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Energy and Carbon Emission Impact of Renewable Energy Policies in Gujarat State

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Abstract:

Gujarat is thought mutually of the economic hubs within the world, for the event of state all the sectors ought to be developed. Among all sectors, the energy sector is thought as backbone for the property development. Since two three decades, the consumption of coal for the availability of correct energy magnified with the upper proportion, that arise the amount of carbon emission (CO2). Gujarat is one amongst the states that have surplus energy provide and state has conjointly advantage of 1600 kilometer coastal space. Per capita electricity consumption of Gujarat is conjointly on top of several state and Asian nation also. With the rise within the demand of recent equipment's and development, proportion of thermal energy conjointly arises, that have arisen the amount of carbon emission. Gujarat government has enacted numerous programmes and policies for the event of renewable resources that is connected with environmental hazard. Here, the research worker had analyzed numerous policies and programme for the renewable sources of energy and its implementation within the state. The research worker has conjointly analyzed the impact of assorted programme and policies on environmental hazard and conjointly its connection with environmental policies of the Indian government. During this paper, the inexperienced passageway project of Indian government and numerous comes for the climate changes also are mentioned. Might Gujarat government cut back the amount of carbon emission and utilization of renewable resources is that the main objective of this paper. Here, the researcher has used secondary information and tabulation technique for analysis for the year 2010 to 2020-21.

Key Words: *Energy Sector, Carbon Emission Rate, Green House Gases, Renewable Energy Resources, Gujarat state, Renewable Energy Policies*

Introduction

Energy presents a fundamental need ranging from, but not limited to, the essential services of cooking, heating, cooling, lighting, mobility, and operation of appliances, to information and communications technology, and machining in every sector of every country. The lack of access to reliable and clean energy supplies is now considered a major barrier to improving human well-being around the globe. The energy sector is at the heart of the development of any economy, since the last four decades most the government of the world has started several policies and programme for improving alternative resources for the production of energy generation. The Indian government has to take high aspirations as it strives to construct an enhanced standard of life standard for the population of almost 1.4 billion. India needs a suitable policy and innovation-driven context to deploy clean energy technologies on a massive scale. It requires more and faster deployment of large-scale solar, wind, and hydropower to enable greater electrification across the country. It also requires the development of new fuels, such as liquid biofuels and biogas, as well as hydrogen produced from electrolysis. Energy efficiency must improve significantly, and carbon removals will have a critical role in moving towards zero carbon emissions. India has opportunities to chart out its unique development pathway rather than take up fossil-fuel-driven paths previously pursued by developed

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economies. At the same time, it will be important for India to ensure that its energy pathway is socially inclusive, economically viable, and ensures the long-term sustainability of resources.

Carbon Footprint in the world

A carbon footprint is a measure of the total greenhouse gas emissions (primarily carbon dioxide and methane) caused by an individual, community, event, organization, service, product, or nation. A greenhouse gas (GHG) is a gas that absorbs and emits thermal radiation, creating a "greenhouse effect" that traps heat near the Earth's surface and ultimately warms the planet.

However, coal-based electricity generating arising a higher proportion of the carbon emission (CO_2) ratio with the higher proportion. Global CO_2 emissions from energy combustion and industrial processes rebounded in 2021 to reach their highest ever annual level. A 6% increase from 2020 pushed emissions to 36.3 Giga Tonnes (GT). Various studies and reports analyze that the worldwide level of energy consumption grew by 2.3% in the year 2018 which was driven by coal and gas-based production. At the local level, the demand for all fuels rose, with fossil fuels meeting nearly 70% of the growth for the second year running.

Carbon Emission Rate (CO_2)

Carbon footprint is that the amount of greenhouse gas emissions related to all the activities of an individual or other entity includes direct emissions, like people who result from fossil-fuel combustion in manufacturing, heating, and transportation, additionally as emissions required supplying the electricity related to goods and services consumed. The carbon footprint concept also often includes the emissions of other greenhouse gases, like methane, laughing gas, or chlorofluorocarbons (CFCs).

Carbon dioxide emissions are the first driver of worldwide temperature change. It's widely recognised that to avoid the worst impacts of temperature change, the planet must urgently reduce emissions. But, how this responsibility is shared between regions, countries, and individuals has been an endless point of contention in international discussions.

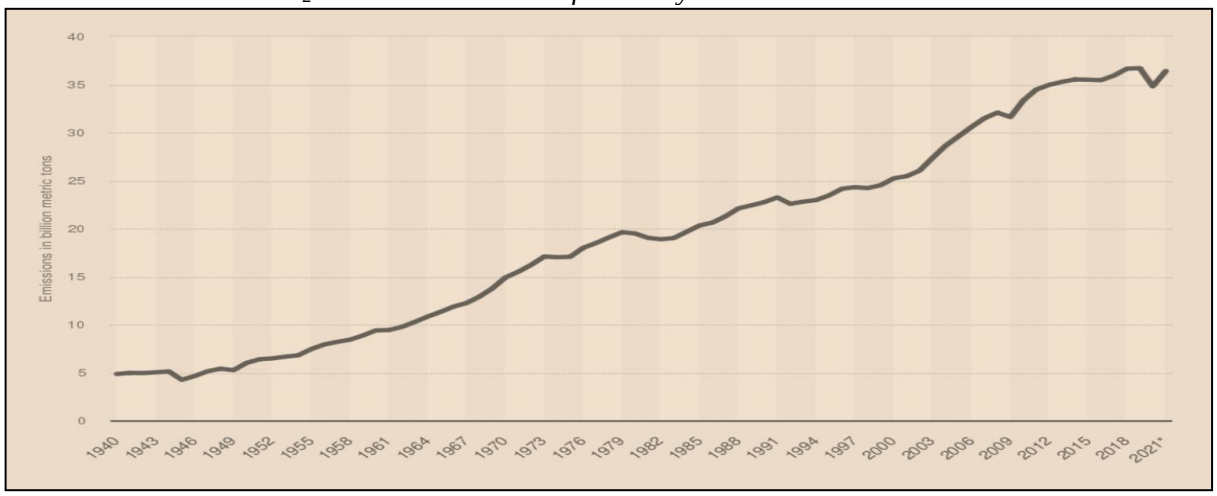
The global average concentration of CO_2 within the atmosphere increased from about 277 parts per million (ppm) in 1750 to 414 ppm in 2020 (up 49%), in 2020, global CO_2 emissions from fossil fuels were 34.8 GtCO2, a decrease of 5.4% from 36.7 $GtCO_2$ in 2019. Global CO_2 emissions within the year 2021 from fossil fuels are projected to grow 4.9% to 36.4 $GtCO_2$, grade which is about 0.8% below the 2019 level. The 2021 growth of 1.6 $GtCO_2$ is comparable to the expansion observed in 2010 following the world financial crisis of 2008-2009: 1.7 $GtCO_2$ or 5.5% above 2009 levels. Global fossil CO_2 emissions in 2021 are set to rebound near their pre-COVID levels after an unprecedented call 2020. Emissions from coal and gas use are set to grow more in 2021 than they fell in 2020, but emissions from oil use remain below 2019 levels.[2]

The record decrease in 2020 emissions was 1.9 billion heaps of CO_2 ($GtCO_2$) [-5.4%], from 36.7 $GtCO_2$ in 2019 to 34.8 $GtCO_2$ in 2020. Emissions are projected to grow 4.9% (4.1% to 5.7%) in 2021, to 36.4 $GtCO_2$. Global emissions in 2021 remain about 0.8% below their level in 2019. The 2021 growth of 1.6 $GtCO_2$ is comparable to the expansion observed in 2010 following the world financial crisis of 2008-2009 (1.7 $GtCO_2$; 5.5% above 2009 levels). The chart given below shows the worldwide annual carbon emission form the year 1940 to 2020.[3]

[2]ANNUAL CO2 EMISSIONS WORLDWIDE 1940-2020 STATISTA, https://www.statista.com/statistics/276629/global-co2-emissions/ (last visited Jan. 2, 2022).

[3]CO2 EMISSIONS (METRIC TONS PER CAPITA) DATA, https://data.worldbank.org/indicator/EN.ATM.CO2E.PC (last visited Jan. 2, 2022).

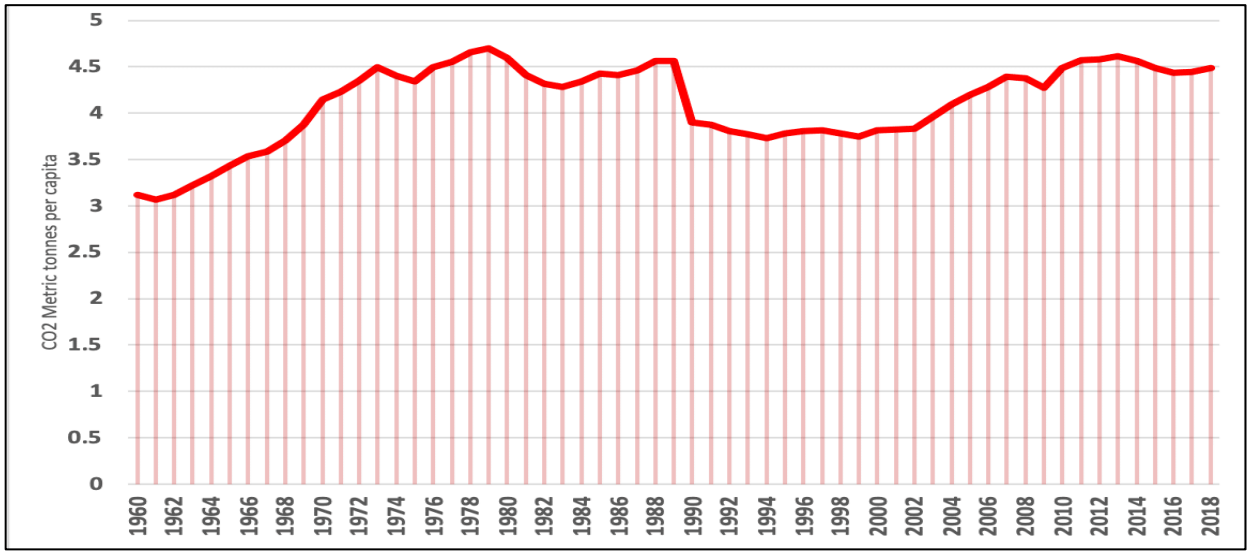
Chart - 1: Annual CO_2 emissions worldwide form the year 1940 to 2020 in billion metric tonnes



Source: ANNUAL CO2 EMISSIONS WORLDWIDE 1940-2020 STATISTA, Https://Www.Statista.Com/Statistics/276629/Global-Co2-Emissions/

According to the chart given above within the year 1940 the ratio of CO2 was 5 billion metric which continuously increased up to 40 billion metric tonnes within the year 2020. Whereas the carbon emission ratio increased faster, Indian economy is additionally on the stood 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: CO2 EMISSIONS (METRIC TONS PER CAPITA) DATA, https://data.worldbank.org/indicator/EN.ATM.CO2E.PC)

The chart – 2 given above shows the per capita carbon emission in metric tonnes that within the year 1950, per capita CO2 emission was 3 Mt which was continuously arise up to 4.5 Mt till 1990 then declined with 3.5 Mt till 2002 and again increased with 4 to 4.5 Mt within the year 2018. The subsequent table – 1 described top 10 countries listed with higher share of CO2 emission and per capita CO2 round the world within 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 CO2 (2020)	Total CO2 (2017)	Per Capita CO2 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: CARBON FOOTPRINT BY COUNTRY 2022, https://worldpopulationreview.com/country-rankings/carbon-footprint-by-country

As per the table given above describe the countries have higher proportion of CO2 emission within 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. Here, per capita CO2 emission of top countries with higher proportion of CO2 emission which was not up to Palau with 55.29 Mt (202) with top followed by Qatar? Here chart 2 and three shows the highest ten countries of carbon emission CO2 and per capita CO2 within the year 2017 and 2020.

Chart – 3: Top Ten Countries of Carbon Emission CO_2

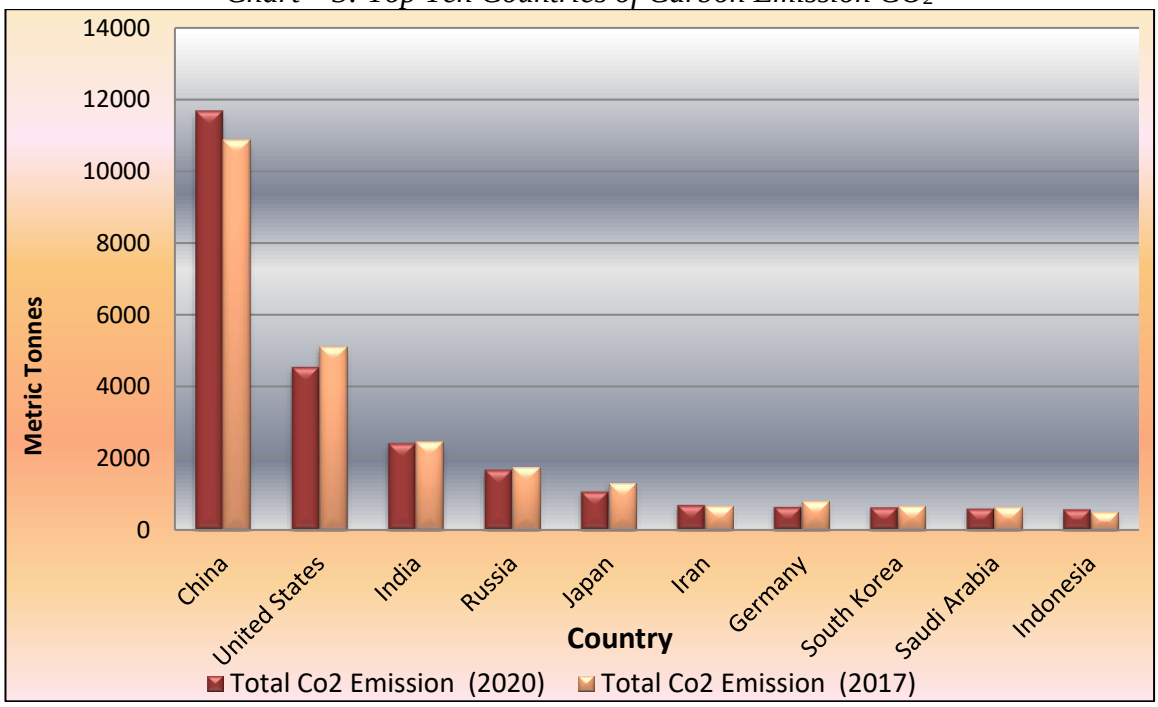
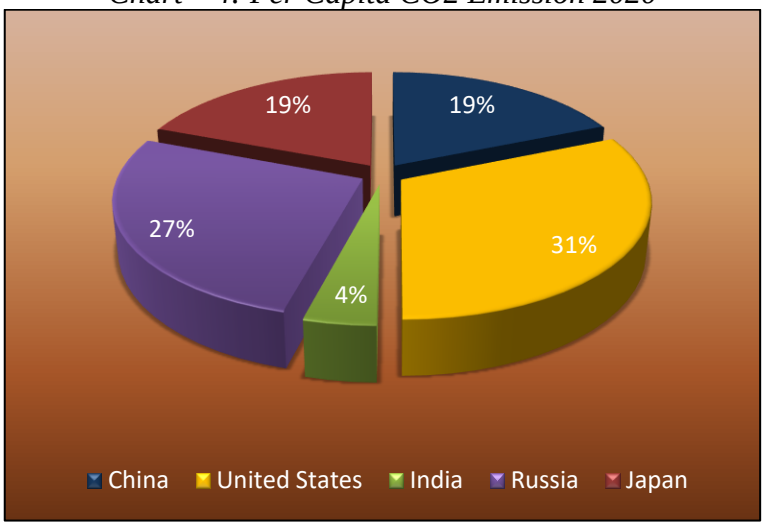


Chart – 4: Per Capita CO2 Emission 2020



According to the chart given above per capita CO_2 emission in US with 31% while India with only 4% within the year 2020.

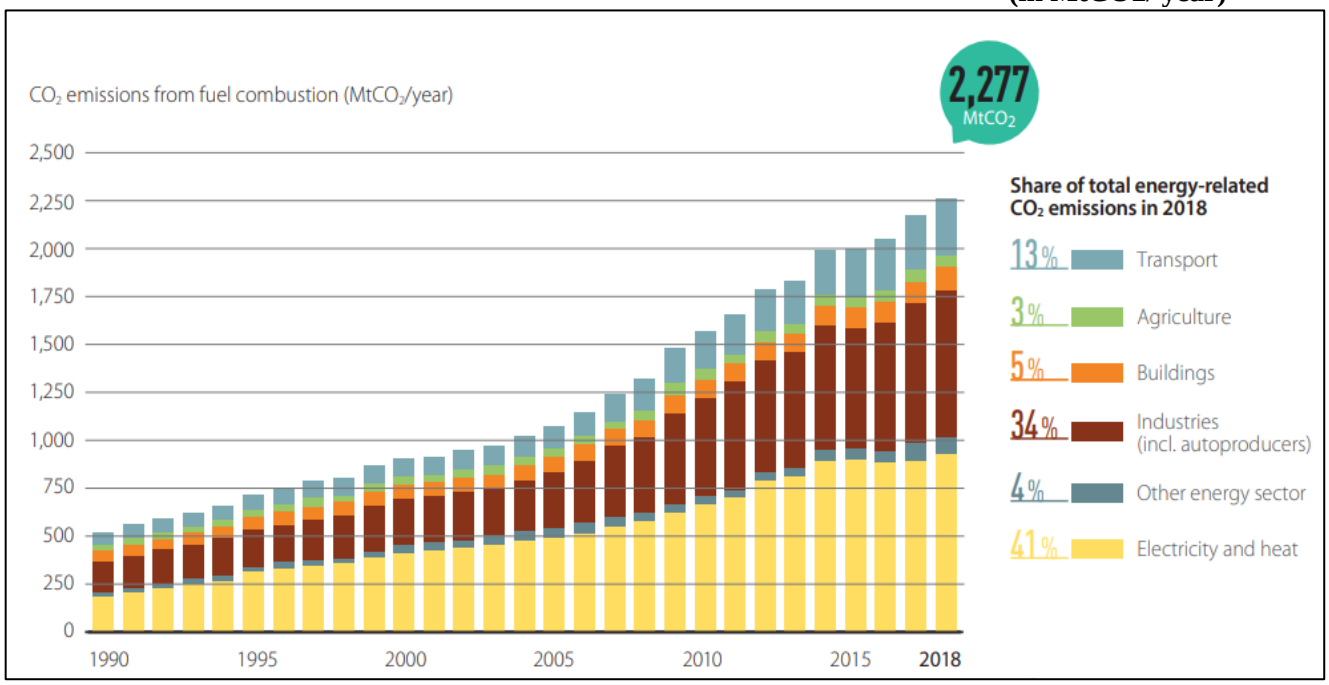
As per the Report of Key World Energy Statistics, 2021 total electricity generation was 26,936 TWh within the year 2019 within which share percentage of coal based electricity was 36.7%, oil 2.8%, fossil fuel 23.6%, atomic energy 10.4%, hydro 15.7%, and other renewable was only 10.8%, which says that the proportion of coal based electricity generation was almost higher compare to other alternatives energy resources. As per the report of the expansion of Electricity Sector form 1917-2021, within 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 within the 2020. Whereas the per capita consumption of electricity of the planet was 3260 KWh and in India was 1181KWh which was comparatively lower from many countries of the globe.

The Global Energy Review 2021, "Despite global economic activity rising above 2019 levels 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 over650 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."

In India, financial healing will bring about 2 hundred Mt better carbon emissions than 2020. This way it's also 1.4 consistent with cent 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 3 instances more than the growth in era from renewable," says the IEA report.

Chart – 5: CO_2 Emission by Fuel Combustion

(in MtCO2/ year)



Source: BROWN TO GREEN: THE G20 TRANSITION TOWARDS A NET-ZERO EMISSIONS ECONOMY, 2019 CLIMATE WORKS FOUNDATION, https://www.climateworks.org/report/brown-to-green-the-g20-transition-towards-a-net-zero-emissions-economy-2019/

The chart given above describes the contribution of the strength associated quarter in carbon emission with inside the year 2018.

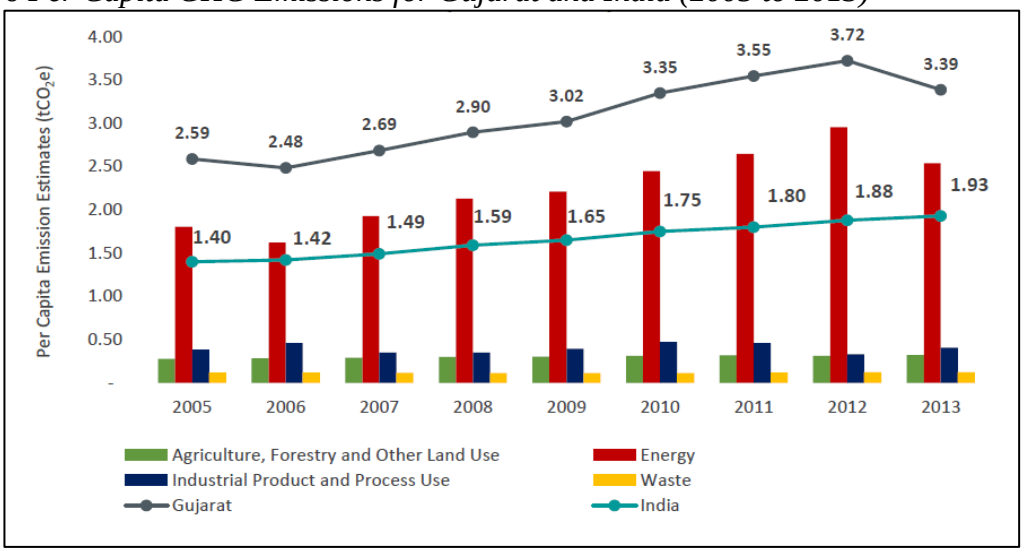
Carbon depth of strength quarter (tones of CO2) consistent with unit of general number on strength deliver changed into 59 tCO_2 with inside the identical within the year.

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 which described Per capita emissions of Gujarat grew from 2.59 tCO2e in 2005 to 3.39 tCO2e in 2013.[4] 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.

[4]Analysis of the Trends of GHG Emissions in India, 2007-2012, GHG Platform India, Vasudha Foundation, CISRS House, 14 Jangpura B, Mathura Road, New Delhi, November 2016

Chart – 6 Per Capita GHG Emissions for Gujarat and India (2005 to 2013)



Source: Analysis of the Trends of GHG Emissions in India, 2007-2012, GHG Platform India, Vasudha Foundation, CISRS House, 14 Jangpura B, Mathura Road, New Delhi, November 2016

The chart – 6 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 CO_2) per unit of total primary energy supply was 59 tCO_2 within the same year. Carbon intensity shows what proportion CO_2 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 which 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 development 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 port along 1600kms costal area, is that the first stage of the country undertaken port privatization for the encouraging the public private partnership (PPP) model.[5]

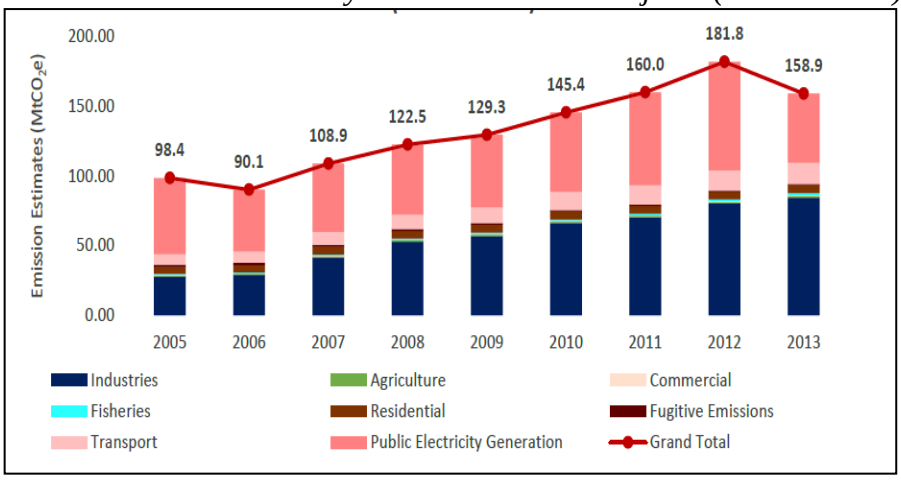
Among all the infrastructural facilities, electricity is sort of a backbone for the development of the all the sector. Gujarat is one the states of the Indian economy have surplus electricity supply and therefore the per capita electricity consumption of the state is also higher than many

[5] Socio- Economic Review of Gujarat State, 2020-21, Budget Publication – 33, Directorate of Economics and Statistics, Government of Gujarat, Gandhinagar, 2022

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 sector.

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 MtCO2e in 2005 to 158.9 MtCO2e. 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 MtCO2e in 2005 to 158.9 MtCO2e.

Chart – 7 GHG Emission by various sectors in Gujarat (2005 to 2013)



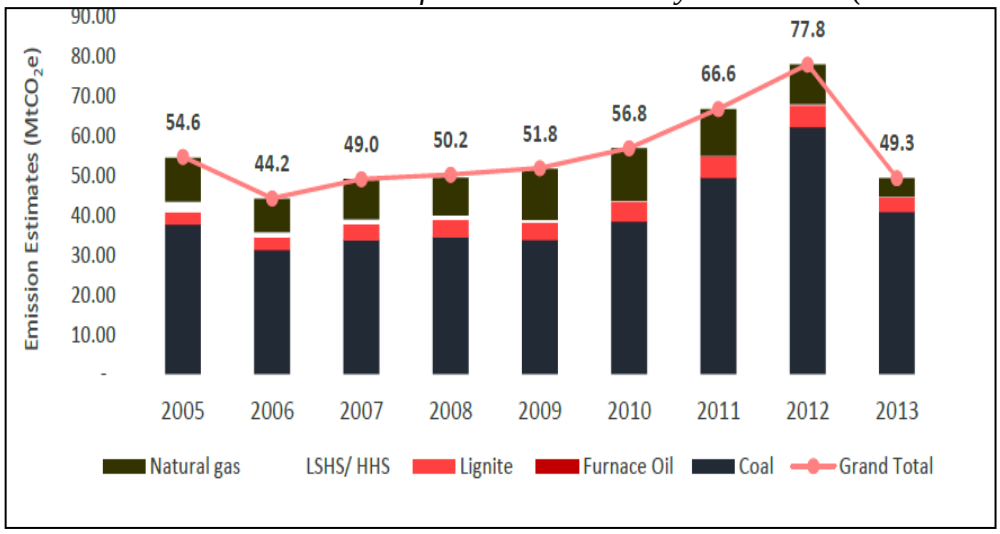
Source: Analysis of Greenhouse Gas Emissions from 2005 to 2013 - Trend Analysis of GHG Emissions in GUJARAT, GHG Platform India, Vasudha Foundation, CISRS House, 14 Jangpura B, Mathura Road, New Delhi, June 2020

The chart – 7 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, within the year 2005, contribution of commercial sector was less than 50%, which continuously increased, that within 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%was contribution was by transportation, agriculture, residential, commercial and other sectors. Here the research has also 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 below. 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: Analysis of Greenhouse Gas Emissions from 2005 to 2013 - Trend Analysis of GHG Emissions in GUJARAT, GHG Platform India, Vasudha Foundation, CISRS House, 14 Jangpura B, Mathura Road, New Delhi, June 2020

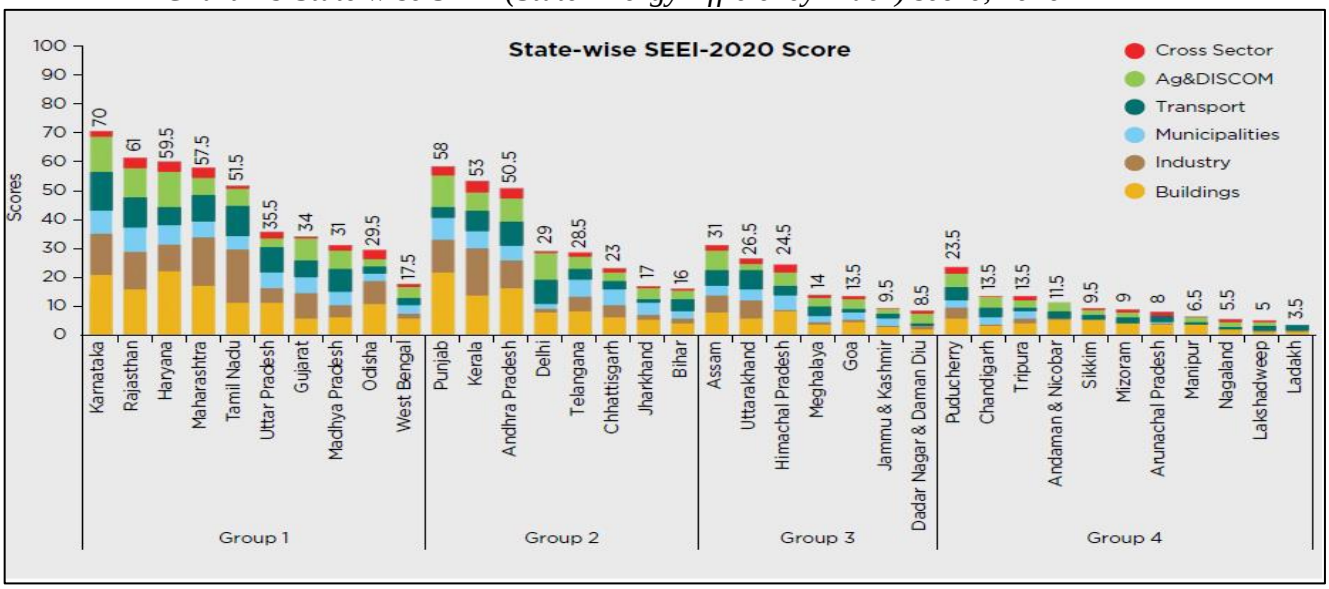
India is fastest growing economy among the world and since last few decades requirement of energy sources arising faster and peak demand of electricity also driven faster, however for the reduction in the level of carbon emission the Indian government has lunched various polices and projects for the improving in the electricity generation by renewable resources. In the year 2010, World Energy Triemma 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.[6]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 59thedition 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.[7] 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

[6]World Energy Trilemma Index, 2021, World Energy Council and in partnership with Oliver Wyman (2021)
[7]Renewable Energy Country Attractiveness Index (RECAI) 2021.59th edition, EY Global Power & Utilities Corporate Finance Leader https://www.ey.com/en_in/recai

use (20%) and Climate policy (20%).[8] 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).[9]

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 1indecate 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 State wise SEEI (State Energy Efficiency Index) score, 2020



Source: The State Energy Efficiency Index 2020, Bureau of Energy Efficiency (BEE) and Alliance for an Energy Efficient Economy (AEEE), Ministry of Power, Government of India, (2020)

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.[10]

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

[8]Jan Burck, Thea Uhlich, Christoph Bals, Niklas Höhne, Leonardo Nascimento, Jamie Wong, Ana Tamblyn and Jonas Reuther, Climate Change Performance Index, 2022, Germanwatch Observing, Analysing, Acting - for Global Equity and the Preservation of Livelihood, 2021,

[9]Jan Burck, Thea Uhlich, Christoph Bals, Niklas Höhne, Leonardo Nascimento, Jamie Wong, Ana Tamblyn and Jonas Reuther, Climate Change Performance Index, 2022, Germanwatch Observing, Analysing, Acting - for Global Equity and the Preservation of Livelihood, 2022

[10]Sweety Pandey, Navin Kumar Vidyarthi, Rajnath Ram and Rakesh Sarwal, "State Energy & Climate Index Round-I", Round – I NITI Aayog, Government of India, (2022)

(VNR) in UN High Level Political Forum (HLPF)[11] 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.[12] 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 crores[13]. 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 possible[14]. 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.[15]

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.

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. Costal and marine system
4. Climate change
5. Control of air and water population
6. Clean coal technology
7. Other area related to protection of environment

[11]PIB, https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1638261 (last visited Jan. 2, 2022)
[12]State 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-electricty-access-and-coverage-in-india.pdf)
[13]DDUGJY, http://www.ddugjy.gov.in/assets/uploads/1548234273fykio.pdf (last visited Jan. 3, 2022)
[14] https://powermin.gov.in/en/content/saubhagya (last visited Jan. 3, 2022)
[15]World Energy Outlook 2021, International Energy Agency (2021)

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 MtCO2ebetween2005-15.

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 Action Plan on Climate Change (NAPCC) was launched in200.Eight National Missions forming the core of the NAPCC:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for A Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

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. molar 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)[16]

[16]BEEINDIA, https://beeindia.gov.in/content/nmeee-1(last visited Jan. 2, 2022).

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. The first state to deploy rooftop solar energy.

Policy Enhancement in Non-Conventional Energy

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 Ahmadabad 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 Ahmadabad.

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 Gujarat.[17]

The Gujarat government had lunched 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 level[18]

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.

The State revised its solar power policy in 2015 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 enhancing 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 governments have launched a number of policies and programmes 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 of lifestyles well 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.

[17]Vibrant Gujarat, https://www.vibrantgujarat.com/assets/img/Sectors/RenewableEnergy.pdf (last visited Jan. 10, 2022)

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

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.