



Untapping the Energy Efficiency Potential in Public Buildings in Bangladesh

Summary of Key Findings

PROJECT SCOPE

Public buildings in Bangladesh are responsible for a significant and increasing share of the national energy consumption and related GHG emissions. The objective of the Energy Efficiency in Public Buildings (EEPB)¹ project was to determine the potential for improving energy efficiency and use of rooftop solar in public buildings in Bangladesh, and subsequently secure government buy-in to consider a loan to undertake a large energy efficiency investment project across the country's public building space (e.g. at least 200-300 public buildings). In the scope of the project the following outputs were achieved:

- » Implementation of energy audits in 12 public buildings, based on the ANSI/ASHRAE/ACCA 211-2008 Level 2 Standard, as stipulated in Figure 1. This included assessments of the performance of appliances in use, the building envelope and rooftop solar PV (potential) as well as recommended energy efficiency measures with respective cost-benefits for each building. A detailed energy audit report for each of the 12 buildings as well as a summary is available upon request. → [here](#)
- » Preparation of a Best-Available-Technology Study, available → [here](#)
- » Extrapolation of the GHG mitigation and cost benefit potential for selected 274 public buildings in Dhaka city since it is the capital and most urbanized city in the country as well as building density is high.
- » Summary of the short, medium and long-term recommendations for action
- » Public Procurement Survey in the scope of the global GIZ Proklima → [Green Cooling in Public Procurement study](#).

Figure 1. Energy Audit Levels. Deloitte (2021). Executive Summary of the Energy Audits

ANSI/ASHRAE/ACCA STANDARD 211-2018

The standard defines three levels of audits, where each successive level builds on the preceding levels. Example: A level 2 audit contains all information gathered in level 1. The standard focuses on reporting the energy use analysis of buildings and an action plan to reduce energy consumption in buildings.

LEVEL 1

WALKTHROUGH ENERGY AUDITS

- | Review building energy bills
- | Preliminary energy use analysis
- | Reviewing energy systems

LEVEL 2

RECOGNITION OF ENERGY SAVINGS OPPORTUNITIES

- | Detailed listing of all inventory in the system
- | Evaluation of energy performance using sample measurements where possible
- | Suggest energy-efficient measures
- | Provide high-level estimates of energy savings potential

LEVEL 3

INVESTMENT GRADE ENERGY AUDIT

- | Review capital-intensive energy-efficient measures
- | Perform building energy simulations
- | Determine the response to changes in energy systems

¹ Project budget: USD 250,000 K-CEP funds, 16 months duration, implemented by GIZ

SUMMARY OF ENERGY AUDIT RESULTS

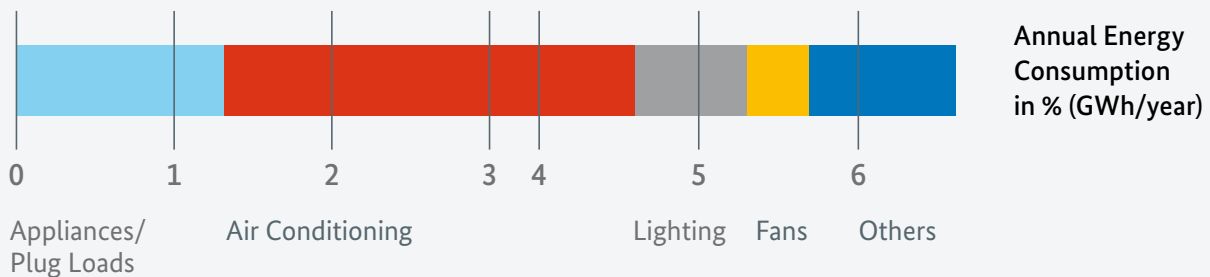
A total of nine energy audits were carried out in public buildings in the Dhaka region and three energy audits were conducted in other divisional cities. Besides one university, all other buildings were government buildings with the use of offices. Most of the examined buildings are older than 50 years and thus no longer meet the best available standards today in the country. To compare against a regional benchmark, the Indian Bureau of Energy Efficiency (BEE) star rating for buildings was used for the analysis for all 12 buildings covered under this study. As per BEE, for a warm and humid climatic zone,

one star rating of an office building will have an energy use intensity (EUI) of 85-75 kWh/m²/year and it goes down to as low as 45 kWh/m²/year for a five star rated building. Thus, as per the benchmark, there is significant potential for optimizing energy consumption and energy costs in the examined buildings.

Figure 3 shows the annual energy consumption of the examined buildings. Inefficient and old Air Conditioners (ACs) with climate-damaging refrigerants (e.g. HFC-410A and HCFC-22) are responsible for the largest share of energy use.

Figure 2. % share of Annual Energy Consumption (GWh) per appliance in examined buildings.

Derived from: Deloitte (2021). Executive Summary of the Energy Audits



PUBLIC BUILDINGS IN BANGLADESH ARE RESPONSIBLE FOR A SIGNIFICANT AND INCREASING SHARE OF NATIONAL ENERGY CONSUMPTION AND THE RELATED GREENHOUSE GAS EMISSIONS. OLD AND INEFFICIENT AIR CONDITIONERS IN PARTICULAR CONTRIBUTE SIGNIFICANTLY TO THIS - NOT ONLY BECAUSE OF THEIR HIGH ELECTRICITY CONSUMPTION, BUT ALSO DUE TO THE CLIMATE-DAMAGING REFRIGERANTS THEY CONTAIN.

PROPOSED ENERGY EFFICIENCY MEASURES

The energy saving potential in public buildings in Bangladesh is considerable and can be achieved with a comprehensive set of mainly appliance-related measures. The following six are the most promising energy efficiency measures by order of highest to lowest energy savings:

» **1. AIR CONDITIONERS**

Replacement of old inefficient ACs with high efficiency ACs (EER of 4.75 or above) (Green ACs²)

» **2. WINDOWS**

Replacement of plain windows with energy efficient glazed windows (Glazed windows)

» **3. LIGHTING**

Replacement of Fluorescent tube lights and CFLs with LED lights (Lighting)

» **4. FANS**

Replacement of old inefficient ceiling fans with high efficiency brush less direct current motor fans (BLDC fans)

» **5. OTHER APPLIANCES**

Switching the power settings of desktops and other appliances to power saving mode (Appliances/Plug Loads)

Figure 3 (see page 5) provides a comparison of different energy efficiency measures according to their energy saving potential and investment costs. Some of the measures can be implemented at low costs and are of more short-term nature whereas other measures require higher investment but would also pay off in the long-term through improved technologies. By replacing old inefficient ACs with high efficiency Green ACs, an average of 6% of electricity consumption could be saved per year across all buildings. If all measures are implemented for the examined buildings, 26% of the energy consumption could be saved, resulting in 1,550 MWh electricity savings per year. The overall investment costs for the 12 buildings are estimated at approx. USD 927,750 per year. The audit findings were used to extrapolate the energy efficiency and conservation potential for selected 274 buildings across the country managed by Public Works Department (PWD). The analysis estimates an approximate electricity savings potential of 11 to 15 million kWh (USD 1.3 to 1.8 million). The implementation of energy efficiency and conservation interventions would bring in a CO₂eq reduction of approximately 7,500-9,000 tCO₂eq per annum (Deloitte, 2021).

A more comprehensive analysis can be found in the executive summary of the energy audits.

² Green ACs means the use of natural refrigerant (e.g. R290), EER of 4.75 or above

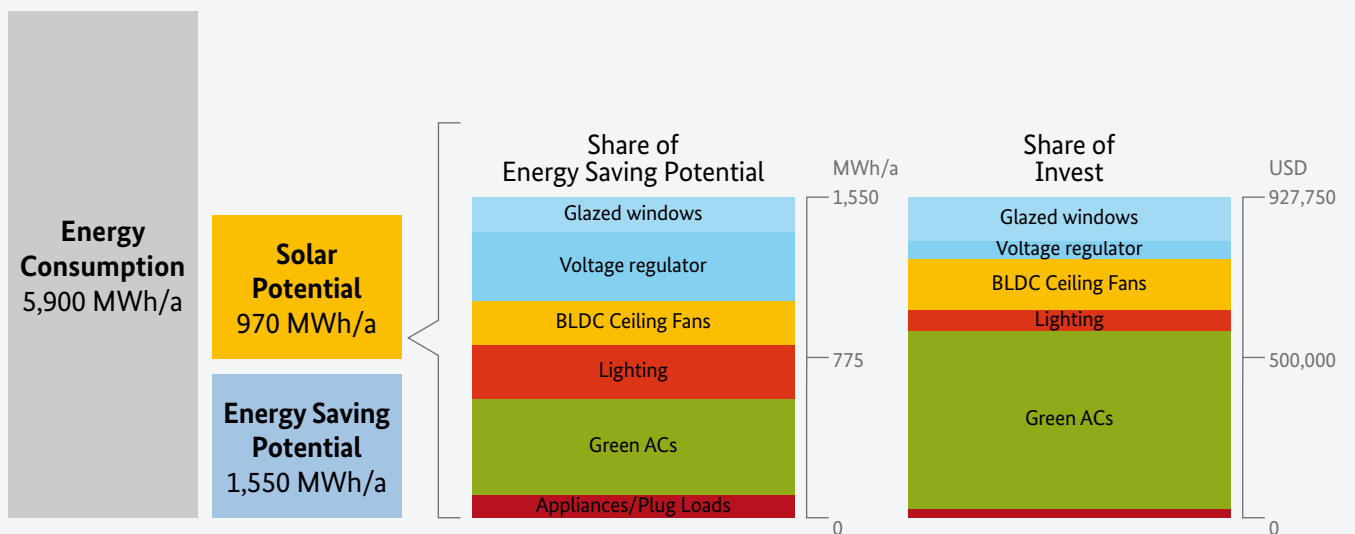


ENERGY AUDITS IN PRACTICE.

Figure 3. Energy Efficiency Measures of examined buildings (Comparison of costs (USD) and energy saving potential (MWh)).

Derived from: Deloitte (2021). Executive Summary of the Energy Audits

Energy Saving Potential of the Measures



EXISTING BARRIERS

FINANCIAL BARRIERS

- » Public procurement rarely considers life-cycle costs (LCC) of appliances and does not prioritize climate-friendly technologies with higher up-front costs.
- » There are no financial incentives in place to overcome higher upfront investment and product novelty of climate-friendly technologies.
- » Most of the examined buildings are older than 50 years and thus no longer meet the best available standards in the country today. As a general practice, public buildings under PWD are subject to refurbishment every 3 years, focusing on extended maintenance or renovation activities. Major retrofitting is carried out for old public buildings which are identified risky to earthquake.
- » Many of the appliances contained in the examined buildings are outdated and have already reached the end of their useful life. Hence, they consume significantly more energy than current market appliances as well as use highly climate-damaging refrigerants. Nevertheless, equipment is mostly used until it breaks down.

REGULATORY BARRIERS

In Bangladesh, Standard and Labeling of Appliance Regulation had not been enacted yet. In 2018, the first draft regulation was prepared, that has been revised and renamed as the Draft Standard and Labeling Regulation for Appliances-2020 in 2021. In this draft, MEPS for any specific appliance has not been suggested. Bangladesh Standards and Testing Institution (BSTI) will declare the minimum energy performance standard (MEPS) of appliances based on the available efficiencies of those appliances in the market and the recommendations on those from Sustainable and Renewable Energy Development Authority (SREDA) and will revise the MEPSs of the appliances as and when required.

AIR CONDITIONERS

- » The draft voluntary MEPS for the years 2018-2020 is 2.7 EER (w/w) and hasn't been enforced. A technical committee is currently planning for a new MEPS to be defined in 2021. Nevertheless, energy efficient ACs³ are becoming more popular on the local market, although the price is on average 80 to 100 USD higher than the conventional and less efficient induction compressor AC units. In the local market only higher efficiency ACs with HFCs (HFC-410A or HFC-32) are available, climate-friendly (non-HFC) energy-efficient ACs would need to be imported, however a high import tax for split ACs (160%) prevents this.
- » Currently, there are no specific regulations for climate-friendly refrigerants in the UAC sector.

³ A list of available climate-friendly and energy-efficient AC models can be found at [Pathway to Net-Zero Cooling Product Data List](#)



ENERGY AUDITS WERE CARRIED OUT IN 12 PUBLIC BUILDINGS IN BANGLADESH. IN ADDITION, FUTURE EMISSION AND COST CALCULATIONS WERE MADE FOR A TOTAL OF 274 BUILDINGS.

REGULATORY BARRIERS

CEILING FANS

- » The draft MEPS for ceiling fans for 2018-2020 (3.32 m³/min/w for 1400 mm sweep) has not yet been updated. Rather, more efficient AC ceiling fans (with MEPS 3.57-4.33 m³/min/w for 1400 mm sweep) are available on the market. The energy standard and labeling regulation has not yet come into effect. As an efficient technology, BLDC ceiling fans are twice as efficient as AC ceiling fans (7.42 m³/min/w). However, the cost is much higher, so the purchase decision usually falls on the cheaper appliances.

LIGHTING

- » No MEPS has been set for lighting appliances. LED lamps are manufactured locally in the country, but the quality varies and there is no quality assurance mechanism.

PV SYSTEMS

- » There is no MEPS for PV systems in place. Further, no installation and maintenance guidelines have been developed for rooftop PV system. Therefore, rooftop PV systems do not provide the expected power output due to improper installation and maintenance.

AWARENESS BARRIERS

- » Often end-users are not aware about the economic (e.g. lower LCC) and environmental benefits of novel/alternatively efficient technologies. This is due to lack of knowledge on building energy performances, the inefficient labelling system for technologies, as well as the poor marketing of the benefits of more efficient technologies.
- » Refrigerants with higher flammability (e.g. HFC-32, HC-290) require special handling. However, most technicians in the country lack the knowledge on how to properly install and repair with flammable refrigerants.



THE CHOICE OF LIGHTING ALSO HAS AN IMPACT ON THE HEAT LOAD IN A ROOM. AS A RULE OF THUMB, 10-15% REDUCTION IN COOLING ENERGY IS POSSIBLE WITH MORE EFFICIENT LIGHTING SYSTEMS.

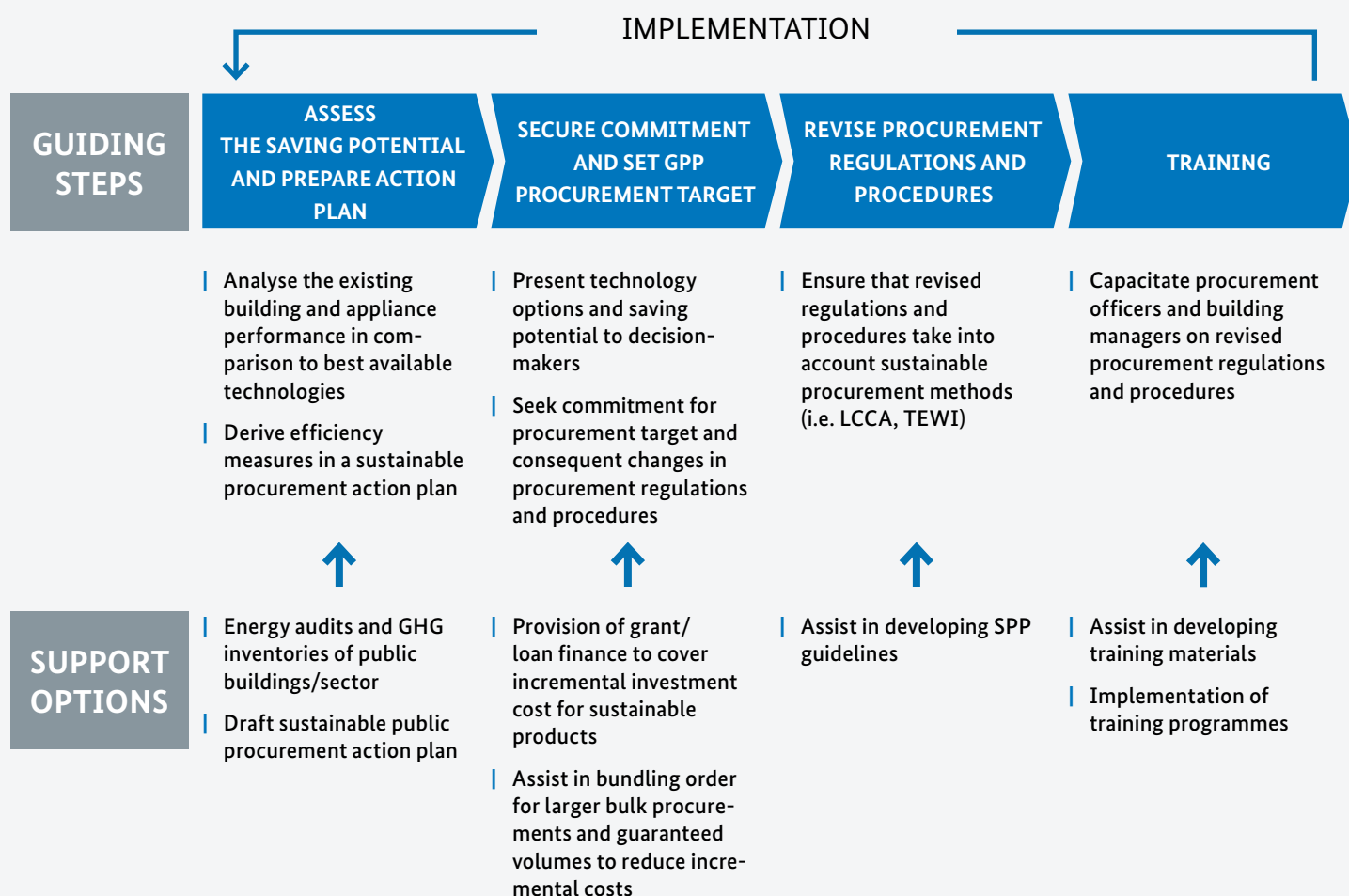
PROPOSED STEPS AND SUPPORT OPTIONS TOWARDS SUSTAINABLE PUBLIC PROCUREMENT

A more ambitious energy performance standards & labelling framework, especially for AC, lighting and fan appliances, is a fundamental requirement for more sustainable public procurement, to support economies of scale to reduce appliance costs, and increase the use of energy efficiency appliances in public buildings in Bangladesh. Especially ACs require qualified and certified service technicians to ensure that state-of-the-art cooling technologies are properly handled and can pull their full performance on a wide scale. Public entities with their often

widely publicly accessible building infrastructure have a huge potential in demonstrating building efficiency, carrying out awareness raising campaigns and thereby acting as a frontrunner.⁴

Permanently and sustainably harnessing the efficiency potential in public buildings requires a revision of public procurement regulations and procedures. In response to the above-mentioned barriers, the following steps and support options are recommended to establish a sustainable public procurement.

Figure 4: Steps and support options for SPP (GIZ, 2021)



⁴ Example of a highly efficient public building front-runner: the Federal Environment Agency in Germany

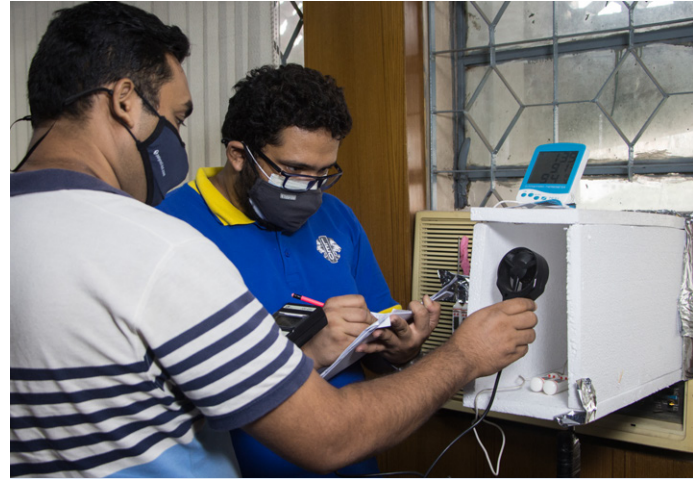
LESSONS LEARNED

This is the first time that a comprehensive energy audit study has been conducted across several public buildings in Bangladesh. Therefore, several challenges were noted during design and implementation of the study such as:

- » Lack of data regarding the potential energy saving opportunities in public buildings.
- » For some buildings, locating the distribution boards was difficult. As the buildings are old, there was lack of electrical line diagrams and hence there were challenges in measuring overall end use loads by power analyzer.
- » Incomplete data due to the COVID-19 pandemic and restriction in movement of staff.

For the calculation, it is therefore important to use literature values from neighbouring countries. In this case, a plausibility check should always be carried out. In addition, it is often helpful to exchange information with the building owners or experts to obtain missing data.

Overall lessons from different projects in the sector show the importance of involving various actors right from the beginning of a project in order to transform the market in a sustainable way and at the speed required. High political commitment as well as willingness of manufacturers, distributors and retailers to invest in the technology are equally relevant as the awareness of end-users. The introduction of a novel technology requires often a significant financial incentive to reach a sufficiently large market share in combination with increasingly stringent MEPS (and refrigerant GWP limit regulations) to trigger and sustain market transformation.

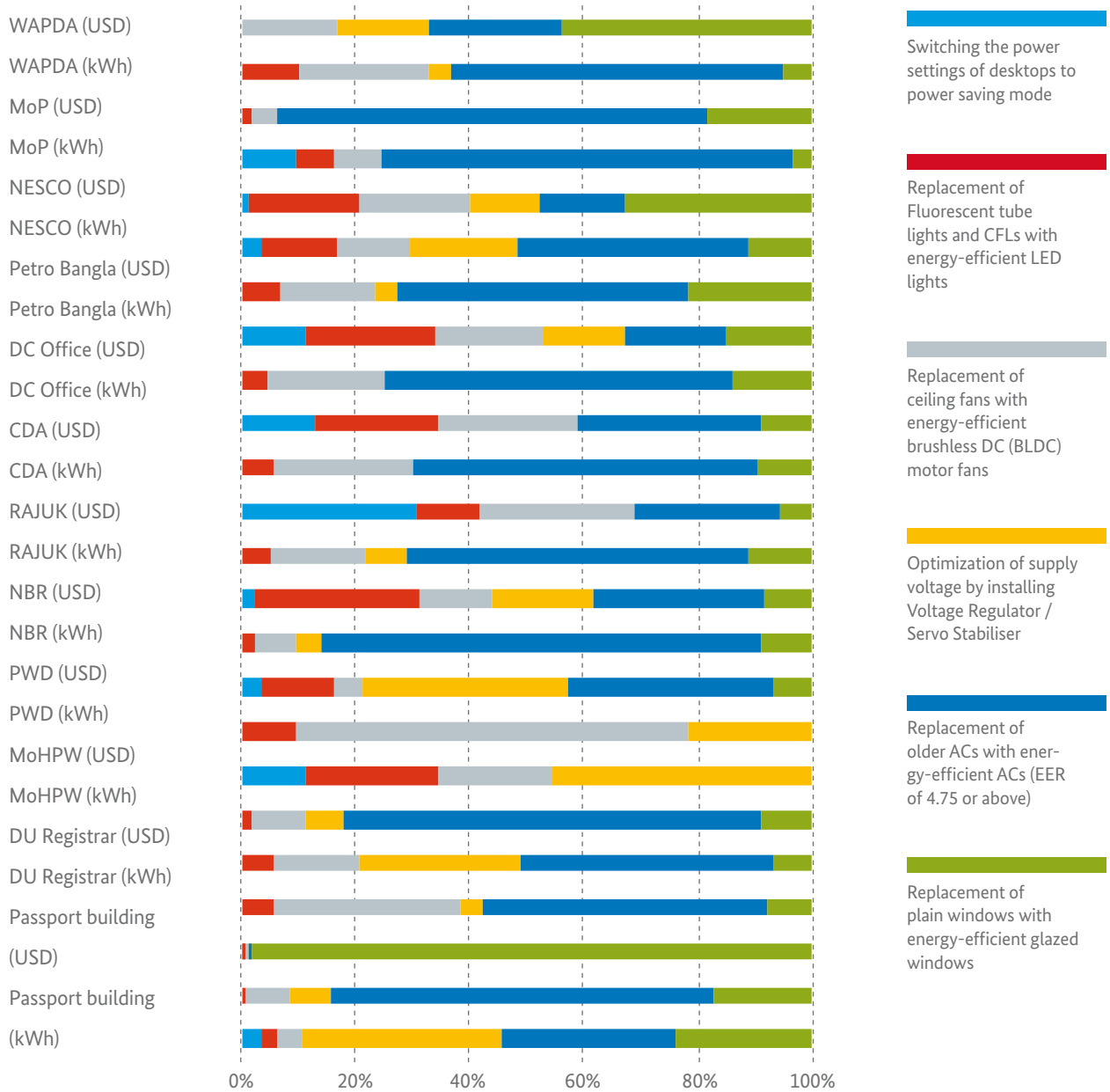


DURING THE ENERGY AUDITS, TEMPERATURE MEASUREMENTS WERE TAKEN ON VARIOUS DEVICES, INCLUDING THE AIR CONDITIONING UNITS.



THE POLYSTYRENE FRAMES ARE USED TO ENSURE THAT THERE ARE NO EXTERNAL TEMPERATURE INFLUENCES DURING THE MEASUREMENT.

ANNEX



IMPRESSUM

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