# Fuel cell Aircraft

- Today's airplanes are powered by turbine engines in form of a turbofan or turboprop
  - \+ Very high power to weight ratio
  - \- $CO_2$ emissions.



**Is a short range fuel cell propelled aircraft with 19 passengers possible?**

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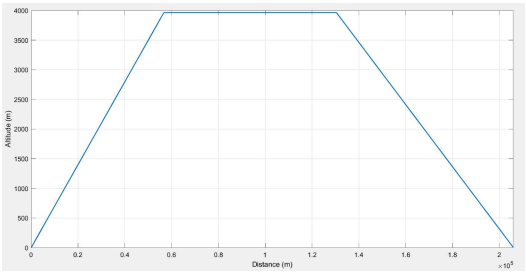
**Maximum takeoff weight for the airplane:**

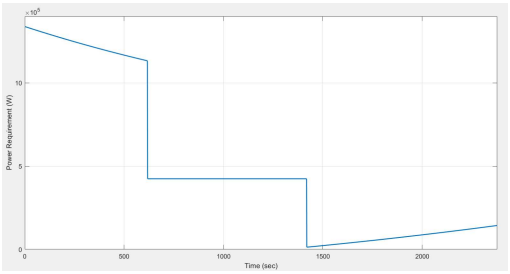
- 8618 kg
- 2400 kg for tanks, fuel and fuel cells.

| Energy climb |
|---|
| 228 kWh |
| **Energy cruise** |
| 94 kWh |
| **Energy descent** |
| 38 kWh |

**Flight journey**




**Flight power requirement during journey**

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**PowerCellution Heavy Duty System 100**

- Weight: 212 kg
- Fuel cell stacks Net power output: 15 – 100 kW
- Max. Continuous power: 0,47 kWh/kg
- 0.39 kW / kg with with cooling system

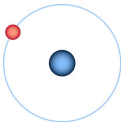
**Cryo tank**

- 15.08 kg of tank per 1 kg of H2
- Total tank weight: 294 kg

**Weight per FCS + cooling:**

- 254,4 kg/system

**Theoretical gravimetric density hydrogen:**



- 33,3 kWh/kg

| Requirements | | |
|---|---|---|
| **Hydrogen** | **Max efficiency** | **Power density** |
| 19,4 kg | During climb → 14 MW | 0,66 kW/kg |

**Project #5 - Aircraft simulations using hydrogen as an energy carrier**

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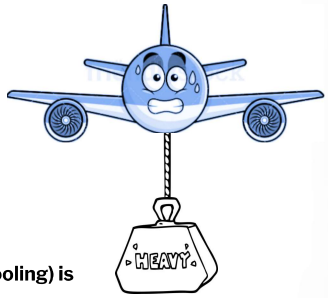
## Result

Amount of FCS that fits in airplane with 19 passengers:
- 8

Amount of FCS needed to make the flight:
- 14

**→ 66 % increase in power density for FC system (+ cooling) is needed to get the plane flying with these conditions.**




## Conclusions

Fuel cell propelled aircraft is possible **but** currently aircraft performance is compromised by mass.

For improved performance:
- ➔ New design is needed
- ➔ Lower weight needed or higher system efficiency
- ➔ High temp. fuel cells requiring less mass for cooling could be an option.