# The hydrogen Synergy

#### **T.H.M. van der Laan<sup>1</sup>** Supervisors: C. Acar<sup>1</sup>, W. Rohlfs<sup>1</sup>

## An integrated fuel-cell / heat-pump system as sustainable heat source

### Current situation

Domestic heating contributes to 10% of the total CO<sub>2</sub> emissions<sup>1</sup>.

- Heat pumps can operate with solar power.
- However, highest heat demand correlates with low solar gains





#### Boost heat pump's COPwith fuel cell's heat <sup>5</sup>.

• Fuel cell's produce next to



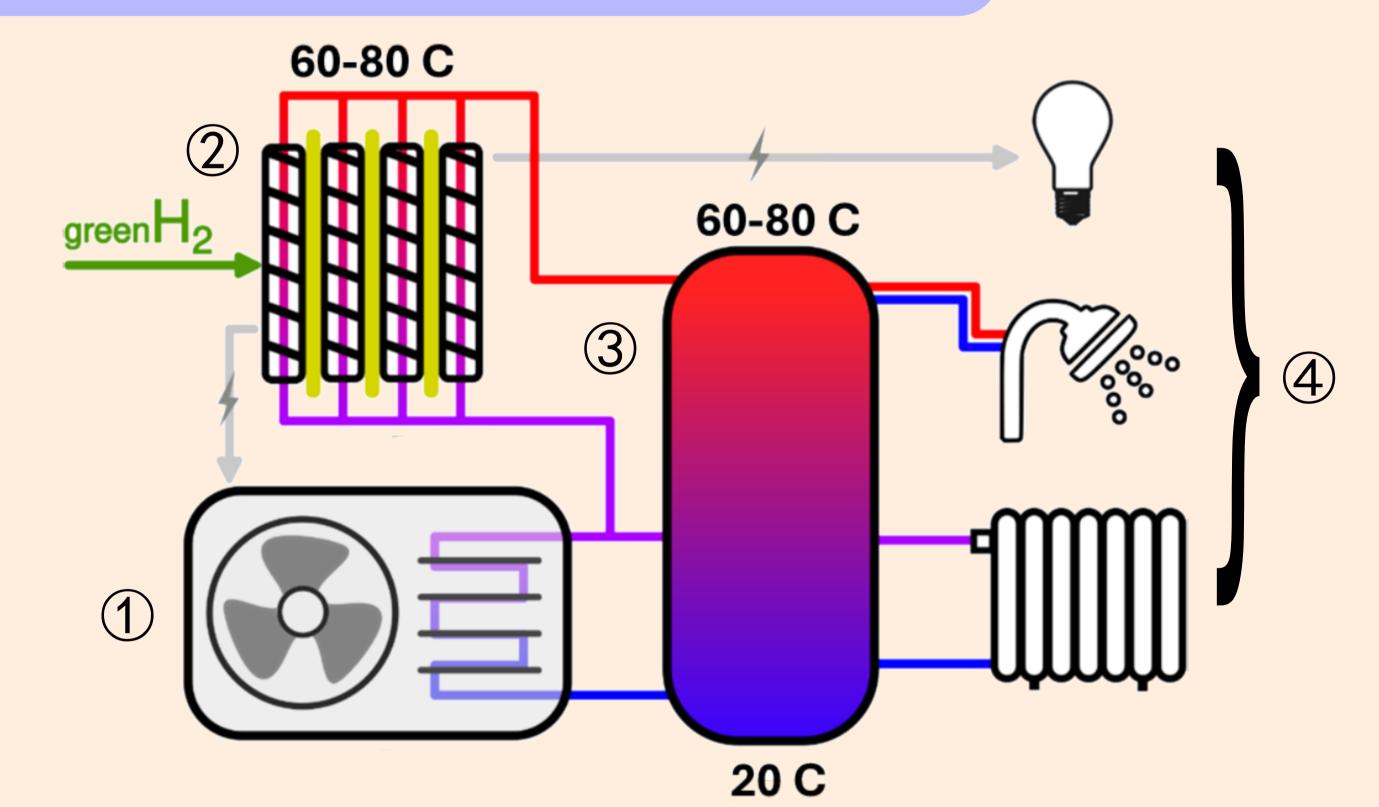


and low solar power performance.

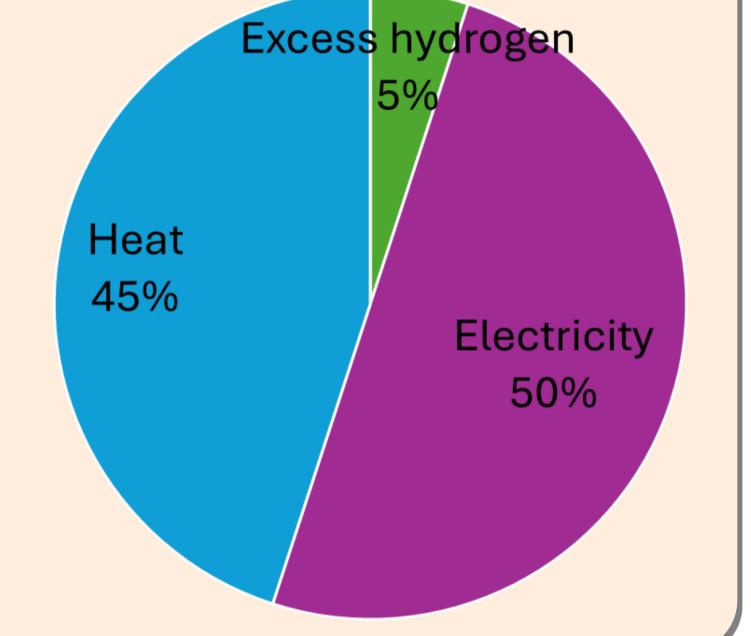
 Furthermore, the Coefficient of Performance (COP) depend on the heat available in the outdoor air<sup>3</sup>.

Doilei								<u> </u>	55,0			
Solar panels			27,5									
Heat pump	4,	,6										
Solar boiler	2,	,8										
	0	10	20	30	40	50	60	70	80	90	100	
2021												

System design



- electricity a substantial amount of heat.
- Total system efficiency can reach 76-90% (HHV)<sup>6</sup>.
- Utilizing green hydrogen as a sustainable long duration energy storage medium<sup>4</sup>.



## Energy systems

Aim to determine feasibility of integrated hydrogen fuel-cell / heat-pump system compared to other energy systems.

• In most houses, other energy systems are present e.g. solar panels<sup>2</sup>.

 Therefore, every additional energy system influences marginal payback time.

1 Heat pump

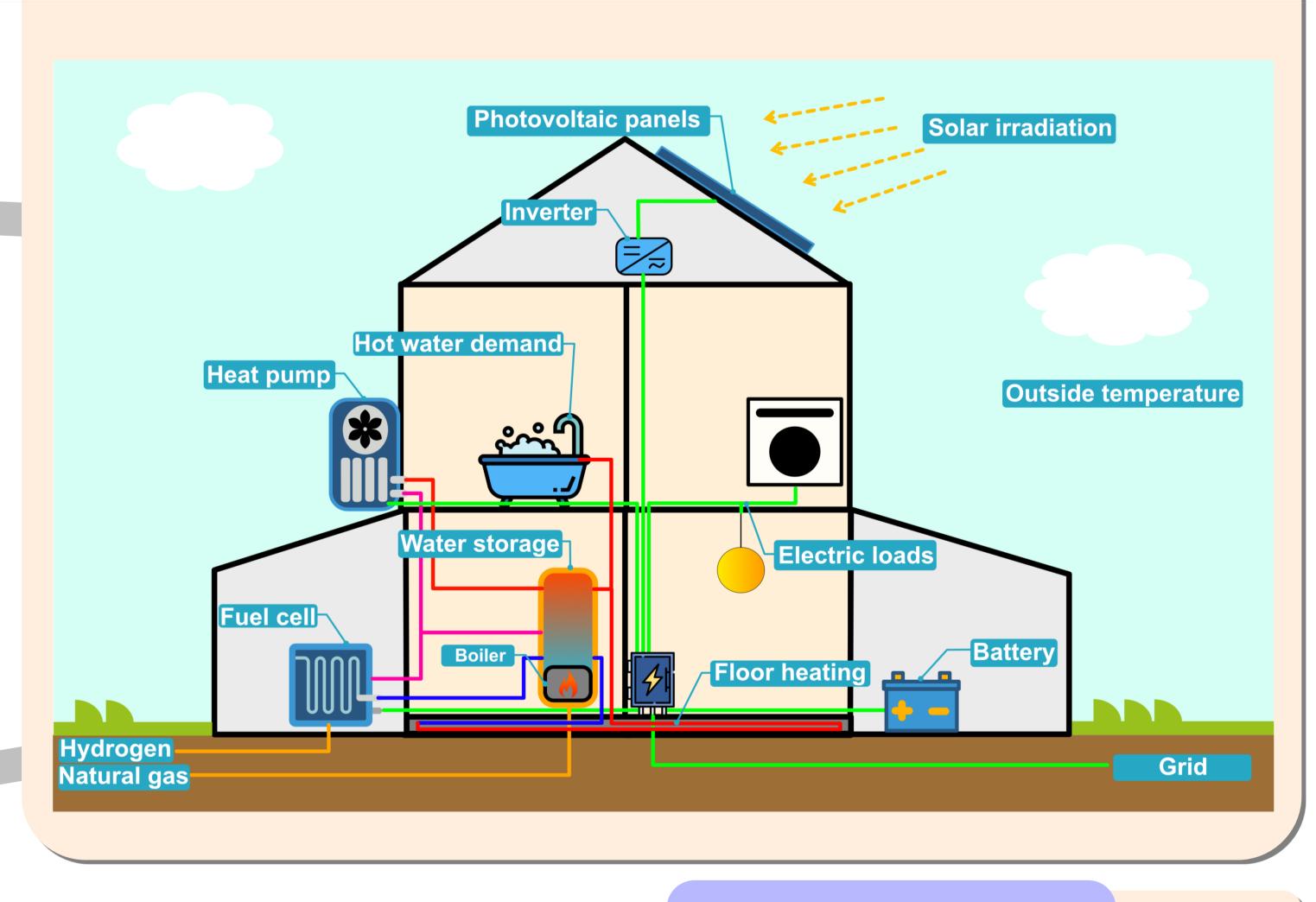
- ② Proton exchange membrane fuel cell
- ③ Buffer tank
- ④ Heat and electricity demand

## Model simulation

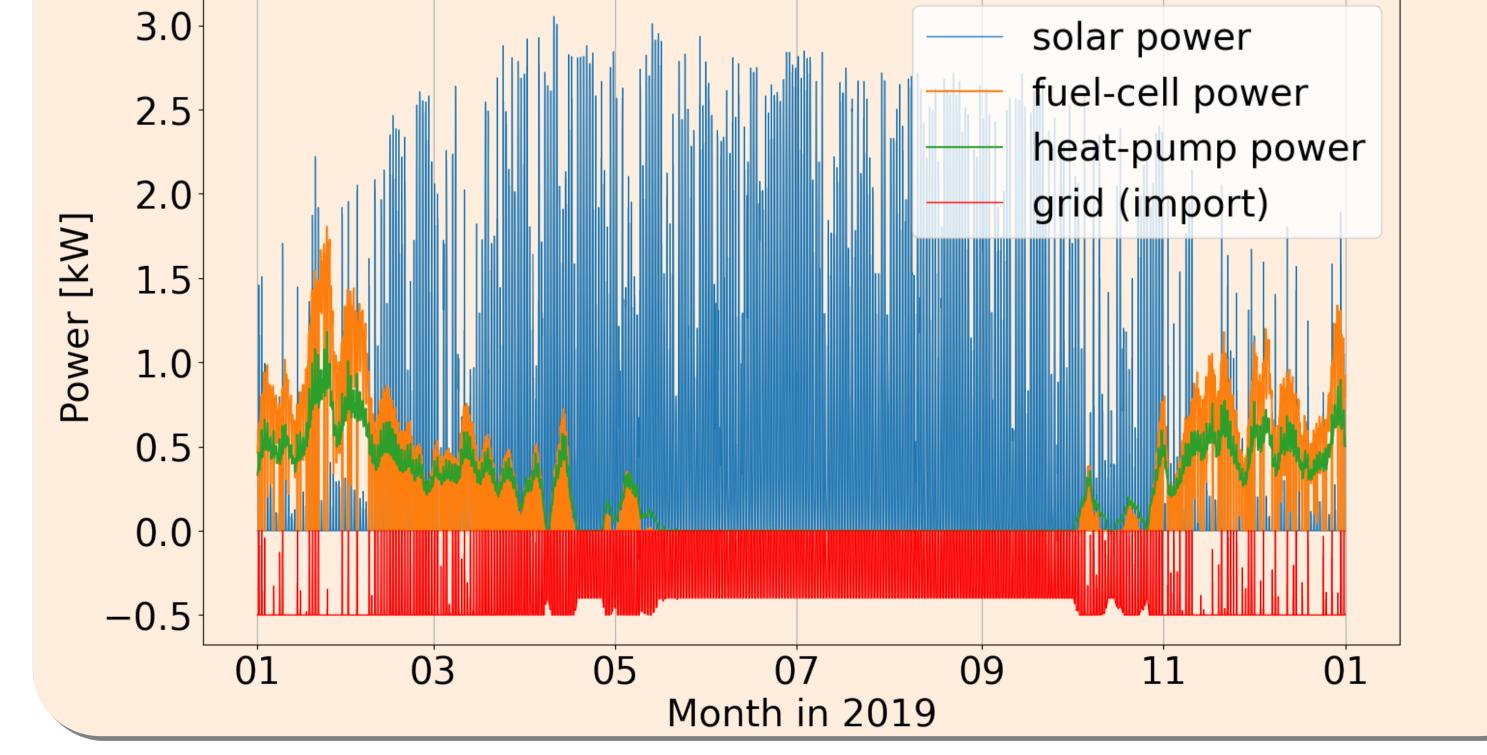
#### Insights:

- Fuel cell operation reduces grid dependence.
- Based on basic price, favor for importing electricity instead of utilizing hydrogen.
- Battery necessary for day and night cycles and to increase renewable utilization.

Simulation of house with solar, heat-pump and fuel-cell system







## Next steps

 Extend model.
Techno-economic analysis.
Improving fuel cell cooling performance.
Demonstrate performance with prototype. (2022): Emissies van broenasgassen (n°CC): www.obs.nl
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1. Department of Thermal and Fluid Engineering, Engineering Technology Contact: t.h.m.vanderlaan@utwente.nl



