Notes for the trainer and additional information:

Full title of the topic: “Use of other resources in construction, use, repair and construction works”

The information on the topic “Use of other resources” should be adapted according to trainees’ involved level of education and knowledge.

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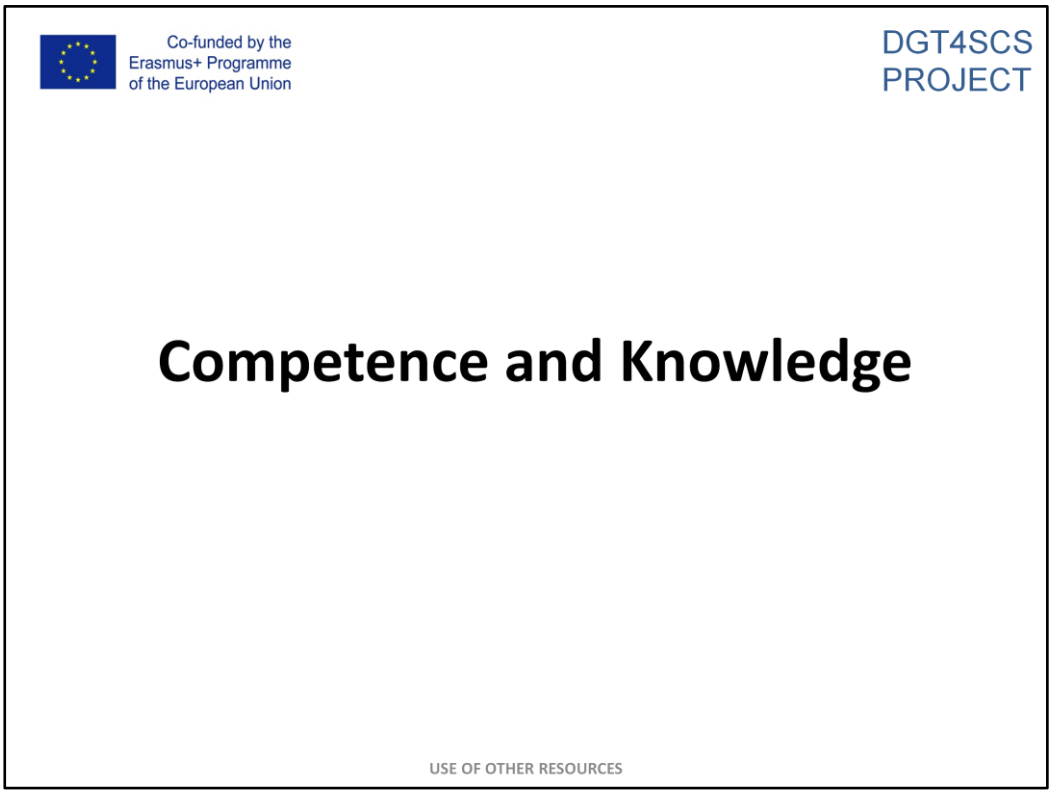
DGT4SCS PROJECT

Contents

Introduction
1. Efficient use of Water
1.1. In building/ during use stage of building
1.1.1. Water saving systems
1.1.2. Metering, labeling, changing habits
1.1.3. Rainwater harvesting systems
1.1.4. Greywater recycling systems
1.2. On construction site/ during construction
1.2.1. How to save water on construction site
1.2.2. Water use during facade insulation works
2. Efficient use of Timber
3. Efficient use of Land
Appendix A1. Construction Site Protection
Sources of information (references)

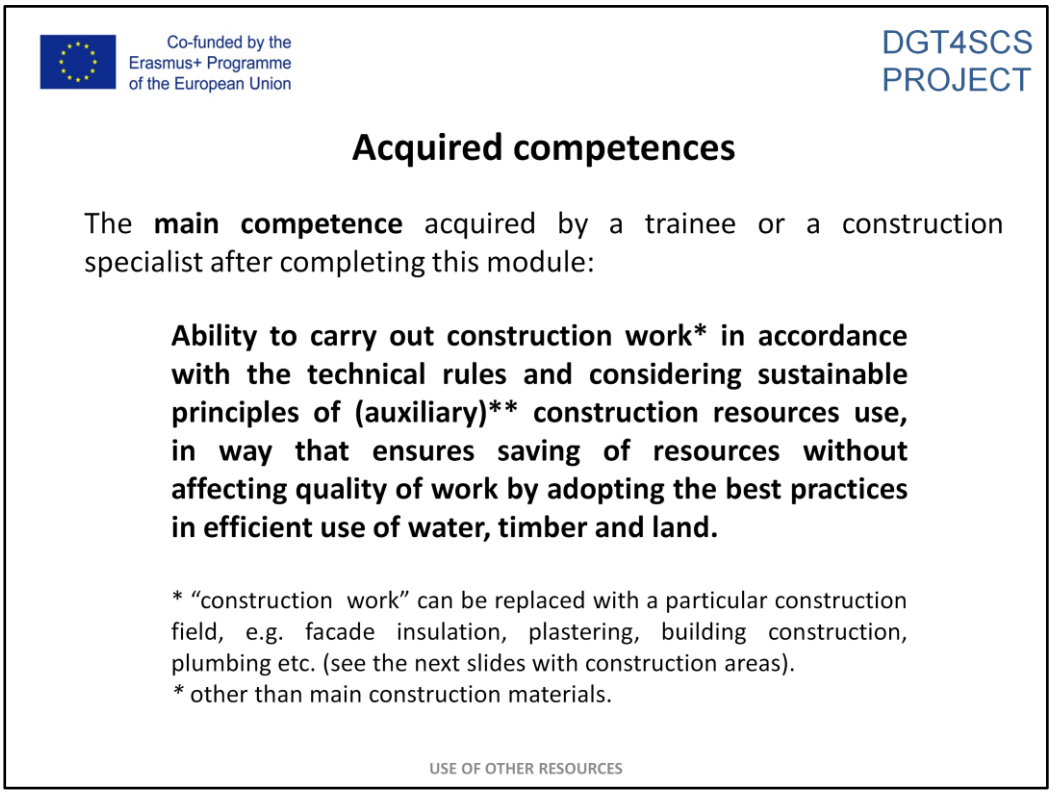
USE OF OTHER RESOURCES

Notes for the trainer and additional information:



Notes for the trainer and additional information:

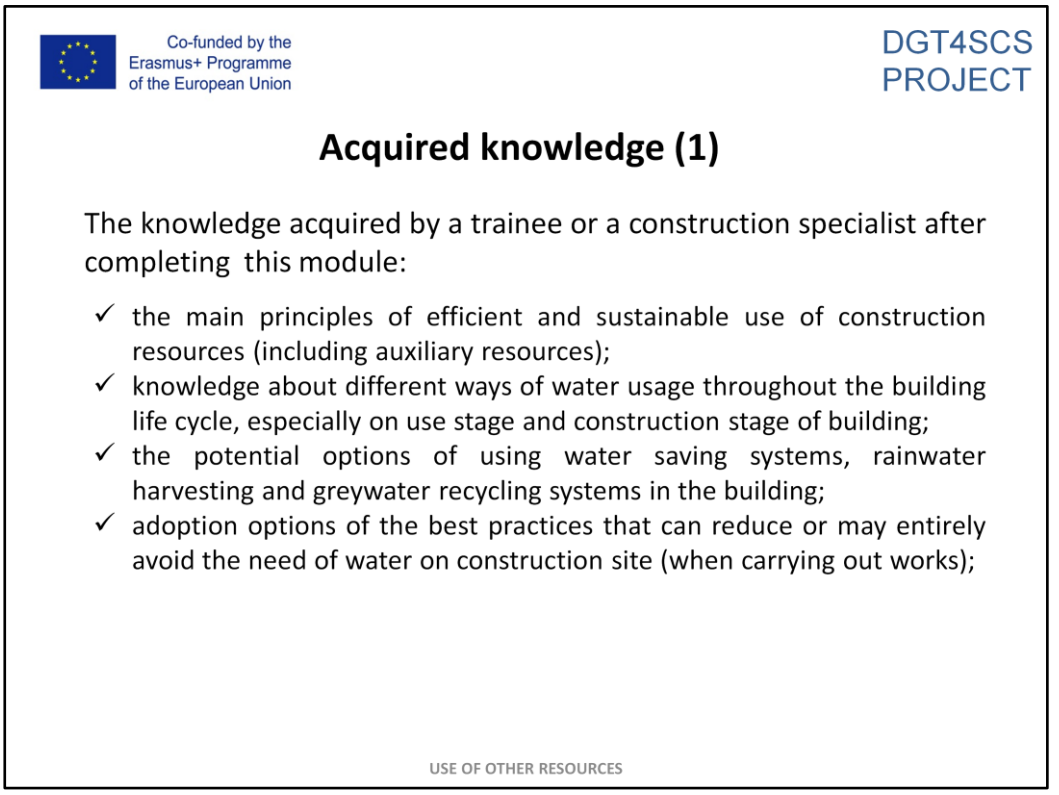
See the next slides.



Notes for the trainer and additional information:

Competence – the combination (selection) of knowledge, skills and attitudes which allow to perform a particular activity.

The main competence and the construction areas in which it can be used are formulated.



Notes for the trainer and additional information:

Here is a list of qualifications which can be gained at Daugavpils Construction Technical School within implemented vocational training programs and which can use the training module topics on Sustainable construction in order to gain competences and knowledge mentioned above:

- Building Technician
- Finishing Work Technician
- Dry Construction Technician
- Engineering Communications Assembler

Description of qualifications and their general competences, knowledge and skills can be found here:

Finishing Work Technician
https://www.latvijaskvalifikacijas.lv/qualification/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-apdares-darbu-tehnikis/
Building Technician
https://www.latvijaskvalifikacijas.lv/qualification/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-eku-buvtehnikis/?doing_wp_cron=1592856313.2323319911956787109375
Dry Construction Technician
https://www.latvijaskvalifikacijas.lv/kvalifikacija/diploms-par-profesionalo-videjo-izglitibu-ar-profesionalo-kvalifikaciju-sausas-buves-tehnikis/
Engineering Communications Assembler
https://www.latvijaskvalifikacijas.lv/qualification/profesionalas-kvalifikacijas-aplieciba-inzenierkomunikaciju-montetajs-2/

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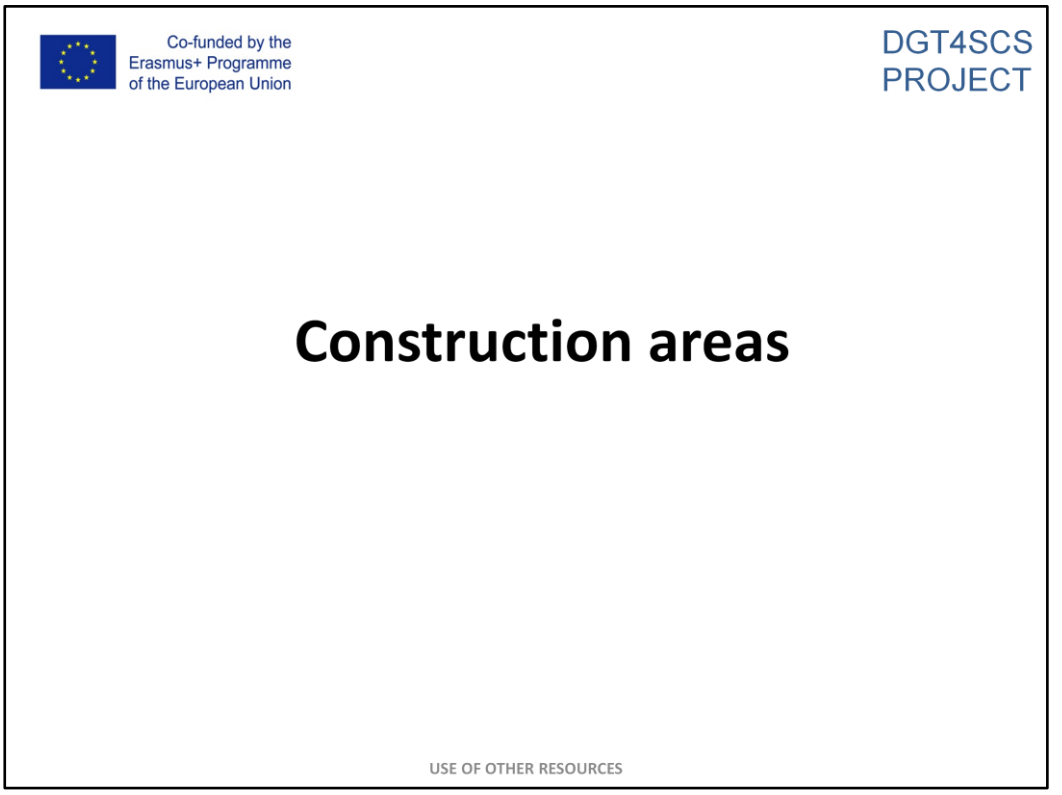
Acquired knowledge (2)

The knowledge acquired by a trainee or a construction specialist after completing this module:

- ✓ importance of using water in the construction process in accordance with technological instruction ensuring quality, strength and durability of construction works;
- ✓ possible ways of efficient timber use in construction work by minimizing timber use without reducing stability and strengths of construction and elements;
- ✓ construction site affect on land used under and around the site and ways of minimizing construction footprint on site;
- ✓ workers' influence on efficient use of resources in construction by their behavior, habits and rules observed.

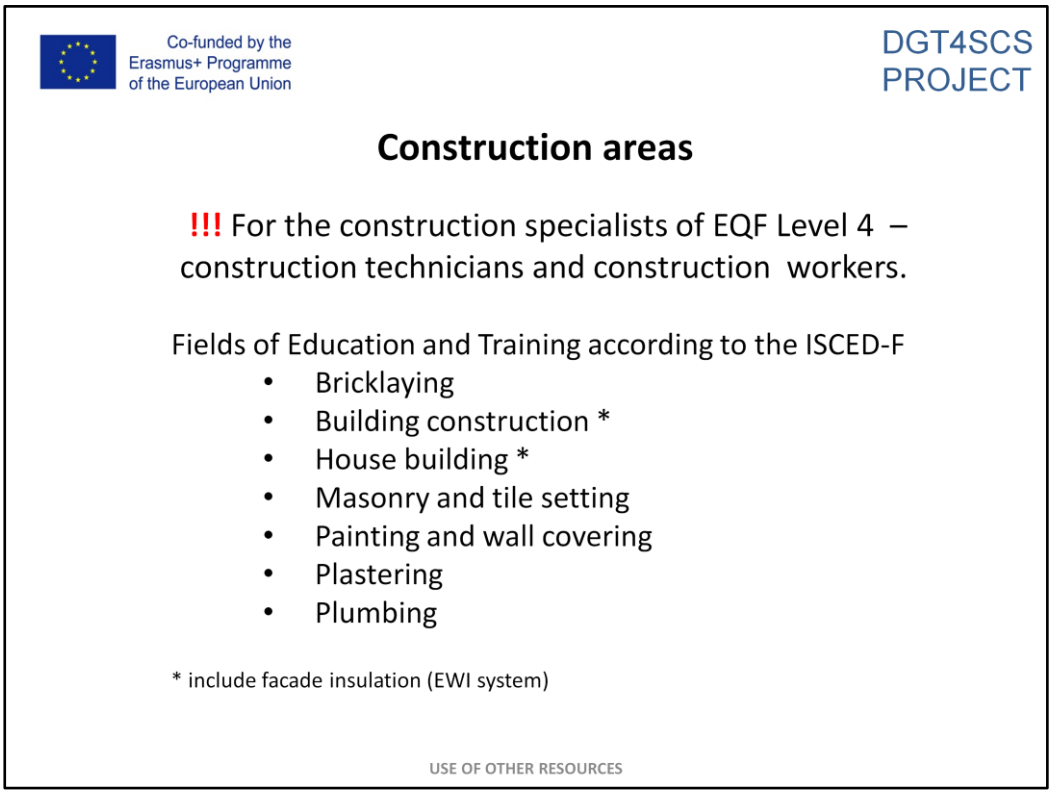
USE OF OTHER RESOURCES

Notes for the trainer and additional information:



Notes for the trainer and additional information:

The construction areas in which the main competence of the topic “Use of other resources” can be used.

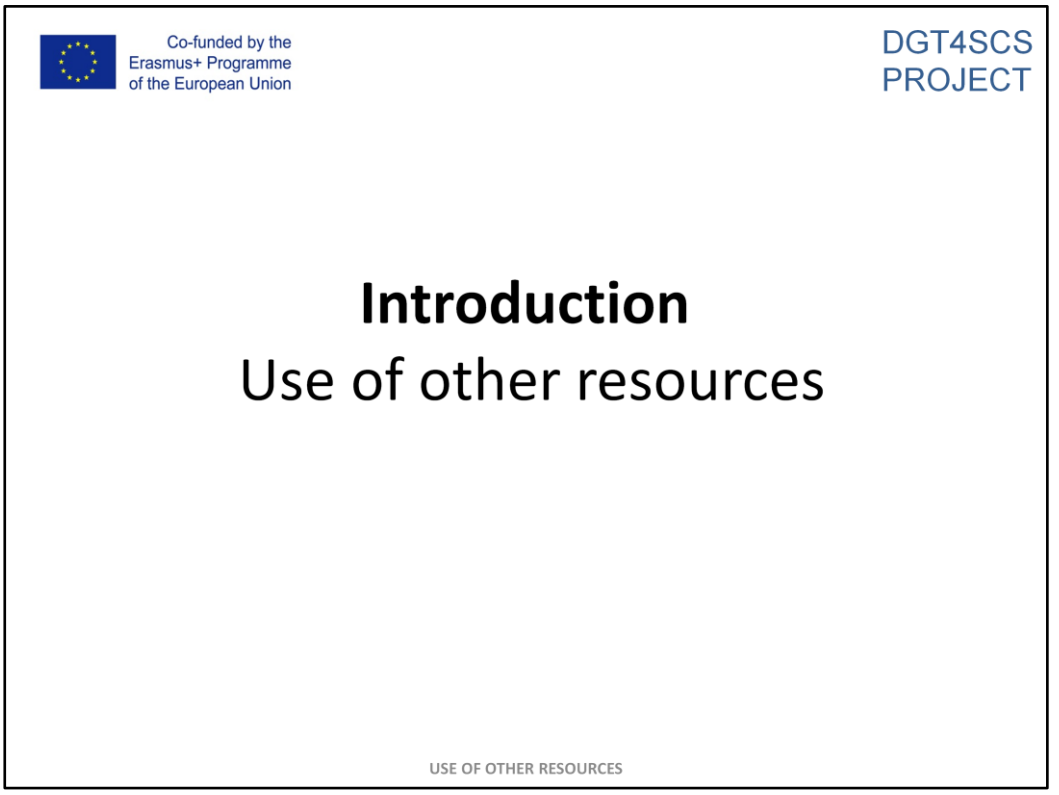


Notes for the trainer and additional information:

The construction areas in which the main competence of the topic "Use of other resources" can be used.

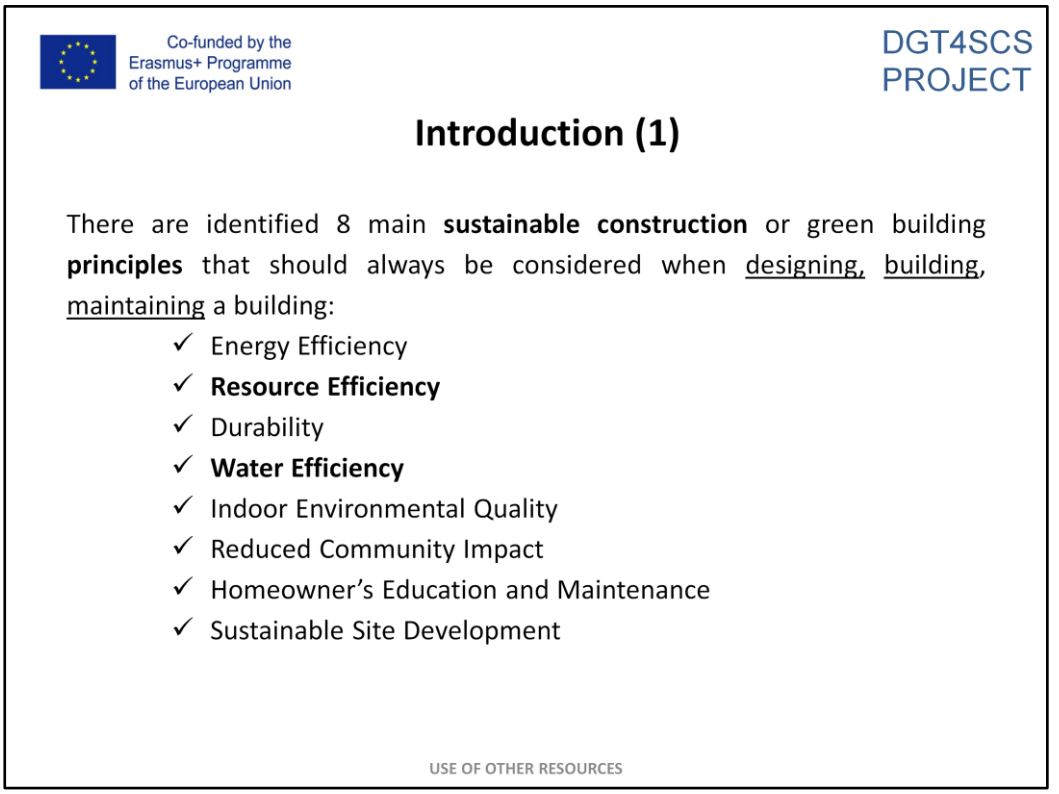
Fields of Education and Training.
Programmes and qualifications with the main content classified under 0732 Building and civil engineering according to the ISCED-F (2013).

Due to a fact that the training module is designed with possibility to adapt it to specific qualification, to make it more general or more specific, according to a trainee's experience, background and level of knowledge as well as in line with a particular qualifications – areas to use competences and knowledge acquired from this topic may be significantly varied.



Notes for the trainer and additional information:

See the next slides.



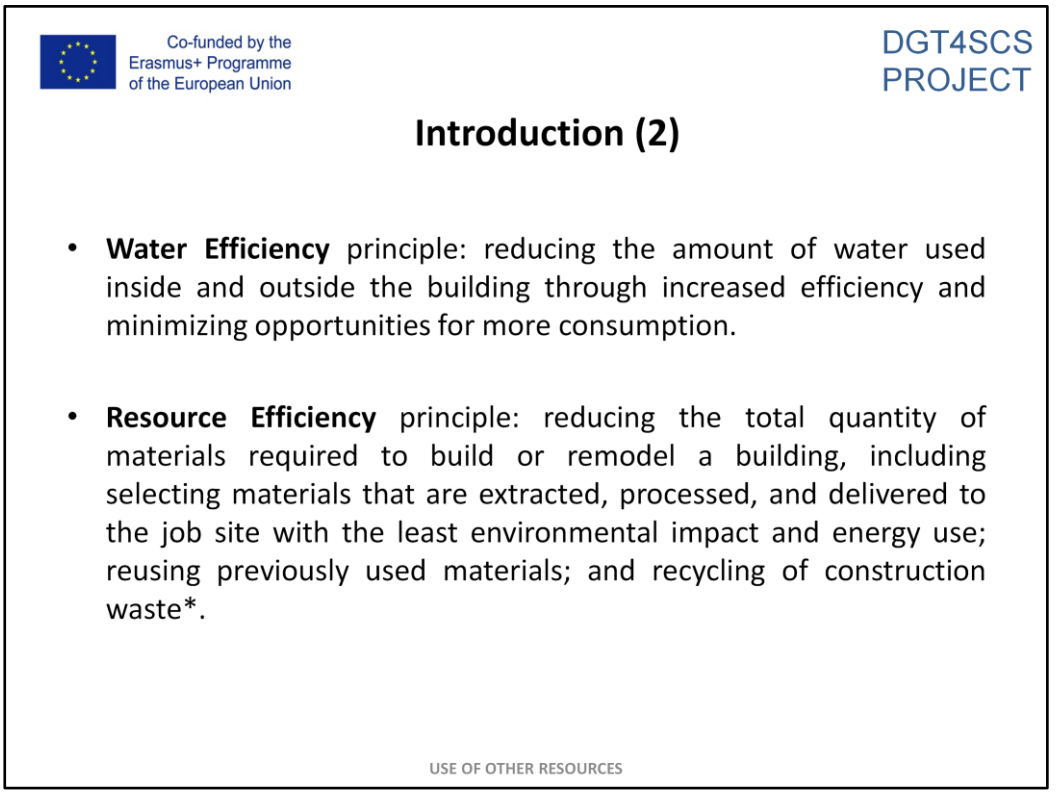
Source:

Kruger A., C. Seville. *Green Building: Principles and Practices in Residential Construction*. Delmar Cengage Learning: 2013. 21 p.

Notes for the trainer and additional information:

These principles are similar to the approach defined by LEED, BREEAM and other green building rating systems.

NB! Principles "Resource Efficiency", "Water Efficiency" are considered within this module.



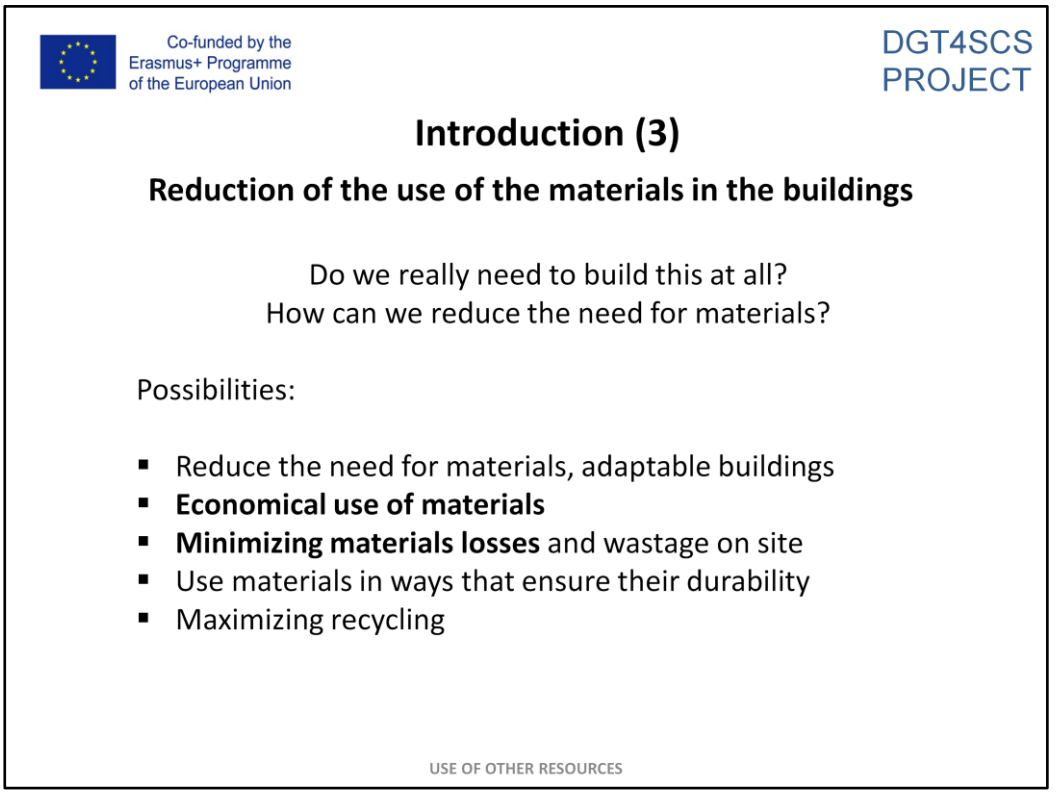
Source:

Kruger A., C. Seville. *Green Building: Principles and Practices in Residential Construction*. Delmar Cengage Learning: 2013. 21 p.

Notes for the trainer and additional information:

Within this training module issue of saving other resources or auxiliary construction resources like water, timber and land is covered neither saving of the constructions materials

* "....recycling of construction waste" – for further information see the training topic "Waste management"



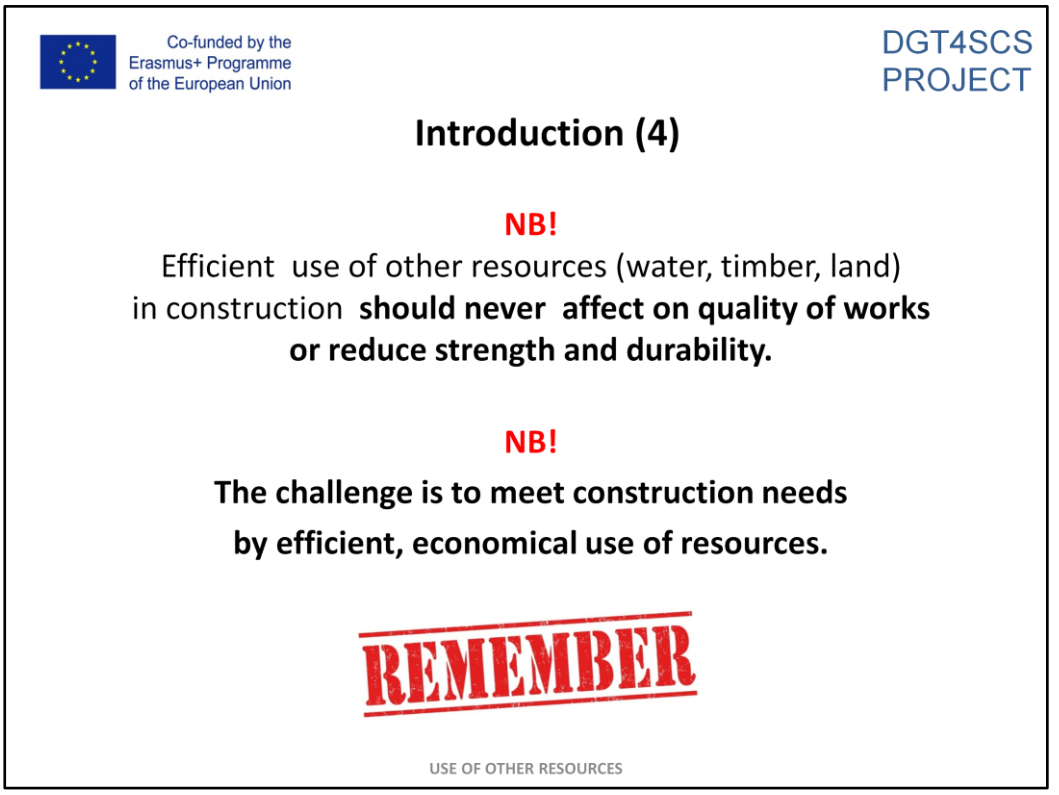
Source:

Berge B., *The Ecology of Building Materials*. Routledge: 2009. 448 p.

Notes for the trainer and additional information:

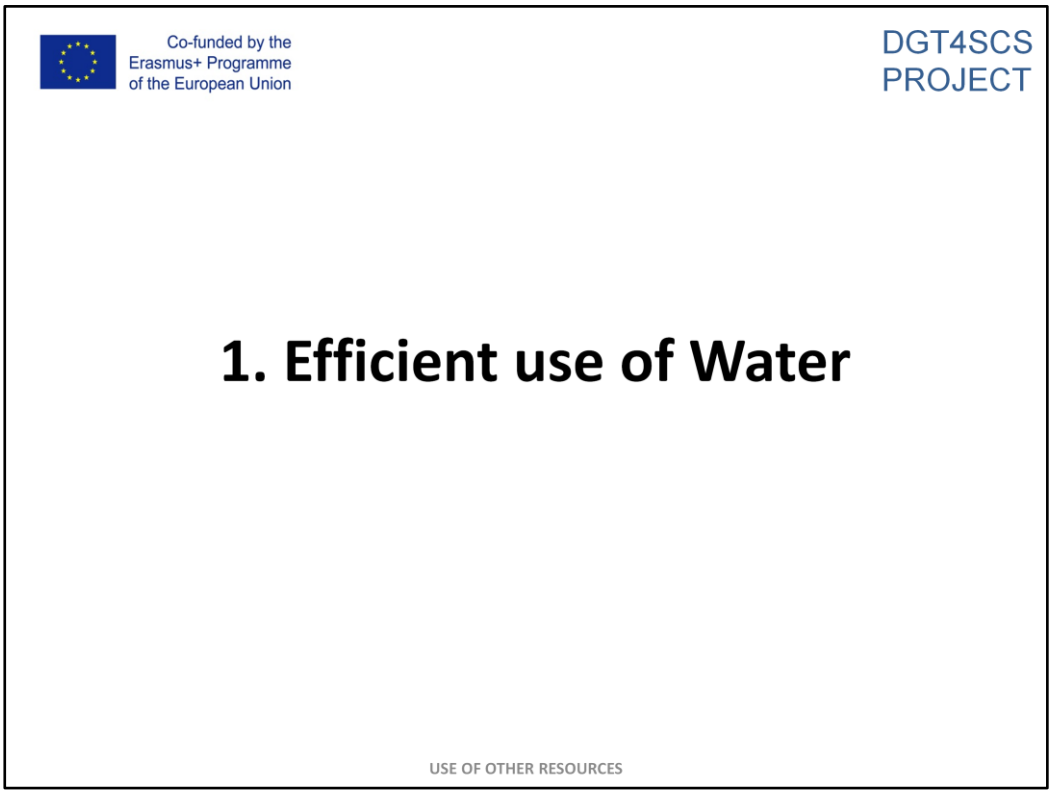
For "Use materials in ways that ensure their durability" see Training Module topic "Durability of construction works"
The module "Use of other resources" review these possibilities: "Economical/efficient use of materials" and "Minimizing materials losses".

Connection to other topics within the training material
"Waste Management", "Durability of construction works".



Source:
Expert guidelines for Construction Specialists' Training on Sustainability. 2020. 7 p.

Notes for the trainer and additional information:



Notes for the trainer and additional information:

See the next slides.

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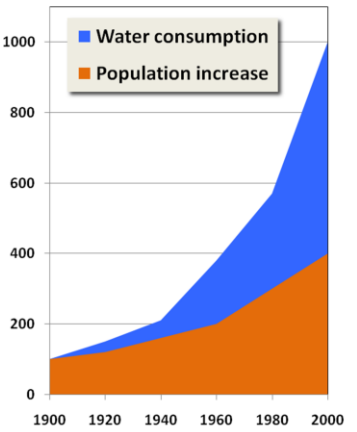
DGT4SCS PROJECT

1. Efficient use of Water (1)

- Water is an essential resource, but only about 0.01 %, is surface water found in rivers and lakes and thus readily accessible.
- Pressures on freshwater resources across the globe are growing due to population growth, increased industrial activity, urbanisation and changing lifestyles.
- During the 1990s, the world's population increased almost fourfold, **while water use increased by about 10 times**.
- **The main goal nowadays is to adopt the best practices that can reduce or may entirely avoid the need of water.**



USE OF OTHER RESOURCES

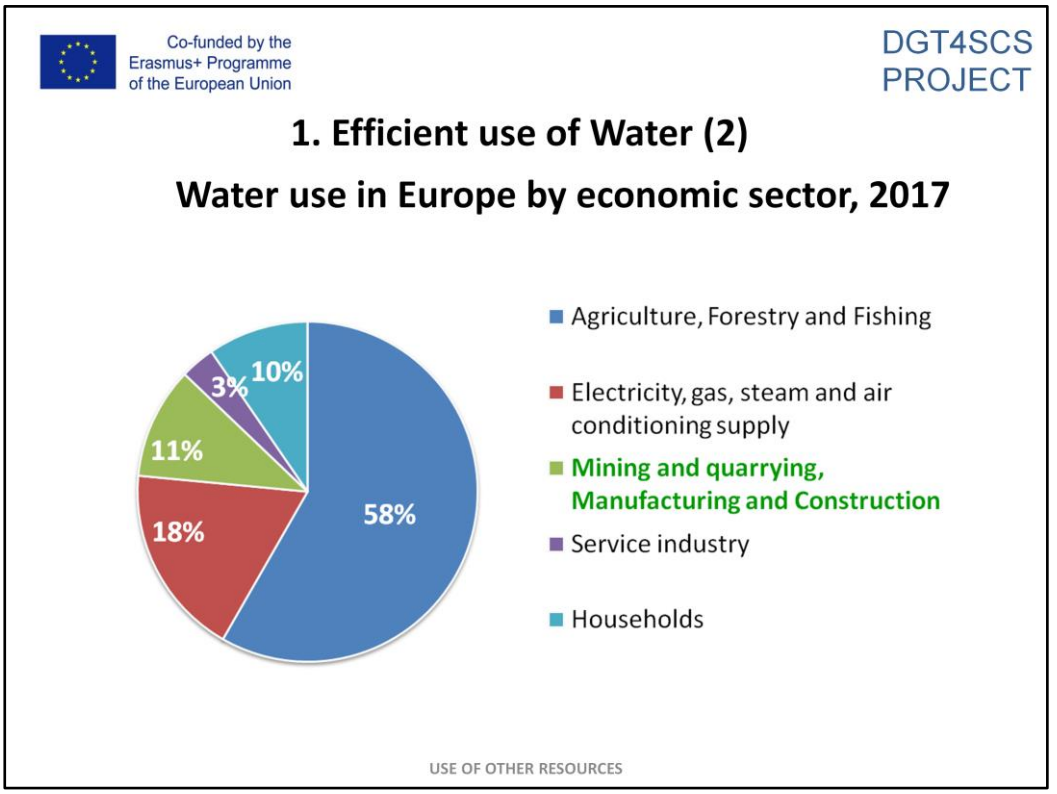
Source:

Bokalders V., M. Block. The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings. Earthscan: London, 2010. 318 p.
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 326 p.

Notes for the trainer and additional information:

Global water deplation**:** of all Earth's water, only 2.75 % is freshwater, and of that, three-quarters, or about 2 percent, is sequestered, or locked up, in glaciers and permanent snow cover. Only a tiny fraction of planetary water, about 0.01 %, is surface water found in rivers and lakes and thus readily accessible.
In today's day, water has become very limited. The wastage of water is incredible, and exhausting ground water, one of the primary sources of water in construction industries, adds to the woe. Water tables in urban areas are depleting due to increasing population and expansion of piped drinking water. And it is declining in rural areas because of lakes and ponds drying.

The actual issue of nowadays **is to adopt the best practices that can reduce or may entirely avoid the need of water**…**thus allowing water to be used for more important consumption.**



Source:
European Environment Agency. Use of freshwater resources in Europe. Available from: https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4 [Accessed 31 May 2020].

Notes for the trainer and additional information:

Building construction industry is one sector which consumes a substantially high amount of water every year. The growing construction activity as a response to the need to meet the demand for housing and infrastructure in the city causes environmental impacts, among which one of the most relevant **is the increase of water use** and pollution during the construction process.

The statistics show that, in Europe, the construction and the use of buildings accounts for about a quarter of all water use.
According to the data shown on chart: agriculture accounts for around 58 % of total water use, followed by 18 % for energy production and 11 % for manufacturing and construction industries; households (use stage of building) use almost 10 % of total water in Europe.

Data coverage:
EEA Member countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom .
Cooperating countries: Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Kosovo.

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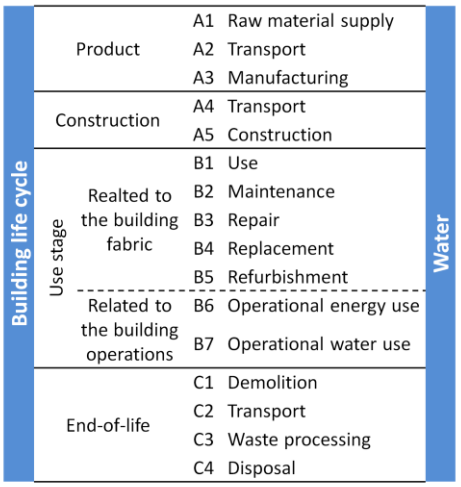
DGT4SCS PROJECT

1. Efficient use of Water (3)

Water and Construction life cycle stages



- **Water is used throughout the construction life cycle**, from the extraction of raw materials to make products, through manufacturing, the construction process and in the use phase of buildings (for bathing, cleaning, etc) and at end of life during the demolition process.
- **How the construction sector uses water**, the products it puts into buildings, how **consumers behaviour**, the availability of innovative products/ processes are highly important.

USE OF OTHER RESOURCES

Source:

Water Efficiency the contribution of construction products. Construction Products Association: 2015. Available from: https://www.constructionproducts.org.uk/media/87904/water_efficiency_report.pdf [Accessed 31 May 2020].

European Standard EN 15978:2011. Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method.

Notes for the trainer and additional information:

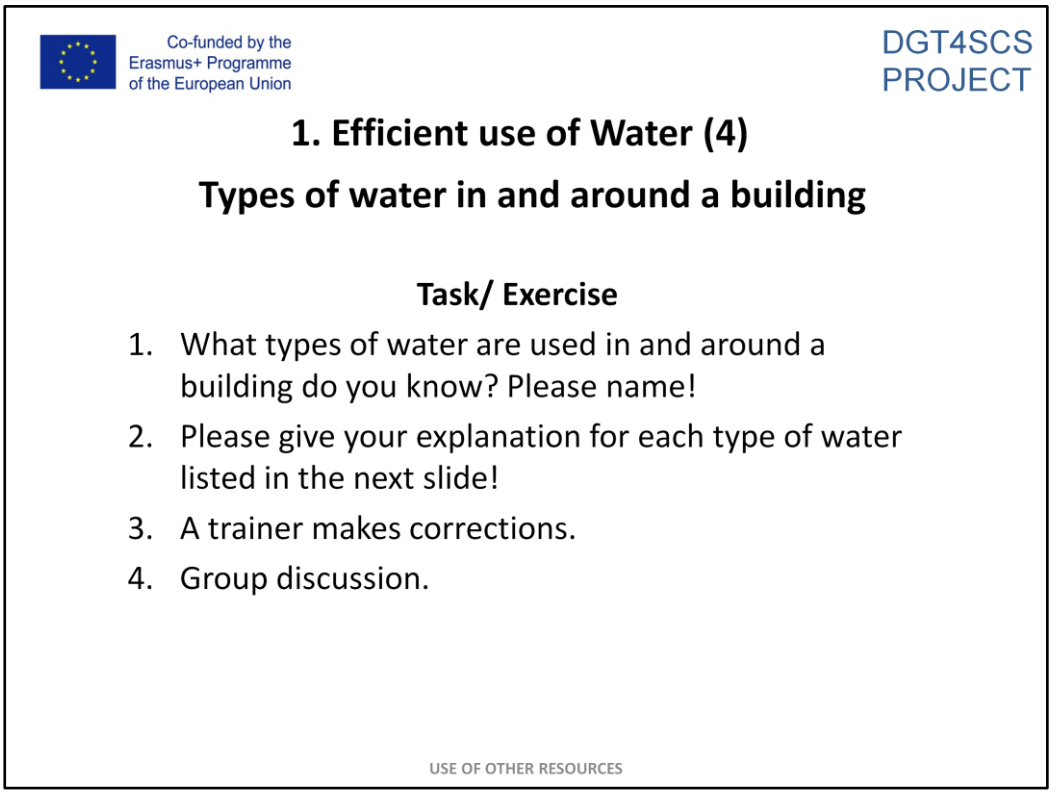
The built environment is a major user of water resources.

Water is used throughout the construction life cycle, from the extraction of raw materials to make products, in the manufacturing phase, during the construction phase, and obviously in the use phase of buildings (homes, offices, schools, hospitals, hotels etc.) for bathing, cleaning etc. Finally water is a resource often used in the demolition process (especially to suppress dust) at end of life of building.

This training module is focused on efficient use of **water on construction stage and use stage of building.**

How the construction sector uses water, the products it puts into buildings and infrastructure and how consumer behaviour is influenced by regulation and the availability of innovative products and processes is therefore highly important. A trainer emphasizes that **a well-planned construction process can achieve a significant saving in water consumption.**

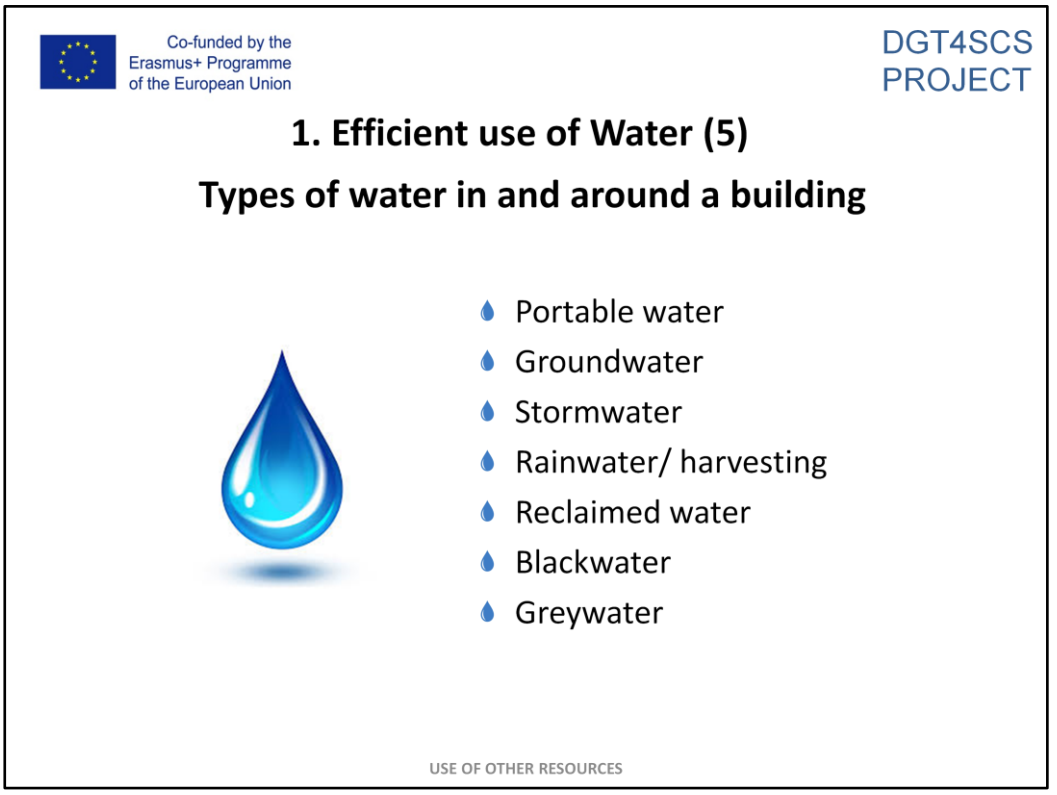
*** Water use in the manufacturing process construction products isn't discussed within this training material. However, a trainer can list types of construction products which need water for its manufacturing: (1) pre-cast concrete and other cement-based products, (2) plastics and resins, (3) wood panels, (4) ceramics, (5) glass, (6) paints, (7) in quarries, (8) steel.



Notes for the trainer and additional information:

Before discussing a sustainable use of water in construction and during the use stage of construction works, it is important to define common terms. Definitions of the most important concepts that should be understood in discussion of the building water systems are provided next.

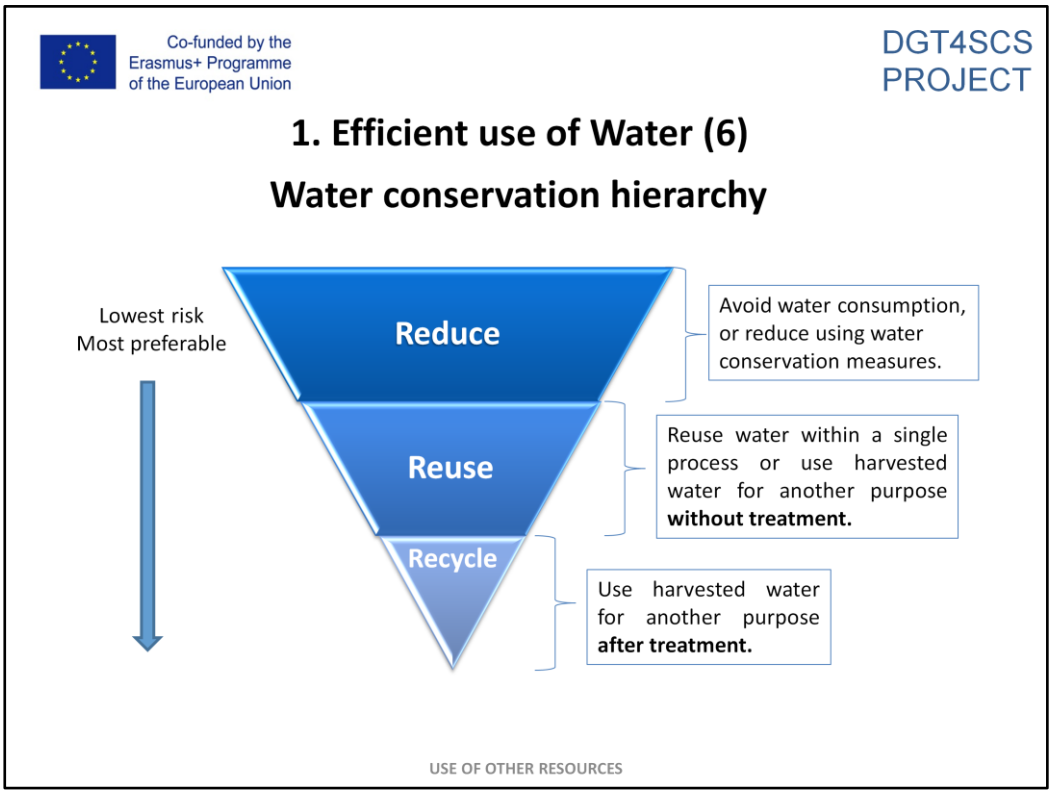
Task: before types of water are named and explanation is given, a trainer asks students "What types of water do you know?"



Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 331-332 p.

Notes for the trainer and additional information:

A trainer lists and explains the types of water (when previous task is done).
Portable water - water that is safe/suitable for human consumption (i.e., has high quality and low risk of harm). Generally is obtained from groundwater or surface water sources and then processed to increase its quality to drinking water standards.
Groundwater - water that is found underground in rock formations, such as aquifers and in soils. Groundwater is extracted for human consumption using shallow wells or deep, artesian wells. Water that seeps into the ground to add to the supply of groundwater is referred to as recharge water.
Stormwater - water that does not infiltrate into the ground and either runs off into bodies of water or enters the stormwater system. Includes water from the precipitation of rain and snow, water from melting snow, and water from overwatering.
Rainwater - water from liquid precipitation, excluding water from snow, hail, and sleet, that has not entered a stream, lake, or other body of water.
Rainwater harvesting - the collection, storage, and use of rainwater. After purification, rainwater is usually very safe and of high quality.
Reclaimed water - water from a wastewater treatment plant that has been treated and can be used for non-potable purposes, such as landscape irrigation, cooling towers, industrial process uses, toilet flushing, and fire protection.
Greywater - is the wastewater generated in households or office buildings from streams without fecal contamination, i.e. all streams except for the wastewater from toilets. Water from (1) showers, (2) bathtubs, (3) bathroom sinks (washbasins), (4) washing machines (laundry), and (5) drinking fountains. Greywater contains a minimum amount of contamination and can be reused for certain applications.
Blackwater - wastewater generated from (1) toilets and bidets which is heavily and directly contaminated with human faeces and/or urine and may contain contaminated solid material, such as toilet paper. This wastewater is highly infectious. Blackwater contains pathogens that must decompose before they can be released safely into the environment.
***Dark greywater** (or blackwater sometimes) – water from kitchen sinks, dish washers and laundry (eg. in Australia these waters are not recycled greywater, but blackwater).
Sewage - a combination of both blackwater and greywater. Also highly infectious.



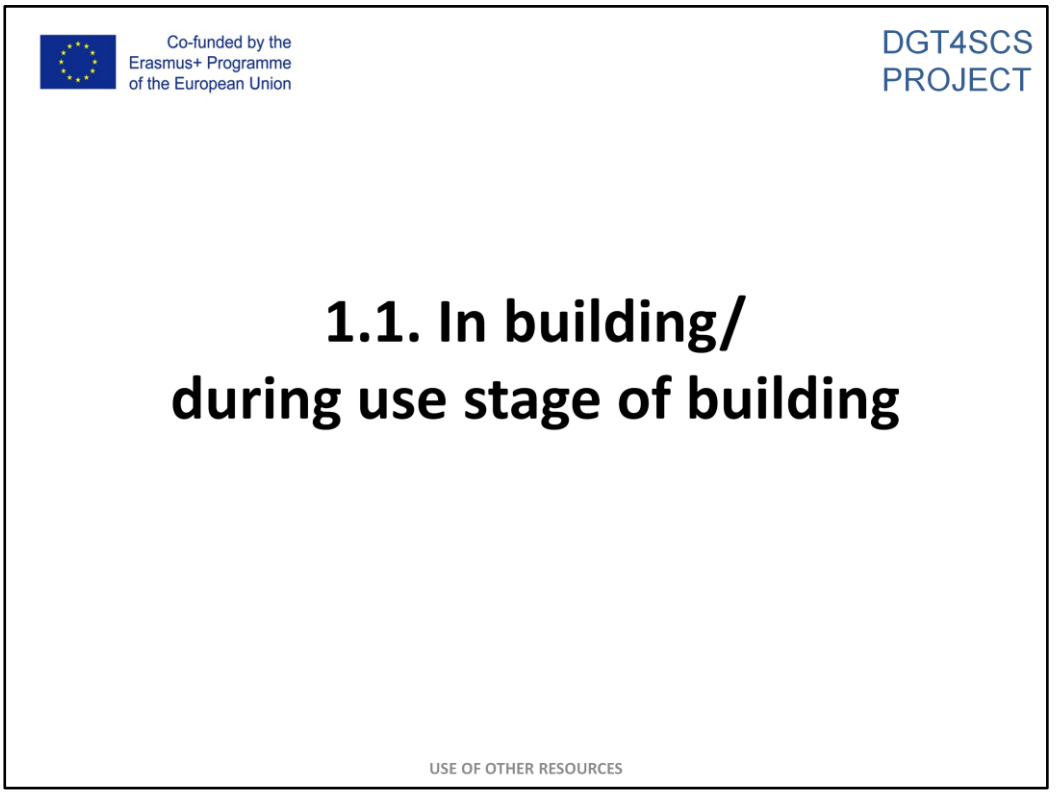
Source:
FORMAR. Vocational training on sustainable buildings maintenance and refurbishment. Project No.539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

There are three ways of water conservation:

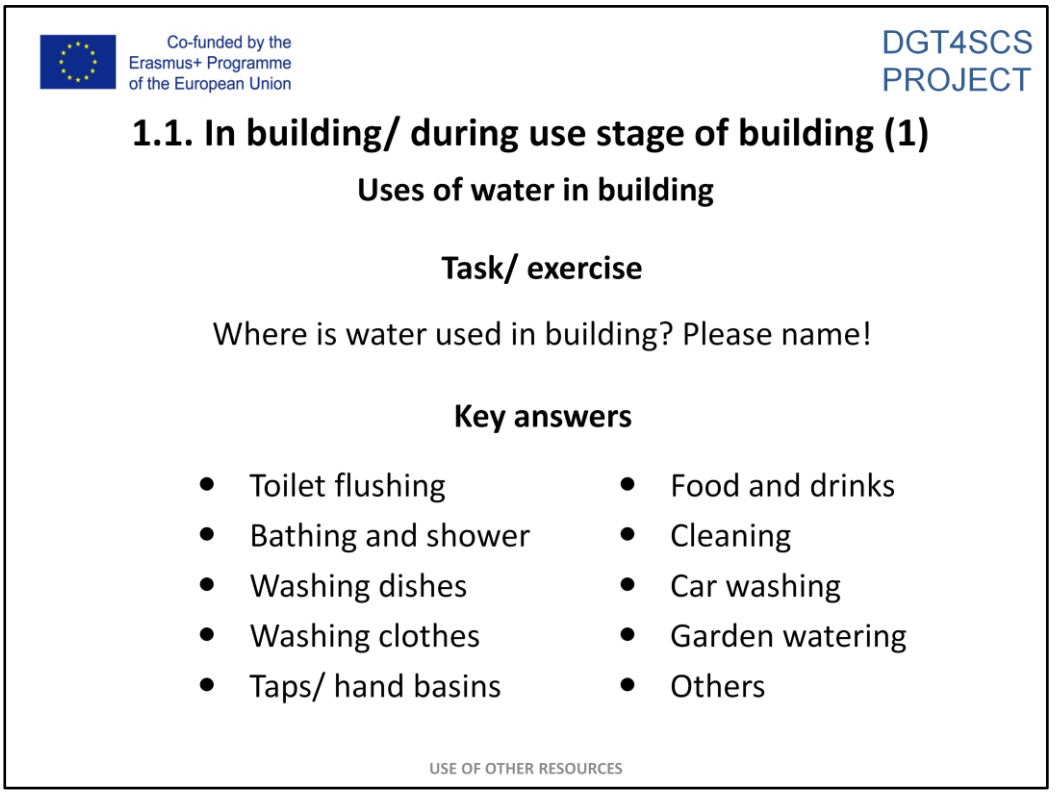
- reduction of water consumption;
- reusage of water within a single process or usage of harvested water for another purpose without treatment;
- recycling – usage of harvested water for another purpose after treatment.

A trainer presents to students the hierarchy to be taken into account in water conservation.
First, the reduction of consumption, followed by re-use of water does not require treatment to be reused and finally reuse of waste waters that requires some kind of treatment. Empathize that is better to reduce water use and avoid generating wastewater at first, than to have to identify alternative water supplies and reuse options. Highlighted that **we should look into reusing low-risk water sources, such as rainwater or storm water, before recycling higher risk source water, such as greywater** and sewage (greywater– non-toilet household wastewater; sewage - toilet wastewater).



Notes for the trainer and additional information:

See the next slides.



Notes for the trainer and additional information:

A trainer names/lists ways of water use in the building (use stage of construction) in slide. Before students should be asked to list ways of water use in the building.

A normal household in a developed country uses about 175-215 liters of water per person per day. With the new water-saving technologies now available on the market for showers, taps, toilets, as well as clothes and dishwashing machines, it is possible to reduce water consumption by 50 per cent without difficulty and without lowering the standard of living or of hygiene.

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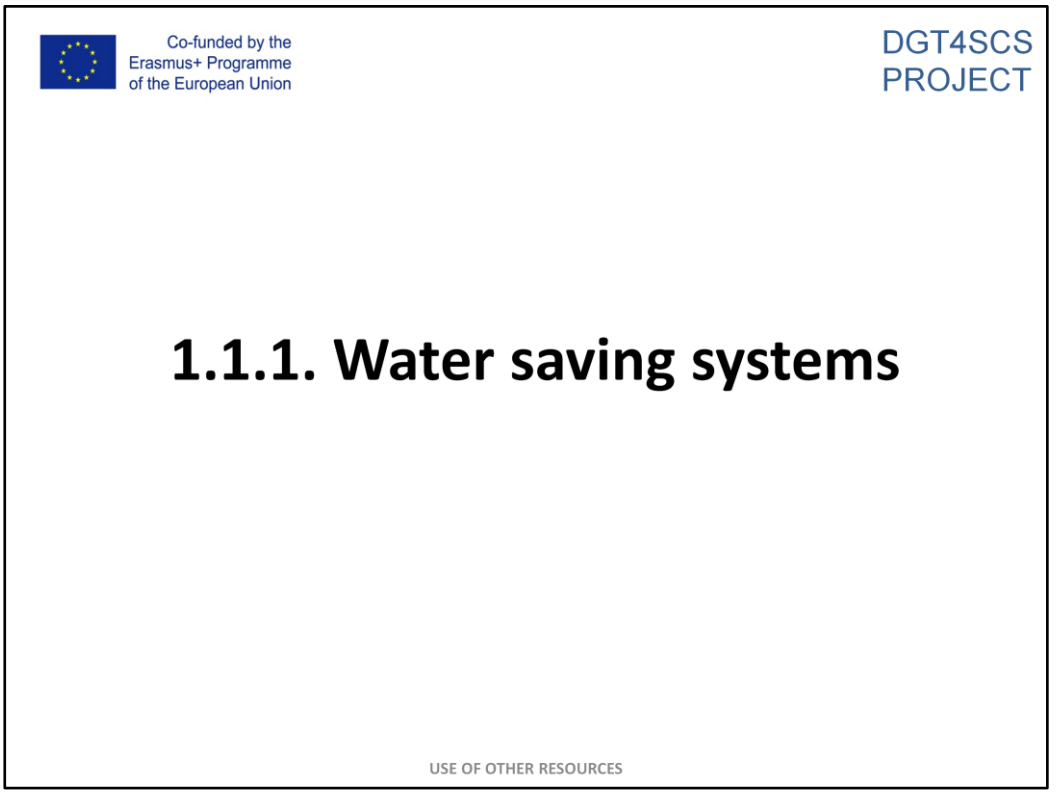
1.1. In building/ during use stage of building (2)

Ways of water conservation in building

Reduce	✓ Water saving systems - appliances/plumbing fixtures ✓ Metering and labeling ✓ Changing habits and behaviour of user
Reuse	✓ Rainwater harvesting systems (use in building and around building)
Recycle	✓ Greywater recycling systems

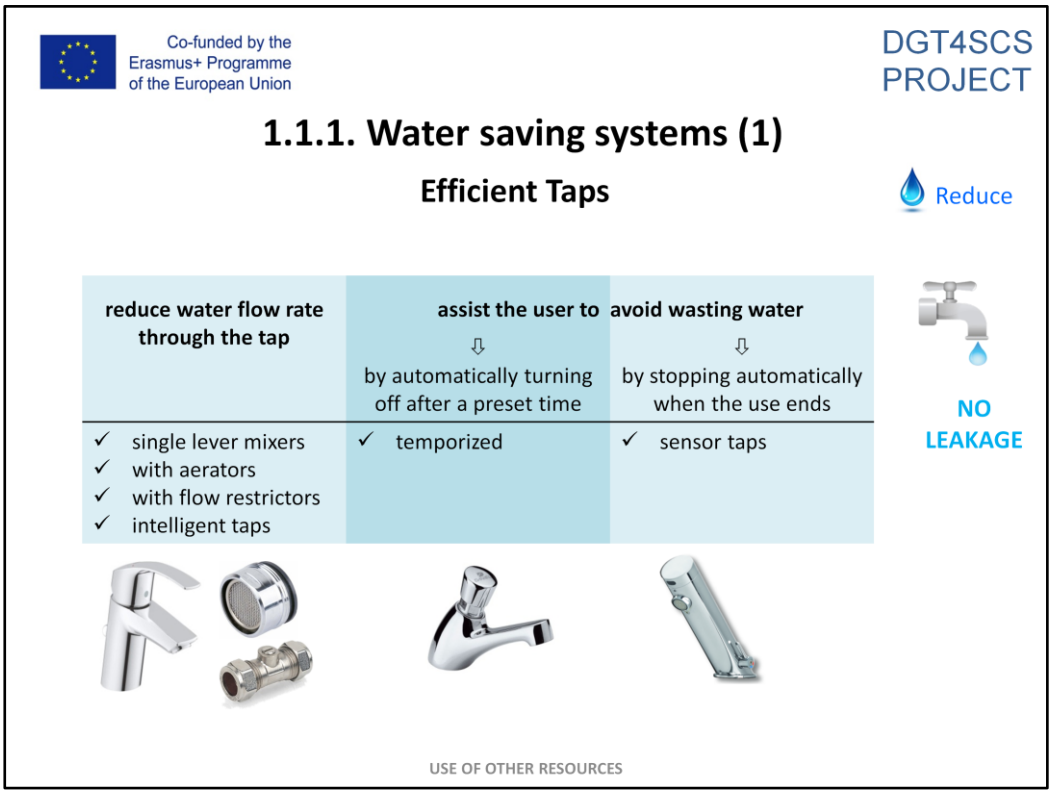
USE OF OTHER RESOURCES

Notes for the trainer and additional information:



Notes for the trainer and additional information:

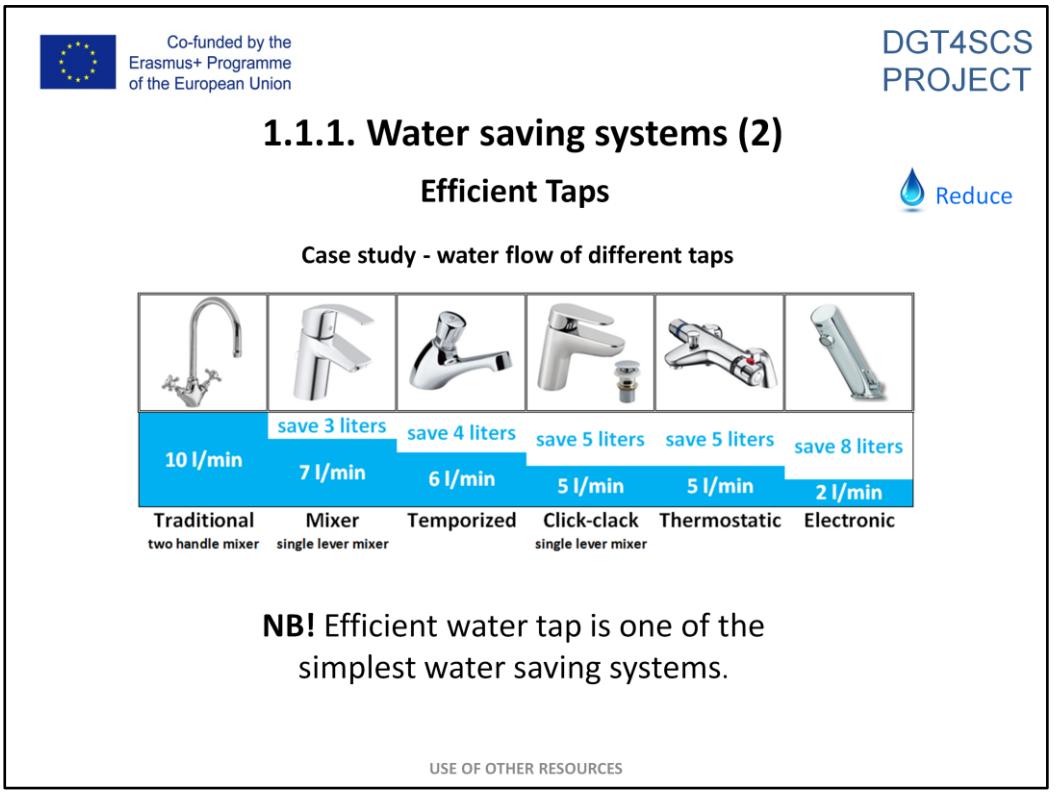
The next slides describe the main types of plumbing fixtures currently in use and their low-flow/high-efficiency alternatives. The issue is - to reduce water use by installing low water use appliances and plumbing fixtures.



Source:
Bokalders V., M. Block. *The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings.* 321-323 p.

Notes for the trainer and additional information:

Water-efficient taps (1) either reduce water flow rate through the tap **or (2)** they assist the user to avoid wasting water by automatically turning off after a preset time (push taps), **or (3)** by stopping automatically when the use ends (e .g. using infrared sensors).
Use of single lever mixer instead of two handle mixer. While you wait, turning the two handles, for the water to reach the right temperature and the right volume, a lot of it flows unused down. Single-lever mixers save water since they can be quickly adjusted to the right temperature. Single-lever mixer taps regulate both water flow and temperature with a single lever. A water-saving tap is a single-lever tap with low water flow in the normal position. It is possible to force the water flow by pushing the lever upwards, but as soon as it is released it automatically returns to the normal flow position. These taps save approximately 30% of water.
Use of tap aerators. These are attachments that either fit onto the end of the tap or can be inserted inside of the existing spout. They control the amount of water that flows through the tap without affecting the water pressure as they mix the water with air. The aerator acts as a sieve, separating a single flow of water into many tiny streams which introduces the air in to the water flow. Also as there is less space for the water to flow through, the water flow is reduced, resulting in water savings.
Use of flow restrictor. It is used to restrict the flow of water to your tap or shower thus reducing your consumption of water. Flow Restrictors are ideal for situations where a Tap Aerators are not suitable
Use of intelligent taps. They consume up to 60% less water than conventional taps. A precision elastomer reacts automatically to changes in the water pressure and changes its shape, ensuring that the water flow is constantly limited to only around 5 liters per minute.
Use of temporized taps. The push bottom process one-time permit access to a specific quantity of water for a certain period of time ranging between 6 and 8 seconds only and than are self closing by cutting off the water automatically which helps and contributes to the preservation of water consumption
Use of sensor taps or electronic taps. They are usually installed in public places. They help to save water by controlling usage based on hand movements. They reduce the probability of leakage. Sensor faucets help to save approximately 60-80 % of water.
!!! Dripping and leaking taps waste large amounts of water.

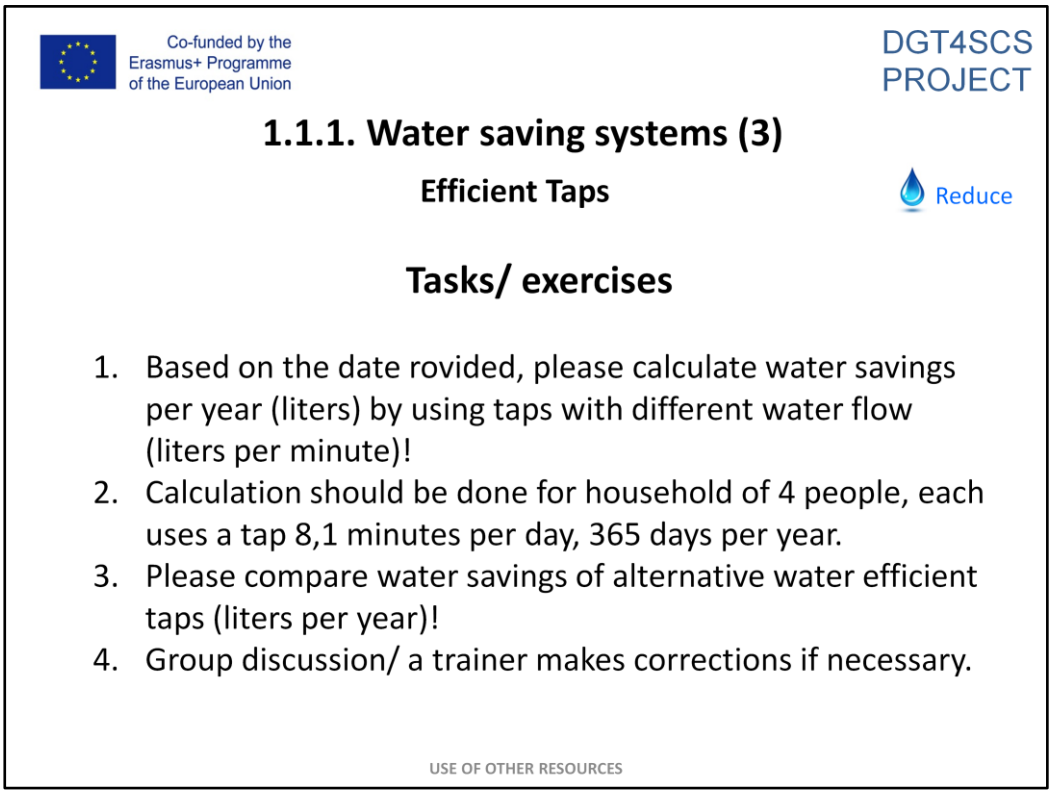


Source:
FORMAR. Vocational training on sustainable buildings maintenance and refurbishment. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:
A trainer explains the water savings achieved with the different water taps alternatives.
Main conclusions after comparison of different water taps:

- ✓ Thermostatic taps save up to 50 % of water
- ✓ Electronic taps save up to 80 % of water
- ✓ Therefore an adequate water tap is one of the simplest water saving systems

Traditional tap – two handles mixer.
Mixer tap/ single lever mixer - one lever that performs two actions: temperature adjustments when moved from right to left; flow adjustments when moved up and down.
Temporized tap - the push bottom process one-time permit access to a specific quantity of water for a certain period of time ranging between 6 and 8 seconds only and then are self closing by cutting off the water automatically which helps and contributes to the preservation of water consumption and the water use responsibly to avoid roaring without supervision, especially in public places like: parks, schools and other.
Mixer tap/ single lever mixer with waste Click-clack - a Click Clack Waste is the most popular option of wastes, as it has a simple design making it easy to use. You simply push down on the stopper once to close it and click it again to open it. Click clack wastes are also referred to as push button wastes or sprung plug.
Thermostatic tap - is a mixer that allows for the sought-after temperature to be selected, which remains constant, even when other taps are opened in the same house. The thermostatic valve mixes the hot and cold water to your pre-selected temperature and reacts instantly to any changes in the pressure or temperature of the water supply by re-adjusting the mix of hot and cold water.
Electronic tap or sensor tap - with electricity supply, the sensor can detect an object, like a hand opposite the basin tap. The solenoid valve opens when an obstruction is perceived. This way, water flows through the pipe and spout. When there is no object in front of the sensor, this device sends the correspondent signal. Electronic taps are usually designed with a low flow rate, an aerator in the spout and system or materials that prevent leakage.



Notes for the trainer and additional information:

In order to help students to gain a practical idea of the water savings achieved with the different water taps alternatives a trainer asks them compare savings of water by each type of tap mentioned on the previous slide.
Calculations are based on:

- water flow of different taps (liters per minute) – see data of the previous slide;
- assumption No 1: people use the tap for bathing hands 8.1 minutes a day in average;
- assumption No 2: water use a household of 4 people, each uses a tap 365 days per year (everyday).

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DGT4SCS PROJECT

1.1.1. Water saving systems (4)

Efficient shower heads

Reduce

With flow restrictor	With control valve/ stop button	With novel spray patterns	Aerating shower heads	Pulse-plate shower heads
				

- ✓ Permanent water savings are better provided through the installation of well-engineered showerheads - **aerating and pulse-plate heads.**
- ✓ For user it is important to feel a powerful spray from a shower without using excess water. Optimal flow - 6 liters per minute.

USE OF OTHER RESOURCES

Source:

Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 338-339 p.
Water Efficiency the contribution of construction products. Construction Products Association: 2015. 18 p.

Notes for the trainer and additional information:

Personal bathing accounts for much of the water use within homes, hotels and other residences.
Non-aerating shower heads. These work by restricting the water flow through them and squeezing it through very small holes. This means the water comes out under more pressure, so it gives a harder, more massaging showering experience.
Low-flow showerheads. These shower heads work by restricting the volume of water that they allow to flow through them. Newer models can reduce the volume of water used by half.

- ✓ **Flow restrictors.** They slow down the water flow going out from the shower mixer. The average flow limiter can save up to 50% of water used in shower. It reduces the flow, but can also reduce the amount of pressure is getting from shower.
- ✓ **Stop button/ control valve.** For temporarily stopping water flow while showering, e.g. to apply soap or shampoo, a shower stop button is practical. They make it possible to turn off the water while preserving the hot-cold adjustment. A shower stop button is installed between the mixer and the shower hose.
- ✓ **Spray patterns**. A variety of spray patterns are also available, ranging from misty to pulsing and massaging. These showerheads typically have narrower spray jets and a greater mix of air and water enabling them to provide what feels like a full-volume shower while using far less water.

Permanent water savings are better provided through the installation of well-engineered showerheads.
The main requirements of users for a satisfying shower are temperature stability, adequate water volume and distribution, and perceived skin pressure. It can be achieved by using more innovative technologies without using excess water - **the aerating shower heads, and the 'pulse plate' shower heads.**

- ✓ **Aerating shower heads** entrap air within the droplet, creating a bigger droplet without the need for a higher volume of water. The resultant impact on the skin feels like a larger droplet and therefore should provide more user satisfaction.
- ✓ **Pulse-plate shower head** works by deflecting droplets backwards into an expansion chamber. This action causes pressure to build and when it reaches a certain level, the water bounces back out of the chamber. The resulting pulsation occurs between 30 and 40 times per second and manipulates the surface tension of the water to ensure that the pressure is as high as possible in every single drop.

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DGT4SCS PROJECT

1.1.1. Water saving systems (5)

Efficient shower heads

Reduce

Case study - shower time using different heads

Parameter	Conventional shower head	Water–efficient shower head 1	Water–efficient shower head 2
Water flow	20 l/min	12 l/ min	6 l/min
Qauntity of water		140 l	
Shower time	7 min	12 min	23 min

✓ It is possible to shower for three times as long with the same quantity of water in modern water-efficient shower heads as in conventional ones.

USE OF OTHER RESOURCES

Source:

Bokalders V., M. Block. *The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings.* 321-323 p.

Notes for the trainer and additional information:

Permanent water savings are better provided through the installation of well-engineered shower heads. The main requirements of users for a satisfying shower are temperature stability, adequate water volume and distribution, and perceived skin pressure.

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DGT4SCS PROJECT

1.1.1. Water saving systems (6)

Efficient toilets

Reduce

Modern toilets use less water (4-6 liters) than their predecessors (12 liters).

Available technologies of water saving toilets (**6 liters and less**):

- gravity tank toilets
- dual-flush toilets
- flushometer toilets
- pressure-assist toilets
- vacuum-assisted toilets
- infra-red controlled flushes

NO LEAKAGE

USE OF OTHER RESOURCES

Source:

Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 338 p.
Water Efficiency the contribution of construction products. Construction Products Association: 2015. 17 p.

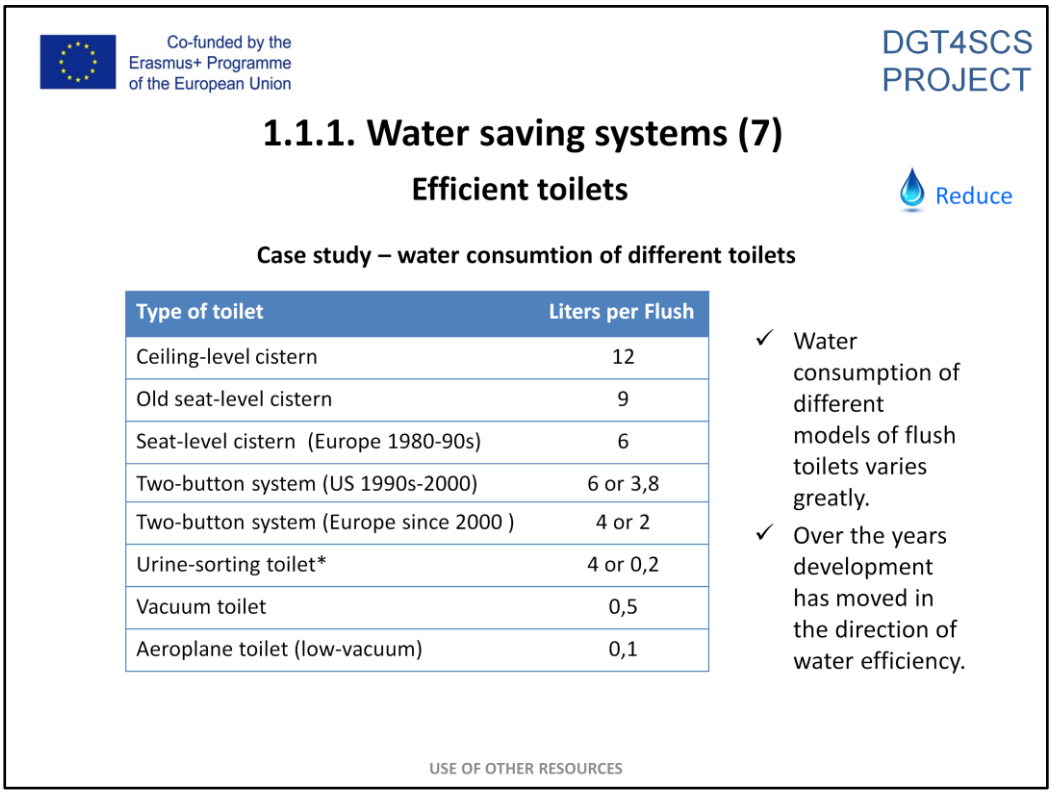
Notes for the trainer and additional information:

- Modern toilets use less water than their predecessors. **Nowadays** all toilets installed have a nominal flush volume **less than 6 liters**. **Old** products flush in excess of **14 liters** of water when used.
- Available technologies of water saving toilets (6 liters and less):
  - Gravity tank toilets. Use basically the same design as for older toilets, but with steeper sides to allow more rapid cleaning during the flush cycle.
  - Dual-flush toilets. Have two buttons (or handles) for flushing, one for minimal needs such as urine, which uses 2-3.8 liters per flush; the second for a maximum flow of 4-6 liters.
  - Flushometer toilets. Capture pressure developed in the flush cycle to assist in the subsequent flush.
  - Pressure-assist toilets. Use a tank-in-tank design to propel additional water into the bowl with each flush. The result is a more efficient, thorough flush that clears solids, debris, leads to less clogging.
  - Vacuum-assisted toilets. Use the reverse principle of a flushometer toilet by employing a vacuum, which is regenerated by flushing action, to pull the wastewater from the toilet. They use 0.5-1.2 liters per flush. Such toilets are common on boats, trains, starting to be installed in blocks of flats.
- Innovations readily available on the market today to reduce the amount of water needed for flushing include (1) **better designed pans**, (2) **dual flush cisterns** and (3) **infra red controlled flushes** to prevent multiple flushes.
- The lowest flush rate with conventional technology is 4 litres per full flush (2.6 liters per par t flush). A flush volume as low as 1.5 liters of water is available on the market but can only achieve this by forcing the water through with a jet of air.
- If there is a risk that the water flow in sewage pipes will be too slow after installation of water-saving technology, a flow increaser can be installed. It consists of a collection tank that collects three/ four flushes before emptying.

Urinal controls are also key to managing water use. Early urinals tended to flush automatically at a regular interval, whereas the latest technologies allow urinals to be flushed only when used and only when buildings are occupied. In addition, flush-free urinals so called water less urinals, may be appropriate in some circumstances– though they still need water for cleaning.

!!! Leaking toilets waste large amounts of water.

***Extra example for trainer: *Iota* folding toilet https://www.youtube.com/watch?v=vTKjXBEBmNg



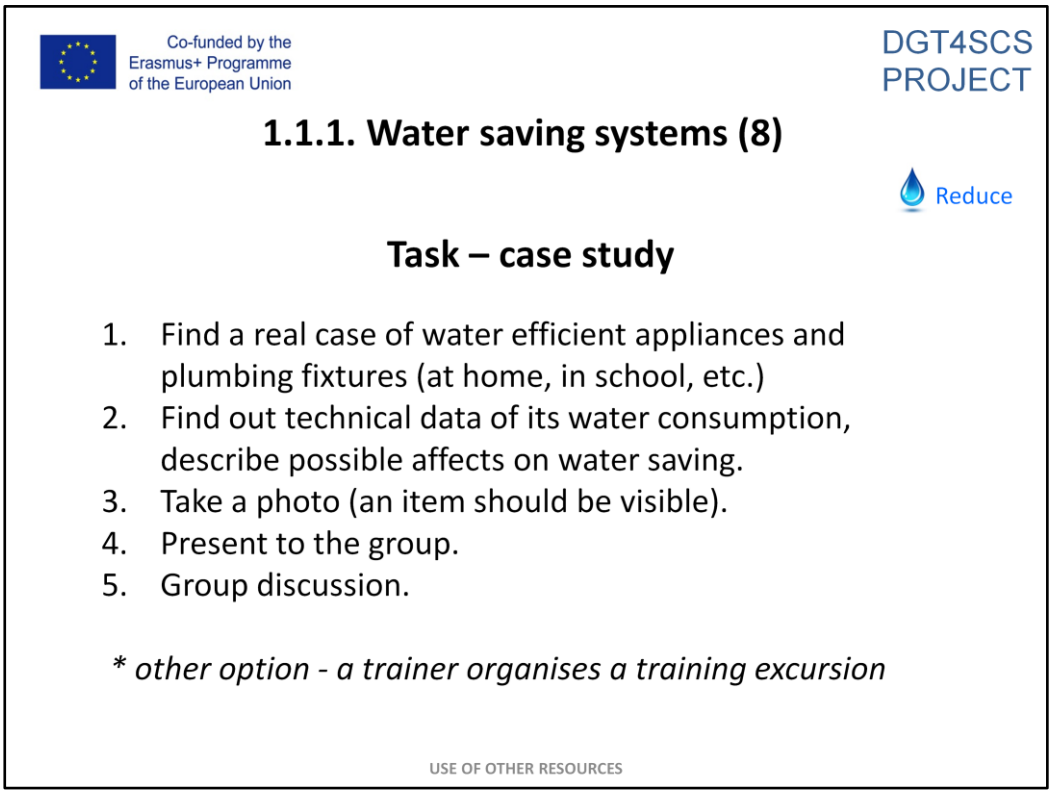
Source:

Bokalders V., M. Block. *The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings.* 325 p.

Notes for the trainer and additional information:

The first flush toilets had a cistern near the ceiling and used 12 liters of water per flush. There were even toilets that used 25 liters of water per flush. When the cistern was moved down behind the seat, flush volume decreased to 9 liters. Since 2000 most new installed toilets in Europe use 4 liters per flash. For example in UK since 2001 is required that all toilets installed have a nominal flush volume less than 6 litres.

* Some separating toilets, e.g. **urine-sorting flush toilets**, flush faeces with 5 liters of water and urine with 0.2 liters.



Notes for the trainer and additional information:

Case study (home work + presentation in class and/ or training excursion).
Ask students to find a real case of water saving /efficient appliances and plumbing fixtures, find out technical data of water consumption, describe possible effect on water saving, take a photo and send to the teacher with description, and present to the group.
Students present results of their surveys in a class, a trainer discuss a case with students.

NB! It is suggested for trainer to organise a training excursion with the group for discovering facilities/ appliances/ fixtures used in the school/ training centre (taps, shower heads, toilets). The case, appliances/ fixtures, technical specification of water consumption, other materials should be prepared by the trainer beforehand in order to ensure high quality training process.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

1.1.1. Water saving systems (9)

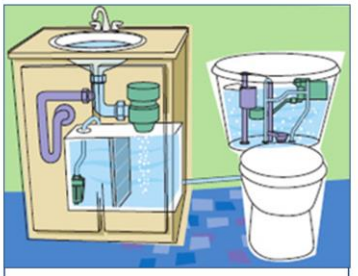
Alternative systems

Recycle

Reduce

A single module of sink and toilet

- ✓ A complex water efficient appliance: integration of the sink and toilet in a single module.
- ✓ The system recycles sink water (greywater) for toilet flushing. Saves fresh water from being wasted on flushing.
- ✓ Can be used in office buildings, in hotels, single-family homes, in apartment buildings/ residences, in school /university dorm rooms.



1. used sink water is captured
2. then is filtered and
3. routed to toilets

USE OF OTHER RESOURCES

Source:

Bokalders V., M. Block. *The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings.* 321-323 p.

Elliot, M., Armstrong, A., Lobuglio, J. and Bartram, J. *Technologies for Climate Change Adaptation—The Water Sector*. Roskilde: UNEP Risoe Centre, 2011. 124 p.

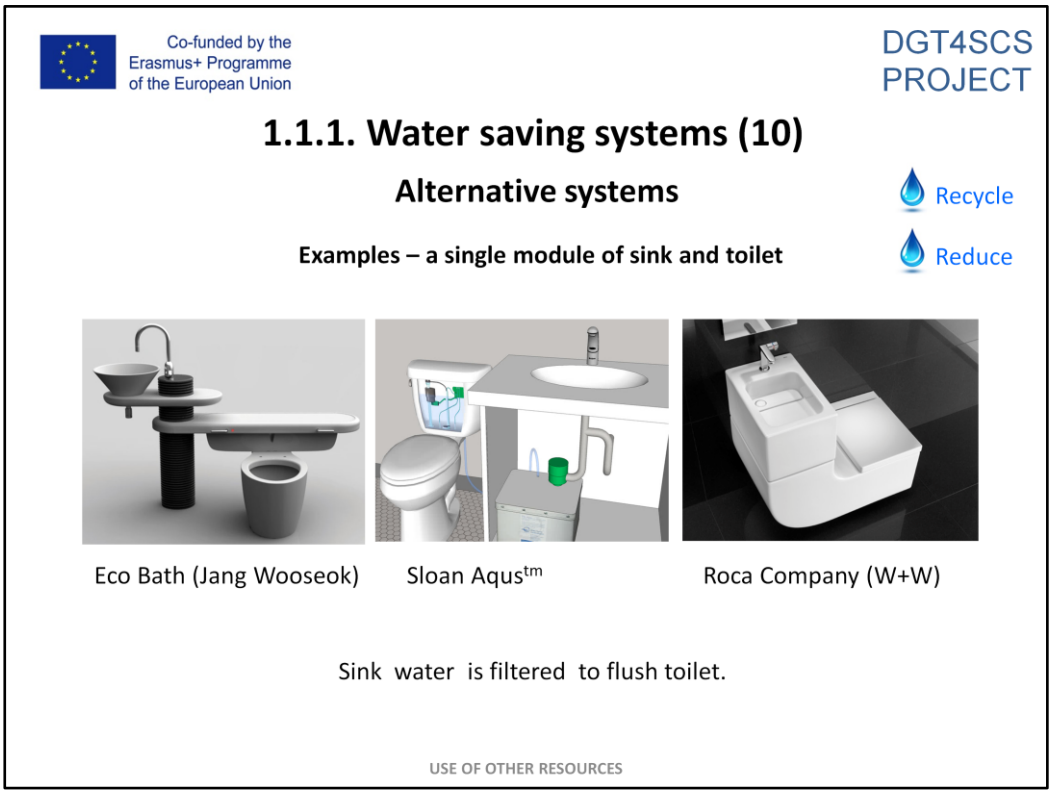
Notes for the trainer and additional information:

Nowadays, there are several alternative systems available to optimize water consumption. Water efficient appliances and fixtures can be more complex. For example, the **integration of the sink and toilet in a single module** – water from the sink (greywater) is used to flush in the toilet.

Work principles of the system: the system captures used bathroom sink water, fileres and routes it to toilets, thereby saving fresh water from being wasted on flushing.

Examples of products:

- The *AQUS* system cleans and filters water that flows down standard sink drains. Water is held in a reservoir installed in the vanity below the sink. When the toilet flushes, water is piped from the reservoir to the toilet tank.
- *Roca* system. The basin of the W+W is integrated on the upper part of the tank of the toilet, allowing the reuse of the water we need to wash ourselves in the flush of the cistern. A selective system discards the waste water, while a powerful filtering system keeps the remaining water clean and disinfected.



Source:

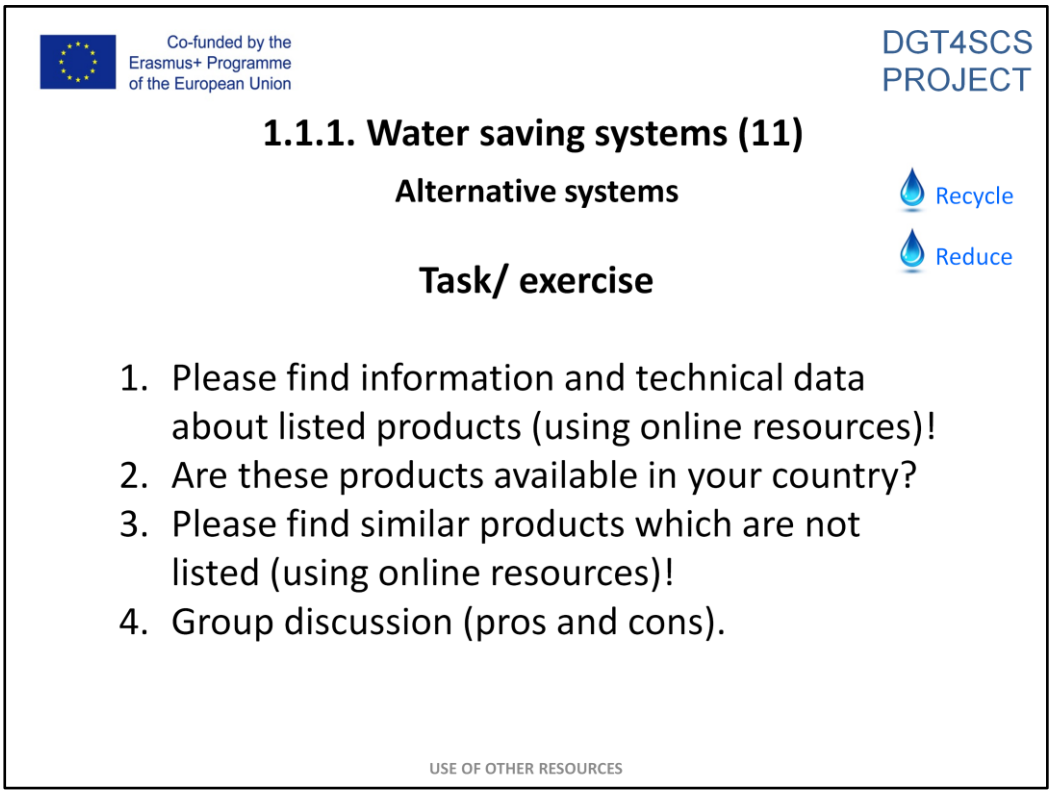
Eco Bath (Jang Wooseok). Available from:
https://www.behance.net/gallery/946751/Eco-Bath [Accessed 31 May 2020].
https://interestingengineering.com/new-proposal-for-water-recycling [Accessed 31 May 2020].
https://www.goodshomedesign.com/innovative-eco-bath-system-jang-woo-seok/[Accessed 31 May 2020]

Sloan Aqus Greywater System. Available from:
https://www.waterwisetech.net/specs/sloan_aqus_information_brochure.pdf [Accessed 1 November 2020].
https://www.yumpu.com/en/document/read/30767036/sloan-aqus-greywater-system-specification-sheet [Accessed 1 November 2020].

Roca Company/ W+W. Available from:
http://www.roca.com/rocalife/ww-basin-and-toilet-one-single-piece [Accessed 31 May 2020].
http://www.roca.com/where-to-find-us/exhibition/points-of-sale-list/points-of-sale-list_/points-of-sale/points-of-sale-list [Accessed 31 May 2020].
http://www.santehnikasveikals.lv/product_info.php?products_id=9172 [Accessed 1 November 2020] (available in Latvia).

Notes for the trainer and additional information:

A trainer comments that there are several examples of good practices/ products ready to apply in buildings such as the ones shown in the slide.
Examples of products and links with their technical data are used for the next task. Links should be given to students to complete the task.

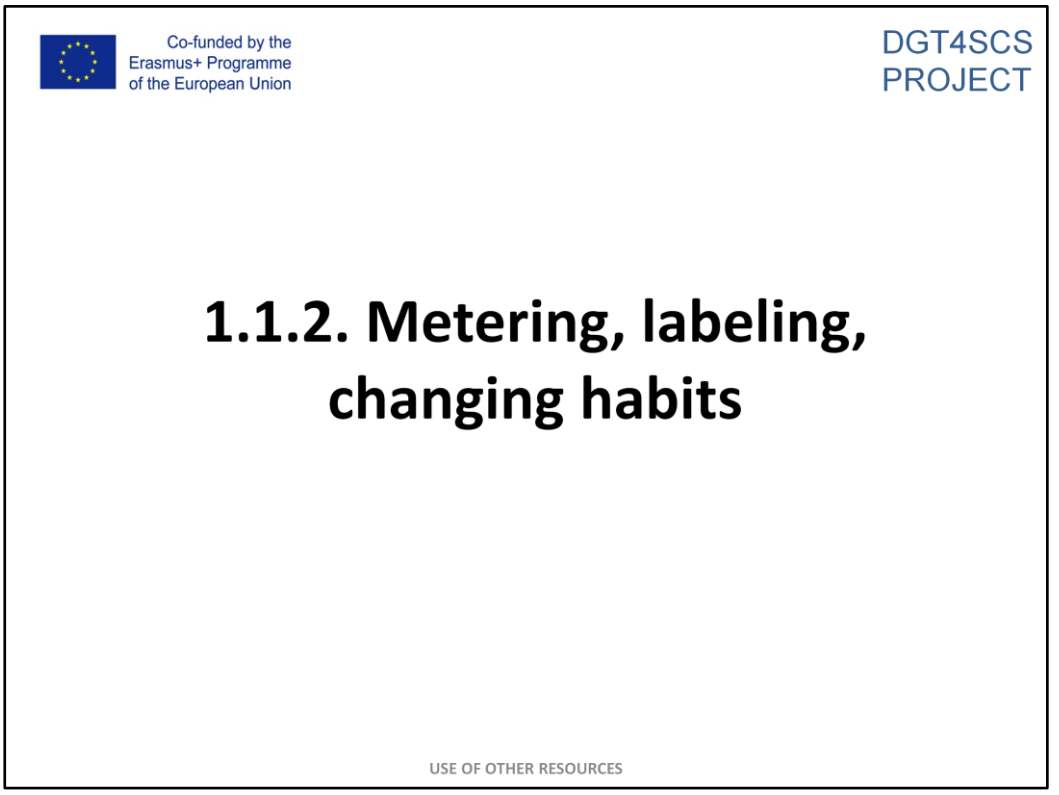


Notes for the trainer and additional information:

A trainer asks students to find information about listed products (a single module of toilet and sink), to check their availability on the local market, possibility of ordering and delivery, to find similar systems. Links should be given to students in order they can complete this task. For examples of listed products and links with their technical data see the previous slide and its notes.

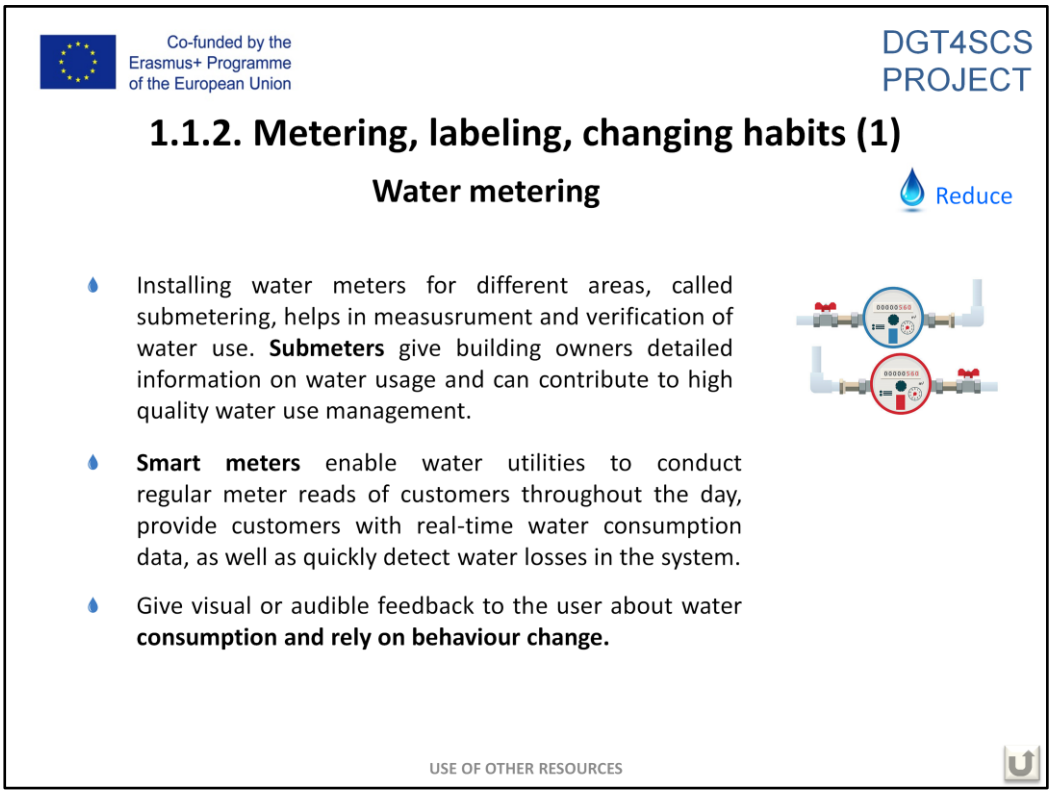
Group discussion is organized in a classroom. A trainer discuses with students advantages and disadvantages of using the single module of toilet and sink:

- possible pros: save water consumption, save place, relatively simple system etc.;
- possible cons: relatively expensive, not wide assortment, not easy to buy in each sanitary engineering shop etc.



Notes for the trainer and additional information:

See the next slides.



Source:
FORMAR. Vocational training on sustainable buildings maintenance and refurbishment. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

A trainer explains to students what are water meters, smart meters, how they can be used to control the water use. The most effective strategy for effective urban water management **is water metering**. A **water meter** measures the amount of water supplied to a consumer over a specified period, traditionally for billing purposes.
Submeters. It is assumed that up to 5% of water used in buildings is being lost due to leakages. Submeters can be tied into building management systems and alarmed so that leaks can be detected in real time.
Smart Meters. Enable water utilities to conduct regular meter reads of customers throughout the day, provide customers with real-time water consumption data, as well as quickly detect water losses in the system. Smart water meters allow user to automatically track the amount of water he uses, giving him greater visibility and control over his usage. Meters also allow users to find and fix leaks more quickly. It can measure both water consumption and energy consumption for water heating. Meters make it easier to see how, where water is being used so users can be as efficient as possible. Researches shows that customers on a meter typically use around 12% less water.
Smart Water Metering (SWM) technology is now being used in many countries. SWM allows water authorities to gain water meter readings remotely and at a higher frequency, and in a format that can be utilised for various purposes including demand and consumption management, leakage detection and water conservation. The ability to collect, analyze and relay water use data to the water user almost in real-time has the potential to cause significant **changes in water use behaviour patterns.**

***Additional reading for trainer:

- *Smart water meter. Quensus. Video.* Available from: https://waterless.solutions/water-meters [Accessed 14 November 2020]
- *Smart water metering technology for water management in urban areas. The Paper.* Available from: https://watersource.awa.asn.au/technology/innovation/smart-water-metering-technology-for-water-management-in-urban-areas/ [Accessed 14 November 2020]
- *Automātiskie ūdens skaitītāji.* Available from: https://viedaisudens.lv/ [Accessed 14 November 2020]
- *Attālināta ūdens skaitītāju rādījumu nolasīšanas sistēma.* Available from: http://www.mesa.lv/media/ADN%20Sistemas%20apraksts.pdf [Accessed 14 November 2020]

Co-funded by the Erasmus+ Programme of the European Union

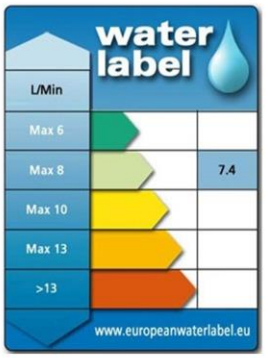
DGT4SCS PROJECT

1.1.2. Metering, labeling, changing habits (2)

Water labeling schemes (a)

Reduce

- ✓ **The European Water Label is a voluntary labeling scheme** launched in 2014 aimed at promoting water efficient devices.
- ✓ Providing consumers with information on the water consumption and efficiency ratings of water-using devices in order to influence their choice in selecting more water efficient devices.
- ✓ The scheme aims to make it easy for installers and consumers to identify which products will save water, money and energy when installed and used correctly. Under the scheme, you can see **how water efficient a product is** by looking at its label like the example shown.



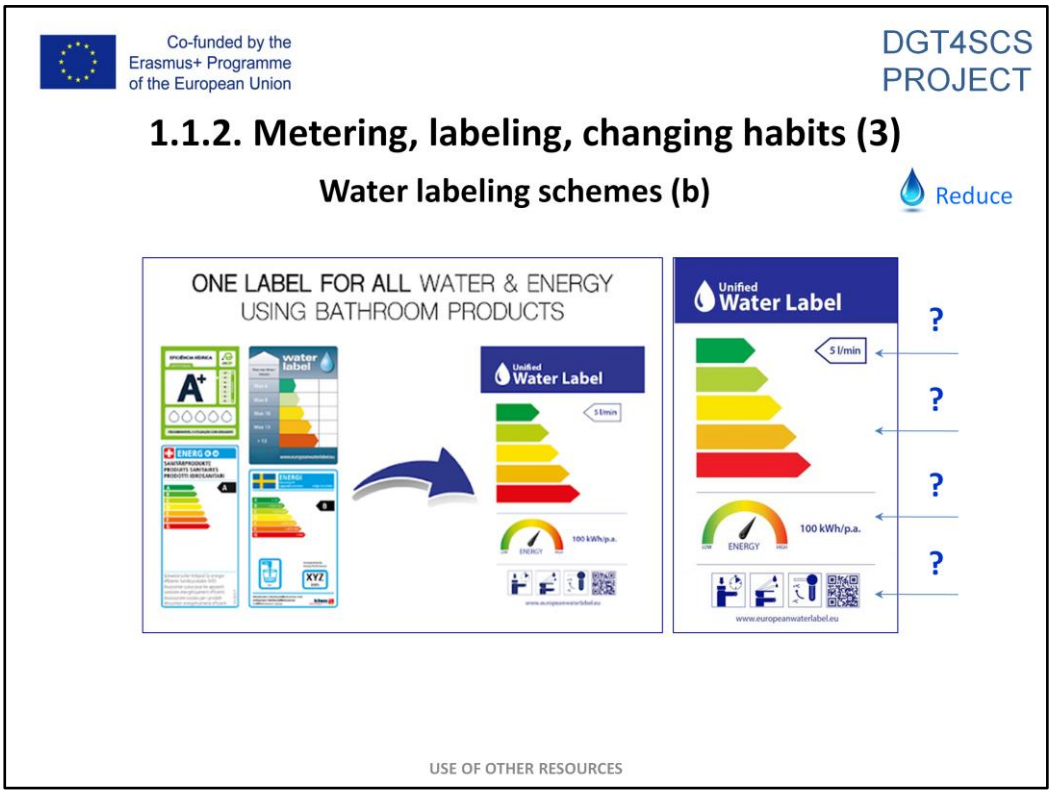
USE OF OTHER RESOURCES

Source:

Kelly, D.A. *The European Water Label: An analysis and review.* Conference Paper, September 2013. School of the Built Environment, Heriot-Watt University, Edinburgh.
The Water Label. European Bathroom Forum, Rue Belliard 12/1040, Brussels, Belgium. Available from: http://www.europeanwaterlabel.eu/ [Accessed 13 June 2020].

Notes for the trainer and additional information:

The labelling and certification of water-using devices, in order to provide efficiency information to consumers, is a relatively new initiative, being implemented in some countries only over the last decade.
Labelling schemes, such as the Water Efficiency Labeling generally use a rating system to indicate the efficiency of the device whilst also stating the water consumption or flow rate figures.
Certification schemes, however, are quality marks awarded to devices whose water consumption is below a certain efficiency target, such as WaterSense (www.epa.gov/watersense/) in the USA and Waterwise (www.waterwise.org.uk/) in the UK. Both types of scheme can be voluntary or mandatory and are often combined with device-specific performance standards.



Source:

Kelly, D.A. *The European Water Label: An analysis and review.* Conference Paper, September 2013. School of the Built Environment, Heriot-Watt University, Edinburgh.

The Water Label. European Bathroom Forum, Rue Belliard 12/1040, Brussels, Belgium. Available from: http://www.europeanwaterlabel.eu/ [Accessed 13 June 2020].

Notes for the trainer and additional information:

The European Water Label – evolution.

The European Water Label, introduced in 2014, developed and supported by The European Industry for Taps and Valves (CEIR) and applicable, not only throughout the EU, but also in Israel, Switzerland, Russia, Ukraine, and Turkey.

The primary aim of this new labeling scheme is to provide a single classification system across all member countries to inform consumers of the water consumption of water-using devices. In doing so, it hopes to make water efficient devices on the market easily identifiable and, thus, help promote the efficient use of household water.

A trainer explains where it is shown on the label "Water consumption", "Performance band", "Energy Usage", "Product feature icon".

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

1.1.2. Metering, labeling, changing habits (4)

Water labeling schemes (c) *

Reduce

		Europe	Portugal	Hong Kong	Singapure	Australia
Device		Voluntary	Voluntary	Voluntary	Mandatory	Mandatory
Toilets	(l/flush)	3.5 ≥ L > 6.0	4.0 ≤ L ≤ 9.0		3.5 ≥ L < 4.5	2.5 > L < 5.5
Showers	(l/min)	6.0 ≥ Q > 13.0	5.0 ≥ Q > 30.0	9.0 ≥ Q > 16.0	5.0 ≥ Q < 9.0	4.5 < Q > 16.0
Taps	(l/min)	6.0 ≥ Q > 13.0	2.0 ≥ Q > 8.0[1] 4.0 ≥ Q > 10.0[2]	2.0 ≥ Q > 6.0[3] 5.0 ≥ Q > 9.0[4]	2.0 ≥ Q > 6.0[1] 4.0 ≥ Q > 8.0[2]	4.5 > Q > 16.0
Urinals	(l/flush)	L = 1.5		1.5 ≥ L > 4.5	0.5 ≥ L < 1.5	7.0 > L > 2.5
Baths	(l/bath)	155 ≥ L > 200				
Washing Machine	(l/kg/cycle)			9.0 ≥ L > 13.0[5] 16.0 ≥ L > 22.0[6]	9.0 ≥ L < 15.0	X
Dishwashers						X
Flow controllers		X				X
Greywater system		X				

USE OF OTHER RESOURCES

Source:

Kelly, D.A. *The European Water Label: An analysis and review.* Conference Paper. September 2013. School of the Built Environment, Heriot-Watt University, Edinburgh.

The Water Label. European Bathroom Forum, Rue Belliard 12/1040, Brussels, Belgium. Available from: http://www.europeanwaterlabel.eu/ [Accessed 13 June 2020].

Notes for the trainer and additional information:

***This is extra material**.

[1] Bathroom taps;

[3] Non-mixing taps;

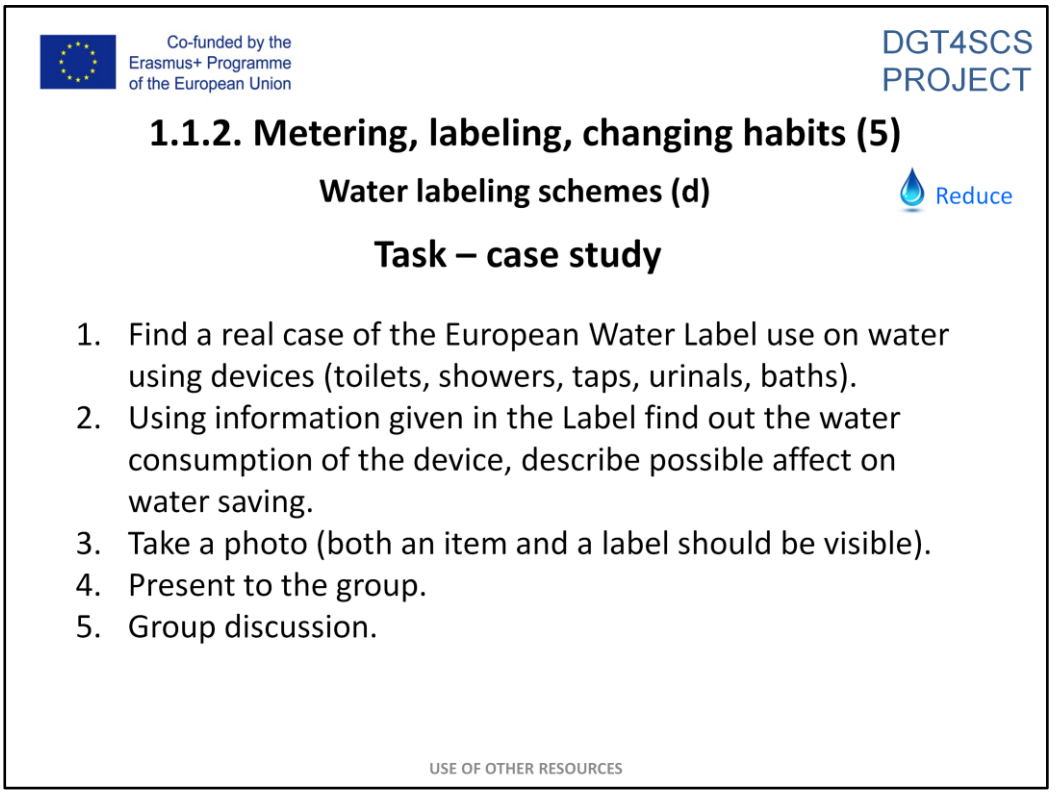
[5] Horizontal drum washing machine;

[2] Kitchen taps;

[4] Mixing taps;

[6] Impellor type washing machine.

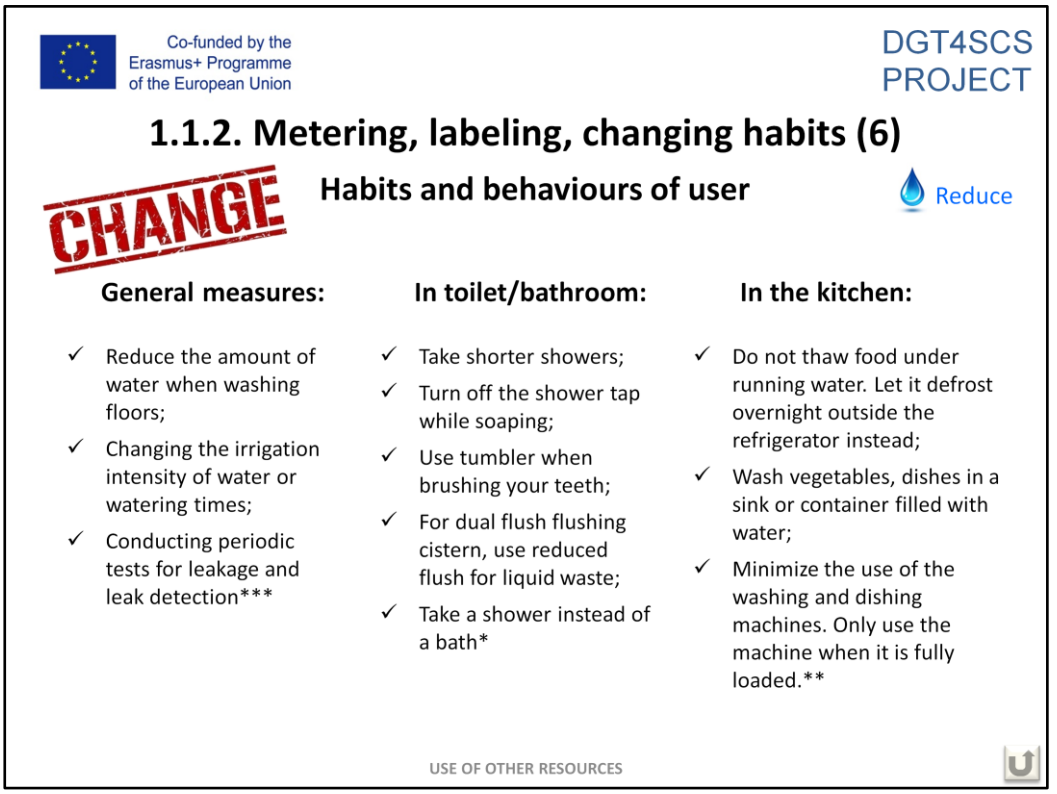
A trainer discuss with students the **water efficiency standards** for selected water-using device labeling schemes. The information is designed specially for trainers and students of EQF Level 5 and higher. Not for students acquired EQF Level 4**.**



Notes for the trainer and additional information:

Case study (home work + presentation in class)

Ask students to find a real case of the European Water Label use on water using devices in a shop, in residential, in the school/ office (toilets, showers, taps, urinals, baths), find out the water consumption of the device using information given in the Label, describe possible affects on water saving, take a photo (both an item and a label should be visible) and send to the teacher with description and present to the group. Students present results of their surveys in a class, a trainer discusses a case with students.



Source:

FORMAR. *Vocational training on sustainable buildings maintenance and refurbishment*. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

* bathing consumes 100 to 200 liters of water, showering - just 40 to 60 liters on average.
** never run washing machines and dishwashers half empty.
*** eliminate leaks, caulk around pipes and plumbing fixtures, conduct annual checks of hoses and pipes.

Other way of water consumption reduction in the household **is changing habits and behaviours of user.**
A trainer mentions some different measures related to “changing habits” and “changing behaviours” proposed to reduce water consumption.
In toilet/bathroom:

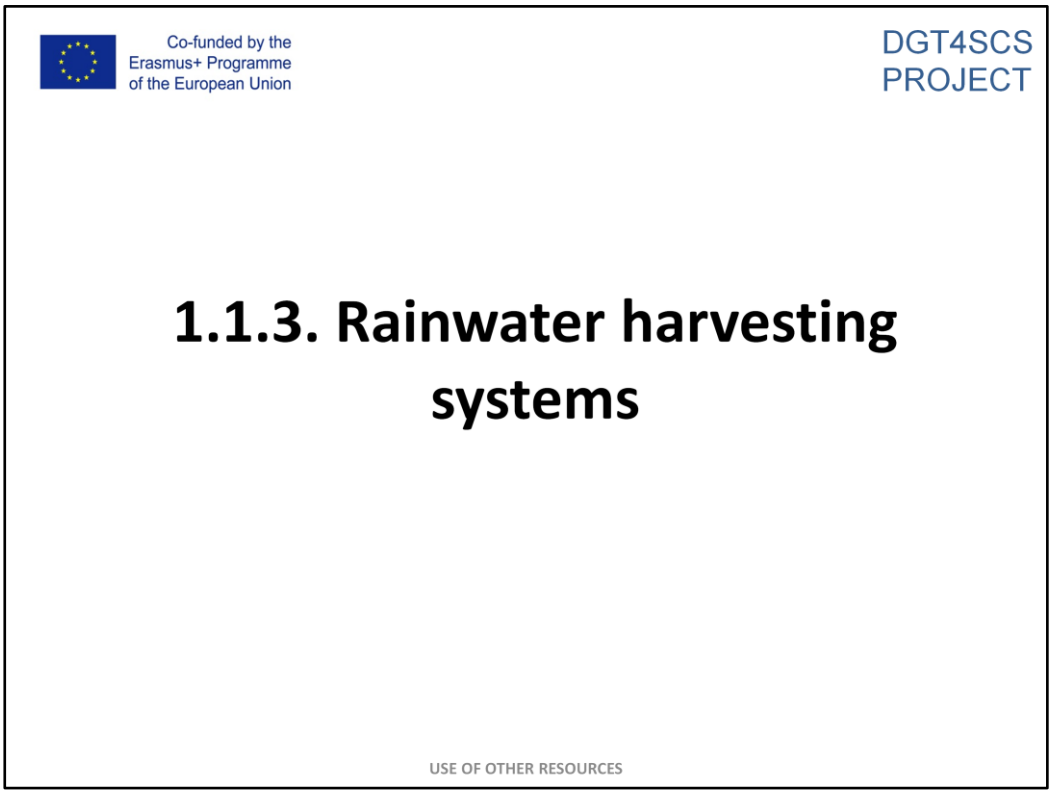
- change usage habits toilet to minimum discharges;
- change of habits in the shower and bath reducing the time of running water.

In the kitchen:

- changing human behaviour to minimize the use of the washing machine;
- changing human behaviour to minimize the use of the dishwasher.

General measures:

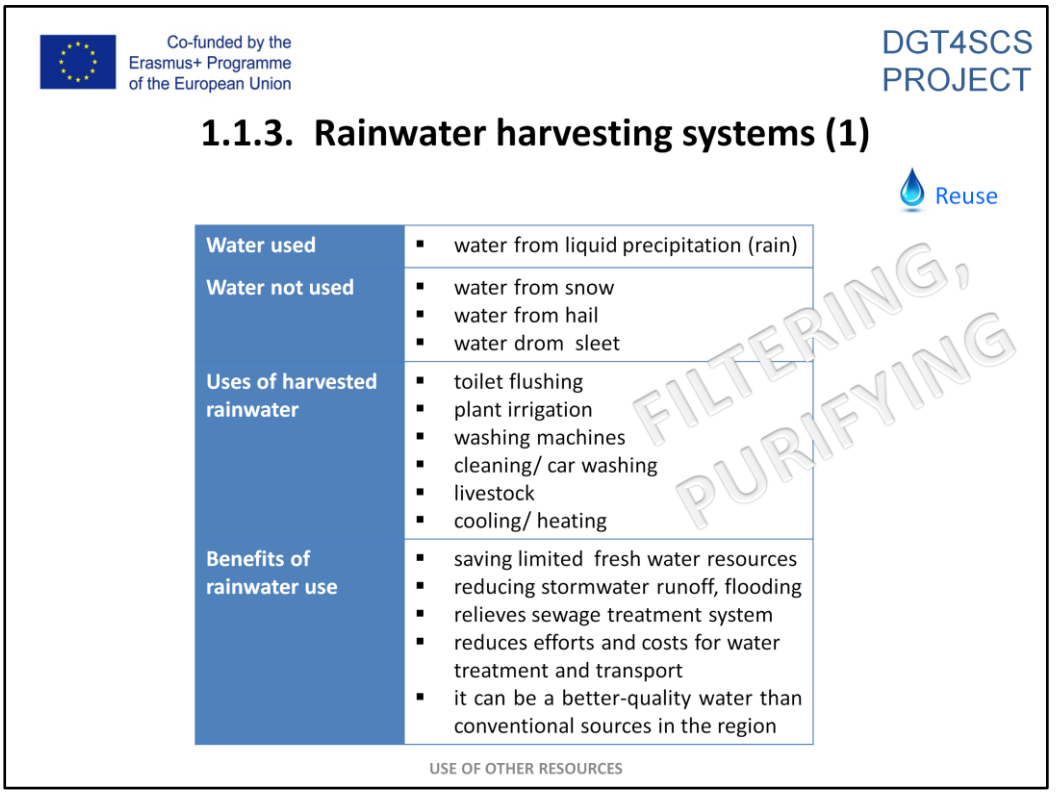
- modification of users’ habits to reduce the amount of water when washing floors;
- changing behaviours by changing the irrigation intensity of water or watering times in gardens;
- conducting periodic tests for leakage and leak detection.



Notes for the trainer and additional information:

Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation. Its uses include watering gardens, livestock, irrigation, domestic use with proper treatment, and domestic heating. The harvested water can also be committed to longer-term storage or groundwater recharge.
Rainwater harvesting is one of the simplest and oldest methods of self-supply of water for households, and residential.

See the next slides about the rainwater harvesting systems.



Source:

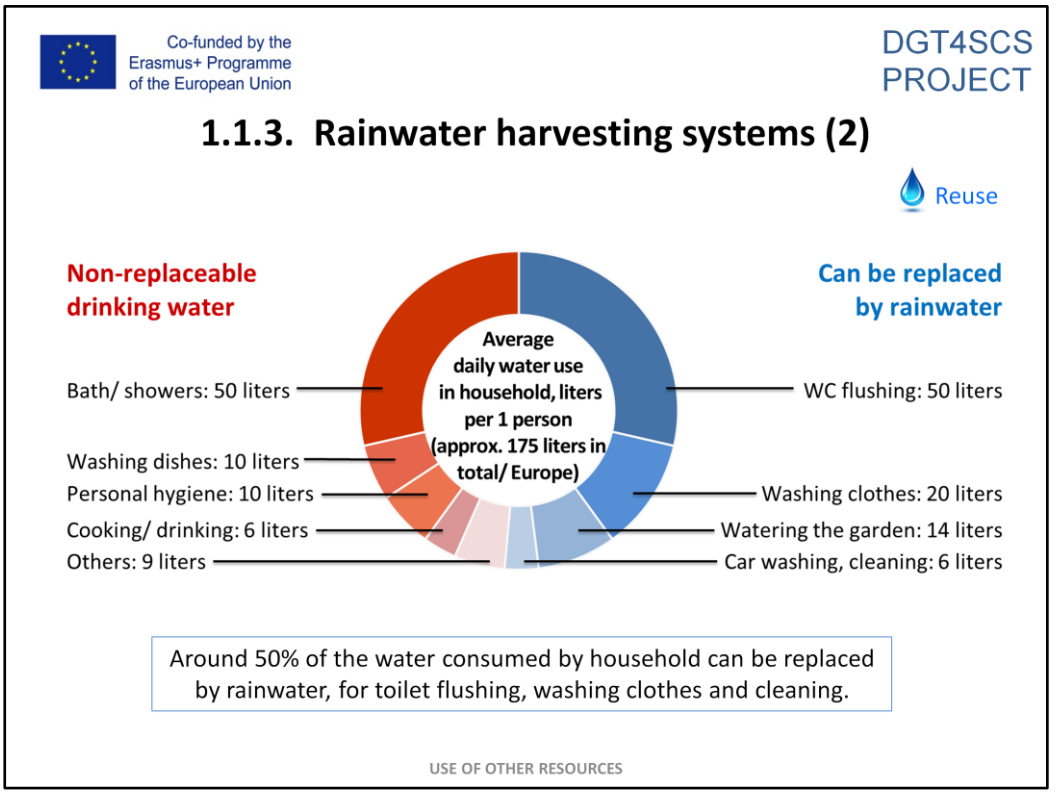
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 340-342 p.
Ways to use rainwater. Available from: https://www.speidel-regenwasser.de/en/rainwater-harvesting/ways-to-use-rainwater.html [Accessed 30 May 2020].
FORMAR. *Vocational training on sustainable buildings maintenance and refurbishment*. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

Rainwater - water from liquid precipitation, excluding water from snow, hail, and sleet, that has not entered a stream, lake, or other body of water.
Rainwater harvesting (RWH) - the collection, storage, and use of rainwater. Rainwater can be collected from many different surfaces (roofs, paved areas, etc) and then filtered in preparation for use. The best surfaces to harvest rainwater from are metal, clay, or concrete. Most systems use the roof surface as the collection area and a large galvanized steel, fiberglass, polyethylene, or ferrocement tank as the storage cistern.
After purification, rainwater is usually very safe and of high quality.

The Benefits of Rainwater harvesting and reuse:

1. saving limited water supplies (groundwater),
2. reducing stormwater runoff and flooding,
3. relieves city sewage treatment systems,
4. reduces efforts and costs for water treatment and transport,
5. it also can be a better-quality source of water than conventional sources in the particular area.



Source:
FORMAR. *Vocational training on sustainable buildings maintenance and refurbishment*. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

A trainer comments that valuable drinking water is too expensive for flushing toilets and irrigating gardens. It is possible to use water of lower quality for toilet and urinal flushing.
The average water consumption in household shows that around 50% of the water consumed can be replaced by rainwater, for example for WC flushing, washing clothes and cleaning.
A rainwater harvesting (RWH) system can cut domestic demand for drinking water by up **to 50%** and therefore also protect the environment. Using rainwater for toilet flushing, washing machines and watering the garden saves precious drinking water.

Co-funded by the Erasmus+ Programme of the European Union

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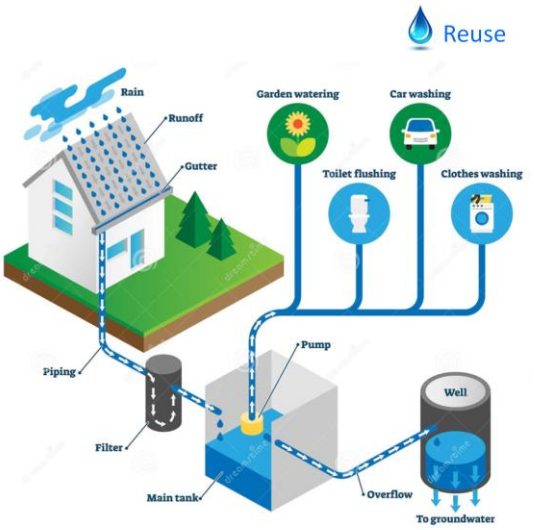
1.1.3. Rainwater harvesting systems (3)

- A rainwater harvesting system includes collection, storage, and use of rainwater. Rainwater is collected and then filtered in preparation for use.
- The roof surface is used as the collection area and a large tank as the storage cistern.

The general components:

- ✓ pre-filters
- ✓ drains/gutters
- ✓ storage containers
- ✓ pumps
- ✓ treatment devices
- ✓ chlorination devices
- ✓ post-filtration equipment



USE OF OTHER RESOURCES

Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 340-342 p.

Notes for the trainer and additional information:

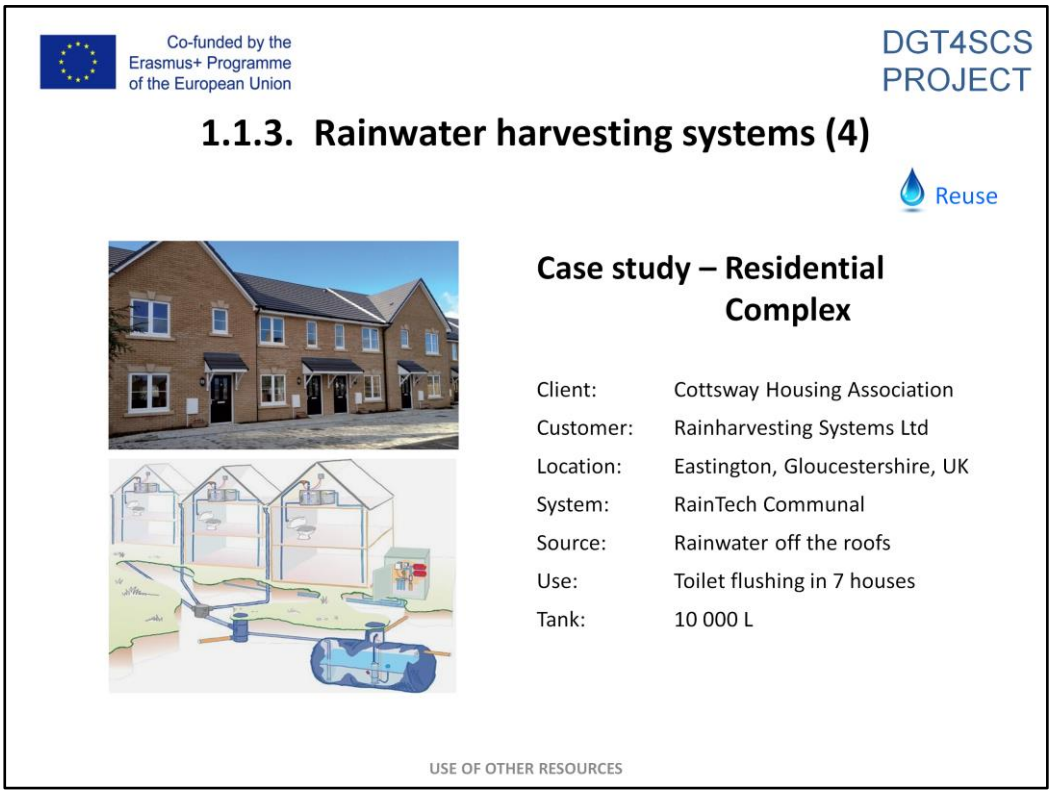
The main components of the RWH system are: (1) pre-filters, (2) drains/ gutters, (3) storage containers (4) pumps, depending on whether the system is pressurized, (5) treatment devices such as UV lights, (6) chlorination devices, (7) post- filtration equipment.
When the water is to be used just for landscape irrigation, **typically only sediment filtration is required**. When water is being collected and stored for potable uses, additional measures **are required to purify it and ensure its safety**.
RWH systems can **range in complexity**, from systems that can be installed with minimal skills, to automated systems that require advanced setup and installation. The basic system is more of a plumbing job than a technical job, as all the outlets from the building's terrace are connected through a pipe to an underground tank that stores water.
A trainer comments that there are several examples of good practices/ products ready to apply in buildings such as the ones shown in the slide.

Examples of **video** can be shown (for plumbers and experienced trainees)

- *"Rainwater harvesting for home and garden" GRAF.* Available from: https://www.youtube.com/watch?v=A8Mq7KQbiHQ [Accessed 1 November 2020].
- *"Operating and installing a rainwater harvesting system" GRAF*. Available from: https://www.graf-water.com/rainwaterharvesting/all-about-rainwater-harvesting/video-operating-and-installing.html [Accessed 1 November 2020].

Examples of rainwater harvesting systems (products):

1. More information for *Rainharvesting Systems Ltd* (UK) systems (principles, components) see here: https://www.rainharvesting.co.uk/rainwater-harvesting-products/ [Accessed 1 November 2020].
2. More information for *Speidel* (Germany) Solutions see here: https://www.speidel-regenwasser.de/en/service/brochures.html?file=files/regenwassernutzung/downloads/service/broschueren/speidel-rainwater-harvesting-2020.pdf [Accessed 1 November 2020].
   https://www.speidel-regenwasser.de/en/rainwater-harvesting.html [Accessed 1 November 2020].
3. More information for *Otto GRAF GmbH* (Germany)/ Graf UK systems (principles, components) see here https://www.graf-water.com/fileadmin/media/Catalogue_R37_Carat_EN.pdf [Accessed 1 November 2020].
4. More information for *Willo* Solutions see here https://wilo.com/lv/lv/S%C5%ABk%C5%86i-un-s%C5%ABk%C5%86u-sist%C4%93mas/S%C4%93rijas-mekl%C4%93%C5%A1ana/Wilo-RainSystem-AF-150_287.html [Accessed 1 November 2020].



Source:
https://www.rainharvesting.co.uk/portfolio/housing/ [Accessed 30 May 2020].
https://www.rainharvesting.co.uk/domestic-rainwater-harvesting/domestic-multi-home/ [Accessed: 30 May 2020].

Notes for the trainer and additional information:

A trainer briefly explains this case study. More detailed explanation can be given for students who learn plumbing and experienced students (according to level of knowledge).

Case study – in Residential Complex/ Social Housing, UK

- The system is designed around a single 10,000 liters tank supplying all 7 properties on the site. The harvested water is pumped to a small individual header tank in each dwelling.
- The header tanks are designed to take water from the rainwater store as long as it is available, but to automatically revert to running from mains water when the main tank runs low, or in the event of power failure. The central controls for the system are securely housed within an external, insulated and lockable enclosure and run from the landlords' power supply.
- Harvesting System: RainTech Communal. It is a **Single Rainwater Storage for multiple homes**. Designed for supplying multiple homes with rainwater from one central storage tank. This reduces capital cost of the system, and the associated installation costs. Can be used for toilet flushing, washing machines, irrigation, car washing.

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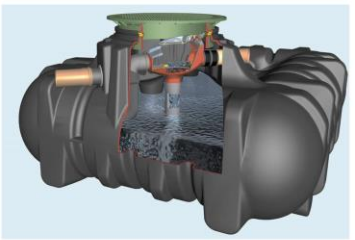
1.1.3. Rainwater harvesting systems (5)

Reuse



Case study – Residential Complex

Client:	Infrastruct CS Ltd
Customer:	Graf UK /Otto Graf GmbH
Location:	Bicester, Oxfordshire, UK
System:	The Platin flat rainwater tank
Source:	Rainwater off the roofs
Use:	Toilet flushing in 91 houses
Tank:	1500 L for each property

USE OF OTHER RESOURCES

Source:
https://www.grafuk.co.uk/north-west-bicester-oxfordshire/ [Accessed 30 May 2020].
https://www.graf-water.com/rainwater-harvesting/tanks-underground/rainwater-flat-tank-platin/platin-flat-tank.html [Accessed 30 May 2020].

Notes for the trainer and additional information:

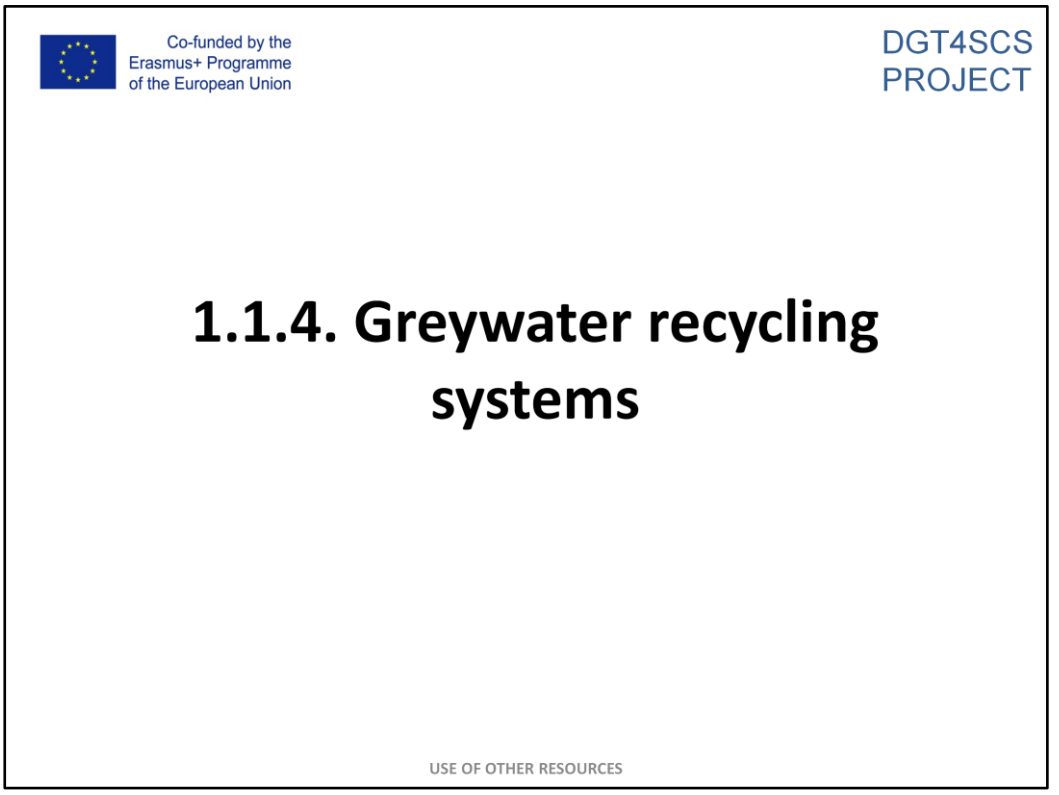
A trainer briefly explains this case study. More detailed explanation can be given for students who learn plumbering and experienced students (according to level of knowledge).

Case study – in Residential Complex

- A complete rainwater harvesting and stormwater management package for each of the **91 properties** – consisting of a 1,500L Platin rainwater harvesting tank and a soakaway made of Rain Bloc modules.
- The overflow pipe from each Platin rainwater harvesting tank feeds into individual soakaways, where water is gradually released back into the underlying ground conditions in a controlled way – reducing pressure on the drains and minimising flood risk
- The Platin tanks sit out of sight underground, and use submersible pumps to feed collected rainwater into a header tank in the loft of each home. The header tanks then gravity-feed the water to the properties' bathrooms, where it is re-used for sustainable toilet flushing.
- The system is engineered to use hardly any mains water, only diverting to the mains supply if the tank is empty (for example, after a particularly hot, dry spell).

*** **Extra Case**

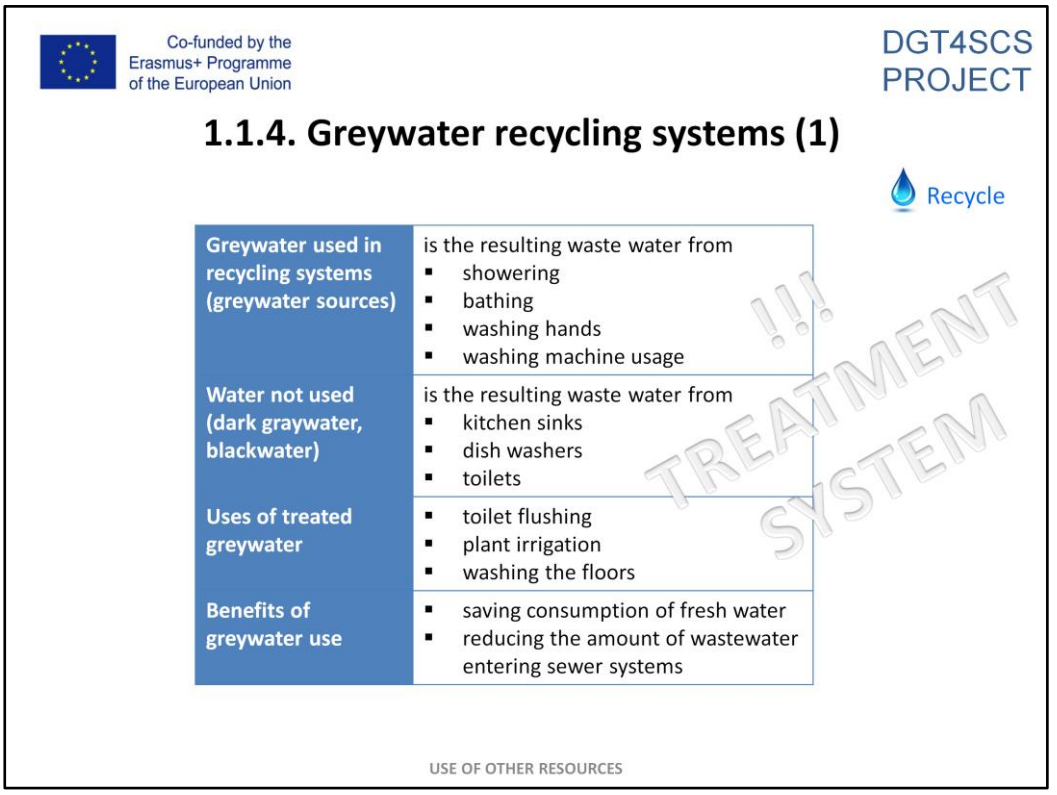
Willo systems in Residential house, Poland. Available from: http://zeus.org.pl/rozruch-wilo-rainsystem-af400/ [Accessed 1 November 2020].



Notes for the trainer and additional information:

Greywater generally is considered to comprise the nonhuman waste fraction of wastewater. Greywater collection involves separating greywater from blackwater, which, as defined previously, is the human waste–contaminated water from toilets and urinals. Greywater generally is used for landscape irrigation, but it also can be used to flush toilets and urinals.

See the next slides about greywater recycling systems.



Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 342-344 p.
FORMAR. *Vocational training on sustainable buildings maintenance and refurbishment*. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

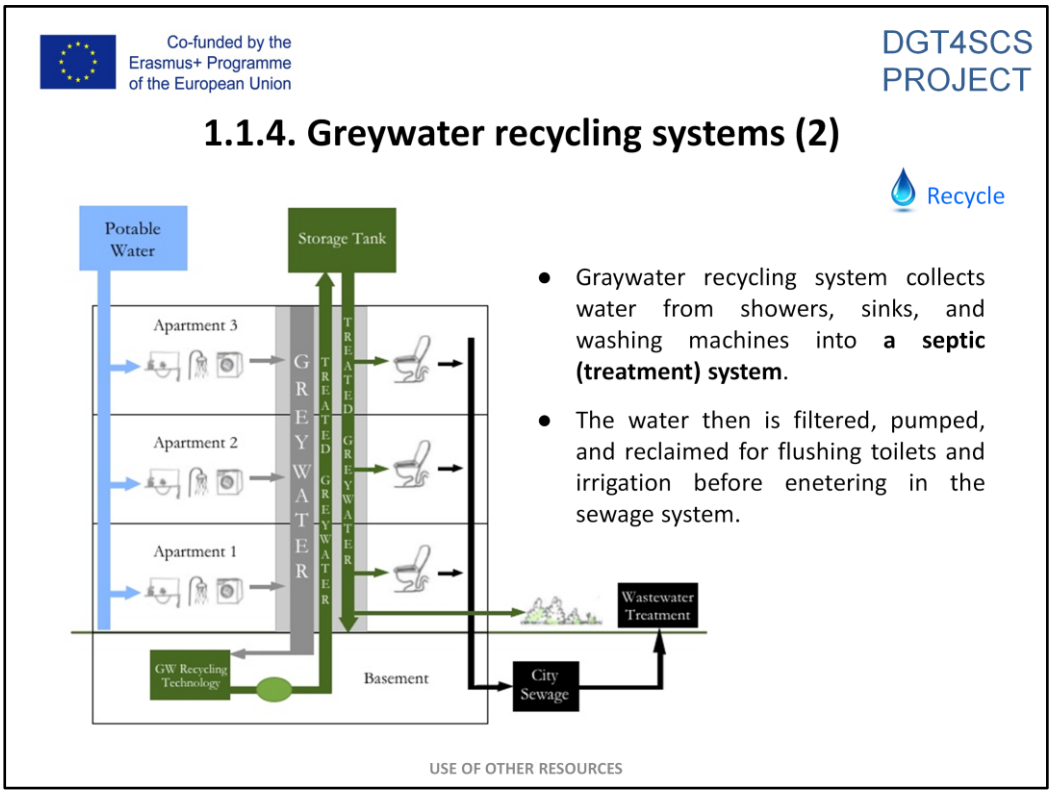
Greywater - is the wastewater generated in households or office buildings from streams without faecal contamination, i.e. all streams except for the wastewater from toilets. Water from (1) showers, (2) bathtubs, (3) bathroom sinks (washbasins), (4) washing machines (laundry), and (5) drinking fountains.

Greywater contains a minimum amount of contamination and can be reused for certain applications. Although greywater reuse still is being debated by public health officials, no case of illness has ever been traced to such reuse.

This greywater can be very economically and easily recycled, for example treating it for reuse in toilet flushing and irrigation. With **proper treatment** greywater can be put to good use. These uses include water for toilet flushing, and also irrigation of plants.
Treated greywater can be used to irrigate both food and non food producing plants. The nutrients in the greywater (such as phosphorus and nitrogen) provide an excellent food source for these plants.

The Benefits of Greywater reuse.
Re-using water does not diminish our quality of life, however it can provide benefits on many levels.
Two major benefits of greywater use are:

1. Reducing the need for fresh water. Saving on fresh water can significantly reduce household water bills, but also has a broader community benefit in reducing demands on public water supply.
2. Reducing the amount of wastewater entering sewers or on-site treatment systems. Again, this can benefit the individual household, but also the broader community.



Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 342-344 p.

Notes for the trainer and additional information:

Greywater recycling system allows to use harvested water for another purpose **after treatment.**

How Is **The Greywater Treated For Reuse.**
There are many ways to treat greywater so that it can be re-used. The various methods used must be safe from a health point of view and not harmful to the environment.
The main components of the greywater recycle system are:
1) greywater buffer tank – collects the incoming water for treatment;
2) aerator (blower) - supplies water with oxygen and keeps membranes free from dirt deposits during treatment process;
3) membrane filters - the specialized hollow membrane fibres reliably prevent passage of bacteria and viruses;
4) a filtration pump, backwash pump, backwash tank;
5) clear water storage tank – keeps water available for use;
6) recycling controller and control module – monitors and controls the treatment process.

All components are connected in one system.

Greywater should not be stored for extended periods of time before use. If a filter is used in the greywater system, it should be one that is easy to clean or self-cleaning. Filter maintenance is a major problem with many greywater systems.

A trainer comments that there are several examples of good practices/ products ready to apply in buildings such as the ones shown in the slide.

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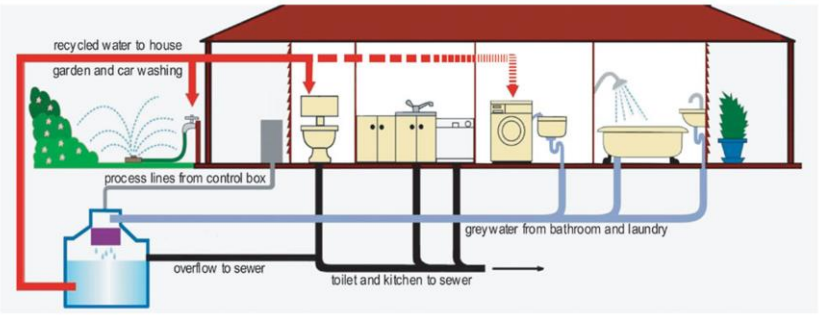
1.1.4. Greywater recycling systems (3)

Recycle



In a greywater recycling system, two pipes are used:

- one pipe removes "blackwater" from toilets, "dark greywater" from kitchen sinks directly into the sewage system;
- the other pipe removes the "**light greywater**" (**bathing, laundry, bathroom sink water**), and transfers it to a tank where **it is treated**;
- the treated greywater is returned to the house for reuse (flushing toilets, irrigation).

USE OF OTHER RESOURCES

Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 342-344 p.

Notes for the trainer and additional information:

Buildings with greywater systems must have dual waste piping systems, one for each type of water. Greywater waste lines should run to a central location where a surge tank can collect and hold the water until it drains or is pumped into an irrigation system or for other appropriate end uses. An overflow for the greywater collection system should be provided that feeds directly into the sewer line.

A trainer comments that there are several examples of good practices/ products ready to apply in buildings such as the ones shown in the slide.

Examples of greywater recycling systems (products) for plumbers and experienced trainees**:**

1. More information for *INTEWA GmbH* systems (principles, components) see here:
   Greywater Recycling. Hotels Schools, Offices Apartment Buildings Sport and Fitness Centres. 16 p.
   Available from:
   https://www.intewa.de/en/products/brochures/?jumpurl=uploads%2Fmedia%2FINTEWA-Greywater_commercial_01.pdf&juSecure=1&mimeType=application%2Fpdf&locationData=1691%3At_content%3A21246&juHash=804405d725018e367abfeccc0c64ae2f6e097b15 [Accessed 1 November 2020].
2. More information for *Hans HUBER AG* Solution see here (on 12 page):
   Huber Solutions for Global Water Challenges. Available from:
   https://www.huber.de/fileadmin/02_solutions/06_Global_Water_Challenges/en_Prospekt_Huber_Solutions_for_Global_Water_Challenges.pdf [Accessed 1 November 2020].

Source:

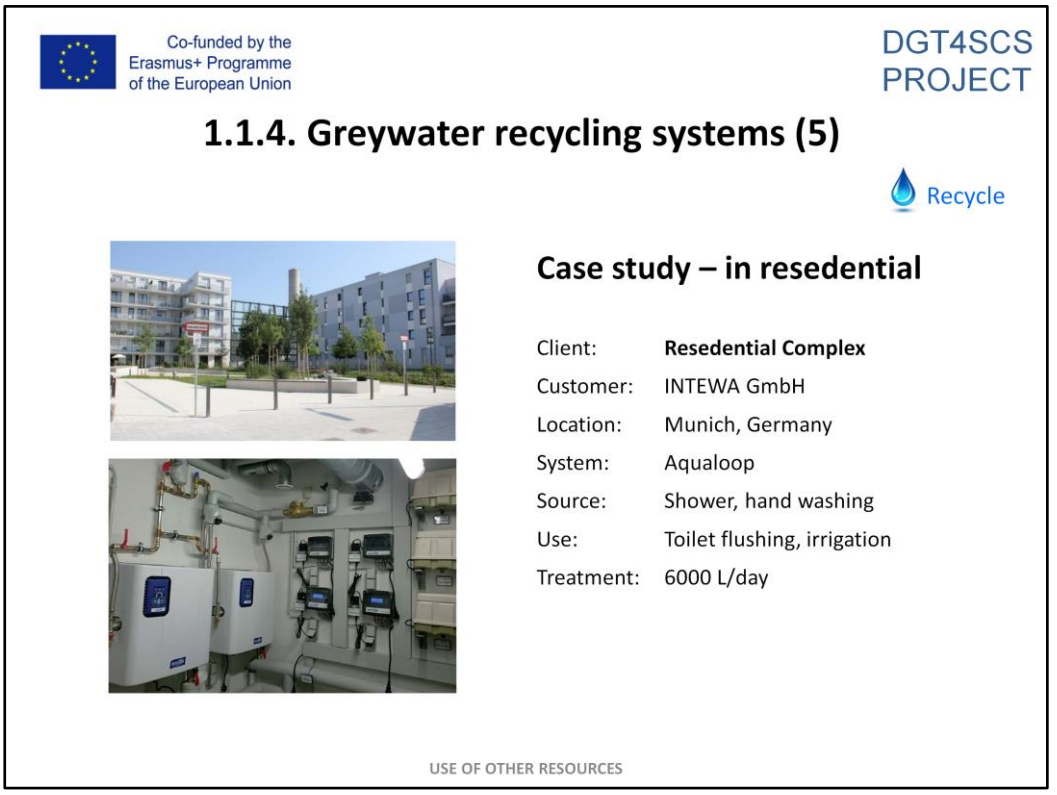
https://www.mosaichouse.com/sustainability/ [Accessed 30 May 2020].
https://www.ambientgreen.com/2017/09/hotel-grey-water-system-with-heat-recuperation [Accessed 30 May 2020].
https://pro.hansgrohe-int.com/5363.htm [Accessed 30 May 2020].
https://pro.hansgrohe.co.uk/4284.htm# [Accessed 30 May 2020].

Notes for the trainer and additional information:

A trainer briefly explains this case study. More detailed explanation can be given for students who learn plumbing and experienced students (according to level of knowledge).

Case study – in hotel Mosaic House:

- The shower water used by up to 236 guests, which averages out over a year at nine cubic meters per day, flows through the Pontos AquaCycle 6000HC* grey water recycling system.
- The water used for flushing the toilets, watering the plants, and washing the floors. The system saves around 4,000 liters of water daily.



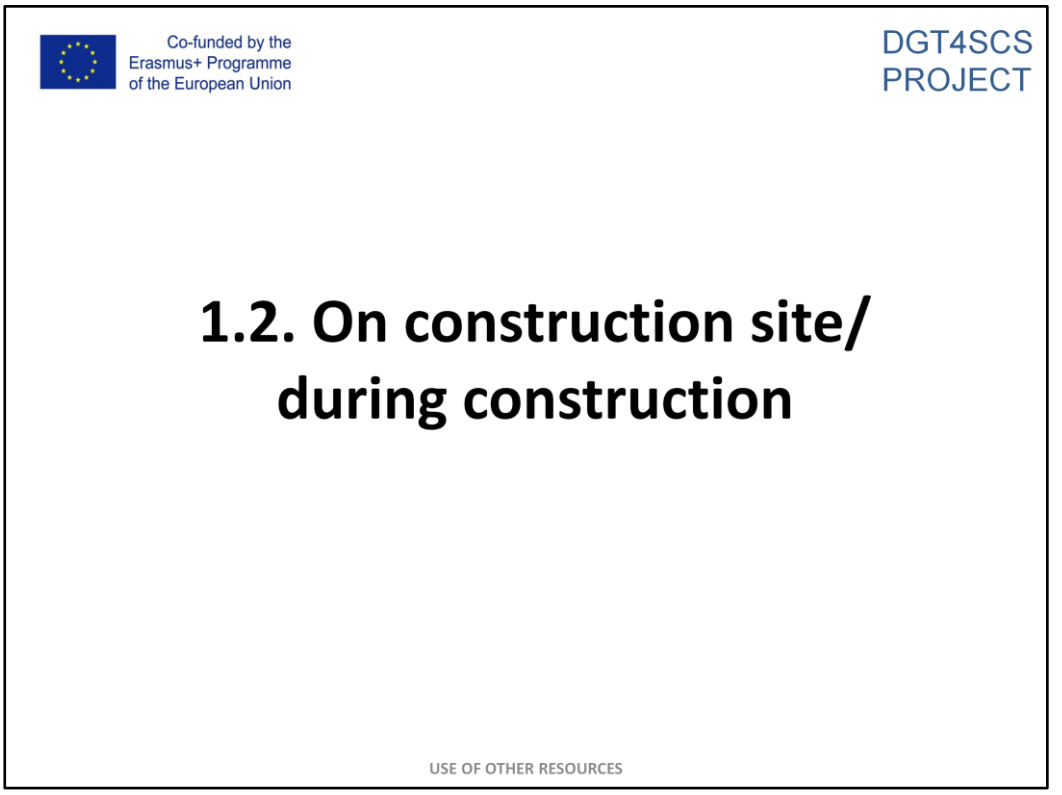
Source:
https://fr.intewa.net/fileadmin/user_upload/documents/Referenzen/AQUALOOP/AL_Wohnpark_Muenchen_2_EN.pdf [Accessed 30 May 2020].
https://www.intewa.de/en/products/brochures/?jumpurl=uploads%2Fmedia%2FINTEWA-Greywater_commercial_01.pdf&juSecure=1&mimeType=application%2Fpdf&locationData=1691%3Att_content%3A21246&juHash=804405d725018e367abfeccc0c64ae2f6e097b15 [Accessed 30 May 2020].

Notes for the trainer and additional information:

A trainer briefly explains this case study. More detailed explanation can be given for students who learn plumbing and experienced students (according to level of knowledge).

Case study – in Resedential Complex/Apartment Building:

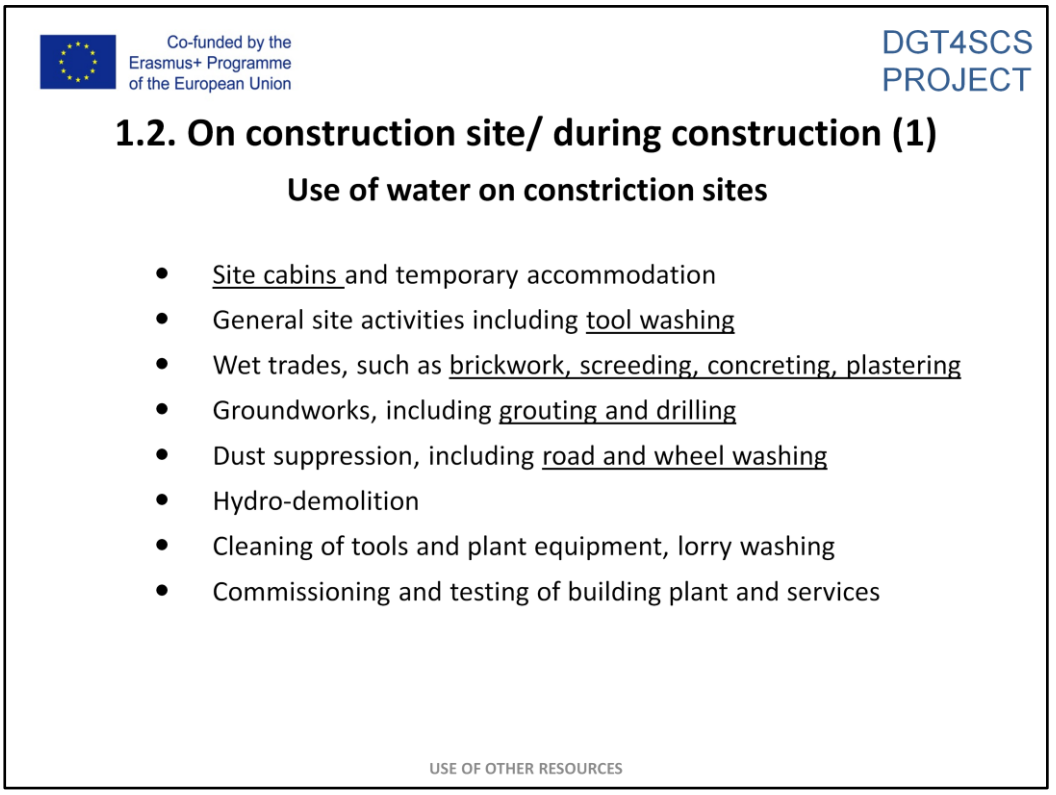
- Germany is a water-rich country, but German frugality means installing AQUALOOP was a great investment. These apartment blocks in Munich are the first of many to squeeze as much value from recycled water as possible. The system will produce enough water to flush the toilets 800 times daily.
- The greywater from showers, bathtubs, and sinks is pre-filtered by a filter before being sent to the bioreactor. This is where the biological treatment is found. The skimmer overflow removes the floating debris. With 4 AQUALOOP Stations in the bioreactor, the water will be ultrafiltered and supplied to a treated water storage tank.
- A supply pump in the treated water storage delivers the treated clear water to a pump and control centre. From there, the toilet system is supplied. The grounds irrigation is achieved with a frequency-controlled double-pump system.



Notes for the trainer and additional information:

The following slides give information of efficient water use during carrying out construction work on the sites. Subtopic considers (1) tips and practices that can be used for saving water on construction sites in general and (2) more specific issue about water use in facade insulation works, which is specially designed as training material and task guide for vocational trainers.

The main objectives of this subtopic is to find out items with the highest water consumption in the construction process, approaches and strategies for minimizing water consumption in construction, as well as to make students to think about water usage carrying out specific construction work (e.g. wall insulation). It is highlighted, that construction works are carried out in accordance with the technical procedure and that quality of implemented work shouldn't be affected by minimized water use (e.g. wall insulation). **That's why efficient use of water in construction is possible and should be assured only if quality isn't affected**.



Source:

Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

A trainer names key water using processes on constriction sites.

The function of water in the construction process can be:

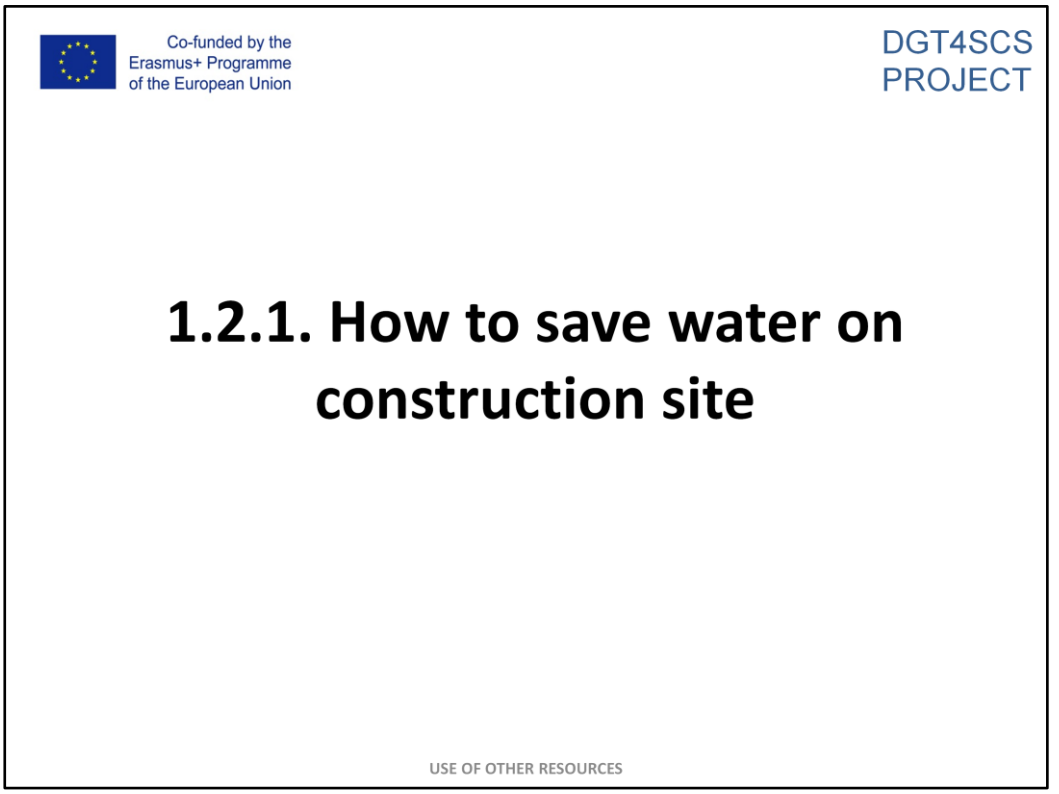
- **As an essential component of the process**. It refers to those activities of the items that use water as an essential element, which, without it, such action would be impossible to perform. Example: concrete, pastes, mortars, plasters, water paints, compaction process and others.
- **As part of the process or material**. It refers to those activities of the items that use water as material or in some part of the construction process when developing the different activities of a given item. Ex: irrigation of formwork, curing of concrete, mortars and plasters, as refrigerant and others.
- **As auxiliar.** It refers to those activities of the items that use the water as an auxiliary to be able to develop in a suitable way the different activities of the item. Ex: cleaning of formworks, tools and equipment and others.
- **As part of the controls or tests**. It refers to those items or activities part of the construction process that need controls or tests. Ex: to make test tubes and cure them in water to verify their resistance, also in the part of the hydraulic installations it is necessary to prove its correct installation, as well as in the windows and cover verifying its impermeability.

Source:
"Water - Sustainability Short" Available from: https://www.youtube.com/watch?v=jkX-1cCXk8Y&feature=youtu.be [Accessed 11 November 2020].
Saving Water. Water use in the building industry. Available from: https://www.smartwatermark.org/smartwateradvice/saving-water-business/building-industry/saving-water/ [Accessed 1 November 2020].

Notes for the trainer and additional information:

A video about water use in construction can be shown to the audience. A trainer chooses one according to trainees' knowledge an qualification.

The example is given here.
In this short animated video it is discussed why water is a significant issue for the construction sector, the impacts it can have on our work and livesp, possibilities to reduce water consumption and more efficient use of water by construction specialist.

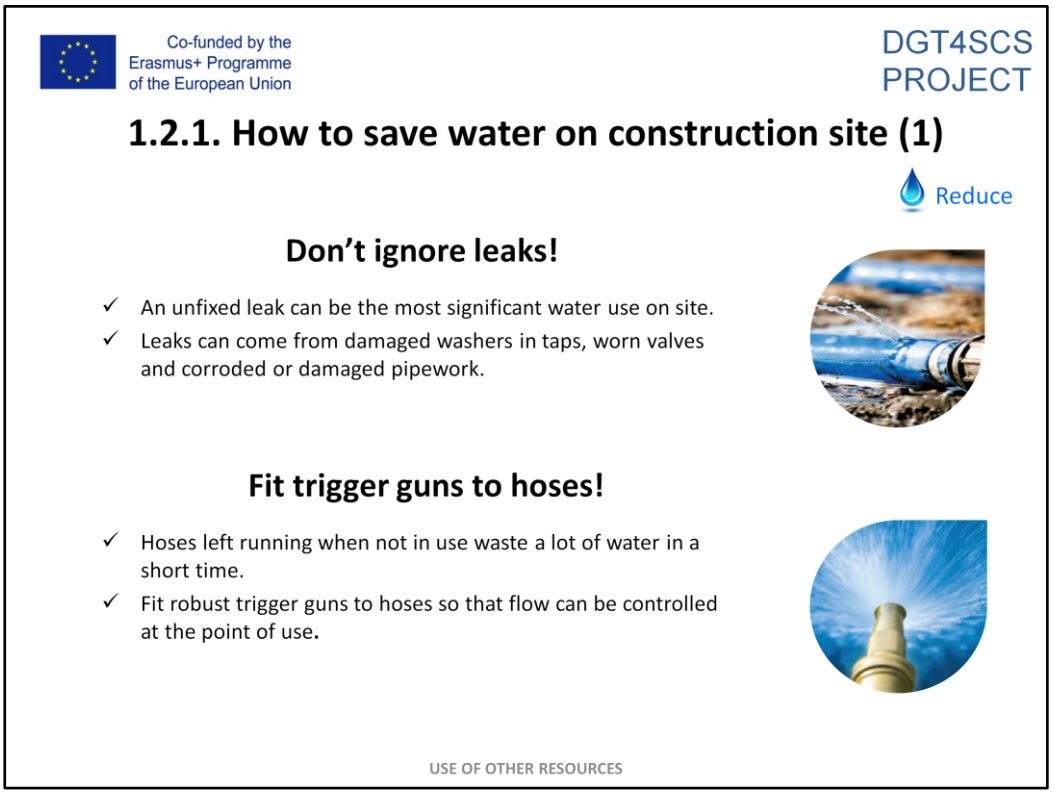


Notes for the trainer and additional information:

Nowadays relatively little work has been carried out on water sustainability on construction sites. Water use is considered a relatively low priority in comparison to the focus on reducing waste and improving the carbon footprint. Current knowledge of water usage and amount on construction sites is limited. It should be continued to collate water use data from construction sites.

For ensuring efficient (economical) water use on construction site it is **important to undertake activities for raising/ improving construction workers' and technicians' understanding about better use of water resources.**

This subtopic provides information about general tips and practices that can be used for reducing water consumption on construction sites and about items with the highest water consumption in the construction process on the site. It is a general subtopic.



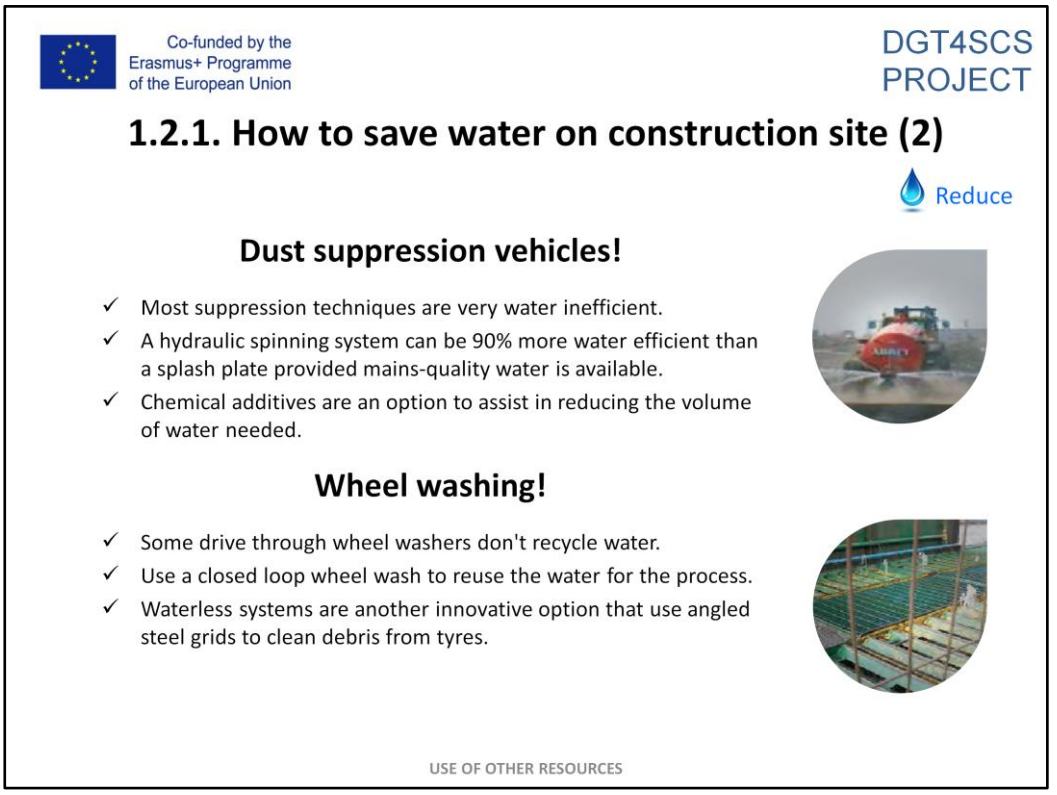
Source:

How to save water on your construction site. Water Saving Guide. Strategic Forum for Construction and WRAP. 2012. 4 p. Available from: https://ccsbestpractice.org.uk/wp-content/uploads/2016/11/Water-Saving-Guide.pdf [Accessed 31 May 2020].

Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this and next 7 slides can save about 15 - 25% of water consumption during construction project implementation.



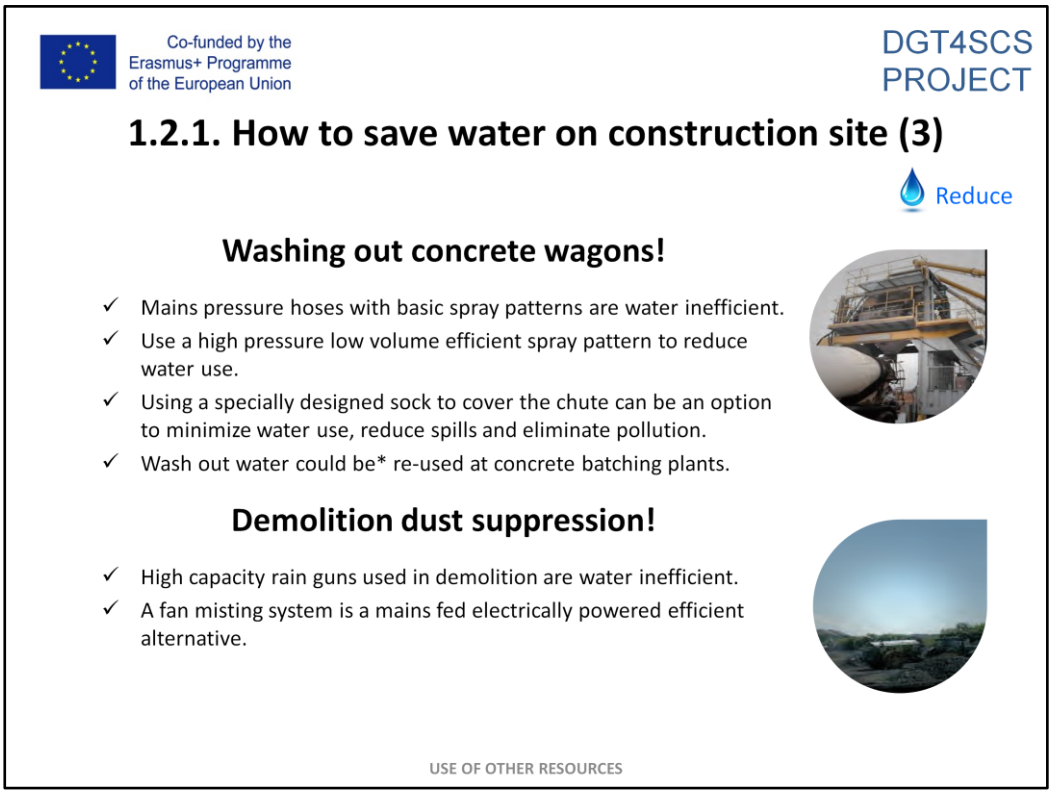
Source:
How to save water on your construction site. Water Saving Guide. Strategic Forum for Construction and WRAP. 2012. 4 p. Available from: https://ccsbestpractice.org.uk/wp-content/uploads/2016/11/Water-Saving-Guide.pdf [Accessed 31 May 2020].
Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this, previous and next 6 slides can save about 15 - 25% of water consumption during construction project implementation.

Dust suppression
Methods used on the sites range from simple pouring or spraying of water to the use of bowsers for larger areas (e.g. roads). Just raising staff awareness of water costs and impacts motivating them the use of spraying instead of pouring of water can improve water use efficiency. The use of water efficient nozzle technology to create a more efficient spray pattern for dust suppression and/or the use of dust wetting additives will improve water efficiency of the bowsers.

Wheel washing
The elements of poor practice in this activity on some sites are common.
For instance, leaving the inlet to the wheel wash storage tank open during normal hours of operation results in water being unnecessarily used on a continual basis. Estimated savings of 75% can be identified from the installation of simple engineering controls.



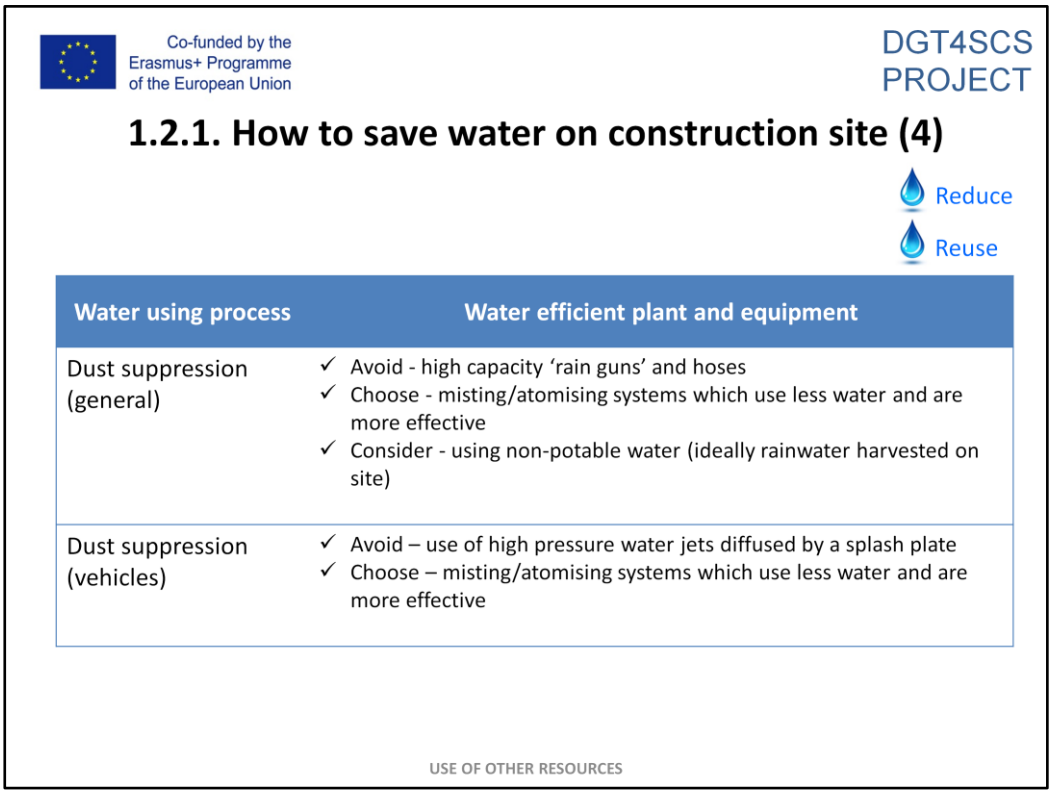
Source:
How to save water on your construction site. Water Saving Guide. Strategic Forum for Construction and WRAP. 2012. 4 p. Available from: https://ccsbestpractice.org.uk/wp-content/uploads/2016/11/Water-Saving-Guide.pdf [Accessed 31 May 2020].
Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this, 2 previous and next 5 slides can save about 15 - 25% of water consumption during construction project implementation.

Cleaning activities (general)
A number of different cleaning activities have been identified; there is potential to improve the water efficiency of all cleaning activities. For instance, through the use of high pressure, low volume pressure washers, and the use of trigger operated spray guns on hoses.

Washing out concrete wagons
There is potential for better collection of rinse water from concrete lorries to maximise the recycling of unused product and water that could improve water efficiency. Furthermore the possibility of reduced costs associated with wastewater disposal are being studied; the cost savings from this could be used to off-set the cost of water efficiency measures for other areas of the construction site.



Source:
The Business Case for improving water efficiency on site. Waste & Resorces Action Programme. Available from: https://www.wrap.org.uk/sites/files/wrap/Water%20efficiency%20during%20construction%20RE%20Business%20Case_0.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this, 3 previous and next 4 slides can save about 15 - 25% of water consumption during construction project implementation.

Dust suppression (extra information)
Use of abstracted water where available should be considered – to offset mains or tankered water supplies. Abstracted water will be lower cost & reduces the need to treat water that does not need to be of a potable standard. **Rainwater harvesting** on site can be considered as well.

Co-funded by the Erasmus+ Programme of the European Union

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1.2.1. How to save water on construction site (5)

Reduce

Water using process	Water efficient plant and equipment
Road sweeping	✓ Avoid - use of an open hose ✓ Ensure -operators are trained in water efficient practices, that vehicles have adjustable spray bars/nozzles and that any stand-alone washers are high pressure (low flow) with trigger controls ✓ Consider - water recirculation systems
Wheel washing	✓ Avoid - manual wheel washing (except when the need is very limited) ✓ Choose - drive-on recirculating systems with a sensor-controlled shut off (where demand is ongoing) ✓ Ensure - Water top-up to settlement tank is controlled (e.g. a float valve), supply pressure reflects site conditions and that the filter in the settlement tank is kept clean to avoid overflows

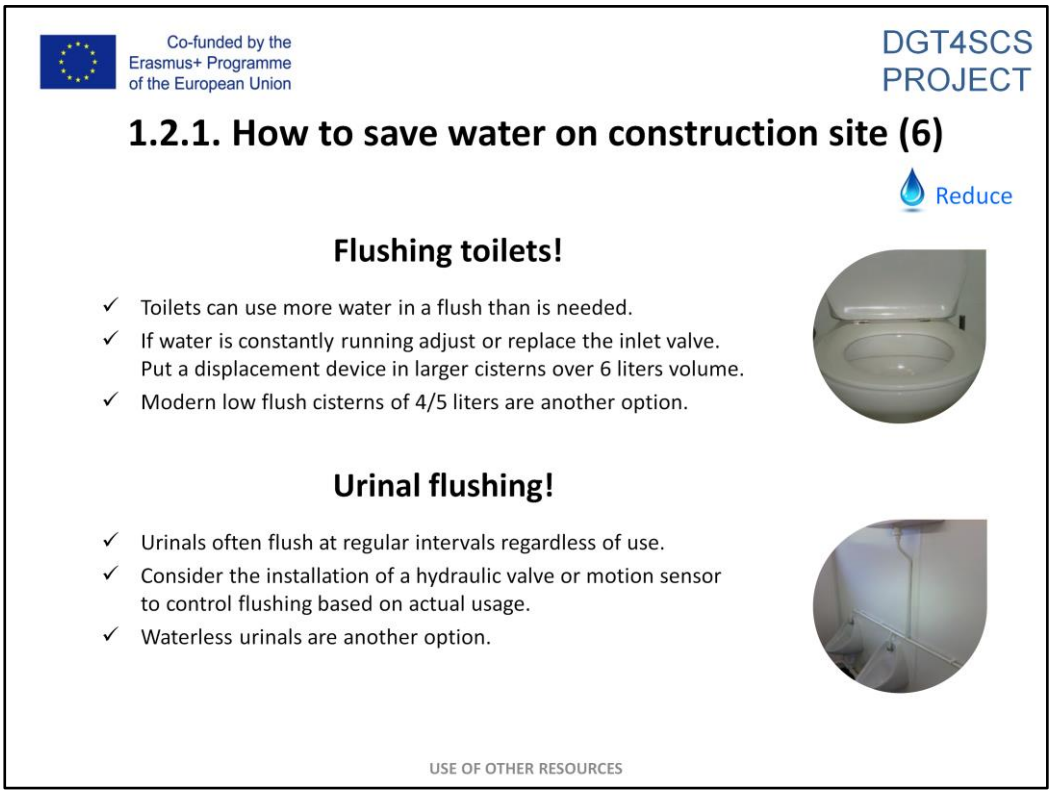
USE OF OTHER RESOURCES

Source:

The Business Case for improving water efficiency on site. Waste & Resorces Action Programme. Available from: https://www.wrap.org.uk/sites/files/wrap/Water%20efficiency%20during%20construction%20RE%20Business%20Case_0.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this, in 4 previous and in the next 3 slides can save about 15 - 25% of water consumption during construction project implementation.



Source:

How to save water on your construction site. Water Saving Guide. Strategic Forum for Construction and WRAP. 2012. 4 p. Available from: https://ccsbestpractice.org.uk/wp-content/uploads/2016/11/Water-Saving-Guide.pdf [Accessed 31 May 2020].

Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this, 5 previous and next 2 slides can save about 15 - 25% of water consumption during construction project implementation.

Flushing toilets/ urinals

Specifying of water efficient toilets and water using fittings in site offices delivers quick savings.

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DGT4SCS PROJECT

1.2.1. How to save water on construction site (7)

Reduce

Running taps!

- ✓ Flow from taps is often more than is needed.
- ✓ Consider adapting taps by either fitting a flow regulating or aerating tap insert.
- ✓ Changing the tap is another option. Turn taps off.

Commissioning water use!

- ✓ High volumes of water are used during building envelope and services commissioning and testing.
- ✓ Plan for these activities considering water recirculating and minimisation. The water used for flushing building services should be isolated as soon as possible after the flush water turns clear.

USE OF OTHER RESOURCES

Source:

How to save water on your construction site. Water Saving Guide. Strategic Forum for Construction and WRAP. 2012. 4 p. Available from: https://ccsbestpractice.org.uk/wp-content/uploads/2016/11/Water-Saving-Guide.pdf [Accessed 31 May 2020].

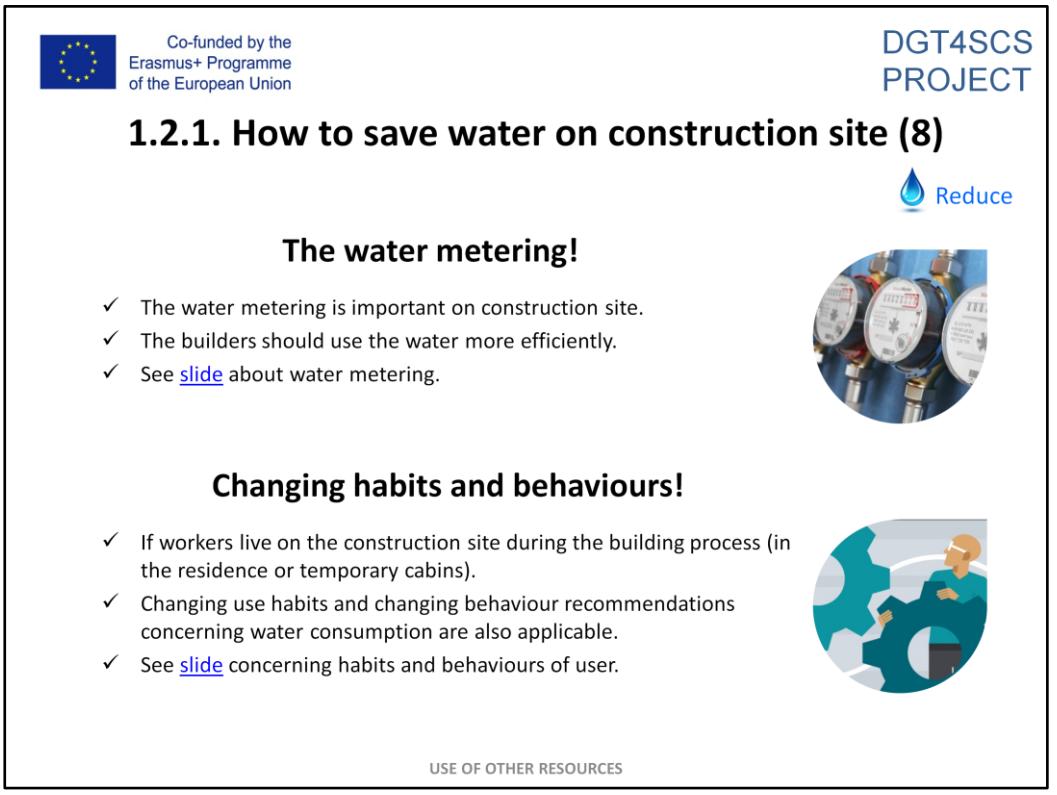
Waylen C., Water: A progress report on reducing water use on construction sites. Construction Products Association, 2011. 17 p. Available from: https://waterwise.org.uk/wp-content/uploads/2019/09/WRAP-2008_Water_A-Progress-Report-on-Reducing-Water-Use-on-Construction-Sites.pdf [Accessed 31 May 2020].

Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this , 6 previous and next 1 slides can save about 15 - 25% of water consumption during construction project implementation.

Running taps

Specifying of water efficient taps and water using fittings in site offices delivers quick savings.



Notes for the trainer and additional information:

The specific tips and key opportunities on how to reduce water use on construction site is provided here. The tips and methods outlined in this and in 7 previous can save about 15 - 25% of water consumption during construction project implementation.

The water metering

It is monitoring and targeting – including sub-metering key areas such as welfare water and any water used for hydro-demolition or commissioning (e.g. of swimming pools). Tracking usage over time will show where water is being used and will help identify leaks or inefficiencies.

For extra information about water metering **see slide No 37** in this training material.

Changing habits and behaviors

The cultural differences across the construction work teams in different countries so far is vast, ranging from those that believe water use should be minimised (almost regardless of cost impact) to those that view water as a cheap commodity with a 'don't pay, don't care' attitude.

For extra information concerning habits and behaviors of user **see slide No 42** in this training material.

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DGT4SCS PROJECT

1.2.1. How to save water on construction site (9)

Cleaning paint Brushes and Rollers

Reduce

- wash brushes and rollers in a pail using as little water as possible;
- don't flush them under running water;
- re-use the water used to clean painting equipment where practicable (for example, use it for cleaning again the following day);
- transfer the water used to clean one roller tray into the next tray to be cleaned, and so on.

NB! Water is used for cleaning brushes from water based paint.

https://www.youtube.com/watch?v=mJr0lc5dDl0&feature=youtu.be

USE OF OTHER RESOURCES

Source:

Tips for Cleaning Brushes (The Journal of Light Construction). Available from: https://www.youtube.com/watch?v=mJr0lc5dDl0&feature=youtu.be [Accessed 31 May 2020].

BruKon- Paintbrush cleaning and storage made EASY! Available from: https://www.youtube.com/watch?v=8L9bMsYbygA&feature=youtu.be [Accessed: 31 May 2020].

Notes for the trainer and additional information:

Solvent based paint waste contains many organic solvents and compounds. These substances don't mix well with water. Water based (latex) paint contains a solid pigment that can increase the turbidity of water. The paints contain biodegradable substances. Tools can be cleaned by water.

Quite often workers (painters) wash brushes, rollers and trays by flushing them under running water, and it causes the excessive consumption of water. There is procedure and practical **tips for** cleaning tools from paint which ensure minimum loses of material (paint), minimum wastage and **minimum water** or solvent used. More detailed information concerning tools' cleaning students acquire during particular training module within their educational programme.

A **video** about tips for cleaning brushes can be shown to the audience. A trainer can give students an extra example of paint brush cleaning product *BruKon* and show them video, too.

Connection to other topics within the training material

"Waste Management"

Cleaning paint brushes and other painting tools is an environmental problem. Large amounts of paint from washing brushes end up in the sewage system.

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DGT4SCS PROJECT

1.2.1. How to save water on construction site (10)

Example - a dry mortar (super glue) for masonry

Reduce

Product - Porotherem Dryfix, Wienerberger

- Generally the maximum water use in masonry construction happens during:
  a) preparation of sand, cement mortar;
  b) curing of walls before/ after plastering.
- Dry mortar or super glue removes the need of wet mortar and drastically reduces the requirement of water for any wall construction (infill masonry or partition walls as well as external walls).

USE OF OTHER RESOURCES

Source:

Saving water during construction. Available from: https://www.wienerberger.in/saving-water-during-construction.html [Accessed 31 May 2020].

Dryfix.System: Smart Bricks offer Smart Solutions. Available from: https://www.wienerberger.in/products/wall/smart-bricks-offer-smart-solutions.html [Accessed 31 May 2020].

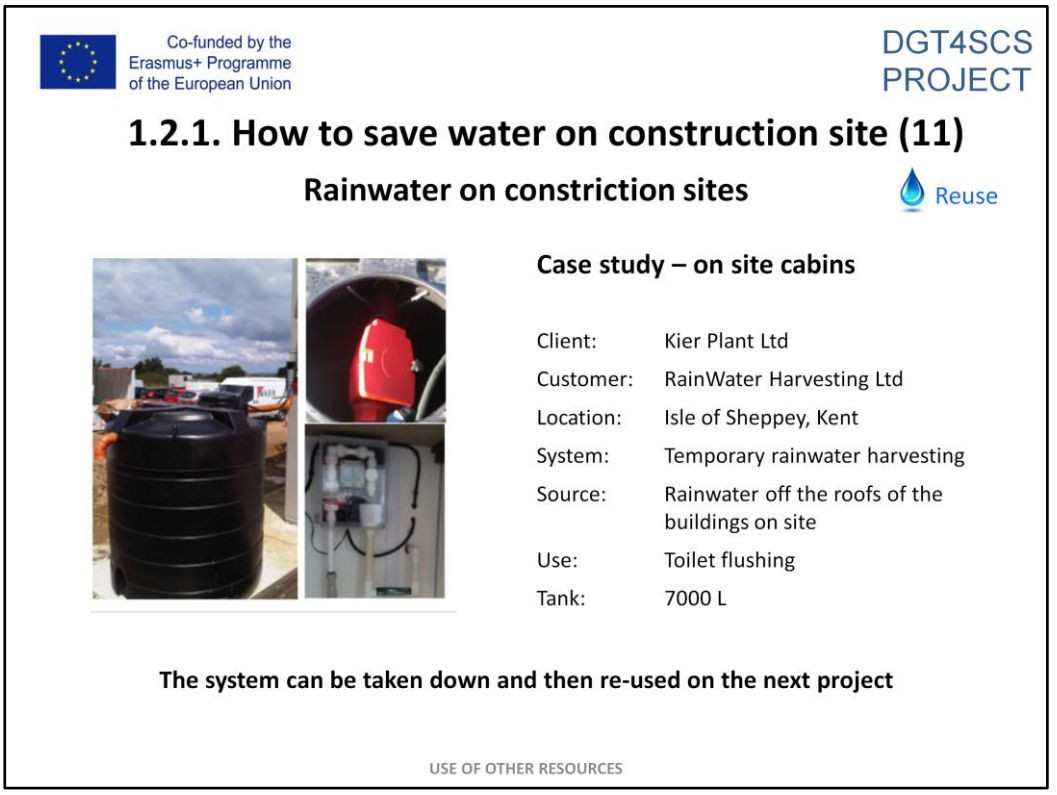
Wienerberger Dryfix precision ground block adhesive. Available from: https://www.youtube.com/watch?v=4oSshtigC4A [Accessed 31 May 2020].

Notes for the trainer and additional information:

According to statistics, we waste on an average 23 liters of water per 1 m^2 of wall construction. Saving water during wall construction can significantly reduce water consumption.

An example of the modern, innovative and sustainable solution for masonry construction can be given by the trainer to students. A group discussion is advisable for more experienced students in line with qualification is acquired.

The *Dryfix.System* produced by Wienerberger is Sustainable, Green Solution to save water, sand, time. It is perfect replacement for cement, mortar and helps build walls by saving natural resources like water and sand. It is a super glue that removes the need for water in wall construction by eliminating the practice of curing. The benefits include: No sand – No Mortar; No Curing; Fastest way of construction; Easy to transport – light in weight, compact, large coverage; Dry Wall System; Clean site; Zero Wastage.



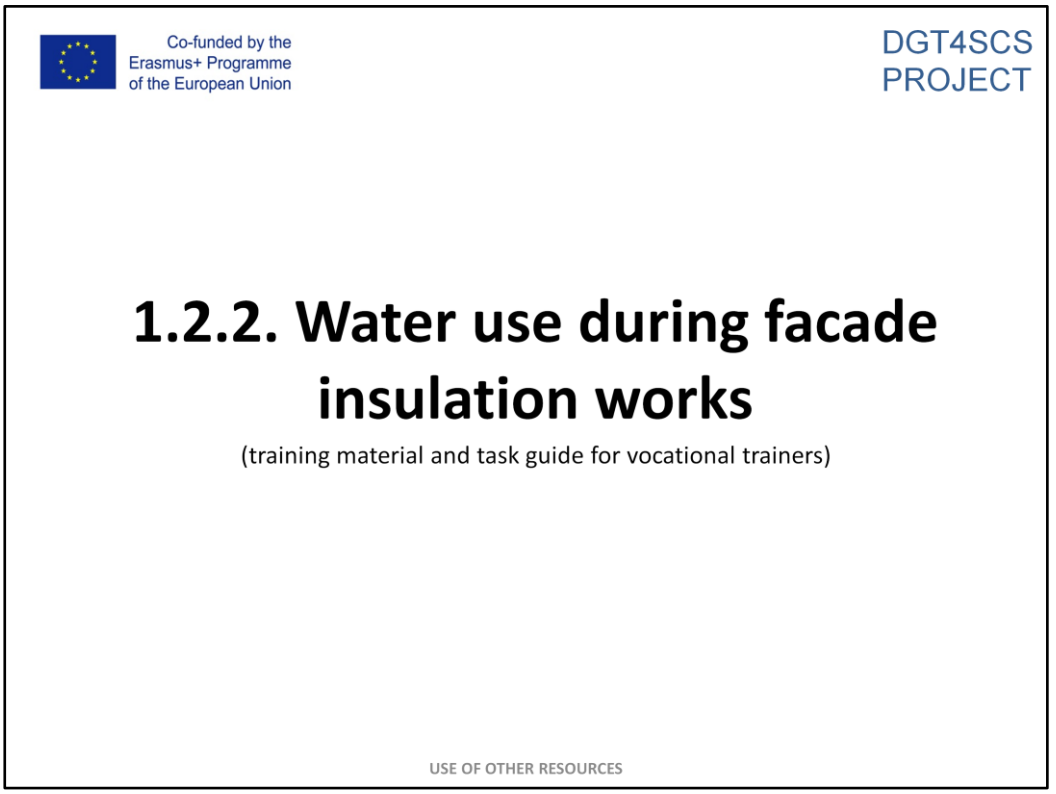
Source:
Temporary rainwater harvesting system installed on site cabins. Available from: https://blog.grafuk.co.uk/2012/02/28/temporary-rainwater-harvesting-system-installed-on-site-cabins/ [Accessed 31 May 2020].

Notes for the trainer and additional information:

A trainer highlights that **rain water should be collected and used wherever is possible on construction site, such for equipment cleaning and flushing toilets**. Every site could make use of such a system of rainwater harvesting to reduce the water required on site and make use of rainwater falling on to site cabins.

A trainer briefly explains the case study. More detailed explanation can be given for students who learn plumbing and experienced students (according to level of knowledge).
Case study – on construction site.

- **Temporary rainwater harvesting system installed on site cabins.** This system has been connected to site cabins which will be situated on a long term project and used by staff on a daily basis.
- The system included a 7,270 liters above ground storage tank, with an internal filter fitted inside the top of the tank, connecting to the downpipe from the guttering of the site buildings. Inside the tank there is a submersible pump which automatically supplies the **WC block inside the building with recycled rainwater on demand, i.e. when a toilet is flushed the pump fills the cistern with water.** Inside the building there is a mains water backup unit which is connected to the mains water supply and provides a top-up system in times when the rainwater tank is empty. This means the operation of the whole system is automatic and there is no maintenance required.
- This system has enabled staff to make use of all of the rainwater that is collected off the roofs of the buildings on site and re-use this free resource to flush their WCs and therefore reduce mains water usage whilst they are on site constructing this new development.
- The system is completely accessible and has been designed in such a way **that once the main development is complete the system can be taken down and then re-used on the next project**.
- As the buildings are only temporary the system will be removed when the cabins are taken away from the site but all products will be able to be used again and again on future sites.

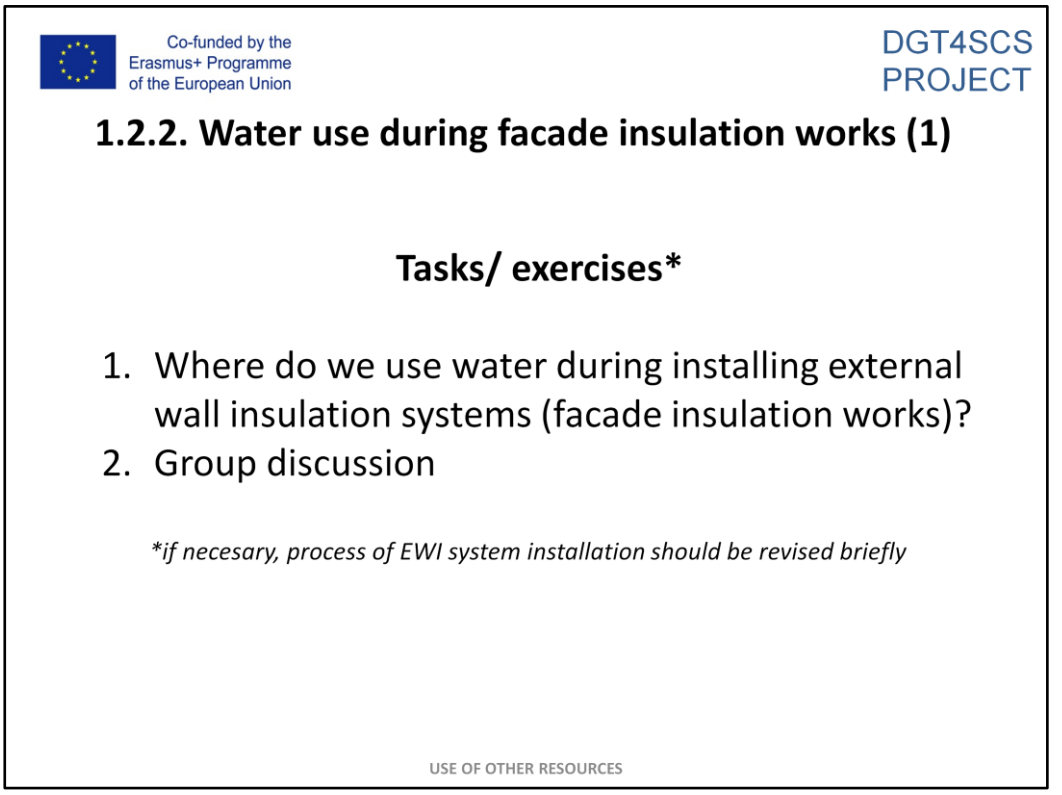


Notes for the trainer and additional information:

It's a specific part of subtopic providing trainees with detailed (depending on qualification and training programme they are acquiring) information and analyze water use in a particular/ specific construction procedure and possibilities to reduce its consumption carrying out works.

For example, **wall insulation works** are studied within the training programme "Building technician" implemented in Latvia. A Trainer has possibility to offer students **more detailed learning material** about water use during facade insulation works and **opportunities/ possibilities of water savings** that are not affecting quality and durability of system. At the same time **material and tasks can be adapted i**n line with participants' level of knowledge or upgraded/ simplified within other qualification (depends on – is/or insulation works included in the programme).

NB! According to trainees' experience, background and level of knowledge presenting of information and tasks (active involvement in learning) should be varied and adapted.

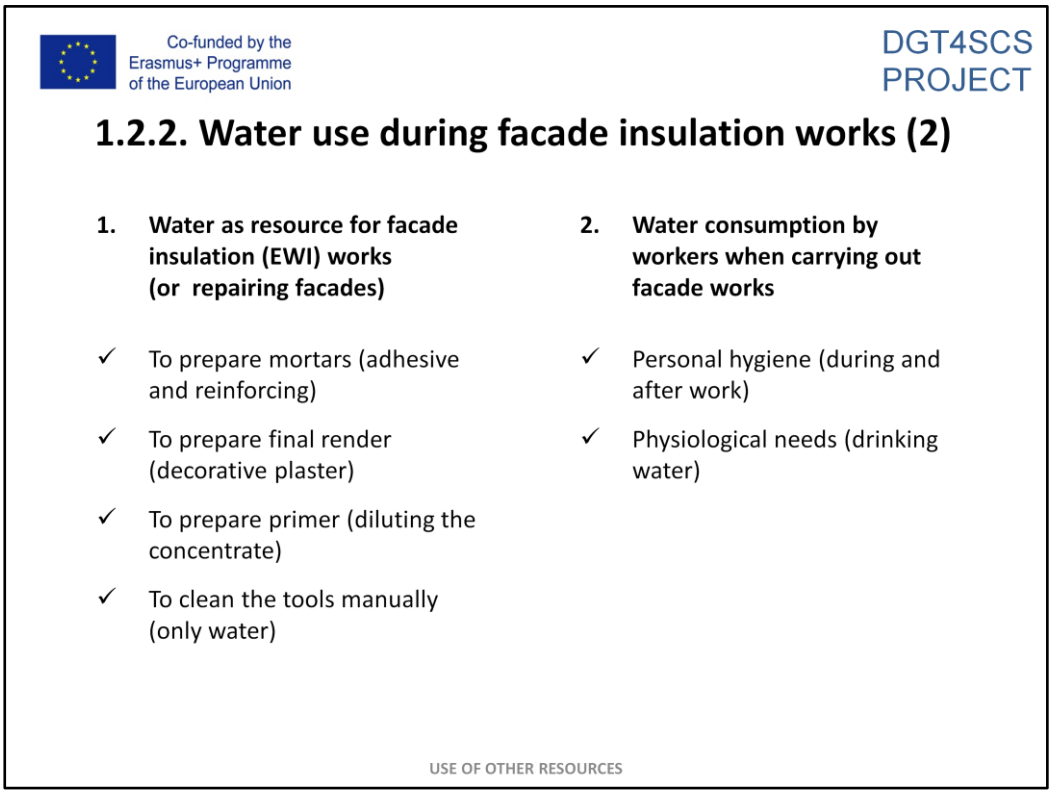


Notes for the trainer and additional information:

Task:
Ask students to name purposes of water use during installing external wall insulation (EWI) systems, before ways in which water in consumed during facade insulation works will be listed (see the next slide).

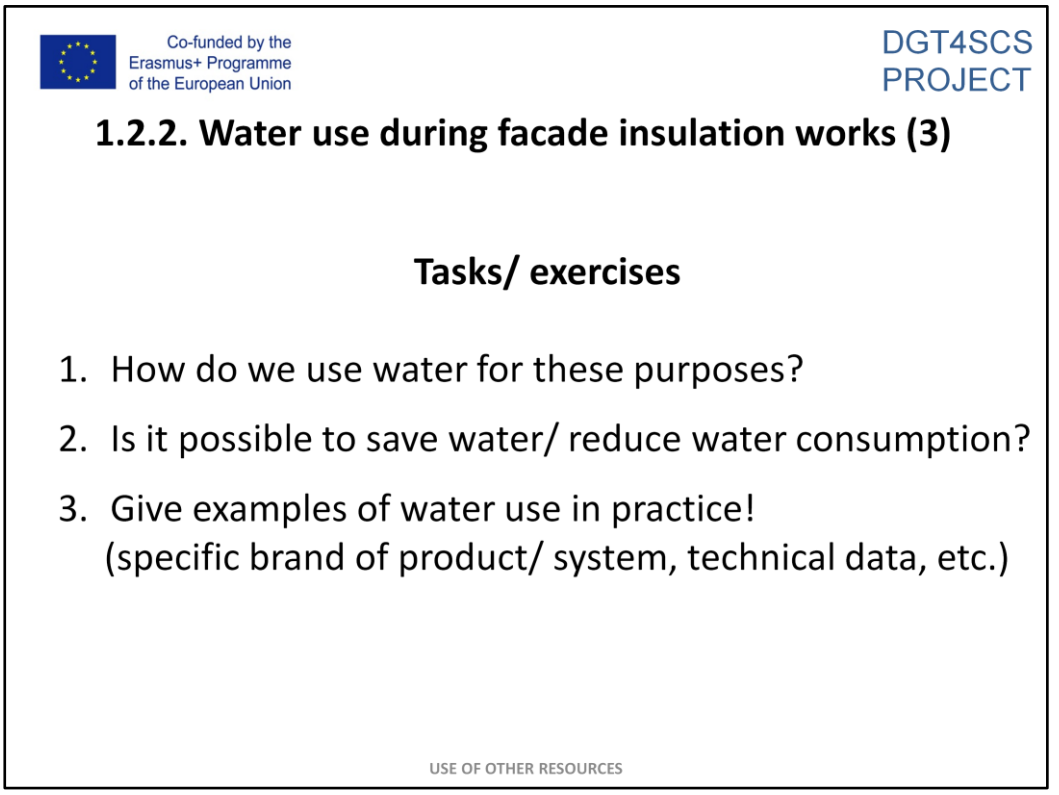
Process of EWI system installation should be revised or explained to students:
- oral - with advanced/experienced trainees;
- by creating **extra slides** - with **not experienced trainees.**

For detailed description of facade insulation technology see the topic “Durability of construction works” (within the set of training material).



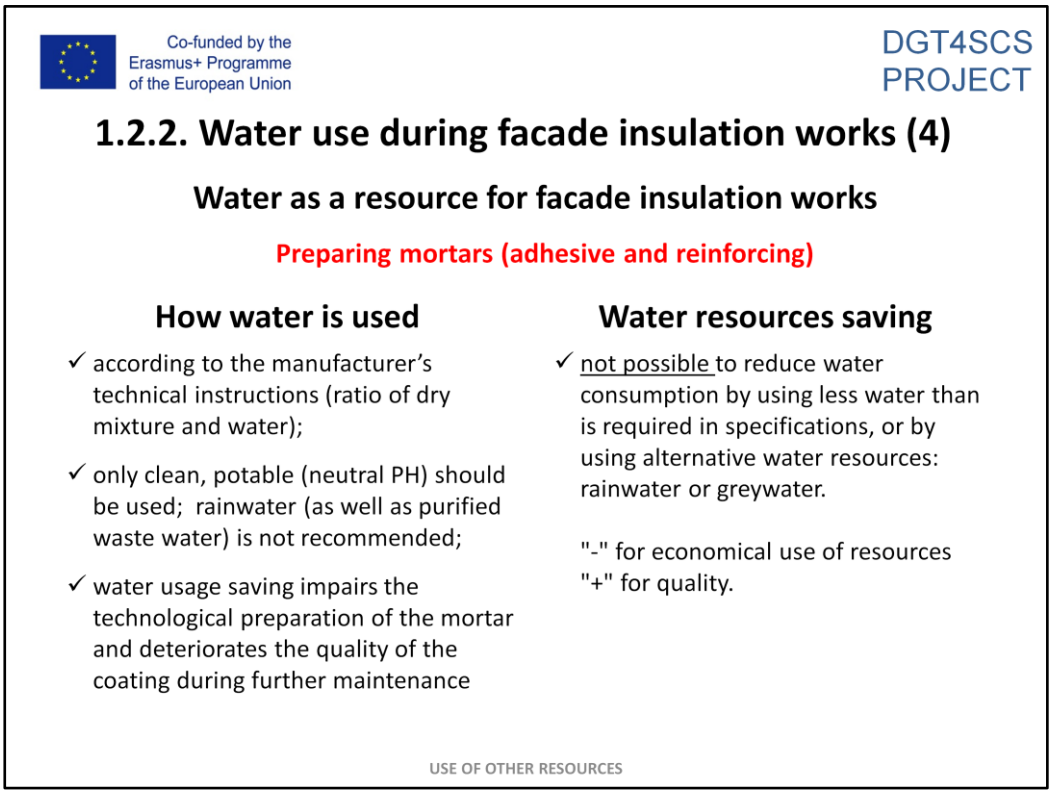
Notes for the trainer and additional information:

A trainer names ways how water is consumed during facade insulation works.
Each purpose of water use is analyzed and discussed separately. Possible ways of water savings are mentioned here.



Notes for the trainer and additional information:

Each purpose of water use is analyzed and discussed separately. Possible ways of water savings are mentioned here.
Task 1. Ask students explain how water is used for named purposes.
Task 2. Ask students to suggest a way of saving water.
Task 3. Ask students to provide examples and explanation of water use in practice.



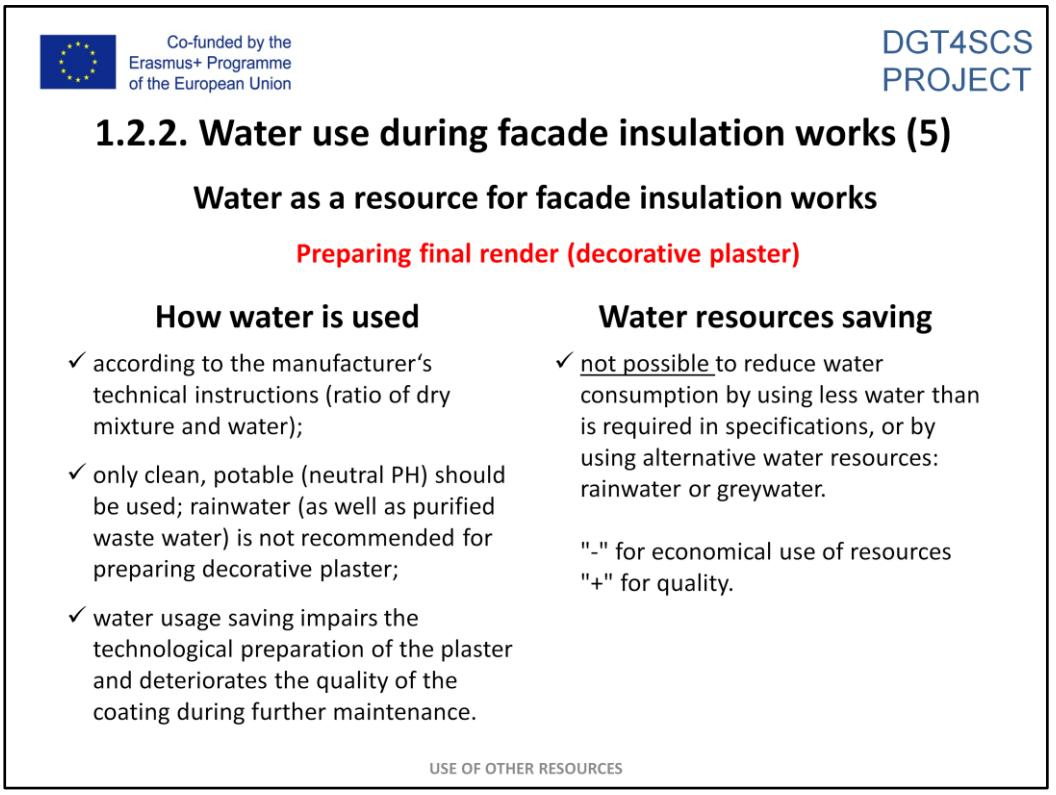
Notes for the trainer and additional information:

Water as a resource of External Wall Insulation (EWI) system installing process (or repairing) is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems., brands, technical data

Preparing mortars (adhesive and reinforcing):

- *example of adhesive brand and technical data:* Sakret BK amount of the water added: 7.5 liters of water for 25 kilos of dry mixture;
- *example of reinforcing mortar brand and technical data:* Sakret BK amount of the water added: 6.5 liters of water for 25 kilos of dry mixture.



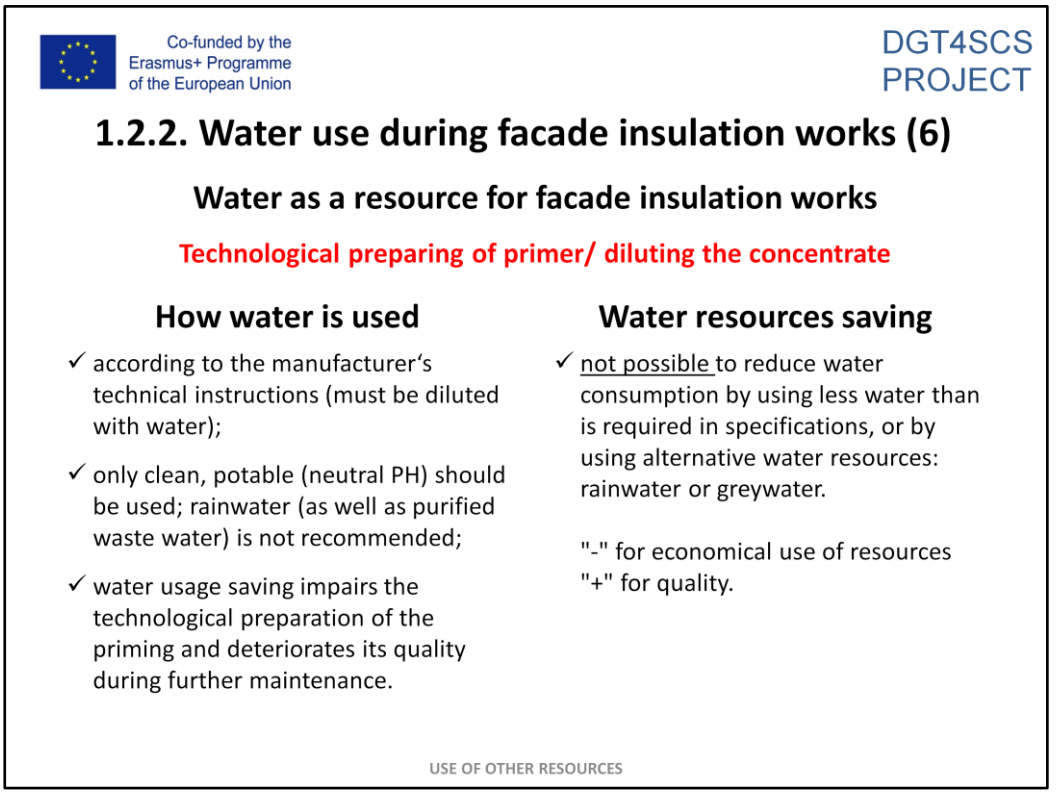
Notes for the trainer and additional information:

Water as a resource of External Wall Insulation (EWI) system installing process (or repairing) is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems, brands, technical data

Preparing final render (decorative plaster):

- *example of final render brand and technical data:* Sakret MRP-E amount of the water added: 5.3 liters of water for 25 kilos of dry mixture.



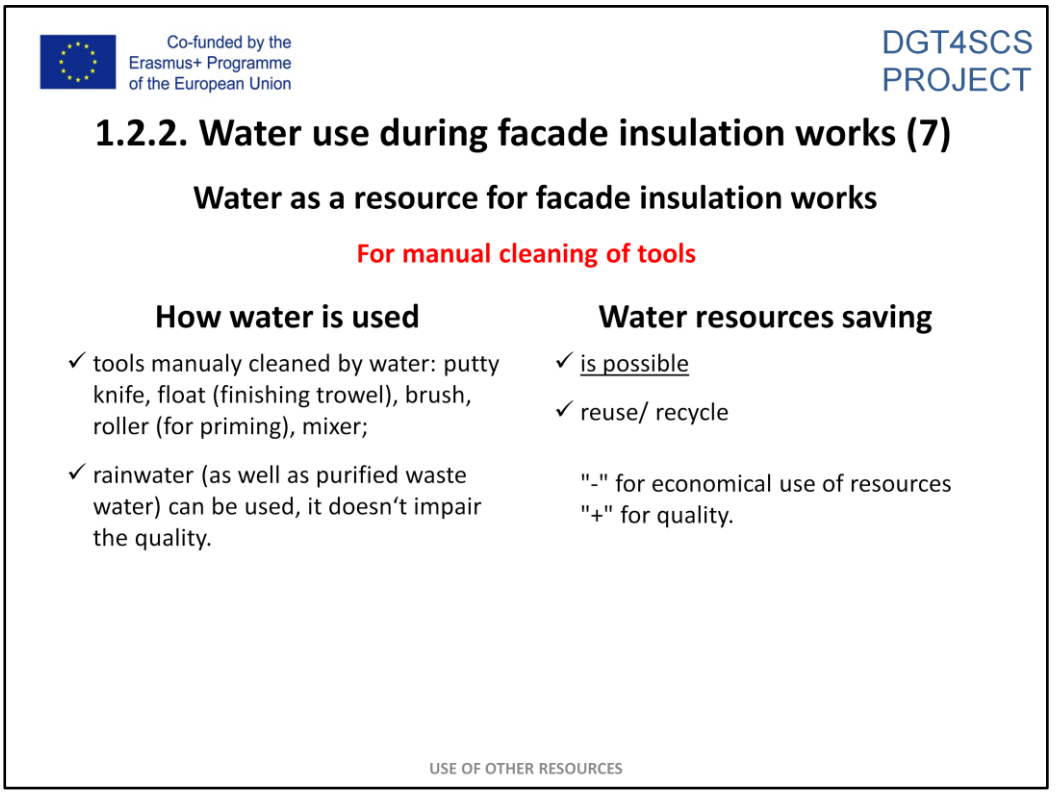
Notes for the trainer and additional information:

Water as a resource of External Wall Insulation (EWI) system installing process (or repairing) is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems, brands, technical data

Technological preparing of primer (diluting the concentrate):

- *example of primer brand and technical data:* Sakret UG, can be used for bonding various dusty and absorbent surfaces and for adjusting the absorbency of the surface before applying mortars and finishing materials, the ratio of the concentration of the priming is 1: 4 (must be diluted with water).



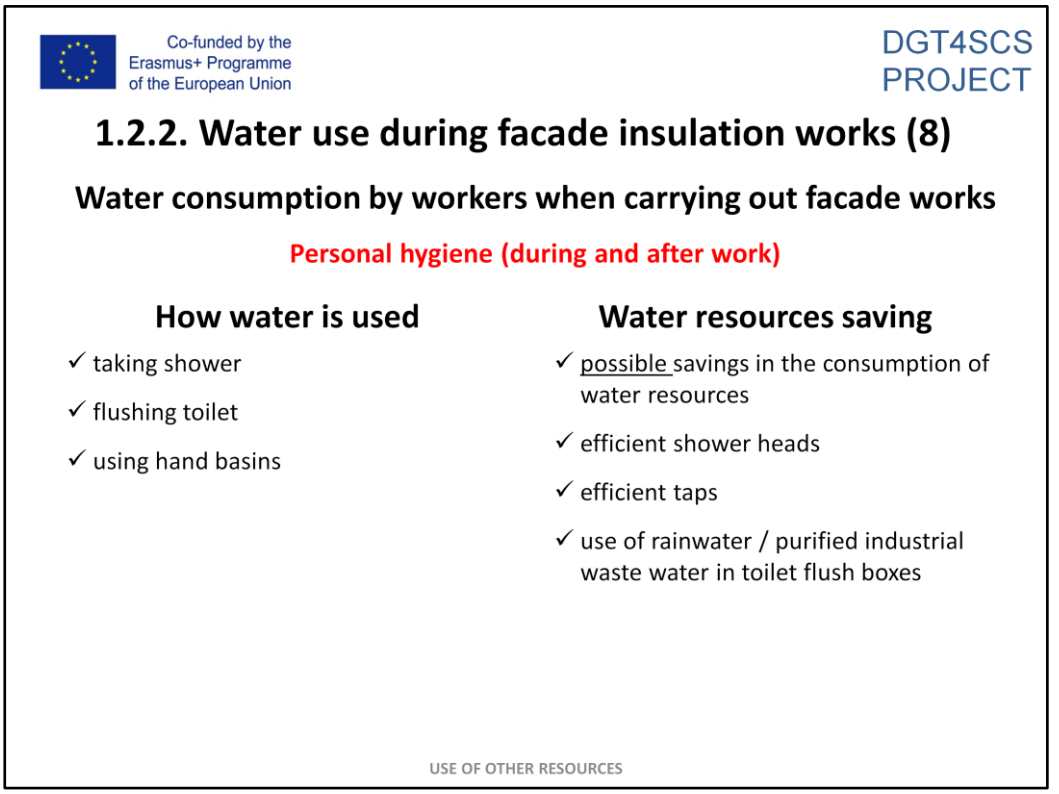
Notes for the trainer and additional information:

Water as a resource of External Wall Insulation (EWI) system installing process (or repairing) is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems, brands, technical data

For manual cleaning of tools:

- *examples of tools cleaned by water:* putty knife, float (finishing trowel), brush, roller (for priming), mixer.



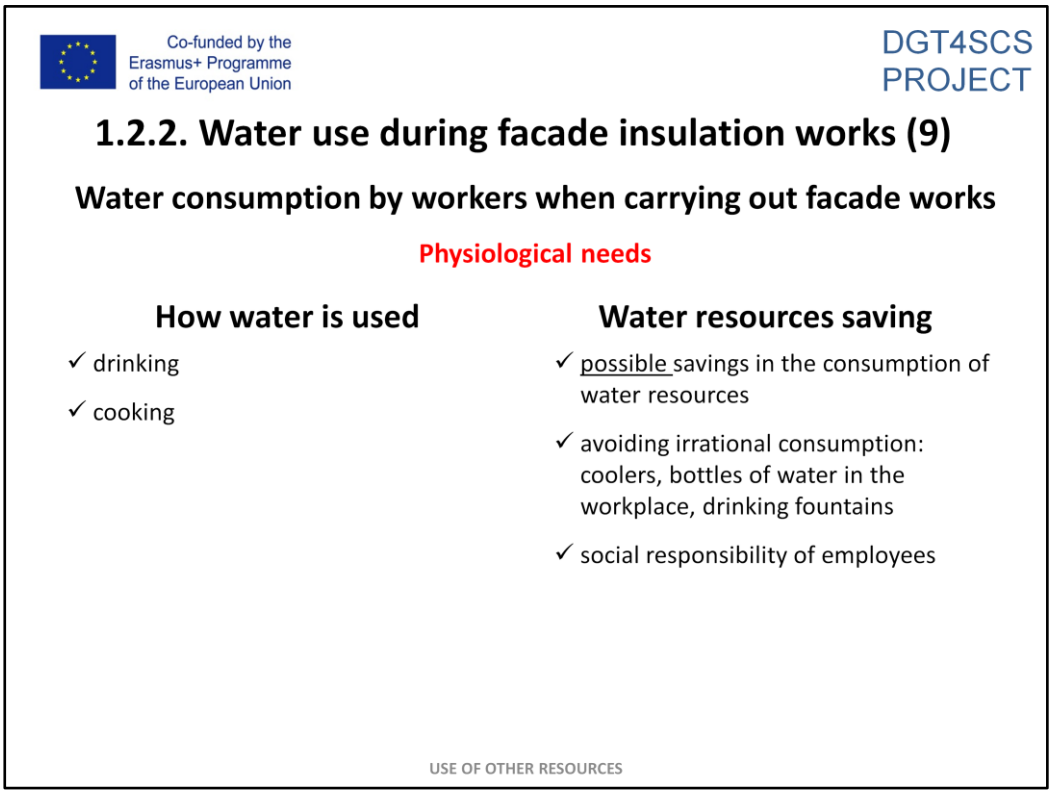
Notes for the trainer and additional information:

Water consumption by construction workers (technicians) when carrying out installation (or repairing) of External Wall Insulation (EWI) system is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems, brands, technical data

Personal hygiene (during and after work):

- *example of efficient shower head*: SAWY PDS shower with limited water flow up to 8-9 l/min



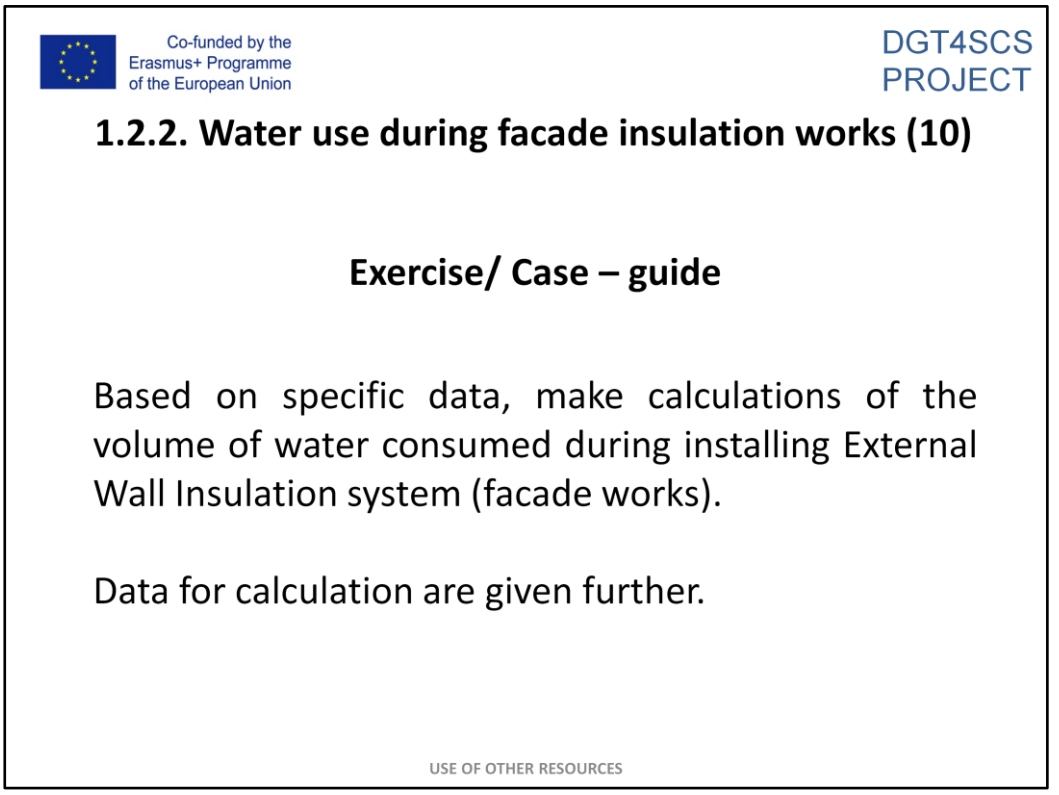
Notes for the trainer and additional information:

Water consumption by construction workers (technicians) when carrying out installation (or repairing) of External Wall Insulation (EWI) system is discussed here (in the perspective of saving water/ efficient use of water).

Possible examples of specific products/ systems, brands, technical data

Physiological needs (drinking):

- *examples of controlled consumption*: coolers, bottles of water in the workplace, drinking fountains.



Notes for the trainer and additional information:

Task guide
A trainer sets data and give students the exercise, if necessary provides an example of calculation. Example of data and calculation is given further (see next slides)

Data which should be given by a trainer:

1. the specific dimensions of the walls (height/ width/ perimeter) for carrying out facade insulation works;*
2. specific kind / type of insulation material (e.g. stone wool), with a specific thickness according to the project requirements;
3. data on the type and brand of the used mortars and manufacturer's technical instruction/ specifications for their use:
    a) adhesive,
    b) reinforcing mortar,
    c) final render (plaster),
    d) primer.
4. deadline for work completion (days, hours) and number of involved workers;
5. average water consumption per person/ worker per day (drinking, hygiene etc.).

** area is the main indicator for the calculation*

The main goal of exercise – to determine **the average amount of water consumed during the construction process.** Students gain the idea of water quantity used.

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DGT4SCS PROJECT

1.2.2. Water use during facade insulation works (11)

Data for calculation (example)

Type of data	Specified data
Dimensions of the walls	1. Dimensions of one wall of the facade (height x width) 7000x12000mm. On the surface of the facade there are two windows (1400x1650mm) and an entrance door (2100x1000mm)
Insulation material	2. Mineral wool with a thickness of 100mm will be used as wall insulation
Used mortars	3. SAKRET products are used for facade insulation works
Adhesive	3.1. Adhesive for gluing SAKRET BK. Link to the material; Link to technical data Material consumption: 4-6 кg/m^2
Reinforcing mortar	3.2. Reinforcing mortar SAKRET BAK. Link to the material; Link to technical data Material consumption: 4-7 кg/m^2

USE OF OTHER RESOURCES

Notes for the trainer and additional information:

Example of calculations (1 part)

Calculations: Facade parameters

1. The area of windows and doors on the insulated surface
   → 1.40 x 1.65 = 2.31m^2 x 2 = 4.62m^2 (Two windows)
   → 2.10 x 1.00 = 2.1m^2 (Door)
2. The area of the insulated wall, facade (including windows and doors) =7.0 x 12.0 = 84m^2
3. The area of the insulated wall, facade (excluding windows and doors) = 84m^2 - 4.62m^2 - 2.1m^2 = 77.3m^2

Calculations: Required materials

1. Mineral wool (thickness 100mm)
   → 77.3m^2 + 5% waste = 77.3m^2 + 3.8m^2 = 81.1m^2
2. Adhesive for gluing thermal insulation materials *SAKRET BK*
   → 81.1m^2 x 5kg / m^2 (consumption) = 405.5kg (quantity of material in kg)
   → 405.5kg / 25kg = 17pcs. (quantity in bags)
   → 17 x 6.5 = **110.5 liters**(the required amount of water for preparing the mixture)
3. Adhesive for reinforcement of thermal insulation *SAKRET BAK*
   → 81.1m^2 x 5.5kg / m^2 (consumption) = 446.05 x 2 = 892.1kg (quantity of material in kg)
   → 892.1kg / 25kg = 36pcs. (quantity of material in bags)
   → 36 x 7.5 = **270.0 liters** (required amount of water for mixing)
4. *SAKRET UG* priming compound for surface treatment
   → 81.1m^2 x 0.15l / m^2 = 12.2l x 2 = 24.4 liters (the amount of soil for processing the facade in two layers)

The concentrated prime must be diluted in a 1: 4 ratio.
   → 24.4 / 5 = 4.88 liters (quantity of primer)
   → 24.4 - 4.88 = **19.52 liters** (quantity of water added)

5. *SAKRET MRP-E* decorative plaster (2mm)
   → 81.1m^2 x 3.2kg / m^2 (consumption) = 259.52kg (quantity of material in kg)
   → 259.52kg / 25kg = 11pcs. (quantity of material in bags)
   → 11 x 5.6 = **61.6 liters** (the required amount of water to prepare the mixture)

Calculations: Water Consumption

Water to prepare the materials = **110.5 + 270.0 + 19.52 + 61.6 = 461.62 ≈ 462 liters**

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DGT4SCS PROJECT

1.2.2. Water use during facade insulation works (12)

Data for calculation (example)

Type of data	Specified data
Final render	3.3. Plaster SAKRET MRP-E (2mm). Link to the material; Link to technical data Material consumption: 3,2 кg/m^2
Primer	3.4. Primer SAKRET UG. Link to the material; Link to technical data Material consumption: 150 ml/m^2
Deadline, workers	4. 7 days (8 hours per day) to do the work by 1 person
Average water consumption by worker (drinking, hygiene)	5. Assumptions: A worker takes 1 shower a day, 12min long, shower head flow 12 l/min. A worker uses hand basin average 4 min per workday, tap flow 5 l/min. A worker uses toilet average 2 times per workday, flush flow 6 l/min. A worker drinks 1 litre of water per workday (still water, tea, coffee).

USE OF OTHER RESOURCES

Notes for the trainer and additional information:

Example of calculations (2 part)

Calculations: Water Consumption by worker
1. Having a shower → 12 min x 12 liters (flow) x 7 days = 1008 liters
2. Using hand basins → 4 min x 5 liters (flow) x 7 days = 140 liters
3. Using a toilet → 2 times x 6 liters (flash flow) x 7 days = 84 liters
4. Drinking water → 1 litre x 7 days = 7 liters
5. Total Water for hygiene, drinking water = **1008 + 140 + 84 + 7 = 1239 liters**

Calculations: Total Water Consumption during facade insulation
Water to prepare the materials + Water for hygiene, drinking water = **461.62 + 1239 = 1701 liters**

*** Explanation of assumptions
Toilet. Statistics show that people go to the toilet five times per day (of which four times are to urinate). So, can be assumed, that a worker goes to the toilet twice per workday (8 hours) in average.
Taps. Statistics show that people use the tap for bathing hands 8.1 minutes a day in average. So, can be assumed, that a worker uses tap 4 minutes per workday.
Drinking water. Statistics show that people drink 2 liters of water per day in average (still water, tea, coffee etc.) Can be assumed, that a worker drinks 1 liter of water per workday

NB! A trainer highlights which works should be carried out until deadline:
1. Preparing facade surface, installation of the starter track (carrier tray), priming, etc.;
2. Fixing (gluing) thermal insulation materials (boards) to the facade surface;
3. Fixing of insulation material (boards) by mechanical fixings;
4. Applying reinforcing mortar, finishing the slopes, reinforcing mesh installation;
5. Applying a primer coat on the reinforcing coat (preparation for processing with topcoats);
6. Application of final render (decorative plaster), as well as its grouting. Finalising works.

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DGT4SCS PROJECT

1.2.2. Water use during facade insulation works (13)

Situations for discussion

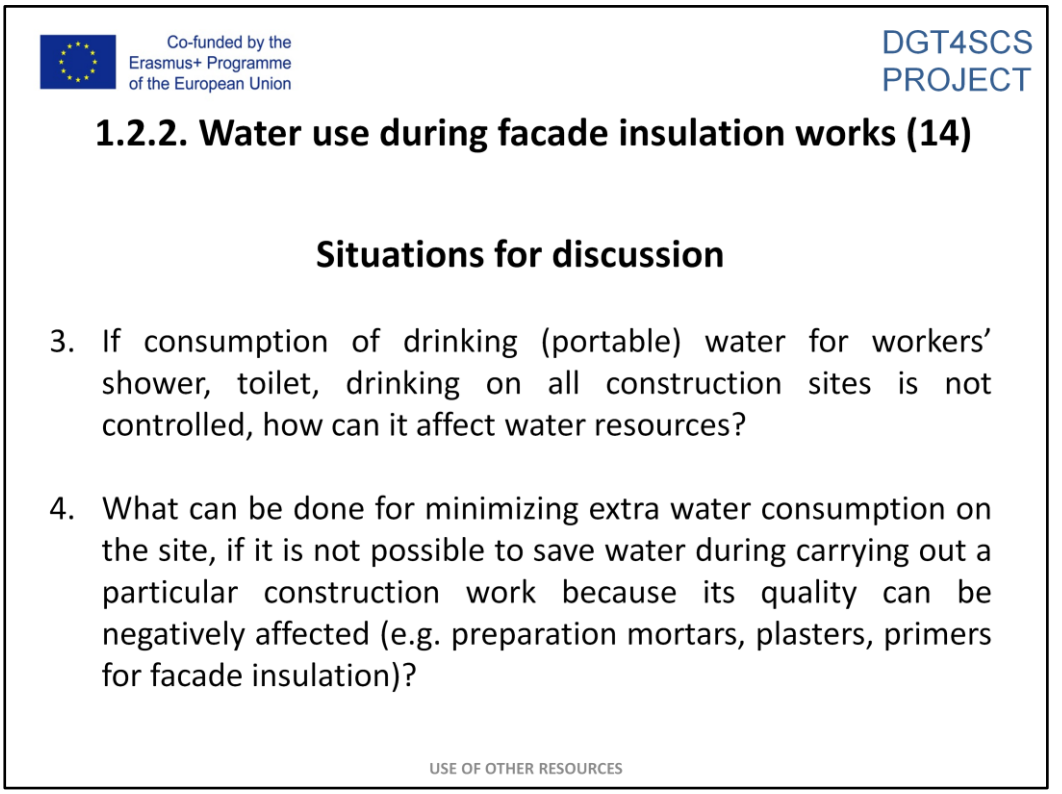
1. What happens if you use rainwater for preparing mortars (adhesive, reinforcing) during insulation works? (pure quality, less durable)

2. What happens if preparing decorative plaster you take less or more water than is shown in the manufacturer's instruction? (if less than necessary/if more than necessary)

USE OF OTHER RESOURCES

Notes for the trainer and additional information:

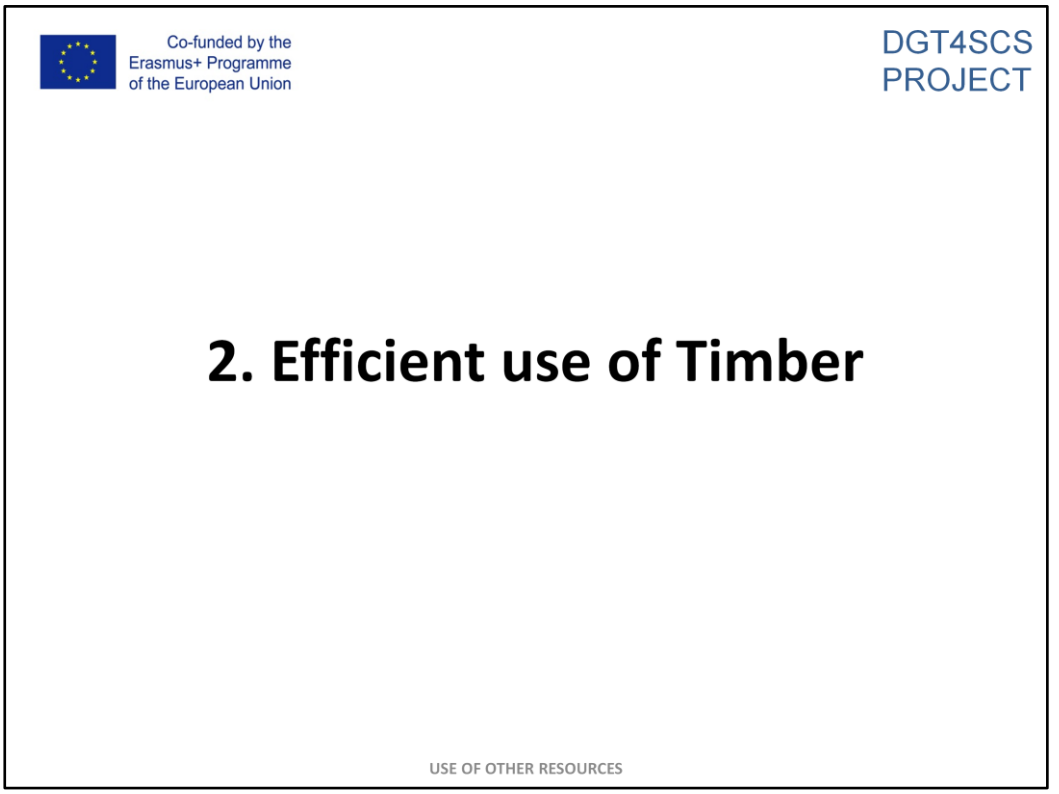
Group discussion is organised in a classroom.



Notes for the trainer and additional information:

Group discussion is organised in a classroom.

A trainer highlights, that, if there no possibility to reduce water consumption during implementing a particular construction work (because it can affect quality, strength and durability in negative way), **make the most use of other opportunities.**



Notes for the trainer and additional information:

It's a general subtopic

This part provides information of several ways of efficient timber use in construction.

Despite the fact, that designers, engineers, and construction managers take care about efficient use of timber on designing and planning stages of construction works (building life cycle – see slide No. **17**), construction technicians and construction workers (eg. carpenters) should know ways of efficient timber use during construction stage. **If workers don't follow the rules in construction stage, planning stage will be failed.**

The task of construction manager is to inform workers about ways of efficient use of timber during construction within a particular project, as well as to plan and control the process (eg. minimizing losses, storage area for off-cuts, using off-cuts, using timber recycling schemes, sort leftover materials etc.).

NB! The information on this subtopic should be varied and adapted according to trainees' experience, background and level of knowledge as well as in line with a particular qualification.

Source:
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 9 p.

Notes for the trainer and additional information:

It was emphasized in introduction of this training module – see slide named "Reduction of the use of the materials in the buildings"

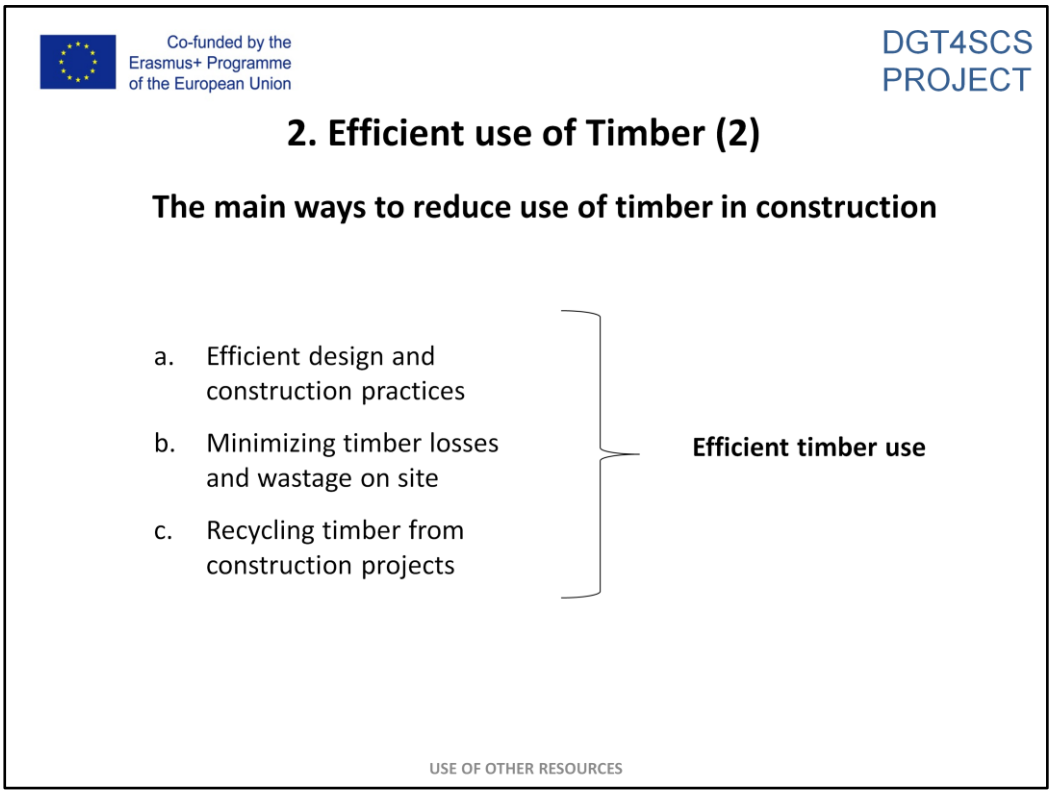
1. Firstly, a trainer briefly discuses with students main uses of timber in construction. Students can be asked to provide a definition of timber in construction and asked to list possible ways of timber use. A trainer makes corrections if necessary.

Timber - the wood of trees cut and prepared for use as building material (also known as **lumber** in American English).
Timber is used for the following works:

- for light construction works like doors, windows, flooring and roofing;
- for other permanent works like for railway sleepers, fencing poles, electric poles and gates;
- for temporary works in construction like scaffolding, centering, shoring and strutting, packing of materials;
- for decorative works like showcases and furniture;
- for body works of buses, lorries, trains and boats;
- for industrial uses like pulps (used in making papers), card boards, wall papers;
- for heavy construction works like columns, trusses, piles.

2. Secondly, a trainer explains ways of efficient timber use in construction - using information of this and the next slides on this subtopic. A trainer highlights that general approaches of timber consumption minimizing in construction exist from middle of 20th century and nowadays there are several common ways of efficient timber use in construction.

Connection to other topics within the training material
"Use of environment friendly construction products and auxiliary materials", "Waste Management", "Durability of construction works".



Notes for the trainer and additional information:

Listed ways of efficient timber use are designed based on previously mentioned possibilities of the reduction of timber use in construction. The following slides give information of the all three ways. For further information about minimizing wastage on site and recycling see Training Module topic "Waste management".

"Use timber in ways that ensure its durability" - isn't considered within this topic (previously mentioned possibility which can reduce the use of the timber in buildings). For it see Training Module topic "Durability of construction works".

However a trainer can create the additional slides using information below and further data he has.
For further data see, for example, *Timber Design for Durability. Information on how to make timber last. National Association of Forest Industries, 2003* (is available on the Internet).

Maximizing the lifespan of timber should be discussed with students in accordance with a particular qualification and students' background.

Durability is a measure of the time timber can perform as intended (and is not the same as strength).
Durability of timber can be degraded by:

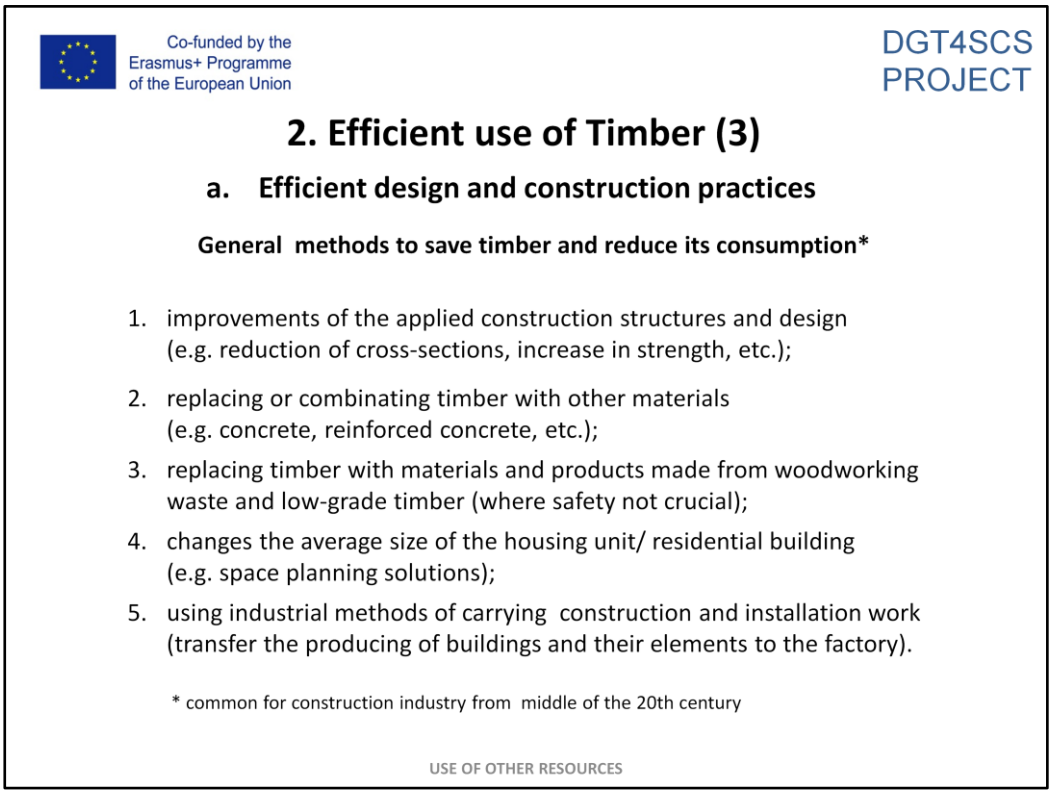
- changes in the moisture content (causing swelling and shrinking);
- mechanical damage (handling);
- biological damage by insects and fungi.

Measures to minimize damage are:

- choosing the right species of timber;
- keeping timber at the right moisture content;
- good storage and careful handling;
- good timber design for durability.

While this should protect most timber in most situations, sometimes it will need to be treated. Be aware that all treatments have associated risks.

Connection to other topics within the training material
"Waste Management"



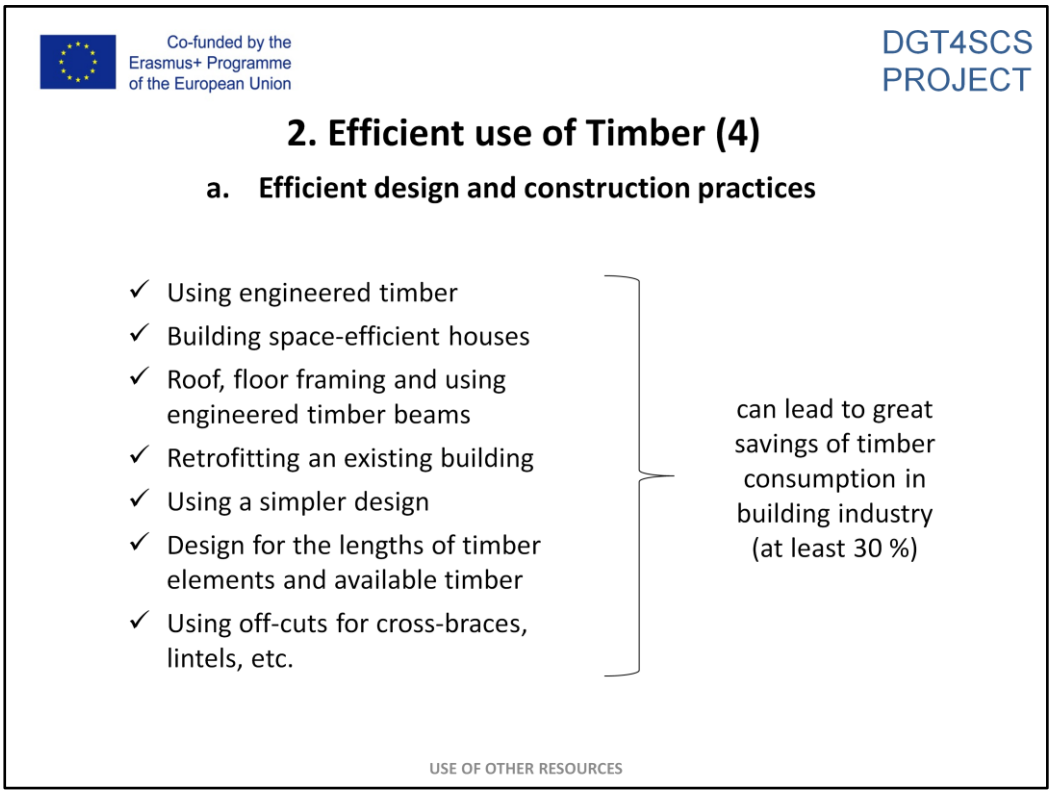
Source:
Using Less Wood in Conventional Structures. Centre for Resourceful Building Technology. USA. Available from: https://www.rainforestinfo.org.au/good_wood/usi_less.htm [Accessed 14 November 2020].
Edminster, A. V. Using Less Wood in Buildings. Available from: http://www.woodconsumption.org/products/annedminster.html#responsibly [Accessed 14 November 2020].

Notes for the trainer and additional information:

A trainer explains general activities/methods of saving timber in construction by using efficient design and construction practices. Should be highlighted, that listed reduction of timber consumption approaches/methods in construction are common for construction industry from middle of the 20th century.

Reducing the average rate of wood consumption in construction can be carried out following the main activities:

1. improvements of the applied construction structures and design – selection of optimal cross-sections and elimination of unnecessary tolerances is most real in housing construction in elements of roofs, interfloor floors and top coatings (***for example, use of large roofing sheets rather than tiles reduces quantity of of battening required);
2. Replacing/ combinating timber with other materials (e.g. concrete, reinforced concrete, gypsum products, etc.);
3. replacing timber with materials and products made from woodworking waste and low-grade timber that is not used for the manufacture of wooden structures, which is an economy due to better use of the timber (where safety not crucial) – is determined by the degree of development and production volumes of substitute materials;
4. changes in the average size and type of the housing unit or residential building (e.g. space planning solutions);
5. using industrial methods of carrying construction and installation work (transfer the producing of buildings and their elements to the factory).



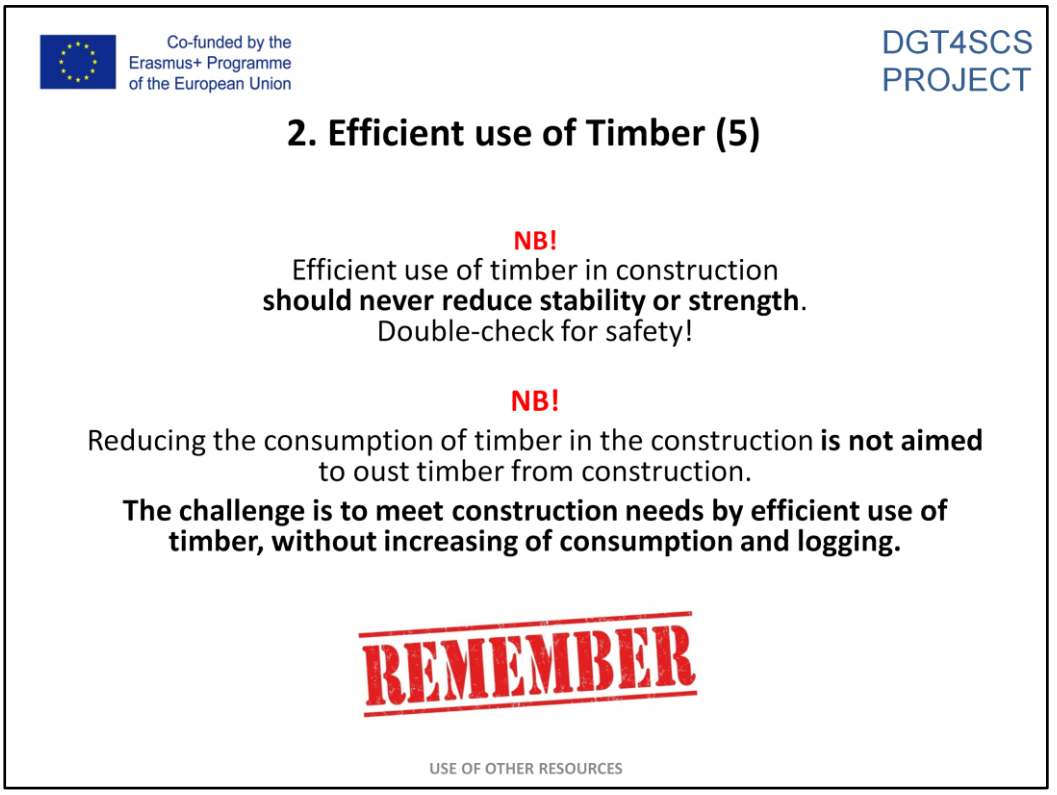
Source:
Using Less Wood in Conventional Structures. Centre for Resourceful Building Technology. USA. Available from: https://www.rainforestinfo.org.au/good_wood/usi_less.htm [Accessed 14 November 2020].
Edminster, A. V. Using Less Wood in Buildings. Available from: http://www.woodconsumption.org/products/annedminster.html#responsibly [Accessed 14 November 2020].

Notes for the trainer and additional information:

Designs (or constructions elements) should maximise the efficient use of timber (this is sometimes called 'reduced timber construction') **without compromising safety**. Reducing of timber waste can be achieved by good design and construction-site practices. Changes in design and construction practices mentioned here can lead to great savings in timber consumption.

- **Engineered timber (massive timber)**, for instance, is stronger and more consistent in quality, with less fibre and weight than solid-sawn wood products. Use of engineered timber-components prevents wood waste from cut-offs at job sites. Consistent quality also means that virtually no wood is culled at the job site. Engineered timber products are available as framing members (eg. beams) and sheet goods. Types: Laminated Veneer Lumber (LVL), Laminated Strand Lumber (LSL), Oriented strand board (OSB), Plywood, Medium density fibreboard (MDF), Composite board, Cross-laminated timber (CLT) etc.
- **Space-efficient houses.** Houses are getting bigger, even though family sizes are decreasing. The most obvious means of cutting the consumption of timber and other resources is to build smaller, space-efficient houses. Multi-family housing uses less wood in shared walls.
- **Retrofitting** an existing building for energy-efficiency, using resource-efficient materials, consumes far fewer natural resources than creating a new building.
- **Roof and Floor Framing.** Using engineered trusses instead of stick framing allows a substantial reduction in the amount of timber. Engineered timber beams use less timber for roof /floor framing.
- **Simplest design.** Simple designs allow for less complex framing that requires less timber. Open floor plans that have few interior walls also reduce timber use.
- **Design or planning lengths, using off-cuts** – reducing timber waste by good design.

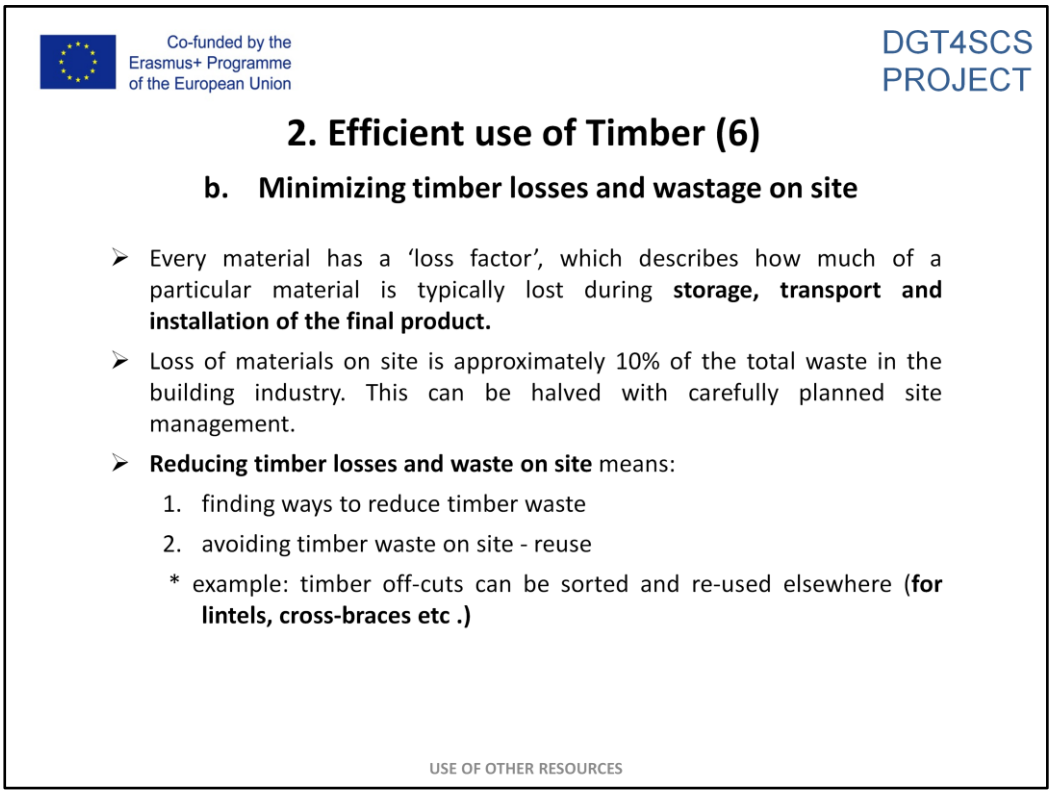
*Reuse can represent one or more additional stages in the lifespan of a piece of wood, depending on a number of factors. Ideally, a building would be designed so that every piece of wood is fully recoverable upon removal from the building, and reusable in the same condition (size, shape, etc.).



Source:
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 9 p.

Notes for the trainer and additional information:

1. Efficient use of timber in construction should never reduce stability or strength. Get the design and works double-checked for safety!
   The rule of reduced timber construction that should be remembered by a designer, engineer, manager, technician and worker.
2. The implementation of all measures aimed at reducing the consumption of timber in the construction and installation work **cannot and should not be considered as a desire to oust wood from construction**. Timber has a strong position in many structural elements of buildings and structures. The challenge is **to meet construction needs in the most efficient way possible without significantly increasing overall consumption of timber** and logging.



Source:

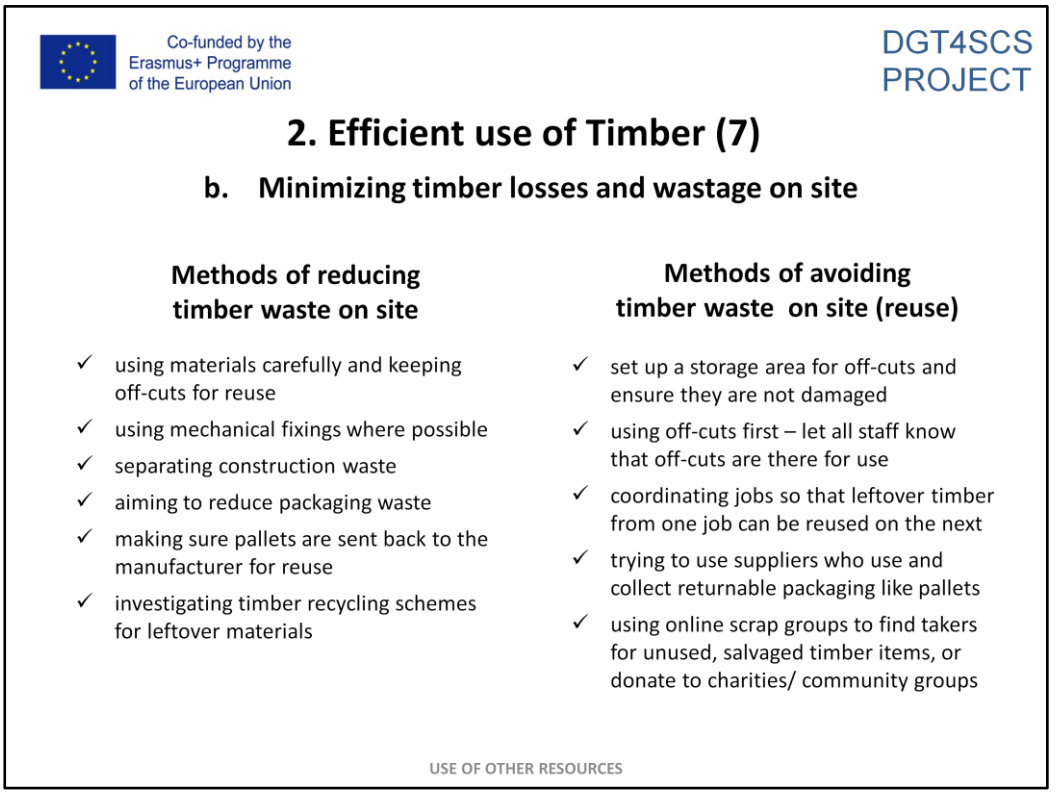
Berge B., *The Ecology of Building Materials*. Routledge: 2009. 9 p.
Use resources efficiently in construction and building trades. Carpentry - how to cut waste and costs. Available from: https://www.nibusinessinfo.co.uk/content/carpentry-how-cut-waste-and-costs [Accessed: 14 November 2020].
Woodworkers, carpenters & joiners: Reducing the cost of waste on site. Waste & Resources Action Programme. 2 p. Available from: https://www.wrap.org.uk/sites/files/wrap/Onsite%20Woodworkers.pdf [Accessed 14 November 2020].

Notes for the trainer and additional information:

Timber as waste:
Timber is normally classed as non-hazardous waste unless it has been treated with certain forms of preservative treatment e.g. creosote; in which case it is classified as hazardous waste.

Minimizing timber waste:
The best way to minimize the amount of timber entering the waste stream is through careful product specification and use. Products should be ordered to size and in a quantity that matches the requirements of the project. Design specification of the structure should take into consideration the product sizes available to reduce the amount of off-cuts produced.

Connection to other topics within the training material
"Waste Management"



Source:

Berge B., *The Ecology of Building Materials*. Routledge: 2009. 9 p.
Use resources efficiently in construction and building trades. Carpentry - how to cut waste and costs. Available from: https://www.nibusinessinfo.co.uk/content/carpentry-how-cut-waste-and-costs [Accessed: 14 November 2020].
Woodworkers, carpenters & joiners: Reducing the cost of waste on site. Waste & Resources Action Programme. 2 p. Available from: https://www.wrap.org.uk/sites/files/wrap/Onsite%20Woodworkers.pdf [Accessed 14 November 2020].

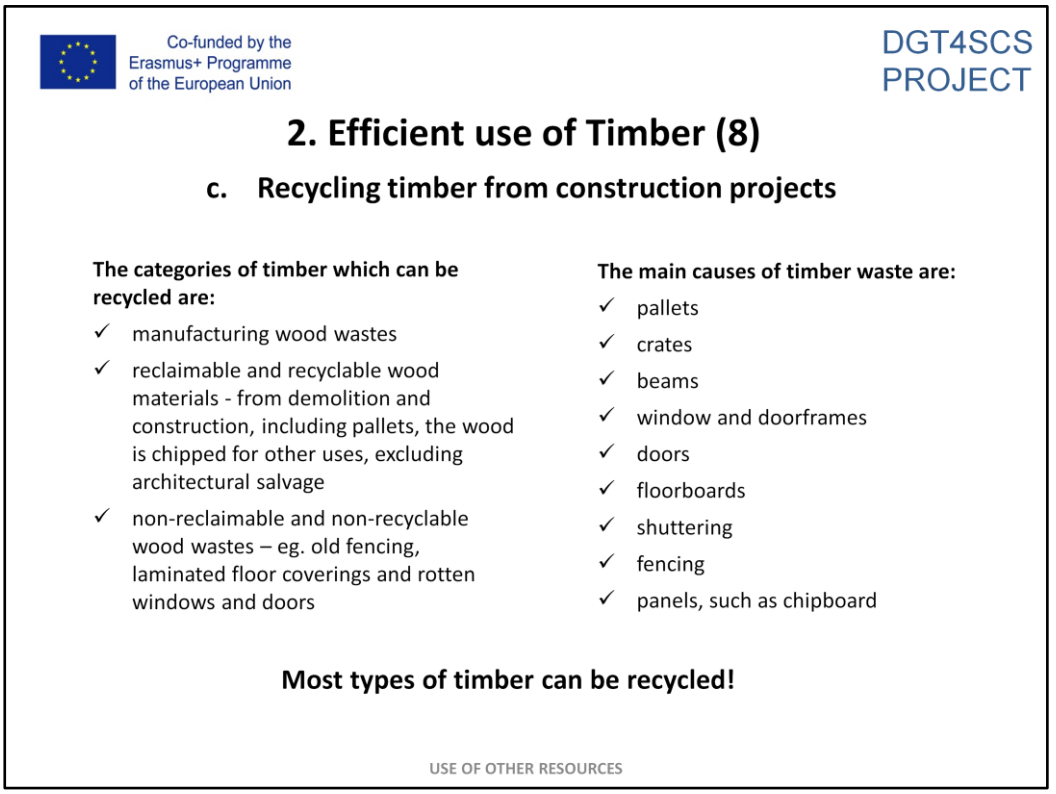
Notes for the trainer and additional information:

Main issues are (1) “How can I reduce timber waste on site?”, (2) “How can I reuse timber/ avoiding waste on site?”

Structural elements that are bolted together can be more easily dismantled and recycled. Larger nailed and glued products offer a more difficult recycling.

Connection to other topics within the training material

“Waste Management”

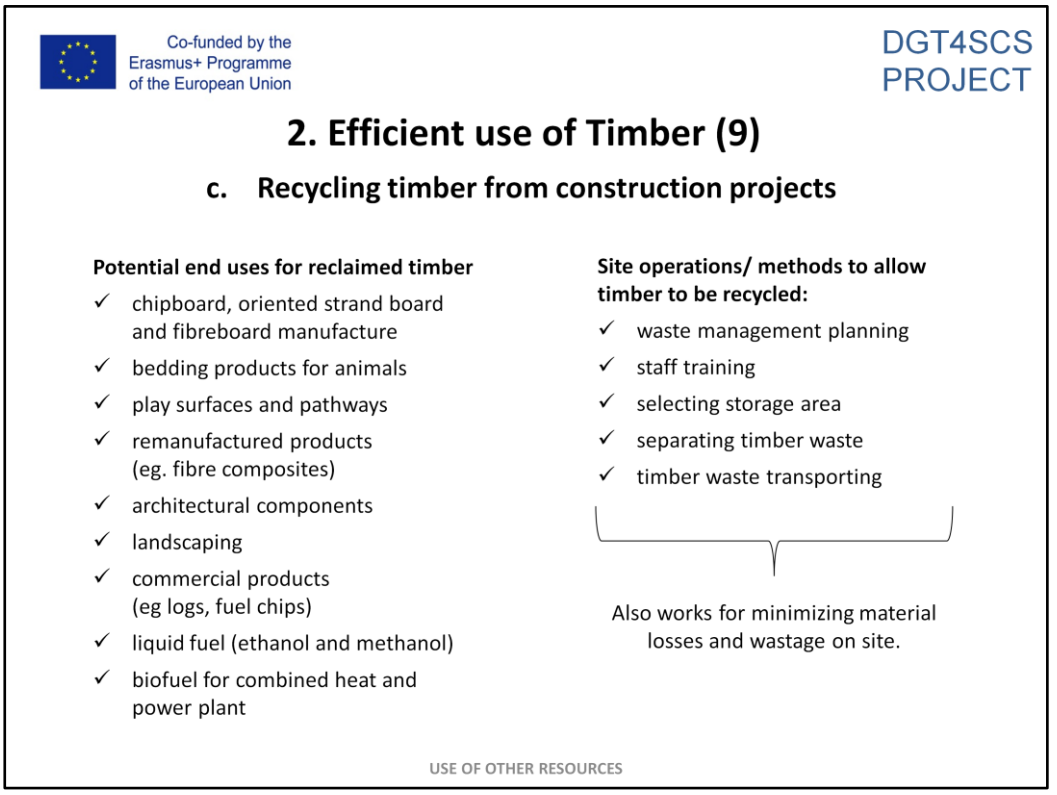


Source:
Recycling construction materials. Recycling wood from construction projects. Available from: https://www.nibusinessinfo.co.uk/content/recycling-wood-construction-projects [Accessed: 14 November 2020].

Notes for the trainer and additional information:

Untreated waste timber (non-hazardous), damaged products and off-cuts can be recycled back into new end products, such as mulch/compost, board products or alternative end uses, such as for energy recovery. There are a wide range of opportunities to recycle timber entering the waste stream.

However, there are some limitations to recycling wood, including:
- ✓ limited waste management options and facilities on site;
- ✓ unknown levels of contamination;
- ✓ low profitability;
- ✓ limited marketplace - there are no real markets for reclaimed laminated wooden flooring as it often contains adhesives, plastics, mixed species of timber and surface finishes;
- ✓ practical difficulties in recycling wood - eg a skip of chipboard is hard to recycle due to the quantity of glue;
- ✓ local government policies.



Source:
Recycling construction materials. Recycling wood from construction projects. Available from: https://www.nibusinessinfo.co.uk/content/recycling-wood-construction-projects [Accessed 14 November 2020].

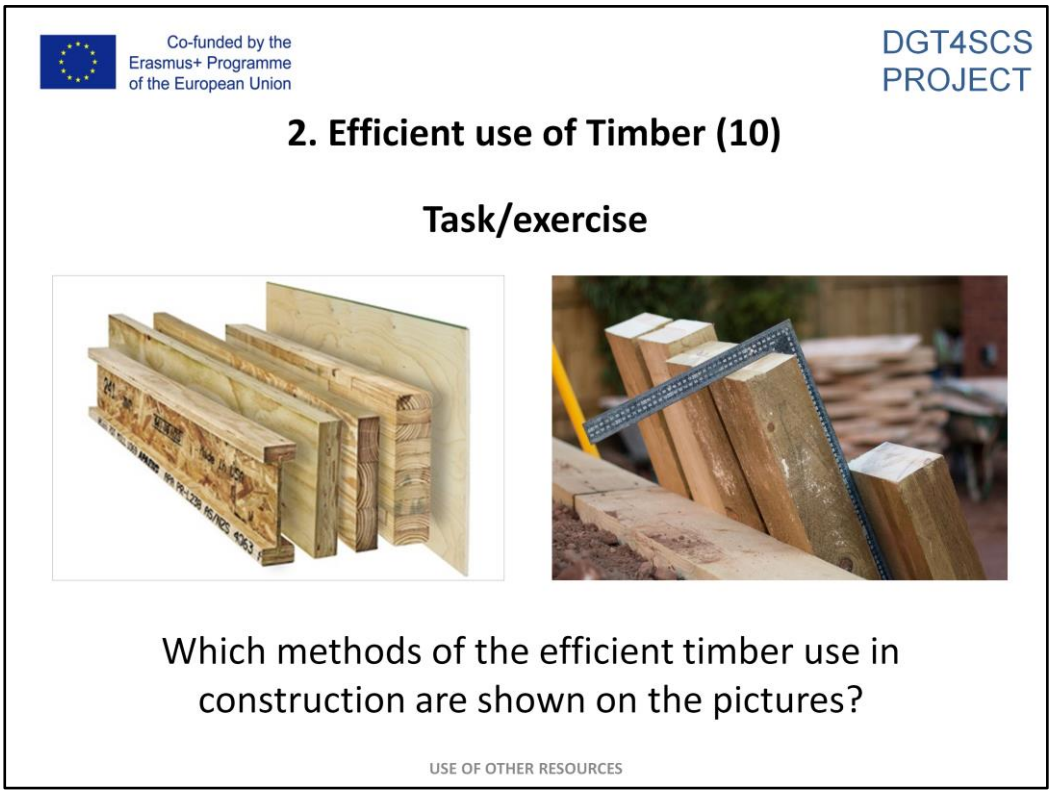
Notes for the trainer and additional information:

Reclaimed (recycled) timber can be used in applications and materials including listed items (see data on the slide). Reclaimed timber - is an umbrella term used to define wood that has been previously logged and used for building or other projects. It can also be referred to as recycled timber or reclaimed wood.

A construction manager can make effective changes to construction site's operations to **allow more timber to be recycled (maximize the recycling options of the timber)** by:

- allowing time for waste management planning;
- providing staff with training in waste reduction and health and safety;
- selecting a secure storage area to protect materials from accidental and weather damage;
- separating wood waste to avoid contamination;
- arranging transport for collection of waste.

These site's operations are also useful in line with **minimizing materials losses and wastage on site** (see previous slides).



Notes for the trainer and additional information:

Task

A trainer shows to the audience pictures/photos to illustrate one of/ or several methods of the efficient timber use in construction and

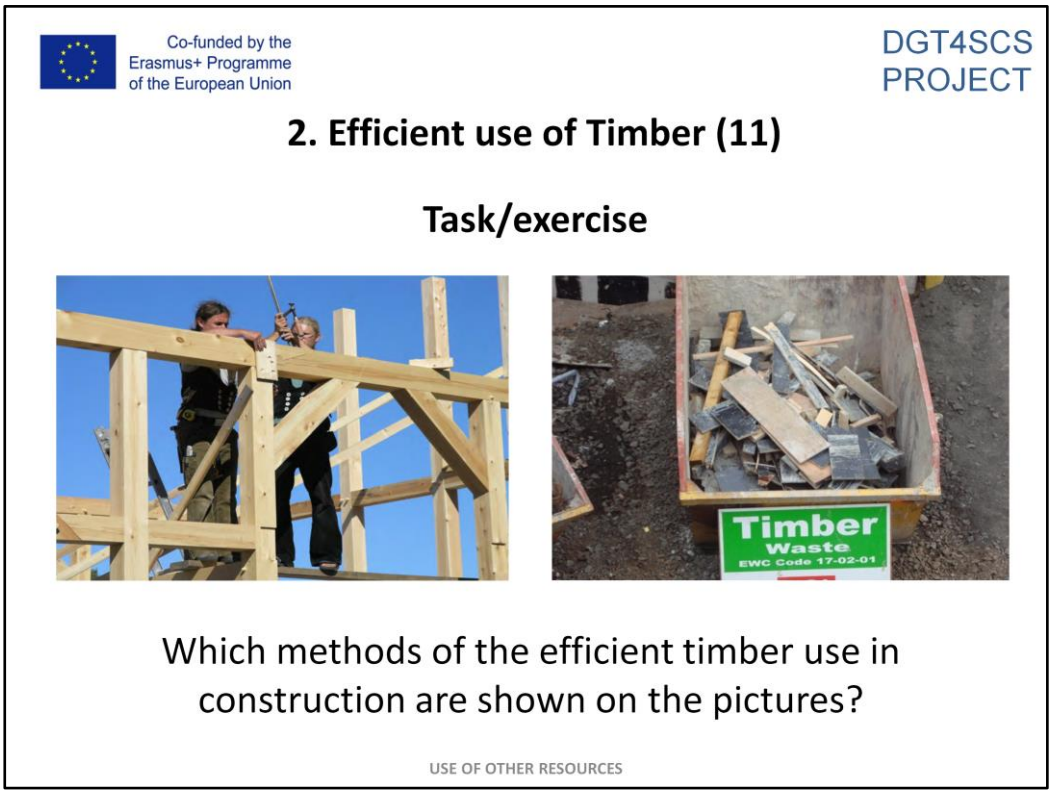
- **ask trainees** which methods and ways of the efficient timber use in construction are shown here and ask them to explain the idea of this method – for **experienced trainees** with background knowledge;
- **explain to students** which methods of the efficient timber use are shown on the pictures and their purpose – for participants **without background** knowledge/ lower knowledge or general public.

The picture on the left, method:

- using of engineered (massive) timber, is part of (a) the efficient construction design and practices.

The picture on the right, methods:

- design (planning) for the lengths of timber elements and available timber, is part of (a) the efficient construction design and practices.
- using off-cuts, is part of the (a) efficient construction design and practices and (b) minimizing timber losses and wastage on site.



Notes for the trainer and additional information:

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- **explain to students** which methods of the efficient timber use are shown on the pictures and their purpose – for participants **without background** knowledge/ lower knowledge or general public.

The picture on the left, methods:

- using frame structures, is part of (a) the efficient construction design and practices;
- using off-cuts for cross-braces, is part of (a) the efficient construction design and practices; (b) minimizing timber losses and wastage on site;
- using mechanical fixings where possible, is part of (b) minimizing timber losses and wastage on site.

The picture on the right, method:

- separating timber waste on site, is part of (b) minimizing timber losses and wastage on site; (c) recycling timber from construction projects.

Notes for the trainer and additional information:

It's a general subtopic
This part provides information about approaches in efficient use of land during construction process (**on construction site**). Information refers to (1) construction site planning and (2) minimising of cleared construction footprint.

Main issue – how to minimalize extras: extra land, **will not be under the construction works**, but necessary to install temporary office, storage, waste collection place, cranes, reinforcement and other construction elements production or assembly place, security and workers premises. Project managers, construction managers take care on planning stage of it, **but workers play a crucial role on construction stage**.

At the same time some of green construction guidelines said, that (1) the arranging layout of construction site properly and (2) restoring the vegetation after project completion are the main aspects to execute the principle of landsaving.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

3. Efficient use of Land (1)

Construction site planning

A **construction site is** an area or **piece of land** on which construction works are being carried out.

Typically, **land will become a construction site** when it is handed over to a contractor to begin the construction works.

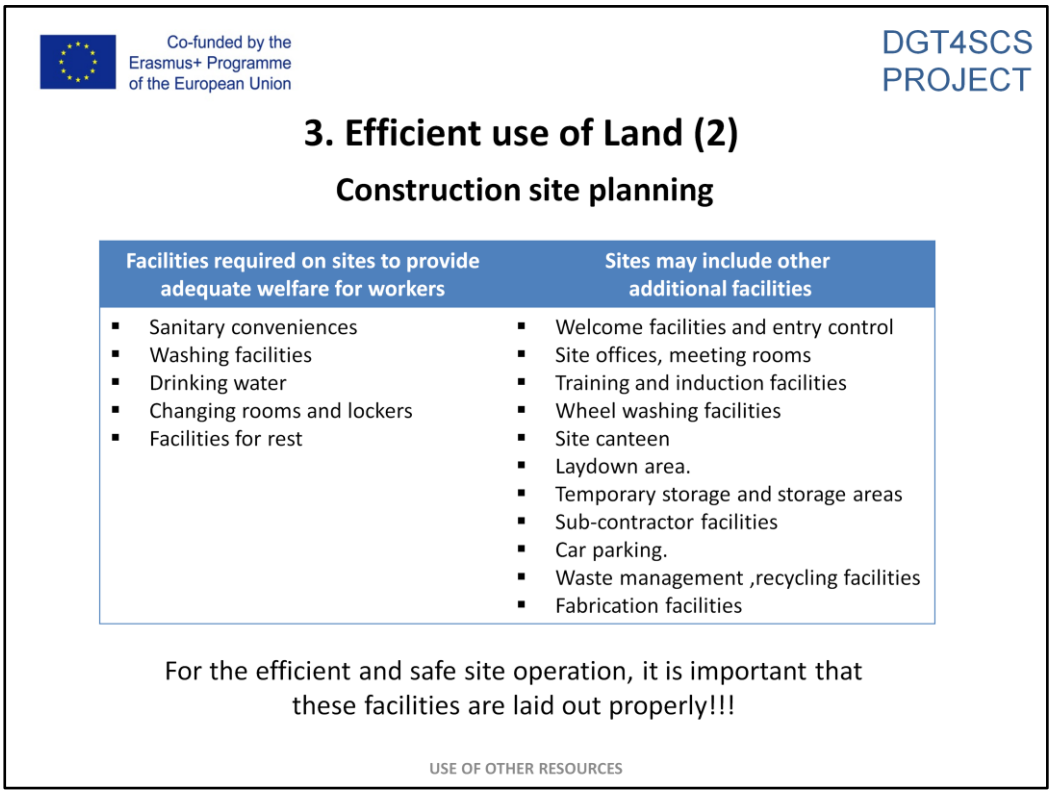
Types of spaces required for construction activities:

- Building component space;
- **Labour crew space;**
- **Equipment space;**
- **Hazard space;**
- **Protected space;**
- **Temporary structure space**

USE OF OTHER RESOURCES

Notes for the trainer and additional information:

Once the project is decomposed into various locations, or space units, understanding the interactions between activities and spaces is needed.



Source:
Construction site facilities. Available from: https://www.designingbuildings.co.uk/wiki/Construction_site_facilities [Accessed 14 November 2020].

Notes for the trainer and additional information:

Construction site facilities: for the eficient and safe site operation, it is important that these facilities are laid out properly.
Highlight that different portable buildings are necessary on site for worker accommodations during the construction process.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

3. Efficient use of Land (3)

Construction site planning

- ✓ For the efficient and safe site operation, it is important that the facilities are laid out properly.
- ✓ Site layout planning involves the following basic processes:
  1. Identifying the site facilities that will be required
  2. Determining the sizes, and other constraints of those facilities
  3. Establishing the inter-relationships between the facilities
  4. Optimising the layout of the facilities on the site

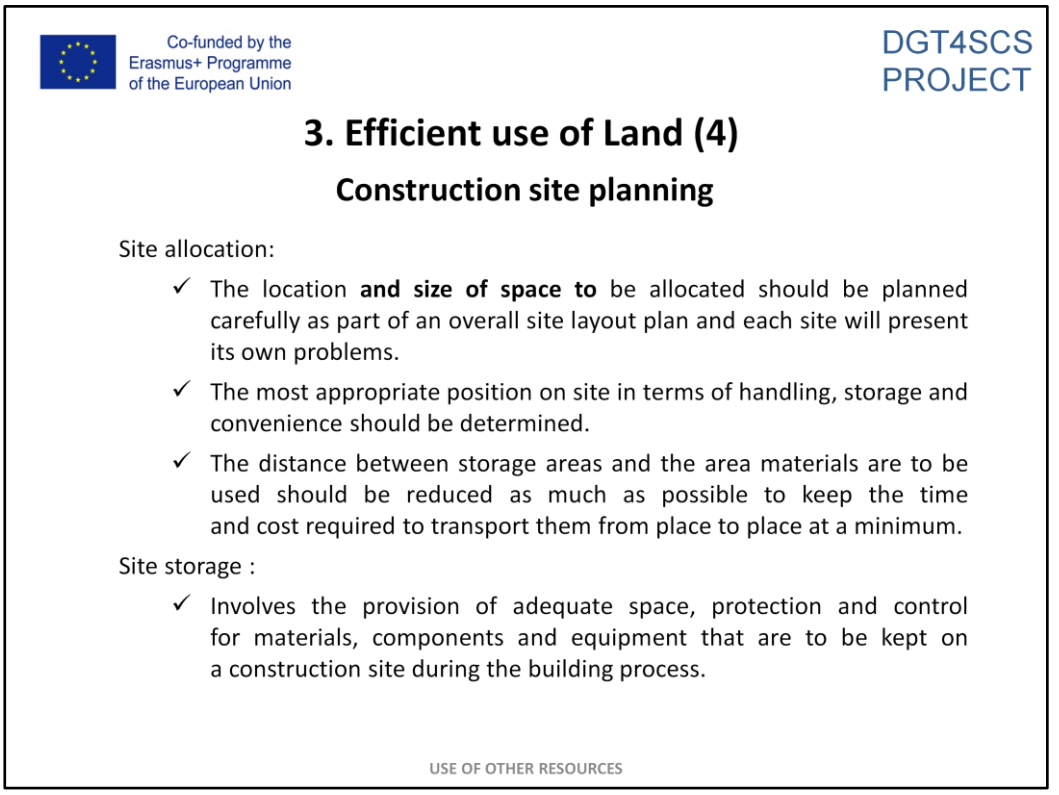
USE OF OTHER RESOURCES

Source:
Construction site facilities. Available from: https://www.designingbuildings.co.uk/wiki/Construction_site_facilities [Accessed 14 November 2020].

Notes for the trainer and additional information:

A well-designed construction site offers more benefits, including the following:

- shortens distances for transporting material to point of use;
- removes blocks to ensure materials easily and quickly move around site;
- maximizes the safe and effective storage of materials;
- avoids duplicate handling of materials and chemicals;
- implements controls to limit theft, breakage, and material waste;
- ensures equipment safely and quickly moves around the site.



Source:

Site storage. Available from: https://www.designingbuildings.co.uk/wiki/Site_storage [Accessed: 14 November 2020].

Notes for the trainer and additional information:

- Failure to adequately plan for storage space can result in congestion, or having more materials on site than storage space allows for.
- Unloading deliveries should take place in a clearly marked designated area, away from other site operations, supervised by a competent person.
- Alternatively, storage areas could be positioned within the reach of a tower crane which can then be used to move materials as required.

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DGT4SCS PROJECT

3. Efficient use of Land (5)

Minimizing site footprint

- Soil and vegetation must be **protected against spilled hazardous substances**:
  - solvent-based substances should be minimized;
  - the use of biodegradable lubricants should be preferred;
  - all hazardous substances must be stored securely;
  - there must be a containment basin;
- The portable/modular **buildings for workers** accommodation **should require the minimum space**, to protect existing vegetation from being trampled and to reduce soil compaction by workers;

NB! In overall a very good space organization in the construction site is crucial.

USE OF OTHER RESOURCES

Source:
FORMAR. Vocational training on sustainable buildings maintenance and refurbishment. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP.

Notes for the trainer and additional information:

In a sustainable construction, the construction footprint typically is minimized, and the construction manager plans the construction process to minimize the destruction of plants and animal habitat
It is important to minimise cleared footprint, avoid and manage sensitive sites.

This slide refers to the soil and vegetation.

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DGT4SCS PROJECT

3. Efficient use of Land (6)

Minimizing site footprint

- **The area of land to be cleared shall be minimised.**
  - Efforts should be made **to upgrade existing access roads**, and coordinate activities across different facilities and staff teams **to use existing** or joint cleared areas or right-of-ways.
  - **Tree clearance** should be kept **to a minimum**, and limited to the footprint of the site and any safety buffer zone. Within construction site boundaries **existing vegetation shall be retained** wherever possible. Trees and areas to be preserved and protected shall be identified and clearly marked as the work area is defined.
  - Construction activities shall be kept strictly to the footprint of designated **site boundaries** and/or the right-of-ways.

USE OF OTHER RESOURCES

Source:
Site Preparation and Construction. Land managemnet Statndard. Available from: http://www.sakhalinenergy.ru/media/user/libraryeng/healthsocial/2015/57-0000-S-90-04-O-0254-00-E%20Appendix%205.pdf [Accessed 14 November 2020].

Notes for the trainer and additional information:

In a sustainable construction, the construction footprint typically is minimized, and the construction manager plans the construction process to minimize the destruction of plants and animal habitat
It is important to minimise cleared footprint, avoid and manage sensitive sites.

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DGT4SCS PROJECT

3. Efficient use of Land (7)

Minimizing site footprint

- **Environmentally sensitive or valuable areas should be avoided**, such as nature reserves, archaeological sites, and areas inhabited by sensitive species. Areas adjacent to surface water bodies are to be avoided to the maximum extent possible.
- Where possible, and as informed by survey data, **construction activities should avoid Red Data Book plants** or ensure their translocation to a safe and suitable area prior to construction.
  - Construction personnel shall be briefed about the location and importance of rare fauna and flora in the area during the induction process.

USE OF OTHER RESOURCES

Source:
Site Preparation and Construction. Land managemnet Statndard. Available from: http://www.sakhalinenergy.ru/media/user/libraryeng/healthsocial/2015/57-0000-S-90-04-O-0254-00-E%20Appendix%205.pdf [Accessed 14 November 2020].

Notes for the trainer and additional information:

In a sustainable construction, the construction footprint typically is minimized, and the construction manager plans the construction process to minimize the destruction of plants and animal habitat.
It is important to minimise cleared footprint, avoid and manage sensitive sites.

Co-funded by the Erasmus+ Programme of the European Union

DGT4SCS PROJECT

3. Efficient use of Land (8)

Minimizing site footprint

- **Site location and design** (including route selection for roads and pipelines) shall be **optimised in order to minimise the amount of soil to be excavated and disturbed** within the site/project boundaries.
- Construction and clearing of **areas prone to erosion or landslides shall be avoided** to the maximum extent practicable (for example, areas of high slope or sensitive soils).
- **Minimised blasting activities** and carried out in seasonal windows that avoid disturbance of hibernating wildlife.

USE OF OTHER RESOURCES

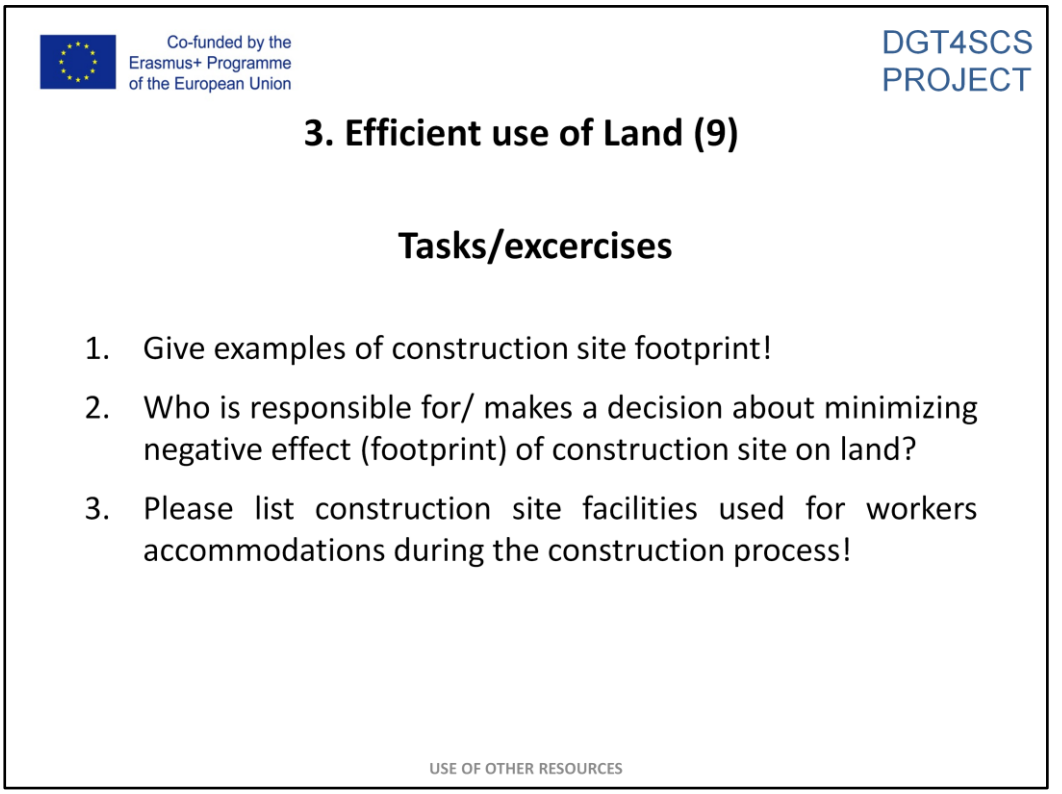
Source:
Site Preparation and Construction. Land managemnet Statndard. Available from: http://www.sakhalinenergy.ru/media/user/libraryeng/healthsocial/2015/57-0000-S-90-04-O-0254-00-E%20Appendix%205.pdf [Accessed 14 November 2020].

Notes for the trainer and additional information:

In a sustainable construction, the construction footprint typically is minimized, and the construction manager plans the construction process to minimize the destruction of plants and animal habitat.
It is important to minimise cleared footprint, avoid and manage sensitive sites.

Site location and design**:**

- ✓ Wherever possible use existing tracks and roads.
- ✓ In remote or extremely sensitive areas, consideration shall be given to using alternatives to conventional road construction. For example, the use of temporary/portable road systems and/or airlifting of equipment, material and personnel should be considered where practicable.

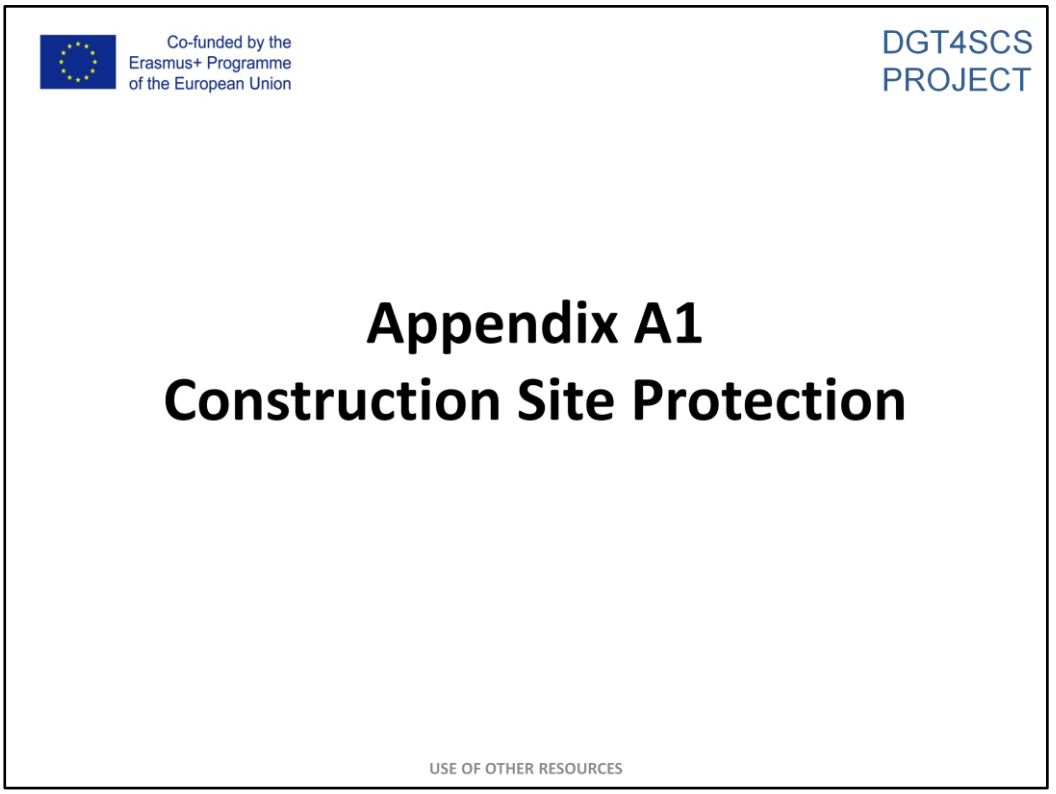


Notes for the trainer and additional information:

Task 1: A trainer asks students to give possible examples of construction site footprint. Additionally students can be asked to name activities of construction worker which can negatively affect land used for the construction site.

Task 2: Ask students to name staff positions which is in charge of making decision concerning minimizing construction footprint. How can workers affect? Group discussion can be organized.

Task 3: A trainer asks students to list construction site facilities used by staff during the construction process and make corrections if necessary.



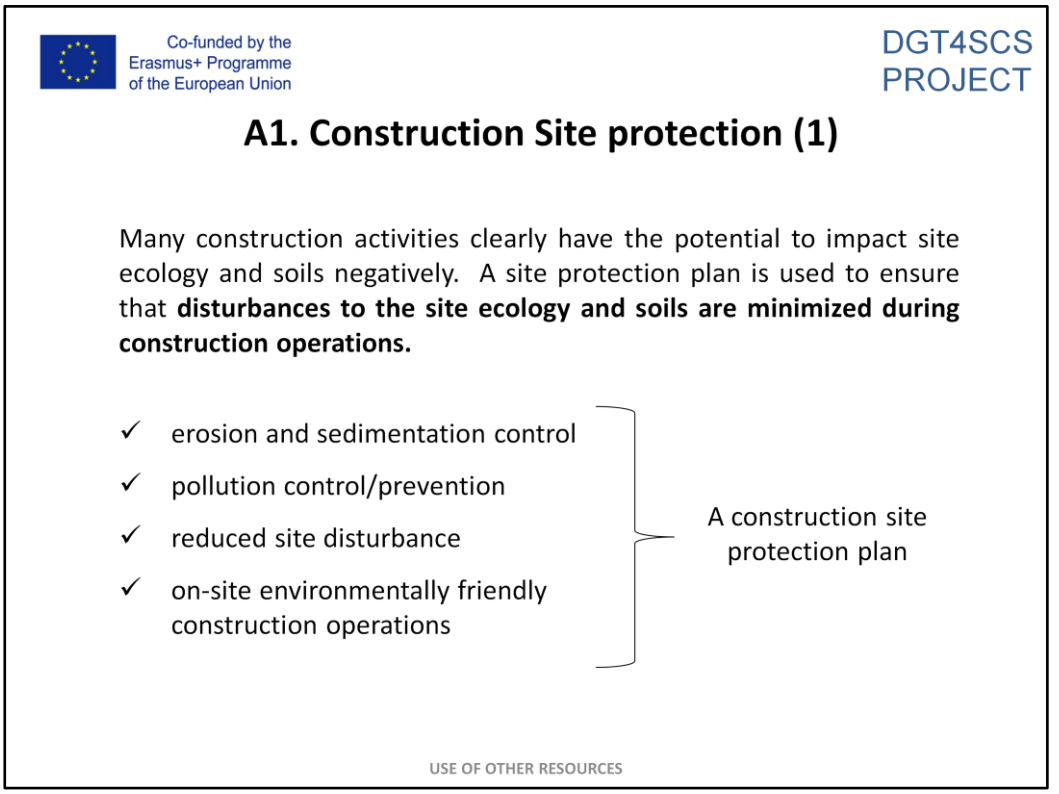
Notes for the trainer and additional information:

Extra subtopic can be highlighted by a teacher within a particular training programme – **construction site protection.**

The role of the construction team in executing a green building project and making it a reality is extremely important and should not be underestimated. The construction team may make contributions that are not specifically covered by building assessment systems (eg. LEED). Examples include improving materials handling and storage; reusing site materials, such as topsoil, lime rock, asphalt, and concrete; metering site electrical and water usage; and reducing pollution generation activities.
This subtopic focuses on construction operations in line with sustainable use of land.

NB! Depends on training programme, qualification and EQF level (more suitable for EQF level 5 and higher).

More detailed information see: Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 467-471 p.



Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 467-471 p.

Notes for the trainer and additional information:

A site protection plan includes erosion and sedimentation control, pollution control, reduced site disturbance, and on-site construction management operations. These issues are discussed in more detail next.

By implementing and executing a site protection plan, the builder will ensure that the existing ecosystems are protected and that the workforce and neighbours have all been considered in the construction process.

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DGT4SCS PROJECT

A1. Construction Site protection (2)

Measures and activities	
Erosion and sedimentation control	Erosion and sedimentation are caused by soil particles from the site being carried by wind or water to other locations. Solutions : • silt fences, storm drain inlet protection, and sediment traps. • infiltration trenches, vegetated swales, and bioretention cells. • grading flow, sheet flow strategy, seeding.
Pollution prevention	Pollutants: light, noise and vibration, dust and airborne particles, airborne chemical emissions, soil and groundwater pollution, surface water pollution, tracked soil on neighbouring streets. • for prevention measures see next slide

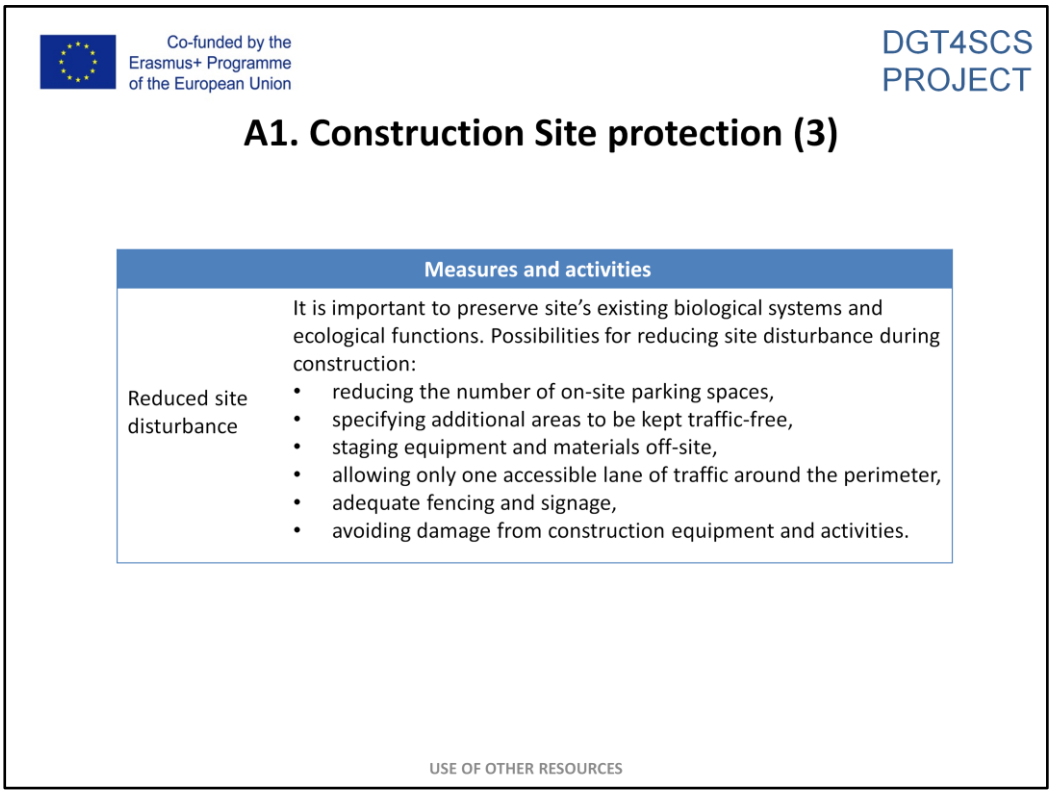
USE OF OTHER RESOURCES

Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 467-471 p.

Notes for the trainer and additional information:

Erosion and sedimentation control measures are important for reducing soil loss and the pollution of nearby water bodies. Erosion and sedimentation are caused by soil particles from the site being carried by wind or water to other locations. Sediment is eroded soil that is suspended, transported, and/or deposited by moving water or wind. Erosion is the process of displacing and transporting soil particles by the action of gravity. The result may be clogged sewer drains, contaminated adjoining sites and water bodies, and possibly costly site rework and cleaning in order to restore the site and surrounding areas to the required condition.. Care must be taken to ensure that soil loss is minimized (must be paid attention to soil loss in the form of airborne dust and stormwater runoff). Erosion-prone areas are identified by design professionals and construction managers so that a plan can be designed that controls water flow in the event of precipitation.
For more best practices see: Kibert...2016. 245 p.

Controlling pollution is a daily responsibility of the construction manager, and it is an activity that protects both workers and areas adjacent to the site. Noise, dust, air pollution, and light are a few types of pollution that can result from construction activities and that must be mitigated by corrective measures. it is important to identify the short- and long-term effects of construction activities and the appropriate measures to reduce their impact. These measures can be either reactive, meaning that the construction activity assumes that pollution problems are going to happen, or proactive, hereby pollution problems are prevented entirely.

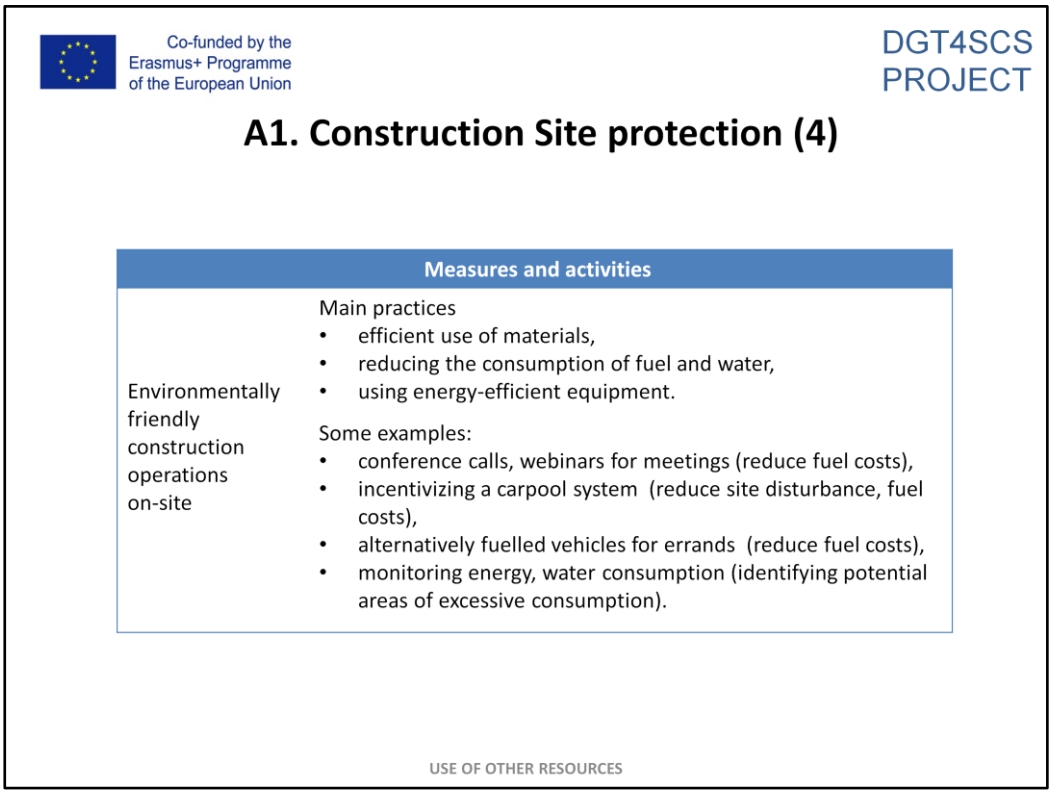


Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 467-471 p.

Notes for the trainer and additional information:

Reduced site disturbance. The very act of constructing a building and the supporting infrastructure that supplies power, water, communications, sidewalks, and roads causes tremendous changes to the existing site. The construction manager must manage procedures for reducing the physical footprint of the construction process.

Sustainable approach - is to determine whether there are any endangered or threatened species located on or near the project site. Determining if endangered or threatened species exist on or near the site can be accomplished by contacting the local Fish and Wildlife Service. If there is a possibility that an endangered or threatened species is located in the area, it is important to conduct visual inspections, formal biological surveys, and an environmental assessment. Although this process may seem like a difficult task, addressing this before construction begins will prevent potential delays in the project. Identifying responsibilities and clearly communicating site-specific requirements to the entire team will greatly improve efforts to minimize site disturbance. Reducing site disturbance also makes it easier to restore the site when the project is complete.



Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 467-471 p.

Notes for the trainer and additional information:

Conducting environmentally friendly construction operations.
There are numerous opportunities to enhance the conduct of construction operations from an environmental standpoint.
Practices that increase efficiency and reduce waste should be included in the site protection plan so that they can be communicated clearly and enforced.

Connection to other topics within the training material
"Energy consumption during construction"

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DGT4SCS PROJECT

A1. Construction Site protection (5)

Examples of Measures for Handling Construction Site Pollution

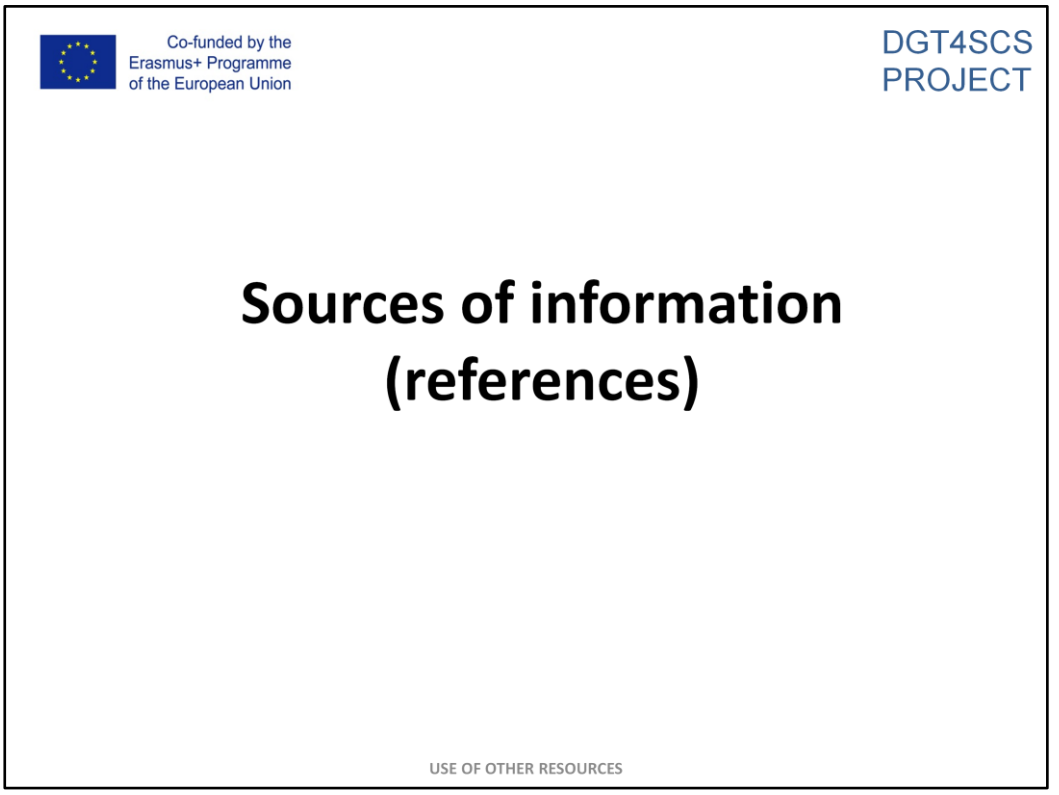
Pollutant	Source(s)	Mitigation Measures	Prevention Measures
Soil and groundwater pollution	Engine drippings Refueling Accidental spills Improper disposal	Spill cleanup plans/equipment Providing contained storage for chemicals and hazardous materials Spill countermeasures such as berms, absorbent mats, and barriers	Centralized refueling Spill prevention training for employees Proper equipment maintenance Using nonhazardous materials where possible
Surface water pollution (heat and contaminants)	Engine drippings Accidental spills Exposed soil without erosion control measures	Spill countermeasures Perimeter silt fences Spill cleanup plans/equipment Providing contained storage stormwater detention basins	Proper equipment maintenance Pervious or high-albedo surfaces Seeding exposed soil Limiting construction disturbance Infiltration basins
Tracked soil on neighboring streets	Vehicle wheels	Vehicle wash stations	Limiting construction disturbance Off-site materials staging Just-in-time delivery

USE OF OTHER RESOURCES

Source:
Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 469 p.

Notes for the trainer and additional information:

Others Examples of Reactive and Proactive Measures for Handling Construction Site Pollution see on 469 p. There are mentioned only examples related with sustainable use of land.



Notes for the trainer and additional information:

See the next slide.

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Sources of information (references)

1. Berge B., *The Ecology of Building Materials*. Routledge: 2009. 448 p.
2. Bokalders V., M. Block. *The Whole Building Handbook. How to Design Healthy, Efficient and Sustainable Buildings*. Earthscan: London, 2010. 703 p.
3. *Expert guidelines for Construction Specialists' Training on Sustainability.* Erasmus+ Programme project "Development of environmentally-friendly (green) training for specialists' in the construction sector" No: 2019-1-LT01-KA202-060695. 2020, 16 p.
4. FORMAR. *Vocational training on sustainable buildings maintenance and refurbishment*. Project No. 539465-LLP-1-2013-1-PT-LEONARDO-LMP. Available from: http://formarproject.eu/ [Accessed 31 May 2020].
5. Kibert C.J., *Sustainable Construction Green Building Design and Delivery*. Wiley: 2016. 608 p.
6. Kruger A., C. Seville. *Green Building: Principles and Practices in Residential Construction*. Delmar Cengage Learning: 2013. 608 p.
7. **Others references are given in the notes of the slides.**