



RENEWABLE ENERGY AND ENVIRONMENTAL POLICIES: WITH SPECIAL REFERENCE TO STATE OF GUJARAT

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ABSTRACT:

Gujarat is regarded as one of the world's economic centers, and as such, all of its sectors should be promoted. Energy is one of the sectors that is regarded as the foundation for the overall development. Since two to three decades ago, the amount of coal consumed to produce adequate electricity has increased proportionately, leading to an increase in carbon emissions (CO₂). Gujarat is one of the states with excess energy supply and benefits from a 1600-kilometer coastline. Gujarat has one of the highest per capita energy consumption rates among many Asian countries and states. Because of the volume of carbon emissions, there has been an increase in the demand for modern technology and development. The Gujarat government has implemented a wide range of programmes and policies to address the issue of renewable resources and the associated environmental risk. Here, the researcher had examined a number of programmes and strategies for the use of renewable energy sources by the state. The researcher has also examined how various programmes and policies have affected environmental risk and how those programmes and policies relate to Indian government environmental policy. The inexperienced passageway project of the Indian government and the numerous concerns for climate change are also highlighted in this paper. The major goal of this research is to see if Gujarat Government can reduce carbon emissions and increase use of renewable resources. Here, the researcher has analyzed data for the years 2010 to 2020 using secondary data and tabulation techniques.

Key Words: *Energy Sector, Carbon emission, Renewable resources, Climate Change and Indian Government Environment Policy.*

Abbreviation

CEEW	Council on Energy, Environment and Water
CFCs	Chlorofluorocarbons
CO ₂	Carbon
DISCOMs	Distribution Companies
DRI	Direct Reduced Iron
GHG	Green House Gas
GSECL	Gujarat State Electricity Corporation Ltd
GT	Giga Tonnes
GW	Giga Watt
IEA	International Energy Agency
KWh	Kilo Watt hour
MMT of CO ₂	Million Metric Tonnes of Carbon Dioxide Equivalent
Mt	Metric Tonnes
MW	Mega Watt
NAAQS	National Ambient Air Quality Standards
SEEI	State Energy Efficiency Index
TWh	Thousand-Watt hour



INTRODUCTION

The idea of environmental protection has been acknowledged since the pre-historic civilization. It is nearly impossible for human beings to develop and flourish while letting our environment die.¹ Energy is a vital need for everything from information and communications technology to machining in every industry around the globe. This need extends to the basic functions of cooking, heating, cooling, lighting, transportation, and appliance functioning. Nowadays, it is believed that one of the biggest obstacles to enhancing human well-being globally is a lack of access to dependable and clean energy sources. Since the last four decades, the majority of governments worldwide have initiated a number of policies and programmes for increasing alternative resources for the production of energy generation.

The energy sector is at the centre of the development of any economy. To build an improved level of living for the country's almost 1.4 billion people, the Indian government must have great objectives. India needs the right policies and an environment that encourages innovation if it is to deploy sustainable energy technologies widely. To enable greater electrification throughout the nation, larger-scale solar, wind, and hydropower installations must be deployed more quickly.

Additionally, it calls for the creation of novel fuels such biogas and liquid biofuels as well as electrolyzed hydrogen. To get to zero carbon emissions, energy efficiency needs to considerably increase and carbon removals are going to be quite important. Instead of following the fossil fuel-driven development paths traditionally taken by major countries, India has the opportunity to design its own distinctive economic track. At the same time, India must make sure that its energy policy promotes equality in society, is financially sound, and guarantees the long-term sustainability of resources.

CARBON FOOTPRINT IN THE WORLD

The total greenhouse gas emissions—primarily carbon dioxide and methane—that a person, community, event, organisation, service, product, or country causes are measured as a carbon footprint. A greenhouse gas (GHG) is a gas that absorbs thermal radiation, emits it, and does both, resulting in a "greenhouse effect" that traps heat close to the Earth's surface and ultimately heats the planet.

Yet, the higher share of carbon emissions (CO₂) that arise from coal-based electrical generation. In 2021, CO₂ emissions from industrial and energy-related processes rose to their highest yearly level ever. Emissions increased by 6% from 2020 to 36.3 Giga Tonnes (GT). According to a number of research and assessments, output using coal and gas drove a 2.3% increase in global energy consumption in 2018. The demand for all fuels increased locally, with fossil fuels providing approximately 70% of the growth for the second year in a row.

REVIEW OF LITERATURE

Jain Manisha, (2022), had analysed the share of various production methods for carbon emission in India. In the study titled **Carbon dioxide emissions from India's industries: Data sources and discrepancies** Indira Gandhi Institute of Development Research shows that the total share of the various industrial sector was highest at 25%, followed by the electricity generation sector. Here, the author has analysed trends and differences between two different data sources viz. *International Energy Agency estimates, and country-level data reported by the central government to the United Nations Framework Convention on Climate Change. In this research study, the author has also noted the estimates of the International Energy Agency (IEA) for CO₂ emission was 2,251 MtCO₂ in the year 2018 in which the share of power generation was 53%, followed by the industrial sector with 25% and 14% of transportation and 4% of residential sources while another sector with 4%².*

Tiseo Ian (2022), has studied the carbon dioxide emission in India from the year 1990 to 2019. According to a study, in the fast-growing economy like India have seen an arising level of emissions continuously and over the last few decades more than 300% up to 2.56 billion metric tonnes (GtCO₂) in the year 2019. Here the researcher has also analysed the condition of COVID – 19 which had dropped globally and per capita emission was comparatively lower than other countries with 1.77 metric tonnes per person.

Nduage I, Yadav Deepak, Bhardwaj Nishan, Elango Sabarish, Biswas Tirth, Banerjee Rangan, Rajagopalan Srinivas (2022), have analysed the life cycle GHG emission associated with the DRI production

¹ Babel, S., & Poduval, S. (2020). A Paradigm Shift Towards Sustainability: An Environmental Irony. *GLS Law Journal*, 2(1), 9 - 20. Retrieved from <https://glsjournal.in/index.php/glsjournal/article/view/18>

² Jain Manisha, "Carbon dioxide emissions from India's industries: Data sources and discrepancies" Indira Gandhi Institute of Development Research, Ideas for India, 2022.



range for the 139.1 to 1880.0 kgCO₂e/t-DRI for the rotary kiln DRI process, 1565.5 to 1969.1 kgCO₂e/t-DRI for the coal gasifier DRI process, and 815.3 to 1160.1 kgCO₂e/t-DRI for the NG reformer DRI process. In the titled '**Comparative Life Cycle Assessment of Natural Gas and Coal-Based Directly Reduced Iron (DRI) Production**', the level of carbon emission by thermal heat from coal gasification was about 17%. Lower than the rotary kiln route.

However, after accounting for electricity consumed in the coal gasification plant, the plant emissions from the rotary kiln and coal gasification process become similar. The life cycle analysis shows that the rotary kiln DRI process offers 4.5-11 per cent lower GHG emissions when compared to the coal gasifier DRI process, primarily due to upstream emissions from iron ore pellets used in the coal gasification process. The study results will be very beneficial to future work on hydrogen-based DRI since the process is analogous to the NG reformer and coal gasification DRI process considered in the assessment.³

Gupta Vaibhav, Biswas Tirth & Gansesan Karthik (2017), had studied a depth assessment of 'Greenhouse Gases Emission Estimates from the Manufacturing Industries in India National Level Estimates: 2005 to 2013'. Here the council has worked as a member of GHG Platform India and published an updated version of previous estimates and also simultaneously at the state level. This study covered mainly three types of greenhouse gases viz. carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), which accounted large share of anthropogenic emissions in India. Last few years, manufacturing arise up to 8% about 315 MMT of CO₂e (2005) to 623 MMT (2013)⁴.

Carbon Emission Rate (CO₂)

The term "carbon footprint" refers to the total amount of greenhouse gas emissions associated with a person or other entity's activities. Direct emissions are those caused by burning fossil fuels during the production, heating, and transportation processes, as well as emissions from the electricity needed to power the consumption of goods and services. The idea of a carbon footprint frequently takes additional greenhouse gases, such as methane, laughing gas, or chlorofluorocarbons, into account as well (CFCs). Climate change is mostly caused by carbon dioxide emissions. It is commonly acknowledged that the world needs to reduce emissions quickly if it is to prevent the worst effects of climate change. Yet, the division of this responsibility among nations, regions, and people has long been a source of dispute in international talks.

The global average concentration of CO₂ within the atmosphere increased from about 277 parts per million (ppm) in 1750 to 414 ppm in 2020 (up 49%), in 2020, global CO₂ emissions from fossil fuels were 34.8 GtCO₂, a decrease of 5.4% from 36.7 GtCO₂ in 2019. Global CO₂ emissions within the year 2021 from fossil fuels are projected to grow 4.9% to 36.4 GtCO₂, grade which is about 0.8% below the 2019 level. The 2021 growth of 1.6 GtCO₂ is comparable to the expansion observed in 2010 following the world financial crisis of 2008-2009:

1.7 GtCO₂ or 5.5% above 2009 levels. Global fossil CO₂ emissions in 2021 are set to rebound near their pre-COVID levels after an unprecedented call in the year 2020. Emissions from oil and gas use are set to grow more in the year 2021 than they fell in the year 2020, but emissions from oil use remain below 2019 levels.⁵

The record decrease in 2020 emissions was 1.9 billion heaps of CO₂ (GtCO₂) [-5.4%], from 36.7 GtCO₂ in the year 2019 to 34.8 GtCO₂ in the year 2020. Emissions are projected to grow 4.9% (4.1% to 5.7%) in the year 2021, to 36.4 GtCO₂. Global emissions in the year 2021 remain about 0.8% below their level in the year 2019. The growth in the year 2021 is 1.6 GtCO₂ which is comparable to the expansion observed in the year 2010 following the world financial crisis of 2008- 2009 (1.7 GtCO₂; 5.5% above 2009 levels). The chart given below shows the worldwide annual carbon emission form the year 1940 to 2020.⁶

Chart – 1

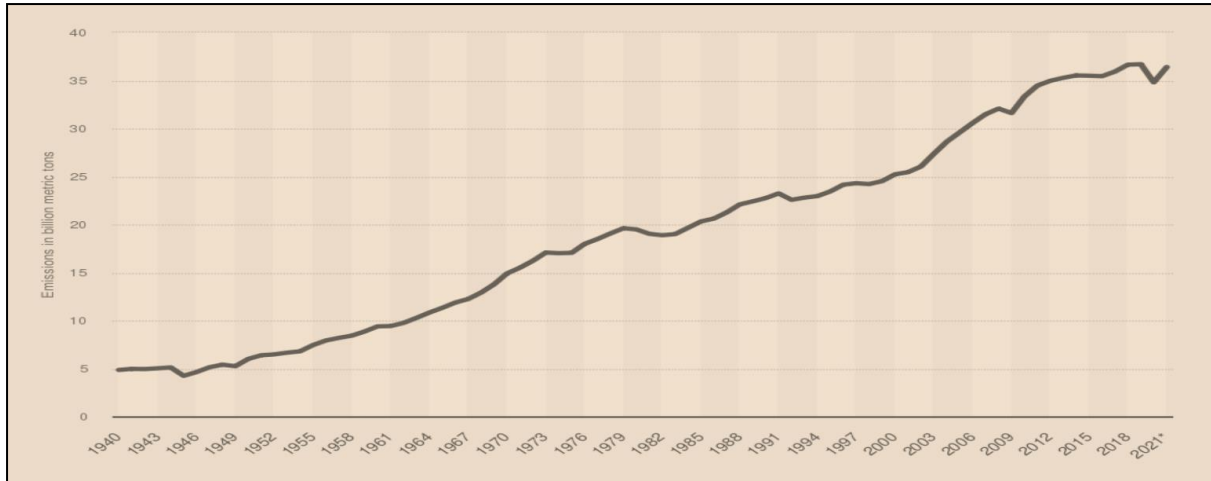
Annual CO₂ emissions worldwide form the year 1940 to 2020 in billion metric tonnes

³Nduage I, Yadav Deepak, BhardwajNishan, ElangoSabarish, BiswasTirth, Banerjee Rangan, Rajagopalan Srinivas "Comparative Life Cycle Assessment of Natural Gas and Coal-Based Directly Reduced Iron (DRI) Production", *Journal of Cleaner Production*, Volume 347, 1 May 2022, 131196

⁴ *Gupta Vaibhav, Biswas Tirth & Gansesan Karthik "Greenhouse Gases Emission Estimates from the Manufacturing Industries in India National Level Estimates: 2005 to 2013"* Published by GHG Platform India, 2017

⁵Global Carbon Project: Export(s) (Friedlingstein 1940 – 2020)

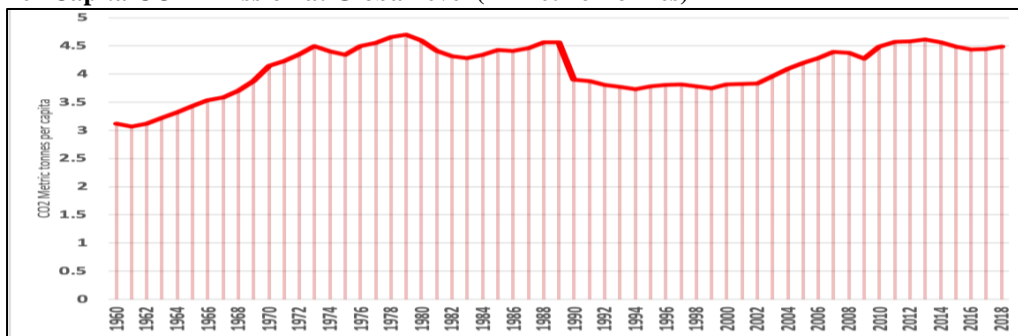
⁶World Bank – API EN.ATM. CO₂E PC DS2 Accessed, 2021



Source: Global Carbon Project: Export(s) (Friedlingstein 1940 – 2020)

According to the chart given above in the year 1940 the ratio of CO₂ was 5 billion metric tonnes which continuously increased up to 40 billion metric tonnes in the year 2020. Whereas the carbon emission ratio increased faster, Indian economy is additionally on the third position for the CO₂. The subsequent chart – 2 shows the trend of per capita CO₂ at global level.

Chart – 2
Per Capita CO₂ Emission at Global level (in Metric Tonnes)



Source: World Bank – API EN.ATM.CO2E PC DS2 Accessed, 2021

The chart – 2 given above shows the per capita carbon emission in metric tonnes. In the year 1950, per capita CO₂ emission was 3 Mt which continuously rose up to 4.5 Mt till 1990 then declined to 3.5 Mt till 2000 and again increased from 4 to 4.5 Mt in the year 2018. The subsequent table – 1 described top 10 countries listed with higher share of CO₂ emission and per capita CO₂ around the world from the year 2017 and 2020.

Table – 1
Top Ten Countries in CO₂ Emission and per capita CO₂ in the world

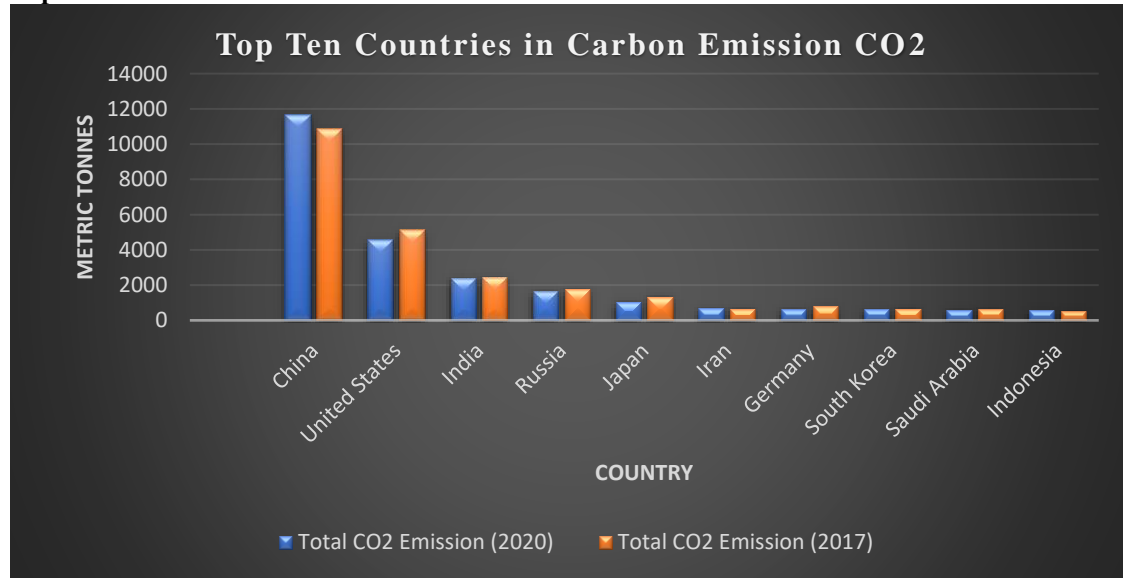
(in Mt)

Sr. No.	Country	Total CO ₂ (2020)	Total CO ₂ (2017)	Per Capita CO ₂ Emission (2020)
1	China	11680.42	10877.22	8.2
2	United States	4535.3	5107.39	13.68
3	India	2411.73	2454.77	1.74
4	Russia	1674.23	1764.87	11.64
5	Japan	1061.77	1320.78	8.39
6	Iran	690.24	671.45	8.26
7	Germany	636.88	796.53	7.72
8	South Korea	621.47	673.32	12.07
9	Saudi Arabia	588.81	638.76	16.96
10	Indonesia	568.27	511.33	2.09

Source: <https://worldpopulationreview.com/country-rankings/carbon-footprint-by-country>

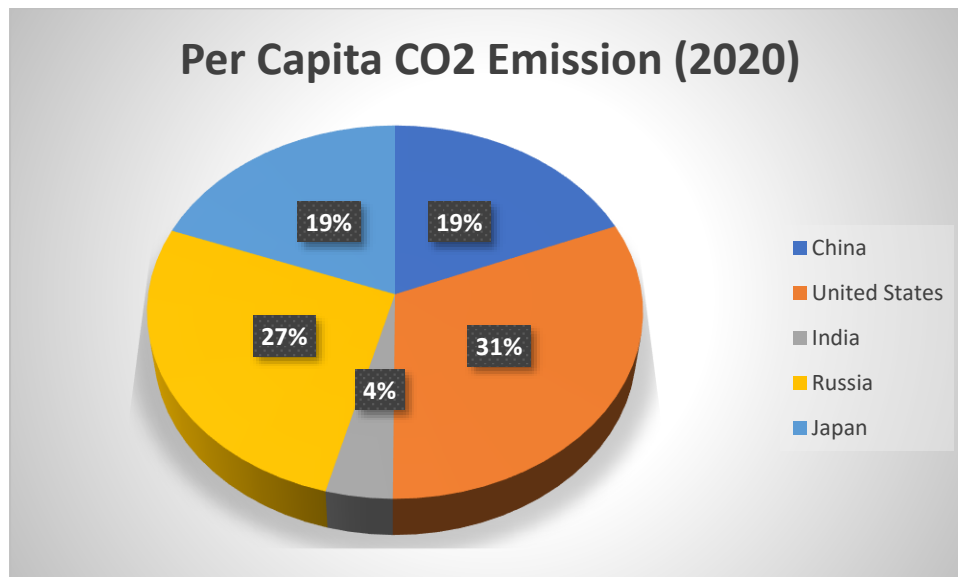
As per the table given above the countries have higher proportion of CO2 emission in the year 2017 and 2020. In carbon emission China stood top with 11680.42 Mt followed by USA with 4535.3 Mt and third was India with 2411.73 Mt. The chart 2 and 3 shows the highest ten countries of carbon emission CO2 and per capita CO2 in the year 2017 and 2020.

Chart – 3
Top Ten Countries of Carbon Emission CO2



Source: Developed by researcher

Chart – 4
Per Capita CO2 Emission (2020)



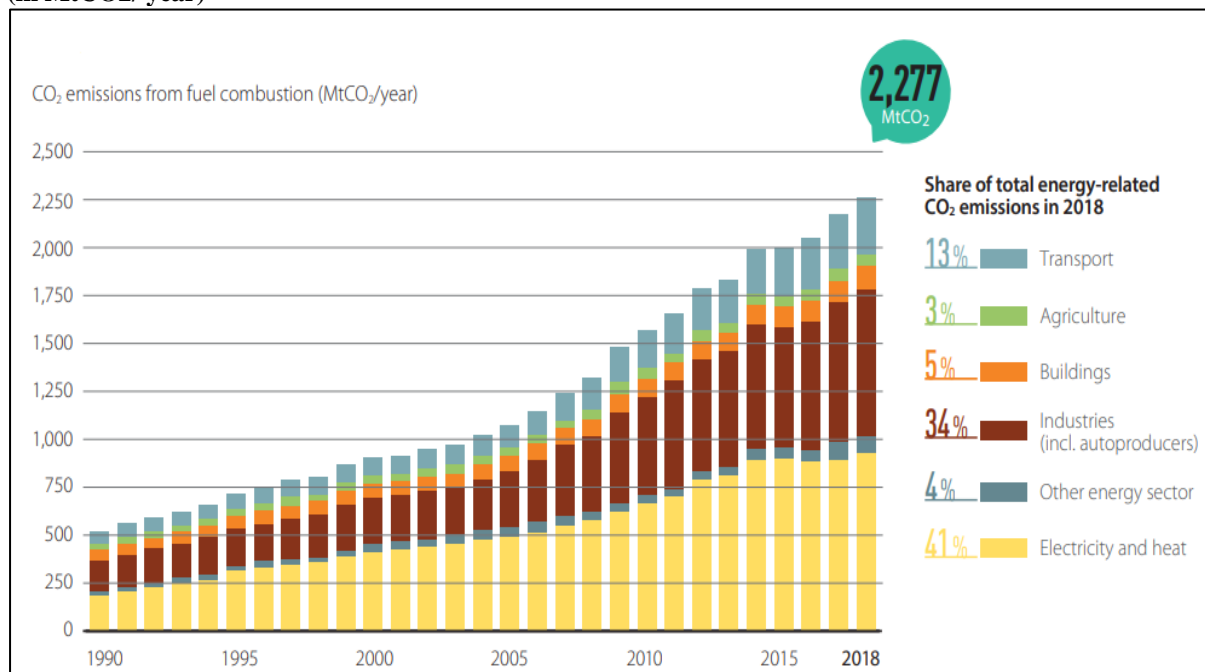
Source: Developed by researcher

According to the chart given above per capita CO2 emission in US was 31% while India was only 4% in the year 2020. As per the Report of Key World Energy Statistics, 2021 total electricity generation was 26,936 TWh in the year 2019 within which share percentage of coal-based electricity was 36.7%, oil 2.8%, fossil fuel 23.6%, atomic energy 10.4%, hydro 15.7%, and other renewable was only 10.8%, which says that the proportion of coal-based electricity generation was almost higher compared to other alternative energy resources. As per the report of the expansion of Electricity Sector form 1917-2021, in the year 2021 total installed capacity of electricity generation of India was 3,82,151 MW and gross electricity generation by utilities was 13,73,180 GWh during which coal based 9,81,443 GWh (71.47%), gas 50,944 GWh (3.71%), hydro

1,50,300 GWh (10.95%), nuclear 43,029 (3.13%) and renewable resources were 1,47,248 GWh (10.72%). Per capita electricity consumption was 1,208 KWh in the year 2020. Whereas the per capita consumption of electricity of the planet was 3260 KWh and in India it was 1181KWh which was comparatively lower from many countries of the globe.

The Global Energy Review 2021 states that, “Despite global economic activity rising above 2019 levels than in 2021 and global energy demand rebounding above 2019 levels, we don't anticipate a full return of CO2 emissions to pre-crisis levels. Even with a rise in CO2 emissions from oil of over 650 Mt CO2 in 2021, oil-related emissions are expected to recover only around half the 2020 drop and thus should remain 500 Mt CO2 below 2019 levels.”⁷ In India, financial healing will bring about 200 Mt better carbon emissions than 2020. This way it's also consistent with and better than the 2019 stage. Again, coal is being attributed to this emission upward thrust. “A rebound in coal call for above 2019 degrees drove the emissions growth in India, with the anticipated upward thrust in coal-fired energy era in 2021 in all likelihood to be more than the growth in era from renewable”⁸ says the IEA report.

Chart – 5
CO2 Emission by Fuel Combustion
(in MtCO₂/ year)



Source: Enerdata 2019, Brown to Green: The G20 Transition Towards A Net-Zero Emission⁹

The chart given above describes the contribution of the strength associated quarter in carbon emission within the year 2018. Total carbon emission in India changed into 2,277 Mt wherein contribution of energy and warmth nearly maximum with 41% observed via way of means of commercial quarter with 34% and lowest changed into agriculture and different strength quarter respectively 3% and 4%. Carbon depth of strength quarter (tones of CO₂) consistent with unit of general number on strength deliver changed into 59tCO₂ with inside the identical within the year. Carbon depth suggests how plenty CO₂ is emitted consistent with unit of strength deliver. The carbon depth of India's strength quarter has been growing considering 1990 and now equals the G20 common of 59tCO₂/TJ. This displays the transition from conventional biomass in the direction of fossil fuels.

As per the trend analysis by the GHG (Green House Gas) platform India, total carbon emission level in the Gujarat state was increased from 141.3 MtCO₂ (2005) to 212.1 MtCO₂ (2013) almost with 5% of growth rate in which contribution of the energy sector was near to 75% followed by the industrial product and process unit sector with 12% while the contribution of agriculture, forestry and other land use and waste sector was respectively 9% and 3% in the year 2012. Here the chart analysed by the GHG platform was also given below

⁷ <https://www.iea.org/reports/global-energy-review-2021>

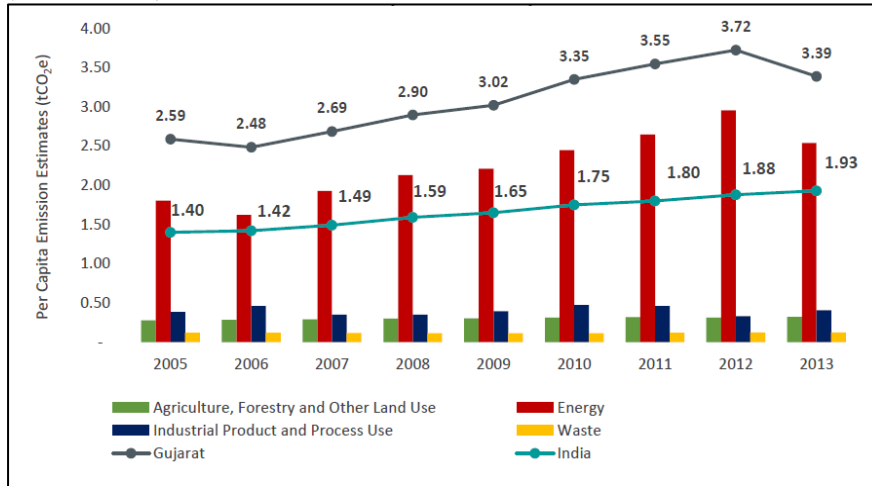
⁸ <https://www.iea.org/reports/global-energy-co2-status-report-2019/emissions>

⁹ Enerdata 2019, Brown to Green: The G20 Transition Towards A Net-Zero Emission

which described Per capita emissions of Gujarat grew from 2.59 tCO₂e in 2005 to 3.39 tCO₂e in 2013.¹⁰ The highest per capita emissions were observed in 2012 owing to increased Energy emissions. When compared to per capita emissions of India, Gujarat registered substantially higher per capita emissions across all the years. The observed growth rate of the per capita emissions in Gujarat and India was 3.42% and 4.07% respectively from 2005 to 2013.

Chart – 6

Per Capita GHG Emissions in Gujarat and India (2005 to 2013)



Source: Trend Analysis of GHG Emissions in GUJARAT, GHG (Green House Gas) platform India

The chart given above describes the contribution of the energy related sector in carbon emission within the year 2018. Total carbon emission in India was 2,277 Mt during which contribution of electricity and heat almost highest with 41% followed by industrial sector with 34% and lowest was agriculture and other energy sector respectively 3% and 4%. Carbon intensity of energy sector (tones of CO₂ per unit of total primary energy supply) was 59tCO₂ within the same year. Carbon intensity shows what proportion CO₂ is emitted per unit of energy supply. The carbon intensity of India’s energy sector has been increasing since 1990 and now equals the G20 average of 59tCO₂/TJ. This reflects the transition from traditional biomass towards fossil fuels.

Gujarat is sixth largest states in terms of geographic area and in ninth position with the population almost 70 million. The state has achieved the excellence of being of the most industrially developed states in India. Gujarat contributes about almost 20% of the entire export of Indian economy. Gross State Domestic Product (GSDP) was Rs.16.59 trillion (US\$267.40 billion) within the year 2021. As per the Department of Promotion of Industry and Internal Trade (DPIIT), within the year 2020 flow of FDI in the Gujarat was about US\$47.8 billion. The ratio of the infrastructural facilities ratio is

additionally memorable, that within the year 2020 total length of the national highway was almost 6,635kms whereas the Gujarat Infrastructure Development Board (GIBD) has prepared Blueprint for Infrastructure Gujarat (BIG) within the same year. State have 10 domestic and a world airport which is higher compare to other states of the country and in the year 2021 the Airports Authority of India (AAI) approved another international airport in Dholera. Total length of the railway lines was about 5,258.49 kms and in 2021, government has allocated around 15 billion for the bullet. However, the state has one major and 41 minor ports along 1600kms costal area, is that the first stage of the country undertaken port privatization for the encouraging the public private partnership (PPP) model.¹¹

Among all the infrastructural facilities, electricity is sort of a backbone for the development of the all the sector. Gujarat is one the states of the Indian economy have surplus electricity supply and therefore the per capita electricity consumption of the state is also higher than many states and India. Total installed capacity of electricity generation of the state was 27,509 MW within the year 2019 and total electricity generation was 71,533 MUs within the same year in which 18,900 MW with conventional sources by 6017 Mw by GSECL (Gujarat State Electricity Corporation Ltd.), 2104 Mw by State IIPs, 6552 MW Private IPPs and 4227 MW by Central sectors.

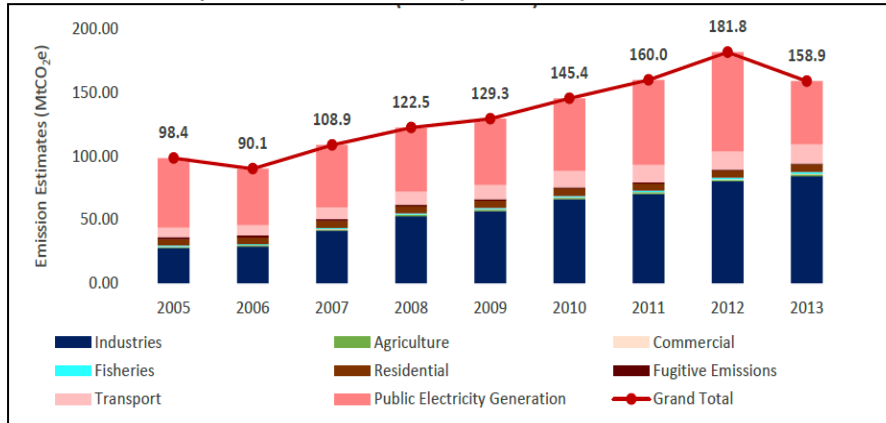
¹⁰Trend Analysis of GHG Emissions in GUJARAT, GHG (Green House Gas) platform India, 2015

¹¹ Socio- Economic Review of Gujarat State, 2020-21

Carbon Emissions from the Energy sector arise from two main sub-sectors viz. Fuel Combustion (Public Electricity Generation, Transport, Industries and Agriculture, Commercial and Residential categories) and Fugitive. In 2013, the Energy emissions of Gujarat were from Fuel Combustion was 99% with the CAGR of 6.17% from 98.4 MtCO_{2e} in 2005 to 158.9 MtCO_{2e}. Carbon Emissions from the Energy sector arise from two main sub-sectors viz. Fuel Combustion (Public Electricity Generation, Transport, Industries and Agriculture, Commercial and Residential categories) and Fugitive. In 2013, the Energy emissions of Gujarat were from Fuel Combustion was 99% with the CAGR of 6.17% from 98.4 MtCO_{2e} in 2005 to 158.9 MtCO_{2e}.

Chart – 7

GHG Emission by various sectors in Gujarat (2005 to 2013)



Source: Trend Analysis of GHG Emissions in GUJARAT, GHG (Green House Gas) platform India

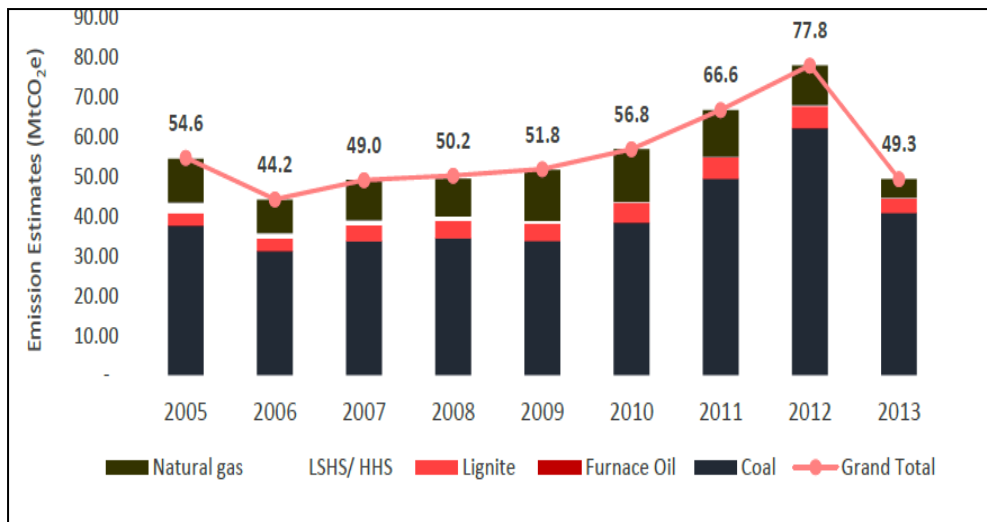
The chart given above shows the GHG emission by the varied sectors and total level of carbon emission in the Gujarat state from the year 2005 to 2013.

The share of commercial sector in the carbon emission shows the increasing trend for the year 2005 to 2013. However, in the year 2005, contribution of commercial sector was less than 50%, which continuously increased, that in the year 2013, the economic sector was on the first position with the contribution in the total carbon emission was 53%, whereas the contribution of share percentage by the general public electricity generation was highest with 45% (2007) which reduced up to 31% in the year 2013. As per the chart given above, within the total carbon emission the contribution of above two sector was almost near to 84% and remaining 16% contribution was by transportation, agriculture, residential, commercial and other sectors. Here, in the research maximum emissions were observed from the burning of Coal and significant emissions were also recorded from gas, Lignite and other fuels.

The year 2013 witnessed the maximum emissions from the Public Electricity Generation category owing to increased emissions from Fuel Combustion in Coal-fired Power Plants of Gujarat as illustrated in Figure 6 above. On an average, Coal contributed to nearly 72% of the emissions from this category followed by Natural Gas (19%) and Lignite (8%) during the reference period.

Chart – 8

GHG Emission Estimates for Public Electricity Generation (2005 to 2013)



Source: Trend Analysis of GHG Emissions in GUJARAT, GHG (Green House Gas) platform India

India is fastest growing economy among the world and since last few decades requirement of energy sources arising faster and peak demand of electricity also driven faster, however for the reduction in the level of carbon emission the Indian government has launched various polices and projects for the improving in the electricity generation by renewable resources. In the year 2010, World Energy Trilemma in which Energy Security, Energy Equity, Environment Stability and also Country Context Dimension was prepared by the World Energy Council for 127 countries. As per the report of the World Energy Council, in the year 2021 India stood on the 75th rank with the Trilemma score of 53.1, energy security 61.2, energy equity 47.1 and environmental stability 50 have grade of BDDc which is comparatively lower than other developing countries. As per the analysis of trend line of score by the World Energy Council that energy equity score has been improving slowly.¹² According to the reports of RECAI, that Corporate Power Purchase Agreements (PPAs) are like diver for the clean energy growth whereas ranking level of various economy reflect, trend of global market condition where investors and firms are prioritising Environmental, Social and Governance (ESG) measures and on-going growth of renewable resources, inclusive policies, and technological advancements in the clean energy transition. However in the 59th edition of ‘Renewable Energy Country Attractiveness Index (RECAI) 2021’ released by Ernst & Young (EY), United States was on the top position with the RECAI score of 72.7, followed by china with 70.7 and India ranked with 3rd position with 70.2 RECAI score that Indian government have enacted.¹³ The New Climate Institute and Climate Action Network International have analysed the Climate Change Performance Index (CCPI) of 63 countries with European Union (EU) for the estimation of the emission level and various policies for the environmental protection with the Nationality Determined Contributions (NDCs). The CCPI is related with the 14 indicators mainly in four categories in which GHG emissions (40%), Renewable energy (20%), Energy use (20%) and Climate policy (20%).¹⁴ The CCPI report indicate that none of the countries have scored more than 77 means performance of selected 63 countries have not performed for the reduction on GHG whereas three developing countries have secured places among the top ten ranking in CCPI 2022 respectively Morocco (8th), Chile (9th) and India (10th).¹⁵

NITI Aayog, Bureau of Energy Efficiency (BEE) and Alliance for an Energy Efficient Economy (AEEE) jointly conceptualized the framework of the State Energy Efficiency Index for the states of India. The structure of the SEE depends mainly on consumption of energy, energy saving potential and influence of implementation of energy efficiency in various sectors and activates of DISCOMs with also policies and regulations, programmes, financial mechanisms, institutional capacity of the adoption of energy efficiency and energy saving. In the year 2020, total 36 states and Union Territory (UT) were analysed with around 68 indicators mainly qualitatively, quantitative and outcome based and all the states are classified into four group viz. Front Runner, Achiever, Contender and Aspirant, in which with the group 1 indicate highest level of Total Final Energy

Consumption and group 4 with lowest. Here the chart describes the four group of SEEI index of year 2020.

Chart – 9

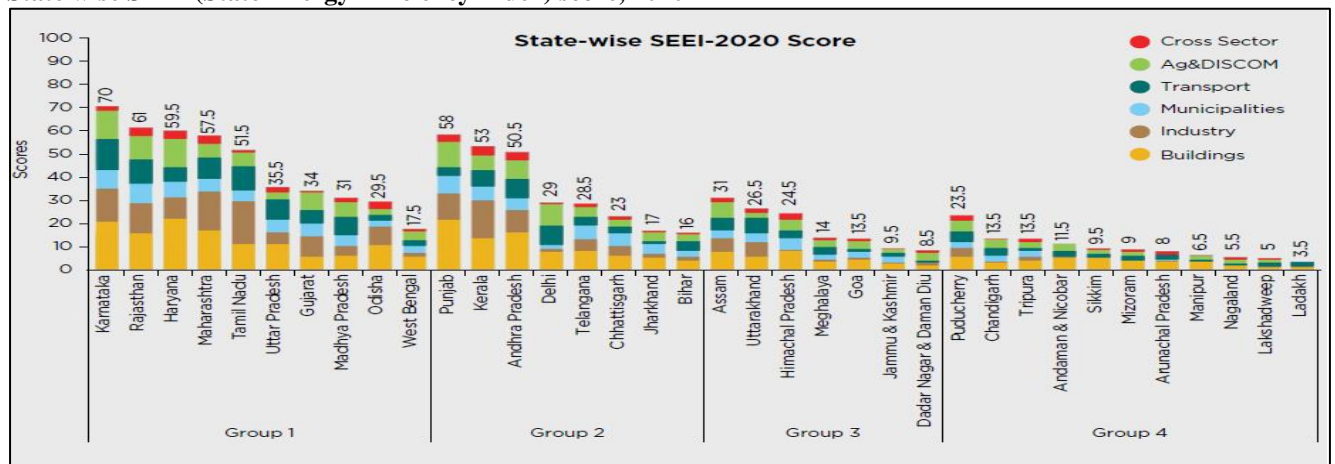
¹²World Energy Trilemma Index, 2021. <https://www.worldenergy.org/publications/entry/world-energy-trilemmaindex-2021>

¹³Renewable Energy Country Attractiveness Index (RECAI) 2021.59th edition, EY Global Power & Utilities Corporate Finance Leader https://www.ey.com/en_in/recai

¹⁴Climate Change Performance Index, 2022. <https://ccpi.org/>

¹⁵CCPI 2022

State wise SEEI (State Energy Efficiency Index) score, 2020



Source: State-wise SEEI-2020 Score

As per the chart given above Karnataka was the top-performing state with a score of 70 followed by Rajasthan with a score of 61 and Gujarat was on the 7th position with 34 in the year 2020.¹⁶

Policies of the Renewable Resources in India and Gujarat

Indian government have numerous measures for the reduction of carbon emission in last few years, in the year 2020 NITI Aayog have presented India’s 2nd Voluntary National Review (VNR) in UN High Level Political Forum (HLPF)¹⁷ with mainly five nectar elements for the achievement of net zero emission by the year 2070 and betterment of renewable resources of electricity generation by 2030 are;

1. Installed capacity of renewable sources up to 500 GW.
2. 50% of total energy requirement fulfil by renewable sources.
3. Reduce the total projected carbon emission with 1 (one) billion tonnes
4. Reduce the level of carbon intensity up to 45%.
5. To achieve the net zero emission by the year 2070.

For the achievements of the above the Council on Energy, Environment and Water have (CEEW) have undertaken Indian Residential Energy Survey (IRES) of 21 states of the country on the basis of annual electric supply to residential for the year 2020 and also analysed the various polices of the states for the reduction of carbon emission.¹⁸ As per the report of the CEEW, electricity supply of residential sector was about 23 hours for the states viz. Delhi, Gujarat, Tamil Nadu and Kerala with the top performers whereas, Jharkhand, Bihar, Haryana, Uttar Pradesh and Assam have to improve. Indian government have started various programmes and projects for the betterment of financial assistance of DISCOMs i.e., Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) scheme was launched in 2014 with a budget outlay of Rs. 43,033 crores¹⁹. In the year 2017, the Saubhagya (Pradhan Mantri Sahaj Bijli Har Ghar Yojana) scheme, the world’s largest universal electrification scheme, was launched in 2017 to focus on the last-mile connectivity to all unelectrified households. Standalone electric grids were provided where connection to the main power grid was not possible²⁰. The Government of India responded by launching the National Clean Air Programme (NCAP) in 2019, with a target to reduce PM2.5 and coarse particulate matter (PM10) concentrations by 20-30% by 2024 from 2017 levels. While such a reduction will not necessarily ensure that cities meet the standards under NAAQS, this is the first time that an air quality improvement target has been linked to a specific date for delivery.²¹

Indian government has prepared various projects and polices for the betterment of renewable energy resources with the target of achievement of installed capacity with 175 GW by the year 2022 in which 100 GW for solar power, 6 GW of wind energy, 10 GW of biomass and 5 GW of small hydro energy. According to the report of the Central Electricity Authority (CEA), by the year 2030 installed capacity would be expected by 60%. Here the researcher has also discussed about the various programme and polices for the improvement of renewable resources.

¹⁶State Energy & Climate Index Round-I

¹⁷ <https://www.pib.gov.in/PressReleaseDetailm.aspx?PRID=1638261>

¹⁸State of Electricity Access in India: Insights from the India Residential Energy Survey (IRES) 020, CEEW Report (<https://www.ceew.in/sites/default/files/ceew-research-on-state-of-electricity-access-and-coverage-in-india.pdf>)

¹⁹<http://www.ddugjy.gov.in/assets/uploads/1548234273fykio.pdf>

²⁰<https://powermin.gov.in/en/content/saubhagya>

²¹World Energy Outlook 2021



INDIA – AUSTRALIA MEMORANDUM OF UNDERSTANDING signed by the both of the government in 2017 in field of environment, climate and wildlife change with the scope;

1. Environmental information system
2. Waste water management, treatment and re-use of treated effluents
3. Coastal and marine system
4. Climate change
5. Control of air and water pollution
6. Clean coal technology
7. Other area related to protection of environment

The Climate Change Policy

In the year 2008, the Climate Change policy was launched by the Indian government with the National Action Plan on Climate Change (NAPCC) with eight missions;

- The National Solar Mission,
- The National Mission for Enhanced Energy Efficiency,
- The National Mission on Sustainable Habitat,
- The National Water Mission
- The National Mission for Sustaining the Himalayan Ecosystem,
- The National Mission for a “Green India”,
- The National Mission for Sustainable Agriculture, and
- The National Mission on Strategic Knowledge for Climate Change.

Numerous power sector policies for the distribution (Ujwal DISCOM Assurance Yojana (UDAY) Scheme and Restructured Accelerated Power Development and Reforms Programme (R- APDRP) was also stated by the government for the betterment of energy sector with 7.5 MtCO₂e between 2005-15.

Another phenomenon for GHG emissions with the concentrations with the climate change and carbon mitigation were launched by the government are;

- UNFCCC (1992)
- Kyoto Protocol (1997)
- Emissions limitations on 41 Annex I countries (31 developed and 10 EIT parties)
- About 5.2% reduction over 1990 and average of 2008-2012
- Carbon Emissions trading markets and mechanisms (CDM, JI, ET) established
- USA government walked away (under President George W. Bush).
- Copenhagen Accord (2010)

National Solar Mission (NSM) by Ministry of New and Renewable Energy with the Targets

- Deployment of 20,000 MW of grid connected solar power by 2022;
- 2,000 MW of off-grid solar applications including 20 million solar lights by 2022;
- 20 million sq. meter thermal collector area;
- To create favourable conditions for developing solar manufacturing capability in the country
- Support R&D and capacity building activities to achieve grid parity by 2022.

National Mission for Enhanced Energy Efficiency

Four initiatives to enhance energy efficiency in energy intensive industries are:

1. Perform Achieve and Trade Scheme (PAT)
2. Market Transformation for Energy Efficiency (MTEE)
3. Energy Efficiency Financing Platform (EEFP)
4. Framework for Energy Efficient Economic Development (FEEED)²²

Nearly 12% of India's total capacity for renewable energy is contributed by Gujarat. Since 2009, Gujarat has had a surplus of electricity. Gujarat is the first fully electrified state in India, and it offers electricity around-the-clock. Its 34 GW total energy generation capacity makes it the most electrified state in the country. Most energy is consumed by industry and agriculture. Domestic consumers consume 17 percent of the total energy produced, utilising 56 and 21 percent of the power generated, respectively. In FY 2019–20, 313 MW of solar energy capacity was erected, and 9,71 percent more wind energy capacity was installed, totalling 14,71 MW. During the fiscal year 2017–18, the state's electricity consumption increased. The private sector is responsible for developing around 97 percent of the renewable energy capacity.

Policy Enhancement in Non-Conventional Energy

²²<https://beeindia.gov.in/content/nmeee-1>



Gujarat's government has unveiled its "Waste to Energy Policy 2016" and "Gujarat Small Hydel Policy 2016" for producing electricity from water and solid waste. Achievements in the Past Two Years Gujarat are the first Indian state to successfully construct a rooftop solar project as part of the solar city initiative.

- A 5 MW solar rooftop project connects to the grid in Gandhinagar
- The Grid-connected 5 MW Solar Rooftop Project in Vadodara.

In addition to the aforementioned, GPCL has installed 1MW Grid Connected rooftop solar projects at Ahmedabad and Gandhinagar government buildings. Government of Gujarat & Government of Gujarat have given its consent in principle for this project to be built on waste land with a 1407 HA area that is located 271 kilometers north of Ahmedabad.

Up until June 30, 2021, the Gujarat Wind Power Policy 2016 will be in force. By the end of 2016, the goal of this strategy and related policies from 2009 and 2013 is to have built wind power capacity of more than 3,800 MW. For a period of 25 years from the date of commissioning or for the duration of the projects, whichever comes first, wind projects installed and commissioned within the operative period are eligible for the advantages and incentives proclaimed under this policy.

The former Gujarat Electricity Board (GEB), which was split up into independent entities on April 1, 2005, as a result of structural changes implemented by the State. These include Gujarat Energy Transmission, Gujarat State Electricity Corporation Limited (GSECL) for generation, and four state discoms for distribution. With four coal-based plants, two gas and two lignite plants, two hydroelectric plants, 10 MW of wind and 89 MW of solar projects, GSECL has an installed capacity of 6.8 GW. Gujarat Electrical Regulatory Commission was established to oversee the state's electricity industry as part of the reforms. The following are a few of the state's major policies:

- Solar Policy (2015)
- Wind Policy (2016)
- Gujarat Small Hydro Policy (2016)
- Waste-to-energy Policy 2016
- Net Metering Regulations for Rooftop Solar (2016)
- State for Rooftop Solar (2016)
- Net Metering Regulations for Rooftop Solar (2016)
- Net Metering Regulations for Rooftop Solar (2016)
- Wind Solar Hybrid Policy (2018).

Gujarat is also emerging as a RE manufacturing hub. Along with RIL capacity, Adani Solar India's largest solar cell and module manufacturer is increasing its manufacturing capacity from 1.5 GW to 3.5 GW. Other companies such as Surat-based Goldi Power are also increasing their capacities. Genesis Ray offers GIS Solutions for Gujarat²³. The Gujarat government had launched the State Action Plan on Climate Change (SAPCC) in the year 2009, with the objective to provide sustainable and climate resilient with the action plan;

- Mainstreaming action on Climate Change in Government Departments
- Devising innovative and forward-looking policies and their means of implementation
- Generating comprehensive Climate Change consciousness among Policy Planners
- Building wide ranging strategic knowledge partnerships
- Ensuring broad based people's participation
- Institutionalizing capacity building at the State level²⁴

National Sustainable Habitat Mission a composting facility planned for all local governments in the city. 75 locations are in operation. The first methane recovery plant to generate electricity from wastewater was established in Surat. The total installed power is 3.5 MW. Over 1.28 million kWh of electricity was generated and reduced 52000 tCO₂ emissions.

Under Gujarat's Solar Power Policy, the state introduced the concept of Solar Parks, which is an innovative way to promote solar installations and power plants. For developers who are willing to set up solar plants in India, land acquisition may be a major stumbling block. The State Government came up with the idea of solar parks, which is a segment of State-owned land designated for the generation of solar energy. This move was well-received by both private investors and developers who were looking to acquire land.

The Jawaharlal Nehru National Solar Mission was announced in 2010 to harness the potential of solar energy in India. This law was enacted with the goal of achieving grid parity by 2022, and to reduce the cost of solar power, which would thereby speed up the investment in this industry.

²³<https://www.vibrantgujarat.com/assets/img/Sectors/RenewableEnergy.pdf>

²⁴ State Action Plan on Climate Change, Government of Gujarat, Climate Change Department with TERI, New Delhi, 2014



The State revised its solar power policy in 2015 in order to continue the success of previous policies. Before announcing this new policy, the State consulted with a number of stakeholders and investors about what else could be done to make it more effective and up-to-date. Gujarat has notably achieved its capacity target of 11,000 MW and has set a target of producing 30,000 MW of green energy, mainly wind and solar, by the end of 2022. Besides this, the company has also implemented several rooftop solar projects generating around 800 MW of power.

CONCLUSION

A fundamental need for energy can be seen in everything from the basic functions of every industry throughout every nation. Nowadays, it is thought that one of the major obstacles to enhance human well-being globally is the lack of access to dependable and clean energy sources. Since the previous four decades, the majority of the world's government have launched a number of policies and programs aimed at enhancing alternative resources for the assembly of energy generation. The energy sector is at the core of the action of any economy. The Indian authorities need to take excessive aspirations as it strives to assemble a better well-known lifestyles known for the populace of almost 1.4 billion. India desires the best coverage and innovation-pushed context to set up smooth electricity technology on a massive scale. It calls for extra and quicker deployment of large-scale solar, wind, and hydropower to permit more electrification throughout the country. It additionally calls for the occasion of new fuels, like liquid biofuels and biogas, nevertheless as hydrogen constructed from electrolysis. Energy performance need to enhance significantly, and carbon removals may have a important function in shifting in the direction of zero carbon emission.

The state of Gujarat saw its carbon dioxide emissions rise from 141.3 MtCO₂ (2005) to 212.1 MtCO₂ (2013), an almost 5% increase in growth. The energy sector contributed nearly 75% of the increase, followed by the industrial product and process unit sector with a contribution of 12%, and the agricultural, forestry, and other land use and waste sectors with contributions of 9% and 3%, respectively, in 2012. Here, the graphic stated below that was generated by the GHG platform was also provided. Gujarat's per-person emissions increased from 2.59 tCO₂e in 2005 to 3.39 tCO₂e in 2013.

Indian and Gujarat government have lunched numerous programme and policies for the reduction of carbon emission with the net zero by the year 2030. Gujarat is also developing as a centre for the production of RE. Along with RIL, Adani Solar, India's largest producer of solar cells and modules, is boosting its production capacity from 1.5 GW to 3.5 GW. Other businesses, like Goldi Power in Surat, are also expanding their capacities. Gujarat's GIS solutions are provided by Genesis Ray.

In order to deliver sustainable and climate resilient solutions with the action plan, the Gujarati government launched the State Action Plan on Climate Change (SAPCC) in 2009.

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