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Global Buildings Performance Network

Building Policies for a Better World

DEEP BUILDING RENOVATION - INTERNATIONAL POLICY GUIDELINES

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Author
Global Buildings Performance Network

Expert Advisers
Adrian Joyce, Adrien Bullier, Ann Edminster, Chris Hughes, Connie Pettersson, Jens Laustsen, Lindsay Robbins, Peter Bach, Robert Sahadi, Rod Janssen, Roger Hitchin, Stacy Lee and Yamina Saheb.

Editor
Dan Staniaszek

INTRODUCTION

Buildings account for around 40% of energy consumption, resulting in 8.8 gigatonnes of direct and indirect CO_2 emissions. In developed regions, most of the buildings that will be standing in 2050 have already been built today and, for this reason, it is all the more crucial for deep renovations[1] to be scaled up over the next 35 years in order to maximise the contribution that the building sector makes to climate change mitigation.

Achieving the huge potential for energy savings in the renovation of the existing building stock will also have many local, national and global benefits, ranging from economic growth and job creation to alleviating fuel poverty.

The premise of this energy renovation policy guide is that the necessary savings in the existing building stock can only be achieved with the widespread adoption and implementation of effective policy packages and support programmes that have a long-term target of achieving deep renovation for all of the existing building stock. A policy package for energy renovations will include a collection of policy instruments that work together to upscale, finance, and promote deep renovations in a jurisdiction. The package of instruments must relate to the specific political, economic and social situation of the jurisdiction.

This guide is divided into three parts:

i. An overview of the Best Practice Criteria that can be developed as part of a deep renovation policy package
ii. Best Practice Case Studies of existing policy packages with recommendations from four webinars from policy makers in leading jurisdictions around the world.
    1. Overall recommendations from front runners in energy renovation policies
    2. The role of energy saving targets and regulatory measures in renovation policy packages – key lessons from global best practices
    3. The role of labelling and certification schemes in renovation policy packages
    4. How to upscale deep renovations using financial mechanisms
iii. A step-by-step guide to implementing a policy package in a country, city or state

[1] Deep Renovation or Deep Energy Renovation is a term for a building renovation that captures the full economic energy efficiency potential of improvements. This typically includes a focus on the building shell of existing buildings in order to achieve very high-energy performance, the improvement of technical systems such as HVAC and lighting, and the incorporation of renewable energy technologies. A deeply renovated building consumes around 75% less primary energy compared to the status of the existing building before the renovation. The energy consumption after renovation for heating, cooling, ventilation, hot water and lighting, is less than 60 kWh/m2/yr. (Definition often used in Europe) [Source: GBPN]

BEST PRACTICE CRITERIA: ENERGY RENOVATION POLICY PACKAGE

In order to support the development of roadmaps for renovation policy packages, the GBPN, with the support of international experts, undertook a global analysis of best practice renovation policies and complementary policy tools that support the uptake of energy efficient renovations. A consensus process was used to develop supporting criteria and sub-questions that could be used as a tool to determine whether a policy package contained best practice elements.

As the project sought to evaluate best practice policy packages for renovation to support a transformation of the building stock, the main focus of the research was on holistic and ambitious building renovation policy packages. The GBPN defined criteria based on literature and the input of experts, and then assessed successful policies; six key themes were identified that form the basis of the renovation policy package used to evaluate the best practice jurisdictions:

1. Regulatory normative measures,
2. Individual building assessment,
3. Financial instruments,
4. Economic instruments,
5. Capacity building, and
6. Overall performance.

A detailed set of 14 criteria was developed to rigorously assess the performance of policy packages under the six key themes. The first five themes assess policy packages implemented by the jurisdiction. The sixth theme acts as an overall performance indicator that analyses the performance of a region's policy package in terms of energy consumption. Details of each of the six themes and the 14 supporting criteria can be found below. Each theme comprises two or three of the 14 criteria.

The methodology used to develop the criteria included a detailed desktop study as well as a peer review process. The desktop study reviewed research reports and academic papers on renovation policy packages from around the world, in order to gather information on best practice policy elements. Current policies for renovation were also examined, specifically in the jurisdictions that were deemed to have a best practice policy package set up, to ensure all possible energy renovation policy elements were included in the Renovation Policy Package Criteria.

A peer review process followed whereby the criteria were sent to an expert group of thirty building energy efficiency renovation policy experts from academia, the private sector, national experts from different regions and international organisations. An agreement was reached on the 14 criteria that form the basis of the assessment of the six themes – see figure1.

Figure 1. Best Practice Themes and Related Criteria

More detailed information on each theme, the criteria and how these support the assessment of each jurisdiction's policy package is outlined below.

Under each of the 14 criteria, sets of questions (sub-criteria) were developed that allowed for each jurisdiction to be assessed using the same amount of detail and rigour.

Each criterion was allocated a score between 0 and 10 points. In order to be awarded the maximum 10 points, the jurisdiction's current policy measures had to be exemplary, progressive, and focused on achieving deep renovation in all cases.

None of the jurisdictions was awarded the maximum score in any of the criteria, as further improvements could be made in all areas.

Theme 1 – Regulatory Measures

This theme considers the level of ambition of the policy package. Targets and regulations are favoured instruments for reducing energy consumption, as they are a cost effective way of ensuring a more efficient building stock in the long-term. To be effective, targets should be well planned, ambitious, realistic and include roadmaps with short, medium and long-term milestones. This theme comprises three criteria:

1. Overall National Targets

An overall national target will set the level of ambition for the jurisdiction in terms of energy or CO_2 savings. The overall reduction target is the umbrella for the different sectoral targets.

This assessment was based on the following sub-criteria:

- How committed to the target is the region?
- How ambitious is the target?
- Is the target achievable?

2. Residential Building Targets

To implement the "deep" renovation scenario, governments will need to set specific, binding and ambitious targets for the renovation of the building stock (in terms of depth and scale) that provide direction to all parties involved and give a clear focus for investment and market development. Energy performance targets will require the whole building stock to be improved/upgraded to a specific level in a given timeframe. The targets should be supported by a roadmap describing how the targets will be realised and will include short, medium and long-term milestones with a clear and well-defined baseline and assessment methodology.

This assessment was based on the following sub-criteria:

- Has the Government set carbon/energy targets for the whole building stock?
- Has the Government set renovation targets for the existing building stock?
- Is there a roadmap leading to these targets?
- Do the roadmaps integrate energy performance of buildings with broader societal goals (social issues such as health, job creation, etc.)?
- How does this support the uptake of deep renovations in the jurisdiction?

3. Public Building Targets

In order to stimulate a 'deep' renovation strategy, specific policy targets for the renovation of public buildings should be stringent and ambitious, setting an example for the level of ambition for renovation of the rest of the building stock. The targets should be binding, supported by a roadmap describing how the targets will be realised and include short, medium and long-term milestones with a clear and well-defined baseline and assessment methodology.

This assessment was based on the following sub-criteria:

- Has the Government set carbon/energy targets for public buildings?
- Has the Government set renovation targets for the existing public building stock?
- Is there a roadmap leading to these targets?
- Do the roadmaps integrate the energy performance of buildings with broader societal goals (social issues such as health, job creation, etc.)?
- Does this support the uptake of deep renovations in the jurisdiction and develop capacity?

Theme 2 –Building Assessment

Regulation of renovation and specific requirements for improvements are important ways to ensure savings in the existing building stock. Holistic building energy codes for new and existing buildings and robust energy labelling schemes are an essential aspect of any renovation policy package. This theme considers both of these policy measures.

4. Building Code Requirements for Renovation

The country/state building code should set minimum energy performance levels and minimum technical requirements to address the renovation of existing buildings. They should also be dynamic and well enforced.

This assessment was based on the following sub-criteria:

- Has the building energy code been revised in light of the renovation targets?
    - Are these requirements performance based and how stringent are they?
    - Are these requirements component based and how stringent are they?
- Is the building code dynamic?
    - Do the energy requirements set in the building code support the national (renovation) targets?
    - Are they frequently revised to follow economic and technical development?
- Is compliance with the building code for renovation and improvement well enforced?
- Do the requirements actively support the uptake of deep renovations in the jurisdiction?

5. Labelling Schemes

Energy certification of buildings supports the implementation of energy efficiency measures as it allows for the comparison of buildings and helps to document the impact of renovation. Such schemes can also be part of an enforcement regime. If labelling schemes are voluntary they need to be designed to support buildings to go beyond the minimum energy renovation standard.

The following sub-criteria assess the level of ambition of certification and labelling schemes:

- Is there a certification scheme in place?
    - Is the certification scheme mandatory or voluntary?
- How frequently must certificates be updated?
- Are certificates required at the time of rent or sale or in connection with renovation activities?
- Is there a public register of the energy performance of buildings, based on certificates?
- Is the certification based on:
    - An energy audit by an independent assessor?
    - A self-assessment?
- Are there proportionate penalties for failure to comply, and are these enforced?
- How does this support the uptake of deep renovations in the jurisdiction?

Theme 3 – Financial Instruments

This theme considers financial and fiscal[2] instruments. As part of an overall policy package, such instruments should be in place specifically to incentivise the uptake of deep energy renovations, given their higher cost.

The three criteria below assess the financial and fiscal remedies in place to address the financing barrier.

[2] "Fiscal" refers specifically to measures relating to government taxation. "Financial" covers all other forms of financial support (grant, subsidies, loans etc)

6. Incentive Schemes

Financial incentives such as subsidies, grants or preferential/soft loans are effective in encouraging building owners and occupants to invest in energy saving measures.

This assessment was based on the following sub-criteria:

- Is financial support offered by the state/country for renovation of buildings?
- What type of support is available?
- Are the incentives provided as part of a holistic package of measures?
- On what basis is financial support made available:
    - "Conditionality" (access to funds is only allowed if substantial savings will be provided)?
    - "Progressivity" (more financing for the most ambitious renovations)?
- Do public funding mechanisms leverage private investment?
- How does this support the uptake of deep renovations in the jurisdiction?

7. Taxation Mechanisms

Barriers to energy renovations are both economic and financial. Fiscal instruments such as tax rebates can provide a possible solution to overcoming these barriers. In order to stimulate deep renovations, such incentives need to be progressive and to promote more holistic and deep solutions.

This assessment was based on the following sub-criteria:

- Tax incentives
    - Have tax exemptions, differentiations and/or reductions that encourage investment in energy performance improvement been established?
    - Are they ambitious?
    - Do tax credits support holistic renovations?
    - Are there tax credits for specific building components?
    - Does this support the uptake of deep renovations in the jurisdiction?
- Energy/carbon taxes
    - Is there a carbon or energy taxation system in place?
    - What is the purpose of the tax?
    - To which actors does the tax apply?
    - Is the tax ring-fenced for investment into sustainable energy (e.g. building energy renovation)?

Theme 4 – Market-Driven Economic Instruments

This theme considers the specific economic and market based instruments that support energy renovations. These instruments are key to an energy renovation policy package as they can create markets for energy renovation that had not previously existed. The criteria under this theme incorporate the main economic and market-based instruments discussed below.

8. Utility-Funded Programmes

As organisations that interact with energy consumers on a regular basis, energy utilities provide a good opportunity for leveraging resources for renovation programmes. The characteristics of utility rate structures (subsidies, demand charges, time of day rates) can affect the affordability of energy, and therefore the desirability of energy efficiency improvements. In some jurisdictions, utilities play a strong role in funding efficiency improvements. This criterion assesses their contribution.

The following sub-criteria support that assessment:

- What type of energy saving measures will be provided and how do they support deep and holistic renovations?
- What kind of funding is available?
- On what basis is financial support made available:
    - "Conditionality" (access to funds is only allowed if substantial savings will be provided)?

- "Progressivity" (more financing for the most ambitious renovations)?
- Up to what percentage of the cost do the utilities pay?

9. Market Instruments

Specific market mechanisms can be implemented to promote energy renovations. Energy Performance Contracts (EPCs), on-bill finance or on-tax finance can provide private or third party financing for energy renovation. Such systems can help to overcome funding issues without affecting public budgets. Energy performance contracting works by selling the services that energy provides (heating lighting etc), and not just the energy. On-bill / on-tax finance attaches debt to the energy meter or the property rather than the building owner, and secures a framework for private finance to be invested in energy renovation. Furthermore, Energy Saving Companies (ESCOs) can provide a range of additional services such as energy audits, energy certification, energy management and invoicing.

This criterion assesses the impact of these market based financing schemes. The following sub-criteria supported that assessment:

- Is the ESCO market well developed in the region?
- Is there a market for energy performance contracting, or a policy to implement on-bill / on-tax finance?
- What services are covered?
- Do ESCOs work on the projects related to deeper energy renovation or low hanging fruit?
- Are there policies in place supporting the use of ESCOs, and/or facilitating access to finance for ESCOs?

Theme 5 – General Information and Capacity Building

This theme assesses complementary instruments that support the implementation of energy renovations. These softer policy instruments, such as information and capacity building, can improve our understanding and awareness of the issues surrounding energy renovation. The first criterion supports information and capacity building. Both of the two criteria below support the implementation of learning and capacity elements of a renovation policy package.

10. Training and Education Campaigns

Awareness raising and information campaigns can support individuals and building operators to reduce their energy consumption by informing them of the benefits of renovation (and why the more ambitious renovation is a cost effective option), the technologies available and the support mechanisms to encourage the consumer to improve the energy performance of their building. In order for a deep path to be followed and for energy renovations to become the norm, appropriate training and accreditation programmes must be in place for trades people and professionals working in the field, as the implementation of energy efficient building solutions requires strong technical capacity and expertise of all parties involved in the renovation process.

This assessment was based on the following sub-criteria:

- Are consumers and market players provided with appropriate energy saving advice and information about relevant incentives for energy efficient renovation?
- Are training activities and accreditation bodies set up for building specialists (e.g. engineers, architects, inspectors, installers, builders, etc.) to increase and maintain their technical capacity for deep renovations?
- Have training and educational materials, which include information on deep renovation, been developed for use in professional training, schools and universities?
- Do the training and education campaigns support the uptake of deep renovations in the jurisdiction?

11. One stop solution centres

One-stop solution centres for energy renovation can play an important part in informing consumers about how to implement a deep energy renovation, from design to financing. Such centres bring key market players together to provide attractive offers and information about deep energy renovation to consumers.

The following sub-criteria assess whether such centres have been developed in the country/region:

- Is there robust collaboration between market actors to deliver deep renovations?
- Is there a successful track record for deep renovation projects conducted under a public-private partnership (PPP)?
- Does this support the uptake of deep renovations in the jurisdiction?

Policy Impact: Overall Performance

To document that the policy package is successful, the energy consumption of the residential building stock in the jurisdiction must have decreased (either per capita, or totally and per unit floor area). The overall performance of the policy package is critical when analysing whether the package can be defined as having "best practice" elements. The following criteria (and sub-criteria) assess the impact of the policies:

12. Reduction in total energy consumption

- Has the overall consumption in residential buildings decreased and, if so, by how much?
- How is this measured?
- What systems are in place to ensure that the reductions continue to be achieved until the targets are reached?

13. Reduction in energy consumption/capita

- Has per capita consumption in the residential buildings decreased and, if so, by how much?
- How is this measured?
- What systems are in place to ensure that the reductions continue to be achieved until the targets are reached?

14. Reduction in energy consumption/unit (m2/ft2)

- Has the area-based consumption (energy use intensity) decreased and, if so, by how much?
- How is this measured?
- What systems are in place to ensure that the reductions continue to be achieved until the targets are reached?

IMPLEMENTING A POLICY PACKAGE: STEP-BY-STEP GUIDE

Overview

This section covers the important steps that can be taken when implementing a policy package for energy renovations, looking at how to develop an audit and renovation programme for different building types in a city, state, region, or country. The programme will be able to support identification and implementation of opportunities for energy efficiency renovations, upgrades and consumer behaviour-based energy savings. The benefits of the programme will be reduced operating costs for residents, better comfort conditions and overall energy savings. With more energy efficient buildings and lower operating costs, more funds will be available for other operational expenses.

The policy package should aim to achieve deep renovation in as many buildings as possible, while also recognising the numerous co-benefits that arise:

- Reduced carbon emissions
- Reduced O&M expenditures
- Increased property value
- Improved air quality
- Improved occupancy rates
- Enhanced public health & safety
- Increased employment opportunities
- Financial savings

Implementation Activity

Identify Renovation Programme Leader

Appoint a suitably qualified person to be responsible for execution and delivery of building renovation projects in the jurisdiction. This person should establish a team or an independent committee to address the development of standards, professional qualifications, verification procedures, and energy savings quantification and tracking tools.

Collect Data on Building Typology

Gather data on the building stock and undertake systematic appraisal of barriers to renovation.

a. Compile a database of information on energy use and savings potential in the building stock based on:

i. Building Characteristics:

- Age
- Type
- No. of occupants
- Floor area
- Heating and cooling degree-days

ii. Energy use for:

- Heating
- Cooling
- Hot water
- Lighting
- Cooking
- Appliances

iii. Technical building systems (with typical replacement lifecycles)

Identify Consumer Behaviour Opportunities

A variety of programmes focus on energy savings resulting from changes in individual and organisational behaviour and decision-making. These can often be implemented with little or no additional costs.

Providing the right information is key to changing the behaviour of occupants. Simple advice such as turning off unused lighting/equipment and how to control heating and cooling appropriately are essential elements of an energy management process to cut energy wastage.

Action points:

- Provide information to end-users on their energy use, comparisons with usage by others, goal setting, rewards and additional tactics that encourage efficient energy use.
- Assist end-users to benchmark their building energy use and improve operating performance through building or equipment tune-ups and changes to operating and maintenance (O&M) routines.
- Inform occupants of and provide subsidies for improved building automation systems that can make it possible to more accurately programme HVAC[3], lighting and hot water systems.
- Some of the zero cost behavioural changes that can be implemented include:
    - Turning thermostats down (heating) or up (cooling)
    - Usage of timers for hot water or space heating/cooling
    - Switching off lights/appliances when not in use
    - Shower rather than bath
    - Closing curtains at night
    - Fixing leaking taps
    - Positioning fridges and freezers in a cool place away from direct sunlight and heat
    - Always washing full loads in washing machine and dishwasher
    - Maintaining hot water boiler

Identify Energy Saving Opportunities

Using results from the benchmarking programme or data collected on buildings by programme staff, identify preliminary opportunities for energy efficiency such as: HVAC system type/performance level/controls, hot water provision, new lighting systems, new heating systems, new computers, new laboratory equipment, etc.

Set Budget and Requirements

Allocate budgets for energy efficiency upgrades in buildings. Secure sources of finance and develop mechanisms that effectively leverage private capital. Address market barriers and provide appropriate financial incentives to support the improvement of the energy performance of the building stock.

a. Develop a finance model for state public benefit fund programmes to support energy efficiency improvements for new and existing construction. As part of this effort, focus on performance-based programmes that provide incentives targeted to developers.
b. Map out the investment horizon
    i. Quantify total annual investment requirements to 2050 needed to deliver the identified renovation opportunities
    ii. Identify existing sources of funding for building energy renovation
        - Owners' private equity
        - Public purse
        - Banks and other sources of finance, e.g. pension funds, investment trusts

[3] HVAC- Heating, Ventilation and Air Conditioning

- ESCOs

iii. Identify possible new funding sources and mechanisms to meet the investment profile from the above list

Technical capacity building and awareness raising

A suitably trained cadre of experts, qualified within the framework of a recognized independent certification/accreditation system, is key to ensuring the correct certification of buildings and energy systems and identification of renovation opportunities.

a. Gear up training programmes covering the key professions, disciplines, and skills
b. Establish knowledge and experience-sharing networks. One-stop solution centres for energy renovation can play an important part in informing consumers on how to implement an energy renovation, from design to financing.
c. Encourage development of local supply chain industry for maximizing macro-economic benefits and to minimize embedded CO_2 emissions
d. Develop promotional and dissemination activities that sensitize building owners to opportunities for deep renovation and that provide stepwise support throughout the renovation process
e. Communicate regularly and publicly on progress of the renovation strategy
f. Support research, development and demonstration projects into new & improved technologies and techniques to deliver deep renovation, including how to scale up best practice to multiple buildings

Additional consumer support

It is expected that the owner/investor is aware of the investment and maintenance opportunities for renovating their specific building type. In order to encourage the owner/investor to provide energy efficient services/upgrades to the building a number of actions could be set up; these will depend on the type of building, its location, and the owner's situation. Some of the most encouraging opportunities include:

- Finance programmes to support upgrades.
- Brochures making a good case for renovation of a specific building type, including:
  - Potential cost savings and supporting economic information
  - Technical advice and practical information
  - Project case studies
- One-stop-shop - establish an office or internet site that provides information and advice on renovating each specific building type.
- Provide a register of suitably qualified tradespeople as part of the one-stop-shop.
- Provide "aggregation services" so that individual residents or businesses, whether in the same building or in disparate buildings, can generate savings opportunities of sufficient scale to attract ESCO involvement

The next section provides case-studies of how best-practice policy packages for building energy renovations are being implemented around the world.

CASE STUDIES: ELEMENTS OF A SUCCESSFUL POLICY PACKAGE

The GBPN hosted a series of four webinars on how to implement a successful policy package that targets energy renovations for residential buildings, based on the findings from the online Policy Tool for Renovation[4]. This tool allows a comparison and analysis of twelve renovation policy packages for buildings in Europe and the United States, using the fourteen criteria described earlier that define a "state of the art" policy package.

Energy renovation policy is still evolving and thus there is scope for further progress. The tool shows where positive steps have already been taken and where jurisdictions can learn from these actions. The tool represents some of the better practices in place globally, however even here there is considerable scope for improvement, given that no jurisdiction scored more than five out of 10. This highlights the need for further development and for learning across the board to support more robust measures. This tool can help a jurisdiction to develop policies effective in reducing the consumption of their overall building stock and in meeting both their sectoral and overall energy saving targets.

As well as providing insight into current best practice policy packages, the webinar presenters were also asked to provide the background history that has supported or driven the move towards energy renovations, including an overview of the political context, market conditions and development of technical capacity. The GBPN supports a holistic approach; what makes a good renovation policy package is the proper combination of all the best practice elements. Each region can learn from others; however, each jurisdiction has to find the right balance of elements and adapt them to the local context.

Each webinar covered a different element within an energy renovation policy package:

- Webinar #1: The overall performance of current best practice renovation policies for residential buildings.
- Webinar #2: The importance of energy saving targets and how they drive energy renovations
- Webinar #3: The role of labelling and certification schemes in renovation policy packages
- Webinar #4: How to upscale deep renovations using financial mechanisms

Webinar #1 The overall performance of current best practice renovation policies for residential buildings.

Which countries or states have been successful in reducing the energy consumption of their residential building stock in the past ten years? What can other jurisdictions learn from their experience? What are the key factors that were significant in driving change? Front-runners from Europe and the United States identified through the GBPN analysis provide insights into "how to" introduce and develop a best practice policy package that contributes to realising a reduction in energy consumption of the residential building stock.

New York – Case Study

Lindsay Robbins from the Cleaner Greener Communities Program, NYSERDA was invited to provide insights into the successes in implementing clean energy in New York's residential sector with a focus on improving the economy and the environment. This webinar was broken down into the key contributing factors that have enabled New York to successfully reduce its energy consumption in buildings. These include stakeholder collaboration, funding and experience, leadership and innovation, political support and partnerships, community-based strategies and market transformation.

[4] http://www.gbpn.org/databases-tools/purpose-policy-tool-renovation

Stakeholder Collaboration

New York State (NYS) players actively collaborate on energy related issues. The leading players all have a key role to play, including: NYSERDA[5], Governor's Office, NYS Legislature, Municipal Utilities, Investor-Owned Utilities, NYS Government Departments (16,000 employees have the ability to implement programmes and policies), New York City Government, NYS Municipalities, businesses and non-governmental organisations.

Funding and Experience

New York has had a 16-year long history of implementing energy programmes and running development programmes with a state-wide collaboration. Over the years, NYS has found ways of harnessing multiple funding sources, from rate-payers to the Federal Government, and has learned what works and what does not. An example of a funding mechanism is the RGGI (Regional Greenhouse Gas Initiative) that is the first mandatory cap and trade programme in the USA.

Leadership and Innovation

National scale programmes throughout the state have been up-scaled and NYS is continually designing innovative development programmes and training standards that often lay the foundation for national standards in the USA. These include:

- Home Performance with ENERGY STAR
- ENERGY STAR Multifamily High Rise Program
- The Building Performance Institute

The advantage of instigating these programmes means that NYS has the technical know-how and a qualified workforce.

Political Support and Partnerships (top-down)

Support from current and past governors and mayors who have ambitious clean energy goals to harness energy saving opportunities has played a leading role in helping the state to reduce energy consumption in buildings. NYS has a robust network of state and municipal governments, agencies, and regulators working together to implement policies and programmes. State Energy Plans are created to think strategically when planning for the future.

Community-Based Strategies (bottom-up)

NYS has put emphasis on bottom-up, community-based strategies and was the first US state to create comprehensive regional sustainability plans for the entire state – this happened at the community level by working groups and communities working together to create clean energy plans. Two of these are described below.

Green Jobs/Green New York Innovative Legislation is a key example of one of NYS' community-based strategies as it shows issues have been tackled using a top-down and bottom-up approach. Originally mandated by the NYS legislator, it is RGGI funded and managed by NYSERDA, focusing on providing technical assistance and finance to small businesses and residential buildings as well as providing guidance to finance energy improvements. It also supports the training of service providers. Key to its success is that a community-based outreach strategy was taken that put a large amount of responsibility on helping participants conduct outreach and navigate the programme so that the outcomes are tailored to the needs of the residents in the community.

Cleaner Greener Communities Mission empowers regions to lead the development of sustainability plans and implement projects that will significantly improve the economic development and environmental well-being of their communities. The programme engages from the bottom-up to ensure that participants are actively working to reduce their energy consumption.

[5] The New York State Energy Research and Development Authority

Market Transformation

Focus has been consistent with regards to legislation on market transformation. New York State has an energy innovation chain based on NYSERDA finding new strategies and technologies and taking them to the developing market point whereby incentives are no longer needed. NYS has nurtured an educated workforce and market mechanisms for delivering clean energy solutions, placing the emphasis and funding on training. NYS is home to a robust network of service providers who can provide the energy improvement services needed to make NYS an energy efficient place.

Over the last 20 years, NYS has put time and effort into consulting firms and developing service-providing firms. Useful information based on measured data on the impacts of energy before and after renovations from past programmes helps to inform the marketplace by providing clients and financers the solid data necessary for investing in renovation.

NYS has found creative activities to stimulate the marketplace. For example the NYC Carbon Challenge is a voluntary leadership programme for 17 of New York City's leading universities, 11 largest hospital organizations, 12 global companies, and 17 residential management firms to pledge to reduce their building-based emissions by 30% or more in just ten years. In addition, 40 Broadway theatres are engaged in a range of sustainability projects through the Broadway Green Alliance. A key goal of NYSERDA is to use competitiveness in the marketplace to stimulate consumer activity and commit to projects.

Focus is placed on connecting clean energy with economic development and finance. Connecting clean energy strategies with economic strategies increases the availability of capital for clean energy projects.

Lessons Learned

It is clear from the webinar that the main success factor that interlinks each of the key contributing factors in NYS is the collaboration between all relevant stakeholders. This collaboration ensures actions are taken, both top-down and bottom-up, that successfully reduce the energy consumption of buildings in the state.

Sweden – Case Study

Conny Pettersson, the president of Swedisol, was invited to provide insights into how Sweden has successfully reduced energy consumption in the residential buildings sector over the past decade. His presentation focused on the historical and political aspects as to how this has been achieved.

Policy and Experience

Sweden has adopted policies targeting the environment since the 1960s. The latest ambition is to achieve an overall national zero-net greenhouse gas (GHG) emissions target for 2050; this is more ambitious than the goals of the European Union. In addition to the overall target, Sweden has an important objective to specifically reduce the consumption of energy from buildings, which, by virtue of the cold climate, are already more efficient than in many other countries. The "Integrated Climate and Energy Policy" (ICEP) introduced the goal of improving energy efficiency in buildings per m^2 by 20% in 2020 and 50% in 2050 compared to 1995.

Policy Package

Sweden's success in reducing the energy consumption of their buildings is directly linked to the fact that they have targets that the market can understand. The key factors in driving change in Sweden were discussed during the webinar. These include:

1. National Targets – overall ambitious energy reduction targets; national energy targets and targets for the building stock.
2. Building Codes having the same requirements for new buildings and the renovation of existing buildings. Most buildings are required to meet an overall performance frame.
3. Labelling Schemes in Sweden calculate the energy performance and this is checked in every building. A large percentage of the building stock has an energy label and strict performance requirements are complied with. Energy audits are required to provide information on energy saving measures.

4. Market Transformation - The Swedish Energy Agency supports local authorities by training them to provide energy efficiency measures. Research and education programmes make up a major part of Sweden's energy efficiency efforts. The Swedish Energy Agency is an important funder of research into improving energy efficiency, above all in buildings and industry.

- One-stop solution centres targeting different sectors: Centre for Renovation / Bebo (Multi-family house) / Belok (Commercial) / Besmå (single family). Existing networks in Bebo/Belok are a big help as they share experiences with different companies and have developed the market to improve energy performance.

Additional Success Factors

There are other important factors that have been central to the reduction of energy use in the building stock. While these are not directly related to policies, they have played an essential part in reducing consumption and improving the energy performance of buildings in Sweden.

1. Sweden's construction sector is a great success factor, as they constantly want to decrease the energy use of the building stock and have been the main driving force behind many of the initiatives.
2. Best practice building data quality is openly available online for anyone that is interested in finding out more about the building stock. Sweden provides information on the building stock and also helps residents by providing recommendations as to what can be done to reduce the energy consumption in buildings.
3. The whole society has high standards for building performance - most of the population are aware of energy efficiency and are taught about energy saving measures and techniques from a young age.
4. There is a high degree of penetration of district heating, heat pumps and triple glazing in Sweden, all contributing to reducing energy consumption.
5. The low rate of new construction in Sweden helps to place relative importance on renovation activities.

Deep Renovation Projects – Industry Support

Notwithstanding the generally good quality of buildings in Sweden, a large proportion of the 1.5 million houses that were built before 1980 are in need of an energy renovation. Three companies, Paroc, (mineral wool producer), Elitfönster (producer of windows) and NIBE (heat-pump producer), are now developing a renZERO ™ concept which is a cost effective renovation concept for houses built before 1980. Improving the energy efficiency of houses in their current situation can be complicated and some ready-made concepts are not on the market. The renZERO ™ project strives to find ways to create a safe and cost-effective solution for energy renovation of single family houses built before 1980. This is a brand new renovation method developed for Nordic weather conditions.

Lessons Learned

In Sweden the importance of the ambitious national and building targets is fundamental to reducing the consumption of existing buildings. As outlined in the webinar, Sweden has one of the most advanced enforcement regimes that focuses on the actual energy consumption of the building. Furthermore, Sweden's construction industry and stakeholders are progressive and push policies and legislation to be more stringent and have had experience in the development of building regulation since the 1940s. Sweden's successful policy package shows that it is important to have both the legislators and the building community working together to reduce the consumption of the building stock, and to show that this can help all aspects of society.

Conclusion – Key measures for improving overall energy performance

A package of measures interlinking political legislation and market support is integral to reducing the consumption of energy in a city/state/country. Both the New York and the Swedish case studies show that collaboration between legislators, the building community and the public is key.

Webinar #2 The importance of energy saving targets and how they drive energy renovations.

Best practice countries and jurisdictions featured in the GBPN Policy Tool for Renovation have set ambitious energy saving targets and regulatory measures (overall national targets, residential building targets and public building targets). In this webinar, the importance of targets and regulations as a key driver for renovation was posed as a question to the speakers. This webinar invited representatives from countries and states that have set ambitious targets to provide the audience with insight into how these have been implemented and what role they play in the policy development, helping other jurisdictions to learn from their experiences.

Germany – Case Study

Jens Laustsen, an experienced policy maker and Director of 2Peach, was invited on behalf of Andreas Schuering, a Policy Officer representing the Federal Ministry for Economic Affairs and Energy in Germany, to discuss the energy saving targets set up in Germany. Insight into Germany's ambitious overall national and building targets, and the key policy elements that are needed to support the energy saving targets presented, were as follows.

Energy Concept or "Energiewende" – The German Energy Strategy

The German government has set both national and building GHG reduction targets for the short and long-term, as follows:

The national targets:

- By 2020:
  - 40% reduction in GHG emissions compared with 1990 levels
  - 20% reduction in Primary Energy Demand (PED) compared with 2008 levels
- By 2050:
  - 80% reduction in GHG emissions compared with 1990 levels
  - 50% reduction in PED compared with 2008 levels

The building targets:

- By 2020
  - 20% reduction in Heat Demand
- By 2050
  - 80% reduction in PED in buildings
  - Existing building stock to be "almost climate neutral" (by reducing heat demand and heating based on renewables)
  - Improving the quality of energy-efficient measures
  - Technical reality: Germany is already building in accordance with these highly efficient standards today
- German Government Coalition Agreement
  - Continuation and increased funding for the CO2-Rehabilitation Programme – KfW[6] Programmes
  - Strengthening of Energy Consulting

CO2-Rehabilitation Programme

KfW has set up an important programme in Germany with the overall aim of reducing energy consumption in the existing building stock as a major contribution to the federal energy saving targets. The key principles of this package are based on a programme of measures that interlink targets, policies, finance and promotional programmes - all play an important role in the overall success of the programme:

[6] KfW is a German government-owned development bank

- German Energy Saving Ordinance (EnEV), the Building Code
- Incentives require achievement of higher efficiency standards than the minimum legal level
- Promotional programmes are focused on a holistic approach
- Focusing on energy efficiency and renewable energies
- Free choice of technology (heating system and building envelope)
- Cost efficiency and reduction of energy consumption are crucial
- "KfW-Efficiency House": a recognised brand for energy efficiency
- Technological standard for new and existing buildings
- The higher the energy performance, the higher the promotional incentives

Key policy elements linked to support the energy saving targets

The German government has been developing energy performance standards since the 1980s. Germany has outlined a clear path towards nZEB (nearly zero energy building) in 2020 (an EU-wide requirement embodied in the Energy Performance of Buildings Directive – EPBD), with a number of scheduled revisions of the code to meet that target, as illustrated in the figure below.

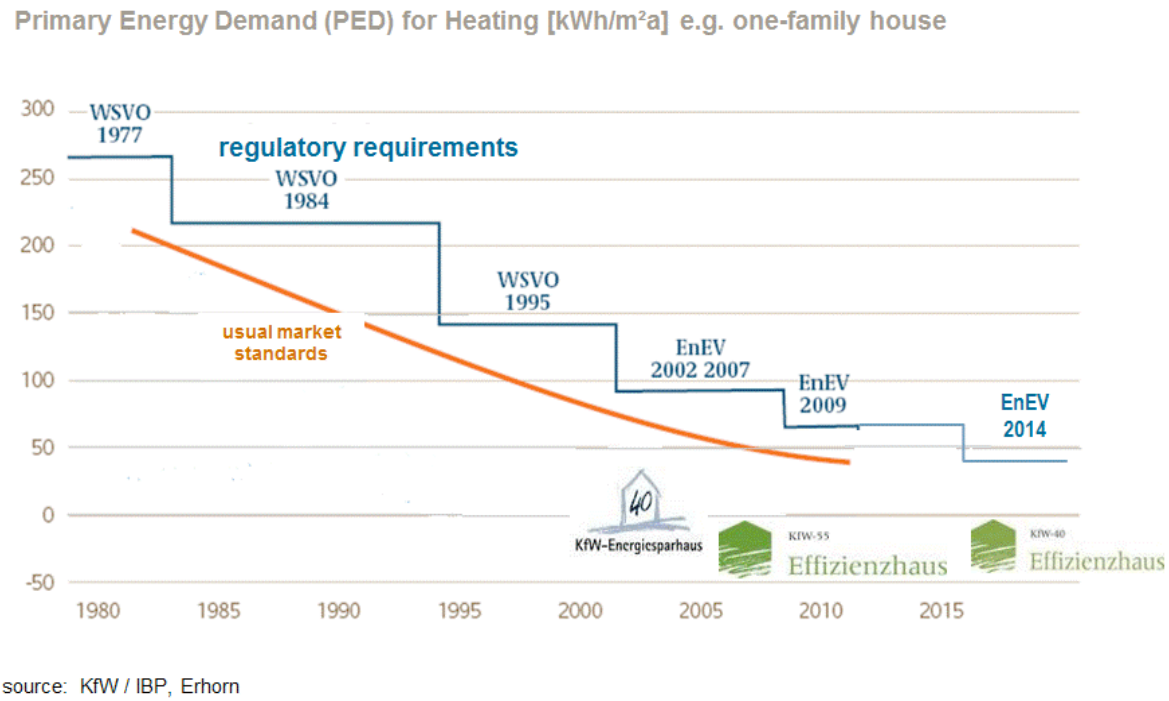

Figure 2. Progressive Nature of Germany's Building Code Revision Process

Germany's Energy Saving Regulations (EnEV) of 2009 sets energy standards for construction and the energy-efficient retrofitting of residential and non-residential buildings with regards to:

- The building envelope
- Heating, cooling and air conditioning techniques, as well as domestic hot water
- EnEV 2009 determines calculation methods and sets regulations for Energy Performance Certificates.

The latest 2014 EnEV sets more stringent performance requirements and a control system for energy performance certificates. It also introduced a Low-Energy Building Standard or Zero Energy Building (ZEB). Other additional elements include:

- Energy indicators for property advertisements
- Proportion of renewable energy in energy performance certificates for new buildings
- Primary energy indicators for all energy performance certificates

CO2-Rehabilitation Finance Programme

KfW-Programmes for Residential Buildings and Buildings of cities/municipalities and social institutions for existing buildings:

- Energy-Efficient Refurbishment of KfW-Efficiency Houses or Single Measures
- Grants or loans up to € 75,000 with a repayment bonus for home owners

The funding works by refinancing through KfW and on-lending through commercial banks. This ensures:

- Competition neutrality with commercial banks
- Concentration on core competences
- Diversification and minimization of risk

Results of the CO2-Rehabilitation Programme (KfW-Programmes) between 2006 and March 2014 show that implementing a renovation programme produces many direct benefits and co-benefits, such as:

- More than 3.5 million housing units were refurbished or newly erected
- Nearly 50% of new residential buildings and 33% of refurbished buildings are co-financed by the CO2-rehabilitation programme
- Nearly 1,940 buildings of cities, municipalities and social institutions were co-financed
- € 11.1 billion in federal funds (2006 – 2013) generated a total investment of around € 162 billion
- Each €1 of public funding leverages on average €12 in private investments
- GHG emission reductions of 7.1 million tonnes per year (for an estimated 30-year lifespan of measures)
- Reduction in heating costs
- Residents live in more comfortable homes
- Increase of market value of building
- Energetic modernisation combined with maintenance measures are often economical
- Reduced national dependence on energy imports
- Investments in energy efficiency create and safeguard annually up to 300,000 jobs in the small and medium-sized construction industry,
- Additional budget revenue (taxes and social security contributions, as well as reducing costs of unemployment) of €4-5 resulting from each €1 of public expenditure.
- Energy-efficient refurbishment and erection of "KfW-Efficiency Houses" demand further training of architects and civil engineers, engineers for heating etc, energy consultants and skilled employees of construction industry

Lessons Learned

In order for the ambitious targets to be met, Germany has developed a programme that ensures buildings are being renovated efficiently. The more transparent and simple the promotional scheme/programme is, the better it is to understand and the easier it is to communicate and disseminate. The mandatory involvement of an energy expert is very important to provide reassurance to the investor, giving a high degree of quality and reliability regarding energy efficiency level reached, target-oriented use of public funds and high degree of reliability regarding the promotional effects. Monitoring of promotional effects is important to show economic and climatic impact and contribution to fulfil the targets of the Federal Government.

Denmark – Case Study

Peter Bach, Chief Adviser, Danish Energy Authority was invited to discuss energy saving targets in Denmark. Mr Bach provided insights into Denmark's ambitious overall national and building targets and discussed the key policy elements that are needed to support the energy saving targets.

Targets - Overview

Denmark has set a target of a 40% saving in carbon dioxide emissions by 2020 relative to 1990 levels. It is anticipated that 50% of all electricity will be generated from renewable sources by 2020. Denmark's overall targets aim to eliminate fossil fuel use by 2050. Given this ambition, the building sector must make a large contribution. For example, the target set for new buildings is 75% less energy by 2020 (c.f. base year 2006).

Policy has delivered significant energy efficiency improvements since 1975 that have successfully decoupled energy consumption from economic growth. Denmark has shown a strong political commitment to reducing energy use, not only during the recent economic crisis, but ever since the first oil crisis in the 1970s. A combination of policies and measures are important: Denmark has adopted energy taxes, regulation and information & awareness programmes.

Energy efficiency is a fundamental part of the long-term solution of having an energy system that relies on 100% renewable energy sources. This means that a great improvement of energy efficiency in all sectors is needed, including electrification. Heating of households in Denmark has realised great savings over the last 35 years. The consumption/m2 is 45% lower today compared to 1975. A very dramatic reduction occurred from 1979 to 1984 due to a combination of measures, mainly a subsidy scheme, regulation and an information and awareness campaign.

Building Codes

The Building Code for new buildings is a very important tool for reducing energy use in Denmark. Dynamic development of building codes requires for:

- Regular updates
- Early announcement of next steps
- Voluntary as well as mandatory low energy classes (nearly zero energy)
- Time to adapt (building sector)
- Know trajectory brings cost down and improves cost-effectiveness
- Enforcement

Existing Building Programmes

A very large energy saving potential lies in existing buildings, as most will still be standing in 2050. This means the whole building stock must be renovated efficiently in the next 35 years. In order for this to happen, Denmark has highlighted some key factors within its renovation strategy. These are:

- Energy renovation needs to be done as part of normal renovation
    - Integration of all energy saving elements
    - Holistic and components
    - Deep renovations
- Energy renovation must be linked to the co-benefits of a healthy economy
    - Include all co-benefits
    - The 2014 building renovation strategy shows that Denmark can reduce consumption in the building stock by 35-45% by 2050, providing a good combination of measures is put in place.

Lessons learned

Denmark's success in reducing the consumption of existing buildings is linked directly to its strong political commitment. Denmark's energy saving target is a very strong and binding commitment and is necessary to spur on additional policy elements. Denmark has learned that targets work as they are easy to monitor and progress and adoption of additional actions can be taken if the target is not being met. A combination of measures is needed to support the targets, including:

- Economic incentives – energy prices
- Regulation – standard, norms, etc.
- Information and change of behaviour

California – Case Study

Ann Edminster, Chair of Green Building Construction Task Force, Commission for Environmental Cooperation (USA, Canada, and Mexico) and energy consultant/educator/advocate in California, was invited to discuss energy saving targets in California. Ms Edminster discussed "The Role of Energy Saving Targets & Regulatory Measures in Renovation Policy Packages" from a Californian perspective.

Background

California (CA) is seen as an energy leader in the USA and has had a state-wide focus on energy efficiency since 1978. 55% of the housing stock predates 1978 (~7M units). Buildings are the second largest contributor of GHG emissions in CA, accounting for around 25% the total, and are seen as the largest single opportunity to make energy savings and reduce emissions. In 2007, the CA Energy Commission identified and recommended that the state target 100% cost-effective energy efficiency opportunities in buildings.

California's Residential Retrofitting Targets

In terms of targets, the principal one was implemented in 2006: Assembly Bill 32, 2006 Global Warming Solutions Act, which calls for 2020 GHG emissions to be capped at 1990 levels. Three years later, in 2009, Assembly Bill 758 was adopted as a means to tackle this ambitious target. The "Comprehensive Energy Efficiency Programme for Existing Buildings" within the 2009 Bill requires for:

- Energy assessments
- Building benchmarking
- Energy rating
- Cost-effective energy efficiency improvements
- Public & private sector energy efficiency financing
- Public outreach & education
- Green workforce training

Outcomes from the Targets (Assembly Bills)

Outcomes and programmes to date coming from the Assembly Bills include:

- Utility programmes refocused on whole-house approaches
- Home sales requirements:
    - Point-of-sale energy rating & disclosure ("HERS II") - pushed for efforts for rating schemes to provide a point-of-sale disclosure and assist in the identification of cost effective retrofit measures
- $20M workforce development programme
- Property-assessed clean energy (PACE) financing pilots
- Building codes support the targets, e.g., 2013 code requires residential retrofits to include replacement of non-compliant plumbing fixtures with water-conserving plumbing fixtures

Additional Measures and Support Mechanisms to meet the Target

Training: Four-day class series directed to train and inform owners, designers, and trades on building energy-efficiency measures necessary to achieve deep energy reductions. This is based on a bottom-up approach through investor-owned utilities funding.

Stakeholder Involvement: CA has a specific directive that requires the Energy Commission & Public Utilities Commission to consult with stakeholders on legislative measures, including:

- Department of Real Estate
- Department of Housing & Urban Development
- Utilities
- Local governments
- Real estate licensees, appraisers
- Builders
- Financial institutions
- Environmental & environmental justice groups
- Commercial property owners
- Small businesses
- Consumer groups

Building Sector Impacts

- Short-term effects and measures have produced new market opportunities that require training to take advantage of the ambitious policies.
- Longer-term needs of CA:
    - Get serious about energy efficiency
    - Focus on building capacity, not just compliance
    - Understand CA's time-dependent valuation (TDV) energy metric
    - Learn new tools
    - Re-examine the toolkit

Lessons Learned

The targets set the stage for what happens on the ground in CA. "Energy Upgrade CA" is being retooled as, based on the early stages of the programme, poor uptake and poor correspondence between the performance and the targets had been seen. There is not enough money to induce efficient retrofits based on incentives alone, so CA needs to find ways to target "opportunistic remodelling". Educating the workforce is clearly necessary, but the acquired skills need to come hand-in-hand with demand. CA needs to find ways to create demand ahead of supply.

Conclusion – Key measures for setting effective energy saving targets

Renovation of existing buildings is an investment in low-carbon and climate-resilient infrastructure and should be achieved in five stages. The initial and critical parts of realizing a low carbon building stock are having a **strategic goal, target setting,** and **policy alignment**. **Regulatory stability** and **consistency** are the key drivers for energy renovation investments.

Webinar #3: The Role of Labelling and Certification Schemes in Renovation Policy Packages

Webinar #3 discussed the importance of labelling and certification schemes in renovation strategies that target energy consumption reductions. Labelling and certification schemes are informative instruments that provide decision-makers with relevant information on specific building typology and allow for a comparison of the building stock. They evoke demand for and awareness of efficiency in buildings and can be used as part of an enforcement regime. However, for labelling and certification schemes to be robust, they need to be accompanied by strong complementary mechanisms such as assessment procedures (audits), training and education programmes for assessors and technology and administrative support.

How can certification schemes drive energy renovations in a jurisdiction and what is the right combination of measures that can support them? This webinar invited best practice jurisdictions to present their story on how to implement a successful labelling and certification scheme as part of a renovation strategy, with the aim of helping other jurisdictions to learn from their experiences.

United Kingdom – Case Study

Roger Hitchin, Consultant and part time Associate with the UK Building Research Establishment (BRE), was invited to discuss the importance of energy labelling schemes in the UK.

Legal Framework

- The European Energy Performance of Buildings Directive (EPBD) applies throughout the European Union; however, Member States (MS) have flexibility on implementation details. The EPBD requires all buildings to have an Energy Performance Certificate (EPC) when they are constructed, sold or let. EPCs provide a property energy rating based on calculations assuming standardised occupancy and weather. They are accompanied by recommendations for improvement measures.

Labelling Schemes in the UK

Mandatory EPCs in the UK are valid for 10 years and can be reused for new tenants as many times as required within that period. They were introduced in 2007. All properties must have an Energy Performance Certificate (EPC) when sold, built or rented. The EPC register is available online and is free to access.

In England and Wales the number of EPCs issued is approximately:

- 11 M for existing dwellings
- 1 M for new dwellings
- 0.5 M for other buildings

The UK's rating scale uses "mirror building": identical geometry, activities:

- This is more robust to some uncertainties:
  - Areas, calculation procedures, weather assumptions
- Provides consistent ratings for multi-use buildings
- Allows parallel use of different calculation tools
  - A to G scale (numerical ratings too)
- Primary metric is greenhouse gas emissions in UK

The UK, like many other territories, also has a voluntary green building labelling scheme BREEAM, providing a whole building approach to measuring and improving all building types. It sets a "best practice standard for efficient and sustainable building design, construction and operation".

Desirable Features of the EPC Process

- *Repeatability:* Different assessors and tools should produce similar results, typically +/- 15% (preferably better)
- *Discrimination:* More efficient properties should have better ratings
- *Credibility*: Technical soundness; realistic results
- *Transparency:* The data and the process should be auditable
- *Easy to produce*
- *Take into account:*
  - Data reliability
  - Calculation complexity
  - Rating scale structure

Data Quality Issues

There are some data quality issues that exist:

- Data reliability in existing buildings is often poor
- Assessors are tempted to guess
  - Restricting choice of options improves reproducibility, but limits precision
- In UK: prioritise consistency over (theoretical) precision
  - Default values which result in a poor rating:
    - Assessor must have evidence to over-ride them
  - Option lists to standardise assumptions where possible
  - Training and quality assurance of assessors and certificates

Calculation Procedures

EPCs can use different procedures to calculate the building's performance.

- Most EU Member States use monthly method from EN13790
  - A few use hourly simulations

- UK allows monthly for all buildings but also hourly for non-residential
    - In practice, hourly only used for complex new buildings.
- Zoning of buildings into separate spaces is important
    - Affects consumption estimates, especially with air conditioning

Recommendations and Refurbishment

Most EPC recommendations are for *elemental* changes (e.g. windows), however, with an indication of approximate cost-effectiveness, some measures could be applied immediately and others only make economic sense when replacing an element for other reasons. Elemental improvements are *minor* refurbishments; *major* refurbishment must meet whole-building requirements. In the UK, EPC software produces a recommendations list and indicative paybacks but the assessor has the responsibility to edit this in light of the specifics of the inspected building.

Mandatory Energy Labelling of Buildings in the UK

Things to think about before implementing a labelling scheme:

- Experiences of implementation in UK and other EU and non-EU countries
- Countries have different priorities: issues are the same – solutions differ
- How EPCs can be used to support other policies

Lessons Learned

Before implementing an EPC regime there is a lot to consider, for example; what criteria are important for the jurisdiction. EPCs in the UK are important to support other policies surrounding buildings, such as the building codes, compliance and financing initiatives. It is important to interlink the mandate of the EPCs with other policy elements to create a legally binding policy package.

Ireland –Case Study

Chris Hughes, from the Sustainable Energy Authority Ireland, was invited to discuss the role of labelling and certification schemes in renovation policy packages and the key lessons from Ireland.

Status - September 2014

Approximately 30% of residential buildings in Ireland have Building Energy Ratings (BER), the Irish version of Energy Performance Certificate. BERs are generated using the Dwelling Energy Assessment Procedure (DEAP) software for homes.

The status of residential buildings with BERs as of September 2014 is provided below (apartments, flats and single family homes):

- 487,161 BERs
- 679 Experts
- 8,438 BERs published in one month (August 2014)

Central BER Register

Ireland has a central online register of all BER labelled buildings. This allows for easy, user-friendly organisation of the certified buildings. The model is a self-service delivery model where qualified certification experts can manage their own BER registrations. A national electricity meter database provides a web service for address confirmation. This tracks BER publications for invoicing and debiting via SEAI's Integra finance system.

Dwelling Energy Assessment Procedure (DEAP)

The DEAP methodology is primarily based on the following:

- ISO EN 13790: Energy performance of buildings: calculation of energy use for space heating and cooling
- Other relevant European and International standards as detailed in the DEAP manual
- Standard Assessment Procedure (SAP) for energy rating of dwellings in the UK

National BER Research Tool

Researchers have access to statistical data on the labelling certificates. Results are viewed onscreen or downloaded for use in Microsoft Excel. The data are automatically updated nightly and the Central Statistics Office combines BER statistics with other data.

Revenue Neutral Model

The model is a self-financing model. In 2013, it generated an income of just over €3M, with revenues received from:

- BER expert registration and annual renewal fees
- Registration levy for each BER published

The revenues are used for:

- Systems design & development - technical methodologies and software, codes of practice, rules and procedures (complaints, disciplinary etc.), finance and business process software, website, etc.
- Ongoing support and maintenance - staffing, licenses, helpdesk, legal advice, etc.
- Quality assurance - auditing systems and personnel, examinations
- Marketing & promotion – advertising, industry engagement, media

Better Energy Homes Scheme

The Better Energy Homes Scheme is set up to support homeowners in making intelligent choices to improve the energy performance of their home and to reduce energy use, costs and greenhouse gas emissions. It is intended to build market capacity and competence by driving contractor standards and quality and to stimulate market innovation. The incentive is a fixed cash grant irrespective of home size. The BER certificate is a mandatory requirement for Better Energy Homes.

Lessons Learned

Ireland has successfully implemented a national level certification & labelling scheme. One of the key features of their success is the organisation and ease of use of the structure of the programme; they have adopted and developed the necessary, accurate and repeatable tools to calculate a building's performance, provided outputs that are necessary for a labelling scheme (BER Cert, Advisory report and Building Regs), trained a sizeable, suitably qualified workforce and established a system of operation and administration that is competent and user-friendly. The National Administration System (NAS) is self-serviced for publication of BERs by assessors and assess the Building Regulations Compliance.

New York –Case Study

Stacy Lee, a Policy Advisor for the New York City (NYC) Mayor's Office of Sustainability, was invited to discuss the role of labelling and certification schemes in renovation policy packages and the key lessons from New York. Ms Lee discussed labelling and certification in a city context.

Statistics on New York City buildings

Prior to 2014, NYC's GHG goal was to achieve a 30% reduction by 2025 from a 2005 baseline, achieving 19% by 2012. In September 2014, the City announced an expanded target to reach 80% reduction by 2050, becoming the largest global city to commit to this goal.

While emissions from buildings have dropped since 2005, more needs to be done to improve energy efficiency. Energy use in buildings contributes to a significant amount of citywide GHG emissions, thus NYC is focusing on achieving deep reductions in buildings. NYC has almost 1 million buildings and 80% are expected to be still standing in 2030. According to the 2014 *New York City Greenhouse Gas Inventory*, in 2013, energy consumption in buildings represented 78% of citywide energy use and contributed toward 70% of citywide GHG emissions.

Energy efficiency in large buildings can make the highest impact; measuring and tracking energy data is essential

The largest buildings represent only 2% of all properties by count but are almost half of citywide square footage. Thus, measuring and tracking large building data provides information for a significant percentage of citywide built area, and

informs building owners, tenants, local government, and the public when they make energy efficiency related decisions. In 2009, NYC launched and passed the Greener Greater Buildings Plan (GGBP) that introduced four local laws:

- Benchmarking
- New York City Energy Code
- Energy Audits and Retro-commissioning
- Lighting Upgrades and Sub-metering

Energy and Water Benchmarking

GGBP targets properties larger than 50,000 sq ft (~4,645 sq m) or groups of buildings over 100,000 sq ft (~9,290 sq m) that in total equates to about 13,000 properties. Requirements are set for public buildings to benchmark their buildings to meet a more stringent standard by reducing the threshold to over 10,000 sq ft (~929 sq m).

Through annual benchmarking and disclosure, properties are labelled with information that is publicly available. The scheme requires building owners to submit their energy and water use data annually through the U.S. Environmental Protection Agency's online tool (ENERGY STAR Portfolio Manager). The data then undergoes a verification process and is disclosed to the public. Analysis of the first three years' worth of data was required by law by the City of New York. The reports published in 2012-2014 reveal findings such as:

- Multifamily properties make up the majority of the largest buildings and use the most energy
- High-energy users are also high water users
- The city's median citywide ENERGY STAR score for eligible, large properties increased and energy consumption decreased in the past three years, but there are a number of non-energy efficiency factors, including Hurricane Sandy, benchmarking tool upgrade, fuel switching, etc.
- The number of ENERGY STAR certified NYC buildings has increased since 2009 and as of September 2014, multifamily buildings are now eligible to certify.
- As of March 2015, NYC has been ranked with the fourth highest number of ENERGY STAR certified buildings in the U.S.

In September 2014, NYC released *One City: Built to Last*, a ten year plan to reduce emissions from buildings by 30% by 2025. One of the initiatives proposed in the plan is to expand benchmarking requirements to private properties over 25,000 sq ft (~2,323 sq m), which will add up to 11,400 more mid-sized properties.

Supporting programmes

Ongoing labelling efforts must be supported with more information, financing, voluntary programmes, education, and mandates. Some of NYC's supporting programmes include:

- U.S. Department of Energy Asset Score
    - Evaluates building envelope; mechanical, electrical, and hot water systems; and other physical assets to generate tailored retrofit recommendations
- NYC Energy Efficiency Corporation
    - Provides loans and enhances credit to undertake retrofits
- NYC Carbon Challenge
    - Universities, hospitals, commercial offices, multifamily buildings sign on to reduce GHG emissions by 30% or more in 10 years
- Building Energy Exchange
    - Learning and presentation space for lighting, and other energy efficiency projects
- NYC Local Energy Code, Audits and Retro-commissioning, Lighting Upgrades, Sub-metering (LL85, LL87, and LL88 of GGBP)
    - Energy code is updated every 3 years; audits and retro-commissioning is required every 10 years; lighting upgrades and sub-metering are required by 2025

Additionally, through *One City: Built to Last*, the City has embarked on a number of new programmes to fast-track energy efficiency. One of the key initiatives is the Energy and Water Retrofit Accelerator, a coordinated outreach and technical assistance programme to help building owners and decision-makers accelerate efficiency retrofits and clean energy investments. The assistance provided will include support to interpret energy use information from benchmarking, auditing, and retro-commissioning data, and help in selecting the right projects to pursue. The programme will help decision-makers select contractors, explain the necessary permits, and navigate the existing financing and incentive programmes to help cover costs. Building maintenance staff will also be given access to training and education to help improve the quality of operations and maintenance. As a result, the programme will bring experience in energy management and project planning to building owners, managers, tenants, and staff that will help them continue to undertake projects in future years.

Public sector leadership is crucial to motivate energy efficiency in the private sector

Since 2007, the City of New York's goal for City buildings is 30% reduction of GHG emissions by 2017. The City benchmarks about 4,000 properties annually and discloses the data online. Additionally, the City strategically targets energy efficiency by promoting efficient operations and maintenance, deploying innovative technologies, and encouraging competition among facility operators. Accelerated Conservation and Efficiency (ACE), a signature City initiative, fast tracks funding for shovel-ready projects and is expected to save $25M/year and reduce emissions by 50,000 $MTCO_2e$.

With the release of *One City: Built to Last*, the City buildings goal has expanded to 35% GHG emission reductions by 2025, with a broader aim to make public buildings models for sustainability. To do so, the City will invest in high value projects in all City-owned buildings, expand solar power on City rooftops, implement deep retrofits in key City facilities, improve building operations and maintenance, pilot new clean energy technology in City buildings, and improve the efficiency and quality of NYC's public housing.

Lessons Learned

Although NYC's labelling and disclosure scheme does not yet target all building types, it is one of the first, and is the largest, scheme in the USA. NYC strives to make the tools and labelling systems user-friendly, efficient and available online. The requirement to submit data to the City provides a means for building owners to request whole building energy data from utilities, which can inform and improve the management of properties' energy usage. Labelling and disclosure schemes, however, need to go hand-in-hand with other policies and laws that help to reduce consumption. With *One City: Built to Last*, NYC links increased information access with outreach and assistance, training, low-cost measures, market transformation, stakeholder coordination, and other key efforts. These will be informed by guiding strategies that include leadership by example, empowerment of residents to take action, high energy performance standards, equitable distribution of benefits, data analysis, and stakeholder feedback.

Conclusions - Key measures for successful building energy labelling schemes

The objective of a labelling scheme is to promote energy efficiency in buildings on the political agenda, raise awareness, provide research data and communicate on available solutions and policies. In order for a scheme to be successful, cross-sector representation needs to be in place and stakeholders need to be able to trust the information provided. This can be achieved through asymmetric information sharing such as evolving standards and progressive integrated approaches. Certification

of independently verified buildings and dissemination of the collected data provides an effective means of communicating the results and encouraging others to participate. Labelling of building performance and energy related products ensures good purchasing and helps with decision-making.

Legislation should require for labelling and certification, be clear and be readily enforceable. The format and content of the labelling scheme should be informative and easy to understand. The implementation of the scheme should be supported by a robust system including:

- Accredited, Independent Testing Facilities
- Accredited, Qualified Professionals
- Open Register of Labels and Certificates

- System of Penalties for Non-Compliance
- Appeals System

Making available a database to support policy is exceptionally useful to inform larger policy decisions. Less restrictive rules on access to data hinders useful analysis that is necessary to support policies. In designing a labelling system it is strongly advised to have a central register, as it is important to know what the current state of the building stock is and to monitor progress. Furthermore, a central register allows for compliance to be measured.

Webinar #4: How to Upscale Deep Renovations Using Financial Mechanisms

The fourth and final webinar in the series addressed the critical question of how financing schemes can be developed to support and leverage the large investments needed to "go deep". Representatives from the European Union and the United States were invited to present their innovative methods of using finance as a way to upscale deep renovations. This webinar provided insights into the implementation of these measures and illustrated how they link with the overall policy framework.

European Union

Adrien Bullier, Project Officer, Intelligent Energy Europe and Horizon 2020 Energy Efficiency Programmes at the European Commission was invited to discuss the different innovative finance schemes for energy renovations in the European Union.

Finance and energy efficiency investments: filling the gap through EU programmes

When looking at projects in the building sector, project developers have a big part to play in implementing energy efficiency. However, project developers have projects but do not necessarily have readily available financial resources to invest. Meanwhile, the finance sector needs bankable projects to invest in. Project developers usually focus on energy payback times, whereas financers look rather at internal rate of return, return on equity, risks and transaction costs.

Public funding can fill the gap between project developers and the finance sector. Currently, the EU structural funds are increasingly used to help the finance sector feel more comfortable in investing in energy efficient projects by providing dedicated credit lines, risk-sharing schemes as well as equity provision.

On the project development side, European funding is being put into setting up local finance schemes, providing development assistance and market facilitation for energy performance contracting. There are also funding opportunities to organise activities that liaise with both sectors and organise dialogue to develop roadmaps and build capacity on both sides – making sure both sectors understand how each other work.

Deep renovation and the finance puzzle

Some of the existing challenges faced by Europe when financing deep renovation include:

1. Energy savings are not yet a credible business for banks as:
   - There is a lack of a track record that leads to higher cost of capital or balance sheet requirements
   - High transaction costs occur due to lack of technical standardization
2. Long-term paybacks are an issue for building owners

These barriers can be overcome by sensible and cost-effective methods, including:

1. Development of financial models that:
   - Use public money to leverage private finance, and
   - Overcome barriers such as building owners' aversion to debt, balance sheet issues, time horizons, and the tenant/landlord split incentive
2. Combining the deep renovation vision with different pieces of the puzzle, which are already available:
   - Public support to drive the supply of finance: soft loans, risk-sharing
   - Public support to drive demand: project development assistance, aggregation / standardisation of small investments

- Innovative financing schemes to bridge the gap between demand and supply e.g. energy performance contracting, on-bill finance, on-tax finance

Energy (savings) performance contracting (EPC): How to maximise energy savings?

EPC is a well-known mechanism for financing building renovation. In an EPC, an energy service company (ESCO) invests in energy efficiency or facilitates access to finance (e.g. building owner taking on a loan). The ESCO carries out the works and guarantees the energy savings, which are used to reimburse the upfront costs. For a deep renovation, this is more complicated as payback periods are longer (~20 years), however there are three levers to implement EPC for deep renovation:

1. Extension of the contract duration to match the payback time of the investment
2. Extra contribution to reimburse the investments: grants or contribution by the building owner as an anticipation of increased building value (so-called "Green value")
3. Lower cost of capital to reduce the contract duration

Limits of energy (savings) performance contracting

1. Confusion between market actors – 'ESCO' ≠ EPC
    - EPC is seen to focus on "low hanging fruits" – mostly due to the client's demand
    - Traditional ESCOs focused on HVAC but in deep retrofit most of the investment is implemented by construction companies
    - Companies supplying EPC for deep retrofit don't necessarily label themselves as ESCOs

2. EPC procurement is more complicated as the building envelope has to be dealt with and knowledge of the existing envelope construction is often limited. Also there are more significant issues to consider in regard to safety regulation (fire hazard) and user interaction (noise, natural light, maintenance considerations). Procurement through competitive dialogue is a more adapted procedure but requires heavier engagement on both the client and bidder's side.
3. Financial issues
    - EPC may not repay all upfront costs for deep retrofit
    - High transaction costs (procurement) and operation costs (monitoring & verification - M&V) leads to a focus on large buildings
    - Higher financial costs are incurred for a "savings guarantee", reducing the financial attractiveness
    - Off-balance sheet accounting depends on Member State procurement rules
4. There needs to be a good match between the ESCO provider and the building owner – both need to understand each other's perspective.

Supporting EPC market uptake

To support the development of the EPC market the building owner needs to go through a series of measures such as audits, technical specifications and legal frameworks and procurement. Market facilitation can assist building owners, a concept developed by the IEA DSM's taskforce XVI on competitive energy services, aiming to help building owners liaise with the ESCO market. To level the risk and reduce transaction cost it is possible to pull groups of buildings together to have a higher investment. It is also possible to bundle building owners together and thus reduce the transaction costs.

Third party investment (TPI) operators can help increase the demand for deep renovations. They develop the projects, provide finance, may take on the energy performance contract, and then outsource the management of the EPC to private companies while keeping their key role as finance provider.

- Deep renovation EPC is not happening due to:
    a. Lack of demand and capacity of building owners
    b. Low appetite of the private sector to finance long-term EPCs
- Some regions in France are creating public TPI operators aiming to:
    a. Develop projects based on EPC
    b. Provide financing specifically focussed on deep renovation
    c. Outsource technical management to private construction companies and ESCOs
- TPI operator for public buildings: OSER (Rhône-Alpes region, France)

a. Public local company (SPL) created by the Region and 8 local authorities to:
    i. carry out the preparatory works to an EPC on behalf of the local authority: feasibility studies, building surveys, etc
    ii. procure an ESCO to implement the works and guarantee savings
b. Leasing contract OSER / local authorities (on balance sheet)
    i. OSER sub-contracts the operational part of the EPC to private sector (back-to-back)
    ii. Provides the skills to procure AND manage long-term complex contracts
    iii. Finance the works which are repaid by the local authority over time – average 22 years
c. Targeted savings 40-75%; savings to cover 35 to 50% of the local authority's annuities
d. OSER expects to refinance itself through assignment of claims on local authority
e. €50 million investments expected in 2014-2016, first tenders mid-2014

- TPI operator for condominiums: Energies Positif (Ile de France region, France)
    a. Equity from the Region, other local authorities and private sector
    b. Acts as a trusted third-party for condominiums (multifamily buildings)
    c. Audits and technical specifications for deep renovation (50-80% savings)
    d. Financial engineering for each household
    e. EPC provider, works and maintenance are sub-contracted to private sector
    f. Expected investments of €100M for 2014-2016 (4,000 dwellings)
    g. www.energiespositif.fr

Disconnecting debt from the building owner

There are solutions to financing deep renovations by disconnecting the debt from the building owner. The idea behind this is to attach it to the building or the energy supply, not the owner. This can be realised by connecting investment repayment to a secured channel to reduce risks and transaction costs. Two key models for this approach are already in place:

- Green Deal (UK): loan is attached to the energy meter; debt collected by energy supplier
- PACE (US): loan is attached to the property; debt collected through local property taxes

Advantages of disconnecting debt from the building owner:

- No need for a performance guarantee reduces transaction costs and financial risk
- Overcomes tenant / landlord split incentive
- Can be passed on to the next owner / tenant
- Standard contracts can be securitised and sold to institutional investors

So far this model has not targeted deep renovations, but 2 French regions (Alsace and Picardie) are planning to adapt the PACE model for deep renovation of detached housing.

Supporting the uptake of financing schemes for deep renovation

Most European Member States either already have, or are establishing, Energy Efficiency Obligations (article 7 of the Energy Efficiency Directive) to generate more investment in energy efficiency, including in deep renovations. Benefits include:

- 1.5% energy savings year on year to be delivered by energy suppliers
- Create additional funding sources for energy savings
- Leverage the customer relationship of utilities
- Member States that do not establish EEOs must introduce other measures that deliver the same level of savings

EU structural and investment funds:

- Allocation to low carbon economy doubled: €38 billion for 2014-2020
- Will be increasingly used through financial instruments e.g. home renovation loans
- Grants should be increasingly allocated for deep renovation

Liaising with the Energy Efficiency Financial Institutions Group (EEFIG)

- Final report on buildings and industry (March 2015)[7]
- Horizon 2020's Energy efficiency call for proposals[8] provides funding for
  - Project development assistance (including ELENA facilities): create a pipeline
  - Development and replication of innovative financing schemes
  - Capacity building
  - Engagement of finance sector to increase financial flows on energy efficiency

Lessons Learned

The insight from the webinar has shown that there are many ways of financing energy renovations, provided the right measures, understanding and collaboration are in place and communication between funders, the building community and buildings owners is transparent. Public funding can help to "fill the gap" between a standard and a deep renovation.

United States

Robert Sahadi, Director, Energy Efficiency Finance Policy, at the Institute for Market Transformation (IMT) was invited to present "Energy Efficiency Finance: Residential Policies and Programmes in the U.S." His presentation looked at the array of finance projects available currently as well as interesting innovative programmes in the pipeline.

Residential Finance Overview

A lot of finance opportunities have become available in the last year, 2014. Benchmarking, codes, and national housing policy are driving demand for residential property improvements. There is a broad menu of financing options for single and multifamily housing. Sources of finance include:

- Federal government – a major player in single family finance
- Multifamily finance provided by combinations of banks, insurance companies, and other real estate investors

Single Family Finance - Unsecured Lending

A lot of finance actions are happening in the unsecured lending scene, such as:

- Warehouse for Energy Efficiency Loans (WHEEL), whose goal is to create a secondary market for residential clean energy loans
- FHA PowerSaver Loans that finance energy efficiency and renewable energy residential upgrades. under $15,000 is unsecured; over $15,000USD is secured.

Mortgage Underwriting

The big goal that the USA is working on is to get the large finance companies to become involved in financing energy efficiency. These are "*Home Energy Efficiency and Mortgage Risks*". A recent study by IMT shows that the default risks on average is 32% lower for energy efficient homes. Energy Efficient Mortgages are becoming popular as a means to finance cost effective improvements.

The SAVE Act

A legislative push is occurring in the US Congress, as a result of which the SAVE Act could emerge under the energy efficiency bill. Under the SAVE Act, mortgage underwriters would include energy in the costs of home ownership, when calculating a borrower's *debt-to-income* ratio. It would also include the *net present value (NPV)* of future energy savings in the valuation.

Multifamily Finance

The average age of U.S. multifamily housing stock is about 40 years, providing a great opportunity to save energy. Improvements to Affordable Housing is often financed by public, government-financed or private-financed initiatives.

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[7] Available at https://ec.europa.eu/energy/en/news/new-report-boosting-finance-energy-efficiency-investments-buildings-industry-and-smes

[8] http://ec.europa.eu/easme/en/energy

GSE Multifamily Finance

The Federal Government and Fannie Mae have developed a new programme called Green Preservation Plus that provides an additional 5% of release that could potentially provide a HVAC system, envelope work or insulation work to a building. Multifamily 1-100 ENERGY STAR score is available in some cities. Property owners must report their score to receive a Fannie Mae Multifamily loan.

Benchmarking Informs Decision-Making

Benchmarking is starting to take off in the USA; some of the more progressive states are already developing benchmarking programmes but this is not fully implemented across the country. Benchmarking will spur on environmental and economic competitiveness.

Local Financing Options

Along with large national financing platforms, other specialised mechanisms are being worked on at local and city levels. Many models are being made available to target cities that have unique needs and existing capabilities. These include loan loss reserves, energy service agreements, tax abatement, On-Bill Financing, Green Banks and PACE.

On-Bill Financing

On-Bill Financing is where the utility provides the up-front capital to finance the energy improvement and the payment comes back through the utility payment, which should normally be less than or equal to the value of the resulting energy cost savings. This method aims to provide the owner with a positive or neutral energy improvement – although the owners pay for it they receive lower or negligent energy bills until they finish paying for the improvement works.

Green Banks

Green banks fill gaps in finance provision by:

- Providing low-interest, long-term financing for clean energy projects
- Leveraging public funds to attract private capital
- Reducing market inefficiencies

The Big Picture

The schemes that are gaining most momentum in the USA are those that are legislated in many cities or states, including:

- Benchmarking policies - implemented in 10 cities, 2 states and 1 county and investors are interested in financing energy efficiency in a city with benchmarking schemes. May be migrated into the financial system.
- PACE system - has been slow to get started; however, it is gaining the momentum and is currently legislated in 31 states plus DC.
- On-bill financing implemented by utilities - exist in 23 states
- Commercial banks - starting to grasp opportunity for EE finance.

Lessons Learned

The finance scene in the USA is vast and intricate; there are many different programmes that target specific markets and building types. It is clear that some of the schemes are taking off and gaining momentum; however, a political push and market support would provide the momentum needed to be scaled up on a national or state-wide level. With more communication between stakeholders in the building community and policy makers, the schemes would become more recognisable, robust and trusted.

Conclusions – Key issues for financing building energy renovation programs

Both presentations covered the wide range of financial mechanisms that are currently in the market. Finance programmes specifically for deep renovations in both the USA and in Europe are quite new. Most need scaling up if they are to achieve significant impact. One challenge is to ensure they grow while keeping a focus on deep renovation. However, the main challenge is the lack of demand.

From one perspective, lack of demand or investment for deep renovation could be considered a market failure and as such, the public sector needs to step in to demonstrate its viability. Transition schemes could be put in place whereby public funding kick-starts the private sector to finance deep renovations. Project development assistance can also help to stimulate demand and implement the technical capacity needed to undertake a new renovation.

Building owners need to be introduced to energy efficiency during normal financing cycles, such as mortgaging, renovating and buying. One of the key levers that needs to be worked on is the fact that renovation of buildings is rarely driven purely by energy considerations. An incentive to save energy needs to be provided at the time when a general renovation is being considered. In addition to improved comfort and lower energy costs, the property value increase of an energy efficient building renovation also needs to be demonstrated to consumers.

CONCLUSIONS

This guide presents critical insights into some of the current best practices in the development of energy renovation policy packages globally and a step-by-step guide to implementing an energy renovation policy package in any given jurisdiction. It draws on the main findings of the GBPN Policy Tool for Existing Buildings and insights from the webinar series to provide a deeper understanding of the practical aspects of a policy package for deep renovations.

The key factors and lessons learned from the various packages are highlighted to illustrate how policy developers can build on these insights to develop and strengthen progressive policies focusing on deep renovations. It is clear that every implementing organization will have its own specific criteria for implementing elements of a policy package and that these must be developed to complement, suit, and be in line with the policies that already exist in that place.

Although every policy package is different, there are some clear and essential steps to take in order to implement a successful package that will help to reduce the energy consumption of the building stock. These steps are based on the well-known direct and indirect intervention schemes: the "sticks, carrots and tambourines" that complement each other within a policy package – the "sticks" being regulations and legal mandatory requirements, "carrots" being incentives, rebates, fiscal instruments, etc., and "tambourines" being awareness and education programmes.

A number of key messages have emerged under the different themes, which apply to all jurisdictions irrespective of location or political context:

1. A collection of policy measures that complement each other need to be combined into one package.
2. Ambitious national targets and sectoral building targets are fundamental components of a renovation policy package, as they provide a strong foundation for the development and implementation of progressive policy packages that aim to achieve the energy saving potential of the building sector.
3. It is necessary to have targets that the market and building community understand and support.
4. Labelling systems such as the European Energy Performance Certificate (EPC) regime should be accompanied by a central register to record the current state of the building stock and its progress towards higher energy performance.
5. It is important to interlink the mandate of the EPCs with other policy elements to create a supportive framework for building owners to understand the rating of their buildings and to have the right encouragement to undertake improvements.
6. Collaboration between all relevant stakeholders, both top-down and bottom-up, is a factor in successfully reducing the energy consumption of buildings.
7. New and innovative financing mechanisms need to demonstrate their benefits to a wider audience by generating and disseminating a track record of results
8. Public funding can kick-start the private sector in financing deep energy renovations.
9. The opportunity to improve building energy performance needs to be raised at key trigger points in the building's life cycle and in normal financing cycles, such as at change of ownership, when financing (or re-financing) e.g. with a mortgage, or when major works such as modernisations are taking place. This will require active involvement of the financing institutions.

GBPN
Global Buildings Performance Network

Building Policies for a Better World

GBPN

Global Buildings Performance Network

Paris, France

+33 (0)1 76 21 81 00
info@gbpn.org

www.gbpn.org
@GBPNetwork

About GBPN

The Global Buildings Performance Network (GBPN) is a globally organised and regionally focused network of experts whose mission is to advance best practice policies that can significantly reduce energy consumption and associated CO_2 emissions from buildings.