INDUSTRIAL GREENHOUSE GAS EMISSIONS IN MAHARASHTRA

Executive Summary

As India's leading industrial state, Maharashtra contributes significantly to the country's greenhouse gas emissions. According to a December 2007 Low Carbon Leader report, the state's carbon footprint was 110 million tonnes CO_2 in 2005. The emission sectors considered for this report covers electricity generation, cement and steel industries. The highest percentage of carbon emissions in India from generation of electricity is by Maharashtra, and the state ranks fourth in emissions from the cement and steel sector. Additional important emission sectors not covered here include transport, agriculture, domestic energy consumptionand municipal solid waste. An attempt has been made to identify the key industries in Maharashtra emitting the largest greenhouse gas emissions, followed by a description on current sustainability status of Maharashtra. The sustainability and environmental parameters of the Chembur facilityof Hindustan Petroleum Corporation Limited has been briefly outlined as a case study. Finally, recommendations on the way forward to lowering the state's carbon emissions have been incorporated from various sources.

INDICATIVE LISTING OF INDUSTRIES WITH HIGH GHG EMISSIONS

Electricity Generation Sector

In India, electricity generation accounted for 35.5% of total CO_2 emission in the year 2010. 90% of the fuel mix used for electricity generation in India is from coal utilisation with oil and natural gas constituting 8% and 2% respectively; however oil is not used to generate electricity in Maharashtra state (INCCA, 2010).

Out of the total 32,505.98 MW of electricity generated in Maharashtra, the share of different utilities is given in the pie chart.In a period from 2011 to 2012, thirteen coal-fired plants in Maharashtra, the highest in the country, released among other pollutants, 2.78 lakh tonnes of nitrogen dioxide and 94.6 million tonnes of carbon dioxide into the air. Large hydropower projects (>250 MW generation capacity) are responsible for methane emissions.

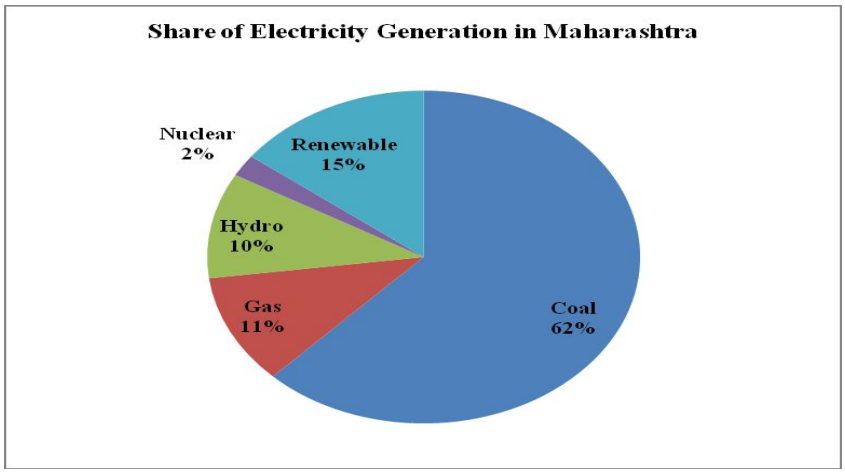
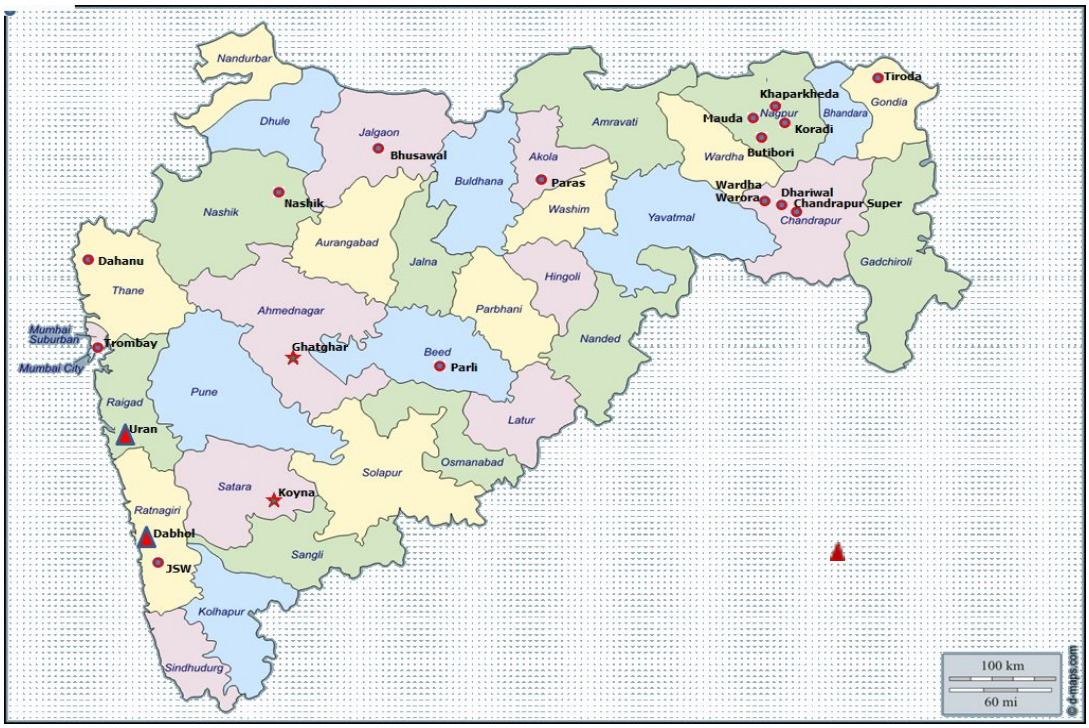


Figure 1: Contribution of different sources for electricity generation in Maharashtra

The companies currently operating functional power plants, along with the district in which they are located are tabulated below:

Sr. No	Power Station	Fuel	Generating Company	Capacity (MW)	District Located
1	Tiroda Thermal Power Station	Coal	Adani Power	2640 (operational)	Gondia
2	Chandrapur Super Thermal Power Station	Coal	Mahagenco	2340	Chandrapur
3	Trombay Thermal Power Station	Coal	Tata Power	1580	Mumbai
4	Bhusawal Thermal Power Station	Coal	Mahagenco	1420	Jalgaon
5	Khaparkheda Thermal Power Station	Coal	Mahagenco	1340	Nagpur
6	JSW Ratnagiri Power Station	Coal	JSW Energy Limited	1200	Ratnagiri
7	Parli Thermal Power Station	Coal	Mahagenco	1130	Beed
8	Mauda Super Thermal Power Station	Coal	NTPC	1000 (operational)	Nagpur
9	Nashik Thermal Power Station	Coal	Mahagenco	630	Nashik
10	Koradi Thermal Power Station	Coal	Mahagenco	620	Nagpur
11	Butibori Power Project	Coal	Reliance Power	600	Nagpur
12	Dhariwal Power Station	Coal	Dhariwal Infrastructure Limited, Calcutta	600	Chandrapur

			Electric Supply Corporation subsidiary		
13	WardhaWarora Power Plant	Coal	KSK Energy Ventures	540	Chandrapur
14	Dahanu Thermal Power Station	Coal	Reliance Infrastructure	500	Palghar
15	Paras Thermal Power Station	Coal	Mahagenco	500	Akola
16	Dabhol Power Station	Gas	Ratnagiri Gas and Power	1967	Ratnagiri
17	Uran Gas Turbine Power Station	Gas	Mahagenco	672	Raigad
18	Koyna Hydroelectric Project	Hydro	Maharashtra State Electricity Board	1960	Satara
19	Ghatghar Dam Power Plant	Hydro	Water Resources Department, Government of Maharashtra	250	Ahmednagar



The total CO_2 equivalent emissions from solid fuel manufacturing and petroleum refining in 2007 was 33.85 million tons in India, and out of this 97% of the emissions were from solid

fuel manufacturing. Two refineries are located in Maharashtra, both in Mumbai: a 5.5 MMTPA capacity refinery owned by HPCL and a 6.9 MMTPA capacity refinery owned by BPCL. Sustainability parameters of HPCL are later briefly outlined as a case study.3

Cement and Steel Industries

Cement and steel industries are major sources, and contribute to 52% of total industrial CO_2 emissions in India. Total contribution of this sector is 202.2 Tg/year with Maharashtra contributing 17.3 Tg/year. Cement plants in Maharashtra are tabulated below:

Sr. No	Company	Cement Plant	District Located
1	ACC Ltd	Chanda Cement Works	Chandrapur
2	Ambuja Cement Ltd	Maratha Cements Ltd	Chandrapur
3	Century Textiles and Inds. Ltd	Manikgarh Cement	Chandrapur
4	India Cements Ltd	The India Cements Ltd- Parli	Beed
5	JSW Steel Ltd	Heidelberg India Cement Ltd-Raigad	Raigad
6	Orient Cement	Orient Cement- Jalgaon	Jalgaon
7	Reliance Cement Company Private Ltd	Reliance Cement Company Private Ltd	Nagpur
8	UltraTech Cement Ltd	UltraTech- Ratnagiri Cement Works	Ratnagiri

MAHARSHTRA SUSTAINABILITY SCENARIO

Among all the states and Union Territories, Maharashtra's contribution is the largest in CO_2 and CO emissions.The state annually emitted in 2007 1101.4 Gg of methane, 105259.9 Gg of carbon dioxide and other emissions but sequestered only 6419.0 Gg of Carbon. Maharashtra's ratio of carbon sequestered to total carbon emitted ranges from 0 to 0.1. This means that annual carbon emission from all sectors is very much higher than annual carbon sequestration potential as compared to states such as Arunachal Pradesh, Mizoram, Andaman and Nicobar and Manipur, whosecarbon ratio is more than one, indicating higher carbon sequestration than carbon emissions.(Ramachandra and Shwetmala, 2012).

However, Maharashtra was the first in India to develop an Energy Conservation Plan in 2005. It was prepared by the Maharashtra Energy Development Agency (MEDA) in partnership with the US Agency for International Development. The aim of the Plan is to develop a comprehensive blueprint and provide leadership in establishing and promoting the energy conservation ethic within government agencies and all consumer classes in the State of Maharashtra. It also seeks to maximise the participation of the private sector in its implementation. The overview of the Plan can be found at http://www.mahaurja.com/PDF/SAPlan.pdf.

To achieve the objectives of the Energy Conservation Plan, MEDA has developed 11 energy conservation programmes covering domestic, public, small- and medium-sized enterprises, commercial and agricultural sectors. The projects include high efficiency lighting, water pumping, motor rewinding and solar water heating technologies. It is estimated that in ten years, the 11 programmes will result in cumulative energy savings of over 20,000 GWh, capacity savings of over 1,000MW, and financial savings of approximately Rs 10,000 Crores (US$2.55 billion).

According to MEDA data, Maharashtra is second in the country in production of power from renewables and the contribution of different sources is tabulated below:

Sr No	Source	India Potential (MW)	Maharashtra Potential (MW)	Achievement as on 30/09/2013 (MW)
1	Wind	49130	5961	3431.86
2	Bagasse co-generation	5000	1250	1088.00
3	Biomass	16881	781	180.00
4	Small Hydro Power	15000	732	271.00
5	Industrial Waste	1700	350	26.12
6	Urban Waste	1700	287	0.0
7	Solar Photovoltaic & Solar Thermal Power	20 – 30/sq.km.	35 – 49/sq.m.	175.15
	Total	89411	9361	5172.13

The Maharashtra Energy Conservation Fund was set up to assist in the financing of qualified energy efficiency projects within the state. The fund will stimulate the market implementation of an energy efficiency infrastructure that includes energy service providers such as Energy Service Companies which are helpful in assisting various sectors to develop and implement cost effective energy efficiency projects. Such projects will improve the efficiency of energy systems, reduce dependence on energy imports, increase productivity and reduce GHG emissions. Maharashtra has also started using fiscal incentives like a green cess on electricity to raise its own funds as Central funds are not always reliable and timely, and this can delay implementation.Maharashtra received a relatively larger fund allocation from the central government for kick-off/ preparatory efforts towards the under the National Mission for a Green India which is part of the National Action Plan on Climate Change.

Policies apart, several private companies strive to lower their emissions as part of the environmental and social responsibility policies, as evidenced in the following case study.

CASE STUDY: HINDUSTAN PETROLEUM CORPORATION LIMITED

Parameter	Details
Resource Use	Crude Oil Water
Water	● Fresh water from BMC ● Salt water from sea
Land	350 acres, Chembur
Source of energy used for industry processes	● Electrical energy (105 MW) ● Fuel Oil for furnaces
Instance of renewable energy use	Solar power (80 kW)
Amount and nature of waste generated	● Process waste water 100% recycled ● Seawater effluent treated and released to sea at a flow rate of 2000m^3/hour
Waste Treatment	Effluent Treatment Plant (ETP)
Pollution Controls in place	● ETP for water treatment ● Gaseous emission low sulphur fuel usage ● Fuel gas firing

	● Flue gas scrubbing unit to remove SO_2 and dust ● Pollution control monitoring for SO_2, NO_x, SPM, CO
Track and measure impact on global warming	GHG inventory every year and ensure CO_2 reduction of 2% per year
Plans/ goals to reduce energy consumption; Energy audits	● Regular energy audits ● Hydrocarbon loss study ● Fuel and loss study
CSR commitments	● Education, Health Care, Child care, Livelihood and Community Development ● 2% of profit

WAY FORWARD

- Enforcement of climate change mitigation measures is often inconsistent, and this needs to change immediately
- Carbon status of a region can be reduced through biological, chemical or physical carbon sequestration processes
- Improvements in energy economy has to be through improvements in energy efficiency, use of renewable sources of energy, CO_2 capture and sequestration on a massive scale and development of carbon free transport
- Use of low carbon footprint biofuels and improvements in the efficiency of vehicles will reduce the carbon from the transport sector
- Emission reduction in the consumer sector includes the design of environment friendly green building, heat pumps, solar heating, use of high efficiency appliances and lighting, shifting to renewable (like solar, wind, hydro, bioenergy, etc.), low-carbon electricity
- Investing in research and development of indigenous technologies for process improvement to mitigate climate change
- Set quantifiable reduction targets to combat GHG emissions

REFERENCES

Referenced from various internet sources; indicative listing only:

INCCA (Indian Network for Climate Change Assessment) Report May 2010-India: Greenhouse Gas Emissions 2007

Low Carbon Leader: States and Regions/DEC.2007

Power Generation from Renewables: MEDA's New Frontier (2013) <http://www.mahaurja.com/PDF/BP_PG_Renewable.pdf>

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ABBREVIATIONS USED

BMC	Brihanmumbai Municipal Corporation
CO	Carbon monoxide
CO_2	Carbon dioxide
ETP	Effluent Treatment Plant
Gg	Giga gram
GHG	Greenhouse gas (es)
HPCL	Hindustan Petroleum Corporation Limited
kW	kilo-Watt
MEDA	Maharashtra Energy Development Agency
MMTPA	Million metric tonnes per annum
MW	Mega-Watt
NO_x	Oxides of nitrogen
SO_2	Sulphur dioxide
SPM	Suspended Particulate Matter
Tg	Tera gram (1 Tg = 1 million tonnes)