ESTIMATING THE SOCIAL AND ECONOMIC DEVELOPMENT IMPACTS OF CLIMATE INVESTMENTS

INITIAL FINDINGS FROM CIF'S CLEAN TECHNOLOGY FUND

The Climate Investment Funds' (CIF) Clean Technology Fund (CTF) is empowering transformation in developing countries by providing resources to scale up low-carbon technologies with significant potential for long-term greenhouse gas emissions savings. The program supports investments in renewable energy, energy efficiency, and low-carbon transport projects in more than 20 countries. CTF funding of $4.5 billion has leveraged an additional $47.9 billion for an approved project portfolio of approximately $52.4 billion.[1]

Climate interventions often have social and economic outcomes that go beyond directly targeted climate benefits. Sometimes called "co-benefits," these outcomes are generally difficult to assess and measure but can significantly strengthen the case for increased climate finance. These outcomes can include job creation, improved health, increased economic activity, market development, and gender equality impacts, as well as the distribution of these benefits and any unintended outcomes. Increasing the knowledge base on these types of development impacts can help climate investment decision makers to take better informed, and thus more impactful, investment decisions. This information and learning can be especially valuable in COVID-19-related economic stimulus and recovery efforts.

Under its learning workstream on development impacts, CIF is undertaking a portfolio analysis and economic impacts modeling effort to examine development outcomes in CTF. Following exploration of potential outcome pathways and available assessment methodologies, three approaches were selected to provide some early estimations of CTF's impacts on *employment* and *economic value added*. They are the employment factor approach (EFA), the International Jobs and Economic Development Impacts (I-JEDI) Model, and the Joint Impact Model (JIM). Approaches such as these, that are rooted in macroeconomic and labor market data, are promising as they can help investors gain directional insights on impact without the need for additional data collection from investees or partners.

This brief outlines the preliminary results of the CTF portfolio analysis and economic impacts estimations and highlights key takeaways and forthcoming activities under the development impacts learning workstream.

1 All CTF program figures in this report are as of June 30, 2019.

QUICK FACTS

DATE
June 2020

PROJECT
Clean Technology Program (CTF)

CIF PROJECT FUNDING
$4.5 billion

EXPECTED PROGRAM CO-FINANCING
$47.9 billion

LEARNING WORKSTREAM
Social and Economic Development Impacts of Climate Investments

CIF'S APPROACH TO DEVELOPMENT IMPACTS OF CLIMATE INVESTMENTS

Building on CIF's ongoing results, impact and portfolio monitoring activities, and increasing stakeholder interest in the development impacts of climate finance, in 2019 CIF launched a learning workstream dedicated to better understanding the social and economic development impacts of CIF's portfolio. This workstream will help increase the knowledge base on development impacts of climate finance, strengthen the investment case for climate programs, and give decision makers improved ways of analyzing climate investments for both climate and other development outcomes.

Comprised of two phases, the workstream will first analyze the potential social and economic impacts of the CTF and SREP portfolios using existing (but new to CIF) economic modeling methodologies and tools. In the second phase, CIF will design, contract, and implement a mixed-methods evaluation on development impacts, comprised of more targeted studies and other approaches. Throughout implementation, the workstream will include a focus on ongoing and real-time learning to help partners and other stakeholders incorporate lessons into climate investment decisions.

IDENTIFYING POTENTIAL DEVELOPMENT IMPACTS OF CTF INVESTMENTS

The objectives and activities of the CTF program areas form the basis for understanding the potential (non-climate) development impacts (see Figure 1).

Review of existing academic and practitioner literature, multilateral development bank (MDB) project documents and reporting, and industry research relating to renewable energy, energy efficiency, and transportation led to the identification of more than 40 potential impact pathways and development outcomes of CTF. These outcomes can be categorized into four impact areas and 10 broad categories of potential CTF development impacts (see Figure 2). Gender is considered a cross-cutting impact across all categories, and each specific outcome could have a gender dimension.

Figure 1.
CTF PROGRAM CORE OBJECTIVES, ACTIVITIES AND RESULTS INDICATORS

PROJECT AREA	PORTFOLIO VALUE (JUNE 2019)	AREA OBJECTIVE	ACTIVITIES FINANCED	CORE RESULTS INDICATORS	CLIMATE INDICATORS
Renewable Energy	US $37.1 billion	Increase the installed capacity or functioning of energy systems	Utility scale RE, mini-grid or off-grid RE, transmission or energy delivery	Installed RE capacity (MW)	GHG emissions avoided or reduced (tCO_2e) Amount of co-financing (USD)
Energy Efficiency	US $7.4 billion	Increase energy efficiency in commercial, industrial, residential and/or public sectors	EE technologies used in new buildings, retrofits, infrastructure, machinery, or appliances	Energy savings (GWh)	
RE & EE	US $2.5 billion	Combination of above	Combination of above	One or both RE & EE indicators	
Transport	US $5.4 billion	Expand low-carbon public transportation systems	New or upgraded transit lines, equipment, access or other	Low-carbon transport passengers (No./day)	

Figure 2.
FOUR CATEGORIES OF DEVELOPMENT IMPACTS

4 IMPACT AREAS	SOCIAL IMPACTS are experienced by people or communities	ECONOMIC IMPACTS contribute to economic growth	ENVIRONMENTAL IMPACTS conserve or protect natural resources	MARKETS IMPACTS contribute to sectoral or systemic improvements
	← Gender dimensions of development impacts →			
10 IMPACT CATEGORIES	1. Health and safety	3. Employment opportunities	5. Water	8. Energy sector security and resilience
	2. Livelihoods, wealth, and quality of life	4. Economic value added (GDP)	6. Ecosystems and biodiversity	9. Competitiveness and industrial development
			7. Agricultural productivity	10. Inclusiveness and energy justice

To create a more manageable and actionable framework, CIF used the following three screening areas to determine which of the 40+ development impact pathways identified might be of highest relevance and value-add to both CIF partners and other stakeholders, as well as practical to assess for a funder such as CIF:

a) Was the development impact pre-identified as a priority "co-benefits"/impact at the launch of CTF, and what was its frequency of mention in MDB CTF project documents?

b) Does the development impact have an established impact evidence base in literature or industry research?

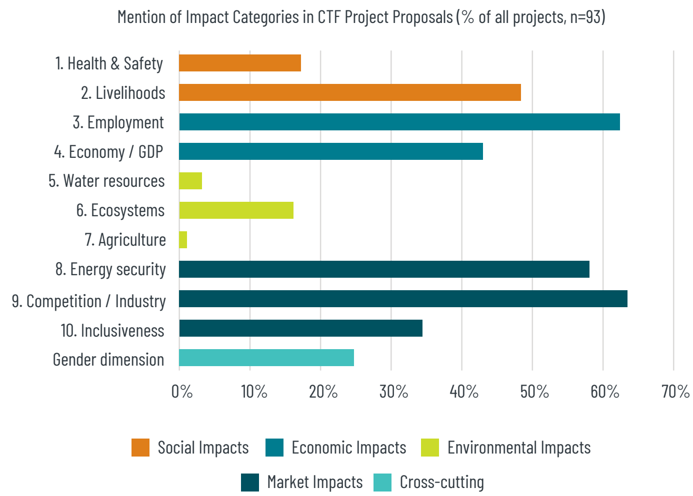
c) Is the development impact included in existing methodologies or impact tools to estimate impact at ex-ante stage?

Pre-identified by CTF program and mentioned in MDB project documents: The original CTF logic model included both core program results relating to climate outcomes (e.g., GHG emissions avoided) as well as several potential development impacts/co-benefits. These were considered a good starting point for research on impact pathways:

- Employment opportunities
- Improved health
- Increased access to energy
- Reduced costs of renewable energy, transport
- Increased energy security
- Improved enabling policy and regulatory environment

CIF also reviewed all available MDB project documents prepared for CTF project approvals[2] to identify which development impacts were most frequently referenced and/or quantified as part of the investment process. Each mention of an impact or outcome was coded and assigned to one of the 10 impact categories (see Figure 2). Figure 3 shows the percent of CTF projects that mention at least one specific outcome within an impact category. The three development impacts most often mentioned by MDBs were 1) competitiveness and industrial development, 2) employment, and 3) energy security, each mentioned in about 60 percent of all CTF project documents. In addition, more than 40 percent of all project documents included at least one quantitative impact indicator estimate or target, for example, the expected number of jobs created or economic value add of the project.

Figure 3.
IMPACTS IN CTF PROJECT PROPOSALS FROM MDB



Established evidence base in literature: Impacts that appeared more frequently and/or with more robust methodologies in the literature with accompanying primary research or modeling were considered of higher relevance for CTF. An emphasis was placed on academic publications, but peer experiences and reports (e.g., MDBs, development finance institutions (DFIs), trade associations, etc.) were also considered relevant to the CTF context. Interviews with study authors and experts helped to clarify evidence base opportunities and limitations.

Availability of existing methodologies and impact tools: To determine which impacts could be practically assessed or estimated with available resources, CIF documented about 20 different analytical methods and modeling approaches to specific social, economic, environmental, or market development impacts. Figure 4 provides a snapshot of some of the approaches evaluated for potential use by CIF within its development impact workstream.[3]

2 Such as project proposals for committees, project appraisal documents (PADs), and results frameworks.

3 This list is not exhaustive and may be expanded upon in future research, CIF welcomes recommendations of other approaches used by partners and other stakeholders. In addition, some approaches are proprietary and could only be assessed at a general level.

Figure 4.
SELECTED DEVELOPMENT IMPACT METHODOLOGIES AND TOOLS

DEVELOPER/USER	TOOL OR APPROACH	RELEVANT IMPACTS ADDRESSED
U.S. Environmental Protection Agency (EPA)	Benefits Mapping and Analysis Program (BenMAP-CE)	Health impacts of pollution reduction; public health savings
Stockholm Environmental Institute (SEI)	Long-range Energy Alternatives Planning – Integrated Benefits Calculator (LEAP-IBC)	Avoided deaths; public health savings; agri-productivity
Steward Redqueen/Development Finance Institutions/AFDB	Joint Impact Model (JIM)	Jobs and value added
American Council for an Energy Efficient Economy (ACEEE)	Dynamic Energy Efficiency Policy Evaluation Routine (DEEPER) Model	Jobs in EE
International Renewable Energy Agency (IRENA), COBENEFITS	Employment factors approach	Jobs in RE
U.S. DoE National Renewable Energy Laboratory (NREL)/USAID	International Jobs and Economic Development Impacts (I-JEDI) Model	Jobs; value added in RE
World Bank/Energy Sector Management Assistance Program (ESMAP)	Clean Energy Employment Assessment Tool (CEEAT)	Jobs in RE & EE
Researchers	Energy and Water Use Models	Water savings in RE
International Finance Corporation (IFC)	Anticipated Impacts Monitoring and Measurement (AIMM) Tool	Jobs; value added; market competitiveness; energy access, resilience, etc.
International Energy Agency (IEA), COBENEFITS	Fuels savings approach	Energy security
Researchers, Evaluators	Value of Lost Consumption (VLC)	Competitiveness, value added

By reviewing the long list of more than 40 potential development outcomes, CIF concluded that approximately 14 development outcomes to be considered for the workstream are most relevant and material to CIF and its stakeholders, are practical to assess, and could drive new learning and approaches to more impactful climate investments (see Figure 5). For each potential outcome, CIF would also consider whether there is a gender dimension and how to include this in the mixed-methods study. Currently, most of the literature and methodologies reviewed lacked gender-disaggregated data or model capabilities, and this is an area that warrants increased attention. Further conversations with partners, stakeholders, and countries may lead CIF to refine or expand the impacts of focus over time.

Figure 5.
CIF WORKSTREAM: POTENTIAL IMPACTS OF FOCUS

CATEGORY	POTENTIAL IMPACTS
1. Health and safety	Reduction in premature deaths from air pollution-related illnesses
	Reduced national healthcare spend
3. Employment opportunities	Direct, indirect, and induced employment
	Energy enabling employment
4. Economic value added (GDP)	Direct, indirect and induced value added (GDP)
	Energy enabling value added (GDP)
8. Energy sector security, resilience and diversification	Lower average generation cost of energy and/or Lower average end user tariffs
	Fewer / shorter power outages / system reliability
	Cost savings on decreased fossil fuel imports
9. Competitiveness, industrial development, and bankability	More credit products for to RE / EE businesses and/or consumers
	Higher capacity of local FIs to serve low-carbon sectors

ESTIMATING THE ECONOMIC IMPACTS OF CTF INVESTMENTS

From the list of potential impacts and available tools, CIF selected one impact category—economic impacts—and two outcomes—employment and economic value added—to begin to assess the potential contributions of the CTF portfolio. To gain insight into how different approaches might be more suitable to the CTF portfolio sectors, available data, or countries three impact approaches were selected for beta testing: Employment factor approach (EFA), the International Jobs and Economic Development Impacts (I-JEDI) Model, and the Joint Impact Model (JIM). Figure 6 outlines the basic parameters of each tool, as well as the percent of the CTF portfolio possible to assess using each methodology.

CIF is a catalytic funder of climate projects in partnership with six MDBs and other investors; it is not a direct investment manager. Therefore, impact estimation and assessment are considered using a contribution approach, rather than an attribution approach, and all estimations of development impacts in this report represent the results of the entire investment (e.g., CIF financing blended with the other resources including of partner MDBs), not only of CIF's funding.

The results of CTF's economic impact approaches' beta testing are summarized in Figure 7 and elaborated in the following sections. The comparison of three approaches was valuable as it brought learnings both on methodological differences as well as a variety of model outputs on employment and value added. All three methodologies were applicable to the CTF context, and each one generated unique impact results (e.g., not duplicated by other models), giving a more robust picture of CTF potential economic impacts.

CTF ECONOMIC IMPACTS

The full beta results estimates are summarized in Figure 7. Using the EFA model for **direct employment impacts**, the CTF portfolio (once fully invested) could contribute up to **1.9 million person-years** of direct employment during project construction phases and approximately **76,000 jobs** during project operations via renewable energy investments alone. Using the JIM model for **indirect employment impacts** shows that the entire CTF portfolio could support over **1.7 million person-years of supply chain employment (26% for women)** and over **1.3 million person-years of induced employment (29% for women)** during project construction phases. The JIM model also estimated **direct and indirect economic value added** of the portfolio during construction, which could total **$20 billion in direct value added and $19 billion in supply chain value added**. Finally, the additional power produced by the CTF portfolio is estimated to generate **enabled economic impacts** of nearly **500,000 jobs and $3.9 billion in value added** for each year of full project operations.

These are promising beta results that may allow CIF and its partners and stakeholders to further convey the broader development impacts of its climate investment portfolio and gain traction for increased ambition and investment into key low-carbon sectors.

Figure 6.
ECONOMIC IMPACTS: 3 APPROACHES APPLIED TO CTF

	A. EMPLOYMENT FACTORS	B. I-JEDI MODEL	C. JOINT IMPACT MODEL
METHODOLOGY	Analytical using technology-based employment factors	Gross input-output (IO) model & multipliers	Gross input-output (IO) model & multipliers Energy sector studies
PORTFOLIO ASSESSED	~70% of CTF portfolio 48 projects 25,682 MW	~11% of CTF portfolio 10 projects 3,263 MW	100% of CTF portfolio 93 projects 27,051 MW
SECTORS ASSESSED	Renewable energy	Renewable energy	Any
IMPACT RESULTS PRODUCED	✔ Direct jobs (construction + operations)	✔ Direct, indirect and induced jobs (construction + operations) ✔ Direct, indirect and induced value added (construction + operations)	✔ Indirect and induced jobs (construction + operations) ✔ Direct, indirect and induced value added (construction + operations) ✔ RE [and finance] enabled jobs and value added
USED BY	Researchers, governments, others	CSIR South Africa, IASS Potsdam	CDC Group, FMO, AFDB, Proparco, etc.
DEVELOPED BY	Various public / private sector research	U.S. Dept. of Energy NREL & USAID	Steward Redqueen & partners

Figure 7.
CTF ECONOMIC IMPACTS: BETA RESULTS SNAPSHOT

	PROJECT PHASE	IMPACT LEVEL	A. EMPLOYMENT FACTORS	B. I-JEDI MODEL	C. JOINT IMACT MODEL
		CTF PORTFOLIO ASSESSED	70%	11%	100%
EMPLOYMENT	Construction (temporary, in person-years)	Direct	1,991,926	103,524	
		Supply chain		43,195	1,753,036
		Induced		70,463	1,336,172
	Operations (permanent, in jobs)	Direct	76,323	1,075	
		Supply chain		1,299	(*)
		Induced		406	(*)
		Energy enabled			494,860
VALUE ADDED	Construction (temporary, in USD)	Direct		$1.23 B	$20.85 B
		Supply chain		$0.93 B	$19.05 B
		Induced		$0.74 B	*(included above)*
	Operations (annual, in USD)	Direct		$0.03 B	(*)
		Supply chain		$0.03 B	(*)
		Induced		$0.02 B	(*)
		Energy enabled			$3.93 B

* The model can generate this impact, but it was not calculated due to an input data gap

The following sections provide a brief overview of each methodology and the results of application to the CTF portfolio. Each approach is also briefly analyzed against five features to facilitate comparison and draw conclusions: 1) applicability to CTF sectors, 2) applicability to CTF countries, 3) relevance/complexity of model input data, 4) availability/complexity of user input data requirements, and 5) relevance and comprehensiveness of the results.

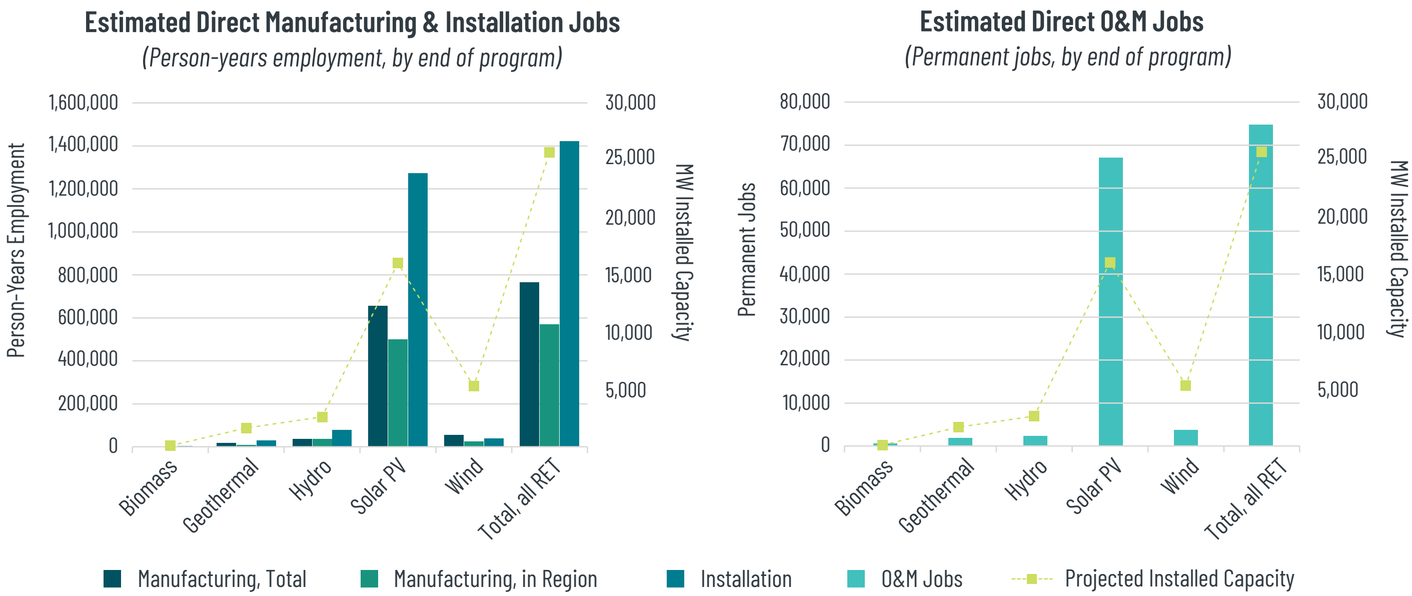
A. Employment Factor Approach

The employment factor approach (EFA) uses technology- or industry-specific employment factors multiplied with the respective installed capacity (in the case of renewable energy) or energy savings (in the case of energy efficiency), to estimate direct job impacts during three project phases: manufacturing, installation (construction), and operations and maintenance (O&M). For the purposes of the CTF portfolio impacts exercise, EFA was used only for the renewable energy portfolio segment, as employment factors were most readily available for renewable energy technologies. EFA was thus applied to approximately 70 percent of the CTF portfolio, or 48 projects with approved value of $37.1 billion and representing approximately 25,000 megawatts (MW) of planned installed capacity. Employment factors for renewable energy technologies were combined with regional multipliers to account for labor productivity differences.[4] Manufacturing employment was estimated in two ways: first, for all manufacturing employment that could take place in any region (e.g., whether local or imported technology), and second, for the proportion of manufacturing employment considered to take place in the same region as the investment (e.g., local technology only)[5]. Figures 8A and 8B shows the direct employment results of CTF's renewable energy portfolio using EFA.

4 This beta test uses the methodology and employment factors, regional multipliers, and regional local manufacturing provided in Rutovitz, J., Dominish, E. and Downes, J. 2015. Calculating global energy sector jobs: 2015 methodology. Prepared for Greenpeace International by the Institute for Sustainable Futures, University of Technology Sydney. Technology decline factors were not considered in this instance.

5 Local manufacturing proportion was not available for biomass or hydro projects; therefore, these technologies may overestimate local benefits.

Figure 8A and 8B.
EMPLOYMENT FACTORS: TOP LINE RESULTS



EMPLOYMENT IMPACTS: UNITS OF MEASUREMENT

Person-year: One *person-year* (or *job-year*) of employment is a unit that stands for one person employed full-time for one year, or two people for half a year, etc. It is often used for manufacturing, installation, and construction employment, which may be temporary in nature, but it may also be used for permanent employment. Used in: EFA, I-JEDI model, JIM

Job or full-time equivalent (FTE): One *job* is equivalent to one full-time position for the full operational life of the facility, which can vary in length depending on the technology. It is often used for O&M employment, which is considered more permanent. Used in: EFA, I-JEDI model

Note that employment estimates that use different units of measurement cannot be summed or compared and must be normalized before a total employment benefit may be calculated from an investment or project. Various normalization methods are available in the literature and should be tested for applicability to the user context and need.

Using EFA, at the completion of CTF's current portfolio of projects, CTF is estimated to contribute to direct employment of approximately 766,000 manufacturing person-years (about 569,000 in the same regions as projects), approximately 1,422,000 installation person-years, and roughly 76,000 O&M jobs. The approach is straightforward and easy to apply to renewable energy portfolios in the context of (gross) direct employment; however, the regional nature of the multipliers may result in a wide range of accuracy between countries and may not reflect realities on the ground. CIF would also need to explore ways to extend the approach to other CTF sectors (energy efficiency, transport) if a full picture of direct employment is desired. Figure 9 summarizes CTF analysis and conclusions on the tool.

Figure 9.
EMPLOYMENT FACTORS: CTF ANALYSIS AND CONCLUSIONS

FEATURE	STRENGTHS	GAPS	CONCLUSIONS
CTF Sectors	Employment factors are tailored to specific RE technologies	Employment factors not easily available for EE, transport	✔ **An easy-to-use gross direct jobs methodology for RE investments;** ✔ **More data on national level multipliers and local manufacturing would improve the confidence level of results;** ✔ **Data gaps on EE and transport employment factors in CTF markets could be filled by collaborations and/or additional market studies.**
CTF Countries	Uses regional multipliers to estimate employment factors and local manufacturing for countries outside OECD	Some RE technologies do not have regional multipliers for CTF regions	
Model Input Data	Approach is simple and easy to understand	Regional multipliers and domestic manufacturing % may vary widely between countries, or may be outdated	
User Input Data	Only MW RE technology installed is required for estimates	Some projects do not select the RE technology until later in implementation	
Impact Results	Direct employment in RE projects	Results are gross not net	

B. International Jobs and Economic Development Impacts (I-JEDI) Model

The I-JEDI model is a public online tool developed by the U.S. Agency for International Development (USAID) and the National Renewable Energy Laboratory (NREL) to analyze the economic impacts of energy development, including renewable energy. The tool uses gross input-output (IO) tables, which are quantitative economic representations of the interdependencies between different sectors of an economy. Also called a Social Accounting Matrix (or SAM), an IO model shows how output from one industrial sector may become an input into another sector, quantifying how much each sector spends, on average, on other sectors in the local economy, on imports, and on salaries, taxes, and profits.

The I-JEDI uses national IO models, combined with labor productivity multipliers, to estimate the direct, indirect, and induced employment, earnings, outputs and value added of renewable energy projects at construction and operational phases.[6] The public version of the I-JEDI contains IO models for five countries (Colombia, Mexico, Philippines, South Africa, and Zambia), thus the model was applied to the CTF portfolio in all these countries except for Zambia, which has no CTF investments. This subset of the CTF portfolio represents 10 projects valued at $5.82 billion (11 percent of CTF's total portfolio) and approximately 3,200 MW of planned installed capacity. Figures 10A and 10B show the topline employment results of the I-JEDI model and Figures 11A and 11B show the topline value added results.

6 For a full description of the I-JEDI methodology, refer to the model User Guide available at https://www.nrel.gov/docs/fy16osti/67036.pdf.

Figure 10A and 10B.
I-JEDI MODEL: TOP LINE EMPLOYMENT RESULTS

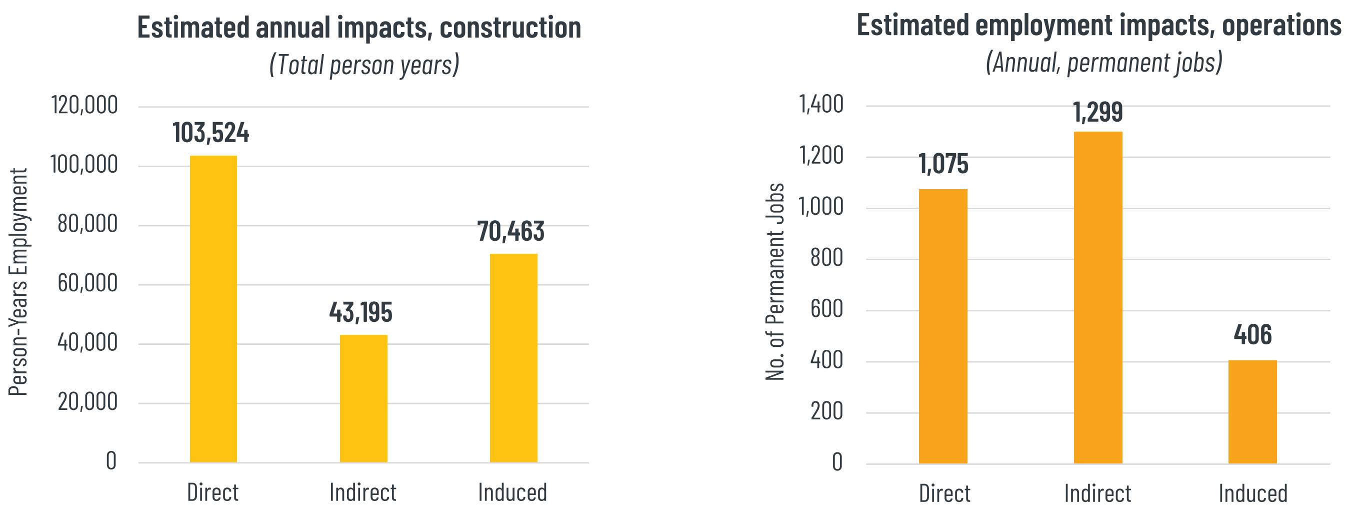
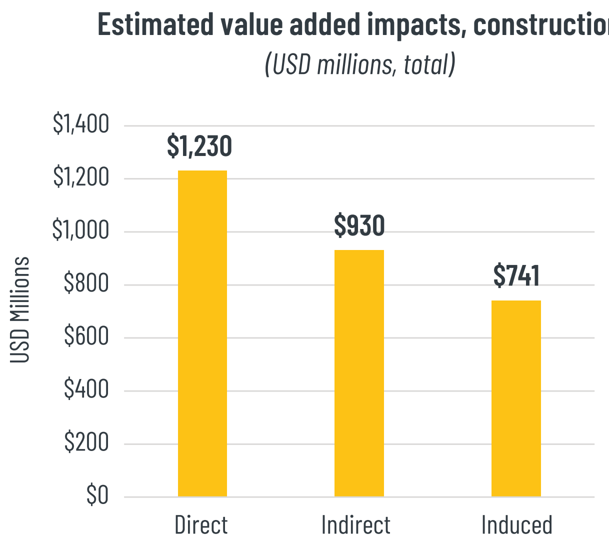
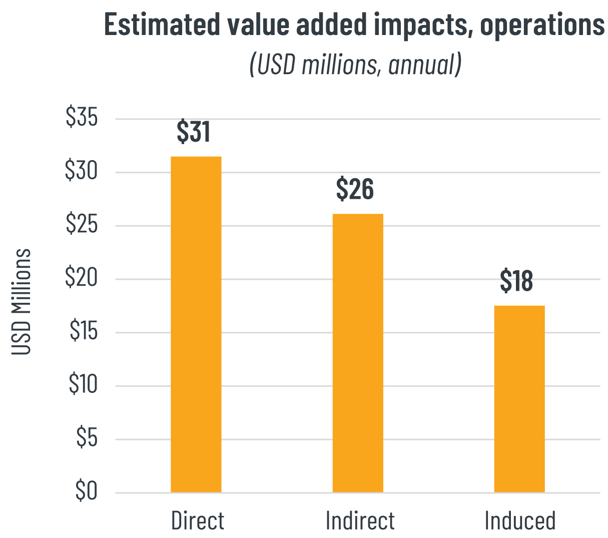


Figure 11A and 11B.
I-JEDI MODEL: TOPLINE VALUE ADDED RESULTS





The I-JEDI model generates additional useful insights into project-level or country-level impacts of selected CTF renewable energy investments, beyond direct employment. Because the model already contains additional inputs relating to the estimated costs (spend) of renewable energy projects and the local manufacturing capacity on a country-by-country basis, the user does not need to have in-depth knowledge of each market. It also lends itself to ex-ante applications.

If different countries or technology investments were being considered, the tool could be used to better understand the economic impacts of different investment scenarios. At this stage, the tool does not lend itself to CTF portfolio-wide analysis due to the lack of IO tables for other countries, and its non-applicability to non-utility scale renewable energy, energy efficiency, or transport investments. The approach analysis for CTF is summarized in Figure 12.

Figure 12.
I-JEDI MODEL: CTF ANALYSIS AND CONCLUSIONS

FEATURE	STRENGTHS	GAPS	CONCLUSIONS
CTF Sectors	IO model is tailored to RE technologies	Model can't be used for non-utility scale RE, EE, or transport	✔ **The I-JEDI is user-friendly and tailored to project-level economic impact estimates of utility-scale RE investments;** ✔ **The model is built for single project inputs, includes only 4 CTF countries, and can't be used in EE or transport, making it less applicable to CTF portfolio-wide analysis.**
CTF Countries	Public IO model available for 4 CTF markets	Public model not available for all other CTF markets, must be developed in-house	
Model Input Data	Includes default RE technology costs and domestic manufacturing % (for 4 countries)	Input data not available for all other CTF markets; Macroeconomic data may need updating	
User Input Data	Minimal data required, e.g. MW installed, market, year	Certain RE technologies (geothermal, biomass) require additional data	
Impact Results	Direct, supply chain and induced employment and value added in RET projects	Results are gross not net; Employment results require normalization	

C. Joint Impact Model (JIM)

As a result of a collaboration with several DFI and IFI partners,[7] Steward Redqueen (a consulting firm based in the Netherlands) has developed the Joint Impact Model (JIM), a tool to estimate the indirect economic impacts of investment portfolios. With a planned launch in 2020, the tool will be publicly available in an online format to interested investors or other users. As with I-JEDI, the JIM uses gross IO models and labor productivity multipliers to estimate indirect and induced employment,[8] and direct, indirect, and induced value added of projects at both construction and operational phases.[9] Using country- and sector-specific data the model can also estimate the share of women's employment in the total employment results.

In addition to these impacts, power generation projects can also have broader impacts on an economy, since an increase in the availability and reliability of energy access, or reduction in energy costs, can translate into higher economy-wide revenues. To account for the power-enabling effects[10] of power generation investments on employment and value added,[11] the JIM uses multipliers that reflect how an increase in a country's power supply translates into additional company revenues.

Since the tool is not sector-specific, it was applied across the entire CTF portfolio, with several adaptations made to ensure compatibility between CTF datasets and the JIM input requirements:

- Because CTF investment activities do not correspond exactly with the tool's economic sectors,[12] high level assumptions were made to select the sectors in which CTF projects could be reasonably expected to 'spend' their investments. In some cases, this was relatively straightforward (e.g., power generation investments often spend on construction), but more difficult in others (e.g., energy efficiency investments may have a wider range of sectoral spend).
- CIF acts as a catalytic funder rather than a direct investment portfolio manager, and thus has less access to specific project or company datasets than other types of investors. To accommodate for this, certain conversions were made from reported project data to complete the required model inputs for values such as energy generated and project values.

The results of the JIM beta test for CTF on employment and value added are shown in Figures 13A and 13B respectively and represent all impacts over all time of the projects.

7 Members of the model user group include BIO, Proparco, FMO, CDC Group, FinDev Canada, and the African Development Bank (ADB).

8 Direct employment is not modeled, as this data point is collected by other SRQ tool users from portfolio companies.

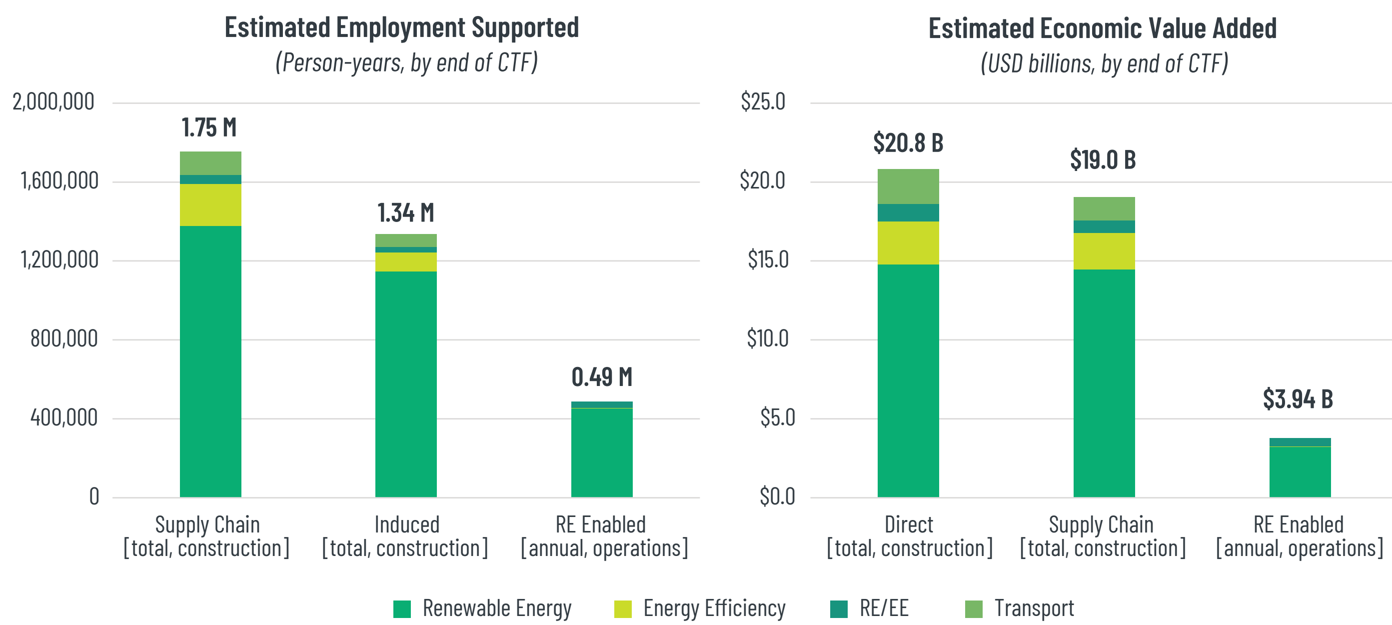
9 A full methodological description of the tool is forthcoming, visit www.jointimpactmodel.com for updates.

10 Also sometimes referred to a 'second order' or 'forward effects'

11 The tool can also estimate the forward effects of financial sector projects; however, that feature was not applicable in the case of CTF.

12 The tool uses NACE statistical classifications of economic activities.

Figure 13A and 13B.
JOINT IMPACT MODEL: TOP LINE RESULTS



The tool estimates substantial indirect employment impacts of CTF projects during construction: up to approximately 1.75 million person-years employment from supply chain effects and about 1.34 million person-years employment from induced economic activity. During construction, the CTF portfolio will also contribute as much as $20 billion in direct value added and $19 billion value added from supply chain effects.[13] The direct, indirect, and induced results during project operations would be additional to this assessment, as they could not be generated due to input data limitations.

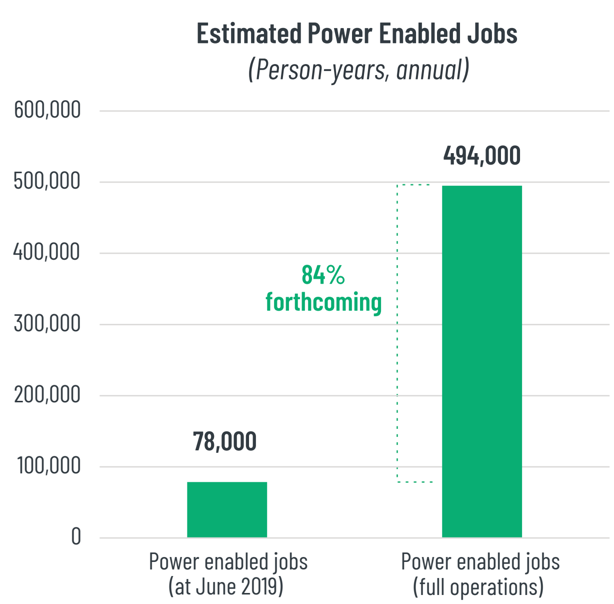
The enabling effects of additional power generation are also a significant contribution of the CTF portfolio and represent recurring annual results over project operational lifetimes. The model estimates the current realized enabling impacts of CTF projects to June 2019 of about 78,000 jobs and US$857 M in value added annually and the expected enabling impacts by end of the program of nearly 500,000 jobs and US$3.94 billion value added annually, see Figures 14A and 14B. At present, the enabling effects of energy savings from energy efficiency projects is not included in the tool but would be a useful addition in future.

Overall, the CTF JIM beta results should be interpreted as directionally indicative estimates at a portfolio level, as outcomes become more accurate over larger numbers of companies or projects. As with other economic models, because they are based on macroeconomic country and sector averages as well as project assumptions and conversions, results may differ from actual practices due to unique company and project characteristics that cannot be observed at an aggregate level.

13 Induced value added is included in the direct and indirect figures and not calculated separately by the tool.

The model is designed to be open source and collaborative with users, and there is ample opportunity to continue to adapt the model to the needs of CTF (or other CIF programs or partners), as well as to refine portfolio datasets for improved model inputs. The ability of the model to estimate the women's share of employment is also attractive, given the importance to CIF of improving data and results on the gender dimensions of development impact, and there is scope to continue to improve the approach. The tool can also estimate expected GHG emissions of project portfolios. Figure 15 summarizes the approach analysis and conclusions.

Figure 14A and 14B.
JOINT IMPACT MODEL: POWER ENABLING RESULTS



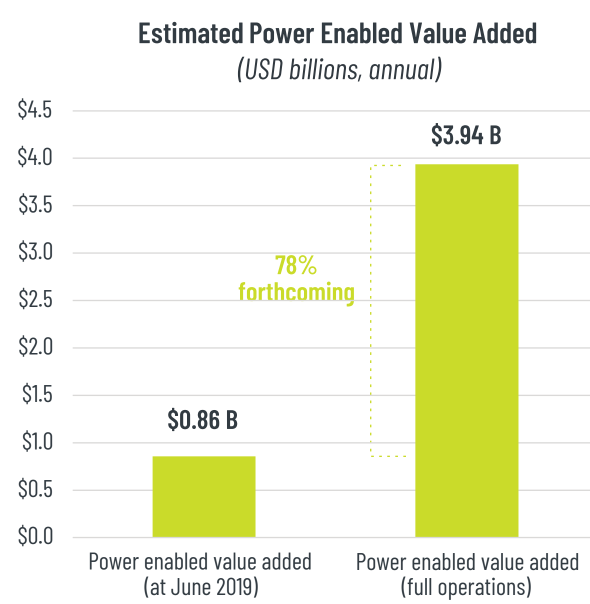


Figure 15.
JOINT IMPACT MODEL: CTF ANALYSIS AND CONCLUSIONS

FEATURE	STRENGTHS	GAPS	CONCLUSIONS
CTF Sectors	Investment effects are available for all sectors; enabling effects are available for RE projects	Improved assumptions for project sectoral spend would improve results; EE enabling effects not available	✔ The JIM model provides a wide set of economic impacts at a portfolio level, including enabling effects of RE which is a key impact of CTF; ✔ CTF data constraints limit model outputs to 7 of 12 currently, which could be improved; ✔ Collaboration on model enhancements and additional market studies could add to energy datasets and strengthen confidence levels of results.
CTF Countries	IO model is available for all CTF countries	Some multipliers may use regional averages, where national multipliers are not available	
Model Input Data	Model input data incorporates recent updates and 7 national energy market studies	Additional national energy market studies would increase enabling effects results confidence	
User Input Data	Input format allows for easier data entry for large portfolios	Not all input data is available to CTF, or requires conversion	
Impact Results	Most economic impacts are generated including enabled value added for RE projects	Direct employment is not included; only 7 / 12 model outputs available to CTF; results may only be reported at portfolio level; model designed for ex-post analysis	

THREE ECONOMIC IMPACTS APPROACHES: SUMMARY COMPARISON, CONCLUSIONS, AND FUTURE RESEARCH

All three tools were relatively well-suited to estimate various economic impacts of renewable energy projects, which account for the majority of CTF projects, and one tool (JIM) was capable of estimating impacts across all sectors. Figure 16 provides a snapshot of the main differences in capabilities of the approaches.

EFA is the most straightforward but relies on a variety of regional multipliers, some of which are not always agreed upon in the literature and can only estimate direct jobs. The I-JEDI tool offers a more comprehensive suite of impact results, and is more tailored to specific markets. It is not adapted to all the countries in which CTF operates, so would require further investment to be used across the entire renewable energy portfolio.

Figure 16.
THREE IMPACT APPROACHES: SUMMARY COMPARISON

	A. EMPLOYMENT FACTORS	B. I-JEDI MODEL	C. JOINT IMPACT MODEL
CTF Sectors	RE only	RE only	All
CTF Countries	All (using regional multipliers)	4 countries	All (using regional multipliers)
Model input data	RE specific	RE specific	All economic sectors; not RE, EE specific
User input data	Minimal	Minimal for 4 countries; High for others	Medium; some CTF data unavailable/converted
Impact results	2 impacts, project or portfolio level	8 impacts, project level	12 impacts (7 in beta), portfolio level
Accessibility	N/A	Open but not maintained	Open via membership model
Community adoption / support	Researchers, Associations	Researchers	DFIs/IFIs
Implementation cost (as-is)	$	$	$
Implementation cost (customized)	$	$$	TBD

The JIM tool offers a wide range of economic impacts in almost all sectors, including enabling effects of renewable energy, although it is intended primarily for ex-post estimations of impacts and does not include direct employment impacts. Due to CTF portfolio data limitations, not all the JIM tool outputs are available to CIF at present, but further investment in input data could improve CTF's results. The tool is adopted by other development investors, and users are engaged with other model developers to help to encourage convergence on approaches. All models had limitations on their treatment of effects from non-renewable energy projects, which should be an area of attention for CIF in the future.

The beta testing revealed methodological and data gaps that many researchers and practitioners are actively working to solve, and whose work CIF will be able to leverage as the workstream continues. The next phase of work will prioritize further research into these methodological challenges, in order to improve robustness of calculations on considerations such as these:

- How the rapid decline in technology costs can affect modelled economic impacts over time
- How to control for differences in years of investments in both input datasets and results
- How to eventually move from gross impacts estimates to net impacts estimates using newly available approaches, such as the CEEAT[14]
- How to improve on regional factors or multipliers to more country-specific input data
- How to normalize unit measurements to create more comparable outputs across approaches (for example, measuring impacts per $1 million invested, or another comparable factor)

KEY TAKEAWAYS AND NEXT STEPS

This exercise was valuable in illustrating how renewable energy, energy efficiency, and transport investments such as in the CTF program can contribute to a wide spectrum of social and economic impacts, as well as what methodologies are available to estimate these outcomes. Key findings and opportunities for the CIF workstream include the following.

On evidence, data, and knowledge gaps:

1 A focus in the literature on renewable energy means that the renewable energy impact evidence base is the most developed. Energy efficiency and transport projects appeared to have received less attention. Expanding this evidence base would improve results estimates in these key low-carbon sectors.

2 There is still a lack of primary data on specific technology markets (e.g., renewable energy, energy efficiency, etc.), energy markets (e.g., prices, supply, demand), and labor markets for many CIF priority countries, as well as some divergence in the literature on agreed datasets. Further workstream activities could focus on helping to fill these data gaps.

3 Gender dimensions of most development impacts of renewable energy, energy efficiency, and transport were weakly reported in the literature or not reflected in most models. It will be important to consider how these data gaps and resulting methodology gaps can be improved upon as part of the workstream.

On tools, models and CIF partners:

4 Many of CIF's partner MDBs and countries are also experimenting with social and economic impact estimations. There are opportunities to collaborate further to apply and adapt these approaches specifically to climate investments, as well as to support methodology alignment.

5 There are a variety of tools and approaches to estimating development impacts that may be suitable for CIF's workstream objectives. Tools that require less investment in model development or extensive primary data collection, but that can support incremental modifications and overall estimations, may be more suited to the needs of a catalytic funder such as CIF, which is primarily interested in portfolio-level results.

6 While modeling techniques are useful for directional, portfolio-level economic impact estimates, there are many development impacts that are qualitative in nature or require more contextual knowledge for accurate reporting. This includes, for example, the impact of CIF investments on health, competitiveness, and energy security or other market level impacts. The plans for a broader, mixed-methods study can help to fill these gaps in the knowledge base.

Next Steps

The CIF workstream will expand its activities in the second half of 2020, with a focus on the following activities:

- Extend the portfolio analysis and economic modeling to a second program, the Scaling Up Renewable Energy in Low-Income Country Program (SREP)
- Build on the completed beta testing for CTF by refining the portfolio data inputs and assumptions—in collaboration with other users—in order to improve confidence levels and breadth of results
- Design and contract a mixed-methods evaluation, with implementation expected to begin in fall 2020. The evaluation will focus not only on economic impacts but also on other social, environmental, and market impacts of CTF and other programs that were identified as potentially significant in the literature and tools review

14 The Clean Energy Employment Assessment Tool (CEEAT) is a new jobs model for renewable energy and energy efficiency being developed by the World Bank Energy General Practice group that relies on scenario comparisons to generate net results.

(see Figure 4). This will also allow qualitative impacts of the portfolio to be studied.

- Incorporate the learnings and ex-ante modeling approaches from the development impacts workstream into the design and implementation of prospective new CIF programs on renewable energy integration to power systems, climate-smart urbanization, climate-smart land use, and low-carbon industry transition, to increase stakeholder ambition based on improved estimates of future co-benefits of climate investments
- Continue the learning agenda throughout the workstream, via publications, webinars, and other channels

CIF encourages its partners, countries, and other stakeholders to share their experiences, needs, or ideas on development impacts in climate investments to help strengthen the case for increased investment in low-carbon development.