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PROJECT PERFORMANCE ASSESSMENT REPORT



ARMENIA

Energy Efficiency Project

Report No. 135626

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**PROJECT PERFORMANCE ASSESSMENT REPORT
ARMENIA
ENERGY EFFICIENCY PROJECT
(TF-12163)**

March 28, 2019

Financial, Private Sector, and Sustainable Development

Independent Evaluation Group

Abbreviations

ESCO	energy service company
EBRD	European Bank for Reconstruction and Development
ESA	energy service agreement
GEF	Global Environment Facility
GHG	greenhouse gas
ICR	Implementation Completion and Results Report
IEG	Independent Evaluation Group
KWh	kilowatt-hour
NEEAP	National Energy Efficiency Action Plan
NPV	net present value
PPAR	Project Performance Assessment Report
R2E2 Fund	Renewable Resources and Energy Efficiency Fund
UNDP	United Nations Development Programme

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This report was prepared by Victoria Alexeeva who assessed the project in November 2018. Vahe Odabashian and Artak Eloghlyan provided technical assistance as local consultants. The report was peer reviewed by Istvan Dobozi and panel reviewed by Christopher David Nelson. Romyne Pereira provided administrative support.

Preface

This Project Performance Assessment Report (PPAR) of the Independent Evaluation Group (IEG) of the World Bank Group evaluates the development effectiveness of the Energy Efficiency Project in Armenia (P116680). The project was selected for a PPAR to learn from an innovative pilot project that influenced the design and experience of other energy efficiency projects and interventions. Energy efficiency is of strategic importance for the World Bank given its role in supporting climate change mitigation, which is a major corporate priority.

The project development objective was to reduce energy consumption of social and other public facilities in Armenia and decrease greenhouse gas emissions through the removal of barriers to the implementation of energy efficiency investments in the public sector. The project was financed through a Global Environment Facility (GEF) grant and government funds totaling \$10.7 million. The project was implemented in 2012–16.

This PPAR presents its findings and conclusions based on a review of the World Bank’s project documentation, combined with a field mission to Yerevan, Armenia conducted jointly with the GEF’s Independent Evaluation Office (IEO) in November 2018. IEG and IEO conducted interviews with a range of different stakeholders linked to the project, including government officials, the implementing agency, World Bank staff, other development partners, academia, beneficiaries, and the private sector.

This report is a pilot effort to reform the structure of the PPAR. The pilot simplifies the main text by focusing on what worked and what did not, by covering other issues in the main text only if they were significant in this project, and by emphasizing the learning function of the report rather than project ratings. However, accountability elements are retained: project ratings and their justification are still present in appendix A, and these ratings are still based on the IEG-Operations Policy and Country Services harmonized project evaluation guidelines, based on assessment against project objectives.

The PPAR mission was conducted together with Anna Birgitta Viggh, GEF IEO senior evaluation officer. Artak Eloghlyan and Vahe Odabashian were local consultants who supported the mission in Armenia and provided technical assistance. The PPAR team is grateful to Sylvie K. Bossoutrot, country manager, and the World Bank Country Management Unit in Armenia for the IEG mission support. Emil Zalinyan provided invaluable technical inputs, and Irina Tevosyan assisted with the most efficient mission organization and logistics. The PPAR team appreciates the generous time and attention given by the government institutions and all concerned parties (see appendix H for a complete list of stakeholders who provided inputs for this project assessment).

Following standard IEG procedure, copies of the draft PPAR was shared with relevant government officials for their review and comment. All comments are included in appendix J of this report.

Summary

Project Background and Description

The project development objective was “To reduce energy consumption of social and other public facilities, and its global environmental objective was “To decrease greenhouse gas emissions through the removal of barriers to the implementation of energy efficiency investments in the public sector.” The project was appraised for \$10.7 million financed through a Global Environment Facility (GEF) grant of \$1.82 million, \$8.3 million from government funding, and cofinancing from the implementing agency, the Renewable Resources and Energy Efficiency (R2E2) Fund, estimated at \$0.54 million. The GEF-financed project was carried out in 2012–16.

This was a pilot project designed to demonstrate a replicable and sustainable model for energy efficiency investments in Armenia’s public sector. The project was to finance energy efficiency upgrades and retrofits in public and social facilities and remove barriers that hampered the wide penetration of energy efficiency investments in Armenia’s public sector. Through public sector energy efficiency investments, the project intended to demonstrate the viability of energy efficiency investments and their economic benefits. Technical assistance was geared to help remove the existing barriers to the realization of energy efficiency potential and create an enabling environment for energy efficiency in Armenia’s public sector. These interventions were to lead to reduced energy consumption in public and social facilities and a decrease in greenhouse gas (GHG) emissions in Armenia.

Results

The energy consumption of selected public and social facilities whose improvements were funded by the project was reduced significantly. The project financed energy efficiency retrofits and upgrades in eligible public and social buildings in Armenia. Sixty-three subprojects were completed at project closure, estimated to result in lifetime energy savings of about 540.2 million kilowatt-hours and CO₂ emission reduction of about 145,700 tons. The results were almost three times the original targets set at appraisal: 216 million kilowatt-hours and 50,500 tons equivalent of CO₂. The project invested in 124 public buildings, exceeding its target, though this represented only a small fraction of the overall needs. This was about 2 percent of more than 5,800 public buildings in Armenia, and according to the government’s National Energy Efficiency Action Plan (NEEAP-2), the

commercial and public service sector has recorded a steady increase of energy consumption since 2010.

The project contributed substantially to removing energy efficiency policy, informational, and knowledge barriers. The government adopted the second National Energy Efficiency Action Plan (NEEAP-2) after technical support under the project. Extensive support geared toward raising awareness helped address informational and knowledge barriers to energy efficiency development, in addition to crowding in other donor funds for energy efficiency investments. The GEF project served as a reference point and source of knowledge to initiate energy efficiency activities in the public and private sectors. All stakeholders interviewed during the evaluation mission acknowledged the R2E2 Fund's role in energy efficiency information initiatives and in raising awareness of potential energy efficiency economic and environmental benefits. The government adopted energy service agreements (ESAs) developed under the project as sample agreements for energy efficiency procurement (Decree No. 728N, dated 25 June 2015). This was an important legal milestone to enable public entities to implement energy efficiency retrofits under the project. However, ESAs cannot be applied after project closure as they were adopted only for the project's duration.

The project was not successful in addressing financing barriers that constrain the implementation of energy efficiency investments at scale in the public sector. The project introduced a new financing model for energy efficiency retrofits in public and social facilities based on a repayment scheme from energy savings. An energy saving agreement was developed to facilitate financing of energy efficiency investments in public and social buildings without public budget support. However, the model has not become sustainable because the barriers to financing were not removed. Under the project, the R2E2 Fund provided turnkey services (energy audit, procurement, detailed design, financing, construction, and monitoring) for energy efficiency upgrades in public buildings. It put significant effort into the capacity building of construction firms, introducing them to performance-based contracting, a new procurement concept, and measurement and verification of energy savings. Despite these efforts, the acquired capacity is largely contained within the fund, which cannot make large investments in energy efficiency in the public sector due to limited funds. Most important, the R2E2 Fund did not partner with a sizable number of commercial banks in a cofinancing mode. There was no spillover effect and continuity in the project's results and no development impact beyond the project interventions.

What Worked, and Why?

Several features in the project design and implementation facilitated successful operationalization of the new concept for energy efficiency financing in the public sector. The project was equipped from the start with necessary technical and financial data to target public buildings with the highest energy-saving potential. The R2E2 Fund did an extensive stocktaking exercise collecting the information on key technical parameters of buildings, energy consumption, and location to correctly identify the specific needs. The project effectively targeted public facilities with the highest potential for energy savings factoring both investment cost and energy savings. Unlike traditional procurement, which is based on the lowest cost, the R2E2 Fund used a net present value (NPV)–based procurement that specified minimum energy savings, but allowed bidders to propose their best technical solutions to maximize energy savings. Bidder selection was based on the highest NPV rather than the lowest cost.

In addition, project implementation benefited greatly from a semiautonomous, highly professional project implementation unit, the R2E2 Fund, which had considerable experience, capacity, and effective management. Many stakeholders identified the R2E2 Fund’s performance as a major driver of the successful implementation of subprojects because of its effective leadership and staff performance.

What Did Not Work, and Why?

The project design focused on facilitating the implementation of subprojects in the public sector and building energy efficiency capacity for a range of stakeholders, but it failed to identify the essential characteristics of a sustainable energy efficiency investment model. Energy specialists note that it is important for an energy efficiency revolving fund to model partnership agreements for financial institutions to involve them in cofinancing or partial credit guarantee arrangements. Because the model introduced by the project is not being replicated and taken up at scale, it represents a missed opportunity to leverage cofinancing from local commercial banks and other private financiers in support of a learning-by-doing approach to build sustained, market-based capacity to develop and finance energy efficiency projects.

To increase the demonstration effects and development impact of similar projects, the R2E2 Fund should have focused on promoting the energy efficiency agenda on a sustainable basis by partnering with different energy efficiency players. There was no concerted effort to

engage and build the capacity of a wider network of energy efficiency players outsourcing various functions to government entities, municipalities, financial institutions, and commercial entities. Besides subcontracting private companies for design and construction, no other entities had a role in the market, for example, identifying energy efficiency projects, preparing economic and financial appraisals, and conducting procurement. Greater efforts might have been necessary to partner with donor organizations. Given that there are numerous donors in Armenia with significant flows of grants and loans in energy efficiency, the R2E2 Fund might have been more active in securing additional financing to build a stronger capital base and ensure the flow of energy efficiency benefits in the public sector. This might have required a coordinated, donor-supported effort that the government should lead.

IEG project ratings are described in appendix A.

Lessons

- **Energy efficiency revolving funds can be market enablers by partnering with commercial and financial institutions, but there are few prospects for scale up and energy efficiency market transformation without the commitment of private businesses.** Ultimately, the domestic financial sector is the key source of sustainable energy efficiency finance. Piloting new models for energy efficiency service provision needs to create suitable local conditions and develop the capacity of commercial financiers through initial cofinancing and risk mitigation. The R2E2 Fund in Armenia did not make systematic efforts to work and partner with financial institutions and other commercial players in the implementation of energy efficiency subprojects. The approach of creating a model of energy services provision for which the R2E2 Fund is the main agent and construction companies are largely passive implementing subcontractors limits longer-term market impacts. In such a setting, the risks of continuity of energy-saving services become the risks of the continuity of the revolving fund itself.
- **Practical demonstration of the technical and financial feasibility of an innovative energy efficiency transaction program can only influence positive systemic change in the legal and regulatory framework if there is government commitment to the approach and long-term funding.** A new financing agreement was piloted under this GEF project to enable public entities to implement energy efficiency retrofits without affecting the budget of the subproject entities. As a result, public

organizations were able to enter into financing agreements that paid for the investment through future monetized energy savings. However, without sufficient government oversight and commitment to these approaches, the sustainability of the model is impossible. The government adopted ESAs as sample agreements for energy efficiency procurement only for the project's duration, and ESAs cannot be applied after the project closure. The project demonstrated the actual energy efficiency improvements have the capacity to repay the investment, but this requires legal support, access to capital and a system for the application of savings to future investment.

- **Appropriate legislation and regulation can provide incentives to undertake energy efficiency measures, but they are not sufficient without a strong government energy efficiency agency in place that is responsible for monitoring and enforcement.** The energy efficiency regulatory and legal framework has advanced significantly (attributable to the project in part), but enforcement and actual implementation are still lagging in several dimensions. Although the government enacted a new modality of energy efficiency delivery in the public sector that was operationalized successfully under the project, it has not followed up with measures to ensure a wider replication and scale-up. A market transformative policy function cannot be farmed out to a revolving fund or a public energy service company lacking authority. The government of Armenia has no effective institutional focal point for energy efficiency implementation support, though this is critical for the wider diffusion of the successful energy efficiency delivery mechanisms in the public sector. As a result, international donors largely set and implement Armenia's energy efficiency agenda.
- **The design of a pilot project needs to go beyond demonstration effects and lay the foundation for sustainable operations over time.** Although this energy efficiency project effectively targeted public facilities with the highest potential for energy savings, essentially harvesting low-hanging fruit, the broader project experience revealed that many public buildings in Armenia did not comply with the eligibility criteria. They are in a poor state of maintenance and repair that would require substantial investments in structural rehabilitation, not just energy efficiency retrofits. Energy cost savings alone supported by the project will not be sufficient to cover the required investments in these buildings unless supplemented by concessionary budgetary funds or grants. Instead of being developed as a direct

payment agent to finance the retrofits, the R2E2 Fund could have focused on enabling commercial financing by acting as an intermediary guarantee fund. As a guarantee fund, it could have fully de-risked principal payments to commercial banks on a rolling basis, thereby attracting commercial financing. However, because the R2E2 Fund made direct payments, it largely decapitalized itself without leveraging its initial funding to attract commercial financing.

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1. Project Background and Context

Sectoral and Institutional Context

1.1 Three key challenges were identified in the energy sector at the time of project appraisal in 2011: emerging power supply gap, threatened energy security, and increasingly unaffordable energy tariffs (World Bank 2012). Energy efficiency represented a large untapped energy resource to Armenia. The Readiness for Investment in Sustainable Energy survey conducted by the World Bank in 2013–14 scored Armenia’s energy efficiency at only 37 out of 100. A World Bank study found that Armenia could save about 5 percent of its gross domestic product by investing in energy efficiency and estimated that public sector investments had the highest return on investment overall (World Bank 2008). The report noted that energy efficiency potential was not being realized because of informational, financing, regulatory, and institutional barriers.

Energy Efficiency Policy, Legal and Regulatory Framework

1.2 The Armenian government prioritized the realization of economically viable energy efficiency potential as one way to solve key challenges in the energy sector. In 2004, the National Parliament passed the Law on Energy Savings and Renewable Energy, creating the legal basis for energy efficiency in Armenia. However, the law was largely declarative and had no provisions for mandatory energy efficiency measures or enforcement. In 2011, the law was amended to add the concept of energy labeling for equipment and clarifications about energy audits. In 2016, amendments and addendums were made to the law, which defined a number of mandatory requirements, such as energy efficiency requirements for buildings; energy balance requirement; labeling requirements for energy consuming devices; disposal requirement for life-threatening and environmental hazardous devices; and energy expertise requirement. The Law on Energy Saving and Renewable Energy was an important milestone that defined many concepts necessary for energy efficiency, serving as the basis to kick-start energy efficiency regulatory measures and as the genesis for an energy framework.

1.3 At the policy making and implementation levels, the most important documents at the time were the *National Program on Energy Efficiency and Renewable Energy of the Republic of Armenia* (2007) and the *Action Plan of the Government of Republic of Armenia Aimed at the Implementation of the National Program on Energy Efficiency and Renewable Energy of Republic of Armenia* (that is, the first phase of the National Energy Efficiency Action Plan (NEEAP-1), adopted in 2010). The system of codes and standards related to energy efficiency of buildings was already well developed at project appraisal.¹ However, the construction norms (though mandatory) were neither checked for compliance by the licensed entities nor enforced by the relevant government bodies,

while application of the standards was completely voluntary. There was also no definite policy in place for public procurement of energy efficient products. Article 13 of 2011 Amendment of the Republic of Armenia Law on Energy Saving and Renewable Energy referred to energy assessment of procured products and services to be implemented “in case if necessary.”

1.4 At the institutional level, there were capacity gaps in policy-making and regulatory bodies, and there was no dedicated energy efficiency agency in Armenia that could anchor and provide leadership on the implementation of energy programs by coordinating government policies in energy efficiency, serving as a clearinghouse for information on energy efficiency, and coordinating various donor-funded programs.

Energy Efficiency Financing

1.5 The government lacked sufficient resources for budget financing of energy efficiency investments in the public sector. Although the banking sector and capital markets were relatively developed in the country, local financial institutions were not lending for energy efficiency projects because of perceived high credit risks, high transaction costs, lack of experience with energy efficiency project finance, and lack of skills to prepare bankable energy efficiency investment projects. Awareness among financial institutions, private entities, public institutions, and energy consumers about the potential financial gains from energy efficiency investments was limited. Most importantly, there was limited borrowing capacity of public sector entities.

1.6 In the local energy efficiency service market, about 30 private firms provided engineering or consulting services for energy efficiency investments in Armenia. However, these firms did not participate as performance contractors or energy service companies (ESCOs) that specialize in energy efficiency project development and implementation and are considered an important market-based mechanism involved in the delivery of energy efficiency investments (World Bank 2008). ESCOs are broadly defined to include any company using energy performance contracting as part of energy efficiency investment transactions.² There are many benefits in using ESCOs to help scale up energy efficiency projects through offering specialized technical and financial services for project design and implementation (Hofer, Limaye, and Singh 2016); they are also dependent on access to finance from financial institutions because of their small capital base.

World Bank Group and Donor Support in Energy Efficiency

1.7 An extensive number of donor activities support energy efficiency in Armenia, and that number has increased over time. At project preparation, the World Bank Group had several operations in the energy sector,³ including a development policy loan, under

which the government adopted the Energy Efficiency Action Plan for 2010–13 that prioritized energy efficiency measures for various sectors. The International Finance Corporation supported the banking sector in developing energy efficiency lending and raising awareness on sustainable energy finance. The European Bank for Reconstruction and Development and the U.S. Agency for International Development (USAID) also supported the banking sector to increase the availability of bank financing for energy efficiency projects. The Global Environment Facility (GEF) administered by the United Nations Development Programme (UNDP) led the external support for policy improvements in the energy efficiency area, including energy efficiency in buildings, appliances, and equipment. It had a parallel project that was complementary in many aspects to the World Bank–implemented GEF energy efficiency project in technical support.

Project Design and Financing

1.8 The project development objective was “To reduce energy consumption of social and other public facilities” (GEF grant agreement dated April 20, 2012, page 7). The global environmental objective was “To decrease greenhouse gas emissions through the removal of barriers to the implementation of energy efficiency investments in the public sector” (World Bank 2012, 4).

1.9 Project preparation was originally initiated in April 2009 under the World Bank’s Electricity Supply Reliability and Energy Efficiency Project. In 2011, the project’s transmission component required more financing than originally budgeted; resources were reallocated from the energy efficiency component to make up for the shortfall, so the energy efficiency component was dropped. In late 2011, the government and the World Bank decided to implement the energy efficiency component as a stand-alone GEF project, with cofinancing from reflows from earlier World Bank investment projects with the implementing agency, the Renewable Resources and Energy Efficiency Fund (R2E2). The government established the R2E2 Fund in 2005 as a nonprofit organization with a mandate to promote the development of renewable energy and energy efficiency markets in Armenia, and to facilitate investments in these sectors.⁴

1.10 The project was financed through a GEF grant of \$1.82 million, \$8.3 million from government funding that consisted of repayments of the revolving funds under the two closed World Bank projects (Urban Heating Project and Renewable Energy Project), and cofinancing from the R2E2 Fund originating from service fees and interest under the proposed energy service agreements (ESAs) estimated at \$0.54 million.⁵ The project was appraised for \$10.66 million (table 1.1). The project implementation period was planned for about three years, from March 27, 2012 to June 30, 2015; the closing date was

subsequently extended for another year to June 30, 2016 because of a slower-than-expected start.

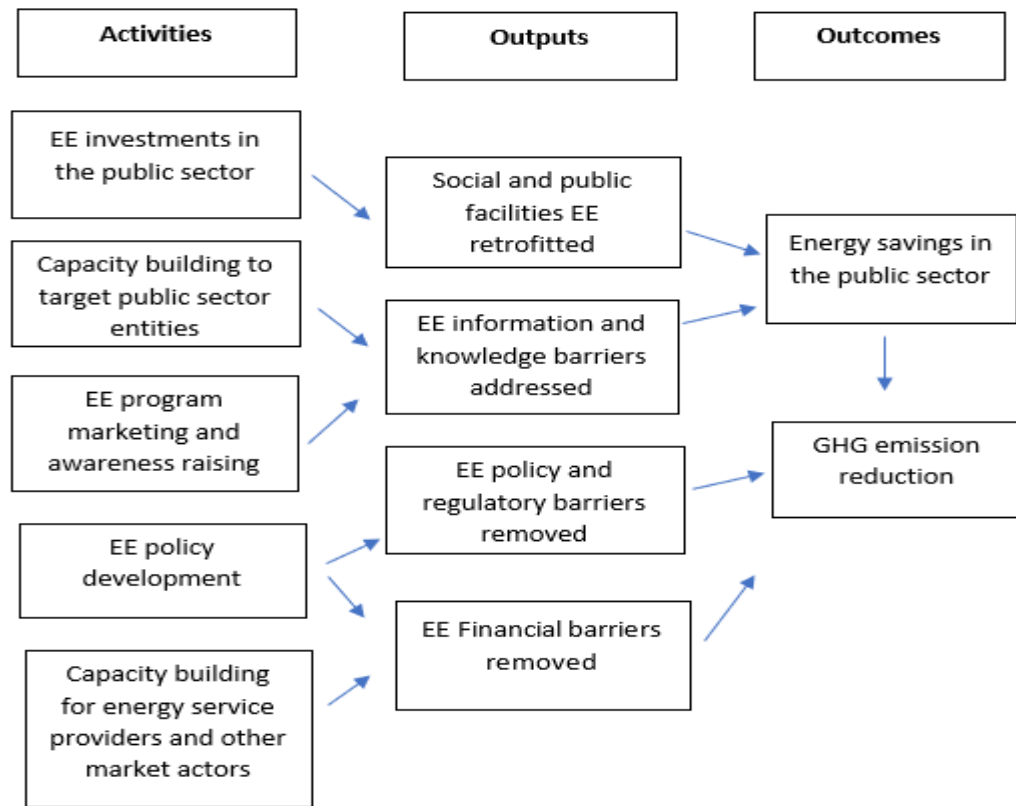
Table 1.1. Energy Efficiency Project Financing by Source and Component (\$, millions)

Components	Appraisal Estimate^a (2012)	Actual Cost^b (2016)	Percentage of Appraisal
Component 1: Energy efficiency investments	8.7	9.83	113
Component 2: Technical assistance	1.96	1.49	76
Total	10.66	11.32	106

Source: a. From World Bank 2012.b. World Bank 2016.

1.11 The project’s theory of change was premised on demonstrating replicable and sustainable models for energy efficiency service provision and related cobenefits. Through energy efficiency investments in public and social facilities, the project intended to demonstrate the viability of energy efficiency investments, thus building the demand for energy efficiency financing. Technical assistance was geared to help remove the existing barriers to the realization of energy efficiency potential and create an enabling environment for energy efficiency in the public sector. These interventions were to lead to reduced energy consumption by public and social facilities and decreased greenhouse gas (GHG) emissions (figure 1.1).

Figure 1.1. Energy Efficiency Project Theory of Change



Note: EE = energy efficiency; GHG = greenhouse gas emissions.

The project included two components:

- Component 1: Energy efficiency investments in public facilities—supported energy efficiency investments in social and other public facilities, for example, schools, kindergartens, hospitals, administrative buildings, and street lighting. The target facilities were selected from more than 5,000 public and social facilities in Armenia, for which the R2E2 Fund had collected information on key technical parameters of buildings, energy consumption, and location.
- Component 2: Technical assistance—supported (i) training and technical assistance to build the technical and financial capacity of the R2E2 Fund; (ii) program marketing and capacity building to target public sector entities to address energy efficiency information and knowledge gaps, build demand for financing, and improve the sustainability of energy savings; (iii) energy efficiency policy development; (iv) capacity building for energy service providers and other market actors to screen, design, appraise, finance, implement, and measure energy efficiency investments in the public sector; and (v) project management.

2. Results

2.1 **The energy consumption of selected public and social facilities whose improvements were funded by the project was reduced significantly.** The project financed energy efficiency retrofits and upgrades in eligible public buildings. Sixty-three subprojects were completed at project closure, estimated to result in lifetime energy savings of about 540.2 million kilowatt-hours and CO₂ emission reduction of about 145,700 tons. The results were almost three times the original targets set at appraisal: 216 million kilowatt hours and 50,500 tons equivalent of CO₂.⁶

2.2 **The project invested in 124 public buildings, exceeding its target, though this represented only a small fraction of the overall needs.** This was about 2 percent of the more than 5,800 public buildings in Armenia. According to NEEAP-2, the commercial and public service sector has recorded a steady increase in energy consumption since 2010. Project-financed facilities included schools and universities, hospitals and medical centers, penitentiary institutions, street lighting, kindergartens, and theaters. The project primarily financed insulation of walls, basements, and attics; repair or replacement of external doors and windows; window optimization; reflective surfacing of walls behind radiators; improvements or replacement of boilers and heating systems; and replacement of mercury vapor lamps with high-pressure sodium vapor lamps (or light-emitting diodes) and incandescent bulbs with compact fluorescent lamps.

2.3 **No energy efficiency subprojects were implemented after project closure, despite a vast potential for energy efficiency investments in buildings.** The R2E2 Fund did not make investments in energy efficiency retrofits in the public sector because of limited funds. Even though repayments from energy savings under subprojects were received in a timely manner, these were not sufficient to continue the same model of investments without additional flow of financial resources. The average payback period for subprojects was eight years,⁷ and the fund had about \$1 million of funds. No additional financing was secured from other sources, including the government or donors.

2.4 **The R2E2 Fund resorted to onlending to deal with the challenge to its own sustainability.** Toward the project closure, the fund started to explore opportunities to onlend its remaining capital through financial institutions at a higher interest rate. It reached agreements with one bank and two credit organizations to onlend to non-gasified communities and individuals to support energy efficiency solutions, including street lighting, insulation works for kindergartens and other community buildings, acquisition and installation of solar panels for water heaters, and photovoltaic stations in households (table 2.1).⁸ The disbursement of funds started at the end of 2017, 18 months

after the project. However, this is a temporary solution for the fund because its onlending operations raise questions in the context of the existing legislation, which allows lending operations only to licensed financial organizations.

Table 2.1. Energy Efficiency Onlending of R2E2 Fund and Estimated Energy Savings

Financial Institutions	Type of Projects	Beneficiaries	Annual Energy Savings (kWh)
ACBA-Credit Agricole Bank CJSC	Energy efficiency for communities	6 communities	549,170
ACBA Leasing CJSC	Energy efficiency for non-gasified communities	394 households and 1 LLC	n.a.
Global Credit UCO CJSC	Energy efficiency for non-gasified communities	509 households	2,612,200

Source: Renewable Resources and Energy Efficiency Fund, Armenia.

Note: kWh = kilowatt-hour; LLC = limited liability company; R2E2 Fund = Renewable Resources and Energy Efficiency Fund.

2.5 The project contribution to energy efficiency policy development in Armenia is notable. The R2E2 Fund completed an assessment of the implementation progress under the first National Energy Efficiency Action Plan (NEEAP-1), which described a set of programmatic and policy measures for energy efficiency improvement for all economic sectors of the country. It became the basis for developing and approving the second phase of the Republic of Armenia NEEAP-2 on February 2, 2017 (2017–18) that assessed the effectiveness of ongoing efforts by the government, donors, international financial institutions, and the private sector to improve the efficiency of energy use since 2010, when Armenia’s first NEEAP was developed.⁹ NEEAP-2 identified important barriers to accelerating the implementation of energy efficiency measures and proposed measures to help overcome them. It is one of Armenia’s most important documents in the energy efficiency field that sets the policy environment.

2.6 Extensive support geared toward raising awareness helped address informational and knowledge barriers to energy efficiency development. The GEF project served as a reference point and source of knowledge to initiate energy efficiency activities in the public and private sectors. All stakeholders interviewed during the evaluation mission acknowledged the R2E2 Fund’s role in energy efficiency information initiatives and raising awareness of energy efficiency cobenefits. Local officials, particularly the Municipality of Yerevan, confirmed their knowledge of the R2E2 Fund model of energy efficiency investments in the public sector that increased awareness of the economic potential for improving energy efficiency in municipal public buildings. Yerevan Municipality is initiating an energy efficiency project with financing from other donors (a loan from the European Investment Bank, grants from the Eastern Europe Energy Efficiency and Environment Partnership-E5P, and the Green Climate Fund

administered by the UNDP and GEF). This project will implement both seismic resilience strengthening (48 buildings) and energy efficiency measures (147 buildings) in public facilities of Yerevan, including kindergartens, and medical, cultural, and athletic buildings. The R2E2 Fund is also known for organizing workshops and an annual event (Energy Week) that brings together a wide range of stakeholders in the energy sector, including the government, the financial and private sectors, nongovernmental organizations, academia, and donors. The R2E2 Fund was incorporated in a Covenant of Mayors as a Supporter and is assisting the communities in preparation of Sustainable Energy Plan, and development of energy efficiency measures for community facilities.

2.7 The project attribution is unclear regarding the removal of regulatory barriers for the implementation of energy efficiency investments in the public sector. The government made changes to 13 provisions of the Law on Energy Savings and Renewable Energy during the project implementation period,¹⁰ but these resulted from the concerted effort of other energy efficiency players in Armenia, particularly the UNDP-GEF that provided support in equipment labeling, certification, and establishment of building codes, among others. The UNDP office in Armenia confirmed close collaboration with the R2E2 Fund in the technical area during project implementation. The government adopted ESAs developed under the project as sample agreements for energy efficiency procurement (Decree No. 728N, dated 25 June 2015). This was an important legal milestone to enable public entities to implement energy efficiency retrofits under the project. The legal adoption of ESAs opened the potential to be used in contracts that would pay for investment through future savings, however, ESAs could not be applied after the project closure.

2.8 The net present value (NPV)-based procurement approach developed under the project has not been adopted formally. The current Law of the Republic of Armenia on Procurement (adopted December 16, 2016, last amended March 23, 2018) includes provisions for “non-price” conditions and criteria (for example, stipulating minimum savings and maximum consumption) for the procured object (article 13), bidding (article 30), and selection of the winner (article 34). This means there are no legal barriers to use NPV (or any other method, for that matter) in public procurement. The Procurement Law specifies that a public facility itself should proceed with tender to select a company to perform energy service in its building. The R2E2 Fund can be selected by a public entity via tender to proceed with an NPV-based procurement, however it needs to be registered in the Anti-Monopole Committee as a unique fund to proceed with energy saving measures in the facilities. Alternatively, a new draft degree could facilitate this, and the fund prepared a draft decree in 2017, but no progress has been made. At the time, the R2E2 Fund is negotiating with the government to accelerate the approval process.

2.9 Capacity and training activities had a positive effect, but there was no scale-up in application of the acquired knowledge and skills for energy efficiency solutions in the public sector. The R2E2 Fund put significant effort into capacity building of construction firms, introducing them to performance-based contracting, a new procurement concept, and measurement and verification of energy savings. The R2E2 Fund developed its own internal capacity and technical skills to identify, assess, and implement energy efficiency projects. Under the project, the R2E2 Fund provided turnkey services (energy audit, procurement, detailed design, financing, construction and monitoring) for energy efficiency upgrades in public buildings. Project stakeholders praised its technical expertise, particularly energy auditing, as confirmed through the interviews. Despite these efforts and positive feedback, the acquired capacity is largely contained within the R2E2 Fund, which no longer invests in energy efficiency in the public sector because of lack of funds. The evaluation team found that none of the construction firms supported under the project developed specialized ESCO-type services similar to those carried out by the R2E2 Fund. Construction firms still search for tenders and opportunities to continue business as usual, though some expressed interest in this business model provided the availability of concessional financing and long-term funds.

2.10 The project piloted, tested, and demonstrated an innovative concept for financing of energy efficiency investments in the public sector, but these have not been replicated to date. The project built a demand for energy efficiency financing in the public sector,¹¹ but the model has not become sustainable. In practice, the R2E2 Fund acted as a public ESCO.¹² It was a self-contained entity that performed an ESCO-type function providing ESAs. Besides the subcontracting of private firms for design and construction, no other entities had a role in the market, for example, identifying projects, preparing financial appraisals, and conducting procurement. There was no concerted effort to engage and build the capacity of a wider net of energy efficiency players outsourcing various functions to government entities, municipalities, financial institutions, and commercial entities. Most important, the R2E2 Fund did not partner with a sizable number of commercial banks in a cofinancing mode. Therefore, there was no spillover effects and continuity, and no development impact beyond the project interventions.

3. What Worked, and Why?

Design and Preparation

3.1 This pilot initiative was built on extensive analytical work and experience in the sector. A technical analysis was performed for Energy Efficiency Armenia (2008),

which estimated that about 5 percent of the country's gross domestic product could be saved through energy efficiency investments, and investments in public facilities had the highest returns with paybacks of two to 10 years. A subproject pipeline was identified during project preparation. The R2E2 Fund did an extensive stocktaking exercise collecting the information on key technical parameters of buildings, energy consumption, and location (World Bank 2012). The fund built on the experience of working with the World Bank and the information and data collected under earlier operations in the public sector, including energy savings from the implementation of energy efficiency measures and financial viability of energy efficiency subprojects.¹³ This facilitated a solid basis for the project initiation.

3.2 The effective analysis correctly identified the specific needs. The project was well prepared and equipped from the start with necessary technical and financial data to target public buildings with the highest energy-saving potential. Financing of facilities was demand-driven, but subject to some basic screening criteria and secondary technical and financial eligibility criteria. The project put an effective monitoring and evaluation system in place to assess the impact of energy efficiency improvements. An energy-saving agreement was developed to facilitate financing of energy efficiency investments in public and social buildings without budget support to demonstrate a new financing model and the economic benefits of energy savings.¹⁴

Implementation and Supervision

3.3 Implementation benefited greatly from a semiautonomous, highly professional project implementation unit, the R2E2 Fund. The R2E2 Fund had considerable experience, capacity, and effective management. Many stakeholders identified the R2E2 Fund's performance as a major driver of the successful implementation of subprojects because of its effective leadership and staff performance. From its functions as a project implementation unit under the World Bank projects, the R2E2 Fund evolved into an established commercial service provider and is marketing its services, taking on repayment and performance risks, and charging fees during the project implementation. The dedicated leadership and strong staff performance helped the project to carry out energy efficiency investments effectively in the public sector.

3.4 Marketing efforts were essential for supporting effective implementation. The R2E2 Fund had to work around barriers that included a lack of incentives to implement energy efficiency projects, and a lack of capacity of public sector entities and design and construction firms. Potential clients were not interested in energy efficiency investments at the beginning of the project, or they preferred grant or budget support for energy efficiency. Implementation progress was very slow during the first 18 months, with delays in the finalization and signing of ESAs and setbacks on procurement—the first

five tenders failed, with one or fewer responsive bids (World Bank 2016). The R2E2 Fund intensified its public awareness campaign, including in focused marketing to target clients, lobbying through line ministries, and advertisements on television, radio, and other media outlets. With awareness increasing about energy efficiency and increased energy tariffs, the demand for energy efficiency investments grew once the initial subprojects were disseminated, accelerating the pace of implementation under the project.

3.5 Accurate targeting and the applied financial model facilitated the project achievement of its development objective of energy consumption reduction in public facilities. The selection criteria for public buildings and a choice of procurement method helped ensure the highest level of energy savings, thus maximizing financial returns under the project.¹⁵ The project effectively targeted buildings with the highest potential for energy savings, factoring both investment cost and energy savings. The application of an NPV-based procurement resulted in more savings per dollar invested and significant overachievement of the project targets. Unlike traditional procurement, which is based on the lowest cost, the R2E2 Fund used an NPV-based procurement that specified minimum energy savings but allowed bidders to propose their best technical solutions to maximize energy savings. Selection was based on the highest NPV rather than the lowest cost. All bids were required to meet or exceed the minimum energy savings level, which was about 30 percent. Overall, the project experience revealed that many public and social buildings in Armenia did not comply with the selection criteria and are in a poor state of maintenance and repair that would require substantial investments in rehabilitation and structural retrofits. Unless some budgetary funds or grants are offered, energy cost savings alone will not be sufficient to cover the required investments in these buildings. For example, of the 326 applications the R2E2 Fund received, 64 percent were rejected because they did not meet the eligibility criteria, mostly in relation to low-baseline energy use (that is, underheating).

4. What Didn't Work, and Why?

Design and Preparation

4.1 A shortcoming at project design was not factoring in cofinancing from financial or commercial entities. The project design focused on facilitating the implementation of subprojects in the public sector and building energy efficiency capacity for a range of stakeholders, but it failed to identify the essential characteristics of a sustainable energy efficiency investment model. Energy specialists note that it is important for an energy efficiency revolving fund to model partnership agreements for financial institutions to involve them in cofinancing or partial credit guarantee

arrangements, indicating that a minimum level (5–10 percent) of own financing by project sponsors is a good practice in energy efficiency funding. Given the legal constraints imposed on budget entities, the fund could have acted as a commercial banks' co-financing/guarantee partner. Financing could have been outsourced to a bank in a co-financing mode or a guarantee form if co-financing partners were not comfortable with the risk profile of the sub-projects or sub-project entities. Evidence from other countries suggests that ultimately, the local banking sector is the key source of sustainable and sizable flows of finance for energy efficiency in most countries. Because the model introduced by the project is not being replicated and taken up at scale, it becomes apparent that this was a missed opportunity to leverage cofinancing from local commercial banks and other private financiers in support of a learning-by-doing approach and for building a sustained market-based capacity to develop and finance energy efficiency projects. The project has not addressed a financing gap constraining the implementation of energy efficiency investments in the public sector at scale. The energy efficiency public sector niche remains the least developed in Armenia. Public buildings accounted for only 0.3 percent of energy efficiency investments channeled by international financial institutions for energy efficiency financing through local financial institutions in 2010–15.¹⁶

Implementation and Supervision

4.2 The project had only modest spillover effects beyond the works under the project, despite intensive engagement and capacity building of construction firms. The NPV-based procurement used under the project prompted construction companies to seek more modern and energy-effective design solutions and technologies, bringing the business-like mindset and sense of ownership to both beneficiaries and contractors. Many construction companies learned about opportunities in the field of energy efficiency, received trainings from the R2E2 Fund, and developed their capacities in procurement and monitoring of energy savings, but have remained classical construction companies. None of the companies that dealt with the R2E2 Fund's energy efficiency initiatives assumed ESCO-type activities similar to those performed by the fund. Based on the insights gained from interviews with the construction companies,¹⁷ the fund has not propagated the establishment of ESCO companies with relevant guidance and technical help on how to become ESCOs. The fund assumed all of the business risks, leaving bidders with only the task of proposing energy-saving solutions, completing the construction works, and ensuring energy savings.¹⁸ For increasing the demonstration effects and development impact of similar projects, the fund should have focused on promoting the energy efficiency agenda on a sustainable basis by partnering with different energy efficiency players instead of focusing on the fund's sustainability. Preparation of feasibility studies and implementation supervision could have been

outsourced to qualified engineering firms. Energy specialists agree that partnering on the identification, financial and economic appraisal, and implementation of the energy efficiency subprojects could have generated a broader market demonstration effect and emergence of independent players that could ensure sustainable and continuous energy efficiency services in the market.

4.3 Activities that sought to maximize energy savings did little to address building structural norms. The project applied the financial model using an NPV-based procurement program that maximized energy savings with minimum investment in public and social buildings. The emphasis was on energy efficiency retrofits and upgrades that could ensure high energy savings and returns on investment. The project design did not allow to include measures that would not ensure cost recovery. The NPV-based procurement developed and used during the project was widely acclaimed as a method that contributed to factoring in the future benefits of energy efficiency measures, prompting market players to seek and use more modern and effective energy efficiency solutions and technologies. Although NPV-based procurement could be more effective and efficient than the least-cost criteria traditionally used for public procurement that generally specify design, technical experts on the building codes raised concerns that this model that emphasized financial performance might make contractors attribute lower priority to meeting technical requirements of the energy efficiency-related codes and standards in the country. This particularly applies to the relatively new codes: the Republic of Armenia Construction Norms (building codes) RACN 24-01-2016 “Thermal Protection of Buildings” (Ministry of Urban Development Order No. 120-N of June 16, 2016) and RACN 22-03-2017 “Artificial and Natural Lighting” (Urban Development Committee Order No. 56-N of April 13, 2017). In the design, bidding, and implementation processes, construction firms might tend to focus on NPV and have little incentive to follow the energy efficiency codes strictly. The major issue that adds complexity is that the codes (norms) in Armenia, though mandatory, are not always enforced vigorously, especially relative to energy efficiency refurbishing of buildings versus new construction.

4.4 Greater efforts might have been needed to partner with financial institutions and donor organizations. Failure to include relevant activities and to plan for cofinancing from financial institutions in design does not preclude the project team from being flexible and proactive to explore these opportunities during the project implementation to ensure continuity of energy efficiency investments in the public sector. In addition, because there are numerous donors in Armenia with significant flows of grants and loans in energy efficiency, the R2E2 Fund might have been more active in securing additional financing to build a stronger capital base.¹⁹ Based on the feedback from various stakeholders and the mission’s own analysis, energy efficiency

donor efforts are not coordinated in Armenia, and there is competition for donor funding among academia, nongovernmental organizations, and financial institutions in Armenia—each is trying to highlight its own efforts and visibility in the energy field. The government of Armenia is supportive of developing the energy efficiency-enabling environment, but in the implementation of energy efficiency, it relies on significant funding from donors and international financial institutions.²⁰ There is no strong institutional focal point in Armenia to coordinate various donor-sponsored programs on energy efficiency to ensure a broader systemic impact. This might have required a coordinated, donor-supported effort that the government should lead.

5. Lessons

5.1 Energy efficiency revolving funds can be market enablers by partnering with commercial and financial institutions, but there are few prospects for scale up and energy efficiency market transformation without the commitment of private businesses. Ultimately, the domestic financial sector is the key source of sustainable energy efficiency finance. Piloting new models for energy efficiency service provision needs to create suitable local conditions and develop the capacity of commercial financiers through initial cofinancing and risk mitigation. The R2E2 Fund in Armenia did not make systematic efforts to work and partner with financial institutions and other commercial players in the implementation of energy efficiency subprojects. The approach of creating a model of energy services provision for which the R2E2 Fund is the main agent and construction companies are largely passive implementing subcontractors limits longer-term market impacts. In such a setting, the risks of continuity of energy-saving services become the risks of the continuity of the revolving fund itself.

5.2 Practical demonstration of the technical and financial feasibility of an innovative energy efficiency transaction program can only influence positive systemic change in the legal and regulatory framework if there is government commitment to the approach and long-term funding. A new financing agreement was piloted under this GEF project to enable public entities to implement energy efficiency retrofits without affecting the budget of the subproject entities. As a result, public organizations were able to enter into financing agreements that paid for the investment through future monetized energy savings. However, without sufficient government oversight and commitment to these approaches, the sustainability of the model is impossible. The government adopted ESAs as sample agreements for energy efficiency procurement only for the project's duration, and ESAs cannot be applied after project closure. The project demonstrated the actual energy efficiency improvements have the capacity to

repay the investment, but this requires legal support, access to capital and a system for the application of savings to future investment.

5.3 Appropriate legislation and regulation can provide incentives to undertake energy efficiency measures, but they are not sufficient without a strong government energy efficiency agency in place that is responsible for monitoring and enforcement.

The energy efficiency regulatory and legal framework has advanced significantly (attributable to the project in part), but enforcement and actual implementation are still lagging in several dimensions. Although the government enacted a new modality of energy efficiency delivery in the public sector that was operationalized successfully under the project, it has not followed up with measures to ensure a wider replication and scale-up. A market transformative policy function cannot be farmed out to a revolving fund or a public energy service company lacking authority. The government of Armenia has no effective institutional focal point for energy efficiency implementation support, though this is critical for the wider diffusion of the successful energy efficiency delivery mechanisms in the public sector. As a result, international donors largely set and implement Armenia's energy efficiency agenda.

5.4 The design of a pilot project needs to go beyond demonstration effects and lay the foundation for sustainable operations over time.

Although this energy efficiency project effectively targeted public facilities with the highest potential for energy savings, essentially harvesting low-hanging fruit, the broader project experience revealed that many public buildings in Armenia did not comply with the eligibility criteria. They are in a poor state of maintenance and repair that would require substantial investments in structural rehabilitation, not just energy efficiency retrofits. Energy cost savings alone supported by the project will not be sufficient to cover the required investments in these buildings unless supplemented by concessionary budgetary funds or grants. Instead of being developed as a direct payment agent to finance the retrofits, the R2E2 Fund could have focused on enabling commercial financing by acting as an intermediary guarantee fund. As a guarantee fund, it could have fully de-risked principal payments to commercial banks on a rolling basis, thereby attracting commercial financing. However, because the R2E2 Fund made direct payments, it largely decapitalized itself without leveraging its initial funding to attract commercial financing.

¹ The following construction norms (codes) were in place: RACN II-7.02-95 Construction Thermophysics of the Building Envelopes: Design Standards; CNM II-7.102-98 Construction Thermophysics of the Building Envelopes; RACN II-7.01-2011 Construction Climatology, CNM Construction of Settlements, Buildings, and Structures under Climatic Conditions of the Republic of Armenia; RACN IV-12.02.01-04 Heating, Ventilation, and Air Conditioning. There are many

energy efficiency standards relating to thermal insulation materials and elements in construction, including some that were approximated or harmonized with the European and ISO standards.

² Energy service companies (ESCOs) normally sign performance-based energy contracts, design the project, install the required equipment, track savings, and receive compensation in the form of materialized energy savings and respective financial savings. In some cases, ESCOs might structure their projects in a way that might transfer the burden of initial investment in required equipment and components to clients, and in other cases, they might finance the whole project. In any case, energy savings represent the main source of income for an ESCO (Taylor et al. 2008).

³ Operations in the sector included the following: Urban Heating Project, International Development Association–Global Environment Facility (GEF) Renewable Energy Project, GEF GeoFund 2: Geothermal Project, and Electricity Supply Reliability Project.

⁴ The Renewable Resources and Energy Efficiency Fund (R2E2 Fund) is governed by a board of trustees chaired by the Minister of Energy Infrastructures and Natural Resources, and includes Ministry of Finance, Ministry of Nature Protection, Urban Development Committee, Territorial Administration and Development, Central Bank of Armenia, and two nongovernmental organizations.

⁵ Under energy service agreements (ESAs), an energy efficiency revolving fund, ESCO, or other energy efficiency service provider offers a full package of services to identify, finance, implement, and monitor energy efficiency projects for clients. The client is usually required to pay all of their baseline energy bill or a portion of it to cover the investment cost and associated fees until the contract period ends. ESA payments can also be bundled with a client's energy bills (World Bank 2014).

⁶ This significant overachievement of the targets was a result of the application of a procurement based on net present value (NPV) under the project that maximized energy savings with minimum investments. The targets were based on conventional estimates at appraisal using the least-cost criteria traditionally applied in Armenia. The NPV-based procurement resulted in more savings per dollar invested. As the ICR (page 17) specifies, the focus was on repayable investments, and less funding was allocated to structural improvements.

⁷ R2E2 Fund project data.

⁸ The R2E2 Fund reached agreements with ACBA-Credit Agricole Bank CJSC, ACBA Leasing CJSC, and Global Credit Universal Credit Organization CJSC.

⁹ The progress analysis of the first National Energy Efficiency Action Plan (NEEAP-1) and development of the second plan (NEEAP-2) were delayed because of difficulties related to availability, completeness, consistency, and reliability of energy efficiency and energy-related data in the country. The lack of statistical data limiting the ability to properly assess the energy efficiency potential and set targets is cited in the implementation progress reports on NEEAP-1 and NEEAP-2. Despite the progress made in 2015–16 in enabling legislative amendments and practical arrangements made between the Ministry of Energy Infrastructures and Natural Resources and

the National Statistical Service of Armenia, there were still hindrances for the development of NEEAP-2 caused by lack of data or its reliability.

¹⁰ The changes included development of energy efficiency and renewable energy standardization documents, labeling of energy efficiency equipment, energy audit regulatory framework, renewable energy net metering, tariffs, and so on.

¹¹ The project received applications for project funding from 327 buildings, though 64 percent of the applications received in the first two years were deemed ineligible, mostly because of low baseline comfort or heating levels, thus requiring additional structural investments beyond energy efficiency interventions (World Bank 2016).

¹² A public ESCO is usually a government-owned company that provides financing and technical assistance for energy efficiency projects in the public sector, with repayments based on energy cost savings (Hofer, Limaye, and Singh 2016).

¹³ Energy audits conducted for eight public facilities and energy efficiency investments in 11 schools under the World Bank–financed Urban Heating Project confirmed the financial viability of energy efficiency investments and indicated the reduction of energy consumption by 30–40 percent.

¹⁴ For public clients, ESAs were not classified as debt, but rather long-term service contracts, thereby allowing financing of government entities that are typically not allowed to borrow and municipalities that may have already reached their debt limits or otherwise have borrowing restrictions.

¹⁵ The screening criteria included (i) confirmation of public ownership of facility; (ii) structural soundness of the facility (absence of major structural damages that may jeopardize integral stability of the building); (iii) absence of plans for closure, downsizing, or privatization of the facility; and (iv) comfort level of more than 50 percent (the comfort level ratio is defined as the actual energy consumption over the estimated energy consumption required to meet all heating and lighting national norms).

¹⁶ Most energy efficiency loans in 2010–15 totaling \$87.96 million were provided to the industry (more than 35 percent), about 22 percent to the electricity sector and power generation, and 18 percent to small and medium-size enterprises. Approximately 14 percent was invested in municipal infrastructure projects.

¹⁷ IEG met with 12 construction firms, or about half of the energy efficiency and renewable energy private companies that dealt with the R2E2 Fund.

¹⁸ The project introduced a performance-based approach, performing a commissioning test that was linked to the contractor payment. Payments were then made based on both milestones and performance. An indicative payment schedule was as follows: 10 percent advance payment, 10 percent after approved final design, 50 percent approved after delivery of project per design, 20 percent after a commissioning test to verify the actual energy savings (against the promised savings and NPV in the contractor bid), and 10 percent after a 12-month defects and liability period (to allow for performance monitoring over one full heating season).

¹⁹ These donors include the World Bank Group, the European Bank for Reconstruction and Development, United Nations Development Programme, European Union, European Investment Bank, AFD, U.S. Agency for International Development, KfW, Green Climate Fund, GEF, Eastern Europe Energy Efficiency and Environment Partnership.

²⁰ This is also evidenced in NEEAP-2 stating that significant additional funding necessary for the implementation of the energy efficiency investments will be required from donors and international financial institutions.

Appendix A. Project Ratings

	ICR	ICR Review	PPAR
Outcome	Highly satisfactory	Highly satisfactory	Moderately satisfactory
Risk to development outcome	Negligible	Modest	Substantial
Bank performance	Satisfactory	Satisfactory	Moderately satisfactory
Borrower performance	Satisfactory	Satisfactory	Moderately satisfactory

Note: The Implementation Completion and Results Report (ICR) is a self-evaluation by the responsible Global Practice. The ICR Review is an intermediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR. PPAR = Project Performance Assessment Report.

Relevance

Based on the overview provided in section 1, the relevance of objectives is rated **high**, and the design is rated **modest**.

Relevance of Objectives

The project development objectives were highly relevant to the challenges in Armenia’s energy sector and the government priorities (discussed in sections 2.1–2.4). The World Bank Group’s 2014–17 Country Partnership Strategy specifically mentioned the continuation of support to energy efficiency measures and reduction in the energy consumption of public buildings (World Bank 2013). The Bank Group’s Systematic Country Diagnostic discusses the priority to scale up the development of energy efficiency measures and states that the government could consider scaling up existing successful models for financing public energy efficiency investments to include other social, public, and residential buildings (World Bank 2017).

The global environment objective was consistent with the Global Environment Facility’s (GEF) climate change focal area, particularly GEF Operational Program 5 (Energy Efficiency), and strategic programs under GEF-4: SP1 “Promoting Energy Efficiency Technologies and Practices in Appliances and Buildings.”

Relevance of Design

The links between outputs, outcomes, and the project development objectives were clear.

The project aimed to reduce energy consumption and decrease greenhouse gas (GHG) emissions through energy efficiency retrofits in public and social buildings. Technical assistance and capacity building were geared to remove barriers to the implementation of energy efficiency investments in the public sector, thus further decreasing GHG

emissions. However, the project design failed to factor in cofinancing from financial institutions or commercial entities. In retrospect, this reduced the chances for the project energy efficiency financing model to be replicated at scale. According to energy experts, a minimum level of own financing by project sponsors (5–10 percent) is a good practice in energy efficiency funding.

The relevance of design is rated **modest**.

Efficacy

The project development objective was “To reduce energy consumption of social and other public facilities” (GEF grant agreement dated April 20, 2012, page 7). The global environmental objective was “To decrease greenhouse gas emissions through the removal of barriers to the implementation of energy efficiency investments in the public sector” (World Bank 2012, 4).

Objective 1: Reduction in energy consumption of social and other public facilities

Outputs

- Cumulative investments in public facilities: target \$8.7 million, achieved \$10.2 million
- Number of public sector buildings commissioned: target 121,¹ achieved 124

Outcome

- The project achieved 250 percent of the original target for energy savings in retrofitted social and other public facilities. The original target was 216 million kilowatt hours saved, and the actual achievement was 540 million kilowatt hours saved. Original estimates were based on previous projects that used conventional procurement. Because the project used a net present value (NPV)–based procurement that maximized energy savings with a minimum level of investments, the results were significantly overachieved.
- The project achieved a reduction of 145,739 tons CO₂ equivalent, almost three times its target of 50,549 tons.

The achievement of objective 1 is rated **substantial**. Although the outcomes were significantly overachieved by project closure, the downgrade from high (as assessed in the ICR and IEG ICR Review) reflects the lack of sustainability of the project outcomes. The longer-term outcome failed to illustrate the ongoing impact on reduction of energy consumption and related CO₂ emissions in the public sector. There was no continuity in

the project's outcomes, and no development impact beyond the project interventions (see section 2, Results).

Objective 2: Removal of barriers to the implementation of energy efficiency investments in the public sector

Outputs

- The analysis was conducted for the implementation progress of NEEAP 1 that became the basis for the Second National Program on Energy Savings and Renewable Energy (NEEAP 2), which the government adopted.
- The government adopted an energy services agreement (ESA) in 2015 that the Renewable Resources and Energy Efficiency Fund (R2E2 Fund) developed to facilitate the implementation of energy efficiency investments in the public sector.
- The project introduced an NPV-based procurement that was not mainstreamed in the national procurement.
- The R2E2 Fund organized a range of energy efficiency public awareness events, including workshops, conferences, seminars, and training for potential bidders and construction firms on procurement and the measurement and verification process. The most widely known is an annual Energy Week conference led by the R2E2 Fund that brings together a wide range of stakeholders in the energy sector and energy efficiency.

Outcome

The R2E2 Fund contributed substantially to removing policy, informational, and knowledge barriers to energy efficiency implementation. The government adopted a sample agreement for energy efficiency investments, but it has not yet been used in practice. The legal adoption of ESAs opened the potential to be used in contracts that pay for investment through future savings; however, this measure on its own has not been able to institute an environment in which investment is under way in Armenia's public sector. The project failed to address financing barriers that constrain the implementation of energy efficiency investments at scale in the public sector. Piloting new models for energy efficiency service provision needed to create local conditions and develop the capacity of financial entities through cofinancing and risk mitigation that could ensure their sustainability. The project did not sufficiently address the barriers to the implementation of energy efficiency investments in Armenia's public sector that could facilitate the continued flow of energy savings (see section 2, Results).

The achievement of objective 2 is rated **modest**.

Efficiency

Economic and Financial Analyses

At appraisal, a cost-benefit analysis was conducted for each type of public facility (hospital, school, kindergarten, municipality building, and street lighting) that might be financed under the project. Ex ante estimated economic internal rates of return (EIRRs) ranged from 31 percent for kindergartens to 77 percent for street lighting. The average payback period ranged from 2.5 years for municipality buildings to 3.8 years for hospitals. The main quantifiable economic benefit from energy efficiency investments in public facilities was the economic value of saved energy. Energy savings were valued at the estimated long-run marginal cost of electricity or gas supply, depending on the facility and the heating option used before implementation of energy efficiency measures. Other benefits, such as emission reduction, were not quantified.

The ex ante financial internal rates of return (FIRRs) ranged from 14 percent for hospitals and schools to 32 percent of municipality buildings. Energy bill reduction was the main estimated benefit, valued at then-current effective electricity and gas tariffs, depending on the type of facility and the heating option the facility used before energy efficiency investments. The estimated financial payback periods ranged from 4.2 to 7.7 years.

At closure, ex post EIRRs were estimated for 47 completed and commissioned subprojects. The payback period for all of these subprojects ranged from 2.6 to 8.8 years, and energy savings ranged from 27 percent to 80 percent, with an average of 50.9 percent. Because of the requirement for full repayment and NPV-based procurement, the investment cost required to achieve these savings was low at only about \$24.40 per square meter (in the buildings sector, about one-half the investment required for World Bank projects in other countries) and at an impressively low cost of only \$0.19 per kilowatt (for all subprojects). However, because of the relatively low grid emission factor in Armenia (0.234 kilograms CO₂ per kilowatt-hour) and baseline heating fuel (natural gas), the cost per ton of CO₂ emissions reduction was higher than in other projects (\$72.20 per ton CO₂), though the cost per ton of CO₂ for the GEF grant was lower at only \$29.80 per ton CO₂.

The ex post FIRRs ranged from 10 percent for schools to 38 percent for street lighting. Tariff increases during the project period and local currency devaluation by 26 percent affected FIRRs. The realized financial payback periods ranged from three to seven years.

Administrative and Operational Efficiency

In the early stage of project implementation, the uptake of subprojects was very slow because of a low demand for energy efficiency investments. This required a one-year extension of the project closing date to complete the planned activities.

Efficiency of the project is rated **substantial**.

Outcome

Relevance of objectives is rated **high**, and relevance of design is **modest**. The first objective of reducing energy consumption of social and other public facilities was substantially achieved. The outcome targets were significantly overachieved by project closure—the stated energy and GHG savings appear significant only in relation to the very modest original targets. However, the longer-term outcome failed to illustrate the ongoing impact on reduction of energy consumption and related CO₂ emissions in the public sector. The second objective of reducing barriers to the implementation of energy efficiency investments in the public sector was modestly achieved. A financing barrier to the implementation of energy efficiency investments in the public sector remains. There was no continuity in the project's outcomes and no development impact beyond the project interventions. Efficiency is rated **substantial**.

Overall, the outcome rating is **moderately satisfactory**.

Risk to Development Outcome

The energy savings from the investments in building retrofits are likely to be maintained. The fund receives 100 percent of financial returns from these investments. At the institutional level, at project closure the R2E2 Fund was expected to be sustainable at least over the following three to five years, even without additional capital because the R2E2 Fund could support investments of \$1.3 million to 1.5 million per year (according to the ICR). In fact, the fund is in a financial survival mode—additional donor support has not been secured, and there is no government support for energy efficiency financing. Onlending of the remaining capital of \$1 million was a survival response and could not be continued under the fund's legal status.

In addition, the government is restructuring the sector by liquidating project implementation units of various international organizations and transferring their functions to ministries. Therefore, the fund's future is highly uncertain because the government (which is completing the implementation of the World Bank projects) considers it a project implementation unit (based on the IEG interviews).

Risk to development outcome is rated **substantial**.

Bank Performance

Quality at Entry

The project was based on extensive analytical work and the World Bank's long-standing engagement in Armenia's energy sector. The implementing agency, the R2E2 Fund, had sufficient experience with implementation of World Bank projects.

This project was originally designed as an energy efficiency component of the 2009 Electricity Supply Reliability and Energy Efficiency Project. It was dropped from this project because of insufficient funds and later resurrected as a stand-alone GEF project with the concept of using resources in the R2E2 Fund that had accumulated as International Development Association loan repayments of earlier World Bank projects.

Overall, a significant shortcoming in the project design was not factoring in cofinancing from financial institutions, which lowered the project's chances for replication and scale up of energy efficiency investments in Armenia's public sector. In addition, the monitoring and evaluation (M&E) design had moderate weaknesses.

Quality at entry is rated **moderately satisfactory**.

Supervision

The World Bank team worked closely with the government and the R2E2 Fund in support of the energy efficiency project implementation and in training the staff in NPV evaluations and World Bank procurement methodology. It conducted periodic implementation support missions and provided operational advice and technical support when needed. The project complied with fiduciary and safeguard policies (ICR, page 23), and no related issues were raised during the IEG evaluation mission after project closure.

In retrospect, because the pilot for energy efficiency financing has not been replicated, the World Bank might have provided direction and support to the R2E2 Fund to ensure a broader energy efficiency impact by, for example, engaging and partnering with financial institutions and commercial entities to ensure sustainability of the energy efficiency financing agenda (see section 4).

Quality of supervision is rated **moderately satisfactory**.

The overall Bank performance rating is **moderately satisfactory**.

Borrower Performance

Government

The government of Armenia initially demonstrated strong commitment to the project during implementation by (i) pledging reflows from the investments of two closed World Bank projects as cofinancing to the GEF grant; (ii) supporting line ministries and other public facilities that participated in the project; and (iii) strengthening the energy efficiency regulatory and legal framework.

On balance, although the government supports the energy efficiency enabling environment, enforcement is lagging, and there is a lack of coordination of significant donor fund flows into energy efficiency without much development impact in energy efficiency in the public sector. The government has not provided support to the R2E2 Fund to ensure scale up and continuation of the energy efficiency financing model in the public sector, which is the only existing program currently in Armenia for these types of investments. Thus, there is a lack of government commitment in investing in energy efficiency in the public sector and supporting the mechanisms to facilitate such investments. In addition, the fund's director under the project was replaced, and there was no further continuity in the appointment of directors, who changed three times within two years after project closure.

The government performance rating is **moderately satisfactory**.

Implementing Agency

The R2E2 Fund has motivated and professionally competent personnel under strong and effective leadership who implemented the project and introduced several innovations to facilitate the energy efficiency implementation in the public sector. These innovations include (i) the introduction and implementation of ESAs, (ii) the use of NPV-based procurement in an industry accustomed to least-cost procurement, (iii) introduction of repayment obligations among clients accustomed to grant-based financing and ensuring full and timely repayment, and (iv) establishment of performance-based payments for contractors who were used to output-based payments. It also provided support to contractors to strengthen their capacity to implement their subprojects, maximize the project's NPV, and act in accordance with the World Bank's procurement guidelines. It provided support to the government for upgrading its institutional and regulatory framework. The R2E2 Fund also implemented aggressive marketing campaigns and an accelerated implementation timeframe, which enabled it to exceed the targeted indicators.

The R2E2 Fund has resorted to on-lending for energy efficiency projects after project closure. It is actively seeking to secure additional financing to continue its operation model and replenish the revolving fund.

Implementing agency performance is rated **satisfactory**.

Borrower performance rating is **moderately satisfactory**.

Quality of Monitoring and Evaluation

Design

Two outcome indicators were identified to measure the achievement of the project development objectives: (i) energy savings in selected buildings, and (ii) related CO₂ emission reduction. A third indicator, the introduction of regulations, legislative amendments, and guidelines to further promote energy efficiency, was considered intermediate and should have been upgraded to a primary outcome indicator because it would affect all expected energy efficiency investments after the project finishes.

The M&E design was highly simplistic and did not reflect the broad nature of activities planned under the technical assistance component. The types of barriers were not specified, and no clear outputs or targets were identified for the institutional outcomes. In addition, the targets of the outcome indicators were based on conventional procurement while the project intended to introduce a new NPV-based procurement.

Implementation

During project preparation and throughout implementation, the R2E2 Fund established its internal M&E capacity and systems for tracking subproject screening results, the pipeline of accepted subprojects, and the commitment and invested amounts for accepted projects.

In addition, the fund developed a measurement and verification system for proper baseline determination of energy consumption, investment repayments (under ESA), NPV assessments, and payments to contractors. The R2E2 Fund, beneficiary, and contractor all monitored subproject performance indicators (indoor temperature, lighting intensity, energy bills, and so on), which helped minimize disputes among the stakeholders. The R2E2 Fund also conducted a beneficiary survey at the end of the project to document social impacts and client satisfaction with the investments.²

Utilization

The R2E2 Fund used the M&E tracking system for reporting project progress and outcomes to the World Bank and the government, including the identification of

subproject delays, repayment progress, and defaults. At the completion of each subproject, the M&E tracking system was used to evaluate energy savings and CO₂ reductions.

The M&E quality is rated **modest** because of moderate weaknesses in the project M&E design.

¹ The Implementation Completion and Results Report and ICR Review indicate the target as 85, considering that several subprojects included multiple buildings.

² The focus of the Independent Evaluation Group (IEG) assessment was on transformational impact of the pilot project on the energy efficiency enabling environment and market. The assessment methodology did not include follow-up surveys with beneficiaries. During the IEG mission, there were two meetings held with the project's beneficiaries for the overall insights. The findings are not reported because they are not representative.

Appendix B. Project Data and Other Issues

Fiduciary and Safeguard Aspects

Financial Management

The Renewable Resources and Energy Efficiency Fund's semiannual interim financial reports were generally submitted on time and approved by the World Bank. Auditors issued unmodified (clean) opinions on the project's annual financial reports. The fund also complied with public disclosure requirement of the audited financial statements.

Procurement

There were no major procurement issues during implementation. Procurement was rated **satisfactory** in all of the Implementation Status Reports (ISRs) throughout the project. Reviews were conducted during the life of the project.

Environmental and Social Safeguards

The project was classified as an environmental category B at appraisal and triggered OP/BP 4.01 Environmental Assessment. An environmental management plan was developed during project preparation, as required, and site-specific plans were shared with the World Bank for approval and publicly disclosed for each individual investment. Stakeholders were given sufficient time and opportunity to share their comments on these plans.

The project retained a **satisfactory** rating on safeguards performance throughout its life. All agreements and permits required for specific works were obtained from the national authorities. Mitigation measures were confined to the proper handling of construction waste and adherence to workplace safety rules. Field supervision of works was performed regularly, and a good record on environmental monitoring outcomes was kept. No damage to the natural environment has been recorded. Streetlight bulbs containing mercury that were replaced with energy-efficient and nontoxic bulbs were sent to adequate municipal storage until relevant facilities for safe destruction or disposal of such waste becomes available in the country. Based on the information obtained during the Project Performance Assessment Report mission, they remain in the municipal storage.

Basic Project Information

Energy Efficiency Project (Global Environment Facility Grant TF12163)

Table B.1. Key Project Data

Financing	Appraisal Estimate (\$, millions)	Actual Estimate (\$, millions)	Actual as Percent of Appraisal Estimate
Total project costs	10.66	11.32	106
Loan amount	1.82	1.81	99.45

Table B.2. Cumulative Estimated and Actual Disbursements

Disbursements	FY12	FY13	FY14	FY15	FY16
Appraisal estimate (\$, millions)	0.30	0.70	1.20	1.70	1.82
Actual (\$, millions)	0	0.15	0.75	1.28	1.81
Actual as percent of appraisal	0	21.42	62.5	75.29	99.45

Table B.3. Project Dates

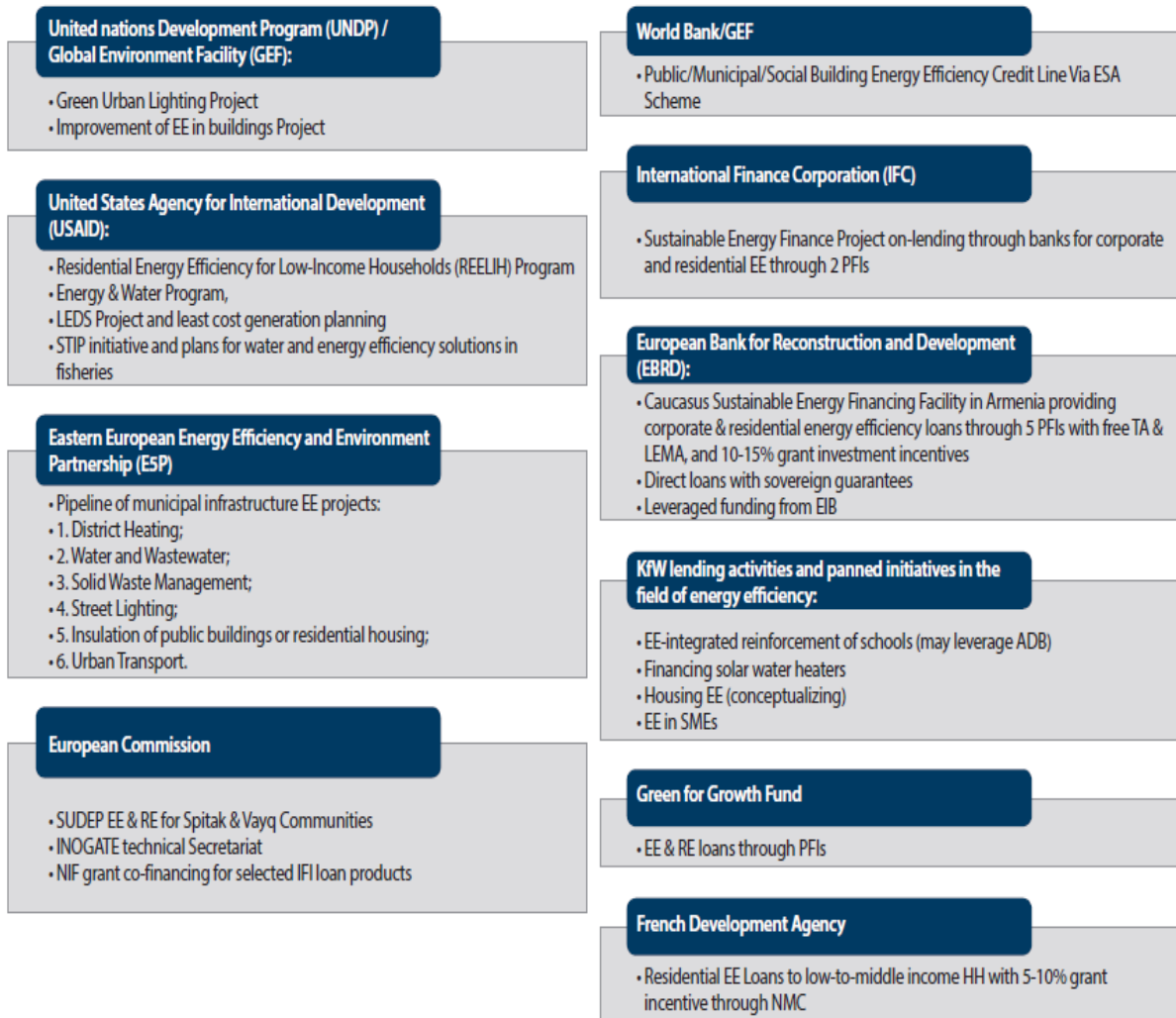
Event	Original	Actual
Concept review	n.a.	02/18/2010
Board approval	n.a.	03/27/2012
Signing	n.a.	04/20/2012
Effectiveness	n.a.	08/10/2012
Closing date	06/30/2015	06/30/2016

Appendix C. R2E2 Fund Energy Efficiency Investments, Financial Data, and Estimated Energy Savings

	Indicators	03/2012–06/2016	07/2016–07/2017	08/2017–10/2018
Process	Cumulative energy efficiency investments in social and other public buildings (\$)	10,197,863		
	Number of public buildings in Armenia	5,800		
	Public facilities retrofitted (number)	124		
	Applications for retrofitting of public buildings (number)	326		
	Number of construction companies contracted under the project	20		
Results	Cumulative energy savings over 20-year useful life of energy efficiency investments (kilowatt-hours)	540,240,000		
	Cumulative CO ₂ emission reduction over 20-year useful life of energy efficiency investments (tons of CO ₂ equivalent)	145,739		
Revolving fund	Cash flow from energy efficiency investments	550,147	855,028	1,473,770
	Repayments	98,495	113,158	126,280
	Complaints (number) ^a	0	0	0

Energy efficiency commercial financiers and financial institutions engaged after project closure	Total energy efficiency-related onlending through commercial banks (\$)			1,098,324
	ACBA-Credit Agricole Bank CJSC (\$)			222,880
	ACBA Leasing CJSC (\$)			347,033
	Global Credit UCO CJSC (\$)			528,411
	Cash flow from onlending to banks			31,713
Types of projects (description)	ACBA-Credit Agricole Bank CJSC			Energy efficiency for communities
	ACBA Leasing CJSC			Energy efficiency for non-gasified communities
	Global Credit UCO CJSC			Energy efficiency for non-gasified communities
Results reported by banks (energy savings, number, and types of beneficiaries)	ACBA-Credit Agricole Bank CJSC			6 communities
	Annual energy savings (kilowatt-hours)			549,170
	ACBA Leasing CJSC			394 households and 1 LLC
	Global Credit UCO CJSC			509 households
	Annual energy savings (kilowatt-hours)			2,612,200
<i>Note:</i>				
a. All issues arising during the bidding or construction process are resolved immediately.				

Appendix D. Overview of Main Donors and International Financial Institution Funds Available for Energy Efficiency in Armenia



Source: International Energy Charter 2017.

Appendix E. List of Existing Energy Efficiency Legal, Regulatory, and Normative-Technical Documents in Armenia

Table E.1. List of the legal, regulatory, and normative technical documents in the Republic of Armenia related to energy saving and energy efficiency of buildings (2018)

I. Legal Acts		
1.	AL-122-N, 09.11.2014	The Law of the RA on Energy Saving and Renewable Energy
2.	25.12.2014, 1504-N	Resolution of the Government of the Republic of Armenia on Implementation of Energy Saving and Energy Efficiency Improvement Measures in Facilities Constructed (Reconstructed, Renovated) under the State Funding
3.		A resolution on “Establishing technical regulations on energy saving and energy efficiency in new residential apartment buildings, as well as in facilities under construction (reconstructed) at the expense of state funds”, to come into force in October 2019.
II. Construction Norms (mandatory building codes)		
1.	RACN II-7.01-2011	Construction Climatology
2.	RACN 24-01-2016	Thermal Protection of the Buildings
3.	RACN 22-03-2017	Artificial and Natural Lighting
III. National Standards (voluntary standards, unless referred to in government-adopted technical regulations)		
1.	AST 240-2005	Energy saving; terms and definitions
2.	AST 246-2006	Energy conservation: Regulatory and procedural guidelines: Basic concepts
3.	AST 247-2006	Energy conservation, energy efficiency, composition of indicators, basic concepts
4.	AST 248-2006	Energy conservation. Energy consuming general industrial equipment. Types, groups, and indicators of energy efficiency; identification

5.	AST 249-2006	Energy conservation; assurance for energy consuming products energy efficiency indexes to their normative values. methods of verification. general requirements
6.	AST 250-2006	Energy conservation; informing the consumers about the energy efficiency of appliances and residential utility equipment; general requirements
7.	AST 254-2006	Energy conservation; energy certificate of the consumer of fuel and energy resources; basic rules; standard forms
8.	AST 255-2006	Energy conservation; methods of determining the economic effectiveness of the energy efficiency measures
9.	AST 256-2006	Energy conservation; secondary energy resources; terms and definitions
10.	AST ISO 16818-2008	Building environment design; energy efficiency; terminology
11.	AST 1434-1-2010	Heat meters, part 1: general requirements
12.	AST 1434-6-2010	Heat meters, part 6: installation, commissioning, operational monitoring and maintenance
13.	GOST EN 822-2011	Thermal insulating products for building applications: determination of length and width
14.	GOST EN 823-2011	Thermal insulating products for building applications: Determination of thickness
15.	GOST EN 824-2011	Thermal insulating products for building applications: determination of squareness
16.	GOST EN 825-2011	Thermal insulating products for building applications: determination of flatness
17.	GOST EN 826-2011	Thermal insulating products for building applications: determination of compression behavior
18.	GOST EN 1602-2011	Thermal insulating products for building applications: determination of the apparent density
19.	GOST EN 1604-2011	Thermal insulating products for building applications: determination of dimensional stability under specified temperature and humidity conditions

20.	GOST EN 1605-2011	Thermal insulating products for building applications: determination of deformation under specified compressive load and temperature conditions
21.	GOST EN 1606-2011	Thermal insulating products in building applications: determination of compressive creep
22.	GOST EN 1607-2011	Thermal insulating products for building applications: determination of tensile strength perpendicular to faces
23.	GOST EN 1608-2011	Thermal insulating products for building applications: determination of tensile strength parallel to faces
24.	GOST EN 1609-2011	Thermal insulating products for building applications: determination of short term water absorption by partial immersion
25.	GOST EN 12085-2011	Thermal insulating products for applications in building: determination of linear dimensions of test specimens
26.	GOST EN 12086-2011	Thermal insulating products in building applications: determination of water vapor transmission properties
27.	GOST EN 12087-2011	Thermal insulating products in building applications: determination of long term water absorption by immersion
28.	GOST EN 12088-2011	Thermal insulating products in building applications: determination of long-term moisture absorption by diffusion
29.	GOST EN 12089-2011	Thermal insulating products in building applications: determination of bending behavior
30.	GOST EN 12090-2011	Thermal insulating products in building applications: determination of shear behavior
31.	GOST EN 12091-2011	Thermal insulating products in building applications: determination of freeze-thaw resistance
32.	GOST EN 12430-2011	Thermal insulating products for building applications: determination of behavior under point load
33.	GOST EN 12431-2011	Thermal insulating products used in building for floating floors: determination of thickness

34.	GOST 31924-2011	Thick building materials and products of high and medium thermal resistance: determination of thermal resistance by means of guarded hot plate and heat flow meter
35.	AST EN 15217-2012	Energy performance of buildings: methods for expressing energy performance and for energy certification of buildings
36.	AST EN 15316-1-2012	Heating systems in buildings: method for calculation of system energy requirements and system efficiencies, part 1: general provisions
37.	AST EN 15603-2012	Energy performance of buildings: overall energy use and definition of energy ratings
38.	AST ISO 23045-2012	Building environment design: guidelines to assess energy efficiency of new buildings
39.	GOST 32025-2012 (EN ISO 8497:1996)	Thermal insulation: determination of steady-state thermal transmission properties of thermal insulation for circular pipes
40.	AST 362-2013	Energy conservation: energy passport of the building. Basic rules. Standard form
41.	AST EN 15242-2014	Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration
42.	AST ISO 9251-2014	Thermal insulation - Heat transfer conditions and properties of materials – Vocabulary
43.	AST ISO 10211-2014	Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations
44.	AST ISO 13789-2014	Thermal performance of buildings - Transmission and ventilation heat transfer coefficients - Calculation method
45.	AST ISO 13790-2014	Energy performance of buildings - Calculation of energy use for space heating and cooling
46.	AST ISO 14683-2014	Thermal bridges in building construction - Linear thermal transmittance - Simplified methods and default values
47.	AST EN 15316-3-3-2015	Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - part 3-3: Domestic hot water systems, generation
48.	AST 371-2016	Methodology for performing energy audit in residential and public buildings

IV. Advisory Handbooks		
1.	06.11.2013 N343 Order of the Minister of Urban Development of the RA	Technical solutions for thermal insulation of envelopes of residential, public and industrial buildings in construction and reconstruction in the RA
2.	23.12.2013 N394 Order of the Minister of Urban Development of the RA	Catalogue of Replicable Energy Efficient Individual Residential Houses in Communities of the RA

Appendix F. Project Performance Assessment Report Overview

About This Report

The Independent Evaluation Group (IEG) assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the World Bank's self-evaluation process and to verify that the World Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20–25 percent of the World Bank's lending operations through fieldwork. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or World Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, interview World Bank staff and other donor agency staff both at headquarters and in local offices as appropriate, and apply other evaluative methods as needed.

Each PPAR is subject to technical peer review, internal IEG panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible World Bank Country Management Unit. The PPAR is also sent to the borrower for review. IEG incorporates both World Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the World Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEG Rating System for Public Sector Evaluations

IEG's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEG evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEG website: <http://ieg.worldbankgroup.org>).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current World Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, country assistance strategies, sector strategy papers, and operational policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared with alternatives. The efficiency dimension is not applied to development policy operations, which provide general budget support. *Possible ratings for outcome:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, highly unsatisfactory.

Risk to development outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for risk to development outcome:* high, significant, moderate, negligible to low, and not evaluable.

Bank performance: The extent to which services provided by the World Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan or credit closing, toward the achievement of development outcomes). The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Borrower performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for borrower performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Appendix G. Methods and Evidence

This evaluation is based on (i) interviews with project stakeholders in Yerevan, Armenia in November 2018, (ii) interviews with World Bank staff, (iii) a review of project documents, and (iv) a review of reports published by the World Bank or other development partners.

The Project Performance Assessment Report (PPAR) evaluation questions focus on the project's catalytic effect in addressing barriers to energy efficiency (energy efficiency) development in Armenia's public sector. This includes looking at demonstration effects and engagement of financial institutions and private companies, market transformation, and the effects on policy and legal and regulatory frameworks. These goals are implicit in the project, based on the project development objective used in the project appraisal document and the Implementation Completion and Results Report. The PPAR aims to determine the effectiveness and causes of the project in affecting the energy efficiency sector development.

Stakeholder interviews focused on generating lessons from the pilot project and on specific questions regarding the following: (i) the project implementation model, (ii) the reason for not continuing the project model, (iii) the project's effects on energy efficiency market development, (iv) the effects of capacity-building activities, (v) effects on energy efficiency awareness, and (vi) effects on energy efficiency policy development.

Project stakeholders included (i) national and local government representatives, (ii) Renewable Resources and Energy Efficiency Fund, (iii) nongovernmental organizations, (iv) financial institutions, (v) construction companies, (vi) academia, (vii) project beneficiaries (directors of public facilities), (viii) development partners in Armenia, and (ix) World Bank staff (see appendix H).

Appendix H. List of Persons Interviewed

Armenia Renewable Resources and Energy Efficiency Fund (R2E2)

Mr. Karen Asatryan, Director

Ms. Zaruhi Gharagyozyan, head of procurement group

Ms. Siranush Gorgyan, Financial Manager

Mr. Hrant Ter-Gabrielyan, Head of Engineering, technical group

Former Directors of R2E2 Fund

Ms. Tamara Babayan, Sustainable Energy Practice Lead, Energy Saving Foundation

Mr. Armen Melkikyan, Country Director for Armenia, Eurasian Development Bank

Ministry of Energy Infrastructures and Natural Resources

Mr. Vahagn Atayan, Head of Energy Efficiency and Technical Normative Division

Urban Development Committee

Ms. Tanya Arzumanyan, Head of the Housing Stock Management and Communal Infrastructures Department

Ms. Yevgenya Atayan, Advisor to the Chairman

Yerevan Municipality

Mr. Tigran Sargsyan, Head of Development and Investment Programs Department

Energy Saving Foundation NGO

Ms. Astghine Pasoyan, Executive Director

Scientific Research Institute of Energy

Mr. Ruben Yeghoyan, General Director

Financial Institutions

ACBA-Credit Agricole Bank

Mr. Hakob Andriasyan, CEO

Mr. Norik Nazaryan, Deputy CEO, Sales Promotion and Regional Management

Mr. Styopa Zakinyan, Deputy CEO, Chief Financial Officer

Mr. Mikhail Amirkhanyan, SME and Corporate Business Department

ACBA Leasing CJSC

Mr. Arsen Bazikyan, General Manager
Mr. Vahagn Shmavonyan, Consumer Attraction and Marketing Division

Global Credit UCO CJSC

Mr. Aram Ghukasyan, Deputy Executive Director

AMERIABANK CJSC

Mr. Karen Hakobjanyan, Head, SME Lending

Private Sector

Renewable Energy Producers Association

Mr. Roman Melikyan, Executive Director

Redinet CJSC

Mr. Andranik Karamyan, CEO

Gevorgyan & Nersisyan Ltd.

Mr. E. Gevorgyan

Zet-Profil Ltd.

Mr. Robert Zakaryan, Director
Gevorg Zaqaryan

Arpi Solar

Mr. Ruben Gevorgyan, CEO

Freenergy

Mr. Hayk Chobanyan, CEO

AR & AR Design Construction

Mr. Ara Petrosyan, President

Arjermek LLC

Mr. Hrant Arabyan, Director

SolarOn

Mr. Arthur Alaverdyan, Founder

Contour Global Hydro Cascade

Mr. Ara Hovsepyan, General Manager

Amber Capital

Mr. Karen Arabyan, COO

Solar Power Station Investor

Mr. Karen Kazaryan

Academia

American University of Armenia

Mr. Alen Amirkhonian, Director, Acopian Center for the Environment

Mr. Artak Hambarian, Associate Director of the Engineering Research Center

Institute of Molecular Biology of the National Academy of Sciences (project beneficiary)

Mr. Arsen Arakelyan, Director, Head of Bioinformatics Group

Kanaker-Zeytun Medical Center (project beneficiary)

Mr. Hayk Petrosyan, Director

Development Partners

United Nations Development Programme/Global Environment Facility

Ms. Diana Harutyunyan, Programme Coordinator

Mr. Vahram Jalalyan, Project Task Leader

United Nations Industrial Development Program

Ms. Anahit Simonyan, Country Representative

Green Economy Financing Facility

Mr. Mikhail Gevorgyan, PFI Relationship Manager

European Bank for Reconstruction and Development

Ms. Anna Khachatryan, Associate Director

KfW

Ms. Bella Andreasyan, Senior Project Coordinator

Habitat for Humanity Armenia

Ms. Luisa Vardanyan, Executive Director

World Bank Group

Ms. Sylvie Bossoutrot, Country Manager for Armenia, Europe and Central Asia Region

Mr. Emil Zalinian, Energy Specialist

Ms. Ani Balabanyan (Lead Energy Specialist, project Task Team Leader)

Mr. Jasneet Singh (Lead Energy Specialist, project co-Task Team Leader)

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Appendix I. Bibliography

- Energy Charter Secretariat. 2015. *In-Depth Review of the Energy Efficiency Policy of Armenia*. Brussels: Energy Charter Secretariat.
- Hofer, Kathrin, Dilip Limaye, and Jas Singh. 2016. "Fostering the Development of ESCO Markets for Energy Efficiency." Live Wire: A Knowledge Note Series for the Energy and Extractives Global Practice, 2016/54, World Bank, Washington, DC.
- Singh, Jas, Dilip R. Limaye, Brian Henderson, and Xiaoyu Shi. 2010. *Public Procurement of Energy Efficiency Services: Lessons from International Experience*. Washington, DC: World Bank.
- Taylor, Robert P., Chandrasekar Govindarajalu, Jeremy Levin, Anke S. Meyer, and William A. Ward. 2008. *Financing Energy Efficiency: Lessons from Brazil, China, India, and Beyond*. Washington, DC: World Bank.
- World Bank. 2008. "The Other Renewable Resource: The Potential for Improving Energy Efficiency in Armenia."
- — —. 2012. "Armenia—Energy Efficiency Project." Project Appraisal Document 67035-AM, World Bank, Washington, DC.
- — —. 2013. Armenia—Country Partnership Strategy, FY14–17. Washington, DC: World Bank.
- — —. 2014. "Western Balkans: Scaling Up Energy Efficiency in Buildings." World Bank, Washington, DC.
- — —. 2016. "Armenia—Energy Efficiency Project." Implementation Completion and Results Report, World Bank, Washington, DC.
- — —. 2017. Armenia—Future Armenia: Connect, Compete, Prosper. Systematic Country Diagnostic. Washington, DC: World Bank.

Appendix J. Borrower Comments

I. Comments from the Government:



ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ԷՆԵՐԳԵՏԻԿ ԵՆԹԱԿԱՈՒՄՔՎԱԾՔՆԵՐԻ ԵՎ ԲՆԱԿԱԼ ՊԱՇԱՏՐՆԵՐԻ ՆԱԽԱՐԱՐՄԱՆ ԹՎՈՒ
МИНИСТЕРСТВО ЭНЕРГЕТИЧЕСКИХ ИНФРАСТРУКТУР И ПРИРОДНЫХ РЕСУРСОВ РЕСПУБЛИКИ АРМЕНИЯ
MINISTRY OF ENERGY INFRASTRUCTURES AND NATURAL RESOURCES OF THE REPUBLIC OF ARMENIA

№ _____

_____ 20 թ.ր.յ.

Mrs. MIDORI MAKINO

MANAGER, SUSTAINABLE DEVELOPMENT DEPARTMENT

INDEPENDENT EVALUATION GROUP

Dear Mrs. Makino

Taking the opportunity I would like to thank you for elaboration of the Draft Performance Assessment Report of Energy Efficiency Project. The Ministry of Energy Infrastructures and Natural Resources have the following

comments on this matter: in the Report.

1. Add in the 1.2 of Project Background and Context;

“Amendments and addendums made to the 2016 Law on Energy Saving and Renewable Energy which define a number of mandatory requirements, such as:

- energy efficiency requirements for buildings;
- energy balance requirement;
- labeling requirements for energy consuming devices;
- disposal requirement for life-threatening and environmental hazardous devices;
- energy expertising requirement”.

2. Add in Legal Acts of Appendix E: List of EE existing legal, regulatory and normative-technical documents in Armenia:

ՀՀ, երևան 0010, Հանրապետության Հրապարակ, Կառավարական տուն 3, հեռ. (37411) 521 964, ֆաքս (37411) 526 365
Р/А, Ерван 0010, Плошадь-Республики, Дом Правительства 3, тел. (27 411) 621 964, факс (27 411) 626 366
Government House 3, Republic Square, Yerevan, 0010, RA, tel. (37411) 521 964, fax (37411) 526 365

II. Comments from the implementing agency, the R2E2 Fund:

Unfortunately, the Government adopted ESAs as a sample agreement for energy efficiency procurement for the WB- Financed Energy Efficiency Project only, thus after the project closing it was impossible to apply it.

The R2E2 Fund tried to continue applying the same model of procurement. It revised the “Open Bidding” Public Procurement document to adjust to NPV- based procurement, but it faced barriers, i.e. the Procurement Law says that a public facility itself should proceed with a tender to select a company to perform energy service in its building. The R2E2 Fund should be selected by the relevant public entity via a tender process to proceed with NPV Procurement. In fact, the R2E2 Fund might be approached directly by a public facility, but only in cases where it is registered with the Anti-Monopoly Committee as a unique fund to proceed with energy service in their facilities, or where there is a new Government Decree adopted. Registration in the Anti -Monopoly Committee is expensive and there is no guarantee of success. With regard to the Government Decree, the R2E2 Fund prepared the Draft Decree with all enclosed documents in the end of 2017, but still, perhaps because of the government changes, the progress is difficult to see. Currently, the R2E2 Fund is negotiating with the new government to accelerate the approval process.

The R2E2 Fund approached Banks for co-financing but given the fact that the majority of public entities have no right for taking out a loan, the Banks preferred working with the private sector.

It is important to note that the R2E2 Fund has not de-capitalized itself and continues making investments in Energy Efficiency and Renewable Energy and is actively seeking financing for replenishment of the revolving fund.

After the project closure, the R2E2 Fund has been working actively in creating the EE environment in Armenia: the Fund organized a series of workshops and Energy Weeks, where priority was given to energy efficiency; it initiated the implementation of energy efficiency projects in cooperation with the financial institutions (i.e., ACBA Credit, ACBA Leasing, Global Credit); it conducted an energy audit of Yerevan Metropolitan; and it cooperated and assisted with the Health PIU and Ministry of Defense of the Republic of Armenia in finding energy efficiency solutions.

Another important achievement is that the R2E2 Fund was incorporated in a Covenant of Mayors as a supporter and is assisting the communities in preparation of a Sustainable Energy Plan, and the development of energy saving measures for community facilities. Also, the R2E2 Fund has successfully passed the first stage of accreditation to Green Climate Fund (GCF) and has already issued documents for the second stage. As soon as the R2E2 Fund becomes eligible for GCF financing, it may get considerable (about 10 million USD) financing for replenishment of the revolving fund.

In the case of a grant, like the UNDP/GEF project, it is easier to meet EE-related codes and standards, but the scheme of our project did not allow us to include measures that would not ensure cost recovery, i.e., insulation of tuff-stone walls.

