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TECHNICAL NOTE

Cost-benefit analysis tool for deploying solar irrigation pumps: The case for Rajasthan

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

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ABSTRACT

The implementation of solar irrigation pumps (SIPs) has the potential to contribute significantly to reducing the energy and emissions impacts of irrigation in Rajasthan by replacing conventional power sources with solar energy for existing grid-connected pumps. This transition would benefit distribution companies (DISCOMs) and farmers by meeting their irrigation demand while reducing reliance on utility-procured power. When a pump is not in use, grid-connected solar pumps can feed electricity generated by the solar panel back to the grid. This can create an extra source of income for farmers. To strengthen the financial sustainability of the agriculture sector, the associated economic aspects of grid-connected SIPs must be explored under component C of the Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM KUSUM) scheme. This technical note seeks to develop a Microsoft Excel–based cost benefit analysis tool to assess the economic viability of SIPs by calculating the monetary benefits to stakeholders such as distribution companies, the Rajasthan state government, and farmers by creating an additional income source. Outputs of the tool include net present value, benefit-to-cost ratio, internal rate of return, and payback period to help stakeholders to understand the benefits of deploying SIPs. This technical note also highlights the reduced carbon footprint resulting from the avoided power procurement costs by DISCOMs.

MOTIVATION

Rajasthan has a predominantly agrarian economy. The state has witnessed rapid agricultural growth in recent years. The agriculture sector contributes approximately 30 percent of the state's gross domestic product (Directorate of Economics and Statistics 2021). Cropping intensity has risen from 115 percent in 2005 to 143 percent in 2020, which nearly matches the national figure of 145 percent in 2020 (Directorate of Economics and Statistics 2021). Electricity supply for irrigation is an essential component in agriculture production. The agriculture sector consumed around 42 percent of total electricity sales by distribution utilities in Rajasthan during fiscal year 2022. This is expected to reach 45 percent by 2030, assuming an 8 percent compounded annual growth rate projected in the 20th National Electric Power Survey by the Central Electricity Authority (RERC 2021a). The Rajasthan government is supplying electricity to the farmers for 7–8 hours a day. The exact time of the day corresponding to the blocks varies. Promoting renewable energy in the agriculture sector could improve energy security for Rajasthan's farmers.

The solar pump scheme for irrigation began in Rajasthan in 2010 with the combination of the Jawaharlal Nehru National Solar Mission, Rashtriya Krishi Vikas Yojana (RKVY) and Water Harvesting Structure scheme under the National Horticulture Mission. Under the scheme, farmers are provided with subsidies from RKVY and the Ministry of New and Renewable Energy (MNRE). In the inception year, a subsidy of 86 percent was provided (30 percent from the MNRE and 56 percent from RKVY). The subsidy was reduced from 86 percent to 70 percent, then 60 percent over the years. With the aim of improving irrigation access, increasing farmers' incomes, and reducing carbon dioxide (CO_2) emissions, in 2019 the Government of India launched the ambitious Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM KUSUM) scheme to provide solar power to irrigation pump sets through both individual and feeder-level solarisation, with a 60 percent subsidy (30 percent from the MNRE and 30 percent from the state government). In doing so, it has taken up the major challenge of reducing the subsidy burden on distribution companies (DISCOMs) brought about by the provision of free or subsidised electricity to agricultural consumers (among others). DISCOMs experience more aggregate technical and commercial (AT&C) losses in Rajasthan than in most other Indian states, as shown in Table 1 (Power Finance Corporation 2022). These occur due to technical inefficiencies, although theft also can result in substantial losses for DISCOMs.

Rajasthan offers a heavily subsidised electricity tariff for the agricultural consumers, INR 16,000 Cr. annually (Tripathy 2022) (if the tariff is not paid on time, this can put further financial strain on DISCOMs), as well as unviable tariffs (DISCOMs sometimes charge lower prices than it costs them to supply electricity, resulting in financial losses). The accrued debt of the three utility companies in Rajasthan had reached 79,000 Cr. by the end of March 2023 (Tripathy 2023). The Ujwal DISCOM Assurance Yojana (UDAY) consumes 75 percent of Rajasthan's energy budget (Tripathy 2023). In this context, the PM KUSUM scheme has huge potential to benefit Rajasthan. KUSUM supports DISCOMs to reduce the cost of power purchase and minimise transmission and distribution losses. In addition to reducing the average cost of supply and direct costs for DISCOMs, KUSUM may also help decrease revenue gaps. Thus, the motivation to develop such a cost-benefit analysis (CBA) tool for deploying solar irrigation pumps (SIPs) under component C is to lessen the subsidy burden of the state government, which took a 75 percent loan (62,000 Cr.) in 2016 from UDAY to save

Table 1 | **AT&C losses (%) in 2020-21, by state**

STATE	AT&C LOSSES (%)
Kerala	7.76
Gujarat	11.35
Goa	12.94
Telangana	13.33
Tamil Nadu	13.81
Himachal Pradesh	14.02
Karnataka	15.36
Uttarakhand	15.39
Haryana	17.05
Punjab	18.03
Assam	18.73
West Bengal	19.54
Manipur	20.33
Chhattisgarh	20.40
Maharashtra	25.54
Rajasthan	26.23

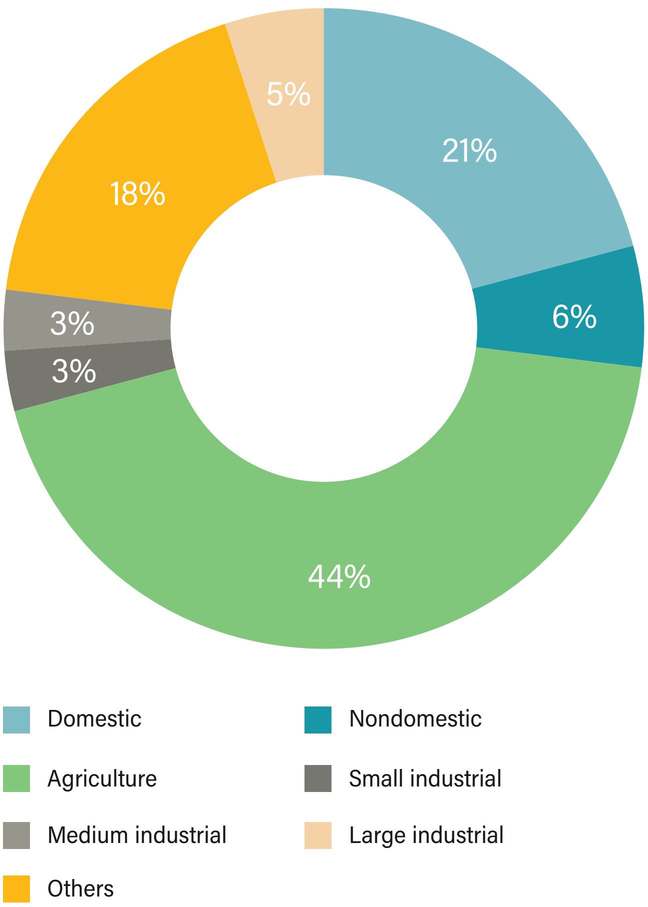
Note: AT&C = aggregate technical and commercial.

Source: Power Finance Corporation, Report on Performance of Power Utilities, 2020–21, 2022, https://www.pfcindia.com/DocumentRepository/ckfinder/files/Operations/Performance_Reports_of_State_Power_Utilities/Report%20on%20Performance%20of%20Power%20Utilities%202020-21%20(1).pdf.

distribution utilities from collapsing (Tripathy 2023). Even after massive assistance from UDAY, distribution companies again had 79,000 Cr. in debt in March 2023. Offering free or heavily subsidised electricity to the agriculture sector may again lead to financial strain for the distribution utilities. Power consumption for agriculture irrigation is growing consistently, with a compound annual growth rate (CAGR) of 8 percent, so solarisation of individual pump sets reduces the dependence of irrigation on electricity supply through the utility. This approach can result in financial gains for DISCOMs and the state government, create a fresh revenue stream for farmers, help the state achieve its renewable purchase obligation (RPO) goals, and facilitate the integration of renewable energy for irrigation while also helping to reduce greenhouse gas emissions.

Rajasthan is rich in renewable energy (RE), with the share of renewable capacity (including solar, wind, biomass, and small hydro) reaching 60 percent as of November 2022 (CEA 2022). Rajasthan has an enormous solar potential of 142 gigawatts (GW) (Energy Department 2019), 127 GW in wind and a share of about 20 percent of India's existing RE capacity (MNRE 2022). Rajasthan receives the highest solar irradiation in the country (5.72 kilowatt-hours [kWh] per square meter per day) and has the highest number of clear sunny days (>325) in a year. Going by the potential and past trends, Rajasthan could contribute up to 90 GW RE capacity by 2030 toward the overall national target of 500 GW by nonfossil fuels (Lee 2023). In Rajasthan, 28 percent of the net cultivable area is irrigated, making it mostly an agrarian state (Directorate of Economics and Statistics 2021). Yet irrigation in the agriculture sector already consumes about 44 percent of the state's total power consumption (~26,367 million units in 2021) (RERC 2021b), as depicted in Figure 1.

Figure 1 | **Energy consumption across sectors in Rajasthan in 2020-21**



Source: Rajasthan Electricity Regulatory Commission, Tariff Order 2022 (data set), https://rerc.rajasthan.gov.in/rerc-user-files/tariff-orders.

Electricity demand in the agriculture sector has grown year on year (YoY) in the state, with a CAGR of 8.99 percent (RERC 2022), as shown in Figure 2.

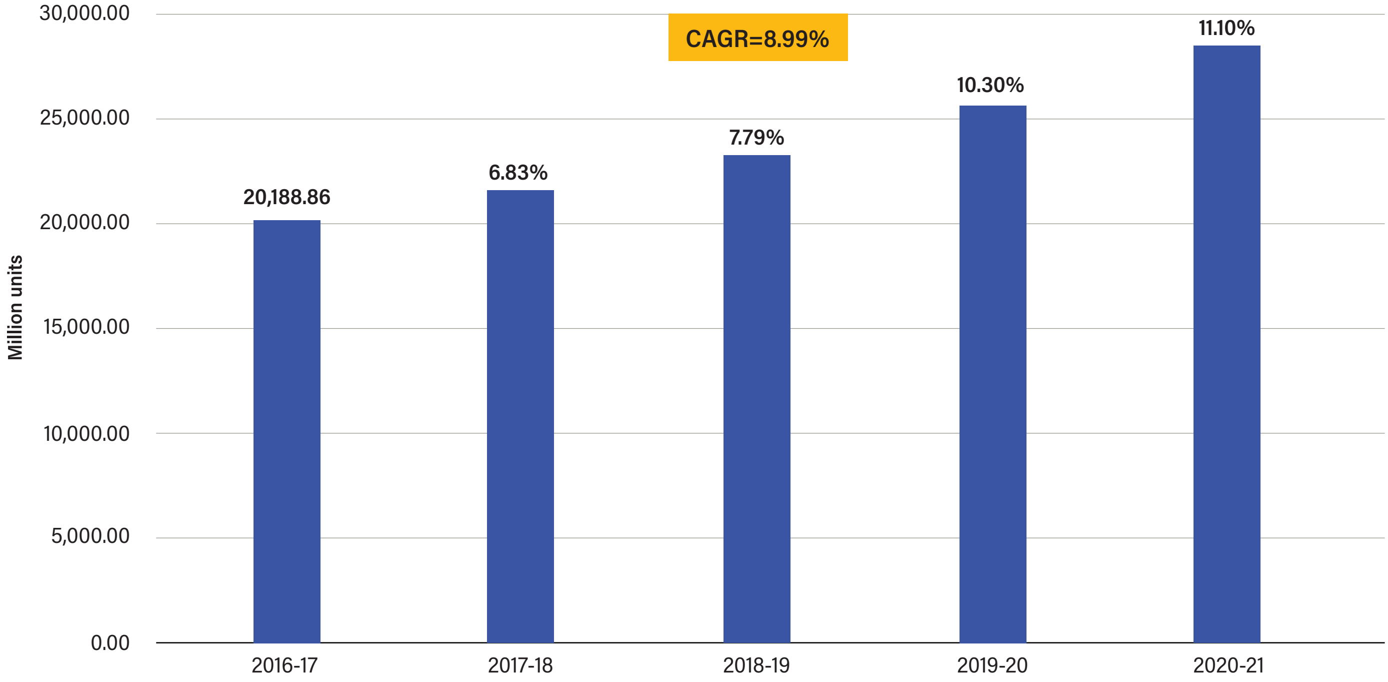
Rajasthan is therefore a good case to explore the potential for the PM KUSUM scheme to lessen financial burdens while also meeting the growing demand for power for irrigation. The PM KUSUM scheme has three components (MNRE 2021), as shown in Figure 3.

Rajasthan is the leading state to meet the target under the PM KUSUM scheme's components A and B, but under component C, growth of the scheme is not significant. Under component C, farmers are hesitant to invest in solar irrigation pumps, as the farmers are receiving heavily subsidised electricity. Private developers also have difficulty obtaining the funding they need, as banks are hesitant to take on the risk. This is why growth of the scheme under component C is not up to the levels of components A and B in the state. Nearly 60,000 stand-alone solar pumps were installed throughout Rajasthan as part of component B. However, only 1026 pumps were reported solarised under the individual grid-connected pump solarisation variant of component C (MNRE 2021), as shown in Figure 4.

Central financial assistance of 30 percent of the benchmark cost for component C, as well as a 30 percent state government subsidy of the same, was to be provided. But farmers are not showing much interest in the upfront contribution in this component. Our discussions with distribution utilities officials in the state found that the scheme has some limitations.

For example, despite 60 percent subsidies being available for adopting SIPs, the DISCOMs unanimously worried that it would be difficult to convince farmers to invest any upfront contribution in this scheme, since farmers are already receiving free or heavily subsidised electricity. In addition, the government subsidies under PM KUSUM are limited to pumps of up to 7.5 horsepower (hp), while in Rajasthan pumps mostly run more than 7.5 hp capacity, as high-capacity pumps are

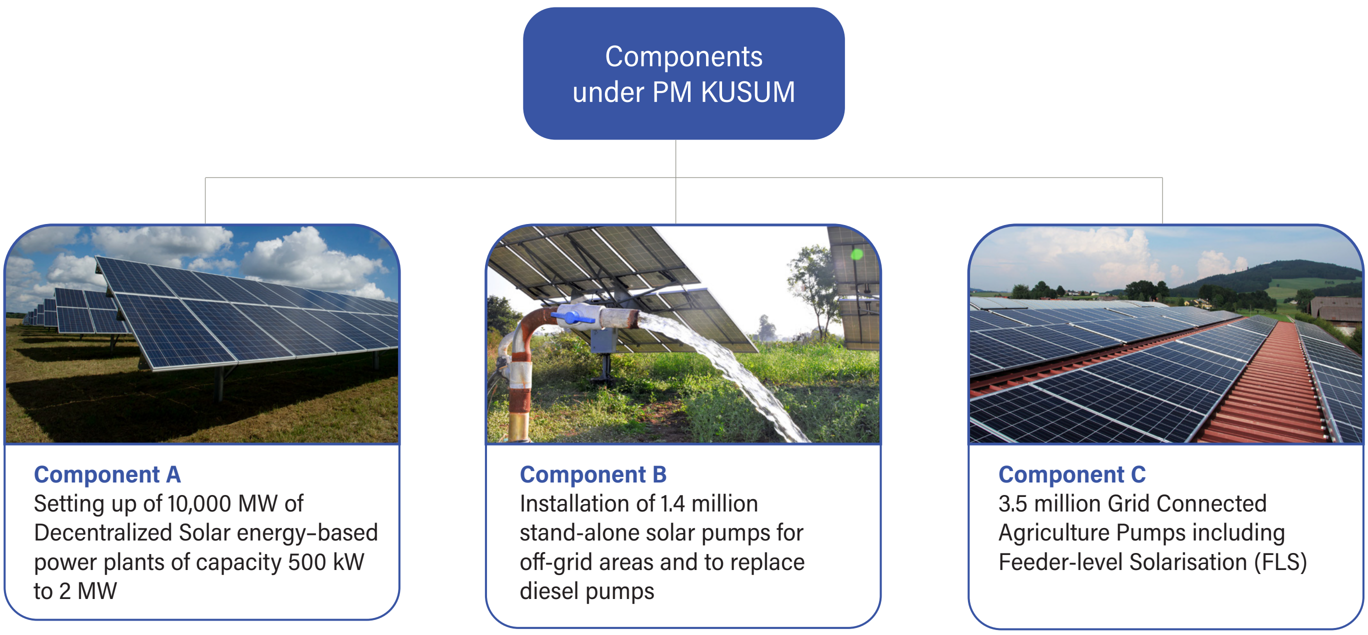
Figure 2 | **YoY growth in demand for power in the agriculture sector**



Notes: CAGR = compound annual growth rate.

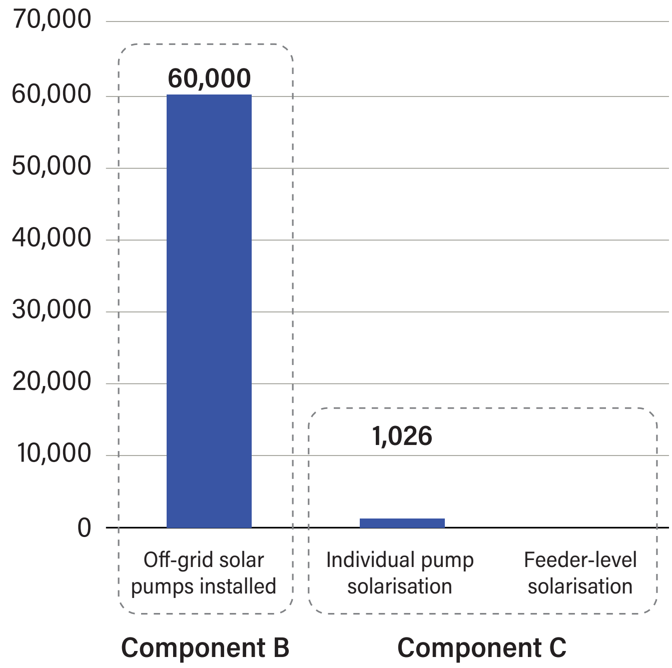
Source: Rajasthan Electricity Regulatory Commission, Tariff Order 2022 (data set), https://rerc.rajasthan.gov.in/rerc-user-files/tariff-orders.

Figure 3 | **Description of PM KUSUM scheme components**



Source: WRI authors

Figure 4 | **Installation of SIPs in Rajasthan under components B and C in 2020–21**



Source: Ministry of New and Renewable Energy, PM KUSUM portal, Government of India, https://pmkusum.mnre.gov.in/landing.html.

needed to reach the state's groundwater table. The consensus is that states that provide free or heavily subsidised agricultural electricity will not be able to implement PM KUSUM. Farmers' upfront contribution is a significant constraint on DISCOMs' ability to implement component C. To overcome these limitations, either Rajasthan state will have to compensate farmers for their upfront contribution with a fully subsidised model or DISCOMs will have to contribute more, with a 10 percent upfront contribution from farmers for solarisation of grid-connected pumps, as in the Andhra Pradesh model,[1] and reduce the feed-in tariff (FiT) from 3.44 INR/kWh to 1.5 INR/kWh. In order to increase uptake of this variant and ensure financial viability of the scheme, we developed a CBA tool and applied it to conduct a CBA of SIPs under individual pump-level solarisation of PM KUSUM's component C for stakeholders such as farmers, DISCOMs, and state government, and offering benefits to ensure financial viability. Solar PV capacity up to two times of pump-rated capacity is allowed under component C. Farmers will be able to use the generated energy from solar PV to meet irrigation needs, and the surplus available energy will be fed back to the grid at the feed-in tariff provided by the state regulatory commission. This will help create a source of extra income for farmers, and help the state to meet its RPO targets. This tool has the provision to accommodate varying levels of subsidy shares provided by the center and the state. In this technical note we haven't considered groundwater exploitation aspects, including analysis of the impact on rainfall patterns, groundwater availability, and utilisation. But the CBA tool is dynamic, and the water element could be incorporated into it in the next part of the study.

The CBA tool

The dynamic nature of the CBA tool allows state users to modify investment scenarios based on their state-specific operating parameters to benefit each stakeholder. The CBA tool also seeks to model the subsidy reduction for the state government as more solar pumps are operationalised. This tool would contribute systemwide changes, and resulting decisions could help reduce burdens for DISCOMs during peak load times, as in Rajasthan during fiscal year 2022, when agriculture consumed around 42 percent of total electricity sales by DISCOMs. This share is expected to reach 45 percent by 2030 (RERC 2021b). In addition, the tool will support the reduction of carbon emissions due to avoided power procurement by DISCOMs from conventional generation sources.

METHODS

In this study four methods of economic viability were used to determine the costs and benefits of SIPs for different stakeholders, such as DISCOMs, the state government and farmers. Economic viability includes net present value (NPV), internal rate of return (IRR), benefit-to-cost (B:C) ratio, and payback period. To develop the CBA tool, the research uses a mixed-method approach. It relies on published material from a range of regulatory and administrative sources to identify power consumption trends for the agriculture sector as well as assumptions for a higher discount rate and lower discount rate to calculate the tool's IRR. In addition, this section describes the framework of the CBA tool; types of data sets, such as operating, regulatory, cost, and environmental parameters; and formulas such as NPV, B:C ratio, and IRR that have been used to develop the tool. This tool helps assess the expenses and benefits faced by the state's key agriculture sector stakeholders, including

- benefits (accruing to farmers) estimation for supplying excess energy generated by the SIP at a feed-in tariff;
- derivation of the gross power procurement and associated costs avoided by the DISCOMs due to surplus energy generated by the SIP; and
- estimation of potential gains for the state government in the event of elimination of tariff subsidies through adoption of SIPs.

Uptake of this Excel-based tool to evaluate the costs and benefits of SIPs for stakeholders should eventually help the state increase the share of SIPs in Rajasthan.

Data description

The CBA tool aggregates data related to investment, regulatory, operating, and environmental parameters. The data sets used to develop the CBA tool are depicted in Figure 5.

Data scope

The initial step in the tool development process was to identify the processes that fulfill the requirements of the CBA tool. The primary and secondary data sets that need to be collected and included in the tool were rating of pump sets, operating days and pumps' operating hours per year, capacity of solar panel per pump sets, cost of an 11-kW solar photovoltaic (PV) system, maintenance cost, capacity utilisation factor (CUF), and various key regulatory parameters.

Collecting these data was a three-step process.

- **First step: Collect primary data.**
  The energy required by the agriculture sector, the average power purchase cost and FiT were taken from the state electricity tariff order. Investment-side parameters like the cost of a proposed 11-kW solar panel system, maintenance cost, and the CUF were gathered from publicly available literature, reports, and websites. These primary data enabled estimation of the total investment required for solar panels and how the stakeholders will perceive such factors before implementation on the ground.
- **Second step: Incorporate interaction with key stakeholders to get a holistic picture of Rajasthan's agriculture sector.**
  Collect secondary data like the operating hours of pumping systems and the degradation factor of energy generated from solar PV complemented by interviews with external stakeholders to understand inputs and assumptions.
- **Third step: Develop an Excel-based tool.**
  - Gather data from the above steps to develop the Excel tool for performing CBA analysis.
  - Reduce carbon emissions by avoiding DISCOMs' power procurement from conventional generators.

Tool development process

In developing the CBA tool, we have segregated parameters into those based on input and those based on output.

The input-side parameters are variable and user-friendly in that they mainly comprise cost, regulatory, and operational parameters. The following input components have been taken into account:

- **Investment:** To understand the investment scenario from the DISCOMs' viewpoint, we first evaluated the total costs of procuring 11-kW solar panels (solar PV capacity up to two times the pump-rated capacity is allowed under component C) after obtaining central- and state-level subsidies.
- **Tariff:** We conducted an analysis to determine the effective tariff for agricultural consumers, taking into account an additional flat rate subsidy of INR 12,000 per connection per year, which is provided by the state government.
- **Solar power generation:** We determined YoY energy generation from the solar panels at 20 percent CUF to analyse the power procurement avoided by DISCOMs to meet the agriculture load.
- **Average power purchase cost (APPC):** We conducted an assessment to quantify the cost savings realised by DISCOMs through the avoidance of gross power procurement expenses from thermal-based power plants, attributable to the utilisation of solar PV generation for irrigation.
- **Avoided transmission and distribution losses:** We analysed the reduction in power procurement from fossil fuel–based power plants, which in turn reduces transmission and distribution losses.

An economic criteria analysis (ECA) showed that these inputs lead to surplus energy generation and monetary benefits across stakeholders. ECA includes net present value, internal rate of return, and benefit-to-cost ratio. Moreover, this framework also considered input-side environment parameters leading to reduced carbon emissions.

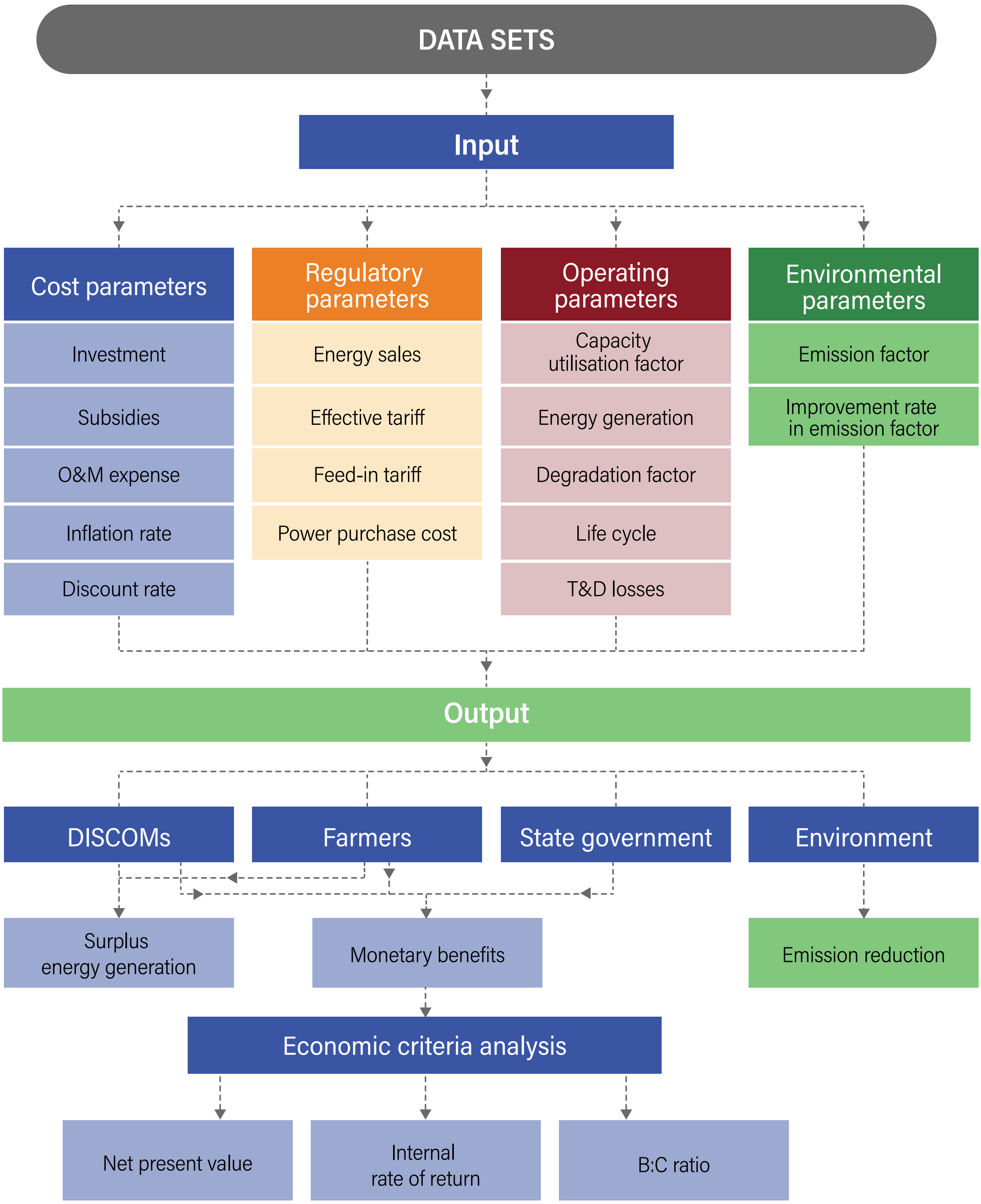
Based on the findings of the scoping exercise, the following economic criteria were identified: NPV, IRR, and B:C ratio based on the monetary savings. This ECA is crucial to calculate return on investment by DISCOMs and farmers.

This tool can be used to assess benefits across different investment scenarios.

Net present value

Net present value is the difference between the present value of all future returns and the present money needed to make the investment. Discounting can be used to calculate the future returns' present value. Discounting is essentially a method for converting future benefits and cost streams to their current value.

Figure 5 | **Framework for cost benefit analysis for solar irrigation pumps**



Notes: B:C = benefit-to-cost; O&M = operations and maintenance; T&D = transmission and distribution.

Source: WRI authors.

The mathematical representation for NPV can be written as

$$NPV = \frac{cf}{((1+r)^1)} + \frac{cf}{((1+r)^2)} + \frac{cf}{((1+r)^3)} \quad (i)$$

$$\ldots\ldots + \frac{cf}{((1+r)^n)} - ICCM$$

NPV = net present value of SIP system

cf = cash flow

r = discount rate

ICCM = initial cost of capital including O&M expenses

If cash flow is different in different years, then NPV would be

$$NPV = \frac{cf1}{((1+r)^1)} + \frac{cf2}{((1+r)^2)} + \frac{cf3}{((1+r)^3)} \quad (ii)$$

$$\ldots\ldots + \frac{cf_n}{((1+r)^n)} - ICCM$$

$$NPV = \Sigma_t^n = 1 \frac{cf_t}{(1+r)t} - ICCM \quad (iii)$$

Where,

n = number of years

t = year in which the investment was made or revenue was accrued.

Internal rate of return

The internal rate of return is the percentage of projected future revenues at which a business can make back its initial investment.

The mathematical representation for IRR can be written as

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b}(r_b - r_a) \quad (iv)$$

Where,

IRR = internal rate of return for SIP

r_a = lower discount rate

r_b = higher discount rate

NPV_a = NPV at lower discount rate

NPV_b = NPV at higher discount rate

Benefit-to-cost ratio

The benefit-to-cost ratio is the ratio obtained by dividing the benefit stream's present value by the cost stream's present value. Accepting projects with a B:C ratio of 1 or greater is the formal selection criterion to measure the project's worth.

The mathematical representation for benefit-to-cost ratio can be written as

$$B{:}C\ ratio = \frac{\Sigma_{t=1}^{n} \frac{B_t}{(1+r)^n}}{\Sigma_{t=1}^{n} \frac{C_t}{(1+r)^n}} \geq 1 \quad (v)$$

Where,

B_t = present value of cash flow

C_t = present value of cost

r = discount rate

n = number of years

In order to carry out the CBA of the SIP system, the parameters shown in Table 2 were considered.

Table 2 | **AT&C technical parameters**

DATA SET	UNIT
Rating of pump set	hp
Operating days of pumping system per year	days
Operating hours of pumping system per day	hours
Reference year for data	year
Reference tariff order for regulatory parameters	year
Rating of solar panel per pump set	kW
Cost of 11-kW solar PV system, including mounting structure and wiring	INR lakhs
Maintenance cost per solar PV system for first five years	INR
Maintenance cost per solar PV system after five years	INR
Effective tariff for energy consumption by farmers after tariff subsidies	INR/kWh
CUF of solar PV system	%
Carbon emission factor at improvement factor of 3.2% per year	kg CO_2/kWh
Life of solar PV system	years

Table 2 | **AT&C technical parameters (cont'd)**

DATA SET	UNIT
Degradation factor in energy generation by solar PV system per year	%
Discount rate for NPV per year	%
Inflation rate on O&M expenses per year	%
Higher discount rate for IRR	%
Lower discount rate for IRR	%

Notes: CO_2 = carbon dioxide; CUF = capacity utilisation factor; hp = horsepower; INR = Indian rupees; IRR = internal rate of return; kg = kilograms; kWh = kilowatt-hour; NPV = net present value; O&M = operations and maintenance; PV = photovoltaic.

Source: WRI authors.

CASE STUDY FOR A 7.5 HP SIP SYSTEM IN RAJASTHAN

Component C of the PM KUSUM scheme has two models: pump-level solarisation and feeder-level solarisation. In this research we focused on individual pump-level solarisation as this model faces many challenges and most stakeholders are not interested in it. Overall, given that the economic viability of individual pump-level solarisation is uncertain, we propose the CBA tool for 7.5 hp capacity SIPs in the state to support the state's solarisation program under the PM KUSUM scheme's component C.

The tool illustrates various long-term investment and savings scenarios to demonstrate the monetary benefits for DISCOMs and create an additional income avenue for farmers. The tool also seeks to model the subsidy reduction for the state government as more solar pumps are operationalised. This tool is dynamic and can be customised for further analysis by states based on state-specific subsidies and operating parameters. The NPV, IRR, and B:C ratio have been estimated in an economic criteria analysis based on the monetary savings.

Monetary benefits to DISCOMs, farmers, and the state government

The assumptions shown in Table 3 were made to estimate the monetary benefits for DISCOMs, farmers, and the state government.

Table 3 | **Assumptions for monetary benefits**

DATA SET	UNIT	VALUES
Rating of pump set	hp	7.5
Operating days of pumping system per year	days	200
Operating hours of pumping system per day	hours	6.5
Reference year for data	year	2021
Reference tariff order for regulatory parameters	year	multiyear tariff (FY 2021–FY 2024)
Rating of solar panel per pump set	kW	11
Cost of 11-kW solar PV system including mounting structure and wiring	INR lakhs	4.97
Effective tariff for energy consumption by farmers after tariff subsidies	INR/kWh	Nil
Capacity utilisation factor of solar PV system	%	20

Notes: FY = fiscal year; hp = horsepower; INR = Indian rupees; kWh = kilowatt-hours; PV = photovoltaic.

Source: S.S. Kalamkar and H. Sharma, "Solarisation of Agricultural Water Pumps in Rajasthan," 2021, https://www.researchgate.net/publication/348898796_Solarisation_of_Agricultural_Water_Pumps_in_Rajasthan; Rajasthan Electricity Regulatory Commission, Tariff Order, 2021, https://rerc.rajasthan.gov.in/rerc-user-files/tariff-orders.

DISCOMs

We examined the prospective costs and benefits of the grid-connected solar irrigation pumps for the DISCOMs to understand their perspective. There are three distribution companies in Rajasthan: Jaipur Vidhyut Vitran Nigam Limited, Jodhpur Vidhyut Vitran Nigam Limited, and Ajmer Vidhyut Vitran Nigam Limited.

The energy generated through solar PV systems offsets the grid-based energy DISCOMs supply to farmers. We used methodology that considers the following factors:

- Avoided power procurement cost by the DISCOMs corresponding to transmission and distribution losses equivalent to energy supplied by DISCOMs to farmers prior to solarisation.
- Avoided power procurement cost by purchasing surplus energy generated from farmers at a reduced renewable energy tariff compared to the power procurement tariff.

The detailed calculation is depicted in Appendix A, which shows that solarisation of existing 36-lakh, grid-connected pumps the DISCOM will accrue a net monetary benefit per year of 13,220 Cr.

Farmers

We have explored the expected costs and benefits of grid-connected, solar irrigation, brushless, direct current–motor pumps to understand the potential costs and benefits from farmers' point of view. The farmers will be able to use the generated energy to meet their irrigation needs, and surplus energy generated through solar PV will be supplied back to the grid at a feed-in tariff of INR 3.44/kWh. This will create an additional income source for farmers.

The detailed calculation is depicted in Appendix B, which shows that solarisation of existing grid-connected pumps will bring farmers a monetary benefit per year of 12,329 Cr., leading to extra income for farmers of INR 34,009 per year per 7.5 HP connection.

State government

The state government is providing DISCOMs with a tariff subsidy of INR 5.55/kWh, including an extra flat-rate subsidy of INR 1,000 per connection, to meet the agricultural demand of providing farmers with free electricity. However, the state government will no longer provide tariff subsidies because of the incorporation of solarisation of grid-connected pumps currently in use, which leads to savings of 14,502 Cr. per year, as shown in Appendix C.

Economic criteria analysis

NPV for DISCOMs and farmers

While calculating NPV we made the assumptions shown in Table 4.

Table 4 | **Assumptions for monetary benefits**

DATA SET	UNIT	VALUES
Rating of pump set	hp	7.5
Operating days of pumping system per year	days	200
Operating hours of pumping system per day	hours	6.5
Reference year for data	year	2021
Reference tariff order for regulatory parameters	year	multiyear tariff (FY 2021–FY 2024)
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Due to the initial cost of investment in the solarisation of pumps, DISCOMs lost 48,261 Cr. in the first year.

In the second year, DISCOMs begin to make money, but at a lower YoY rate because of the reduced amount of energy generated by solar PV. An annual degradation rate of 0.6 percent is considered in energy generation, which leads to an NPV for DISCOMs after 25 years of 71,485 Cr., as calculated in Appendix D. A sensitivity analysis is carried out on the farmers' NPV of savings over a 25-year period at a 7 percent discount rate, since the NPV of the savings is expected to decline annually at a discount rate of 7 percent. The sensitivity analysis is depicted in Figure 2.

Farmers started making money after installing solar photovoltaic systems in the first year because their initial investment was only 10 percent of the total cost of the system. When an annual 0.6 percent degradation is taken into consideration, the amount of energy generated by solar PV starts decreasing after the first year, which slows down the YoY profit, leading to an NPV for farmers after 25 years of 1,23,169 Cr., as calculated in Appendix E.

The NPV for DISCOMs and farmers is depicted in Figure 6.

Internal rate of return

When calculating the IRR, we maintain the same assumptions as those used for estimating the NPV mentioned earlier. The only difference lies in the rate assumptions, which are shown in Table 5.

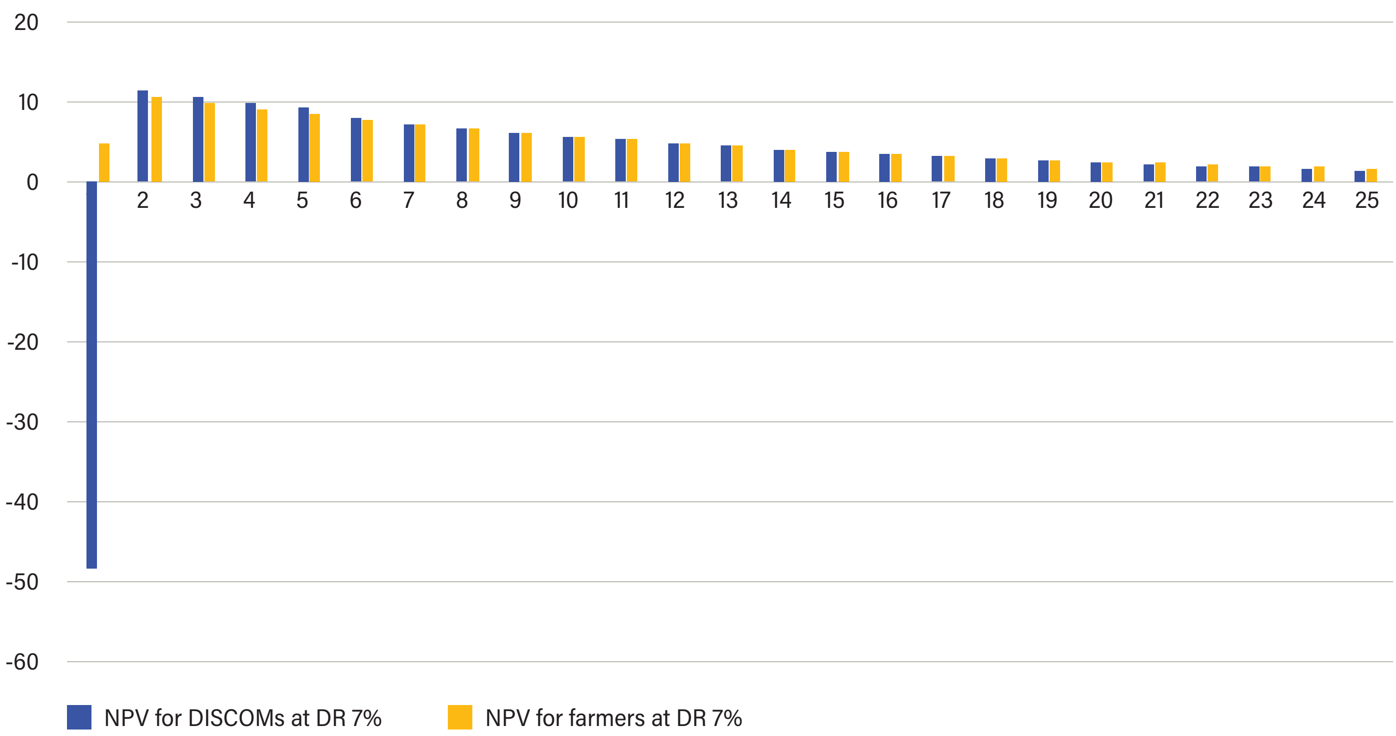
Table 5 | **Assumptions for IRR**

DATA SET	UNIT	VALUES
Higher discount rate for IRR	%	30
Lower discount rate for IRR	%	7

Note: IRR = internal rate of return.

Source: S.S. Kalamkar and H. Sharma, "Solarisation of Agricultural Water Pumps in Rajasthan," 2021, https://www.researchgate.net/publication/348898796_Solarisation_of_Agricultural_Water_Pumps_in_Rajasthan.

Figure 6 | **NPV for DISCOMs and farmers**



Notes: DISCOM = distribution company; DR = discount rate; NPV = net present value.
Source: WRI authors.

After 25 years of SIP system operation, the NPVs for DISCOMs at a higher rate (30 percent) and a lower rate (7 percent) are estimated as 8,079 Cr. and 71,485 Cr., respectively, leading to an IRR of 27.7 percent, as calculated in Appendix F. For farmers, the higher rate (30 percent) and lower rate (7 percent) NPVs are estimated as 33,991 Cr. and 1,23,169 Cr., respectively, leading to IRR of 38.7 percent, as formulated in Appendix G.

Benefit-to-cost ratio

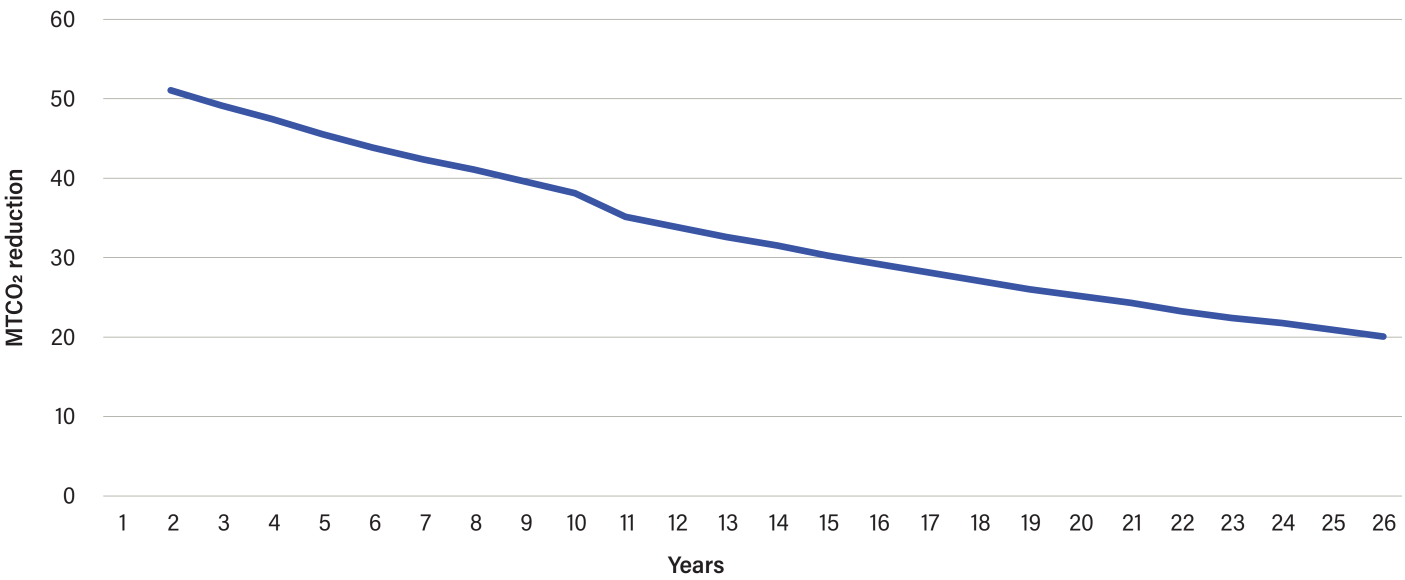
When calculating the B:C ratio, we maintain the same assumptions as those used for estimating the NPV mentioned earlier. After 25 years of SIP system operation, the NPVs for DISCOMs on cost and savings at a discount rate of 7 percent are estimated as 72,564 Cr. and 44,050 Cr., respectively, leading to a B:C ratio of 1.9, as calculated in Appendix H, whereas for farmers the NPVs on cost and savings at a discount rate of 7 percent are estimated as 8,063 Cr. and 1,31,232 Cr., respectively, leading to a B:C ratio of 16.28, as calculated in Appendix I.

Environmental benefits (carbon dioxide emissions reduction)

We analysed CO_2 emissions reduction YoY due to irrigation. The energy generated from solar PV leads to avoidance of energy procured by DISCOMs from conventional generating stations, including T&D losses of equivalent energy. We forecast a 51 million TCO_2 emission reduction during the first year due to DISCOMs' avoided power procurement from conventional generators. YoY emission reduction is shown in Figure 7, while the detailed calculation is depicted in Appendix J.

Given the existing fuel mix for electricity generation in the country, we have considered a starting initial emission factor for calculating CO_2 emissions reduction as 0.79 kg CO_2/kWh. When accounting for a YoY emission factor improvement rate of 3.2 percent due to the growing proportion of renewable energy in the generating capacity (CEA 2023), the emissions factor considered is 0.658 kg CO_2/kWh. This improvement in the emissions factor leads to a total CO_2 emissions reduction of 828 million tonnes of carbon dioxide ($MtCO_2$) from the irrigation sector in Rajasthan after 25 years of SIP operation.

Figure 7 | **YoY CO_2 emissions reduction**



Note: $MtCO_2$ = million tonnes of carbon dioxide.

Source: WRI authors.

LIMITATIONS OF THE TOOL

This tool is limited to cost benefit analysis of adoption of SIPs for irrigation purposes. This tool does not provide for scenario analysis of existing cropping patterns and farmers' income for future productivity scenarios. Changes in crops grown during kharif and rabi season, including expansion and shrinkage of area under various crops, are not taken into account. Similarly, estimation of the costs and profits of various crops under several price scenarios, based on market price and economic price, is not considered in this study. Provision for phase-wise SIP implementation is also not available in this tool. The quality of the groundwater may further constrain the amount of water available for irrigation. The pumps might not be strong enough to reach the groundwater level.

As we progress further toward achieving scale, it will be important to understand holistically the development changes that take place around farming communities, looking beyond income, and to understand the socioeconomic impacts on farmer livelihoods, shifts in agricultural production and cropping patterns as well as sustaining water use.

CONCLUSION

To develop the CBA tool, we calculated the total cost of solar panel procurement equivalent to 7.5 hp pumps. We used four economic criteria methods to examine the costs and benefits of solarisation of existing grid-connected pumps in Rajasthan: NPV, IRR, B:C and payback period. We learned that the solarisation of existing grid-connected pumps was cost-effective. Feasible costs and assistance from DISCOMs and the state government will embolden more farmers to opt for solar irrigation pumps. This tool will also help other states offer benefits by taking different sizes of pumps into account according to each state's requirements. States can customise the tool for analysis based on their specific subsidies and other operating parameters.

Based on the assessment of Rajasthan's SIPs with this CBA tool, we found that solarisation of existing 7.5 hp grid-connected pumps has the potential to benefit farmers, DISCOMs, and the state government and that rollout of KUSUM's pump-level solarisation of a variant under Component C is feasible. However, this technical note shows a reduced burden during the peak load times for DISCOMs, as the agriculture sector accounts for 44 percent of the total energy consumed in the state. Our case study shows the YoY Mt CO_2 emission reduction due to avoided power procurement from conventional generating stations. This tool will increase awareness of SIPs' benefits to farmers. Outputs from this tool will help in providing recommendations to planners of the PM KUSUM scheme that prioritise the precise relationship between the subsidies and pump size according to the state requirement. Apart from YoY CO_2 emissions reduction in this note, future research could comprehensively analyse groundwater usage after solarisation of irrigation pumps.

APPENDIX A. MONETARY BENEFITS TO DISCOMS

Table A-1 | **Result analysis for monetary benefits to the DISCOMs**

PARAMETERS		VALUES IN FY 2021	
Energy supplied by DISCOMs (MU) to farmers		26,367	
Total number of 11-kW solar panels (lakhs)		36	
Energy generated from solar PV (MU) @ 20% CUF		62,206	
Feed-in tariff (INR/kWh) for surplus energy generated by solar PV		3.44	
Energy procured by DISCOMs from farmers (MU)		35,839	
APPC (INR/kWh)		4.96	
Parameters	**Benefits to DISCOMs per year in case of avoided power procurement cost**	**Parameters**	**Benefits to DISCOMs per year in case of energy procured by farmers**
Reduction in energy supplied by DISCOMs to farmers (MU)	26,367	Energy supplied by DISCOMs (MU)	26,367
Approved distribution loss	15%	Energy generated from solar PV (MU) @ 20% CUF	62,206
Energy required at DISCOM periphery	31,020	Feed-in tariff (INR/kWh)	3.44
Intrastate transmission loss (%)	3.33%	Energy procured by DISCOMs from farmers (MU)	35,839
Energy required at state periphery (MU)	32,088	APPC (INR/kWh)	4.96
Interstate transmission loss	2.79%	Approved distribution loss	15%
Gross energy required (MU)	33,009	Energy required at DISCOM periphery	42,164
Energy equivalent to distribution losses (MU)	4,653	Intrastate transmission loss (%)	3.33%
Energy equivalent to intrastate transmission losses (MU)	1,069	Energy required at state periphery (MU)	43,616
Energy equivalent to interstate transmission losses (MU)	921	Interstate transmission loss	2.79%
Total energy equivalent to T&D losses (MU)	6,642	Gross power procurement avoided (MU)	44,868
APPC (INR/kWh)	4.96	Energy procured by DISCOMs (MU) from farmers @ tariff 3.44 (INR/kWh)	35,839
Savings for DISCOMs of reduction in power procurement equivalent to T&D losses, including subsidy provided by state government (INR Cr.)	3,295	Energy procured by DISCOMs (MU) from power plants @ APPC 4.96 (INR/kWh)	44,868
Average billing rate including tariff subsidy (INR/kWh)	0	Benefits to DISCOMs (INR Cr.)	9,925
Revenue loss for DISCOMs corresponding to reduction in power supply to farmers (INR Cr.)	0	Gross power procurement avoided (MU)	44,868

Table A-1 | **Result analysis for monetary benefits to the DISCOMs (cont'd)**

Parameters	Benefits to DISCOMs per year in case of avoided power procurement cost	Parameters	Benefits to DISCOMs per year in case of energy procured by farmers
Benefits to DISCOMs	3,295		
Net benefits to DISCOMs per year (INR Cr.)			13,220

Notes: APPC = average power procurement cost; CUF = capacity utilisation factor; DISCOM = distribution company; FY = fiscal year; kWh = kilowatt-hours; MU = million units; PV = photovoltaic; T&D = transmission and distribution.

Source: WRI India authors' analysis.

APPENDIX B. MONETARY BENEFITS TO FARMERS

Table B-1 | **Result analysis for monetary benefits to the farmers**

PARAMETERS	BENEFITS TO FARMERS PER YEAR FROM SELLING SURPLUS ENERGY TO DISCOMS AT FEED-IN TARIFF
Energy required by the pump set (MU)	26,367
Energy generated from solar PV (MU) @ 20% CUF	62,206
Energy procured by DISCOMs (MU) from farmers due to surplus energy generated from solar PV	35,839
Feed-in tariff (INR/kWh)	3.44
Savings for farmers (INR Cr.) for first year	12,329
Savings for farmers (INR/connection/year)	34,009

Notes: CUF = capacity utilisation factor; DISCOM = distribution company; INR Cr. = 10 million Indian rupees; kWh = kilowatt-hour; MU = million units; PV = photovoltaic.

Source: WRI India authors' analysis.

APPENDIX C. MONETARY BENEFITS TO STATE GOVERNMENT

Table C-1 | **Result analysis for monetary benefits to the state government**

PARAMETERS	BENEFITS TO STATE GOVERNMENT PER YEAR FROM ELIMINATION OF TARIFF SUBSIDY
Energy supplied by DISCOMs (MU)	26,367
Subsidy provided by state government (INR/kWh)	5.5
Benefits to state government for eliminating the tariff subsidy amount (INR Cr.)	14,502

Notes: DISCOM = distribution company; INR Cr. = 10 million Indian rupees; kWh = kilowatt-hour; MU = million units.

Source: WRI India authors' analysis.

APPENDIX D. ESTIMATION OF NPV FOR DISCOMS

Table D-1 | **Result analysis for NPV estimation-DISCOMs**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV AT DISCOUNT RATE OF 7%
1	-48,261	13,220	-51,639	-48,261
2	11,457	13,117	13,117	11,457
3	10,624	13,014	13,014	10,624
4	9,851	12,912	12,912	9,851
5	9,134	12,811	12,811	9,134
6	7,817	12,710	11,731	7,817
7	7,206	12,609	11,572	7,206
8	6,641	12,510	11,410	6,641
9	6,117	12,411	11,245	6,117
10	5,631	12,312	11,076	5,631
11	5,181	12,214	10,904	5,181
12	4,764	12,117	10,729	4,764
13	4,377	12,020	10,548	4,377
14	4,019	11,924	10,364	4,019
15	3,688	11,828	10,175	3,688
16	3,381	11,733	9,981	3,381
17	3,096	11,639	9,781	3,096
18	2,833	11,545	9,576	2,833
19	2,589	11,452	9,364	2,589
20	2,364	11,359	9,146	2,364
21	2,155	11,267	8,921	2,155
22	1,961	11,175	8,689	1,961
23	1,782	11,084	8,448	1,782
24	1,617	10,993	8,200	1,617
25	1,463	10,903	7,942	1,463
Payback period (months)	17	NPV after 25 years (INR Cr.)		71,485
Total cost incurred, including O&M expenses (INR Cr.)				**6,626**

Notes: DISCOM = distribution company; INR Cr. = 10 million Indian rupees; NPV = net present value; O&M = operations and maintenance.

Source: WRI India authors' analysis.

APPENDIX E. ESTIMATION OF NPV FOR FARMERS

Table E-1 | **Result analysis for estimation of NPV-farmers**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV AT LOWER DISCOUNT RATE OF 7%
1	7,207	12,329	5,122	4,787
2	0	12,200	12,200	10,656
3	0	12,073	12,073	9,855
4	0	11,946	11,946	9,113
5	0	11,820	11,820	8,427
6	109	11,694	11,586	7,720
7	115	11,570	11,454	7,133
8	122	11,446	11,324	6,591
9	130	11,323	11,193	6,088
10	137	11,200	11,063	5,624
11	146	11,079	10,933	5,194
12	154	10,958	10,804	4,797
13	164	10,838	10,674	4,429
14	173	10,718	10,545	4,090
15	184	10,600	10,416	3,775
16	195	10,482	10,287	3,484
17	206	10,364	10,158	3,216
18	219	10,248	10,029	2,967
19	232	10,132	9,900	2,737
20	246	10,017	9,771	2,525
21	261	9,902	9,641	2,329
22	276	9,788	9,512	2,147
23	293	9,675	9,382	1,979
24	310	9,563	9,252	1,824
25	329	9,451	9,122	1,681
Payback period (months)	1.09	NPV after 25 years (INR Cr.)		1,23,169
Total cost incurred, including O&M expenses (INR Cr.)				**1,15,963**

Notes: DISCOM = distribution company; INR Cr. = 10 million Indian rupees; NPV = net present value; O&M = operations and maintenance.

Source: WRI India authors' analysis.

APPENDIX F. ESTIMATION OF IRR FOR DISCOMS

Table F-1 | **Result analysis for estimation of IRR-DISCOMs**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV AT LOWER DISCOUNT RATE OF 7%	NPV AT HIGHER DISCOUNT RATE OF 30%
1	64,859	13,220	-51,639	-48,261	-39,722
2	0	13,117	13,117	11,457	7,762
3	0	13,014	13,014	10,624	5,924
4	0	12,912	12,912	9,851	4,521
5	0	12,811	12,811	9,134	3,450
6	979	12,710	11,731	7,817	2,430
7	1,037	12,609	11,572	7,206	1,844
8	1,100	12,510	11,410	6,641	1,399
9	1,166	12,411	11,245	6,117	1,060
10	1,236	12,312	11,076	5,631	803
11	1,310	12,214	10,904	5,181	608
12	1,388	12,117	10,729	4,764	460
13	1,472	12,020	10,548	4,377	348
14	1,560	11,924	10,364	4,019	263
15	1,654	11,828	10,175	3,688	199
16	1,753	11,733	9,981	3,381	150
17	1,858	11,639	9,781	3,096	113
18	1,969	11,545	9,576	2,833	85
19	2,088	11,452	9,364	2,589	64
20	2,213	11,359	9,146	2,364	48
21	2,346	11,267	8,921	2,155	36
22	2,486	11,175	8,689	1,961	27
23	2,636	11,084	8,448	1,782	20
24	2,794	10,993	8,200	1,617	15
25	2,961	10,903	7,942	1,463	11
NPV after 25 Years (INR Cr.) at lower discount rate of 7%					71,485
NPV after 25 years (INR Cr.) at higher discount rate of 30%					-8,079
IRR (%)					**27.7**

Notes: DISCOM = distribution company; INR Cr. = 10 million Indian rupees; IRR = internal rate of return; NPV = net present value.

Source: WRI India authors' analysis.

APPENDIX G. ESTIMATION OF IRR FOR FARMERS

Table G-1 | **Result analysis for estimation of IRR-farmers**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV AT LOWER DISCOUNT RATE OF 7%	NPV AT HIGHER DISCOUNT RATE OF 30%
1	7,207	12,329	5,122	4,787	3,940
2	0	12,200	12,200	10,656	7,219
3	0	12,073	12,073	9,855	5,495
4	0	11,946	11,946	9,113	4,183
5	0	11,820	11,820	8,427	3,183
6	109	11,694	11,586	7,720	2,400
7	115	11,570	11,454	7,133	1,825
8	122	11,446	11,324	6,591	1,388
9	130	11,323	11,193	6,088	1,056
10	137	11,200	11,063	5,624	803
11	146	11,079	10,933	5,194	610
12	154	10,958	10,804	4,797	464
13	164	10,838	10,674	4,429	352
14	173	10,718	10,545	4,090	268
15	184	10,600	10,416	3,775	203
16	195	10,482	10,287	3,484	155
17	206	10,364	10,158	3,216	117
18	219	10,248	10,029	2,967	89
19	232	10,132	9,900	2,737	68
20	246	10,017	9,771	2,525	51
21	261	9,902	9,641	2,329	39
22	276	9,788	9,512	2,147	30
23	293	9,675	9,382	1,979	22
24	310	9,563	9,252	1,824	17
25	329	9,451	9,122	1,681	13
NPV after 25 Years (INR Cr.) at lower discount rate of 7%					1,23,169
NPV after 25 years (INR Cr.) at higher discount rate of 30%					30,648
IRR (%)					**38.7**

Notes: INR Cr. = 10 million Indian rupees; IRR = internal rate of return; NPV = net present value.

Source: WRI India authors' analysis.

APPENDIX H. ESTIMATION OF BENEFIT-TO-COST RATIO FOR DISCOMS

Table H-1 | **Result analysis for estimation of benefit-to-cost ratio—DISCOMs**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV ON COST (INR CR.) AT DISCOUNT RATE OF 7%	NPV ON SAVINGS (INR CR.) AT DISCOUNT RATE OF 7%
1	64,859	13,220	-51,639	60,616	12,356
2	0	13,117	13,117	0	11,457
3	0	13,014	13,014	0	10,624
4	0	12,912	12,912	0	9,851
5	0	12,811	12,811	0	9,134
6	979	12,710	11,731	652	8,469
7	1,037	12,609	11,572	646	7,853
8	1,100	12,510	11,410	640	7,281
9	1,166	12,411	11,245	634	6,751
10	1,236	12,312	11,076	628	6,259
11	1,310	12,214	10,904	622	5,803
12	1,388	12,117	10,729	616	5,380
13	1,472	12,020	10,548	611	4,988
14	1,560	11,924	10,364	605	4,624
15	1,654	11,828	10,175	599	4,287
16	1,753	11,733	9,981	594	3,975
17	1,858	11,639	9,781	588	3,685
18	1,969	11,545	9,576	583	3,416
19	2,088	11,452	9,364	577	3,167
20	2,213	11,359	9,146	572	2,935
21	2,346	11,267	8,921	567	2,721
22	2,486	11,175	8,689	561	2,522
23	2,636	11,084	8,448	556	2,338
24	2,794	10,993	8,200	551	2,167
25	2,961	10,903	7,942	546	2,009
NPV after 25 years (INR Cr.)				72,564	1,44,050
Benefit-to-cost ratio					**1.99**

Notes: INR Cr. = 10 million Indian rupees; NPV = net present value.

Source: WRI India authors' analysis.

APPENDIX I. ESTIMATION OF BENEFIT-TO-COST RATIO FOR FARMERS

Table I-1 | **Result analysis for estimation of benefit-to-cost ratio—farmers**

LIFE (YEARS)	INITIAL COST (INR CR.)	ANNUAL SAVINGS (INR CR.)	NET COST INCURRED (INR CR.)	NPV ON COST (INR CR.) AT DISCOUNT RATE OF 7%	NPV ON SAVINGS (INR CR.) AT DISCOUNT RATE OF 7%
1	7,207	12,329	5,122	6,735	11,522
2	0	12,200	12,200	0	10,656
3	0	12,073	12,073	0	9,855
4	0	11,946	11,946	0	9,113
5	0	11,820	11,820	0	8,427
6	109	11,694	11,586	72	7,792
7	115	11,570	11,454	72	7,205
8	122	11,446	11,324	71	6,662
9	130	11,323	11,193	70	6,159
10	137	11,200	11,063	70	5,694
11	146	11,079	10,933	69	5,263
12	154	10,958	10,804	68	4,865
13	164	10,838	10,674	68	4,497
14	173	10,718	10,545	67	4,157
15	184	10,600	10,416	67	3,842
16	195	10,482	10,287	66	3,550
17	206	10,364	10,158	65	3,281
18	219	10,248	10,029	65	3,032
19	232	10,132	9,900	64	2,802
20	246	10,017	9,771	64	2,588
21	261	9,902	9,641	63	2,391
22	276	9,788	9,512	62	2,209
23	293	9,675	9,382	62	2,041
24	310	9,563	9,252	61	1,885
25	329	9,451	9,122	61	1,741
NPV after 25 years (INR Cr.)				8,063	1,31,232
Benefit-to-cost ratio					**16.28**

Notes: INR Cr. = 10 million Indian rupees; NPV = net present value.

Source: WRI India authors' analysis.

APPENDIX J. ESTIMATION OF CARBON DIOXIDE EMISSIONS REDUCTIONS (MTCO₂)

Table J-1 | **Result analysis for CO_2 emissions reductions**

LIFE (YEARS)	YEAR	ENERGY GENERATED BY SOLAR PV (MU)	REDUCTION IN GROSS ENERGY REQUIRED (MU)	EMISSION FACTOR (KG CO_2/KWH NET)	YOY TOTAL MILLION TCO_2 EMISSIONS REDUCTION
1	2020–21	62,206	77,877	0.658	51
2	2021–22	61,833	77,410	0.637	49
3	2022–23	61,462	76,945	0.617	47
4	2023–24	61,093	76,484	0.597	46
5	2024–25	60,726	76,025	0.579	44
6	2025–26	60,362	75,569	0.560	42
7	2026–27	60,000	75,115	0.548	41
8	2027–28	59,640	74,665	0.531	40
9	2028–29	59,282	74,217	0.514	38
10	2029–30	58,926	73,771	0.477	35
11	2030–31	58,573	73,329	0.462	34
12	2031–32	58,221	72,889	0.447	33
13	2032–33	57,872	72,451	0.433	31
14	2033–34	57,525	72,017	0.419	30
15	2034–35	57,180	71,585	0.406	29
16	2035–36	56,836	71,155	0.393	28
17	2036–37	56,495	70,728	0.381	27
18	2037–38	56,156	70,304	0.369	26
19	2038–39	55,820	69,882	0.357	25
20	2039–40	55,485	69,463	0.346	24
21	2040–41	55,152	69,046	0.335	23
22	2041–42	54,821	68,632	0.324	22
23	2042–43	54,492	68,220	0.314	21
24	2043–44	54,165	67,810	0.304	21
25	2044–45	53,840	67,404	0.294	20
Total $MtCO_2$ emissions reduction for the entire life of solar PV (25 years)					828

Notes: CO_2 = carbon dioxide; kg = kilograms; kWh = kilowatt-hours; Mt = million tonnes; MU = million units; PV = photovoltaic; TCO_2 = tonnes of carbon dioxide; YoY = year on year.

Source: WRI India authors' analysis.

ABBREVIATIONS

B_t	present value of cash flow
Cf	cash flow
C_t	present value of cost
ICCM	initial cost of capital including operations and maintenance expenses
IRR	internal rate of return for solar irrigation pump system
n	number of years
NPV	net present value of solar irrigation pump system
NPV_a	NPV at lower discount rate
NPV_b	NPV at higher discount rate
r	discount rate
r_a	lower discount rate
r_b	higher discount rate
t	year in which the investment was made, or revenue was accrued

ENDNOTE

1 Andhra Pradesh fully subsidised model for pump-level solarisation. With zero contribution from the beneficiaries, the DISCOMs bore all the costs associated with the pilot initiative. In order to offset the large subsidy, the DISCOMs maintained the FiT at a low 1.5 INR/kWh.

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ABOUT WRI

WRI India, an independent charity legally registered as the India Resources Trust, provides objective information and practical proposals to foster environmentally sound and socially equitable development. Our work focuses on building sustainable and liveable cities and working towards a low carbon economy. Through research, analysis, and recommendations, WRI India puts ideas into action to build transformative solutions to protect the earth, promote livelihoods, and enhance human well-being. We are inspired by and associated with World Resources Institute (WRI), a global research organization. Know more: www.wri-india.org.

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. Liveable 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 inform 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.