GBPN
Global Buildings Performance Network

Building Policies for a Better World

REDUCING ENERGY DEMAND IN EXISTING BUILDINGS: LEARNING FROM BEST PRACTICE RENOVATION POLICIES

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LIST OF ACRONYMS

ACEEE – American Council for an Energy-Efficient Economy
BEEC – Building Energy Efficiency Code
BPIE – Buildings Performance Institute Europe
CDD – Cool Degree Days
CPUC – California Public Utility Commission
CSEP – China Sustainable Energy Programme
dEA – Dutch Energy Agreement
DECC – Department of Energy and Climate Change
DENA – German Energy Agency
DPE – Diagnostic de Performance Energétique'
ECBC – Energy Conservation Building Code
EC – European Commission
ECO – Energy Company Obligation
EE – Energy Efficiency
EIA - Energy Information Administration in the United States
EP – Energy Performance
EPC – Energy Performance Certificates
ESCO – Energy Service Company
EU – European Union
Ft2 – Feet squared
GBPN – Global Buildings Performance Network
GDP – Gross Domestic Product
GHG – Greenhouse Gas
HDD – Heating Degree Days
ICEP – Integrated Climate and Energy Policy
IEA – International Energy Agency
IECC – International Energy Conservation Code
IMT – Institute for Market Transformation
M2 – Metres Squared
NJCEP - New Jersey's Clean Energy Programme
NYSERDA – New York State Energy Research and Development Authority
PNNL – Pacific Northwest National Laboratory
U.S. – United States
USD – U.S. dollar

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The GBPN's report "Buildings for Our Future" shows that if best practices[1] are up scaled globally by 2050, energy consumption in buildings can be reduced by 30% relative to today's levels. This is possible in spite of expected growth in population, floor space and comfort levels in developing regions. To achieve this, the 'deep' scenario requires that existing buildings will have to reduce consumption by 70% globally, which has been shown to be technically feasible by mainstreaming building technology with the support of aggressive policies.

To support the feasibility of the 'deep' scenario, the GBPN recognises the need for the development of a package of ambitious, complementary and sustainable energy renovation policies that can ensure significant energy savings in existing buildings. Consequently, the aim of this project was to identify elements that are critical when developing future energy renovation policies for *residential buildings*. Focus has been placed on this building typology following the outcome of the CEU's Scenario Analysis, whereby the residential building stock has been calculated to consume two thirds of overall building consumption, globally (Urge-Vorsatz et al., 2012). This documentation includes an assessment of best practice policies, incentives and programmes that support energy renovation of buildings, with strong emphasis on 'deep' renovation[2].

In light of this potential, the GBPN developed a project to support the up-scaling of deep renovation across the residential building stock, by defining a policy package for energy renovations and analysing current best practices in consideration of this definition. The results of this analysis are represented in an on-line interactive tool that can be accessed on the GBPN website. State of the art was defined by identifying the key elements/criteria that are necessary to ensure that all buildings are renovated towards zero energy. The methodology used to develop the criteria included a detailed desktop study of current literature on renovation policy as well as a peer review process. Six key themes were identified as intrinsic to the development of a state-of-the-art renovation policy package: regulatory normative measures, building assessment, financial instruments, economic instruments, capacity building and overall performance indicators. A set of sub-criteria was developed to further define state of the art under these six themes and to rigorously assess the performance of policy packages under the themes. The sixth theme acts as a performance indicator that analyses the performance of a country's or states policy package in terms of reduced energy consumption.

Current best practice policy packages for renovation in residential buildings were analysed in light of the criteria developed. Policy packages were selected for analysis where elements of best practice as defined in the fourteen criteria were present or where a reduction in residential energy consumption, between 2000 and 2012, using five indicators (relative, per capita, unit floor area, GDP and dwelling) was found. Best practice policy packages were selected from the European Union (E.U.) and the United States (U.S.) due to the large existing building stock, slow replacement rates and the more advanced experience in renovation policy in both regions. The policy packages selected for inclusion were those that met all or most of the requirements described above. The jurisdictions selected include in Europe include: Denmark, France, Germany, the Netherlands, Sweden and the United Kingdom. The chosen states in the U.S. include: California, Massachusetts, New Jersey, New York, Oregon and Vermont.

With the support of a panel of international experts (the Scoring Committee), each best practice policy package was scored against the criteria developed (and their sub-criteria). This analysis illustrates the current performance of each of the policy packages while also facilitating a comparative analysis between the 12 packages. Each criterion was allocated a maximum score of 10 points. In order to be awarded the maximum 10 points the jurisdiction's current policy measures must be

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[1] A **best practice** is a method or technique that is proven to be superior to others achieved with other means. Best practice can be used as a benchmark but it can also be improved over time. [Source: GBPN Glossary]
[2] Please find a full definition of a **"deep" renovation** in the GBPN Report "What is a Deep Renovation Definition?", http://www.gbpn.org/reports/what-deep-renovation-definition

progressive and target deep renovations. None of the jurisdictions were awarded the maximum score in any of the criteria as further improvements could be made in all areas.

The scores for each jurisdiction are illustrated in the Policy Tool for Renovation. The tool allows the user to develop their own analysis by selecting the criteria that are of interest to them. Policy packages can be compared using a single criterion or using multiple criteria. The tool allows the user to:

- Compare policy packages based on different criteria by selecting and deselecting criteria in the interactive tool area;
- Generate graphs based on time series data for energy performance in the respective countries/regions; and
- Access detailed information about each of the policy packages.

A number of key findings have emerged from the research:

1. Energy renovation policy is an emerging field and there is scope for further progress. The tool shows elements where positive steps have been taken and where countries and states can learn from these actions.

2. The countries and states that were successful in reducing all consumption indicators were found to have holistic policy packages in place that address key aspects of the renovation process.

3. There is no such thing as an overall "best" policy package and all countries and states can benefit from best practice sharing.

4. Financial mechanisms need to be locally adapted and linked to broader national renovation strategies. This is true for most of the criteria.

5. Among the current best practice renovation policies, there is a general absence of clear and ambitious targets for the renovation of the existing building stock.

Jurisdictions must go beyond current best practice in order to encourage the wide scale up take of deep renovations of the building stock. 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 and use those lessons to find the right balance of elements adapted to their local context.

INTRODUCTION

Rationale

A huge potential for energy savings lies in the renovation of the existing building stock and achieving this potential will have many local, national and global benefits. It is technically feasible to avoid an increase in global energy use from buildings through mainstream adoption of holistic policy measures that encourage the rapid uptake of deep energy efficient renovation and nearly zero energy new builds. By 2050, it is possible for the world's buildings to be consuming 30% less energy than they do today, this figure takes into account exponential growth in population, floor space and comfort levels in developing regions (GBPN, 2013). To achieve this, the GBPN's 'deep' scenario requires for a 70% reduction in global energy consumption of the existing building stock for space heating and cooling by 2050.

This can only be achieved if sustainable energy policies and supporting programmes play an effective role in ensuring reductions of emissions from the building sector. This means that today's state-of-the-art-deep renovation practices become standard practice within 10 years.

> "The Deep scenario demonstrates the greatest energy-related CO_2 mitigation potential from buildings that can be achieved, globally, by 2050. This scenario is underpinned by the broadest possible implementation and mainstreaming of today's state-of-the-art construction and retrofit approaches and technologies. It demonstrates that it is technically possible to reduce energy used for thermal comfort in buildings by 30% and associated CO_2 emissions by approximately 40% globally by 2050 (as compared to 2005 values), despite the projected growth in floor area – estimated to be around 130% over this period – and an increase in comfort levels." Buildings for Our Future, GBPN, 2013

Achieving the 'deep' scenario requires the development and effective implementation of ambitious energy renovation policies. This is a huge challenge due to the fact that existing policy efforts are not ambitious or far ranging enough. The GBPN is therefore focussed on determining how policy makers can implement the 'deep' scenario in their jurisdictions.

Project Scope

This project concentrated on identifying elements that are critical in the development of *deep* energy renovation policies for *existing residential buildings*. To do this, the GBPN documented the design of current policy packages for existing residential buildings by highlighting the elements and combinations of policies that are successful in reducing the energy consumption of this building typology. This documentation includes an assessment of policies, incentives and programmes that support energy renovation of buildings.

The GBPN chose to focus exclusively on policies that target the residential building sector as, globally, the residential buildings sector's energy use is more than three times greater than the commercial building sector and, by 2050, is predicted to almost double. For this, it is prerequisite that strong policies are in place that will reduce the energy consumption of the residential building sector.

The results of this study and the comparison of the best practice policy packages are presented as an online renovation policy interactive comparison tool; highlighting best practice policies and packages that support the scaling up of deeper renovations. It was not the aim to find one all-inclusive best practice policy package, as one solution does not fit all, but rather to identify combinations and individual elements that have proven to work. The comparative tool will support experts and stakeholders in policy development to analyse and compare policies on multiple levels in order to search for solutions that can be adaptable to a local context.

Project Objectives

In light of the potential reduction of energy consumption in the building sector offered by the "deep" policy scenario, the GBPN's project aimed to support the up-scaling of deep renovations across the residential building stock, by defining a state of the art policy package for renovation and analysing current best practice policy packages in light of this definition. The GBPN sought to analyse the overall framework of the policy packages in order to support jurisdictions by learning from best practice in order to develop efficient policies in their own regions. This new in-depth analysis of the combination of elements and mechanisms behind current best practice renovation policy packages is intended to assist decision makers in accelerating the design of more and deeper renovation policies to help tackle climate change while generating multiple economic and societal benefits.

Methodology

The project was undertaken in three phases:

- Phase 1 – IDENTIFYING BEST PRACTICE CRITERIA
    - Development of "state-of-the-art" criteria for a renovation policy package
- Phase 2 – SELECTION OF BEST-PRACTICES
    - Collection of best practice policy packages and analysis of these based on the criteria
    - Scoring of best practice policy packages under the developed criteria
- Phase 3 – DEVELOPING THE POLICY TOOL
    - Development of online Policy Tool for Renovation.

Phase 1 - The GBPN developed a project that sought to identify key themes and elements that support the development of policy packages that drive the existing building stock towards deep renovation. Initially, criteria for defining a state of the art renovation policy package was developed by reviewing current literature on policy packages, current best practice policy packages and using a panel of renovation policy experts who gave their input and reviewed of the criteria. Thirty national and international experts supported the defining of the final criteria.

Phase 2 - In order to identify current best practice elements of policy packages for the residential building stock, the GBPN first conducted a desk study on the current state of play, searching for jurisdictions that have significantly reduced their energy consumption in existing buildings. Each policy package was selected based on two main criteria:

- A demonstration of their policies including elements that cover energy renovations; and
- A reduction of residential energy consumption (relative, per capita, unit floor area, GDP and dwelling).

Phase 3 - The final stage collected the information and data gathered in these two phases, used the defined criteria to score each policy package and developed a comparative and analytic tool that allows the user to conduct a comparison of single or multiple elements of a best practice renovation policy package in selected countries or states.

IDENTIFYING BEST PRACTICE CRITERIA

Overview

In order to support the development of roadmaps for renovation policy packages, the GBPN, with the support of international experts, began to analyse 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 energy efficiency renovation policy packages. The GBPN defined criteria based on literature and experts and then assessed successful polices, six key themes were identified that form the basis of the renovation policy package used to evaluate the best practice jurisdictions, these are

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 package 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 consists of two or three of the 14 criteria as outlined in the table below. The methodology used to develop the criteria included a detailed desktop study of current literature in the field of building energy efficiency policy 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 for renovation. The desk study also looked at current policies for renovation, specifically 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 of review and modification was followed whereby the criteria were sent to an expert group following several rounds of modification. Thirty building energy efficiency renovation policy experts from academia, the private sector, national experts from different regions and international organisations, participated in the review of the criteria for a renovation policy package. An agreement was reached on the 14 criteria that form the basis of the assessment of the individual key themes. The criteria for renovation policy packages are listed in the table below:

Figure 2.1. Best Practice Themes and Related Criteria

As can be seen from Figure 2.1, each theme comprises of 2 or 3 criteria that form the elements of a "state-of-the-art" renovation policy package. 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. The sub-criteria were set up in order to assess the individual elements of each of the policy measures.

Each criterion was allocated a score between 0 and 10 points, 10 being the highest. In order to be awarded the maximum 10 points, the jurisdiction's current policy measures should be progressive and target deep renovations. None of the jurisdictions were awarded the maximum score in any of the criteria as further improvements could be made in all areas. Sub-questions assisted in the design of a scoring system used to assess each jurisdiction under each theme, criteria and sub question.

It is to be noted that it is only possible for a jurisdiction to score the maximum points for a criterion if the policy measure (criterion) that is being assessed supports the uptake of deep renovations.

Theme 1 – Regulatory Measures

This theme is designed to consider 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 efficient, targets should be well planned, ambitious, realistic and include roadmaps with short, medium and long-term milestones. This theme considers the ambition of regional/national measures based on the criteria below:

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 for the whole residential building stock to be improved/upgraded to a specific level in a certain number of years. 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 and should set an example for the level of ambition for renovation of the rest of the building stock. The targets should be as binding as possible, 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 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 by 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/states' building code should set minimum energy performance levels and minimum technical requirements for the renovation of the existing building stock. 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?
    - Are the energy requirements set in the building code supporting 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?
- Does 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 document and support buildings to go beyond the minimum energy renovation standard, for instance by documenting deep renovations.

The following sub-criteria assess the ambitiousness of such schemes:
- Is there a certification scheme in place?
    - Is the certification scheme mandatory?
    - Is the certification scheme voluntary?
- How frequently must the 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?
- 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 the specific financial instruments that support energy renovations. One of the main barriers to energy renovations is a lack of access to finance and the high costs of loans. Financial (and fiscal) instruments can help to overcome

such obstructions. As part of a policy package a number of instruments should be in place to incentivise the uptake of energy renovations. Especially for deep renovations, financial support can be needed in order to drive the market and to develop cost efficient solutions.

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

6. Incentive Schemes

Financial incentives such as subsidies, grants and loans are effective in encouraging building owners and occupants to invest in energy saving measures. These instruments, with better terms and/or reduced interest rates, for building energy efficiency improvements will finance all or most of the investment. Public funds can be a catalyst for encouraging the use of private funding – they can be used as a tool to encourage investment in projects to go beyond cost-optimal.

This assessment was based on the following sub-criteria:
- Is there fiscal support offered by the state/country for renovation of buildings?
- What type of fiscal support is available?
- Are the incentives provided as part of a holistic package of measures?
- On what basis is the incentive distributed:
  - "Conditionality" (access to funds is only allowed if substantial savings will be provided)?
  - "Progressivity" (more financing for the most ambitious renovations)?
- Do funding mechanisms promote the involvement of private financing to leverage 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 been established?
  - Is the exemption ambitious?
  - Do tax credits support holistic renovations?
  - Tax credit for specific components?
  - Does this support the uptake of deep renovations in the jurisdiction?
- Energy or carbon taxes?
  - Is there a carbon/energy taxing system set up?
  - What does this target?
  - Who does the tax apply to?
  - Is the tax ring-fenced (invested into energy efficiency)?

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 have not previously existed. The criteria under this theme incorporate the three main economic and market-based instruments.

8. Utility-Funded Programmes

Utilities provide a good opportunity for leveraging resources for renovation programmes. Utility programmes may be restricted to measures that relate to the fuel type they provide. 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. Utilities play a strong part in funding efficiency in some jurisdictions and this criterion assesses their contribution.

The following sub-criteria support that assessment:
- What type energy saving measures will be provided and how do they support deep and holistic measures?
- What kind of funding is available and does it support deep and holistic measures?
- On what basis is the incentive distributed:
    - o "Conditionality" (access to funds is only allowed if substantial savings will be provided)?
    - o "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 Saving Companies (ESCOs) and Energy Performance Certificates (EPCs) can be used as a mechanism to encourage deep renovation via third party financing. Such systems can help to overcome funding issues without impeding public costs. Pay as you save or performance contracting works by selling services and not energy. This criterion assess the impact of these market based third party schemes.

The following sub-criteria supported that assessment:
- Is the ESCO market for energy renovations well developed in the region?
- Are there other systems such as save as you pay or selling service not energy?
- What services are covered?
- Do ESCOs work on the projects related to deeper energy efficient renovation or low hanging fruits?
- Are there policies in place supporting the use of 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 buildings. 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 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.

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 ensure 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 centre

One-stop solution centres for energy renovation are not very common yet but 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 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?

13. Reduction in energy consumption/capita
- Has the overall 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 overall 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?

SELECTION OF BEST PRACTICE RENOVATION POLICY PACKAGES

Overview

To identify best practice policy packages for existing buildings, the GBPN conducted a desk study to locate the countries and jurisdictions that significantly reduced the energy consumption of their existing residential building stock. For the first stage of this project, the GBPN focussed on two of its regions, the EU and the U.S. In both of these regions, the majority of the buildings that are expected to be standing in 2030 are already built and renovation activity is already extensive and an essential measure.

In order for a country or state to be selected for the GBPN's Renovation Policy Comparison Tool, it must have reduced the energy consumption of their existing residential building stock over the past decade.

The best practice regions were selected following a literature review of current best practice renovation policy packages in the EU and the U.S. and information from other databases (such as the BigEE[3] and the IEA). The GBPN's regional hubs, the BPIE (EU), IMT (U.S.) and external partners supported the selection of best practice policy packages by reviewing the jurisdictions selected following the literature review. Narrowing the selection down to twelve jurisdictions was a complex task given the scarcity of jurisdictions that fully implemented a package of measures that support the uptake of efficient renovations.

For the second phase, in order for a country or state to be selected as a study region in the GBPN's Renovation Policy Comparison Tool, it had to meet the following criteria:

- Consumption reduction over the past decade
  - Total consumption
  - Consumption/capita
  - Consumption/unit of floor area
  - Consumption/household – will decrease if other two criteria are met.
  - Consumption/GDP
- Representative sample of countries/states (in terms of size, population and climate zones).

Use of a combination of indicators provides insight as to where policies have been effective in reducing the energy consumption in buildings in the past, and will help to eliminate those results that are due to non efficiency related savings such as economic turmoil. The selected jurisdictions were analysed and compared in order to better understand the policy dynamics and to ascertain the current best practice policy packages that have been instrumental in reducing the energy consumption in the existing building stock.

The GBPN assessed all of the jurisdictions within the EU and U.S. against the same criteria; the chosen regions are those that met almost all of the criteria listed above. It is to be noted that for one or two special cases, a jurisdiction was selected based exclusively on the reputation of their best practice policy package, providing the consumption indicators remained steady. While the GBPN has focused mainly on the EU and the U.S., the lessons learned from these regions were designed so that they can be applied globally.

Countries in the EU and States in the U.S.
Based on the above criteria, six jurisdictions were chosen in both the EU and U.S. The regional sections below present the detailed findings of each of the selected study jurisdictions. The regional sections go into detail regarding the region's policy package and information on the change in energy consumption indicators. The selected countries and states' evaluation are presented in individual graphs below.

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[3] http://www.bigee.net/en/

Explanation of Graphs

Each country/state's graph shows a timeline from 2000 to 2011 with the aim of presenting the trends for each of the objective criteria; total consumption, consumption/capita, consumption/unit, consumption/dwelling and consumption/GDP. The units for each of the criteria differed; therefore we normalised each to a hundred (2000=100) in order to see the trends side-by-side. In the best-case scenario, the total consumption, consumption/capita, consumption/unit, consumption per GDP and the consumption/dwelling will all have a steadily decreasing trend. For many of the regions this is not always the case due to economic, geographic and social factors.

The EU

The Chosen Countries in the EU

While 13 countries in Europe have managed to decrease their total residential energy consumption since 2000, this study has focused on six of these that are best suited to our objective criteria described in the section above. The six chosen countries represent just under 50% of the EU population and around 60% of the EU's total residential consumption. The consumption data for the EU countries was sourced from ODYSSEE, who provide detailed energy statistics for the European Union and candidate countries and is seen as the primary source for reliable building performance data in Europe. To secure integrity, we compared the trends in ODYSSEE's data to the International Energy Agency's (IEA) and the EU's statistical office Eurostat's residential data sets. For the chosen countries in Europe the ODYSSEE data showed very similar trends to that of the IEA and hence, was regarded as being robust. The data for population and floor area were sourced from Eurostat.

> Together, the selected countries represent around 50% of the EU's population. Total population of chosen countries: 240.6 million and almost 60% of the EU's total residential consumption. Total population of the EU: 504 million (Eurostat, 2012).

When choosing the European countries, GBPN wanted them to represent the different regions in Europe. The sections below provide detailed information on the six chosen regions.

Denmark

Adopted in 2011, Denmark's "Energy Strategy 2050" includes stringent and ambitious targets that are intended to make considerable cuts in future energy use, with the aim of independence from fossil fuels by 2050. Within the strategy, it is stated that the building sector will have a key part to play in realising this goal being one of the largest consuming sectors in Denmark, mostly through heating. Since the 1960s, Denmark has had policies in position targeting renovation of the building stock. Their package of measures range from mandatory building codes for renovation, energy taxes, labelling schemes and energy savings obligations. Denmark's building code complements this ambitious Energy Strategy, and has been gradually tightened since its adoption in 1960s. The intention is for the implementation of progressively rigorous building codes until the zero energy requirement is achieved.

The Policy Tool for Renovation highlights seven key areas where Denmark's Renovation Policy Package excels: overall country reduction targets, building reduction targets, building code requirements for renovations, labelling schemes, taxation mechanisms, utility-funded energy efficiency programmes and training and education campaigns.

In the early 2000s, Denmark's residential energy consumption remained constant; however, since 2006 the total consumption, consumption/capita, m^2 and in dwellings have all been steadily decreasing. The GDP has generally remained stable, continuing a downward trend steeper than the other indicators, apart from a slight bump in 2008 during the financial crisis. Population is 5.6 million (Eurostat, 2012).
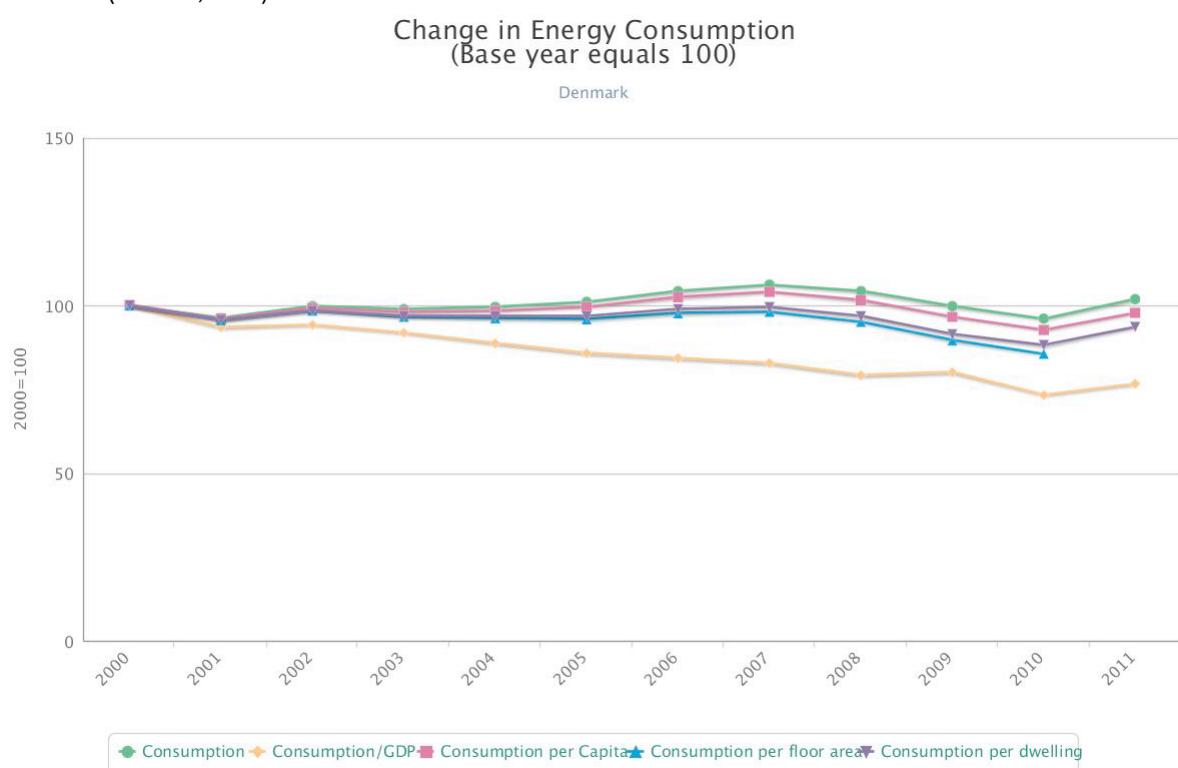

Figure 3.1 Objective Criteria in Denmark, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

France

In 2007, the "Grenelle de l'environnement" round table brought together representatives of both national and regional governments and organisations with the objective of establishing an agreement on key issues surrounding the environment and sustainable development. From this, ambitious targets were set for reducing France's carbon emissions by 75% by 2050, compared to 1990. The Grenelle de l'environnement also established specific building sector targets taking into account a reduction of energy consumption in the building sector by 2050 (of 38%) and a target number of buildings to be renovated per year as of 2013. Alongside the Grenelle de l'environnement, a number of other policy measures exist that aim to reduce the consumption of energy of the existing building stock that include tax reductions, tax credits and zero interest loans. France introduced their version of Energy Performance Certificates (EPCs) called 'Diagnostic de Performance Energétique' (DPE) in 2006.

The Policy Tool for Renovation highlights five key areas where France's Renovation Policy Package excels: overall country reduction targets, labelling schemes, incentive schemes (including tax rebates), and training and education campaigns.

All residential consumption indicators in France have been reducing steadily for the past few decades as well as the consumption per GDP, making it a prime candidate for the comparison study. It is one of the largest countries in Europe and home to different climatic zones. Population is 65.3 million (Eurostat, 2012).
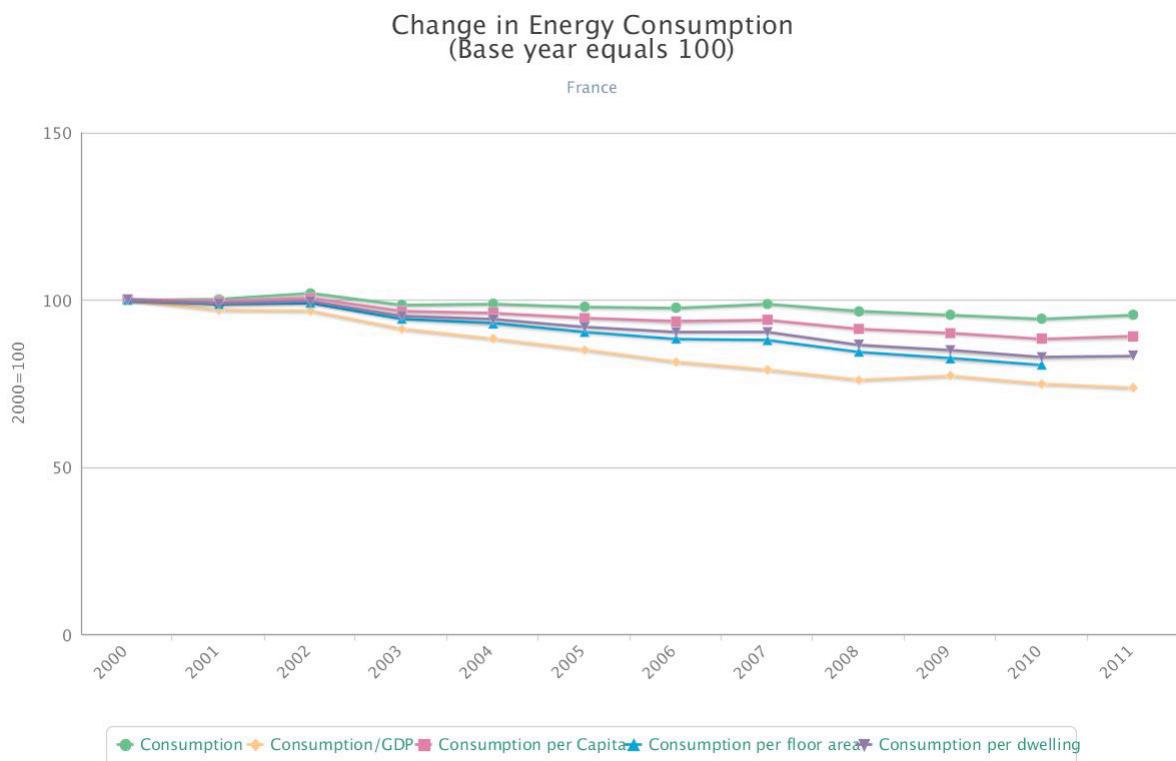

Figure 3.2. Objective Criteria in France, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

Germany

Germany has a direct target for its building stock aiming to use close to zero energy by 2050. This is to be achieved by both new and existing buildings to greatly increase their energy efficiency while using renewable energy sources to cover the remaining energy demand. Germany's "Energy Concept" of 2010 requires that the primary energy demand of buildings be reduced by 80% in 2050, with an intermediate milestone of a reduction in heat demand of 20% by 2020. The targets are to be achieved based on three pillars: legislation (codes and labelling schemes), financial support and provision of information and advice on energy efficiency measures. The current energy efficiency efforts are well packaged. The state bank, KfW, and the German Energy Agency (Dena) are the federal government's official agencies designated to support energy efficiency in Germany; Dena provides citizens with information and advice and acts as a "centre of expertise", as a one-stop shop, while the KfW provides financial incentives and loans to promote energy efficiency.

The Policy Tool for Renovation highlights eight key areas where Germany's Renovation Policy Package excels: overall country reduction targets, building reduction targets, building code requirements for renovations, labelling schemes, taxation mechanisms, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.

The residential consumption in Germany has been reducing for the past decade as well as the consumption per GDP, making it a prime candidate for the comparison study. It is also one of the largest countries in Europe. The trends in consumption and the GDP show that Germany went through a few turbulent years around the 2008 financial crisis yet both trends were back to normal by 2010. Population is 81.8 million (Eurostat, 2012).
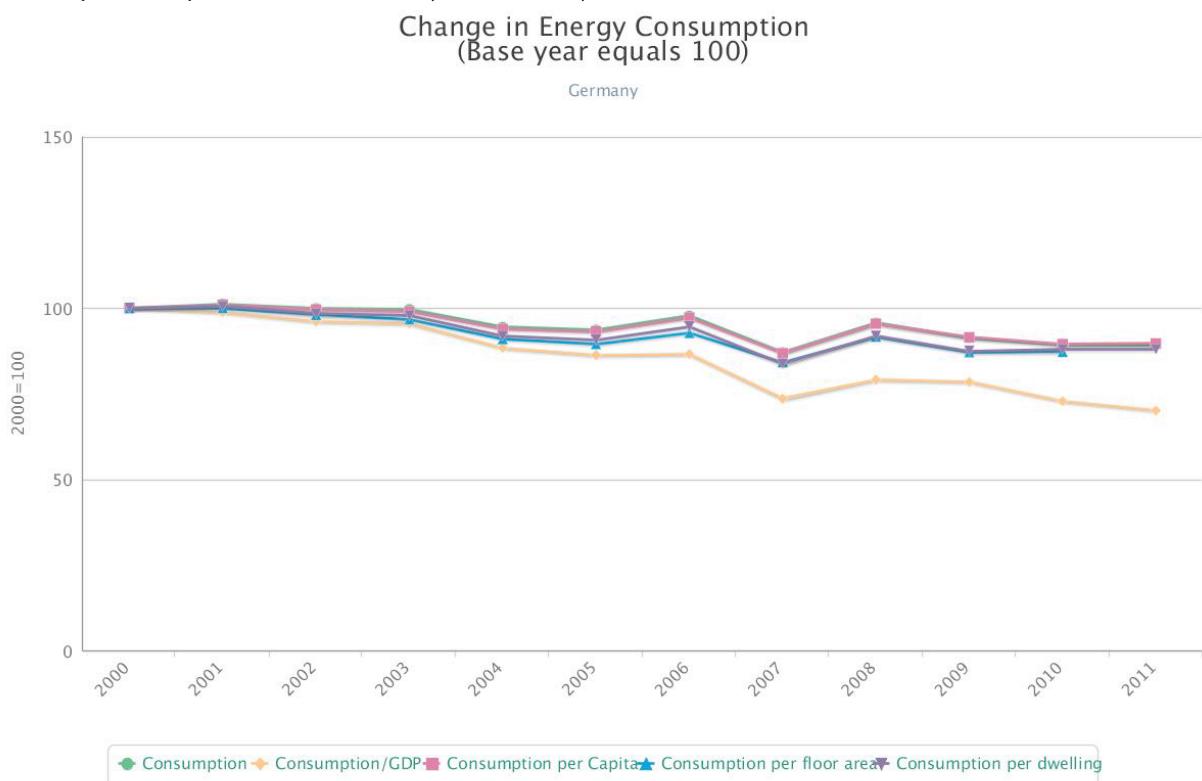

Figure 3.3 Objective Criteria in Germany, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

The Netherlands

Under the Energy Agreement (dEA) for Sustainable Growth, the Netherlands has set a goal for a sustainable energy supply system by 2050. The Agreement sets overall building targets for the Netherlands, establishing specific building sector targets that take into account a target number of buildings to be renovated by 2020, and an increase in energy labelling for the existing building stock by at least two label steps. By 2030, the average for the existing building stock is targeted to be label A (or better). The dEA for Sustainable Growth calls upon market parties to actively promote ESCOs and "Green Leases" and has introduced a National Energy Saving Fund as a new financial mechanism in 2014. Since the 1990s, the Netherlands has had strong taxation mechanisms in place to support energy efficiency efforts, as of 2000, energy premiums on the purchase of energy-efficient appliances and other energy-saving measures for households were made available.

The Policy Tool for Renovation highlights six key areas where the Netherland's Renovation Policy Package excels: overall country reduction targets, labelling schemes, incentive schemes, taxation mechanisms, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.

The residential consumption in the Netherlands has been reducing steadily for the past few decades as well as the GDP, making it a prime candidate for the comparison study. There is a slight increase in 2008-2009 that can be explained by the financial crisis in Europe during that period. Population is 16.7 million (Eurostat, 2012).
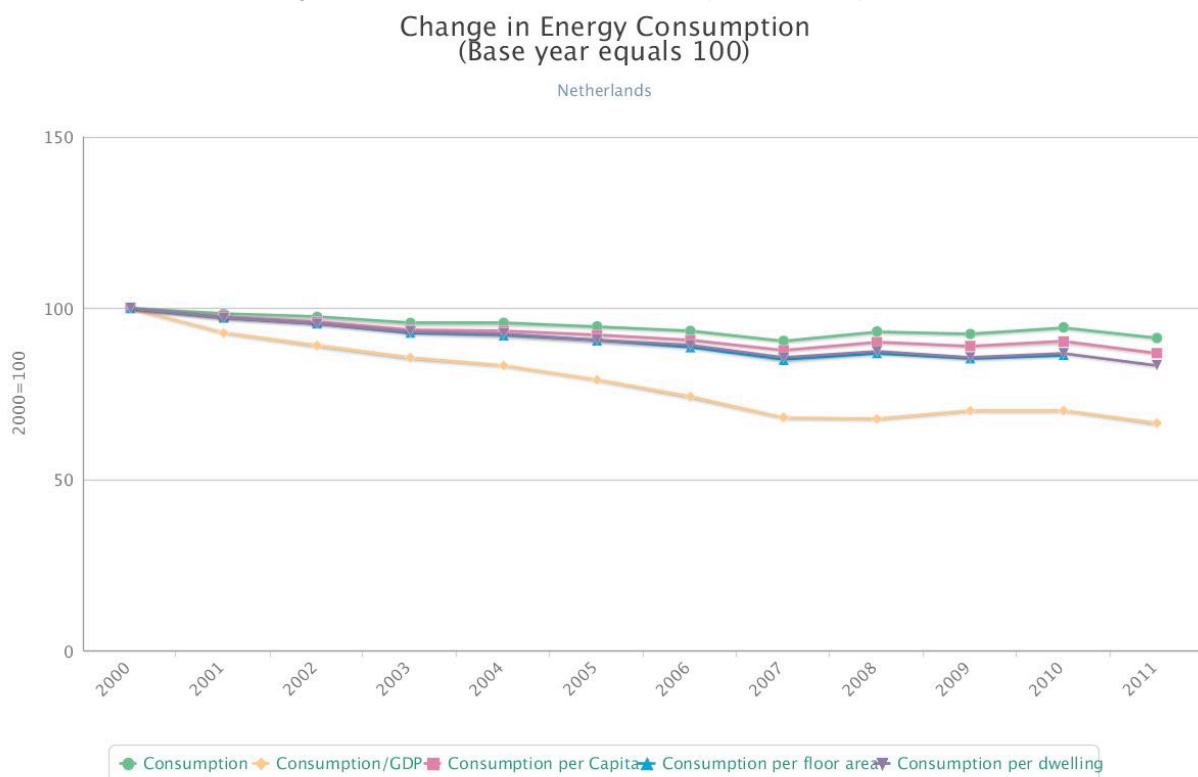

Figure 3.4. Objective Criteria in the Netherlands, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

Sweden

Sweden has adopted policies focusing on the environment since the 1960s. The government has set a stringent national zero-net greenhouse gas emissions target for 2050. In 2009, Sweden's 'Integrated Climate and Energy Policy' (ICEP) introduced the goal of increasing energy efficiency in buildings by 20% in 2020 and 50% in 2050. Supporting these ambitious targets, Sweden's building code's energy requirements are extremely rigorous for both new builds and building renovations. The package of measures supporting energy renovations range from mandatory building codes that target renovation, energy taxes, mandatory and voluntary labelling schemes and education and training schemes. By 2007, Sweden's subsidies for renovation measures were abolished due to the fast market uptake of energy efficient materials and design, for this the renovation industry remained strong.

The Policy Tool for Renovation highlights five key areas where Sweden's Renovation Policy Package excels: overall country reduction targets, building code requirements for renovation, labelling schemes, training and education campaigns and a one-stop solution centre.

Sweden's residential consumption, consumption/capita, consumption/m2 and consumption/dwelling have all been decreasing throughout the past 10 years as well as the consumption per GDP except from the period between 2007-2009. Sweden's population is 9.5 million (Eurostat, 2012).
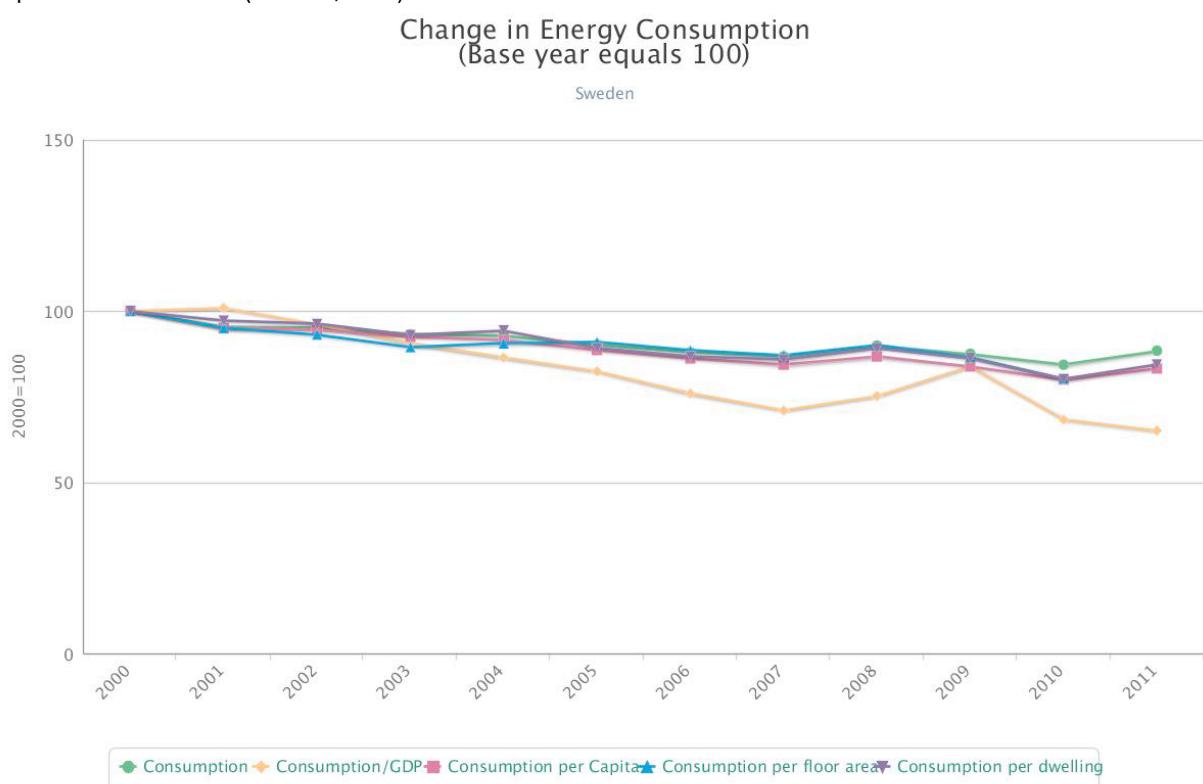

Figure 3.5. Objective Criteria in Sweden, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

United Kingdom

In 2013, the United Kingdom introduced the "Green Deal", a loan system designed to encourage and assist citizens to undertake energy renovations using a package of measures, rather than merely targeting individual measures. The aim of this is to realise larger energy and carbon savings per property. These loans are attached to the electricity meter of the building, not the resident, and thus encourage higher investment by allowing a longer payback period, which is not constrained by a possible future sale of the property. The Green Deal policy is still at a very early stage of adoption and has not yet reached significant market uptake. The government has not set national targets for the renovation of the building stock but estimates have been made for the quantity of specific measures that will be undertaken by the Green Deal. The United Kingdom has set obligations for energy companies, under the Energy Company Obligation (ECO), that realise a significant amount of energy savings in the residential sector each year. This obligation began under a different name in the 1990s. Energy Performance Certificates (EPCs) were introduced in the United Kingdom in 2007.

The Policy Tool for Renovation highlights five key areas where the United Kingdom's Renovation Policy Package excels: overall country reduction targets, building code requirements for renovations, labelling schemes, incentive schemes (including tax rebates) and the Green Deal's one stop solution centre.

Over the past 10 years the UK has managed to decrease its total residential consumption, consumption/capita, and consumption/m2. These reductions began in 2004, four years before the financial crisis and therefore these two cannot be linked. Although there was an increase in overall energy consumption in 2010, it then decreases in 2011 to continue with the downward trend. The Department of Energy and Climate Change (DECC) explains this unusually high level of consumption in 2010 as being driven by an exceptionally cold winter (DECC, 2012). Population is 63.2 million (Eurostat, 2012).
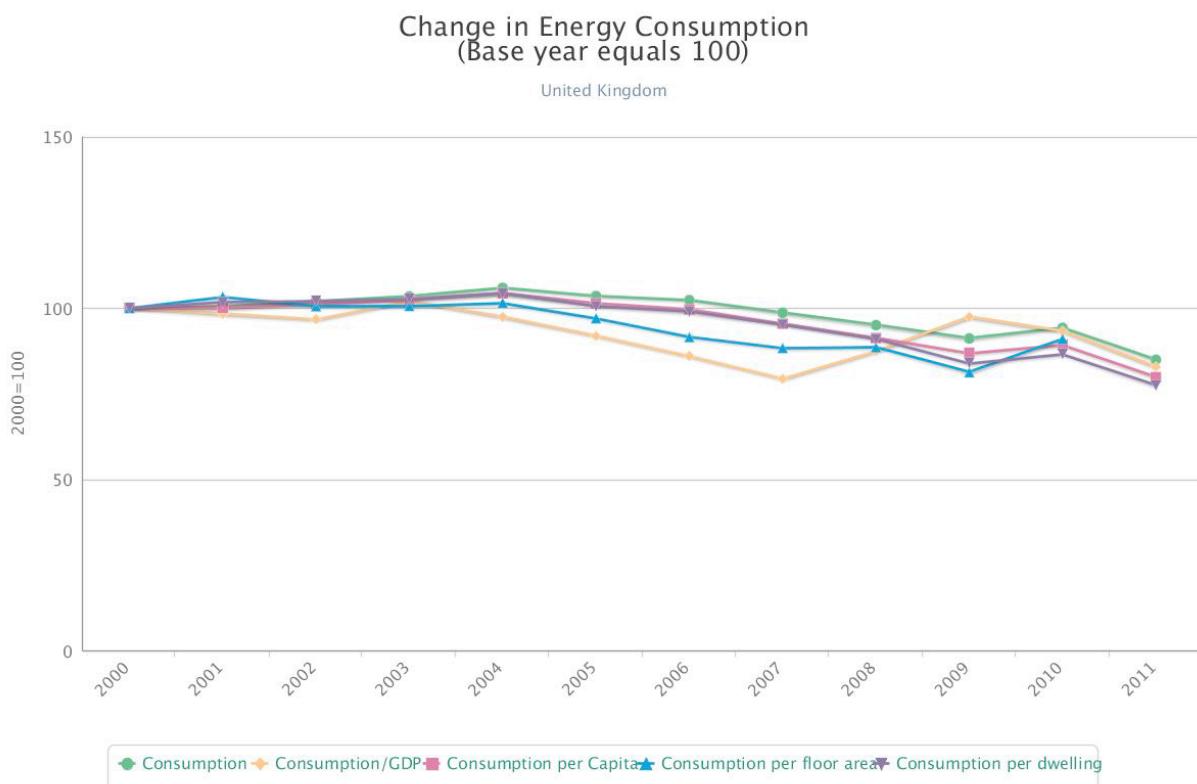

Figure 3.6. Objective Criteria in UK, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

The U.S.A.

The Chosen States in the U.S.A.

Although GBPN also used consumption/capita as objective criteria in Europe, we have noticed that most countries in Europe have not increased their population dramatically enough to have a significant impact on the total energy consumption. This, however, is not the case in the U.S. as many states have significantly increased their population and, hence, this study deems the consumption/capita as being one of the most important criteria when choosing the six participating states in the U.S.

Six U.S. states were chosen that suit our objective criteria that are described in the section above. Together, these states represent around a quarter of the U.S. population and just over 30% of the total U.S. energy consumption.

> Together, the selected states represent around a 25% of the U.S. population and just over 30% of the total U.S. consumption. Total population of chosen states: 77.9 million. Total population of the U.S.: 318 million (U.S. Census Bureau, 2012).

The total consumption data for each state was sourced directly from the Energy Information Administration (EIA), the Official Energy Statistics from the U.S. The IEA's total consumption data for the U.S. was then compared with the International Energy Agency's (IEA) data set for the U.S., these both showed very similar trends; the total residential consumption in the U.S. has increased by 0.2% between 2000 – 2008. The number of dwellings was sourced from the U.S. Census Bureau, Housing Units Intercensal Estimates (2000 – 2010), Annual National and State Housing Unit Estimates, the floor space was sourced directly from Pacific Northwest National Laboratory (PNNL) and the population estimates were sourced from the U.S. Census Bureau, State Intercensal Estimates (2000-2012), Annual Population Estimates.

The visual presentation of the consumption/m2 differs from the other graphs as many of the data points for a time series data set were not available.

When choosing the regions to study in the U.S., we chose states from all over the country. The chosen states are California, Massachusetts, New Jersey, New York, Oregon and Vermont.

The sections below provide detailed information on the six chosen regions in the U.S.

California

California has set a state target to reduce GHG emissions to 1990 levels by 2020 and to further reduce emissions to 80% below 1990 levels by 2050. A specific target has been set that aims to reduce household energy use by 40% by 2020. Since the mid-1970s, California has implemented energy-efficiency measures such as building codes and appliance standards with stringent efficiency requirements. New legislation (AB 758) that provides financing for building owners to undertake efficiency improvements was adopted to encourage energy retrofit efforts. The California Public Utility Commission (CPUC) organises and regulates all utility-funded energy efficiency programmes. The CPUC acts as a central hub for energy efficiency retrofits in California working with investor-owned utilities, programme administrators, and merchants to develop programmes and measures to transform technology, increase communications and advice and promote the uptake of energy retrofits.

The Policy Tool for Renovation highlights five key areas where California's Renovation Policy Package excels: overall country reduction targets, building code requirements for renovations, utility-funded energy efficiency programmes, market development for ESCO based energy efficiency programmes and training and education campaigns.

The overall residential consumption indicators have remained fairly steady in California, except from 2010 when they all increased slightly. California has seen a swell of population in the last decade. Population is 38 million (U.S. Census Bureau, 2012).
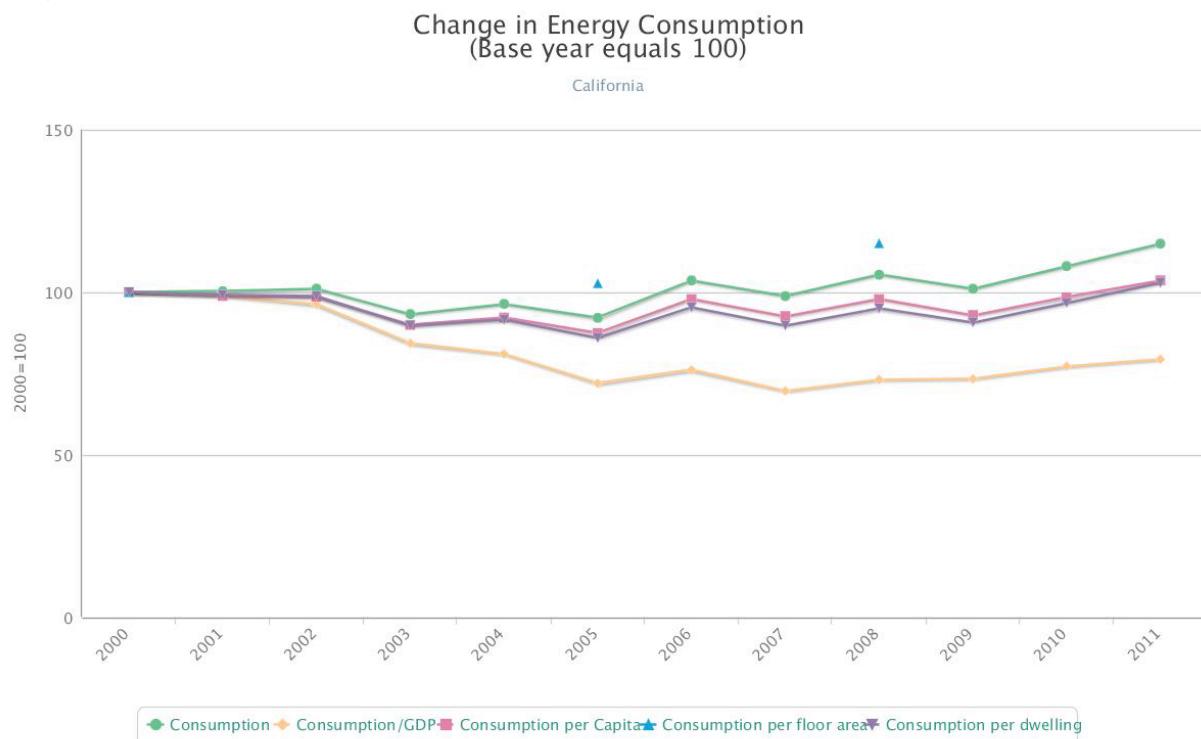

Figure 3.7. Objective Criteria in California, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

Massachusetts

Massachusetts' Green Communities Act, 2008, requires utilities to increase their investment in energy efficiency measures. This Act requires adoption of three-year revision planning cycles, with the 2013 goal requiring utilities to save 2.76% by 2015 by developing cost-effective energy solutions for the building sector. The 2008 Global Warming Solutions Act sets an overarching national target for Massachusetts to reduce its GHG emissions from 80% below 1990 levels by 2050. The Massachusetts' "Stretch Energy Code" is a voluntary appendix to the Massachusetts Building Code that allows cities to elect to adopt more demanding requirements. Massachusetts has a home energy certification scheme currently in a pilot phase, the Energy Performance Score. The Mass Save programme acts as a one-stop solution centre that provides advice, information and financial guidance to all citizens of Massachusetts. Massachusetts, for the third year in a row, won first place in the American Council for an Energy-Efficient Economy's (ACEEE) annual energy efficiency state scorecard.

The Policy Tool for Renovation highlights five key areas where Massachusetts' Renovation Policy Package excels: overall country reduction targets, building code requirements for renovations, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.

The total residential energy consumption in Massachusetts has continually decreased since 2003, with the consumption/capita and the consumption/dwelling following the same trend. There was a dip in consumption in the year of 2006, from 2007 this continued along the previous trend. The GDP has decreased annually from 2000 with a slight fluctuation in 2006 where it remained steady from then to 2009 where it began to decrease once more. Massachusetts' population is 6.7 million (U.S. Census Bureau, 2012).
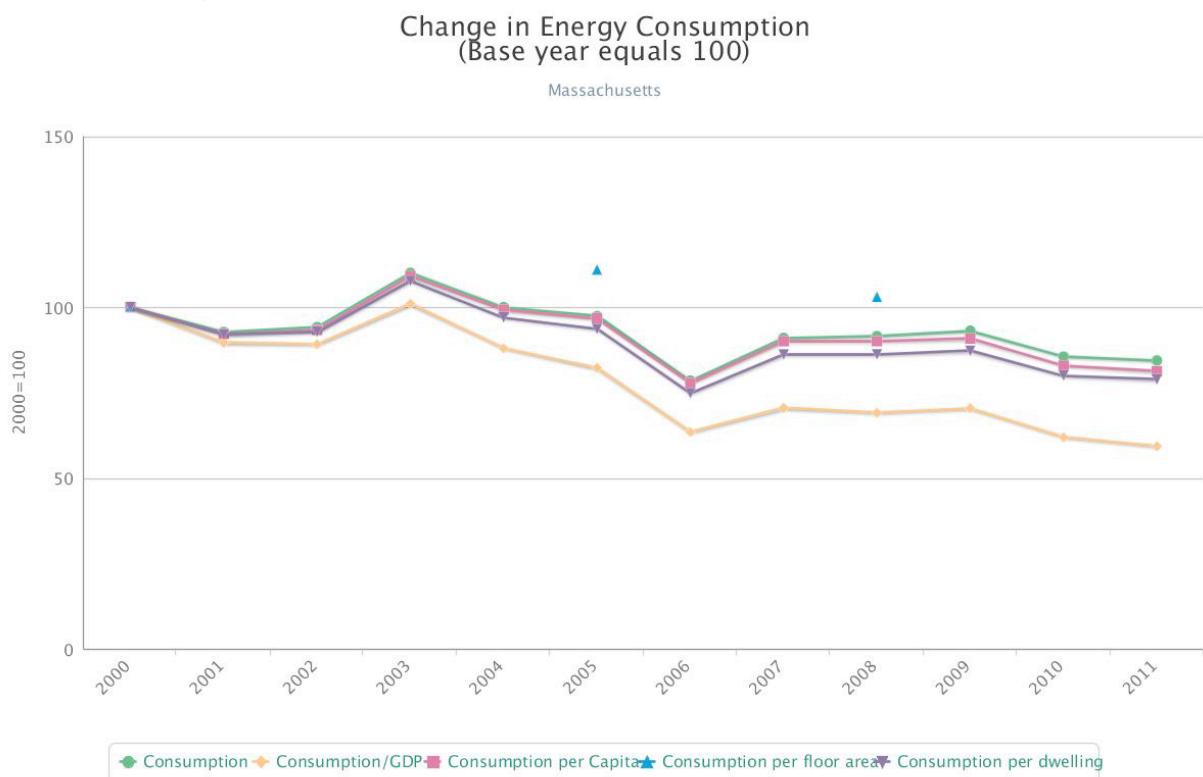

Figure 3.8. Objective Criteria in Massachusetts, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

New Jersey

The New Jersey Global Warming Response Act (2007) sets an emissions target of 1990 levels by 2020 and 80% below 2006 levels by 2050; however, no targets for the building sector (neither new build or renovations) currently exist. New Jersey's Clean Energy Programme (NJCEP) offers financial incentives, advice and services to residents, business owners and local governments to help them save energy and money. Through the NJCEP energy savings have continued to increase in the past few years. Running alongside the NJCEP is the Edison Innovation Clean Energy Fund that sponsors research on energy efficiency and development. New Jersey State offers financial incentives for energy efficiency improvements.

The Policy Tool for Renovation highlights three key areas where New Jersey's Renovation Policy Package excels: overall country reduction targets, utility-funded energy efficiency programmes and training and education campaigns.

The total residential energy consumption has continually decreased from 2003, with the consumption/capita, consumption/m2 and the consumption/dwelling following the same trend. There was a dip in the consumption trend in the year of 2006, in 2007 this continued along the previous trend. Consumption/GDP has decreased annually from 2000 with a slight fluctuation in 2006 where it remained steady from then to 2009 where it began to decrease once more. New Jersey's population is 9 million (U.S. Census Bureau, 2012).
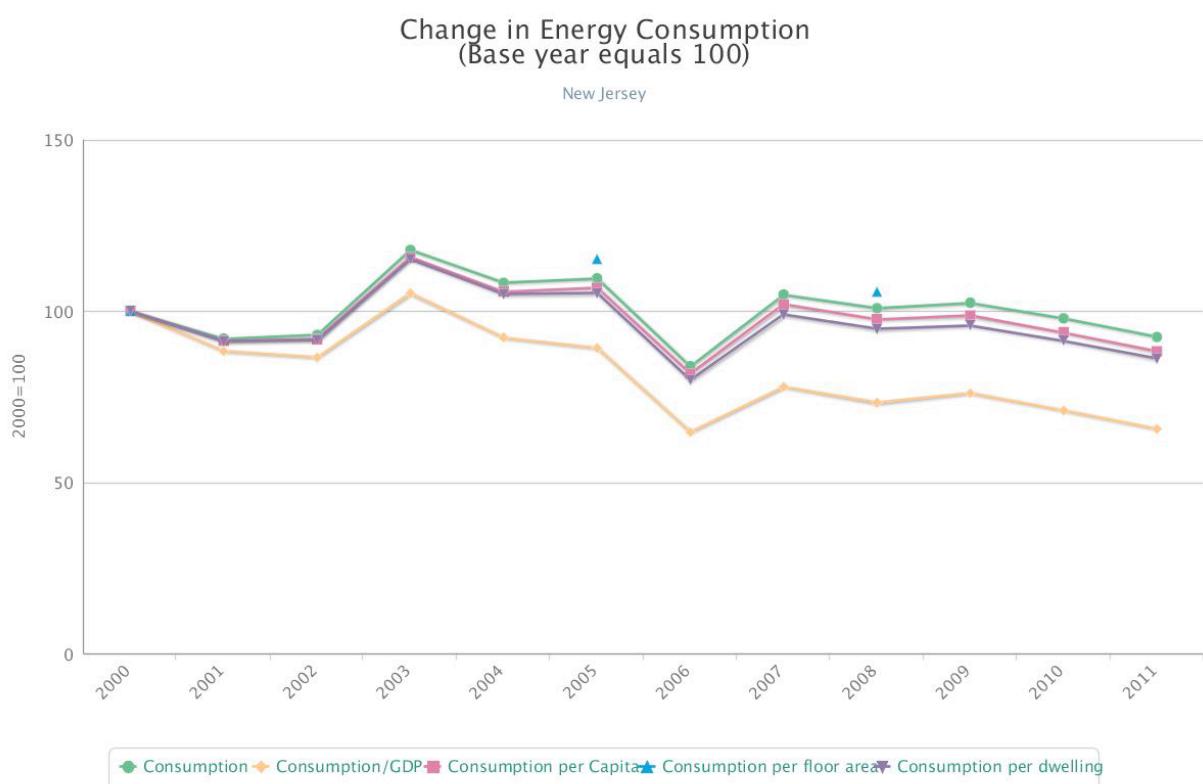

Figure 3.9. Objective Criteria in New Jersey, all consumption units are normalised in relation to 2000, GDP is normalised to year 2010.

New York

New York State has an energy efficiency portfolio standard target for all of its buildings. Energy savings targets are planned every three years with a goal of reducing the state's energy consumption in building energy use by 15% by 2015. New York's overall national policy goal is to reduce GHG emissions by 5% below 1990 levels by 2010, 10% below 1990 levels by 2020, and 80% below 1990 levels by 2050. New York State offers tax credits and bonds that encourage energy efficiency investment. Home energy improvements are exempt from property taxation up to the amount that the improvements increase the value of the home. Electricity and natural gas efficiency programmes are run by the utilities and New York State Energy Research and Development Authority (NYSERDA), and have achieved significant energy savings in past years. NYSERDA acts as New York's one-stop solution centre, providing individuals with advice and guidance on energy efficient design, finance and solutions for reducing their home's energy consumption.

The Policy Tool for Renovation highlights five key areas where New York's Renovation Policy Package excels: overall country reduction targets, incentive schemes, utility-funded energy efficiency programmes, market development schemes and training and education campaigns.

Although the energy consumption in New York's has fluctuated over the studied period, there is a clear downward trend for all studied indicators. This makes New York a prime candidate for our study. All of the consumption indicators show a downward trend. The population of New York is estimated to be 19.6 million (U.S. Census Bureau, 2012).
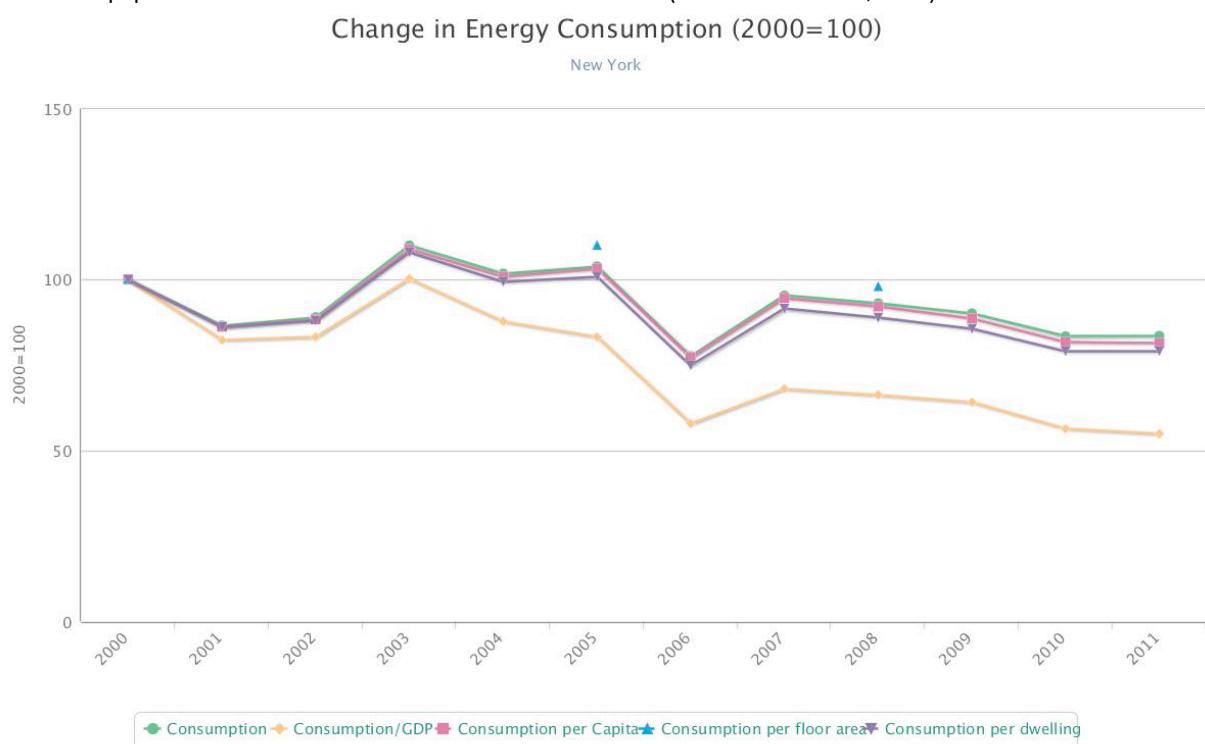
Figure 3.10. Objective Criteria in New York, real units factored to near 100

Oregon

Oregon's Strategy for GHG emissions reductions includes state-wide emissions targets set at 10% below 1990 levels by 2020 and 75% below 1990 levels by 2050. Oregon's building code has more stringent requirements than the standard U.S. building code, IECC 2009. Energy Trust of Oregon and utility companies have organised electricity and natural gas efficiency programmes that provide funding and advice to citizens. Alongside these incentive programmes, Oregon set up a tax deduction scheme that supports efficiency improvements. Oregon is home to a number of research centres that focus on energy efficiency, specifically the Energy Trust Oregon acts as a one-stop solution centre which provides energy efficiency advice on incentives, services and how to reduce the amount of energy used in a building.

The Policy Tool for Renovation highlights two key areas where Oregon's Renovation Policy Package excels: overall country reduction targets and building code requirements for renovation.

All consumption criteria decreased from 2000 to 2004. From 2004, all of the consumption indicators began to rise. Despite this, consumption/GDP has been flat since then, as GDP has continued to grow. Population of Oregon is 4 million (U.S. Census Bureau, 2012).

Change in Energy Consumption
(Base year equals 100)
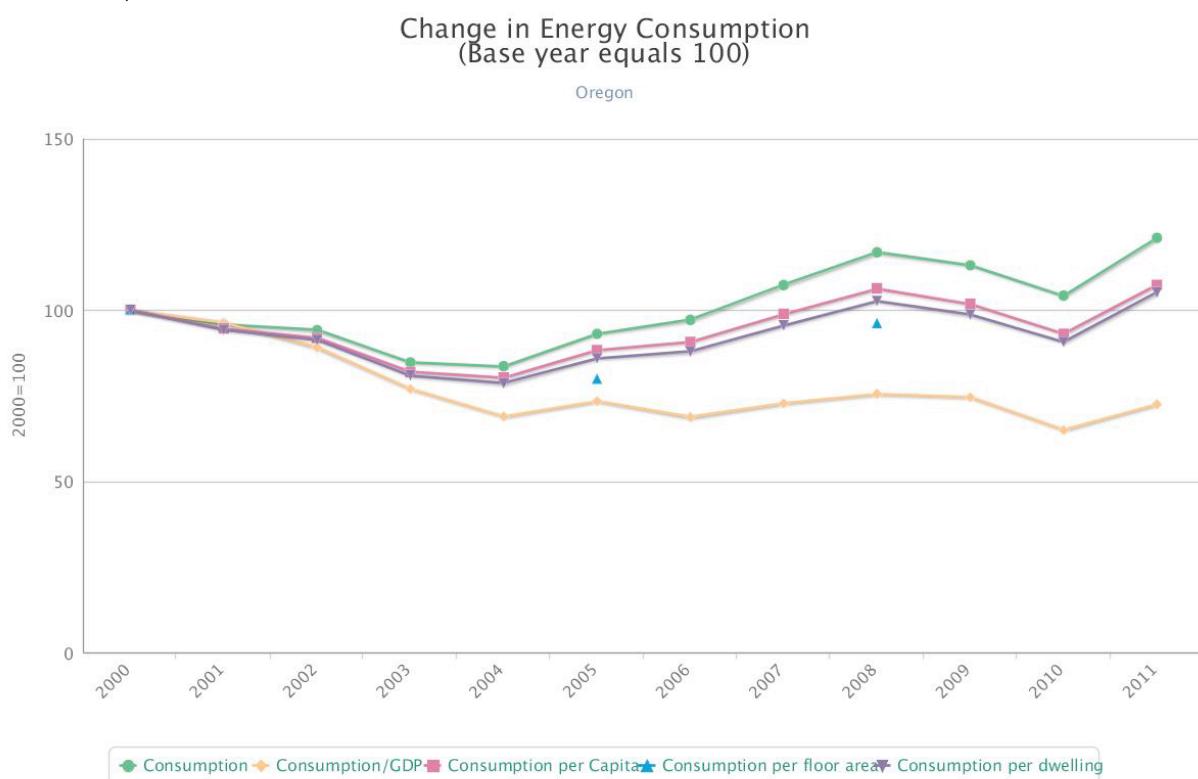
Oregon

Figure 3.11. Objective Criteria in Oregon, real units factored to near 100

Vermont

As of 2007, Vermont introduced sector specific targets related to building energy efficiency. These include reducing both fuel use and energy bills by 25% in 60,000 homes by 2017, and 80,000 homes by 2020 and reducing fuel needs and fuel bills by an average of 25% in housing units served by energy utilities. Vermont's building requirements complement the reduction targets set and are more stringent than the standard US code of 2009, IECC. Funding is offered by utilities in Vermont to support energy efficient improvements to homes. Efficiency Vermont works together with the utilities to promote the financial programmes offered. They also develop local partnership programmes that focus on energy saving opportunities; these programmes include providing consumers with guidance, educational materials, training and financial support.

The Policy Tool for Renovation highlights three key areas where Vermont's Renovation Policy Package excels: overall country reduction targets, utility-funded energy efficiency programmes and a one-stop solution centre.

Over the past 10 years, Vermont's energy consumption, consumption per floor area, household and capita have all followed a very similar trend. They have all fluctuated, sometimes increasing and sometimes decreasing compared to 2000 levels. Generally, although the fluctuations are quite large, it could be said that the trend has remained largely stable. Population of Vermont is 0.6 million (U.S. Census Bureau, 2012).
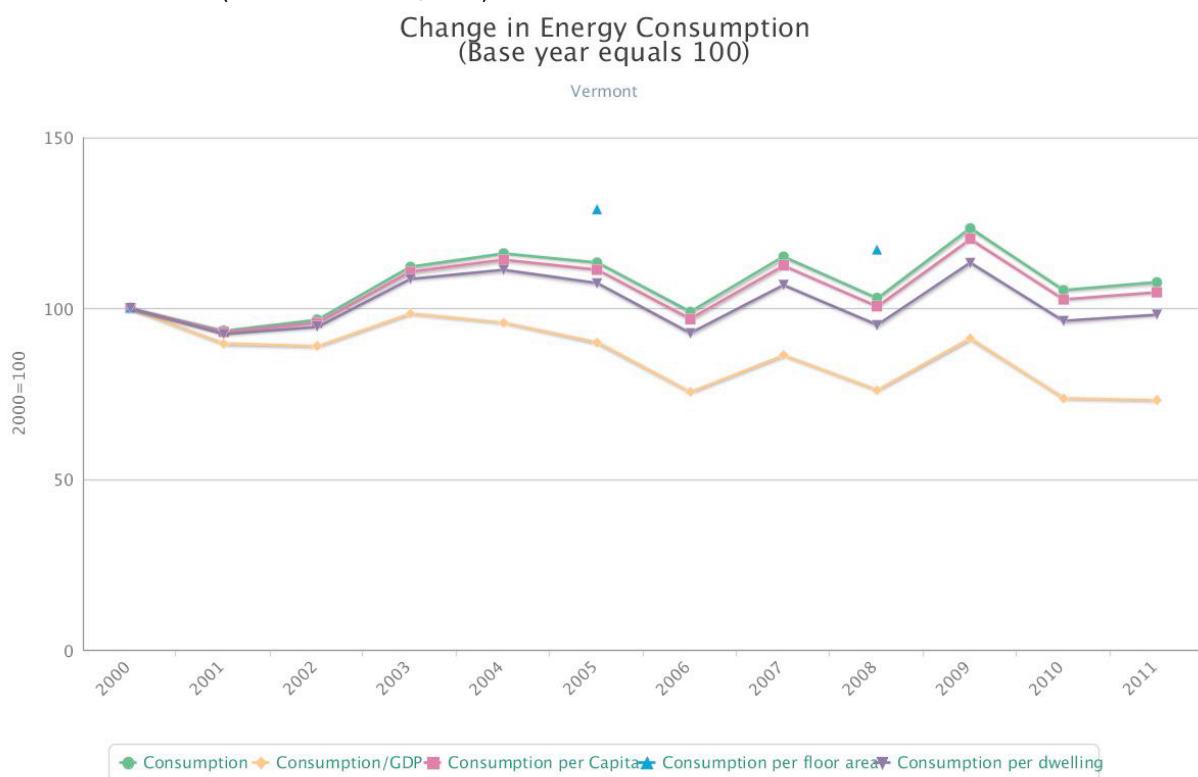
Figure 3.12 Objective Criteria in Vermont, real units factored to near 100 Application of the Tool

Summary of the 12 Best Practice Jurisdictions

A summary table can be found below that aims to summarise the findings of the analysis of each of the best practice jurisdictions. It is possible to see the standout policy elements from each of the 12 jurisdictions in the table below. The Policy Tool for Renovation highlights the key areas where the jurisdiction's Renovation Policy Package excels.

Table 3.1. Standout policy elements from each of the 12 jurisdictions

Jurisdiction	Standout Elements of the Policy Package
California	Overall country reduction targets, building code requirements for renovations, utility-funded energy efficiency programmes, market development for ESCO based energy efficiency programmes and training and education campaigns.
Denmark	Overall country reduction targets, building reduction targets, building code requirements for renovations, labelling schemes, taxation mechanisms, utility-funded energy efficiency programmes and training and education campaigns.
France	Overall country reduction targets, labelling schemes, incentive schemes (including tax rebates), and training and education campaigns
Germany	Overall country reduction targets, building reduction targets, building code requirements for renovations, labelling schemes, taxation mechanisms, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.
Massachusetts	Overall country reduction targets, building code requirements for renovations, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.
The Netherlands	Overall country reduction targets, labelling schemes, incentive schemes, taxation mechanisms, utility-funded energy efficiency programmes, training and education campaigns and a one-stop solution centre.
New Jersey	Overall country reduction targets, utility-funded energy efficiency programmes and training and education campaigns.
New York	Overall country reduction targets, incentive schemes, utility-funded energy efficiency programmes, market development schemes and training and education campaigns.
Oregon	Overall country reduction targets and building code requirements for renovation.
Sweden	Overall country reduction targets, building code requirements for renovation, labelling schemes, training and education campaigns and a one-stop solution centre.
United Kingdom	Overall country reduction targets, building code requirements for renovations, labelling schemes, incentive schemes (including tax rebates) and the Green Deal's one stop solution centre.
Vermont	Overall country reduction targets, utility-funded energy efficiency programmes and a one-stop solution centre.

DEVELOPING THE POLICY TOOL FOR RENOVATION

Overview

Ambitious and robust energy efficiency policies and supporting measures play a critical role in ensuring a significant reduction in both energy use and carbon emissions from buildings. By facilitating a detailed analysis of policy packages for renovation, this tool supports policy makers to understand the combinations of policies and supporting measures that have been successful in reducing energy consumption in renovated residential buildings in the selected countries/regions. By understanding how jurisdictions have designed and implemented these measures, policy makers can use this information to strengthen the development of ambitious renovation policy packages in the future.

The tool allows the user to develop his or her own analysis by selecting the criteria that are of interest. Policy packages can be compared using a single criterion or using multiple criteria. The tool allows the user to:
- Compare policy packages based on different criteria by selecting and deselecting criteria in the interactive tool area.
- Generate graphs based on time series data for energy performance in the respective countries/regions.
- Access detailed information about each of the policy packages.

Scoring Principles

With the support of a panel of international (the Scoring Committee) experts in the field, each of the twelve best practice policy packages have been scored against the defined "state-of-the-art" criteria to capture their current performance, enable their comparison and provide insight about what needs to be done to accelerate more and deeper renovation policies. A scoring system was devised with the help of the expert committee that used each of the sub-criteria as the basis for scoring each of the policy packages against each criteria. Each criterion was assigned a maximum score of ten points that were distributed according to the importance of the sub-criteria within the criteria. To receive a full 10 points for a specific criterion, the jurisdiction must have fully implemented the "state-of-the-art" policy measure and its implementation must be showing significant support towards the uptake of deep renovation. No jurisdiction was awarded a maximum score of 10 for any criterion. The table below gives an example of the scoring matrix of the scoring system used to weigh each jurisdiction. The table shows the system used to score each jurisdiction on criterion 1: Overall National Targets.

Table 4.1 Scoring Matrix (Further matrices of each criteria and related scoring can be found in the appendices)

Theme 1 – Regulatory Normative Measures		
Criterion 1: Overall country reduction targets	**Max Score**	**Explanation**
How committed to the target is the region?	**3**	Binding target/political agreement on national targets (3 points) Part of strategy/strongly committing policy papers (2 points) Vague declaration (1 point)
How ambitious is the reduction target?	**4**	<40% (0.5 points) 40-60% (1 point) 60-80% by 2050 (2 points) 80-100% by 2050 (3 points) 100% + by 2050 (4 points)
Is the target achievable?	**3**	Strong action taken, reductions seen (3 points) Clear & realistic roadmap & actions taken (2 points) Little action taken (1 point)
Total Possible Awarded Points:	**10**	

A Scoring Committee was assigned to award the scores to each jurisdiction. This ensured the process was not biased and removed any subjectivity from the scoring process. During a One-Day Workshop the Scoring Committee awarded each sub-criterion within each of the policy packages a score that reflected the jurisdiction's progress in that field.

Each jurisdiction was awarded a score by the Scoring Committee that was then reviewed against each of the other jurisdictions, with a view to eliminating any unrepresentative scores.

Interactive Tool

The final scores for each jurisdiction were entered online into the back end of the Policy Tool for Renovation. The scores for each jurisdiction are illustrated in the Policy Tool for Renovation "Interactive Tool" area. Users of the tool are encouraged to play with the tool by selecting and deselecting different elements of the criteria. The overall score of a jurisdiction will change when specific elements of the policy package are selected and deselected. Figure 4.1 illustrates the interactive element of the Policy Tool for Renovation.

Figure 4.1. Image of GBPN Policy Tool for Renovation (All criteria selected)
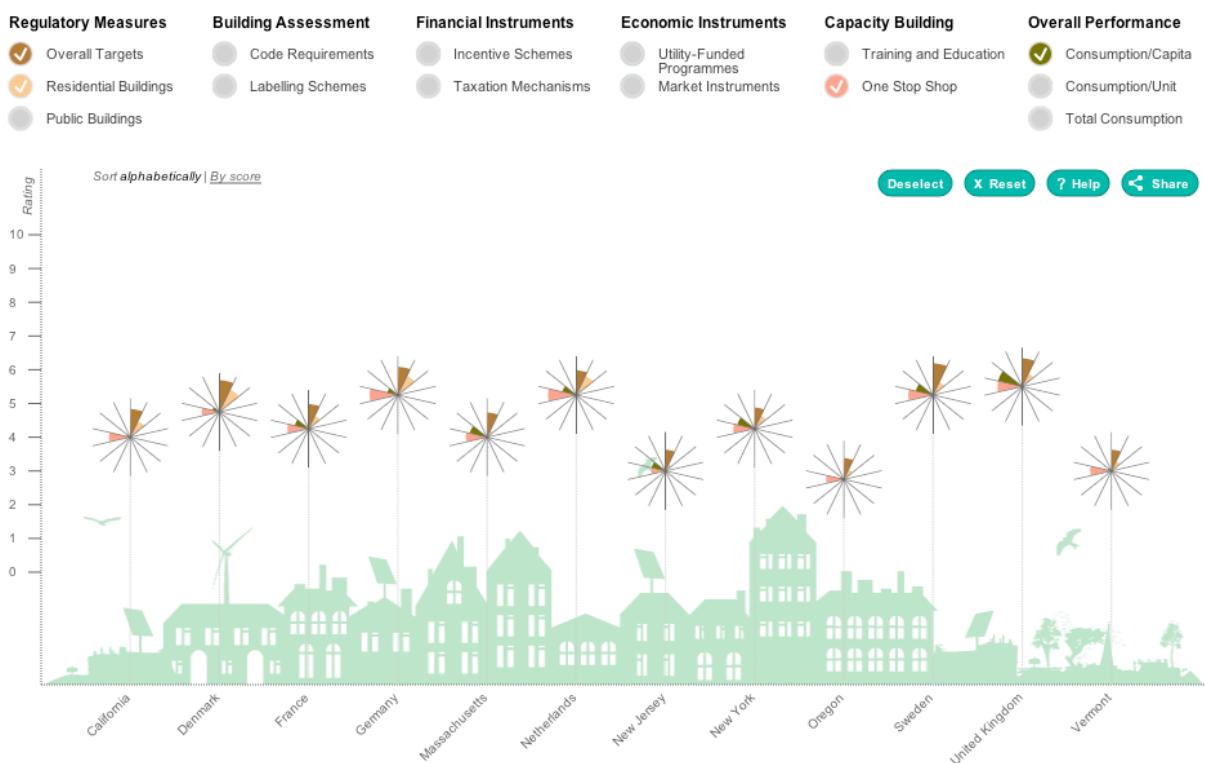
Figure 4.2. Image of GBPN Policy Tool for Renovation (4 criteria selected)

Generate Graphs

It is possible to generate graphs using data that was collected to analyse each of the jurisdiction's consumption indicators. The graphs show a change in energy consumption over time, the base year (2000) is indexed to 100. It is possible to compare the data in two ways:

- Single energy consumption variable across multiple countries/regions.
- Multiple variables in a single country or region.

The possible variables for selection include:

- Total Consumption
- Consumption per GDP
- Consumption per Capita
- Consumption per floor area
- Consumption per dwelling
- Population
- Floor Area
- Number of dwellings
- GDP

Policy Packages

This area of the online tool provides the user with a full set of information on each of the jurisdiction's policy elements.

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CONCLUSIONS

The main outcomes of the GBPN project has been the development of a set of fourteen criteria that define the key elements of a best practice policy package for the renovation of residential buildings. With the support of a panel of international experts in the field of energy renovation, twelve best practice policy packages have been scored against the criteria to capture their current performance, enable comparison and provide insight into what needs to be done to accelerate more and deeper renovation policies and supporting elements.

The results of the research are represented in an online tool that allows the interactive visualisation of the scoring of each jurisdiction under each criterion. The tool facilitates comparisons between the jurisdictions and allows users access to detailed information as well as a generate graphs section that is based on time series data against normalised energy performance indicators in the respective countries/states. The tool's purpose is to strengthen today's renovation policy packages and encourage the adoption and upscale the implementation of "best practice" policy packages around the world.

Key findings of the tool

A number of key findings have emerged from the research completed by the GBPN:

1. Energy renovation policy is an emerging field and there is scope for further progress. The tool shows elements where positive steps have been taken and where countries and states can learn from these actions.

   In many cases, the experts in the scoring committee weighed a jurisdiction with a maximum score of 5 out of 10. Showing that, although advancement has been made there is still scope for further progress especially concerning deep renovation.

2. Ambitious policy packages must respond to the dynamic nature of the building sector. Meaning that polices need to be based on long-term targets and elements need to be updated on regular basis as technologies and measures improve.

3. The countries and states that were successful in reducing all consumption indicators were found to have holistic policy packages in place that address many aspects of the renovation process.

   The current best practice regions use a combination of measures to complement each other to support the reduction of their residential building sector's energy consumption.

4. There is no such thing as an existing overall "best" policy package and all countries and states can benefit from best practice sharing.

   The results of the tool show that some jurisdictions have scored well in one criterion while others have scored better in other criteria. The tool allows an understanding of where jurisdictions have performed well and also where they could improve.

5. Financial mechanisms need to be locally adapted and linked to the state of the existing building stock, availability of technologies and broader national renovation strategies.

   National incentives and taxation mechanisms are widely used in the European countries whereas utility-funded and ESCO based mechanisms are used more frequently in American states.

6. Among the current best practice renovation policies, although national targets for reductions of energy and CO_2

emissions have been set, there is a general absence of clear and ambitious targets for the renovation of the existing building stock.

Many of the jurisdictions lack the presence of short-term implementation plans or roadmaps to lead the way to realising their overall national targets.

7. Most of the selected countries and states have not yet set building renovation targets for the public sector.

Public sector building targets were deemed as an essential criterion to be included in the state of the art criteria for a renovation policy package. They are required to lead the way and to foster market transformation for energy renovation in a jurisdiction.

The GBPN research 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 adapted to their local context.

The tool will be used as the basis for further capacity building in the area of renovation policy, the Policy Tool for Renovation being the first project in a series of activities on "how to" upscale more and deeper renovations. Following on from the Interactive Tool, a series of Webinars will be held that will be based on the findings from the Policy Tool for Renovation. Lastly, some of the best performing policy packages for renovation will be studied more deeply and presented as a case study report.

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ANNEX ONE – SCORING MATRICES

Theme 1 – Regulatory Normative Measures	Max Score	Explanatory Note
Criterion 1: Overall National Targets		
How committed to the target is the region?	3	Binding target/political agreement on national targets (3 points) Part of strategy/strongly committing policy papers (2 points) Vague declaration (1 point)
How ambitious is the reduction target?	4	<40% (0.5 points) 40-60% (1 point) 60-80% by 2050 (2 points) 80-100% by 2050 (3 points) 100% + by 2050 (4 points)
Is the target achievable?	3	Strong action taken, reductions seen (3 points) Clear & realistic roadmap & actions taken (2 points) Little action taken (1 point)
Total Possible Awarded Points:	10	

Theme 1 – Regulatory Normative Measures	Max Score	Explanatory Note
Criterion 2: Building & Renovation Targets		
Has the Government set national / subnational carbon / energy / energy efficiency reduction targets for the overall building stock?	3	If there is an official reduction target set then a score of 3 can be given providing that the target is long-term (1 point) and that there are intermediate milestones in place (1 point). An idea / opinion (1 point).
Are renovation targets included in the national / subnational carbon / energy / energy efficiency targets (no. of buildings or floor area, renovation rate and level of renovation)?	3	If there is an official renovation reduction target set then a score of 3 can be given providing that the target is long-term (1 point) and that there are intermediate milestones in place (1 point). An idea / option (1 point). Are these targets strong enough to significantly contribute to national reduction targets?
Is there a roadmap leading to these targets?	4	Is the roadmap binding and realistic? If so, a score of 3 points can be given. If one of the two is true, the jurisdiction will score 2 points. If it's just an idea / option then it gets 1 point. Link to roadmap.
Total Score	10	

Theme 1 – Regulatory Normative Measures	Max Score	Explanatory Note
Criterion 3: Public Building Targets		
Has the Government set carbon/energy reduction targets for public buildings?	3	If there is an official reduction target set (3 points) The target is long-term (1 point) Intermediate milestones in place (1 point).
Are renovation targets included in the national carbon energy targets (no. of buildings, renovation rate and level of renovation)?	3	If there is an official renovation reduction target set then a score of 3 can be given providing that the target is long-term (1 point) and that there are intermediate milestones in place (1 point). An idea / option (1 point). Are these targets strong enough to significantly contribute to national reduction targets?
Is there a roadmap leading to these targets? Y/N (Description of roadmap). Do the roadmaps integrate energy performance of buildings with broader societal goals (social issues such as health, job creation, etc.)? Y/N	4	Is the roadmap binding and realistic? If so, a score of 3 points can be given. If one of the two is true, the jurisdiction will score 2 points. If it's just an idea / option then it gets 1 point. Link to roadmap.
Total Score	10	

Theme 2 – Building Assessment	Max Score	Explanatory Note
Criterion 4: Building codes include requirements for renovations		
Technical requirements: Stringent component-based requirements for renovations in the code?	3	The component-based requirements must be stringent, progressive and tight in order for the region to be awarded maximum points. Does the building code stipulate low maximum u-values for the most important building parts (at least walls, floors, roofs, windows/skylights and doors).
		Does the code stipulate low maximum psi-values or is thermal bridging included in the building envelope calculation?
		Are the u-values established relevant to the climate? Are they low compared to international best practice? Close to best to get full score! How well is this supported for existing buildings - does they follow trend on new? Otherwise minus 0.5 (max 0.5 points)
		Does the code require a strict level of air-tightness including testing?
Holistic approach: Are there performance-based requirements for renovations in the code? Frame requirements	3	Overall performance targets covered by the code would give an automatic 3 points. If the code is partially performance-based or ambitious it will score 2 points. (Questions to help the scoring process: Does the code set an overall performance frame for buildings (kWh/m2 per year)? Does the code take primary energy use, GHG emissions or peak loads into account? Does the calculation take passive heating, passive cooling, natural ventilation, natural light and shading or other natural elements into account?) Model frame approach (2 points).

Implementation: good enforcement that support the code?	3	Strict and sound compliance mechanism set up (1 points)? Including penalties (2 points)? It's critical; and very cost effective step, without which, none of the other criteria in this section matter.
Dynamic codes	1	Has the code set zero energy targets for the future (are there binding targets based on a roadmap, which are achievable, realistic and relevant to the country/region and state of the market) (0.5 points)? Is there regular and frequent revision cycles (0.5 points)?
Total Score	10	

Theme 2 – Building Assessment	Max Score	Explanatory Note
Criterion 5: Labelling Schemes		
Is there a mandatory certification scheme for buildings in place?	2	Does this cover most of the building stock? Specific types of buildings? What percentage of the building stock is covered by this scheme is this significant?
Are there voluntary certification schemes set up in the country/state?	2	What percentage of the building stock is covered by this scheme, is this significant? Do they encourage for renovations to be better than the minimum standard? Most important factor for voluntary labelling schemes: the more ambitious the scheme is beyond minimum standard the more it will be awarded. An ambitious scheme should be close to 25% or above. If new should demonstrate that 25 % is within range if continues for some years.
How frequently are certificates issued / renewed (are certificates available at time of rent or sale or every number of years)? Is there a publically available register of the energy performance of buildings?	2	Frequency of issued and renewed certificates (1 point). Are certificates available at time of rent or sale or every number of years (1 point). Is there a publically available register of the energy performance of buildings (1 point).
What is the methodology when issuing certificate? Are **energy audits** the primary means for certifying a building? Are there training schemes set up for accreditors?	3	Higher points awarded to the more reliable measuring system - energy audit would be given the maximum points, a self-assessment would be given 0. (To secure the robustness of the assessment we are looking for: liability assurance, accreditor is recognised by a certified organisation). An important point to check is the methodology to issue the certificate. Is it based on consumption data or on experts estimates
Are there penalties for failure to comply, and are these enforced?	1	How often the penalties have been applied?
Total Score	10	

Theme 3 - Financial Instruments	Max Score	Explanatory Note
Criterion 6: Incentive Schemes		

Are loans / subsidies / grants available for renovation of buildings and are they ambitious?	3	Maximum points awarded to schemes that are ambitious, see questions below. Long term loans only could deliver deep renovation - are the offered loans / subsidies / grants long-term? How much is the total funding per capita?
		Is there a target number/percentage of buildings to be covered by the incentive?
		How many buildings have been covered?
		Is a holistic approach taken?
		What parts of the building are covered?
		Integration of programmes (is it easy for consumers to find information from a single program or portal?
Are the incentives included in a long-term action plan?	2	Official plan: 2 points
On what basis is the incentive distributed: "Conditionality" (only access to funds is allowed if substantial savings will be provided) and or "Progressivity" (more financing for the most ambitious renovations)? Are the offered incentives based on long-term support?	4	2 points if the instrument is based on conditionality and 2 if it is based on progressivity.
Are funding mechanisms promoting the involvement of private financing to leverage investments?	1	
Total Score	10	

Theme 3 - Financial Instruments	Max Score	Explanatory Note
Criterion 7: Taxation Mechanisms		
a) Are tax exemptions, differentiations and/or reductions set up and is it ambitious?	3	Maximum points awarded to schemes that are ambitious, see questions below. How much is the total funding per capita?
		Is there a target number/percentage of buildings to be covered by the incentive?
		How many buildings have been covered?
		Is a holistic approach taken?
		What parts of the building are covered? High percentage payback?
Tax credit for a holistic renovation or specific components?	2	Y/P/N
b) Is there a carbon/energy taxing system set up?	4	Is there a fixed charge/tonne of emission / energy produced? Is it ambitious? Who does the tax apply to?
Is the tax ring-fenced (invested back into efficiency)?	1	Y/N
Total Score	10	

Theme 4 - Economic Instruments	Max Score	Explanatory Note

Criterion 8: Utility-Funded Programmes

Question	Max Score	Explanatory Note
Does the scheme cover a large part of the consumers and does it of a significant size? Who is eligible? Residential, commercial, both?	4	Is there a regulatory requirement for the utility to invest in efficiency (otherwise, the utility may reduce or stop funding in bad years)? Points are awarded depending on the size of the programme - energy or CO2 or USD per capita or per used MWh?
Does the system cover all parts of energy efficiency improvements of buildings and does it support more holistic approach? What energy saving measures will be provided?	2	Holistic measures will score the maximum of 2 points. Substantial parts building parts and systems covered will give 1 point. How well the utility funded programs are aligned with the government established goals and processes? If the utility has good programs but they are not well integrated with public goals they could end up working at cross-purposes.
If subsidies are given are these significant? Up to what percentage of the cost do the utilities pay?	2	"Significant"=The greater percentage of the renovation paid by utilities the more points will be allocated.
Is the funding conditional and progressive: Does the funding increase the deeper the retrofit?	2	Y / Partially / N. How is deepness measured - projected or actual savings?
Total Score	10	

Theme 4 - Economic Instruments	Max Score	Explanatory Note

Criterion 9: Market Instruments

Question	Max Score	Explanatory Note
Is there a significant market for energy savings performance contracting / energy performance contracting system set up?	4	The number of allocated points will go to the jurisdictions where the size of market can be compared to the size of the jurisdiction. Possibly a simplified way of capturing this might be to use two questions: are there standardized contract types in the ESPC industry? What is the average contract period?
Is the ESCOs market for energy renovations well developed and does it cover most parts of building and the technical system?	2	Y / P / N
Do ESCOs work on the projects related to deeper energy efficient renovation?	2	Y / P / N
Are targets for energy savings backed up by policies and ambitious public targets (a quantitative target for EE improvement and linked to ESCO funding) that include a system for monitoring and verifying savings?	2	Y / P / N
Total Score	10	

Theme 5 - Capacity Building	Max Score	Explanatory Note

Criterion 10: Training and education Campaigns

Information provided to consumers and market parties?	2	Are consumers and market parties provided with energy saving advice and information about relevant incentives and campaigns for energy efficient renovation? Do these programmes include information for both owners and tenants and professionals?
Training activities and accreditation bodies in jurisdiction?	4	Are there *training activitie*s and accreditation bodies in your region set up for building specialists (e.g. engineers, architects, inspectors, installers, builders, etc.) to increase and ensure their technical capacity for deep renovations?
Training and education materials?	4	Have training and *educational materials* been developed for use in professional training and universities? Additional points for information on deep renovation.
Total Score	10	

Theme 5 - Capacity Building	Max Score	Explanatory Note
Criterion 11: One Stop Solution Centre		
Is there a public/national agency/coordinator?	4	Is there a public/national agency/coordinator supporting energy efficiency renovation activity in the jurisdiction?
Doe they provide advice, financing, quality control, safeguarding etc.?	3	Are they providing advice, financing, quality control, safeguarding… Is there support available for individuals and/or large-scale investors?
Public-private partnership (PPP)?	2	Is there a successful track record of implementing/delivering deep renovation projects through public-private partnerships (PPP)?
Demonstration Projects?	1	Demonstration projects for progressive deep renovations in the region?
Total Score	10	

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