WRI INDIA

TECHNICAL NOTE

Financial Analysis of Charging station (FACt)

A tool for easy financial evaluation of public charging infrastructure deployment in India

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CONTENTS

Technical notes document the research or analytical methodology underpinning a publication, interactive application, or tool.

Suggested Citation: Das, S., P. Bansal, and P. Mulukutla. 2023. "Financial Analysis of Charging station (FACt)." Technical Note. Mumbai: WRI India. Available online at https://doi.org/10.46830/writn.22.00085

ABSTRACT

The aim of ***F**inancial **A**nalysis of **C**harging s**t**ation* ***(FACt)*** (the "Tool") is to help build an understanding of the business case for rolling out public charging infrastructure for electric vehicles (EVs) in India in different contexts. The MS-Excel-based tool is a flexible, transparent, and user-friendly solution to the problem of conducting a quick preliminary assessment of the financial justification for setting up a public charging station (PCS). The wide-ranging outputs from the Tool provide a well-rounded view of the financials of a public charging infrastructure project, including the project cost composition and the possible impact of various factors on the return. Currently, there is no publicly available open access application-based solution, made for the Indian market, that achieves the stated goals of FACt. The model is particularly useful for entities that are interested in gaining a foundational understanding of PCS finances in India, such as financial institutions, policymakers/regulators, real estate companies, urban local bodies, and implementing agencies. It is designed to allow several implementation situations and charging use cases spanning the gamut of technological, operational, financial, and regulatory aspects to be accounted for in the financial calculation. Cities in India can benefit from FACt as it can help them identify the financial barriers to private sector deployment of PCSs, enabling stakeholders to design policies to overcome them.

INTRODUCTION

Motivation

The availability of adequate public charging infrastructure is widely considered a prerequisite for EV adoption (IEA 2022a). To this end, the central government and subnational governments in India have emphasized rolling out public charging points. Financial incentives have been offered to encourage the setting up of public chargers for EVs. The government has advocated setting up at least one charging point in every 3 km by 3 km grid in a city to allay range anxiety (Ministry of Power–GoI

2022). Despite the policy push, on-ground implementation of public charging infrastructure has not seen much traction.

One of the major causes of this slow progress is the high-risk perception of the investment. There is a perceived uncertainty around the business case for establishing and running a PCS.[1] This is often attributed to factors such as the high up-front investment in charging equipment and the ancillary electrical setup, expensive space rental in cities, uncompetitive electricity tariffs for EV charging, the additional cost of operators to staff the facility, and suboptimal asset utilization due to the lack of charging demand (The World Bank 2021; Sandalkhan et al. 2021; IEA 2022b; Singh 2021; Das and Banerjee 2022; Pathak and Patel 2021).

The nascency of the electric mobility sector, its fast-evolving technological and business landscapes, and the different charging use cases[2] make it difficult to templatize the implementation mechanisms. It is evident that no silver bullet can make investment in public charging infrastructure attractive. A range of policy or regulatory interventions along with a fresh take on the tender clauses may be necessary. These efforts will need to strike a balance between the interests of the parties involved in the implementation of PCSs, especially the charge point operator (CPO),[3] the electricity distribution utility, and the land-owning entity.

To this end, *it is critical to build an understanding of the business case for setting up a PCS in applicable contexts and different charging use cases.* The present understanding of the financials of a public charging infrastructure project for many stakeholders in the sector, other than the established charging service providers, is largely superficial and liable to be influenced by market commentary and the gray literature.[4] The need thus arises to empower these actors with a freely available, open access resource that can help decode the financial performance of an investment in PCS deployment and also yield insights into the associated financial aspects. A simple, user-friendly tool can help build the capacity of the stakeholders, who may not have the expertise to appreciate and deal with the problem. No open access tool for this purpose that is suitable for India's EV sector is available in the public domain. The current solutions are primarily developed for advanced economies.[5] Importantly, the dynamics of electric mobility markets vary considerably from one major economy to another. The variation can be seen in aspects such as the profiles of EV stock and charging patterns, types of charging units deployed and the entailed costs, electricity pricing and supply regulations, provision for land, personnel cost, charging fees, applicable rates for taxes and interest on loans, and inflation. Hence, it is critical to capture the state of play unique to a country. A bespoke analytical solution thus needs to be developed for the Indian market.

Objectives of FACt

FACt, the Excel-based tool presented here, is a flexible, transparent, and user-friendly solution to the problem of conducting a quick preliminary assessment of the financial justification for setting up a PCS in India. The wide-ranging outputs from FACt provide a well-rounded view of the financials of a public charging infrastructure project, including the project cost composition and the possible impact of various factors on the return. This Tool is primarily meant to help develop a foundational understanding of PCS finances. For in-depth financial analysis of an investment, the use of more extensive calculations using a suite of financial indicators is recommended. This application should not be considered a one-stop solution for investment decision-making.

FACt serves the aforementioned objectives by enabling the user to achieve the following:

- Understand the composition of the entailed cost of setting up and running a PCS.
- Estimate the possible project internal rate of return (project IRR) for a CPO (see Box 1).
- Gauge the contributions of the key input variables to the project's net cash inflow.
- Undertake sensitivity (what-if) analysis to assess impacts of changes in specific input variables on the project IRR.
- Understand the changes in the values of input parameters needed to achieve the hurdle rate (see Box 2).
- Forecast over the project contract period the potential incomes of the stakeholders and the break-even year for the investment (see Box 3).

Box 1. **What is the internal rate of return?**

The *internal rate of return (IRR)* is the annual rate of growth that an investment is expected to generate. The higher the IRR, the more desirable the investment. However, before making an investment decision, one should also evaluate other financial metrics such as the net present value and debt-service coverage ratio.

> Box 2. **What is the hurdle rate?**
>
> The hurdle rate is the minimum rate of return on an investment that will offset its costs. The hurdle rate is generally equal to the company's cost of capital.

> Box 3. **What is breakeven?**
>
> Realizing *breakeven* in this case means that the aggregate revenue from the PCS (including the charging fee revenue, income from parking charges, and secondary net revenue) along with any financial support from the government to the project is able to match at a given point in time the cumulative cash outflow from the investment, which includes both the up-front capital expenditure (primarily on charging and ancillary infrastructure) and recurrent expenses (i.e., the cost of electricity, land rental, operator cost, and other operational and maintenance expenses) up to that time. The breakeven year is the year when breakeven is achieved.

Uniqueness of the tool

FACt is one of its kind—currently, there is no publicly available open access application-based solution made for the Indian market that offers the functions of the Tool. Some of the key features of the Tool are the following:

- It accounts for several implementation contexts covering technological, operational, financial, and regulatory aspects in the financial calculation.
- It is curated for the Indian context as it takes into account the mainstream EV chargers, electricity tariff framework and regulations, land arrangement, and other factors.
- The user has to provide a limited number of mandatory inputs. The default values (preloaded in the Tool) are customizable. Further, all data required to be entered are commonly available with the stakeholders.
- It offers flexibility, in that the user can consider various PCS configurations, CPO income mechanisms, types of electricity connections, tariff designs, and land rentals to account for different public charging use cases.
- It allows the user to benchmark the resulting project IRR and get a sense of the conditions required to achieve the targeted rate of return.
- It is a transparent application that helps the user perform analyses and gain insights into the different aspects of the charging business and its viability; all the assumptions and methods are clearly explained.

Although the user can use this tool to assess several implementation situations and charging use cases accurately, cases could occur in which certain aspects, especially those concerning new regulations and business models, might not be fully captured.

Potential use cases of FACt

The model is expected to benefit entities interested in achieving a foundational understanding of PCS finances in India, such as financial institutions, policymakers/regulators, real estate companies, urban local bodies, and implementing agencies. Cities in India can benefit from FACt as it will help them identify financial barriers to private sector deployment of PCS, thus enabling stakeholders to design policies that may overcome them. The following are some of the specific use cases of FACt:

- An analyst in an early-stage start-up that is planning to venture into or is already in the business of providing EV charging services to customers can use this tool to quickly conduct a preliminary viability assessment of setting up a PCS in a certain context.
- An officer in a real estate company that is planning to rent out unused space to CPOs at its properties can apply FACt to identify a suitable rental mechanism and fix the rental rates.
- A loan officer of a retail bank can use FACt to get a sense of the financial outcome from a proposed charging infrastructure project for which a company has submitted an application for a loan.
- An officer of a nodal public agency, department, or ministry can use FACt to gauge the possible financial attractiveness to CPOs of deploying public charging infrastructure in a given policy and regulatory environment.
- An official of a city authority entrusted to design project tenders for installing and managing a PCS can use FACt to assess the viability of the projects and understand the impact of various tender clauses and site characteristics on the project financials.

Approach to the development of FACt

FACt was developed using a three-pronged approach: need assessment, tool conceptualization, and user feedback.

Need assessment

A series of interactions with stakeholders and an in-depth literature review were used to understand the major challenges in scaling up charging infrastructure rollout. A major gap was found in understanding the business viability of setting up a PCS. This gap has been slowing down on-ground implementation, as highlighted in the section titled "Motivation" (The World Bank 2021; Das and Banerjee 2022). The team also reached out to select players to understand how this possible knowledge gap could be bridged, and it was during the ensuing interactions that the idea of formulating an Excel-based financial tool germinated.[6] Subsequently, WRI India organized an EV Masterclass to socialize the concept of an Excel-based tool, which was well received by the participants and potential funders.[7] These need assessment activities led to the formalization of the research initiative to develop FACt. Also, the target stakeholders (users of the Tool) were identified and invited to submit detailed feedback on FACt's design and function.

Conceptualization of FACt

As ideated during the stakeholder consultation, Excel was found to be the best-suited platform for the application because of its popularity across a cross section of potential users, easy accessibility, sufficient flexibility, user-friendliness, and its comprehensive suite of functions. The need assessment helped identify the possible project financial indicators or target outputs. It was found that answers to the following key questions would help potential stakeholders:

- What would be the cumulative and operating costs of the project?
- How attractive would the project be under the given conditions?
- What major factors could impact the project's business viability?
- What could be the possible financial impact of changes in the input (independent) variables or factors?
- What did the revenue trends for investors, distribution utilities, and land-owning entities (the three main actors associated in a project's implementation) look like?
- What would it take to make the project financially viable?

Accordingly, the Tool provides the following major outputs:

- **Cost dissection:** This shows estimates of the total project cost, including the operating cost and the major cost components and sub-components over the 10-year project period.[8]
- **Project IRR:** This is a commonly applied indicator for evaluating the profitability of a potential investment, which is the core function of the Tool.
- **Contributions of the key input parameters or variables:** This output shows the contribution of key variables, such as the capital investment, charging fees, cost of electricity, land rental, cost of operator/crew, and average daily active use of charging units, to the project's net cash inflow.
- **Sensitivity (what-if) analysis:** This is used to predict possible changes in the project IRR value with ±10 and ±20 percent variations in the values of the key input parameters compared to their original or baseline values.
- **Revenue profiles:** These show the projections of the possible yearly revenue trends for the CPO, the distribution utility, and the land-owning entity over the entire project duration.
- **Solver analysis:** This indicates how the key input parameters must be changed to achieve the benchmark or target rate of return.

User feedback on FACt

Extensive feedback from the identified potential users was central to the development of FACt, which was carried out in multiple stages. To seek specific feedback, detailed demonstrations of the draft Tool were given to the stakeholders,[9] and several changes were made in the design and function of the draft Tool based on their inputs, which were documented for future reference. Moreover, the stakeholders were made part of a robust peer review exercise while advancing FACt from its beta version. FACt is thus the product of effective collaboration with its potential users.

HOW TO USE FACt

The landing page of FACt titled "User Guide" provides instructions on how to use the Tool (Figure 1).

The Tool comprises a number of input pages and output or results worksheets. The input pages are used to feed the model with the required input data, and the output pages display the corresponding results. More details are given in the following sections.

Figure 1 | **"User Guide" page of FACt**

Financial Analysis of Charging station (FACt)

A Tool For Easy Financial Evaluation Of Public Charging Infrastructure Deployment In India

About the Tool:

The aim of FACt is to help the user conduct a quick preliminary assessment of the financial justification for setting up an electric vehicle (EV) public charging station (PCS) in India. The wide-rangingoutputs from the tool provide a well-rounded view of the financials of a public charging infrastructure project, including the possible impact of different factors. This tool is primarily intended to help develop a foundational understanding of PCS finances.

Why Use This Tool:

FACt enables the user to achieve the following:

1. Understand the **composition of the entailed cost** of setting up and running a PCS (see the "***Cost Dissection***" page).
2. Estimate the possible **project internal rate of return** (project IRR*), which is the primary financial yardstick for evaluating the financial attractiveness of investing in a public charging infrastructure project (see the "***Project IRR & Sensitivity***" worksheet).
3. Gauge the **contributions of the key input variables** to the project's net cash inflow (see the "***Project IRR & Sensitivity***" page).
4. Undertake **sensitivity (what-if) analysis** in the ±10% and ±20% ranges, to show how changes in the given range in the values of individual independent variables affect the project IRR (the dependent variable; see the "***Project IRR & Sensitivity***" worksheet).
5. Use the tool feature "Solver" to **understand the changes in the values of the key input parameters** needed **to achieve the benchmark rate of return**,also known as the hurdle rate (if the project IRR in the base case falls short of the target; see the "***Solver***" page).
6. **Forecast over the 10-year project period the potential incomes** of the stakeholders (i.e., the charge point operator [CPO], the power distribution utility, and the land-owning entity) that are directly involved in implementing a PCS (see the "***Revenue Profile***" worksheet).

**As defined by the guidelines issued by the Ministry of Power or any other competent authority.*
The internal rate of return (RR) is the annual rate of growth that an investment is expected to generate. The higher an IRR, the more desirable the investment

Key Features:

1. The tool is designed in such a way that several implementation contexts covering technological, operational, financial, and regulatory aspects can be taken into account in the financial calculation.
2. It requires a limited number of mandatory inputs from the user, and all data to be entered are commonly available with the stakeholders.
3. It offers flexibility, in that the user can consider various PCS configurations, income mechanisms for a CPO, types of electricity connections, tariff designs, and land rentals to take into account different public charging use cases.
4. FACt is curated for the Indian context as it takes into account the mainstream EV chargers, electricity tariff framework and regulations, land arrangement, and other factors.

Steps To Use the Tool Effectively:

1. **Access:** Download the MS Excel file from WRI India's Electric Mobility practice area page (https://www.wricitiesindia.org/content/electric-mobility), and check the background details and tutorial video on the website.
2. **Familiarize:** After opening the Excel file and enabling the *Editing and Macros* options (see the commands at the top of the file), visit the current page ("User Guide") for a description of FACt and instructions on how to use it. When the Excel file is first opened, a security alert from Microsoft is triggered as the file contains VBA code. To unblock the file, follow the steps mentioned in the Technical Note. For information on the required inputs and produced outputs, see the "Input Data Table" and "Output Data Table" pages, respectively.
3. **Start:** Click on the *Start* button on the current worksheet to open the "User Inputs" worksheet along with the "Pre-set Inputs" page.
4. **Provide:** Enter the requested inputs on the "User Inputs" worksheet in accordance with the given guidance, and if required, click the *Clear All Inputs* button at the bottom of the worksheet to key in a fresh set of input values.
5. **Validate:** Click the *Check Pre-set Inputs* button to visit the "Pre-set Inputs" worksheet and ascertain whether the default input values are appropriate for the required analysis; if not, change the input values accordingly. To restore the default values, click the *Restore Default Inputs* button at the bottom of the worksheet.
6. **Generate:** Press the *Check Results* button on the "Pre-set Inputs" page to produce the results and open the first of the four output-related pages.
7. **Visit:** Explore the "Cost Dissection" worksheet to understand the project cost composition and annual operating cost over the 10-year operation of the PCS.
8. **See:** Go to the "Project IRR & Sensitivity" page for results on the project IRR, the impact of key input variables, and sensitivity analysis.
9. **Explore:** Visit the "Revenue Profile" worksheet to check the 10-year projection of the potential incomes of the CPO, the power distribution utility, and the land-owning entity.
10. **Apply:** Click the *Solve* button at the bottom of the "Solver" page to understand the scenario in which the benchmark project IRR is achieved (if it is not reached in the base case); to refresh the page, click the *Restore* button.
11. **Understand:** Check "Input Data Table" and "Output Data Table" pages for more details about the different types of required inputs and the produced outputs.
12. **Learn:** For more information about FACt, download and read the associated Technical Note, which is available on the website.

Caveats:

1. Macros should be enabled in the Trust Settings after opening the Excel file; otherwise, some functions of the Tool will not work.
2. It is strongly suggested to run FACt in a device with an active Microsoft Office license. Office 2016 or any later version of MS Office is recommended.
3. Some features of FACt such as Solver may not work properly under macOS. However, the tool will be able to generate reliable results for the project IRR.
4. It is recommended that the user acquire a fundamental understanding of a PCS and its operation before applying the tool.

Disclaimer:

The purpose of FACt is to help develop a foundational understanding of PCS finances. This application should not be considered a one-stop-solution for assessment of and/or decision-making regarding an exisiting or proposed project or investment. The functions of FACt and the produced results are the sole responsibility of the users of this tool. Neither WRI India nor the creators of FACt can be held, directly or indirectly, responsible or accountable for the use of this tool and/or the results. The tool uses some third-party information, the source of which should be independently verified by users.

Start

User Guide	User Inputs	Pre-set Inputs	Cost Dissection	Project IRR & Sensitivity	Revenue Profile	Solver	Input Data Table	Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

Input pages

FACt mainly uses four categories of data: technological, operational, financial, and regulatory. These four sets of data are captured in two ways:

- **User inputs:** These are very context or case specific and hence must be provided by the user. FACt requires a limited number of such inputs, which makes the Tool quick and easy to use.
- **Pre-set inputs:** These are default values that are already preloaded in the Tool, but the user can change them depending on the context. The user does not have to collect and provide these input data unless the default values must be replaced with new inputs.

A short description of each of the input pages follows. Table A-1 in Appendix A gives the details (including the units of the concerned inputs, sources of input data collection, the purpose of the inputs, and specific guidance for users) of the input parameters. These details are also given in FACt.

User inputs

Figure 2 shows a sample "User Inputs" page. Users can input data into this worksheet. For specific guidance on each input parameter, a user can hover the cursor on the concerned cell in the worksheet or refer to the "Input Data Table" page of the Tool or Table A-1 in Appendix A of this document.

The following categories of data are covered by this input worksheet.

PCS CONFIGURATION, UTILIZATIONS, AND FEE RATES

- The user is required to input the *number of charging units,* the *average daily active use of the charging unit in terms of hours,* and the *charging/swapping fees* for the corresponding types of charging units.
- The charging unit type signifies the type of charging solution deployed at the PCS (slow charger, moderately fast charger, fast charger, or a stack battery charging system for swappable batteries).
- The eight EV charging solutions recognized in the guidelines issued by the Ministry of Power, GoI, on January 14, 2022, and commonly deployed at PCSs have been listed on this page. For details about these charging units, see the notified guidelines and their amendments.
- For the types of charging units that are not on the list, the user should provide the required inputs under the category "Other Charger Type" on both the input pages (i.e., "User Inputs" and "Pre-set Inputs").
- Importantly, FACt considers that the charging units are used at their rated output power levels. In reality, the effective power level during a charging session can fall below the rated power depending on the recommended C-rate of the EV's battery (if a DC charging unit is used) and/or the power rating of the vehicle's on-board charger (if an AC charging unit is used).

PAYMENTS TO BE MADE TO THE DISTRIBUTION UTILITY

- The user is first required to input the *energy charge* and the *demand charge,* elements of the two-part tariff structure.

  The energy charge is the variable component of the tariff and is linked to the recorded electricity consumption (kWh), energy charge is the variable component of the tariff and is linked to the recorded electricity consumption (kWh), whereas the demand charge is the fixed component of the tariff, its value depending on the sanctioned load or contract demand (kVA[10]) of the given electricity connection. For the energy charge, it is recommended to consider the landed cost or all-in rate of electricity (i.e., inclusive of taxes and other state-levied charges). Information on these charges[11] can be obtained from the state tariff orders for their serving distribution utilities, which are usually available on the websites of State Electricity Regulatory Commissions or the distribution utilities.
- The user is then required to specify whether a *new dedicated electricity connection* is necessary to energize the PCS. A new dedicated electricity connection is typically required to take advantage of the preferential tariff (also known as the EV tariff), if this benefit is offered by the electricity distribution utility. An existing connection can be used if the PCS is established on the premises of a host facility such as a workplace or shopping complex.

PAYMENTS TO BE MADE TO THE LAND-OWNING ENTITY

- The user is required to provide inputs under this category only if land rental is applicable. For instance, land rental may not be applicable for a shared workplace or residential charging use case as the concerned organization or the housing society is likely to own the land and offer space to the CPO free of charge to make cost of installation, and consequently the cost of service, economical.
- In scenarios where a land rental is applicable, the user has to select whether the land rental is fixed on a monthly basis or is variable (that is, linked to the actual electricity consumption at the facility). The latter land rental arrangement is often referred to as the revenue sharing model. According to the revised consolidated Guidelines & Standards for Charging Infrastructure for Electric Vehicles (EV) released by the Union Ministry of Power on January 14, 2022, land available with the government/public entities shall be provided for installation of a PCS to a government /public entity on a revenue sharing basis at a fixed rate of ₹1/kWh (used for charging), to be paid to the land-owning agency from the PCS business on a quarterly basis. A Model Revenue Sharing agreement has also been included in the guidelines. Such a revenue sharing agreement may be initially entered into by the parties for a period of 10 years. The revenue sharing model may also be used by a public land-owning agency to provide land to a private entity for installation of a PCS on a bidding basis with a floor price of ₹1/kWh.
- To give the user a sense of the possible total land requirement to set up a PCS with the given configuration and thus arrive at the monthly total fixed land rental, FACt autonomously estimates and displays the total land requirement on the "User Inputs" page. However, this

Figure 2 | **A sample "User Inputs" page**

Mandatory Inputs to be Provided by Users

Page description: Mandatory User Inputs

Attention: Hover the cursor on the input parameters for specific guidance. Brackets in the input parameters indicate the units of the values. If a parameter, for example, a type of charging unit, is not applicable, leave the concrtned input cell blank.

PCS Configuration, Utilization, and Fee Rates

Type of Charging Units	Number of Charging Units	Average Daily Active Use of Charging Unit in Year 1 of Operation (hours per day)	Charging/Swapping Fees (₹/kWh)
LEV AC			
AC Type-2	1	11.008	
Bharat AC 001			
Bharat DC 001	1	5.00	14
CCS-2 DC Wallbox Charger			
CCS-2	1	3.00	17
CHAdeMO			
Stack Battery Charging System for Swappable Batteries			
Other Charger Type 1			
Other Charger Type 2			
Other Charger Type 3			

Remark: The EV charging solutions recognized in the guidelines issued by the Ministry of Power, GoI, on January 14, 2022, and commonly deployed at PCSs have been listed above.
Enter inputs for at least one charging unit, and leave blank the input cells corresponding to the types of charging units that are not applicable.
For the types of charging units that are not on the list but are applicable, provide the required inputs under "Other Charger Type" on this page as well as in the "Pre-set Inputs" worksheet.

Payment to Electricity Distribution Utility	
Energy Charge (₹/ kWh)	6.50
Demand Charge (₹/ kVA month)	300
Has a New Dedicated Electricity Connection been Applied for to Energize the PCS?	YES

Information on the energy charge and other state-levied charges and taxes can be obtained from state tariff orders, which are usually available on the websites of the State Electricity Regulatory Commissions or DISCOMs.

Ascertain whether a demand or fixed charge is applicable to the PCS. Information on the demand charge can be obtained from the state tariff orders, which are usually available on the websites of the State Electricity Regulatory Commissions or DISCOMs.

Payment to Land-owner	
Is Monthly Land Rental Fixed?	NO

Remark: Depending on the selected answer to the above question, enter a numerical value for one of the following input parameters. If land rental is not applicable, ignore the following input parameters.

Monthly Total Fixed Land Rental (₹)	
Land Rental Rate per Electricity Consumption (₹/ kWh)	2.00

Estimated Land Requirement (sq. m)0	**.00**

Operation Cost	
Is the PCS manned for the entir daily operational time?	YES

Subsidies	
Available Total Capital Subsidy (₹)	30000

Check Pre-set inputs **Clear all inputs**

User Guide | **User Inputs** | Pre-set Inputs | Cost Dissection | Project IRR & Sensitivity | Revenue Profile | Solver | Input Data Table | Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

is not a direct input to the other results of the Tool. This FACt autonomously estimates and displays the total land requirement on the "User Inputs" page. However, this is not a direct input to the other results of the Tool. This value is for the user's reference only; the user has to provide the inputs related to land rental on this page.

OPERATION COST AND SUBSIDIES

- The user must specify whether the PCS will be staffed for the entire daily operational time or not.
- The operational hours may differ depending on the operation of the host facility. For instance, the operational hours for a charging station at a workplace may be 16 hours as against 24 hours for a stand-alone charging station.
- The user is also required to input the eligible total capital subsidy amount (non refundable) available under central and state schemes. The information on the applicable capital subsidy will be available in the EV policies or scheme documents.

After keying in the required input values on this page, the user should click the *Check Pre-set Inputs* button to validate the default input values. To input a fresh set of values, the user should click the *Clear All Inputs* button at the bottom of the worksheet.

Pre-set inputs

Figure 3 shows a sample "Pre-set Inputs" page. Here, the Tool is preloaded with default values for a set of parameters that are less case specific or more difficult to specify for a user who does not have much experience in the sector. However, the values may change depending on the implementation context, and hence the user is allowed to modify the given values. For specific guidance, the user can hover the cursor on each of the different input parameter cells on the worksheet or refer to the "Input Data Table" page of the Tool or Table A-1 in Appendix A of this Technical Note.

The following categories of data are covered in this input worksheet.

CHARGING UNIT CONFIGURATIONS AND COSTS

- This section feeds default or pre-set values for the power ratings and the unit costs of the eight types of charging units recognized in the applicable guidelines issued by the Ministry of Power, GoI, on January 14, 2022, and are commonly deployed at PCSs. For certain types of charging units, such as AC Type-2 and CCS-2, various products or models are available in the market with different power ratings and, consequently, different price tags. The Tool is preloaded with default values for charger power ratings and the costs of models that are commonly deployed in public charging infrastructure in India currently. The user can consider a different set of values for charger power ratings and costs to accurately reflect the applicable PCS configuration. For example, instead of 7 kW, one can input 22 kW as the power rating for AC Type-2. The value of the cost per charging unit should be revised accordingly. Similarly, a PCS may house a stack battery charging system with more or less than 12 battery charging units and with different power ratings for each unit. The user can modify the required input values accordingly.
- For charging units other than the eight listed on the page, the user can provide the required inputs under the charging unit category "Other Charger Type."

OTHER COSTS FOR CHARGERS/STACK BATTERY CHARGING SYSTEM

- The worksheet includes pre-set values for the cost of civil works and installation and commissioning costs as a percentage of the total cost of the charging system. These costs are used to estimate the cost of charging equipment as part of the overall capital investment, as also reflected later on the "Cost Dissection" page of the Tool.

ANCILLARY ELECTRICAL INFRASTRUCTURE

- This section of the Tool feeds pre-set values for the power factor of the electricity connection, the cost of the distribution transformer (DT) and associated equipment per 50 kVA rated capacity, meter costs, and the ancillary electrical infrastructure installation cost (including labor).
- The power factor is a measure of how effectively the incoming power is used in the electrical system. A high power factor indicates that the power supplied to the electrical system is effectively used. A system with a low power factor consumes the incoming electricity supply inefficiently, resulting in losses. Information on the power factor can be obtained from the serving distribution utility.
- The cost of the DT and associated equipment per 50 kVA rated capacity, along with the ancillary electrical infrastructure installation cost (including labor), are set using the utility-provided values, and the meter costs are set using the India Smart Grid Forum's values. The India Smart Grid Forum is a public-private partnership initiative of the Ministry of Power, GoI.

Figure 3 | **A sample of "Pre-set Inputs" page**

Pre-set Inputs That Users Can Change

Page description: This input worksheet is preloaded with default values for the given parameters. However, the values may change depending on the situation, and hence, users have been given the flexibility to input their own data.

Attention: Hover the cursor on the input parameters for specific guidance. Brackets in the input parameters indicate the units of the values.
If a type of charging unit is not applicable, users need not delete the given input values. The Tool filters out invalid pre-set input values based on the user response on the "User Inputs" page.

Charging Unit Configurations and Costs

Type of Charging Unit	Power Rating of the Charging Unit (kW)	Cost per Charging/ Swapping Unit (₹)
LEV AC	3.3	3500
AC Type-2	7	38000
Bharat AC 001	10	40000
Bharat DC 001	15	200000
CCS-2 DC Wallbox Charger	25	700000
CCS-25	0	1100000
CHAdeMO	50	1050000
Stack Battery Charging System for Swappable Batteries	12	2080000
Other Charger Type 1	00	
Other Charger Type 2	00	
Other Charger Type 3	00	

Remark: Enter the above inputs if the charger types are not in the given list. By default, no other charger type is considered. For certain types of charging units such as AC Type-2 and CCS-2, various products or models are available in the market with different power ratings and, consequently, different price tags. The Tool is preloaded with default values for charger power ratings and costs of models that are commonly deployed in public charging infrastructure in India currently. The user can consider a different set of values for charger power ratings and costs to accurately reflect the applicable PCS configuration. For example, instead of 7 kW, one can input 22 kW as the power rating for AC Type-2. The value of the cost per charging unit should be revised accordingly. Similarly, a PCS may house a stack battery charging system with more or less than 12 battery charging units and with different power ratings for each unit. The user can modify the required input values accordingly.

Other Costs for Chargers/ Stack Battery Charging System	
Cost of Civil Works as a Percentage of the Total Cost of the Charging System (%)	5
Installation and Commissioning Costs as a Percentage of the Total Cost of the Charging System (%)	20

The charging system refers to the charging units to be installed at a PCS, including the stack battery charging system, if any.

Ancillary Electrical Infrastructure	
Power Factor of the Electricity Connection0	.85
Cost of the Distribution Transformer (DT) and Associated Equipment per 50 kVA Rated Capacity (₹)	150000
Meter Cost (₹)	3500
Ancillary Electrical Infrastructure Installation Cost (including Labor) (₹)	250000

The information can be obtained from the serving DISCOM.

User Guide | User Inputs | Pre-set Inputs | Cost Dissection | Project IRR & Sensitivity | Revenue Profile | Solver | Input Data Table | Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

- These costs are used to infer the cost of ancillary equipment as part of the overall capital investment, as also reflected later on the "Cost Dissection" page of the Tool.

OTHER POSSIBLE INCOMES FOR CPOS

- Users are required to input the parking charges (if applicable) for each of the selected charging unit types. By default, the Tool considers parking charges to be zero. These charges are typically applicable only to certain use cases employing slow/moderately fast chargers such as destination charging (such as malls) and charging at public-authority-owned parking. For shops and rest stops, customers usually park for 15–30 minutes, making a fast-charging solution ideal; hence, parking charges may not typically be applicable here.
- As a CPO may explore secondary income sources at the facility through advertisements, public conveniences, refreshment kiosks, and so on, to complement its core revenue from the charging business, the "Pre-set Inputs" page can capture the secondary net revenue for the CPO. By default, the Tool does not consider any non core income.

OPERATIONAL DETAILS

The worksheet includes pre-set values for the daily operational hours and annual operational days of the PCS. The default values are 24 and 365, respectively.

OTHER TECHNICAL DETAILS

- The worksheet includes values for the power demand threshold for an exclusive DT, charger efficiency, time for planned annual maintenance, and auxiliary electricity consumption.
- The power demand threshold (kVA) for an exclusive DT is a critical parameter that can potentially impact the up-front investment of the CPO. If the sanctioned load for the electricity connection of the PCS equals or exceeds the given threshold, the CPO would be required to install an exclusive DT for the PCS. The Tool by default considers the threshold value applicable to the National Capital Territory of Delhi. However, the value varies from state to state and can be obtained from the applicable State Electricity Supply Code Regulations. One may also check with the concerned electricity distribution utility.
- Charger efficiency can be defined as the percentage of power drawn from the energy source that is actually fed to the vehicle battery. The default efficiency is 98 percent.
- The Tool considers 5 percent of operational hours as the time set aside for planned annual maintenance of the PCS. EV charging units require periodic checks for wear and tear, as well as to keep the overall system clean.
- Auxiliary electricity consumption is related to other electrical end uses at the PCS, such as illumination at the site.

OTHER OPERATIONAL AND MAINTENANCE COSTS (ANNUAL)

- This section of the Tool feeds values for annual maintenance costs as a percentage of the cost of the core hardware, the insurance cost as a percentage of the total cost of the charging system, the electric vehicle supply equipment (EVSE) management software cost per unit of dispensed electricity, the hourly operator cost if the PCS is staffed, and the minimum alternate annual operator cost for a crewless facility.
- The hourly operator cost becomes applicable (and the corresponding value is triggered in the "Pre-set Inputs" page) if the user chooses "Yes" to answer the question of whether the PCS needs to be staffed. In that case, the hourly operator cost is fed into the calculation. The hourly rate is the minimum wage limit for semi-skilled labor notified by the Ministry of Labour & Employment, GoI.
- An operator may be required for periodic checks and troubleshooting at a PCS even if it is crewless. In this case, a dedicated operator may not be required. A lump-sum cost has been considered for this purpose as a minimum alternate annual operator cost.

FINANCING

- The worksheet includes pre-set values for debt as a percentage of the capital investment, the construction period (which is notional, for the purpose of accounting), the loan repayment period, and the rate of interest on the loan.
- The default loan repayment period is taken to be six years based on the commonly used lending practice.
- Default values based on the State Bank of India's benchmark prime lending rate (BPLR) have been provided for the interest rate on loans.

OTHER COSTS INCURRED BY CPO

- The pre-set values in the Tool account for cost items such as service-line-cum-development charges (SLDC) and tax rates.
- SLDC is a one-time charge that a consumer has to pay to the serving electricity distribution utility when applying for a new electricity connection. The amount is usually linked to the sanctioned load (kVA) for the connection. SLDC becomes applicable (and the corresponding value is triggered on the "Pre-set Inputs" page) if the user states on the "User Inputs" worksheet that a new dedicated electricity connection is needed. By default, SLDC charges are based on the rates prevailing in the National Capital Territory of Delhi. Information on the charges for a new connection can be obtained from the concerned serving distribution utility.
- Default values based on the current landscape have been provided for the corporate tax and minimum alternate tax (MAT) rates.

BENCHMARKING

- To assess the business attractiveness of an investment in a PCS, benchmarking the estimated project IRR against a hurdle rate is an industry-wide practice. For this purpose, the Tool bases the benchmark rate of return on the State Bank of India's BPLR.

YEAR-ON-YEAR (Y-O-Y) ESCALATIONS

- The "Pre-set Inputs" worksheet has default values for the Y-o-Y escalations of the cost or operational parameters, which tend to vary with time. These include the electricity rate, land rental, other operational and maintenance (O&M)

costs, charging fees, hourly parking charges, secondary revenue, and average daily active use of charging units.

- The default Y-o-Y escalation rates are based on stakeholder consultations or past trends. The user can change these rates depending on the market outlook.

After changing the input values on this worksheet, a one-click option, *Restore Default Inputs,* can be used to restore the defaults if required. The *Check Results* button will take the user to the first of the four output-related pages.

Output pages

The Tool offers six different outputs: project cost composition, calculation of the project IRR, estimation of the contributions of the key input parameters to the project's net cash inflow, sensitivities of major input variables, revenue trends for the associated actors, and Solver analysis (which helps identify the changes in the values of the key input parameters needed to achieve the benchmark rate of return). These six sets of outputs are captured by the Tool on the following four output pages. The *Print* button on each output worksheet can be used to print the entire active worksheet in formats such as PDF.

The following section gives a short description of the output pages. Table A-2 in Appendix A shows the details (such as the outputs, the section in which the output is displayed in the Tool, the unit of the output, and guidance specific to the output for users) of each output.

Cost dissection

This output page produces the following two sets of results (see Figure 4).

BREAKUP OF THE TOTAL PROJECT COST OVER THE PROJECT PERIOD

The breakup shows the estimates for the major components and their sub-components over the 10-year project period. The components include the following:

- Capital investment
  - Cost of charging equipment
  - Cost of ancillary equipment
- Cost of electricity
  - Energy charges
  - Demand charges
- Land rental
- Other O&M costs
  - Operator cost
  - EVSE management software cost
  - Maintenance costs and miscellaneous expenses
- Interest on term loan

The 10-year costs for the given components are also expressed per unit of dispensed electricity,[12] which can be considered the buildup for the cost of the charging service over the entire project period. This can be a useful yardstick for setting the charging fee. The project period is considered 10 years, in line with the procurement practices for setting up and operating a PCS in India.[13] In the majority of cases, the concessionaire agreements are found to be effective for about 10 years. Hence, market players are interested in understanding the financial viability of a project for the span of the concessionaire period. Policymakers and implementing agencies, therefore, should also frame the tender clauses or the concessionaire agreement such that an investor would be able to realize modest returns during the project period; that is, 10 years. Hence, to support in the financial evaluation and make the results meaningful and relevant, the Tool too adopts a similar project timespan for the associated calculations. All duration-sensitive outputs from the Tool are based on a 10-year project period. If required, from the results, one can easily deduce the possible outcome for a little shorter or longer project timeline.

TOTAL ANNUAL OPERATING COST OF RUNNING A PCS

The analysis of the annual operating cost includes estimates for the cost of electricity, land rental, and other O&M costs over the 10-year operation of the PCS. The breakup is also presented graphically.

Project IRR and sensitivity

Figure 5 shows a sample "Project IRR & Sensitivity" page. The underlying core methodology of the Tool is the one widely used in the industry for calculating the *project IRR,* a commonly applied indicator for evaluating the profitability of a potential investment. The Tool auto-generates the IRR based on the user-provided inputs on the input pages.

Once the IRR for a project is determined, it is typically compared with the investor's hurdle rate or cost of capital. If the IRR equals or exceeds the cost of capital, the project is considered investment worthy. A hurdle rate, which is also known as the benchmark, or minimum acceptable rate of return, is the minimum rate of return or target rate that the investor expects to realize on an investment. The rate is generally

Figure 4 | **A sample "Cost Dissection" page**

Cost Dissection

Page description: This output worksheet shows the results for the project IRR, the contribution of the given input parameters to the projectÕs net cash inflow, and the sensitivity analysis (whose purpose is to find out how the target or dependent variable, in this case the project IRR, is affected by changes in the input variables).

Print

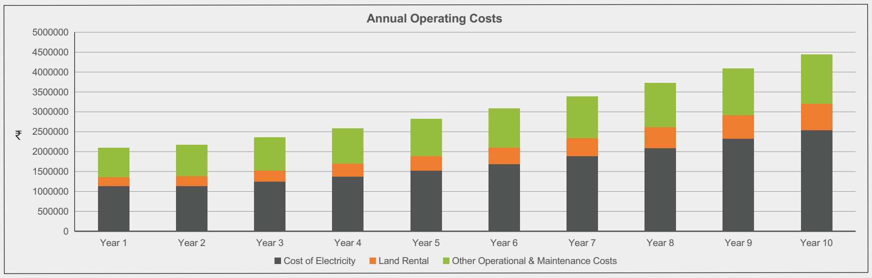
Project Cost Breakup

Major Cost Components	Cost Sub-components	Total Cost (₹)	Cost per Unit of Electricity Dispensed (₹/ kWh)
Capital Investment		**1926000**	**1.16**
	Cost of Charging Equipment	*1672500*	*1.01*
	Cost of Ancillary Equipment	*253500*	*0.15*
Cost of Electricity		**16974475**	**10.21**
	Energy Charges	*13190476*	*7.93*
	Demand Charges	*3670599*	*2.21*
Land Rental		**4058608**	**2.44**
Other Operational & Maintenance Costs		**9722950**	**5.85**
	Operator Cost	*6803759*	*4.09*
	EVSE Management Software Cost	*1741145*	*1.05*
	Maintenance Costs and Miscellaneous Expenses	*1178045*	*0.71*
Interest on Term Loan		**541688**	**0.33**
Aggregate Cost of the Project		**33223721**	**20**

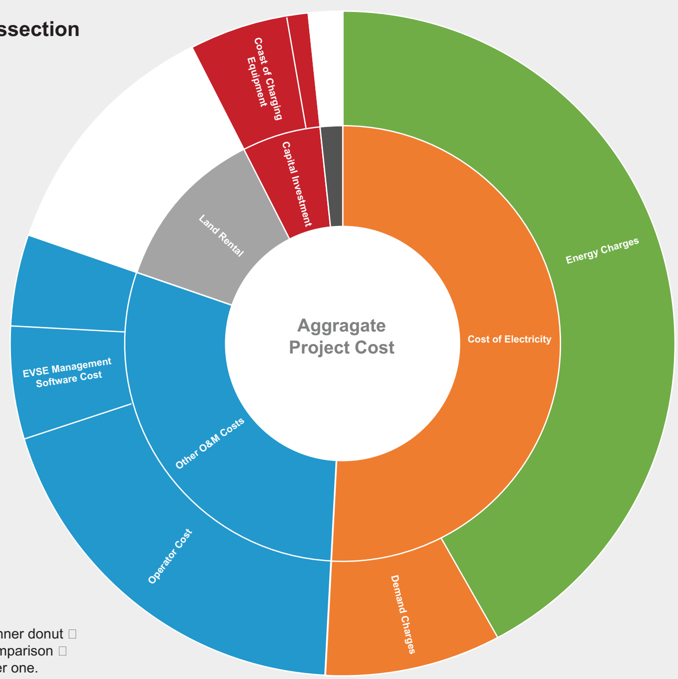
Remark: Minor cost elements have not been listed and are not part of the aggregate project cost shown in the above table.

Annual Operating Cost

Cash Outflows / Year		Cumulative over a 10-year period	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cost of Electricity	₹	16974475	1142041	1132471	1249121	1380266	1527804	1693883	1880937	2091723	2329362	2546868
Land Rental	₹	4058608	217985	246978	279826	317042	359209	406984	461113	522441	591925	655106
Other Operational & Maintenance Costs	₹	9722950	739309	787269	832680	880967	932332	986998	1045202	1107202	1173276	1237715
Total Operating Cost	₹	**30756033**	**2099335**	**2166718**	**2361627**	**2578275**	**2819345**	**3087865**	**3387252**	**3721365**	**4094562**	**4439689**



Cost Dissection

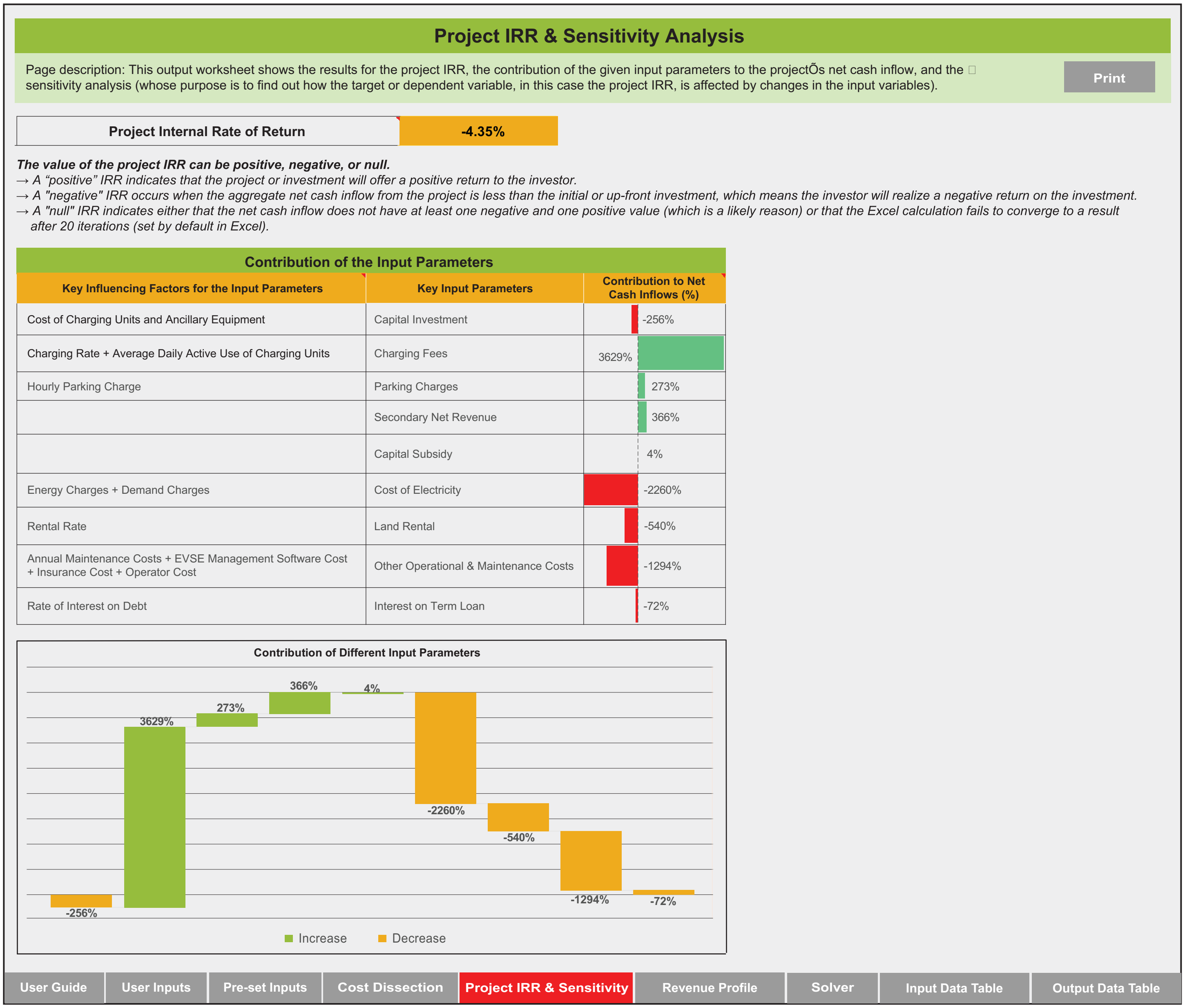


Size of the inner donut is not for comparison with the outer one.

User Guide | User Inputs | Pre-set Inputs | **Cost Dissection** | Project IRR & Sensitivity | Revenue Profile | Solver | Input Data Table | Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

Figure 5 | **A sample "Project IRR & Sensitivity" page**



Project IRR & Sensitivity Analysis

Page description: This output worksheet shows the results for the project IRR, the contribution of the given input parameters to the projectÕs net cash inflow, and the sensitivity analysis (whose purpose is to find out how the target or dependent variable, in this case the project IRR, is affected by changes in the input variables).

Print

Project Internal Rate of Return	-4.35%

The value of the project IRR can be positive, negative, or null.

→ A "positive" IRR indicates that the project or investment will offer a positive return to the investor.
→ A "negative" IRR occurs when the aggregate net cash inflow from the project is less than the initial or up-front investment, which means the investor will realize a negative return on the investment.
→ A "null" IRR indicates either that the net cash inflow does not have at least one negative and one positive value (which is a likely reason) or that the Excel calculation fails to converge to a result after 20 iterations (set by default in Excel).

Contribution of the Input Parameters

Key Influencing Factors for the Input Parameters	Key Input Parameters	Contribution to Net Cash Inflows (%)
Cost of Charging Units and Ancillary Equipment	Capital Investment	-256%
Charging Rate + Average Daily Active Use of Charging Units	Charging Fees	3629%
Hourly Parking Charge	Parking Charges	273%
	Secondary Net Revenue	366%
	Capital Subsidy	4%
Energy Charges + Demand Charges	Cost of Electricity	-2260%
Rental Rate	Land Rental	-540%
Annual Maintenance Costs + EVSE Management Software Cost + Insurance Cost + Operator Cost	Other Operational & Maintenance Costs	-1294%
Rate of Interest on Debt	Interest on Term Loan	-72%

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

determined by assessing the cost of capital, which in turn is commonly equated with the BPLR of the largest retail public sector bank in the country. The Tool by default considers the average BPLR for the current year of the State Bank of India, which is a public sector bank and also the largest retail bank in India. However, the Tool allows the user to set a different hurdle rate for benchmarking the project IRR.

The value of the project IRR can be positive, negative, or null, as described in the following:

- A "positive" IRR indicates that the project or investment is expected to offer a positive return to the investor.
- A "negative" IRR occurs when the aggregate net cash inflow from the project is less than the initial or up-front investment, which means the investor will realize a negative return on the investment.
- A "null" IRR indicates that either the net cash inflow does not have at least one negative and one positive value (which is a likely reason) or the Excel calculation fails to converge

to a result after 20 iterations (set by default in Excel [CFI 2022]).

As part of the impact analysis, the Tool analyzes the dataset to gauge the *contributions of the key input parameters or variables* (such as the capital investment, charging fees, parking charges, capital subsidy, cost of electricity, land rental, average daily active use of charging units, and other O&M costs) to the project's net cash inflow. Based on the data input by the users on the input pages, the table and the corresponding graph of the contributions of the key input parameters or variables are automatically updated in the Tool and reflected in the displayed results. The key factors influencing the input parameters are listed alongside the input parameters in the table. The Tool also predicts possible changes in the project IRR value with ±10 and ±20 percent variation in the values of the key input parameters compared to their original, or base-case, values using the *sensitivity (what-if) analysis.* The given variation range is considered reasonable for studying the uncertainty in the project IRR associated with changes in the key input variables. For investment in public charging infrastructure, the key input variables are the capital investment, charging fees, capital subsidy, cost of electricity, land rental, other O&M costs, and the average daily active use of the charging units. The Tool is able to auto-generate the results without user intervention.

The sensitivity analysis is helpful for the stakeholders of the charging infrastructure ecosystem because the values of the input parameters constantly evolve depending on market developments, consumer preferences, and government regulations. This feature of the Tool will enable stakeholders to easily forecast the likely fluctuations in the project IRR.

Revenue profile

Figure 6 shows a sample "Revenue Profile" page. Based on the data input by users on the input pages, the table and the

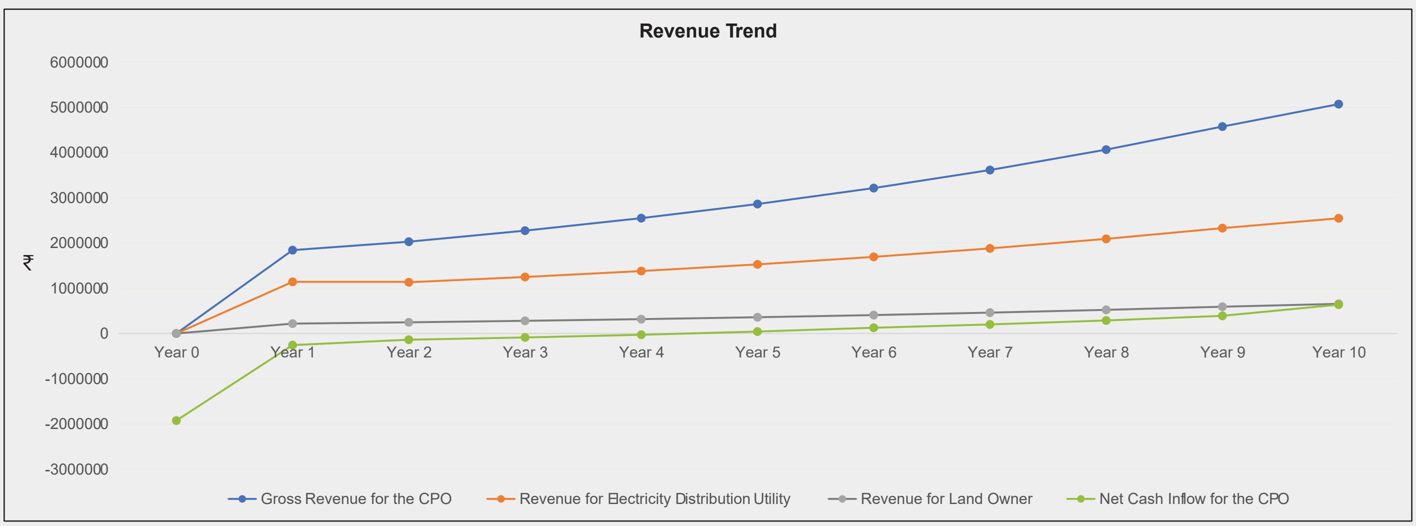
Figure 6 | **A sample "Revenue Profile" page**

Revenue Profiles

Page description: This output sheet shows the projection of the possible incomes for the CPO, the power distribution utility, and the land-owning entity over the project duration of 10 years. Moreover, the specific years in the project period that are envisaged to register a positive net cash inflow for the CPO will automatically appear in green, indicating that the breakeven for the project has been achieved at the given point in time.

Print

Cashflows / Year		Cumulative over 10-year period	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Gross Revenue for the CPO	₹	32097005	0	1842858	2029248	2273677	2549850	2861968	3214787	3613696	4064801	4575017	5071103
Net Cash Inflow for the CPO	₹	-751245-	1926000-	256477-	137470-	87950-	28425	42623	126922	199938	287682	390446	637465
Revenue for Electricity Distribution Utility	₹	169744750		1142041	1132471	1249121	1380266	1527804	1693883	1880937	2091723	2329362	2546868
Revenue for Land Owner	₹	40586080		217985	246978	279826	317042	359209	406984	461113	522441	591925	655106



User Guide | User Inputs | Pre-set Inputs | Cost Dissection | Project IRR & Sensitivity | Revenue Profile | Solver | Input Data Table | Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

corresponding graph representing the revenue trends for the entire project duration are automatically updated in the displayed results.

The Tool projects the gross revenue and net cash inflow for the CPO, the revenue for the distribution utility, and the revenue for the land-owning entity over the project duration. This is to give a sense of the possible revenues for the actors involved in the implementation of a PCS. It is considered an important insight for implementing agencies, regulators, city authorities, and policymakers.

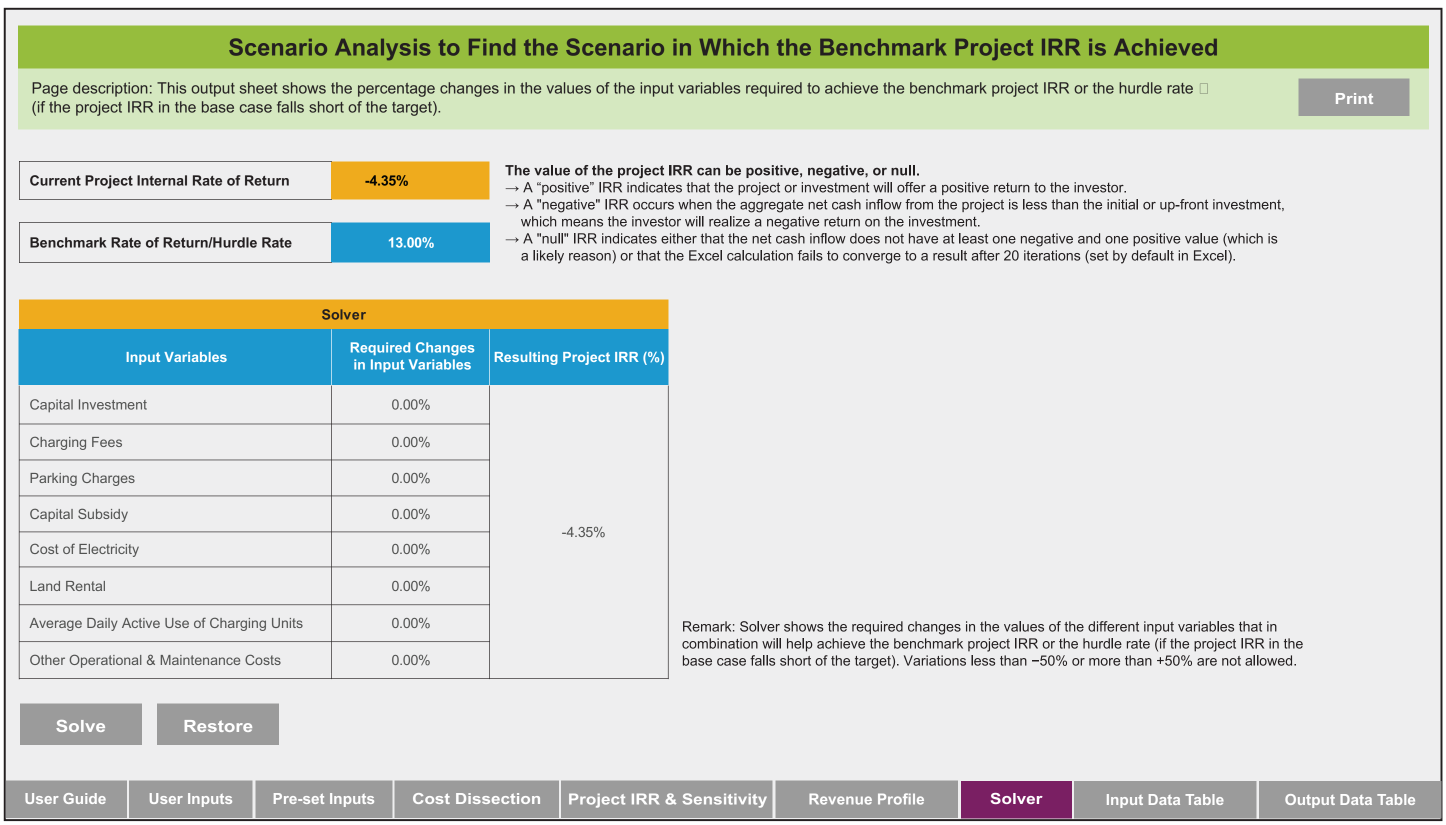
Moreover, the specific years in the project period that are envisaged to register a positive net cash inflow for the CPO will automatically appear in green, indicating that the breakeven for the project has been achieved. This visual representation would help users easily identify the break-even year if it is within the project duration of 10 years.

Solver

Figure 7 shows a sample "Solver" page. Solver shows the required changes in the values of the different input variables that in combination will help achieve the benchmark project IRR or the hurdle rate (if the project IRR in the base case falls short of the target). With the click of a button, the Tool produces the required results. While carrying out the iterations, Solver takes into account the individual contributions of the input variables to the project IRR as reflected in the earlier section (the "Project IRR & Sensitivity" page) of the Tool. Boundary conditions have also been imposed on the Solver function to ensure that the results from the permutations and combinations of the input variables are realistic.

In addition, on this page, the user can conduct sensitivity analyses by varying the input parameters over any range.

Figure 7 | **A sample "Solver" page**



Scenario Analysis to Find the Scenario in Which the Benchmark Project IRR is Achieved

Page description: This output sheet shows the percentage changes in the values of the input variables required to achieve the benchmark project IRR or the hurdle rate (if the project IRR in the base case falls short of the target).

Print

Current Project Internal Rate of Return	-4.35%
Benchmark Rate of Return/Hurdle Rate	13.00%

The value of the project IRR can be positive, negative, or null.
→ A "positive" IRR indicates that the project or investment will offer a positive return to the investor.
→ A "negative" IRR occurs when the aggregate net cash inflow from the project is less than the initial or up-front investment, which means the investor will realize a negative return on the investment.
→ A "null" IRR indicates either that the net cash inflow does not have at least one negative and one positive value (which is a likely reason) or that the Excel calculation fails to converge to a result after 20 iterations (set by default in Excel).

Solver		
Input Variables	**Required Changes in Input Variables**	**Resulting Project IRR (%)**
Capital Investment	0.00%	-4.35%
Charging Fees	0.00%	
Parking Charges	0.00%	
Capital Subsidy	0.00%	
Cost of Electricity	0.00%	
Land Rental	0.00%	
Average Daily Active Use of Charging Units	0.00%	
Other Operational & Maintenance Costs	0.00%	

Remark: Solver shows the required changes in the values of the different input variables that in combination will help achieve the benchmark project IRR or the hurdle rate (if the project IRR in the base case falls short of the target). Variations less than −50% or more than +50% are not allowed.

Solve | Restore

User Guide | User Inputs | Pre-set Inputs | Cost Dissection | Project IRR & Sensitivity | Revenue Profile | Solver | Input Data Table | Output Data Table

Note: The purpose of the above figure is to help in referring to the particular page of the Excel tool.
Source: Financial Analysis of Charging station (FACt) tool developed by WRI India.

Steps to use the tool effectively

The user should follow these steps in the following sequence and consult the specific guidance given on the relevant worksheets or pages:

- **Access:** Download the Excel file of FACt from WRI India's Electric Mobility practice area page (https://www.wricitiesindia.org/content/electric-mobility) and check the background details and tutorial video on the website.
- **Familiarize:** After opening the Excel file and enabling the *Editing* and *Macros* options (see the commands at the top of the file), visit the "User Guide" page for a description of the Tool and instructions on how to use it. For information on the required inputs and available outputs, visit the "Input Data Table" and "Output Data Table" pages, respectively. When the Excel file is first opened, a security alert from Microsoft is triggered as the file contains VBA code. To unblock the file, go to the folder where the file is saved. After right-clicking the file, choose *Properties* from the context menu. Select the *Unblock* checkbox at the bottom of the *General* tab and click *OK*. This permission needs to be given only once.
- **Start:** Click the Start button on the "User Guide" worksheet to open the "User Inputs" page along with the "Pre-set Inputs" worksheet.
- **Provide:** Follow the instructions to enter the requested inputs on the "User Inputs" page and, if required, click the *Clear All Inputs* button at the bottom of the worksheet to key in a fresh set of input values.
- **Validate:** Click the *Check Pre-set Inputs* button to visit the "Pre-set Inputs" worksheet and ascertain whether the default input values are appropriate for the required analysis; if not, change the input values accordingly. If required, the default values can be restored by clicking the *Restore Default Inputs* button at the bottom of the page.
- **Generate:** Press the *Check Results* button on the "Pre-set Inputs" page to produce the results and open the first of the four output-related pages.
- **Visit:** Explore the "Cost Dissection" worksheet to understand the project cost composition and annual operating cost over the 10-year operation of the PCS.
- **See:** Go to the "Project IRR & Sensitivity" page for results on the project IRR, the impact of the key input variables, and sensitivity analysis. While considering the results from the sensitivity analysis, ensure that the "Solver" is not used simultaneously (i.e., the values under "Required Change" against individual input parameters should remain 0 percent). Otherwise, the standard sensitivity results will change.
- **Explore:** Visit the "Revenue Profile" page to check the 10-year projection of the potential incomes of the CPO, the power distribution utility, and the land-owning entity. The years registering a positive net cash inflow for the CPO will automatically appear in green, indicating the breakeven for the project. The break-even point of the investment can also be found from the auto-generated chart, at the point where the line plot of the net cash inflow of the CPO crosses the X-axis;[14] that is, the "0" mark on the Y-axis.[15]
- **Apply:** Click the *Solve* button on the "Solver" page if the resulting *project IRR* falls below the hurdle rate. A command box will pop up with the following text: "Solver has found a solution. All constraints and optimality conditions are satisfied." Two options are available: (i) "*Keep the Solver Solution*" or (ii) "*Restore Original Values*," where the default selection is Option (i). Click the *Ok* button to display the results. If the *project IRR* is "null," input values under the column "Required Change" against the input parameters such that the resulting *project IRR* changes to a non-null value. Even a negative *project IRR* value will suffice. Then click the *Solve* button, and repeat the above steps. To refresh the page, click the *Restore* button.
- **Understand:** Check the "Input Data Table" and "Output Data Table" pages for more details about the different types of required inputs and the produced outputs.
- **Learn:** Download and read the Technical Note available on the website for more information about FACt, including the applied methodology.

BEHIND THE CURTAIN: HOW THE TOOL WORKS

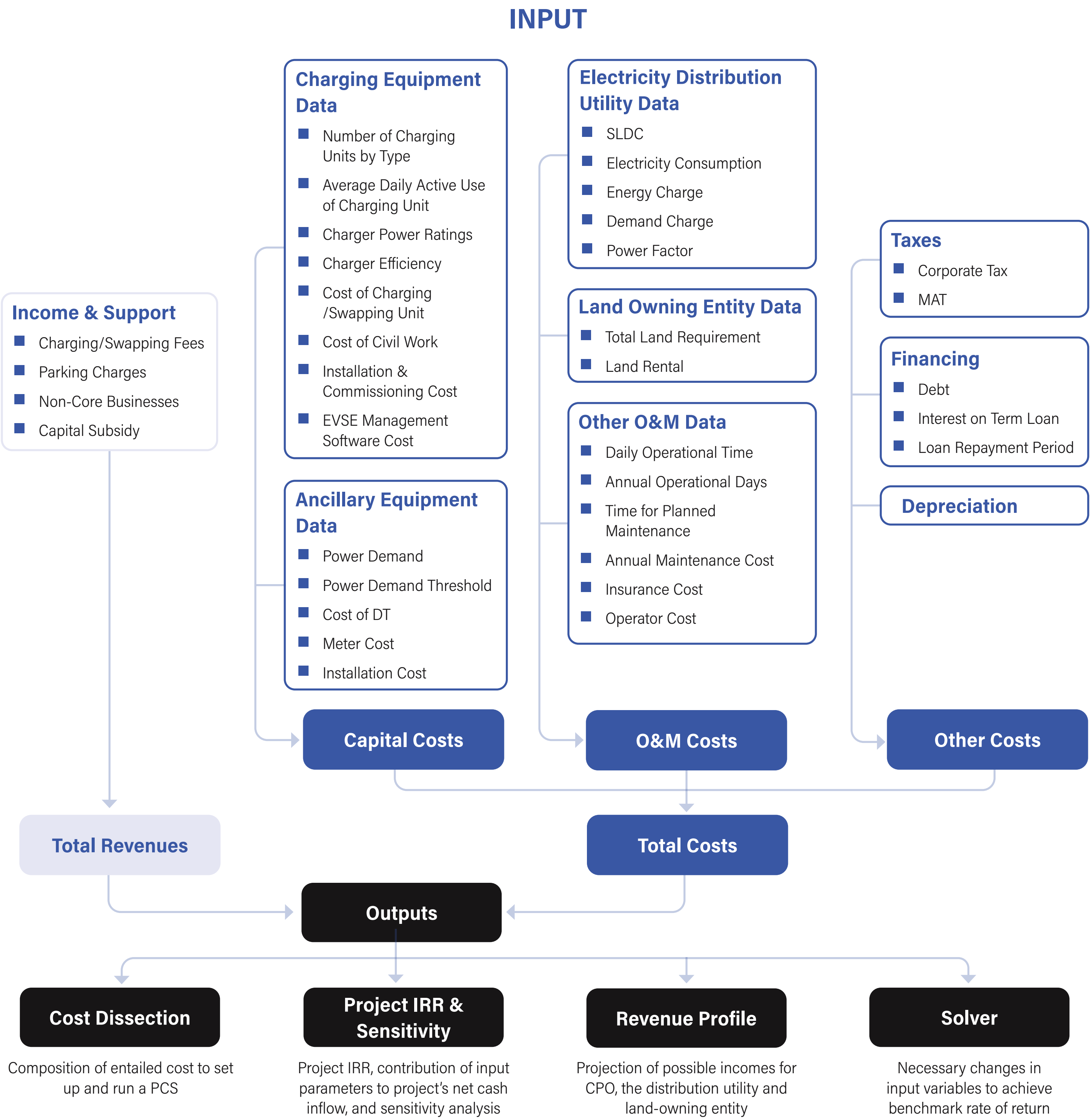
Figure 8 shows how the broad logic of the Tool works at the back end of the given input and output pages, linking the different input and output parameters.

Formulas for calculating different parameters

Dissecting the cost

The Tool disaggregates the project cost into major components and their sub-components, both up-front and recurring, and estimates them for the 10-year project period. Moreover, the estimated costs are expressed per unit of dispensed electricity; that is, as $\frac{\sum_{n=0}^{N} ci_n}{\sum_{n=0}^{N} E_n}$

Figure 8 | **Overview of the functioning of the Tool**



Source: WRI India authors.

where:

Ci_n = Cost due to item i in the nth year of the project

E_n = Total dispensed electricity in the nth year of the project

N is the total project period; that is, 10 years.

Estimating the project IRR

The formula for calculating the *project IRR* is as follows:

$$0 = CF_0 + \frac{CF_1}{(1 + IRR)} + \frac{CF_2}{(1 + IRR)^2} + \frac{CF_3}{(1 + IRR)^3} + \cdots + \frac{CF_n}{(1 + IRR)^n}$$

That is, $\sum_{n=0}^{N} \frac{CF_n}{(1 + IRR)^n} = 0$

where:

CF_0 = The capital investment or outlay in the project; that is, the up-front investment expected to be incurred to set up a PCS

The capital investment cost usually covers the capital needed to build the charging station:

Capital investment = Cost of Charger/Battery Swapping System + Cost of Ancillary Electrical Infrastructure

(Note: These costs are used to calculate the investment and are exclusive of Goods & Services Tax (GST).)

CF_1, CF_2, CF_3 … CF_n = Cash flows; that is, all the possible incomes or cash inflows (including the capital subsidy) and one-time as well as recurrent expenditures for setting up and operating a PCS

n = Each period; that is, one year in this case

N = The project period; that is, the contract period to operate the PCS, which is considered 10 years

The given IRR formula can be applied in Excel using the IRR function.

The IRR for a project is typically compared with the investor's hurdle rate or cost of capital, and the project is considered investment-worthy if the IRR equals or exceeds the cost of capital. The hurdle rate, as explained previously, is the minimum required rate of return or target rate that the investor expects to realize on an investment. The Tool allows the user the flexibility of setting a different hurdle rate for benchmarking the project IRR.

The cash inflows include the following:

- Income from EV charging fees
- *Charging Fee Revenue* = (Number of Charging Units × Charger Power Rating × (Average Daily Active Use of Charging Unit ÷ Number of Daily Operational Hours × 100) × (Number of Daily Operational Hours × Number of Annual Operational Days) × (1 – Time for Planned Annual Maintenance)) × Charging or Swapping Fee Rate

  (Note: This formula must be separately applied to each of the different charging unit types to arrive at the cumulative charging fee revenue)
- Income from parking charges (if applicable)
- *Income from Parking Charges* = (Number of Charging Units × (Average Daily Active Use of Charging Unit ÷ Number of Daily Operational Hours × 100) × (Number of Daily Operational Hours × Number of Annual Operational Days) × (1 – Time for Planned Annual Maintenance)) × Hourly Parking Charges
- Net income from secondary sources or non core businesses such as advertisements (if applicable)
- Capital subsidy from the government (if applicable)

On the other hand, cash outflows cover the following:

- Cost of electricity
  Cost of electricity = (Energy Charge per kWh × Annual Electricity Consumption) + (Demand Charge per kVA Month × Power Demand of the Charging Station × Number of Months)
- Land rental
  The land rental, when fixed on a monthly basis, can be calculated as follows:
  Land Rental = Total Monthly Land Rental × Number of Months

  When linked to electricity consumption, land rental can be calculated as follows:

  Land Rental = Annual Electricity Consumption × Rate of Land Rental per Unit of Electricity Consumption
- Other O&M costs
  Other O&M Costs = Annual Maintenance Costs + EVSE Management Software Cost + Insurance Cost + Operator Cost
  Here, annual maintenance costs are calculated as a percentage of the cost of chargers and of the DT. The cost

- of the EVSE management software is pegged at ₹1 per unit of dispensed electricity. The insurance cost is calculated as a percentage of the cost of the chargers. The operator cost comprises the costs of staffing the PCS. If the facility is crewless, there is a fixed cost for periodic checking and troubleshooting.
- Taxes (set in accordance with the applicable tax regime)
  - Corporate tax
  - MAT[16]

  (Note: GST is not considered as it is directly passed on to EV customers.)
- Interest on the term loan and depreciation are also duly accounted for in accordance with standard practice.

Gauging the contribution of key input parameters

To evaluate the contribution of a key input parameter or variable to the net cash inflow, the Tool calculates its cumulative share (in the form of a cash inflow or outflow) in the aggregate net cash inflow or income for the project over the entire project period; that is, as $\frac{\sum_{n=0}^{N} CFi_n}{\sum_{n=0}^{N} CF_n}$

where:

CF_i = Cash inflow or outflow due to item i

CF = Absolute value of all cash flows

Undertaking sensitivity (what-if) analysis

Based on the given key input variables and the sensitivity range, the analysis is carried out using the *Data Table* function of "What-If Analysis" in the *Data* tab of Excel.

Projecting potential revenue for concerned stakeholders

The Tool utilizes the parameters considered in the project IRR calculation to forecast the possible incomes of the CPO, the power distribution utility, and the land-owning entity over the project contract period of 10 years. Accounting for the gross and net revenues from the PCS is straightforward for the CPO because these are already included in the project IRR calculation. To estimate the revenue for the power distribution utility from the PCS, the Tool considers the value of the "Cost of Electricity," which is a cash outflow item in the project IRR computation. Similarly, the revenue for the land-owning entity from the PCS is equal to the "Land Rental," which is accounted as a cash outflow item in the project IRR calculation.

Executing Solver

The Tool employs the Solver function (under the Data tab), an Excel add-in, but simplifies the execution by applying Excel macros to give users a hassle-free experience.

CAVEATS FOR THE USER

Despite the well-thought-out approach to formulating and designing the Tool, rigorous user testing, and prompt troubleshooting, the following limitations (or risks) of the Tool have been identified.

Limited quality risk

FACt requires the user to provide a limited number of mandatory inputs and validate or change a set of default input values. Detailed guidance is available if the user needs it. Also, the data validation function of Excel has been applied on the input worksheets to flag and prevent inappropriate data inputs. The analytical framework employed in the Tool is an industry standard. However, there could still be an element of risk if the user provides data inputs that do not appropriately reflect the context, in spite of the given guidance. This situation is beyond the control of the Tool.

Avoidable usage glitches

On the "User Guide" page of the Tool, specific caveats have been given. The user should be aware of the following:

- Macros should be enabled in the Trust Settings after opening the Excel file; otherwise, some functions of the Tool will not work.
- The Tool should be run in a device with an active Microsoft Office license. Office 2016 or any later version of MS Office is recommended.
- The Mac operating system (macOS) should be avoided as some features of the Tool such as Solver may not function properly.
- When the Excel file of the Tool is opened for the first time, a security alert from Microsoft could be triggered, as the file contains VBA code. *Permission* to open the file has to be granted using the process laid down by Microsoft. The required guidance has been provided in this Technical Note.
- In case of difficulty in viewing the texts on the pages of the Tool, the worksheet sizes should be adjusted by zooming in or out.

Need for understanding EV charging infrastructure

To use FACt effectively, it is recommended that the user have a fundamental understanding of PCS operations before applying it. Going through the literature on public charging infrastructure may be useful in this regard.

After taking these few precautions and with suitable preparation, the user can use the Tool effectively without any difficulty.

DISCLAIMER

The purpose of this tool is to help develop a foundational understanding of PCS finances. This application should not be considered a one-stop-solution for assessment of and/or decision-making regarding an existing or proposed project or investment. The functions of the Tool and the produced results are the sole responsibility of the users of this tool. Neither WRI India nor the creators of the Tool can be held, directly or indirectly, responsible or accountable for the use of this tool and/or the results. The Tool uses some third-party information, the source of which should be independently verified by users.

APPENDIX A

Table A-1 | **Input data table**

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
***User Inputs* worksheet**				
Number of charging units		-	To consider the public charging station (PCS) configuration that will impact capital expenditures (CAPEX) and operating expenses (OPEX)	The user has to enter positive integral values for each type of charging unit.
Average daily active use of charging unit in year 1 of operation	Hours per day	-	To calculate the income and operational cost of the charge point operator (CPO) and revenues of the distribution utility and land-owning entity	The user has to enter a numerical value for each type of charging unit. Note that the daily active use of a charging unit refers to the daily number of hours for which the unit is being used, or is expected to be used, for EV charging. The number of hours of active use of a charging unit is different from (and less than) the daily operational hours of the charging facility. The active use of a charging unit, which depends on the demand for EV charging at the facility, helps estimate its capacity utilization. For example, if a charging unit is in active use for 4 hours a day on average out of the daily operational hours (16 hours), its capacity utilization would be 25% (4/16 × 100).
Charging /swapping fees	₹/kWh	-	To calculate the CPO's income	The user has to enter a value for each type of charging unit used in Year 1. These fees are exclusive of GST. The following are some suggested values for charging/swapping fees per kWh: - ₹7 to ₹11 for slow and moderately fast (AC) chargers - ₹12 to ₹18 for fast (DC) chargers - ₹30 to ₹40 for battery swapping.
Energy charge	₹/kWh	-	To calculate the CPO's operational cost and the distribution utility's revenues	The user has to enter the value applicable for Year 1. It is recommended to consider the landed cost or all-in rate of electricity (i.e., inclusive of taxes and other state-levied charges). The energy charge and other charges vary from state to state. Information on the energy charge and other state-levied charges and taxes can be obtained from the state tariff orders, which are usually available on the websites of State Electricity Regulatory Commissions or distribution companies (DISCOMs).

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
Demand charge	₹/kVA month	-	To calculate the CPO's operational cost and the distribution utility's revenues	The user has to enter the value applicable for Year 1. The user must also ascertain whether a demand or fixed charge is applicable to the PCS. This depends on state regulations and hence varies from state to state. Information on the demand charge can be obtained from the state tariff orders, which are usually available on the websites of the State Electricity Regulatory Commissions or DISCOMs. To convert kW to kVA, divide kW by the power factor.
Monthly fixed land rental	₹	-	To calculate the CPO's operational cost and the land-owning entity's revenues	The user has to enter the value applicable for Year 1 only if the land rental is based on the area requirement.
Land rental rate per electricity consumption	₹/kWh	-	To calculate the CPO's operational cost and the land-owning entity's revenues	The user has to enter the value applicable for Year 1 only if the land rental is set per unit of electricity consumption.
Available total capital subsidy	₹	-	To calculate the project internal rate of return (IRR)	The user has to enter this input if a capital subsidy is applicable. The total amount of direct capital subsidy applicable to the PCS under central and state/city schemes must be considered. This amount is not refundable. Information on capital subsidy is available in EV policies or scheme documents.
***Pre-set Inputs* worksheet**				
Power rating of the charging unit	kW	▪ Charging infrastructure guidelines issued by the Ministry of Power, Government of India ▪ Portal on charger products that are commonly available in the market	To calculate the electricity consumption and power demand at a PCS	The user has to enter values for other types of charging units. Caveat: The Tool assumes that the charging units are used at their rated output power levels. In reality, the effective power level during a charging session could drop below the rated power, depending on the recommended C-rate of the EV's battery (if a DC charging unit is used) and the power rating of the vehicle's on-board charger (if an AC charging unit is used).
Cost per charging /swapping unit	₹	Stakeholder consultation	To calculate the CPO's capital costs	The user has to enter values for other types of charging units.
Cost of civil works as a percentage of the total cost of the charging system (%)		Assumption based on stakeholder consultation	To estimate the CPO's capital costs	The user has to enter a numerical value without the % symbol. The charging system refers to the charging units to be installed at the PCS, including a stack battery charging system, if any.

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
Installation and commissioning costs as a percentage of the total cost of the charging system (%)		Assumption based on stakeholder consultation	To estimate the CPO's capital costs	The user has to enter a numerical value without the % sign. The charging system refers to the charging units to be installed at the PCS, including a stack battery charging system, if any.
Power factor of the electricity connection		Based on industry practice; the information can be obtained from the serving DISCOM.	To convert values expressed in kW to kVA and vice versa	The power factor is a measure of how effectively the incoming power is used in an electrical system. A high power factor indicates that the power supplied to the electrical system is effectively used. A system with a low power factor consumes the incoming electricity supply inefficiently, resulting in losses.
Cost of the distribution transformer (DT) and associated equipment per 50 kVA rated capacity	₹	Cost Data Sheet of BESCOM[a]	To estimate the up-front installation cost of the PCS	Apart from the DT's cost, this includes the cost of earthing, the high tension /low tension (HT/LT) panel, cabling and trenching, and local distribution panels. These costs are incurred if a HT connection is necessary.
Meter cost	₹	ISGF White Paper[b]	To estimate the up-front installation cost of the PCS	The cost does not include the installation cost.
Ancillary electrical infrastructure installation cost (including labor)	₹	Cost Data Sheet of BESCOM[a]	To estimate the up-front installation cost of the PCS	
Daily operational hours		Considered 24 hours by default	To calculate the CPO's income and operational cost, and the distribution utility and land-owning entity's revenues	The value could be less than 24 hours if the PCS is set up inside a host facility, depending on the facility's operational time.
Annual operational days		Considered 365 days by default	To calculate the CPO's income and operational cost, and the distribution utility and land-owning entity's revenues	Planned maintenance time is by default taken into account in the calculation, and hence, the operational days need not be adjusted for maintenance requirements.
Parking charges	₹/hour	Considered not applicable by default	To calculate the CPO's income	The user has to enter the values applicable for Year 1 for each type of charging unit. Parking charges are commonly applicable to slow/moderately fast chargers.
Secondary net revenue for the CPO from non -core business	₹/month	Considered not applicable by default	To calculate the CPO's income	If applicable, the user has to enter the net revenue for Year 1 from secondary income sources such as advertisements, public convenience facilities, and refreshment kiosks. The net revenue should not take into account the costs attributed to the operation of the PCS.

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
Power demand threshold for an exclusive DT	kVA	The default value of 118 kVA (100 kW) is taken from the Delhi Supply Code Regulation[c]	To determine the requirement for a dedicated DT at a PCS	This input value depends on state regulations and hence varies from state to state. The information can be obtained from the applicable State Electricity Supply Code Regulations.
Charger efficiency (%)		Stakeholder consultation	To calculate the electricity consumption at a PCS	The user has to enter a numerical value without the % symbol.
Time for planned annual maintenance (%)		Assumption based on stakeholder consultation	To estimate the effective operational time of the PCS, which impacts the CPO's operational cost and income, and the distribution utility's revenues	The user has to enter a numerical value without the % symbol.
Auxiliary electricity consumption (%)		Assumption based on stakeholder consultation	To calculate the electricity consumption at a PCS	The user has to enter a numerical value without the % symbol. Auxiliary electricity consumption is related to other electrical end uses at the PCS, such as for illumination at the site.
Annual maintenance costs as a percentage of the cost of the core hardware (%)		Based on industry practice	To calculate the CPO's other operational and maintenance (O&M) costs	The user has to enter a numerical value without the % symbol.
Cost rate for electric vehicle supply equipment (EVSE) management software	₹/kWh	Assumption based on stakeholder consultation	To calculate the CPO's other O&M costs	
Insurance cost as a percentage of the total cost of the charging system (%)		Assumption based on stakeholder consultation	To calculate the CPO's other O&M costs	The user has to enter a numerical value without the % symbol.
Hourly total operator cost if the PCS is staffed	₹/hour	The default value is ₹65 per hour according to the minimum wage limit notified by the Ministry of Labour & Employment, Government of India. However, the value varies from city to city and from state to state.[d]	To calculate the CPO's other O&M costs	The user has to enter the value applicable for Year 1. The total operator cost (which depends on the number of operators deployed) per hour must be considered if the PCS is staffed.
Minimum alternate annual operator cost if the facility is crewless	₹	Assumption based on stakeholder consultation	To calculate the CPO's other O&M costs	Note that an operator may be required for troubleshooting at a PCS even if it is crewless. A lump-sum cost has been considered.
Debt as a percentage of the capital investment (%)		Based on the standard accounting method	To estimate the yearly interest on the term loan to be paid out as part of debt financing for the EV charging business	The user has to enter a numerical value without the % symbol.

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
Construction period	Months	For accounting purposes, it is considered 12 months; i.e., one full year	To estimate the yearly interest on the term loan to be paid out as part of debt financing for the EV charging business	
Loan repayment period	Years	Based on the commonly used lending practice	To estimate the interest on the term loan to be paid out as part of debt financing for the EV charging business	
Rate of interest on loan (%)		The default value is 15%, in accordance with the State Bank of India's benchmark prime lending rate. However, the value may change depending on the marginal cost of funds based lending rate (MCLR) of the bank and the credit score of the borrower.	To estimate the yearly interest on the term loan to be paid out as part of debt financing for the EV charging business	The user has to enter a numerical value without the % symbol. If there is no debt, 0 must be entered. If multiple lenders are involved, the weighted average lending rate must be considered.
Service-line-cum -development charge paid for a new electricity connection application	₹/kW	The default charge is ₹1,500/kW. However, this value depends on state regulations and hence varies from state to state. The required information can be obtained from the serving DISCOM[e]	To estimate the up-front PCS installation cost and the distribution utility's revenue	This is the one-time charge that a consumer has to pay to the serving electricity distribution utility when applying for a new electricity connection; this charge varies from state to state. The amount is usually linked to the sanctioned load (kW) for the connection.
Corporate tax rate (%)		The default rate is 25%. However, the Ministry of Finance and Corporate Affairs, Government of India, can change this value[f]	To estimate the net income/profit from the PCS operation	The user has to enter a numerical value, if applicable, without the % symbol.
Minimum alternate tax (MAT) rate (%)		Cleartax[f]	To estimate the net income/profit from the PCS operation	GST on service is not considered as it is directly passed on to the EV customers.
Hurdle rate or benchmark rate of return (%)		By default, the State Bank of India's benchmark prime lending rate (BPLR) at a given point of time is taken into account, which is currently about 13%. The value changes with time.[g]	To check whether the project IRR crosses the benchmark rate and thus determine whether the charging business is profitable or not; to understand the changes in the values of the key input parameters to achieve the benchmark rate, using the tool feature Solver (if the project IRR in the base case falls short of the target)	This is to enable comparison with the resulting project IRR to assess the business attractiveness of the investment in the PCS. The user has to enter a numerical value, if applicable, without the % symbol.
Escalation of the electricity rate (%)		Assumption based on stakeholder consultation	To calculate the CPO's operational cost and the distribution utility's revenues over a 10-year period	The user has to enter a numerical value without the % symbol.

INPUTS	UNITS OF THE INPUTS	SOURCES OF INPUT DATA COLLECTION	PURPOSE	GUIDANCE FOR USERS
Land rental escalation (%)		Assumption based on stakeholder consultation	To calculate the CPO's operational cost and the land-owning entity's revenues over a 10-year period	The user has to enter a numerical value, if applicable, without the % symbol.
Escalation of other O&M costs (%)		Assumption based on stakeholder consultation	To calculate the CPO's other O&M costs over a 10-year period	The user has to enter a numerical value without the % symbol.
Escalation of the charging fees (%)		Assumption based on stakeholder consultation	To calculate the CPO's income over a 10-year period	The user has to enter a numerical value without the % symbol.
Escalation of the hourly parking charges (%)		Assumption based on stakeholder consultation	To calculate the CPO's income over a 10-year period	The user has to enter a numerical value without the % symbol.
Increase in secondary revenue (%)		Assumption based on stakeholder consultation	To calculate the CPO's income over a 10-year period	The user has to enter a numerical value without the % symbol.
Increase in the average daily active use of charging units (%)		Assumption based on stakeholder consultation	To calculate the CPO's income and operational cost, and the distribution utility and land-owning entity's revenues over a 10-year period	The user has to enter a numerical value without the % symbol.

Note:

[a] BESCOM n.d.

[b] ISGF 2016

[c] DERC 2017

[d] Office of the Chief Labour Commissioner 2022

[e] PTI 2019

[f] Cleartax 2022

[g] SBI 2022

Table A-2 | **Output data table**

OUTPUTS	TOOL PAGES ON WHICH THE OUTPUTS ARE DISPLAYED	UNITS OF THE OUTPUTS	GUIDANCE FOR USERS
Project cost breakup	Cost Dissection	₹	The breakup of the total project cost over the project period shows the estimates for the major components and their sub components over the 10-year project period. The components include the following: ▪ Capital investment · Cost of charging equipment · Cost of ancillary equipment ▪ Cost of electricity · Energy charges · Demand charges ▪ Land rental ▪ Other operational and maintenance (O&M) costs · Operator cost · Electric vehicle supply equipment (EVSE) management software cost · Miscellaneous expenses ▪ Interest on term loan
Cost per unit of electricity dispensed	Cost Dissection	₹/kWh	The 10-year costs for the given components are expressed per unit of dispensed electricity, which can be considered the buildup for the cost of the charging service over the entire project period.
Total annual operating cost of running a public charging station (PCS)	Cost Dissection	₹	Analysis of the annual operating cost shows estimates for the cost of electricity, land rental, and other O&M costs over the 10-year operation of the PCS.
Project internal rate of return (IRR) (%)	Project IRR & Sensitivity		The project IRR is a commonly employed indicator for evaluating the profitability of a potential investment. The Tool estimates the possible project IRR for a charge point operator (CPO) from the investment in setting up a PCS of a certain configuration in a given context. The underlying core methodology applied in the Tool for calculating it is the one widely used in the industry. Once the IRR for a project is determined, it is typically compared with the investor's hurdle rate or cost of capital. If the IRR equals or exceeds the hurdle rate, the project is considered investment worthy.

OUTPUTS	TOOL PAGES ON WHICH THE OUTPUTS ARE DISPLAYED	UNITS OF THE OUTPUTS	GUIDANCE FOR USERS
Contribution of the key input parameters to the net cash inflow (%)	Project IRR & Sensitivity		As part of the impact analysis, the Tool analyzes the dataset to gauge the contributions of the key input parameters or variables (such as capital investment, charging fees, parking charges, capital subsidy, cost of electricity, land rental, average daily active use of charging units, and other O&M costs) to the project's net cash inflow. Based on the data input by users on the input pages, the table and the corresponding graph on the contributions of the key input parameters or variables are automatically updated in the Tool and reflected in the displayed results.
Sensitivity to the key input parameters (%)	Project IRR & Sensitivity		The Tool predicts possible changes in the project IRR value with ±10% and ±20% variations in the values of the key input parameters compared to their original or base-case values using the *sensitivity (what-if) analysis.* The given range is considered reasonable for studying the uncertainty in the project IRR associated with changes in the key input variables. As far as investment in public charging infrastructure is concerned, the key input variables are the capital investment, charging fees, capital subsidy, cost of electricity, land rental, other O&M costs, and the average daily active use of charging units. The Tool is able to auto-generate the results without user intervention.
CPO's gross revenue	Revenue Profile	₹	The Tool analyzes the dataset to project the revenue trends (which include the CPO's gross revenue and net cash inflow, the distribution utility's revenue, and the land-owning entity's revenue) over the entire project duration. This is to give a sense of the possible revenues for the actors involved in the implementation of a PCS. On the basis of the data input by the users on the input pages, the table and the corresponding graph representing the revenue trends for the entire project duration are automatically updated to show the results.
CPO's net cash inflow	Revenue Profile	₹	
Electricity distribution utility's revenue	Revenue Profile	₹	
Land owner's revenue	Revenue Profile	₹	
Required changes in input variables to achieve the benchmark rate of return /hurdle rate (%)	Solver		*Solver* shows the required changes in the values of the different input variables that in combination will help achieve the benchmark project IRR or the hurdle rate (if the project IRR in the base case falls short of the target). While carrying out the iterations, *Solver* takes into account the individual contributions of the input variables to the project IRR. Certain boundary conditions have also been imposed on the *Solver* function to ensure that the results from the permutations and combinations of the input variables are realistic. With the click of a button, the Tool produces the required results. In addition, on this page, the user can conduct sensitivity analyses by varying the input parameters over any range.

ENDNOTES

1. The definition of a PCS depends on the guidelines issued by the Ministry of Power or any competent authority from time to time.
2. Charging use cases may include charging at public parking areas, charging at destinations (e.g., shopping malls), on -the-go charging, community charging at shared residential and workplace facilities, and so on.
3. It is responsible for setting up and running a PCS.
4. Some blogs describe business opportunities in charging infrastructure without carrying out the required calculations.
5. These include EVI-FAST: Electric Vehicle Infrastructure – Financial Analysis Scenario Tool (NREL, n.d.); EV Charging Financial Analysis Tool – Atlas Public Policy (Atlas Public Policy, 2019); and EV Charging Financial Analysis Tool – Alternative Fuel Toolkit (Deployment of Alternative Vehicle and Fuel Technologies Initiative, n.d.).
6. One-on-one interactions with stakeholders such as charge point operators, distribution utilities, and real estate agencies occurred in April 2021.
7. The Masterclass was part of the Electric Mobility Forum, a platform for stakeholder engagement that was organized from September 13 to September 17, 2021. One of the sessions was "Charging Infrastructure Development."
8. The project period is considered 10 years, in line with the procurement practices for setting up and operating PCSs in India. A detailed explanation is given in the "Cost Dissection" section of this document.
9. The operation of the draft tool was demonstrated to players such as CPOs, real estate companies, and public sector undertakings.
10. To convert kW to kVA, divide kW by the power factor. The default value of the power factor is given in Table A-1 in Appendix A.
11. Along with other state-levied charges and taxes.
12. Dispensed electricity is the energy fed to charge EVs and is different from the electricity consumption at a PCS. It primarily depends on the power ratings (kW) and the average daily active use of the charging units (hours) and the yearly escalation rate of the latter.
13. Design, Build, Finance, Operate, Maintain, and Transfer of land (DBFOMT) is the fundamental implementation model for a PCS.
14. The horizontal axis of the graph.
15. The vertical axis of the graph.
16. This special tax is to ensure that a commercial entity pays a minimum amount of tax even after enjoying the benefits of various deductions, exemptions, depreciation, and so on, on the income generated.

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ACKNOWLEDGMENTS

The authors would like to thank NITI Aayog, especially Sudhendu J. Sinha, Adviser (Infrastructure Connectivity – Transport and Electric Mobility) and Diewakarr Anupam Mittal, Young Professional (Electric Vehicles) for their support while this research was conducted.

The authors also thank Dr. Indradip Mitra, Team Leader – E-mobility at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (India), and Madhav Pai, Executive Director of WRI India Ross Center, for their encouragement.

The authors express gratitude to the following external reviewers (ordered by surname): Sanjana Chhabra (Manager – Policy, Advocacy and Government Relations, Statiq), Pushpendra Vishal Kaushal (former Business Operations Lead, Statiq), Sahana L (Energy Adviser, GIZ India), Chrishant Macwan (Senior Business Developer, System Level Solutions, and Senior Business Analyst, VerdeMobility), Anant Mehra (Product Head, Bolt), and N. Mohan (former Deputy General Manager, Head – EV Charging Infrastructure, Convergence Energy Services Limited).

The authors are also grateful to the following internal reviewers (ordered by surname): Garima Agrawal, Brittany Barrett, Logan Byers, Shahana Chattaraj, Sudeshna Chatterjee, Chaitanya Kanuri, Michelle Levinson, Sharvari Patki, Ashim Roy, and Ramesh S.

In addition, the authors also thank Emilia Suarez (Publications Coordinator, Research, Data and Innovation, WRI) for her support on the publication, Avinash Dubedi for his guidance on formulating certain macros for the Tool, and Nikita Gupta, Garima Jain, Santhosh Matthew Paul, Visual Best, and Rama Thoopal, who supported the copyediting, design, and production of the Tool and the technical note.

This publication is part of NDC Transport Initiative for Asia (NDC-TIA). NDC-TIA is ably supported by International Climate Initiative (IKI). IKI operates under the leadership of the Federal Ministry for Economic Affairs and Climate Action, in close cooperation with its founder, the Federal Ministry of Environment and the Federal Foreign Office. For more details, visit: www.ndctransportinitiativeforasia.org.

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ABOUT WRI INDIA

WRI India is a research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.