Economic and Environmental Impact of Diesel Gensets use by Commercial and Industrial Units of Goa

A White Paper

August 2021

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GOA NEEDS RELIABLE GRID POWER

Goa is one of India's small and most vibrant states. With an area of 3,702 sq. km, it has an estimated population of 1.53 million in 2021[1]. As a major tourist destination, the state also has a floating population almost ten times of resident population, who stayed there for more than a week[2].

Goa's dynamic tourism industry together with mining and a diversified manufacturing base has enabled it to achieve the highest per capita gross domestic product (GDP) of US$ 6,698 amongst all Indian states[3]. This is almost two-and-a-half times more than India's per capita GDP. It must be noted here that in the past four decades agriculture has been offering part-time employment to a significant portion of the population[4].

The economic achievements of the state are dependent on power consumption - it ranks first amongst states with a per capita power consumption of 2,396 kilo-watthours (kWh) in 2019-20 [5]. Its installed generation capacity is 595.77 megawatt (MW) (as of May 2021)[6]. A White Paper [7] published by Goa recently determined that 40% of the power consumption is by the commercial and industrial units. Figure 1 presents the electricity consumed by different consumers in Goa during 2018-19[8].

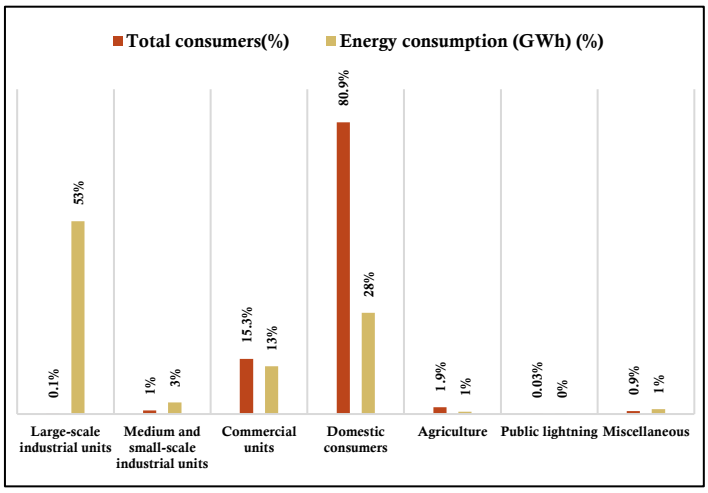

Figure 1: Electricity consumed by different consumers in Goa

According to the Central Electricity Authority (CEA) the peak demand of the state was around 625 MW in FY 2019-20[9]. However, the state's annual electricity consumption in 2018-19 was 3787 GWh[10] which is significantly more than it can produce. According to the study conducted by the CEA in 2019, the peak demand is expected to almost double in the next 15 years. The projected peak electricity demand of Goa would be 684 MW based on Partial Adjustment Model (PAM) baseline scenario and 1,285 MW based on Seemingly Unrelated Regression (SUR) baseline scenario in the year 2037[11]. Figure 2 presents the forecast of peak electricity demand from 2023-37.

[1] https://www.census2011.co.in/census/state/goa.html
[2] https://www.goatourism.gov.in/tourist-arrival-statistics/
[3] https://en.wikipedia.org/wiki/List_of_Indian_states_and_union_territories_by_GDP_per_capita
[4] http://www.iloveindia.com/states/goa/economy.html
[5] https://cea.nic.in/dashboard/?lang=en
[6] https://cea.nic.in/installed-capacity-report/?lang=en
[7] https://cea.nic.in/wp-content/uploads/general/2020/GR_2020.pdf
[8] https://cea.nic.in/wp-content/uploads/general/2020/GR_2020.pdf
[9] https://www.manthan-india.org/wp-content/uploads/2021/02/Mollem-Note-FINAL-ManthanV2.pdf
[10] https://cea.nic.in/wp-content/uploads/general/2020/GR_2020.pdf
[11] https://cea.nic.in/old/reports/others/planning/pslf/Long_Term_Electricity_Demand_Forecasting_Report.pdf

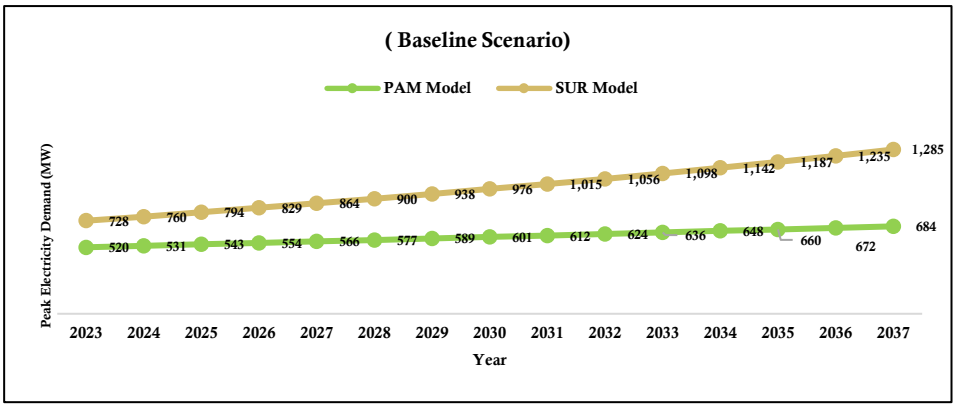

Figure 2: Forecasted peak energy demand (2023-2037)

The current power demand of the state is being partially met through imports from both the Western and Southern grid[12] - providing a total of 492 MW[13]. The reliability of power supply from the Southern Grid is expected to improve after the construction of a substation. However, the state is suffering from frequent outages/interruptions due to multiple issues in the power transmission such as overloaded/inefficient Extra High Voltage sub-stations and transformers[14].

Due to the lack of reliable grid power, the state is heavily dependent on diesel gensets. According to the CEA[15], the industrial units of Goa generated 30.86 giga-watt hours (GWh) electricity in 2018-19 only from diesel. It was also reported that during 2018, the per capita diesel consumption of Goa was 225.6 kg- three and a half times higher than the national average of 66.9 kg[16].

The cost of power generation through diesel gensets is high largely on account of the high cost of the fuel[17]. As per India Infrastructure Research, the average capital cost of a liquid fuel (diesel/naphtha/kerosene/furnace oil)-based plant works out to ₹ 34 million per MW. The cost of power generation from a diesel genset can range from Rs 16 per unit to Rs 40 per unit[18] resulting in additional cost to the units. This per unit cost would have now increased by 23% on account of the recent rise in fuel prices across the country. This in turn increases the cost of production and reduces competitiveness of the industry in Goa. Reduced profit margins result in lower capital investments in the state vitiating the economic growth cycle.

Additionally, frequent usage of diesel gensets causes a severe impact on human health as well as the surrounding environment. The National Clean Air Programme (NCAP) of the Government of India identifies diesel generators as the major source of air pollution in Indian cities and states.[19]

[12] https://timesofindia.indiatimes.com/city/goa/entire-state-will-draw-power-from-western-grid-cabral/articleshow/69833160.cms
[13] https://www.goaelectricity.gov.in/Regulations/White%20Paper.pdf
[14] https://www.goaelectricity.gov.in/Regulations/White%20Paper.pdf
[15] https://cea.nic.in/wp-content/uploads/general/2020/GR_2020.pdf
[16] https://www.thegoan.net/perspective/electricity-needs-of-a-growing-goa/64105.html
[17] https://powerline.net.in/2018/01/06/backup-power/
[18] https://powerline.net.in/2018/01/06/backup-power/
[19] https://www.sciencedirect.com/science/article/pii/S2590162120300368

A study by Pandey *et.al.* (2020)[20] attributed approximately 1.67 million deaths to air pollution in India during 2019, accounting for 17.8% (15.8-19.5) of the total deaths in the country.

An online repository Urban Emissions Info [21] shares that in the year 2018, diesel generators in Panaji, the capital of Goa, emitted 400 $PM_{2.5}$, 450 PM_{10}, 2,800 NO_x and 8,900 CO. Besides, the total greenhouse gases (GHG) emission in 2013-14 in Panaji city stood at 144,599 tonnes of CO_2, with the commercial and institutional sector (including industries) contributing 30.6%[22]. The emissions from continuous operation of diesel gensets have been identified by the Goa Pollution Control Board[23] as one of the contributors to air pollution that is preventing the state from becoming an environment-friendly tourism and industrial destination.

The Government of Goa has adopted several measures to reduce the pollution generated from diesel gensets. These measures include providing subsidies on solar energy, directing industries and other establishments to retrofit all operational diesel gensets with the capacity of 125 KVA and above with emission control devices, amongst others. In addition, it has mandated that installation of diesel gensets at residential, commercial, and industrial establishments will be made only after securing an approval from the Goa Electricity Department.[24] However as mentioned previously a long-term solution to the power woes of the state and resulting economic and environmental challenges can only be addressed by a regular and reliable grid power supply.

E2 IMPACTS OF UNRELIABLE GRID POWER IN GOA

Earlier this year, Insight Development Consulting Group (IDCG) conducted a study to gain a better understanding about the present scenario of power supply in Goa with special focus on economic and environment (E2) impact of diesel gensets used by commercial and industrial units in the state.

The study was conducted by adopting a mixed methods approach including review of secondary data and primary research. The study obtained 215 primary responses across a cross-section of the commercial and industrial establishments from the state, *viz.* shacks, shops, hotels and restaurants (large, medium & small), healthcare institutes, government offices, educational institutes, industries (large, medium & small) and fisheries/cold storages. Interactions with local industry associations were conducted to triangulate the findings and obtain a reasonable understanding of the existing situation.

[20] https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(20)30298-9/fulltext#%20
[21] https://urbanemissions.info/india-apna/panjim-india/
[22] https://indianexpress.com/article/india/india-news-india/ghgs-emission-in-panaji-3-times-more-than-national-average-green-house-gas-pollution-2887793/
[23] http://goaspcb.gov.in/Media/Default/uploads/17731.pdf
[24] https://www.goa.gov.in/wp-content/uploads/2016/05/Electricity-Dept-Charter.pdf

DIESEL POWER IS EXPENSIVE

Daily outages of up to two hours are a norm in the state - with all respondents confirming it. Approximately 84% and 92% of the respondents from North Goa and South Goa respectively reported power outages. Figure 3 presents the average hours of availability of grid power to commercial and industrial consumers.

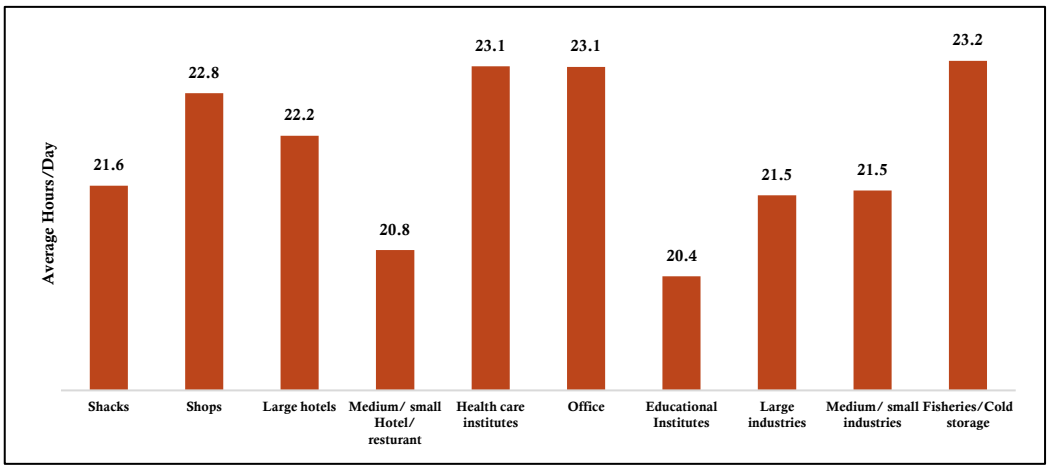

Figure 3: Average grid electricity availability per day

All responding industrial units and hotels have captive diesel gensets. Amongst them, all large-scale industries and hotels and three-fourths of medium and small-scale industries are greatly dependent on gensets to meet their power requirements. Except government offices, all categories of respondents were dependent on diesel gensets to some extent. This was further validated during interactions with the Goa State Industries Association. The key reasons for these outages identified by the respondents are maintenance work and power demand & supply mismatch.

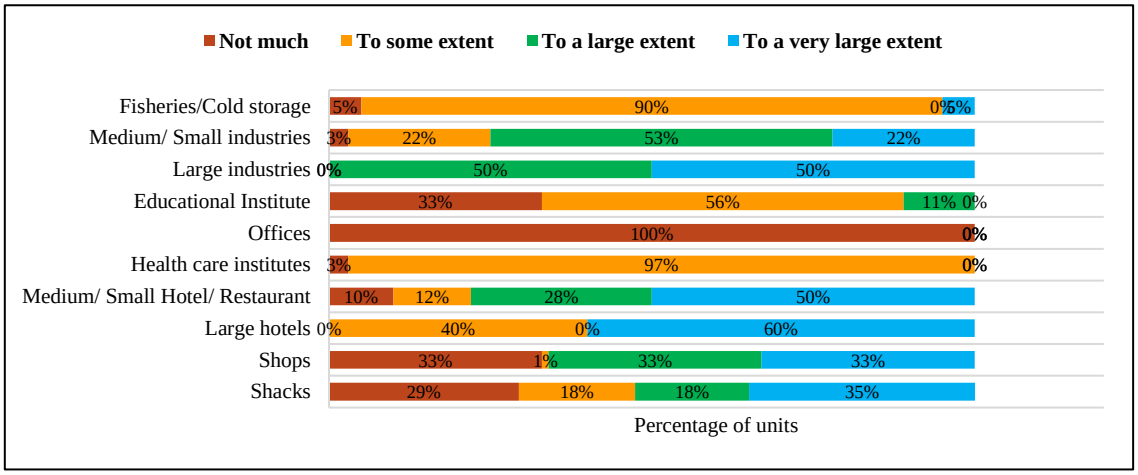

Figure 4: Dependency of surveyed units on Diesel gensets

The dependence of diesel gensets range from none in government offices to over a fifth of power needs for shacks. It may not be incorrect to say that about a tenth of the power needs of the commercial and industrial units are being met through diesel gensets. Solar rooftop plants have

been installed at many units especially government offices with 35% of their power needs being met by it. However, respondents informed that requirements of both large area and capital for solar or renewable plants has further reinforced the dependence on diesel gensets.

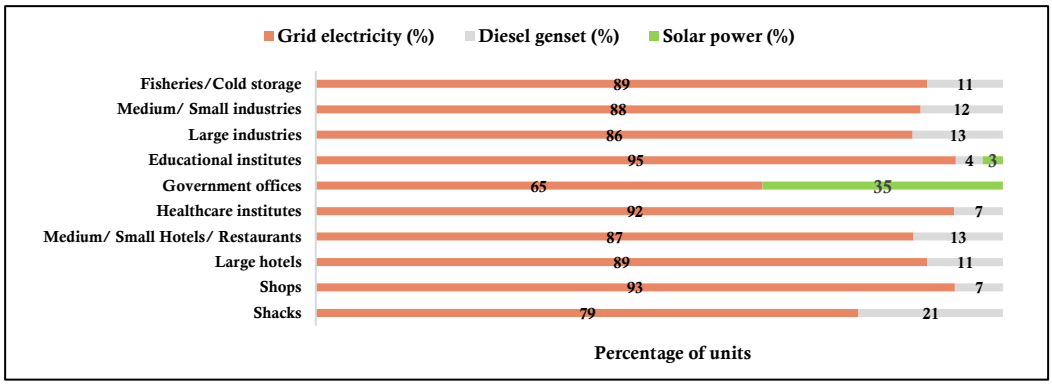

Figure 5: Proportion of electricity demand met through different power generation units

Meeting a tenth of their power requirements through diesel gensets can be significantly expensive for commercial and industrial units. This means higher cost of production, reduced competitiveness and investable profits. The respondents suggested that the difference in the hourly expenditure of electricity produced through diesel genset by hotels and industries estimated to be 5 to 16 times more compared to grid electricity (see Figure 6). Many industrial units partially or completely shut down their operation during outages as they are not able to meet the high expenses required for running the gensets. These expenses of operating and maintaining diesel gensets could be as high as ₹ 20 million in some cases.

Hotels however are not able to shut operations during outages and continue to operate. Others like shops have invested in inverters or shared diesel gensets to tide over the outage. Some have no power back-up; largely because they cannot even afford the operation and maintenance cost of a shared diesel genset.

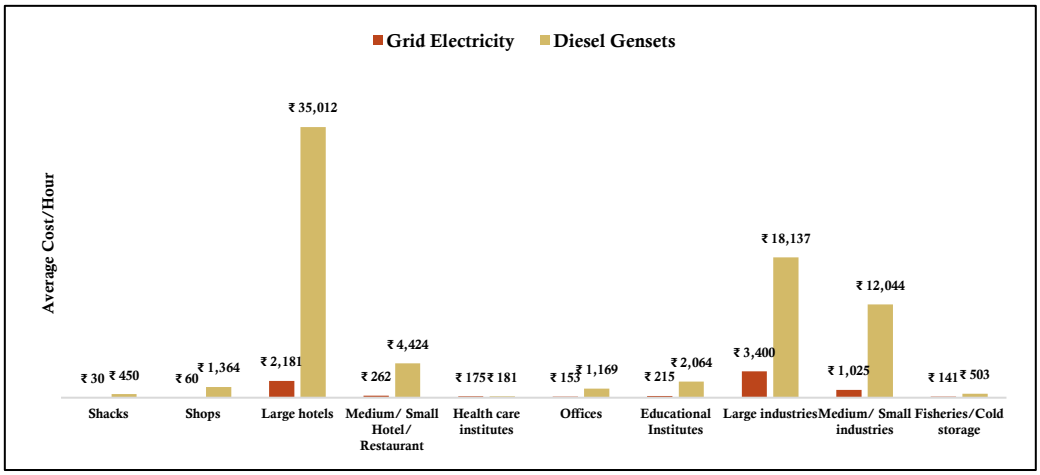

Figure 6: Expenses incurred on usage of grid electricity and diesel genset

DIESEL POWER DAMAGES ENVIRONMENT AND HEALTH

It is widely known that diesel gensets emit harmful gases such as oxides of Nitrogen, Sulphur oxides, carbon monoxide, and particulate matter, *etc.* that substantially reduce the quality of air. The Goa State Pollution Control Board (GSPCB) air quality monitoring report 2018-19 estimated that pollution levels in urban areas of Goa *like.* Margaon, Panaji, Vasco, Ponda, Amona and Mapusa, *etc.* are higher than the permissible limits[25]. In another study in Goa by Prof Lalit Dandona *et.al.*[26] ,719–1130 deaths were attributed to air pollution of which 42.5% were people younger than 70 years. The study also stated diesel gensets as one of the major sources of air pollution.

None of the respondents highlighted the negative impacts of diesel generators on health but agreed with the adverse impact on the environment. It is estimated during the study that diesel gensets emit 1.80 million tonnes of CO_2 annually in Goa which is 0.075% of the total emissions of India during 2020[27]. Though Goa is extensively engaged in increasing the green cover through various plantation and conservation measures, it is estimated that almost 86 million trees[28] are required to be planted annually to offset the CO_2 emissions caused only from the usage of diesel gensets by commercial and industrial units.

RELIABLE GRID POWER IS THE ANSWER

Goa's economic base of tourism and industry suffers financially due to power outages. The environment of the state gets adversely impacted by the pollution that is caused by diesel gensets that help overcome the challenges caused by these outages.

Strengthened power transmission and distribution infrastructure can significantly reduce both these negative impacts on E2 and also help Goa meet its clean energy goals.

While the distribution network in the state is being upgraded through undergrounding, the transmission infrastructure requires significant multi-state investments. Further state needs to enhance overall availability of the power supply for the medium to long term.

The availability of grid power will also significantly reduce CO_2 emissions in the state by a third. It is estimated that burning a litre of diesel 0.3 KWh of power and generates around 2.67 kg of CO_2 whereas 1 KWh of grid electricity generates 0.82 kg[29,30] of CO_2. This reduction will improve the overall environment of the state enhancing its status as a green, sustainable part of the world.

[25] http://goaspcb.gov.in/Media/Default/uploads/APRIL%202018%20TO%20MARCH%202019.pdf
[26] https://www.thelancet.com/action/showPdf?pii=S2542-5196%2818%2930261-4
[27] https://www.statista.com/statistics/1119152/annual-carbon-dioxide-change-in-india/
[28] ttps://www.viessmann.co.uk/heating-advice/how-much-co2-does-tree-absorb
[29] https://cea.nic.in/wp-content/uploads/baseline/2020/07/user_guide_ver14.pdf
[30] http://erpc.gov.in/wp-content/uploads/2018/06/carbon-emissions-from-power-sector-7062018.pdf