The effects of varying thermal comfort expectations on the electricity supply system

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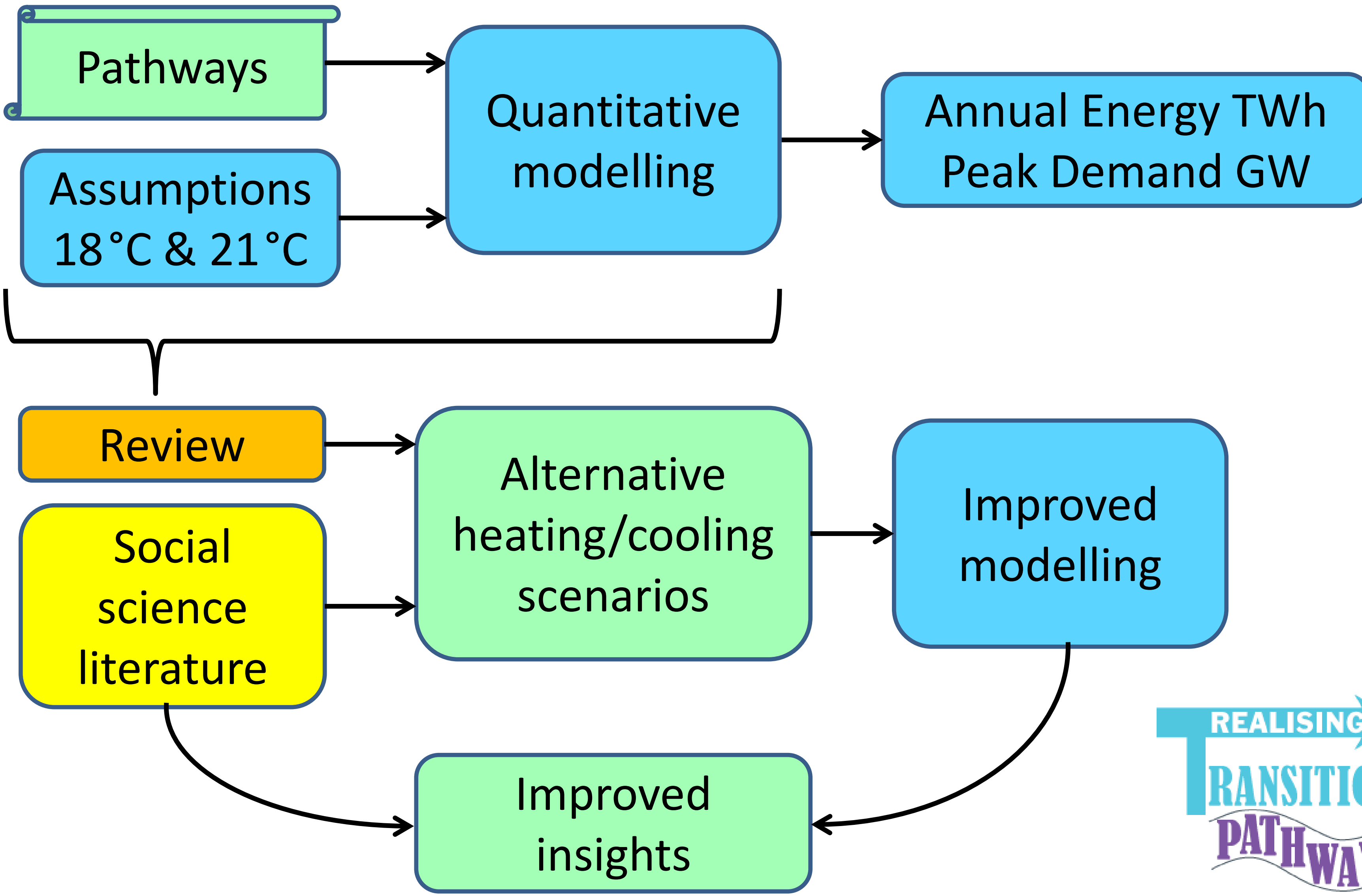
26th February 2016

Overview of interdisciplinary process



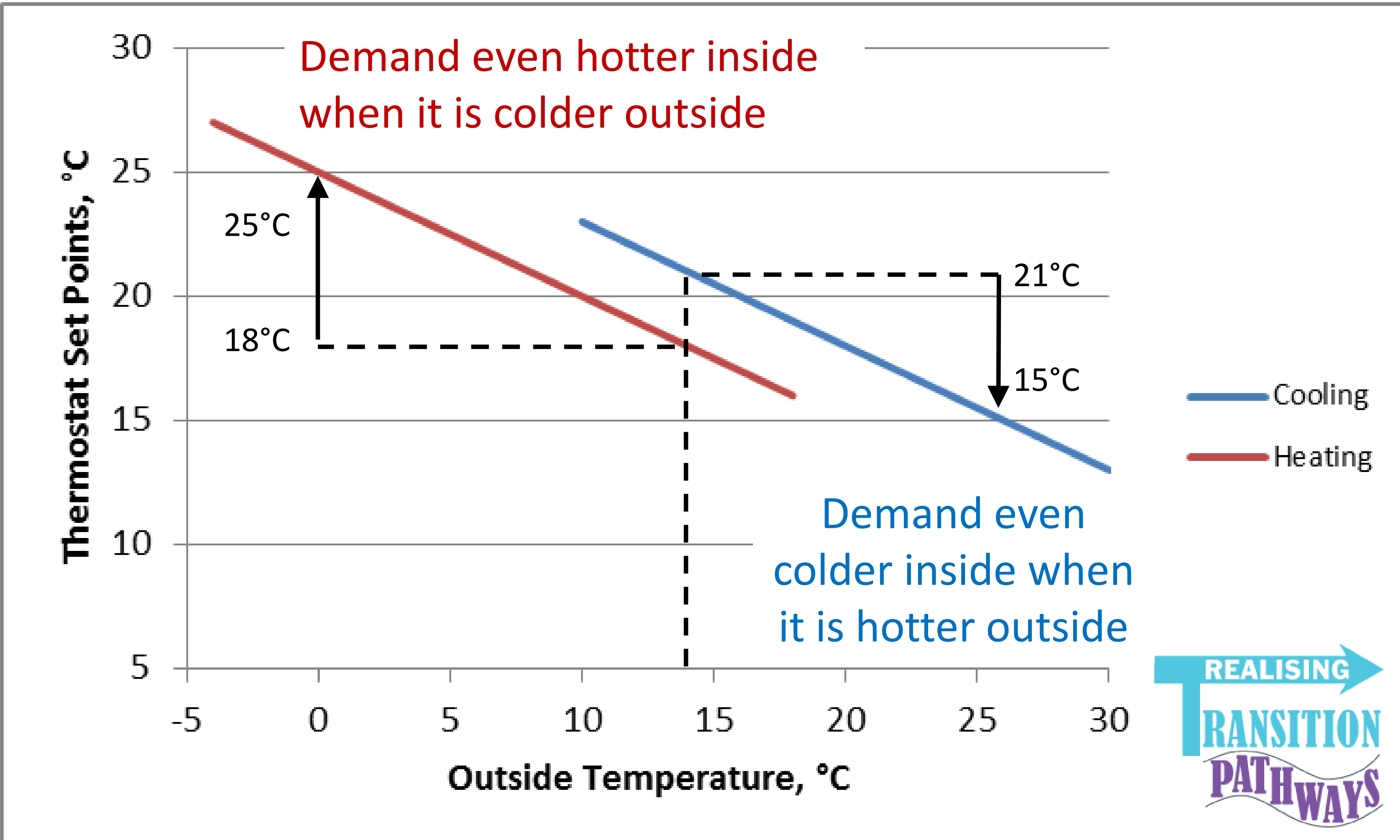
Alternative heating/cooling scenarios

UEA ‘Service Expectations Experiment’

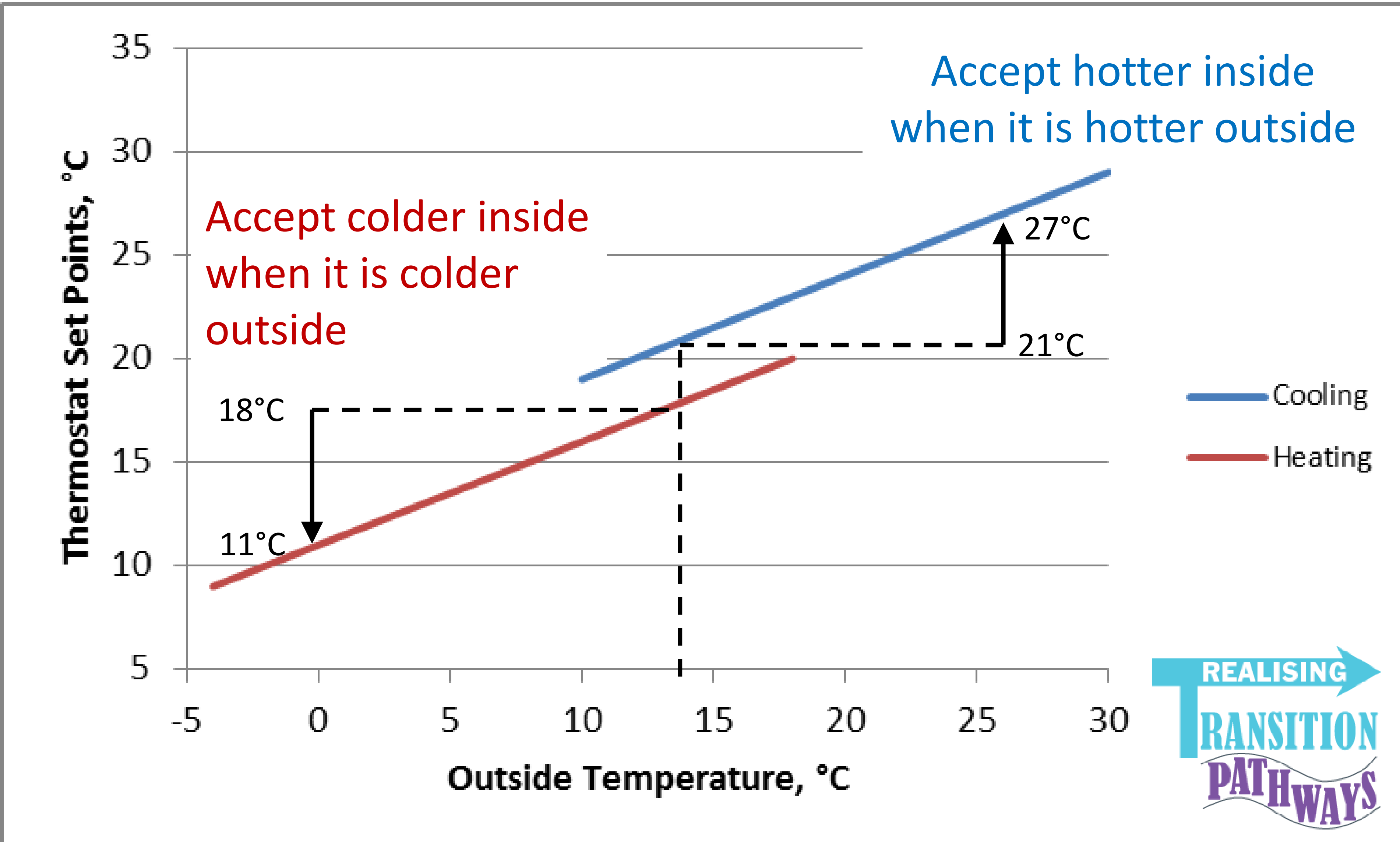
- Thermal comfort
- Literature review – eg Chappells & Shove (2005)
- Qualitative description of scenarios
- Quantitive description of scenarios

1. Base case
   - Market Rules Pathway
   - Electrification heating & uptake of cooling
   - Heating setpoint: 18 °C
   - Cooling setpoint: 21 °C
2. More demanding
3. Less demanding
4. Flexible demand (time shifting)

2. More Demanding



3. Less Demanding

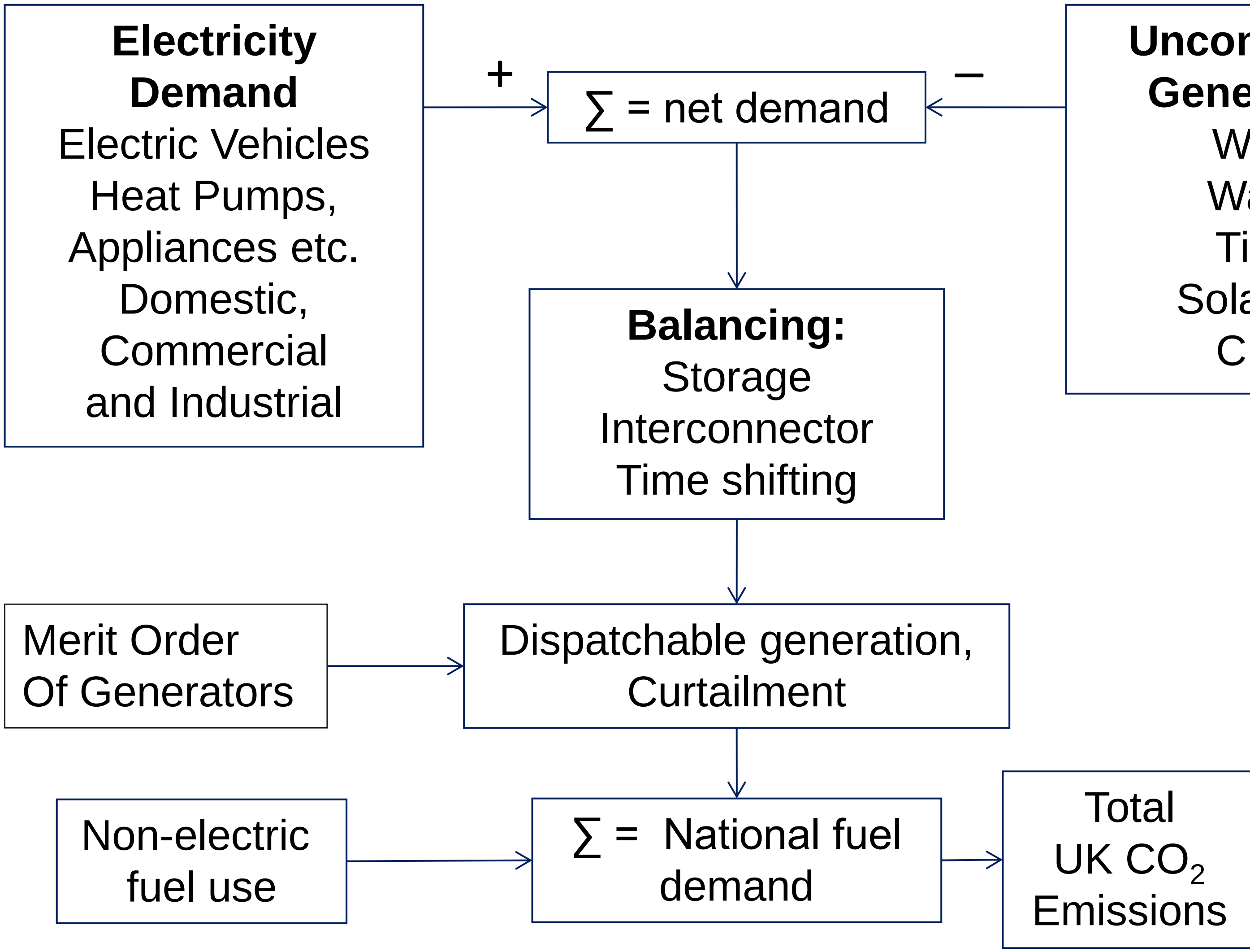


REALISING TRANSITION PATHWAYS

Models and Data

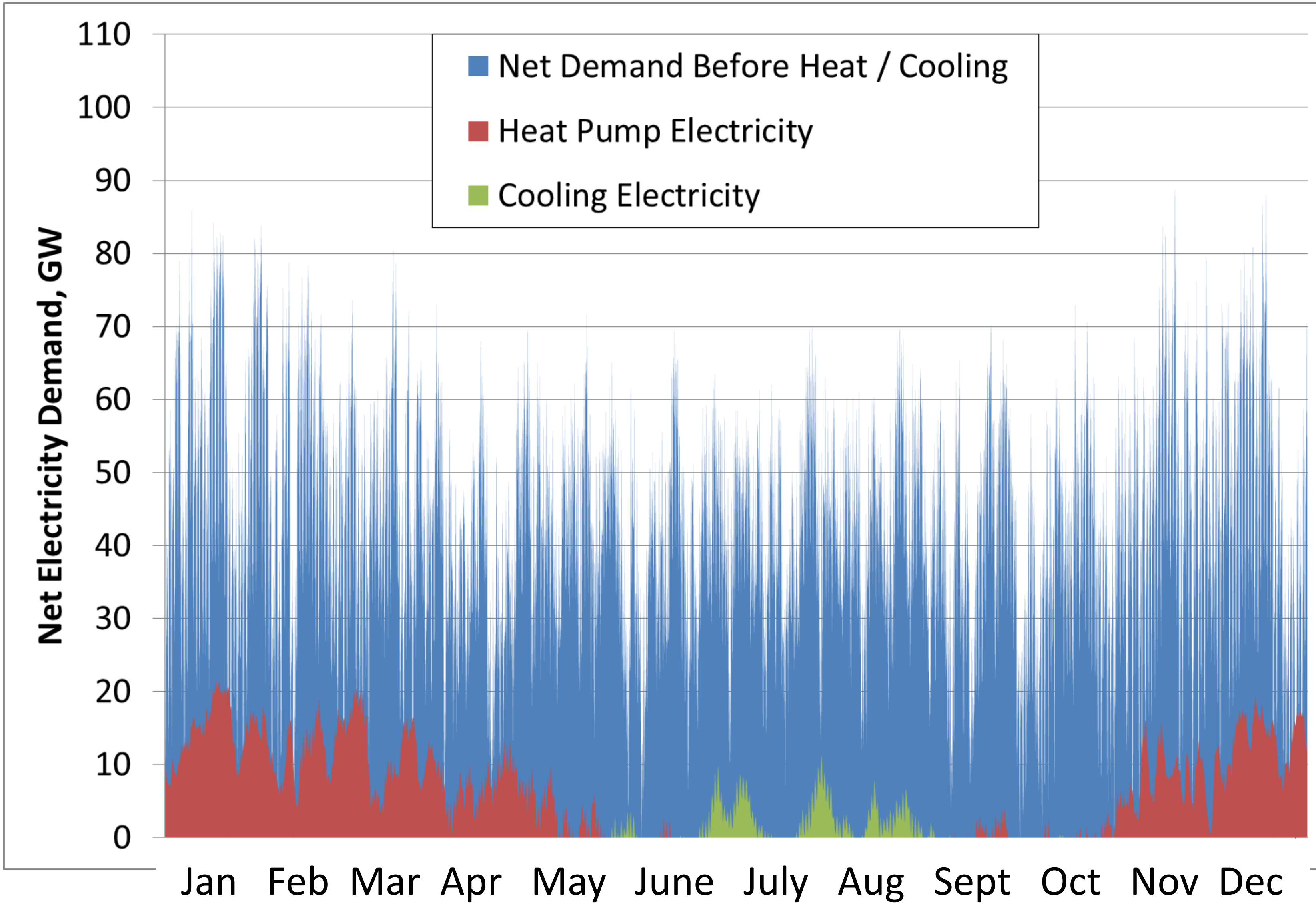
- Surrey Demand model
  - Heating technologies and efficiencies
- Strathclyde Supply-Side model
  - Electricity generation mix
- Loughborough Grid-Balancing model (FESA)
  - Hourly time-step model with weather data
- DECC 2050 Calculator
  - Heat loss rate, solar gain, incidental heat gain
- Cambridge Housing Model
  - Thermal mass of houses

FESA – Hourly grid-balancing model

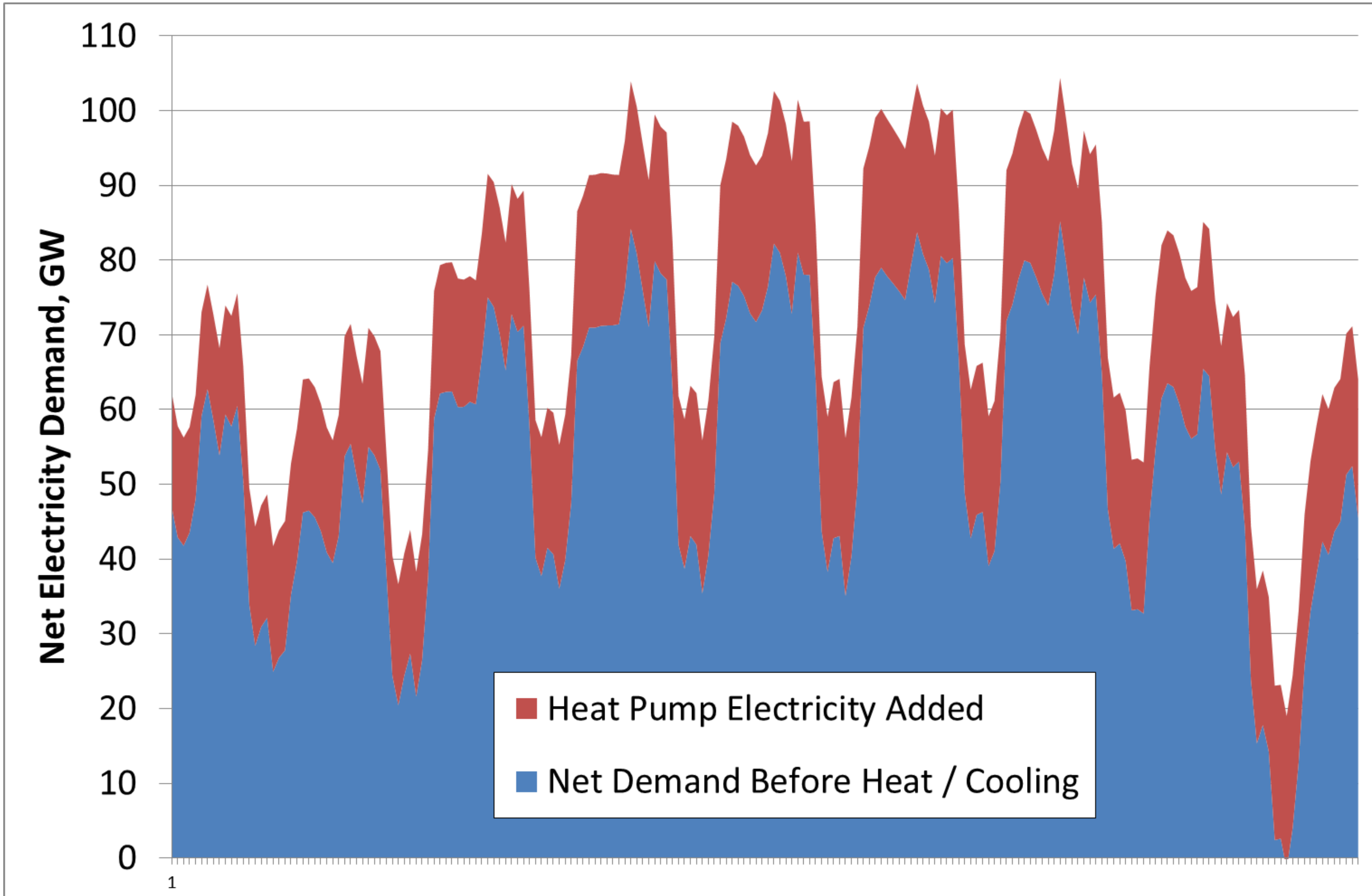


REALISING TRANSITION PATHWAYS

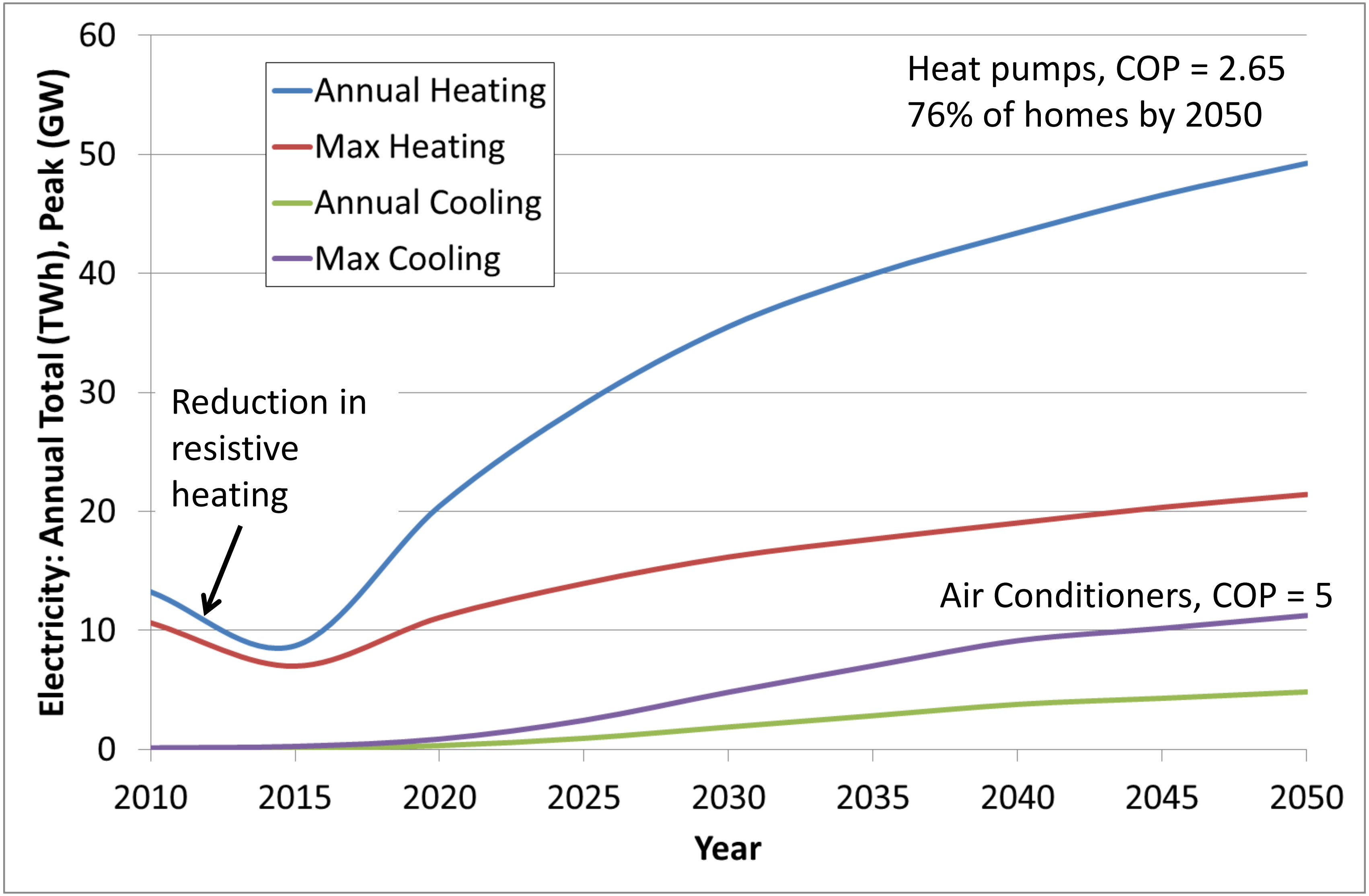
1. Base case – Market Rules 2050



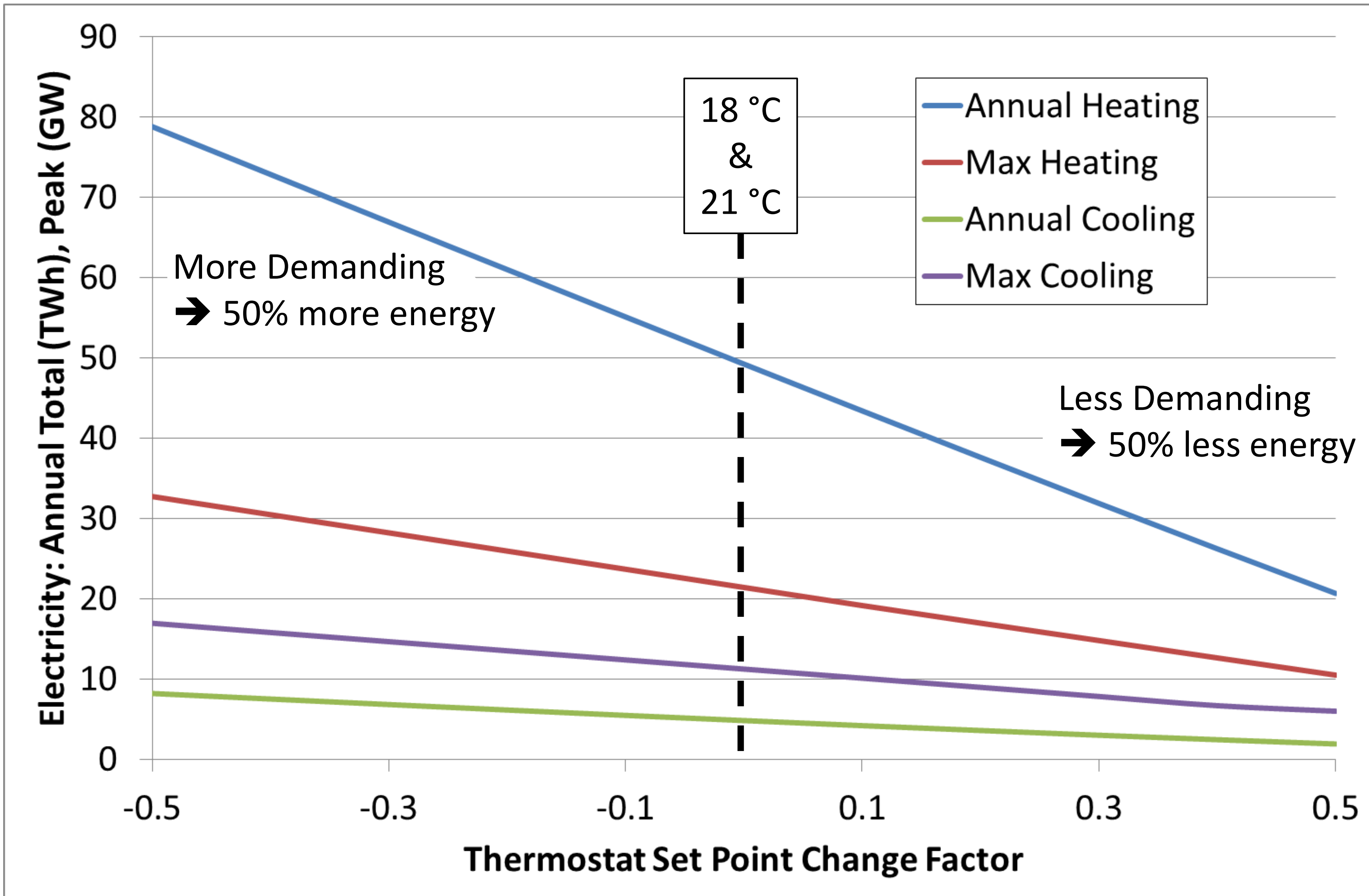
Nine days in January (peak demand)



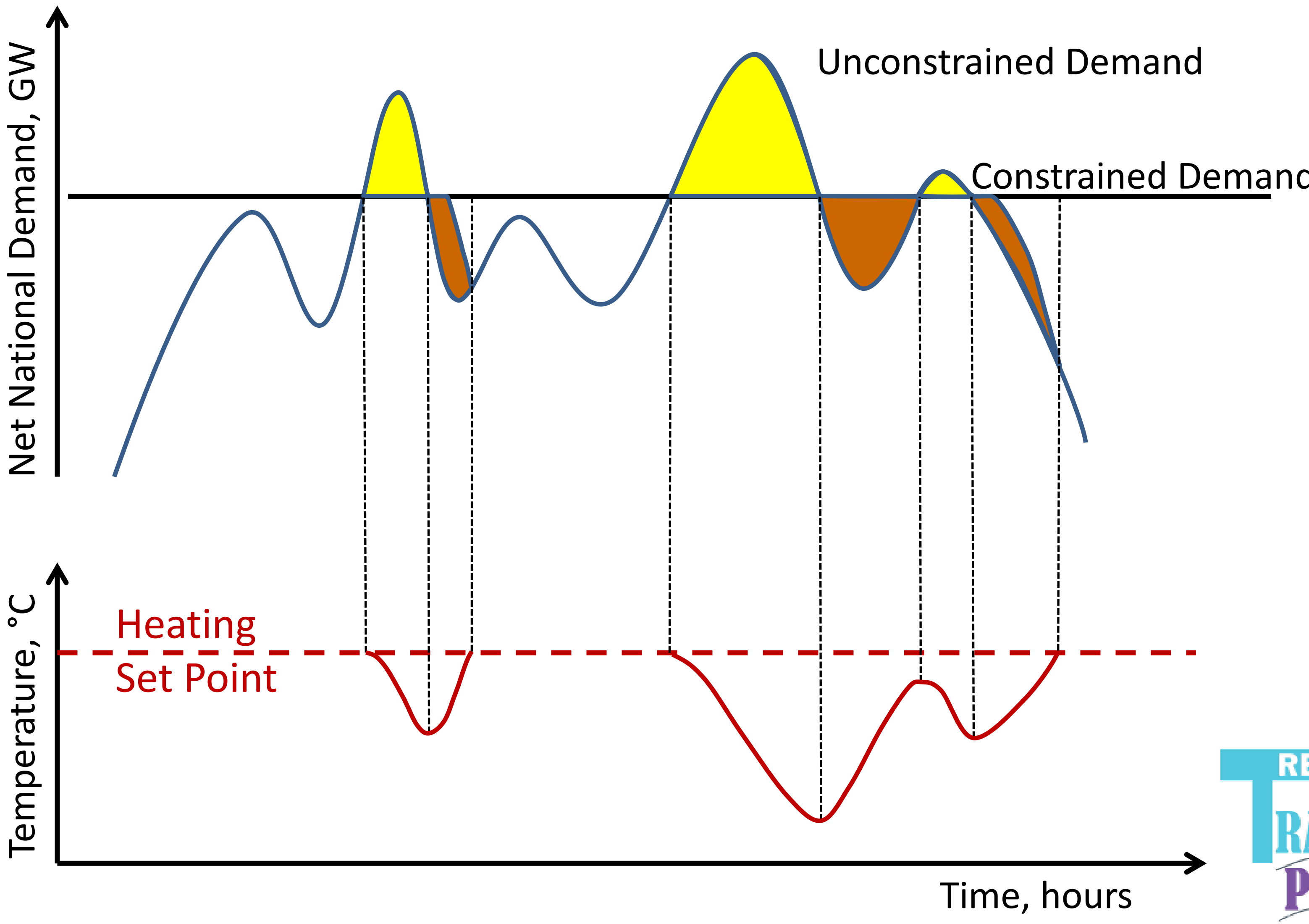
1. Base case: 18°C & 21°C



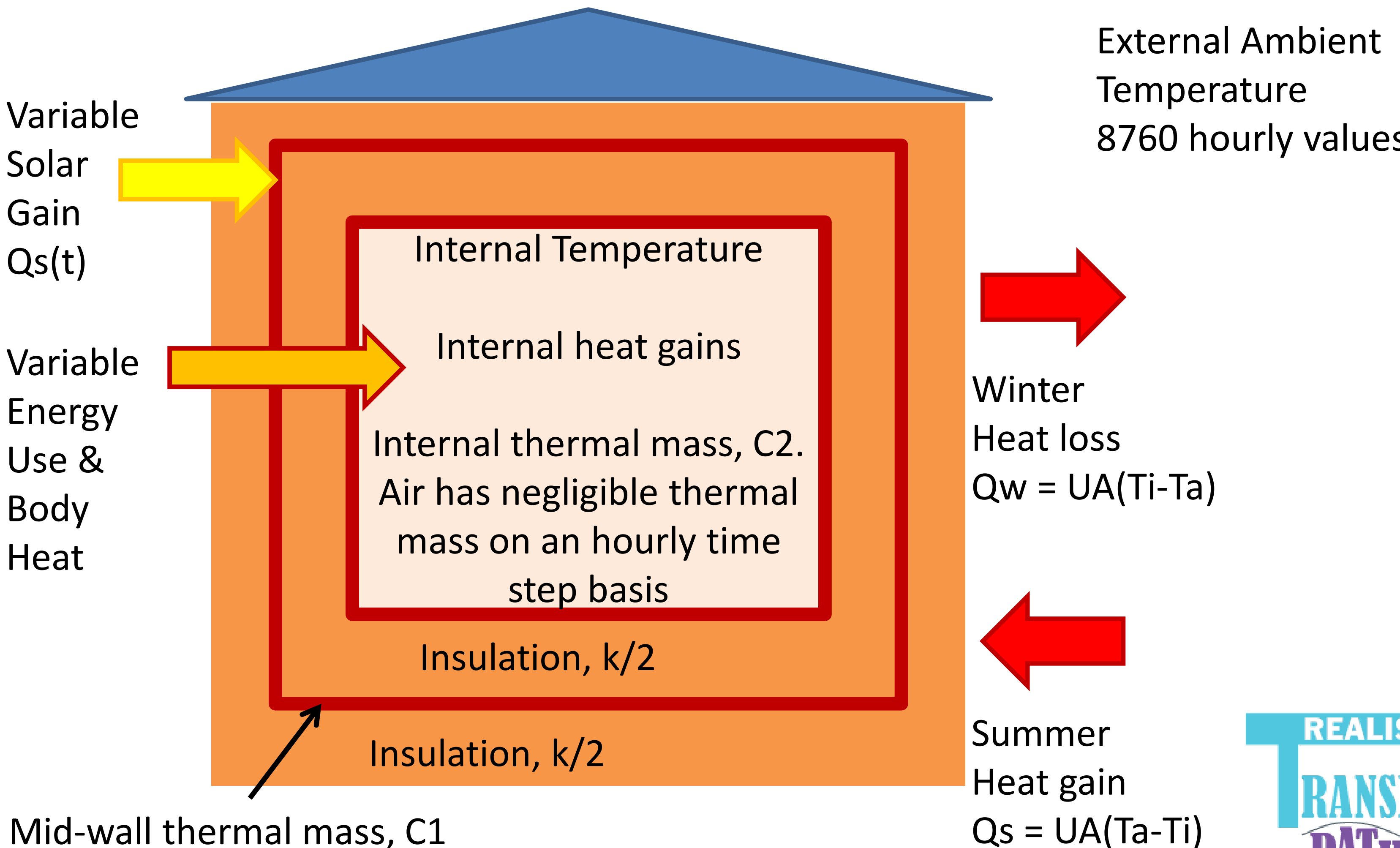
2. More demanding and 3. Less demanding



4. Flexible demand : peak demand reduction

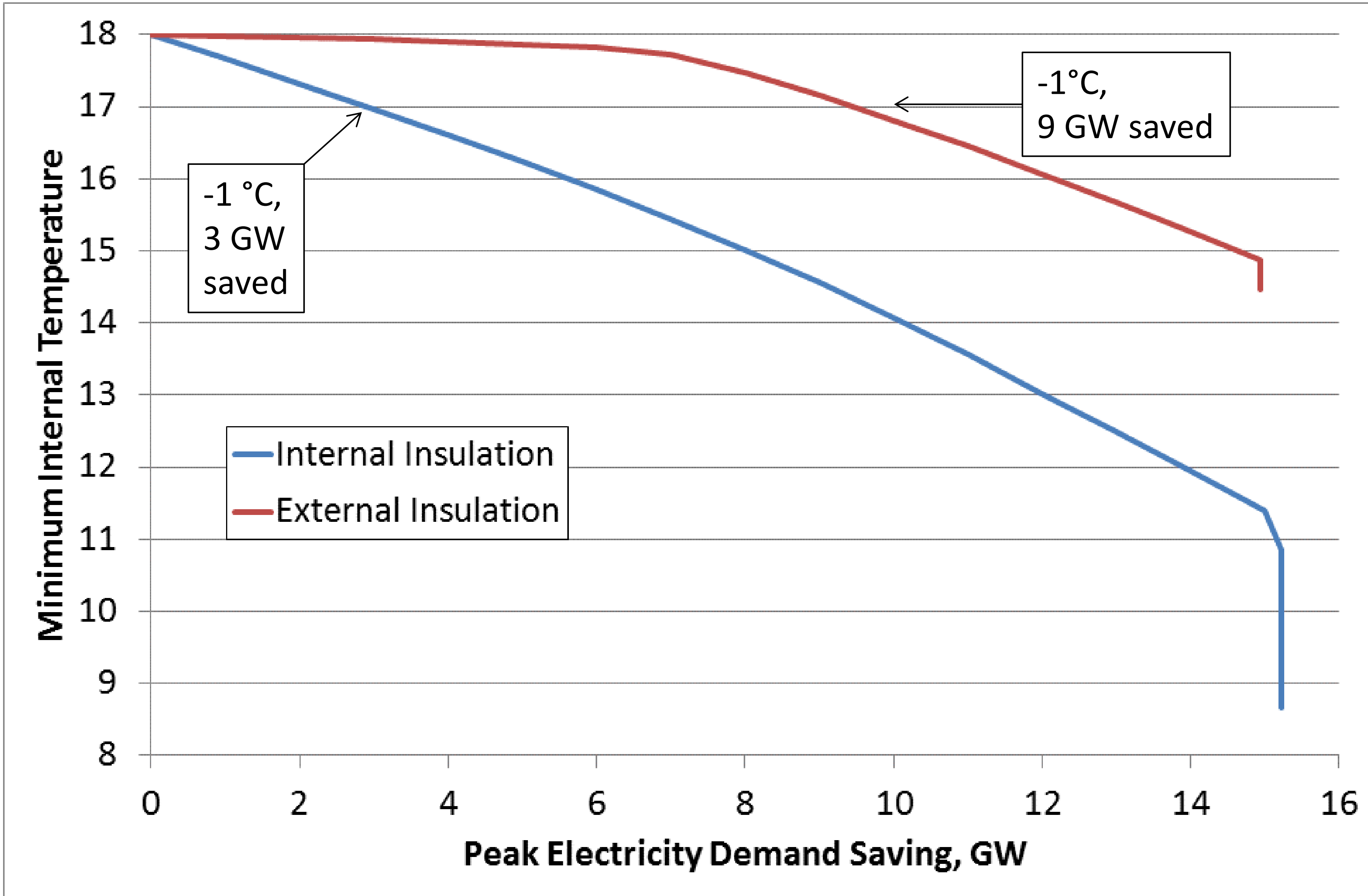


Building thermal model

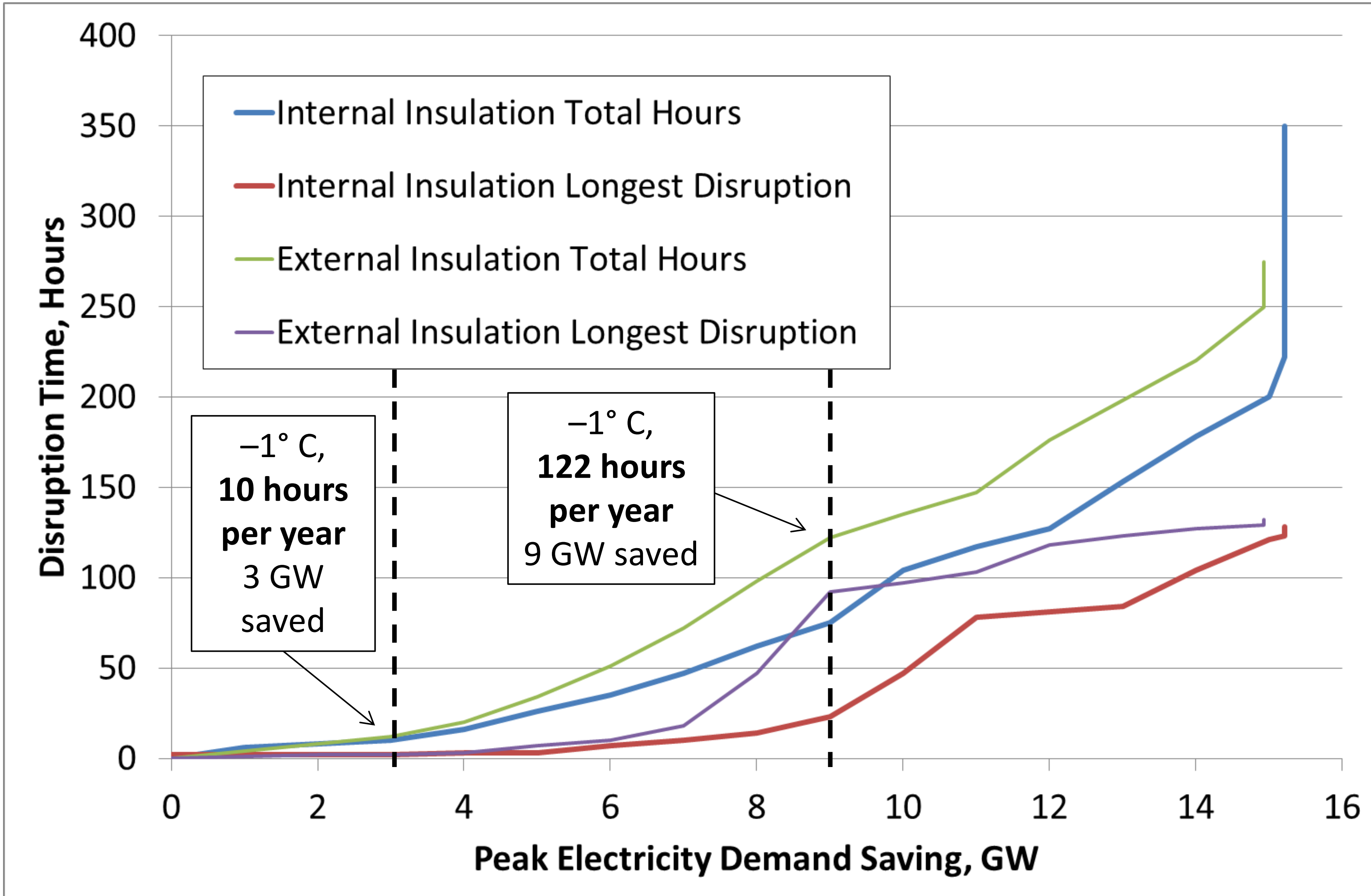


REALISING TRANSITION PATHWAYS

Maximum temperature reduction



Duration of temperature reduction



Conclusions

- Estimates of annual total energy (TWh) and of peak demand (GW) used for heating are very sensitive to assumptions about thermal comfort expectations.
- "over compensation" for outside temperatures could add 50% to annual electricity used for heating.
- Allowing temperatures to vary could save 50%.
- Occasional reduction of 1°C could reduce peak demand by 3 GW to 9 GW …
depending on whether insulation is internal or external.

REALISING TRANSITION PATHWAYS