Using System Dynamics to Better Understand the Dynamics of Reliable Availability, Affordability, and Cleaner Electricity

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Extended Abstract

The Issue: Energy embodies a necessary and sufficient condition for almost all aspects of modern societies. There is an increasing urgency and drive by the UN, through Sustainable Development Goals (SDGs) (e.g., SDG No. 7: clean and affordable energy for all people), for cleaner energy for all. Policymakers, therefore, are introducing new regulations and designing attractive incentives to have a fair amount of cleaner energy in their overall energy supply mix. Consequently, with the adoption of the Paris Agreement (PA) in 2015, countries have committed, voluntarily, to the reduction of CO_2 emissions. The Pak-INDC presents principles and actions that are underway for reducing GHG emissions. It also describes mitigation and adaptation measures already being implemented in Pakistan together with their efficacy. On the other hand, several coal-fired power plants are being executed under China-Pakistan Economic Corridor (CPEC). Pakistan still is heavily using thermal/fossils (e.g., 67% of the electricity supply was based on thermal generation (i.e., coal, oil, and gas) in 2019) for electricity generation. On the other, the country is renewable resource-rich and has a successful nuclear power experience with an abundance of available indigenous nuclear power fuel and fuel-manufacturing capability. Therefore, we want to address the question: Will the existing policies help achieve the target CO_2 reductions? If the answer is not affirmative then the next logical question worth exploring is, what would be the best (i.e., cleaner and affordable) energy supply mix to achieve the desired CO_2 emission reduction for the country?

Methodology: The availability of data for a modeling-based analysis and the availability of an existing dynamic model (i.e., MDESRAP) entices us to consider Pakistan's case. A modeling-based analysis, where underlying assumptions and mechanisms in the Pak-INDC are explicitly accounted for, will allow us to verify the role of current mechanisms and policies in reducing emissions in the frame of the PA. Figure 1 presents our theoretical framework for policy

assessment and design that is being used in this book. This design consideration in a policy design requires the policymaker to apply a systematic and holistic decision-making approach where the achievement of a reliable, affordable, and cleaner electricity supply is the goal of their energy policy.

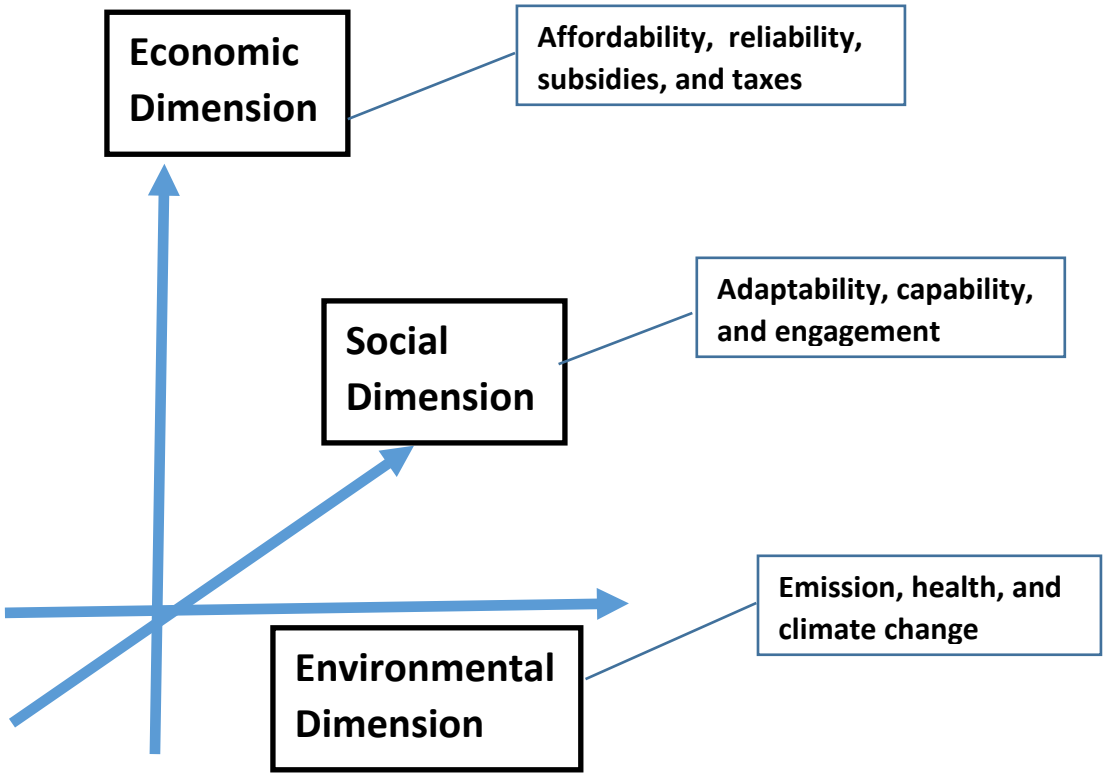

Figure 5: Multidimensional Framework for Policy Assessment and Design

Key findings: Contrary to the expectation of Govt. of Pakistan, their voluntarily made commitment to the reduction of CO_2 emissions is not going to be achieved by the current Energy Policy of Pakistan. On the other hand, the current energy policies and mechanisms (i.e. BAU and CPEC-based projects), appear to deviate from the power-related CO_2 emissions by the addition of 347.3 $MtCO_2$ to the target of 64.3 $MtCO_2$ in the year 2030. Based on our comparative analysis of the three options: (i) staying the course (i.e., no substantial adjustment or change in the existing energy policy invectives), (ii) indigenous clean and renewable resource-focussed alternate, and (iii) nuclear power dominant scenario, it appears that Pakistan is better off (i.e., in terms of reliable availability, affordability, and cleaner supply of electricity), with adding more nuclear power plants to their electricity generation capacity.