Block 3: Energy Efficiency Measures and Technologies

3.2 RES in buildings

Feedschools, by GEA

This block is part of a training package developed to provide local authorities with free tuition that may inspire and help them in adopting new technical and financial solutions to implement ‘nearly Zero Energy Building’ (NZEB) renovation activities in schools.

This block will introduce to the possibilities of renewable energy in your buildings. The focus is on thermal solar energy, PV-panels, biomass and heat pumps.

Basic level: Technical knowledge is not needed, the training gives a first overview

Learning Objective:

In this block attendees will be provided with a short overview of typical renewable energy sources in buildings (especially in schools). You get recommendations, first hints for planning, advantages and disadvantages and possible problems.

3.2 Units:

3.2.1 Thermal solar energy

3.2.2 PV-panels

3.2.3 Biomass

3.2.4 Environmental energy (with heat pumps

3.2.5 Information

3.2.1 Thermal solar energy

3.2.1 objective

After being introduced you get an introduction to thermal solar energy. You get recommendations for the right dimensioning.

To implement renewables in buildings is state of the art and a very important factor for reducing CO2 emissions.

Renewables have grown rapidly in recent years, driven by cost reductions for solar photovoltaics and policy.

The use cases of renewables in buildings are very diverse:

Solar power for heat and electricity, geothermal power, biomass and biogas, maybe in future hydrogen...

Photo: Gerd Altmann at PIXABAY

Thermal solar power can be integrated well into existing buildings and heating systems.

It is mainly for hot water use but also for heating and can be well combined with heat pumps.

In schools, the problem is very often that there is no use for the heat in summer and therefore poor economics, but fits perfect to (outdoor) pools and buildings with high hot water demand.

Photo: PublicDomainPictures at PIXABAY

Recommendations for the right dimensioning you can find on the following table:

only hot water usage		
recommended collector m² per liter hot water demand and day	storage volume [m³] per m² collector	typical specific solar gain [kWh] per year and m² collector
0,05 - 0,07	0,05 - 0,06	300 - 350

hot water and heating usage (50% solar share)		
recommended collector m² per 1 MWh heat consumption	storage volume [m³] per m² collector	typical specific solar gain [kWh] per year and m² collector
1,5 - 1,75	0,066 - 0,075	280 - 320

3.2.2 PV panels

3.2.2 objective

You get basic information about the right planning, optimization of the own usage, planning instruments and typical solar gain.

PV-panels are state-of-the-art!

The prices for PV-systems are still falling (-25% since 2016), but also the feed-in tariffs are falling.

Therefore the economic focus normally lies on a high own usage of the produced electricity.

- Analyse your electricity consumption in detail to get the most economic dimension of your PV-system
- Battery storage systems raise the share of own use

Photo: Solarimo at PIXABAY

- Typical gain per year ca. 1000 kWh per kWp (south oriented, 700 - 800 on south oriented facades
- don't forget lightning protection and other security equipment
- mind shading – make detailed simulation
- is a solar roof register or similar planning instruments available in your city?
- You need ≈ 6-8 m² panels per 1 kWp, the efficiency varies between 12 – 20%

Photo: 272447 at PIXABAY

Photo: solar roof register City of Graz

3.2.3 Biomass

3.2 .3 objective

You get basic information about biomass, efficiency and emissions.

Biomass in solid, liquid or gaseous form (wood and wood-pellets, biogas, etc.) is a usually locally sufficient available energy source and CO2-neutral (fast regenerating).

Its used for heating, electricity and also cooling in absorption processes.

Main focus in buildings is heating.

Modern biomass boilers have an efficiency of up to 106 % (condensing) and very low emissions

Nevertheless there are restrictions in some areas and cities (like Graz) because of emissions (particulate matter)

Photo: Mrdidg at PIXABAY

3.2.4 Environmental energy (with heat pumps)

3.2.4 objective

You get basic information about typical sources for heat pumps, advantages and disadvantages of different heat pumps/situations.

Environmental energy can be used very well in combination with heat pumps (for heating and cooling).

You have several typical sources:

- ground heat (deep drill and flat collector)
- ground water (approval necessary!)
- air (often noise problems)
- solar heat (optimizes the solar gain of solar thermal collectors and PV-panels as electrical source – different types)

It is highly recommended to have a low temperature heat distribution system and a efficient storage system!

ADVANTAGES – DISADVANTAGES of different heat pumps/situations:

Ground source (deep drill)	Ground water
+ works in a lot of areas	+ very efficient
+ efficient heating and cooling	+ heating & cooling
+ very efficient	+ very reliabel
- permissions	+ 5 - 500 kW possible
- higher investments	- permissions
	- take care of the water content and quality

Air heat pump	Solar heat pump
+ almost everywhere possible	+ almost everywhere possible
+ lower investments	+ very efficient
- high effort for defrosting	+ 100% renewable possible
- higher running costs	- higher investments (multiple systems)
- noise	- control system cruzial point
- very low efficiency for higher temperatures (hot water)	- not many manufacturers with proofed systems

Optimise the system for your location!

3.2.5 useful information

3.2.5 objective

You get some useful information (online links) on EU-level and a contact point to the creator of this module.

Renewable Energy Directive:

https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive_en

National renewable energy action plans 2020:

https://ec.europa.eu/energy/topics/renewable-energy/national-renewable-energy-action-plans-2020_en

Renewable Energy Statistics:

https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

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SELF ASSESSMENT TEST (1)

How much solar gain do get out of 1 m^2 thermal collector and year?

- ☐ 30 kWh/year
- ☐ 280 – 350 kWh/year
- ☐ 1000 kWh/year

What are in general the problems with solar thermal energy in schools?

- ☐ The temperature is not sufficient for a hygienic hot water supply
- ☐ No or too less hot water and heat demand in summer
- ☐ It can not be integrated into the heating system

How much solar gain do you get out of 6-8 m^2 PV-panel on the roof (south oriented)?

- ☐ 300 kWh/year
- ☐ 500 kWh/year
- ☐ 1000 kWh/year

SELF ASSESSMENT TEST (2)

In which forms biomass is in general local accessible (multiple choices possible)?

- ☐ solid (like wood)
- ☐ liquid (like biofuel)
- ☐ gaseous (like biogas)
- ☐ radiation (like solar heat)

What are the advantages of solar heat pumps?

- ☐ A lot of proofed manufacturers are on the market
- ☐ Almost everywhere possible
- ☐ Easy to control

SELF ASSESSMENT TEST (ANSWERS)

How much solar gain do get out of 1 m^2 thermal collector and year?

- ✓ 280 – 350 kWh/year

What are in general the problems with solar thermal energy in schools?

- ✓ No or too less hot water and heat demand in summer

How much solar gain do you get out of 6-8 m^2 PV-panel on the roof (south oriented)?

- ✓ 1000 kWh/year

SELF ASSESSMENT TEST (ANSWERS)

In which forms biomass is in general local accessible (multiple choices possible)?

- ✓ solid (like wood)
- ✓ liquid (like biofuel)
- ✓ gaseous (like biogas)

What are the advantages of solar heat pumps?

- ✓ Almost everywhere possible