CSTEP'S SOLAR TECHNO-ECONOMIC MODEL FOR PHOTOVOLTAICS (CSTEM PV)

User Guide

Center for Study of Science, Technology & Policy (CSTEP)

May 14, 2020

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1. Introduction

The Center for Study of Science, Technology and Policy (CSTEP) built the CSTEP's Solar Techno-Economic Model for Photovoltaics (CSTEM PV). It is an open-access, Web-based tool which can serve as a useful model to perform prefeasibility analysis for utility-scale and mini-grid solar plants from a techno-economic standpoint. To establish ease of access and utility, the researchers at CSTEP built this model based on *publicly available/open data*. It is aimed to cater to policymakers, researchers, and industry-trackers for informed decision-making.

This tool is available at http://cstem.cstep.in/cstem/

It has two access options:

- Registered User – Access to all features of the tool for case simulation, including download of outputs in excel and image formats
- Guest User – Access to all features of the tool for case simulation; no provision for download of outputs in any format

Ease of access and use has been a cornerstone in the design-thought process. The user interface of the tool has been designed to be intuitive and informative to the best possible extent. This manual covers the following topics to provide additional guidance to the user via screenshots:

- Creation of user account and log-in
- Building a new case
- Means to download outputs

2. Homepage and User Access

The landing page of the tool presents an introductory video and provisions for registration / login. The menu options provide the following information:

- **About** - Brief details about CSTEP and the features of the CSTEM tool
- **Publications** – Support publications like the manual for the tool, technical reports detailing the mechanics of the tool and some additional relevant publications
- **Credits** – List of team members who contributed to the development of the tool
- **Feedback** – Section to provide feedback, post queries and comments
- **Contact Us** – Contact information of CSTEP
- **Disclaimer** – User code of conduct, terms and conditions for using the tool

Figure 1 to Figure 3 provide some guiding information about the landing / homepage

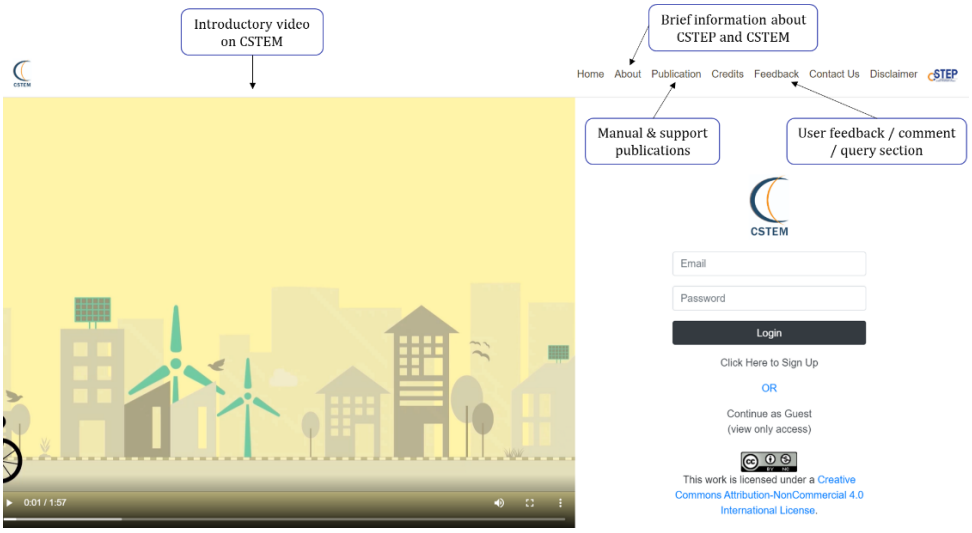

Figure 1: Home page: Pre-login

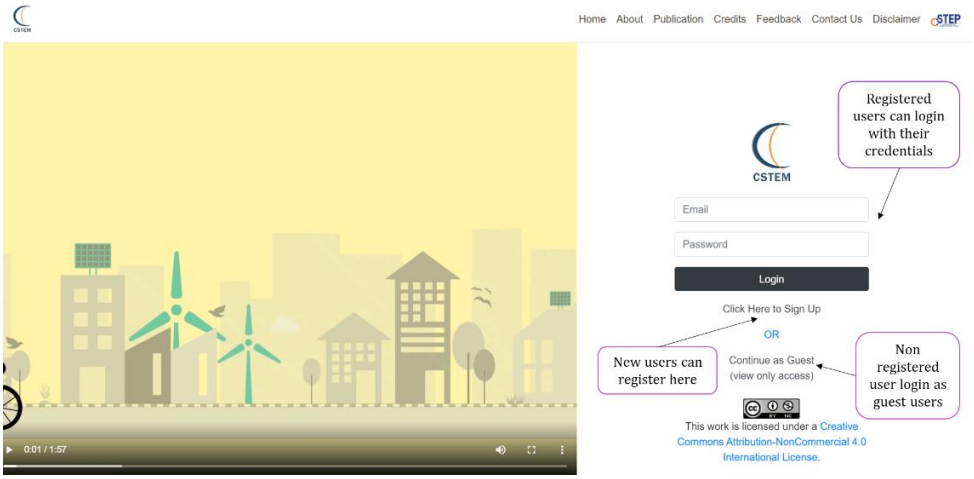

Figure 2: Access for existing users

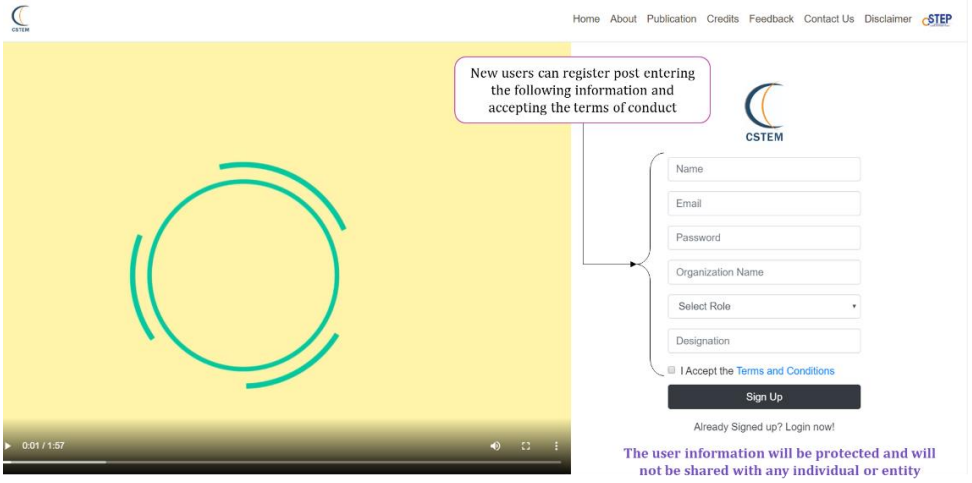

Figure 3: Registration for new users

3. Building a Case for Analysis

Figure 4 illustrates the post-login landing page. The users can choose to:

- Check a demo-case to understand the various kinds of outputs presented post-simulation for a preset case definition
- Simulate their own case of interest

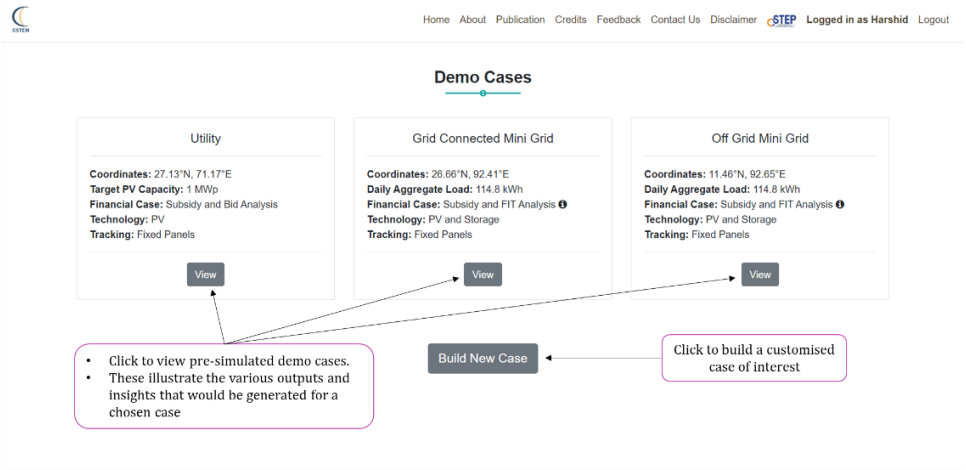

Figure 4: Post-login landing page

The inputs template differs for simulation of utility-scale and mini-grid systems. These are illustrated in sections 3.1 and 3.2. The output template however is similar for both utility and mini grid systems. The broad details and information pertaining to download of outputs is presented in section 4. Default benchmark numbers and valid ranges have been provided at every step to guide the user for building the case.

3.1 Inputs: Utility-Scale PV plant

Figure 5 to Figure 14 illustrate the details of the inputs sequence for simulating a utility-scale PV plant after clicking the 'Build New Case' button in Figure 4. The broad sequence of inputs for simulating the case is as follows:

- Case definition (Figure 5)
- Input-output mapping for a utility-scale PV plant (Figure 6)
- Choosing location of interest and additional details (Figure 7 and Figure 8)
- Plant-design details (Figure 9)
- Choice of technology (Figure 10)
- Loss and related details (Figure 11)
- Capital-cost-related components (Figure 12)
- Operation cost, bid and subsidy information (Figure 13)
- Financial parameters including loan, tax, etc. (Figure 14)

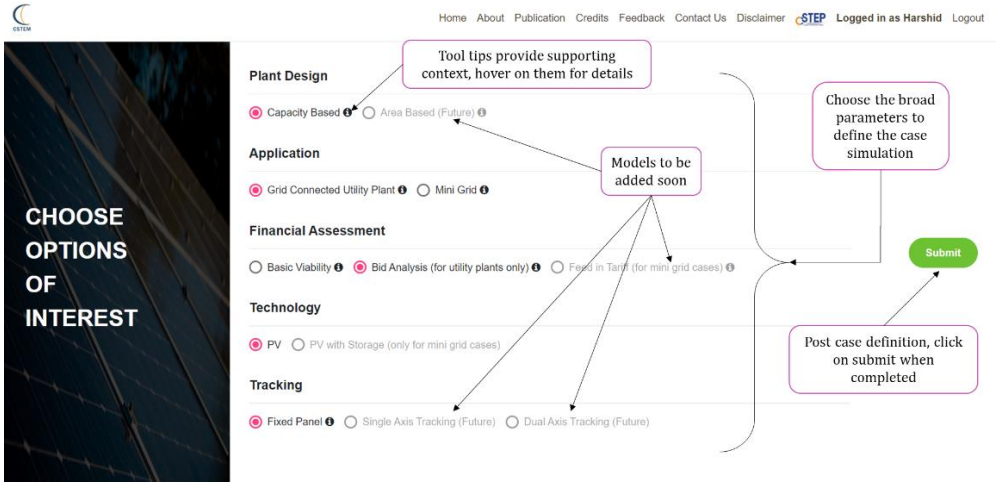

Figure 5: Case definition – utility plant

Figure 6: Input-Output map for simulating a utility scale PV plant

Figure 7: Choosing the location of interest

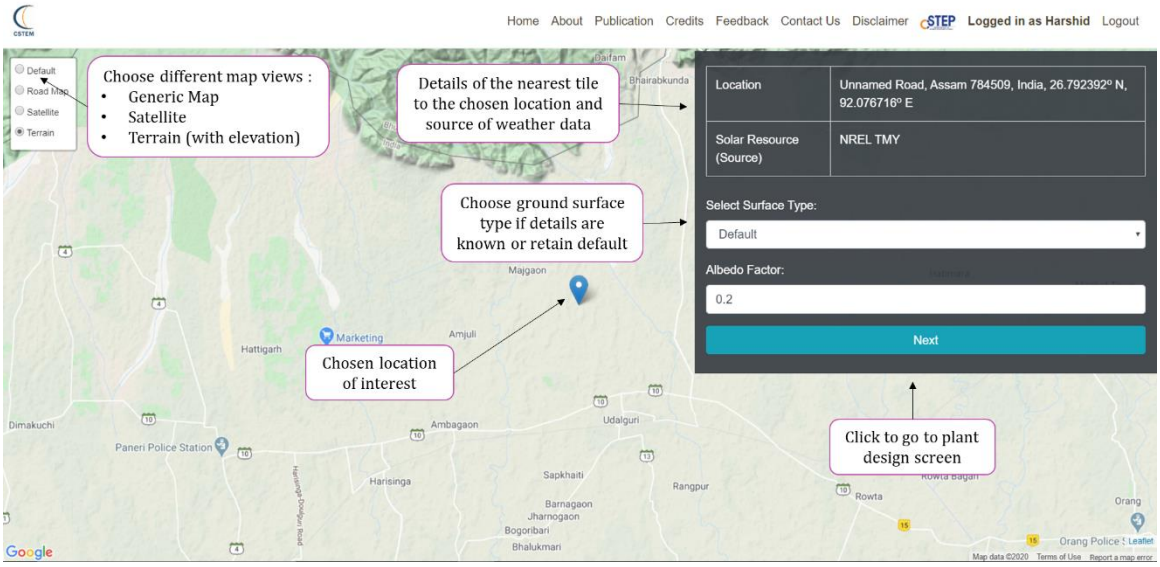

Figure 8: Choice of surface area

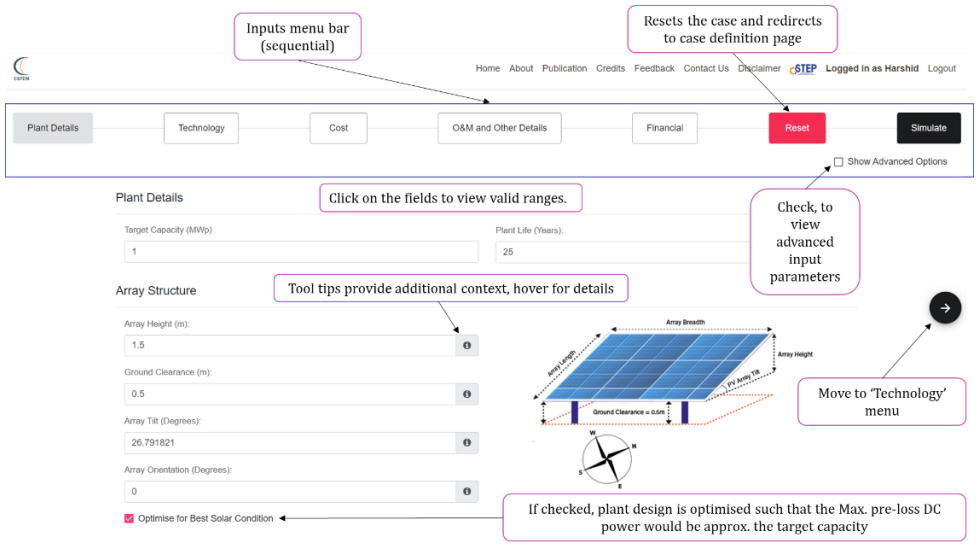

Figure 9: Utility PV plant design

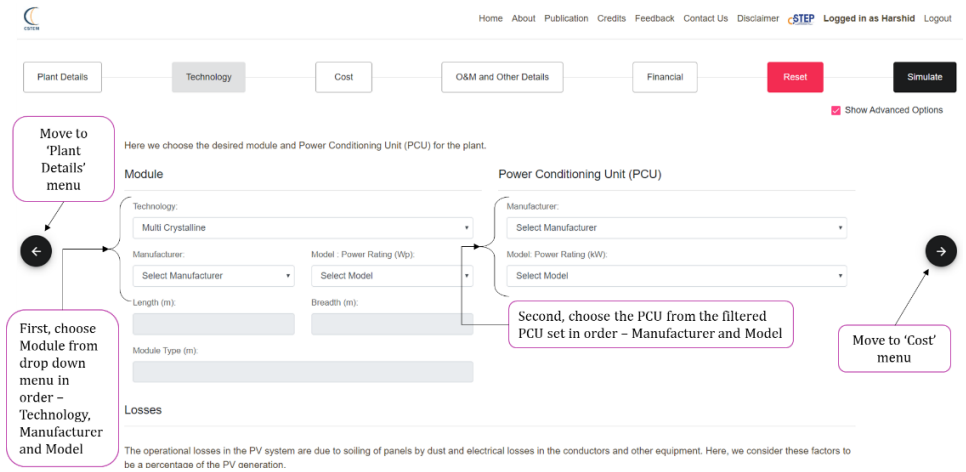

Figure 10: Choice of technology

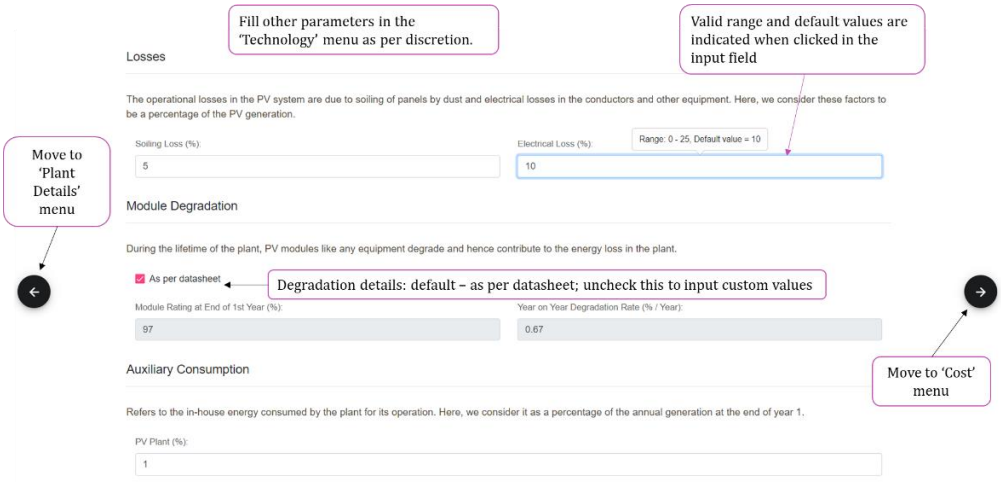

Figure 11: Loss and related details

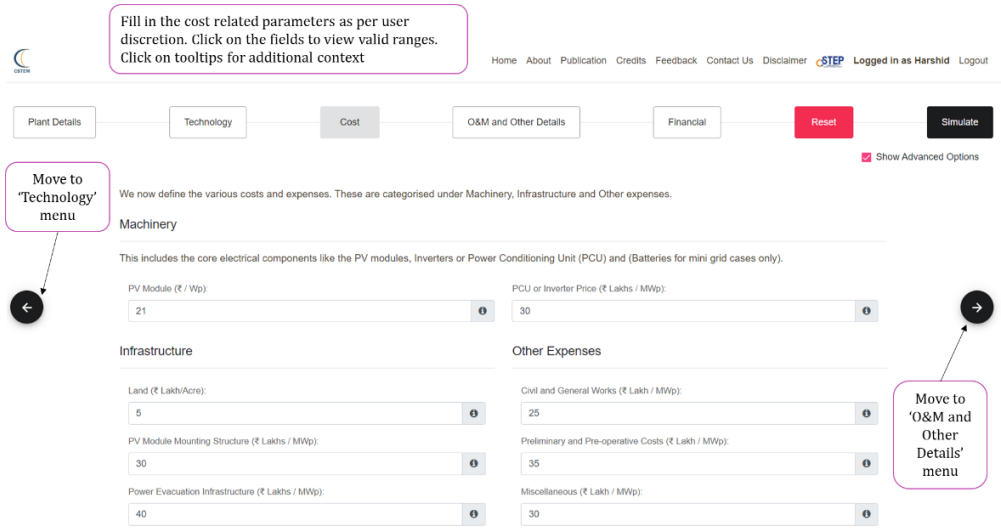

Figure 12: Capital cost–related components

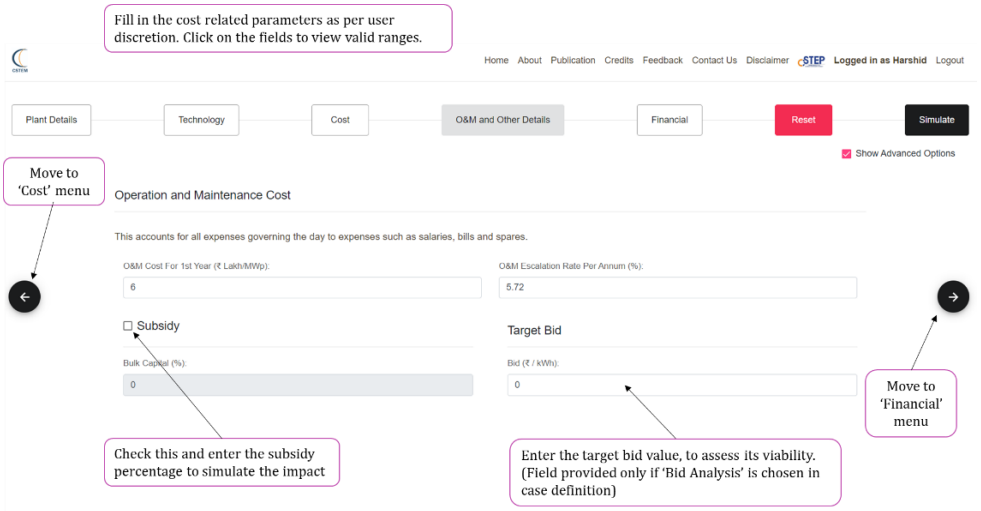

Figure 13: Operation cost, bid and subsidy components

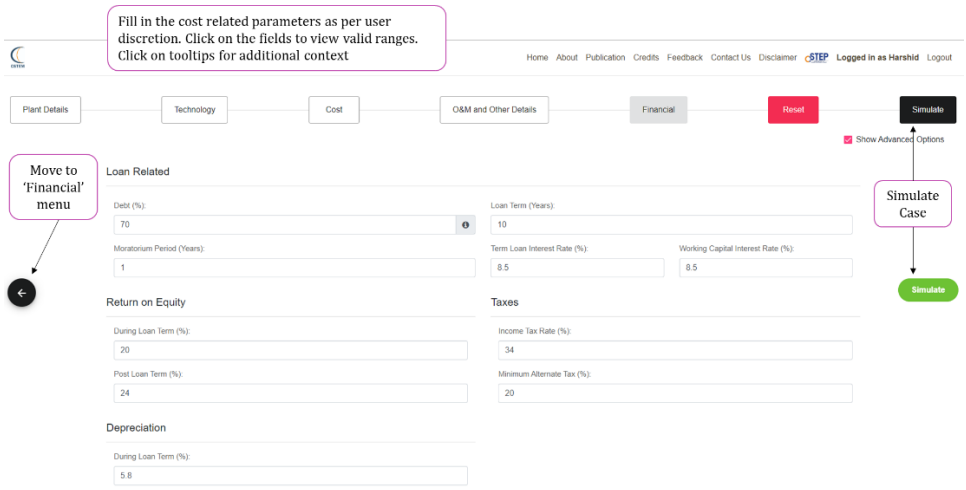

Figure 14: Financial parameters including loan, tax etc.

3.2 Inputs: Mini-Grid PV Plant

Figure 15 to Figure 26 illustrate the details of the inputs sequence for simulating a mini-grid plant post clicking 'Build New Case' button in Figure 4. The broad sequence of inputs for simulating the case is as follows:

- Case definition (Figure 15)
- Input-output mapping for simulating a mini-grid PV plant (Figure 16)
- Choosing location of interest and additional details (Figure 17 and Figure 18)
- Load, losses and plant-capacity details (Figure 19 and Figure 20)
- Choice of technology: PV module, PCU, battery & other details (Figure 21 and Figure 22)
- Plant-design details (Figure 23)
- Capital-cost-related components (Figure 24)
- Operation cost, subsidy, feed in tariff components (Figure 25)
- Financial parameters including loan, tax, etc. (Figure 26)

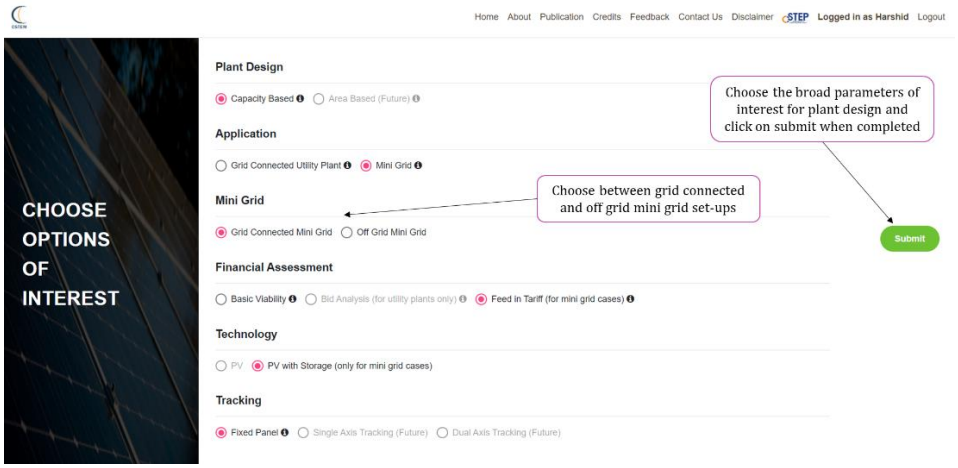

Figure 15: Case definition – mini grid

Figure 16: Input-Output map for simulating a mini-grid PV plant

Figure 17: Choosing the location of interest

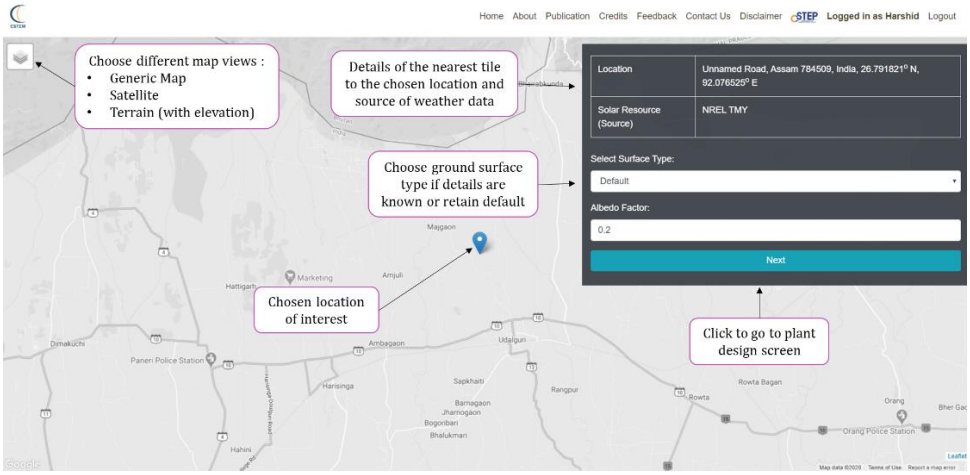

Figure 18: Choice of surface area

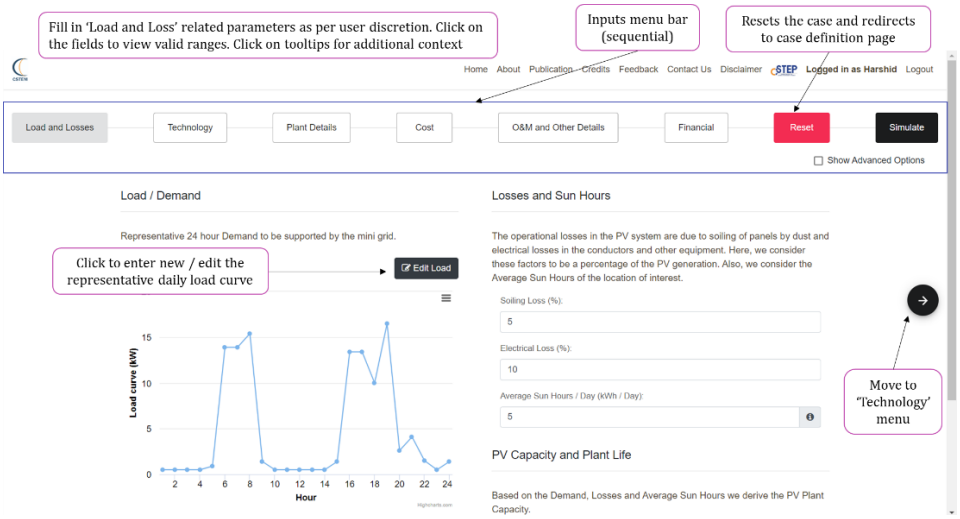

Figure 19: Load- and loss-related details

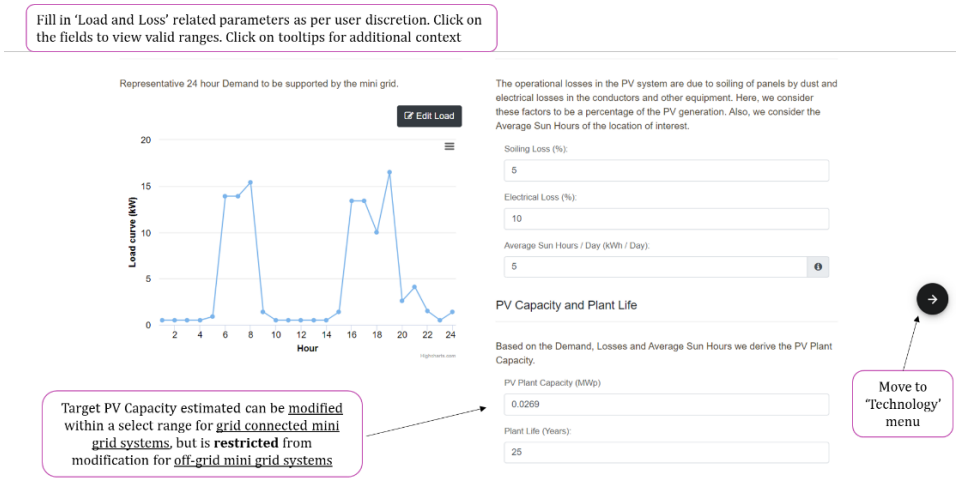

Figure 20: PV capacity and plant life details

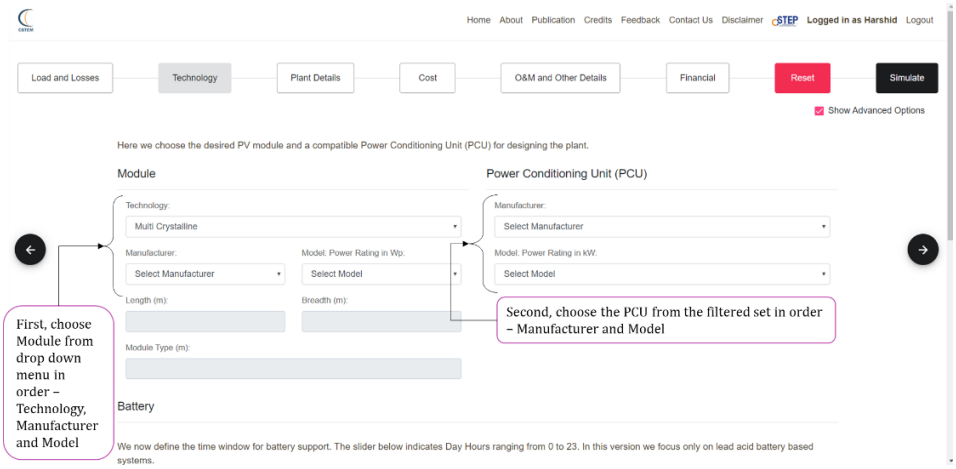

Figure 21: Choice of technology (PV module and PCU)

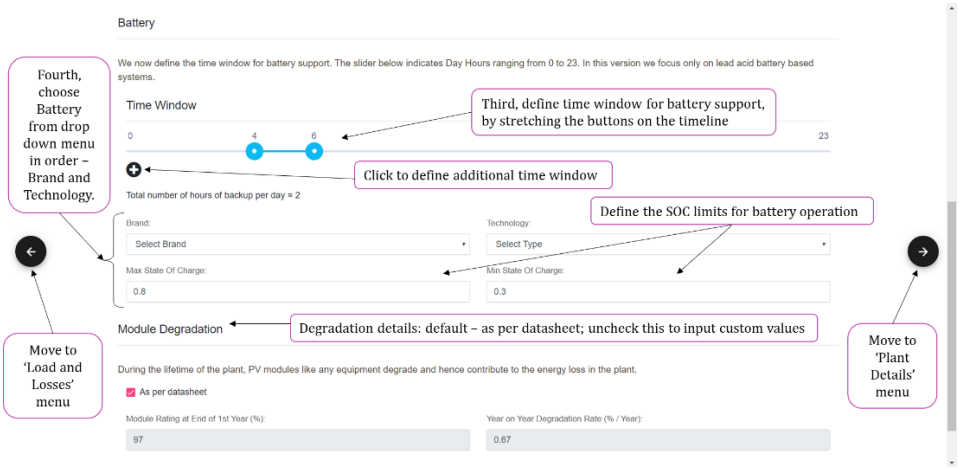

Figure 22: Choice of technology, battery, and other details

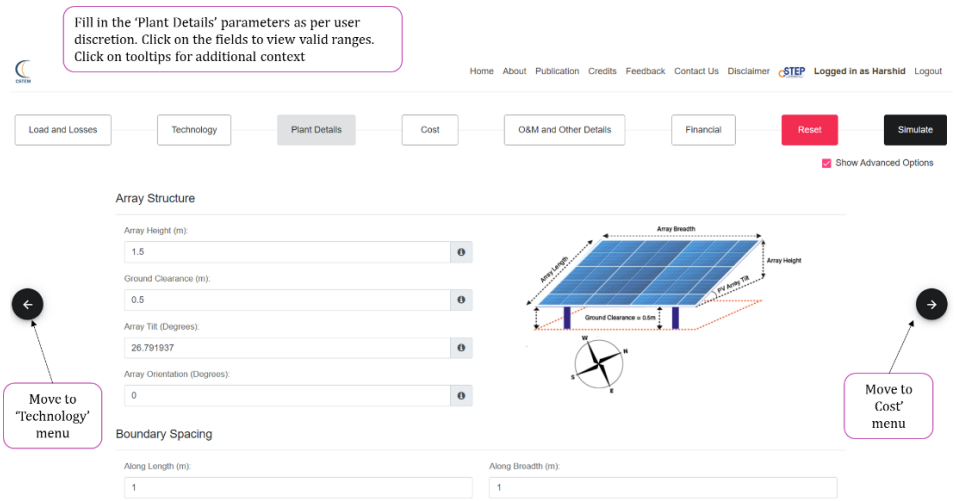

Figure 23: Plant design details

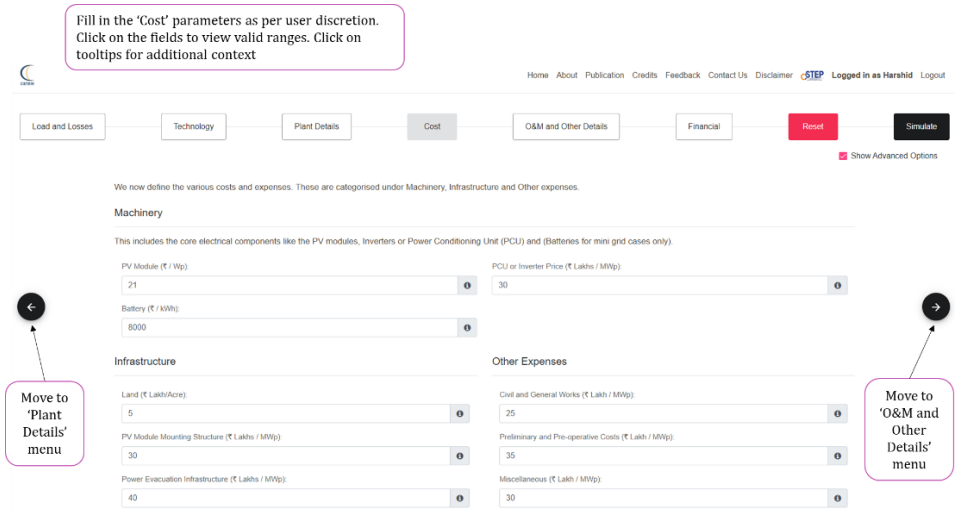

Figure 24: Capital cost components

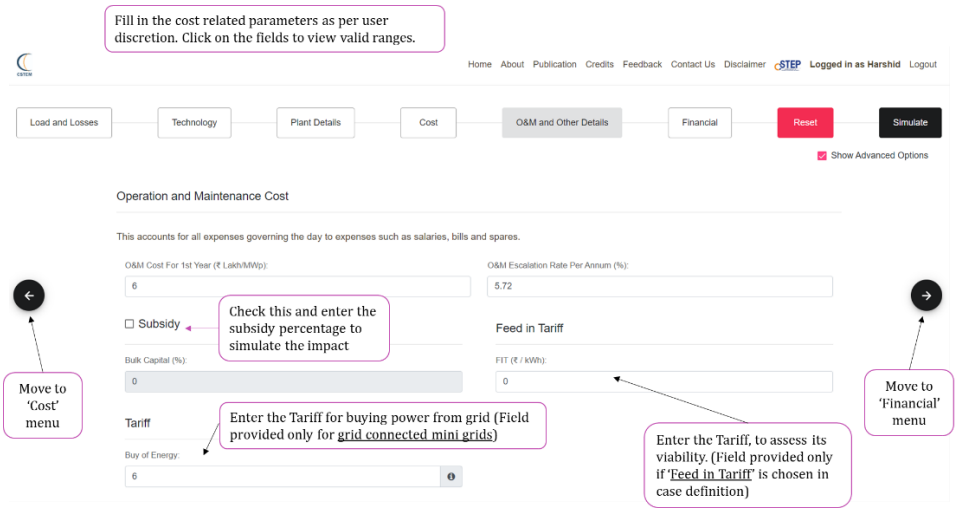

Figure 25: Operation cost, subsidy, and feed-in tariff components

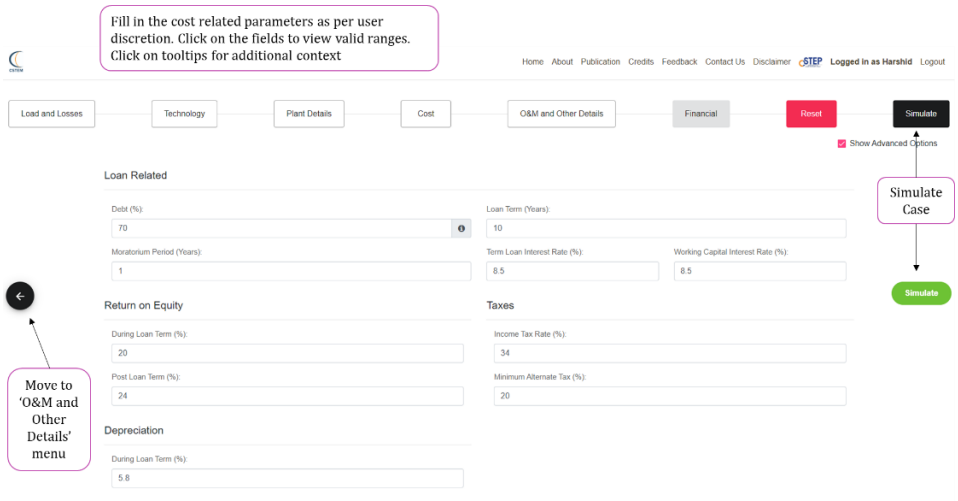

Figure 26: Financial parameters including loan, tax, etc.

4. Output-Screen Layout and Download

The post-simulation output screens have a generic layout for both utility-scale and mini-grid systems. There is no specific order to view the outputs. Provisions for performing a new simulation, as well as sub-menu tabs to navigate within the current tab, have been provided (mid-right end of the screen), as illustrated in Figure 27. Figure 28 presents a summary of the broad information covered under each tab.

We encourage the users to check the demo cases to understand the various outputs available for different case definitions, prior to building custom cases of interest.

Support text and tool tips (indicated in Figure 29) have been provided to add context to the outputs.

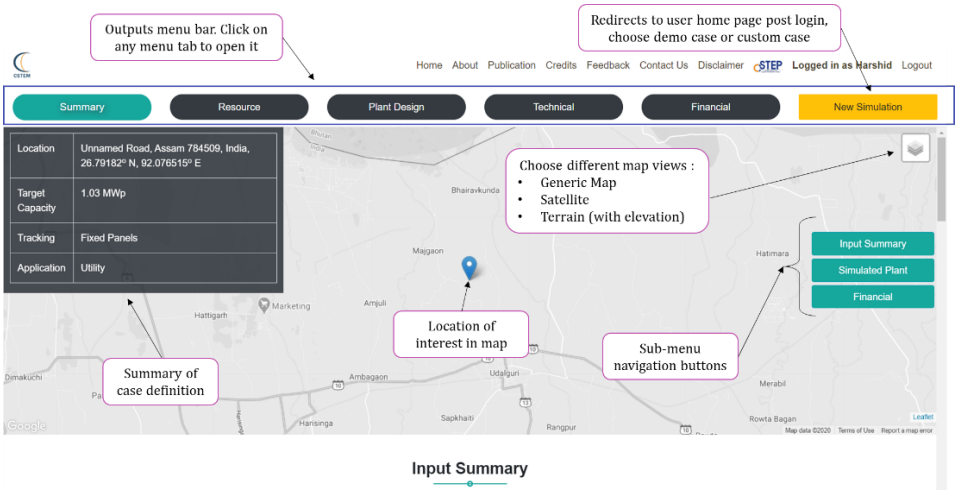

Figure 27: Layout of the output screens

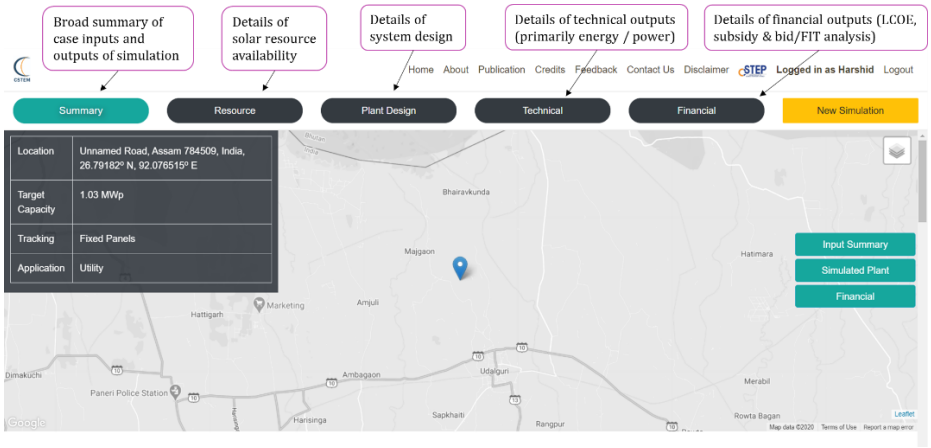

Figure 28: Summary of details covered in each screen

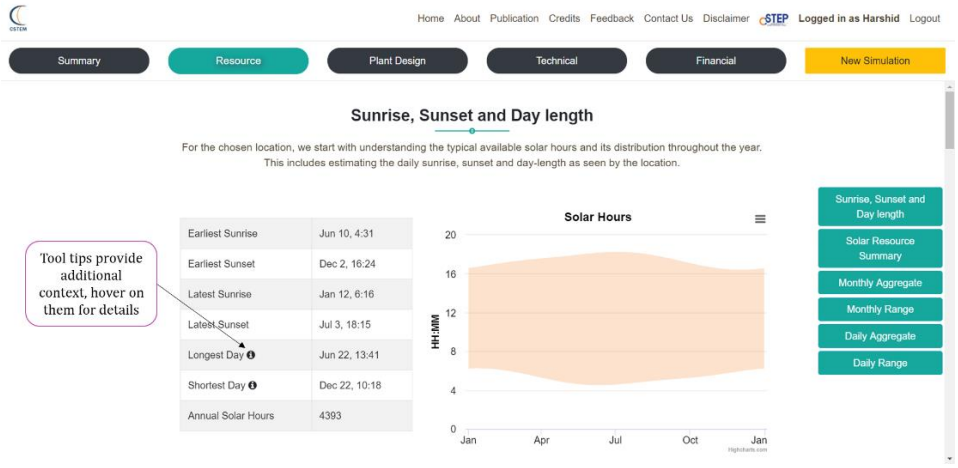

Figure 29: Tooltips for additional context

Registered users can download the various outputs by clicking on the menu icon on the top ends of the graphs of interest. These are encircled and indicated in Figure 30, Figure 31, and Figure 32.

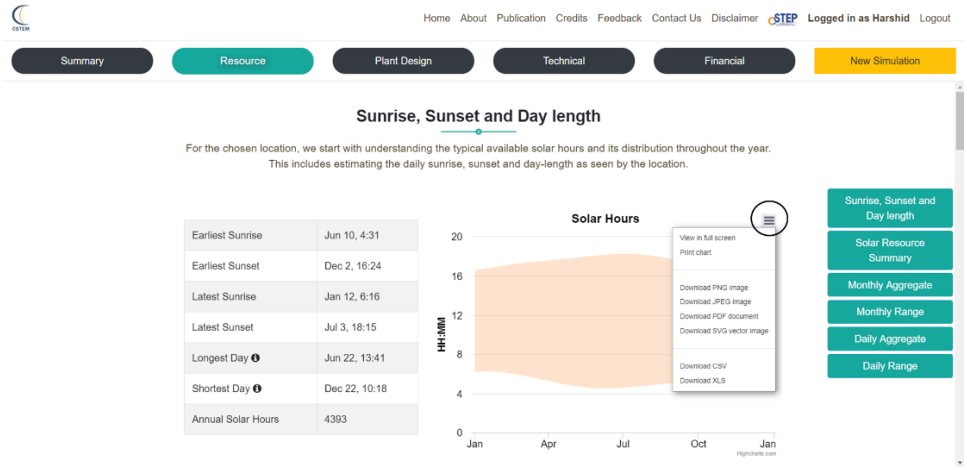

Figure 30: Output download menu icon type 1

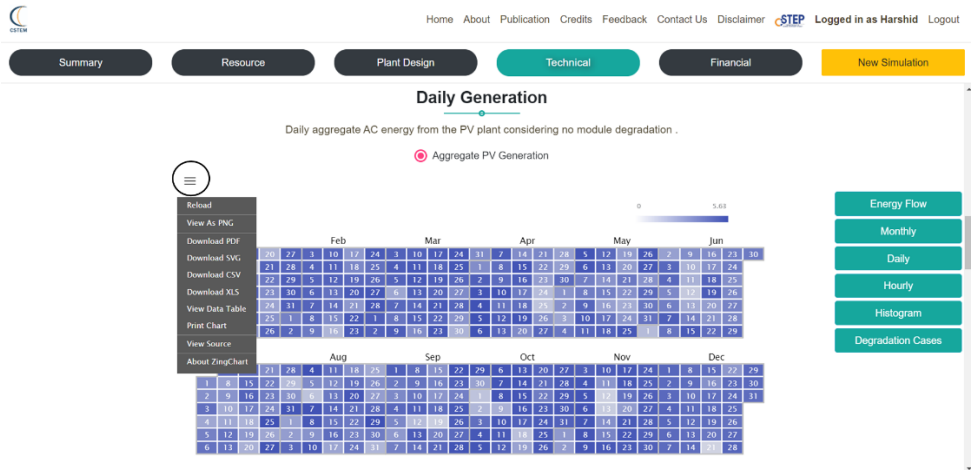

Figure 31: Output download menu icon type 2

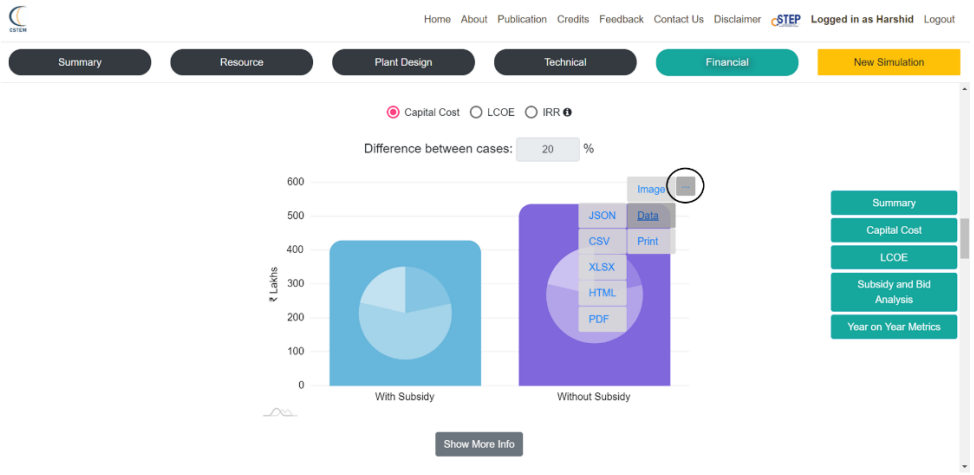

Figure 32: Output download menu icon type 3

Interested users can check the reports in the '[Publication]' section for accessing material which detail the mechanics of the tool.

5. Acknowledgements

We gratefully acknowledge the generous support provided by various institutions for the development of CSTEM PV. The development of the base version of CSTEM PV was supported by:

- Government of India Institutions: Ministry of New and Renewable Energy, and Department of Science and Technology
- Core Grants: Oak Foundation, and Think Tank Initiative of International Development Research Centre (IDRC)

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We thank the National Renewable Energy Laboratory, USA, for providing the weather data related to solar-energy modeling.

We also wish to thank our friends in the industry and academia for providing their valuable feedback. It would enable us to think ahead to cater to their respective needs.

About CSTEP

The Center for Study of Science, Technology and Policy (CSTEP) is one of India's leading think tanks. Our work is in the areas of climate, environment & sustainability, energy & power, AI for social impact, materials & strategic studies and computational tools for policymaking. Our research leverages innovative technology-based ideas to solve developmental challenges. We provide policy advice to Central and State Governments and are a part of various Government Committees. We collaborate with national and international research institutions to build a coherent narrative on policy challenges and solutions for India's sustainable development. CSTEP currently has over 140 employees working out of three offices in India. Our vision is to be the foremost institution for policy analysis in India.

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