

# Fuel Cell Powered Generator for Homes

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# Field of Application

- Houses
- Apartments
- Small stores
- Other small residences

# Engineering Requirements

- Power generation of 1-5 kW
- Continuous operation for up to 6 weeks
- 40,000 total operational hours
- Installed on a wall or roof of residence

# Selection of Fuel & Oxidizer

Choice A: Pure Hydrogen

- No Carbon Waste (cleaner for environment)
- Expensive
- Not as readily available

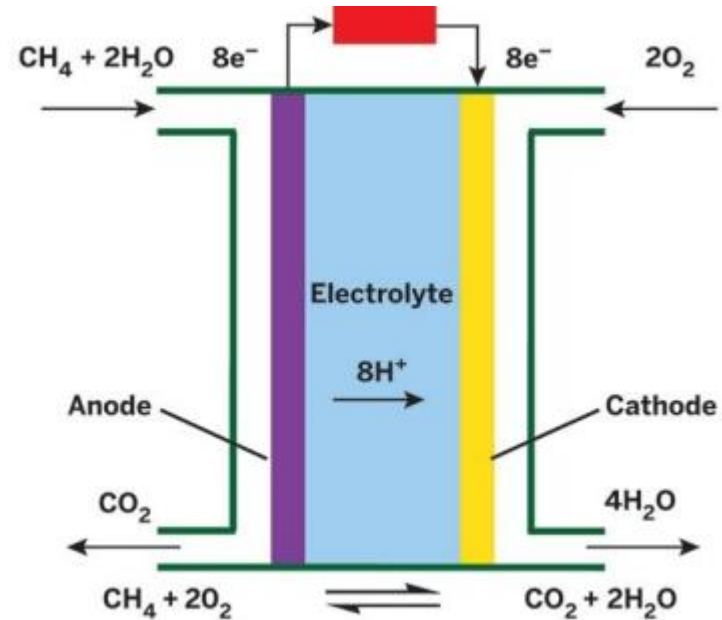
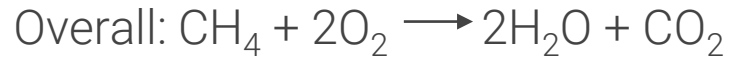
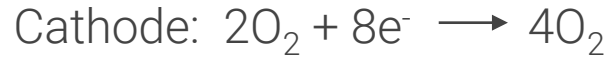
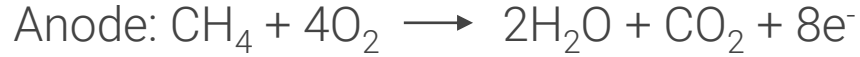
Choice B: Natural Gas (Methane, Propane..)

- Cheaper
- Produces Carbon waste
- Most homes already equipped with a natural gas line

Due to practicality we opt to use Natural Gas

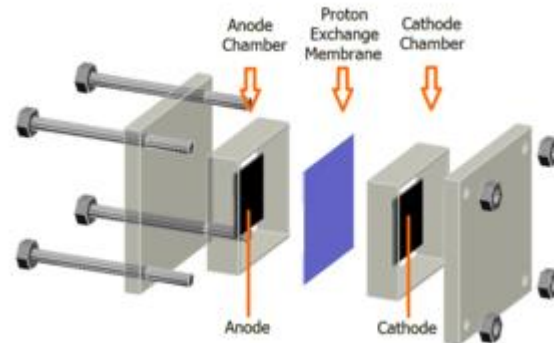
Air will be used as an oxidizer

# Electrochemical Reaction



# Design and Structure Assumptions

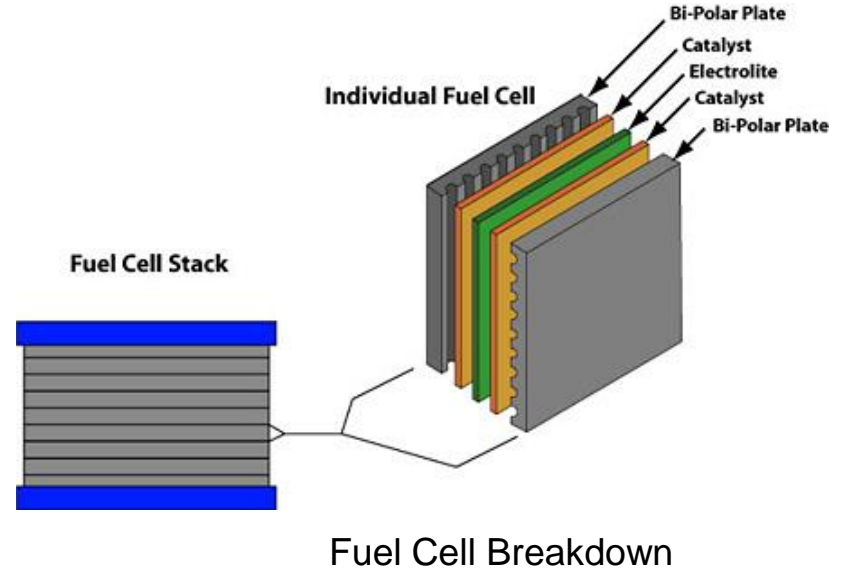
- Should be small and compact to fit in tight places inside homes
- Water should be filtered out in order to be used for the process.
- Heat can be recycled and used for other processes
- Should be kept away from sources of excess heat as well as open flame in case natural gas would ignite



Compact Fuel Cell

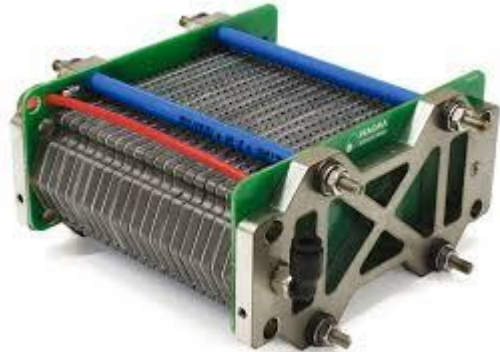
# Design and Structure (cont'd)

- Membrane should be catalyst coated using Platinum
- This increases efficiency as performance from the fuel cell
- In order to increase efficiency and performance membrane and catalyst layer should be close
- Reducing potential bulging



# Design and Structure (cont'd)

- Plate stack designed utilized with an assumed maximum consumption of 3kW
- Assuming an efficiency of 50 mW/cm<sup>2</sup>
- Length and Width of 20 cm by 30 cm meaning area of 600 cm<sup>2</sup>
- Roughly 100 plates would be required for this process



Fuel Cell sStack



# Comparison (Renewable)

## Solar

### Pros

- No pollution
- Silent

### Cons

- Limited to time of the day and the weather condition

## Wind

### Pros

- No pollution
- Low operational cost

### Cons

- Space
- High installation price
- Noise
- Limited to windy areas

# Comparison (WATT)

- WATT Imperium
- Uses SOFC system for powering
- Can be stacked to provide desired power



WATT Imperium

Specifications			
<b>Continuous Power:</b>	500W	<b>Max Hybrid Power:</b>	1,150W
<b>Nominal Voltage:</b>	12Vdc or 24Vdc	<b>Core Size (L x W x H):</b>	22.5in x 12.5in x 12.5in
<b>Core Weight:</b>	46lbs (Dry Weight)	<b>Fuel Source:</b>	LPG (HD-5) or Natural Gas (NG)
<b>Fuel Consumption @ rated power:</b>	0.34 lb/hr (LPG) or 8.55 cu. ft./hr (NG)	<b>Fuel Pressure:</b>	0.5psi
<b>Ambient Temp. Rating:</b>	-10° to 40° C	<b>Noise:</b>	45dBA @ 3ft

Specifications

# Comparison (TESLA)



- Solar Roof converts solar energy to electricity
- Powerwall stores the electricity for future use
- Can be stacked to increase the storage
- Designed to self-power homes 24/7



Solar Roof

Storage  
→



Powerwall

# Benefits

- More efficient compared to gas or diesel engines
- Silent operation
- Eliminates pollution
- Can recycle heat in housing (cogeneration)

# Conclusion

- SOFC offers:
  - Fuel flexibility
  - Use of a non-precious metal catalyst
  - Waste heat which can be used for cogeneration
  - Readily available and widely studied technologies
- The estimated price would need to be decreased in order to be cost competitive
- Technologies must be improved to reduce maintenance requirements
- Methane is not readily available in all residences
- This is not the cleanest energy because there are still CO<sub>2</sub> emissions

# References

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## Images

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