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the sustainable building association

2010 Annual Conference

Celebrating 21 years of the AECB

Something Old, Something New

1-2 October 2010 • WISE Building, CAT

Organised by:

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In association with

Passivhaus Trust
The UK Passive House Organisation

AECB

2010 Annual Conference

Energyflo Construction Technologies

Dynamic Insulation

for Energy Efficient, Low Carbon Building Envelopes

Mohammed Imbabi

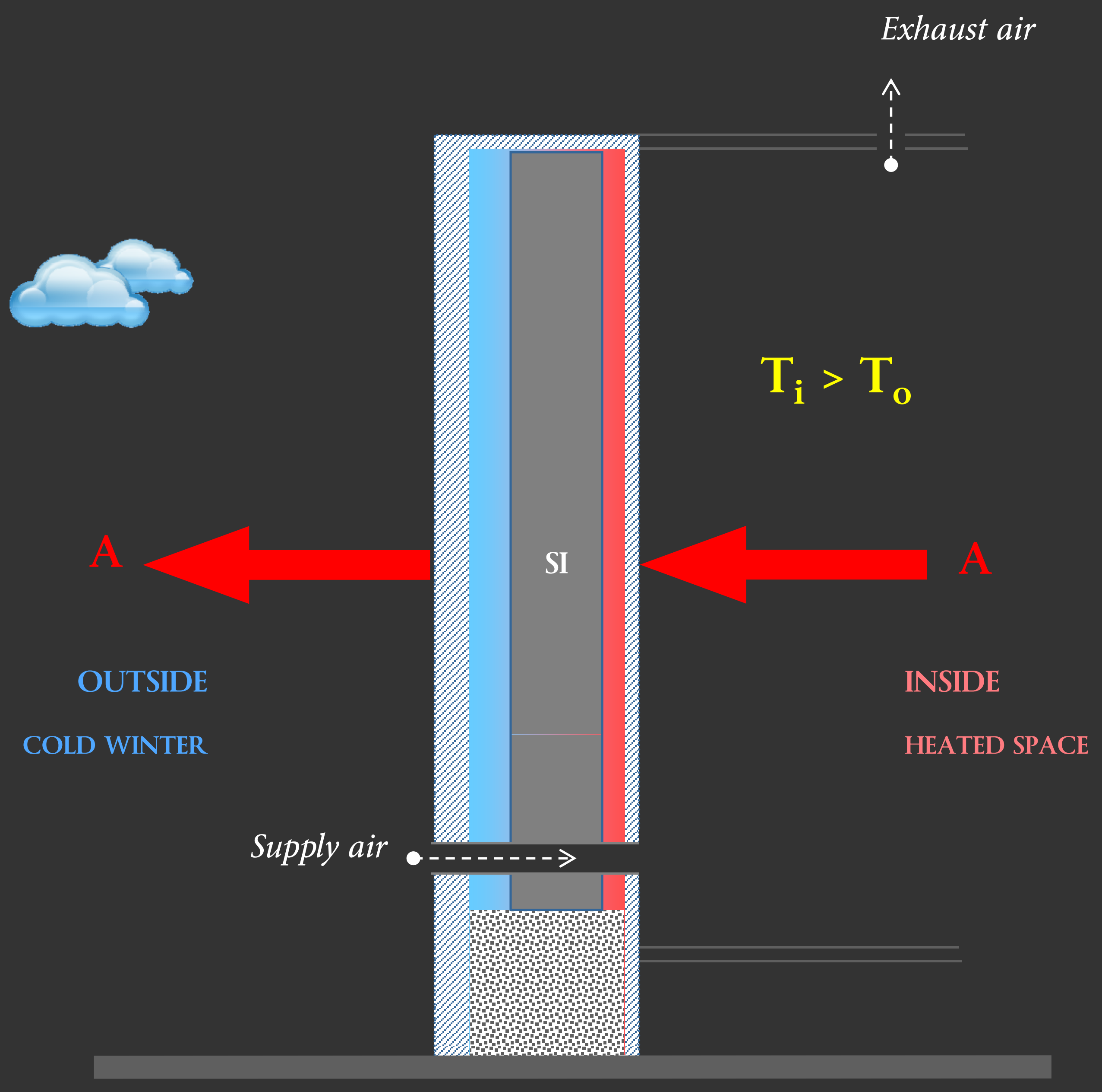
Energyflo Construction Technologies Ltd
Edinburgh, Scotland (UK)

What is dynamic insulation ?

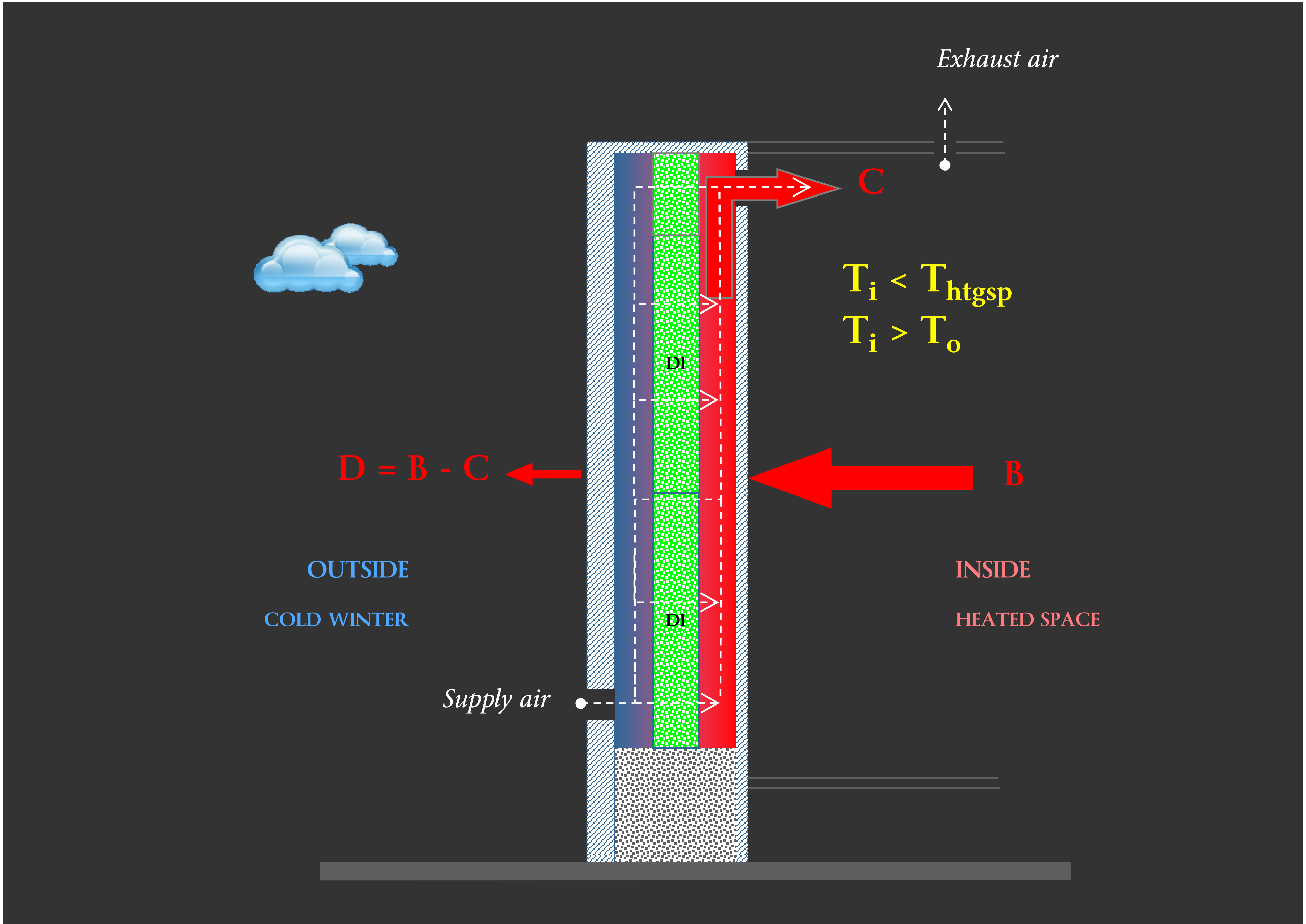
- Dynamic Insulation (DI) is a multi-functional approach to thermal insulation that replaces conventional insulation in the building envelope.

- DI transforms the building envelope into a heat recovery device and fresh air ventilation source.

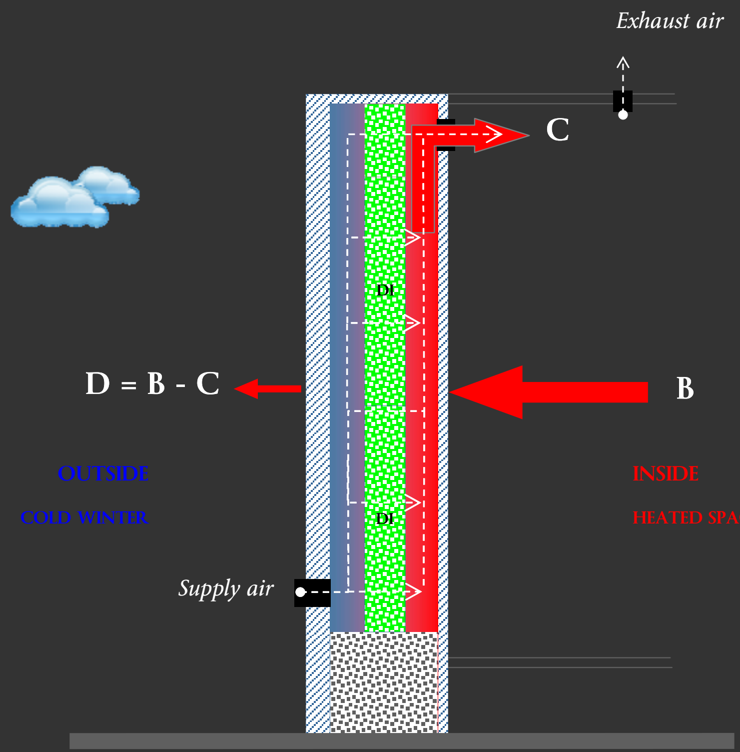
- DI transforms the building into a sustainable, energy efficient Dynamic Breathing Building, or DBB™.



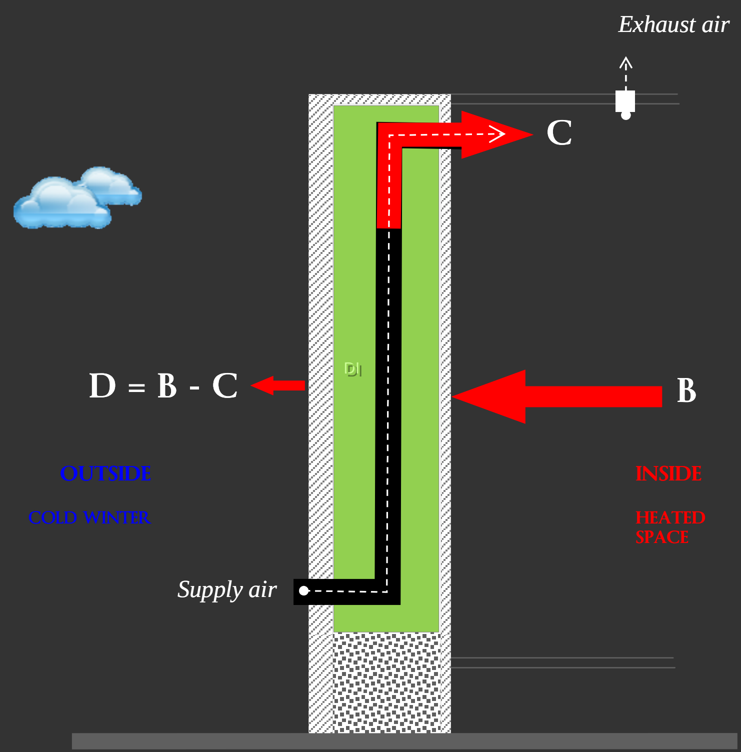
CONVENTIONAL THERMAL INSULATION



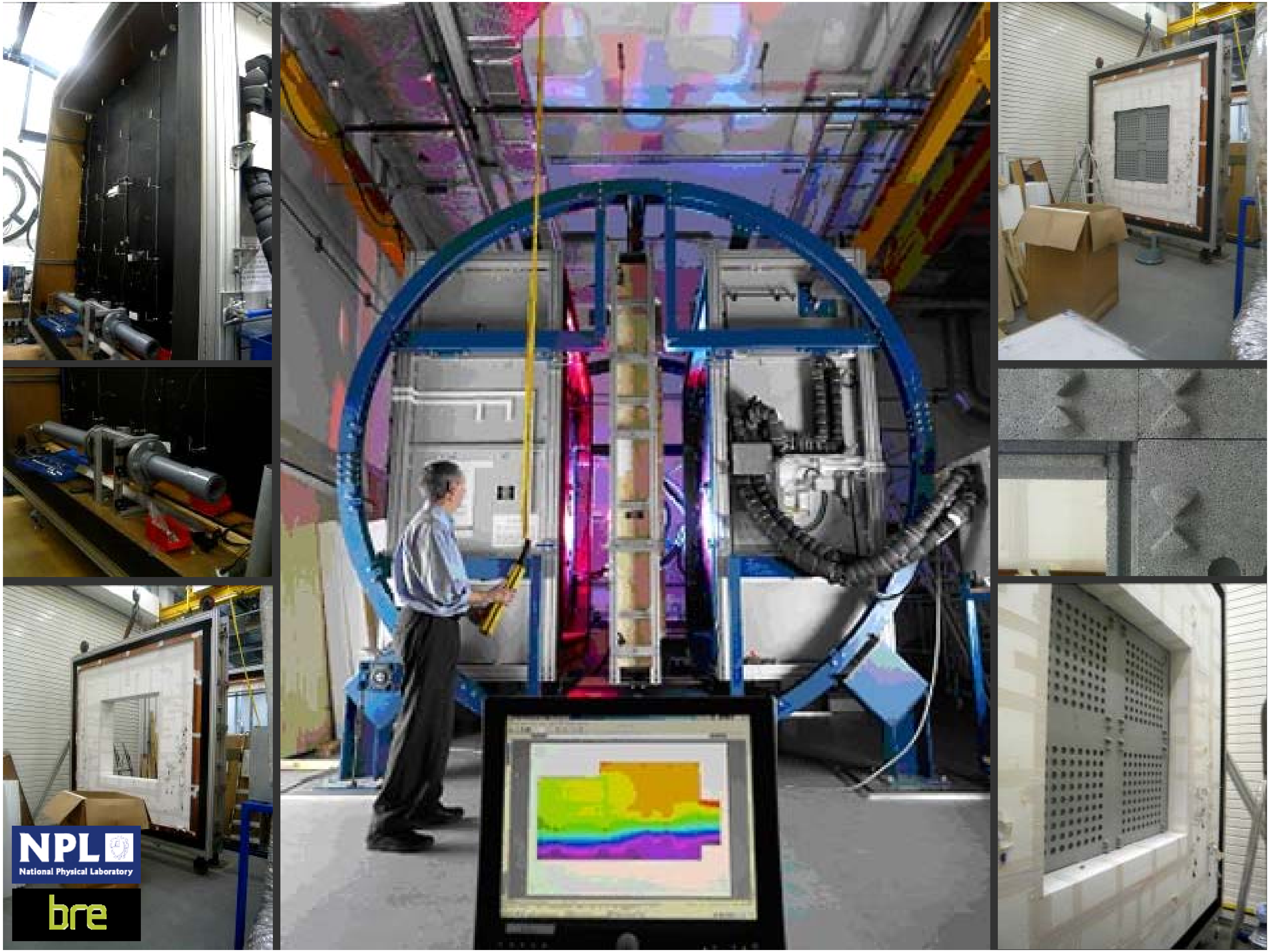
DI 'NORMAL' HEAT RECOVERY MODE

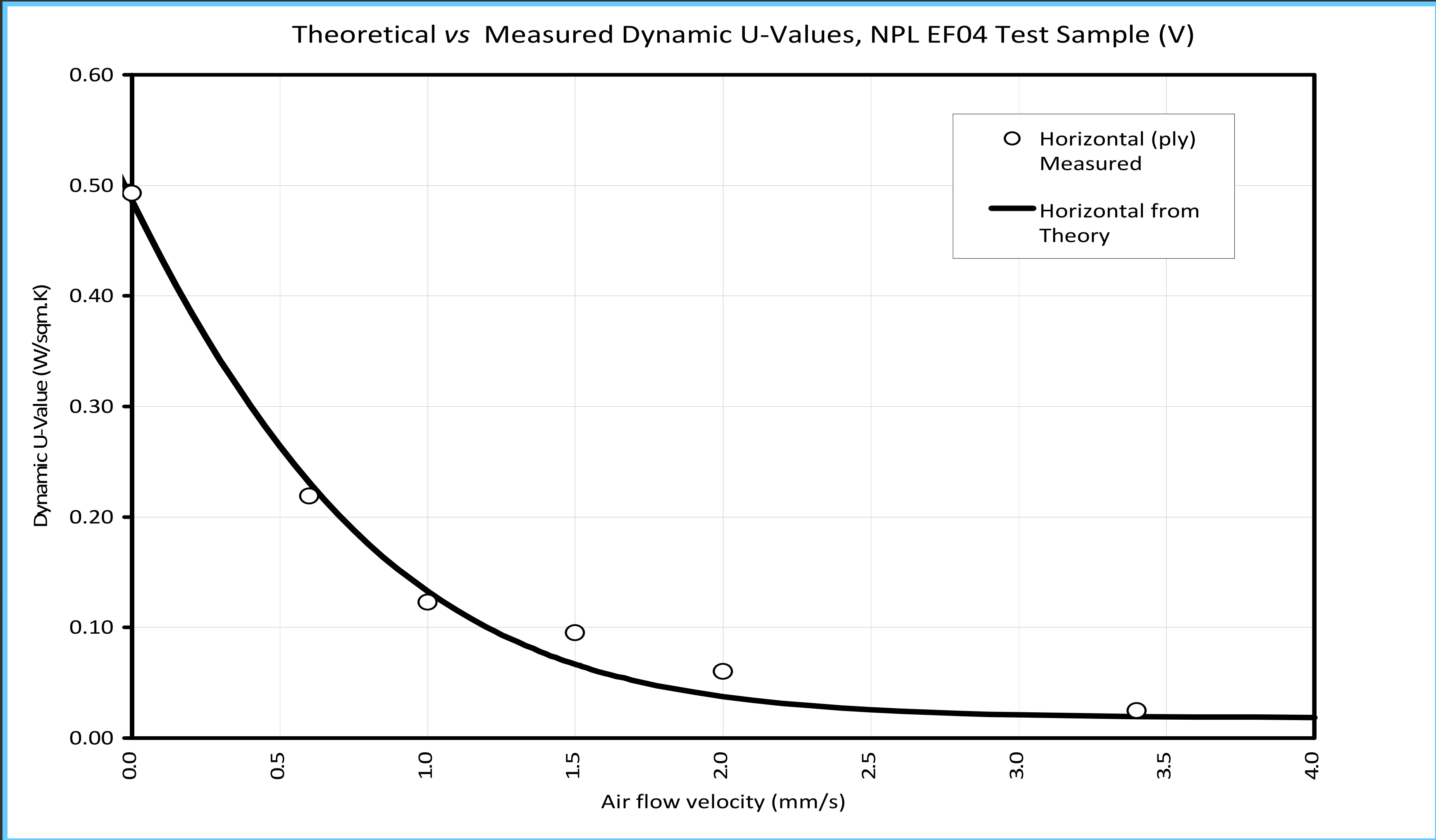


Permeodynamic (TYPE-I)

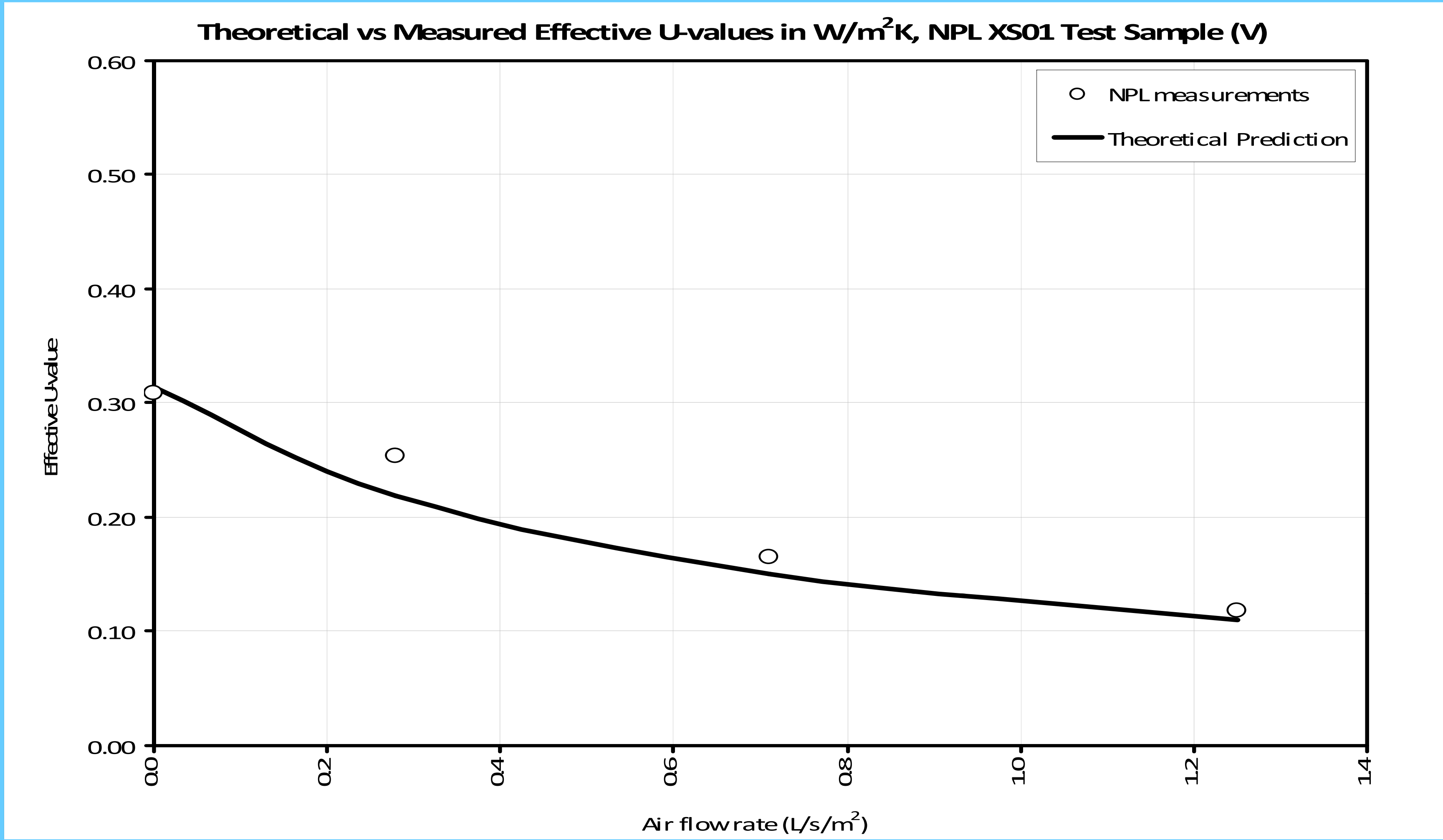


Parietodynamic (TYPE-II)

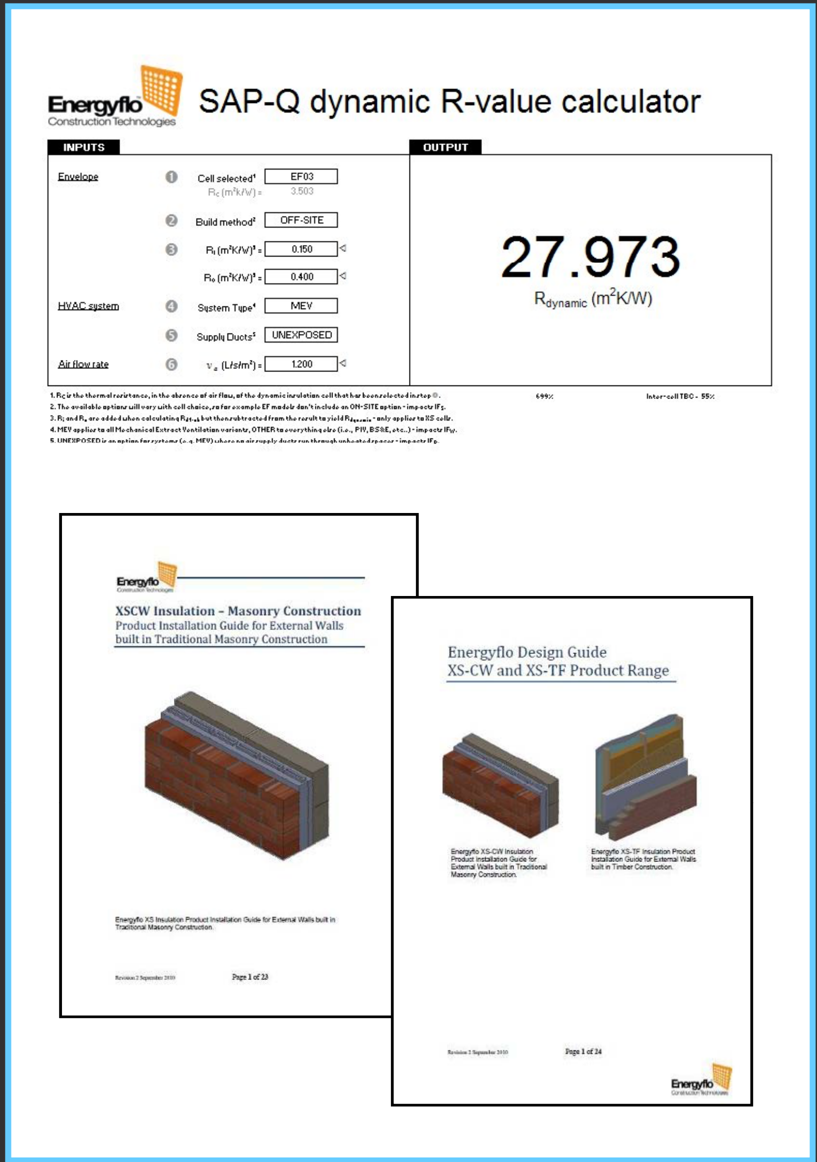

NPL
National Physical Laboratory
bre



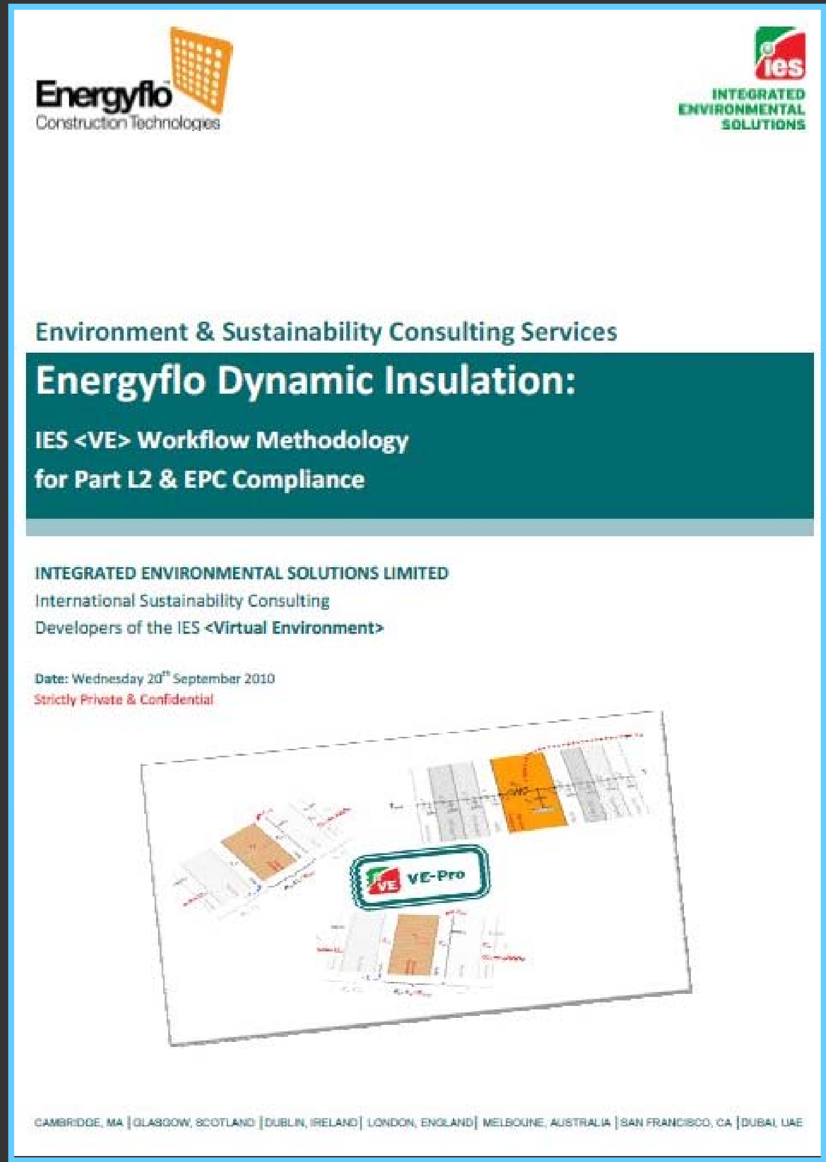
TYPE-I PERMEODYNAMIC U-VALUE CURVE



TYPE-II PARIETODYNAMIC U-VALUE CURVE

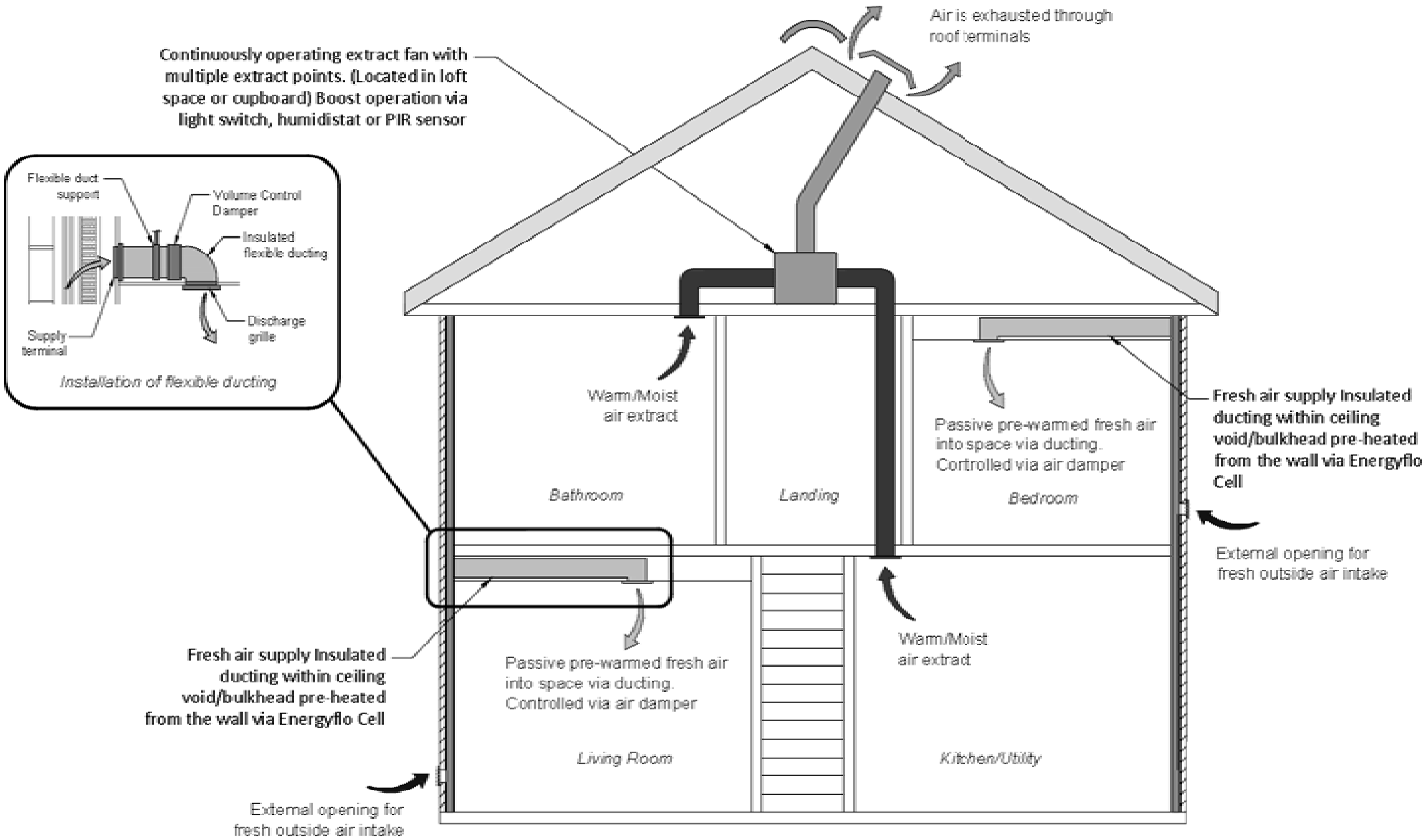


DOMESTIC

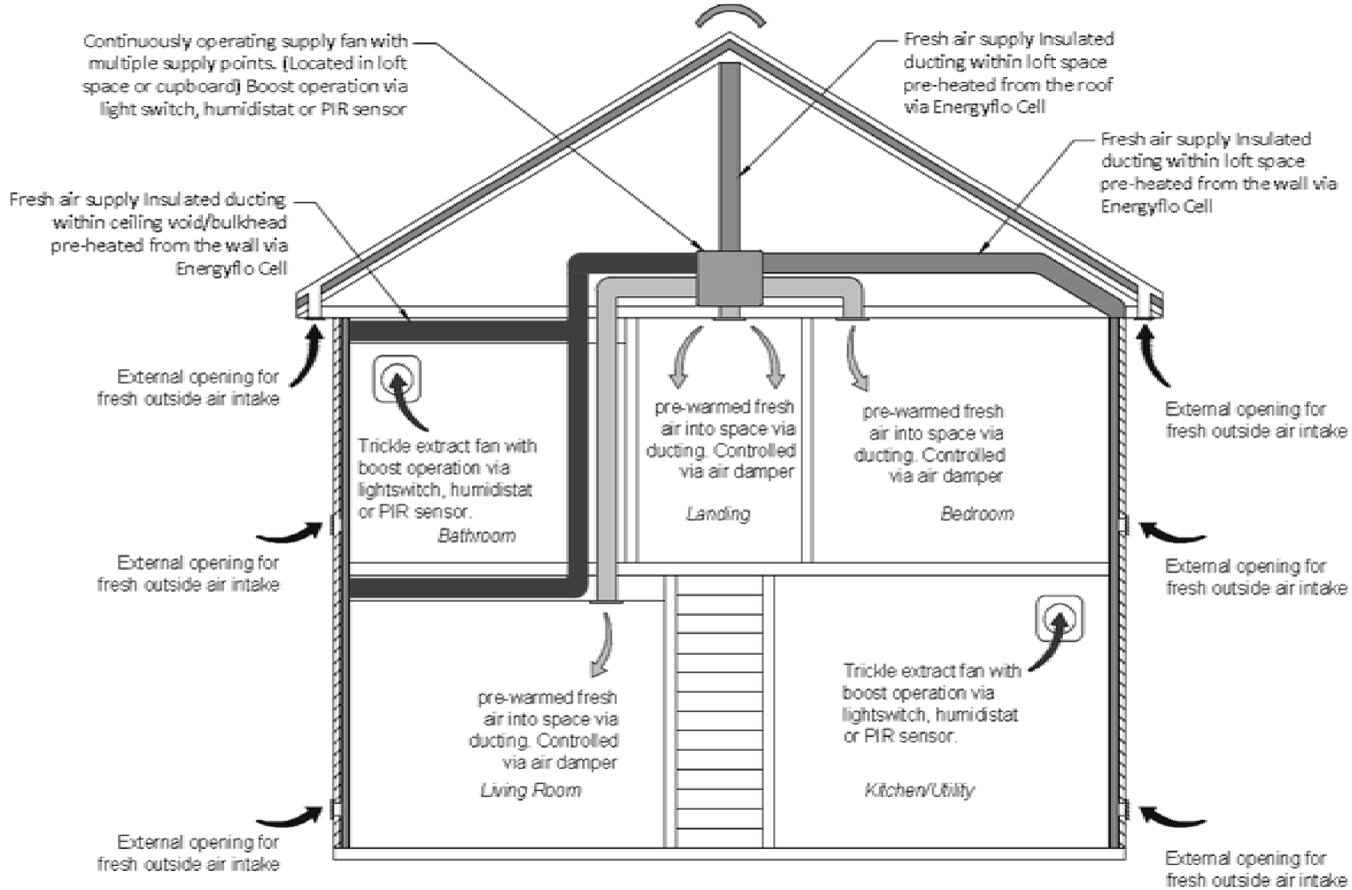


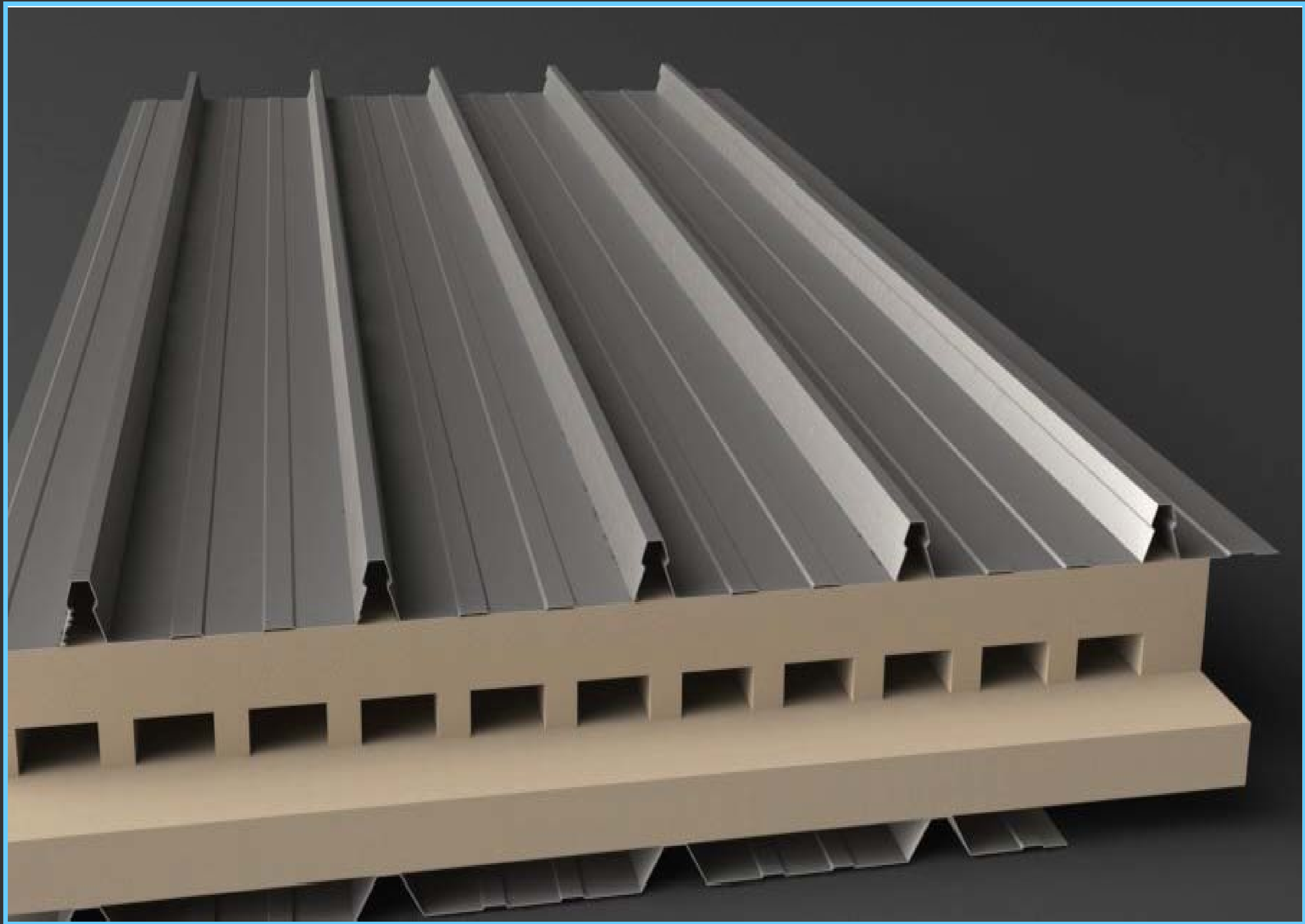
COMMERCIAL

Energyflo® with Mechanical Extract Ventilation (MEV)



Energyflo® with Positive Input Ventilation (PIV)





CASE STUDY - LOMOND HOMES

Conventionally insulated house Dynamically insulated house

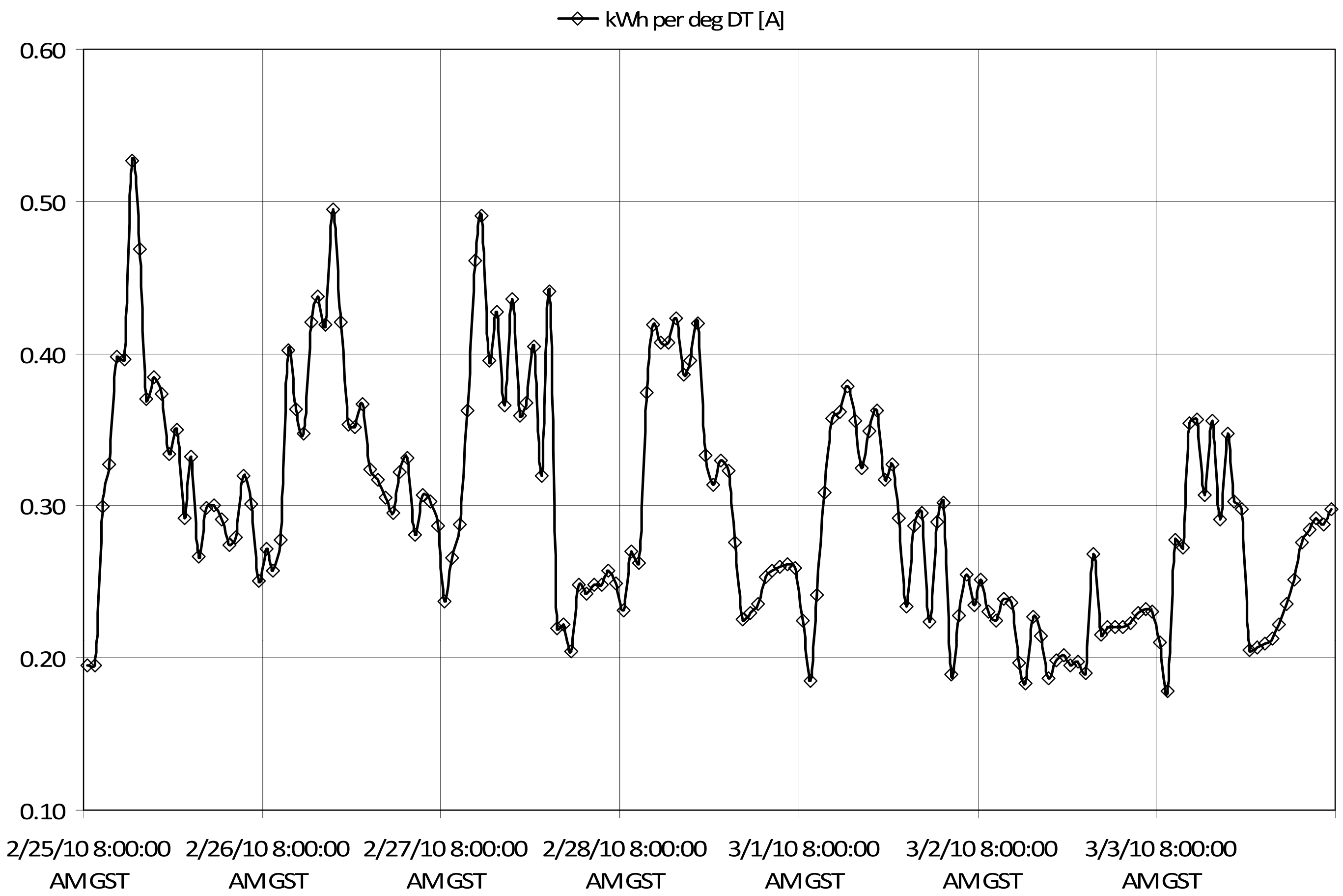
CASE STUDY - LOMOND HOMES



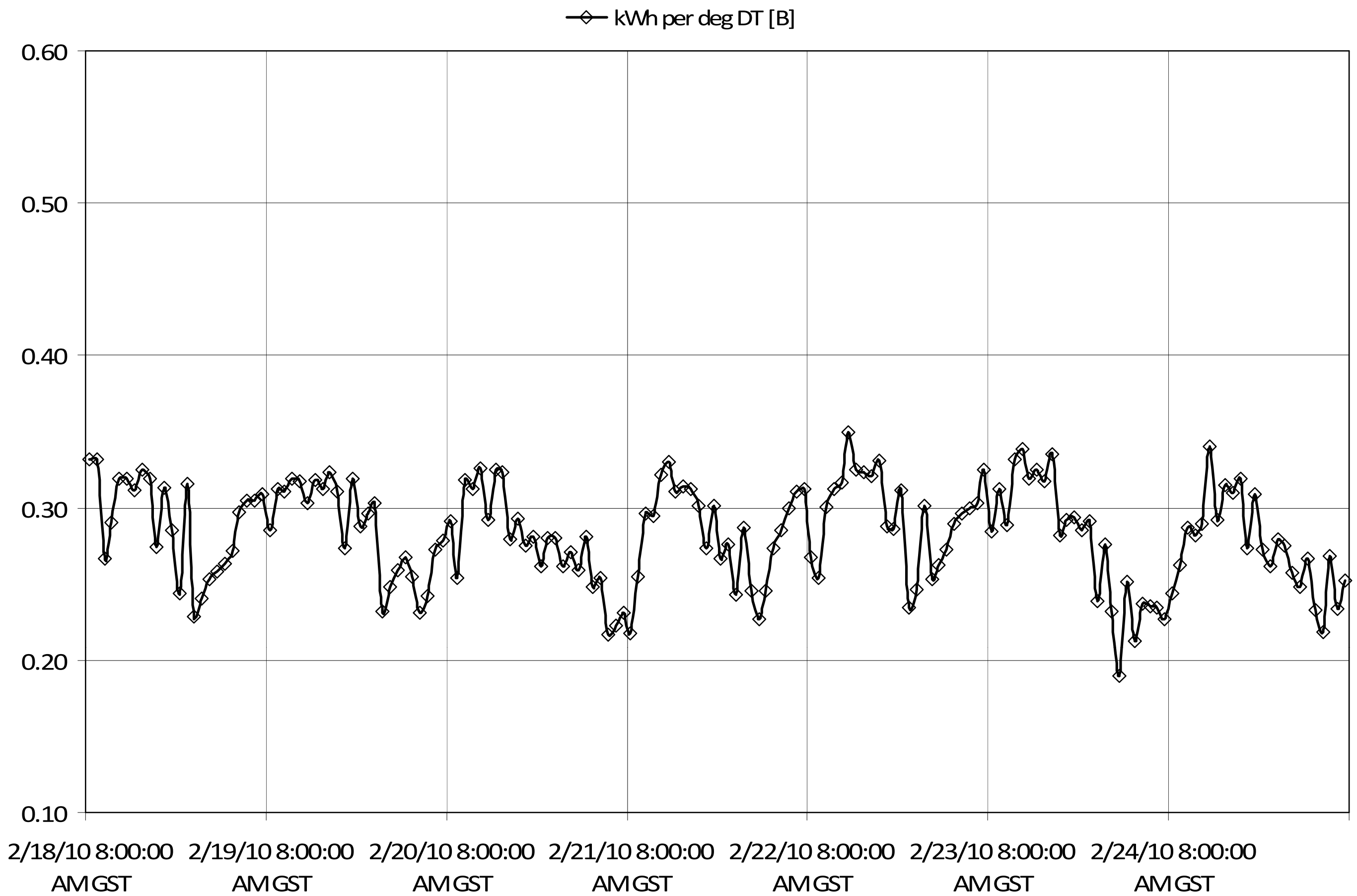




CASE STUDY – AHCC ECO-VILLA (UAE)



CASE STUDY – AHCC ECO-VILLA (UAE)



CASE STUDY – AHCC ECO-VILLA (UAE)

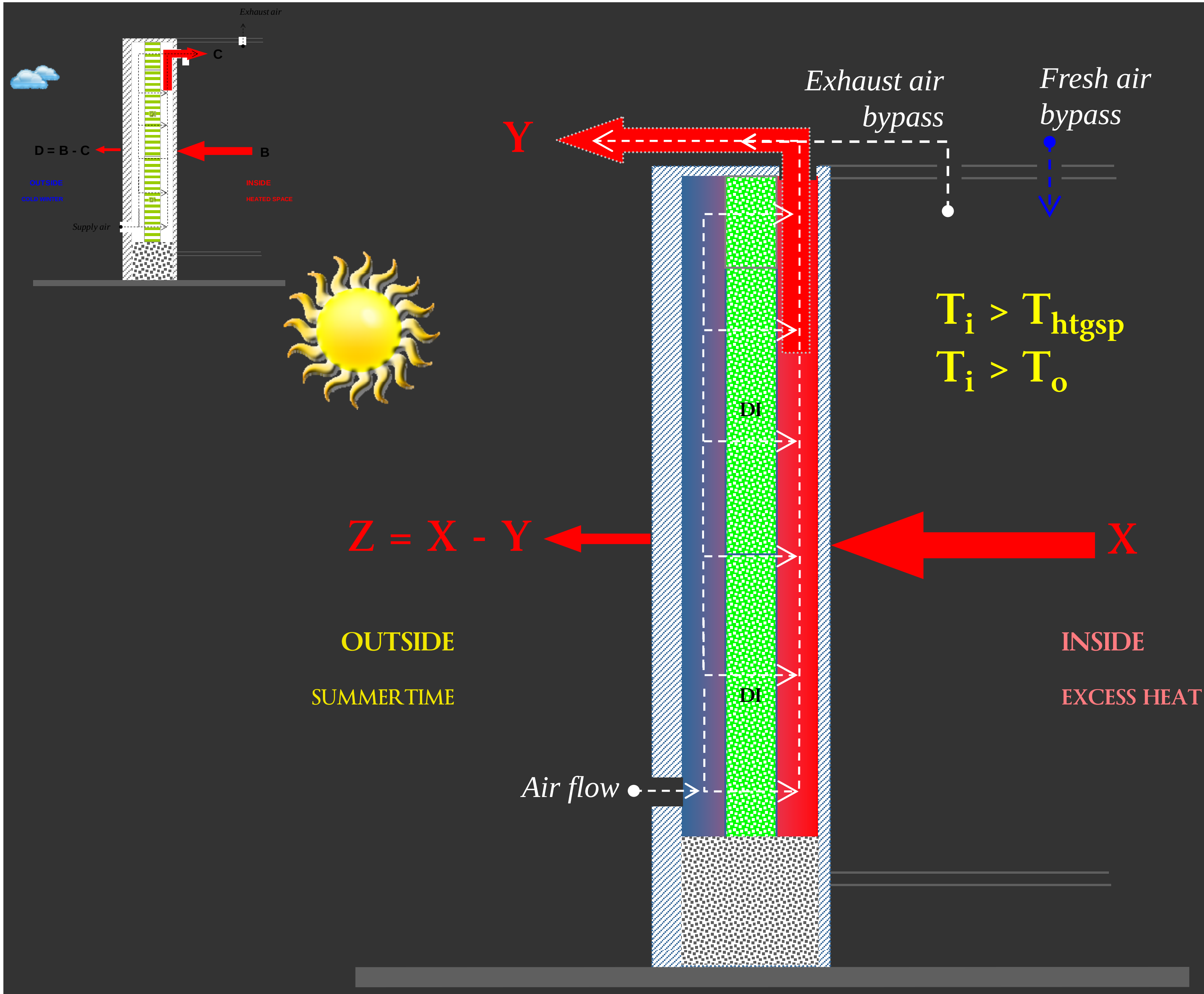
What else can DI do ?

- It can do different things and be used in different ways.

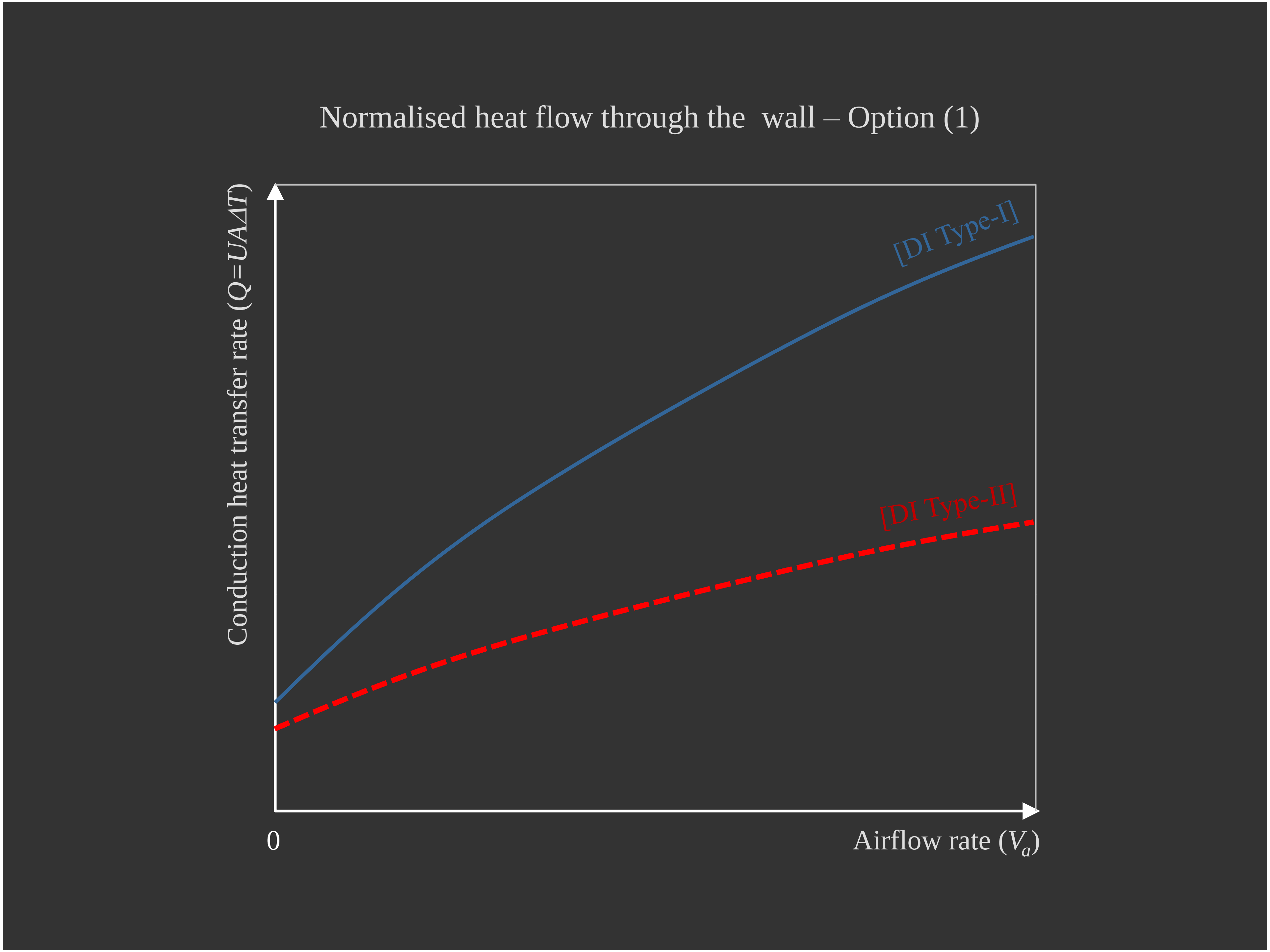
- When it is cold outside it can supply fresh air and reduce building fabric conductance via heat recovery. Similarly, when it is hot outside it can supply fresh air and reduce fabric conductance via coolth recovery.

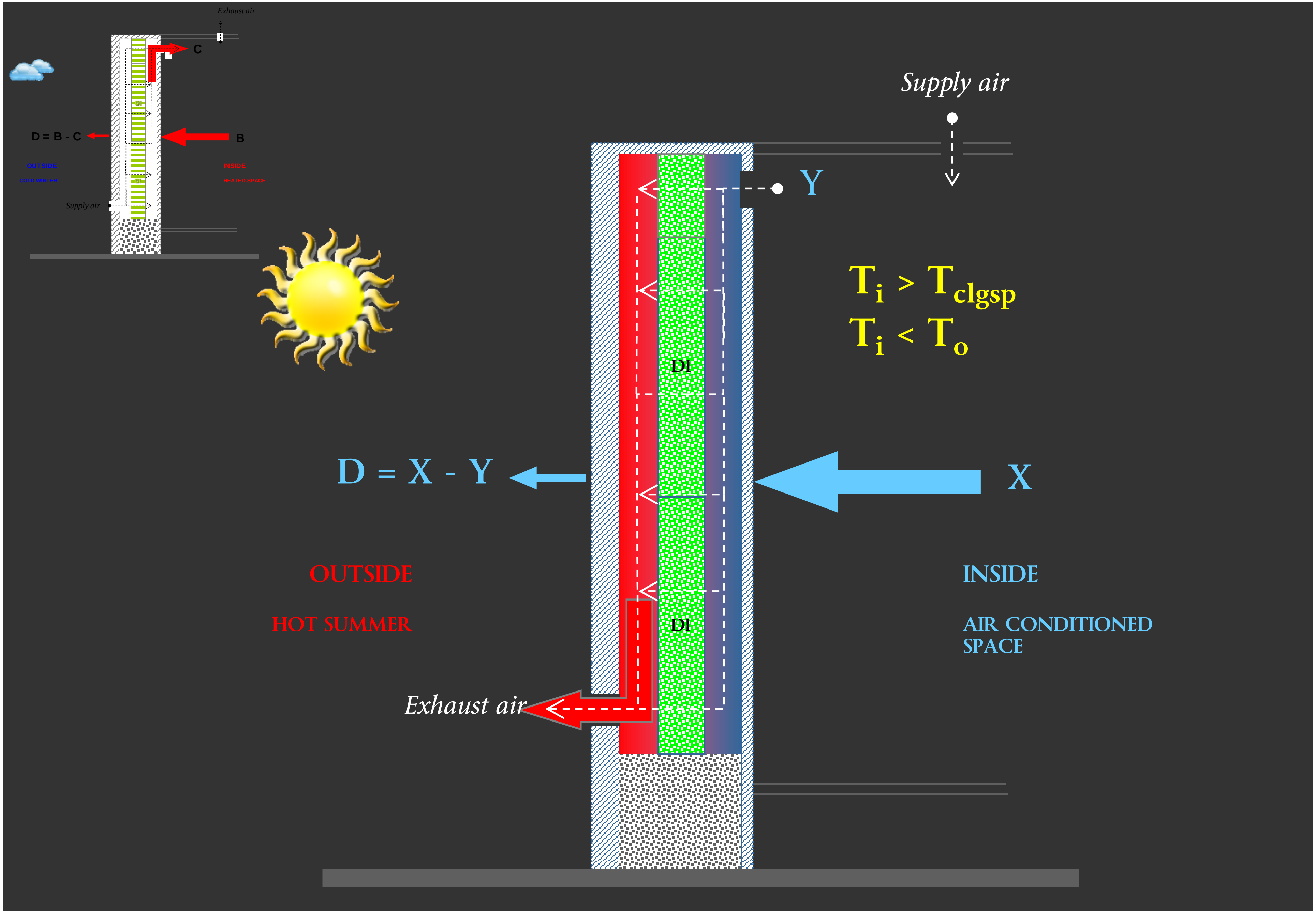
- DI can also be operated in modes that dissipate surplus heat from the building, either through either FLUX or MASS heat dissipation.

Note: HEAT and COOLTH in the above context are interchangeable.

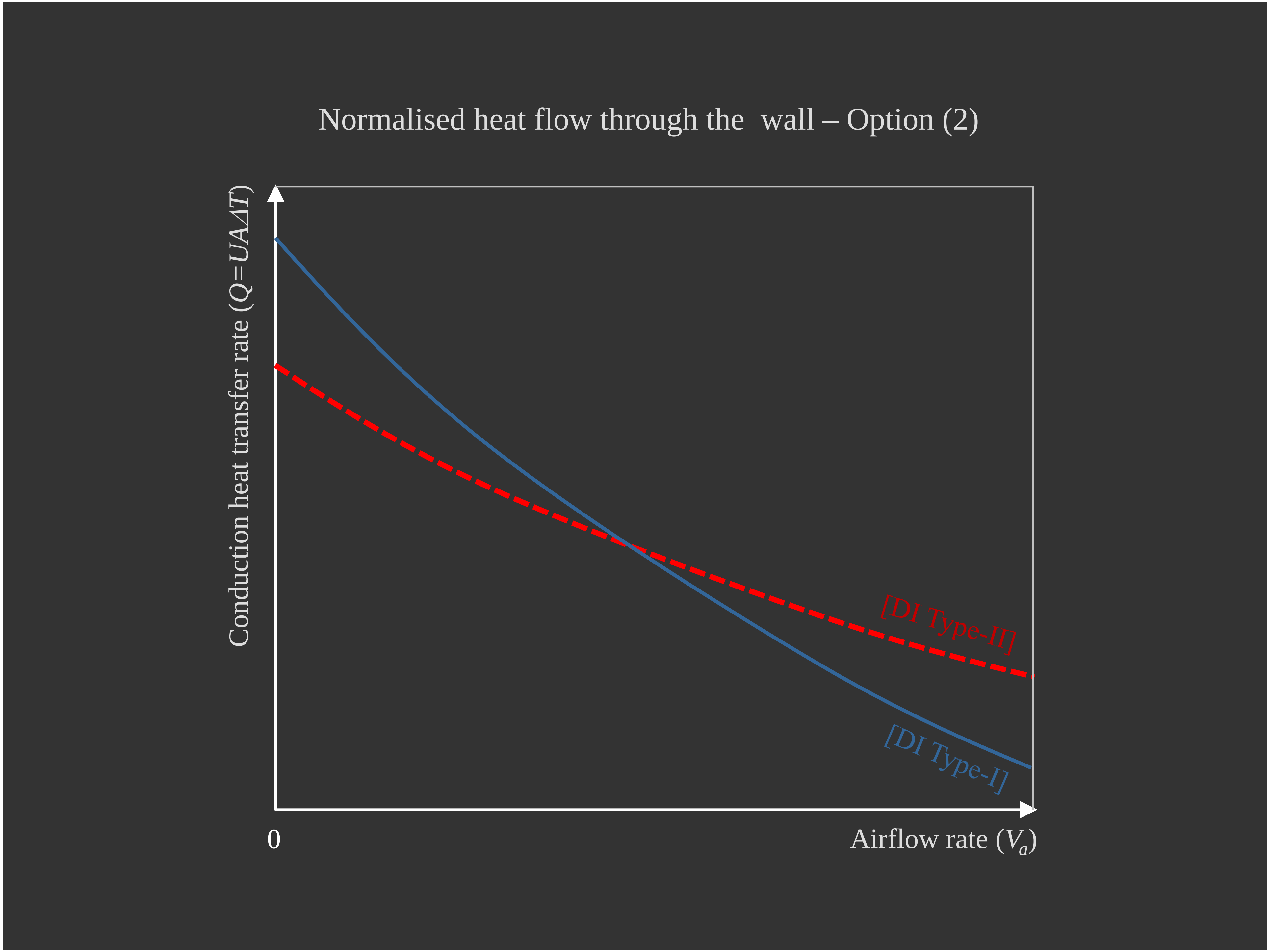


Option (I) FLUX HEAT DISSIPATION (FHD) MODE


Normalised heat flow through the wall – Option (1)
Conduction heat transfer rate (Q=UAΔT)
[DI Type-I]
[DI Type-II]
0
Airflow rate (Va)



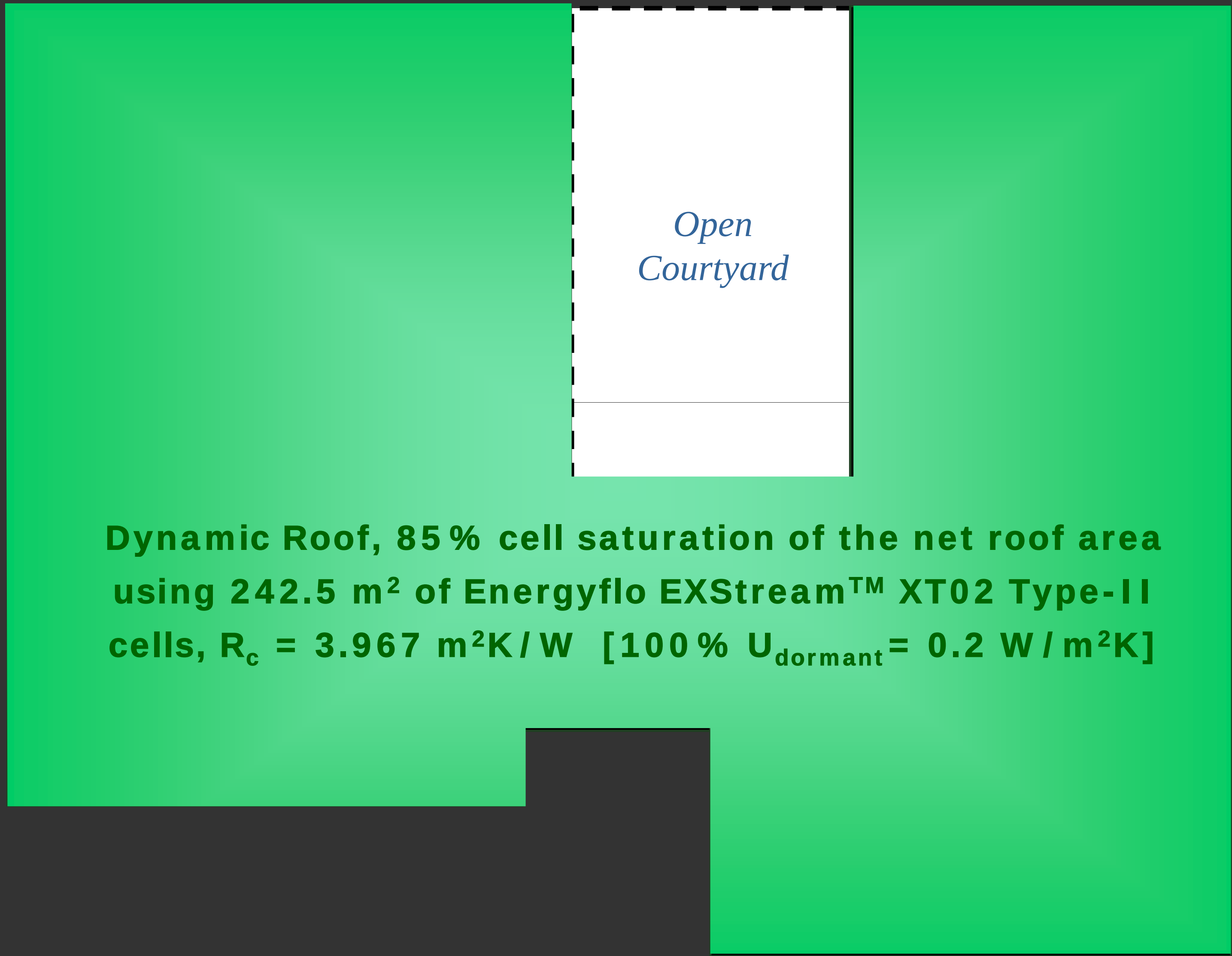
Option (II) MASS HEAT DISSIPATION (MHD) MODE



Normalised heat flow through the wall – Option (2)
Conduction heat transfer rate (Q=UAΔT)
[DI Type-II]
[DI Type-I]
0
Airflow rate (V_a)

Case Study: Generic Small Office

Area total = 317 m^2, Volume total = 855 m^3



FHD preliminary results

- Winter performance
  - 0.84 L/m^2/s fresh air airflow rate;
  - Dynamic U-value of 0.06 W/m^{2}K:
  - Composite U-value of 0.086 W/m^{2}K:
  - Net 57% reduction in roof heat loss.

- Summer overheating in temperate climates (no A/C))
  - T_i = 32^{O}C when T_o = 24^{O}C @ standard ventilation rate;
  - DI bypassed, T_i = 27.2^{O}C @ 2.5 times boost ventilation rate;
  - FHD @ 2.5 times boost ventilation rate = 900 W of cooling;
  - Bypass FA supply is required when using FHD.

MHD preliminary results

- Hot climate performance
  - In hot climates, air conditioning is used to maintain indoor thermal comfort and so the reduction in dynamic U-value is the same as before at 57%;

  - MHD can potentially yield further reductions in energy demand. The exhaust of cold air through the roof can help to counteract direct fabric solar gain. From the work of Lee et al (2009) on ventilated roofs, our initial estimates suggest a 50% reduction in sol-air temperature is achievable;

  - Lastly, MHD will eliminate the risk of interstitial condensation in hot-humid climates.

Conclusions

- The use of DI as a means to delivering low, tuneable U-values in thin construction has been introduced.
- We show how this functionality can be used to enhance building thermal performance across seasons and climate regions.
- We show how the fabric thermal load of a building can be reduced during active heating and cooling seasons, and also how DI can be re-configured to enhance heat dissipation and help maintain thermal comfort.

Conclusions

- Headline performance figures have been presented using case studies to quantitatively illustrate the strengths and limitations of DI.

- FHD and MHD are new ways in which DI can be used:

  - Initial results for FHD suggest a cooling effect can be achieved that may be beneficial in some, if not all cases.

  - The use of MHD in hot climates combines reduced fabric conductance and solar gain.

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