

# *“Development of **Web-GIS** Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities”*

The banner features a header with logos for CREST (Clean Energy Research, Science & Technology Promoting Society), teri (The Energy and Resources Institute), the Ministry of New and Renewable Energy Government of India, CII (Confederation of Indian Industry), and SHAKTI SUSTAINABLE ENERGY FOUNDATION. Below the logos, the title "Promoting Rooftop Solar Photovoltaic Systems" is displayed. The main content area is divided into six panels: a lightbulb with a green plant growing inside, a screenshot of the Web-GIS tool interface showing a map and data, a photograph of a house with solar panels on its roof, a close-up of solar panels, a bar chart showing data, and another photograph of solar panels.

**December 23, 2013  
Chandigarh, IND**

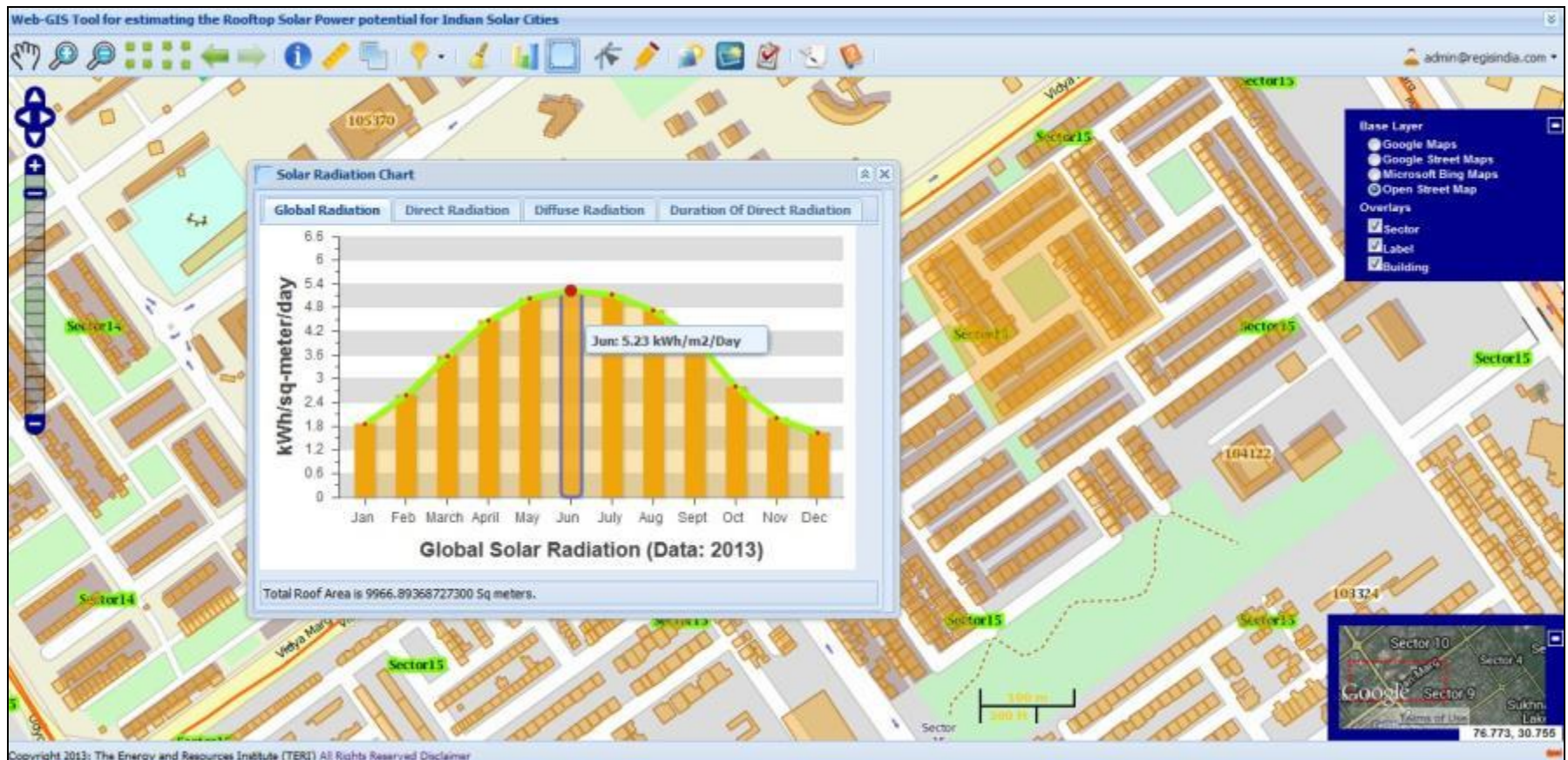
# Study Objective



Creating Innovative Solutions  
for a Sustainable Future

To develop a high performing and flexible Web-GIS tool to estimate the rooftop solar power potential for a city.

## Phase I: Chandigarh Area



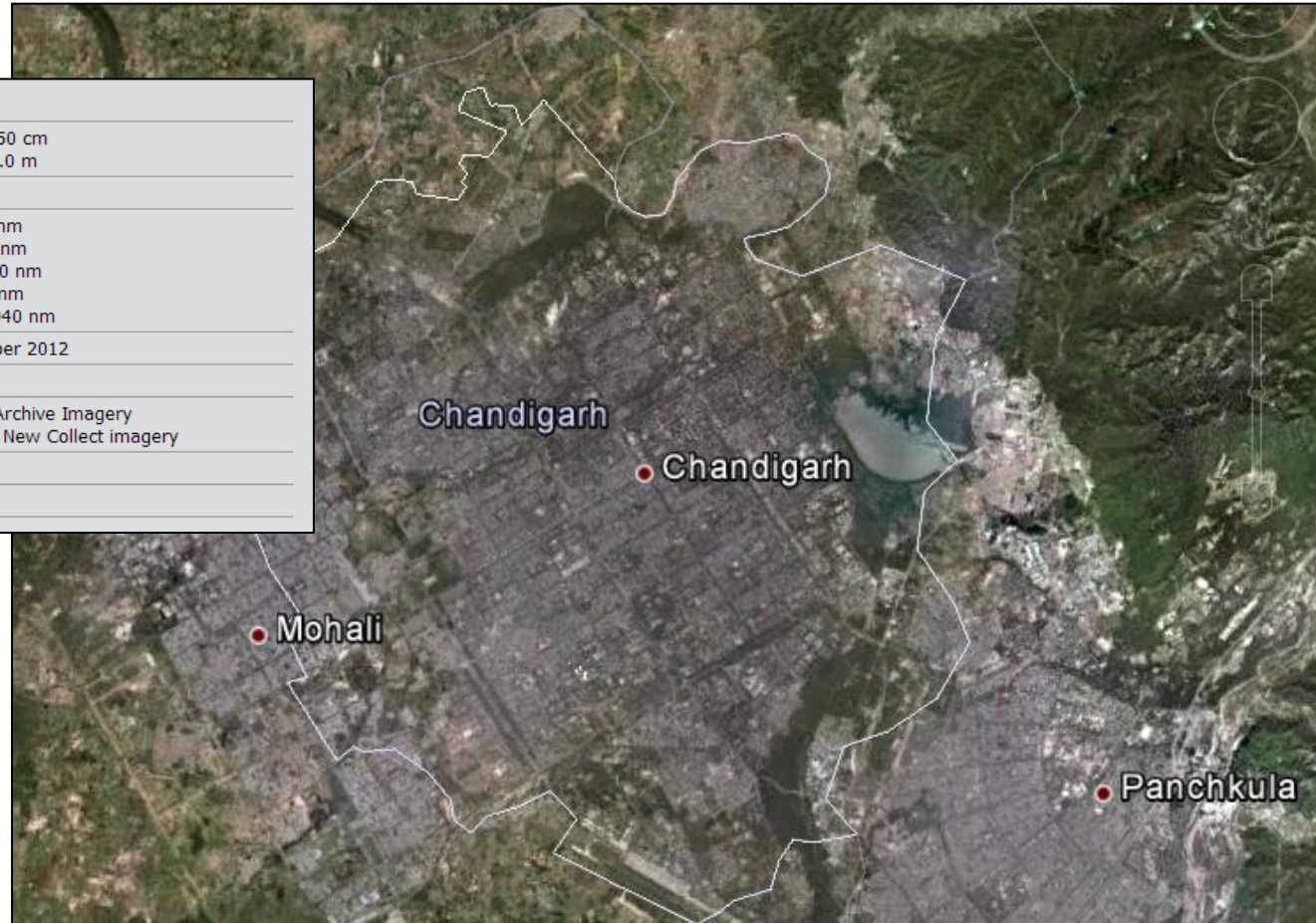
# Study Area



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for a Sustainable Future

## Pleiades-1A

| Specifications           |                                                                                                    |
|--------------------------|----------------------------------------------------------------------------------------------------|
| RESOLUTION               | Panchromatic 50 cm<br>Multispectral 2.0 m                                                          |
| NOMINAL SWATH WIDTH      | 20km at Nadir                                                                                      |
| BANDS                    | Pan: 450-830 nm<br>Blue: 430-550 nm<br>Green: 500-620 nm<br>Red: 590-710 nm<br>Near IR: 740-940 nm |
| ARCHIVE AVAILABILITY     | From September 2012                                                                                |
| PROGRAMMABILITY          | YES                                                                                                |
| MINIMUM AREA OF PURCHASE | 25 sqkms for Archive Imagery<br>100 sqkms for New Collect imagery                                  |
| STEREO AVAILABLE?        | YES                                                                                                |
| BEST SCALE               | 1 : 2000                                                                                           |



Source: Google Earth (<http://www.google.com/earth/index.html>)

Source: <http://www.astrium-geo.com/pleiades>

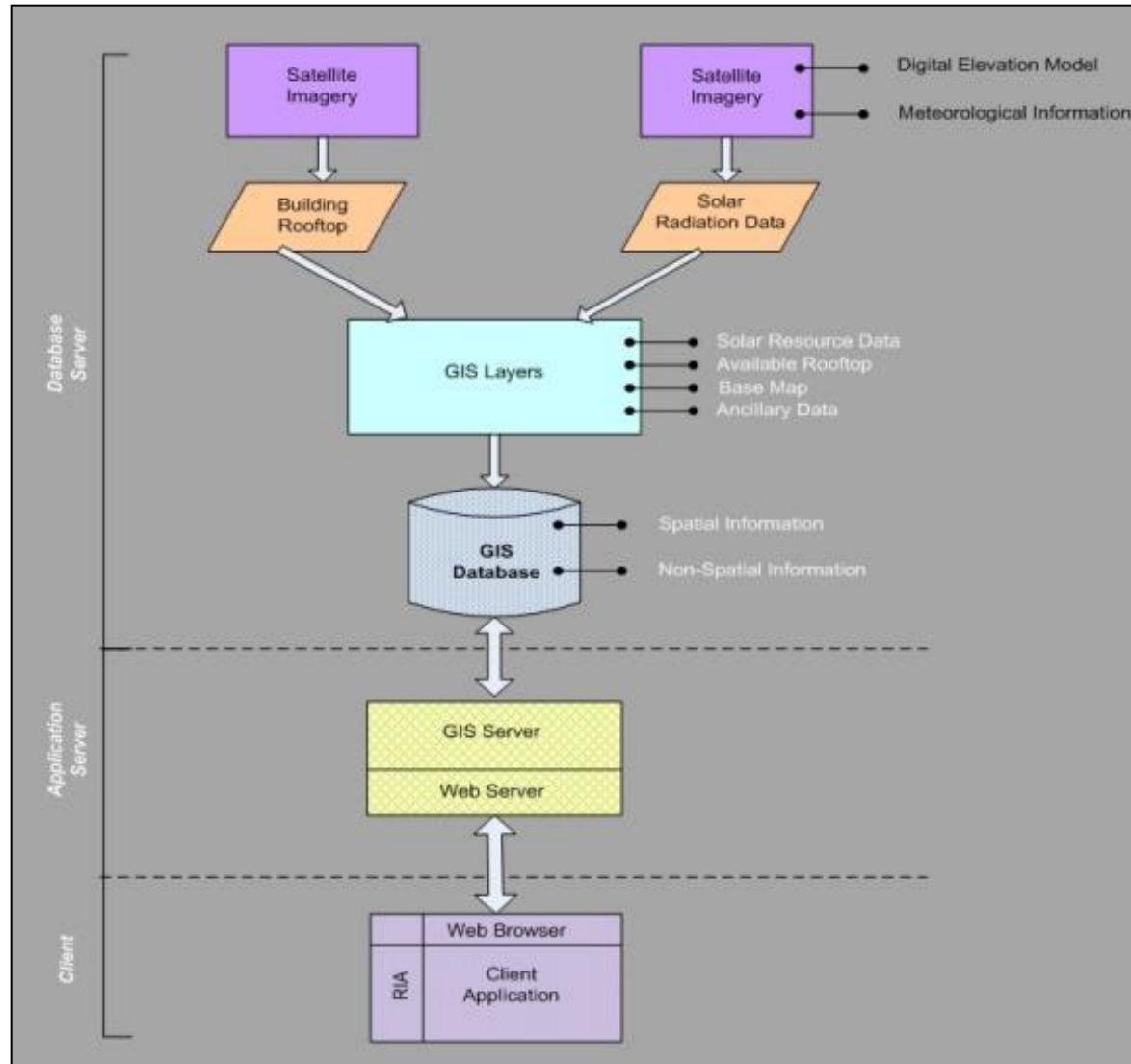
## Pleiades Satellite Imagery Coverage: Chandigarh Area



# Methodology



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# GIS Data-sets for Chandigarh Area (Building Rooftop)



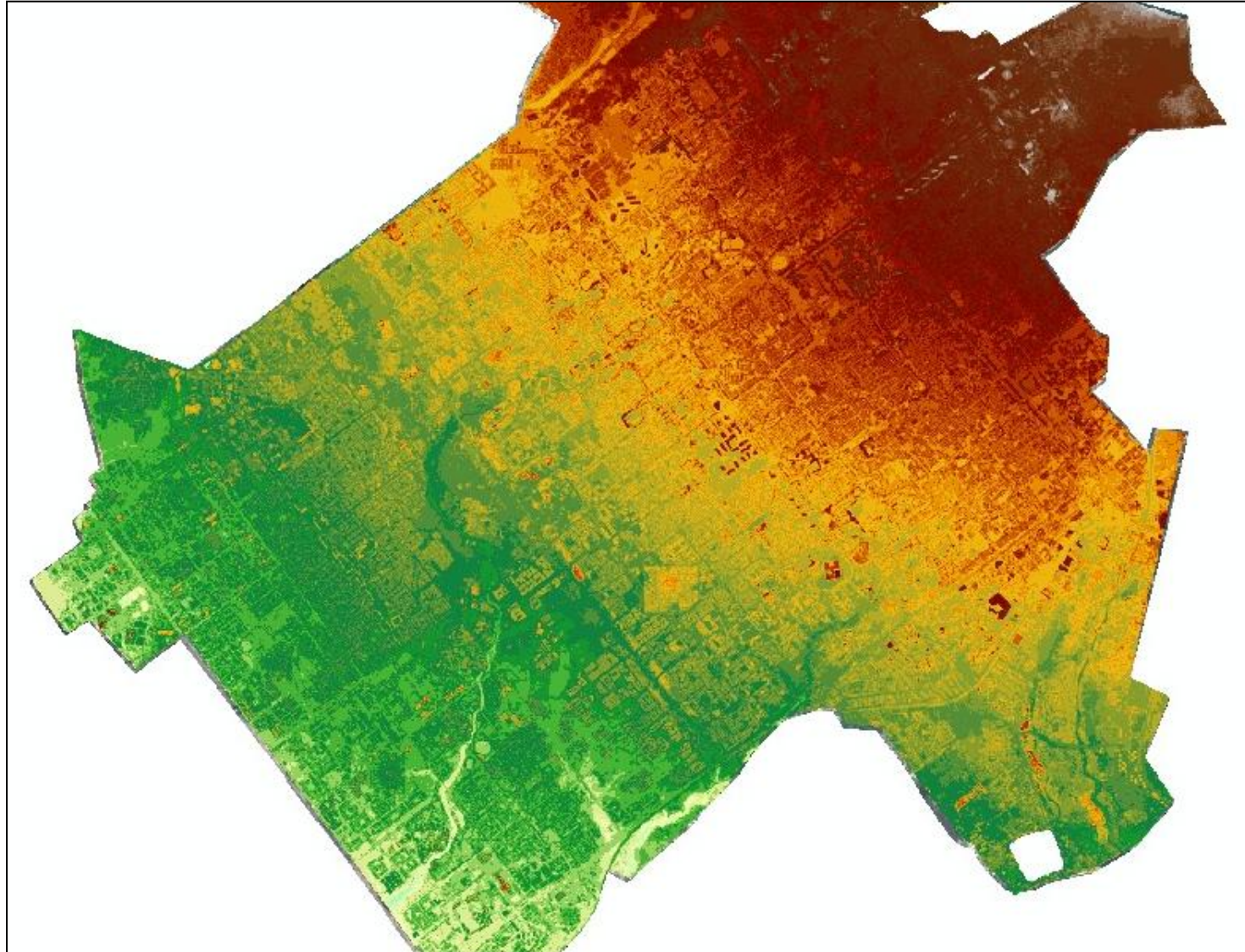
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# 7 Digital Surface Model (DSM) for Chandigarh



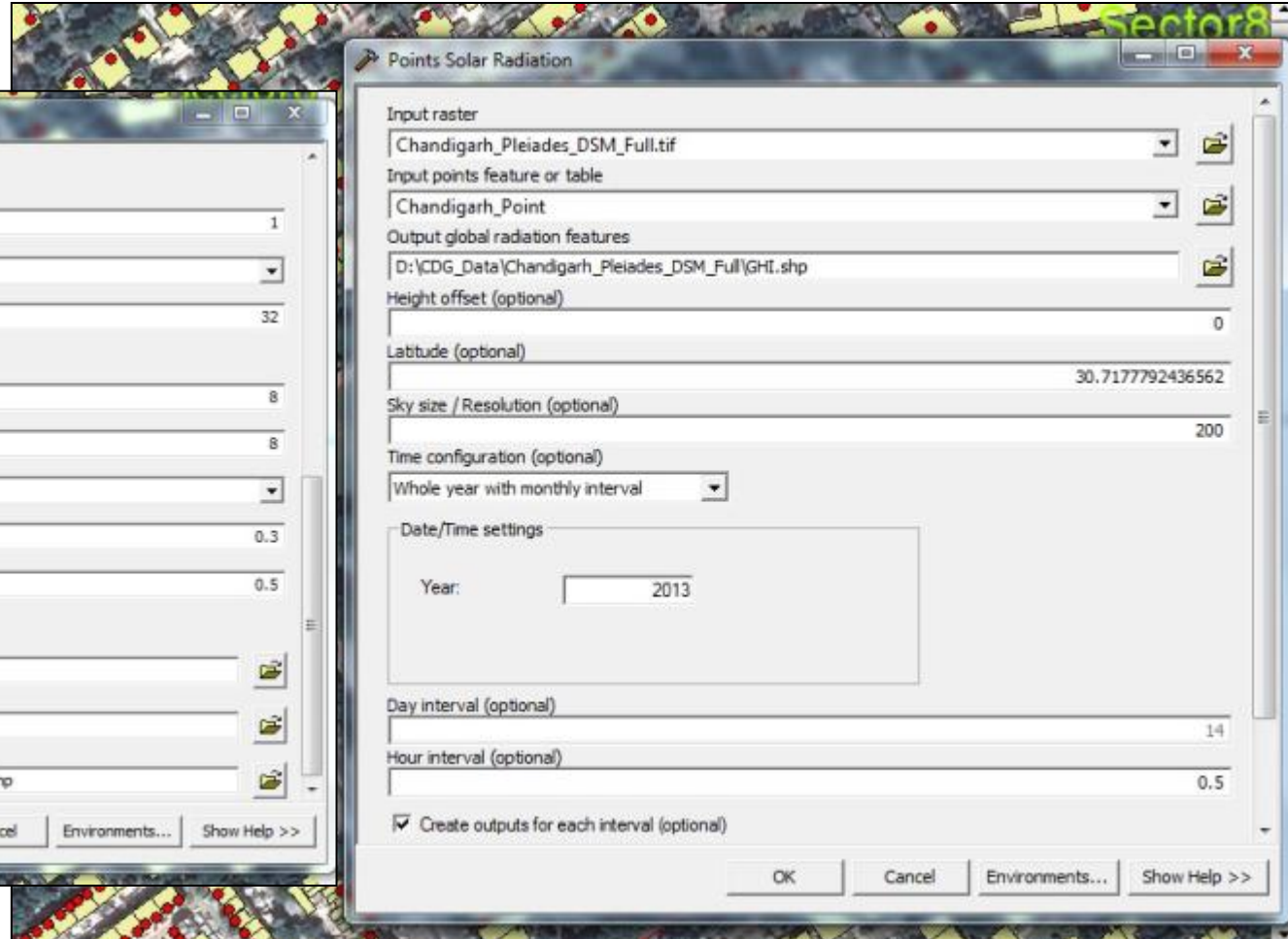
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# Solar Radiation Analyst



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ESRI ArcGIS Solar Radiation Tools:

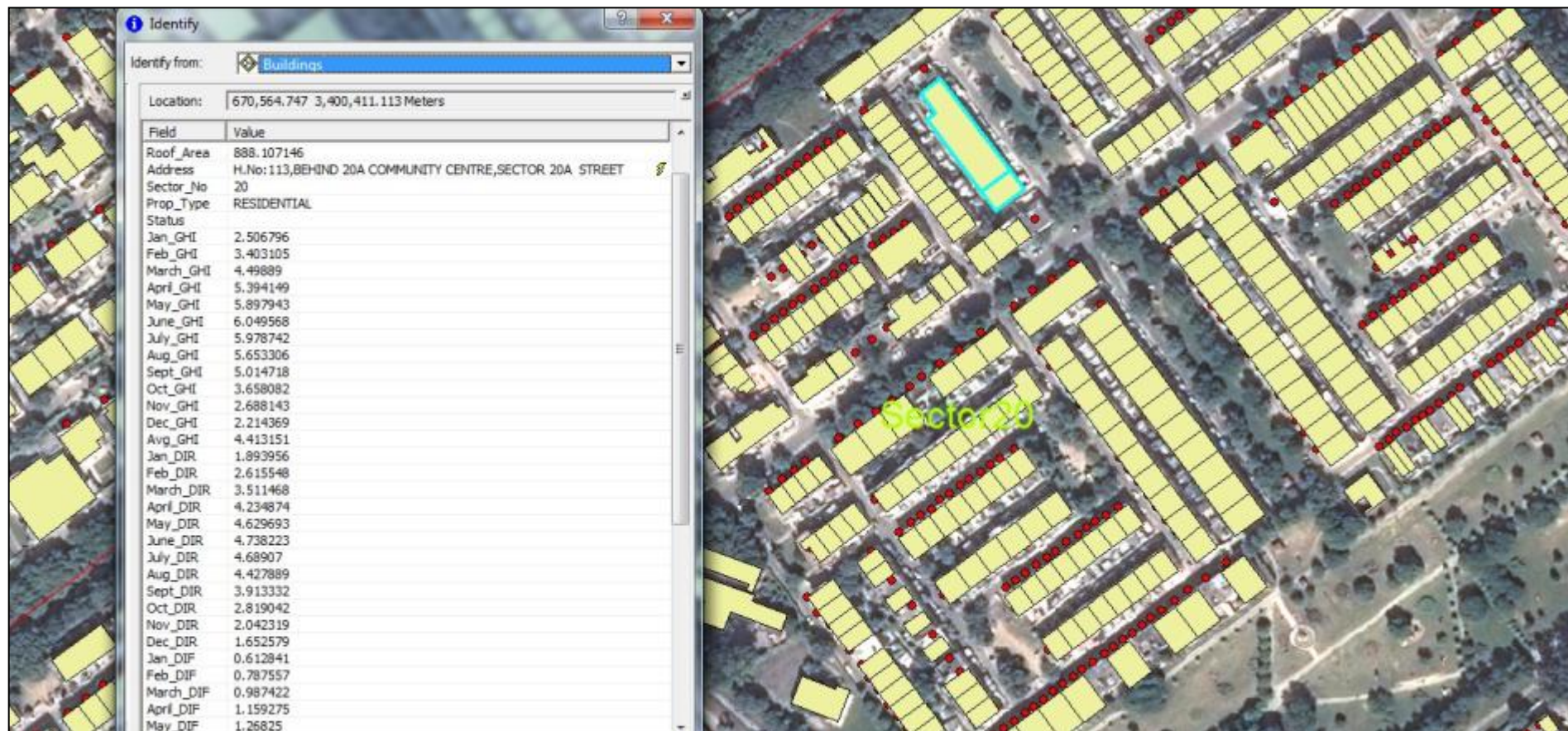
[http://resources.arcgis.com/en/help/main/10.1/index.html#/An overview of the Solar Radiation tools/009z000000t4000000/](http://resources.arcgis.com/en/help/main/10.1/index.html#/An%20overview%20of%20the%20Solar%20Radiation%20tools/009z000000t4000000/)



# Rooftop Area and Solar Radiation



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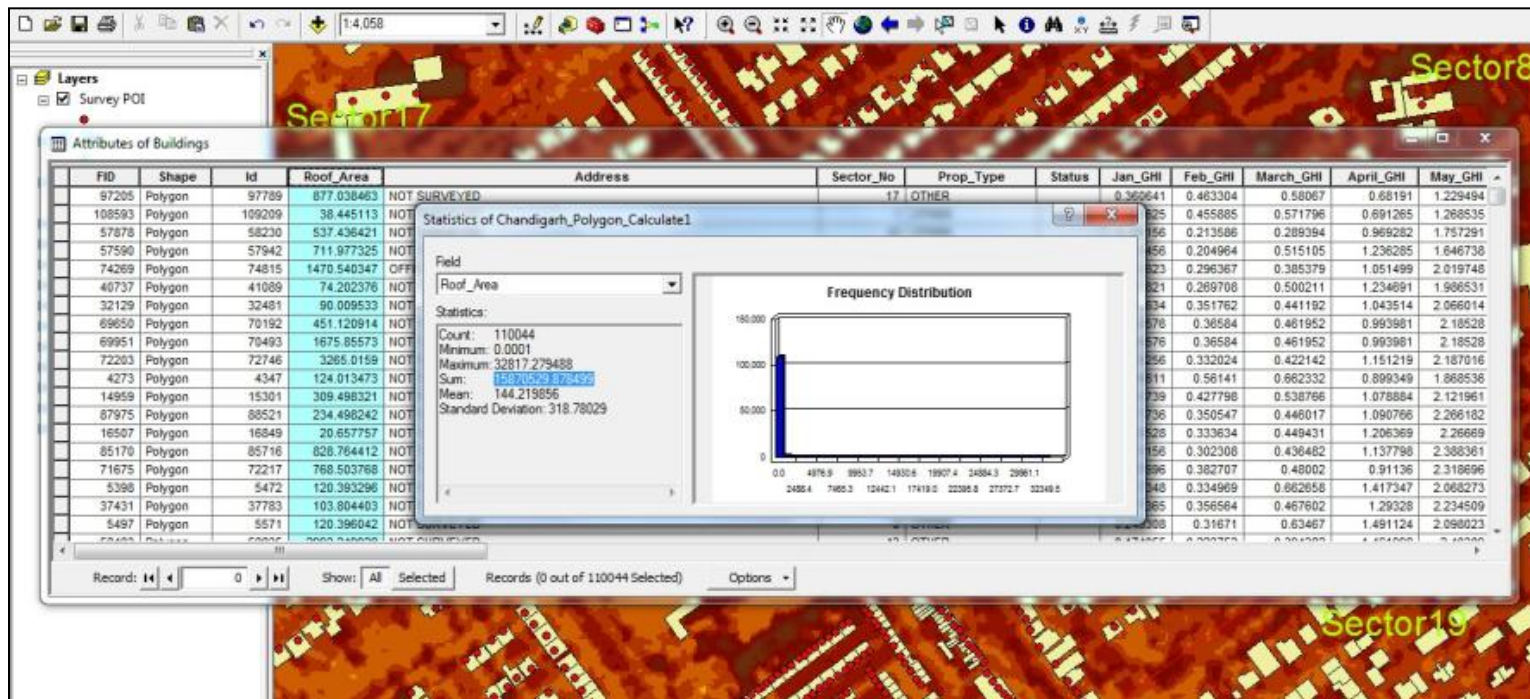


# Analysis Results: Chandigarh Area



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- ✓ Total Buildings Surveyed (Nos.): 14,000 (approx.) ## ##To be crossed-checked.
- ✓ Total Rooftop Digitized (Nos.): 1,10,500 (approx.) ##
- ✓ Potential Roof Area (70%) for Solar PV (Area > 10 Sq-M && GHI > 4kWh/m<sup>2</sup>/Day): 4 Sq-Kms. (approx.) ##
- ✓ Ground Validation for actual Roof Area, and Solar Radiation: 50-60 Samples (approx.)
- ✓ Validation using Solar PV Generation Data: 5-10 Samples (approx.), TBD.



# Using Open-Source GIS and What's new in this study?



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- ✓ **Web Application: Open Layers, Ext-JS, Geo-Ext, PHP, and Ajax;**
- ✓ **Open-Source GIS Server: Geo-Server, and Map-Server;**
- ✓ **Open Geo-Database: PostgreSQL with PostGIS;**
- ✓ **Tile-Server Caching, Cloud based, and Publicly Accessible.**

# Rooftop Solar Web-GIS Tool (Beta)



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regisindia.teriin.org/solar/Solar-WebGIS.php

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

**teri**  
The Energy and Resources Institute

First-of-kind Cloud based Open-Source Web-GIS Architecture for estimating the Rooftop Solar Power potential for Chandigarh Solar City

An Initiative Supported by **SHAKTI**  
SUSTAINABLE ENERGY FOUNDATION

admin@regisindia.com

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Source: <http://regisindia.teriin.org/solar/Solar-WebGIS.php>

# Rooftop Solar Web-GIS Tool (Home Page)



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regisindia.teriin.org/solar/index.php

Google

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

Login

Username

Password

Login

[CREATE AN ACCOUNT](#)

## Create New Account

Contact No.\*

Address Line1\*

Sector\*

State\*

City/District\*

Country\*

-----Select Sector----- ▾

-----Select State----- ▾

India

I agree to the [Terms & Conditions for Service](#) For Solar Web-GIS Tool

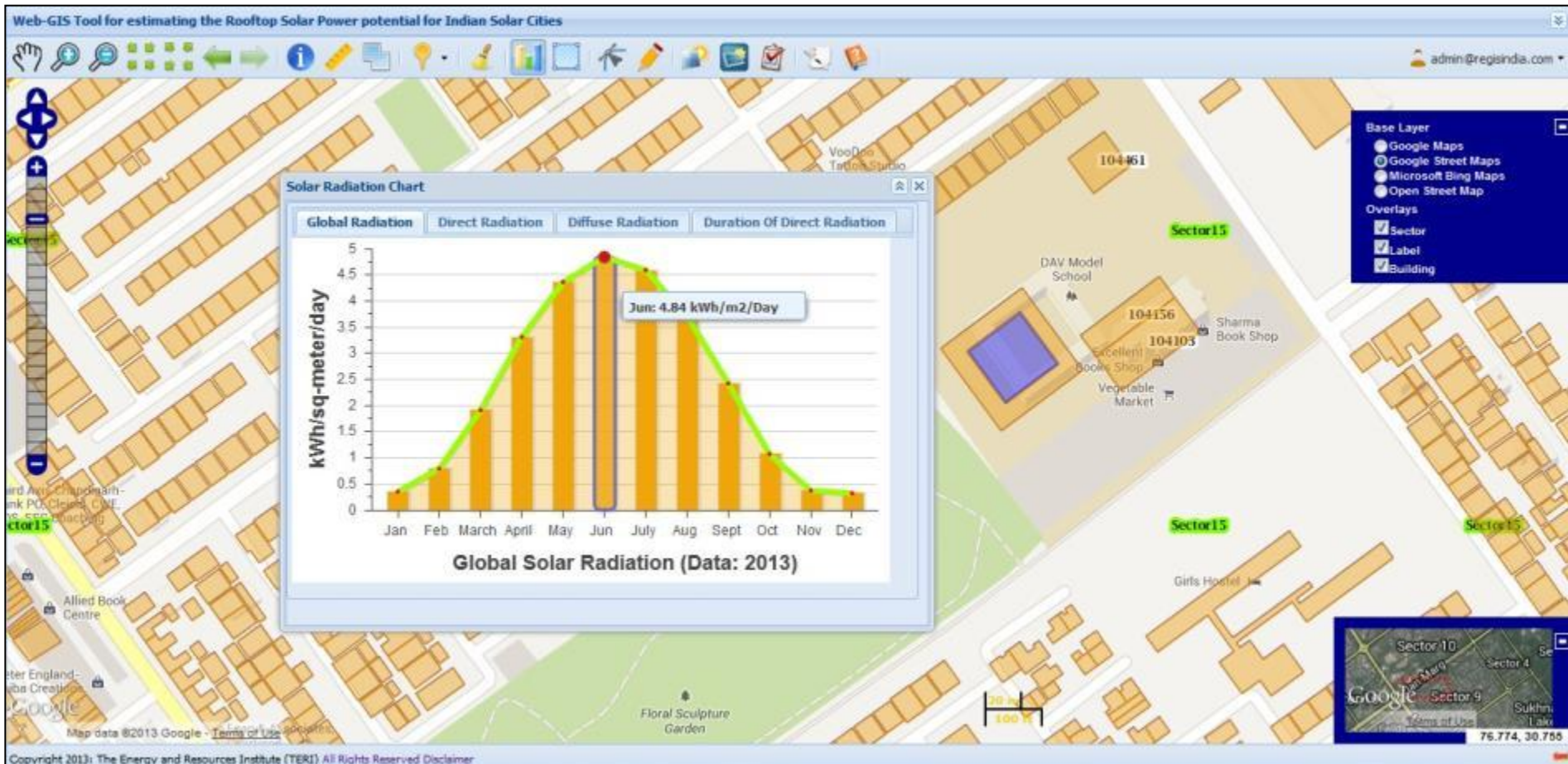
Submit

Reset

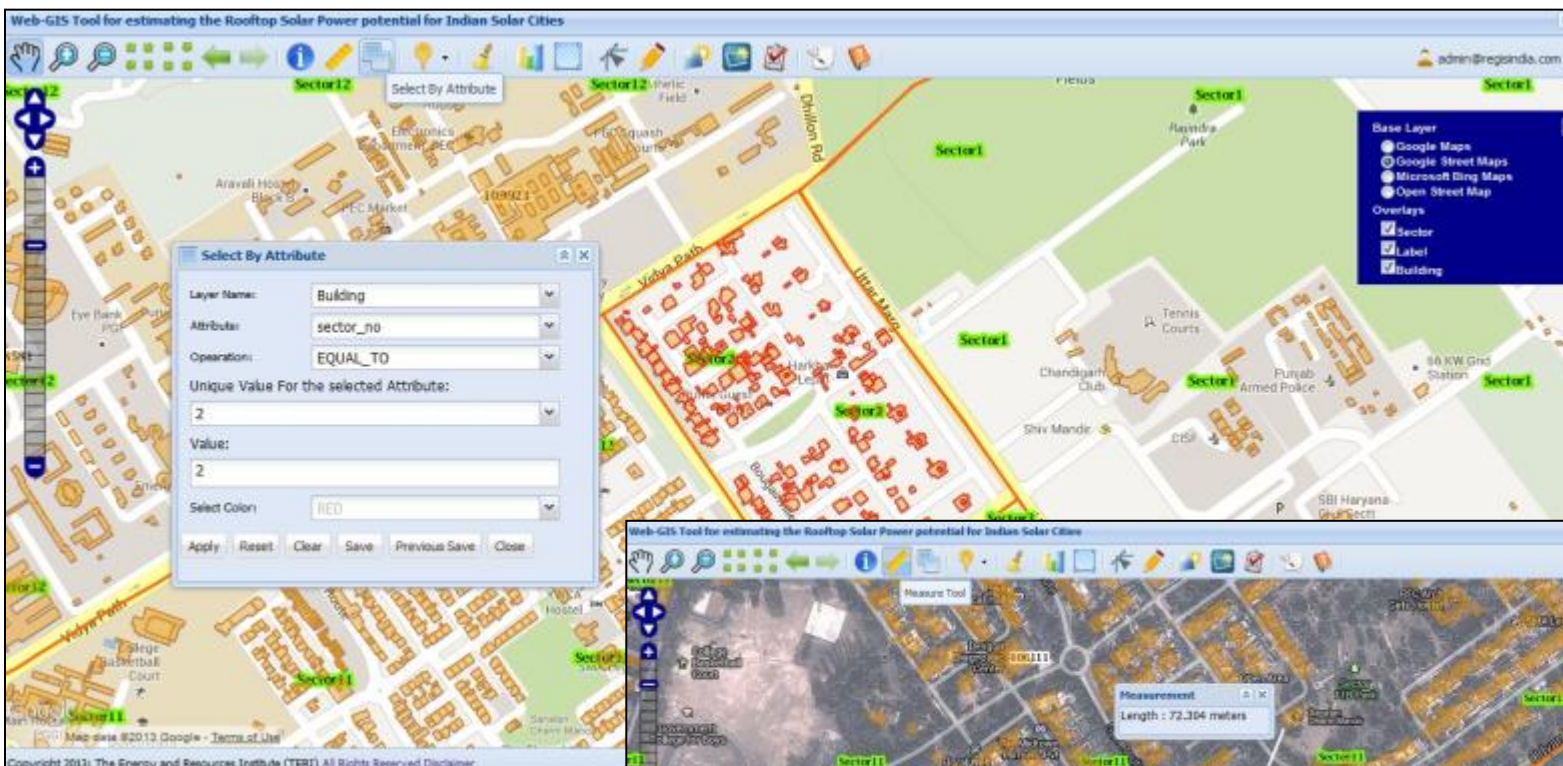
# Rooftop Solar Web-GIS Tool (Base Maps)



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Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities



Select By Attribute

Layer Name: Building

Attribute: sector\_no

Operation: EQUAL\_TO

Unique Value For the selected Attribute: 2

Value: 2

Select Color: RED

Apply Reset Clear Save Previous Save Close

Base Layer

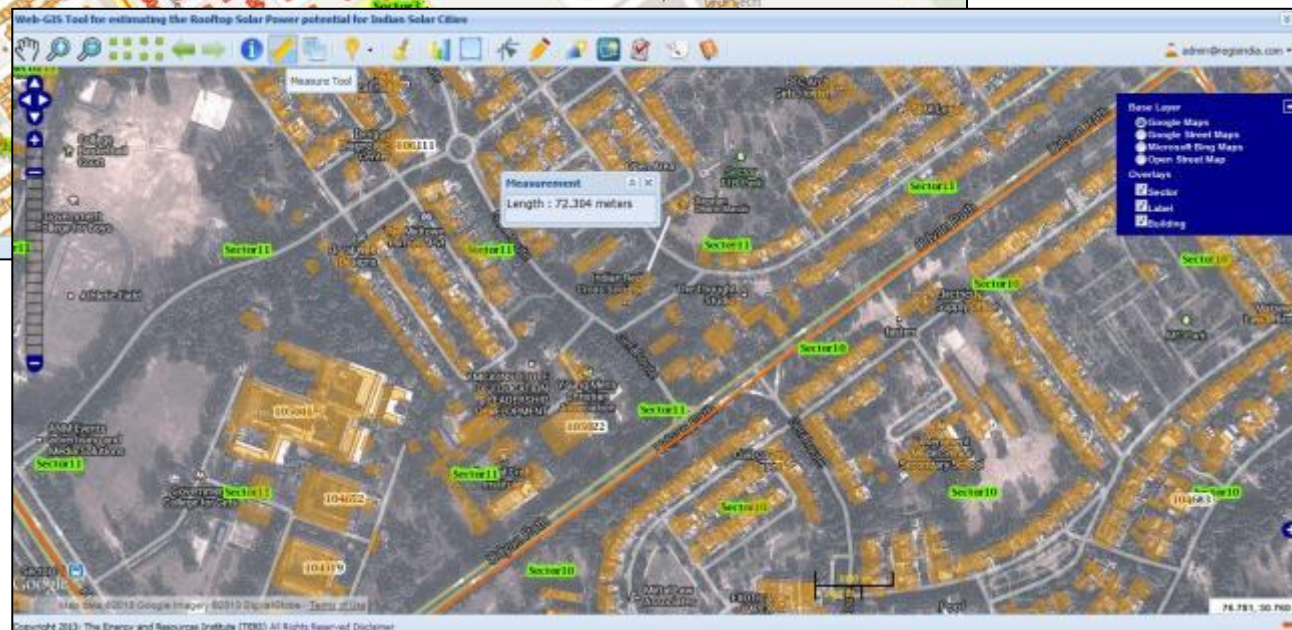
- Google Maps
- Google Street Maps
- Microsoft Bing Maps
- Open Street Map

Overlays

- Sector
- Label
- Building

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Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities



Measurement

Length: 72.364 meters

Base Layer

- Google Maps
- Google Street Maps
- Microsoft Bing Maps
- Open Street Map

Overlays

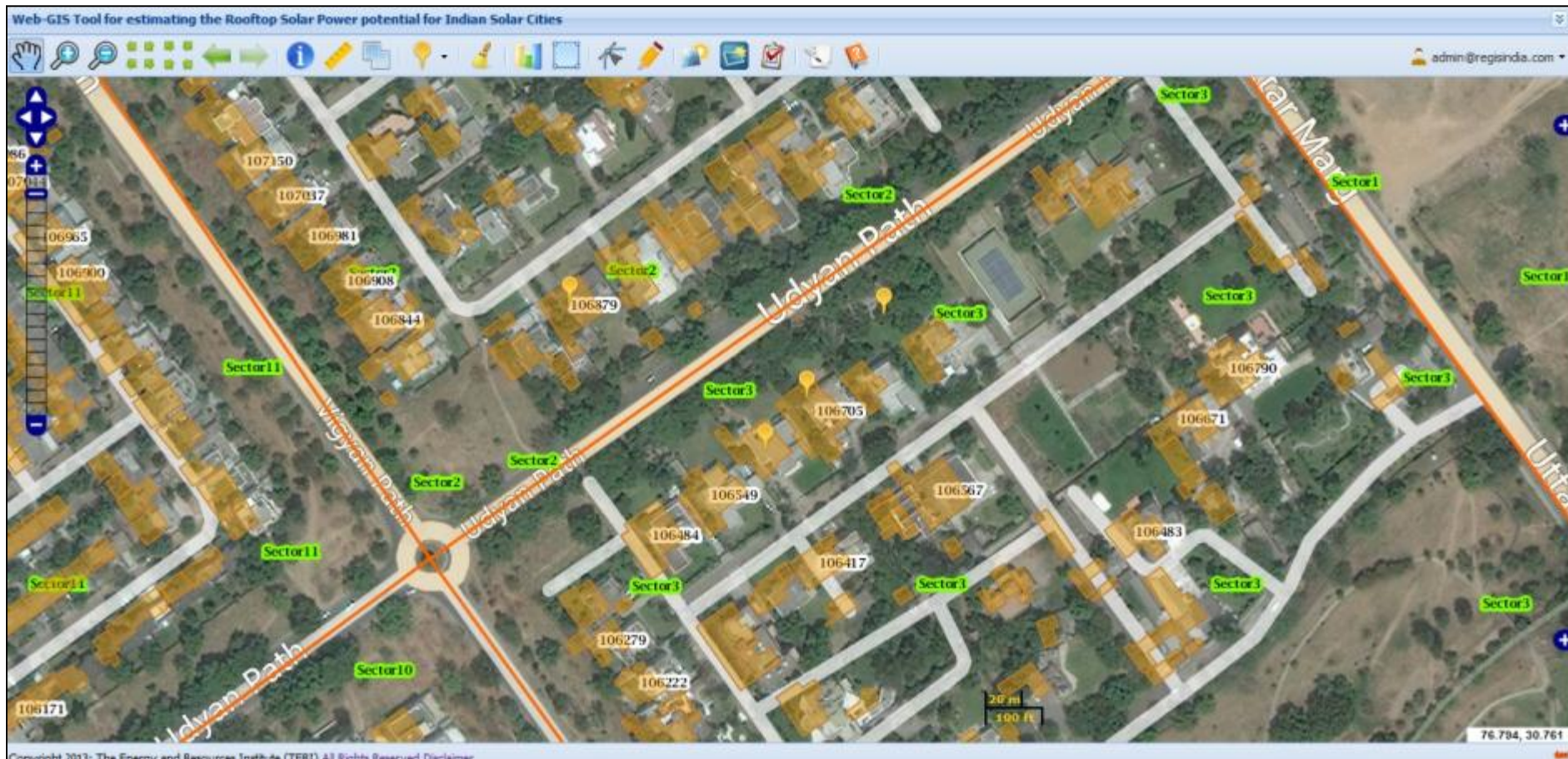
- Sector
- Label
- Building

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# Rooftop Solar Web-GIS Tool (Placeholder)



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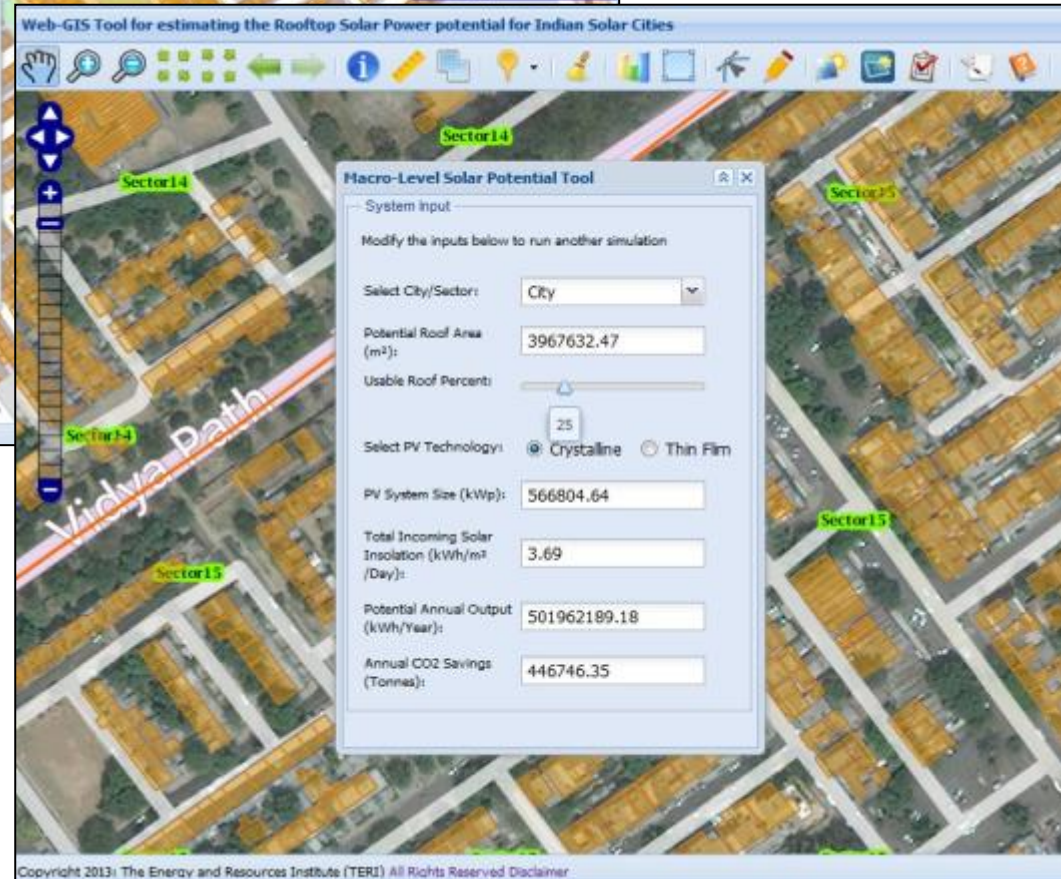
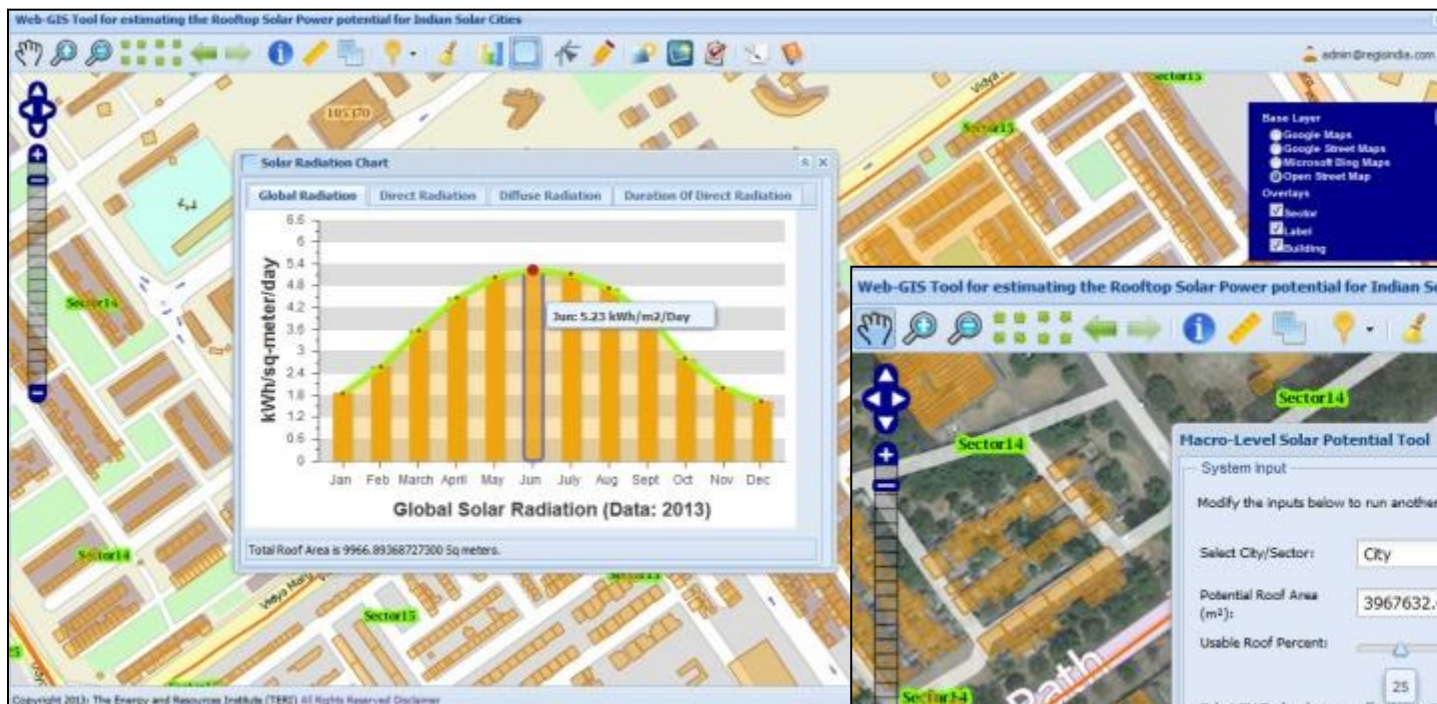




# Rooftop Solar Web-GIS Tool (Core Tools)



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regisindia.teriin.org/solar/Solar-WebGIS.php

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

Simulation Model Calculation Tool

admin@regisindia.com

### Solar Simulation Model Calculation Tool

Modify the inputs below to run another simulation:

Potential Roof Area (m<sup>2</sup>):

Usable Roof Percent:

Select PV Technology:  Crystalline  Thin Film

Select System Type:  Grid-Tied  Off-Grid

System Cost per Watt:

PV System Size (kWp):

Building Type:

Electricity Unit Rate (INR):

Tilt Angle (Deg.):

#### System Output

Total Incoming Solar Insolation (kWh/m<sup>2</sup>/Day):

Potential Annual Output (kWh/Year):

Potential Cost Savings (INR):

Annual CO<sub>2</sub> Savings (Tonnes):

Potential System Cost (INR):

Subsidy/Incentive (%):

Capital Investment (INR):

Payback (in Yrs.):

#### System Output

This table shows the amount of electricity(KWh) generated by this system each month, and the amount in INR that those values translate into.

| Month     | Output (KWh) | Value* (INR) |
|-----------|--------------|--------------|
| January   | 270.374      | 2162.992     |
| February  | 246.863      | 1974.906     |
| March     | 305.64       | 2445.121     |
| April     | 352.662      | 2821.294     |
| May       | 352.662      | 2821.294     |
| June      | 317.396      | 2539.164     |
| July      | 246.863      | 1974.906     |
| August    | 293.885      | 2351.078     |
| September | 293.885      | 2351.078     |
| October   | 293.885      | 2351.078     |
| November  | 270.374      | 2162.992     |
| December  | 282.129      | 2257.035     |

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# Solar Simulation Model (Report)



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The Energy and Resources Institute

First-of-kind Cloud based Open-Source Web-GIS Architecture for  
estimating the Rooftop Solar Power potential for Chandigarh Solar City



An Initiative Supported by

**SHAKTI**  
SUSTAINABLE ENERGY  
FOUNDATION

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| Description                                               | Value        |
|-----------------------------------------------------------|--------------|
| Address                                                   | NOT SURVEYED |
| Potential Roof Area (m <sup>2</sup> )                     | 32.8         |
| Usable Roof Percent                                       | 50           |
| PV Technology                                             | Crystalline  |
| System Type                                               | Grid-Tied    |
| System Cost Per Watt                                      | 80           |
| PV System Size (kWp)                                      | 4.69         |
| Building Type                                             | RESIDENTIAL  |
| Electric Unit Rate(INR)                                   |              |
| Tilt Angle (Deg.)                                         |              |
| Total Incoming Solar Insolation (kWh/m <sup>2</sup> /Day) |              |
| Potential Annual Output (kWh/Year)                        |              |
| Potential Cost Savings (INR)                              |              |
| Annual CO2 Savings (Tonnes)                               |              |
| Potential Annual System Cost (INR)                        |              |
| Subsidy/Incentive (%)                                     |              |
| Capital Investment (INR)                                  |              |
| Payback (In Yrs.)                                         |              |

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

| Email-ID        | Address  | Roof Area     | Usable Roof Percent | PV Technology | System Cost |
|-----------------|----------|---------------|---------------------|---------------|-------------|
| admin@regand... | Sector 2 | 317.394743886 | 100                 | Crystalline   | 80          |
| admin@regand... | Sector 2 | 206.26        | 25                  | Crystalline   | 80          |
| admin@regand... | Sector 2 | 32.8          | 50                  | Crystalline   | 80          |

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Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

admin@regisindia.com

Map showing Rooftop Solar Power potential for Indian Solar Cities. The map displays buildings with yellow/orange roofs and green labels for sectors (Sector 1, Sector 2, Sector 11, Sector 12). Streets shown include Vidya Path, Vigyan Path, and Jantar Mantra. A building with ID 108275 is highlighted in blue.

**Editing Tool**

Save Delete

**Building Details**

Building Details Global Radiation Direct Radiation

Building Details

Address\*:

Sector\*:

Building Height\*:

Building Type\*:

Next>>

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20 m  
200 ft

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

admin@regsindia.com

About Rooftop Solar WebGIS Tool

Base Layer

- Google Maps
- Google Street Maps
- Microsoft Bing Maps
- Open Street Map

Overlays

- Sector
- Label
- Building

About Project

About FAQ Feedback

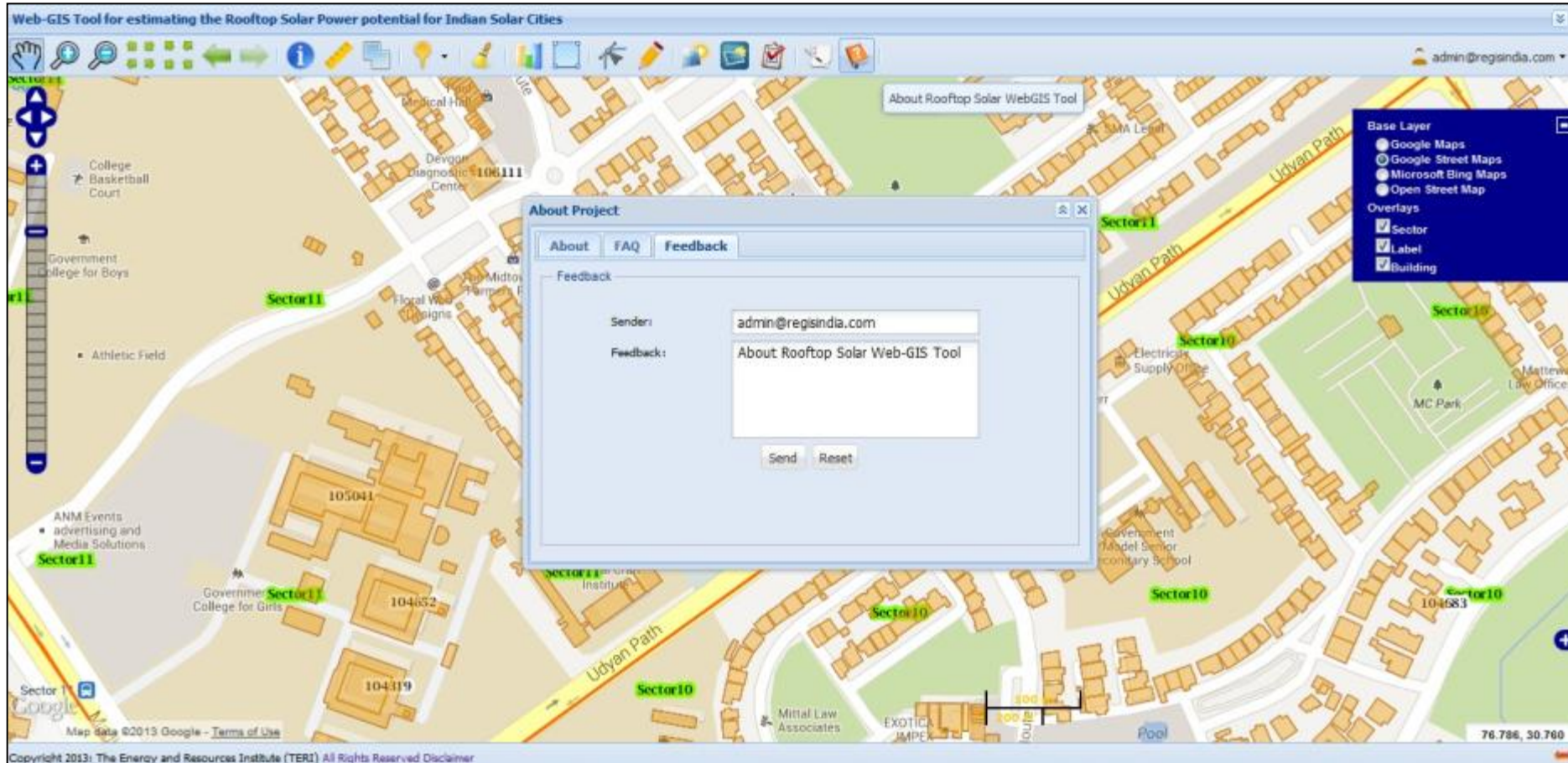
Feedback

Sender: admin@regsindia.com

Feedback: About Rooftop Solar Web-GIS Tool

Send Reset

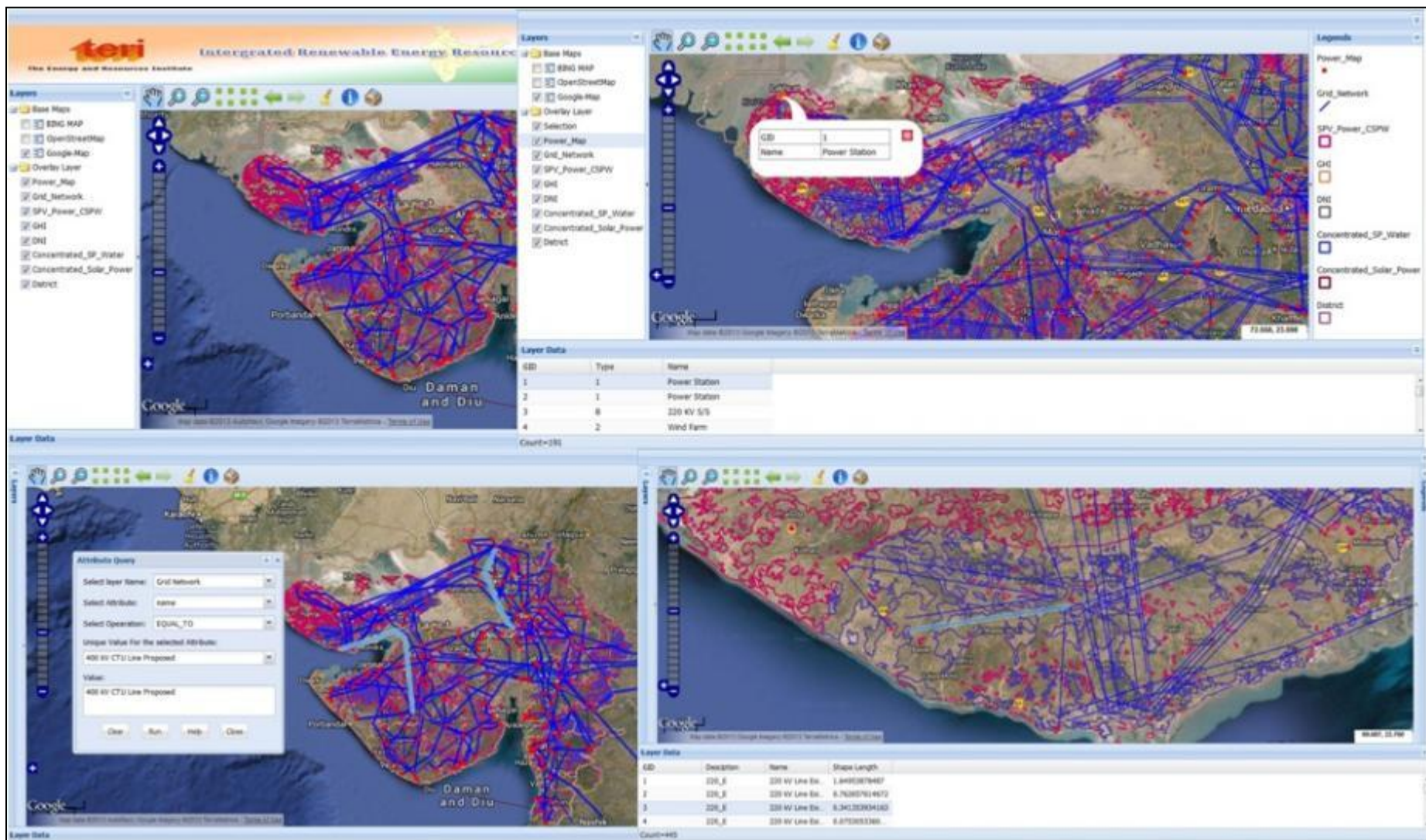
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# Web-GIS based Renewable Energy Atlas for Gujarat (Ongoing Project)



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# Rooftop Solar Web-GIS Tool for NCT-Delhi (Proof of Concept)



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Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

First-of-its-kind Cloud based Open-Source Web-GIS Architecture for estimating the Rooftop Solar Power potential for NCT-Delhi

The Energy and Resources Institute

adm@res.in

Base Layer

- Google Maps
- Google Street Maps
- Microsoft Bing Maps
- Open Street Map

Overlays

- Sector
- Label
- Building

Address: Connaught Place New Delhi, Delhi 110001, India, Sector-0

Property Type: Residential

Property Area (Sq.Mtr): 2479

Property Area (Morla): 118.4962

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Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities

Simulation Model Calculation Tool

Global Radiation Chart

Global Radiation: Direct Radiation: Diffuse Radiation: Downward GPF

kWh/m<sup>2</sup>-meter/day

Jan Feb March April May Jun July Aug Sept Oct

Global Solar Radiation (Data: 2013)

Solar Simulation Model Calculation Tool

System Input

Modify the inputs below to run another simulation:

Potential Roof Area (m<sup>2</sup>): 90.6

Usable Roof Percent: [Slider]

Select PV Technology:  Crystalline  Thin Film

Select System Type:  Grid-Tied  Off-Grid

System Cost per Watt: 80

PV System Size (kWp): 12.34

Building Type: Commercial

Electricity Unit Rate (₹/kWh): 6

Tilt Angle (°): 13.0290

System Output

Total Incoming Solar Irradiation (kWh/m<sup>2</sup>/Day): 5.1899

Potential Annual Output (kWh/Year): 18924.8

Potential Cost Savings (₹/kWh): 90149

Annual CO2 Savings (Tonnes): 14.26

Potential System Cost (₹/kW): 1035200

Subsidy Incentive (%): 40%

Capital Investment (₹/kW): 621120

Payback (in Yrs.): 6.48

System Output

This table shows the amount of electricity (kWh) generated by the system each month, and the amount in ₹ that these values translate into.

Month Output (kWh) Value\* (₹)

| Month     | Output (kWh) | Value* (₹) |
|-----------|--------------|------------|
| January   | 1226.575     | 7371.452   |
| February  | 1121.743     | 6730.456   |
| March     | 1286.624     | 8320.946   |
| April     | 1402.49      | 9014.938   |
| May       | 1602.49      | 9614.938   |
| June      | 1442.241     | 8653.444   |
| July      | 1121.743     | 6730.456   |
| August    | 1335.498     | 8012.488   |
| September | 1335.498     | 8012.488   |
| October   | 1335.498     | 8012.488   |
| November  | 1226.575     | 7371.452   |
| December  | 1281.992     | 7691.95    |

Export Results Submit Enquiry System Output Local Installer

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# RE-GIS India (Website Highlights)



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teri Geo-Spatial Gateway for estimating Renewable Energy potential

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HOME ROOFTOP SOLAR WEB-GIS TOOL RE-GIS ATLAS KNOWLEDGE CENTRE TECHNOLOGY IMPORTANT WEBSITES

## GIS: Designing Our Future

Welcome to the Renewable Energy Geo-Spatial Gateway of India (RE-GIS India)..!

**Expert Exchange/Blogs**

- An overview of E2E ArcGIS Solar Radiation Tools
- Calculation of Solar Resource using Point Solar Radiation Tool (Solar Analyst)
- Understanding Solar Radiation Analysis
- How Solar Radiation is calculated
- Discovering the World Through GIS

**Related Projects**

- Rooftop Solar Web-GIS Tool for India **NEW**
- International Projects on Web-based Solar Photovoltaic Mapping Tools
- GIS for Renewable Energy

**Featured News**

- Beta Version of Rooftop Solar Web-GIS Tool will be Released soon with enriched Chandigarh Data-sets
- First Demonstration has been completed including comments from various Stakeholders for Rooftop Solar Web-GIS Tool **NEW**
- GIS Field Survey activity has already been initiated for Chandigarh Area
- GIS Data collection process has been started for Chandigarh Area
- Draft Copy of Software Requirement Specification (SRS) Document for Rooftop Solar Web-GIS Tool

**Renewable Energy Gyan Manthan**

- RE Gyan: WRI Sustainability Portal by TERI Gateways to Sustainable Development
- Discussion Forum: Youth Connect
- Online Survey:
  - Household Level Electricity Survey
  - Industry Survey on Smart Grid Capabilities in India
- Quick Connect Quiz
- Guidance GIS Day **NEW**

**FORTECOMING EVENTS**

First Stakeholders Workshop for the Demonstration of Rooftop Solar Web-GIS Tool  
20/12/2013  
Chandigarh  
Rooftop Solar Web-GIS Tool  
Demonstration Workshop for Official Launching  
14/01/2014  
New Delhi

**FORTECOMING TRAINING PROGRAMS**

First Training Programme on Rooftop Solar Web-GIS Tool  
17/01/2014  
New Delhi

Second Training Programme on Rooftop Solar Web-GIS Tool  
24/01/2014  
New Delhi

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EMAIL \*

**EVENTS CALENDAR**

Oct 2013

| M  | T  | W  | T  | F  | S  | S  |
|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  |    |
| 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 |    |    |    |    |

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## International Projects on Web-based Solar Photovoltaic Mapping Tools

**Rooftop Solar Web-GIS Tool**

Web-GIS Tool for estimating the Rooftop Solar Power potential for Indian Solar Cities  
First-of-kind Cloud based Open-Source Web-GIS Architecture for Solar Energy Applications in India  
Phase-I Chandigarh Solar City

**FORTECOMING EVENTS**

Demonstration of Rooftop Solar Web-GIS Tool  
20/12/2013  
Chandigarh  
Rooftop Solar Web-GIS Tool  
Demonstration Workshop for Official Launching  
14/01/2014  
New Delhi

**FORTECOMING TRAINING PROGRAMS**

First Training Programme on Rooftop Solar Web-GIS Tool  
17/01/2014  
New Delhi

Second Training Programme on Rooftop Solar Web-GIS Tool  
24/01/2014  
New Delhi

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EMAIL \*

**EVENTS CALENDAR**

Oct 2013

| M  | T  | W  | T  | F  | S  | S  |
|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  |    |
| 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 |    |    |    |    |

Map showing Chandigarh Solar City with various locations marked.



# Outcomes from the Study



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for a Sustainable Future

**This proposed Web-GIS tool will be an ideal medium to showcase investors the logistics of rooftop solar energy investment. The proposed tool will have following benefits:**

- ✓ **It will enable user to estimate the rooftop solar power potential of selected area or, buildings for a particular location w.r.t. various SPV technologies (crystalline/thin-film);**
- ✓ **Will act as a Decision Support System (DSS) to carry out the pre-feasibility assessment of putting rooftop PV system for a particular location;**
- ✓ **Will help users to estimate potential GHG mitigation through solar rooftop PV systems for a given locality;**
- ✓ **Assess the viability of any rooftop projects based on possible business models and financial schemes available.**

# Thank You



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