

Sustainable (Re)Construction

The Potential of the Renovation Market

Annotated Briefing
The Hague Centre for Strategic Studies & TNO | December 2013



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SUSTAINABLE (RE)CONSTRUCTION

THE HAGUE CENTER FOR STRATEGIC STUDIES (HCSS) AND TNO

Annotated Briefing

Authors: Artur Usanov, Eline Chivot, João Silveira, Emily Knowles

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HCSS, LANGE VOORHOUT 16, 2514 EE THE HAGUE

T: +31 (0) 70-3184840 E: INFO@HCSS.NL

W: STRATEGYANDCHANGE.NL

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Sustainable Urban (Re)Construction

The potential of the renovation market

Annotated briefing for TNO

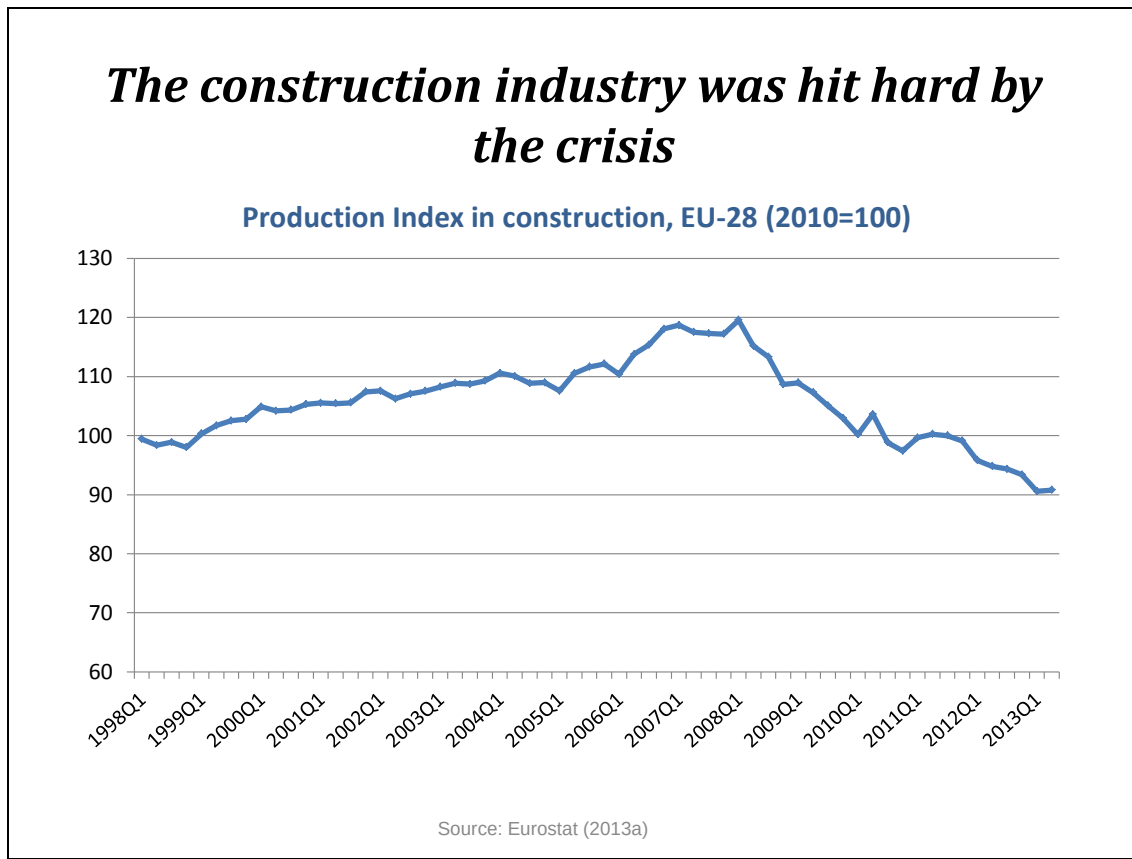
Outline

- 1) Introduction and background
- 2) Maintenance and renovation: general information
- 3) The renovation market
- 4) Climate change and renovation
- 5) City competitiveness and renovation
- 6) Renovation market forecast
- 7) Implications and conclusions

1. Introduction and Background

Research objectives

- This briefing explores the potential of the renovation market within a broader context of sustainable construction in Europe.
- *Research objectives of the project:*
 - To assess the potential of the renovation market in Europe and its drivers;
 - To identify barriers to its development and suggest policies and practices to overcome them.



The construction industry in Europe is mired in a deep crisis. After reaching its peak in the first quarter (Q1) of 2008, construction output in the EU-28 has been declining for more than 5 years. From 2008(Q1) to 2013(Q1), production in construction in the EU-28 declined by 25%.

Construction employment in such countries as Ireland, Spain, Latvia and Bulgaria dropped by 50% or more from its peak before the crisis. In the Euro area as a whole, it declined by more than a quarter and in the EU-28 – by 22%.

Definition of construction:

The construction industry is defined here as all building and construction activities covered by Section F in NACE Rev.2 (The Statistical Classification of Economic Activities in the European Community or *Nomenclature statistique des activités économiques dans la Communauté européenne*).

These activities comprise:

- The construction of buildings,
- Civil engineering (construction of roads, railways, bridges, tunnels, utility and water projects),
- Specialized construction activities (includes demolition and site preparation, electric, plumbing and other installation, roofing, building completion and finishing).

This is a rather narrow definition of the construction industry that excludes, for example, architectural and project management services related to building projects, manufacturing of building materials, real estate services and some other construction related activities.

A detailed explanation of the NACE classification is provided Eurostat (2013b).

However, the construction industry remains a key economic sector in Europe

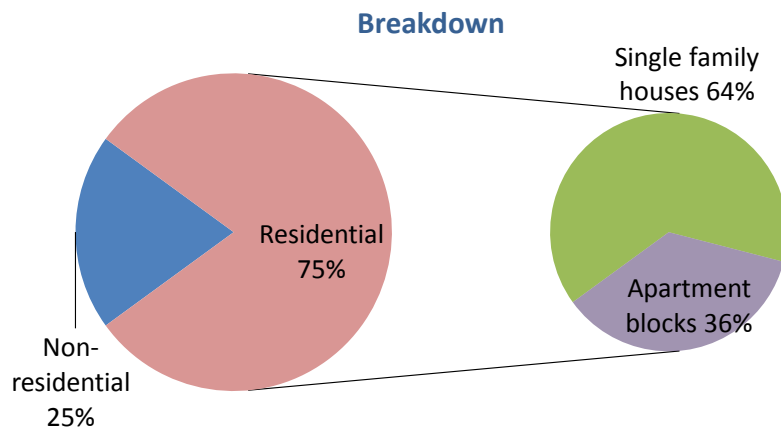
In 2010, the EU's construction sector:

- Employed 13.4 million persons or 10% of total workforce in non-financial business economy;
- Had a turnover exceeding 1.5 trillion euro;
- Generated 8.4% of value added in non-financial business economy;
- Included 3.3 million enterprises, most of them small – with an average number of employees of only 4 persons per firm (95% of the total has less than 20 employees).

Source: Eurostat (2013b)

Building stock in Europe

- The output of the construction industry is highly visible – it is our built environment.
- European countries (i.e., the EU-27, Switzerland and Norway) have a very large building stock – 24 billion m² (or 48 m² per capita).



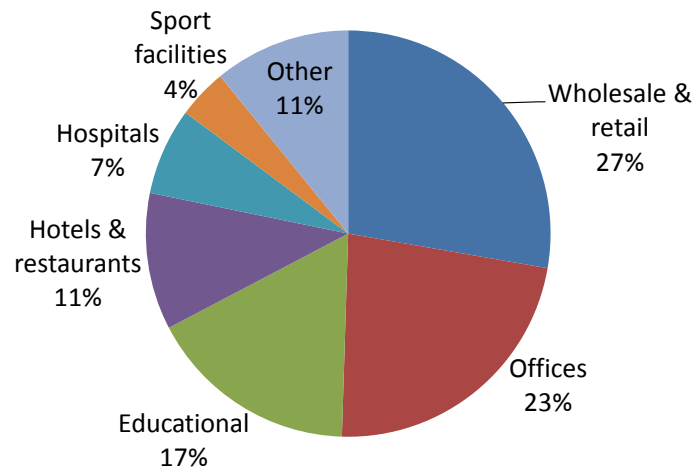
Source: BPiE (2011a). Data for European countries, i.e., the EU-27, Switzerland, and Norway.

The gross useful floor space of all EU buildings is comparable to the land area of Belgium (30,500 km²).

Data are collected for European countries, which include the EU-27, Switzerland and Norway.

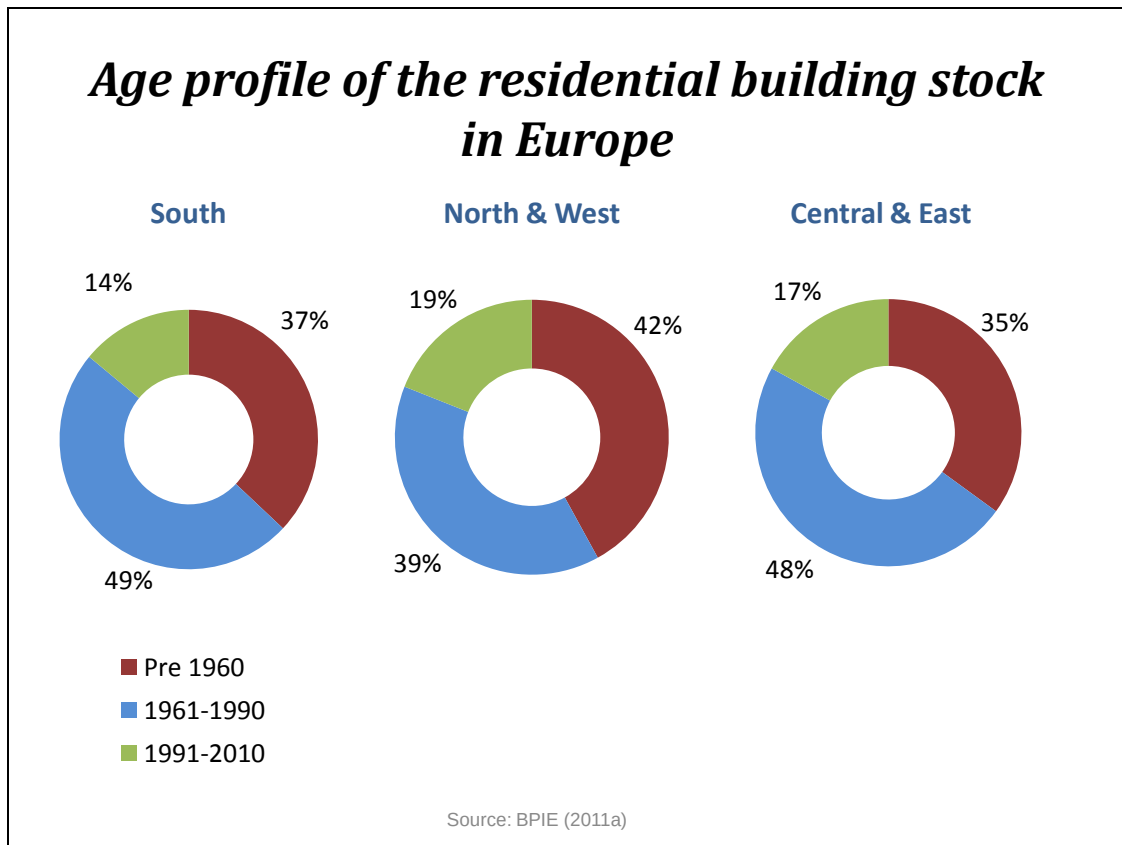
Non-residential building stock in Europe

- Its size varies from 8 m² per capita in Central & Eastern Europe to 15 m² in Northern & Western Europe.



Source: BPIE (2011a). Data for European countries, i.e., the EU-27, Switzerland, and Norway.

Data are collected for European countries, which include the EU-27, Switzerland and Norway.



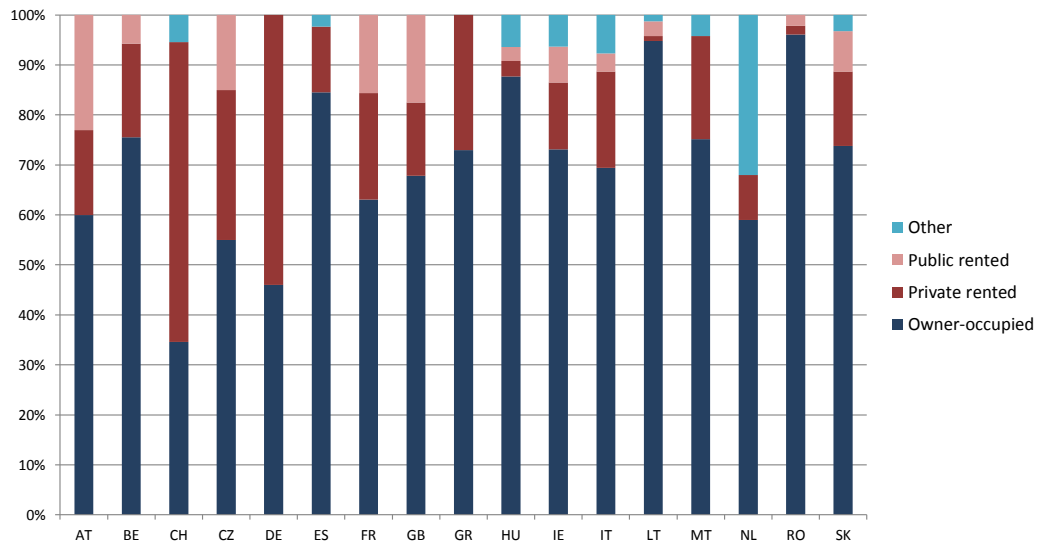
There is a substantial variation in terms of the age profile among EU member states, but not among broader regions. The oldest building stock (with more than 40% of residential floor space built before 1960) is in France, Sweden, Denmark, Bulgaria, the Czech Republic and the UK.

The share of owner-occupied residential buildings was higher than 50% in all EU countries where data were available.

Definition of the regions on the chart:

- South: Cyprus, Greece, Italy, Malta, Spain, Portugal;
- North & West: Austria, Belgium, Germany, Denmark, Finland, France, Ireland, Luxembourg, Netherlands, Norway, Sweden, the UK;
- Central & East: Bulgaria, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia.

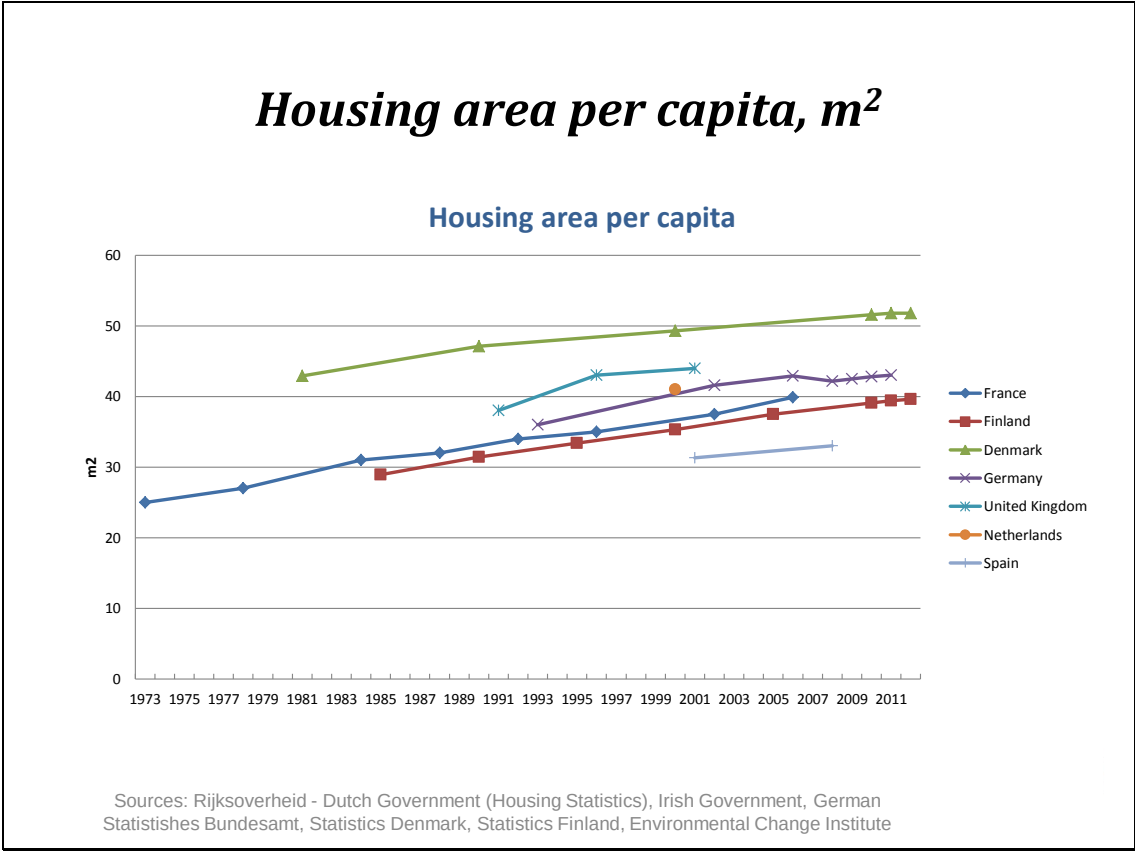
Tenure of residential buildings in Europe by the number of dwellings



Source: BPIE (2011a), OTB (2010)

The 'other' category includes social housing associations (Netherlands, the UK), building cooperatives (Switzerland), empty dwellings, etc.

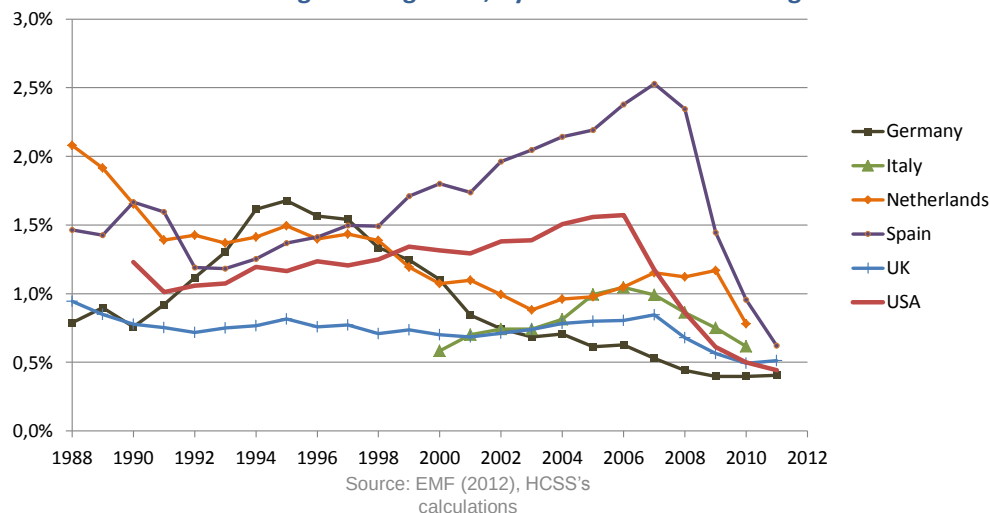
For France – data refer to m².



New construction rates in the residential sector

- The rates are volatile but they are typically within the range 0.5% - 1.5%.

**Annual housing completions as %-age
of existing dwelling stock, by the number of buildings**



The new construction rate is the main determinant of the building stock renewal rate. This chart provides information on housing completions for some of the major EU countries collected from Hypostat publications by the European Mortgage Federation.

Housing completions reflect a volatile nature of the construction sector, and often tend to follow a boom-and-bust pattern. The Netherlands had experienced such a boom followed by a bust in the 1980s. Germany had a surge in new residential construction in the middle of the 1990s after the reunification, after which new housing construction has been falling for 15 years. More recently, in the first decade of 21st century, a number of countries have experienced a strong growth in residential construction, particularly Spain and Ireland (not shown here). All these booms were followed by painful busts. Despite the volatility, housing completions as a percentage of the existing residential building stock have rarely exceeded 1.5% over the last 25 years, and have tended to stay within the range of 0.5% to 1.5%. In the current environment, and in most of the EU countries, this rate tends to be near the lower bound of the range.

New construction rates in the non-residential sector

- Average new construction rates in the non-residential sector in representative European countries:

Country	Private offices	Public buildings	Weighted average for all types
Germany 2005-2008	0.7%	0.9%	1.0%
Sweden 2001-2008	1.2%	n/a	1.3%
Hungary 2000-2010	4.0%	0.7%	1.7%
Poland 2005-2009	5.3%	5.3%	2.3%
Spain 2005-2009	4.7%	4.0%	4.2%

Source: Ecofys (2011)

Information on the construction rates for non-residential buildings is more limited. But existing estimates show that it does not differ substantially from the residential construction rate. The estimates given in the table above cover mostly pre-crisis years, and should be adjusted downward for future projections, in particular for Spain.

Demolition rates

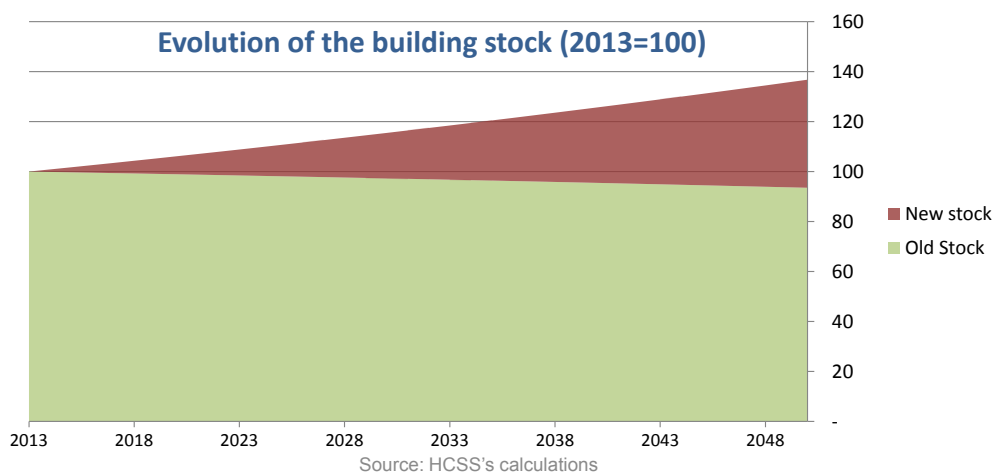
- The demolition rate is the other determinant of the building stock renewal (along with the new construction rate).
- Demolition rates are substantially lower than new construction rates. In the largest EU countries i.e., Germany, France and the UK, the demolition rates in recent years were around 0.1% or lower.
- In most EU member states demolition activities declined compared to the 1980s level.
- Demolition mostly occurs in the context of urban renewal and low occupancy rates.
- Market demand, or more specifically the mismatch between demand and supply, and land prices have often a larger impact on demolition decisions than technical quality of buildings.

Source: OTB (2010), Itard et al. (2008)

Information on demolition is spotty and less extensive than on new construction.

The large size of the existing building stock makes renewal a very slow process

- Assuming the new construction rate of 1% per annum (p.a.) and the demolition rate of 0.15% p.a. implies that 68.5% of the 2050 building stock is already built. ***This highlights the importance of renovation if substantial changes in the building stock are wanted.***



The chart shows the changes in the building stock over time with the constant new construction rate of 1% per annum p.a. and the demolition rate of 0.15% p.a. These values assume some increase in the construction activity in the future compared to today's values. Given these assumptions, almost 70% of the building stock in 2050 is already built. These implies that renovation policies are essential for making large changes in the building stock.

2. Maintenance and Renovation: General Information

Maintenance and renovation

- In a broad sense, maintenance and renovation include all work done on an *existing building or structure*, either to maintain its consumer properties or to improve or change them (i.e., modernization or conversion of buildings).
- Such work covers a broad range of activities and this is reflected in a multitude of terms used to describe them:
 - *Maintenance, sustainment, repair, restoration, retrofit, refurbishment, modernization, remodeling, rehabilitation, conversion, alteration, makeover, reconstruction, revamping, updating, reuse...*
- It also leads to differences in definitions and often incomparable data.
- It is useful to separate two broad categories:
 - **Maintenance** – Regular activities to keep a building in a normal operating condition. It does not increase value of the asset.
 - **Renovation** – Less frequent, project-type activities that involve improvement of a structure.

In general terms, maintenance and renovation always involve work on an existing building or structure, in contrast to new construction.

Maintenance

- **Maintenance** is work necessary to realize the originally anticipated useful life of a fixed asset.
- Maintenance includes periodic or occasional inspection; adjustment, lubrication, and cleaning of equipment; replacement of parts; painting; resurfacing; and other actions to assure continuing service and prevent breakdowns.
- Maintenance does not prolong the design service life of the property or equipment, nor does it add to the asset's value.
- Maintenance differs from operations, which encompass those activities that are related to a building's normal performance of its functions. Operations include utilities, waste management, window cleaning, etc.
- Repair is work that restores damaged or worn-out property to a normal operating condition. Repairs are curative, while maintenance is preventive.
- Maintenance and repair expenses are often grouped together (2 to 4% of the replacement value of the property is often recommended, but it depends on the building age, complexity, the level of use, the climate, etc.).

Source: US NRC (1990)

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Renovation

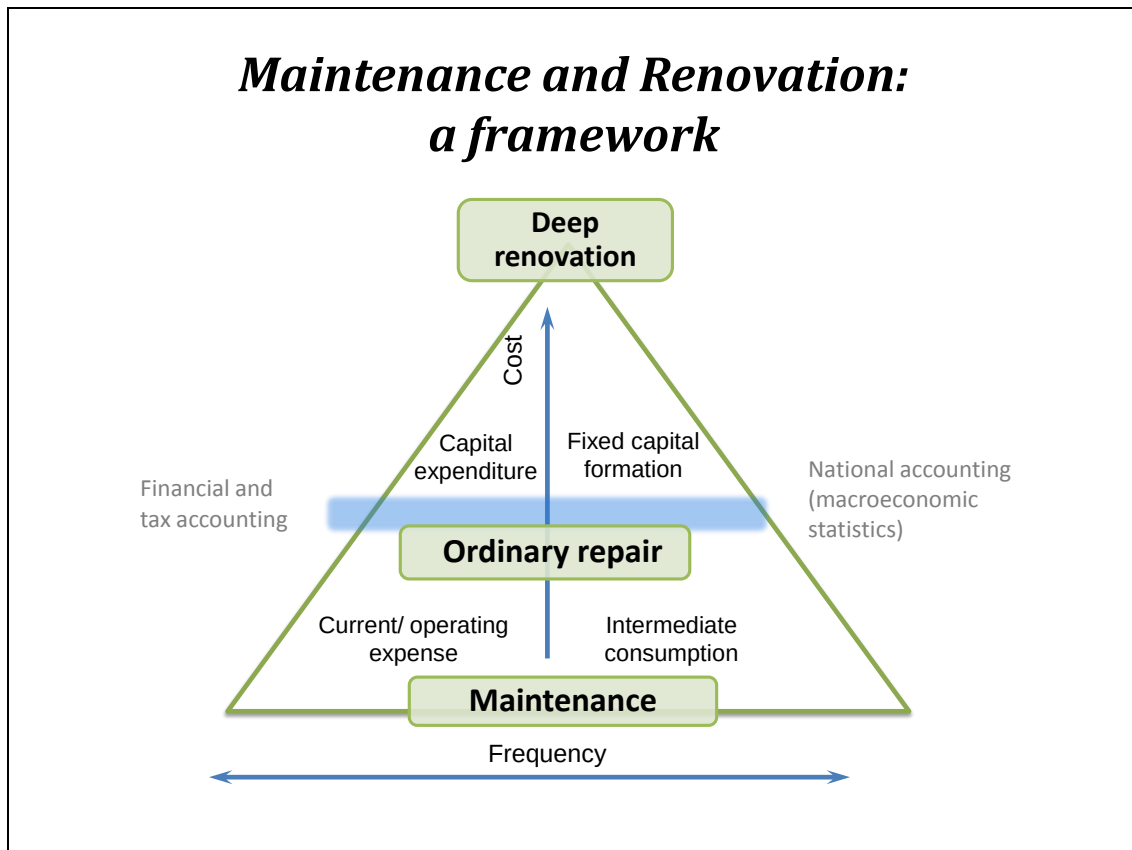
- We define **renovation** broadly as any improvement of buildings (structures). This definition excludes ordinary (current) repairs.
- Renovation increases the value of a building while maintenance only preserves it.
- As a consequence, renovation is considered a capital expenditure (or investment) – unlike maintenance, which is a current expense.
- Renovation is typically a project activity conducted over a specific time period with a separate budget – while maintenance is a regular, continuous activity.
- Renovation projects are typically more expensive (as a percentage of the building's value) than maintenance activities over the same (project) period or on annual basis.
- The border between renovation and maintenance is not clear cut in some cases (in particular for repairs).
- In this briefing, we focus mainly on renovation.

Source: Vainio et al. (2011)

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There are many different terms, which are often used as synonymous (or practically synonymous) with renovation (retrofit, refurbishment, remodeling, rehabilitation, etc.). Some experts try to provide nuances in their use. For example, Vainio (2011) sees renovation as an umbrella term for the following categories:

- 'Refurbishment' and 'renewal', where a building or parts thereof are renewed;
- 'Modernization', 'rehabilitation', 'retrofit or refit', 'refresh' and 'upgrading', where the quality of the object is significantly improved, for instance by improving the energy efficiency of a building, linking it to the water and sewer networks, or installing a lift;
- 'Rebuilding' and 'reconfigure', where the purpose or manner of use of a building is altered;
- 'Restoration', which aims to preserve or bring back the cultural historical value or architectural value of the object.



This diagram illustrates the relationship between maintenance, repair and renovation. The distinction is similar to the one between a current expense and a capital expenditure in financial/tax accounting, and between intermediate consumption and fixed capital formation in the system of national accounts. The main idea is that renovation increases the value of a building/structure or extends its service life. Maintenance and ordinary repairs simply sustain building/structure in working order.

Different types of renovation

Type of renovation	Content	% of total
Maintenance	Routine repair of broken, worn out elements or preventive replacement	20-35
Modernization	Upgrade of building equipment and finishes, adding extra value	25-30
Extension	Increasing usable area by adding extra story or extra room	10-15
Energy improvement	Adding insulation, upgrade of windows, heating, change for renewable energy source	10-15
Change of occupants	Renovation executed when a dwelling changes hands	10
Emergency	Repairs forced by exceptional causes such as storms, floods, fires	5-8
Accessibility	Modifications in order to adapt the dwelling for older or disabled occupants	5

Source: Euroconstruct (2010)

This table from the Euroconstruct report lists the main types of renovation. It includes maintenance as a type of renovation which, in our view, is not correct from a methodological point of view. The list is also not exhaustive. For example, it does not include conversion to a new use or restoration (preservation of historical buildings). Nevertheless, it provides an expert estimate for the frequency of the main categories of renovation.

This table, along with our review of the literature, indicates the major reasons for renovation:

- Accumulated wear and tear;
- Obsolescence;
- Damages from natural or man-made accidents and catastrophes;
- Changes in legislation and codes (might include among others aspects new requirements to ensure accessibility and improve energy efficiency);
- Enhancement of building's functions (improving the building's appearance, energy efficiency, air quality, increasing its usable area, etc.);
- Changes in use (new occupants, conversion to a new use, including adaptive reuse).

3. The Renovation Market

What do we know about renovation activity?

- Systematic information on renovation activity is limited and exists only for a few countries.
- Renovation market data from different sources vary substantially.
- Comparability of data on renovation across different sources and countries is limited due to varying definitions and data collection methods.
- We collected statistical data from different sources on:
 - Renovation rates
 - Construction output or investment in renovation.

Renovation rates: general comments

- The renovation rate measures the percentage of the building stock renovated annually.
- Official statistical agencies typically do not collect this type of information.
- Data from other sources often show substantial variability, most probably due to different definitions of renovation.
- The reverse of the renovation rate (i.e., 1/renovation rate) shows the renovation cycle or the average time period between two consequent renovations of the same building.
- Some estimates of the renovation rate for the EU:
 - 1.2% in 2008 (European Commission in SEC (2011) 277)
 - 3% overall and 1.5% as energy-related (EC in SEC (2011) 779)
 - 1% (Novikova, 2008)
 - 1.2-1.4% (Janssen, 2010)
 - 1.8% (for the EU-15, Petersdorff, 2004).

Source: BPIE (2011a)

The last three sources are as quoted in BPIE's report (2011a), which in turns cites Ürge-Vorsatz, D. et al. (2010).

Residential renovation rates

Country	BPIE (2011)	Tuominen et al (2012)
Austria	1.2	n/a
Czech Republic	3.0	0.9
Denmark	n/a	1.9
Finland	1 – 1.5	3.1
Germany	0.7	1.8
Italy	1.2	n/a
Netherlands	3.5	1.8
Portugal	1.5	1.1
UK	n/a	1.9

- As this table shows, data on the renovation rate in the same country can differ 100% or more depending on the source.

Non-residential renovation rates

- For the non-residential sector, Ecofys (2011) indicates much higher renovation rates:

Country	Total renovation rate (yearly)	Energy-related (yearly)	Not energy related (yearly)
Germany	11.0%	2.3%	8.7%
Sweden	14.3%	2.8%	11.4%
Hungary	6.2%	1.7%	4.5%
Poland	5.6%	1.2%	4.4%
Spain	20.1%	4.1%	16.0%

Conclusion: Estimates of the renovation rates should be taken with a grain of salt. More effort in the comprehensive collection of data related to renovation would be beneficial for policy making.

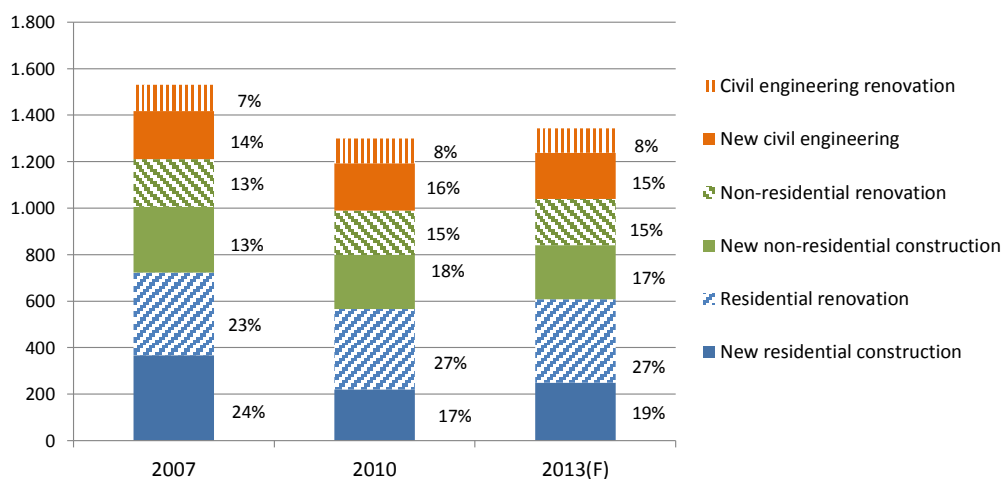
Source: Ecofys (2011)

Renovation market size

- Statistical data on the size of the renovation market (in monetary terms) are more comprehensive and of better quality than on renovation rates.
- Some official statistical agencies (e.g., in France, the UK, Finland) collect data on either investment in renovation or on production output in renovation.
- Industry organizations (FIEC, Euroconstruct) also collect and report similar data on a regular basis.
- They all show similar trends:
 - The share of maintenance and renovation is generally increasing over time;
 - Maintenance and renovation in many cases are already bigger than new construction;
 - The renovation market is much more stable than the new construction market.

Renovation is almost half of the total construction market in Europe

European Construction Market, 2007-2013, in million EUR
Including residential and non-residential buildings, and infrastructure



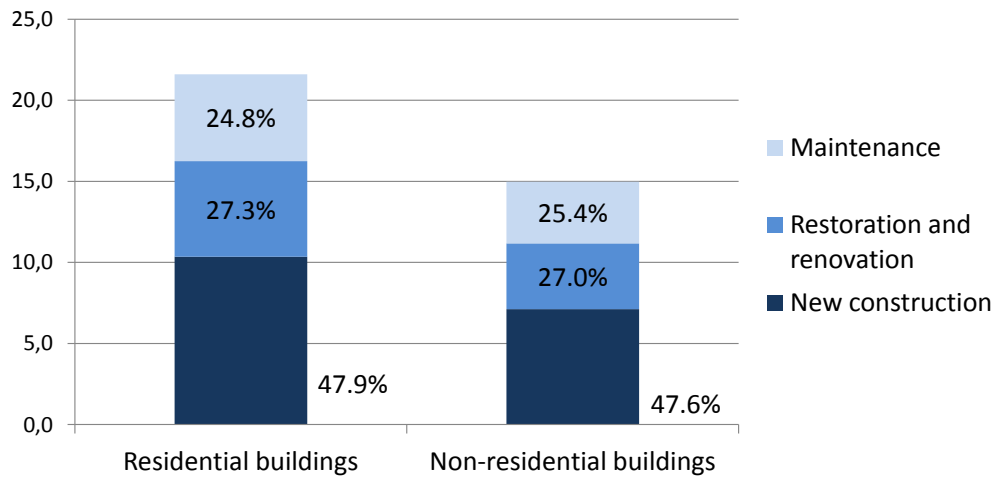
Source: Martins (2011). Data for European countries, i.e., the EU-15 (excluding Luxembourg), plus the Czech Republic, Hungary, Poland, Slovakia, and Switzerland.

Data from Euroconstruct, an association of European research organizations in the construction industry, show that while the total construction market declined after 2007, the share of renovation has increased from 44% of the total in 2007 to 49% in 2010. Renovation is particularly important in residential construction, where it was 56% larger than new construction in 2010.

Data were collected for 19 countries covered by Euroconstruct, the EU-15 (excluding Luxembourg) plus the Czech Republic, Hungary, Poland, Slovakia and Switzerland.

Data from the Netherlands illustrate split between maintenance and renovation

Construction output in the Netherlands by activity
billion EUR, 2012

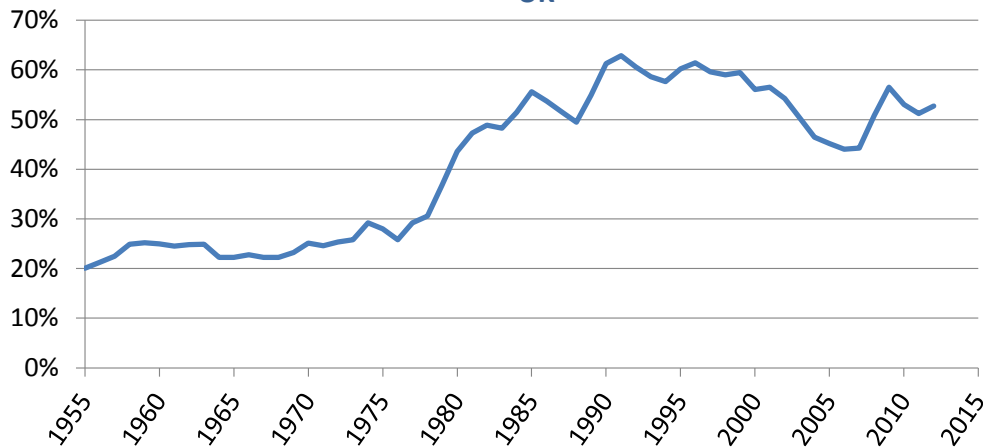


Source: EIB (2013)

Renovation and maintenance activities are sometimes grouped together in statistical reports on the construction industry. In other cases, it is not clear whether data include these two activities combined or only renovation. The Dutch institute EIB is one of the few organizations that provides separate data both for maintenance (*onderhoud*) and renovation (*herstel en verbouw*). These data are for the Netherlands only. They illustrate that between 2010 and 2012, renovation was slightly larger than maintenance, both in the residential and non-residential construction sectors.

Long-term data also point to an increasing share of renovation and maintenance

Share of repair and maintenance in residential construction, UK

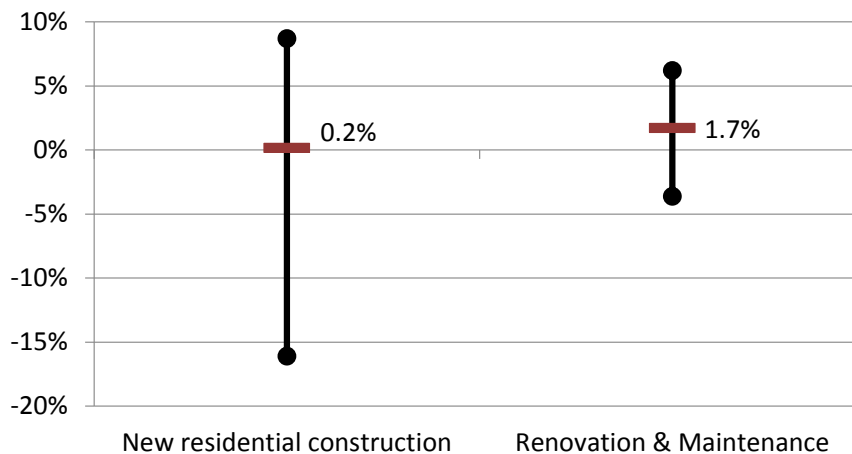


Source: ONS (2013)

The UK Statistical Office (ONS) has collected data on repair and maintenance in residential construction from 1955. This chart shows that the share of repair and maintenance in residential construction increased rapidly starting in the second half of 1970s, and by the middle of the 1980s, it exceeded new construction (i.e., its share exceeded 50%). It declined in 2000s, as investment shifted to new construction in the pre-crisis years. But in the aftermath of the crisis, its share increased again.

The renovation business is much more stable than new construction

The Min, Average and Max annual growth rates in the EU residential construction , 1994-2012



Source: HCSS's calculations based on FIEC (2013)

Previous slides showed that the share of renovation in the total construction market has increased. This implies that the growth rate of renovation was higher than for new construction. In addition, the variation in the annual growth rate for renovation business was significantly less than for new construction. This demonstrates that renovation and maintenance are a much more stable business than new residential construction. This potentially brings important advantages for companies: a more stable flow of work means more reliable cash flow, better planning, improved access to credit, better opportunities to invest in personnel training and other advantages (all other things being equal).

Implications for policy – interim observations

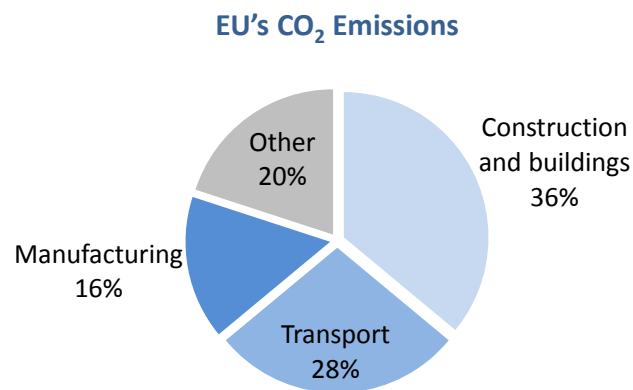
- Our discussion so far yields two important observations:
 - Renovation is a large and growing part of the construction market;
 - The renewal rate of the building stock is low.
- These two observations imply that strategies dealing with built environment should pay more attention to renovation.
 - More knowledge should be gathered at the European level; comprehensive studies on renovation should be conducted (e.g., with data collection), and common measurements and concepts should be developed.
- Next, we consider the role of renovation in two broader policies:
 - Climate change mitigation
 - City competitiveness.

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4. Climate Change and Renovation

Climate change concerns

- Buildings (and the construction industry) account for a large share of energy consumption, and therefore **greenhouse gas emissions** (GHG).
 - The energy consumption of houses and buildings is responsible for 40% of the EU's total energy consumption and 36% of the EU's total CO₂ emissions.



Source: European Commission (2013)

EU-27 households' energy consumption at home (%)



Source: Odysee indicators, www.buildup.eu

EU climate change and energy efficiency goals

- In 2007, the EU adopted the climate package setting '20-20-20' goals for 2020:
 - A 20% reduction in EU greenhouse gas emissions from 1990 levels;
 - Raising the share of EU energy consumption produced from renewable resources to 20%;
 - A 20% improvement in the EU's energy efficiency.
- The building sector should play a key role in achieving the energy efficiency targets.
- EU longer-term targets (for 2050) are much more ambitious and envision a reduction of GHG emissions in the residential and service sector by 88-91%, compared to the 1990 level.
- Many studies suggest that the renovation rate should double or triple to achieve these goals, given the low rate of building stock renewal in the EU.

Source: European Commission (2008)

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The EU's 2020 energy targets set national binding targets for CO₂ reduction for which energy efficiency in the building sector will be crucial.

Some national targets for new buildings:

- Finland: Passive house standards by 2015
- France: By 2020 new buildings should be energy-positive
- Germany: By 2020 buildings should be operating without fossil fuels
- Hungary: Zero emissions by 2020
- Ireland: Net zero energy buildings by 2013
- Norway: Passive house standards by 2017
- UK (England & Wales): Zero carbon as of 2016.

EU longer-terms ambitions for reducing GHG emissions are outlined in the European Commission's "Roadmap for moving to a competitive low carbon economy in 2050" which aims at decreasing CO₂-emission levels by 80 to 95% by 2050, relative to the levels of 1990 (European Commission, 2013).

Energy efficiency in buildings is a cost-effective way to reduce GHG emissions

- Among various options for climate change mitigation, investment in energy efficiency in buildings is one of the most cost-effective ways to reduce GHG emissions.
- In many cases, such investments have a negative total cost given today's energy prices – i.e., their upfront costs can be paid back through a reduced energy bill without subsidies.
- The technical and economic potential of energy efficiency in buildings is also large in absolute terms (absolute volume of GHG reduction) – the existing building stock *“represents the single biggest potential sector for energy savings”* (European Commission).

There is substantial literature on the cost and potential for GHG emissions reduction for various technologies. The results of such an assessment are often expressed as the Marginal Abatement Cost Curve (MACC). McKinsey has developed such cost curves for several countries, including the US, Germany, Poland, etc. (see, for example, McKinsey, 2009). The MACC for the EU countries was developed in a study for the European Commission by Fraunhofer ISI and Partners (2009).

The existing building stock *“represents the single biggest potential sector for energy savings”* (European Commission, 2011a).

Energy-efficient renovation provides multiple benefits

- In addition to GHG emission reductions, energy-efficient renovation provides multiple other benefits:
 - **Economic benefits:** economic stimulus - positive impact on GDP, public finances and energy import bill; increased employment; higher property values; potential export growth.
 - **Environmental benefits:** reduced air pollution; better inside air quality.
 - **Societal benefits:** reduced fuel poverty; health; increased comfort and productivity.
 - **Energy system benefits:** energy security; avoided new generation capacity; reduced peak loads.

Sources: Copenhagen Economics (2012),
Ecofys (2012), BPIE (2013)

Economic benefits:

- Increase in property values for more energy efficient buildings
- Up to 2 million new jobs in Europe (1 million if 20%-2020 objective is achieved) + a market opportunity of EUR 5–10 billion in energy service markets
- Boost to the construction sector
- Increase of the EU's GDP.

Environmental benefits:

- Reduction of sulfur dioxide and mono-nitrogen oxides emissions, saving the equivalent of 4 billion barrels of foreign oil each year, thereby reducing energy bills and Europe's CO₂ footprint.

Societal benefits:

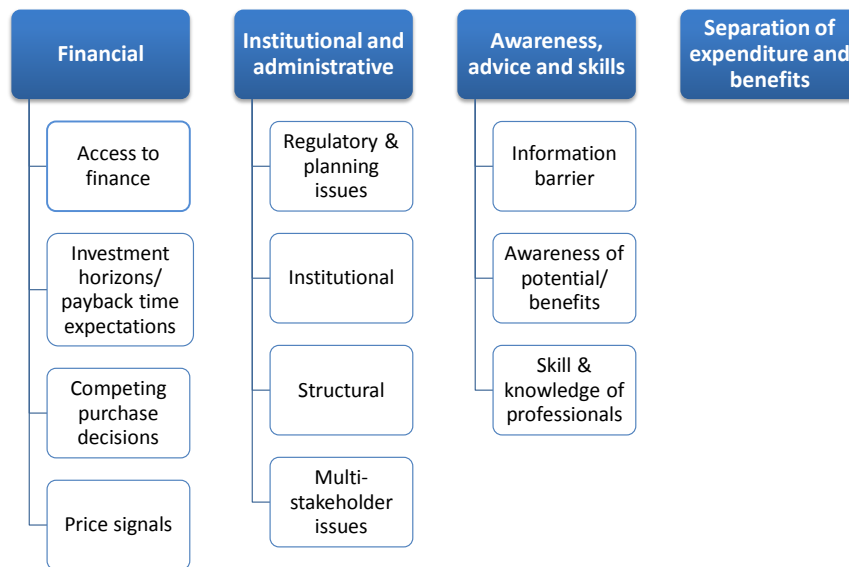
- Improved social welfare, less 'fuel poverty': more affordable warmth for low income households after renovation
- Improved indoor air quality with related health benefits
- Improved energy services (lighting, thermal comfort, less over/underheating, etc.), which can improve productivity in working environment.

Energy system benefits:

- Potentially improving energy security by reducing imports of fossil fuels
- Avoiding new generation capacity
- Reduced energy demand leading to less problems in the transmission and distribution of energy.

Why is the investment in energy-efficient renovation lower than it could be?

Barriers



Source: BPIE (2011b)

Financial barriers:

- *Competing purchase decisions* – Energy costs represent only a small fraction of business (or consumer) costs. Moreover, energy efficiency measures are not visible (unlike PV systems), which makes them less attractive for the environmentally conscious public
- *Price signals* – Energy pricing for consumers does not always reflect externalities, nor does it always provide efficient signals.

Institutional and administrative barriers:

- *Regulatory and planning regimes* – Delays, national differences
- *Institutional* – Bias among institutional investors toward more familiar supply-side investment
- *Multi-stakeholder issues* – Multi-family residential buildings have many owners/tenants, therefore reaching a common solution might be very difficult.

Separation of expenditure and benefits:

Also known as split incentives or landlord-tenant barriers.

Policies to facilitate investments in energy-efficient renovation

- **Regulatory instruments:** building codes, standards (e.g., for insulation levels), labeling, mandatory audit programs, energy performance certificates.
- **Economic and market-based instruments:** trading schemes, energy performance contracting (ESCO market).
- **Fiscal incentives** such as tax reductions, carbon taxes, subsidies/grants, loan programs ('zero rate eco-loans'), green public procurement.
- **Public investment** in R&D and infrastructure.
- **Communication:** publicity campaigns, information, education.
- **Organizational instruments:** agreements between governments and housing associations, road mapping, etc.

Source: Itard et al. (2008)

Many countries in Europe have implemented a broad range of policies for the sustainable renovation of the housing stock, in particular through incentives such as tax reductions, subsidies and preferential loans, to address the main barriers to energy improvements.

- Finland: Use of subsidies – mostly for energy audits and energy saving agreements implementing energy efficiency. Set of criteria for urban planning, permit procedures, construction, values for pollution, use of resources, etc. Energy grants. Economic instrument to reduce consumption in existing buildings. Adoption of the 'Strategy for Renovation 2017' by the Finnish Ministry of Environment in 2007.
- Germany: The renovation strategy is mainly based on regulation (insulation levels) and communication (campaigns broadening knowledge about energy efficiency).
- The Netherlands: Organizational instruments, agreements between the government and Dutch housing associations.

The EU Legislation

- **The European Energy Efficiency Directive (2012/27/EU)** includes rules to remove barriers to energy efficiency in the energy market and overcome market failures in energy supply and use:
 - Public bodies are required to refurbish 3% of their buildings (>500 m²) each year to reduce their energy consumption;
 - Certification schemes introduced for providers of energy services to ensure a high level of competence.
- **The Energy Performance of Buildings Directive (2010/31/EU)** sets higher energy performance standards for all buildings:
 - Member states have to set minimum energy performance requirements for buildings at cost-optimal levels;
 - Building undergoing major renovation should meet these requirements;
 - Starting in 2021, all new buildings should be nearly zero-energy buildings.

The European Energy Efficiency Directive – Directive 2012/27/EU:

“This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020”.

Energy companies are requested to reduce energy sales by 1.5% every year among their customers. This can be achieved via improved heating systems, fitting double-glazed windows or insulating roofs.

The public sector is required to renovate 3% of buildings "owned and occupied" by the central government in each country (only buildings with a useful area larger than 500 m², lowered to 250 m² as of July 2015).

EU countries are requested to draw up a roadmap to make the entire buildings sector more energy efficient by 2050 – commercial, public and private households included (EurActiv, 2012).

Directive 2010/31/EU on the energy performance of buildings (EPBD):

The EPBD aims to enforce the energy performance standards on all buildings, new or existing. Originally adopted in 2002, it is the main legislative instrument at EU level for improving the energy use and efficiency in the building sector. Key goals for member states include:

- Starting in 2021, all new buildings must be nearly zero-energy buildings (NZEBs); public buildings should be NZEBs after 2018;
- Minimum energy performance requirements for all buildings set at cost-optimal levels.

The Energy Efficiency Plan 2011:

One way to achieve this Plan is by fostering low energy consumption in the construction sector. Obstacles hindering this include split incentives. To overcome these, the training of architects, engineers and technicians should be adapted, for example under the 'Agenda for new skills and jobs' initiative (European Commission, 2011b).

Technological innovations for renovation and retrofit

- Most of the technology required for deep reductions in building energy use is already commercially available. Some examples:
 - High-performance windows (with high thermal resistance and high solar heat gain in cold/moderate climates),
 - Hot water condensing boilers (efficiency 92-95%),
 - Heat pumps,
 - Efficient lighting (compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs),
 - Better control system in commercial buildings,
 - Etc.
- R&D efforts should focus on reducing costs and improving the efficiency and integration of components.

Some information sources related to these issues include:

- Herkel and Kagerer (2011)
- IEA (2011)
- European Commission (2009).

Organizational and institutional innovations for renovation and retrofit

- **Public-Private Partnerships (PPPs)**, such as the EU Energy-efficient Buildings (EeB) PPP initiative: collaboration with the construction industry, research and demonstration activities in renovation or construction projects.
- **Energy performance contracting (EPC)**: agreements between clients and energy service companies to implement projects enhancing energy efficiency in buildings. EPC transfers technical and commercial risks to energy service companies, which have better capacity to manage such risks. Benefits include: quantifiable energy savings based on long-term contractual guarantees, comfort upgrade, etc.

Public Private Partnerships (PPPs):

As part of the European Economic Recovery Plan in 2009, EUR 1 billion was allocated to implement the Energy-efficient Buildings (EeB) PPP initiative, in order to promote environmental technologies and energy efficient systems and materials in both new and renovated buildings. The purpose is twofold: boosting employment and innovation in construction, and aiming for high energy-efficiency standards – reaching the 2020 target to reduce CO2 emissions. Through the EeB PPP, the European Commission collaborates with the industry, supports research and demonstration activities in renovation or construction projects. Topics include: “new materials for energy-efficient building components, nanotechnology-based approaches for high performance HVAC systems, energy saving technologies and a systemic approach for the retrofitting of existing buildings, ICT for energy-efficient buildings and energy-positive neighborhoods and the demonstration of nearly zero energy building renovation for cities and districts” (European Commission, Directorate-General for Research and Innovation, 2012).

Energy Performance Contracting:

EPC agreements between clients and contractors successfully deliver savings and long-term contractual guarantees (regarding the results, such as comfort, energy cost savings, etc.). Projects based on EPC implement measures that include building systems (e.g., heating, ventilation...), but not frequently comprehensive renovation. Financing can be taken care of as

part of an EPC agreement. Technical and commercial risks are outsourced to the energy service company. Obstacles include: the lack of knowledge (for implementation), long payback periods, lack of integrated planning, among others (Bleyl-Androschin and Schinnerl, 2008).

5. City Competitiveness and Renovation

City competitiveness

- City competitiveness is a very broad topic.
- Cities **compete to attract** people, businesses and events that will together support their prosperity and vibrancy.
- There are many aspects of city competitiveness (see for example EIU, 2013):
 - Government effectiveness,
 - Low crime rates,
 - Transport links, etc.
- One of the central aspects of competitiveness is the ***built environment***, including ***physical infrastructure***.
- Maintenance and renovation are essential to keep infrastructure and built environment in good condition.
- Nevertheless, it is logical to ask whether new construction is more important for competitiveness than renovation.

Indicators of city competitiveness are discussed, for example, by The Economist Intelligence Unit (2013).

Cities develop elements of urban vibrancy by emphasizing e.g., cultural heritage, opportunities for innovation, diversity – **and the built environment** (PwC, 2005). Renovation policies should be put in a broader context of city competitiveness. They are relevant, because they can be cost-efficient if carefully managed and can attract new businesses, residents and tourists by improving quality of life.

Renovation can be typically fostered through the **regeneration of neighborhoods**, and at a smaller scale, through the conversion or '**adaptive reuse**' of an abandoned or historical building.

Adaptive reuse involves using parts of the whole structure of an existing building and giving it a new, different function. It is considered as an alternative to preservation or demolition. Structures are adapted and preserved for a sustainable new use, without compromising their historic integrity.

Renovation or new construction?

- There is no simple answer for all circumstances.
- Local conditions are often unique and solutions have to be developed on a case-by-case basis.
- However, there are some general factors that in many situations might favor renovation (Power, 2008):
 - Large scale demolition programs are often unpopular and face resistance from the residents;
 - Demolition is often slow due to legal process related to the expropriation of property;
 - Demolition often lead to negative indirect effect on neighboring properties and local services (schools, shops, banks); involves the loss of social capital;
 - Costs are often higher for demolition + new build than for renovation;
 - The environmental impact is typically higher for new construction.
- We highlight two approaches illustrated by case studies:
 - **The conversion or 'adaptive reuse'** of buildings
 - **Area regeneration** based on renovation of properties.

Source: Power (2008)

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Conversion and adaptive reuse

- Adaptive reuse is the process of reusing an old site or building for a purpose other than which it was built or designed for.
- Changes in built environment are often slower than changes in technology, social norms, economic life, etc. This implies that buildings have to be adopted to a new use over time (or demolished). Typical candidates for adaptive reuse include industrial buildings (as industry moves out of cities), community buildings (churches, schools), or administrative buildings.
- **Advantages:** historical preservation – improves the character of the city; often faster and less expensive; smaller environmental impacts.
- **Barriers:** potential contamination of sites (e.g., asbestos); frequent need for modification of older buildings to meet the requirement of building codes; a perception of increased maintenance costs; risk associated with older building stock; inertia.
- **Recommendations:** a careful consideration of the building location, accessibility, the targeted end user (demand) and the conversion costs is necessary for success.

This definition is from Wikipedia and Bullen (2011).

What are the main lessons learned and the conditions required for adaptive reuse to be beneficial?

Examining the risks, threats and opportunities helps define critical success factors and whether renovation makes sense. The building location, the targeted end user (demand) and the conversion costs are intrinsically linked and must be carefully considered to evaluate the feasibility of such projects (Hilde et al., 2007).

The integrity of buildings and its upgrading to modern standards may indeed generate additional expenses, thereby impacting the feasibility of the project. For example, in the Tate Modern Project discovery of toxic materials on-site added 20% to the overall construction budget since they proved to be very costly to remove. Adding value to the building and creating income opportunities in the urban area (e.g., commercial zones in the Eindhoven residential reuse project) may compensate for such costs (Hein and Houck, 2008; Remøy and van der Voordt, 2007).

The case for adaptive reuse of historical buildings: Tate Modern Museum

- Removal of the machinery, preservation of the structure and steel and brick skeleton, new foundation and roof, restoration of the interior
- Objectives: improvement and modernization of London's cultural image, preservation of an iconic building
- Now one of the UK's top tourist attractions, generating £100 million yearly to London.



Bankside Power oil-gas station's conversion to the Tate Modern Museum, London (2000)



Tate Modern in London: Bankside Power oil-gas station's conversion to the Tate Modern Museum, London (2000). The project consisted of the conversion of Bankside Power Station including the removal of the machinery; only the structure and steel skeleton were left. The interior was reconstructed, new foundation and roof had to be built. It is now a highly successful museum, with many visitors. It is often named as a showcase of the potential rewards generated by adaptive reuse (Tate Museum, n.d.; Hein and Houck, 2008). A similar example is the Battersea Power station in London, its planned reconstruction and refurbishment to include office space, housing, leisure areas (Building.co.uk)

Historical renovation is not new: for instance, the Palads Theater in Copenhagen, which was Europe's largest cinema in 1912, was constructed in the old central railway station Hovedbanegård.

The Alter Hof in Munich (2006) provides a good example as well. The objective was to "restore legibility to the former castle site as a spatial entity within the inner city context" – integrating a historical building further in the modern urban landscape (Hein and Houck, 2008). Costs: EUR 25 million (German-Architects, n.d.). The project consisted in the extension of the historical site with an opening of its facades. The interior space was restored and reused. The roof system was removed to add two concrete floors with a new roof on top. German laws required the reuse of original building materials, such as bricks, which were reused in different parts of the building. Such requirements may impact the financial feasibility of renovation projects.

The case for adaptive reuse of buildings: Eindhoven luxury apartments

- In Eindhoven, old municipal health-care offices converted into high-end apartments (suitable neighborhood)
- Improvement of the isolation and renovation of the façade, with a preservation of the building's original features and identity with the reuse of the elevator and staircases
- Commercial zones at the base of the building to add extra income and value.



The 1958 renovated 'Granida'
Building in Eindhoven

There are high office vacancy levels in the Netherlands and Germany – it is also an increasing trend at the global level. Housing supply can be scarce in Europe (in particular in the Netherlands, for instance). In this regard, the potential of the existing building structure is not negligible.

A number of actions which have been taken to respond to these needs in the Netherlands.

- In Eindhoven, offices from the municipality were converted into luxury apartments, on the basis of a competition held for developers and architects. The renovation project improved the isolation of interior walls and floors. The façade had to be significantly modified due to technical problems and inconformity with modern standards, but the original features and identity of the building were preserved as the elevator and staircases were reused. A commercial zone was created at the base of the building (with a pharmacy and a health center) to add value and income.
- In Groningen, KPN's old office buildings were transformed into student housing (83 rooms). The walls were made fire- and soundproof (with layers of gypsum plates). Minimal level of invasive work was required, for a radically different building use and function. This improved building security, population mix and the city's vibrancy.

The conversion of Groningen's old KPN building was well located (near the city center), and it was possible to decrease an originally very high price to make the new accommodations affordable for students. Furthermore, little work had to be done to radically change the

building's original function, which limited costs and saved construction time. In the case of Eindhoven, the building's inconformity with modern standards generated renovation costs that were more important than in the Groningen case. This is why the building's conversion could only be economically feasible if converted into high-end apartments.

Source: Remøy and van der Voordt (2007).

Area regeneration

- Area regeneration (or urban renewal) is often associated with the large scale demolition of existing buildings and new construction.
- Over time, however, urban renewal has become less focused on the removal of existing buildings, and more on renovation and rehabilitation.
- Examples described next illustrate the point that area regeneration can be undertaken successfully by relying (mainly) on renovation and conversion.

Source: Wikipedia, n.d.b.

Area regeneration: Roubaix (France)



'L'Usine', a former factory, now a major outlet store attracting millions of visitors



'La Piscine', a former swimming pool, now a radiant and successful museum

- A city affected by economic, social and infrastructure decay
- The city's renovation program includes processes of 'residentialization' (778 buildings) and conversion of buildings such as former textile dyeing factories into parks or major factory outlets, or an old swimming pool into an art and industry museum (La Piscine, 2001)
- Objectives: social upgrading, improvement of quality of life for the inhabitants, changing the city's image for an economic boost.

Roubaix (near metropolitan Lille, France) is a town in a former industrial region profoundly affected by economic, social and infrastructure decay with high unemployment rates and degradation of housing.

- Main objectives of the *Projet de Rénovation Urbaine* (PRU): social upgrading and improvement of quality of life for the inhabitants, but also economic regeneration by attracting new enterprising people, changing the town's image (Rénovation Urbaine, n.d.).
- The project involved a large-scale rehabilitation of dwellings, construction or renovation of social and educational centers, etc.

Policies in Roubaix have been aiming to rebuild the city's economy. A tax-free zone was introduced in the center, in order to attract businesses including the encouragement of small shops. A former factory was transformed into a site with about 50 top-brand outlet stores attracting millions of visitors each year.

Regeneration program in the city provides a positive example: recently a renovation project for the Pile district was adopted including a process of 'residentialization' and the transformation of zones such as a former textile dyeing factory into an urban park (Cadell et al., 2008; La Fabrique des Quartiers, n.d.)

Area regeneration: Rotterdam's Do-It-Yourself houses ('klushuizen')



- Improvement of Rotterdam's deprived areas through the conversion and renewal of obsolete buildings
- Well-managed and affordable for all parties, with multiple sources of collaboration and funding, including property buyers, partnership with architects, banks and housing agency
- Very popular project, which has rendered the city more attractive to residents, enhanced social cohesion and individual commitment
- Started in 2004, runs through 2014.

The objective of the DIY Houses project was to improve Rotterdam's deprived neighborhoods by converting and renovating obsolete buildings. The participation of buyers was included as an alternative source of private funding, thereby supporting the project's financial sustainability. The project is ongoing (2004-2014) and is based on a public investment of EUR 16.1 million (EUR 30,000 allocated to each old property purchased). So far, 450 old apartments have been sold to private buyers, and have been converted into around 210 new properties. The project was supported by partners, including two banks providing loans to the buyers, and a housing association selling additional 85 properties. Initially, the resources for 170 properties were supported by a governmental fund for urban renewal. The city of Rotterdam covered all these costs from 2009 onwards, including selling, communication and publicity.

Long-term investment is ensured by a safeguarding mechanism with control and rules. Before buying, individuals must prove they are financially able to renovate the house; they must secure permits and develop renovation plans in cooperation with an architect. Buying involves living in the house for at least the first three years. After renovation and one year after handover, the property must be in conformity with standards for insulation, construction and safety. Huge fines can be applied in case these standards are not reached. Houses are offered at least once a year.

This project is considered successful and promising for several reasons:

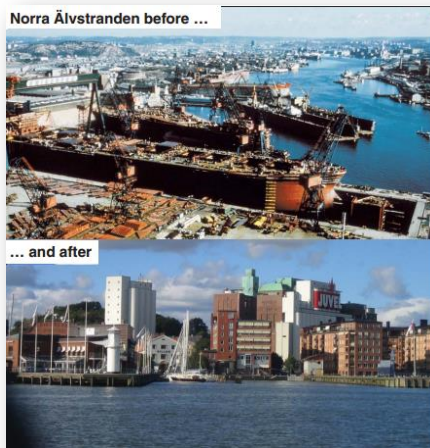
- Minor implementation costs compared with the traditional renovation schemes;

- Reduction of obsolete buildings without burdening the government's or city's budget;
- The project's public recognition and international publicity: Winner of the EUROCITIES 2011 Innovation award; featured in the New York Times in January 2012;
- Popularity of the DIY houses concept, ensuring the neighborhoods' long-term upgrading: Surveys among inhabitants and potential dwellers/buyers indicate that the initiative is very much appreciated. Contributes to an urban dynamic based on the participation, organization and ownership of new residents;
- Individual creativity, commitment, social inclusiveness and urban diversity: Possibility to buy and renovate houses at affordable prices. A well-educated population migrates to multicultural environments. DIY houses have attracted residents from outside Rotterdam.

Sources: Eurocities (2013a and 2013b), Municipality of Rotterdam (2012), Panagos (2013).

Similar DIY projects include: Bristol's Empty Homes, loft conversions in Edinburgh, Lancaster (UK) and Greenwich Village, Chelsea in the US (former industrial district in Manhattan).

Area regeneration: Norra Älvstranden (‘Northern Riverside’) in Gothenburg



- Redevelopment project on former shipbuilding yards, based on the reuse and conversion of existing buildings and facilities
- Cost-efficient, achieved economic revitalization with more businesses, jobs, residents and students
- Improved the waterfront, preserved cultural heritage, attraction of knowledge and innovation
- Started in the 1990s, runs through 2025.

Norra Älvstranden provides an example of a successful redevelopment project on Gothenburg's former shipbuilding yards, redeveloped into a new mixed-use area.

Objectives: bringing about the redevelopment of the district and improve the waterfront, in a way that would not cost Gothenburg any money. Promoting economic development, innovation, education, and the preservation of cultural industrial heritage.

A number of industrial buildings were converted into a hotel, exhibition halls, offices, workspace for small firms, etc. Business and technical education are promoted through a science park, and the development of an IT cluster (supported by companies like Volvo) with adequate facilities to further consolidate the local economy. The whole district is well connected with the rest of the city, through a new ferry service across the river. As it is part of its historical identity, the ship repair yard still operates in the district. In Lindholmen (center), the shipyards' heritage has been also preserved through the refurbishment of original working-class buildings.

The investment has been 11 billion Swedish kronas (EUR 1.25 billion) so far. It includes the Government's initial subsidies and investment in a research facility, but none of the funding originates from the public sector (financially 'self-contained' project).

The success of the project is already perceptible: there are already more jobs, more housing and a better environment has emerged. It has become a place where people choose to live in, and which includes a diversity of very large businesses (including IT, high-tech) that invest in it.

Property values have however increased and there is few social or affordable housing: the district does not receive public subsidy, but must continuously invest in improving infrastructure and the environment.

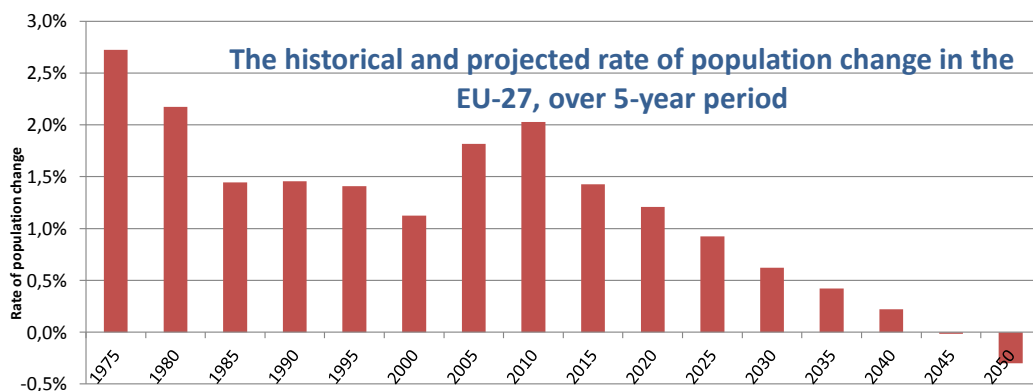
Norra Älvstranden is set to become a major economic driver regionally. There are currently over 400 businesses with 15,000 employees. It is anticipated that in 2025 (date of completion), it will include 13,000 residents (6000 in 2006), 13,000 students (about 9000 in 2006), and 40,000 people will work there.

Sources: Cadell et al. (2008), URBED (2006).

6. Renovation Market Forecast

Renovation should grow more rapidly than new construction

- There are two basic reasons for this:
 1. Building stock is getting bigger and older
 2. Population growth will be slower than in the past.



Source: Eurostat (2012)

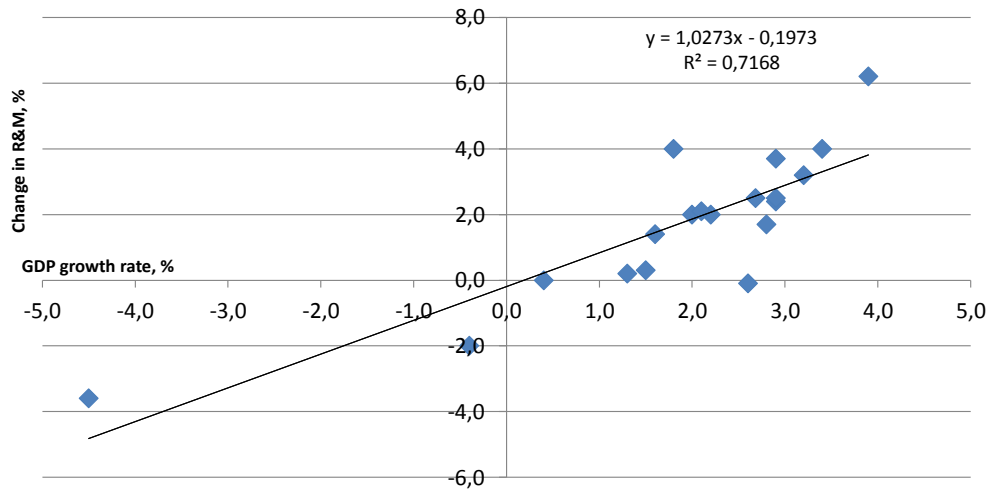
Main reasons for the shift from new construction to renovation:

1) The *first reason* is similar to the 'steady state' argument in economics. As the capital stock in the economy increases, the larger share of total output (and investment) will be used to offset depreciation of the stock. This argument cannot be directly used for housing because houses are consumption rather than productive assets. Still, new buildings are not getting cheaper in real terms (probably because land is in limited supply, stricter environmental regulation, slow progress in labor productivity in construction). Therefore, it is unlikely that consumers will continue to expand the residential floor area per capita indefinitely, and it should level off, probably, rather soon. At the same time, current trends do not indicate that the housing area are per capita is leveling off (see p.17).

In general (ignoring demolition), the building stock is getting older if the new construction rate is lower than $1/T$, where T is the average age of the building stock. Currently, the new housing construction rate is lower than 1%, while the average age in most countries is younger than 50 years. This implies that the new construction rate should be more than 2% p.a. to keep the average age stable. Therefore, the building stock on average is indeed getting older.

2) The *second reason* is lower population growth in the future. The chart shows the historical and projected population growth rate over 5-year periods (e.g., data for 2010 refer to the rate of population change over 2006-2010). The long-term declining trend is quite visible. Eurostat expects that by 2050, the total population in the EU-27 will be declining. Interestingly, the latest construction boom coincided with a pick-up in population growth mainly due to migration.

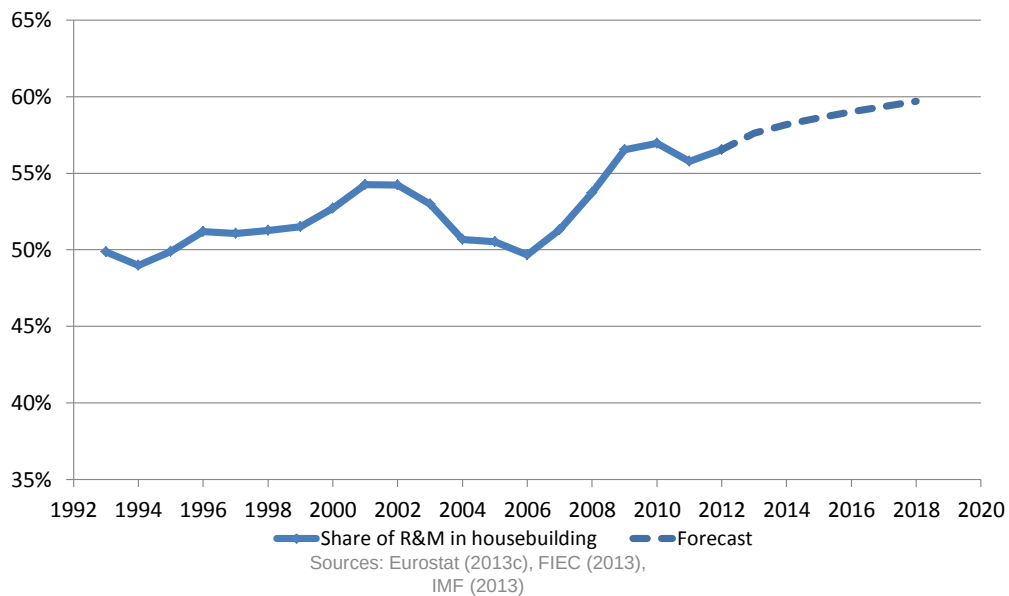
Changes in renovation and maintenance output and in GDP are closely correlated



Vertical axis: percentage change in "rehabilitation and maintenance" (R&M) production in housebuilding (i.e., only in residential construction) in the EU-27 over 1994-2012 (source: FIEC 2013);
Horizontal axis: change in GDP (source: Eurostat 2013c)

The vertical axis on this chart shows a percentage change in renovation output in residential construction and the horizontal axis shows real changes in EU GDP. This chart illustrates that a close correlation exists between changes in economic output (GDP) and renovation and maintenance output. This relationship can be used to forecast the future evolution of the renovation market.

In the 'business as usual' scenario, the share of renovation & maintenance is expected to grow to 60% by 2018 in the EU



The EU market for renovation and maintenance (in housebuilding /residential construction) in constant prices is expected to grow at approximately the same rate as EU GDP. The IMF forecasts that the EU GDP growth rate will gradually increase from 1.3% in 2014 to 1.9% in 2018. The renovation and maintenance market should grow at similar but slightly lower rates: 1.1% in 2014 to 1.7% in 2018. Since new housebuilding is expected to be roughly flat over the same period, the share of maintenance and renovation in residential construction will be almost 60%.

Climate change mitigation as a boost to the renovation market

- In order to reach the EU energy efficiency goals in the building sector, the renovation rate should increase significantly.
- Various studies show a large range of estimates for the related renovation costs.
- However, the potential impact on the renovation market can be assessed using a simple parametric model, which includes two most important parameters:
 - The renovation rate per year (p.a.)
 - The cost of renovation per m².
- The next slide shows the results of this model graphically.

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Some of the recent studies that have tried to assess the volume of investment required to improve energy efficiency in the EU building stock include among others:

- Fraunhofer (2009),
- Houser (2009),
- Copenhagen Economics (2012),
- Ecofys (2012),
- BPIE (2011a).

These (and other) studies rely on different approaches and arrived at different results. A review and the comparisons of some of these studies can be found in Ecorys (2012a) and Climate Strategy and Partners (2012).

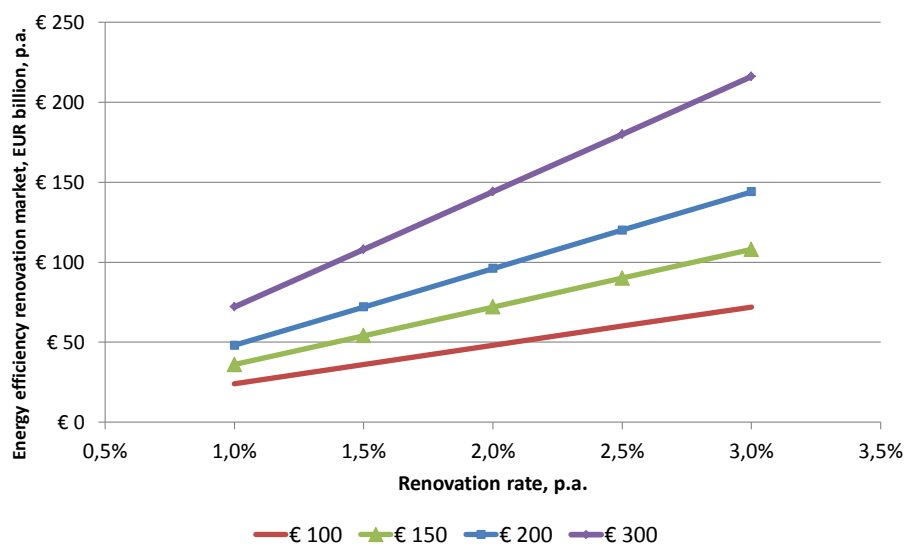
Given the large uncertainty of the existing estimates, the total investment in energy efficient renovation can be assessed as a product of two aggregate parameters:

- The renovation rate per year (p.a.) – i.e., how many buildings can be renovated each year,
- The cost of renovation per m².

These parameters can be estimated more easily by construction experts based on historical data and their engineering and market knowledge.

Energy efficiency renovation market, EUR billion p.a.

- Each line corresponds to a specific average cost of renovation per m².



Source: HCSS's calculations

This chart shows the results of the calculations. Each line corresponds to the specific average cost of renovation in EUR per m² of the floor area. These costs cover only measures directly aimed at improving energy efficiency. These costs are multiplied by the renovation rate (shown on the horizontal axis) and the total building floor area in the EU (24 billion m²) to calculate the total investment (shown on the vertical axis in billion EUR). For example, if the renovation rate is 3% p.a. and the average cost is EUR 200/m², the total annual investment in building energy efficiency renovation is then close to EUR 150 billion.

How large could the boost to the renovation market be?

Many studies show that the rate of energy efficient renovations should increase from existing 1.0-1.5% to 2.5-3% p.a. to reach the EU energy efficiency goals. What will be the impact on the renovation market? There are two basic ways of thinking about this problem that provide correspondingly lower and upper bounds on market expansion estimates:

- The model illustrated on the previous chart implies that an increase in the renovation rate by 1 percentage point translates into an absolute annual increase of the European renovation market of €24 billion (if the average cost of renovation is €100/m²) or €72 billion (if the cost is €300/m²). These figures are likely to provide a lower bound of the market expansion since they account only for the cost of energy efficiency improvements.
- Another way of reasoning assumes that an increase in the renovation rate does not change the average cost of renovation per building (or per m²) substantially, because building owners do not limit renovation only to energy efficiency improvements. This implies that, for example, doubling the renovation rate (say from 1.5% to 3%) will cause a doubling of the renovation market size. This provides an upper bound for the market expansion.

Given a large variation in published estimates of the renovation market size and renovation rates in the EU, it is difficult to make a direct comparison between these two approaches. For example, estimates for the residential renovation market size developed by two respected industry organizations, Euroconstruct and FIEC, typically differ by 20-30%. For the UK, the difference is almost 50%. FIEC estimates the “rehabilitation and maintenance” market while Euroconstruct evaluates the “renovation” market. But despite a supposedly broader coverage, FIEC’s estimates are systematically lower.

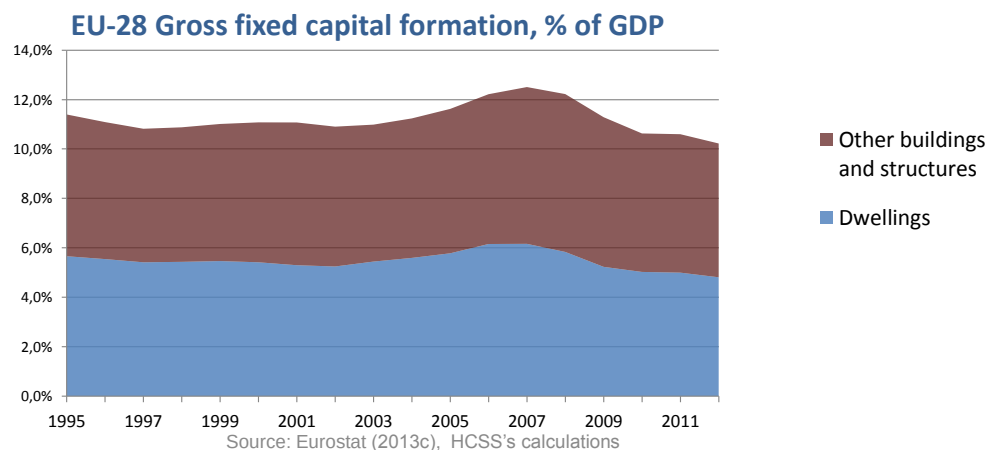
Nevertheless, using FIEC data and assuming that the current renovation rate of 1.5% will increase to 3% and specific average cost of energy-efficient renovation is 300 EUR/m² implies that the residential market might increase within the following range:

- *Lower bound – EUR 81 billion* (=300 EUR/m²*24 billion m²*0.75*(3.0%-1.5%))
- *Upper bound – EUR 250 billion* (250 billion is the residential renovation market size in the EU in 2012 according to FIEC, therefore doubling the renovation rate will double its size as well).

For comparison, the study by Climate Strategy and Partners mentioned on a previous slide calculated an ‘order of magnitude’ estimate of EUR 100 billion p.a. until 2020.

What are the implications?

- Even lower estimates for the energy efficiency renovation market suggest that investment needs are quite substantial (in the order of 0.5-2.0% of EU-28 GDP only in the residential sector).
- At the same time, investment in buildings and structures has been stable as a percentage of GDP over time.



Over the last two decades in the EU, total investment in dwellings has been between 5.0-6.0% of GDP (with small exceptions in 2006, 2007 and 2012). The largest share of came by far from the private sector. This suggests that for example, raising 1% of GDP annually for investment in energy efficiency in the residential sector would be quite challenging – this value is approximately the difference between a depressed and a booming residential construction market. And this includes new construction as well. If the renovation goals are to be met, new construction is likely to remain depressed as investment funds are going to be reallocated to renovation at the expense of new construction.

7. Implications and Conclusions

Prospects for the construction industry

- The construction industry is a vital component of the European economy.
- It was severely hit by the financial and economic crisis.
- New housing construction is especially struggling in a context of austerity, limited credit, and weakened household confidence.
- Nevertheless, the construction sector remains an important potential source of growth in Europe.
- In particular, the potential of renovation and maintenance as a booster for the construction market must be considered.

Potential of the renovation market

- The renewal rate of the existing building stock in Europe is low (less than 1% p.a. in recent years). As a result, the impact of new construction on the quality and properties of the building stock is limited.
- Given buildings' long lifespans, the renovation of existing buildings is essential for achieving society's economic, environmental and societal goals.
- The renovation market will increase in importance in the future for a number of reasons:
 - The building stock in Europe is getting older
 - Lower population growth
 - Energy efficiency and climate change mitigation goals are likely to lead to a substantial expansion of the renovation market in the next few decades (since energy efficiency in buildings is one of the most cost-effective ways to reach these goals)
 - Renovation is essential for city competitiveness.

Innovation is the key to address renovation challenges

- The need to increase renovation rate is obvious, but investment budgets are limited even at the macroeconomic level.
- ***The key to this challenge is innovation:*** building and infrastructure owners will have to do more with less.
- All types of innovation are important: from technological (e.g., new construction materials) to organizational and financial (e.g., attracting capital from large investors by aggregating many small renovation projects).
- The construction industry is generally a laggard compared to many other industries in terms of research intensity and productivity growth.
- This increases the role of public research organizations such as TNO in promoting best practices and solutions, and sharing knowledge on the built environment.
- Public policies in general need to become more comprehensive in addressing many barriers (from regulation to taxation) that hold back the development of the renovation market.
- The shift to renovation will have (and is already having) structural consequences for the construction industry.

APPENDIX 1: BIBLIOGRAPHY

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HCSS, LANGE VOORHOUT 16, 2514 EE THE HAGUE
T: +31 (0) 70-3184840 E: INFO@HCSS.NL
W: STRATEGYANDCHANGE.NL