Policy scenarios and recommendations on nZEB, deep renovation and RES-H/C diffusion: the case of Bulgaria

D4.3and D5.6 from Entranze Project

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ENTRANZE Project

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Project consortium:

EEG	Energy Economics Group Institute ofPower Systems and Energy Econom-icsVienna University of Technology
NCRC	National Consumer Research Centre
Fraunhofer	Fraunhofer Society for the advancement of applied research
CENER	National Renewable Energy Centre
eERG	end use Efficiency Research Group, Politecnico di Milano
Oeko	Öko-Institut
SOFENA	Sofia Energy Agency
BPIE	Buildings Performance Institute Europe
Enerdata	Enerdata
SEVEn	SEVEn, The Energy Efficiency Center

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The ENTRANZE project

The objective of the ENTRANZE project is to actively support policy making by providing the required data, analysis and guidelines to achieve a fast and strong penetration of nZEB and RES-H/C within the existing national building stocks. The project intends to connect building experts from European research and academia to national decision makers and key stakeholders with a view to build ambitious, but reality proof, policies and roadmaps.

The core part of the project is the dialogue with policy makers and experts and will focus on nine countries, covering >60% of the EU-27 building stock. Data, scenarios and recommendations will also be provided for EU-27 (+ Croatia and Serbia).

This report provides model based policy scenarios and related recommendations for Bulgaria. The input data and results were discussed intensively with policy makers and stakeholders. Similar reports are available for all target countries of the project ENTRANZE, which are Austria, Bulgaria, Czech Republic, Germany, Spain, Finland, France, Italy and Romania.

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Executive Summary

This paper describes the methodology and results of policy scenario simulations for Bulgaria and recommendations prepared within the ENTRANZE project.

In May 2012, after the official lunch of ENTRANZE project, the national policy group for the consultation of scenario development and policy recommendations on nearly zero energy buildings in Bulgaria was established. Several consultations were held with policy maker and other stakeholders from national, regional and local authorities, universities, chambers of architects and engineers, installers and other NGOs. The meetings organized and expert discussions included analysis of the building stock and existing data on energy performance and energy efficient and RES technologies from one side and from the other the results of other studies carried out in the course of the project, especially the analyses of barriers for investors and cost optimality calculations for renovations. The policy sets have been discussed and revised several times during policy group meetings and after discussions within ENTRANZE consortium. The impacts of the policy scenario have then been simulated with the Invert/EE-Labmodel. Finally, recommendations have been derived from the results of the calculation and discussed by the policy group.

For Bulgaria the following three policy scenarios were discussed and proposed:

1) The first policy set is connected to the so called “base model”. That means continuing the policies in the building sector without further changes and development.
2) The second policy set is connected to introduction of stronger and strict building codes up to 2015 along with financial instruments and stimulus. This policy set is referred to “Medium Term Policies”.
3) The third policy set, called “Policies in 2 steps +”, is connected to introduction of stronger and strict building codes in 2 following stages in 2015 and in 2020 again along with financial instruments for support but also in conjunction with pilot buildings (as good examples) and broad information campaigns.

The main issues discussed during the policy group meetings were related with the problems of the renovation process and the importance of introduction of green building design practices and principles in our legislation. The issues of financial supporting and incentives for renovation of buildings were also highlighted as a critical factor for accelerating the rate of rehabilitation of the existing stock. The main focus of the policy sets were on the existing building stock and how to ensure good quality and quantity of renovated buildings. Another important barrier to be focused in the policy set is the problem of getting agreement of all owners and implementing major renovation activities in multifamily buildings.

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The following main findings have been obtained:

- The energy demand for space and water heating is expected to decrease by up to 17-23% (depending on the energy prices)in 2030 compared to 2008 level in the optimistic “Policies in 2 steps +” scenario. In the business as usual scenario (BAU), demand would be reduced by 11-16%in 2030.
- There is an increasing role of renewables in building heating energy demand.
- The envisaged increase in the renovation rates vary between detached single family houses (from 0.11% for Policy Set 1 to 0.58% for Policy Set 3) and multi-family houses for example (from 0.45% for Policy Set 1 to 0.79% for Policy Set 3) as in case of high energy price further increase can be expected.
- The scenarios foresee investments between 6 and 14 billion EUR in the building sector for the period till 2030.

The Bulgarian ENTRANZE Policy Group elaborated the following policy principles to be proposed for the national policy for the building sector:

1. Introduction of building codes with stronger requirements for energy performance characteristics and use of RES at one stage in 2015 or at two stages – in 2015 and in 2020. Changes in the legislation for home owners associations are also necessary in order to ensure minimum level of agreement and mechanisms for implementation of energy renovation measures in case the majority of owners agree to undertake such measures.
2. Ensuring financial support – the use of currently available local, national and EU funds and in addition mobilisation of public private partnership initiatives (including ESCOs), soft bank loans and further tax reduction. The effective implementation of energy saving obligations for the energy suppliers has been also considered an important support instrument for buildings renovation.
3. Capacity building and training for professionals were also proposed as a necessary guarantee for improving the quality of construction work and consequently to ensure in this way the sustainability of the results.
4. Information and awareness raising campaigns are important to overcoming many market barriers for new energy efficient and renewable technologies and to ensure good quality of renovation of the buildings stock.

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1. Introduction

A key element for investigating the potential future impact of policy instruments and for deriving policy recommendations in ENTRANZE is the development of policy scenarios. These scenarios have been simulated so as to project the development of the building stock and its energy demand in the EU-27 (+Croatia and Serbia) up to 2030, with a specific focus on 9 countries, referred later as "target countries"[1]. In particular, the future deployment of Nearly Zero Energy Buildings and RES-H/C in the EU building stock is investigated and corresponding cost, expenditures and benefits are assessed. The impacts of different policy instruments on the diffusion process and the building related energy demand are investigated, considering economic, technical, non-technical and institutional barriers and rebound-effects. The impact of the scenarios has been simulated until the year 2030, with a particular focus on the year 2020, according to the target setting of the EPBD and the RED.

For each target country, a set of at least three different policy scenarios has been developed. These policy scenarios have been defined according to the specific needs, ideas and suggestions of the policy makers and stakeholders involved in the national discussion processes, the so called "policy group". These policy scenarios have been then been simulated with the Invert/EE-Lab model and associated to 2 scenarios of international prices

Bulgarian policy group was set by SOFENA in May 2012 and included 3 university professors, 3 experts from ministries and the State Sustainable Energy Development Agency, and 7 experts from NGOs like professional organizations and energy agencies. Most of them participated to all meetings, providing valuable feedback and recommendations on the basic information and on the policy sets and scenarios development.

Four policy group meetings were held in Bulgaria. Members were informed about the recent project developments, results and publications of ENTRANZE. During the discussions and expert work the proposals for policy sets for Bulgaria were presented. Part of the discussions was also the state of art in other EU countries and what type or policy instruments were applicable for Bulgaria.

This report provides a summary of these national policy scenarios as well as corresponding conclusions and recommendations.

[1]Austria, Bulgaria, Czech Republic, Germany, Spain, Finland, France, Italy and Romania.

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The report starts with a documentation of the methodology in chapter 2. Chapter 3 provides the policy sets which were defined in the policy group meetings. Chapter 4 presents the resulting scenarios in terms of energy demand projections and related renovation activities in the building stock. Finally, chapter 5 includes the recommendations.

2. Methodology

The methodology of the ENTRANZE project is based on three pillars:

1. The selection and description of policy scenarios based on a participatory stakeholder process;
2. The modelling of the impact of these policy sets with the Invert/EE-Lab model;
3. Preparation of recommendations

In the following chapters the methodology behind the three pillars will be explained in more detail.

2.1 Pillar 1: Methodology for selection and description of policy sets

The selection of policy sets for the scenario calculation relied on the results of the previous activities in the project, especially the study on public and socialacceptance and perception of nearly zero-energy buildings and RES-H/C, the cost optimality calculation and the analysis of specific barriers for different types of buildings and ownership groups (Table 1). The policies were selected so as to most effectively address and overcome these barriers. All results of the previous work have been discussed with the policy group members in policy group meetings and bilateral discussions. Additionally expert interviews have been carried out. Finally, the current policy measures have been considered, and the policy scenarios have been set up following discussions in the policy group.

Table 1: Barriers for different types of buildings and ownership groups

Building type, target group respectively	Barriers
Owner-occupied single-family homes	Financial barriers: high initial investment costs for refurbishment measures at the building structure or for improving or replacing the heating system as well as the access to capital or the cost of capital. long payback times.
Owner-occupied multi-family buildings	Financial barriers: high initial costs and long payback periods Difficulty of taking decisions about refurbishment measures due to the different nature of owners in such buildings
Rental buildings owned by private or social companies	Financial barriers do still apply: mainly the long payback times and the access to capital.

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Other general barriers, concerning all target groups, include[2]

- information deficits about the economic benefits from refurbishment measures, and the availability of support schemes;
- legal and technical barriers, such as the low value of some buildings, the uncertainty of the long-term value of a property, and sometimes the poor quality of refurbishment measures.

2.2 Pillar 2: Methodology for modelling policy impact in Invert/EE-Lab

Invert/EE-Lab is a dynamic bottom-up simulation tool that evaluates the effects of different settings of economic and regulatory incentives and consumer and behavior on the total energy demand, energy mix, CO2 reductions and costs for space heating, cooling and hot water in buildings. More information is available on www.invert.at or e.g. in (Kranzl et al., 2013) or (Müller, 2012).

2.2.1 General approach of modelling policy instruments in Invert/EE-Lab

Invert/EE-Lab models the decision making process of agents (i.e. building owner types) regarding building renovation and heating, hot water and cooling systems. Policy instruments may affect these decisions (in reality and in Invert/EE-Lab) in the following ways:

- Economic incentives change the economic effectiveness of different options and thus affect investment decisions. This change leads to higher market share of the supported technology in Invert/EE-Lab (via the nested logit approach).
- Regulatory instruments (e.g. building codes or renewable heat obligations) restrict the technological options that decision makers have: limited compliance with these measures can be taken into account by limiting the information level of different agents regarding this measure (see next bullet point).
- Information, advice, etc: agents have different levels of information; lack of information may lead to neglecting innovative technologies or to a lack of awareness regarding subsidies or other support policies. Information campaigns and advice can increase this level of information. Thus, the consideration of innovative technologies, knowledge about support programmes and compliance with regulatory standards increases.

[2] For more explanation see deliverable D2.4 (Heiskanen et al., 2012) and Deliverable D5.4 (Bürger, V., 2013).

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- R&D can push technological progress. The progress in terms of efficiency increase or cost reduction of technologies can be implemented in Invert/EE-Lab.

More specific examples of modelling policy instruments in Invert/EE-Lab are described in the annex of this report.

2.2.2 Key input data to the model

The Invert/EE-Lab model requires the following main categories of input data:

- **Disaggregated description of the building stock**: The scenarios presented in this report are based on the building stock data as described in the reports “Building sector and energy demand in target countries” and the corresponding online data tool, both available at www.entranze.eu.
- **Cost data of heating, hot water and cooling systems as well as of renovation options**: These data have been collected and checked with national experts and literature in the frame of the cost-optimality calculations. The background data and results of these techno-economic analyses are documented in the report on “Cost of energy efficiency measures in buildings refurbishment: a summary report on target countries” (Fernandez-Boneta, 2013) and the report on cost/energy curves (Pietrobon et al., 2013),both available at www.entranze.eu.
- **Definition of renovation packages:** As described above, for those measures leading to a reduction of the energy need (e.g. renovation of building envelope or heat recovery systems) Invert/EE-Lab requires a set of pre-defined renovation packages from which consumers or other investors, called “agents” may select. The selection and definition of these renovation packages was done based on the cost-optimality calculations in this project (Pietrobon et al., 2013) and the derived energy-cost matrices (Fernandez-Boneta, 2014). Based on these calculations, three packages have been selected: The standard renovation package more or less reflects the current practice of thermal building renovation, the “good” renovation package reflects a set of measures near the cost-optimality point whereas the “ambitious” renovation package refers to a level of renovation which is near the “minimum primary energy” level as indicated in Pietrobon et al., (2013). Annex **Fehler! Verweisquelle konnte nicht gefunden werden.**lists the main indicators for the renovation packages taken into account for the modelling and scenario development.

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2.2.3 Energy price scenarios and the link to the model POLES

Energy price scenarios are a highly relevant and sensitive input data for the Invert/EE-Lab model. POLES has been established. POLES developed two scenarios for the overall development of the global energy system that led to projections of international fuel prices:

The **"Reference"** scenario assumes that only on-going and already planned climate policies are taken into account and that no consensus is reached at international level. Sustained growth of China and other emerging countries is a powerful driver of energy demand at world level leading to high international oil and gas prices but to lower domestic prices. Energy prices for end-users at country level were then projected, taking into account changes in international prices and taxes (excise tax[3], VAT) and a carbon price[4].

The **"Ambitious Climate"** scenario explores the implications of more stringent climate policies and reinforced support for renewables at world level driven by successful. negotiations between advanced and emerging economies on climate change. International fossil fuel prices are lower as a result of a lower demand but domestic prices are higher due to higher taxes and the cost of policies to reach the emissions abatement targets.

The resulting two energy price scenarios were then used in Invert/EE-Lab as an input, as well as the corresponding primary energy factors and CO2-emission factors of electricity, based on POLES projections of the power mix and CO2 emissions by country. On the other hand, the results of the model Invert/EE-Lab were checked with POLES regarding the potential feedback loop on energy prices.

International prices

Over the 2010-2030 period, prices are expected to increase for oil, gas and coal. Trends are significantly stronger in the reference scenario, as in the ambitious scenario the demand for oil and gas is growing less rapidly resulting in lower tensions on the international markets. More details are available below by type of fuel for both scenarios.

[3]Including existing energy & environmental taxes.
[4]Carbon prices are different from EU ETS prices and refer to an aggregate metric in POLES used to characterise the effort necessary to reach climate objectives: they might be seen as "shadow prices" for policies stimulating low-carbon technologies.

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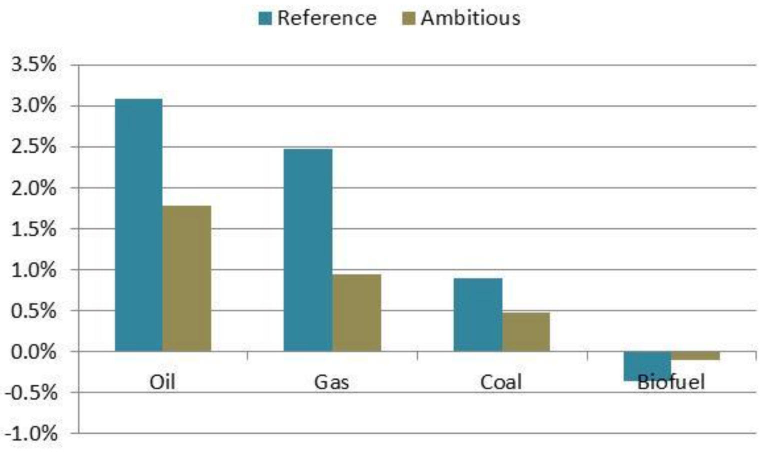
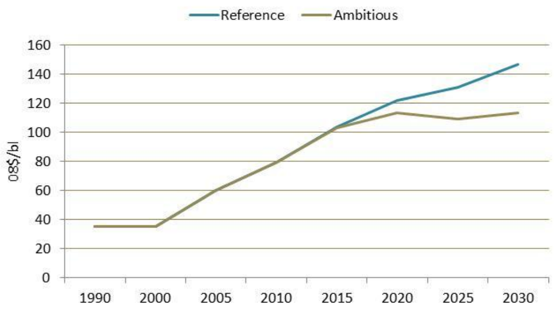


Figure 1: Annual growth rate of international energy price over 2010-2030

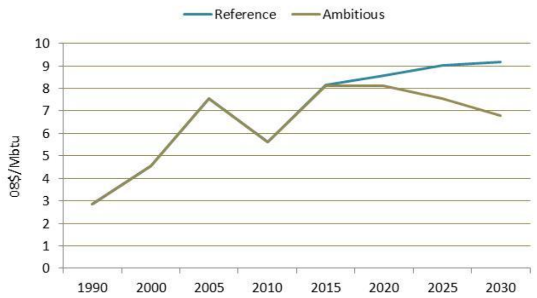
Source: POLES-Enerdata

Oil



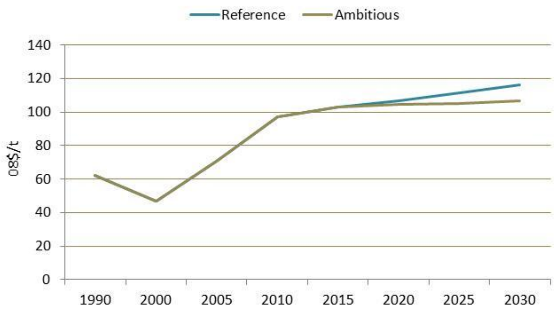
In the reference scenario, oil price is expected to increase at a rapid pace of 6.5%/year from 2000 until 2020, which will then slow down to 2%/year until 2030. In the ambitious scenario, it increases less rapidly until 2020 (3.6%/year), and remains almost steady reaching 100$/bl in 2030. This lower price is explained by the decreasing oil demand.

Gas



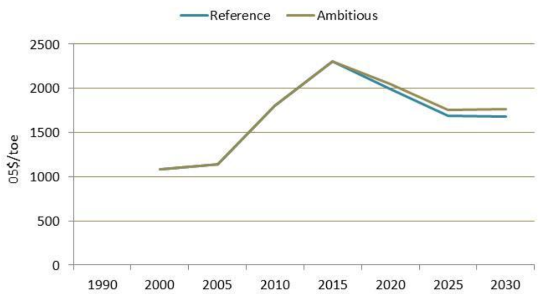
Gas price in Europe is expected to increase by 7.6%/year for both scenarios until 2015 (Figure 8). Then it will continue to increase on average until 2030 by 0.8%/year in the reference scenario whilst it is decreasing in the ambitious scenario by 1.2%/year because of decreasing demand.

Coal



Coal prices are expected to increase steadily across time in Europe, with a slightly less rapid trend concerning the ambitious scenario, i.e. 0.5%/year compared to 0.9%/year for the reference scenario. This price increases in both scenario is due the: the fact that production costs will increase with income in producing regions.

Biomass



After a short-term to increase due to the strong dynamic in biofuel demand in all sectors, the biomass price[5] will decrease by roughly 2%/year until 2025 thanks to market self-regulation. It will again slightly increase (until 2050) because of a strong penetration of biofuels, the high mitigation option.

Figure 2: European energy price forecasts until 2030

[5]Prices for biomass refer to modern biomass (i.e. pellets or wood chips).Prices are based on simulation of land use and international biomass trade, and unlike for other fuels they do not take into account historical prices

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Residential domestic prices[6]

Excise taxes and VAT have been assumed constant in these projections. Historical data for 2010 and 2011 come from Eurostat or IEA. Oil and gas prices are projected to increase by respectively 5.9% and 5.2%/year in the ambitious scenario over the period 2010-2030. In the reference scenario the progression will be lower because of lower carbon tax (2.9% and 1.5%/year respectively for oil and gas) (Figure 12).The coal price will increase rapidly in the ambitious scenario[6], by up to 9%/year, whereas it would decrease in the reference scenario by 2.3%/year.

The electricity price is modelled on the basis of the price of fossil fuels, the power mix and the cost of generation of electricity. It also includes taxes. The average price will increase by 2%/year in the ambitious scenario and by 0.8%/year in the reference one. The electricity price is expected to peak in 2030 at around 3 400 $05/toe (40 000 $05/MWh) in the ambitious scenario and at 2 500 $05/toe (30 000 $05/MWh) in the reference scenario.

Prices for biomass refer to modern biomass (i.e. pellets or wood chips). Prices are based on simulation of land use and international biomass trade, and unlike for other fuels they do not take into account historical prices. Thus it is best to use these prices as indexes for the evolution of biomass prices rather than use their absolute value. Biomass prices are slightly decreasing between 2010 and 2030

[6] Domestic prices are in constant euros (i.e. without inflation), from which you can derive an average variation by period.

[6]Trends are different across target countries, for instance the coal price is increasing by more than 10%/year for Bulgaria, Finland and the Czech Republic and up to18%/year in Romania over 2010-2030, while it increases by on average 5%/year in the other target countries.

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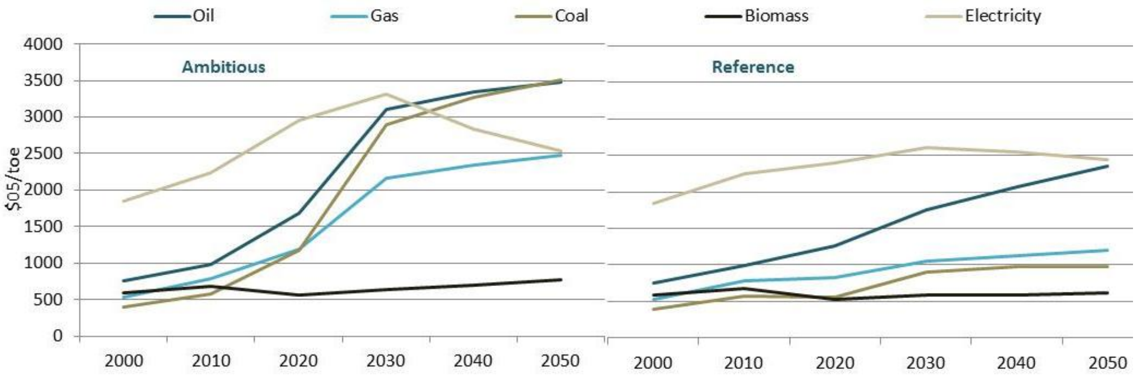

Figure 3: EU-27 residential domestic prices forecasts by type of energy until 2050

Source: POLES-Enerdata

2.3 Pillar 3: Methodology for deriving recommendations

The recommendations have been derived in close interaction with the stakeholders based on the results of the scenario calculation. Recommendations for other Member States were also considered.

The developed recommendations have been evaluated on the basis of the criteria listed in Table 2.

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Table 2: Selection of qualitative assessment criteria

Criteria	Key questions
Target achievement	To which extent is an instrument appropriate to achieve a quantifiable target (e.g. renovation rate, annual final/primary energy savings, GHG reduction)? For instance does BAU reach 30% of energy savings in 2030? Or the proactive scenario or CO2/energy tax can reduce 2008 consumption level by 40% in 2030?
Target compatibility	Can the instrument be designed as to incorporate incentives to steer investments into deep renovation measures that are compatible with the long-term needs? The BAU includes a bunch of incentive measures to boost renovation while the proactive scenario is going a step further by enforcing renovation concerning certain type of dwellings. What are the impact and the acceptability of these measures?
Type and strength of steering effects	Which steering effects are applied (e.g. steering effect by putting a financial burden or substantive duty on building owners or energy consumers; steering effect through the support regime) and how strong are they? Who is targeted by the instrument in the proactive scenario for instance? Who benefit the tax revenue in CO2/energy tax scenario?
Cost allocation	In case of financial support programs, e.g. CO2/energy tax scenario, who is finally providing the counter-financing (e.g. tax payer, energy consumers, building owners)? How does this relate to important environmental economic principles such as the polluters pays principle or generally the ability-to-pay principle? Does the instrument allow for avoiding asymmetric allocation burdens (e.g. allocating all costs to e.g. private households due to their generally low price elasticity of demand)? What is the rate of tax revenue distributed to target (e.g. social dwellings in the case of CO2/energy tax scenario)?

Source: Bürger/Klinski 2013 and Bürger/Varga 2009

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3. Policy set description

In this part of the report the policy sets which will be further investigated regarding their potential impact were described. An overview of existing policy measures in Bulgaria is presented, and some general considerations for the selection are set. The policy sets are defined according to the discussion process in the policy group meetings.

3.1 Overview of policy instruments for improving energy performance of buildings

Figure 5 gives an overview about the categories of existing policy instruments for the improvement of the energy condition of buildings. For more detailed information see the report “Overview and assessment of new and innovative integrated policy sets that aim at the nZEB standard” of the ENTRANZE-project (Bürger, 2013).

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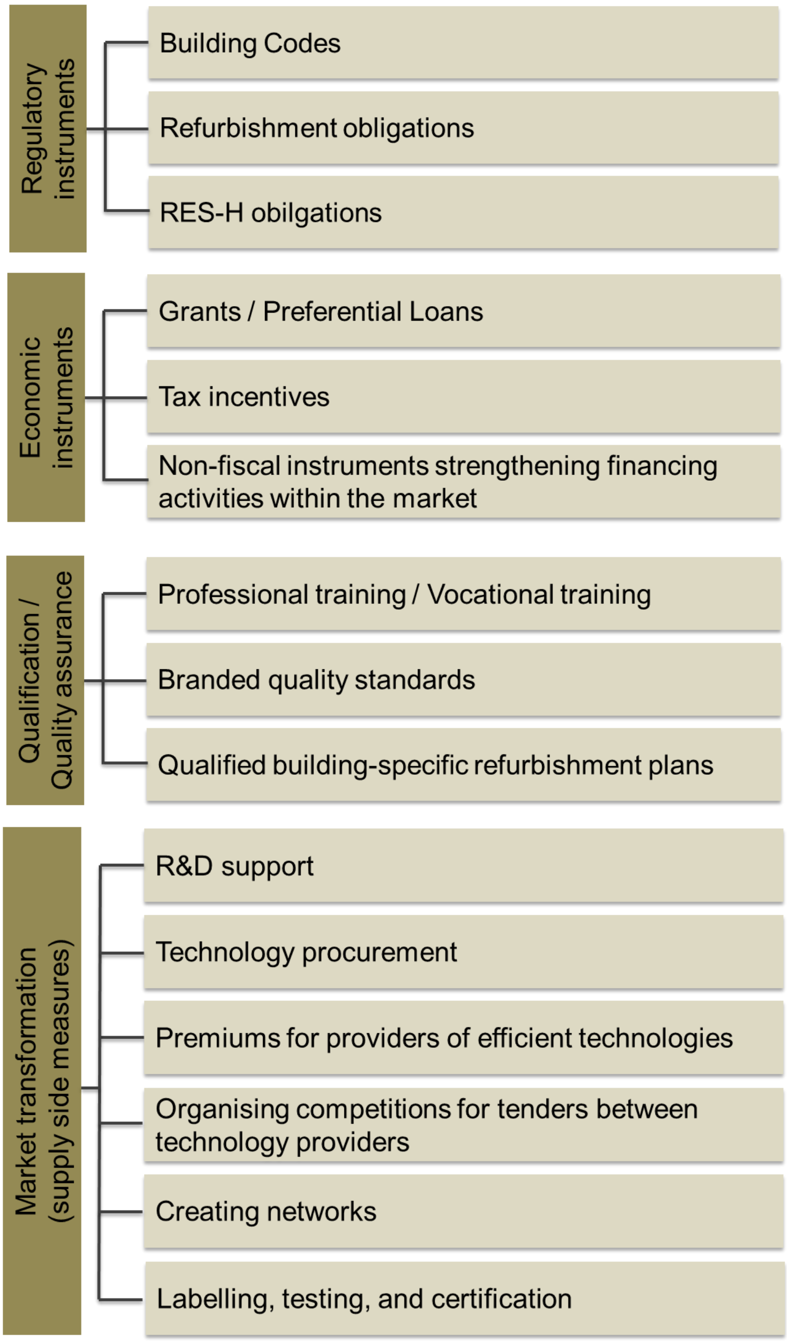

Figure 4: Categories of policy instruments (part 1)

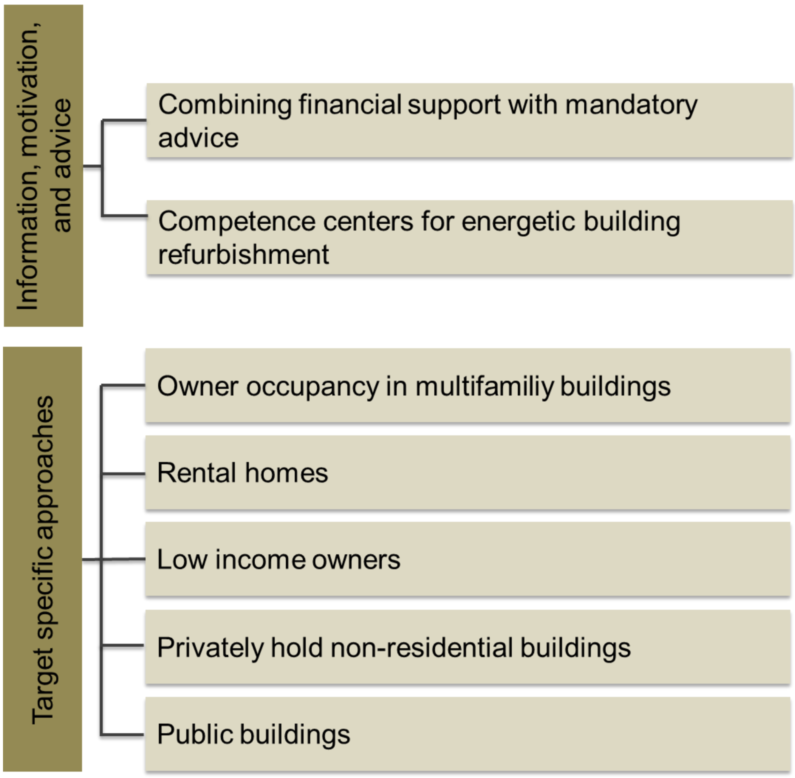

Figure 5: Categories of policy instruments (part 2)

For the combination of different instruments in a policy set some considerations should be taken into account:

- Instruments should be designed as to address the main barriers that hamper investments in the efficiency of buildings. In addition the policy package should include elements that enable to target the needs of the major target groups. The instruments in the policy package should reflect the market maturity of the different technologies.
- If a certain barrier (e.g. a financial barrier) is addressed by two or more instruments at the same time, this should be adequately justified (e.g. by the fact, that the instruments offer different accesses to financial support which might aim at different target groups). It should be avoided that instruments are simply redundant (which might only lead to higher administrative costs).
- In general administrative costs of a policy package should be kept as low as possible. This includes the transaction costs for the state but also all other system participants. For that reason it should be assessed to which extent syner-

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gies could be exploited when administering several instruments at the same time.

- In order to increase public acceptance for the communicative perspective the policy package should be kept as simple as possible. The main elements of a package should be easy to communicate.

3.2 Policy sets defined for the scenario calculation

Based on the portfolio of policy instruments and the considerations regarding the selection of policy packages, the policy group decided to analyse the following policy sets:

- “Base model” is the first policy set based on the “business as usual” model. The model means continuing the policies in the building sector without further changes and development.
- The second policy set “Medium Term Policies” envisages the introduction of stronger and strict building codes up to 2015 along with financial instruments and stimulus.
- The third policy set “Policies in 2 steps +”is connected to introduction of stronger and strict building codes in 2 following stages in 2015 and in 2020 again along with financial instruments for support but also in conjunction with pilot buildings (as good examples) and broad information campaigns.

Policy set 1 BASE MODEL	**Policy set 2** MEDIUM TERM POLICIES	**Policy set 3** POLICIES IN 2 STEPS+
1.Building performance requirements from 2009 + 2.Limited financial resources from the EU funds and state budget + 3. Sporadic information campaigns and capacity building initiatives	1.Legislative measures: • Stricter building codes from 2015 for new buildings and in case of major renovation (30% reduction of the U-values for the building components) • Legislation changes in the home owners legislation for ensuring major renovation if the majority of owners agree on this. + 2.EU funds and subsidies from the state budget and national funds. + 3.Information campaigns for households.	1.Legislative measures: • Stricter building codes from 2015 for new buildings and in case of major renovation and further strengthening in 2020 (20% additional reduction for the new buildings) • Legislation changes in the home owners legislation for ensuring major renovation if the majority of owners agree on this. + 2. EU funds and subsidies from the state budget and national funds with higher grant. Low interest loans to support the private sector. + 3. Introduction of energy saving obligation scheme – White Certificates. + 4. Wider information campaigns. + 5. Capacity building based on Build up skills ”models

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4. Model results

The models results are illustrated with graphics taken directly from the on line Entranze scenario result tool (http://www.entranze.eu/about/home). This tool provides the results of alternative policy scenarios in terms of development of the building stock and its energy demand in Bulgaria, at EU level and for 8 other target countries[7] up to 2030. The results can be displayed for 2 variants of domestic prices, as explained above.

4.1 Energy demand, energy mix and renewables

In the case of low price scenario, the energy demand for space and water heating is expected to decrease by 17% between 2008 and 2030 in the "Policies in 2 Steps+" scenario (Figure 6). In the business as usual scenario (BAU), the reduction is around 11% in 2030.

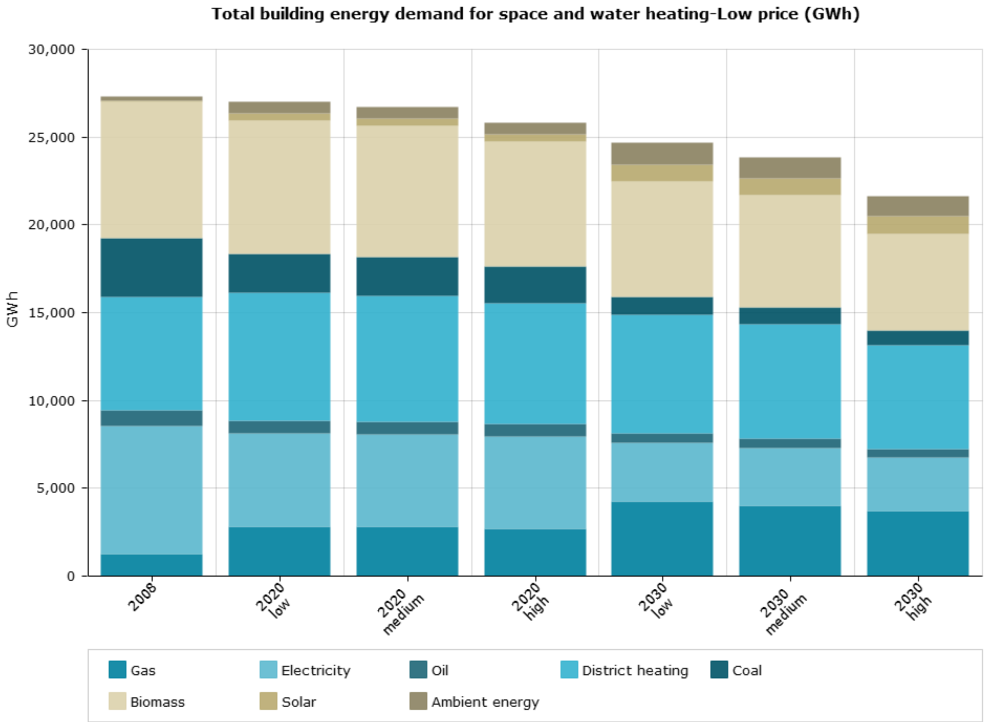

Figure 6: Bulgarian building energy demand for space & water heating-Low price

Source: Entranze

[7]Austria, Bulgaria, Czech Republic, Germany, Spain, Finland, Italy and Romania

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In the high price scenario, the energy consumption for space and water heating is decreasing more rapidly: by 18,5% between 2008 and 2030 in the "Medium Term Policies scenario, by 22,6% in "Policies in 2 Steps+" scenario.(Figure 7).

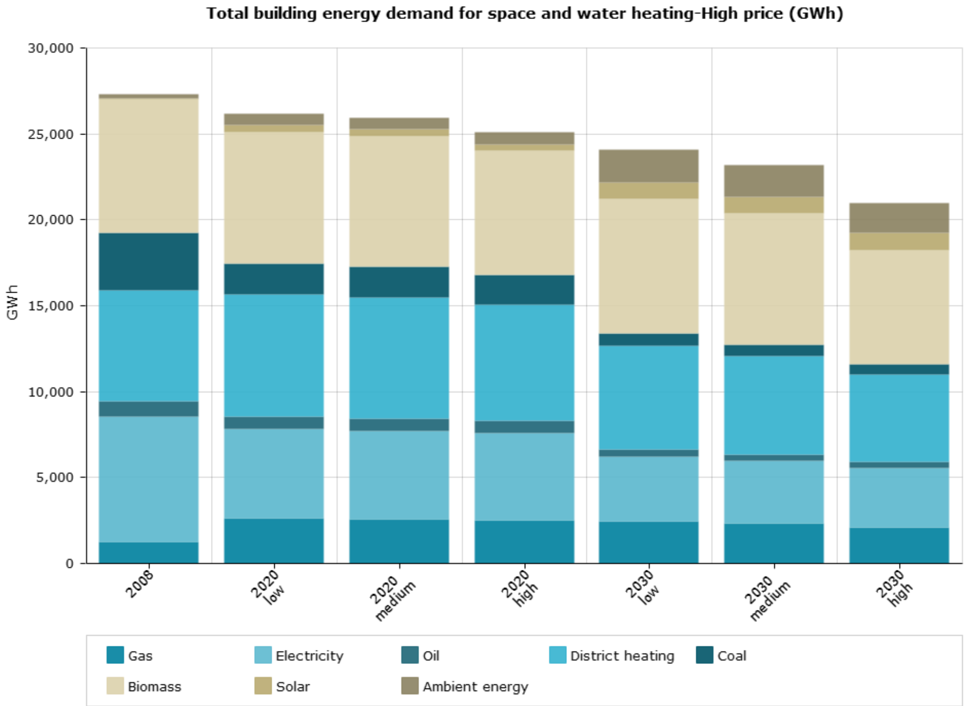

Figure 7: Bulgarian building energy demand for space & water heating-High price

Source: Entranze

The share of non-delivered energy (i.e. solar and ambient energy) is increasing over time from around 2% of final energy use in 2008 to around 10% (Figure 8).

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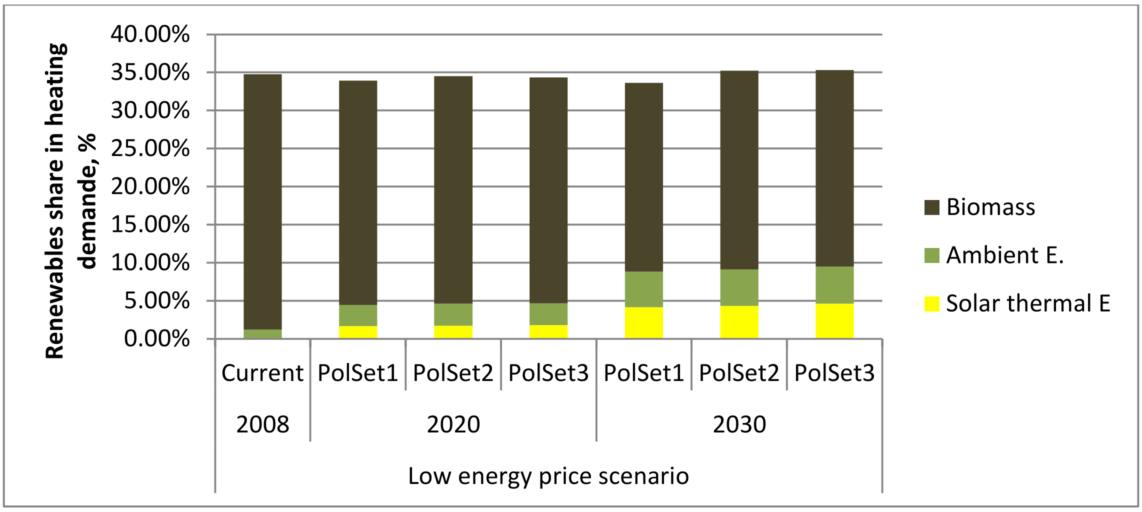

Figure 8: Renewables share in heating demand in Bulgaria

Source: Entranze

Heating energy demand is decreasing over time by 0.4% and 0.5%/year in BAU (according to price variant) between 2008 and in 2030, by 0.6-0.7 %/year in the “Medium Term Policies” scenario and up to 0.9 to 1.1%/year (according to price variant, Figure 9) in the “Policies in 2 steps+” scenario.

Consumption for air cooling is increasing by 265% over period 2008-2030 with the corresponding diffusion of this end-use.

Consumption for lighting is decreasing by 21 %/year in the BAU over the period 2008-2030, 24% in the “Medium Term Policies” scenario and up to 43% in the “Policies in 2 steps+” scenario. These different trends are due to different level of technology diffusion (LEDs, halogen lamps, etc).

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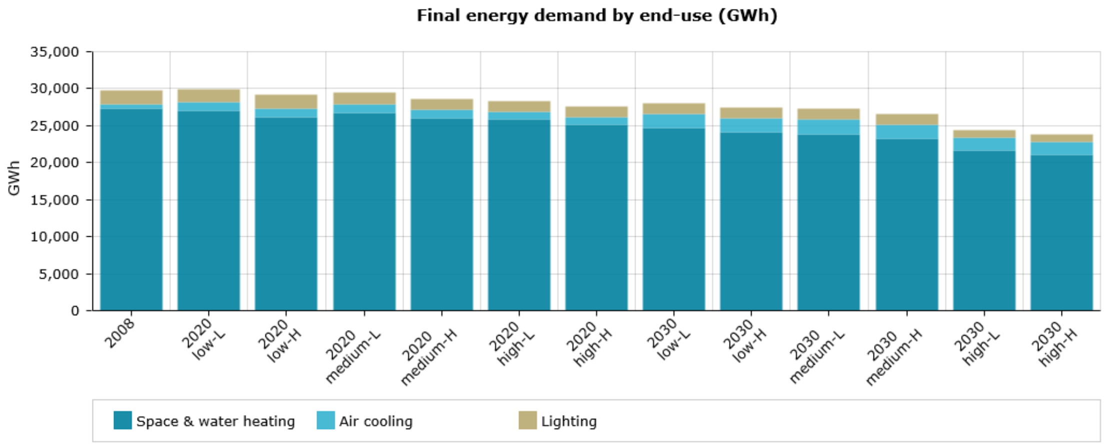

Figure 9: Final energy demand for heating, cooling and lighting in Bulgaria

Source: Entranze

Heating consumption per m² is decreasing in a range of 10% to 12% till 2030 in the BAU scenario according to price variant (Figure 8). The decrease is expected to be around 13-15% in "Medium Term Policies" scenario and in a range of 21 to 23 % in the "Policies in 2 Steps+" scenario according to price variant. Air cooling consumption per m² is expected to decrease as well by 3% for the period.

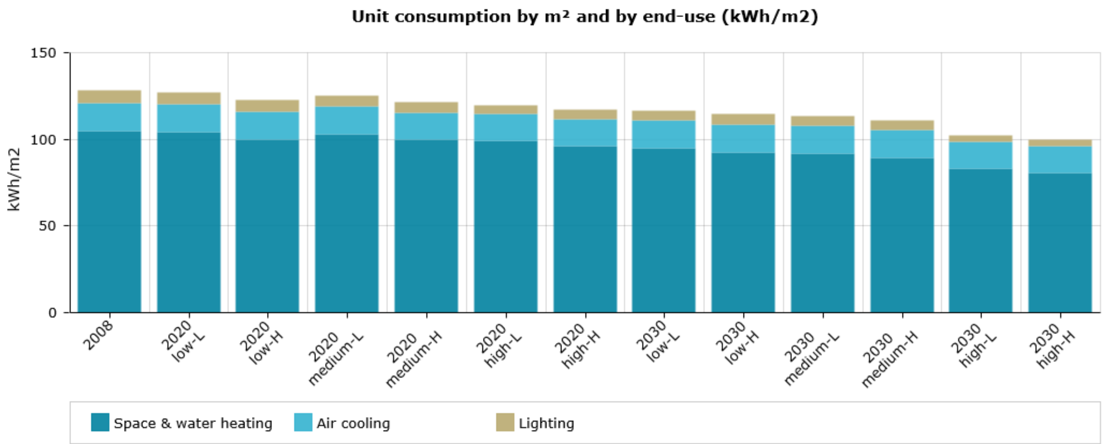

Figure 8: Unit consumption by m² in buildings for heating and cooling in Bulgaria

Source: Entranze

Energy savings are expected to be more important in residential sector – between 16 and 33% reduction for the period 2008-2030. For the non-residential buildings there is even expected increase by 4-5% of the energy consumption due to the increased comfort and consumption for space heating and DHW.

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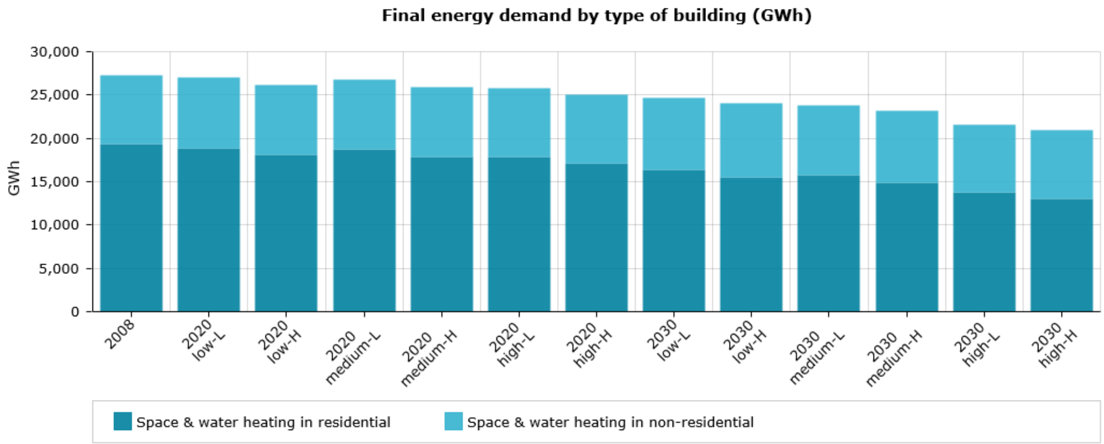

Figure 9: Final heating demand by type of building in Bulgaria

Source: Entranze

4.2 Renovation activities

The building stock renovated since 2008 is increasing over time differently according to the scenario. The ambitious scenario “Policies in 2 Steps +” foresees that in 2030 almost25% of the 2008 stock will be renovated with a strong share of deep (20%) and medium renovation (4%). Dynamics of renovation are much lower in BAU and “Medium Term Policies” scenario: around 4-8% of the stock will be renovated in 2030.

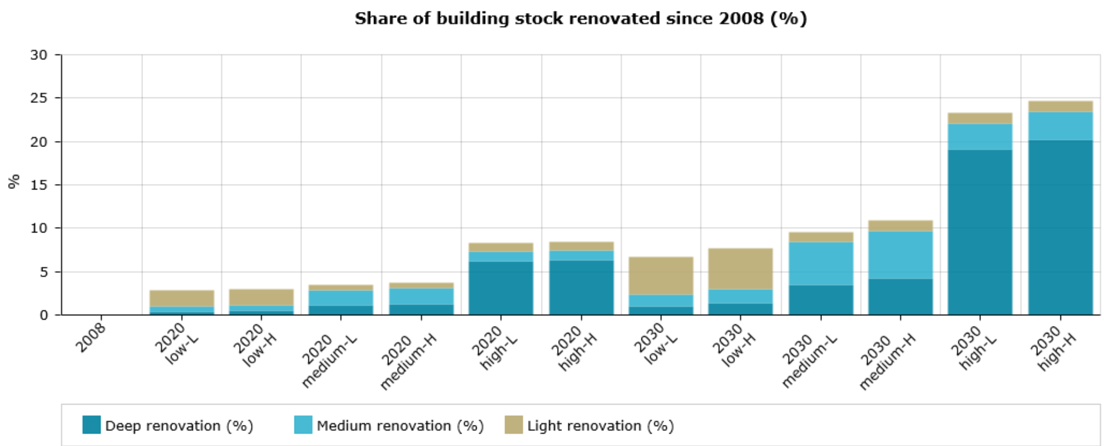

Figure 10: Share of building stock renovated since 2008 in Bulgaria

Source: Entranze

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4.3 Economic indicators, investments and public expenditures

A direct consequence of the renovation activities is that the induced investments are significantly higher in the proactive scenario (between €550 million and €780 million in 2030 according to price variant) compared to "Medium Term Policies" scenario (€250 million) or "Base Model" (€150 million, Figure 11).

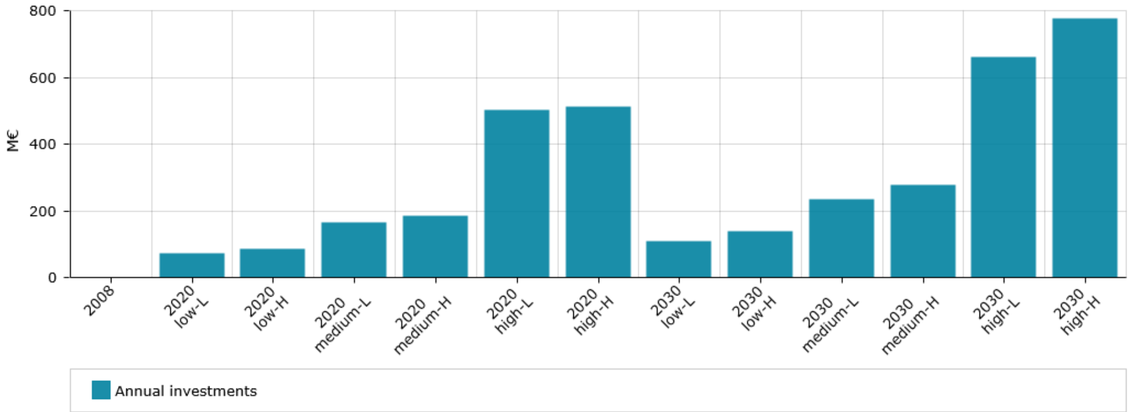

Figure 11: Annual investment dedicated to thermal renovation in Bulgaria

Source: Entranze

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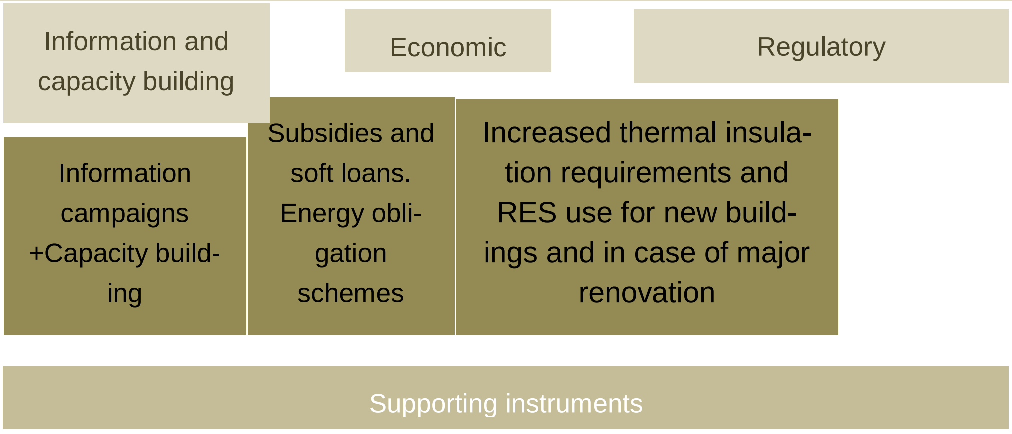
5. Recommendations

The recommendations described below were derived from the results of the work packages of the ENTRANZE-project, especially from the simulation of the policy scenarios and the discussion within the policy group.

Based on the scenario simulations, recommendations regarding a package of new and adapted instruments have been developed. The main instruments should always be accompanied by supporting instruments: measures for buildings always needs to involve a set of measures and go beyond the consideration of single policy instruments. The main pillars of additional elements in the policy bundle are shown in Figure 12.Due to the discussions with experts and policy makers, there seems to be a higher need for intensifying and improving building renovation activities. Therefore, the recommendations and main pillars of policy instruments focus on efficiency improvement and thermal renovation.

Figure 12: Bundle of new, additional instruments recommended



5.1 Information campaigns and capacity building

Information campaigns

In Bulgaria, there is still a significant need for awareness-raising campaigns; communicating in a clearer and more effective way information to consumers and market players about regulations, incentives and other available technical and support measures. Therefore awareness campaigns are an important and effective instrument contributing to overcoming the market barriers caused by a lack of proper information as well as to create more confidence in the decision to invest into upgrading the energy performance of buildings.

While national strategies and legislation foresee awareness on energy performance of buildings as a necessary step forward, there is often no financial support and the information activities are not properly implemented. Most of the public campaigns are

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organized at local level and accompany projects financed by the EU or International Funds. However, so far local authorities in Bulgaria were not very active in information, dissemination and awareness activities due to the above mentioned financial constraints.

To date there is no strategic approach to communication and information activities concerning energy efficiency and renewable energy in buildings. The main sources of information concerning energy efficiency and renewable energy are professional chambers and associations.

As a conclusion it is important to improve the actual framework and to further elaborate and implement a communication and dissemination plan at national level for the building energy efficiency sector in Bulgaria. The steps are several: 1. Elaboration of the above mentioned plan; 2. Creating a mechanism for its implementation; 3. Monitoring and evaluation of the results.

Training and capacity building

The implementation of a roadmap for the training of construction specialists (engineers, designers and technicians) and installers require further efforts for changing the educational programmes and the process of quality assurance at different stages (from design to operational stage). Within the Build-Up Skills imitative of the EU Commission, a Roadmap for Trainings to Develop Skills and Knowledge on Intelligent Energy Solutions in Buildings for Bulgaria until 2020 had been already developed. This Training Roadmap proposes several incentives schemes, educational programmes and courses aiming to the improvement of Bulgarian construction workforce qualifications and skills (http://www.buildupskillsbg.com/uploads/9/8/8/4/9884716/bus_bg_report-small.pdf). The roadmap is ambitious and the expected result is to deliver a higher number of trained installers also for new and renewable heating technology such as heat pumps, biomass boilers, solar thermal installations. Therefore, the increased number of installers will stimulate the market of RES and their use in buildings. Together with better quality of the instalment work and maintenance, we can expect additional increase of RES energy from this sources with 10-15% compared to scenario 2.

The roadmap also proposes training activities to facilitate the transition to an integrated and holistic approach for building design and renovation in Bulgaria. Thus the designers and civil engineers have to improve the quality of design and construction of new buildings and for renovation of the existing building stock. It is estimated that such training will have a higher impact in minimising the gap between designed and real energy performance of buildings and to achieve in practice the predicted energy savings in case of buildings renovation. According to ENTRANZE modelling results appear that in some cases, e.g. the introduction on wide scale of the passive house design, the implementation of energy management systems and similar, additional reduction of energy consumption can be expected. Nevertheless, the impact of training measures foresee in the policy sets for Bulgaria are estimated to be at around 2-3% reduction of the actual energy demand of the existing building stock.

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5.2 Financial Incentives

The financing instruments proposed in the ENTRANZE policy sets assume that renovation measures leading to buildings with higher energy performance should be rewarded by a higher financial support, such as higher grants or lower interest for dedicated loans:

- ***Loans*** with lower interest in combination with grants for energy efficiency measures and RES implementation for the cases of major renovation. Lower interest rates will stimulate the process of renovation as time as some of RES technology has longer payback period and therefore are not yet very attractive for wider use at market levels (e.g. solar thermal for multi-family buildings, ground sourced heat pumps and others etc.).
- ***Higher grants*** for major renovation of multifamily buildings ***with the support*** of the EU Funds and on financial resources from CO2 emission trading system. At the moment, one of major barriers to energy renovation of block of flats are on social and financial side. Therefore the further allocation of about 200-300 mln. EUR (till 2020) may contribute to overcoming these barriers and will generate energy savings of about 800 MWh for each mln. EUR of public money invested.

Financial schemes have the objective to foster market development and create long term impact beyond the lifetime of the specific support measure. They are key in the successful implementation of energy policies for buildings in Bulgaria. Such a financial scheme should be embedded in a successfully working regulation framework and to be accompanied by broad information campaigns creating awareness amongst building owners.

Grants and preferential loans are the most prevalent forms of instrument and, based on available data, are also the most successful and cost-effective ones. The financial support should be carefully assessed in order to avoid too high or too low incentive levels. They can either slow-down the market uptake or not stimulate the market uptake properly by not giving the right compensation for additional costs.

Moreover it is necessary to create easily accessible and effective financial instruments, avoiding unnecessary intermediate bodies in the financing chain and unjustified additional costs.

To maximise the benefits of energy efficient buildings it is necessary to support the development of local supply chain industries and services. Closing the economic cycle in the country itself will multiply the macro-economic benefits. The objective should be to make the biggest proportion of investments at local level. This will lead to the creation of sustainable jobs and additional tax revenues for public budgets.

Energy saving obligations

The requirements for 1.5% savings per year for the supplier companies will be implemented in the national legislation. There is still no clear evidence how this policy will be realized in practice however we assume equal share of savings for buildings and for industry. It is expected that a scheme with white certificates will be proposed for Bul-

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garia. Measures to be implemented by the energy supplier are expected to be mainly information campaigns, consultations or some low cost investments (mainly for lightening of the common areas or others).

5.3 Regulatory measures

The first condition for moving to nearly zero-energy buildings in Bulgaria is the reinforcement of current building codes by a gradual increase of the energy performance requirements of buildings as well as their systematic enforcement and compliance controls mechanisms.

The upcoming legislation transposing the Energy Performance of Buildings Directive (EPBD) at national level will ensure that energy performance requirements are part of the building codes. In addition, EPBD requires for the nZEB to have a significant amount of the energy need supplied by onsite and nearly renewable energy and appropriate further requirements have to also be integrated in the building codes.

Currently, in the Bulgarian building codes there are requirements for *U-values* of specific building components. The energy performance for each new building is calculated on the reference minimum *U-value* prescribed by law. The technical documentation for the design of new buildings includes a compulsory estimation of the energy performance of buildings at the design stage and a report done by an independent expert for checking the compliance of the design with the existing energy performance and prescriptive requirements. In case of non-compliance, the permission for constructing the building is not given.

In the proposed step-by-step approach, it is foreseen a 30% reduction of the U-values for the building components in 2015 and 20% additional reduction from 2020 for the new buildings as comparing to current requirements. Thus the definition of the nZEB will require less energy for the new buildings. While for the existing buildings the levels of energy consumption from 2015 will remain the same.

As one of the major barriers for implementation of major renovation in multifamily apartment buildings is the current home owners legislation, it is very important changes to be adopted in order to ensure the process when the majority of home owners agree on undertaking such renovation activities.

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A Annex

A.1 : Specific examples of modelling policy instruments in Invert/EE-lab

In the following, we will give some examples how policy instruments can be modelled and which level of detail we can cover. However, in most cases I would try not to overwhelm policy makers with details. For the policy group meeting it might be absolute sufficient to decide on the principle design of the instrument. The specific design will be suggested (and simulated) by us and can be discussed in a further step with policy makers (during the summer/autumn), if required.

- Investment subsidies for renovation measures

For simulating the impact of investment subsidies for renovation measures, the following parameters have to be defined:

- The standard of renovation measures being supported (e.g. in terms of U-values for building components; may differ between building categories; three different levels of renovation packages can be defined for each building category).
- The percentage of overall investment costs being granted by the scheme (may differ between building categories).
- Optional: maximum support level in €/m² floor area and/or €/building (Investment subsidies)
- Optional: Total support budget (M€ on an annual basis, can change from year to year)

The agents in Invert/EE-Lab decide among the options “no thermal renovation measure” and several different renovation measures including policy measures, as defined above, targeting on them individually. The policy instrument will increase the market uptake of this specific type of renovation measure addressed in the policy instrument depending on the agents awareness of the instrument and the relevance of economic aspects in the decision making process of different agents.

- Investment subsidies for renewable heating

For simulating the impact of investment subsidies for renovation measures, the following parameters need to be defined:

- The percentage of overall investment costs being granted by the scheme for different heating technologies.

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- Optional: maximum support level €/building and/or dwelling (Investment subsidies)
- Optional: Total support budget (M€ on an annual basis, can change from year to year)

The agents in Invert/EE-Lab decide among the different heating and hot water options. The instrument will increase the market uptake of the specific type of (renewable) heating system addressed in the policy instrument depending on the agents awareness of the instrument and the relevance of economic aspects in the decision making process of different agents.

- Investment subsidies for renewable heating independent on public budget

Similar to the conventional investment subsidies financed by the public budget we are able to simulate the impact of instruments financed e.g. on a levy on fossil fuels. (see. e.g. Bürger, 2013) There are different specific options for adapting the levy automatically on the support level of renewable heating systems. In case that you select such a system, we will decide together with you on the detailed setting of these systems.

- Building codes for new buildings

Minimum standards for new buildings are defined exogenously in Invert/EE-Lab. All new buildings will have at least this minimum standard. So, the definition of this standard is a relevant regulatory instrument. For this definition, we need the U-values of relevant building components (if there are performance based criteria in kWh/m^2/a, we will have to convert this value into typical U-values consistent with this performance based criteria).

(Optional, also geometry data of new buildings may be changed. As a default, we will use the geometry data from the last building construction period, e.g. 2000-2008.)

- Building codes for renovation of buildings

As a default, in Invert/EE-Lab building owners are free to select either “no thermal renovation measure” or some level of renovation measures. However, Invert/EE-Lab can introduce an obligation to carry out at least a minimum set of thermal renovation measures in case that a building is being refurbished.

- RES-H obligations

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For an obligation to use renewable heating, there are the following options to be defined in Invert/EE-Lab:

- When will the obligation come into force? (a) in case of new building construction, (b) in case of renovation of buildings or (c) in case of each change of heating systems
- Which share of renewable heating is obligatory for this specific building? (e.g. 25%, 50%, 75%?)
- Are there penalties in case that the obligation is not being fulfilled? How high are they (€/m² floor area).
- Optional: the penalty may also be linked to increasing the thermal efficiency of the building
- Optional: there might be a weighting between different renewable energy carriers, i.e. solar thermal might be weighted higher than biomass.

- Information, training, advice

Information, training advice may lead to higher awareness level of different type of agents. Invert/EE-Lab is able to model the impact of a higher level of awareness from different type of agents. However, Invert/EE-Lab is not able to model the link between information campaigns and the increase of the awareness level.

- R&D

For each technology implemented in Invert/EE-Lab, cost reduction (or increase) or efficiency development over time up to 2030/2050 can be defined. This changes the attractiveness of the different options and subsequently (according to the logit-approach) the market share of different measures, energy carriers and technology options.

Invert/EE-Lab is not able to model the link between R&D-expenses and the cost reductions. So, there is the need to make own assumptions based on expert guess to which extent R&D policies might lead to technological progress.

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A.2 Documentation of the model Invert/EE-Lab

In addition to the short overview of the model Invert/EE-Lab in chapter 2, this annex provides a few more information.

Invert/EE-Lab is a dynamic bottom-up simulation tool that evaluates the effects of different promotion schemes (in particular different settings of economic and regulatory incentives) on the total energy demand, energy carrier mix, CO2 reductions and costs for space heating, cooling and hot water preparations in buildings. Furthermore, Invert/EE-Lab is designed to simulate different scenarios (price scenarios, insulation scenarios, different consumer behaviours, etc.) and their respective impact on future trends of energy demand and mix of renewable as well as conventional energy sources on a national and regional level. More information is available on www.invert.at or e.g. in (Kranzl et al., 2013) or (Müller, 2012).

The basic structure and concept is described in Figure 13.

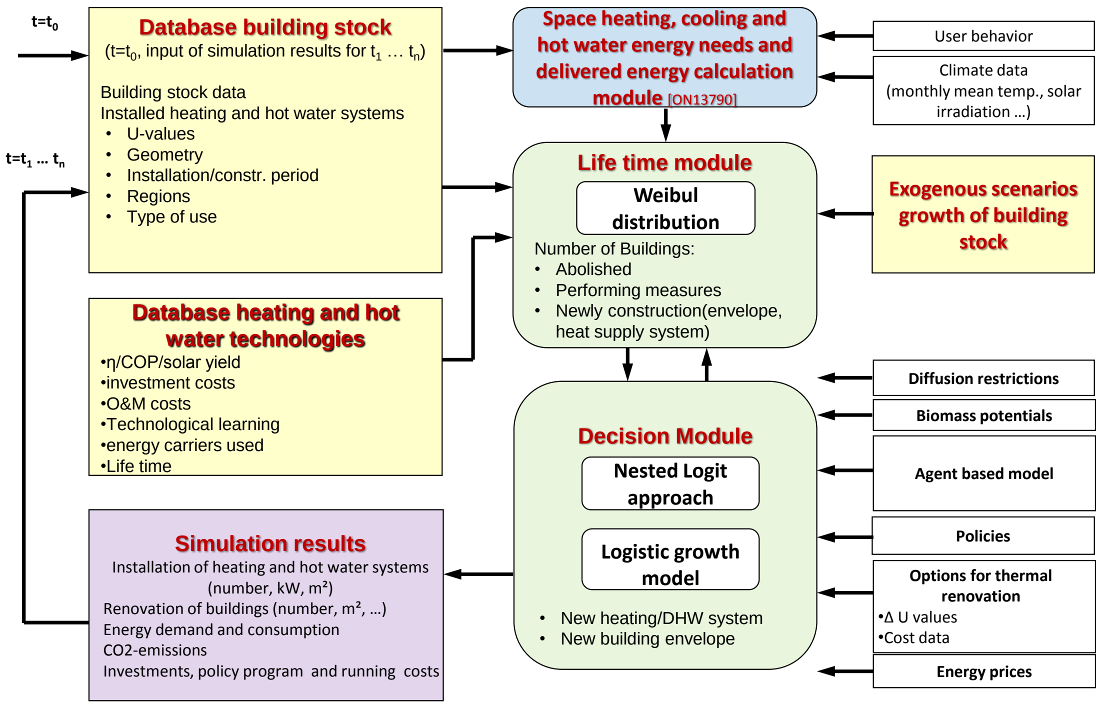

Figure 13: Overview structure of Simulation-Tool Invert/EE-Lab

Invert simulation tool originally has been developed by Vienna University of Technology/EEG in the frame of the Altener project Invert (Investing in RES&RUE technologies: models for saving public money). In more than 30 projects and studies for more than

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15 countries, the model has been extended and applied to different regions within Europe, see e.g. (Kranzl et al., 2012), (Kranzl et al., 2013), (Biermayr et al., 2007), (Haas et al., 2009), (Kranzl et al., 2006), (Kranzl et al., 2007), (Nast et al., 2006), (Schriefl, 2007), (Stadler et al., 2007). The last modification of the model in the year 2010 included a re-programming process and accommodation of the tool, in particular taking into account the inhomogeneous structure of decision makers in the building sector and corresponding distributions (Müller, 2010). The current state of the model relies on this new calculation-core (called EE-Lab) leading to the current version of the model Invert/EE-Lab.

The basic idea of the model is to describe the building stock, heating, cooling and hot water systems on highly disaggregated level, calculate related energy needs and delivered energy, determine reinvestment cycles and new investment of building components and technologies and simulate the decisions of various agents (i.e. owner types) in case that an investment decision is due for a specific building segment.The core of the tool is a myopical, multinominal logit approach, which optimizes objectives of “agents” under imperfect information conditions and by that represents the decisions maker concerning building related decisions.

The model enables the definition of a various number of different owner types as instances of predefined investor classes: owner occupier, private landlords, community of owners (joint-ownership), and housing association. The structure is motivated by the different perspectives regarding building related investments. For instance, energy cost savings are only relevant for those owners which occupy the building. The corresponding variable relevant to landlords is a refinancing of energy savings measures through additional rental income (investor-tenant dilemma). Owner types are differentiated by their investment decision behaviour and the perception of the environment. The former is captured by investor-specific weights of economic and non-economic attributes of alternatives. The perception relevant variables – in-formation awareness, energy price calculation, risk aversion – influence the attribute values. More details regarding the integration of stakeholder specific investment behavior in the model Invert/EE-Lab is documented in Steinbach, (2013).

Coverage and data structure

The model Invert/EE-Lab up to now has been applied in all countries of **EU-28 (+ Serbia)**. A representation of the implemented data of the building stock is given at www.entranze.eu.

Invert/EE-Lab covers **residential and non-residential buildings**. Industrial buildings are excluded (as far as they are not included in the official statistics of office or other non-residential buildings).

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The following figure shows the disaggregated modeling of the building stock within each country. The level of detail, the number of construction periods etc. depend on the data availability and structure of national statistics. We take into account data from Eurostat, national building statistics, national statistics on various economic sectors for non-residential buildings, BPIE data hub, Odyssee, which are finally summarized in the ENTRANZE database (www.entranze.eu).

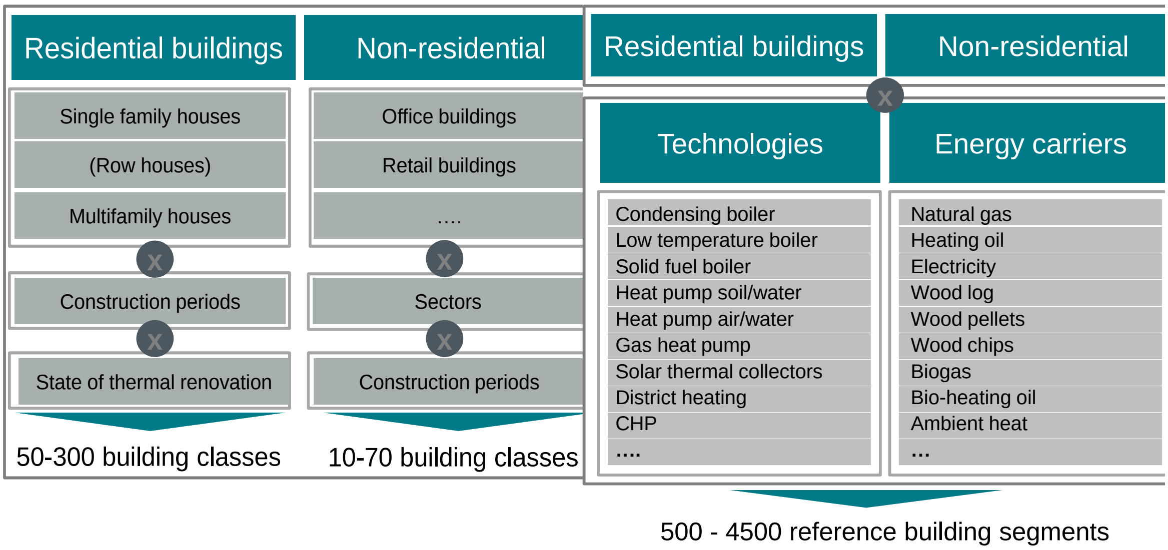

Figure 14: Disaggregated modelling of the building stock within each country. Where relevant climatic zones are taken into account within a country.

Outputs from Invert/EE-Lab

Standard outputs from the Invert/EE-Lab on an annual basis are:

- Installation of heating and hot water systems by energy carrier and technology (number of buildings, number of dwellings supplied)
- Refurbishment measures by level of refurbishment (number of buildings, number of dwellings)
- Total delivered energy by energy carriers and building categories (GWh)
- Total energy need by building categories (GWh)
- Policy programme costs, e.g. support volume for investment subsidies (M€)
- Total investment (M€)

Moreover, Invert/EE-Lab offers the possibility to derive more detailed and other type of result evaluations as well. Based on the needs of the policy processes we will have to discuss which other type of evaluations of the result data set might be required.

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