Renewable Energy

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Executive summary

Immense growth potential

- India has low conventional energy resources compared to its required energy needs driven by huge population and rapidly increasing economy. But India can harness the huge potential of solar energy as it receives sunshine most of the year. It also has vast potential in hydro power sector which is being explored across states in the northeast.
- As of January 2021, India had 92.55 GW of renewable energy capacity, including 38.79 GW from solar and 38.68 GW from wind power.
- India is the only country, among the G20 countries, which is on track to achieve its targets under the Paris Agreement.
- India plans to add 30 GW of renewable energy capacity along the desert on its western borders of Gujarat and Rajasthan.

Ambitious targets

- In 2018, the Government of India has set an ambitious target of achieving 227 GW of renewable energy capacity by 2022 and 275 GW by 2027. These include adding 114 GW of solar capacity, 67 GW of wind power and 31 GW of floating solar and offshore wind capacity by 2022.
- The government plans to establish renewable energy capacity of 523 GW (including 73 GW from Hydro) by 2030.

Increasing investment

- The renewable energy space in India has become highly attractive for investors and received FDI inflows of US$ 9.83 billion between April 2000 and December 2020.
- More than US$ 42 billion has been invested in India's renewable energy sector since 2014.
- India ranked seventh on the EY Renewable Energy Country Attractive Index 2020.

Source: *EY Recai (November 2018) , Central Electricity Authority, MNRE, DPIIT, Livemint, IWTMA*

Advantage India

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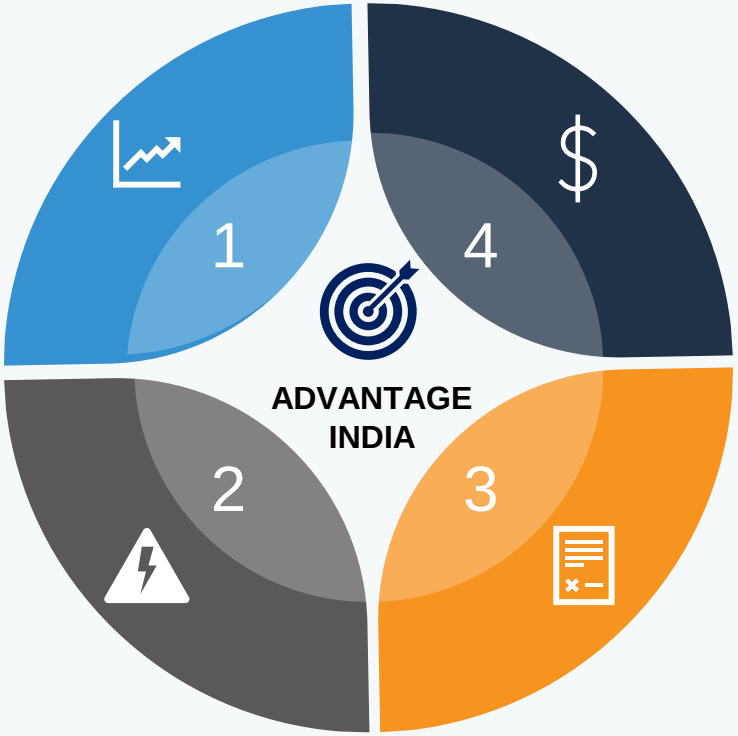
Advantage India

1. Robust Demand

- India has a relatively low per capita energy and electricity consumption. Per capita electricity consumption in India reached 1,208 units in 2019-20.
- As the economy grows, the electricity consumption is projected to reach 15,280 TWh in 2,040 from the 4,926 TWh in 2012. Most of the demand will come from real estate and transport sectors.

2. Competitive Advantage

- India was ranked fifth in wind power, fifth in solar power and fourth in renewable power installed capacity, as of 2019.
- India ranked seventh on the EY Renewable Energy Country Attractive Index 2020.
- Power generation from solar and wind projects are likely to be cost-competitive relative to thermal power generation in India in 2025-2030.
- As per the British Business Energy, India ranks third on renewable energy investments and plans.



4. Increasing Investment

- Non-conventional energy sector received FDI inflows of US$ 9.83 billion between April 2000 and December 2020.
- With Government's ambitious green energy targets, the sector has become quite attractive for both foreign and domestic investors.
- By 2028, India can see investment worth US$ 500 billion in renewable energy.

3. Policy Support

- The Indian Government aims to achieve 227 GW of renewable energy by 2022.
- The government plans to establish renewable energy capacity of 523 GW (including 73 GW from Hydro) by 2030.
- PLI-scheme worth Rs. 4,500 crore (US$ 610.23 million) for high-efficiency solar PV modules manufacturing over a five-year period.

Note: *TWh - Terawatt Hour, PLI - Production-Linked Incentive*
Source: *Central Electricity Authority, Ministry of New and Renewable Energy, Mercom India, EY, News sources, BloombergNEF*

Market Overview and Trends

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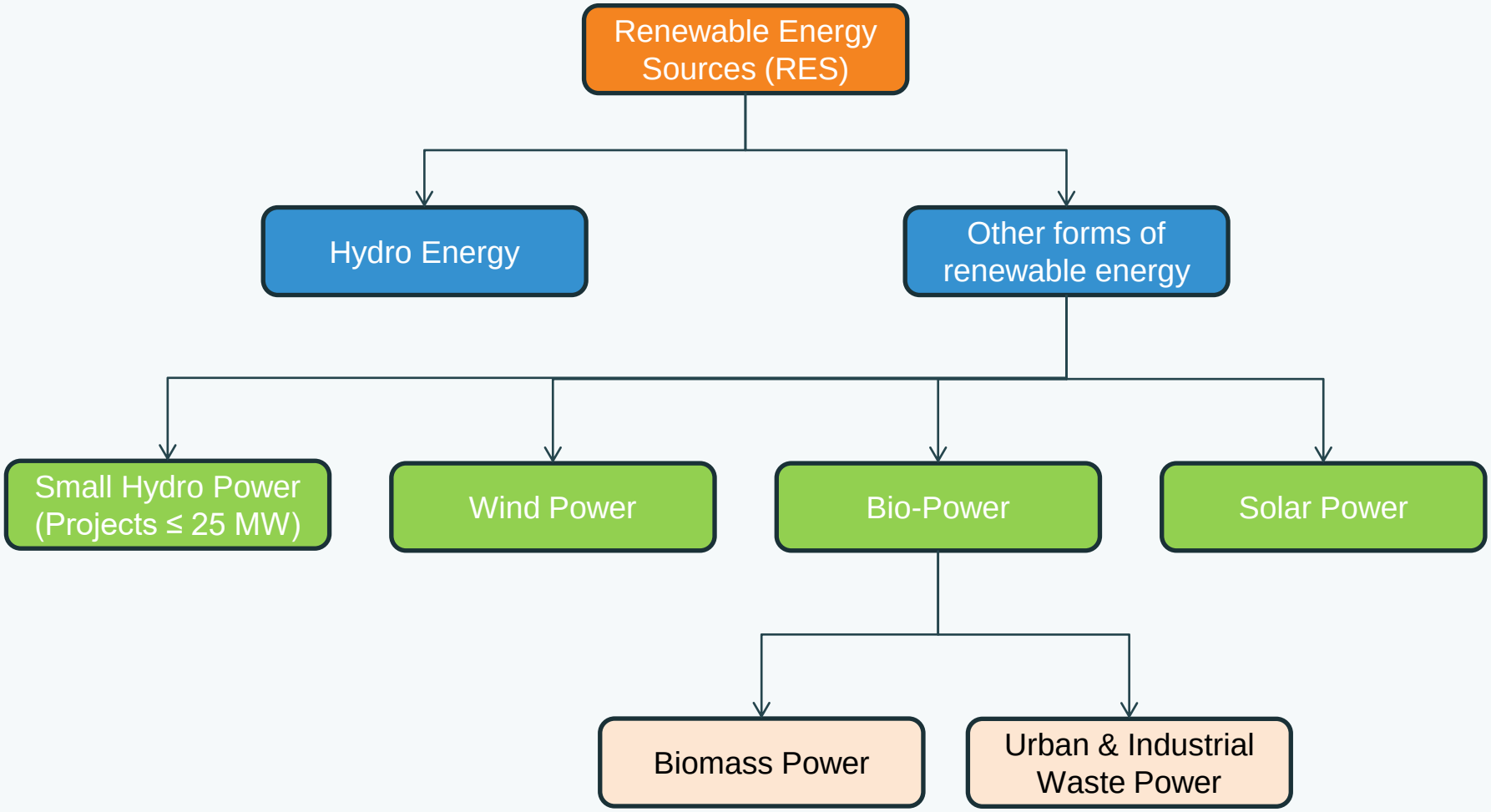
Renewable Energy Sources



Source: *Central Electricity Authority (CEA)*

Generation capacity has increased at a healthy pace… (1/2)

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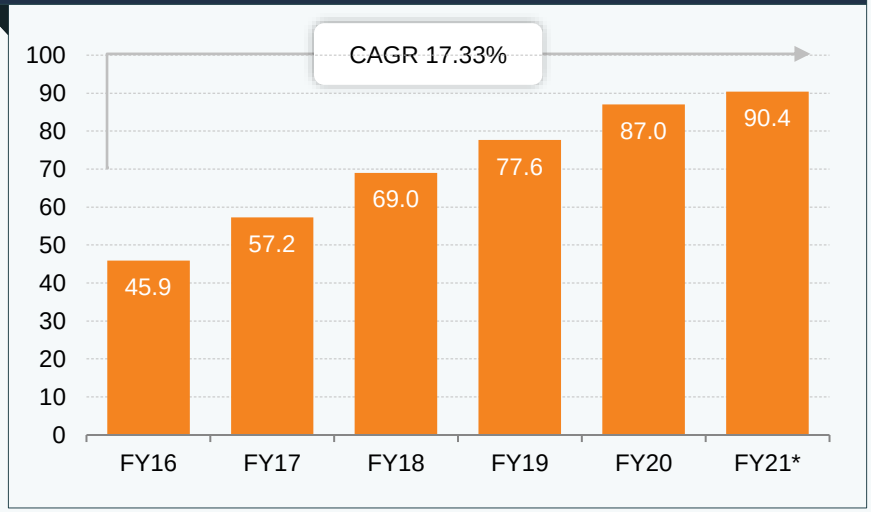
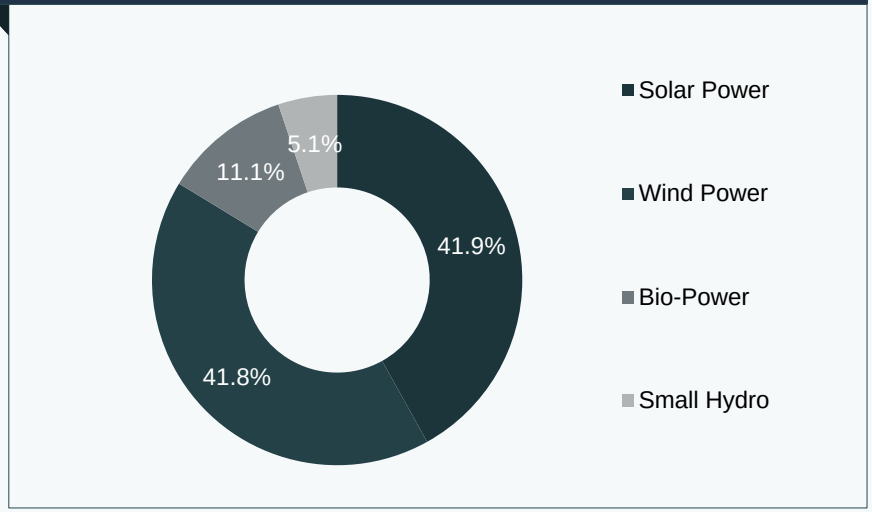
Installed Renewable Energy[1] Capacity[2] (GW)



Installed Renewable[1] Capacity[2] Breakup – January 2021

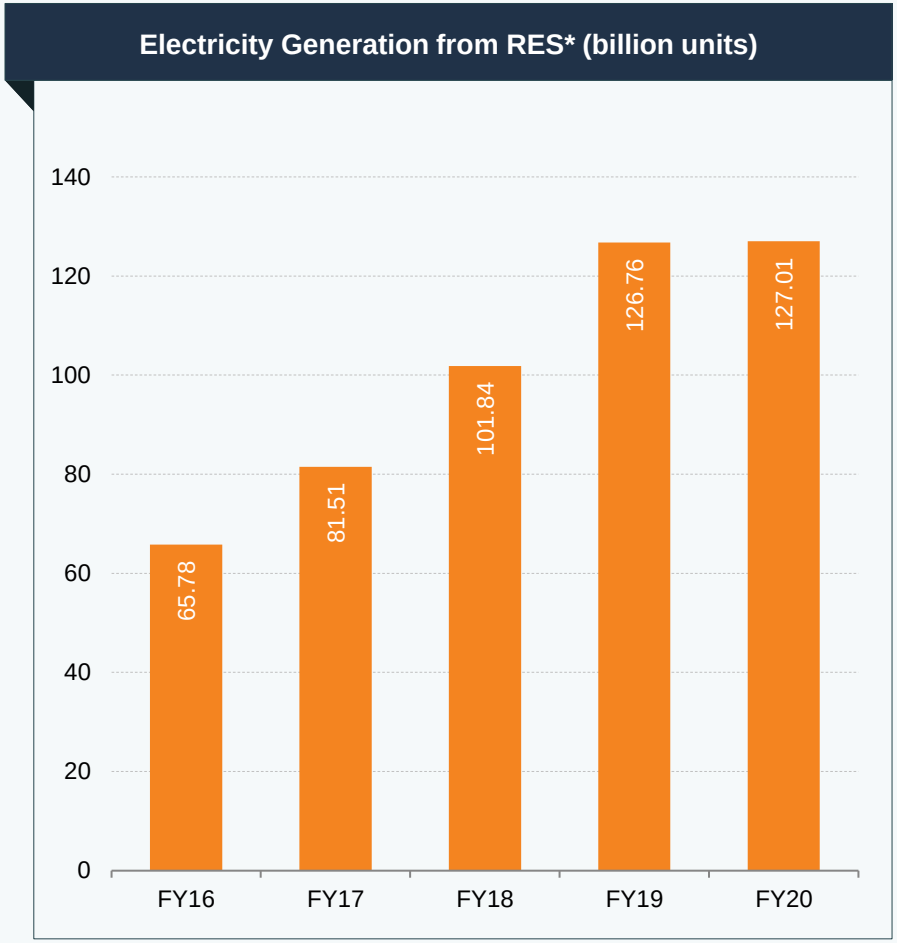


- The International Energy Agency's World Energy Outlook projects a growth of renewable energy supply to 4,550 GW in 2040 on a global basis.
- Installed renewable power generation capacity has increased at a fast pace over the past few years, posting a CAGR of 17.33% between FY16-FY20. India had 87 GW renewable energy capacity in FY20.
- As of January 31, 2021, installed renewable energy capacity stood at 92.55 GW, of which solar and wind comprised 38.79 GW and 38.68 GW, respectively. Biomass and small hydro power constituted 10.314GW and 4.76 GW, respectively.
- According to the year-end review (2020) by the Ministry of New and Renewable Energy, another 49.59 GW of renewable energy capacity is under installation and an additional 27.41 GW of capacity has been tendered. This puts the total capacity of renewable energy projects (already commissioned or in the pipeline) at ~167 GW.

Notes: *GW- Gigawatt, [1]Large Hydro power projects not included as they are not included in renewable energy targets of GOI, [2]grid interactive capacity, *- Until November 2020*
Source: *Central Electricity Authority (CEA), International Renewable Energy Agency (IRENA), MNRE*

Generation capacity has increased at a healthy pace…(2/2)

- Power generation from renewable energy sources (excluding large hydro) in India reached record 127.01 billion units in FY20.
- The country ranks fifth worldwide in terms of the total installed wind power capacity.
- The Government of India is aiming to achieve 227 GW of renewable energy capacity by 2022, much ahead of its target 175 GW as per the Paris Agreement.
- Government plans to establish renewable energy capacity of 523 GW (including 73 GW from Hydro) by 2030.
- Solar installation in India is expected to increase 360% by 2020.
- Off-grid renewable power capacity has also increased.
- In 2019, India installed 7.3 GW of solar power across the country, establishing its position as the third-largest solar market in the world.



Note: *RES - Renewable Energy Source, *Large Hydro power projects not included, SPV - Solar Photovoltaic System, MWeq - Megawatt Equivalent*
Source: *CEA, Make in India, MNRE, Mercom India*

Solar power generation growth likely to outweigh other sources by 2022…(1/2)

- Due to its favourable location in the solar belt (400 S to 400 N), India is one of the best recipients of solar energy with abundant availability.
- Growth in solar power installed capacity is expected to surpass the installed capacity of wind power, reaching 114 GW by 2022. A total of 38 solar parks, with >25 GW of combined capacity, were approved in India until September 2020.
- India stands 5th among countries with a maximum installed capacity of solar rooftop installations. Gujarat, Maharashtra, Rajasthan and Tamil Nadu account for 53.6 % of the solar rooftop installations in India, as of January 2021.
- The biggest solar project financed in India is the 709 MW NLC Tangedco PV plant - which is coming up at a cost of about US$ 500 million.
- Adani Group aims to become the world's largest solar power company by 2025 and the biggest renewable energy firm by 2030.
- In June 2020, Adani Green Energy won a major tender to set up 8 GW of manufacturing-linked solar energy project with an investment of Rs. 45,000 crore (US$ 6.38 billion).
- In November 2020, SunSource Energy announced that it will develop a 4 MW grid-connected floating solar PV power project, along with a 2 MW Battery Energy Storage System in Andaman and Nicobar Islands, which was won in a tender bid with the Solar Energy Corporation of India.

Top 20 state-wise solar installations in India (January 2021)

Rank	State	Capacity (MW)
1	Karnataka	7,346.85
2	Rajasthan	5,397.08
3	Tamil Nadu	4,315.78
4	Gujarat	4,042.09
5	Andhra Pradesh	3,996.5
6	Telangana	3,936.36
7	Madhya Pradesh	2,458.22
8	Maharashtra	2,289.97
9	Uttar Pradesh	1,667.5
10	Punjab	947.1

Source: *CEA, Make in India, India Solar Handbook 2017, MNRE, Mercom India, Bloomberg NEF, Solar Energy Corporation of India, News Article*

Solar power generation growth likely to outweigh other sources by 2022…(1/2)

- In November 2020, Ladakh got the largest solar power project set-up under the central government's 'Make In India' initiative at Leh Indian Air Force Station with a capacity of 1.5 MW.
- In December 2020, the solar power tariff dropped to an all-time low of Rs. 1.99 per unit in an auction of projects of 500 MW capacity by the Gujarat Urja Vikas Nigam Ltd. (GUVNL).
- The world's largest floating 600 MW solar energy project will be constructed at the Omkareshwar Dam in the Khandwa district of Madhya Pradesh at the estimated cost of Rs. 3,000 crore. The project is expected to begin power generation by FY23.

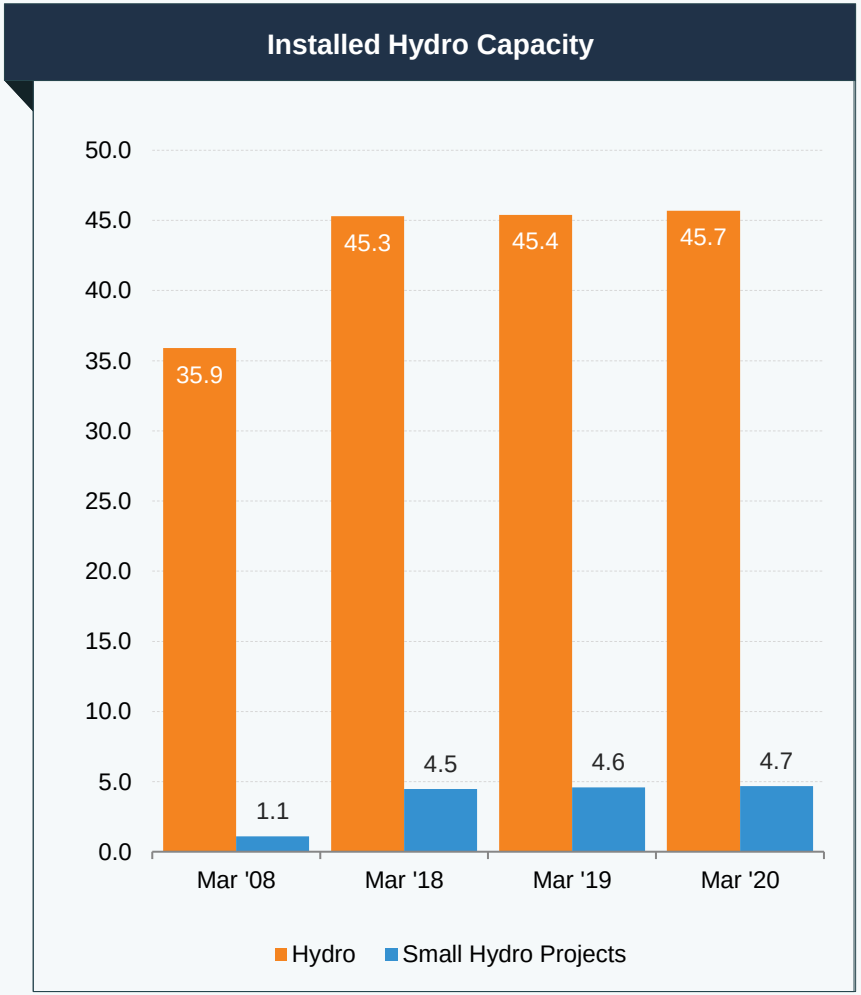
Top 20 state-wise solar installations in India (January 2021)

Rank	State	Capacity (MW)
11	Haryana	407.83
12	Odisha	401.72
13	Uttarakhand	353.41
14	Chhattisgarh	243.11
15	Kerala	189.75
16	Delhi	176.46
17	Bihar	157.41
18	West Bengal	149.84
19	Jharkhand	48.63
20	Chandigarh	45.16

Source: *CEA, Make in India, India Solar Handbook 2017, MNRE, Mercom India, Bloomberg NEF, Solar Energy Corporation of India, News Article*

Growth in hydro power

- India has overtaken Japan, becoming the nation with the fifth-largest hydropower production capacity in the world with a total installed base at over 50 GW, and is only behind Canada, US, Brazil and China according to International Hydropower Association (IHA).
- India has the hydro power potential of around 145 GW, of which 45 GW is already been utilised.
- Hydro power projects in India are classified into conventional hydro projects and small hydro electric projects. Small hydel projects are included in the Government's renewable energy sources (RES) targets.
- In March 2019, large hydro power Projects (HPO) were declared as part of non-solar Renewable Purchase Obligation (RPO).
- Installed capacity from large hydel projects in India increased from 35.9 GW in March 2008 to 45.69 GW in March 2020, while capacity from small hydel plants increased four-fold to 4.7 GW in the same period.
- A new hydro power policy for 2018-28 has been drafted for the growth of hydro projects in the country.
- In October 2020, Patel Engineering announced that it has won an order worth Rs. 1,564.42 crore (US$ 211.15 million) to build 2,000 MW Subansiri Lower Hydro Electric project in Arunachal Pradesh.
- In November 2020, the Cabinet Committee on Economic Affairs approved an investment of Rs. 1,810.56 crore (US$ 245.59 million) for the 210 MW Luhri Stage-I hydroelectric project located on the Sutlej river in Shimla and Kullu districts of Himachal Pradesh.
- In January 2021, the government approved eight hydropower projects of 144 MW over the Indus River and its tributaries in Ladakh.



Source: *CEA, Ministry of Power, News Article*

Strategies Adopted

Strategies adopted

FULL INTEGRATION

- Suzlon, a key player in the wind power segment, is a vertically integrated company. It has been producing, installing and maintaining all wind turbines. It has service support centres across the globe.
- The return of fully integrated players exceed engineering, procurement and construction (EPC) contractors.

DECENTRALISED SOLAR POWER

- Selco Solar Pvt Ltd started installing solar panels in slums which were not connected to the grid as a pilot project in 2008, and has since, expanded into other states as well. They have also used standardized financial packages to get the slum people move from kerosene to solar power.
- Off-grid solar power is growing at a fast pace in India, with sales of 781,000 off-grid solar products in the first half of 2019.

PPA & LOWER TARIFFS

- Power purchase agreements with states have become an important part of the project cycle for Indian companies.
- Solar tariffs in India have reduced from ~Rs. 7.36/kWh (US 10 cents/kWh) in FY15 to Rs. 1.99/kWh (US 3.57 cents/kWh) in FY20.

SHIFT TOWARDS NON-CONVENTIONAL ENERGY

- India's leading conventional energy producers are shifting towards non-conventional energy resources to achieve their sustainability goals and contribute towards generating clean energy.
- As per the Central Electricity Authority (CEA) estimates, by 2029-30, the share of renewable energy generation would increase from 18% to 44%, while that of thermal is expected to reduce from 78% to 52%.

Source: *CEA, Company website, Livemint, Mercom, GOGLA, News Article, KPMG*

Growth Drivers

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Renewable energy growth drivers

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Government commitments

- The Government is aiming to achieve 227 GW of renewable energy capacity by 2022, much ahead of its target of 175 GW as per the Paris Agreement. The government plans to establish renewable energy capacity of 523 GW (including 73 GW from Hydro) by 2030.
- In March 2019, the Government approved the agreement between Ministry of New and Renewable Energy (MNRE) and Denmark's Ministry for Energy, Utilities and Climate with an aim to focus on offshore wind energy and a letter of intent to establish an Indo-Danish Centre of Excellence for renewable energy in India.
- 60 solar cities will be developed in India as part of Ministry of New and Renewable Energy's Solar Cities program.
- In May 2020, amid the COVID-19 pandemic, India was estimated to install 5,000 MW of solar capacity by end-2020.
- Delhi Government decided to shut down thermal power plant in Rajghat and will develop it into 5,000 KW solar park.

Investment

- The renewable energy space in India has become very attractive from investors' perspective; and received FDI inflows of US$ 9.83 billion between April 2000 and December 2020.
- More than US$ 42 billion has been invested in India's renewable energy sector since 2014 and requires US$ 500-700 billion in the next few years.

Favourable policies and incentives

- Renewable energy projects are included in priority sector lending, which is relatively cheaper than other sources of credit.
- In June 2019, the Government planned to launch transmission line tenders worth US$ 5 billion in phases. The phased process would help in achieving 227 GW renewable energy capacity in India by 2022.
- In November 2020, the government announced production-linked incentive (PLI) scheme worth Rs. 4,500 crore (US$ 610.23 million) for high-efficiency solar PV modules manufacturing over a five-year period.

Source : *Invest India, KPMG, MNRE, News Sources*

Government policies

1 Repowering policy

- Promotes optimum utilisation of wind energy resources by creating facilitative framework for repowering.
- Interest rate rebate of 0.25% over and above the existing interest rate rebate offered to new wind energy projects will be provided.
- All fiscal and financial benefits offered to new wind power projects will be extended to repowering projects.

2 Wind-solar hybrid policy

- Aims to achieve a hybrid wind-solar capacity of 10 GW by 2022.
- Hybridisation of the two technologies will help in:
  - minimising variability
  - optimal utilization of infrastructure including land and transmission systems

3 Renewable Purchase Obligations (RPOs)

- RPO's are a mechanism by which state electricity commissions are obliged to purchase certain percentage of power from renewable energy sources.
- Also, floor prices of the RPO have been set to provide certainty to companies. The floor price has been set at US$ 144 per MW.

6 Government Scheme

- The renewable energy ministry expanded the scope of PM-KUSUM scheme to generate more solar energy in the farm sector.
- To support small farmers, solar projects <500 kW may be allowed by states based on techno-commercial feasibility.

5 India Energy Modelling Forum

- In October 2020, the government announced a plan to set up an inter-ministerial committee under NITI Aayog to forefront research and study on energy modelling. This, along with a steering committee, will serve the India Energy Modelling Forum (IEMF), which was jointly launched by NITI Aayog and the United States Agency for International Development (USAID).

4 Scheme for development of solar parks and ultra mega solar power projects

- The Solar Energy Corporation of India (SECI) implemented large-scale central auctions for solar parks and has awarded contracts for 47 parks with over 25 GW of combined capacity.

Note : *GW - Gigawatt*
Source : *Ministry of New and Renewable Energy (MNRE), News Articles*

2 PROMOTING DOMESTIC PRODUCTION

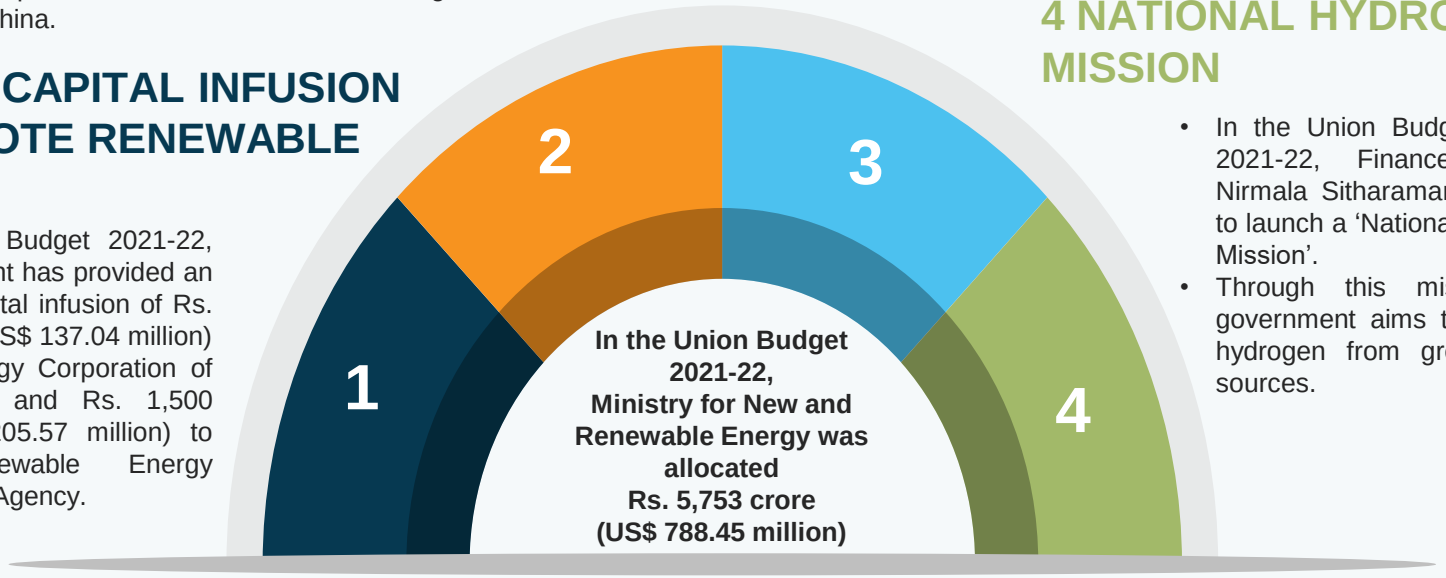
- To promote domestic production and boost domestic capacity under 'Atmanirbhar Bharat', the government will notify a phased manufacturing plan for solar cells and solar panels.
- To encourage domestic production, customs duty on solar inverters has been increased from 5% to 20%, and on solar lanterns from 5% to 15%.
- Further, an exemption to all items of machinery, instruments, appliances, components, or auxiliary equipment for setting up solar power generation projects is being rescinded. This is primarily to emphasis on domestic manufacturing and reduce imports from China.

3 GREEN ENERGY CORRIDOR

- The scheme is proposed for maximisation of renewable energy generation and integration with the main grid without compromising on the security and stability of power system.
- Under Union Budget 2021-22, the government allocated Rs. 300 crore (US$ 41.12 million) for the 'Green Energy Corridor' scheme.
- Provision of CFA (Central Financial Assistance) will be utilised for capacity addition of cumulative 6000 ckm transmission infrastructure under the intrastate Green Energy Corridor project in 2021-22.

1 HIGHER CAPITAL INFUSION TO PROMOTE RENEWABLE SECTOR

- Under Union Budget 2021-22, the government has provided an additional capital infusion of Rs. 1,000 crore (US$ 137.04 million) to Solar Energy Corporation of India (SECI) and Rs. 1,500 crore (US$ 205.57 million) to Indian Renewable Energy Development Agency.



4 NATIONAL HYDROGEN MISSION

- In the Union Budget Speech 2021-22, Finance Minister Nirmala Sitharaman proposed to launch a 'National Hydrogen Mission'.
- Through this mission, the government aims to generate hydrogen from green power sources.

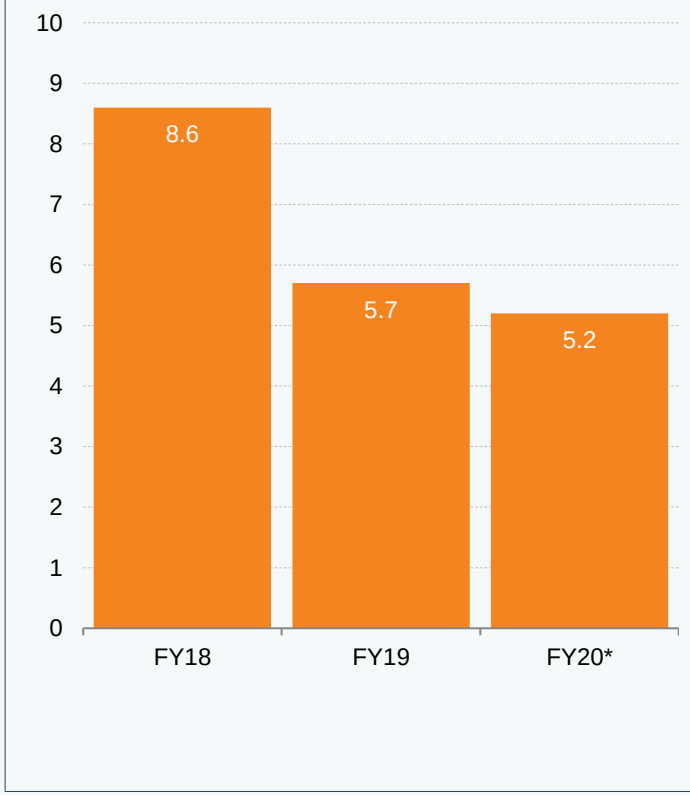
Notes : *GW - Gigawatt, MW - Megawatt, ckm - circuit kilometres*

Source : *Ministry of New and Renewable Energy (MNRE), Make in India, International Labour Organization , Bloomberg Quint*

Increasing investments: FDI inflow and key deals… (1/2)

- 100% FDI is allowed under automatic route for projects of renewable power generation and distribution subject to the provisions of the Electricity Act, 2003.
- In June 2020, Adani Green Energy won a major tender to set up 8 GW of manufacturing-linked solar energy project with an investment of Rs. 45,000 crore (US$ 6.38 billion).
- On July 08, 2020, UK's energy major BP announced its plans to invest US$ 70 million in India's Green Growth Equity Fund (GGEF) with an aim to rapidly scale-up commercially viable low carbon solutions.
- In October 2020, Tata Power announced its plan to develop 100 MW solar project in Dholera Solar Park of Gujarat.
- On November 17, Energy Efficiency Services Limited (EESL), a joint venture of PSUs under the Ministry of Power and the Department of New & Renewable Energy (DNRE), Goa, signed an MoU to discuss roll-out of India's first Convergence Project in the state.
- In December 2020, SJVN Limited, a PSU under the Ministry of Power, entered an MoU with Indian Renewable Energy Development Agency Ltd. (IREDA), a PSU under the Ministry of New & Renewable Energy, to avail services for its green energy projects.
- In January 2021, the Adani Group announced that Total would acquire a 20% minority interest in Adani Green Energy Ltd. for a US$ 2.5 billion investment.

New Investments in Clean Energy in India (US$ Billion)



Note: *PSU – Public Sector Undertaking, *-until December 2019*
Source: *DPIIT, MNRE, News Article*

Increasing investments: FDI inflow and key deals… (2/2)

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Major FDI Investments in Renewable Energy Sector

Foreign Collaborator	Country	Indian Company	FDI Equity Inflow (US$ mn)
Asian Development Bank	India	Avaada Energy Pvt Ltd.	50
Asian Development Bank	Philippines	Renew Power Ventures Pvt. Ltd.	44.69
AIRRO Singapore Pte Ltd.	Singapore	Diligent Power Pvt. Ltd.	41.07
ORIX Corporation	Japan	Lalpur Wind Energy Pvt. Ltd.	37.75
ENEL Green Power Development B.V.	Netherlands	BLP Energy Pvt. Ltd.	32.61
DEG-DEUTSCHE-InvestitionsUnd-Entwicklun	Germany	WELSPUN Renewables Energy Pvt Ltd.	32.50
ENERK International Holdings Ltd.	Seychelles	RKM POWERGEN Pvt Ltd.	32.50
OSTRO Renewal Power Limited	Mauritius	OSTRO Energy Pvt Ltd.	32.21
AREVA Solar Inc.	U.S.A	AREVA Solar India Pvt Ltd.	31.53

Opportunities

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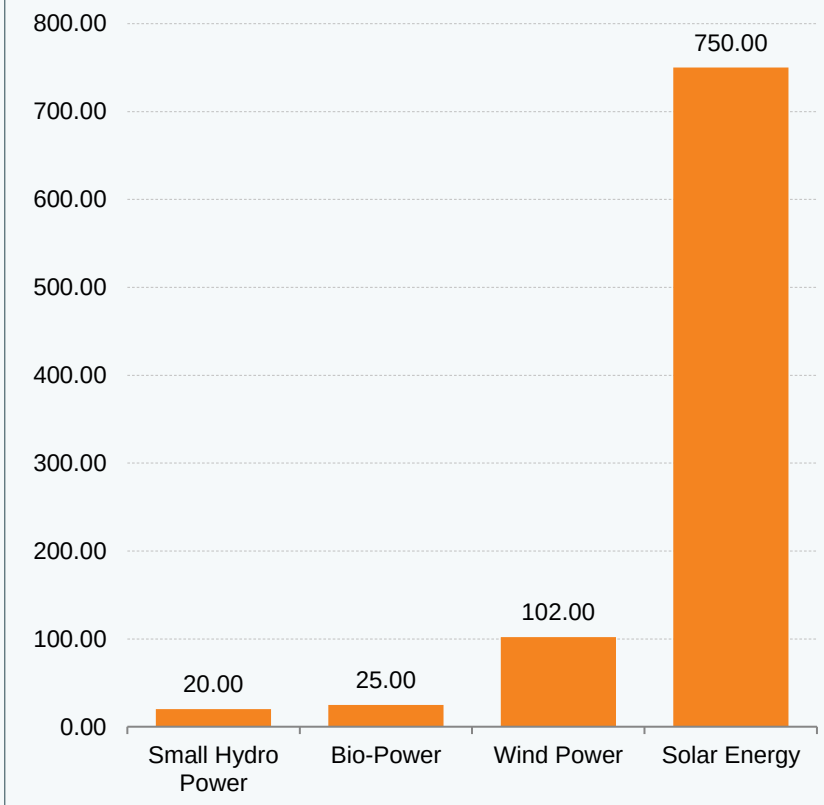
Huge untapped potential

- India is estimated to have renewable energy potential of 900 GW from commercially exploitable sources - Solar energy: 750 GW; Wind power[1]: 102 GW; Bio-energy: 25 GW; and Small Hydro: 20 GW.
- Recognising this potential, a target of 175 GW of renewable energy capacity by 2022 has been fixed.
- Renewable energy capacity is estimated to be 523 GW (including 73 GW from Hydro) by 2030.
- In India, there is an estimated potential of about 8,000 MW of tidal energy.
- Around 15,000 MW of wind-solar hybrid capacity is expected to be added between 2020-25.

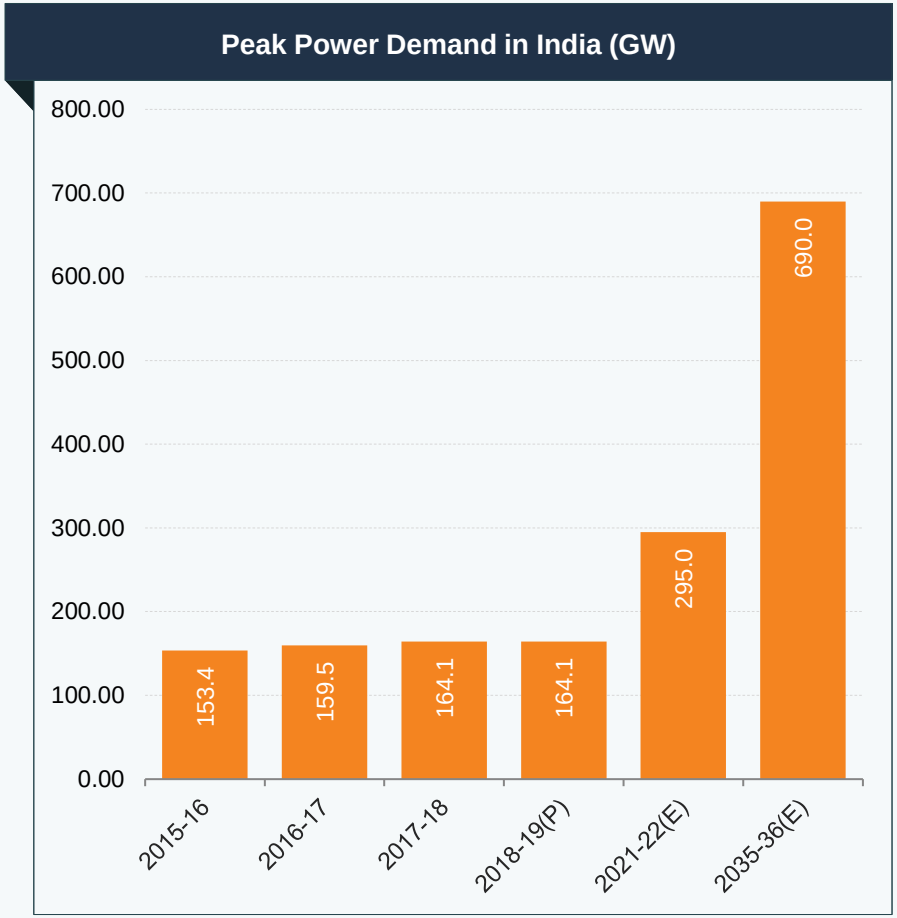
Renewable Energy Potential in India



Notes: *GW - Gigawatt, [1]Wind Power potential is at 80 metres above ground level, MW-megawatt*
Source: *Ministry of New and Renewable Energy (MNRE), Central Electricity Authority (CEA), IIT Chennai Study*

Rising power demand

- India's power demand has been rising at a fast pace. It is estimated that India will require an additional power supply capacity of 450 GW by 2034.
- The peak power demand of the country reached 183.80 GW in FY20.
- It is estimated that this demand will rise to 295 GW by 2021-22 and 690 GW by 2035-36.
- India has an electricity-GDP elasticity ratio of 0.8. 7% growth in energy supply will be required if India is to grow at 8%. This shows that electricity will continue to remain a key input in India's GDP growth.

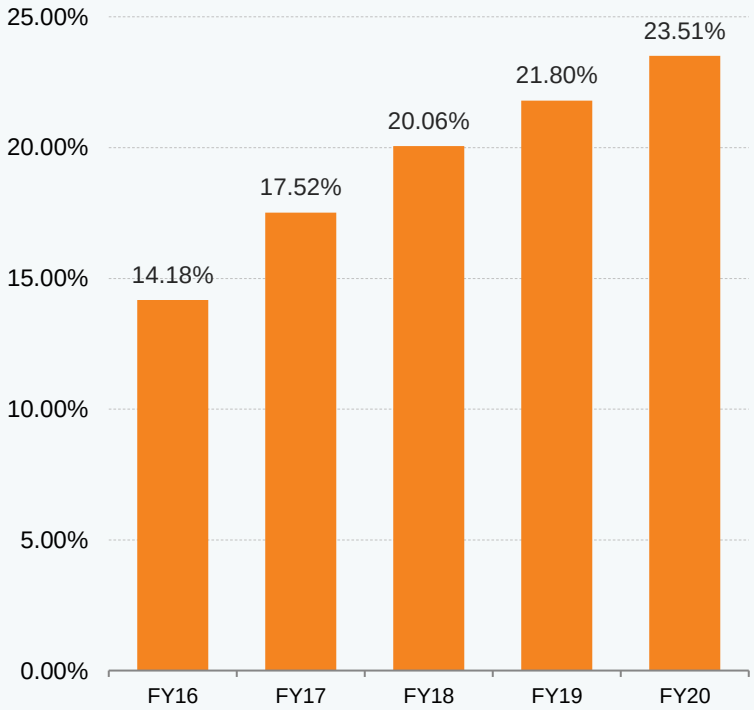


Note: *GW - Gigawatt, P - Provisional, E - Estimated*
Source: *Business Standard, Capacity addition estimates by CEA*

Move towards renewable sources

- It has been estimated that renewables will comprise 49% of India's power generation by 2040.
- Over the last few years there has been an increase in percentage contribution of renewable energy to total installed capacity. In 2013-14, the contribution was 12.92% ,which increased to 23.51% by March 2020.
- India aims to achieve a total of 175 GW of installed renewable energy capacity by 2022.
- Replacing coal plants with renewable sources is expected to save India Rs. 54,000 crore (US$ 8.4 billion) annually due to reduced power costs.
- About 5,000 compressed bio-gas plants will be set up across India by 2023.
- In November 2020, the Airports Authority of India (AAI) signed an MoU with NTPC Vidyut Vyapar Nigam, an NTPC subsidiary to promote use of electric vehicles and set up solar power plants at its airports.
- The Government of India wants to develop a 'green city' in every state of the country, powered by renewable energy. The 'green city' will mainstream environment-friendly power through solar rooftop systems on all its houses, solar parks on the city's outskirts, waste to energy plants and electric mobility-enabled public transport systems.
- According to the analytics firm British Business Energy, India ranked 3rd globally in terms of its renewable energy investments and plans in 2020.

RES (excluding large hydro) as a percentage of total installed capacity (%)



Source: *Ministry of New and Renewable Energy (MNRE), Central Electricity Authority (CEA), Greenpeace India, Minister of Petroleum and Natural Gas*

Key Industry Contacts

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Key industry contacts

Agency	Contact Information
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Solar Energy Corporation of India (SECI)	A-2/158, Janakpuri, New Delhi-110058, India Tel: 91 11 25618472, 45652708 Fax: 25611622 E-mail: cvjvarma@gmail.com, cvjv1933@yahoo.com Web site: www.seci.gov.in
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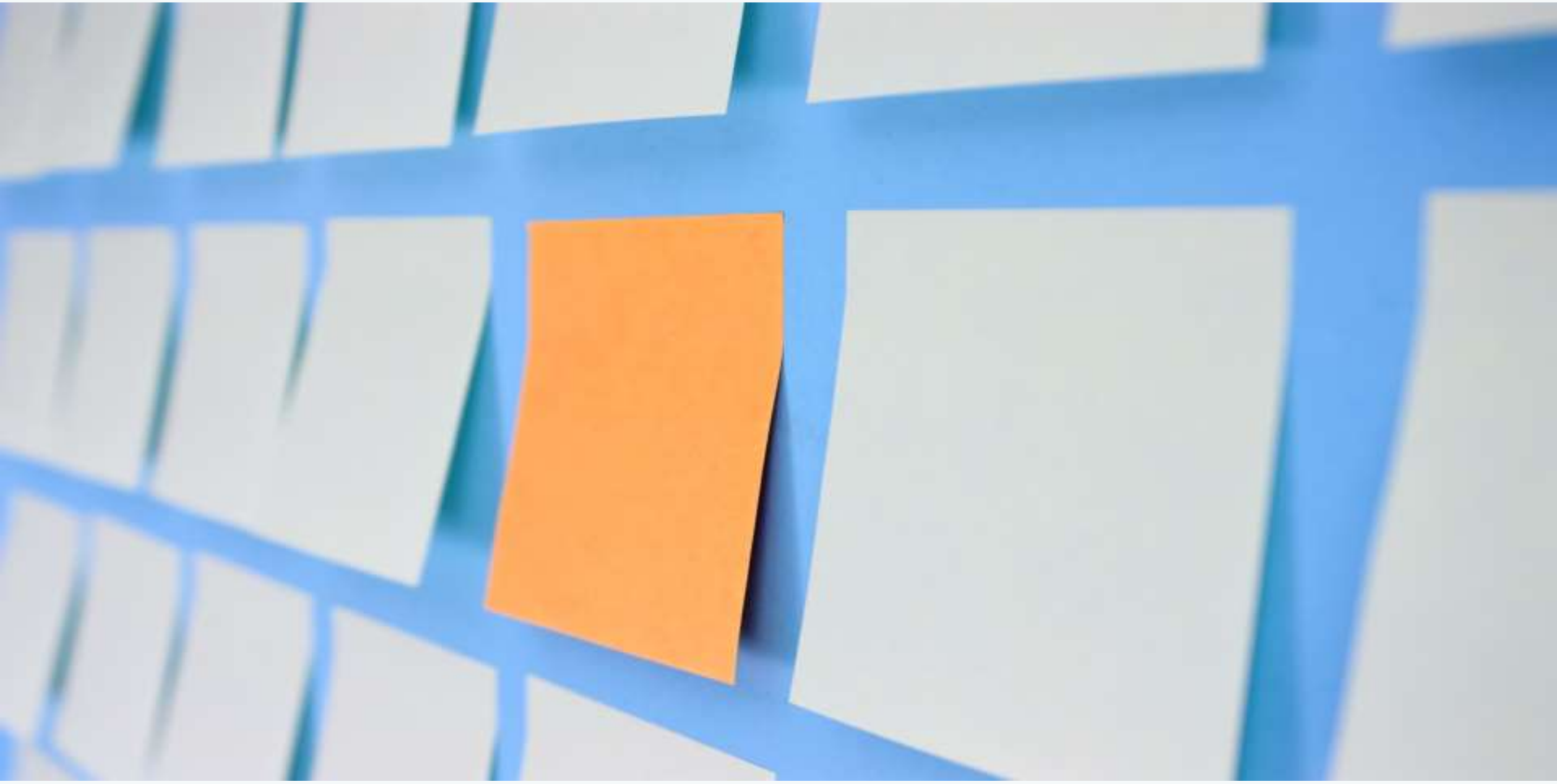
Appendix



Glossary

- CAGR: Compound Annual Growth Rate
- FDI: Foreign Direct Investment
- FY: Indian Financial Year (April to March)
- GOI: Government of India
- Rs.: Indian Rupee
- US$: US Dollar
- Wherever applicable, numbers have been rounded off to the nearest whole number

Exchange rates

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Exchange Rates (Fiscal Year)

Year	Rs. Equivalent of one US$
2004-05	44.95
2005-06	44.28
2006-07	45.29
2007-08	40.24
2008-09	45.91
2009-10	47.42
2010-11	45.58
2011-12	47.95
2012-13	54.45
2013-14	60.50
2014-15	61.15
2015-16	65.46
2016-17	67.09
2017-18	64.45
2018-19	69.89
2019-20	70.49
2020-21	73.51

Exchange Rates (Calendar Year)

Year	Rs. Equivalent of one US$
2005	44.11
2006	45.33
2007	41.29
2008	43.42
2009	48.35
2010	45.74
2011	46.67
2012	53.49
2013	58.63
2014	61.03
2015	64.15
2016	67.21
2017	65.12
2018	68.36
2019	69.89
2020	74.18
2021*	73.25

Note: *As of January 2021*
Source: *Reserve Bank of India, Average for the year*

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