

Insight Report

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# National Energy Trilemma Index 2020 edition

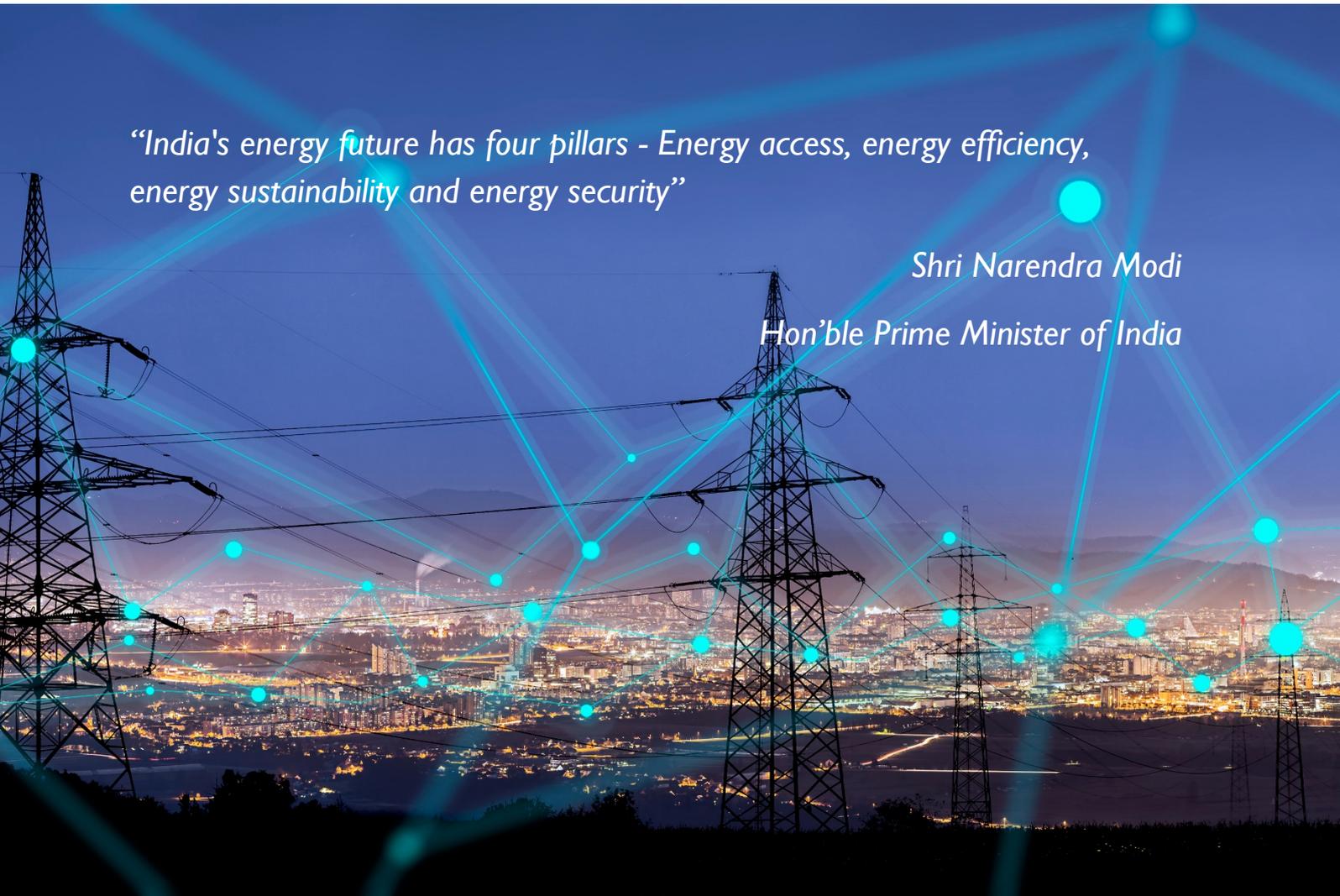


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*“India's energy future has four pillars - Energy access, energy efficiency, energy sustainability and energy security”*

*Shri Narendra Modi  
Hon'ble Prime Minister of India*





## MESSAGE FROM CHAIRMAN



**Sanjiv Nandan Sahai,**  
Secretary, Ministry of Power  
& Chairman, WEC India

Globally, Energy Systems are becoming more sustainable as energy transition continues to gather pace, driving increasing shares in low-carbon generation and greater energy productivity. Looking at the divergence of differing systems & contexts, each country will need to determine its own best energy policy pathway considering its national situation and priorities.

Out of many countries who have signed Paris agreement, India is one of the few countries which is on track to meet its NDC commitments. India is likely to achieve these goals sooner and go beyond them by 2030. India aims to achieve 175 GW of renewable energy capacity by 2022 and commits to further achieve 450 GW by 2030.

The “National Energy Trilemma Index” prepared by WEC India is a maiden attempt at the national level to assess the performance of the States & UTs across each of the three dimensions: Energy Security, Energy Equity & Environmental Sustainability. I hope this Index will help policy makers and stakeholders at the State & UT level in identifying their priority areas and formulate strategies to improve holistically across these dimensions.

I believe that the Index will be recognized as a benchmarking instrument and invaluable tool, for facilitating and accelerating the pace of energy transition across the states and the country as a whole.

**Sanjiv Nandan Sahai**



## MESSAGE FROM SECRETARY GENERAL



**Gurdeep Singh,**  
Chairman and Managing  
Director, NTPC &  
Secretary General, WEC  
India

Managing a globally successful energy transition is important to the future of humanity and the planet and it presents unprecedented challenges and opportunities. The energy sector in India as well as globally is going through an unprecedented transition phase. The transformation of the energy systems from fossil fuels to clean energy to combat climate change has been significant. Technology disruptions have unlocked vast new sources of energy while changing the contours of demand for that energy.

India, as one of the fastest growing large economies in the world, is emerging as an epicentre of this grand energy transition and is steadily on its way to transition from fossil fuels to renewable energy. The targets that the country has set itself are closer to being achieved and even surpassed. India has successfully achieved country wide household electrification and aims to provide '24x7 Power for All'. Committed to environmental sustainability, India has one of the largest renewable energy expansion programs. While India paves the way towards rapid economic and industrial growth, its commitments to reduce carbon emissions relative to its GDP by 33% to 35% from 2005 levels by 2030 is a major development that is likely to shape the country's energy future. The country is taking major initiatives in bringing secure, affordable and sustainable energy to all its citizens.

There is a growing consensus that States/UTs play an important role in meeting country's targets/ commitments. In view of this World Energy Council India (WEC India) has developed a "National Energy Trilemma Index" for all the States/UTs which will act as a tool to trigger the needed actions by State Governments.

The Index presents the findings and highlights the issues, enablers at the State & UT level which eventually will encourage the States/UTs further to accelerate their pace towards the energy transition process and help the country meet its commitments & targets on time.

**Gurdeep Singh**



***Energy transitions are fundamental processes behind the evolution of human societies: they both drive and are driven by technical, economic, and social changes***





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## I. EXECUTIVE SUMMARY

Energy demand was projected to grow by 12 % between 2019 and 2030 before the pandemic struck, however, the growth over this period will now decline. The growth in this period is projected to be 9% in the STEPS (Stated Policies Scenario), and only 4% in the DRS (Delayed Recovery Scenario). With demand in advanced economies on a declining trend, all of the increase comes from emerging market and developing economies, led by India.

India is a major force in the global energy economy and will lead the demand for energy globally over the next 10 years. The energy consumption has more than doubled since 2000, propelled higher by a rising population and rapid economic growth.

The world is now moving through a grand transition phase where the global energy sector is shifting from fossil-based systems of energy production and consumption — including oil, natural gas and coal — to renewable energy sources like wind and solar, batteries & zero carbon technologies. This transition will be enabled by information technology, smart technology, policy frameworks and market instruments.

The ongoing Covid-19 pandemic has led to an unprecedented global economic and social crisis in the past few months which has delivered a brutal shock to almost all the countries. It has significantly affected all the sectors including the energy sector thereby curbing investments and slowed down the expansion of key clean energy technologies.

Building sustainable, equitable and resilient economies by aligning short-term recovery efforts with the medium-and long-term objectives of the Paris Agreement and the UN sustainable development agenda is crucial in the current scenario. This energy transition is a connected policy challenge – success involves managing the three core dimensions; Energy Security, Energy Equity and the Environmental Sustainability of Energy Systems throughout the transition process.

This report presents the findings from the National Energy Trilemma Index 2020, summarising the energy system performance and energy transition readiness of all the Indian States & Union Territories across these three Trilemma dimensions: Energy Security, Energy Equity and the Environmental Sustainability. The objective of this exercise is to provide decision makers with information on States's/UT's relative performance of their energy systems. Deeper analysis at state level will give policy makers real insights on past trends, policy coherence, effectiveness and future perspective.

For this exercise, 28 states & 8 UTs were analysed for their performance based on 41 sub indicators across 11 composite indicators corresponding to three energy trilemma dimensions as well as state context. **Out of the 28 states monitored, Karnataka, Gujarat, Himachal Pradesh, Tamil Nadu, Kerala, Haryana,**

**Maharashtra, Goa, Telangana and Punjab are the top 10 performers in National Energy Trilemma Index 2020. Chandigarh, Delhi and Puducherry are top 3 performers amongst UTs.**

The overall top three States across all the dimensions (**Gujarat, Himachal Pradesh, Karnataka**) have balanced policies to provide a high baseline in each indicator of the Trilemma and have maintained steady economic growth. Their rapidly improving energy systems are the result of a focus on electrification, energy generation diversity, and infrastructure investment, push towards clean energy transition.

For the **Energy Security** dimension, the top performing states are **Goa, Himachal Pradesh, Gujarat, Kerala, Maharashtra, Karnataka, Uttarakhand, Telangana, Chhattisgarh, Punjab**. These states have the most robust and secure energy systems that manage supply and demand effectively.

For the **Energy Equity** dimension, the top performing states are **Himachal Pradesh, Goa, Punjab, Haryana, Karnataka, Kerala, Uttarakhand, Gujarat, Maharashtra, West Bengal** which have high concentration of population with access to abundant and affordable energy & clean cooking fuels.

Top performers **Environmental Sustainability** are **Karnataka, Mizoram, Tamil Nadu, Himachal Pradesh, Telangana, Manipur, Madhya Pradesh, Gujarat, Maharashtra, Assam** which are taking major initiatives towards decarbonization, climate change and pollution control in context of sustainable economic growth.

## 2. INTRODUCTION

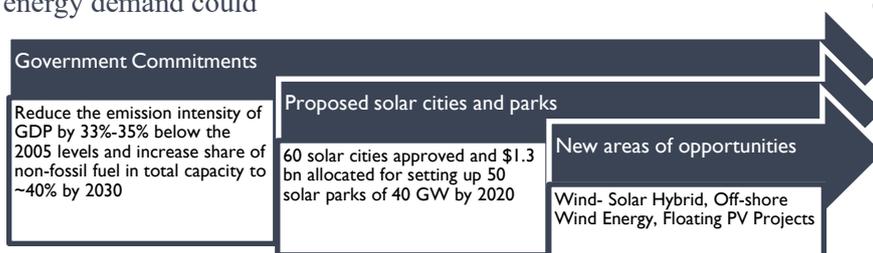
### India is a nation with distinct demographics, resource base and economic trajectory.

With a population of 1.4 billion and one of the world's fastest-growing major economies, India's actions in the energy sector will be vital for the future of the global energy markets and has global implications in this carbon-constrained and environmentally constrained world. India's energy sector has shown surprising resilience in the face of the COVID-19 pandemic with supplies holding up admirably despite the global turmoil in financial and commodity markets. India has made progressive strides in combating the COVID-19 outbreak, but the crisis has also tested our institutional readiness and financial resourcefulness to tackle such exigencies.

India is aspiring for a USD 5 trillion economy by 2025, which translates to an annual GDP growth rate (at current prices) of 12 – 13% (~8% real GDP growth) over the next 5 years. To achieve this target, the Government has envisaged a group of economic and social infrastructure projects over a period of five years with a sanctioned amount of USD 1.4 Trillion. The energy sector leads these investments accounting for over USD 340 Billion in projected investments. Opportunities abound across all segments of the energy sector from conventional to renewables; 100% FDI is permissible in Oil & Gas, power generation across the entire chain of generation, transmission and distribution and in coal mining as well.

### The Indian energy sector is undergoing tectonic shift involving all the components of the sector

India will remain a primary contributor to future growth in world energy demand. Based on current policies, as per IEA estimate, India's energy demand could double by 2040, with electricity demand potentially tripling as a result of higher focus on manufacturing within the country (Make in India), improved electricity penetration, increased appliance ownership and cooling needs. India is also expected to attract significant foreign investment into the energy sector, across modes of energy – electricity, coal and Oil & Gas.<sup>1</sup>



India has transcended from an era of chronic power shortages into an energy surplus scenario over the past 2-3 years. The electricity demand in the country has increased rapidly and is expected to rise further in the years to come. The power sector is witnessing eventful developments in not only generation and transmission segment, but also in distribution segment.

In the **energy equity** front, India has made impressive progress in recent years in increasing citizens' access to electricity and clean cooking and has also successfully implemented a range of energy market reforms and carried out a huge amount of renewable electricity deployment, notably in solar energy.<sup>2</sup> Looking ahead, the government has laid out an ambitious vision to bring secure, affordable and sustainable energy to all its citizens.

<sup>1</sup> IEA

<sup>2</sup> IEA Report: India 2020

Around 750 million people in India gained access to electricity between 2000 and 2019, reflecting strong and effective policy implementation. The government has laid out an ambitious vision to bring secure, affordable and sustainable energy to all its citizens.

Electricity access provided to almost 100 % Households and aims to realize '24x7 Power for all, other measure include scheme for solarisation of irrigation pumpsets, use of barren land for Solar plants by farmers. Continued expansion of LPG connections and subsidies for LPG delivered via Direct Benefit Transfer.

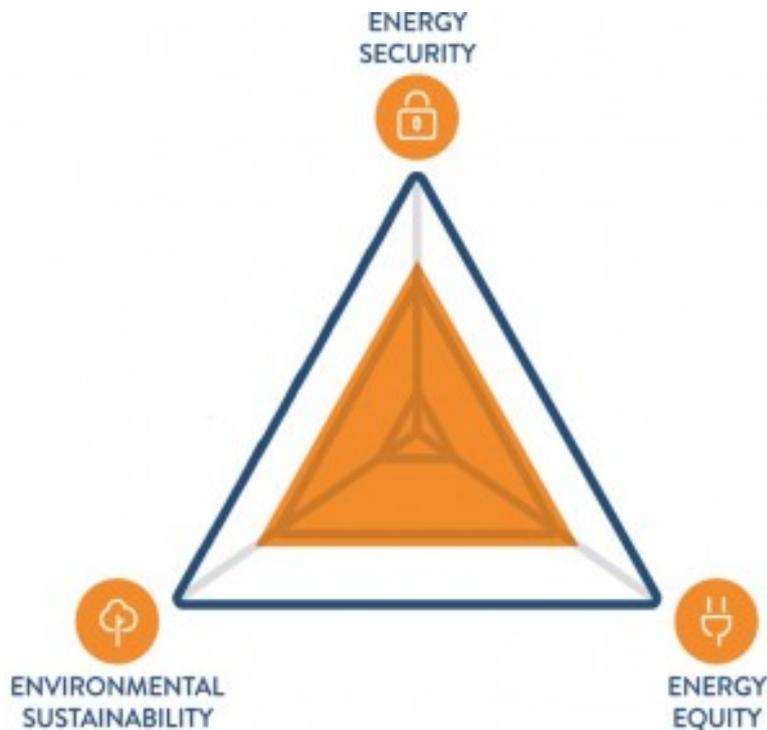
Climate Change is at the centre of India's thinking. India is well ahead on the trajectory in achieving its NDC's to the 2015 Paris agreement, particularly in achieving the target for 33% decrease in GHG intensity of GDP compared to 2005 levels and 40% non-Fossil installed capacity by 2030. India has been successful in adoption of a low carbon growth strategy, and this has been reflected in policy making, with the climate agenda receiving a particularly strong impetus.



Both the energy and emission intensities of India's gross domestic product (GDP) have decreased by more than 20% over the past decade. India's per capita emissions today are 1.6 tonnes of CO<sub>2</sub>, well below the global average of 4.4 tonnes, while its share of global total CO<sub>2</sub> emissions is around 6.4%. India is spearheading a greener future with one of the largest renewable expansion programmes in the world.

To sum up, with rise in energy demand, India would face challenges of a great magnitude and character unseen before. Addressing these challenges will have major impacts for other sectors, such as water, food, urban planning and transport. India is committed to energy sustainability and is spearheading a greener future with large scale renewable expansion programmes. The need for optimum utilization of the country's abundant energy resources both conventional and renewable present ample scope for innovations in combining technologies and new business models. As the sector boundaries get blurred, there are several areas of synergies and avenues for collaboration to be explored and it is opportune time, for the energy community to discover and capture the multitude of opportunities in India's energy transition journey.

### 3. WHAT IS TRILEMMA



**THE ENERGY TRANSITION IS A CONNECTED POLICY CHALLENGE – SUCCESS INVOLVES MANAGING THE THREE CORE DIMENSIONS; ENERGY SECURITY, ENERGY EQUITY, ENVIRONMENTAL, SUSTAINABILITY**

*The World Energy Council’s definition of energy sustainability is based on the above three core dimensions: Energy Security, Energy Equity, and Environmental Sustainability of Energy Systems.*

*Balancing these three goals constitutes a ‘Trilemma’ and balanced systems enable prosperity and competitiveness of individual countries.*

### 3.1 QUANTIFYING ENERGY TRILEMMA



**ENERGY SECURITY**

**MEASURES:**

- Ability to meet current and future energy demand
- Withstand and respond to system shocks

**COVERS:**

- Effectiveness of management of domestic/external energy sources
- Reliability and resilience of energy infrastructure



**ENERGY EQUITY**

**MEASURES:**

- Ability to provide universal access to reliable, affordable, and abundant energy for domestic and commercial use

**COVERS:**

- Basic access to electricity and clean cooking fuels and technologies
- Access to prosperity-enabling levels of energy and affordability



**ENVIRONMENTAL SUSTAINABILITY**

**MEASURES:**

- Ability to mitigate and avoid environmental degradation and climate change impacts

**COVERS:**

- Productivity and efficiency of generation, transmission
- Distribution, decarbonisation, and air quality

*Source: WEC Energy Trilemma Index Report 2020*

WEC used Trilemma Index tool to quantify the concept; The tool quantifies the Energy Trilemma Concept across the three dimensions- Energy Security, Energy Equity and Environmental Sustainability.

**Sub- Indicators:** To gauge the energy transition, a set of indicators which could provide a deeper understanding of an issue or dimension and helps develop a clear picture of the whole system, including its inter-linkages and trade-offs need to be identified. The indicators are widely used as a tool for communicating energy issues to policy makers and the public.

*The sub indicators are assigned weightages and scores of each sub-indicators are aggregated after being normalized and rescaled. The scores of the sub- Indicators are calculated based on a range of global data sets that capture performance across the three dimensions as well as the country context. Each country’s overall Index ranking is based on the calculation of underlying indicators which aggregate to composite indicators across the dimensions.*

### 3.2 WORLD ENERGY COUNCIL ENERGY TRILEMMA INDEX TOOL

#### APPROACH AND RATIONALE

The Index is a quantification of the Energy Trilemma, which is defined by the World Energy Council as the triple challenge of providing secure, equitable and affordable, environmentally sustainable energy.

The Energy Trilemma Index assesses current and past performance across the three dimensions of Energy Security, Energy Equity, and Environmental Sustainability. A fourth dimension of Country Context is also included within the calculations, to capture important differences in countries’ institutional and macroeconomic contexts.

The model combines 32 quantitative indicators. The scores and rankings are based on a range of global data sets that capture both energy performance and the national context in which energy is managed. Each country’s

overall Index ranking is based on the calculation of 32 underlying indicators which aggregate up to 11 categories across the four dimensions (including country context).

- **Performance indicators** include supply and demand, the affordability of and access to energy, intensity and efficiency of energy use, and emissions associated with energy systems.
- **Contextual indicators** consider the broader circumstances of energy performance, including a country's ability to provide coherent, predictable and stable policy and regulatory frameworks, initiate R&D and innovation, and attract investment.

**The Energy Trilemma Index is an annual exercise by the World Energy Council in partnership with global consultancy Oliver Wyman and Marsh & McLennan Advantage since 2010. In 2020 World Energy Trilemma Index, 108 countries are ranked with an assigned three-letter grade representing the balanced score for their country's energy system.<sup>3</sup>**

The Energy Trilemma Index can be used to learn from leading performers and best practice, assess effectiveness of energy policies for enabling balanced transition management, analyse the urgency of competing priorities, test the relative impact of focus shifts and new directions, support dialogue on integrated policy innovation

## **DIMENSIONS**

**Energy Security:** Measures a nation's capacity to meet current and future energy demand reliably. The dimension covers the effectiveness of management of domestic and external energy sources, as well as the reliability and resilience of energy infrastructure.<sup>4</sup>

**Energy Equity:** Assesses a country's ability to provide universal access to reliable, affordable, and abundant energy for domestic and commercial use. The dimension captures basic access to electricity and clean cooking fuels and technologies, access to prosperity-enabling levels of energy consumption, and affordability of electricity, gas, and fuel. Access to reliable and affordable energy is an enabler of economic prosperity, but increasing emphasis is now being paid to quality of energy supply

**Environmental Sustainability:** Represents the transition of a country's energy system towards mitigating and avoiding potential environmental harm and climate change impacts. The dimension focuses on productivity and efficiency of generation, transmission and distribution, decarbonisation, and air quality.

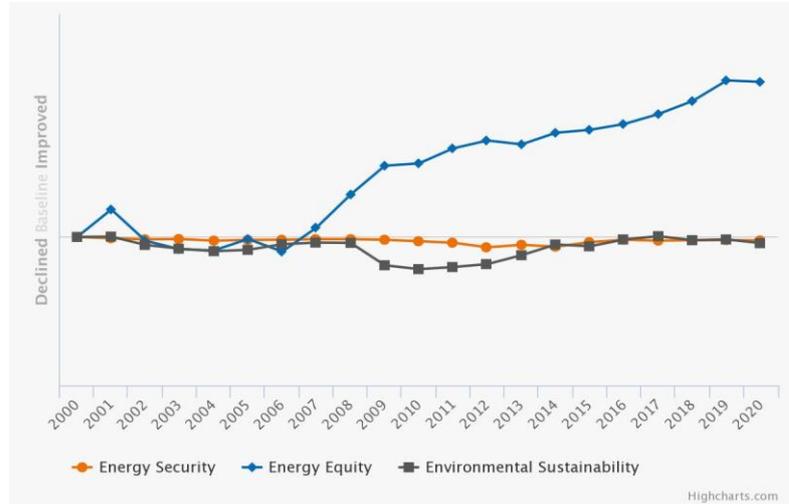
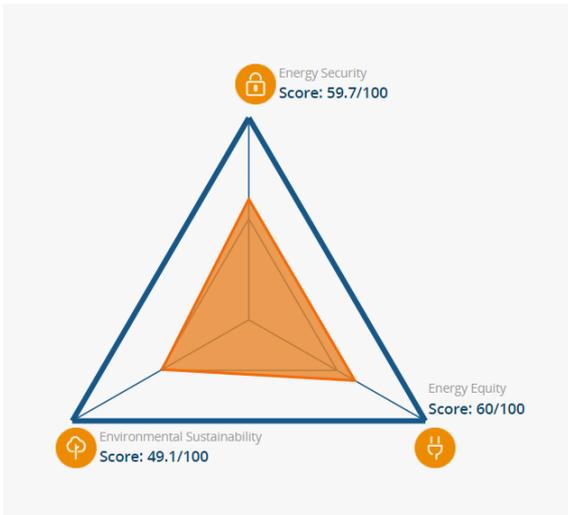
**Country Context:** Focuses on elements that enable countries to effectively develop and implement energy policy and achieve energy goals.

<sup>3</sup> WEC Energy Trilemma Index 2020

<sup>4</sup> WEC Energy Trilemma Index 2020

# INDIA'S RANKING

*In 2020, India ranked 86<sup>th</sup> out of 108 countries.*



**The Trilemma rank of India is influenced by the performance in the indicators: 'Import dependence', 'Energy Storage' and 'CO2 emission per capita'. The increased 'import dependence' of Oil and Gas is to meet the higher energy needs of a growing economy. The 'energy storage' of Oil and Gas is a strategic subject and cannot be discussed. The CO2 per capita emission naturally increases with improved per capita consumption of energy.**

# NATIONAL ENERGY TRILEMMA INDEX 2020





## 4.1 ADDRESSING TRILEMMA CONCEPT AT STATE LEVEL

**Energy has always been a driver of change and lifeline of a nation's economy. Over the last few years, India is marching on the path of energy transition and is way ahead in achieving the goals for Paris Agreement.**

The efforts to meet the Paris agreement goals very much hinges on the overall success of State's overall performance in the energy and allied sectors. The performance of state across energy security, energy equity, environmental sustainability and macroeconomic environment factors such as economic growth, governance, innovation ecosystem among others will be pivotal to the whole transition process. To map the performance of States, there is a need to develop an effective tool which could capture the above-mentioned parameters in a holistic manner and would be helpful to States/UTs by benchmarking their performance against their peers and plot the course for successful energy transition.

Similar indexing/benchmarking exercises have been undertaken at global level such as Energy Trilemma Index (WEC), Energy Transition Index (WEF) etc. In India, at state level, similar benchmarking exercises for the states have been carried out in specific areas, such as innovation (Innovation Index), human development (HDI Index), energy efficiency (Energy Efficiency Index), Sustainable development goals (SDG Index), logistics, ease of doing business etc by different organisations/departments under Government of India.



**However, an outcome-based framework to evaluate states' progress on energy sector has not been developed as on date.**

In order to understand the ground realities of the states' performance in energy domain, World Energy Council India has made a maiden attempt to develop a tool titled **“National Energy Trilemma Index”** on lines of Energy Trilemma Index of World Energy Council and Energy Transition Index of World Economic Forum.

The tool can be used uniformly across the state, and union territories, to assess the status of energy sector as well as provide a comparative picture among the states, considering aspects unique to state level challenges, opportunities, drivers, avenues, initiatives, institutional reforms and achieved outcomes.

## 4.2 APPROACH FOR DEVELOPMENT OF INDEX

The question now arises; how to design an effective, un-biased and holistic tool for measuring the performance, across the four dimensions i.e. Energy Security, Energy Equity, Environmental Sustainability and State's context.

### *Sub-Indicators*

The term indicator is defined as “a summary measure related to a key issue or phenomenon and derived from a series of observed facts or reported perceptions, attitudes or expectations.”<sup>5</sup>

Traditionally, the indicators transform the basic statistical information to provide a deeper understanding of an issue or dimension or performance and helps develop a clear picture of the whole system, including its inter-linkages and trade-offs. These indicators are form the basis of National Energy Trilemma Index exercise and are termed as sub-indicators in this exercise for ex. Access to Electricity, Share of Renewable Energy, Emission Intensity, Diversity of Electricity Installed capacity, economic growth etc. However, if we have to analyse from a broader perspective, these sub-indicators present a myopic view and focus on one aspect of energy sector and is not integrated do not adopt integrated approach, particularly when we address at a country or state level.

### *Composite indicators*

***“A composite indicator is created when individual indicators are combined into a single measure. Composite indicators are often used to measure multidimensional and, in many cases, abstract concepts, which cannot be captured by single indicators”.*** The composite indicators reduce the pool of information provided by a myriad of sub-indicators to a level that makes analysis convenient and provides a uniform scale on which comparative performance of countries or states can be gauged. For ex. Energy Access is measured by rate of electrification, access to clean cooking fuels.

### *Framework*

The National Energy Trilemma Index as a tool is the outcome of aggregation of wide range of composite indicators (which in turn are aggregation of sub-indicators) covering important dimensions of Energy Security, Energy Equity, Environmental Sustainability and State Context. The tool attempts to highlight the performance of the States, benchmark against their peers, and identify priority areas for policy interventions and resource mobilization to accelerate energy transition.

### HIGHLIGHTS

- Adaptation from Energy Trilemma Index of WEC as well as other indexing exercises of global agencies as well as of Indian government.
- Metric to measure performance of states in energy sector as well as transition readiness of the states
- Attempt to assess performance of 28 States & 8 UTs using data from public domain (verified sources) such as CEA, MoSPI, PPAC, Ministry of Power, NITI Aayog, DPIIT, Ministry of Commerce etc
- Useful tool for States to benchmark their progress against national targets as well as relative performance compared to their peers
- Support States/UTs to identify priority areas and data gaps

<sup>5</sup> [https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.42/2017/Seminar/Chapter\\_3\\_-\\_Typology\\_of\\_indicators\\_2017.05.18\\_-\\_for\\_seminar.pdf](https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.42/2017/Seminar/Chapter_3_-_Typology_of_indicators_2017.05.18_-_for_seminar.pdf)

## 5. OVERVIEW



### State Context

<b>Macroeconomic Environment</b>	<ul style="list-style-type: none"> <li>•Economic Growth Rate</li> <li>•Ease of Doing Business Index</li> <li>•States Start up ranking Index</li> </ul>
<b>Regulations, Institutions &amp; Governance</b>	<ul style="list-style-type: none"> <li>•Human Development (HDI) Index</li> <li>•Good Governance Index</li> <li>•SDG Index</li> </ul>
<b>Stability for Investment &amp; Innovation</b>	<ul style="list-style-type: none"> <li>•Innovation Index</li> <li>•Logistics Index</li> <li>•Industry, Infrastructure &amp; Innovation</li> <li>•Sustainable Mobility (Presence of EV, Sustainability mobility policies)</li> </ul>

# 4 Dimensions, 11 Composite Indicators, 41 Sub- Indicators

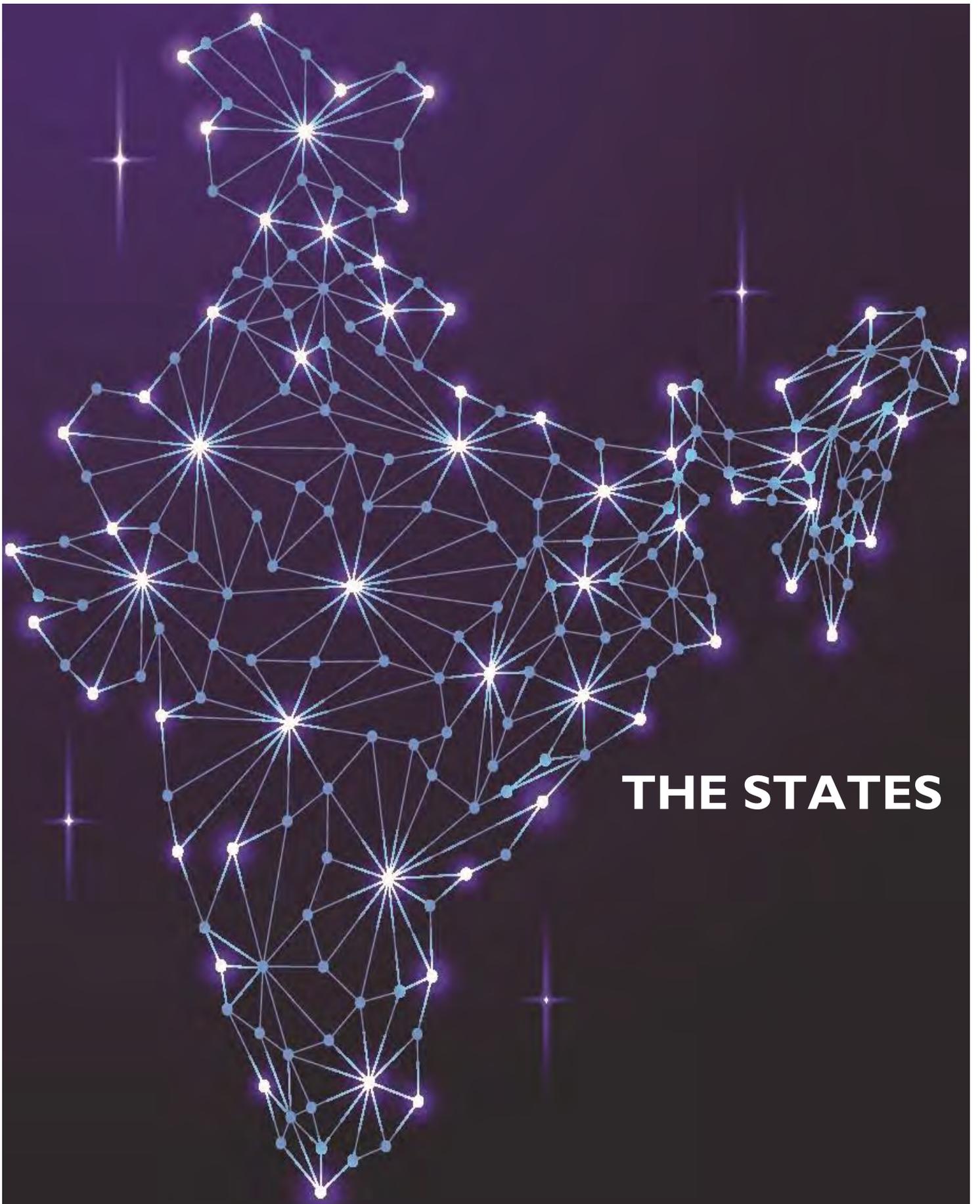
The National Energy Trilemma Index measures and compares the performance of the states in energy sector based on 41 sub- indicators across 11 composite indicators, corresponding to the imperatives of the energy trilemma index of WEC i.e. Energy Security, Energy Equity and Environmental Sustainability as well state context.

<p><b>Energy Security</b> 25%</p> <p><i>Assesses the extent to which a state's energy supply (especially electricity) is secure, accessible and diversified</i></p> <p><b>Composite Indicators (2)</b></p> <p><b>Sub-Indicators (10)</b></p>	<p><b>Electricity Diversity and Power Supply Position Viability of Energy Systems</b></p> <ul style="list-style-type: none"> <li>• Diversity of Electricity (Installed Capacity)</li> <li>• Share of RE in Electricity Capacity</li> <li>• Installed capacity (Electricity)- Growth Rate</li> <li>• Electricity consumption per capita</li> <li>• RE Potential</li> <li>• Energy/Power Supply Position (Surplus/Deficit)</li> <li>• AT &amp; C Losses</li> <li>• ACS-ARR Gap</li> <li>• Load Shedding Hours/Outages- Industries</li> <li>• Average Hours of Supply- Agriculture</li> </ul>
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<p><b>Energy Equity</b> 25%</p> <p><i>Assesses a state's access to electricity, clean cooking and modern fuels. Assesses the affordability of electricity, gas, and fuel as well as reforms to support the affordability</i></p> <p><b>Composite Indicators (3)</b></p> <p><b>Sub-Indicators (11)</b></p>	<p><b>Energy Access Affordability Performance of Utilities</b></p> <ul style="list-style-type: none"> <li>• Access to Electricity</li> <li>• Access to clean cooking</li> <li>• LPG Coverage</li> <li>• Average Cost of Power</li> <li>• Non-Subsidised LPG Price (14.2 kg Cylinder)</li> <li>• Petrol Prices</li> <li>• Diesel Prices</li> <li>• Profit/Loss of Utilities (PAT) of Utilities</li> <li>• Net-worth of State Utilities,</li> <li>• Total Borrowings of State Utilities</li> <li>• Ease of making payments by DISCOM</li> </ul>
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<p><b>Environmental Sustainability</b></p> <p><i>Assesses transition of a state's energy system towards mitigating and avoiding potential environmental harm and climate change impacts.</i></p>	<p>25%</p>
<p><b>Composite Indicators (3)</b></p>	<p><b>Energy Resource Productivity</b> <b>Decarbonisation</b> <b>Emissions &amp; Pollution</b></p>
<p><b>Sub-Indicators (10)</b></p>	<ul style="list-style-type: none"> <li>• Energy Efficiency Score</li> <li>• Performance of Clean Energy (Capacity/Potential)</li> <li>• Energy Intensity (in toe/INR Crore)</li> <li>• Notification of SAPCC (State Action Plan for Climate Change, State renewable Energy Policy)</li> <li>• CO2 saved from LED Bulbs per 1000 population,</li> <li>• Percentage of Forest Cover</li> <li>• Emission per Capita</li> <li>• Air Quality Index</li> <li>• PM2.5 mean annual exposure</li> <li>• PM10 Mean annual exposure</li> </ul>

<p><b>State Context</b></p> <p><i>Assesses state's ability to deliver on investments, regulations &amp; governance, stability of institutions &amp; innovation parameters</i></p>	<p>25%</p>
<p><b>Composite Indicators (3)</b></p>	<p><b>Macroeconomic Stability</b> <b>Regulations, Institutions &amp; Governance</b> <b>Stability for Investment &amp; innovation</b></p>
<p><b>Sub-Indicators (10)</b></p>	<ul style="list-style-type: none"> <li>• Economic Growth</li> <li>• Ease of Doing Business Index</li> <li>• States Start up ranking Index</li> <li>• Human Development Index (HDI)</li> <li>• Good Governance Index</li> <li>• SDG Index</li> <li>• Innovation Index</li> <li>• Logistics Index</li> <li>• Industry, Infrastructure &amp; Innovation Index,</li> <li>• Sustainable Mobility Policies</li> </ul>



# THE STATES

## 6.1 RATIONALE FOR SELECTION OF INDICATORS

- 1. Criteria for selection of Indicator:** All the indicators were selected against the following key principles:
  - **Reliability** – utilizing reliable source data from renowned institutions and Government agencies
  - **Reusability** – sourcing data from the same providers on an annual basis, thus facilitating updates of the data
  - **Quality** – selecting data that represents the best measure available, given constraints and updated data.
- 2. Equal Weightages:** Each of the core dimension i.e. Energy Security, Energy Equity, Environmental Sustainability and State Context has been given equal priority and weighting. Assignment of equal weights to variables in composite indices has been debated from the perspective of robustness and interpretation of the aggregate scores. However, due to the lack of empirical evidence on the relative importance of variables within and across dimensions for all the states for which the Index provides coverage, the variables have been weighted equally.
- 3. Importance and Interlinkages among dimensions:** The imperative core dimensions of the National Trilemma Index are of mutual importance and are interlinked and there are no empirical evidences that why one dimension should be of higher weightage than the other.\

## 6.2 METHODOLOGY

### STEP 1: IDENTIFICATION OF INDICATORS, SOURCE & SELECTION OF STATES & UTs

- **Identification of performance indicators and allocation of weightages:** To ensure that the indicators and weightages reflect the states' role in promoting energy transition.
- **Identification of Sources:** The next step would be to identify the source of data, from where corresponding data could be fetched. (Annexure B)
- **Selection of States & Union Territories:** In the third step, the states & UTs would be selected on the basis of; availability of data and willingness to be part of the study.

### STEP 2: DATA COLLECTION, VERIFICATION AND VALIDATION

Collection of publicly available information from the websites of State Electricity Boards/Regulatory Commissions/Energy Development Agencies and other state nodal agencies. The National Trilemma Index would only use data vetted by Central/State/SDAs and BEE, or data from central government databases and reports

### STEP 3: ANALYSIS OF DATA RECEIVED AND SCORING OF STATES

1. **Normalisation:** The data value of corresponding sub-indicator of the state would be normalized to a common unit (where each of the 41 sub-indicators, where applicable is rescaled using the linear transformation formula  $(\text{data values} - \text{worst}) / (\text{best} - \text{worst})$ ) from across the scope states and rescaled for 0-100 for comprehensibility.

The best score represents the best performance and worst score represents the worst performance on the sub-indicator across all states/UTs.

*Normalization is a scaling technique in which values are shifted so that they end up ranging between 0 and 1. Here's the formula for normalization:*

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}}$$

*Here, Xmax and Xmin are the maximum and the minimum values of the feature respectively.*

- *When the value of X is the minimum value in the column, the numerator will be 0, and hence X' is 0*
- *On the other hand, when the value of X is the maximum value in the column, the numerator is equal to the denominator and thus the value of X' is 1*

*If the value of X is between the minimum and the maximum value, then the value of X' is between 0 and 1*

2. **Calculation of sub-indicator scores:** Corresponding individual sub-dimensional score would be calculated by taking into account the sub-indicator weightage for each State/UT
3. **Calculation of Dimension Scores and Aggregation:** For each State/UT, the scores obtained for individual sub-indicators for each state/UT would be aggregated into one score, first for each composite indicator and then across all the composite indicators.
4. **Ranking:** The ranking of states is determined by sorting the scores.

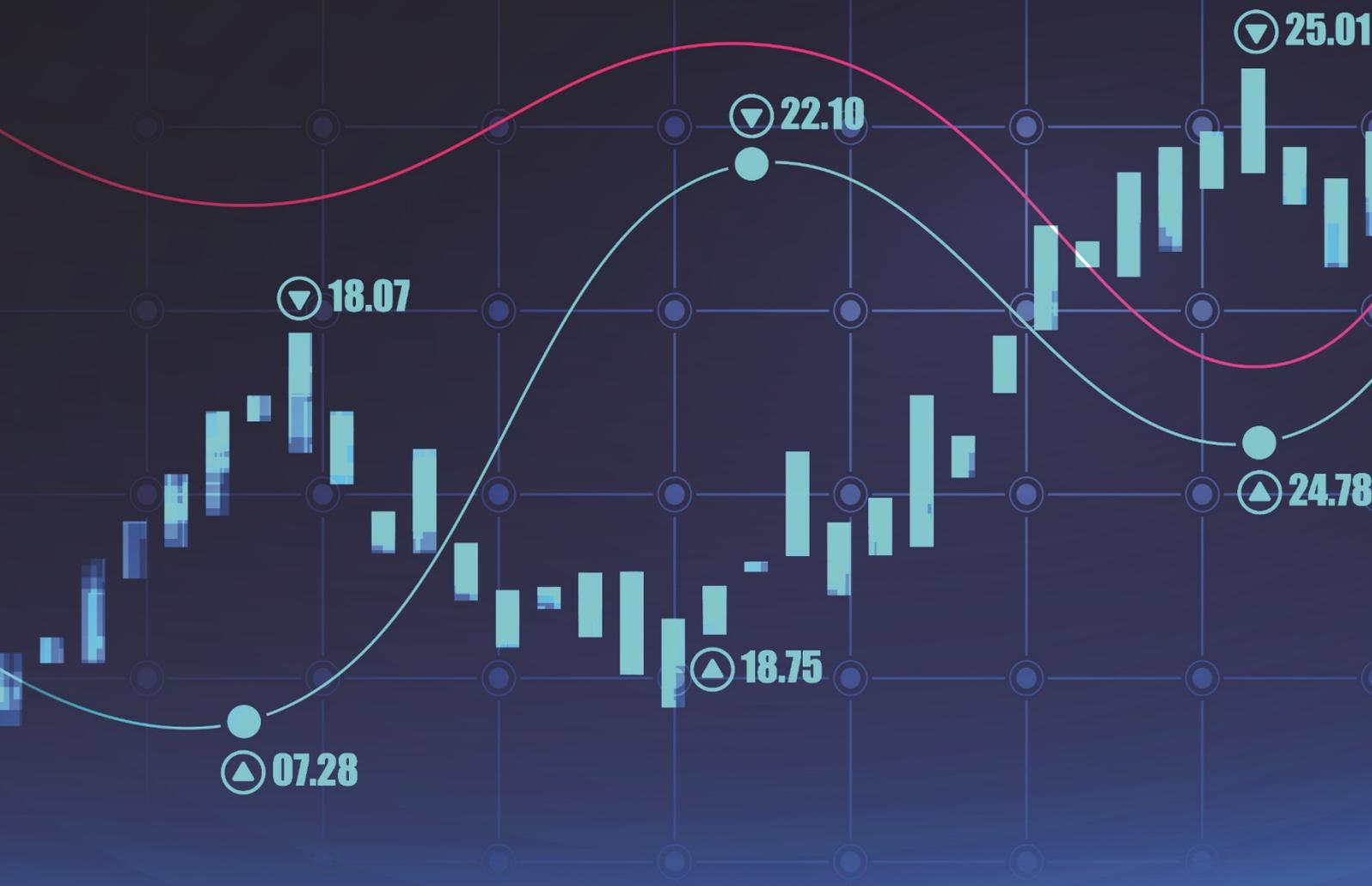
### Calculation of Diversification (ECMI)

**Energy Mix Concentration Index (ECMI)** derived from Herfindahl-Hirschman Index (HHI Index) is commonly applied to measure market concentration analysis. In this exercise, we have calculated the diversity of electricity (Installed Capacity) using the HHI Index formula.

$$\text{Diversity of production} = \left( \left( \frac{-d}{c+h} \right) * \text{LN} \left( \frac{d}{c+h} \right) \right) + \left( \left( \frac{-e}{c+h} \right) * \text{LN} \left( \frac{e}{c+h} \right) \right) + \left( \left( \frac{-f}{c+h} \right) * \text{LN} \left( \frac{f}{c+h} \right) \right) + \left( \left( \frac{-g}{c+h} \right) * \text{LN} \left( \frac{g}{c+h} \right) \right) / \text{LN}(4)$$

where d is the share of the electricity source “c+ h” is the total installed capacity. Smaller values of the ECMI indicates less diversification, with 0 being the least diversified and 1 being the highest diversified.

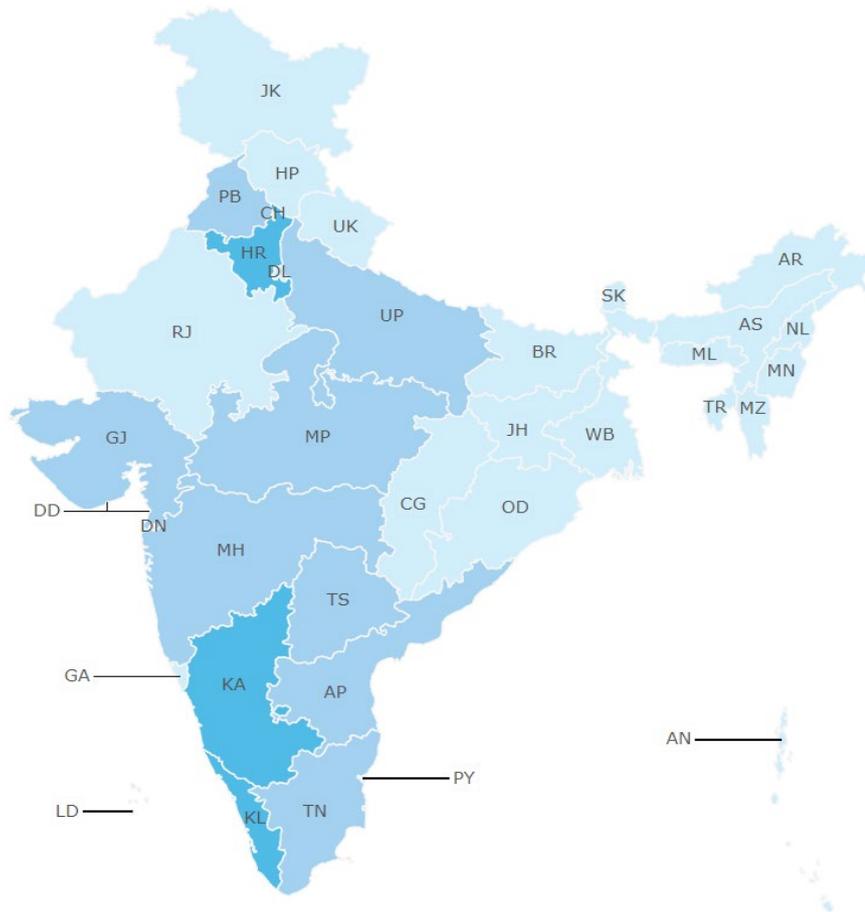
# INDICATORS



## 6.3 INDICATORS

<b>ENERGY SECURITY</b>	<b>Electricity Diversity and Power Supply Position (12%)</b>		<b>Viability of Energy/Electricity Systems in the state (13%)</b>			
	Diversity of Electricity (Installed Capacity)	2%	AT & C Losses	4%		
	Share of RE in Electricity Capacity	2%	ACS-ARR Gap	3%		
	Installed capacity (Electricity Growth Rate)	2%	Load Shedding Hours/Outages- Industries	3%		
	Electricity consumption per capita	2%	Average Hours of Supply- Agriculture	3%		
	RE Potential (estimated in GWp)	2%				
	Energy/Power Supply Position (Surplus/Deficit)	2%				
<b>ENERGY EQUITY</b>	<b>Energy Access</b>	<b>10%</b>	<b>Affordability</b>	<b>7%</b>	<b>Performance of Utilities</b>	<b>8%</b>
	Access to Electricity	4%	Average Cost of Power	3%	Profit/Loss of Utilities (PAT) of Utilities	2%
	Access to clean cooking	3%	Non-Subsidized LPG Price	2%	Net-worth of State Utilities	2%
	LPG Coverage	3%	Petrol Prices	1%	Total Borrowings of State Utilities	2%
			Diesel Prices	1%	Ease of making payments by DISCOMs	2%
<b>ENVIRONMENTAL SUSTAINABILITY</b>	<b>Energy Resource Productivity (9%)</b>		<b>Decarbonisation (9%)</b>		<b>Emissions and Pollution (7%)</b>	
	Energy Efficiency Score	3%	Notification of SAPCC (State Action Plan for Climate Change, State renewable Energy Policy)	3%	Air Quality Index	3%
	Performance of Clean Energy (Capacity/Potential)	3%	CO2 saved from LED Bulbs per 1000 population (in tonnes)	2%	PM2.5 mean annual exposure	2%
	Energy Intensity (in toe/INR Crore)	3%	% of Forest Cover (Forest Cover wrt total area)	2%	PM10 Mean annual exposure	2%
			Emission per Capita (in MtCO2e)	2%		
<b>STATE CONTEXT</b>	<b>Macroeconomic Environment (9%)</b>		<b>Regulations, Institutions &amp; Governance (9%)</b>		<b>Stability for Investment &amp; innovation (7%)</b>	
	Economic Growth Rate	3%	Human Development Index (HDI) Index	3%	Innovation Index	3%
	Ease of Doing Business Index	3%	Good Governance Index	3%	Logistics Index	3%
	States Start up ranking Index	3%	SDG Index	3%	Industry, Infrastructure & Innovation (corresponding to SDG Index)	0.5%
					Sustainable Mobility (Presence of EV, Sustainability mobility policies)	0.5%

# SCOPE STATES



## Andaman & Nicobar Islands (AN)- UT

Andhra Pradesh (AP)

Arunachal Pradesh (AR)

Assam (AS)

Bihar (BR)

Chandigarh (CH)- UT

Chhattisgarh (CG)

Dadra and Nagar Haveli (DN)- UT

Daman and Diu (DD)- UT

Delhi NCT (DL)-UT

Goa (GA)

Gujarat (GJ)

Haryana (HR)

Himachal Pradesh (HP)

Jammu & Kashmir, Ladakh (JK) - UT

Jharkhand (JH)

Karnataka (KA)

Kerala (KL)

Lakshadweep (LD)- UT

Madhya Pradesh (MP)

Maharashtra (MH)

Manipur (MN)

Meghalaya (ML)

Mizoram (MN)

Nagaland (NL)

Odisha (OD)

Puducherry (PY)- UT

Punjab (PB)

Rajasthan (RJ)

Sikkim (SK)

Tamil Nadu (TN)

Telangana (TS)

Tripura (TR)

Uttarakhand (UK)

Uttar Pradesh (UP)

West Bengal (WB)

# KEY FINDINGS



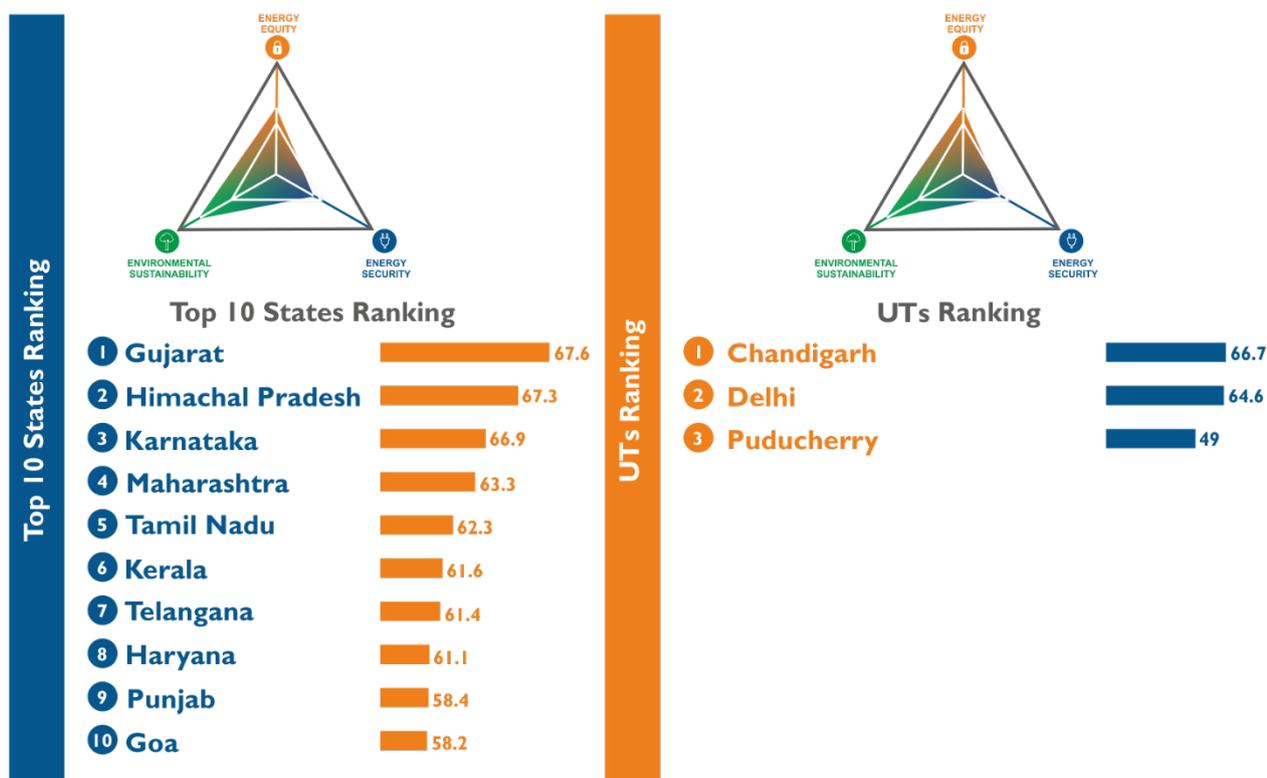
## 7. KEY FINDINGS

# National Energy Trilemma Index 2020

- 1 Gujarat
- 2 Himachal Pradesh
- 3 Karnataka
- 4 Maharashtra
- 5 Tamil Nadu
- 6 Kerala
- 7 Telangana
- 8 Haryana
- 9 Punjab
- 10 Goa



### 2020 NATIONAL ENERGY TRILEMMA INDEX TOP PERFORMERS



## TOP PERFORMERS ACROSS CATEGORIES

### ENERGY SECURITY - TOP 10 PERFORMERS

- 1 GOA
- 2 HIMACHAL PRADESH
- 3 GUJARAT
- 4 KERALA
- 5 MAHARASHTRA
- 6 KARNATAKA
- 7 UTTARAKHAND
- 8 TELANGANA
- 9 CHHATTISGARH
- 10 PUNJAB

### ENERGY EQUITY - TOP 10 PERFORMERS

- 1 HIMACHAL PRADESH
- 2 GOA
- 3 PUNJAB
- 4 HARYANA
- 5 KARNATAKA
- 6 KERALA
- 7 UTTARAKHAND
- 8 GUJARAT
- 9 MAHARASHTRA
- 10 WEST BENGAL

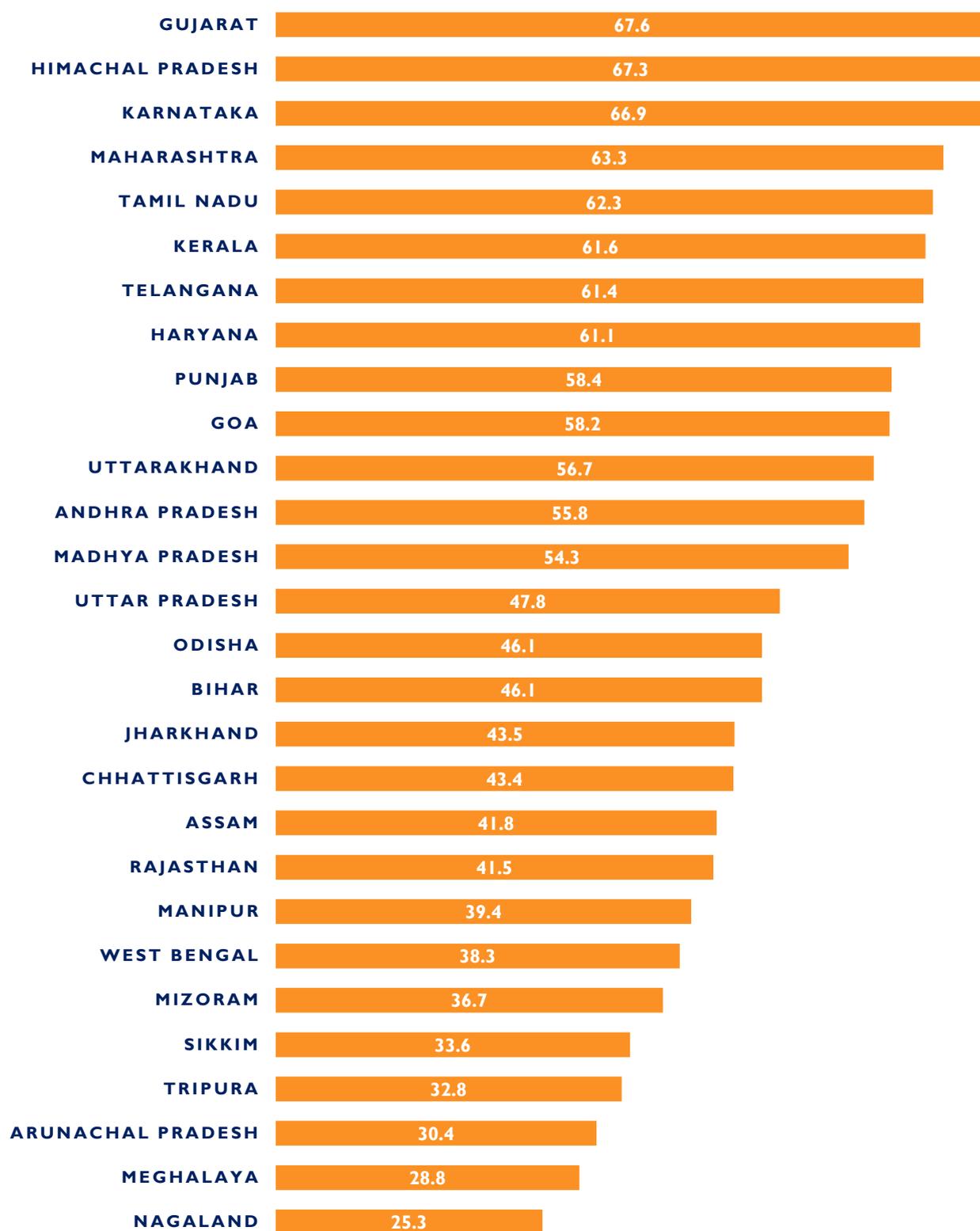
### ENVIRONMENTAL SUSTAINABILITY - TOP 10 PERFORMERS

- 1 KARNATAKA
- 2 MIZORAM
- 3 TAMIL NADU
- 4 HIMACHAL PRADESH
- 5 TELANGANA
- 6 MANIPUR
- 7 MADHYA PRADESH
- 8 GUJARAT
- 9 MAHARASHTRA
- 10 ASSAM

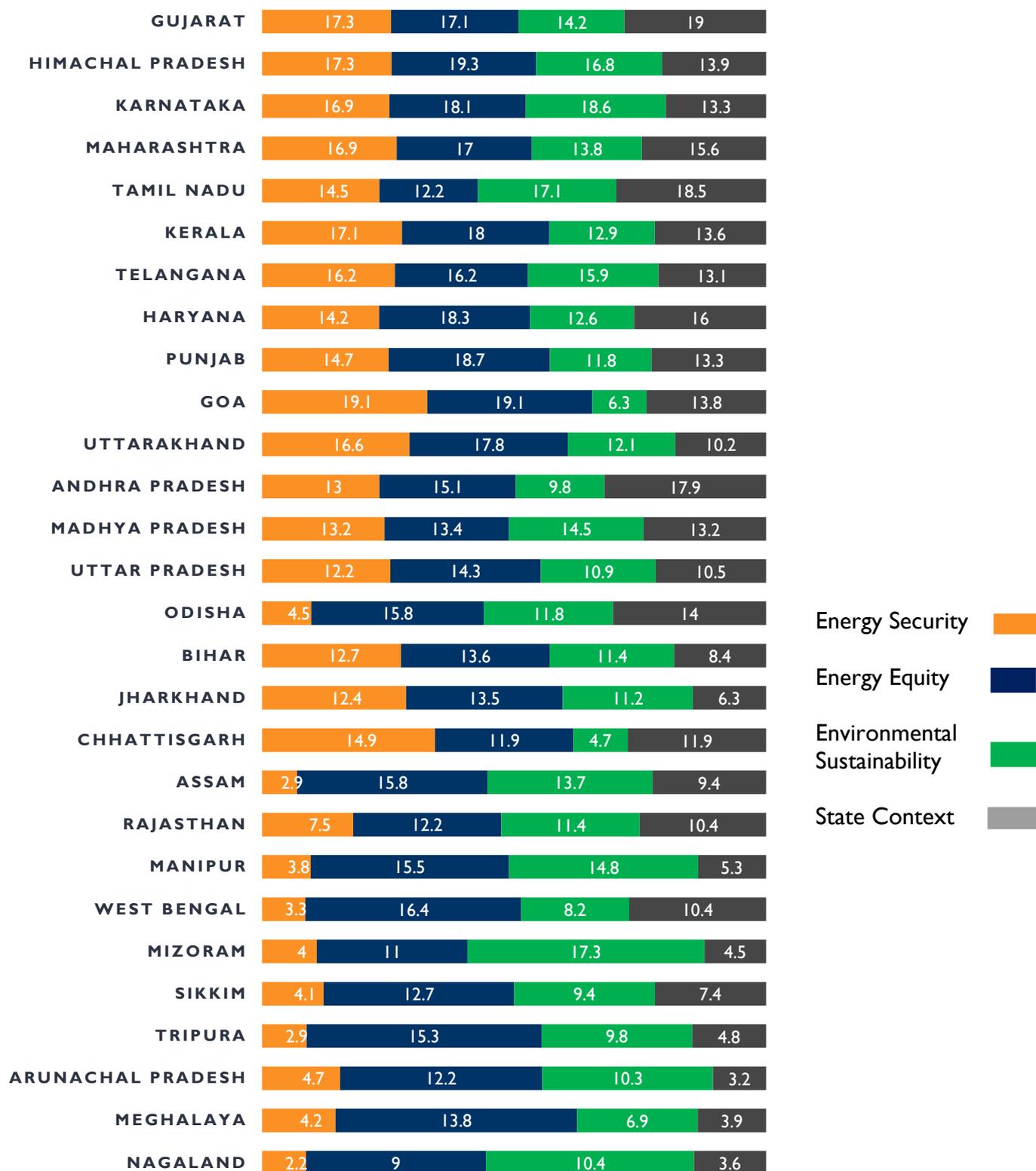
### STATE CONTEXT - TOP 10 PERFORMERS

- 1 GUJARAT
- 2 TAMIL NADU
- 3 ANDHRA PRADESH
- 4 HARYANA
- 5 MAHARASHTRA
- 6 ODISHA
- 7 HIMACHAL PRADESH
- 8 GOA
- 9 KERALA
- 10 KARNATAKA

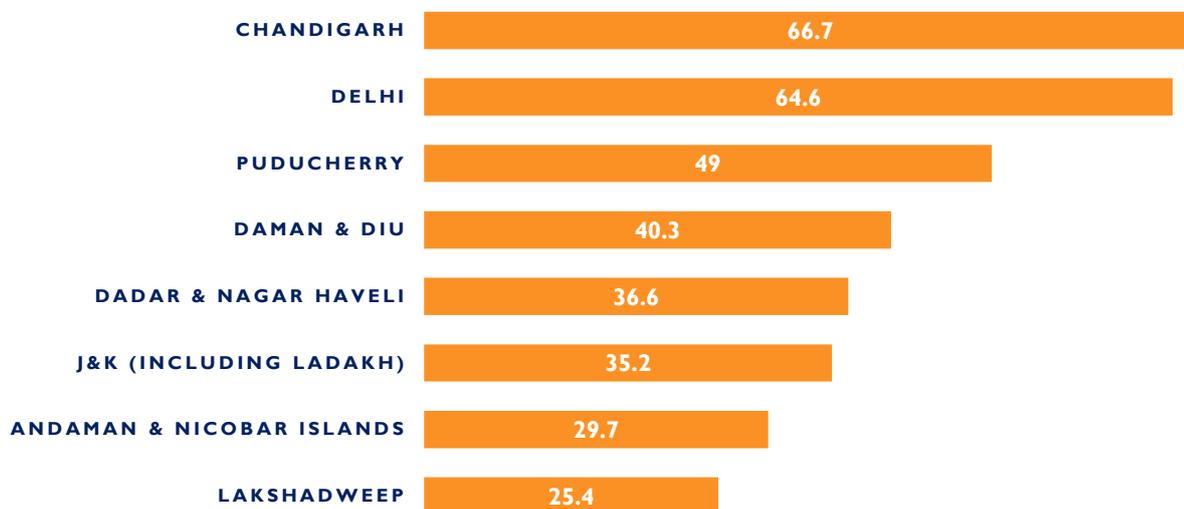
## NATIONAL ENERGY TRILEMMA INDEX: STATE RANKINGS 2020



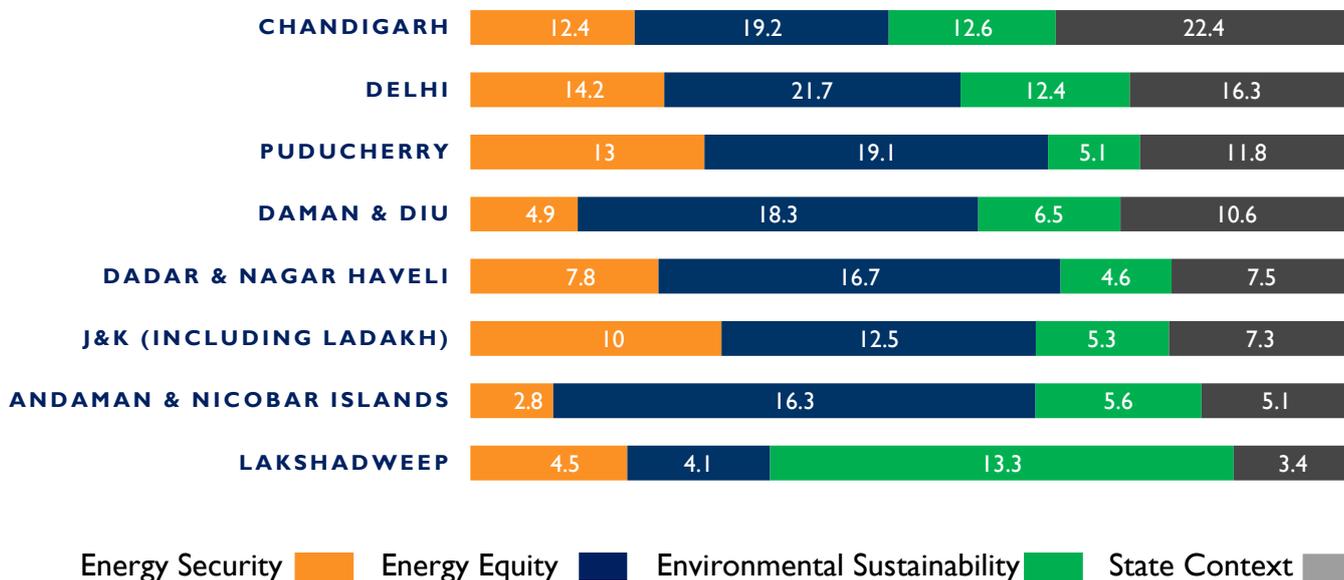
## NATIONAL ENERGY TRILEMMA INDEX STATE-WISE INDICATOR SCORES



## UNION TERRITORY RANKINGS 2020



## UT INDICATOR- WISE SCORES



# GUJARAT

- **2nd largest producer of crude oil (onshore) and natural gas**
- **Ranked #1 in Logistics in the country according to the National Logistics Index 2019**
- **World's largest petroleum refining hub at Jamnagar**
- **Highest number of operational ports and commercial cargo ports**



# BEST PERFORMERS IN STATES

## STATE- GUJARAT

 **GSDP (2018-19): 204 \$ Billion**

 **GSDP Growth Rate (YoY): 13.1%**

 **Per Capita Income: 2866 \$**

**Score: 67.6**

**Overall Rank: 1**

**Energy Security: 3**

**Energy Equity: 8**

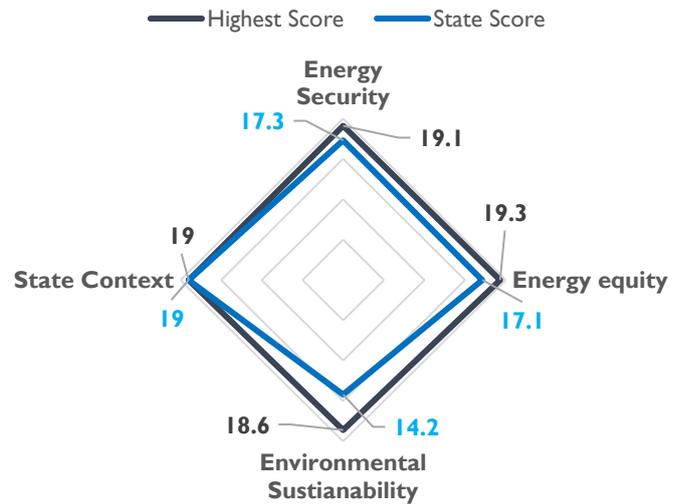
**Environmental Sustainability: 8**

**State Context: 1**

### Top Performance Dimension

Energy Security

State Context



**Gujarat** is located on the western part of the country and has a coastline of 1,600 kms. The state is one of the leading industrialised states in India has ranked #1 in the National Logistics Index 2019; ranked #1 in Export Preparedness Index 2020; ranked #3 in National Council of Applied Economic Research's State Investment Potential Index (N-SIPI) in 2018. The FDI inflow in Gujarat reached US\$ 26.6 billion between April 2000 and March 2020 and the state accounted for about 5% share in the overall FDI inflows in India.

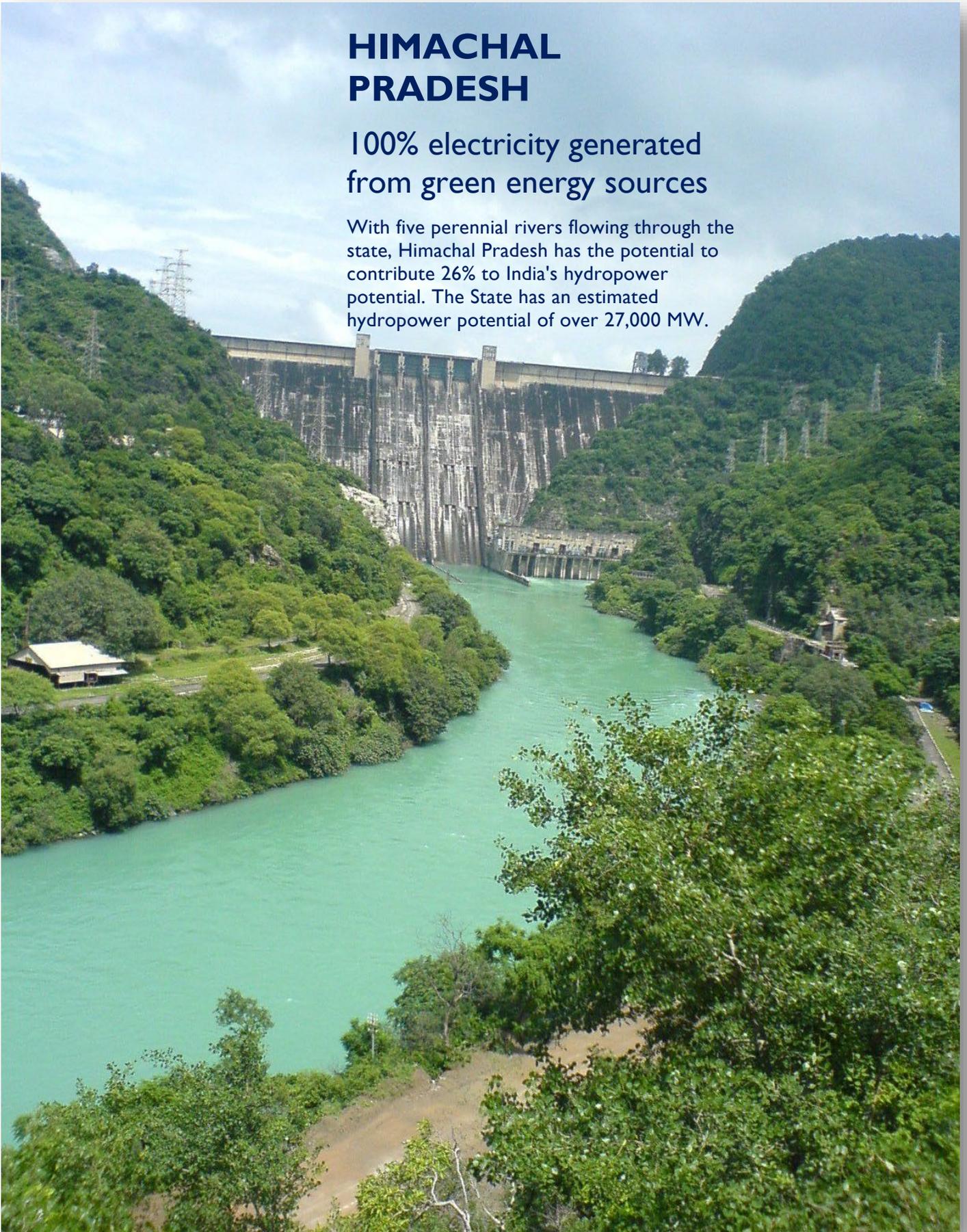
The state has performed (Rank #1) in the State Context dimension with macroeconomic environment, investment environment, regulations & governance contributing to the overall score. In the Energy Security dimension, the state is ranked #3 owing to the high scores in diversity of power supply and viability of electricity system. The state has achieved 100% electrification at the household level, with ~67% population having access to clean cooking fuels. The state has one of the lowest AT & C losses with 24x7 power supply.

**Key Industries:** *Agro and food processing, Dairy, Chemicals and petrochemicals, Textiles and apparels, Engineering and auto, Gems and jewellery, Oil and gas, Pharmaceuticals and biotechnology, IT, Minerals, Ports, power and Tourism.*

# HIMACHAL PRADESH

100% electricity generated  
from green energy sources

With five perennial rivers flowing through the state, Himachal Pradesh has the potential to contribute 26% to India's hydropower potential. The State has an estimated hydropower potential of over 27,000 MW.



## STATE- HIMACHAL PRADESH

 **GSDP (2018-19): 21.7 \$ Billion**

 **GSDP Growth Rate: 11.2%**

 **Per Capita Income: 2531 \$**

**Score: 67.3**

**Overall Rank: 2**

**Energy Security: 2**

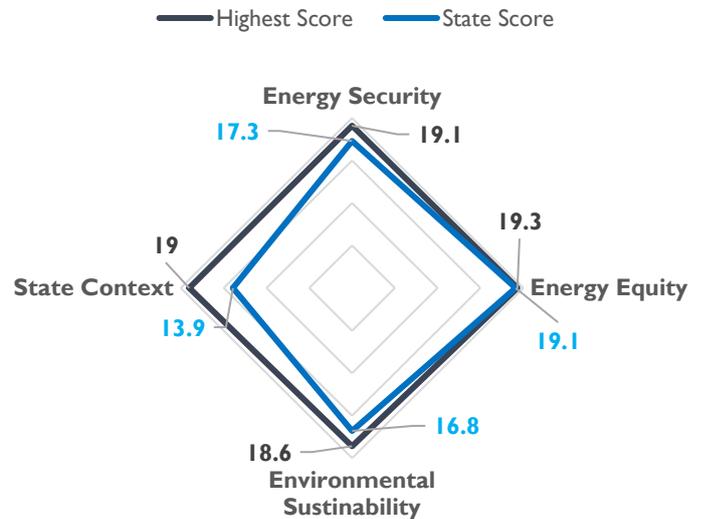
**Energy Equity: 1**

**Environmental Sustainability: 4**

**State Context: 7**

### Top Performance Dimension

Energy Equity, Energy Security



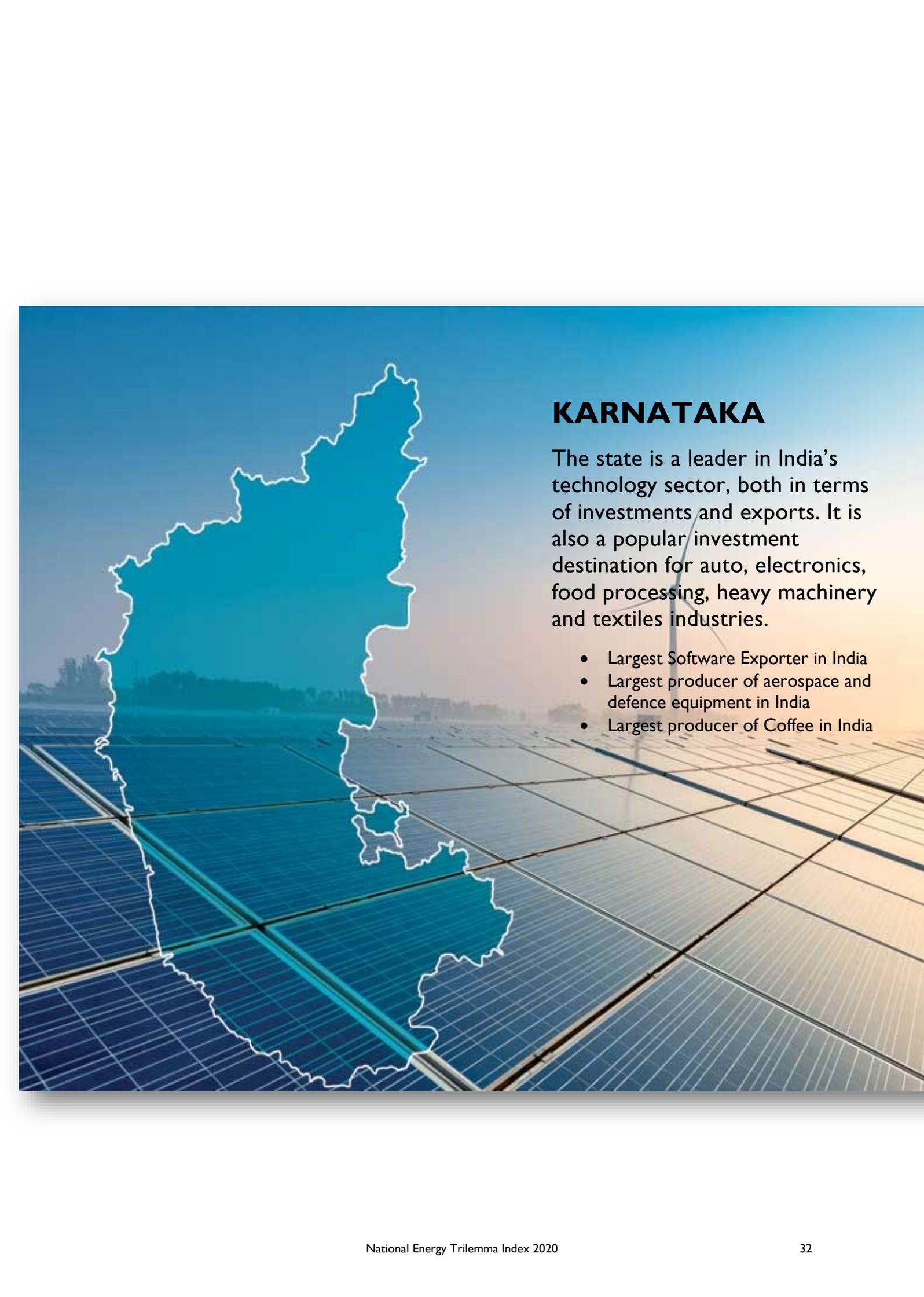
**Himachal Pradesh** is located in the northern region of India, with five perennial rivers flowing through the state. The state has an estimated hydropower potential of over 27 GW. The state scores high on the Energy Equity dimension and ranks #1 among the states. The state has achieved 100% electrification, with ~51% population having access to clean cooking fuels. The State has one of the lowest AT& C losses.

The State has a notable performance in the Energy Security dimension as well (Rank #2) due to greater viability of electricity/energy systems in the state. As of March 2020, Himachal Pradesh had a total installed power generation capacity of 4.07 GW. Hydro power accounted for 2.8 GW of total installed power generation capacity, followed by renewable power (0.9 GW) and thermal power (0.2 GW). Under thermal power, coal accounted for 151.69 MW and gas accounted for 62.01 MW of total installed power.

The state ranks #4 in the environmental sustainability dimension owing to the excellent Air quality index, with less concentration of PM 2.5 and PM 10 pollutants.

The state has also attracted investments in other sectors including in pharmaceuticals, IT and food processing industries.

**Key Industries:** *Textiles, pharmaceuticals, food procurement and processing, light engineering, IT and electronics, cement, tourism and hydropower*



## KARNATAKA

The state is a leader in India's technology sector, both in terms of investments and exports. It is also a popular investment destination for auto, electronics, food processing, heavy machinery and textiles industries.

- Largest Software Exporter in India
- Largest producer of aerospace and defence equipment in India
- Largest producer of Coffee in India

## STATE- KARNATAKA

 **GSDP (2018-19): 216 \$ Billion**

 **GSDP Growth Rate (YoY): 13.9%**

 **Per Capita Income: 2961\$**

**Score: 66.9**

**Overall Rank: 3**

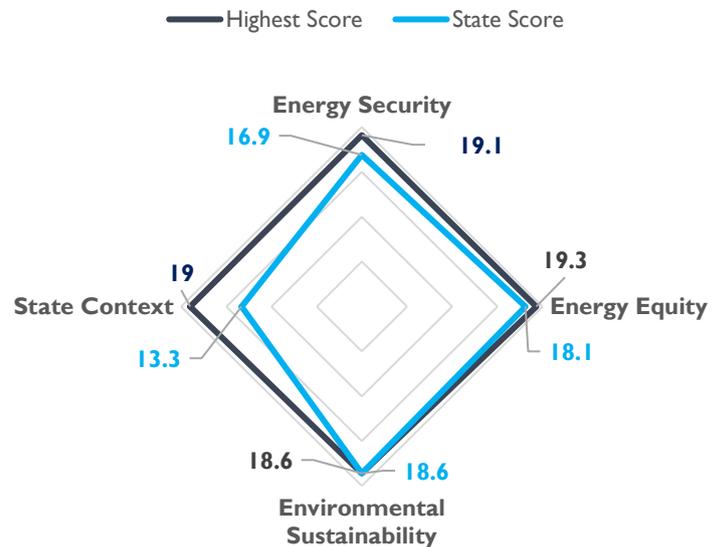
**Energy Security: 6**

**Energy Equity: 5**

**Environmental Sustainability: 1**

**State Context: 10**

**Top Performance Dimension**



*Environmental Sustainability*

**Karnataka** is located in the southern part of the country, surrounded by the Arabian Sea on the west, Goa on the northwest, Maharashtra on the north, Andhra Pradesh on the east, Tamil Nadu on the southeast, and Kerala on the southwest. The state's per capita GSDP was Rs. 253,444 (US\$ 3,595) in 2019-20. The per capita GSDP (in Rs.) increased at a CAGR of 11.70% between 2011-12 and 2019-20.

The state ranks #1 in the Environmental Sustainability dimension followed by Energy Equity (Rank #5) and Energy Security (Rank #6). Improvement in the Air Quality Index, performance of Clean Energy Energy and high percentage of forest cover have contributed to the high score of Environmental Sustainability dimension.

As of August 2020, the state had an installed power generation capacity of 29.8 GW. Of this, central utilities, private utilities and state utilities contributed 4.01 GW, 17.0GW and 8.8 GW respectively. The state has achieved 100% electrification and approximately 81% of the population have access to clean cooking fuels. LPG penetration has reached ~106% as on 1<sup>st</sup> April 2020.

**Key Industries: IT and ITeS, biotechnology, engineering, electronics and telecom, automotive, textiles and apparel, aerospace, animations, tourism and renewable energy**

# MAHARASHTRA



## STATE- MAHARASHTRA

 **GSDP (2017-18): 387.4 \$ Billion**

 **GSDP Growth Rate: 10.6 %**

 **Per Capita Income: 3466 \$**

**Score: 63.3**

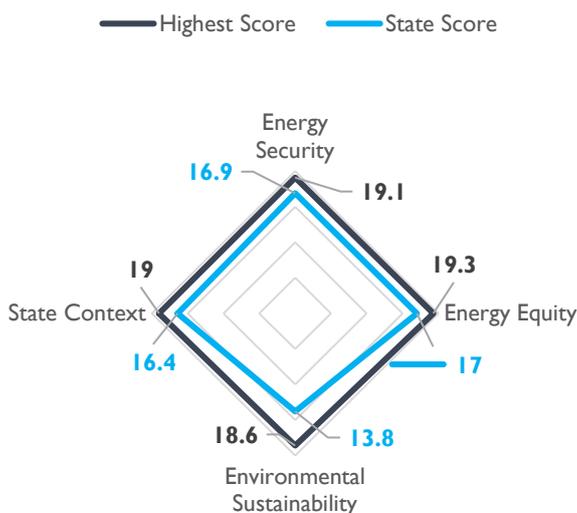
**Rank: 4**

**Energy Security: 5**

**Energy Equity: 9**

**Environmental Sustainability: 9**

**State Context: 5**



### Top Performance Dimension

State Context, Energy Security

**Maharashtra** lies on the western coast of India. It is the third largest state in India, occupying approximately 9.4% of the country's total geographical area. The State has the highest GDP in the country. Mumbai, the state's capital also known as the financial capital of India, houses the headquarters of major corporate and financial institutions. Maharashtra is the automobile manufacturing hub of the country.

The state has ranked #1 in Export Preparedness Index in 2020. Moreover, the state has attracted over \$7.2 Bn of Foreign Direct Investments during Oct'19-Mar'20. Maharashtra recorded \$65 bn worth of exports in 2019-20, contributing about 21% to India's net exports.

The state is ranked #4 in the national energy trilemma index rankings with energy security and state context dimensional scores contributing to the overall score. The state has achieved 100% electrification with ~63% of the population having access to clean cooking fuels. The state has a diversified installed electricity capacity with 22% (of installed capacity) coming from renewables. The state is ranked # 5 in energy security and state context dimension.

**Key Industries: Pharmaceuticals, biotechnology, IT and ITeS, electronics, engineering, auto and auto components, oil and gas, food and agro processing, gems and jewellery, banking, financial services and insurance (BFSI) and textiles**

# TAMIL NADU

- State with the 2nd highest GDP in India
- Ranked 9th globally in net share of wind energy in total power generation
- Among top 10 manufacturing hubs in the world with over 1.7 million installed capacity of cars



## STATE- TAMIL NADU



**GSDP (2018-19): 229.7 \$ Billion**



**GSDP Growth Rate: 12.5%**



**Per Capita Income: 3181 \$**

**Score: 62.3**

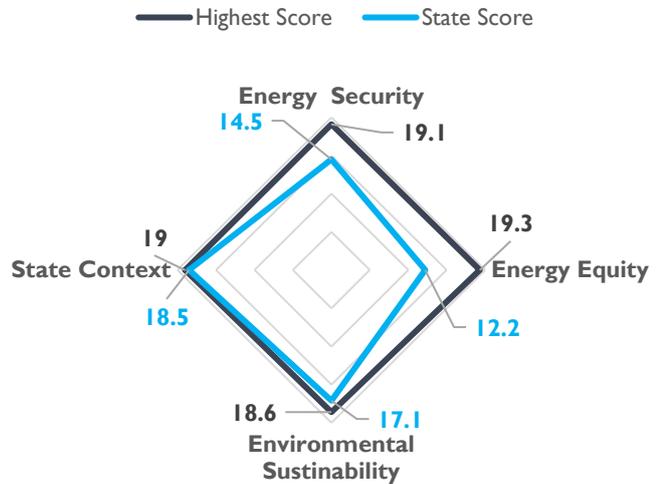
**Rank: 5**

**Energy Security: 11**

**Energy Equity: 25**

**Environmental Sustainability: 3**

**State Context: 2**



### Top Performance Dimension

State Context

**Tamil Nadu** is the fourth largest state and has the 2<sup>nd</sup> highest GDP in the country. Tamil Nadu ranks #3 in Export Preparedness Index in 2020 and moreover, the state is the 2<sup>nd</sup> highest contributor to India's renewable energy capacity at 14.8 GW and has a total installed power capacity of 32.9 GW. The state is ranked 9th globally in net share of wind energy in total power generation.

The state ranks #2 in the state context with macroeconomic environment, regulations & governance and stability for innovation & investments indicators contributing to the dimension. The state has achieved 100% electrification and approximately ~87% of the population has access to clean cooking fuels. LPG penetration in the state has reached 100%. The state lags in the ease of making payment to discoms and borrowings.

**Key Industries:** *Textiles, heavy commercial vehicles, automobile and auto components, engineering, IT and ITeS, cement, banking and financial services, drugs and pharmaceuticals, agro and food processing, leather tanning industries, electronic hardware and tourism*

# KERALA



## STATE- KERALA

 **GSDP (2017-18): 106.6 \$ Billion**

 **GSDP Growth Rate: 7.8 %**

 **Per Capita Income: 3088 \$**

**Score: 61.6**

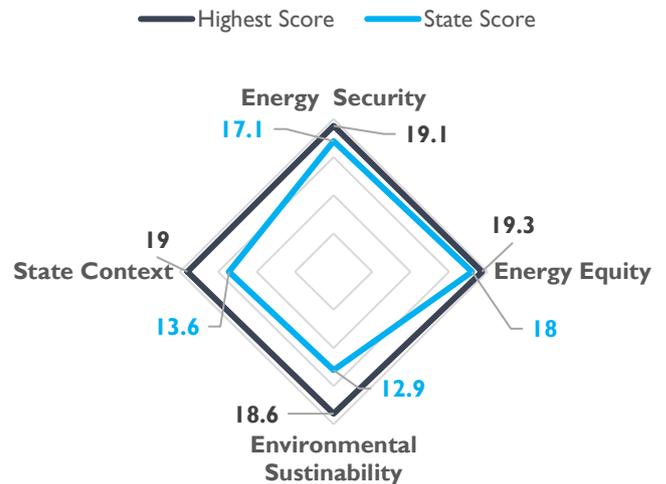
**Rank: 6**

**Energy Security: 4**

**Energy Equity: 6**

**Environmental Sustainability: 11**

**State Context: 9**



### Top Performance Indicator

Energy Security

**Kerala** is a highly advanced society and scores high on human development indicators with the highest literacy rate, highest life expectancy, lowest population growth and the highest ratio of females to males in India. The state is one of the few states to have marketed its natural beauty successfully to the leisure tourism sector. The state's unique heritage and cultural diversity has attracted tourists from around the world. The FDI inflow in the state (including Lakshadweep) between April 2000 and March 2020, reached US\$ 2.94 billion.

The state is ranked #6 in the overall rankings; ranked #4 in the energy security dimension, #6 in the energy equity dimension, #9 in the state context. The state has achieved 100% electrification with ~81% population having access to clean cooking fuels. AT & C losses of Kerala is one of the lowest among the states and UTs.

As of August 2020, the state had a total installed power generation capacity of 5.7 GW, of which 2.1 GW was accounted by state utilities, 2 GW by central utilities and 1.4 GW by the private sector.

Kerala topped (Rank # 1) in the SDG Index of NITI Aayog in 2018 & 2019; ranked #8 in the Innovation Index (NITI Aayog); ranked #10 in the Export Preparedness Index.

**Key Industries:** Handlooms and power looms, rubber, bamboo, coir, khadi and village, sericulture, seafood and other marine products, cashew, mining, tourism, food processing, spice and spice extracts, IT & electronics

Source: IBEF, Invest India

# TELANGANA



## STATE- TELANGANA



**GSDP (2019-20): 131.16 \$ Billion**



**GSDP Growth Rate: 12.6 %**



**Per Capita Income: 2696 \$**

**Score: 61.4**

**Rank: 7**

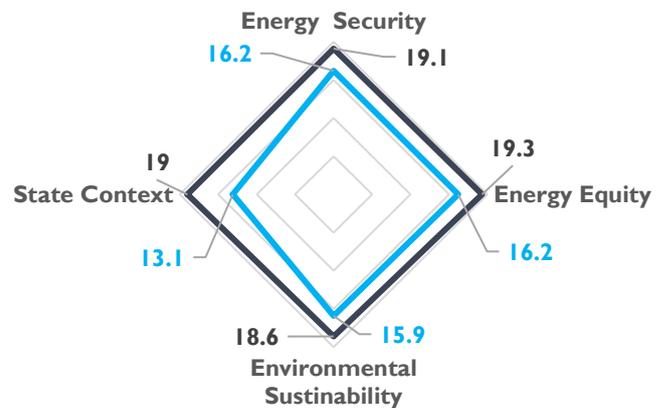
**Energy Security: 8**

**Energy Equity: 11**

**Environmental Sustainability: 5**

**State Context: 13**

— Highest Score — State Score



### Top Performance Indicator

*Environmental Sustainability*

**Telangana** is the 2nd highest contributor to India's IT exports and the state's capital, Hyderabad, is a major IT hub of the country. The state also contributes nearly one-third to India's production and one-fifth to its exports in the pharmaceutical sector. Telangana ranks #3 in the Business Reform Action Plan 2019

The state ranks #7 in the overall National energy trilemma index rankings and features in top 10 across two categories (Rank #5 in environmental sustainability and Rank #8 in the energy security dimension). The state has achieved 100% household electrification, with ~90% of population having access to clean cooking fuels and LPG penetration has reached 100%.

As of July 2020, the total installed power capacity of Telangana was 16.39 GW. Out of this, ~ 8 GW was contributed by state utilities, 6.2 GW MW by private utilities and ~2 GW by central utilities. Thermal power was the largest contributor in the state's total installed capacity with 9.6 GW, followed by hydropower with a contribution of ~2.5 GW, renewable energy with ~4 GW and nuclear power with 148.73 MW. Renewables account for 25% of the total installed capacity.

The state is ranked #4 in the India Innovation Index 2019 (NITI Aayog), #5 in the SDG Index 2019 (NITI Aayog); ranked #6 in the Export Preparedness Index 2020 (NITI Aayog); ranked #3 in the Ease of doing business 2019 (DPIIT).

**Key Industries: Information technology, pharmaceuticals manufacturing, tourism, textile, mines and minerals**

**Source: IBEF, Invest India, NITI Aayog**

# HARYANA



## STATE- HARYANA



**GSDP (2017-18): 93 \$ Billion**



**GSDP Growth Rate: 11.6 %**



**Per Capita Income: 3025 \$**

**Score: 61.1**

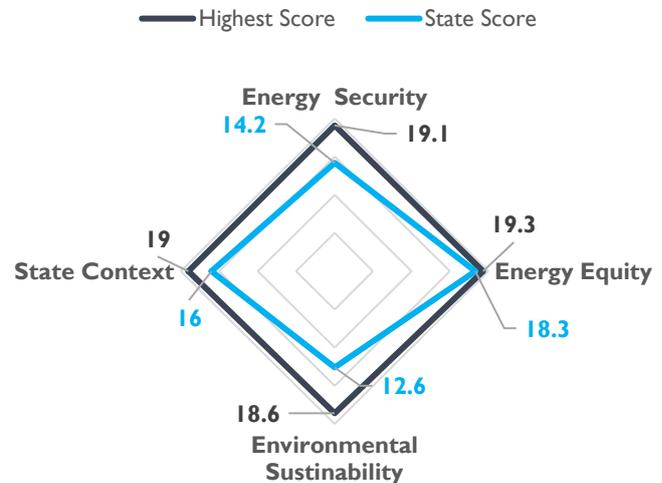
**Rank: 8**

**Energy Security: 12**

**Energy Equity: 4**

**Environmental Sustainability: 12**

**State Context: 4**



### Top Performance Indicator

Energy Equity, State Context

**Haryana** is among the northern most state in India and adjacent to Delhi, the national capital of India. With an area covering 1.3% of the country, Haryana contributed near 3.63% to India's GDP in 2018-19. The state ranks 17th in terms of population in India, home to around 2% of the country's total population and is one of the country's largest automobile hubs and has also emerged as a base for the knowledge industry, including IT and biotechnology.

The state is ranked #7 in India Innovation Index 2019 (NITI Aayog); ranks #3 in Export Preparedness Index 2020 under Landlocked states category. Haryana's electronics and IT exports stood at \$7.2 bn during 2016-17, which is 6.2% of the total electronics and IT exports from India.

The state ranks #8 in the overall National energy trilemma index rankings and features in top 10 across two categories (Rank #4 in Energy Equity and State context dimension. The state has achieved 100% household electrification, with ~70% of population having access to clean cooking fuels and LPG penetration has reached 100%.

As of August 2020, Haryana had a total installed power-generation capacity of 12.29 GW, of which, 5.5 GW was contributed by the private sector, 2.9 GW by state facilities and 3.8 GW by central facilities.

**Key Industries: Automotive, agro-based industry, IT and ITeS, textiles, oil refining, biotechnology and petrochemicals**

**Source: IBEF, Invest India**

# PUNJAB



## STATE- PUNJAB



**GSDP (2018-19): 74.10 \$ Billion**



**GSDP Growth Rate: 9 %**



**Per Capita Income: 2646 \$**

**Score: 58.4**

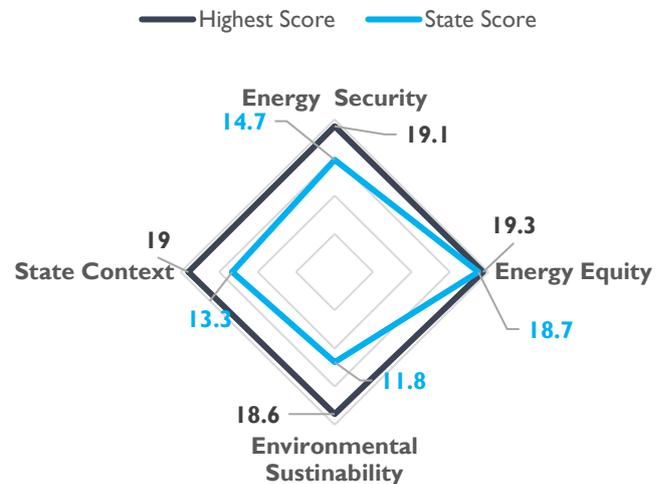
**Rank: 9**

**Energy Security: 10**

**Energy Equity: 3**

**Environmental Sustainability: 14**

**State Context: 11**



### Top Performance Indicator

Energy Equity

**Punjab**, one of the northernmost states of India and is called the “Granary of India”. The state has the largest agricultural area under irrigation and has an excellent network of irrigation facilities with ~99.9 % of net sown area under irrigation. The state is the largest producer of wheat and rice in the country. Moreover, the state is also the largest producer of machine, hand tools and bicycle components in the country. The state has one of the highest road densities amongst Indian states at 133 km per 100 sq. km

The state ranks #9 in the overall trilemma index rankings at the national level, ranks #3 in the energy equity dimension. The state has achieved 100% household electrification, with ~85% of population having access to clean cooking fuels and LPG penetration has reached 100%. The state offers a conducive environment to encourage power generation from renewables, with an ambition of achieving 15% energy from renewables by 2022. Policies such as Net Metering and New & Renewable Sources of energy are in place to support the transition to renewables.

The state ranks #13 in India Innovation Index 2019 (NITI Aayog), ranks#12 in the SDG Index 2019, ranks #19 in the Ease of Doing Business Index (DPIIT)

**Key Industries: Tractors and auto components, agro-based industries, bicycles and bicycle parts, chemical products, food products, light engineering goods, pharmaceuticals and textiles**

**Source: IBEF, Invest India, DPIIT**

# GOA



## STATE- GOA



**GSDP (2018-19): 12.15 \$ Billion**



**GSDP Growth Rate: 9.08 %**



**Per Capita Income: 7144 \$**

**Score: 58.2**

**Rank: 10**

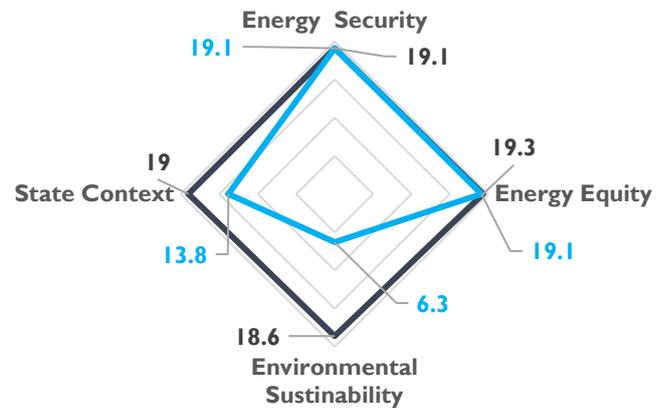
**Energy Security: 1**

**Energy Equity: 2**

**Environmental Sustainability: 27**

**State Context: 8**

— Highest Score — State Score



### Top Performance Indicator

Energy Security, Energy Equity

**Goa** is located on the west coast of India and is well known as a tourist paradise for its natural scenery, unique beaches, and cultural diversity. The State has the highest per-capita income and the economic growth is driven by the strong performance of its industrial sectors such as mining, tourism, and pharmaceuticals. The state has a well-developed social, physical, and industrial infrastructure and virtual connectivity. The FDI inflow in the state stood at US\$ 1,053 million between April 2000 and March 2020.

The state ranks #10 in the overall trilemma index rankings at the national level, ranks #1 in the energy security and ranks #2 in the energy equity dimension. The state has achieved 100% household electrification, with ~95% of population having access to clean cooking fuels and LPG penetration has reached 100%. As of August 2020, Goa had a total installed power generation capacity of 584.83 megawatt (MW). The share of renewables in the total installed capacity is ~90%.

**Key Industries: Tourism, food processing, IT & ITeS, mining, biotechnology, pharmaceuticals and fishing.**

**Source: IBEF, Invest India**

# CHANDIGARH



## BEST PERFORMERS IN UTs

### STATE- CHANDIGARH



**GSDP (2017-18): \$ 5 Billion**



**GSDP Growth Rate: 8 %**



**Per Capita Income: 3878 \$**

**Score: 66.7**

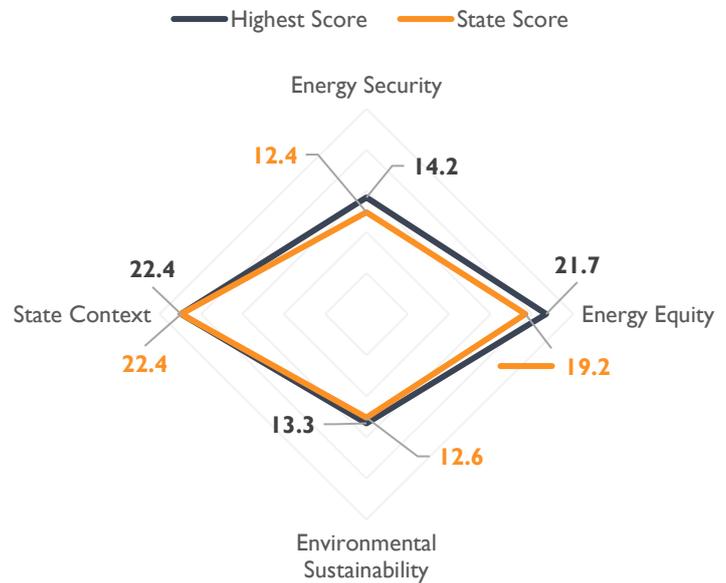
**Overall Rank: I**

#### Top Performance Indicator/s

Energy Equity

Environmental Sustainability

State Context



**Chandigarh** is considered to be one of the best-planned cities in the country. The high quality of social infrastructure, large green spaces and its compact size, makes it an ideal destination to live and work. Chandigarh recorded close to \$71.9 mn worth of exports in 2018-19.

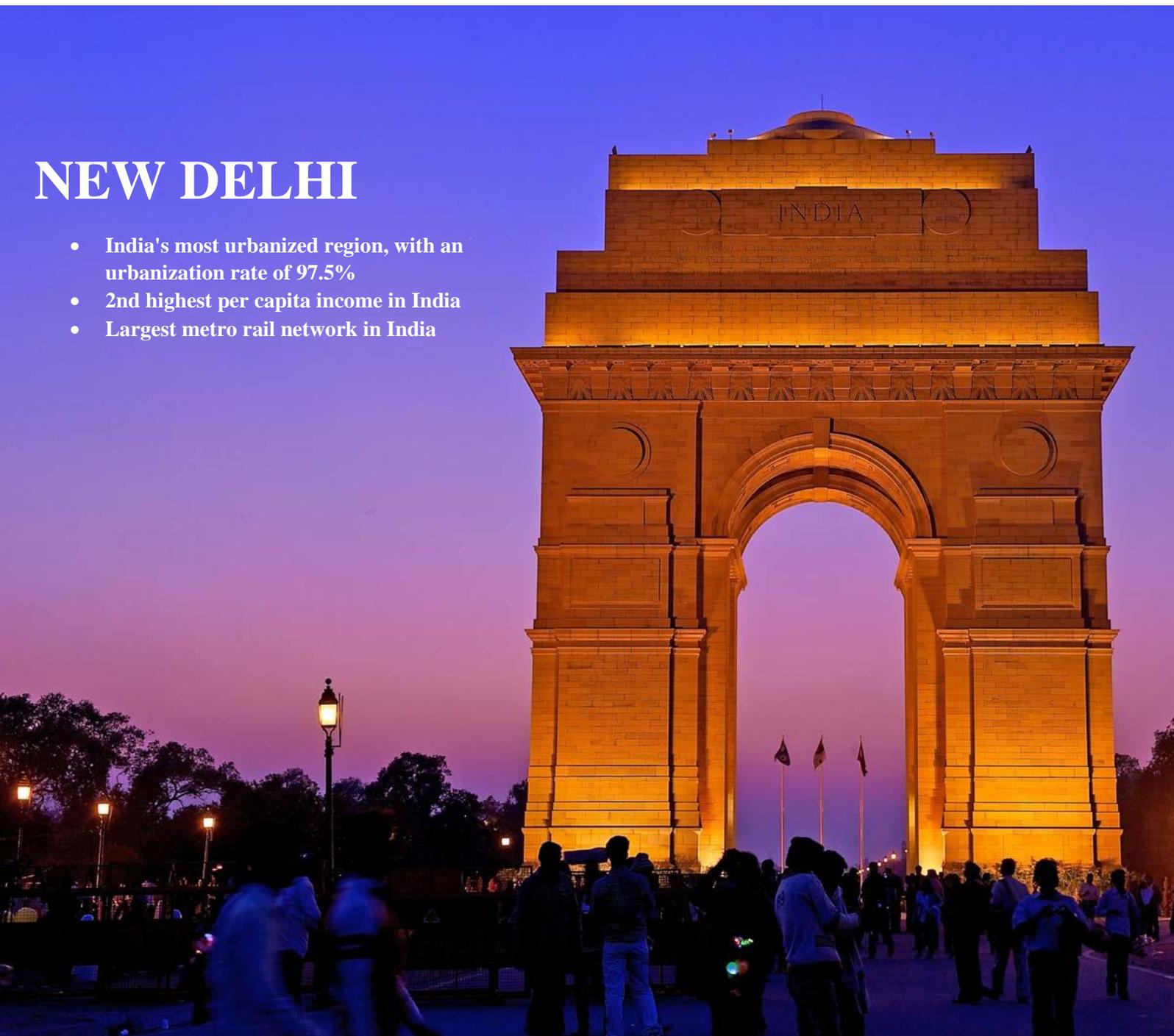
In the overall rankings among UTs, Chandigarh tops the chart with an aggregate score of 66.7 in the UT category. The UT ranks #1 in the UT context, ranks #2 in the energy security dimension as well as energy equity dimension.

In other index rankings, Chandigarh leads the rankings (Rank #1) in SDG Index 2019 (NITI Aayog), ranks #2 in the India Innovation Index. The UT has 20 % share of renewable energy and ~49% share from Hydro. The UT has achieved 100% household electrification with ~90% population having access to clean cooking fuels.

**Source: IBEF, Invest India**

# NEW DELHI

- India's most urbanized region, with an urbanization rate of 97.5%
- 2nd highest per capita income in India
- Largest metro rail network in India



## STATE- DELHI



**GSDP (2018-19): 109 \$ Billion**



**GSDP Growth Rate: 12.82 %**



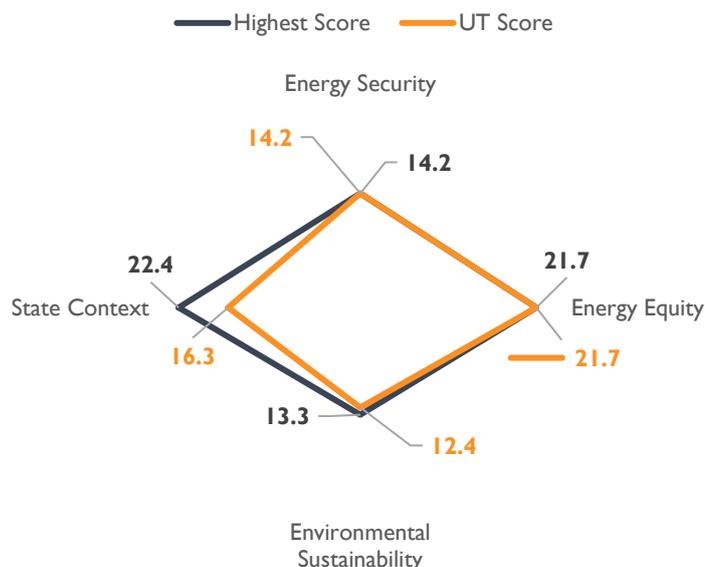
**Per Capita Income: 5055 \$**

**Score: 64.6**

**Rank: 2**

**Top Performance Indicator**

Energy Security, Energy Equity



**Delhi** (capital of India) is one of the fastest growing regions of India, consistently recording a growth rate of about 12.82% in 2018-19 (GSDP). The capital city is a popular tourist attraction, majorly for street shopping, the variety of cuisines served here and its rich cultural heritage.

The UT has the 2<sup>nd</sup> highest per capita income in India and is one of the country's most urbanized region (urbanization rate: 97.5%). The City boasts of having the largest metro rail network in the country. FDI inflows in Delhi (including part of Uttar Pradesh and Haryana) stood at US\$ 96.41 billion between April 2000 and March 2020. The Government of Delhi has been committed towards creating a progressive business environment. The new Industrial Policy 2010-21 aims to provide a conducive environment for knowledge-based and hi-tech IT/ITeS industries in Delhi.

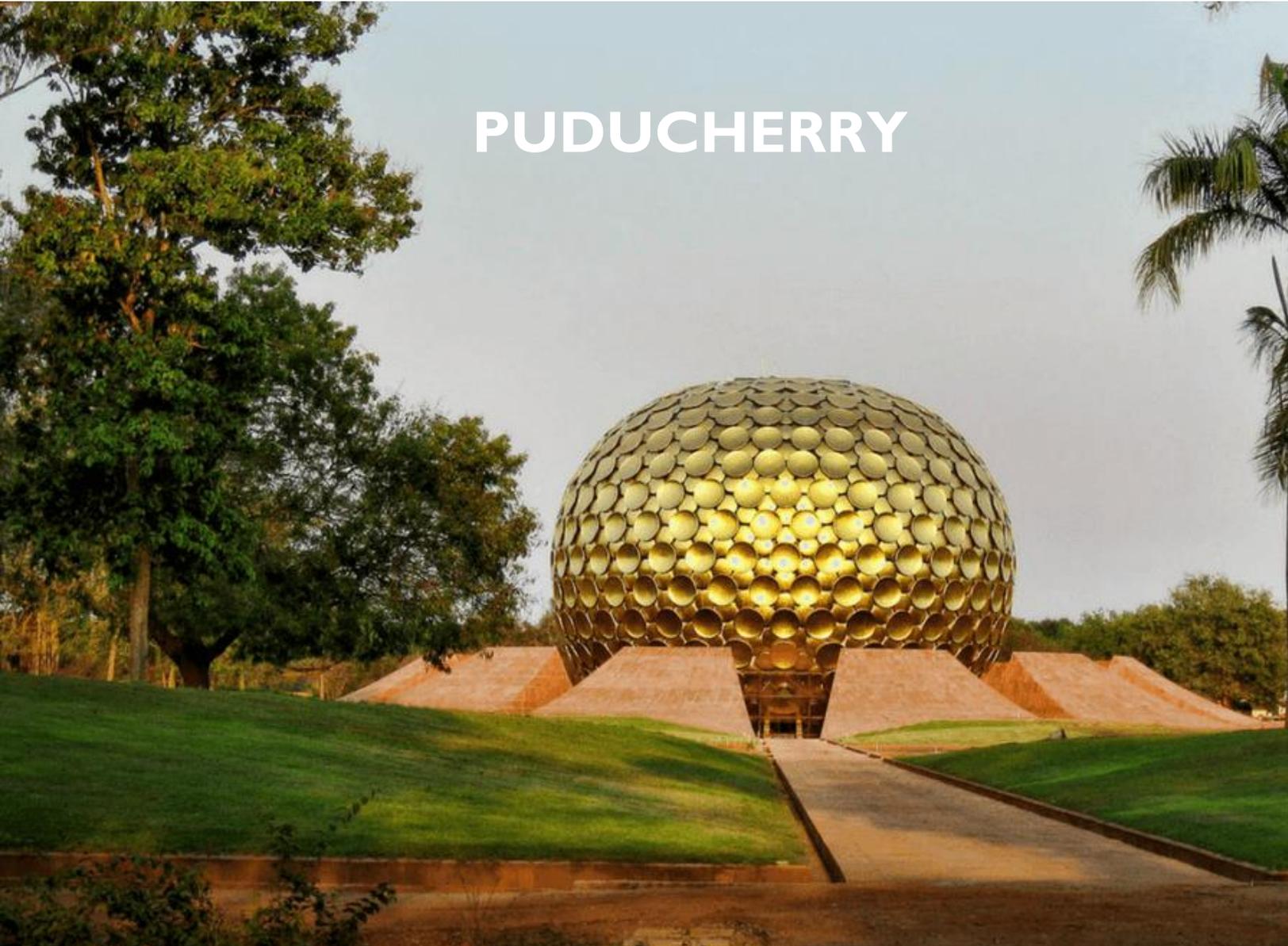
The UT ranks #2 in the overall national energy trilemma index rankings (UT category); ranks #1 in the energy equity dimension as well as in the energy security dimension (UT category). The UT has achieved 100% household electrification with ~95% population having access to clean cooking fuels.

The UT ranks #1 in the India Innovation Index 2019 (NITI Aayog), ranks #12 in the ease of doing business rankings; ranks #5 in the SDG Index 2019 (NITI Aayog)

**Key Industries: Banking, financial services and insurance (BFSI), Agri and processed food, construction and real estate, IT and ITeS, Tourism and Logistics**

**Source: IBEF, Invest India**

# PUDUCHERRY



## STATE- PUDUCHERRY



**GSDP (2018-19): 5 \$ Billion**



**GSDP Growth Rate: 11.3 %**

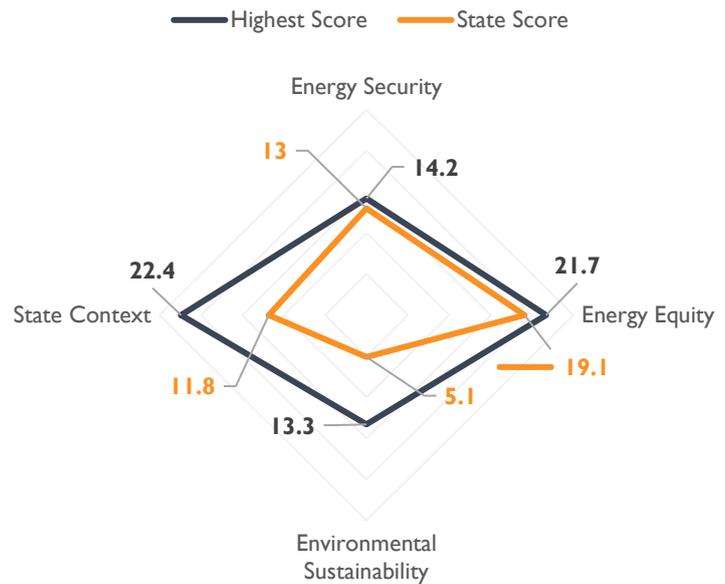


**Per Capita Income: 2952 \$**

**Score: 49**

**Overall Rank: 3**

**Top Performance Indicator/s**  
Energy Security, Energy Equity, State Context



**Puducherry**, is situated on the Coromandel Coast of the Bay of Bengal. Being a former French colony, the territory witnesses a prominent presence of French culture. Agriculture and tourism sectors are major contributors to the economy of Puducherry and about 35% of the UT's population depends on agriculture and allied activities. Puducherry recorded over \$382.8 million worth of exports in 2018-19.

The UT has mineral deposits of limestone, clay, lignite, phosphate rocks, canker and laterite, among others. Some of the key industries in Puducherry include chemicals, textiles, leather, electronics, light engineering, metals, tourism and food processing.

The UT ranks #3 in the overall national energy trilemma Index rankings (UT category); ranks #2 in the energy security category, ranks #3 in the energy equity category as well as in the UT context.

The state ranks #6 in the India Innovation Index 2019 (NITI Aayog), ranks #27 in the ease of doing business rankings; ranks #2 in the SDG Index 2019 (NITI Aayog)

**Sources: Invest India, NITI aayog, DPIIT**

# 8. ANNEXURES



## ANNEXURE A

### BENCHMARKING EXERCISES AT GLOBAL LEVEL

**World Economic Forum- Energy Transition Index:** The Index benchmarks countries on the performance of their energy system and their readiness for energy transition. Offers a framework for countries to design long-term energy transition roadmaps by considering current energy system performance and highlighting the necessary enablers that improve countries' readiness for energy transition

**The Energy Security Risk Index of the Global Energy Institute:** Provides detailed insights into energy security risks for major energy consuming countries in absolute terms as well as relative to the OECD average.

**Regulatory Indicators for Sustainable Energy (RISE):** Benchmarks national policies and regulatory frameworks on energy access, energy efficiency and renewable energy.

**The IEA Policy and Measures databases:** Offer access to information on energy-related policies and measures taken or planned to reduce greenhouse gas emissions, improve energy efficiency and support renewable energy development and deployment.

**The PBL Netherlands Environmental Assessment Agency:** Provides the Climate Pledge Nationally Determined Contribution (NDC) tool, which projects country-level emissions to 2030, under the scenario of full implementation of Paris Agreement NDCs,

and under the trajectory of current national climate and energy policies.

**The Energy Transitions Commission (ETC):** Aims to accelerate change towards low-carbon energy systems that enable robust economic development and limit the rise in global temperature to well below 2°C.

**The Climate Action Tracker:** Tracks the emission commitments and actions of countries and provides an upto-date assessment of individual national pledges, targets and NDCs as well as currently implemented policy to reduce their greenhouse gas emissions

## **BENCHMARKING EXERCISES AT NATIONAL LEVEL**

**India Innovation Index**

**NITI Aayog**

**Export Preparedness Index**

**NITI Aayog & Institute of  
Competitiveness**

**Sustainable Development Goal  
(SDG) Index**

**NITI Aayog**

**Human Development Index**

**Global Data Lab**

**Good Governance Index**

**Ministry of Personnel, Public  
Grievances and Pensions**

**Start Up Ranking Index**

**Ministry of Commerce & Industry**

**Ease of Doing Business**

**DPIIT**

**Logistics ease across different  
states (LEADS) Index**

**Ministry of Commerce**

**State Energy Efficiency Index- BEE**

## ANNEXURE B

### DIMENSION: ENERGY SECURITY

Energy security measures the ability to meet current and future energy demand. It considers the following elements:

1. Electricity Diversity and Power Supply Position
2. Viability of Energy/Electricity Systems in the state

Indicator Category	Indicator	Description	Reference Year	Source
<b>Security of Supply and Energy Demand</b>	<b>Diversity of Installed Capacity</b>	Diversity of energy supply supports greater security and independence. An over-reliance on one resource can make a system vulnerable to shocks in energy delivery. Sub indicator used is Installed capacity by fuel type (GW). Calculated using HHI index	<b>2019-20</b>	<b>CEA</b>
	<b>Share of RE in Electricity Capacity (%)</b>	Percentage (%) share of renewable energy in state's overall installed power capacity	<b>2019-20</b>	<b>CEA</b>
	<b>Installed Capacity (Electricity)- Growth Rate (in %)</b>	Percentage change in installed capacity from 2016-17 to 2017-18	<b>2017-18/16-17</b>	<b>CEA</b>
	<b>Electricity consumption per capita (kWh/capita)</b>	Electricity consumption per capita measures the average kilowatt-hours (kWh) of electrical power consumed per person in a particular region. Calculated as Total electricity consumed in a state/ population of the state.	<b>2018-19</b>	<b>CEA</b>
	<b>RE Potential (estimated in GWP)</b>	Achievable energy generation from renewable energy sources in a state.	<b>2019</b>	<b>MoSPI</b>
	<b>Energy/Power Supply Position (Surplus/Deficit %)</b>	It is the difference between the power/ energy requirement of a state and actual Power/energy supplied in a state. Gives an idea whether a state is having surplus energy or needs additional power to meet its requirements.	<b>2018-19</b>	<b>CEA</b>

Indicator Category	Indicator	Description	Reference Year	Source
<b>Viability of Energy/Electricity Systems in the state</b>	<b>AT&amp;C Losses (%)</b>	It is the difference between energy input units into the system and the units for which the payment is collected. It is the actual measure of overall efficiency of the distribution business as it measures both technical as well as commercial losses.  AT& C Loss (%) = (Energy Input – Energy Realised) X 100	<b>2018-19</b>	<b>PFC India Report</b>
	<b>ACS-ARR Gap (Rs./ Unit)</b>	Calculated as difference between ACS (average cost of supply per unit of power) and ARR (average revenue realised per unit)	<b>June 2020</b>	<b>UDAY Portal</b>
	<b>Load Shedding Hours/Outages- Industries</b>	The deliberate shutdown of electric power in the industrial sector, generally to prevent the failure of the entire system when the demand strains the capacity of the system.	<b>2019-20</b>	<b>CEA</b>
	<b>Average Hours of Supply- Agriculture</b>	Average of daily hours of supply to agriculture sector in a state	<b>2019-20</b>	<b>CEA</b>

## DIMENSION: ENERGY EQUITY

Energy equity measures the ability to provide access to reliable and affordable energy for domestic and commercial use. It considers the following elements:

1. Energy Access
2. Affordability
3. Performance of Utilities

Indicator Category	Indicator	Description	Reference Year	Source
<b>Energy Access</b>	<b>Access to Electricity (%)</b>	Indicator captures the percentage of households or population that have access to electricity	2019-20	NITI Aayog
	<b>Access to clean cooking (%)</b>	Percentage of households that have access to clean cooking facilities	2018-19	SDG Index (NITI Aayog)
	<b>LPG Coverage (%)</b>	The proportion or percentage of households with an LPG connection	June 2020	PPAC
<b>Affordability</b>	<b>Average Cost of Power (from non-RE power) (in Rs./kWh)</b>	Average cost of electricity supplied from non RE sources in a particular state	2018-19	CERC
	<b>Non-Subsidized LPG Price (Rs/14.2 kg Cylinder)</b>	Non subsidized LPG price in rupees per 14.2 kg cylinder	June 2020	PPAC
	<b>Petrol Prices (in Rs./litre)</b>	Price per litre of diesel including subsidies and taxes	June 2020	PPAC
	<b>Diesel Prices (in Rs./litre)</b>	Price per litre of petrol including subsidies and taxes	June 2020	PPAC
<b>Performance of Utilities</b>	<b>Profit/Loss of Utilities (PAT) of Utilities (Rs. Crores)</b>	Profit after tax (PAT) can be termed as the net profit available for the shareholders after paying all the expenses and taxes by utilities.	2018-19	PFC India Report
	<b>Net-worth of State Utilities (Rs. Crores)</b>	Net worth can be computed by deducting the total liabilities from the total assets that are owned by the state utilities	2018-19	PFC India Report
	<b>Total Borrowings of State Utilities (Rs. Crores)</b>	Measures the total liabilities, or debts of a utility. Financial lenders or business leaders may look at a utility's balance sheet to factor the debt ratio to make informed decisions about future loan options.	2018-19	PFC India Report

	<b>Ease of making payments by DISCOMs (Rs. Crores)</b>	Refers to overall outstanding dues of state Discoms to power generators	<b>March 2020</b>	<b>PRAAPTI Portal</b>
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### **DIMENSION: ENVIRONMENTAL SUSTAINABILITY OF ENERGY SYSTEMS**

Environmental sustainability measures the ability to mitigate natural resource depletion and environmental degradation. It considers the following elements:

1. Energy resource productivity
2. Decarbonisation
3. Emissions and Pollution

<b>Indicator Category</b>	<b>Indicator</b>	<b>Description</b>	<b>Reference Year</b>	<b>Source</b>
<b>Energy Resource Productivity</b>	<b>Energy Efficiency Score</b>	The State Energy Efficiency Index categorises states as 'Front Runner', 'Achiever', 'Contender' and 'Aspirant' based upon their efforts and achievements towards energy efficiency implementation.	<b>2019</b>	<b>BEE</b>
	<b>Performance of Clean Energy (Capacity/Potential)</b>	Computed as the ratio of installed RE based capacity in a state to RE potential of a state.	<b>2019-20</b>	<b>CEA</b>
	<b>Energy Intensity (in toe/INR Crore)</b>	The final energy intensity is the energy consumed by end users (for example, industry, transport, households, services and agriculture) excluding the use of petroleum products and natural gas as chemical feedstocks. The final energy intensity is the ratio of final energy consumption over GDP	<b>2014-15</b>	<b>BEE</b>
<b>Decarbonisation</b>	<b>Notification of SAPCC (State Action Plan for Climate Change, State renewable Energy Policy)</b>	Whether the state has notified its State Action Plan for Climate Change policy for promoting generation of electricity through renewable energy sources or not.	<b>2020</b>	<b>MoEFCCC SREDA</b>
	<b>CO2 saved from LED Bulbs per 1000 population (in tonnes)</b>	Reductions in CO2 emissions in tonnes per thousand population by switching from an incandescent bulb to a LED bulb	<b>2019-20</b>	<b>NITI Aayog</b>
	<b>% of Forest Cover (Forest Cover wrt total area)</b>	Measures the total forest cover as a percentage of the geographical area of the state.	<b>2019</b>	<b>Forest Survey of India</b>

	<b>Emission per Capita (in MtCO<sub>2</sub>e)</b>	Measures the total amount of CO <sub>2</sub> emissions from fuel combustion per capita	2014-15	BEE
<b>Emissions and Pollution</b>	<b>Air Quality Index</b>	Air Quality Index or AQI measures the concentration of PM 2.5 levels -- fine particles of less than 2.5 microns that can enter the bloodstream and penetrate the lungs and heart - which are linked to chronic respiratory diseases.	July 2020	State AQI Dashboard, AQI India
	<b>PM2.5 mean annual exposure</b>	Defined as the average level of exposure of a state's population to concentrations of suspended particles measuring less than 2.5 microns in aerodynamic diameter, which are capable of penetrating deep into the respiratory tract and causing severe health damage. Exposure is calculated by weighting mean annual concentrations of PM2.5 by population in both urban and rural areas.	July 2020	State AQI Dashboard, AQI India
	<b>PM10 Mean annual exposure</b>	Average level of exposure of a state's population to concentrations of suspended particles measuring between 2.5 & 10 microns in aerodynamic diameter	July 2020	State AQI Dashboard, AQI India

### DIMENSION: STATE CONTEXT

State context measures the ability of states to balance the three core dimensions of the energy trilemma. It considers the following elements:

1. Macroeconomic Environment
2. Regulations, Institutions & Governance
3. Stability for Investment & innovation

Indicator Category	Indicator	Description	Reference Year	Source
<b>Macroeconomic Environment</b>	<b>Economic Growth Rate</b>	It is measured as the percentage rate of increase in the real gross domestic product (GDP) of a state.	2019-20 wrt 2015-16	IBEF, Ministry of Commerce, Govt. of India
	<b>Ease of Doing Business Index</b>	The Ease of doing business index ranks states against each other based on how the regulatory environment is conducive to business operations.	2017	Department of Finance, Industry, Energy, Commerce & Industry, State Government/ Invest India, RBI (Handbook of Indian States 2018-19)
	<b>Start up ranking Index</b>	It ranks states/UTs based on the start up ecosystem available	2018	Start Up India, Ministry of Commerce

Indicator Category	Indicator	Description	Reference Year	Source
<b>Regulations, Institutions &amp; Governance</b>	<b>Human Development Index (HDI)</b>	HDI is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions.	<b>2018</b>	<b>Global Data Lab</b>
	<b>Good Governance Index</b>	It is a uniform tool across States to assess the Status of Governance and impact of various interventions taken up by the State Government and UTs.	<b>2019</b>	<b>Ministry of Personnel, Public Grievances and Pensions, Govt of India</b>
	<b>SDG Index</b>	Measures state's performances across 17 Sustainable Development Goals	<b>2019-20</b>	<b>NITI Aayog</b>
<b>Stability for Investment &amp; innovation</b>	<b>Innovation Index</b>	The index ranks the states based on their innovation capability, the challenges and opportunities that lie for states and actions needed by policy makers to foster innovation.	<b>2019</b>	<b>NITI Aayog</b>
	<b>Logistics Index</b>	The State Logistics Performance Index is arrived at using a ranking methodology based on a series of meetings with stakeholders and online surveys in the key areas of the logistics like infrastructure, services, timelines, traceability, competitiveness, security, operating environment and efficiency of regulation. The LEADS establishes the base line of performance in the logistics sector based on the perception of users and stakeholders at the State level. It assess the status of logistics efficiency in each State.	<b>2019</b>	<b>National Logistics Index, (LEADS), Ministry of Commerce &amp; Industry</b>
	<b>Industry, Infrastructure &amp; Innovation (corresponding to SDG Index)</b>	Corresponds to SDG goal 7. Measures state's performance towards the Goal of Industry, Innovation, and Infrastructure.	<b>2019</b>	<b>NITI Aayog-SDG Index</b>
	<b>Sustainable Mobility (Presence of EV, Sustainability mobility policies)</b>	Measures the state's performance in terms of presence of sustainable mobility policies, number of EVs, charging infrastructure etc.	<b>2019-Till Present</b>	<b>State Transport Undertaking</b>





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