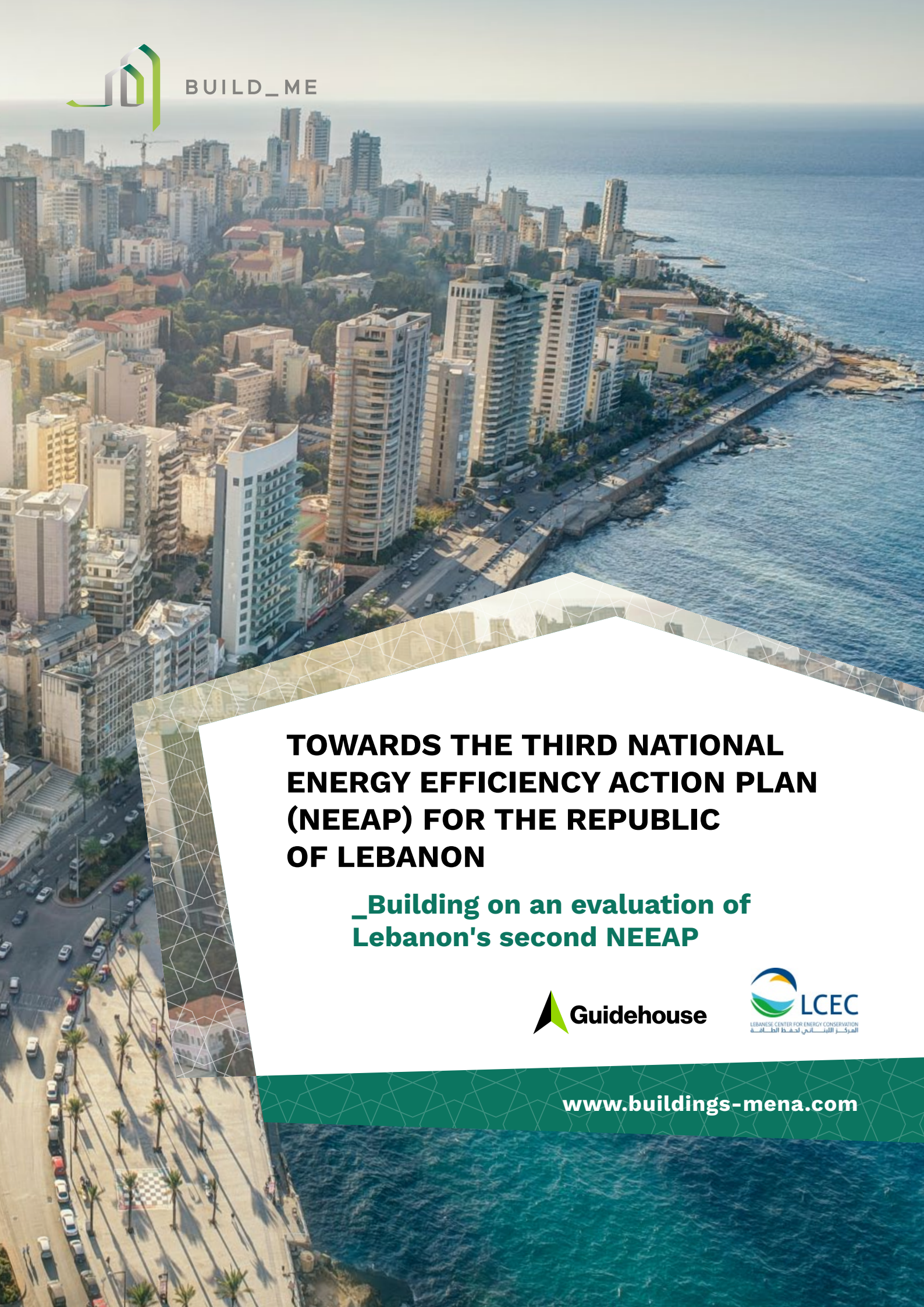

BUILD_ME

TOWARDS THE THIRD NATIONAL ENERGY EFFICIENCY ACTION PLAN (NEEAP) FOR THE REPUBLIC OF LEBANON

_Building on an evaluation of Lebanon's second NEEAP

Guidehouse

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LEBANESE CENTER FOR ENERGY CONSERVATION
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Towards the third National Energy Efficiency Action Plan (NEEAP) for the Republic of Lebanon_Building on an evaluation of Lebanon's second NEEAP

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Project:

Accelerating 0-emission building sector ambitions in the MENA region (BUILD_ME). Prepared on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety under the International Climate Initiative

Project Reference No.: 206596

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December 2020

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BUILD_ME is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) supports this initiative on the basis of a decision adopted by the German Bundestag.

The information and views set out in this publication are those of the authors and do not necessarily reflect the official opinion of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection.

Supported by:

Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection

based on a decision of
the German Bundestag

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1. INTRODUCTION

Continuous population and economic growth and accelerated urbanization have increased the demand for residential areas in urban centers in Lebanon. Since 2010, Lebanon develops the National Energy Efficiency Plan (NEEAP) in five-year steps to meet the growing energy demand by improving energy efficiency in the building sector, thus providing a strategic roadmap for the development of this vital sector. Transforming the building sector is one of the major challenges to achieve national energy targets.

This report was prepared by Guidehouse Energy, Sustainability and Infrastructure (Guidehouse ESI) in cooperation with the Lebanese Center for Energy Conservation (LCEC) and supports the development of a new NEEAP for the period 2021-2025. It aims to:

1. Evaluate the building specific measures of the existing National Energy Efficiency Action Plan for Lebanon (NEEAP 2016- 2020), and

2. develop recommendations for the next Lebanese NEEAP (2021-2025), derived from the evaluation of the second NEEAP as well as based on the first phase results of the BUILD_ME project and additional discussions between LCEC and Guidehouse experts.

The BUILD_ME project which is financed by the International Climate Initiative (IKI) aims to increase ambitions towards achieving climate-neutral building standards in the MENA region by providing technical assistance for pilot projects and facilitating policy dialogue. The main target countries are Lebanon, Jordan, and Egypt.

The project is divided into two main phases: Phase I from 2016-2018 and Phase II from 2019-2021. During the first project period, we have developed a comprehensive understanding of the barriers to invest in energy-efficient or renewable energy-based heating and cooling systems in the region, which led to several recommendations to address these identified barriers. The second phase of the project focuses on implementing, upscaling, and permanently adopting the recommendations developed in the first phase. Through a policy dialogue with relevant stakeholders, BUILD_ME aims to improve building code implementation and incorporate building sector specific targets into the nationally determined contributions (NDCs) of the target countries as well as other national and local strategies.

In the context of other projects supporting the energy efficiency policy making process in Lebanon, Guidehouse was involved in the development of the first Lebanese NEEAP (2011-2015) as well as in developing recommendations for the second NEEAP (2016-2020).

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2. STATUS QUO

2.1 National and local efficiency strategies in Lebanon

Energy efficiency policies play a fundamental role in the transition towards a sustainable energy future. Although tangible achievements have been accomplished since the first NEEAP was launched, the development and implementation of more stringent energy efficiency policies is in an ongoing process.

Lebanon is facing a diversity of crisis: economic, financial, and political, in addition to the effects of the COVID-19 pandemic and its associated lockdowns that emerged in March 2020 and the tragic explosion at the Beirut port on 04 August 2020. Already in October 2019, the country witnessed a financial crisis, which led to the devaluation of the Lebanese pound and a severe inflation. All of these add on the existing crisis of electricity blackouts and energy shortages that Lebanon faces. As such, it is an action priority to scale up efforts in the energy efficiency in the building sector, with comparatively low investments, in order to alleviate the impact of energy and electricity demand on the economy, to reduce the economy's dependence on fossil fuels and to increase levels of independence, resilience and stability. This could create a major incentive and a greater determination from policy makers to push for a stronger energy efficiency agenda that will benefit the country economically and environmentally.

At the national level, Lebanon's main energy efficiency strategy began in 2010 with the first NEEAP that covered the years 2011-2015 and was later followed by the second action plan for the next period of five years, 2016-2020. Both NEEAPs included major initiatives that covered all sectors and tackled both the energy generation and the end user consumption.

At the local level there are no concrete energy efficiency strategies for municipalities. However, the second NEEAP for Lebanon included in its end-use measures for the public sector an initiative called "Sustainable Energy Action Plan (SEAP) for municipalities", which aims to establish a plan for the efficient use of energy in 10 different municipalities. Unfortunately, this initiative was not implemented due to a lack of financial resources and awareness.

2.2 Background and baseline

Since 2009, the Lebanese Government has shown full support to the development of energy efficiency measures in Lebanon. On 21 June 2010, the Lebanese Government adopted the policy paper for the Electricity Sector as a national strategy for Lebanon. The policy paper included 10 initiatives, among which three initiatives were dedicated to energy efficiency and renewable energy. Based on the contents of the policy paper, LCEC developed the first NEEAP for Lebanon for the period 2011-2015 which was adopted by the Lebanese Government on 10 November 2011. The NEEAP introduced 14 initiatives that tackled both renewable energy and energy efficiency and constituted a governing framework for the deployment of renewable energies in the country.

In March 2016, the second NEEAP for the period 2016-2020 was adopted, with energy efficiency measures being the foremost priority. In the same year, the National Renewable Energy Action Plan for the same period was also published. Both action plans focused on measures that pave the way to achieving the target of 12% of the country's energy mix from renewable energy for both electricity generation and heating purposes, by 2020.

The third NEEAP covers the period 2021-2025 and will enhance the roadmap towards the path of sustainability. It will shape the policy dialogue for all stakeholders in Lebanon who acknowledge that energy efficiency is the cheapest and most readily available "fuel source" Lebanon could benefit from.

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2.3 Vision and targets

The vision of Lebanon's third NEEAP for the period 2021-2025 is twofold: Firstly, to learn as well as build on the measures adopted in previous action plans, and secondly, to firmly re-establish the goal of the Lebanese Government in tackling the national growth in energy consumption. The NEEAP 2021-2025 will set a clear path for 2025 as a first step in reaching the target of 30% renewable electricity consumption by 2030.

The Ministry of Energy and Water, with the recommendations of LCEC, considers that the potential for improving energy efficiency is huge and can be realized quickly if a strong commitment from all stakeholders is achieved.

However, it should be noted that investments, including in renewable energy and energy efficiency projects, have become a challenge as a result of a reduced access to financing in light of a deteriorating economy. The Republic of Lebanon is seeking to attract international financing in support of its critical sectors and to overcome the problems of the power sector, in order to meet its target of 30% from RE by 2030. As such, commitment from stakeholders and access to financing will enable the expansion of energy efficiency measures.

Based on previous efforts the NEEAP will provide new and stricter measures that will help in reducing the annual growth in energy consumption, thus facilitating the way forward towards a 30% renewable energy target by 2030.

2.4 Measures for the building sector in the 2nd NEEAP 2016-2020

The building sector covers all services which require significant energy consumption such as heating and air conditioning systems, ventilation, domestic hot water, and interior lighting, as well as all other equipment commonly used in the different sectors (electrical appliances, commercial and industrial cooling, office technology, etc.).

Previous NEEAPs for Lebanon covered a range of policies that encouraged both the promotion of energy efficiency in new buildings, and the energy-efficient renovations of the existing building stock.

In fact, in the NEEAP 2016-2020 the following nine measures targeting the building sector were developed and adopted:

- Double wall ordinance
- Testing facility for buildings components
- Improving energy efficiency in the building code
- Use of energy-efficient equipment
- Energy performance certificate for buildings
- Energy audits for public buildings
- Implementing energy efficiency measures in selected public buildings
- Pilot project (Green building)
- Capacity building for refurbishment

In section three, a more thorough review of each of these initiatives is discussed.

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3. EVALUATION OF THE 2ND NEEAP 2016-2020

3.1 Evaluation methodology

This section focuses on the following nine end-use measures that can be applied in the building sector as proposed in the current NEEAP 2016-2020 (see chapter 2.4). These measures are distributed between regulations, action plans and implementation. They tackle all types of buildings including residential, tertiary, public and industrial buildings.

The aim of the evaluation is to assess each measure in terms of the extent to which it has been implemented. Therefore, each measure is evaluated individually to get an overview of how much of the building specific NEEAP action items have been implemented in the Lebanese policy cycle in recent years.

Each measure is briefly described, followed by an assessment of the current status of the implementation of the measures, deciding which of the three dimensions “pending”, “in progress” or “achieved” describes the level of attainment best. All information available at the time of writing has been used for this evaluation. In addition, relevant statistics on the implementation and information on ongoing activities of each measure were provided by LCEC wherever data availability made this possible.

3.2 Evaluation of end-use measures in the building sector

Table 1: Measure N_01

Short title of measure
Double wall ordinance
Short description of measure
This measure aims to: • Set the double wall ordinance that improves a building’s envelope performance. • Implement the ordinance in 100 buildings (total floor area of 100,000 m^2). Double wall insulation as stated in the Lebanese building code is optional. The aim of this measure is to make the double wall configuration mandatory in the new buildings in Lebanon, by considering the double wall composition as follows: Air, plaster, 10 cm concrete, 5 cm insulation air cavity, 15 cm concrete, 2 cm plaster and air. The overall U_w-value envisaged is 1.57 W/m^2K.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
The adoption of a double wall ordinance is currently still in the legislative process. The ordinance has been implemented on 100 buildings, mostly through the National Energy Efficiency and Renewable Energy Action (NEEREA) financing mechanism. The corresponding statistics have therefore been included in the evaluation of measure “use of efficient equipment” (see 0).

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Suggestion for further development
Accelerate the legislative process and the engagement of the involved stakeholders. It has been shown that the double wall measure can save significant amounts of energy. We suggest, as a measure for the next NEEAP, to make this a mandatory measure in new buildings. This aim should be clearly stated in the NEEAP.

Table 2: Measure N_02

Short title of measure
Testing facility for building construction material
Short description of measure
This measure aims to set up a test facility able to assess the thermal properties of building components. The testing facility will allow certification of the components according to the Lebanese standards and open the door for research and development (R&D) of new efficient materials, especially locally manufactured ones.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
The testing facility was installed at the Faculty of Engineering of the Lebanese University. It requires an additional upgrade as minor sensors and instrumentation materials are missing due to lack of financial resources. Output indicator: Testing facility has been implemented and requires upgrades as mentioned above. Outcome indicator: N/A
Suggestion for further development
The testing facility requires additional funding, in order to procure additional sensors, which would add more accuracy to the test results. A continuation of the facility should be part of the next NEEAP with the aim to continuously improve and develop standards for building components. This measure connects with the suggested Measure A_04.

Table 3: Measure N_03

Short title of measure
Building code
Short description of measure
This measure aims to improve the energy efficiency standard of new buildings.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved

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Ongoing activities
A report to improve the existing building thermal standards including an analysis of the Thermal Standards for Buildings in Lebanon (TSBL 2005), which is the only thermal standard for buildings available in Lebanon is currently being prepared. The analysis is carried out in cooperation with LCEC, LIBNOR - The Lebanese Standards Institution and with consultation of a number of national experts. A technical committee TC205: Building Environment design at LIBNOR has been preparing a new building code to be entitled Building Environmental Performance Principles, Requirements and Guidelines. This code will include five sections: Energy, Indoor Environmental Quality (IEQ), Water, Waste and Site. TC205 includes stakeholders from both public and private sectors that were divided into five working groups relative to the proposed sections. This committee has already prepared the Energy and IEQ sections and the final draft shall be shared soon with the committee for commenting. Due to the Beirut port explosion, other priorities have emerged. Thus, the committee's work is currently postponed till further notice.
Suggestion for further development
A building code should be finalized and approved within the period of the coming NEEAP. This building code should be mandatory for all new buildings. A concept on how to ensure the monitoring and enforcement of the building code should be developed.

Table 4: Measure N_04

Short title of measure
Use of efficient equipment
Short description of measure
This measure aims at using energy-efficient equipment in 200 buildings of 1,000 m^2 each (total floor area tackled around 200,000 m^2 of residential and non-residential buildings excluding public buildings). Energy-efficient equipment in public buildings is covered under "Green procurement for new and existing public buildings" measure and is not included here.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
The LCEC analyzed the Lebanese market through extensive surveys that covered both retailers and consumers across all Lebanon and over a period of six months. A national standard and labelling scheme are proposed to be implemented in the near future, as well as resulting policies and measures to incentivise all stakeholders (manufacturers, importers, suppliers and consumers) to promote energy-efficient home appliances. Moreover, the NEEREA financial scheme, an initiative adopted in the first NEEAP, has subsidized energy efficiency projects over the period 2016-2020. The scheme financed over 219 energy efficiency projects delivering a total of 285 GWh of cumulative energy savings. The main technologies/measures financed were building envelope improvement (double wall, thermal insulation, double and triple window glazing), LED lighting systems, efficient Heating, Ventilation and

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Air Conditiong (mainly VRV[1]/VRF[2] systems), and motion detectors. The projects targeted, in particular, the commercial and residential sectors, and to a certain extent the industrial sector. In August 2018 LCEC in partnership with the Italian Ministry of Environment Land and Sea (IMELS) started the Italian Energy-Efficient Home Appliances (IEEHA) programme which aims at reducing the energy demand of Lebanese households by incentivizing the market to shift towards more energy-efficient technologies of Italian brands and/or manufactured in Italy. Consumers will benefit from a financial rebate when purchasing an eligible product from one of the retailers partnering with the programme. Expected savings are ~ 0.474 GWh in 2020 and ~ 0.948 GWh in 2021.
Suggestion for further development
More awareness campaigns and incentives targeting consumers are needed in order to promote the use of energy-efficient equipment. See the suggested Measure A_01 on this. To promote the use of energy-efficient equipment and the two financing schemes, awareness campaigns should also be conducted for retailers, as they are in direct contact with consumers.

Table 5: Measure N_05

Short title of measure
Energy performance certificate for buildings
Short description of measure
This measure aims at establishing a system of certification and labelling of the energy performance of buildings and setting minimum energy performance requirements for new buildings. The measure also includes data collection on labelling of an occupied area of 200,000 m^2.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
As part of the BUILD_ME project, LCEC is currently identifying new specifications for new buildings as a basis for the calculation of the energy reference values. In addition, LCEC is developing a concept for a voluntary energy performance classification scheme for buildings. The proposal of a voluntary scheme as first step would allow to test the classification scheme and its applicability before going to the next level of mandatory EE measures in buildings. In the mandatory phase, in form of standard, decree or law minimum energy performance requirements will be set.
Suggestion for further development
After the establishment of a certification and labelling system for buildings, LCEC shall develop further actions and incentives for property owners to improve the ratings of their buildings. LCEC is in the process of developing the energy performance requirement for each classification level. In addition, a roadmap is being set to identify actions needed to make the voluntary scheme a mandatory one.

[1] Variable Refrigerant Volume
[2] Variable Refrigerant Flow

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Table 6: Measure N_06

Short title of measure
Energy audits for public buildings
Short description of measure
This measure aims at performing energy audits for 200 public buildings including all types of usage: hospitals, schools, administrations, etc.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
In 2016, LCEC conducted, within the MED-ENEC project (European Aid financed project 2006-2017) activities, walk-through energy audits on three schools that are located within the coastal climatic zone. Two of the three schools belonged to the public sector. After extrapolating the results over the total number of public schools in the coastal climatic zone in Lebanon, the yearly potential energy savings were estimated to be around 5,000 MWh. The main retrofitting measures that were considered for this specific climatic zone were lighting, office equipment, and air conditioning. Energy audits were also conducted at the Ministry of Social Affairs and Zahle Governmental Hospital (in the Bekaa Governorate). Additionally, LCEC is currently involved in two projects dealing with energy efficiency in the public sector. The first project entitled “BIM for Energy Efficiency in Public buildings – BEEP” aims at strengthening the use of Building Information Modelling (BIM) to enhance energy efficiency in buildings. Within the project activities, thorough energy audits of two case studies will be performed (Municipality of Tripoli Building and Rachid Karami Municipal Cultural Center), in order to feed into the energy simulations of three energy renovation scenarios to be performed on the two buildings. The second project entitled “Energy Smart Mediterranean Schools Network - ESMES” targets the educational sector through the public schools in Lebanon, where one public school and another vocational school will receive renewable energy and energy efficiency rehabilitation measures. Within the project activities, energy audits will be performed before and after the implementation of the renewable energy and energy efficiency measures on the mentioned public and vocational schools.
Suggestion for further development
Only 2% of the targeted 200 audits were achieved. It should be reassessed if this measure should be continued. If yes, a plan should be developed how existing barriers can be overcome, in order to carry out the audits. Promoting and supporting energy audits in public buildings should be continued as also promoted in Measure A_01. Furthermore, LCEC shall push further the performance of energy audits by proposing an additional measure that promotes the implementation of Energy Performance Contracts (EPC), targeting public buildings in general, and the municipalities in particular. EPCs are also suggested in Measure A_06. To further support this measure and as part of Lebanon’s NEEAP, LCEC has set a qualification process for Energy Service Companies (ESCO) and Energy Audit companies. ESCOs are energy service

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companies that are specialized in energy efficiency improvement services, including implementation. Energy Audit companies offer energy management services including energy audits.

LCEC's qualification process aims at supporting the ESCO market, promoting energy efficiency investments and helping stakeholders (potential beneficiaries and local financial institutions) identify ESCOs and Energy Audit companies.

The LCEC launches rounds of qualification throughout the year. To be a qualified ESCO or Energy Audit company, the applicant must fill in the application and have a cumulative passing score for all sections. A list of qualified companies is issued after each round of qualification process.

It should be noted that the number of energy audits in the private sector is much higher. As part of the NEEREA financing scheme, project proposals for photovoltaics (PV) installation with an installed capacity equal or greater to 60 kWp should do a mandatory energy audit.

Table 7: Measure N_07

Short title of measure
Implementing measures in selected public buildings
Short description of measure
This measure aims at implementing energy efficiency measures in selected public buildings. These measures may include, but are not limited, to the following: • High performance double flow ventilation with heat recovery. • Use of energy-efficient equipment based on Minimum Energy Performance Standards (MEPS) for heating, cooling and ventilation equipment[3]. • Use of renewable energy for hot water and electricity generation. • Improvement of the building envelope (U-value, infiltration, insulation, glazing, fenestration…). • Use of green lighting and installation of dimmers and motion sensors on lights where possible to control electricity use. • Behavioural change and awareness.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
LCEC is currently involved in two projects dealing with energy efficiency in the public sector. The first project entitled "BIM for Energy Efficiency in Public buildings – BEEP" aims at strengthening the use of BIM to enhance energy efficiency in buildings.[4] The testing of this emerging technology on built heritage will be performed to demonstrate its scalability to the entire building stock. The project will provide public administrations with a powerful method for the energy rehabilitation of public buildings to be supported with private financing through Energy Performance Contracting. The second project entitled "Energy Smart Mediterranean Schools Network - ESMES" targets the educational sector through the public schools in Lebanon, where one public school and another vocational school will receive renewable energy and energy efficiency rehabilitation measures.

[3] MEPS developed in measure H 01 "Minimum Energy Performance Standards"

[4] The BEEP and ESMES projects are listed as activities both for "Energy audits for public buildings" (see Table 7: Measure N_07) and "Implementing measures in selected public buildings" (see Table 8: Measure N_08). This is because the two projects feed into the two measures within different activities, as explained in the description of the ongoing activities.

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Suggestion for further development
LCEC shall further promote this measure and prioritize public buildings that have lower energy performance than others, as is the case with historical public buildings. In general, the measure is missing quantifiable amount (e.g., How many measures shall be carried out on how many buildings?) and a clear objective of what the output of this measure should be (e.g., a report showing economic feasibility of energy efficiency measures). Therefore, this measure should be further specified and supplemented by quantifiable indicators. The measure should be developed further from “selected public buildings” to a more structured approach. The EU Energy Efficiency Directive (EED) could serve as an example here. The EED sets as a requirement that 3% of the total floor area of all (central) government and administration buildings (>250m^2) which do not meet the minimum energy performance requirements is renovated each year.

Table 8: Measure N_08

Short title of measure
Pilot project
Short description of measure
This measure aims at building an exemplary green building (LCEC new premises). The building should include all possible energy-efficient measures where the building energy consumption should be lower than 35 kWh/m^2/year. Factors to be considered are: • Building envelope • Ventilation and tightness • Efficient equipment • Efficient lighting • Water pipes and air ducts insulation • Building Management System (BMS) • Use of renewable energy sources The estimated savings compared to an actual building would be around 115 kWh/m^2/year considering that an average consumption of a current building is 150 kW/m^2/year.
Status of measure implementation
☒ pending ☐ in progress ☐ achieved
Ongoing activities
Due to legal and financial obstacles, the project has been put on hold. However, instead of erecting a new LCEC building, LCEC might be moving to another office that can be refurbished with energy-efficient technologies (the funds are available).
Suggestion for further development
This measure should not be continued in the next NEEAP.

Table 9: Measure N_09

Short title of measure

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Capacity building for refurbishment
Short description of measure
This measure aims to educate and train workers on best practices in the renovation of buildings with a focus on measures to improve energy efficiency towards sustainable concepts.
Status of measure implementation
☐ pending ☒ in progress ☐ achieved
Ongoing activities
Several workshops held aimed at increasing capacity building on measures to improve energy efficiency. In addition, the Energy Transition Facility (ETF), in collaboration between the Ministry of Foreign Affairs and the Netherlands Enterprise Agency as the executor and LCEC, are working on developing technical guidelines for renovation for residential buildings. The guidelines are addressed to engineers and architects. This will include a workshop with the engineers and architects to discuss and disseminate the guidelines.
Suggestion for further development
Capacity building on the best practices in the energy management and renovation of the building sector should be continuously supported and promoted. The adoption of a certification and labelling scheme for the building sector, along with the implementation of energy audits and promotion of EPC contracts would increase jobs within the energy efficiency domain, and therefore the need for experienced personnel.

3.3 Re-initiating building related measures from the NEEAP 2016-2020 in the NEEAP 2021-2025

Based on the evaluation of the NEEAP 2016-2020 end-use measures in the building sector 1 out of 9 measures are still pending, 8 out of 9 measures are in progress and 0 out of 9 measures were achieved completely in the period of the 2nd NEEAP. As assessed by LCEC, some of these measures are recommended to be re-initiated and included in the NEEAP 2021-2025 to reaffirm their relevance. Their quantitative targets may need to be adjusted to reflect progress that has already been made as shown in chapter 3.2.

Measures that are still pending are:

- **Pilot project**: Re-initiation not recommended as shown in Table 8: Measure N_08

Other measures that are already in progress:

- **Double wall ordinance:** Re-initiation not recommended as shown in Table 1: Measure N_01
- **Testing facility for building construction material**: Re-initiation recommended as shown in Table 2: Measure N_02
- **Building code**: Re-initiation recommended as shown in Table 3: Measure N_03
- **Use of efficient equipment**: Re-initiation recommended as shown in Table 4: Measure N_04
- **Energy performance certificate for buildings**: Re-initiation recommended as shown in Table 5: Measure N_05
- **Energy audits for public buildings**: Re-initiation recommended as shown in Table 6: Measure N_06

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- **Implementing measures in selected public buildings:** Re-initiation recommended as shown in Table 7: Measure N_07
- **Capacity building for refurbishment**: Re-initiation recommended as shown in Table 9: Measure N_09

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4. ADDITIONAL POLICY RECOMMENDATIONS FOR THE 3RD NEEAP 2021-2025

4.1 Implementation of BUILD_ME policy recommendations in the NEEAP 2021-2025

Between 2016 and 2018 the BUILD_ME project has worked with a large number of stakeholders to create a broad and robust fact base on energy efficiency in buildings in Lebanon. Based on these findings, a set of policy modules per stakeholder group was compiled to address the identified barriers to the development of the building sector in Lebanon towards a sustainable future. In a three-part approach, the rationale, implementation and impacts were analyzed.

The overall approach to the impact assessment was to develop policy modules containing a description of the different measures, their quantitative impacts and an outline on how to implement them. For more detailed information on the methodology of the following policy recommendations of the first project phase findings of BUILD_ME visit https://www.buildings-mena.com/info/progress-reports-2016-2018 and download the Lebanese progress report 2016-2018[5].

In cooperation with LCEC it was assessed whether the policy recommendations of the first phase of BUILD_ME have already been implemented in the current NEEAP 2016-2020 and, if not, what potential barriers hinder the implementation. In a next step, LCEC experts evaluated through discussions with their internal and external network whether an implementation for the NEEAP 2021-2025 would be recommended or not. In the following, the results of the assessment of BUILD_ME phase 1 measures in the Lebanese building sector are presented in an overview:

Table 10: Measure B_01

Enforce mandatory energy performance standards for heating and cooling equipment being imported in the country.	
Short description:	One of the main barriers project developers are facing in implementing energy-efficient solutions is the fear to lose competitive edge with other developers, who chose low-cost equipment to sell apartments at minimum upfront cost to their customers. By banning the import of technologies that do not respect the MEPS from entering the market, authorities can ensure to project developers the same level playing field. In addition, MEPS would facilitate the sales of efficient equipment's in retail stores as equipment will be using an energy labelling. Stakeholders involved: Ministry of Energy and Water, Ministry of Economy and Trade, the Ministry of Industry (for local manufacturing), the Ministry of Finance through the Directorate of General Customs, LIBNOR and LCEC.
Measure proposed by:	Public authorities
Type of policy:	Regulation
Target group:	Heating and cooling equipment / Technology suppliers
Potential barriers of measure:	Commitment from Ministry of Economy and high cost of EE solutions

[5] Navigant (2020): Accelerating zero-emission building sector ambitions in the MENA region (BUILD_ME)

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Enforce mandatory energy performance standards for heating and cooling equipment being imported in the country.	
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes

Table 11: Measure B_02

Regulate laws that enable municipalities to offer incentives for energy-efficient buildings beyond the double wall ordinance.	
Short description:	Municipalities are bound by legislation which restricts their rights to give explicit incentives to energy-efficient buildings. The current building code provides the municipalities the option to give one limited incentive for buildings for the usage of double wall. Update the law in order to give municipalities a bigger role in the permitting procedure. The municipality as a local authority, will have a better insight on the projects that are being developed under its jurisdiction. After giving the municipalities this power, they could give incentives for new buildings that are more environmentally friendly by prioritizing their applications and giving them incentives such as higher investment opportunities. This needs to be combined with the need to strengthen enforcement systems in order to discourage any free riders. By offering additional incentives to project developers implementing energy efficiency solutions, municipalities can spur market demand.
Measure proposed by:	Public authorities
Type of policy:	Regulation
Target group:	Municipalities
Potential barriers of measure:	Lack of financial resources at the municipal level.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes

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Table 12: Measure B_03

Enforce the implementation of the solar ordinance that mandates new residential buildings to have solar water heaters on their rooftop in accordance with space availabilities, otherwise mandate the installation of a heat pump.	
Short description:	With the absence of a solar ordinance, real estate developers do not find themselves obliged to equip their buildings with Solar Water Heaters (SWH). The solar ordinance has been developed by LCEC and is currently at the level of Higher Council of Urban Planning for approval. The solar ordinance will enforce a minimum SWH installation in new buildings. This will be combined with the need to install air-to-water heat pumps in buildings with limited roof availability. A strong enforcement system needs to be developed as well as intensive capacity building activities for engineers in order to familiarize them with the new requirements.
Measure proposed by:	Public authorities
Type of policy:	Regulation
Target group:	New constructions (residential)
Potential barriers of measure:	As per Lebanese and International common practice, SWH is linked to the National Renewable Energy Action Plan (NREAP) and not the NEEAP. The solar ordinance is currently being discussed on a ministerial level but will not be related to the NEEAP.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	No

Table 13: Measure B_04

Update Lebanese building code to include an energy-efficient code for heating and cooling. The code becomes mandatory for all new buildings' construction.	
Short description:	Engineers in Lebanon oversize heating and cooling systems, prioritizing safety and comfort over efficiency, and do not design control systems to optimise operation and cut energy costs. Heating and cooling load modelling is rarely conducted, back on the envelope calculations are common practice. The Lebanese building code needs to be updated in order to include an energy-efficient code for heating and cooling installations. LIBNOR, the Order of Engineers, LCEC and the Higher Council for Urban Planning cooperate to update and ensure the implementation of the building code. LIBNOR takes the lead to create Lebanese green standards for building codes. The code shall require engineers to submit detail calculation of the heating and cooling demand of the building, considering passive and active measures in energy efficiency and limiting safety factors standards like American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE). LCEC supports LIBNOR in preparing the codes and the Order of Engineers and Architects (OEA) forms a technical committee to review the new codes.

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Update Lebanese building code to include an energy-efficient code for heating and cooling. The code becomes mandatory for all new buildings' construction.	
	Reviewing the building code is crucial for accelerating EE measures at the design level. This recommendation is the base or the starting point for other recommendations such as enforcement, incentives differentiation and accelerating the permitting process as it sets the rules for EE measures and designs.
Measure proposed by:	Project developers
Type of policy:	Regulation
Target group:	New constructions
Potential barriers of measure:	Potential barrier is to make it mandatory.
Part of NEEAP 2016-2020?	In progress
Implementation for NEEAP 2021-2025 recommended?	Yes

Table 14: Measure B_05

Strengthen enforcement systems in the construction and maintenance phase, applying severe penalties to the engineering design company for non-compliance to the energy efficiency building code and to the facility manager of the residential building for not reporting annual energy consumption.	
Short description:	Most of the projects present an initial plan for the authorities and then undergo multiple modifications without notice. In addition, municipalities' inspectors lack the engineering knowledge to inspect the compliance of innovative energy-efficient solutions e.g., air-to-water heat pumps. Enforcement systems in the construction and maintenance phase need to be strengthened. Severe penalties must be imposed on the engineering design firm in case of improper planning leading to non-compliance with the rules on energy-efficient buildings and on the building manager of the residential building in case of failure to report the annual energy consumption.
Measure proposed by:	Project developers
Type of policy:	Regulation / Organizational
Target group:	New constructions
Potential barriers of measure:	Lack of financial resources from building owners and facility managers.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes

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Table 15: Measure B_06

Differentiate financial incentives between energy efficiency projects, offering highest incentives for projects with highest ambition, and distribute a standard economic tool that can benchmark applications.	
Short description:	Financial incentives currently exist in Lebanon for applying energy efficiency measures. The current framework does not give an incentive to reach the highest energy savings, it follows a minimum savings only approach. In addition, the financial calculations conducted by engineers in the NEEREA loan application are not detailed enough and simplistic. There is no standard baseline to compare the benefits of the energy efficiency measure, which makes it impossible for LCEC to benchmark the applications and screen best in class measures. LCEC should develop a standard tool that conducts the cost benefit calculations of different energy efficiency measures, following a) user specific engineering input on the heating and cooling demand of the building, b) capital cost of the energy efficiency measure, and c) technical efficiency of the measure. The tool should be apt to categorize the measures in bronze, silver or gold packages according to the (dynamic) payback period. Measures with shortest payback period are sorted in bronze, longest payback with gold. Higher incentives (e.g., increasing grace period, lower interest, increasing floor area) should be granted to gold package. These measures will be the ones with the highest Net Present Value (NPV).
Measure proposed by:	Project developers
Type of policy:	Organizational / Financial
Target group:	EE projects
Potential barriers of measure:	Lack of financial resources for incentives.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes (Need more information about feasibility and applicability)

Table 16: Measure B_07

Digitalize permitting process.	
Short description:	Bureaucratic procedures slow down the permitting process and increase cost on the side of project developers. Once an energy efficiency building code is put in place, the process of assessment for compliance with the new code and enforcement needs to be as transparent and clear as possible. By digitalising the permitting process, it is possible to automate and standardise the individual steps, which increases efficiency and transparency. Identify funding and third party to prepare an online platform and application system to be adopted by the relevant authorities in collaboration with the OEA, the Higher Council for Urban Planning and local authorities. This third party will be responsible to computerize the building design review and permitting process by implementing new software with online applications and machine

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Digitalize permitting process.	
	verification processes. In this process, faster measures can be implemented for projects with energy efficiency measures. Lessons can be learned from the Ministry of Finance and Ministry of Telecommunication where digitalization has proven to enhance operation.
Measure proposed by:	Project developers
Type of policy:	Organizational / Administrative
Target group:	EE projects
Potential barriers of measure:	Previous experience in digitalizing official procedures proved to be time consuming and hard to accomplish (i.e., the adoption of smart meters by the Lebanese utilities).
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	No

Table 17: Measure B_08

Improve electricity supply in Lebanon in order to reduce energy subsidies and improve the business case of energy efficiency technologies.	
Short description:	Electricity tariffs levels are set below cost recovery in Lebanon. The cost of electricity generation by Electricite de Liban (EDL) reached 22.73 US c/kWh while electricity tariffs range from 2.33 to 13.33 US c/kWh depending on consumption bands. Tariffs need to be gradually increased with the improvements in electricity supply. This will give a boost for energy efficiency measures, which will pay back faster and have a higher NPV compared to a baseline. The policy paper for the Electricity Sector, published by the Ministry of Energy and Water, includes a specific plan to gradually restructure and increase the electricity tariff in conjunction with the increase of supply. It also includes the adoption of special tariffs for low-income consumers and productive sectors, and to implement Time of Use (TOU) tariffs in conjunction with the implementation of Automatic Meter Reading (AMR) schemes. These tariffs are to be regularly reviewed to reflect actual costs without causing further deficit to the National Treasury.
Measure proposed by:	Suppliers
Type of policy:	Regulation
Target group:	Electricity tariffs
Potential barriers of measure:	Electricity supply issues are tackled in the Ministry of Energy and Water's Policy paper.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	No

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Table 18: Measure B_09

Incentivise suppliers to import energy-efficient technologies by facilitating import procedure.	
Short description:	One of the main barriers suppliers are facing in importing energy-efficient technologies is the fear of losing the competitive advantage over other suppliers who have chosen low-cost equipment in order to sell it to their customers at minimal upfront costs. By banning the import of technologies that do not respect the MEPS from entering the market, authorities can ensure to suppliers the same level playing field. In addition, MEPS would facilitate the sales of efficient equipment's in retail stores as equipment will be using an energy labelling. The first step would be to impose high fines on products not meeting requirements or producers' labels, then to enforce MEPS to ban products with low energy performance. Furthermore, to upgrade Industrial Research Institute (IRI) laboratory facilities to facilitate the testing procedures and standards, then to upgrade IRI's testing facility to test energy performance measures (IRI to follow international standards and certifications to reduce the level and time of testing), and to increase its capacity in order to decrease response time. In the meantime, LIBNOR would prepare standards for efficiency requirements. Products that are already certified from accredited laboratories abroad, and that have the correct energy performance labels would benefit from reduced testing requirements.
Measure proposed by:	Suppliers
Type of policy:	Regulation / Financial incentive
Target group:	Technology suppliers
Potential barriers of measure:	Cooperation with the Ministry of Finance; training of customs personnel to identify products that are eligible for tax waive off.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes

Table 19: Measure B_10

Build capacity at the supplier's floor staff level on the economic and environmental benefits of energy-efficient technologies imported in the country (after finalizing MEPS).	
Short description:	Our interviews with 300 consumers in Lebanon proved that the biggest driver for them to purchase an energy-efficient heating or cooling technology at a retail store is the ability of the vendor to present convincing arguments to defend the case. Vendors should guide customers in their purchase, explaining that the benefits of energy efficiency pay off over the life cycle of the equipment and how the present value of the technology should be their decision factor for a profitable investment. They should inform them about the possibility of financing mechanism to cover the additional upfront cost. The second factor driving consumers in Lebanon to purchase energy-efficient technologies was the presence of an energy

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Build capacity at the supplier's floor staff level on the economic and environmental benefits of energy-efficient technologies imported in the country (after finalizing MEPS).	
	efficiency label, hence the importance of finalizing the MEPS in Lebanon. Intensive capacity building activities for the suppliers' floor staff level is needed to equip them with the correct knowledge to better sell and favour heating and cooling technologies with higher energy efficiency even at higher costs, informing consumers about available financing options. This needs to be combined with a labelling scheme and a widespread public awareness campaign.
Measure proposed by:	Suppliers
Type of policy:	Regulation / Organizational
Target group:	Technology suppliers
Potential barriers of measure:	Requires approval of Council of Ministers and Member of Parliament to become mandatory.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes – Can be consolidated with Measure B_01 and Measure B_09.

Table 20: Measure B_11

Raise awareness of the end user on the social, economic and environmental benefits of energy-efficient and renewable energy solutions in the building sector.	
Short description:	Lack of awareness on the added benefits for the country for every kWh saved or produced with renewable power compared to business as usual and how reduction in energy subsidies could translate in improved public services. Lack of awareness on the impacts of climate change in Lebanon for future generations. Lack of awareness of end-users on the existence of loans and the possibility to retrofit their residents to reduce their energy consumption. Advertisements should raise the awareness of citizens in their role in reducing the public debt of the country by reducing their energy consumption by investing today in energy-efficient and renewable solutions. A national website grouping all information on the potential of energy efficiency measures in residential households and the contacts of certified ESCOs able to implement these measures should be built. Lessons from the campaign "Deutschland Macht Effizienz" (Germany goes for Efficiency) can be transferred. To be most effective at changing traditional ideologies, campaign should target universities and schools and introduce curriculums on impacts of climate change and mitigation measures. Finally, all new public buildings should have at their entrance their Energy Performance Certificate and market how energy-efficient solutions are reducing the energy bill of the building and saving CO_2 emissions. This measure has been taken in Germany and proven to be effective at raising awareness.
Measure proposed by:	Banks
Type of policy:	Informational

Raise awareness of the end user on the social, economic and environmental benefits of energy-efficient and renewable energy solutions in the building sector.	
Target group:	End user (e.g., homeowners)
Potential barriers of measure:	Economic situation which might affect NEEREA loans.
Part of NEEAP 2016-2020?	Yes
Implementation for NEEAP 2021-2025 recommended?	Yes

Table 21: Measure B_12

Build a legislative framework that offer incentives for end-users to purchase an energy-efficient house.	
Short description:	The NEEREA loan does not offer a low interest loan for end-users who wish to purchase an energy-efficient apartment/household available in the market. It offers a low interest loan for investing in single energy-efficient or renewable energy measures in your own property or it offers a low interest loan for a project developer that plans to take energy efficiency measures in his project to be sold to a client. There is hence no direct incentive for an external buyer to buy an energy-efficient apartment. If a project developer is able to raise funds from investors without a NEEREA loan to implement energy-efficient solutions in his new project, the existence of direct incentives for end-users in purchasing an energy-efficient house would facilitate the sales of his apartments considerably. To avoid the Central Bank from excessive subsidies, new apartments built by a project developer who benefitted from a NEEREA loan cannot benefit again from direct low interest loans to end user.
Measure proposed by:	Banks
Type of policy:	Regulation / Organizational
Target group:	House buyers
Potential barriers of measure:	First a classification scheme must be put in place. A legislation then would require all buildings to have a certain classification. In addition, to control it, trusted energy auditors need to be trained in order to classify buildings, and judicial police needs to be involved to impose violations and penalties.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	No

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Table 22: Measure B_13

Offer training and capacity building to support bank officers in understanding the context and business opportunities of energy efficiency lending, with a focus on efficient heating and cooling technologies.	
Short description:	Because of the non-conventionality of the cash flows of an energy-efficient asset, bankers do not understand how to value energy-efficient solutions and considers their applications similar to normal goods, instead of depreciable assets.
Measure proposed by:	Banks
Type of policy:	Informational / Organizational
Target group:	Bank officers
Potential barriers of measure:	The current economic situation might affect the issuing of NEEREA loans.
Part of NEEAP 2016-2020?	Yes
Implementation for NEEAP 2021-2025 recommended?	Yes

Table 23: Measure B_14

Implement faster methods for loan approvals.	
Short description:	The application for a NEEREA loan can be time consuming. Applications need to go first through a commercial bank, then to Banque de Liban (BDL) for approval and then BDL transfers the technical report to LCEC who acts as the technical arm for BDL and reviews the applications. The application is then reviewed and shared back and forth between the consultant in charge of the application and LCEC. Bankers lacked the knowledge to take an educated opinion once they received the application and transfer any issue to LCEC. Since there existed no list of eligible technologies and products that could qualify for a NEEREA loan at the time when the loan was initiated, every application came with a new technology from a certain supplier. LCEC had to cross check quality of supply and ensure that applications from the consultants are complete and up to standard, which may have caused delays in application approval.
Measure proposed by:	Banks
Type of policy:	Organizational / Administrative
Target group:	Loan approval processes
Potential barriers of measure:	Economic situation which might affect NEEREA loans.
Part of NEEAP 2016-2020?	No
Implementation for NEEAP 2021-2025 recommended?	Yes

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4.2 Suggestions of additional policy recommendations and measures in the building sector for the NEEAP 2021-2025

In order to complement the already existing measures in the building sector, further measures were found in joint meetings between Guidehouse and LCEC, whose implementation in the Lebanese building sector has not yet been achieved. The individual measures were evaluated in an iterative process and examined with regard to the type of policy, the target group, potential energy and greenhouse gas (GHG) savings, possible barriers, accountability and estimation of the time needed for their implementation. Following measures could be identified by Guidehouse and LCEC:

Table 24: Measure A_01

Awareness campaigns to inform public about energy efficiency benefits and how to proactively save energy.	
Short description:	Information campaigns which aim to promote behavioural change on energy use (e.g., adjustment of HVAC temperature setpoint[6]). Actions to increase public awareness, to induce behaviour change, and to provide education constitute an important element of policies and programs to support energy efficiency and energy savings. In particular, the overall goal of these policies and programs is to reduce energy consumption through non-technological measures. Energy behaviour change can be targeted at individuals, at communities and at organizations.
Type of policy:	Informational
Target group:	Public audience
Potential barriers of measure:	Difficulty in enforcing and controlling the adjustment in temperature. Likewise, difficulty in convincing users to change their behaviours.
Part of NEEAP 2016-2020?	No

Table 25: Measure A_02

Reduce window fraction of new constructions.	
Short description:	Solar gains are directly connected to a building's window fraction. Increasing the window fraction increases the demand for cooling and reduces the demand for heating. Decreasing the window fraction has the opposite effect. In areas with a high cooling demand, the southern window fraction should be reduced in order to save cooling energy. Regions with low cooling demand and higher heating demand should increase the southern window fraction and decrease the northern window fraction. Usually, varying the southern window fraction has larger effects than other directions.
Type of policy:	Technical
Target group:	New constructions
Potential barriers of measure:	Architects might be opposing to the idea since it would alter the design. Preference given to natural ventilation and lighting.
Part of NEEAP 2016-2020?	No

[6] It is recommended that room temperatures in cooling periods are maintained at 25°C and should not exceed a set temperature of 21°C in heating periods. Source: https://www.buildings-mena.com/files/LEB_IKI_Report_Lamartine_Hills_final.pdf

Table 26: Measure A_03

Decreasing cooling demand by installation of solar shadings (e.g., overhangs).	
Short description:	The increase in shading leads to a decrease in the energy demand for cooling in summer. At the same time, however, the demand for heating energy can increase in cold months due to solar shadings. It is recommended to install mobile shading devices that hold back about 75% of the direct sunlight. During heating periods, those devices should be moved in order to allow for solar gains. Horizontal overhangs should be used for southern windows and vertical overhangs should be installed in East/West directions.
Type of policy:	Technical / Informational
Target group:	Public and private buildings
Potential barriers of measure:	Financial resources
Part of NEEAP 2016-2020?	No

Table 27: Measure A_04

Empower R&D facilities within academic institutions targeting energy efficiency technologies.	
Short description:	Empower R&D facilities within the academic institutions in Lebanon to investigate and test innovative energy efficiency technologies, which could lead in the future to innovations towards the local production of goods for energy-efficient buildings e.g., construction materials. Building materials needed to construct buildings require a high proportion of imported products (equipment and/or raw materials) and thus contribute enormously to increasing foreign debt. The import of these materials leads to a considerable currency outflow and a direct increase in foreign debt. It is therefore vital that future development activities promote the local production of construction materials.
Type of policy:	Research & market introduction
Target group:	New constructions
Potential barriers of measure:	Financial resources
Part of NEEAP 2016-2020?	No

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Table 28: Measure A_05

Lighting and Automation.	
Short description:	Using lighting controls to automate the on and off times of lights and HVAC as needed can save energy. Common types of lighting and HVAC controls include: • Dimmers to provide variable indoor lighting which can reduce the wattage and output. • Motion sensors to automatically turn outdoor lights on when they detect motion and turn them off a short while later. • Occupancy sensors to turn on lights when someone enters a room and save energy by turning lights off soon after. • Photosensor control to prevent outdoor lights from operating during daylight hours. • Timer controls to turn lights and HVAC on and off at specific times[7]. Enforce the installation of motion detectors in central government buildings to control the lighting loads. Additionally, retrofit existing lighting fixtures within central government buildings by installing efficient LED lighting. Additionally, expand further to the private sector by making the control of lighting and HVAC mandatory, especially in the hospitality sector (i.e.: mandatory occupancy sensors in rooms).
Type of policy:	Regulation
Target group:	Public and private sector buildings
Potential barriers of measure:	Requires legislation
Part of NEEAP 2016-2020?	No

Table 29: Measure A_06

Implementation of EPC within the public sector.	
Short description:	Promote the use of performance-based energy contracts within the public sector in general, and at the municipal level in particular. EPC can prove to be an efficient solution to the implementation of energy efficiency measures in the public sector, mainly by shifting the risk towards the private sector (ESCOs).
Type of policy:	Regulation/Guidelines
Target group:	Public sector
Potential barriers of measure:	Lack of experience and knowledge in the Lebanese market. Low energy-tariff that discourages investors since projects will not have an acceptable payback period and reasonable profit. This tendency has currently changed due to the increase in the cost of kWh provided by private generators; this could be seen as an opportunity to enforce EPCs. No sufficient laws and regulations in place that can govern such contracts.

[7] Source: https://www.energy.gov/energysaver/save-electricity-and-fuel/lighting-choices-save-you-money/lighting-controls

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Implementation of EPC within the public sector.	
Part of NEEAP 2016-2020?	No

Table 30: Measure A_07

Promote heat recovery system on diesel generators.	
Short description:	With the widespread use of private diesel generators in Lebanon, as a result of the supply shortage of electricity from the main utility, promoting heat recovery systems on diesel generators with long operational times could play a major role in decreasing energy consumption related to space and water heating. Possible lock-in effects of other renewable energy systems (e.g., solar thermal) should definitely be considered.
Type of policy:	Regulation
Target group:	Equipment
Potential barriers of measure:	Adoption of a regulation imposing the mandatory installation of heat recovery systems for private diesel generators with long operational times.
Part of NEEAP 2016-2020?	No

Table 31: Measure A_08

Set a requirement for advance modelling and energy simulations of new buildings (criteria to be set), in order to predict the energy consumption footprint prior to new construction (i.e.: BUILD_ME Building Energy Performance tool).	
Short description:	To set a requirement for all new buildings to perform energy simulations for new buildings in order to predict the energy consumption footprint prior to the start of construction.
Type of policy:	Regulation
Target group:	Project developers
Potential barriers of measure:	Adoption of regulation; lack of expertise in building modelling.
Part of NEEAP 2016-2020?	No

Table 32: Measure A_09

Complete a comprehensive assessment/feasibility study for a district cooling pilot project for a cluster of buildings in Lebanon	
Short description:	Perform a pilot study of a district cooling project for a cluster of buildings in a Lebanese town, which can contribute to energy savings instead of Business-as-usual (BAU) scenario where individual HVAC systems are installed.
Type of policy:	Research
Target group:	HVAC
Potential barriers of measure:	Funding/Feasibility barriers especially related to existing infrastructure.
Part of NEEAP 2016-2020?	No

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Table 33: Measure A_10

Setting up prepayment top-up electricity meters (pay-as-you-go meters) which affect the behaviour of consumers (behaviour change, rationing and budgeting of electricity from consumers, increased awareness on consumption).	
Short description:	Replace analog electric meters with prepayment top-up meters, where consumers use a top-up card or key to load money onto the meter. Similar to a pay-as-you-go mobile phone, money is taken from a balance every time the consumer uses energy – and when they run out of credit, the power will be temporarily switched off until another top-up.
Type of policy:	Regulation
Target group:	Consumers/Utility
Potential barriers of measure:	Legal barriers
Part of NEEAP 2016-2020?	No

Table 34: Measure A_11

Empower customers with access to information by providing them with online access to their historical electricity bills, with data visualizations highlighting their yearly/seasonal consumption trends.	
Short description:	Access to information, along with visualizations of yearly and seasonal consumption trends with benchmarking to peer groups, contribute to consumers' awareness regarding the electricity consumption.
Type of policy:	Informational
Target group:	Consumers/Utility
Potential barriers of measure:	Implementation/Bureaucratic barriers
Part of NEEAP 2016-2020?	No

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5. BUNDLING OF MEASURES FOR THE NEEAP 2021-2025

The evaluation of the individual measures of the NEEAP 2016-2020 in Chapter 3.2 showed that a high proportion of measures in the building sector could not yet be implemented. Furthermore, the assessment of the BUILD_ME Phase 1 measures in Chapter 4.1 and the additional policy recommendations identified by Guidehouse and LCEC in Chapter 4.2 showed that the NEEAP 2021-2025 should be supplemented by further measures in addition to the uncompleted measures of the NEEAP 2. In order to facilitate the implementation of the identified measures in the currently difficult context in Lebanon, the measures recommended for the NEEAP 2021-2025 were first bundled into eight subgroups and then put together in two packages with different characteristics.

- **Package 1: Get the basics right** contains basic measures that should be implemented in the short term and require relatively manageable financial resources (so-called "low hanging fruits") in order to save energy.

- **Package 2: High performance** summarizes the measures that can achieve high energy savings, but also require larger financial resources for their implementation and are subject to greater barriers and payback periods.

The packages of measures developed by Guidehouse and LCEC differ in terms of their use of financial resources, potential barriers in their implementation, and effectiveness on energy savings in the building sector. It is recommended to focus first on the measures of policy package 1, which can be implemented with manageable financial resources and good effectiveness on energy savings. The implementation of measures of the policy package 1 should be the basis for further, more ambitious measures. The implementation of measures from package 2 should therefore be understood as the next step towards energy efficiency in the Lebanese building sector, which is associated with higher financial resources and greater barriers in the policy cycle and should be addressed after successful implementation of the basic requirements (package 1).

In the following, the individual subgroups are first divided into the two packages, followed by a breakdown of the packages with their respective individual measures and references in the report.

Package 1: Get the basics right

Measures with low investment and fast payback (“low hanging fruits").

- Optimization of existing systems
- Information and training on financing EE projects
- Mandatory standards for energy-efficient equipment
- Awareness raising and training for EE in buildings

Package 2: High performance

More advanced measures delivering high energy savings.

- Mandatory standards for energy efficiency in new constructions
- Improving energy efficiency in public buildings
- (Financial) incentives for energy efficiency
- Research & Development

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5.1 Package 1: Get the basics right

Optimization of existing systems

- Decreasing cooling demand by installation of solar shadings (e.g., overhangs) – ***For more details see Table 26: Measure A_03***
- Lighting and automation – ***For more details see Table 28: Measure A_05***

Information and training on financing energy efficiency projects

- Raise awareness of the end user on the social, economic and environmental benefits of energy-efficient and renewable energy solutions in the building sector ***– For more details see Table 20: Measure B_11***
- Offer training and capacity building to support bank officers in understanding the context and business opportunities of energy efficiency lending, with a focus on efficient heating and cooling technologies ***– For more details see Table 22: Measure B_13***
- Implement faster methods for loan approvals – ***For more details see Table 23: Measure B_14***

Mandatory standards for energy-efficient equipment

- Enforce mandatory energy performance standards for heating and cooling equipment being imported in the country ***– For more details see Table 10: Measure B_01***
- Incentivize suppliers to import energy-efficient technologies by facilitating import procedure ***– For more details see Table 18: Measure B_09***
- Build capacity at the supplier's floor staff level on the economic and environmental benefits of energy-efficient technologies imported in the country (after finalizing MEPS) ***– For more details see Table 19: Measure B_10***
- Promote heat recovery system on diesel generators – ***For more details see*** **Table 30: Measure A_07**

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Awareness raising and training for energy efficiency in buildings

- Energy performance certificate for buildings **– *For more details see Table 5: Measure N_05***
- Awareness campaigns to inform public about EE benefits and how to proactively save energy **– *For more details see Table 24: Measure A_01***
- Capacity building for refurbishment – ***For more details see Table 9: Measure N_09***
- Setting up prepayment top-up electricity meters (pay-as-you-go meters) which affect the behaviour of consumers (behaviour change, rationing and budgeting of electricity from consumers, increased awareness on consumption) **– *For more details see* Table 33: Measure A_10**
- Empower customers with access to information by providing them with online access to their historical electricity bills, with data visualizations highlighting their yearly/seasonal consumption trends **– For more details see Table 34: Measure A_11**

5.2 Package 2: High performance

Mandatory standards for energy efficiency in new constructions

- Building code to improve the energy efficiency standard of new buildings **– *For more details see* Table 1: Measure N_01*, Table 3: Measure N_03 and Table 13: Measure B_04***
- Reduce window fraction of new constructions **– *For more details see Table 25: Measure A_02***
- Set a requirement for advance modelling and energy simulations of new buildings (criteria to be set) in order to predict the energy consumption footprint prior to new construction (i.e.: BIM) **– *For more details see* Table 31: Measure A_08**
- Strengthen enforcement systems in the construction and maintenance phase, applying severe penalties to the engineering design company for non-compliance to the energy efficiency building code and to the facility manager of the residential building for not reporting annual energy consumption **– *For more details see Table 14: Measure B_05***

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Improving energy efficiency in public buildings

- Implementing measures in selected public buildings ***– For more details see Table 7: Measure N_07***
- Energy audits for public buildings ***– For more details see Table 6: Measure N_06***
- Implementation of EPC within the public sector ***– For more details see* Table 29: Measure A_0**

(Financial) incentives for energy efficiency

- Regulate laws that enable municipalities to offer incentives for energy-efficient buildings beyond the double wall ordinance ***– For more details see Table 11: Measure B_02***
- Differentiate financial incentives between energy efficiency projects, offering highest incentives for projects with highest ambition, and distribute a standard economic tool that can benchmark applications ***– For more details see Table 15: Measure B_06***
- Use of efficient equipment ***– For more details see Table 4: Measure N_04***

Research & Development

- Complete a comprehensive assessment/feasibility study for a district cooling pilot project for a cluster of buildings in Lebanon ***– For more details see* Table 32: Measure A_09**
- Empower R&D facilities within academic institutions targeting energy efficiency technologies ***– For more details see* Table 27: Measure A_04 and Table 2: Measure N_02**

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6. QUANTIFIED IMPACT ASSESSMENT OF RECOMMENDATIONS

In October 2021, the BUILD_ME project team has finalized an impact assessment of four policy packages consisting of different measures proposed in this document. More details regarding the methodology can be found in the report entitled “Impact Assessment of Policy Packages Lebanon”.

The four policy packages are:

- Information and training on financing energy efficiency projects (Code: PP_02) that includes the following measures:
    - Raise awareness of the end user on the social, economic and environmental benefits of energy-efficient and renewable energy solutions in the building sector.
    - Offer training and capacity building to support bank officers in understanding the context and business opportunities of energy efficiency lending, with a focus on efficient heating and cooling.
    - Implement faster methods for loan approvals.
- Mandatory standards for energy-efficient equipment (Code: PP_03) that includes the following measures:
    - Enforce mandatory energy performance standards for heating and cooling equipment being imported in the country.
    - Incentivise suppliers to import energy-efficient technologies by facilitating import procedure.
    - Build capacity at the supplier’s floor staff level on the economic and environmental benefits of energy-efficient technologies imported in the country (after finalizing MEPS).
    - Promote heat recovery system on diesel generators (accounts for only 1 % of NEEREA projects) for the heating of domestic hot water (target military barracks).
- Mandatory standards for energy efficiency in new constructions (Code: PP_06) that includes the following measures:
    - Double wall ordinance.
    - Building code to improve the energy efficiency standard of new buildings.
    - Reduce window fraction of new constructions.
    - Update Lebanese building code to include an energy-efficient code for heating and cooling. The code becomes mandatory for all new buildings’ construction.
    - Set a requirement for advance modelling and energy simulations of new buildings (criteria to be set) in order to predict the energy consumption footprint prior to new construction (i.e.: BIM).
    - Strengthen enforcement systems in the construction and maintenance phase, applying severe penalties to the engineering design company for non-compliance to the energy

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efficiency building code and to the facility manager of the residential building for not reporting annual energy consumption.

- (Financial) incentives for energy efficiency (Code: PP_08) that includes the following measures:
    - Regulate laws that enable municipalities to offer incentives for energy-efficient buildings beyond the double wall ordinance.
    - Differentiate financial incentives between energy efficiency projects, offering highest incentives for projects with highest ambition, and distribute a standard economic tool that can benchmark applications.
    - Use of efficient equipment.

The assessment also included an integrated package that considers all packages would be implemented in parallel. The summary of results and conclusions are presented on the following page.

The assessment has shown that on single package level, package 6 (PP_06) can already save ~41% accumulated emissions compared to a BAU path between 2021 and 2030. The integrated module, considering all packages would be implemented, could even mitigate up to 55% accumulated emissions. The specific emissions as a result from the different policy measures could be reduced by ~61% from policy package 6 and ~81% from the integrated module compared to a BAU case. The other main results are shown in Table 35.

Table 35. Main emission results 2030

Policy package	Specific emissions in new constructions in 2030 [kgCO_2e/(m²*a)]	Emissions from newly constructed buildings in 2030 [ktons CO_2e]	Accumulated emissions from newly constructed buildings 2021-2030 in 2030 [ktons CO_2e]
BAU_00	32.1	81.7	1,926.6
PP_02	21.8	55.5	1,553.8
PP_03	17.1	43.5	1,399.9
PP_06	12.5	31.8	1,136.8
PP_08	22.4	56.9	1,577.2
Integrated	6.0	15.2	861.2

Interesting is also a slightly more detailed analysis of the useful-net energy and final energy demands of the different packages for the year 2030 that can be found in Table 36.

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Table 36. Main energy results 20308

Policy package	Useful-net energy demand [kWh/(m²*a)]				Final energy demand [kWh/(m²*a)]			
	Heating	Cooling	DHW	Total	Heating	Cooling	DHW	Total
BAU_00	30.4	62.7	8.8	102.0	34.7	25.1	10.4	70.2
PP_02	17.6	53.6	8.8	80.0	21.3	20.0	10.2	51.5
PP_03	22.9	60.0	8.8	91.8	21.2	18.2	9.1	48.6
PP_06	4.8	39.5	8.8	53.1	7.1	13.6	10.6	31.2
PP_08	19.3	52.9	8.8	81.0	23.2	20.4	10.0	53.6
Integrated	0.0	24.7	8.8	33.5	0.6	8.7	9.4	18.7

In cases where the building envelope is very good (PP_06) and as a result also the integrated module and reducing the energy demand to almost 0 it does not make sense to still install an expensive heating system. In the concrete case of policy Package 6, the planned heating systems still foresee a share >30% of heat pumps that however, from the author's perspective would not be a reasonable focus of the bundle. When the demand is reduced to almost 0, just the cheapest systems should be allowed to be installed.

[8] **Useful-net energy demand** represents the physical energy demand of a building for reaching / holding a specific internal temperature. The useful-net energy demand results from the energy losses through the building envelope thus depends on the quality of windows, insulation thickness, heat bridges, air tightness, construction materials etc. The **final energy demand** in addition considers the efficiency of the supply system for generating heat or cold and therefore is the quotient of useful-net energy demand and efficiency of the supply system. Is the efficiency lower 100%, the final energy demand is higher than the useful-net energy demand, is the efficiency greater than 100% (heat pumps and ACs), the final energy demand is lower.

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