Urban Resilience Sector Guidance:
Power Sector

This document is a companion document to USAID's Urban Resilience Framework, and aims to support USAID staff and implementing partners to build activities into energy sector programming that strengthen urban resilience and consider integrated resilience programming that combines multiple sectors such as environment, private sector, and governance, to connect energy and energy systems to other domains of urban resilience. This guidance includes:

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CHALLENGES AND OPPORTUNITIES

USAID works to support the supply of safe, reliable, and sustainable energy for people in urban and rural areas. These objectives are challenged by difficulties associated with providing available and cost-effective technologies, changing consumer behaviors and practices, and operationalizing clean energy policies at national and local levels.

In urban areas, rapid population growth, increasing heating and cooling demands, and unstable weather patterns are examples of shocks and stresses that add to the challenge of delivering reliable energy. At the same time, the resilience of urban populations is particularly dependent on reliable and resilient energy supply, given the dependence of other essential services, like water and sanitation, on electricity provision.

What is Urban Resilience?

Urban resilience refers to the ability of urban systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability while positively transforming towards sustainable, equitable, and inclusive development. Shocks and stresses include those from climate change as well as other sources such as rapid urbanization or conflict. Urban systems include people, communities, infrastructure, the natural environment, and cultures, norms, and policies in cities and towns.

As a sector, energy is the highest contributor to global greenhouse gas (GHG) emissions, accounting for 73 percent of total emissions.[1] Unsurprisingly, most of those emissions (70%) come from consumption for a variety of uses in urban areas[2], particularly from energy use in buildings and transportation, and methane emissions from waste. Many of the same dynamics that contribute to high GHG emissions also exacerbate climate-related and other stresses and shocks. For example, buildings without reliable, safe, or adequate electricity connections present fewer options to adapt to changing temperatures or to be adapted for multiple uses in crisis (such as for shelter, clinics, or schools). Around half of the measures required to reduce GHG emissions are under the control of municipal governments, offering an opportunity to combine resilience and low emissions development.

Utilities are also an important partner to ensure that power systems are resilient and can continue delivering this essential service when it's needed most. Increased temperatures due to climate change will reduce efficiency of electricity transmission and distribution systems, as well as stress the capacity of generation and grid networks due to an increase in consumer cooling demands. Moreover, energy infrastructure (e.g. transmission and distribution lines, substations, power plants, and pipelines) can be vulnerable to extreme weather events, as well as other shocks, such as those related to conflict, causing sometimes dangerous disruptions to energy services.

USAID's energy sector programming typically centers around partner countries' need to resolve shortfalls in power supply, reliability concerns, and low access to energy. Ensuring an efficient supply of energy can support urban resilience solutions as unreliable energy supply and delivery can cause service breakdowns for other sectors - such as healthcare.

Applying a resilience lens to strategic energy sector development can enable a deeper understanding of the challenges and opportunities facing energy generation and delivery in urban settings. While a typical approach to planning and investing in urban energy systems may reference baseline conditions or follow historical trends in energy demand, it may overlook significant changes in demand and consumption from new or changing stresses, such as forecasted temperature increases or significant population growth tied to migration. Systems may be designed to manage the rare occurrence of a heat wave or hurricane, but not to manage a rapid uptick in the number and intensity of such conditions.

Of course a resilient energy system is about more than keeping the lights on – energy is a critical resource for a city to withstand both shocks and stresses. In a catastrophic event, reliable energy services are central to recovery. Energy is needed to provide food and shelter to displaced residents, to ensure public safety, and to provide essential healthcare. Energy is needed to build back an economy and job opportunities. It is also needed to maintain basic operations and as such, a global political or economic crisis that cuts off oil and/or gas supplies would also be disastrous for a city reliant on those power sources.

Sustainable energy services are a basic necessity for functional urban environments that meet the needs of their residents for economic opportunity, safe living environments, and reasonable quality of life. At the same time, clean energy services help to (1) mitigate climate change, air pollution, and environmental damage; (2) adapt to increasing temperatures and unstable weather patterns; and (3) recover from shocks and stresses. Working with local governments and organizations to identify and prioritize essential services in

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[1] International Energy Agency, *Greenhouse Gas Emissions from Energy: Overview,* https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview

[2] United Nations, *Generating Power;* https://www.un.org/en/climatechange/climate-solutions/cities-pollution

the event of a disaster (e.g., hospitals vs. government; food storage, shelter, etc.) and the level of energy service needed can lay a strong foundation for resilience.

Many of the existing strategies used by USAID to improve energy services can contribute to urban resilience. These practices strengthen the ability of urban energy systems to withstand shocks and stresses by making the system more efficient, expanding the available options for diversification of energy sources--especially during a shock, and safeguarding energy infrastructure against shocks and stresses, such as extreme weather events.

FIVE BUILDING BLOCKS TO URBAN RESILIENCE

The **Urban Resilience Framework** identifies five building blocks to improve urban resilience, which can be applied to the energy sector and other sectors:

1. **Inclusive Planning** - Deploy inclusive, evidence-based planning that accounts for future risk
2. **Governance** - Strengthen urban governance
3. **Finance** - Unlock financial capital and budget for resilience
4. **Social Capital** - Build and strengthen networks of relationships and bonds within and across communities
5. **Natural Capital** - Restore and protect the natural systems that can contribute to resilience

The building blocks are intended to guide a comprehensive approach for USAID programming, but are of course general and intended to be localized to specific contexts. The energy sector in particular is infrastructure-intensive, so attention should be given to ensuring that siting and construction not only comply with USAID policies such as the Agency's construction policy[3], but also reflects resilience principles that anticipate future risks.

The table below illustrates how use of the building blocks in the energy sector may lead to localized actions.

Table 1. Building Blocks to Strengthen Energy and Urban Resilience

Approach	**Description**	**Illustrative Actions**
Inclusive Planning	Formulate evidence-based plans and actions, in consultation with relevant communities, that ensure minimum energy requirements are met and	Build utility and other organizational capacity for data collection, assessing risk to the energy system, and scenario planning, and increase focus on resilience as a core energy sector objective to guide investment and growth

[3] USAID's construction policy is available at https://www.usaid.gov/sites/default/files/documents/1868/303maw.pdf

	consider past and future shocks and stresses	Engage communities in data collection and analysis, particularly on issues of energy demand and consumption, energy efficiency, energy theft and reliability needs.
		Collaborate with city officials, businesses and community groups on forecasting future energy demand under different scenarios.
		Promote learning through monitoring of resilience activities and use of tracking tools (e.g., Resilience Rating System[4])
Governance	Align diverse actors, policies, and strategies for coordinated action to strengthen urban governance	Support collaboration between utilities, local government entities and businesses on new incentives, projects, and policies to enable energy efficient buildings, adoption of distributed energy resources, and embedded urban renewable energy generation (such as solar and wind generation directly on the distribution grid).
		Build joint activities with utilities, local government and businesses to address energy theft, while encouraging energy efficiency and identifying options to expand investment in DER particularly for the urban poor.
		Update policy and regulatory frameworks to prioritize and create standards for resilience in energy sector planning and operations. Align utility plans to subnational and national resilience strategies and policies.
		Ensure regulatory frameworks and government support adequately

[4] A Summary - Resilience Rating System, World Bank; https://openknowledge.worldbank.org/bitstream/handle/10986/35039/Resilience-Rating-System-A-Methodology-for-Building-and-Tracking-Resilience-to-Climate-Change-A-Summary.pdf?sequence=9&isAllowed=y

		compensate energy service providers for delivering resilience solutions
Finance	Unlock financial capital and budget to ensure resources to initiate and sustain contextually appropriate actions to promote resilience	Build utility capacity to incorporate resilience into energy investment planning and specifications
		Engage the private-sector in development of distributed energy systems, power as a service, and energy efficiency solutions
		Foster relationships and shared objectives between financial institutions (including development banks), energy sector actors and other stakeholders to increase opportunities for resilience finance
Social Bonds	Build social capital by deepening social systems that facilitate collective action in response to shocks and stresses	Engage local organizations in energy efficiency improvements and building code enforcement
		Increase awareness of diverse local groups of energy and air quality concerns and help build public demand for investment in reliable energy and improved air quality through clean energy strategies
		Emphasize and leverage local expertise and networks in design and implementation of distributed energy projects.
Natural Systems	Restore and protect natural capital, and use natural assets to withstand shocks and address vulnerabilities	Seek to increase the use of the natural environment to reduce energy demand (e.g., through shade tree planting)
		Develop siting guidance for new infrastructure that recognizes the risks to resilience of certain aspects of the natural environment (e.g., avoid transmission and distribution infrastructure, such as lines and

		substations, in areas prone to flooding or falling trees)

Applying these building blocks to the energy sector requires exploring new areas of collaboration and asking additional questions to understand the actors, institutions, resources, and policies that play a role in establishing resilient energy.

KEY QUESTIONS TO IDENTIFY AND ASSESS OPPORTUNITIES

Applying the five building blocks for strengthening urban resilience requires identification of key risks, assets, actors, capacities, change levers, and integration opportunities that exist in specific urban areas. Opportunities for integrated programming can be identified through a review of existing programs and earmarks that may impact the energy sector. For example, municipal finance and decentralization activities may introduce challenges and opportunities for utility reform; programs supporting urban security may be tailored to include energy-efficient street lighting or energy theft.

While not exhaustive, the following questions can help USAID staff working in the energy sector to identify and analyze potential interventions.

Geographic Focus

If programs do not have a predetermined urban area(s), an initial step is to identify specific cities, or areas within cities, on which to focus. A key question to ask is:

- Where do **development challenges,** including stresses and shocks, **converge**? (This can increase the likelihood that investments cut across sectors and yield co-benefits). For example, a city dealing with high levels of air pollution may provide an opportunity for the city government to work with the energy utility, transportation authorities, and health officials to identify joint interventions, such as support for clean public transport vehicles and electric vehicle infrastructure.

Risks and Assets

- What are the physical, financial, social, and natural **assets** (including services) of the identified intervention area? Are there funds or public programs available to address housing needs that could incorporate energy efficiency? Are there buildings or open spaces that would be suitable for electrifying, retrofitting to be more energy efficient, and/or installing distributed energy resources? Are there local businesses that could effectively participate in a market for clean energy or energy efficiency solutions?
- What are the primary **shocks** that could threaten the delivery of reliable clean power? (e.g., flooding, extreme heat, conflict, supply chain disruptions, etc.). Available online tools such as Think Hazard may provide useful inputs into answering these questions.
- What are the chronic **stresses** that threaten a resilient energy sector? (e.g., income inequality, underdeveloped social services, underinvestment, etc.)
- How does the lack of a reliable energy system put physical, financial, social, and natural assets at **risk?** For example, do people seek other energy sources that degrade the environment and exacerbate environmental risks, such as charcoal?

Actors and Capacity

- What **authorities** are held by whom? What roles do the utility, local government, and other actors play in energy provision, particularly distribution? The authorities needed to build resilience to the system in urban areas will often be divided across different national, regional, local, public, and private actors and will vary between countries.
- What **governance capacity** exists in the potential intervention area (i.e., national, provincial, local)? What institutions are critical to the well-being of communities, particularly during natural or man-made crises? Where are they located? How can resiliency efforts ensure these institutions have consistent access to energy? Which of these institutions have the authority to make the necessary political, fiscal, and/or administrative decisions ? What are the key pieces of the policy, legal and regulatory framework which govern their actions?
- Who are the **key stakeholders** and what capacity exists outside of government structures to address energy needs (e.g., private sector, citizen associations, etc.)? How do they engage with decision-makers? For example, are there local organizations that promote green building standards?
- Which local institutions and groups possess **knowledge or data** to better understand risks and assets? Are there local universities or NGOs that are working on clean energy?

Levers of Change and Integration Opportunities

- Do any of USAID's **existing programs** work in the identified urban areas? Which of these can strengthen energy resilience? How might they work together? How might new programming work with existing programs? Is there an opportunity to coordinate with other sectors also planning new programming?
- What has **already been done, or is currently being done,** related to improving energy resilience? (e.g., Have any other donors worked with the host country on this? Have local authorities addressed this as a priority?)
- What are the possible **co-benefits** to addressing energy resilience? (e.g., public health, disaster preparedness, public safety, reduced air pollution, new investment opportunities, etc.)
- Who are the **leaders and champions** among host government institutions, community organizations, the private sector, or development agencies that can advocate for needed changes?

By considering these key questions up front, potential entry points to strengthen energy resilience and contribute to urban resilience may become clear.

ENERGY OPPORTUNITIES TO STRENGTHEN URBAN RESILIENCE

Below are examples of significant opportunities to strengthen urban resilience with interventions that already form a core part of USAID's approach to strengthening the energy sector. These are just examples--not an exhaustive list.

Energy Efficiency

Energy efficiency inherently enables an equal or increased level of service using less energy. In cities with unreliable or expensive service, energy efficiency can improve the resilience of the entire energy system, as well as for individual buildings or households. One important resilience strategy for cities is to strategically and adaptively use the building stock for multiple uses, especially during shocks. For example, public buildings may be adapted for use as cooling centers in cities with extreme heat--a measure particularly important for

populations living in substandard housing. Supporting building electrification, adoption of high efficiency heating, ventilation, and cooling equipment, and improving building energy codes support cities' ability to implement such resilience strategies. Additionally, supporting government programs to retrofit existing buildings to be more efficient, especially low-income housing, gives households more options to adapt to changing conditions (such as by making the use air conditioning more affordable). Building codes can be utilized to further encourage passive heating and cooling methods for additional cost and energy savings. USAID/Mexico completed a study addressing residential cooling demand[5] to assist with a policy response, and provides a useful case study for countries responding to increased cooling demands as urban residents experience rising temperatures. There are many other examples of energy efficiency as an urban resilience strategy, including switching incandescent public street lighting to LED lights, creating cost savings and improving public safety at the same time. India, Mexico, and the Philippines have already adopted this practice in several cities.[6]

Distributed Energy Resources (DER)

In tandem with energy efficiency, distributed energy resources (such as rooftop solar, battery storage, microgrids, or embedded generation) are an important resilience strategy for urban populations. Rooftop solar, when designed to operate in "island mode" can ensure some level of electricity service even when the main grid is down. This can require working with the utility and regulator to determine whether islanded systems can be supported. Similarly, battery storage, especially as a complement to distributed renewables, can enable extended uninterrupted service during shocks. Larger scale urban resilience measures may include microgrids or even embedded generation, where generation assets are connected directly to the distribution network rather than far away on the transmission network. This can enable a city to continue powering essential services independent of the rest of the grid. After Hurricane Sandy, New York University became an exemplar of the power of microgrids to help cities weather bigger and more damaging storms. While the rest of the city shut down, the university kept running through a microgrid served by a 13 MW combined heat and power plant running independent from the main grid.

Grid-scale Renewable Energy

Renewable energy at utility scale capitalizes on domestically supplied electricity generation to buffer against price volatility in international oil, gas, and coal markets, while mitigating emissions that cause air pollution and climate change. Renewable energy is distinct from fossil fuel-based energy because the cost of power provision is almost entirely related to the cost of capital associated with the construction of the renewable energy generation facility keeping the price steady for the length of the power purchase agreement. After that agreement expires, the marginal price can be almost nothing. By contrast, fossil fuel prices comprise a major portion of the generation cost and are subject to price fluctuations from international supply and demand without long-term contracts or inefficient government intervention.[7] Price stability allows for more effective resilience investments at the utility, city, and household level. Furthermore, eliminating government intervention in the form of price caps or subsidies can further free money for investment in high priority initiatives.

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[5] https://www.usaid.gov/energy/sonora-air-conditioning-analysis

[6] https://blogs.worldbank.org/energy/led-street-lighting-unburdening-our-cities

[7] https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf

Energy Sector Planning

Energy sector planning is the gold standard for laying out the future trajectory of all generation, transmission, and distribution investments according to the objectives set, such as cost, emissions, and reliability, through inclusive processes. It is one of the strongest tools for achieving many of USAID's energy sector objectives. With utilities in the U.S. and other countries (such as South Africa) this takes the form of *integrated resources planning (IRP)*. This process can range in complexity, but done well, it builds long-term considerations of financial viability, least cost generation, clean energy targets, energy security objectives, and, increasingly, resilience into energy sector development decisions. Utilities use IRPs to forecast demand and analyze multiple options to meet demand—including distributed energy resources and energy efficiency, which have particular relevance to urban resilience—while achieving other related objectives (like increasing renewable energy capacity). Energy sector planning in this way is a critical part of USAID's approach to scaling up renewable energy because it supports improving financial viability of utilities (allowing them to plan for least cost generation, which is often solar and wind), sends long-term signals to the private sector on the utility's investment plans, and can bring transparency and good governance to a sector often plagued by corruption. This provides a ripe entry point for building resilience into the process, as it further strengthens objectives of long-term financial health and reliability of the sector, such as better assessing water supply risks when planning for new generation, especially hydropower, or assessing changes to load as the climate changes, especially from air conditioning.

One key strength of long-term energy sector planning is a transparent, multi-stakeholder approach. USAID can go further in our support by collecting, analyzing, and incorporating new data on energy dynamics and risks specific to urban populations (such as increased electrification, migration, urban heat island effect, etc). Sources of risk to the energy sector go beyond weather, which impact demand and reliability, and include geopolitical strife impacting fuel imports and urban migration. Deeper recognition and risk analysis enables development and assessment of new options. This approach is key to *Ghana's Integrated Resource and Resilience Planning* (IRRP) program,[8] an example of how USAID is programming new ways to ensure sustainability, and in Lao PDR under USAID Clean Power Asia.[9] Under the Ghana IRRP program (described in further detail below), USAID helped bring in new stakeholders to increase visibility of climate risks and to identify options to respond to these risks in ways that differ from historical practice, leading to generation and transmission solutions that will improve the viability of the utility, reliability of electricity service, and resilience of the sector, while reducing emissions.

Resilient Infrastructure Investment Planning

Compared with energy sector planning, resilience planning is a much more discrete process. Resilience planning assesses the most critical infrastructure and the events that could affect them to prioritize "hardening" them. Typically extreme events are disasters, which are becoming more extreme and frequent due to climate change, but they can also include cyberattacks, physical terrorist attacks, and disruptions to fossil fuel supplies. The risk assessment process involves identifying critical infrastructure, evaluating the consequences of losing it, evaluating the degree to which improvements could reduce the probability of outages, and analyzing the costs and benefits of improvements.[10] With a better understanding of the risk profile for critical infrastructure against the most impactful extreme events, utilities and government partners

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[8] https://www.usaid.gov/energy/sure/ghana-irrp

[9] https://www.sei.org/projects-and-tools/projects/irrp-lao-pdr/

[10] https://eta-publications.lbl.gov/sites/default/files/feur_11_resilience_final_20190401v2.pdf

can prioritize investments to increase the likelihood that the most critical elements of the power system can maintain operations or recover quickly from extreme events.

Electric Vehicles/Transportation

Transportation systems, specifically accessible mobility options, play a major role in urban resilience. Urban populations must be able to move around the city--and outside of the city--to respond immediately to shocks and they must be able to access critical services to build resilience to shocks and stresses before and while they are happening. This is especially important for people living in poverty for whom private cars are not affordable or accessible. Public transit, paratransit, and bike and pedestrian infrastructure are the primary modes of transportation to enable affordable, equitable, and accessible mobility. It is essential that the resilience needs of different urban populations are factored into transportation planning, such as by considering more than just home-to-work trips when planning new service and infrastructure.

In addition, in energy systems with high levels of clean energy, electric vehicles can reduce reliance on imported fuels. One oft-cited example, Bogota's TransMilenio Bus Rapid Transit (BRT) system, has recently begun electrifying its bus fleet to become even more energy efficient and contribute to Colombia's target of being carbon neutral by 2050.[11] USAID can encourage resilient urban transportation sectors by supporting public transit and energy efficient transportation vehicles and policies that enable investment in associated infrastructure, like charging stations. For example, USAID/India supported initial electric vehicle (EV) charging station infrastructure in 2020. Estimates are for the network to grow from 60 stations in 2020 to over 2,000 by 2022.[12]

PROGRAM HIGHLIGHTS

The USAID/Vietnam Urban Energy Security project promotes deployment of advanced, distributed energy solutions such as rooftop solar, electric vehicles, waste-to-energy, and other energy efficiency solutions in urban areas in Danang and Ho Chi Minh City. Launched in 2019, the four-year program responds to the dual challenges of rising energy demand and air pollution in urban areas. By its completion, the project aims to deploy at least 40 megawatts of advanced distributed energy systems, mobilize at least $60 million in public and private investment for such systems, and also develop a minimum of five innovative and scalable solutions to energy issues. Under this project, USAID is providing technical assistance in support of Danang City Government's efforts to invest in advanced energy solutions that, if successful, could enhance the city's competitiveness, catalyze other green investments, and improve environmental conditions for citizens. That technical support includes a review of city and national policies to enforce the city's Energy Action Plan as well as the creation of a task force to support the power company in improving energy resilience and security. Similarly, the USAID/Vietnam Low Emission Energy project intends to accelerate the development and adoption of clean energy solutions. This will be accomplished by developing clean energy strategies, building the capacity of government institutions to create an environment conducive to the development of renewable energy, and by strengthening government capacity to enforce energy efficiency implementation.

Integrated resource and resilience planning (IRRP) is gaining traction as a strategic approach and is one way that USAID's energy portfolio is addressing resilience. In Ghana, where power supply shortfalls interfere with day to day activities of households, businesses, and essential government services, USAID applied IRRP to meet the power sector's challenge–pointing to another way USAID's energy portfolio addresses resilience.

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[11] https://bogota.gov.co/en/international/new-era-transmilenio-transmiapp-and-largest-electric-fleet

[12] https://www.usaid.gov/india/energy-and-environment

The approach centers on improving the resilience of the power system through a least-cost and least-regret decision-making framework that helps power sector planners (1) understand how the power system will perform when faced with certain threats, including climate change, and (2) prioritize among alternative responses. Applying this approach, USAID/Ghana's Integrated Resource and Resilience Planning program brought different power sector stakeholders together and provided data and training to promote better understanding of climate change implications for the power sector, identify key metrics to measure resilience of the power sector, and identify adaptation measures to respond to risks.

The siting of energy infrastructure has profound impacts on urban resilience. Cities and towns that rely on energy infrastructure that is sited in vulnerable areas are more prone to power loss from threats like wind and flood. In the Lao People's Democratic Republic, USAID supported a vulnerability assessment that resulted in recommendations such as creating regulations to move power distribution equipment away from high-wind areas and out of flood zones, training employees in better vegetation management, and siting equipment properly to avoid hazards. In Nepal, the Millennium Challenge Corporation compact is supporting increased access to clean energy, including the construction of power lines connecting clean energy generated by hydropower.[13] The transmission towers are intentionally sited to avoid climate hazards. The National Renewable Energy Laboratory (NREL) has authored a Power Sector Resilience Planning Guidebook that is one of several resources available on the Resilient Energy Platform.

There is an increasing awareness of the intersection between disaster risk reduction and the energy sector. When paired with energy storage technologies, distributed generation systems provide back-up power during grid outages caused by disasters by going into "island-mode." Islanded distribution systems ensure consumers have access to power during long-term power outages that impact central grid systems more severely, as can occur after major natural disasters. One example can be found in Ocho Rios, Jamaica, which supports increased electric reliability through distributed solar and wind and microgrids.[14] The Association of Caribbean States' (ACS) initiative Green Response to Disasters published a case study which contains recommendations for enhancing resilience in the energy sector for disaster-prone Caribbean countries.

FUNDING

USAID Funding

USAID clean energy funding can advance a variety of measures that can contribute to increased urban resilience ranging from energy sector planning exercises to deployment of new technology to capacity building. This includes supporting deployment of renewable energy technologies including distributed energy resources and utility-scale renewable energy plants, smart-grids, and battery storage. USAID can also support increased energy efficiency through technical assistance, institutional development and enabling the flow of finance to these activities. With clean energy funding, USAID can also help advance low-carbon transport options and support activities that reduce short-lived climate pollutants. Funding directed for other objectives can also be used to achieve these resilience objectives, such as economic growth and private sector engagement, as well as health, education, or adaptation funds, depending on the focus of the project.

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[13] https://www.mcc.gov/where-we-work/program/nepal-compact

[14] https://www.nrel.gov/docs/fy16osti/66597.pdf

Leveraging Non-USAID Funding

The amount of investment *mobilized* (in US$) for energy projects (including clean energy) as supported by U.S. government assistance is reported as in the billions of dollars,[15] underscoring just how much USAID funding is able to catalyze from other sources, especially the private sector. For example, a Public Private Partnership through the Power Africa program created a fund with blended private and public financing for solar energy installations, enabling African businesses to access the "energy as a service" model, whereby they can pay a monthly tariff for their power and avoid the large upfront capital costs of clean energy installations. The initial $1.3 million grant USAID provided to the CrossBoundary Energy fund attracted more than $10 million in private sector equity and has been paid back to the U.S.Treasury with a five percent return.[16] Loan guarantees are another well-utilized tool to catalyze private loans to fund energy investments.

MONITORING, EVALUATION AND LEARNING

Energy programs that aim to improve urban resilience may need to monitor and evaluate progress on **building capacities** related to specific types of shocks or stresses. If possible, programs should identify the shocks and/or stresses expected in the program area, and corresponding indicators and methods for tracking their occurrence and severity. Larger activities can consider recurrent monitoring pre- and post-shock where appropriate. And because urban resilience tends to focus on urban **systems**, it is important to consider metrics that accurately capture the spatial and functional aspects of energy programming that affect the program's desired outcomes.

USAID has a list of **standard indicators** that are used to streamline reporting.[17] Several of these may be appropriate to use for programs supporting urban resilience in the energy sector. The use of Congressionally-earmarked funding may necessitate the use of one of the climate-change standard indicators. For example, this standard indicator for earmarked climate adaptation may be relevant for activities addressing urban energy resilience: *Number of people using climate information or implementing risk-reducing actions to improve resilience to climate change as supported by USG assistance (EG.11-6).*

USAID standard indicators relating to energy:

- Number of beneficiaries with improved energy services due to USG assistance (EG.7.1-1)
- Amount of investment mobilized (in USD) for energy projects as supported by USG assistance (EG.7.2-1)
- Number of laws, policies, regulations, or standards to enhance energy sector governance formally proposed, adopted, or implemented as supported by USG assistance (EG.7.3-1)
- Number of people trained in technical energy fields supported by USG assistance (EG.7.3-2)
- Number of people trained in clean energy supported by USG assistance (EG.12-1)

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[15] Ibid, page 117.

[16] https://www.usaid.gov/sites/default/files/documents/Final-10.13_CrossBoundry_.pdf

[17] For the full list of FY21 Standard Indicators, please see https://www.state.gov/wp-content/uploads/2021/11/Public-PPR-Full-MIL-Standard-Indicators-Report.xlsx

- Number of institutions with improved capacity to address clean energy issues as supported by USG assistance (EG.12-3)
- Number of laws, policies, regulations, or standards addressing clean energy formally proposed, adopted, or implemented as supported by USG assistance (EG.12-3)
- Amount of investment mobilized (in USD) for clean energy as supported by USG assistance (EG.12-4)
- Clean energy generation capacity supported by USG assistance that has achieved financial closure (EG.12-5)
- Greenhouse gas (GHG) emissions, estimated in metric tons of CO2 equivalent, reduced, sequestered, or avoided through clean energy supported by USG assistance (EG.12-6)
- Projected greenhouse gas emissions reduced or avoided from adopted laws, policies, regulations, or technologies related to clean energy as supported by USG assistance (EG.12-7)

KEY RESOURCES

- "Power Sector Resilience Planning Guidebook" is a reference for power sector resilience planning that introduces policymakers, power sector investors, planners, system operators, and other energy-sector stakeholders to the key concepts and steps involved in power sector resilience planning. Users can apply this knowledge in the development of strategic, country-specific processes and identify actions that increase power sector resilience. Created by the National Renewable Energy Laboratory (NREL) in partnership with USAID in 2019. URL: https://resilient-energy.org/training-and-resources/publications/73489-guidebook-final.pdf/view Also see NREL's Resilience Roadmap, which is located at the following URL: https://www.nrel.gov/resilience-planning-roadmap/
- "Productive Use Of Energy In African Micro-Grids: Technical And Business Considerations" is a report authored by NREL with funding from USAID in support of the Power Africa Beyond the Grid program in 2018. The report is a resource that entrepreneurs and developers can use to understand the technical and business model challenges related to productive use of energy in smaller micro-grids. It focuses on small agricultural processing, and small industrial and commercial loads. URL: https://www.nrel.gov/docs/fy18osti/71663.pdf
- "The Enhancement of Resilience to Disasters and Climate Change in the Caribbean through the Modernization of the Energy Sector" study provides alternatives to enhance the overall resilience of energy systems in the region and take advantage of the investment and policy complementarities between climate change adaptation and disaster risk management. United Nations Economic Commission for Latin America and the Caribbean (ECLAC), 2020. URL: https://www.cepal.org/sites/default/files/publication/files/45098/S1901175_en.pdf
- "Energy Resilience Takes on Renewed Urgency." This World Bank article from 2017 discusses their work to strengthen energy infrastructure, improve emergency recovery plans, and test more resilient equipment. URL: https://www.worldbank.org/en/news/feature/2017/11/10/energy-resilience-takes-on-renewed-urgency
- Guidelines for Climate Proofing Investment in the Energy Sector," published by the Asian Development Bank in 2013, aims to present a step-by-step methodological approach to assist project teams to assess and incorporate climate change adaptation measures into energy investment projects. URL: https://www.adb.org/sites/default/files/institutional-document/33896/files/guidelines-climate-proofing-investment-energy-sector.pdf
- "Good Practice Note for Energy Sector Adaptation," published by the World Bank in 2019, aims to support incorporation of climate adaptation and resilience into power sector projects for client

countries. URL: https://openknowledge.worldbank.org/bitstream/handle/10986/37712/Good-Practice-Note-for-Energy-Sector-Adaptation.pdf?sequence=1&isAllowed=y

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