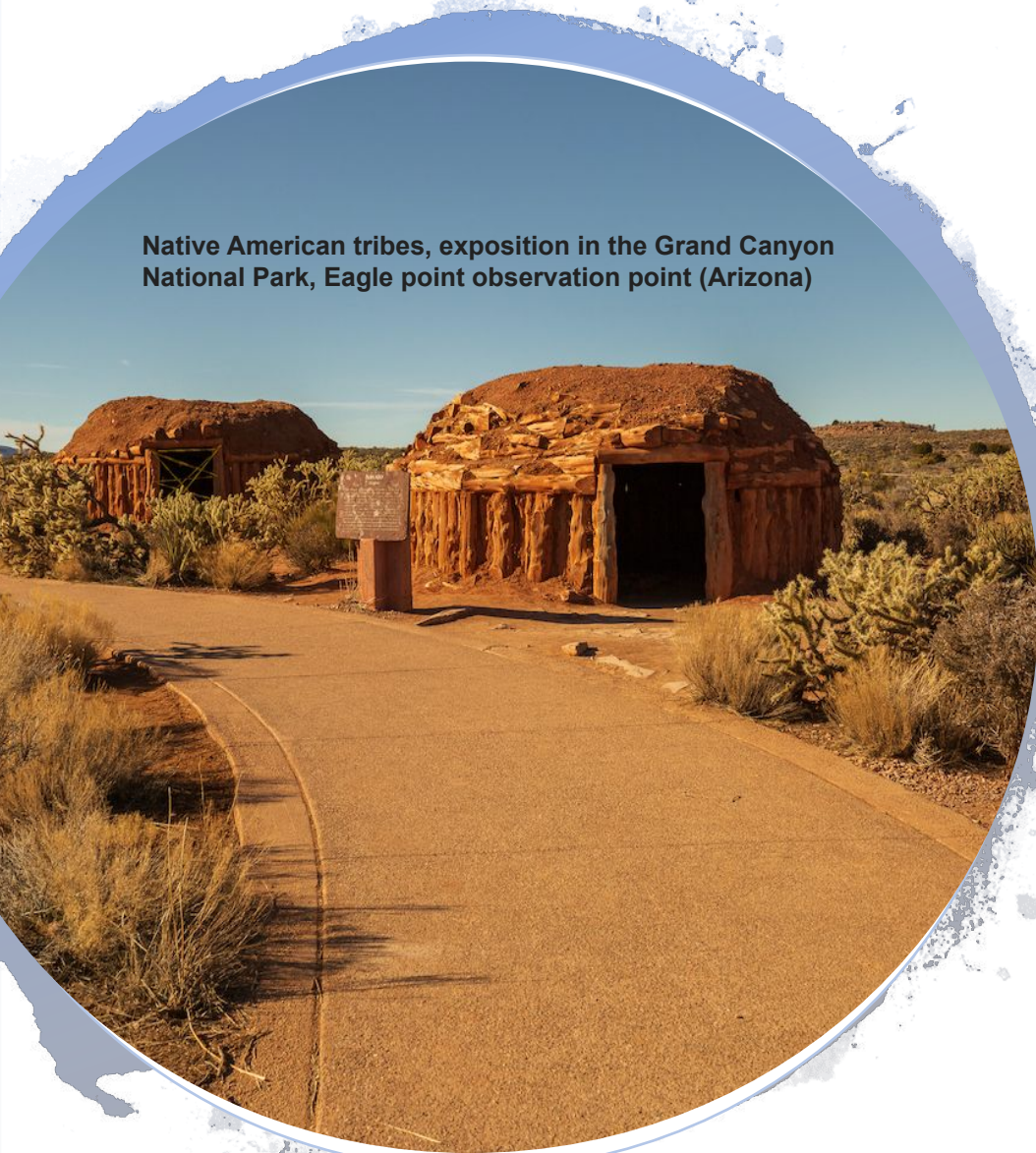


Native American tribes, exposition in the Grand Canyon  
National Park, Eagle point observation point (Arizona)



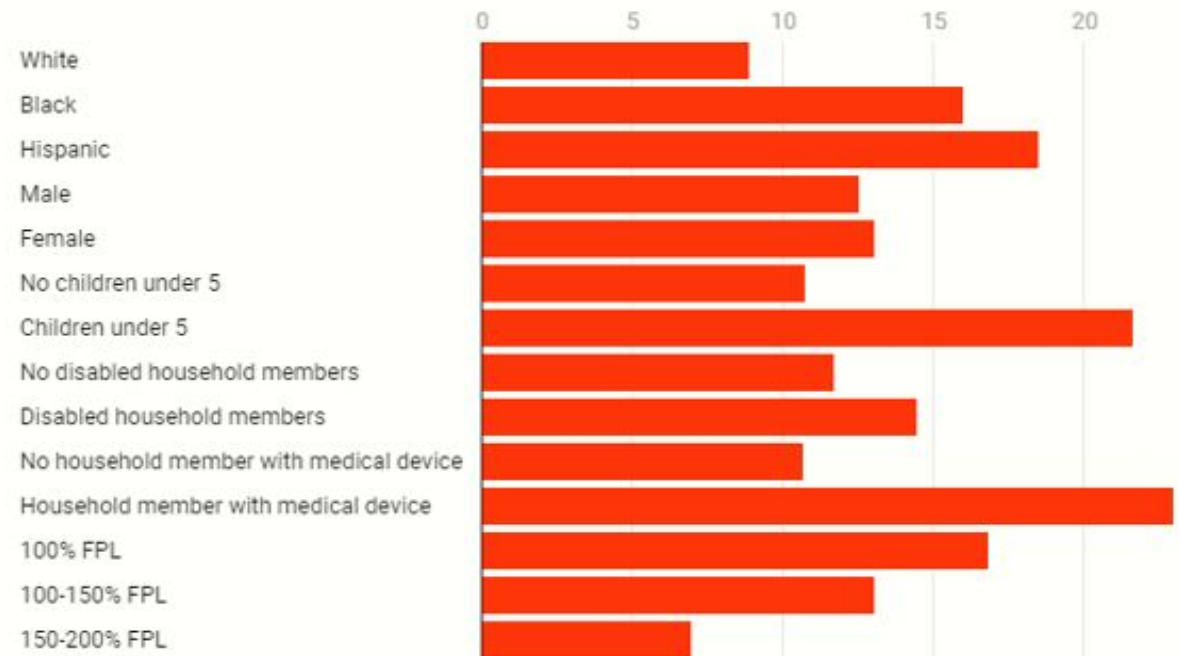
**Fuel Cell Technology for  
Micro-Grids & Green Hydrogen  
Generation integrated for  
improved comfort for homes  
or farms**

*ALL INFORMATION PROVIDED IN THIS  
PRESENTATION IS CONFIDENTIAL AND  
PROPRIETARY*

- United States has aggressive goals to be net-zero carbon emissions by 2050
- Increased consumptions of NG by 12.8% (2017-19) & electrical power increased 6.9% (2018-2019)
- Electricity prices are higher because of PTC and hardship on Americans who cannot pay their utility bills
- Electrical grid is overburdened
- Farms' runoff creates issues with the watershed

### Many U.S. households are struggling with energy bills during the COVID-19 pandemic

Percentage of respondents who reported being unable to pay an energy bill from late April through late May of 2020, by demographic group. (FPL = Federal poverty level)



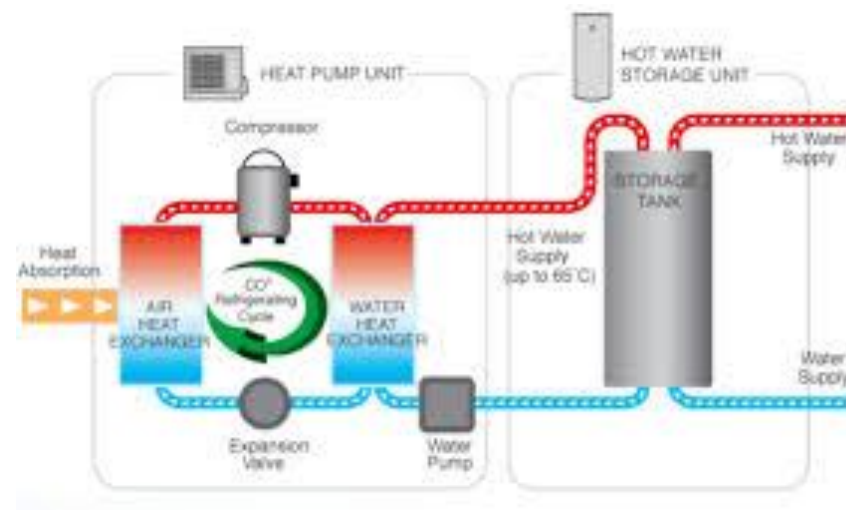
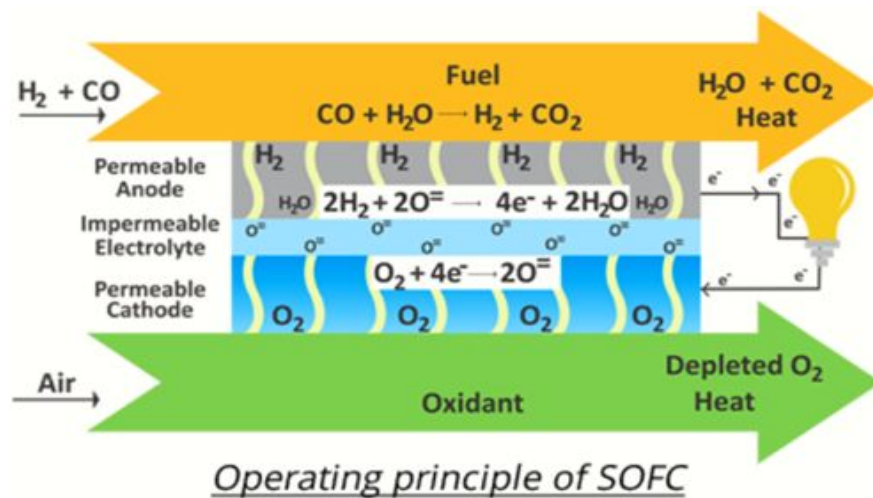
Carley, S., & Konisky, D. (2020, July 30). *Energy is a basic need, and many Americans are struggling to afford it in the COVID-19 recession.* The Conversation.

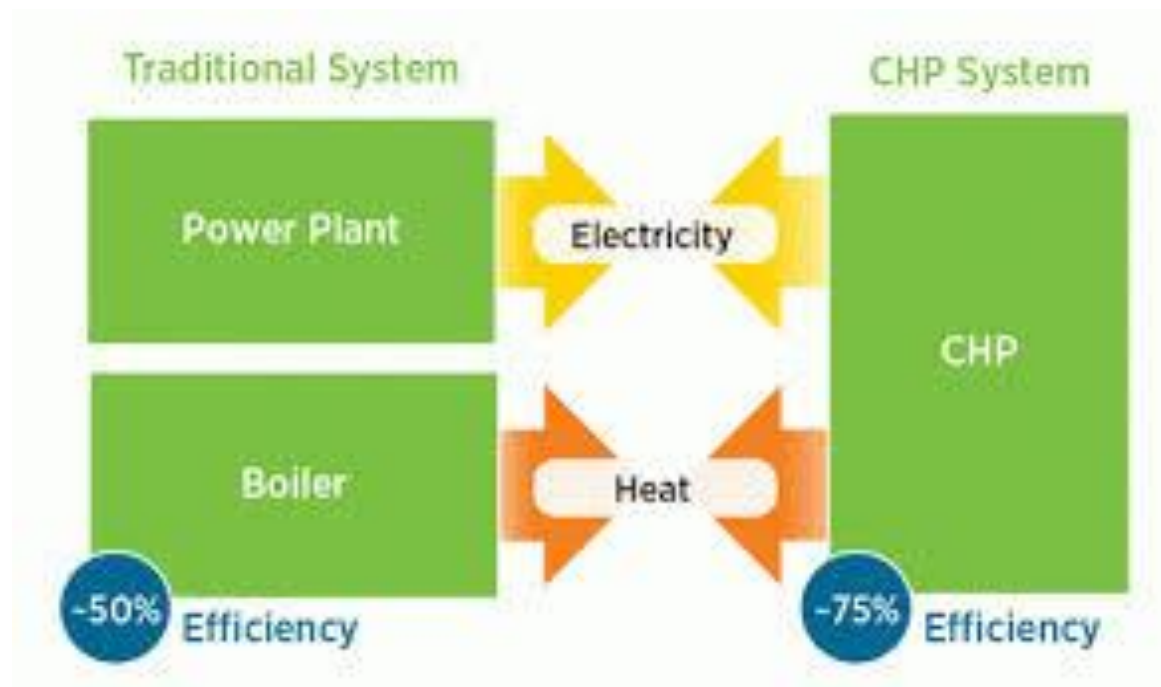
h2e/Hexis:  
1.5kW SOFC



## ICHP

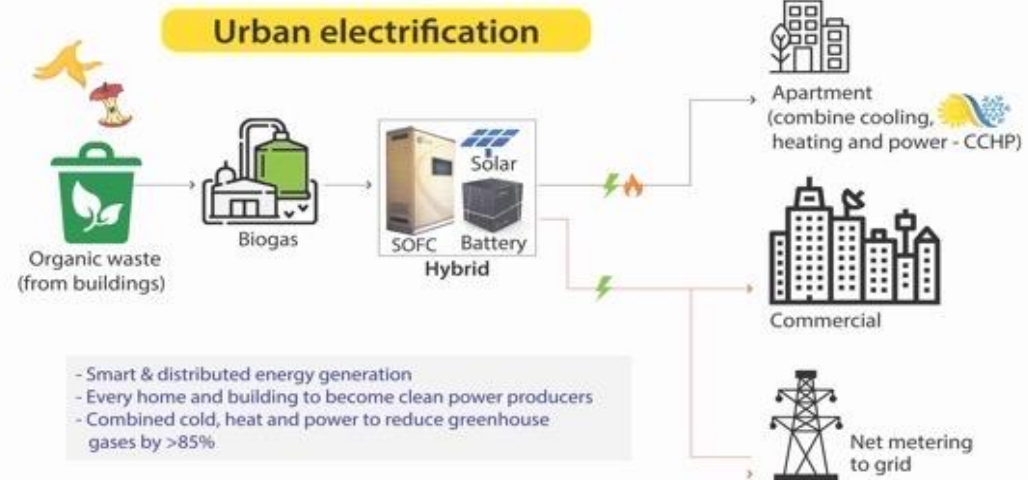
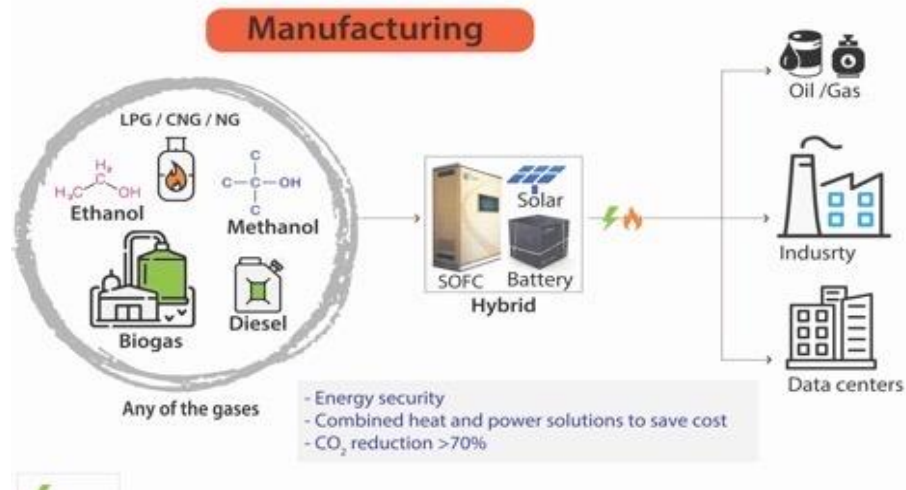
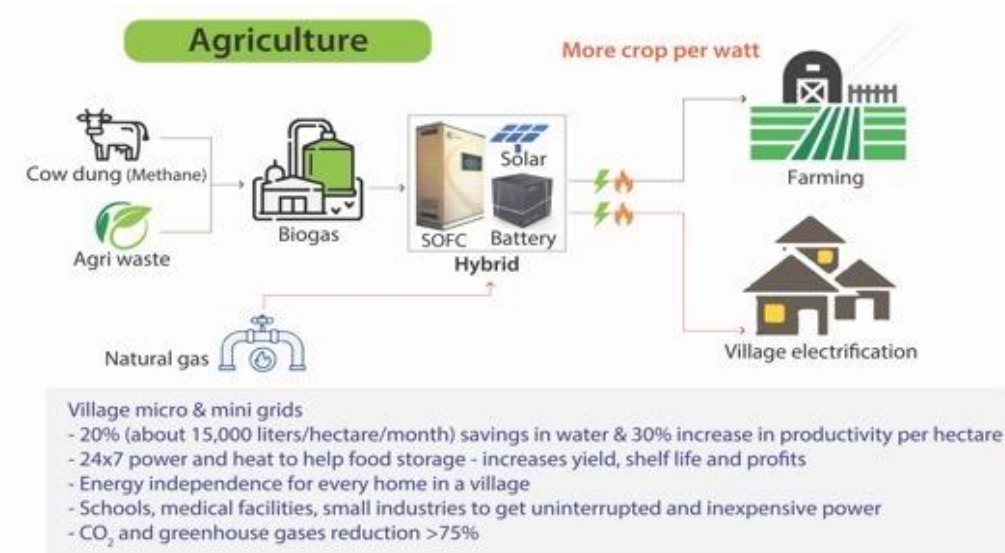
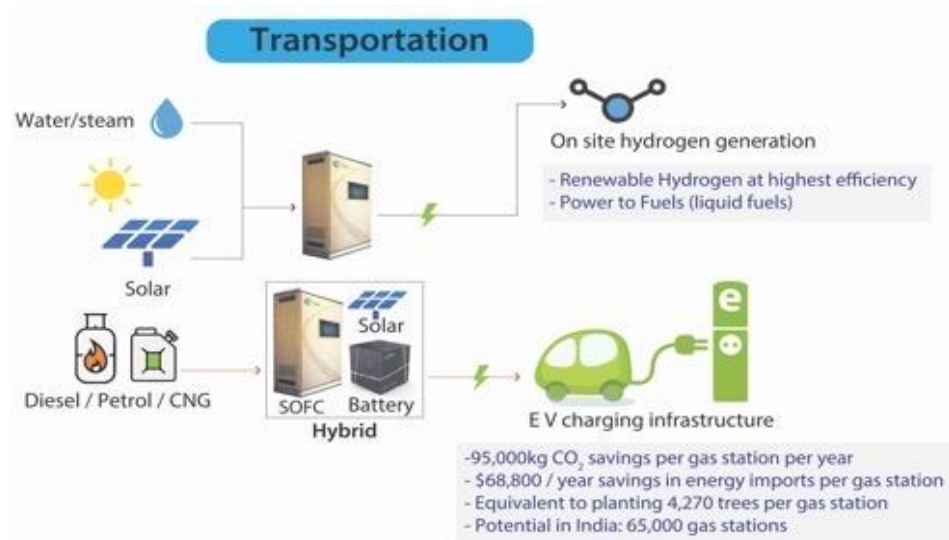
Integrated Cooling, Heat, & Power



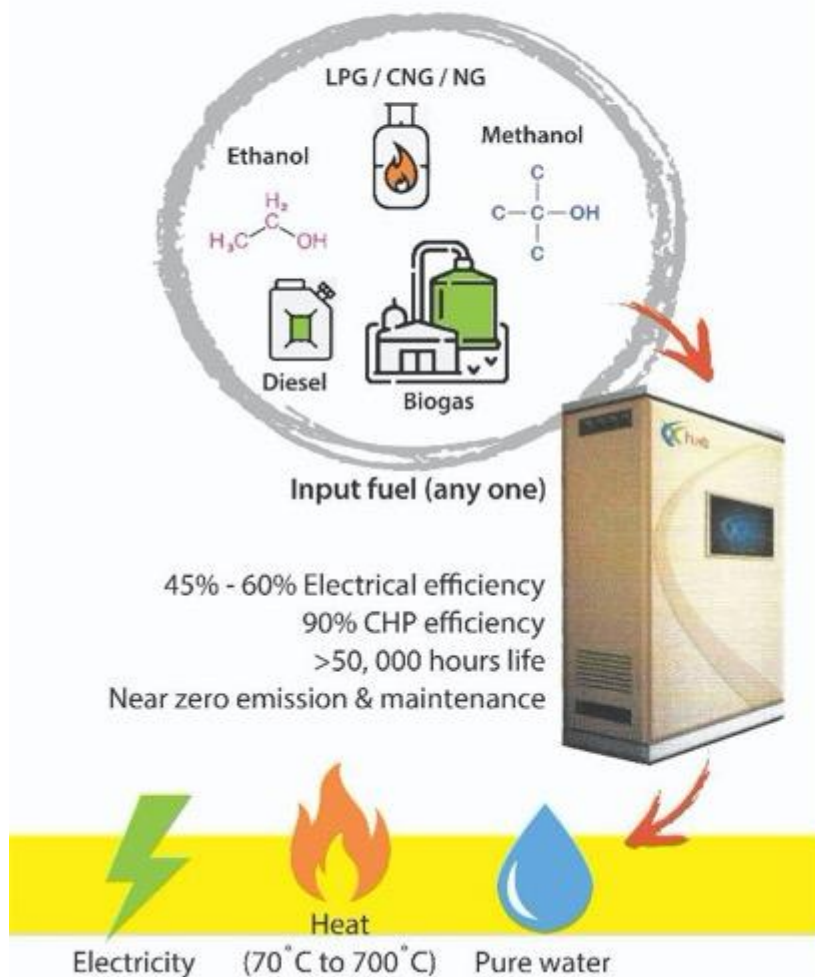


Combined Heat and Power (CHP) is a process in which heat engines are used to generate electricity and useful heat simultaneously. The conventional method of producing usable heat and power separately has a typical combined efficiency of 45 percent; CHP systems can operate at levels as high as 85 percent.

- Multi-fuel capabilities with utilization of conventional fuels and/or alternate fuels such as biogas. Technology is fuel flexible & not dependent on 99.9% pure hydrogen.
- Silent operation and zero to negligible emissions based on type of fuel used.
- Highest possible conversion efficiencies compared to incumbent technologies.
- Reduced lifecycle costs.
- Capability to integrate with other renewable technologies and create a multi-energy platform.
- 45% to 60% electrical efficiency and 85% to 90% CHP efficiency.
- Reformation capabilities being extended to liquid fuels covering entire spectrum of hydrocarbons from natural gas to biodiesel.
- ***Easily Scalable technology from 100 Watts to MW.***



## From Fuel to Power Multi Fuel Capability



## From Powder to Power



Commercially proven  
SOFC/SOEC stack

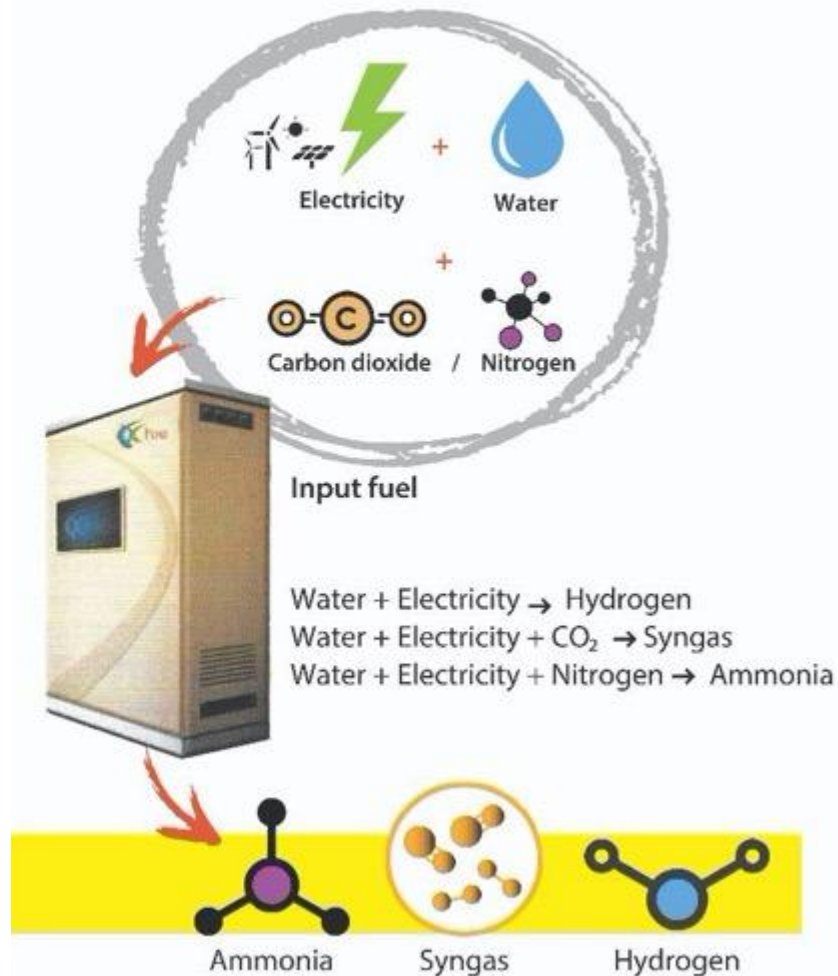
100% recyclable & reusable

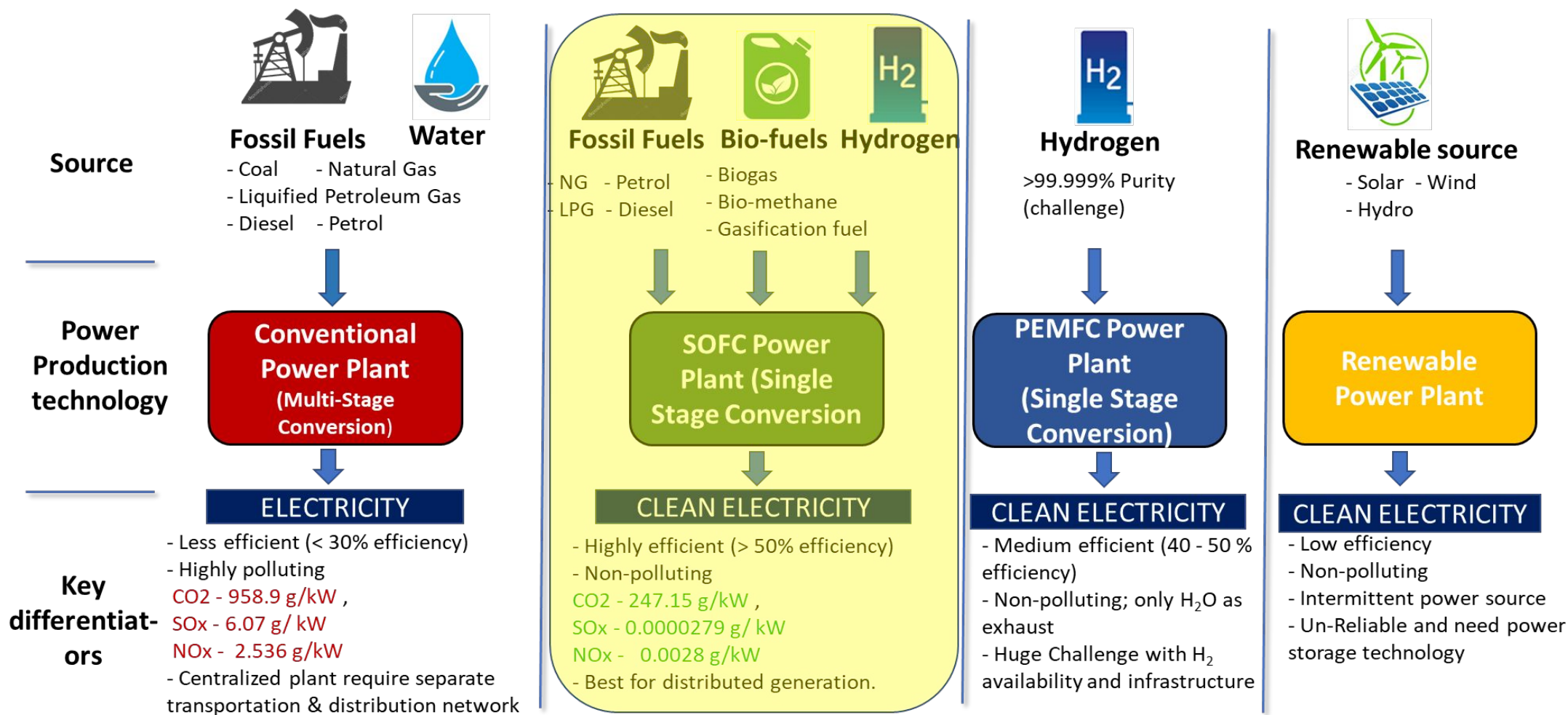
Robust & long life

Inexpensive raw material  
(no precious or rare  
earth material used)

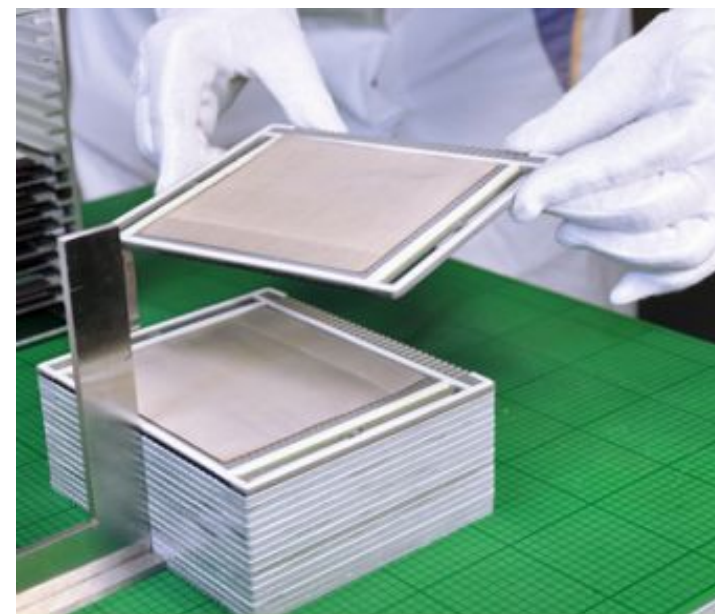
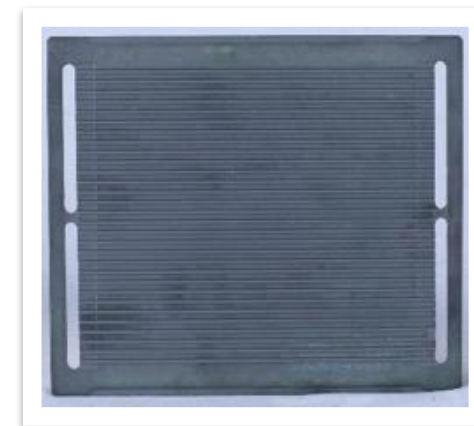
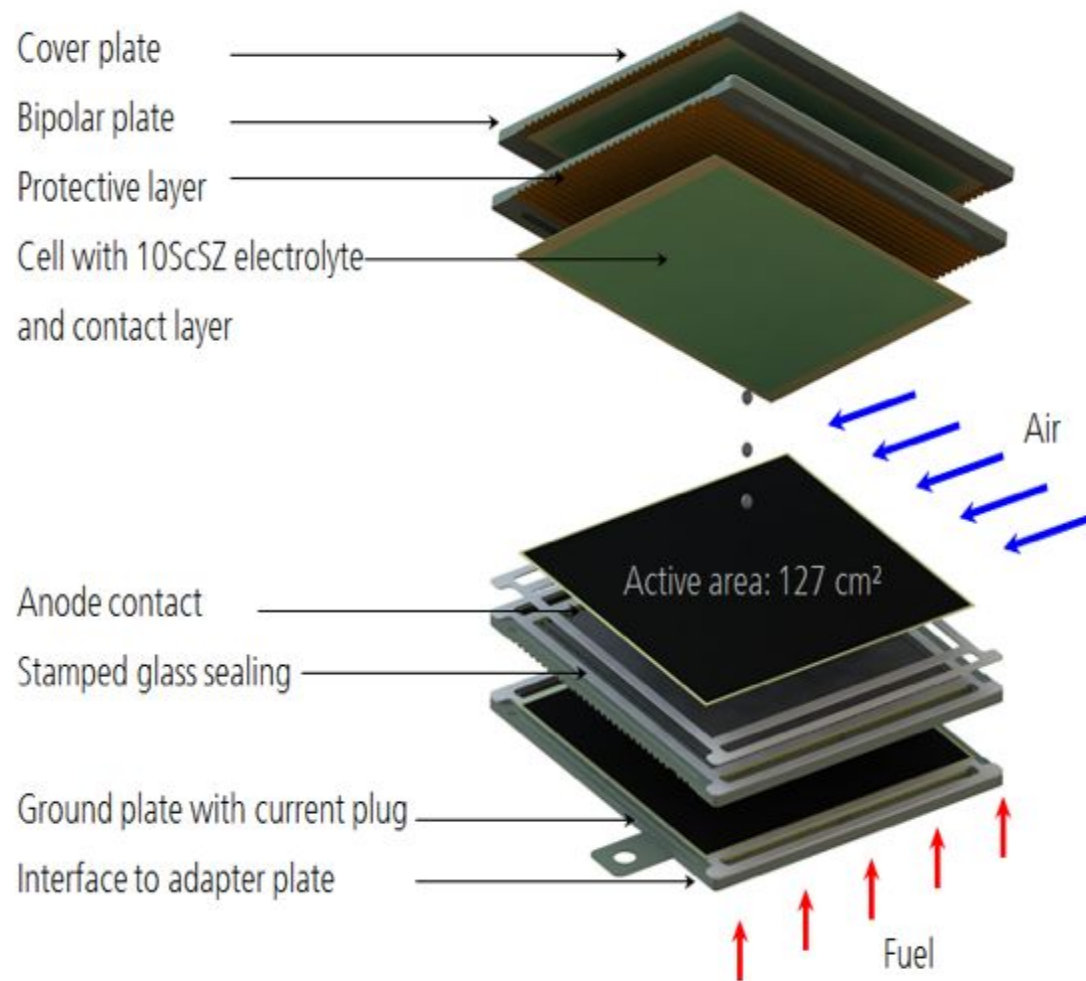
(no precious or rare  
earth material used)

## From Power to Fuel Reversible Technology

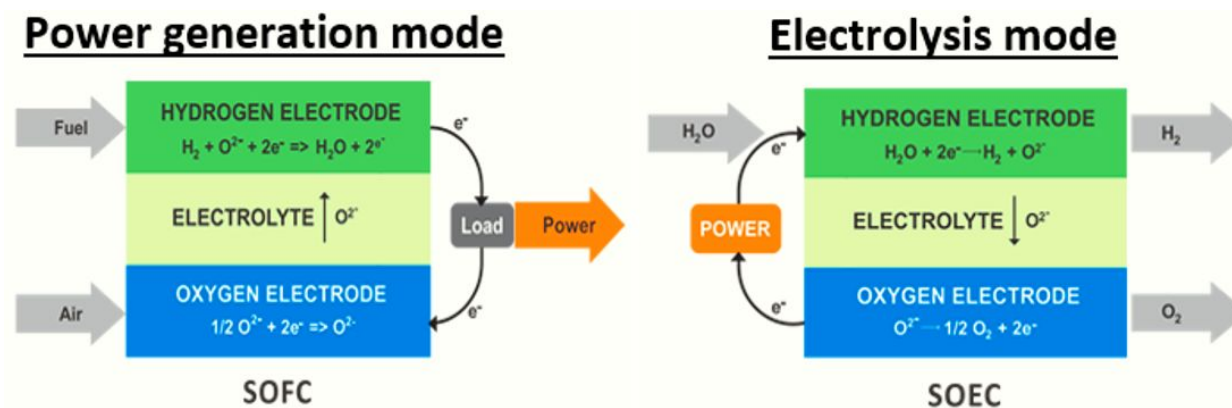




h2e develops and manufactures the reversible stack for **ELECTROLYSER AND FUEL CELL**

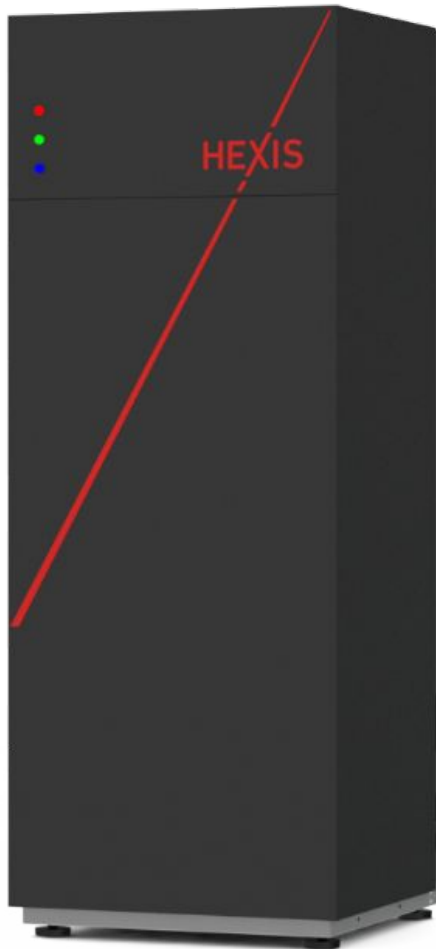


High temperature Solid Oxide Fuel Cell capable of operating in reverse mode



## Advantages

- High power density: > 30 W/cell (SOFC)
- Multiple Operating modes: SOFC, SOEC, rSOC
- Electrical efficiency of > 50% and CHP Efficiency upwards of 95%
- Multi-fuel capable (gaseous fuels like biogas, LPG, NG, & liquid fuels like methanol, diesel, gasoline)
- Non-polluting & highly reliable
- No precious metals used



- Local
- Efficient (95%)
- Independent
- Environmentally Friendly
- Resilient
- Saves money
- Backup, in case of a power outage

- Electrical power output - 1.5 kW<sub>el</sub> (AC, net)
- Thermal power output ca. 2 kW<sub>th</sub>
- Fuel - Natural gas (also with hydrogen additions)
- Modulation range - 100 % - 30 %  
all-year operation possible with warm water generation
- Electrical efficiency - 40% AC, net (CPOx)
- Total efficiency - 95% (LHV, Return= 30°C)
- Lifetime unit ≥ 15 years

### **FCU designed for easy integration in a heating appliance by OEMs**

- Fits to single & small multi-family houses and small commercial applications
- Can work as stand-alone CHP or can be combined with auxiliary burner
- In contrast to PEFC system: no limitations on heating systems (return temperature fitting to all houses)
- Combination with battery energy storage system to increase self consumption and autonomy in combination with E-mobility running in field test; island grid capability planned



## HEXIS

- Winterthur (CH) and Konstanz (D)
  - SOFC CHP systems for Europe  
HEXIS-Stacks
  - SOC Cells and Electrochemistry  
SOC Fundamentals
  - 50 employees
  - Ca. 30 years of SOFC
- 100 % owned by mPower – h2e  
till 06/2020 owned by Viessmann



- Pune (IN), New York (USA)
- Hybrid solutions: Combining Solar, Biogas, Battery, and SOFC
- Production hub for emerging countries



- Dresden (D)
- SOFC Stacks and SOEC Stacks
- Empowering others

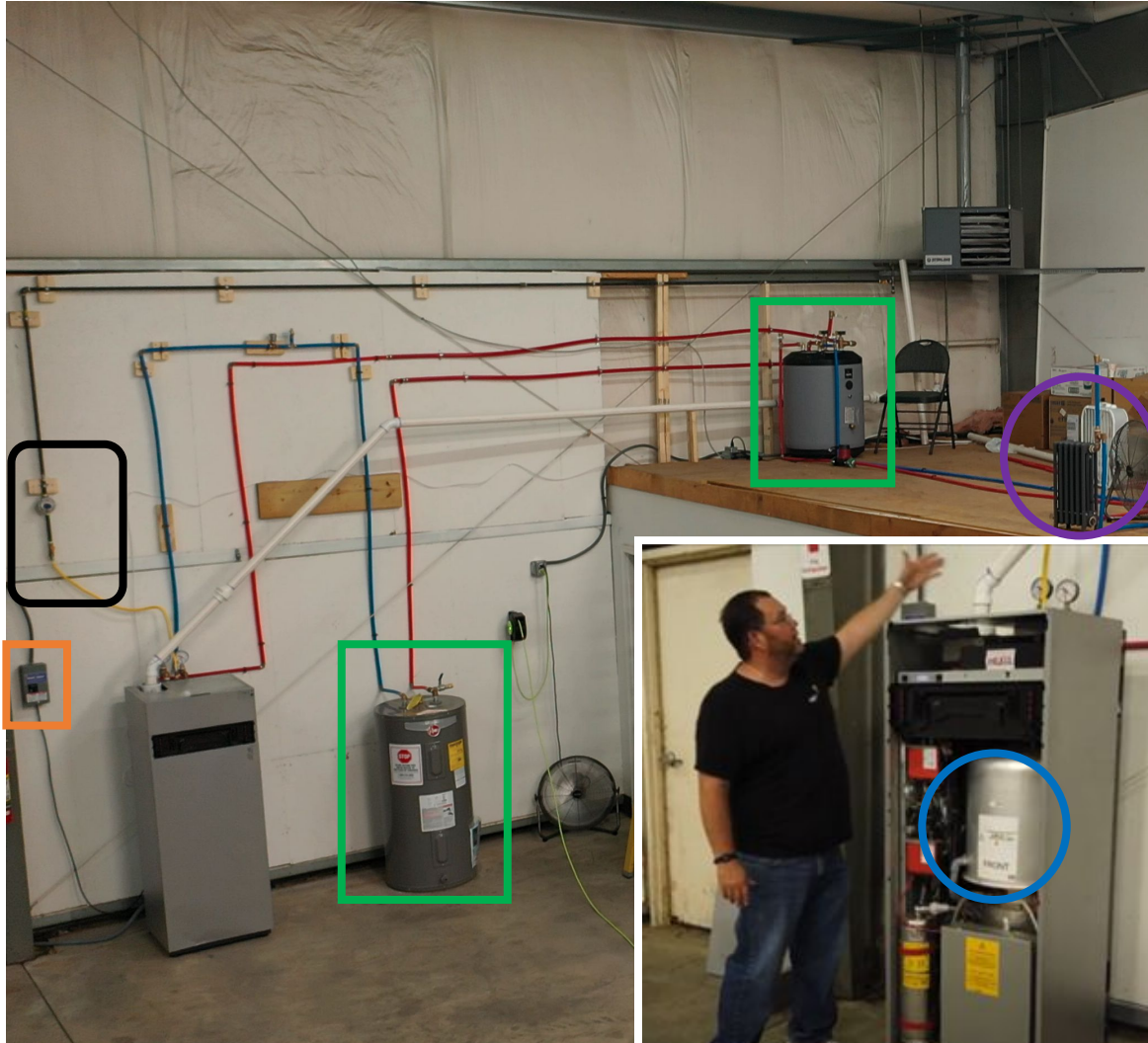


*PACE is an endorsement of Hexis' fuel cell product*

<https://pace-energy.eu/sfc-vpp-roadmap/>

- \$225M Invested
- **3m Operating Hours**
- Over 100 years of experience

- Certification Europe UL/CSA Standard
- 6<sup>th</sup> PACE Partner



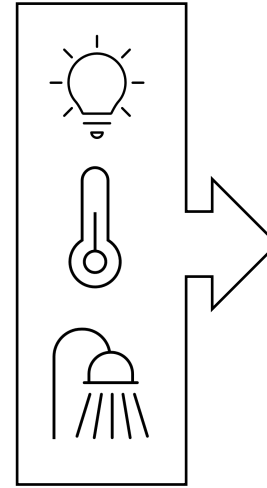
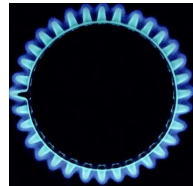
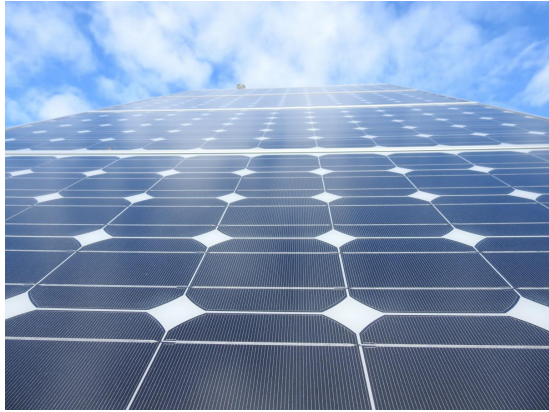
- **Fuel Cell Stack**
- **Electric Hook-up Double Pull 30 Amp**
- **Natural Gas Hook-up with Regulator**
- **Water System**
- **Radiator Heat Reduction System**



- Farms
- Tribal Partnership
- Micro homes



Acoma Indian Reservation, also known as Sky City, outside Albuquerque, New Mexico



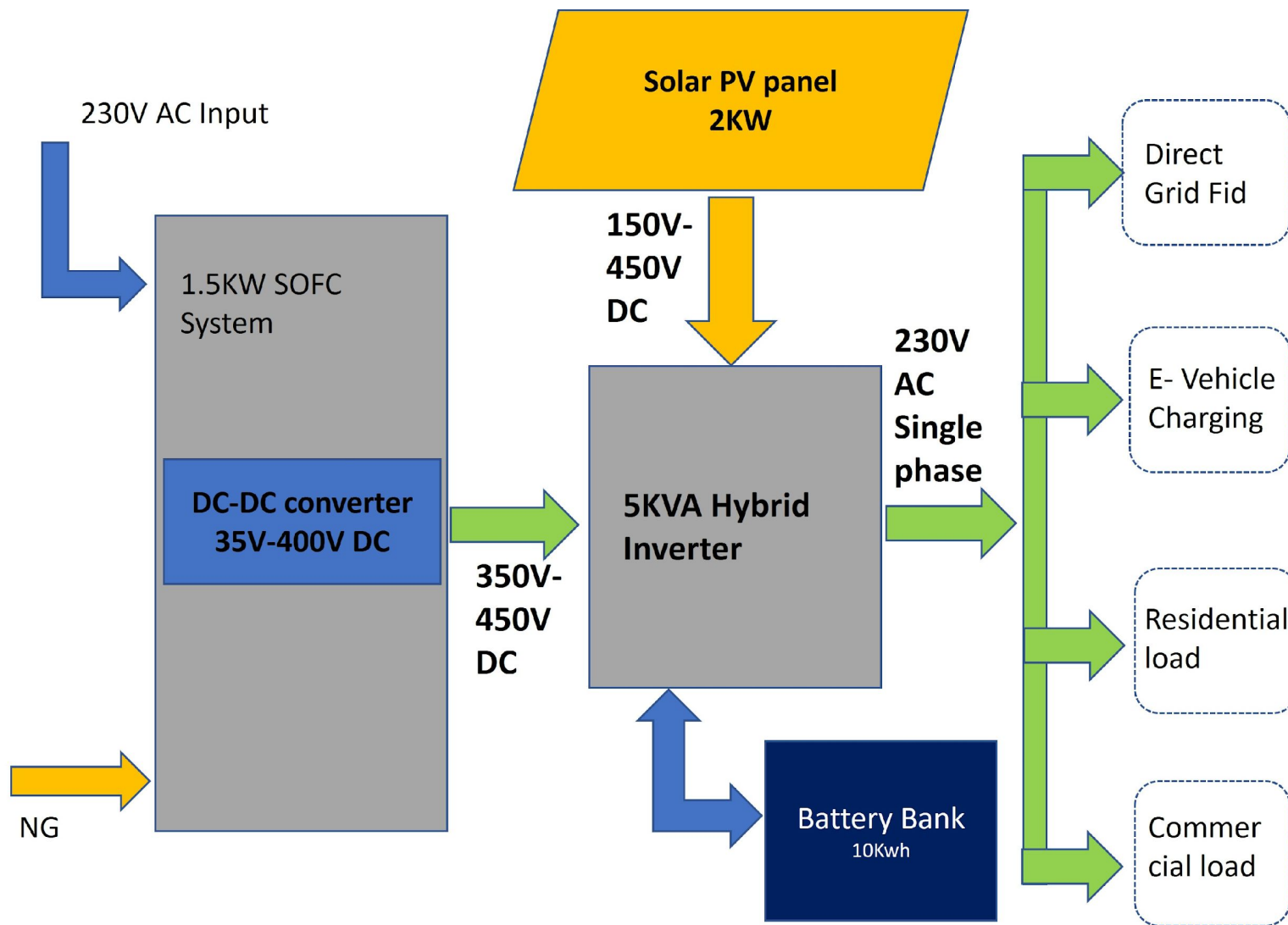
Acoma Pueblo Sky City Indian Reservation outside Albuquerque, New Mexico



Heat/Cooling Mode



- o Higher Efficiency up to 95%
- o Reduce CO2 Emissions along with a decline in air and sound pollution
  - ✓ 30–50% reduction in CHP or 80% with Biogas
- o Fuel Flexibility
  - ✓ Clean fuels biogas or methane
- o 7|24|365 operational
- o DI Water & usable heat
  - ✓ Bi product with usable heat and DI (Deionized) water
- o Ag waste use as fuel
- o Lower Nitrogen, Phosphate, and Sulfate runoff to watershed
- o Only technology that can lower air, sound, and water pollution



**System is flexible to connect and support micro grid structure.**

## 2023 Lab

Lucas County, OHIO



# Questions? Thank You!

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