



The effectiveness of federal renewable policies in India[☆]

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ARTICLE INFO

Keywords:

Renewable energy
Finance
Policy
India

ABSTRACT

The Government of India has set ambitious targets for renewable energy. However, unsubsidized renewable energy is still at least 50% more expensive than fossil fuel power, and requires policy support at federal as well as state levels. In this context, a comparative evaluation of the effectiveness of these policies becomes important. Using financial models, we provide a framework to compare existing federal policies – generation based incentive, viability gap funding, and accelerated depreciation – for wind and solar technologies with a new class of debt-related federal policies. Our main finding is that, debt-related policies offer the most potential for cost-effectiveness in the long-term; they also perform well across other criteria. A particularly attractive policy is reduced-cost, extended-tenor debt which, compared to existing policies, would reduce total subsidies by up to 78%, have 100% viability gap coverage potential, and provide 76% of subsidy recovery.

1. Introduction

1.1. Motivation

As India focuses on reducing its dependence on conventional energy and mitigating climate change, the role of renewable energy becomes prominent. The Government of India aims to incentivize the use of renewable energy, create a competitive domestic production base for renewables, and increase the existing renewable energy capacity to 55,000 MW by 2017 [22].

However, renewable energy is more expensive than conventional power in India. Unsubsidized renewable energy is at least 50% more expensive than the average pooled (wholesale) purchase cost of electricity.² Therefore, it still requires policy support, which is usually provided through a combination of federal and state policies.

The federal government provides policy support through the Ministry of New and Renewable Energy (MNRE). The federal policies currently offered are as follows: (a) a generation based incentive of INR 0.5/kWh (USD 8.33/MWh) for wind projects,³ (b) viability gap funding up to 30% of project capital/installation cost for solar projects, and (c) accelerated depreciation of 80% for solar projects [25].

These federal policies cover only part of the viability gap –the

difference between the per unit cost of unsubsidized renewable energy and the average pooled purchase price of INR 3.5/kWh (USD 58.33/MWh). The rest is supported by state governments by entering power purchase agreements with renewable projects, and agreeing to pay feed-in tariffs for 20–25 years.

This raises the key question: *Are these federal policy mechanisms cost-effective* ([12,13]) That is, are these policies the best use of finite public resources? Answering this question not only requires a comparison of these policies, but also an exploration of alternatives. Furthermore, this requires comparing policies against multiple criteria that influence the policymakers' decisions; these include: viability gap coverage potential, subsidy recovery potential, generation effectiveness, etc. (see Section 1.2).

This comparison requires not only comparing the existing policies but also exploring a new class of debt-related policies. In our previous work [32]; we examined the impact of policy on the cost of renewable energy projects. We found that the unfavorable terms of debt are the most pressing problems currently faced by Indian renewable energy developers. Compared to similar projects in the US, three factors – high interest rates, short tenor and variable rate of interest – raise the cost of renewable energy by 24–32% [32]. This provides a rationale for considering policies that could make low-cost, long-term debt avail-

[☆] A preliminary version of this paper, by the same authors, appeared as a working paper, available at <http://climatepolicyinitiative.org/wp-content/uploads/2014/03/Which-Federal-Policies-can-be-Most-Effective-Full-Study.pdf>.

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² Average pooled purchase cost is the weighted average pooled price at which the power distribution companies purchased electricity in the previous year from all energy suppliers, except renewable energy sources.

³ For conversion purposes, we use 60 INR=1 USD, to reflect the approximate conversation foreign exchange rate during 2014–15. In the text, we have provided both INR and USD numbers; however, the figures/tables are primarily in INR. Finally, the choice of INR/KWh and USD/MWh was mostly for cosmetic purposes.

able.

1.2. Our work

In this paper, we examine *federally administered debt-related policies* that directly address the issues of high cost and short tenor of debt and compare them against *existing federal policies*. Based on our conversations with Indian policymakers, we compare and contrast the impact of these policy mechanisms across four key criteria.⁴

- 1. What is the cheapest way to subsidize renewable energy [12,13]?** The total cost of a policy to the government helps determine its *cost-effectiveness*. Given the limited resources for providing policy support, cost-effectiveness is a critical criterion for assessing different policies. We measure this by the net present value (NPV) of the total subsidy, which is the sum of state, federal and tax subsidies. This question is answered in [Sections 2.3.2.2 and 3.2](#).
- 2. Is it possible for the federal government to support renewable energy in the absence of state-level support?** *Viability gap coverage potential* assesses the extent to which, without depending on state-level support, a federal policy can bridge the difference between the unsubsidized cost of renewable energy and the average pooled purchase price. High viability gap coverage potential reduces the federal government's dependence on state governments to meet renewable targets, and would make it easier to gather state support for renewable goals. This question is answered in [Sections 2.3.2.1 and 3.1](#).
- 3. How much of the budgetary allocation could the government recover over time?** The *subsidy-recovery potential* is the percentage of the federal subsidy cost that could be recovered by the government over the lifetime of a renewable project. This enables the government to assess the extent to which funds deployed under a particular federal policy could be reused for other government priorities. This question is answered in [Sections 2.3.2.3 and 3.3](#).
- 4. How do we ensure that a policy mechanism incentivizes production of power, and not just capacity installation ([12,13])** This criterion examines whether the policy incentivizes the production of power or installation of capacity –also known as *generation effectiveness*.⁵ The focus typically is to identify a policy that best supports the government's objective of reaching 15% of electricity generation through renewable energy by 2020 [27]. This question is answered in [Sections 2.3.2.4 and 3.4](#).

We use detailed project-level cash flow models to investigate the impact of these policies on the economics of the two dominant renewable energy technologies in India – onshore wind and solar photovoltaic (PV), referred to as wind and solar henceforth.⁶ The methodology, including the use of cash-flow models, is described in detail in [Section 2.3](#) as well as [Appendix B](#).

1.3. Prior work

We note that despite similar work in other contexts ([18,2,19,3]; USPREF[36]); there is no prior literature that compares this set of

policies and criteria, and in the Indian context. In the next paragraph, we start with a general discussion of literature on the effectiveness of renewable policies. In the remainder of this sub-section, we examine only studies that are closest to our analysis, given that they focus on project-level financial modeling of renewable projects, and examine various policy pathways. For a broader review of literature that examines the impact of policy on financing of renewable energy, including how policies influence investor behavior, we recommend that the reader refer to Shrimali et al. [32].

Lipp [17] studied renewable energy policies in Denmark, Germany and the United Kingdom to identify the key success factors for renewable energy. They found that policy design and commitment are the key factors for success, and that the design features of feed-in tariffs allow it to address the needs of the renewable energy sector. Toke [35] also asserted that the German feed-in tariff is more cost-effective compared to the British Renewables Obligation; however, Frondel et al. [11] argued that feed-in tariffs failed to harness the requisite market incentives for viable and cost-effective introduction of renewable energy into Germany's energy mix. Neuhoff et al. [28] argued that simple schemes and clear compliance mechanisms have a positive outcome in terms of increasing impact. Uncertainty regarding the continuation of incentive schemes creates risks for the developer, particularly when investment costs are higher.

Wiser [39] and Wiser and Pickle [40] were among the first to examine the impact of policy on renewable financing. They showed that the costs of these projects are sensitive to financing terms that effective policies must take into account. Varadarajan et al. [37] examined the cost of renewable energy projects in developed countries. They showed that policy support provided 36–81% of the cost of these projects. They also examined the impact of policy pathways and found that the duration of revenue support had the largest impact (11–15%) followed by revenue certainty (4–11%). In a similar study, [18,19] examined the impact of U.S. federal policies – the investment tax credit, the production tax credit, and accelerated depreciation – on e costs for utility-scale solar projects. They demonstrated that: (a) loan guarantee programs can reduce cost by approximately 20%; (b) the termination of the 1603 Treasury grant program would increase the cost of tax equity capital by 2–4% points, raising the LCOE from utility-scale solar projects by 3–20%; and delaying the IRR target year by one can improve the LCOE by 7–27%.

In continuation to [18,19], Mendelsohn and Feldman [20] examined the impact of financing renewable energy projects via capital market instruments, such as asset-backed securities, master limited partnerships, and real estate investment trusts. They showed that the use of these instruments can reduce the cost of renewable energy by 8–16% or even more. In a follow up study to Varadarajan et al. [37], Varadarajan et al. [38] studied federal incentives for renewable energy in USA and found that tax incentives leak money, while taxable cash incentives enable the government to save money. A similar result had also been discovered by Palmer and Burtraw [29] who found that renewable energy production tax credit is the least cost-effective at supporting renewable energy since it lowers electricity prices at the expense of tax payers.

Varadarajan et al. [38] also demonstrated that a cash grant half the size of the current investment tax credit would be equivalent, a finding that has also been reported in BPC [3] as well as in Bolinger [2]. In a similar study, USPREF [36] examined the impact of the investment tax credit on tax-returns. They found that these projects can deliver a 10% rate of return for the government for residential and commercial solar projects. Bolinger [2], taking the perspective of project sponsors, examined the relative performance of U.S. tax related policies, such as accelerated depreciation, investment tax credit and production tax credit from. He found that monetization makes sense for all but the most tax-efficient sponsors.

However, these studies are based on developed economies, such as the U.S. and the EU. Shrimali et al. [32], in contrast, focus on financing

⁴ These discussions were primarily with the Ministry of New and Renewable Energy (MNRE) and the Ministry of Finance. We note that another criterion could be maximizing deployment given yearly budget constraints. However, under this criterion, it is hard to compare policies given variability of subsidy cash-flows over time.

⁵ Poor enforceability of contracts in India may cause developers to create renewable energy capacity to avail of a subsidy and sell the project assets. For example, early critics of accelerated depreciation argued that the design of the policy incentivized businesses to create capacity to avail of the tax benefit and sell the project without generating power.

⁶ The cash flow model (or statement), which is commonly used in finance, in addition to income statement and balance sheet, is essentially a view on a project (or company) finances. The cash flow model is used to assess where a project (or company) is economically viable. These models are typically built in Microsoft Excel.

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