FISCAL INCENTIVES AND SOLAR POWER GENERATION IN INDIA: WITH SPECIAL REFERENCE TO ROOFTOP PHOTOVOLTAIC AND SMALL SOLAR POWER GENERATION PROGRAMME (RPSSGP) SCHEME

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Abstract

In a fossil fuel dominated world, with a vision of net-zero emissions by 2070, India has adopted a "remove, target, and shift" approach by moving away from its heavy reliance on fossil fuel, to foster clean energy alternatives. By systematically reducing fossil fuel subsidies, the country has unlocked opportunities for investment in solar energy and upgradation of energy grid providing tax incentives and fiscal assistance. In this reformative approach Government of India has taken several initiatives for reducing the uses of fossil fuel and encouraging dependence on green energy including solar. The Solar Rooftop Scheme is an innovative program designed to encourage the extensive use of solar energy by utilizing rooftop spaces for electricity generation.

The Government of India has offered direct assistance in form of generation based incentives (GBI) and indirect assistance by providing 80% depreciation allowance clubbed with 20% accelerated depreciation allowance resulting to 100% tax benefits for capital asset additions for generating solar power. In the union budget 2017 the Government has slashed down the rate

of depreciation to 40% resulting only 60% of asset addition as tax benefit for initial year on the rational that investors or project developers have only focused on catering tax benefits in earlier years but later time they are not focusing on increasing efficiency.

This study aims to throw light on India's solar power potential and to examine the fiscal initiatives to promote solar power generation. The study further attempts to observe whether the accelerated depreciation scheme and its subsequent changes have impacted solar power generation in India in presence of assistance via generation based incentives (GBI. Specifically, it focuses on analyzing solar power generation data for rooftop photovoltaic systems under the Rooftop Photovoltaic and Small Solar Power Generation Programme (RPSSGP) in the periods before and after the reforms in tax incentives through accelerated depreciation scheme.

Keywords: solar power, rooftop photovoltaic, incentives, accelerated depreciation, GBI

I. Introduction

Indian tax laws have always strived to encourage economic and industrial growth through various fiscal incentives in the form of tax exemptions, deductions, rebates, and reliefs for corporate and non-corporate businesses. These incentives are supposed to encourage savings and channel investments into diverse industrial sectors, especially in emerging regions, for socio-economic development. The key objectives of these tax incentives are to encourage savings, stimulate investment in all industries, and foster socio-economic development. They also encourage taxpayers to pay taxes and make tax planning since these incentives reduce their tax burden. Moreover, the measures

aim to attract domestic as well as foreign investors, making the economy strong and putting business strategies on par with international standards. The tax savings provided through these incentives are quite instrumental in stimulating economic activities, expanding businesses, and fostering investment in industrial development. These further contribute to welfare and economic growth, establishing a cycle of development and progress.

Diversification of sources of energy generation has become a requirement for India due to the increasing energy requirements. Non-renewable energy, in addition to renewable energy, has assumed great importance. In 1992, India formed the Ministry for Non-Conventional Energy Sources (MNES) to concentrate on the development of renewable energy. This ministry was reformatted and renamed the Ministry of New and Renewable Energy, MNRE, in the year 2006; its aim is to upgrade new and renewable energy in order to cater to India's energy requirements. This MNRE has undertaken widespread research into the exploitation of renewable sources of energy such as sun, wind, and atomic; however, due to being most readily available across the globe, the sun-wind power became the popular choice. Reddy, Mallick, and Chemisana (2013), in their study have observed solar power generation is the most cost-effective and attractive source of alternative electricity production.

Solar power generation is experiencing rapid growth globally. According to the study of Sayeed et.al.(2021), the introduced limit of wind power and solar power innovation has nearly multiplied, with an extra of 99 GWh of sun-powered PV vitality that became a matrix associated in 2017. There are two primary technologies used worldwide for generating solar power, namely photovoltaic systems and concentrating solar power systems. Photovoltaic

systems (PVs) require solar panels to produce electricity whereas lenses and mirrors are used in concentrating solar power systems (CSPs). Among these, the photovoltaic technology has been widely preferred due to its simplicity and ease of operation. Generally solar panel installations under photovoltaic technology fall into three categories: ground-mounted solar power systems, rooftop solar power systems, and off-grid solar power systems.

Table - 1.1 describes installation of solar panels under photovoltaic system in 2020 in different developed countries throughout the globe. The list of countries as shown in Table - 1.1 is only illustrative, not exhaustive.

Table -1.1
Solar Panel Installation Statistics in Different Countries in 2020

Country	New Installation	Total Installation
Canada	15	3325
UK	177	13563
Australia	1699	17627
India	4122	39211
Germany	4583	53783
Spain	5378	14089
USA	41890	75572
China	49655	254355

Source: *https://en.wikipedia.org/wiki/Solar_power_in_India.(2021)*
https://en.wikipedia.org/wiki/Solar_power_by_country.(2021)

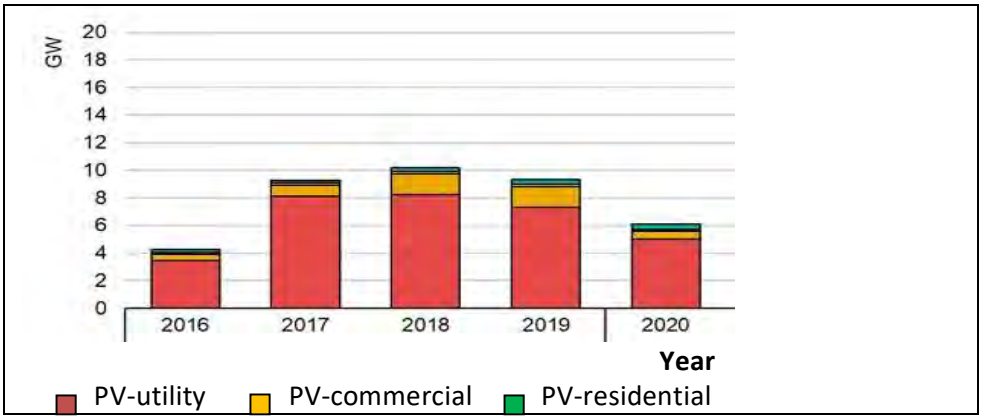
The table 1.1 is self-indicative. It emphasizes India's contribution to global solar power generation using photovoltaic technology. It is very clear from the table India’s contribution to total solar panel installation is quite notable.

In India among all other renewable energy capacity additions in solar project is worth mentioning.

Figure - 1.1 signifies the net capacity additions of different renewable energy for a period 2013 to 2020.

Figure – 1.1

Capacity Additions in Different Renewable Energy Generation in India (2013 to 2020)

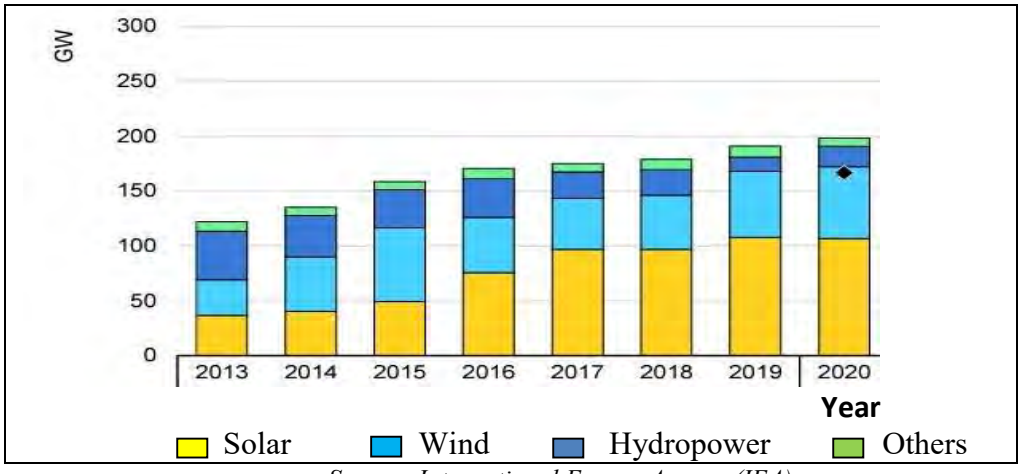


Source: International Energy Agency (IEA)

Figure 1.1 is self-explanatory. It demonstrates a remarkable growth in capacity addition in solar power generation for a period of eight years (2013 to 2020). This increased solar power generation capacity stems from growth in both photovoltaic systems and concentrating solar power systems. As photovoltaic is the most popular technology today due to its simplicity and easy operation, this paper attempts to illustrate the expansion of solar power generation capacity obtained through photovoltaic systems. Figure-1.2 illustrates the capacity of solar power using photovoltaic (PV) technology.

Figure- 1.2

Capacity Additions in PV System of Solar Power Generation in India (2016 to 2020)



Source: International Energy Agency (IEA)

Figure 1.2 highlights an intriguing observation: the growth in capacity addition for solar power generation using PV technology has shown a downward trend since 2018. This capacity addition includes the combined contributions from PV-utility, PV-commercial, and PV-residential sectors.

Several initiatives have been taken by the Government of India, through its Ministry of New and Renewable Energy, MNRE, to promote and hasten the generation of solar power in India. There are two major incentives offered by Government of India to increase the generation of solar power. First, an advantage for quicker depreciation within the first years of the service life of the asset that can generate power and second, through Generation-Based Incentive or GBI, a scheme through which the project is registered in the program. As per MNRE guidelines, GBI rate shall be retained for 25 years' period (MNRE, 2011).

The Government of India Government of India, through its Ministry of New and Renewable Energy, MNRE, has provided several fiscal incentives to encourage the generation and usage of solar energy. There are two major incentives offered by Government of India to increase the generation of solar power. First, an advantage for quicker depreciation within the first years of the service life of the asset that can generate power and second, through Generation-Based Incentive or GBI, a scheme through which the project is registered in the program. As per MNRE guidelines, GBI rate shall be retained for 25 years' period (MNRE, 2011).

Depreciation allowances, combined with accelerated depreciation, have been key incentives for promoting solar power generation and utilization. To further accelerate renewable energy development, the Indian government introduced the Generation-Based Incentive (GBI) scheme in 2009. In 2017, the government revised its policy, reducing both the depreciation rates and the benefits associated with accelerated depreciation for equipment and machinery essential for solar power generation. Muthiyan and Parekh (2016) observed that investors in solar projects would be substantially affected by the proposed depreciation rate cap in the budget for 2016-17. The benefit that they had hitherto enjoyed would be cut in half in the first year and spread over subsequent years. They explained this by using hypothetical examples in their analysis. According to Goel (2016), strong foundations for solar energy generation are being built in India through revising package of incentives.

II. Objectives of the Study

Considering the changing policy landscape in India and insights from existing literature, the objectives of the current study are as follows:

i) To study the status of solar power generation using photovoltaic technology in India.
ii) To examine the modifications in fiscal policies, such as tax benefits and the Generation-Based Incentive (GBI) scheme, implemented by the Government of India from time to time.
iii) To assess the influence of changes in fiscal policies, including changes in tax incentives and the implementation of Generation-Based Incentive (GBI) scheme, on advancing solar power generation across the country.

III. Research Methodology

The study is mainly based on secondary data. Data for the descriptive analysis, addressing the first two objectives, have been sourced from the International Energy Agency (IEA) and the Indian Renewable Energy Development Agency Limited (IREDA). For the third objective, data on power generation from projects under the Rooftop Photovoltaic and Small Solar Power Generation Scheme (RPSSGP) have been obtained from IREDA. States with high and moderate levels of support through GBI assistance for solar energy generation have been selected, on the assumption that higher GBI support promotes higher solar power generation.

Data on solar energy generation and Generation-Based Incentive (GBI) rates for various project developers have been collected annually from different states using IREDA resources. States offering higher GBI assistance were chosen. The GBI has been calculated by multiplying the applicable rate with the generation data sourced from IREDA. In addition, the rates for accelerated depreciation available to these project developers have been obtained from budget documents across different years.

During the present study, data has been collected for a period eight years from 2013-14 to 2020-21. The year 2013-14 was selected as the initial year for the present study. As major reform in tax incentives provided by the Government of India aiming towards solar power generation was done in 2017, the study designates 2017 as the midpoint. Therefore, the research duration is split into two parts: the pre-restructuring period, from 2013-14 to 2016-17, and the post-restructuring period, from 2017-18 to 2020-21, depending on the major restructuring of tax incentives related to accelerated depreciation allowance on equipment's associated with photovoltaic solar power generation. The data so obtained have been analyzed through descriptive statistics using both aggregative and non-aggregative techniques. In aggregative analysis the data related to the country itself and then state-wise data are studied. In non- aggregative analysis data related to different projects engaged in photovoltaic power generation under Rooftop Photovoltaic and Small Solar Power Generation Scheme (RPSSGP) has been analyzed.

IV. Indian Scenario in Solar Power Generation Through Rooftop Photovoltaic Cells

The Government of India has made considerable efforts in boosting solar energy capacity through initiatives such as the National Solar Mission and various state-level solar policies, with public-private partnerships playing a significant role. The installed solar capacity in the country saw an impressive growth between 2010 and March 2020, increasing 233 times from 161 MW to 37,627 MW. This marks a strong commitment by India towards expanding its solar energy sector. The installed solar capacity as of March 2020 is at 37,627 MW. The central government has also provided around ₹380 crore in

the previous year for the National Solar Mission to boost up the generation of solar power. To facilitate solar energy development, nearly 43 solar parks were established, ensuring land availability for solar power plant developers (Jayapradha et.al., 2021).

According to the same article by Jayapradha et.al. (2021), initially, India had set a target of achieving 20 GW of solar energy capacity by 2022. However, this goal was accomplished four years ahead of schedule, prompting the government to revise the target to 100 GW, which includes 40 GW from rooftop solar installations, backed by a $100 billion investment plan.

The Government of India has undertaken several initiatives directed towards increasing the generation capacity of solar power and facilitating its use. An upsurge in the consumption of solar power is tantamount to an increase in its generation. Table 4.1 shows usage of solar power in various selected states in India across different years. These states have been selected based on utilization of the solar power during the final year of the study time, 2020-21. The table presents the statistics of ten states with topmost utilization of solar power and also demonstrates the acceleration in solar power utilization.

Table - 4.1

Usage of Solar power in Selected States (All figures are in MW)

State	**Year**					
	2015-16	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Karnataka	77	146	1,028	1232	6,096	7355
Rajasthan	942	1,270	1,813	2564	3,227	5733
TamilNadu	143	1,061	1,692	1897	2,575	4475

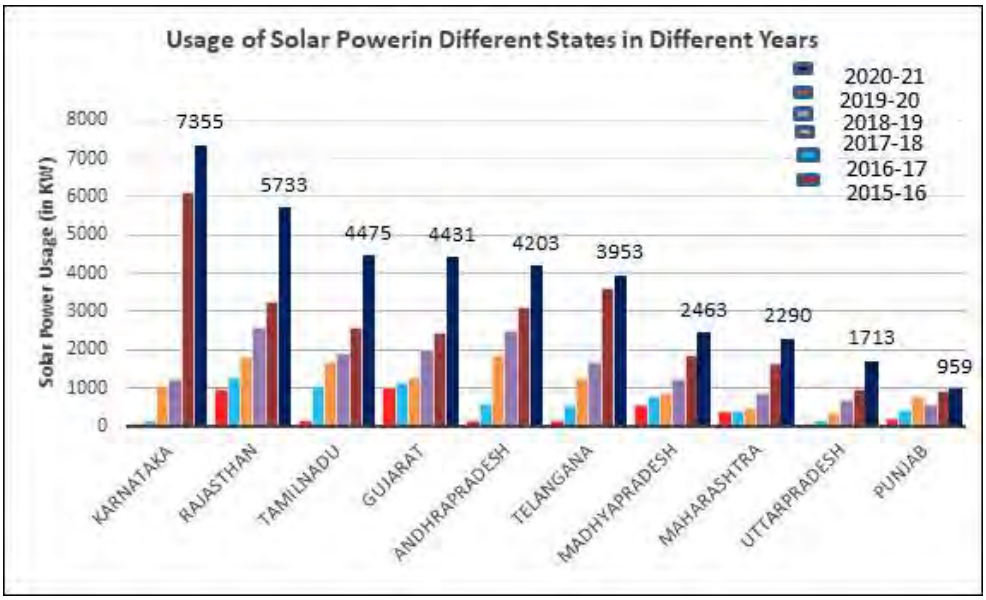
Gujarat	1,000	1,119	1,249	1985	2,440	4431
AndhraPradesh	136	573	1,867	2463	3,086	4203
Telangana	167	528	1,287	1686	3,592	3953
MadhyaPradesh	559	776	857	1232	1,840	2463
Maharashtra	361	386	453	867	1,634	2290
UttarPradesh	71	144	337	697	960	1713
Punjab	185	405	794	560	906	959

Source: https://en.wikipedia.org/wiki/Solar_power_in_India (2021)

The table 4.1 is self-explanatory. From the table it is evident that presently the usage of solar power is maximum in Karnataka with a huge rate of acceleration in usage. Comparison between solar power usage data of 2015-16 and 2020-21 data depicts a growth of almost 9500%. In Tamil Nadu and Andhra Pradesh this growth is about 3000%. Telengana and Uttar Pradesh have shown growth of around 2400% in utilization of solar power between the year 2015-16 and 2020-21.

From Table-4.1 a graph can be drawn to analysis the comparative growth of solar power usage in those ten states for a period of six years i.e. from 2015-16 to 2020-21. The figure 4.1 portrays this comparative growth of utilization of solar power in selected ten states of India from 2015-16 to 2020-21.

Figure-4.1



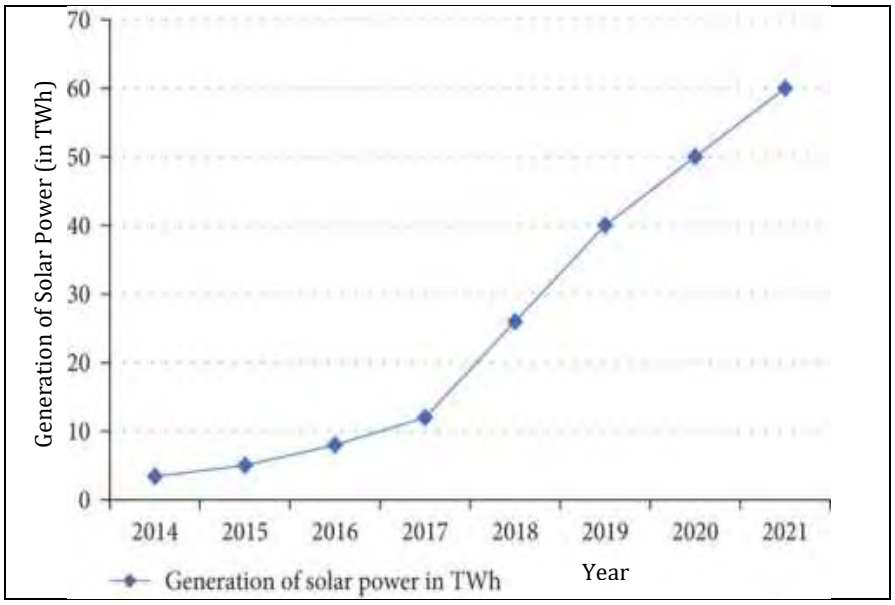
Source: Table-4.1

The figure 4.2 is self-explanatory. Highest growth in the usage of solar power has been found in the state of Karnataka followed by Rajasthan, Tamil Nadu, Gujarat, Andhra Pradesh and Telangana respectively. Not so massive but a significant growth in the usage of solar power has been observed in Madhya Pradesh, Uttar Pradesh and Punjab with in a tenure of 2015-16 to 2020-21. Such a huge growth in usage of solar power in different states of India as portrayed in Table-4.1 and Figure-4.1 indicates noteworthy increase in generation of solar power. Table-4.1 and Figure-4.1 are only indicative not exhaustive. Significant increase in usage of solar power can only be ensured by the huge growth in usage of solar power.

Figure 4.2 portrays the growth in generation of solar power.

Figure-4.2

Growth in Generation of Solar Power in India (in TWh)



Source: https://en.wikipedia.org/wiki/Solar_power_in_India.(2021)

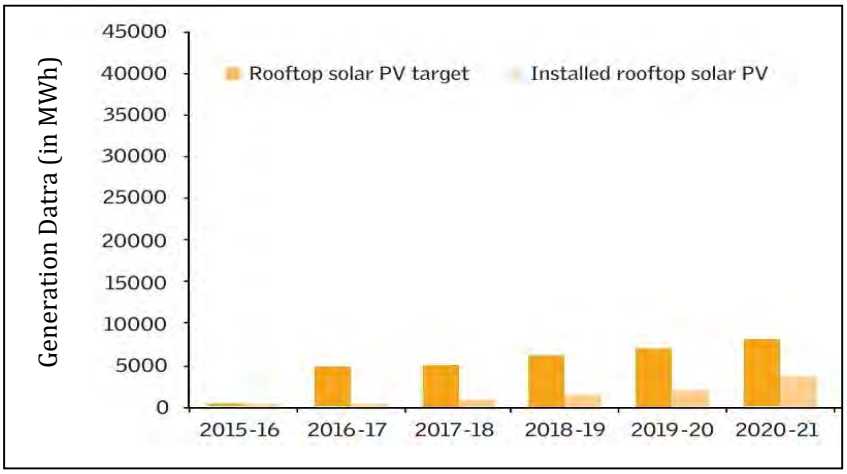
Figure - 4.2 indicates a huge growth in solar power generation. In this figure growth path has been drawn on the basis of cumulative data of generation through photovoltaic systems as well as concentrating solar power systems. It also includes solar power generation through rooftop photovoltaic. The present study has made an attempt to portray the growth of solar power generation through rooftop PV in between 2015-16 to 2020-21 in cumulative as well as of different selected states. Stat-wise comparison of growth of rooftop PV is only indicative not the exhaustive.

Figure-4.3 has shown the growth of solar power generation throughout India for a period of six years i.e between the year 2015-16 to 2020-21 and Figure-

4.4 has indicated state-wise growth of solar power generation for the same period of six years i.e between the year 2015-16 to 2020-21.

Figure-4.3

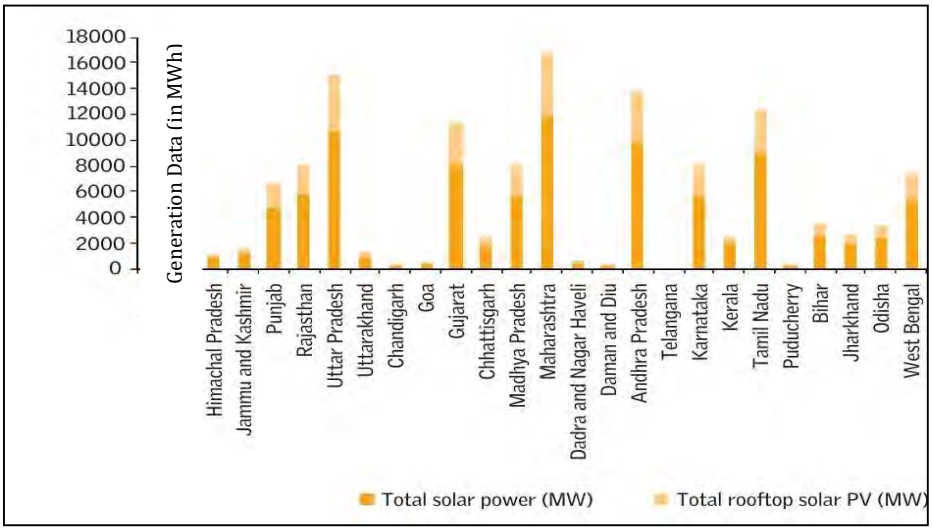
Rooftop Solar Power Generation in India (in MWh)



Source: Ministry of New and Renewable Energy

Figure-4.4

State-wise Rooftop Solar Power Generation (in MWh)



Source: Ministry of New and Renewable Energy

Figure-4.3 and Figure-4.4 are self-explanatory. Both the figure indicates significant growth of solar power generation through rooftop PV but Figure4.3 indicates that though significant growth has been observed in solar power generation through rooftop PV but the target is yet to achieved.

To boost up the generation of solar power though rooftop PV the Government of India has taken several steps. Fiscal incentives in term of generation based incentives (GBI) and tax incentives in terms of additional or accelerated depreciation in the first year of installation of solar panels have been implemented by the Government of India with some subsequent changes. Next section of the study deals with those incentives.

V. Fiscal Incentives as Support of Generation of Solar Power through Rooftop Photovoltaic Cells

Being an essential source of non-renewable energy, the Government of India promotes solar energy with fiscal incentives. Incentives offered by the government to support solar power projects can be broadly classified into two categories, which are discussed in the following paragraphs.

A. Tax Incentive through Additional /Accelerated Depreciation:

Accelerated depreciation scheme does not encourage project developers directly; instead, it is the saving mechanism in terms of taxes that reduces the liabilities for project developers. Project developers can enhance their after-tax benefits and increase the short-term cash flows thus provided (Sud et al., 2015). As the capital expenditures in solar power generation technology are very high, additional depreciation in initial year of project acts as a cushion to project developers engaging in solar power generation activities.

Under Section 32(1)(iia) of the Income Tax Act, developers involved in the generation of solar power are eligible for accelerated or additional depreciation as a bonus. As per the amendment introduced in the Finance Act, 2012, any assesse engaged in power generation, whether for commercial purposes or captive consumption, is entitled to an additional allowance of 20% of the actual cost of new plant and machinery or equipment in the first year on a written-down value basis, provided that normal depreciation is calculated on a written-down value basis. To date, only those generating power for captive consumption were eligible for this benefit.

More specifically, businesses generating solar power can take an extra 20% deduction of the actual cost of newly installed plants and machinery used for manufacturing in the initial year of installation of capital assets exclusively meant for solar power generation. Section 32(1) provides depreciation of 80 percent for solar energy tangible assets comprising solar photovoltaic modules and panels, solar pumps, solar power systems, flat or pipe type of collectors, solar cookers, water heaters, driers, refrigerators, among others, up to AY 2017-18 (FY 2016-17). But since assessment year 2018-19 (FY 2017-18) onwards, depreciation percentages for all such assets reduced to 40 percent.

Thus a notable decline in fiscal incentives regarding the depreciation allowances for solar energy tangible assets has been observed after financial year 2016-17. Previously, businesses were allowed to depreciate up to 80% of the solar power plants within the first year of their operation. In addition, under Section 32(1)(iia) of the Income Tax Act, 1961, business entities could also claim a deduction of 20% of the actual cost of newly installed plant and machinery for manufacturing purposes. The said provision made solar energy

projects eligible for 100% depreciation if they operated for more than 180 days in the initial financial year. For solar power project operational for a less period of 180 days in a financial year, the benefits for depreciation allowance will be split between two consecutive financial years (Singhania & Singhania, 2016). For eligibility for availing the benefits, the project/ business should be initiated in the financial year 2016-17 or prior to that.

According to the Press Release by MNRE in 2011, the majority of investors invested in small scale projects only to take the advantages of tax saving benefits under AD schemes in the initial years. Initial capital cost of the project has been linked to the incentives from AD schemes which directs towards higher level of capacity additions. According to the Press Release by MNRE in 2015, investor or project developers have only focused on catering tax benefits in earlier years but later time they are not focusing on increasing efficiency. As AD scheme energizes the capacity building rather than generation from capacity, there is no mechanism to monitor and penalize underperformed project developers in terms of power generation. With that rational Government of India (GoI) took a step to revise the rate of tax incentives in terms of depreciation allowance and additional depreciation allowance in the Union Budget 2017.

With a changed policy, plants set up after April 1, 2017, and which have operated for more than 180 days in any financial year shall be allowed depreciation allowance of 40% in normal throughout the asset life clubbed with 20% of additional/accelerated depreciation in the initial year. Therefore, the owner of the solar power generation project is allowed to claim 60% depreciation on tangible assets during the first year of the operation (Singhania & Singhania, 2017). This is significantly lower than the previous policy, although still

beneficial to those engaged in the generation of solar power. In addition, solar energy systems that have been in operation for less than 180 days in a financial year can claim half of these benefits, i.e. 30% (half of 60%) as depreciation allowance in the initial year (Singhania & Singhania, 2020).

As this additional tax incentive encourage project developers to invest in solar power generation by reducing post tax profits ion initial year, reduction in the benefit might lower the investment in solar power sector and thus generation of solar power.

Table-5.1 illustrates depreciation rates for different assessment years.

Table-5.1
Depreciation Allowance Offered (From 2014-15 to 2020-21)

Previous Year	Rate of Effective Depreciation Allowance		
	Rate of Depreciation Allowance (%)	Rate of Accelerated Depreciation Allowance (%)	Effective Rate of Depreciation Allowance (%) *
2014-15	80%	20%	100%
2015-16	80%	20%	100%
2016-17	80%	20%	100%
2017-18	40%	20%	60%
2018-19	40%	20%	60%
2019-20	40%	20%	60%
2020-21	40%	20%	60%

Source: Budget Documents of Different Years

Note:* If asset is used for more than 180 days effective rate will be full otherwise effective rates will be half

The intent of allowing additional or accelerated depreciation is to attract new investment in this emerging sector and encourage further growth. According to Muthiyan and Parekh (2016), due to a proposed cap on the rate of depre-

ciation in the budget 2016-17, the benefit that was available to the solar project investors would be halved in the first year and spread over the subsequent years. With arbitrary examples they have analyzed the situation. Next section (Section 6) deals with whether the reduction in these additional benefits in initial year has any effect on the solar power generation projects.

B. Generation Based Incentives

In 2009, Ministry of New and Renewable Energy (MNRE) launched the Generation-Based Incentive scheme (GBI) for attracting and widening the base of various investor groups with an aim of enhancing investment by independent power producers. GBI scheme provides direct financial assistance in the initial years in terms of GBI loans. The minimum direct assistance in terms of loans extended to project developers under this GBI scheme is ₹20 lakhs (MNRE, 2011). In the initial phase Indian Renewable Energy Development Agency (IREDA) has selected 78 projects with a total capacity of about 98 MW for which the Ministry will provide GBI of Rs. 12.41 per KW. The GBI scheme will offer direct financial incentives in the early stages meant for attracting a wide range of investors into the solar power generation sector.
According to the guidelines of MNRE, Generation-Based Incentive (GBI) can be availed for the net solar power generation alone under Rooftop PV and Small Solar Power Generation Programme (RPSSGP). Generation Based Incentive claims submitted by the project developers could only be processed by the Indian Renewable Energy Development Agency (IREDA) on proper invoicing and on submission of Joint Meter Readings (JMRs) and invoices (MNRE, 2011).

A project developer is required to be initially pre-registered with the state designated agency and thereafter register online with IREDA. The first 100 MW capacity projects registered with IREDA are eligible for GBI. Those solar plants that generate less than 1,100 units (KW) in a year shall not be eligible to avail GBI facility.

This direct financial support in the form of Generation-Based Incentive (GBI) loans would attract a wide array of investors into the solar power sector and thus help the growth of this sector. As the incentive is directly linked to power generation, the GBI program by the Government of India has impacted solar energy production in a positive way. Hence, project developers are incentivized more by producing more amounts of solar power.

VI. Fiscal Incentives and Generation of Solar Power

The Government of India has spotlighted the intention of project developers to capacity buildup in order to exploit additional /accelerated depreciation (AD) once a project is under way. According to an MNRE press release published in 2011, higher returns from AD resulted in malpractice among investors who focused more on tax advantage than on power generation itself. As a control measure the Government has slashed down the rate of depreciation to 40% from 80% having also a slash in effective benefit from 100% to 60% (clubbed with 20% AD) in initial year of capacity addition. The government, in a bid to address these challenges, introduced the Generation-Based Incentive (GBI) scheme together with the AD system in 2009. This dual approach aims to attract investors through AD while simultaneously boosting power generation through GBI. Therefore, it is essential to examine whether GBI scheme is effectively encouraging investment and supporting the development of solar power projects instead of a significant cutback in AD scheme.

For observing these effects on the generation of solar power the study period has been divided into two. First one is pre-restructuring period of tax incentive for additional or accelerated depreciation allowance and second one is related to post-restructure of tax incentive for additional or accelerated depreciation allowance.

Table – 6.1

GBI vis-a-via Solar Power Generation in Pre and Post Restructuring of AD

Period of Reference	Previous Year	Rate of Effective Depreciation Allowance			Generation based Incentive (GBI)#		Solar Power Generation	
		Rate of Depreciation Allowance (%)	Rate of Accelerated Depreciation Allowance (%)	Effective Rate of Depreciation Allowance (%) *	GBI offered (rupees)	% of change in each year	Solar Power Generation (KW)	% of change in each year
Pre Restructure of AD	2013-14	80%	=	80%	13549144	-	117957732	-
	2014-15	80%	20%	100%	14168502	4.57	127000694	7.67
	2015-16	80%	20%	100%	14631112	3.26	129065677	1.63
	2016-17	80%	20%	100%	16106745	10.08	130267169	0.93
Post Restructure of AD	2017-18	40%	20%	60%	14026316	-12.92	121298649	-6.88
	2018-19	40%	20%	60%	13517388	-3.62	113318389	-6.58
	2019-20	40%	20%	60%	12260014	-9.30	106295114	-6.20
	2020-21	40%	20%	60%	11680422	-4.73	99995811	-5.93

Source: IREDA and Budget Documents for different years for rates of AD.

Note:* If asset is used more than 180 days effective rate will be full otherwise effective rates will be half

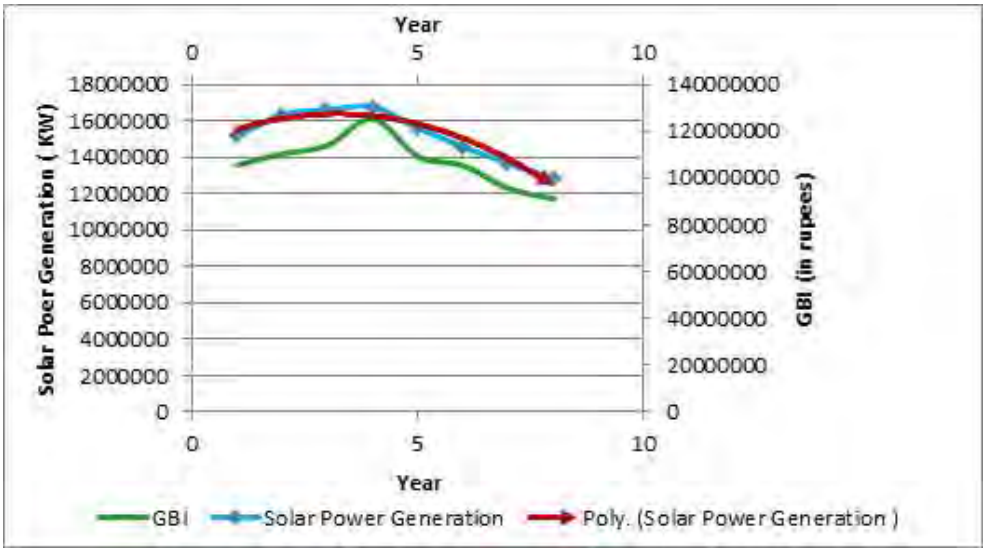
 # Cumulative GBI for projects selected by IREDA in first phase

GBI for each project calculated as Product of Rate of GBI as applicable and Solar Power Generation

Table-6.1 has been constructed on the basis of Solar Power Generation Data released by IREDA. Aggregative data of selected states having high GBI assistance were used to construct the table. Total generation of solar power for each state was an aggregate figure of solar power generation by different project developers under Rooftop Photovoltaic and Small Solar Power Generation Programme (RPSSGP) Scheme. From Table-6.1 it is evident that GBI as well as generation of solar power have been reduced in the period of post restructure of AD. In pre-restructure period solar power generation data demonstrated positive changes. Generation based Incentives (GBI) also displayed positive changes in the period of pre-restructure of tax incentive in form of accelerated depreciation. Very interestingly GBI has been accelerated quite a faster rate than solar power generation pointing the fact that high GBI doesn't signify high solar power generation every time. In the year 2016-17 almost 13% increase in generation based incentive induced less than 1% growth in solar power generation. It has also been observed from Table-6.1 that after cutting off of benefit for tax incentives through accelerated depreciation generation of solar power under Rooftop Photovoltaic and Small Solar Power Generation Programme (RPSSGP) Scheme decreased by almost 7% in 2017-18. A reduction of almost 13% in generation based incentive (GBI) has been noted in the year 2017-18. GBI and solar power generation were declined by 3.6% and 6.6% respectively in 2018-19. In 2019-20 changes in GBI availed and solar power generation were 9.3% and 6.2% respectively. The decreasing trend has been continued for GBI assistance and the generation of solar power in 2020-21 also. Changes were counted as almost 5% and 6% in case of both GBI and solar power generation.

Table 6.1 displays a graphical representation to observe the movement of generation based incentives and solar power generation and a polynomial trend line has been drawn to show the ups and down in solar power generation during the study period.

Figure-6.1
Movement of GBI and Solar Power Generation in Pre and Post restructure of AD



Source: Table-6.1
Note: In horizontal axis, 0 = 2012-13, 2 = 2014-15, 4 = 2016-17, 6 = 2018-19, 8 = 2020-21

The figure is self-explanatory. Figure-6.1 indicates that a positive growth has been observed both in GBI and solar power generation in the period of pre-restructure of accelerated depreciation but growth rate of GBI is significantly high than that of solar power generation. The trend line fitted indicates a negative growth of solar power generation in the period of post-restructure of accelerated depreciation.

After analysis of aggregative data, the study has made an attempt to observe the state wise picture. For that purpose, ten states with high GBI assistance under Rooftop Photovoltaic and Small Solar Power Generation Programme

(RPSSGP) according to the IREDA data are chosen. For each state growth of solar power generation are observed in Table 6.2.

Table-6.2
State wise Solar Power Generation in Pre and Post Restructuring of AD under RPSSGP Scheme (figures in KW)

States	Pre AD Restructure Period				Post AD Restructure Period			
	2013-14	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-2019**	**2019-20**	**2020-21**
Rajasthan	22042390	23636614	17254420	23419760	19311950	17725648	21687028	21279591
	-	7.23	-27.00	35.73	-17.54	-8.21	22.35	-1.88
Andhra Pra-desh	7157102	7389073	6976230	6658513	6201209	4819387	4940111	3693485
	-	3.24	-5.59	-4.55	-6.87	-22.28	2.50	-25.23
Tamil Nadu	8783448	8827392	9296430	8744565.8	8405024	7771021	7594772	7314429
	-	0.50	5.31	-5.94	-3.88	-7.54	-2.27	-3.69
Telengana	7259450	7448060	7580080	7202325	7026375	6977205	6316865	3932770
	-	2.60	1.77	-4.98	-2.44	-0.70	-9.46	-37.74
Chattisgarh	5839080	6267600	6207456	6306504	5985816	5880239	3159768	2662382
	-	7.34	-0.96	1.60	-5.09	-1.76	-46.26	-15.74
Jharkhand	17481480	20748780	20043800	19658860	19469480	19371260	16399700	17533420
	-	18.69	-3.40	-1.92	-0.96	-0.50	-15.34	6.91
Maharashtra	7296310	7692562	7955516	7153132	7203980	7329431	6722906.9	6558835
	-	5.43	3.42	-10.09	0.71	1.74	-8.28	-2.44
Orissa	9449990	10280534	10064573	10459654	10114717	9553124	8502005	8457631
	-	8.79	-2.10	3.93	-3.30	-5.55	-11.00	-0.52
Uttar Pradesh	6503678	7664794	5039050	8600990	6920310	9682503	8100748	8390651
	-	17.85	-34.26	70.69	-19.54	39.91	-16.34	3.58
Uttarakhand	6360606	6516040	5986735	6007150	5655890	5693418	5480820	5095875
	-	2.44	-8.12	0.34	-5.85	0.66	-3.73	-7.02

Source: IREDA

Table 6.2 indicates the fact that almost all the states have experienced a negative growth in generation of solar power in the post AD restructure period except Uttar Pradesh. Rajasthan and Andhra Pradesh experienced a positive growth in solar power generation in the year of 2019-20 falling within the span of post AD restructure period. Thus solar power generation in the period of post restructure of provision related to additional / accelerated depreciation has shown a negative growth despite of promoting financial assistance through GBI indicating a strong positive association between tax benefits for accelerated depreciation and solar power generation.

The study has made an effort to observe the association between tax benefits for accelerated depreciation and solar power generation from the point of view of investors engaged in the project of generation of solar power in high GBI states. The list of project developers used are only indicative not exhaustive.

Table-6.3 below exhibits the negative growth of solar power generation under Rooftop Photovoltaic and Small Solar Power Generation Programme (RPSSGP) Scheme in the period of post restructure of tax benefits through accelerated depreciation. The drawings from the table reveals the fact that reduction in tax incentives through accelerated depreciation reduce the asset utilization in projects for generation of solar power resulting a negative growth in generation of solar power.

Table-6.3
of Solar Power by Selected Project Developers under Generation RPSSGP Scheme (all figures are in KW)

Name of Project Derveloper		Pre AD Reform Period				Post AD Reform Period			
		2013-14	2014-15	2015-16	2016-17	2017-18	2018-2019	2019-20	2020-21
Amrit Jal Ventures Ltd.	Solar Power Generation (KWh)	1454136	1575119	1533520	1453953	1372303	1045435	849868	753412
	% of change	-	8.32	-2.64	-5.19	-5.62	-23.82	-18.71	-11.35
Andromeda Energy Tech. Pvt Ltd	Solar Power Generation (KWh)	1092060	1151150	1155100	1126800	1110720	1071290	1033370	596160
	% of change		5.41	0.34	-2.45	-1.42	-3.55	-3.54	-42.31
SDS Solar private limited.	Solar Power Generation (KWh)	2769408	3024288	3025872	2989080	2809584	2820960	1480800	1098712
	% of change		9.20	0.05	-1.22	-6.01	0.40	-47.51	-25.80
Chattisgarh Investments Ltd.	Solar Power Generation (KWh)	1691724	1675884	1750404	1708824	1696008	1664400	1678152	1634724
	% of change	-	-0.94	4.45	-2.38	-0.75	-1.86	0.83	-2.59
Sukbir Solar Energy Pvt. Ltd.	Solar Power Generation (KWh)	1260100	1288608	1312968	1333820	1261654	1192698	1074167	926812
	% of change		2.26	1.89	1.59	-5.41	-5.47	-9.94	-13.72
Bhavani Engineering	Solar Power Generation (KWh)	1562025	1635625	1637285	1597290	1564620	1511370	1262780	993440
	% of change	-	4.71	0.10	-2.44	-2.05	-3.40	-16.45	-21.33
R.L. Clean Power Pvt. Ltd.	Solar Power Generation (KWh)	1562960	1404160	1406080	1414320	1316320	1123440	1150640	1140960
	% of change	-	-10.16	0.14	0.59	-6.93	-14.65	2.42	-8.77
Rays Power Private Limited	Solar Power Generation (KWh)	936830	1050840	1261290	1422690	1298880	1027580	1088960	1290340
	% of change	-	12.17	20.03	12.80	-8.70	-20.89	5.97	-7.10
Lanco Solar Pvt. Ltd.	Solar Power Generation (KWh)	1031819	1542479	1618299	1660502	1200993	1149930	1099999	123523
	% of change	-	49.49	4.92	2.61	-27.67	-4.25	-4.34	-91.18
Dhruv Milkose Pvt. Ltd.	Solar Power Generation (KWh)	1269090	1289690	1252390	1270860	1284430	1192340	1097500	1054445
	% of change		1.62	-2.89	1.47	1.07	-7.17	-7.95	-3.92

Source: IREDA

VII. Conclusion

This analysis through different tables and figures reflects the notion that tax incentives reduction through slashing of additional or accelerated depreciation lowers the incentive rates that negatively impact investors and developers of a project. Slashing down of tax benefit in initial year compel them to face higher tax liabilities. It weakens their interest in developing the capacity of solar plants and establishing new solar plants. This negative effect eventually slows down the production of solar power. Accordingly, the goal of the government in enhancing solar power generation and use through the Rooftop Photovoltaic and Small Solar Power Generation Programme (RPSSGP) will face a challenge.

The efficiency in solar power generation may be improved through the application of highly advanced solar panels which use photovoltaic cells with the highest concentrations. In addition, project developers should apply advanced energy management technologies and high-quality solar meters in monitoring the efficiency of the solar panels. Additional initial tax incentives may be effective enough to attract greater investments in good quality solar panels, high quality solar meters to make the generation of solar power more efficient. The reduction in tax incentives has discouraged investors and project developers from investing in high quality capital assets necessary for solar energy projects, negatively impacting the generation of solar power and hindering the government's green energy goals under the RPSSGP schemes. High-efficiency solar panels with concentrated photovoltaic cells and energy management technologies can enhance solar power generation, but their high initial costs pose a challenge.

Reinstating an 80% depreciation rate with an additional 20% accelerated depreciation in the first year would provide 100% tax benefits, encouraging investment in high-quality solar panels and energy management technologies. Enhanced tax benefits, in terms of accelerated depreciation clubbed with fiscal incentives like GBI assistance can attract small investors and project developers to invest more in the projects of solar power generation and motivate captive users to adopt solar power, encouraging growth in solar power generation.

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