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Approach Paper

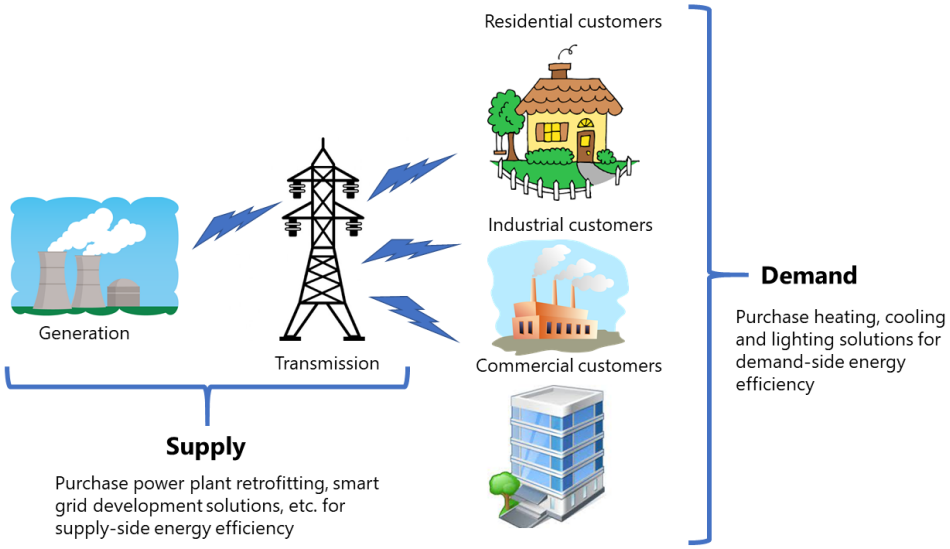
World Bank Group Support to Energy Efficiency: An Independent Evaluation of Demand-Side Approaches

July 21, 2021

1. Background and Context

1.1 Energy efficiency can be defined as a reduction in the amount of energy required to maintain or improve energy services to households, businesses, and communities (World Bank 2017). Energy efficiency improvements can be categorized as supply-side approaches (for example, those targeting the energy generated via grid infrastructure, utilities, and power producers) and demand-side approaches (for example, those focusing on the energy use of industries, commercial entities, and households figure 1.1). Supply-side approaches to improve energy efficiency include upgrading and retrofitting power plant turbines, efficient transmission lines, and smart-grid applications to reduce energy losses and capture waste heat during energy generation. Demand-side energy efficiency (DSEE) approaches include upgrading industrial plants, equipment, and appliances, retrofitting public infrastructure and residential buildings, improving fuel efficiency, and end-user incentives and load-shape modification programs by utilities and service providers. About one-third of global energy produced is consumed in residential, public, and commercial buildings, where it is used for space heating, cooling, ventilating, lighting, cooking, water heating, refrigeration, and operating electric and mechanical devices.

Figure 1.1. Energy Efficiency Supply and Demand



Source: Independent Evaluation Group.

1.2 Energy efficiency primarily contributes to addressing climate change, but it also addresses three critical development challenges: firm productivity, energy security, and household energy affordability and access. Countries face one or more of these challenges based on the sizes of their economies, the historical evolution of their industrial, urban, energy, and power sectors, and the availability of local energy sources, including renewable energy.

1.3 Energy efficiency contributes to climate change mitigation by reducing fossil fuel consumption and related greenhouse gas emissions. Energy efficiency could reduce annual energy-related emissions by 12 percent compared with 2017 levels—an amount equivalent to 3.5 gigatons of carbon dioxide—thereby delivering over 40 percent of the abatement required by the Paris Agreement (IEA 2019). By reducing greenhouse gas emissions, energy efficiency contributes to Sustainable Development Goal (SDG) 13 ("Take urgent action to combat climate change and its impacts") and to achieving the Paris Agreement goal to limit global warming to 1.5 degrees Celsius compared with preindustrial levels. Through Nationally Determined Contributions (plans made under the Paris Agreement), many countries have identified climate-friendly policies that include residential and commercial energy efficiency retrofits, clean heating and cooling, and green procurement.

1.4 Energy efficiency increases firm productivity because it translates into lower energy amounts needed per unit of production. Increased productivity in turn leads to higher economic growth and may lead to job creation. Energy efficiency generates productivity gains by lowering the amount of energy needed to produce a unit of output, by lowering maintenance costs, and by improving operation and process reliability, which reduce equipment downtime, shutdowns, or system failures. Energy efficiency increases correspond to reductions in energy intensity, which is defined as the quantity of energy required per unit of gross domestic product. Achieving SDG 7 ("Ensure access to affordable, reliable, sustainable, and modern energy for all") will require reducing energy intensity by at least 3 percent per year from now through 2030 (United Nations 2020; IEA et al. 2020). If firms improve energy efficiency and invest the money saved on energy in productive assets, they can increase growth and employment (SDG 8, "Decent work and economic growth").

1.5 Energy efficiency interventions, along with renewable energy investments, also increase the energy security and current account balances of nations that depend on imported energy. Energy security is the uninterrupted availability of energy that eases the needs for energy imports and reduces volatility in energy supply and prices. By reducing overall energy demand, energy efficiency can reduce reliance on imports of oil, gas, and coal. It also reduces the likelihood of supply interruptions—energy that is not being used cannot be interrupted. Both avenues improve energy security. A sustained

decrease in the amount of imported energy, which is generally more expensive, has a positive effect on a country's current account balance. Together with a reduction in energy intensity, an increase in a country's current account balance contributes to long-term economic stability and growth. Macroeconomic stability is the goal of SDG target 17.3 ("Enhance global macroeconomic stability, including through policy coordination and policy coherence").

1.6 Energy efficiency can increase individuals' and households' disposable income by lowering energy bills and contribute to increased access to energy. Energy efficiency can lower both the overall energy bills and the percent of income devoted to energy, which is particularly beneficial for low-income households in terms of affordability. Lower energy costs can also contribute to increased access to energy by expanding the level and duration of energy services that can be provided by a fixed amount (or cost) of energy (World Bank 2017).

1.7 To sustain progress on climate change and define the path toward addressing other development challenges related to energy efficiency, SDG 7 includes the target of doubling the global rate of improvement in energy efficiency from 1.3 percent in 2010 to 2.6 percent by 2030. At an estimated $250 billion per year (2010–19), public and private sector financing for energy efficiency remained at an average of 15 percent of total energy investment. Energy demand is expected to grow 1–2 percent annually in developed countries during 2018–30 (IEA 2019), and it is expected to grow even more in developing economies (estimated 5–7 percent, 2018–30), driven by industrial initiatives, demographic changes, and consumer behavior. To keep energy demand at today's level, global investment in energy efficiency would need to double by 2025 and double again by 2040 from its 2019 levels (15 percent of total investment; IEA 2019).

1.8 The coronavirus (COVID-19) pandemic and the consequent global economic downturn have intensified the relevance and urgency of improving energy efficiency. COVID-19 has resulted in lower oil prices, which will tend to reduce energy efficiency and postpone investments to improve it. It has also limited the ability of many households and businesses to pay for electricity services, including energy efficiency upgrades, given the loss of income associated with the drop in employment and economic activity. Challenges related to COVID-19 could manifest as a slowdown or, in the worst case, a sudden-stop in the financing of energy efficiency solutions as national priorities change. As a result, even greater efforts will be needed to meet the energy efficiency targets in a post COVID-19 world (IEA et al. 2020). Conversely, countries have an opportunity to consider options for economic stimulus that not only respond to the immediate crisis but also ensure longer-term social, economic, and environmental sustainability, including energy efficiency. For example, DSEE investment could be a key strategy for immediate job creation and could be a central element of stimulus

packages. COVID-19 also provides opportunities for improved energy efficiency by contributing to increased firm productivity and reduced energy intensity globally, which could provide a fertile ground for the World Bank Group to accelerate such developments. For a postcrisis recovery, the Bank Group has emphasized "rebuilding better" policy choices that focus on greener, more sustainable, and resilient growth, shifts in behaviors, and scaled-up action. This focus is outlined in the Bank Group's integrated approach to promoting a strong and durable recovery and growth through green, resilient, and inclusive development. Energy efficiency is identified as one of the largest untapped opportunities in the Bank Group's Climate Change Action Plan 2021–2025, and scaling it up is a critical element of the energy transition (World Bank Group 2021).

2. Evaluation Purpose, Scope, and Audience

2.1 The purpose of the evaluation is to assess how well the Bank Group is supporting client countries in scaling up up DSEE to achieve development outcomes. The evaluation will examine the extent to which Bank Group interventions improve DSEE and contribute to achieving SDG 7 and SDG 13. Where evidence is available, the evaluation will assess the effectiveness of the Bank Group's DSEE efforts in contributing to post-COVID-19 green, resilient and inclusive recovery.

2.2 The evaluation will focus on the Bank Group's DSEE interventions. There are three reasons for this focus: the significant potential for demand-side interventions to reduce greenhouse gas emissions; the market, institutional, and behavioral barriers that DSEE interventions face; and the potential for expanding demand-side measures through Bank Group support.

i. DSEE measures have a large potential for reducing greenhouse gas emissions. In 2018–19 alone, DSEE improvements offset almost half of the potential increase in global energy demand that would otherwise have occurred due to economic growth (IEA 2020). The International Energy Agency (IEA) estimates that energy efficiency demand interventions could be responsible for more than 40 percent of the reduction in energy-related greenhouse gas emissions over the next 20 years. Moreover, demand-side measures are economical: more than a quarter of all greenhouse gas abatement potential—approximately 11 billion tons of carbon dioxide equivalent per year—could be realized by implementing demand-side measures for which the energy savings outweigh the up-front investments (McKinsey 2009).

ii. DSEE interventions face institutional, market, and behavioral barriers that are limiting their scale. Institutional barriers include inadequate regulatory and legal frameworks, regulatory uncertainty, poor planning, low capacity, and limited infrastructure investment. The market failures include information asymmetries among energy producers and consumers, financial risks, and capital market imperfections that lead to overall private sector underinvestment in energy efficiency. Behavioral barriers include habits, social norms, lack of trust, and lack of awareness of the economic benefits of energy efficiency measures. These barriers limit the diffusion of energy efficiency technologies and interventions and contribute to a slow uptake of energy efficiency.

iii. The Bank Group has the potential to scale up DSEE interventions. The Bank Group has been providing support to energy suppliers for decades through mainstream interventions, such as transmission line upgrades and supply-side energy efficiency investments. Demand-side interventions, however, account for only one-quarter of the Bank Group portfolio (2011–20). This is partly due to the difficulties in reaching the multiple and fragmented beneficiaries (households and owners of industrial, commercial, and public buildings), the limited interest of government counterparts, and, for the International Finance Corporation (IFC), the challenge to achieve an adequate return on investments in DSEE interventions, which makes them harder to fund and scale up.

2.3 This evaluation will cover the World Bank (International Bank for Reconstruction and Development and International Development Association) and IFC, including lending, advisory, analytics, and knowledge products for fiscal year (FY) 2011 to FY20. The evaluation will build on the findings of previous Independent Evaluation Group (IEG) evaluations on related energy topics. The evaluation will focus on World Bank and IFC efforts to support DSEE improvements in client countries and corporates during 2011–20.[1] Findings and insights from earlier IEG evaluations on the energy sector (namely, World Bank 2015 and World Bank 2020) will be used as a baseline and potential benchmark in assessing the Bank Group's more recent performance in newer areas, such as industrial cooling solutions used in refrigeration capacity and services to

[1] Although the Multilateral Investment Guarantee Agency (MIGA) asked to be excluded from the evaluation when the Approach Paper was initially prepared, MIGA's management comments dated 6/12/2021 **[Please rewrite this date as "June 12, 2021" or "December 6, 2021" as appropriate.]** asked the Independent Evaluation Group (IEG) to include MIGA in view of MIGA's contributions to the Climate Change Action Plan and ongoing changes with MIGA's Impact Measurement and Project Assessment Comparison Tool system. The scope of the evaluation will cover MIGA subject to the nature and magnitude of MIGA's demand-side energy efficiency interventions and to receiving MIGA's portfolio information in a timely fashion.

support food security, for example. This evaluation will benefit from past IEG complementary thematic evaluations (for example, World Bank 2018b), Country Program Evaluations (for example, on Ukraine [World Bank forthcoming] and the Philippines [World Bank 2019b]), and project performance reports (for example, World Bank 2018a; World Bank 2019a).

2.4 The evaluation will include Bank Group partnership programs (cross-sectoral initiatives) that support energy efficiency, including two large programmatic advisory initiatives. Notable partnerships include the Global Environmental Facility, the Clean Technology Fund, and the Carbon Trust. Standards supported by the World Bank include Excellence in Design for Greater Efficiencies and the Building Research Establishment Environmental Assessment Method delivered through advisory services partly supported through trust funds. The evaluation will also cover the Energy Sector Management Assistance Program (ESMAP) and the Green Building Market Transformation Program (GBMTP), which are two large Bank Group programmatic advisory initiatives that support energy efficiency and are described in more detail in the portfolio section of this Approach Paper.

2.5 The audience for this evaluation includes Bank Group shareholders and management, partners, and clients. In addition to Bank Group Board members, this evaluation will address World Bank Global Practices (Energy, Transport, and Finance Competitiveness, and Innovation), IFC climate business, IFC industry groups, development partners (for example, African Development Bank, Asian Development Bank, Global Environmental Facility, Green Climate Fund), client countries pursing energy efficiency–related reforms (in particular, low-income countries and industrializing countries), and IFC private sector clients that have invested in energy efficiency.

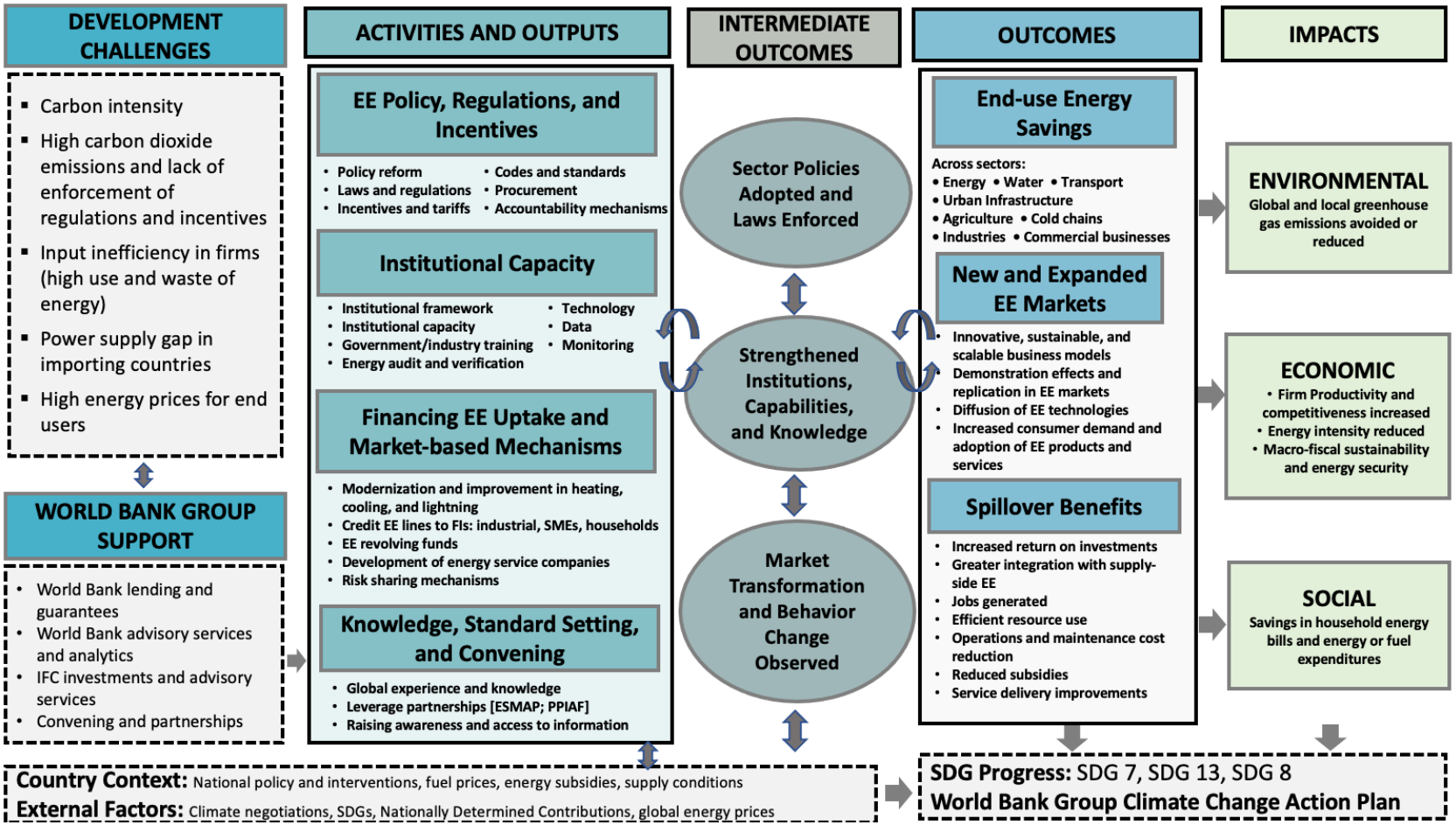
3. Theory of Change

3.1 This evaluation will be informed by a theory of change that hypothesizes the mechanisms through which Bank Group energy efficiency support leads to intermediate and higher-level development outcomes. The theory of change is depicted in figure 3.1. As described in section 1, the Bank Group's DSEE interventions address four main, mostly interlinked, development challenges: (i) high greenhouse gas emissions, (ii) input inefficiency in firms, (iii) high dependence on imported energy, and (iv) household affordability and access. The Bank Group uses various instruments (lending, Program-for-Results, development policy loans, advisory services and analytics, and IFC investments and platforms) to address these development challenges by leveraging partnerships through its convening power.

3.2 The Bank Group supports improvements in energy efficiency through a combination of interventions that influence policies, strengthen institutional frameworks, transform energy efficiency markets, and improve knowledge and standards. First, the Bank Group can support the development of national policies, regulations, and incentives, including tariff reforms that define a legal framework for DSEE. Second, the Bank Group can support the development of national institutional frameworks among clients and energy efficiency actors, both public and private. It can also strengthen knowledge of relevant institutions through capacity building, training, promotion of energy audits and certifications, leveraging technology solutions, monitoring, and data systems. Third, the Bank Group can support clients with the deployment of heating, cooling, and lighting solutions by supporting the development of market-based mechanisms through direct lending and investments, through intermediation activities (for example, credit lines and revolving funds), and through unique financing solutions (for example, results-based financing) that offer incentives for scaling up energy efficiency. Finally, the Bank Group can set standards and leverage partnerships that raise awareness globally and harmonize activities toward the achievement of the SDGs.

3.3 The Bank Group activities and outputs can lead to three kinds of intermediate development outcomes. One is the adoption of sector policies and the enactment of laws that address barriers to energy efficiency financing and perceived risks. Second, the institutions that benefited from those activities can gain know-how and technical capacity and develop technology-based solutions to monitor and promote energy efficiency improvements. Third, as more financing of energy efficiency projects evolves through intermediation activities and various business models (for example, longer tenors and lower interest rates for energy efficiency improvements), the overall reach across firms and households can also be observed as an intermediate development outcome.

Figure 3.1. Theory of Change for World Bank Group Demand-Side Energy Efficiency Interventions



Source: Independent Evaluation Group.
Note: World Bank interventions interact with influencing actors at all stages of the results chain but are especially important in translating energy efficiency reforms and intermediate outcomes into final outcomes achieved at scale. EE = energy efficiency; ESMAP = Energy Sector Management Assistance Program; FI =; IFC = International Finance Corporation; PPIAF = Public-Private Infrastructure Advisory Facility; SDG = Sustainable Development Goal; SME = small and medium enterprise.

3.4 The intermediate outcomes are expected to result in three kinds of final development outcomes. First, they have an immediate effect on the reduction of energy consumption needed for a specific activity. Second, they can have a demonstration effect in scaling up energy investments at the national level to achieve energy savings across sectors. Third, the demonstration, replication, and innovation effects observed from financing energy efficiency can lead to new, expanded, or improved functioning of domestic and regional markets. Fourth, the intermediate outcomes are expected to lead to spillover benefits associated with energy efficiency improvements, including financial benefits or cost savings due to reduction in energy use, higher profits from cost reductions associated with energy saved in production processes, jobs creation due to the additional economic activity associated with increased sales of energy efficient goods and services, increased availability of energy and improved service reliability, and increase in comfort and property values because of building retrofits.

3.5 Long-term impacts of energy efficiency interventions can be classified into three categories: environmental, economic, and social (as elaborated in section 1).

4. Evaluation Questions

4.1 The evaluation's overarching question is, "How well is the World Bank Group supporting client countries to scale up DSEE to achieve development outcomes?" The three specific questions and subquestions are as follows:

1. How effective have the Bank Group's DSEE interventions been in achieving development outcomes? These outcomes are (i) achieving end-use energy savings, (ii) supporting market transformation, and (iii) attaining spillover benefits (such as increased return on investments, greater integration with supply-side and improved service delivery).

2. How coherent are the Bank Group's DSEE interventions (i) internally (for example, coordination and joint initiatives across World Bank Practice Groups and IFC sectors) and (ii) externally (for example, across development partners and other energy efficiency actors)?

3. What untapped opportunities and mechanisms exist for the Bank Group to support clients to realize their energy efficiency potential? (i) What are the untapped opportunities for Bank Group engagement to support energy efficiency across sectors? (ii) What innovative mechanisms proved effective and sustainable and can be mainstreamed to scale up DSEE interventions?

5. Evaluation Portfolio

5.1 During the FY11–20 evaluation period, the Bank Group supported supply- and DSEE through lending, investment, advisory, and analytical work. The Bank Group portfolio totaled approximately $31.5 billion over the FY11–20 evaluation period (table 5.1). Although amounts varied by fiscal year (figure 5.1), IFC investment services portfolio (at approximately $6.1 billion for the period) has been on average about one-fourth of the World Bank lending portfolio (at approximately $25 billion for the period). The World Bank and IFC have increased and broadened support for energy efficiency since 2014 in alignment with the Climate Change Action Plan. The World Bank has contributed to more than 2.8 million megawatt hours of energy savings annually for its clients (countries and firms) in the FY11–20 period.

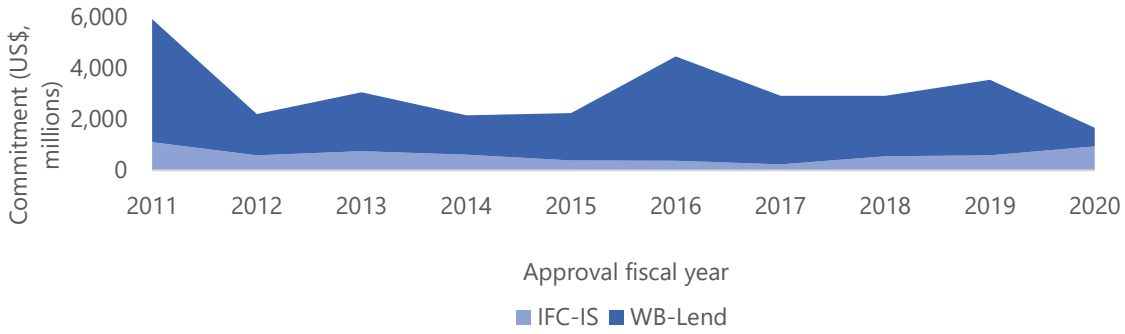
5.2 The preliminary portfolio analysis conducted for the Approach Paper could not clearly identify the components of energy efficiency projects that are either supply- or demand-side interventions. The evaluation will carry out an in-depth portfolio review that will separate the supply- and DSEE portfolios. At this preliminary stage, our estimates suggest that DSEE interventions represent roughly one-quarter of the total World Bank energy efficiency portfolio.

Table 5.1. Overview of the World Bank and IFC Energy Efficiency Portfolio (Demand and Supply), FY11–20

Portfolio	Projects (no.)	Commitment Volume (US$, millions)
World Bank lending	209	24,964
World Bank advisory services and analytics	60	281
IFC investment services	178	6,137
IFC advisory services	117	71
Total size	564	31,453

Source:
Note: Project expenditures in World Bank Advisory and IFC advisory services are treated as proxies for commitment volume (illustrative only). For evaluation purposes, development policy financing series are counted as one development policy financing operation. Portfolio includes both supply- and demand-side support. IFC = International Finance Corporation.

Figure 5.1. World Bank and IFC Energy Efficiency Lending Portfolio (demand and supply)

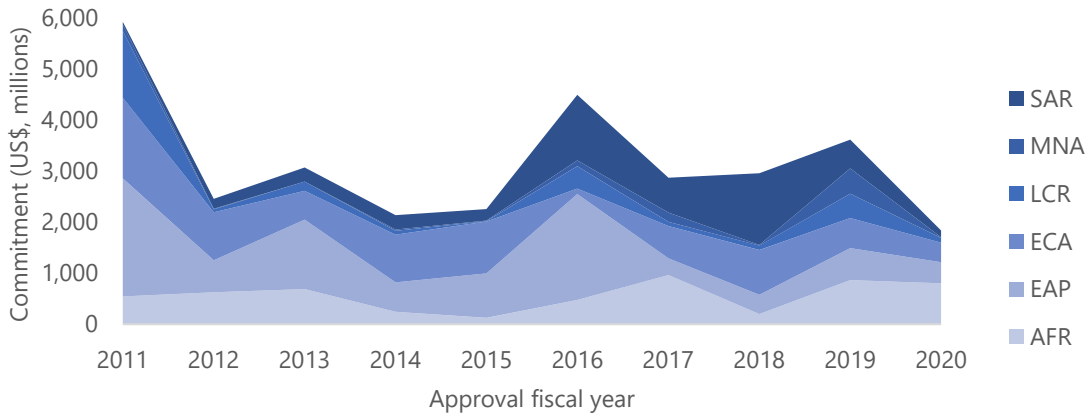


Source:
Note: IFC-IS = International Finance Corporation investment services; WB-Lend = World Bank lending.

5.3 The preliminary portfolio review of energy efficiency projects suggests that the World Bank has used investment project financing (IPF) more than development policy financing (DPF), and that IFC has used debt more than equity instruments. For the World Bank, energy efficiency support includes investment loans (IPFs, including trust-funded operations), DPFs with energy efficiency–related prior actions by the line ministries responsible for energy, transport, and water, and Program-for-Results financing. IPF lending in support of energy efficiency has increased substantially since 2014, especially in lower-middle-income countries, accompanied by increased analytical and advisory services supported by ESMAP on public infrastructure and cooling solutions (since 2018). DPFs that support energy efficiency are a small share of operations and are often part of broader multisectoral policy programs. Climate-informed DPFs support sustainable and resilient growth through climate policy actions, including the introduction of energy efficiency requirements for buildings. For IFC, debt instruments have been used more than equity. The World Bank's Energy and Extractive Industries Global Practices makes up 80 percent of the energy efficiency portfolio. IFC's Manufacturing and Services project portfolio makes up 58 percent of the total energy efficiency portfolio. It includes advisory services work on industrial efficiency, green buildings, and certifications.

5.4 Preliminary portfolio analyses of Bank Group interventions shows that most operations supporting energy efficiency were concentrated in middle-income countries, especially in Europe and Central Asia. There also has been a high degree of variation in the regions to which energy efficiency programs were targeted (figure 5.2). Although the overall support for energy efficiency declined in recent years from the highs in 2011 and 2016, the Africa portfolio on energy efficiency has been growing. A more detailed portfolio review is presented in appendix A.

Figure 5.2. World Bank Lending and IFC Investment Portfolio, by Client Regions



Source: Data from World Bank Group and ESMAP databases; inputs from World Bank Energy and Extractives GP and IFC Climate Business team.
Note: Portfolio includes both supply- and demand-side interventions. AFR = Africa; ECA = Europe and Central Asia; EAP = East Asia and Pacific; IFC = International Finance Corporation; LCR = Latin America and the Caribbean; MNA = Middle East and North Africa; SAR = South Asia.

5.5 The evaluation will also cover the following two large programmatic, advisory initiatives:

- The ESMAP, a multidonor trust fund, supports energy efficiency programmatically, focusing on both supply- and demand-side issues through *City Services* and *Efficient and Sustainable Buildings*. ESMAP is also supporting the development of public-private approaches and mechanisms to unlock private sector capital for investments in energy efficiency infrastructure.

- The GBMTP is part of IFC's programmatic approach to steer construction in rapidly urbanizing economies onto a lower-carbon path. The program targets developers, owners, governments, banks and building professionals. It outlines the benefits of working together to unblock the potential for an era of green construction and development. The program supports building certifications and standard-setting work, in addition to catalyzing financial intermediation through commercial banks and capital markets in alignment with environment, social, and governance best practices.

6. Design and Methods

6.1 The evaluation will address the evaluation questions by using a variety of methods at three levels of analysis: global, country, and intervention. Table 6.1 lists the methods that will be used for each evaluation question (rows) at each level of analysis (columns). The selection criteria for the country-level and intervention-level case studies,

and the key methods to be used to address the evaluation questions at each level, are described next.

Table 6.1. Evaluation Questions and Methods

No.	Evaluation Questions	Multilevel Analysis		
		Global	Country	Intervention
1	How effective have the World Bank Group's demand-side energy efficiency interventions been in achieving development outcomes?	• Portfolio review and analysis • Software-aided content analysis of Project Appraisal Documents	• Portfolio review and analysis • Comparative analysis of country case studies • Software-aided content analysis of (i) Country strategy documents (ii) Semistructured interviews with staff, development partners, and stakeholders	• Portfolio review and analysis • Comparative analysis of intervention case studies • Software-aided content analysis of (i) Project documents (ii) Semistructured interviews with staff, development partners, and stakeholders • Empirical analysis of geospatial project data
2	How coherent are the World Bank Group's demand-side energy efficiency interventions internally and externally?	• Portfolio review and analysis • Software-aided content analysis of corporate and Practice Group strategies	• Software-aided content analysis of (i) Evaluation and validation documents (ii) Semistructured interviews with staff, development partners, and stakeholders	• Software-aided content analysis of (i) External evaluations (ii) Semistructured interviews with staff, development partners, and stakeholders
3	What untapped opportunities and mechanisms exist for the World Bank Group to support clients to realize their energy efficiency potential?	• Software-aided content analysis of (i) Global innovation reports (ii) Corporate strategies (iii) Regional and Practice Group strategy documents (iv) Staff interviews	• Software-aided content analysis of (i) Semistructured interviews with staff, development partners, and stakeholders (ii) Country-level data collected under evaluation questions 1 and 2	• Software-aided content analysis of (i) Evaluated and nonevaluated projects (ii) Semistructured interviews with staff, development partners, and stakeholders

Source: Independent Evaluation Group.

6.2 The evaluation will rely on the application of the principle of analytical generalization. It generalizes (to the extent possible) findings from case-based data collection (at intervention and country levels) to the broader portfolio (that is, interventions and countries with similar characteristics). A sampling approach will ensure the sampling of relevant diversity in the portfolio of DSEE interventions. Where findings hold under varying country or intervention conditions, generalizability of findings will be stronger.

6.3 The evaluation will select a sample of country case studies and undertake up to five deep-dive country case studies. The cases will be selected using four indicators. One indicator is the level of Bank Group intervention in the country. Case studies will be

selected with both high and low levels of Bank Group intervention to allow for adequate variation in portfolio size and diversity. The second indicator is based on the World Bank Group Regulatory Indicators for Sustainable Energy, which evaluate countries by their sustainable energy performance in three areas: electricity access, energy efficiency, and renewable energy. Countries will be selected with both high and low scores to allow for adequate variation in portfolio size and diversity. A third indicator is based on the level of industrialization in the country, as determined by the United Nations Industrial Performance Index. Countries will be selected with both high levels of industrialization and low levels of industrialization to allow for adequate variation in portfolio size and diversity. The final indicator will be country income level. Here, the case selection will prioritize lower-middle-income countries and low-income countries because they are the countries with the most significant challenges in meeting the SDGs 7, 8, and 13. Nevertheless, some upper-middle-income countries will be included for comparison purposes. The application of the four filters resulted in the identification of the 7-potential country case studies in table 6.2, out of which five cases will be selected. See appendix D for details.

Table 6.2. Sampled Case Study Countries

		Sampling Criteria			
No.	Country	World Bank and IFC intervention	RISE energy efficiency score (avg., 5 years)	Industrialization score (avg., 5 years)	Client country lending group
1	Egypt, Arab Rep.	High	Low	High	LMIC
2	Ghana	Low	Low	Low	LMIC
3	Morocco	Low	High	High	LMIC
4	India	High	High	High	UMIC
5	Indonesia	High	Low	Low	UMIC
6	Rwanda	High	Low	Low	LIC
7	Uzbekistan	Low	High	Low	LMIC

Source: Independent Evaluation Group.
Note: Industrialization score is based on United Nations' Industrial Performance Index. LIC = low-income country; LMIC = lower-middle-income country; RISE = Regulatory Indicators for Sustainable Energy; UMIC = upper-middle-income country.

6.4 In addition, a sampling approach will be pursued to study intervention-level cases. To support the generalizability of the evaluation's findings and to identify unique interventions and business models worthy of replication effects, a sampling approach will be undertaken for intervention-level case-based analysis in countries with high energy intensity level (for example, in Turkey, Mexico, and China). An intervention is defined as a package of activities that aim to achieve specific intermediate outcomes. An intervention could be a stand-alone program (for example, energy efficiency in buildings), a joint approach between the World Bank and IFC for a project, or a joint lending-advisory approach to address barriers to DSEE. Selection of interventions for a more in-depth analysis will be based among other things on the following criteria: (i)

volume in the identified portfolio, (ii) stakeholder demand and inputs from consultations, (iii) availability of evidence on outcome achievements, demonstration and replication effects, and (iv) representativeness (that is, interventions containing features that are similar to other current or future interventions in the portfolio): "typical case" purposive sampling. The evaluation will follow a nested approach to purposive sampling, that is, the intervention case studies will be selected from interventions in case study countries.

6.5 Bank Group effectiveness in achieving energy efficiency outcomes (evaluation question 1) will be studied by multiple methods. First, causal models will be developed to connect World Bank–IFC lending and nonlending interventions to the three outcomes: achieving end-use energy savings; supporting market transformation; and attaining and demonstrating multiple cobenefits of energy efficiency improvements. Portfolio review and analysis will be used to extract evidence (for example, from project completion reports, expanded supervision reports, and validation notes) on how World Bank–IFC interventions achieved key energy efficiency performance indicators. At the country and intervention levels, software-aided content analysis will be applied to country cases and to intervention cases. The case-based analysis is based on semistructured interviews with staff, development partners, and stakeholders and desk reviews of portfolio data, and it will focus on gathering evidence on achievement of the development objectives. Software-aided content analysis of these data will be used to discern patterns of causality across countries and across interventions.

6.6 The empirical analysis at the intervention level—also part of the assessment of effectiveness—will use geospatial data to assess whether Bank Group support has increased energy efficiency. Some energy projects may have been implemented in such a way that only some of the households in the project area benefited. The expected impact of these projects would differ between the households that benefited and those that did not. Using geospatial data to associate household location with energy-related outcomes, this analysis will estimate how effective selected Bank Group projects have been in increasing energy efficiency. Refer to appendix C for further detail on research questions and methods.

6.7 The coherence of Bank Group approaches (evaluation question 2) will be assessed using primarily software-aided content analysis comparing corporate strategies (at the global level) to evaluations (at the country and intervention levels). At the global portfolio level, portfolio review and analysis and software-aided content analysis of project and country documents will be conducted to gather evidence on World Bank–IFC coordination on intervention design and implementation. At the country and intervention levels, software-aided content analysis of evaluation and validation documents and of semistructured interviews with staff, development partners, and

stakeholders will be conducted to gather evidence on what worked and what did not, and the extent to which World Bank and IFC activities were consistent with corporate strategies and the activities of development partners in supporting energy efficiency improvements.

6.8 Untapped opportunities and mechanisms for the Bank Group to help clients realize their energy efficiency potential (evaluation question 3) will be assessed by comparing Bank Group work at the country and intervention levels with global innovations in energy efficiency. At the global portfolio level, software-aided content analysis of (i) reports on global innovations, (ii) corporate strategy documents, (iii) regional and Practice Group strategy documents, and (iv) staff interviews will be conducted to assess untapped opportunities and where mechanisms exist to scale up. At the country and intervention levels, software-aided content analysis of (i) country case studies, (ii) evaluated and nonevaluated projects, and (iii) semistructured interviews with staff, development partners, and stakeholders will be conducted to gather evidence on potential engagement gaps, constraints to scaling energy efficiency initiatives, risks, and opportunities.

6.9 The evaluation will use four main sources of data and information. First, it will use Bank Group data, documents and information in country strategy related documents (for example, Country Partnership Frameworks, Country Learning Reviews, Country Program Evaluations), projects (for example, Concept Notes, Project Appraisal Documents, Implementation Completion Reports, Project Performance Assessment Reports, Expanded Project Supervision Reports, Project Completion Reports, validation notes, review meeting minutes, IFC Anticipated Impact Measurement and Monitoring assessments), and knowledge products (for example, Systematic Country Diagnostics, Country Private Sector Diagnostics, Country Economic Updates, Public Expenditure and Financial Accountability reviews). Second, it will use data and information collected in internal and external stakeholder interviews. Third, it will use data on government initiatives, subsidies, local or regional energy efficiency standards, and risk perception of investors (industrial or commercial) from the ESMAP database and IEA documents at the country level for benchmarking purposes (for example, on level of outcome achievements) in case studies. Fourth, the evaluation will use household-level data, firm-level data, data on energy use, and project location from World Bank and IFC project documents and remote sensing, and geospatial data from external sources.

6.10 The evaluation will benefit from software-aided content analysis of qualitative data, including interviews and documents. The evaluation will use a specialized software program, NVivo, to structure a database according to major DSEE themes and subthemes (in line with the three evaluation questions: effectiveness, coherence, and innovation and untapped opportunities). Data recorded from document reviews and

interviews will be classified and coded under the main themes and subthemes. Triangulation and pattern analysis across interviews and between interviews and document review data will strengthen the internal and external validity of findings on specific evaluation questions and subquestions. NVivo analysis will allow for findings to be consolidated at the country level and across countries. The same can be done for types of interventions (for example, building retrofits, lighting, upgrade of equipment, and appliances), energy efficiency clusters (for example, industrial, residential, public infrastructure, and commercial) and types of measures (for example, on-lending through financial intermediaries, energy service companies, revolving funds, and guarantees). Finally, interview evidence will be consolidated around each of the three main evaluation questions: effectiveness, coordination, and innovation and untapped opportunities.

7. Evaluation Limitations and Mitigation

7.1 The proposed evaluation methodology faces several limitations. A general limitation of the case study approach is that the sample of countries or interventions to be studied may be biased and the application of the principle of analytical generalization may be limited. Poor quality or availability of data in some countries may limit the specificity and precision of the analysis, but it might also point out data issues that need to be addressed in the future. In addition, it may be difficult to find unambiguous benchmarks on some qualitative dimensions of DSEE (for example, behavioral change of end users).

7.2 The evaluation team may use online surveys and will conduct remote interviews that may be limited by response rates, stakeholder availability and priorities during the COVID-19 crisis. Due to the COVID-19 pandemic, all case study missions, field interviews, and consultations will be conducted remotely. The evaluation team will consider online surveys to gather quantitative and qualitative data. There may be challenges in ensuring comparative insights and lessons with sufficient external validity; the latter could be mitigated through careful selection of case studies, and consistent implementation of evaluation strategy.

8. Quality Assurance Process

8.1 The Approach Paper and evaluation will undergo standard IEG quality assurance processes, including internal IEG and Bank Group management review and external peer review. This evaluation will be peer-reviewed by experts on energy efficiency issues:

i. **Melanie Slade** is the senior manager, energy efficiency, IEA, Austria. This reviewer can provide global and emerging market perspectives and reflect on economic and financing barriers.

ii. **Barry Bredenkamp** is the general manager, South African National Energy Development Institute responsible for the energy efficiency, data and knowledge management, and corporate communications portfolios and was previously senior manager at Eskom, the national utility in South Africa.

iii. **Daniel Kammen** is a distinguished professor of energy, University of California, Berkeley, former adviser, Global Environment Facility, 2010–2011, World Bank's first chief technical specialist for renewable energy and energy efficiency, and former United States Department of State's science envoy.

iv. **Kofi Agyarko is** director of renewable energy, energy efficiency and climate change, Energy Commission, Ghana.

Marialisa Motta, IEG Financial, Private Sector, Infrastructure, and Sustainable Development manager, and José Carbajo, IEG Financial, Private Sector, and Sustainable Development director, will provide guidance and internal departmental quality assurance to the team.

9. Staffing and Resources

9.1 The evaluation team comprises of experts in various aspects of energy efficiency. This evaluation will be led by Raghavan Narayanan, senior evaluation officer, and co-led by Victoria Alexeeva, evaluation officer. The team will include as core team members Joy Butscher (evaluation officer), Onno Ruhl (adviser), Virginia Ziulu (data science specialist), Nikki Tan (research and portfolio analysis consultant), Hiro Kambe (research officer), Tao Tao (research and portfolio analysis consultant), Romayne Pereira (program assistant), Emelda Cudilla (program assistant), Maria Shkaratan (senior consultant, energy economist), Stratos Tavoulareas (senior consultant, energy and private sector specialist), Franz Loyola (econometrician), Aarre Laakso (senior consultant, editor), Amshika Amar (case study consultant), Nana Sika Ahiabor (case study consultant), and Wasiq Ismail (case study consultant). It may include additional IEG staff with expertise in specific areas (for example, DPFs and partnerships). The evaluation will benefit from advice and inputs from Jozef Vaessen (IEG methods adviser).

9.2 This evaluation will be shared with the Bank Group management for review in the third quarter of FY22 and submitted to the Committee on Development Effectiveness

in the third quarter FY22. The proposed budget of $810,000 includes $35,000 for outreach and dissemination.

10. Outreach and Learning

10.1 An evaluation outreach strategy will be designed for both internal and external audiences. In addition to the final report, an outreach plan will be developed in close collaboration with the IEG communications team. Key internal audience and stakeholders include Committee on Development Effectiveness, Bank Group management, and country economists and staff from the Energy and Extractives Global Practice and IFC industry groups (Infrastructure; Financial Institutions Group; Manufacturing, Agribusiness, and Services; and Disruptive Technologies and Funds). External audience include the development partners (for example, the IEA and the Organisation for Economic Co-operation and Development). Learning agenda will be supported through key engagements with operational staff.

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Appendix A. Review of World Bank, Trust Fund, and International Finance Corporation Advisory Services Portfolio Focused on Energy Efficiency

Portfolio Identification Methods

The energy efficiency portfolio was constructed by using a combination of the following approaches:

i. Energy, Extractive Industries, and Finance, Competitiveness, and Innovation Global Practices' documentation and monitoring reports
ii. Data extraction from business intelligence, iPortal and Energy Sector Management Assistance Program databases
iii. International Finance Corporation (IFC) ING, Manufacturing, Agribusiness, and Services, Financial Institutions Group, and climate advisory documentation and monitoring reports
iv. Product lines and keyword identification in IFC (for example, SEF, Global Environmental Facility, green buildings, Excellence in Design for Greater Efficiencies)
v. Independent Evaluation Group databases on related evaluations

Assumptions on Time Period and Staff Data Entry Issues

The evaluation period is from fiscal year (FY) 2011 to FY20. Energy efficiency projects that approved from FY11 is scoped in the energy efficiency evaluation portfolio. For IFC advisory services projects where the approval fiscal year is missing, if available, the earliest milestone is regarded as the approval fiscal year, otherwise left as missing.

Assumptions on Commitment Volumes and Expenditures Incurred on Advisory and Analytics Interventions

The commitment amount for World Bank advisory services and analytics is estimated by the Energy Global Practice portfolio review. For the IFC advisory services project, the commitment amount estimated using the total expenditures for the closed projects and IFC commitment for active projects. For World Bank lending projects, the commitment amount is estimated by the Energy GP portfolio review for components with energy efficiency, the disbursement rate is assumed to be 100 percent. For some IFC investment services projects, the commitment amount in the portfolio is different from the documented final value, to be cross-checked and corrected.

The finalized portfolio will be verified with World Bank and IFC management counterparts after the clearance of the Approach Paper.

Table A.1. Summary Table

	Total	
Institution and Service	**(no.)**	**Commitment or expense (US$, millions)**
IFC advisory services	117	71.11
IFC investment services	178	6,136.77
World Bank advisory services and analytics	60	280.7
World Bank lending	209	24,964.06
Total	564	31,452.64

Source:

Appendix B. Structured Literature Review on Energy Efficiency

Objective and Scope

The objective of this literature review is to provide the evaluation team some background information on studies that looked at energy efficiency as it relates to the following topics:

- Energy efficiency and behaviors, incentives, and knowledge
- Energy efficiency and country factors (for example, readiness)
- Energy efficiency and exogenous factors

The review will inform the team on the established links or relationship between energy efficiency and the development outcomes pursued by the World Bank Groupthrough the theory of change. The period covered in this exercise will be fiscal years 2011–20.

Search Strategy

The search strategy to identify studies on the mentioned topics will be done primarily through Google Scholar searches with the following keywords:

- "Energy Efficiency" and "Country Barriers"
- "Energy Efficiency" and "Consumer Demand"
- "Energy Efficiency" and "Innovation"

The main sources for the review would be peer-reviewed journals and would implement a backward citation tracking method. That is, the review would start by looking at the first 20 relevant articles from the search results and track the literature backward as they are cited in the materials. These studies should have the following characteristics:

- Must have abstracts focusing on the selected topics
- Must be published in peer-reviewed journals or cite studies from peer-reviewed journals
- Must have quantitative analysis/evidence or cite results from quantitative studies/evidence

The selected articles will be examined in detail and the review will further collect the citations found within. The information from these documents would be extracted through full-text reading and will be summarized in a final note.

Appendix C. Econometrics and Geospatial Analysis Proposed for Energy Efficiency Interventions

Objective: Provide empirical evidence on the effectiveness of World Bank Group engagement in the energy sector, focusing on demand-side approaches aimed at improving energy efficiency outcomes during the evaluation period.

Approach: The team will identify Bank Group projects whose expected impact differs across certain groups of households or firms in the respective client countries. Using existing survey data at the household and firm level and geospatial data (for grids), within-country quasi-counterfactual analysis will be performed using a difference-in-differences (DiD) framework. This approach will aim at identifying causal evidence on the effectiveness of the considered Bank Group interventions (subject to the econometric challenges arising from the observational nature of the underlying data) and focus on a small subset of Bank Group interventions in specific client countries.

Counterfactual Analysis (Difference-in-Differences) Using Household Survey and Geospatial Data

The team will identify Bank Group projects whose expected impact differs across certain groups of households in the respective client countries. In particular, this may be based on geographic aspects where projects were implemented in such a way that mainly only a known subset of locations benefited. Using geo-coded household survey data and geospatial data on energy-related outcomes as the outcome variables, this approach will allow the creation of treatment and control groups to estimate treatment effects based on a DiD approach. Specifically, the following outcome variables will be considered (depending on data availability):

- Energy intensity (grid level): Based on geospatial data (see appendix D.2 for details).
- Energy access/poverty (households) and energy access/reliability (firms): Research shows that there exist important links among energy access/poverty and energy efficiency (Alstone, Gershenson, and Kammen 2015). An advantage of focusing on energy poverty is that proxies of energy poverty can be constructed using standard survey items on household assets for which data are available for many developing countries, for example, using the Multidimensional Energy Poverty Index following Nussbaumer et al. (2011). Data from firm-level panel surveys (for example, the Enterprise surveys) containing information about access to electricity and frequency or cost of outages may be used to estimate the effects of interventions targeted at the private sector.

- Energy consumption (household level): For countries with available data on energy consumption from household surveys, for example, as described in Falchetta et al. (2019).

In addition, the creation of treatment and control groups based on other aspects than geographic locations will be considered, such as based on sector of occupation (for example, if interventions affected only households working in the agricultural sector). In each case, additional analyses will be performed to assess the empirical plausibility of the assumptions (for example, parallel trends) underlying the identification strategy. Alternative methods for estimating counterfactuals, such as propensity score matching approaches, will be considered where these appear to be suitable given the available data sources and structure.

Geospatial Analysis—Gridded Energy Intensity Estimation

Problem Setting

Energy efficiency improvements have increased steadily in recent years, thanks to concerted policy efforts in major economies. Rates of improvement in global primary energy intensity—defined as the percentage drop in global total primary energy supply per unit of gross domestic product—were more sustained in 2010–16 than they had been in 1990–2010. Global primary energy intensity was 5.1 megajoules per US dollar (2011 US dollar at purchasing power parity) in 2016, a 2.5 percent improvement from 2015, that was close to the Sustainable Development Goal (SDG) 7.3 target to achieve average annual energy intensity improvements of 2.6 percent (IEA et al. 2020). However, the improvements slowed down in 2017 and 2018, only reaching 1.7 percent and 1.2 percent improvements in energy intensity due to weaker energy efficiency policy implementation (IEA 2019). The International Energy Agency currently estimates that the energy intensity improvement of the annual average rate to 2030 is 2.4 percent, 0.3 percent below the SDG 7.3 target.[2]

Local actors play a critical role in implementing energy efficiency measures, but such an effort has not been well examined on a granular level. Local entities influence the achievements of national-level energy efficiency through a set of local initiatives, institutional settings, and leadership (Puppim de Oliveira 2009; Schreurs 2008). Indeed, in several countries, international and national policies are unfolded, and de facto implemented, at the subnational level (Puppim de Oliveira 2009). For example, the Vietnam Green Growth Strategy has set national targets and indicators to be achieved by 2020, including reducing energy intensity per unit of gross domestic product by 1.0–1.5 percent per year. The national government provided a clear mandate and ownership to 63 provinces to design their own respective Provincial

[2] Sustainable Development Goal 7: Data and Projections: Energy Intensity: https://www.iea.org/reports/sdg7-data-and-projections/energy-intensity

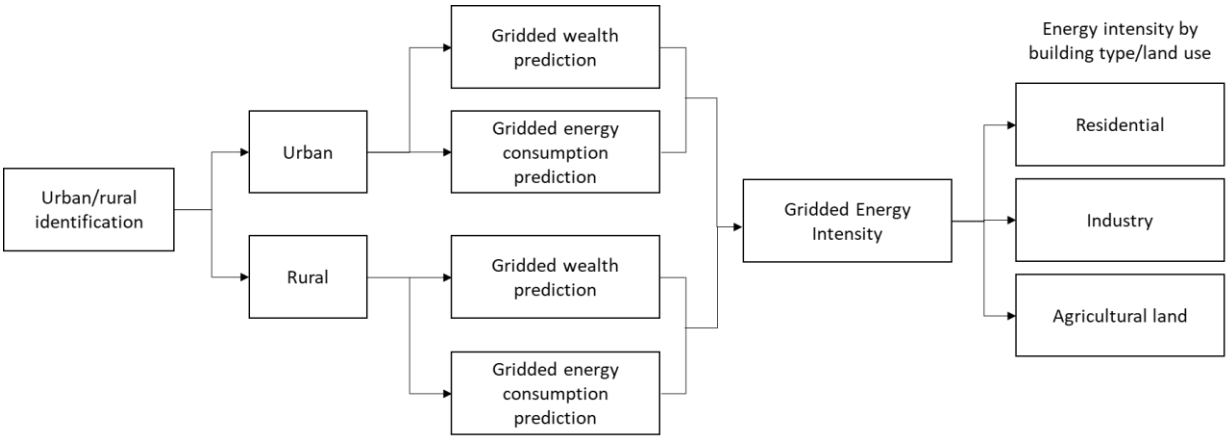
Green Growth Action Plans (LEDS-GP 2014). However, energy efficiency measured at the national level is an imperfect proxy for energy efficiency on a granular level (Belzer 2014). The heterogeneous implementation of energy efficiency measures at the local level needs to be disentangled from higher levels of aggregation to the local level.

Estimating subnational energy intensity would inform the effectiveness of energy efficiency projects at the subnational or household level. The estimation of the energy intensity is possible at the household level by applying several extrapolation methods, but it depends on the data availability and spatial resolution. It may also allow the evaluation to conduct an impact evaluation if a proper comparison group is identifiable.

Methods

This analysis estimates the gridded energy intensity at the local level in a country, and the indicators can be analyzed at a more granular level based on building type and land use. First, we distinguish between urban and rural areas to better estimate data at the local level. Next, we will predict gridded wealth and energy consumption. Wealth prediction will use the Demographic and Health Survey (DHS) wealth index as input data and analyzes its correlation with satellite images to predict a gridded wealth index at the local level. For energy consumption, the World Bank's Multi-Tier Framework (MTF) Survey for Measuring Energy Access or the Living Standards Measurement Study (LSMS) will be used as input training data, which will be referenced to the nighttime satellite images to predict gridded energy consumption. These analysis of wealth and energy consumption will apply the method of Convolutional Neural Networks (CNNs). Then, by taking the ratio of energy consumption to wealth, we obtain the gridded energy intensity. Computer vision techniques are then applied to classify street-level images into building types, such as residential and industrial. For this purpose, a 360-degree camera is deployed to capture the images. We also use global land cover data to identify agricultural land. Finally, the energy intensity of the building type and land use can be estimated. A diagram of the analysis is shown in **Error! Reference source not found.**, and the detailed methodology is described below.

Figure C.1. Analytical Diagram



Source:

1. Identification of urban and rural areas: since urban and rural areas have different patterns of wealth and energy consumption; we begin the following analysis by separating urban and rural areas. Urban and rural areas are dichotomously identified and categorized using Global Human Settlement Layer data.

2. Wealth prediction: The analysis will apply CNNs to predict the discrete values of wealth; CNNs are a common method for analyzing visual images, and by iteratively computing training data and values in the image, CNNs allow us to make predictions with a certain degree of accuracy about unknown data. In this analysis, we predict the gridded wealth index by gridding the geographic space (for example, 30 m^2) and analyzing the relationship between the input data of the DHS wealth index and satellite images using CNN.

3. Predicting energy consumption: Similarly, CNNs are applied to predict gridded energy consumption. The World Bank's MTF Survey for Measuring Energy Access or the LSMS will be used as input data. After gridding consumption data of MTF or LSMS, we predict the gridded energy consumption by computing the correlation between survey data and nighttime satellite images by using CNNs.

4. Estimate gridded energy intensity: Using the predicted wealth and energy consumption data, the analysis will calculate the ratio of energy consumption to wealth and estimate gridded energy intensity.

5. Identification of building types (by residential/industrial/public): Classify buildings by residential/industrial and estimate energy intensity for each building type. A 360-degree camera will be deployed to collect street-level images. Once the representative street images are captured, the team will apply a computer vision-based object detection algorithm (specifically the YOLO algorithm) to detect the type of buildings in the images. The building types identified in the images will be geo-referenced with gridded energy intensity data, allowing the team to analyze the energy intensity of each building type.

6. Identification of agricultural land: Since agricultural land is a significant contributor to rural energy consumption, agricultural land will be classified using MODIS (Moderate Resolution Imaging Spectroradiometer) land cover type data and geo-referenced to gridded energy intensity data.

Empirical Strategy

Gridded energy intensity data set can be prepared for different years and allow for estimation of changes in specific geographic areas of intervention before and after the project. Empirical strategies will be employed, such as spatial DiD and/or propensity score matching.

Limitations

Data: Estimates of energy intensity depend on the availability of energy consumption data from LSMS and DHS data. LSMS surveys of energy consumption data have recently been initiated (Falchetta et al. 2019); for example, in Africa, data are available for only three countries. They are Malawi (2016–17), Nigeria (2015–16), and Uganda (2013–14).

Spatial resolution: Nighttime satellite data are known to have only moderate spatial resolution. For example, the DMSP/OLS, commissioned by the US Air Force Department of Defense in 1992, has a spatial resolution of about 1x1 km. Also, VIIRS, launched by National Oceanic and Atmospheric Administration in 2011, has a spatial resolution of about 500 x 500 meters. The DHS and LSMS also randomize the geographic coordinates of the survey targets within a range of 7.65–10 km/pixel for anonymization purposes (Yeh et al. 2020). The required spatial resolution granularity depends on the research question of what level of aggregation of regional information is required.

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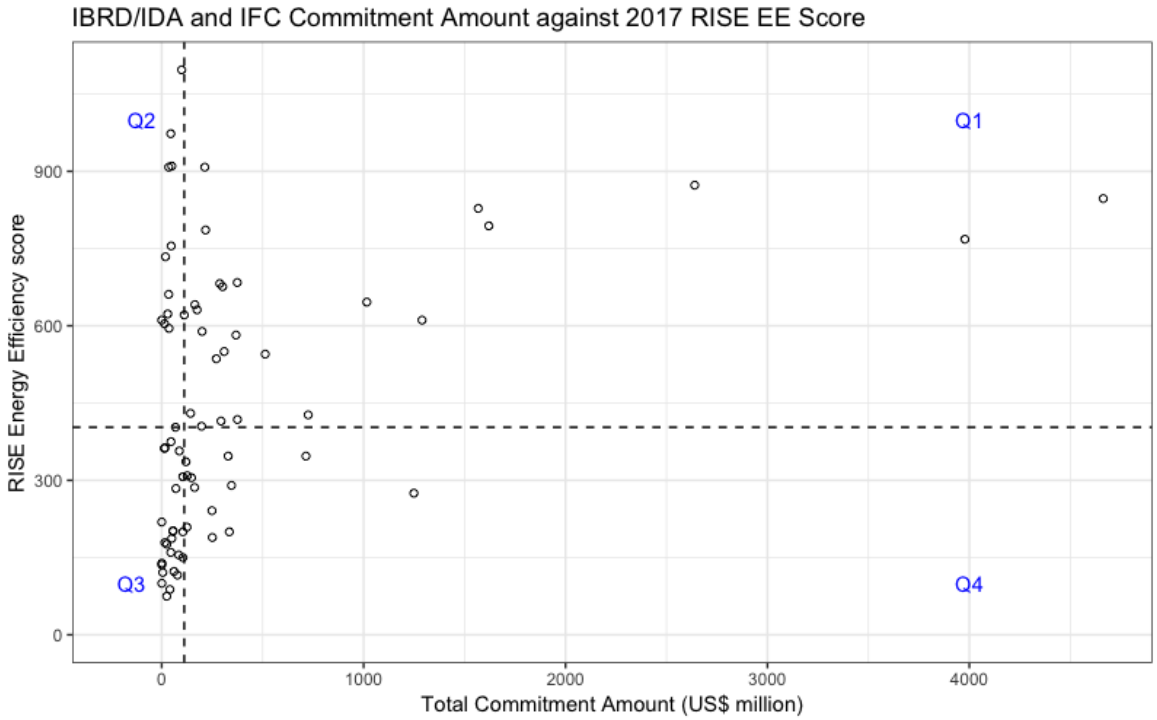
Appendix D. Selection Rationale of Case Studies

The World Bank Group created Regulatory Indicators for Sustainable Energy (RISE)to evaluate countries by their sustainable energy performance. RISE spans three areas: electricity access, energy efficiency, and renewable energy. By exploring the energy efficiency component of the RISE score surveyed in 2017, we can group countries into four following cases based on the RISE energy efficiency score and the amount of commitment of International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA) and International Finance Corporation (IFC) projects. The area of figure D.1 is divided into four smaller areas by the median of the total commitment on the x-axis and the median of the total RISE energy efficiency score on the y-axis (fragmented lines).

Figure D.1. Total Commitment Amount by Country against 2017 RISE Energy Efficiency Score.



Source: Independent Evaluation Group.
Note: The fragmented lines are the median values of each axis. The score of the energy efficiency component of RISE used in this report is calculated by taking the sum of the raw score of 13 subindicators (maximum is 1,300). These indicators are (1) national energy efficiency planning, (2) energy efficiency entities, (3) information provided to consumers about electricity usage, (4) energy efficiency incentives from electricity rate structures, (5) incentives and mandates: industrial and commercial end users, (6) incentives and mandates: public sector, (7) incentives and mandates: utilities, (8) financing mechanisms for energy efficiency, (9) minimum energy efficiency performance standards, (10) energy labeling systems, (11) building energy codes, (12) transport, and (13) carbon pricing and monitoring. RISE = Regulatory Indicators for Sustainable Energy

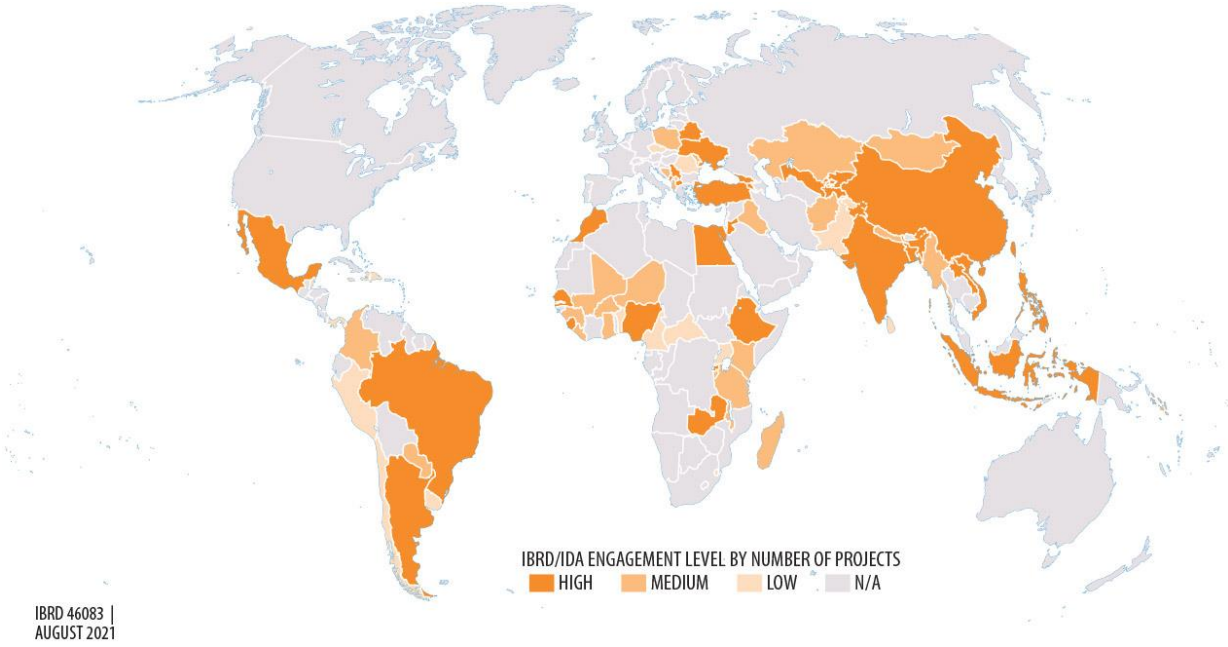
Figure D.2 present various ways of grouping energy efficiency portfolio and evaluates level of engagement[3] based on the number of interventions or the amount of commitment in each country and region. The projects included in this analysis are limited to projects that were approved between fiscal year (FY) 2011 and FY20. The amount of commitment is in US dollars where it is designated as $.

[3] The categorization of the level of engagement is done by calculating the tercile of the data based on a certain criterion, such as the number of projects or interventions and the commitment amount. If the criterion is discrete (for example, number of projects), a hard cutoff is implemented so that one value of the criterion is matched to a single category. If the criterion is continuous (for example, amount), a soft cutoff is implemented so it is possible that one value of the criterion may be in two different categories depending on the position of the data point on the distribution.

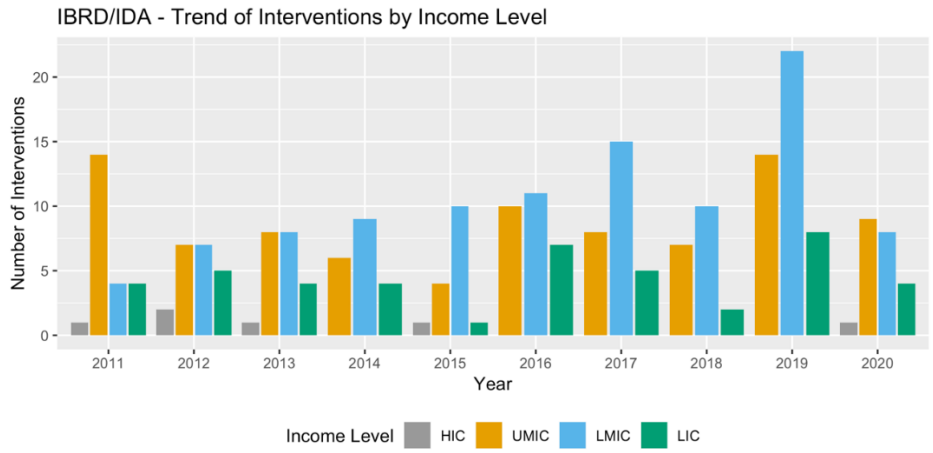
International Bank for Reconstruction and Development and International Development Association Projects

Figure D.2. IBRD and IDA Intervention Levels

a. By number of projects



b. Trend of interventions by country income level



Source:
Note: HIC = high-income country; LIC = low-income country; LMIC = lower-middle-income country; UMIC = upper-middle-income country.

The chart in figure D.2, panel b, shows a strong upward trend in the number of interventions in lower-middle-income countries (LMICs) between 2011 and 2019. Additionally, most of the projects are in industrialized or middle-income countries. Tables D.1–D.3 list the **top five**

countries with high IBRD/IDA level of engagement based on number of interventions in FY11–20, classified by income level. The income level classification is from FY20.

Table D.1. Low-Income Countries with Highest IBRD/IDA Engagement in Energy Efficiency

Ranking	Country	Income Level	Projects (no.)
1	Rwanda	LIC	5
2	Tajikistan	LIC	4
3	Ethiopia	LIC	3
4	Sierra Leone	LIC	3

Source:
Note: IBRD = International Bank for Reconstruction and Development; IDA = International Development Association; LIC = low-income country.

Table D.2. Lower-Middle-Income Countries with Highest IBRD/IDA Engagement in Energy Efficiency

Ranking	Country	Income Level	Projects (no.)
1	India	LMIC	13
2	Vietnam	LMIC	11
3	Ukraine	LMIC	8
4	Uzbekistan	LMIC	8
5	Indonesia	LMIC	7

Source:
Note: IBRD = International Bank for Reconstruction and Development; IDA = International Development Association; LMIC = lower-middle-income country.

Table D.3. Upper-Middle-Income Countries with Highest IBRD/IDA Engagement in Energy Efficiency

Ranking	Country	Income Level	Projects (no.)
1	China	UMIC	17
2	Armenia	UMIC	6
3	Mexico	UMIC	6

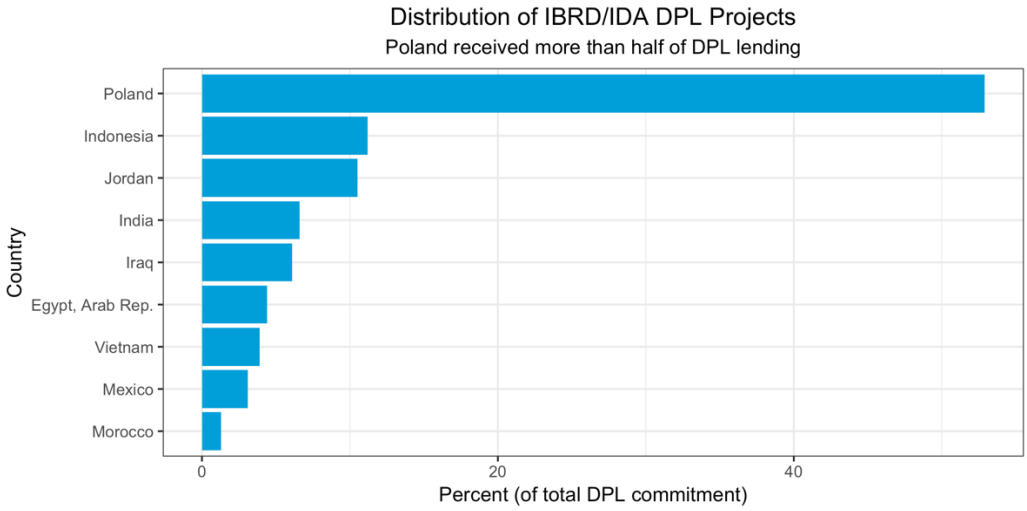
Ranking	Country	Income Level	Projects (no.)
4	Turkey	UMIC	6
5	Belarus	UMIC	4

Source:
Note: IBRD = International Bank for Reconstruction and Development; IDA = International Development Association; UMIC = upper-middle-income country.

IBRD Development Policy Loan Specifics

Figure D.3 shows all countries that have development policy load projects between FY11 and FY20. Poland has received approximately 52 percent of all development policy loan lending related to energy efficiency.

Figure D.3. Distribution of IBRD/IDA Development Policy Loan Projects

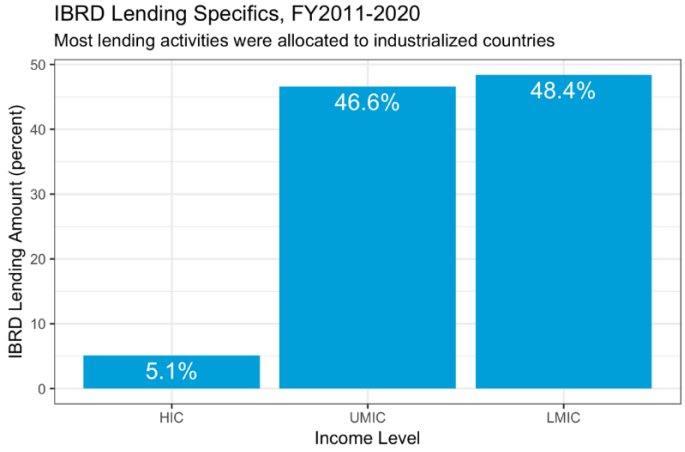


Source:
Note: DPL = development policy loan.

IBRD Lending Specifics

Middle-income countries, both LMICs and upper-middle-income countries (UMICs), received the largest shares of IBRD lending between 2011 and 2020 (figure D.4).

Figure D.4. IBRD Lending Specifics, FY11–20



Source:
Note: HIC = high-income country; LMIC = lower-middle-income country; UMIC = upper-middle-income country.

Tables D.4 and D.5 list the **top five** UMICs and LMICs with highest combined lending amount during the evaluation period respectively.

Table D.4. Upper-Middle-Income Countries with Highest IBRD Lending Amount in Energy Efficiency

Ranking	Country	Income Level	Commitment (US$, millions)
1	China	UMIC	4,174.2
2	Mexico	UMIC	1,274.65
3	Turkey	UMIC	1,014.9
4	Iraq	UMIC	283.1

Source:
Note: IBRD = International Bank for Reconstruction and Development; UMIC = upper-middle-income country.

Table D.5. Lower-Middle-Income Countries with Highest IBRD Lending Amount in Energy Efficiency

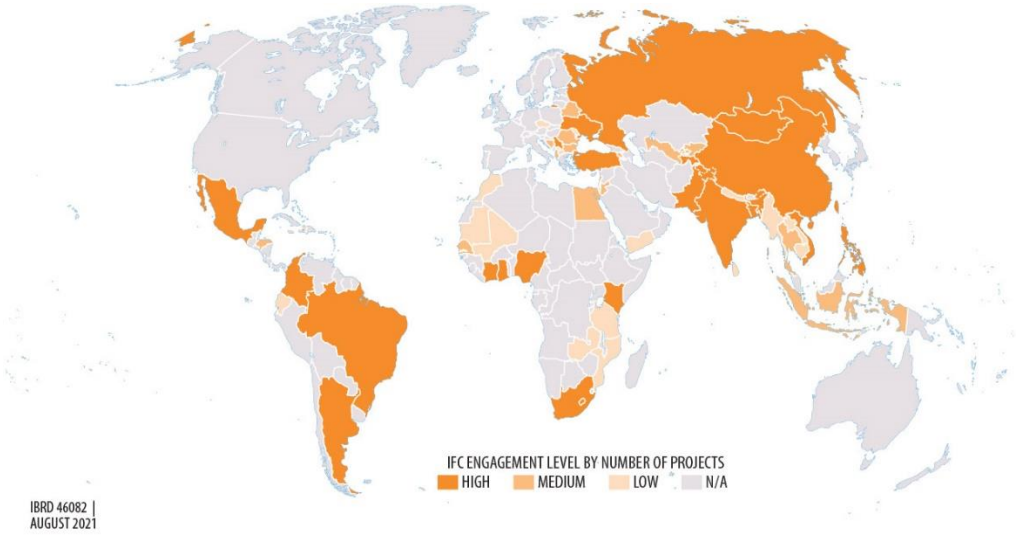
Ranking	Country	Income Level	Commitment ($, millions)
1	India	LMIC	3,457.73
2	Vietnam	LMIC	2,273.8
3	Indonesia	LMIC	1,217.63
4	Ukraine	LMIC	1,185.42
5	Philippines	LMIC	287.08

Source:
Note: IBRD = International Bank for Reconstruction and Development; LMIC = lower-middle-income country.

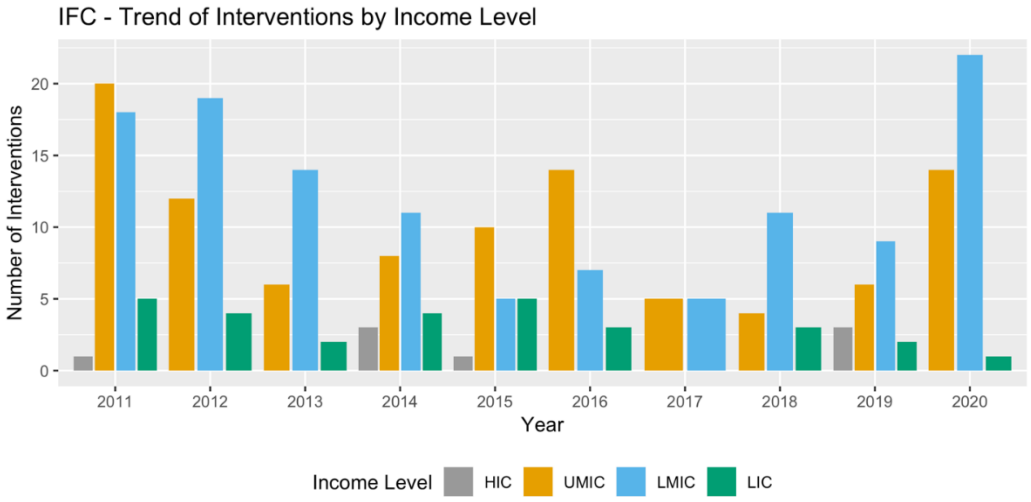
International Finance Corporation Projects

Figure D.5. IFC Engagement Level

a. By number of projects



b. Trend of interventions by income level



Source:
Note: HIC = high-income country; IFC = International Finance Corporation; LIC = low-income country; LMIC = lower-middle-income country; UMIC = upper-middle-income country.

There is no clear single direction pattern on IFC's projects; however, the majority of the projects were conducted in UMICs and LMICs (that is, industrialized countries according to the evaluation's definition) during the evaluation period. Next, we examine UMICs, LMICs, and low-income countries (LICs) that have the most IFC projects during this period.

The following tables list **top five countries** with high IFC level of engagement based on number of interventions in FY11–20, classified by income level. The income level classification is from FY20. Among the LICs, only Tajikistan is classified as high level of engagement with nine projects.

Table D.6. Lower-Middle-Income Countries with Highest IFC Engagement in Energy Efficiency

Ranking	Country	Income Level	Projects (no.)
1	India	LMIC	28
2	Mongolia	LMIC	10
3	Bangladesh	LMIC	9
4	Côte d'Ivoire	LMIC	9
5	Pakistan	LMIC	7

Source:
Note: IFC = International Finance Corporation; LMIC = lower-middle-income country.

Table D.7. Upper-Middle-Income Countries with Highest IFC Engagement in Energy Efficiency

Ranking	Country	Income Level	Projects (no.)
1	China	UMIC	17
2	Brazil	UMIC	16
3	Turkey	UMIC	14
4	Russian Federation	UMIC	12
5	Mexico	UMIC	8

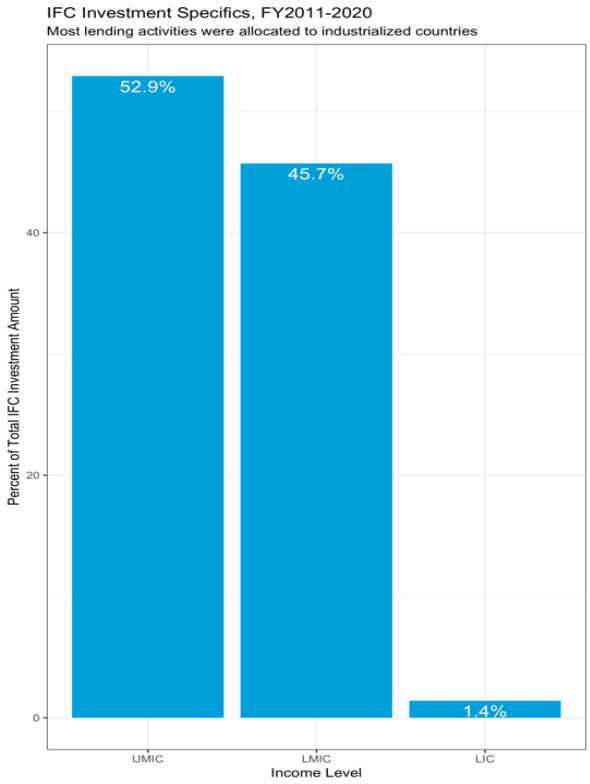
Source:
Note: IFC = International Finance Corporation; UMIC = upper-middle-income country.

IFC Investment and Advisory Specifics

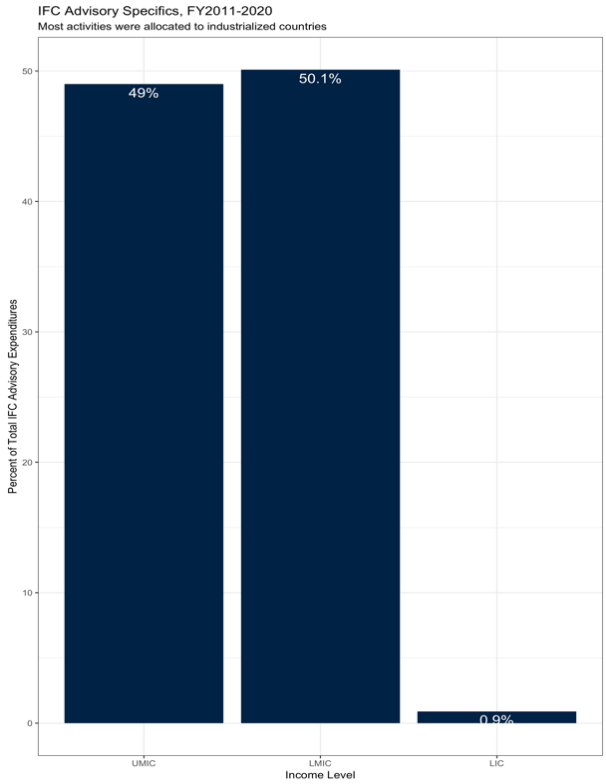
The breakdowns by income level paint a similar picture to IBRD lending specifics where most of the commitment amount were allocated to industrialized countries (UMICs and LMICs). On the investment side, the majority of the commitment was given to UMICs. On the advisory side, most of the expenditures were allocated for LMICs, but the difference is marginal (figure D.6).

Figure D.6. IFC Investment and Advisory Lending by Country Income Level

a. IFC investments, FY11–20



b. IFC advisory services, FY11–20



Source:
Note: IFC = International Finance Corporation; LIC = low-income country; LMIC = lower-middle-income country; UMIC = upper-middle-income country.

On investment side, tables D.8 and D.9 list the top five countries that received the most IFC investment commitment during the evaluation period.

Table D.8. Countries with Highest IFC Investment Amount in Energy Efficiency

	UMIC		LMIC	
Ranking	Country	Commitment ($, millions)	Country	Commitment ($, millions)
1	Turkey	605.34	Côte d'Ivoire	512.74
2	China	486.54	India	511.72
3	Russian Federation	371.66	Vietnam	363.75
4	Mexico	291.9	Bangladesh	178.25
5	Argentina	246	Nigeria	155

Source:
Note: IFC = International Finance Corporation; LMIC = lower-middle-income country; UMIC = upper-middle-income country.

On the advisory side, table D.9 shows the top five countries that received the most IFC advisory commitment during the evaluation period.

Table D.9. Countries with Highest IFC Advisory Commitment in Energy Efficiency

	UMIC		LMIC	
Ranking	Country	Commitment ($, millions)	Country	Commitment ($, millions)
1	Colombia	6.56	India	8.28
2	South Africa	4.32	Pakistan	4.38
3	Serbia	3.21	Vietnam	2.24
4	Russian Federation	2.63	Bangladesh	2.18
5	China	2.38	Indonesia	1.46

Source:
*Note:*LMIC = lower-middle-income country; UMIC = upper-middle-income country.

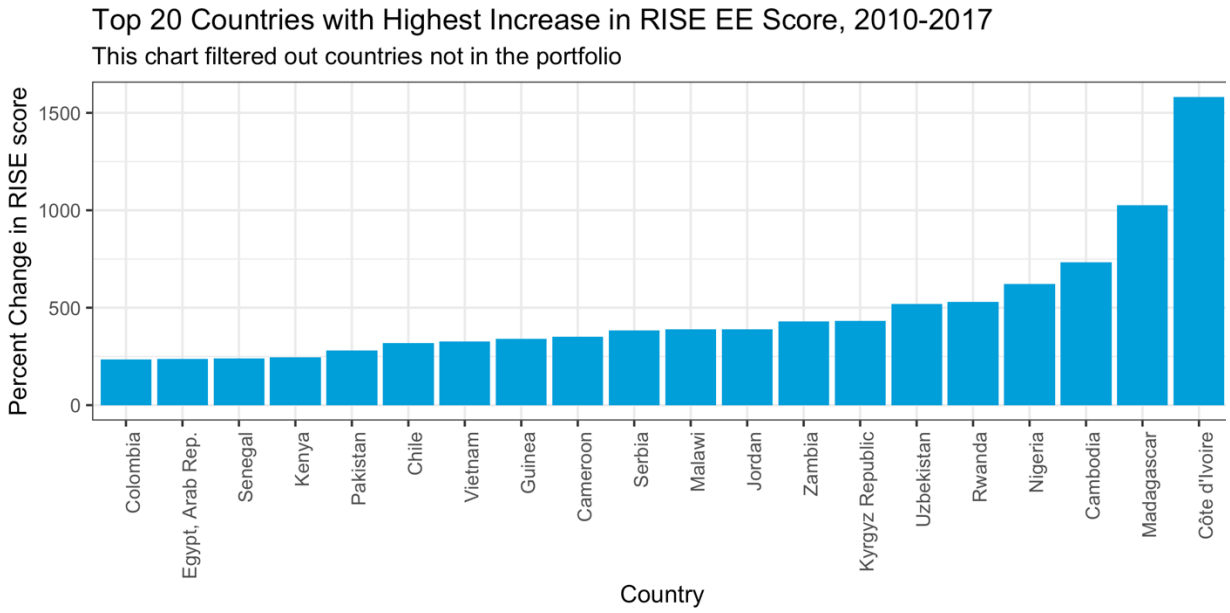
Energy Efficiency Partnerships (Global Environmental Facility and Clean Technology Fund)

Table D.10.

Ranking	Country	Commitment ($, millions)
1	China	1,132.94
2	Turkey	233.64
3	Colombia	190.9
4	Uzbekistan	4.5
5	China	1,132.94
6	Mexico	0
7	World Region	0

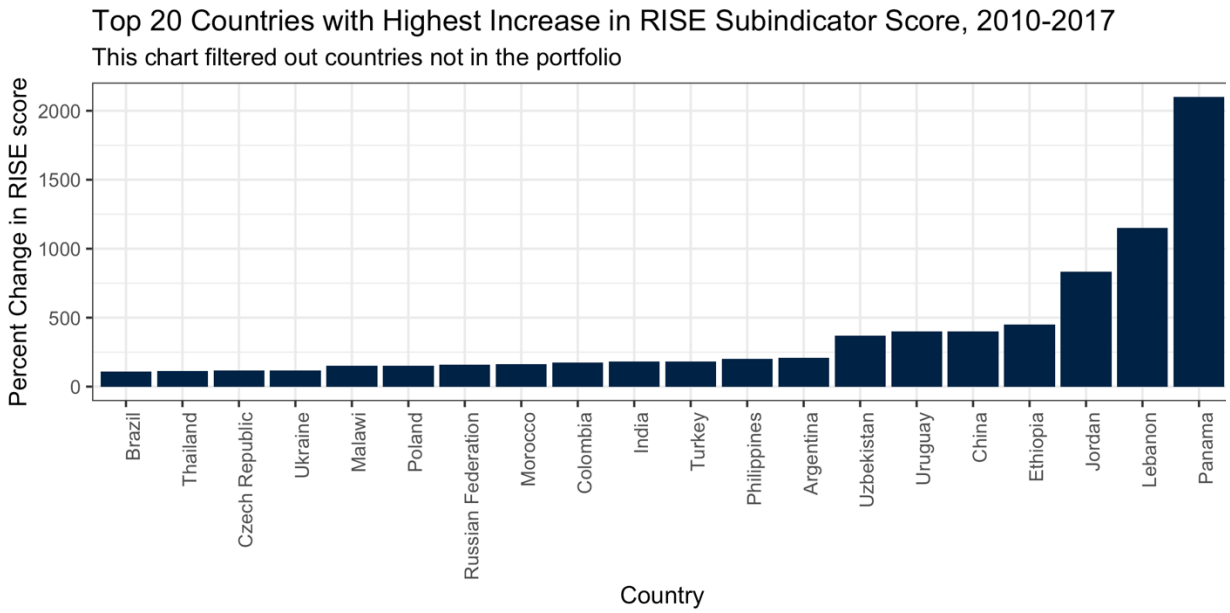
Historical Regulatory Indicators for Sustainable Energy Score 2010 – 2017

Figure D.7. Change in RISE Score between 2010 and 2017 (All indicators)



Source:
Note: RISE = Regulatory Indicators for Sustainable Energy.

Figure D.8. Change in RISE Score between 2010 and 2017 (3 subindicators)



Source:
Note: RISE = Regulatory Indicators for Sustainable Energy.