

# Analysis of Solar Irradiation and Modeling of Large Scale PV Power Plant Implementation in Central Tamil Nadu

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## ABSTRACT

In recent years, the environment has extremely polluted and climatic changes, due to the usage of fossil fuel for generation of electricity and other sectors. Nowadays the power generation based on fossil fuel does not meet the consumer demand due to deficiency. In this study the Photo voltaic techniques is used for analysis its performance under various weather condition and implement in central Tamil Nadu. Based on Solar irradiation Data/report from National Renewable Energy Laboratory (NREL) the rating of distributed PV power generation has been selected and modelled in MATLAB environment and evaluate the simulation results. Finally the proposed system will be recommended to implement a massive PV plant at Central Tamil Nadu in India.

**KEY WORDS:** Solar, Irradiance, Photovoltaic, Power system.

## 1. INTRODUCTION

Fossil fuels are being extracted between demand and supply it is more likely that fuel expenses will face a steep hike in near future. Coal mining results in destruction of ecosystems and also endangers the lives of mine worker (Anderson, 2016; Ssekulima, 2016; Bae, 2016). The coal mining destroys wide areas of land and results in ecological imbalance. Though the fossil fuels meet our energy and fuel needs, still it's a high time to look forward for the alternative renewable energy source such as wind turbines, solar panels, tidal generators and compost. As our non-renewable resources are set to decline in the years to come, it is important for us to move toward renewable source of energy like solar, wind, hydropower, biomass and tidal. Solar energy not only benefits individual owners, but also benefit environment as well (Cervantes, 2016; Chai, 2016; Shinozaki, 2016; Masral, 2015). Solar energy is one of the most widely used renewable energy source

## 2. METHODS & MATERIALS

**Methodology:** The main objective of this work is to analysis the solar irradiation for Central Tamil Nadu (Lynch, 2015). We have selected 8 District and 32 Locations. The solar irradiation has been calculated using NREL PV/Watt Software for the above selected areas.

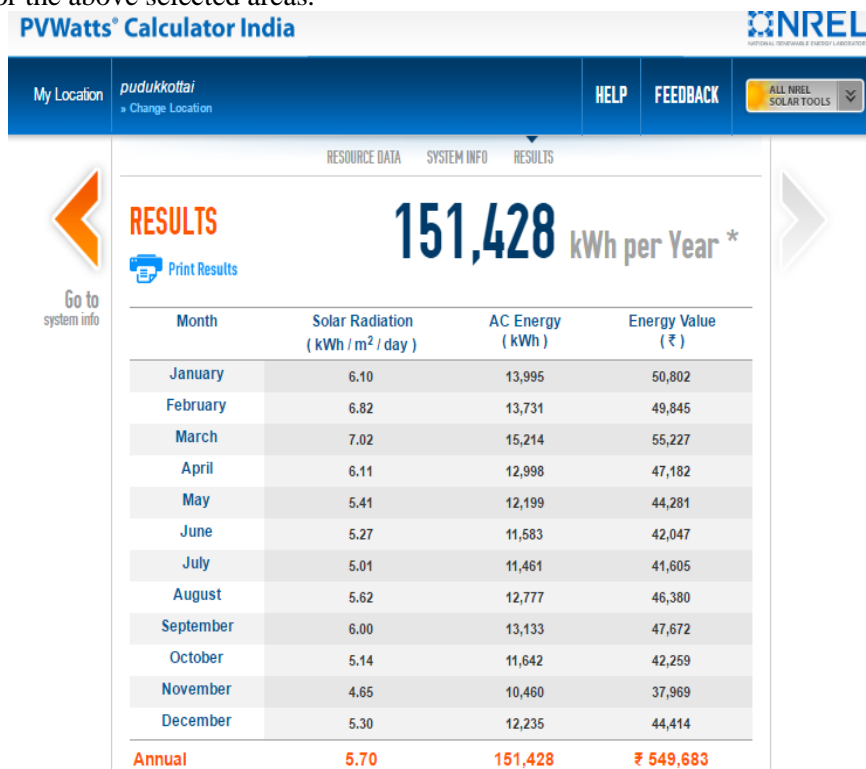


Figure.1. PV Watts Software - NREL



Figure.2. Cuddalore District Map

Table.1. Cuddalore District

Month	Chidambaram	Panuruti	Neyveli	Tittugudi
January	6.18	6.06	6.39	6.15
February	6.82	6.89	7.09	7.22
March	7.04	7.02	7.16	7.05
April	6.27	6.28	6.27	6.31
May	5.98	5.59	6.01	5.82
June	5.36	5.29	5.32	5.25
July	5.33	5.16	5.07	5.15
August	5.48	5.50	5.71	5.38
September	6.00	5.79	5.76	5.98
October	5.13	5.19	5.16	5.28
November	4.70	4.50	4.80	4.74
December	5.32	5.36	5.23	5.42
<b>TOTAL</b>	<b>5.80</b>	<b>5.72</b>	<b>5.83</b>	<b>5.81</b>

Average: 5.79

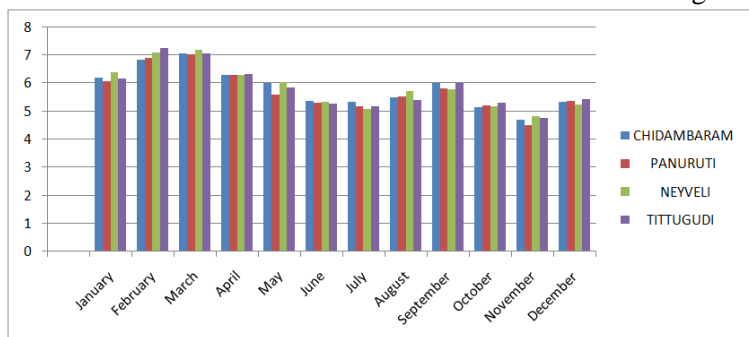


Figure.3. Cuddalore District Solar Irradiation Graph

**District: Cuddalore:** The solar irradiation has been calculated for Cuddalore district as shown in figure. We have selected 4 locations such as Chidambaram, Panuruti, Neyveli, Tittugudi. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 1. The average solar irradiation for this district is 5.79 kwh/m<sup>2</sup>.

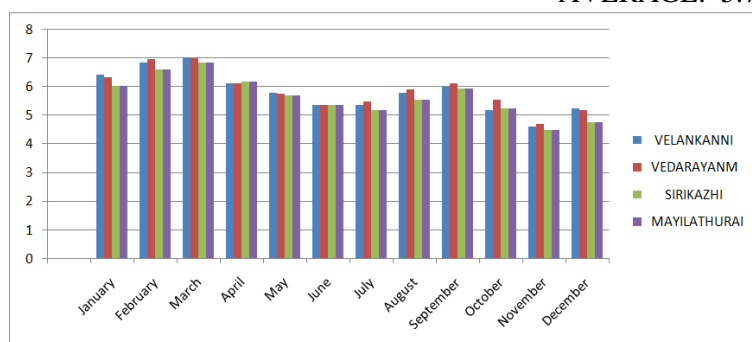


Figure.4. Nagapattinam District Map

**Table.2. Nagapattinam District**

Month	Velankanni	Vedarayanm	Sirikazhi	Mayilathurai
January	6.41	6.32	6.02	6.02
February	6.81	6.93	6.62	6.62
March	7.00	6.98	6.81	6.81
April	6.12	6.13	6.17	6.17
May	5.78	5.76	5.69	5.69
June	5.35	5.37	5.37	5.37
July	5.36	5.49	5.17	5.17
August	5.78	5.90	5.56	5.56
September	6.01	6.13	5.95	5.95
October	5.17	5.55	5.24	5.24
November	4.62	4.71	4.49	4.49
December	5.23	5.17	4.75	4.75
<b>TOTAL</b>	<b>5.80</b>	<b>5.87</b>	<b>5.65</b>	<b>5.65</b>

AVERAGE: 5.74

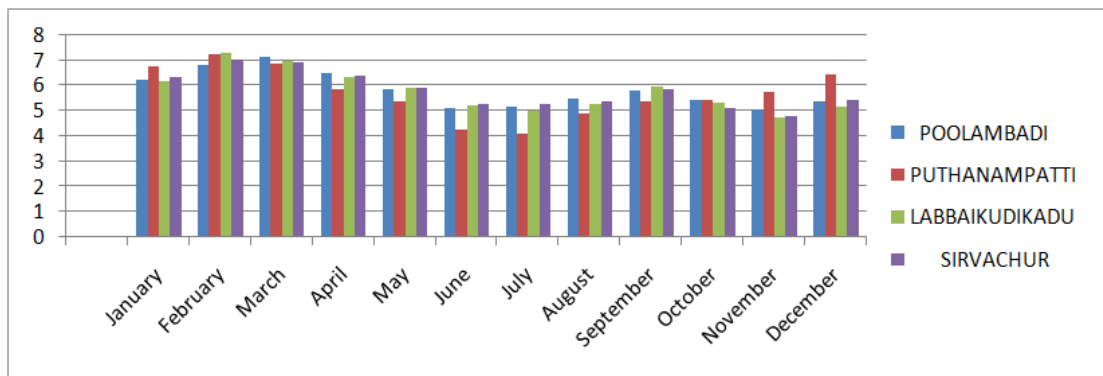
**Figure.5. Nagapattinam District Solar Irradiation Graph**

**District: Nagapattinam:** The solar irradiation has been calculated for Nagapattinam district as shown in figure. We have selected 4 locations such as Velankanni, Vedarayanm, Sirikazhi, Mayilathurai. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 2. The average solar irradiation for this district is 5.74 kwh/m<sup>2</sup>.

**Figure.6. Perambalur District Map****Table.3. Perambalur District**

Month	Poolambadi	Puthanampatti	Labbaikudikadu	Sirvachur
January	6.21	6.73	6.17	6.28
February	6.80	7.23	7.25	6.98
March	7.10	6.84	6.94	6.90
April	6.45	5.84	6.29	6.36
May	5.85	5.35	5.86	5.87
June	5.10	4.23	5.21	5.23
July	5.13	4.07	5.00	5.25
August	5.48	4.89	5.23	5.36
September	5.76	5.37	5.96	5.83
October	5.41	5.40	5.31	5.08
November	5.01	5.73	4.72	4.75
December	5.37	6.40	5.14	5.40
<b>TOTAL</b>	<b>5.81</b>	<b>5.67</b>	<b>5.76</b>	<b>5.77</b>

AVERAGE: 5.75



**Figure.7. Perambalur District Solar Irradiation Graph**

**District: Perambalur:** The solar irradiation has been calculated for Perambalur district as shown in figure. We have selected 4 locations such as Poolambadi, Puthanampatti, Labbaikudikadu, Sirvachur. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 3. The average solar irradiation for this district is 5.75 kWh/m<sup>2</sup>.

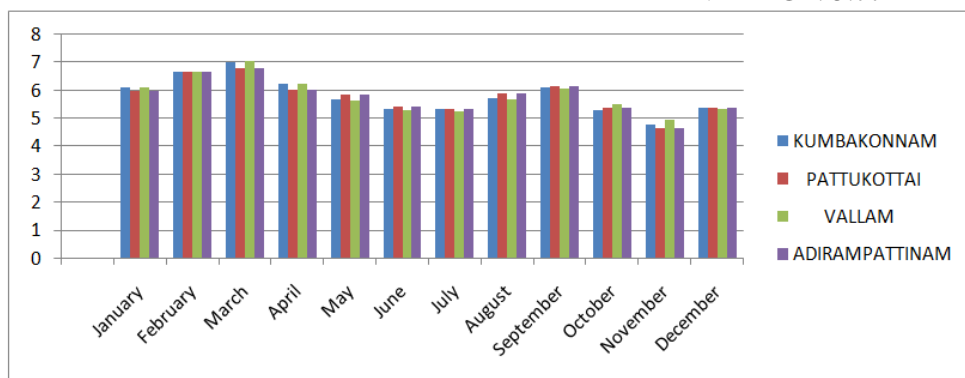


**Figure.8. Thajavur District Map**

**Table.4. Thajavur District**

Month	Kumbakonnam	Pattukottai	Vallam	Adirampattinam
January	6.07	5.93	6.06	5.93
February	6.61	6.61	6.63	6.61
March	6.96	6.78	7.03	6.78
April	6.22	6.01	6.21	6.01
May	5.64	5.82	5.60	5.82
June	5.31	5.38	5.26	5.38
July	5.32	5.31	5.20	5.31
August	5.69	5.85	5.66	5.85
September	6.09	6.12	6.02	6.12
October	5.26	5.35	5.47	5.35
November	4.76	4.61	4.92	4.61
December	5.33	5.36	5.31	5.36
<b>TOTAL</b>	<b>5.77</b>	<b>5.76</b>	<b>5.78</b>	<b>5.76</b>

AVERAGE: 5.77



**Figure.9. Thajavur District Solar Irradiation Graph**

**District: Thajavur:** The solar irradiation has been calculated for Thajavur district as shown in figure. We have selected 4 locations such as Kumbakonnam, Pattukottai, Vallam, Adirampattinam. The solar irradiation has been

measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 4. The average solar irradiation for this district is 5.77 kwh/m<sup>2</sup>.



Figure.10. Ariyalur District Map

Table.5. Ariyalur District

Month	Sendurai	Reddipalayam	Kallayam	Paluvur
January	6.18	6.03	6.53	6.12
February	6.96	6.65	6.90	6.66
March	6.93	6.96	6.79	7.03
April	6.37	6.19	5.80	6.16
May	5.88	5.66	5.09	5.95
June	5.29	5.35	4.30	5.32
July	5.19	5.19	4.60	5.21
August	5.47	5.55	5.16	5.52
September	6.01	5.87	5.71	5.82
October	5.42	5.42	5.68	5.32
November	4.58	4.75	5.51	4.85
December	5.22	5.28	6.03	5.25
<b>TOTAL</b>	<b>5.79</b>	<b>5.74</b>	<b>5.68</b>	<b>5.77</b>

AVERAGE: 5.75

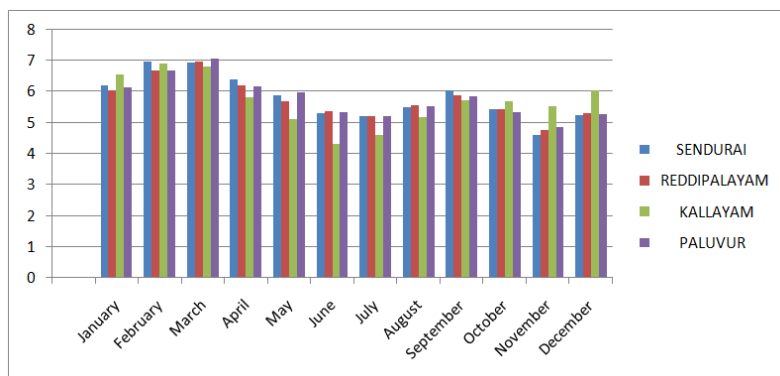


Figure.11. Ariyalur District Solar Irradiation Graph

**District: Ariyalur:** The solar irradiation has been calculated for Ariyalur district as shown in figure. We have selected 4 locations such as Sendurai, Reddipalayam, Kallayam, Paluvur. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 5. The average solar irradiation for this district is 5.75 kwh/m<sup>2</sup>.

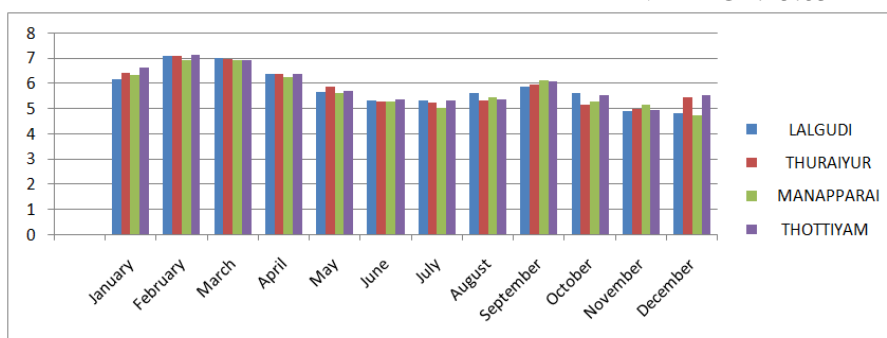


Figure.12. Trichy District Map

**Table.6. Trichy District**

Month	Lalgudi	Thuraiyur	Manapparai	Thottiyam
January	6.20	6.40	6.31	6.62
February	7.07	7.09	6.89	7.10
March	7.00	6.94	6.90	6.92
April	6.35	6.37	6.25	6.37
May	5.69	5.87	5.61	5.71
June	5.32	5.28	5.31	5.37
July	5.32	5.24	5.04	5.35
August	5.65	5.33	5.44	5.39
September	5.90	5.97	6.12	6.08
October	5.62	5.17	5.27	5.55
November	4.93	5.01	5.16	4.97
December	4.81	5.45	4.74	5.53
<b>TOTAL</b>	<b>5.82</b>	<b>5.84</b>	<b>5.75</b>	<b>5.91</b>

AVERAGE: 5.83

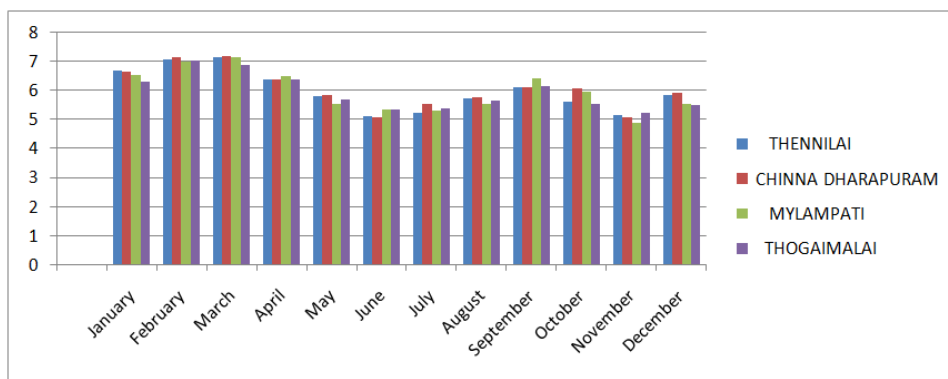
**Figure.13. Trichy District Solar Irradiation Graph**

**District: Trichy:** The solar irradiation has been calculated for Trichy district as shown in figure. We have selected 4 locations such as Lalgudi, Thuraiyur, Manapparai, Thottiyam. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 6. The average solar irradiation for this district is 5.83kwh/m<sup>2</sup>.

**Figure.14. Karur District Map****Table.7. Karur District**

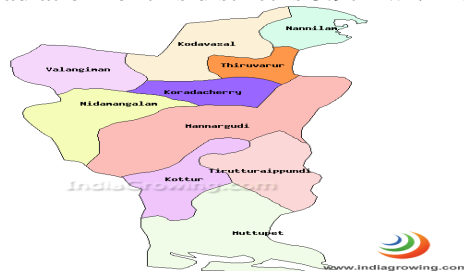
Month	Thennilai	Chinna Dharapuram	Mylampati	Thogaimalai
January	6.66	6.63	6.51	6.28
February	7.06	7.13	6.96	7.00
March	7.13	7.15	7.13	6.87
April	6.34	6.37	6.45	6.34
May	5.78	5.80	5.53	5.67
June	5.11	5.06	5.32	5.32
July	5.21	5.50	5.30	5.37
August	5.71	5.74	5.52	5.62
September	6.09	6.10	6.41	6.12
October	5.59	6.05	5.95	5.52
November	5.12	5.04	4.85	5.19
December	5.81	5.91	5.51	5.48
<b>TOTAL</b>	<b>5.97</b>	<b>6.04</b>	<b>5.95</b>	<b>5.90</b>

AVERAGE: 5.97



**Figure.15. Karur District Solar Irradiation Map**

**District: Karur:** The solar irradiation has been calculated for Karur district as shown in figure. We have selected 4 locations such as Thennilai, Chinna Dharapuram, Mylampati, Thogaimalai. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table.7. The average solar irradiation for this district is 5.97 kwh/m<sup>2</sup>.

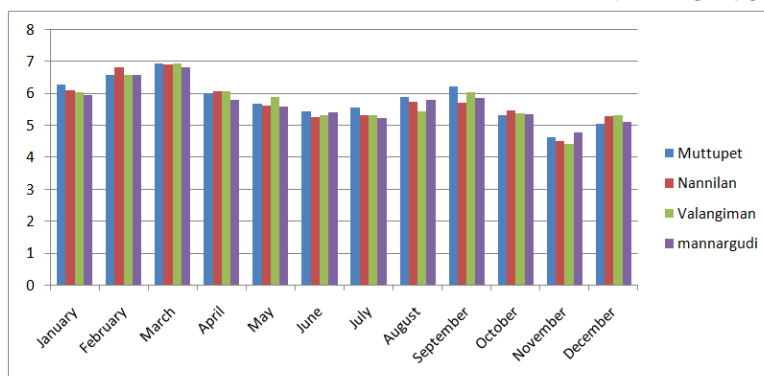


**Figure.16. Thiruvarur District Map**

**Table.8. Thiruvarur District**

Month	Muttupet	Nannilan	Valangiman	Mannargudi
January	6.27	6.07	6.01	5.94
February	6.57	6.80	6.57	6.57
March	6.93	6.88	6.93	6.79
April	6.00	6.05	6.06	5.79
May	5.66	5.59	5.87	5.58
June	5.41	5.25	5.30	5.38
July	5.53	5.31	5.30	5.22
August	5.88	5.71	5.41	5.79
September	6.19	5.69	6.03	5.84
October	5.30	5.46	5.36	5.33
November	4.62	4.49	4.40	4.75
December	5.02	5.28	5.29	5.08
<b>Total</b>	<b>5.78</b>	<b>5.72</b>	<b>5.71</b>	<b>5.67</b>

AVERAGE : 5.70



**Figure.17. Thiruvarur District Solar Irradiation Map**

**District: Thiruvarur:** The solar irradiation has been calculated for Thiruvarur district as shown in figure. We have selected 4 locations such as Muttupet, Nannilan, Valangiman, Mannargudi. The solar irradiation has been measured throughout year for the above location using NREL PV/Watts Software. The solar irradiation values is presented in table 8. The average solar irradiation for this district is 5.70 kwh/m<sup>2</sup>.

District	Average Solar Irradiation in kW/m <sup>2</sup> / day
Cuddalore	5.79
Nagapattinam	5.74
Karur	5.75
Ariyalur	5.77
Thajavur	5.75
Thirchy	5.83
Perambalur	5.97
Thiruvarur	5.70

### 3. RESULTS

In this paper we have analysed solar irradiance at 32 locations in 8 districts of central Tamil Nadu. Based on the above analysed result the Perambalur district is recommended to install large scale PV power plants.

### 4. CONCLUSION

In this paper we have studied and analysed solar irradiation of North Tamil Nadu for implementation for large scale photovoltaic power plant. We have been selected 32 location from 8 different district in south Tamil Nadu for calculate the solar irradiation availability data by using NREL PV /Watt software from UNITED STATES. The 32 location solar irradiation availability of throughout year data is presented in this paper. Based on analyses of solar irradiation availability data Perambalur district is selected as a best location for implementing large scale Photovoltaic power plant among 9 districts. The other districts are recommended to implement Photovoltaic power system based solar irradiation availability.

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