

India's Energy Overview

December 2023

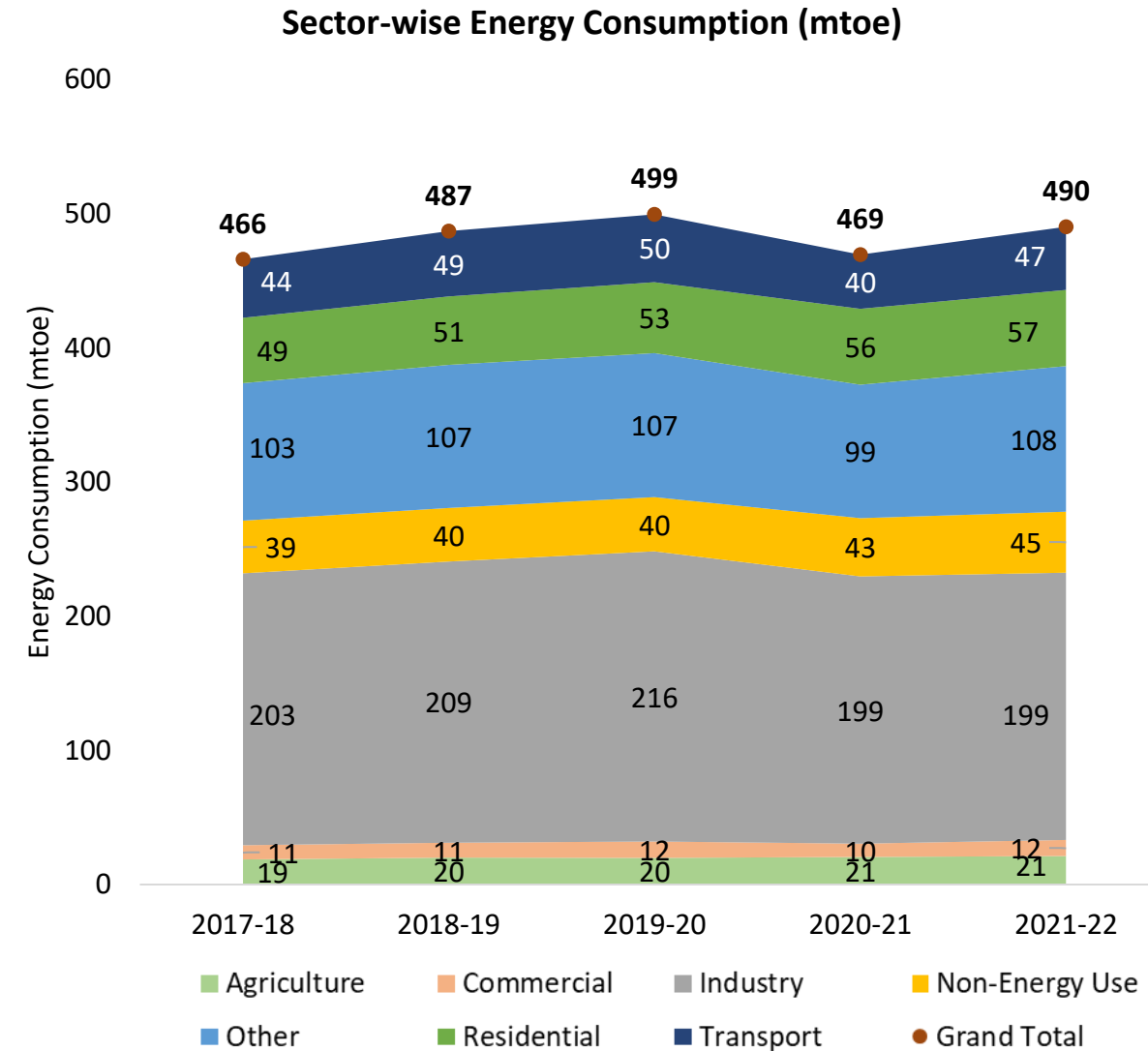
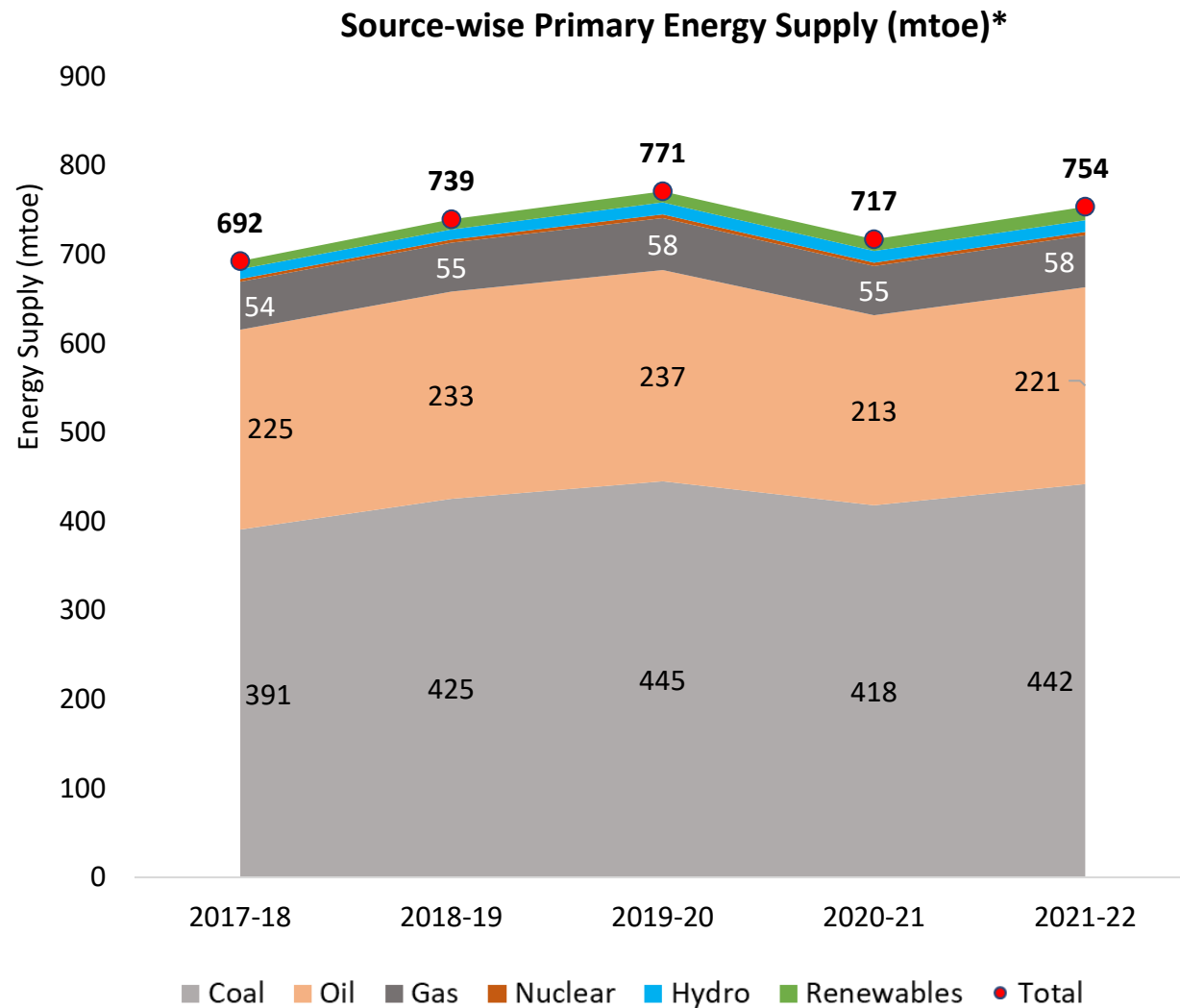


VASUDHA
FOUNDATION
Green ways for a good earth!

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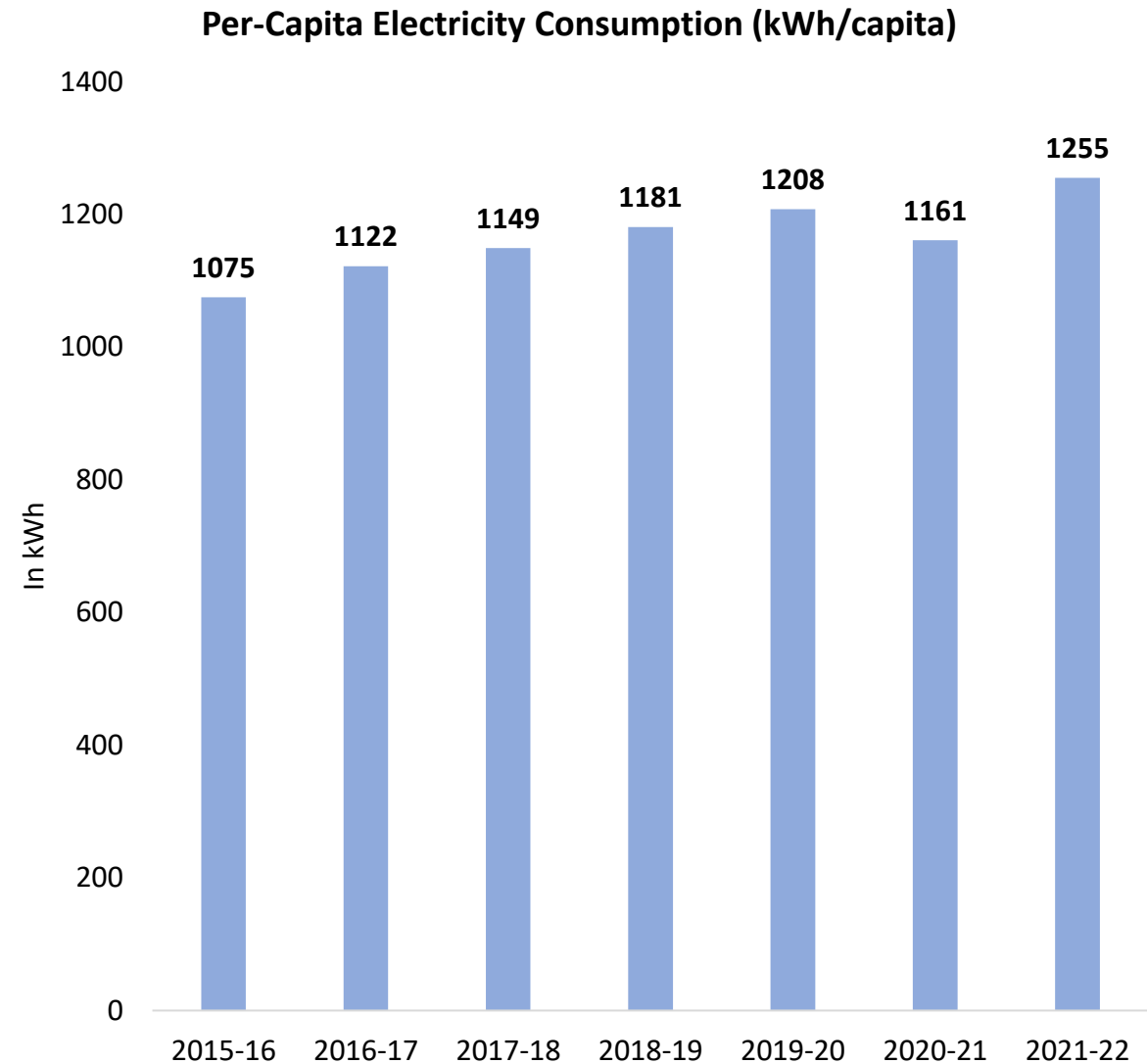
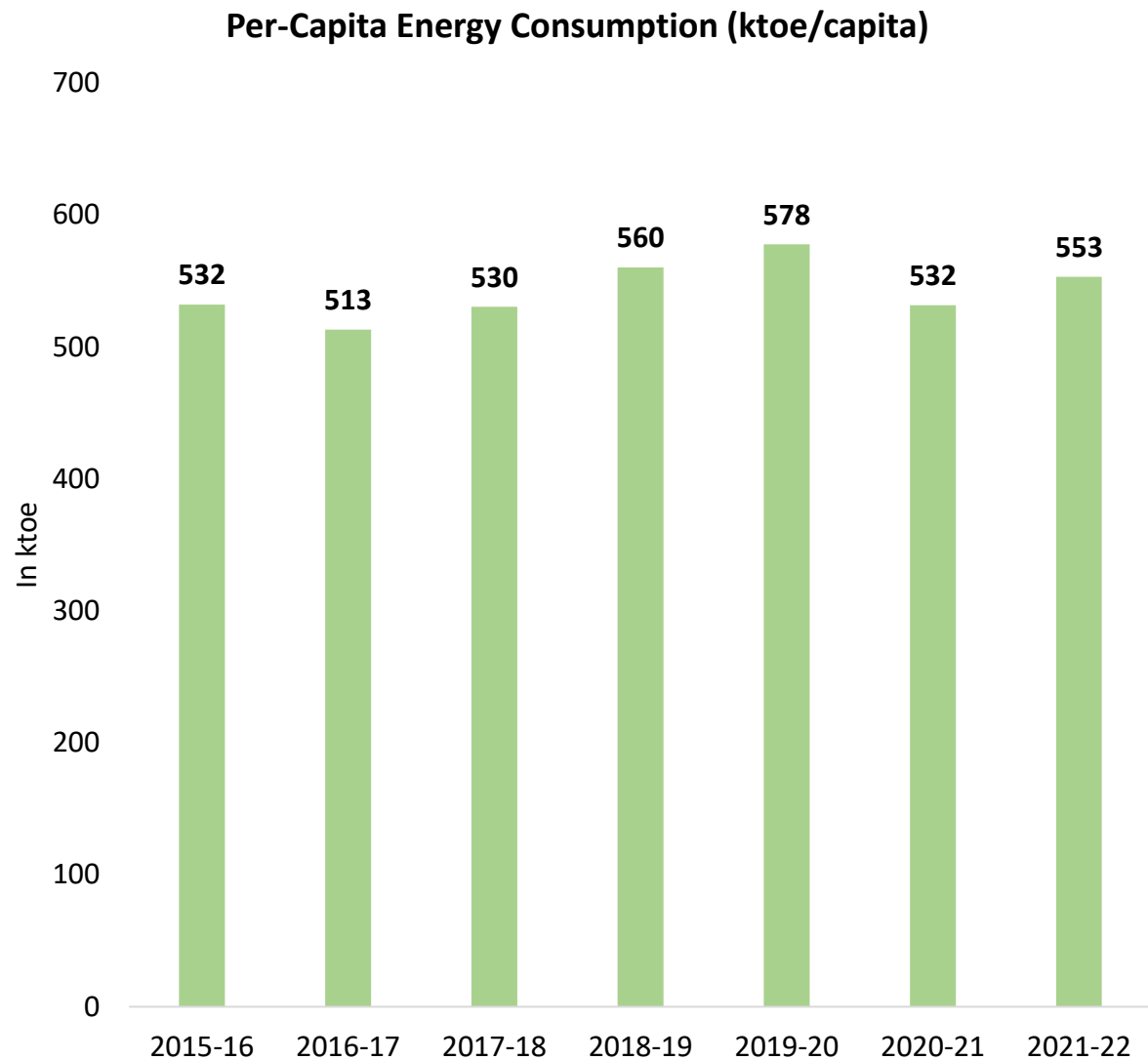
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Primary Energy Mix* in India

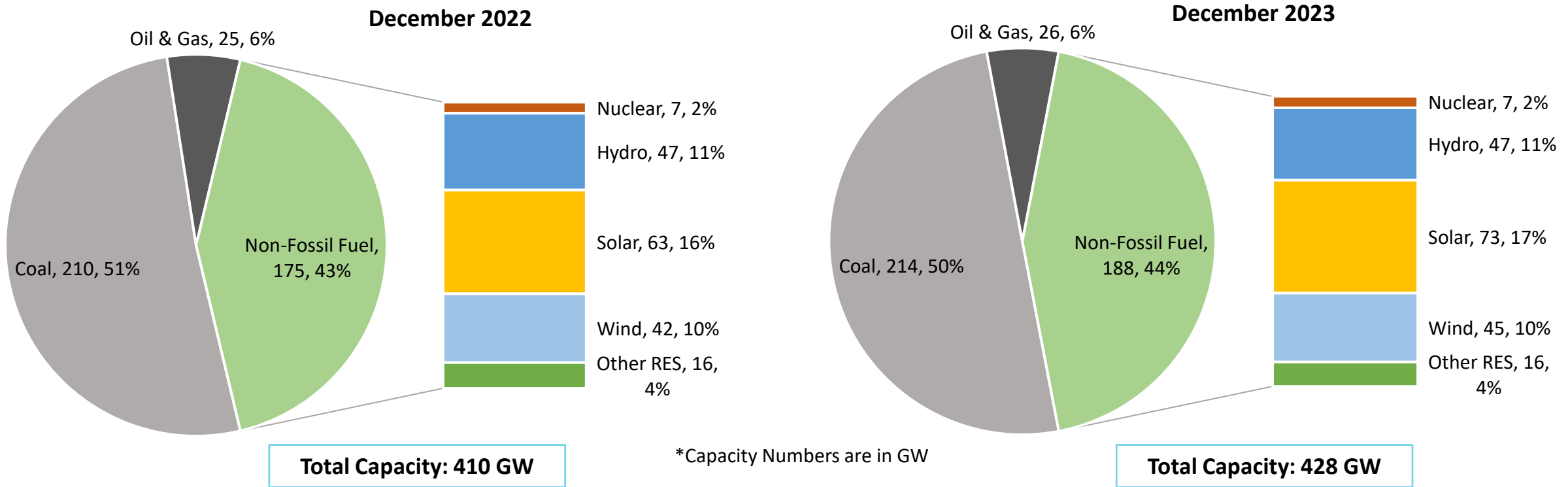


*Excluding biofuels, waste, and other non-commercial source of energy

Per-Capita Energy and Electricity Consumption

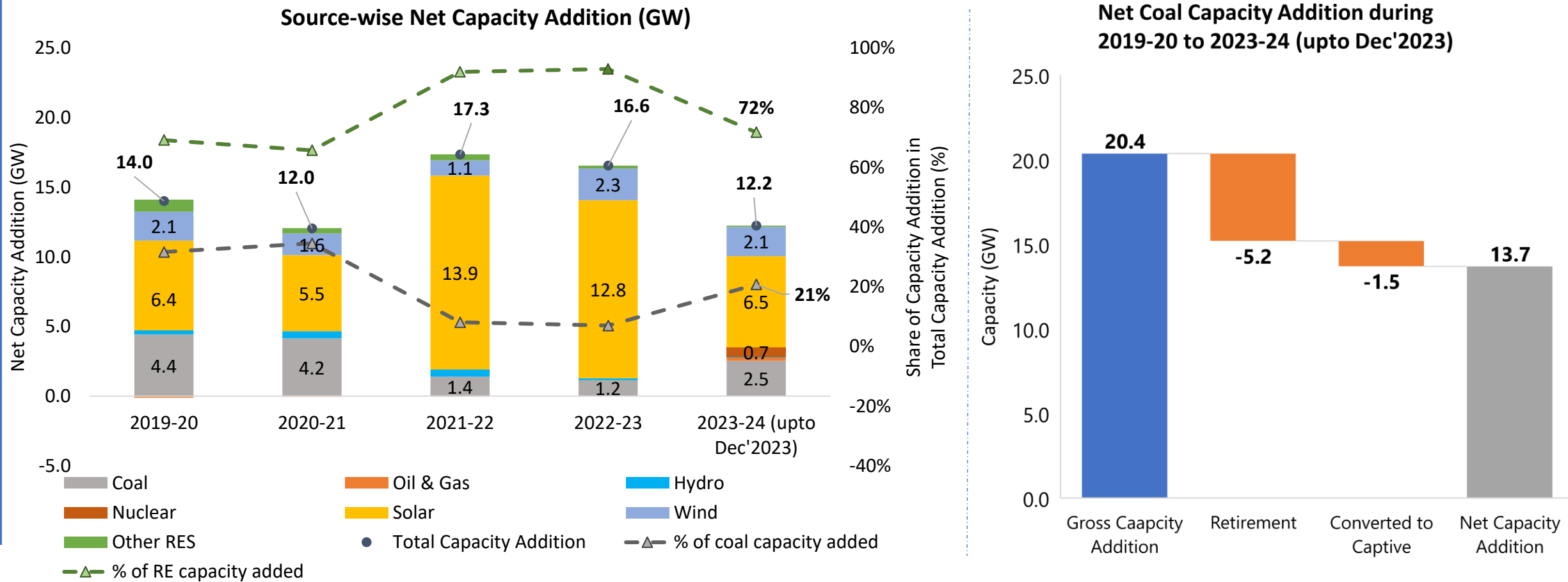


India's Electricity Capacity Mix (Utility-scale)



- India's electricity generating capacity is 428 GW as on Dec'2023 [coal 214 GW (50%), solar 73 GW (17%), hydro 47 GW (11%), and wind 45 (10%)].
- As on Dec'2023, the share of non-fossil-based electricity capacity is 44% against the set target of 50% non-fossil capacity by 2030.
- As on Dec'2023, India's renewable energy capacity (including large hydro) stood at 181 GW out of 428 GW.

India's Electricity Capacity Addition in last 5 years



- A total of 58 GW of generation capacity has been added in RE (Hydro, solar, wind, and other RES) over the past 5 years, whereas the net coal capacity addition during the same period was 14 GW, mostly in the central sector.
- The share of RE addition in total capacity has shown an increasing trend (from 69% in 2019-20 to 93% in 2022-23).

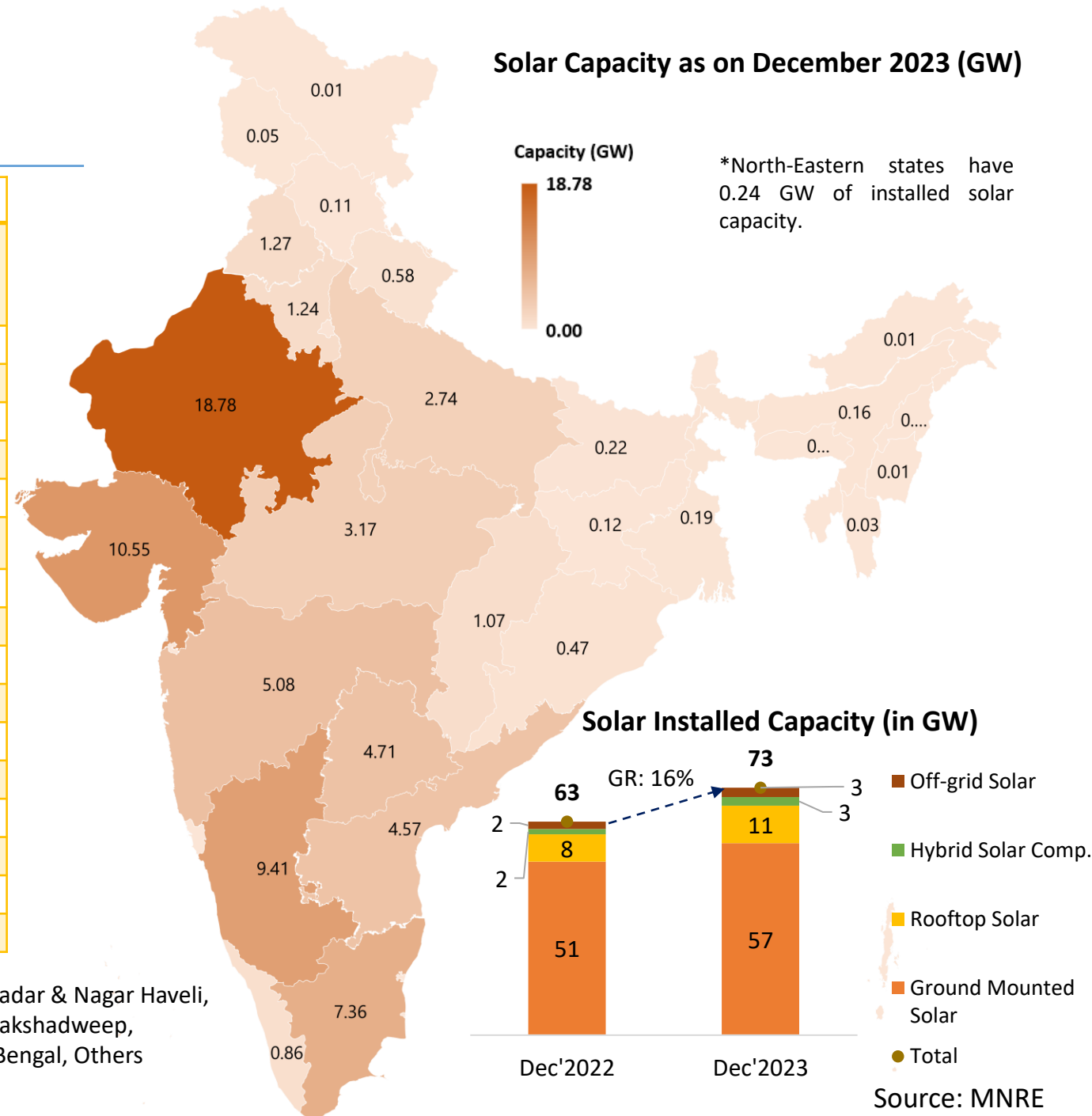
State-wise Solar Capacity

as on December 2023

State-wise installed capacity of Solar Power (GW)					
States	Ground Mounted	Rooftop	Solar Component in Hybrid	Off Grid	Total Solar Power
Rajasthan	15.2	1.0	2.0	0.6	18.8
Gujarat	7.0	2.9	0.6	0.1	10.5
Karnataka	7.8	1.6	0.0	0.0	9.4
Tamil Nadu	6.8	0.4	0.0	0.1	7.4
Maharashtra	3.1	1.7	0.0	0.3	5.1
Telangana	4.4	0.3	0.0	0.0	4.7
Andhra Pradesh	4.3	0.2	0.0	0.1	4.6
Madhya Pradesh	2.8	0.3	0.0	0.1	3.2
Uttar Pradesh	2.3	0.3	0.0	0.2	2.7
Punjab	0.9	0.3	0.0	0.1	1.3
Haryana	0.3	0.5	0.0	0.5	1.2
Chhattisgarh	0.6	0.1	0.0	0.4	1.1
Kerala	0.3	0.5	0.0	0.0	0.9
Uttarakhand	0.3	0.3	0.0	0.0	0.6
Others	0.9	0.7	0.0	0.3	1.9
All India	56.9	11.1	2.6	2.8	73.3

Others include- Andaman & Nicobar, Arunachal Pradesh, Assam, Bihar, Chandigarh, Dadar & Nagar Haveli, Daman & Diu, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Ladakh, Lakshadweep, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Puducherry, Sikkim, Tripura, West Bengal, Others

Solar Capacity as on December 2023 (GW)

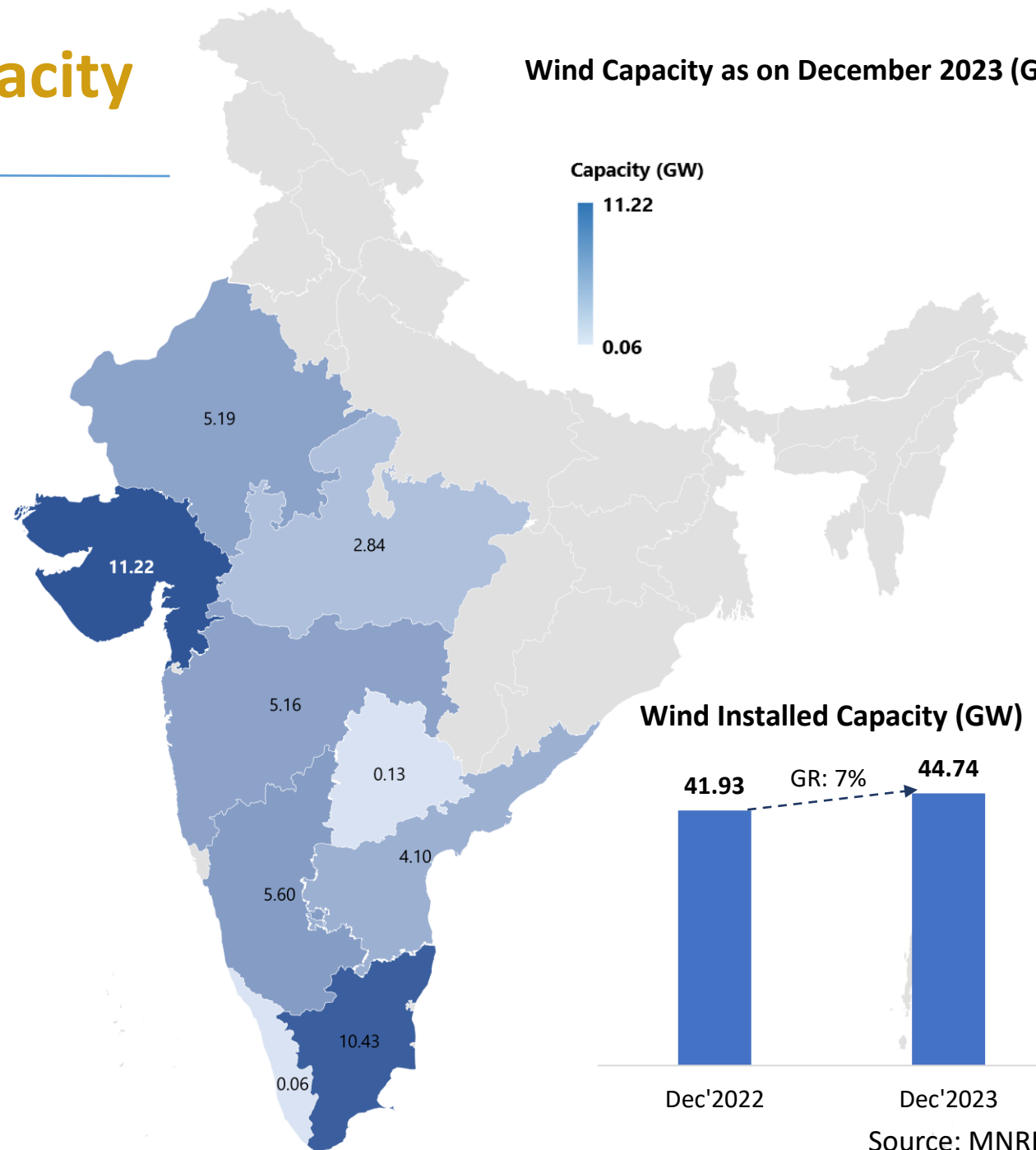


State-wise Wind Onshore Capacity

as on December 2023

Wind Capacity as on December 2023 (GW)


State-wise installed capacity of Wind (Onshore) Power	
States	Installed Capacity (GW)
Gujarat	11.22
Tamil Nadu	10.43
Karnataka	5.60
Rajasthan	5.19
Maharashtra	5.16
Andhra Pradesh	4.10
Madhya Pradesh	2.84
Telangana	0.13
Kerala	0.06
India Total	44.74

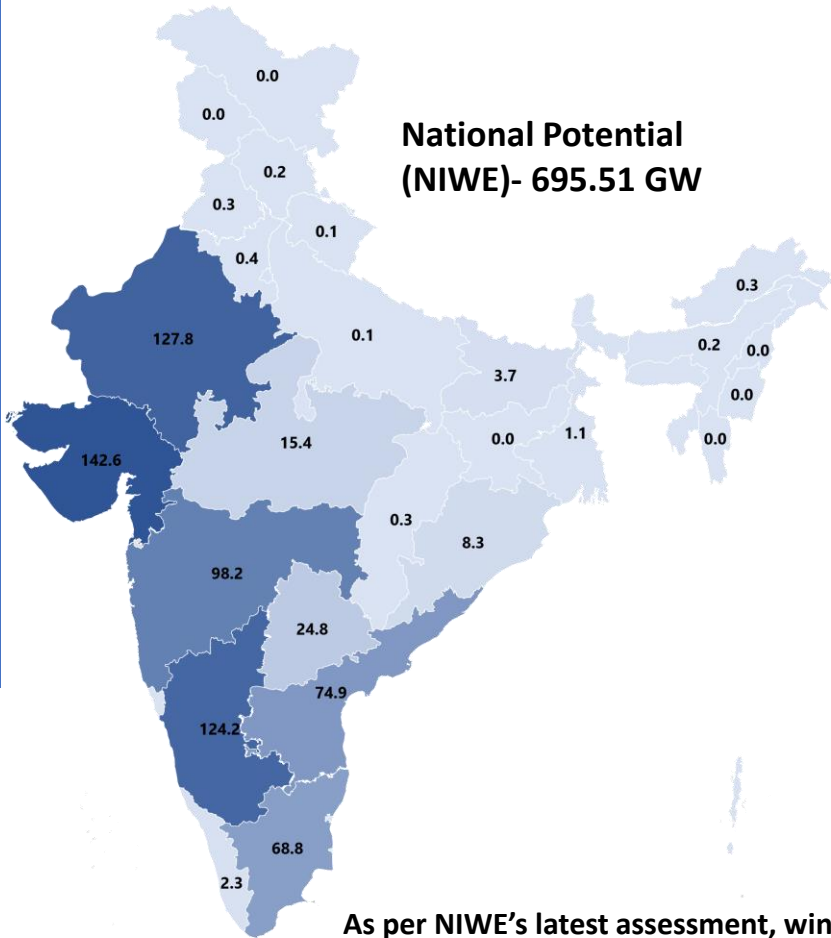


RE Potential and Installed Capacity (1/2)

RE potential in the state

Wind Onshore Potential at 120m agl


State Potential (GW)  0.0 142.6

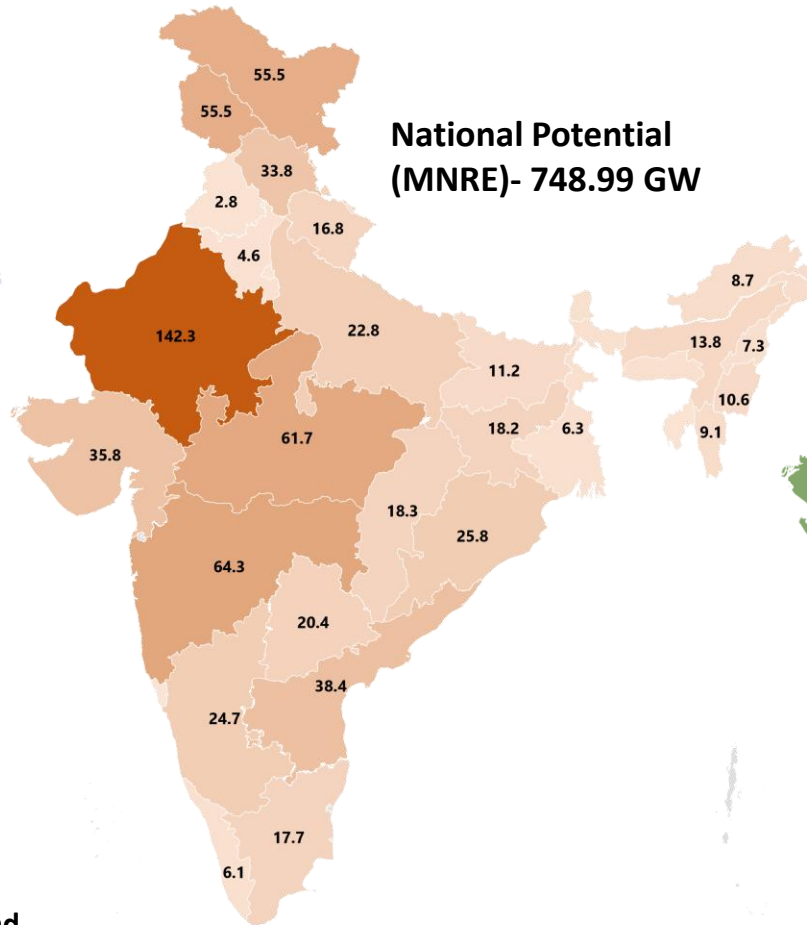


National Potential (NIWE)- 695.51 GW

As per NIWE's latest assessment, wind potential at 150m agl is 1164 GW.

Solar Potential


State Potential (GW)  0.9 142.3

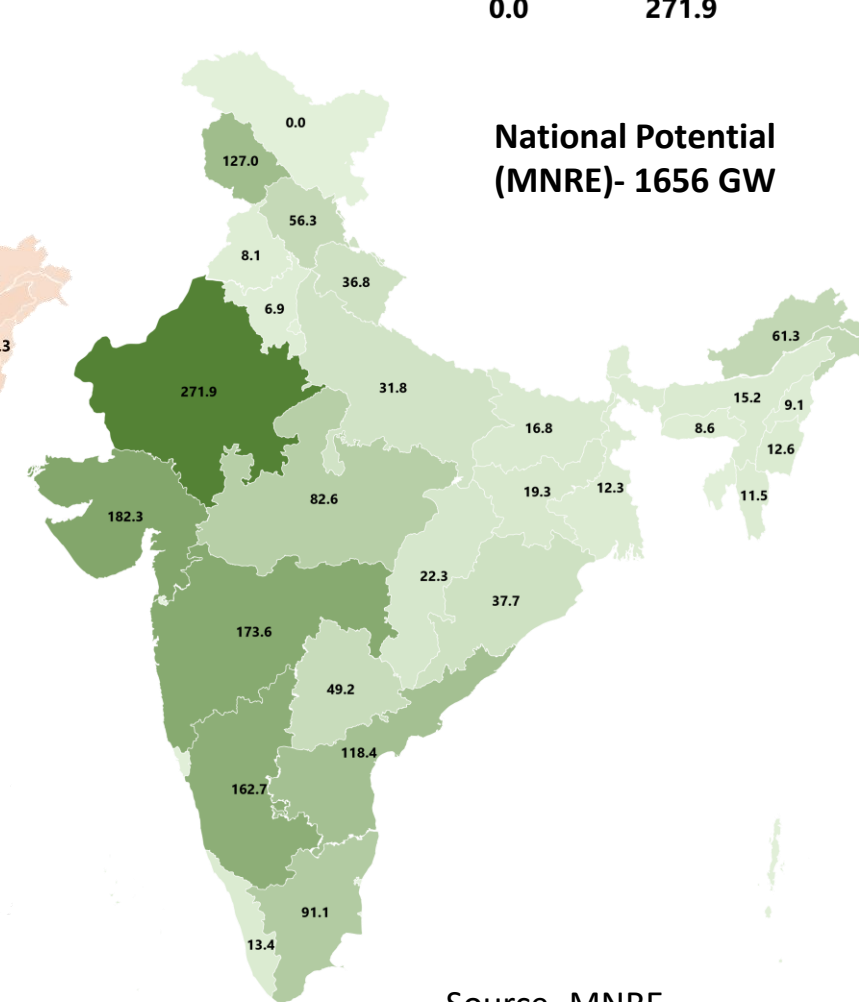


National Potential (MNRE)- 748.99 GW

Market potential for SPV rooftop is 124 GW.

Renewable Energy Potential (all sources including large Hydro)

State Potential (GW)  0.0 271.9



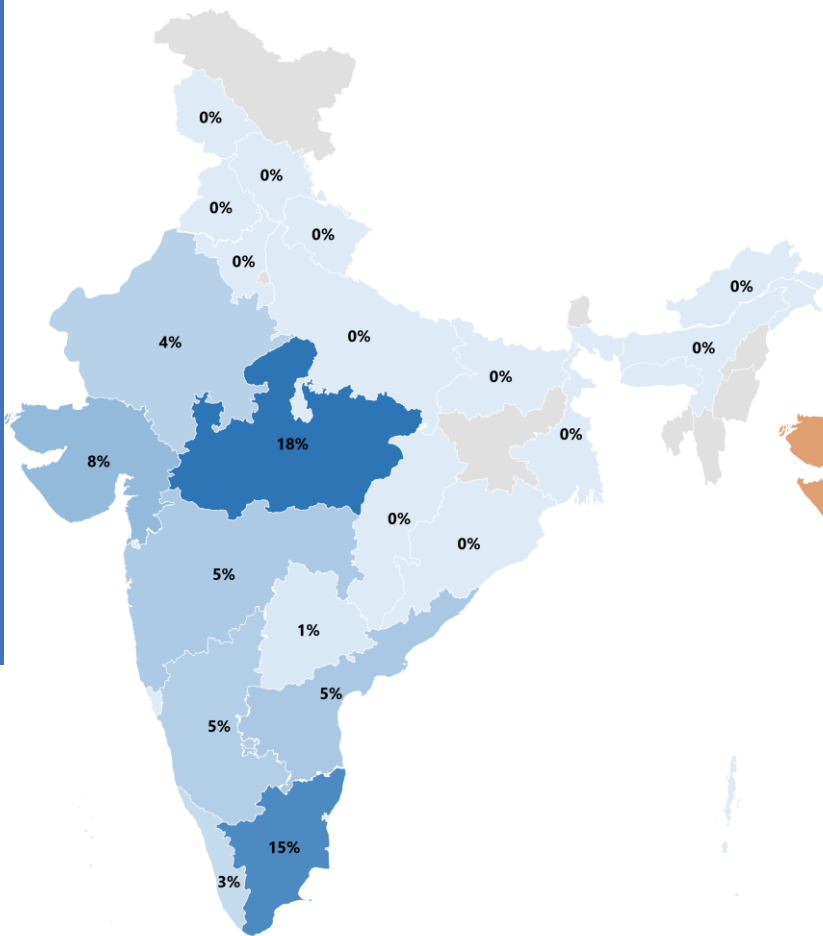
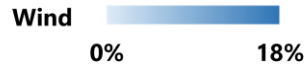
National Potential (MNRE)- 1656 GW

Source- MNRE

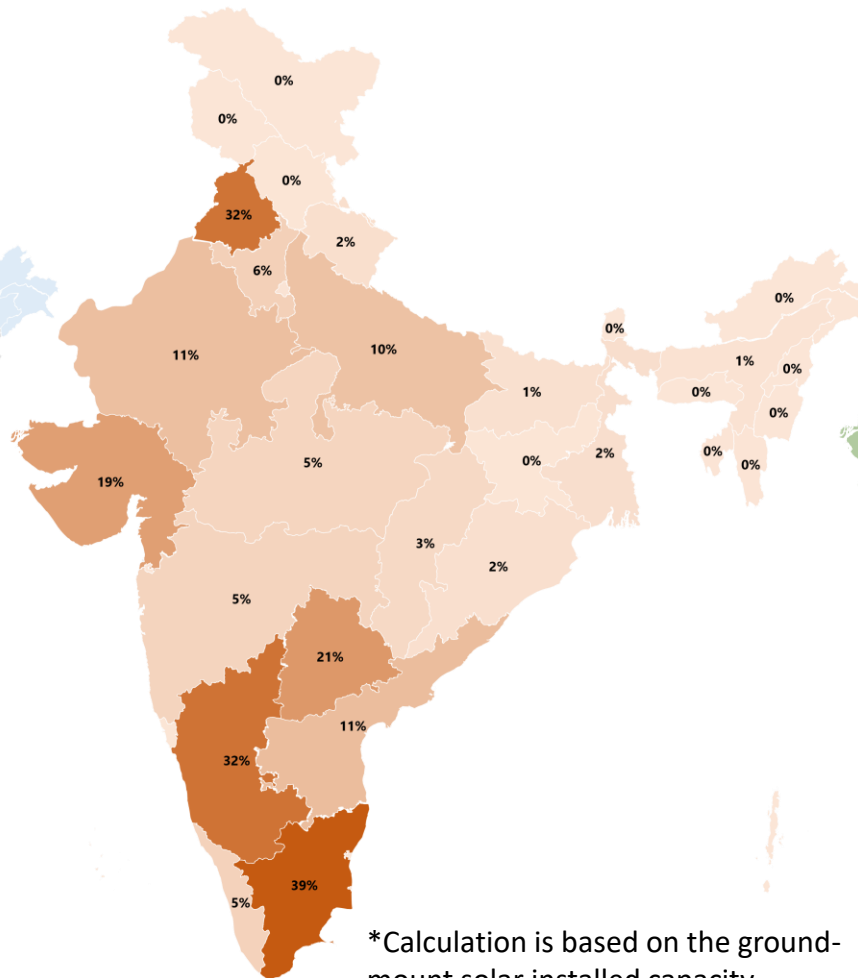
RE Potential and Installed Capacity (2/2)

RE Installed capacity as a Percentage of the total resource potential in the state as on December 2023

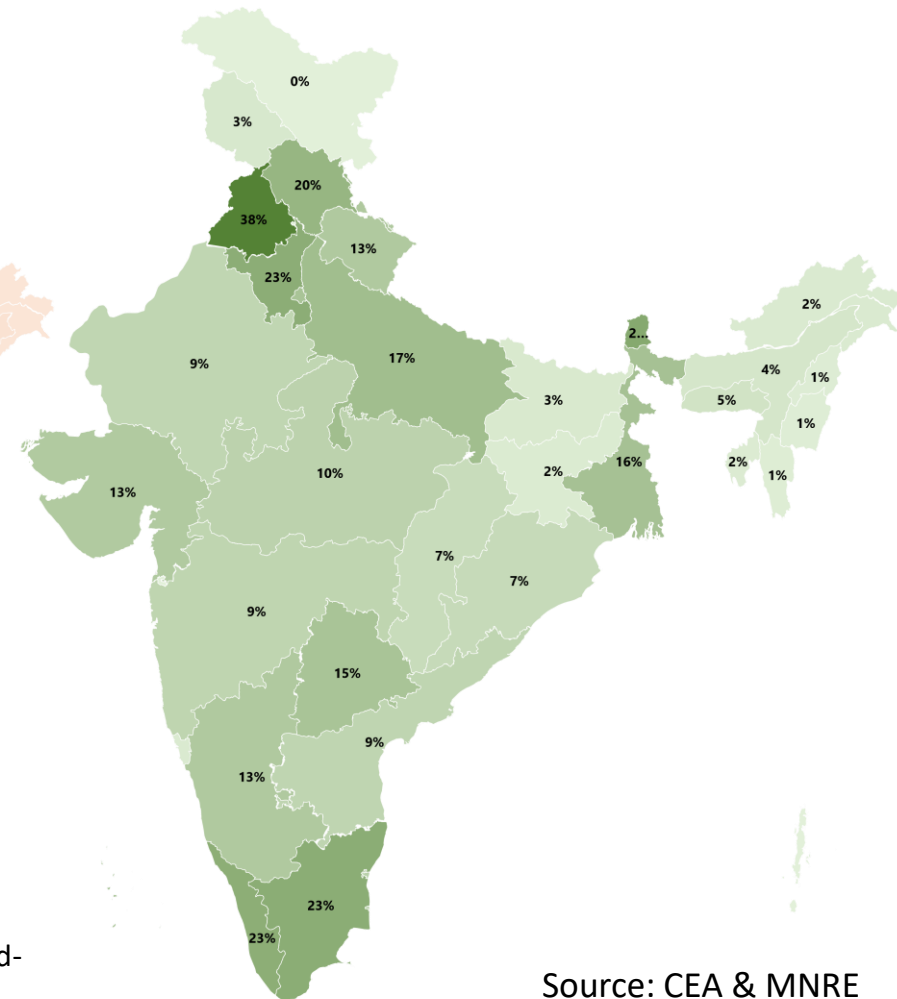
Wind Onshore Capacity



Solar Capacity*



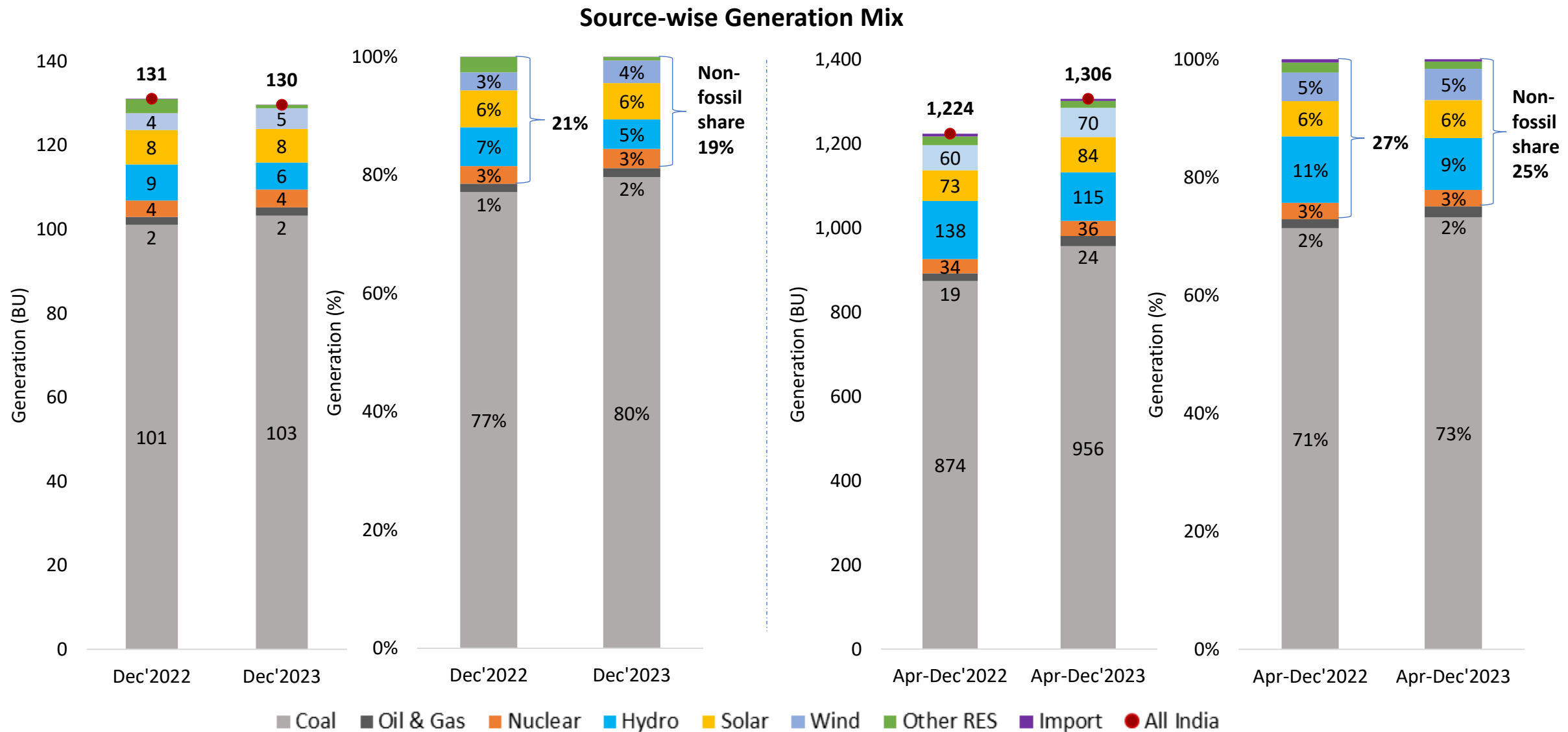
RE Capacity (all sources including large hydro)



*Calculation is based on the ground-mount solar installed capacity.

Source: CEA & MNRE

India's Electricity Generation Mix

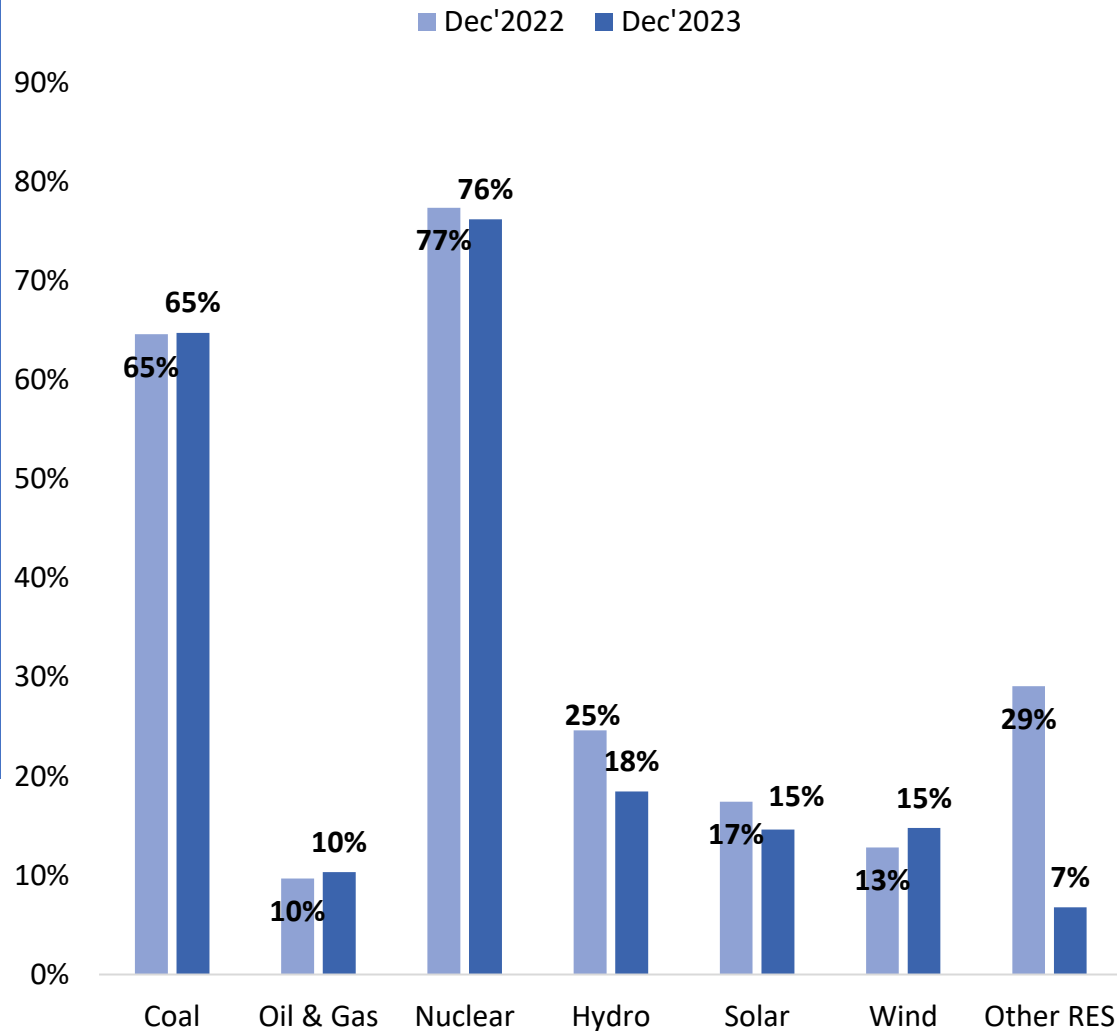


NOTE: The generation data for Dec'2023 is provisional.

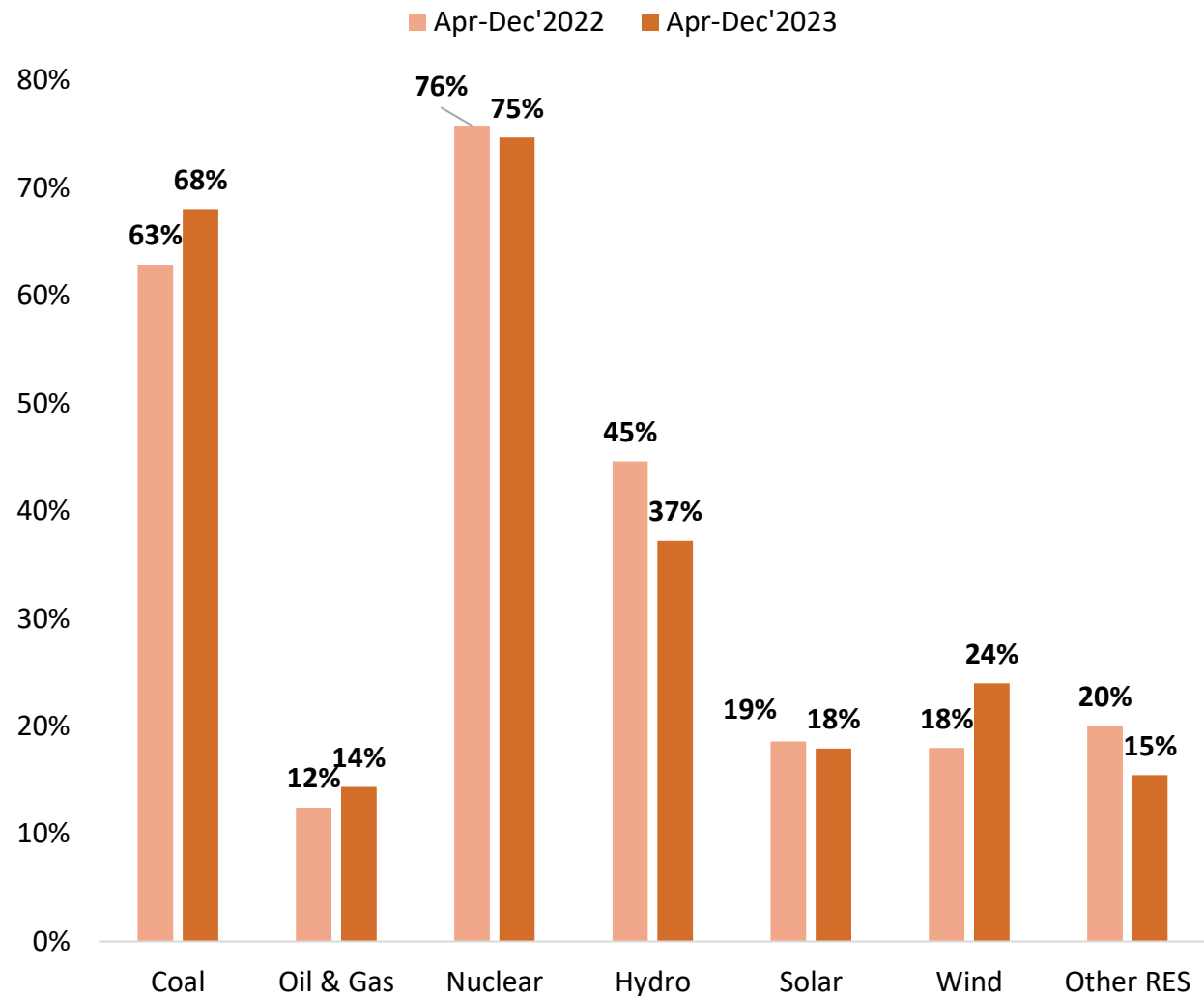
Source: CEA

Source-wise PLF/CUF

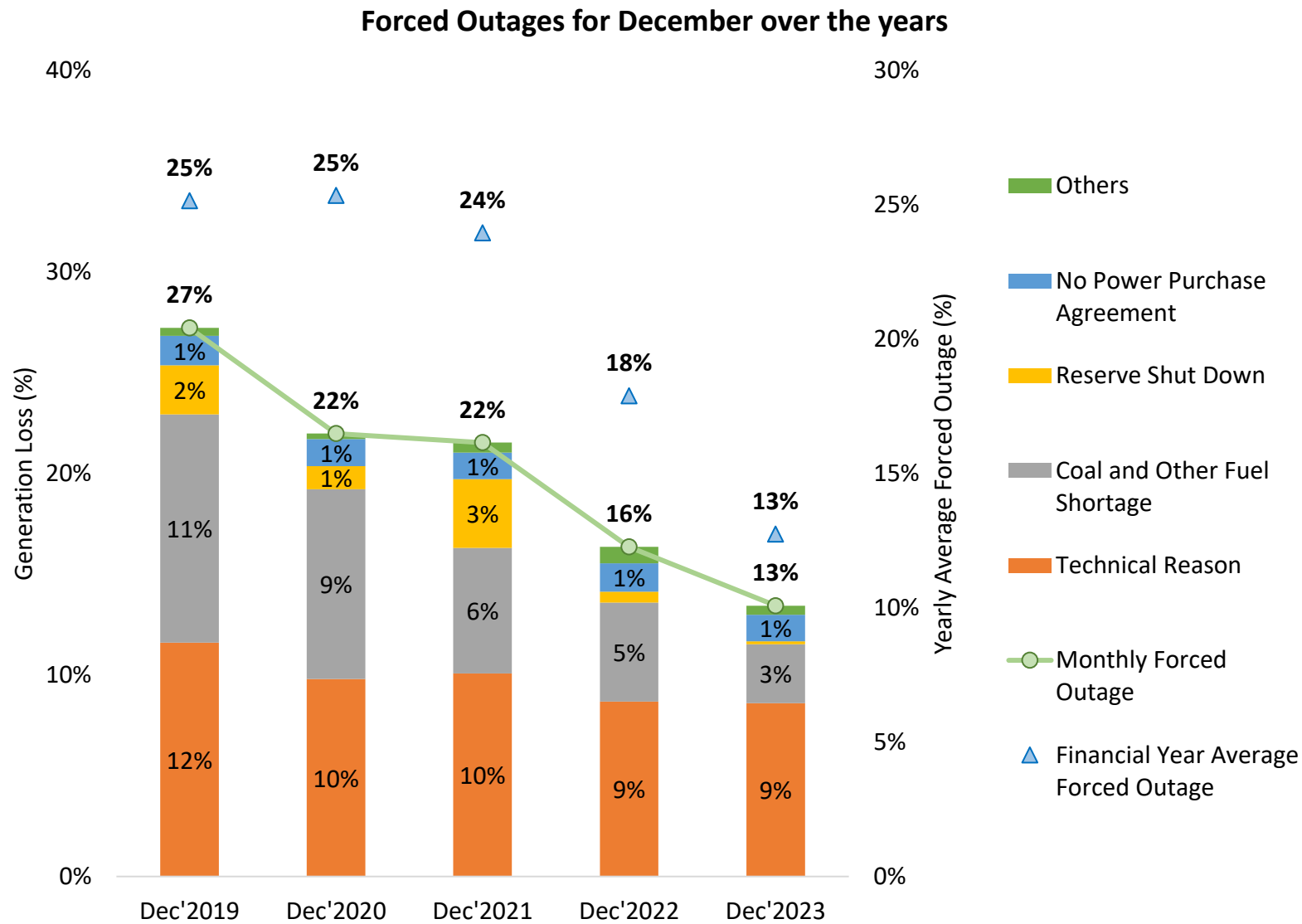
Source-wise PLF/ CUF in December (%)



Source-wise PLF/ CUF Comparison (%)



Thermal Generation Loss and Reasons for Forced Outages



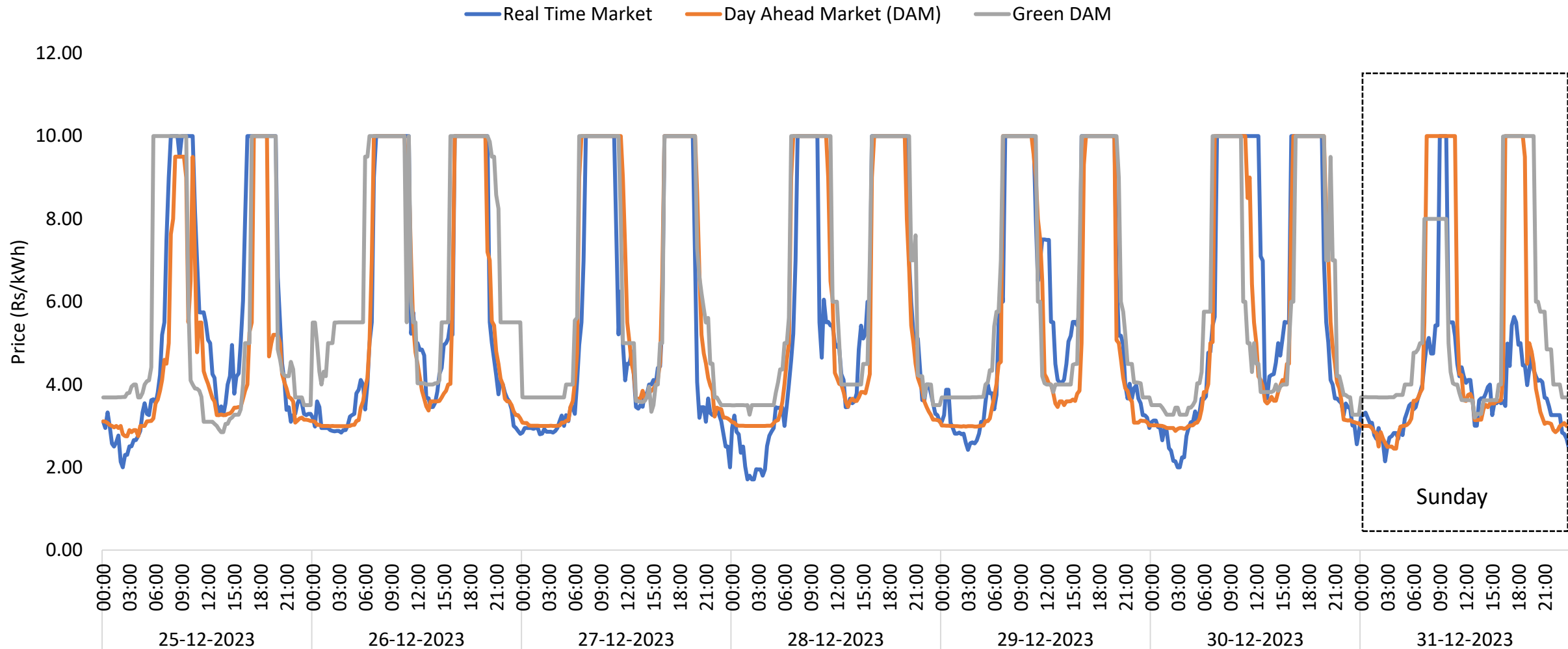
Year/ Month		Average Forced Outage Share
Yearly	FY 2021-22	24%
	FY 2022-23	18%
	FY 2023-24 (up to Dec'2023)	13%
Monthly	Dec'2021	22%
	Dec'2022	16%
	Dec'2023	13%

Thermal includes only Coal and Lignite Plants.

Source: ICED

Indian Electricity Exchange (IEX) Market Snapshot

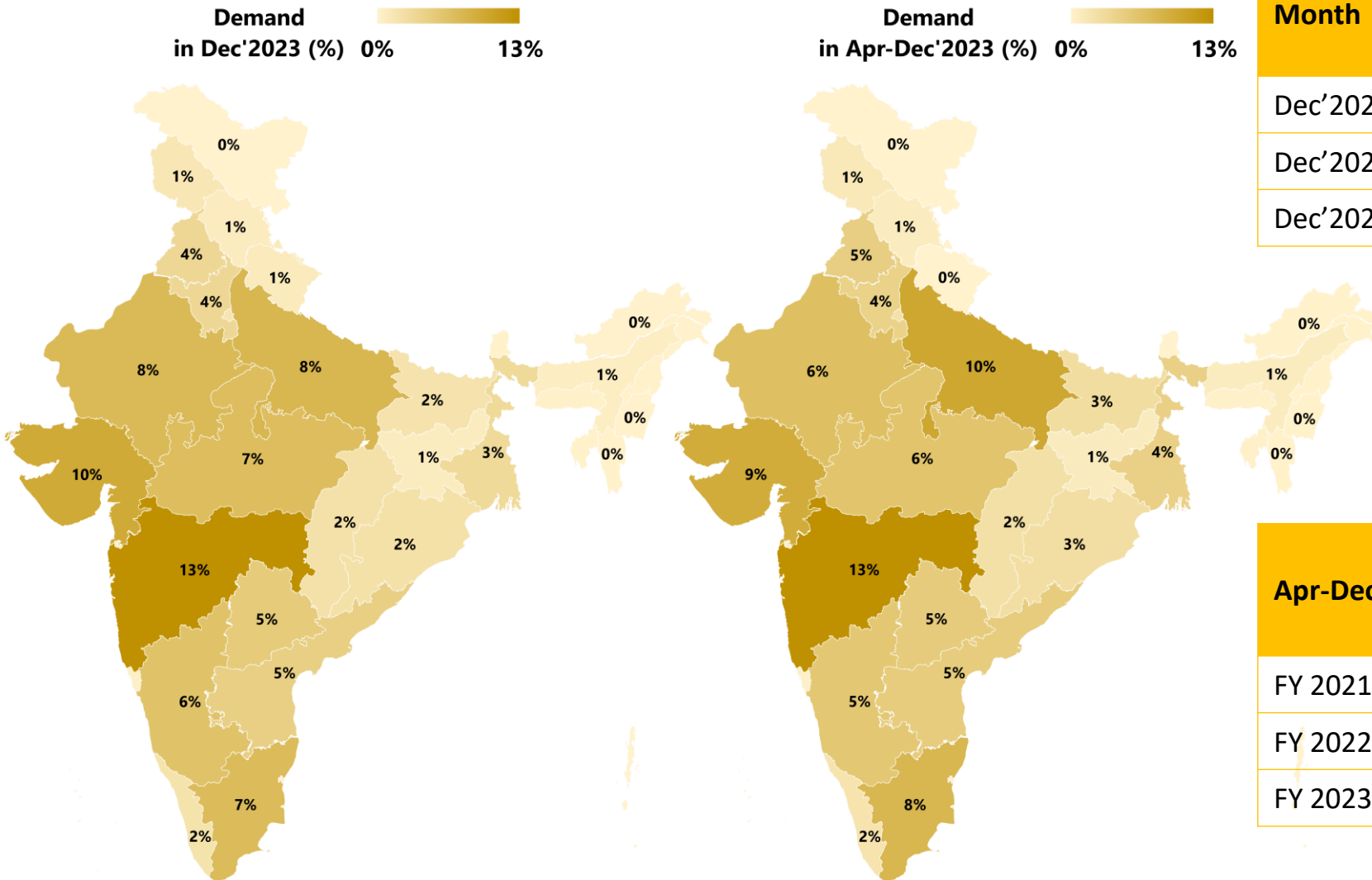
Market Clearing Prices of last 7 days of December 2023



In April 2023, CERC revised the price ceiling from ₹12/kWh to ₹10/kWh in the power exchange market.

National and State level Electricity Demand

State-level Electricity Demand as a percent of National Demand (%)



Month	Electricity Demand (BU)	Electricity Supply (BU)	Gap (BU) (+/-)
Dec'2021	110	109	0.4
Dec'2022	122	122	0.4
Dec'2023	123	123	0.1

Apr-Dec	Electricity Demand (BU)	Electricity Supply (BU)	Gap (BU) (+/-)
FY 2021-22	1030	1026	4
FY 2022-23	1138	1132	6
FY 2023-24	1224	1221	3

NOTE: The demand represented above includes intra state T&D losses.

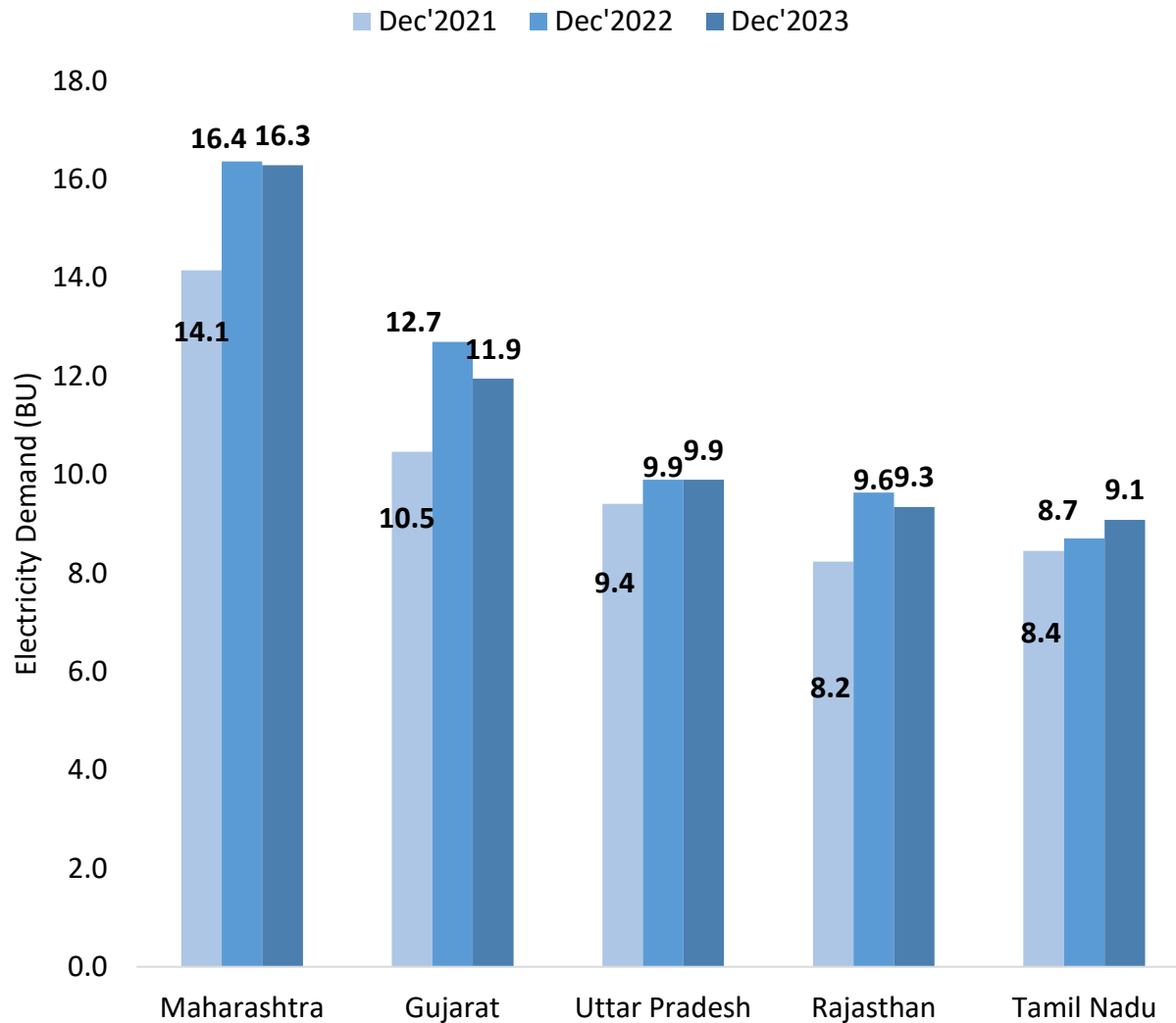
Source: CEA

India's Monthly Electricity Requirement and Supply

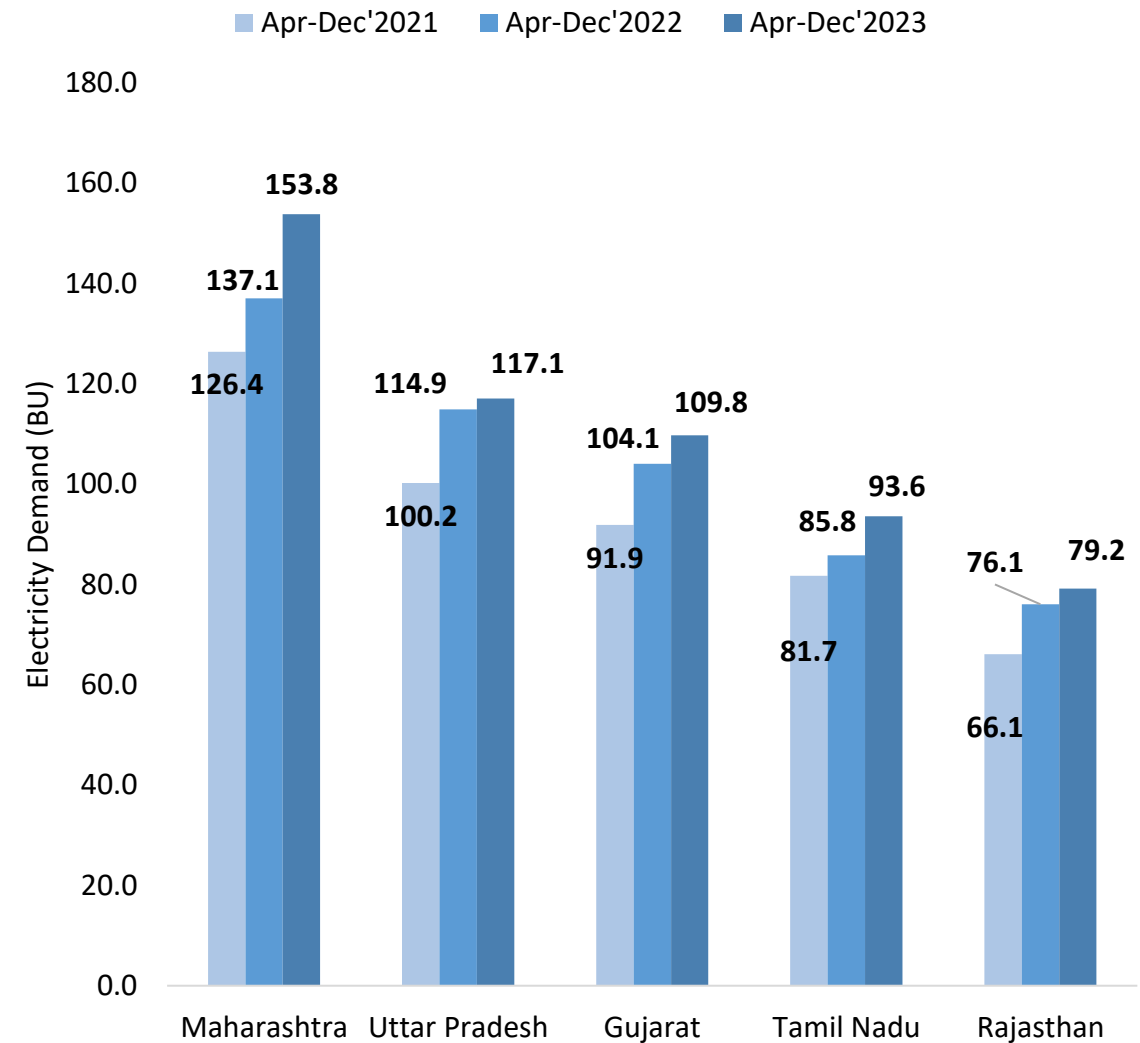


Monthly Electricity Demand of the top 5 states

States with Highest Electricity Demand in December (BU)

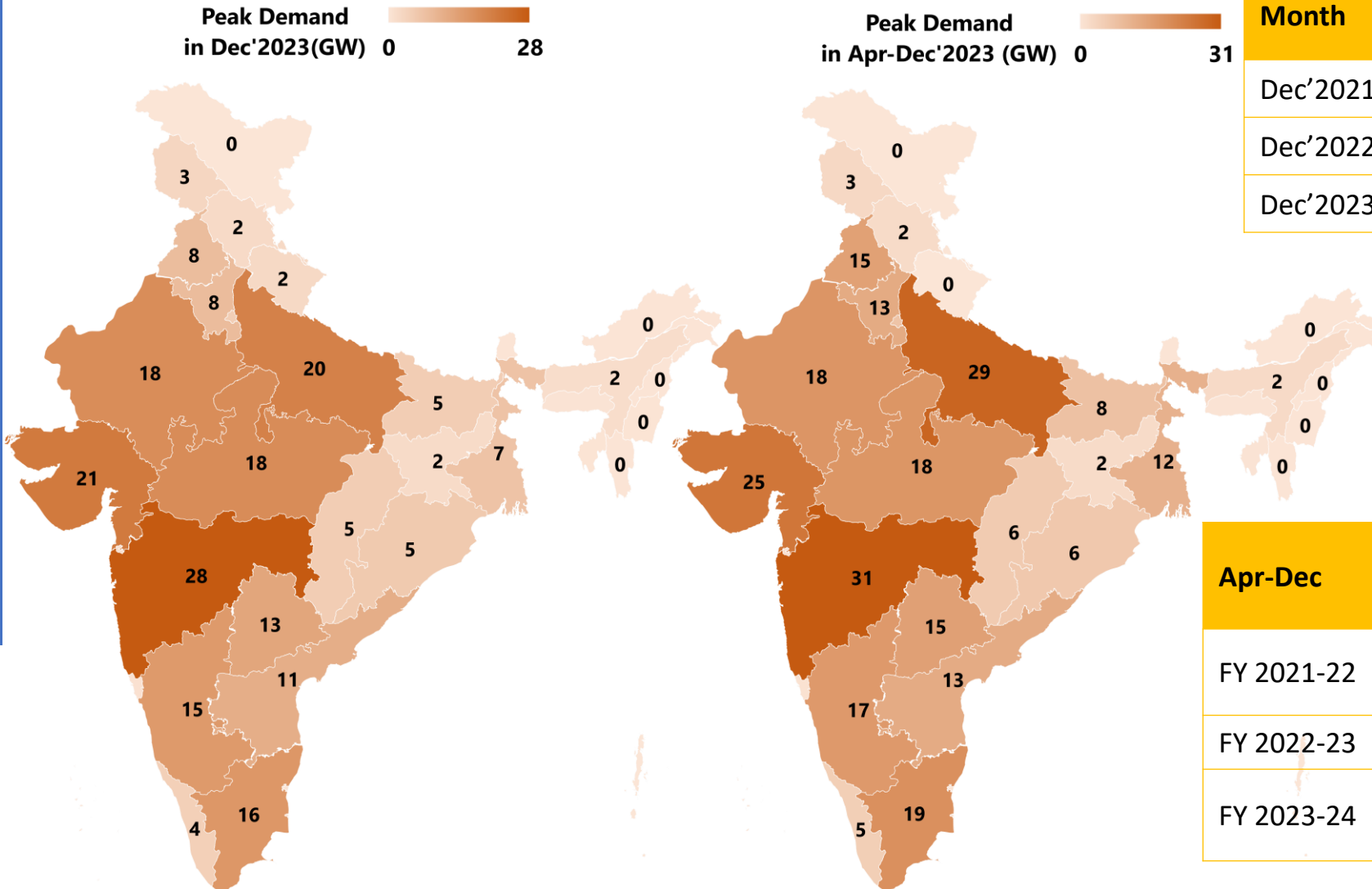


States with Highest Electricity Demand (BU)



National and State level Peak Electricity Demand

State-level Peak Electricity Demand (GW)



Month	Peak Demand (GW)	Peak Supply (GW)	Gap(BU) (+/-)
Dec'2021	184	183	1.1
Dec'2022	206	205	1.4
Dec'2023	214	214	0.0

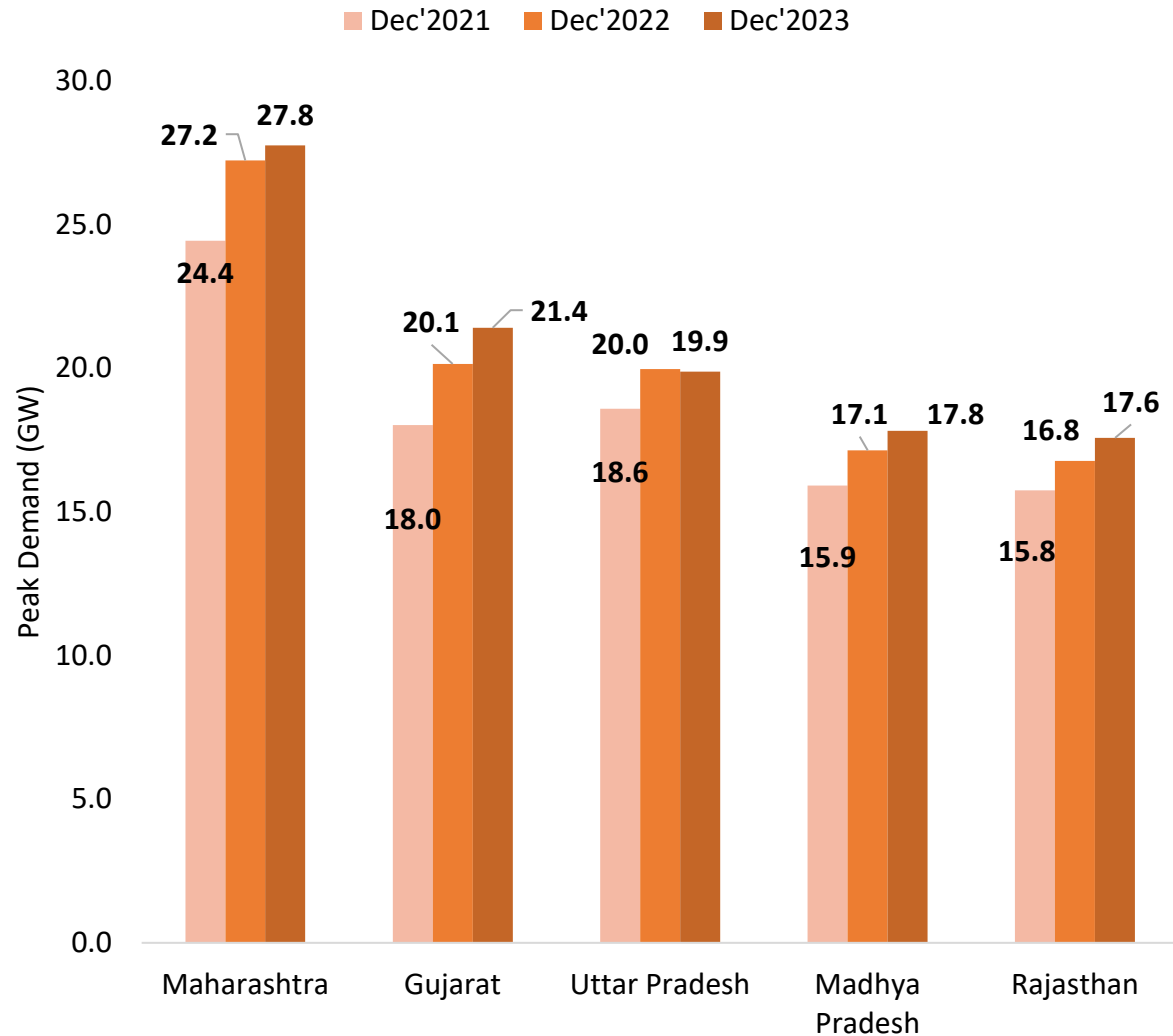
Apr-Dec	Peak Demand (GW)	Peak Supply (GW)	Gap (BU) (+/-)
FY 2021-22	203	201	2
FY 2022-23	216	207	9
FY 2023-24	243	240	3

India's Monthly Peak Electricity Demand and Supply

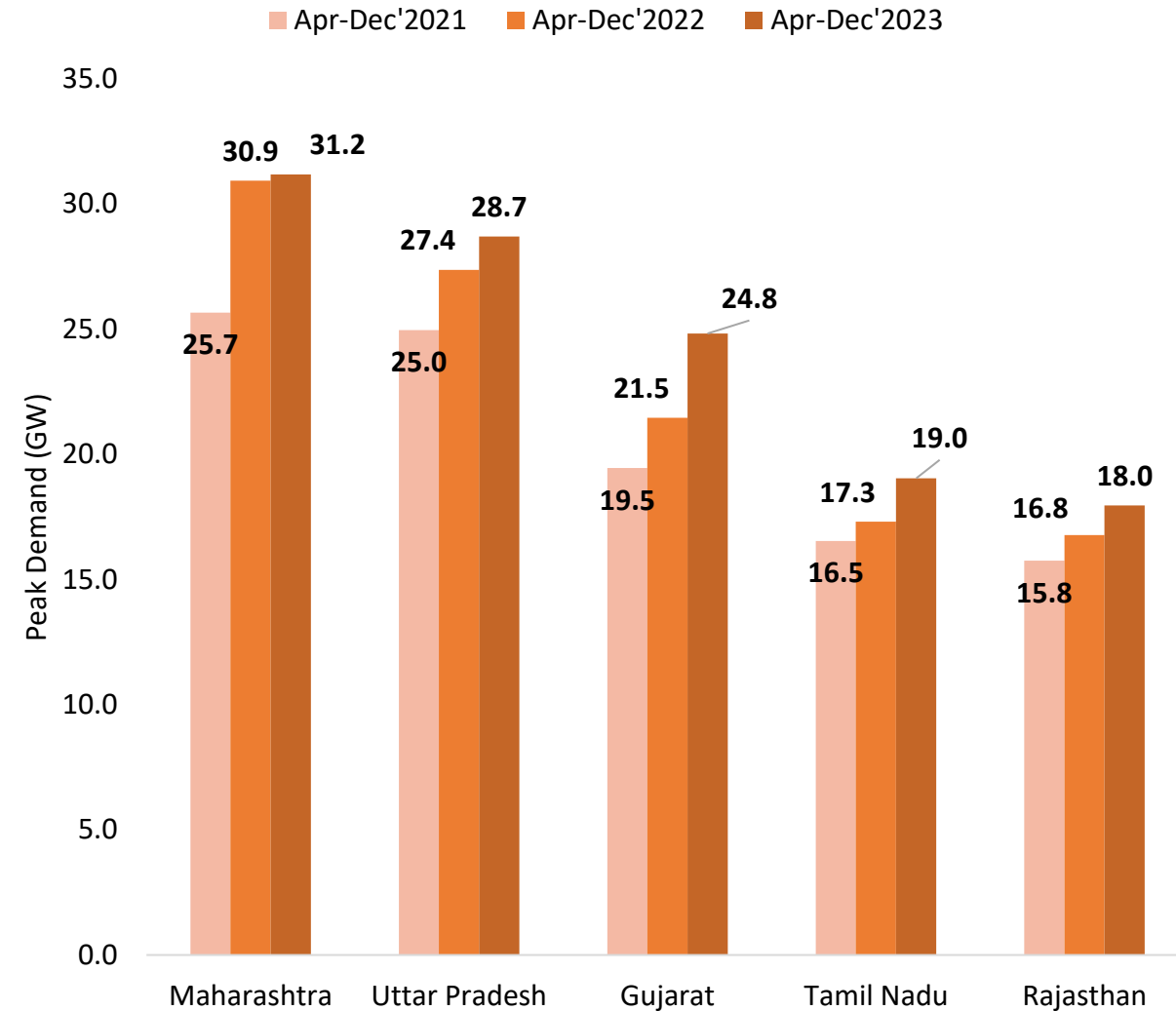


Monthly Peak Electricity Demand of the top 5 states

States with Highest Peak Electricity Demand in December (GW)



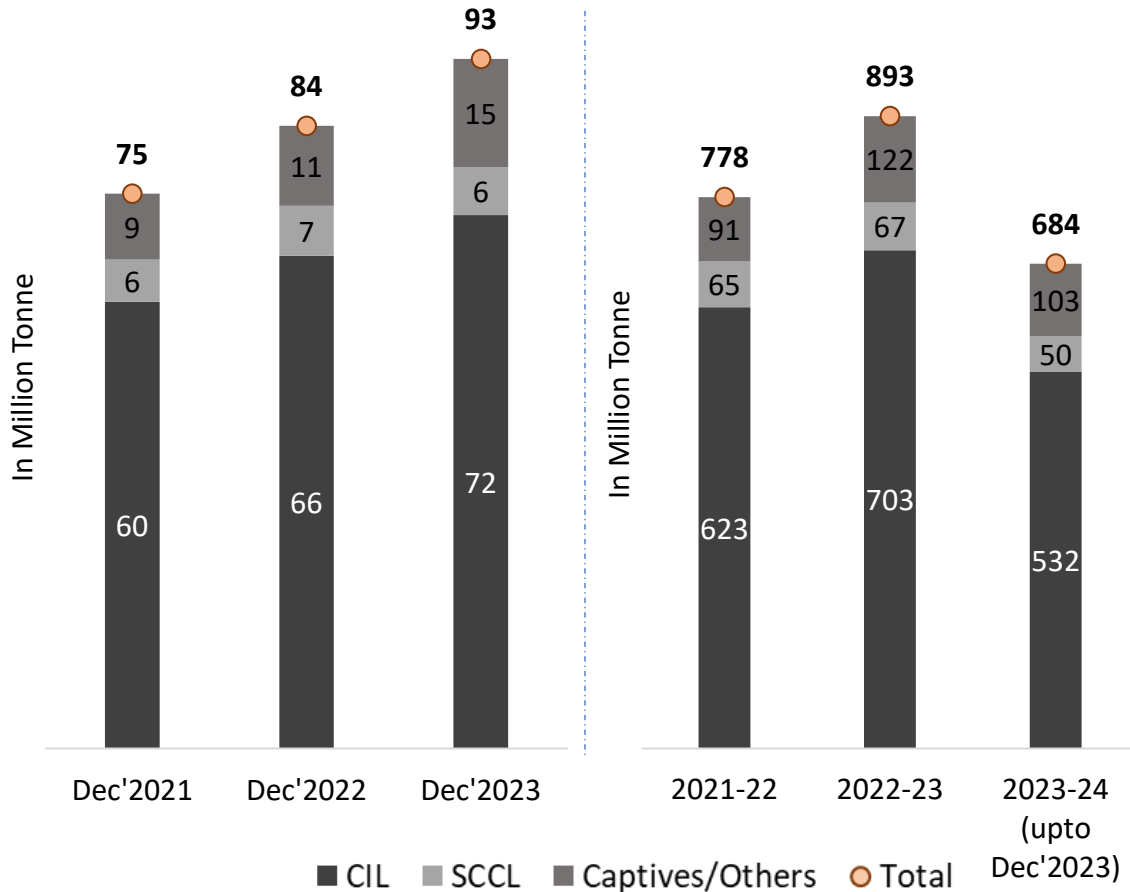
States with Highest Peak Electricity Demand (GW)



Source: CEA

Monthly Coal Statistics

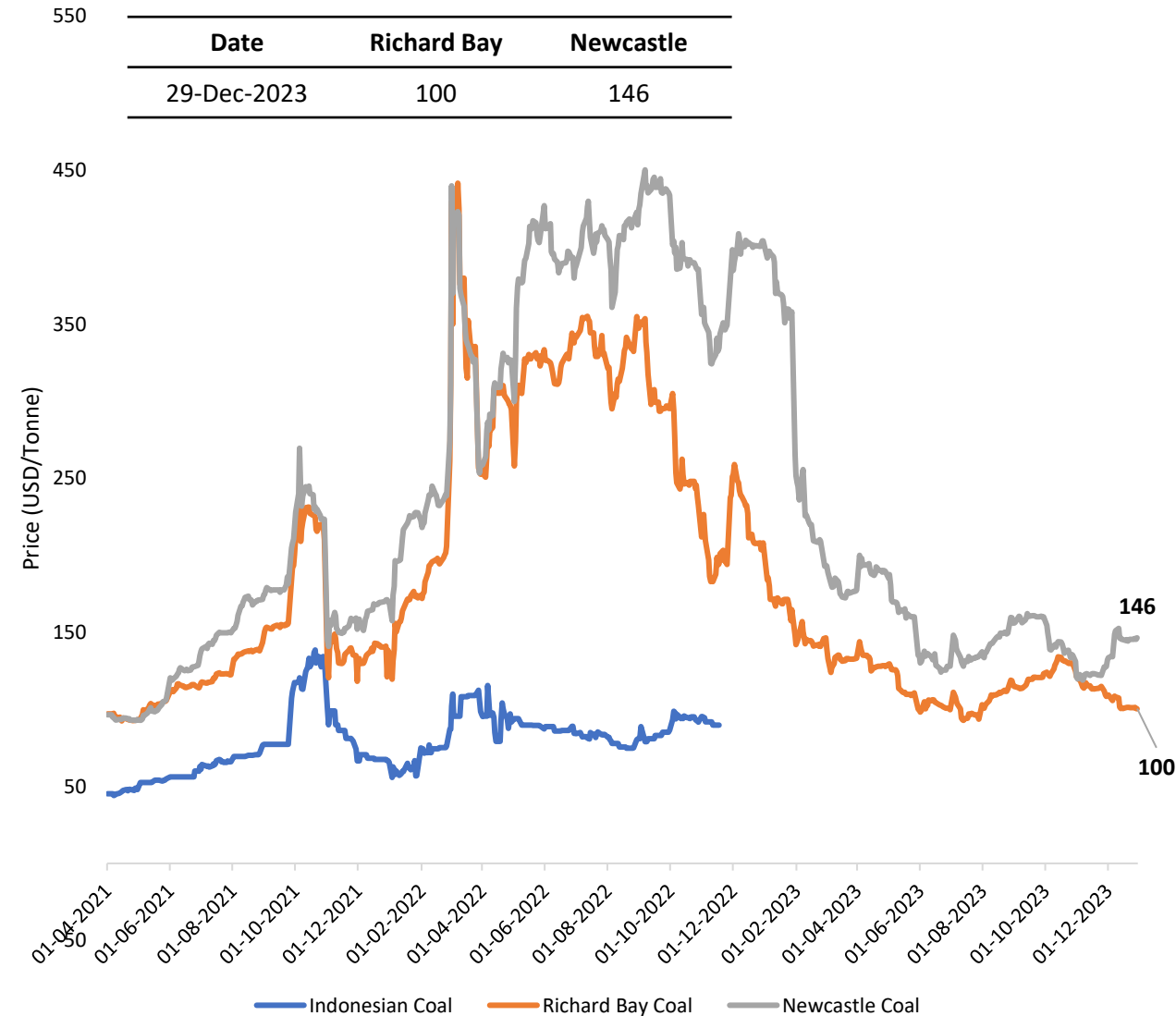
Monthly/ Annual Coal Production (in Million Tonnes)



India's coal production increased in Dec'2023 (93 MT) by 11% as compared to Dec'2022.

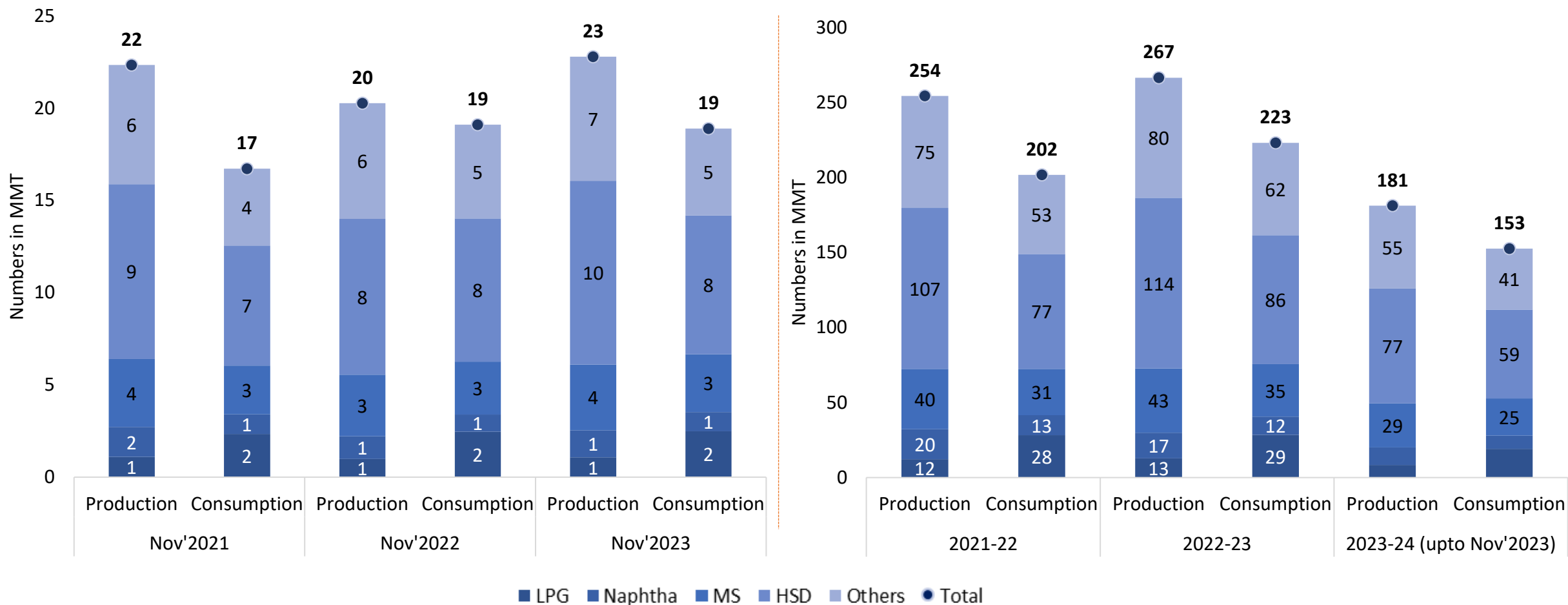
Source: Ministry of Coal

International Coal Prices



Petroleum Products Market Scenario (1/3)

Petroleum Product-wise Production & Consumption (MMT)



Others include ATF, SKO, LDO, Lubes, FO, LSHS, Bitumen, pet coke, and others.

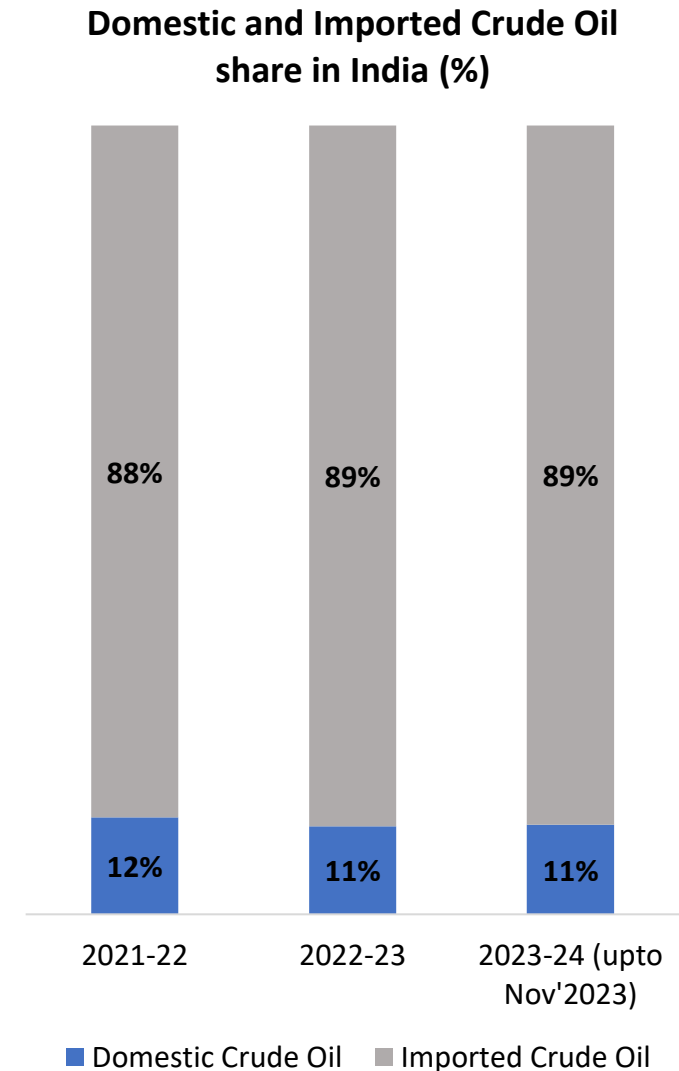
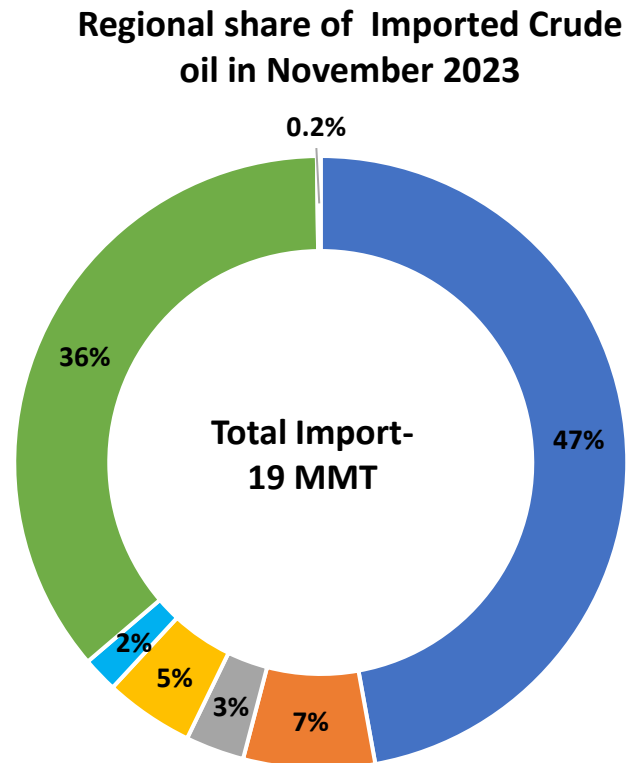
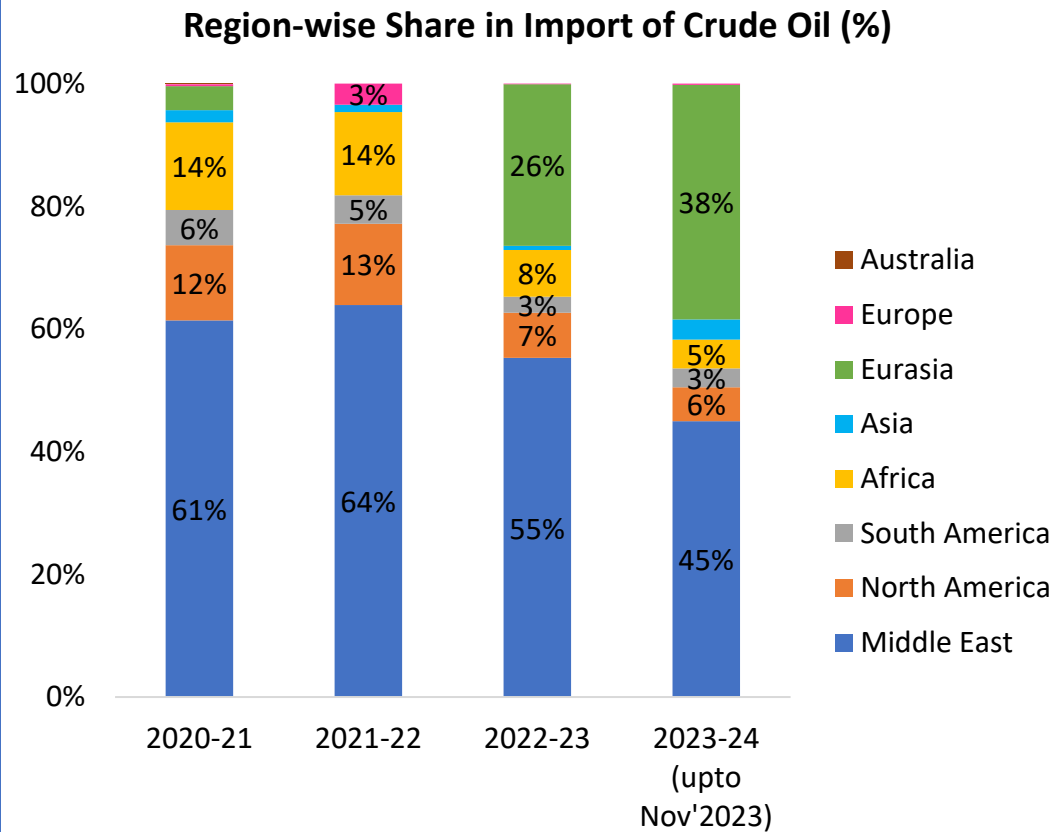
Abbreviations: ATF- Aviation Turbine Fuel, FO- Furnace Oil, HSD- High-Speed Diesel, LDO- Light Diesel Oil, MS- Motor Spirit (Petrol), SKO- Superior Kerosene Oil, LSHS- Low Sulphur Heavy Stock, LPG- Liquefied Petroleum Gas, MMT- Million Metric Tonne

Petroleum Products Market Scenario (2/3)

Import/Export of Crude Oil and Petroleum Products ('000 Tonnes)							
Petroleum Products	Import/ Export	Monthly			Yearly		
		Nov'21	Nov'22	Nov'23	2021-22	2022-23	2023-24 (upto Nov'2023)
Crude Oil	Import	18340	19003	18569	212382	232700	153203
	Export	0	0	0	0	0	0
	Net Import	18340	19003	18569	212382	232700	153203
LPG	Import	1581	1778	1719	17043	18335	11959
	Export	46	42	44	513	540	342
	Net Import	1535	1736	1675	16530	17796	11617
Diesel	Import	6	7	5	43	322	25
	Export	2781	1979	2832	32407	28494	18498
	Net Import	-2775	-1972	-2827	-32364	-28172	-18473
Petrol	Import	31	211	71	671	1069	717
	Export	1035	843	872	13482	13127	8701
	Net Import	-1003	-631	-801	-12812	-12058	-7983
Others	Import	1399	1627	2353	21259	24871	19285
	Export	1332	1818	1888	16352	18854	13246
	Net Import	67	-190	464	4907	6017	6039

*Others include ATF, Naphtha, SKO, LDO, Lubes, FO, LSHS, Bitumen, pet coke, and others.

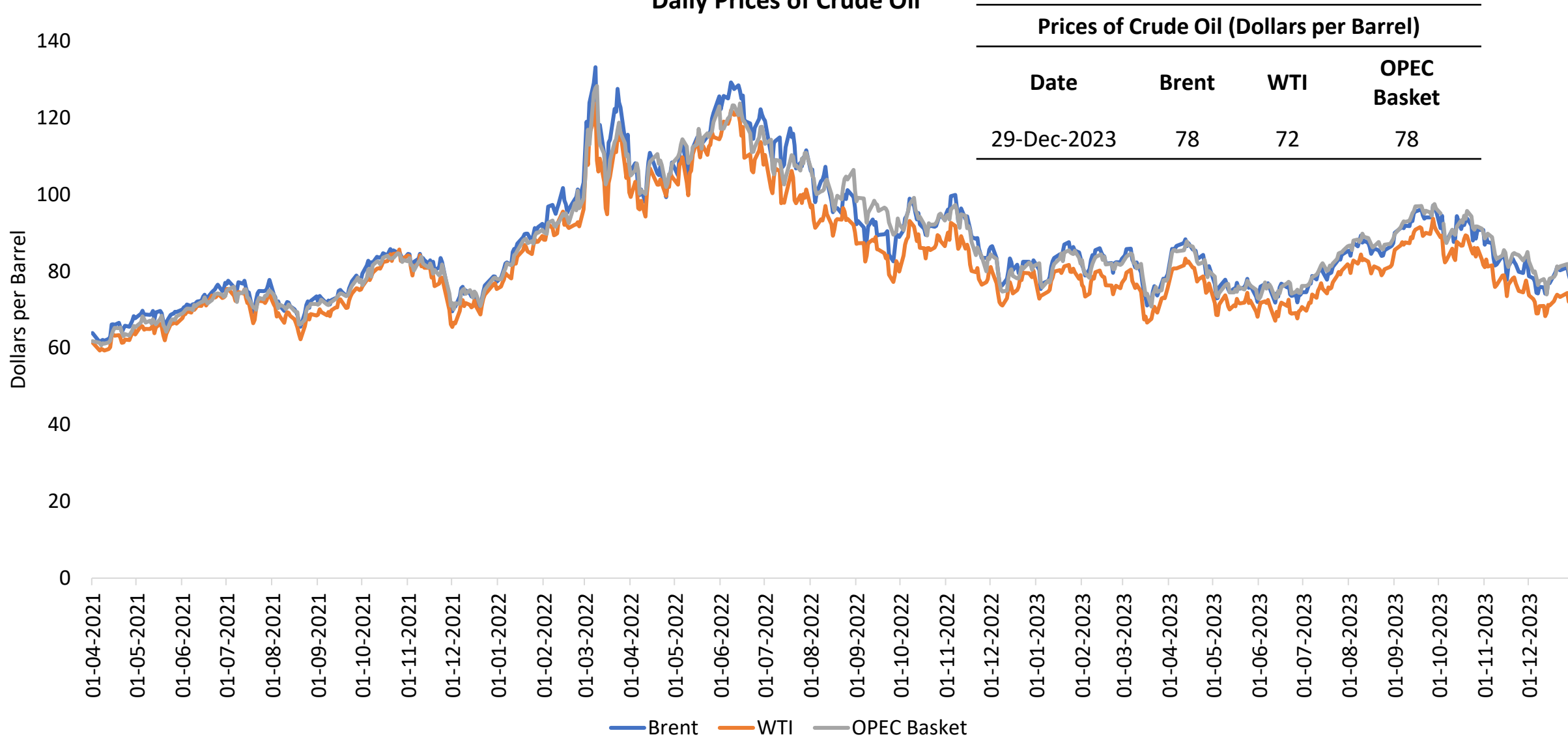
Petroleum Products Market Scenario (3/3)



Total Import of Crude Oil (MMT)			
Total Import	2021-22	2022-23	2023-24 (up to Nov'2023)
Crude Oil	212	233	153

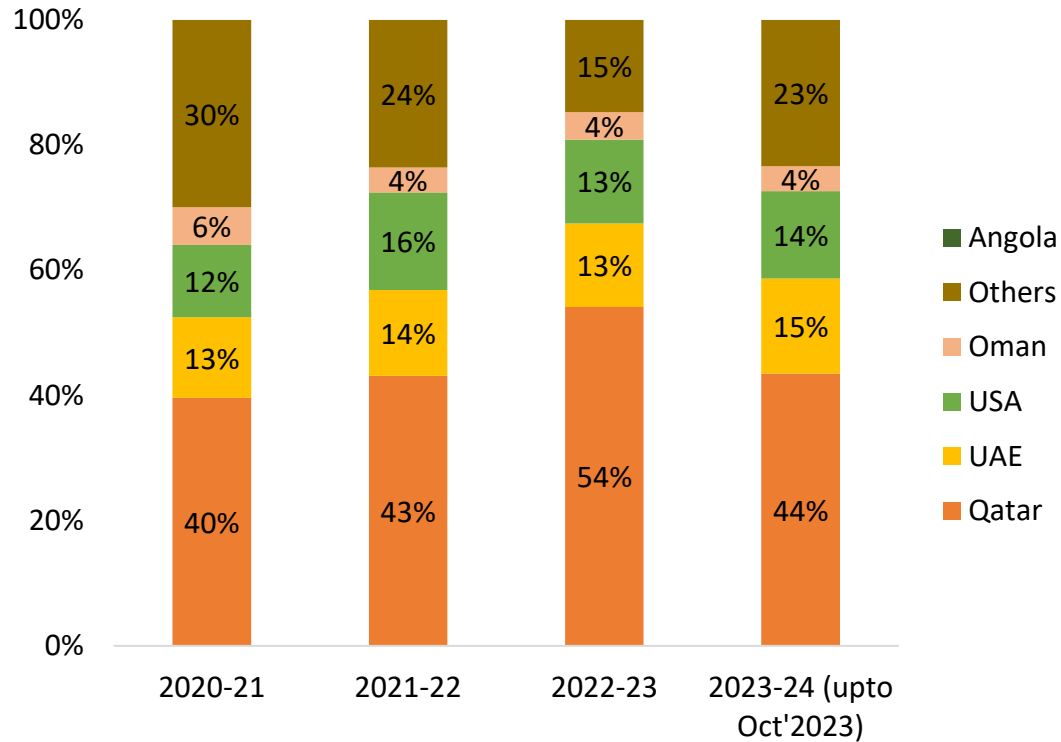
Daily Prices of Crude Oil

Daily Prices of Crude Oil

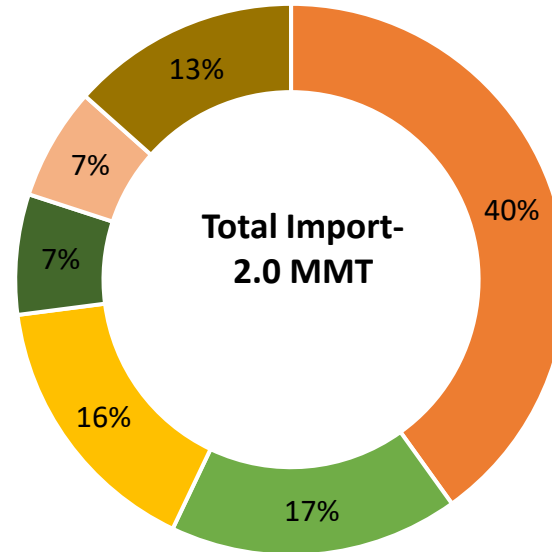


Gas Market Scenario

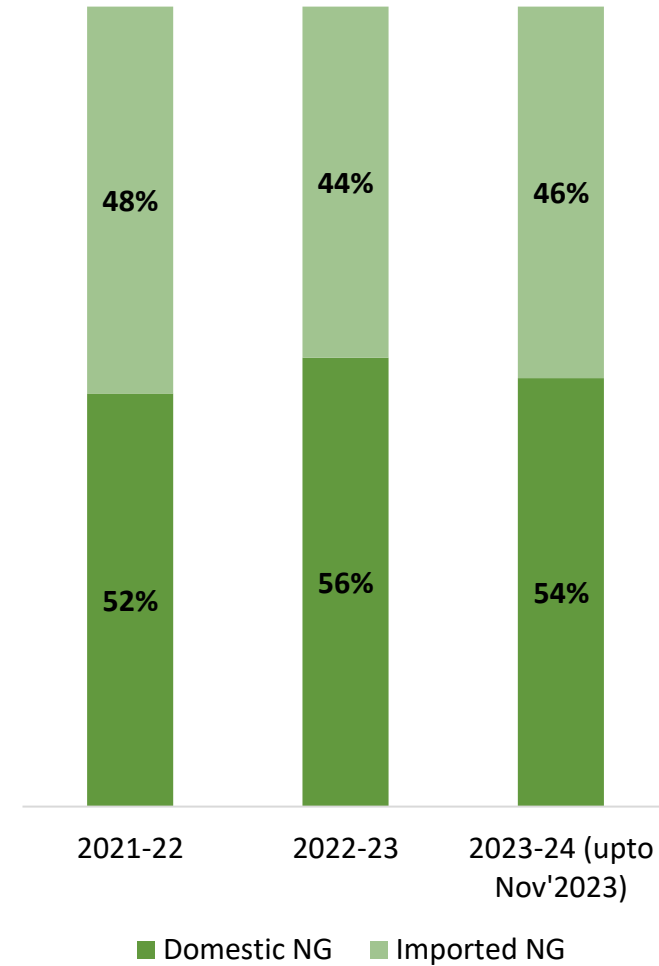
Region-wise Share in Import of LNG (%)



Country Share of Imported LNG in October 2023



Domestic and Imported Natural Gas share in India (%)



Others include- Equatorial Guinea, Trinidad, Cameroon, Egypt, France, Algeria, Belgium, Indonesia, Turkey, Russia, Spain, Malaysia, Brunei, Netherlands, Norway, and others.

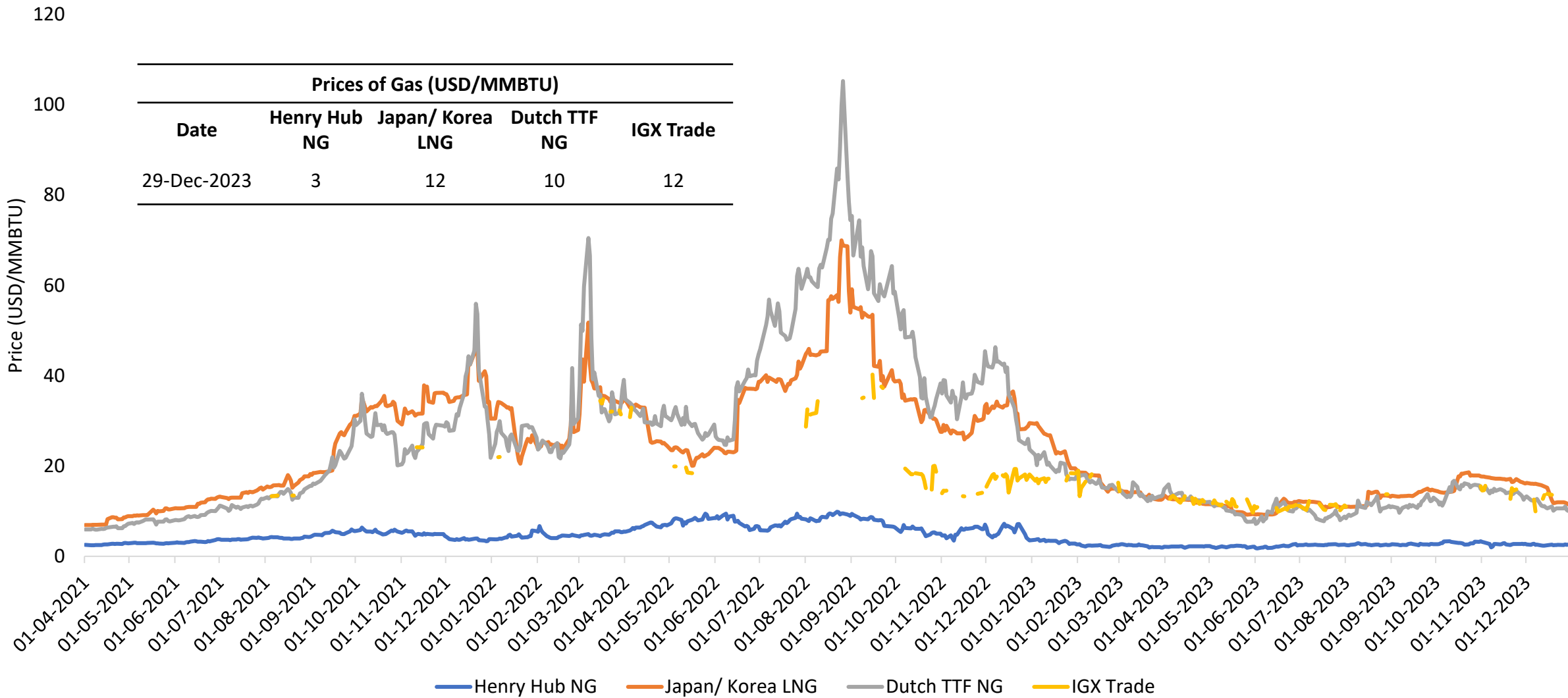
Total Import of Liquefied Natural Gas (LNG) (MMT)			
Total Import	2021-22	2022-23	2023-24 (upto Nov'2023)
LNG	23.42	19.85	15.44

NOTE: The data is latest available

Source: MoCI and PPAC

Daily Prices of Gas

Gas Daily Market Price

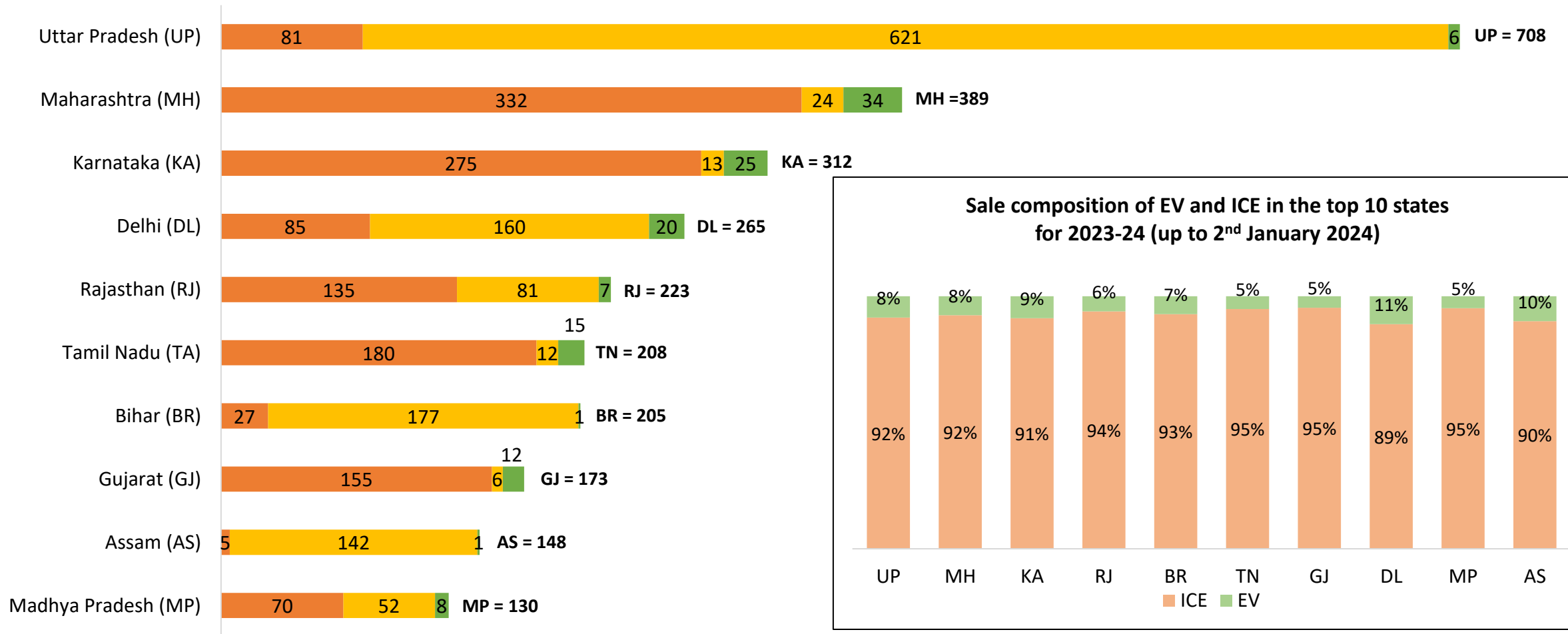


Prices of Gas (USD/MMBTU)				
Date	Henry Hub NG	Japan/ Korea LNG	Dutch TTF NG	IGX Trade
29-Dec-2023	3	12	10	12

MMBTU- Million Metric British Thermal Unit

Status of Electric Mobility in India

**Top 10 States for Electric Vehicles (in Thousands)
as on 2nd January 2024**



2 Wheeler 3 Wheeler 4 Wheeler & others

Source: VAHAN Dashboard

Recent Interventions to promote Renewable Energy

Solar

Under the [PLI scheme](#), the GOI has announced INR 19,500 crores to incentivize the manufacturing of domestic solar PV modules.

[CFA/ subsidy](#) is available for residential solar rooftop projects up to 10kW.

CFA is applicable under [RTS Phase II](#) for residential consumers in rural areas under the VNM arrangement up to 3kW.

The [inter-state transmission charges](#) are waived for 25 years for the projects being commissioned before 30th June 2025.

The [updated RPO](#) compliance supports solar integration of up to 33.57% of the electricity purchased by DISCOMs/states till the year 2029-30.

[PM KUSUM scheme](#) has been extended till Mar'26 to install pump sets up to 15 HP in selected areas.

[Approved List of Models and Manufacturers](#) abeyance till 31 March 2024. MNRE has reduced the application fee by 80% and the inspection fee by 70%.

Wind

[Reverse auctions have been scrapped](#) for wind projects. A traditional two-part (technical and financial) bid system has been put in place.

To support [off-shore wind](#), SECI will invite bids for up to 4GW to set up offshore wind plants off the coast of Tamil Nadu and Gujarat.

The ISTS charges are waived for 25 years for the [onshore projects](#) being commissioned before 30th June 2025 and for [off-shore projects](#) on or before 31st December 2032.

The [updated RPO](#) compliance supports WIND integration of up to 6.94% of the electricity purchased by DISCOMs/states till the year 2029-30.

The [draft National Repowering Policy](#) for wind power projects is released for the optimum utilization of wind energy resources by maximizing energy (kWh) yield per sq. km of the wind project areas.

The GoI has decided to invite bids for 50 GW of RE annually, which includes up to [10 GW of wind](#) capacity.

Energy Storage

Ministry of Power has released the [guidelines for the development of PSP](#) with the target of 26.7 GW of PSP and 47.2 GW of BESS to integrate with RE capacity till 2032.

[PLI scheme](#) unveiled for setting up 50 GWh ACC battery storage with an outlay of ₹18,100 crores.

Under the [Waste Management Rules 2022](#), the disposal of waste batteries in landfills and incineration is prohibited and the recycling of waste batteries is made mandatory.

[CERC](#), under RRAS regulation, has allowed the use of energy storage in secondary and tertiary ancillary support.

[The Energy Storage Obligation](#) of DISCOMs is pegged at 4.0% up to 2029-30.

The [pilot projects](#) are:

- i. 1.4 MW SPV Project with 1.4 MWh BESS in Lakshadweep.
- ii. 50 MWp SPV Project with 20 MW/50 MWh BESS in Phyang, Ladakh
- iii. 100 MW SPV Project with 40 MW/120 MWh BESS in Chhattisgarh.

Green Hydrogen (H₂)

[National Green Hydrogen Mission](#) was approved by the Cabinet in January 2023. The mission aims to meet the target of 5 million metric tonnes of green hydrogen production by 2030. The initial outlay for the Mission will be INR 19,744 crores.

MOP has extended the [waiver of ISTS charges](#) from 30th June 2025 to 31st December 2030.

MNRE has proposed using [green H₂ in Direct Reduced Iron \(DRI\) production](#) by partly replacing natural gas with H₂ in gas-based DRI plants.

Indian Railways to run [35 Hydrogen trains under "Hydrogen for Heritage"](#) at an estimated cost of ₹ 80 crores per train and ground infrastructure of ₹ 70 crores per route on various heritage/hill routes.

The pilot projects are-

- i. 25kW AC hydrogen grid at NETRA that includes a 500kW PEM electrolyzer
- ii. 5MW PEM electrolyzer at NTPC Vindhyachal.

Key Highlights or Announcements of December 2023

- On 7th December 2023, the MNRE issued the [National Repowering & Life Extension Policy for Wind Power Projects- 2023](#), superseding the policy for Repowering of the Wind Power Projects- 2016. The updated policy allows the refurbishment of wind turbines to extend their operational life beyond the design life, pending safety and performance assessments adhering to relevant standards, through modifications in components such as gearbox, blades, generator, controller, etc. The policy aims to enhance the utilization of wind energy resources by maximizing energy (kWh) yield per square kilometer of the project area and utilizing the latest state-of-the-art onshore wind energy technologies. According to the National Institute of Wind Energy, the country's estimated repowering potential is 25.41 GW, considering wind turbines with a capacity below 2 MW.
- The power department of West Bengal unveiled the [West Bengal Green Hydrogen Policy 2023](#) on 5th December 2023. The policy is notified for a period of five years, with the vision of facilitating the identification of green hydrogen demand centers through GIS mapping and developing the ecosystem for advancements in green hydrogen/ ammonia infrastructure across the value chain.
- The transport department of Bihar released the revised '[Bihar Electric Vehicle Policy, 2023](#)'. The estimated comprehensive budgetary allocation is Rs 56.5 crores, covering rebates on motor vehicle tax, purchase incentives, charging station incentives, and power tariff incentives throughout the policy period. The main objectives of the policy are:
 - To ensure that 15% of the new vehicles purchased and registered in Bihar are electric vehicles by 2028.
 - To develop an accessible and robust network of EV charging infrastructure in the state.
 - To encourage startups and investment in the field of electric mobility and associated support sectors like data analytics, IT, R&D, etc.
 - To improve the quality of the environment by reducing air pollution.



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