Passivhaus 101
Heat Balance

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Heat Balance

Sometimes called heat or Energy Balances

Energy is always conserved - it is never lost. However, energy can leave a certain area, resulting in "energy losses" for this specific area.

Consequently, energy balances can only be prepared for restricted spatial areas with clearly defined boundaries. These boundaries are called the envelope.

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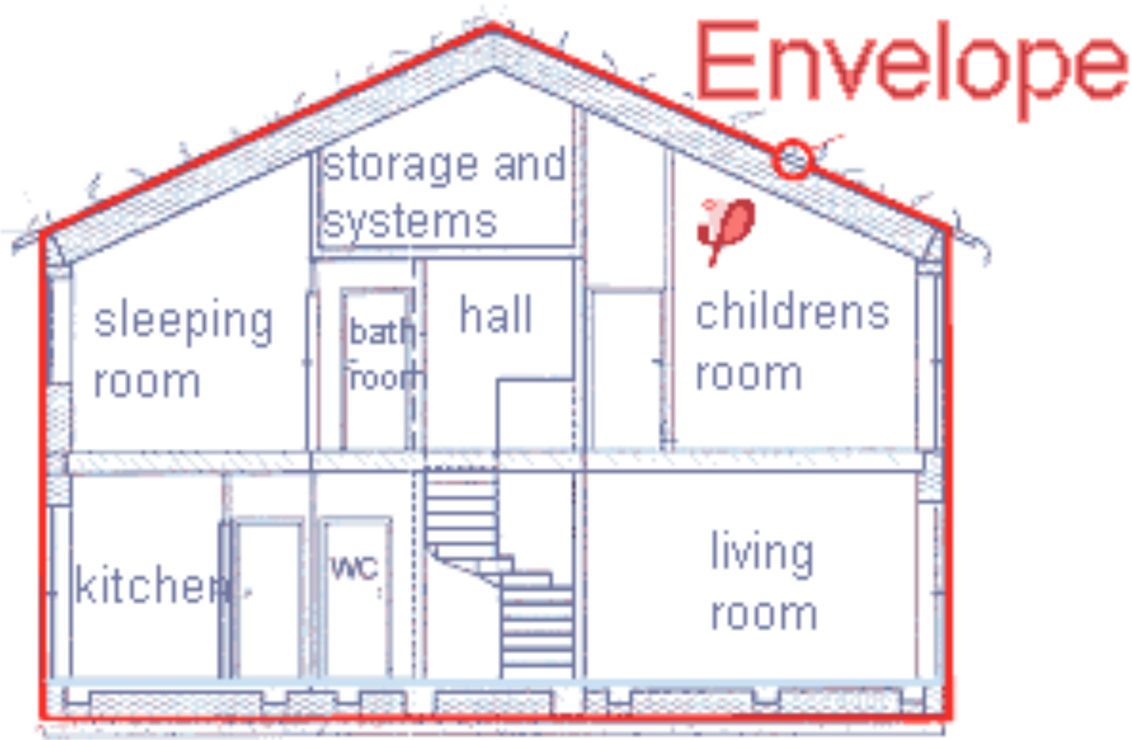

It is convenient, to define the envelope for energy balances of a building at the external surface of the insulation.

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The purpose of heating or cooling is to keep the temperature comfortable, i.e. constant, inside the building being considered

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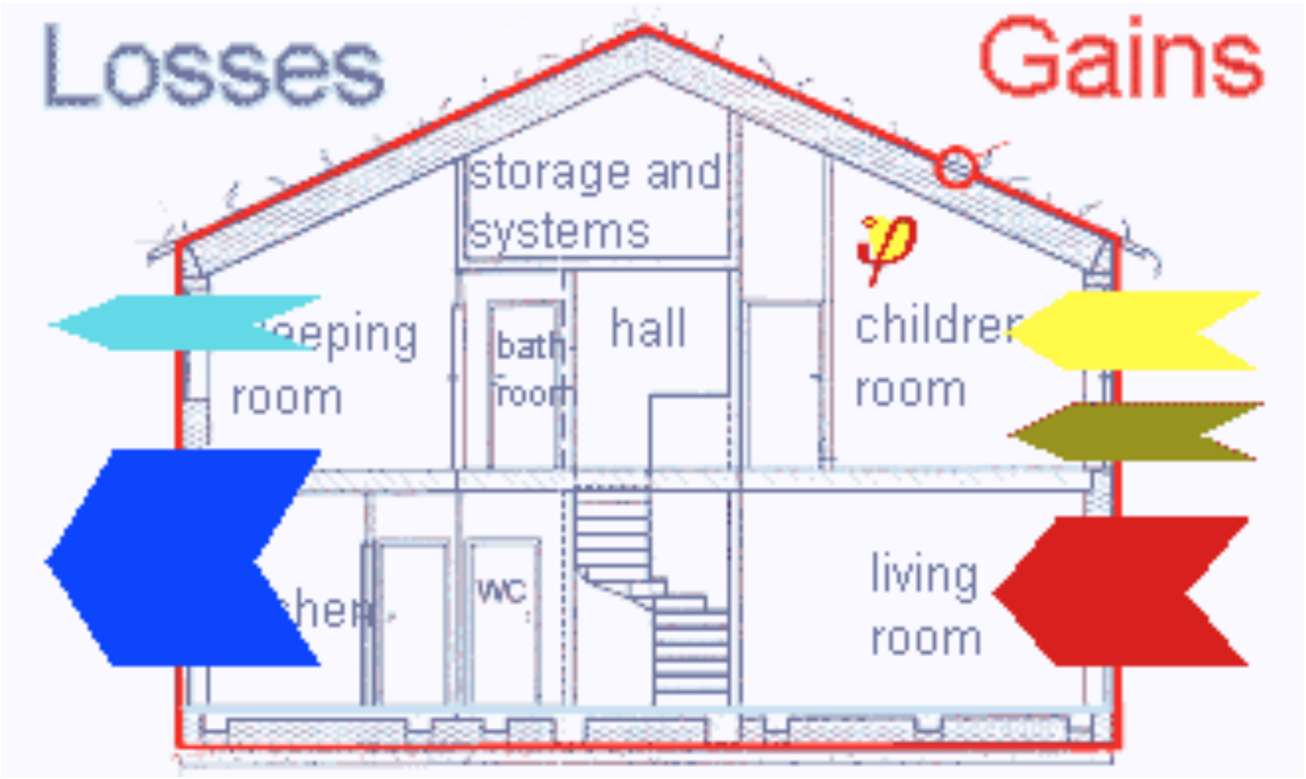

e.g. warm air which escapes through a window is a heat loss
Therefore, the energy flowing out has to be replaced

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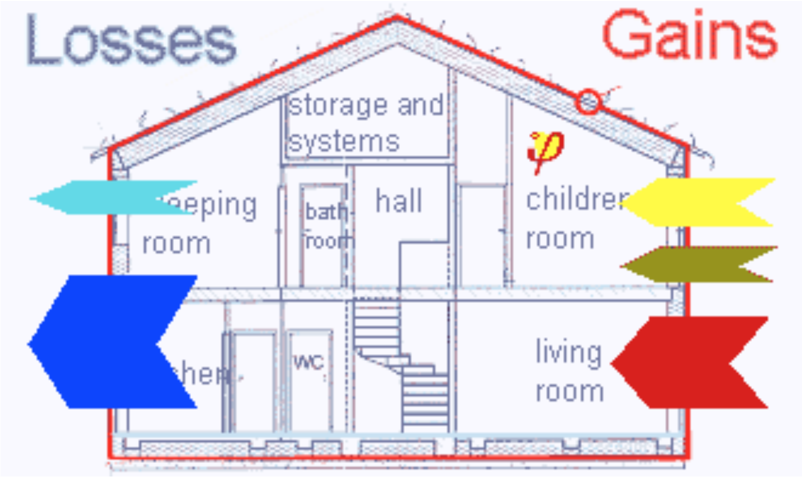

Heat losses (transmission and ventilation losses) exit the building through the envelope.

Heat gains enter the building through the same envelope.
Using the law of energy conservation: the sum of the gains equals the sum of the losses as long as the internal energy does not change.

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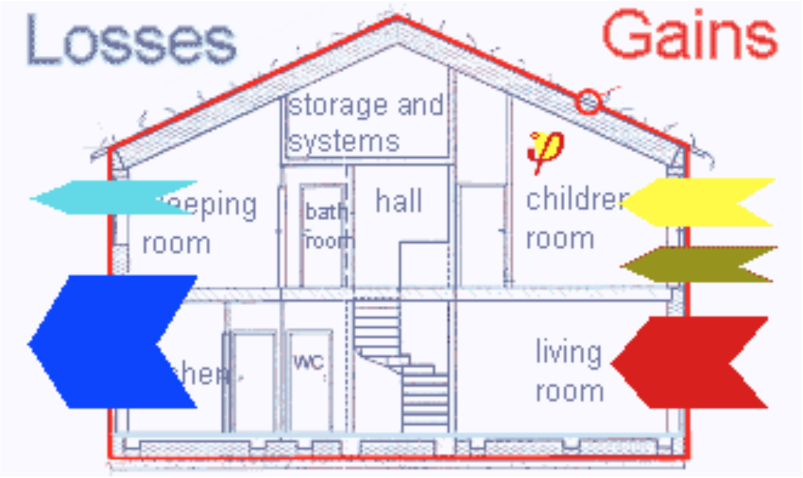

"Heating" therefore, is only a replacement of this heat loss and can therefore be reduced by more effective prevention of losses.

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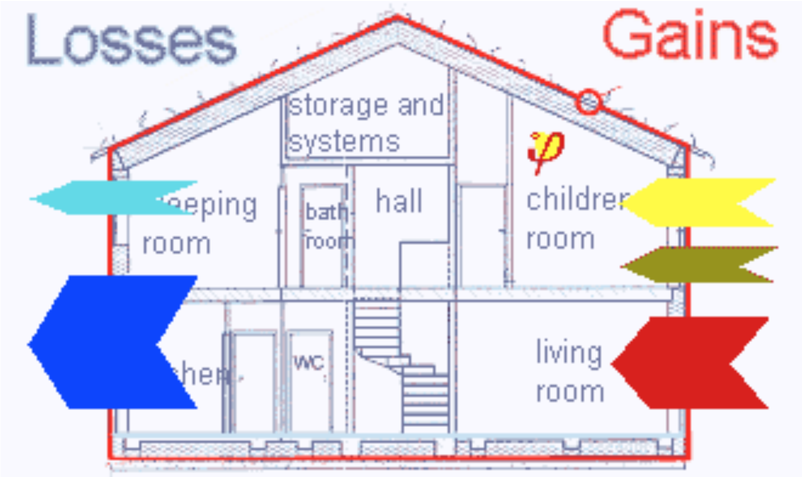

Free "heat gains": e.g. solar radiation entering through windows (**passive solar energy**) and the energy which enters the house through the electricity supply and is converted to the so-called **"internal heat sources"**

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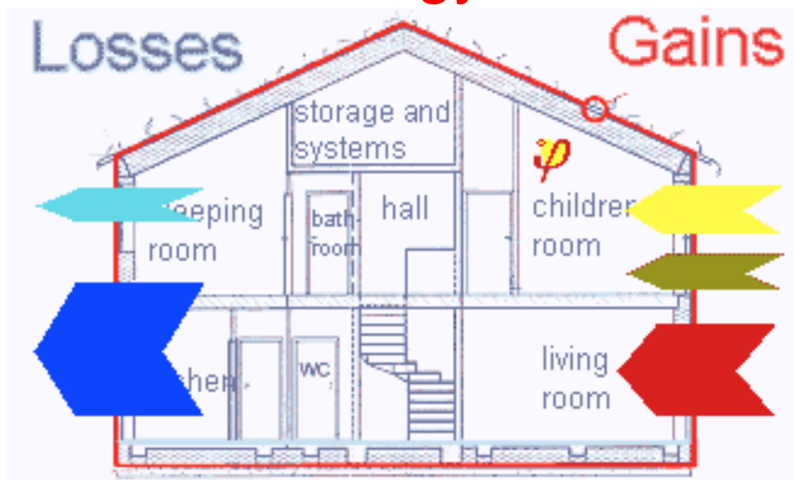

The Energy Balance is:

The sum of the heat losses = the sum of the heat gains.

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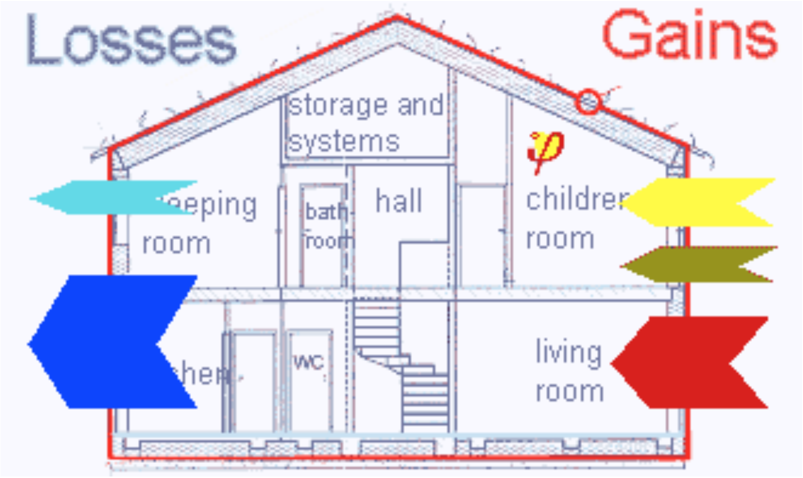
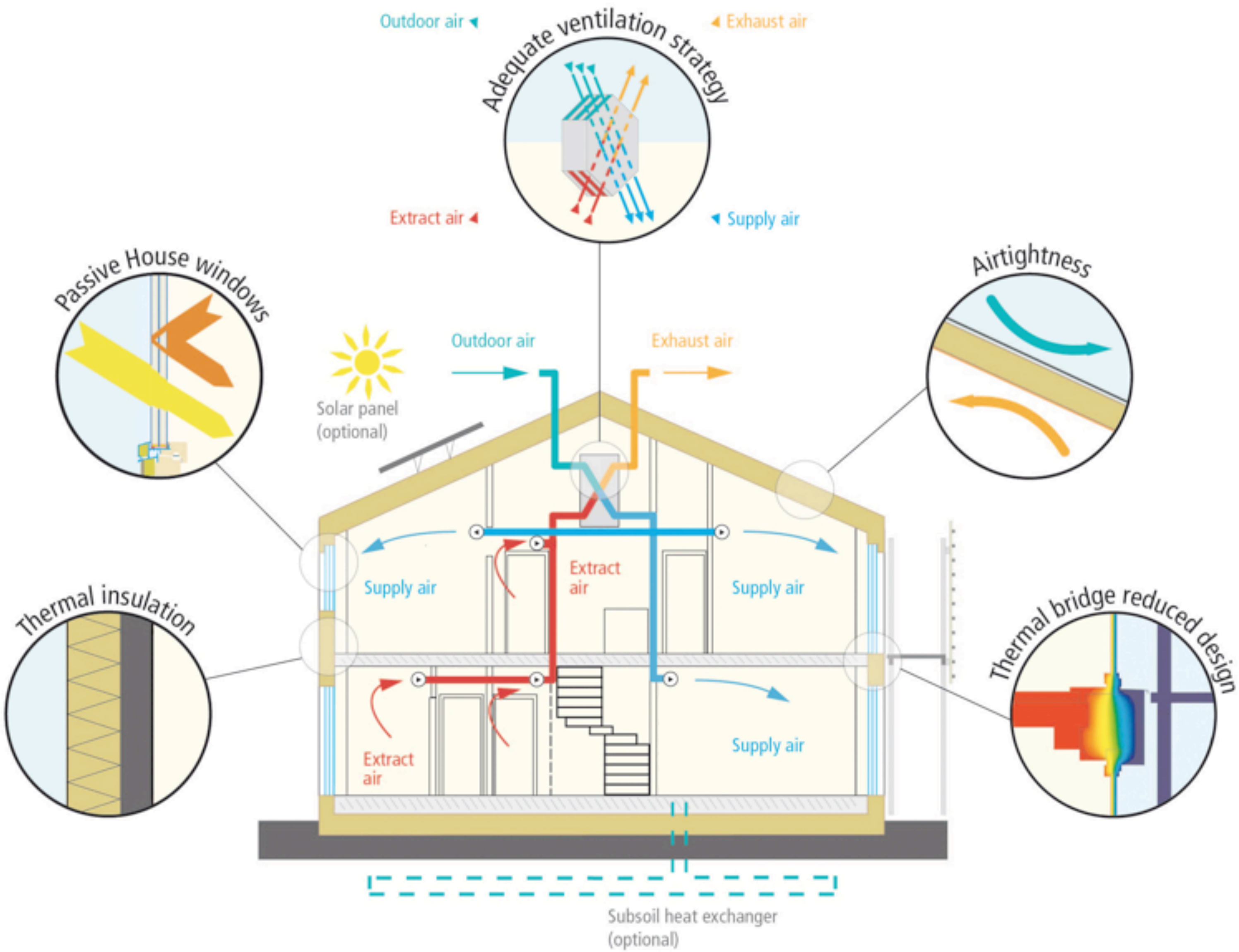


Conclusion:

The reduction of heat losses first and foremost means:

1. Good insulation
2. Good windows
3. High airtightness
4. Highly efficient heat recovery from exhaust air.


Outdoor air
Adequate ventilation strategy
Exhaust air
Extract air
Supply air
Passive House windows
Airtightness
Outdoor air
Exhaust air
Solar panel
(optional)
Supply air
Extract
air
Supply air
Thermal insulation
Thermal bridge reduced design
Extract
air
Supply air
Subsoil heat exchanger
(optional)

Heat Balance

Space Heating Demand = Total energy to heat building for a year

Heat Load = Maximum hat load required on coldest day of the year to heat the building

Heat Balance

Steps:

1. Calculate the losses (transmission + ventilation)

Heat Balance

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2. Calculate the gains (solar + internal)

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1. Calculate the losses (transmission + ventilation)

2. Calculate the gains (solar + internal)

3. The Heat balance on heat space demand

= Losses minus Gains

Note this is for space heat demand, there's a similar calculation for heat load)

Heat Balance

Heat Balance =
Transmission Losses + Ventilation Losses − n x(Solar Heat Gains + Internal heat Gains)

(There's a 'Utilisation' Factor for 'Free' Heat that's also included in the Gains (n))

$$Q_H = (Q_T + Q_V) - n \times (Q_S + Q_I)$$

Heat Balance

Heating Degree Hours = heating season as 67kKh/a (67,000 degree hours per year) for Birr or 60kKh/a for Dublin

Transmission Losses:

Are U from Galway?

Transmission Loss = Area x U value x Temperature Correction(f_T) x Heating Degree Hours (G_T)

Now work through your own example with the following values:

U value = 0.15 W/m2K for walls 0.8 W/m2K for windows
f_T for walls = 1
f_T for floors = 0.8
Heating Degree Hours = 62 (Temperature difference between inside & outside & depends on location):
Dublin = 60KWh/a
Birr = 67KWh/a – This effectively is the ‘heating season’ as 67kKh/a (67,000 degree hours per year)