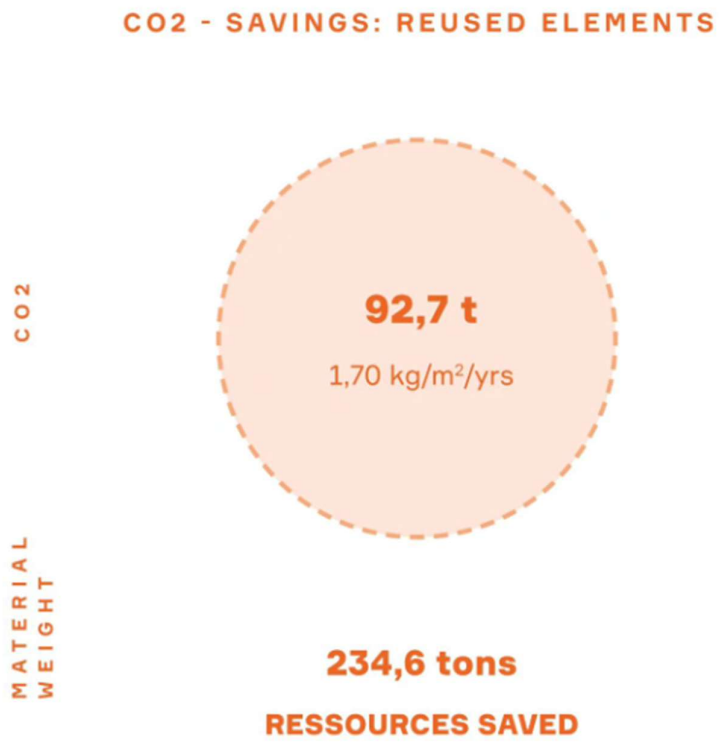
Contents

1.1. Reuse of solid interior products and installations

Solid interior products and installations are not often discussed in the context of reuse, and some of them are not currently included in the LCA methodology (the elements included in the LCA can be found here).

Nevertheless, they are a considerable part of the overall carbon footprint of the building, and their reuse should be considered in new construction and renovations.

! *According to Lendager's analysis made for office renovation, reusing existing flooring with minimal surface treatments, retaining most interior walls and furniture, and leaving technical installations (e.g., ventilation ducts, plumbing, radiators) in place resulted in substantial new material (~235 t) and carbon emissions (~93 t) savings, which corresponds to 1.7 kgCO_{2_eq}/m^2/year saved.*



Source: https://www.instagram.com/p/C_-VFu7MVye/?img_index=1

- What can be often reused: fire safety equipment, radiators, ventilation ducts, pipes, sanitary appliances, doors.
- What is challenging to reuse: small pieces of electronic equipment (as they become obsolete relatively fast due to technological development), whole windows (as they might not be compliant with current standards on thermal insulation, tightness, etc.), lighting equipment (due to increasing energy-efficiency standards).

! *The rule for reuse is that products should be complete and in the same condition as before dismantling.*

1.1.1. Fire safety equipment

Fire safety equipment is naturally suitable for reuse as its lifespan is long, and its documentation is complete and accessible as it needs to be tested annually.

1.1.1.1. How to reuse and recycle

- Fire hose cabinet:
  - check the quality of a fire hose if there are any surface damages (e.g., cracks);
  - check if the hose and other elements are free from bacteria (they can grow in water standing in piper over time);
  - check the shut-off valves;
  - protect from damage during transport and storage;
  - pressure-test after reassembly;
  - get approval for use.
    - ! *In ENTRA's KA13 project, a Norwegian complete full-scale circular project, 12 fire hose cabinets were reused without major technical problems.*
- Fire doors:
  - protect from damage during transport and storage;
  - in case a certification sign is missing, it is possible to receive documentation from a supplier;
  - good to have a fire advisor on-site to assess if doors can be reused (however, in case of modifications needed, often the supplier will have to be involved to reach the final decision on their approval).
    - ! *In ENTRA's KA13 project, a fire door was modified and reused. Due to the modification (i.e., removing the glass panel above the door), it had to be checked if the doos could hold their certification with their supplier and a fire advisor.*
    - ! *In the case of old fire doors (e.g., from before the 80s), asbestos was used in them, so they might be hazardous to handle. Grout containing asbestos can be recognised by its pink or reddish colour and it may have a fibrous structure.*

1.1.2. Cast iron radiators

Radiators are relatively easy to dismantle, have a long lifespan, and their appearance and capacity have not changed significantly over the years – this makes their reuse easier. Additionally, as new radiators can be relatively expensive, it can pay off to reuse them, especially with good logistics.

! *According to the assessment in Bengt Dahlgren Gothenburg's guide, reusing a 500mm x 1000 mm radiator can save from 11 up to 41 kg of CO_{2_eq}, depending on the number of panels and convector plates.*

1.1.2.1. How to reuse and recycle

- check available documentation on what flows (system temperature and output power) the radiators were designed for;

  ! *If documentation is missing, the capacity and function need to be assessed; it can start by matching an old radiator with a corresponding product type for which specification is known.*

- protect from damage during transport and storage:
  - remember to plug the pipe connections and radiator coupling;
  - if possible, transport and store radiators side by side to avoid their deformation and other damages while stacked on top of each other;
- assess the radiators' tightness (pressure-test), function, and aesthetics (e.g., cracks, rust, etc., to be repaired or the need for their repainting);

  ! *In some facilities, venting and degassing of radiators might have been deficient, leading to oxygen presence in the system, thus increasing the risk of corrosion and, eventually, leaking. This is why a thorough check of radiators' properties is crucial.*

  ! *Radiators affected by rust can be ground down and welded in case of any leaks.*

- check for filters and how much contamination has occurred since the last filter change, and for the type of radiator coupling (as, especially in the older types, these couplings are "site-build" and cannot be dismantled with keeping their functional properties);
- if needed, clean the radiators by flushing them through and, additionally, using, for instance, scrapping off the loose paint by sandblasting,
- if needed, repaint the radiators and reassess their capacity with an additional paint layer;
- pressure-test after reassembly.

  ! *In ENTRA's KA13 project, a Norwegian complete full-scale circular project, 150 radiators were reused. Some of them were designed for other heating mediums with different temperature parameters. However, energy calculations proved that, with higher window quality (less energy loss), such radiators would be enough.*

1.1.3. Pipes

The feasibility of pipe reuse depends on their type, size, location, and desired function and needs to be assessed individually. This is why it is advised to engage contractors specialised in pipelaying to evaluate the potential for pipe reuse on-site and, if positive, dismantle the pipe themselves as they hold the best qualifications to do so in a way that the pipe will not be damaged. Consequently, the desire to reuse pipes has to be expressed early in the project.

1.1.3.1. How to reuse and recycle

- when harvesting, keep standardised sizes;
- sort out harvested pipes according to their function;
- protect from damage during transport and storage;
- before disassembly, clean the pipes.

! *One of the recommendations from ENTRA's KA13 project, a Norwegian complete full-scale circular project, is to engage pipelaying experts in harvesting pipes for reuse. This can help avoid mistakes such as cutting pipes into smaller pieces with unstandardised sizes, thus increasing the workload of pipelayers to join them again (which happened in the project) and increasing the costs of the assembly phase.*

1.1.4. Ventilation ducts

Ventilation ducts are "passive" elements, and they typically wear less than "working" elements (e.g., motors or fans), which increases their reuse potential. However, due to their relatively low price, reuse is often unattractive for project owners. Therefore, to enhance duct reuse, focus on lengths which suit your projects (as rejoining ducts can be costly).

! *According to the assessment in Bengt Dahlgren Gothenburg's guide*, reusing ventilation ducts can save from 3.5 up to 96 $kgCO_{2\_eq}/m^2$, depending on the duct size and shape.

! *An example of a grassroots initiative in reuse is Swegon's RE:3 project, aiming at streamlining the recycling of cooling and ventilation products. Swegon is a manufacturer and retailer of such products, which resells used products with a repair guarantee.*

1.1.4.1. How to reuse and recycle

- check for documentation on ventilation duct specification (especially acoustic, pressure drop, and corrosion-resistance parameters) – if such is not available, reuse the ducts in spaces with the lowest requirements regarding these parameters;
- protect during storage and transport, especially from surface damage, deformation, and corrosion.

1.1.5. Cable ladders, wall ducts

Cable ladders and cable wall ducts/channels have a high reuse potential as their design hasn't changed much over the years and are usually not visible to tenants. Hence, their reuse is less dependent on aesthetics.

! *According to the assessment in Bengt Dahlgren Gothenburg's guide, reusing a 400 mm cable ladder can save around 5.6 kgCO_{2_eq}/m.*

1.1.5.1. How to reuse and recycle

- usually, there is no need to collect detailed documentation on the properties of cable ladders and wall ducts; often, it is enough to check the type of the elements and look for documentation for new products of a corresponding type;
- in cases in which the corrosivity of the environment is relevant, precisely document the corrosivity class from which the element comes to plan its reuse correspondingly to the corrosivity class of the space they will be reused in;

! *If such is not available, reuse the cable ladders and wall ducts in spaces with the lowest requirements regarding corrosivity.*

- check the surface for damages (e.g., scratches, holes, rust) and if any hazardous substances are present (e.g., lead in the case of old ducts – can be checked by XRF measurements);

! *White rust (i.e., chalky substance that forms on the surface of zinc materials) usually does not significantly influence the functionality and longevity of cable ladders/wall ducts.*

- protect from any surface damages and deformation during transport and store in a dry space;

! *Plastic or steel wall ducts? There is no significant difference in quality and lifespan between plastic and steel wall cable ducts; however, steel can get scratched more easily than plastic ones. Therefore, storing and transporting plastic ones might be more manageable.*

- while reinstalling, ensure that the products can be dismantled and reused again in the future.

! *In ENTRA's KA13 project, a Norwegian complete full-scale circular project, 90 m of plastic wall ducts were reused. There were no significant problems with the reuse.*
In Vasakronan's KAJ16 project, a Swedish complete full-scale circular project, 400 m of cable ladders were harvested from a demolished building, and 100% of cable ladders in a new 16-storey building will be reused.

1.1.6. Electrical cabinets

Electrical cabinets have high reuse potential as their documentation is usually available, and their design has not changed much over the years. In case of their reuse, the inside parts are replaced.

! *Reusing electrical cabinets on-site is already common, so it is often not considered a reuse but just a "business as usual". If reuse is impossible, cabinets are often sold to appliance cabinet companies, which resell them with new components inside.*

! *According to the assessment in Bengt Dahlgren Gothenburg's guide, reusing a standard cabinet (1800 mm x 800 mm) can save from 250 to 400 kgCO_{2_eq}/cabinet depending on the cabinet material, production process, and country of origin.*

1.1.6.1. How to reuse and recycle

- gather the documentation of the cabinet and verify its suitability for the project (e.g., if the cabinet meets the IP class requirements);

! *When planning to reuse an electrical cabinet without knowing its exact sizes, assume 1200 mm x 1800 mm to ensure enough space to fit either a floor (usually 1200 x 1800 mm) or a wall cabinet (usually 1000-1200 mm x 800-1200 mm).*

- check the cabinet for possible damages (e.g., unsealed holes);

! *If incoming cabling is removed, flanges need to be replaced, as removing the cabling might cause holes.*

- clean thoroughly before reusing as dust and any other dirt can damage the electronics installed inside;
- protect from any surface damages and deformation during transport and store in a dry space;
- while reinstalling, ensure that the products can be dismantled and reused again in the future.

1.1.7. Sanitary equipment

The reuse potential of sanitary equipment is high as: their design and functionality do not change significantly over the years, it's relatively easy to find spare parts for them, and their dismantling is relatively easy.

! *According to the assessment in [Bengt Dahlgren Gothenburg's guide]*
! *, reusing:*
- *a toilet set can save from 80 to 140 kgCO_{2_eq}/set, depending on a bowl (floor-standing, wall-hung) and flush type;*
- *a standard-size washing basin/sink can save around 60 kgCO_{2_eq}/piece;*
- *a mixer tap/faucet from 10-14 kgCO_{2_eq}/piece, depending on its type.*

! *Currently, sanitary equipment is usually reused either by individual stakeholders or between projects of the same owner. For instance, such secondary equipment can be found in Iceland on [Efniveitan's website].*

1.1.7.1. How to reuse and recycle

- Toilet sets:
  - while planning for reuse, remember that a complete toilet set includes mounting screws and, for wall-mounted toilets, parts that are built into the wall; try to harvest all or as many as possible of these elements;
  - check for any cracks or surface damage;
  - check the tightness of a gasket between a cistern and a toilet and a fill valve;
  - check if a toilet flush works, including a float valve;
  - empty the cistern;
  - clean before dismantling;
  - be careful when disassembling the supply water connection;
  - check the possibility of converting to double-flush (if applicable);

    ! *Older toilets sometimes do not have an option of two flushing volumes, which can lead to increased water consumption. Some manufacturers sell separate flush valves to convert an older toilet into a double-flush toilet. In case this is unavailable, such toilets can be located in spaces which are rarely used (e.g., basement); however, there may also be locations where a non-flushing WC seat may be preferable, for example, at the far end of a common waste water pipe to "rinse out" the main pipe better.*

  - protect from damage while transporting and storing:
    - it is suggested that max. 3 toilet bowls should be stored and transported on one pallet;

    ! *Pallets produced before 2010 or manufactured outside of the EU may be treated with methyl bromide. They are marked with the letters MB and should be avoided. However, most pallets in Europe are marked EPAL or HT, which indicates that the material has been treated with heat rather than chemical substances.*

        - toilet bowls should be screwed onto a pallet using the same holes and screws that were used before dismantling;
        - wall-mounted toilets should be put down as the pallet were the wall they were mounted on;
        - protect toilet bowls from rubbing against each other (to avoid surface damage).

- Washing basins/sinks:
    - while planning for reuse, remember that a complete washing basin/sink set includes gaskets and wall brackets; try to harvest all or as many as possible of these elements;
    - check for any cracks or surface damage;
    - be careful with supply water connection that can be easily bent off;
    - protect from damage while transporting and storing:
        - max. 3-4 washing basins/sinks should be stored and transported on one pallet;

        ! *Pallets produced before 2010 or manufactured outside of the EU may be treated with methyl bromide. They are marked with the letters MB and should be avoided. However, most pallets in Europe are marked EPAL or HT, which indicates that the material has been treated with heat rather than chemical substances.*

        - protect against the products rubbing against each other;
        - use pallet collars if several layers of products are to be stacked on top of each other – in that case, there must be a pallet between each layer.

- Mixer taps/faucets:
    - while planning for reuse, remember that a complete mixer tap/faucet set includes detached water connections from the wall and gaskets; try to harvest all or as many as possible of these elements;
    - check for any scratches or surface damage;
    - check if sealings and knobs/handles do not leak;
    - check if a flow limiter (if necessary) can be used to reduce water consumption;

        ! *Older mixer taps can consume more water than new ones; in such cases, a flow limiter can be used to reduce water consumption.*

    - protect from damage during transport and storage:
        - if there are any loose parts, collect them, pack, and label them carefully to indicate where they belong;
        - place a bottom plate of, for instance, corrugated cardboard, on the pallet to prevent smaller parts from falling through;
        - use pallet collars if several layers of products are to be stacked on top of each other – in that case, there must be a pallet between each layer.

1.1.8. Doors

Doors reuse potential is high. Currently, they are usually reused either by individual stakeholders or between projects of the same owner. For instance, such secondary doors can be found in Iceland on Efniveitan's website.

1.1.8.1. How to reuse and recycle

- while planning for reuse, remember that a complete door set includes a door leaf with hinges, frame with hinges, threshold, door knob/handles with associated screws, lockbox, keys, door automation (with associated screws, mounting plate, and stop guard), and other accessories; try to harvest all or as many as possible of these elements;

  ! *Finding a door that completely matches the initially designed door scheme can be challenging. This is why flexibility from designers, project owners, and other stakeholders involved in decision-making related to the aesthetics and functionality of the interior is advised.*

- check the surface for any damages (e.g., scratches, holes);
- dismantle door knobs/handles for more efficient storage and avoiding scratches (if possible);
- put door knobs/handles together, pack them separately, and label them carefully to know to which door they belong;

  ! *In ENTRA's KA13 project, a Norwegian complete full-scale circular project, some reusable doors were not reused eventually as the door leaves were separated from the frames, and it was difficult to match them again. Therefore, proper labelling of complete door sets is of crucial importance.*

- if there is a lock cylinder, the key must not be in it (as it can break during transport) but must be taped to the door leaf;
- protect from damage during transport and storage;
  - be careful with the cover plate (as it is very visible and needs to be in perfect condition);
  - fasten the door and frame to door parts without thresholds to prevent the door from opening during transport and handling;
  - use wooden studs to prevent damage to protruding parts (e.g. door handles, hinges);
  - protect the frames against scratching from the hinges if there is no distance between them;
  - protect the corners of glass doors and never place glass against hard surfaces;
  - place a bottom plate of, for instance, corrugated cardboard on the pallet to prevent smaller parts from falling through;

! *Pallets produced before 2010 or manufactured outside of the EU may be treated with methyl bromide. They are marked with the letters MB and should be avoided. However, most pallets in Europe are marked EPAL or HT, which indicates that the material has been treated with heat rather than chemical substances.*

- protect elements with corrugated cardboard to avoid scratches when using cargo storage roll trolleys;
- do not load more than 3-4 pieces of door automation systems on a pallet;
- do not load more than 500 kg/pallet (4-5 thick steel doors) or 200 kg/cargo storage roll trolley for easier internal handling and transport;
- use pallet collars if several layers of products are to be stacked on top of each other – in that case, there must be a pallet between each layer.

Sources and further readings:

1) EU Construction & Demolition Waste Management Protocol, including guidelines for pre-demolition and pre-renovation audits of construction works, 2024.
2) Bengt Dahlgren Gothenburg's guide (in Swedish). 2022.
3) IVL Svenska Miljöinstitutet. Arbetsguide - Återbruk av fasta interiöra byggprodukter (in Swedish). 2018.
4) IVL Svenska Miljöinstitutet. Arbetsguide - Återbruk av möbler och annan lös inredning (in Swedish). 2018.
5) IVL Svenska Miljöinstitutet. BYGGÅTERBRUKSGUIDEN - En vägledning för att underlätta återbruk av byggprodukter i bostäder (in Swedish). 2021.
6) Karlsson A, Ratfelt A, Eerola P, Bladh S. Återbruksguiden för installationer – Bengt Dahlgren (in Swedish). 2022.z
7) CCBuild. Återbruk av belysning - Demonterings- och hanteringsinstruktioner (in Swedish). 2018.
8) CCBuild. Återbruk av beslag och dörrautomatik - Demonterings- och hanteringsinstruktioner (in Swedish). 2018.
9) CCBuild. Återbruk av vägg och tak - Demonterings- och hanteringsinstruktioner (in Swedish). 2018.
10) CCBuild. Återbruk av VVS-produkter - Demonterings- och hanteringsinstruktioner (in Swedish). 2018.
11) CCBuild. Återbruk av dörrpartier - Demonterings- och hanteringsinstruktioner (in Swedish). 2018.
12) Erfaringsrapport ombruk (Eng. Experience report reuse) - Kristian Augusts gate 13. 2021.
13) Circle House - Denmark's first circular housing project. 2018.