

India Electrical Power Supply & Demand – Solar, Wind, Coal and Gas – A Comparison

Reducing global warming in a meaningful way

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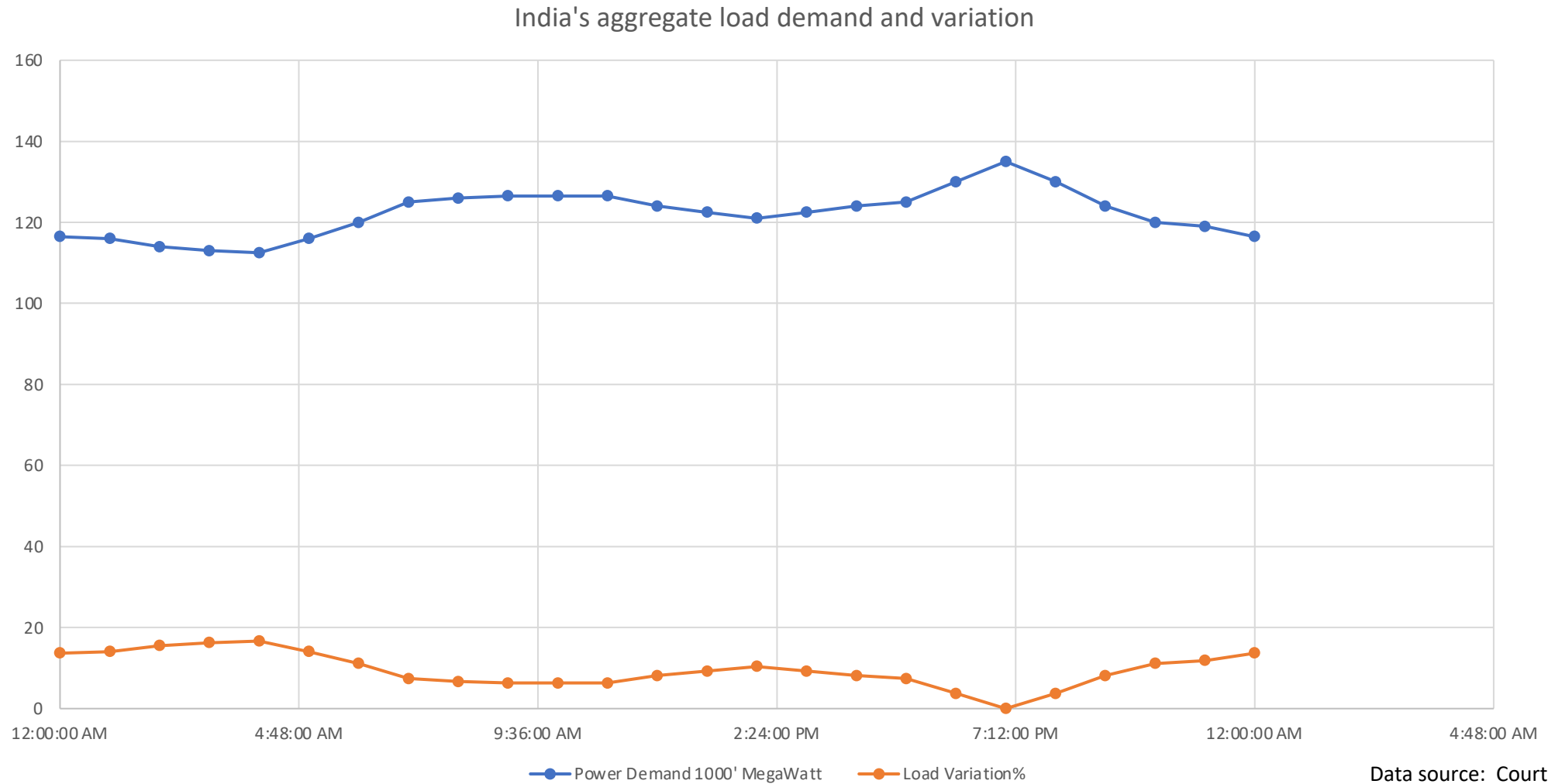
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Commentary

1. India: Surprisingly, despite the installed coal fired power generation capacity share of 56.9% of the total generation capacity, it supplies 71.5% of India's power demand; and it is primarily used to balance supply & demand.
2. Daily normal power demand variation is @15% or about 20,000 MW-hr. (slide 3).
3. *Solar + Wind power combined supply variation (slide 4, 5,6) can be 50%. This large variation of up to 25,000+ Megawatt-hr aggravates the grid load balancing. The thermal efficiency of the coal fired boilers and steam turbine power generators falls when it idles during high Wind and Solar power supply period (slide 7).*
4. These large & long duration variations are also unlikely to met by battery, hydel or hydrogen power storage.
5. One power system subsidizing the other power system is unfair and could lead to litigations.
6. USA/China/India/EU/Russia/Saudi Arabia/Brazil are the largest users of electrical energy with large variations in demand and supply. Demand for reduction in usage of hydrocarbons has become an emotional issues – this should be eschewed. *This pursuit without fully understanding the electrical load balancing requirements is only exacerbating the global climate problem.*
7. Talk to us, if you need our assistance to develop a real green national power strategy.



Aggregate daily electrical load demand and variance India - 2019



Data source: Courtesy: Kajal Gaur, PSOC Ltd.



India - Solar, Wind, Coal and Gas - Comparison Installed Power – Supply – Utilization – Market Share - 2020-21

	Solar	Wind	Coal	Gas
Installed generation capacity in MW-hr.	36910.53	38433.55	209294	24924
Installed generation capacity in percentage (%)	10.1%	10.4%	56.9%	6.8%
Total annual power supplied in 20-21 in MW-hr.	60,402,000	60,150,000	981,239,000	51,027,000
Utilization factor percent (%) = Total power gen ÷ (Installed power x 8760)	18.68%	17.87%	53.52%	23.37%
Market share in percentage (%)	4.40%	4.38%	71.47%	3.72%
Comments	Peaks March to June. About 50% output in winter months	Peaks for 5 months. For 6 months it is @20% of peak power	New plants for 50,000 MW-hr. being planned	Gol wants to increase gas share from 6 to 15%
Notes: 1. All values are approximate based on web information. 2. MW-hr. = Megawatt hour, Hydro (11.7) & Nuclear (3.4). 2. Gas share of 6% is based on both power, petrochemicals (including Urea production) and domestic (cooking gas) use.				



Aggregate solar radiation energy variance India wide – annual and daily

Annual Variation in Solar hours	Annual Hours	Percentage
Solar clear sun hours	2856	32.60
Solar hours with cloud cover	1527	17.43
Total hours of Solar power / annum	4383	50.03
Total hours in a year	8760	100.00

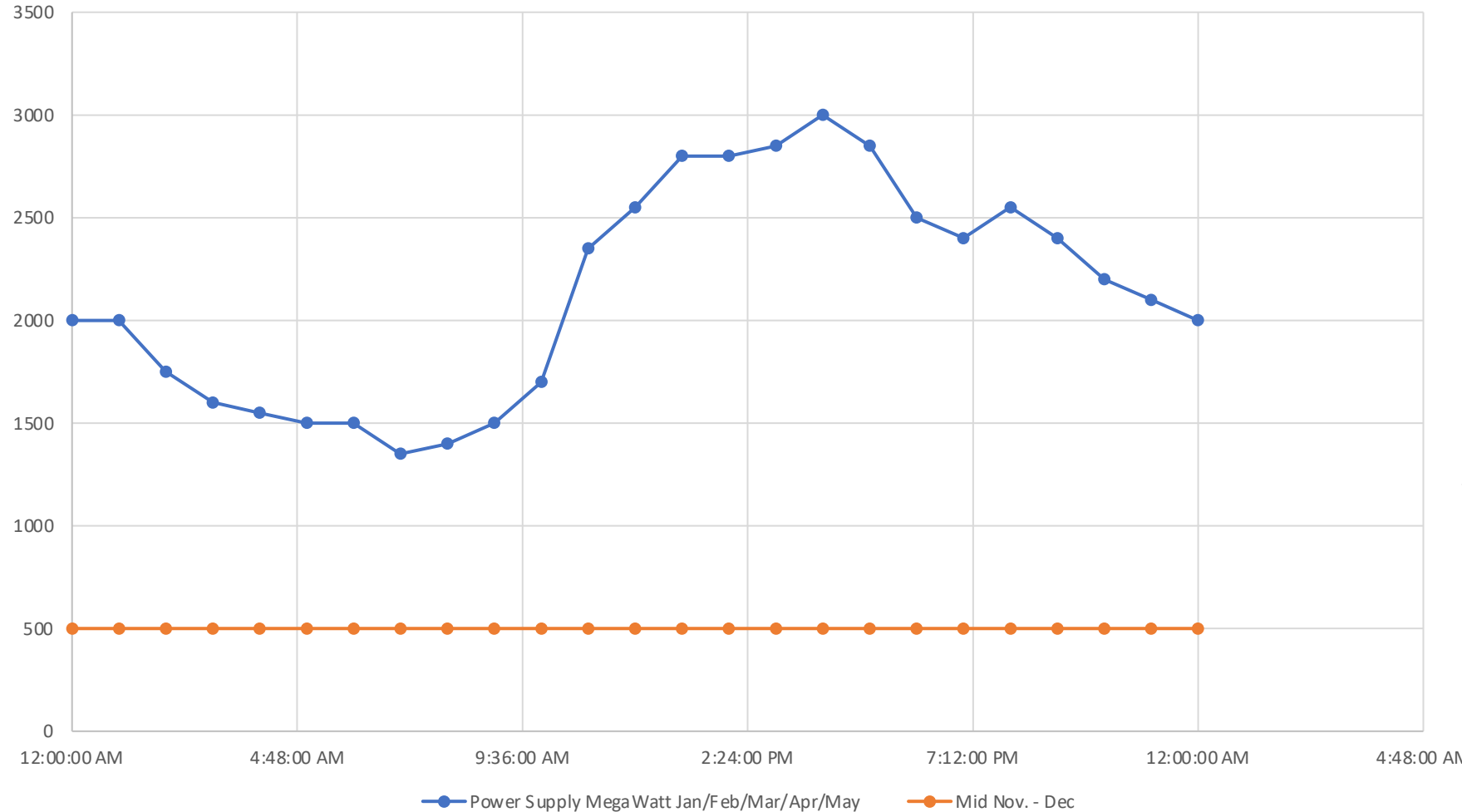
Seasonal Variation in Solar power (beam radiation)	Low (kWh/m ² – day)	High(kWh/m ² – day)	Percent variation over season	Hours of sunlight in a day
Summer (March to June)	2.88	7.88	63.4%	12.98
Rain (July to October)	3.13	6.22	49.72	12.55
Winter (November to February)	4.97	5.17	4.03	10.55

Data source: Estimation of solar radiation and optimum tilt angles for south-facing surfaces in humid, subtropical climatic region of India by B. Jamil et.al. in Science Direct. 2016



Wind energy generation variance in Tamil Nadu (2020)

Aggregate Wind Power Supply – Tamil Nadu



Notes:

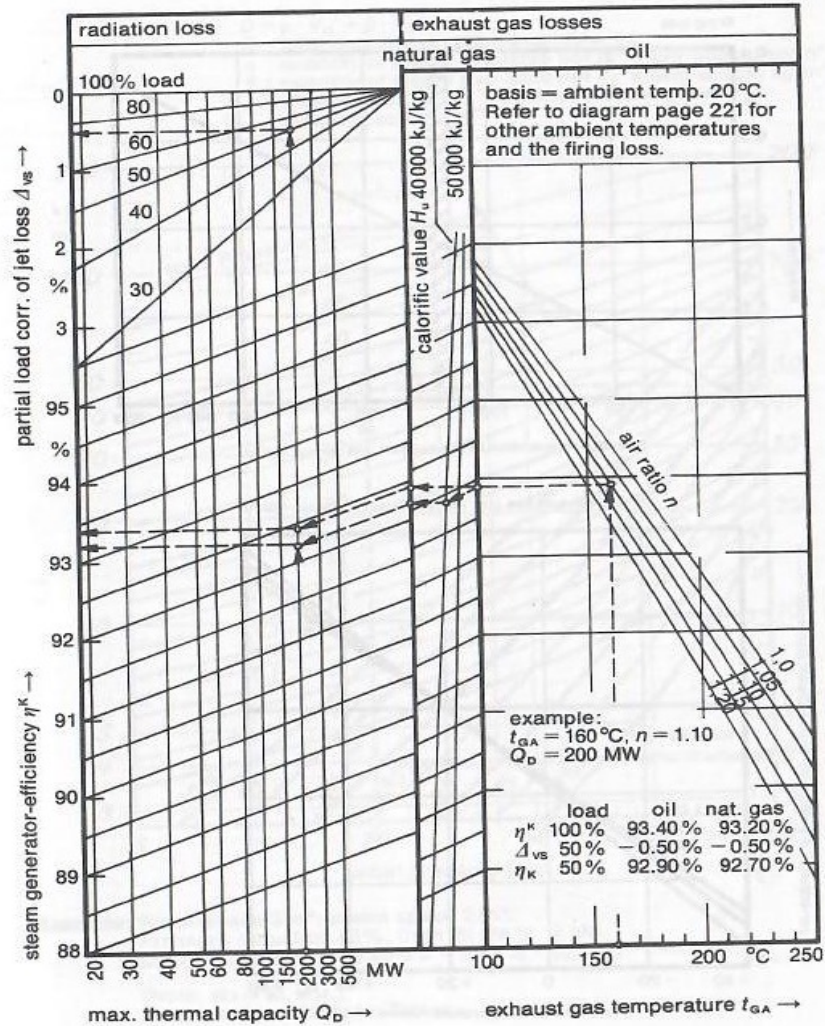
1. June to Mid November the aggregate power supply is less than 200 MW (~10% of the peak season).
2. Most Wind power installations in India are located in the state of Tamil Nadu and Gujarat.

Data source – courtesy Pratha Jhawar of downtoearth.org.in

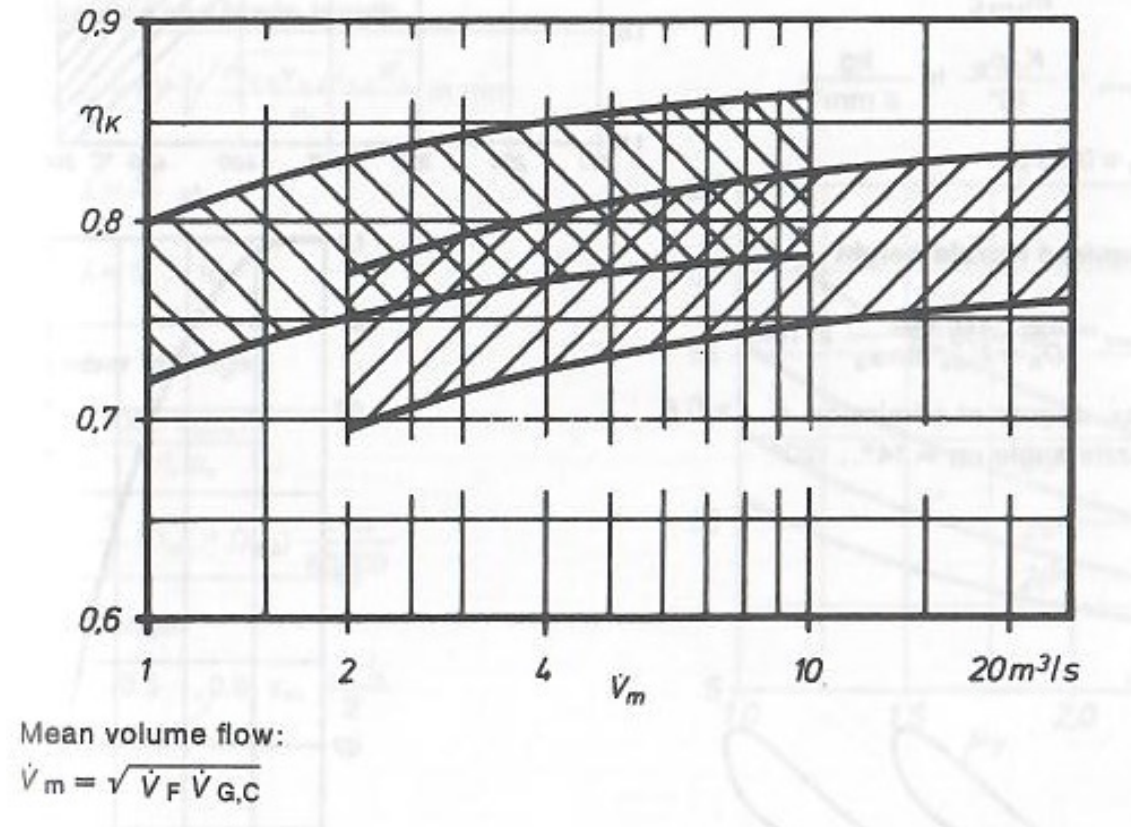


Coal / Gas fired boiler and steam turbine efficiency variation due to change in load

Change in boiler efficiency due to change in load/ flow



Change in turbine efficiency due to change in load/ flow



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