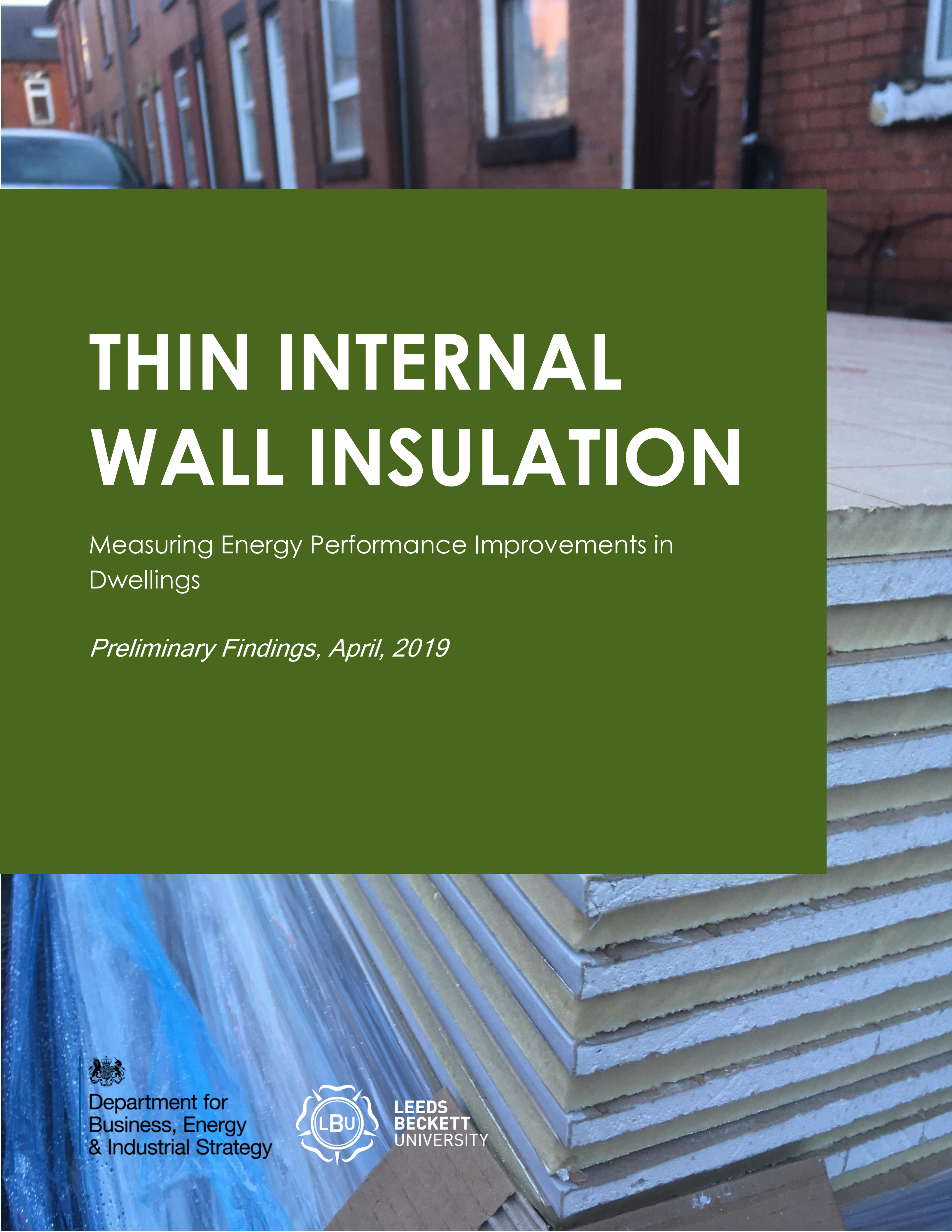


THIN INTERNAL WALL INSULATION

Measuring Energy Performance Improvements in Dwellings

Preliminary Findings, April, 2019

Department for Business, Energy & Industrial Strategy

LEEDS BECKETT UNIVERSITY

WHY DO WE NEED THIN INTERNAL WALL INSULATION (TIWI)?

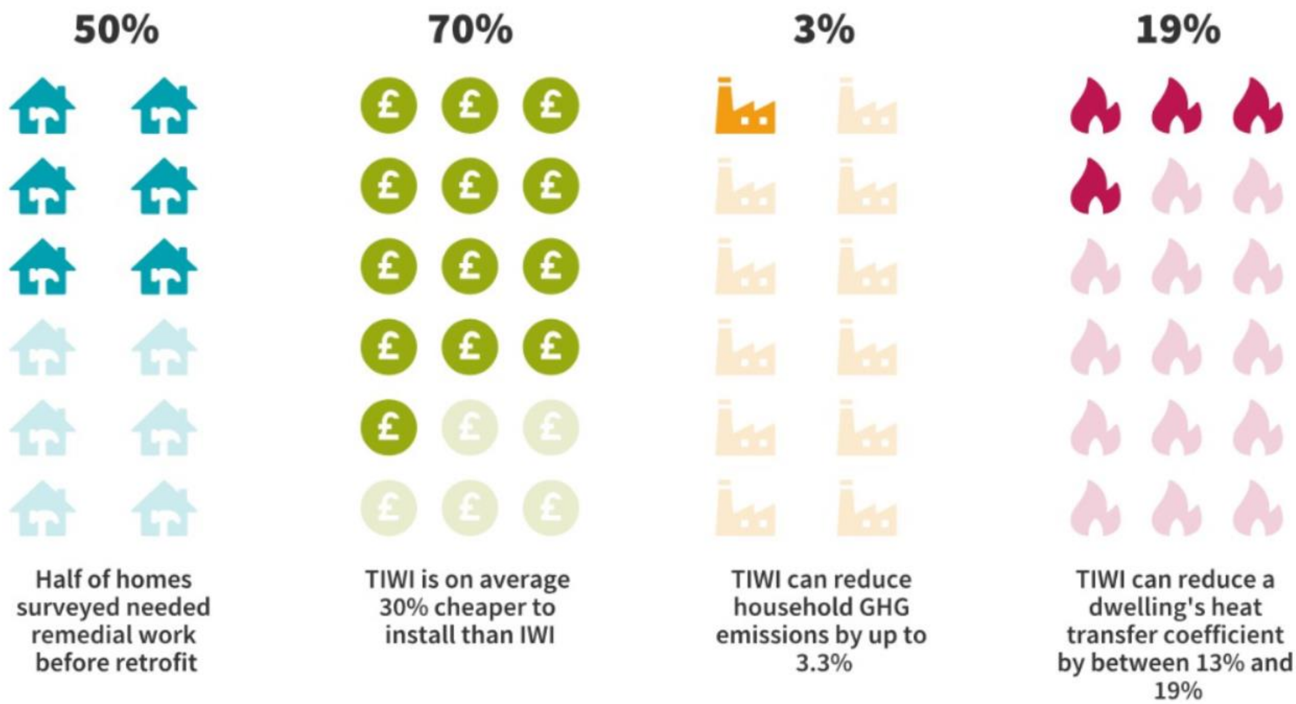
Thin Internal Wall Insulation (TIWI) can provide significant energy savings for almost 8 million uninsulated solid wall homes in the UK. The current solid wall insulation (SWI) market, including retrofits undertaken via ECO, has been focused on installing thicker internal wall insulation (IWI) to achieve U values of 0.3 W/m^2K. However, this has resulted in low market penetration with only around 7% of ECO retrofits including SWI, meaning IWI accounts for less than 1% of ECO measures. In addition, conventional IWI has been found, in some instances, to be disruptive to householders and increases the risk of moisture problems manifesting in homes. TIWI may provide a solution to this, if it is easier to install, cheaper, lower risk and still reduces fuel bills for solid wall homes.

EVALUATING THE PERFORMANCE OF TIWI

This report presents the preliminary findings from before and after building performance evaluation (BPE) field trials undertaken to measure the impact of 6 TIWI and 1 conventional IWI retrofits. Their impact on thermal bridging and hygrothermal models identified how they affected moisture risk. Dynamic simulation models predicted the energy demand reductions to evaluate potential carbon and fuel bill savings. Coheating test measured the reduction in the heat transfer coefficient (HTC) measured in W/K, which describes the holistic impact on the home's heating demand. In addition, blower door tests and heat flux measurements quantified the difference that the retrofits had on infiltration (uncontrolled air leakage) and fabric heat loss, i.e. wall U value measured in W/m^2K, respectively. Appraisal of the installation costs and how the TIWI products could overcome installation barriers was undertaken, supported by surveys in 100 homes to identify insulation and dwelling characteristics that affected costs or risks, such as requirements to replace plumbing, boilers & radiators, apply decoration or repair damp walls.

FINDINGS

TIWI provides substantial benefits for uninsulated solid wall dwellings at lower cost and reduced risk of condensation, although thicker insulation will provide further energy savings. However, TIWI cannot completely remove moisture risk and it is essential that both IWI and TIWI are fitted appropriately to walls in good repair.



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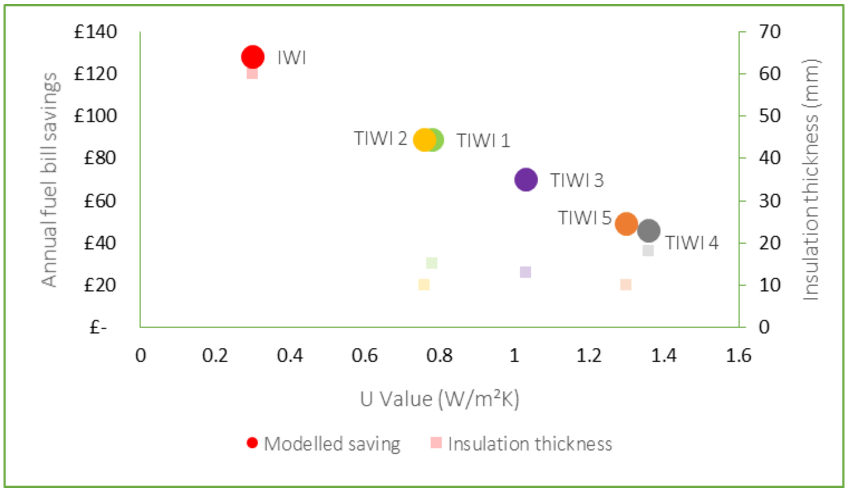
FUEL BILLS SAVINGS



A dynamic simulation model (DSM) was used to evaluate the retrofits on a single case study home (assuming it is heated using a gas boiler) to identify annual fuel bill savings (the effects of TIWI 6 couldn't be modeled via DSM). As can be seen despite being only 20% to 30% the thickness of conventional IWI, and despite having U values between 0.8 and 1.4 when installed on solid brick walls, TIWI provides between 40% and 70% of the fuel bill savings that conventional IWI achieved.

MOISTURE RISK

Thermal models to identify cold bridging, and blower door tests to measure infiltration rates, were used to investigate impacts on moisture risks resulting from conventional IWI and TIWI.

Using TIWI on window jambs can cut the risk of surface condensation in half, compared to leaving jambs uninsulated. Conventional IWI retrofits often already use TIWI in these locations as well.

TIWI made no measurable change to air tightness, meaning it is unlikely to reduce indoor air quality or increase relative humidity.

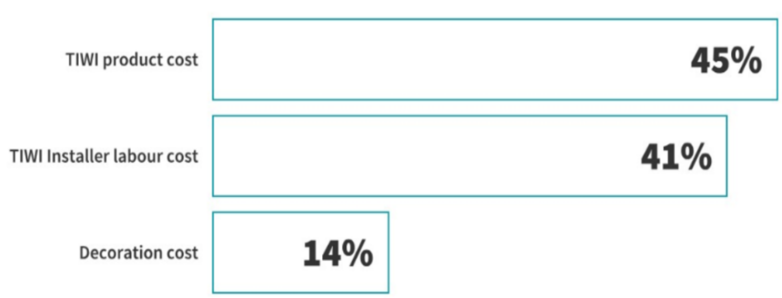
TIWI appplied to walls causes around two thirds less thermal bridging on uninsulated window jambs than IWI, and therefore doesn't increase condensation risk as much as IWI.

Conventional IWI increases thermal bridging and surface condensation risk in neighbouring properties more than TIWI, though both retrofits will increase the risk.

Note: Both IWI & TIWI can increase condensation risk on adjacent surfaces & neighboring homes.

INSTALLATION COSTS

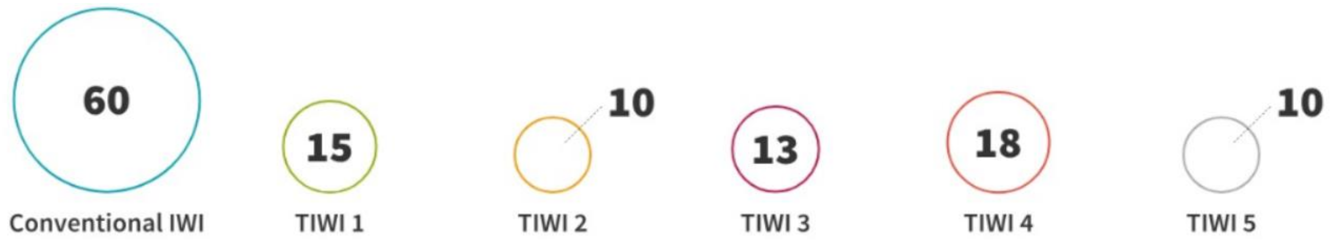
TIWI products that are similar to conventional IWI laminate boards had similar labour costs. Some TIWI require multiple house visits, which increases labour costs and time. TIWI may gain market share despite this since they can take up to a third less floor area than conventional IWI. In addition, some TIWI do not require decoration and these were the cheapest TIWI to install.



FABRIC HEAT LOSS

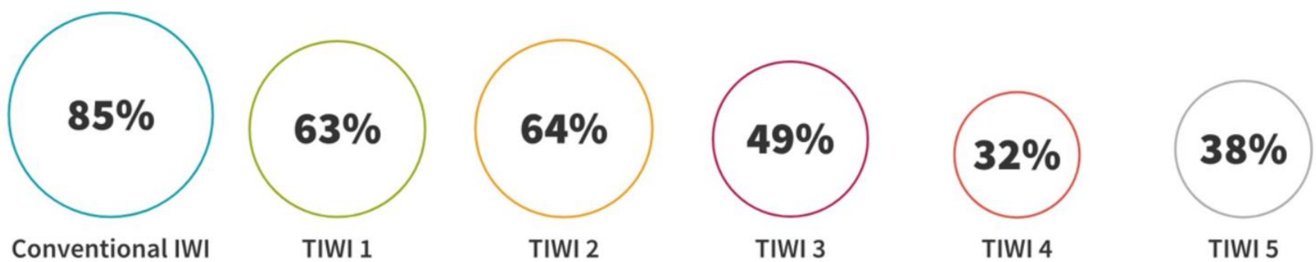
The effectiveness of the additional thermal resistance (R-value) provided by insulation products is determined by its thermal conductivity and its thickness. The conductivity of the IWI and TIWI differed depending on its material, however, insulation is also subject to the law of diminishing returns. For example, the conventional IWI was in some instances four times thicker than TIWI and yet provide only 22% more benefit, as shown below, indicating TIWI can substantially reduce fabric heat loss despite being considerably thinner than conventional IWI.

Insulation thickness (mm)



Thermal resistance (R value) of insulation (m^2K/W)

Reduction in U value due to insulation



CONCLUSION

TIWI could contribute to Government retrofit policies to improve the EPC score of dwellings, provide greater market penetration and reduce the likelihood of retrofits creating moisture risks in homes. The requirement to improve solid wall U values to 0.3 W/m^2K in current retrofit standards may be a deterrent and can cause confusion when applying the regulations for builders and building control officers. Cavity wall retrofits can also struggle to improve walls to this U value, and as such cavity wall retrofits are allowed to achieve a U value of 0.55 W/m^2K. A similar leniency in the approach to U values for solid wall retrofits may increase their uptake, resulting in benefits to homeowners and a greater reduction in national energy consumption.

This project has been undertaken by the Leeds Sustainability Institute (LSI) at Leeds Beckett University. This report is an advanced summary of the main findings in advance of completion of the final report.

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