Application of Digital Technologies to Promote Smart Integration of Buildings in Sustainable Energy Sector

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Abstract: *Sustaining global economic and social growth and supporting deployment of emerging technologies imposes the need of changing energy system production and consumption patterns. In the transformation pathway, energy efficiency is considered the first clean energy source, of highest importance to meet the challenge of clean transition of the energy sector, towards its climate neutrality and resilience. Reaching the global net zero targets doesn't include only increased use of cleaner energy, but also requires a significant improvement in more efficient energy use. Considering that buildings are complex energy sub-systems occupying about 40% of the total energy consumption and contributing by about 36% to the CO_2 emissions, improving their energy performance will make significant contribution to the energy system clean transition*

Introduction

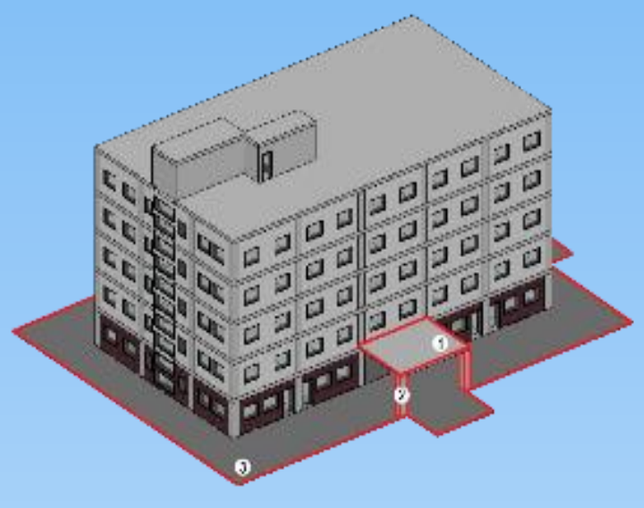
Improving energy performance of building stock requires a systemic approach based on inclusivity of all economic and social actors, that can be achieved mostly effectively by digitalization. Digitalization offers potential to increase energy efficiency through technologies that gather and analyze data before making changes to the physical environment, thus expanding the view of energy efficiency: from end-use to system efficiency.

Hypothesis

BIM as a sustainability supportive technology based on a holistic collaborative management of buildings.Its analytical, simulation and visualization capabilites enable validating design decisions in early stages, and help design more energy efficient solutions based on real data measurements and predictions, as well as simulate life cycle behaviour of buildings.

Results

A precondition is producing digital twins of the assets, including information affecting its energy performance. Application of digital modelling tools (BIM) has been confirmed to leverage generation of sustainable energy systems and solutions, reduce gaps and enable continuous improvement of operational energy, thorugh systemic engagement of all stakeholders.



Digital twin of a building used for analysis (https://energybimcert.eu/)

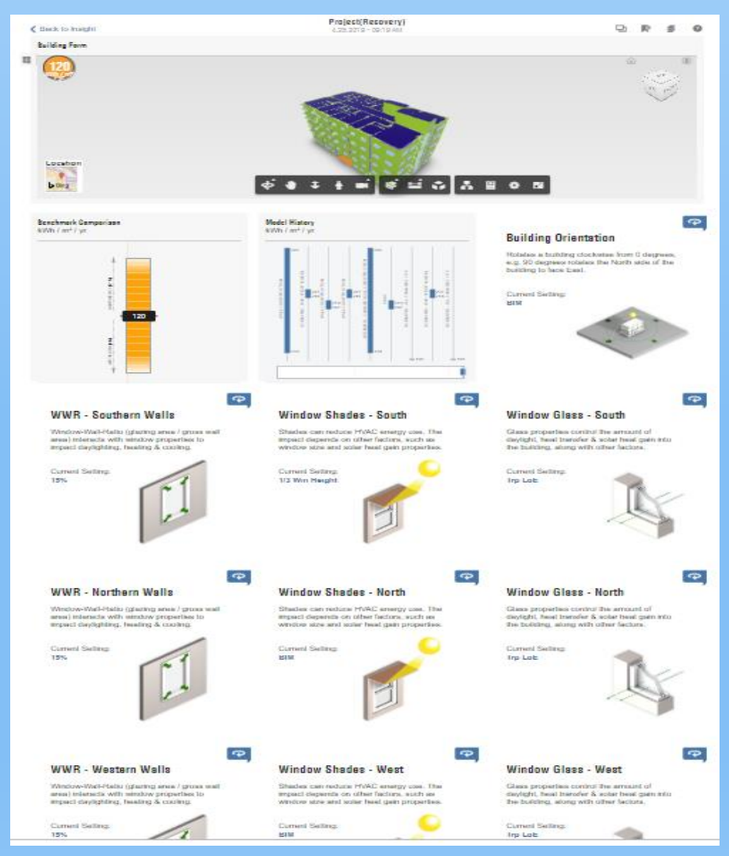
Methodology applied

Developed digital twins of new and renovated buildings, within the H2020 funded project BIMcert, were used for complex simulations of energy efficiency, renewable energy and performance gaps, and showed measureable impacts of implementation of digital technologies for: increased energy efficiency, participation of clean energy and reduction of energy performance gap.

Findings

The study demonstrated the following energy effects of application of BIM :

- Increased energy savings by 16,86% (29 kWh/m^2/year),
- Total share of energy generated by on – site renewable sources : 33 kWh/m^2 per year, which is 30% of the total energy consumption of the building.
- The expected reduction of gap between designed and actual energy performance is over 25%, due to accurately designed energy consumption and management system supported by the BIM model.



Setting the alternatives for analysis (https://energybimcert.eu/)

- **Reduction of gap** between designed and actual energy performance is over **25%**, due to accurately designed energy consumption and management system supported by BIM model

	EUI Min	EUI Mean	EUI Max	Cost Min	Cost Mean	Cost Max
Alternative	[kWh/m^2/yr]	[kWh/m^2/yr]	[kWh/m^2/yr]	[EUR/m^2/yr]	[EUR/m^2/yr]	[EUR/m^2/yr]
Base Run	215	220	227	40.1	41.5	43.2
1	144	213	320	22.3	29.5	44
2	138	205	308	21.2	28.1	42
3	189	204	201	21.9	23.2	24.9
4	130	194	292	19.6	26.2	39.3
5	130	193	291	19.5	26	39
6	128	191	288	19.1	25.6	38.4
7A	165	172	178	13.8	15.2	16.9
7B	137	143	150	11.7	13.1	14.2
8	110	110	110	9.63	9.63	9.63

Overview of results (https://energybimcert.eu/)

Conclusions

Digitalization used in all stages of a building life cycle leverages exchange of information, enables simulation of energy behavior and optimization of consumption patterns.

One of the basic features is enabling digital collaborative environment for efficient share of data, which includes energy system operators, construction sector and a wide community of buildings' users.

Digital energy twins enable inclusion of buildings in the energy system of the future, not only as smart, rational consumers, but also as new clean energy producers.

References:

https://energybimcert.eu/

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