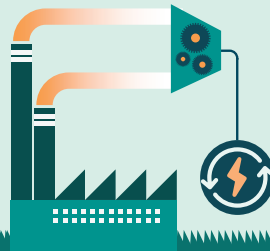
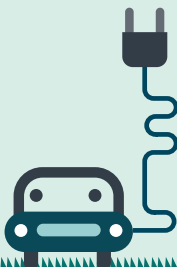




Green Growth Strategy for Karnataka



Global
Green Growth
Institute



BCCI-K

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Green Growth Strategy for Karnataka

Consortium Partners



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BCCI-K



December, 2014

Acknowledgement

This report forms deliverables of the project initiated by the Global Green Growth Institute (GGGI) and the Bangalore Climate Change Initiative - Karnataka (BCCI-K) with its consortium partners: Center for Study of Science, Technology and Policy (CSTEP, Bengaluru), Indian Institute of Science (IISc, Bengaluru), University of Agricultural Sciences (UAS, Bengaluru), Institute for Social and Economic Change (ISEC, Bengaluru), Integrated Natural Resource Management (INRM, New Delhi) and the London School of Economics—India Observatory (LSE-IO, London).

This report synthesizes the outputs from the research conducted by the consortium. The contents were drafted by Prasoon Agarwal and Ajith Radhakrishnan with inputs from Jason Eis, Siddarthan Balasubramania and Ankit Singhvi. Members of project consortium, especially Sharath Rao, Nihit Goyal, Shweta Srinivasan, Mohd. Sahil Ali and Indu K. Murthy, provided valuable comments. This report also benefited greatly from inputs and suggestions by various officials from Government of Karnataka, academia, and professionals from relevant industries. Special thanks to Swati Sharma and Sahil Gulati for their editorial support and assisting authors in preparing report for publication. Above all, the project would not have been successful without the leadership provided by Professor B.K. Chandrashekar, Chairman, BCCI-K.



VIDHANA SOUDHA
BANGALORE - 560 001

Date : 03/12/2014

Cm/PS/285/2014

MESSAGE

I am very pleased to release the report “Green Growth Strategy for Karnataka”, an outcome of research and analysis carried out by a consortium of some of the eminent institutions in India. The study is led by the Bangalore Climate Change Initiative – Karnataka (BCCI-K) and supported by the Global Green Growth Institute (GGGI). The efforts of BCCI-K in preparing such a comprehensive assessment of green growth potential are quite laudable.

As Karnataka embarks on an accelerated economic development, the Government is taking conscious steps to ensure that growth is socially inclusive, and that environmental protection measures are in place. However, rapidly growing demand for energy, water and other natural resources poses immense challenges to attain sustainable development. Against this background, research and analysis of environmental related issues help in evolving integrated, long-term planning in achieving the State’s development goals. The report has pointed out that private sector can play an important role to complement Government’s efforts in the process.

The State Government, through EMPRI, has prepared a State Action Plan on Climate Change with specific framework measures of adoption and mitigation. The report of BCCI-K will be a useful document in this direction.

I congratulate all the participating institutions (IISc, CSTEP, UAS, ISEC, INRM and LSE) in their research effort and for their pioneering work and in particular, Prof. B.K. Chandrashekar and BCCI-K for the leadership, and GGGI for its support.

Siddaramaiah
(SIDDARAMAIAH)
Chief Minister

Foreword

ಎಂ. ಮದನ ಗೋಪಾಲ್, ಭಾ.ಆ.ಸೇ

ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿ
ಅರಣ್ಯ, ಪರಿಸರ ಮತ್ತು ಜೀವಶಾಸ್ತ್ರ ಇಲಾಖೆ

M. Madan Gopal, IAS

Additional Chief Secretary to Government
Forest, Ecology and Environment Department



ಕರ್ನಾಟಕ ಸರ್ಕಾರದ ಸಚಿವಲಯ

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Karnataka's importance to India's economic progress has been well established. As one of the industrial powerhouses of the nation, and a leader in the service and IT industries, the state's continued development is integral to the overall growth of the nation. However, this progress is being threatened by as well as posing a threat to environmental sustainability. For instance, projections, presented in this very report, indicate that temperatures will rise by as much as 1.5 to 2 degrees by 2030. Needless to say, this will have profound effects on agriculture, an important sector and provider of livelihood for much of the state's population. Water, a precious resource that so many of us take for granted, is also expected to pay the toll of over-use, with resources in the north eastern districts depleting.

Given the challenge, I was very happy to learn about the collaborative project between the Bangalore Climate Change Initiative—Karnataka (BCCI-K) and the Global Green Growth Institute (GGGI) when it first came to my attention earlier this year. As the Government of Karnataka has already initiated measures in preparing Action Plan on Climate Change through Environment Management and Policy Research Institute (EMPRI), the Report of BCCI-K will facilitate the strengthening the said Plan of Action.

I firmly believe that the analysis and recommendations presented in this Report will enable policy makers to identify and prioritize green growth opportunities that support the development goals of the state government.

Like in most parts of the world, reconciling economic growth and environmental sustainability is an enormous challenge to the government. The Green Growth Strategy for Karnataka report addresses this challenge and makes special effort to be socially inclusive in its recommendations, ensuring that the vulnerable sections of society are very much at the center of our development plans.

The pioneering research that has gone into this report has been led by experts from reputed institutions, including Dr. Anshu Bharadwaj from Centre for Study of Science, Technology and Policy (CSTEP, Bangalore), Prof N.H. Ravindranath from the Indian Institute of Science (IISc, Bangalore) and many others, all brought together under the aegis of Prof. B.K. Chandrashekar, the chairman of BCCI-K. I complement GGGI for their support to this important research. I am sure that the Report will get serious consideration from the government and policymakers in Karnataka in tune with the State Action Plan. Such collaborated action on sustainable basis will ensure a greener, cleaner and economically progressive Karnataka.


I congratulate BCCI-K and GGGI, for all their efforts towards building a better Karnataka.

M. Madan Gopal, IAS

Additional Chief Secretary & Principal Secretary
Forest, Ecology and Environment Department
Government of Karnataka

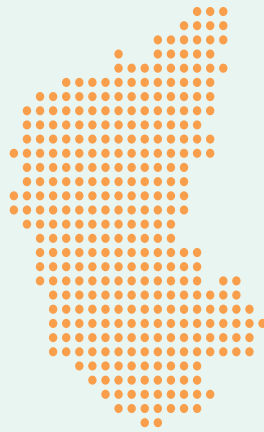
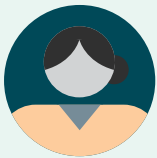
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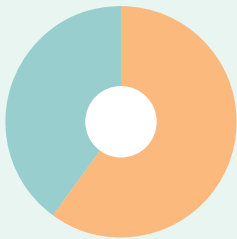
1 | Context

KARNATAKA



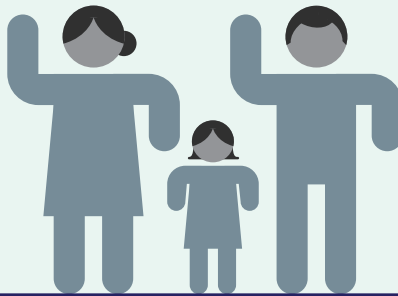
60%

Share of Services Sector in GSDP



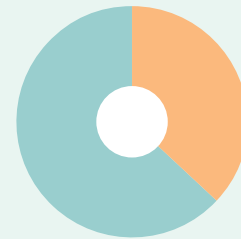
61

Million People



37%

Urbanization



Karnataka is the eighth largest state in India, with a population of about 61 million people. The state contributed 5.46% of the Gross Domestic Product (GDP) of India in 2011-12. During the 11th Five Year Plan period (2007-08 to 2011-12), Karnataka's Gross State Domestic Product (GSDP) grew at a Compound Annual Growth Rate (CAGR) of about 7.2%, driven by its diverse manufacturing base and strong performance in the services sector, which has been growing at 9%. The state showed steady growth over the last decade, and with

a progressive industrial and trade policy, it is also known to be investor friendly. Karnataka boasts a strong base of educational and research institutions and is one of the most urbanised states in India.

Karnataka's service economy, riding high on the success of the Information Technology (IT) and Information Technology Enabled Services (ITES) boom, contributes highest to the GSDP (around 60%) followed by Industrial and Agricultural sectors. Over the past few decades, a



sectoral shift has occurred in the state economy from agriculture to the services sector. However, because of low employment elasticity and requirement of specific skill-set in the services sector, shift of labour from agricultural to services sector has been difficult. Northern Karnataka has higher relative poverty and consumption inequality compared to other regions.

The Western Ghats which occupy 23% of Karnataka's geographical area, has the highest population density

(~600/Km²) among the 34 biodiversity hotspots recognized globally. Even as the total forest cover of Karnataka has increased over the years, a decline in the area under dense forests is a concerning trend. Habitat fragmentation and invasion by alien species, such as *Lantana camara*, threaten the composition and biodiversity values of forests.

2 | Motivation

Reality

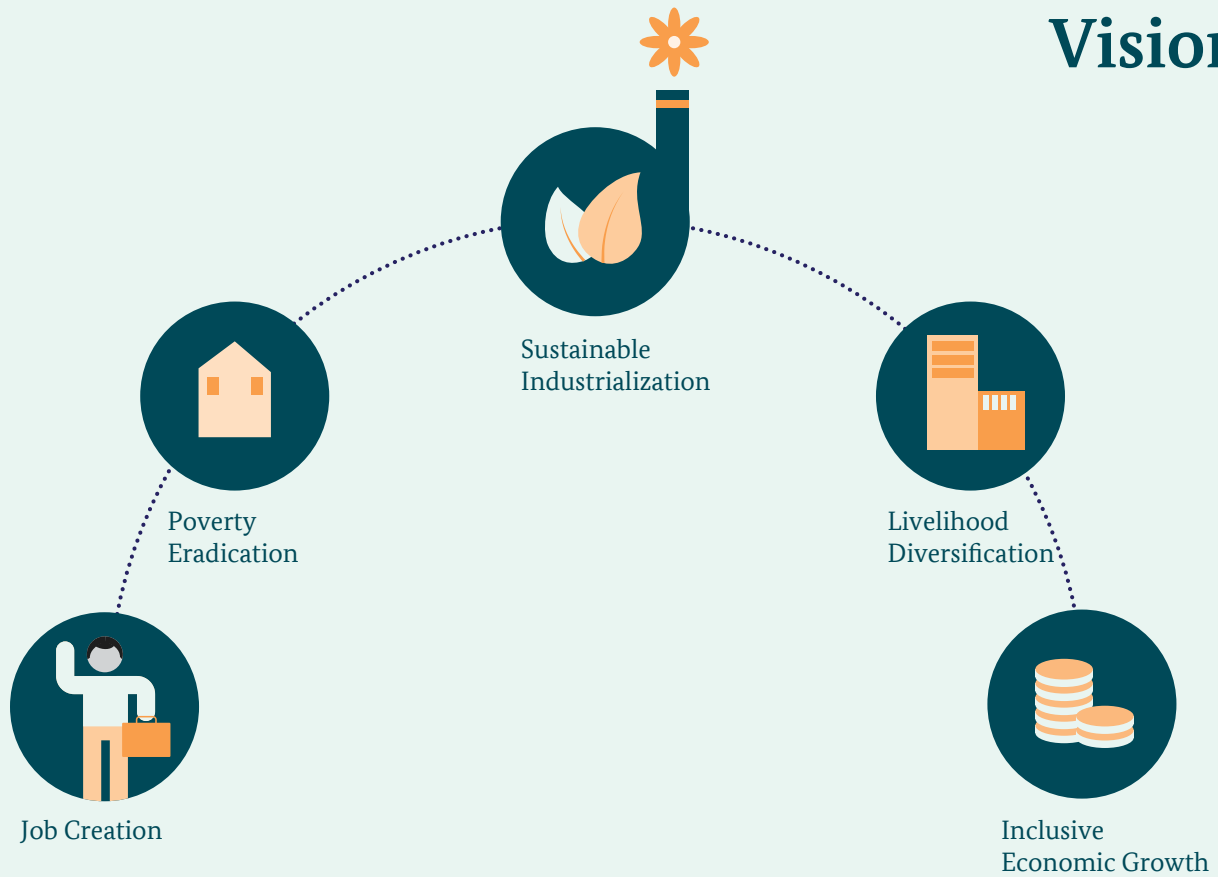


As a progressive state, Karnataka envisions job-oriented, inclusive economic growth. This will require sustainable industrialization and livelihood diversification. However, such a transition is likely to increase the demand for resources and energy significantly. Additionally, the state's dwindling resources and increasing vulnerability to climate change may threaten the achievement of inclusive growth. The highly vulnerable districts across Karnataka also rank lowest in indicators of human development. Also, the decline

in poverty in Karnataka during the last decade has been slower as compared to other southern states. Hence, there is an urgent need for increasing climate resilience and adaptive capacity of its people.

Karnataka Vision 2020 policy and State Action Plan on Climate Change (SAPCC) recognize this need and considers 'sustainability of the state's environment and natural resources' as one of the primary approaches to 'job oriented inclusive economic growth'. Thus, the

Vision



state should focus on green growth, i.e. meeting the allied developmental imperatives of economic growth, environmental sustainability and poverty reduction, in order to realize its vision.

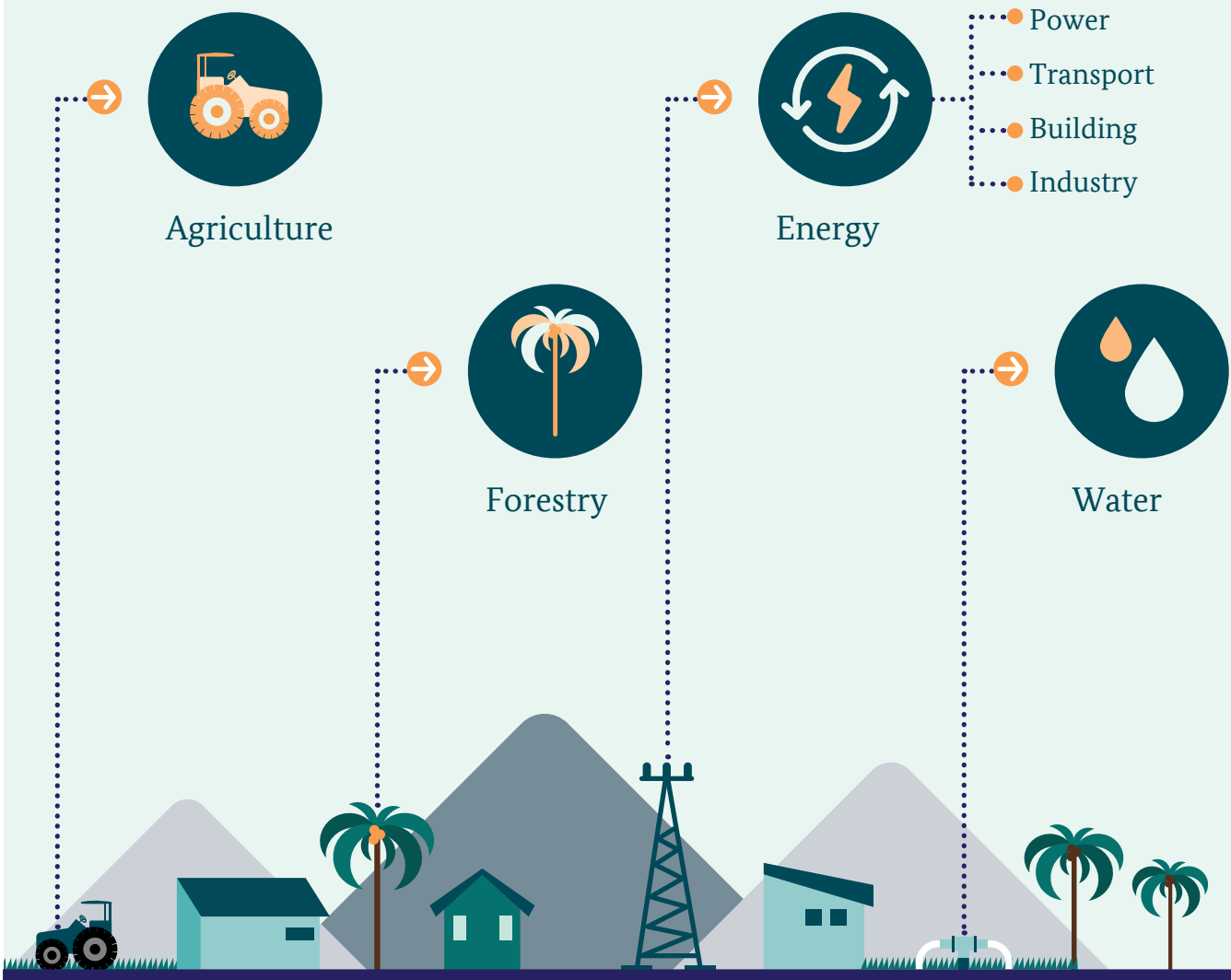
Accordingly, this report presents a Green Growth Strategy that evaluates the sustainability challenge over a long-term horizon, and proposes a set of feasible interventions in order of priority.

WHAT IS GREEN GROWTH?

The World Bank defines green growth as growth that is efficient, clean, and resilient—efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters.

3 | Approach

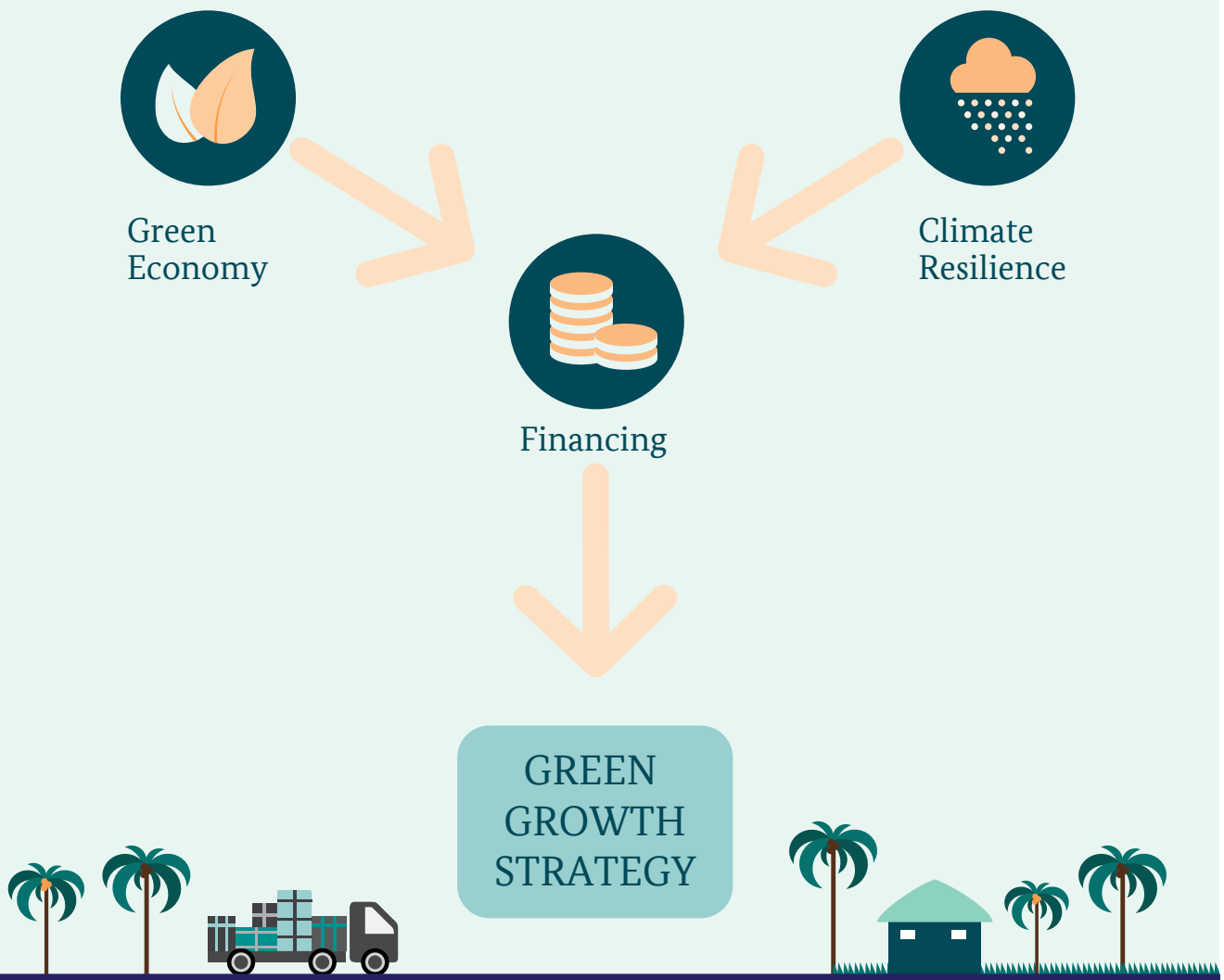
Sectors



This report synthesizes two volumes of work¹ mapping out opportunities for sustainable growth in the following key sectors:

- 1 Energy
- 2 Agriculture
- 3 Water
- 4 Forestry

The **Green Economy Strategy** focused on buildings, agriculture, industries, transport, and power supply – sectors which account for almost all of the state’s energy requirement and over 70% of its 2010 GHG emissions. The **Climate Resilience Strategy** focused on agriculture, forestry and water sectors. A long list of green growth opportunities for these sectors was identified based on their potential to reduce energy demand and Green House Gas (GHG) emissions and increase climate resilience in the long run. Further, based on the ability of these



opportunities to meet multiple green growth objectives over the long term, a prioritised set of implementable short term interventions was identified. Sectoral government plans, annual reports and policy documents such as the SAPCC were used to determine the prioritisation criteria, which included green growth benefits beyond mitigation and adaptation, such as energy security, job creation, pollution reduction, land and water resource conservation, and reduced vulnerability to climate change. Finally, an evaluation of implementability (based on financial,

political and/or social criteria) of these key opportunities was also conducted, to prioritise opportunities requiring policy focus and/or deeper analysis.

The detailed technical research was complemented by an extensive consultation with stake holders. With stake holders from various government departments, academic institutions under the aegis of Bangalore Climate Change Initiative – Karnataka (BCCI-K), as well as specific external domain experts, to define the problem

Fig 1 Analytical Approach

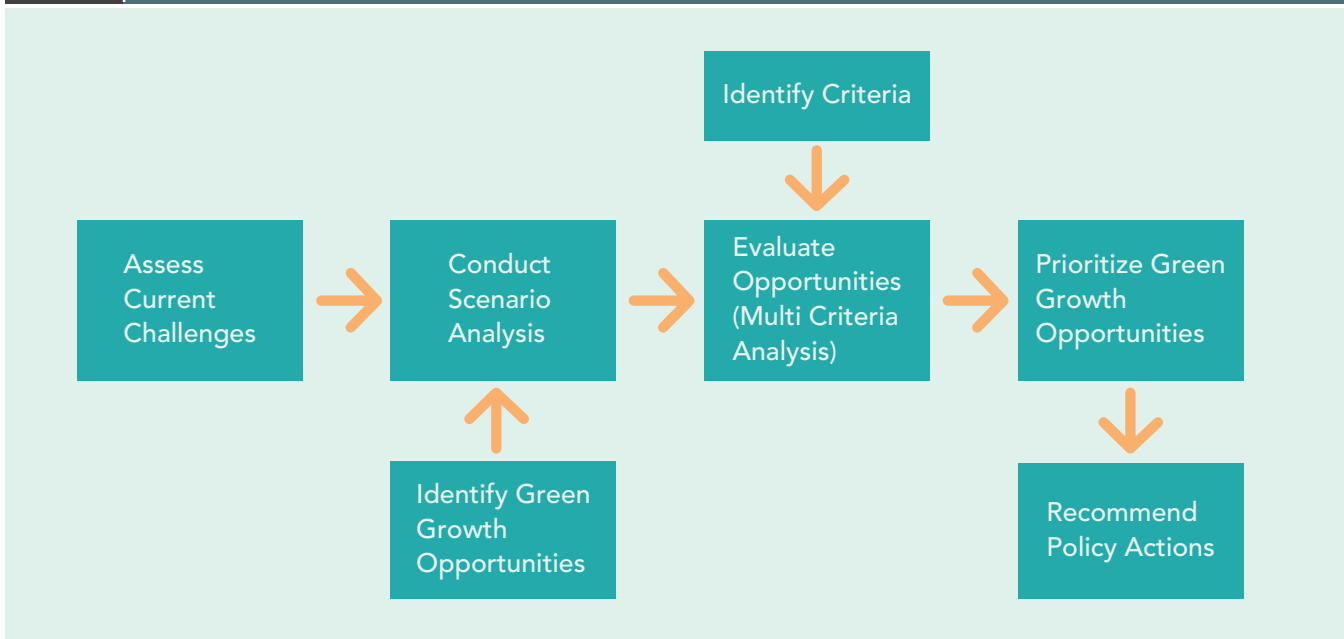
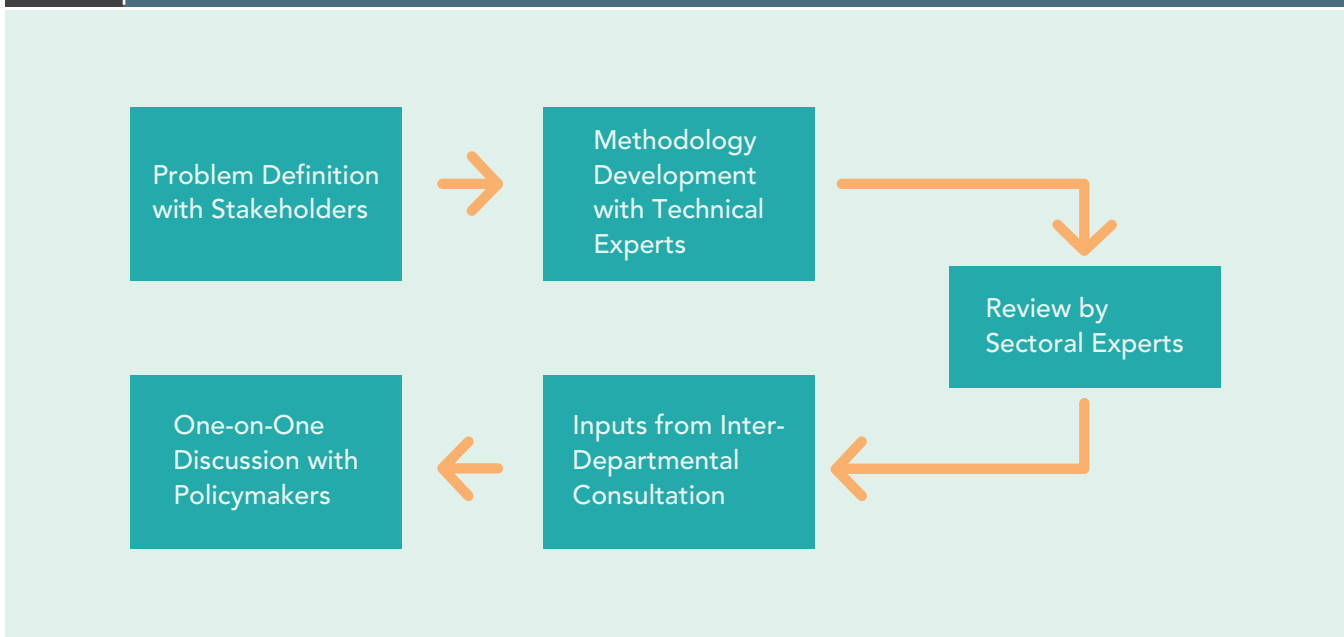


Fig 2 Stakeholder Consultation Approach



and design research methodologies. The initial research findings and approaches were reviewed by a technical committee comprising of senior government officials and technocrats. Their feedback was used to revise and validate research assumptions. The final results of the research have been disseminated to various government officials via one-on-one outreach interactions. Other

outreach activities include stakeholder workshop, media interactions and departmental policy briefs.

The implementation phase, will further engage civil society and government stakeholders in identified districts, to facilitate the process.

MODELING TECHNIQUES USED IN SCENARIO ANALYSIS

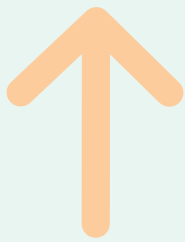
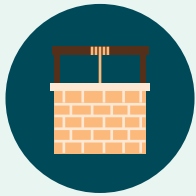
The analysis was carried out using modeling techniques that are extensively deployed for planning and forecasting by various country and state governments.

To analyze the future implications of Karnataka's growth path on energy, and correspondingly on environment, we have engaged The Integrated MARKAL EFOM System (TIMES). TIMES is an optimization energy system tool that enables users to consistently analyze interactions of growth with energy demand and its impact on supply, evaluated in the context of resource availability, technology and policy.

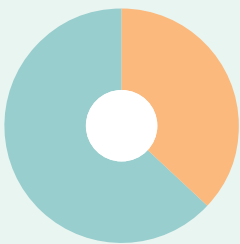
The impact of climate change on water resources, agriculture and forest ecosystems was assessed using climate response dynamic or process models using climate projections from CMIP5 (an ensemble mean of 18 Global Climate Models (GCMs)) under multiple scenarios. INFOcrop simulation model was used to predict the productivity of Rice, Maize, Jowar, Ragi and Red gram crops using the crop trends calibrated against the decadal mean (2001-2010) of realized yield taken as the baseline yield. The well-known ArcSWAT GIS model was used to study the river systems. The model was then validated using stream flows data to simulate future scenarios. The impact of climate change on Karnataka's forests was assessed using a dynamic global vegetation model - the IBIS (Integrated Biosphere Simulator) and an ensemble of five Earth System Models from CMIP-5.

Footnote 1 'Transitioning towards a Green Economy in Karnataka' (CSTEP, 2014), and 'Transitioning towards Climate Resilient Development in Karnataka' (IISc, 2014)

4 | Current Status



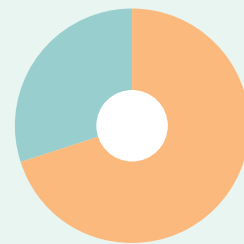
37%
Irrigation using
Groundwater



33%
Share of
Agriculture
Sector in
Electricity
Demand



70%
Forest Cover
Classified as
Dense Forests



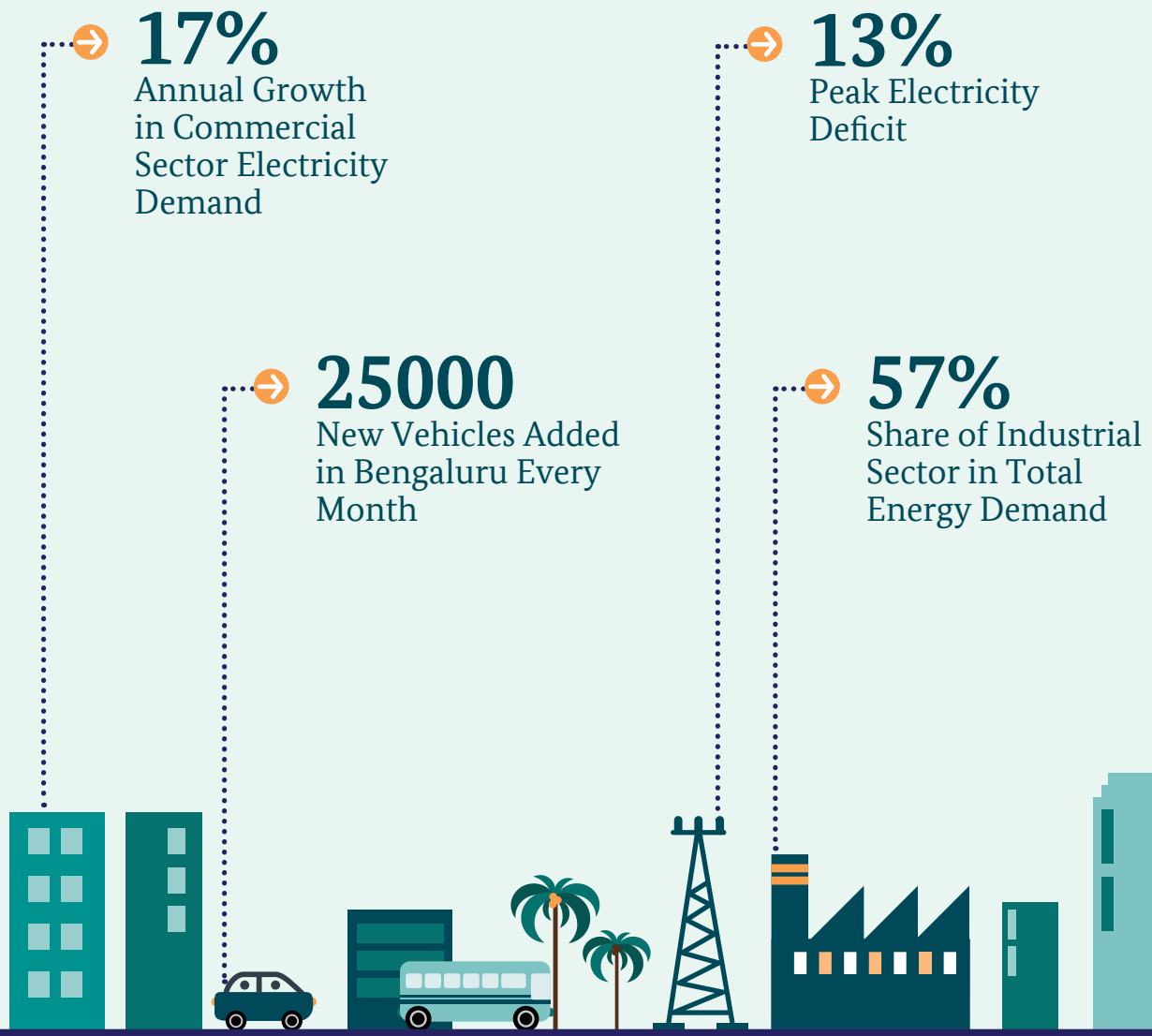
Current status and challenges for key sectors:



AGRICULTURE

- There has been a significant increase in production of cereals, pulses, cotton, sugarcane and tobacco over the last decade. The state also recorded an impressive 5.6% growth in agriculture (amongst top five in India) against a national average of 3.3% during the eleventh plan period.

- Convergence of government schemes such as *Bhoochetana*, has led to increased productivity gains (28%) in agriculture.
- Installation of telemetric rain gauges at Hobli² level in the state contributed to increase in farm income through weather forecasting. Average farm income has increased 10-fold between 2008 and 2013.
- The state has very high reliance on groundwater for irrigation. 37% of irrigated land is being supplied with



underground water, most of it using pumps that are highly energy inefficient.

- ▶ Agriculture consumes about one-third of the total (grid-supplied) electricity in the state.
- ▶ Electricity subsidy of INR 6,100 crores earmarked for 2014-15.



INDUSTRY

- ▶ Karnataka is the fifth most industrialized state.
- ▶ Driven by large mineral reserves of iron ore, limestone, etc., it is among the top producers of iron and steel (I&S) (~10 Mt) and cement (~15 Mt).
- ▶ Industries consumed 9 million Tons of Oil Equivalent (Mtoe) of energy in 2010 (57% of the total) – I&S using

63% of this energy. Most of this energy consumption is in the form of thermal energy.

- ▶ Energy costs can account for up to 40% of manufacturing costs in large industries.



BUILDING

- ▶ 61 million people living in over 10 million houses consume 19% of total electricity supplied, with the demand growing at 10% per annum (p.a.).
- ▶ People have low access to modern cooking fuels - one out of three urban households, and nine out of ten rural households do not have access to LPG as a primary cooking fuel.
- ▶ 37% urbanization; majority of the state's income is generated in cities, where service-sector related activity is concentrated.
- ▶ Bengaluru has about 100 million sq. feet of commercial floor-space, and electricity consumption per unit area is much above the approved threshold.
- ▶ Overall, commercial sector has 11% share in state's electricity demand, growing at 17% p.a.



TRANSPORT

- ▶ Karnataka has 100 Billion Passenger Kilo Meter (BPKM) of urban transport demand, of which 50% is met by buses, and 30% by 2-Wheelers.
- ▶ Bengaluru, which accommodates over 40% of the vehicles in the state, accounts for a significant share of urban transport demand. The city is planned primarily for motorised travel and ranks amongst the lowest in the country on walkability.
- ▶ Despite Bengaluru's bus fleet being the highest in the country (over 6,000 buses), private vehicles in the city are increasing by 25,000 per month.



POWER

- ▶ There is a significantly high peak deficit (over 13%).
- ▶ No coal reserves in the state; coal plants operating at very low Plant Load Factors (PLFs) due to linkage problems and other issues.
- ▶ High solar and wind potential but slow development due to issues of land acquisition, evacuation infrastructure, and environmental clearances.
- ▶ Low specific emissions from power generation due to high share of hydro power, which is unlikely to be maintained in future due to rapid demand growth and ecological concerns with hydro power.
- ▶ High Transmission & Distribution (T&D) losses of 18%.



WATER

- ▶ The Central Ground Water Board (CGWB) has identified 90 Talukas in the state with depleting ground water of which half are graded critical. Further development of groundwater resources is not feasible as more than 90% aquifers are hard rock aquifers. State Water Policy (2002) objectives of creating an additional irrigation potential of 16 lacs hectares by using ground water, could be undermined.
- ▶ The energy subsidy bill for agriculture is expected to increase with the projected decline in ground water availability. INR 6,100 crores (USD 1 billion) has been earmarked for subsidies on electricity for agricultural uses in the 2014-2015 budget.
- ▶ Analyzing the time series data from 1979, we find that Yadgir, Raichur and Gulbarga districts are the most vulnerable to water availability, while 16 districts fall in high vulnerability category. This could adversely impact the food security due to reduction in per capita water availability in Karnataka.



FORESTRY

- ▶ Karnataka ranks fourth in India with regard to area under tree cover with close to 70% of forest cover classified as dense forests.
- ▶ It also has the highest per-capita forest cover among all southern Indian states (0.059 Hectare). Very dense and moderately dense forests together constitute roughly 11% of the total geographic area of the state.
- ▶ The Western Ghats region, which covers about 60% of forest area of Karnataka, is one of the 18-mega biodiversity hotspots of the world.
- ▶ Decadal analysis shows decline in area under dense forests while area under open forests is increasing, suggesting degradation of forests.



ENVIRONMENT

- ▶ Economic development is causing significant stress on natural resources (land and water degradation) and environment (SO_x, NO_x, Particulate Matter, and GHG emissions).
- ▶ Almost 10 kilo tons per day (ktpd) of waste is generated and 80% collected waste is sent to landfill, leading to land and water degradation and methane emissions of 60 kt.
- ▶ 1,300 million Liters per Day (MLD) of domestic and commercial waste water (WW) is generated out of which 30-40% is treated; untreated WW discharged into water-bodies.
- ▶ PM concentrations in Bengaluru is already in violation of National Ambient Air Quality Standards; Transport contributes to 42% of PM10 and 68% of NO_x emissions in the city.

- ▶ SO_x and PM emissions from thermal power plants is likely to cause significant health problems for Karnataka in the future.

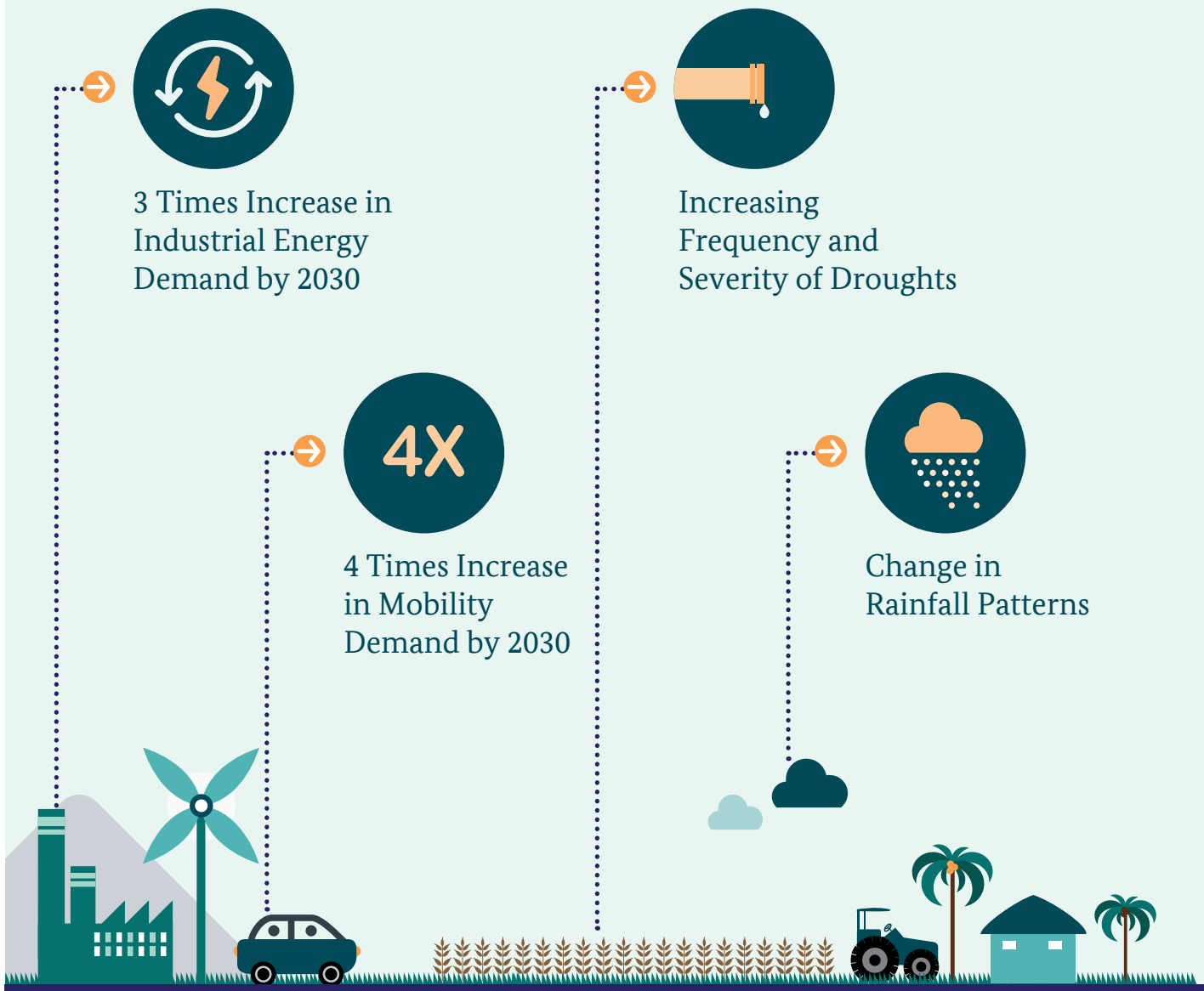
- ▶ GHG emissions from energy and waste sectors are calculated as 79 Mt CO₂e in 2010, translating into per-capita emissions of 1.3 tCO₂ per person.



CLIMATE CHANGE

- ▶ Climate change is a force multiplier that could exacerbate livelihood, socio-economic and water resource vulnerability in Karnataka resulting in a drag on the state's Human Development Index (HDI) goals. Hence, there is a need to improve and better target coping strategies to reduce current and future vulnerability.
- ▶ Uneven exposure to droughts, floods and stagnant farm incomes and low levels of value addition to farm produce could threaten the realization of 4.5% growth rate set by the state agricultural policy.
- ▶ A total of 4.2 million hectares of crop was damaged and lives lost in various natural calamities recorded from 2006-2011 in the state. The state lost standing crops of 1.6 million hectares during 2012-13 accumulating a total loss of USD 618 million. Karnataka's food grain production also dropped by 8% to 12.5 million tons during the same period.
- ▶ Karnataka is increasingly becoming warmer. Temperature trends over the last century suggest that Karnataka state has warmed by about 0.4°C while average annual rainfall has reduced in the corresponding period by 10%. Our analyses based on 100 years' data show that parts of northern Karnataka; Bijapur, Gulbarga, Yadgir and Raichur have warmed up more (≥0.6°C) than other districts of Karnataka.

5 | Challenges and Opportunities



Below we present some sectoral and cross-sectoral challenges and opportunities (in that order), by quantifying the extent of both. The key sectoral insights are presented first, followed by a discussion on cross-sectoral insights.

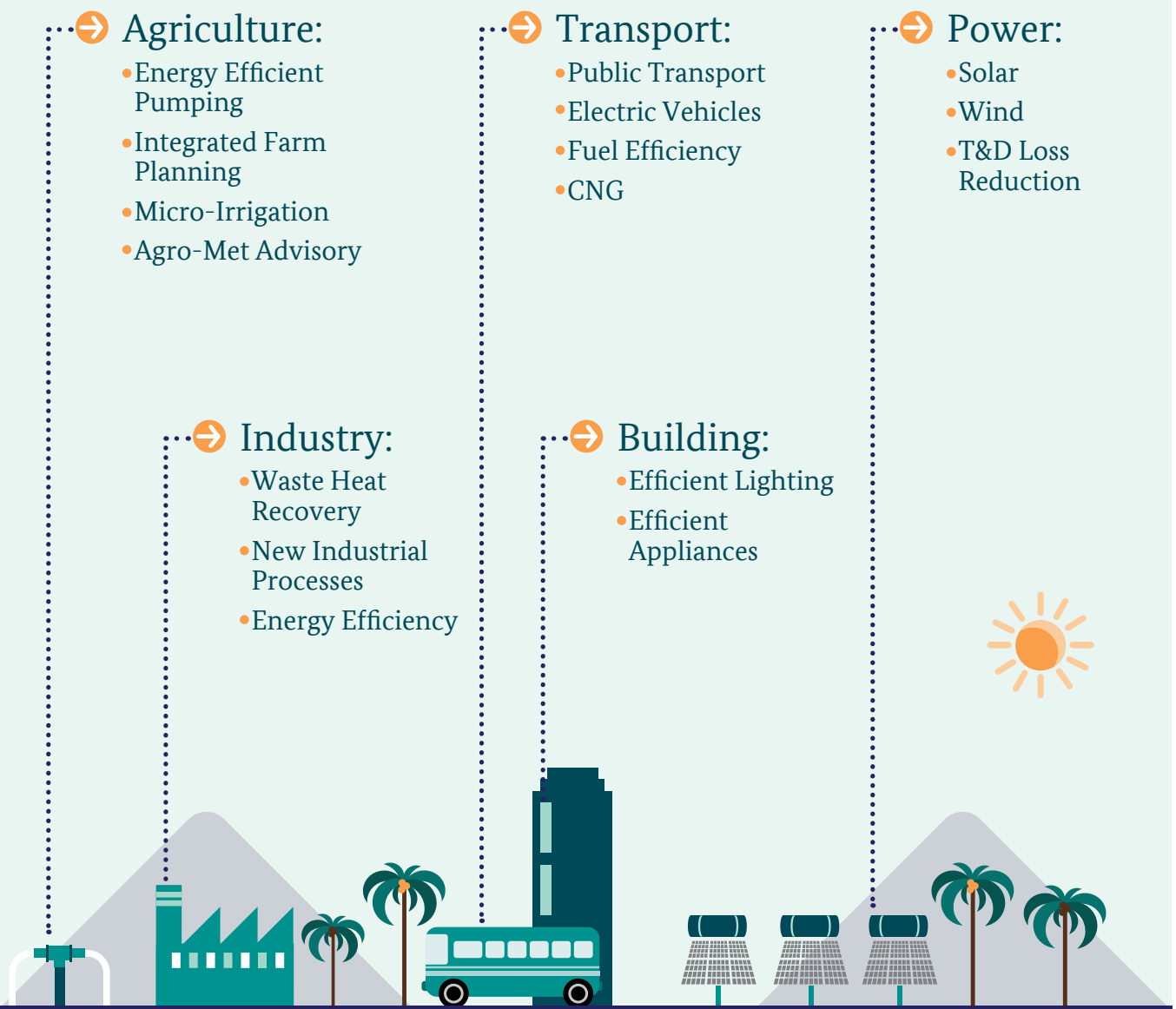


AGRICULTURE

► Climate projections indicate that most parts of Karnataka could experience 1.5–2 °C warming relative

to the levels in pre-industrial period (1880s) by 2030s if emissions of GHG continue to increase.

- Gains in agriculture productivity are likely to be offset by losses from untimely high-intensity rainfalls, more frequent droughts. Change in rainfall patterns (declining Kharif season rainfall and increasing Rabi and summer season rainfall) can adversely impact Kharif/Rabi sowing time and lead to pest-disease outbreaks, bringing down the grain yields.



▶ A possible increase in frequency and severity of droughts, with variance in rainfall will deplete the groundwater table and intensify energy demand for pumping. Demand for electricity for irrigation pumping is expected to double and reach 21 tWh in 2030, with a subsidy bill of over INR 100 billion per year in 2030. Diesel consumption of tractors and farm machinery may cross 1.2 Mt by 2030 pushing the fossil fuel subsidy envelope to INR 22 billion.

▶ Options identified to adapt and realize the benefits of green growth include: promoting water and nutrient use efficiency through fertigation, crop diversification using integrated farming models, packaging agro-met advisories with farm extension services, soil-fertility management and appropriate crop insurance models. The study found that increased efficiencies in fertilizer use can help save on operational costs (20-25%) and increase fertilizer availability to crops by 25-30% and accrue savings to the tune of INR 7-9 billion/year in fertilizer subsidies.



INDUSTRY

- ▶ Due to sustained industrialization, energy demand in industries is projected to grow by three times, reaching 32 Mtoe by 2030, out of which almost 29 Mtoe will be thermal (mostly imported industrial grade coal), and the balance from electricity (almost 32 TWh). Iron and steel sector will account for 73% of the total industrial energy demand.
- ▶ Using currently available best technologies, the Specific Energy Consumption in various industries can be reduced by 20-45%. Some key interventions could be waste heat recovery technologies like top-pressure recovery turbine (TRT), efficient production techniques like continuous casting, and energy-efficiency measures like variable-frequency drives. Such interventions could reduce thermal coal & electricity requirement by 10% and 27% respectively, cumulatively saving INR 200 billion for industries by 2030.



BUILDING

- ▶ Bengaluru's commercial floor space area will increase almost three fold to reach 300 million sq. feet by 2030 driven by high growth in services. In this context, commercial sector electricity demand in the state is projected to increase from 4 TWh in 2010 to 48 TWh in 2030. Together the demand from commercial and residential buildings is set to grow seven-fold from what it is today, contributing more than half of the state's electricity consumption in that year.
- ▶ Increased penetration of efficient lighting and appliances can reduce electricity demand in buildings sector by 15% in 2030, leading to an average annual reduction of almost INR 1,900 in residential electricity bill per household.



TRANSPORT

- ▶ By 2030, more than half of Karnataka's 72 million people will live in cities. Coupled with increasing urban sprawl, this will mean a four-fold increase in mobility demand over the next 20 years. Despite the ongoing efforts to build metro trains and expand bus network, the number of vehicles on road is likely to grow by over three times to reach 20 million, thereby worsening congestion, road safety and air quality. Oil consumption from freight and passenger transport will also increase to 15 Mtoe, from about 4 Mtoe currently.
- ▶ Public transport can meet up to 50 % of the mobility demand with focused policy efforts, such as increasing the size and variety of bus fleet, timely implementation (and further augmentation) of the Bengaluru Metro, and inter-modal integration. These could reduce vehicles on the road by 3 million, reducing energy demand for passenger transport by over 10%. However, the choice of fuel for these buses will have significant implications for the air quality in cities, with electric and CNG based buses yielding obvious benefits over diesel.



POWER

- ▶ Electricity demand in the state will grow four-fold by 2030, largely driven by the increased demand from residential and commercial buildings. To meet this demand, the installed capacity in the state must increase to 40 GW by 2030 from the current capacity of 12 GW. If ongoing efforts in renewable energy (RE) deployment are not accelerated, coal capacity of about 18 GW would be required by 2030, much of it using imported coal, with substantial implications for state's energy security.
- ▶ Electricity demand in the state can be reduced by about 20 TWh through improved energy efficiency in buildings, industry, and agriculture. Along with other green interventions, such as aggressive reduction in T&D losses (limited to 7%) and increase in the share of renewable energy (to at least 30%), coal requirement for the power sector can be reduced by 20 Mt in 2030 – nearly double the consumption by the sector in 2010.



WATER

- ▶ Major river systems in the state including: Cauvery, Krishna, Netravati, Sharavati and Kali were analysed for the overall water availability. Both availability and consumption of water in the part of Cauvery basin that falls in Karnataka is projected to increase. Supply to various reservoirs in Cauvery, Netravati, Kali, Krishna, and Sharavati river basins may not be greatly reduced under climate change scenarios.
- ▶ Overall water resources vulnerability is expected to increase in North-Eastern districts including Yadgir, Raichur and Bidar.
- ▶ Water demand from the power generation sector driven largely by cooling for coal fired plants is likely to double to about 1.7 Billion Cubic Meters (BCM) in 2030. Approximately 840 Million Cubic Meters (MCM) of domestic waste water (DWW) will be generated in 2030, of which half will remain untreated. Meanwhile, 60-65% of the 1 BCM of Industrial Waste Water (IWW) generated by 2030 will be unfit for reuse and contribute to water pollution. This, along with the growing demand for agricultural produce, rapid urbanisation is likely to stress limited water resources.
- ▶ With improved secondary and tertiary treatment capacity for municipal and industrial WW, 3.1 BCM of water can be made available for reuse in 2030, representing about 8% of the then irrigation requirement. Additionally, by improving energy efficiency and using cleaner energy, water consumption from power sector could be reduced by 20%, releasing 304 MCM in 2030 for other uses.
- ▶ Adoption of micro-irrigation in water intensive crops like sugarcane can result in significant savings (electricity- 2,500 units/ha/year and water-40-50%) and increase farm production. Rehabilitation of Tank based irrigation systems and application of tank silt in farm can increase crop yield with 14-25% rate of returns.



FORESTRY

- ▶ Approximately one-third of the forest grids studied are projected to undergo change in forest type in the near term relative to baseline. Area under dense forests is decreasing rapidly in Karnataka, a 16% drop from 2000.
- ▶ In the Western Ghats, both evergreen and deciduous forests are likely to be seriously threatened: existing plant species is expected to face dieback (that is, begin to wither) or die—and it is uncertain whether they will be succeeded by species that can establish and thrive under the new climate.
- ▶ Among the biodiversity-rich natural forests of the Western Ghats, the dry deciduous forests are considered the most vulnerable whereas the semi-evergreen and evergreen forests are considered less vulnerable. The eastern flank of the Western Ghats is dominated by dry deciduous forests and plantations, which are inherently more vulnerable.
- ▶ Forests are estimated to contribute to INR 1,199 and INR 3,561 per household per year through Non-Timber Forest Products (NTFPs) in the evergreen and deciduous zones, respectively. Conservation-linked afforestation approaches can boost natural resources based livelihood incomes of forest dependent tribal communities by 10-15%. This would translate to an additional income of INR 2,000-2,500 per forest-dependent household per year.



ENVIRONMENT

- ▶ By 2030, almost 22 kt per day of municipal solid waste (MSW) will be generated, requiring 130 ha of land (72 ha in Bengaluru alone). Water and land degradation due to leaching of toxic waste (of high organic and moisture content) will be a major environmental concern.
- ▶ Segregation and alternate treatment of MSW can reduce the amount of landfill waste by half, land requirement by 100 ha, and methane emissions by 40%.

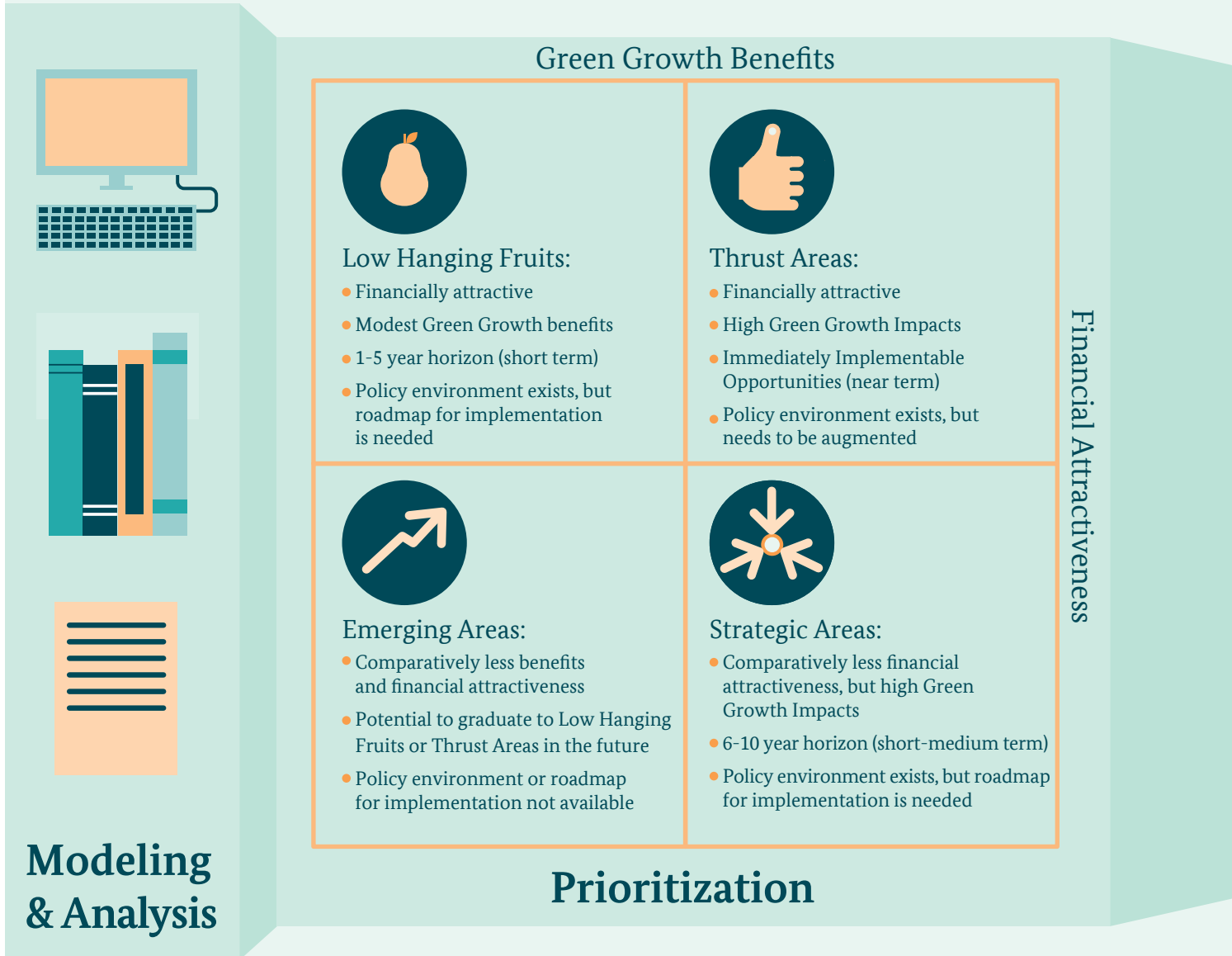
- ▶ Rising energy demand coupled with increasing share of coal will result in a four-fold increase in GHG emissions to about 307 MtCO₂e by 2030. Air quality is also likely to worsen over the next decade, particularly in Bengaluru. By 2020 annual PM and NO_x emissions from transport in Karnataka will increase by 50% to about 18 kt and 175 kt respectively.
- ▶ All green interventions taken together can reduce CO₂e emissions by 30% and PM₁₀ emissions by 40% in 2030. Annual SO_x emissions in the power sector can be cut by 34%, and fossil fuel dependence reduced by 22%.





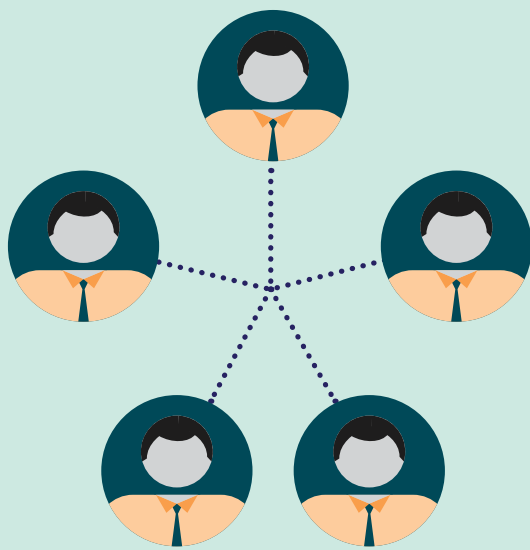
Picture by: Prof. M.B. Raju Gowda

6 | Green Growth Strategy

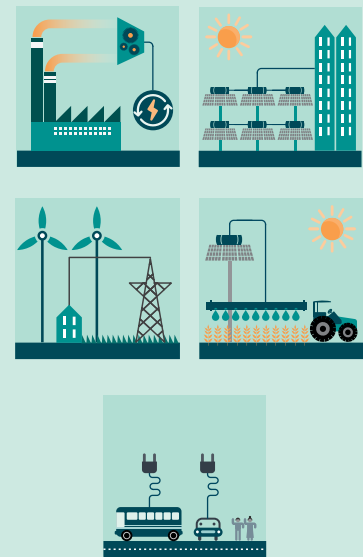


The entire set of green growth interventions, both for mitigation and adaptation, considered in this analysis yield significant benefits and are important to ensure Karnataka's green growth transition. However, in order to present an implementation roadmap and initiate requisite and timely policy action, key opportunities have been prioritised into 4 different categories, based on their financial attractiveness/implementability, quantum of green growth benefits, and policy relevance.

Green Growth opportunities are often incomparable to each other in terms of their benefits (e.g. congestion reduction is relevant for public transport, but not for other sector). Hence, this is a unique attempt at prioritizing these opportunities using a unified and aggregated criterion (Benefits and Financial Attractiveness/Implementability). Further iterative reviews



Stakeholder Consultation



Deep Dives for Implementation

will enhance the validity of this methodology, especially in terms of defining the various benefits parameters and attributing weights. The relevance of the tool is in its utility for prioritization and decision-making.

6.1 Green Economy Interventions:

In order to arrive at a prioritised set of interventions, the economic (jobs, energy security), social (poverty alleviation), environmental (air quality, land and water use efficiency) and carbon mitigation benefits were compared against their financial attractiveness (investment requirement and payback period) for a set of sixteen key green interventions (Figure 3).

Fig 3 Prioritization of Green Economy Opportunities


1 Thrust Areas

General energy efficiency measures in industries, T&D loss reduction, and intensification of public transport emerge as opportunities that have relatively high green growth benefits and are financially more attractive. Hence, these merit immediate attention to ensure that their benefits may be captured without significant economic burden.

The current policy progress on these opportunities has been limited. State programs have focused on pilots or broad-based measures, but a clear policy roadmap or support for T&D loss reduction or energy efficiency measures in industries, especially MSMEs, is lacking. In order to realise the benefits of enhanced public transport system, considerable effort is needed to expand the existing bus fleet and the metro network in a timely manner, along with better inter-modal integration.

2 Strategic Areas

Wind is strategically significant as it has the highest green growth benefits over Business as Usual (BAU), including fuel savings worth INR 17 billion in 2030. Further, with

coal prices projected to rise in the future, it is likely to become more financially attractive over time. However, the additional cumulative investment required is very high (~INR 250 billion). Thus, the opportunity would need an appropriate enabling environment and policy support to address technical (and other challenges) associated with its development.

The National Wind Energy Mission is in the offing, and given the state's high wind resource potential, wind park development and improved evacuation infrastructure could play a key role in realizing the benefits from Wind Power, when supported with appropriate financing incentives (Refer to case studies booklet).

3 Low Hanging Fruits

Almost all of the efficiency improvement measures, such as Energy Efficient (EE) Appliances & lighting, Agriculture Demand Side Management (AgDSM), Waste Heat Recovery (WHR) and Automobile Fuel Efficiency, appear as low hanging fruits. Additionally, some interventions such as Non-Motorized Transport (NMT) and Advanced Waste Water Treatment (AWWT) relate to better urban planning

WIND CASE STUDY

Wind energy is an effective and affordable way for Karnataka to meet the 20% renewable energy target by 2030, as proposed in the Karnataka renewable energy policy. This would translate to a total capacity deployment of about 11,000 MW in the state. Wind energy generation offers significant benefits in terms of clean power, local job creation and reduced import dependence on coal.

Karnataka has the third largest installed base of wind power capacity in the country. The current deployment is about 2,200 MW for a state where the potential has been estimated to be over 100,000 MW (CSTEP, 2013).³ The capacity addition in Karnataka has plateaued at approximately 200 MW per year. Karnataka had the slowest uptake in wind capacity both in terms of year-by-year percentage and MW of capacity, among the 4 states having significant on shore wind potential namely Tamil Nadu, Maharashtra and Rajasthan. Moreover most of the large wind farms proposed in the state are yet to take off and bulk of the capacity commissioned in the state is fragmented with 90% of the projects having less than 20 MW capacity.

Estimates show that over 9,000 MW of wind power capacity could be added by 2030. This includes 2,500 MW of additional capacity above the current plan. At today's technology cost, this entails an average investment of about INR 54,000 crores translating into an annualized investment of INR 3,600 crores and capacity addition of 600 MW.

Some of the critical issues hindering the growth of wind energy are land availability, transmission capacity for wind energy and seasonal variability in wind generation. The state government needs to resolve these issues to accelerate wind capacity addition from 200 MW per year to about 600 MW per year.

There are two established mechanisms to support development of wind energy. The first mechanism is generation based incentive which has a longer track

record and better support from financial institutions due to certainty of revenues. It is completely dependent on the subsidy given by the state. The second mechanism is the Renewable Energy Certificate (REC) which is a market based mechanism. Government saves INR 1.13 per KWh of generation based incentive for projects which are setup under REC mechanism. The success of attracting projects under REC mechanism is dependent on relative attractiveness of state of Karnataka vis-à-vis other wind endowed states primarily in terms of site availability and connectivity.

The districts of Chikkaballapur, Chamrajnagar, and Chitradurga could be explored for wind farm development. First, these districts have high wind potential, second, they are close to Bengaluru which is the largest load center in the state, and third, they are relatively poorer and more vulnerable to climate change and hence in need of development opportunities. Karnataka Renewable Energy Development Limited (KREDL) has recently de-allocated about 2,500 MW of wind capacity of some developers on account of lack of progress. Consequently, some wind sites will free up allowing for immediate implementation on development of wind farms.

For this project/program, it is recommended that ADB Clean Energy Financing Partnership Facility (CEFPF) for sourcing funds to develop wind farm infrastructure. These funds would be either in the form of grant or low cost financing with potential investment of USD 3-5 million for building infrastructure for a 400-500 MW wind farm. These farms can then be marketed to prospective developers to invest in wind generation capacity. At the domestic level, the National Clean Energy Fund (NCEF) is a government of India fund which can be explored for development of wind forecasting tools and grid integration pilots. These initiatives would allow for integration of higher share of renewable energy in the overall generation mix. NCEF allows for up to 40% Viability Gap Funding (VGF) and has a corpus of INR 15,000 crore.

ELECTRIC VEHICLE CASE STUDY

India is on track to become the third largest road transportation market by 2020 driven by strong economic growth and rapid urbanization. In the next 20 years, a steady economic growth, higher working population, and longer trips due to urban sprawl will lead to a four-fold increase in the demand for urban transport, nearly tripling the demand for passenger transport as a whole.

The growth in transportation sector has resulted in higher oil imports, higher GHG emissions and particulate matter (PM₁₀ and PM_{2.5}), noise pollution and congestion in urban areas. Most of the cities in India surveyed by World Health Organization (WHO) have been rated among the most polluted cities in the world especially on count of PM pollution. PM concentrations in Bengaluru are already in violation of National Ambient Air Quality Standards (NAAQs).

Air pollution is a significant problem in India resulting in loss of about 1.7% of GDP as per estimates by World Bank in 2014. While it may not be accurate to directly deduce from national loss percentage, 1.7% of state GDP would translate to a loss of economic activity of about INR 5,100 crores per year for Karnataka.

Noise pollution in urban areas has also emerged as a significant health issue. Prolonged exposure to elevated noise levels has been linked to sleeping disorder, noise induced hearing losses and increased risks of heart stroke. Estimates suggest that economic cost of noise pollution is even higher than that of air pollution.

There have been multiple initiatives to reduce emissions in the transportation sector ranging from fuel efficiency, introduction of alternative fuels like CNG, promotion of NMT and electric vehicles.

Electric vehicles are found to be the most effective in combating local air pollution with zero tailpipe emissions and lower noise pollution. In Indian context,

electric vehicles also help in enhancing fuel security with reduced oil and gas imports. National Electric Mobility Mission Plan (NEMMP 2020) is the most comprehensive plan undertaken by Government of India to accelerate adoption of electric vehicles in the Indian market.

There are four key barriers to adoption of electric vehicles. These barriers are related to policies, technology, infrastructure and cost economics. As per our analysis, electric buses for use in public transport are closest in overcoming these barriers.

Karnataka is best positioned to take lead in introducing electric buses in their public transport system. With one of the largest intra-city public transport network, with a fleet of over 6,000 buses, it can emerge as a significant market for the Original Equipment Manufacturer (OEM) in the near future. Bengaluru Municipal Transport Corporation (BMTTC) has successfully piloted an electric bus for over 3 months with positive results. Going forward, adoption by state road transport corporations with fleet of over 25,000 buses can reduce PM emissions by 25%.

The Total Cost of Ownership approach, as proposed in NEMMP 2020 was used to arrive at subsidy requirement for adoption of electric buses. For electric buses, current viability gap is estimated at about INR 60-70 lacs per bus. This is for buses which are equivalent in service and quality to Volvo air conditioned buses being currently used by BMTTC. This subsidy gap can be bridged by a combination of direct incentives, waiver of import duty and taxes and low cost interest loans. A combination of low cost loan from Clean Technology Fund and quantification of societal benefits can also bridge the subsidy gap.

Karnataka could thus focus on electrification of its state fleet of buses and government vehicles in the short term to drive adoption. Further, the BMTTC can expand on their initiative to bring in electric buses and initiate development of enabling infrastructure.

and management, and would be key enablers to some of the thrust areas, such as NMT infrastructure is closely linked to integrated public transport.

In order to maximize realization of green growth benefits from the AWWT opportunity, the government would need to strictly enhance municipal waste water treatment facilities in a timely manner and enforce Common Effluent Treatment Plants (CETP) for industrial units, especially micro, small and medium enterprises (MSMEs). Further, augmentation of the State Clean Energy Fund (SCEF) could facilitate all demand-side measures in the power sector.

Specifically, AgDSM projects are already being implemented in a phased manner with collaboration between the Karnataka government and Energy Efficiency Services Limited (EESL). Case studies from EESL indicate that returns from efficient pumping are high, and an initial corpus from SCEF can enable rollout throughout the state with considerable ease through public-private partnerships.

In addition, WHR measures and new industrial processes are low hanging fruits for the industry sector. By recovering thermal losses in industrial plants, WHR presents an opportunity to reduce electricity consumption and increase energy efficiency. States such as Andhra Pradesh and Rajasthan consider WHR as cogeneration, which is counted as a renewable energy source under the states' Renewable Purchase Obligations (RPO). Karnataka could use similar incentives (Refer to case studies booklet).

4 Emerging Areas

The recent policy push from the government on solar is a step in the right direction, and will aid the development of solar power in the state. Solar rooftops can be exploited to offset the high land footprint of grid-connected solar power, and solar technologies coupled with mini-grids can also provide electricity access in the energy deprived areas. However, there is a strong need to address the key implementation bottlenecks, which will be crucial in achieving the ambitious targets (Refer to case studies booklet).

Similarly, Electric Vehicles (EVs) have the highest job creation potential and contribute significantly to improving air quality in cities (Refer to case studies

booklet). The job potential could be further enhanced if Karnataka, already a leader in electric car manufacturing, expands its manufacturing capacity for sales domestically and internationally.

It is important to evaluate whether these options can be taken up as they become financially more attractive or technically feasible. Further, one should track if these technologies can have a wider application to enable greater benefits. As an example, electric buses, which are at a pilot stage in India, could become commercially viable if the storage technology improves. EVs could then potentially become a 'thrust area' with a wider application in public transport.

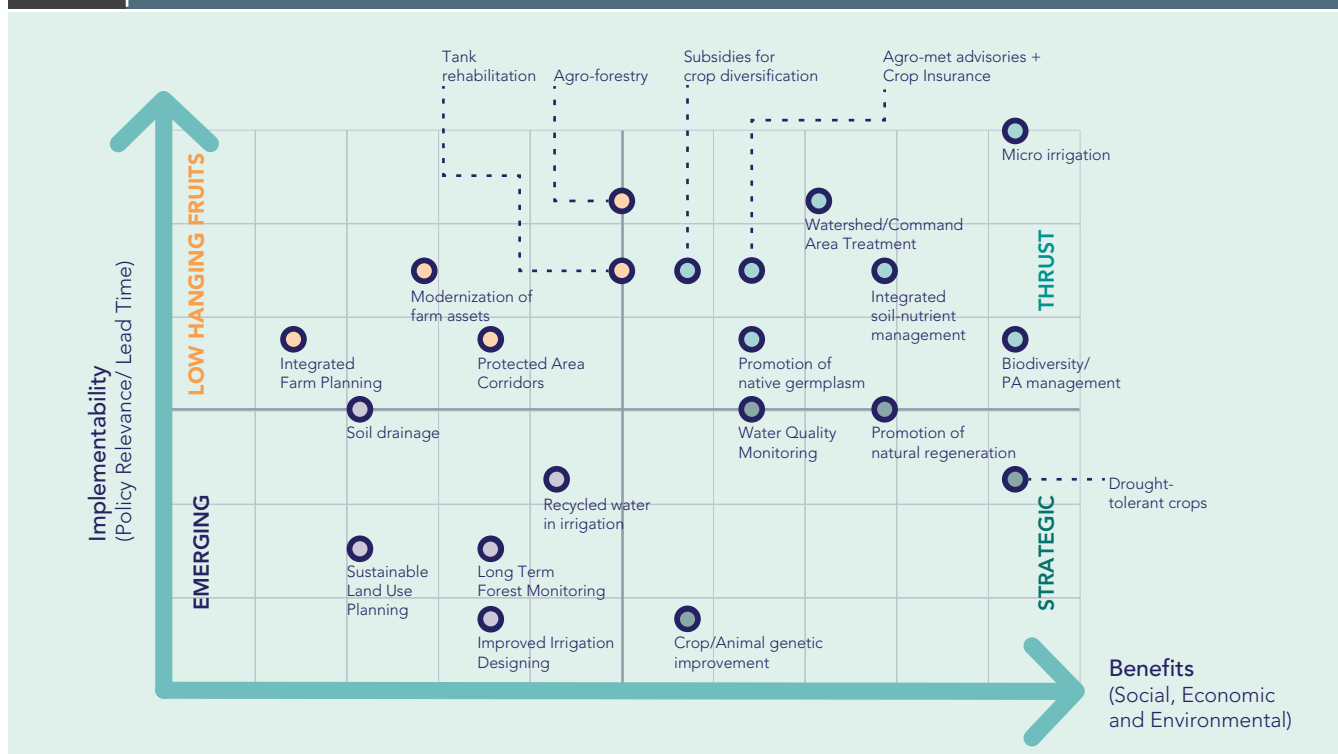
6.2 Climate Resilience Interventions

For climate resilience, 42 adaptation opportunities from water, agriculture, forestry sectors and the cross-sectoral soil-water-nutrient nexus were evaluated using a benefits based approach, focusing on economic (income generation, impacts avoided), social (inclusiveness, institutional readiness), and environmental benefits (sustainability). 14 shortlisted priority opportunities were then plotted against cost-effectiveness (a comparison of the relative costs and outcomes (effects) of two or more courses of action).

1 Thrust Areas

Among the adaptation opportunities, improvements in water and irrigation management (reduced water demand by increasing soil moisture, water retention and reducing run-off through water harvesting); Improvements in water use efficiency in irrigation (through participatory irrigation management), as a cluster, offered immediate opportunities, leveraging co-benefits in food, nutrition, equitable development and environmental sustainability. These opportunities can be readily implemented with the existing resources and would yield social benefits such as equity, livelihood security and income. Protected Area management and forest rehabilitation are thrust areas that can yield ecosystem services in Karnataka.

In agriculture, the government needs to aim for convergence of integrated approaches that target improvements in water and soil health. This includes programs that target soil fertility management, efficiency

Fig 4 Prioritization of Climate Resilience Opportunities


improvements in irrigation and fertilizer application, and post-harvest value addition.

2 Strategic Areas

Solar Photo Voltaic (SPV) powered micro irrigation offers a significant strategic green growth opportunity with co-benefits over BAU including savings in fuel subsidies, cost of cultivation, water consumption and social inclusion. Declining returns on large irrigation projects and the need to increase water use efficiency and farm productivity has attributed pivotal importance to micro irrigation in the agricultural sector. Quality and assured power could incentivize offloading the grid connected farmers. The loss due to power outage in the agriculture sector is estimated at 2-3.6% of Gross State Domestic Product (GSDP).

The technology can also result in potential fuel savings to the tune of 3.54 billion liters over the life span of SPV pumps, if 100% diesel pumps are replaced by SPV pumps in the state. These savings could roughly translate to a potential foreign exchange savings of INR 6.7 billion (USD 113 million) per year on diesel imports.

However the initial capital investment required for SPV based micro irrigation systems is sizeable (approximately 5-6 times the cost of an electric pump of similar power). The National Solar Mission and Rashtriya Krishi Vikas Yojana (RKVY) offer an opportunity to develop and integrate centrally sponsored subsidy schemes for the promotion of SPV micro irrigation systems. (Refer to case studies booklet).

3 Low Hanging Fruits

Large number of opportunities that are easy to implement, cost effective and offer significant co-benefits arise from increasing efficiencies of soil, water and fertilizer consumption. These include promotion of integrated strategies in soil, water and fertilizer management. The Government of Karnataka has installed Telemetric Rain Gauges (TRGs) which could act as a backbone for promotion of integrated services: agro-met advisories, local extension services embedding crop insurance packages.

Cost benefit analyses indicate economic gains from these opportunities to be the highest for drip irrigation. Rehabilitation of tank-based minor irrigation will address concern on equity and sustainability.

4 Emerging Areas

Emerging areas could be part of a larger set of actions that help realize the co-benefits from adaptation. Installation and monitoring of bore well meters, subsidy support for soil drainage enhancement in problem soils/areas are examples. There are also opportunities where tangible benefits are ambiguous in the implementation time

frame. Recommendations to reform administrative and institutional systems and planning processes; e.g. establishing long-term forest monitoring programs; coordination of planning activities, designing climate proofed irrigation infrastructure are examples. These opportunities score low due to perceived barriers in realizing co-benefits and low implementability.

MICRO IRRIGATION CASE STUDY

Karnataka ranks third in the area under drip irrigation in India. The Hon'ble Chief Minister has placed a significant emphasis on micro irrigation for all groups of farmers in the 2014 state budget. There is a clear opportunity to integrate fertigation (fertilizer application through drip irrigation) with this positive initiative and realize much larger benefits and savings in fertilizer consumption and abatement of pollution.

Fertilizer use efficiency of 60-80%, and water use efficiency of 90-95% is possible through drip irrigation systems. It is estimated that for every acre-inch of water saved, the farmer is willing to invest INR 933 on drip irrigation. The benefits and co-benefits of SPV based micro irrigation systems were assessed to optimize water, energy and nutrient use efficiencies in agriculture.

Prohibitive capital costs of SPV micro-irrigation systems, lack of awareness on fertigation methods, and the absence of a single window system for availing subsidies and technical support are the main perceived barriers. Promotion of subsidy support to increase adoption (3-5 years) could reduce the payback period from 3.75 years to 2 years for SPV powered micro irrigation.

Public Private Partnerships involving a co-financing model could be explored. Current subsidy support policy for drip irrigation also needs to be aligned with the SPV subsidy policies to ensure inclusiveness. A clear road map for implementation and delivery of SPV based drip irrigation model needs to be prepared. (Refer to the case studies booklet).

6.3 Financing of Green Growth: Funding Landscape

A robust financing ecosystem is critical for sustained pursuit of these green growth opportunities. The three key drivers for green growth deployment are policies with state government budgetary support, central government aided development programs and cross border climate finance. These drivers create an enabling environment for private sector participation in green growth opportunities.

Global climate finance for 2013 has been pegged at USD 354 billion (CPI, 2013)⁴. This is significant but insufficient

for rapid low carbon transition globally. Moreover this figure shows only marginal growth from 2012, which is a worrisome trend. Private sector and market based mechanisms have emerged as the largest source of climate finance with contribution of about 60%. A stable policy with key interventions by governments is a key enabler to scale up the private sector engagement. It is important to note that over 70% of these funds have been deployed for development of renewable energy generation, primarily from solar and wind.

The Clean Development Mechanism (CDM) under the United Nations Framework Convention for Climate

Change (UNFCCC) has been a key enabler in the last decade to finance green growth technologies and solutions especially in developing countries. However with an uncertain future, CER (Certified Emission Reduction) certificate prices have collapsed from a high of Euro 24 to Euro 0.36 per ton of Carbon. The collapse of CER prices has made CDM ineffective in financing green technologies. Under the new treaty, Green Climate Fund (GCF) is a United Nations Fund to help developing nations fight global warming. The funds are expected to be committed by 2015 UNFCCC's 21st session of the Conference of Parties to be held in Paris. The target for this fund is to raise USD 100 billion by 2020.

There are many global funds which have a mandate to work in India out of which some are active in the country. None of the 25 funds which have been researched for this report are currently active in Karnataka, but are active in India. This report identifies funds which may be targeted by the government to invest in climate resilient green growth in Karnataka.

Mitigation and adaptation are two broad areas of intervention considered in this report. Mitigation accounts for over 94% of the global climate finance and almost all of the private sector contribution in climate finance. This is expected, given the scale of the market opportunity and ease of replicability in terms of contracting and regulations. Whereas in the case of adaptation, the opportunities are fragmented and interventions need to be customized. It also highlights the crucial role of local governments to be self-reliant in improving the adaptive capacity of their constituency.

On mitigation, Karnataka has an opportunity to build on its success of adoption of renewable energy generation in the state. As an example, Wind energy generation can be increased substantially by focused development of wind farms in districts of Chikkaballapur, Chamrajnagar, and Chitradurga. ADB Clean Energy Financing Partnership Facility (CEFPF) of USD 250 million can be targeted for development of wind farm infrastructure with appropriate grid connectivity and inviting private developers to install more capacity. The other significant opportunities are rooftop solar, waste heat recovery and adoption of electric vehicles in the state.

Karnataka spent about INR 4,577 crores (IISc, 2014)⁵ in 2012-13 under the government of India development programs.



These programs also help improve the adaptive capacity in the state. The study reviewed thirteen programs and found that three of these could be leveraged for climate resilient development in the state. National Food Security Mission (NFSM) with an outlay of INR 15-20 crores per year, Accelerated Irrigation Benefits Program (AIBP) with an outlay of about INR 650-700 crores year and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) with an outlay of about INR 1,307 crores per year are three programs that may be explored for proposed recommendations in this report on climate resilience. These programs have been identified given their mandate, availability of unutilized funds during a year and enabling



Picture by: Ramesh, www.flickr.com/photos/rameshng/13938784383/

infrastructure for deployment of these funds in the state. Adaptation for Smallholder Agriculture Program (ASAP) by International Fund for Agricultural Development (IFAD) with a pool of USD 240 million is a promising fund for livelihood diversification which should be pursued by Karnataka. This fund is already active in India and is working with states of Jharkhand and Orissa.

Footnote 3 'Wind Power in Karnataka and Andhra Pradesh: Potential Assessment, Costs, and Grid Implications' (CSTEP, 2013)
 4 'The Global Landscape of Climate Finance 2013' (Climate Policy Initiative, 2013)
 5 'Transitioning towards Climate Resilient Development in Karnataka' (IISc, 2014)

7 | The Way Forward



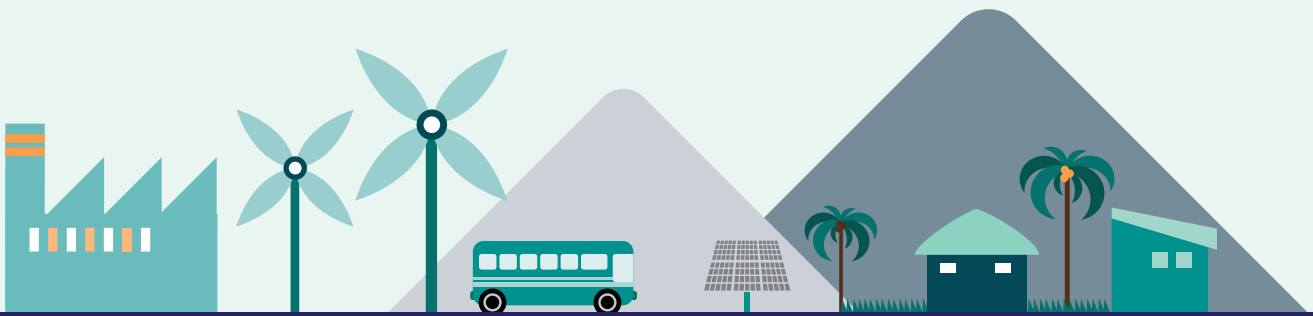
Pilot Projects



Data &
Monitoring



Green Growth
Task Force



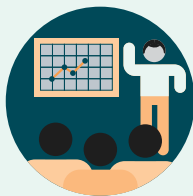
After evaluating Karnataka's long-term sustainability challenges, this report presents a green growth strategy for the state by identifying, assessing, and prioritizing relevant and feasible opportunities. Implementation of this strategy, however, still requires concerted policy action and creation of action plans for specific interventions.

The following interventions are recommended to foster green growth in the state:

- **Leveraging Green Investments** – Mobilizing finance is fundamental to the success of the strategy. In this context, in addition to the government spending, the role of the private sector (both domestic and international) and development institutions is critical. The state government already has several progressive policies and with some additional measures in identified sectors and opportunities, the investment flows could be even faster. An important step is to convert the identified opportunities as well as other specific policy measures of the government into



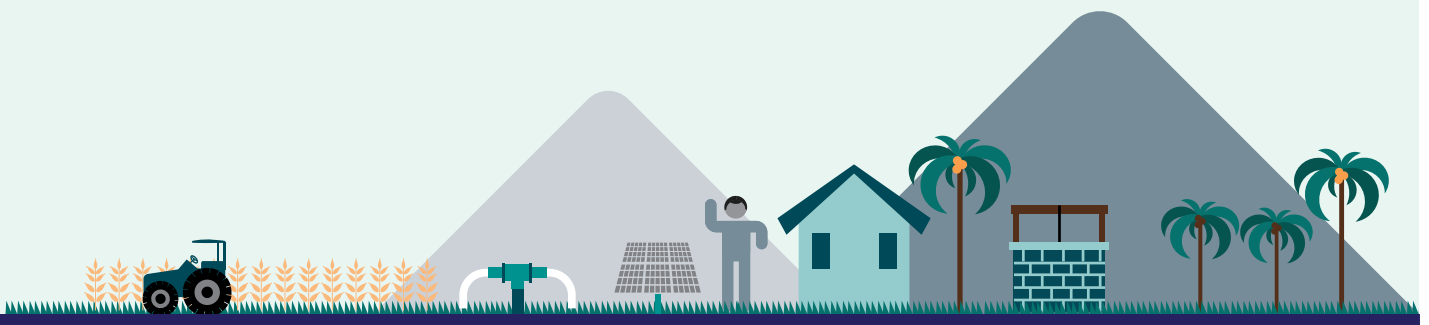
Green Investments



Capacity Building



Implementation Plans & Policy Design



investment grade (bankable) projects. This would substantially reduce the risk perception of the financial institutions and expedite investment.

- ▶ **Commissioning Pilots in Opportunity Areas** – Undertaking pilot projects in the key opportunity areas will be an important step to evaluate the strategies before they are scaled up for implementation at the state level. Feedback from the pilots will provide new learnings that will be instrumental in calibrating the implementation plans for scaling up these opportunities.
- ▶ **Setting up a Green Growth Task Force** – An inter-departmental Green Growth Task Force is envisioned to be the working committee that will assess the outcomes of pilots, providing inputs to development of green growth plans and overseeing their implementation. The Task Force will ensure that the state delivers on green growth goals that are aligned with its vision. The Task Force, with strategic advice from the concerned departments and technical experts, will also be involved in monitoring of state's green growth planning and implementation.

- ▶ **Capacity Building** – Enhancing technical, institutional and coordination capacity at various levels of the government is very crucial for the design and implementation of green growth plans. In addition, academic and research institutions, non-profit organizations and the private sector in the state will also have a direct role to support the implementation of state’s green growth plans and hence their capacities will have to be augmented as well.
- ▶ **Plugging Data and Policy Gaps** – Planning green growth strategies will require further research and analysis in the sectors shortlisted to arrive at concrete targets prior to designing implementable strategies. This may involve collecting and synthesizing existing and new data to facilitate preparation of the strategies as well as accurate monitoring of their impacts. Moreover as advised by several senior officials, it is important to identify gaps in exiting policies and suggest new policy measures to enable implementation.



Picture by: Pankaj Kaushal, www.flickr.com/photos/pankaj/557262557

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