TRACKING JOBS IN PROJECTS FOCUSED ON CLEAN ENERGY AND PRODUCTIVE USES OF ELECTRICITY

DISCUSSION PAPER

ESMAP
Energy Sector Management Assistance Program

THE WORLD BANK
IBRD • IDA

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Anna Aghababyan, Kavita Rai, and Megan Lang

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ABOUT ESMAP

The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and over 20 partners to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the World Bank, ESMAP works to accelerate the energy transition required to achieve Sustainable Development Goal 7 (SDG7), which ensures access to affordable, reliable, sustainable, and modern energy for all. It helps shape World Bank strategies and programs to achieve the World Bank's Climate Change Action Plan targets. Learn more at: https://www.esmap.org.

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About this Report

This discussion paper providing strategies for tracking and enhancing job creation in the clean energy projects was undertaken under a program of analytical work that investigates the impacts of the global transition to clean energy on the quantity and quality of jobs in low- and middle-income countries. Under the program, entitled "Estimating the Job Creation Potential of the Clean Energy Transition," the World Bank's Energy Sector Management Assistance Program (ESMAP) undertook multiple streams of analysis:

- A review of the literature and commonly used methodologies of investigation
- Modeling of economywide job impacts of policies supporting the clean energy transition in selected countries in Sub-Saharan Africa
- Case studies of the effects on employment of selected World Bank clean energy projects
- Deep dives into the impact on jobs of closure of coal-fired power plants; of productive uses of electricity associated with mini grids in Nigeria; and of the Rusumo Falls Hydropower Project.

Building on the above-mentioned steams of analysis, the program has also produced a high-level report summarizing its findings and conclusions "Jobs for a Livable Planet: Job Creation Potential of the Clean Energy Transition."

The reports developed under this program together aim to support low- and middle-income countries in reaping greater socioeconomic benefits from the energy transition by supporting them in increasing the number and quality of local jobs generated while implementing clean energy projects. Realizing the benefits of the jobs created by clean energy interventions will depend on effective planning and preparation in the early stages of projects and sustained support during their implementation.

The reports target multiple audiences, from policy makers to development practitioners and academics. They also aim to familiarize energy specialists with the effects of energy projects on jobs and give them tools that enable them to take account of—and, where possible, maximize—the socioeconomic benefits of the clean energy transition.

The reports can be found at https://www.esmap.org/publications.

Abbreviations

DPOs	Development Policy Operations
ESMAP	Energy Sector Management Assistance Program
ESSP	Energy Sector Support Project
GGGI	Global Green Growth Institute
GHG	greenhouse gas
kV	kilovolt
MSMEs	micro, small, and medium enterprises
MTF	Multi-Tier Framework
NGO	nongovernmental organization
O&M	operation and maintenance
PDO	Project Development Objective
PUE	productive use of electricity
RE1/RE2	rural electrification projects
TOC	Theory of Change
ToRs	terms of reference
UNIDO	United Nations Industrial Development Organization

All currency is in United States dollars (US$, USD), unless otherwise indicated.

Executive Summary

This discussion paper is intended to support World Bank energy sector teams in fostering job creation as an explicit, additional objective of the Bank's clean energy lending. Through examples and discussion, the paper illustrates how to conceptualize relevant theories of change; identify appropriate strategies and interventions to enhance job creation; and specify, measure, and track employment-related indicators in the project context. The paper focuses on specific projects, not the economywide effects of clean energy interventions. It is anticipated that this paper will be of interest to other multilateral development banks and development agencies supporting clean energy interventions.

To enable a better understanding of how the global transition to clean energy affects national employment rates, specifically by creating jobs, the Energy Sector Management Assistance Program (ESMAP) conducted a series of case studies of various World Bank projects. The case studies offer pointers on integrating job creation targets—and their monitoring—in projects advancing the global energy transition. In addition to these real-world examples, the discussion paper draws upon the multiple streams of analysis including a review of existing literature, and commonly used methods of estimating jobs (bottom-up engineering models, input-output tables, computable general equilibrium models, and econometric assessments) summarized in the report "Jobs for a Livable Planet: The Job Creation Potential of the Clean Energy Transition" (ESMAP 2023b). It also builds on the lessons and recommendations of the ESMAP report titled "Promoting Productive Uses of Electricity: Increasing Development Benefits and Investment Returns to Expand Access to Energy in Rural Regions of the Developing World" (ESMAP 2023a).

In the present discussion paper, the focus is on how to estimate and track the jobs created due to the World Bank's lending projects. Economywide estimates have been excluded, to ensure a clearer understanding of how efforts to foster job creation, and especially the longer-term outcomes of greater job quality and job equity, can be designed for optimal effect. Of particular importance is the design of a "theory of change" (TOC), whereby sets of assumptions explain the different steps linking project activities to outcomes and, eventually, to the Project Development Objectives. The discussion paper has six chapters, including sections on designing a TOC for clean energy investments and productive uses of electricity (PUEs), and evaluating projects' employment outcomes. It concludes with a list of recommendations.

Monitoring Clean Energy Projects' Effects on Employment

Clean energy projects—including efforts to expand renewable energy supply, increase access to clean electricity, promote efficient power sector planning, and foster an enabling environment for low-carbon energy development pathways—can help meet the Sustainable

Development Goals and advance the global decarbonization agenda. Importantly, such projects can be designed to explicitly target employment outcomes, which are important to track since they indicate that a project is boosting economic activity and job creation. Chapter 1, the paper's introduction, highlights what we know of clean energy projects' employment outcomes, provides the definitions of three job categories (direct, indirect, and induced), and discusses the methodologies used to estimate employment. The subsequent chapters provide more points of reference, including for tracking employment indicators.

The Importance of Setting a Theory of Change

In any project, articulating a TOC is an essential step before devising measures to track jobs. A TOC comprehensively illustrates how a set of interventions/activities may lead to the change that a program or project is trying to achieve within a particular context. Designing a TOC helps ensure that a project is grounded in evidence. Specifically, charting the steps in a causal pathway allows project designers to assess whether that pathway is valid and can be developed through an iterative process. It also informs the design of effective performance monitoring and evaluation systems to further identify suitable indicators that can measure the success of interventions along the causal pathway.

Chapter 2 highlights the causal pathways linking activities, outputs, and energy- and employment-related outcomes within clean energy projects, as well as the underlying assumptions that must hold for hypothesized causal pathways to be valid. If assumptions do not hold, projects need to carry out complementary activities that help ease the constraints.

Chapter 3 presents an example TOC for a clean energy development project that has job creation as an explicit objective. Four key sets of project activities are highlighted: (1) infrastructure investments, (2) capacity building, (3) the use of incentives, and (4) community development. Specifically, the TOC illustrates how these activities can create direct and indirect jobs associated with a project, besides induced jobs at various project stages. It is worth noting that in the TOCs' design, jobs are created at the output as well as outcome stages depending on the causal pathway.

Most induced jobs are created at the outcome stage, since projects often have to be operational and/or under implementation for such jobs to be plausible. For example, productive uses are set up once electricity is available (outputs), and then jobs are created; or community development projects are executed whereby local businesses can provide services, boosting induced jobs. Most induced jobs are created at the long-term outcome stage, after projects are completed. Besides an overarching TOC, this document also includes, in appendix D, project-specific TOCs for a selected sample of World Bank–financed clean energy projects (including investments in solar mini grids, hydropower, grid extension, and power sector reform).

This discussion paper presents key indicators that World Bank projects focusing on clean energy can use to better capture employment-related outcomes.[1] It also provides examples of specific types of jobs (direct, indirect, or induced) corresponding to each indicator. Appendix A details subsets of outcome indicators, including units of measurement; baseline values; definitions; types of projects where the indicators can be used; options for disaggregation, data sources, and calculations; and additional notes.[2]

Chapter 4, on the estimation of induced jobs, includes two subsections: (1) a brief macrolevel summary of induced jobs, which is included despite the paper's project-level focus; and (2) a subsection on productive uses of electricity, which follows a similar pattern to that in chapter 3. It provides a more in-depth analysis of TOCs related to PUE projects, which target ecosystem strengthening for the conducive growth of enterprises. A few illustrative examples from selected World Bank projects and external sources are provided. Outcome indicators are detailed in appendices A and C.

Evaluating Project Impacts on Employment

Chapter 5, on impact evaluations for employment outcomes, discusses when and why World Bank project teams may wish to consider integrating impact evaluations into projects, with a focus on measuring indicators that are otherwise difficult to attribute, and on tracking job outcomes beyond project closure dates. An impact evaluation measures impacts by comparing the indicators adopted for a credible control group with the indicators adopted for project beneficiaries. This allows impacts to be attributed to a specific project, and allows project teams to measure a wider range of indicators against a control group. Credible inferences on longer-term project impacts can in turn be drawn. These long-term outcomes are important, and project design and implementation can work toward their eventual realization.

Impact evaluations are broadly grouped into two categories: randomized controlled trials and quasi-experiments. While randomized controlled trials are referred to as the "gold standard" for impact evaluation, it is not always feasible to randomize projects, especially those that involve large infrastructure investments. Chapter 5 is not designed as a comprehensive guide to conducting impact evaluations. Instead, it provides high-level guidance for project teams on when such evaluations are feasible, how to incorporate them into a project's TOC, and where to locate further resources to design and implement them.

Lessons and Recommendations

Chapters 6 and 7 offer lessons and recommendations for improving clean energy investments' domestic and local employment outcomes. The section also highlights examples of how such approaches have been deployed in selected clean energy projects. Following are some of the key lessons and recommendations:

- Job creation indicators can be combined (e.g., direct and indirect job estimates) to shed light on the overall employment outcomes associated with projects.

- Outcome measurements are crucial especially in tracking jobs, and should extend beyond direct employment, especially to help understand longer-term impacts, which may continue beyond a project's completion.
- Employment-related data are difficult to track, since the process relies on different subsets of project implementers, especially in case of larger infrastructure projects. Clean energy projects should thus require that implementing entities, including subcontractors, provide the data required to track employment indicators, especially related to direct jobs.
- Complementary investments in capacity building, including skill training for workers, can enhance direct employment outcomes, and promote PUEs. Such investments will boost projects' induced employment impacts.
- Indicators tracking induced jobs shed light on impacts and not necessarily total employment.
- Employment indicators should cover short- and long-term employment outcomes. Key indicators must be disaggregated to measure job creation, job equity, and job quality based on relevant factors, especially gender and vulnerability status. This is an essential step toward addressing the barriers that limit opportunities for these groups. Both short- and long-term employment outcomes require the support of additional investments (public and private) and capacity, including for technical analysis, monitoring, and evaluation.
- Given that jobs are an important development indicator, employment targets need to be tracked systematically in projects. Investing in the substantive analyses and other efforts required to meet targets calls for a shift in corporate and government priorities.

Endnotes

1. In doing so, this document builds on existing World Bank resources on job indicators (World Bank 2017b). In particular, this prior work focused specifically on "job operations," a World Bank lending activity that has an explicitly stated and substantive link to creating jobs, improving the quality of existing jobs, and helping people connect to jobs or move to better jobs. By contrast, this document considers projects that focus primarily on clean energy; thus, the optimal job indicators are likely to differ.
2. World Bank (2017b) contains additional information on forms and manuals for collecting job data, and terms of reference.

ONE
INTRODUCTION: THE NEED TO INCREASE, AND TRACK, JOB CREATION

The transition to clean energy can create job opportunities and support economic activity while advancing the global decarbonization agenda. Many aspects of this transition—including investments in renewable energy; grid strengthening to absorb variable renewable power; decentralized generation, including for energy access; digitization of the energy sector; energy-efficient appliances; and energy efficiency in buildings, industry, and transport—have significant potential to create both domestic and local employment. Analyses undertaken by the International Renewable Energy Agency (IRENA) and the International Energy Agency[1] commonly acknowledge that many aspects of the transition to zero-carbon power have significant potential to create local employment (IRENA 2020; IEA 2020). Nevertheless, estimations have been mainly at a global level, while quantification at a local level remains a challenge.

Expanded and improved energy services can not only create jobs in the energy sector, but also boost economic activity and job creation in the broader economy. The expansion of access to energy increases its productive uses. Meanwhile, the retirement of fossil-fuel-fired plants and mine closures, among other changes in a clean energy transition, could also potentially lead to job losses. These losses must be accounted for and managed under the global decarbonization agenda. Before providing an overview of what we know of the energy transition's employment impacts, this discussion paper will focus on job categories, as explained in the following subsection.

1.1 Defining Jobs

This discussion paper considers three categories of jobs[2] created by the clean energy transition: direct, indirect, and induced (as defined in box 1.1). The delineation of each category can vary depending on the topic being evaluated and may cause confusion. For example, economywide reforms might generate different types of direct jobs (all of them in the energy sector) than investment projects (in installation, and operation and maintenance [O&M] only). Global assessments could consider manufacturing jobs as direct, whereas project-based assessments would consider them as indirect since they are not within the scope of a specific project. Or jobs resulting from the productive use of energy (thanks to a project expanding access) could be classified as direct rather than induced. The scope of a project would thus have to be specified when starting to track jobs.

The energy transition also entails the reskilling of workers from old "brown" (fossil-fuel-related) jobs to new "green" (clean energy) jobs. However, the process is not straightforward, and to model a direct one-to-one conversion from a brown to a green job would not necessarily replicate the reality on the ground. A key reason is that direct and indirect jobs in clean energy are typically spatially distributed, unlike jobs in conventional generation projects. Transitioning from a brown to a green job is not always realistic, since new and emerging jobs are highly complex, mastering new skills requires education, and the

BOX 1.1

DEFINITIONS OF JOB TYPES

Direct jobs are jobs generated directly by core project activities (i.e., without considering the intermediate inputs required to manufacture renewable energy equipment). For example, if a funder pays a construction company to retrofit buildings, then the company's local workers who undertake this project are considered to have direct jobs. This definition also considers the employees of subcontracted companies. Another example would be if a construction firm hires a subcontractor to help with its work. In this case, the local employees of both companies engaged in the project are considered to have direct jobs.

Direct jobs include all jobs related to the installation, and operation and maintenance of clean energy projects. For off-grid solar projects, the distribution, marketing, and sales of solar equipment would also be considered direct jobs.

Indirect jobs include jobs in upstream industries performing and supporting the core activities of clean energy deployment. Such activities include, for example, manufacturing the equipment and materials used for project facilities. Workers in such positions may produce steel, plastics, or other materials, or they may provide financial, banking, and other services. These industries are not directly involved in project-related activities but produce intermediate inputs along the value chain of relevant energy technologies supported by a clean energy project. Indirect jobs may also be located abroad, since material, metals, and equipment are produced in a handful of countries.

Induced jobs[3] result when the people directly and indirectly employed or associated with a project spend their earnings. As opposed to indirect jobs, induced jobs are found in all sectors of an economy since they stem from the final demand for goods and services. A subset of induced jobs include "productive uses of electricity" jobs, which are created by electricity consumers due to new power supply or improvement in the delivered power supply due to a project. These can be considered as the net jobs created. For example, improved electricity access can help women engage in selling textiles since they can use electric sewing machines and also work into the evening, with lights turned on, increasing their productivity.

The delineation of direct, indirect and induced jobs may vary based on the level of analysis. For example, global assessments may consider manufacturing jobs as direct, whereas project-based assessments may consider them indirect.

Source: Original compilation for this discussion paper; ESMAP 2023b.

geographical distribution of green jobs may not necessarily overlap with that of brown jobs. For example, countries closing coal-fired power plants are increasingly facing the challenge of redeploying workers from these plants, besides revitalizing the communities dependent on these jobs. Evidence from case studies (ESMAP 2023k) indicates that planning the job transitions of coal-fired power plants' workers must consider local circumstances, not only of the country in question, but also the community.

1.2 What Do We Know of the Jobs Created by the Clean Energy Sector?

A number of global energy organizations and think tanks have estimated the number of clean energy jobs created globally. For example, IRENA provides a yearly review estimating the jobs in renewable energy worldwide. The latest edition of this review reported 12.7 million jobs in 2021, with solar photovoltaics, bioenergy, hydropower, and wind energy being key technologies (IRENA 2022a). For each technology, jobs encompass the entire production chain, from manufacturing, installation, and O&M, to employment in upstream sectors in the renewables supply chain. It is worth noting that a handful of countries host renewable energy jobs, with Asian countries alone accounting for 64 percent of global renewable energy jobs in 2020. Most of the jobs discussed in estimates are in the direct and indirect categories. One of the reasons is also because manufacturing of renewable energy equipment is in a limited set of countries, and thus over a short to medium term, employment gains will primarily favor exporters of clean technology components.

To better understand the employment impacts of the energy transition and shed light on the potential for job creation at the country level, the Energy Sector Management Assistance Program (ESMAP) conducted a series of case studies on the jobs created by various World Bank projects, besides a general equilibrium modeling of the impacts of enhanced energy supply on labor markets. The case studies provide pointers for integrating job creation targets—and their monitoring—in energy transition projects. Analysis of the main findings, messages, and conclusions is presented in a report (ESMAP 2023b). In contrast to this discussion paper, that report analyzes economywide impacts. It presents methodologies such as bottom-up engineering models, input-output tables, computable general equilibrium models, and econometric assessments, which are commonly found in academic and applied/policy literature and are used to analyze the economywide impacts of job creation. Common job-related findings include:

- **Direct jobs.** Sustainable energy infrastructure projects tend to generate significant numbers of temporary yet high-quality direct construction jobs and fewer direct O&M jobs. The O&M jobs, however, generally last several decades.

- **Indirect jobs.** The degree of indirect employment will depend on the volume of input that projects require from upstream sectors and the employment factors in these sectors (i.e., number of employees required per unit of output in the upstream sectors). Suppliers (e.g., equipment/inputs) are established entities that already employ staff. Projects may thus not be creating new jobs.
- **Induced jobs.** Induced jobs are likely to represent the majority of jobs created by the energy transition. These jobs are not restricted to the energy sector and could eventually become more durable than direct jobs. However, there is limited ground-based evidence on induced job creation. Electrification projects can create induced jobs through productive uses of electricity, as can the demand resulting from projects (e.g., increased demand for solar rooftop projects).

It was also found that:

- **The direct and indirect employment impacts of sustainable energy investments needs to be evaluated more systematically** to strengthen investors' confidence in employment ratios. The typical approach to calculating employment ratios could be improved upon through surveys of additional geographical areas for specific industries. It is also advisable to disaggregate employment data at least by value chain segment, citizenship (domestic vs. international), gender, ethnicity, age, and (dis)ability (World Bank 2022b).
- **Gender.** The project case studies did not include any specific measures to address gender. However, for all projects studied, women's employment represented a minor share of direct employment—a maximum of 14–15 percent in two cases, well below the share of women working in the energy sector (45.9 percent) or renewable energy sector (32 percent) (IRENA 2022b). No clear trend was seen in the types of jobs held by women across the cases studies. However, a majority of the female workforce was found to be hired for semiskilled or unskilled positions.

Regarding methodologies, the existing literature is mostly enriched by data from ex ante modeling, to assess sectoral or economywide job creation impacts, and less by ex post modeling (due to lack of data and empirical evidence). While studies using ex ante methods have analyzed a wide range of policy interventions and projects in developing countries to estimate direct, indirect, and induced job creation mechanisms, ex post methods—necessary to establish causality—have had a narrower focus on induced jobs.

This discussion paper specifically focuses on World Bank projects and will not consider economywide impacts. The paper attempts to simplify the process for project teams, providing examples of ways to design a theory of change (TOC) as a sequence of causal steps from a set of four activities to target employment outputs, outcomes, and long-term outcomes. Details of designing a TOC are presented in chapter 2 (focused on clean energy) and chapter 3 (on productive uses of electricity). Table 1.1 outlines the three job categories (direct, indirect, and induced), and related estimation and data collection methods, among others.

TABLE 1.1

Matrix for Job Estimation, Measurement, and Monitoring

JOB CATEGORY	ESTIMATION METHODS (FOR PROJECTS)	MEASURES/ INDICATOR TYPE TO USE	DATA COLLECTION METHODS/ SOURCES	DATA COLLECTION CONSIDERATIONS	TYPES OF RESULTS MEASURED	REASONS THE CATEGORY IS IMPORTANT TO MEASURE
Direct	Count jobs	Jobs created due to construction, installation, and operation and maintenance	Estimated based on data derived from interviews and project documentation	Need for disaggregated employment data from contractors/ subcontractors	Outputs, unless specific training is provided—then these become outcomes (i.e., demonstration effect for similar projects). For example, the Kosovo case study—see appendix D and figure D.2.	Job creation is a positive "side effect" of an energy project. Energy projects typically focus on measuring contributions to energy systems, although their construction and operation generate wider economic effects, of interest to many governments.
Indirect	Estimated using employment factors (e.g., per megawatt installed or other unit of equipment supported by a project)	Jobs created upstream in the supply chains for the equipment used in projects' construction, and operation and maintenance (e.g., the materials and metals needed for solar photovoltaic panels)	From literature assessing similar projects and similar circumstances (e.g., same country)	1. The degree of indirect employment will depend on the volume of input that clean energy projects require from upstream sectors and the employment factors in these sectors (i.e., number of employees required per unit of output in the upstream sectors) 2. Estimating upstream supply chains for all materials would be too complex and is not deemed feasible	Outputs, unless specific training is provided—then these become outcomes	Estimating indirect jobs helps governments define industrial strategies and make decisions about which parts of supply chains are of interest to localize in the country. The number of jobs created is only one argument in the decision-making. The competitiveness of the possible industrial sector to be created remains an important consideration.
Induced	Quantitative evaluation, impact evaluation	Employment, jobs linked to productive use	Survey data, administrative data	Budget, cost, and administrative burden associated with sharing administrative data; verification of data quality; data availability for a control group (if using impact evaluation)	PDO outcome, long-term outcome	Long-term effects of a project, broad-based economic changes, net effects on job creation.

Source: Original compilation for this discussion paper.

Note: PDO = Project Development Objective.

1.3 The Need to Track Jobs in Projects Involving Multilateral Development Banks

While job creation may not always be a Project Development Objective (PDO) on its own, it is possible to design clean energy projects to explicitly target employment outcomes. For example, assuming local employability is hindered by lack of training of and experience among local workers, a clean energy project could create more jobs if investments in local skill building are bundled with support for the construction of clean energy infrastructure. Understanding these dynamics would allow project teams to better articulate potential project benefits when engaging with local stakeholders.

Key to this discussion paper is the design of a TOC for clean energy projects. The TOC will help target employment outcomes, which entail not only the number of jobs created, but also longer-term outcomes, such as job quality and job equity. These are significant, especially to make an energy transition socially sustainable—by making it just and inclusive. Specifically:

- **A TOC for job creation associated with clean energy interventions can inform the design of project-level activities.** Clear articulation of the underlying causal pathways linking clean energy project investments to immediate and long-term job creation can help project teams identify the optimum package of activities to be included in clean energy projects. Further, recognition of the assumptions that must hold for project-level outcomes to influence the expected impacts can help highlight the extent to which complementary investments must be made alongside core project activities to ease the binding constraints that can limit project-level outcomes.
- **Tracking key job indicators can enable a systematic assessment of potential employment impacts of clean energy investments.** The clean energy transition is widely expected to deliver a range of benefits beyond those related to energy and greenhouse gas emissions. These include job creation (IEA et al. 2022). Yet, this link to employment is not typically articulated as part of the PDOs of the World Bank's clean energy lending operations. This is primarily because job creation and other employment outcomes are generally seen as beyond the scope of energy sector investments. Integrating the activities, outputs, outcomes, and corresponding indicators outlined in this document into projects' results frameworks can increase the degree to which employment-related results attributable to clean energy projects are identified and assessed comprehensively.
- **The body of empirical knowledge must be expanded and project design enhanced to increase the job-related benefits of all clean energy projects.** Tracking employment outcomes would expand the knowledge base, as would improving the methods used to track them. These efforts would enhance understanding of the positive and negative employment outcomes of project implementation, especially in developing countries.

Appendix D presents the TOCs of World Bank–financed clean energy projects for which ESMAP conducted a series of case studies, including investments in rooftop solar panels and solar mini grids (Pakistan and Nigeria, respectively), hydropower (India), energy efficiency upgrades (Kosovo), grid infrastructure (Peru and Malawi), and power-sector reform (Rwanda). These templates (besides those provided in the report) will give project teams opportunities to draw on more tailored TOCs for different types of projects.

Note: This discussion paper focuses on project-level job creation rather than tracking the economywide effects of the energy transition, for example, job substitution and/or displacement (e.g., from the fossil fuel industry) and job transformation. An economywide analysis of these types of jobs are provided in case studies of Morocco and Egypt (World Bank 2022c, 2022d).

Endnotes

1. IEA (2020) analyzes the employment potential of various energy investments. It does so with the aim of identifying energy investments that could support a green recovery from the pandemic. Also, IRENA (2020) assesses the regional employment impacts of the energy transition using an integrated global macroeconometric model (see also IRENA [2022a]).
2. Appendix B summarizes a jobs classification compiled by the World Bank Jobs group. Induced jobs are considered as a subset of indirect jobs.
3. Some induced jobs are “replication” jobs—jobs created due to increased demand for a particular type of project or installation spurred by an initial project. For example, a rooftop solar installation in a public building could lead to a sudden increase in demand for other rooftop solar installations. Subsequent jobs created could be accounted for as jobs induced by the original project.

TWO

METHODOLOGY: THEORY OF CHANGE

A theory of change (TOC) comprehensively illustrates how a set of interventions/activities may lead to the change that a program or project is trying to achieve within a particular context. The TOC is presented as an overarching framework and provides a snapshot for understanding systematically, and logically, the links between interventions and anticipated goals/impacts. There are two primary benefits to developing a TOC:

1. **A TOC helps ensure that a project is grounded in strong evidence.** Specifically, charting the explicit steps in a causal pathway allows project managers and analysts to assess whether each node and link along that pathway is valid. If this is not the case, project activities might not trigger the process needed to lead to the desired long-term change, despite flawless project implementation—a lapse known as "theory failure" (Rossi, Lipsey, and Freeman 2004). The tracking process can help in designing realistic outcomes and establish a common understanding of how to achieve a goal or create an impact.

   The TOC is to be developed through an iterative process and can be represented in different ways depending upon the project design and specific country context.
2. **A TOC helps inform the design of effective performance monitoring systems.** Specifically, TOC development allows analysts to identify suitable indicators to measure the success of an intervention at each node along the causal pathway. These indicators can help track progress and, if needed, reorient project activities and efforts.

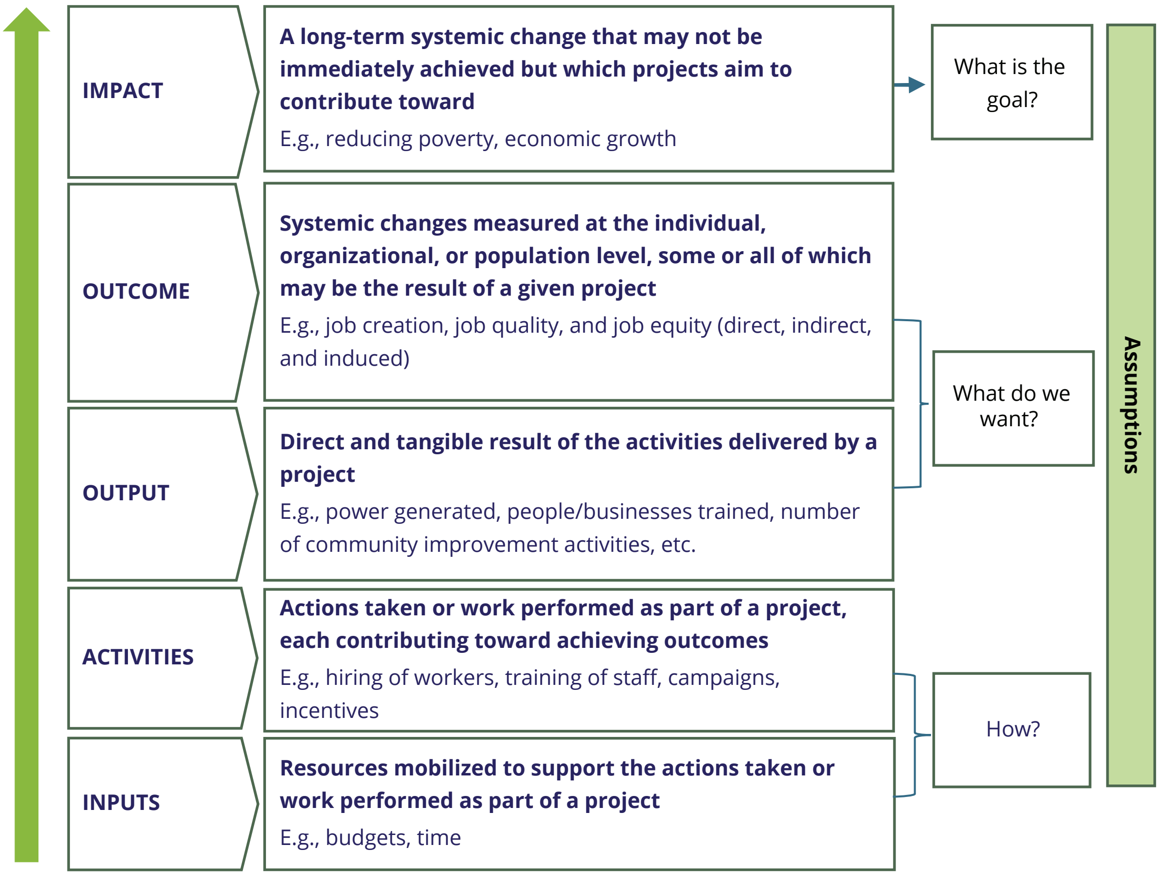
   Effective performance monitoring systems also help identify implementation gaps, which in turn can help explain low or no impact on the desired outcomes over the longer term. For example, a project would fail to activate the first step in the causal pathway if the activities were not delivered as planned or implemented poorly. The project may thus not achieve the desired longer-term change. Articulating all the steps in the causal pathway allows analysts to identify indicators and measures for what is known as "implementation failure" (Rossi, Lipsey, and Freeman 2004).[1] Specifically, if changes earlier on in the causal pathway are not being realized, or delivered imperfectly, and the intended results fail to materialize, then there is little value in tracking downstream indicators (e.g., outcomes). Articulating all the steps in the causal pathway also provides an early indication to enable course correction as needed.

In designing a TOC, the long-term goal or impact is identified and aimed to be achieved through related outputs and outcomes, which are represented by key metrics or indicators. Specifically, a TOC for a clean energy project would typically depict the logical relationship among five key components in a results chain as shown in figure 2.1.

Note: The TOCs presented in this discussion paper are not intended to be replicated in their entirety since the causal pathways will be context and country specific. Project teams may select relevant indicators as appropriate in the design of specific projects. Similarly, the assumptions presented in the TOCs are examples, and each project must assess assumptions based on the country context.

FIGURE 2.1

Key Components of a Theory of Change for a Project/Program



Source: Original compilation for this discussion paper.

The TOC must draw on situational and country context analysis, previous evaluations of similar projects, and consultation with stakeholders, including Bank staff and, specifically, the project team. Measuring employment outcomes can be complex and requires increased capacity and resources. Thus, project teams need to design the TOC taking all these factors into consideration.

2.1 Tracking and Indicators: Measuring Employment-Related Outcomes

While a TOC provides the overall change framework, the key to measuring a project's effectiveness lies in detailing the individual components, from inputs to outcomes. A TOC is also used as an input to design project monitoring and evaluation efforts. This exercise often utilizes a results framework as a tool that describes components in detail through sets of indicators. Explicitly defining indicators can yield a clear insight into the effectiveness of interventions. This section provides information on the employment-related outcome indicators that project teams can identify and select based on the design of a clean energy project, and the project's expected links to employment if related to the Project Development Objective(s).

Table 2.1 provides key outcome indicators related to the three job types: direct, indirect, and induced (i.e., those linked to productive uses of electricity, PUEs). The indicators are as follows:

(1) **Job creation.** This domain covers employment, a key outcome across all three job types (box 2.1). Note that job creation may also be an output depending on a project's design.

(2) **Job quality.** Jobs differ substantially in terms of quality. Among the job quality indicators captured, wages—both nominal and real—is the primary indicator. Real wages are important because they are affected by the cost of living, which can be reduced by clean energy projects. Depending on the job type, other indicators may include job formality status, coverage under social security insurance, and the number of working hours.

It must be noted that the data collection burden associated with additional metrics (besides wages) varies by job type. For example, it will be relatively easy to collect information on job safety standards and employment benefits for direct jobs, whereas this will be moderately challenging for induced jobs and extremely challenging for indirect jobs. For this reason, this discussion paper does not recommend that project teams collect data on all job quality metrics for all job types. Other indicators, such as safety at work, on-time payments, and other job benefits, can also be derived from qualitative assessments or through the monitoring processes. Capturing these indicators will strengthen job-quality-related results.

(3) **Job equity.** Job equity is measured by disaggregating the employment outcomes of interest within the two previous indicators based on various marginalization-related attributes (e.g., gender, vulnerability status, age, and, for some indicators, skill level). This disaggregation may also depend upon the specific country context, both legal and social (e.g., groupings based on identities of religions, youth, indigenous groups, etc.).

While table 2.1 provides a list of indicators against three key outcomes to track employment, appendix A provides details on these indicators, including, among others, their definitions, ways to calculate them, and the source information. Combinations of

TABLE 2.1

Local Clean Energy Job Indicators, by Job Type and Outcomes

TYPE	TABLE	INDICATORS	OUTCOMES			RELEVANCE
			CREATION	QUALITY	EQUITY*	
Direct	A.1	Direct employment of domestic (or local) workers in person-years (for the design, supervision, construction, and operation and maintenance of clean energy projects)	X		X	Essential
	A.2	Number and share of individuals trained by a project who the project subsequently employs as direct workers	X		X	Essential
	A.3	Wages of direct local workers		X	X	Essential
	A.4	Job formality status—share of local direct workers employed formally (and informally)		X	X	Essential
	A.5	Number and share of direct workers covered by social security insurance		X	X	Optional
	A.6	Average number of hours worked by local direct workers per week		X	X	Optional
Indirect	A.7	Share of project inputs procured domestically	X			Essential
	A.8	Country- and sector-specific estimates of the number of indirect jobs created by each direct job in person-years or full-time equivalent	X			Optional
	A.9	Indirect employment of domestic workers in person-years or full-time equivalent	X		X	Essential
Induced (including PUEs)	A.10	Employment rate of working-age project beneficiaries	X		X	Essential
	A.11	Employment rate of project beneficiaries who received training (e.g., in PUE MSMEs related to appliances/equipment, business development, market creation, etc.)	X		X	Essential
	A.12	Amount of electricity used by project beneficiaries—individuals and MSMEs—to operate appliances and equipment for PUEs (e.g., water pumps, cooling, etc.)	X		X	Essential
	A.13	Increase in beneficiaries' awareness of PUEs	X			Optional
	A.14	Wages of project beneficiaries		X	X	Essential
	A.15	Share of employed project beneficiaries who are formally employed		X	X	Essential

Source: Original compilation for this discussion paper.

Notes:

[a] Unless otherwise stated, "wages" refers to nominal wages. For equity, the outcomes listed are disaggregated based on vulnerability status, gender, and age (other attributes can be added depending on the country context).

[b] "Beneficiaries" include individuals as well as small and medium enterprises. Beneficiaries must be defined during project design.

[c] For some indicators (A.10, A.11, A.14, and A.15), attribution to the project should be carefully assessed, as well as the likelihood that the desired outcomes can be achieved within the project's timeline.

[d] The theories of change (TOCs) and indicators presented in this discussion paper are not intended to be replicated in their entirety since the causal pathways will be context and country specific. Project teams may select relevant indicators as appropriate in the design of specific projects, besides choosing essential or optional indicators. MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

BOX 2.1

DEFINING THE CREATION OF NEW JOBS

"Job creation" is mainly defined at two key levels: direct/indirect and induced. Often, direct and indirect jobs are linked to project inputs; meanwhile, it would be important, in project monitoring, to differentiate between "new jobs created" and other outcome aspects that a project can influence, for example, job quality and job equity.

However, it is not straightforward to define direct and indirect job creation, especially as "new jobs created." This is because a workforce may already exist, and workers might have had jobs in the absence of a project. This lack of clarity is pronounced for indirect jobs, where industries supporting projects already exist, and more so in advanced markets, where countries have invested more efforts to educate and train the renewable energy labor force. For example, of the 903 workers reported to be employed during the Sindh Solar Energy Project in Pakistan, 458 were new employees and the remaining 445 were existing workers. However, there was no information on whether the new employees held similar jobs prior to joining the Sindh Solar Energy Project.

Given the challenge of monitoring the creation of new jobs, it is critical to track the quality of employment, and also the distribution of benefits, with an eye to equity, especially among women, youth, and the vulnerable (as defined by countries).

Source: Original compilation for this discussion paper; ESMAP 2023b, ESMAP 2023h.

these indicators are utilized throughout this discussion paper to show the causal pathway from activities to outcomes. Project developers should take guidance also from the notes provided below table 2.1.

Appendix C presents further nonemployment outcome indicators primarily for PUEs, besides the above set of indicators.

Endnote

1. "Theory failure" and "implementation failure" are distinct concepts covered by Rossi, Lipsey, and Freeman (2004). Theory failure refers to the validity of the outlined causal pathway, whereas implementation failure refers to the extent to which proximal activities/inputs were delivered effectively to result in distal outcomes.

THREE

DESIGNING A THEORY OF CHANGE FOR EMPLOYMENT IN CLEAN ENERGY PROJECTS

This section presents an overarching Theory of Change (TOC) that highlights key pathways linking clean energy investments to employment and development outcomes. Specifically, the TOC (shown in figure 3.1) illustrates how different types of project-level investments in clean energy (including in renewable energy infrastructure and to increase energy efficiency) can create local direct and indirect jobs associated with a project, as well as net induced jobs at various stages of the project cycle (see box 1.1 in chapter 1 for the definitions of these job types). In doing so, the overarching TOC provides a template that project teams can adapt to specific circumstances (e.g., based on the specific project objectives).

Figure 3.1 also highlights key assumptions along the causal pathway that must hold for project activities to translate into outputs, which lead to the eventual outcomes. For example, project-level investments in female workers' training are unlikely to yield improved employment outcomes if sociocultural norms facilitating female labor force participation are absent. More distal outcomes such as job creation due to increased availability of affordable and reliable electricity services are similarly unlikely to be achieved since electricity access—or quality—is not the sole binding constraint on enterprise creation and growth (e.g., if access to finance—and not electricity—is the key constraint for business creation and expansion). If these assumptions do not hold, projects need to carry out complementary activities that help ease the constraints that hinder beneficiaries from using improved or newly available energy services for productive purposes. This may mean going beyond the typical focus on only electricity, and integrating supporting services (e.g., finance and market access) into project design.

In addition to the overarching TOC, appendix D presents project-specific TOCs and employment-related indicators for selected clean energy projects financed by the World Bank, including investments in rooftop solar panels and solar mini grids (Pakistan and Nigeria, respectively), hydropower (India), energy efficiency upgrades (Kosovo), grid infrastructure (Peru and Malawi), and power sector reform (Rwanda). These additional templates will give project teams opportunities to draw on more tailored TOCs and related indicators for different types of projects.

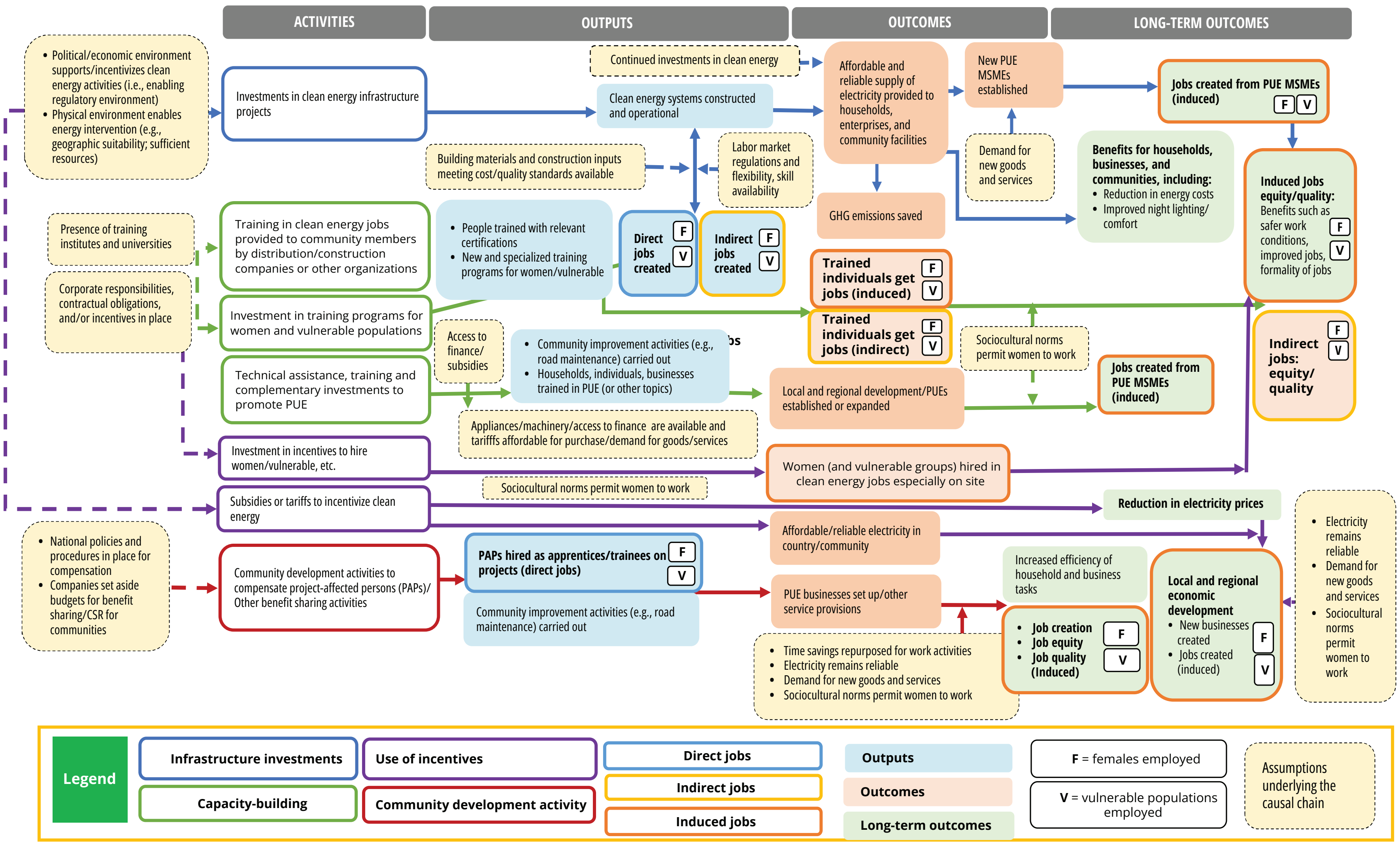
3.1 Categorization and Mapping Activities to Outcomes

The review of clean energy projects through case studies showed that activities often fall into four distinct categories (see figure 3.1):

1. **Infrastructure investments** include direct investments to support the value chain, particularly the construction, rehabilitation, and operation and maintenance of clean energy infrastructure (e.g., renewable energy projects, mini grids, stand-alone solar devices for energy access, transmission and distribution lines, and energy efficiency interventions). Investments can be both public and private.
2. **Capacity building** includes investments in complementary educational programs, including clean-energy-specific training (short to long term) that increases the likelihood of project success.

FIGURE 3.1

Overarching Theory of Change for Clean Energy Interventions



Source: Original compilation for this discussion paper.

Note: CSR = corporate social responsibility; GHG = greenhouse gas; MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

3. **Use of incentives,** typically monetary inducements that promote clean energy policies and solutions.
4. **Community development** includes efforts to compensate households and individuals adversely impacted by projects, or other benefit-sharing activities beyond compensation in the project areas.

Each category holds potential to create jobs (direct, indirect, induced), as well as boost job quality and job equity at different project stages.

Drawing on the case studies, the activities under individual categories are not exclusively related to jobs and employment; instead, they are interlinked to create new employment opportunities and related skill development, which augment job quality over time.

3.1.1 Infrastructure Investments

Investments (public and private) in building clean energy infrastructure/energy access value chain(s) result in direct employment in the firms contracted for construction (including skilled labor such as engineers and architects, semiskilled labor such as electricians, and unskilled labor such as construction workers) and indirect jobs in firms serving as upstream suppliers of the inputs for construction. While projects may promote and acquire domestic and local contractors/subcontractors, there will be a trade-off between the need to involve international expertise and capacities and the delivery of investment activities by local entities. These considerations must be included in the TOC (figure 3.2).

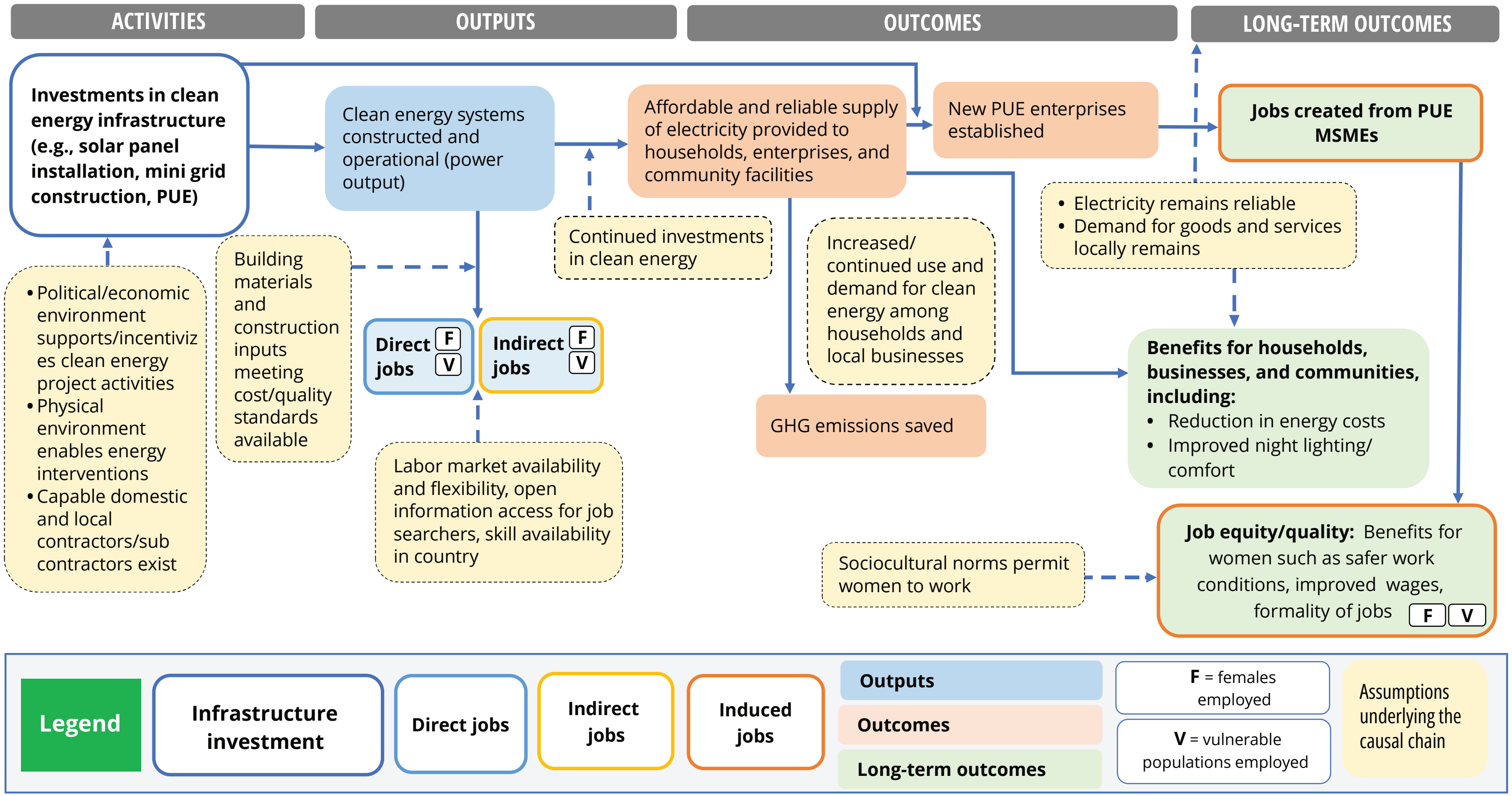
Simultaneously, new micro, small, and medium enterprises[1] promoting productive uses of electricity (PUEs) are established and/or existing enterprises that switch to using electricity. Further, these jobs or productive use enterprises may be temporary. The development outcomes and goals are achieved when these jobs are sustained and these productive use enterprises continue to operate, providing long-term quality employment with competitive wages and other benefits. Table 3.1 provides an example of how infrastructure investments lead to outcomes under a set of assumptions. Results may be hindered if the assumptions made (in the TOC) are not met.

It is valuable to note the multiple pathways leading to induced local jobs. For example, if energy-using appliances, equipment, and tools are easily available in local markets and affordable for project beneficiaries, then investing in their PUE could lead to the creation or expansion of productive use businesses using newly available electricity services. This would, in turn create (induced) jobs. Table 3.2 lists examples of direct, indirect, and induced jobs from the case studies. Job classification may vary depending upon the country context.

Examples of employment-related outputs and outcomes from selected case studies are provided in box 3.1.

FIGURE 3.2

Theory of Change for Infrastructure Investment Activities and Related Outputs, Outcomes, and Assumptions



Source: Original compilation for this discussion paper.

Note: GHG = greenhouse gas; MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE 3.1

Examples of Infrastructure Investment Activities and Related Outputs, Outcomes, and Assumptions

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
Direct investments (public and private) for construction, rehabilitation, and operation and maintenance activities Investments (public and private) in productive use enterprises	• Political/economic environment supports/incentivizes clean energy project activities (i.e., enabling regulatory environment) • Electricity remains reliable • Physical environment enables energy interventions (e.g., geographic suitability for hydropower, sufficient resources) and their sustainability/reliability • Labor market regulations and flexibility (to facilitate free job entry and workers moving across jobs/locations), open information access for job seekers • Human capital and skill available • There exists a demand (and investments are available) for specific goods and services for productive use enterprises to be established and sustained • Sociocultural norms permit women to work	• Power output of constructed and operational clean energy project(s) • Direct and indirect jobs created	• Affordable and reliable electricity supply • New productive use enterprises (micro, small, and medium enterprises) established • Greenhouse gas emissions saved • Benefits for households, businesses, and communities	• Jobs created in productive use businesses (induced jobs) • Job equity/job quality, for example, safer working conditions, improved wages, and job formality according to gender and vulnerable group • (Non-job-related indicators could include profitability of energy-using businesses)

Source: Original compilation for this discussion paper.

*Greenhouse gas savings in tonnes of carbon dioxide equivalent due to the project's operation over the reporting period. Project teams should refer to experts to determine the baseline and actual carbon computation methods depending on, for example, the technology(ies) and the fuels replaced. The basic calculation is provided in appendix C.

TABLE 3.2

Examples of Clean Energy Jobs, by Job and Project Type

JOB TYPE	PROJECT TYPE			
	HYDROPOWER*	T&D	OFF-GRID SOLAR	ENERGY EFFICIENCY
Direct				
Design	Engineers, environmental and social (E&S) experts, gender and social inclusion (GSI) experts, lawyers, finance experts	Engineers, surveyors, E&S experts, GSI experts, foresters, lawyers	Engineers, GSI experts	Engineers, energy auditors, architects
Supervision	Managers, accountants	Managers, accountants	Managers, accountants	Managers, accountants
Construction	Engineers; construction workers; electricians; plumbers; clerks; data entry personnel; cleaners; drivers; security guards; mechanics; drilling and blasting workers; H&S, E&S, and GSI experts; site managers; monitoring and evaluation experts; compliance and quality control experts; community engagement specialists; etc.	Construction workers; cable jointers; fitters; masons; bar-benders; electricians; brick layers; procurement officers; engineers; H&S, E&S, and GSI experts; storekeepers; foresters; forest guards	Construction workers, solar panel installers, electricians, security guards, manual labor, bricklayers, welders, painters, transportation professionals	Construction workers, asbestos mitigation technicians, electricians
Operations	Management, sales, site managers, storekeepers, camp site officers, security personnel, drivers	Management, sales, site managers, storekeepers, camp site officers, security personnel, drivers	Management, sales, site officers, security personnel	n.a.
Maintenance	Hydropower maintenance staff (engineers and other technical experts, operators, technicians, etc.)	Grid maintenance staff	Off-grid maintenance staff	Building maintenance staff
Indirect	Producers of hydropower plant components, cement, steel, glass, binding wires	Producers of information technology equipment, wiring, electrical equipment, tools, safety clothing, timber	Solar panels, inverters, wiring, batteries, mounting structures	Building materials, insulation materials, windows, doors, lighting
Induced (productive use)	All jobs benefiting from increased and improved electricity access (typically more urban customers since they are grid connected) PUE enterprises can include, among others, agro-processing machineries, welding machines, mobile phone charging, salons/ barber shops, printing, photocopying, lighting business centers, refrigerators, irrigation pumps	All jobs benefiting from increased and improved electricity access (typically more urban customers since they are grid connected) Like hydropower, grid-connected PUE can also include higher-wattage appliances/ equipment since there is no restriction on electricity use	All jobs benefiting from increased and improved electricity access (typically rural customers since they are off grid) Off-grid solar PUEs are/ maybe limited in terms of power consumption and appliances/ equipment (see glossary for some examples of both)	Dependent on the project's nature and can be PUE businesses in lighting, cooling (air conditioners), etc.

Source: Original compilation for this discussion paper.

Note: *Note that these jobs could also be similar to other renewable energy technologies such as solar and wind. The classification in this table is based on a selection of case studies of World Bank projects. The list of jobs by project is not exhaustive and may vary according to the technologies used in a project. E&S = environmental and social; GSI = gender and social inclusion; H&S = health and safety; PUE = productive use of electricity; T&D = transmission and distribution; n.a. = not applicable.

BOX 3.1

CASE STUDY EXAMPLES OF INFRASTRUCTURE INVESTMENT ACTIVITIES

Kosovo. Companies/consortia were awarded financing for energy efficiency and renewable energy retrofits in central government buildings (including assessment of building energy audit reports, preparation of renovation design plans, and renovation-related construction). Retrofits were performed in 87 buildings, resulting in 326 direct person-years (see note) of employment over 2016–21, 24 person-years per million euros, and 9 person-years per 1,000 megawatt-hours.

Peru. Subsidies were provided to partially finance the capital costs of electricity access projects in rural areas. The electricity grid was extended to serve households (105,000 in the first phase, RE1) and small enterprises in previously underserved regions of Peru. In the second phase, RE2, there were new potential connections (42,669), new connections (36,518), and productive units adopting electricity equipment (4,376) in 2017. The World Bank invested an estimated $36 million.

One study indicates that RE1 beneficiaries enjoyed an employment rate of 88.4 percent following the intervention (in 2016), and a rise in average monthly income per capita of 63 percent. RE2 beneficiaries had 57 person-years (domestic) of direct employment in design, management, construction, and operation and maintenance, besides the direct jobs created by nongovernmental organizations to build capacity for productive uses of electricity. They also benefitted from 154 job-years (domestic) due to the demand for the inputs for construction and operation and maintenance.

Source: ESMAP 2023e; ESMAP 2023i.

Note: This document assumes that there are 2,080 working hours per year (40 hours per week multiplied by 52 weeks per year). For their estimates, project teams must study the labor laws of the countries where projects are being developed.

3.1.2 Capacity Building

These activities include investments (public and private) in complementary education, including training programs, and clean-energy-specific technical assistance, which increases the likelihood of project success (box 3.2). Table 3.3 presents some of the proposed outputs and outcomes for capacity building. Outputs related to training programs can be targeted at specific groups (e.g., number of females, members of vulnerable population groups, and individuals displaced by project activities, as was done under the Rampur Hydropower Project in India). This will enhance skill development and foster project-related employment opportunities for such individuals. The Kosovo Energy Efficiency and Renewable Energy Project supported operation and maintenance training for building staff in areas where energy efficiency upgrades were made. This was to ensure the availability of sufficiently skilled workers to carry out these activities following project completion (World Bank 2014).

BOX 3.2

AN EXAMPLE OF CAPACITY-BUILDING ACTIVITIES FROM INDIA

As part of the World Bank–supported construction and operation and maintenance of the 412 megawatt Rampur run-of-river hydroelectric power plant in Himachal Pradesh, India, vocational training programs (including tuition expense reimbursement and monthly stipend provision) were established to support industrial training institutes in offering technical education to youth in the project-affected areas. This was supplemented with apprenticeship schemes for technically qualified youth to work for up to one year in project-related activities.

Results. By 2015, seven years after project initiation, 195 candidates were trained in industrial training institutes; of these, 31 candidates, or about 16 percent, were female. About 89 percent of the candidates had completed their courses and 55 percent, including 13 females, had been employed by contractors.

Source: ESMAP 2023d.

TABLE 3.3

Examples of Capacity-Building Activities and Related Outputs, Outcomes, and Assumptions

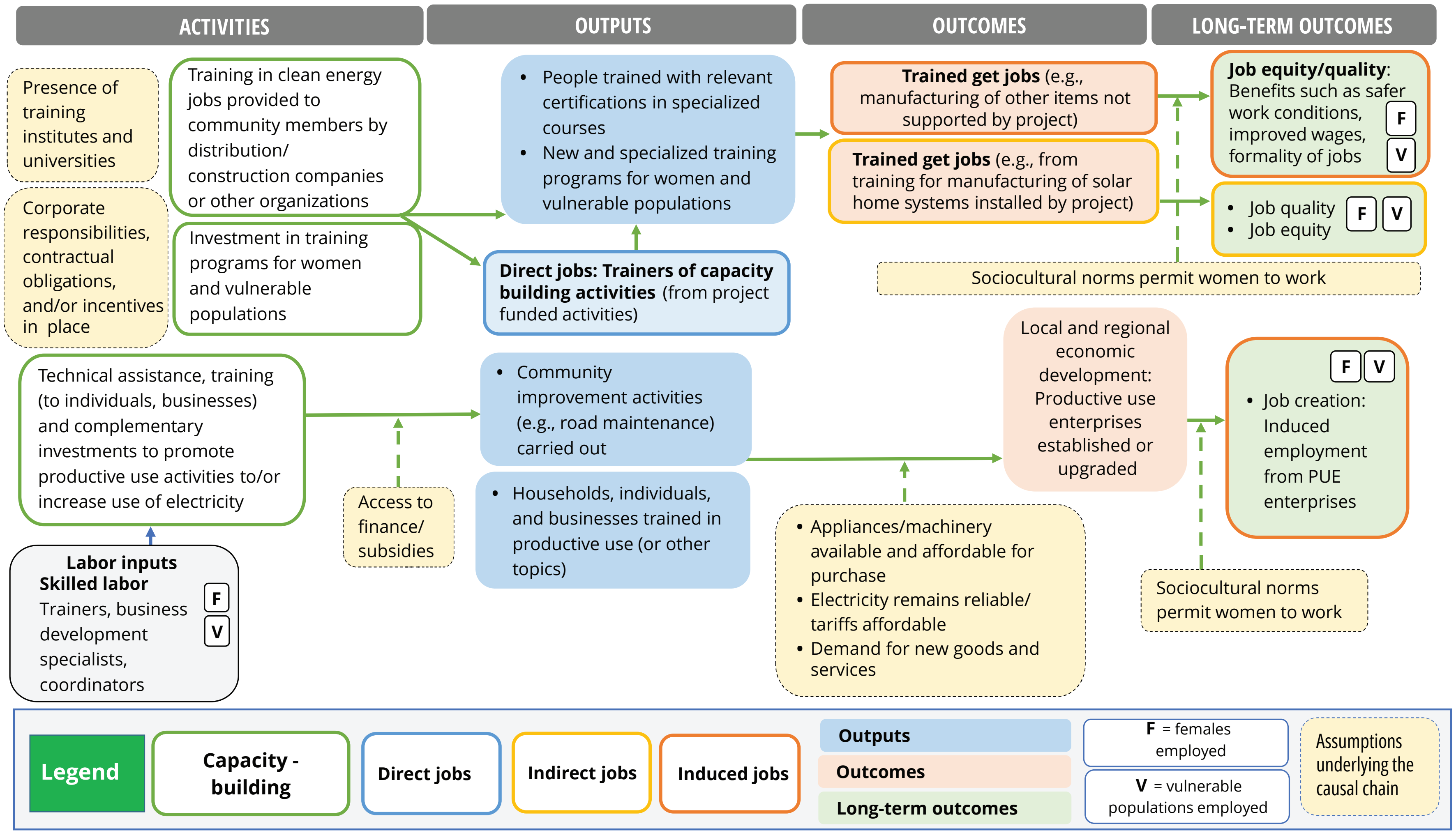
SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
• Training and skill development (on various topics) by projects • Investments in training programs for women and vulnerable populations	• Presence of training institutes and universities • Sociocultural norms allow women to work	• People trained through specialized courses • New and specialized training programs for women and vulnerable populations • Direct jobs (trainers in capacity-building programs/activities)	• Trained people (including project-affected people) are employed in projects/sectors (induced) • Indirect jobs in the manufacturing of goods and materials (e.g., wires, transformers, electrical equipment) for supporting clean energy investments	Job equity/job quality, for example, safer working conditions, improved wages, and job formality according to gender and vulnerable group
Technical assistance, training (to individuals and businesses), and complementary investments to promote productive use activities to/or increase the use of electricity	• Access to finance/subsidies • Electricity remains reliable • Tariffs affordable for establishing productive use of electricity enterprises • Appliances/machinery available and affordable • Demand for goods and services locally remains	• Community improvement activities (e.g., road maintenance) carried out • Households, individuals, and businesses trained in productive use	• Local and regional economic development. Productive use enterprises established or upgraded	• Jobs created in productive use businesses (induced)

Source: Original compilation for this discussion paper.

Capacity-building programs may entail multiple levels of inputs and activities to achieve outcomes, which may vary based on project design and goals (figure 3.3). For example, if a number of women were trained in productive uses of mini-grid- or grid-based electricity, then their skills can be project outputs. Further investments and training and business development support can help the women start new PUE businesses—which will be project outcomes. Further, long-term outcomes could include better job quality, measured via indicators such as increase in nominal and real wages—the latter important because they are affected by the cost of living, which can be reduced by clean energy projects. Similarly, households earning an informal income with PUE appliances can also increase their income and improve their service quality. Specific job quality indicators can also include formality status, coverage under social security insurance, and the number of working hours.

FIGURE 3.3

Theory of Change for Capacity-Building Activities and Related Outputs, Outcomes, and Assumptions



Source: Original compilation for this discussion paper.

Note: PUE = productive use of electricity.

3.1.3 Use of Incentives

This refers to monetary inducements promoting clean energy policies and solutions. For example, the Nigeria Electrification Project provides mini grid operators with performance-based grants based on the number of new customers they connect (see box 3.3). The grants are being provided with an aim to incentivize rapid and efficient uptake of mini grid electricity connections (World Bank 2018). Table 3.4 presents examples of incentives that lead to the eventual job-related outcomes, and figure 3.4 outlines a TOC for such incentives.

Box 3.3 describes an example of the use of incentive activities.

BOX 3.3

AN EXAMPLE OF INCENTIVES FROM NIGERIA

Performance-based grants (initially set at $350 per connected end user) were used in Nigeria to incentivize the uptake of mini grid electricity connections. Energy-related outputs included the installation and commissioning of mini grids (a target of 850 mini grids with solar generation, battery storage, and diesel backup generation), besides increased access to affordable and reliable electricity services for households and enterprises, cost savings due to reduced dependence on diesel generators, and the use of productive use and household appliances.

Some outcomes included enhanced comfort/quality of life (e.g., with fan and lighting) and the creation of new businesses and jobs providing higher incomes. It is worth noting that electricity access was the intended primary outcome, although case studies such as this have shown that other additional outcomes could be adopted in project design.

Source: ESMAP 2023g.

TABLE 3.4

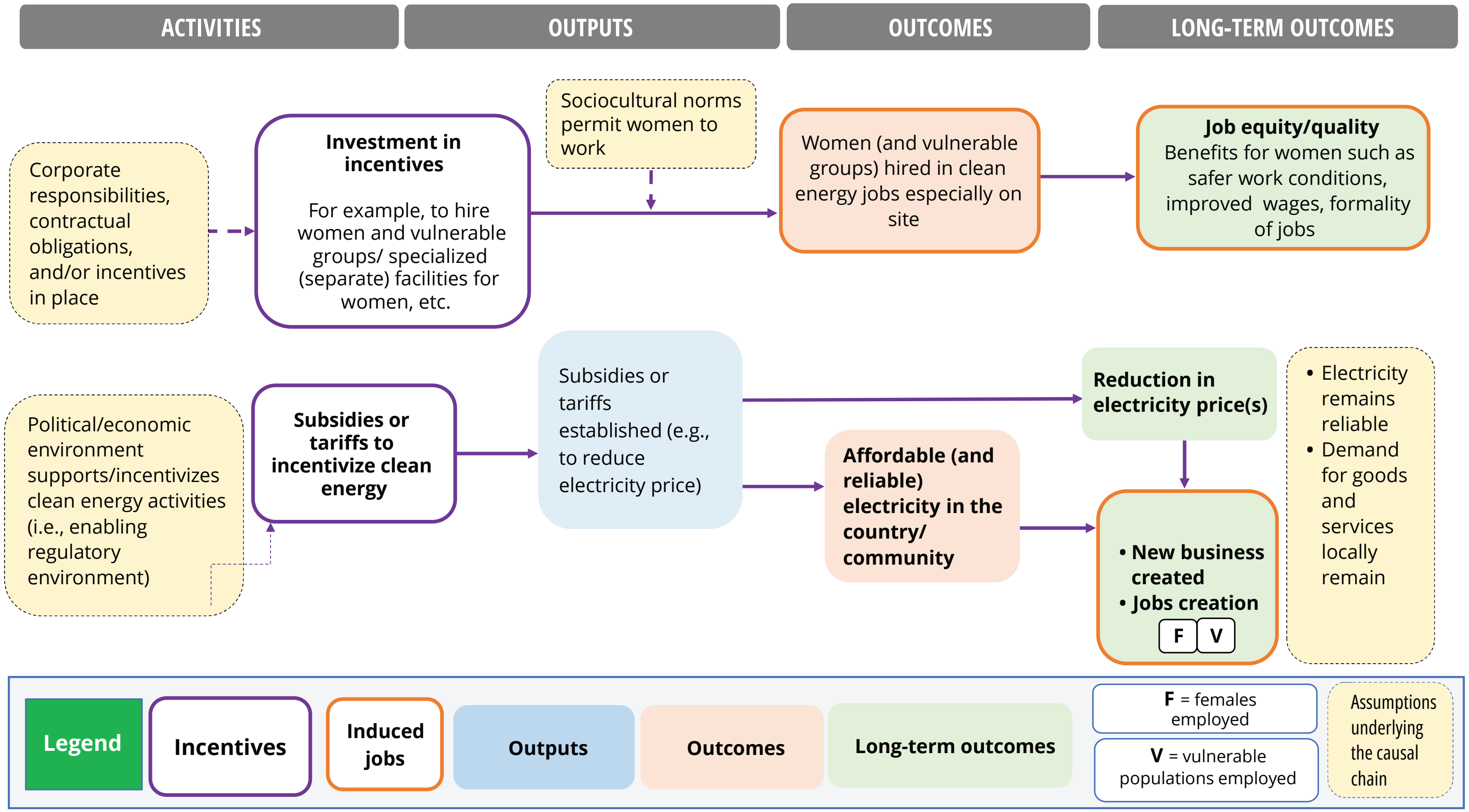
Examples of the Use of Incentives and Related Outputs, Outcomes, and Assumptions

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
Subsidies or tariffs to incentivize clean energy	Political/economic environment supports/incentivizes clean energy activities (i.e., an enabling regulatory environment)	• Subsidies or tariffs to incentivize clear energy established	• Affordable (and reliable) electricity in the country/community	• Reduction in electricity price(s) • New businesses created
Investment in incentives, for example, to hire women and vulnerable groups or for specialized (separate) facilities	Sociocultural norms permit women to work Corporate responsibilities, contractual obligations, and/or incentives in place		• Women (and vulnerable groups) hired for renewable energy jobs especially on site (mostly on direct jobs)	Job equity/job quality, for example, safer working conditions, improved wages, and job formality according to gender and vulnerable group

Source: Original compilation for this discussion paper.

FIGURE 3.4

Theory of Change for Incentives, and Related Outputs, Outcomes, and Assumptions



Source: Original compilation for this discussion paper.

3.1.4 Community Development

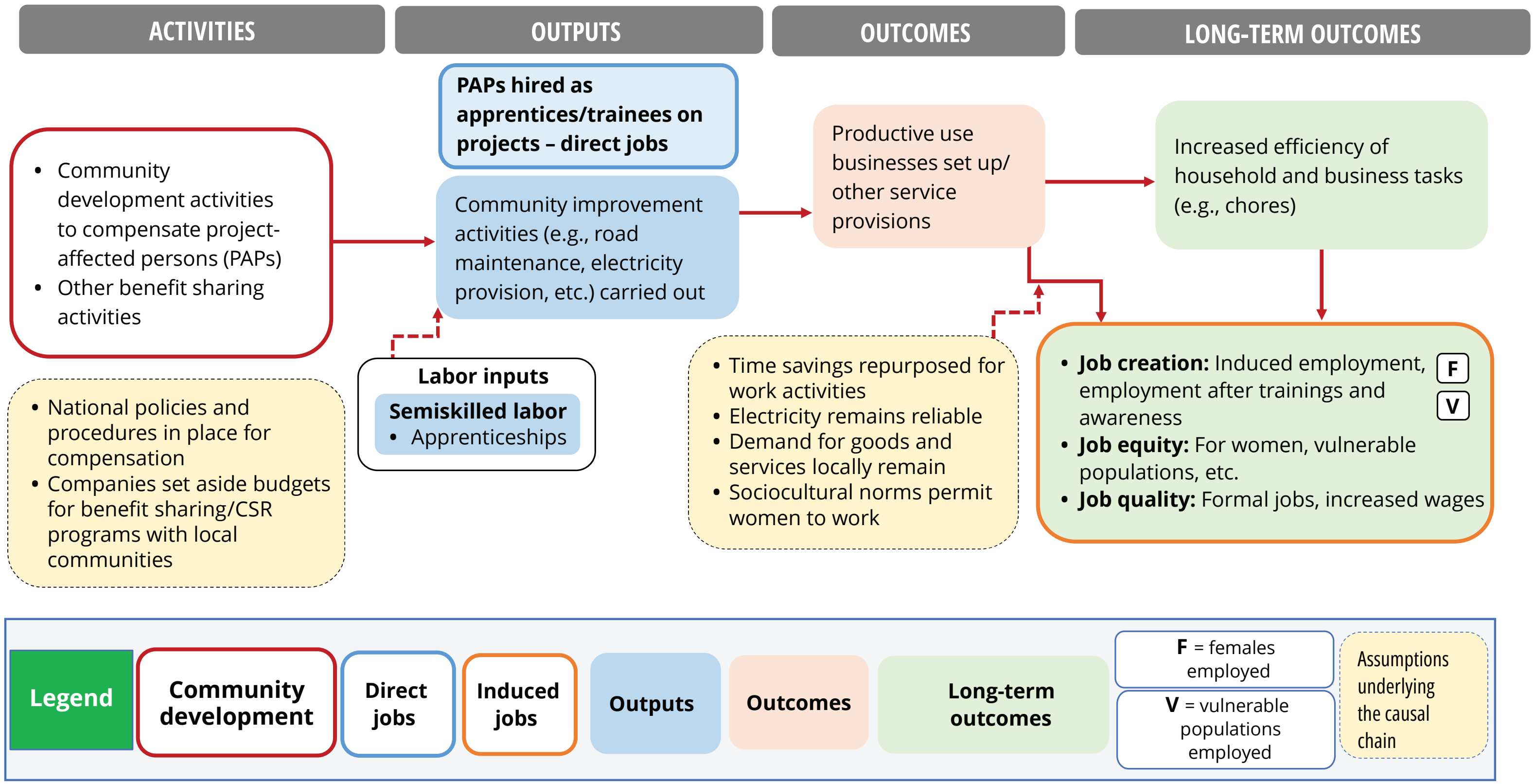
Community development includes efforts to compensate households and individuals adversely affected by projects, as well as other benefit sharing activities beyond compensation (figure 3.5 and table 3.5). When community development activities are undertaken, there is a high probability of employment growth in related businesses and/or improvement in the quality of employment due to different activities (long-term outcomes).

The Energy Sector Management Assistance Program's Sustainable Renewables Risk Mitigation Initiative provides multiple examples and details, especially on provisions for benefit sharing with communities, in a socioeconomic guidance report (World Bank 2022b).

Box 3.4 describes an example of community development in India, based on the case studies covering selected World-Bank-financed clean energy interventions.

FIGURE 3.5

Theory of Change for Community Development Activities and Related Assumptions, Outputs, and Outcomes



Source: Original compilation for this discussion paper.

Note: CSR = corporate social responsibility.

TABLE 3.5

Examples of Community Development Activities and Related Assumptions, Outputs, and Outcomes

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
Community improvement activities	• Projects (developers, contractors) set aside additional budgets and investments for community improvement activities • The corporate social responsibility components of contractors are strong	• Community improvement activities • Project-affected persons hired on jobs in new activities (direct jobs)	• New businesses through induced electricity use or other service provision by local businesses	• Job creation due to local businesses (induced) • Job equity/job quality, for example, safer working conditions, improved wages, and job formality according to gender and vulnerable group

Source: Original compilation for this discussion paper.

BOX 3.4

COMMUNITY DEVELOPMENT: AN EXAMPLE FROM INDIA

The Rampur Hydropower Project in India entailed the acquisition of approximately 30 hectares of privately owned land. This displaced 29 families. To mitigate adverse livelihood impacts, the project included resettlement and rehabilitation support, including the provision of housing plots and rehabilitation grants to houseless/landless families (World Bank 2007). These resettlement and rehabilitation activities also supported investments in community-level infrastructure and social sector investments unrelated to the main hydropower scheme (e.g., water and sanitation services, street lighting, construction of a secondary school, and provision of mobile health vans). The long-term residents of the project-affected areas received annuity payments from the proceeds of power generation.

Following are some of the project's outputs and outcomes:

- The project-affected families received 100 free units of electricity per month.
- Infrastructure improvement and social sector activities were performed in the project-affected areas; this improved human capital (e.g., increased secondary enrollment and improved health outcomes).
- The residents of the project-affected areas received free electricity and annuity payments; these resulted in higher supplementary incomes.
- Community development activities led to an over 50 percent rise in average income in the project-affected communities relative to the recorded baseline incomes.

Source: ESMAP 2023d.

Endnote

1. The Organisation for Economic Co-operation and Development (OECD 2021) defines an enterprise "as a legal entity possessing the right to conduct business on its own, for example to enter into contracts, own property, incur liabilities and establish bank accounts. An enterprise may be a corporation, a quasi-corporation, a non-profit institution, or an unincorporated enterprise. Enterprises can be classified in different categories according to their size; for this purpose, different criteria may be used, but the most common is number of people employed. Small and medium-sized enterprises (SMEs) employ fewer than 250 people, further subdivided into micro enterprises (fewer than 10 employees), small enterprises (10 to 49 employees), medium-sized enterprises (50 to 249 employees), and large enterprises employ 250 or more people."

FOUR

DESIGNING A THEORY OF CHANGE FOR CLEAN ENERGY PROJECTS WITH A FOCUS ON INDUCED JOBS

Literature shows that the energy transition can create a significant volume of induced jobs, especially in the presence of large-scale governmental stimulus/investment programs. The effects of smaller projects cannot be dismissed either. Electrification, to the degree it is possible in each context, creates induced jobs especially through productive uses of electricity (PUEs) and related employment. This chapter focuses on PUE projects in rural areas, where the need for electricity is greatest.

4.1 Induced Jobs Due to Project-Related Economic Activity

Induced jobs are found in all sectors of an economy since they stem from the final demand for goods and services. The initial project-induced demand for a particular type of project/installation also results in the creation of replication jobs. An example of this is a sudden demand for rooftop solar installations spurred by a few successful projects.

While a better understanding of the Theory of Change (TOC) related to induced job creation is important, this discussion paper will not focus on induced jobs that are related to a wider program, since the paper mainly has a project-level focus. However, a case study from Rwanda reflects economywide induced job creation, besides highlighting the need to track jobs, preferably including employment outcomes in Project Development Objectives, to gain clarity on whether programs themselves have created impacts (box 4.1).

Evaluation of the impact on induced jobs requires collecting specific microdata. This evaluation should be included in the design stage of clean energy projects or programs and will require significant investment in data collection and tracking.

As seen in the case study of Rwanda, induced jobs can be complex to track since the process essentially includes factors other than those at the program level. Other cases reviewed also showed the difficulty of tracking induced jobs. They also underlined the need to isolate the job creation impacts of improved power quality or superior electrification access from confounding factors.

The literature review conducted for this paper and case studies (ESMAP 2023b to ESMAP 2023j) recommend ex post employment impact evaluations using randomized controlled trials to ascertain the causal impacts of clean electricity investments over the wider range of employment outcomes. Embedding such evaluations into programs' (and projects') design will foster a clearer and more granular understanding of induced employment outcomes.

BOX 4.1

LESSONS FROM RWANDA: THE NEED FOR TRACKING INDUCED PUE JOBS

To support the Government of Rwanda in institutionalizing least-cost principles for power sector expansion, the World Bank approved three consecutive annual Development Policy Operations between 2017–18 and 2019–20. The Program Development Objective was to enable fiscally sustainable expansion of electricity services in the country by containing the fiscal impact of the electricity sector and to improve the operational efficiency, affordability, and accountability of electricity services. Over the course of these operations, the observed changes in the electricity sector included:

- A 14 percent increase in installed capacity, from approximately 209 megawatts to 238 megawatts.
- An approximately 13 percentage point increase in electricity access.
- A 60 percent decrease in the reported number of electricity outages in Rwanda, from approximately 7,500 per year to 3,000 per year.
- The above reduction coinciding with the creation of approximately 600,000 jobs, over 75 percent of which in the agriculture sector, possibly due to improved productivity and favorable weather conditions in 2020. Energy-intensive sectors such as manufacturing did grow in economic terms (by some 10 percent in value), although this did not result in a significant increase in employment (+10 percent).

Findings suggest that a causal link between power sector reforms and induced job creation may not be directly traceable, since these result from a combination of factors. For example, manufacturing jobs did not necessarily increase as much as expected, despite significant improvements in access to electricity services and their quality, and generation capacity. This may have been due to other constraints (e.g., access to finance) and variables inhibiting employment expansion. Another reason why employment outcomes did not materialize, may be that sufficient time had not yet elapsed to see the impacts of infrastructure investment.

Importantly, job creation and improvement of labor market outcomes were not objectives of the three Development Policy Operations considered. However, future operations could present valuable opportunities to assess the extent to which underlying changes in access to and quality of electricity services may affect labor outcomes over time. In particular, it is expected that improving electricity access will increase the number and quality of jobs.

Source: ESMAP 2023j.

4.2 Induced Jobs Due to Productive Uses of Electricity

PUEs support socioeconomic progress especially in the local communities where electricity projects—grid, mini grid, and off-grid projects—are located. Importantly, such projects catalyze the growth of PUE-related micro, small, and medium enterprises (MSMEs). Globally, most PUE projects implemented are a part of mini grid or off-grid stand-alone projects. In these cases, small-scale electrification enables communities and individuals to gain an income and enjoy an improved quality of life primarily through increased mechanization and the utilization of electrical appliances and equipment. The greater electricity consumption facilitated by PUE MSMEs also allows clean energy generation projects to increase their economic viability through new revenue streams.

The focus in this section is on productive uses involving *direct inputs of electricity* in any commercial, agricultural, or industrial activity that produces goods or services, not energy (nonelectric, in the form of thermal or mechanical energy). In developing countries, PUEs are often linked to agriculture (e.g., irrigation, grain milling, and electric fencing), manufacturing (e.g., carpentry, tailoring, and welding), and services (e.g., shops using refrigerators, computer training centers, and mobile phone charging stations). They result in income or productivity growth especially in rural and periurban areas. PUEs are promoted in clean energy projects for multiple reasons. They are promoted, for example, because they:

- Enable the utilization of off-peak electricity consumption, which supports the financial viability of systems; higher sales for utilities could help justify grid extensions.
- Promote the growth of local MSMEs in rural communities.
- Enable households to earn more—this can make electrical appliances and equipment more affordable and trigger greater use of electricity.

Meanwhile, PUEs have shown less-than-expected spontaneous growth and their adoption has also not been as anticipated. This may be because PUEs' promotion is often subsumed within clean energy projects, which often produces mixed results. A key reason is that the focus while planning electricity projects is primarily on their physical aspects (especially grid extensions), whereas support to PUEs becomes secondary or negligible. Or rural electrification projects, which are often located in remoter areas, can be driven more by political than economic factors, with a general assumption that PUEs will grow organically. However, PUEs require more collective input(s) in terms of resources, capacities, and market linkages and development.

The ESMAP report (2023a) categorizes five building blocks (planning, regulations, finance, technology, and marketing) that comprise a PUE ecosystem (figure 4.1). Some of these building blocks are reflected in the following subsections.

FIGURE 4.1

Building Blocks of PUE Development

Source: ESMAP 2023a.

Note: MSMEs = micro, small, and medium enterprises.

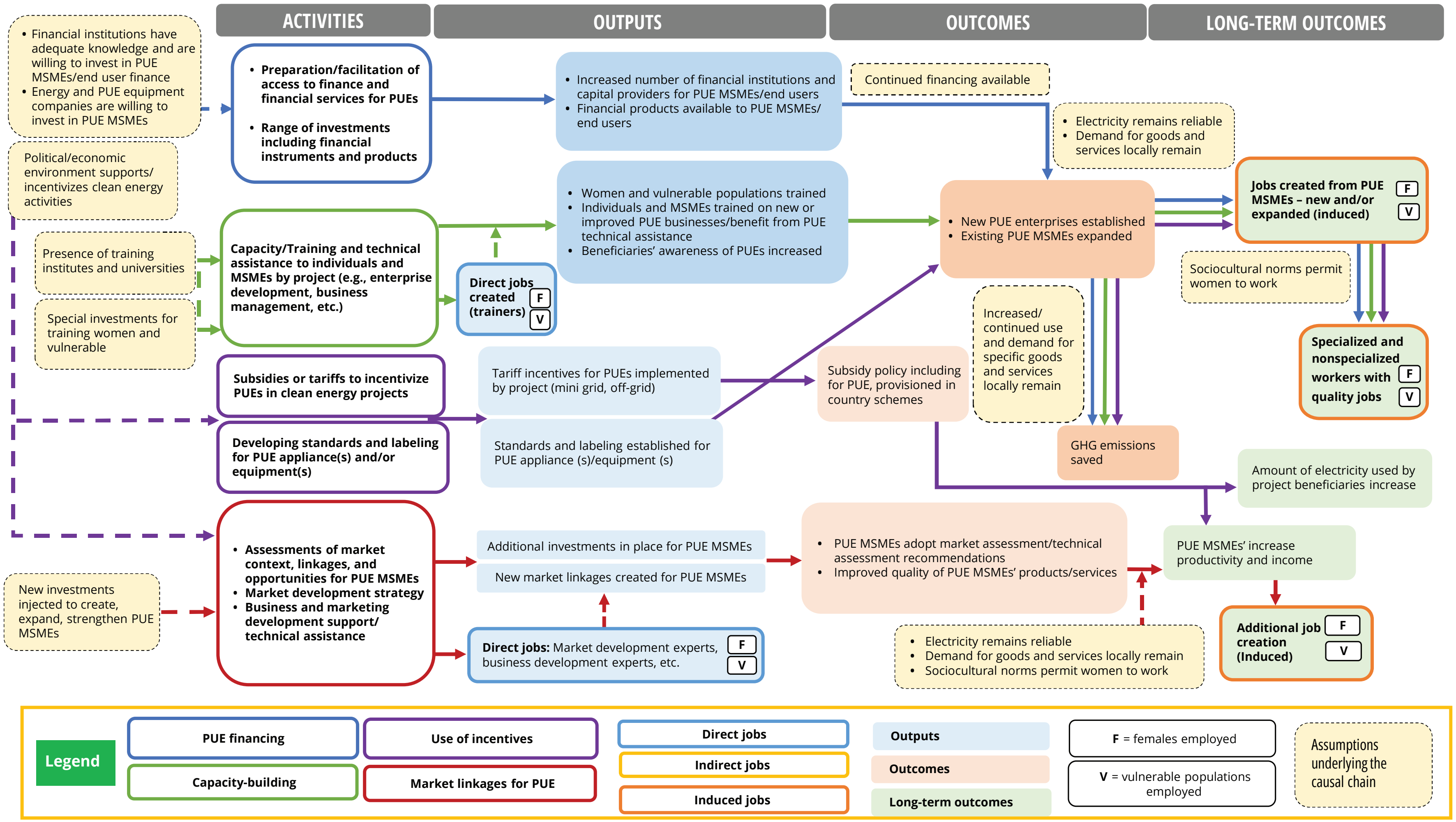
4.2.1 Designing PUE Projects

The design of PUE projects or programs can be conceptualized in multiple ways. For example, they can be designed with:

1. **PUEs as a component within the development of clean energy project(s).** The design of projects (grid, mini grid, off-grid) considers PUE aspects. This can also be relevant to other projects such as agriculture, water, and irrigation projects, which can integrate PUEs. This is outlined in the TOC in chapter 3 of this document (figure 3.1).
2. **A specific focus on strengthening the ecosystem to develop and support PUE MSMEs** to reach their full potential: financing, capacity building, incentives, and market linkages. The TOC for this is presented in figure 4.2 and explained further in this subsection.

FIGURE 4.2

Overarching Theory of Change for Strengthening the Ecosystem for PUEs



Source: Original compilation for this discussion paper.

Note: GHG = greenhouse gas; PUE = productive use of electricity; MSMEs = micro, small, and medium enterprises.

4.2.2 Categorizing and Mapping PUE-Related Activities to Outcomes

PUE-related activities can be categorized as follows depending upon a project's conceptualization. The first three categories are also presented in section 3.1:

1. **Investments/financing.** These activities include direct investments and financing, public and private, toward establishing or expanding PUE enterprises, including for equipment purchases.
2. **Capacity building for PUEs.** These activities include public and private investments in complementary educational programs, including PUE-focused training to stakeholders targeted by projects.
3. **Use of incentives.** These activities refer often to policy and regulatory incentives promoting PUEs.
4. **Market linkages and business development.** These activities include strengthening MSMEs and improving their products' and services' linkages along market supply chains for different types of PUE businesses.

Each category holds the potential to create jobs, besides ensuring job quality and job equity. Generally, jobs related to PUE enterprises result from electricity access in previously unelectrified areas, as well as from service quality improvement in electrified areas. Both electricity access and service quality improvement can allow households and enterprises to use electricity for productive, income-generating activities. This may translate to employment growth or an improvement in the quality of employment, for example, in wages and job formality. **In this discussion paper, all PUE-related jobs are considered induced jobs.**

Considering equity especially in terms of gender is important in PUEs since women and men often play different roles in a productive economy; women tend to earn lower wages and run informal enterprises mostly from home, whereas men are more active in mechanized electricity-intensive sectors, own more businesses, and typically employ other men (IDS 2019).

In the following subsections, the categories of the TOC (as in figure 4.2) are elaborated on further. **Activities under any of the four categories above can potentially boost PUEs, although the greatest impact will be achieved when a project (or a program) is designed to strengthen the overall ecosystem (all four categories) so that PUE enterprises can achieve their full potential.** Appendices A and B provide the details of the outcomes presented in this section.

FINANCING

Once clean energy infrastructure becomes operational, there is often an associated growth of PUE MSMEs, resulting in the creation of induced jobs. These MSMEs require financing to establish or strengthen their businesses. PUEs entail different types of finance interventions, including bulk procurement (from governments, development partners, or others), up-front grants, results-based financing, social impact bonds, subsidies, credit, debt, crowdfunding, guarantees, and insurance (ESMAP 2023a). Developers of mini grid projects can also provide credit indirectly. For example, in Tanzania, Jumeme, a solar mini grid company, ran a shop where small and medium enterprises could acquire appliances on credit (Besnard 2019).

Most PUE MSMEs are in rural and remote communities, although programs also target PUE MSMEs in grid-connected peri-urban areas. Financing for enterprises/end users comes from a range of sources, including governments, development partners, nongovernmental organizations, community organizations, equipment suppliers, energy companies, and a range of financial institutions (commercial, microfinance, savings groups, etc.). Table 4.1 provides an example of how PUE-focused investments and financing may lead to outputs and outcomes (including long term) under a set of assumptions. Results may be hindered if the assumptions made (in the TOC) are not met. Figure 4.3 outlines an example TOC.

TABLE 4.1

Examples of PUE Financing Activities and Related Outputs, Outcomes, and Assumptions

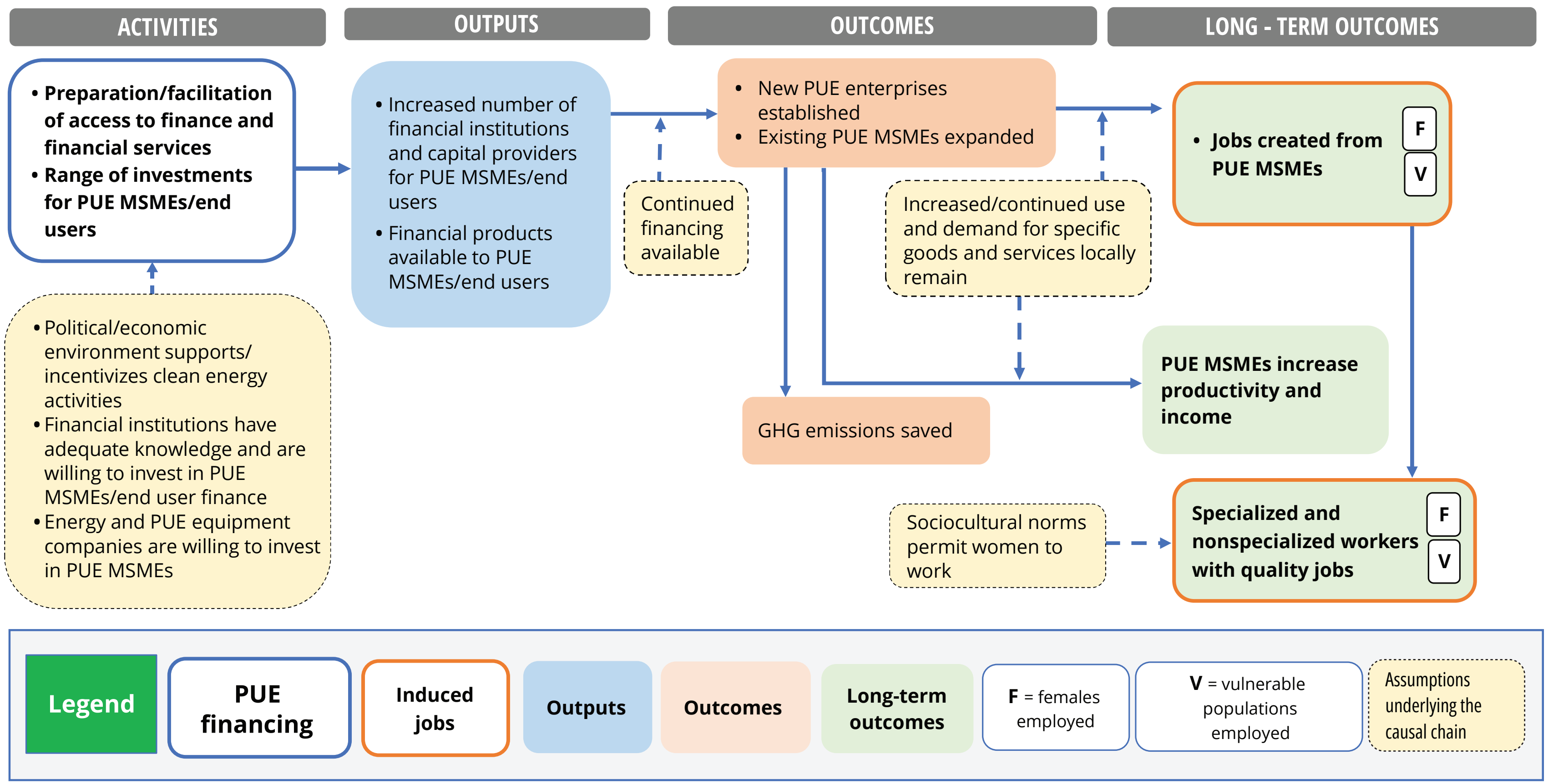
EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
• Preparing/facilitating access to the finance and financial services of financial institutions for PUE enterprises and end users. Further subactivities include, for example, assessments, awareness raising, training, and facilitation of access to financial institutions • A range of investments (public and private), including financial instruments and products, and complementary investments made available for PUE MSMEs/end users	• Political/economic enabling environment supports/incentivizes PUE enterprises (i.e., an enabling regulatory environment) • A demand for specific goods and services exists among PUE enterprises • Financial institutions have adequate knowledge and are willing to invest in PUE MSMEs/end-user finance • Energy and PUE equipment companies are willing to invest in PUE MSMEs • Sociocultural norms permit women to work	• An increased number of financial institutions and capital providers for PUE enterprises/end users (households) • Financial products available to PUE MSMEs	• New PUE MSMEs established • Existing PUE MSMEs expanded (e.g., through the addition of financed PUE electrical appliances/equipment) • Greenhouse gas emissions saved	Local/regional economic resilience through: • Job creation (and retention) due to new or expanded PUE MSMEs • PUE MSMEs' increased productivity and income • Specialized and nonspecialized workers with quality jobs (e.g., higher incomes, formal jobs, better working conditions) according to gender

Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

FIGURE 4.3

Theory of Change for PUE Financing Activities and Related Assumptions, Outputs, and Outcomes



Source: Original compilation for this discussion paper.

Note: GHG = greenhouse gas; MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

BOX 4.2

MALAWI: FINANCING FOR ELECTRICITY INFRASTRUCTURE CREATES INDUCED PUE JOBS

To address power sector challenges in Malawi, the World Bank provided $84.7 million in financing to the Energy Sector Support Project (ESSP), which was designed to complement large-scale power sector investments of the Millennium Challenge Corporation (MCC) through its $351 million Malawi Compact, which was signed in 2011 and ended in 2018. The investments were primarily to strengthen the electricity network and conduct feasibility and design studies for expansion, generation, and transmission; demand-side management and energy efficiency; capacity building; and technical assistance. These investments created an opportunity to provide electricity connections to new customers.

Results. The utility Electricity Supply Corporation of Malawi Limited reported making 2,655 new connections through both the ESSP and MCC projects. An estimated 375 induced new jobs were created. The project investments in distribution assets were associated with a measurable increase in reliable electricity. For example, average electricity interruptions fell from 11 in 2015 to 6.5 in 2018 in the ESSP area, representing 40 percent less frequent outages.

A study of 61 enterprises, each interviewed twice (2009 and 2014), revealed a close association between the reliability of electricity and the number of full-time jobs. A 32–40 percent reduction in outages was associated with a 6–7.6 percent increase in employment among formal (registered) firms. The study did not estimate jobs generated due to local economic growth potentially associated with the injection of investment funds in the project areas; new project designs could estimate this and monitor indicators and results directly (as presented in table 4.1).

Source: ESMAP 2023f.

CAPACITY BUILDING

These activities include, for example, training in technical skills, management, and business development, besides technical assistance focused on strengthening PUE activities/MSMEs. The rationale for the TOC is that this capacity building and technical assistance will catalyze the creation of PUE MSMEs and/or the strengthening of existing PUE MSMEs (outcomes). This will in turn lead to more and better jobs and provide opportunities to support women-led

PUE MSMEs (long-term outcomes). In some cases, however, jobs were also found to be reduced but sustained.

This discussion paper considers sustainability (job retention) as a longer-term impact that can materialize beyond a project's implementation period. Considering this information, it is important to track other outcomes, such as the quality and equity of the jobs provided by PUE enterprises/projects. This outcome tracking is important, since in some cases, the quantity of jobs has fallen even as their quality has improved (see box 4.3).

BOX 4.3

RETENTION OF PUE JOBS: QUALITY VS. QUANTITY

Results from studies are showing that energy for productive uses may reduce job opportunities in the short term due to, for example, mechanization and efficient appliances/equipment. In Vietnam, the introduction of electric grain driers reduced the labor requirement per ton of rice by 85 percent. Job reduction drives people to find other jobs, which may take time or new skill acquisition.

Findings from Peru suggested that a rural electrification project created productive use of electricity (PUE) enterprises and new jobs but also eliminated enterprises, with the net effect being unclear. The use of new technologies displaced labor. For example, the introduction of mechanical milking and machinery to harvest and sort olives replaced manual work, and PUE enterprises engaged in both activities reduced their employment. In some cases, the reduction in employment was also found to be sustained over time. In other cases, after the initial displacement of labor, businesses expanded their operations and the types of jobs changed. For example, an Amazonian coffee producer that employed two to three workers and produced coffee for local consumption could operate its processing plants and select higher-quality coffee beans more efficiently after the project intervention, which provided it with three-phase electrical power, partially enabling it to export coffee internationally. The business hired additional workers for export-related roles, which were not required previously, for example, for updating certification requirements, record keeping, and marketing.

Source: ESMAP 2023i; Klooss 2020.

TABLE 4.2

Examples of PUE Capacity-Building Activities and Related Outputs, Outcomes, and Assumptions

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
PUE-related training, skill development provided by projects (e.g., enterprise development, and skill training—technical, management, business training) Technical assistance to individuals and businesses for promoting PUEs and benefiting MSMEs (includes research and development, inputs to product development, policies, etc.)	• Presence of PUE-related training institutes and experts in the country/region • Special investments for training women and vulnerable populations; sociocultural norms allow women to participate in training • Electricity remains reliable • Local demand for goods and services remains + availability of appliances/ equipment for PUEs	• Women and vulnerable populations trained • Individuals and MSMEs trained on new or improved PUE businesses • Beneficiaries' awareness of PUEs increased • Direct jobs (trainers in capacity-building activities) • Individuals and MSMEs benefit from technical assistance for PUEs	• PUE MSMEs established • Existing MSMEs expanded • Greenhouse gas emissions saved	• Job creation (and retention) due to new or expanded PUE MSMEs • PUE MSMEs' increased productivity and income • Specialized and nonspecialized workers with quality jobs (e.g., higher incomes, formal jobs, better working conditions) according to gender

Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

Table 4.2 presents some of the outputs and outcomes of capacity-building activities, along with the assumptions that must hold for the activities to translate into outcomes. An example case is described in box 4.4. Outputs related to training programs can be targeted at specific groups depending upon the aspects of the PUE supply chain/value chain that require strengthening (e.g., entrepreneurs, PUE appliance/equipment suppliers, and employees of PUE MSMEs such as operators and managers). These capacity-building activities will need to enhance skill development and foster project-related employment opportunities for such individuals.

Training combined with other technical assistance, including research and development (e.g., of efficient appliances and equipment, and knowledge products can lead to better job quality as an outcome, measured with indicators such as nominal and real wage increase for PUE businesses' employees. Smaller micro-household-based income-generating businesses can also improve their sales through better product and service quality. Results may be hindered if the assumptions made (in the TOC) are not met. Figure 4.4 outlines an example TOC.

BOX 4.4

BRIDGING THE PUE SKILLS GAP THROUGH A MINI GRID PROJECT IN TANZANIA

In Tanzania, the International Institute for Environment and Development's Energy Change Lab worked with a mini grid developer with eight operational systems serving 1,500 customers. The project utilized skill gap bridging as a practical approach for promote adoption of productive uses of electricity (PUEs). Since many local businesses lacked the skills to start and run their enterprises effectively, initial skill gaps were determined, for example, in basic management, financial planning, record keeping, equipment use, and maintenance.

Locally appropriate training material, including videos, were combined with training sessions, including those focused on the technical skills to operate new equipment, and entrepreneurial and business skills. A network of PUE champions, community change agents, were trained to develop their own PUE businesses, support other community members in developing new PUE businesses, and also catalyze peer-to-peer learning. Follow-up mentoring was also provided.

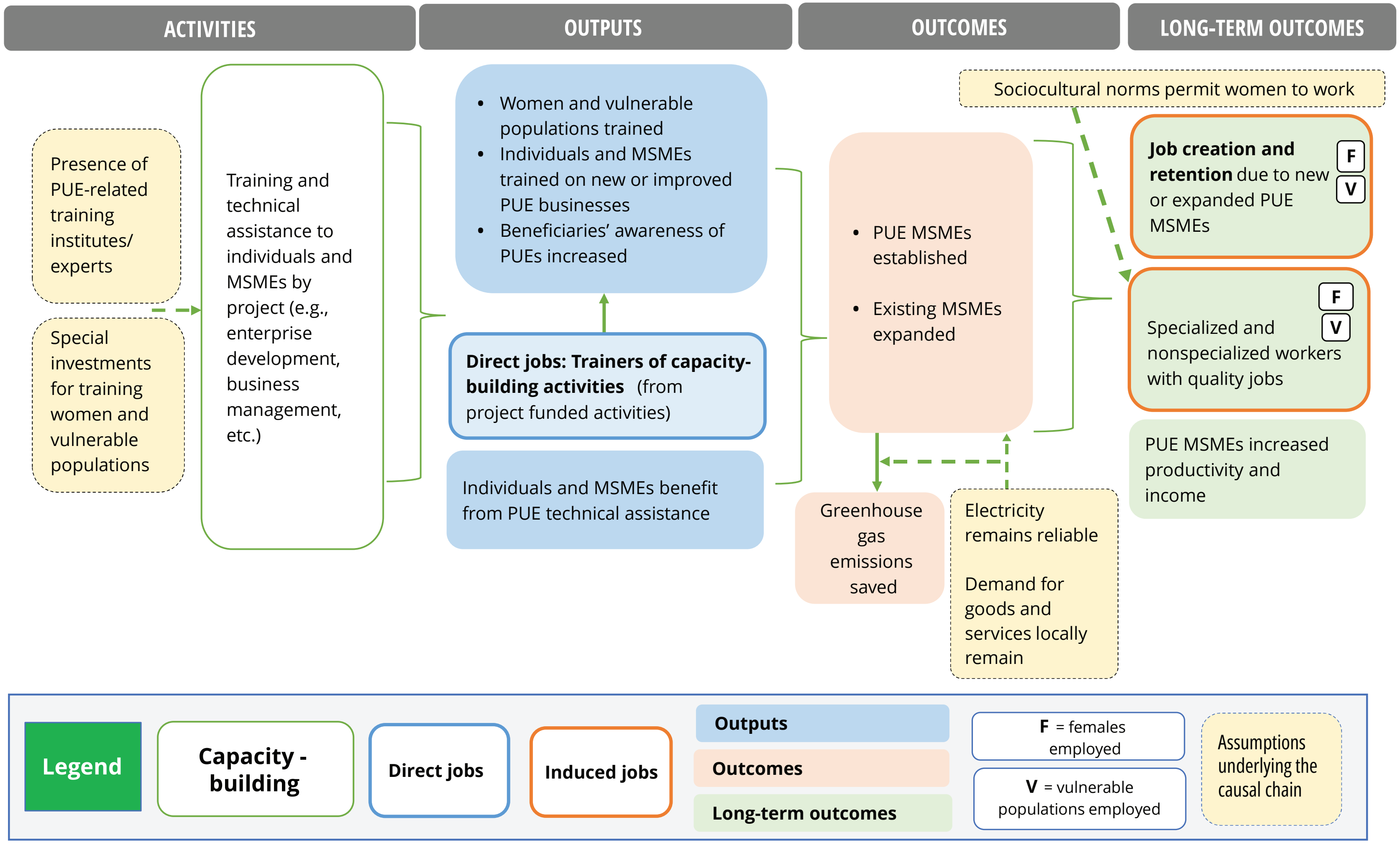
Results:

- 15 PUE champions established their own businesses and cascaded training to 52 entrepreneurs (32 men and 20 women) operating 45 PUE businesses and employing 49 individuals.
- The PUE businesses were microenterprises: refrigeration was the most popular (15), followed by cinemas (5), welding (4), carpentry (4), and popcorn making (4), among others. Their monthly income ranged between $60 and $200.

Source: Johnstone, Rai, and Mushi 2019.

FIGURE 4.4

Theory of Change for PUE Capacity-Building Activities and Related Assumptions, Outputs, and Outcomes



Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE 4.3

Examples of PUE Incentive Activities and Related Outputs, Outcomes, and Assumptions

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
Subsidies or tariffs to incentivize PUEs in clean energy projects	Political/economic environment supports/incentivizes clean energy–related activities (i.e., an enabling regulatory environment)	• Tariff incentives for PUEs implemented by projects (mini grid, off-grid)	• Subsidy policy for clean energy projects, including for PUEs, provisioned in national schemes • New PUE MSMEs established • Existing PUE MSMEs expanded • Greenhouse gas emissions saved	• Project beneficiaries use more electricity for productive purposes/ specific appliances/ equipment (e.g., water pumps and cooling) • Job creation (and retention) due to new or expanded PUE MSMEs • Specialized and nonspecialized workers with quality jobs (e.g., higher incomes, formal jobs, better working conditions) according to gender
Developing standards and labeling for PUE appliance(s) and/or equipment	Same as above	Standards and labeling established for PUE appliance(s)/equipment	• New PUE MSMEs established • Existing PUE MSMEs expanded • Greenhouse gas emissions saved	• Job creation (and retention) due to new or expanded PUE MSMEs • PUE MSMEs' increased productivity and income
Preparation of, design of, and lobbying for tax incentives, including import duty, value added tax, and goods and services tax exemptions for PUE appliances/equipment	Same as above	Fiscal or other incentives for PUE-related appliances and equipment set by government		

Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

USE OF INCENTIVES

In this section, the term "incentives" often refers to the specific policies or regulations promoting PUE development and solutions, which are also crucial for investments toward PUE enterprises/products. For example, the first set of activities outlined in table 4.3 are critical to initiate PUE MSMEs' growth. These activities could include the design of appropriate tariffs and connection costs, and the service quality of clean energy projects/grid extensions that influence PUEs' adoption. Different time-of-day tariffs for PUE enterprises could make electricity affordable and competitive with other forms of energy/fuels for PUE MSMEs. Tariff incentives can significantly increase electricity use if they are adjusted based on load location, load size, connection type, and also the seasonality of business (Besnard 2019).

Further, standards and labeling for related appliances/equipment and tax incentives may ensure the efficiency and growth of PUE MSMEs and related job creation. Box 4.5 presents an example of an overall policy incentive targeting PUEs from Peru. Figure 4.5 outlines an example TOC.

BOX 4.5

INCENTIVIZATION OF PUEs IN PERU

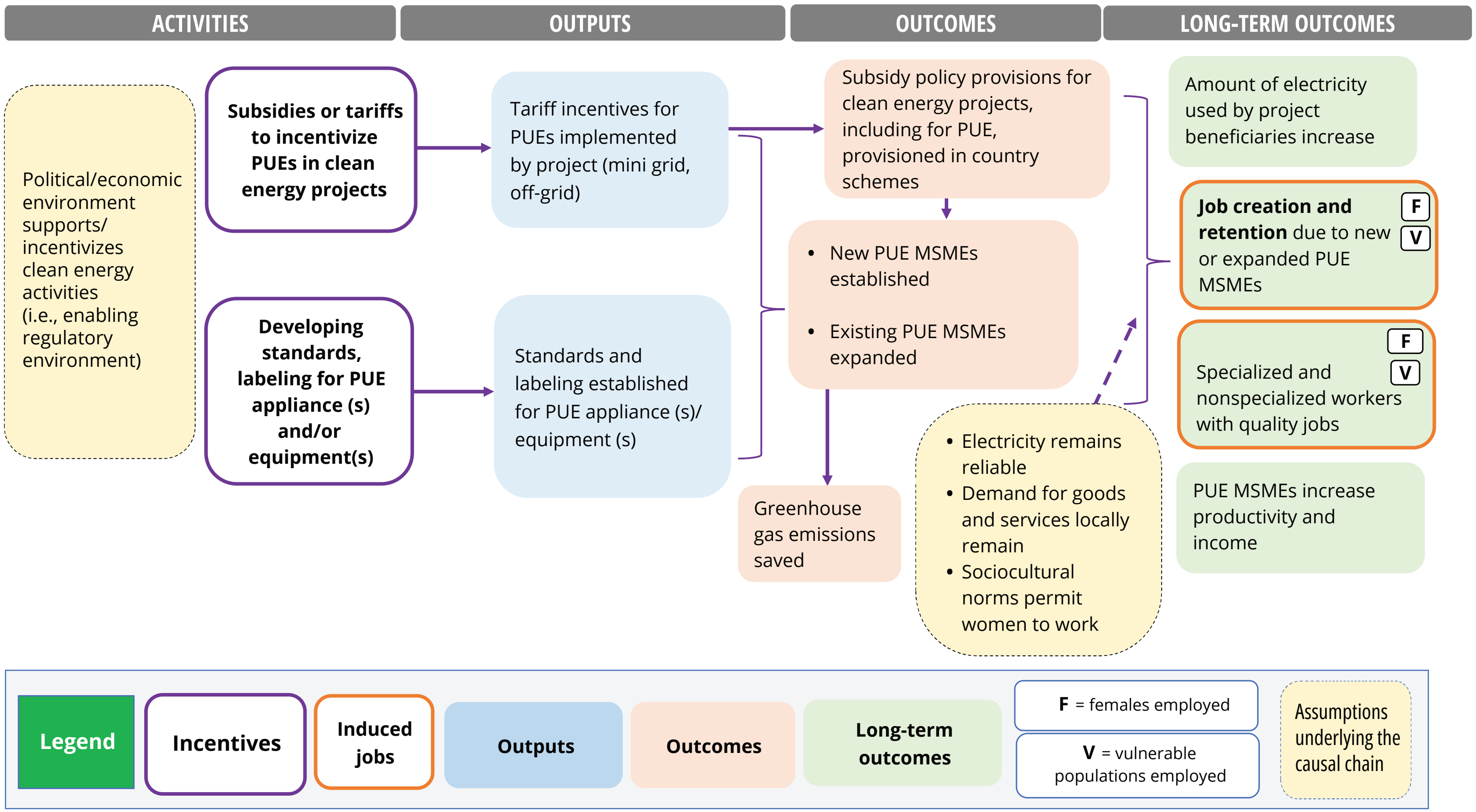
The Peruvian government has made a concerted effort to increase rural electricity access through the Rural Electrification Law of 2006 and by establishing the General Directorate of Rural Electrification (DGER) within the Ministry of Energy and Mines in 2007. Electricity coverage has increased significantly as a result. The DGER's National Plan for Rural Electrification 2016–25 recognizes that promoting productive uses of power fosters economic and social development, and it aims to exploit the potential through capacity building and education of rural producers in coordination with other government agencies in various agrifood value chains.

In 2020, a Supreme Decree approved a new regulation to promote further project development for the electrification of rural populations and promote productive uses of electricity among them, including through facilitating investments. The regulation contemplates the allocation of 1 percent of rural electrification funds to finance the acquisition of electrical equipment to produce goods and provide services.

Source: Franco et al. 2017; bnamericas 2020.

FIGURE 4.5

Theory of Change for PUE Incentive Activities and Related Assumptions, Outputs, and Outcomes



Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

MARKET LINKAGES AND TECHNOLOGY DEVELOPMENT

For PUE development, it is critical to improve appliance and equipment products (technology development) and strengthen their market linkages. Since many PUE MSMEs are in rural areas, their products and services have to be competitive with the products and services available in foreign markets, or even those available in the domestic and local markets. Assessment of the market supply chain and the associated infrastructures is essential to develop a market development strategy that could enable PUE MSMEs to improve their businesses, improve product and service quality, and eventually achieve higher sales (table 4.4). Further, business development support for MSMEs, including, for example, product pricing, branding, advertising, marketing, sales, and management, will strengthen the growth of PUE enterprises, improving job quality in the longer run (box 4.6). Figure 4.6 outlines an example TOC.

TABLE 4.4

Examples of Market Linkage Activities and Related Outputs, Outcomes, and Assumptions

EXAMPLES OF SPECIFIC ACTIVITIES	ASSUMPTIONS	OUTPUTS	OUTCOMES	LONG-TERM OUTCOMES
• Assessment of market context, linkages, and opportunities for PUE MSMEs • Market development strategy • Business and marketing development support, including technical assistance for PUE MSMEs	• Political/economic environment supports/ incentivizes clean energy activities (i.e., an enabling regulatory environment) • New investments (public and private) are injected into the creation/ expansion/strengthening of PUE business(es) • Local demand for goods and services remains • Electricity remains reliable	• New market linkages created for PUE MSMEs (e.g., access to buyers for products and linkages with better/appropriate market suppliers) • Additional investments in place for PUE MSMEs • Direct jobs (e.g., market development and business development experts)	• PUE MSMEs adopt market assessment/ technical assessment recommendations (e.g., buy additional efficient appliances/equipment and new investments) • Improved quality of PUE MSMEs' products/ services	• PUE MSMEs' increased productivity • Additional jobs created

Source: Original compilation for this discussion paper.

BOX 4.6

BENEFITS FROM PUEs IN PERU'S RURAL ELECTRIFICATION PROGRAM

Between 2006 and 2017, the World Bank contributed to two consecutive rural electrification projects in Peru, referred to as FONER I and II. The first project (RE1) aimed to increase electricity access in rural areas, including productive uses of electricity (PUEs), while the second project (RE2)—an extension of the first project—aimed to reach increasingly distant locations from the grid with more dispersed populations (World Bank 2011). Memoranda of understanding were signed with distribution companies interested in promoting productive uses, and a contract was signed with competitively selected nongovernmental organizations to provide technical assistance to local businesses to promote PUEs, including through sensitization campaigns to enhance knowledge of electricity's applications for business activities.

The PUE businesses included, among others, those using electric motors to grind grains and process coffee, electric pumps for irrigation to improve agricultural yield, and refrigeration. Efforts were also made to increase businesses' access to complementary services. The nongovernmental organizations utilized business development techniques, including market assessments, to find opportunities for electricity-based productive uses, besides assistance with preparing business plans and obtaining credit from financial institutions, integration with other projects and government programs, and coordination with distribution companies on the provision of adequate electricity connections. Activities were targeted at different regions, primarily agriculture (vegetables, coffee, livestock, dairy, etc.) and off-farm activities (artisanal mining, ceramics, bakery, metal working, carpentry, etc.).

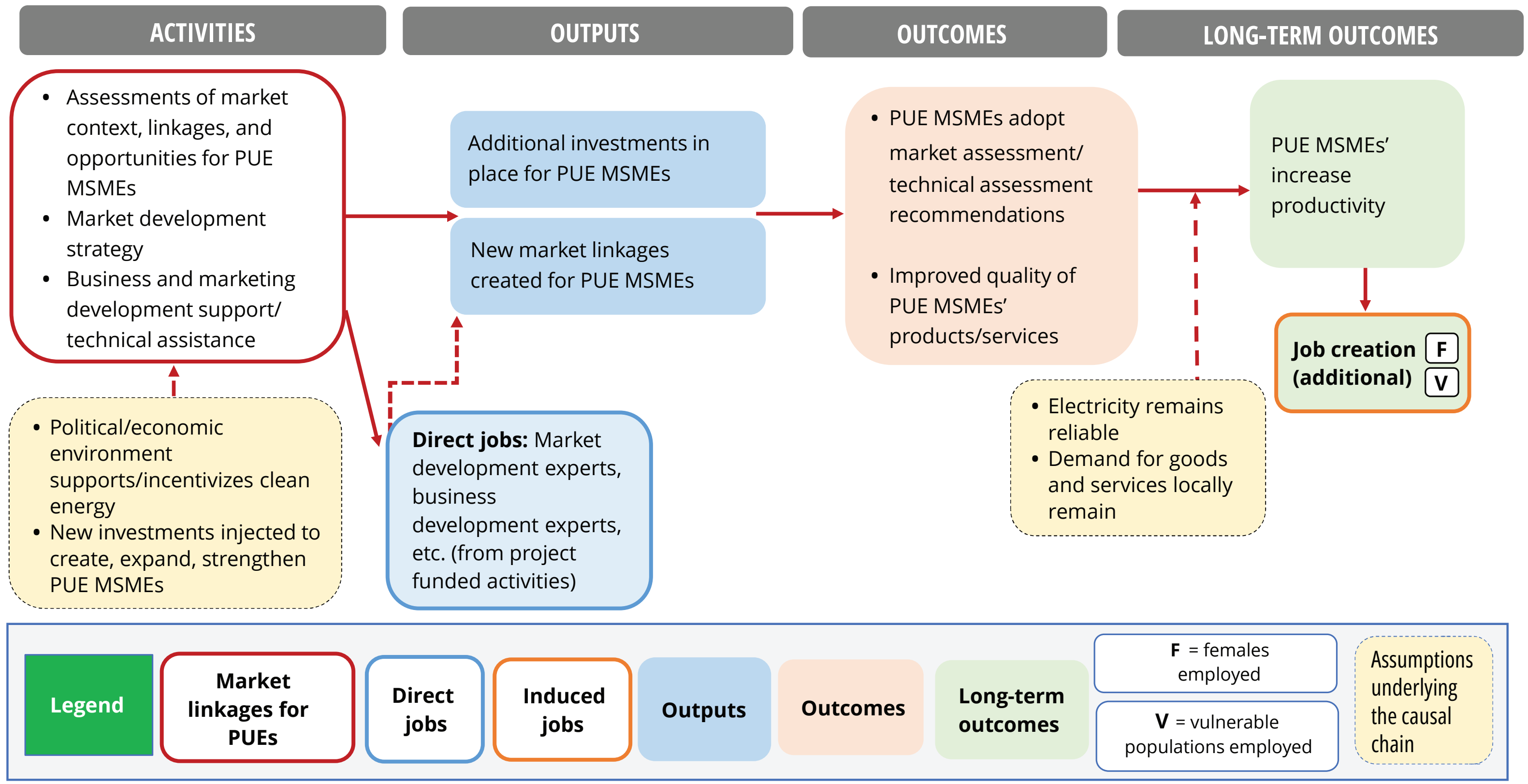
Results:

- Countrywide, 600 interventions under both projects increased the electricity demand by 22.3 gigawatt-hours per year, exceeding the projects' combined targets of 19.5 gigawatt-hours.
- A total of 25,000 enterprises adopted PUE equipment, with a total investment of $14 million in PUEs. The electricity consumption of the participating producers rose from 56 to 240 kilowatt-hours per month, an increase of more than 300 percent.
- Other reported benefits included an increase in productive hours during the day (56 percent), higher levels of production (39 percent), better product quality (40 percent), and higher market prices (39 percent).
- A third of the producers benefiting were women who were active in bakeries, dairy production, ceramics, and textiles.

Source: Franco et al. 2017.

FIGURE 4.6

Theory of Change for Market Linkage Activities and Related Assumptions, Outputs, and Outcomes



Source: Original compilation for this discussion paper.

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

FIVE

IMPACT EVALUATION

While many jobs-related outputs and outcomes materialize within a project period, certain outcomes and impacts take longer to materialize. Still others are difficult to measure and accurately attribute to a specific project. In such cases, project teams may wish to undertake an impact evaluation.

An impact evaluation is any approach that measures impact by comparing indicators among a credible control group to indicators among project beneficiaries. This section first discusses why project teams may wish to consider including an impact evaluation in their broader monitoring and evaluation strategy and how to think about impact evaluation within a project's theory of change. It then discusses the conditions under which impact evaluations are feasible. The purpose of this chapter is not to provide project teams with the full set of technical skills required to implement an impact evaluation, but to help them determine whether an impact evaluation would be useful and feasible and to point them to further resources.

5.1 Why Consider an Impact Evaluation

Impact evaluations offer two interrelated advantages. First, they provide a means to credibly attribute impacts to specific projects. Second, they allow projects to measure a wider range of indicators, both in terms of the indicators that are being measured and the period over which they are measured.

Defining a credible control group allows projects to observe what would have happened had they not been implemented—also called a counterfactual. Counterfactuals allow for impacts to be attributed to specific projects because, by definition, the only difference between a credible control group and project beneficiaries is the project's presence. Comparing outcomes between the control group and project beneficiaries removes a host of factors that could lead to changes for the project beneficiaries over time. For instance, greater macroeconomic stability may facilitate nationwide employment growth. In such contexts, attributing all employment growth to a clean energy project is inaccurate. Instead, comparing employment rates in the control group against beneficiary communities allows analysts to accurately attribute impacts to specific projects even in the face of wider economic changes unrelated to the projects. Counterfactuals also allow projects to measure impacts despite economic disruptions. Consider two neighboring villages, both experiencing a severe drought during the project period. Overall employment rates may have declined in both villages over time, but comparing the rates may show that the village that benefitted from a clean energy project was better able to cope with the impacts of the drought. Identifying a credible control group allows projects to measure and attribute impacts independent of concurrent events.

The presence of a credible control group can enable projects to assess a wider range of indicators. If an indicator can be measured between project beneficiaries and the control group, then the project's impact on this indicator can be estimated. This is especially important when considering the impacts of clean energy projects on induced jobs. Rather than trying to identify jobs that are linked to clean energy or productive uses of energy, impact evaluation allows for simple comparisons of employment rates between project beneficiaries and a control group. Such comparisons may be important when clean energy projects could induce some jobs while displacing others (e.g., fossil-fuel-related jobs). Impact evaluation can allow project teams to credibly study net changes in employment.

Comparing project beneficiaries to a control group also makes it possible to draw credible inferences about longer-term project impacts. As time passes and other factors impact employment, it becomes less and less credible to claim employment growth post project completion by simply presenting employment rates over time. With a credible control group, it is possible to separate wider, long-term employment changes from employment changes occurring only in the beneficiary communities.

Returning to the Theory of Change for productive uses of electricity (PUEs) provides a useful illustration of the benefits of impact evaluation. Two key outcomes in figure 4.2 (chapter 4) are "jobs created from new and/or expanded PUE MSMEs" and "PUE MSMEs' increased productivity." In some contexts, defining a PUE MSME (micro, small, and medium enterprise) may be straightforward. In other cases, electricity access or improved electricity service contributes to economic productivity in multiple ways, making attribution to a specific project difficult. Impact evaluation ensures that the impacts on productivity and employment are correctly attributed to projects.

Impact evaluation is critical when indicators imply a comparison group. For instance, one outcome in figure 4.2 is "improved quality of PUE MSMEs' products/services." Such an indicator implies a need for some comparison to measure improvements. Although before/after comparisons may suffice in some scenarios, the most accurate comparisons come from defining a credible control group.

5.2 When Is an Impact Evaluation Feasible?

Four questions help determine when an impact evaluation is feasible. While these questions are meant as a high-level guide, determining the answers is often complex. Consulting with experts, either internally or externally, is useful in determining whether a project is a good candidate for impact evaluation and, if so, what resources would be required:

1. ***Is the project's design already finalized?*** While ex post impact evaluations may be possible for some projects, planning for an impact evaluation from the early stages of project design increases the likelihood of success and improves credibility. Defining a control group after a project is already underway or after certain outcomes have

already been observed is less credible than defining a control group before a project commences. This is because ex post evaluations could allow project teams to select favorable control groups. Incorporating an impact evaluation from the early stages of project design also ensures that a project budgets for the resources required to collect and analyze data.

2. ***Are data, or the resources to collect data, available for both project beneficiaries and the control group?*** Projects generally plan for the collection of data on project beneficiaries, or have systems in place that allow the tracking of outputs and outcomes based on administrative data. When conducting an impact evaluation, project teams must ensure that analogous data are available for the control group. For certain indicators from clean energy projects, data for the control group may not pose a challenge. For instance, a project that uses interconnected solar mini grids to improve the reliability of the national grid may be interested in the impact on the demand for electrical technicians. In this case, the utility may likely have administrative data on the number of times electrical technicians are sent to control versus beneficiary neighborhoods. For indicators requiring primary data collection, or for indicators for which administrative data are only available for project beneficiaries, project teams have to include data collection costs in their budget.

   Besides budgeting for primary data collection, project teams should discuss data requirements with implementing agencies and other entities, which may be asked to provide data. Such discussions have two purposes. First, as with any data source, the quality of data for the treatment and control groups must be verified. While administrative data may be relatively low cost to obtain, their accuracy is not guaranteed. Differences in data quality between the treatment and control groups are especially important to assess since they could lead to biased estimates. Understanding whether, why, and how administrative data are generated is critical to assessing data availability. Second, even if data that would be useful for an impact evaluation are collected by implementing agencies and other project partners during their regular business activities, sharing those data may entail costs or impose other burdens. Private companies may require additional safeguards to ensure that the proprietary data they share remain secure from competitors. National utilities may have to comply with stringent data privacy regulations that render data sharing nontrivial. Just as budgeting for primary data collection is best done in the early stages of project preparation, conversations with potential data providers should also be initiated early.

3. ***Is the sample size adequate?*** Impact evaluations require a sufficiently large sample size to detect statistically significant effects. However, the number of project beneficiaries is often not appropriate to use in a power calculation. For instance, a project providing electricity access to rural villages may serve tens of thousands of beneficiaries; however, since the project is administered at the village level, the relevant number for statistical power calculation is the number of villages. Determining whether a project has an adequate sample size for an impact evaluation is a nontrivial, nuanced issue. Consultation with experts during impact evaluation could help project teams better understand whether a project's size and scope will make investing in an impact evaluation worthwhile.

4. ***Is the project design conducive to an impact evaluation?*** The next section outlines a wide range of settings that are suitable for impact evaluation. It is worth noting that most impact evaluations do not require randomization. Determining whether a project's design aligns well with one of the impact evaluation strategies, or whether small changes are required to bring it into alignment, is the final consideration when assessing the feasibility of an impact evaluation.

5.3 Suitable Settings for an Impact Evaluation

Impact evaluations can be broadly grouped into two categories: randomized controlled trials and quasi-experiments. While random assignment is often referred to as the "gold standard" for impact evaluation, it is not always feasible to randomize projects. Randomization can be especially difficult in projects that involve large infrastructure investments. This section outlines the settings where project teams may wish to consider randomization, before discussing three alternatives to randomization: phased project rollout, subnational discontinuities in program or project eligibility, and matching.[1]

5.3.1 Random Assignment

A project may be well suited for a randomized controlled trial when it is possible to randomly determine which individuals, firms, or communities benefit from it and which do not (see, for instance, Barron and Torero [2014]; Aklin et al. [2017]). Although random assignment may appear infeasible, certain scenarios lend themselves to randomization. The most common scenario arises when budget constraints limit the number of project beneficiaries, leading to oversubscription. When all potential project beneficiaries cannot be served, transparent, random assignment can be an equitable approach to determine who benefits from the project.

Random assignment carries two interrelated advantages relative to quasi-experiments. First, randomizing ensures that, on average, project beneficiaries are directly comparable to the control group. As such, it is straightforward to establish a credible control group when using random assignment. Second, random assignment entails fewer data requirements than certain quasi-experimental approaches. While it might still be beneficial to collect baseline data or obtain preproject data, multiple rounds of data collection are not strictly necessary for establishing the credibility of the control group.

Although random assignment may not be feasible for all project components, it may be feasible for specific subcomponents. For instance, a project may be expanding the national grid and using subsidies to encourage firms to adopt productive use appliances.

Randomizing the grid's expansion is likely infeasible, although it may be feasible to have interested firms register for a lottery for productive use subsidies. While the project team may not be able to determine the overall employment impact of grid expansion in such cases, it could determine the impact of productive use subsidies by examining the number of people employed by the lottery's winners against the number of people employed by the firms that registered for the lottery but were not selected. Project teams should carefully consider which project components they are most interested in evaluating and which are the most feasible to evaluate.

5.3.2 Phased Project Rollout

When projects roll out to beneficiaries in a staggered manner, a difference-in-differences approach can be adopted to evaluate impact. The fundamental assumption underlying the difference-in-differences approach is that project beneficiaries would have followed the same trend as the control group had a project never been implemented. For example, consider a state that has 200 rural villages that are candidates for stand-alone mini grids, but current funding can cover only 100 mini grids. Random assignment is not possible because transporting materials and constructing the mini grids entail economies of scale. The 100 villages in the northern half of the state receive mini grids in the first round of funding, while the 100 villages in the southern half await the next tranche of funds. Provided the southern villages followed the same trends as the northern villages before the mini grids' installation, they can form a credible control group (see, for instance, Grogan and Sadanand 2013; Khandker, Barnes, and Samad 2013; Lenz et al. 2017).

Establishing that two groups followed the same trends before project implementation imposes additional data requirements relative to random assignment. Impact evaluation in this case will require—at a minimum—two data points before project implementation for the project beneficiaries and the control group. This will makes it possible to compare trends before project implementation. In settings with high-quality administrative data, these additional data requirements will not pose challenges. However, for projects relying entirely on primary data collection, adopting a difference-in-differences approach is difficult since it requires multiple rounds of data collection before project implementation, simply to determine whether the proposed control group is credible. Countries with regular household- or firm-level surveys may have sufficient data to establish parallel trends, although such data are often not sufficiently granular to provide clear evidence for the locations affected by a project.

Following a difference-in-differences approach also requires that data are available for both the pre- and post-implementation period for all indicators of interest. Unlike random assignment, where the experiment's design ensures that project beneficiaries and the control group are identical, on average, before project implementation, difference-in-differences relies on controlling for preexisting differences between project beneficiaries and the control group. This again makes the difference-in-differences approach well suited for settings where administrative data are available for indicators of interest.

5.3.3 Subnational Discontinuities in Project Eligibility

When discontinuities occur in project eligibility, project teams can conduct an impact evaluation that focuses on comparing “just eligible” project beneficiaries to a “just ineligible” control group. Discontinuities in eligibility can take many forms. For instance, Burlig and Preonas (2022) evaluate a rural electrification program in India where only villages with more than 300 inhabitants were eligible. They obtain an estimate of the program’s impact by comparing villages with just over 300 inhabitants to those with just under 300 inhabitants. Discontinuities can also be geographic: grid densification projects may offer to subsidize grid connections only for households within a certain distance of an existing grid (e.g., He 2019). When using discontinuities in eligibility to evaluate impact, the establishment of a credible control group involves showing that beneficiaries could not manipulate their eligibility. Typically, this is done by plotting the distribution of the variable that determines eligibility. The variable is plotted to show that the distribution is smooth across the eligibility threshold. For instance, in Burlig and Preonas (2022), it would raise suspicion if the distribution of village sizes showed a significant increase just over 300 inhabitants. Establishing a credible control group requires collecting or obtaining data on the variable that determines eligibility, in addition to all indicators of interest.

Using discontinuities for impact evaluation could be especially appealing for large infrastructure projects, where randomization is not feasible. However, the discontinuity approach has a key limitation: it only allows impacts to be estimated for beneficiaries who fall just within the eligibility threshold. This limits the relevant sample, potentially making it more difficult to obtain an adequate sample size. In some cases, discontinuity designs may also lead to underestimates of a project’s true impacts. Consider a project that extends the national grid to new neighborhoods within a city. Comparing the number of employees in the firms just within the newly extended grid’s range with those in the firms just out of its range will produce reliable estimates of the project’s impacts, but only among firms on the grid’s outskirts. If the just eligible firms are farther from market centers than the beneficiary firms that are not on the border of eligibility, then the estimated impacts for the just eligible firms may be lower than the true impacts among all beneficiary firms.

5.3.4 Matching

When all other approaches to impact evaluation are infeasible, matching is a way to leverage to conduct and impact evaluation. Matching involves creating a control group that resembles project beneficiaries as closely as possible, on as many observable dimensions as possible, prior to project implementation (see, for instance, Bensch, Kluve, and Ankel-Peters 2011). Matching relies on the assumption that it is possible to observe sufficient relevant characteristics of both the control group and project beneficiaries to create a credible control group.

Matching fundamentally relies on obtaining data on a wide range of preproject characteristics. The data must predate project implementation, because projects may alter certain characteristics for project beneficiaries. For instance, matching project beneficiaries to a control group based on household asset ownership observed after the commencement of an energy access project will systematically bias results because project beneficiaries are more likely to have invested in electrical appliances than the control group. Any data recorded after a project's commencement cannot be used to define the control group. The data must cover a wide range of characteristics, because all relevant characteristics are assumed to have been included while matching.

While often appealing initially, defining a control group credibly purely based on matching is difficult since observing all relevant characteristics is rarely possible. For instance, suppose a clean energy project installed solar electricity equipment at health facilities on a first come, first served basis. While the project team may have detailed administrative data on the facilities' characteristics such as size, fees, building quality, staff educational levels, and measures of staff quality, it is impossible to observe how much value they place on electricity and know how that value correlates with other outcomes. If the facilities valuing electricity highly are the ones trying to increase the number of patients served, then they may have planned to hire more staff than the facilities valuing electrification less even in this project's absence. Attributing all differences between these two types of facilities to electricity access would be inaccurate.

Given the difficulty of observing all relevant characteristics, it is more common to use matching in combination with other approaches to impact evaluation. For example, if data are available for multiple periods prior to project implementation, then matching can be combined with difference-in-differences approaches. Combining matching with other impact evaluation approaches could increase precision, making it possible to evaluate impact with smaller sample sizes. Matching can similarly increase statistical power when paired with randomization.

5.4 Conclusion: Integrating Impact Evaluation

Impact evaluation can be a powerful tool to expand the number of indicators tracked and to credibly measure and attribute impacts to projects. Although impact evaluations can be resource intensive, a basic understanding of the different approaches could help project teams assess whether an impact evaluation will be feasible. Since this chapter provides only a high-level introduction to impact evaluation, table 5.1 lists resources for further learning and to help project teams identify impact evaluation experts for collaboration (table 5.2).

TABLE 5.1

Resources for Further Learning

SOURCE	SUMMARY
Development Impact Evaluation (DIME) Wiki	A resource designed to be used by monitoring and evaluation specialists, researchers, and project teams. It is good for developing a general intuition about different impact evaluation strategies, besides delving deeper into different methodologies. See in particular randomized controlled trials and quasi-experimental methods.
Development Research in Practice: The DIME Analytics Data Handbook	A detailed resource on designing and implementing empirical research. It is targeted mostly at research professionals, but contains some insights that may help project teams collaborate more effectively with experts in evaluating impact.
J-PAL's Introduction to Randomized Evaluation	A nontechnical reference specifically on randomized controlled trials. It is helpful for determining whether randomization is feasible and analyzing how to incorporate randomization into a project.

TABLE 5.2

Resources for Identifying Experts

SOURCE	SUMMARY
ESMAP Multi-Tier Framework (MTF)	A standardized tool for measuring energy access and energy uses. Existing MTFs may be suitable as baseline measures for some projects, or project teams may wish to collaborate with MTF data experts.
Development Research Group (DECRG)	See the researchers page for a list of DECRG researchers who may have relevant expertise, or refer to the database of cross-support engagements to see which researchers have been involved in similar projects.
Development Impact Evaluation (DIME)	See the experts page to identify impact evaluation experts who have experience in related areas.
List of J-PAL affiliates	See the list of affiliated professors and invited researchers to learn which external academic partners may be interested in partnering on impact evaluation.

Endnote

1. Note that instrumental variables strategies have also been used to study the effects of energy projects (e.g., Dinkelman 2011; Lipscomb, Mobarak, and Barham 2013; Khandker et al. 2012; Grogan 2016; Thomas et al. 2020). We do not cover instrumental variables in this chapter due to the difficulty associated with finding a credible instrument.

SIX
LESSONS ON BOOSTING EMPLOYMENT THROUGH CLEAN ENERGY AND PRODUCTIVE USE PROJECTS

This chapter discusses potential lessons on ways to increase employment created by clean energy projects (including productive uses of electricity [PUE] projects) domestically (within country) and locally (in the area immediately surrounding a project site). To do so, it draws on insights and experiences from case studies of selected World Bank–financed projects and a World Bank report on productive use (ESMAP 2023a). Some examples are outlined in table 6.1.

The overarching lessons covering both topics are summarized below:

- **Outcome measurement must go beyond direct employment measures, especially to foster an understanding of longer-term impacts.** One of the main indicators is to track project-related job creation in a clean energy project. This outcome can be easily conveyed to local stakeholders when describing a project's potential benefits for their countries or local project areas.

  However, this indicator does not shed light on job quality or job equity, which hold significance in projects that have to achieve developmental outcomes (economic growth, socioeconomic impacts, social inclusion and gender equity, etc.). As already elaborated on in the previous sections, these outcomes can be covered by a series of subindicators for determining job quality (namely, wages, job formality status, social security insurance coverage, and number of weekly working hours for direct local workers). Further, each of these direct job indicators can be disaggregated by marginalization status (e.g., gender) to shed light on the extent to which the direct jobs associated with a project benefit key subpopulations equitably.
- **Data on project-related employment can be sourced from project implementers, relevant literature, or project beneficiaries.** Project implementers are entities that implement projects (e.g., firms tasked with the design, construction, and/or maintenance of project-financed clean energy infrastructure). They can include government entities; private firms performing design, construction, and operation and maintenance work; and nongovernmental organizations (NGOs) providing complementary services (such as training to project beneficiaries). The relevant literature refers to peer-reviewed and gray literature publications describing the relationships between indirect and direct job outcomes (when estimating indirect job creation) and between intermediate outcomes and outcomes for beneficiaries (when estimating induced employment outcomes) (e.g., UNIDO and GGGI 2015). Project beneficiaries include individuals, households, and enterprises benefiting from improved energy efficiency, quality, or access due to a project.
- **Complementary investments in skill training for workers have the potential to enhance direct employment outcomes.** Design and construction tasks associated with clean energy infrastructure routinely require workers with specialized skills (such as electrical engineering, architecture, and surveying) as well as more generalized vocational training (such as electricians), as shown in table 3.2. Project implementers also often provide on-the-job training, as was the case for the Sindh Solar Energy Project in Pakistan, where newly hired workers received training on health, safety, and environment standards, or the use of specialized engineering software. This suggests that implementing entities performing design, supervision, construction, and operation

TABLE 6.1

Examples of World Bank Projects that Aimed to Boost Local Employment

CATEGORY OF ACTIVITIES	SUBACTIVITIES	EXAMPLES FROM SELECTED CASE STUDIES
Infrastructure investment	Local employment requirements in tenders	• **India.** The Project Development Objective included (1) making India's Northern Electricity Grid more reliable through the addition of renewable, low-carbon energy, and (2) making the Satluj Jal Vidyut Nigam, a state-owned enterprise involved in hydroelectric power generation and transmission, more effective. The project had to fulfil requirements that favored hiring local labor; specifically, 70 percent of the project's workers had to be hired from within the state where the project was implemented. • **Pakistan.** The project's focus was to increase solar power generation and electricity access in the Sindh Province of Pakistan. Issues with hiring women led to some respondents suggesting that hiring requirements might help produce more equitable outcomes by gender.
Enhancement of local skills and capabilities	Productive use investments	• **Peru.** Nongovernmental organizations first worked closely with electricity distribution companies to identify potential new areas for expanded electricity access. Then they raised awareness among the targeted local businesses (e.g., coffee cooperatives and milk producers) and helped them develop the skills to use electricity to support their business activities (including identifying new opportunities for business expansion, besides technical skills). Finally, the nongovernmental organizations helped businesses access other complementary services to use electricity for productive purposes, including access to financing opportunities. The degree to which the employment associated with the PUEs at the end of the intervention was sustained during the five years after the project's completion was explored. The findings suggest that this project may have created some new jobs but also eliminated others, with the net effect being unclear. • **India.** Under the community development measures mandated by the State Hydropower Policy, the project supported technical education for local youth by providing opportunities for them to undergo vocational training at industrial training institutes (including reimbursement of tuition expenses and a monthly stipend for eligible candidates from project-affected families). Selected youth received training on various productive activities such as tailoring and beauty services.
	Direct employment training	• **India.** Under the community development measures mandated by the State Hydropower Policy, the project supplemented support for technical education for local youth with an apprenticeship scheme. Under the apprenticeship scheme, technically qualified youth in project-affected areas were given an opportunity to be involved in the project for one year and gain relevant skills and experience. Some apprenticeships subsequently converted into longer-term jobs. • **Kosovo.** As part of broader support for energy efficiency and renewable energy investments, the project provided training to energy efficiency and renewable energy service providers (including design and construction firms) to ensure adequate technical competency (including on understanding energy audits and identifying construction weaknesses). The project resulted in the creation of 326 person-years (domestic) of direct jobs due to the design and construction of energy efficiency building retrofits, installation of solar and energy efficiency appliances, and training and audits. Job numbers are not corelated to training only.
Community development	Improving local infrastructure	• **India.** Parallel investments to improve complementary infrastructure (such as roads, piped water, and sewage services) reportedly enhanced the benefits of improved electricity by making it more accessible and desirable for the project-affected communities. Project teams designing energy sector interventions should aim to coordinate with teams in other sectors to identify opportunities for such complementary investments.
	Project-specific activities targeting women/vulnerable populations	• **Peru.** Respondents reported that investments in the Second Rural Electrification Project helped increase productive employment opportunities for female and indigenous workers.

and maintenance believe complementary investments to expand relevant skill training (particularly in more remote, rural areas), in turn making local workers more employable, potentially increase project-level job creation.

The availability of a workforce with relevant skills may also support continued investments in clean energy infrastructure beyond the scope of a particular project. For example, respondents interviewed as part of a case study covering the Kosovo Energy Efficiency and Renewable Energy project, which supported energy efficiency upgrades in public sector buildings, reported that, due to the nationwide rise in demand for energy efficiency investments, the experience gained by workers through their employment in project-related activities eventually became applicable beyond the project.

Further, implementing entities across several reviewed projects reported that staff with experience on similar types of jobs, especially workers with semiskilled jobs, are viewed favorably in comparison with staff with formalized training only. For example, in the Rampur Hydropower Project in India, staff with five or more years of experience of operating heavy machinery were acceptable in lieu of a license/certificate for operating such machinery. This suggests that support to expand apprenticeships or internships could be as impactful as funding for formal training programs. It is worth noting, however, that evidence on the effectiveness of business training programs in the African context is generally mixed (e.g., Berge et al. 2012; Campos et al. 2017). More recent studies suggest that business training programs could be made more effective if they are better adapted to local conditions (McKenzie 2021).[1] Multiple examples and details are also provided in the socioeconomic guidance report of the Energy Sector Management Assistance Program (ESMAP) Sustainable Renewables Risk Mitigation Initiative (World Bank 2022b).

6.1 At the Local Level

Complementary investments to promote PUEs may increase induced employment impacts. A growing body of research suggests that complementary services are necessary to fully realize the expected benefits of clean energy infrastructure investments (e.g., Peters, Harsdorff, and Ziegler 2009). For example, projects designed to increase electricity access and use through new or upgraded infrastructure in low-income countries could face challenges that influence the desired outcomes because the beneficiaries cannot afford improved services or are simply unaware of the potential economic benefits of using them effectively.

Complementary services promoting PUE (e.g., sensitization or information campaigns to increase awareness about how electricity can be used, provision of financing to make electric appliances and equipment more affordable, and business development initiatives to foster the creation and growth of electricity-using enterprises) could help raise awareness. For example, efforts to promote PUE were part of the Second Rural Electrification Project in Peru, where local NGOs were hired to raise awareness among the targeted local businesses and help them develop the skills to use electricity to support their business activities (including identifying new opportunities for expansion, besides the related technical skills). These NGOs also partly supported businesses in accessing other complementary services, including access to financing opportunities for purchasing the items required to use electricity for productive purposes. Complementary services that can be delivered as part of clean energy interventions generally fall under three key categories (Morrissey 2018):

1. **Awareness raising and education.** Potential beneficiaries may not understand the benefits of electrification. Complementary services specifically for raising awareness of electrification's benefits to productivity and well-being broadly and/or the benefits associated with the use of specific appliances could thus be bundled to make electricity services more desirable and strengthen the resulting employment impacts (Peters and Sievert 2016). Such complementary services may also be designed to focus on the development of enterprises and electrification-related skills in the project areas. For example, vocational training may enable beneficiaries to use electricity for new types of productive uses, which did not exist previously. Similarly, business development support specifically promoting electricity's use by enterprises may help existing enterprises identify new opportunities for utilizing electricity services to conduct their business activities. This will help enterprises grow and create new jobs.
2. **Financial services.** Lack of access to finance can constrain potential beneficiaries, especially those in low-income areas, from accessing electricity services. The provision of supportive finance (e.g., subsidies to cover connection costs) could help electrify larger numbers of households and enterprises, besides increasing the use of electricity among them. Financing may also be provided to support the adoption of productive use electrical appliances and equipment. However, note that the benefits related to the adoption of electrical appliances may not sustain over the longer term if an established supply chain for such appliances is absent in remote, rural areas as beneficiaries may be unable to repair or service the appliances (Pattanayak et al. 2019).
3. **Market access.** A growing body of research finds evidence of complementarities between electricity services and other infrastructure (e.g., Chaurey and Le 2022). Investments in complementary infrastructure (such as roads or telecommunication) could ease other (nonelectrification) binding constraints, enable greater market access, and encourage the creation and relocation of enterprises in project areas. Market access may be necessary to encourage PUEs, since there may be a close link between potential benefits in the form of higher incomes due to increased sales of new goods and services produced using electricity and households' and enterprises' ability to tap into markets located in economically active urban areas. It is worth noting that significant coordination (across multiple ministries and policy makers, donors, and project teams) may be needed to ensure that large-scale investments in nonelectrification infrastructure projects complement investments for expanding electricity access.

In addition, the following are also important:

- **Strategic design of PUE projects.** PUE projects must be designed strategically, preferably following an ecosystem approach (see also under Recommendations), whereby different aspects become building blocks (financial, technical, and business capacity building; incentives; and market linkages).

- **Quality of PUE appliances and equipment.** Quality PUE appliances and equipment are critical for the success of PUE MSMEs (micro, small, and medium enterprises). This includes working closely with appliance and equipment sellers, besides working with governments on quality control and standards, and the supply of the appliance and equipment to rural enterprises.

Endnote

1. Specifically, McKenzie’s (2021) meta-analysis of randomized controlled trials on the impact of business training programs suggests that training increases profits and sales by 5–10 percent on average. In other words, despite the short duration of most business training programs, they do deliver some benefits to firms; however, the magnitude of the benefits is typically too small for individual experiments to be able to detect. McKenzie (2021) also highlights that business training programs could be made more effective by incorporating gender (e.g., by helping women entrepreneurs enter new sectors with higher growth potential), *kaizen* (continuous improvement) methods (e.g., highlighting the importance of routine equipment maintenance), localization and mentoring (e.g., highlighting local best practices and fostering opportunities for entrepreneurs to meet with peers), heuristics (e.g., highlighting “rules of thumb” to separate household and business finances), and psychology (e.g., personal initiative training).

SEVEN
RECOMMENDATIONS

On Employment Indicators

- **Job creation indicators can be combined to shed light on the overall employment outcomes associated with projects.** Project teams can combine the estimates of direct and indirect employment (both of which can be measured in person-years) to estimate the total number of jobs associated with a project. Note that combining this aggregated metric with data on induced employment is not recommended, given data collection challenges and the lack of evidence concerning the estimation of a project's induced employment impact—in person-years—against a counterfactual scenario in such a way as to consider the likely duration of impact (see table A.10 for a detailed discussion of these issues).
- **Direct employment should be measured in person-years whenever possible since projects can vary substantially in terms of the amount of work done by each worker.**[1] Ideally, these person-year data would be based on the actual hours worked. It is often possible to obtain such information from documents maintained by implementing entities. However, when that is not possible, project teams can rely on alternative methods. For example, data on the number of full- and part-time workers hired each year can be used to estimate the total hours of work.
- **Indicators tracking induced jobs should shed light on impacts and not total employment.** While this document recommends a focus on the total direct and indirect employment, it also recommends focusing on projects' induced employment impacts, made via improvements in energy availability and quality.[2] This is partly because the identification of all jobs created for project beneficiaries is likely infeasible. It is also challenging to attribute the creation of these jobs specifically to projects. The focus on induced employment impacts is also because many projects might collect survey data to estimate impacts on other outcomes. Adding employment as an outcome to an existing evaluation based on these data might add little in the way of additional resources in that case. That said, in many cases, it will not be possible to obtain rigorous estimates of a project's impacts on induced productive use employment. In these cases, it may be possible to use data on projects' impacts on other outcomes, for example, electricity access or quality, and then multiply those estimates by estimates from existing literature on the employment impacts of these intermediate outcomes.
- **Employment indicators should cover both short- and long-term employment.** Short-term direct employment on clean energy projects refers to employment associated with design, supervision, and construction. Longer-term direct employment refers to ongoing O&M work. The longer-term outcomes are often equally, if not more, important than the short-term outcomes because they last for far more years and can thus result in person-years of employment that are often similar in magnitude to those associated with short-term employment.
- **Employment equity can be tracked and measured by disaggregating key indicators.** Outcomes can often be disaggregated by relevant factors such as vulnerability status, gender, and age. Vulnerability status can refer to an employee's prior skill level and whether they belong to a group for which employment outcomes are traditionally worse.[3] This equity lens can be applied to the majority of indicators outlined in this document.

A key exception is indirect employment, which refers to the employment required to provide the inputs used by direct employees. It is generally difficult to obtain detailed information on indirect employees. This document, hence, does not recommend attempting to obtain these disaggregated data for indirect workers.

- **Indicators imposing significant data collection or reporting burdens on implementing entities and subcontractors should be avoided.** For example, some donors have proposed project-level indicators to capture the numbers of direct short-term ("temporary") jobs associated with clean energy investments (e.g., MCC 2022). However, accurate estimation of these numbers entails a need to avoid double counting of individuals across contracts and implementing entities. While possible in theory, this could create an excessive burden since it requires employers to provide data with sufficient information on each employee to distinguish individuals employed across multiple contracts, firms, or positions. Focusing on person-years addresses this issue since double counting is no longer a concern.

On the Design of Productive Use Projects

- **Utilize a micro, small, and medium enterprise (MSME)-focused ecosystem design process.** An ecosystem perspective that includes the needs and potential of MSMEs, including small holders and income-earning households, provides better results for boosting rural productivity. The interconnected links between and among planning, policies and regulations, financing, and technical aspects, including capacity building, can make increased gains and impacts, including in jobs, or job quality, and livelihoods through productive uses of electricity (PUEs) possible if they are well analyzed and linked. Discussion and participative assessments with stakeholders, including at the local level, could help build partnerships for implementation.
- **Consider PUE uptake beyond electricity/energy connections.** Many PUE projects are designed to focus primarily on electricity use. Equal emphasis must be placed on designing strategies for linking the adoption of PUE MSMEs, or household-run businesses, to the production of goods and services, and markets. The need to link to appropriate financing is equally important. Often, global supply chains reach remoter communities at scale, offering products at competitive prices. Thus, PUE MSMEs must also be competitive in terms of pricing, quality, and reliability—all of which are critical for their survival and long-term sustenance.

On Process

- **Additional resources in investments (public and private) are needed to support employment as well as track it.** Considering infrastructure is resource intensive, project components directly supporting clean energy infrastructure investments often comprise the largest share of planned project budgets. For example, over 90 percent of the $400 million in World Bank financing planned for the Rampur Hydropower Project in India was allocated for the construction of the 412 megawatt Rampur run-of-river hydroelectric plant (World Bank 2007). For projects to achieve development or socioeconomic outcomes, it would be important for project teams to include additional resources (inputs) for investments in activities such as supporting productive use enterprises and, importantly, include such outcomes in the Project Development Objective (PDO) and provide funds for tracking the PDO and impact evaluation.

- **The terms of reference (ToRs) for clean energy projects should not include stipulations that impose barriers to direct and indirect domestic/local employment, provided doing so does not adversely impact the quality of implementation.** Some ToRs include requirements that could limit direct and indirect domestic/local employment. To avoid such requirements, if they are not essential for a project's effective implementation, project teams should ensure that all ToRs are reviewed carefully. Box 7.1 offers an example from Kosovo.
- **Efforts are needed to address barriers limiting employment opportunities among females and vulnerable populations.** Projects must make concerted efforts to employ females and members of vulnerable populations (such as religious minorities or youth). This can be challenging when certain jobs (for example, those in construction) are perceived as unsuitable for certain types of workers, when there is a perceived need to have separate facilities for those workers, and when there are safety and security concerns for women—all of which often apply to female workers, as was the case for the Sindh Solar Energy Project in Pakistan. Project-level resources could be utilized to

BOX 7.1

LIMITS ON TERMS OF REFERENCE REQUIREMENTS IN KOSOVO

Contract specifications reportedly pertaining to the hiring of international workers for certain tasks and the procurement of materials from abroad constrained the potential for both direct and indirect local labor. Project teams should carefully consider the implications of contract specifications, including assessing the types of constraints that might be introduced and how stakeholders might respond to them.

Source: ESMAP 2023e.

address some of these perceived constraints. For instance, allocating project funding for separate facilities for female workers could be a relatively inexpensive approach compared with increasing the number of jobs created for females due to clean energy investments.

Data Collection

- **Clean energy projects should require implementing entities to provide the data required to track direct employment indicators.** Most implementing entities should require little effort to provide these data if such requirements are made explicit in the Project Operations Manual and Public Information Management. Implementing entities likely already maintain employment records with many (if not all) of the required details. If such requirements cannot be stipulated in the World Bank documents, then implementing entities could also be directed to furnish estimates as part of proposals submitted to win project-related contracts. Most implementing entities likely generate this information to inform proposal costing, even if these details are not included in the submitted proposals; this means that requiring this information would likely not increase the level of effort needed to bid on project contracts. Project contractors could be asked to collect and report data on key pieces of information such as person-years of employment associated with project activities (to shed light on job creation), hourly wages paid (to shed light on job quality), and the share of workers who completed a firm-sponsored training (to capture key intermediate outcomes that might shed light on human capital formation) (World Bank 2017b). In many cases, this information may have to be disaggregated for key subgroups (such as foreign workers, women, and youth).
- **Implementing entities can also be required to collect data on employment outcomes from subcontractors.** Layers of subcontracting can often make it more challenging to obtain data from subcontractors than the implementing entities directly associated with a project. Making the provision of employment indicators an explicit requirement in the ToRs for implementing entities may help to address this issue. Specifically, the ToRs should clarify that the indicator data should account for all staff working on project sites, including those hired directly by an implementing entity as well as those hired by subcontractors.
- **Beneficiaries and comparable nonbeneficiaries can be surveyed to estimate the degree to which a project enhances employment outcomes for beneficiaries.** Project teams often conduct such surveys to track progress on a variety of indicators already included in project-level results frameworks (e.g., household-level electricity access). In such cases, the data collection protocols can be amended relatively easily to also gather data on employment indicators for individuals, households, and/or enterprises.
- **For PUEs, appraisals are required to realistically assess opportunities, taking into account local dynamics and market risks.** In addition to surveys, community meetings, focus groups, and discussions, along with direct consultation with potential

entrepreneurs and businesses, are crucial for revealing opportunities, entry points, and partnerships. Additional effort will be required to include women and other socially disadvantaged groups. Data on and analysis of operational value chains for products and services are also required.

Endnotes

1. Person-years are computed by dividing the sum of the hours worked by all employees on a project by the number of hours typically worked in a year. The exact definition of a person-year may vary depending on the circumstances. This document assumes that there are 2,080 working hours per year (40 hours per week multiplied by 52 weeks per year). Using person-years as the unit of measurement also addresses challenges related to the double counting of workers who may have been employed by multiple entities or on multiple roles during a project.
2. Project beneficiaries are individuals likely to receive a project's energy benefits. In some cases, a project might benefit the entire community where it is implemented (e.g., updated electricity access for a grid or mini grid project), since any of its members could be hired by or purchase goods from an electricity consumer. In other cases, benefits might be limited to specific households receiving an intervention that is less likely to benefit other community members (e.g., a solar home system or energy efficiency upgrades for a home might be less likely to generate benefits for community members who are not direct beneficiaries).
3. The jobs toolkit prepared by the World Bank (2017b) uses the term "access" to refer to employment equity. This document uses the term "equity" instead because, in the clean energy field, "access" generally refers to having access to energy.

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APPENDIX A

Job Indicators: Definitions and Guidance

Appendix A provides additional details on the indicators specifically related to the jobs described in table 2.1. Note the following categories:

- **Direct jobs: Tables A.1–A.6**
- **Indirect jobs: Tables A.7–A.9**
- **Induced jobs (including productive use of electricity [PUE] jobs) : Tables A.10–A.15**

TABLE A.1

Direct Employment

TOPIC	INFORMATION
Indicator name	Direct employment of domestic (or local workers) in person-years
Related indicators	• Number of local people employed in different stages of project implementation • Unemployment rate in the area*
Unit of measure	Number of person–years or full-time equivalent (FTE)
Baseline	Zero (since project jobs did not exist before the project started)
Definition	Direct jobs are jobs that are created for implementing a project. They include: • Short-term jobs (for design, supervision, and construction) and longer-term jobs (for operation and maintenance). • Jobs performed on site, such as construction work. For example, if a company is hired to produce poles from logs and workers that work on the site, then that would be considered direct labor. However, if this work is done elsewhere and the poles are brought to the site in a finished condition, then that would be considered indirect labor • On-site or off-site work (design, supervision, operation, and maintenance). These jobs are typically for the employees of entities receiving World Bank funding. It also includes their subcontractors. These entities might include local governments, utilities, nongovernmental organizations, and private firms. By contrast, the work done by suppliers is generally considered indirect labor Direct jobs are also: • **Domestic**, referring to those who are the legal residents of a country, and • **Local**, referring to those who are the residents of the immediate area surrounding a project site.
Sources of definition	Developed during case studies based, in part, on World Bank (2017b, 2022a), UNIDO and GGGI (2015), and Pollin and Chakraborty (2015)
For which types of projects	For projects employing local workers for implementation (or can also be for domestic workers for a project)
Data source	Data on direct jobs can often be obtained from a project itself and from the subcontractors of the project entities. Foreign workers should be excluded.

(*continues*)

TABLE A.1

Direct Employment (*Continued*)

TOPIC	INFORMATION
Calculation	Ideally, **person-years** would be calculated based on the hours worked assuming 2,080 hours per year (52 weeks at 40 hours per week, or dependent on the labor rules of the country where a project is implemented). However, if only data on the days or months worked are available, then person-years can be computed based on the available data. **Full-time equivalent** jobs are those jobs where a specific number of hours are considered full-time work. For example, if a company considers 40 hours per week full time, then two employees working 20 hours per week would equal a 1.0 full-time equivalent. According to the International Labour Organization, the threshold that categorizes workers as full time and part time varies between countries but is usually either 30 or 35 hours per week (ILO n.d.).
Options for disaggregation for equity outcomes	By vulnerability status, gender, age, skill requirements, short term versus long term, full time versus part time, and new versus old

Discussion

*Unemployment rates (an alternative indicator noted in table A.1) can be used to estimate a project's impacts on the total jobs in person-years. The estimated person-years of direct jobs can be multiplied by the local unemployment rate if there is a concern that many of the direct jobs resulting from a project are not better than what the workers would have had in the project's absence.[1] This provides a cost-effective method for estimating a project's direct employment impact. Alternatives would likely be costlier or more difficult to justify. For example, a rigorous estimation of direct employment impacts would likely require a substantial increase in planning and data collection costs.[2] Note that if data on unemployment are unavailable, it is not clear that the correction provides substantial savings.

Another alternative would be to limit the counts of direct jobs to new workers. This method, however, poses a challenge: many new workers might have had jobs even in a project's absence and some existing workers might have lost their jobs in its absence. Data such as these may have to be collected if counting direct new jobs. For this reason, if the goal is to estimate a project's local employment impacts, then the recommendation is to multiply the local unemployment rate by the number of local workers (new and existing), based on the assumption that the same fraction of those workers would be unemployed in the project's absence.

TABLE A.2

Employment Rate of Trained Direct Workers

TOPIC	INFORMATION
Indicator name	Number and share of individuals trained by a project who the project subsequently employs as direct workers
Related indicators	• Number of individuals who completed training • Trainees' satisfaction rate • Number of trainees employed by a project
Units of measure	Number and percentage
Baseline	Zero (since no prior project training)
Definition	This indicator tracks the number and share of individuals who completed the employment-related training delivered by a project (e.g., skill training related to project tasks and occupational safety training) and were subsequently employed by the project as direct workers.
Sources of definition	• World Bank 2017b • Project case studies
Data source	• Institution providing training (e.g., training evaluation report) • Post-training survey on trainees' job status • Project + contractors who are involved in the project
Calculation	• Number of trainees recruited for the project • Percentage of trained individuals employed by the project (direct workers only)
For which types of projects	For projects training individuals for their implementation
Options for disaggregation	By vulnerability status, gender, and age And preferably by project stage—construction, operation and maintenance, monitoring, etc.
Relevant job outcome	• Job creation
Additional note	This indicator can also be used to determine whether trainees are recruited, for example, by other projects or companies.

TABLE A.3

Direct Wages

TOPIC	INFORMATION
Indicator name	Wages of direct local workers
Related indicators	• Wages of direct local workers relative to the typical wages in an area • Annual earnings of direct local workers relative to local annual earnings
Unit of measure	Local currency (or US dollars)
Baseline	Wages of direct local workers on previous jobs (preferably the average of the last two full-time or major jobs)
Definition	Wages refer to the monetary compensation received by workers per hour. In some cases, it may be easier to obtain data on the typical payment in other units of time (e.g., per day, per week, per month, or per year). The wages of direct local workers can be easily compared with the typical wages in an area. Going beyond this (i.e., to attempt to estimate a project's impacts on the workers' wages) may impose a substantially larger data collection burden and is not recommended.
Sources of definition	• World Bank 2017b • Project case studies
Data source	Wage data—from local workers Wage data—from the project + its contractors and subcontractors

(*continues*)

TABLE A.3

Direct Wages (*Continued*)

TOPIC	INFORMATION
Calculation	Wage rate—amount of wage paid to a worker per unit of time (e.g., hourly, 52 weeks at 40 hours per week, or as per the country's labor laws) Calculation of full-time equivalents in table A.1
For which types of projects	For projects employing local workers for their implementation
Options for disaggregation	By vulnerability status, gender, age, and skill level
Relevant job outcomes	• Job quality • Job equity (when disaggregated)
Additional note	This indicator can also be used to track the domestic direct workforce, that is, those who are a country's legal residents (as opposed to the residents of the immediate area surrounding a project site).

Discussion

Case studies on selected World Bank–funded clean energy projects suggest that obtaining good-quality data on direct wages may not be easy especially when these data are collected retrospectively. Many of the entities contacted as part of these case studies did provide some information on the subject, although that information was not easily comparable across projects or conducive to the creation of broader summary metrics. Implementing entities might be able and willing to furnish this information if it was a project requirement included in the terms of reference.

TABLE A.4

Job Formality Status of Direct Workers

TOPIC	INFORMATION
Indicator name	Share of local direct workers employed formally (and informally)
Related indicators	Percentage of local labor force with formal jobs
Unit of measure	Percentage of local direct workers
Baseline	Prevalence of formal employment in the project area (if available)
Definition	According to the International Labour Organization (Hussmanns 2005), a worker is considered to have an informal job if "their employment relationship is, in law or in practice, not subject to national labor legislation, income taxation, social protection or entitlement to certain employment benefits (paid annual or sick leave, etc.) for reasons such as: non-declaration of the jobs or the employees; casual jobs or jobs of a limited short duration; jobs with hours of work or wages below a specified threshold (e.g. for social security contributions); employment by unincorporated enterprises or by persons in households; jobs where the employee's place of work is outside the premises of the employer's enterprise (e.g. outworkers without an employment contract); or jobs for which labor regulations are not applied, not enforced, or not complied with for any other reason." In practice, the criteria typically used to categorize workers as informal include a lack of social security insurance coverage, a lack of entitlement to paid annual or sick leaves, and a lack of a written employment contract. Formal jobs do not have these characteristics.

(*continues*)

TABLE A.4

Job Formality Status of Direct Workers (*Continued*)

TOPIC	INFORMATION
Sources of definition	• Hussmanns 2005 • Project case studies
Data source	Project + contractors and subcontractors
Calculation	• Define key criteria for formal and informal jobs as per local labor laws • Number of direct workers recruited from surrounding areas for a project compared with the overall project labor force
For which types of projects	For projects employing local workers for their implementation
Options for disaggregation	By vulnerability status, gender, age, and skill level
Relevant job outcomes	• Job quality • Job equity (when disaggregated)
Additional note	This indicator is possibly only for construction, and operation and maintenance.

TABLE A.5

Direct Workers Covered by Social Security Insurance

TOPIC	INFORMATION
Indicator name	Number and share of direct workers covered by social security insurance
Related indicators	• Number of direct workers covered by pension/health insurance schemes • Number of direct workers contributing toward pension/health insurance schemes • Increase in the number of direct workers covered by social security insurance • Increase in the number of direct workers covered by pension/health insurance schemes • Increase in the number of direct workers contributing toward pension/health insurance schemes
Unit of measure	Number/percentage
Baseline	Dependent on context-specific characteristics (e.g., universal provision of social security insurance, provision of social security insurance through employment only)
Definition	Social security insurance may include, for example, a pension insurance scheme, health insurance, unemployment insurance, maternity and family benefits, disability insurance, and work accident insurance.
Sources of definition	• World Bank 2017b • Project case studies
Data source	Projects'/contractors'/subcontractors' human resource divisions/departments
Calculation	• Direct workers covered by or contributing toward pension/health insurance schemes • Annual data measurement for direct workers contributing toward pension/health insurance—compared with the baseline (year 1)
For which types of projects	For projects employing local workers for their implementation
Options for disaggregation	By vulnerability status, gender, age, and skill level (skilled, semiskilled, unskilled) Can also be domestic or local
Relevant job outcomes	• Job quality • Job equity (when disaggregated)
Additional note	Many unskilled workforces may not have formal contracts or insurance. Tracking based on skill level/gender/vulnerability status is thus recommended.

TABLE A.6

Average Hours Worked Per Week by a Local Direct Worker

TOPIC	INFORMATION
Indicator name	Average number of hours worked per week by local direct workers
Related indicators	n.a.
Unit of measure	Number of hours
Baseline	Zero for previously unemployed workers and nonzero for previously employed workers (e.g., 40 hours per week for workers employed full time previously)
Definition	Hours worked include the work hours of full-time and part-time workers (see definition/calculation in table A.1), and part-year workers, paid and unpaid overtime, and the hours worked on additional jobs (if available). It excludes the time not worked on account of public holidays, annual paid leaves, own illness, injury and temporary disability, maternity leave, parental leave, schooling or training, slack work for technical or economic reasons, strike or labor dispute, bad weather, compensation leave, and other reasons.
Sources of definition	• World Bank 2017b • Project case studies
Data source	Project contractors and subcontractors
Calculation	Number of hours typically calculated at 52 weeks at 40 hours per week or as per the country's labor laws
For which types of projects	For projects employing local workers for their implementation
Options for disaggregation	By vulnerability status, gender, age, and skill level
Relevant job outcomes	• Job quality • Job equity (when disaggregated)

n.a. = not applicable.

TABLE A.7

Procurement of Inputs

TOPIC	INFORMATION
Indicator name	Share of project inputs procured domestically
Related indicators	Percentage of goods procured domestically in a particular sector in a given country
Unit of measure	Percentage
Baseline	Zero (since the project did not exist before it started)
Definition	Total project spending on domestically procured project inputs divided by the total project spending on all project inputs
Sources of definition	• UNIDO and GGGI 2015 • Pollin and Chakraborty 2015
Data source	Project procurement unit
Calculation	See definition
For which types of projects	For projects using procured inputs for their implementation
Options for disaggregation	n.a.
Additional notes	Domestic spending on inputs is assumed to improve employment outcomes domestically by either creating more jobs or increasing the earnings of existing workers. This indicator is also important for measuring indirect job creation.

n.a. = not applicable.

TABLE A.8

Ratio of Indirect and Direct Employment

TOPIC	INFORMATION
Indicator name	Country- and sector-specific estimates of the number of indirect jobs in person-years created by each direct job or of the number of full-time equivalents
Related indicators	n.a.
Unit of measure	Ratio of person-years to person-years, or full-time equivalent to full-time equivalent
Baseline	n.a.
Definition	This indicator refers to the ratio of indirect and direct person-years or indirect and direct full-time equivalents of employment obtained from the relevant literature on similar projects in similar countries. This ratio is used for obtaining an estimate that is as directly relevant as possible to the country and sector covered by a project. For example, such information can be found for several countries and types of clean energy projects in UNIDO and GGGI (2015) and Pollin and Chakraborty (2015). Calculation of full-time equivalents in table A.1.
Sources of definition	• UNIDO and GGGI 2015 • Pollin and Chakraborty 2015
Data source	Relevant literature
For which types of projects	For projects employing direct workers who use procured inputs for implementation
Options for disaggregation	n.a.
Relevant job outcomes	Job creation

n.a. = not applicable.

TABLE A.9

Indirect Employment

TOPIC	INFORMATION
Indicator name	Indirect employment of domestic workers in person-years or full-time equivalents
Related indicators	• Number of domestic workers employed indirectly • Unemployment rate in the area
Unit of measure	Person-years or number of full-time equivalents
Baseline	Zero (since the project did not exist before it started)
Definition	Indirect jobs are jobs that are created to provide inputs to the entities/industries performing and supporting the core activities, especially during project implementation. Indirect jobs will almost always be done away from project sites (see the definition of direct jobs in table A.1).
Sources of definition	• Project case studies • World Bank 2022a, 2022b • UNIDO and GGGI 2015 • Pollin and Chakraborty 2015

(*continues*)

TABLE A.9

Indirect Employment (*Continued*)

TOPIC	INFORMATION
Data source	Derived from project implementers + contractors
Calculation	Indirect job person-years can often be estimated by multiplying estimates of direct job person-years by the ratio of indirect and direct person-years of employment obtained from research on similar projects in similar countries (as described in table A.7), adjusted by the share of inputs procured domestically (as described in table A.6). Use the same calculation method as for full-time equivalent jobs (see calculation in table A.1).
For which types of projects	For projects employing domestic (and local) people to provide the inputs required for implementation
Options for disaggregation	Not recommended since these data would likely be difficult to obtain. This indicator would target the domestic rather than local workforce (since entities/industries would mostly be away from project sites) *Note:* A domestic workforce is composed of legal residents of a given country.
Associated job output/outcomes	Job creation Job equity (when disaggregated)

Discussion

Estimates of indirect jobs typically depend upon the direct-jobs-related information provided by project implementers. It would also be helpful if project implementers could specify what fraction of their inputs was procured domestically and what fraction was imported. This information can be used in combination with existing literature on the ratio of indirect and direct jobs to estimate the indirect jobs for a specific project. For example, if all goods were imported, then there would be no local indirect jobs.

TABLE A.10

Induced Employment

TOPIC	INFORMATION
Indicator name	Employment rate for working-age project beneficiaries
Related indicators	Number of working-age project beneficiaries employed
Unit of measure	Percentage of working-age project beneficiaries employed
Baseline	Estimated employment rate for project beneficiaries in a project's absence
Definition	Estimated impact of a project on the employment rate for working-age project beneficiaries, where the impact is estimated by comparing the employment outcomes for the beneficiaries to an estimate of the counterfactual (what would have happened in a project's absence).
Source of definition	• World Bank 2017b • Project case studies
Data source	• Project monitoring and evaluation • PUE enterprises • Other enterprises in the local project area

(*continues*)

TABLE A.10

Induced Employment (*Continued*)

TOPIC	INFORMATION
Calculation	The delineation of the counterfactual is linked to the empirical approach used to evaluate a project's employment impacts (e.g., a randomly selected control group in a randomized controlled trial or a preintervention baseline in a pre-post study). Employment should include all types of employment (full time, part time, formal, and informal), but it can be disaggregated if sufficient data are available. The age cutoff to define who is of working age can be determined based on a country's local conditions/laws. Employment can be categorized by type according to project design with respect to beneficiaries (e.g., disaggregation of those self-employed) or according to income generation activity of, for example, individuals/MSMEs. The above will need specialized skills for evaluation and a much higher budget to conduct the required studies. The suggestion is that if projects are smaller (e.g., a small mini grid), then data can be obtained through a survey of beneficiaries, for example, PUE-related individuals, households, and MSMEs.
For which types of projects	For all projects that have the potential to impact the employment rates for beneficiaries
Options for disaggregation	By vulnerability status, gender, age, job type (e.g., subsistence agriculture jobs versus other types of jobs), and part time versus full time
Relevant job output/ outcomes	• Job creation • Job equity (when disaggregated)

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

Discussion

In many situations, it may be difficult to create an indicator that combines induced employment with direct and indirect employment. Capturing all types of jobs could be done using either a count of jobs or a count of person-years. Both options involve challenges.

The number of induced jobs created by a project can be estimated by multiplying the project's estimated impact on beneficiaries' employment rate by the number of beneficiaries. However, it may be more difficult to obtain a precise estimate of the number of direct and indirect jobs created by a project because the double counting of workers is often difficult to avoid. For example, many firms will be able to report on the number of workers they had at different times, but they would find it more difficult to identify how many unique workers they had in the months (or years) that it took to implement a particular project.

Reporting on person-years overcomes the double counting issue but entails other challenges. Specifically, obtaining person-year data for induced employment is difficult because it requires knowing how long projects' impacts last. A typical evaluation will include only one or two data collection periods after a project is implemented. This could make it difficult to obtain a precise estimate of how long (on average) impacts last. To simplify this approach, an assumption could be made about a specific average duration for project impacts (e.g., one year). Using this assumption would justify estimating a project's induced employment impacts in person-years by multiplying the average duration of impacts on a set number of beneficiaries by the estimated impact of a project on local employment rates.

Another alternative is to keep the indicators of direct/indirect jobs and induced jobs separate. The optimal solution is likely to vary by project depending upon the availability of data.

Survey data can be used to estimate a project's induced employment impacts.[3] These data can be obtained from individuals, households, and/or enterprises. If households are surveyed, they can be asked about the employment outcomes for all adult members. If enterprises are surveyed, they can be asked about the employment outcomes for all employees. Obtaining data on enterprises could be cost-effective if response rates are high, given that some enterprises hire large numbers of employees. Yet, especially larger enterprises often have low response rates to enterprise surveys, meaning that it may be more efficient to survey households or individuals.[4]

TABLE A.11

Employment Rate for Trained Beneficiaries

TOPIC	INFORMATION
Indicator name	Employment rate of project beneficiaries who received training (e.g., in PUEs, the individuals or MSMEs related to appliances and equipment, business development, market creation, financing, etc.)
Related indicators	• Number of project beneficiaries trained—individuals, MSMEs • Trainees' satisfaction rate • Trainees' attendance and engagement
Unit of measure	Percentage
Baseline	Percentage of project beneficiaries employed before they received training
Definition	This indicator tracks the share of individual beneficiaries who completed training and are employed. All forms of employment are considered (e.g., full time, part time, formal, informal).
Sources of definition	• World Bank 2017b • Project case studies
Data source	• Institution providing training (e.g., training evaluation report) • Post-training survey on trainees' job status • PUE enterprises in local project area(s) • Project monitoring experts
Calculation	Dividing the number of trainees (project beneficiaries) recruited by PUE enterprise(s) in local area(s) by the total beneficiaries trained
For which types of projects	For projects providing training for individuals such as PUE-related and other community development projects in project area(s)
Options for disaggregation	By vulnerability status, gender, age, and short-term versus long-term workers
Relevant job outcomes	• Job creation (induced) • Job equity (when disaggregated)

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE A.12

Induced Electricity Use

TOPIC	INFORMATION
Indicator name	Amount of electricity used by project beneficiaries—individuals and MSMEs—to operate appliances and equipment for PUEs (e.g., water pumps, cooling, etc.)
Related indicators	• Connection rates to the appliances/equipment used by households/enterprises for PUEs • Quality of electricity services (e.g., the frequency and total duration of the outages experienced per week by project beneficiaries, and the frequency and total duration of the voltage fluctuations experienced per week)
Unit of measure	Kilowatt-hours/month
Baseline	Electricity used prior to a project
Definition	Impact of a project on the amount of electricity used by the beneficiaries/individuals and MSMEs using electricity for productive purposes
Source of definition	Project case studies
Data source	• From the utility or developers of mini grids/standalone electricity plants • Project monitoring experts • Survey of households/enterprises/PUE MSMEs on the units utilized per month • Anecdotal case studies/focus group discussions
Calculation	• Units used (kilowatt-hours/month)—from electricity bills—for PUE enterprises • For specific appliance(s)/equipment in households and businesses—calculated based on the hours used on an average per week or per month
For which types of projects	For projects that are likely to impact the use of electricity
Options for disaggregation	By vulnerability status, gender, and age
Relevant job outcomes	• Job creation • Job equity (if disaggregated)

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE A.13

Awareness of Productive Uses of Electricity

TOPIC	INFORMATION
Indicator name	Increase in beneficiaries' awareness of PUEs
Related indicators	Percentage of beneficiaries owning appliances and equipment supporting PUEs
Unit of measure	Percentage
Baseline	Baseline awareness of PUEs
Definition	Impact of a project on the beneficiaries' awareness of the ways households and/or enterprises can use electricity for productive purposes. Awareness could be expressed as the percentage of productive use beneficiaries that are aware of PUEs on average. Project teams would have to identify relevant lists of PUEs appropriate for the project context. These lists would be used to assess the awareness of individual beneficiaries
Source of definition	Project case studies

(*continues*)

TABLE A.13

Awareness of Productive Uses of Electricity (*Continued*)

TOPIC	INFORMATION
Data source	• Survey of beneficiaries (households and MSMEs) owning PUE appliances and equipment in local project area(s) • Project monitoring experts
Calculation	Number of PUE appliances and equipment owned by project beneficiaries (informal income generation—nonregistered)
For which types of projects	For projects that are likely to impact PUEs (e.g., by providing PUE-related training to beneficiaries)
Options for disaggregation	By vulnerability status, gender, and age
Relevant job outcomes	Job creation

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE A.14

Induced Wages

TOPIC	INFORMATION
Indicator name	Wages of project beneficiaries
Related indicators	• Average wages of project beneficiaries • Typical wages in a project area (e.g., government rates)
Unit of measure	Local currency (or US dollars)
Baseline	Wages of direct local workers on previous jobs (if available)
Definition	Estimated impact of a project on the wages of adult project beneficiaries
Source of definition	• World Bank 2017b • Project case studies
Data source	• PUE enterprises in the local project area • Project monitoring experts
Calculation	Wages refer to the monetary compensation received by workers per hour. In some cases, it may be easier to obtain data on the typical payment in other units of time (e.g., per day, per week, per month, or per year).
For which types of projects	For projects that might impact the wages of project beneficiaries (including PUE MSMEs) by changing the extent to which electricity is used for productive purposes in a project area
Options for disaggregation	By vulnerability status, gender, age, and part time versus full time
Relevant job outcomes	• Job quality • Job equity (when disaggregated)

Note: MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity.

TABLE A.15

Job Formality Status of Project Beneficiaries

TOPIC	INFORMATION
Indicator name	Share of employed project beneficiaries who are formally employed
Related indicators	• Number of working-age project beneficiaries currently employed • Number of working-age project beneficiaries currently employed formally • Share of working-age project beneficiaries employed formally
Unit of measure	Percentage of employed working-age project beneficiaries
Baseline	Prevalence of formal employment in the project area (if available)
Definition	This indicator tracks the subset of formally employed beneficiaries among the beneficiaries employed by a project (see table A.10). According to the International Labour Organization (Hussmanns 2005), a worker is considered to have an informal job if "their employment relationship is, in law or in practice, not subject to national labor legislation, income taxation, social protection or entitlement to certain employment benefits (paid annual or sick leave, etc.) for reasons such as: non-declaration of the jobs or the employees; casual jobs or jobs of a limited short duration; jobs with hours of work or wages below a specified threshold (e.g., for social security contributions); employment by unincorporated enterprises or by persons in households; jobs where the employee's place of work is outside the premises of the employer's enterprise (e.g., outworkers without an employment contract); or jobs for which labor regulations are not applied, not enforced, or not complied with for any other reason." In practice, the criteria typically used to categorize workers as informal include a lack of social security insurance coverage, a lack of entitlement to paid annual or sick leaves, and a lack of a written employment contract. Formal workers do not share these characteristics.
Sources of definition	• Hussmanns 2005 • Project case studies
Data source	• PUE enterprises in local project area(s) • Project monitoring experts
Calculation	*For PUE enterprises*: Dividing the number of working-age project beneficiaries employed formally by PUE enterprises by the total workers in all PUE enterprises
For which types of projects	For projects employing local workers for their implementation
Options for disaggregation	By vulnerability status, gender, age, and skill level
Relevant job outcomes	• Job quality • Job equity (when disaggregated)

Endnotes

1. The direct jobs created by a project might not be better than existing jobs if, for example, many subcontracted workers are being paid the minimum wage in the area to perform unskilled labor (e.g., in construction) and would have had similar employment even in the project's absence.
2. For example, one could obtain data on current employment and the pre-project characteristics of the direct workers and of a large number of people in similar communities who were not hired by a project and then use propensity score matching to obtain a sample of comparison workers similar to the direct workers. Impacts could be estimated by comparing the employment outcomes for the direct workers to those for the comparison group. Another alternative would be to ask the direct workers what their pre-project employment outcomes were and estimate impacts using a simple pre-post analysis. Both methods would entail far higher data collection costs than the recommendations made in table A.1.
3. Impact is estimated by comparing the employment outcomes for the beneficiaries to an estimate of the counterfactual (what would have happened in a project's absence). The delineation of the counterfactual is linked to the empirical approach used to evaluate a project's impacts on employment (e.g., a randomly selected control group in a randomized controlled trial or a preintervention baseline in a pre-post study).
4. Similarly, when surveying enterprises, targeting head offices might be advantageous since they could, in theory, report on all branch establishments. However, response rates for head offices may be lower than for establishments, which might possess better data. Finally, it may also be easier to obtain sampling frames on establishments rather than head offices.

APPENDIX B

Job Classification by the World Bank Jobs Group

TYPES OF JOBS	JOB CLASSIFICATION AND DEFINITIONS	
	WORLD BANK JOBS GROUP	**DISCUSSION PAPER***
Direct	The direct jobs "channel" refers to jobs that are created or destroyed, or whose quality or terms of employment change within the entity(ies) or sector(s) receiving the treatment. This includes jobs to operate and maintain any project asset(s)/service(s) over the anticipated life of the investment or new/improved service or function.	Jobs that are generated directly by the core project activities (i.e., without considering the intermediate inputs required to manufacture renewable energy equipment or construct and operate facilities)
Indirect	**Indirect job "channels" are considered opposite to "direct" jobs.** Indirect jobs are categorized into three types: i) **(Forward) factor usage jobs.** These are job outcomes that occur when a change in the available supply, quality, or cost of an input; a productive factor; or a condition causes a change in either (i) the supply of labor by workers who utilize or rely on that factor or condition[1], or (ii) the demand for labor among producers that utilize or rely on that factor or condition (e.g., through forward value chain linkages). For example, *with better access to reliable power, enterprises (such as cement factories but also many others) may expand or contract their operations and hire more (or less) labor*. In many cases, especially for infrastructure projects, this is the primary job impacts channel. ii) **(Backward) supply chain jobs.** These jobs include impacts that are created due to (i) changes in the demand for domestically produced inputs among the entities directly impacted by an intervention and (ii) the enterprises that use the treated goods or services. While such channels almost always exist, it may be challenging to identify the most relevant ones for overall job impacts. iii) **Consumption spillover jobs**. Consumption spillover job impacts are created due to changes in the demand for goods and services among the people experiencing a change in income due to direct jobs, forward factor usage jobs, and backward supply chain job impacts. **These impacts occur in other markets, besides those impacted via the other channels—also called "induced" job impacts sometimes.**	Jobs in upstream industries performing and supporting the core activities of clean energy deployment (e.g., manufacturing the equipment and materials used for project facilities). Workers in such positions may produce steel, plastics, or other materials, or may provide financial, banking, and other services. These industries are not directly involved in project-related activities but produce intermediate inputs along the value chain of relevant energy technologies supported by a clean energy project. *Can relate to forward factor usage jobs and supply chain jobs*
Induced		Jobs resulting from the spending of earnings by the people directly and indirectly employed or associated with a project. As opposed to indirect jobs, induced jobs are found in all sectors of an economy since they stem from the final demands for goods and services. They include "productive uses of electricity" jobs, which are created either when new power supply enables electricity access for consumers or when a project improves the power supply. These can be considered as the net job created. *Can relate to backward supply chain jobs and consumption spillover jobs*

Source: For the World Bank Jobs group definition—Limestone Analytics 2023; notes on discussion paper developed by authors.

Note: *In this discussion paper, the definitions are derived from the terms used in the literature for energy-related jobs.

Endnote

1. Most job outcomes are due to shortfalls in demand relative to supply. However, there are instances when labor supply is the limiting factor for improved job outcomes. This is more often the case for certain segments of the labor force, for example, for women who face social or legal barriers, or ethnic minorities that may lack the threshold skills. Factor usage job impacts can also occur when an intervention changes the cost (including the social and opportunity cost) and/or benefit of working, inducing a shift in labor supply

APPENDIX C

Details on the Nonemployment Outcomes of Projects Focused on Productive Uses of Energy

NO.	OUTCOMES/ LONG-TERM OUTCOMES	SPECIFIC INDICATORS	UNIT OF MEASURE	BASELINE	CALCULATION
1	New PUE MSMEs established and/or existing PUE MSMEs expanded	Number of new PUE MSMEs established after electrification	Number (and types) of new PUE MSMEs	Zero (since electricity not in the area)	Increase in the number of PUE MSMEs utilizing electricity from a project and using electrical appliances/equipment for production (e.g., better drying of food products) and/or providing services (e.g., shops using refrigerators, charging stations for mobile phones, and computer training centers)
		Number of existing MSMEs that expanded products and/or services using electricity after a project	Number of PUE MSMEs	Prevalence of MSMEs in a project area prior to a project	Number of previous MSMEs that have converted to utilizing electricity/new electrical appliances and equipment for production and/or providing services
2	PUE MSMEs' increased productivity and income through improved/ increased services and sales	Increase in PUE MSMEs' production and/or their provision of products and/or services	Amount/number of products and/or services produced and/or provided	• Zero (since electricity not in the area) for new enterprises • **For existing enterprises:** Document production before electrification	Detailed information on the production of goods or the number of services provided by PUE MSMEs using electrical appliances and equipment For enterprises expanding into PUEs, calculate the difference between baseline production and production after the use of electricity/electrical appliances and equipment
		Increase in PUE MSMEs' income	Income per week or per month (in US dollars or the country's currency) through products/ services sold	• Zero (for new enterprises) • Income preelectrification (for existing enterprises expanding to PUEs)	Income per week or per month through sales and revenue, and changes (increase or decrease) in income for individual monitoring periods calculated for PUE enterprises For existing enterprises expanding to PUEs, the current income should be measured against the baseline

(*continues*)

NO.	OUTCOMES/ LONG-TERM OUTCOMES	SPECIFIC INDICATORS	UNIT OF MEASURE	BASELINE	CALCULATION
3	Improved quality of PUE MSMEs' products and/or services	Increase in value added products and/or services	Number of products and/or services with value added	• Zero (for new enterprises) • Products sold/services provided before electrification (for existing enterprises expanding to PUEs)	List the improvements in products according to the type of PUE enterprise (e.g., better drying of food products and packaging) and/or the improvements in service quality (time taken for providing services such as in agro-processing and at computer training service centers) *Note*: This indicator can also be measured based on customers' satisfaction with the quality of products and services.
4	Amount of electricity used by project beneficiaries for productive purposes/specific appliances	Electricity used by PUE MSMEs	Unit of electricity (e.g., kilowatt-hour/ megawatt-hour)	Zero (since electricity not in the area)	Total electricity consumed by PUE MSMEs each month/quarter/ year (depending on projects' monitoring and evaluation cycle). Calculate the percentage growth each quarter or year to assess stability and/or progress. The amount of electricity consumed can be calculated based on enterprises' electricity payments/ bills. Or, in the case of informal microbusinesses, check the power consumption of electrical appliances and equipment and multiply by hours used per week/ month and tariff/unit (separate calculations if day/night tariffs). However, such a calculation(s) may only provide an approximation and will depend on the quality of information/data received from an enterprise. Calculate the percentage growth in electricity utilization due to additional appliances and equipment for the expanding enterprises (e.g., they may at times also be using a solar but switching to the electricity grid).

(*continues*)

NO.	OUTCOMES/ LONG-TERM OUTCOMES	SPECIFIC INDICATORS	UNIT OF MEASURE	BASELINE	CALCULATION
5	Fuel costs avoided and GHG emissions saved	GHG emission savings by PUE MSMEs	Tons of CO_2 equivalent	Average quantity of fuel used by individual MSMEs per month prior to a project (diesel, kerosene, firewood, charcoal, etc.)	Basic calculation is GHG = A × EF, where: • GHG = emissions (e.g., amount of CO_2 or CH_4) • A = data on the magnitude of human activity resulting in emissions or removal over a given period (e.g., liters of fuel consumed) • EF = emission factor—a coefficient that relates activity data to the quantity of a chemical compound that is the source of later emissions. Emission factors are often based on a sample of measurement data and are averaged to arrive at a representative emissions rate for a given activity level under a given set of operating conditions (amount of carbon per unit of activity, for example, kilograms of CO_2 per liter of fuel burned). Refer to experts for different methodologies/calculations according to the energy resource(s) developed by a project (e.g., biomass, solar, and hydro). For World Bank projects, net GHG emissions (tCO_2eq/year) are defined in the corporate scorecard as follows: *The World Bank's contributions relate to project net GHG emissions calculated as an annual average of the difference between project gross (absolute) emissions aggregated over the economic life-time of the project and the emissions of a baseline (counterfactual) scenario aggregated over the same time horizon. The indicator is based on an ex-ante estimation performed during project preparation using World Bank-approved GHG accounting methodologies. The indicator value is negative if the project is reducing emissions, and positive if the project is increasing emissions* (World Bank 2020).

Source: Original compilation for this discussion paper.

Note: CH_4 = methane; CO_2 = carbon dioxide; GHG = greenhouse gas; MSMEs = micro, small, and medium enterprises; PUE = productive use of electricity; tCO_2eq = tons of CO_2 equivalent.

APPENDIX D

Project-Specific TOCs and Indicators

TABLE D.1

An Overview of the Case Studies Used for the Discussion Paper and the Subsequent TOCs Presented in Figures D.1–D.7

NO.	PROJECT NAME	OVERVIEW OF PROJECT	DEVELOPMENT OBJECTIVE
1	Rampur Hydropower Project (India) *2007–14*	Construction of the Rampur Hydropower Project to improve India's Northern Electricity Grid and activities to compensate those adversely impacted by the project. The case study focused on Component 1—construction of the 412 megawatt Rampur run-of-river hydro scheme.	(1) Make the India's Northern Electricity Grid more reliable through the addition of renewable, low-carbon energy from the Rampur Hydropower Project, and (2) make the Satluj Jal Vidyut Nigam Limited (SJVN) more effective with respect to the preparation and safe implementation of economically, environmentally, and socially sustainable hydropower projects.
2	Kosovo Energy Efficiency and Renewable Energy Project *2014–23*	Energy efficiency and renewable energy investments in central government buildings in a number of cities and towns in Kosovo. The case study focused on Component 1—retrofitting and upgrading of 140 government buildings.	(1) Reduce energy consumption and fossil fuel use in public buildings through energy efficiency and renewable energy investments, and (2) enhance the broader policy and regulatory environment for energy efficiency and renewable energy.
3	Malawi Energy Sector Support Project (ESSP) *2013–18*	Strengthening and expansion of the electricity transmission and distribution network across Malawi, feasibility studies for new generation capacity, demand-side management and energy efficiency measures, and capacity building and technical assistance for key power sector actors. The case study focused on Component 1a (ESSP)—construction and rehabilitation of 33 and 11 kilovolt lines and uprating of five existing substations + the Infrastructure Development Project (MCC Malawi Compact).	Increase the reliability and quality of power supply in major load centers in Malawi.
4	Nigeria Electrification Project *2018–23*	The case study focused on Component 1—construction of 850 mini grids with solar generation, battery storage, and diesel backup generation.	Increase access to electricity services for households; public educational institutions; and underserved micro, small, and medium enterprises.
5	Sindh Solar Energy Project (Pakistan) *2018–23*	The case study focused on Component 2—distributed solar: procurement, installation, and operation and maintenance of 20 megawatts of distributed solar power and associated energy management systems in hospitals in a number of cities and towns in Sindh.	Increase solar power generation and electricity access in Pakistan's Sindh Province.

(*continues*)

TABLE D.1

An Overview of the Case Studies Used for the Discussion Paper and the Subsequent TOCs Presented in Figures D.1–D.7 (*Continued*)

NO.	PROJECT NAME	OVERVIEW OF PROJECT	DEVELOPMENT OBJECTIVE
6	Second Rural Electrification Project (Peru) *2011–17*	Rural electrification and related technical assistance for productive uses of electricity in four regions of Peru. The case study focused on Component 1—electrify 42,500 households, small businesses, and community facilities through grid expansion or the installation of individual solar photovoltaic systems, and Component 2—technical assistance for rural electrification to promote productive uses of electricity, build key stakeholders' capacity, and improve the regulatory environment for rural electrification.	(1) Efficiently and sustainably increase electricity access in rural areas of Peru, and (2) build upon the achievements of the First Rural Electrification Project but operate under more challenging conditions, providing electricity services in localities that are increasingly distant from the grid and with more dispersed populations.
7	Rwanda Policy Development Operations *2017–20*	Three consecutive annual Policy Development Operations between 2017–18 and 2019–20.	Enable fiscally sustainable expansion of electricity services in the country by containing the electricity sector's fiscal impact and improve the operational efficiency, affordability, and accountability of electricity services.

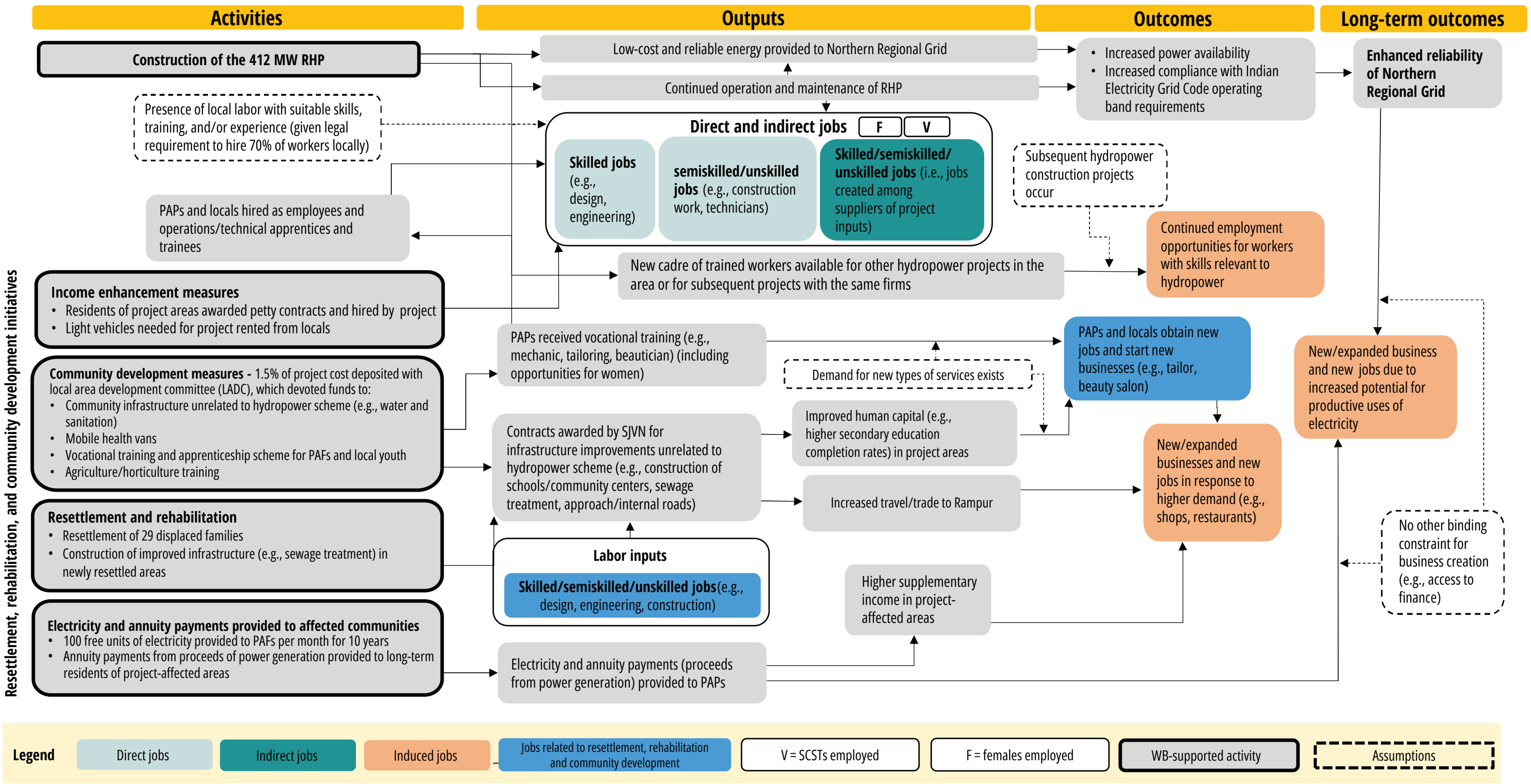
Source: ESMAP 2023b.

Note: MCC = Millennium Challenge Corporation.

India: Rampur Hydropower Project

FIGURE D.1

Theory of Change for the Rampur Hydropower Project



Source: ESMAP. 2023d.

Note: MW = megawatt; PAF = project-affected families; PAP = project affected person; RHP = Rampur Hydropower Project; SCSCT = scheduled caste and scheduled tribe; SJVN = Satluj Jal Vidyut Nigam Limited; WB = World Bank.

TABLE D.1A

Activities Conducted as Part of the Case Study on the Rampur Hydropower Project

TYPE	ACTIVITIES
Infrastructure investments	Construction of the 412 megawatt run-of-river hydroelectricity scheme
• **Community development activities*** • **Capacity-building activities***	**Community development measures:** 1.5 percent of project cost deposited with the local area development committee, which devoted funds to: • Community infrastructure unrelated to the hydropower scheme • Mobile health vans • Vocational training and apprenticeship opportunities for the project-affected families and local youth • Agriculture/horticulture training
Community development activities	**Income enhancement measures:** • Residents of project areas awarded petty contracts and hired by the project • Light vehicles required for the project rented from locals
	Resettlement and rehabilitation: • Resettlement of 29 displaced families + construction of improved infrastructure in newly resettled areas
	Electricity and annuity payments provided to affected communities: • 100 free units of electricity provided to the project-affected families for 10 years • Annuity payments from the proceeds of power generation provided to the long-term residents of the project-affected areas

Source: ESMAP 2023d.

Note: *Activities undertaken as part of "community development measures" had elements of community development activities (e.g., investments in community infrastructure unrelated to the hydropower scheme) and capacity-building activities (e.g., vocational training and apprenticeship opportunities).

TABLE D.1B

Indicators Tracked as Part of the Case Study on the Rampur Hydropower Project and Other Potential Indicators for Similar Projects

JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	• Number of individuals trained and subsequently employed by the project
	Quality	• Wages of direct workers • Job formality status of direct workers • Direct workers covered by social security insurance	• Average hours worked by local direct workers per week or per month
	Equity	• Number/share of direct workers who were women, youth, or belonged to marginalized communities (namely, scheduled castes and scheduled tribes) as well as project-affected families	• Equity data (workers who were women, youth, or belonged to marginalized communities) related to job quality
Indirect	Creation	• Share of project inputs procured domestically • Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job • Indirect employment of domestic workers (to create the inputs used by the project) in person-years	• None
Induced (PUE)	Creation/ equity	• Employment of project beneficiaries/PUE MSMEs • Employment of project beneficiaries/PUE MSMEs who/that received training	• New micro and small businesses due to a higher demand for goods and services (e.g., shops and restaurants) • Impact on job creation due to the amount of electricity used by project beneficiaries for operating PUE appliances and equipment/ supporting business
Combined	Creation	• Implementation employment (direct and indirect) in person-years	• Employment rate for working-age project beneficiaries
Induced	Quality/ equity	• n.a.	• Impact on the wages of project beneficiaries

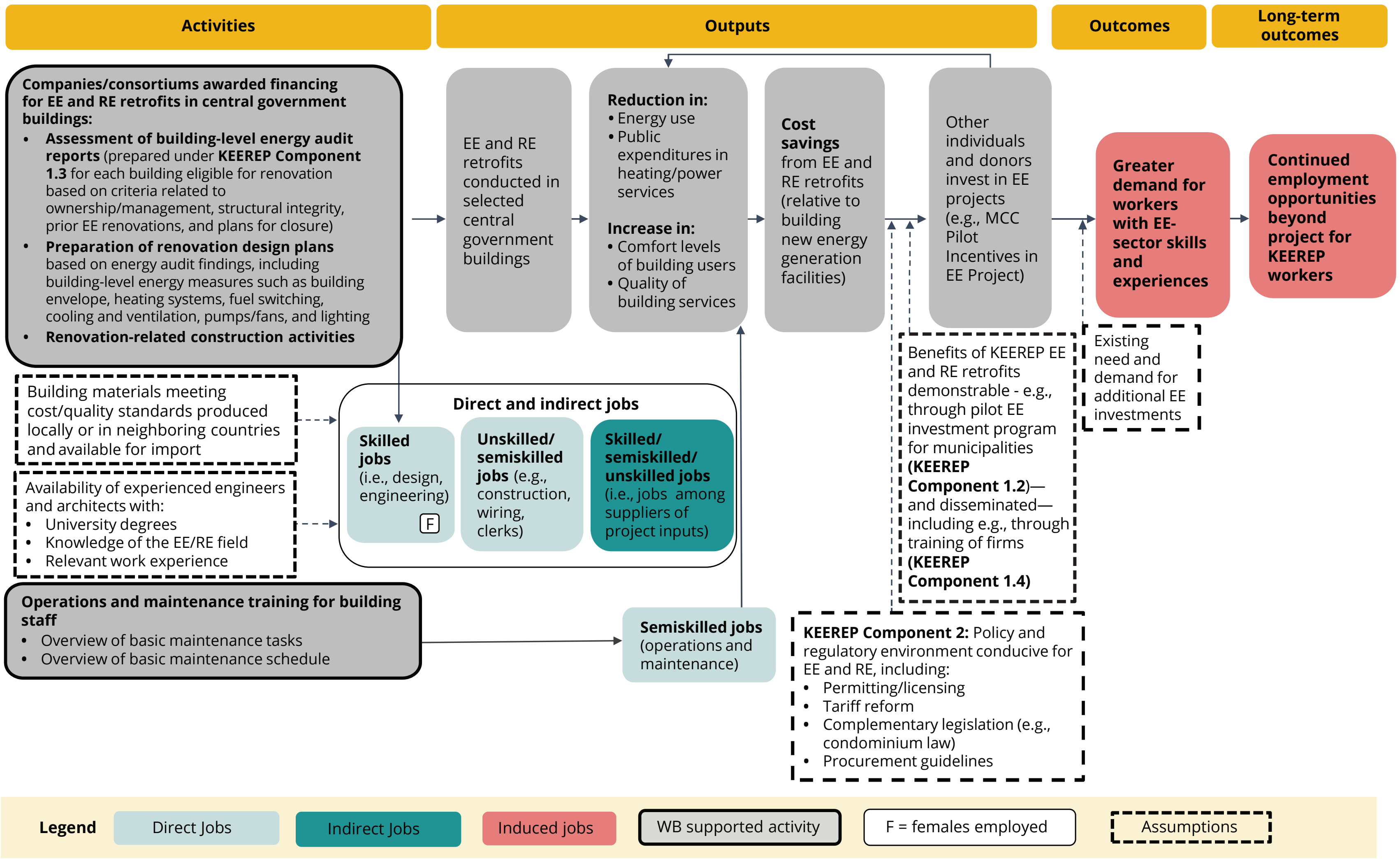
Source: ESMAP 2023d.

Note: As shown in figure B.1, the Rampur Hydropower Project carried out several resettlement-, rehabilitation-, and community-development-related initiatives, which were associated with the creation of "local development jobs" (i.e., jobs unrelated to the construction of the hydroelectricity scheme central to the project's development objective). MSMEs = micro, small, and medium enterprises; n.a. = not applicable; PUE = productive use of electricity.

Kosovo: Kosovo Energy Efficiency and Renewable Energy Project

FIGURE D.2

Theory of Change for the Kosovo Energy Efficiency and Renewable Energy Project



Source: ESMAP 2023e.

Note: EE = energy efficiency; KEEREP = Kosovo Energy Efficiency and Renewable Energy Project; RE = renewable energy.

TABLE D.2A

Activities Conducted as Part of the Case Study on the Kosovo Energy Efficiency and Renewable Energy Project

TYPE	ACTIVITIES
Infrastructure investments	Companies/consortia awarded financing for energy efficiency and renewable retrofits in central government buildings, including: • Assessment of building-level energy audit reports • Preparation building renovation design plans • Renovation-related construction
Capacity-building activities	Operation and maintenance training for building staff, including: • An overview of the basic maintenance tasks • An overview of a basic maintenance schedule

Source: ESMAP 2023e.

TABLE D.2B

Indicators Tracked as Part of the Case Study on the Kosovo Energy Efficiency and Renewable Energy Project and Other Potential Indicators for Similar Projects

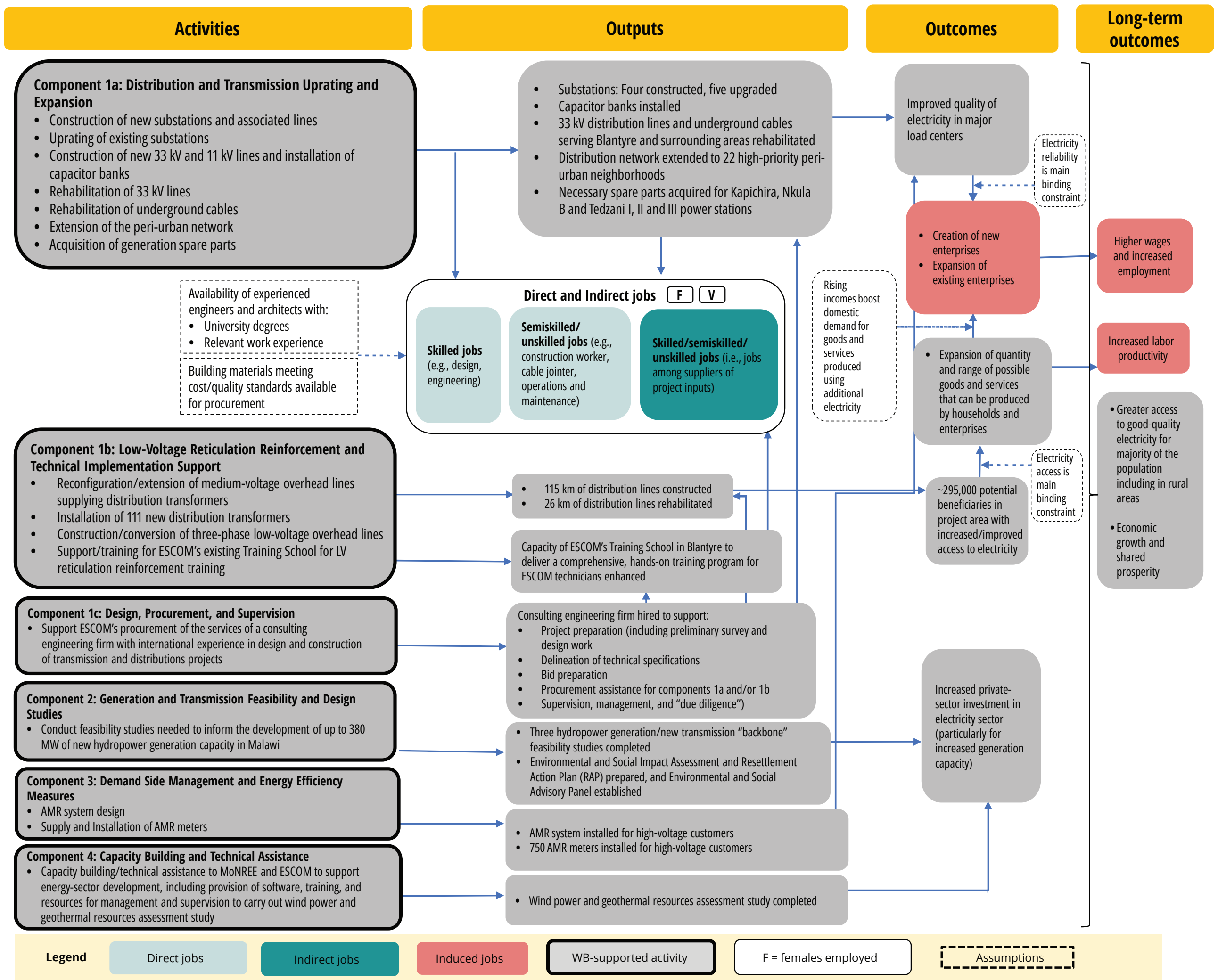
JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	• Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	• Increase of beneficiaries' awareness (communication and behavior change campaigns) of energy efficiency and renewable energy investments for public buildings • Number of individuals trained and subsequently employed by the project
	Quality	• Wages of direct workers • Job formality status of direct workers • Number/share of direct workers covered by social security insurance	• Average hours worked by local direct workers per week or per month
	Equity	• Number/share of direct workers who were women	• Equity data related to job quality (e.g., wages and formality status)
Indirect	Creation	• Share of project inputs procured domestically • Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job • Indirect employment of domestic workers (to create the inputs used by the project) in person-years	• None
Combined	Creation	• Implementation employment (direct and indirect) in person-years	• Induced employment • Individuals trained by the project who can find other similar employment opportunities

Source: ESMAP 2023e.

Malawi: Energy Sector Support Project

FIGURE D.3

Theory of Change for the Energy Sector Support Project



Source: ESMAP 2023f.

Note: AMR = automatic meter reading; ESCOM = Electricity Supply Corporation of Malawi Limited; km = kilometer; kV = kilovolt; LV = low-voltage; MoNREE = Ministry of Natural Resources, Energy and Environment; MW = megawatt; WB = World Bank

TABLE D.3A

Activities Conducted as Part of the Case Study on the Energy Sector Support Project

TYPE	ACTIVITIES
Infrastructure investments	Transmission and distribution uprating and expansion: • Construction of four new substations and associated lines • Uprating of five existing substations • Construction of new 33 kilovolt (kV) and 11 kV lines and installation of capacitor banks • Rehabilitation of 33 kV lines • Rehabilitation of underground cables • Extension of the peri-urban network • Acquisition of generation spare parts

Source: ESMAP 2023f.

TABLE D.3B

Indicators Measured/Tracked as Part of the Case Study on the ESSP and Other Potential Indicators for Similar Projects

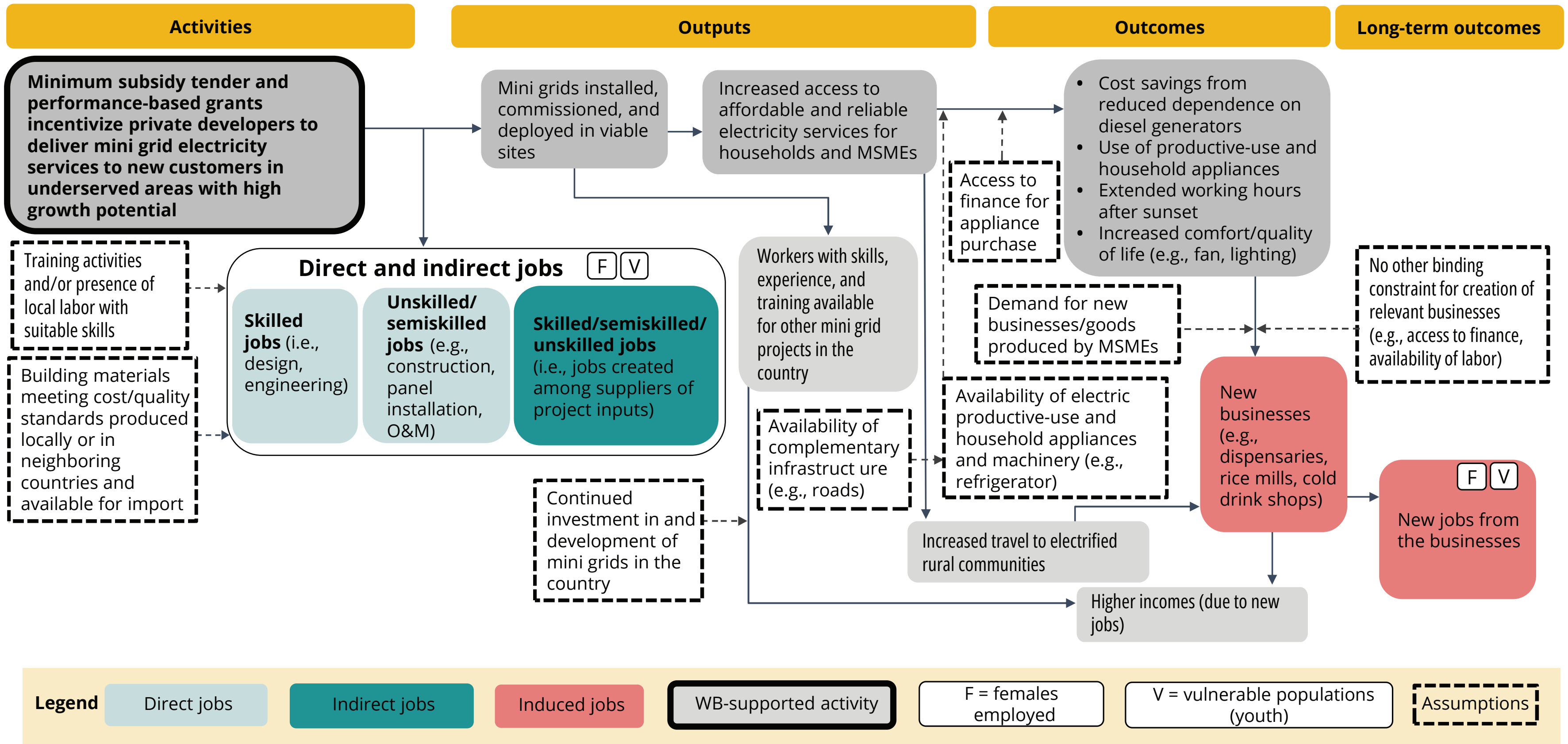
JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	• Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	• Number of individuals trained and subsequently employed by the project
	Equity	• Number/share of direct workers who were women	• Number/share of direct workers who were local (vs. foreign)
	Quality	• n.a.	• Wages of direct workers • Job formality status of direct workers • Number/share of direct workers covered by social security insurance
Indirect	Creation	• Share of project inputs procured domestically • Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job • Indirect employment of domestic workers (to create the inputs used by the project) in person-years	• None
Induced (productive use of electricity)	Creation	• Not measured directly; data estimates and employment data estimates derived from South Africa	• Employment of project beneficiaries • Other induced employment (e.g., employment of project beneficiaries who received training)
Combined	Creation	• Implementation employment (direct and indirect) in person-years	• None

Source: ESMAP 2023f. n.a. = not applicable.

Nigeria: Nigeria Electrification Project

FIGURE D.4

Theory of Change for the Nigeria Electrification Project



Source: ESMAP 2023f.

Note: AMR = automatic meter reading; ESCOM = Electricity Supply Corporation of Malawi Limited; km = kilometer; kV = kilovolt; LV = low-voltage; MoNREE = Ministry of Natural Resources, Energy and Environment; MW = megawatt; WB = World Bank

TABLE D.4A

Activities Conducted as Part of the case Study on the Nigeria Electrification Project

TYPE	ACTIVITIES
Infrastructure investments	Minimum subsidy tender for mini grids, including the selection of 250 prospective mini grid sites and invitation of bids from private sector developers for the minimum capital cost subsidies required to provide electricity to these sites
Capacity-building activities	On-the-job training of direct workers by mini grid developers on the skills relevant to the mini grid sector (e.g., operation and maintenance)
Use of incentives	A performance-based grants program to incentivize mini grid operators to deliver electricity services to new customers

Source: ESMAP 2023g.

TABLE D.4B

Indicators Tracked as Part of the Case Study on the Nigeria Electrification Project and Other Potential Indicators for Similar Projects

JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	None
		Number/share of individuals trained by the project subsequently employed by the project as direct workers	
	Quality	Wages of direct workers	
		Job formality status of direct workers	
		Number/share of direct workers covered by social security insurance	
	Equity	Number/share of direct workers who were women or youth	
Indirect	Creation	Share of project inputs procured domestically	None
		Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job	
		Indirect employment of domestic workers (to create the inputs used by the project) in person-years	
Induced (productive use of electricity)*	Creation	Impact on the employment of project beneficiaries	Employment rate for project beneficiaries who received training
	Quality	Impact on the wages of project beneficiaries	Share of employed project beneficiaries who are formally employed
	Equity	Impacts disaggregated by gender and studied separately for youth	Equity data related to job quality (e.g., wages and job formality)
Combined	Creation	Implementation employment (direct and indirect) in person-years	None

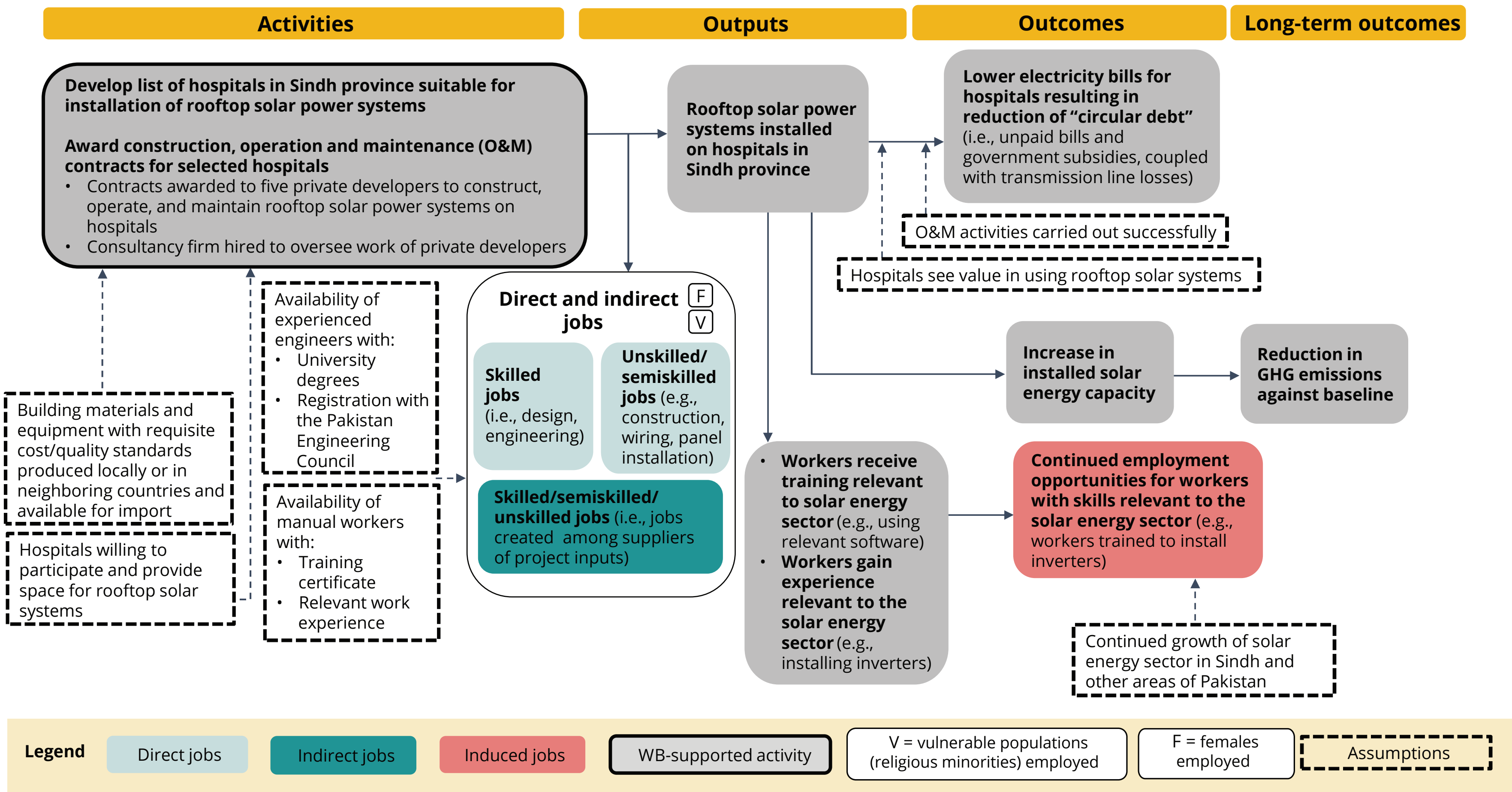
Source: ESMAP 2023g.

Note: *Impacts on induced jobs were estimated using a separate, companion survey of approximately 1,200 households with and without access to mini grids.

Pakistan: Sindh Solar Energy Project

FIGURE D.5

Theory of Change for the Sindh Solar Energy Project



Source: ESMAP 2023h.

Note: GHG = greenhouse gas; WB = World Bank.

TABLE D.5A

Activities Conducted as Part of the Case Study on the Sindh Solar Energy Project

TYPE	ACTIVITIES
Infrastructure investments	Focus on Component 2 of the Sindh Solar Energy Project—procurement, installation, and operation and maintenance of 20 megawatts of distributed solar power and associated energy management systems in and around hospitals, including: • Building identification • Feasibility studies • Contracting and leasing arrangements • Acquisition of the necessary permits

Source: ESMAP 2023h.

TABLE D.5B

Indicators Tracked as Part of the Case Study on the Sindh Solar Energy Project and Other Potential Indicators for Similar Projects

JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	• Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	• Number and share of individuals trained by the project subsequently employed by the project as direct workers
	Equity	• Number/share of direct workers who were women or members of religious minorities	• Equity data related to job creation and quality indicators
	Quality	• n.a.	• Wages of direct local workers • Share of local direct workers employed formally (and informally)
Indirect	Creation	• Share of project inputs procured domestically • Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job • Indirect employment of domestic workers (to create the inputs used by the project) in person-years	• None
Combined	Creation	• Implementation employment (direct and indirect) in person-years	• Induced jobs—employment rate for project beneficiaries who received training

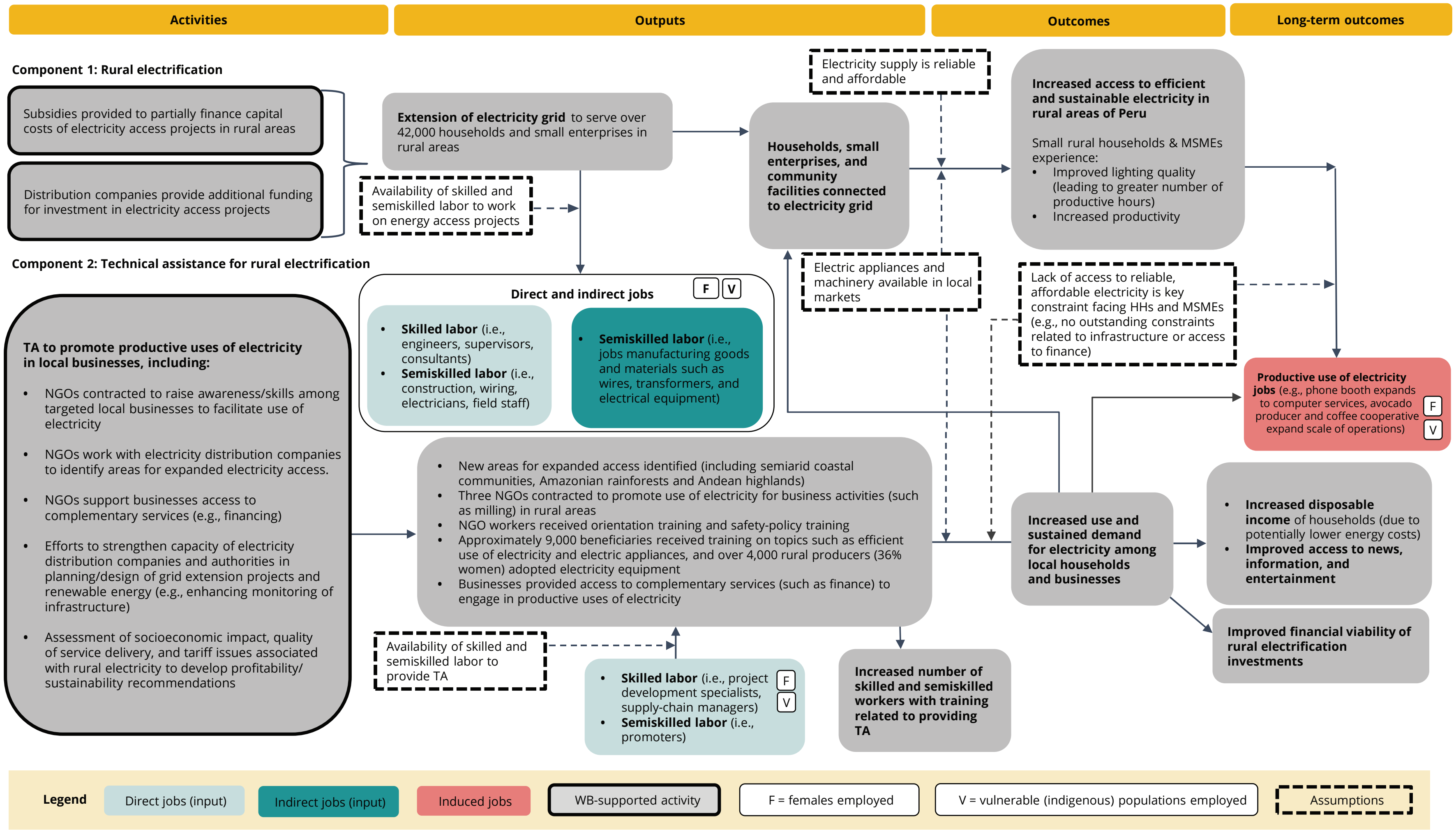
Source: ESMAP 2023h.

n.a. = not applicable.

Peru: Second Rural Electrification Project

FIGURE D.6

Theory of Change for the Second Rural Electrification Project



Source: ESMAP 2023i.

Note: HH = household; MSMEs = micro, small, and medium enterprises; NGO = nongovernmental organization; TA = technical assistance; WB = World Bank.

TABLE D.6A

Activities Conducted as Part of the Case Study on the Second Rural Electrification Project, Peru

TYPE	ACTIVITIES
Infrastructure investments	Investments in rural electrification subprojects to increase electricity coverage for 42,500 households, small businesses, and community facilities, including: • Grid extension (through the construction of new low- and medium-voltage transmission lines and a substation) • Installation of individual solar photovoltaic systems (comprising a mountable module, a controller, a battery, and a set of fluorescent lamps)
Capacity-building activities	Technical assistance for rural electrification: • Promoting productive uses of electricity • Assessing national renewable energy resources (through, for instance, supporting feasibility studies) • Providing assistance to electricity distribution companies and other stakeholders to effectively increase access to electricity services through photovoltaic and/or grid extension projects • Improving the regulation and monitoring of rural electrification

Source: ESMAP 2023i.

TABLE D.6B

Indicators Tracked as Part of the Case Study on the Second Rural Electrification Project and Other Potential Indicators for Similar Projects in Peru

JOB TYPE	OUTCOME	INDICATORS BY PROJECT	OTHER POTENTIAL INDICATORS
Direct	Creation	Direct employment of domestic workers in person-years (for design, supervision, construction, and operation and maintenance)	Number and share of individuals trained by the project and subsequently employed by the project as direct workers
	Quality	Wages of direct workers	Equity data (women and indigenous groups) related to job quality indicators
		Job formality status of direct workers	
		Number/share of direct workers covered by social security insurance	
	Equity	Number/share of direct workers who were women	
Indirect	Creation	Share of project inputs procured domestically	None
		Region- and/or sector-specific estimate(s) of the number of indirect jobs in person-years created by each direct job	
		Indirect employment of domestic workers (to create the inputs used by the project) in person-years	
Induced (productive use of electricity)	Creation	Impact on the employment of project beneficiaries	Employment rate for project beneficiaries who received training (e.g., in PUE appliances and equipment, business development, and financing)
	Quality	Impact on the wages of project beneficiaries	None
		Impact on the job formality status of project beneficiaries	
	Equity	Impacts disaggregated by gender and indigenous status	
Combined	Creation	Implementation employment (direct and indirect) in person-years	

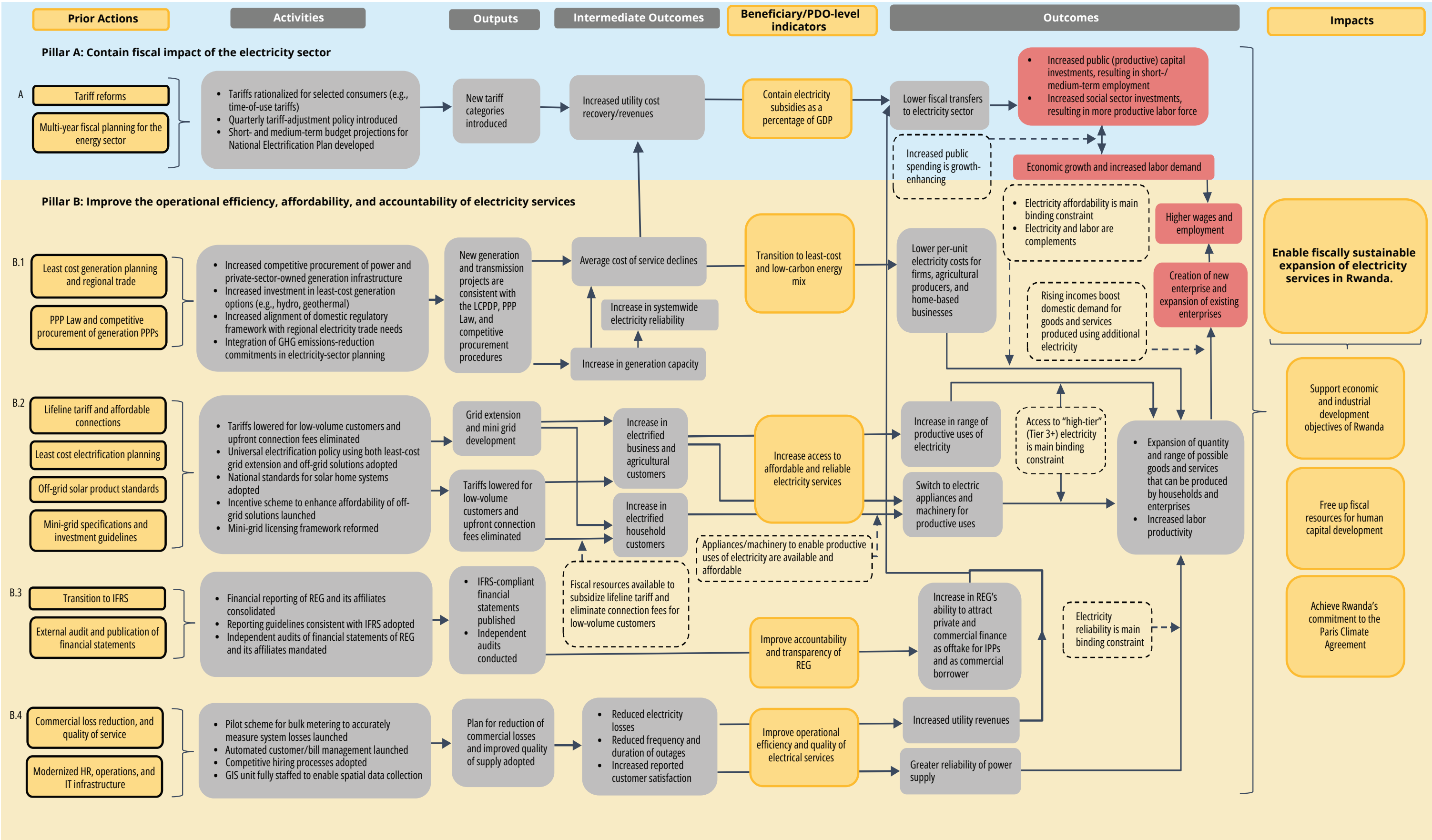
Source: ESMAP 2023i.

Note: PUE = productive use of electricity.

Rwanda: Energy Sector Development Policy Loans

FIGURE D.7

Theory of Change for the Energy Sector Development Policy Loans



Source: ESMAP 2023j

Note: GDP = gross domestic product; GHG = greenhouse gas; GIS = Geographic Information System; HR = human resource; IFRS = International Financial Reporting Standards; IPP = independent power producer; IT = information technology; LCPDP = Least-Cost Power Development Plan; PDO = Project Development Objective; PPP = public-private partnership; REG = Rwanda Energy Group; WB = World Bank.

Activities Conducted as Part of the Case Study on the Energy Sector Development Policy Loans

To support the Rwandan government in institutionalizing least-cost principles for power sector expansion, the World Bank approved a series of three consecutive annual Development Policy Operations (DPOs) between 2017–18 and 2019–20. The Program Development Objective (PDO) was to enable fiscally sustainable expansion of electricity services in the country through containing the electricity sector's fiscal impact and improve the operational efficiency, affordability, and accountability of electricity services. Specifically, the policy actions supported as part of the series aimed to address three main challenges in the power sector:

- **Lower the cost of electricity service delivery and facilitate a transition to a low-carbon energy mix.** By the end of the series, it was envisioned that Rwanda would have adopted the Least-Cost Power Development Plan, whose preparation was a prerequisite for the first DPO in the series. This would guide the prioritization of investments in least-cost energy resources such as hydropower and solar power.
- **Increase revenues from electricity service delivery.** By the end of the series, the Energy Utility Corporation Limited, a subsidiary of the Rwanda Energy Group responsible for maintaining electricity infrastructure (such as power plants and transmission/distribution networks) and electricity service delivery, was expected to have implemented a series of measures to enhance transparency, reduce nontechnical losses, and facilitate the recovery of operating costs through an updated pricing system.
- **Enhance affordability for low-income consumers.** By the end of the series, reduction in electricity service delivery cost combined with a strategy for greater electricity access for low-income consumers was expected to boost demand and incentivize electricity consumption. The adoption of international quality standards for solar products was also expected to help create a conducive business environment for private actors in the off-grid energy market and boost access to energy services for lower-income consumers.

As an example, table D.7 presents the full list of the required prior actions completed as part of the DPO series.

TABLE D.7

Prior Actions Completed as Part of the DPO Series and Related Result Indicators

DESCRIPTION OF PRIOR ACTION	RESULT INDICATOR	BASELINE	TARGET
Pillar A: Contain the fiscal impact of the electricity sector	**Result indicator A1**: Contain electricity subsidies as a percentage of GDP	(FY2016–17): 1.4% of GDP	(FY2020–21): No more than 1.5% of GDP
	Result indicator A2: Implement the quarterly tariff adjustment	(FY2016–17): No	(FY2020–21): Yes
Pillar B: Improve the operational efficiency, affordability, and accountability of electricity services ***B.1: Transition to a least-cost and low-carbon energy mix***	**Result indicator B1**: Ensure all generation and transmission projects initiated or accepted by the government over the past 24 months are consistent with the LCPDP and comply with the PPP Law and competitive procurement procedures	(September 2017): No	(December 2020): Yes
B.2: Increase access to affordable and reliable electricity services	**Result indicator B2**: Increase the electrification rate nationwide (percentage of households)	(September 2017): 40.7%	(December 2020): 61% (38% on-grid, 23% off-grid) (2019): 42% among female-headed households
	Result indicator B3: Increase the electrification rate among rural households (percentage of households)	(June 2017): 16%	(December 2020): 25%
B.3: Improve the accountability and transparency of the REG	**Result indicator B4**: Independent audits of the REG, EDCL, and EUCL comply with the IFRS, without qualifications, and are published within the first two quarters of the following year	(September 2017): No	(December 2020): Yes
B.4: Improve the operational efficiency and quality of electricity services	**Result indicator B5**: Reduce total electricity sector losses as a percentage of electricity supply	(FY2017–18): 22%	(FY2019–20): 19%
	Result indicator B6: Reduce the average duration (SAIDI) and average frequency of interruptions (SAIFI)	SAIDI (2017): 44 hours SAIFI (2017): 265	SAIDI (2020): 28 hours SAIFI (2020): 183.4
	Result indicator B7: Implement and publish an annual customer satisfaction survey	(2017): No	(2020): Yes

Source: World Bank 2019.

Note: EDCL = Energy Development Corporation Limited; EUCL = Energy Utility Corporation Limited; FY = fiscal year; GDP = gross domestic product; IFRS = International Financial Reporting Standards; LCPDP = Least-Cost Power Development Plan; PPP = public-private partnership; REG = Rwanda Energy Group; SAIDI = System Average Interruption Duration Index; SAIFI = System Average Interruption Frequency Index.

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