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gFT glass & façade technology research group

A PARAMETRIC FEASIBILITY STUDY ON ACTIVE VACUUM INSULATION PANELS FOR BUILDINGS

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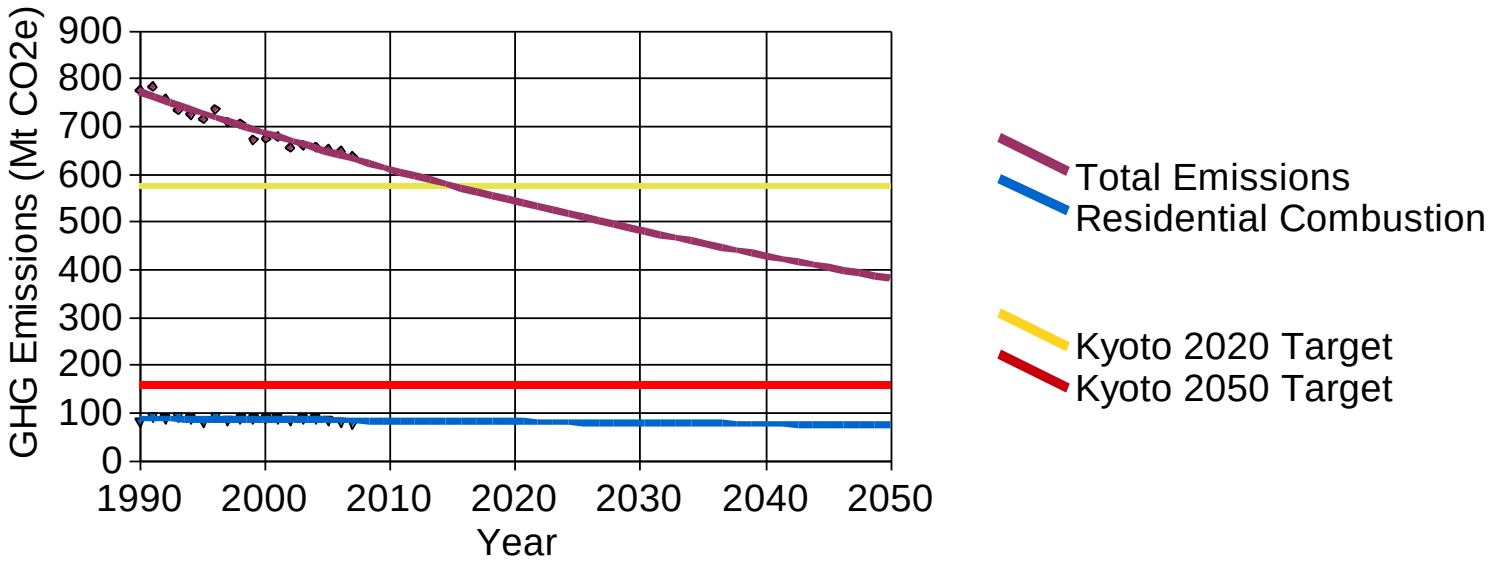
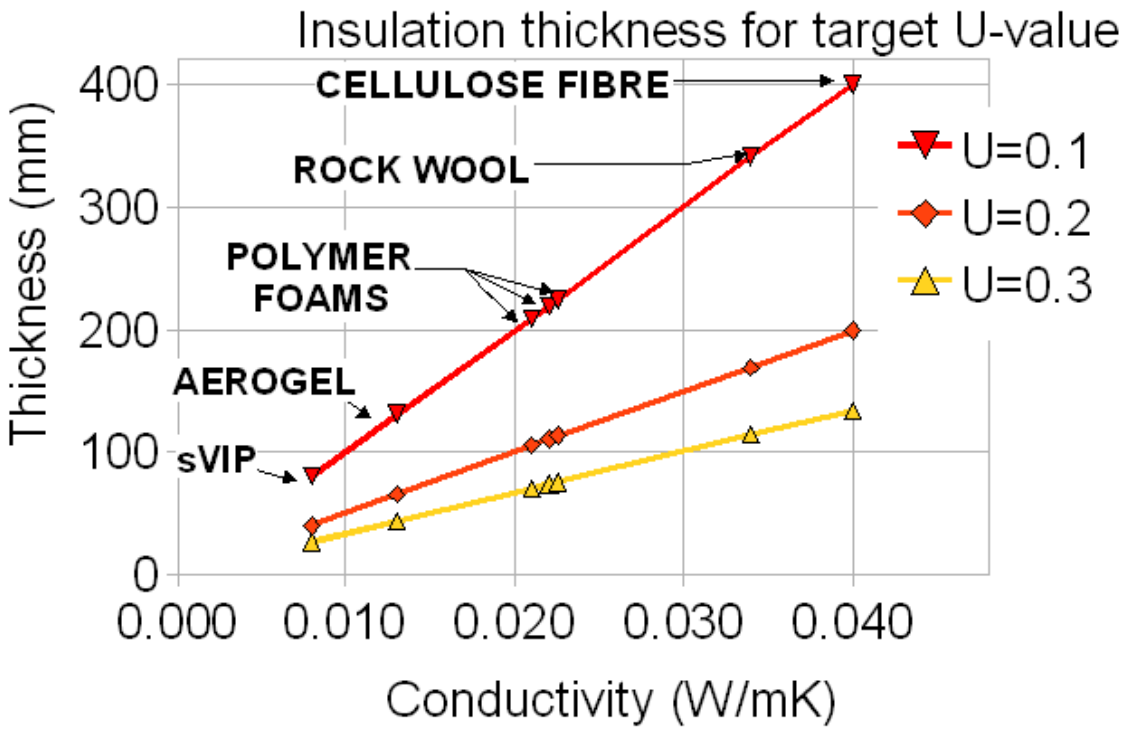
IVIS 2009

Product Environment

- UK needs to reduce CO_2 emissions
- Large contribution due to domestic heating



Achieving Low U-values

- Two approaches: thick *vs.* high performance
- 

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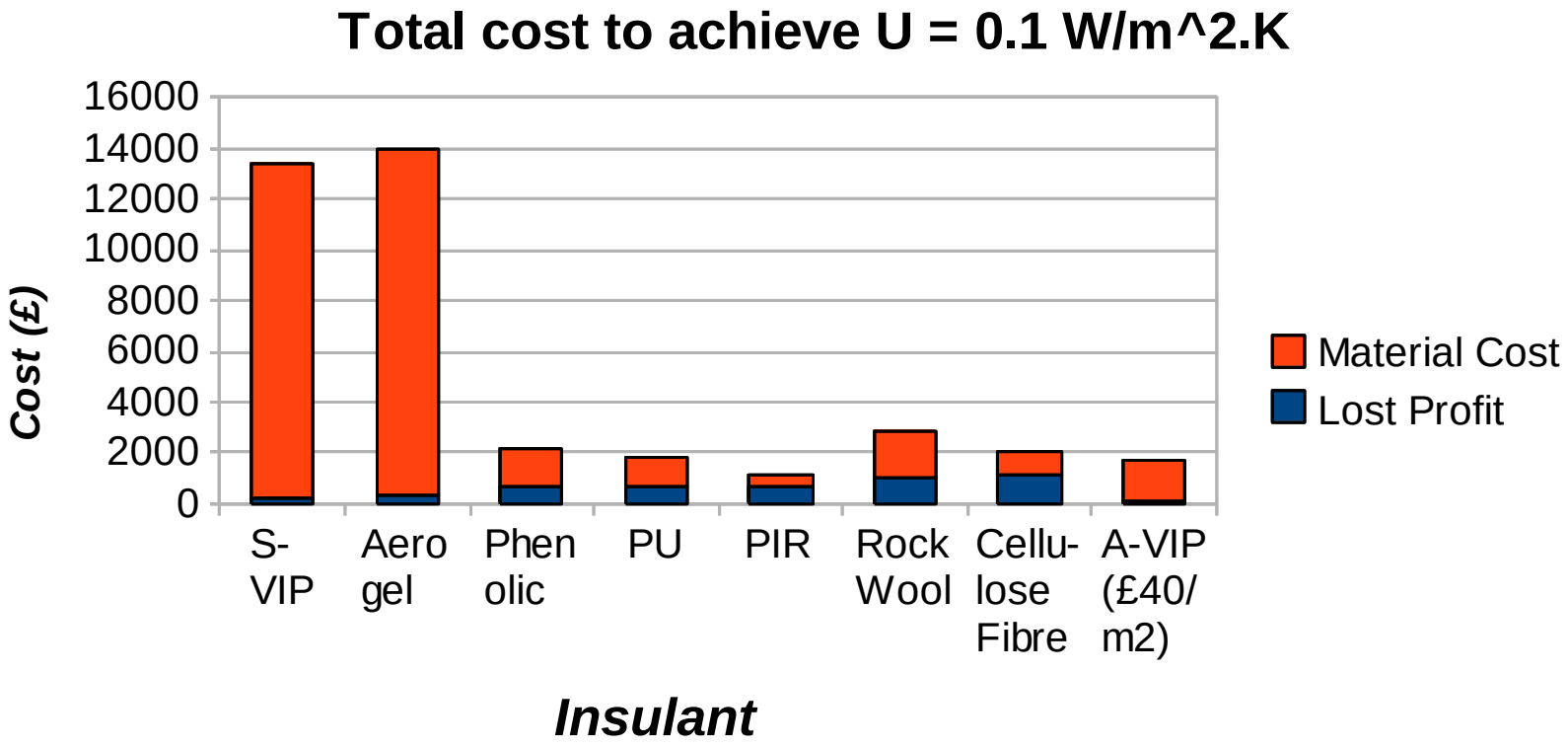
Design Target

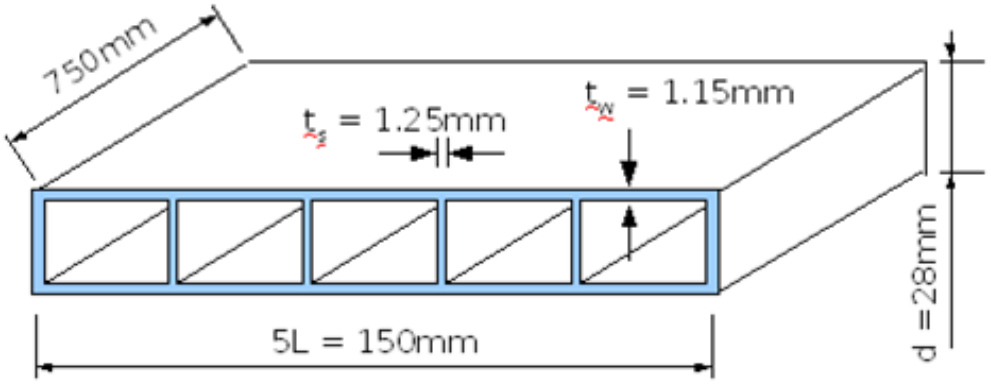
- Cavity wall construction: 100 year service life

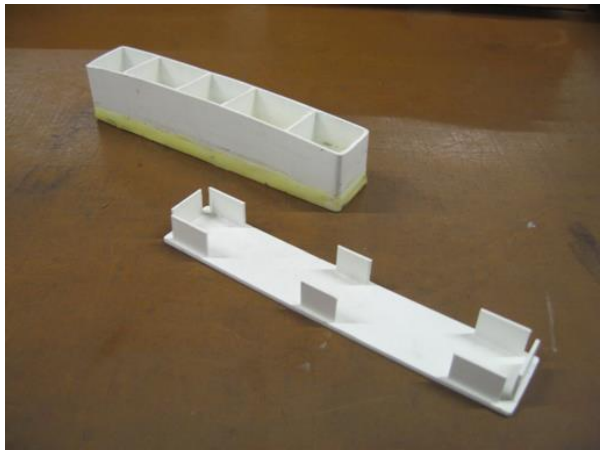


- Design target for new Vacuum Insulation: U=0.1W/m^{2}K, t=40mm, £40/m^2, 100 year life

Active Vacuum Insulation Panel

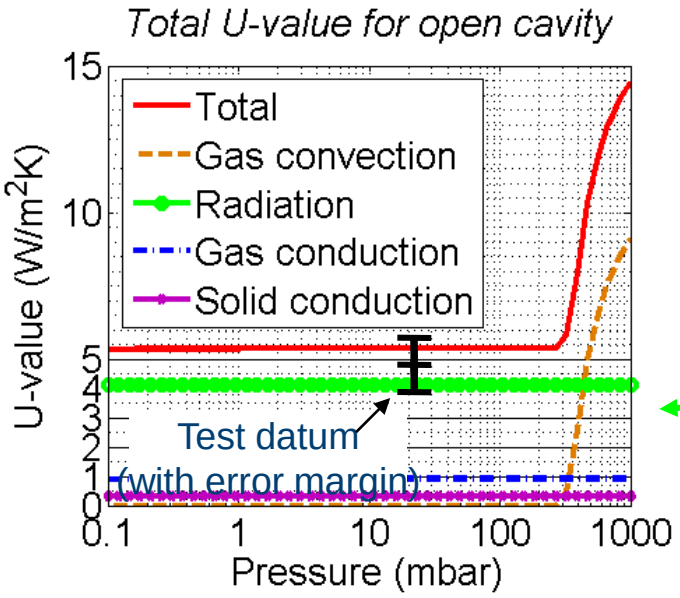
- Thermal and structural modelling
- Validation of model
- Design optimisation

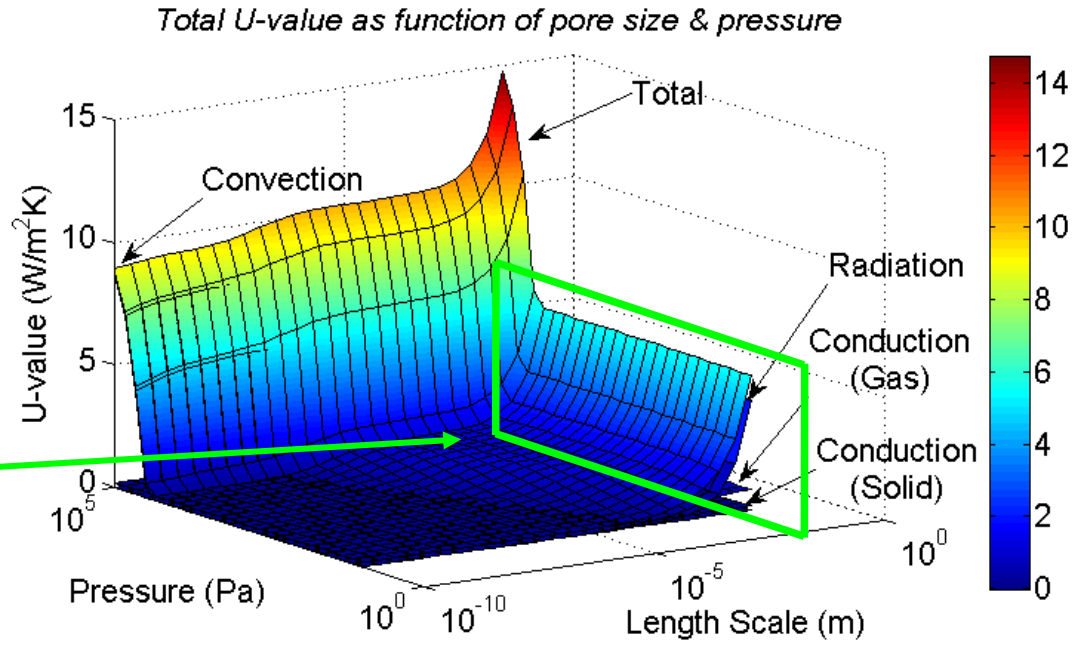




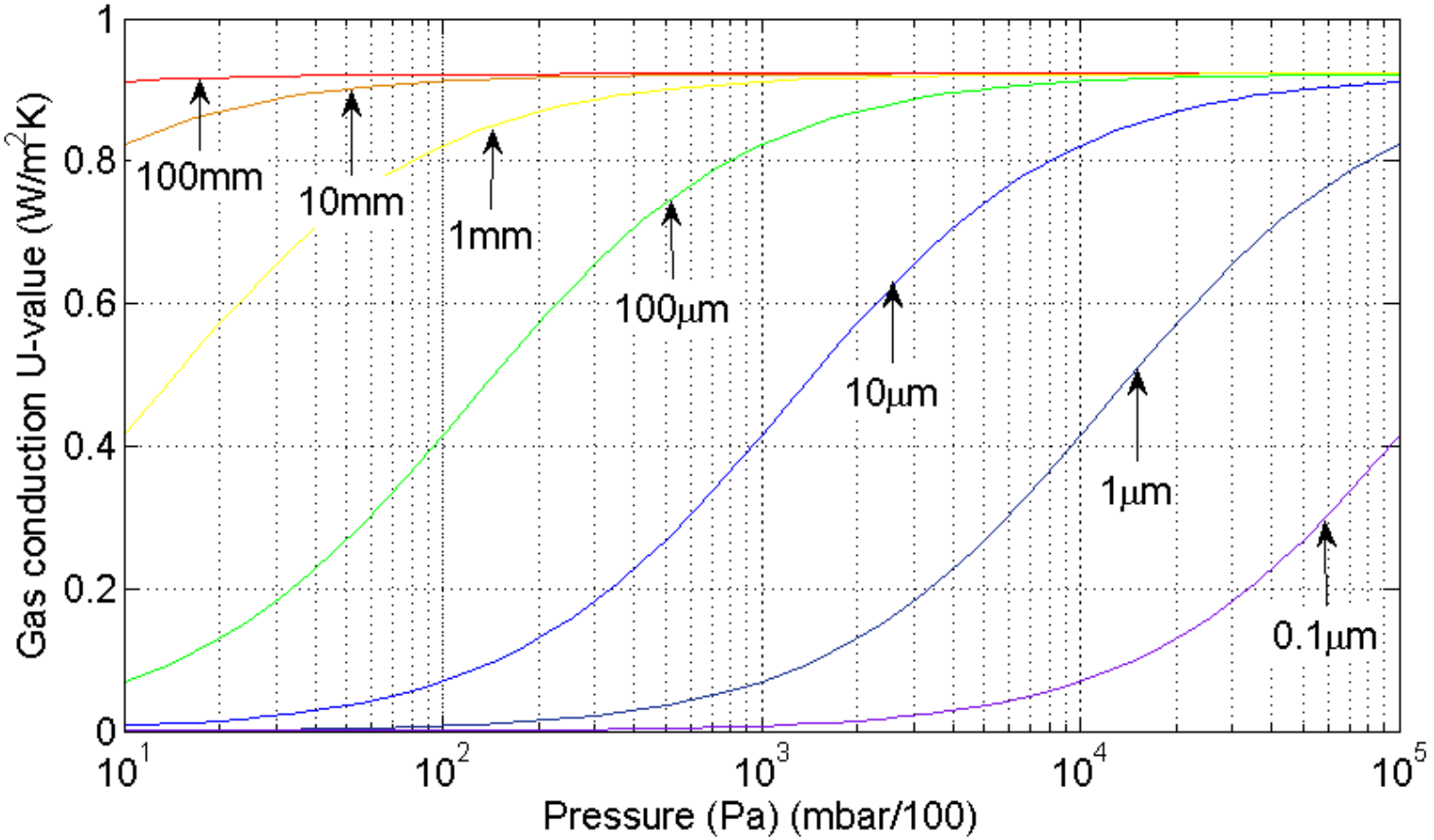
Modelling

- Initial results disappointing (U ≥ 5.3W/m^{2}K)
- Agreement between model and test results
- Porous filler material will be required

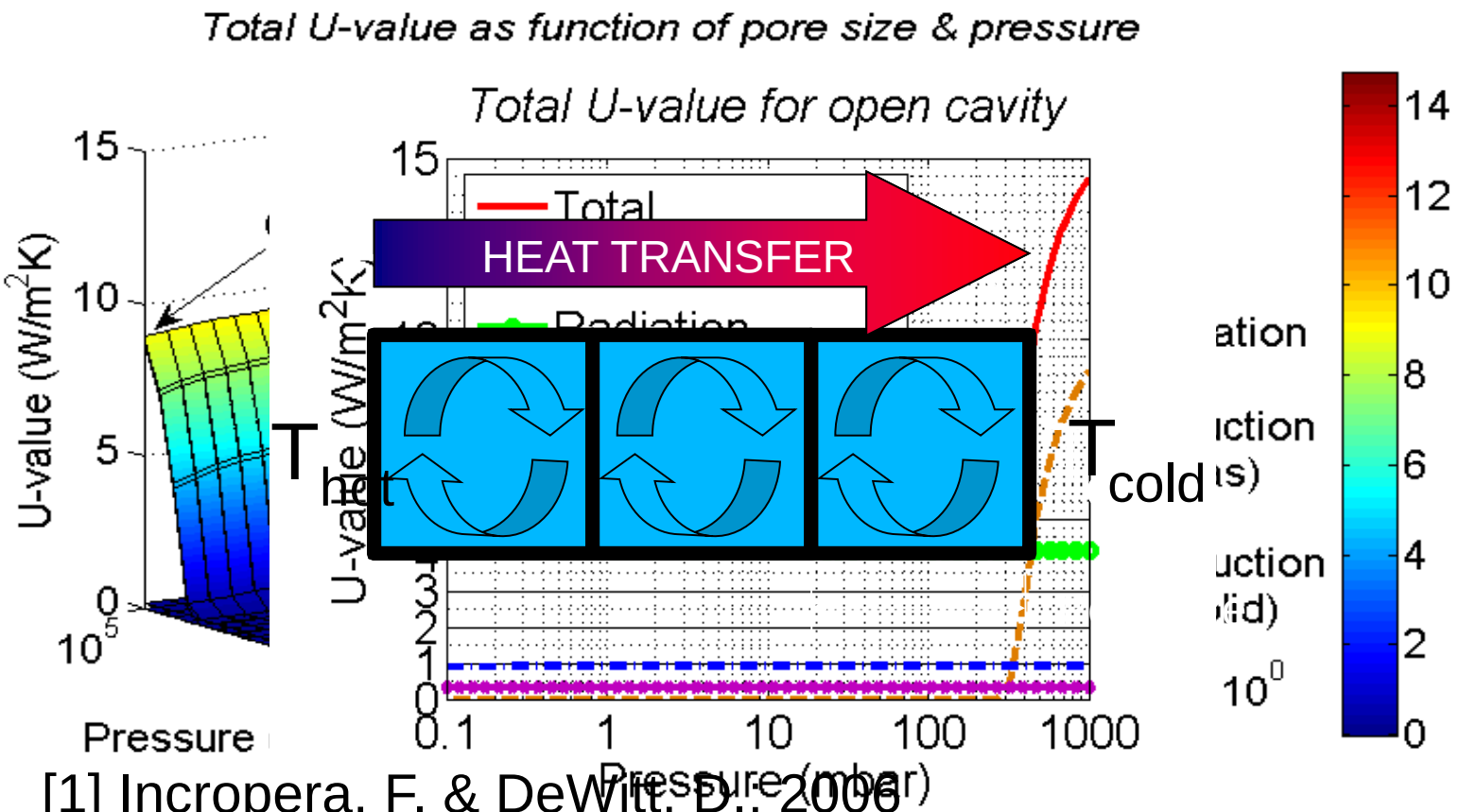




Optimisation: Gas Conduction

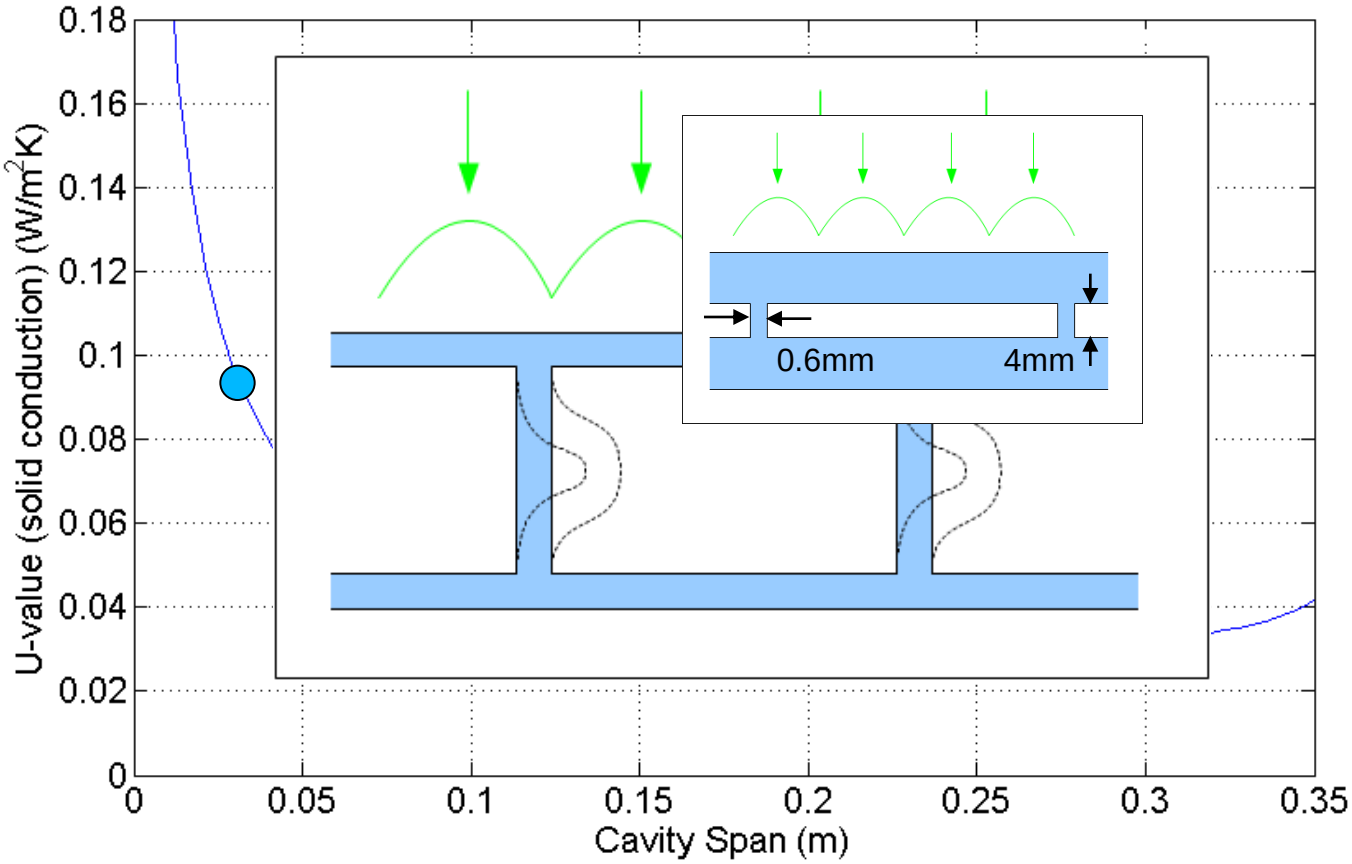


Optimisation: Gas Convection



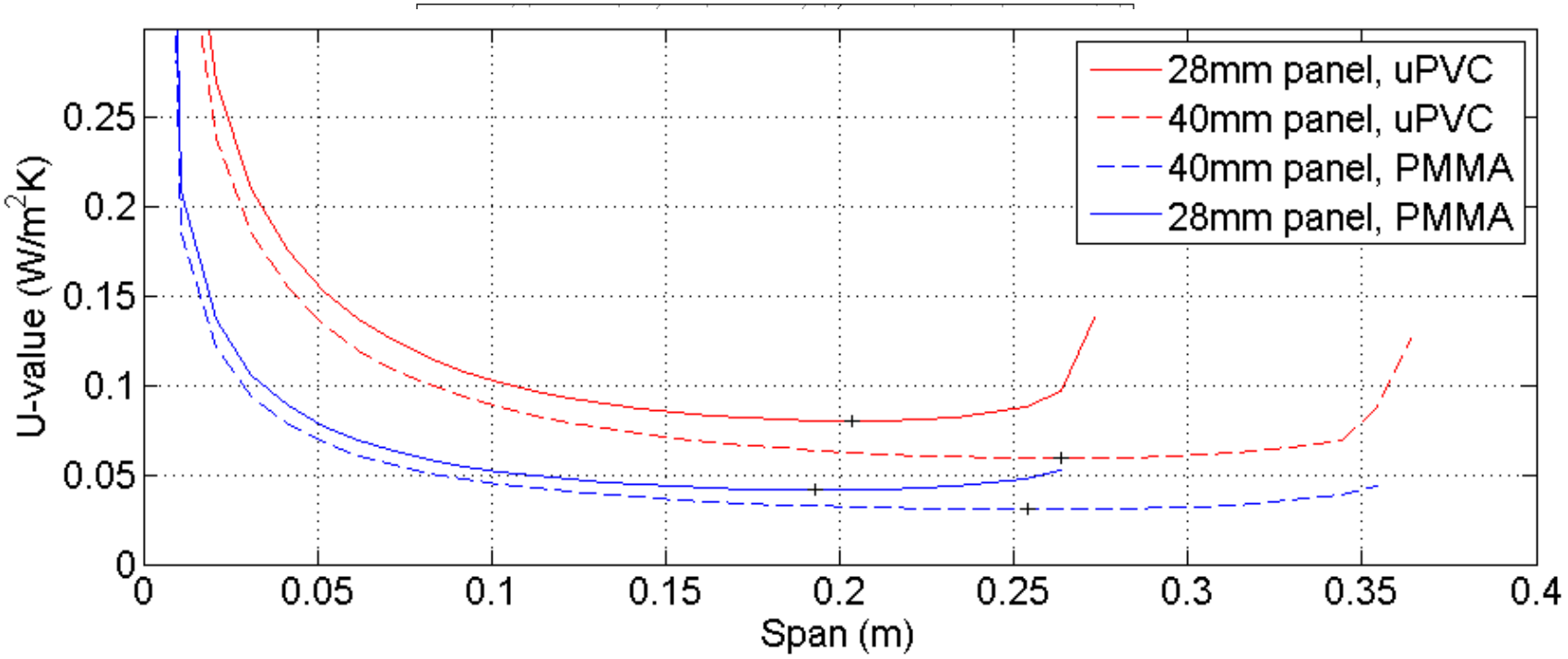
[1] Incropera, F. & DeWitt, D., 2006

Optimisation: Solid Conduction



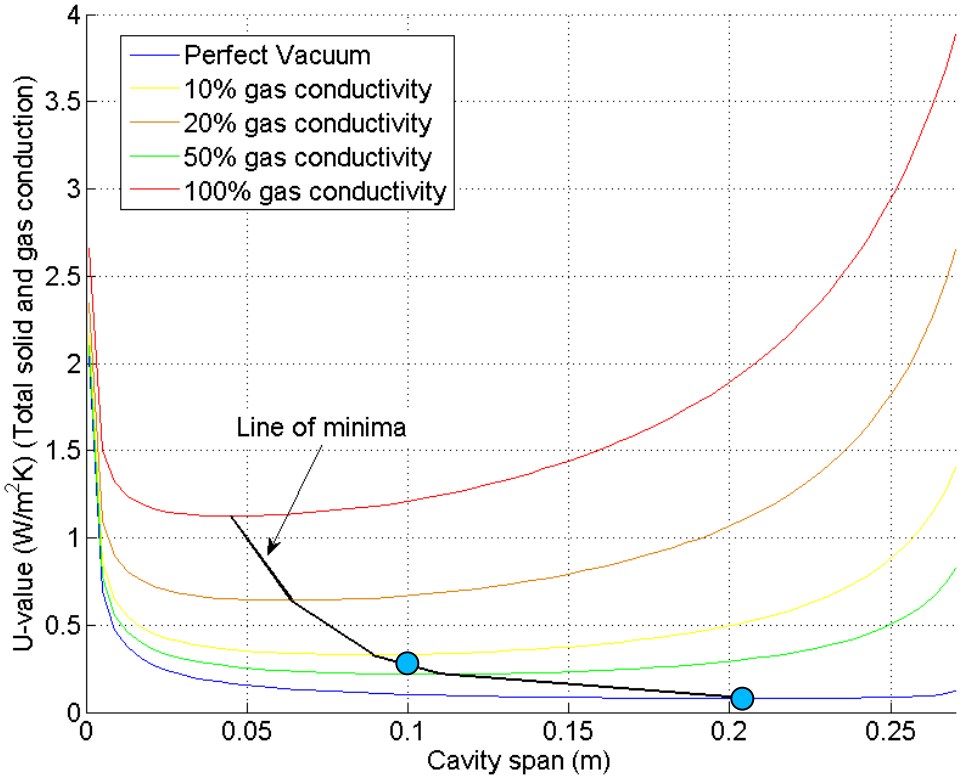
Material Selection: Panel

- Buckling of side ribs dominates: maximise $E^{1/3}/\lambda$
- PMMA (perspex) best performing polymer

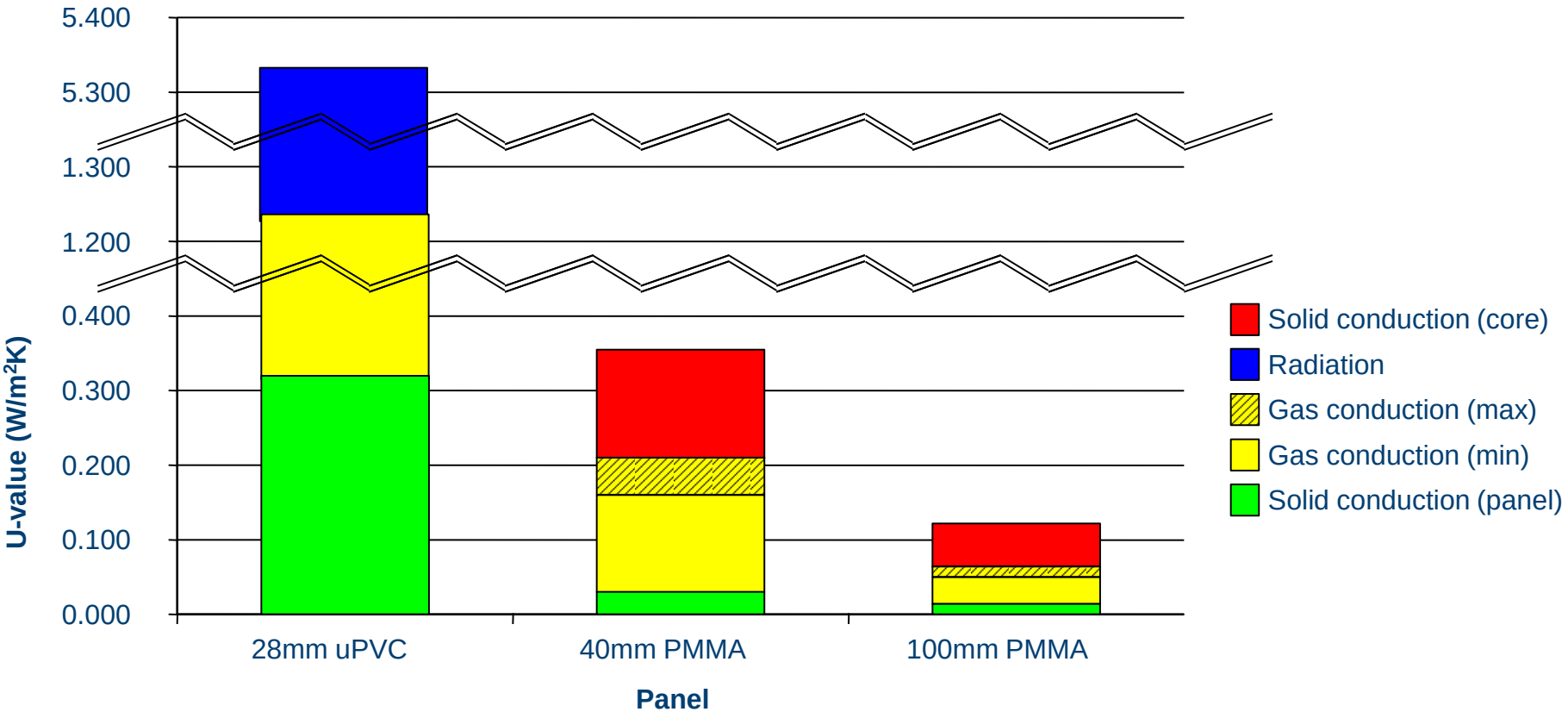


Material Selection: Core

- Core material: elastomeric PU open-cell foam
- Conductivity < 5.8mW/mK (target 4mW/mK)



Optimisation Results



Conclusions: Active High Performance Insulation

- Total U ≤ 0.1W/m^{2}K may be possible in thin panel
- Fine porous filler required
- Trade-off: depressurisation *vs.* conductivity
- Tunable insulation unlikely in thin panel
- Periodic de-pressurisation (10 years) feasible

Further Research

- Ageing issues: permeation, outgassing, vapour
- Numerical modelling/testing with porous core
- Design of de-pressurisation system
- Prototype manufacture and testing
- Cost-Benefit Analysis with other insulants

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