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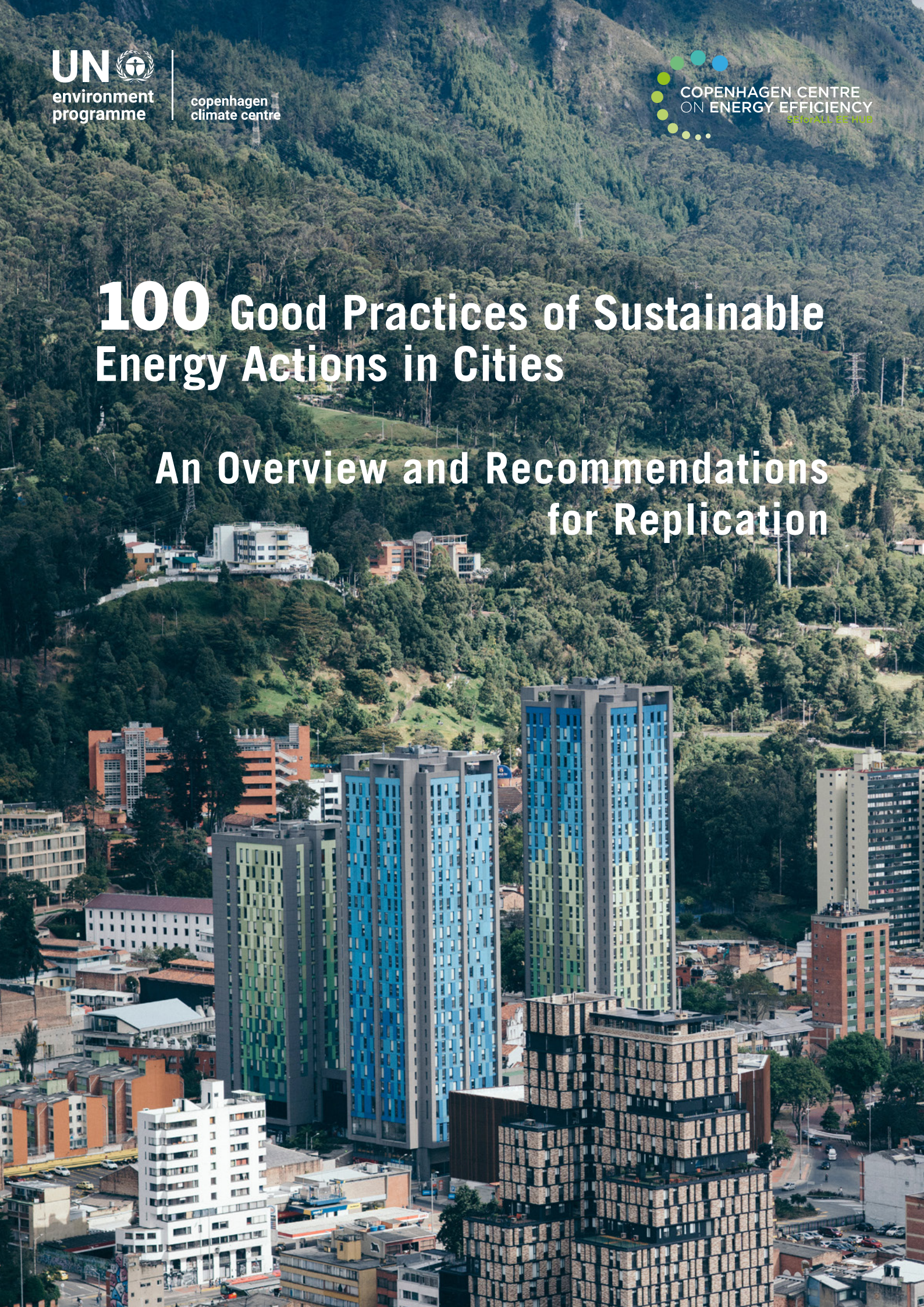
SEforALL EE HUB

100 Good Practices of Sustainable Energy Actions in Cities

An Overview and Recommendations for Replication



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Acronyms & Abbreviations

C2E2	Copenhagen Centre on Energy Efficiency
EV	Electric Vehicle
EU	European Union
ESCO	Energy Service Companies
EPC	Energy Performance Contracting
GHG	Greenhouse gas
IEA	International Energy Agency
GDP	Gross Domestic Product
KMS	Knowledge Management System
LATAM	Latin America
OECD	Organisation for Economic Co-operation and Development
PPP	Public-private partnership
SDG	Sustainable Development Goals
SEforALL	Sustainable Energy for All
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollars
WEF	World Economic Forum

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Executive summary

Cities are the centres of human activities, responsible for a significant proportion of global energy use, and therefore GHG emissions. The World Bank estimates that in 2021, 57 percent of the global population was living in cities, and the trend of global urbanization is expected to continue in the decades to come (World Bank, n.d.). The urban heat island effect magnifies the impact of climate change, resulting in cities becoming more exposed to extreme weather patterns. Many cities have set ambitious climate goals, leading the clean-energy transition towards net zero emissions.

Energy efficiency is known as the "first fuel" because it is virtually available everywhere, with the advantage that it has multiple environmental and social benefits, among others. However, cities often face information, financial, and capacity barriers in energy-efficiency implementation, especially at scale.

In line with the global trend of increasing climate change mitigation actions, some cities are successfully implementing energy-efficiency policies, programmes, and projects. Through their innovative business models, contractual arrangements, and financial solutions, they can help showcase the way forward for other cities struggling to unlock the opportunities for energy efficiency.

The Copenhagen Centre on Energy Efficiency (C2E2) is the SEforALL Energy Efficiency Hub and has the mandate of advocating and supporting the achievement of SDG 7.3 – doubling the global rate of energy-efficiency improvement. Between 2018 and 2021, C2E2 used a standard template to systematically collect good practices of energy-efficiency actions in cities and published them on the Knowledge Management System, available at https://c2e2.unepccc.org/collection/good-practices-of-cities/.

The C2E2 team gathered 100 good practices through extensive online searching and desk research, aiming to provide a valuable source of information for governments and other stakeholders interested in developing and boosting energy-efficiency actions in cities.
This report is a summary of the 100 good practices available in the C2E2 collection. Based on the analysis, the report also provides recommendations on how to replicate the good practices and scale up energy-efficiency actions in cities.

1 Introduction

Energy efficiency, with its low marginal costs and multiple economic, social, and environmental benefits, is an important solution for achieving the global climate goal under the Paris Agreement and the Sustainable Development Goal (SDG) 7 - Affordable and Clean Energy.

Cities face huge opportunities for energy-efficiency improvement due to their high shares of energy demand in the global context, corresponding GHG emissions, and control of the enormous economic and human resources for energy-efficiency actions. Despite increasing awareness and ambition by cities to act on climate change and move towards clean energy, cities still have many opportunities to act on energy efficiency. Such opportunities are not yet realised because cities still face challenges such as relatively small size of retrofits, need for coordination among different stakeholders, upfront investments volumes, lack of skilled professional support for project assessment and project design, and implementation, and lack of credit rating due to the technical complexity and perceived risks of energy-efficiency interventions by financiers.

This synthesis report on the 100 good practices aims to shed light on how to replicate success stories and scale up energy-efficiency actions in cities.

This report targets mayors and other municipal energy efficiency action planners and coordinators, energy service companies and businesses providing energy-efficiency technology and solutions, national policymakers, international agencies, and organizations advocating for energy efficiency and climate mitigation.

1.1 THE RATIONALE FOR SCALING UP ENERGY-EFFICIENCY ACTIONS IN CITIES

Cities are home to around 57% of the 8 billion people on earth in 2021 (World Bank, n.d.). Despite covering only 3% of the global land area (WEF, 2021), cities contribute on average more than 75 percent of a country's Gross Domestic Product (GDP) and are the main engines of national economic growth. As the centres of industrial, commercial, transport, and cultural activities, cities rely on undisrupted energy services. Globally, cities consume about 75 per cent of global primary energy and emit between 50 and 60 per cent of the world's total greenhouse gases (UNHABITAT, n.d.).

In the face of the global warming and climate change, cities are increasingly taking action to mitigate and adapt to climate change. As of November 2022, the UNFCCC website recorded 11,361 cities engaged in a variety of climate actions.

According to the International Energy Agency (IEA, 2021), existing cost-effective technologies can double the global energy-efficiency rate by 2040. In addition, energy-efficiency policies can deliver about 40% of the global GHG emission reductions needed to achieve the 2 °C climate target under the Paris Agreement by 2040. Moreover, tapping into these energy-efficiency opportunities can also bring about multiple social and economic benefits.

To harvest the multiple benefits of energy efficiency, SDG 7.3 aims to double the annual global rate of improvement of primary energy intensity in 2010-2030 to 2.6 percent, versus the 1.3 percent during 1990-2010. However, during 2010-2019, the average annual global improvements in energy intensity were around 1.9 percent, well below the 2.6 percent needed (IEA, IRENA, UN, World Bank and WHO, 2022).

Despite their attractive economic returns, many energy-efficiency opportunities fail to attract investments for their implementation. Based on an extensive questionnaire survey, the UNECE and the UNEP DTU Partnership (2017) identified twelve main barriers common globally and the 55 member countries of UNCEE regions:

1) Lack of specific policies, programmes, legislation, by-laws, norms, and standards
2) Inadequate implementation and enforcement of policies and legislation
3) Administrative barriers, bureaucracy
4) Political/ economic instability in the country
5) High interest rates for energy-efficiency projects
6) Low energy prices
7) Difficulties with obtaining commercial loans and other types of financing
8) Lack of understanding of energy-efficiency financing by banks and other financial institutions
9) Low awareness about the multiple benefits of energy-efficiency projects
10) Lack of technical expertise and capacity to identify/ evaluate/ implement projects
11) Uncertainty about performance
12) Problems with using savings on energy-efficiency measures

The 2022 energy crisis is driving up energy prices and overall inflation. In the struggle to secure energy supplies, governments, businesses, and households also realise it is imperative to cut their energy demand and speed up the transition from fossil fuel imports to local renewable energy sources (IEA, 2022a).

1.2 THE C2E2'S COLLECTION OF 100 GOOD PRACTICES IN CITIES

Energy efficiency is the fastest and most cost-effective way for cities to reduce greenhouse gas emissions and to save money and energy. Energy-efficiency actions can also reduce local air pollution, improve social equity, and create jobs.

As the SEforALL Energy Efficiency Hub, the Copenhagen Centre on Energy Efficiency collected 100 success stories of energy-efficiency actions by cities during 2018-2021. The 100 good practices were collected through extensive online desk research and are presented in a common format (see Table 1). The results were published on the C2E2 Knowledge Management System (KMS)(C2E2, n.d.) for free public access.

TABLE 1. Template for presenting the good practices

Name of good practice	
1. Good practice profile	Location:
	Population:
	Climate:
	Duration:
	Sector:
	Funding sources:
	City Networks:
1. Achievements	Savings: economic and energy saving, and GHG emission reductions
	Solutions (in a nutshell):
	Multiple benefits: local job creation, safety, air pollution reduction and other social and environmental benefits
3. Rationale, innovative solution, and success factor	Objective:
	Solutions:
	Funding: amount and source
	Innovation:
	Success factors:
4. Replicability	Significant outcomes:
	Synergies with local policies
	Political alignment: with national/municipal target, priorities, and strategies
	Marketability:

Among the four parts of the template, Parts 1 and 2 are brief highlights, while Parts 3 and 4 are more detailed descriptions. That explains the differences between the "Solutions" in Part 2 and Part 3. The former is a short summary, while the latter offers more detail. Marketability captures to what extent the solution can be replicated without strong government financial and policy support.

Criteria for selecting the 100 good practices. The main factors in choosing the 100 good practices include: 1) meeting the minimum data requirements in the predefined template, 2) recent cases, the projects or programmes have a starting date of 2000 or later, 3) the good practice implementation is ongoing or has been completed, and 4) the case studies come from reliable and known sources.

The 100 cases cover all the cases that can be found in English websites or publications, except for a few cases available from sources originally in Chinese, Spanish, and Russian.

Many more energy-efficiency projects and programmes have taken place in the past two decades, but they were not captured in this study due to unavailability of detailed descriptions in the languages covered by the C2E2 team.

Balance among good practice selection. This study aimed to balance the 100 good practices in terms of technical action areas and geographical distribution.

The information relied on existing data from different sources, mainly from the databases of C40 good practices of cities, European Union (EU) project initiatives (Celsius project & Stunning project), and Energy Cities. The good practices capture the following features of each project/programme using a predefined template (example here): 1) Action's technical areas (sectors), 2) Funding source, 3) Continent, 4)Financial instruments/financial mechanisms used to fund the project, and 5) Type of energy-efficiency programme. A complete list of the 100 good practices is presented in Appendix 1: List of the 100 good practices of energy-efficiency actions in cities in the C2E2 KMS collection at the end of this report. Section 3 provides an overview of the 100 good practices in the above aspects and sheds light on the success factors behind those projects and programmes.

2 Methodology of the case study analysis

This report gives an overview of 100 good practices on energy efficiency, focusing on trends and funding sources, financial mechanisms, and different types of initiative used to implement the good practices. The result of this report aims to serve as a stimulus, providing examples for future action and a basis for further studies when comparing across different practices or cities.

The research methodology used in the study combines elements of qualitative and quantitative analysis to answer the following research questions:

- What are the general features of the 100 good practices?
- What are their funding sources?
- How much energy savings (percent range) do the good practices achieve?
- How to replicate the good practices to scale up energy-efficiency actions?

2.1 METHODOLOGY

The report combines both qualitative and quantitative analysis. Qualitative analysis is used in the dimensions that do not need quantification, covering dimensions 1) to 6) in the list below.

Quantitative Analysis is for dimensions 7) and 8) on the funding amount and energy savings. The required data for the quantitative analysis include the following information: 1. Starting date, 2. Funding amount and 3. Energy savings.

1) Actions' technical areas. The data for the energy-efficiency-related practices were disaggregated in the following fields of action: 1) Buildings, 2) Transport, 3) Lighting, 4) District energy, 5) Water efficiency and 6) Cross-cutting. Crosscutting means a good practice covers two or more of the five specific technical areas.

2) Geographic location. This study disaggregated the compiled data in the following continents: 1. Australia and Oceania, 2. Europe, 3. Latin America (LATAM), 4. Asia and 5. North America.

3) Funding sources. The funding sources include three categories: public, private, or public-private funding sources.

4) Financing mechanisms for funding the good practices. Under this category, one can find debt financing, public grants, risk mitigation instruments, among others.

5) Energy efficiency program. This category is disaggregated by government-led initiatives, practices implementing different technologies, Energy Service Companies (ESCO)-based solutions, and Public-private partnerships (PPPs).

6) Starting date. This data category was crucial in supporting the elaboration of the different funding amounts because the starting date of the projects was taken as the date for implementing exchange rates of national currencies into USD.

7) Funding amount. For comparability considerations, all the amounts are converted into USD worth in 2020, to exclude inflation influences.

8) Energy savings. The amount of avoided energy used represented in percentage (%).

2.2 LIMITATIONS

This scope of analysis is the C2E2's collection of 100 good practices of energy efficiency projects and programs in cities. There may be many more successful cases, but due to data unavailability, they are excluded from this analysis.

Another issue is comparability. The 100 case studies passed the screening with a pre-defined methodology, to ensure a certain level of detail among all the good practices. Yet most case studies do not elaborate on how they calculate such indicators as investment, energy savings, and greenhouse gas emissions.

Some good practices belong to more than one sub-category in a dimension. For instance, some good practices cover both building and lighting or combine funding from debt, grants, and PPPs. To illustrate this issue, when grouping different project incentives (Figure 4), we include a sub-category of *energy-efficiency technologies*, to cover the good practices that did not elaborate the implementation arrangements, such as public tendering or PPPs (an example here). Therefore, we created the sub-category of *Implementation of energy-efficiency technologies across different technical areas* (Figure 4), to cover all the practices without sufficient data. This sub-category is further analyzed based on the funding sources and mechanisms (Public, private and public-private).

Financial instruments / financial mechanisms. Some good practices combine two or more different financial instruments

or financial mechanisms. For instance, 67 good practices receive public fund (Figure 3); a practice (here) belongs to both the *multilateral funds and the loans* (Table 1) sub-categories. Additionally, there are 28 public-private funded projects (Figure 3); one can find a practice (here) that belongs to two sub-categories. When assessing the financial instruments/ mechanisms used in the different practices (Table 1), this practice belongs to both the *Others* and the *Debt financing* sub-categories, because the good practice received funding from both grants (Others) and bank capital (Debt financing).

Lack of data. Only 62 percent of the good practices have data on funding amounts, and only 28 percent have data on energy savings. Furthermore, only 22 percent have data on both the funding amount and energy savings, making it possible to compare their unit costs of energy saving.

Lack of updated information on some good practices. The good practices were collected during the period from 2018 to 2021. By the time of this report's preparation, the status of some good practices may have changed, but due to lack of information, their status is not updated in the C2E2 KMS database and this report.

3 Overview of the good practices and some analysis

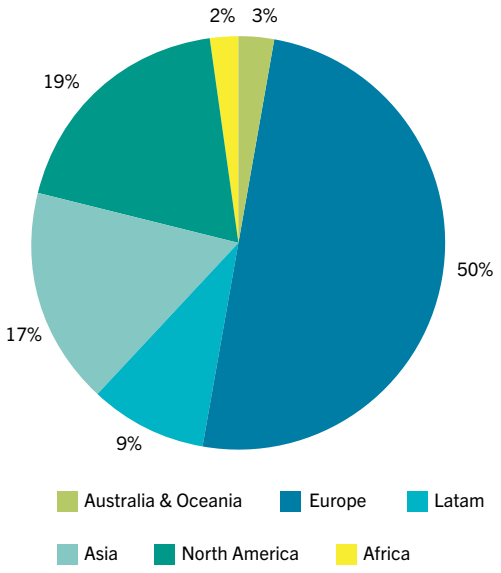
This section presents the findings from the qualitative and quantitative analysis of the 100 good practices of cities. First, general results provide an overview of the good practices. Thereafter, key findings are presented to answer the research questions of the study: Which are the main features of the energy-efficiency projects and programmes, how are they funded, how much energy savings do they achieve, and what are the replication opportunities?

3.1 COMPOSITION OF THE GOOD PRACTICES

3.1.1 By Continent

Figure 1 illustrates the geographical distribution of the good practices. As explained above, most of the good practices analysed were from Europe, representing 50% of the cases, and with Australia & Oceania having the least contribution. This representation provides an overview of the cases collected and does not necessarily reflect the actual distribution of energy-efficiency programmes and projects worldwide. The data just indicate that more case studies are available on energy-efficiency programmes and projects in Europe. For instance, according to IEA (2022), from 2015 to 2020, the countries with the fastest annual energy-intensity improvements included the United Kingdom (2.8%), France (2.6%), Germany, the United States and China at 2.5% and India at 2.4%.

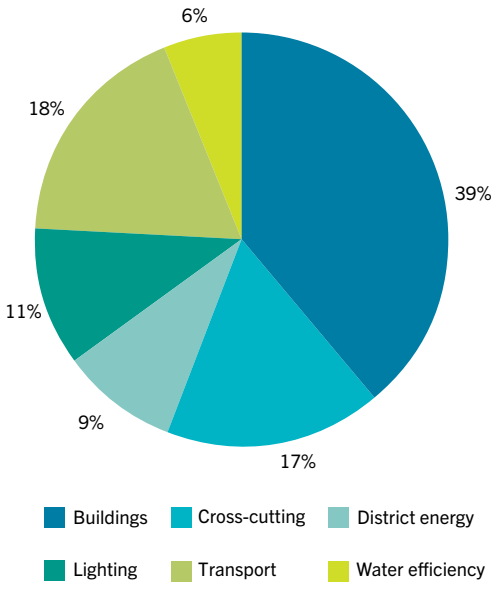
Figure 1. Continental location of the 100 Good Practices



3.1.2 Action technical areas

This study has grouped the good practices in the following technical action areas: buildings, transport, lighting, district energy, water efficiency, and cross cutting. Crosscutting means the good practice covers more than one of the specific action areas: for example, smart urban development plans or smart communities, mass retrofitting of buildings and lighting, or addressing an initiative that targets small and medium enterprises. The action areas with most representation is the buildings-sector (39%), followed by the transport sector (18%) and cross-cutting (17%) (an example here). Finally, the technical action area with the fewest collected cases (6%) is water efficiency.

Figure 2. Representation of good practices across technical action areas



3.2 Key financial related findings

Figures 1 and 2 provided a framework for the collected data. This section showcases the main responses to the first question of this study: What are the trends and highlighted impacts of the 100 good practices in terms of 1) finance, including funding sources, financial mechanisms, and different types of initiatives?

3.2.1. Funding sources

Figure 3. Representation of funding sources across the 100 good practices and their respective action area

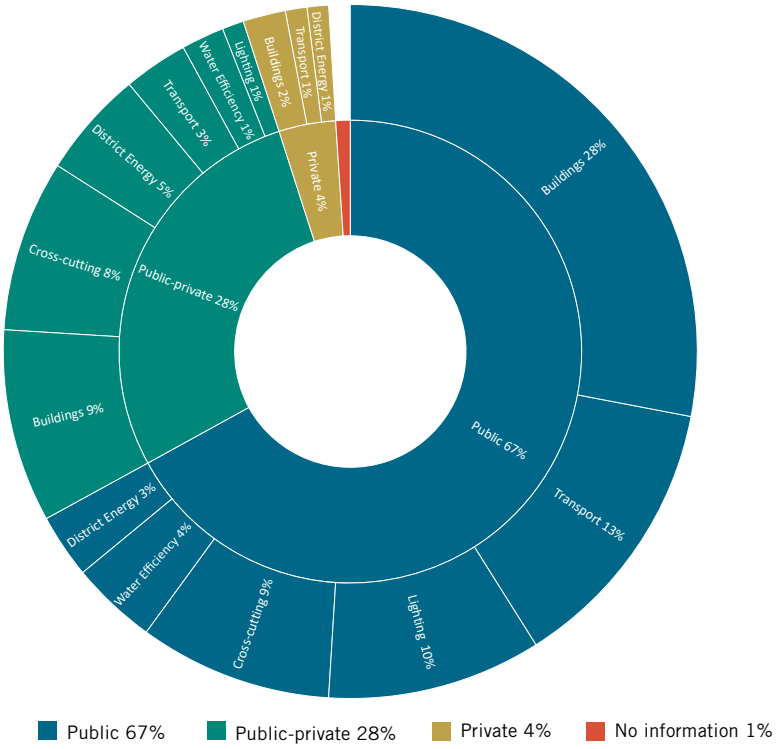


Figure 3 represents the distribution of funding sources (public funding, public-private, and private) from the 100 good practices among the six action areas of this study. As can be observed, public funding is the predominant funding source (67%), followed by public-private sources (26%) and solely private funding (4%). The buildings sector remains the key action area in receiving funds from the three different types of funding analysed; followed by the transport sector (13%), and crosscutting (8%).

The buildings sector has more good practices in the C2E2 collection than any other sector. A recent IEA Study (2022b) indicated that this trend continued in 2021. Investment in energy efficiency in the global construction sector grew significantly by 16% from 2020 to 2021, totalling roughly USD 237 billion. This is the highest increase in building energy-efficiency investment since the initial World Energy Investment report in 2014.

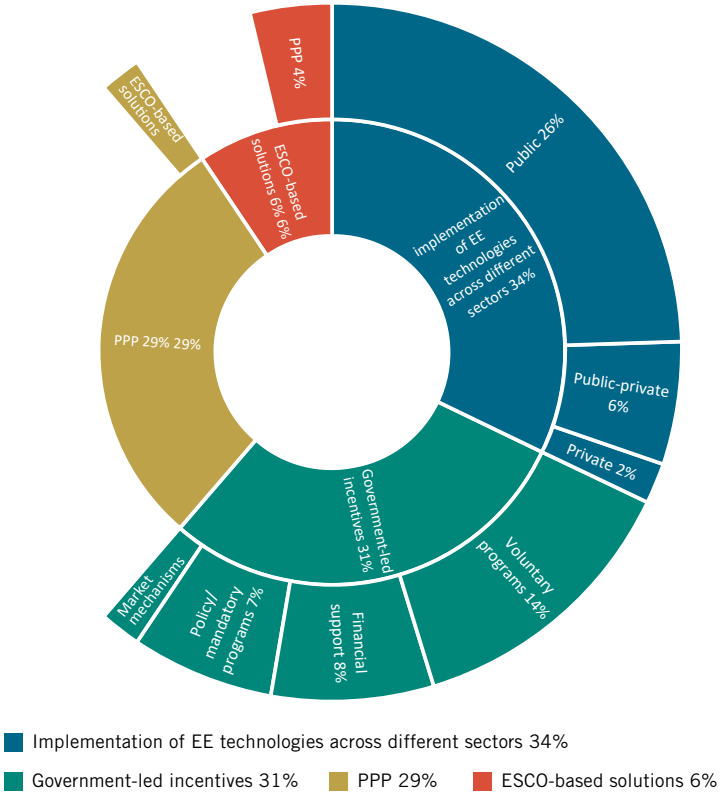
Several nations offer programmes that use the tax system to encourage building owners to invest in energy efficiency while receiving tax refunds or repayments.
Furthermore, private finance schemes are becoming more and more popular. Green mortgage products, which provide lower interest rates to buyers of energy-efficient homes or homeowners who engage in retrofits, are gaining attention, particularly in the United Kingdom and Australia.

3.2.1 By Energy-efficiency programmes

Figure 4 represent the different enabling factors of the 100 good practices; some are financial incentives or regulatory requirements, and others are business models or contractual arrangements for risk management and project implementation (like ESCOs and PPPs) or the deployment of specific technologies. The good practices are grouped into government-led initiatives, implementation of different energy-efficiency technologies and measures across various action areas, ESCO-base solutions, and PPPs.

The biggest share of good practices is the implementation of energy efficiency technologies and measures across different action areas (34%), most which are publicly funded. The energy-efficiency measures and technologies vary from zero-energy buildings (here) to smart tele-management systems (here). The second biggest category is government-led initiatives (31%), comprising from voluntary programmes (14%) to market-based mechanisms (2%). The third most represented group is PPP (29%), containing a small fraction of ESCO-based solutions (2%). Finally, the smallest share of energy-efficiency programmes is purely ESCO-based solutions (6%), more than half of which contain the PPP approach (4% out of 6%).

Figure 4. Representation of energy-efficiency programmes distributed among Government-led initiatives, PPP, ESCO-based solutions, and implementation of different EE methods across various action areas



Regarding government-led initiatives, IEA (2021a) projected that government regulations could enable EE investment to rise by 10% in 2021 to almost USD 300 billion. Moreover, efficiency-related spending accounts for two-thirds of government clean-energy and sustainable-recovery actions. Additionally, government legislation and other behavioural initiatives can solve some of the hurdles to using energy-efficient equipment (Resources for the Future, 2020).

A Public-Private Partnership (PPP) is a public-private cooperation that funds and operates through a partnership of a government body with one or more private business initiatives. The PPP model is a less-known type of investment but is ideal for initiatives aimed at improving EE. PPPs are increasingly used to implement EE projects successfully (BASREC, 2022). Furthermore, the presence of ESCO-based solutions under the PPP model is getting more attractive.

The public sector sometimes uses private companies, the Energy Service Company (ESCO), to implement activities related energy service provision in recent years through PPP agreements. The contractual arrangements are traditionally based on Energy Performance Contracting (EPC). The adoption of EPC has yet to reach its full potential, primarily due to two underlying problems. First, the challenge of distributing benefits equally among the public and private parties to ensure a win-win situation and the need for adequate public procedures to select the most suitable EPC scheme given certain circumstances (Carbonara & Pellegrino, 2017).

3.2.3. By Financial instruments, financial mechanisms, and other financial aid

TABLE 1. Representation of FIs, financial mechanisms, and other financial aid used in different projects categorised by their type of funding

Type of funding	FIs/financing mechanism	Description	Action area	%	TOTAL (%)
Public funded projects	Debt Financing	Loans (incl. discounted loans, public loans, soft loans, etc)	Buildings	3%	7%
			Transport	4%	
		City´s debt/green bonds	District energy	1%	2%
			Cross-cutting	1%	
	Public funds without detailed specification	Multilateral funds	Buildings	4%	9%
			Lighting	3%	
			Cross-cutting	2%	
		Multilateral funds and city funds	Transport	4%	8%
			Cross-cutting	1%	
			Buildings	1%	
			District energy	1%	
			Lighting	1%	
		National & city budget	Buildings	8%	27%
			Cross-cutting	2%	
			Lighting	5%	
			Transport	8%	
			Water efficiency	4%	
	Government initiatives	Subsidies	Buildings	1%	3%
			Transport	1%	
			Cross-cutting	1%	
	Public and risk mitigation instruments	Public grants	Buildings	6%	8%
			Transport	1%	
			Cross-cutting	1%	
	Public energy utility corporation funds		Buildings	2%	3%
			District energy	1%	
	Others – non-direct monetary provision	Policies, innovative finance arrangement, voluntary programs & cap-trade systems	Buildings	7%	7%
Public-private funded projects	Debt Financing	Private Loans (incl. bank loans and loan loss reserve)	Cross-cutting	1%	2%
			Buildings	1%	
	Others	Voluntary programs, mix of green finance instruments and grants	Cross-cutting	1%	6%
			Transport	2%	
			Buildings	3%	
	Public-private funds without detailed information	Multilateral funds together with private funds	Cross-cutting	4%	7%
			Buildings	3%	
		Public-private funds (no further specification)	Buildings	3%	15%
			Cross-cutting	4 %	
			District energy	5 %	
			Lighting	1%	
			Water efficiency	2 %	
		Multilateral funds and city budget	Cross-cutting	1%	1%
	Private funded projects				4%
	No information				1%

NOTE: The sum of the total initiatives is more than 100, as some practices included more than one type of initiative (mutually inclusive).

As shown in Table 1, most of the public-funded projects analysed are financing through national and city budgets (27%), especially in the buildings sector (8%). Another major funding source of public funded projects is multilateral funds (9%), mostly coming from EU sources, without details of the specific financing instruments used, followed by the provision of public grants (8%) and the combined provision of multilateral funds together with city-budget support (8%). Another public funding source is through debt financing, specifically, via loans (7%).

Regarding public-private funded projects, the most prominent representation is found in financing from public and private entities without further specification (16%), followed by financing through multilateral funds and private funds (7%). The data obtained from the public-private funded projects did not inform about the type of FIs used, in the sense that there is a lack of information on whether funds from multilateral institutions were grants or debt financing – loans. However, the combination of public and private funds allowed for the strategic use of multilateral finance (mainly from the EU) and the mobilization of private capital flows.

Finally, under privately funded projects (4%), there is insufficient data to know which type of financial instruments were used.

According to the IEA (2021), increasing private investment demands the engagement of FIs – providing debt and equity - to meet the capital structure of energy firms and assets. Under IEA climate-driven scenarios, 50% of global investment needs would be financed by debt when international debt-to-GDP levels are rising, putting a significant burden on governments' and enterprises' capacity to pay this debt.

3.3 KEY HIGHLIGHTS RELATED TO ENERGY SAVINGS

This section presents the data analysis of the energy savings obtained from the different practices, focusing on energy savings obtained per action area, continent, and depending on the type of funding. Additionally, an analysis comparing funding amounts and energy savings per action area is included at the end of the section.

3.3.1 By energy savings against action areas

Table 2 and Figure 6 show the maximum and minimum energy savings per action area in percentage. As not all cases analysed provided data in this regard, it has not been possible to show results from the transport and water-efficiency action areas. Results show that the maximum energy savings are obtained in the district-energy and buildings action areas. District energy also offers a minor difference between the minimum (70%) and maximum energy savings (90%). Finally, the minimum energy savings (12%) is also found in the buildings sector.

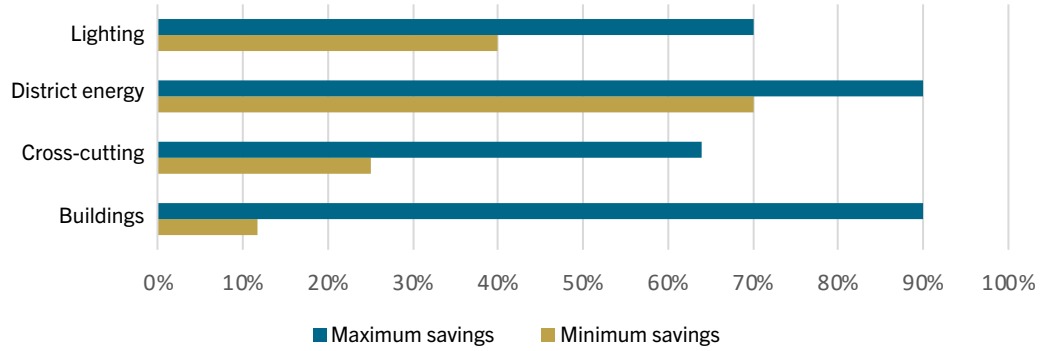
The IEA in its 7th Annual Global Conference on Energy Efficiency explains that the transportation and buildings action areas have the most significant short-term potential. In the Net Zero Scenario, energy demand in the buildings sector will decline the most by 2030, while the transportation sector has the greatest opportunity for reducing energy demand.

TABLE 2. Maximum and minimum energy savings (%) per action area

Savings / Action area	Buildings	Cross-cutting	District energy	Lighting
Minimum savings	12%	25%	70%	40%
Maximum savings	90%	64%	90%	70%
# of good practices providing data	14	5	2	7

NOTE: Only 28 practices provided enough data to analyse energy savings per action area; therefore, it was not possible to provide data on all the action areas.

Figure 6. Maximum and minimum energy savings per action area (%)



NOTE: Only 28 practices provided enough data to analyse energy savings (%) per action area.

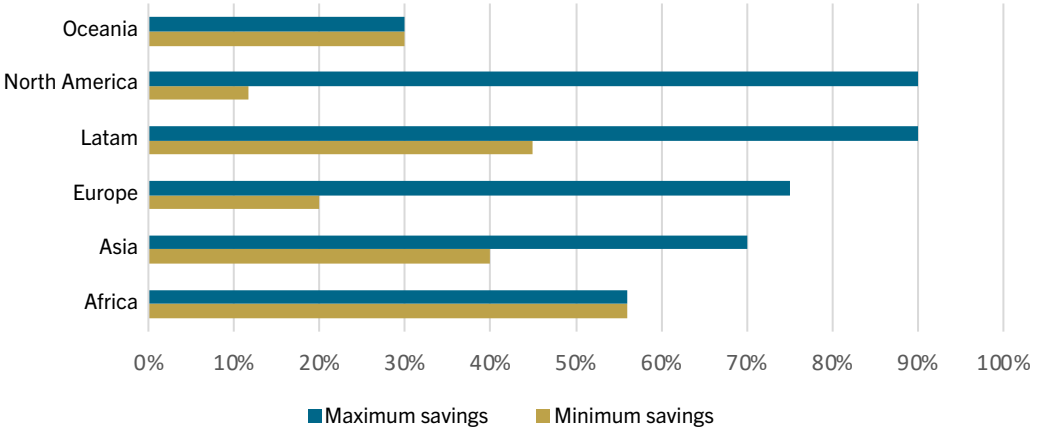
3.3.2. By energy savings against continents

TABLE 3. Maximum and minimum energy savings (%) per continent

Savings / Continent	Africa	Asia	Europe	Latam	North America	Oceania
Minimum savings	56%	40%	20%	45%	11.7%	30%
Maximum savings	56%	70%	75%	90%	90%	30%
# of good practices providing data	1	2	16	4	4	1

NOTE: Only 28 practices provided enough data to analyse energy savings per continent

Figure 7. Maximum and minimum energy savings per continent (%)



NOTE: Only 28 practices provided enough data to analyse energy savings (%) per continent.

Table 3 and Figure 7 show the maximum and minimum energy savings per continent from 28 practices. In this sense, North America and Latam account for the highest energy savings. And at the same time, North America accounts for the minimum energy savings among all continents analysed. Additionally, Oceania and Africa show the same maximum and minimum energy savings because there was only one practice to analyse for each of those continents.

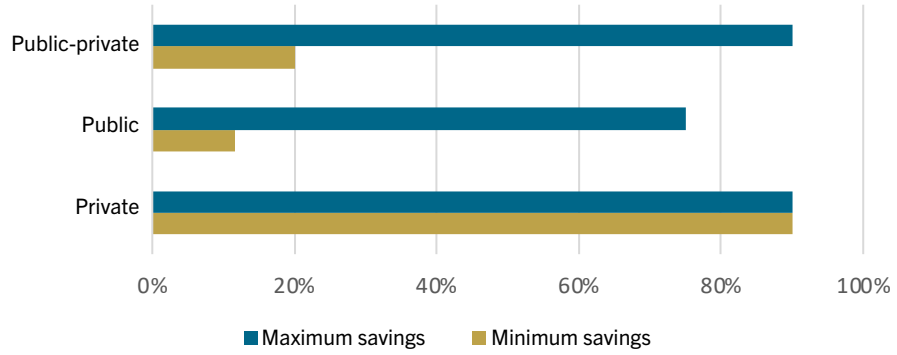
3.3.3. By energy savings against funding sources

TABLE 4. Maximum and minimum energy savings per Funding source.

Savings / Funding source	Private	Public	Public-private
Minimum savings	90%	11%	20%
Maximum savings	90%	75%	90%
# of good practices providing data	1	21	6

NOTE: Only 28 practices provided enough data to analyse energy savings (%) per funding source.

Figure 8. Maximum and minimum energy savings per funding source (%)



NOTE: Only 28 practices provided enough data to analyse energy savings (%) per action area.

Table 4 and Figure 8 depict the maximum and minimum energy savings compared with the type of funding sources from 28 practices. The only privately funded project (here), a buildings-sector related project, provided the maximum energy savings (90%). Followed by public-private funded projects, where data was obtained from six different practices, accounting also for a maximum energy saving of 90%. Finally, it is found under publicly funded projects the minimum energy savings, 11.7%.

These results may indicate a strong need for cooperation between public and private entities when investing in EE-related projects and achieving the most significant impacts on energy savings.

3.3.4. By funding amounts against energy savings

This section shows the overall results of comparisons between different practices. The comparison focuses on the funding amounts of some practices and their respective energy outcomes in terms of energy savings produced. In this sense, this analysis examines if practices with higher funding amounts achieve the highest results in energy savings or if this correlation only sometimes applies. It is essential to remember that different practices across action areas have their particularities, length, size, complexity, etc.; therefore, this analysis will only compare among the same action areas. Additionally, it is vital to notice this analysis needs to consider baseline scenarios for comparing energy savings within different practices.

Standardization of the investment amount for compatibility:

a. **Exchange rate**. The quantitative analysis on funding amounts aimed to have all data on US dollars (USD), and for doing so, an exchange rate assuming the start date of the project was taken to convert different currencies into USD. The main source of the exchange rates was the World Bank databases. However, some practices provided funding amounts in a currency other than the national currency. For example, in a Danish practice (here), where the funding source was provided in EUR, as opposed to Danish Krones. The approach to solve this issue was to use the EU 27 Organisation for Economic Co-operation and Development (OECD) exchange rate, as the World bank databases did not provide EU 27 exchange rates.

b. Gross Domestic Product (GDP) deflator. The GDP deflator and a baseline scenario of 2015 were used to reflect inflation for the funding amount data and changes in overall prices in the economy, considering GDP deflator data from the World Bank databases. As most of the data was not provided in USD, there was a need to normalize the data, assuming a baseline scenario.

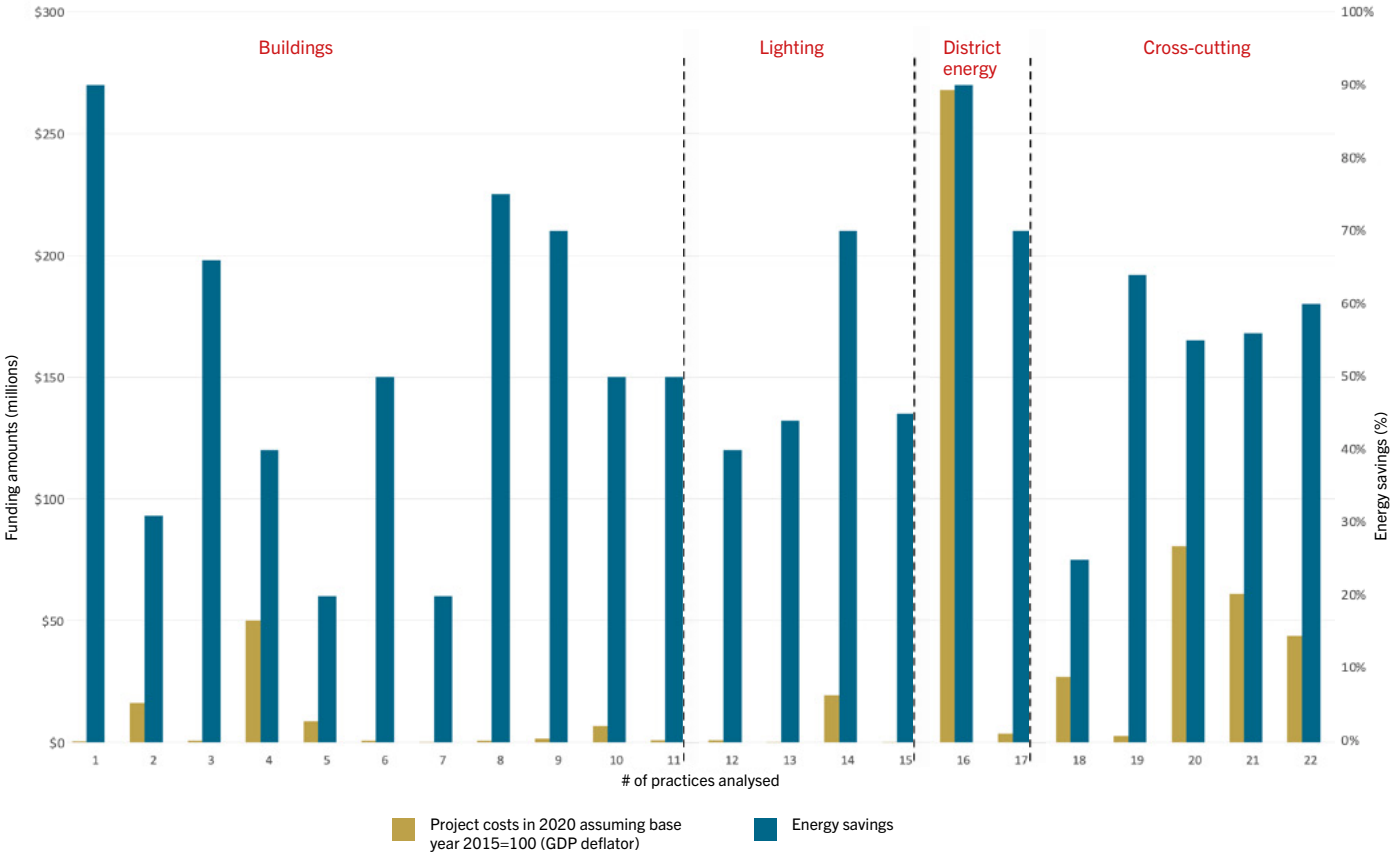
c. Funding amounts. After applying exchange rates and the GDP deflator, the total funding amounted to for 2020 (assuming the baseline scenario of 2015) of the good practices were obtained by the following formula: [Funding amount (taking the exchange rates and the starting year) * (GDP deflator 2020/GDP deflator of the starting year)].

d. Base year. Regarding the funding amount calculations, the selection of 2015 as the baseline scenario for the GDP deflator was because it was the closest to this year provided by the World Bank data. Therefore, using 2015 as the baseline scenario, the total project costs for 2020 (for the 22 good practices that provided data) were calculated using the following equation:

Project costs in 2020 assuming base year 2015
*= project costs after applying exchange rates**
(GDP deflator 2020/GDP deflator of starting year)

Equation 1. Formula to obtain the total project costs for 2020, taking 2015 as the baseline year for the GDP deflator. NOTE: 1) The exchange rates, as mentioned in section a, were obtained from the World bank data sets and the OECD.; 2) the GDP deflator of starting year, uses 2015 as the baseline scenario; 3) the calculation was used with information obtained from (Mynarz, 2016)

Figure 10. Funding amounts of 22 practices compared to their respective energy savings



NOTE: Only 22 practices provided enough data to make this analysis.

TABLE 5. Funding amounts of 22 practices compared to their respective energy savings and action areas

	Funding amounts in 2020 assuming base year 2015=100 (GDP deflator) in millions (USD)	Energy saving levels	Action area
1	**$0.42**	**90%**	Buildings
2	$16.28	31%	
3	$0.60	66%	
4	**$49.98**	40%	
5	$8.76	20%	
6	$0.61	50%	
7	$0.10	20%	
8	**$0.62**	**75%**	
9	$1.51	70%	
10	$6.79	50%	
11	$0.69	50%	
12	$0.75	40%	Lighting
13	$0.25	44%	
14	$19.34	70%	
15	$0.20	45%	
16	**$267.89**	**90%**	District energy
17	$3.49	70%	
18	$26.86	25%	Crosscutting
19	$2.52	64%	
20	$80.57	55%	
21	$61.10	56%	
22	$43.58	60%	

NOTE: Only 22 practices provided enough data to analyse funding amounts against energy savings

Figure 10 and Table 5 show data from 22 practices, as not all 100 practices provided enough information for this analysis. Starting with the buildings sector, the results show that the highest energy savings (90%) are achieved in practice #1 (here), with one of the lowest funding amounts in 2020 accounting for $416,876.90. Additionally, practice #8 (here) accounts for the second highest energy savings (75%), with also one of the lowest funding amounts, $620,417 for the year 2020.

For the lighting action area, practice #14 (here) achieved the highest energy savings and with funding amounts of $19.34 million, representing the highest within the action areas. Regarding district energy, practice #16 (here) accounts for the highest energy savings (90%), with funding amounts in 2020 of $267.89 M. In fact, practice #16 accounts for the largest funding amounts among all action areas. Considering a simplistic analysis, one could argue that the higher the funding amounts, the higher the energy savings achieved. However, this statement could be wrong, as all the different analyzed practices don´t have the same characteristics.

Finally, regarding cross-cutting practices, the highest energy savings (64%) are found in practice #19 (here), with the lowest funding amounts, $ 2.5 million within the action areas.

In relative terms, it is observed that funding amounts tend to be higher in the district-energy and cross-cutting action areas, as these two action areas are typically more extensive in size and duration and need infrastructure compared to street lighting or building retrofitting.

3.4 Replicability of the good practices

The 100 energy-efficient projects and programmes in cities can attribute their successful implementation to multiple factors: including, but not limited to, the ability to mobilize sufficient funding from multiple sources, the ability to engage key stakeholders through proper contractual arrangements, including technology, technical service, investment, and equipment providers, the selection of technology solutions suitable for the local context, as well as awareness from local leaders and memberships of relevant like-minded city networks.

Among the different action areas, efficient lighting represents the technology of short payback period and can to some extent be implemented on commercial basis. In contrast, water efficiency, district energy, and transportation are closely related to urban infrastructure and generally require large amounts of investments and longer payback periods. Public buildings are intermediate, since complexity and costs can vary significantly.

TABLE 6. Suggestions for replicability emanated from the analysis of the 100 good practices categorised in terms of energy-efficiency programmes

Goverment-led incentives	**Voluntary programmes (incl. one stop shops, reporting schemes, retrofitting campaigns, etc)**	• **Partnerships** formed with utilities, public interest groups, energy service provider real estate portfolios, and other stakeholders proved invaluable for programme development, outreach, and recommended actions to increase energy performance. • **Share of data and lessons learned so actions can be replicated**. • Promoting the voluntary climate leadership **portion in relation with city climate goals** • **Being part of city networks** (i.e., European Covenant of Mayors) for persuading the City Council support. • **Energy Retrofitting programs** (here). Replicability depends on whether municipalities can access external energy efficiency grants and have internal funding to subsidize residential energy retrofit actions. • **Effective Stakeholder engagement**.
	Financial support including subsidies, loans, investment bundling, etc.	• **Bundling investment** (here). The establishment of a new model of multilevel governance among local authorities lead to bundling investments in sustainable energy, promoting economies of scale and simplifying administrative procedures. • **Green bonds** (here): o Seize the right moment to issue a green climate bond. o Put in place a well-working reporting structure to increase transparency • **Energy Smart Loans** (here). Enhance the high leverage rate and low-administrative load for the government to make an attractive and low-cost option for motivating energy-efficiency actions by homeowners. • **Project bundling** (here). o Ease on legal restrictions through the creation of a trust.
	Market mechanisms	• The importance of having a clear pathway to follow to achieve ambitious targets. • Increasing transparency and accountability.
	Policy support/ mandatory programs	• **Stakeholder engagement.** • **The relevance of creating an environment conducive to the growth of new businesses** (here).
Implementation of technologies in various action areas	**Lighting**	• **Ex-post evaluation**, with a focus on the effectiveness and sustainability.
	Buildings	• **Dissemination and promotion** to raise awareness and facilitate replication.
	Cross cutting	• Communication with future users and inhabitants • Focus on replication of projects that are in their maturity, final states • Replication in cities with similar climate policies, strong commitment, and a shared vision.
	District energy	• Adaptability to different climate conditions.
	Transport	• **Electric bus implementation** (examples here and here). o It is essential to focus on the funding component and the technical aspects of battery packs to scale these kinds of projects. o Implementation of technical improvements such as opportunity charging. • **Electric light-rail line implementation** (here): o Local metro and tram systems are expensive local transport infrastructure and requires land acquisition and strong local coordination.
PPP	**Lighting**	• **Political engagement** • **Streetlight retrofitting implementation** (here). o The model is marketable, in the case that municipalities own streetlights. o The operation and maintenance of streetlights is funded by local tax or government budget.
	Buildings	• **Project bundling** (here). o To unlock investment is key the existence of a proper Fund scheme, which can be applied and repli–cated in other geographies and even other action areas.
	Water efficiency	• **Stormwater management** (here). Focus on the replicability of a system that fits the city needs. • **Rainwater infiltration projects** (here). The concept of rainwater infiltration to improve resilience in cities can be widely extended to other cities with a risk of flooding, making good use of public-private partnerships.
	Cross cutting	• **Collaborations** between businesses and between businesses and academia have synergistic effects. • **Sharing research efforts** and expertise accelerates innovation. • **Procurement processes** (here). Use the competition between contractors involved in the project to drive up standards across the development
	District energy	• **A district-heating and cooling network implementation** (here). It is necessary to implement the solution during the urban regeneration or development of a densely populated area. • **Deep-lake water-cooling system** (here). o It is key to choose the right ownership structure and business model based on regulatory powers, financing capacity, risk tolerance and the degree of access to low-cost finance o **The wholly public model** is particularly suitable for cities with strong financing capability. o **The hybrid public-private** and **wholly private models** enable cities to leverage private investments with lower risk to the municipal government, while keeping a certain degree of involvement in or oversight of the project.
	Transport	• **Bus-electrification implementation** (here). Robust urban governance and green-finance mechanisms are required. • **Bus electrification and ferries implementation** (here). Efficient coordination and adoption of public policies and the implementation of PPPs are key factors for replicability.
ESCO-based projects	**District energy**	• **Excess heat recovery from sewage water implementation in Cologne** (here). o The general replication requirements for demo technologies are evaluated using seven criteria: the availability of the exploited source, flexibility to varied climate conditions, simplicity of permission, installation, operation, and necessary investment cost. o When it comes to replication potential at the European level, more than 84 % of the EU population is connected to a sewage network. The value rises if the analysis is limited to urban areas only; this means that the replication potential for the Cologne demonstrator is exceptionally high, thanks to its adaptability to different climate conditions and use of economically viable conventional technologies

As indicated in Appendix 1, some of the good practices are from such sources as C40, Covenant of Mayors, and ICLEI. These advocacy organizations play an active role in promoting energy-efficiency and climate actions in cities through their networks of city members, experience sharing, and technical support.

Most of the good practices are from Europe and the US, while studies in other continents are rarer. This could be for multiple reasons: 1) the key advocates of energy-transition and climate action in cities, like C40, ICLEI, Covenant of Mayors are all initiatives that originated in North America and Europe, and funded by governments and organizations in these regions. Although their members are now beyond these two regions, developed-country cities may still lead the movement towards clean-energy transitions and low-carbon development. 2) In addition to stronger climate awareness, the cities in developed countries also face both more policy and public pressure of green development and with better financial resources and technical capacity to do so. 3) More importantly, in both the US and the EU, there are more supportive policies from the federal government and the EU to support energy-efficiency actions. The US has several lines of federal government programmes and targeted programmes to support and encourage cities in taking actions towards energy efficiency.

In the US, both the federal government and some state governments offer grants, target programmes, and guidance supporting energy-efficiency actions in cities. For instance, the Federal Department of Energy has many guiding documents and case studies on energy-efficiency actions, and grant lines targeting energy-efficiency actions in cities. The Northwest Energy Efficiency Alliance also actively promotes energy-efficiency actions in cities and collects successful stories on energy-efficiency actions among its city members. The EU, in its effort to lead the global transition toward clean energy and climate neutrality, has not only common policies in the form of energy-efficiency standards and building-performance codes, but also EU-wide research and demonstration projects and programmes on energy-efficiency actions in cities.

4 Conclusion and recommendations

Despite its various limitations, the 100 good practices in the C2E2 collection of energy-efficiency actions in cities based on desk research can shed some light on the existing analysis. Based on the team's experience in developing this report, it is also important to maintain standard and easy accessibly data on such successful good practices. This goes a long way in encouraging, motivating, and empowering individuals and organizations to replicate or adapt these good practices in their context. Section 3 offers indicative snapshots of the most common types of energy-efficiency actions that cities are taking, and clues on the innovative solutions that help some of those cities overcome the numerous barriers facing energy efficiency implementation.

In this section, the authors try to draw some conclusions from the analysis done in Section 3 and offer some recommendations for future work of collecting and analysing such good practices and further replicating and scaling up the successful cases presented.

Recommendations for future similar studies. The good practices had been captured through several years of online search and editing, based on a predefined template. As the search only covers online case studies in English, Chinese, and Spanish since 2000, the collection cannot be taken as exhaustive. There may be more published cases beyond the searching results and even more energy-efficiency projects and programmes in cities, that have not been captured in detailed studies.

For future research on good practices of energy efficiency or other climate mitigation initiatives in cities, the results of this analysis show the limitations of relying on secondary sources of information. An in-depth analysis of a smaller collection of good practices can make it feasible to contact the original report authors or the specific cities to cross-check the data and address the issues of lacking data or data calculations based on unspecific, probably different, assumptions. Limiting the case studies to a sector or technology can avoid the issue of good practices covering more than one category in a dimension.

Recommendations on replicating the successes. As municipal governments control vast amounts of public resources and many energy-efficiency actions need government approval or facilitation, strong political will by mayors and other municipal leaders can make a big difference in local energy efficiency implementation.

As energy-efficiency actions vary a lot and each of them often faces multiple barriers, there is no one-size-fits-all solution to turn energy-efficiency opportunities into successful implementation cases. Municipal governments manage public buildings and facilities, like public transport, water supply, street lighting, government buildings, schools, and hospitals, they have many opportunities to showcase energy-efficiency actions and boost the demand for energy-efficient products and services through taking energy-efficiency actions. Moreover, municipal governments can leverage such actions through full public funding, or mobilize private cooperation through public-private partnerships, or seek services from ESCOs.

Moreover, the government can also motivate energy-efficiency actions by private businesses and households through energy-efficiency standards and labelling, mandatory energy-efficiency requirements, grants, low-interest credit lines, and subsidies. This analysis has shown that most of the energy savings are found in private and public-private funded projects. One possible reason is that energy-efficiency actions often bring multiple benefits, therefore the pursual of these opportunities. Local governments may regard energy-efficiency actions as policy objectives and public benefits other than energy saving, such as improving local air quality, reducing indoor air pollution, addressing urban traffic congestion, or improving public safety. In contrast, private investors attach high importance to energy and financial savings and investment returns.

National, state, and provincial governments can create enabling environments for energy-efficiency actions by enacting energy-efficiency regulations, standards, labelling, and long-term strategies and pathways. They can provide economic incentives on energy efficiency and motivate actions. Public authorities can also provide grants, subsidies, and concessional loans for energy-efficiency actions and help city stakeholders access international support from multilateral agencies and international advocacy organizations.

The remarkable success of Europe and North America in energy-efficiency actions also highlights the importance of city networks and advocating organizations, like C40, EU-funded research and demonstration projects, in raising awareness, promoting successful experience, and disseminating knowledge and skills in designing and implementing energy-efficiency actions.

Finally, the C2E2 collection of good practices indicates the remaining vast opportunities for energy-efficiency actions and the existence of rich local innovations in unlocking opportunities. It points to the need to further scale up and speed up the actions to deliver the full benefits of energy efficiency, especially under the current international background of high energy prices, high uncertainties of continuous energy supply, and the global imperative need for effective greenhouse gas emission reduction.

Bibliography

Ali, S. M. (2021). IFRS 9 - Financial Instruments. Retrieved from https://vls-online.com/blog/ifrs-9-financial-instruments

APM. (2022). What is investment appraisal and project funding? Retrieved from https://www.apm.org.uk/resources/what-is-project-management/what-is-investment-appraisal-and-project-funding/

BASREC. (2022). Increasing Energy Efficiency through PPP projects. Retrieved from http://basrec.net/projects/energy-efficiency-and-ppp/

C2E2. (n.d.). Good practices in cities. Retrieved from https://c2e2.unepccc.org/?s=good+practices+in+cities

Carbonara, N., & Pellegrino, R. (2017). Public-Private Partnerships for Energy Efficiency Projects: A Win-Win Model to Choose the Energy Performance Contracting structure.

CFI. (2022). Sources of Funding. Retrieved from https://corporatefinanceinstitute.com/resources/accounting/sources-of-funding/

IEA. (2021). Financing Clean Energy Transitions in Emerging and Developing Economies.

IEA. (2021). How Energy Efficiency Will Power Net Zero Climate Goals. Commentary by Alyssa Fischer. . Retrieved from https://www.iea.org/commentaries/how-energy-efficiency-will-power-net-zero-climate-goals

IEA. (2022). Energy Efficiency 2022. Retrieved from https://iea.blob.core.windows.net/assets/7741739e-8e7f-4afa-a77f-49dad-d51cb52/EnergyEfficiency2022.pdf

IEA. (2022a). World Energy Outlook 2022.

IEA. (2022b). 7th Annual Global Conference on Energy Efficiency. The value of urgent action on Energy Efficiency.

IEA. (n.d.). Energy savings. Retrieved from https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/energy-savings

IEA, IRENA, UN, World Bank and WHO. (2022). Tracking SDG7 progress across targets: indicators and data .

IFRS. (2022). IAS 32 Financial Instruments: Presentation. Retrieved from https://www.ifrs.org/issued-standards/list-of-standards/ias-32-financial-instruments-presentation/

Linkedin. (2020). What is an Initiative & What is Initiative Management ? Retrieved from https://www.linkedin.com/pulse/what-initiative-management-mohammed-ali-alamir-ali-cscp#:~:text=An%20initiative%20is%20simply%20a,Institute)%20explanation%20of%20a%20project.

Mynarz, J. (2016). Comparing money across time and space. Retrieved from Open Budgets: https://openbudgets.eu/post/2016/07/20/comparing-money-across-time-and-space/

Resources for the Future. (2020). Energy Efficiency 101. Retrieved from https://www.rff.org/publications/explainers/energy-efficiency-101/

UNECE and UNEP DTU Partnership. (2017). Overcoming Barriers to Investing in Energy Efficiency. .

UNEP. (n.d.). Financial mechanism. Retrieved from https://leap.unep.org/knowledge/glossary/financial-mechanism

UNHABITAT. (n.d.). Urban Energy. Retrieved from https://unhabitat.org/topic/urban-energy

USDA. (n.d.). A Guide to Funding Resources. Retrieved from https://www.nal.usda.gov/economics-business-and-trade/guide-funding-resources

World Bank. (n.d.). Urban population (% of total population). Retrieved from https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

World Bank. (n.d.). World Bank Open Data. Retrieved from https://data.worldbank.org/

World Economic Forum. (2021). Net Zero Carbon Cities: An Integrated Approach INSIGHT REPORT JANUARY 2021.

APPENDIX 1:

List of the 100 good practices of energy-efficiency actions in cities in the C2E2 KMS collection

No.	Name of Good Practice	Country	Duration		Action area	Funding source	Source of info
			Start	End			
1	1200 Buildings	Oceania	2010	2020	Buildings	Public	C40
2	Accelerate SUNShINE: Support scheme for renovation of multifamily residential buildings, municipality public buildings are bundled for Energy Performance contracting based procurement	Europe	2017	2020	Buildings	Public	CORDIS (European Commission)
3	Residential development with centralised district heating system	Latam	2010	completed	Buildings	Private	RUCANTU
4	BEnerGI Street Lighting	Europe	2015	2019	Lighting	Public	BEENERGI
5	Blue Gate District	Europe	2001	ongoing	Cross-cutting	Public-private	BLUE GATE ANTWERP
6	Building Retrofit Program (BRP) Loan Support Scheme	Asia	2012	ongoing	Buildings	Public	C40
7	Chicago Retrofit Chicago Energy Challenge	North America	2012	2021	Buildings	Public	C40
8	Climate smart district	Europe	2011	2020	Cross-cutting	Public-private	MALMO MUNICIPALITY
9	CO2 reporting programme for small and medium sized facilities	Asia	2010	now	Cross-cutting	Public-private	TOKYO METROPOLITAN
10	Cross-sectoral urban development plan	Europe	2010	2020	Cross-cutting	Public	FLIPECO
11	Districlima Network	Europe	2002	2004	District heating and cooling	Public-private	DISTRICLIMA
12	EcoEnlight	Europe	2011	2013	Lighting	Public	COVENANT OF MAYORS
13	Energy and water efficient apartments	Oceania	2011	ongoing	Buildings	Public	CITY OF SYDNEY
14	Energy efficiency in City Buildings	Africa	2013	ongoing	Buildings	Public	CAPETOWN GOVERNMENT
15	Energy Efficiency Investments in multi-family houses	Europe	2018	2022	Buildings	Public	CORDIS (European Commission)
16	Energy efficient retrofits	North America	2015	2017	Buildings	Public	CITY OF KNOXVILLE
17	Enwave Energy Corporation - Deep lake water cooling system	North America	2004	2004	District cooling	Public-private	C40
18	FESTA Public buildings	Europe	2015	2018	Buildings	Public	CORDIS (European Commission)
19	First zero energy building in India	Asia	2011	2013	Buildings	Public	Ministry of Environment, Forestry and Climate Change – government of India
20	HONG KONG – Buildings Energy Efficiency Ordinance (BEEO)	Asia	2012	ongoing	Buildings	Public	C40
21	Installation of ICT technologies in social housing	Europe	2010	2013	Buildings	Public-private	CORDIS (European Commission)
22	International Low Carbon City	Asia	2012	2025	Buildings	Public-private	C40
23	Klimastrasse	Europe	2014	2017	Cross-cutting	Public	SMART CITY COLOGNE
24	LED street lighting	Latam	2014	ongoing	Lighting	Public	SCHREDER
25	London's Business Energy Challenge (BEC)	Europe	2014	ongoing	Buildings	Public	C40
26	Lyon Smart Community	Europe	2011	2017	Cross-cutting	Public-private	METROPOLE GRAND LYON
27	Mass retrofitting - Hackbridge	Europe	2005	2025	Cross-cutting	Public-private	SMART CITIES (EUROPEAN COMMISION)

28	MLEI 2020 TOGETHER Public buildings and lighting	Europe	2014	2016	Cross-cutting	Public	TORINO – CITTA METORPOLITANA
29	MLEI Accelerate Street Lighting	Europe	2012	2016	Lighting	Public	ENERINVEST
30	Provincial Technical Assistance Resources for Investments and Development on Energy efficiency (PARIDE)	Europe	2012	2015	Lighting	Public	EUROPEAN COMMISSION
31	Nordhavnen Smart District	Europe	2011	2040	Cross-cutting	Public	STATE OF GREEN
32	Oslo, Norway's street lighting retrofit	Europe	2011	ongoing	Lighting	Public	C40
33	Public lighting LED retrofits with remote monitoring systems	Latam	2015	?	Lighting	Public	LEDINSIDE
34	Rainha Dona Leonor renovation	Europe	2009	2014	Buildings	Public	COVENANT OF MAYORS
35	Refurbishment of public buildings and modernization of public lighting	Europe	2013	2017	Cross-cutting	Public-private	EUROPEAN COMMISSION
36	SEATTLE – The Seattle Building Energy Benchmarking and Reporting Program	North America	2012	ongoing	Buildings	Public	C40
37	Smart City	Asia	2016		Lighting	Public	PHILIPS
38	Smart LED Retrofit	Latam	2013	2016	Lighting	Public	ICLEI
39	Stockolm Royal Seaport	Europe	2010	2030	Cross-cutting	Public	ECODISTRICTS
40	Sustainable Buildings Certification Programme	Latam	2009	ongoing	Buildings	Public	C40
41	The urban redevelopment of Hammarby Sjöstad	Europe	2004	2016	Cross-cutting	Public-private	HAMMARBY SJÖSTAD EKONOMISK FÖRENING
42	TransMilenio Bus Rapid Transit (BRT)	Latam	2000	ongoing	Transport	Public	ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAM
43	Urban redevelopment and expansion of the city centre (HafenCity)	Europe	1997	2011	Cross-cutting	Public-private	HAFENCITY
44	Vancouver - South East False Creek Neighbourhood (SEFC)	North America	2010	onwards	District energy	Public	CITY OF VANCOUVER
45	Växjö - Fossil Fuel Free City	Europe	1991	2030	Cross-cutting	Public	NORDREGIO
46	Waterfront	North America	2001	2025	Cross-cutting	Public	WATERFRONTORONTO
47	One-stop-shop Riga	Europe	2018	on going	Buildings	Public	ENERGY CITIES
48	Climate bond financing adaptation actions in Paris	Europe	2015	2031	Cross-cutting	Public	ENERGY CITIES
49	Energy renovation of residential buildings through soft loans and third-party financing	Europe	2016	2020	Buildings	Private	ENERGY CITIES
50	Public-private partnership for a large-scale building retrofit programme	Europe	2017	ongoing	Buildings	Public-private	ENERGY CITIES
51	Revolving energy saving fund	Europe	2014	?	Buildings	Public	ENERGY CITIES
52	Sustainable Building Facilitator - One stop-shop	Europe	2018	2021	Buildings	Public	ENERGY CITIES
53	Energiesprong in France - Typical brick individual house	Europe	2018		Buildings	Public	RENOVATION HUB
54	Tokyo-energy efficiency cap and-trade scheme	Asia	2010	currently	Buildings	Public	REALDANIA
55	BANGKOK MITSUBISHI UFJ LEASE LTD (BMUL) RISK-SHARING PROJECT	Asia	2011	2023	Cross-cutting	Public - private	IFC
56	"St.St. Kiril and Methodius" Primary School building	Europe	2015	2016	Buildings	Public	RENOVATION HUB
57	Social housing apartments and district single family houses	Europe	2017	2018	Buildings	Public	RENOVATION HUB
58	Effective water management cuts costs and carbon, and boosts resilience	North America	N/A	N/A	Water efficiency	Public	REALDANIA
59	Framework guides effort to rapidly restore water bodies	Asia	2015-2016	currently	Water efficiency	Public-private	REALDANIA
60	Innovative stormwater management approach takes advantage of synergistic opportunities	Europe	NA (recently)		Water efficiency	Public	REALDANIA

61	Not a drop goes to waste with a recycled water programme and rain-fed greenspaces	Europe	2019	2025	Water efficiency	Public	REALDANIA
62	Pledge provides clean and free water for all and invests in a water secure future	Asia	2013	currently	Water efficiency	Public	REALDANIA
63	Sponge city soaks up rainfall to boost climate resiliency	Asia	2015	2037	Water efficiency	Public-private	REALDANIA
64	Addis Ababa.Sub-Saharan Africa´s First Light Rail Train	Africa	2011	2015	Transport	Public	REALDANIA
65	Auckland's City Rail Link for a Compact Sustainable City	Oceania	2015	2024	Transport	Public	C40
66	Boosting Bucaramanga's bicycle inclusiveness	Latam	2016	2019	Transport	Public	REALDANIA
67	City-wide rapid bus electrification-Guangzhou	Asia	2018		Transport	Public-private	REALDANIA
68	Data Gathering of Dockless Transport Use in Mexico City	Latam	2019	currently	Transport	Public	C40
69	Eco buses in Venice Lido and Pellestrina Islands	Europe	2018	2021	Transport	Public	C40
70	Electric buses purchase of bus stock with associated infrastructure	Europe	2020	2029	Transport	Public	C40
71	Electrifying Kolkata's buses and ferries	Asia	2019	2030	Transport	Public	REALDANIA
72	Gothenburg. Collaborative Approach to Public Transit Innovation	Europe	2015	currently	Transport	Public-private	REALDANIA
73	Milan's Network of Public Transport Going Full Electric by 2030	Europe	2017	2030	Transport	Public	C40
74	Seattle. Getting Ready for Mass Electrification of Transport	North America	N/A	2025	Transport	Public	REALDANIA
75	Stockholm-Sweden's Beloved City initiates	Europe	2013	currently	Transport	Private	REALDANIA
76	Taiyuan. World's Fastest Electric Taxi Fleet Overhaul	Asia	2015	2016	Transport	Public	REALDANIA
77	Tokyo - Big Data to Promote Eco-Friendly Freight Transport	Asia	Currently		Transport	Public	C40
78	Wuhan - Carbon Credit Scheme Bolsters Massive Bike-Share Program	Asia	2015	currently	Transport	No information	REALDANIA
79	Heat recovery from the London Underground in Islington	Europe	2014	2017	District energy	Public	CELSIUS PROJECT (EUROPEAN UNION)
80	Waste heat recovery from sewage water in Cologne	Europe	2012	2016	District energy	Public-private	CELSIUS PROJECT (EUROPEAN UNION)
81	Open District Heating in Stockholm	Europe	2014	N/A	District energy	Public-private	CELSIUS PROJECT (EUROPEAN UNION)
82	Helsingborg District Cooling	Europe	2017	2018	District energy	Public	CELSIUS PROJECT (EUROPEAN UNION)
83	Industrial residual heat and transmission in Leiden, Netherlands	Europe	2017	ongoing	District energy	Private	CELSIUS PROJECT (EUROPEAN UNION)
84	MurMur.Retrofitting private buildings to reduce energy consumption	Europe	2010	2014	Buildings	Public-private	ENERGY CITIES
85	Super Supermarkets	Europe	2016	2019	District energy	Public-private	CELSIUS PROJECT (EUROPEAN UNION)
86	City Hall Energy Retrofit – City of Espanola	North America	2011	2011	Buildings	Public	SOUTHWEST ENERGY EFFICIENCY PROJECT
87	Energy Advisory Service, Rebates and Microloans - Boulder County	North America	2010	ongoing	Buildings	Public	SOUTHWEST ENERGY EFFICIENCY PROJECT
88	Energy Code Outreach and Adoption Project, City of Mesa	North America	2010	2011	Buildings	Public	SOUTHWEST ENERGY EFFICIENCY PROJECT
89	Energy Efficiency with New Joint Office of Sustainability, Silver City & Grant County	North America	2010	2011	Buildings	Public	SOUTHWEST ENERGY EFFICIENCY PROJECT

90	Creative Energy Financing and Employee Behavior in City of Tempe	North America	2010	2012	Buildings	Public-private	SOUTHWEST ENERGY EFFICIENCY PROJECT
91	Energy retrofitting of Hospital Firule, KBC Split	Europe	2016	2017	Buildings	Public-private	RUDAN
92	Energy Smart Loans, Snohomish County	North America	2012	?	Buildings	Public-private	SNOHOMISH COUNTY
93	Income-based Residential Energy Retrofit Program, City of Flagstaff	North America	2009	?	Buildings	Public	SOUTHWEST ENERGY EFFICIENCY PROJECT
94	Leveraged Financing for Energy Efficiency and Renewable Energy Initiative, City of Reno	North America	2008	2012	Buildings	Public-private	SOUTHWEST ENERGY EFFICIENCY PROJECT
95	Streetlight retrofitting in the City of Santa Clarita	North America	2017	2019	Lighting	Public-private	SOUTHWEST ENERGY EFFICIENCY PROJECT
96	Houston Green Office Challenge (HGOC)	North America	2010	2014	Buildings	Public-private	C40
97	Aarhus Light-rail project	Europe	2013	2017	Transport	Public	EUROPEAN COMMISION
98	Building Energy Benchmarking Ordinance	North America	2012	2015	Buildings	Public	C40
99	Public Bike-sharing Program	Asia	2008	?	Transport	Public	ENERGY SMART COMMUNITIES INITIATIVE
100	Argentinian Network of Municipalities Step Up Sustainable Purchasing	Latam	2020	currently	Lighting	Public	FORBES