Green Inland Ports

Good Practices

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the European Union

New buildings with sustainability requirements

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1.1 Description

Around 40% of all energy consumed in the European Union (EU) can be attributed to buildings. Around 85% of buildings in the EU were built before 2000 and amongst those, 75% have a poor energy performance (European Commission, n.d.). (More stringent) sustainability requirements may be set up for new buildings. This can be limited to the port area, but also arranged on for example national level. Green Buildings Standards generally divide requirements into separate topics such as energy efficiency, indoor air quality, sustainable site selection, and materials and resource use (Durable Building Solutions, n.d.). Hnin, T., (2023) sums up that the most common green building requirements or characteristics include energy efficiency, water saving, minimizing harm to the environment, relying on renewable resources, non-toxic building materials, efficient use of space, and responsible harvesting and use of materials. United Nations, (n.d.) describes that for four major shifts are needed to reduce greenhouse gas (GHG) and air pollutant emissions in the construction sector: excess floor area should be minimized, energy intensity should be reduced, the emissions intensity of energy use should decrease, and embodied carbon emissions from construction should be reduced. Buildings are responsible for a significant share of greenhouse gas emissions. Regulations on the aforementioned topics can reduce much of GHG emissions, as well as air pollutants and the depletion of other resources.

Building standards currently exist in most countries, as they guarantee a safe and efficient design and construction, but also in many cases an efficient arrangement of the already scarce land. For example, in the Netherlands regulations within the so-called 'Bouwbesluit' (building decree) include safety, health, usability, sustainability, and environment. Other countries have well-known Green Building Rating Systems as well, such as:

- BREEAM (Building Research Establishment Environmental Assessment Method) set up in the United Kingdom, but applied in 75 countries around the world
- LEED (Leadership in Energy and Environmental Design) set up by the United States Green Building Council, but applied in 185 countries around the world
- DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) set up by the German Sustainable Building Council, but applied in 30 countries
- CASBEE (Comprehensive Assessment System for Built Environment Efficiency) set up/operating in Japan
- G-SEED (Green Standard for Energy and Environmental Design) set up/operating in Korea

Park, M. et al., (2015) created an overview, which can also be seen as a comparison of different building rating systems and which emission reduction categories they apply within their rating system. The overview is shown in Table 1.

Table 1 - Categories associated with GHG reduction technologies for different building certification systems (Park, M. et al., 2015)

G-SEED	LEED	BREEAM	CASBEE
1. Land Use and Transportation	1. Integrated design	1. Maintenance	Q. Environmental quality performance of buildings
2. Energy and Environmental Pollution	2. Location and Transportation	2. Health and Wellness	Q-1. Indoor environment
3. Materials and Resources	3. Sustainable Land	3. Energy use	Q-2. Service quality
4. Water Cycle Management	4. Water Efficiency	4. Transportation	Q-3. Outdoor environments (in the land)
5. Maintenance	5. Energy and Air Quality	5. Water Resources	LR. Environmental load reduction performance of the building
6. Ecological environment	6. Materials and Resources	6. Materials and Resources	LR-1. Energy
7. Indoor Environment	7. Indoor Environment	7. Waste	LR-2. Materials and Resources
	8. Creative Design	8. Use of the land and Ecological environment	LR-3. Other Environments than the land
	9. Priority of Regional Features	9. Pollution	
		10. Innovation	

On 28 May 2024, the EU's "Revised Energy Performance of Buildings Directive" (Directive 2024/1275) entered into force, which represents an important step forward in the EU's commitment to improve energy efficiency and reduce greenhouse gas emissions from buildings, an effort for the EU to become more aligned with the Green Deal goals (Palomo, H., 2024). The Directive applies to the energy demand of the typical use of the building (heating, cooling, ventilation, domestic hot water and lighting) and the on-site carbon emissions from fossil fuels. Member States will have until 29 May 2026 to establish a scheme to realize all the

requirements mentioned in the Directive (European Commission, 2024). However, according to the Revised Energy Performance of Building Directive Article 11, Member States shall ensure that new buildings are zero-emission buildings from 1 January 2028 (applying to new buildings owned by public bodies), or from 1 January 2030 (all new buildings). This means that buildings within the port area must also comply with the requirements specified in this Directive from 1 January 2028 (buildings owned by public bodies) or 1 January 2030 (all other buildings) onwards. Before these years, countries may decide to implement a transitional timeframe in which new buildings have to comply with less stringent requirements, or port authorities can set their own requirements for new buildings from their role as a port landlord.

The port of Rotterdam is a good example of how this good practice can work out in practice (Port of Rotterdam, n.d.). Portlantis is a new building on the 'Tweede Maasvlakte' (second Maasvlakte), in which visitors can experience the expansion of the port of Rotterdam (port experience centre). The site includes a wind turbine and solar panels that help generate energy. The water basin of the sprinkler system can be used to recover heat from the heating system. The building almost fulfils the demands of an energy-neutral building (BENG) and has a "Very good" BREEAM sustainability label. Due to the sturdy sand, a concrete foundation of 1 metre in thickness is sufficient, which exists out of 700 m3 concrete, consisting for 30% rubble granulate. A large share of the construction is re-mountable, meaning that re-use of materials is possible. The design also takes into account the sun irradiation and windows have a sun-resistant coating, meaning that less lighting would be necessary.

1.2 Specific aim of the measure

The immediate goal is to reduce the negative impact on the environment caused by buildings in the broadest sense of the principle, i.e. not only during construction, but also during the use of the building. For example, when a building is (near) carbon/energy neutral, greenhouse gases and air pollutants will be reduced. If the building can use water efficiently and has a good drainage system, less water is needed and the environment is less affected. The building can interact well with the environment, meaning that it will not place a burden on biodiversity, but rather can create more life around it by facilitating nesting space and habitats for animals such as birds, insects and other wildlife. Directive 2024/1275 is a good starting point, but only applies on energy demand and the use of fossil fuels. Because sustainable building goes further than this, think of all the different categories that have been mentioned in the building certification systems in Table 1, it would be beneficial to expand the requirements of sustainable buildings.

1.3 Known ports that apply sustainability requirements for new buildings

- Port of Rotterdam

1.4 Stakeholders

- Port authority: Within their landlord role, they can set requirements to new buildings that will be built in the port area. This includes companies that are already located in the port area, but want to realize a new building, companies that wants to settle in the port area for the first time, and buildings that are owned and used by the port authority, which includes the case of the port of Rotterdam.
- Companies that want to settle in the port area: If they want to realize a new building in the port area, they will be subject to the more stringent building requirements.
- National and European legislation: Like explained above in the description, Directive 2024/1275 has come into effect in 2024, putting strict requirements for new buildings from 2028 and onwards. National legislations need to be adjusted to be in line with this European Directive. However, countries can also choose to allow only net-zero buildings even before 2028.
- Building companies and architects: This good practice means that the design of buildings and the way of building (more sustainability) within the relevant port areas would become different compared to the regular techniques.

1.5 Voluntary or mandatory

Whether this good practice is voluntary or mandatory depends on the country the inland port is located and the ambitions of the specific country. However, in general this good practice would be voluntary on the short term until 1 January 2028 (buildings owned by public bodies) or 1 January 2030 (all buildings), as the Directive 2024/1275 indicates that from this moment, all newly built buildings need to be net-zero.

1.6 Realised/potential impact

Ahmed, N. et al., (2020) found that reinforced concrete has a significant negative impact on the environment, as it represents 78% of the total embodied carbon emissions, which include the carbon dioxide emissions associated with materials and construction processes throughout the whole lifecycle of a building or infrastructure (Carbon Cure, 2024). Heavy cast concrete and autoclaved aerated concrete can be used as alternatives, as they achieve 23% and 50% reduction in the total embodied carbon emissions respectively.

Amaral, R. E. C. et al., (2020) have made an overview of different energy-efficient techniques:

Passive building energy-saving technologies

- Building envelopes: They separate the interior space of a building from the exterior environment and play an essential role in reducing the energy consumption of buildings if there is adequate insulation. A well-insulated building envelope can save up to 22% of energy consumption (Zhou, Z. et al., 2018).

- Window glazing: 60% of a building's energy can be lost through windows. Near-infrared electrochromic windows may save up to 50% of energy compared to conventional window materials, without sacrificing visual comfort (Cannavale, A. et al., 2020).
- Passive heating: Passive heating technologies rely on solar heat energy. One of the typical technologies is the Trombe wall that allows for transferring solar heat energy into buildings to meet part of the heating load. Elsaid, A. M. et al., (2023) estimates that a Trombe solar wall (combination of glass and dark material that absorbs heat to conduct heat slowly into the building) and phase-change materials (PCMs, a material that releases/absorbs sufficient energy at phase transition to provide useful heating or cooling) may achieve maximum energy saving of 36% in the summer and up to 55% in the winter (Cao, X. et al., 2016, Hu, Z. et al., 2017).
- Passive cooling: Passive heating can be provided by nighttime ventilation with cold night air, ground cooling, and sun shading technologies. Ground cooling systems, such as earth-air heat exchangers, can save 38% of electricity consumption compared to electric heaters. Case studies in Germany, Italy and Turkey demonstrated 13-44 kWh/m2 energy savings thanks to nighttime ventilation. A case study of an office building in Athens showed that a green roof used for shading enabled energy savings of 19% (Cao, X. et al., 2016, Gao, J. et al., 2018).

Energy-efficient heating, ventilation, and air conditioning (HVAC), domestic hot water, and lighting

- HVAC Systems: Evaporating cooling is a growing technology for providing cool air to buildings, especially efficient in hot and dry climate zones. The technology is based on the use of water to increase air humidity, resulting in temperature reduction and allows savings around 16% of energy compared to conventional air conditioners. Sensible and enthalpy heat recovery systems that use heat exchange between cool intake and warm exhausted air streams make it possible to recover 60-95% wasted energy and provide additional ventilation. Radiant heating and cooling systems have been proven to be up to 15-20% more energy-efficient compared to conventional systems. Air conditioning systems with variable air volume show excellent energy savings of up to 30% compared to conventional systems (Cao, X. et al., 2016, Cuce, P. M. & Riffat, S., 2016, Okochi, G. S. & Yao, Y., 2016).
- Energy-efficient and autonomous lighting: For a more extensive explanation, see the good practice on "LED and smart lighting". LED lighting is up to 80% more efficient than conventional bulbs, and is expected to reduce energy consumption by 40% in 2030 (Primiceri, P. & Visconti, P., 2017).
- Renewable energy generation systems: For a more extensive explanation, see the good practice on "clean alternatives to energy generation".

Energy management

- Smart Grids: Automated delivery systems for information and energy. It uses computers that communicate with buildings and power sources, allowing information about power consumption to flow from the smart meter in the home to a transformer to the power company and back. Using computers, the smart grid can monitor the system itself. It can see when certain parts of the power grid are getting old or no longer efficient. This helps with load shedding during peak hours and allows the power company to monitor energy use, detect peaks, monitor peak usage times and restore power faster after a blackout, and enable the integration of renewable energy (Kakran, S. & Chanana, S., 2018, Santacana, E. et al., 2010).

- Smart Meters: This is to some extent similar to good practice "energy management software". These are advanced meters that can collect data on consumers' electricity consumption, transmit that data to other power system participants on the local power grid, and get pricing information from distribution system operators to turn on appliances and machinery (Ciuciu, I. G. et al., 2012).

Other benefits must also be considered. United Nations, (n.d.) indicates that for every US$ 1 million invested in retrofits and efficiency measures in new construction, an estimated 9 to 30 jobs are created.

1.7 Possible obstacles when implementing good practice

- Sustainable building will be more expensive to build and operate, because more care must be taken with construction methods and materials. Sustainable materials and technologies are often less available or less durable because of the early market stage of the material or technology (Murphy, P., n.d.).
- There is no standard definition of a sustainable building and there is a lack of consensus on best practices and technologies to use. This means that there are no clear guidelines, and all the different certification systems have their own criteria and standards, which can be confusing for developers and consumers (Murphy, P., n.d.).
- Sustainable architecture and buildings can be perceived as boring or uninspiring, leading to difficulties for architects to sell their designs (Murphy, P., n.d.).

1.8 Key learnings

- Buildings are responsible for a relatively large share of energy consumption within the European Union, namely around 40%.
- EU Directive 2024/1275 on making buildings more sustainable has come into force in 2024. This directive is limited to the energy demand of the building, stimulating high energy performance and using renewable energy sources to meet the energy demand. It only applies to new buildings of public bodies from 2028 and to all new buildings from 2030.
- Various forms and techniques of sustainable building can save a significant share of energy consumption and GHG emissions, as described above in section 'Realized/potential impact'.

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