Challenges and Policy Implications for Low Carbon Pathway for Kerala:
An Integrated Assessment Modelling Approach

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Executive Summary

Among the Indian states, the state of Kerala has a very low carbon footprint. The per capita emission for Kerala is only 0.09 ton CO_2e in comparison to the national average of 2.24 ton CO_2e. A principal reason for low emission in Kerala vis-à-vis India is the low share of emission from power sector in the state. This stems partly from the fact that while Kerala's own power generation comes primarily from hydel, and, the state is heavily dependent on the import of power from other states. Nearly 56 per cent of Kerala's total power comes from the rest of India, which is mostly coal-based power. Surely, when all the states adopt a low carbon pathway, the availability of cheap power from the neighbouring states may not be a reality. There is no guarantee that the supply will be available as all the states will face hardship during energy transition. So, the state needs to harness its potential of non-fossil fuels for power generation and also needs to explore the renewable energy sources like waste to energy, off shore wind farm, floating solar firms on water bodies.

Adopting low carbon pathway implies not only augmenting capacity of non-fossil-based power use, but also increasing energy efficiency in all the sectors of the economy, as increased gain in energy efficiency leads to energy saving and thereby lower carbon footprint.

Understanding feasible policy choices and financial implications are a must for adopting the right policy interventions for transition towards a low carbon pathway.

This study is a small endeavour in this direction. However, in one respect this study differs from other similar studies, which is our belief that price plays a crucial role in determining choices of the feasible technologies, depending on the supply/demand situation. Only by understanding the combined forces of behavioural realities, markets and prices, and technological innovation and infrastructure together, coherent responses can be built for transition energy systems. Furthermore, as Kerala is a small state of India, its economy is impacted by the happenings in the rest of India or world. So, the economic framework needs to take this into account.

In this context, we have resorted to an integrated assessment modelling (IAM) tool to analyse the issues. Integrated assessment framework typically links a macro model with a bottom-up energy model so that the sectoral outputs and prices are not exogenous to the system in a typical bottom–up energy model, but are endogenously determined within the system. Most developed countries adopt this type of modelling tool for analysing energy transition issues. However, in the Indian context, this tool, to the best of our knowledge, has not been adopted, at a subnational level. Furthermore, we also have considered into account the move towards energy transition in the rest of India while analysing Kerala's policy dilemmas as we believe that Kerala's economy cannot be studied in isolation.

Our business as usual (BAU) scenario assumes that Kerala's economy will hover around 6 per cent per annum growth over the model run period namely, 2022–2050. Per capita emission will rise from 0.7 tons CO_2e in 2025 to 3.73 tons CO_2e in 2050. Imported electricity will still play an important role in BAU, even though the share of renewable domestic electricity will rise. According to our estimates, US$ 236 billion investment will be required in the energy sector during the period 2025–2050.

Our policy run indicates that command and control approach, such as restriction on import/production of fossil-based electricity, without any policy intervention specific to renewable energy capacity enhancement, will not lead to augmentation of the capacity of renewable electricity within Kerala. This kind of drastic step might only lead to the loss of Kerala's State Domestic Product (SDP) as all sectors might face contraction due to reduced supply of electricity and higher price of electricity.

A market-based approach with tax/subsidies performs better in limiting the SDP loss during the transition. The results improve significantly in terms of restricting emission without hampering economic growth, if the assumption on increased energy efficiency along with productivity growth is incorporated into the model for energy transition. Higher energy efficiency, further leads to energy saving leading to lower emission and lower energy requirement. An energy efficiency to the tune of 2.5 per cent concomitant with productivity growth of 1 per cent annum lead to positive growth, on an average, in most of the sectors. This also leads to the lower increase in per capita emission. With these policy interventions, per capita emission will rise only to 2.18 ton CO_2e in 2050 versus 3.73 ton CO_2e in 2050 in the base run. Of course, this will also lead to lower investment need.

Our results show that direct employment from operation and maintenance of power plants would be significantly more than the baseline employment projection from 2040 onwards, and the policy scenario 3 (aggressive use of renewable energy, increased energy efficiency, and productivity growth) is expected to provide 0.8 million more direct employment in the energy sector in Kerala as compared to the baseline scenario. Total employment from operation and maintenance of power plants, which captures the direct, indirect and induced employment generated from all sectors as a result of inter-industry linkage among different sectors, is also likely to surpass baseline scenario from the year 2040 onwards and it is expected to provide 1.1 million more employment by 2050 as compared to baseline scenario. Investment in renewable energy not only increases employment generated from operation and maintenance, but also from manufacturing and installation of new power plants. Policy scenario 3 is expected to generate an additional 75 thousand employment in Kerala in 2050, as compared to the baseline scenario.