

India: Emerging Leadership on Climate Change

**An Overview concerning India's Domestic Laws,
and the Instruments and Measures of Climate Change Mitigation**

**Malini Mehra, Centre for Social Markets
December 2008**



This paper aims to summarize India's policies and measures to address climate change, and to introduce major determinants and consequences of that policy, as well as the actors involved in the policy process. An overview of sector-based mitigation policies is also given. The report is focused on Energy Efficiency and Renewable Energies, as these involve major mitigation strategies and embrace many of the key components aimed at reducing greenhouse gas emissions.

Disclaimer

The views expressed herein are the authors' responsibility and do not necessarily reflect those of the Heinrich-Böll-Foundation or any other organization.

For further information about the Heinrich-Böll-Foundation, please visit the website at www.boell.org or www.boell-india.org

Requests or comments may be sent to Arne Jungjohann at arne@boell.org

© Heinrich Böll Foundation North America. December 2008
All rights reserved.



Contents

0. Introduction	3
1. Climate Change Impacts in India	
2. Key Players in Climate Policymaking in India	6
3. India's policy framework on GHG abatement & National Action Plan on Climate Change	10
3.1 India's Energy Economy	11
3.2 The governmental Response to the Energy Challenge and Climate Change	12
3.3 Policy Structure with regard to GHG abatement	13
3.4 National Action Plan on Climate Change	16
4. Focus on Renewable Energies	17
5. The Future is Green	21
Annex	24
Bibliograph	28



0. Introduction

India is moving on climate change and energy issues. That much is clear from a steady evolution of government policy in recent years, and initiatives from the public and private sectors and civil society. This article outlines how climate change is impacting the country and profiles emerging policies and initiatives with a particular emphasis on the renewable energy sector. It concludes with a discussion of the outlook for the coming period and opportunities offered in 2009.

In India as in the United States, thinking about energy issues has traditionally been dominated by the discourse of energy independence and energy security. This is not of recent vintage. In his Independence Day Address to the nation in August 2005, the President of India, stressed that "Energy Independence has to be our nation's first and highest priority. We must be determined to achieve this within the next 25 years, therefore by the year 2030." In India, concerns about energy security were sharpened in the 1970s after the two oil shocks and led to the creation in 1981 of the Commission for Additional Sources of Energy (CASE) by the Government of India (GoI). This body was the precursor to what is now a fully-fledged ministry – Ministry for New and Renewable Energy (MNRE) - the first such in the world.

While much of the historic thinking has been guided by India's search for new and affordable sources of energy, current thinking is also influenced by a growing appreciation of the threat posed to India's development by climate change.

1. Climate Change Impacts on India

India has strong reason to be concerned. Many studies have underscored India's vulnerability to climate change (see Box 1 for IPCC's projected impacts). As a tropical country with a long coast line, India is experiencing sea surges and salinization affecting infrastructure, agriculture, fisheries, livelihoods and human health. The encroaching salt water will poison fields and make coastal agriculture unviable, deepening the crisis that is already full-blown in India's farm sector. Just these impacts alone could severely test India's governance systems and its institutional and social resilience. Unless dealt with effectively they could also quickly turn into political challenges.



Box 1

What the IPCC says about climate change in South Asia

The IPCC's 2001 Report projects that global temperatures will rise by 1.4–5.8 degrees Celsius over the next 100 years. For India, this could mean a 2.7–4.3 degrees Celsius rise by 2080. The panel also predicted an increase in rainfall over the sub-continent by 6–8 per cent and sea level rise up to 88 centimeters by 2100.

Local climate change will affect the region in various ways. Changing rainfall patterns are likely to affect food security. Extreme events, such as droughts, torrential rain, flash floods, cyclones and forest fires, could become more common. Rising sea levels could threaten coastal mangrove and wetland systems, and increase the flood risk faced by the quarter of India's coast dwelling population.

In its 2007 Report, the IPCC has updated its projections for South Asia and India to include the following:

- Glacier melt in the Himalayas is projected to increase flooding, rock avalanches from destabilized slopes, and affect water resources within the next two to three decades. This will be followed by decreased river flows as the glaciers recede.
- Freshwater availability ... particularly in large river basins is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s.
- Coastal areas, especially heavily-populated mega-delta regions ... will be at greatest risk due to increased flooding from the sea and in some mega-deltas flooding from the rivers.
- Climate change is projected to impinge on sustainable development of most developing countries of Asia as it compounds the pressures on natural resources and the environment associated with rapid urbanization, industrialization, and economic development.
- It is projected that crop yields ... could decrease up to 30% in ... South Asia by the mid-21st century. Taken together and considering the influence of rapid population growth and urbanization, the risk of hunger is projected to remain very high in several developing countries.
- Endemic morbidity and mortality due to diarrheal disease primarily associated with floods and droughts are expected to rise ... due to projected changes in hydrological cycle associated with global warming. Increases in coastal water temperature would exacerbate the abundance and/or toxicity of cholera in South Asia.

Source: United Nations Intergovernmental Panel on Climate Change (UNFCCC, 2007). "Climate Change 2007: Synthesis Report. Summary for Policymakers-An Assessment of the Intergovernmental Panel on Climate Change". Pg 13, para:7. New York City, USA.

For the 700 million people in rural India who are dependent on the most climate-sensitive sectors for their livelihoods - agriculture, forests and fisheries - the future will bring declining crop yields, degraded lands, water shortages and ill health. It will also bring confusion and helplessness as people lose their traditional capacity to 'read' the weather and adjust accordingly. When the rains do not come and when the natural world does not behave as it should, societies which have survived by observing the world and adapting to it lose essential coping skills. Climate change therefore, at a most profound level, disempowers by rendering traditional knowledge useless. How this will affect identity and culture amongst India's tribal and other indigenous communities is something yet to be fully understood.



As for the more tangible impacts of climate change like floods, droughts, heat waves, cyclones, storm surges, displacement and pestilence etc. - these are not just projections for a distant future. The impacts are taking place now.

Phenomena consistent with climate change projections for India can already be seen across the country. 2008 and 2007 have brought 'wild weather' to South Asia with the worst floods in living memory and more than 20 million people displaced. Islands and villages in the Bay of Bengal have been lost to sea-level rise causing a drift of ecological refugees to Kolkata. The Super Cyclone of 1999 wreaked havoc on Orissa, knocking decades off its development and killing more than 30,000. Heat waves across the country have caused untold deaths and human distress. Rising temperatures and a retreating snow-line in Himachal have fatally affected its once-legendary apple industry.

The rapid melting of the Himalayan glaciers - the source of India's major river systems - is a cause for particular alarm. IPCC estimates suggest that they may shrink to one-fifth of their volume within a few decades. Initially this may cause floods as the waters melt - and then a water crisis of unprecedented proportions as the rivers run dry.

Seven of the world's major river basins originate in the Himalayan and Tibetan plateaus. They are the source of water for 40% of humanity. China, India, Nepal, Bhutan and Burma all share these borders. If the rivers do run dry, a more serious cause of regional destabilization can scarcely be imagined. When it happens, it will make India's current inter-state water conflicts look like child's play in comparison. But this is not only a story of human impact. It is estimated that up to 50% of the country's flora and fauna could be threatened, with at least a quarter of India's biodiversity lost. For a country with such a long and mythic self-identification with its plant and wildlife, the loss of its natural heritage will carry both socio-cultural as well as significant livelihood implications.

As if this were not bad enough, India has the misfortune of being geographically prone to natural disasters with over 8% of its landmass susceptible to floods and 68% susceptible to drought. Of the 7500 kilometers long coastline, approximately 5700 kilometers are prone to cyclones.¹ Climate change will merely magnify these unfortunate natural attributes.

While cities will not be spared – none have climate risk strategies in place – given India's deeply stratified society, the hardest hit will be the poor and the marginalized. India is home to one third of the world's poor – 400 million of whom have no access to electricity. India also still has a growing and predominantly youthful population. By 2030, the country will have overtaken China as the world's most populous nation with an estimated population of 1.4 billion - 60% of whom will be dwelling in urban centers. The future of the world will therefore be largely Indian. As the country's policymakers seek to secure the development gains of a decade of unprecedented growth, it is to

¹ National Five Year Plan, 2008: 207

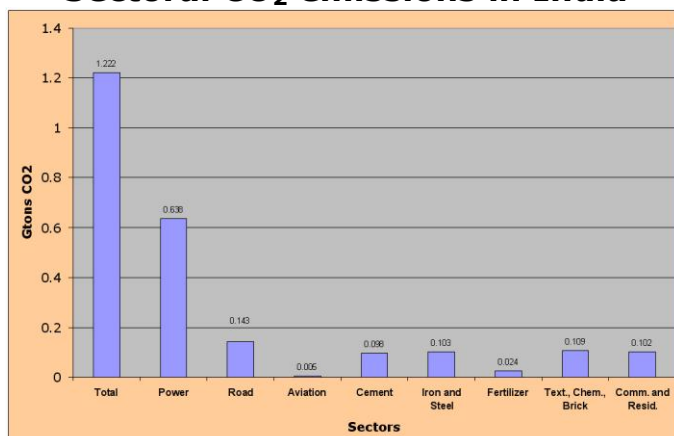


this future that they must look to craft a new vision for India in a climate-changed world.

India's policymakers are known for saying that they did not create the climate problem, and have emphasised the inequity of expecting too much from a country with such low per capita emissions where one third of the population still lives below the poverty line. This is true. But while it has not been an historic emitter – over the period 1850–2000, India accounted for only 2% of global GHG emissions, compared to 30% by the USA – the past is no predictor of the future. For example, in the period 1990-2000, emissions in the US grew by 16%, but in India they grew by 51%.² As India's economy grows and consumption patterns change, there is little doubt that emissions will rise and the country's footprint increase dramatically. The International Energy Agency (IEA) projects that India will become the third-largest emitter by 2015, precisely the time when global Greenhouse Gas (GHG) emissions need to peak if we are to avoid the severest impacts of climate change.

The Indian Government says it is already spending over 2% of GDP currently on measures to adapt to the impact of climate variability³. At a macro level, a 2007 study by the Carbon Disclosure Project estimated that climate change could result in a loss of 9-13% in the country's GDP in real terms by 2100.⁴

Figure 1
Sectoral CO₂ emissions in India



Source: Garg et al, 2006

The costs therefore are indeed high. India's problem is its energy economy. The country has an extremely high dependence on fossil fuels - in particular on imported oil and dirty coal which it has in great abundance. Fossils fuels are responsible for 83% of India's CO₂ emissions, with deforestation accounting for much of the rest. Coal alone accounts for 51%⁵ with emissions concentrated in the power sector (see Figure 1). Addressing climate change effectively therefore will require a transformation of India's energy economy.

² Stokes, May 2008

³ India: Addressing Energy Security and Climate Change, MoEF Oct 2007

⁴ Times of India, Sept 3, 2008

⁵ Garg et al, 2006



2. Key Players in Climate Policy-Making in India

India is a federal republic comprising 28 different states and 7 union territories. National policy making on climate, energy and environmental issues, however, is set by the Central Government in New Delhi. The key ministries traditionally leading on domestic policymaking on these issues have been the Ministry of Environment and Forests (MoEF), the Ministry of New and Renewable Energy (MNRE) and the Ministry of Power. (The Ministry of External Affairs leads on international negotiations such as those under the UNFCCC.) Their respective mandates and ambits are described below.

Ministry of Environment and Forests

The Ministry of Environment & Forests is the nodal agency in the central government responsible for the planning, promotion, co-ordination and overseeing of environmental and forestry programmes. The Ministry is also the nodal agency for India for the United Nations Environment Programme (UNEP). At present the ministerial portfolio for MoEF is held by the Prime Minister himself.

According to government sources, the principal activities undertaken by MoEF, consist of “conservation & survey of flora, fauna, forests and Wildlife, prevention & control of pollution, afforestation & regeneration of degraded areas and protection of environment, in the frame work of legislations.” The primary tools at the service of the ministry are “surveys, impact assessment, control of pollution, regeneration programmes, support to organizations, research to solve solutions and training to augment the requisite manpower, collection and dissemination of environmental information and creation of environmental awareness among all sectors of the country's population.”⁶

Ministry of Science and Technology

MoEF has traditionally been the key ministry in charge of coordinating environmental and climate policy. It still continues to do so formally. However, in the past two years it has been overtaken by the Ministry of Science and Technology which has begun to assert itself and bring technology more into the mix in terms of government response to climate change. The Ministry's growing voice and influence on climate policy has been signaled by its minister, currently Kapil Sibal, acting as the government's de facto spokesman and key negotiator on international climate policy.

Proliferation of Power Ministries

India has four ministries charged with energy-related portfolios – the ministries of power, coal, petroleum and natural gas, and new and renewable resources respectively. The fact of so many ministries, with potentially overlapping briefs and objectives, has created policy coordination and coherence challenges. Of these four ministries, the ones that have been most closely associated with the formulation of

⁶ NAPCC 2008



government policy on climate change have been the ministries of power and new and renewable resources respectively.

Ministry of Power

According to its official description, the Ministry of Power is “concerned with perspective planning, policy formulation, processing of projects for investment decision, monitoring of the implementation of power projects, training and manpower development and the administration and enactment of legislation in regard to thermal, hydro power generation, transmission and distribution.” The Ministry of Power is also responsible for the administration of two key pieces of legislation - the Electricity Act, 2003, and the Energy Conservation Act, 2001 – which have set the framework for India’s energy policies.

Ministry for New and Renewable Energy

As noted above, the origins of this ministry lie in India’s drive towards energy self-sufficiency sparked by the oil shocks of the 1970s which led to the establishment of the Commission for Additional Sources of Energy (CASE). This body evolved over the next two decades into the Ministry for New and Renewable Energy whose mandate is to “develop and deploy new and renewable energy for supplementing the energy requirements of the country.”⁷ MNRE supports the entire spectrum of new and renewable energies with the help of regional offices, three specialised research institutions and a non-banking financial company – Indian Renewable Energy Development Agency (IREDA).⁸ Its current minister, M Vilas Muttemwar, has been a strong proponent of green energy and an enthusiast for driving clean technology growth in India.

Advisory Council on Climate Change

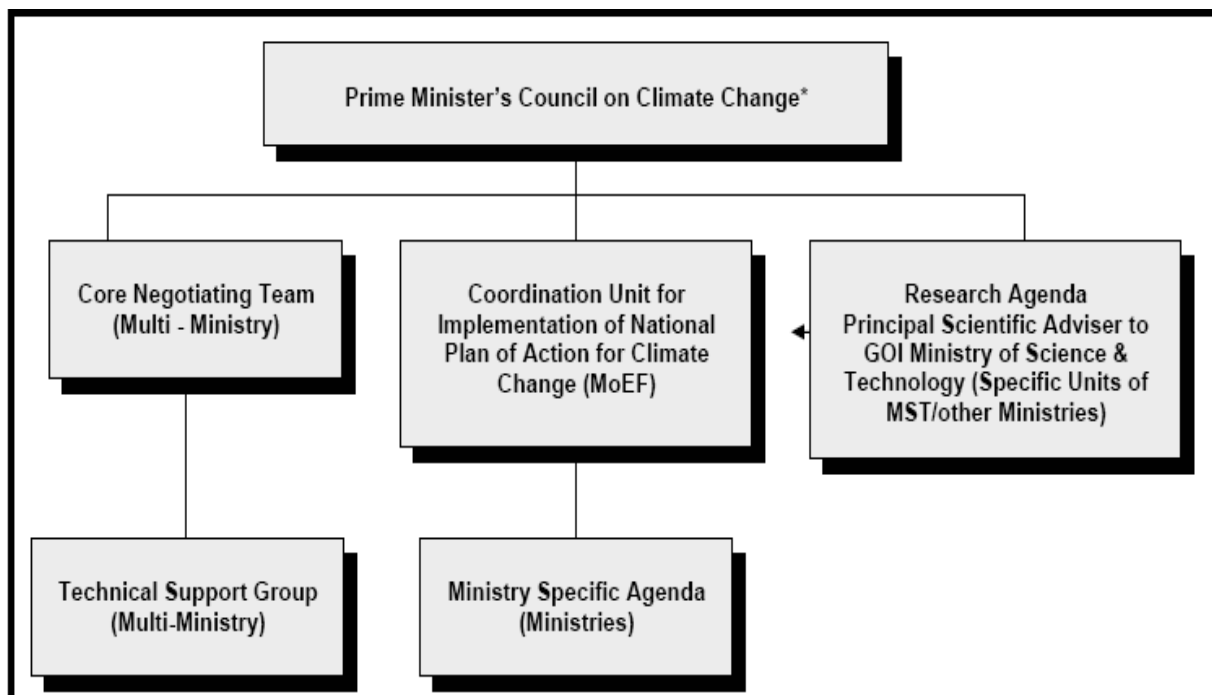
In June 2007, the Government announced the constitution of a high-level advisory group on climate change. Under the direct chairmanship of the Prime Minister himself, the Council on Climate Change (see Figure 2, organogram of the PM’s advisory council) was established to “coordinate national action plans for assessment, adaptation and mitigation of climate change”, and to “advise the Government on proactive measures that can be taken by India to deal with the challenge of climate change.” It was also tasked with facilitating inter-ministerial coordination and guiding policy in relevant areas.

⁷ MNRE website

⁸ MNRE website



Figure 2: Organogram of the Prime Minister’s Council on Climate Change



Source: Prime Minister’s Council on Climate Change(2007). “National Action Plan on Climate Change” Pa 7.Government of India. New Delhi. India.

The establishment of the Council under the chairmanship of the PM sent a positive signal that the Government was taking the issues seriously. Its multi-stakeholder membership (see Box 2) of representatives from the administration, a cross-section of ministries, science and academia, civil society, business and industry, and the media was welcomed as a mark of openness and a willingness to engage on this important issue. The composition of the advisory council is at the Prime Minister’s discretion and no indication has been made so far of a change to it.



Box 2: Membership of the Prime Minister's Advisory Council on Climate Change

Official Members

Ministers for External Affairs, Finance, Environment and Forests, Agriculture, Water Resources, and Science and Technology; Montek Singh Ahluwalia, Deputy Chairperson of Planning Commission; R. Chidambaram, Principal Scientific Advisor to the Prime Minister; V. Krishnamurthy, chairperson National Manufacturing Competitiveness Council; C. Rangarajan, chairperson Economic Advisory Council; Ajay Mathur, chairperson Bureau of Energy Efficiency; the Foreign Secretary; the Union Environment and Forests Secretary; and the Principal Secretary to the Prime Minister.

Non-official Members

R.K. Pachauri, chairperson The Energy and Resources Institute (TERI); Prodipto Ghosh, former Principal Secretary, MoEF; currently with TERI; Sunita Narain, Centre for Science and the Environment; Chandrakshekar Dasgupta, former Ambassador to EU; Ratan Tata, chairperson, Tata Group; Raj Chengappa, Executive Editor, India Today; and R. Ramachandran, Science Editor, Frontline.

NB.: As of Nov 2008

The section below picks up on the much-anticipated National Action Plan on Climate Change that was eventually released in June 2008 by the Council. While some expect that the institutional architecture of policy making on climate change may change in the coming months as a result of the issuance of the Action Plan, at present the key institutions leading on this issue at the central government level remain the ministries noted above and the Advisory Council.

3. India's policy framework on GHG abatement and the National Action Plan on Climate Change

As a developing country with a large population that is yet to enjoy the fruits of economic growth, such as improved living standards, India has a real dilemma when it comes to climate change. The country's planners are keen to assert the need for India to have the economic and environmental space to grow, and are fearful of any curbs as implied by mandatory emissions reductions. In an address earlier this year to the country's scientists, India's science and technology minister put the perceived trade-off bluntly: "Any effort to significantly limit greenhouse gas emissions will require changes in economic activity that could impose costs on our society."⁹

While the Government recognizes that "Global warming will affect us seriously," it concludes that "the process of adaptation to climate change must have priority" and that "The most important adaptation measure is development itself."¹⁰ On mitigation, the Government is unequivocal: "With a share of just 4% of global emissions, any amount of mitigation by India will not affect climate change." Instead the government

⁹ Kapil Sibal statement at 95th Indian Science Congress (2008)

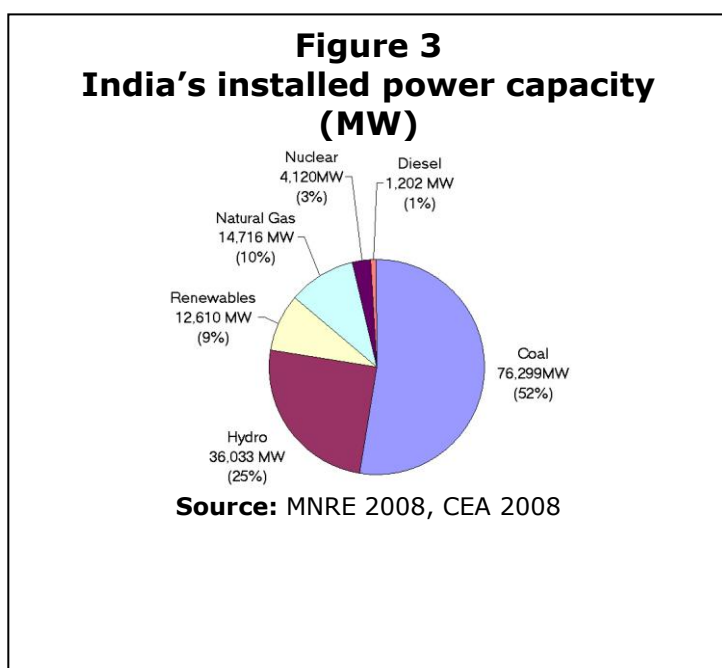
¹⁰ National Five Year Plan, June 2008:205



calls for action by developed countries and a burden sharing formula based on historic culpability, common but differentiated responsibilities and differences in respective capabilities, and the per capita emissions principle. Furthermore, the Prime Minister has pledged that India's per capita emissions (presently 1.2 tons annually) will never exceed those of developed country levels.

As with most countries, India's planners are still wedded to conventional growth-based economic orthodoxy. The country's key planning document, the Eleventh Five Year Plan (2007-2012) wants faster and more inclusive growth. It sets a target of 9% growth in the five year period, reaching 10% by the end of the Plan¹¹. This is ambitious indeed. Just to maintain its present 8% GDP growth rate, India will need to add 500MW of power each week for the next 25 years. Although the laudable aim of the Plan is poverty reduction and inclusive growth, its unintended consequence could be to undermine development itself. If IPCC figures are to be believed, India will experience "the greatest increase in energy and greenhouse gas emissions in the world if it sustains eight percent annual economic growth or more as its primary energy demand will then multiply at least three to four times its present levels".¹²

India's energy economy



Since a secure and uninterrupted power supply is seen as the primary impediment to India's growth what does this mean in pure numbers. At present, India has the fifth largest installed power capacity in the world at close to 145 GW (see Figure 3)¹³. This is far behind the US at 1076 GW and China at 710 GW respectively. As can be seen from Figure 3, the overwhelming majority of this comes from coal-based generation and is projected to remain so for some time (India contains the world's fourth largest coal reserves). Of the current figure of 145 GW

renewable energy - if one includes large hydro in this - comprises 48.6 GW.

For a country of India's size and growth ambition, 145 GW is not nearly enough and the Government has made it a priority to raise this figure by 80GW by 2012, and then expand to 800 GW by 2030.¹⁴ Financing such an expansion of energy infrastructure will not come cheap and the IEA has estimated that it could cost \$1.25 trillion with the

¹¹ National Five Year Plan June 2008: PM's Foreword

¹² Times of India, Sept 3, 2008

¹³ Ringwald, CSM 2008:7

¹⁴ Ibid. 2008:8



majority of investment concentrated in the power sector.¹⁵ Little wonder then that India's planners have placed such emphasis on finance for development at multilateral fora, and are such staunch advocates of instruments such as the Clean Development Mechanism (CDM) which can potentially transfer large-scale resources.

As the IPCC and other bodies have noted, the emissions rise implied by such an expansion of fossil-fuel based energy supply could be extremely grave. India's planners are starting to heed the warning. In an effort to assess the pros and cons of different energy pathways for the country, the country's Planning Commission studied the projected carbon emissions from eleven different scenarios ranging from coal-dominant to low-carbon ones and found there to be a difference of nearly 35% between the best and the worst-case scenario. Under the business-as-usual scenario, emissions would rise from the present 1.2 Gt per capita/year, to a high of 5.5 Gt per capita/year by 2031-32. Under the low-emissions scenario, the rise would be a much less 3.9 Gt per capita/year.¹⁶ According to research by The Energy Research Institute (TERI), this will come at a price however. It estimates that India will need to invest an additional \$5 billion annually for a minimum of five years if it is to make a transition to a low-carbon energy pathway.¹⁷

India's planners therefore should be under no illusions about the emissions implications of different energy choices before them, and that a change of direction is very much needed.

The Governmental response to the energy challenge and climate change

The Government has recognized that business as usual is no longer tenable and made some changes. While the National Action on Climate Change (NAPCC) is notable for its lack of targets and timetables, the country's key planning document, the Eleventh Plan, commits the country to reducing energy intensity per unit of GHG by 20% from the period 2007 to 2017. The Eleventh Plan, articulated before the launch of the NAPCC, also seeks to boost access to cleaner and renewable energy by 'exploiting existing resources (e.g., hydropower and wind power) developing nuclear power, and also supporting research in newer areas such as biofuels from agro-waste, solar energy, etc.'¹⁸

The government is keen to emphasize that it has in fact been pursuing carbon abatement policies for many years in India's own interest. This has been largely to minimize energy consumption and reduce costs, in particular that of oil imports, as well as attend to the environmental and health consequences of its fossil-fuel dependency. These measures have included greater energy efficiency, fuel substitution, price reforms and the removal of subsidies to encourage a more carbon-friendly energy market. Energy pricing remains an intractable political issue, however, where the government has been unable to act decisively and perverse incentives still encourage waste rather than efficiency.

¹⁵ Ibid. 2008:7

¹⁶ Planning Commission 2006:50

¹⁷ Stokes 2008

¹⁸ National Five Year Plan June 2008:207



Policy structure with regard to GHG abatement

India has in place a number of key statutes, institutions, policies and programs that provide a framework – though not always a coherent one – for GHG abatement in the country.¹⁹ Primary among these are agencies such as the Bureau of Energy Efficiency and a set of key pieces of legislation headlined by the following policies:

The Integrated Energy Policy, adopted in 2006, seeks to create a more joined-up government response to managing the energy agenda through the following measures: promote energy efficiency in all sectors; focus on mass transport; encourage renewables including biofuels plantations; accelerate the development of nuclear and hydropower for clean energy; promote research and development into clean energy technologies. Reforming energy markets to ensure price competition and reflect true resource costs is another key objective and promoted through additional statutes including: Electricity Act 2005, Tariff Policy 2003, Petroleum & Natural Gas Regulatory Board Act, 2006, etc.

Further pieces of relevant legislation include the Rural Electrification Policy (2006) which promotes renewable energy technologies where grid connectivity is not possible or cost-effective; the New and Renewable Energy Policy (2005) which promotes utilization of sustainable, renewable energy sources, and accelerated deployment of renewables through indigenous design, development and manufacture; the National Environment Policy (2006), and the Notification on Environment Impact Assessment (EIA, 2006) which address the environmental impact of economic activities and how to manage them.

Given that the interplay between energy, environment and development policy is a highly complex one, the government has sought to address a number of inter-related objectives through these and similar statutes. These objectives including the following:²⁰

- Remove entry barriers and raise competition in exploration, extraction, conversion, transmission and distribution of primary and secondary energy;
- Accomplish price reform, through full competition at point of sale;
- Promote tax reform to promote optimal fuel choices;
- Augment and diversify energy options, sources and energy infrastructure;
- Provide feed-in tariffs for renewables (solar, wind, biomass cogeneration);
- Strengthen, and where applicable, introduce independent regulation.

¹⁹ NAPCC 2008; MoEF 2008

²⁰ Taken from NAPCC 2008: 16-18



The Government also notes that its low per capita energy consumption, or the ‘energy gap’, is a consequence of “compulsory forced energy savings” by the poor due to poverty. Activities which are currently not on the energy balance sheet due to deprivation, include the following:²¹

- Lack of electricity connections and, if connected, a lack of electric appliances and adequate light bulbs in rural households;
- Lack of piped water or pumps that require long trips by women and children on foot to obtain surface water;
- Lack of cooking fuels as a result of which the poor depend on biomass rather than clean and convenient fossil fuels;
- Lack of fans and heating devices for a large percentage of households that are necessary for comfort and productivity;
- Lack of basic infrastructure such as schools, hospitals, and roads that are essential elements for human development.

While gaps and inconsistencies exist, and policy implementation and enforcement remain problematic, the Government can point to a range of efforts that have been embarked on over the years to enable the country to address its energy and environment challenges.

Box 3 provides a list of some of the more high profile measures that the Government has promoted in previous years and seeks to enhance and boost under the newly-articulated National Action Plan on Climate Change referred to in more detail below.

²¹ Ibid.



Box 3:

Sample of GHG Abatement initiatives by the Government of India

1. INTRODUCTION OF LABELLING PROGRAMME FOR APPLIANCES

An energy labeling program for appliances was launched in 2006, and comparative star-based labeling has been introduced for fluorescent tube-lights, air conditioners, refrigerators, and distribution transformers. The labels provide information about the energy consumption of an appliance, and thus enable consumers to make informed decisions. The Bureau of Energy Efficiency has made it mandatory for refrigerators to display energy efficiency label and is expected to do so for air conditioners as well. The standards and labeling program for manufacturers of electrical appliances is expected to lead to significant savings in electricity annually.

2. ENERGY CONSERVATION BUILDING CODE

An Energy Conservation Building Code (ECBC) was launched in May, 2007, which addresses the design of new, large commercial buildings to optimize the building's energy demand based on their location in different climatic zones. Commercial buildings are one of the fastest growing sectors of the Indian economy, reflecting the increasing share of the services sector in the economy. Nearly one hundred buildings are already following the Code, and compliance with the Code has been incorporated into the mandatory Environmental Impact Assessment requirements for large buildings. It has been estimated that if all the commercial space in India every year conform to ECBC norms, energy consumption in this sector can be reduced by 30-40%. Compliance with ECBC norms is voluntary at present but it is expected to soon become mandatory.

3. ENERGY AUDITS OF LARGE INDUSTRIAL CONSUMERS

In March 2007 the conduct of energy audits was made mandatory in large energy-consuming units in nine industrial sectors. These units, notified as "designated consumers" are also required to employ "certified energy managers", and report energy consumption and energy conservation data annually.

4. MASS TRANSPORT

The National Urban Transport Policy emphasizes extensive public transport facilities and non-motorized modes over personal vehicles. The expansion of the Metro Rail Transportation System in Delhi and other cities and other mass transit systems, such as the MetroBus project in Bangalore, are steps in its implementation. The state government of Maharashtra recently announced that it will impose a congestion tax to discourage the use of private cars in cities where it has created "sufficient public transport capacity".



Box 3. Cont...

5. CLEAN AIR INITIATIVES

In urban areas, one of the major sources of air pollution is emissions from transport vehicles. Steps taken to reduce such pollution include (i) introduction of compressed natural gas (CNG) in Delhi and other cities; (ii) retiring old, polluting vehicles; and (iii) strengthening of mass transportation as mentioned above. Some state governments provide subsidies for purchase and use of electric vehicles. For thermal power plants, the installation of electrostatic precipitators is mandatory. In many cities, polluting industrial units have either been closed or shifted from residential areas.

6. PROMOTION OF ENERGY SAVING DEVICES

The Bureau of Energy efficiency has introduced "The Bachat Lamp Yojana", a program under which households may exchange incandescent lamps for CFLs (compact fluorescent lamps) using clean development mechanism (COM) credits to equate purchase price. Some states have made mandatory the installation of solar water heaters in hospitals, hotels and large government and commercial buildings. Subsidy is provided for installation of solar water heaters in residential buildings.

7. PROMOTION OF BIOFUELS

The Biodiesel Purchase Policy mandates biodiesel procurement by the petroleum industry. A mandate on Ethanol Blending of gasoline requires 5% blending of ethanol with gasoline from 1st January, 2003, in 9 States and 4 Union Territories.

Source: National Action Plan on Climate Change, GoI 2008:16-18

National Action Plan on Climate Change

The most recent and authoritative articulation of the Government's response to climate change has come in the National Action Plan on Climate Change (NAPCC). Put together under the guidance of the Advisory Council on Climate Change, and released by the Prime Minister on 30 June 2008, the Plan sets out the Government's thinking and key initiatives on the issue. In his launch address, the Prime Minister noted, "Our vision is to make India's economic development energy efficient. Over a period of time we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources."²² Shyam Saran, the Prime Minister's special envoy on climate change has described the Plan as a strategy for the country to "stabilise its greenhouse gas emissions at a lower and more sustainable level and eventually reduce them significantly".²³

²² Press Trust of India, Monday, June 30, 2008 (New Delhi)

²³ Press Trust of India, Wednesday, June 18, 2008 (Bangalore)



If these are the ambitions of the policy-makers behind the Plan, what does it actually do? In its own words, the National Action Plan on Climate Change “identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively.” It is therefore more appropriately a development plan with climate change characteristics, rather than a climate change plan with development characteristics. This framing, and the cautious approach of the Government, is emphasized quite categorically in the Plan itself: “In view of the large uncertainties concerning the spatial and temporal magnitude of climate change impacts, it is not feasible to design strategies exclusively for responding to climate change. Rather, the need is to identify and prioritize strategies that promote development goals while also serving specific climate change objectives. ... It is imperative to identify measures that promote our development objectives, while also yielding co-benefits for addressing climate change effects. Cost-effective energy efficiency and energy conservation measures are of particular importance in this connection. Similarly, development of clean energy technologies, though primarily designed to promote energy security, can also generate large benefits in terms of reducing carbon emissions.”²⁴

The Plan lays great store by the use and development of new technologies, and seeks to deliver on these objectives through the establishment of eight core areas – called ‘Missions’ – intended to deliver maximum benefits in terms of domestic climate change mitigation and adaptation, in the broader context of promoting sustainable development. The eight Missions are solar energy, energy efficiency; sustainable habitat; water; sustaining the Himalayan ecosystem; green India; sustainable agriculture; and sustainable knowledge for climate change. Most of the Missions build on existing programmes, but give them a “change in direction, enhancement of scope and effectiveness and accelerated implementation of time-bound plans”.

Annex 1 contains descriptions of each of these Missions articulated in the GoI’s own words. Detailed programs for each of the eight missions are to be drawn up by the responsible Ministries and submitted to the PM and his Advisory Council in December 2008. An opportunity for public consultation and engagement has also been indicated by the government.

4. Focus on renewable energies

The above sections have underscored the importance that successive Indian governments have placed on alternative and clean energy options in order to address the country’s energy, economic and security concerns. In recent years, this has received greater impetus as a result of growing environmental and climate change-related concerns.

India’s early investments in creating a policy framework and institutions supportive of the development of clean energy for the country have now begun to gain traction and deliver. India is now a key global player in this arena with the fourth largest installed wind energy capacity and the second largest for biogas production (see Figure 4 on

²⁴ NAPCC, GoI 2008:17



India's renewable energy breakdown). An Indian company, Suzlon, is now Asia's largest producer of wind turbines and the fifth largest in the world. The motivation for the company's founder, Tulusi Tanti, was to provide a reliable source of power for the millions in India who are either not served or under-served by the country's energy infrastructure. As a businessman he had experienced first-hand the damage to productivity caused by erratic power supply and resolved to do something about. A similar can-do approach now seems to be evident even in bureaucratic circles.

Figure 4
India: Renewable energy breakdown

Technology	Cumulative Achievements (MW)
GRID-INTERACTIVE	
WIND	8,757
SMALL HYDRO	2,181
BAGASSE CHP	801
BIOMASS	606
WASTE-to-ENERGY	56
SOLAR PV	2
SOLAR THERMAL	0
GEO THERMAL	0
TIDAL/WAVE	0
OFF-GRID	
BIOMASS	95
BIOMASS GASIFIER	86
WASTE-to-ENERGY	24
SOLAR PV	2
TOTAL	12,610

SMALL-SCALE SYSTEMS	Cumulative Achievements
FAMILY BIOGAS PLANTS	4 million
SOLAR STREET LIGHTS	69,549
SOLAR HOME SYSTEM	363,399
SOLAR LANTERN	585,011
SOLAR PUMPS	7,148 nos.
SOLAR WATER HEATING (collector area)	2.15 million sq.m.
SOLAR COOKERS	620,000
WIND PUMPS	1,294 nos.

Source: MNRE 2008

The Government has set a target of 14 GW to 20 GW of additional renewable capacity for the 11th Five Year Plan (2007-12) and launched a number of initiatives designed to attract private sector investment into manufacturing and renewable power generation. These range from efforts by the central government to establish a green venture capital fund to promote technological development and energy efficiency, to a slew of efforts at the sub-national level by India's states to attract renewable energy investment. For example, in a spin on the traditional model, southern states such as Tamil Nadu are seeking to establish 'green' special economic zones (SEZs) focusing on servicing the needs of the growing renewable energy sector through dedicated manufacturing, research and development, and services.



Renewable Energy – Country Attractiveness Index

All Renewables Index at Q4 2007

Ranking*	Country	All Renewables	Wind Index	Onshore Wind	Offshore Wind	Solar	Biomass/Other	Infrastructure***
1 (1)	US**	70	71	77	56	72	63	72
2 (2)	Germany	67	66	65	68	73	68	66
3 (3)	India	66	67	76	44	62	60	66
4 (4)	Spain	64	65	70	50	72	57	73
4 (5)	UK	64	67	65	73	51	59	70
6 (6)	China	61	66	69	57	45	49	63
7 (7)	Italy	60	59	64	44	69	56	66
8 (8)	Canada	59	62	67	49	43	51	66
9 (8)	France	58	59	60	54	60	56	61
10 (10)	Portugal	57	58	63	46	62	49	64
10 (10)	Greece	57	59	63	49	59	43	60
12 (12)	Ireland	55	58	59	56	37	47	65
13 (14)	Australia	53	53	56	44	61	49	60
14 (13)	Sweden	52	52	52	52	44	57	53
15 (16)	Netherlands	50	51	51	51	50	43	49
16 (15)	Denmark	49	51	47	60	44	47	61
17 (16)	Belgium	48	52	50	57	36	37	53
17 (16)	Norway	48	50	50	50	32	48	53
17 (19)	Poland	48	51	53	45	42	36	46
20 (20)	Japan	45	46	48	40	48	34	51
20 (20)	Brazil	45	45	49	35	45	41	44
22 (22)	New Zealand	44	47	51	38	33	32	45
23 (23)	Finland	38	36	36	37	27	56	41
24 (24)	Turkey	36	37	38	33	38	27	35
25 (25)	Austria	35	30	41	N/A	48	49	49

Source: Ernst & Young, 2008

In an effort to provide policy and price guidance, support and streamlining to state-led initiatives, the Ministry of New and Renewable Energy (MNRE) is formulating a Draft National Renewable Energy Policy that will seek to establish a national renewable portfolio standard (RPS) with electricity targets for state utilities of 10% renewable by 2010, and 20% renewable by 2020. Given the leeway that individual states have through their Electricity Regulatory Commissions to set tariffs for utilities, and more broadly improved managerial and commercial performance by reformed utilities, one is beginning to see the emergence of a comparable situation in India to that of the US and Germany where feed-in tariffs, utility reforms and inter-state competition combined to create a dynamic market for renewable energy generation.

As noted above, the Government has also been a staunch supporter of instruments such as the Clean Development Mechanism (CDM) under the UNFCCC and used it to accelerate adoption of clean technology, renewable energy, energy conservation and efficiency in India. As a result of the enthusiastic take-up by Indian firms of CDM credit opportunities, and a general openness to carbon trading, India accounts for more than one third of all CDM projects registered worldwide, and is the second largest after China in terms of the volume of CERs (certified emissions reductions). The CDM has added great impetus to the push for renewable energy in India and created strong financial incentive for the private sector to engage in the search for carbon-abatement technologies. India's experience with instruments such as the CDM puts it in a prime position to both benefit from, and influence, the development of, the \$30 billion dollar international carbon market.



India's asset base of highly-skilled, tech savvy professionals, a strongly enterprising culture, large market and supportive policy framework have made it a destination of choice for cleantech investors the world over. The country now ranks as the third most attractive place to invest in renewable energy, behind the US and Germany, on Ernst & Young's Country Attractiveness Index (see Figure 5). UNEP and New Energy Finance have recorded a steady rise in renewable energy investments in the country across the range of sources from private equity and venture capital, to asset finance, public markets and M&A's (see Figure 6). The era of big private sector investments in renewable in India has finally arrived with single deals now reaching the \$100 million mark. as with the Moser Baer solar photovoltaic deal in 2006 which will expand the production of PV thin film from 40 MW to a whopping 600 MW by 2010.²⁵

Figure 6
India: Renewable energy investments by type



Source: UNEP/ New Energy Finance, 2007

The renewable renaissance in India, however, is not just dominated by large investments or titanic players; the real story is in what is happening at the ground level. A recent assessment of key trends in the field in India²⁶ found an efflorescence of investments across a range of sectors, from transportation to housing, but also innovations in micro-financing to provide renewable energy alternatives for low-income urban and rural households. For example, the Bangalore-based firm, SELCO has teamed up with Sewa Bank to provide affordable home lighting solutions for poor households. Elsewhere there are emerging examples of village-based renewable energy entrepreneurs providing fee-paying services such as solar roof generated electricity, solar lighting and mobile phones to their neighbors. For a country with 400

²⁵ Ringwald, 2008:17

²⁶ Op cit.



to 600 million people with no or limited access to electricity these are highly meaningful innovations with paradigm shifting potential. Flexible options for those who are off-grid in India are sorely needed and these examples are charting a way forward. What is needed, however, for a country of India's sub-continental proportions are solutions that are scalable and sustainable. The pace of experimentation with renewable technologies is showing that those solutions may finally be within sight and help provide the win-win-win of generating jobs, satisfying unmet needs, and reducing greenhouse gas emissions.

5. The future is green

In the last two years, there appears to have been a discernible shift in public awareness on climate change in countries such as India. Films like 'An Inconvenient Truth' have been very important in alerting people to the gravity of the climate crisis and shaping attitudes. The award of the Noble Peace prize to Al Gore and the Intergovernmental Panel on Climate Change (IPCC), headed by an Indian scientist, kept the issue in the headlines in 2007 and prompted greater media coverage than ever before. Surprisingly, according to the 2007 Pew Global Attitudes survey, 57 percent of those polled in India said that global warming was a very serious national problem, compared to only 47 percent of Americans polled who thought the same.²⁷

One can also find growing recognition in policy circles of the need for urgent and effective action to address climate change and energy security, and related insecurities such as food and water, in an integrated manner. As the IEA noted in its World Energy Outlook 2007, the "primary scarcity facing the planet is not of natural resources nor money, but time," as "Investment now being made in energy-supply infrastructure will lock in technology for decades, especially in power generation. The next ten years will be crucial, as the pace of expansion in energy-supply infrastructure is expected to be particularly rapid." The report concludes that China's and India's energy challenges will thus be the world's energy challenges and call for collective responses.

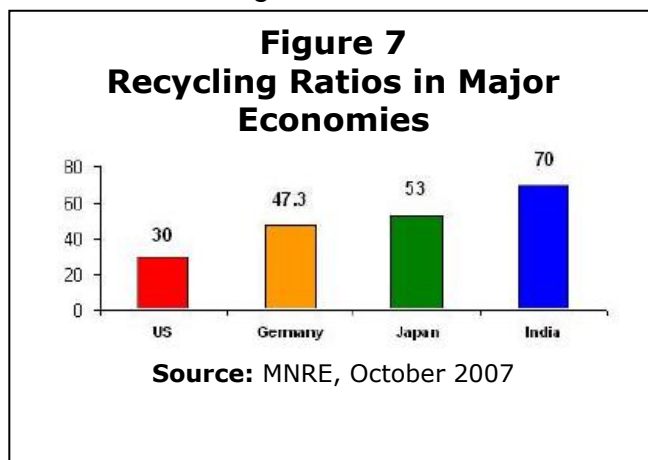
The penny is dropping in India and, as the sections above show, the country's policymakers, entrepreneurs, business and industry are beginning to respond to both the energy challenge and the greater climate challenge. In particular, the global energy and economic scenario has conspired to create the conditions for a renaissance of renewable energy the likes of which we have not seen since the early-1970s. Only this time, if current trends are to be believed, it is likely to grow – and grow – until it becomes established as a core and unshakeable part of energy systems everywhere.

²⁷ Stokes 2007



For much of its history, India has been a sustainer society, using and reusing resources, and still enjoys one of the highest recycling rates in the world (see Figure 7). Whereas such practices have been largely driven by poverty, they are now being re-valued and embraced as sensible responses to resource scarcity, environmental problems and global warming. With sections of its growing middle class of 250 to 300 million, now recognizing the wasteful nature of modern consumption and production patterns, one is beginning to see the emergence of green consumer consciousness. Across the country one can see experimentation with 21st century holistic living and an emphasis on lifestyle change supportive of a green economy and society. In many respects, this change has been spurred by the return to India of US-based professionals who have reversed the 'brain drain' to a 'brain gain,' and brought with them disenchantment with the excesses of western consumerism and a re-appreciation of organic and sustainable living. Without romanticizing India's much-vaunted ancient green credentials, this has certainly tapped into a pre-consumer society green ethos that is still prevalent in India.

Around the country, cities and municipalities are showing a growing appetite for tackling energy and environmental challenges, particularly in transportation - India's fastest growing user of energy. Bangalore is leading the way with a state-of-the-art low-emissions mass transit system, Mumbai and Delhi have joined the international C-40 Cities Climate Leadership Group,²⁸ and Delhi is subsidizing the purchase of India's best-selling Reva electric cars. A new breed of eco-developer is focusing on



housing seeking to capitalize on a projected \$4 billion market for green build by 2012,²⁹ and pushing existing building codes on energy efficiency.

Civil society groups are mobilizing and initiatives such as Climate Challenge India are leading the way in providing new thinking and optimism. India's Generation Next is coming together in networks such as the Indian Youth Climate Network and campus agitation is occurring.

Media leadership is emerging with national papers and magazines dedicating themselves to climate coverage. At the sub-national level, Madhya Pradesh, one of India's largest states, has broken new ground by establishing a committee on climate change.

This growing public constituency for greener development pathways, and private sector commercial interest in the sustainability market, will add further impetus to policymaking in this area in India. While the Government's National Action Plan on Climate Change has been criticized for a lack of vision, urgency and concrete targets and timetables it provides a framework that can be built on. For example, it does contain some innovations such as a domestic 'cap-and-trade' system to incentivize

²⁸ www.c40cities.org

²⁹ CII report



emissions reductions in nine energy intensive sectors: thermal power plants; fertilizer; cement; iron and steel; chlor alkali; aluminum; railways; paper and pulp; and textiles.

The Government can claim some credit for a number of achievements which provide a good foundation for further improvements to be made. Since 2004, India has managed to decouple economic growth from energy use, with the economy growing at a rate of over 9% per year, but an energy growth rate of less than 4% per year.³⁰

These are important efforts, but it will take more than a smattering of good examples to make the change needed. Instead of following the example of developed countries, India needs to opt for smart, low-carbon growth and make sustainability the organizing principle of its economy and modernization agenda. For a country with an advanced nuclear programme and space exploration ambitions, leapfrogging from a high-carbon to a low-carbon energy economy is timely and possible.

Across India, there is a palpable sense that the country has awoken and is on the move on climate change. These are small beginnings, but they represent a huge opportunity. 2009 is a very different year to those before it. With elections in both India and the United States, and domestic electorates more alive to the need for action and leadership, it is a game-changing moment. Both India and the US need a new narrative that looks forward not backwards. One where the politics of blame is replaced by the recognition of a shared dilemma,, and the value of collective action. This will be all the more important as both countries gear up for engagement in international negotiations for a Global Deal on climate change under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC).

The shaky global economy provides a stark backdrop of why co-operation in an interdependent world is the only way forward. To succeed, climate change must be re-framed as an agenda of hope, growth, innovation and opportunity. It must be used to mobilize and imbue with optimism a new sense of national purpose. India has a billion good reasons for leadership on climate change. Addressing it could be the best means for the country to secure prosperity and sustainable development as it seeks to emerge as a major power in the 21st century.

³⁰ India: Addressing Energy Security and Climate Change, MoEF Oct 2007: 1



Annex 1

The Eight Missions of India's National Action Plan on Climate Change

1. National Solar Mission

A National Solar Mission will be launched to significantly increase the share of solar energy in the total energy mix while recognizing the need to expand the scope of other renewable and non fossil options such as nuclear energy, wind energy and biomass.

India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting a decentralized distribution of energy, thereby empowering people at the grassroots level. Photovoltaic cells are becoming cheaper with new technology. There are newer, reflector-based technologies that could enable setting up megawatt scale solar power plants across the country. Another aspect of the Solar Mission would be to launch a major R&D program, which could draw upon international cooperation as well, to enable the creation of more affordable, more convenient solar power systems, and to promote innovations that enable the storage of solar power for sustained, long-term use. . (very descriptive paragraph)

2. National Mission for Enhanced Energy Efficiency

The Energy Conservation Act of 2001 provides a legal mandate for the implementation of the energy efficiency measures through the institutional mechanism of the Bureau of Energy Efficiency (BEE) in the Central Government and designated agencies in each state. A number of schemes and programs have been initiated and it is anticipated that these would result in a saving of 10,000 MW by the end of 11th Five Year Plan in 2012.

To enhance energy efficiency, four new initiatives will be put in place. These are:

- A market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.
- Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
- Creation of mechanisms that would help finance demand side management programs in all sectors by capturing future energy savings.
- Developing fiscal instruments to promote energy efficiency



3. National Water Mission

A National Water Mission will be mounted to ensure integrated water resource management helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. The Mission will take into account the provisions of the National Water Policy and develop a framework to optimize water use by increasing water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing. It will seek to ensure that a considerable share of the water needs of urban areas are met through recycling of waste water, and ensuring that the water requirements of coastal cities with inadequate alternative sources of water are met through adoption of new and appropriate technologies such as low temperature desalination technologies that allow for the use of ocean water.

The National Water Policy would be revisited in consultation with states to ensure basin level management strategies to deal with variability in rainfall and river flows due to climate change. This will include enhanced storage both above and below ground, rain water harvesting, coupled with equitable and efficient management structures.

The Mission will seek to develop new regulatory structures, combined with appropriate entitlements and pricing. It will seek to optimize the efficiency of existing irrigation systems, including rehabilitation of systems that have been run down and also expand irrigation, where feasible, with a special effort to increase storage capacity. Incentive structures will be designed to promote water-neutral or water-positive technologies, recharging of underground water sources and adoption of large scale irrigation programs which rely on sprinklers, drip irrigation and ridge and furrow irrigation.

4. National Mission on Sustainable Habitat

A National Mission on Sustainable Habitat will be launched to make habitat sustainable through improvements in energy efficiency in buildings, management of solid waste and modal shift to public transport. The Mission will promote energy efficiency as an integral component of urban planning and urban renewal through three initiatives.

i. The Energy Conservation Building Code, which addresses the design of new and large commercial buildings to optimize their energy demand, will be extended in its application and incentives provided for retooling existing building stock.

ii. Recycling of material and Urban Waste Management will be a major component of ecologically sustainable economic development. India already has a significantly higher rate of recycling of waste compared to developed countries. A special area of focus will be the development of technology for producing power from waste. The National Mission will include a major R&D program, focusing on bio chemical conversion, waste water use, sewage utilization and recycling options wherever possible.

iii. Better urban planning and modal shift to public transport. Making long term transport plans will facilitate the growth of medium and small cities in ways that ensure efficient and convenient public transport.

In addition, the Mission will address the need to adapt to future climate change by improving the resilience of infrastructure, community based disaster management, and measures for improving the warning system for extreme weather events. Capacity building would be an important component of this Mission.



5. National Mission for Sustaining the Himalayan Ecosystem

A Mission for sustaining the Himalayan Ecosystem will be launched to evolve management measures for sustaining and safeguarding the Himalayan glacier and mountain eco-system. Himalayas, being the source of key perennial rivers, the Mission would, inter-alia, seek to understand, whether and the extent to which, the Himalayan glaciers are in recession and how the problem could be addressed. This will require the joint effort of climatologists, glaciologists and other experts. We will need to exchange information with the South Asian countries and countries sharing the Himalayan ecology.

An observational and monitoring network for the Himalayan environment will also be established to assess fresh water resources and health of the ecosystem. Cooperation with neighboring countries will be sought to make the network comprehensive in its coverage.

The Himalayan ecosystem has 45 million people who practice hill agriculture and whose vulnerability is expected to increase on account of climate change. Community-based management of these ecosystems will be promoted with incentives to community organizations and panchayats for protection and enhancement of forested lands. In mountainous regions, the aim will be to maintain two-thirds of the area under forest covers in order to prevent erosion and land degradation and ensure the stability of the fragile ecosystem.

6. National Mission for a Green India

A National Mission will be launched to enhance ecosystem services including carbon sinks to be called Green India. Forests play an indispensable role in the preservation of ecological balance and maintenance of bio-diversity. Forests also constitute one of the most effective carbon-sinks.

The Prime Minister has already announced a Green India campaign for the afforestation of 6 million hectares. The national target of area under forest and tree cover is 33% while the current area under forests is 23%.

The Mission on Green India will be taken up on degraded forest land through direct action by communities, organized through Joint Forest Management Committees and guided by the Departments of Forest in state governments. An initial corpus of over Rs 6000 crore has been earmarked for the program through the Compensatory Afforestation Management and Planning Authority (CAMPA) to commence work. The program will be scaled up to cover all remaining degraded forest land. The institutional arrangement provides for using the corpus to leverage more funds to scale up activity.



7. National Mission for Sustainable Agriculture

The Mission would devise strategies to make Indian agriculture more resilient to climate change. It would identify and develop new varieties of crops and especially thermal resistant crops and alternative cropping patterns, capable of withstanding extremes of weather, long dry spells, flooding, and variable moisture availability.

Agriculture will need to be progressively adapted to anticipate climate change and our agricultural research systems must be oriented to monitor and evaluate climate change and recommend changes in agricultural practices accordingly.

This will be supported by the convergence and integration of traditional knowledge and practice systems, information technology, geospatial technologies and biotechnology. New credit and insurance mechanisms will be devised to facilitate adoption of desired practices.

Focus would be on improving productivity of rain-fed agriculture. India will spearhead efforts at the international level to work towards an ecologically sustainable green revolution.

8. National Mission on Strategic Knowledge for Climate Change

To enlist the global community in research and technology development and collaboration through mechanisms including open source platforms, a Strategic Knowledge Mission will be set up to identify the challenges of, and the responses to, climate change. It would ensure funding of high quality and focused research into various aspects of climate change.

The Mission will also have, on its research agenda, socio-economic impact of climate change including impact on health, demography, migration patterns and livelihoods of coastal communities. It would also support the establishment of dedicated climate change related academic units in Universities, other academic and scientific research institutions in the country which would be networked. A Climate Science Research Fund would be created under the Mission to support research. Private sector initiatives for development of innovative technologies for adaptation and mitigation would be encouraged through venture capital funds. Research to support policy and implementation would be undertaken through identified centers. The Mission will also focus on dissemination of new knowledge based on research findings.



Bibliography

Carbon Disclosure Project and World Wildlife Fund for Nature India (CDP) (2007). *Carbon Disclosure Project Report 2007: India*. New Delhi: CDP and WWF India.

Central Electricity Authority (CEA) (2008), Ministry of Power. Government of India: New Delhi.

Ernst and Young (2008). *Renewable Energy Country Attractiveness Indices, Q4 2007*. United Kingdom: Ernst and Young.

Fitter, Pierre Mario with Alexis Ringwald (2008) *The Green Trade*, in *Businessworld*, (22 Sept , 2008) 32-38

Garg, Amit, P.R. Shukla, Manmohan Kapshe (2006). *The sector trends of multigas emissions inventory of India*, in *Atmospheric Environment* 40 (2006) 4608-4620.

Government of India (2007). *India: Addressing Energy Security and Climate Change*, Ministry of Environment & Forests, Oct 2007

Government of India (2008). *National Action Plan on Climate Change*. Prime Minister's Council on Climate Change, 30 June 2008.

Government of India (2008). National Five Year Plan, ,

Government of India (2008). Statement by. Kapil Sibal at 95th Indian Science Congress (January 2008)

International Energy Agency (IEA) (2007). *World Energy Outlook 2007: China and India Insights*. Paris: OECD/IEA.

Ministry of New and Renewable Energy (MNRE) (2008). *Estimated medium-term (2032) potential and cumulative achievements as on 31.03.2008* . 2008

Planning Commission (2006). *Report of the Expert Committee on Integrated Energy Policy*. New Delhi, Government of India.

Ringwald, Alexis. *India: Renewable Energy Trends* (2008). Centre for Social Markets, Kolkata, India. August 2008.

Stokes, Bruce (2008), *Global Warming: Envy yes, Green no* in. *National Journal*. Sat. May 3, 2008

United Nations Environment Program, SEFI and New Energy Finance (UNEP) (2007). *Global Trends in Sustainable Energy Investment 2007*. Paris: SEFI.

United Nations Intergovernmental Panel on Climate Change (UNFCCC, 2007). *Climate Change 2007: Synthesis Report. Summary for Policymakers-An Assessment of the Intergovernmental Panel on Climate Change*. Pg 13, para:7. New York City, USA