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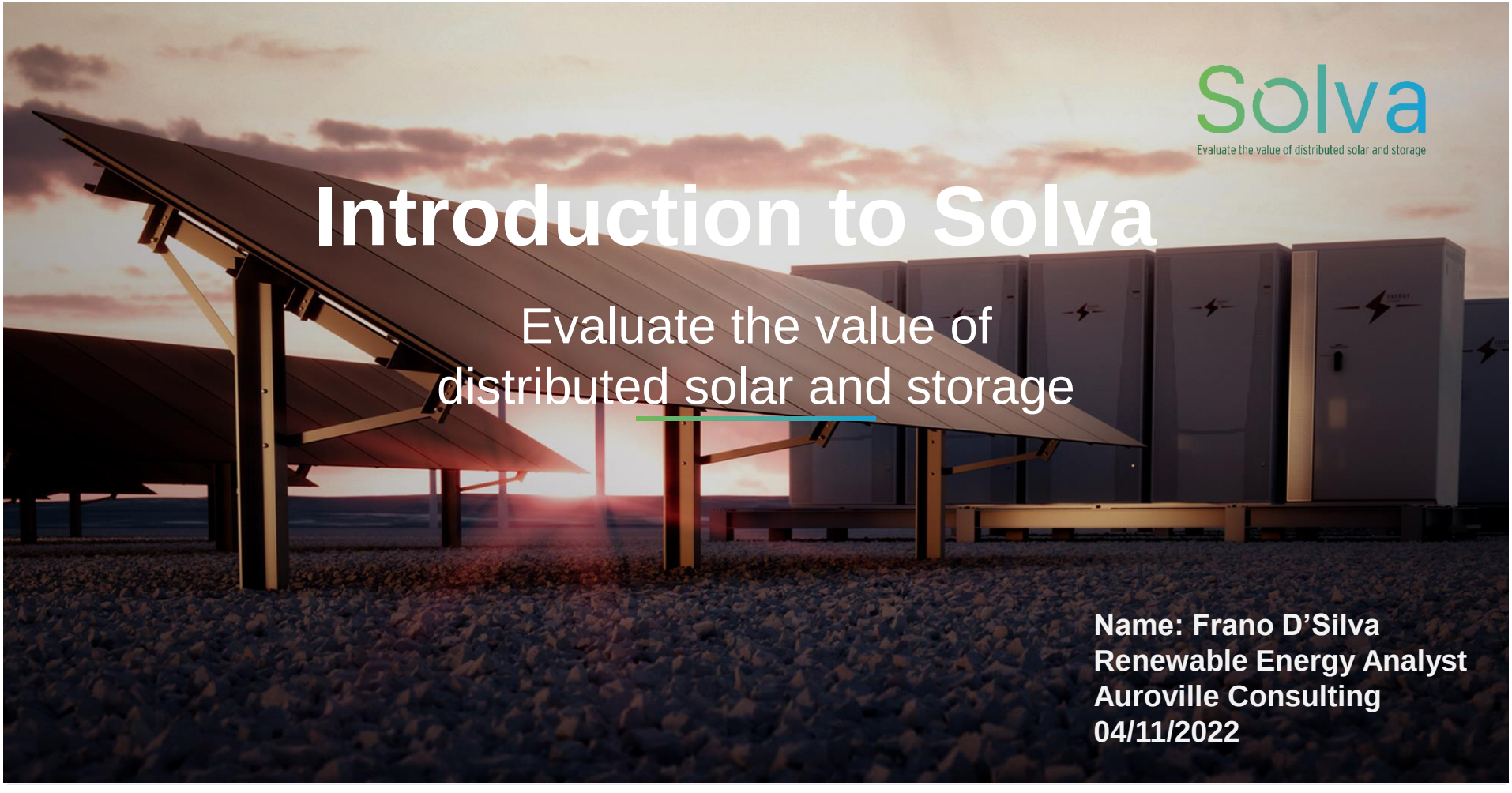

Solva

Evaluate the value of distributed solar and storage

Introduction to Solva

Evaluate the value of distributed solar and storage

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Auroville Consulting
04/11/2022

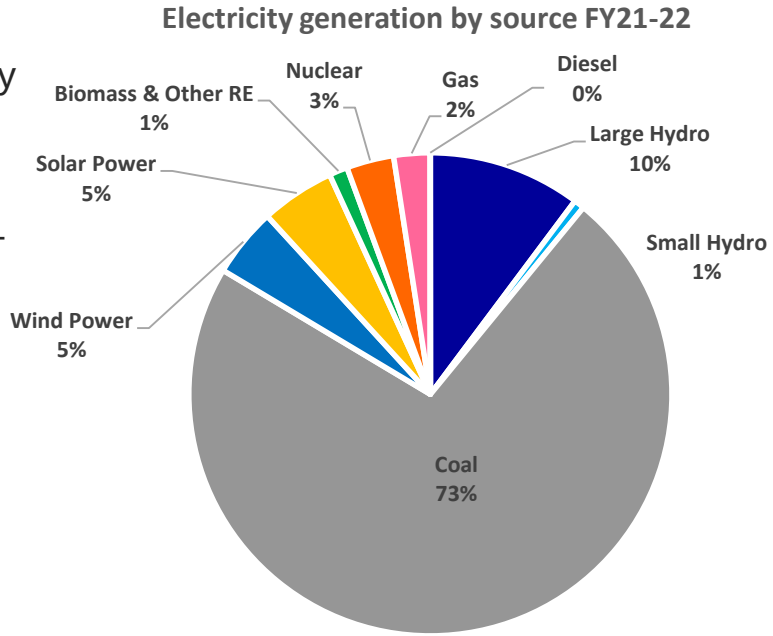
Agenda

1 Background
2 Solva – intro
3 Power Flow Analysis
4 VODER analysis

Background

Renewable energy targets (India) - 2030

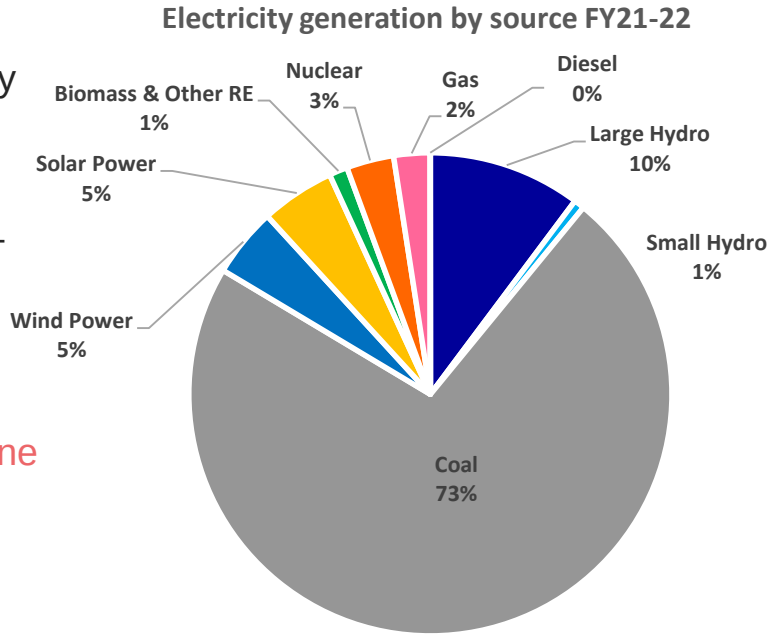
- Reducing emission intensity of India's GDP by 45% in 2030
- 500GW non-fossil fuel based energy installed capacity by 2030
- MoP released the new RPO targets – 43% by 2029 – 30*



Ref. https://pib.gov.in/ > Home/All Features/Features Details – 09/09/22 & CEA for electricity demand projection ; * RPO & Energy storage trajectory till 2029-30 (MoP) 22/07/2022

Renewable energy targets (India) - 2030

- Reducing emission intensity of India's GDP by 45% in 2030
- 500GW non-fossil fuel based energy installed capacity by 2030
- MoP released the new RPO targets – 43% by 2029 – 30*
  - Tamil Nadu has announced to add a 20 GW of solar energy by 2030. This is expected to be done at every district through distributed systems



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Solva - intro

Solva – Evaluate the value of distributed solar and storage

Solva
Evaluate the value of distributed solar and storage

Solva is a web application for simulating the economic and societal benefits of integrating distributed renewable energy resources into the modern power system.

Solva allows users to:

- Undertake a DT/Feeder/Substation level power flow analysis.
- Evaluate the network benefits and social benefits for distributed solar and energy storage.
- Identify system sizes and dispatch strategies to optimize the value of distributed solar and energy storage.

Solva – Potential users

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Grid operators – To assess the network value of integrating DER at the distribution network

Regulators – To inform the feed-in tariff setting process

Policymakers – To assess the societal (Health & Environment) benefit from the DER integration

Researchers – To study and analyse the impact of integrating DER at the distribution network

Solva – Evaluation steps

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1. Power flow analysis

- Active power
- Voltage

2. Value of distributed energy resources (VODER)

- Network Benefits
- Societal Benefits

Power flow analysis

Grid interconnection points

DT level

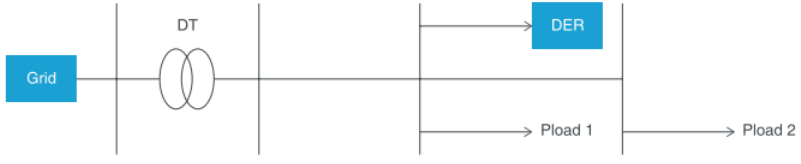

Figure 2: DT with DER located in the middle of the LT feeder.

HT Feeder

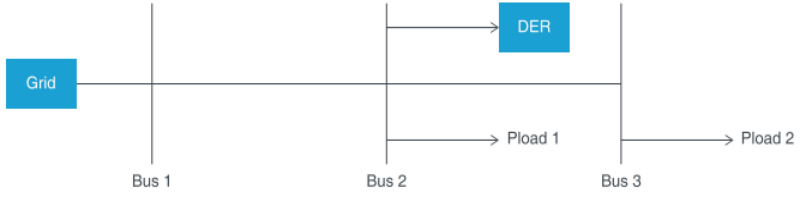

Figure 1: An HT feeder with DER located in the middle of the feeder.

Substation level

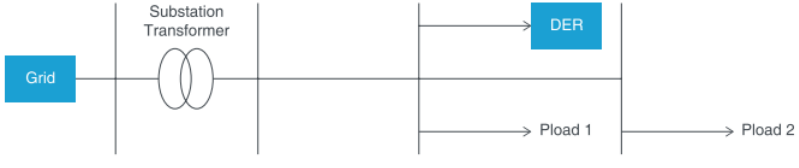

Figure 3: Substation model with DER located middle of the HT feeder.

VODER analysis

Existing research

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- CEEW conducted a study to find the value of grid connected rooftop solar for a distribution company in Delhi
    - https://www.ceew.in/publications/valuing-grid-connected-rooftop-solar-framework-assess-cost-and-benefits-discoms
- NREL conducted an analysis to quantify the value of rooftop solar benefit – Gujrat & Jharkhand
    - https://www.nrel.gov/docs/fy21osti/78442.pdf

Ref. Valuing Grid-connected Rooftop Solar, CEEW; Ref. Quantifying Rooftop Solar Benefits: a State-Level Value of Solar Analysis for India, NREL

Existing research

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- Other examples
  - USA
    - New York
      - VDER framework
        - https://www.nyserda.ny.gov/All-Programs/ny-sun/contractors/value-of-distributed-energy-resources
    - Minnesota
      - VOS methodology
        - https://mn.gov/commerce-stat/pdfs/vos-methodology.pdf
  - Australia
    - VaDER
      - https://www.aer.gov.au/system/files/CSIRO%20and%20Cutler%20Merz%20%E2%80%93%20Value%20of%20distributed%20energy%20resources%20-%20Methodology%20study%20%E2%80%93%20Final%20report%20%E2%80%93%20October%202020_1.pdf

Ref. Valuing Grid-connected Rooftop Solar, CEEW; Ref. Quantifying Rooftop Solar Benefits: a State-Level Value of Solar Analysis for India, NREL

VODER methodology used

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Network benefits

Avoided cost of energy (INR/kWh)
Avoided distribution capacity cost (INR/kWh)
Avoided transmission capacity cost (INR/kWh)
Avoided generation capacity cost (INR/kWh)

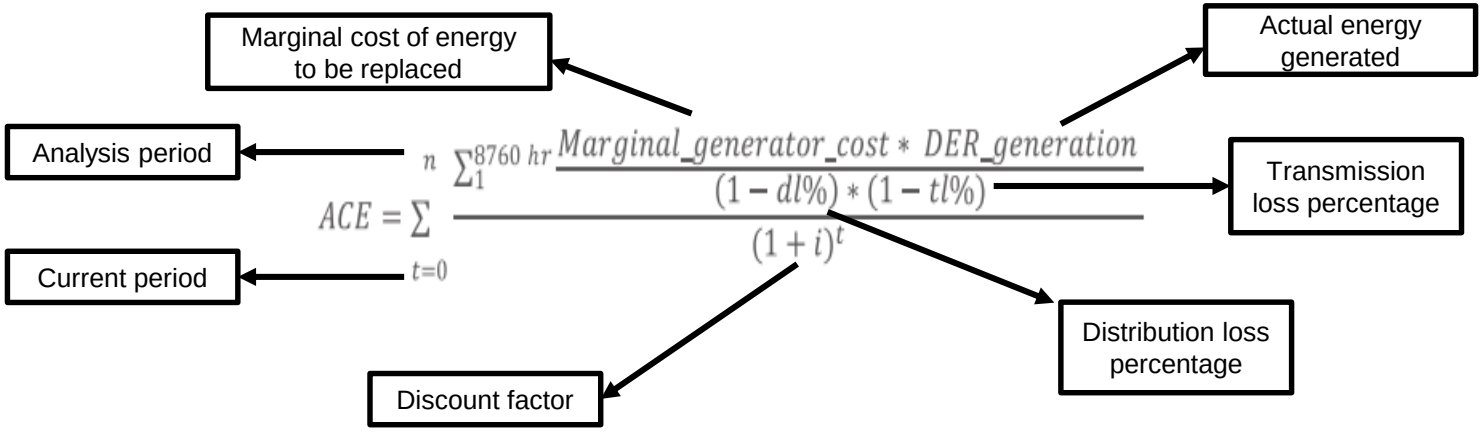
Societal benefits

Avoided CO2, NO2, SO2 & PM2.5 emission costs (INR/kWh)

Total VoDER benefit = Network benefit + Societal benefit

Avoided cost of energy

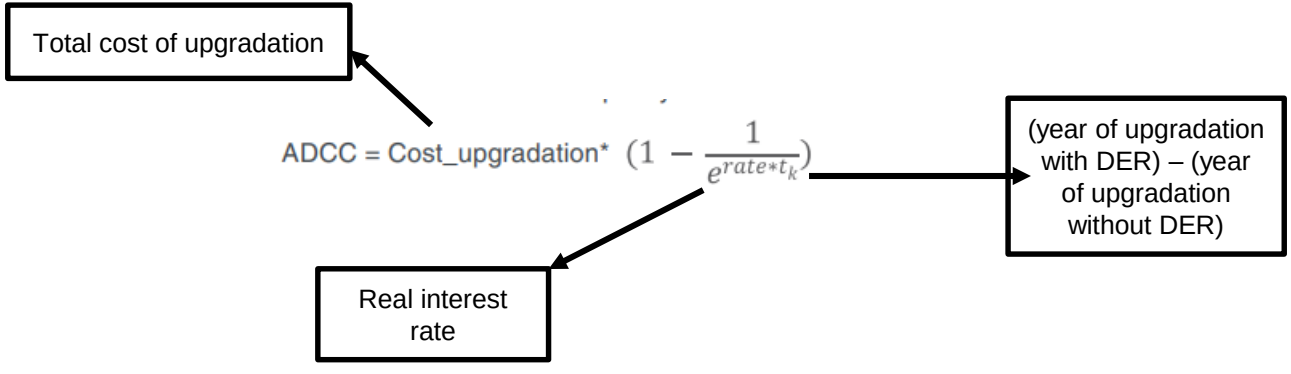
Avoided cost of energy (INR/kWh) : Distributed generation displaces energy from marginal generator – the highest cost centralised generator at the top of the dispatch stack in any given hour.



Disclaimer: DER is assumed to replace coal; hence marginal cost estimated is for coal power plants.
Transmission loss percentage is assumed to be an average taken from Tariff order (4%)

Avoided distribution capacity cost

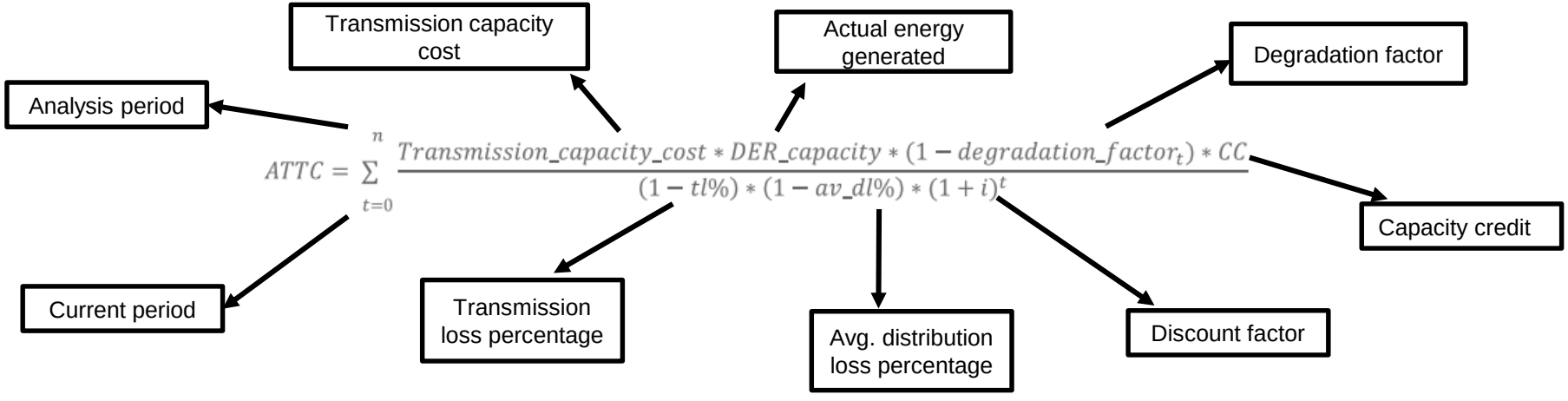
Avoided distribution capacity cost (INR/kWh): we calculate the distribution capacity upgrade cost with and without the solar PV and storage (BAU case and DER case)



Disclaimer: We assume 50% of load is transferred to the new DT/Feeder/Substation

Avoided transmission capacity cost

Avoided transmission capacity cost (INR/kWh) : Distributed generation meets the load locally and helps in reducing the need for contracting transmission capacity during peak hours



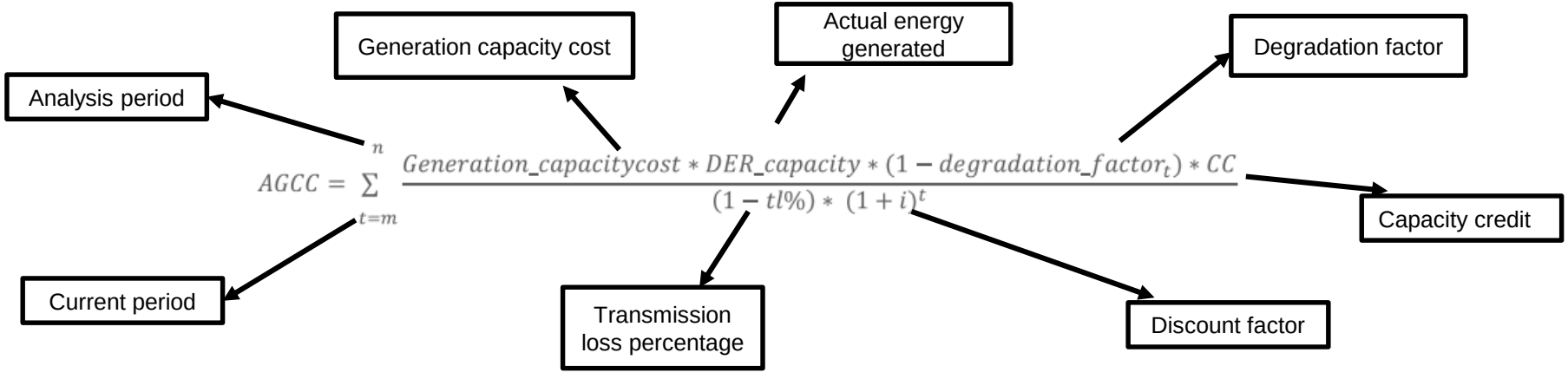
Avoided transmission capacity cost

Avoided transmission capacity cost (INR/kWh) : **Capacity credit**: for DER, it is the output of the distribution resource as a fraction of the total peak capacity during top ‘N’ transmission load hours; (N = 100)

$$CC = \frac{\sum_{t=1}^{N} \frac{DER\_output}{DER\_capacity}}{N}$$

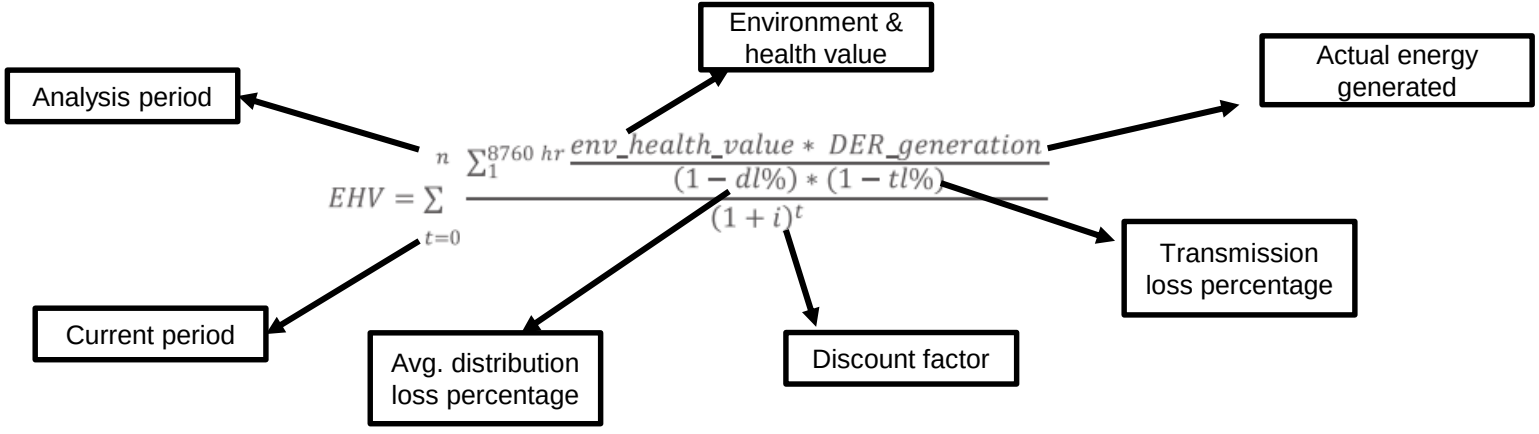
Avoided generation capacity cost

Avoided generation capacity cost (INR/kWh): The value of avoided generation capacity depends on when in future the net demand exceeds the total contracted capacity, and the distribution utility must contract new capacity



Societal benefits

Avoided CO2, NO2, SO2, PM2.5 (INR/kWh): The environmental and health value for the pollutants that are emitted from burning fossil fuels represent their external cost to the economy.



Societal benefits

Avoided CO2, NO2, SO2, PM2.5 (INR/kWh) : **Environmental & Health value:** This is the product of emission rate (kg/MWh) and value of avoided emission (INR/kg)

Emission	Value of avoided emission (INR/kg)	Emission rate (kg/MWH)	Source
CO2	3.54	980	Ricke et al. (2021)
NO2	400	4.3	Bowen et al. (2021), EPIC (2018)
SO2	500	7.05	
PM2.5	5000	1.15	EPIC (2018)

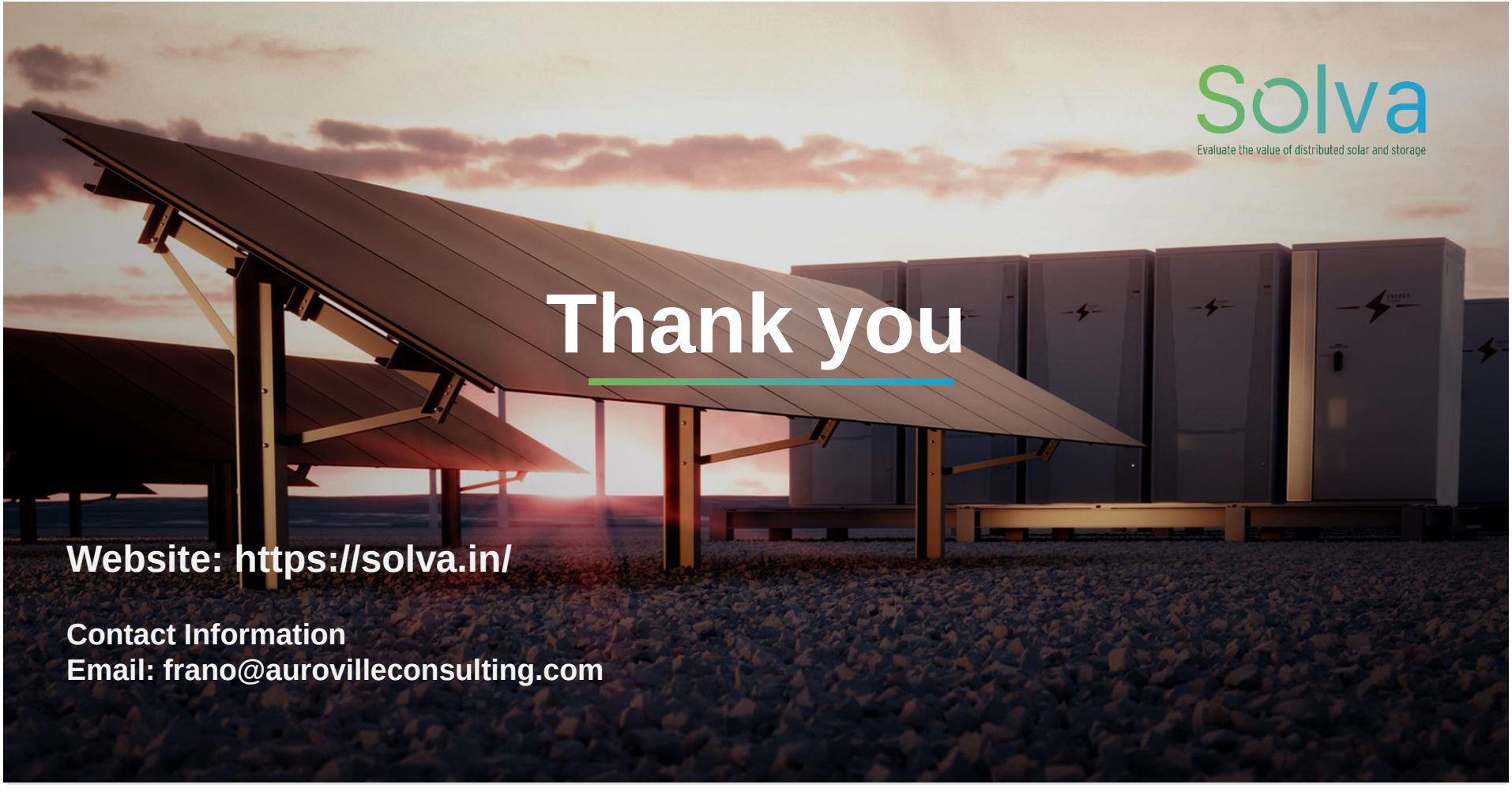
Disclaimer: The CO2 value is the social cost of carbon

Simulation

Inputs/Feedback

Feedback

1. Any suggestions concerning the methodology and/or the UI?
2. What are possible use cases that you see for Solva?
3. How can Solva be disseminated?


Solva
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