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SWAPPING EXPENSIVE COAL CONTRACTS FOR RENEWABLE ENERGY CAN SAVE GOA ₹264 CR. ANNUALLY

PRESS RELEASE

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Analysis by think tank Climate Risk Horizons (CRH) has shown that Goa can save ₹264 cr. annually through a transition plan that replaces its most expensive coal power contracts with renewable energy. The state is currently hosting the G20 Energy Transition Ministerial Meeting and the Energy Transition Working Group meeting under India's G20 presidency, where tackling climate change and reining in carbon emissions has been considered a priority.

Despite being a small state with significant renewable energy potential, Goa remains dependent on coal power for over 75% of its electricity requirements. Reliance on the dirty fuel is not only driving power costs higher, it has undermined the state's energy security, according to CRH.

"Based on floating solar PV projects in Kerala and Andhra Pradesh, we have estimated that just 5 man-made reservoirs in Goa can host as much as 426 MW of solar. The resulting tariff would be much lower than what Goa is currently paying for electricity from coal power plants in other states," said Harshit Sharma of Climate Risk Horizons. "In addition, replacing additional expensive coal power purchases with renewable energy from nearby states would deliver further savings, bringing the total up to a minimum of ₹264 cr. per year, and possibly much more."

Solar tariffs in India have remained below that of most coal power plants. The recent development of floating solar offers even more promise, as floating solar has delivered higher capacity factors than traditional ground mounted solar, while also avoiding land constraints. The analysis cites the example of NTPC's floating solar projects in Kerala and Andhra Pradesh.

In total, replacing the most expensive coal power purchases with a mix of in-state floating solar and out-of -state renewable energy purchases would enable Goa to take the share of renewables in its energy mix to 48%, at considerable savings.

Floating solar Photovoltaic potential of reservoirs in Goa

Reservoirs	Total Area (Acres)	20% of area (Acres)	Capacity (MW)	Annual Generation (MU)
Amthane	168	33.6	8.4	18.49
Anjunem	625	125	31.25	68.79
Panchwadi	131	26.2	6.55	14.42
Chapoli	272	54.4	13.6	29.94
Salaulim	7324	1464.8	366.2	806.06
Total	**8520**	**1704**	**426**	**937.69**

Total Annual Savings from replacing 243 MW coal with solar/renewable energy

	Coal Capacity Replaced (MW)	Energy Replaced (MU)	% Share of total energy demand	Annual Savings (Cr.)
Savings from replacing most expensive coal power plants with 426 MW FPV	152.47	951.71	19.12	181.26
Savings from replacing rest of the Coal plants above ₹3/kWh with RE at ₹3/kWh	90.91	615.42	12.36	83.14
Total	**243.38**	**1567.13**	**31.48**	**264.4**

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Replacing 243 MW of coal power with renewable energy can save Goa ₹264 cr. annually

Goa is hosting the G20 Energy Transition Ministerial Meeting and the Energy Transition Working Group meeting under India's G20 presidency, at a time when G20 economies are under increasing pressure to step up their renewable energy growth in the face of worsening impacts from climate change.

Despite being a small state with significant renewable energy potential, Goa remains dependent on coal power to fulfil its electricity requirements. The state's energy action plan envisions 100% renewable energy targets in all sectors by 2050 and 50% power from renewable energy by 2030, though a roadmap to achieve this goal has not been laid out. Decarbonisation of the electricity sector will play a major role as the state currently has per capita power consumption twice the national average.This brief suggests a pathway to tap Goa's renewable energy potential, moving towards climate goals while delivering significant financial savings for the state as a whole.

Key findings:

- Goa is dependent on coal for more than 75% of its electricity, higher than the national average.
- Goa has at least 426 MW of floating solar potential at five man-made reservoirs. If other lentic water bodies are taken into consideration, the potential is considerably higher.
- This floating solar would deliver electricity at a lower average cost, resulting in savings for the state. In addition, replacing other more expensive coal power purchases with renewable energy from nearby states would deliver further savings.
- A total savings of ₹264 cr. per year is possible by replacing the most expensive coal contracts with renewable energy from a mix of floating solar and inter state contracts.

Background

Goa has no coal power plants within its borders, yet is dependent on electricity from coal supplied by other states for over 75% of its annual scheduled requirement. Goa's coal dependency in scheduled energy terms is higher than the national average.

For this power from the national grid, Goa pays an average of ₹5-6 per unit. The government then sells this coal-fired power at a subsidised rate to consumers in Goa with a subsidy of 'at least' ₹2 per unit, which is paid for by the state exchequer with a budgetary allocation of ₹350 cr. ($44 million).[1]

Table 1: Share of coal and renewables in Goa's energy mix

	Share of total Scheduled Energy (%)	Share of total Contracted Capacity/Allocation (%)
Coal	76.9	56.2
Renewables	17.13	28.7

NB: Scheduled Energy is the anticipated/planned electricity consumption in Million Units(MU), whereas contracted capacity is the capacity allocation from a power plant contracted by the state and measured in Megawatts(MW)

1 https://www.hindustantimes.com/cities/others/panaji-aims-to-be-solar-city-in-2-years-goa-cm-101679120934821.html

Goa government's plans for renewable energy

The Goa government plans to explore the possibility of using abandoned mining pits to help set up floating solar power units as well as reservoirs for pumped storage.[2]

In 2022, twelve companies had replied to the state government's request for expressions of interest (EOI) for solar power developers to install grid-connected floating solar power plants in four reservoirs across Goa: Amthanem, Chapoli, Selaulim, and Anjunem.[3] These projects could significantly lower the overall cost of power for Goa. The current status of these projects is unknown.

The Electricity Department of Goa (EDG) has also signed a Power Purchase Agreement with SECI for 150 MW RTC Peak Power from combined sources of Renewable Power consisting of Solar, Wind and Battery Energy Storage System (BESS). Supply is due to start from FY 2023-24 at the rate of ₹4.03 /unit at Goa border.[4]

Goa's Floating Solar PV Potential

Goa is a small state with significant forest cover, and these factors are often viewed as an impediment to the state's development of a renewable energy industry. However, the state does have significant RE resources that can be developed in a socially and environmentally just manner, including floating solar PV on man-made reservoirs.

Floating solar has some advantages over ground-mounted solar PV: a much lower land footprint and a much higher capacity utilisation factor. Projects like Kayamkulam in Kerala and Simhadri in Andhra have demonstrated annual CUF approaching 25% and even up to 31% in favourable months. Higher utilisation factors and lower land requirement could make floating solar a win-win for a small state like Goa.

The CUF assumed for calculation of total annual energy generation is 25.11% and is based on CERC approved developer estimates verified by actual generation data of NTPC projects in Kerala[5] and Andhra Pradesh.[6] For the purpose of estimating total capacity, only 20% of the available reservoir area has been considered, so as to manage any possible impacts on the reservoir's ecosystem and reduce obstruction to existing activities such as fisheries, navigation etc. The tariff from these projects is assumed at ₹3.16/kWh based on the Kerala project already referenced.

The floating solar potential considered in this analysis is limited to five man-made reservoirs listed below. But the scope of FPV in Goa may not be limited to reservoirs, it can also be expanded to abandoned mining pits which the state government is already considering for FPV or Pumped Hydro Storage, and it can also provide a distributed energy solution for private or community ownership in smaller water bodies, giving local individuals and communities a direct stake in state's energy generation. If we take into account all the lentic water bodies available in the state, the potential capacity would be much higher, but this analysis restricts itself to larger man-made reservoirs.

Based on the assumptions of 25.11% CUF, 4 acres of water surface per MW, and utilising only 20% of the reservoir area, the total installed capacity on these five reservoirs would be 426 MW, generating about 938 million units (MU) of energy annually. This would account for about 19% of the states total energy scheduled for 2023-24.

2 https://www.hindustantimes.com/cities/others/goa-to-explore-using-abandoned-mines-for-pumped-storage-floating-solar-minister-101677855747447.html

3 https://solarquarter.com/2022/03/29/floating-solar-power-plants-project-in-goa-12-companies-raise-hands/

4 http://jercuts.gov.in/writereaddata/UploadFile/edgoaorder_1066.pdf

5 https://cercind.gov.in/2022/orders/341-GT-2019.pdf

6 https://cea.nic.in/wp-content/uploads/resd/2023/05/May_2023_Report-1.pdf

Table 2: FPV potential of reservoirs in Goa

Reservoirs	Total Area (Acres)	20% of area (Acres)	Capacity (MW)	Annual Generation (MU)
Amthane	168	33.6	8.4	18.49
Anjunem	625	125	31.25	68.79
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Total	**8520**	**1704**	**426**	**937.69**

Additional savings from cross border RE purchases

Although the state has sufficient renewable energy potential within the state to provide for most of its current and future energy needs, for this study we have only considered 426 MW of easily deployable FPV which can generate around 938 MU of cheap power annually. This is still insufficient to completely replace all of the expensive coal power PPAs. Therefore, keeping in mind the fact that there are sufficient renewable sources available in the country at much lower tariffs than Goa's current coal contracts, we have tried to explore savings from replacing expensive coal with renewables through a two stage transition process.

In the first stage Goa needs to replace coal contracts of approximately 152 MW from four higher tariff power plants. In table 3, a composition of high tariff plants is shown such that their total scheduled energy closely matches the anticipated energy production from 426 MW of planned floating solar projects. If Goa were to replace the 951 MU of energy from 152.47 MW of coal contracts generating at an average per unit cost of ₹5.06/kWh, with 426 MW of FPV generating at per unit cost of ₹3.16/kWh, this would result in an annual savings of ₹181.26 cr. as shown in Table 3 below.

TABLE 3: Savings from replacing most expensive coal power plants with 426 MW FPV

Power Plant	Energy Dispatch (MU)	Total Cost (Cr.)	Tariff (₹/kWh)	Cost @3.16/kWh	Savings pa (Cr.)
RSTPS	612.13	269.18	4.4	193.43	75.75
Gadarwara	117.34	76.94	6.55	37.08	39.86
Mouda I	94.60	59.4	6.28	29.89	29.51
Mouda II	127.64	76.48	5.99	40.33	36.15
Total	**951.71**	**482**	**5.06**	**300.74**	**181.26**

The second stage of the transition involves replacing the remaining coal contracts having tariffs above ₹3/kWh with energy from renewable projects outside the state. This would involve replacing 90.91 MW of coal contracts generating 615.42 MU of energy annually at average cost of ₹4.35/kWh with renewable energy at ₹3/kWh. This would translate into a saving of ₹83.14 cr. as shown in Table 4 below.

TABLE 4: Savings from replacing remaining coal plants above ₹3/kWh with RE at ₹3/kWh

Power Plant	Energy Dispatch (MU)	Total Cost (Cr.)	Tariff (₹/kWh)	Cost @3.16/kWh	Savings pa (Cr.)
VSTPS-IV	113.83	35.10	3.08	34.15	0.95
VSTPS-V	51.54	17.00	3.30	15.46	1.54
Solapur	69.43	57.05	8.27	20.83	36.22
Lara	97.59	42.87	4.39	29.28	13.59
Khargone	88.35	54.68	6.19	26.51	28.18
Sipat-II	194.68	61.07	3.14	58.40	2.67
Total	**615.42**	**267.77**	**4.35**	**184.63**	**83.14**

Thus, the annual savings from replacing all expensive coal contracts with both deployment of FPV within the state and purchasing RE from outside the state would be ₹264.4 cr., removing 243.38 MW of coal power from the state's energy mix. At this point, renewable energy would make up about 48% of the state's electricity mix in FY24.

TABLE 5: Total Annual Savings

	Coal Capacity Replaced (MW)	Energy Replaced (MU)	% Share of total energy demand	Annual Savings (Cr.)
Savings from replacing most expensive coal power plants with 426 MW FPV	152.47	951.71	19.12	181.26
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Total	**243.38**	**1567.13**	**31.48**	**264.4**

The above savings analysis is based on costs, energy and tariff estimates approved by Joint Electricity Regulatory Commission (JERC) in the ARR order for FY24[7].

7 http://jercuts.gov.in/writereaddata/UploadFile/edgoaorder_1066.pdf

Estimating actual costs and unreliability of coal power systems

Power sourced from coal is generally inflationary in nature, and is becoming increasingly more expensive compared to renewables. A major driver is the cost of the fuel itself. In addition, the long supply chain of coal power in India lends itself to disruptions.

Financial year 2023 saw such disruption leading to high power costs, evident from the data in Goa's FY23 Annual Performance Review (APR) order[8], when compared with the earlier estimates for FY23. The total Power Purchase Cost (PPC) for 2022-23 which was earlier estimated at ₹1840 cr.[9], has been revised up at ₹2260 cr. for the same FY23 in the Annual Performance Review by JERC, which pushed up the DISCOM's Annual Revenue Requirement by ₹428 cr. This surge in cost of power was mainly due to the shortage of domestic fuel resulting in the forced blending of more expensive, imported coal at power plants. If such a scenario were to repeat, Goa's actual savings from replacing these coal power contracts with renewable energy would be even higher.

8 http://jercuts.gov.in/writereaddata/UploadFile/edgoaorder_1066.pdf
9 http://jercuts.gov.in/writereaddata/UploadFile/22-23%20GED%20Tariff%20Order_1205.pdf

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