GHG Platform INDIA

Climate Mitigation Policy Evaluation for

The State of Gujarat

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Table of Contents

Tables and Figures

Introduction

This document seeks to highlight the impacts that the implementation of certain specific policies, programmes, schemes, missions, laws, etc. may be having on the climate. Where these impacts are beneficial, it would be useful to accelerate their implementation. On the other hand, where such impacts of implementation are negative, i.e. leading to an increase in the GHG emissions, it provides an opportunity to modify the policy design in a way the negative impacts on the climate can either be minimized or eliminated altogether. Further, if the pursuit of implementation of certain policies, programmes, schemes, missions, laws etc. are antithetical to the pursuit of India's climate objectives but still desirable from a developmental perspective, then the approach being proposed in this document provides a framework for decision making that is based on informed choices and recognition of the tradeoffs that are involved for a developing country such as India. This document shall be of key importance to the state government, policy makers, climate change researchers, students, organizations working in the domain of the climate change and other key stakeholders. Further, as India, both at the National as well as Sub-National levels, raises its levels of climate action to meet India's NDC commitments, it is crucial to assess whether these actions have produced a meaningful impact, particularly in their ability to capitalize the co-benefits of climate action. It is challenging to measure the effects of such policies on GHG emissions as their pathway is not always direct. Further, consistency is required in timeframes of assessment, and baseline assumptions. The exercise is highly dependent on these factors and the quality of data dictates the uncertainty associated with such assessments. This study is an attempt to initiate a process of system evaluation of policies from a climate perspective, and will hopefully will add significant value as it analyzes the industrial policies from a GHG mitigation perspective, and other indicators such as delivery of resources towards supporting implementation (input indicators), and policy administration activities (activity indicators).

About the document

This document contains the following elements:

- A listing of the policies/ programmes/ schemes/ missions/ laws applicable within boundary of the state of Gujarat considered for analysis across the sectors;
- Analysis of achievement of targets under the policies/ programmes/ schemes/ missions/ laws. and an its assessment of GHG emission implications.
- An assessment, wherever possible of the positive and/or negative impacts of the implementation of these policies on the climate;
- The assumptions involved in making our assessment as well as the information that we have considered for arriving at our conclusions

Energy Sector

This document provides a summary of all policies implemented in the energy sector, the agencies responsible for implementation, and the implementation period. In addition, information pertaining to data sources and availability are also provided in this section. The document also explains the budgetary allocation set aside towards successful implementation of these policies. To evaluate these policies, we have identified a set of impact indicators, which are sub-sector specific in nature. These include megawatts of installed capacity (electricity generation), number of LED bulbs distributed (buildings), and transport system length (Bus Rapid Transit System- BRTS).

Finally, using these data, we estimated overall emissions saved (cumulative) by each of these policies since their inception. Activity-specific assumptions and emission factors (fuel or technology) were used to estimate the emissions.

IPPU Sector

This document contains the following elements:

- Market based mechanisms like PAT and CDM have been considered for the assessment as they have a direct impact on reducing the emissions intensity of the manufacturing sector. These have been categorized under GHG emissions mitigation instruments. The Energy Conservation (EC) Act 2001, clearly mandates state government to form a State Designated Agency (SDA) to coordinate, regulate and enforce the provisions of the PAT scheme within the state (Ministry of Power, 2001). Gujarat has been one of the few states to have a considerable amount of CDM projects (third highest state in India) between 2005 and 2015(UNFCCC, 2019). Although, the scheme is ~~primarily~~ implemented by non-state actors (corporates, enterprises, or PSUs), it is essential to show the mitigation results in the state.
- Polices and/or mitigation actions have been listed in Table 1 and further evaluated using a framework that assesses them through three parameters: input, activity and GHG Impact.
- Mitigation polices and/or mitigation actions considered for the evaluation are mostly those that directly or indirectly have impact on GHG emissions. Additionally, section 4 includes summary of key impacts from only those polices and/or mitigation actions deemed more relevant in reducing GHGs.
- Methodology and assumptions to analyze the GHG impact are clearly outlined for each of the polices and/or mitigation actions assessed.
- For polices and/or mitigation actions that are still under implementation, GHG impacts are assessed till 2018. However, cumulative GHG reductions are provided for the period 2005 to 2015. e.g. RTS was implemented in 2012, but the cumulative GHG reduced from the scheme is estimated only till 2015 to account for the assessment period.

AFOLU Sector

While there are no specific policies for the AFOLU sector that are being implemented to meet any specific climate objectives, an identification and listing of policies that have implications on and interact with climate change, was done. Eight of these policies were specifically located within the AFOLU sector domain, while two additional policies were identified from a cross-cutting perspective. To the extent possible, quantification of the GHG emissions/removal was done for many of these policies. However, where such quantification was not possible, data gaps were identified and specific recommendations

were made regarding how to quantify climate impacts of the implementation of these policies in the future. The reference period for the analysis was 2005-2015, unless otherwise specified.

Waste Sector

The analysis provided in this document is primarily intended to identify and quantify, where possible, the GHG and non-GHG impacts of policy and mitigation actions. The findings can be used by decision makers and government institutions to gauge the implications of scaling up action and identify opportunities to make necessary modifications in policy design and implementation for enhancing mitigation impact.

This policy evaluation report is developed as part of GHG Platform India initiative, which is a collaborative effort of various civil society organizations. The project is funded by Shakti Sustainable Energy Foundation.

- Vasudha Foundation holds the secretariat for the platform and is responsible for the GHG emission estimation and analysis for AFOLU sector.
- ICLEI – Local Governments for Sustainability, South Asia (ICLEI South Asia) is responsible for GHG emissions estimation and analysis for waste sector.
- Center for Study of Science, Technology and Policy (CSTEP) is responsible for GHG emission estimation and analysis for energy sector.
- Council on Energy, Environment and Water (CEEW) is responsible for GHG emission estimation and analysis for industrial processes and product use sector.
- World Resources Institute India (WRI India) is responsible for designing the policy evaluation framework along with the partners and for peer review of analysis done by all partners previously mentioned

Executive Summary

Key Highlights

The highlights of this particular document include the following aspects:

Energy Sector

- This report examines ten policies implemented in Gujarat's energy sector and includes policies and programmes at the electricity generation and demand side. The analysis evaluates the GHG impact of these policies and quantifies the overall emissions ($MtCO_2e$) saved between 2005 and 2015. The energy sector includes policies implemented in sub-sectors such as electricity generation, transport, and buildings. Based on this, we estimate that a total of about 114.35 $MtCO_2e$ was avoided through the implementation of these policies.
- Amongst the policies evaluated, transmission and distribution (T&D) loss reduction resulted in maximum savings (approximately 67% of the total). It is important to note that due to paucity of data, we have considered only CO_2 emissions in the electricity generation. Further, relevant indicators have been defined to evaluate these policies. These include budgetary allocation, policy targets, and other sector-specific activity data.

IPPU Sector

- The polices and/or mitigation actions considered under the study have a cumulative emission reduction impact of 13.5 $MtCO_2e$ during the period 2005 to 2015. GHG impacts from three polices and/or mitigation actions– the Rooftop Solar (RTS) Scheme, Perform Achieve and Trade (PAT) Scheme, and voluntary participation of industry under the Clean Development Mechanism (CDM) have been estimated.
- A three-year moving-average trend of emission intensity, energy intensity, and the carbon intensity of the energy mix indicate that:
    - Energy intensity of the sector increased by 13 per cent during 2007 to 2011,but decreased by 7 per cent during 2011 to 2015, which also happens to be the period when majority of the policies and/or mitigation actions were operational.
    - However, the improvement of the energy intensity during the second half of the assessment period (2011-15) was offset by increasing carbon intensity of the energy mix. Thus, resulting in marginal impact on the emissions intensity levels. The carbon intensity of the energy mix indicated a reduction by 6 per cent during 2007-2011 but increased by 7 per cent during 2011-15.

AFOLU Sector

- Between 2005 and 2015, an average of 12.95$MtCO_2e$ are being removed per year due to the implementation of the policies under the AFOLU sector. However, an average of 0.22$MtCO_2e$ per year from 2005 to 2015 is added to the atmosphere due to diversion of forestland and other developmental purposes. In this assessment, ten policies and programmes for the state of Gujarat have been analyzed to assess the impacts of climate change and quantify the mitigation of Greenhouse Gas (GHG) from Agriculture, Forestry and Other Land Use (AFOLU) sector the criteria for which has been discussed in the subsequent sections (refer section 1 and 2 for further details).
- This evaluation makes an attempt to assess the data needs required to evaluate or measure the benefits or harm that accrues to the climate due to the implementation of the policies and

programmes being evaluated. Secondly, this evaluation could form the basis that would allow the State to make decisions regarding continuing the implementation of policies that may not have a positive impact on climate change due to their overwhelming social and/or environmental benefits or make changes in the design of these policies in order to minimize or eliminate the harm that their continuing implementation may cause to the climate.

Waste Sector

- 11 programmes, schemes, and missions implemented in the state of Gujarat for the Waste sector over 2005 to 2015 have been assessed, primarily related to solid waste and domestic wastewater treatment and discharge[1]. Methane (CH_4) emissions from municipal solid waste have been reduced by 228 tonnes of carbon dioxide equivalent (tCO_2e) per year due to increased processing as of 2015, with 1,167 tonnes of solid waste vermi-composted per day through 93 new vermi-composting facilities constructed across the state over the period from 2007 to 2015.
- For domestic wastewater, implementation of actions including construction of household level and community toilets and construction of sewage treatment plants (STPs) are estimated to result in additional CH_4 emissions of about 660,489 tCO_2e annually. Over 3.8 million individual household latrines (IHHLs) and about 1,500 million liters per day (MLD) of sewage treatment capacity have been constructed through the programmes and schemes, and are thereby expected to have resulted in associated social, environmental and economic benefits.

Key Findings

The key findings of this exercise are provided below:

Energy Sector

- Owing to policies implemented in boosting renewable energy installations (except large hydro) , around 33 $MtCO_2e$ was saved between 2005 and 2015. It is important to note that 217 MW of solar and wind installations were already in operation before 2004-05. In addition, 59 $MtCO_2e$ was saved due to electricity generated from large hydro and nuclear, which are not directly linked to any state-specific policies. That said, these fossil-free fuel resources played a pivotal role in decarbonising the state electricity sector.
- National policies in power sector related to distribution (Ujwal DISCOM Assurance Yojana (UDAY) Scheme and Restructured Accelerated Power Development and Reforms Programme (R- APDRP)) accounted for 7.5 $MtCO_2e$ of savings in energy sector int the 2005-2015 period. These are primarily due to efforts made in minimising transmission and distribution losses.
- The GHG impact of BRTS (0.57 $MtCO_2$) is estimated to be minimal, in comparison with other decarbonisation efforts in the energy sector. Nonetheless, reduction in pollutants such as nitrogen oxides and particulate matter might show better results to quantify the impact of this policy.
- In the buildings sector, a total of 6.6 $MtCO_2e$ was saved, owing to initiatives anchored by the central government viz; LED bulb distribution and penetration of efficient appliances.

[1] Industrial wastewater has been excluded due to limited availability of information in the public domain on implementation of actions, specific to industry sectors that generate organic wastewater, to be able to evaluate impacts

IPPU Sector

- Out of the eight polices and/or mitigation actions assessed in total, GHG reduction impacts have been estimated from 3 of them – RTS, PAT Cycle 1 Scheme, and CDM. Overall, around 13.5 $MtCO_2e$[2] is the estimated GHG reduced from these three polices and/or mitigation actions assessed.
- The emissions reductions are provided for different time periods when the schemes are implemented. An estimated 0.022 $MtCO_2e$ emissions reduced from industrial RTS Scheme. The scheme was implemented in 2012 and emission reductions are estimated for 2012 till 2015. The implementation of PAT Cycle I (2012-2015) resulted in nearly 2.28 $MtCO_2e$ emission reduction. While, CDM projects from the state, during 2005 – 2015, contributed to 11.16 $MtCO_2e$ emission reductions.
- Manufacturing schemes like Technology and Quality Upgradation Support to MSMEs (TEQUP) and Credit Linked Capital Subsidy Scheme (CLCSS), and subsidies towards quality certification (ISO 9000) indirectly contributed to GHG mitigation (GoG, 2016-2017) (PIB, 2019) However, due to unavailability of information the emissions savings was not estimated.
- Most of the GHG mitigation arises from polices and/or mitigation actions post the 2010 period. For instance, RTS is assessed till 2015, and PAT Cycle I fall between 2012 and 2015. Hence, despite the rising emission intensity of industries during 2005 to 2011, mitigation actions have been able to reduce the energy intensity of the sector during the latter half.
- Coal remained the dominant source of energy while natural gas penetration levels remained low in the state even with the advent of the LNG Terminal Policy 2012. Lack of sustained supplies of cheaper domestic gas has been a serious bottleneck in expanding the gas-based production capacity especially for an energy intensive sector like iron and steel(Sen, 2015). Currently, there are only 2 gas-based production facility operational - Essar steel (Hazira) and JSW (Dolvi and Vijayanagar) in the country.

AFOLU Sector

- The feed and fodder Development Programme as well as the Cattle and Buffalo Development Programme (Agriculture, Farmers Welfare and Co-operation Department 2019) are the two active programmes focusing on the livestock category in Gujarat and are governed by the Directorate of Animal Husbandry, Agriculture, farmers Welfare and Co-operation Department, Government of Gujarat. The data required to make qualitative or quantitative judgement regarding the impact of the policy was not available in public domain and thus could not be evaluated. However, the information gaps have been mentioned in table 1.

- Further, the active policies and programmes for Land sub-sector assessed in the present study fall under the governance of the Forest Department of Gujarat and are namely, Social forestry scheme, Soil and Moisture Conservation, and the Wildlife Protection Act, 1972 which collectively removed nearly, 133.99 $MtCO_2e$ of GHGs per year. As per Forest Conservation Act, 1980, there was a diversion of 8444.53 ha of land for the purpose of irrigation, agriculture, construction of roads and transport lines, establishment of townships etc. which led to a decrease in the carbon removals leading to an approximate annual escape of 0.21 $MtCO_2e$ GHGs.

- Under the third category called the Aggregate sources and non-CO_2 emission sources on Land, the National Food Security Mission has been analyzed. This mission governed by the Agriculture,

[2] Million tonnes of CO_2eq with AR2 GWP values

Farmers Welfare & Co-operation Department, Government of Gujarat. A comprehensive analysis of this missions indicates that a total of 1666.03 tCO_2e of GHGs were added to the emissions due to this scheme. Another scheme analyzed for this sub-sector was the Soil Health Card (also implemented by the Agriculture, Farmers Welfare & Cooperation Department). However, the data required to make qualitative or quantitative judgement was not available and thus the impact of this scheme could not be evaluated. However, the information gaps have been rightly mentioned in table 1 below.

- Two of the policies/programmes analyzed in the present study fell under the cross-cutting category. First was the National Mission on Micro Irrigation which was implemented by the Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat. It was observed that the enforcement of this scheme led to an average emission of 5760.29 tCO_2e of GHGs per year into the atmosphere. The other scheme under this category was the much recent Pradhan Mantri Ujjawala Yojana governed by the Ministry of Petroleum and Natural Gas. According to the present analysis, this scheme led to a reduction annual GHG emissions by 2.31 $MtCO_2e$ due to decrease in the usage of fuelwood.

Waste Sector

- While it is seen that GHG emissions have increased by 660,489 tCO_2e on annual basis as of 2015 due to improvements in domestic wastewater collection and treatment infrastructure, implementation of this action also delivers positive impacts in terms of cleanliness, sanitation, hygiene, land and water pollution, public health, and quality of life. The increase in GHG emissions should be viewed in light of the scale of infrastructure implementation and the peculiarity of improved wastewater collection and treatment systems having relatively higher CH_4 generation potential as compared to that in the absence of such systems.
- Opportunities exist to promote low carbon infrastructure creation and yield lower GHG emissions while delivering intended goals of the policies and programmes. Adoption of low emission solutions such as anaerobic treatment methods with CH_4 recovery in wastewater treatment plants can result in multiple benefits including clean energy generation locally through biogas or methane use, GHG emission reduction, and lower sludge disposal (Global Methane Initiative, 2013).
- There is a need to strengthen processes for data reporting and archiving to accurately and consistently capture requisite year-on-year information in order to better evaluate mitigation impacts of policies and actions within a given timeframe. Gaps were observed in the quality and availability of data available over the assessment period across the programmes, schemes and missions, which limited further comprehensive and collective assessment of impacts.

Table 1: Summary of policies and/or mitigation actions assessed and GHG emissions impact

Energy Sector		
No. of policies and/or mitigation actions (Total)	**8**	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**53.11 $MtCO_2e$ (2005-2015)**	
Policy/Programme/Mitigation Action	**Current Status**	**GHG Impact/ Data required to calculate the Impact**
Installation of solar power plants	Under implementation	4.44 $MtCO_2e$(2009-2015)
Installation of wind power plants	Under implementation	28.16 $MtCO_2e$ (2007-2015)
Installation of rooftop solar plants	Under implementation	0.09 $MtCO_2e$(2015)
Improvement of T&D infrastructure	Under implementation	7.48 $MtCO_2e$(2005-2015)
Improvement of plant efficiency (thermal power plants)	Under implementation	5.65 $MtCO_2e$(2012-2015)
Bus Rapid Transit System (BRTS) Ahmedabad	Under implementation	0.57 $MtCO_2e$(2007-2015)
Unnat Jyoti by Affordable LEDs for All (UJALA) scheme	Under implementation	2.01 $MtCO_2e$ (2007-2015)
Standards and Labelling programme	Under implementation	6.66 $MtCO_2e$ (2007-2015)
IPPU		
No. of policies and mitigation actions (Total)	8	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**13.5** $MtCO_2e$ **(from 3 PMIs assessed)**	
Brief description of policy and/or mitigation action	**Current status at the time of report preparation [e.g. adopted, under implementation, implemented, completed]**	**Impact - GHG emission reduction, in ($MtCO_2e$) over a given time**
Industrial Energy use & IPPU		
Rooftop Solar Scheme 2012	under implementation	0.022 $MtCO_2e$
PAT Cycle I	Completed	2.28 $MtCO_2e$
Clean Development Mechanism	under implementation	11.16 $MtCO_2e$
LNG Terminal Policy 2012	under implementation	Not estimated due to lack of data
Interest Subsidy for technology upgradation	under implementation	Not estimated due to lack of data
Subsidy for quality certification (ISO 9000)	under implementation	Not estimated due to lack of data
Technology and Quality Upgradation Support to MSMEs (TEQUP)	under implementation	Not estimated due to lack of data
Credit Linked Capital Subsidy Scheme (CLCSS)	under implementation	Not estimated due to lack of data
AFOLU		
No. of policies and/or mitigation actions (Total)	**10**	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**Data required to calculate the GHG emissions of all polices was not available in continuation from 2005 to 2015 therefore it is not applicable. However, an indication of the annual GHG emissions and removals due to these policies has already been provided in the text above.**	

Policy/Programme/Mitigation Action	Current Status	GHG Impact/ Data required to calculate the Impact
Feed and Fodder Development Programme	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Quantity of feed additives added to the fodder • Quantity of Green fodder provided to the animals • Details of the target population • Improved emission factors due to better feed intake
Cattle and Buffalo Development Programme	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Details of the target population • Improved emission factors due to better feed intake
Social Forestry Scheme	under implementation	-51724908.24tCO_2e[3]
Soil & Moisture Conservation (SMC)	under implementation	-90743397.51tCO_2e[4]
Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	under implementation	-2322555.38tCO_2e[5]
Wildlife Protection Act, 1972	under implementation	-121249089.39tCO_2e[6]
Soil Health Card	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Actual Area covered under the scheme • Actual Reduction in the fertilizer usage due to the scheme
National Mission on Food Security	under implementation	8330.13tCO_2e[7]
Waste		
No. of policies and/or mitigation actions (Total)	11	
Policy/Programme/Mitigation Action	**Current Status**	**GHG Impact/ Data required to calculate the Impact**
Municipal Solid Waste Management Project	Under implementation	-228 tCO_2e per year as of 2015
Total Sanitation Campaign	Completed	+121,227 tCO2e per year as of 2010
Nirmal Bharat Abhiyan (Clean India Campaign)	Completed	+137,286 tCO_2e per year in total as of 2014
Integrated low cost sanitation scheme	Completed	+6,438 tCO_2e per year as of 2007
Nirmal Gujarat Sauchalaya Yojana	Ongoing	+5,752 tCO_2e per year as of 2010

[3] Refer to Annexure 1 for assumptions and calculation method.
[4] Refer to Annexure 1 for assumptions and calculation method.
[5] Refer to Annexure 1 for assumptions and calculation method.
[6] Refer to Annexure 1 for assumptions and calculation method.
[7] Refer to Annexure 1 for assumptions and calculation method.

Pay and Use Toilet Scheme	Ongoing	+17,107 tCO_2e per year as of 2015
UIG Scheme	Completed	+243,799 tCO_2e per year as of 2015
UIDSSMT	Completed	• Envisaged to have led to additional GHG impact as seen in other similar programmes while resulting in positive impacts in terms of cleanliness, sanitation, hygiene, pollution and health • Information needed to quantify GHG emissions impact incudes ○ Year-wise information on sewage treatment capacity constructed through STPs from 2005 to 2014 Details of the type of treatment system (aerobic/anaerobic) in the new STPs
National river conservation programme	Under implementation	+66,618 tCO_2e per year as of 2017
Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	Under implementation	+38,884 tCO_2e per year as of 2014
Mahatma Gandhi Swachata Mission, Gujarat	Under implementation	+23,379 tCO_2e per year as of 2015
Cross-cutting		
National Mission on Micro Irrigation	Under implementation	-46082.31 tCO_2e[8]
Pradhan Mantri UjjwalaYojna	Under implementation	-6938074.95 tCO_2e[9]

<u>Note</u>: Under GHG emissions impact, negative emission figures denote a decrease in GHG emissions due to policy action as compared to the baseline. Positive emission figures denote an increase in GHG emissions due to the policy action as compared to the baseline.

[8] Refer to Annexure I for assumptions and calculation method.

[9] Refer to Annexure I for assumptions and calculation method.

1. Setting the context

On one hand, this exercise has been conducted to measure the actual impacts of governmental policies, programmes, schemes, missions etc. that are being implemented for mitigating climate change. On the other hand, this exercise is also making a small beginning to try and gauge the impacts on climate of activities that may not have a specific focus on dealing with climate change, but nevertheless have an effect upon it.

For this purpose, we have tried to collect information regarding the various governmental policies, programmes, schemes, missions etc. and their implementation that is available in the public domain, and then made an attempt to try and quantify the impacts on the climate wherever possible. This also includes identifying specific indicators that we have tried to use for making our assessment. Wherever, we have not been able to quantify such impacts, we have highlighted the data that would be required to do so. The rationale is that ideally, all policies being implemented by the government, irrespective of whether their primary objective is to deal with climate change or not, ought to be judged, among other aspects, on whether they have a positive or negative impact on climate change. Wherever there are negative impacts of a policy or programme on climate change, policy makers can exercise the choice. If the social and other environmental impacts of such policies are positive, to continue to implement them either as they are or with appropriate changes in the policy design. Such an evaluation is also essential in order to begin a systematic process of integrating climate change into governmental actions.

The key economic sectors that have been looked at include Energy, IPPU, AFOLU and Waste.

The state for which we decided to carry out this exercise was Gujarat, which has an economic structure that is comprehensive enough to cover all aspects of the analysis that we were intending to carry out.

Energy Sector

To ameliorate the impact of climate change, central and state governments implement policies that are often focused on crucial sectors. These policies collectively aim to minimise the impact either directly or indirectly. Direct impact refers to policies that focus mainly on reducing emissions that contribute to global warming and climate change. In case of indirect impact, sector-specific indicators take precedence over emissions-related indicators. In this context, this exercise evaluates policies that are implemented in Gujarat, and further quantifies the emissions (tCO_2e) that have been avoided. Based on the GHG platform's experience, the sectors are sub-classified into four sectors namely Energy, IPPU, AFOLU, and Waste. All the policies, implemented both by the centre and the state government of Gujarat, are considered in this exercise.

IPPU Sector

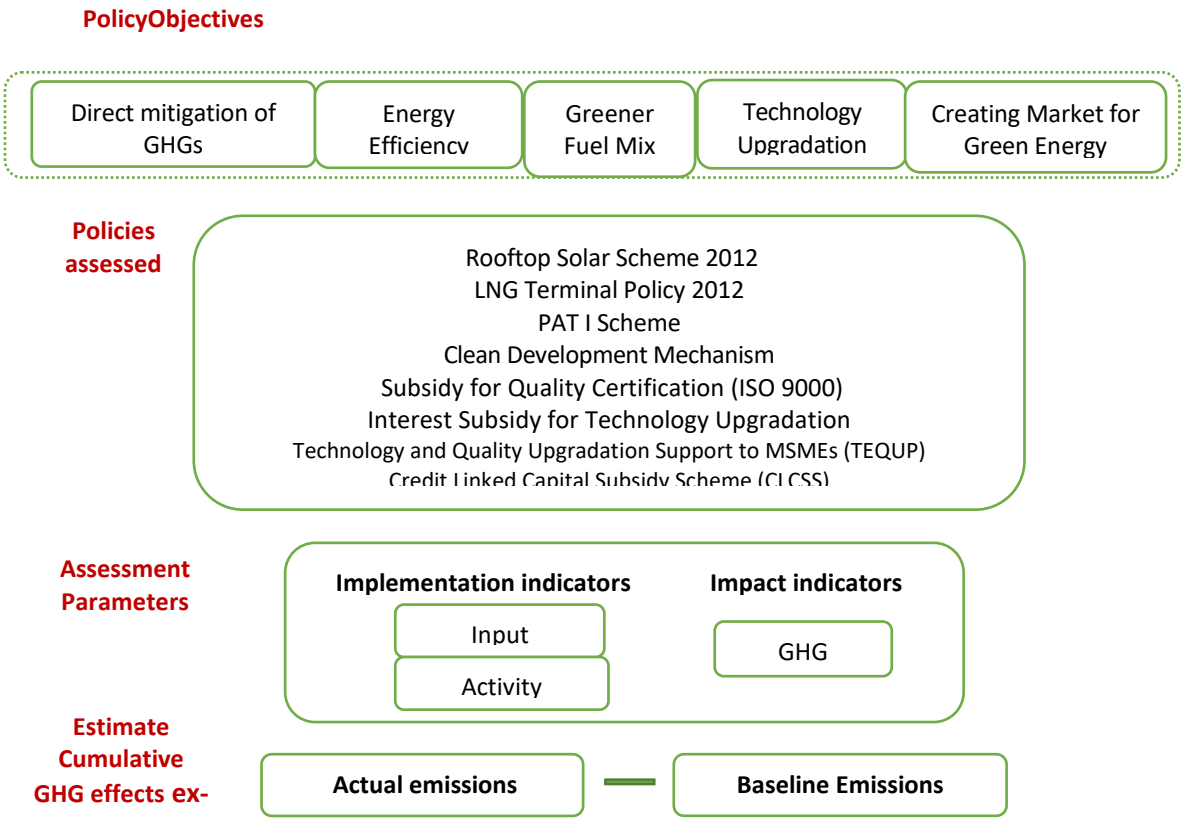
The study intends to sensitize officials from various line departments of Gujarat and numerous stakeholders ranging from industry, academia, civil society groups, about the impact of polices and/or mitigation actions implemented in the state in reducing the GHG emissions intensity of the manufacturing sector. Along with emissions reduction potential, the contribution of policies towards broader GHG reduction goals such as reducing energy intensity of the sector by adopting energy efficiency measures, utilizing cleaner techniques in production processes are taken into consideration for evaluation. Also, it provides recommendations on whether the ongoing mitigation efforts requires continuation, adjustment, expansion or implementation of additional policy measures. This study

provides answers to some of very pertinent questions around the role of polices and/or mitigation actions towards climate mitigation at sub-national level such as:

- What were the most relevant polices and/or mitigation actions implemented/introduced in Gujarat within 2005 – 2015 aimed at reducing emissions from industrial operations?
- How successful was the polices and/or mitigation actions in achieving impact? Are there any direct GHG mitigation and/or any co-benefits?
- What are key drivers influencing such polices and/or mitigation actions– structural change in the manufacturing Industry; energy efficiency measures; shift to cleaner fuels or improved supply infrastructure, etc.
- What could be the future options to further improve emissions intensity of manufacturing units in Gujarat?

Defining various parameters of the polices and/or mitigation actions is the initial step followed by identifying relevant parameters through which policies are compared and assessed. Subsequently, the impact of individual polices and/or mitigation actions is demonstrated with a sound evidence-based framework supported by both qualitative and quantitative assessments. The results are collectively analyzed to assess cumulative impacts of polices and/or mitigation actions from baseline emissions in finding overall effect throughout the monitored period. The key economic sectors that have been considered are the manufacturing sector and renewable. This assessment follows the framework shown in Figure 1.

Figure 1: Polices and/or mitigation actions assessment framework



Source: Authors' Analysis

Gujarat is one of the leading industrialized states in the country that has demonstrated a strong growth in economic activity during recent decades. GDP for the state (at current prices), grew at 14 per cent between 2011 - 12 and 2016 - 17 (RBI, 2019), higher than the national GDP growth rate of 12 per cent (RBI, 2019). The manufacturing sector had 32.6 per cent share in Gujarat's net state value added in 2016 - 17 (Reserve Bank of India, 2019). A combination of factors has spurred this swift growth – right policy support coupled with effective institutional arrangements and funding mechanisms for policy design and implementation has played a key role in facilitating these developments in the state. Gujarat contributes about 6 per cent to the country's total gas production (Energy & Petrochemicals Dept, 2017). The city gas distribution network in the state has extensive expansion with 4551 industrial connections to Piped Natural Gas (PNG) as on April 2018 (PPAC, 2019). The state has the single largest industrial connection, representing 60 per cent of the country's total industrial connections.

Nonetheless, high levels of industrial activity are associated with harmful emissions since burning of fossil fuels is a major source of industrial GHGs. Hence Gujarat, a highly industrialized state with ample policies implemented and one of the few states with high number of industrial DCs allotted in PAT Cycle I (37) forms an ideal model for policy evaluation.

AFOLU Sector

For the AFOLU sector, while there were no specific policies that are being implemented for the objective of climate change mitigation, we undertook an analysis of which policies, during the course of their implementation, would lead to either emissions or removal of greenhouse gases within the AFOLU sector. To the extent possible, we tried to quantify these emissions and/or removals. However, where such quantification was not possible due to gaps in data, we identified the specific data elements that need to collated during the course of policy implementation to make the required quantification of policy impacts possible and allow the decision makers to make informed choices regarding India's development pathway on the one hand as well as meeting the Country's NDC commitments on the other.

Waste Sector

On the one hand, this exercise has been conducted to gauge the actual impacts of governmental policies, programmes, schemes, missions etc. pertaining to waste sector that are being implemented for mitigating climate change. On the other hand, this exercise is also making a small beginning to try and gauge the impacts on climate of activities that may not have a specific focus on dealing with climate change, but nevertheless have an effect upon it. For this purpose, we have tried to collect information regarding the various governmental policies, programmes, schemes, missions etc. and their implementation, and then made an attempt to try and quantify the impacts on the climate wherever possible. This also includes identifying specific indicators that we have tried to use for making our assessment. Wherever, we have not been able to quantify such impacts, we have highlighted the data that would be required to do so. The rationale is that ideally, all policies being implemented by the government, irrespective of whether their primary objective is to deal with climate change or not, ought to be judged, among other aspects, on whether they have a positive or negative impact on climate change. Wherever there are negative impacts of a policy or programme on climate change, policy makers can exercise the choice, if the social and other environmental impacts of such policies are positive, to continue to implement them either as they are or with appropriate changes in their design. Such an evaluation is also essential in order to begin a systematic process of integrating climate change into governmental actions. This report captures the policy impact evaluation for the Waste sector. The state for which we decided to carry out this exercise was Gujarat, which has an economic structure that

is comprehensive enough to cover different sectors (Energy, IPPU, AFOLU, Waste) of the state-level policy impact evaluation analysis that the GHG Platform India intended to carry out. Gujarat is deemed to be one of the states in the country to have proactively implemented climate policies and actions across different sectors (The Climate Group, 2019). It was one of the first States to establish a dedicated Climate Change Cell for steering its climate change programmes and actions (IFMR Lead, 2017). Thereby, Gujarat was selected as the state for further investigation of the multi-sectoral policy impact evaluation to be undertaken under the GHG Platform India.

2. Coverage and Period

This document evaluates the impacts of implementation of policies, programmes, schemes, missions etc. that pertain to the Energy, IPPU, AFOLU and Waste sector in Gujarat.

The study covers three greenhouse gases – Carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). These three gases generally account for large share of GHG emissions. There are other greenhouse gases like hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6)and Nitrogen tetrafluoride (NF_3) with relatively high global warming potential; however, their total contribution is known to be very minuscular. The emissions have been reported in tCO_2e using the GWP values from the IPCC second assessment report[10].

Energy Sector

Gujarat is an industrial state located in western India, spanning 196244 sq.km in area[11], with a population of 60.4 million, as per the 2011 census. The policies, programmes, and schemes implemented in the energy sector in Gujarat are evaluated, and their impacts examined by calculating emissions avoided. The analysis estimated three major gases in the energy sector- carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). However, due to limited data, emissions from sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) and Nitrogen Tetrafloride (NF3) are not considered in this analysis. Some of the key sources that contribute to emissions from the energy sector include public electricity generation (PEG), buildings (residential and commercial), transport (vehicular emissions), agriculture (pumps and tractors), fisheries (fleets), and fuel production.

This exercise considers 2005-2015 as the time period to evaluate the impact of the policies. Some of the policies implemented in this time period remained active beyond 2015, or were amended at the end of the operative period, like the wind power policy. The rationale behind choosing 2005 is because it aligns with India's climate targets (Nationally Determined Contribution), which assume 2005 as the baseline year. The terminal year—2015 has been chosen to maintain consistency with current emission estimation activity under the GHG Platform India.

All relevant policies and schemes implemented are tabulated below. This table also provides information on the duration of the policy, administrative body, and information availability.

Table 2: List of policies with duration, administrative body and availability of information

Policy/Scheme	Source category	Policy duration	Administrative body	Lack of Information
Solar Power Policy 2009 (Energy and Petrochemicals Department 2009)	PEG	2009—2014	GEDA	Installed capacity targeted by end of policy period is not provided

[10] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_sar_wg_I_full_report.pdf

[11] https://gujecostat.gujarat.gov.in/sites/default/files/STATISTICAL%20OUTLINE-2017-FINAL-21917.pdf

Policy/Scheme	Source category	Policy duration	Administrative body	Lack of Information
Solar Power Policy 2015(Energy and Petrochemicals Department 2015)	PEG	2015—2020	GEDA	Installed capacity targeted by end of policy period is not provided
Wind Power Policy 2007 and Amendment to Wind Power Policy in 2009(Energy and Petrochemicals Department 2007, Energy and Petrochemicals Department 2009)	PEG	2007—2012	GEDA	Installed capacity targeted by end of policy period is not provided
Wind Power Policy 2013 (Energy and Petrochemicals Department 2013)	PEG	2013—2016	GEDA	Installed capacity targeted by end of policy period is not provided
Subsidy for Residential Rooftop Solar Plants-2016 (Energy and Petrochemicals Department 2016)	Decentralised power generation	2015[12]—2022	GEDA	To support installation of upto 20 MW. Electricity generation data is not available.
Integrated Power Development Scheme (IPDS)/R-APDRP (Power Finance Corporation Ltd 2019)	PEG	2008—till date	DISCOMS	Data not available
Ujwal DISCOM Assurance Yojana (UDAY) Scheme(MoP 2016)	PEG	2015—2019	DISCOMS	Not applicable
Perform Achieve Trade (PAT) cycle-1 scheme for thermal power plants	PEG	2012-2015	GEDA	Year-wise efficiency improvement data is not available for few plants
Unnat Jyoti by Affordable LEDs for All (UJALA)	Building	2015—Till date	Energy Efficiency Services Limited (EESL)	Target and end year not specified
Standards and Labelling Programme(BEE 2018)	Buildings	2006—Till date	Bureau of Energy Efficiency (BEE)	End year not specified
Bus Rapid Transit System (BRTS) (Department 2019)	Transport	2009 (Ph1); 2011 (Ph2)	Ahmedabad Janmarg Ltd.	Modal shift and Average ridership

[12]Subsidy scheme for RTPV is applicable for plants commissioned in 2015

Apart from these policies/regulations, few other regulatory actions indirectly contributed to reduction in GHG emissions during this period, such as Open Access Regulations 2011, Demand Side Management Regulations 2012 (GERC 2011). However, the impact of these policies was not analysed in this study due to the lack of data on hourly load curves, plant-wise open access sanctions and export data. Gujarat has also notified policies on small hydel and waste to energy power generating units post 2016.

IPPU Sector

This assessment includes polices and/or mitigation actions undertaken for the manufacturing sector of the state of Gujarat(refer Table 3). Also, cross-sectoral policies like the Rooftop Solar Scheme 2012, which plays a major role in emissions mitigation have been analyzed in the study. Market based mechanisms like PAT and CDM have been considered for the assessment as they have a direct impact on reducing the emissions intensity of the manufacturing sector. Although, the scheme is primarily implemented by non-state actors, it is essential to show the mitigation results in the state. However, the CDM scheme also consists of cross-sectoral interventions and, only those that focus solely on fuel switch or energy efficiency processes are considered in the assessment. These schemes have been assessed across 11 industrial sub-sectors for the period 2005 to 2015. Due to unavailability of reliable information, petroleum refinery, mining and quarrying, construction, manufacture of solid fuels and other energy industries are excluded from the assessment.

The energy and emissions estimates represent both primary and secondary form of energy consumed by the industries (including energy consumed for on-site energy transformation). Emissions represent CO_2, CH_4 and N_2O, and AR2 GWP values have been used to convert to the carbon dioxide equivalents. These three gases collectively account for a large share of emissions from India. The IPCC 2006 guidelines do mention about other gases have very high levels of global-warming potential (GWP) such as hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride etc. (also collectively known as F-gases). This study does not cover these F-gases as their total contribution is known to be very small (or unmeasured) in India for the period under investigation.

Table 3: Types of Policy Instruments of IPPU sector assessed in this study and Time Period

Policies and Mitigation Actions in Gujarat	Policy/scheme Initiating on or before 2005	Year of Initiation if Policy/scheme was initiated after 2005	Year(s) for which information was available for evaluation
LNG Terminal Policy 2012	No	2012-ongoing	NA
Rooftop Solar Scheme 2012	No	2012- ongoing	2014 onwards
PAT Scheme (Cycle I)	No	2012-2015	2012-2015
Clean Development Mechanism	Yes	2004-ongoing	2004-2005 onwards

Policies and Mitigation Actions in Gujarat	Policy/scheme Initiating on or before 2005	Year of Initiation if Policy/scheme was initiated after 2005	Year(s) for which information was available for evaluation
Interest Subsidy for technology upgradation	Yes	2004-ongoing	2004-2005 to 2014-2015
Subsidy for quality certification (ISO 9000)	Yes	2004- ongoing	2004-2005 to 2014-2015
Technology and Quality Upgradation Support to MSMEs (TEQUP)	No	2010-ongoing	2010-2011 onwards
Credit Linked Capital Subsidy Scheme (CLCSS)	Yes	2000-ongoing[13]	2011-2012 to 2014-2015

Source: Authors' compilation

AFOLU Sector

Most of the assessment in this document deals with policies, schemes, missions, programs, regulations and acts originating prior to 2005 and continuing. Notably, Pradhan Mantri Ujjwalla Yojna which was launched in 2016 has also been included in this assessment. However, the evaluation has only been done for the years for which the data was available publicly or through RTI. A snapshot of the data and the timeframe for which this data was available is provided in the table below:

Table 4: Snapshot of the AFOLU data and the timeframe for which this data was available

Policy Name	Policy Initiating on or before 2005	Year of Initiation if Policy was initiated after 2005	Year(s) for which information is available for evaluation
Fodder and Feed Development Programme	Yes	-	NA
Cattle and Buffalo Development Programme	Yes	-	NA
Social Forestry Scheme	Yes	-	2005-06 to 2015-16
Soil & Moisture Conservation (SMC)	Yes	-	2015-16
Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	Yes	-	2005-06 to 2015-16
Wildlife Protection Act, 1972	Yes	-	2005-06 to 2015-16
Soil Health Card	No	2015	NA
National Food Security Mission	No	2007-08	2007-08 to 2011-12
National Mission on Micro irrigation	Yes	-	2005-06 to 2012-13
Pradhan Mantri Ujjwala Yojna	No	2016	2016 to 21.04.19

Note: NA – Not Available

[13] http://www.dcmsme.gov.in/schemes/Faqs.pdf

Waste Sector

This document evaluates the impacts realized through implementation of policies, programmes, schemes, and missions related to the Waste sector in Gujarat.. The geospatial boundary of this impact evaluation for the Waste sector is limited to the state of Gujarat in India, spanning a geographical area of 196,024 sq. km and housing a population of 60.4 million as of 2011 (Government of Gujarat, 2019). In terms of GHG emissions impacts, CH_4 gas which is of relevance to the Waste sector has been included in the assessment. GHG emissions have been reported in tonnes of CO_2e using the GWP values from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report[14].

The sub-sectors/source categories of 'Solid waste disposal' and 'Domestic Wastewater treatment and discharge' are included in this assessment. The source category of 'Industrial wastewater treatment and discharge' has been excluded since publicly available information is insufficient to understand level of activity and actions specific to industry sectors that generate organic wastewater and thereby evaluate impacts. Though discussions have been undertaken with the Gujarat Pollution Control Board (GPCB), we have been unable to secure any information to enable analysis on industrial wastewater.

The time period considered for the impact evaluation in this document is from 2005 to 2015. The initial year has been selected as 2005 to align with India's NDC under the Paris Agreement, 2016, which targets reducing the emissions intensity of its GDP by 33–35% by the year 2030 as compared to that in the base year of 2005 (GoI, 2016). The latest emissions estimates (version 3.0) prepared under the GHG Platform India initiative extend up to 2015 and thereby the impact evaluation spans until the same year.

The impact evaluation covers policies, programmes, schemes, and missions that originated prior to 2005 and during the time period of 2005-2015, and which completed implementation before 2015 as well as ones which continue to be implemented post 2015. A summary of the policies considered in the analysis, their period of implementation, and timeframe for which data to carry out impact evaluation was available is provided in Table 5.

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Smart Cities Programme are two large scale programmes that were launched by Government of India in June 2015. Implementation of both these infrastructure programmes is expected to have notable implications on solid waste and wastewater management and associated impacts across Indian states. However, given that these two programmes were rolled out towards the end of our assessment period and focused on development of proposals and plans in their initial stages, they have not been considered in this analysis since implementation of actions would primarily happen post year 2015 (i.e. outside the assessment period).

This policy analysis for the Waste sector was carried out based on secondary research including available reports from Central Pollution Control Board and GPCB, and literature on the central and state government schemes pertaining to waste sector and policy/scheme official websites. Officials from GUDC Limited were also consulted to get additional information and clarification on certain programmes and their assumptions – based on which some key assumptions were made.

[14] Available at https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_sar_wg_I_full_report.pdf

Table 5: Snapshot of Waste Sector policies/programmes considered and the timeframe for data availability

Policy and/or Mitigation Action Name	Policy/programme action initiating prior to 2005	Year of Initiation if Policy was initiated on or after 2005	Year of completion (if policy ended prior to 2015) or continuing post 2015	Year(s) for which information was available for evaluation between 2005-2015
Municipal Solid Waste Management Project	No	2005	Continuing	2007-2015
Total Sanitation Campaign	Yes	1999	2012	2005-2010
Nirmal Bharat Abhiyan or Clean India Campaign	No	2012	2014	2012-2014
Integrated low cost sanitation scheme	Yes	1980	2007	Aggregate until 2007 (from 1980 onwards)
Nirmal Gujarat Sauchalaya Yojana	No	2008	Ongoing	2008-2010
Pay and Use Toilet Scheme	No	2005-2006	Ongoing	2005-2015
Urban Infrastructure and Governance (UIG) Scheme	No	2005	2014	2005-2014
Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT)	No	2005	2014	2005-2014
National river conservation programme[15]	Yes	1985	Continuing	Aggregate until 2017 (from 1995 onwards)
Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	No	2009	Continuing	2009-2015
Mahatma Gandhi Swachata Mission, Gujarat	No	2014-15	Continuing	2015-16

[15] The river cleaning programme in the country initiated with the launching of the Ganga Action Plan in 1985. The Ganga Action Plan was expanded to cover other rivers under the National River Conservation programme in the year 1995 including the state of Gujarat.

3. Evaluation of policies and/or climate mitigation actions

The sections that follow, we provide details of the policies that have been considered for this analysis and the indicators that were identified to make an assessment of their impacts on climate change mitigation:

Energy Sector

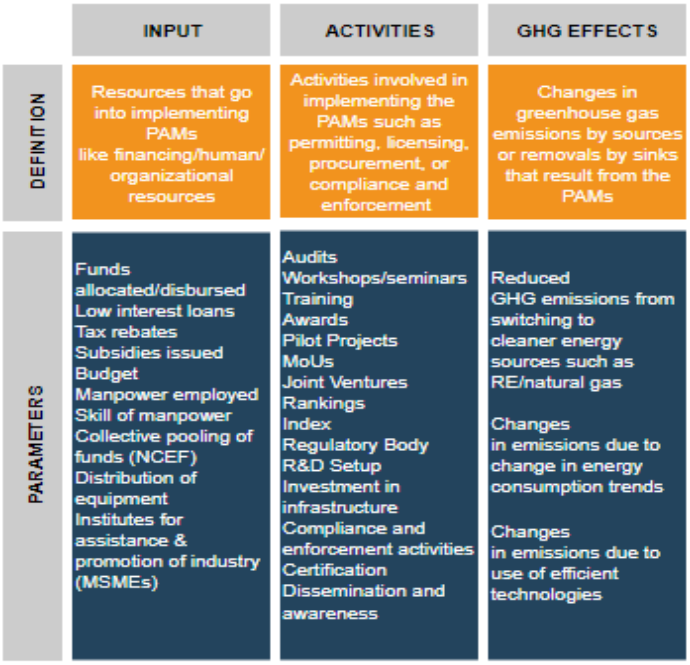
This section provides a list of policies and climate mitigation actions taken up by the government of Gujarat. National policies relevant to this exercise are sourced from respective line ministries and departments such as the Ministry of New and Renewable Energy (MNRE), Ministry of Power, and the Ministry of Road Transport and Highways. State-specific policies are obtained from respective state departments and agencies such as Gujarat Energy Development Agency (GEDA), Gujarat Urja Vikas Nigam Ltd. (GUVNL), Gujarat Power Corporation Ltd. (GPCL), and State Transport Department. For the calculation of emission reduction in the residential sector through Unnat Jyoti by Affordable LEDs for All (UJALA) scheme, launched on 1 May 2015, the number of LED bulbs sold during May to December 2015 has been considered. Data required to estimate emissions avoided are obtained from publications in the public domain, such as the annual reports and statistical books.

The section highlights the budgetary allocation made for each sector and polices (selective). Table 6 contains data on financial indicators compiled from published government reports and other documents to understand expenditures earmarked against each of these policies. In addition, table 6also provides data on indicators (activity-based) used to measure the implementation of these policies. For example, policies implemented in power sector often assume megawatts (MW) of installed capacity, using which, the targets are devised.

IPPU Sector

Three parameters are identified for this assessment to measure the effectiveness of polices and/or mitigation actions in mitigating GHG emissions. These indicators are a combination of qualitative and quantitative elements that provide a sense of the impacts, as well as explain processes and interventions that drove policy outcomes. Figure 2 shows assessment parameters and sub parameters for a detailed comprehensive picture based on which the polices and/or mitigation actions are assessed.

Figure 2: Assessment Parameters for Evaluating polices and/or mitigation actions and examples



Source: Authors' compilation

The tables that follow, provide details of the policies that is analyzed through the indicators identified to make an assessment. Various inputs that have gone into the policies assessed for this analysis is shown in Table 6. The activity indicators, are listed in Tables 7 and impact indicators are listed in Annexure 1, table 12. Table 8 gives sector wise policies and/or mitigation actions/outcomes; and table 10 provides a detailed analysis of polices and/or mitigation actions assessed.

Table 6: List of policies and input indicators under all the sectors

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
Finance					
Energy	Assistance for renewable energy installations	Assistance for providing solar -based decentralized electrification in remote areas and grid-connected distributed solar power pilot projects on agriculture and wasteland	GEDA	Allocated INR 70 crores in 2015-16	As published in 'Budget Estimates of Energy and Petro-chemicals Deapartment for 2015-16' https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_588_2015-2-24_643.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
	Solar Green Projects	Financial assistance to support installation of grid-connected solar power plant and RTPVs	GEDA	Allocated INR 29 crores 2012-13, INR 31 crores in 2013-14, INR 40 crores in 2014-15 and INR 42 crores in 2015-16	As published in 'Budget estimates of Climate Change Department for 2014-15'https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_452_2014-5-6_853.pdf As published in 'Budget estimates of Climate Change Department for 2015-16' https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_621_2015-2-24_545.pdf
	Solar City - Gandhinagar Project	Financial assistance to support installation of grid-connected solar power plant	GEDA	Allocated INR 5 crores in 2008-09 and INR 28.6 crores in 2013-14	As published in'Gujarat Energy and Petrochemicals department 2008-09 budget estimates' https://financedepartment.gujarat.gov.in/Documents/Bud-Guj_249_2014-2-18_799.pdf 'Climate Change department budget estimates 2013-14' https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_35_2014-2-13_227.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
	Assistance for renewable energy installations	Financial assistance to support renewable energy installations	GEDA	INR 10.65 crores in 2012-13, INR 11.25 crores in 2013-14 and INR 21 crores were allocated in 2014-15	As published in 'Climate Change department budget estimates' 2014-15 https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_452_2014-5-6_853.pdf
	Solar Power Policy 2009	Investment resulted with introduction of Solar power policy-2009	Energy and Petrochemical-s Department, Government of Gujarat	Resulted in solar power projects worth INR 9000 crores between 2009 –2015	As published in 'Solar power policy-2015' (Energy and Petrochemicals Department 2015) https://www.gseb.com/DownloadFiles/File/GUVNL/Gujarat%20Solar%20Power%20Policy%202015.pdf
	PAT scheme	Share capital contribution to GUVNL for new initiative in R & M of GSECL Power Plants	GUVNL	Allocated INR 215 crore in 2015-16	As published in 'Budget Estimates of Energy and Petro-chemicals Department for 2015-16 https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_588_2015-2-24_643.pdf
	UDAY scheme	Share capital contribution to GUVNL for shifting / replacement of poles and distribution lines	Energy and Petrochemical-s Department, Government of Gujarat	Allocated INR 100 crore in 2015-16	As published in 'Budget Estimates of Energy and Petro-Chemicals Department for 2015-16' https://financedepartment.gujarat.gov.in/Documents/Bud-Eng_588_2015-2-24_643.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
	Rural and Urban Developmen-t Project	Plan expenditure on road transport	Urban Development Department, Ports and Transport Department, Government of Gujarat	INR 1513.95 Crore-plan expenditure for development of road transport between 2004-05 and 2015-16	As published in the Basic Transport Statistics of Gujarat 2016-17 https://gujecostat.gujarat.gov.in/transports-branch
	Bus Rapid Transit System (BRTS) - Ahmedabad	Approved cost	Ahmedabad Janmarg Limited	INR 493 Crore for the first Phase and INR 488 Crore in the second	https://www.carbonn.org/uploads/tx_carbonndata/File1_AHMEDABAD%20BRTS.pdf
Budgetary allocation support/expenditure on schemes					
IPPU (Manufacturing)	**LNG Terminal Policy 2012**	Investment for building up of LNG Terminal	Energy and Petrochemicals Department	LNG terminal developed with an investment of Rs 50.41 billion ($730m), funded through a combination of debt and equity financing. The project received Rs. 35.287 billion ($560m) in funding from a group of 11 Indian banks in April 2015	https://guj-epd.gujarat.gov.in/uploads/LNG_Terminal_policy_2012.pdf https://www.hydrocarbons-technology.com/projects/mundra-lng-terminal/
Manufacturing	**Clean Development Mechanism**	Finance allocated CDM Projects as of 2012 on a national scale	National Clean Development Mechanism Authority (NCDMA)	From the 3000 projects implemented in the country as of 2012 represent an estimated investment of over Rs. 1.6 trillion since its inception in 2004	http://ncdmaindia.gov.in/ViewPDF.aspx?&pub=2.pdf
Manufacturing	**Credit Linked Capital Subsidy Scheme**	Total Expenditure in Rs. Lakhs till December 2017 (national figures and no figures found for State level	Small Industries Development Bank of India (SIDBI)/National Bank for Agriculture and Rural	At a national level, a total expenditure of Rs. 283,444.16 lakhs were reported till December 2017.	https://msme.gov.in/sites/default/files/MSME-AR-2017-18-Eng.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
			Development (NABARD)	However, disaggregated data at the state level could not be found.	
Manufacturing	**TEQUP**	Amount sanctioned and expenditure incurred in scheme	Scheme presently under direct benefit transfer cell	Rs. 1,57,500 is the amount sanctioned and Rs. 1,07,370 is the expenditure incurred for scheme in Gujarat during 2016-2017	http://dcmsme.gov.in/ANNUAL_REPORT_2016_17/Annual%20Report%20Ahmedabad.pdf
Financial Incentive (subsidies/tax/loan)					
Manufacturing	**PAT Scheme Cycle I (2012-2015)**	ESCerts serve as a financial incentive for those DCs who surpass their energy efficiency target	Administrator (BEE) Registration (POSOCO) Trading Platform ((PXIL, IEX)	From the M&V report submitted under PAT cycle I in Gujarat, it is found that around 5,51,669.6 nos. of ESCerts (Energy Savings Certificates) have been generated by 40 DCs in the state.	CCD, GoG, https://ccd.gujarat.gov.in/energy-conservation-inner.htm
Manufacturing	**Clean Development Mechanism**	Certified Emissions Reduction Credits (CERs)[16] can be generated from CDM projects and trades/sold to earn emission reduction targets	National Clean Development Mechanism Authority (NCDMA)	The state has earned Rs. 12.63 crore CER credits	CCD, GoG, https://ccd.gujarat.gov.in/mitigation-initiatives.htm#cerc
Manufacturing	**Interest Subsidy for technology modernization /upgradation**	Interest subsidy provided for technology modernization/upgradation	Industries & Mines Department	- Interest Subsidy provided amounts to Rs. 140,708.22 lakhs for 79314 no of units from year 2004 -2005 to 2014-2015	Industries in Gujarat Statistical Information – 2014 – https://ic.gujarat.gov.in/documents/pagecontent/INDUSTRIES-INGUJ-2014-report.pdf https://ic.gujarat.g

[16]equivalent to one tonne of CO_2

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					ov.in/interest-subsidy-year-2014-15.aspx
Manufacturing	**Subsidy for Quality Certification (ISO 9000)**	Subsidy for Quality Certification (ISO 9000)/	Industries & Mines Department	Subsidy for Quality Certification (ISO-9000) amounts to Rs. 10385.84 lakhs for 4489 no of units from time period of 2004 -2005 to 2014-2015	Industries in Gujarat Statistical Information – 2014 – https://ic.gujarat.gov.in/documents/pagecontent/INDUSTRIES-INGUJ-2014-report.pdf https://ic.gujarat.gov.in/interest-subsidy-year-2014-15.aspx
Renewable	**Rooftop Scheme 2012**	Tax rebate for supporting rooftop solar	GEDA, Govt. of Gujarat	Tax rebates on accelerated depreciation of 40 per cent for rooftop solar systems for industrial segment	http://icrier.org/pdf/Working_Paper_353.pdf
Renewable	**Rooftop Scheme 2012**	Low cost loan scheme for grid-connected RTS	IREDA	In July 2015, IREDA launched a low-cost loan scheme for grid-connected RTS with loan interest rate per annum of 9.90 per cent– 10.75 per cent. Although this data is from Surat Municipal Corporation it is assumed that the rate is applicable to the whole of Gujarat	Surat Municipal Corporation http://suratsolar.suratmunicipal.gov.in/Financ.aspx
Manufacturing	**CLCSS**	Subsidy provided for CLCSS in Gujarat	NABARD/ SIDBI	In the state, a total subsidy of Rs.42,847.3 lakhs were provided for 7571 units from 2011-2012 to 2014-15	http://pib.nic.in/newsite/mbErel.aspx?relid=116585

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
Manufacturing	**TEQUP**	Reimbursement of National/ International Product Certification	Scheme presently under direct benefit transfer cell	The total amount sanctioned was Rs 80 lakh for 2012-2013, and Rs 25 lakh for 2014-2015 While, the total amount disbursed was Rs. 74,66,720 in 2012-2013, and Rs. 23,89,195 in 2014-2015	http://dcmsme.gov.in/ar-12-13/ANNUAL%20REPORT-Final-Ahmedabad-2012-13.pdf http://dcmsme.gov.in/ANNUAL_REPORT_2014_15/anual%20report_ahemdabad.pdf
Manufacturing	**LNG Terminal Policy 2012**	Subsidies provided under the policy	Energy and Petrochemicals Department	No data found for the specific indicator	
Human Resources					
Manufacturing	**PAT Scheme Cycle I (2012-2015)**	Human resources input into scheme (national figures)	BEE	Capacity building on a national level (state level figures not available): - 13718 Energy Auditors and Managers certified - 219 Energy Auditors accredited - 53 empaneled accredited energy auditors Capacity building of over 5000 engineers and operators	https://www.beenet.gov.in/GuideLine/Bhubaneswar/Overview%20of%20PAT%20Scheme.pdf https://beeindia.gov.in/sites/default/files/Approved%20List%20of%20Empanelled%20Accredited%20Energy%20Auditor%20Firms%20for%20PAT%20M&V%20%20(1).pdf
Manufacturing	**TEQUP**	No of beneficiaries under TEQUP scheme in state	Scheme presently under direct benefit transfer cell	Number of Product Certification Units MSME-DI Ahmedabad – 173 from 2010-2011 to 2015-2016	http://dcmsme.gov.in/msme%20di%20wise/MSME_DI_Ahemdabad.pdf
Manufacturing	**TEQUP**	No of participants in TEQUP programmes	Scheme presently under direct benefit transfer cell	156 participants (2012-2013) 204 participants (2014-2015) 234 participants (2016-2017)	http://dcmsme.gov.in/ar-12-13/ANNUAL%20REPORT-Final-Ahmedabad-2012-13.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					http://dcmsme.gov.in/ANNUAL_REPORT_2014_15/anual%20report_ahemdabad.pdf http://dcmsme.gov.in/ANNUAL_REPORT_2016_17/Annual%20Report%20Ahmedabad.pdf
Manufacturing	Credit Linked Capital Subsidy Scheme	Total no. of beneficiaries till Dec, 2017 (national figures)	NABARD/ SIDBI	Total 4081 no of beneficiaries (benefit provided in cash) till December 2017.	https://msme.gov.in/sites/default/files/MSME-AR-2017-18-Eng.pdf
AFOLU	Fodder and Feed Development Programme	Funds allocated in year 2017-18 to support the programme	Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat	Rs. 1233.86 lakhs allocated in year 2017-18 to support the programme	Budget details from Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat https://doah.gujarat.gov.in/Images/animalhusbandary/pdf/Bulletin-2017-18.pdf
	Cattle and Buffalo Development Programme	Funds allocated in year 2017-18 to support the programme	Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat	Rs. 13465.12 lakhs allocated in year 2017-18 to support the programme	Budget details from Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat https://doah.gujarat.gov.in/Images/animalhusbandary/pdf/Bulletin-2017-18.pdf

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
	Social Forestry	Funds allocated for social forestry	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	Rs 3,220,684[17] thousand was allocated in year 2015-16 for social forestry	Derived from Budget Estimates of Forests and Environment Department For 2015-2016 https://openbudgetsindia.org/dataset/b1f3a74c-f5d8-4f56-b057-c0753b864254/resource/6f621072-3172-4402-bc0b-ee92c6efce28/download/08---forests--environment.pdf
	Soil Moisture Conservation (SMC)	Funds allocated for implementation of the scheme in 2015-16.	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	Allocation of 21,358.58 lakhs for the implementation of the scheme in 2015-16.	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	Information regarding specially marked funds for implementation of the Forest Conservation Act, 1980, is not available	Gujarat Forest Department	Information regarding specially marked funds for implementation of the Forest Conservation Act, 1980, is not available	

[17] Comprises of finances from subheads 01, 10, 15, 16, 24, 28, 29, 30,31,32 of minor head 101 under major head 4406.

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
	Wildlife Protection Act,1972	Funds allocated for the protection of wildlife	Gujarat Forest Department	Rs. 3,527,094[18] thousand was allocated for the protection of wildlife	Derived from Budget Estimates of Forests and Environment Department For 2015-2016 https://openbudgetsindia.org/dataset/b1f3a74c-f5d8-4f56-b057-c0753b864254/resource/6f621072-3172-4402-bc0b-ee92c6efce28/download/08---forests--environment.pdf
	Soil Health Card	Funds allocated for the implementation of the scheme in 2015-16	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	Allocation of 602.19 lakhs for the implementation of the scheme in 2015-16	Derived from a news published by Press Information Bureau Government of India http://pib.nic.in/newsite/PrintRelease.aspx?relid=124570
	National Food Security Mission (NFSM)	Funds allocated for NFSM in Gujarat.	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During the XIth plan (2007-08 to 2011-12), a total of Rs 7662 lakhs was allocated for NFSM in Gujarat[19]	(Haque, n.d.) http://www.csdindia.org/pdfs/Project-reports/ROLE%20OF%20NATIONAL%20FOOD%20SECURITY%20MISSION%20(NFSM)%20IN%20IMPROVING%20AGRICULTURAL%20PRODUCTIVITY.pdf
Waste (Solid Waste Disposal)	Municipal Solid Waste Management Project	Funds allocated for program implementation	Gujarat Urban Development Company (GUDC) Limited	INR 240 Crore allocated for program implementation	As published on the Website of Urban Development and Urban Housing Department, Gujarat

[18] Comprises of finances from Major heads 2406 and 4406. Under 2406, budget details of minor head 001 was considered. Budget details of sub- heads 05 under minor head 800 was considered. Budget details of sub-head 02 under minor head 110 were used. Under 4406, subheads 18 and 23 were considered under minor head 101.

[19] Kindly refer to Annexure-9for the activity-wise financial allocation on this mission.

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					https://udd.gujarat.gov.in/MSWMSWM.php
Waste (Domestic Wastewater Treatment and Discharge)	Total Sanitation Campaign	Funds allocated for program implementation	Rural Housing & Rural Development Department, Government of Gujarat[20]	Expenditure of INR 219.38 Crore between 2007-2010 for program implementation	As published in WaterAid, 2012: Sanitation Sector Financing in India, Table 2.15 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Bharat Abhiyan (Clean India Campaign)	Funds allocated for program implementation	Rural Housing & Rural Development Department, Government of Gujarat[20]	Expenditure of INR 117.09 Crore in 2012-13 and 2013-14 for program implementation	Report of the Comptroller and Auditor General of India on Performance Audit of Total Sanitation Campaign /Nirmal Bharat Abhiyan for the year ended March 2014, Annex 4.1, Page 113 http://www.indiaenvironmentportal.org.in/files/file/cag%20report%20on%20total%20sanitation%20campaign.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Integrated low cost sanitation scheme	Funds allocated for program implementation	Urban Development and Urban Housing Department, Government of Gujarat	Information not available	
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Gujarat Sauchalaya Yojana	Funds allocated for program implementation	Urban Development and Urban Housing Department, Government of Gujarat[20]	Expenditure of INR 5.2 Crore between 2008-2010 for program implementation	As published in WaterAid, 2012: Sanitation Sector Financing in India, Table 3.4 http://indiawashforum.com/wp-

[20] Identified based on field interactions of the ICLEI SA team with relevant state departments

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Pay and Use Toilet Scheme	Funds allocated for program implementation	Gujarat Municipal Finance Board	Expenditure of INR 33.64 Crore between 2005-06 to 2009-2010 for program implementation	As published in WaterAid, 2012: Sanitation Sector Financing in India, Table 3.6 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	UIG Scheme	Funds allocated for program implementation	Gujarat Urban Development Mission[20]	Expenditure of INR 5055.37 Crore between 2005 to 2013 for program implementation	Urban Development and Urban Housing Department, Government of Gujarat (2013): Status of JNNURM projects, Page 6 http://cdn.cseindia.org/userfiles/Gujarat-state%20presentation.pdf
Waste (Domestic Wastewater Treatment and Discharge)	UIDSSMT	Funds allocated for program implementation	Gujarat Urban Development Mission	Expenditure of INR 375.61 Crore between 2005 to 2013 for program implementation	Development and Urban Housing Department, Government of Gujarat (2013): Status of JNNURM projects, Page 2 http://cdn.cseindia.org/userfiles/Gujarat-state%20presentation.pdf
Waste (Domestic Wastewater Treatment and Discharge)	National river conservation programme	Funds allocated for program implementation	Gujarat Water Supply and Sewerage Board; Gujarat Urban Development Company[20]	Total expenditure of INR 583.8 Crore until December 2018.	Statewide and Town wise Details of Sanctioned Cost, Expenditure and STP Capacity created In 76 Towns Under National River

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					Conservation Plan https://nrcd.nic.in/writereaddata/FileUpload/76_Towns_FEB19.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	Funds allocated for program implementation	Gujarat Urban Development Mission; Gujarat Urban Development Company[20]	• Allocation of INR 7000 Crore for program implementation. • Allocated additional INR 15000 Crore for five years starting from 2012-13 under phase II	Gujarat State Socio-Economic Review 2012-13. As indicated under Urban Development, page xii http://re.indiaenvironmentportal.org.in/files/file/Gujarat%20Socio_Economic_Review%202012-13.pdf
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	Mahatma Gandhi Swachata Mission, Gujarat	Funds allocated for program implementation	Urban Development and Urban Housing Department, Government of Gujarat; Commissionerate of Rural Development	• Expenditure of INR 715.73 Crore during 2015-16 for Swachh Bharat Mission (Gramin). • Allocation of INR 57.29 Crore in 2014-15 and INR 157. 72 Crore in 2015-16	Swachh Bharat Mission (Gramin) Annual Implementation Plan 2016-17 for Gujarat State, Table 2, page 5. https://ruraldev.gujarat.gov.in/writereaddata/images/pdf/Final-AIP-Gujarat-2016-17.pdfWebsite of Swachh Bharat Mission (Urban). http://swachhbharaturban.gov.in/sanction.aspx?id=&encryptdata=eK991SygGmU+1zk0nElwGfN6WyfQz/kaqtdWw3/1jAuwD6xo91BnjVMJ2qOUgtN11PjPDb1qgEy8/c1GSb1z15vDV7YHOz58667u/+JjsUk=

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
Cross-cutting	National Mission on Micro irrigation	Funds allocated for Micro Irrigation (MI) during 2005-06 to 2012-13	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During 2005-06 to 2012-13, financial Allocation of Rs 72471 lakh was made for Micro Irrigation (MI) in Gujarat.	Derived from the study published by Ministry of Agriculture, Farmers Welfare & Co-operation, Government of India http://pmksy.gov.in/microirrigation/Archive/IES-June2014.pdf
	Pradhan Mantri UjjwalaYojna	Not enough data available to identify the financial allocation of the scheme.[21]	Ministry of Petroleum & Natural gas, Government of India	Not enough data available to identify the financial allocation of the scheme.[22]	
Other Inputs					
AFOLU	Social Forestry scheme	Total area targeted to be covered under this scheme in 2015-16,	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	In 2015-16, a total area of 11740 ha was targeted to be covered under this scheme	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Soil Moisture Conservation (SMC)	Total area targeted to be covered under this Soil Moisture Conservation during 2015-16	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	During 2015-16, a total area of 35390 ha was targeted to be covered under this scheme	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writerea

[21] Though the state wise allocation of the funds in not known, the national allocation for the implementation of the scheme is Rs 8000 crore as mentioned on http://www.pmujjwalayojana.com/about.html

[22] Though the state wise allocation of the funds in not known, the national allocation for the implementation of the scheme is Rs 8000 crore as mentioned on http://www.pmujjwalayojana.com/about.html

Sector	Name of policy and/or mitigation actions	Input Indicator	Responsible Organization	Input Indicator Parameter	Data Source(s)
					ddata/images/pdf/GFS_2015-16.pdf
	Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	Not enough data available to identify the other inputs	Gujarat Forest Department	Not enough data available to identify the other inputs	
	Wildlife Protection Act, 1972	Not enough data available to identify the other inputs	Gujarat Forest Department	Not enough data available to identify the other inputs	
	Soil Health Card	During 2015-16 to 2016-17 • Number of samples to be collected and tested • Number of SHCs to be printed and distributed	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During 2015-16 to 2016-17 • 3320144 samples to be collected and tested • 4885610 SHCs to be printed and distributed	Derived from the official website of Soil Health Card Scheme https://soilhealth.dac.gov.in/PublicReports/DistrictWiseProgress
	National Food Security Mission	Not enough data available to identify other inputs of the scheme.	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	Not enough data available to identify other inputs of the scheme.	
Cross-cutting	National Mission on Micro irrigation	Total area targeted to be covered under Micro Irrigation during 2005-06 to 2012-13.	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During 2005-06 to 2012-13, a physical area of 461020 ha to be under MI	Derived from the study published by Ministry of Agriculture, Farmers Welfare & Co-operation, Government of India http://pmksy.gov.in/microirrigation/Archive/IES-June2014.pdf
	Pradhan Mantri UjjwalaYojna	Not enough data available to identify the other inputs of the scheme.	Ministry of Petroleum & Natural gas, Government of India	Not enough data available to identify the other inputs of the scheme.	

To assess the implementation of a policy and/or programme, specific activity indicators have been identified and listed against the said policy/programme. Table 7 below provides an extensive list of policies and their corresponding activity indicators.

Energy Sector :

Major activities in power sector policies that resulted in increased RE installations are signing of Power Purchase Agreement (PPA) with RE power producers, setting up of Renewable Power Purchase Obligations (RPO) targets for utilities/DISCOMs, introduction of subsidy schemes to support RE power generators, increasing electricity tariff, providing grid connectivity to RE plants and permitting private power producers to lay transmission lines (GERC 2011). Apart from the power sector, a few policies on BRTs system from transport sector and impact of national programmes such as UJALA and Standards and Labeling in the state are also considered for the analysis. The aforementioned activities are tabulated in Table 7.

Table 7: Sector wise Activity Indicators identified for each policy and/or mitigation actions

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
Licensing, permitting and/or procurement functions					
Energy	Solar Power Policy-2009	Solar power project installations during policy period	GEDA	Cumulative installed capacity increased to 995.84 MW by the end of March 2015 with average annual installed capacity addition of 199 MW[23].	GEDA https://geda.gujarat.gov.in/Gallery/Media_Gallery/solar_power_capacity_31-05-2019.pdf
	Wind power policy-2007, Amendment to wind power policy-2007 (2009)	Wind power project installations during policy period	GEDA	Cumulative installed capacity increased to 2966 MW by the end of March 2012 with average annual installed capacity addition of 465 MW[24]	GEDA, NIWE and Gujarat SLDC website https://niwe.res.in/information_isw.php https://geda.gujarat.gov.in/Gallery/Media_Gallery/Wind_Power_Capacity_Addition_in_Gujarat_as_on_31.05.2019.pdf https://www.sldcguj.com/EnergyAccount/energy_account_new.php
	Wind power policy-2013	Wind power project installations	GEDA	Cumulative installed capacity increased to 3643 MW by the end	GEDA, NIWE https://niwe.res.in/inf

[23] Average annual installed capacity between FY 2010-11 to FY 2014-15.

[24]The policy period ended in June 2012. Due to the lack of data on monthly installation, cumulative installed capacity till March 2012 is mapped to this policy. Average annual installed capacity is taken for FY 2007-08 to FY 2011-12.

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		during policy period		of FY 2014-2015 with average annual installed capacity addition of 234 MW[25]	ormation_isw.php https://geda.gujarat.gov.in/Gallery/Media_Gallery/Wind_Power_Capacity_Addition_in_Gujarat_as_on_31.05.2019.pdf
	Subsidy for residential rooftop solar		GEDA	Cumulative installed capacity increased from 170 kW in 2008-09 to 16 MW in FY 2014-2015	GEDA https://geda.gujarat.gov.in/Gallery/Media_Gallery/Solar_Status-July_2019.pdf
	UDAY/R-APDRP scheme	T&D loss reduction during policy period	DISCOMs	T&D loss reduced from 30.4% in 2004-05 to 19.1% in 2015-16	CEA general review books 2004-05 to 2015-16
	PAT scheme	Efficiency improvement during scheme period	GEDA	17 designated consumers under thermal power plants in Gujarat reduced their plant heat rate below their baseline value	BEE Notification: https://beeindia.gov.in/sites/default/files/3%20S.O.%20687%20dated%2030.%20Mar%202012-%20Targtes%20under%20PAT%20-%20I.pdf Heat rates are referred from the below mentioned weblinks: GERC Tariff orders: http://www.gercin.org/uploaded/document/en_1427868449.pdf http://www.gercin.org/uploaded/document/ca3e5900-5a63-415b-9075-2d653a8a797d.pdf
	Unnat Jyoti by Affordable LEDs for All (UJALA)	Number of LED bulbs distributed in the State during that period	Energy Efficiency Services Limited (EESL)	Approximately 2.2 crore LED bulbs distributed in Gujarat from May to December, 2015	Unnat Jyoti by Affordable LEDs for All – Conserve Electricity, Conserve Energy (MoP 2017)
	Standards and Labelling	Energy saved by the use of	Bureau of Energy	Energy saved by the use of energy-	Report on 'Energy Conservation and

[25] This policy came into force from July 2013. Though monthly data is not available, we have considered installation from April 2013. Annual average installed capacity is taken between FY 2013-14 and FY 2014-15.

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
	Programm-e	energy-efficient appliances	Efficiency (BEE)	efficient star-rated appliances in residential buildings amounting to 3,145 GWh	Commercialization in Gujarat' https://beeindia.gov.in/sites/default/files/ctools/Report%20on%20Demand%20Side%20Management%20in%20Gujarat.pdf
	Standards and Labelling Programm-e	Energy saved by the use of energy-efficient appliances	Bureau of Energy Efficiency (BEE)	Energy saved by the use of energy-efficient star-rated appliances in commercial buildings amounting to 3,333 GWh	Report on 'Energy Conservation and Commercialization in Gujarat' https://beeindia.gov.in/sites/default/files/ctools/Report%20on%20Demand%20Side%20Management%20in%20Gujarat.pdf
IPPU (Manufacturing)	**PAT Scheme Cycle I (2012-2015)**	• Registration System Registration fee	POSOCO (registry) BEE (administrator)	• Interested DCs to whom ESCerts have been either issued or are entitled to purchase by MoP have to register themselves with 'Registry' i.e. POSOCO to become eligible entity. One-time Registration Fee of Rs. 15000/- per eligible entity for transaction of ESCerts.	https://beenet.gov.in/UI_Forms/Registry/default.aspx?AspxAutoDetectCookieSupport=1 https://beenet.gov.in/(X(1)S(edqxpdcj53jy4dbinwpojcdc))/UI_Forms/Registry/Registry_Doc/Fee%20order_24th%20March%202017.pdf
Manufacturing	**PAT Scheme Cycle I (2012-2015)**	Certification	BEE (administrator)	Issuance of ESCerts, a certification of excess energy saving that can be traded. From the M&V report submitted under PAT cycle I in Gujarat, it is found that around 5,51,669.6 nos. of Energy Savings Certificates (ESCerts) have been generated by 40 DCs in the state.	CCD, GoG: https://ccd.gujarat.gov.in/energy-conservation-inner.htm
Manufacturing	**Clean Development**	Registration of	MoEFCC	Registration of projects done by CDM	http://www.cdmpipeline.org/

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
	Mechanism	CDM projects		Executive Board. A total of 239 projects registered in Gujarat from inception till data available as of 1st October 2018 in the UNEP database	
Manufacturing	**LNG Terminal Policy 2012**	Licensing Agreement	Energy and Petrochemicals Department	In February 2015, construction firm BAM Infraconsult signed a licensing agreement with Adani Ports and Special Economic Zone (APSEZ) for the installation of Xbloc breakwater armour units on the reclaimed land area for protection of Mundra LNG Terminal	https://www.hydrocarbons-technology.com/projects/mundra-lng-terminal/
Manufacturing	**LNG Terminal Policy 2012**	• Memorandum of Understanding (MoU) Joint Ventures	Energy and Petrochemicals Department	• SPC and Adani signed a memorandum of understanding (MoU) to set up the Gujarat LNG terminal during the Vibrant Gujarat Global Investors' Summit in 2007 GSPC and Adani subsequently formed a JV to build the LNG import terminal in Pipavav approved by the GoG in August 2011	https://www.hydrocarbons-technology.com/projects/mundra-lng-terminal/
Manufacturing	**Perform Achieve and Trade (PAT) Scheme Cycle I (2012-2015)**	MoU with Engineers India Limited (EIL) for implementation of PAT Scheme in Petrochemical sector	BEE (administrator)	MoU was signed with EIL for implementation of energy efficiency in Petrochemical sector, under the PAT scheme	https://beeindia.gov.in/sites/default/files/press_releases/MoU_Press%20Release.pdf
AFOLU	Data regarding licensing, permitting and/or procurement functions was not found to be relevant for our analysis and was thus not considered				

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
Waste (Solid Waste Disposal)	Municipal Solid Waste Management Project	• Number of vermicomposting facilities constructed • Number of regional sanitary landfill facilities constructed Procurement and distribution of equipment for collection and transportation of municipal solid waste	GUDC Limited	• 93 vermi-composting plants constructed from 2005-2015 (see Annexure 13) • 7 regional landfill sites constructed from 2005-2015 • It is reported that 75,800 units of equipment in total such as Refuse Compactor Vehicles, Front End Loaders, Mini Trucks, Tractors, and Trolleys have been purchased and distributed for Primary & Secondary collection of waste in phase I of the project. The duration of phase I is not available.	• CPCB Annual Reports from 2007-08 to 2015-16 https://gpcb.gujarat.gov.in/webcontroller/page/annual-report • Website of Urban Development Department – municipal solid waste (MSW) project webpage https://udd.gujarat.gov.in/projects_SWM.php
Waste (Domestic Wastewater Treatment and Discharge)	Total Sanitation Campaign	Improved access to sanitation for households through installation of individual household latrines	Rural Housing & Rural Development Department, Government of Gujarat	• 4,036,449 IHHLs constructed from 2001 up to Feb 2011 • 2,439,175 IHHLs constructed from 2007 to 2010	• Report of CAG of India on Performance Audit of Total Sanitation Campaign/ Nirmal Bharat Abhiyan for the year ended March 2014, Table 3.2 http://www.indiaenvironmentportal.org.in/files/file/cag%20report%20on%20total%20sanitation%20campaign.pdf • WaterAid, 2012: Sanitation Sector Financing in India, Table 2.13 http://indiawashforum.com/wp-content/uploads/2016

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
					/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Bharat Abhiyan (Clean India Campaign)	Improved access to sanitation for households through installation of individual household latrines and institutional latrines	Rural Housing & Rural Development Department, Government of Gujarat	Toilets constructed for the period 2012-13 to 2014-15 includes: • IHHLs: 663,007 nos. • School toilets: 5,780 nos. Anganwadi toilets: 941 nos.	Swachhta status report 2016, Table 2.2, page 7 http://mospi.nic.in/sites/default/files/publication_reports/Swachhta_Status_Report%202016_17apr17.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Integrated low-cost sanitation scheme	Improved access to sanitation for households through installation of individual household latrines	Urban Development and Urban Housing Department, Government of Gujarat	129,528 IHHLs constructed from 1980 up to 2007	WaterAid, 2012: Sanitation Sector Financing in India, section 3.7.4 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Gujarat Sauchalaya Yojana	Improved access to sanitation for households through installation of individual household latrines	Urban Development and Urban Housing Department, Government of Gujarat	115,737 IHHLs constructed from 2008 to 2010.	WaterAid, 2012: Sanitation Sector Financing in India, Table 3.4 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Pay and Use Toilet Scheme	Improved access to sanitation for households and at community level Through installation of community latrines	Gujarat Municipal Finance Board	• 1,102 community toilets estimated to be constructed in total from 2005 to 2015. • From 2005-06 to 2009-10, 841 pay and use toilets reported to be constructed. 92 toilets sanctioned between 2013 to 2015 (considered to be constructed).	• Website of Swachh Bharat Mission Urban – Gujarat: Pay and Use Toilet Scheme webpage http://www.mgsm-gujarat.in/Projects/pay-and-use-toilet-scheme-6 • WaterAid, 2012: Sanitation Sector Financing in India, Table 3.5 http://indiawashforum.com/wp-

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
					content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	UIG Scheme	• Treatment capacity of sewage treatment facilities constructed • Number of sewerage projects undertaken Number of solid waste management projects undertaken	Gujarat Urban Development Mission	• 1,043 MLD of sewage treatment capacity estimated to be constructed based on information provided by GUDC Limited (see Annex IV) • 13 sewerage projects completed in cities as of September 2013 • 1 solid waste projects completed in cities as of September 2013	• Information provided by GUDC Limited • Annual Report 2015-16, Gujarat Pollution Control Board, Governmnt of Gujarat, section 5.10 https://gpcb.gujarat.gov.in/uploads/AR_2015_2016_ENG.pdf • Inventorization of Sewage Treatment Plants, Central Pollution Control Board, March 2015, Table 12. https://nrcd.nic.in/writereaddata/FileUpload/NewItem_210_Inventorization_of_Sewage-Treatment_Plant.pdf • Gujarat Institute of Development Research (2014): State Finances in Gujarat: An Evaluation, Table 44 https://fincomindia.nic.in/writereaddata/html_en_files/oldcommission_html/fincom14/others/7.pdf
Waste (Domestic Wastewater Treatment and Discharge**)**	UIDSSMT	• Treatment capacity of sewage treatment facilities constructed Number of sewerage projects undertaken	Gujarat Urban Development Mission	Information not available	NRCD - STPs Capacity Sanctioned/Created under National River Conservation Plan STPs Capacity Sanctioned/Created under National River Conservation Plan https://nrcd.nic.in/writereaddata/FileUpload

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
					/30714343STPs%20capacity%20sanctioned%20created%20under%20NRCP.pdf
Waste (Domestic Wastewater Treatment and Discharge)	National river conservation programme	Treatment capacity of sewage treatment facilities constructed for water pollution abatement	Gujarat Water Supply and Sewerage Board; Gujarat Urban Development Company	• 285 MLD of sewage treatment capacity constructed from 1995 to 2017	NRCD - STPs Capacity Sanctioned/Created under National River Conservation Plan STPs Capacity Sanctioned/Created under National River Conservation Plan https://nrcd.nic.in/writereaddata/FileUpload/30714343STPs%20capacity%20sanctioned%20created%20under%20NRCP.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	• Treatment capacity of sewage treatment facilities constructed for improved wastewater treatment	Gujarat Urban Development Mission; GUDC Limited	• 157.8 MLD of sewage treatment capacity constructed from 2009 to 2015 (see Annex IV) This capacity includes 153.41 aerobic STPs and 4.39 anaerobic STPs	Information provided by GUDC Limited
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	Mahatma Gandhi Swachata Mission, Gujarat	Improved access to sanitation for households through installation of individual household latrines	Urban Development and Urban Housing Department, Government of Gujarat; Commissioner ate of Rural Development	• A total of 470,393 IHHLs were constructed in 2015-16	MOSPI Swachhta Status Report 2016, Table 2.2 http://mospi.nic.in/sites/default/files/publication_reports/Swachhta_Status_Report%202016_17apr17.pdf
Information collection and tracking of Available Data					
Energy	Bus Rapid Transit System, Ahmedabad	Per capita trip rate, Modal share of total trips, average trip length mode-wise, Population	Ahmedabad Janmarg Limited	Per capita trip rate 1.16 Modal share in 2006 (Bus 15%, Car 3.1%, 2W 35%, 3W 8.8%) Modal share 2011 (Bus 8%, BRTS 11.5%, Car	Gujarat Infrastructure Development Board - Bus Rapid Transit system Report http://www.gidb.org/downloads-bus-rapid Bus as low-carbon mobility solutions for urban India : Evidence

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
				3.1%, 2W 35%, 3W 8.8) Average trip length in km (Bus 12, Train 36.8, Car 11.2, 2W 6.8, 3W 5.2)	from two cities https://trid.trb.org/view/1128841 Promoting Low-Carbon Transport in India Low-Carbon Mobility in India and the Challenges of Social Inclusion Bus Rapid Transit (BRT) Case Studies in India https://unepdtu.org/wp-content/uploads/2019/01/bus-rapid-transit-brt-case-studies-in-india-to-unep-risoe.pdf
IPPU Renewable	**Rooftop Scheme 2012**	Approval Time for RTS PV system	GEDA, Govt. of Gujarat	• Installations of approx. 200 MW Roof-top SPV across municipal corporations and municipalities under 12th Plan • Approximately around 4 months of approval time for RTS system	https://mnre.gov.in/file-manager/UserFiles/presentations-pwc-workshop-06092012/GEDA.pdf https://guj-epd.gujarat.gov.in/uploads/gr_18022016_b1.pdf
IPPU Manufacturing	**PAT Scheme Cycle I (2012-2015)**	• Documentation and verification of DCs Web portal	BEE/ GEDA	• Documents like PAN, TAN, CIN, etc. required for verification BEE developed PATNet portal for all the DCs through which they upload their forms and ESCerts can be electronically issued	http://knowledgeplatform.in/wp-content/uploads/2017/08/Familiarization-of-ESCerts-Trading-Process-.pdf
AFOLU	Feed and Fodder Development Programme	• Number of chaff cutters supplied	Directorate of Animal husbandry, Agriculture,	• 2519 Chaff cutter supplied • 9000 fodder mini kits supplied	Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		• Number of fodder mini kits supplied • Subsidies given for cattle sheds • Number of demonstrations of mini kits • Production of green fodder Production of fodder seeds	farmers Welfare and Co-operation department, Government of Gujarat	• 541 subsidies given for cattle sheds • 215 demonstration of mini kits conducted. • 611.30 MT of Green fodder produced 7510 kg of fodder seeds produced	operation department, Government of Gujarat https://doah.gujarat.gov.in/Images/animalhusbandary/pdf/Bulletin-2017-18.pdf
	Cattle and Buffalo Development Programme	• Number of Villages covered, artificial insemination carried out, animals treated, males castrated and sexual cases treated under Intensive cattle development • Number of AI and crossbreeding centers and AI conducted under key village schemes, • Number of cattle and buffaloes bred at the sperm	Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat	• Under the Intensive cattle development, 4887 villages covered, 1144156 artificial insemination carried out, 473829 animals treated, 91332 males castrated and 132405 sexual cases treated. • Under the key village schemes, 27 AI and 27 cross breeding centers exist, 13492 AI conducted • Breeding of 2683 cattle and 1362 buffaloes at the sperm stations 4834 calves born by AI Under the key village schemes	Directorate of Animal husbandry, Agriculture, farmers Welfare and Co-operation department, Government of Gujarat https://doah.gujarat.gov.in/Images/animalhusbandary/pdf/Bulletin-2017-18.pdf

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		stations Number of calves born by AI under key village schemes,			
	Social Forestry scheme	• Increase in the number of trees and tree density across the years. Area covered under trees through social forestry.[26]	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	• The number of trees outside the forest area increased from about 25.1 crores in 2003 to 26.9 crores in 2009 to 30.14 cores in 2013 in the state, and tree density from 16.1 trees/ha in 2009 to 18.5 trees/ha in 2013. During 2015-16, a total area of 11947ha[27] was brought under the trees through social forestry.	Published on the official website of the Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/social-forestry-introduction.htm https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Soil Moisture Conservation (SMC)	Area under SMC[28]	Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar	During 2015-16, a total area of 35390 ha[29] was covered under the scheme	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.

[26] Includes activities like strip plantation, gramvan, environment plantation, drip irrigation plantation, farm forestry, river bank plantation etc.

[27] Includes activities like strip plantation, gramvan, environment plantation, drip irrigation plantation, farm forestry, river bank plantation etc.

[28] Includes activities like Forest improvement in Dense Forest, Gap Planting in Open Forest Area, Development of Degraded Forest Land, Canopy Plantation, MFP Canopy Plantation,Eco-Restoration, Bamboo Augmentation in Forest Area, Grassland Improvement, Drip Irrigation, Teak Khair and Bamboo, Improvement Technology Plantation, Coastal Border Plantation, Coastal Border Sandy Shore, Fast Growing Species Plantation- Nilgiri, Mangrove (Cher) Plantation etc.

[29] Includes activities like Forest improvement in Dense Forest, Gap Planting in Open Forest Area, Development of Degraded Forest Land, Canopy Plantation, MFP Canopy Plantation,Eco-Restoration, Bamboo Augmentation in Forest Area, Grassland Improvement, Drip Irrigation, Teak Khair and Bamboo, Improvement Technology Plantation, Coastal Border Plantation, Coastal Border Sandy Shore, Fast Growing Species Plantation- Nilgiri, Mangrove (Cher) Plantation etc.

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
					gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	Area of forest diverted for non-forest purpose	Gujarat Forest Department	Total area diverted from forests for non-forest purpose under the Forest Conservation Act, 1980 from 2004-05 to 2015-16 was 8444.53 ha	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Wildlife Protection Act, 1972	Area under national parks and sanctuaries.	Gujarat Forest Department	As on 2015-16, a total area of 4181.47Ha was under national parks and sanctuaries.	Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Soil Health Card	• Samples collected and tested SHCs Printed	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During 2015-16 to 2016-17 • 3347080 soil samples collected and tested 5537742 SHCs printed and distributed	Derived from the official website of Soil Health Card Scheme https://soilhealth.dac.gov.in/PublicReports/DistrictWiseProgress
	National Food Security Mission	During the XIth Plan (2007-08 to 2011-12) • Area under rice cultivation • Area under wheat	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During the XIthPlan (2007-08 to 2011-12) the following area was covered under NFSM[30] • 20553[31] ha of land was covered under rice	(Haque, n.d.) http://www.csdindia.org/pdfs/Project-reports/ROLE%20OF%20NATIONAL%20FOOD%20SECURITY%20MISSION%20(NFSM)%20IN%20IMPROVING%20

[30] The detailed activities of the NFSM are given in Annexure-I.

[31] The area under integrated nutrient management and plant protection chemical distribution for rice was assumed be the added harvest area of rice under NFSM.

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		cultivation • Area under pulses cultivation		cultivation • 98885[32] ha of land was covered under wheat cultivation 284474[33] ha of land was under pulses cultivation	AGRICULTURAL%20PRODUCTIVITY.pdf
Waste	**No information is available with regard to this aspect**				
Cross-cutting	National Mission on Micro irrigation	• Increase in area under MI • Reduction in cost of electricity • Reduction in Fertilizer consumption • Increase in the income of farmers Increase in the irrigated area	Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat	During 2005-06 to 2012-13 • Area under MI increased by 14.07% from 1358.91 ha to 1550.07 ha • Electricity consumption for irrigation purpose reduced by 39.92% from 6.78 hr./day to 4.07 hr./day • Fertilizer use reduced by 42.73% from 158.93 kg/ha to 91.03 kg/ha Farmers income has increased by 68.02% from 55703 Rs/ha to 93593 Rs/ha	Derived from the study published by Ministry of Agriculture, Farmers Welfare & Co-operation, Government of India http://pmksy.gov.in/microirrigation/Archive/IES-June2014.pdf
	Pradhan Mantri UjjwalaYojna	Number of LPG connections released in the state.	Ministry of Petroleum and Natural Gas	As on 21.04.2019, a total of 2522600 LPG connections have been released.	Published on the official website of the Pradhan Mantri UjjwalaYojna http://www.pmujjwalayojana.com/released-connections.html
Compliance and Enforcement					
IPPU Manufacturing	**PAT Scheme Cycle I (2012-2015)**	• Performance assessment document to be submitted	BEE/ GEDA	• Performance assessment document to be submitted by DCs	https://beeindia.gov.in/sites/default/files/PAT%20Rules%20and%

[32] The area under integrated nutrient management and sprinkler distribution for wheat was assumed be the added harvest area of wheat under NFSM.

[33] The area under integrated nutrient management, integrated pest management and sprinkler distribution for pulses was assumed be the added harvest area of pulses under NFSM.

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		• Mandatory Energy Audit or MEA • Monitoring and Verification Process (M&V) • Amount of money collected in fines for non-compliance		within 4 months of the conclusion of the target year specifying compliance with the energy consumption norms and standards • Mandatory energy audit (MEA) is a compulsory energy audit conducted by every DCs in their plant premises within 18 months from the date it has been notified. • M&V is carried out after completion of a PAT cycle to assess the energy savings done by DCs. The first PAT Cycle ended on 31st April 2015 and 48 out of 52 designated consumers (industries) of Gujarat have submitted their target achievement reports. Out of 52 industries – 8 industries have been served "show cause notice" for non-compliance. Penalties for non-compliance of provisions by DCs shall be liable to a penalty of Rs. 10 lakh rupees	20Obligations%20of%20DCs%20under%20PAT%20Scheme_Abhishek%20Kumar_0.pdf https://beeindia.gov.in/sites/default/files/Bee%20FAQ%20Book%20PRINTED%20ONE_0.pdf https://ccd.gujarat.gov.in/energy-conservation-inner.htm http://www.npcindia.gov.in/wp-content/uploads/2017/02/1.-PAT-Scheme-by-Mr.-Piyush-Sharma-GIZ-BEE.pdf
Manufacturing	**LNG Terminal Policy 2012**	• MoEFCC and CRZ Compliance Report • NOC from	Energy and Petrochemicals Department	• Mundra LNG terminal received environmental and coastal regulation zone (CRZ)	http://www.haziralngandport.com/pdf/ecr-may17-to-oct17.pdf

Sector	Name of the policy and/or mitigation action	Activity Indicator	Responsible Organization	Indicator	Data Source(s)
		Gujarat Pollution Control Board Environmental Impact Assessment		clearance from the Ministry of Environment & Forests (MoEF) in 2013 • NOC from GPCB Complied for Hazira Terminal EIA study carried out for Hazira terminal	https://gpcb.gov.in/pdf/HAZIRA_LNG_EIA_PART_I.PDF https://www.hydrocarbons-technology.com/projects/mundra-lng-terminal/
Workshops, symposia and seminars					
Manufacturing	**Technology and Quality Upgradation Support to MSMEs (TEQUP)**	Nos of awareness programme conducted (national figures)	Scheme presently under direct benefit transfer cell	382 nos of awareness programs conducted since its inception from 2010-2011	http://my.msme.gov.in/MyMsme/Reg/COM_TequpAppForm.aspx
Others					
No Other information is available					

Further, kindly refer to annexure-I for details on impact indicators and GHG impacts of these policies and programmes.

Impact indicators

Impact indicators could be categorised between GHG impact—reduction of GHG emissions due to the implementation of policies—and non-GHG impact—comprising sustainable development benefits. Monitoring the effects alongside inputs and activities can help provide assurance that a policy instrument is delivering the intended impact.

Energy Sector

Table 12 (in Annexure1) tabulates the impact of various policies in the energy sector in reducing GHG emissions. All India GHG grid emission factor was used to estimate GHG emissions avoided with the introduction of policies. The calculation method for estimating annual grid emission factor, GHG emissions abated in each energy sector are also provided (CEA 2016). Also, it is important to note that apart from policies, market conditions also play a significant role in CO_2 savings. For example, the capital cost of solar power plant has seen a significant reduction post 2010 (IRENA 2016, IRENA 2018, Mytrah Energy Limited 2015). This has also led to an increase in the installed capacity of solar power plants. In this study, we have not evaluated the impact of market conditions, supply chains and other factors on increasing the RE-installed capacity.

Table8 below provides a description of the policy/mitigation action/scheme/regulation/act highlighting the type of mitigation action it would pertain to, the GHGs it would have an impact on as well as other key indicators.

Table 8: Sector-wise list of policies and/or mitigation actions or outcomes

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
Energy	Installation of solar power electricity generating sources	Policy	CO_2	2009-2015	National Solar Mission	• Increase in installed capacity
	Installation of wind power electricity generating sources	Policy, infrastructure development programmes to increase grid connectivity to wind farms and R&D	CO_2	2007-2015	National Action Plan on Climate Change	• Increase in installed capacity
	Installation of RTPVs	Policy and subsidy	CO_2	2015	MNRE subsidy	• Increase in installed capacity
	Improvement of T&D infrastructure	Infrastructure programmes	CO_2	2005-2015	UDAY, R-APDRP	• Decrease in T&D loss
	Improvement in thermal power plant efficiency through PAT	Renovation and Modernization activities	CO_2	2012-2015	National Mission on Enhanced Energy Efficiency	• Increase in plant efficiency

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
	scheme (cycle 1)					
	Dedicated route for buses in Ahmedabad-BRTS	Infrastructure programmes	CO_2	2009-2015	Jawaharlal Nehru National Urban Renewal Mission	• Number of passengers using BRTS
	Higher usage of LED bulbs	Policy and subsidy	CO_2	2015	National Mission on Enhanced Energy Efficiency	• Number of Led bulbs sold
	Higher usage of energy efficient appliances	Policy and subsidy	CO_2	2006-2015	Energy Conservation Act 2001	• Number of energy efficient appliances sold
IPPU Renewable	**Rooftop Scheme 2012**	Scheme	CO_2, CH_4, N_2O emissions saved by easing the burden on local power grids	2014-2018	Jawaharlal Nehru National Solar Mission	• Megawatt installed by industrial RTS Energy generated from industrial RTS
IPPU Manufacturing	**Perform Achieve and Trade (PAT) Scheme Cycle I (2012-2015)**	Scheme	CO_2, CH_4, N_2O emissions saved through reduction in specific energy consumption	2012-2015	National Mission for Enhanced Energy Efficiency	Reduction in specific energy consumption
Manufacturing	**Clean Development Mechanism (CDM)**	Scheme	CO_2, CH_4, N_2O emissions (some projects also account for reduction in emissions in the form of NOx and SOx)	2005-2015	Clean Development Mechanism (UNFCCC mandate)	• Amount of emissions avoided (no of CERs achieved from CDM projects)
Manufacturing	**LNG Terminal Policy 2012**	Policy	CO_2, CH_4, N_2O lower carbon emissions for per unit of energy combusted	2012-ongoing		• Percentage of gas uptake by industries (reducing carbon intensity of energy mix)
Manufacturing	**Interest Subsidy for technology**	Scheme	CO_2, CH_4, N_2O emissions saved	2004-2005 to 2013-	Under Industrial Policy 2003 Gujarat	• No of industrial units covered under scheme by

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
	upgradation		through reduced levels of energy consumption/ fuel switch to cleaner energy	2014		type of project (energy efficiency improvement vs fuel switch) • Energy efficiency savings achieved Amount of subsidy disbursed
Manufacturing	**Subsidy for quality certification (ISO 9000)**	Scheme	CO_2, CH_4, N_2O emissions saved through reduced levels of energy consumption/ fuel switch to cleaner energy	2004-2005 to 2013-2014	Under Industrial Policy 2003 Gujarat	• No of industrial units covered under scheme Amount of subsidy disbursed
Manufacturing	**Technology and Quality Upgradation Support to MSMEs (TEQUP)**	Scheme	CO_2, CH_4, N_2O emissions saved through reduced levels of energy consumption/ fuel switch to cleaner energy	2010-ongoing	Under National Manufacturing Competitiveness Programme (NMCP)	• Energy efficiency savings achieved List of beneficiaries under TEQUP Scheme
Manufacturing	**Credit Linked Capital Subsidy Scheme (CLCSS)**	Scheme	CO_2, CH_4, N_2O emissions saved through modernization	2001 onwards	Under infrastructure development programme	• Total no. of beneficiaries Total expenditure under scheme
AFOLU	Feed and Fodder Development Programme	Feed Additives/Green Fodder supplements	CH_4	2005-06 to 2017-18	National Livestock mission	• Reduced flock size/population • Lower per livestock emissions
	Cattle and Buffalo Development Programme	Improved productivity with reduced or constant emissions	CH_4	2005-06 to 2017-18	National Livestock mission	• Reduced flock size/population • Lower per livestock emissions
	Social Forestry Scheme	Increase in number of trees outside	CO_2	2005-06 to 2015-16	Green India Mission	• Increase in the number of trees outside forests in

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
		forests (TOF)				the state • Increase in area under coverage • Increase in girth and height of the trees
	Soil & Moisture Conservation (SMC)	Increase in soil organic carbon and forest area	CO_2	2005-06 to 2015-16	Green India Mission	• Area covered under SMC
	Diversion of forest land for non-forest purpose	Reduction in CO_2 removals	CO_2	2005-2015	Forest Conservation Act 1980	• Reduction in forest area
	Wildlife Protection Act, 1972	Maintenance of CO_2 removals capacity of the terrestrial ecosystem	CO_2	2005-2015	Wildlife Protection Act, 1972	• Area protected by the regulation
	Soil Health Card	Improve the nutrient proportion of the soil in order to reduce the usage of the fertilizers	N_2O	2015-6 to 2017-18	National Mission for Sustainable Agriculture (NMSA)	• Area covered under the scheme • Consumption of fertilizers by its type
	National Food Security Mission	Reduction of GHG emissions from the cultivation of food crops	CO_2, N_2O, CH_4	2007-08 to 2011-12	National Food Security Mission	• Expansion of net sown area under Wheat and pulses. • Reduction in net sown area under rice • Expansion of net sown area under rice cultivation through more efficient technology
Waste (Solid Waste Disposal)	Municipal Solid Waste Management Project	Infrastructure program	CH_4	2007-2015	MSW Rules, 2000 and revised MSW, 2016	• Tonnes of waste being vermi-composted • Tonnes of waste sent to disposal facilities
Waste (Domestic Wastewater	Total Sanitation Campaign	Infrastructure program	CH_4	2007-2010	Total Sanitation Campaign	• Number of households with access to

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
Treatment and Discharge)						sanitation
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Bharat Abhiyan (Clean India Campaign)	Infrastructure program	CH_4	2012-2014	Nirmal Bharat Abhiyan (Clean India Campaign)	• Number of households with access to sanitation
Waste (Domestic Wastewater Treatment and Discharge)	Integrated low cost sanitation scheme	Infrastructure program	CH_4	1980-2007	Integrated low cost sanitation scheme	• Number of households with access to sanitation
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Gujarat Sauchalaya Yojana	Infrastructure program	CH_4	2008-2010	Nirmal Bharat Abhiyan (Clean India Campaign)	• Number of households with access to sanitation
Waste (Domestic Wastewater Treatment and Discharge)	Pay and Use Toilet Scheme	Infrastructure program	CH_4	2005-2015	Nirmal Bharat Abhiyan (Clean India Campaign)	• Number of households and institutions with access to sanitation
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	UIG Scheme	Infrastructure program	CH_4	2005-2014	Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	• Increase in capacity for wastewater treatment • Increased coverage of wastewater collection network • Increased collection efficiency, tonnes of waste processed and disposed in scientific manner
Waste (Domestic Wastewater Treatment and Discharge)	UIDSSMT	Infrastructure program	CH_4	2005-2014	JNNURM	• Increase in capacity for wastewater treatment •
Waste (Domestic Wastewater Treatment and Discharge)	National river conservation programme	Infrastructure program	CH_4	1995-2017	National river conservation programme	• Increase in capacity for wastewater treatment • Reduction in water pollution levels of rivers
Waste (Domestic Wastewater	Swarnim Jayanti Mukhya	Infrastructure program	CH_4	2009-2015	-	• Increase in capacity for wastewater treatment

Sector	Policy/Mitigation Action	Type of Mitigation Action	Coverage (GHG)	Period	Relevant national action plan	Key performance indicator
Treatment and Discharge)	Mantri Shaheri Vikas Yojana					• Increased coverage of wastewater network
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	Mahatma Gandhi Swachata Mission, Gujarat	Infrastructure program	CH_4	2015-16	Swachh Bharat Mission	• Number of households and institutions with access to sanitation
Cross-cutting	National Mission on Micro Irrigation	Enhancement of the water use efficiency in a sustainable manner with decline in the use of fertilizers and electricity	N_2O	2005-06 to 2012-13	National Mission of Micro Irrigation	• Usage of fertilizers per hectare • Consumption of electricity per day
	Pradhan Mantri Ujjawala Yojana	Reduction in CO_2 removals	CO_2	2016-2019	Pradhan Mantri UjjwalaYojna	• Amount of fuelwood used before and after the implementation of the scheme

4. Analysis of the identified policy and/or mitigation action

Table 10 below, delivers an analysis of the climate change impacts of the selected policies/mitigation actions/schemes/regulations/acts. It also highlights the methodological assumptions that have been adopted to arrive at our assessment of the policies.

Energy Sector

Each policy carries a set of assumptions and indicators required to estimate emissions avoided. These assumptions vary between policies, and are dependent on the nature of the sector. For example, capacity utilisation factor (CUF) is a key assumption used to estimate the amount of energy generated in RTPV projects (Annexure-2). Though the policy mentions the capacity intended to be installed, to estimate the GHG emissions, we require CUF and emission factor. Similarly, sector-relevant assumptions are employed to estimate emissions. Table 10 provides data on the methodological assumptions employed to arrive at the results.

IPPU Sector

Estimating GHG effect of policy and mitigation actions

The study indicated a total emissions reduction of ~ 13.5 $MtCO_2e$ from the 3 polices and/or mitigation actions(11.16 from CDM, 2.28 from PAT-I, and 0.022 from RTS) (Please refer to Annexure 3, table A3.1). During the analysis period, the emissions intensity of industrial output from the manufacturing sector in the state has marginally increased with CAGR of 1 per cent. At a sub-sectoral level chemicals & fertilizers and iron & steel industries show an increase in emissions intensity – increased with a CAGR of 3 per cent and 9 per cent respectively). While, non-ferrous industries, machinery and non-metallic industries indicate a decreasing emissions intensity trends with a CAGR of 8 per cent, 4 per cent and 2 per cent respectively (Refer Annexure 5).

Our further analysis tried to evaluate the factors influencing the emissions intensity of the manufacturing sector in Gujarat – industrial structural composition, energy intensity, and carbon intensity of the energy mix. The structural composition of the manufacturing sector represented by the shares of GVA from sub-sectors in overall manufacturing is represented in Table 9. It can be seen that during the period, the high-energy intensive industries – iron & steel, chemical & fertilizers, textile and leather, and non-metallic minerals (primarily cement) showed a marginal decrease in their value-add contribution. Thus, indicating a structural transition away from energy intensive manufacturing. Whereas an increase in economic contribution can be observed from the transport equipment sector and machinery sector (to some extent). However, considering the significant economic contribution (~42 per cent) from the high-energy intensive sectors in Gujarat, any change in the energy intensity of production and fuel switches would have an implication in the emissions intensity of the overall manufacturing sector.

Table 9: Trend of sub-sectoral GVA shares in overall manufacturing sector during 2005 to 2015

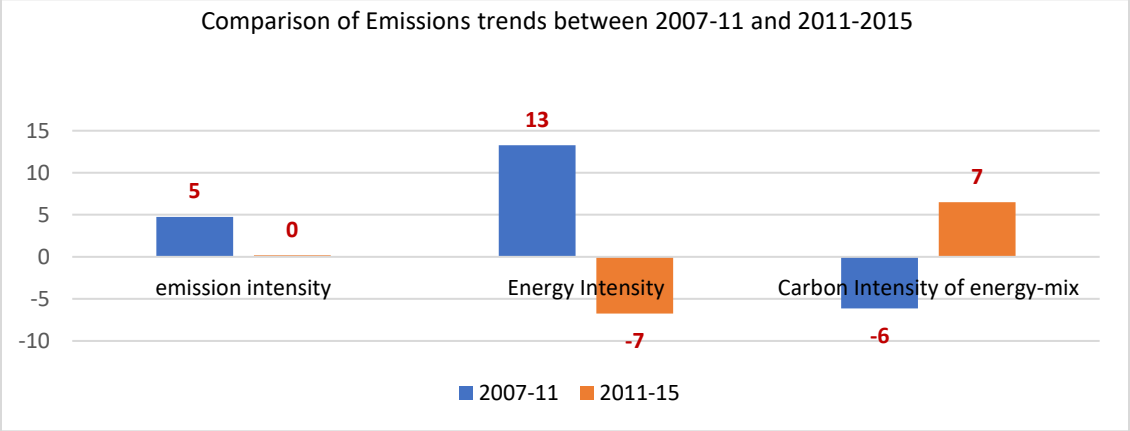
Industry Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Chemicals & fertilisers	17%	15%	14%	16%	16%	15%	16%	16%	16%	17%	15%
Food Processing, Beverages and Tobacco	12%	11%	13%	13%	10%	11%	12%	10%	11%	10%	11%
Iron and Steel	14%	14%	14%	12%	14%	13%	13%	10%	10%	11%	11%
Machinery	17%	18%	20%	20%	20%	20%	21%	21%	20%	19%	18%
Non-Ferrous Metals	3%	3%	3%	2%	3%	3%	2%	2%	2%	2%	2%
Non-Metallic Minerals	5%	5%	6%	7%	5%	5%	5%	6%	5%	6%	7%
Non-specified Industry	5%	5%	5%	6%	9%	7%	6%	6%	8%	7%	7%
Pulp, Paper and Print	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Textile and Leather	12%	14%	12%	12%	10%	10%	10%	11%	13%	12%	10%
Transport Equipment	13%	12%	10%	10%	11%	13%	12%	14%	12%	15%	17%
Wood and wood products	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: Authors' Analysis

The energy intensity showed a similar trend to that of the emissions intensity even at the sub-national levels. At the aggregated levels it increased with a CAGR of ~ 1 per cent. Non-ferrous metals, machinery, and non-metallic industries (primarily cement manufacturing) showed a decreasing trend in energy intensity with a CAGR of 8 per cent, 8 per cent, and 2 per cent respectively. While chemicals and fertilizer and iron and steel showed an increase in their energy intensity levels. These sectors increased with a CAGR of ~ 4 per cent and ~ 10 per cent respectively (Refer to Annexure 6).

The carbon intensity of energy-mix (also referred as carbon intensity) across the industrial sector showed a consistent decrease till 2010 and increased to the initial levels thereafter (Refer to Annexure 8). Figure 3 compares the intensity trends of the manufacturing sector in the state across the two time-periods –2007 to 2011 (referred as the first period) and 2011 to 2015 (referred as the second period).

Figure 3: Intensity trends compared between 2007 -2011 and 2011 -2015



Source: Authors' Analysis

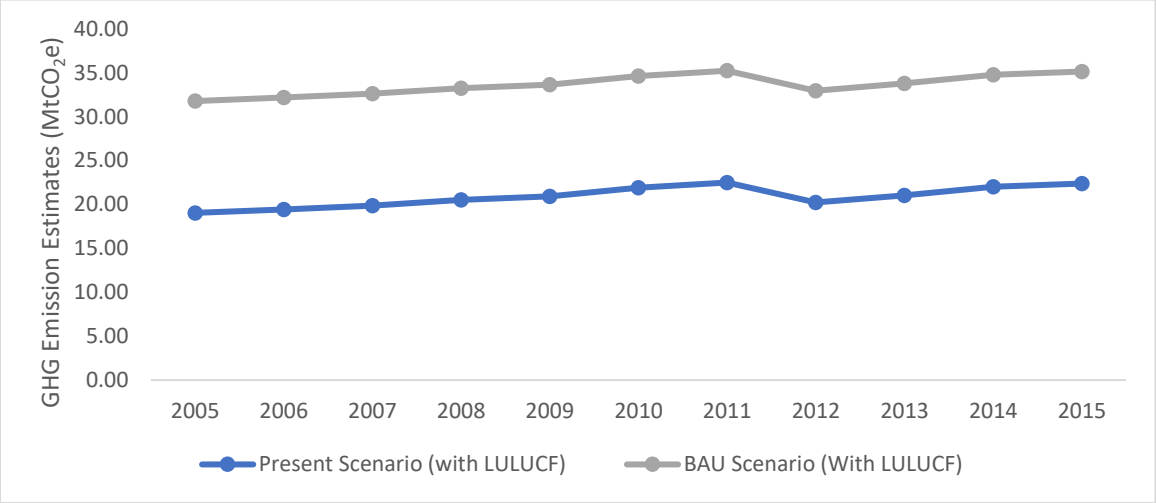
It can be seen that in the first period, the emissions intensity increased by 5 percent, which is driven by 13 percent an increase in energy intensity and a 6 percent reduction in carbon intensity of energy mix. In the second period there was no observed change in the emissions intensity levels. However, unlike the previous period, the energy intensity of production showed a decrease indicating the implementation of policy interventions during the period. This corresponds well with the fact that majority of the policies enacted such as PAT-I, RTS and CDM have reaped GHG reduction benefits over the latter half of the assessed period. However, these benefits achieved through energy efficiency improvements have been offset by the increasing carbon intensity of the energy mix. The energy mix has been primarily dominated by coal with interim peaks of in natural gas consumption between 2008 and 2009.

Chemicals and fertilizer industry showed a consistent increase in the share of gas from ~ 3 per cent in 2005 to ~ 23 per cent in 2015 and a decrease in the share of coal (~ 68 per cent in 2005 to ~ 52 per cent in 2015). This indicates a move towards adopting cleaner fuels. On the other hand, iron and steel sector show increase in utilization of coal (~ 48 per cent in 2005 to ~ 83 percent in 2015), whereas gas consumption peaked only in 2008 (~ 56 per cent) and 2009 (~ 48 per cent). In the non-metallic minerals sector, coal and grid electricity has replaced petroleum fuels in their energy mix during the period. One common trend that existed across majority of the sectors is the sudden increase in gas consumption between 2008 and 2009.

One can possibly attribute this to the increase levels of domestic gas production during that period (MoP&NG, 2017).

In overall, majority of the fuel share is still met by coal (54 per cent in 2015), therefore a shift towards cleaner fuels can help reduce specific energy consumption especially from energy intensive industries in the state. For instance, sectors like iron and steel, non-metallic, paper, pulp and print and textile industries have majorly relied on coal while showing marginal uptake of natural gas.

Figure 4: Impact of AFOLU Policies in Gujarat (2005 to 2015)



The emission scenarios[34] in this assessment have been bifurcated into two types, the present scenario and the business as usual (BAU) scenario[35]. The present scenario is the actual GHG emissions estimated for Gujarat from 2005 to 2015[36]. This scenario accounts for reduction/emissions as a result of policy implementation from 2005 onwards in Gujarat. Therefore, to arrive at the business as usual scenario (BAU), the impact of the implemented policies and schemes (as per data availability) was accounted. The total awarded emissions were subtracted while the removals from each policy were added to the present scenario emissions to arrive at the BAU trendline (2005 to 2015). Each of the scenario has been depicted inclusive of the emissions/removals from Land use, land-use change, and forestry (LULUCF).

It was observed that most of the policies falling under the LULUCF category removed a major part of the AFOLU sector emissions and their implementation should be strengthened further. This can be ascertained from the magnitude of deviation between the present (22.40 $MtCO_2e$) and the BAU scenario (35.13 $MtCO_2e$) which was around 12.73 $MtCO_2e$. There was, however, not much difference between present scenario and BAU scenario without LULUCF.

[34] Please note that as historical GHG emissions were not available beyond 2005, the BAU scenario could not be depicted using the conventional method.

[35] The trends in this figure do not represent removals from the National Parks and Sanctuaries to avoid double counting as the area under these is already a part of the forest area which has been used as the activity data to calculate the removals from Forest land. Also, the increase in carbon sink due to the Pradhan Mantri Ujjawala Yojana has also not been added into the trend as the said policy was launched in 2016 only.

[36] Source: GHG Platform India Phase-III Emission estimates (2005 to 2015)

Table 10: Detailed analysis of selected policies and/or mitigation actions

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
Energy Sector			
Solar Power Policy- 2009	Promote green and clean power, Promote R&D in solar, and increase local manufacturing	GHG emissions were estimated using year-wise all India grid emission data from CEA. This is mainly due to data gaps in electricity generation data in biomass and small hydro. Also, we feel that the state grid emission factor will be lower than the national grid emission factor, due to higher natural gas, nuclear share in the electricity generation mix (GETCL 2019, CEA 2016). Electricity generation data from biomass power plant between 2007 and 2010 were not available. 2011 electricity generation data were considered for these years, as installed capacity remained the same between 2007—2011. For small hydro, electricity generation between 2008—09 and 2010—11, is considered the same as the electricity generation in 2007—08 and 2011—12.	There is significant uptake of solar power plants between 2009—2015. This has contributed to considerable reduction in GHG emission from power sector. Prior to 2009, there were no solar installations. Solar power policies have driven solar installations during this period. However, market conditions, capital cost of solar power plant and import duty waivers for solar panels might also have contributed to the increase in solar installations. Analysis of impact of these factors on RE uptake is out of scope of the current study.
Solar Power Policy- 2015	Promote green and clean power, reduce fossil-fuel dependency and reduce cost of renewable energy generation		
Wind Power Policy-2007, Amendment to Wind Power Policy-2007 in 2009	To accelerate the investment in wind-installed capacity and improve grid connectivity in wind farm locations		There is significant uptake of wind power plants between 2007—2015. Wind power policies have driven wind installations during this period. However, market conditions, including the capital cost of power plant might also have contributed to the increase in solar installations. Analysis of impact of these factors on RE uptake is out of scope of the current study.
Wind Power Policy-2013			
Subsidy for Residential Rooftop Solar Plants	To increase RTPV-installed capacity	Data on electricity generation from RTPV was not available. It was estimated from PVsyst V6.80 tool. Other specifications considered are: Type of PV - Silicon PV; Manufacturer - Canadian Solar	There is considerable increase in capacity additions of RTPV in 2015. The installed capacity has gone up by 2.4 times in 2015 compared to 2014 (PVsyst 2017). However, apart from subsidies, regulatory actions from DISCOMs and GEDA, market conditions like capital cost reduction of RTPV panels

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
			might also have contributed to the increase in RTPV installations. There is no government reports/documents available in public domain to analyse the impact of these factors on RTPV uptake. Therefore, factors other than government subsides are not analysed in the current study.
UDAY/IPDS/R-APDRP scheme	To reduce T&D loss	Data on year-wise T&D loss, electricity consumption and electricity generation were taken from CEA general review books (CEA 2006) (CEA 2007) (CEA 2008) (CEA 2009) (CEA 2010) (CEA 2011) (CEA 2012) (CEA 2014)	There is a significant reduction in T&D loss between 2005-2015.
PAT scheme	To improve plant efficiency of thermal power plants	Year-wise heat rate were taken from GSERC tariff orders (GERC 2015) (GERC 2016)	Thermal power plants in Gujarat are operating at high efficiency compared to plants in other states. Therefore, only marginal CO_2 savings is seen with efficiency improvement.
Bus Rapid Transit System (BRTS) Ahmedabad	Reduce the need for travel, and the travel distance and dependence on motorised transport	Emission savings have been estimated from 2011 until 2015, for which the activity data is available. All new BRT buses are considered to be using Compressed Natural Gas (CNG)	The emissions reduction due to the introduction of BRTS could not be quantified due to the unavailability of fuel consumption data and hence, GHG impact due to introduction of BRTS in Janmarg on Ahmedabad's transportation could not be quantified. However, BRTS has enhanced mobility by inducing new trips of up to 13% of total commuters. Introduction of BRTS also resulted in overall reduction in trip costs in Ahemdabad (Darshini Mahadevia 2013).
Unnat Jyoti by Affordable LEDs for All (UJALA) scheme	To promote the use of energy-efficient LED bulbs as a substitute for incandescent or CFL bulbs in order to reduce CO_2 emissions	Energy savings have been estimated during the period May to December, 2015 as the programme was launched on 1 May 2015. The total number of LED bulbs sold in the State was used to estimate the total amount of CO_2 saved as a result of this policy. The methodology considered the replacement of 60W (MoP 2017) tube-lights with 9W energy-efficient LED	The policy managed to fulfil its objective of CO_2 reduction, as a reduction of 1.62 $MtCO_2$ was achieved in the first year of its launch in 2015 (MoP 2017). Continuous stringent implementation of this

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
		lights. The number of hours of usage per household was considered to be six (NITI Aayog 2016)	policy would be able to further reduce greenhouse gas emissions in the future.
Standards and Labelling Programme	To promote the use of energy-efficient, BEE star-labelled appliances in residential and commercial buildings	The energy saved per year was obtained from April 2006 till March 2015. The total GHG emissions saved per year was calculated by using the grid emission factor for Gujarat for that year and consequently, the total cumulative savings were calculated.	The Policy fulfilled its objective of CO_2 reduction through the use of energy-efficient ACs and refrigerators as the cumulative CO_2 saved amounted to 2.56 $MtCO_2$ from the residential building sector and about 2.72 $MtCO_2$ from the commercial building sector. This policy would help in achieving further savings as it is implemented for other appliances
Industrial energy use and IPPU			
Rooftop Scheme 2012	To promote the development of distributed rooftop-based solar PV projects	For estimating CO_2 reduction from RTS, initial step was to convert the RTS capacity installed into energy generated by applying the formula given below followed by multiplying the energy generated with yearly grid factor. Assumptions: *Where:* Installed capacity = Capacity installed in RTS Capacity Utilization Factor (CUF) = **18** per cent Actual number of plant operating days = 365 Actual number of operating hours = 24 Grid factor (kgCO2/kWh) = (2014=0.83; 2015=0.82; 2016=0.83; 2017=0.83; 2018=0.83)	As of 30th September 2018, manufacturing industry contributed to 0.316 $MtCO_2e$ reduction of CO_2 emissions and 0.025 by 2015. Due to non-availability of authentic data, emissions reduction has been calculated only for the period between October 2014 to September 2018.
Perform Achieve and Trade (PAT) Scheme Cycle I (2012-2015)	To mandate specific energy efficiency improvements for most energy intensive industries through target setting and tradable energy saving certificates	Assumptions: Where: *SEC base year* – Baseline energy consumption per unit of product for the baseline year (average of three years) *SEC target year* – Specific energy consumption for target year 2014 - 2015 *Product Output - Physical Output (average of three years)* Designated Consumers (DCs) consist of six manufacturing sectors (cement, chlor-alkali, fertilizer, iron and steel, pulp & paper, textile) and thermal power plants are excluded from	Overall this assessment estimates a reduction of 2.28 million tons of CO_2 and energy savings of 0.34 Mtoe on average for three years from 37 DCs of Gujarat

<table>
<tr><th>Policy and/or mitigation action</th><th>Objective</th><th>Methodological Assumption</th><th>Result/Opinion</th></tr>
<tr><td></td><td></td><td>assessment. Due to unavailability of data for specific energy consumption achieved in target year 2015, it is assumed all the DCs in Gujarat have achieved their specific energy consumption targets. The emissions reduction is estimated on an average of three years. Carbon Intensity of six sectors is calculated for the latest available year 2015</td><td></td></tr>
<tr><td>Clean Development Mechanism (CDM)</td><td>To assist countries in fulfilling their commitments to reduce emissions and achieve sustainable development</td><td>Around 22 CDM registered projects are identified that are specifically related to energy efficiency and fuel switch activities (UNEP DTU, 2019). For each project their annual estimation of emissions reduction in tonnes of CO_2e are extracted from individual project design documents available from CDM web portal. Project documents provide description of project activities along with annual estimation of emission reduction. Total estimated carbon reductions are calculated between the crediting starting from 2005 – 2015 for each project. Table below shows estimation conducted.
<table>
<tr><th>Years</th><th>Annual estimation of emission reduction in tonnes of CO2e</th><th>Total 22 proj assessed</th></tr>
<tr><td>2005</td><td>195958.3</td><td>2005-2010</td></tr>
<tr><td>2006</td><td>533096.17</td><td>5</td></tr>
<tr><td>2007</td><td>924890.47</td><td></td></tr>
<tr><td>2008</td><td>1049632.72</td><td>2011-15</td></tr>
<tr><td>2009</td><td>1099330.72</td><td>6</td></tr>
<tr><td>2010</td><td>1115663.52</td><td></td></tr>
<tr><td>2011</td><td>1428880.02</td><td></td></tr>
<tr><td>2012</td><td>1435146.27</td><td></td></tr>
<tr><td>2013</td><td>1329686.02</td><td></td></tr>
<tr><td>2014</td><td>1046790.52</td><td></td></tr>
<tr><td>2015</td><td>1004607.82</td><td></td></tr>
<tr><td>Total (tCO_2e) →</td><td>11163682.55</td><td></td></tr>
<tr><td>Total ($MtCO_2e$) →</td><td>11.16</td><td></td></tr>
</table></td><td>Thus, it was observed that emissions avoided are to the tune of 11.16 $MtCO_2e$ from 37 projects. Thus, total estimated CERs amount to 22 $MtCO_2e$.However, these are only estimated emissions that is envisaged from the project during its crediting years. It is difficult to measure the actual GHG reduction as this amount is provided in monitoring reports of individual projects which are available only for a few years and that too is very irregular. Hence this approach was not feasible and this is one of the major limitations in calculating actual GHG emissions reductions saved from CDM projects</td></tr>
<tr><td>LNG Terminal Policy 2012</td><td>To provide clean and cheaper energy for industrial purposes, and to encourage investments in building</td><td>As GHG impacts from gas could not be assessed because of unavailability of required data, the gas infrastructure in the state including production and utilization is assessed along with examining the trend of gas consumption</td><td>Increasing share of natural gas is observed in industries like petrochemical and refining and chemicals and fertilizers. However, it is</td></tr>
</table>

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	up infrastructure for receiving and re-gasification of LNG	within the fuel mix in industries. As on April 2018 there are 4551 Industrial Piped Natural Gas connections (PPAC, 2019).There are 3 LNG Terminals, Hazira LNG terminal with a capacity of 5 MMTPA, Dahej LNG Terminal (15 MMTPA), Mundra LNG Terminal (5MMTPA). Our analysis from Annual Survey of Industries (ASI) database indicates that there is increased uptake of gas in chemicals and fertilizer sector.	primarily used as feedstock in the fertilizer sector. The share of natural gas in industrial energy mix remained marginal during the analysis period. (2005-2015)
Interest Subsidy for technology upgradation	Subsidies provided to enable industries to improve their energy efficiency processes	Estimating the GHG impact is not possible since the datapoints required for estimating GHG reductions such as energy savings is not available in the public domain. Thus, the number of units that availed subsidy is provided with the subsidy amount from 2004-2005 to 2013-2014. Further data on type of technologies implemented was also not available.	Data is available from 2004-2005 to 2014--2015 for Gujarat and in overall Rs. 140708.22 lakhs of interest subsidy are given for 79314 units from the time period of from year 2004 -2005 to 2014 – 2015
Subsidy for quality certification (ISO 9000)	To assist in establishing and maintain an effective quality system while adhering to statutory and regulatory requirements.	ISO 9000 Certification deals with quality management systems that helps organizations to establish and maintain an effective quality system while adhering to statutory and regulatory requirements. Estimating the GHG impact is not possible since the datapoints required for estimating GHG reductions such as energy savings is not available. Thus, other parameters are assessed such as the subsidy amount disbursed in the state	Data is provided for 2004-2005 to 2014-2015 which amounts to Rs. 10,385.84 lakhs of subsidy given for quality certification (ISO-9000) for 4489 no of units
Technology and Quality Upgradation Support to MSMEs (TEQUP)	To encourage the use of energy efficient technologies in MSMEs to reduce cost of production and emissions	Estimating the GHG impact is not possible since the datapoints required for estimating GHG reductions such as energy savings due to uptake of energy efficient technologies is not available. Thus, other parameters are assessed such as the no of TEQUP programmes conducted and its participants. Reimbursement of National/International Product Certification are provided with total amount sanctioned and disbursed	In overall, the number of Product Certification Units under the MSME-DI Ahmedabad is over 173 from 2010-2011 to 2015-2016
Credit Linked Capital Subsidy Scheme (CLCSS)	It aims to facilitate technology up-gradation by providing 15 per cent upfront capital subsidy up to a maximum cap of ₹ 15.00 lakhs to MSE units	Estimating the GHG impact is not possible since the datapoints required for estimating GHG reductions such as improvements in energy consumption levels or fuel switches in the process of modernization or capacity expansion was not available.	Subsidy of Rs. 42847.304 lakhs provided for 7571 units from 2011 – 2012 to 2014-15 (up to 28.2.2015) for Gujarat
AFOLU			

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
Feed and Fodder Development Programme	• To acquaint farmers with improved fodders and help them to routinely use these, Fodder Minikits and necessary information related to fodder are provided by Seed Development Centers. • To prevent wastage of fodder in animal feed and subsequent loss to farmer, subsidy on purchase of Hand Operated Chaff cutter is provided to the farmers. • To protect livestock and livestock production from adverse climatic effects of heat, rain and cold subsidy is provided on establishment of cattle shed to the farmers.	• Feed additives and green fodder are provided to reduce enteric fermentation. However, since there is no evidence that the scheme covers this aspect, therefore, this section is not applicable.	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Quantity of feed additives added to the fodder • Quantity of Green fodder provided to the animals • Details of the target population • Improved emission factors due to better feed intake In our opinion these gaps in information need to be plugged to form adequate opinion on the policy under consideration.
Cattle and Buffalo Development Programme	• To educate Cattle owners for rearing the cattle in scientific manner and to make awareness and encourage Livestock owner to keep good high yield animal for the year. • To provides a good quality organic manure for improving. Crop fertility & crop yields. • To provide subsidy on shed	• Cattle become more productive, thus reducing the need for large flock sizes/ livestock population • Improve productivity with reduced or constant emissions However, since there is no evidence that the scheme covers this aspect, therefore, this section is not applicable.	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Details of the target population • Improved emission factors due to better feed intake In our opinion these gaps in information need to be plugged.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	construction, purchase of Chaff Cutter, Fogger system, milking machine and animal insurance for 3 years.		
Social Forestry Scheme	Promotion of tree planting on non-forest land to • To increase tree cover outside the forest areas. • To encourage participation of people and institutions in plantation related activities. • To increase the production of forest produce (Small timber, firewood, fodder, fruits) to meet the needs of the local population. • To enhance the productivity of the degraded farm lands through tree plantation. • To augment the income of farmers through agroforestry. • To create livelihood opportunities for rural poor. • To improve carbon stock in the tree cover outside forest areas.	• Area covered under social forestry was assumed to fall under open forests. • Increase of trees outside forests • Increased area under tree cover • Increased girth and height of trees	During 2015-16, a total of -51724908.24tCO_2e[37] was removed from the atmosphere due to the social forestry scheme.

[37] Refer to Annexure I for the calculation method.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
Soil & Moisture Conservation (SMC)	Enhancing the land productivity and increasing the soil moisture availability for a longer period.	• Area covered under SMC was assumed to fall under open forests. • Increase in soil organic carbon and area under SMC.	From 2005 to 2015, nearly 90743397.51[38] of GHGs were removed from the atmosphere due to SMC
Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	The objective of the Act is to ensure the conservation of forests. Wherever necessary, the act provides for a procedure to allow the use of forests for non-forest purposes.	Reduction in CO_2 removals	From 2005-06 to 2015-16 the total reduction in CO_2 removals was 2322555.38tCO_2e[39].
National Parks and Sanctuaries (Wildlife Protection Act 1972)	To provide for the protection of Wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto	Protection of area under the regulation	Till 2015-16, a total of 121249089.39tCO_2e[40] of CO_2 was removed from the atmosphere due to the protection of National Parks and Sanctuaries
Soil Health Card	• promoting Integrated Nutrient Management (INM) through judicious use of chemical fertilizers including secondary and micro nutrients in conjunction with organic manures and bio-fertilizers for improving soil health and its productivity • strengthening of soil and fertilizer testing facilities to provide soil test-based recommendations to farmers for improving soil	• Area covered under the scheme • Consumption of fertilizers by its type However, since there is no evidence that the scheme covers this aspect, therefore, this section is not applicable.	The specific data inputs that are required to make such a judgment include, in our opinion: • Actual Area covered under the scheme • Actual Reduction in the fertilizer usage due to the scheme In our opinion these gaps in information need to be plugged

[38] Refer to Annexure I for calculation method.
[39] Refer to Annexure I for calculation method.
[40] Refer to Annexure I for calculation method.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	fertility • ensuring quality control requirements of fertilizers, bio-fertilizers and organic fertilizers under Fertilizer Control Order, 1985 • upgradation of skill knowledge of soil testing laboratory staff, extension staff and farmers through training and demonstrations; promoting organic farming practices etc.		
National Food Security Mission	• Increasing production of rice, wheat and pulses through area expansion and productivity enhancement in a sustainable manner in the identified districts of the country • Restoring soil fertility and productivity at the individual farm level • Creation of employment opportunities • Enhancing farm level economy (i.e. farm profits) to restore confidence amongst the farmers • Creating awareness about the use of improved seed and	The following assumptions were kept under consideration: • The area under integrated nutrient management and plant protection chemical distribution for rice was assumed be the added to the existing harvest area of rice. • No overlap between the areas under integrated nutrient management and plant protection chemical distribution for rice. • Continuous flooding was assumed to the type of management practice adopted for rice cultivation.	8330.13 tCO_2e[41] of GHG emissions were added to the atmosphere due to rice cultivation from 2007-08 to 2011-12 under NFSM.

[41] Refer to Annexure I for calculation method.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	crop production technology.		
Waste Sector			
Municipal Solid Waste Management Project	• To develop the Solid Waste Management sector in Gujarat and enable implementation of MSW Rules, 2000. • Support management and funding of activities like land acquisition, hiring of technical consultants, waste characterization studies, other technical studies, waste processing and disposal facilities, etc. to strengthen collection, transportation, treatment and disposal of solid waste.	• Impact estimated for 2007-2015 wherein activity data is available • All newly constructed vermi-composting plants are operating well and processing MSW as required • GHG emissions generated from composting process itself are negligible and not accounted for Composition of solid waste as considered in the baseline remains the same over the period of implementation	Reduction in GHG emissions of 228 tCO_2e per year as of 2015 due to construction of vermi-composting facilities through the project between 2007 to 2015[42]
Total Sanitation Campaign[43]	• To improve the general quality of life in rural areas and accelerate sanitation coverage in rural areas through access to toilets to all by 2012 • Eradicating the practice of open defecation, in a community-led and people-centered manner.	• Impact estimated for 2007-2010 wherein activity data is available • All new IHHLs constructed are operational and in use • Latrine constructed is assumed to be of two pit pour flush latrine type[44] • In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 121,227 tCO_2e per year as of 2010 due to construction of IHHL as reported between 2007 to 2010 for the scheme Year-wise information on IHHLs, community sanitary complex and institutional toilets (in schools, anganwadi/ balwadi) constructed across 2005-2012 needed to better estimate GHG emissions impact over the assessment period
Nirmal Bharat Abhiyan (Clean India Campaign)	• Creation of Total Sanitation • Environment: The end of open defecation and achievement of a clean environment, where fecal waste is safely contained and disposed. • Adoption of hygienic practices: All people in the rural areas, especially children and	• Impact estimated for 2012-2014 wherein activity data[46] is available • All new IHHLs constructed are operational and in use • Latrine constructed is assumed to be of two pit pour flush latrine type[44] • In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 137,286 tCO_2e per year in total as of 2014 due to construction of toilets in households, schools, and anganwadis as reported from 2012 to 2014 for the scheme. ○ IHHLs: 32,952 tCO_2e per year ○ School toilets: 89,727 tCO_2e per year ○ Anganwadi toilets:

[42] See Annexure 11 for details of the calculation approach and Annexure 10 for activity data used

[43] See Annexures 10, 11, and 12 for details of the calculation approach, activity data used, and sample calculation for domestic wastewater emission impact estimation respectively

[44] As per Ministry of Drinking Water and Sanitation (2012): Handbook on Technical Options for On-site Sanitation.

[45] As per State of Environment Report Gujarat 2012, Table 4.3 – 'Discharge points of untreated waste water in urban centers of Gujarat'. Available at http://gujenvis.nic.in/PDF/waste.pdf

[46]The scheme was re-launched as Swachh Bharat Mission in October 2014. The construction of new toilets, as reported in financial year 2014-15, is considered to be achieved under this scheme due to lack of data on monthly or calendar year basis.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	care givers. • Shall adopt safe hygiene practice during all times. • Creation of clean physical environment in villages.		14,608 tCO_2e per year
Integrated low cost sanitation scheme	To convert/construct low cost sanitation units through sanitary two pit pour flush latrines with superstructures and appropriate variations to suit local conditions and construct new latrines where economically weaker section (EWS) households have no latrines and practice open defecation in urban areas.	• Impact estimated for 1980-2007 wherein aggregate[47] activity data is available as reported • All new IHHLs constructed are operational and in use • Latrine constructed is assumed to be of two pit pour flush latrine type[44] • In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 6,438 tCO_2e per year as of 2007 due to construction of IHHLs as reported between 1980 to 2007 for the scheme • Year-wise information on IHHLs, community sanitary complex and institutional toilets (in schools, anganwadi/ balwadi) constructed from 2005-2007 needed to better estimate GHG emissions impact over the assessment period
Nirmal Gujarat Sauchalaya Yojana	To set up efficient system to reduce waste, recycling resources and promote these practices as a way of life for sustainable development and clean environment	• Impact estimated for 2008-2010 wherein activity data is available • All new IHHLs constructed are operational and in use • Latrine constructed is assumed to be of two pit pour flush latrine type[44] • In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 5,752 tCO_2e per year as of 2010 due to construction of IHHLs as reported between 2008 to 2010 for the scheme • Year-wise information on IHHLs, community sanitary complex and institutional toilets (in schools, anganwadi/ balwadi) constructed across the assessment period needed to better estimate GHG emissions impact over the assessment period
Pay and Use Toilet Scheme	To establish better urban toilet standards and culture in the State of Gujarat through construction of community toilet complexes in urban areas	• All new community toilets constructed are operational and in use • Septic tank is the technology adopted for the community toilets[48] • In the absence of community toilets, in the baseline case the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45] • On an average, user traffic of 190 per day per community toilet is assumed[49]	• Additional GHG emissions of 17,107 tCO_2e per year as of 2015 due to construction of community toilets as reported between 2005 to 2015 for the scheme

[47] In the absence of annual data or data for the period of 2005 to 2015, cumulative number of IHHLs reported to be constructed from 1980 to 2007 is used to assess GHG impact.

[48] Ministry of Housing and Urban Affairs (2018): Advisory on Public and Community Toilets, Section 3.5.3. http://164.100.228.143:8080/sbm/content/writereaddata/Advisory%20on%20Public%20and%20Communuity%20Toilet.pdf

[49] Estimated based on average of number of users reported in Table 1, page 2 of Anantakrishnan, L. and Srivastava, P., 2018. Closing the gap between sustainability and affordability: Communal sanitation in urban slums of India. IN: Shaw, R.J. (ed). Transformation towards sustainable and resilient WASH services: Proceedings of the 41st WEDC International Conference, Nakuru, Kenya, 9-13 July 2018, Paper 2872, 6 pp. Available at https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/35522/1/Anantakrishnan-2872.pdf

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
UIG Scheme	• Integrated development of infrastructure services. • Ensure adequate funds to meet deficiencies in urban infrastructure service. • Plan development of cities. • Provide basic services to Urban Poor. • Scale-up delivery of civic amenities, provision of utilities and universal access to Urban Poor. • Redevelop old cities. Secure effective linkages between asset creation and asset management.	• Based on GUDC inputs, STPs installed in the cities of Ahmedabad, Surat, Porbandar, Vadodara and Rajkot were funded by UIG component of the JNNURM programme. It is assumed that all STPs commissioned in these cities from 2005 to 2015 are funded through the UIG scheme. • STPs using aerobic treatment technology are assumed to be 'not well managed/overloaded' and thereby lead to methane generation. In the absence of STPs installed the untreated wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 243,799 tCO_2e per year as of 2015 due to construction of sewage treatment plants as reported between 2009 to 2015 for the scheme • Year-wise information on sewage treatment capacity constructed through STPs from 2005 to 2014 needed to better estimate GHG emissions impact over the assessment period
UIDSSMT	• Improve infrastructural facilities and help create durable public assets and quality oriented services in cities & towns • Enhance public-private-partnership in infrastructural development • Promote planned integrated development of towns and cities.	• STPs installed in Junagadh along with 41 other Municipality were reported to be covered under UIDSSMT • STPs using aerobic treatment technology are assumed to be 'not well managed/overloaded' and thereby lead to methane generation. • In the absence of STPs installed the untreated wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• STP construction is envisaged to have led to additional GHG impact as seen in other similar programmes while resulting in positive impacts in terms of cleanliness, sanitation, hygiene, pollution and health • To quantify GHG emissions impact estimation over the assessment period, information needed incudes ○ Year-wise information on sewage treatment capacity constructed through STPs from 2005 to 2014 ○ Details of the type of treatment system (aerobic/anaerobic) in the new STPs
National river conservation programme	• To improve the water quality of the rivers, which are the major water sources in the country, through the implementation of pollution abatement works such as collection, transportation and treatment of municipal	• Impact estimated for 1995-2017 wherein aggregate activity data is available as reported • The breakup of installed sewage treatment capacity into aerobic and anaerobic treatment systems as reported for Gujarat[50](100% aerobic) by CPHEEO, 2005 is used for apportioning the STP capacity installed under this scheme • Wastewater treated in aerobic system is considered to be 'not well managed/over loaded' • In the absence of STPs installed the untreated	• Additional GHG emissions of 66,618 tCO_2e per year as of 2017 due to construction of sewage treatment plants as reported between 1995 to 2017 for the scheme • To better estimate GHG emissions impact estimation over the assessment period, information needed incudes

[50] CPHEEO (2005): Status of Water Supply, Sanitation and Solid Waste Management in Urban Areas. Estimated based on reported information referred from Appendix 2: Table B-2 and Table B-3, https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Status%20Study_Water%20Supply_Sanitation_Solid%20Waste%20Management_CPHEEO_2005.pdf

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	sewage, river front development, low cost sanitation, electric crematoria etc.	wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	○ Year-wise information on sewage treatment capacity constructed through STPs from 2005 to 2015 ○ Details of the type of treatment system (aerobic/anaerobic) in the new STPs
Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	• Augmenting urban infrastructure relating to road network, drinking water supply, sewage systems, solid waste management, civic facilities in urban areas, special projects to enhance quality of life in urban areas of Gujarat. Focus on cities not covered by JNNURM	• Impact estimated for 2005-2014 wherein activity data is available • Wastewater treated in aerobic system is considered to be 'not well managed/over loaded' In the absence of STPs installed the untreated wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of ~~243,799~~ 38,884 tCO_2e per year as of 2014 due to construction of sewage treatment plants as reported between 2005 to 2014 for the scheme Year-wise information on sewage treatment capacity constructed through STPs from 2009 to 2015 needed to better estimate GHG emissions impact estimation over the assessment period
Mahatma Gandhi Swachata Mission, Gujarat	• To ensure all cities, towns and villages should become clean; have fully functional sewerage system leading to improved health. • People living in cities, towns and villages should have access to a clean living environment. Achieve 100 per cent open defecation free India by 2019	• All new IHHLs constructed are operational and in use • Latrine constructed is assumed to be of two pit pour flush latrine type[44] • In the absence of IHHLs the wastewater is assumed to be discharged in water bodies (43.3%) and land (56.7%) as applicable for Gujarat[45]	• Additional GHG emissions of 23,379 tCO_2e per year as of 2015 due to construction of IHHLs as reported for 2015-16 for the scheme
Cross-cutting			
National Mission on Micro Irrigation	The main objectives of NMMI are as follows: • To increase the area under micro irrigation through improved technologies. • To enhance the water use efficiency in the country. • To increase the productivity of crops and farmers'	It was assumed that the total fertilizer consumption was that of urea.	From 2005-06 to 2012-13, the indirect emissions due to deposition of NH_3 on soil from fertilizers reduced by 46082.31tCO_2e[51].

[51] Refer to Annexure I for calculation method.

Policy and/or mitigation action	Objective	Methodological Assumption	Result/Opinion
	income. • To establish convergence and synergy among on-going government programmes. • To promote, develop and disseminate micro irrigation technology for agriculture/horticulture with modern scientific knowledge. • To create employment opportunities for skilled and unskilled person especially unemployed youth.		
Pradhan Mantri Ujjwala Yojna	• To provide a clean cooking fuel • To prevent hazards health related issues among the millions of rural populations due to use of fossil fuel.	The following assumptions were kept under consideration: • Number of connections released were equal to the number of number of households introduced to LPG (i.e. switching from firewood to LPG). • LPG usage in 100 households saves 1 ha of forests each.[52]	6938074.95[53] of GHG emissions were saved from being emitted into the atmosphere per year.

[52] https://www.wlpga.org/wp-content/uploads/2015/09/substituting-lp-gas-for-wood-carbon-and-deforestation-impacts1.pdf

[53] Refer to Annexure I for calculation method.

5. Conclusion

Energy Sector

Gujarat has high potential for wind and solar-based power generation and the state government has initiated and promoted it through several policies. In the context of GHG emissions avoided, the direct and indirect impact of policies implemented in energy sector amounts to about 53.11 $MtCO_2$[54]. There are some non-fossil fuel based power generation, like large hydro and nuclear, which is not accounted for under any of the State or Central policies. However, these power generation sources contribute significantly to the overall emission reduction scenario. Thus, the overall emissions reduction in the considered period (including large hydro and nuclear) was estimated to be 114.35 $MtCO_2$. It is important to note that the emissions reduced can be largely attributed to large Hydro and nuclear (which did not have any direct policy specification) installations. RTPV installations in the state have also contributed to GHG reduction in the period of interest. However, policies/mitigation actions/subsidies for their installations came up after our period of interest. Policies implemented in the renewable energy division resulted in high proportions of emission reduction, compared to other sectors (refer table 11).

The mitigation activities in PEG sector in Gujarat were majorly focused on deployment of RE-generating stations, and energy conservation measures to reduce T&D loss. Gujarat has the third highest RE installations after Maharashtra and Tamil Nadu (MoSPI 2017). Some of the major efforts by the Gujarat government to increase RE-installed capacity are electricity duty and cess exemption, CDM benefits for solar power projects and wheeling charges exemption. In case of transmission and distribution of electricity, the T&D loss in Gujarat (19.1%) is lesser than the Indian average (22.2%) in 2015 (Raghav 2017, MoSPI 2017). It can be seen that the mitigation efforts in power sector are on track. However, in case of demand sector, higher thrust for policies are required. Some of the interventions required in the key sectors are:

Transport: There is a need for public transport policy and push for electric vehicles in the state.
Buildings: Adoption of energy conservation building code for new construction; Push for energy-efficient appliances.
Agriculture: Replacement of inefficient irrigation pumps with BEE-star rated pumps; Promote solar irrigation pumps.

IPPU Sector

Although we have been able to quantify the emissions reduction from the polices and/or mitigation actions, their impact on the entire manufacturing sector was not noticeable. For instance, mandatory energy saving targets like PAT have been successful in mitigating GHG emissions, its coverage was limited to large energy consumers as identified under the Energy Conservation Act of 2010 (amendment). The cumulative emissions saved from PAT-I represented only ~ 1 per cent of the cumulative emissions for the period.

Reducing the existing thresholds by 30 per cent– 40 per cent will unlock further potential in reducing energy efficiency while avoiding significant increase in transaction costs per unit of energy targeted (Biswas, Janakiraman, & Ganesan, 2019). However, its impact on the reduction of emissions intensity may not turn out to be proportional, as already identified by the study. Even considering that energy intensive sectors like iron and steel, cement, ammonia, and petrochemicals to achieve the best-in-class

[54]Emission reduction from large hydro and nuclear power plants are excluded, as it doesn't fall under any policy.

energy efficiency levels within the next 10 years, the cumulative emissions from these sectors between 2010 and 2050 would still represent 13 per cent of the global carbon budget under the 2Degrees scenario (Biswas, Ganesan, & Ghosh, 2019). Thus, highlighting the need for policy actions that aims for deep decarbonisation of the industrial sector.

Trends of RTS indicated a rapid deployment in the industrial sector especially between 2017 and 2018 supported by net-metering regulations and revised guidelines on installation timelines. Considering that ~ 23 per cent of energy demand by the industrial sector is catered by electricity, indicates further potential of GHG mitigation from the RTS scheme.

Incentivising a transition to low carbon energy sources for meeting thermal energy needs of the sector will unlock a higher emissions reduction potential alongside with reduced air pollution. However, coal remains to be the primary fuel catering to majority of the energy needs and uptake of natural gas in the sector has largely limited to two sectors – chemicals and fertiliser and petroleum refineries (including petrochemicals). One of the major concerns of industries is the lack of availability of cheap and sustained supplies of natural gas in the economy. In order to incentivise a transition to a cleaner energy mix, fuel prices need to reflect the true cost of their environmental impact. One such intervention could be through levying a lower tax or rebate on natural gas and increasing tax on polluting fuels in order to ensure no additional burden on the state exchequer.

Out of all the policies and mitigation instruments evaluated, CDM has been able to achieve the largest emissions reduction. This clearly reiterates to the policymakers the potential of a carbon market in reducing the emissions footprint of the manufacturing sector. However, we have to inculcate key learnings from the CDM and PAT to design an effective market-based programme eliminating some of the known bottlenecks like target setting to incentivise continual improvement, and high transaction costs associated with project validation and M&V.

Recently, Gujarat even piloted the emissions trading scheme to control pollution for Particulate Matter in a selected industry cluster in Surat region by allotting permits by the Gujarat Pollution Control Board. In this platform, the industries can trade with one another for settling their allotted permit balance (GPCB, 2019). Gujarat is the first state in the country to pilot such a scheme and it would further benefit the state if they were to consider extending the scheme in covering GHG emissions as well. This presents an opportunity for Gujarat to present as the leading industrialised state in India both in terms of economic output as well as sustainable manufacturing practices.

AFOLU Sector

To conclude and reiterate, we provide below a summary of the policies that were considered and their impacts on climate change in the AFOLU sector. While we appreciate that many of these policies have objectives that are not primarily addressing climate change, nevertheless, it is important to integrate relevant climate change indicators to carry out a multi variable analysis of their usefulness and effectiveness for better decision making vis-à-vis climate change as India comes to grips with the issue.

Further, it is pertinent to note that around 12951664.16 tCO_2e of GHGs is being sequestered per year due to the implementation of some of these policies, while on the other hand around 216763.10 tCO_2e of additional GHGs is being emitted per year while implementing some others.

Waste Sector

The Government of Gujarat has undertaken significant efforts to address the challenges of solid waste generation and its management, and the lack of access to sanitation and infrastructure to handle and treat domestic wastewater. To improve municipal solid waste management, the Government of Gujarat invested in several processing facilities including vermicomposting plants and focused on augmenting waste management in large cities and promoting cluster based approach in smaller cities since 2005 through a combination of Central and State government programmes. With regard to domestic wastewater, there has been emphasis on construction of household toilets to improve hygiene and make urban and rural areas open defecation free. Efforts have been undertaken to expand the sewerage network and domestic wastewater treatment capacity in urban areas (Gujarat Ecology Commission, 2017).

The objectives of the policies, programmes and actions assessed for the Waste sector in this document are generally seen to not place direct emphasis on addressing impacts of climate change. This assessment has helped to look at the policies and actions from a climate mitigation lens, while noting that a number of these policies and actions are intended to tackle multiple development, social, economic, and environmental needs. The analysis provided in this document is primarily intended to identify and quantify, where possible, the GHG and potential non-GHG impacts (refer Annex 1) of policy actions. The findings can be used by decision makers and government institutions to gauge the implications of scaling up action and identify opportunities to make necessary modifications in policy design and implementation for enhancing mitigation impact.

As per our estimates, CH_4 emissions have reduced by 228 tCO_2e on annual basis as of 2015 due to increased processing of municipal solid waste through vermi-composting and thereby avoidance of emissions from its disposal (see Table 11). For domestic wastewater, it is estimated that CH_4 emissions of about 660,489 tCO_2e in total are being additionally emitted on an annual basis due to implementation of actions relating to domestic wastewater.

While the increase in GHG emissions from domestic wastewater related actions may seem significant, it is important to view these GHG impacts in the light of the scale of implementation and the contribution of the actions to addressing the sanitation gap while also delivering other benefits such as improved public health and hygiene, improved quality of life, reduced land, water, and air pollution, employment opportunities for construction of new sanitation facilities ((Planning Commission, 2013).

The programmes assessed are reported to have led to the construction of over 3.8 million new IHHLs from 2005 to 2015, thereby delivering access to basic sanitation to a large number of people. Construction of new sewage treatment plants has augmented capacity to treat domestic wastewater in urban areas by nearly 1,500 MLD, which is significant with total sewage generation reported to be 4,119 MLD in 2015 (Gujarat Ecology Commission, 2017). The implementation of these actions is expected to have delivered positive impacts in terms of cleanliness, sanitation, hygiene, land and water pollution, public health, and quality of life.

It is also important to note why GHG emissions have increased as compared to the baseline condition:

- In the absence of the IHHLs, community toilets, and sewage treatment plants, the wastewater would find its way to water bodies and to land[55], conditions under which methane generation is

[55] 56.7% of untreated wastewater in Gujarat state is discharged to land while remaining 43.3% is discharged into sea, river and lake. As per State of Environment Report Gujarat 2012, Table 4.3 – 'Discharge points of untreated waste water in urban centers of Gujarat'. Available at http://gujenvis.nic.in/PDF/waste.pdf

lower. Discharge of wastewater into sea, river and lake has a methane correction factor[56] (MCF) of 0.1 as per the 2006 IPCC Guidelines. Wastewater discharged into land decomposes largely under aerobic conditions, thereby not leading to CH_4 emissions and having no MCF value attributed to it[57].

- On the other hand, household latrines have MCF value of 0.1 when used by 3-5 persons while community latrines (and ones connected to septic tanks) have a higher MCF value of 0.5. This translates to GHG emissions from wastewater rising from 7.7 kg CO_2e per capita in the absence of IHHLs to 17.9 kg CO_2e per capita once IHHLs have been constructed.
- For sewage treatment plants, MCF value of 0.8 is applicable for anaerobic reactors/digesters and MCF of 0.3 applies to aerobic treatment-based plants which are not well managed and overloaded. This implies that GHG emission for every MLD of wastewater in Gujarat is seen to increase by nearly 7 times to 274,525.8 kg CO_2e once sewage treatment plants are installed as compared to 39,433.1 kg CO_2e when this wastewater is being discharged without any treatment in place.

Thereby, the peculiarity of improved wastewater collection and treatment systems having higher methane generation potential results in higher GHG emissions as compared to emissions in the baseline condition.

Improvements in wastewater collection and treatment infrastructure are much needed to progress up the sanitation ladder and offer opportunities to capture and mitigate CH_4 emissions, which would not exist in the absence of such infrastructure. Latrines with pits have higher GHG emission impact (Kulak M., 2017). CH_4 emissions from on-site sanitation (household and community latrines) can be reduced through use of aerobic treatment and anaerobic capture of CH_4 generated before its release to the atmosphere.

Significant opportunities exist for emission mitigation in STPs, particularly the ones using anaerobic process for domestic wastewater treatment, with around 30 percent of CH_4 generated in such systems being lost as dissolved gas in the treated effluent (Global Methane Initiative, 2013). Anaerobic wastewater treatment systems are more beneficial than aerobic processes because of the potential for CH_4 capture and recovery which may be used beneficially or directed to a flare, leading to decreased GHG emissions while using lower energy in comparison to aerobic processes. Anaerobic systems also result in lower sludge disposal costs. Biogas generated from anaerobic digesters can also be used on-site to offset the use of conventional fuel that would otherwise be used to produce electricity and thermal energy. Such mitigation opportunities need to be considered during infrastructure creation through policies and programmes. Improved management of existing aerobic treatment based plants can contribute to lowering their emission generation potential. The 'methane correction factor' value for 'not well managed aerobic systems' is 0.3 as against a 'methane correction factor' value of 0 (and therefore no CH_4 emission) for 'well managed aerobic treatment systems'. Therefore, it is important that policies and programmes also promote efficient management of aerobic treatment systems that are constructed.

[56]Methane Correction Factor (MCF) is an indication of the degree to which the wastewater treatment system is anaerobic (and thereby generates GHG emission) and this parameter varies with the type of treatment or discharge pathway. The emission factor EF_j for a given type of treatment system or discharge pathway is a product of the maximum CH_4 producing potential (Bo) (default value of 0.6 kg of CH_4/kg BOD as per 2006 IPCC Guidelines) and the respective MCF value for that particular wastewater treatment and discharge system.

[57] As derived from 2006 IPCC Guidelines, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Figure 6.1, Table 6.1, and Table 6.3. Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

There is a need to strengthen processes for data reporting and archiving to accurately and consistently capture requisite information to undertake such policy evaluation exercises. Year-on-year information on installation of sewage treatment plants and toilets was not available across most programmes and schemes over their period of implementation. The information is available on an aggregate basis (i.e. from commencement of programme until latest year) and in some instances beyond the analysis period. In addition, inconsistencies were observed with regard to the quality of data available on the implementation and achievements of the programmes and schemes. For instance, the IHHLs reported to be constructed under Total Sanitation Campaign is greater than the Census count[58]. Therefore reliably assessing the impacts of various programme or scheme within a particular timeframe is challenging.

Table 11: Summary of policies and/or mitigation actions assessed of all sectors

Energy Sector		
No. of policies and/or mitigation actions (Total)	**8**	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**53.11 $MtCO_2e$ (2005-2015)**	
Policy/Programme/Mitigation Action	**Current Status**	**GHG Impact/ Data required to calculate the Impact**
Installation of solar power plants	Under implementation	4.44 $MtCO_2e$(2009-2015)
Installation of wind power plants	Under implementation	28.16 $MtCO_2e$ (2007-2015)
Installation of rooftop solar plants	Under implementation	0.09 $MtCO_2e$(2015)
Improvement of T&D infrastructure	Under implementation	7.48 $MtCO_2e$(2005-2015)
Improvement of plant efficiency (thermal power plants)	Under implementation	5.65 $MtCO_2e$(2012-2015)
Bus Rapid Transit System (BRTS) Ahmedabad	Under implementation	0.57 $MtCO_2e$(2007-2015)
Unnat Jyoti by Affordable LEDs for All (UJALA) scheme	Under implementation	2.01 $MtCO_2e$ (2007-2015)
Standards and Labelling programme	Under implementation	6.66 $MtCO_2e$ (2007-2015)
IPPU		
No. of policies and mitigation actions (Total)	8	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**13.5** $MtCO_2e$ **(from 3 PMIs assessed)**	
Brief description of policy and/or mitigation action	**Current status at the time of report preparation [e.g. adopted, under implementation, implemented, completed]**	**Impact - GHG emission reduction, in ($MtCO_2e$) over a given time**
Industrial Energy use & IPPU		
Rooftop Solar Scheme 2012	under implementation	0.022 $MtCO_2e$
PAT Cycle I	Completed	2.28 $MtCO_2e$
Clean Development Mechanism	under implementation	11.16 $MtCO_2e$
LNG Terminal Policy 2012	under implementation	Not estimated due to lack of data

[58] As reported in section 3.1.2 of the Report of the Comptroller and Auditor General of India on Performance Audit of Total Sanitation Campaign /Nirmal Bharat Abhiyan for the year ended March 2014. Available at http://www.indiaenvironmentportal.org.in/files/file/cag%20report%20on%20total%20sanitation%20campaign.pdf

Interest Subsidy for technology upgradation	under implementation	Not estimated due to lack of data
Subsidy for quality certification (ISO 9000)	under implementation	Not estimated due to lack of data
Technology and Quality Upgradation Support to MSMEs (TEQUP)	under implementation	Not estimated due to lack of data
Credit Linked Capital Subsidy Scheme (CLCSS)	under implementation	Not estimated due to lack of data
AFOLU		
No. of policies and/or mitigation actions (Total)	**10**	
GHG emission reductions in total of all listed policy and/or mitigation actions over a given period of time (If possible)	**Data required to calculate the GHG emissions of all polices was not available in continuation from 2005 to 2015 therefore it is not applicable. However, an indication of the annual GHG emissions and removals due to these policies has already been provided in the text above.**	
Policy/Programme/Mitigation Action	**Current Status**	**GHG Impact/ Data required to calculate the Impact**
Feed and Fodder Development Programme	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Quantity of feed additives added to the fodder • Quantity of Green fodder provided to the animals • Details of the target population • Improved emission factors due to better feed intake
Cattle and Buffalo Development Programme	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Details of the target population • Improved emission factors due to better feed intake
Social Forestry Scheme	under implementation	-51724908.24tCO_2e[59]
Soil & Moisture Conservation (SMC)	under implementation	-90743397.51tCO_2e[60]
Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	under implementation	-2322555.38tCO_2e[61]
Wildlife Protection Act, 1972	under implementation	-121249089.39tCO_2e[62]
Soil Health Card	under implementation	Data required to make qualitative or quantitative judgement was not available. The specific data inputs that are required to make such a judgment include, in our opinion: • Actual Area covered under the scheme • Actual Reduction in the fertilizer usage due to the scheme

[59] Refer to Annexure 1 for assumptions and calculation method.
[60] Refer to Annexure 1 for assumptions and calculation method.
[61] Refer to Annexure 1 for assumptions and calculation method.
[62] Refer to Annexure 1 for assumptions and calculation method.

National Mission on Food Security	under implementation	8330.13tCO_2e[63]
Waste		
No. of policies and/or mitigation actions (Total)	11	
Policy/Programme/Mitigation Action	**Current Status**	**GHG Impact/ Data required to calculate the Impact**
Municipal Solid Waste Management Project	Under implementation	-228 tCO_2e per year as of 2015
Total Sanitation Campaign	Completed	+121,227 tCO2e per year as of 2010
Nirmal Bharat Abhiyan (Clean India Campaign)	Completed	+137,286 tCO_2e per year in total as of 2014
Integrated low cost sanitation scheme	Completed	+6,438 tCO_2e per year as of 2007
Nirmal Gujarat Sauchalaya Yojana	Ongoing	+5,752 tCO_2e per year as of 2010
Pay and Use Toilet Scheme	Ongoing	+17,107 tCO_2e per year as of 2015
UIG Scheme	Completed	+243,799 tCO_2e per year as of 2015
UIDSSMT	Completed	• Envisaged to have led to additional GHG impact as seen in other similar programmes while resulting in positive impacts in terms of cleanliness, sanitation, hygiene, pollution and health • Information needed to quantify GHG emissions impact incudes o Year-wise information on sewage treatment capacity constructed through STPs from 2005 to 2014 Details of the type of treatment system (aerobic/anaerobic) in the new STPs
National river conservation programme	Under implementation	+66,618 tCO_2e per year as of 2017
Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	Under implementation	+38,884 tCO_2e per year as of 2014
Mahatma Gandhi Swachata Mission, Gujarat	Under implementation	+23,379 tCO_2e per year as of 2015
Cross-cutting		
National Mission on Micro Irrigation	Under implementation	-46082.31 tCO_2e[64]
Pradhan Mantri UjjwalaYojna	Under implementation	-6938074.95 tCO_2e[65]

Note: Under GHG emissions impact, negative emission figures denote a decrease in GHG emissions due to policy action as compared to the baseline. Positive emission figures denote an increase in GHG emissions due to the policy action as compared to the baseline.

[63] Refer to Annexure 1 for assumptions and calculation method.
[64] Refer to Annexure I for assumptions and calculation method.
[65] Refer to Annexure I for assumptions and calculation method.

Annexures

Annexure 1: Impact Indicators

Table 12: Identification of impact indicators for policy and/or mitigation actions for all sectors

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
GHG impact					
Energy	Solar Power Policy-2009, 2015	GHG emissions of annual average 0.63 $MtCO_2$ was reduced between 2009—15	2009 – 2015	GHG impact between 2009—15 = $\sum_{2009\text{-}2015}$ Annual solar ground - mounted electricity generation in the year of interest × All India grid emission factor in the year of interest	Activity data: Solar electricity generation: Gujarat SLDC annual report 2010-11, 2017-18 Emission factor: All India grid emission factor: CDM- CO_2 Baseline Database (CEA)
	Wind Power Policy-2007, Amendment to wind power policy-2007 in 2009, Wind Power Policy-2013	GHG emissions of annual average 3.1$MtCO_2$ was reduced between 2007—15	2007—2015	GHG impact between 2007—15=$\sum_{2007\text{-}2015}$ Annual wind electricity generation × All India grid emission factor (weighted average) in the year of interest	Wind Electricity generation: CEA General Review Book (2004-05), MNRE website https://mnre.gov.in/state-wise-cumulative-wind-generation-data-billion-units-bu
	Subsidy for Residential Rooftop Solar Plants	GHG emissions of 0.044 $MtCO_2$ is reduced in 2015	2015—2020	GHG impact in 2015= RTPV electricity generation (2015) x All India grid emission factor (weighted average) in 2015 Electricity generation from RTPV in 2015= 1677 x cumulative installed capacity in 2015 1677 MWh is the annual generation from an RTPV of 1 MW installed capacity installed in Gujarat.	RTPV installed capacity: GEDA website https://geda.gujarat.gov.in/Gallery/Media_Gallery/Solar_Status-July_2019.pdf RTPV electricity generation is estimated from installed capacity using PVsyst v6.80 tool for given power plant specifications (see Annexure-II)

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
	IPDS/ R-APDRP, UDAY Scheme	GHG emissions of annual average 0.68 $MtCO_2$ is reduced between 2005—2015	2002—2019	GHG impact= $\sum_{2005-2015}$ Electricity generation avoided with Transmission & Distribution (T & D) loss improvement w.r.t previous year × All India grid emission factor (weighted average) in the year of interest	Activity data: T&D loss %: CEA General review books (2004-05 to 2014-15) Total electricity consumption: CEA General review books (2004-05 to 2014-15)
	Bus Rapid Transit System - Ahmedabad	GHG emissions of 0.567 $MtCO_2$ was reduced between 2005—15	2005—2015	Emissions avoided = (Population × Trips × Modal share without BRTS × EF) - (Population × Trips × Modal share with BRTS × EF)	Per-capita trip rate, mode share, and emission factor: Promoting low-carbon mobility in India and Gujarat development boardIndustrial Development Board
	Unnat Jyoti by Affordable LEDs for All (UJALA)	GHG emissions of about 1.62 $MtCO_2$ was reduced during May to December of 2015	May to December, 2015	GHG impact = No. of LED bulbs sold in 2015 × Difference in Wattagebetween incandescent and LED bulbs × Annual hours of usage Grid emission factor	Unnat Jyoti by Affordable LEDs for All – Conserve Electricity, Conserve Energy (MoP 2017)
	Standards and Labelling Programme	Cumulatively, GHG emissions of about 2.56 $mtCO_2$ and 2.72 $MtCO_2$ was saved from 2007 to 2015 in the residential and commercial building sectors, respectively	April, 2006 to March 2015	GHG impact = Energy saved by energy-efficient appliances × Grid emission factor	Energy Conservation and Commercialization in India (USAID 2009)
IPPU Renewable	Rooftop Scheme 2012	• Manufacturing Industry generated energy • GHG emissions avoided from captive	31st October 2014 to 30th September 2018	$\boldsymbol{Energy\ generated} = Installed\ Capacity * Operating\ days * Hours * Capacity\ Utilisation$ Emissions reduction = energy generated*grid emission factor	Bridge to India

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
		generation of power			
IPPU Manufacturing	Perform Achieve and Trade (PAT) Scheme Phase I (2012-2015)	• The carbon intensity of each sector • Emission reduction from each sector • Energy savings • Energy consumption No of ESCerts issued	2012-2015	Initial step followed for calculating emissions reduction consists of calculating the energy savings for each sector through the equation: $\boldsymbol{Energy\ Savings} = (SEC\ base\ year - SEC\ target\ year) * Product\ Output * 1.5$ Carbon Intensity is estimated individually for each 6 sectors assessed through the equation: $\boldsymbol{Carbon\ Intensity} = \frac{Emissions}{Energy\ consumption}$ Finally, emissions reduction is estimated by applying the equation: $\boldsymbol{Emissions\ Reduction} = Carbon\ Intensity * Energy\ Savings$	BEE, MoP
Manufacturing	Clean Development Mechanism (CDM)	• Amount of GHG emissions saved from CDM projects No of CERS issued	2005-2015	Around 22 CDM registered projects are identified that are specifically related to energy efficiency and fuel switch activities (UNEP DTU, 2019). For each project their annual estimation of emissions reduction in tonnes of CO_2e are extracted from	UNEP, DTU 2019 http://www.cdmpipeline.org/

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
				individual project design documents available from CDM web portal. Total estimated carbon reductions are calculated between the crediting starting from 2005 - 2015.	
Manufacturing	LNG Terminal Policy 2012	Unavailable to estimate emissions due to data limitations hence: • Gas production data Consumption in industries is estimated	2012-ongoing	This analysis has found declining share of gas production in the state from 3773 million Cub. mtrs to 1403 million Cub. mtrs and further dips to 389 million Cub. mtrs in 2018. In overall the gas consumed in industries does not show a significant rise (increasing from 1.060 mtoe in 2005 to 2.794 mtoe in 2015).	PPAC, https://www.ppac.gov.in/
Others schemes/ programmes	Interest Subsidy for technology upgradation/ Subsidy for quality certification (ISO 9000)/ TEQUP/CLCSS	GHG impact for these schemes was not possible as the data such as energy savings achieved from these schemes is not available	2004-2005 to 2014-2015	Parameters such as the amount of subsidies provided to units, total amount sanctioned and disbursed, awareness programs and participants are given	
AFOLU	Social Forestry	51724908.24 tCO_2e of GHG emissions reduced	2005-06 to 2015-16	GHG Impact= Area covered under Social forestry *Carbon stock density*(-44/12))/10^6 It was assumed that the area under social forestry fell in Open forests (OF).	Activity Data: Gujarat Forest Statistics for years 2005-06 to 2015-16 available at https://forests.gujarat.gov.in/guj-forest-statistics-pv.htm Carbon Stock Density: FSI State of Forest Report -2017 Carbon Stock in India(s) Forest http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
					india-forest-2017.pdf
	Soil & Moisture Conservation (SMC)	90743397.51tC O_2e of GHG emissions reduced	2005-06 to 2015-16	GHG Impact= Area covered under SMC*Carbon stock density*(-44/12))/10^6 It was assumed that the area under Soil & Moisture Conservation (SMC) fell in Open forests (OF).	Activity Data: Gujarat Forest Statistics for years 2005-06 to 2015-16, Forest Department of Gujarat available at https://forests.gujarat.gov.in/guj-forest-statistics-pv.htm Carbon Stock Density: FSI State of Forest Report -2017 Carbon Stock in India(s) Forest http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-india-forest-2017.pdf
	Diversion of forests for non-forest purpose under the Forest Conservation Act, 1980	-2322555.38tCO_2e of GHG removals decreased	2005-06 to 2015-16	GHG Impact= Area diverted *Carbon stock density*(-44/12))/10^6	Activity Data: Gujarat Forest Statistics 2015 – 2016, Forest Department of Gujarat https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf Carbon Stock Density: FSI State of Forest Report -2017 Carbon Stock in India(s) Forest http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-india-forest-2017.pdf
	Wildlife Protection Act,1972	121249089.39 tCO_2e of GHG emissions reduced		GHG Impact= Area under National Parks and Sanctuaries*Carbon stock density*(-44/12))/10^6	Activity Data: Gujarat Forest Statistics 2015 – 2016, Forest Department of Gujarat https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
					Carbon Stock Density: FSI State of Forest Report -2017 Carbon Stock in India(s) Forest http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-india-forest-2017.pdf
	National Food Security Mission	8330.13tCOe of GHG emissions were added to the atmosphere due to rice cultivation during the XIth Plan	2007-08 to 2011-12	Area under rice cultivation*EF*GWP of CH_4 The following assumptions were kept under consideration: • The area under integrated nutrient management and plant protection chemical distribution for rice was assumed be the added to the existing harvest area of rice. • No overlap between the areas under integrated nutrient management and plant protection chemical distribution for rice. • Continuous flooding was assumed to the type of management practice adopted for rice cultivation.	Activity Data: Derived from (Haque, n.d.)http://www.csdindia.org/pdfs/Project-reports/ROLE%20OF%20NATIONAL%20FOOD%20SECURITY%20MISSION%20(NFSM)%20IN%20IMPROVING%20AGRICULTURAL%20PRODUCTIVITY.pdf Emission factor- BUR-II http://envfor.nic.in/sites/default/files/press-releases/BUR%20Report%20Final%200219-ilovepdf-compressed.pdf
Waste (Solid Waste Disposal)	Municipal Solid Waste Management Project	228.5 tCO2e of GHG emissions reduced per year as of 2015 from vermi-composting	2007-2015	GHG Impact= Quantity of waste vermi-composted (avoided from being disposed in dumpsites) x GHG emissions per tonne of	Activity data: • MSW vermi-composted: CPCB Annual Reports from 2007-08 to 2015-16 (see Annexure V)

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
				MSW (2005-2015)	https://gpcb.gujarat.gov.in/webcontroller/page/annual-report • Vermi-composting plants constructed: Website of Urban Development Department – MSW project webpage https://udd.gujarat.gov.in/projects_SWM.php Emissions factor: • GHG emissions per tonne of MSW (2005-2015): Kolsepatil, N., Anandhan, S., Sekhar, A., (2019). Greenhouse Gases Emissions of India (subnational estimates): Waste Sector (2005-2015 series) dated July 1, 2019, Retrieved from: http://www.ghgplatform-india.org/waste-sector • IPCC 2006 Guidelines, Vol. 5, Chapter 3: Solid Waste disposal. http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf
Waste (Domestic Wastewater	Total Sanitation Campaign	Additional GHG emissions of 121,227 tCO_2e	2007-2010	GHG Impact= [Policy scenario emissions[66] generated with new	Activity data: IHHLs constructed: WaterAid, 2012:

[66] All emissions factors for applicable discharge and treatment pathways in the policy scenario and baseline scenario for all policies and programmes considered in this assessment have been sourced from 2006 IPCC Guidelines for National GHG inventories, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Table 6.2 and Table 6.3. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
Treatment and Discharge)		per year as of 2010 due to construction of IHHLs as reported between 2007 to 2010		household latrines used by 3-5 persons[67]] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets]	Sanitation Sector Financing in India, Table 2.13 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Bharat Abhiyan (Clean India Campaign)	Additional GHG emissions of 137,286 tCO_2e per year in total as of 2014 due to construction of toilets in households, schools, and anganwadis as reported between 2012 to 2014 • IHHLs: 32,952 tCO_2e per year • School toilets: 89,727 tCO_2e per year • Anganwadi toilets: 14,608 tCO_2e per year	2012-2014	GHG Impact = [Policy scenario emissions generated with new household latrines used by 3-5 persons] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets]	Activity data: IHHLs constructed: Swachhta status report 2016, Table 2.2, page 7 http://mospi.nic.in/sites/default/files/publication_reports/Swachhta_Status_Report%202016_17apr17.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Integrated low cost sanitation scheme	Additional GHG emissions of 6,438 tCO_2e per year as of 2007 due to construction of IHHLs as reported between 1980 to 2007	1980-2007	GHG Impact= [Policy scenario emissions generated with new household latrines used by 3-5 persons] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land,	Activity data: IHHLs constructed: WaterAid, 2012: Sanitation Sector Financing in India, section 3.7.4 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-

[67] In the emissions calculations for all policies and programmes where IHHLs were constructed, average BOD value per capita per day for Gujarat state has been sourced from NEERI (2010): Inventorization of Methane Emissions from Domestic & Key Industries Wastewater – Indian Network for Climate Change Assessment

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
				sea, river in absence of household toilets]	Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Nirmal Gujarat Sauchalaya Yojana	Additional GHG emissions of 5,752 tCO_2e per year as of 2010 due to construction of IHHLs as reported between 2008 to 2010	2008-2010	GHG Impact= [Policy scenario emissions generated with new household latrines used by 3-5 persons] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets]	Activity data: IHHLs constructed: WaterAid, 2012: Sanitation Sector Financing in India, Table 3.4 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Pay and Use Toilet Scheme	Additional GHG emissions of 17,107 tCO_2e per year as of 2015 due to construction of community toilets as reported between 2005 to 2015	2005-2015	GHG Impact= [Policy scenario emissions generated with new community latrines with septic tanks] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets]	Activity data: a) Community toilets constructed: • Website of Swachh Bharat Mission Urban – Gujarat: Pay and Use Toilet Scheme webpage http://www.mgsm-gujarat.in/Projects/pay-and-use-toilet-scheme-6 • WaterAid, 2012: Sanitation Sector Financing in India, Table 3.5 http://indiawashforum.com/wp-content/uploads/2016/05/Sanitation-Financing-Report-2011.pdf b) Type of latrine used (septic tank) to inform selection of MCF: • Ministry of Housing and Urban Affairs (2018): Advisory on Public and Community Toilets, Section 3.5.3. http://164.100.228.143:8080/sbm/content/writereaddata/Advisory%20o

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
					n%20Public%20and%20Community%20Toilet.pdf
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	UIG Scheme	Additional GHG emissions of 38,884 tCO_2e per year as of 2015 due to construction of sewage treatment plants as reported between 2009 to 2015 for the scheme	2005-2014	GHG Impact= [Policy scenario emissions generated with wastewater treatment in new sewage treatment plants] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of sewage treatment plants]	Activity data: a) Sewage treatment capacity constructed: • Information provided by GUDC Limited (see Annex IV) • Annual Report 2015-16, Gujarat Pollution Control Board, Government of Gujarat, section 5.10 https://gpcb.gujarat.gov.in/uploads/AR_2015_2016_ENG.pdf • Inventorization of Sewage Treatment Plants, Central Pollution Control Board, March 2015, Table 12. https://nrcd.nic.in/writereaddata/FileUpload/NewItem_210_Inventorization_of_Sewage-Treatment_Plant.pdf b) Information on biological oxygen demand (BOD): • Guide Manual: Water and waste Water Analysis, CPCB, Page: 69. http://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMjA0XzE1MjQ2NTA4OTNfbWVkaWFwaG90bzEyODI3LnBkZg==
Waste (Domestic Wastewater Treatment and Discharge)	National river conservation programme (NRCP)	Additional GHG emissions of 66,618 tCO_2e per year as of 2017 due to construction of sewage	1995-2017	GHG Impact= [Policy scenario emissions generated with wastewater treatment in new sewage treatment plants] – [Baseline emissions	Activity data: a) Sewage treatment capacity constructed: • NRCD - STPs Capacity Sanctioned/Created under National River Conservation Plan

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
		treatment plants as reported between 1995 to 2017		from direct discharge of untreated wastewater into a combination of land, sea, river in absence of sewage treatment plants]	https://nrcd.nic.in/writereaddata/FileUpload/30714343STPs%20capacity%20sanctioned%20created%20under%20NRCP.pdf b) Percentage of aerobic and anaerobic treatment systems: • CPHEEO (2005): Status of Water Supply, Sanitation and Solid Waste Management in Urban Areas. Estimated based on reported information referred from Appendix 2: Table B-2 and Table B-3, STPs Capacity Sanctioned/Created under National River Conservation Plan https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Status%20Study_Water%20Supply_Sanitation_Solid%20Waste%20Management_CPHEEO_2005.pdf
Waste (Domestic Wastewater Treatment and Discharge)	Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana (SJMMSVY)	Additional GHG emissions of 243,799 tCO_2e per year as of 2014 due to construction of STPs as reported between 2005 to 2014	2009-2015	GHG Impact= [Policy scenario emissions generated with wastewater treatment in new sewage treatment plants] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of sewage treatment plants]	Activity data: Sewage treatment capacity constructed and type of treatment technology: • Information handed over by GUDC (see Annex IV)
Waste (Domestic Wastewater	Mahatma Gandhi Swachata Mission, Gujarat	Additional GHG emissions of 23,379 tCO_2e	2015-16	GHG Impact= [Policy scenario emissions generated with new	Activity data: IHHLs constructed: MOSPI Swachhta Status

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
Treatment and Discharge; Solid Waste Disposal)		per year as of 2015 due to construction of IHHLs as reported for 2015-16		household latrines used by 3-5 persons] – [Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets]	Report 2016, Table 2.2 http://mospi.nic.in/sites/default/files/publication_reports/Swachhta_Status_Report%202016_17apr17.pdf
Cross-cutting	National Mission on Micro irrigation	46082.31tCO_2e of Indirect GHG emissions due to NH_3 deposition on soil from fertilizers reduced. However, total emission reduction could not be calculated due to lack of data on consumption of fertilizers by their type.	2005-06 to 2012-13	GHG Impact[68]= Indirect emissions due to NH_3 deposition on soil before MI-Indirect emissions due to NH_3 deposition on soil after MI. It was assumed that the total fertilizer consumption was that of urea.	Activity data: Derived from the study published by Ministry of Agriculture, Farmers Welfare & Co-operation, Government of India http://pmksy.gov.in/microirrigation/Archive/IES-June2014.pdf Emission factor- BUR-II http://envfor.nic.in/sites/default/files/press-releases/BUR%20Report%20Final%200219-ilovepdf-compressed.pdf
	Pradhan Mantri Ujjawala Yojana	As on 21.04.19, 6938074.95tCO_2e of GHG emissions were saved from being emitted into the atmosphere per year.	2016 to 21.04.19	GHG Impact= Area saved from wood extraction*Carbon stock density*(-44/12))/10^6 The following assumptions were kept under consideration: • Number of connections released were equal to the number of number of households introduced to LPG (i.e. switching	Activity Data: Derived from taking assumptions from (Johnson, n.d.) https://www.wlpga.org/wp-content/uploads/2015/09/substituting-lp-gas-for-wood-carbon-and-deforestation-impacts1.pdf Carbon Stock Density: FSI State of Forest Report -2017 Carbon Stock in India(s) Forest http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-

[68] The GHG Emissions were calculation using the equation. GHG Emissions= Urea consumption*Fraction of Fraction of gas loss through volatilized N from Urea application*Emission factor for Indirect Emissions - Atmospheric Deposition, Urea or Other fertilizer*(44/28) *310

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
				from firewood to LPG). • LPG usage in 100 households saves 1 ha of forests.[69]	india-forest-2017.pdf
Non-GHG impact[70]					
AFOLU Sector	Forestry Sector[71]	1369.6 lakh[72] employments generated in the forestry sector from 2004-05 to 2015-16	2004-05 to 2015-16	Based on record	Published on Gujarat Forest Statistics 2015 – 2016, Monitoring Branch, Principal Chief Conservator of Forests & Head of The Forest Force Gujarat State Gandhinagar https://forests.gujarat.gov.in/writereaddata/images/pdf/GFS_2015-16.pdf
	Soil Health Card	421 jobs created	2015-16 to 2017-18	Based on Record	Published on the official Website of Soil Health Card https://soilhealth.dac.gov.in/Content/Manpower/Gujarat/GujaratManpowerSoilSamplesTesting.pdf
Waste Solid Waste Disposal	Municipal Solid Waste Management Project	• Improved soil and nutrient conservation through use of organic compost • Revenue generation through sale of compost • Reduced land, water, and air	2007-2015	Information to arrive at quantitative estimates for non-GHG impacts realized under the listed policies and programmes is not available	

[69] https://www.wlpga.org/wp-content/uploads/2015/09/substituting-lp-gas-for-wood-carbon-and-deforestation-impacts1.pdf

[70] It should be noted that only those policies have been listed in this section for which data was available to quantify the non-GHG impact (qualitative and quantitative) of the policy.

[71] This implies to all the schemes under the forestry sector.

[72] This number includes the employment generated by all the schemes under the Forestry sector.

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
		pollution • Employment generation for operating new vermi-compost and landfill facilities • Improved public health			
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	• Total Sanitation Campaign • Integrated low cost sanitation scheme • Nirmal Gujarat Sauchalaya Yojana • Pay and Use Toilet Scheme Mahatma Gandhi Swachata Mission, Gujarat	• Improved quality of life • Reduced land, water, and air pollution • Improved public health Employment/income generation for construction of new latrine facilities	2005-2015	Information to arrive at quantitative estimates for non-GHG impacts realized under the listed policies and programmes is not available	
Waste (Domestic Wastewater Treatment and Discharge; Solid Waste Disposal)	• UIG Scheme • UIDSSMT • National River Conservation programme Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	• Improved quality of life • Reduced land, water, and air pollution • Improved public health Employment generation for construction and/or operation of new waste and wastewater management facilities	2005-2015	Information to arrive at quantitative estimates for non-GHG impacts realized under the listed policies and programmes is not available	

Sector	Name of policy and/or mitigation actions	Impact Indicator	Period	Calculation method	Data Source(s)
Cross-cutting	National Mission on Micro irrigation	• Income of the farmers increased at rate of 68.02% from Rs 55703/Ha to Rs 93593/Ha • Cost of irrigation reduced by 49.30% from ₹11046/ha to ₹5599/ha	2005-06 to 2012-13	Based on literature	Derived from the study published by Ministry of Agriculture, Farmers Welfare & Co-operation, Government of India http://pmksy.gov.in/microirrigation/Archive/IES-June2014.pdf

Annexure 2

Sample calculation to assess the impact of the Energy Sector

Public Electricity Generation

Sample calculation for CO_2 emissions savings from electricity generation from fossil-free sources are provided below:

Wind sector:

$$CO_2 \text{avoided with wind power generation}_{2014-15} = Electricity\ generation\ (GWh) * All\ India\ grid\ emission\ factor_{2014-15}\ (kg/kWh)$$

= 5,660* 10^6 * 0.83 *10^{-9}= 4.7 Mt CO_2

Solar RTPV:

Since, data on electricity generation from RTPV is not available, we estimated it using PVsyst V6.80 tool.
Specifications for PV: Silicon PV (Canadian Solar); module size- 330 W_p.
Based on these assumptions, annual electricity generation from a 1 MW solar PV located in Gujarat is 1677 MWh.

$$\text{Electricity generation from RTPV}_{2014-15} = Installed\ capacity_{2014-15}\ (MW) * 1677\ MWh/MW$$

= 16 * 1677 *10^{-3} = 26 GWh

$$CO_2\ avoided\ with\ RTPV\ power\ generation_{2014-15} = Electricity\ generation_{2014-15}\ (GWh) * All\ India\ grid\ emission\ factor_{2014-15}$$

= 26 * 10^6 * 0.83 *10^{-9} = 0.02 Mt CO_2

Reduction in T&D loss

Step 1: For any given year, electricity demand and T&D loss are used to estimate electricity required by the generating units

$$\text{Electricity requirement (based on T\&}D\ loss\ in\ 2013—14) = \frac{Electricity\ demand_{2013-14}}{(1 - T\&D\ loss\%)_{2013-14}}$$

= 66,878/ (1-18.11%) = 90,231 GWh

Step 2: Using the electricity requirement from previous step and the subsequent year's generation (available from CEA), we calculate the electricity avoided due to T&D improvements between these years.

$$Electricity\ avoided_{2014-15} = Electricity\ generation_{2014-15} - [Electricity\ generation_{2013-14} * T\&D\ loss\ (\%)_{2013-14}]$$

= 91,538 - 90,231

= 1,308 GWh

Step 3: CO_2 avoided with T&D improvement = Electricity avoided$_{2014\text{-}15}$ (kWh)* All India grid emission factor (kg/kWh)

= 1,308 * 0.83*10^{-3} = 1.09 Mt CO_2

Transport:

Calculation method for CO_2 emissions savings from mitigation action of implementing BRTS

The savings in emissions by the implementation of BRTS in Ahmedabad were calculated by estimating the difference in emissions in the city without BRTS in the modal structure and with BRTS. To estimate the emissions, the following equation has been used.

$$Emissions\ CO_2 = \sum_{i=1}^{n} P * T * S_i * L_i * F_i$$

Where
i – Represents the modes 1 to n
P – Population
T – Per capita trip rate
S – Modal structure/share (%)
L – Average trip length for a given mode (km)
F – Emissions factor of a given mode (gCO2/km)

To estimate the emissions, key data such as the population of Ahmedabad, per capita trip rate, modal structure, average trip length and emissions factors were sourced from various published government statistical reports, studies and other literature. The table below provides a summary of data used and sources.

Table A2.1: Mode-wise key transport parameters

Mode Structure	**Bus**	**BRTS**	**Car**	**2W**	**3W**	**Source**
2006	15.00%	-	3.10%	35.00%	8.80%	(Joshi, Mahadevia and Datey 2012)
2011	8.40%	10.50%	2.50%	25.30%	8.30%	
Average trip length (km)	12	12	11.2	6.8	5.2	
Average vehicle occupancy	28.4	45	1.08	1.02	1.02	(Bajracharya 2008)

Table A2.2: Ahmedabad travel characteristics

Annual Utilisation	254 days	(Bajracharya 2008)
Per capita trip rate	1.16	(GIDB and GoG 2006)

Sample calculation for CO_2 emissions savings estimation from BRTS in Ahmedabad

A. Calculation of emissions before the implementation of BRTS

Step 1: Estimating the passenger transport demand in passenger kilometer (pkm)

The passenger transport demand for a given mode (For example car) in a given year is estimated using the equation below.

$$Passenger\ kilometer\ (pkm) = \sum_{i=1}^{n} P * T * S_i * L_i$$

- Population of Ahmedabad in 2011 – 6412713.12
- Per capita trip rate – 1.16
- Modal share of car – 3.1%
- Average trip length by a car – 11.2 km

$$Passenger\ kilometer\ (pkm) = * 1.16 * 3.1\% * 11.2$$

$$Passenger\ kilometer\ (pkm) = 2212601$$

Annually, the passenger transport demand by car = 6412713.12 pkm * annual utilisation
= 2582733 * 254
= 656 million pkm

Step 2: Calculation of emissions for the estimated passenger transport demand

The passenger transport emissions for a given mode are calculated by multiplying the emissions factor with the estimated transport demand of that mode as illustrated in the equation below.

$$CO_2\ Emissions = pkm * F$$

The emissions factors for various vehicles are listed in the table below

Table A2.3: Mode specific emission factors for Ahmedabad

2011	gCO_2 / VKM	Source
2-Wheeler (2-Stroke)	37.7	(Prabhu and Pai 2011)
2-Wheeler (4-Stroke)	43.8	
Autorickshaw (Petrol 2-Stroke)	62.8	
Autorickshaw (Petrol 4-Stroke)	73.8	
Autorickshaw (CNG)	67.7	
Autorickshaw (LPG)	61.4	
Car (Petrol)	142.2	
Car (Diesel)	182.3	
Car (CNG)	142.2	
Bus (Diesel)	806.5	
Bus (CNG)	602.2	
BRTS (CNG)	602.2	

$$CO_2\ Emissions = 656 * \frac{142.2}{1.08}$$

Where 1.08 is the conversion factor for Vehicular Kilometer (VKM) to Passenger Kilometer (PKM).
CO_2 emissions from passenger cars in Ahmedabad before the implementation of BRTS are estimated to be 0.0863 $MtCO_2$. Similarly, CO_2 emissions from passenger cars in Ahmedabad after the implementation of BRTS in 2011 are estimated to be 0.0811 $MtCO_2$

Emissions savings from cars = Emissions before implementation of BRTS – Emissions after implementation of BRTS
= 0.0863 – 0.0811

= 0.0051 $MtCO_2$

Similarly the overall emissions savings with the implementation of BRTS in Ahmedabad has been estimated for other modes for each year. The sum of emissions savings from all the modes between 2009 and 2011 is the total emissions savings through the implementation of BRTS in Ahmedabad.

Buildings

Energy savings from replacement of incandescent bulbs with LED bulbs =
No of LED bulbs sold * (Wattage of incandescent bulb – Wattage of LED bulb) * Annual hours of usage

= 21819649* (60W -9W) * 2190 hours
= 2437 GWh
CO2 avoided = Energy savings from replacement of incandescent bulbs with LED bulbs * All India grid emission factor

= 2437 GWh * 0.825 t/MWh
= 2.01 $MtCO_2$

Annexure 3: Cumulative Policy Impact (IPPU Sector)

Table A3.1. Cumulative GHG impact ex-post

Cumulative GHG Reduction from Schemes												
Years assessed	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Emission reduction ($MtCO_2e$)
Rooftop Solar												0.025
PAT I												2.28
CDM												11.16
Total Reduction from Schemes →												**13.5**

Annexure 4: Analytical discussion for few key policies (IPPU Sector)

I. Rooftop Solar (RTS)

The rise in RTS installation has been more of a recent phenomenon. Particularly, the industrial sector seems to have responded well as shown in the analysis (Table A4.1). In particular, the industrial segment witnessed a steep rise with 98 MW net increase in capacity installed between 2017 to 2018 amounting to estimated reduction of 0.113 $MtCO_2e$ (BTI, 2018). This could be attributed due to supporting instruments introduced around 2016 such as the 'Net Metering Rooftop Solar PV Grid Interactive Systems Regulations 2016 which aimed to encourage RTS. Within the same year, the state government rolled out the guidelines 'Prescribing Timeline for Speedier installation of RTS plants'to promote quicker installation of RTS. It sets the timeline of approximately 4 months for system setup right from the registration process till the issuance of commissioning certificate (GoG, 2016). Industries have an advantageous position when it comes to meeting the high upfront costs for installation (approximately Rs. 48,300 per kWp) (kilowatt peak) (SMC, 2016). The manufacturing sector contributed to around 0.316 $MtCO_2e$ of emissions reduction from 2014 – 2018 which is higher than the amount reduced by residential and governmental buildings (0.183 $MtCO_2e$) and from commercial building (0.114 $MtCO_2e$) (table A4.1).

Table A4.1. Estimated emission reduction from Rooftop Solar in Gujarat

Year	Industry Capacity Installed (MW)	Industry Estimated CO2 reduction ($MtCO_2e$)	Commercial Capacity installed (MW)	Commercial Estimated CO2 reduction ($MtCO_2e$)	Residential & Govt Capacity installed (MW)	Residential & Govt Estimated CO_2 reduction (MtCO2e)
As of October 31, 2014	9.8	0.013	12	0.016	15.1	0.020
As of October 31, 2015	19	0.025	12	0.016	13	0.017
As of September 30, 2016	21	0.027	17	0.022	31	0.041
As of September 30, 2017	48	0.062	19	0.025	36	0.047
As on September 30, 2018	146	0.189	28	0.036	46	0.059
Total est. CO_2 reduction	Total →	0.316	Total →	0.114	Total →	0.183
Estimated reduction (as of 2015)	$MtCO_2e$	**0.025**				

Source: Authors' Analysis

II. Perform Achieve and Trade Scheme (2012-2015)

In PAT I cycle around 37 DCs identified have been identified for Gujarat excluding the power sector *(MoP, 2012)* covering 6 industrial sectors, viz., iron and steel, cement, fertilizer, pulp and paper, textile, chlor-alkali. In total, they consume about 6 million toe of energy. Iron and steel sector consume around 36 per cent of energy, followed by cement and fertilizer sectors which consume 32 per cent and 20 per cent of energy. Total savings in energy were estimated around 0.49 million toe further leading to an equivalent emissions reduction of 2.28 million tonnes of CO2 in phase I for Gujarat DCs. Table A4.2 provides analysis and table A4.3 shows national and state wise estimated target reduction for each sector.

Table A4.2 . Estimated emission reduction from PAT I Scheme

PAT CYCLE I - GUJARAT					
6 Sectors	**No. of Identified DCs**	**Energy Consumption (Million toe)**	**Share Consumption (per cent)**	**Energy Reduction (Million toe)**	**Emissions Reduction (million tons of CO2)**
Iron & Steel	4	2.16	36.11	0.184	0.97
Cement	8	1.90	31.86	0.150	0.64
Fertilizer	4	1.18	19.71	0.101	0.32
Pulp & Paper	2	0.13	2.13	0.009	0.05
Textile	12	0.27	4.59	0.025	0.13
Chlor- Alkali	7	0.36	6.07	0.035	0.17
Total	**37**	**6**	**100**	**0.504**	**2.28**

Source: Authors' Analysis

On sector specific energy consumption (SEC), the textile industries had the highest targeted reduction, which is around 0.10 toe per unit tonne of product (Table A4.3). However, the median of the targeted SEC of the textile industries in the state are still significantly high compared to the national targets. Similarly, for cement manufacturing plants, the median of the targeted SEC is also higher compared to the national targets. For the remaining sectors, the state level targets are either at par or lower when compared to the national targets. Significant potential can be seen in further increases in targets for the textile and cement sectors in-order to bring their SECs close to the national targets. Further, benchmarking of the sectoral SECs across international best practices for similar production processes will unlock higher mitigation potential.

Table A4.3. Comparison of sectoral targets (median) between state and national levels

PAT I Cycle Median Targets - Gujarat				PAT I Cycle Median Targets - National			
Industry type	Baseline SEC (toe/tonne)	Target SEC (toe/tonne)	Target reduction to be achieved (toe/tonne)	Industry type	Baseline SEC (toe/tonne)	Target SEC (toe/tonne)	Target reduction to be achieved (toe/tonne)
Iron & Steel	0.59	0.56	0.03	Iron & Steel	0.66	0.62	0.04
Cement	0.11	0.11	0.01	Cement	0.09	0.08	0.00
Fertilizer	0.37	0.36	0.01	Fertilizer	0.53	0.37	0.17
Pulp & Paper	0.61	0.58	0.03	Pulp & Paper	0.66	0.63	0.03
Textile	2.22	2.12	0.10	Textile	0.70	0.66	0.04
Chlor- Alkali	0.29	0.27	0.02	Chlor- Alkali	0.31	0.30	0.02

Source: (Ministry of Power, 2012)

III. LNG Terminal Policy 2012

Gujarat introduced its LNG Terminal Policy 2012 with the particular mandate of meeting its rising demand for natural gas by developing infrastructure, expanding natural gas market and to provide clean and cheaper fuel for industrial purposes (EPD, 2012). Key demand drivers for gas particularly from industries have arisen because of its perceived benefits over other fossil fuels with lower carbon emissions and environmental pollution for per unit of energy consumed. There is an increasing uptake of gas over the years in the chemicals and fertilizers industries where it is primarily used as a feedstock rather than fuel. However, majority of the manufacturing industry sectors (iron and steel, machinery, non-ferrous, non-metallic minerals, textile and leather) indicate an increasing trend of natural consumption as energy till 2010. One can plausibly attribute this trend to higher production (hence higher availability to non-priority sectors) of domestic natural gas during the period.

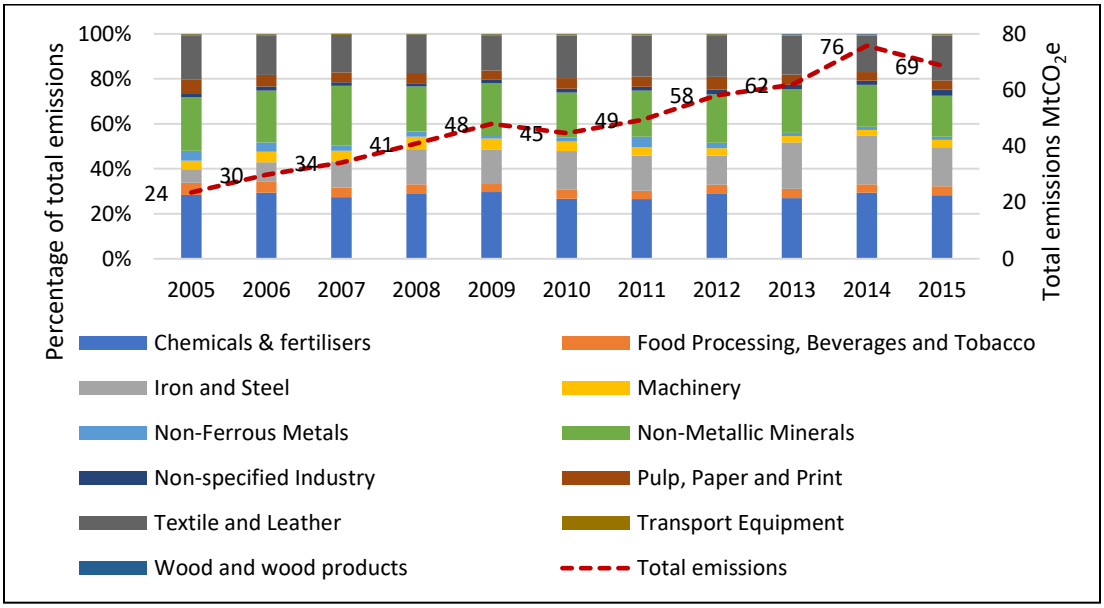
IV. Other Industrial policies and measures

Other industrial policies such as the ISO (9000) certification scheme, interest subsidy for technology upgradation, TEQUP, CLCSS provide assistance and subsidies for uptake of energy efficient technologies. This is evident from the states budgetary support towards the industrial sector. Amongst the major industrialised states, Gujarat has the third largest expenditure for the industrial sector (after Tamil Nadu and Maharashtra) and second largest for expenditure towards the MSME sector (after Tamil Nadu) (Biswas, Sharma, & Ganesan, 2018). However, due to unavailability of data, the impact on emissions could not be estimated.

Annexure 5: Manufacturing Sector Energy consumption and related emissions/emission intensity trends (IPPU Sector)

Total industrial energy consumption in Gujarat increased from 5 Mtoe in 2005 to 13 Mtoe in 2015 with a CAGR of 11 per cent – higher than the national energy use emissions growth rate. Chemicals and fertilizer sector are the single largest consumer of energy, roughly representing 32 per cent of total industrial energy consumption in 2015. Followed by non-metallic minerals and textile sectors both representing ~ 19 per cent of total energy consumption. The iron and steel sector with 17 per cent consumption in 2015, showed the highest growth rate (24 per cent CAGR) in energy consumption between 2005 and 2015.

Figure 5: Emission Trends of Industries in Gujarat (MtCO2e)



Source: Authors' Analysis

The associated energy derived emissions increased from 24 $MtCO_2e$ to 69 MtCO2e increasing with CAGR of 11 per cent during the period 2005 to 2015 (figure 1). Sectors like chemicals and fertilizers, non-metallic minerals, textile and leather, iron and steel contribute around 86 per cent of the share of emissions during 2015 and these sectors have also shown significant increase in emissions. Emissions from chemicals and fertilizers sectors increased from 7 $MtCO_2e$ to 19 $MtCO_2e$ between 2005 to 2015 with a CAGR of 11 per cent during this period. While iron and steel show a 12-fold increase in emissions from 1 $MtCO_2e$ to 12 $MtCO_2e$ with CAGR of 24 per cent in the same time period. Textile which is an important industry in Gujarat (since it contributes to a significant share in the exports) has shown nearly three times of increase from 5 $MtCO_2e$ to 14 $MtCO_2e$. Non-metallic mineral sector has doubled its emissions over this period with increasing CAGR of 8 per cent.

Annexure 6: Emissions Intensity trends from Industries in Gujarat (tCO2e/Million INR production output) (IPPU Sector)

Figure 6: Emissions Trends from Industries in Gujarat

Emission Intensity tCO2e/million INR

Emission Intensity 2.36 – 92.44

Industry	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Metallic Minerals	90.35	90.97	92.44	82.69	79.02	75.49	78.83	85.37	79.98
Pulp, Paper and Print	39.54	38.05	36.27	36.54	36.73	40.39	42.79	45.19	41.05
Textile and Leather	32.14	32.22	32.43	32.25	31.23	30.33	30.28	32.24	33.31
Iron and Steel	17.17	23.03	32.63	36.37	33.86	29.66	32.94	37.01	34.65
Chemicals & fertilisers	12.95	14.27	15.37	15.31	14.68	14.55	15.24	17.56	16.77
Non-Ferrous Metals	12.12	9.53	7.45	7.29	9.70	11.63	11.61	8.27	6.37
Wood and wood prod..	5.46	6.33	7.52	8.32	8.43	8.42	9.08	11.79	13.50
Food Processing, Bev..	6.13	5.52	5.12	5.07	5.22	5.47	5.75	6.28	6.11
Machinery	5.51	6.01	6.19	5.96	5.04	4.29	4.03	3.99	3.84
Transport Equipment	2.70	2.61	2.36	2.42	2.73	3.76	4.60	5.67	5.98
Non-specified Industry	4.41	4.37	4.05	3.76	3.38	3.26	3.30	3.00	3.05

Source: Authors' Analysis

Annexure 7: Energy Intensity Trends from Industries in Gujarat (tCO2e/toe) (IPPU Sector)

Figure 7: Energy Intensity Trends from Industries in Gujarat

Energy Intensity (toe/Million INR)

Energy Intensity 0.29 – 21.05

Industries	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-Metallic Minerals	19.97	20.13	21.05	18.97	17.89	16.68	17.28	18.64	17.12
Pulp, Paper and Print	8.40	8.14	7.81	7.86	7.83	8.52	8.95	9.41	8.50
Iron and Steel	3.11	4.74	7.77	9.11	8.27	6.22	6.53	7.33	6.85
Textile and Leather	6.20	6.38	6.76	6.91	6.67	6.24	6.04	6.33	6.47
Chemicals & fertilisers	2.79	3.29	3.70	3.68	3.36	3.06	3.25	3.99	3.88
Non-Ferrous Metals	2.65	2.07	1.63	1.69	2.27	2.67	2.64	1.79	1.32
Wood and wood prod..	0.70	0.83	1.10	1.30	1.39	1.37	1.39	1.65	1.75
Food Processing, Bev..	1.09	1.00	0.93	0.91	0.90	0.92	0.97	1.07	1.02
Machinery	0.95	1.11	1.20	1.15	0.89	0.65	0.56	0.53	0.49
Transport Equipment	0.35	0.32	0.29	0.30	0.35	0.47	0.56	0.64	0.64
Non-specified Industry	0.40	0.44	0.47	0.47	0.40	0.34	0.34	0.32	0.33

Source: Authors' Analysis

Annexure 8: Carbon Intensity Trends from Industries in Gujarat (tCO2e/toe) (IPPU Sector)

Figure 8: Carbon Intensity Trends from Industries

Carbon Intensity tCO2e/toe

Carbon Intensity 4.05 – 11.00

Industry	2007	2008	2009	2010	2011	2012	2013	2014	2015
Non-specified Industry	11.00	10.04	8.84	8.05	8.69	9.73	9.77	9.50	9.16
Transport Equipment	7.79	8.28	8.25	8.15	7.75	7.94	8.15	8.85	9.36
Wood and wood prod..	7.81	7.69	7.20	6.53	6.10	6.15	6.57	7.09	7.71
Machinery	5.80	5.49	5.22	5.30	5.93	6.66	7.18	7.62	7.89
Food Processing, Bev..	5.60	5.53	5.51	5.60	5.81	5.95	5.93	5.88	5.99
Textile and Leather	5.18	5.06	4.83	4.67	4.69	4.86	5.01	5.09	5.15
Iron and Steel	5.50	5.12	4.52	4.05	4.26	4.86	5.08	5.09	5.17
Pulp, Paper and Print	4.71	4.67	4.64	4.65	4.69	4.73	4.78	4.81	4.83
Non-Ferrous Metals	4.75	4.73	4.63	4.31	4.26	4.38	4.48	4.66	4.83
Non-Metallic Minerals	4.52	4.51	4.39	4.37	4.44	4.53	4.56	4.58	4.69
Chemicals & fertilisers	4.67	4.35	4.19	4.19	4.45	4.75	4.70	4.45	4.36

Source: Authors' Analysis

Annexure 9 AFOLU Sector

Table A9.1: Crop wise details of financial allocation and activities done under the National Food Security Mission during the XIth Plan

Crop	Financial Allocation	Activities
Rice	• 762 demonstrations on improved packages of practices to be given with a total of Rs 19 lakh to be spent on this activity. • 226 demonstrations on systematic rice irrigation to be given with a total of 7 lakh to be spent on this activity. • 101 demonstrations on hybrid rice to be given with a total of Rs 3 lakh to be spent on this activity. • Production of hybrid rice was not initiated in Gujarat • 990 quintals of hybrid rice targeted to be distributed with a total of Rs 20 Lakh to be spent on this activity. • 23220 quintals of HYV seeds targeted to be distributed with a total of Rs 116 lakhs to be spent on this activity. • 24920 ha of land to be under integrated nutrient management (lime/ micronutrients) with a total of Rs 125 lakh to be spent on this activity. • Plant protection chemical to be distributed to 12300 ha of land with a total of Rs 62 lakhs to be spent on this activity • 86 ha of land was targeted for Farmers Field School with a total of Rs 15 lakhs to be spent on this activity. • 500 pump sets to be distributed with a total of Rs 50 lakhs to be spent on this activity. • 5301 farm machineries to be distributed with a total of Rs 193 lakh to be spent on this activity.	• 509 demonstrations on improved packages of practices given • 155 demonstrations on systematic rice irrigation were given • 25 demonstrations of hybrid rice given • 7187 quintals of HYV seeds distributed • 8811 ha of land was under integrated nutrient management (lime/ micronutrients) • Plant protection chemical distributed to 11742 ha of land • 37 ha of land was under Farmers Field School • 500 pump sets were distributed • 6758 farm machineries distributed in this state
Wheat	• 4985 demonstrations on improved packages of practices to be given with a total of Rs 100 lakh to be spent on this activity. • 246500 quintals of HYV seeds targeted to be distributed with a	• 4942 demonstrations on improved packages of practices were given • 132111 quintals of HYV seeds distributed • 98401 ha of land was under

Crop	Financial Allocation	Activities
	total of Rs 1233 lakhs to be spent on this activity. • 141700 ha of land to be under integrated nutrient management (gypsum + micronutrients) with a total of Rs 709 lakhs to be spent on this activity • 1600 pump sets to be distributed with a total of Rs 160 lakhs to be spent on this activity. • 550 ha of land was targeted for distribution of sprinklers with a total of Rs 41 lakhs to be spent on this activity. • 252 Farmers Field School to be set up with a total of Rs 43 lakhs to be spent on this activity. • 2952 farm machineries to be distributed with a total of Rs 431 lakhs to be spent on this activity	integrated nutrient management (gypsum + micronutrients) • 1625 pump sets were distributed • 484 ha of land saw the distribution of sprinklers • 212 Farmers Field School set up • 4308 farm machineries distributed
Pulses	• 779 quintals of breeder pulses to be purchased from ICAR with a total of Rs 41 lakhs to be spent on this activity. • 41506 quintals of Foundation and certifies seeds of pulses to be produced with a total of Rs 415 lakhs to be spent on this activity. • 70809 quintals of Foundation and certifies seeds of pulses to be distributed with a total of Rs 850 lakhs to be spent on this activity. • Application of Integrated Nutrient Management was targeted at 215897 with a total of Rs 1161 lakhs to be spent on this activity. • 97254 ha of land to be under integrated pest management with a total of Rs 662 lakhs to be spent on this activity. • 1800 pump sets to be distributed with a total of Rs 180 lakhs to be spent on this activity. • 758 Farmers Field School to be set up with a total of Rs 129 lakhs to be spent on this activity. • Sprinklers to be distributed over 2116 ha of land with a total of Rs	• 176 quintals of breeder pulses purchased from ICAR • 37041 quintals of Foundation and certified seeds of pulses produced • 40667 quintals of Foundation and certifies seeds of pulses distributed • Application of Integrated Nutrient Management was at 195363 Ha • 88413 ha of land under integrated pest management • 2175 pump sets distributed in the state • 917 Farmers Field School set up • Sprinklers distributed over 698 ha of land • 6964 improved farm machineries purchased • 7606 technology demonstrations held

Crop	Financial Allocation	Activities
	159 lakhs to be spent on this activity. • 4318 improved farm machineries to be purchased with a total of Rs 608 lakhs to be spent on this activity. • 6500 technology demonstrations to be held with a total of Rs 130 lakhs to be spent on this activity.	

Annexure 10: Key activity data collected for policy and programme actions to estimate impact (Waste Sector)

Table A10.1: Key activity data collected for policy and programme actions to estimate impact (Waste Sector)

Policy/Programme	Activity data used for estimating GHG emission impacts	Period for which data corresponds to
Municipal Solid Waste Management project	Municipal solid waste vermi-composted: 1,167 tonnes per day (see Annexure 13 for details)	2007-2015
Total sanitation campaign	IHHLs constructed: 2,439,175 nos.	2007-2010
Nirmal Bharat Abhiyan (Clean India Campaign)	IHHLs constructed: 663,007 nos. School toilets constructed: 5,780 nos. Anganwadi toilets constructed: 941 nos.	2012-2014
Integrated low cost sanitation scheme	IHHLs constructed: 129,528 nos.	1980-2007
Nirmal Gujarat Sauchalaya Yojana	IHHLs constructed: 115,737 nos.	2008-2010
Pay and Use Toilet Scheme	Community toilets constructed: 1,102 nos.	2005-2015
UIG Scheme	Total sewage treatment capacity constructed: 1,043 MLD (see Annexure 12 for details)	2005-2014
National river conservation programme	Total sewage treatment capacity constructed: 285 MLD	1995-2017
Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana	Total sewage treatment capacity constructed: 157.8 MLD (see Annexure 12 for details)	2009-2015
Mahatma Gandhi Swachata Mission, Gujarat	IHHLs constructed: 470,393 nos.	2015-16

Annexure 11: Sample Calculation for estimation of GHG emission impact (Waste Sector)

Calculation method for CH_4 Emissions Impact Estimation from mitigation action of constructing new household latrines

$$CH4\ Emissions = (U * T * EF * ((TOW - S) - R) \quad \text{-------Equation 1}$$

Where,

CH_4 Emissions = Methaneemissions in inventory year, kg CH_4/yr
TOW = total organics in wastewater in inventory year, kg BOD/yr
S = organic component removed as sludge in inventory year, kg BOD/yr (default value of 0[73])
U = fraction of population in income group i in inventory year (value = 1.0 in this case)
T = degree of utilization of treatment/discharge pathway or system in inventory year (value =1.0 in this case)

EF = emissions factor, kg CH_4/kg BOD
R = amount of CH_4 recovered in inventory year, kg CH_4/yr (default value of 0[74])

The emissions factor EF for various type treatment system or discharge pathways is a function of the maximum CH_4 producing potential (B_o) and the corresponding methane correction factor (MCF) for the waste water treatment and discharge system.

[73] As per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6: Wastewater Treatment and Discharge. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

[74] As per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 6: Wastewater Treatment and Discharge and NEERI document on Inventorisation of Methane Emissions from Domestic & Key Industries Wastewater – Indian Network for Climate Change Assessment, 2010.

$$CH4\ Emission\ Factor\ EF = B_O * MCF \text{--------Equation 2}$$

Where,
EF = emissions factor, kg CH_4/kg BOD
B_o = maximum CH_4 producing capacity, kg CH_4/kg BOD (Default value 0.6[75])
MCF = methane correction factor (fraction)

Table A11.1:Default MCF values for Domestic Wastewater by treatment type and discharge pathway

Type of treatment and discharge pathway or system	Description	MCF
Sea, river and lake discharge	Rivers with high organic loadings can turn anaerobic	0.1
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3
Anaerobic digester for sludge	CH_4 recovery is not considered here.	0.8
Anaerobic reactor	CH_4 recovery is not considered here.	0.8
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2
Anaerobic deep lagoon	Depth more than 2 metres	0.8
Septic system	Half of BOD settles in anaerobic tank	0.5
Latrine	Dry climate, ground water table lower than latrine, small family (3-5 persons)	0.1
Latrine	Dry climate, ground water table lower than latrine, communal (many users)	0.5

Source: 2006 IPCC Guidelines, Vol. 5, Chapter 6; Table 6.3

The equation for TOW in domestic wastewater is:

$$TOW = P * BOD * 0.001 * I * 365 \quad \text{-------- Equation 3}$$

Where,
TOW = total organics in wastewater in inventory year, kg BOD/yr
P = population in inventory year, (person)
BOD = country-specific per capita BOD in inventory year, g/person/day,
0.001 = conversion from grams BOD to kg BOD
I = correction factor for additional industrial BOD discharged into sewers

Sample Calculation of GHG Emissions Impact for Total Sanitation Campaign wherein 2,439,175 latrines are reported to be constructed in individual households from 2007-2010

A. Calculation of Policy scenario emissions generated with new household latrines

Step 1: Calculation of TOW as per Equation 3

- Households with new toilets constructed (2007-2010)= 2,439,175
- Average household size (persons) = 4.9[76]
- BOD = 38.9 gm/person/day[77]

[75] As per 2006 IPCC Guidelines, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Table 6.2.
Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf
[76] As per Census 2011. Available at http://www.censusindia.gov.in/2011census/hh-series/HH-1/DDW-HH01-0000-2011.XLS
[77] Value for Gujarat as per NEERI document on Inventorization of Methane Emissions from Domestic & Key Industries Wastewater – Indian Network for Climate Change Assessment, 2010.

- I= default value[78] (1.00 for uncollected wastewater)

TOW
$= P * BOD * 0.001 * I * 365$
= 2,439,175 households x 4.9 persons/household x 38.9 gm/person/day x 0.001 x 1 x 365 days
= 169,699,869 kg BOD/Year

Step 2: Calculation of CH_4 Emissions Factor for each Treatment Discharge Pathway as per Equation 2

CH_4 EF for wastewater discharged through household latrines (used by 3-5 persons)
=Bo x MCF = 0.6 x 0.1 = 0.06

Step 3: CH_4 Emissions Calculation as per Equation 1

CH_4 emissions from for wastewater discharged through household latrines
= (0.06 kg CH_4/kg BOD) x (941,463,924.15 kg BOD/Year x - 0) – 0)
= 10,181,992 kg CH_4/year
= 10,181.99 tonnes CH_4/year

CH_4 emissions in tonnes of CO_2e in Policy Scenario
= Emissions intonnes of CH_4 x GWP of CH_4
= 10,181.99 x 21[79]
= 213,821.83 tonnes of CO_2e

B. Calculation of Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets

Step 1: Calculation of TOW as per Equation 3

- Households without toilets (2007-2010)= 2,439,175
- Average household size (persons) = 4.9
- BOD = 38.9 gm/person/day[77]
- I= default value[78] (1.00 for uncollected wastewater)

TOW
$= P * BOD * 0.001 * I * 365$
= 2,439,175 households x4.9 persons/household x 38.9 gm/person/day x 0.001 x 1 x 365 days
= 169,699,869 kg BOD/Year

Step 2: Calculation of CH_4 Emissions Factor as per Equation 2

- 56.7% of untreated wastewater is discharged to land while remaining 43.3% is discharged into sea, river and lake[80].
- Discharge of wastewater into sea, river and lake has a MCF value associated with it (0.1 as given in Table A11.1).
- Wastewater discharge into land does not lead to significant CH_4 emissions and therefore has no corresponding MCF value attributed to it[81].

[78] Based on 2006 IPCC Guidelines, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Equation 6.3. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf
[79] As per IPCC Second Assessment Report. Available at https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_sar_wg_I_full_report.pdf
[80] As per State of Environment Report Gujarat 2012, Table 4.3 – 'Discharge points of untreated waste water in urban centers of Gujarat'. Available at http://gujenvis.nic.in/PDF/waste.pdf
[81] As derived from 2006 IPCC Guidelines, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Figure 6.1, Table 6.1, and Table 6.3.

CH_4 EF for portion of untreated wastewater discharged into sea, river and lake
=Bo x MCF = 0.6 x 0.1 = 0.06

Step 3: CH_4 Emissions Calculation as per Equation 1

CH_4 emissions from 43.3% portion of wastewater directly discharged into sea, river and lake in the absence of sanitation facilities
= (0.06 kg CH_4/kg BOD) x ([941,463,924.15 kg BOD/Year x 43.3%]- 0) – 0)
= 4,409,258.62 kg CH_4/year
= 4,409.3 tonnes CH_4/year

CH_4 emissions in tonnes of CO_2e in Baseline case
= Emissions intonnes of CH_4 x GWP of CH_4
= 4,409.3 x 21[79]
= 92,594.4 tonnes of CO_2e

C. Total GHG impact of the policy or action
= Policy scenario emissions – Baseline emissions
= 213,821.83 - 92,594.4
= + 121,227.4 tonnes of CO_2e

Sample Calculation of GHG Emissions Impact for Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana wherein 157.39 MLD sewage treatment plants are reported to be constructed from 2009 to 2015

A. Calculation of Policy scenario emissions generated with new sewage treatment capacity

Step 1: Calculation of TOW as per Equation 3

- Total capacity of aerobic treatment plants= 153.41 MLD
- Total capacity of anaerobic treatment plants= 4.39 MLD
- BOD of domestic wastewater = 198 mg/L[82]
- BOD generated in aerobic treatment plants= 153.41 MLD x 198 mg/L = 30,375,180 g/day
- BOD generated in anaerobic treatment plants= 4.39 MLD x 198 mg/L = 869,220 g/day
- I= 1.0[83]

TOW (aerobic treatment)
= $BOD * 0.001 * I * 365$
= 30,375,180 g/day x 0.001 x 1.0 x 365 days
= 11,086,941 kg BOD/Year

TOW (anaerobic treatment)
= $BOD * 0.001 * I * 365$
= 869,220 g/day x 0.001 x 1.0 x 365 days
= 317,265.30 kg BOD/Year

Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf
[82] The BOD of domestic waste water is assumed on the basis of the study conducted by Central Pollution Control Board.The study states that the average BOD of domestic waste water in thirteen Indian states (including Gujarat) is around 198 mg/L. See Page: 69 of Guide Manual: Water and waste Water Analysis, CPCB. Available at:
http://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMjA0XzE1MjQ2NTA4OTNfbWVkaWFwaG90bzEyODI3LnBkZg==
[83] Based on 2006 IPCC Guidelines, Vol. 5, Chapter 6: Wastewater Treatment and Discharge, Equation 6.3. It is assumed that there is no mixing of industrial wastewater to have consistency in baseline and policy scenarios, and that STPs operate at installed capacity and thereby I=1.0.
Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_6_Ch6_Wastewater.pdf

Step 2: Calculation of CH_4 Emissions Factor as per Equation 2

CH_4 EF for wastewater discharged through centralized aerobic sewage treatment plants (assumed as not well managed)
=Bo x MCF = 0.6 x 0.3 = 0.18

CH_4 EF for wastewater discharged through anaerobic digester/reactor
=Bo x MCF = 0.6 x 0.8 = 0.48

Step 3: CH_4 Emissions Calculation as per Equation 1

CH_4 emissions from for wastewater treated through aerobic sewage treatment plants
= (0.18 kg CH_4/kg BOD) x (11,086,941 kg BOD/Year x - 0) – 0)
= 1,995,649 kg CH_4/year
= 1,995.65 tonnes CH_4/year

CH_4 emissions from for wastewater treated through anaerobic sewage treatment plants
= (0.48 kg CH_4/kg BOD) x (317,265.30 kg BOD/Year x - 0) – 0)
= 152,287 kg CH_4/year
= 152.29 tonnes CH_4/year

CH_4 emissions in tonnes of CO_2e in Policy Scenario
= Emissions intonnes of CH_4 x GWP of CH_4
= (1,995.65+ 152.29) x 21[79]
= 45,106.67 tonnes of CO_2e

B. Calculation of Baseline emissions from direct discharge of untreated wastewater into a combination of land, sea, river in absence of household toilets

Step 1: Calculation of TOW as per Equation 3

- Total volume of wastewater that is untreated= 157.80 MLD
- BOD of domestic wastewater = 198 mg/L[82]
- BOD generated= XX MLD x 198 mg/L = 31,244,400 g/day
- I= 1.0[78] (for uncollected water)

TOW
= $BOD * 0.001 * I * 365$
= 31,244,400 g/day x 0.001 x 1.0 x 365 days
= 11,404,206.00 kg BOD/Year

Step 2: Calculation of CH_4 Emissions Factor for each Treatment Discharge Pathway as per Equation 2

- 56.7% of untreated wastewater is discharged to land while remaining 43.3% is discharged into sea, river and lake[80].
- Discharge of wastewater into sea, river and lake has a MCF value associated with it (0.1 as given in table A11.1).
- Wastewater discharge into land does not lead to significant CH_4 emissions and therefore has no corresponding MCF value attributed to it[81].

CH_4 EF for portion of untreated wastewater discharged into sea, river and lake
=Bo x MCF = 0.6 x 0.1 = 0.06

Step 3: CH_4 Emissions Calculation as per Equation 1

CH_4 emissions from 43.3% portion of wastewater directly discharged into sea, river and lake in the absence of sanitation facilities

= (0.06 kg CH_4/kg BOD) x ([11,404,206.00 kg BOD/Year x 43.3%]- 0) – 0)

= 296,312 kg CH_4/year

= 296.312 tonnes CH_4/year

CH_4 emissions in tonnes of CO_2e in Baseline case

= Emissions intonnes of CH_4 x GWP of CH_4

= 296,312 x 21^{79}

= 6,222.6tonnes of CO_2e

C. Total GHG impact of the policy or action

= Policy scenario emissions – Baseline emissions

= 45,106.67 - 6,222.6

= + 38,884 tonnes of CO_2e

Annexure 12 : Information collected from GUDC on STPs constructed under UIG Scheme and Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana until 2015 (Waste Sector)

Table A12.1: STPs constructed under UIG Scheme and their treatment capacities

Sr. No.	Operator's Name / Location	Capacity in MLD	Technology	Aerobic/Anaerobic	Scheme
1	Ahmedabad Municipal Corporation - ASP technology based, nr.Pirana, Ahmedabad	180	ASP	Aerobic	UIG, JNNURM
2	Ahmedabad Municipal Corporation - ASP technology based, Ahmedabad	60	ASP	Aerobic	UIG, JNNURM
3	Ahmedabad Municipal Corporation - ASP Technology based, nr. Vasna, UASB, Vasna, Ahmedabad	35	ASP	Aerobic	UIG, JNNURM
4	Ahmedabad Urban Development Corporation - ASP technology based, Vill: Gyaspur, Ahmedabad	240	ASP	Aerobic	UIG, JNNURM
5	Ahmedabad Urban Development Corporation - ASP technology based, vill.Vinzol, Ahmedabad	70	ASP	Aerobic	UIG, JNNURM
6	Rajkot Municipal Corporation, Madhapar Sewage Treatment Plant, Dist. Rajkot	44.5	ASP	Aerobic	UIG, JNNURM
7	Rajkot Municipal Corporation, Raiya Sewage Treatment Plant, Dist. Rajkot	51	ASP	Aerobic	UIG, JNNURM
8	Surat Municipal Corporation –Bamroli	100	ASP	Aerobic	UIG, JNNURM
9	Surat Municipal Corporation -Vriav-Kosad	84	ASP	Aerobic	UIG, JNNURM
10	Surat Municipal Corporation –Asarma	15	ASP	Aerobic	UIG, JNNURM
11	Surat Municipal Corporation –Khajod	25	ASP	Aerobic	UIG, JNNURM
12	Surat Municipal Corporation –Dindoli	66	ASP	Aerobic	UIG, JNNURM
13	Vadodara Municipal Corporation – Kapurai (JNNURM)	43	ASP	Aerobic	UIG, JNNURM
14	Vadodara Municipal Corporation -Sayaji Garden (JNNURM)	8.5	ASP	Aerobic	UIG, JNNURM
15	Vadodara Municipal Corporation – Chhani	21	ASP	Aerobic	UIG, JNNURM

Table A12.2: STPs constructed under Swarnim Jayanti Mukhya Mantri Shaheri Vikas Yojana and their treatment capacities

Sr. No	Treatment Facility	Name of Towns/ ULB	Type of Treatment Technology	Treatment Capacity of STP in MLD
1	STP	Nadiad	SBR	50.5
2	STP	Petlad	A2O	4.39
3	STP	Gandhinagar - Jaspur	ASP	76
4	STP	Gandhinagar - Sargasan	SBR/CASP	10
5	STP	Gandhinagar - Sargasan	SBR/CASP	2

Sr. No	Treatment Facility	Name of Towns/ ULB	Type of Technology	Capacity of OP in MLD
1	Oxidation Pond	Savarkundala	Oxidation Pond	4.76
2	Oxidation Pond	Gadhada	Oxidation Pond	2.19
3	Oxidation Pond	Bayad	Oxidation Pond	1.54
4	Oxidation Pond	Kathlal	Oxidation Pond	2.85
5	Oxidation Pond	Mahudha	Oxidation Pond	1.32
6	Oxidation Pond	Patdi	Oxidation Pond	1
7	Oxidation Pond	Sojitra	Oxidation Pond	1.25

Annexure 13: Details of Vermi-composting plants in 2015 (Waste Sector)

Table A13.1

Vermi-Composting plants: Construction Completed & Operational					
Sr. No.	Name of ULBs	Waste Generated (TPD)	Sr. No.	Name of ULBs	Waste Generated (TPD)
1	Bhanvad	4	48	Kaalol	7.1
2	Dhrol	8	49	Dhandhuka	17
3	Dwarka	12	50	Devghadhbaria	4.2
4	Jam Jodhpur	5	51	Bardoli	16.9
5	Kalawad	3.5	52	Unjha	9
6	Khambhaliya	10	53	Kheda	5.1
7	Bhayavader	5	54	Karjan	7.7
8	Wankaner	12	55	Songhadh	6.5
9	Salaya	3	56	Chakalasi	7.7
10	Bantva	5	57	Jambusar	12.7
11	Chorvad	5	58	Dharampur	5.1
12	Kodinar	12	59	Ode	5.5
13	Manvadar	6	60	Pardi	6.5
14	Una	12	61	Kapdwanj	12.9
15	Vanthali	2	62	Jasdan	8.5
16	Visavadar	4	63	Padra	7.5
17	Kutiyana	4	64	Dabhoi	15.7
18	Ranavav	8	65	Mahemdabad	6.9
19	Limbdi	12	66	Dahegam	10.5

20	Thangadh	6.5	67	Randhanpur	10
21	Bagsara	12	68	Bhachau	6.35
22	Chalala	4.5	69	Rapar	6.5
23	Lathi	4	70	Dakor	6.4
24	Gadhada	3	71	Bavla	7.5
25	Gariyadhar	12	72	Bayad	8
26	Talaja	18	73	Vadali	7
27	Anklav	5.4	74	Mandvi	10.59
28	Boriyavi	4.2	75	Rajpipla	10
29	Balasinor	8.6	76	Upleta	13
30	Karmsad	7	77	Anjar	17.09
31	Mansa	6.7	78	Surendranagar	48
32	Kadi	12	79	Vadhwan	20
33	Siddhpur	18	80	Gondal	45
34	Harij	5	81	Vapi	39.6
35	Chansama	4	82	Visnagar	12
36	Viramgam	15	83	Disa	20
37	Tharad	12	84	Savarkundla	25
38	Kheralu	4	85	Morbi	36.43
39	Vijapur	14	86	Drangadhra	10
40	Himmatnagar	24	87	Kalol	35.3
41	Ider	8	88	Godhara	46.7
42	Vadnagar	5	89	Patan	40
43	Khedbrahma	8	90	Khambhat	24.3
44	Modasa	15	91	Ankleshwar	26.3
45	Pratij	6	92	Porbandar	45
46	Talod	7	93	Mahuva	26
47	Halol	11.5		**Total**	**1167.96**

Note: The sum total quantity of waste vermi-composted based on plant-wise information reported by GPCB comes to 1167.96 TPD which has been used in emission calculations. The GPCB Annual Report 2015-16, Page 70 reports this figure erroneously as 529.72 TPD. Available at https://gpcb.gujarat.gov.in/uploads/AR_2015_2016_ENG.pdf

Acronyms and Abbreviations

This list of abbreviation is not an exhaustive list, but an illustration of the potential layout.

AC	Air-conditioner
AFOLU	Agriculture, Forestry and Other Land Use (2006 IPCC Guidelines)
AI	Artificial Insemination
APDRP	Accelerated Power Development Reforms Programme
BAU	Business as usual
BEE	Bureau of Energy Efficiency
BOD	Biological Oxygen Demand
BRTS	Bus Rapid Transit System
BUR-II	Biennial Update Report-II
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reduction
CH_4	Methane
CLCSS	Credit Linked Capital Subsidy Scheme
CO_2	Carbon dioxide
DCs	Designated Consumers
DISCOM	Distribution Companies
EESL	Energy Efficiency Services Limited
EF	Emission Factor
FSI	Forest Survey of India
GEDA	Gujarat Energy Development Agency
GERMI	Gujarat Energy research and Management Institute
GHG	Greenhouse Gas(es)
GoG	Government of Gujarat
GPCB	Gujarat Pollution Control Board
GPCL	Gujarat Power Corporation Ltd.
GUDC	Gujarat Urban Development Company
GUVNL	Gujarat Urja Vikas Nigam Ltd.
GWP	Global Warming Potential
Ha	Hectare
HYV	High Yield Variety
IHHLs	Individual household latrines
INR	Indian Rupees
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Process and Product Use
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
Kg	Kilogram
LED	Light Emitting Diode
LPG	Liquified petroleum gas
MCF	Methane correction factor

MI	Micro Irrigation
MLD	Million liters per day
MNRE	Ministry of New and Renewable Energy
MOEFCC	Ministry of Environment Forest and Climate Change
MoP	Ministry of Power
MoP&NG	Ministry of Petroleum and Natural Gas
MSME	Micro, Small and Medium Enterprises
MSW	Municipal solid waste
MT	Metric tone
MW	Megawatt
N_2O	Nitrous oxide
NDC	Nationally Determined Contributions
NFSM	National Food Security Mission
NH3	Ammonia
NIWE	National Institute of Wind Energy
OF	Open Forests
PAT	Perform Achieve and Trade
PEG	Public Electricity Generation
PNG	Piped Natural Gas
PPA	Power Purchase Agreement
PPAC	Petroleum Planning & Analysis Cell
RAPDRP	Restructured Accelerated Power Development and Reforms Programme
RE	Renewable Energy
REC	Renewable Energy Certificates
RPO	Renewable Purchase Obligations
Rs	Rupees
RTPV	Rooftop Photovoltaics
RTS	Rooftop Solar
SDG	Sustainable Development Goals
SEC	Specific Energy Consumption
SHC	Soil Health Card
SLDC	State Load Dispatch Centre
SMC	Soil Moisture Conservation
STP	Sewage treatment plant
T&D	Transmission and Distribution
tCO_2e	Tones Carbon dioxide equivalent
tCO_2e	Tonnes of carbon dioxide equivalent
TEQUP	Technology and Quality Upgradation (TEQUP) Programme
UDAY	Ujwal DISCOM Assurance Yojana
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
UIG	Urban Infrastructure and Governance
UJALA	Unnat Jyoti by Affordable LEDs for All

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