



Cost-effective rehabilitation of public buildings into smart and resilient nano-grids using storage

Thematic Objectives: B.4 - Environmental protection, climate change adaptation and mitigation (Address common challenges in environment)

Priority: B.4.3 - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings

Countries: Cyprus, Greece, Israel, Italy

Output n°: 4.1

Output Title: Tools Development for renovating public buildings with PV+ESS+DSM hybrid

Activity n°: 4.1.2

Activity title: Development of a policy makers' tool for policy recommendations

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1 Document Info

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2 Document History

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3 Copyright

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1 Project summary

In an effort to address high energy consumption in the building sector that is mainly fossil – fuelled, support rural areas and areas powered by weak grids, which are common in the MENA region, and achieve higher grid penetration of renewable energy sources (RES) while maintaining grid stability and power quality, this project aims at the implementation of cross border pilots that will support innovative and cost – effective energy rehabilitation in public buildings based on the nanogrid concept. Thus, BERLIN project focuses on the increase of photovoltaics (PV) penetration, which coupled with energy storage and demand – side management (DSM) will increase the energy efficiency (EE) of the buildings. The implementation of these technologies in a cost – effective way will result in high level of self – resilient public buildings that are green, smart, innovative, and sustainable. A total of 6 pilot buildings will be implemented by the end of the project, namely 1 in Cyprus, 2 in Greece, 2 in Israel and 1 in Italy.

The project started in September 2019 and will be completed in September 2023.

2 Introduction

The policy makers tool provides recommendations for policies and regulations that promote the adoption of the photovoltaics (PV) and energy storage systems (ESS) in public buildings with the potential for demand side management (DSM), referred here as PV+ESS+DSM scheme. Except from recommendations, it offers numerical results about (i) the profitability of PV+ESS+DSM systems in certain building types and (ii) the energy self-sufficiency of the building.

It consists of 7 tabs. The first three tabs, “Technical input”, “Financial input”, “Incentives/regulations for PV+ESS+DSM”, are used to collect all the required input data from the user. The next tab, i.e., “Run”, is used to load the inputs and execute the simulation. The last three tabs are used to display the numerical results (“NPV Results” and “SSR results”), as well as the recommendations for policies and regulations (“Recommendations”). Further information is provided within the next sections.

The policy makers tool was developed with the financial assistance of European Union under the ENI CBC Mediterranean Sea Basin Programme, under the project [“BERLIN – Cost-effective rehabilitation of public buildings into smart and resilient nano-grids using storage”](#). Feel free to use the tool for your analyses.

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3 Technical input tab

Here please select all the information regarding the building you want to examine. Further help on the available options will be presented by leaving your mouse on the corresponding field.

MATLAB App
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Help on the tool About BERLIN

Technical input

Financial input

Incentives/regulations for PV+ESS+DSM

Run

NPV Results

SSR Results

Recommendations

Use of the public building

What is the main use of the public building?

Annual building consumption in kWh

Choose the range of photovoltaic (PV) system capacities to examine

School building ▼

20000

0.5 to 2 kWp per 1000 kWh

1 to 3 kWp per 1000 kWh

2 to 5 kWp per 1000 kWh

Energy storage system (ESS) to PV size to examine

What is the ESS to PV size rate to be examined?

0.5 kWh/kWp

1 kWh/kWp

2 kWh/kWp

Building location

In which country is the building located?

Greece ▼





Daily flexibility level of the building loads

Are there flexible loads in the buildings that could participate in demand side management (DSM) strategies?

If yes, what is the part (%) of load demand energy that can be shifted within a day?

No Yes

0

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4 Financial input

Here please select all the information regarding:

- The electricity tariffs. In case of a Time of Use (ToU) pricing scheme, please pay attention to insert the information of the different time zones correctly:
 - Please select the starting time of the different tariff zones, in ascending order, beginning from Zone A.
 - Example 1: pricing scheme with 2 zones: 16:00-20:00 and 20:00-16:00 of the next day, two starting hours are considered in ascending order: 16:00 for Zone A and 20:00 for Zone B.
 - Example 2: pricing scheme with 3 zones: 10:00-16:00, 16:00-20:00 and 20:00-10:00 of the next day, three starting hours are considered in ascending order: 10:00 for Zone A, 16:00 for Zone B, and 20:00 for Zone C.
- The Feed-in Tariff provided to the prosumer as a reimbursement for any excess photovoltaic (PV) produced energy that is injected into the utility grid.
- The systems purchase and installation cost, including VAT.
- The discount and the inflation rate.

Further help on the available options will be presented by leaving your mouse on the corresponding field.

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Help on the tool About BERLIN

Technical input
Financial input
Incentives/regulations for PV+ESS+DSM
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Electricity tariffs

Flat or Time of Use (ToU) tariffs Flat Time of Use ToU Tariff Zones 2




	Flat / ToU Zone A	ToU Zone B	ToU Zone C
Start time of tariff zone	16 ▾ 00 ▾	21 ▾ 00 ▾	00 ▾ 00 ▾
Production charges (€/kWh)	0.167	0.3	0
Network charges (€/kWh)	0.02259	0.02259	0
Taxes on electricity (€/kWh)	0.02207	0.02207	0
VAT (%)	6		

Reimbursement for excess photovoltaic (PV) energy

Does a Feed-in Tariff exist Yes No If yes, import in €/kWh 0.07

PV and battery system purchase and installation cost (incl. VAT)

PV and hybrid inverter cost (€/kW)	1000	Discount rate (%)	4
ESS cost (€/kWh)	600	Inflation rate (%)	3

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5 Incentives/regulations for PV+ESS+DSM tab

In this tab, information about the existing framework of incentive policies is collected.

MATLAB App
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Help on the tool About BERLIN

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Incentives for photovoltaic (PV) system installation

Financial subsidy for PV system and hybrid inverter in €

Financial subsidy for PV system and hybrid inverter in % of the purchase cost ▲ ▼

Annual financial subsidy for owning a PV (e.g. tax reduction) in €/year

Is there an active net-metering scheme in place? No Yes

Is there an active net-billing scheme in place? No Yes

Incentives & regulations for energy storage systems (ESS)

Financial subsidy for ESS in €

Financial subsidy for ESS in % of the purchase cost ▲ ▼

Annual financial subsidy for owning an ESS (e.g. tax reduction) in €/year




Are ESSs permitted by the regulations of electrical network operator? No Yes

Is the installation of ESS obligatory for new PV systems? No Yes


Incentives for demand side management (DSM)

Compensation for investing in shiftable devices? No Yes

Compensation for electrifying thermal loads? No Yes

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6 Run tab

As described on the tab, the outputs of the tool are presented following three sequential steps:

- 1) **Load the inputs.** Once the inputs are loaded, they are validated and if all values are correctly entered, a message of successful loading will appear and the button “Run the analysis” will be enabled. If an error exists, a related warning will appear. The user has to correct the invalid hours and press again the “Load inputs” button.
- 2) **Run the analysis.** As soon as the inputs are successfully loaded the user has the option to run the analysis. A message of successful analysis will appear as soon as the analysis calculations are complete.

Load Inputs	
Run the analysis	<i>Analysis completed successfully</i>
Print the results	

- 3) **Print the results.** Since the analysis is successfully completed, the user can press the third button to print the results in the following three tabs.

Load Inputs	
Run the analysis	<i>Analysis completed successfully</i>
Print the results	<i>Results are printed</i>

All imported values are maintained until the tool is closed. In case the user changes some of the values in the first three tabs, the three steps have to be repeated to receive the new results.

Further help on the available options will be presented by leaving your mouse on the corresponding field.

MATLAB App

Help on the tool About BERLIN

Technical input Financial input Incentives/regulations for PV+ESS+DSM Run NPV Results SSR Results Recommendations




Please follow the steps:
1) Press the button "Load inputs".
2) Press the button "Run the analysis" and wait until the message of a successful analysis appears.
3) Press the button "Print results" and wait until the message of completed printing appears. The results will be printed in the Tabs to the right.


Notes:
i) The numerical results correspond to a policy that incentivizes the prosumer to maximize the self-consumption of the building, as proposed by the most recent Directives of the European Commission.
ii) It is assumed that charging and discharging the battery from/to the utility grid is not allowed. The analysis is based on the inputs received from the first three tabs.
iii) The policy recommendations are produced based on the inputs received from the first three tabs.

Load Inputs

Run the analysis

Print the results

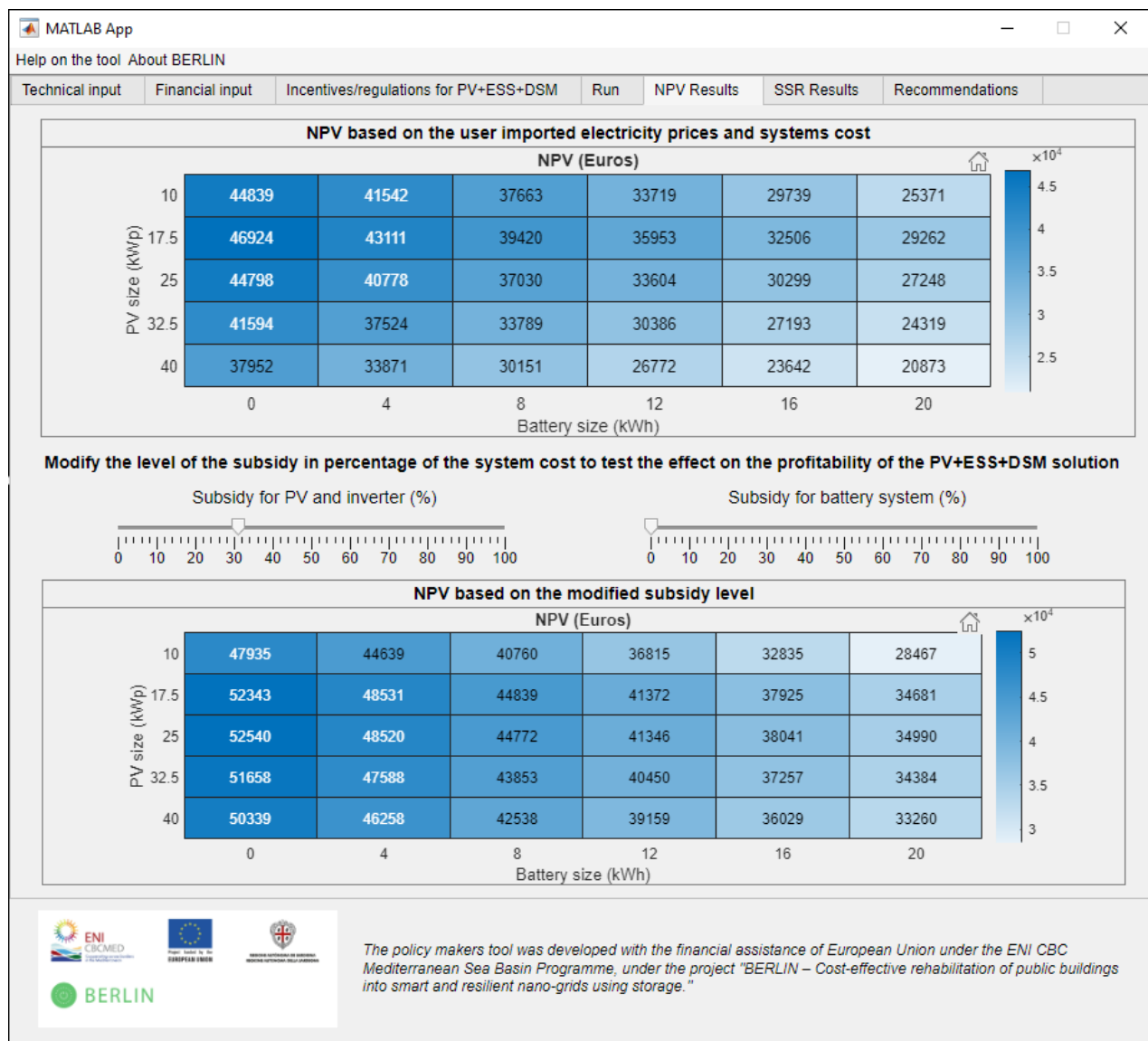


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7 Net present value (NPV) results tab

In the first figure, the NPV based on the imported data by the user is demonstrated for the different combinations of PV and battery capacity.

In the second figure, the NPV based on the imported data by the user and the modifications inserted by moving the two sliding bars is demonstrated. This figure shows the effect of the financial subsidies on the profitability of the investment on PV+ESS+DSM schemes.

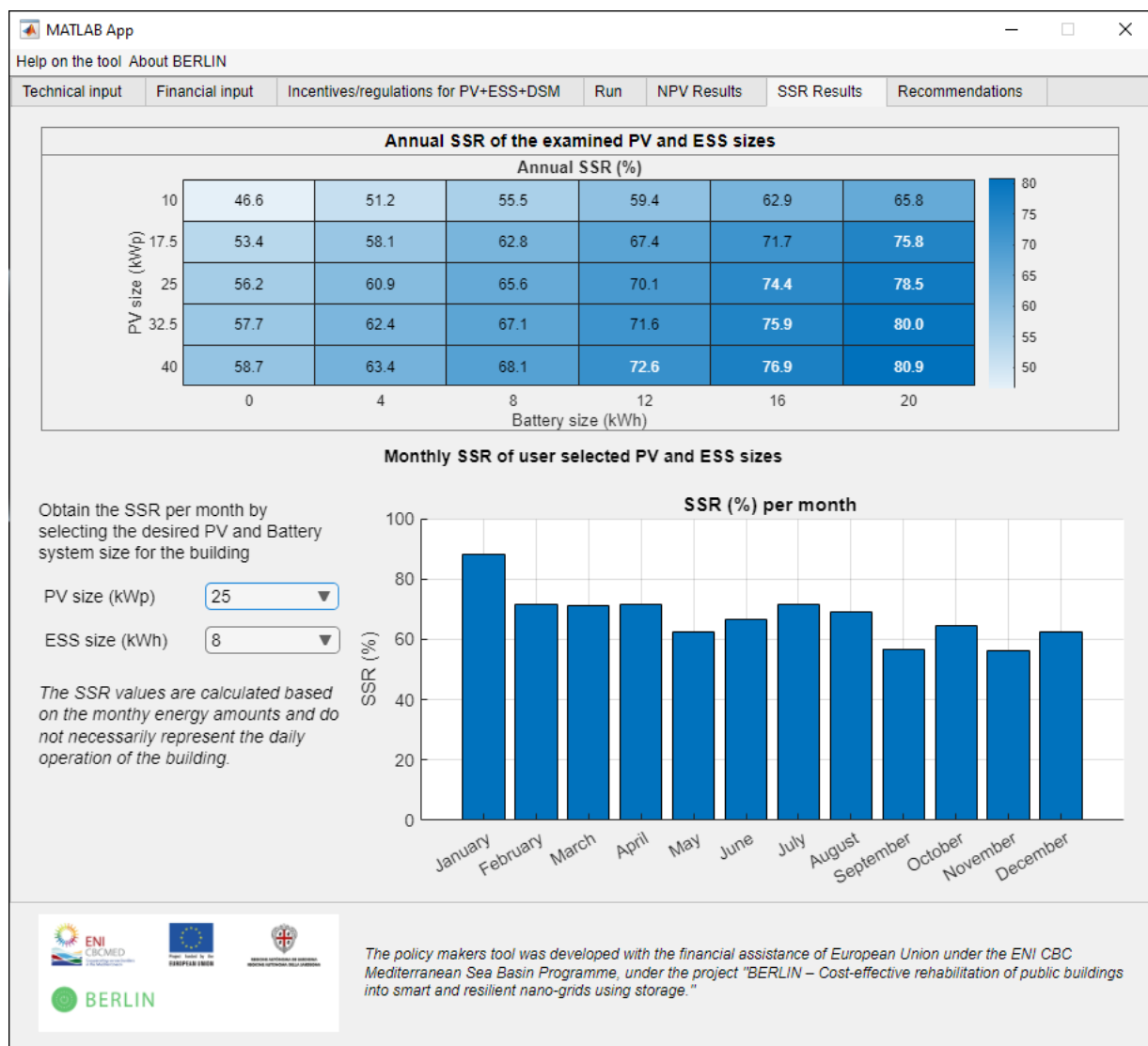


8 Self-sufficiency rate (SSR) results tab

In the first figure of this tab, the annual SSR based on the imported data by the user is demonstrated for the different combinations of PV and battery capacity. SSR is defined as the portion of the load demand energy that is covered by own PV production either directly or at a later time exploiting the battery, and can be calculated as follows:

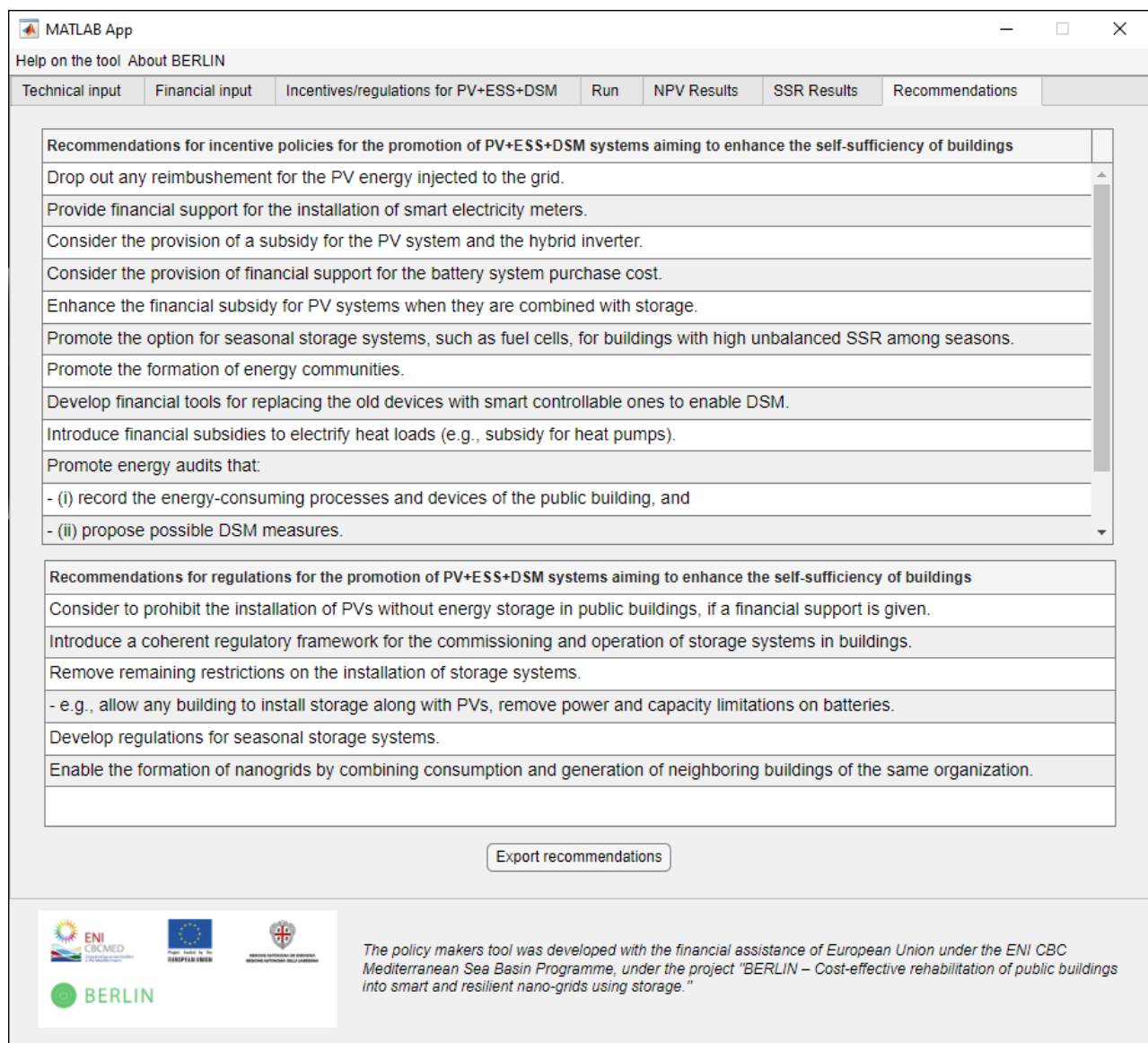
$$SSR = \frac{[Consumption\ energy] - [Energy\ imported\ from\ grid]}{[Consumption\ energy]}$$

The second figure illustrates the monthly SSR values for the PV-battery combination selected on the left-side of the figure.



9 Recommendations tab

The last tab provides the recommendations for policies and regulations that promote the PV+ESS+DSM system, aiming to enhance the self-sufficiency of buildings. By pressing the button “Export recommendations”, the user can save all the presented recommendations in a Microsoft Excel file. The Excel file is separated into two sheets, one used for the policies and the other for the regulations.



MATLAB App

Help on the tool About BERLIN

Technical input Financial input Incentives/regulations for PV+ESS+DSM Run NPV Results SSR Results Recommendations

Recommendations for incentive policies for the promotion of PV+ESS+DSM systems aiming to enhance the self-sufficiency of buildings

- Drop out any reimbursement for the PV energy injected to the grid.
- Provide financial support for the installation of smart electricity meters.
- Consider the provision of a subsidy for the PV system and the hybrid inverter.
- Consider the provision of financial support for the battery system purchase cost.
- Enhance the financial subsidy for PV systems when they are combined with storage.
- Promote the option for seasonal storage systems, such as fuel cells, for buildings with high unbalanced SSR among seasons.
- Promote the formation of energy communities.
- Develop financial tools for replacing the old devices with smart controllable ones to enable DSM.
- Introduce financial subsidies to electrify heat loads (e.g., subsidy for heat pumps).
- Promote energy audits that:
 - (i) record the energy-consuming processes and devices of the public building, and
 - (ii) propose possible DSM measures.

Recommendations for regulations for the promotion of PV+ESS+DSM systems aiming to enhance the self-sufficiency of buildings

- Consider to prohibit the installation of PVs without energy storage in public buildings, if a financial support is given.
- Introduce a coherent regulatory framework for the commissioning and operation of storage systems in buildings.
- Remove remaining restrictions on the installation of storage systems.
 - e.g., allow any building to install storage along with PVs, remove power and capacity limitations on batteries.
- Develop regulations for seasonal storage systems.
- Enable the formation of nanogrids by combining consumption and generation of neighboring buildings of the same organization.

Export recommendations

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