Sub-national actions on climate change in India and implications for international collaboration

This discussion paper has been authored by Arabinda Mishra, Nimisha Pandey, Himani Upadhyay, Parul Gupta, and Atul Kumar, TERI, with contribution from other colleagues, for the 17th Conference of Parties to the United Nations Framework Convention on Climate Change, 28 November–9 December 2011, Durban, South Africa

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Abstract

In the absence of a legally binding agreement at the international climate negotiations, actions based on national self-interest are encouraging signs for managing climate change. With the formulation of a climate change action plan at the national level, the role of the states becomes significant as they will be at foreground for implementation of climate action because of their proximity to the consequences. However, in spite of the intention and the aspiration to manage the challenge, lack of matching resources to create the needed capabilities presents a more immediate constraint to climate action at the sub-national level. With this background, the paper evaluates the climate change action plans proposed by a few Indian states and presents some insights related to states' preparedness and the role of international stakeholders.

"The challenges to achieve the ultimate objective of the Convention will require the collective efforts of all parties and stakeholders, including the spheres of governments from national, sub-national to local governments. The contribution of sub-national governments will be essential to achieve the ambitious commitments of the future agreements. Sub-national governments are playing and will play a critical role for developing and putting into practice the general measures established by the countries. Therefore we further call on the UNFCCC to give explicit recognition to the work of state and regional governments as a model for international cooperation and as instrumental in the implementation of a post-2012 agreement."

Statement of Action, Delivered to the UNFCCC in Poznan, Poland

While central governments set policy directions much of the innovative thinking and action will come from the sub-national level.

Yvo de Boer, UNFCCC Executive Secretary, during the 2nd Governors' Global Climate Summit in Los Angeles in 2009

Under the Copenhagen Accord, India has pledged a 20-25% reduction (excluding the agricultural sector) in GHG emissions intensity per unit of GDP by 2020 from a 2005 baseline (Planning Commission, 2011). To meet and exceed this goal, a multi-pronged approach has been proposed - increasing fuel efficiency standards by 2011; adopting building energy codes by 2012; increasing forest cover to sequester 10% of its annual emissions; and increasing the fraction of electricity derived from wind, solar, and small hydro from the current 8% to 20% by 2020 (ref). India's National Action Plan on Climate Change (NAPCC) identifies 8 National Missions to provide a structure and support to mitigation and adaptation actions (NAPCC, 2008). Subsequent to the framing of the NAPCC, the national government directed the States to formulate individual State Action Plans on Climate Change (SAPCC) (PIB, 2009).

Need for sub-national actions and role of federal state

Limiting global temperature rise is an immense and urgent challenge that requires close collaboration and coordination among all decision-makers around the world both at the international and national levels. Importantly, 50-80% of GHG emissions are influenced by local behavior and investment choices while adaptation to climate change is very site dependent (UNDP 2010). Consequently, there is a growing consensus about the necessity to involve new actors like local authorities, the private sector and civil society in policy responses to the climate change challenge. To shift to a low carbon economy, new types of policies, partnerships and instruments are needed. Moreover, it is actually the sub-national governments/authorities – regions, states, and cities who will have to implement most of the low carbon technologies and policies necessary to curb global warming and alongside build resilience to the likely adverse impacts of a changing climate.

Sub-national actions are critical in addressing climate change due to their proximity to the consequences of climate change. Though the actions by sub-national stakeholders are local in nature, their benefits are distributed globally.

Sub-national actions are critical in addressing climate change due to their proximity to the consequences of climate change (Oliveira, 2009). Though the actions by sub-national stakeholders are local in nature, their benefits are distributed globally and provide information feedbacks to policies at the national and international level. Sub-national and local-level involvement can also facilitate cross-sector policy interventions and provide models for climate action that can be emulated across the various levels of climate policy architecture. Therefore, sub-national governments can certainly emerge as laboratories for the innovation, development, and implementation of actions on climate change.

Role of federating states

Implementation of climate change policy needs to take place at all scales of governance. In the Indian federal system, the responsibilities and areas of jurisdiction of the Centre and the State governments are demarcated through the Union List and the State List, respectively, enumerated in the Seventh Schedule of the Indian constitution (Constitution of India). This distinction of responsibilities plays an important role in the context of environment federalism and climate policy. The impacts of climate change are typically cross-sector in nature and require policy responses on multiple fronts in a coordinated and coherent manner. In India, some of the sectors

directly related to natural resources, such as agriculture, water, fisheries, mines and land use, are placed under the jurisdiction of individual States. In addition, sectors such as selected industries and transport, which are important concerns of climate policy-makers by virtue of being energy- and emissions- intensive in nature, are also the components of the State List. On the other hand, several areas relevant to climate policy, including trade representation, agreements and conventions, atomic power, mineral and oil resources are concerns of the Union (Jorgensen, 2011). This division of responsibilities highlights the magnitude of influence States potentially exert on climate policy and environmental decision making in general. Apart from the constitutional provisions, States also have an important responsibility of implementing the policies formulated at the national level. However, it is necessary to acknowledge the broader role of States as initiators and innovators, rather than mere "executors" (Jorgensen, 2011). Kaswan (2007) notes that letting States develop environmental protection policies can also allow them to serve as "laboratories of invention" for technological and regulatory innovation. Thus, the role of States needs to be enlarged, along with the provision of greater autonomy—state action should be than more than mere implementation of top-down policies and involve individual bottom-up policies as well (Jorgensen, 2011). In sum, States can be regarded as drivers of multi-level climate policy and significant climate policy players, despite the enlarged role of the Centre in the foreground and its residuary powers.

In addition, the importance of the role of States in policy-formulation can be understood in the context of the wide socio-economic and climate-geographic dissimilarities across regions, especially in a diverse country such as India. Since the mitigation responsibility, potential, and capacity varies considerably across States, it is necessary to tailor policies in accordance with local circumstances. Clearly, bottom-up policies formulated at the sub-national level and devised according to the local factors and socio-economic conditions serve this purpose well, since sub-national actors have access to unique information regarding ground realities, that may not be available at the national level (Burtraw and Shobe, 2009). Stated differently, decentralized decision-making is expected to be more efficient while uniform federal standards may be inefficient and inappropriate when applied to particular areas (Kaswan, 2007).

State action plans on climate change (SAPCCs) in India

In August 2009, the national government of India directed all the States to develop their respective State Action Plan on Climate Change (SAPCC), guided by and consistent with the structure and strategies of the NAPCC. (Figure 1). The individual SAPCCs are expected to lay out sector- specific as well as cross sector time-bound priority actions, along with indicative budgetary requirements, supplemented with details of the necessary institutional and policy infrastructure to support the operationalization of actions.

In order to decentralize NAPCC objectives into local context, a common framework has been developed (MoEF, 2010) which emphasizes

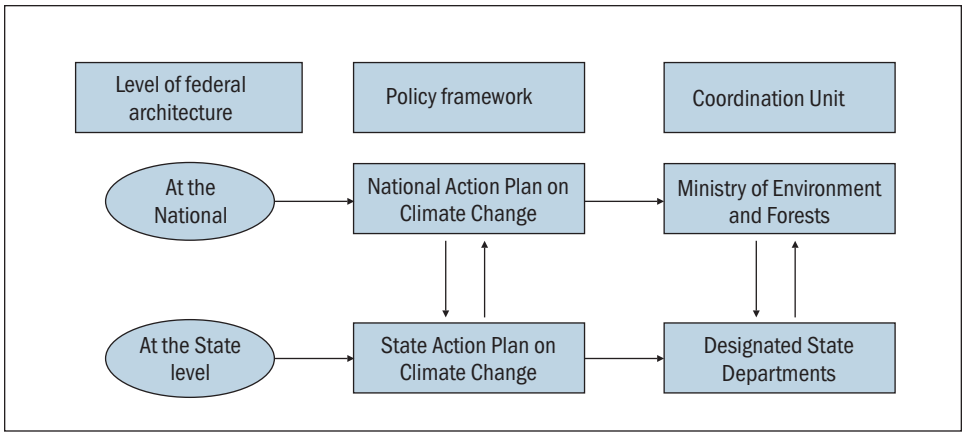

Figure 1 Preparation of action plans on climate change at the national and state level

on harmonizing national and state level actions while also incorporating regional and site specific variations. The common framework is expected to enable proper coordination of the process of preparation of SAPCCs and its subsequent implementation under varied regional and local contexts.

The implementation of the SAPCCs requires appropriate institutional arrangements. At the Centre, different ministries lead the responsibility to develop objectives, implementation strategies, timelines, and monitoring and evaluation criteria for each of the national missions. The Ministry of Environment and Forests (MoEF) is the coordinating agency for implementation of the NAPCC (Figure 1). At the State level, however, a variety of institutional arrangements have emerged, ranging from Climate Change Cells in a nodal department to a full-fledged Department of Climate Change as in the case of the State of Gujarat. The policy making process (Figure 2) being adopted by all the States indicates a participatory approach to preparation of the SAPCCs. There is however considerable variation among States in terms of the form and extent of stakeholders' participation in the process of SAPCC preparation.

The state steering committee, state advisory group and core agency are the three pillars for developing the SAPCC. Their responsibilities and roles are outlined in Figure 2. After the SAPCC is prepared, the National Steering Committee (NSC) in the Ministry of Environment and Forest (MoEF) would be responsible for the final endorsement and approval of the SAPCC.

Climate change is not a subject that can be addressed in isolation by one department; it requires active inter-departmental cooperation.

Climate change is not a subject that can be addressed in isolation by one department; it requires active inter-departmental cooperation. Generally, the preparation of SAPCCs in India has witnessed line departments providing primary inputs to the nodal department, which in consultation with technical experts has sought to develop a coherent policy document. Cross-department integration of strategies has been attempted in varying ways: while in some States presentation of the SAPCC before a high-level Committee of Secretaries has enabled quick iteration and consensus-building, in others the process has been tedious and often superficial.

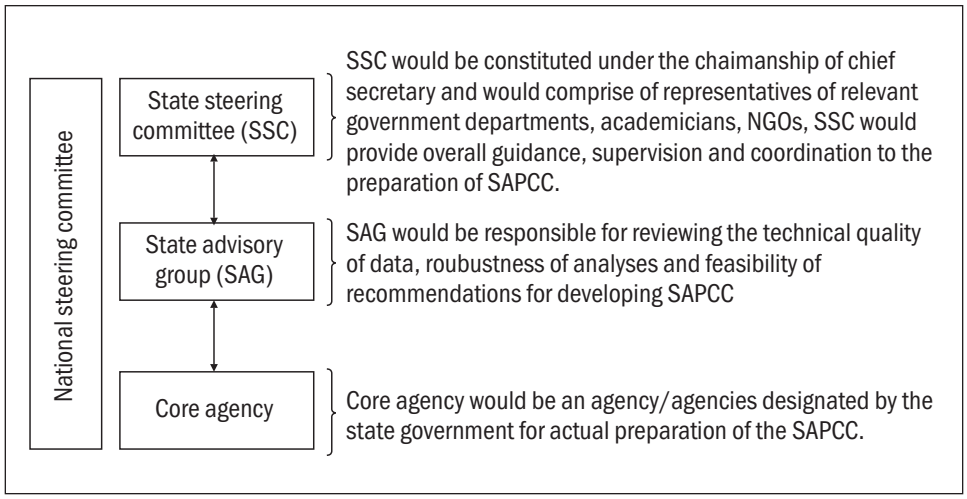

Figure 2 Process of preparation of SAPCCs

Prior to the NAPCC there was little action on the sub-national level that directly emerged out of climate change concerns. The NAPCC itself has been primarily a centrally coordinated enterprise that benefited little from the expertise and views of other stakeholders at the sub-national levels during the process of its formulation. Within the federal structure, the NAPCC was envisaged without instituting any plan of action at the state and local levels at which the policies would have to be actually implemented (Jayashree Vivekanandan, 2009). Ideally, the identification of specific policy actions in the SAPCCs should have been based on robust scientific assessments of climate change related vulnerabilities and emissions mitigation potential at the sub-national level. In practice, most of the SAPCCs have relied on nationally conducted exercises like the NATCOM (National Communications to the UNFCCC) or the work done by the Indian Network for Climate Change Assessment (INCCA) for scientific inputs. Though they do give significant insights about impacts and vulnerabilities at a regional level, however the scale of assessments do not capture the State specific local impacts and vulnerabilities which are important while designing State level action on climate change.

The absence of relevant strategic knowledge at the local scale has meant that States have by and large focused on no-regret measures and in many cases relied on scaling up or replication of existing development related programmes and actions. Centrally coordinated capacity building initiatives would have certainly helped to enhance States' understanding of the various Missions elucidated in the NAPCC and ensured a harmonized outcome of the sub-national policy response to climate change.

Current status

At present, out of 28 states, 16 States have submitted their draft SAPCC to the Ministry of Environment and Forest (MoEF) for its approval (Business Standard, September 29, 2011; Financial Express, 2011). These include Manipur, Meghalaya, Arunachal Pradesh, Mizoram, Sikkim, Tripura, Assam, Delhi, Uttarakhand, Madhya Pradesh, Himachal Pradesh, Haryana, Rajasthan, Karnataka and Chandigarh. Some states like Delhi, Orissa, West Bengal, Union territory of Puducherry and Meghalaya have completed the process and have finalized their action plan. The remaining States are at various stages of drafting their SAPCC.

SAPCCs and three hypotheses: context, content, and constraints

Hypotheses

Given the above background on the current status of sub-national climate policy-making process and initiatives in India, the primary objective of this paper is to assess and understand the relevance and practicability of SAPCCs. For this purpose, we have chosen six States* – West Bengal, Karnataka, Rajasthan, Madhya Pradesh, Orissa, and Assam. It is expected that the six SAPCCs would be varying in terms of both strategic approach and content and the first hypothesis that we pose is that such variation is closely reflective of the widely differing development context across the select States. We shall test this hypothesis through an assessment of the selected SAPCCs, focusing on the synergies and linkages with development objectives.

Secondly, we would assess whether the selected action plans have been developed with adequate emphasis on the different components of an "ideal" strategy—namely research and development, policy and institutions and technology development and dissemination. For this purpose, we choose the energy sector as an illustration and assess the sector-specific policies for each State.

The final—and perhaps the most important—step in policy development is its implementation. We shall examine, based on the proposed strategies in SAPCCs, the potential implementation challenges and opportunities states might face. A set of criteria have been defined to assess the overall (and not limited to the energy sector) implementability of the SAPCCs and the status of every state has been evaluated on each of these criteria.

Context: development situation and SAPCC priorities

Table 1 presents the development background of the six chosen States in terms of their contribution to the national GDP and population and Figure 3 presents the relative shares of different sectors in each State's income.

The selected States collectively contribute to less than a quarter of the country's GDP, while constituting nearly a third of the national population

Table 1 Development profile of the six selected States

State	Population (thousands)[1]	Percentage contribution to national population	GSDP (Billion $)[2]	Percentage contribution to national GDP	Rank in terms of contribution to national GDP	Human Development Index (2006)[3]
West Bengal	91,348	7.55	61.89	6.52	6	0.64
Karnataka	61,131	5.05	53.04	5.59	7	0.62
Rajasthan	68,621	5.67	37.73	3.97	8	0.54
Madhya Pradesh	72,598	6.00	33.58	3.53	10	0.52
Orissa	41,947	3.47	25.34	2.67	14	0.53
Assam	31,169	2.58	2.09	1.55	17	0.59

[1] UNIDOW, Economy of the Federal States For Year 2011, Available at: http://unidow.com/india%20home%20eng/statewise_gdp.html Last accessed: November 23, 2011

[2] FDI and HDI estimates for India , States/UTs, Results and Analysis, Figures for 2009—10, at 2004-05 constant prices; Source: Directorate of Economics and Statistics (different states. (Conversion rate Rs.47.3617/USD.)

[3] http://wcd.nic.in/publication/GDIGEReport/Part2.pdf Last accessed: November 24, 20111

* Amongst the six SAPCCs, four are in public domain which include Orissa, Karnataka, West Bengal, and Madhya Pradesh while for Rajasthan and Assam, TERI has taken the advantage of working closely with the state governments in preparing their SAPCCs.

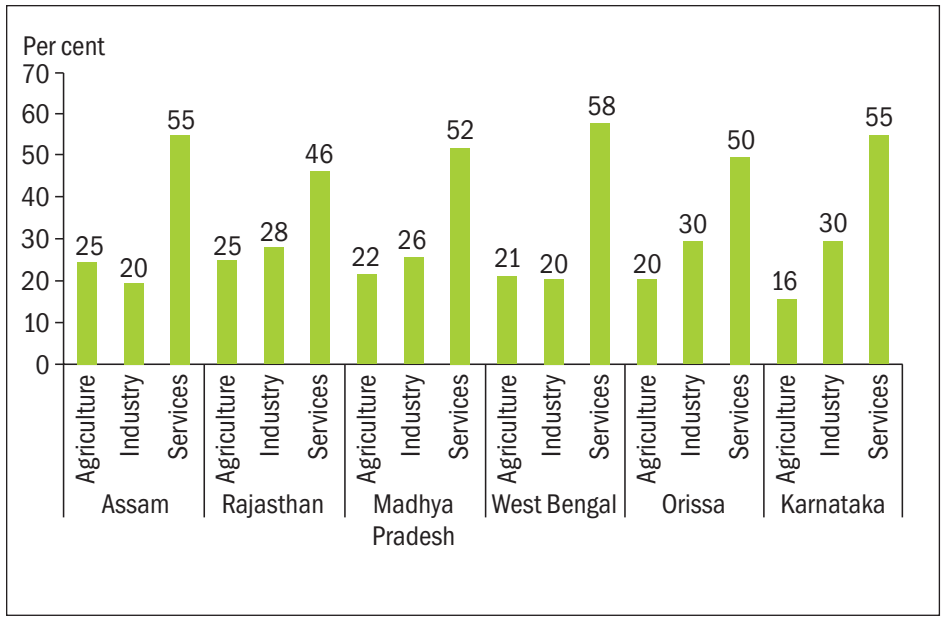

Figure 3 GDP composition of states in terms of agriculture, industry and services sectors' contribution

Source Ministry of Statistics and Programme Implementation, MOSPI, GOI

figure. Most of these States have a large rural population, while many have a significant population below the poverty line. A look at the disaggregated figures (Table 1) reveals that there exists considerable variation in income and population figures across States, roughly pointing to the dissimilar development status (also reflected in the HDI figures) which serves as the potential source of differences in policy priorities. For example, West Bengal's population is about three times higher than Assam, while the income differential is thirty times, despite the sectoral contributions being similar. There also exist some features peculiar to certain States: for instance, Madhya Pradesh is marked by a difficult and inaccessible terrain and a significant tribal population, while Rajasthan is characterized as a drought-prone arid region. Such unique socio-geographical factors result in a varied development context which is expected to be reflected in dissimilarities in the pace and strength of state-level response to climate change.

Further, it can be seen in Figure 3, that for all the States, the services sector (comprising of banking, tourism, construction, telecommunications and others) forms the most significant component of income, while agriculture and industry are quite similar in their contribution to the State Gross Domestic Product (SGDP). However the sectoral distribution of income alone does not provide the complete picture—for example, despite agriculture being the most important source of livelihood in States such as Rajasthan and Assam, the corresponding contribution of the sector to GDP in both the States is the lowest. This indicates the relatively low factor productivity in agriculture, suggesting the need for immediate reforms in this sector, as it is one of the most important concerns from the adaptation perspective as well.

The analysis presented in Figure P1-P12 summarize the emissions profile with respect to different sectors and fuel mix, for the different States. The sectoral distribution of GHG emissions highlights the energy-intensive sectors in the States, thus indicating their respective mitigation potential. Further, each State's dependence on the different kinds of fuel is reflected in the figures on fuel mix. Apart from indicating the differences in fuel dependence and emissions-intensity across States, information regarding the sectoral composition and fuel mix of emissions profile can help in setting priorities in terms of focusing on renewable energy sources, identifying the sectors with greater scope for energy efficiency and so on. Thus, the emissions profile, reflecting the relative status of development of various sectors in the economy, can play a role in guiding the process of preparing SAPCCs, especially with respect to the energy sector.

Figures P1—P12: GHG Emissions Profile for Different States

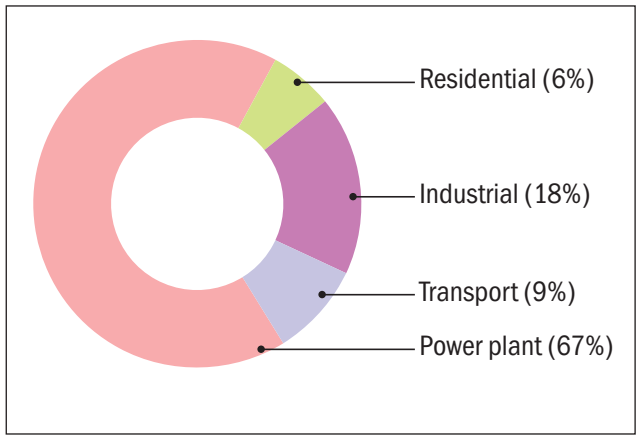

Figure P1 West Bengal: GHG Emissions Profile (Sectoral Distribution)(2005)

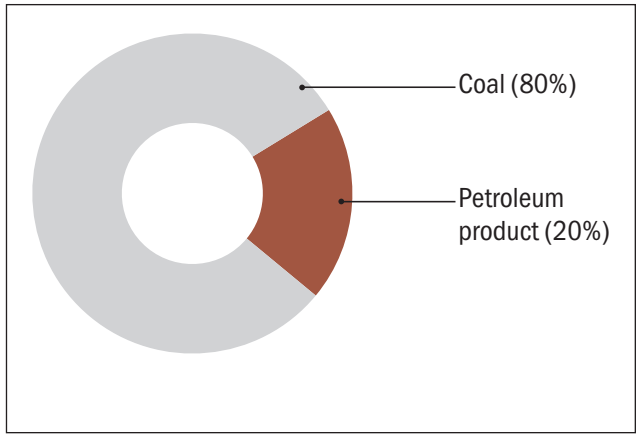

Figure P2 West Bengal: GHG Emissions Profile Fuel Mix) (2005)

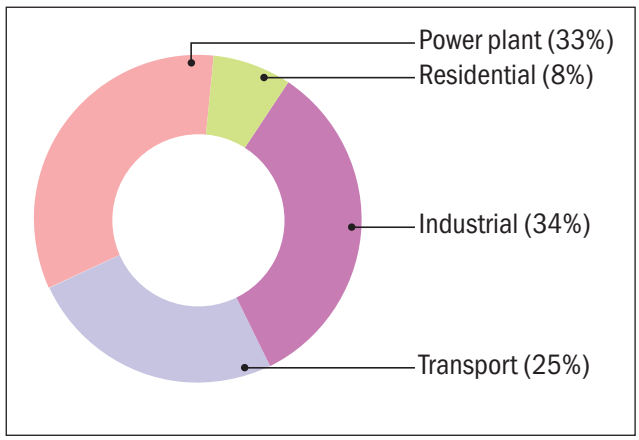

Figure P3 Karnataka: GHG Emissions Profile (Sectoral Distribution) (2005)

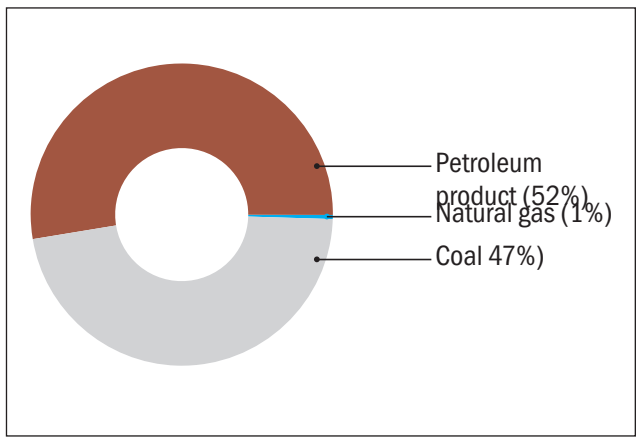

Figure P4 Karnataka: GHG Emissions Profile (Fuel Mix) (2005)

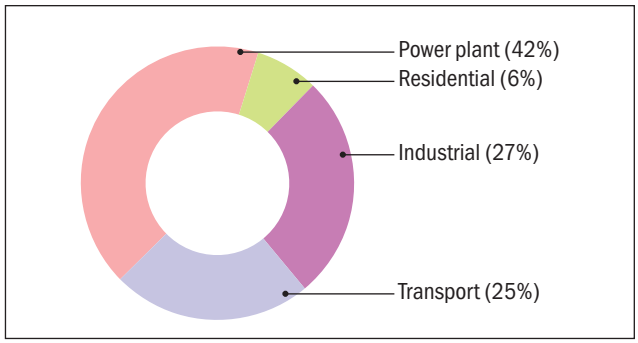

Figure P5 Rajasthan: GHG Emissions Profile (Sectoral Distribution) (2005)

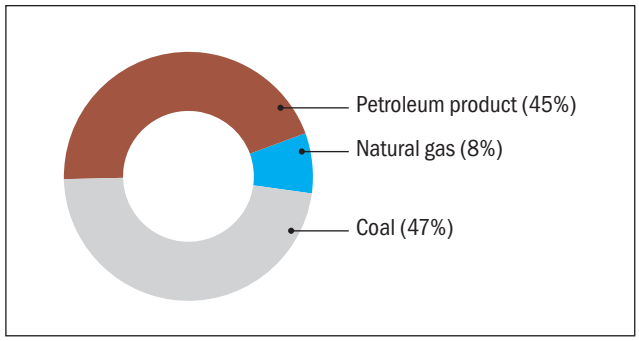

Figure P6 Rajasthan: GHG Emissions Profile (Fuel Mix) (2005)

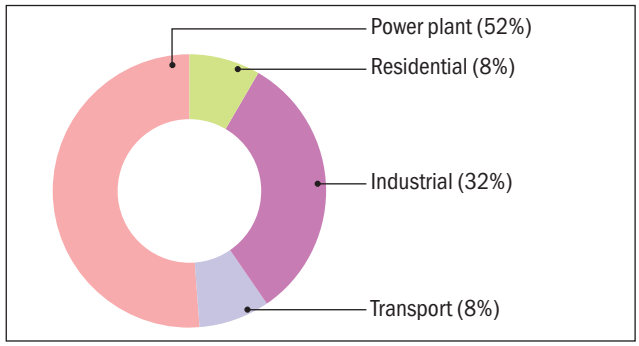

Figure P7 Madhya Pradesh: GHG Emissions Profile (Sectoral Distribution) (2005)

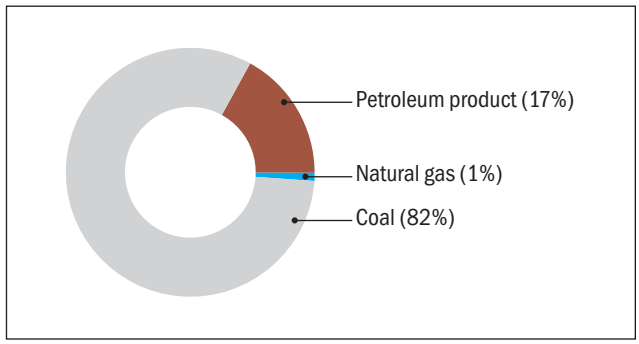

Figure P8 Madhya Pradesh: GHG Emissions Profile (Fuel Mix) (2005)

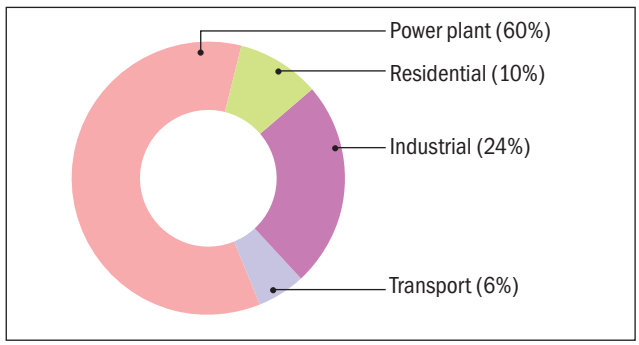

Figure P9 Orissa: GHG Emissions Profile (Sectoral Distribution) (2005)

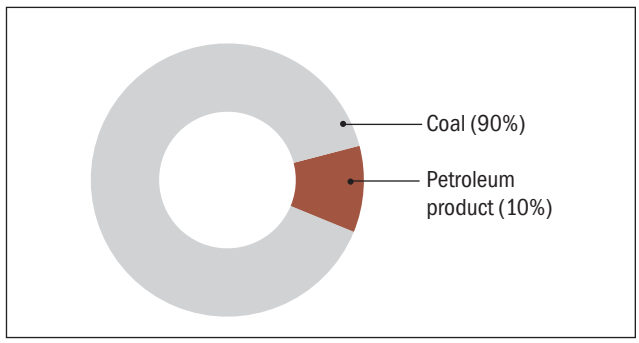

Figure P10 Orissa: GHG Emissions Profile (Fuel Mix) (2005)

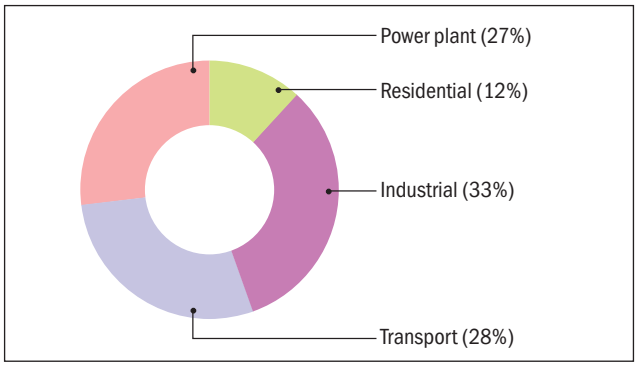

Figure P11 Assam: GHG Emissions Profile (Sectoral Distribution) (2005)

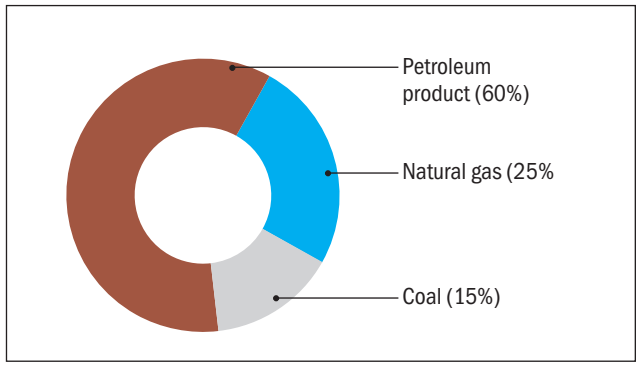

Figure P12 Assam: GHG Emissions Profile (Fuel Mix) (2005)

Table 2 presents a comprehensive list of state identified priority sectors and sub-sectors in order to mitigate the impacts of climate change. Once again, one clear inference that can be drawn from this illustration is that essentially states' development concerns have guided the process of framing of climate related policies and strategies. For instance, subjects like agriculture, livelihoods, forest management, water availability and supply (for irrigation, drinking), urban governance (waste management, transport), energy efficient power generation and distribution, health issues (climate sensitive, vector borne diseases), industrial energy efficiency, and renewable energy generation have garnered adequate attention across the states. However, there are some issues which are specific to the context of certain states only, for example, land degradation, desertification and wastelands in Rajasthan; floods in Orissa, West Bengal, and Assam; tribal population in Rajasthan and Madhya Pradesh. Some issues like coastal biodiversity and sea-level rise are unique to states like Orissa because of its geographic position.

Table 2 Priority Sectors and Sub-sectors Identified in the SAPCCs

Broad Sectors ↓ / States →	Sub-sector	West Bengal	Karnataka	Rajasthan	Madhya Pradesh	Orissa	Assam
Agriculture and allied sectors	Agriculture (including dry spells, organic farming, agri-biodiversity, agroforestry)	√	√	√	√	√	√
	Livestock and livestock products	√	√	√	√	√	√
	Fisheries	√	√		√	√	√
	Horticulture	√		√	√	√	
	Wastelands			√			
Biodiversity and forests	Forests products and livelihoods	√	√	√	√		√
	Forest Management	√	√	√	√	√	√
	Forest Protection & Monitoring (including fire management)	√	√	√	√	√	√
	Wildlife	√	√				√
	Biodiversity	√	√				√
	Land degradation and desertification			√			
	Bio-resources		√				√
Water resources	Water availability and water supply	√	√	√	√	√	√
	Water for irrigation	√	√	√	√	√	√
	River conservation	√	√				
Natural disasters	Droughts	√	√	√	√		
	Floods	√				√	√
	Landslides	√					√
	Cyclonic storms	√				√	√
	Forest fires	√			√	√	√
Urban governance and sustainable habitat	Waste management	√	√	√	√	√	√
	Transport	√	√	√	√	√	√
	EE in buildings	√	√	√	√	√	√
	Water supply	√	√	√	√	√	

Table 2 Contd...

Broad Sectors ↓ / States →	Sub-sector	West Bengal	Karnataka	Rajasthan	Madhya Pradesh	Orissa	Assam
Renewable energy	Wind	√	√	√	√	√	
	Hydro		√			√	√
	Solar	√	√	√	√	√	√
	Biomass	√	√	√	√	√	√
Energy security and access	Energy efficiency in thermal power generation, clean coal technologies	√	√	√	√	√	
	Rural electrification				√		√
	Decentralized generation	√		√		√	
	Reduction in T&D losses	√	√	√	√	√	√
Health	Vector-borne diseases	√	√	√	√	√	√
	Malnutrition & food security			√	√	√	√
	Safe drinking water	√	√	√	√	√	√
	Heat stress	√		√			
Rural development	Agriculture based livelihoods		√		√	√	√
	Tribal population			√	√		
	Poverty	√		√	√		
	Infrastructure	√		√	√	√	√
Industry	Energy efficiency in industry	√	√	√	√	√	√
	Waste management	√	√	√	√	√	√
	Mining					√	
Coastal zone	Coastal biodiversity		√			√	
	Sea level rise		√			√	
	Coastal erosion and pollution		√			√	
	Salinity	√	√				
Strategic knowledge		√		√			

Content: SAPCCs and the energy sector

As mentioned above, the paper aims to review the SAPCCs of the States of Karnataka, Orissa, Assam, Rajasthan, West Bengal, and Madhya Pradesh to understand and assess the strategies that have been proposed for the energy sector to promote the causes of energy security and at the same time optimizing the opportunities for green energy generation and energy conservation.

Energy is recognized as the prime mover of economic growth. Availability of energy with required quality of supply is not only key to sustainable development, but also has a direct impact and influence on the quality of life and food security. However, more than 400 million people in India do not have access to electricity and 700 million people depend on the inefficient use of biomass sources for cooking (IEA, 2010). Moreover, the energy sector is the largest source of GHGs, accounting for 58% to India's emission inventory (MoEF 2010). Thus, India is currently facing an acute dilemma of tackling energy poverty and accelerating the de-carbonization of its economy.

The high priority of energy security on the domestic agenda has given great impetus to India's renewable energy and energy efficiency programmes. Table 3 presents a summary of India's proposed and the ongoing initiatives to achieve the goals of emission reduction and clean energy generation.

The strong emphasis on energy efficiency and renewable energy at the national level would need matching prioritization and complementing action at the State level. With respect to the States selected, as shown in Table 4, majority of the States have severe electricity shortages and need

Table 3 Selected Indian 'clean energy' targets and climate measures

Carbon intensity	20-25 per cent reduction in emissions of carbon dioxide per unit of GDP by 2020 against 2005 levels
Renewable energy generation capacity	Increase of 40GW by 2022 from current generation capacity of approximately 17 GW
Renewable electricity	1 per cent increase per annum in the share of renewable energy in the electricity mix, reaching 15 per cent by 2020
Solar power	20GW of on-grid installations by 2022; 2 GW of off-grid generation capacity
Biofuels	20 per cent blending of bioethanol and biodiesel in transportation fuels by 2017
Nuclear	Cumulative installed capacity of 60GW by 2030

Sources: National Action Plan on Climate Change (2008); Eleventh Five Year Plan 2007-2012, Planning Commission (2008)

Table 4 Summary of Energy Scenario of Selected States[4]

State	Energy deficit/surplus	Dominant source	Contribution from renewables	Main energy consumers	Future energy demand
West Bengal	Peak-load deficits of 296 MW (as of 2008)	Thermal (96%)	Hydro (4%)	Industry, domestic sector	Peak demand projected to be around 9000 MW by 2021
Karnataka	Deficit of 20% (peak demand supply gap 13.2%)	Thermal (50.8%)	Hydro (27%)	Industry, transport, agriculture, domestic sector	55% increase over the next 6 years
Rajasthan	Supply deficit of around 20%	Thermal (53%)	Hydro (19.14%), Wind and biomass (13%)	Industry, agriculture	11400 MW by 2016-17
Madhya Pradesh	Peak deficit of about 34% in 2007-08	Thermal (58%)	Hydro (42%)	Industry, agriculture, household consumption	-
Orissa	Deficit of 15.5%	Hydro (70%)	Hydro (70%)		Average demand projected to be around 4000MW in the next 2—3 years
Assam	Peak deficit of about 9% apart from transmission and distribution losses of 30-40%	Gas (59%)	Hydro (22.4%), Solar/Biomass (0.5%)	Industry	Demand roughly rising by 12% each year

[4] Data, information, inferences from the various state action plans on climate change

significant additions in capacity to meet the demand of its rapidly growing economy in future.

Figure 4 depicts that coal and petroleum products are the dominant source of energy supply in most of the selected States and will remain the leading energy source in the future under business as usual scenario as well. In this regard, renewable energy and energy efficiency can play a dominant role in enhancing energy security issues, address environmental concerns, and create a market for technology applications based on renewable energy and energy efficiency. In fact renewable energy development and promotion of energy efficiency can also be an important tool for spurring regional economic development, particularly for many underdeveloped States, which have significant potential for harnessing such resources. It can provide secure electricity supply to foster domestic industrial development, attract new investments, and hence serve as an important employment growth engine, generating additional income.

Given this background, the States have placed utmost thrust on promoting energy efficiency and generation of green energy. Table 5 presents a summary of key strategies and activities proposed in the selected SAPCCs for the energy sector. This is followed by a discussion of the proposed strategies for each State.

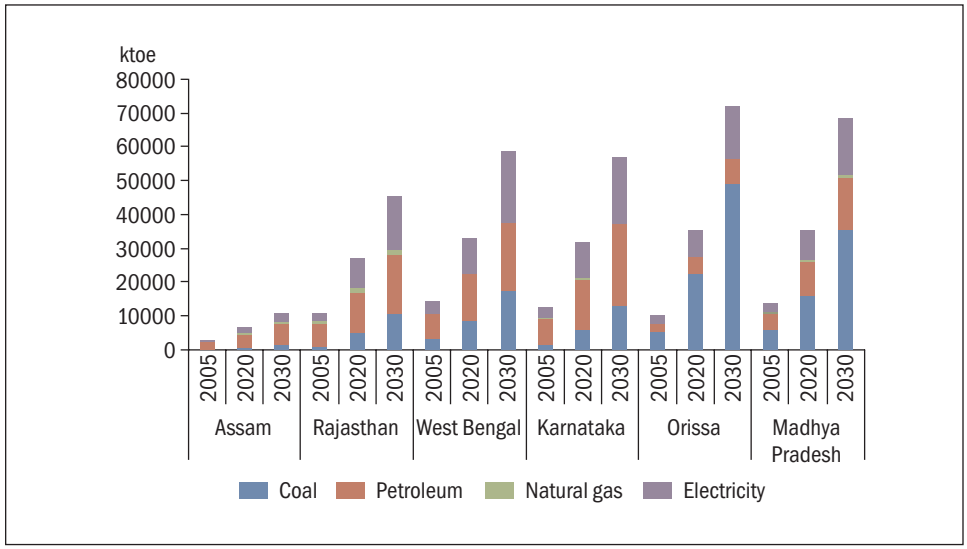

Figure 4 Current Status and Projections for End-use Energy Consumption by Fuel Type for the Selected Statese

Source TERI Analysis (2011)

[5] TERI's preliminary analysis based on the energy supply and consumption patterns across sectors and taking in account demographic change, economic growth prospects and the anticipated technological and policy changes upto 2030.

Table 5 A Summary of Key Strategies and Activities Proposed in the Selected SAPCCs for the Energy Sector

States	Policy Intervention, Innovation and Institutional Governance	Research and Development	Technology Deployment and Dissemination
West Bengal	• Promotion of renewable energy through PPP models • An incentive program to incentivize green energy producers, material and device manufacturers • Enhanced provisions for off-grid and stand-alone decentralized generation systems • Development of curriculum and certification programs (for production, engineering, installation and maintenance activities) • Empanelment of energy auditors and Electricity Services Companies (ESCO) to facilitate implementation of PAT • Mainstreaming climate related strategies into energy infrastructure planning, implementation	• Geographically focused assessment of energy potential - solar, wind, and biomass • Collaborative R&D activities to improve efficiency in green energy materials and devices (e.g. PV technologies) • Risk assessment of energy sources in anticipated extreme climate events and thereby identification of risk minimization strategies	• Technology validation of existing technologies through demonstration projects (solar thermal and biomass gasification technologies)
Karnataka	• Setting up of a high level research council to guide the overall technology development strategy • Notification of the Energy Conservation Building Code (ECBC) at the state level • Accelerated focus on private sector investments and PPPs to promote RE and energy efficiency • Provisions for soft loans • Scaling up of off-grid decentralized applications to promote rural electrification backed by regulatory incentives • Creation of a platform for certification and rating of manufacturers of solar thermal applications for domestic solar industry • Subsidy options for farmers to grow plantations supporting bio-fuels at • large scale In-depth assessment of leveraging carbon finance • Making renewable purchase obligation (RPOs) mandatoryw	• Research on piloting viable options for a subsequent larger-scale deployment of bio-fuels • Development of a state-of-the art testing, certification and monitoring facility backed by adequate R&D and leveraged through PPP models to promote use of improved cook stoves	• Development of automated load shedding system • Development of improved cook stoves for vulnerable populations
Rajasthan	• Creation of energy conservation fund for energy efficiency and renewable energy measures • Creation of a renewable energy infrastructure development fund • Provision of fiscal incentives to promote setting up of RE manufacturing units	• Creation of solar centre of excellence to enable applied research and commercialization of nascent technologies • Detailed assessment study and forecasting for preparing an integrated plan for biomass • Conducting studies to assess the impacts of climate change on the state's energy systems • Technical assessment of potential sites for large scale wind and solar farms vis-à-vis available land resources, investors, state's RPOs • Technical study on DSM options especially in commercial buildings and SME sector	• Creation of prototypes of RE technology systems for to enable communities understand the technology and also for policy makers to conduct reliable economic evaluation

Table 5 A Summary of Key Strategies and Activities Proposed in the Selected SAPCCs for the Energy Sector

States	Policy Intervention, Innovation and Institutional Governance	Research and Development	Technology Deployment and Dissemination
Madhya Pradesh	• Creation of a separate division on climate change • Market instruments like green tariff to bring about increased use of green technologies • Leveraging international finance through market mechanisms like CDM to promote RE and EE • Gradual increase in the renewable purchase obligation (RPOs) of the state • Adoption of PPP models of investment and implementation for RE projects • Enhanced focus on energy plantation to promote use of biomass based energy • A phased approach for solar power generation, decentralized, rural solutions		• Use of super-critical, carbon-capture, fluidized bed boiler, coal gasification, etc. technologies
Orissa	• A restructuring of the energy department, creation of separate entities within the department for renewable energy, energy efficiency, energy conservation • Development of state level energy efficiency standards for various sectors adopting Energy Conservation Building Code (ECBC) • New policy for DSM measures at the utility level	• Feasibility studies and pre-investment assessments to identify sites for both on grid and off grid applications of RE, selection of entrepreneurs, requisite policy support, and potential funding sources • Feasibility studies for the implementation of clean coal technologies	• Enhanced use of clean coal technologies like super-critical boilers, combined cycle power generation, washing of coal, coal gasification, etc.
Assam	• Setting up of a new entity within the department of power to focus on energy efficiency related initiatives in the state • Adoption of standards for industrial processes • Mandatory energy audits in all commercial and industrial facilities • Incentives and subsidies for uptake of renewable technologies • Identification of responsibility centers for renewables	• Technical assessments to assess the potential of renewable energy applications and identify regions and technologies required • Sector specific studies to determine interventions required to undertake energy efficiency • Assessment of demand side management measures • Energy need/demand assessment in all sectors	

West Bengal One of the key features of West Bengal's SAPCC is the consideration of the energy sector in light of mitigation needs, adaptation needs, and minimization/avoidance of risks emanating from climate change. The SAPCC has at each stage, identified the key implementing agencies and support groups. For a majority of the proposals, targets, timelines, and funding requirements have been identified. There are elaborate recommendations for creating awareness on energy efficiency among the stakeholders. Use of demonstration projects for user education in the areas of solar thermal and biomass gasification/combustion technologies has been highlighted. However, more emphasis needs to be laid on the introduction of efficient technologies like super-critical technology given the predominance of the coal sector in the State (Table 4, Figure 4). The suggestions on incentivizing demand-side management (DSM) and renewable energy lack the clarity on the type of financial instruments to be used and the stakeholders impacted

upon. The State has significant potential for biomass, solar, wind and small hydro based power generation.

Karnataka Karnataka's SAPCC does put forward elaborate proposals on creation of policy support and R&D and a corresponding implementation framework. However, the climate strategies need to be based on scientific assessments, such as the gas-based power potential, solar potential, energy demand and consumption trends across sectors and regions in the State, market acceptance of energy efficient consumer products, etc. The SAPCC has identified the need for reviewing gaps in existing renewable energy financing arrangements and for identifying means for improving banking services for the benefit of renewable energy deployment. The need for creation of institutional capacity for a market/platform for sale of carbon credits and fiscal incentives for adoption of energy-efficient appliances has been highlighted but has not been backed by any tangible implementation strategy in this direction. Likewise, there are no specific plans on how the Perform, Achieve and Trade (PAT) mechanism would be executed (with respect to the role of State and local governance and the industry sector) in the State for best results. There is no discussion on how inter-departmental/ inter-agency coordination shall be ensured for effective implantation of the proposed strategies.

Rajasthan The Rajasthan SAPCC is quite holistic in approach and ambitious in terms of activities that have been proposed to enhance the energy supply of the State. The SAPCC has a huge thrust on creation of research infrastructure especially on renewable sources of energy. Besides suggesting feasibility assessment studies for biomass, wind and solar energy generation, the recommendation on technical assessments of impacts of climate change on the energy systems of the State is worth mentioning as most of the other SAPCCs fail to recognize its importance. Use of prototype projects to promote community's understanding and enhance policy makers' confidence in the areas of solar and biomass technologies is a good suggestion. The State is yet to define the targets, timelines, and funding requirements of the various proposed activities. There is not much clarity on how inter-departmental/inter-agency coordination shall be ensured for effective implantation of the proposed strategies.

Madhya Pradesh One of the key features of the Madhya Pradesh SAPCC is the identification of the key implementing agencies for specific strategies and the tentative timeframes. This certainly indicates a certain degree of clarity in the planning process of the State and also the extent of priority assigned to that proposal. Recommendations on adoption of PPP models for deployment of energy efficient technologies is very opportune given the recent growth in awareness of the private sector in pursuance of energy efficiency. The State has laid adequate thrust on drawing linkages with the national and international market mechanisms on GHG reduction and energy efficiency. Although the plan does have repeated mention on interdepartmental

coordination and synergy at the State level and adequate coordination with the central agencies in light of the national goals of the NAPCC, no tangible action or strategy has been suggested to achieve this. Need for R&D activities to promote renewable energy generation has been stressed but the actual identification of R&D needs to realize the set targets of RE in the total energy mix of the State is yet to be done. The SAPCC has several suggestions on DSM and reduction of T&D losses but no surveys or assessment studies have been proposed to gauge the State's potential and the key impediments in this sphere.

Orissa Although Orissa's SAPCC does come up with a list of proposals covering all possible issues, the actual implementation plan with the key implementing agency and the impacted stakeholders for the suggested activities need to be identified. There is no definition of targets, timelines, financial implications, funding sources, etc. Synergies with the objectives and goals of NAPCC need to be worked out by the State authorities. Further, the State needs to identify strategies to promote R&D in the State to bring about indigenization of the clean coal technologies which are to be pursued aggressively in the State in the coming years. Given the State's low energy access situation, issues like rural electrification or 'energy for all' deserves greater attention in the plan. The SAPCC recommends enhanced use of biofuels, but still needs to work out plans to incentivize farming of biofuels in place of food crops or use of wastelands for this purpose. The roles and responsibilities of the local governments, municipal bodies, etc. to implement the strategies effectively also need to be defined.

Assam Assam's SAPCC does take into account the local needs and potential of the State. Although there is discussion on harnessing the renewable potential in the region but nothing has been said with regard to the uncertainty in the supply of renewable energy (risk mitigation), especially with regard to hydro (the State has immense hydro potential) in light of the frequent floods hitting the State each year. There is no recommendation on conducting market surveys with regard to acceptance of energy saving products amongst the consumers. Although, rural electrification is one of the prime concerns of the State, no strategies have been proposed to undertake demonstration/ pilot projects (e.g. solar, biomass, etc.) in the rural areas. There is mention of 'smart industrial clusters' but the concept has not been detailed.

Essentials for effective implementation of SAPCCs

- Relevant data inventorization and management
- Robust scientific assessments to base the projections and strategies
- Understanding and awareness of the additionality in climate change action
- Identification of funding mechanisms for capacity building (including human and technology resources)
- Coordination among the stakeholders – policy makers (inter and intra departmental), funders, technology providers, entrepreneurs, impacted communities, etc.
- Monitoring and evaluation capacity and mechanism

Constraints: implementation of SAPCCs

Climate change is new and an evolving subject for policy making in India at the sub-national level and the SAPCCs will be the first and primary planning exercise for the States to address the uncertainties associated with climate change. The SAPCCs cover a broad range of strategies reflecting the State context and priorities. With the strategies prepared the next step would be towards implementation. In order to assess how the States are prepared to implement their stated actions, a set of 'capabilities-based' criteria have been developed encompassing the following (Table 6).

- Financial Resources: key to initiating and implementing action
- Human and Technical Capabilities: new subject for policy making hence need for relevant capabilities to facilitate effective action
- Coordinated Institutional Arrangements: interdisciplinary issue like climate change requires close association among various departments
- Data and Information: vital for conducting research and scientific assessments and increasing the pol of knowledge
- Research and Scientific assessments: foundation for informed decision making

Table 6 Implementation assessment of the six selected SAPCCs

States/ implementation checklist	Assam	Orissa	Karnataka	Rajasthan	Madhya Pradesh	West Bengal
Focus on data and information generation, availability and management	**Yes** (mention with respect to sectoral missions)	**Yes** (Climate Change Agency for sharing data and information)	**Yes** (mention with respect to sectoral missions)	**Yes** (developed a state mission on strategic knowledge on climate change)	**Yes** (mention with respect to sectoral missions)	**Yes** (proposes a Institute for Climate Change Research & Ecological Design or Management)
Focus on research and scientific assessments	**Yes** (emphasis on need for scientific assessments)	**Yes** (emphasis on need for scientific assessments)	**Yes** (proactive –has done vulnerability indexing for all districts)	**Yes** (emphasis on need for scientific assessments)	**Yes** (emphasis on need for scientific assessments)	**Yes** (emphasis on need for scientific assessments)
Cross sectoral integration of Institutional arrangements	**Yes** (not in detail)	**Yes** (Orissa Climate Change Agency)	No	**Yes** (not in detail)	No	No
Focus on Capacity Building	**Yes** (integrated with the sectoral actions)	**Yes** (integrated with the sectoral actions)	**Yes** (identified capacity building needs according to the each action)	**Yes**(in some sectors only)	**Yes** (integrated with the sectoral actions)	**Yes** (integrated with the sectoral actions)

Contd...

Table 6 Contd...

States/ implementation checklist	Assam	Orissa	Karnataka	Rajasthan	Madhya Pradesh	West Bengal
Estimation of Financial Resources required	Yes (approximate total for the SAPCC)	Yes (action wise financial requirements)	Yes (waiting for distribution of finance under each of the national missions)	Yes (for some; action wise)	No	Yes (for most; action wise)
Sources of finance	No	Yes (identified sources for every action and includes central assistance, state government allocations, external funding, donor agencies etc.)	No	No	No	No
Monitoring and Evaluation framework/ mechanism	Yes (present initial thoughts, yet to detail them out)	Yes (sector specific M&E framework)	No	Yes (present initial thoughts, yet to detail them out)	Yes (three step M&E framework)	No

Data generation and management

An issue which often is a challenge in scientific assessments in India is the availability of data and its quality at the local level. It is important for States to reform the current approaches to data generation, its maintenance and sharing. From the table it can be inferred that all the States have given due importance to information and data generation, availability and management, in order to facilitate climate change related assessments, though the focus is varied. Rajasthan is the only State which has taken a cue from the NAPCC and has developed a State Mission on Strategic Knowledge on Climate Change. The State of West Bengal presents a unique approach and proposes to set up an Institute for Climate Change Research & Ecological Design or Management with an aim towards formulation of strategic knowledge (encompassing climate change issues, energy security and food security) for sustainable development in the state. Similarly Orissa has proposed setting up a Climate Change Agency which will facilitate sharing of information in a public domain and Madhya Pradesh has already initiated the process of institutionalizing a State Knowledge Management Centre on Climate Change. The other States also discuss the importance of generating and managing data with respect to their sectoral missions.

Research and scientific assessments

Scientific impacts, vulnerability and risk assessments are the foundation for informed decision making. Considering the paramount uncertainties associated with climate change it is extremely necessary that SAPCCs should have strong focus on research and scientific assessments. Except for the State of Karnataka where vulnerability indexing for all districts has

been done to identify the most vulnerable districts the other States are yet to initiate scientific assessments on similar lines. All the States have strongly iterated the need for scientific assessments to better understand climate change concerns and promote research activities to continuously increase the pool of knowledge. Also, all States have laid a significant emphasis on promoting scientific research and education in context of climate change.

Cross sector coordination

For implementation of the SAPCC, an efficient and effective institutional arrangement becomes imperative. In order to address the varied interdisciplinary issues associated with climate change it is essential that climate action is well coordinated and integrated amongst various departments. Orissa has proposed setting up a climate change agency which will be responsible for coordination of climate actions between central government, funding agencies and State departments. The State of Assam and Rajasthan do touch upon the importance of close coordination amongst departments at the State level although it is not discussed in detail. The other three states i.e. Karnataka, West Bengal and Madhya Pradesh do not discuss the cross sectoral integration of institutional arrangements.

Capacity building

Climate change is an interdisciplinary issue which requires a fresh approach and a good understanding of new management tools, polices and implementation mechanisms. Thus there is need to build both technical and human capabilities. Amongst all the States, Karnataka has identified capacity building needs according to the each action proposed, as one of the primary focus areas. All the other States have also highlighted the need to train human resources and build technical capabilities as a key activity which has been integrated with the sectoral actions.

Financial estimates

Finance constitutes an integral and crucial component for delivery of actions identified in the SAPCCs. Amongst the six States, Karnataka and Madhya Pradesh have not estimated the quantum of financial resources required for the activities identified in their respective SAPCCs. Karnataka, in fact, refers to the funding available under the national missions. The State of Assam has calculated a ball park figure of the additional finance required for implementing the SAPCC. Amongst the other three states, Orissa has estimated financial requirements for all its activities while West Bengal has estimated for most and Rajasthan has done for some.

Sources of finance

For the SAPCC actions that would be integrated with existing policies and programs, financing is expected through usual budgetary outlays. However for additional actions, added resources will be required to bear the incremental costs. How will these be arranged; what will be the different instruments and delivery mechanisms for mobilizing this finance are important questions that need to be addressed for effective implementation. Amongst the six States only Orissa has identified the sources of finance which include central assistance, state government allocations, external funding, support from donor agencies, etc.

Monitoring and Evaluation (M&E)

Monitoring and evaluation of SAPCC actions is important to ensure continuous improvements in the process. The focus of the M&E framework is to assess the implementation process with respect to the targets envisioned, financial resources used and strategies accomplished. Except for the States of Karnataka and West Bengal all other States have developed an M&E framework for their SAPCCs. The State of Madhya Pradesh has developed a three step M&E framework which includes M&E at development objective level, sectoral level and project level. The State of Orissa has developed a sector specific M&E framework wherein it has identified the targets which need to be monitored, programs which have to be evaluated along with the frequency at which it needs to be done. The States of Rajasthan and Assam have developed their M&E framework; however they are yet to detail out the process which needs to followed for conducting M&E exercises.

Role of international community

Revisiting the Bali Roadmap

The recognition of local and sub-national governments as 'governmental stakeholders' and key actors for climate action under COP 16 Agreements is certainly one of the milestones in the ongoing climate change debate. The Indian States are demonstrating early leadership in coming up with their SAPCCs and this deserves recognition at the international level. However, beyond this recognition, the sub-national governments need to be provided with the primary requisites, namely finance, technology, and capacity (three key pillars of the Bali Action Plan) along with the incentives and encouragement to expand their commitments to mitigate climate change. The international community needs to play the role of a collaborator in this regard.

Sub-national governments often may not have adequate knowledge about all the existing technologies that could be useful in dealing with climate change related issues and the international community can help the States to identify the relevant technologies. But there is no guarantee that such techniques could be easily accessible. If the State governments or any organization operating at State levels can negotiate technology transfer with mutually agreed terms, then there will be no problem. Since sources of such technologies are likely to be foreign private firms, State government or other agencies can directly deal with such firms. But if such negotiation is not successful, then the role of the Central government will become important. A State government can request the Central government for taking appropriate measures including compulsory licensing, if a technology is denied or an exorbitantly high royalty is asked for. Though Indian patent law has provisions for compulsory licensing, taking such an action will not be easy due to international political complexities, since it is a controversial issue. This could be made easy if the global community forms an opinion in favour of allowing IPR flexibility in accessing climate related technologies.

On the finance front, mobilizing the private sector investments in climate action in collaboration with international partners would go a long way in creating attractive business models for climate action especially at the sub-national level given the paucity of funds and superseding significance

of development issues. Looking outside India, a number of subnational governments in developed countries have initiated comprehensive policies and strategies to finance mitigation and adaptation projects within their own borders and beyond. However, while certain subnational governments in developing countries may have those powers and have the same level of ambition to tackle climate change, the resources they can access are often insufficient for the purpose. capabilities at the local level. The international community needs to create a leveraging effect by serving as a catalyst towards a sustainable economic development and facilitating access to new sources of financing and technology for sub-national governments.

In addition to access to finance and technology, sub-national authorities and local governments need to be made aware of the climate change challenges at stake, the existing international framework and what they can do to further their own regional development with examples of initiatives successfully implemented by other local authorities. Further, they need to have access of the relevant strategic knowledge in the form of scientific assessments and projections, vulnerability studies, technology evaluations, and market trends. To give an example of what may constraint such access, one can refer to climate modeling simulations (both global and regional) and impact assessment studies which require sophisticated computational infrastructure support. Most of the developing countries do not have such capacities in terms of human as well as computational. Thus, increasing awareness in the field of climate sciences through capacity building initiatives at different levels (starting from workshops/e-learning modules to actual modeling exercises) is imperative. The international organizations need to work closely with the developing country bodies (both at national and sub-national levels) in creating the much required strategic knowledge to address climate change. Climate change being a global problem, the strategic knowledge generated to deal with its impacts should be treated as a 'global public good' and disseminated to the widest possible audience for effective results.

Conclusion

SAPCCs represent the first planning exercise for the States to prepare themselves for the uncertainties associated with climate change. Climate change and related issues are in its infancy in garnering policy discussions at the State level in the country. Though India has an active presence at the international platform in climate change discussions, a similar platform is yet to develop in the country wherein State discussions on climate change gain prominence. Most of the States are waking up to subject of climate change but there is in general a low level of understanding of the issue and its implications, which emphasizes the need for building capabilities of local level knowledge institutions. Further, as evident from the SAPCCs, there is varying level of preparedness amongst the States with respect to climate change, with a few States sensing significant economic opportunities to emerge in the future and accordingly positioning themselves in terms of strategic goals and measures. Above all, what seems to be emerging is the realization that the preparation and implementation of SAPCCs would

be a continuously evolving process which requires a constant focus on in-process learning and improvement.

References

Boer J D, Wardekkar J A, and Sluijs J P V. 2010. Frame-based guide to situated decision making on climate change. *Global Environment Change* 20:502–510.

Burtraw D and Shobe B. 2009. State and Local Climate Policy under a National Emissions Floor, Paper prepared for an international conference: Climate Change Policy: Insights from the U.S. and Europe Paris, 23–24 March 2009.

Business Standard. 29 September 2011. 12 states yet to draw up action plan, Online. Available at: http://www.business-standard.com/india/news/12-states-yet-to-drawaction-plan/450836/, accessed November 2011.

Constitution of India, Ministry of Law and Justice, Government of India. Available at http://lawmin.nic.in/coi/SEVENTH-SCHEDULE.pdf, accessed November 16 2011.

Financial Express. 23 July 2011. Deadline missed, state of inaction on climate change plan, Online, Available at: http://www.financialexpress.com/news/deadline-missed-state-of-inaction-on-climate-change-plan/821063/0, accessed November 2011.

IEA. 2010. Energy poverty - How to make modern energy access universal? Online, Available at: http://www.iea.org/weo/docs/weo2010/weo2010_poverty.pdf.

Jörgensen K. 2011. Climate Initiatives at the Subnational Level of the Indian States and their Interplay with Federal Policies, Paper presented at the 2011 ISA Annual Convention, 16–19 March 2011. Montreal: Canada.

Kaswan A. 2007. The Domestic Response to Global Climate Change: What Role for Federal, State, and Litigation Initiatives? *University of San Francisco Law Review* 42(1). Univ. of San Francisco Law Research Paper No. 2010-10. Available at SSRN: http://ssrn.com/abstract=1129828.

Karnataka State Action Plan on Climate Change (Draft). 2011. Department of Ecology and Environment, Government of Karnataka, Online. Available at: http://www.indiaenvironmentportal.org.in/files/file/Karnataka%20SAPCC%20draft.pdf , Accessed, November 2011.

MoEF. 2010. Towards a Common Framework for preparation of State Level Strategy and Action Plans on Climate Change National Consultation Workshop, New Delhi, 19 August 2010, Available at : moef.nic.in/downloads/others/Experts-SAPCC-Preeti.pdf.

MoEF. 2010a. India: Greenhouse Gas Emissions 2007, Online. Available at: moef.nic.in/downloads/public-information/Report_INCCA.pdf.

Moser S C. 2010. Now more and ever: The need for societally relevant research on vulnerability and adaptation to climate change. *Applied Geography* 30: 464–474.

Ministry of Statistics and Programme Implementation, MOSPI, Government of India. http://www.rbi.org.in/scripts/AnnualPublications.aspx?head=Handbook of Statistics on Indian Economy.

Madhya Pradesh State Climate Change Action Plan (draft). 2011. Environmental Planning and Coordination Organization, Housing and Environment Department, Government of Madhya Pradesh Online. Available at : epco.in/ccc/Draft_MP_SAPCC.pdf , Accessed, November 2011.

NAPCC (National Action Plan on Climate Change). 2008. Accessed October 2011, Available at : http://pmindia.nic.in/Pg01-52.pdf.

Oliveira J A P. 2009. The implementation of climate related policies at sub-national level: An analysis of three countries. *Habitat International* 33: 253–259.

OCCAP (Orissa Climate Change Action Plan) (draft). 2010. Department of Forest and Environment, Government of Orissa, Online, Available at: http://orissa.gov.in/portal/occap.pdf, accessed: October 2011.

PIB (Press Information Bureau). 2009. PM's address at the National Conference of Ministers of Environment & Forests, 18 August 2009, PIB: Government of India, Online. Available at : http://pib.nic.in/newsite/erelease.aspx?relid=51926.

Planning Commission. 2011.Interim Report of the Expert Group on Low Carbon Group Strategies for Inclusive Growth. Accessed November 2011, Available at: http://planningcommission.nic.in/reports/genrep/Inter_Exp.pdf.

UNDP. 2010. A territorial approach to climate change, Online. Available at: http://www.nrg4sd.org/sites/default/files/default/files/content/public/29-climatechange/background/tacc/down_to_earth_donor_proposal-version_1_mars_2010.pdf, accessed November 2011.

West Bengal State Action Plan on Climate Change (Draft). 2011. Government of West Bengal Online. Available at: http://www.indiaenvironmentportal.org.in/files/file/West%20Bengal%20State%20Action%20Plan%20on%20Climate%20Change%20-Part%20I.pdf , Accessed November 2011.

Vivekanandan J. 2009. A Weather Vane of Change? Creating Spaces for Co-Governance in Climate Change, Working Paper SIID- 03/2009, Online, Available at: http://www.siid.org.in/images/WP3_A%20Weather%20Vane%20of%20Change%20-%20Creating%20Spaces%20for%20Co-Governance%20in%20Climate%20Change.pdf, Accessed, November 2011.

For further details, contact

Nimisha Pandey
Earth Science and Climate Change Division
The Energy and Resources Institute (TERI)
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi – 110 003

Tel. 2468 2100 or 4150 4900
Fax 2468 2144 or 2468 2145
India +91 • Delhi (0) 11
E-mail nimisha.pandey@teri.res.in
Web www.teriin.org