



# Energy Efficiency Best Practices

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## Energy Efficiency

**Reducing** the amount of **energy** used while **producing** the **same output**

By inverting the nominator with the denominator, we could get the “**energy intensity**” ratio

Reducing the amount of primary resources usage  
Reducing the energy consumption

Four types of indicators: Thermodynamic      Physical-Thermodynamic  
Economic-thermodynamic      Economic

$$\text{Energy Efficiency} = \frac{\text{Useful Output of a process}}{\text{Energy input into a process}}$$

$$\text{Energy Efficiency} = \frac{\text{Output (€)}}{\text{Energy input into a process}}$$

$$\text{Energy Efficiency} = \frac{\text{Output (e.g. tonne kilometers)}}{\text{Energy input into a process}}$$

$$\text{Energy Efficiency} = \frac{\text{National Energy Input (€)}}{\text{National Output (€ GDP)}}$$



# What can we do to influence energy efficiency?

## Technical challenges



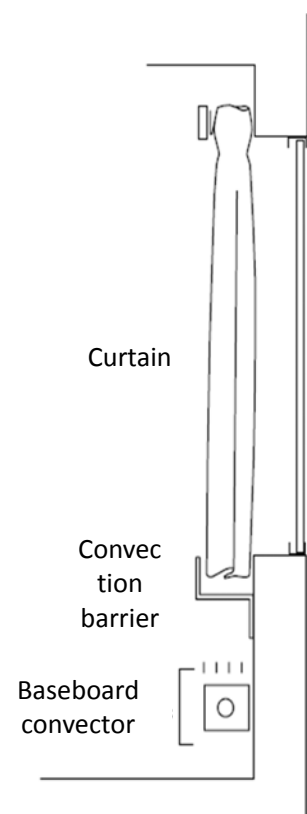
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## Emitters

### Measures for improving the energy efficiency

- ☐ Maintenance of the system: easier for EH while requires more skills for water and air systems (thermodynamic systems) → 20 ~ 50 % of potential improvement
- ☐ Replacing manual valves by thermostatic valves → enables better temperature control
- ☐ Free the surrounding of the convectors for better heat distribution
- ☐ Upgrading the heating system → how a heat pump could replace electric heaters ?
- ☐ Zoning heating system
- ☐ Take the heating system out of poorly insulated walls



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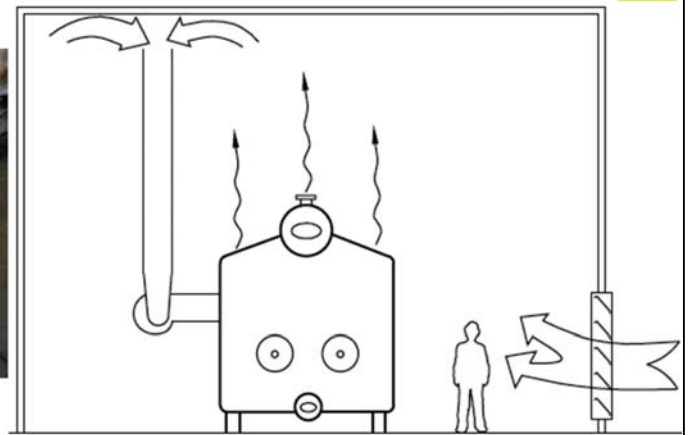
# Heat Losses

## Measures

- Design the insulation in the most efficient way → Infinite insulation is not a solution
- In case of existing insulation, maintain the insulation in good conditions
- Recover the radiative heat loss for warming up the incoming combustion air



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# Lighting

- Energy efficiency in lightings aims to have a similar luminosity with a lower energy consumption

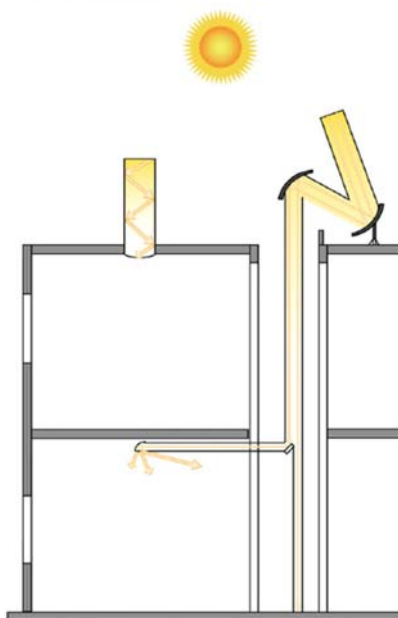
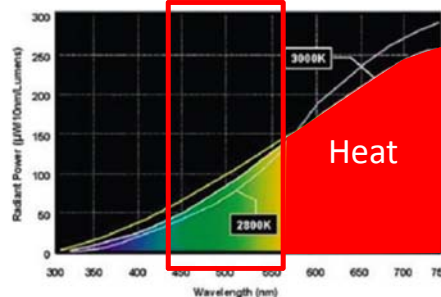


Fig. 13. Schematic diagram of light pipe systems: a straight light pipe (left); a light pipe with bends (right).

Spectral Power Distribution Curves  
Incandescent and Halo-Phosphor Fluorescent Colors

Incandescent



Spectral Power Distribution Curves  
Tri-Phosphor Fluorescent Colors

SP30

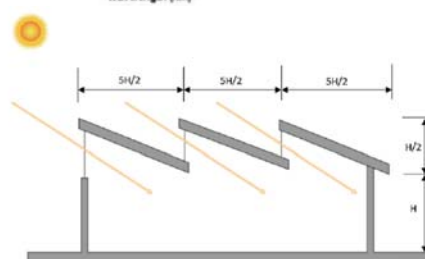
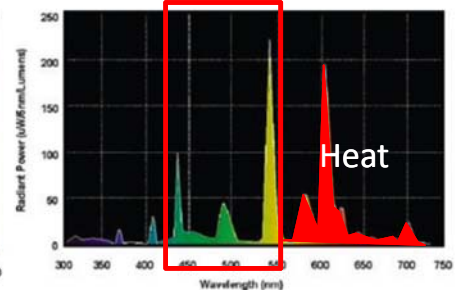
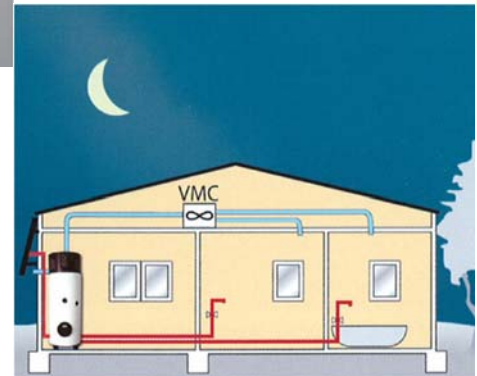
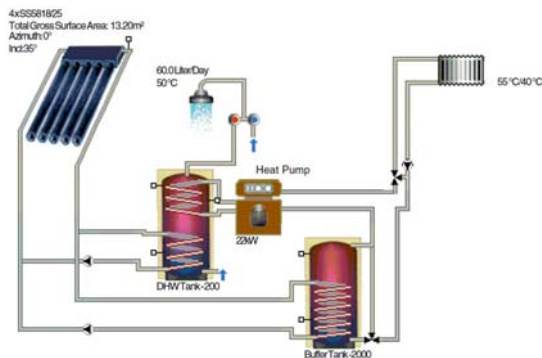


Fig. 12. A single-sided sawtooth system provides directional distribution of daylight inside the room.



# Energy Production



# Ventilation

- Ventilation aims to maintain a good air quality
- Air to air heat exchanger. It controls the exhaust and the air intake. Different possible configurations ("octopus" or in series)
- Fully controlled. No openings, thus the losses from ventilation come from the building permeability
- Exhaust heat is recovered from 60 to 90 % (technology dependent)
- Fan(s) is(are) involved in the process (energy source). Electric resistance may be used for the frost
- Can be coupled with other heat recovery system such as the pre-heat underground system → increase in efficiency



# Building Design

- Broad definition of buildings:
  - Green Buildings, Passive buildings, Zero Energy Buildings, Net zero energy buildings, Positive energy building, Low energy buildings, etc...



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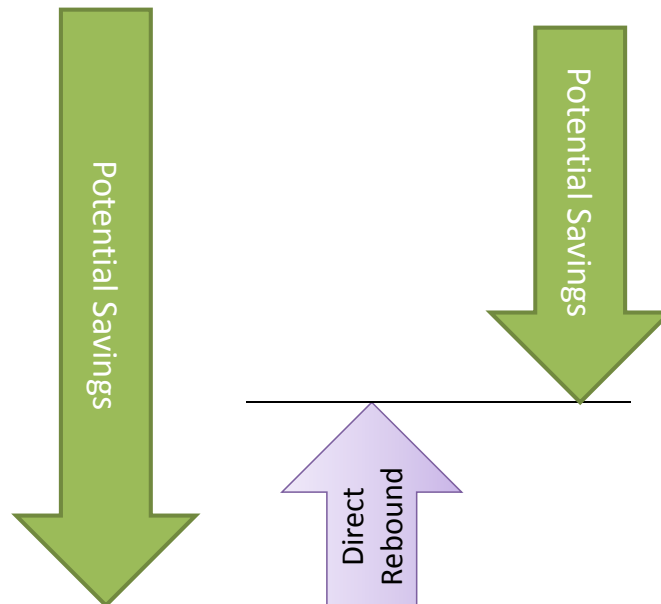
Non-technical challenges



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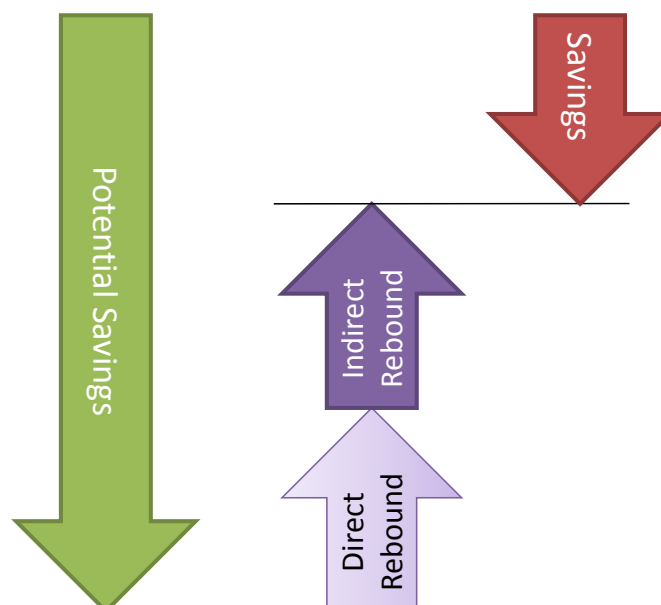
# Rebound Effect

- Behavioural or systemic response to a measure taken to reduce environmental impacts that offset the effect of the measure → lower benefit than anticipated, or negative



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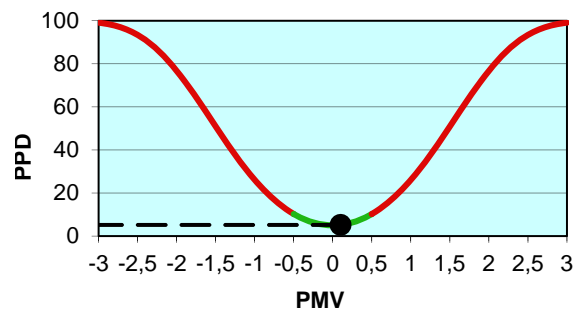


# Comfort

- Heating and cooling are of primary concerns to enable good working environment
- It influences thermal comfort (ISO 7730)
- Heating and cooling have different importance depending on the industry. In office buildings, it may represent the first source of energy consumption.

**PMV:** Predicted Mean Vote (0 = Neutral, -3 = very cold, + 3 = very warm)

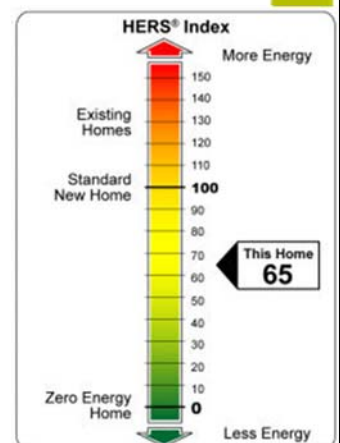
**PPD:** Predicted Percentage Dissatisfied (5-100 %)



# Auditing

- Information about current energy use.
- Inefficient energy losses detection.
- Energy performance improvement.
- Cost-effective solutions for improving energy usage.
- 20 % of audited homeowners implemented energy efficiency because of the audit in The Netherlands

Measure	Recommended	Adopted	Planned	% adopted
Boiler replacement	570	265	42	54
High performance glazing	1227	357	109	38
Roof insulation	875	183	103	33
Floor insulation	1089	235	123	33
Wall insulation	1048	335	80	40
Heat recovery shower	29	1	2	10
Heat recovery ventilation	31	5	0	16
Insulation of piping	191	48	8	29
Draught proofing	373	109	30	37
Renewable technology	668	87	118	31





# Summary

- Provide Energy Audit
- Improve building envelope
- Replace or renovate heating system
- Control system implementation
- Upgrade street lighting, traffic lighting,
- ...
- Green Building Catalogue:
  - [http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/Catalogue\\_GB\\_July2011-August\\_2012.pdf](http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/Catalogue_GB_July2011-August_2012.pdf)



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# THANK YOU!



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