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Economic and environmental effectiveness of renewable energy policy instruments: Best practices from India

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ABSTRACT

Renewable Energy (RE) has been identified as a key tool to counter climate change and enhance energy security. Countries across the globe have been promoting this sector by several policy measures. However, limited research has been undertaken on the economic and environmental efficacy of RE policy instruments, especially in context of emerging economies like India, which have witnessed substantial capacity addition and have set ambitious targets to de-carbonize their economy. This paper identifies 25 innovative practices followed in India which have enabled accelerated RE capacity addition with minimal financial obligations. These include energy entrepreneurship, energy democratization, private sector participation, hedging and apportioning RE procurement, use of auctions with stringent participatory norms, creditworthy counter-party, leverage of risk capital by developmental institutions, regular revision of tariffs, environmental cess on polluting industries, long-term RE purchase trajectory and incentivizing green power output. Results indicate high financial impact of instruments (support of US$ 3–5/MW h over applicable tariff) which gets neutralized when tax inflow is considered. Lower carbon abatement cost (US$ 3–6/tCO2eq) depicts high environmental efficacy. The paper shares best practices from India in terms of efficient use of RE policy enablers, which may be contextualized in other emerging economies as per the local requirements.

Contents

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1. Introduction

With energy production and usage accounting for two third of the world's greenhouse-gas emissions GHG [1], there has been global efforts towards shifting the existing fossil fuel based energy systems to low-carbon technologies, including renewable energy technologies (RET) like solar, wind, hydro and biomass. International Energy Agency (IEA) has estimated that towards limiting the temperature rise to two degree centigrade (450 ppm, or, ppm scenario by 2050) [2], the total installed capacity of renewable energy sources for electricity production needs to be augmented to 3770 GW by 2035. This shall require annual investments of over US $550 billion in climate change mitigation and adaptation technologies [3].

During the year 2014, the global installed renewable energy capacity crossed 650 GW [4], associated with investment of US $270 billion, primarily from wind (cumulative capacity of 370 GW) and solar photovoltaic systems (cumulative capacity of 177 GW). Renewables accounted for nearly half of all new power generation capacity in the year 2014 [1]. The top five countries in terms of deployment of renewable energy capacity are China, United States, Germany, Spain and India, with the emerging economies accounting for more than half the capacity addition during this period [4].

The reasons for adopting renewable energy may vary in case of developed and developing economies. Developed nations are promoting clean energy technologies due to their heightened sensitivity towards the environment and being mandated under the various international climate conventions like the United Nations Framework on Climate Change, or, UNFCCC [6]. On the other hand, the reasons for developing economies to advocate renewable energy technologies include enhancement of their energy security (reduction in energy imports), besides bridging the energy deficit and enabling energy access to the masses through decentralized systems in form of lifeline energy services like cleaner forms of basic lighting devices (solar lanterns) and cooking systems (biogas plants).

India has its own sets of reasons for pursuing a low-carbon growth trajectory. This includes large share of fossils in its energy supply chain (over 80% share of coal based power in the grid) [7], leading to high levels of greenhouse gas (GHG) emissions, making it the fourth largest emitter globally [8]. It is also promoting renewable energy in decentralized formats to enable energy access to the un-electrified/under-electrified rural masses.

It has envisioned 15% of electricity contribution from renewable energy sources by 2020 as against the present share of 6% [15], advocated under the National Acton Plan on Climate Change (NAPCC). The electricity requirement is projected to increase to 1900 Billion units (BU) by the year 2022 [16] from the present levels of about 1100 BU [17]. Hence, over 300 BU of green power would be required as against the present levels of 60 BU [18] (fivefold increase). This shall necessitate significant scaling up of RE capacity in similar terms.

Renewable Energy projects are associated with high upfront (capital) cost and lower levels of energy generation (due to limited availability of natural resources like solar radiation and wind velocity), leading to higher cost of energy generation. Besides, they lack the ability to reach economies of scale (due to limited availability of contiguous land area in resource rich regions); most wind and solar projects are limited to not more than few hundred megawatts of capacity.

As such, to make renewable power competitive with conventional power sources and enhance their techno-commercial viability, countries across the globe have been supporting the sector by way of several regulatory enablers and market-based instruments [9]. The three main support mechanisms employed by governments to finance renewable energy development programs are feed-in-tariffs (FIT), tax incentives, and tradable green certificates, or TGC [10].

It has been found that the impact of institutional investments can be scaled up by use of these policy instruments. FIT is more effective in case of upcoming energy technologies, whereas, TGC is an appropriate market policy used for mature technologies, whose projects are self-sustainable without any grant/ subsidy [11]. Other mechanisms include RE legislations, renewable purchase obligations, subsidy and grants, low cost preferential funding, carbon taxes and cap and trade programs.

Within these set of measures, it has been opined that the financial instruments have the maximum impact as they directly reduce the cost of installing RE projects which enhances the financial viability, or, reduce the cost of energy generation, or provide part of both these benefits. Research suggests that support through capital allowances is more efficient than energy market in promoting renewable energy [12].

However, in the case of developing economies, there are constraints in terms of availability of monetary resources at competitive terms due to competing demands from other sectors like education, healthcare, agriculture and infrastructure. As such, it is of paramount importance that utilization of scare resources is done in the most prudential manner.

Interestingly, the growth of renewable energy sector in India (especially grid-connected wind and solar photovoltaic technologies) can be attributed to a more pronounced role of non-financial instruments (over financial dependency). These non-financial instruments includes wheeling and banking of power with grid, solar capacity auctions and bundling (with coal), citizens participation through green bonds and captive projects, renewable purchase obligations and tradable green certificates. Some other measures include encouraging local manufacturing and provision of low cost funds. Further, the country is endowed with good level of natural resources (like solar radiation and wind regime) and has a large skilled work force, making projects viable at affordable tariff levels; solar and wind tariffs are in the range of US $80–90 per MW h [19,20]. IRENA, in one of its report, has mentioned that the levelized cost of electricity generated from renewable technologies in China and India typically falls in a lower range when compared with other countries [103].

As a result of these innovative and enabling policies, India today is the only developing country among the top five nations in terms of total installed RE capacity (43 GW as on March 2016 [14]);