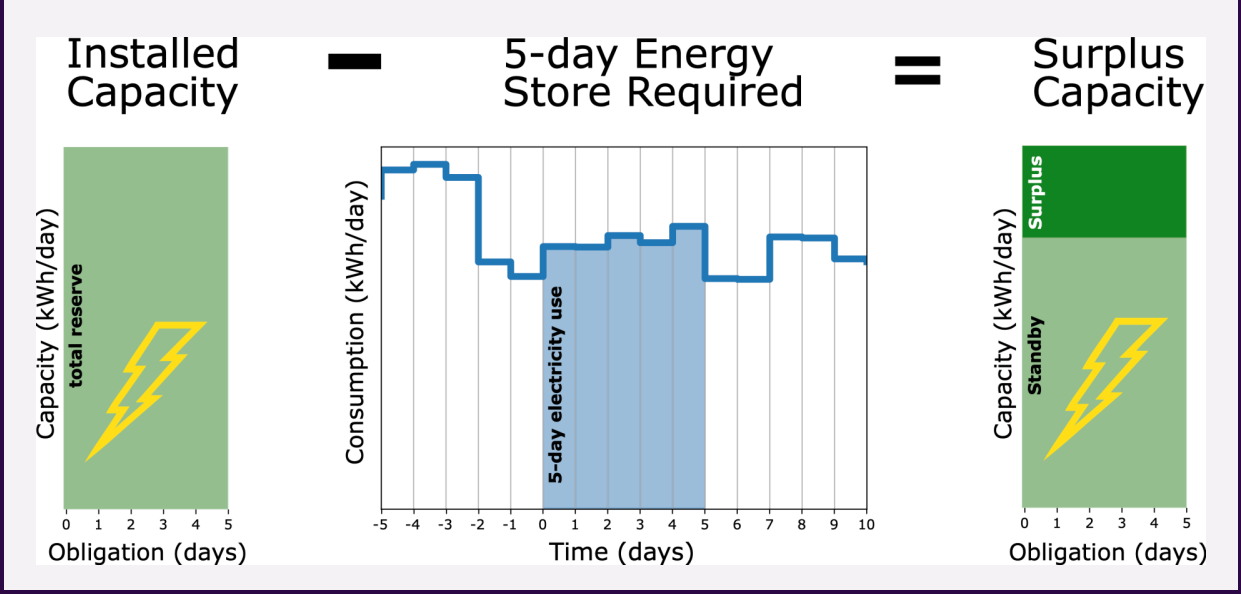
Climate-Sensitive Power Reserves to Improve Grid Resilience



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UKRI Natural Environment Research Council

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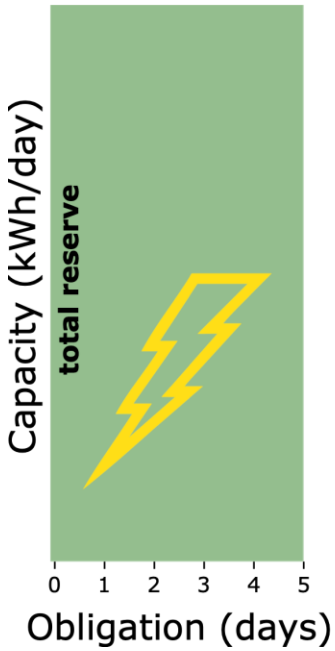
University of Reading

UTILISING SURPLUS RESERVE CAPACITY

Installed Capacity



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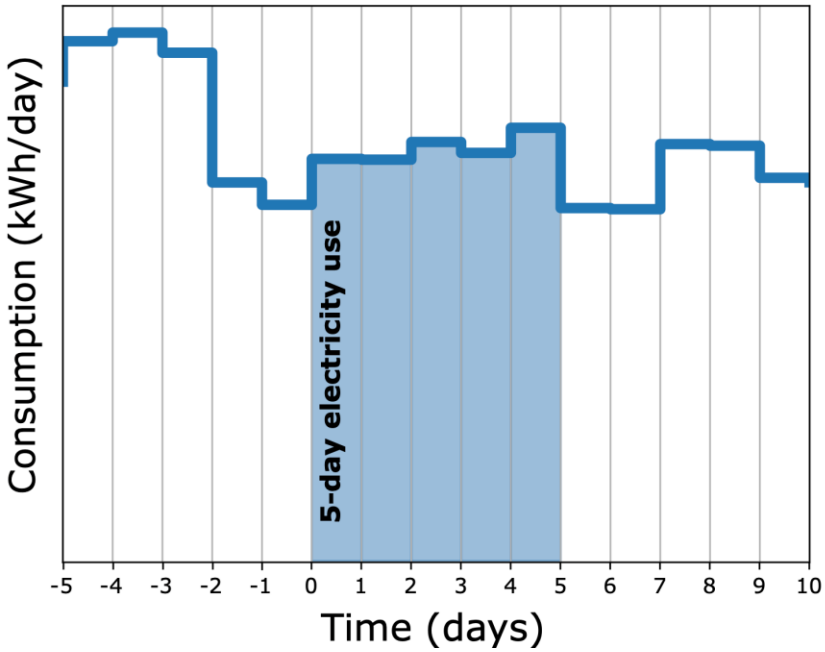
5-day Energy Store Required



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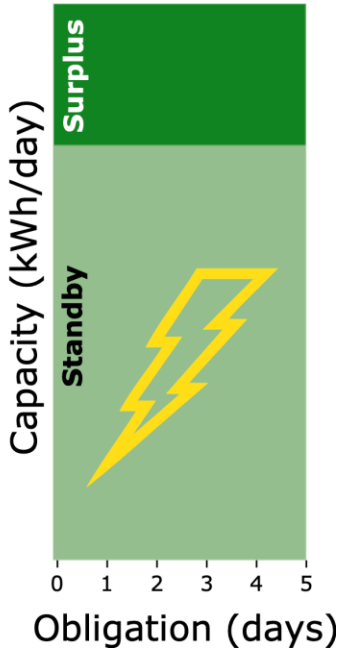
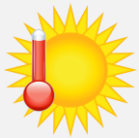
Surplus Capacity



WEATHER SENSITIVE DEMAND MODEL FOR…



1. Using reanalysis data:
   a) Dimension the reserve power system
   b) Identify surplus storage characteristics

2. Are GCM-derived demand timeseries consistent with reanalysis?

3. In climate change scenarios calculate:
   a) new capacity requirements
   b) new surplus characteristics?

Home working will be reliant on robust telecoms, but this is an industry used to outages, typically caused by problems such as storms, and falling trees hitting overhead lines.

BT operates 6,000 UK exchanges, each of which has a backup generator. Simon Lowth, BT's chief financial officer, said this week it has held talks with the government about potentially using the generators for wider public use "to help cope with demand at peaks". Its ubiquitous green cabinets, seen on Britain's street corners, which provide broadband connections, have four hours of backup power.

Home working will be reliant on robust telecoms. Photograph: Christopher Furlong/Getty

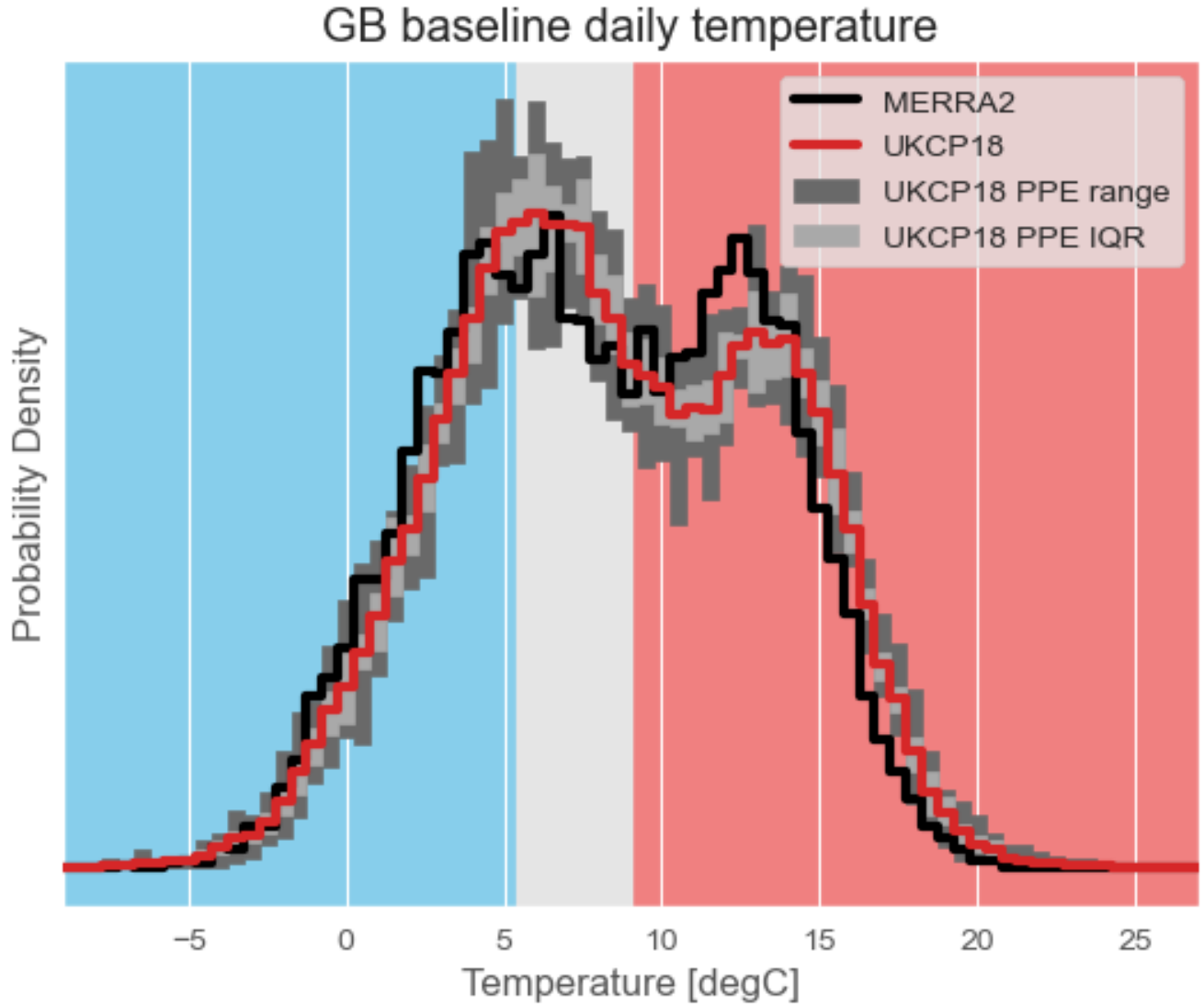
In nearly 40 years as a shopkeeper, James Daunt has had to deal with power cuts many times. "Sometimes there's a flood or a huge JCB digger has gone through your power supply," says the founder of Daunt Books, and managing director of Waterstones. "You might run the power from the guy next door, or sometimes you're literally going round

SIMULATING BT/INFRASTRUCTURE DEMAND

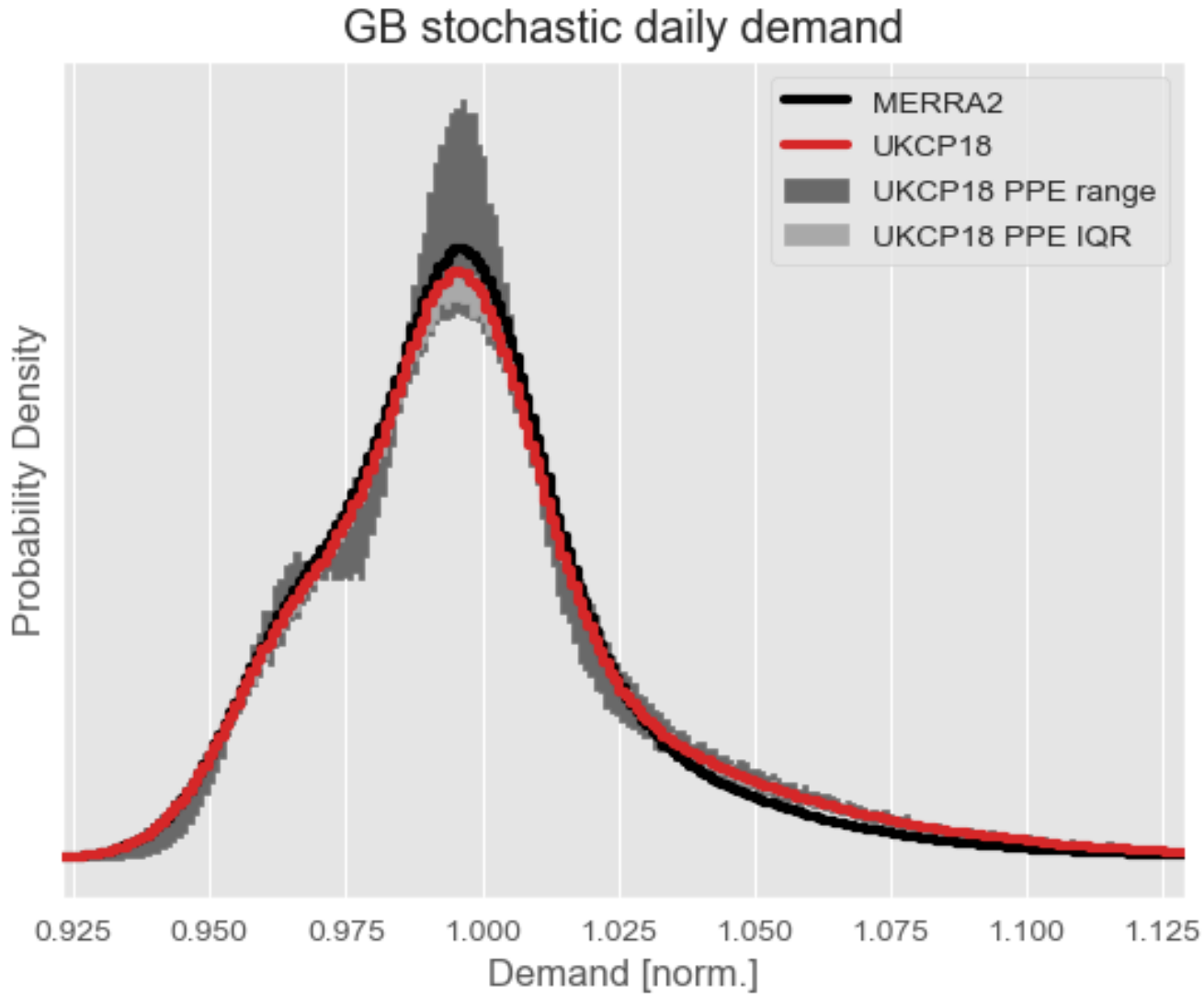
$$\mathcal{D}(T) = \mathcal{D}_0 + \alpha_{\mathrm{HDD}} \times \mathrm{HDD}(T) + \alpha_{\mathrm{CDD}} \times \mathrm{CDD}^2(T)$$

- $\mathcal{D}_0$: No temperature impact
- α_{HDD}: "Heating" Gradient
- $\mathrm{HDD}(T)$: Heating Degree Day ($T_0 - T$)
- α_{CDD}: "Cooling" Gradient
- $\mathrm{CDD}^2(T)$: Cooling Degree Day ($T - T_0$)

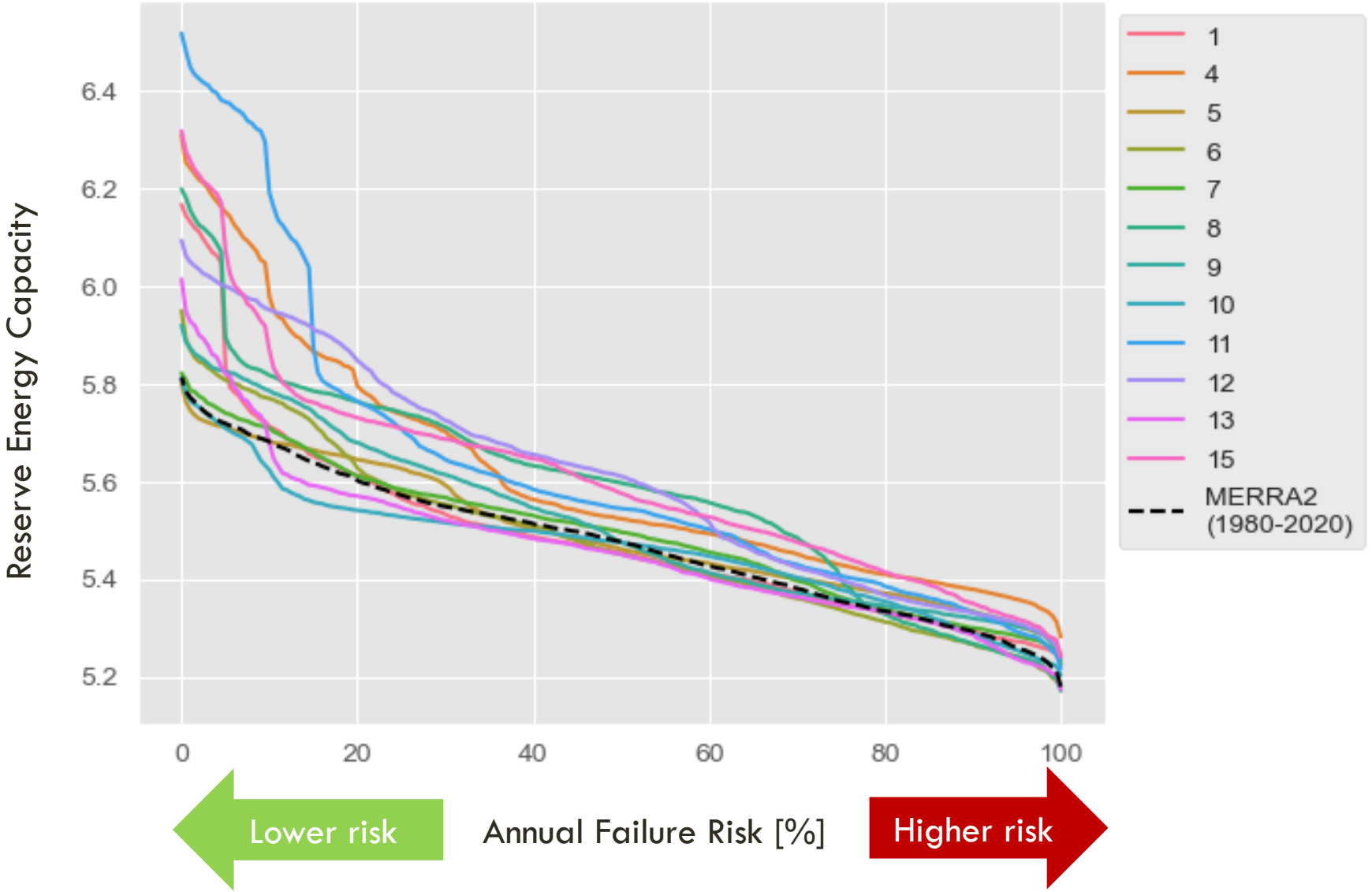
MERRA2 CONSISTENT WITH UKCP18 (HISTORIC PERIOD)

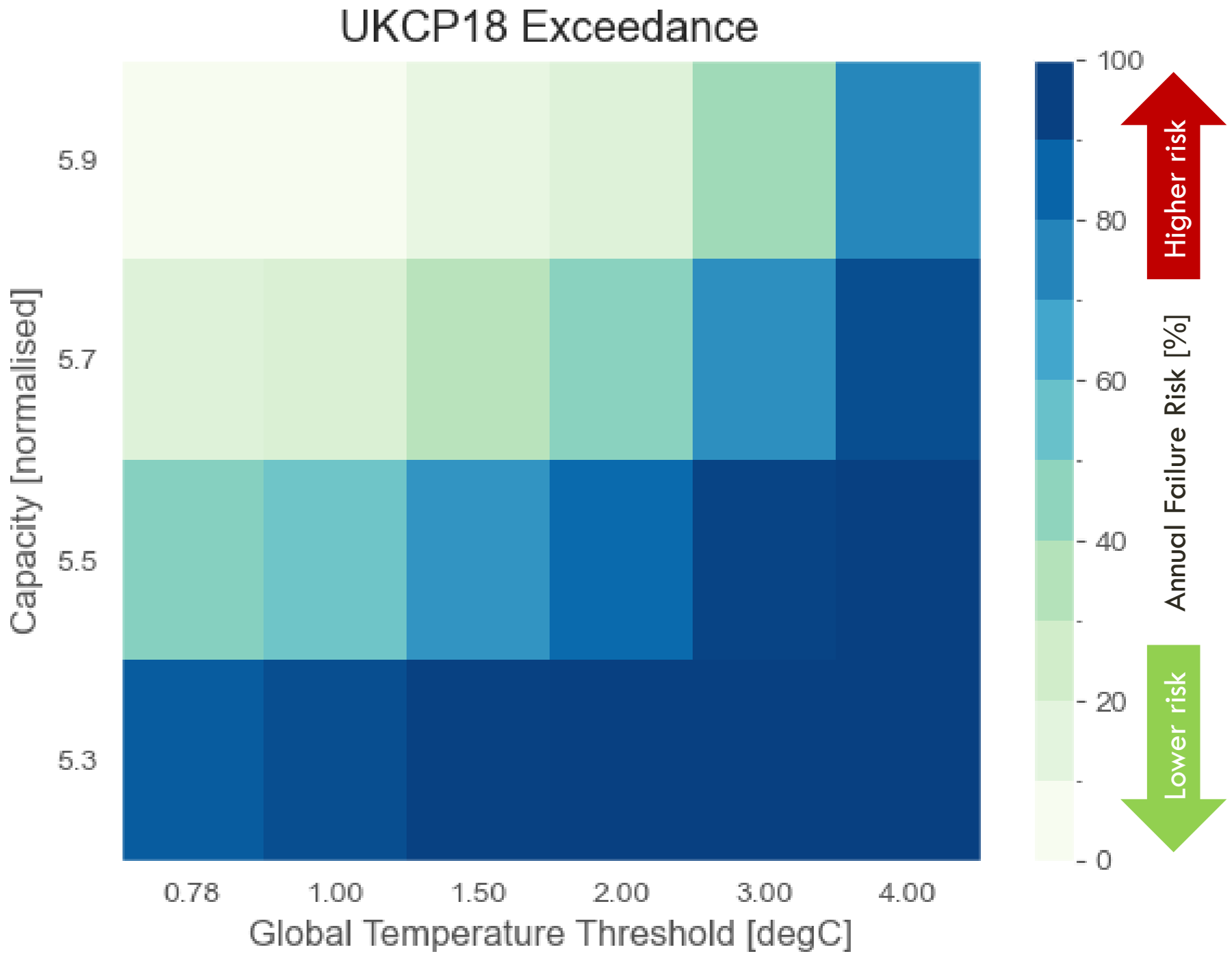


BUT THERE IS NON-LINEAR TRANSFORM TO DEMAND…

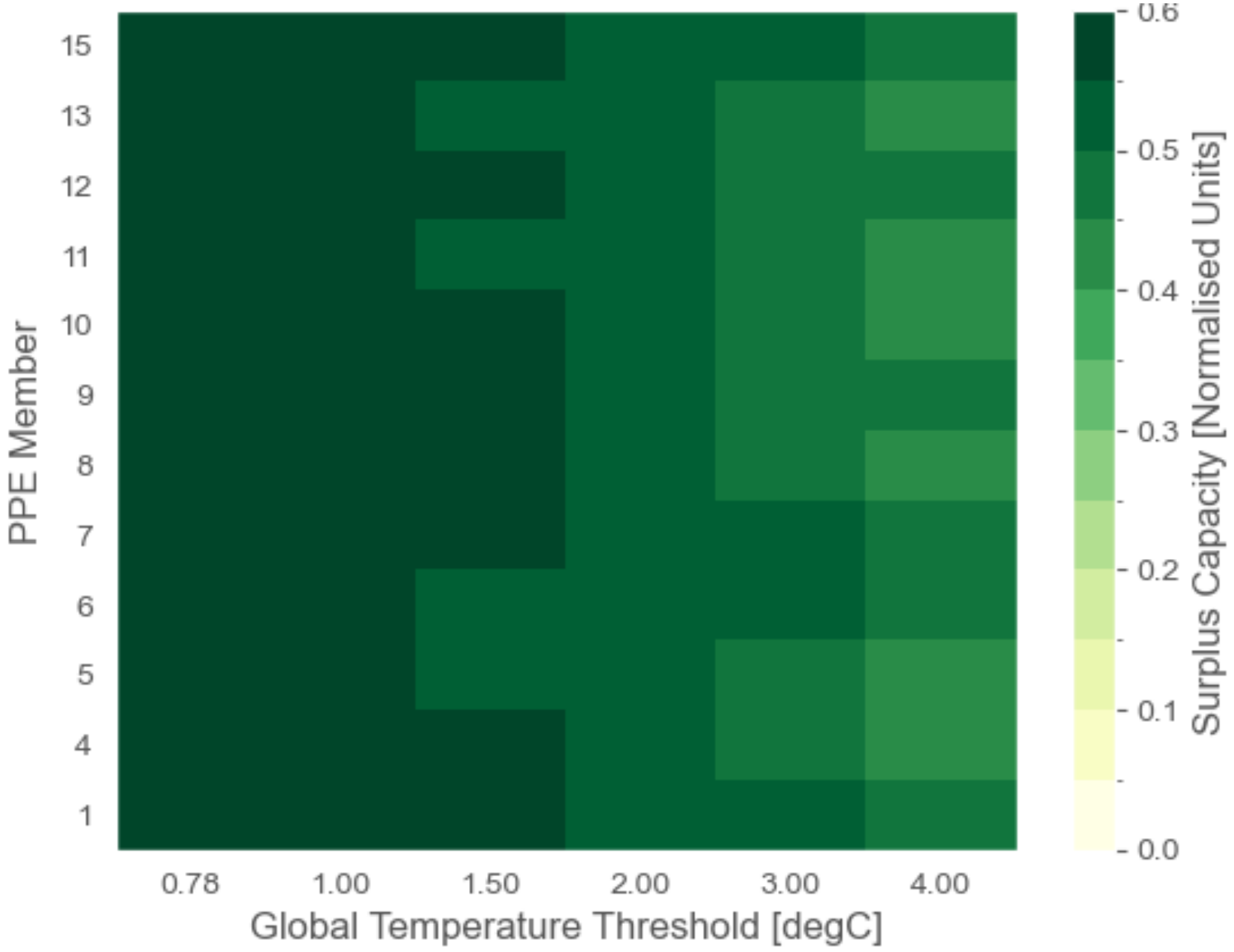


LARGE SPREAD IN ENERGY REQUIREMENTS, DEPENDS ON GCM (PRESENT CLIMATE)




UKCP18 Exceedance
Capacity [normalised]
5.9
5.7
5.5
5.3
0.78
1.00
1.50
2.00
3.00
4.00
Global Temperature Threshold [degC]
100
80
60
40
20
0
Annual Failure Risk [%]
Higher risk
Lower risk

ANNUAL SURPLUS DECREASES IN FUTURE
(INSTALLED CAPACITY UNCHANGED)



CONCLUSIONS:

- Reserve requirements (and "surplus" capacity) are sensitive to temperature, vary seasonally
- A risk-aware decision framework was developed, using meteorological data to estimate reserve capacity requirements of critical infrastructure
- Case-study using UKCP18 climate projections showed:
  - Greater reserve capacity needed in future climate, to maintain levels of risk (disagreement on **how much** is needed)
  - "Surplus" capacity is reduced in future climates (strong agreement)

Part I (reanalysis data only) Submitted to Meteorological Applications (pending):
Surplus Capacity in Reserve Systems for Critical Infrastructure with Weather-Driven Demand. Fallon, Brayshaw, Methven & Krug

Part II (climate-risk assessment) is under preparation.

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