Design and operation of a UK based community energy scheme

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Copenhagen, 12-13 September 2017

SCENe Sustainable Community Energy Networks

3rd international conference on
SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING
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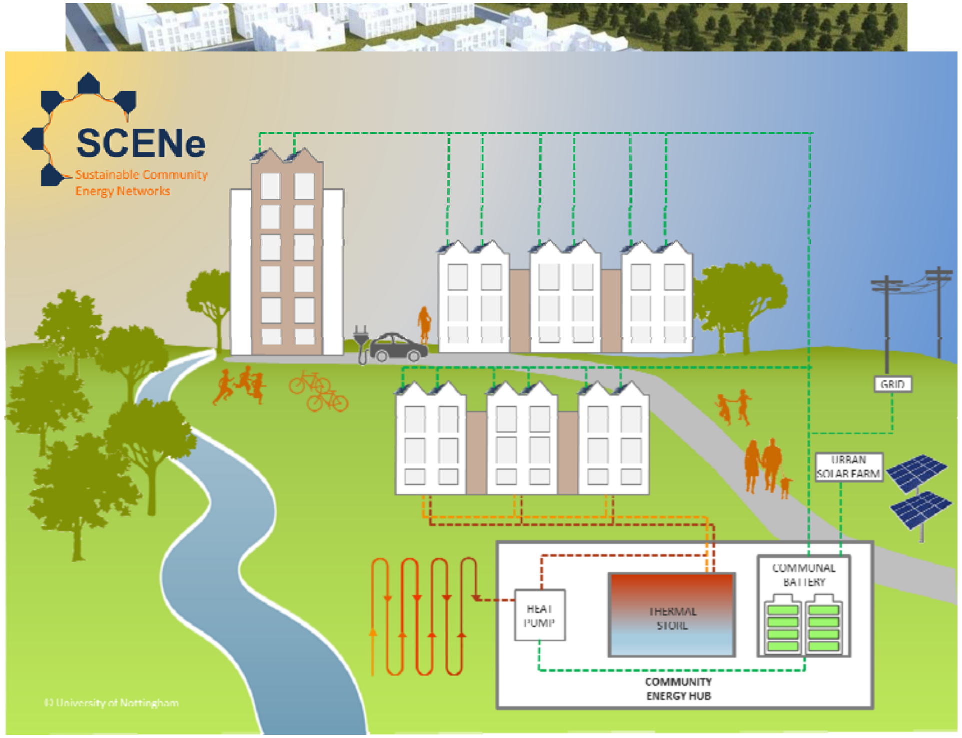
Introduction

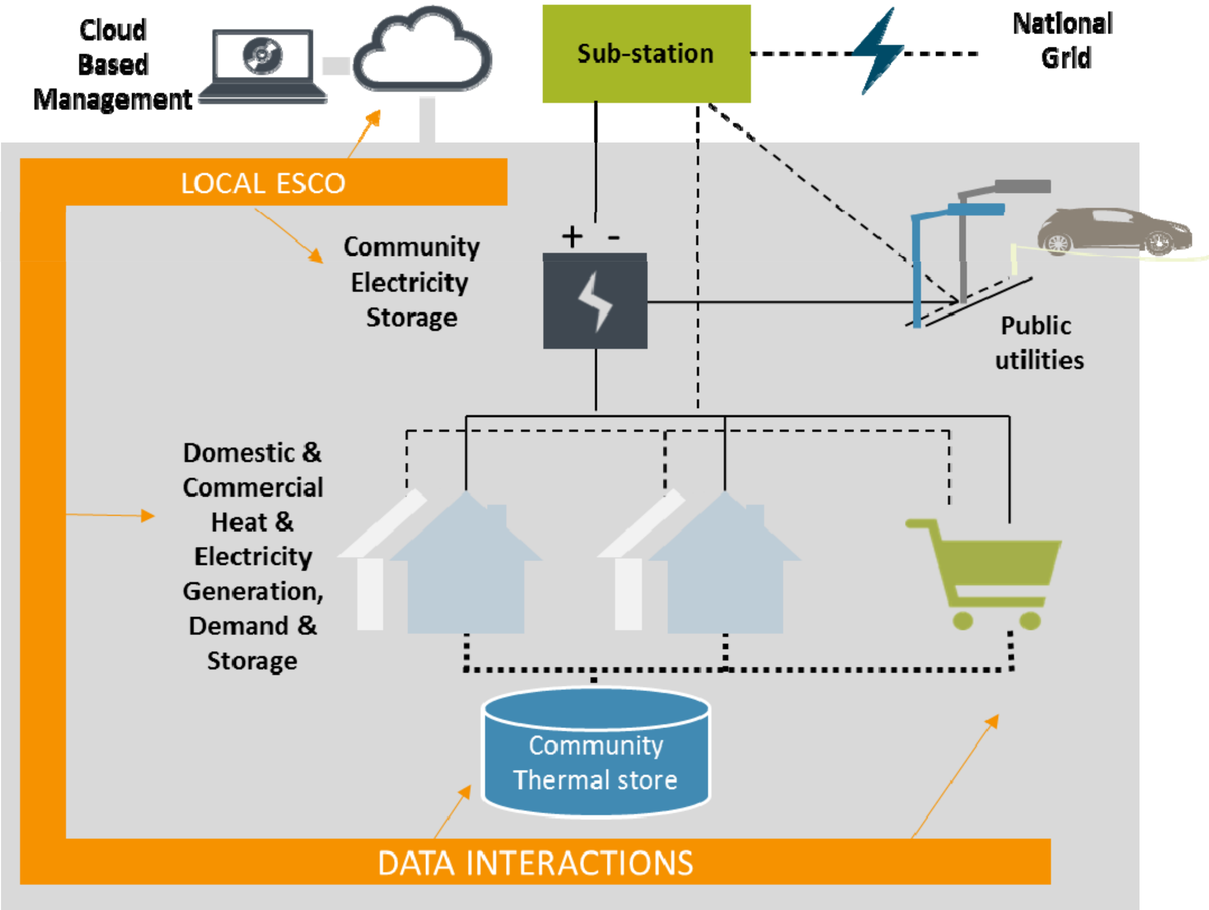
- DH covers < 2% of UK heat market
- DECC (BEIS) forecasts estimate that 43% of building stock can be connected in a cost effective way by 2050
- 320m£ budget to increase DH penetration
- Regeneration of ex-industrial area

Trent Basin development

- 33 new low-energy houses
- Creation of an "Energy Service Company" ESCO
- Low-temperature Heat network
- Thermal Storage
- PV Field
- Battery Bank



SCENe Energy System



SCENe Model: Electricity network

- EnergyPro to simulate operation of the heat and electricity network
- 450 kW PV field
- 2.1 MWh Battery Bank: charge/discharge rate 0.5 MW, η=89%
- Wholesale Electricity price from 2016 UK Spot Market
- Retail electricity price: 47% wholesale price, 53% grid costs, taxes, commodities
- Energy system can exchange electricity with main grid
- Domestic electricity demand was disregarded
- Nottingham CIBSE weather file

SCENe Model: Heat Network

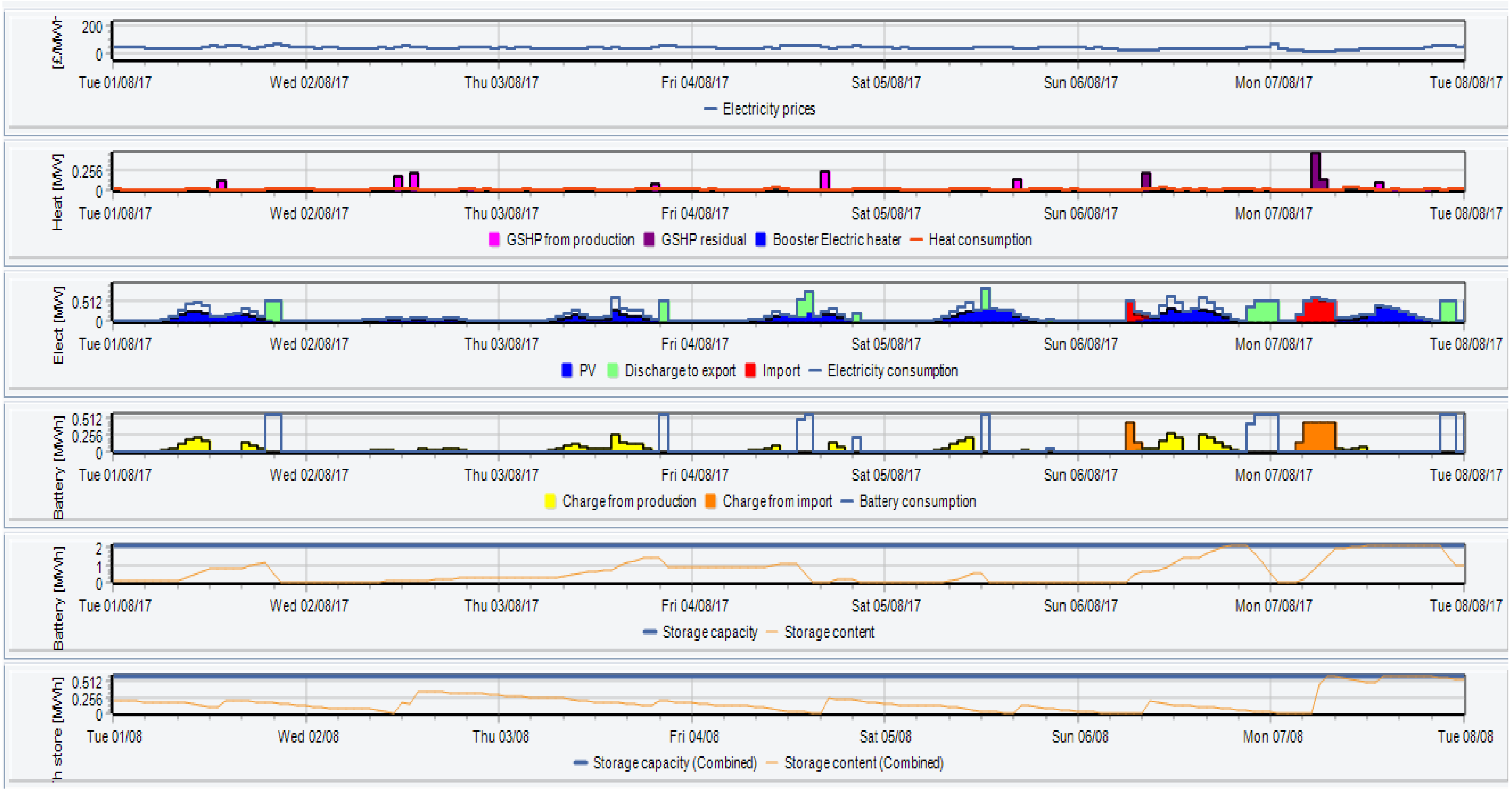
- SH demand: underfloor heating and/or low-temp radiators
- DHW demand: flat-station with electric heater on the secondary side. Total water volume ≤ 3l. DHW Comfort Temperature 50 °C
- ΔT of 5 °C at the heat exchanger
- Reference scenario: 55/25 °C supply/return temperatures
- Heat tariff: 95 £/MWh
- Heat demand profiles obtained from stochastic predictions
- 20 m^3 Thermal Storage
- Temperature in/out ground source: 10/8 °C

Research Strategy

Aim: to predict the optimal operation of the community energy networks

- To maximise the use of local energy generation
- To optimise the use of the energy storages
- To compared different operation strategies

EnergyPRO: summer operation



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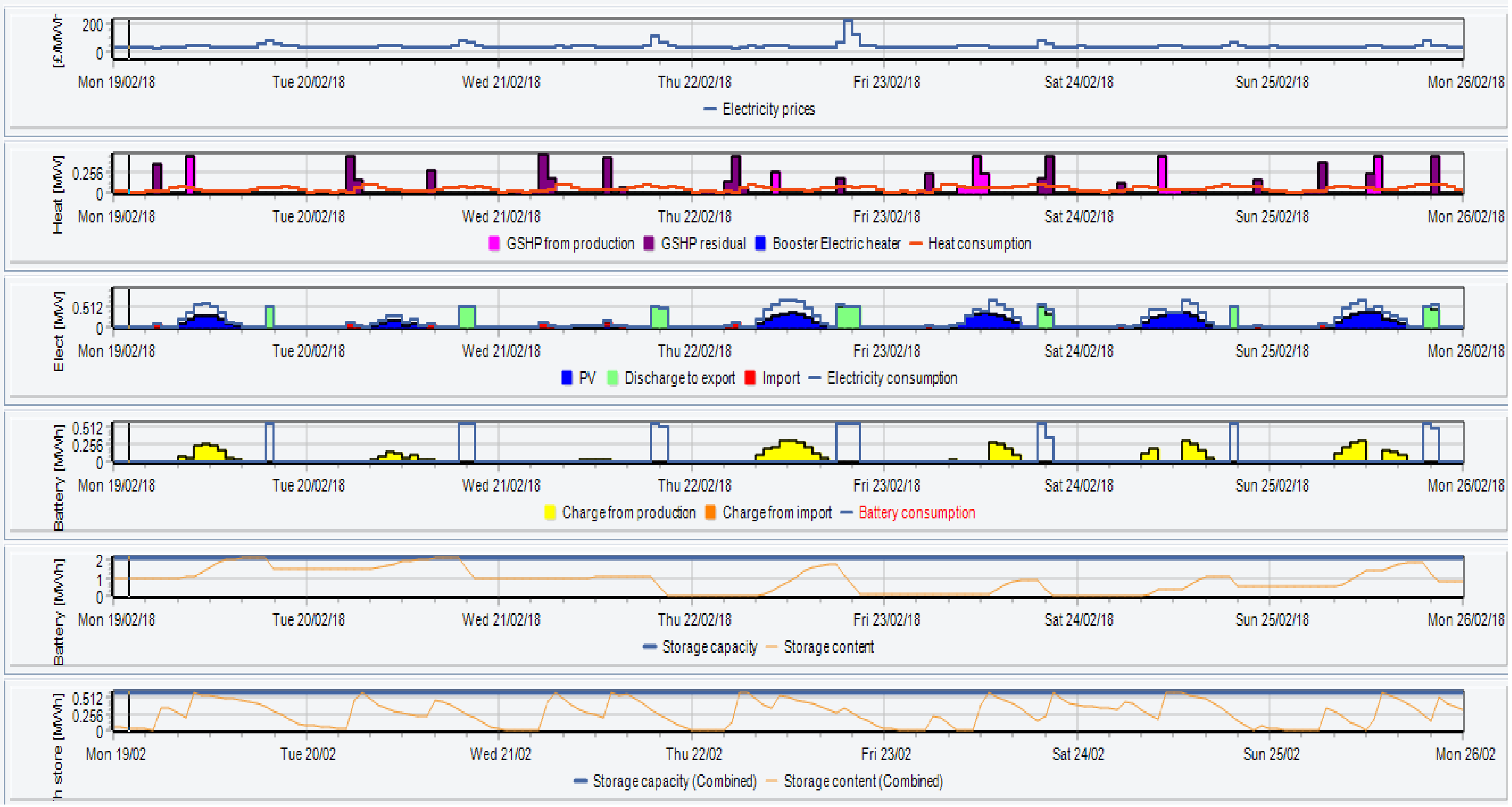
EnergyPRO: winter operation



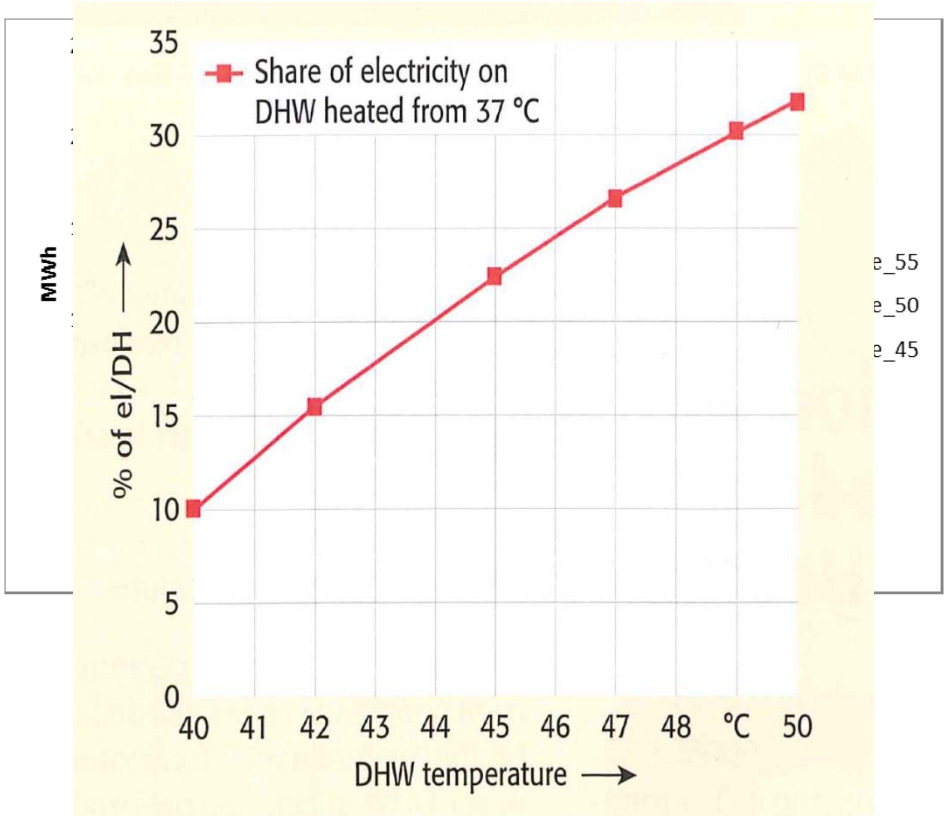
Scenarios Comparison

SCENARIOS	Operation Income (£)	Heat Losses (%)	COP	GSHP from generation (%)	Export from Battery (%)
SCENe_55	55,739	19.1%	4.1	27	70
SCENe_50	56,925	18.4%	4.5	28	69
SCENe_45	58,135	17.5%	4.9	29	68

Heat network: electric heater

- Heat network operation at different supply temperatures
- Danfoss report illustrates use of electric heater for DHW

Share of Electricity for heated DHW (%)	ΔT= 7°C	ΔT= 12°C
Danfoss	20	30
EnergyPro	18.6	30.9



Focus of future investigation

- To validate the stochastic predictions for heat demand profiles
- To validate the operation of the community energy scheme
- To assess new scenarios
- To complete a detailed financial model considering the project lifetime

Thank you!

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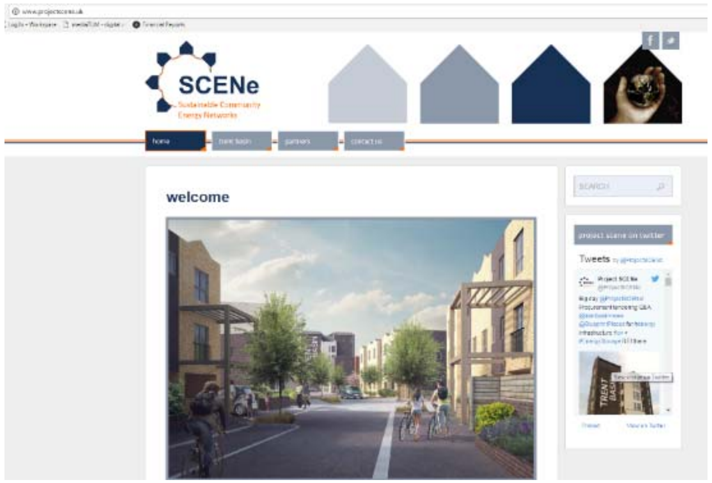

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