ZERO CARBON HUB

Carbon Compliance Standard
Technical Working Group

SUMMARY OF OUTPUTS:
Notes on modelling sensitivities

Sensitivities modelled

Variations in Technology

Individual

- Gas boiler + SHW (+PV)
- ASHP + SHW (+ PV)
- GSHP (+PV)
- GSHP + SHW (+ PV)
- GSHP + biomass back boiler (+ PV)
- Biomass boiler (+ PV)

Communal

- Gas boiler + SHW (+PV) [Apartment block]
- Biomass CHP + gas boiler (+ PV)
- Gas CHP + biomass boiler (+ PV)
- Gas CHP + gas boiler (+PV), CHP fraction 0.7 or less
- Gas CHP + gas boiler (+PV), no tank in dwelling

Variations in Fabric Specification

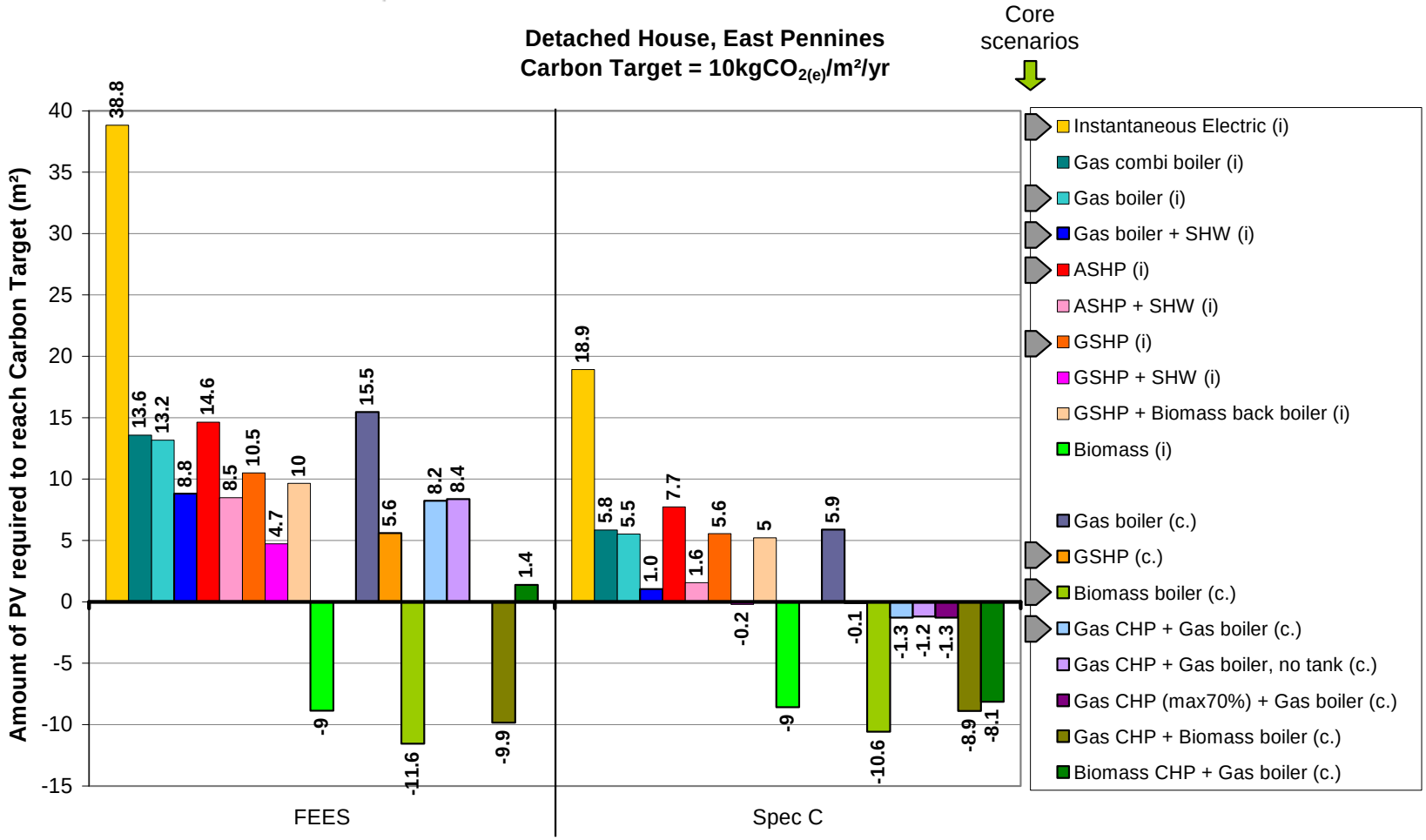
- Regional FEES
- Thermal mass parameter

Other Variations

- Additional house types (inc modest solar design dwelling)
- $CO_{2(e)}$ emission factor changes
- Roof orientation for PV output

Modelling sensitivity: Technologies

e.g. Carbon Target = 10kg$CO_{2(e)}$/m²/yr Detached House

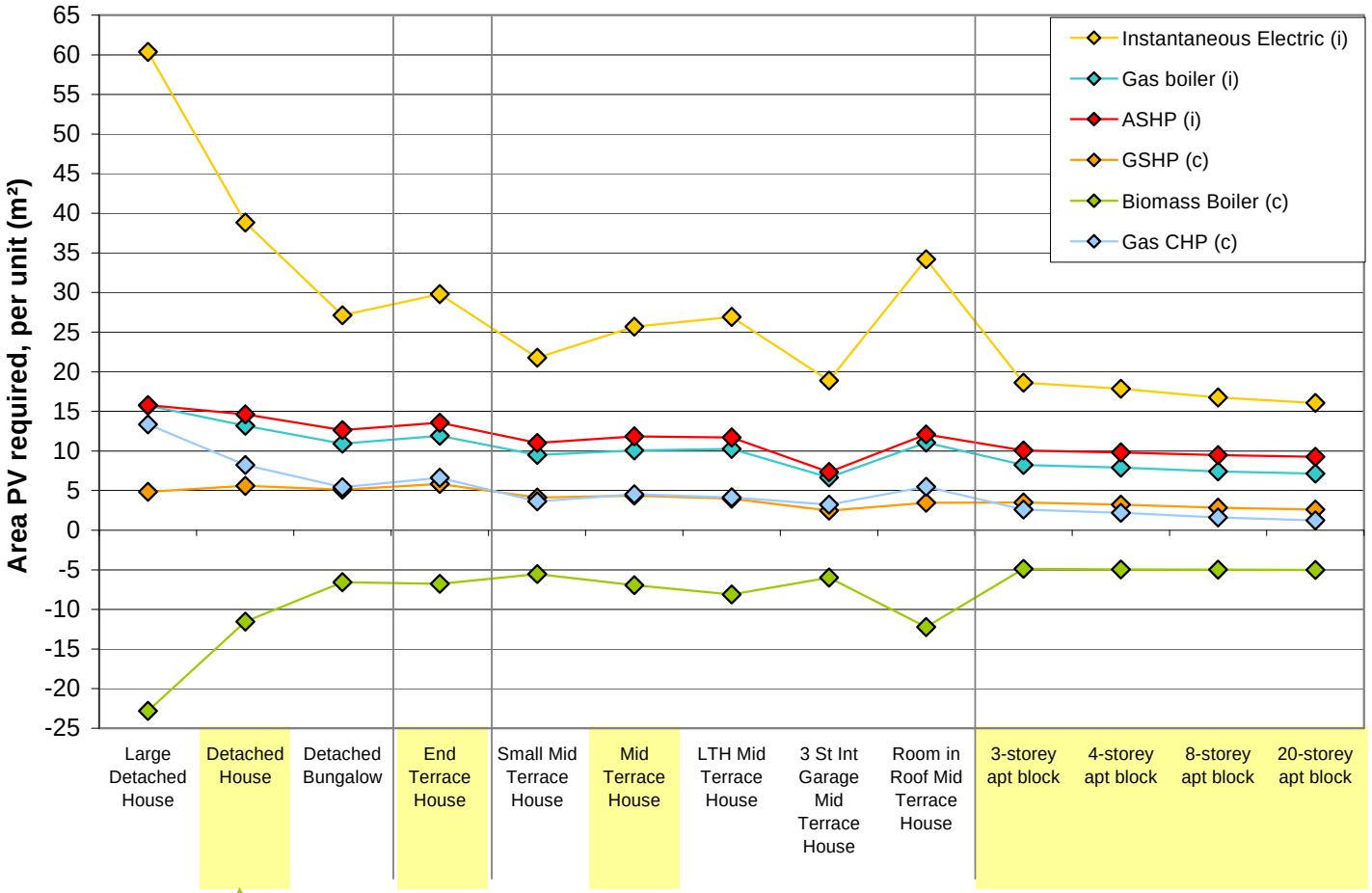


NOTES

- Technical WG concluded that core technology scenarios are representative of the broad spectrum of sensitivities modelled
- Similar picture across all dwelling types

Modelling sensitivity: Dwelling types

Additional Dwelling Types
e.g. Carbon Target = 10kg$CO_{2(e)}$/m²/yr
East Pennines, FEES

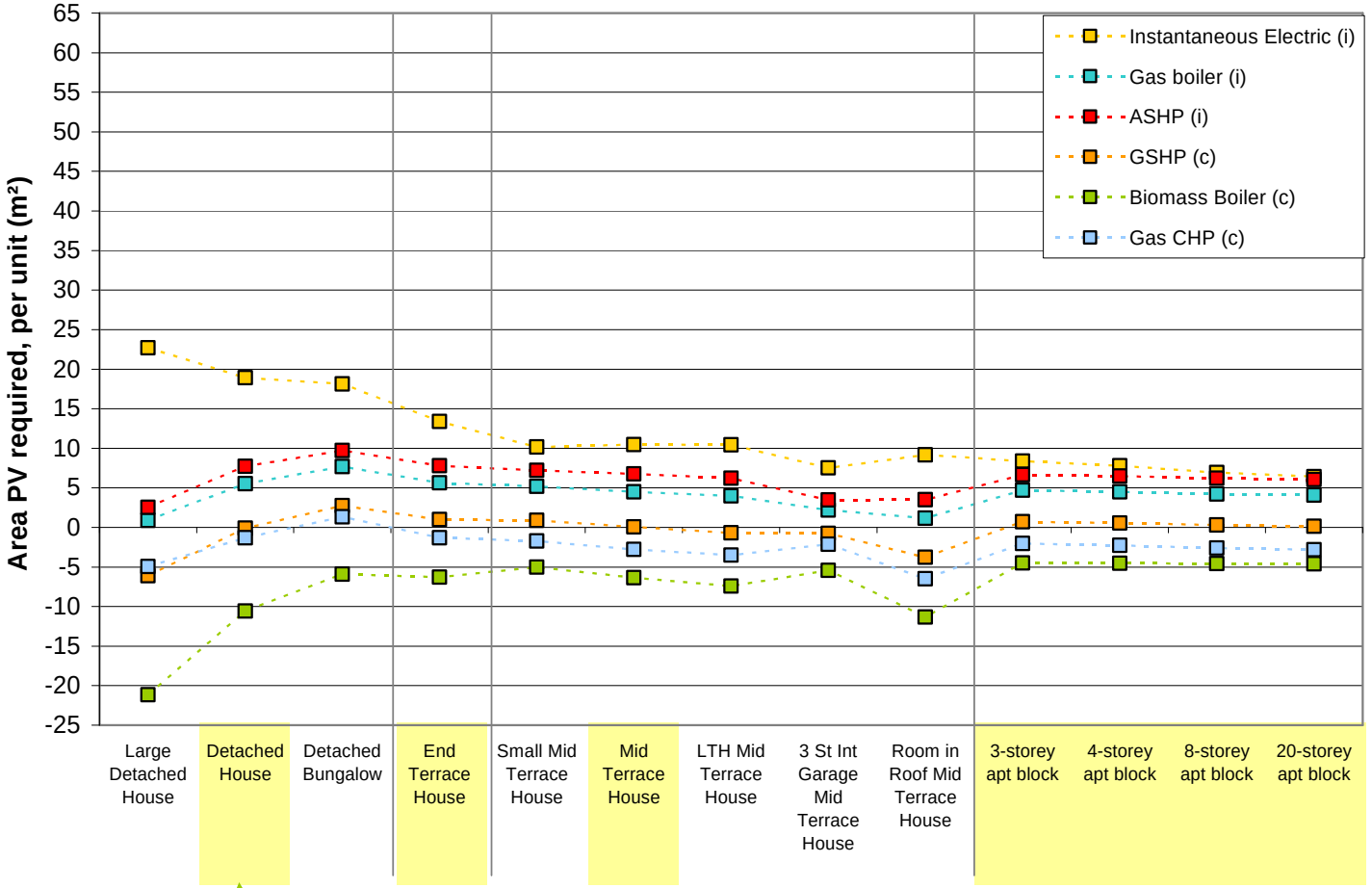


Core dwelling types marked in yellow

NOTES

- Technical WG concluded that core dwelling types are representative of the range of standard dwelling types that might be built
- The roof area available for solar technologies is similar for similar types of dwelling, and 2.5/ 3-storey dwellings do not appear to be disadvantaged
- The detached bungalow can be seen as a proxy for a FOG, with carbon performance similar to the core detached house
- See also Spec C results over the page

Additional Dwelling Types
e.g. Carbon Target = 10kg$CO_{2(e)}$/m²/yr
East Pennines, Spec C



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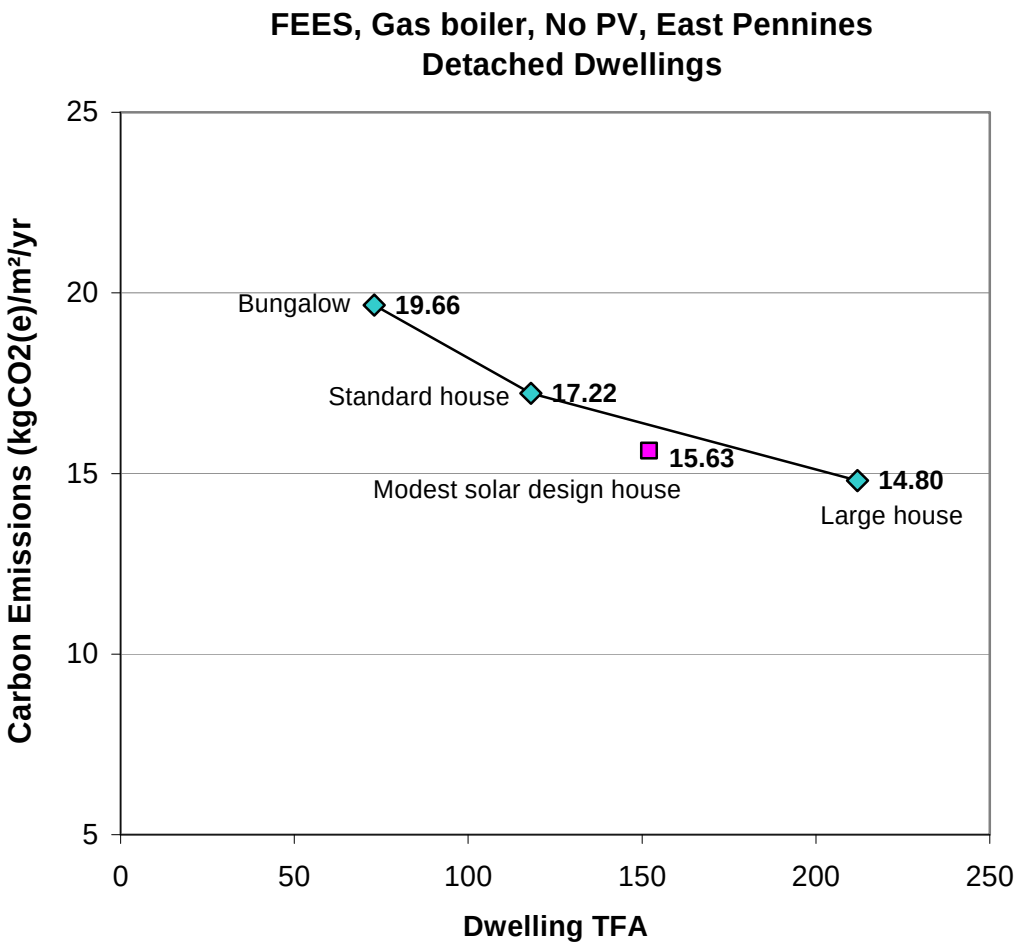
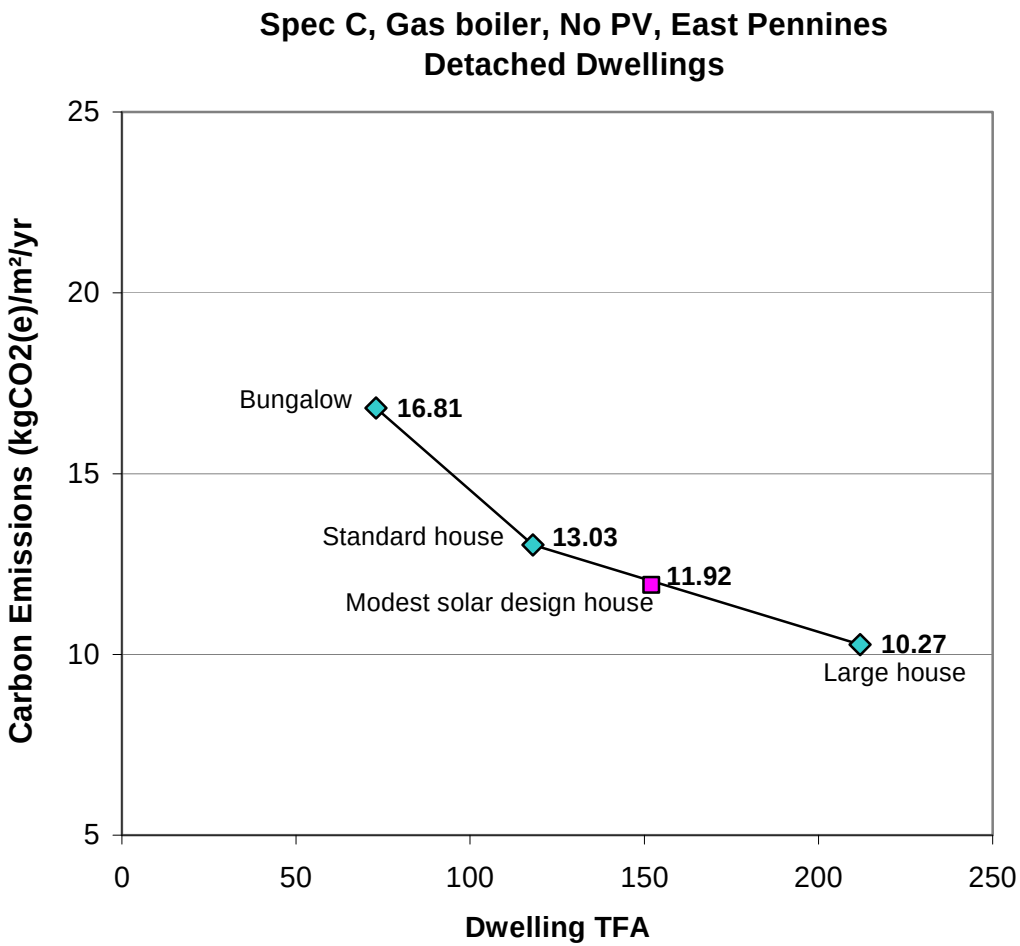
- See also FEES results on the previous page

Modest passive solar design dwelling



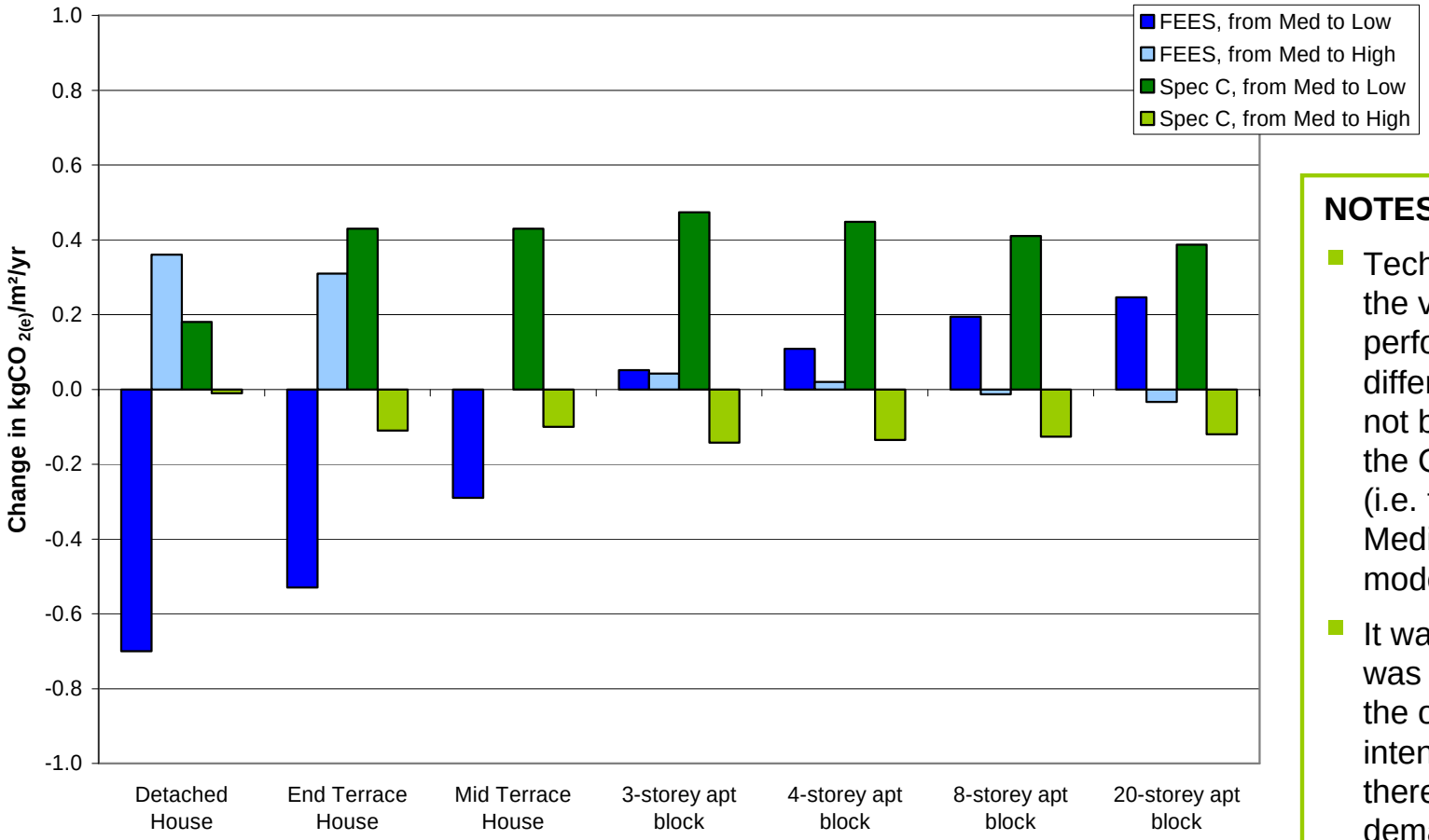


NOTES

- Technical WG concluded that modest passive solar design could give marginal upside to carbon performance, but it was not so significant as to be necessary to take this into account when determining the Carbon Compliance level.

Modelling sensitivity:
Thermal Mass Parameter

Sensitivities: Change in carbon emissions due to change in Thermal Mass Parameter (TMP)



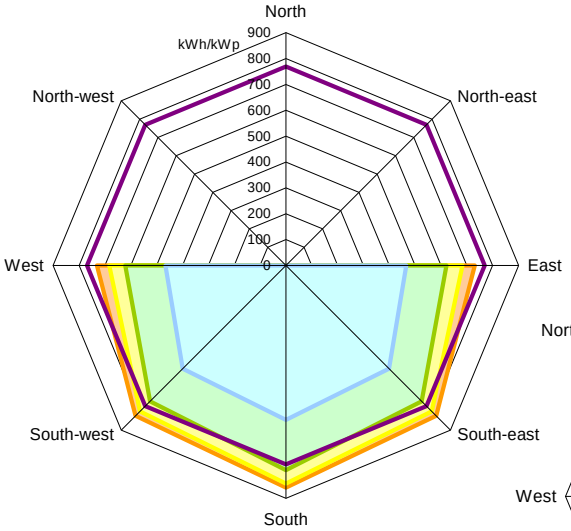
NOTES

- Technical WG concluded that the variance in carbon performance when assuming different thermal mass should not be material to determining the Carbon Compliance level (i.e. the assumption of Medium TMP in the dwelling models is OK)
- It was felt that in reality TMP was more likely to influence the occurrence, frequency and intensity of overheating and therefore affect cooling demand more so than heating

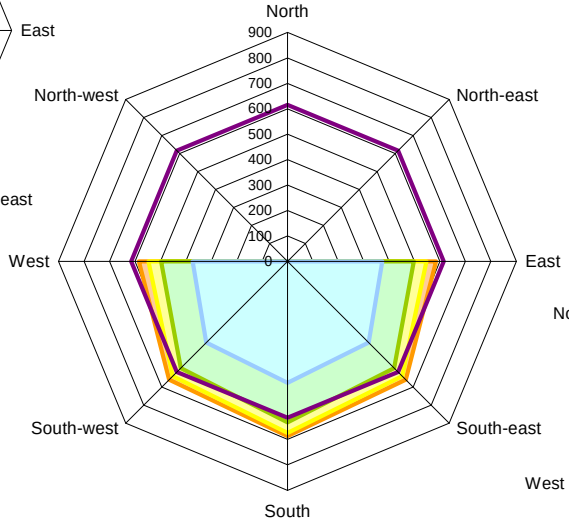
Modelling sensitivity: PV output

PV output, East Pennines Overshading

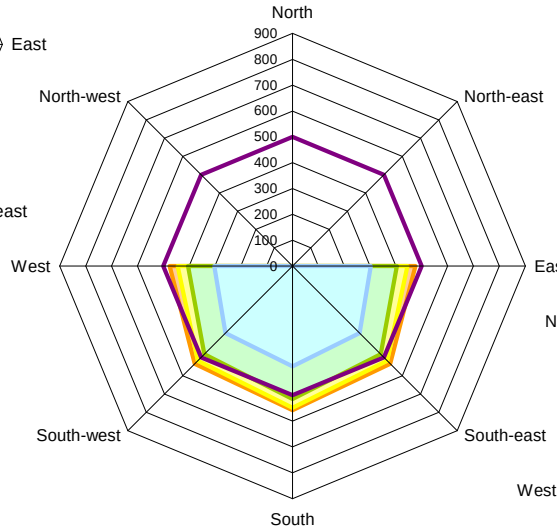
None/ very little (<20%)



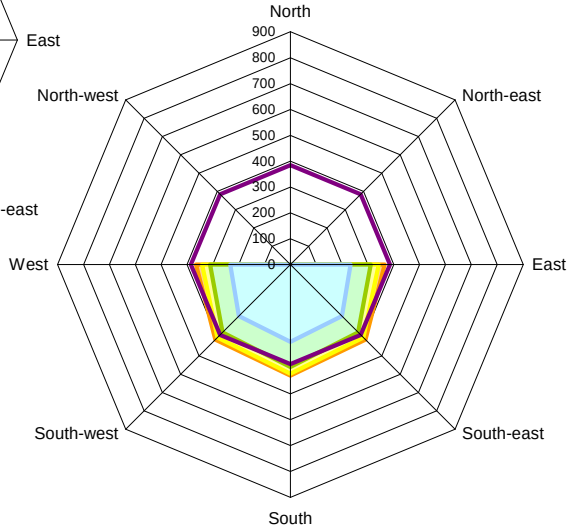
Modest (20-60%)



Significant (60-80%)



Heavy (>80%)



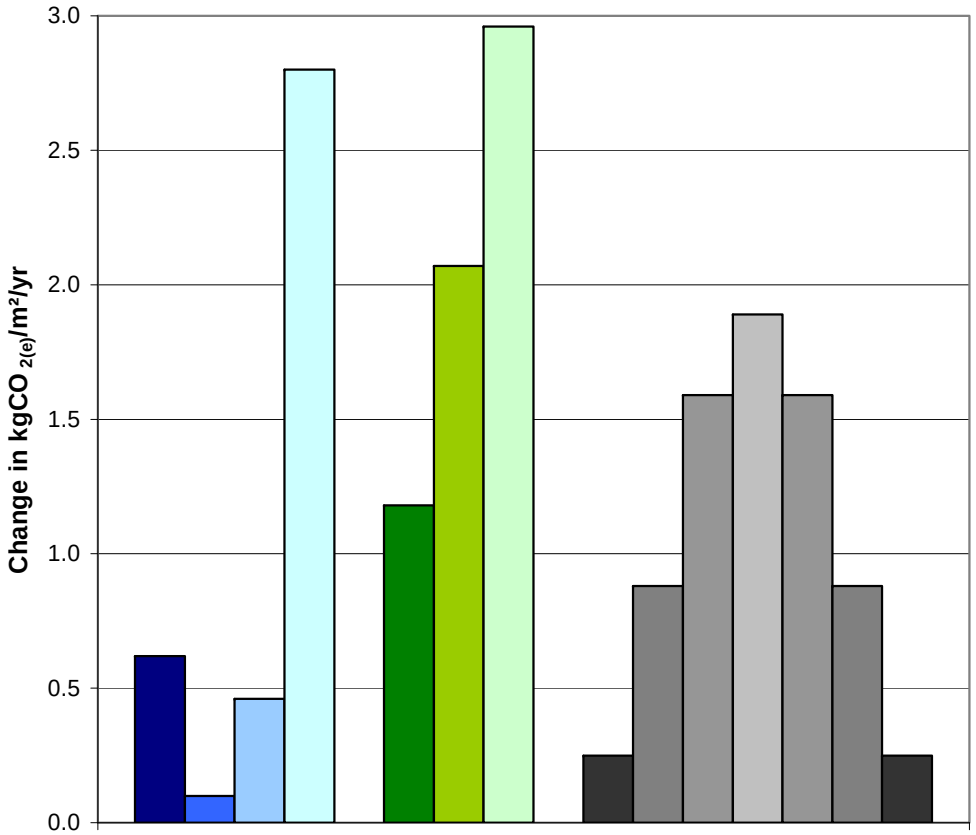
Inclination

- 30°
- 45°
- 60°
- Vertical
- Horizontal

NOTES

- Effect of orientation on PV performance is small compared to the effect of overshading
- Panel inclination can also have a relatively large effect compared to change in orientation

Sensitivities:
Change in carbon emissions due to change in PV Inclination, Overshading, Orientation



FOR 1kWp PV (End terrace, FEES, EP)
FROM: South, 30deg, Very little overshading

- TO: South, Horizontal, Very little overshading
- TO: South, 45deg, Very little overshading
- TO: South, 60deg, Very little overshading
- TO: South, Vertical, Very little overshading
- TO: South, 30deg, Modest overshading
- TO: South, 30deg, Significant overshading
- TO: South, 30deg, Heavy overshading
- TO: South East, 30deg, Very little overshading
- TO: East, 30deg, Very little overshading
- TO: North East, 30deg, Very little overshading
- TO: North, 30deg, Very little overshading
- TO: North West, 30deg, Very little overshading
- TO: West, 30deg, Very little overshading
- TO: South West, 30deg, Very little overshading

NOTES

- Technical WG concluded that the standard assumptions of PV performance in the modelled dwellings should be altered to:
- SE/SW orientation
- 45deg inclination
- None/ v. little overshading
- This it to take into account the general situation that available roof areas may not be perfectly orientated, or may not be at the most advantageous pitch, or may experience a greater amount of overshading