

Use of hydrogen in off-grid installations A techno-economic assessment



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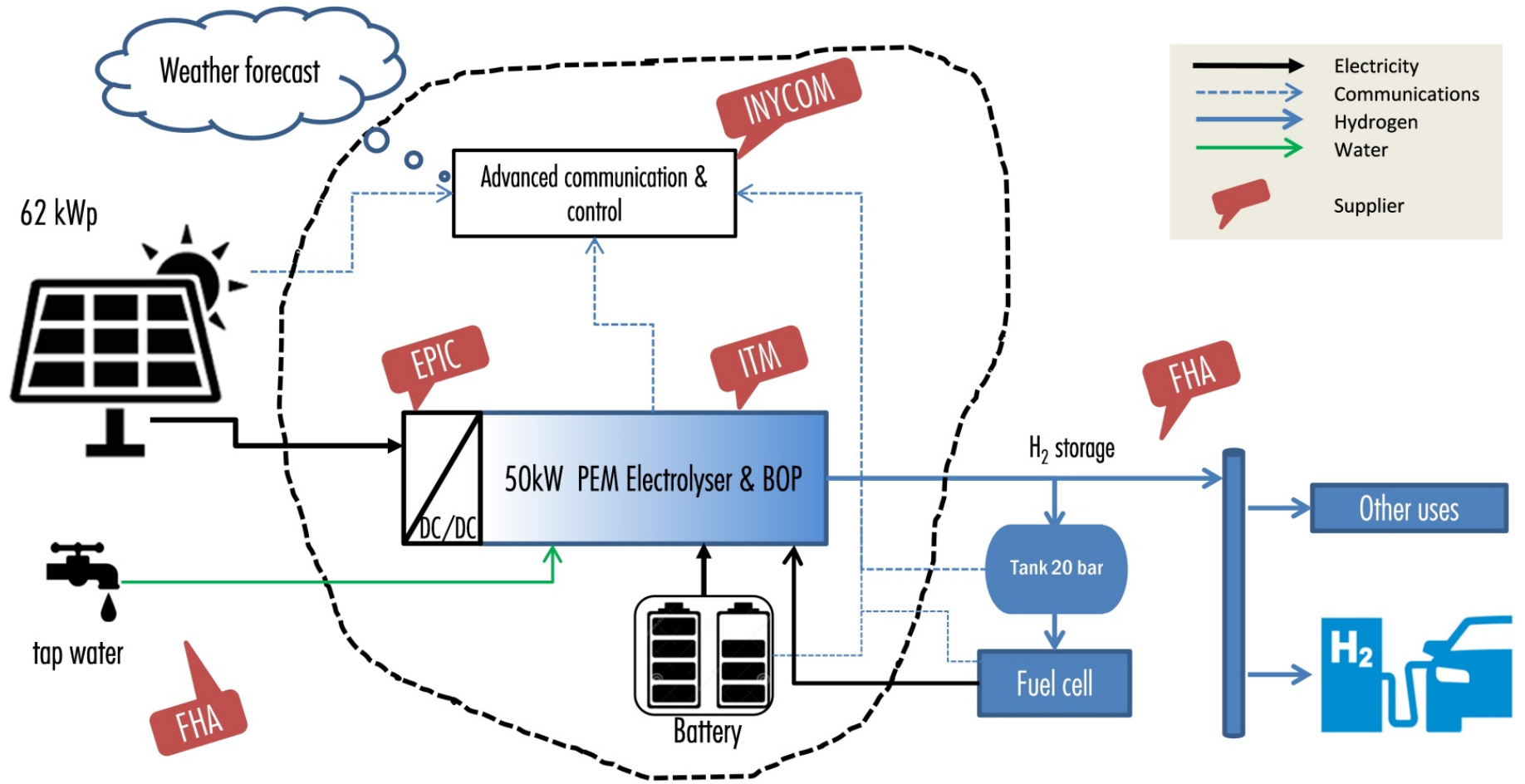




PEM ELECTROLYSERS FOR OPERATION WITH
OFFGRID RENEWABLE INSTALLATIONS

www.ely4off.eu

Overview



Available at demo site (Huesca)

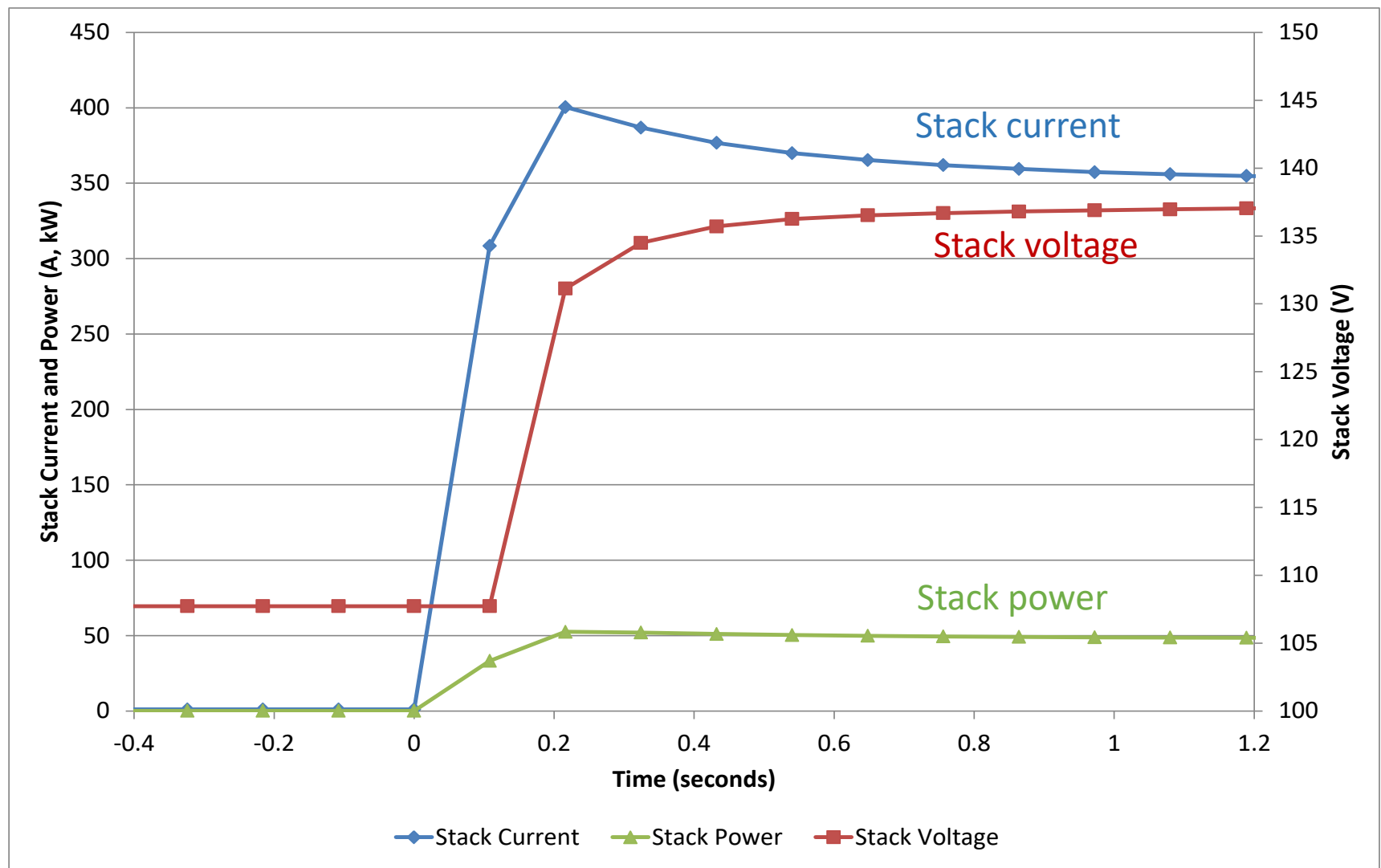
Scope to be developed in ELY4OFF

Already existing in FHA (updating of storage foreseen within ELY4OFF)

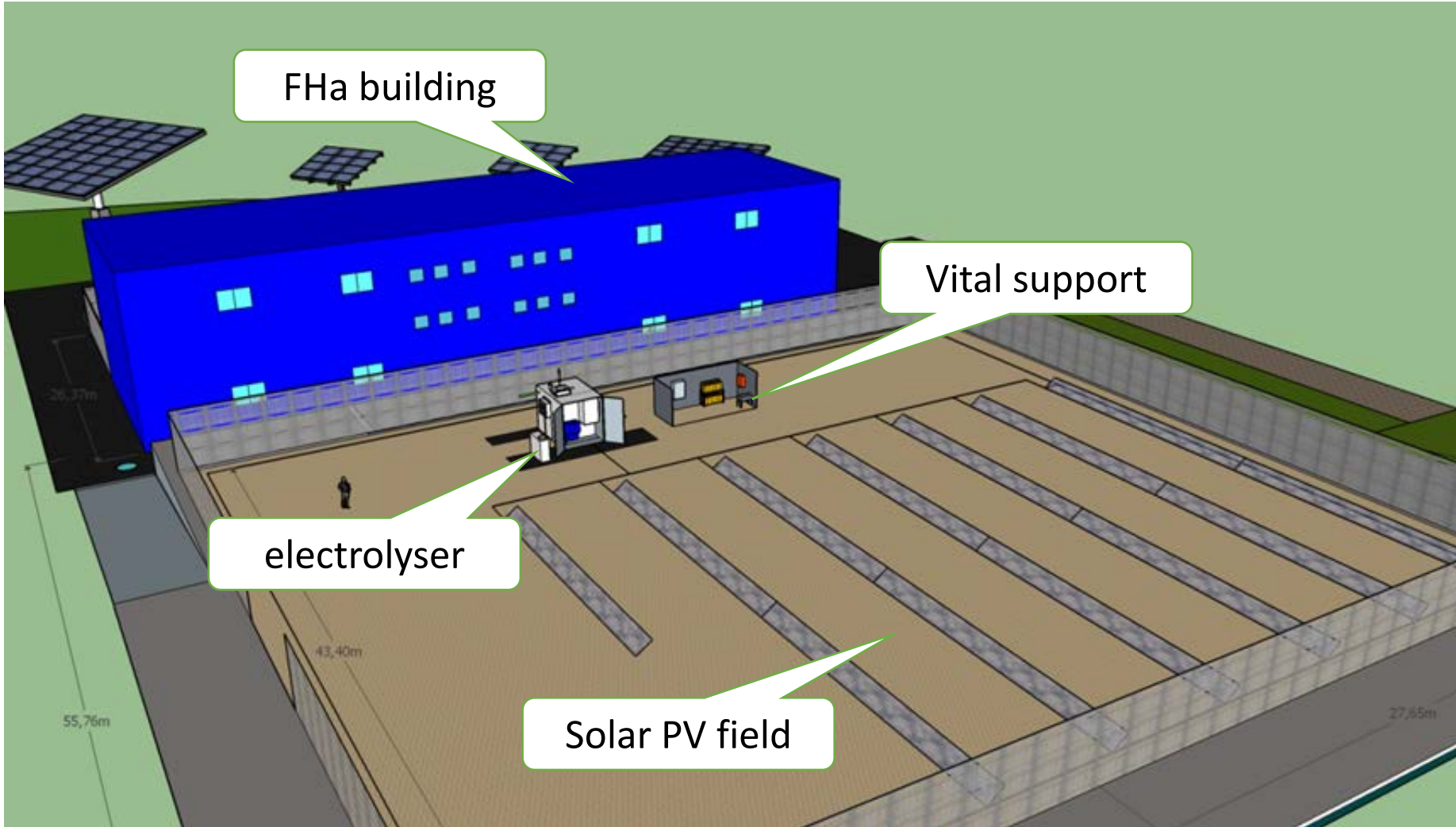
Already existing in FHA

Electrolyser performance

voltage and current response to application of a 0% to 100% signal



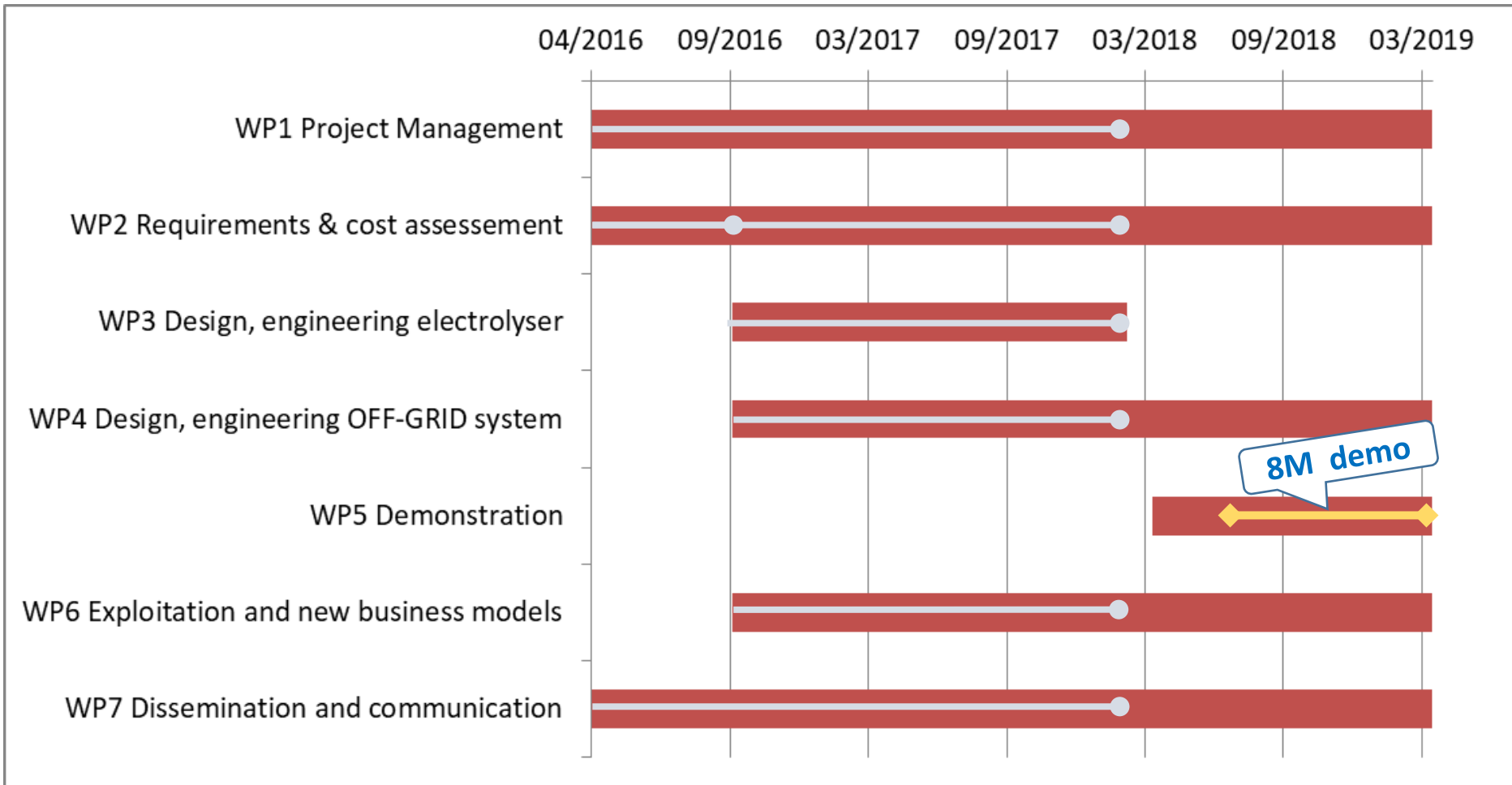
Demo site (FHA)



Solar field at demo-site



Budget: 2.315.217 €



Different **business cases** foreseen for off-grid hydrogen in Ely4Off:

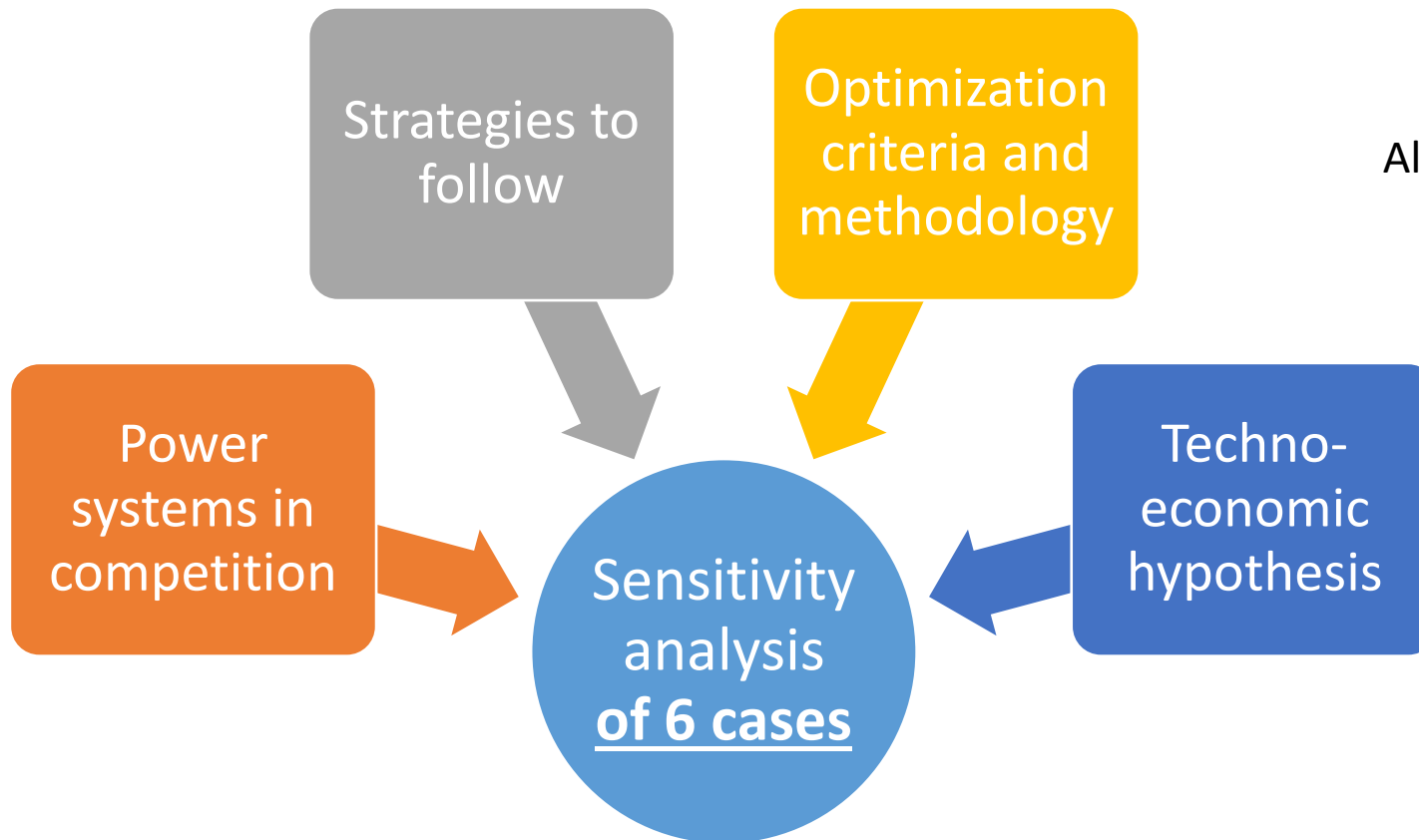


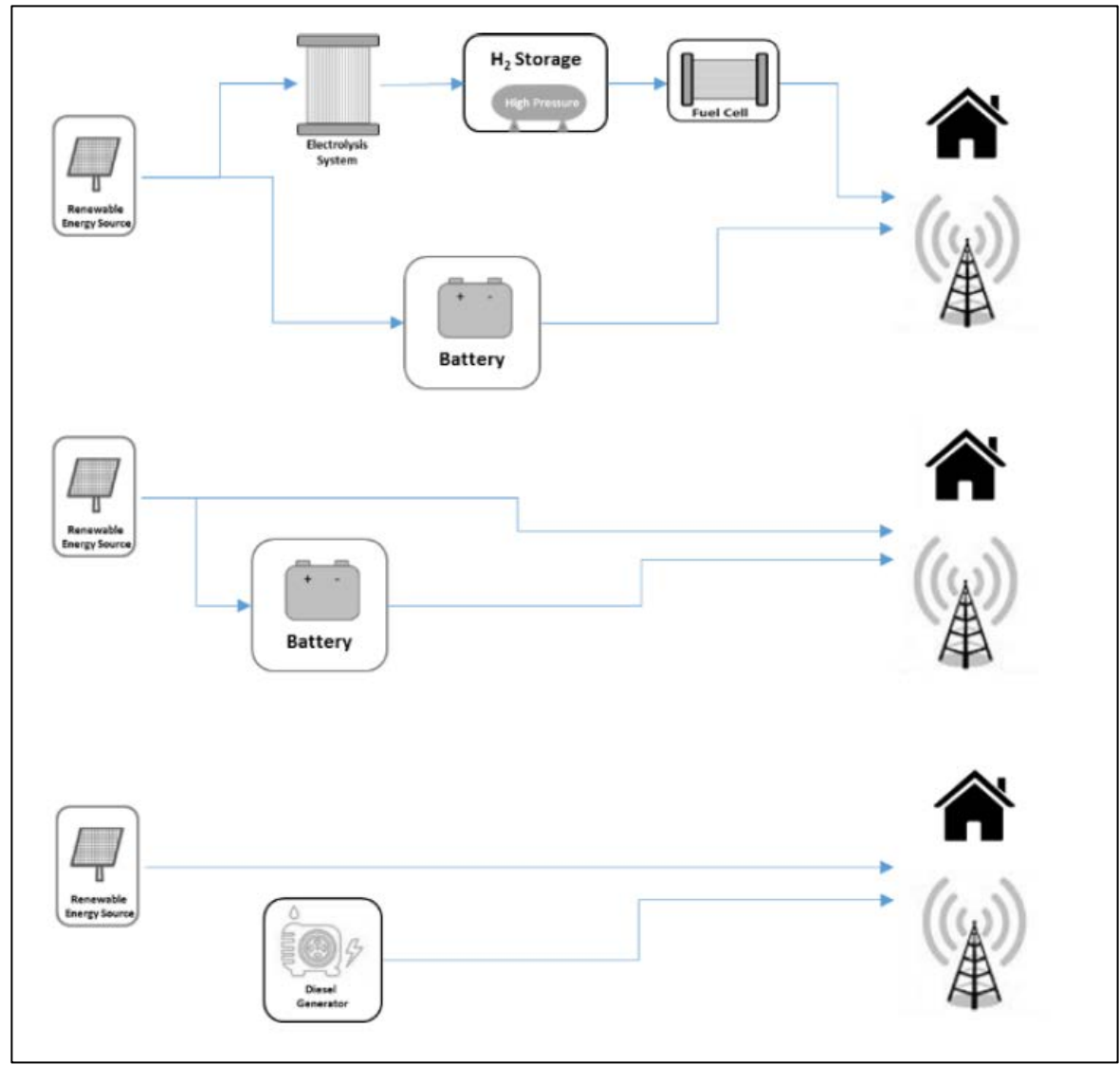
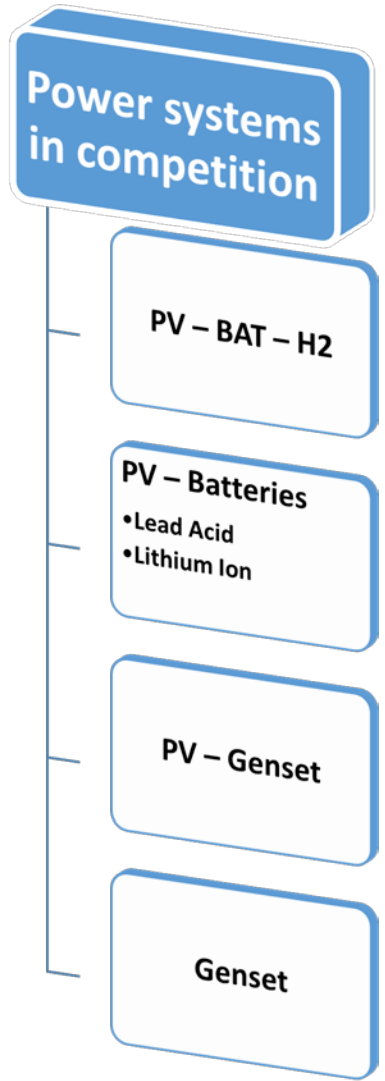
	N°	Market
EU (highly electrified scenario)	1	Energy system for isolated areas (e.g. mountains and islands)
	2	Replacement of diesel engines in off-grid installations to support existing/new installed RES off-grid installations
	3	Backup system for failure events in weak grids
	4	Off-grid Hydrogen Refueling Stations (HRS) to supply to FCEVs
Developing countries (weakly electrified scenario)	5	Weak grids
	6	Replacement of diesel engines
Other	7	Catastrophic events
	8	Green hydrogen for niche industrial applications
	9	Power-to-Gas

1st business case: Energy system for isolated areas



Cyril Bourasseau
Alexander Chabert





Tenerife

Case 1: Steady load 1 kW (off-grid telecom antenna)

Case 2: Steady load 4 kW (off-grid telecom antenna)

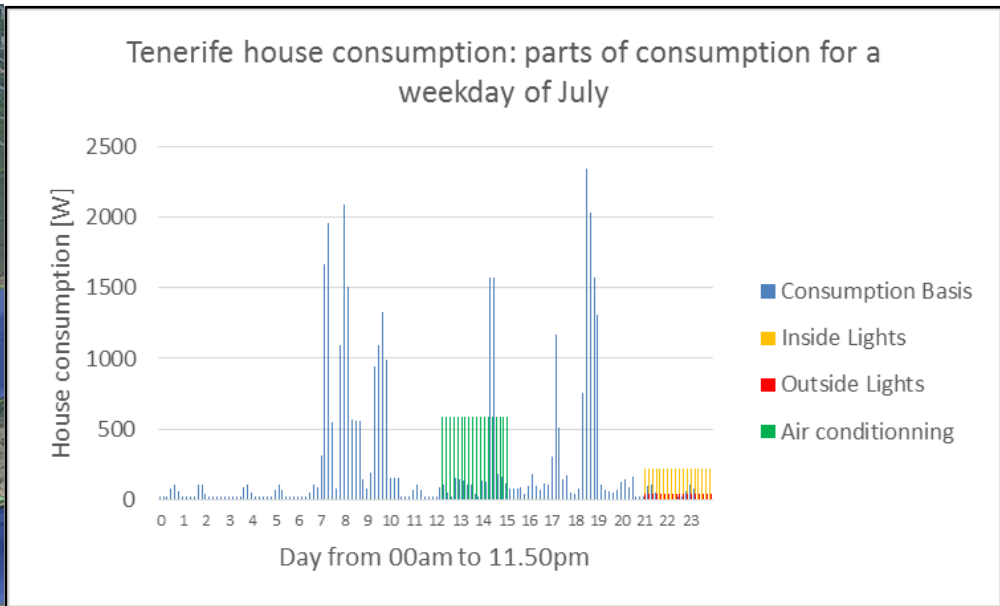
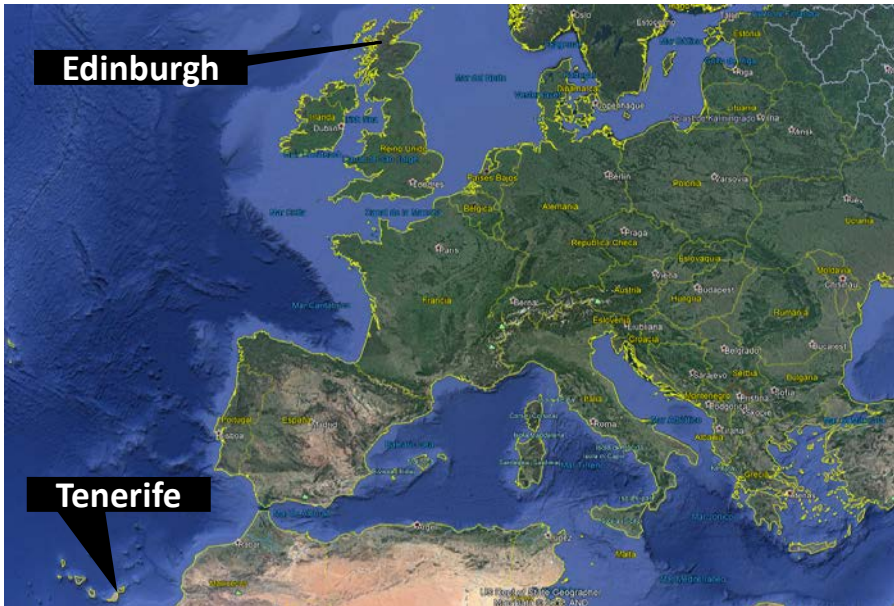
Case 3: Variable load (house profile)

Edinburgh

Case 4: Steady load 1 kW

Case 5: Steady load 4 kW

Case 6: Variable load (house profile)



Technoeconomic hypothesis

**Simulation period:
1 year with 10
minutes time step**

**Economic basis: 20
year, 8% discount
rate**

**Investment,
replacement and
O&M costs**

Optimization and criteria methodology

**Economic
criterion:
Levelized Cost of
Electricity (LCE)**

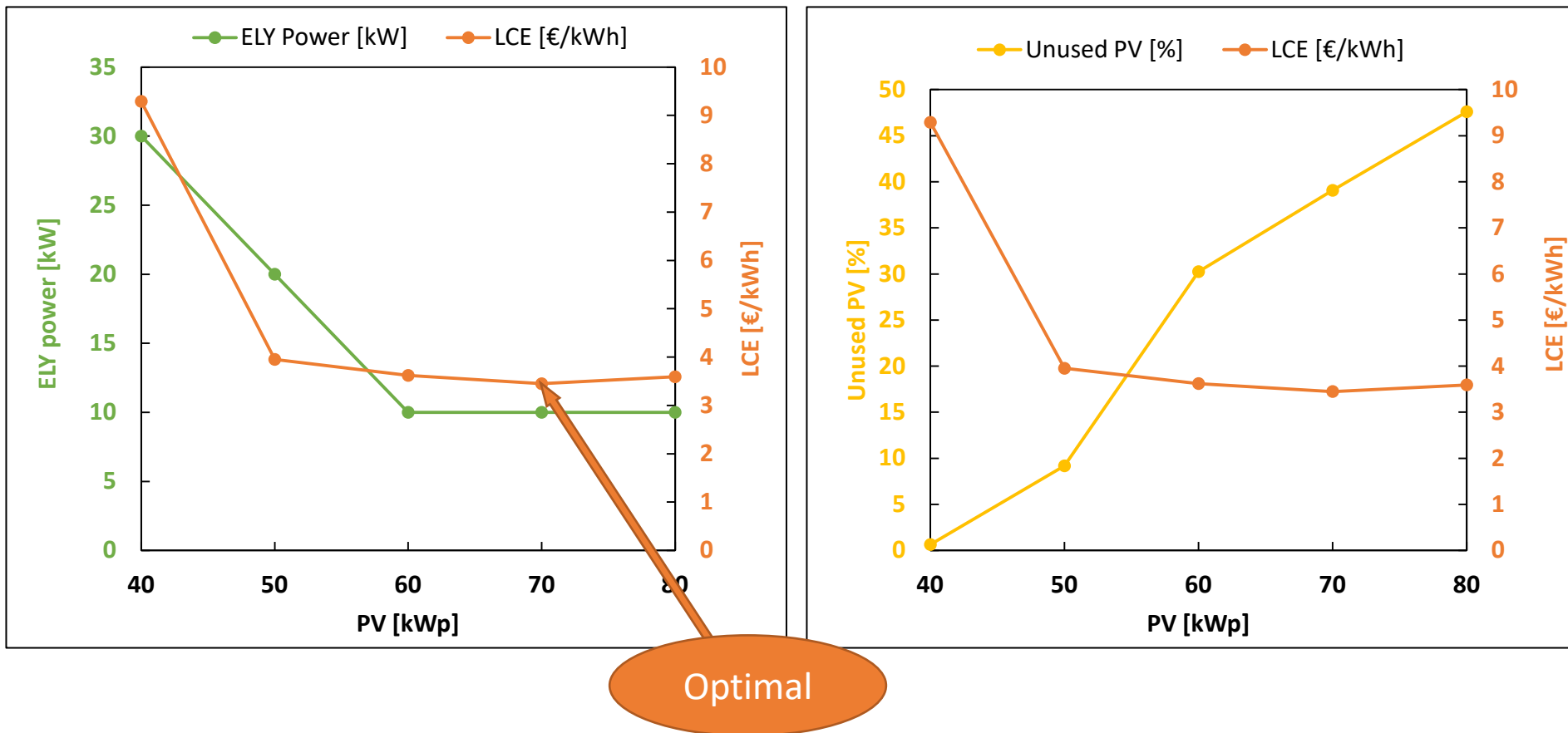
**Technical
criterion:
unsatisfied load
0%**

Odyssey Software

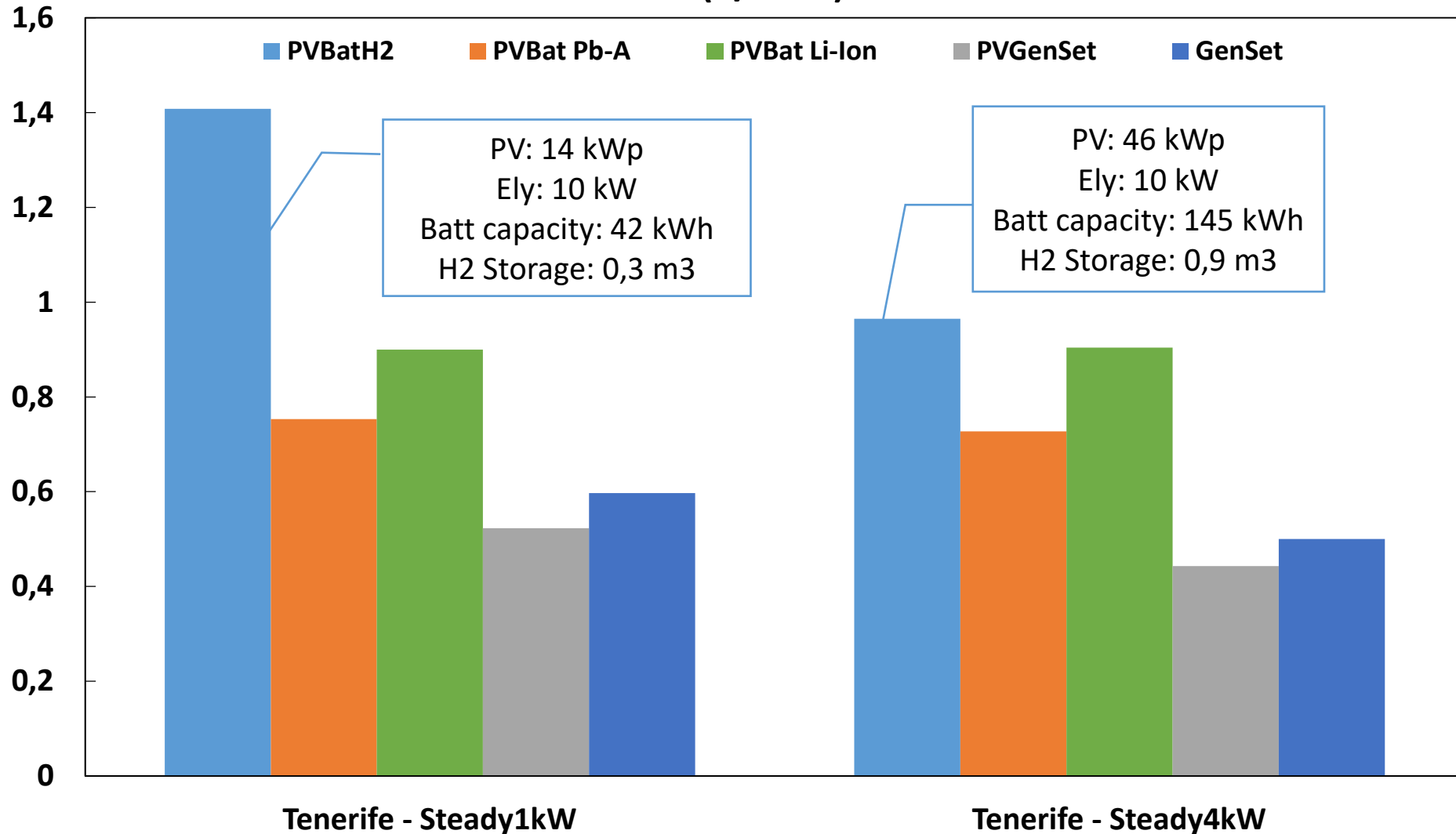


Sensitivity analysis are performed to find the optimal configuration for each location.

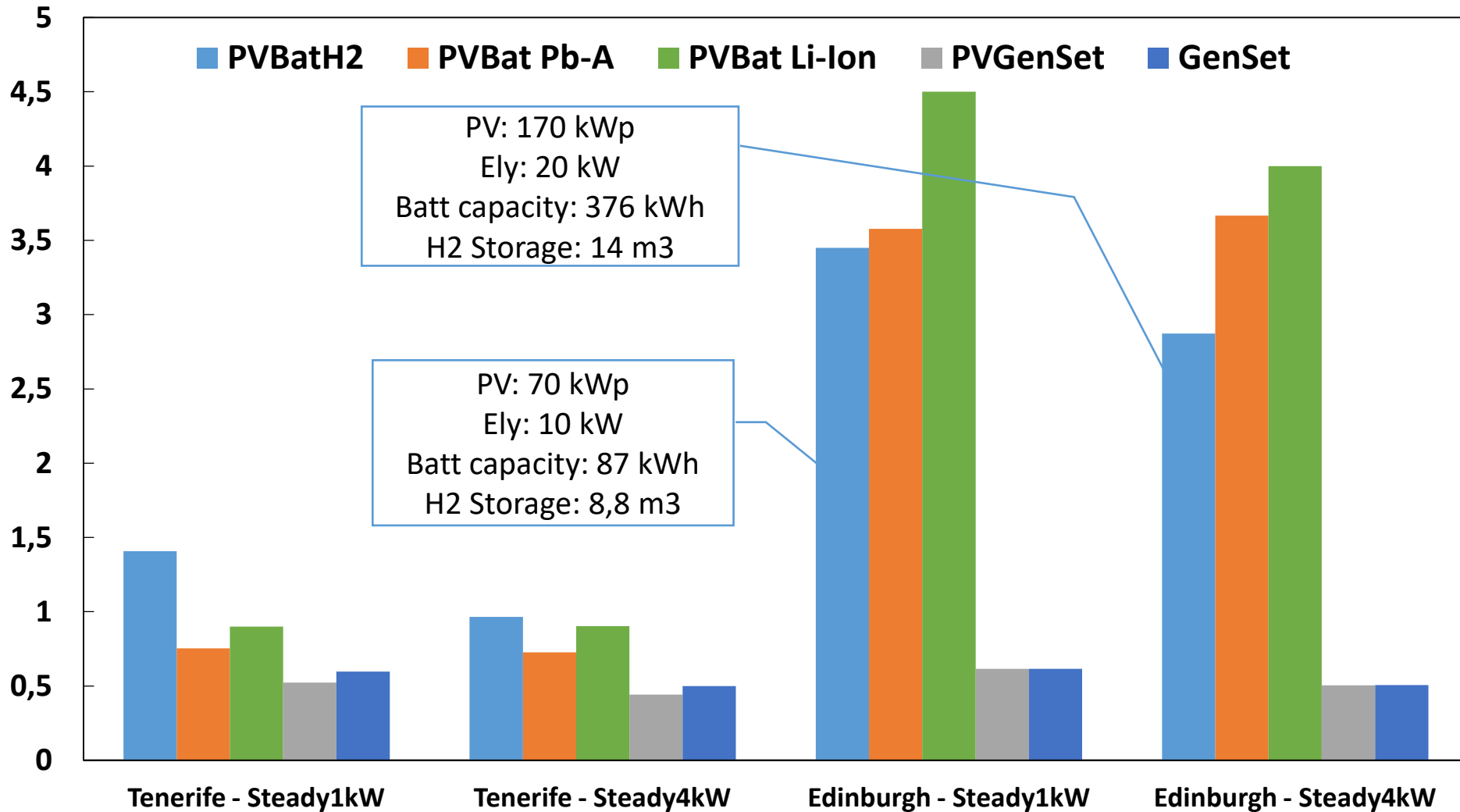
Example Case #4: *Edinburgh - Steady 1kW - PVBatH2 system depending on PV*



LCE (€/kWh)

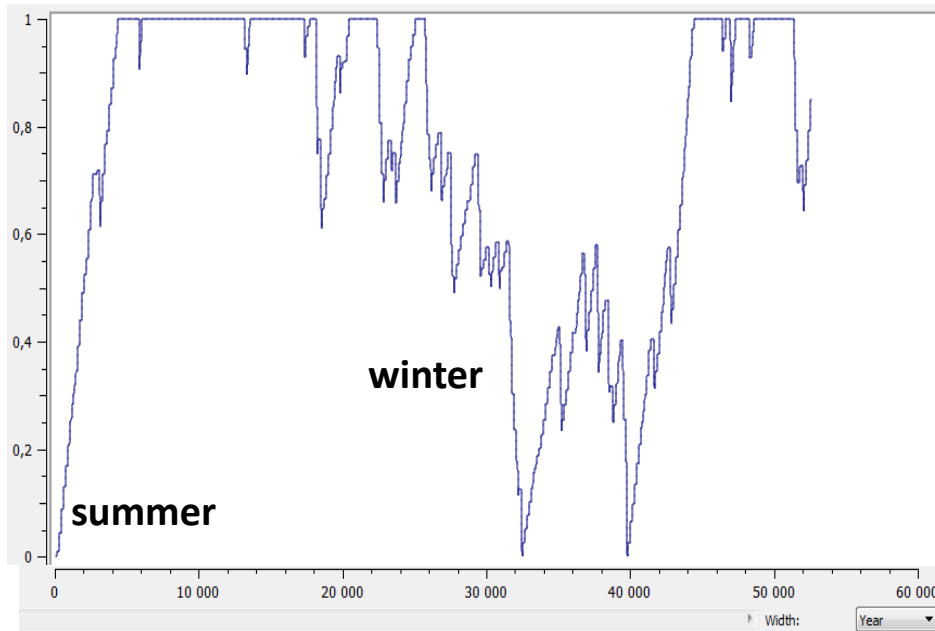


LCE (€/kWh)

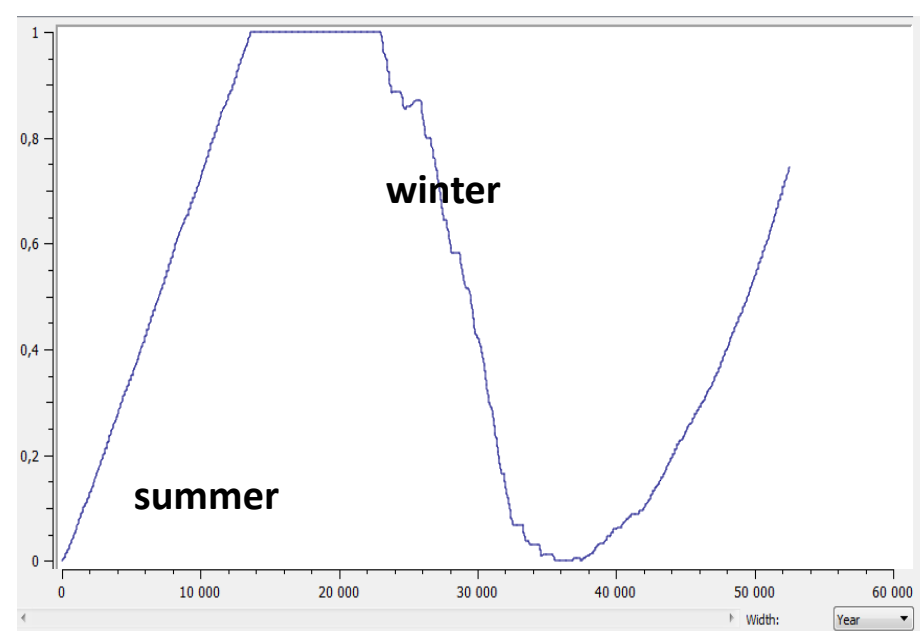


Hydrogen storage profile for steady 4 kW

Tenerife

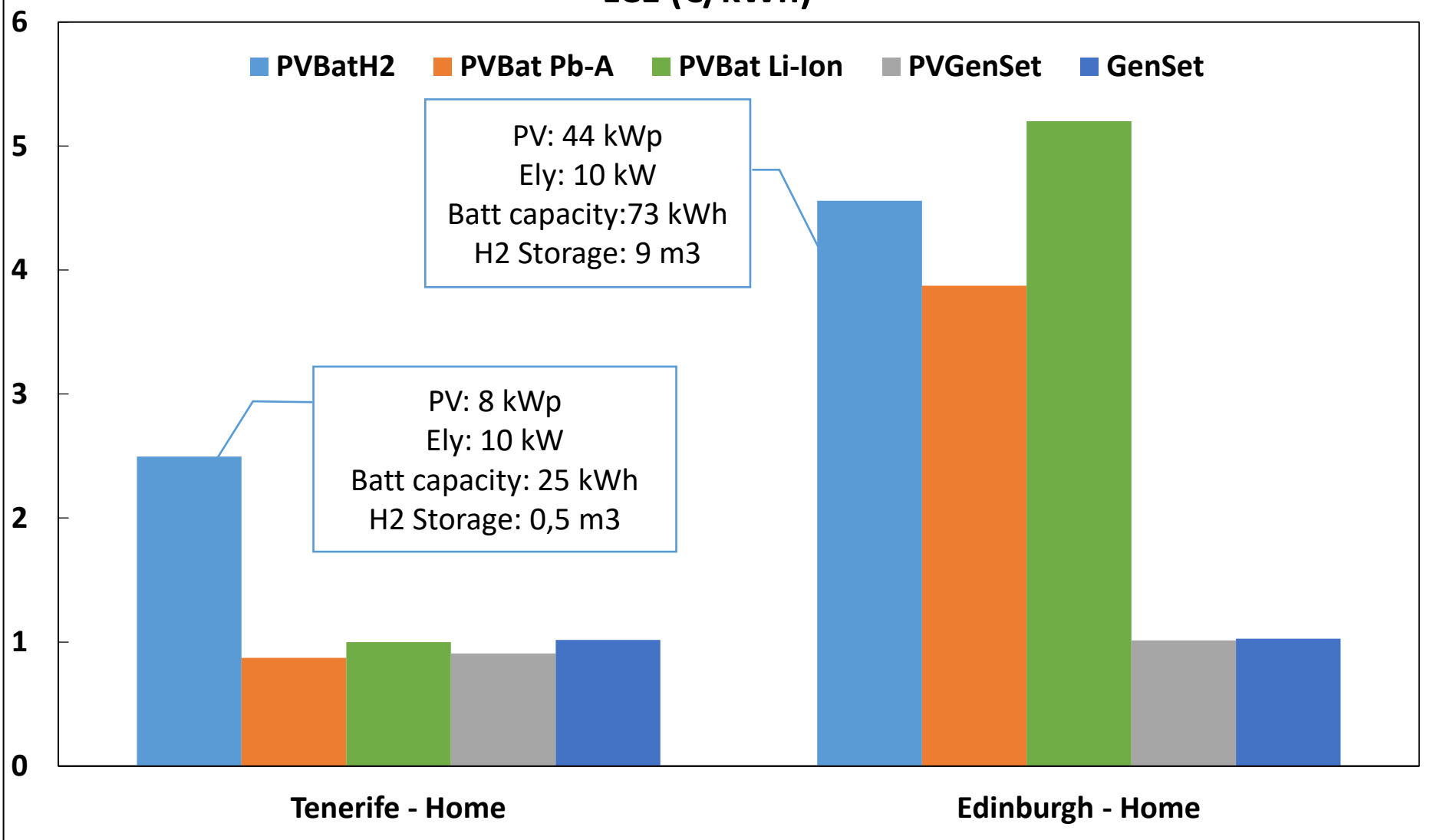


Edinburgh



LCE (€/kWh)

■ PVBatH2
 ■ PVBat Pb-A
 ■ PVBat Li-Ion
 ■ PVGenSet
 ■ GenSet



- ❑ Diesel based systems is the lowest cost solution even with 3€/litre (all the results presented before were done with 2 €/litre)
- ❑ LCE for PV-BAT and PV-BAT-H2 in Tenerife are **3 times <** in Edinburgh
- ❑ PV peak power is **3 times >** in Edinburgh
- ❑ Elements giving economic advantage to hydrogen are:
 - ✓ **High seasonality for PV** production → requiring large quantity of energy stored in summer to be reused in winter
 - ✓ Powering a **demanding profile during nights** requiring daily energy shift from day to night
 - ✓ A **constrained PV production** due to limited available surface for example

Supported by:



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