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ENERGY PERFORMANCE
OF BUILDINGS

Energy Community Workshop on Renovation of Multi-Apartment Buildings

EPBD requirements for existing buildings and holistic approach for deep renovation – EU experience and lessons learned

Susanne Geissler, Thursday, 24 June 2021, 9:45-10:30



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820497.

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- Introduction: Overview of legal framework
- Overview of EPBD requirements in a wider sense
- Some building related EPBD requirements
- Renovation strategy
(with a view to Renovation wave and EPBD revision)
- Take away



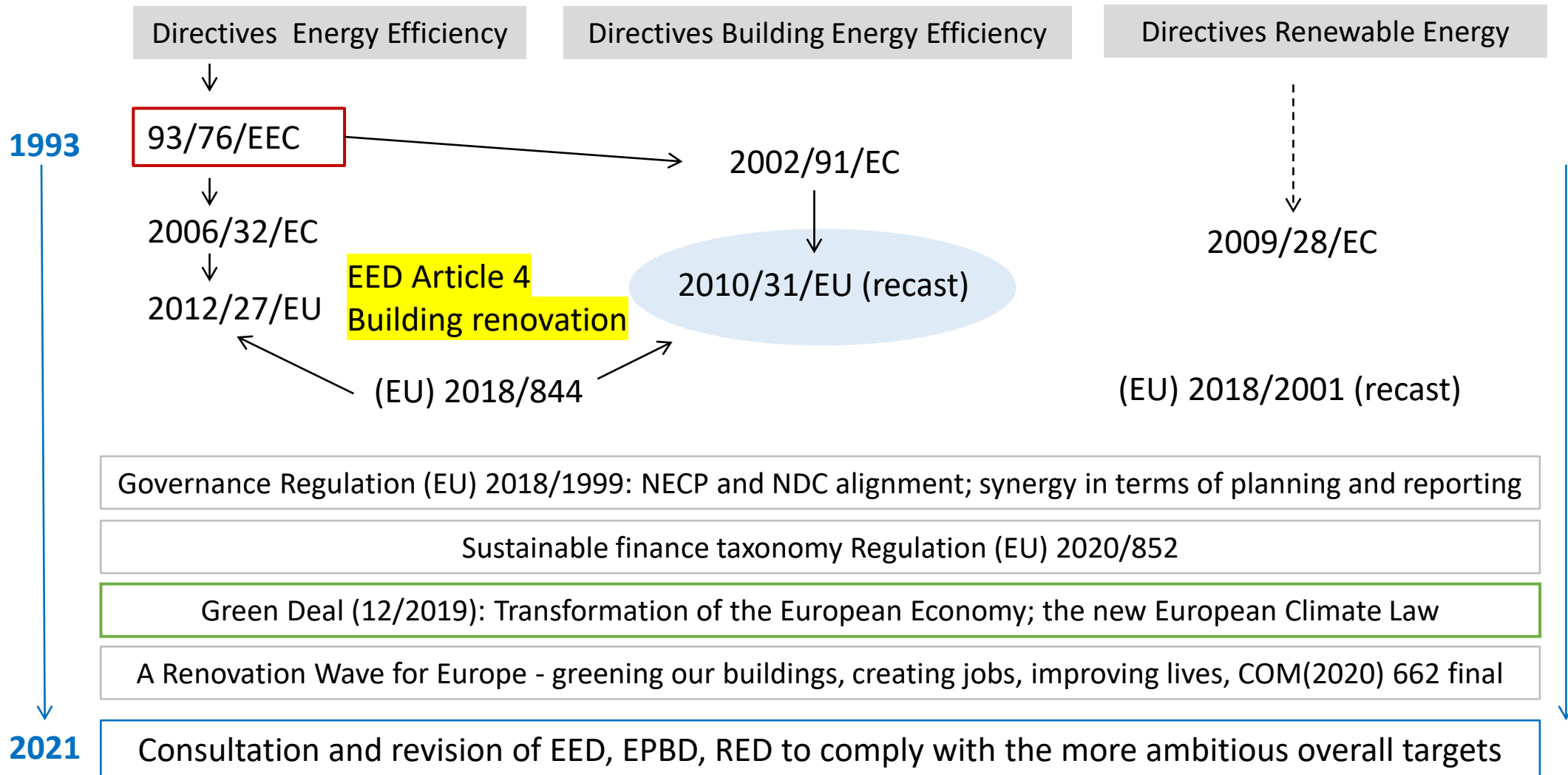
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Introduction

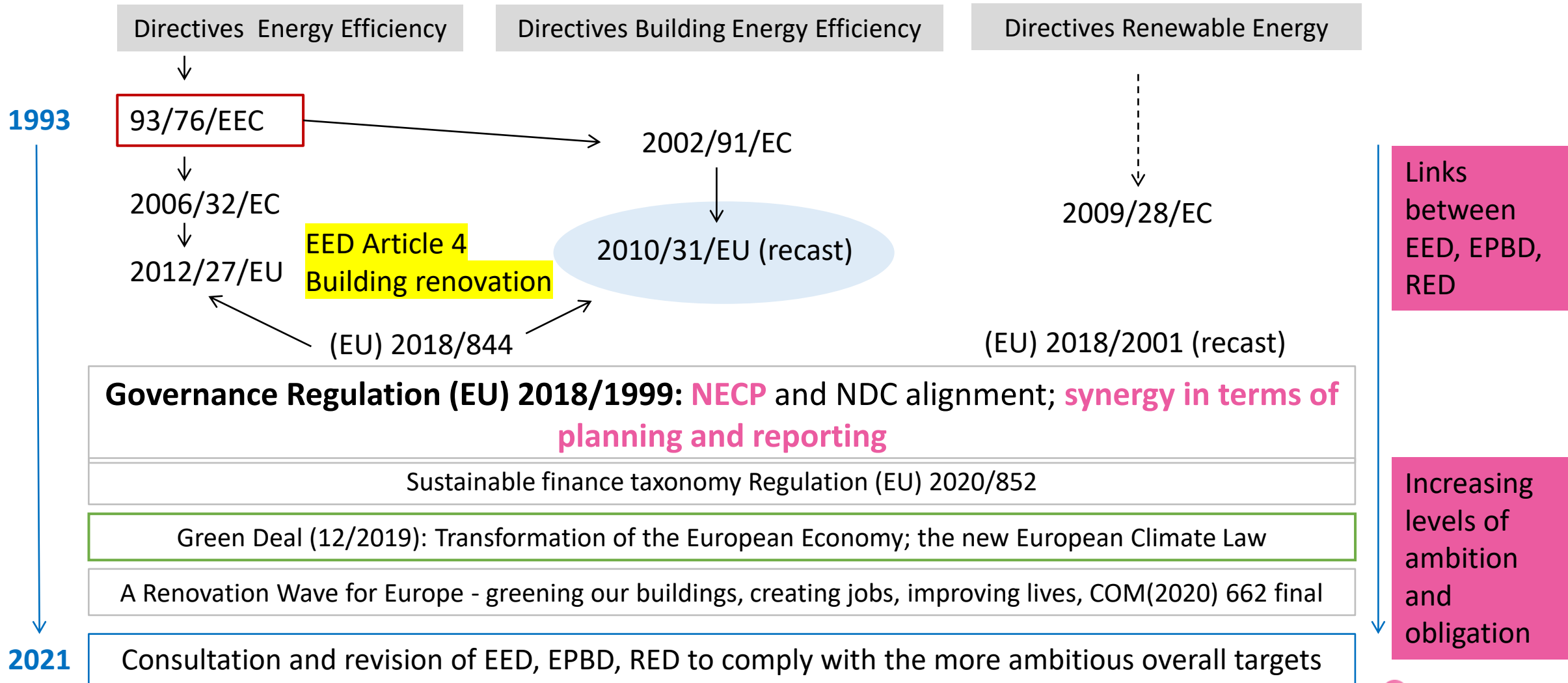


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Overview of legal framework



Overview of legal framework



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Overview of EPBD requirements in a wider sense



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Objective: to achieve actual energy savings, reduction of CO2 and wider benefits (user comfort)

There are 3 pillars:

- Ambition of building related requirements (Building envelope and Technical building systems)
- Quality of the EPC and inspection reports: can it be trusted? → requirements
- Quality of the works: is skilled labour available and is the works properly implemented? → requirements

Building related requirements

- regarding primary energy, final energy, CO2
- regarding building products and components of the building envelope
- regarding Technical Building Systems (TBS)

Quality of the EPC

Quality assurance based on qualified experts:

- Defined access conditions
- Mandatory trainings
- Quality checks of EPCs and improvement system including penalties

Quality of the works

- Trainings for skilled trades to be passed
- Commissioning of the works before handing over
- Control after 6 -12 months after handover

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There are 3 pillars:

- Ambition of building related requirements
- Quality of the EPC and inspection reports: can it be trusted? → requirements
- Quality of the works: is skilled labour available and the works properly implemented? → requirements

To consider the 3 pillars is especially important with regard to ESCO projects
(ESCO = Energy Service Company)
ESCO invests in the building and recovers the investment through savings

Building related requirements

- regarding primary energy, final energy, CO2
- regarding building products and components of the building envelope
- regarding TBS

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Quality of the EPC – requirements for independent experts (EED: energy auditors for buildings)

- **Access conditions** to attend training: university degree in architecture or engineering (or comparable practical experience)
- Pass the **examination of training** for residential buildings and/or for non-residential buildings
- **Quality checks:** EPCs are uploaded to a database to be checked by the independent control system. Experts submitting faulty EPCs have to attend another training, and if the problem persists can be fined and/or lose the license to issue EPCs

(Examples: e.g. Portugal, Belgium)

- **EPC for existing buildings** are often **calculated on default data and standard user conditions** and do not substitute an investment grade energy audit! Link with **energy auditors** for buildings

Quality of the works

Build up Skills: Funding for Member States to identify qualification needs and to develop and implement trainings on EE and RE in buildings

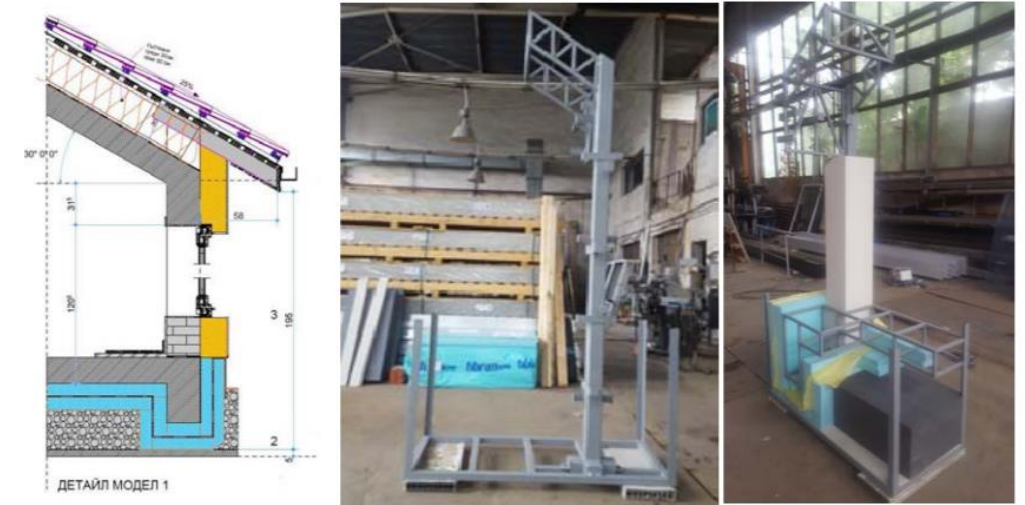
- Romanian example: Building Knowledge Hubs (BKH) established for training skilled labor
- In Austria, such centres for hands-on training exist as part of the dual vocational training system. Focus of Build up Skills was on short trainings on the construction site for new staff from abroad.

http://www.train-to-nzeb.com/uploads/9/8/8/4/9884716/2.2_setting_up_of_4_bkhs.pdf

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KITTING OUT THE BKHs

During the sixteen month period, great work was carried out in the design and development of the demonstration models as suggested from the aforementioned ToR document.



The Bulgarian team have designed each model which are currently being constructed in materials suitable for the climate and needs in Bulgaria. The first model demonstrates the importance of continuous insulation, air tightness and thermal breaks. Advice from PHA and PHI have assisted with the design of the model and construction is well underway. It should be noted that the transportation of the models is also an important factor when implementing the design.

Other works include the establishment of the RES technologies with the construction of a mounted working solar panel demonstration models.





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Some building related EPBD requirements



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EPBD requirements – Major renovation

(25% of surface of building envelope or renovation cost > 25% building value)

Directive 2010/31/EU amended by Directive (EU) 2018/844)

Article 7 Existing buildings

Member States shall take the necessary measures to ensure that when buildings undergo major renovation, the energy performance of the building or the renovated part thereof is upgraded in order to meet minimum energy performance requirements set in accordance with Article 4 in so far as this is technically, functionally and economically feasible.

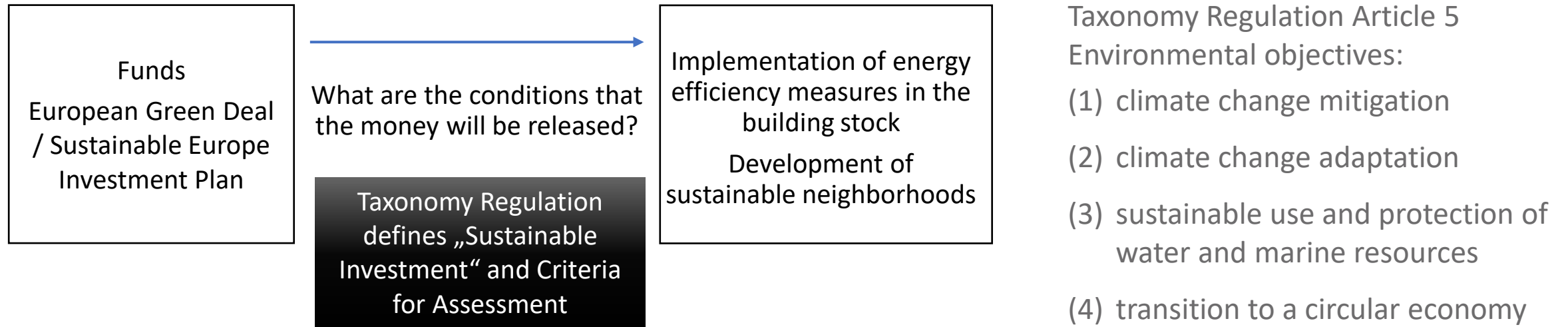
Those requirements shall be applied to the renovated building or building unit as a whole. Additionally or alternatively, requirements may be applied to the renovated building elements.

...

'Member States shall encourage, in relation to buildings undergoing major renovation, high-efficiency alternative systems, in so far as this is technically, functionally and economically feasible, and shall address the issues of healthy indoor climate conditions, fire safety and risks related to intense seismic activity.'

Requirements for individual building components and building energy performance (kWh/m²a) → see EPBD country reports <https://epbd-ca.eu/>

EPBD requirements and financing



- Taxonomy Regulation: “Regulation of the European Parliament and of the Council on the establishment of a framework to facilitate sustainable investment, and amending Regulation 2019/2088 on sustainability-related disclosures in the financial services sector”
- This Regulation establishes the **criteria for determining whether an economic activity is environmentally sustainable** for the purposes of establishing the degree of environmental sustainability of an investment.
- Obligation to report, but no minimum obligation so far

- Taxonomy Regulation Article 5
Environmental objectives:
- (1) climate change mitigation
 - (2) climate change adaptation
 - (3) sustainable use and protection of water and marine resources
 - (4) transition to a circular economy
 - (5) pollution prevention and control
 - (6) protection and restoration of biodiversity and ecosystems

Technical Screening Criteria: Building Renovation

Excerpt of Criteria Catalogue (→Annex of Delegated Act)

A renovation is eligible (a sustainable activity) when it meets either one of the following thresholds:

- a) **The building renovation complies with the applicable requirements for major renovations:** As set in the applicable national and regional building regulations for ‘major renovation’ implementing Directive 2010/31/EU. The energy performance of the building or the renovated part upgraded meets cost-optimal minimum energy performance requirements in accordance with the respective directive.
- b) **Alternatively, it leads to a reduction of primary energy demand (PED) of at least 30 %:** The initial primary energy demand and the estimated improvement is based on a detailed building survey, an energy audit conducted by an accredited independent expert or any other transparent and proportionate method, and validated through an Energy Performance Certificate. The 30% improvement results from an actual reduction in primary energy demand (where the reductions in net primary energy demand through renewable energy sources are not taken into account), and can be achieved through a succession of measures within a maximum of three years.

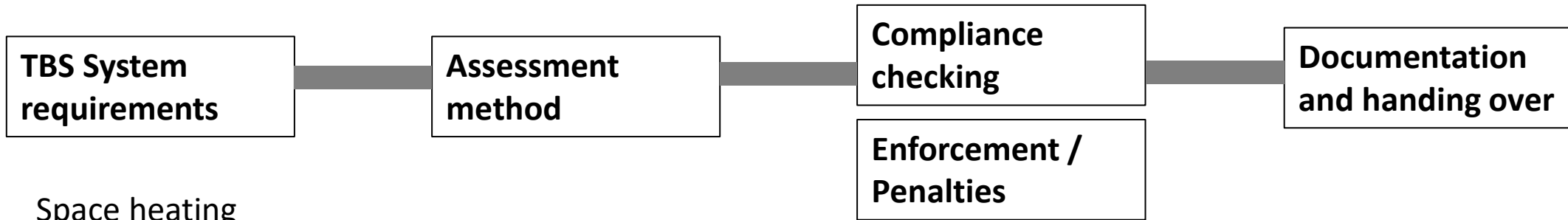
https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852/amending-and-supplementary-acts/implementing-and-delegated-acts_en

https://ec.europa.eu/finance/docs/level-2-measures/taxonomy-regulation-da-2020-annex-1_en.pdf

Renovation wave:
Adjustment to be expected, definition of “Deep Renovation” should be included

EPBD requirements regarding TBS

Directive 2010/31/EU amended by Directive (EU) 2018/844)



Space heating
Space cooling
Ventilation
Domestic hot water
Built-in lighting
Building automation
and control
On-site electricity
generation

Article 8 (1) and 8 (9):

- require the application and assessment of energy performance requirements with relation to Technical Building Systems, when a technical building system is installed, replaced or upgraded,
- including documentation to be passed on to the building owner which can be used for the verification of compliance with minimum requirements.

TBS Study with examples from Member States:

https://ec.europa.eu/energy/studies_main/preparatory-studies/technical-assistance-study-ensuring-optimal-performance-technical-building-systems-under-energy_en

- Important provision regarding phasing out fossil fuels
- Continuous monitoring can help mitigate system performance assessment limitations, but it does depend on the design and installation, and operation of the system.

Commission Recommendation 6.1(2)

(2) The EPBD requires system requirements to be drawn up for all technical building system requirements. This particularly entails drawing up requirements for systems that were not required to have them before the amendment. In doing this, all areas of system requirements must be covered: overall energy performance, proper installation, appropriate dimensioning, adjustment and control. Applicable standards and technical guidelines at EU and national level should also be considered, in particular the Energy Performance of Buildings standards developed by CEN (84) under Mandate M/480 (85).

COMMISSION RECOMMENDATION (EU) 2019/1019 of 7 June 2019 on building modernisation, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019H1019>

Different system requirements areas

| Type of requirement | Refers to | Examples | |
|------------------------------|--|--|---|
| | | BACS | On-site electricity generation |
| 'overall energy performance' | The performance of the system as a whole (not to be confused with the performance at product or component level and the performance of the whole building) | Control capabilities that have an impact on building energy performance (e.g. following EN 15232 standard ⁽¹⁾) | System performance factor of a photovoltaic (PV) system (e.g. following EN 15316-4-6 standard ⁽²⁾) |
| 'appropriate dimensioning' | The appropriateness of the system size or capacity given the needs and characteristics of the building under expected use conditions | Determine the optimal control capabilities based on the type of building, expected usage, potential energy savings | Determine the optimal size of the PV system based on electricity cost reduction, available mounting area and other constraints that could apply |
| 'proper installation' | The way the system should be installed in the building in order to operate properly | Installation by a trained and/or certified installer | Installation by a trained and/or certified installer |
| 'appropriate adjustment' | Testing and fine-tuning actions on the system, once installed, under real usage conditions | Sequence of tests to be performed after installation to check that the system operates in accordance with its specifications | Sequence of tests to be performed after installation to check that the system operates in accordance with its specifications |
| 'appropriate control' | Desired or required control capabilities of systems | Scope of control functions | (Where applicable) control of electricity feed (e.g. to grid, self-consumption, or storage) |

⁽¹⁾ EN 15232 'Energy performance of buildings — Impact of Building Automation, Controls and Building Management'.

⁽²⁾ EN 15316-4-6 'Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-6: Heat generation systems, photovoltaic systems'.

Mandatory minimum energy performance standards 'MEPS'

The European Commission has committed to propose MEPS in the revision of the Energy Performance of Buildings Directive (EPBD) in 2021.

MEPS are regulated standards that require targeted buildings to meet a minimum level of energy performance at a future date or trigger point like rent or sale.

| Where | Introduced | Fully enforced | Building stock sector, tenure, building type | Metric | Minimum standard |
|---------------------------|------------------------------------|------------------------|---|--------------------------|---|
| Netherlands | 2018 | 2023 | Office buildings | EPC | EPC C |
| France | 2019 | 2028 | Private homes | EPC | EPC E |
| France | 2019 | 2023 | Rented homes | Energy performance | Worst-performing: using >450 kWh/m ² /year |
| France | 2019 | 2030, 2040, 2050 | Tertiary sector buildings over 1,000m ² | Final energy consumption | 40% in 2030, 50% in 2040, 60% in 2050 |
| Flanders, Belgium | 2015, 2019 | 2020, 2023 | All homes, but only enforced for privately rented homes | Technical measures | Minimum roof insulation Double glazing |
| Brussels-Capital, Belgium | 2019 (Announced) 2021 (Regulation) | 2030, every five years | All domestic and non-domestic buildings | Technical measures | Measures specified by EPC |

Mandatory renovation/minimum performance requirements are one of the most impactful measures for increasing the rate of building renovation and have already been explored and implemented in some Member States. Mandatory renovation/minimum performance requirements could be introduced progressively and target specific segments as a priority.

<https://www.raponline.org/knowledge-center/next-steps-for-meps-designing-minimum-energy-performance-standards-for-european-buildings/>

Louise Sunderland and Marion Santini (June 2021): Next steps for MEPS: Designing minimum energy performance standards for European buildings, REGULATORY ASSISTANCE PROJECT



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Renovation strategy



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Article 2a Long-term renovation strategy

Each Member State shall establish a long-term renovation strategy including a roadmap with measures and measurable progress indicators to support the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy efficient and decarbonised building stock by 2050.

Article 2a Long-term renovation strategy

Elements of the LTRS (with regard to multi-apartment buildings):

- (a) overview of the national building stock
- (b) identification of **cost-effective approaches**
- (c) policies and actions to stimulate **cost-effective deep renovation**, including **staged deep renovation**, introducing an **optional scheme for building renovation passports**;
- (d) overview of policies and actions **to target the worst performing segments**; contributing to the **alleviation of energy poverty**;
- (f) an overview of national initiatives to promote smart technologies, **skills and education**, etc.
- (g) an **evidence-based estimate of expected energy savings and wider benefits**, such as those related to health, safety and air quality.

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Cost effective approaches: depending on construction method, energy standards, type of heating / cooling; phase out fossil; critical is suppressed demand

c) More details on next slides

Worst performing buildings: only energy?
No, including structure and building material

Energy poverty: EnC study; Energy Poverty Observatory
<https://www.energypoverty.eu/> **example Ireland**

Skills: <https://www.buildup.eu/en/skills/about-build-skills> North Macedonia participated in Pillar I and Pillar II
example Romania



Wider benefits: <https://combi-project.eu/> Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe

Article 2a Long-term renovation strategy

To support the mobilisation of investments into the renovation needed to achieve the goals referred to in paragraph 1, Member States shall facilitate access to appropriate mechanisms for:

- (a) the aggregation of projects;
- (b) the reduction of the perceived risk of EE operations;
- (c) the use of public funding to leverage additional private-sector investment or address specific market failures;
- (e) accessible and transparent advisory tools, such as one-stop-shops for consumers and energy advisory services, on relevant energy efficiency renovations and financing instruments.

PDA – Project Development Assistance (e.g. ELENA, but less investment required)

Building Energy Performance presented on a map

Monitoring

One-stop-shop



LTRS: One-stop-shop for building renovation

A one-stop-shop is a virtual and/or physical place where homeowners can find all information and services they need to implement an ambitious global energy renovation project.

In order to increase the renovation rate in one defined area, the one-stop-shop needs to cover the following services and propose them, ideally, 'under one roof':

- Proactive engagement of homeowners
- Energy renovation and financial plan
- Coordination of the renovation process on behalf of the homeowner
- Longterm and affordable financing
- Guaranteed results and post-work monitoring

▶ **Proactive engagement of homeowners:** market segmentation, targeted communication and marketing tools are a key to reach out to the right groups at the right moment (e.g. young families, elderly people, low-income households, etc.) with the right message.

▶ **Energy renovation and financial plan:** These tailor-made plans should aim at achieving deep renovation – implemented in one shot or planned step-by-step, depending on the financial means of each homeowner.

▶ **Coordination of the renovation process on behalf of the homeowner.**

▶ **Long-term and affordable financing** especially for low and medium income families, elderly people and other vulnerable groups who cannot access other financing means although the value of their energy savings is large enough to pay off.

▶ **Guaranteed results and post-work monitoring** including of the quality of works and, ideally, energy savings.



The full set of services proposed by a one-stop-shop

LTRS: One-stop-shop for building renovation

INNOVATE partners have identified four types of business models.

Their difference lies in their roles and responsibilities.

The main difference between these models is the responsibility the one-stop-shop bears for the result of the renovation works and for the overall customer journey.

| Business model | Roles & responsibilities | Practical example of what the one-stop-shop offers to homeowners |
|--|--|--|
| 1 Facilitation model | <ul style="list-style-type: none"> • Raise awareness on energy renovation benefits • Provide general information on optimal renovation works • First advice at the 'orientation stage' | It advises on how to renovate your house and can provide you with the list of suppliers. |
| 2 Coordination model | <ul style="list-style-type: none"> • Coordinate existing market actors (suppliers) • Make sure all one-stop-shop services are offered to homeowners • No responsibility for the result of renovation works (only overlooking the whole process) • No responsibility for the overall customer journey (just the first part) | It advises on how to renovate your house and will push suppliers to comply with their promises. Suppliers remain responsible for the final result. |
| 3 All-inclusive model | <ul style="list-style-type: none"> • Offer a full renovation package to homeowners • Bear responsibility for the result of renovation works • Bear responsibility for the overall customer journey | The one-stop-shop is a contractor that sells you the whole service package and is your main contact point in case something goes wrong with suppliers. |
| 4 ESCO-type model | <ul style="list-style-type: none"> • Offer a full renovation package with guaranteed energy savings to homeowners • Bear responsibility for the result of renovation works • Bear responsibility for the overall customer journey | The one-stop-shop sells you the renovation package and guarantees the energy savings for the contract duration. The one-stop-shop is paid through energy savings achieved. |

<http://www.financingbuildingrenovation.eu/>

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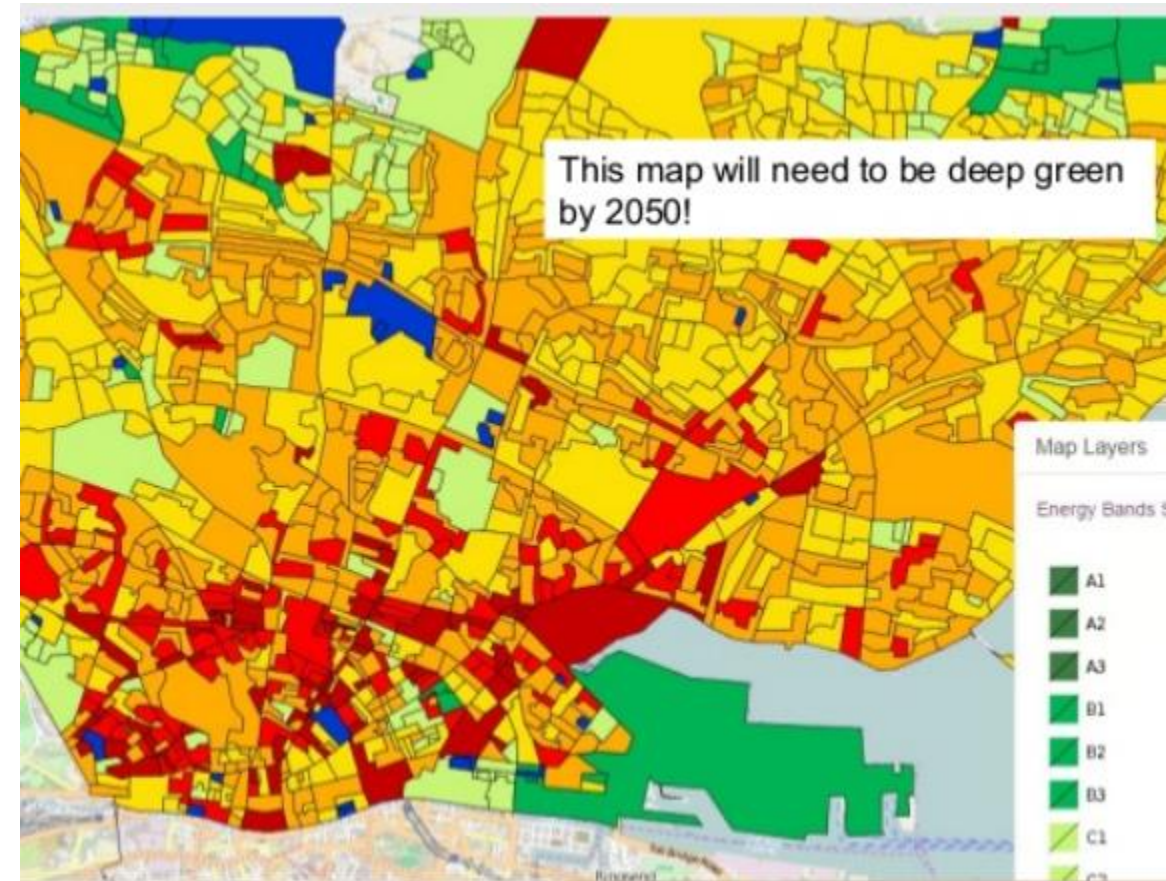
Geocoded Building related data for policy making and reporting – e.g. energy poverty alleviation, project aggregation

Legal framework needed:

- EPCs contain coordinates for easy geocoding (address is not sufficient)
- **Upload of EPC and all data to the database;** can be used for independent control system; to build a database on the building stock; and for policy making and awareness creation
- **Regulate issues concerning data protection** of personal data and synergies regarding the use of non-personal data (INSPIRE Directive <https://inspire.ec.europa.eu/inspire-directive/2>)
- **This is in line with developments on digitalisation, Smart Readiness and Building Information Modelling (BIM)**

It will support the aggregation of energy efficiency projects and the planning of decentralised renewable energy projects.

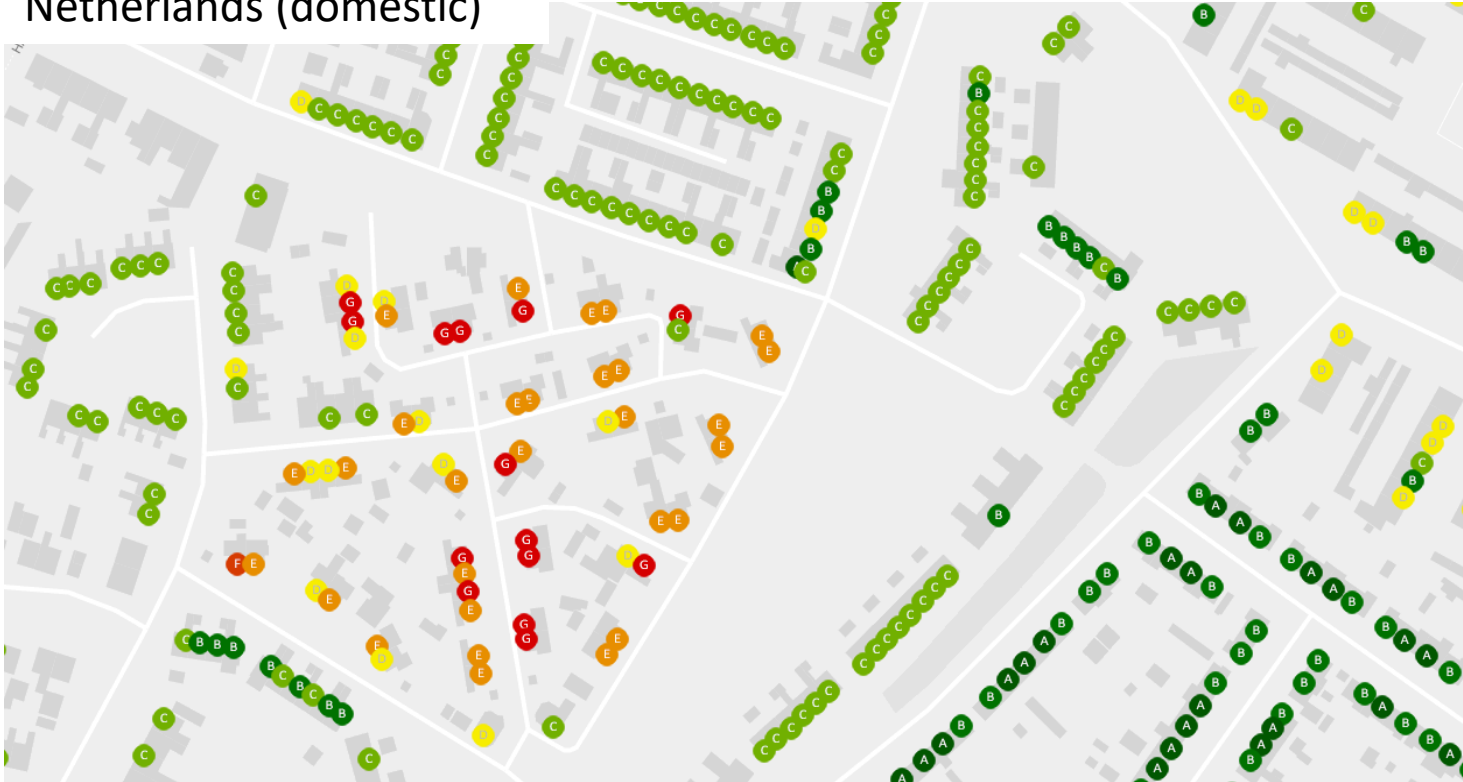
Regarding the Taxonomy Regulation, internet based databases will make it easier for financing institutions to get access to verified indicators needed to assess the environmental sustainability of investment.



Example: Dublin, Ireland; Building Energy Ratings 2015
<http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html>

Most countries use a database and many use GIS based information

Netherlands (domestic)



| | |
|---------------------|------------------------------|
| Print | |
| Report/Alter Remove | |
| Local Authority | Doetinchem |
| Post Code | 7009EW |
| Address | 2, Madoerastraat, Gelderland |
| Energy Rating | G |
| Country | Netherlands (Domestic) |
| Enerfund Score | Coming Soon |

| | |
|---------------------|------------------------------|
| Report/Alter Remove | |
| Local Authority | Doetinchem |
| Post Code | 7009EW |
| Address | 6, Madoerastraat, Gelderland |
| Energy Rating | G |
| Country | Netherlands (Domestic) |
| Enerfund Score | Coming Soon |

Energy

Rating

A B C D E F G

Filter

The level of publicly available information differs from country to country.

While Denmark publishes many details including the address of single family houses, other countries use the full data set in the administration and publish only aggregated data.

<http://enerfund.eu/>

Deep renovation

Staff Working Document (SWD(2013) 143 final): Deep renovations (are) leading to significant (typically more than 60%) efficiency improvements.

Renovation Wave (SWD(2020) 550 final): Deep renovations that reduce energy consumption by at least 60%.

- Deep renovation is understood to be a renovation that should generate at least 60% energy savings, whether carried out in a single stage or in a number of staged renovations.
- Legal definition needed to be used for the Taxonomy regulation.

https://qualdeepc.eu/wp-content/uploads/2020/11/QualDeEPC_D3.1_Green-paper_20201105_final-comp.pdf

<http://medzeb-happen.eu/>

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Deep renovation and Building Renovation Passport (BRP)

Basically, there are two main possibilities to achieve a deep renovation, not only from the technical point of view, but also in terms of economic feasibility:

- During a longer period of time, based on the **step-wise** implementation of renovation measures in the correct sequence, following a renovation plan, which is also called '**renovation roadmap**', and uses the so-called '**logbook**' to store building data and record the interventions during time.
- In a short time carried out **in one go**, for instance with prefabricated elements improving the energy efficiency of the building envelope, including the implementation of renewable energy systems.

The BRP can facilitate both one-step and staged renovations by setting out the required measures and in which sequence they ought to be implemented.

Deep renovation and Building Renovation Passport (BRP)

Among others, the purpose is to **avoid the risk of 'lock-in' future renovation solutions due to a lack of foresight.**

E.g. If an outer wall is insulated today, it will not be renovated again in the near future. Buildings that have been partially restored, but with insufficient depth, will likely not be renovated again before a decade or two.

Feasibility study (with examples from Member States) according to Article 19a EPBD:

https://op.europa.eu/en/publication-detail/-/publication/a38ea088-aead-11ea-bb7a-01aa75ed71a1/language-en?WT.mc_id=Searchresult&WT.ria_c=37085&WT.ria_f=3608&WT.ria_ev=search
<https://www.epbd19a.eu/>

The main arguments for staged deep renovation

Excerpt:
Feasibility
study
according to
Article 19a
EPBD

1. Lower upfront cost enables more people to engage in energy renovations (that might lead to a low-energy level over time).
2. Carrying out renovation works at the time when certain building components (windows, boilers, etc.) must be replaced anyway due to completion of service life reduces costs (see section on trigger points).
3. Staged renovation enables flexibility and the possibility to incorporate measures that weren't considered initially, such as additional rooms or space planning requirements.
4. Staged renovation allows the integration of new technologies that may not exist or have reached maturity when the renovation is initiated.
5. Staged renovation may not require the building to be completely vacated and regular activities can (partially) continue.
6. Staged renovation reduces overall carbon emissions due to usage of legacy equipment with the new systems.

Measures in line with
maintenance and repair plan

The main arguments for one-step renovation

1. Lower risk of lock-in effects (e.g. the obstruction of highly efficient renovation measures because of recently performed low efficient measures) because of the possibility of integrated planning and implementation of the renovation.
2. The cumulative energy savings are higher in one-step renovation if it's carried out immediately.
3. Overall quality of renovation is better in one-step renovation (better airtightness, less thermal bridges, systems dimensioned consistently with envelope performance).
4. Staged renovation can cause a larger inconvenience to the occupants due to multiple construction works on the building's envelope.
5. Lower total investment costs as synergies arise, from scaffolding to site set-up to planning costs, along with being able to scale heating equipment to lower capacities.
6. Greater ability to assess work quality and building performance than after a partial renovation (blower-door test not relevant if the building envelope is only partly renovated).
7. Indoor environmental conditions can be improved more effectively than in staged renovation.

Prefabrication, industrialised
solutions

Deep renovation – in one go - prefabrication

Social housing GAP Austria

<http://www.gap-solutions.at/en/>



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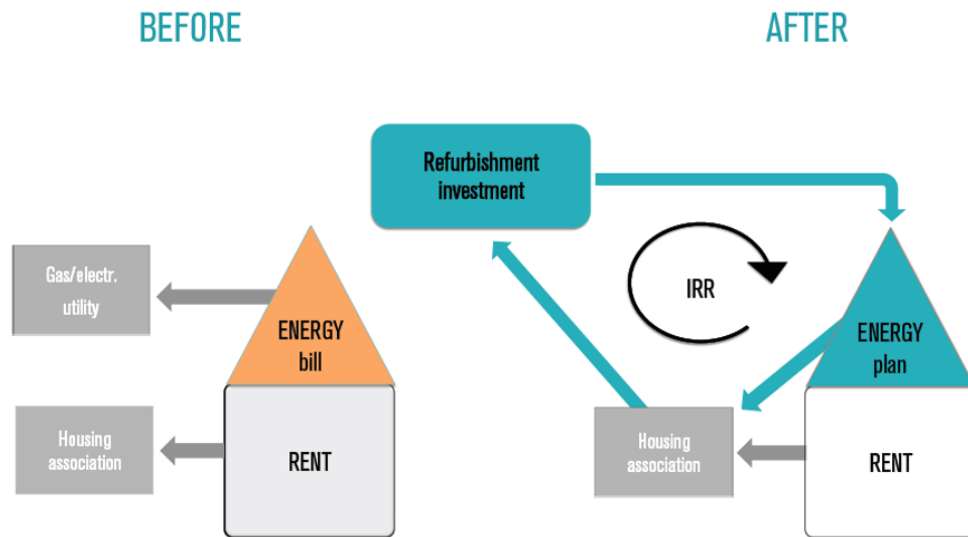
12:40



<https://4rineu.eu/>

Deep renovation – in one go - prefabrication

Examples Energiesprong for Multi apartment buildings: ESCO business model
<https://energiesprong.org/energiesprong-starts-innovation-project-for-apartment-buildings/>



EnergieSprong Business Renovation and Payback Model



EnergieSprong in house monitoring of energy consumption

Regarding business model: might need to be adapted due to suppressed demand / energy poverty

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Take away



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To consider when developing the national legislation

- 3 Pillars: ambitious building related requirements, requirements regarding quality of the EPC and the independent experts, requirements regarding quality of the works
- EPC Database and link with GIS, e.g. to identify priority areas for aggregated renovation projects (including targeted alleviation of energy poverty): Good practice e.g. Portugal, Denmark, Ireland, Flanders/Belgium
- Challenge: good coverage of building stock with EPC is necessary, which is often not the case. Possible solution: (Mandatory) BRP integrated into EPC database system (e.g. Austria, voluntary)
- Project development assistance is absolutely necessary for increasing the renovation rate (including energy audits)
- A grant component will be needed due to suppressed demand / energy poverty; solutions to be financed at national level with reduced cost for building owner
- The comprehensive concept of One-Stop-Shop should be implemented (engagement – advice – planning & finance – implementation – monitoring)

Renovation wave and EPBD revision

The Renovation Wave already indicated some specific aspects which will be addressed in the revision of the EPBD, namely:

- the phased introduction of mandatory minimum energy performance standards for all types of buildings (public and private),
- an update of the framework for Energy Performance Certificates,
- the introduction of Building Renovation Passports and
- the introduction of a ‘deep renovation’ standard in the context of financing and building decarbonisation objectives.

Useful documents

European Climate Law: https://ec.europa.eu/clima/policies/eu-climate-action/law_en

Renovation Wave: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

COMMISSION STAFF WORKING DOCUMENT Preliminary analysis of the long-term renovation strategies of 13 Member States. Brussels, 25.3.2021 SWD(2021) 69 final

https://ec.europa.eu/energy/sites/default/files/swd_commission_preliminary_analysis_of_member_state_itrss.pdf



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