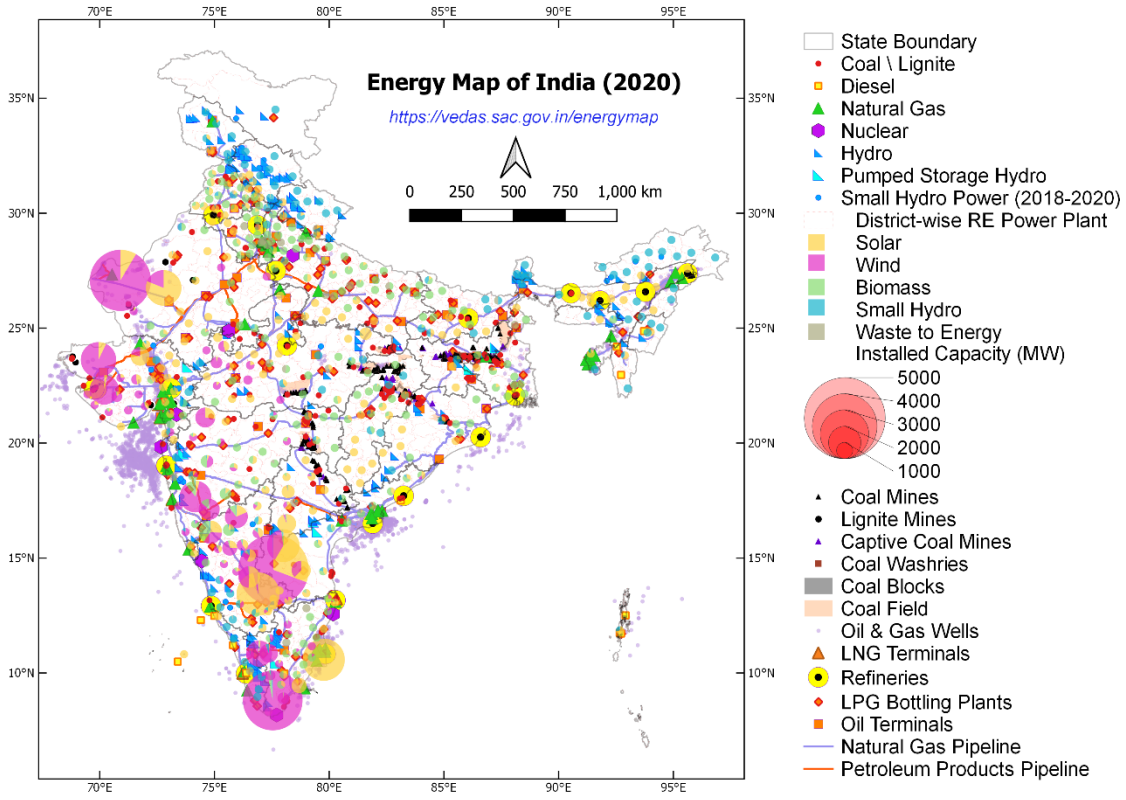
GEOSPATIAL ENERGY MAP OF INDIA

USER GUIDE



Associated Departments & Ministries

Ministry of Power
Ministry of New and Renewable Energy
Ministry of Coal
Ministry of Petroleum and Natural Gases
Department of Atomic Energy

PROJECT TEAM

NITI Aayog

- Dr Rakesh Sarwal, Additional Secretary (Energy)
- Shri Rajnath Ram, Adviser (Energy)
- Shri Navin Kumar Vidyarthi, Director (Energy)
- Ms. Saumya Pandey, Young Professional (Energy)

ISRO Headquarter, Bangalore

- Shri Shantanu Bhatawdekar, Director, EDPO
- Dr P. G. Diwakar. Director, EDPO [till Aug 2020]
- Ms Vijaya Bhanu, Scientist \ Engineer SG

Space Applications Centre, Ahmedabad

- Dr Raj Kumar, Deputy Director, EPSA
- Shri Shashikant Sharma, Group Director, VRG
- Dr Markand Oza, Division Head, CGDD [till Oct 2020]
- Dr Gaurav Jain, Scientist \ Engineer SF
- Ms. Shweta Mishra, Scientist \ Engineer SE
- Shri Pankaj Bodani, Scientist \ Engineer SE
- Shri Arpit Agarwal, Scientist \ Engineer SC

Central Electricity Authority, Ministry of Power

- Shri M. A. K. P. Singh, Chief Engineer (IT)
- Shri Vijay Menghani, Chief Engineer (IT) [till Mar 2020]

Ministry of New & Renewable Energy

- Shri Pankaj Saxena, Scientist F

Coal Controller's Organisation, Ministry of Coal

- Shri Indradeep Roy Chowdhury, Deputy Director

Petroleum Planning and Analysis Cell, Ministry of Petroleum and Natural Gas

- Ms. Anju Mishra, Additional Director (D&ES)
- Shri Rohit Dawar, Additional Director (D&ES) [till Mar 2020]

Department of Atomic Energy

- Shri S. K. Agrawal, SO/G, Member, Nuclear Controls & Planning Wing
- Shri S. M. Basha, SO/G, Member, Nuclear Controls & Planning Wing

Standardisation Testing and Quality Certification Directorate

- Shri Suresh Chandra, Director

National Informatics Centre

- Shri Adarsh Saiwal, Scientist F

TABLE OF CONTENT

1. LIST OF FIGURES

2. EXECUTIVE SUMMARY

2.1 The energy data in India is fragmented and scattered across multiple organisations. While different ministries may have detailed information and maps, about their respective domain of expertise as per mandate, there is no consolidated energy map available in India that may provide a holistic picture of the entire energy sector. Mostly, the available maps are static (i.e. in PDF or JPG formats), and hence inhibit integration with the associated features of topography and other physical infrastructure.

2.2 Geospatial energy map attempts to identify and locate all primary and secondary sources of energy and their transportation/transmission networks to provide a comprehensive view of energy production and distribution in a country. Geographic Information System (GIS) of energy assets will be useful for ensuring real-time and integrated planning of energy sector of India, given its large geographical distribution and interdependence.

2.3 Keeping the above perspective in mind, the NITI Aayog collaborated with Indian Space Research Organisation (ISRO) and signed a Memorandum of Understanding (MoU) on June 07, 2017 to develop a comprehensive GIS-based Energy Map of India. The GIS-based energy map is intended to provide valuable inputs for formulating policies such as National Energy Policy (NEP) and Vision Document - 2035, reviewing such policy interventions, and assisting Energy Ministries in policy formulation, besides encouraging private sector participation in the energy sector.

2.4 The process of developing GIS maps started with a inter-ministerial meeting with Ministry of Coal, Ministry of Power, Ministry of New and Renewable Energy, Ministry of Petroleum and Natural Gas, and Department of Atomic Energy. During the discussions, these ministries were requested to appoint nodal officers to provide relevant information and data coordinates. The data received was collated, validated, verified, corrected and organized in a systematic database.

2.5 The web-based geospatial energy map of India for visualisation of spatial and non-spatial data on renewable and non-renewable power plants, oil and gas downstream sector, renewable energy potential, fossil fuel resources, and other energy assets in India. The access to geospatial energy portal is provided through login credentials for restricted authorised users only. The web-based geospatial energy map of India has been deployed on VEDAS Server at SAC, Ahmedabad.

2.6 The current form of map provides visualisation of static data of over 25 thematic layers. The static data of all types of conventional power plants, including thermal (coal, diesel and natural gas), hydro and nuclear power plants, refineries, LNG terminals, LPG bottling plants, POL terminals, oil and gas wells, coal fields, coal blocks, district-wise

data on renewable energy (including solar, wind, small hydro, biomass & waste to energy plants), and renewable energy resource potential (wind and solar energy) have been organized and published on the energy map.

2.7 The major functionalities in the geospatial energy map of India include visualisation of static and dynamic data, interactive and user-friendly map navigation, pre-composed energy data views, basic feature attribute query, dynamic data visualisation, locating and filtering power plants by text-keywords, state-level energy data visualisation, thematic layer metadata information display, tabular view of attribute tables, and additional tools (upload KML/GPX files, area/distance measurement tools, and tools for feature drawing).

2.8 The geospatial energy portal also has provisions for displaying dynamic data. The dynamic data on power plants (monthly electricity generation), refineries (monthly production), and captive coal mines (monthly production and dispatch) have been included.

2.9 The web-based energy map provides access to several reference layers. These reference layers include Bhuvan WMS of village boundaries, transportation network and high-resolution satellite data, Cartosat-1 DEM, and other base layers such as highways, railway lines, rivers, cities and administrative boundaries.

2.10 A three-tier data updating application has been developed that enables ‘edit-user’ to update attribute data (non-spatial), ‘nodal officer’ to approve or reject the changes, and ‘administrator’ to incorporate the changes in database.

2.11 The GIS-based energy map of India may be useful for geospatial planning of resource. The planning may include infrastructure planning for upcoming solar parks, coal blocks, crude oil and natural gas pipelines, investment guidance for financial institutions, disaster management of possible energy disruption and emergency response, safety of energy assets due to harsh climatic conditions. This may also help in resource and environmental conservation measures, inter-state coordination on infrastructure planning including different corridors of energy and road transport highway.

2.12 India has opened up various aspects of energy exploitation (generation/ conversion/ transmission/ consumption) to private sector. Energy markets have immense potential to bring in efficiency gains. Therefore, GIS-based mapping of energy assets will be advantageous to all concerned stakeholders and will help in accelerating the policy-making process.

3. GEOSPATIAL ENERGY PORTAL: USER GUIDE

3.1 Introduction

Geospatial energy portal provides interactive and user-friendly access to the energy map of India over internet. The major functionalities incorporated in the energy portal are:

a. Visualisation of static energy maps;
b. Interactive and user-friendly map navigation;
c. Pre-defined energy data views;
d. Retrieval of feature information;
e. Dynamic data visualisation of power plants, captive coal mines and refineries;
f. Finding power plants by text-keyword;
g. Visualisation of state energy maps;
h. Drawing and measurement tools; and
i. Three-level mechanism for updating attribute data.

Figure 1 shows the home page of geospatial energy portal. The portal currently permits un-restricted access to metadata, which enables visitors in obtaining basic information on the thematic layers included in the energy map of India.

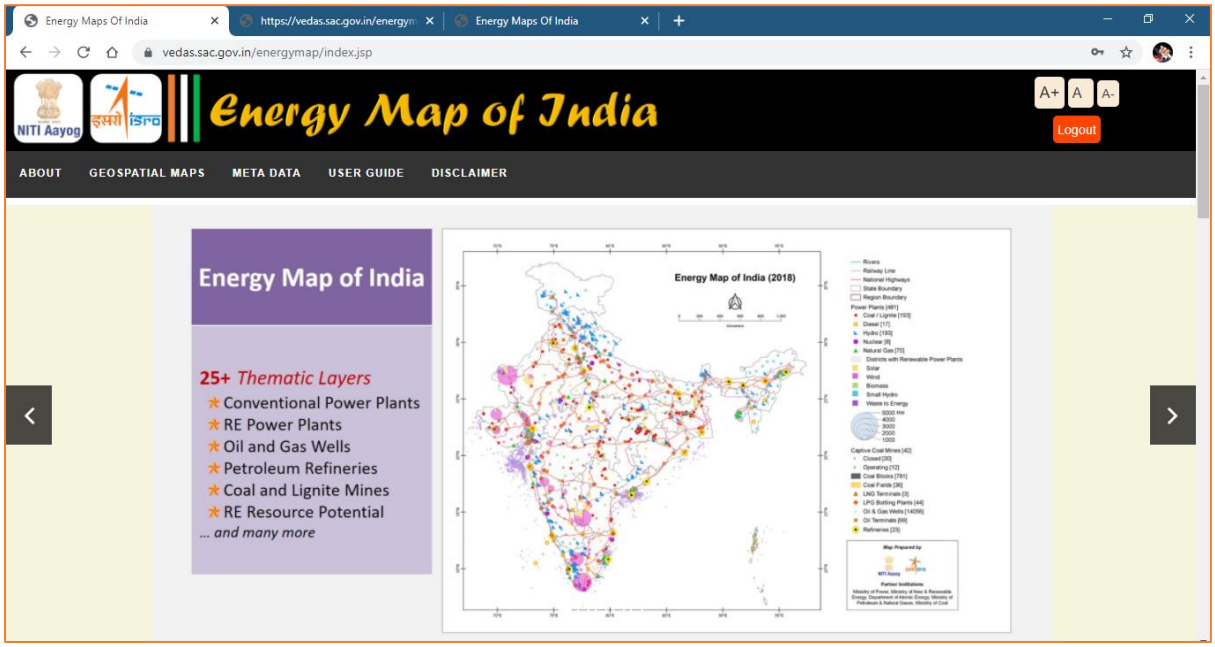


Figure 1: Geospatial Energy Portal Home Page

The access to the geospatial data of energy map of India is currently restricted to the authorized users only. The login screen requests for user name, password and captcha (figure 2).

The request for user account may be forwarded to **Shri Navin Kumar Vidyarthi** (navin.vidyarthi@nic.in), **Director (Energy), NITI Aayog**, through the authorized **Nodal Officers** from the participating ministries / departments, as provided on the website (**figure 9**).

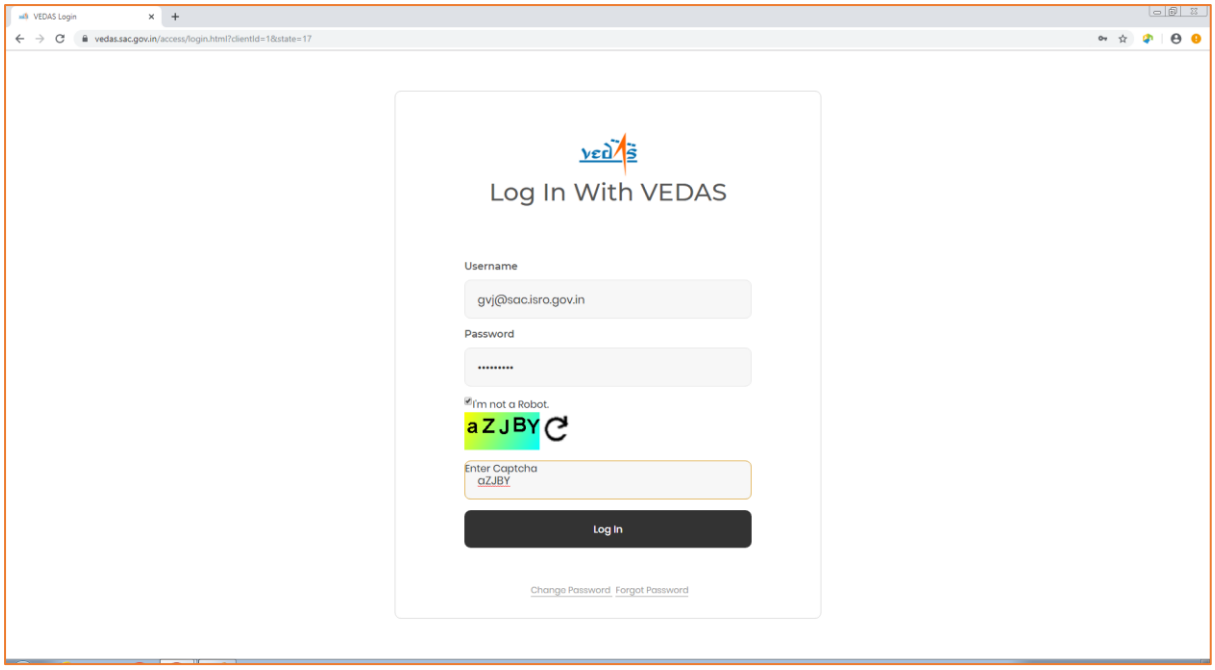


Figure 2: Energy Portal Login Page through VEDAS

The website currently uses the credentials of VEDAS portal for providing access. User is subsequently requested for permission to retrieve profile information from VEDAS account, which will aid in providing personalized content to end users in future.

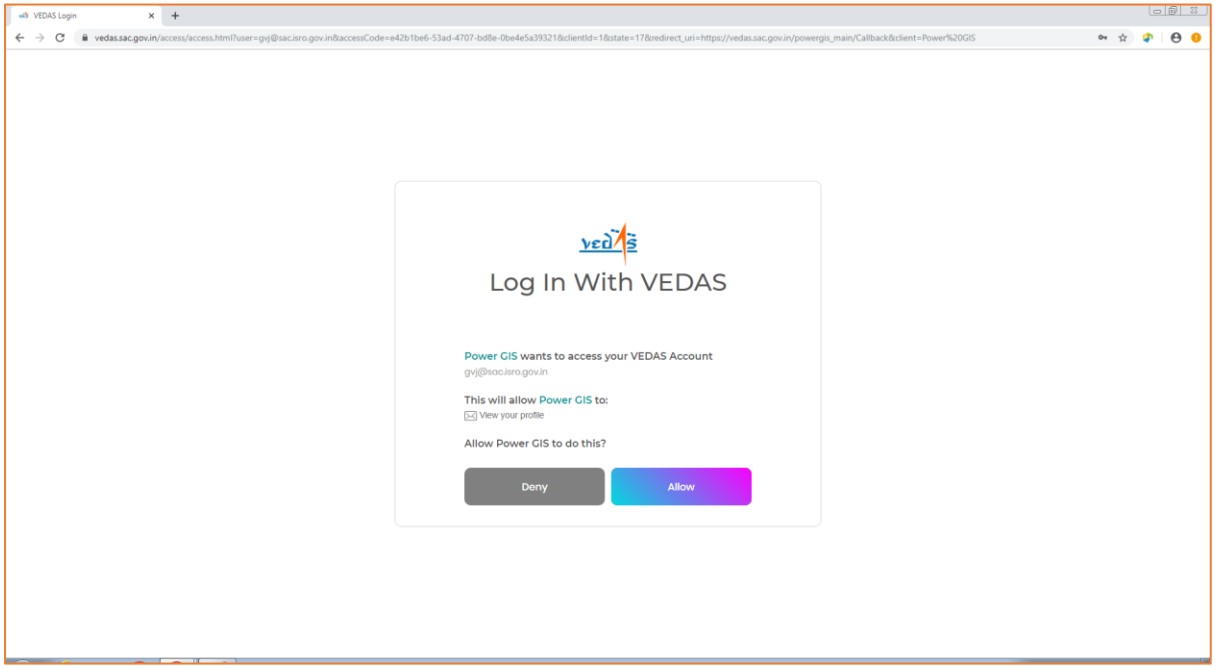


Figure 3: Request for Access to VEDAS Profile

The successful verification of user credentials will enable access to the geospatial energy map of India (figure 4). Accordingly, menu-bar displays a button linking to the maps.

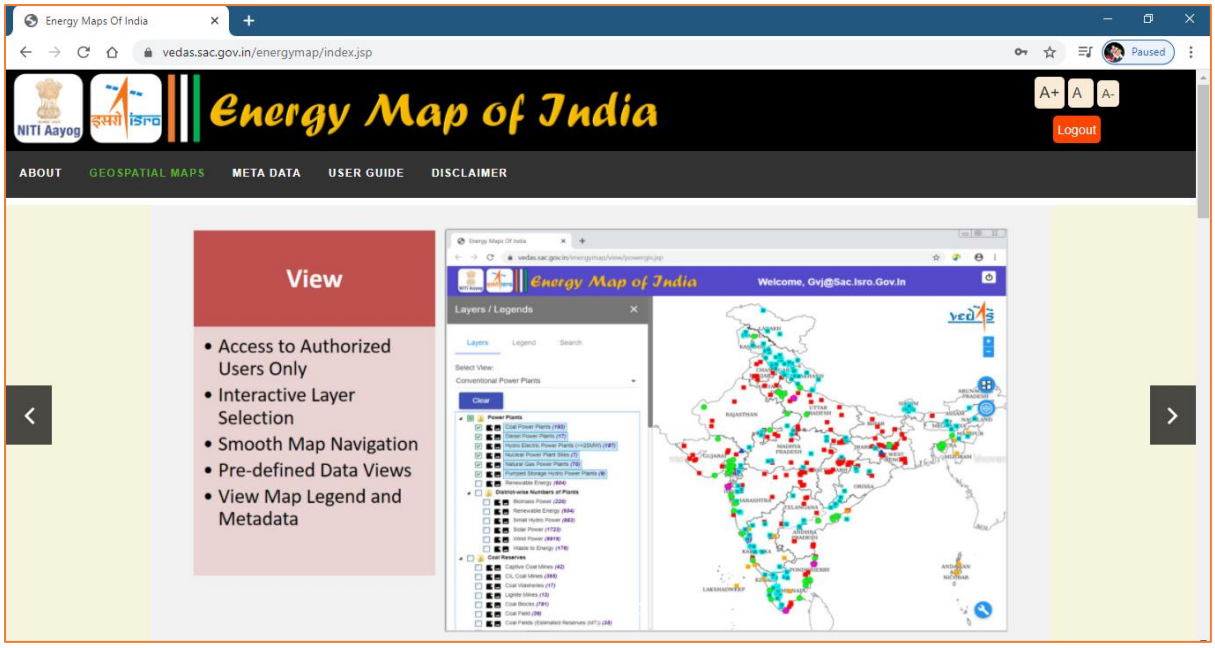


Figure 4: Access to Geospatial Energy Portal on Successful Password Validation

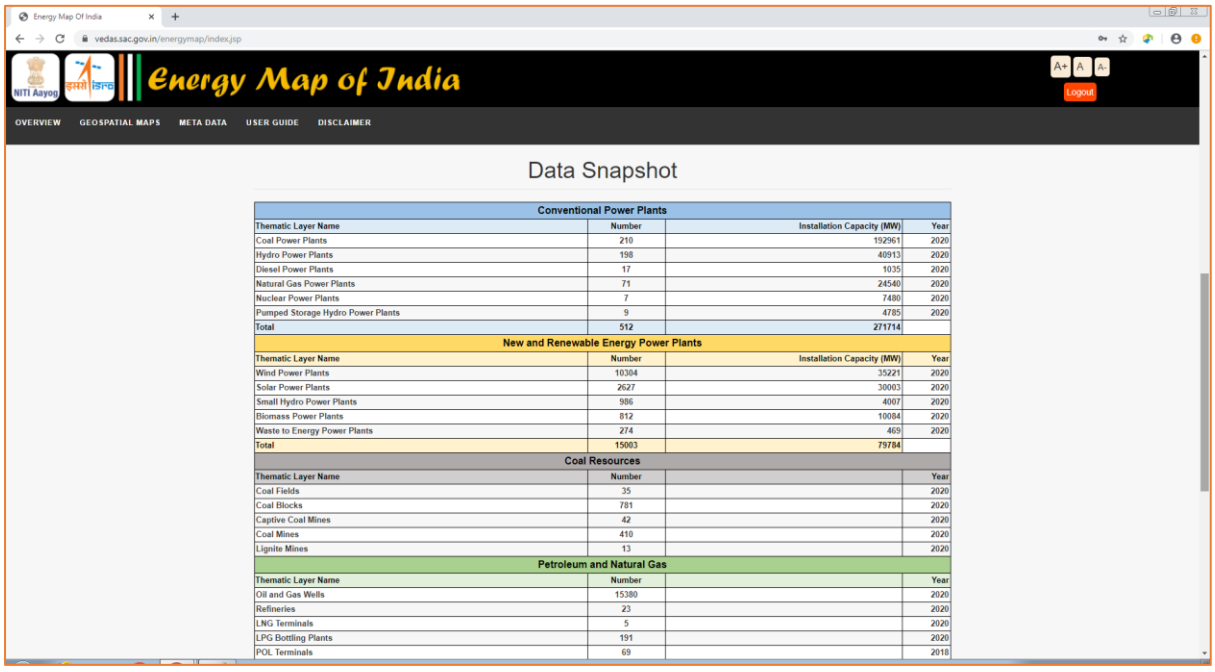
About section on home page provides a brief introduction to the website.

Figure 5: Overview Section

Further details are provided on separate page explaining the need and utility of energy portal from the ‘More Info’ Link or the ‘Overview’ button on menu-bar (figure 6).

Figure 6: About Section

Data Snapshot section on the home page retrieves feature count of the thematic layers (vector) populated in the GIS-based energy map (figure 7).



Conventional Power Plants			
Thematic Layer Name	Number	Installation Capacity (MW)	Year
Coal Power Plants	210	192961	2020
Hydro Power Plants	198	40913	2020
Diesel Power Plants	17	1035	2020
Natural Gas Power Plants	71	24540	2020
Nuclear Power Plants	7	7480	2020
Pumped Storage Hydro Power Plants	9	4785	2020
Total	512	271714	
New and Renewable Energy Power Plants			
Thematic Layer Name	Number	Installation Capacity (MW)	Year
Wind Power Plants	10304	35221	2020
Solar Power Plants	2627	30003	2020
Small Hydro Power Plants	986	4007	2020
Biomass Power Plants	812	10084	2020
Waste to Energy Power Plants	274	469	2020
Total	15003	79784	
Coal Resources			
Thematic Layer Name	Number		Year
Coal Fields	35		2020
Coal Blocks	781		2020
Captive Coal Mines	42		2020
Coal Mines	410		2020
Lignite Mines	13		2020
Petroleum and Natural Gas			
Thematic Layer Name	Number		Year
Oil and Gas Wells	15380		2020
Refineries	23		2020
LNG Terminals	5		2020
LPG Bottling Plants	191		2020
POL Terminals	69		2018

Figure 7: Data Snapshot

Data Partners section on the home page mentions the ministries and department of Government of India that have contributed in development of this website (figure 8). The footer section provides useful links, including the links to NITI Aayog and ISRO.

Figure 8: Data Partners and Useful Links

Each ministry is hyperlinked to respective official website. The List of Nodal Officer is also provided below the information on Ministries (figure 9).

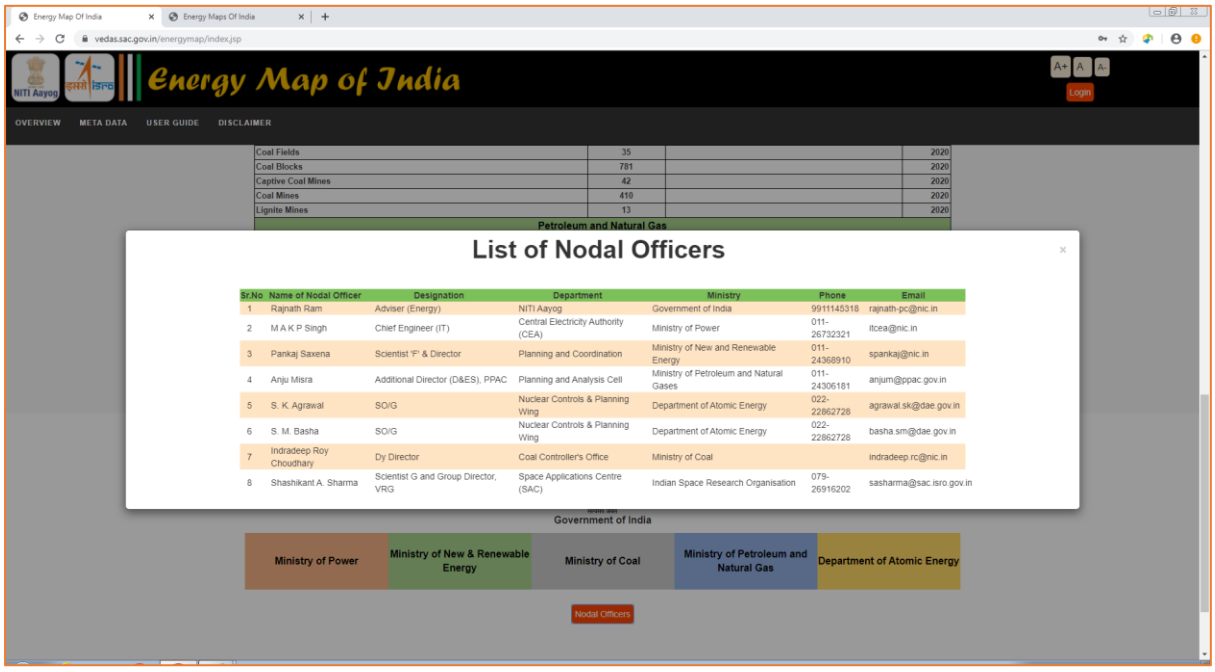


Figure 9: Nodal Officers

The metadata button on home page opens the metadata section. The list of thematic layers related to energy section is populated in the drop-down control. The metadata of selected layer is displayed underneath (figure 10).

Figure 10: Metadata Search

Disclaimer section can be accessed from the button provided in the menu-bar. It explains the limitation of data and its usability (figure 11).

Figure 11: Disclaimer

3.2 Spatial Data Visualisation

The list of all thematic and reference layers is provided in collapsible hierarchical tree format as shown in figure 12. The layers are grouped in seven categories (nodes), viz. power plants, coal reserves, petroleum and natural gas, transmission and distribution layers, renewable energy resources, state-wise information, and reference layers.

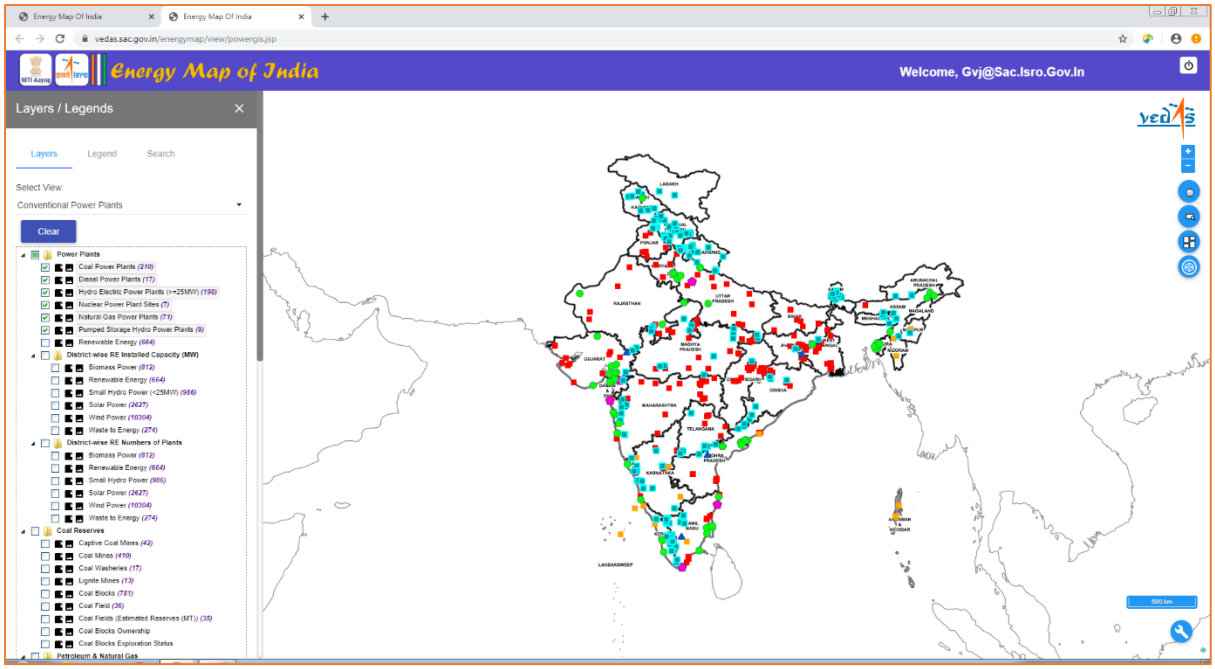


Figure 12: Static Geographic Data Visualisation

The power plants category includes conventional power plants (coal, diesel, natural gas, nuclear, hydro-electric, and pumped storage hydro-electric power plants), and district-wise installed capacity map of solar, wind, small hydro, biomass, waste to energy and all-combined renewable energy power plants.

The coal reserves category includes maps of captive coalmines, washeries, coal blocks, coalfields, coal fields with estimated reserves, coal block ownership, coal block exploration status, and coal washeries.

The petroleum and natural gas category include refineries, LNG terminals, LPG bottling plants and POL terminals along with oil and gas wells.

Transmission lines obtained from Open Street Map (OSM) along with dynamic point-cluster map of sub-stations is included under transmission and distribution lines category.

The renewable energy resources included in the energy map provides Global Horizontal Irradiation (GHI) derived by NIWE as well as satellite derived annual average GHI based on data from 2009-2018.

The reference maps include administrative boundaries and high-resolution satellite imageries obtained from Bhuvan Portal in addition to layers on infrastructure (airports, railway station, railways and highways) and natural resources (rivers and reservoirs).

The legend of each layer can be viewed under the ‘Legend’ tab. Alternatively, the icon shown next to each layer also shows the legend of corresponding layer. The icon , shown

alongside the legend icon, displays the metadata of corresponding layer in a pop-up window. Metadata provides relevant information of the thematic layer such as its name, feature type, contact information, concerned ministry, map scale, citation and survey year.

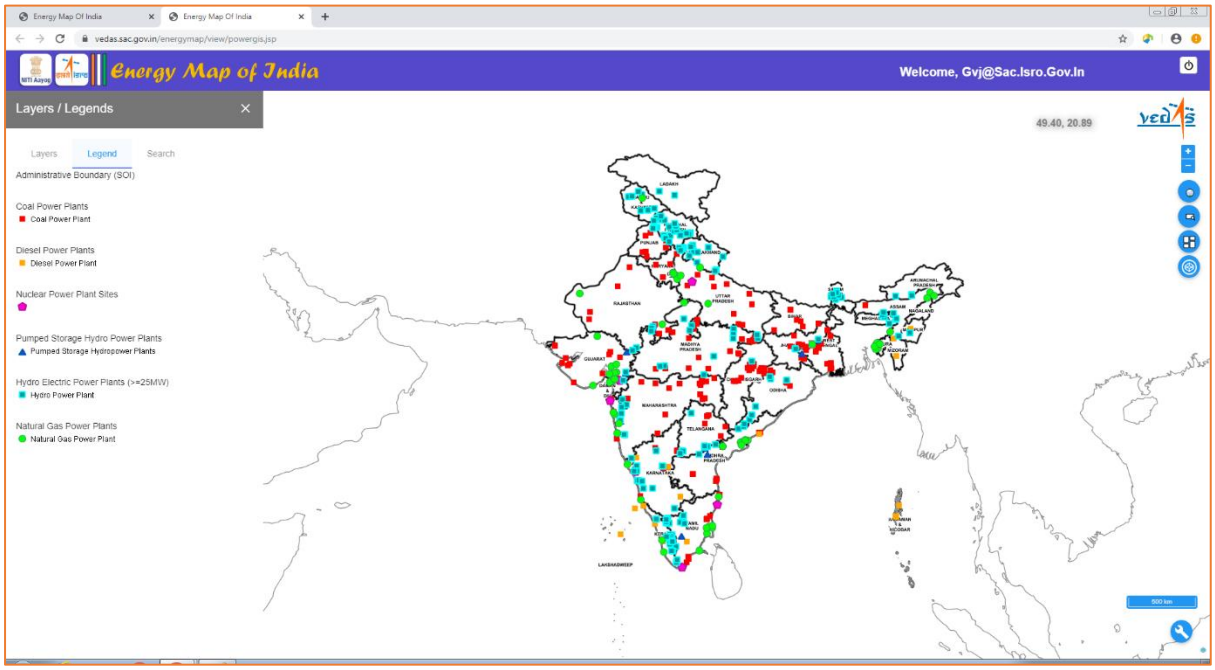


Figure 13: Legend Panel Display

The website provides user-friendly interface with interactive navigation control (icon + on map canvas for Zoom in and icon − for zoom out) as shown in figure 14. The maximum scale at which a given map can be visualised is defined in the layer's metadata as per database design. The layer / legend panel may be collapsed / minimized to increase the view area of map canvas.

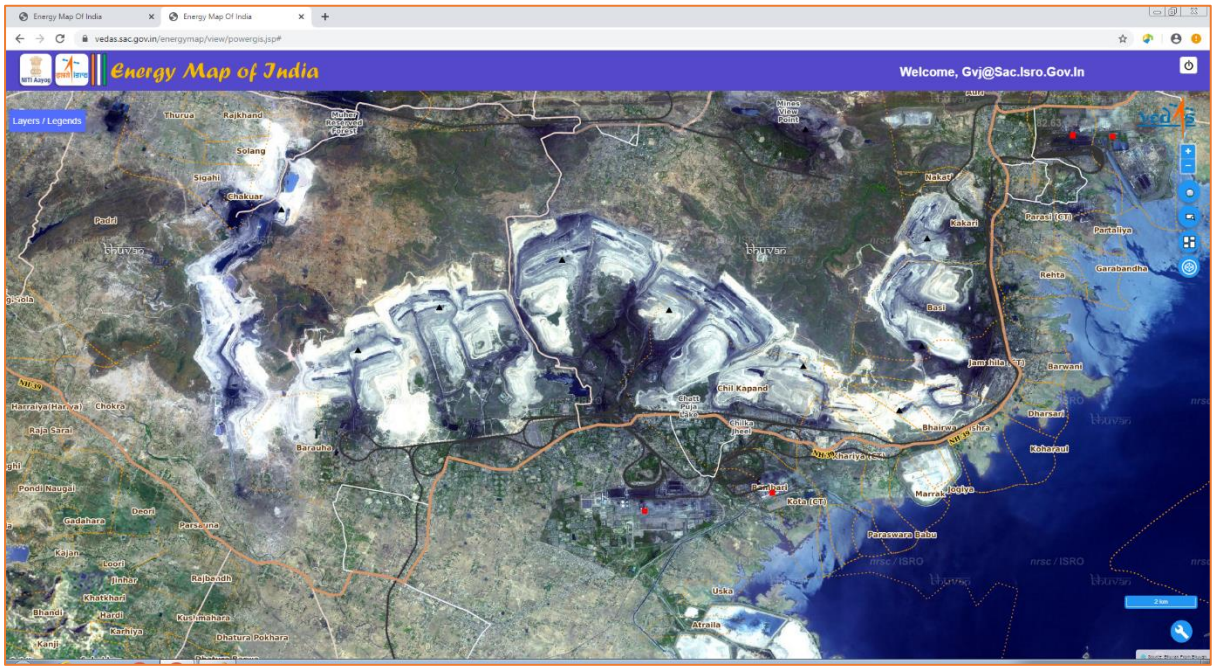


Figure 14: Interactive and User-friendly Map Navigation

Reference layers can be selected from the table of content of layers in Layers panel. The GIS-layers of Infrastructure, Administrative Boundaries and Natural Features can be overlaid on the thematic layers. The high spatial resolution satellite imagery obtained from Bhuvan can be used as Base Map (figure 15).

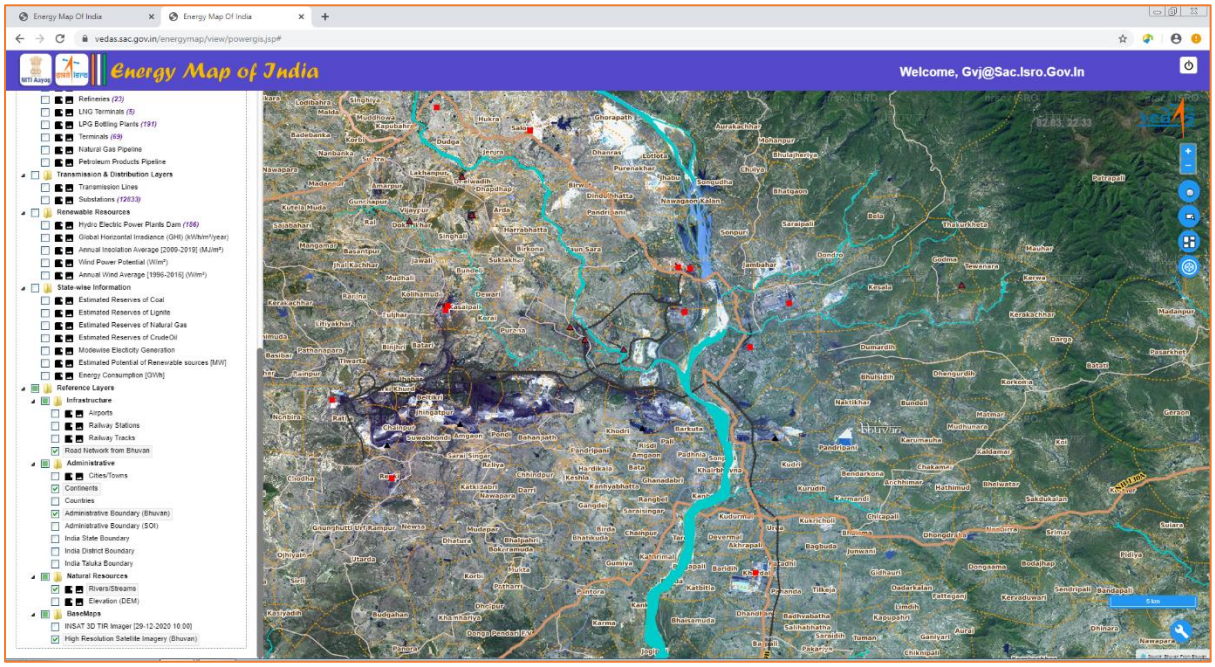


Figure 15: Overlay Layers and Base Maps

Latest Thermal Infrared (TIR) Image acquired by INSAT-3D satellite showing distribution of clouds in near-real time can be displayed (figure 16).

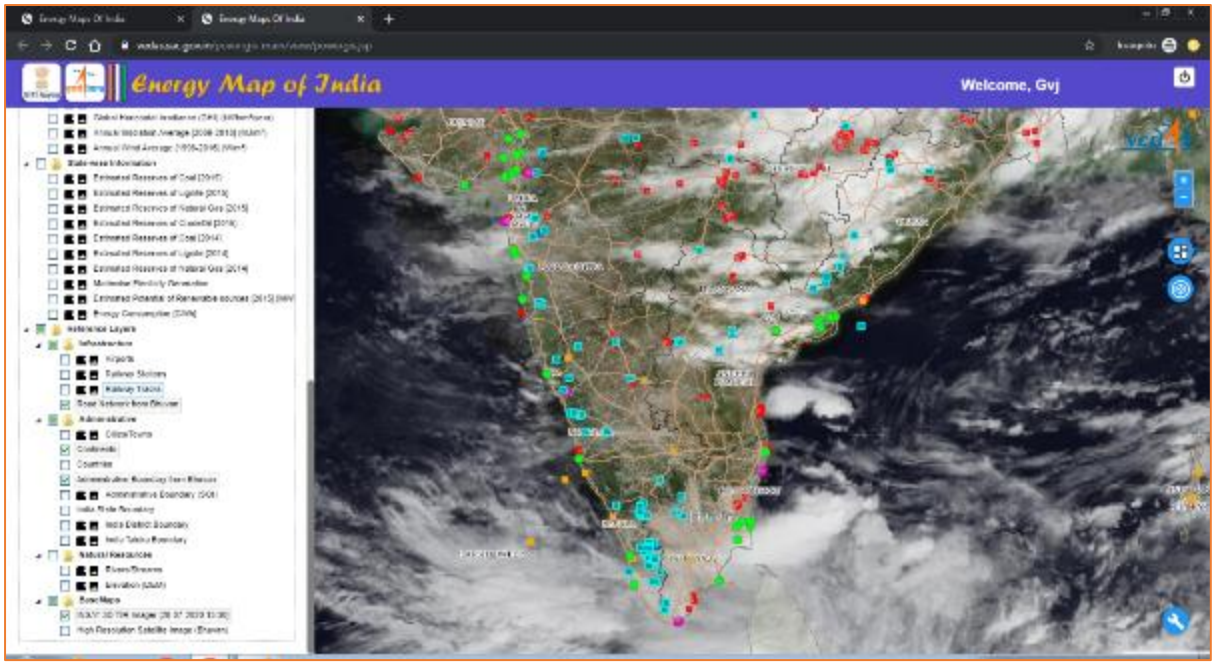


Figure 16: Real-time Weather Data Integration (Beta)

Digital Elevation Model (DEM) with 10.0 m spatial resolution, derived from Cartosat-1 satellites of ISRO has been provided to depict terrain. (Figure 17)

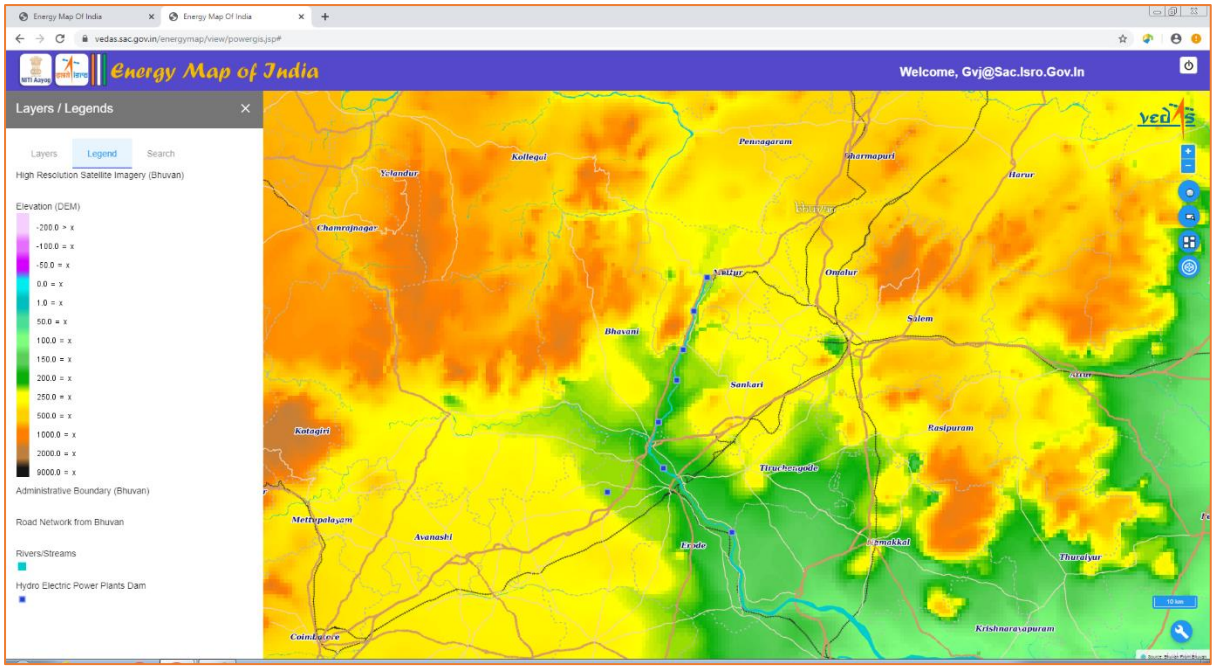


Figure 17: Terrain Data

The energy data is further grouped into ten pre-defined views: (1) conventional power plants; (2) biomass; (3) coal; (4) fossil fuel resources; (5) hydro-electric; (6) natural gas; (7) petroleum; (8) renewable energy power plants; (9) solar; and (10) wind. In each of these views, relevant layers are made visible while retaining the state of visibility of other layers.

Figure 18 shows thermal power plants based on coal, natural gas and diesel, hydro power plants and nuclear power plants, as part of the 'conventional power plants' map view.

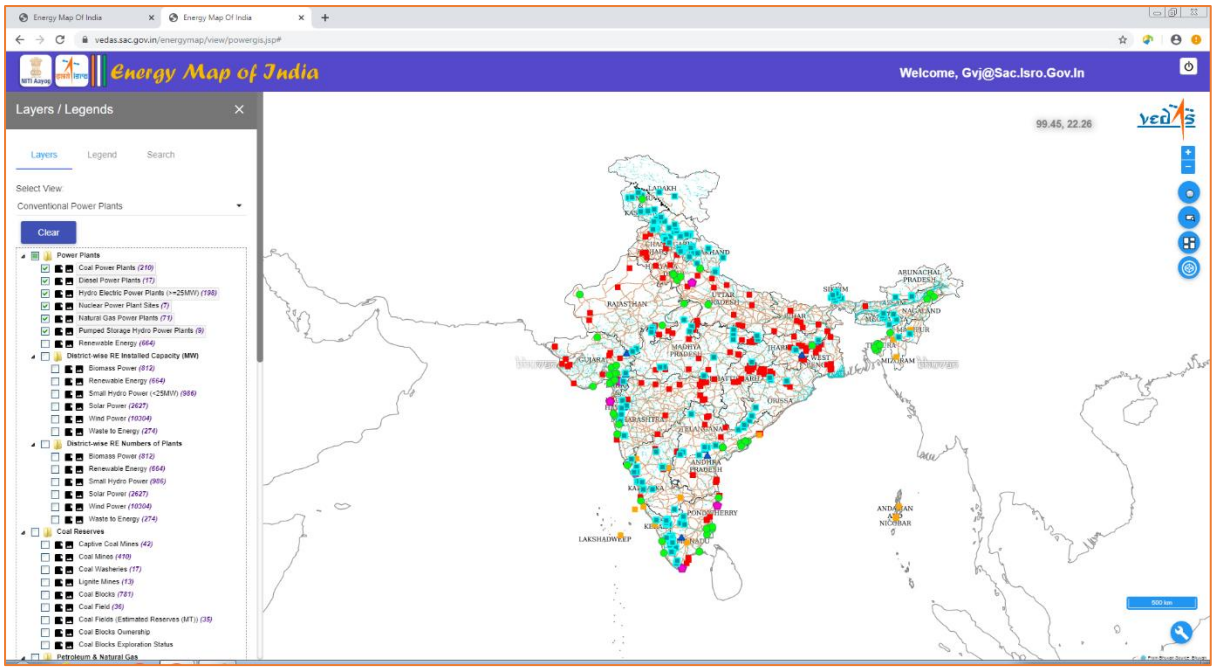


Figure 18: Energy Data View for Conventional Power Plants

The fossil fuel resources shows oil and natural gas wells, captive coalmines, coalfields and coal blocks. (Figure 19)

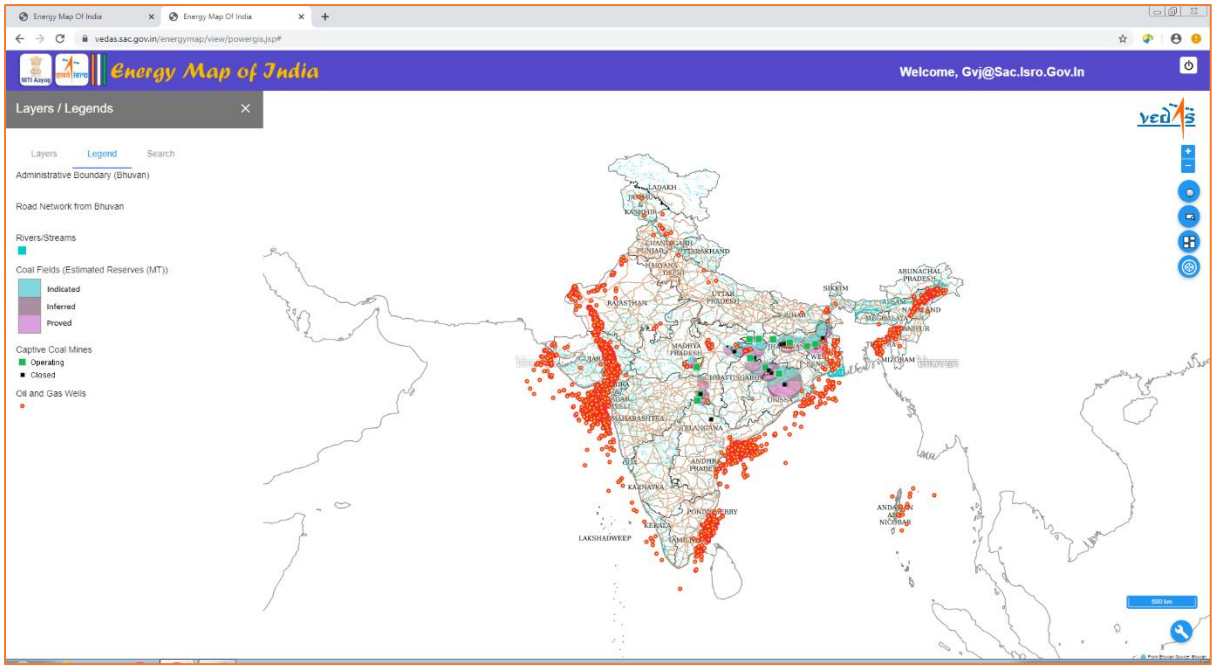


Figure 19: Energy Data View for Fossil Fuel Resources

The energy portal also shows the state-wise information obtained from published reports. The state-wise estimated reserves of coal, lignite, natural gas and crude oil for years 2014 and 2015, as published in the Energy Statistics (MOSPI, 2016), are shown by proportionate-symbol maps. The state-wise renewable energy potential is shown as pie-chart indicating share of different sources of renewable energy on the basis of data provided in Energy Statistics (MOSPI, 2016). Similarly, mode-wise electricity generation, represented by pie-chart map, and energy consumption choropleth map, are derived from the All India Electricity Statistics (CEA, 2014). (Figure 20)

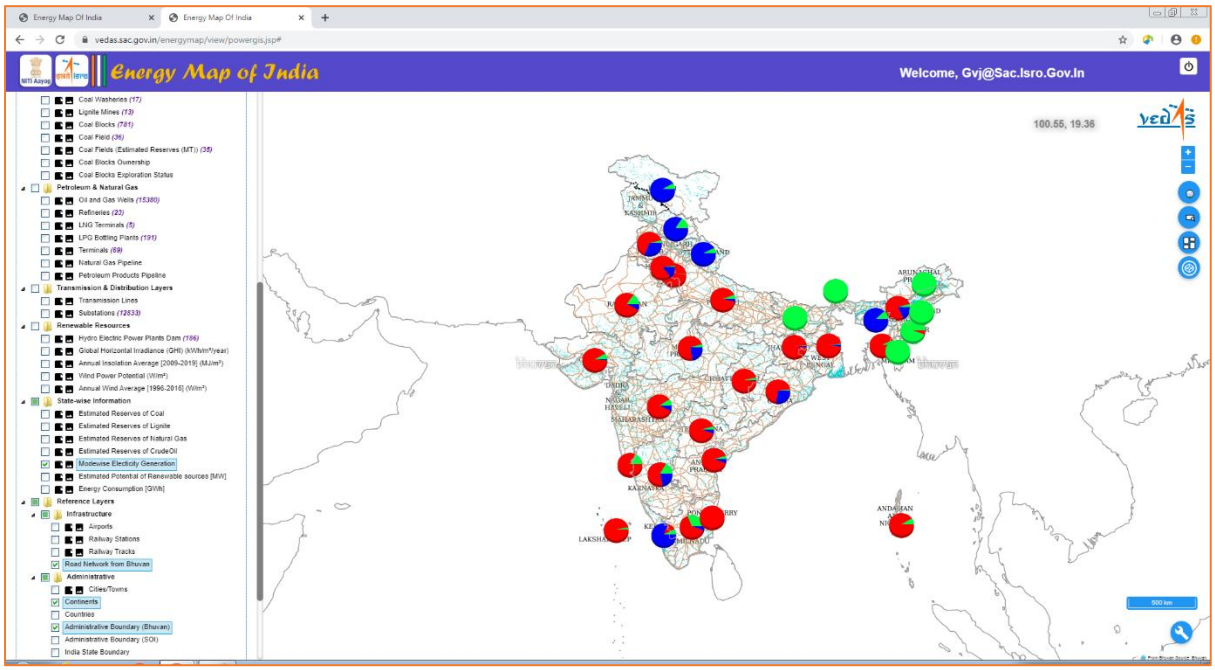


Figure 20: State-level Data Visualisation

Data tables (icon on map canvas) and charts (icon on map canvas), based on data in Energy Statistic (MOSPI, 2016) and All India Electricity Statistics (CEA, 2014) used to generate these maps, can be viewed as shown in figure 21 and figure 22 respectively.

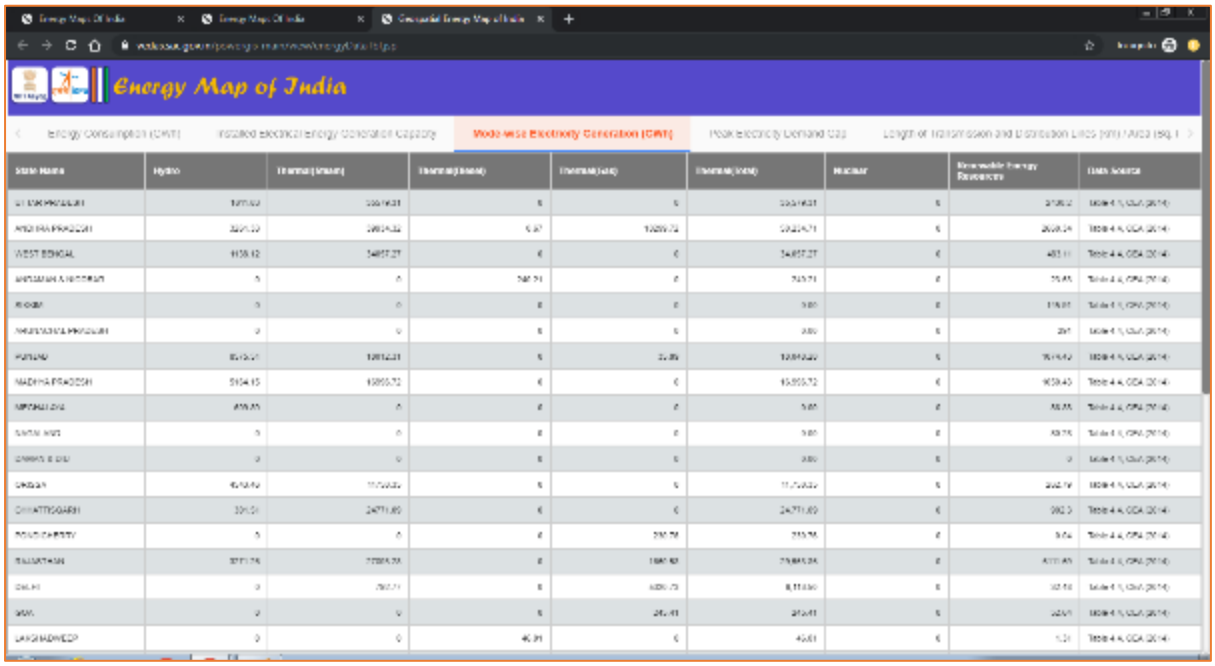


Figure 21: Tabular View of State-level Data

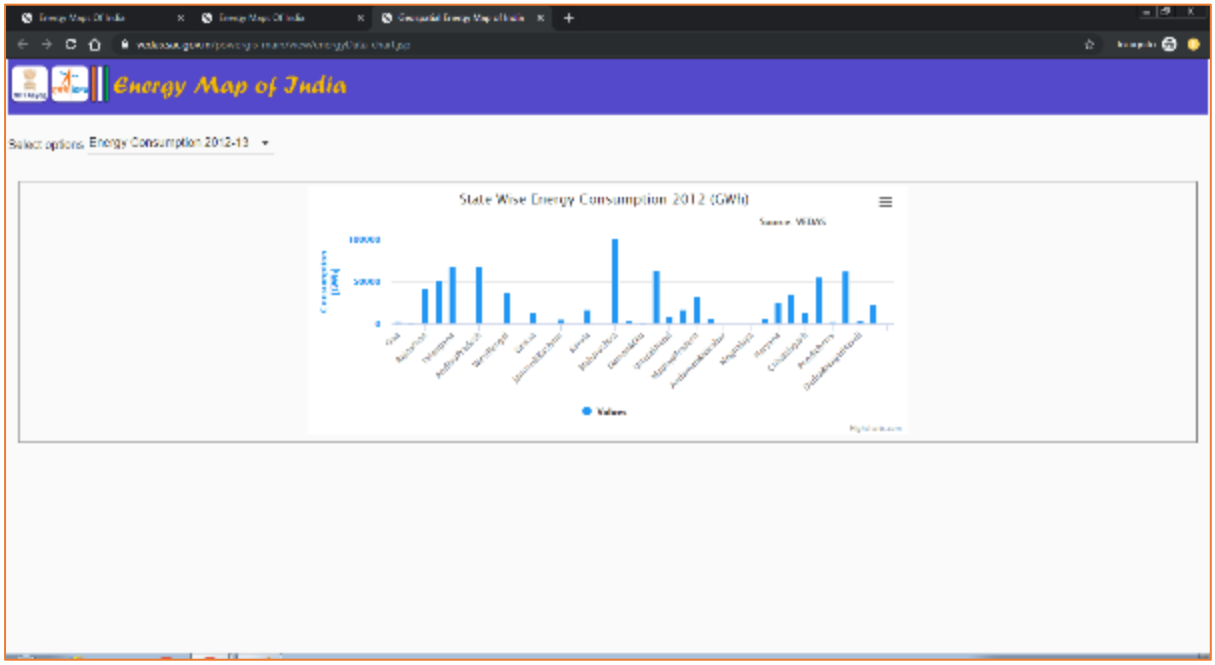


Figure 22: Chart View of Selected State-level Data

3.3 Query Functionalities

The geospatial energy portal supports three types of queries for retrieval of required information: what-lies query, where-lies query, and state-level energy map query.

The ‘what-lies’ query provides attribute information of a feature in the map at a given location. Figure 23 shows the attributes of a coal power plant located in Odisha state. User can also zoom-in to its location from the ‘Zoom to Feature’ button.

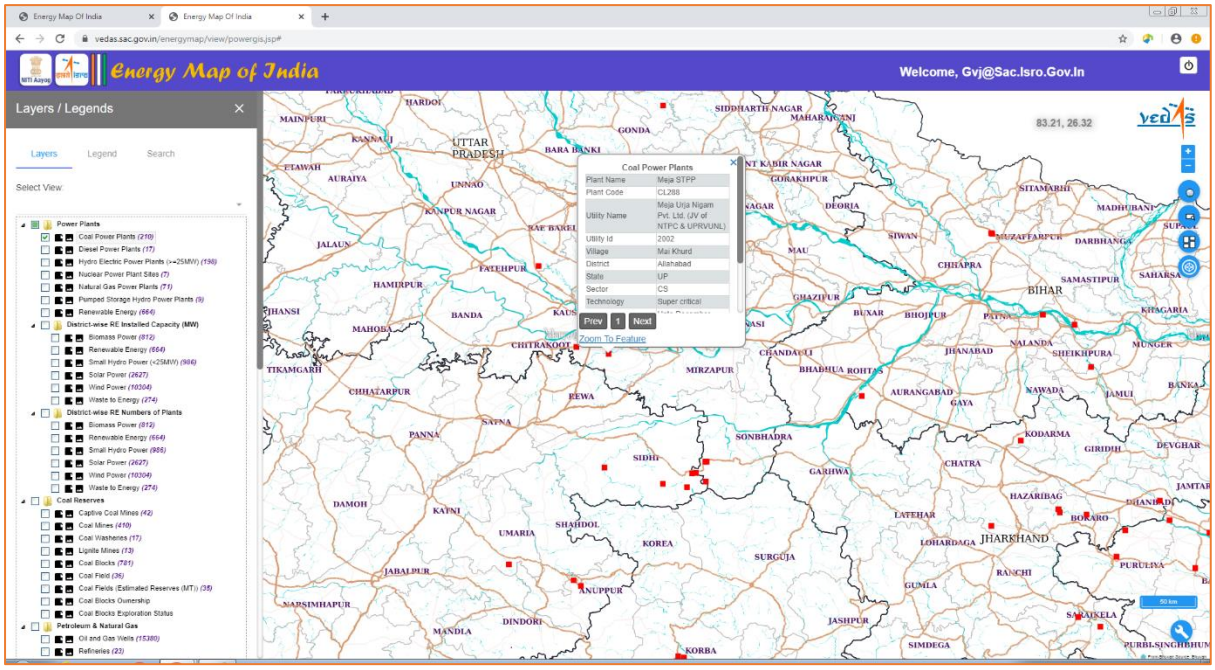


Figure 23: Basic Feature Information of Conventional Power Plant

Figure 24 shows the feature information of district-wise solar power plants. The more info tab provides link to all solar power plants in the selected district.

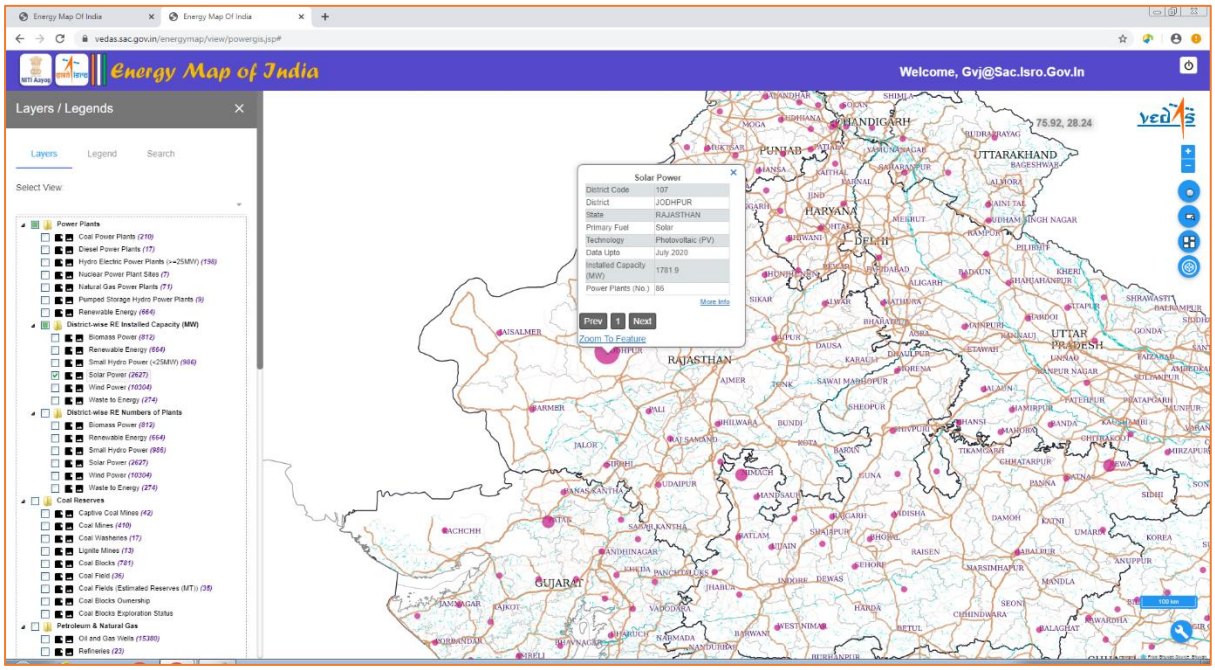


Figure 24: Basic Feature Information of District-wise Solar Power Plants

Figure 25 provides feature information of captive coalmines.

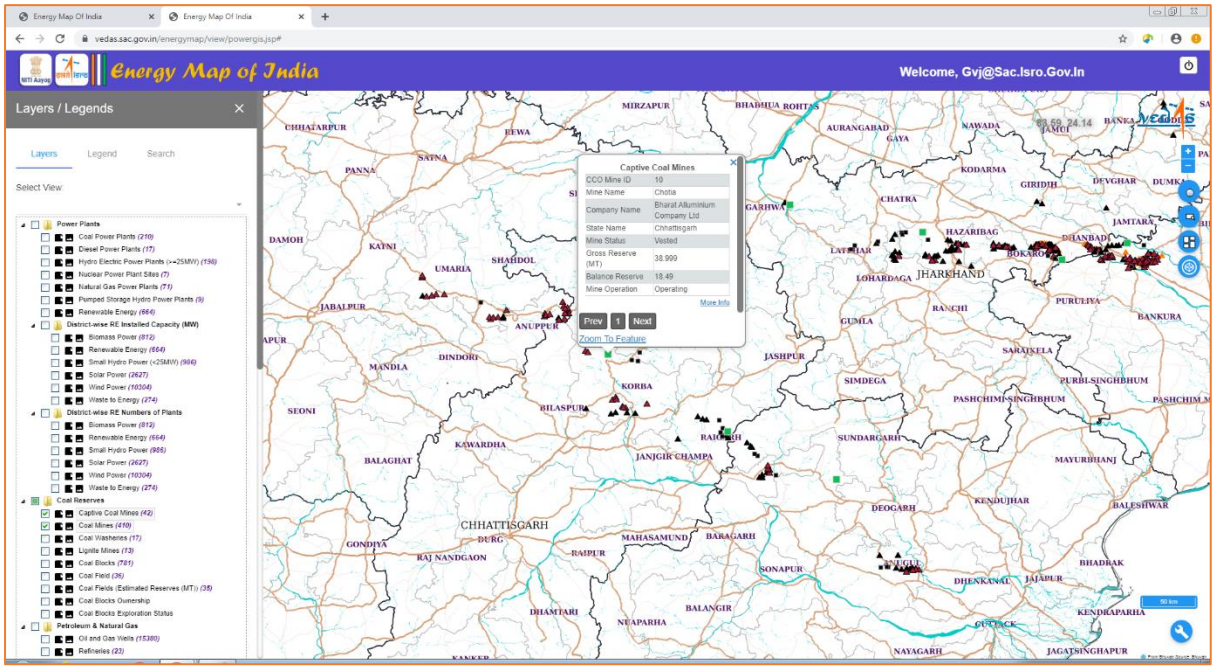


Figure 25: Basic Feature Information of Captive Coal Mines

Figure 26 provides feature information of petroleum refineries.

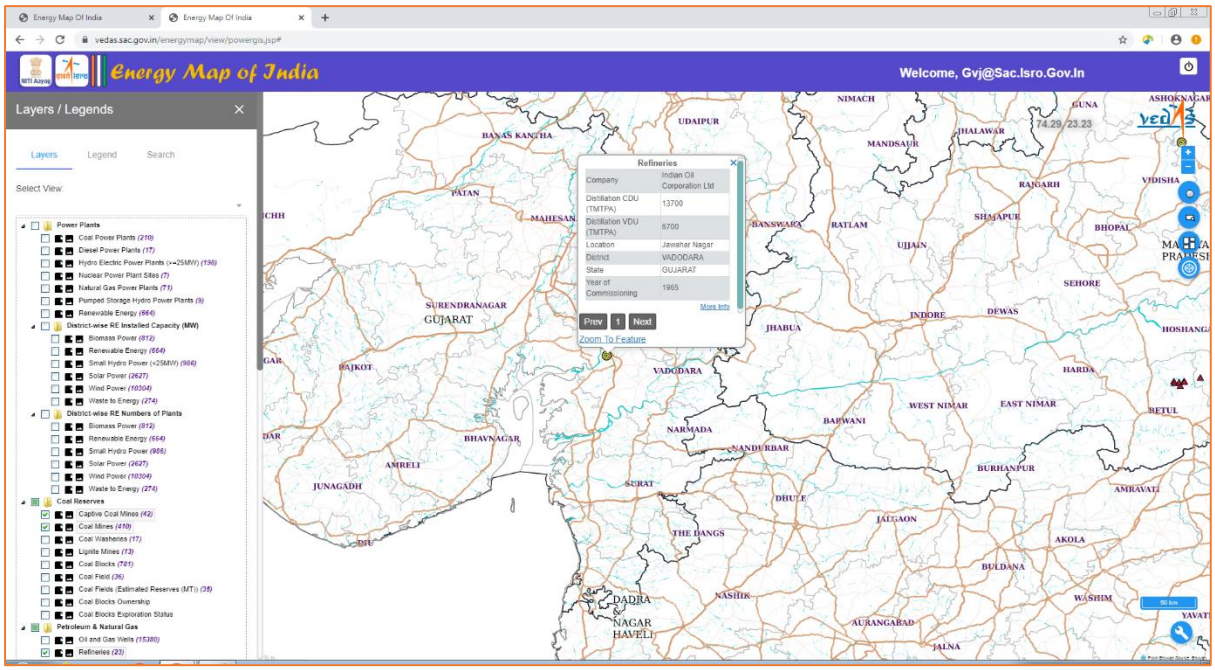


Figure 26: Basic Feature Information of Refinery

The additional details, such as list of renewable-energy power plants in a given district, coal reserves of a coal field, unit-wise details of power plants, and dynamic information (if available), can be retrieved from the hyperlinks to 'More Info'.

Figure 27 shows detailed feature information of a power plant, unit details, location and dynamic information including monthly electricity generation, monthly plant load factor,

monthly program and quarterly target achievement. This information may be downloaded as a PDF file.

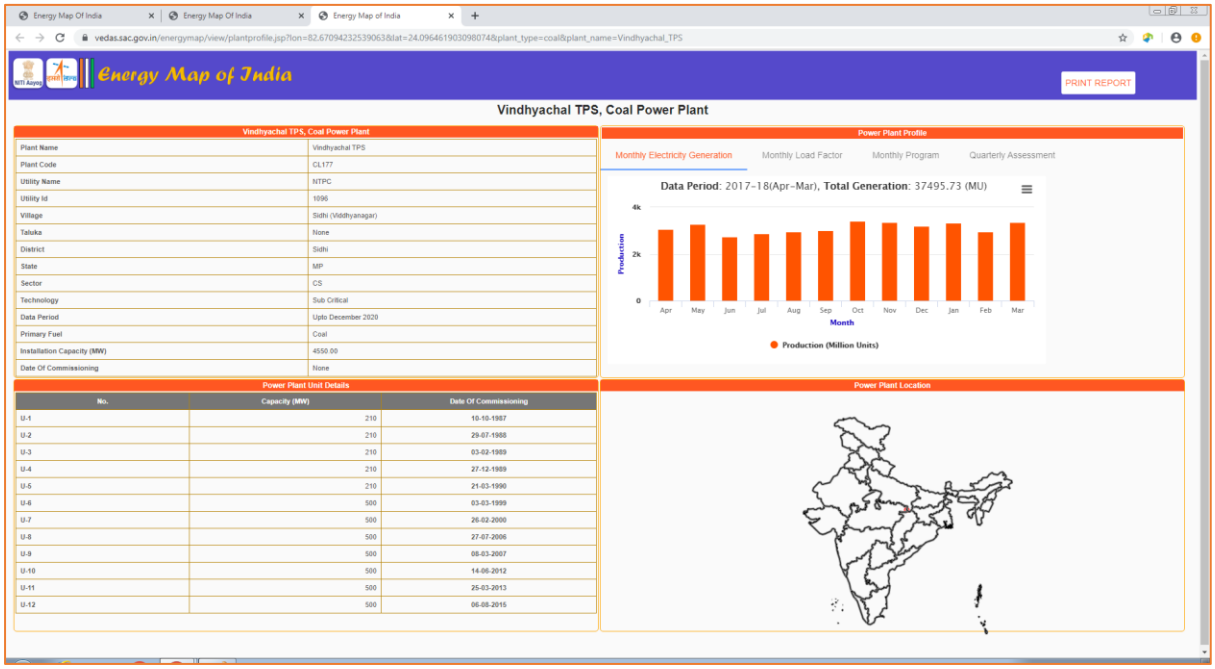


Figure 27: Detailed Feature Information of Conventional Power Plant

The dynamic information is also provided for captive coalmines and crude oil refineries, in addition to the conventional power plants.

The monthly production and despatch information of captive coalmines for the financial years 2015-16 to 2019-20 has been provided as bar chart (figure 28).

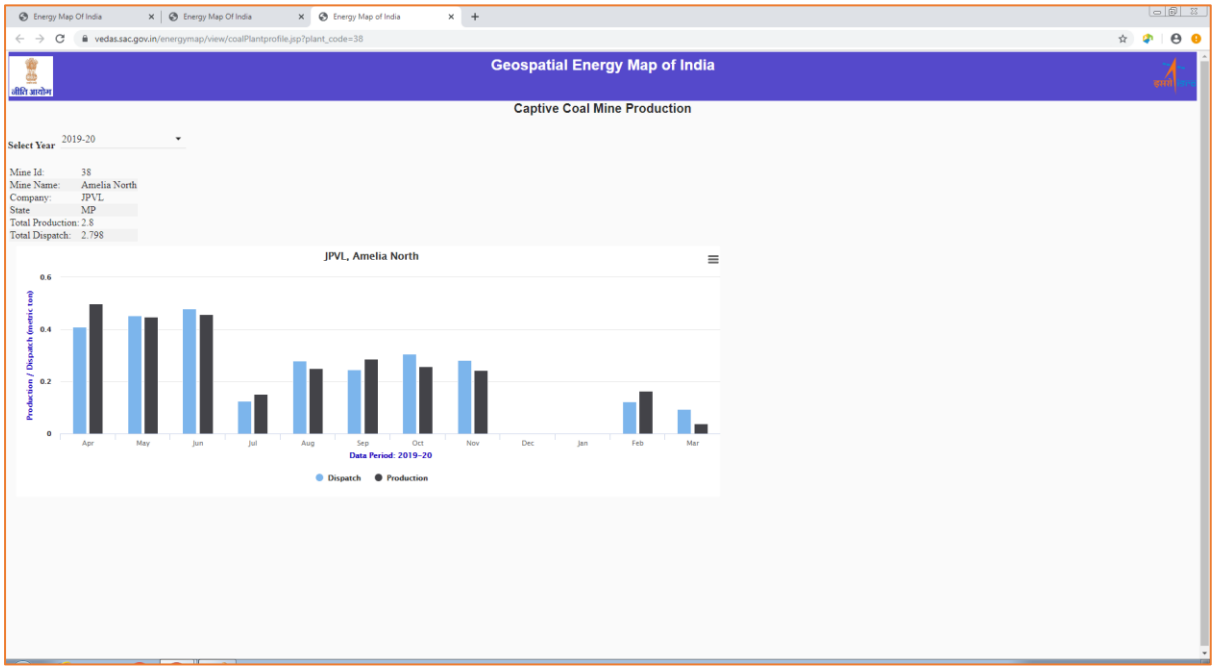


Figure 28: Dynamic Information on Captive Coal Mines

The monthly crude oil production of refineries from F.Y. 2011-12 to 2017-18 has also been provided (figure 29).

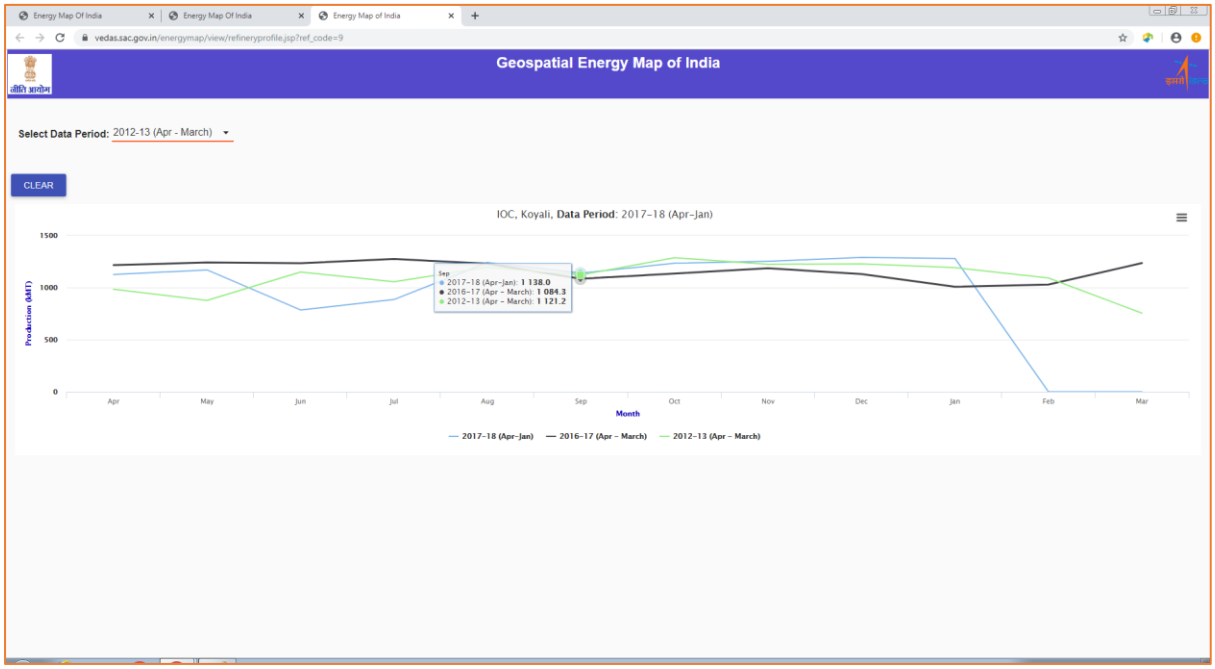


Figure 29: Dynamic Information on Crude Oil Refineries

The new and renewable energy data is organised at district level. The feature information provides district-level attribute information such as name of district, number of power plants and their total installed capacity in the district. The detailed information on all power plants within a district is provided by hyperlink for more information in separate window with pagination providing controls for page navigation. Figure 30 shows Chitradurga district has 218 wind power plants with 630.1 MW installed capacity. Figure 31 lists all wind power plants in Chitradurga district.

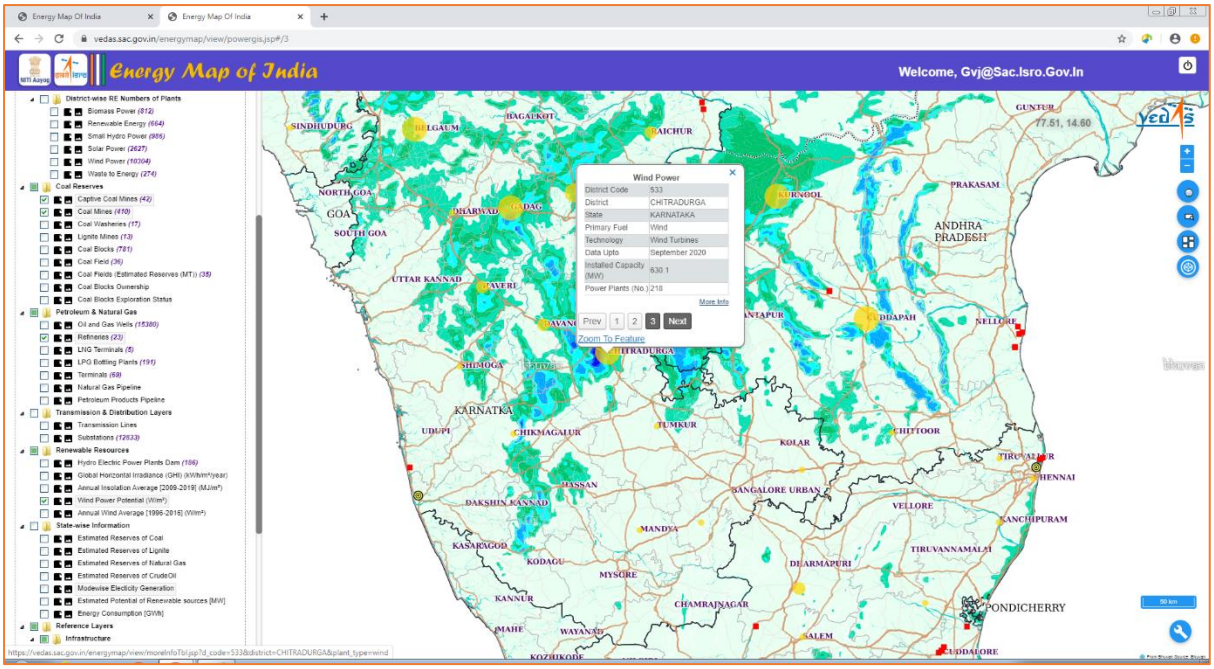
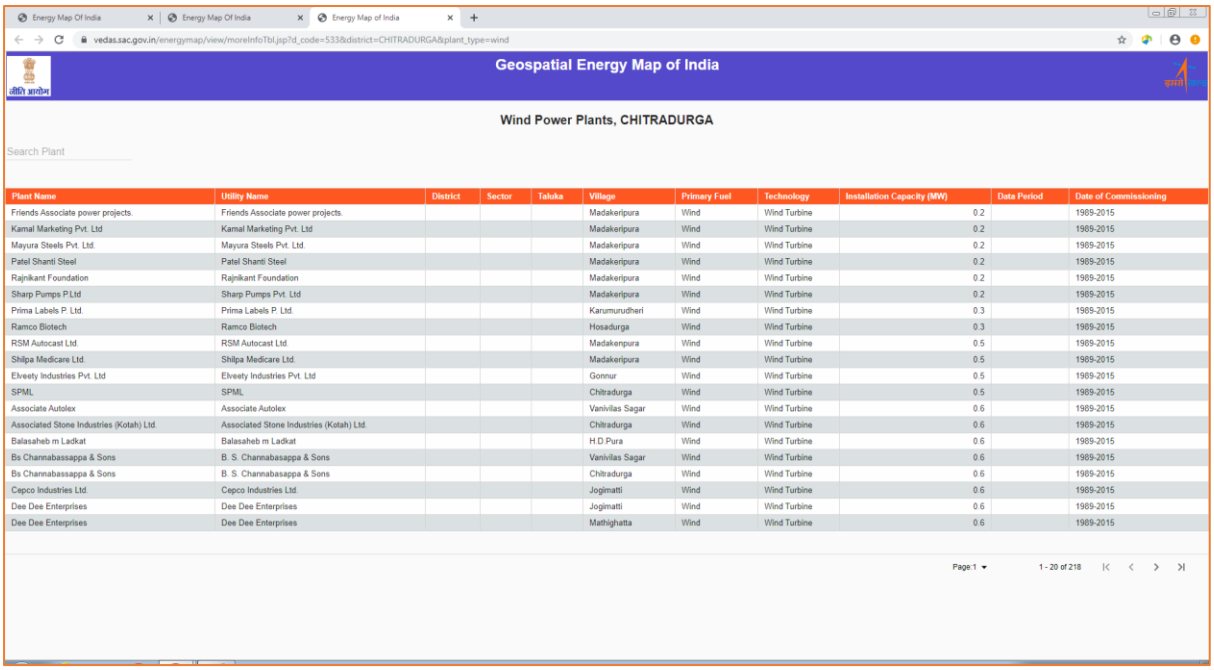


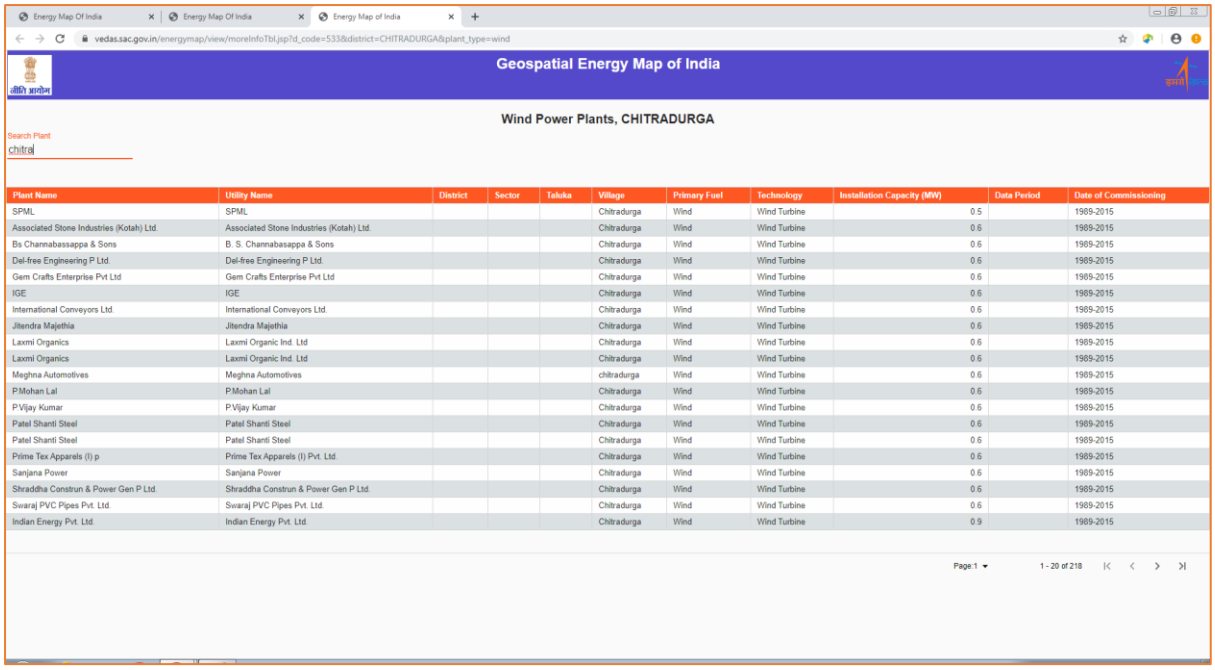
Figure 30: Feature Information of District-wise Wind Power Plants



Plant Name	Utility Name	District	Sector	Taluka	Village	Primary Fuel	Technology	Installation Capacity (MW)	Data Period	Date of Commissioning
Friends Associate power projects.	Friends Associate power projects.				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Kamal Marketing Pvt. Ltd	Kamal Marketing Pvt. Ltd				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Mayura Steels Pvt. Ltd.	Mayura Steels Pvt. Ltd.				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Patel Shanti Steel	Patel Shanti Steel				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Rajnikant Foundation	Rajnikant Foundation				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Sharp Pumps P.Ltd	Sharp Pumps Pvt. Ltd				Madakeripura	Wind	Wind Turbine	0.2		1989-2015
Prima Labels P. Ltd.	Prima Labels P. Ltd.				Karumurudheri	Wind	Wind Turbine	0.3		1989-2015
Ramco Biotech	Ramco Biotech				Hosadurga	Wind	Wind Turbine	0.3		1989-2015
RSM Autocast Ltd.	RSM Autocast Ltd.				Madakenpura	Wind	Wind Turbine	0.5		1989-2015
Shilpa Medicare Ltd.	Shilpa Medicare Ltd.				Madakeripura	Wind	Wind Turbine	0.5		1989-2015
Elveety Industries Pvt. Ltd	Elveety Industries Pvt. Ltd				Gonnur	Wind	Wind Turbine	0.5		1989-2015
SPML	SPML				Chitradurga	Wind	Wind Turbine	0.5		1989-2015
Associate Autolex	Associate Autolex				Vanivilas Sagar	Wind	Wind Turbine	0.6		1989-2015
Associated Stone Industries (Kotah) Ltd.	Associated Stone Industries (Kotah) Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Balasaheb m Ladkat	Balasaheb m Ladkat				H.D.Pura	Wind	Wind Turbine	0.6		1989-2015
Bs Channabassappa & Sons	B. S. Channabasappa & Sons				Vanivilas Sagar	Wind	Wind Turbine	0.6		1989-2015
Bs Channabassappa & Sons	B. S. Channabasappa & Sons				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Cepco Industries Ltd.	Cepco Industries Ltd.				Jogimatti	Wind	Wind Turbine	0.6		1989-2015
Dee Dee Enterprises	Dee Dee Enterprises				Jogimatti	Wind	Wind Turbine	0.6		1989-2015
Dee Dee Enterprises	Dee Dee Enterprises				Mathighatta	Wind	Wind Turbine	0.6		1989-2015

Figure 31: Detailed Feature Information of District-wise Wind Power Plants

Text-keyword based filter has been provided to restrict the results in display. Figure 32 shows the list of wind power plants in Chitradurga district, while filtering wind power plants in village named ‘Chitradurga’.



Plant Name	Utility Name	District	Sector	Taluka	Village	Primary Fuel	Technology	Installation Capacity (MW)	Data Period	Date of Commissioning
SPML	SPML				Chitradurga	Wind	Wind Turbine	0.5		1989-2015
Associated Stone Industries (Kotah) Ltd.	Associated Stone Industries (Kotah) Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Bs Channabassappa & Sons	B. S. Channabasappa & Sons				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Del-free Engineering P Ltd.	Del-free Engineering P Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Gem Crafts Enterprise Pvt Ltd	Gem Crafts Enterprise Pvt Ltd				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
IGE	IGE				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
International Conveyors Ltd.	International Conveyors Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Jitendra Majethia	Jitendra Majethia				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Laxmi Organics	Laxmi Organic Ind. Ltd				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Laxmi Organics	Laxmi Organic Ind. Ltd				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Meghna Automotives	Meghna Automotives				chitradurga	Wind	Wind Turbine	0.6		1989-2015
P.Mohan Lal	P.Mohan Lal				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
P.Vijay Kumar	P.Vijay Kumar				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Patel Shanti Steel	Patel Shanti Steel				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Patel Shanti Steel	Patel Shanti Steel				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Prime Tex Apparels (I) p	Prime Tex Apparels (I) Pvt. Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Sanjana Power	Sanjana Power				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Shraddha Construn & Power Gen P Ltd.	Shraddha Construn & Power Gen P Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Swaraj PVC Pipes Pvt. Ltd.	Swaraj PVC Pipes Pvt. Ltd.				Chitradurga	Wind	Wind Turbine	0.6		1989-2015
Indian Energy Pvt. Ltd.	Indian Energy Pvt. Ltd.				Chitradurga	Wind	Wind Turbine	0.9		1989-2015

Figure 32: Text-keyword Filtering of Wind Power Plants

The text-keyword based search of power plants is only supported for conventional power plants. The text keyword is searched in the entire attribute table of selected power plant type to provide greater flexibility in querying the data. It may, therefore, be used for retrieving the location of a specific power plant by its name, locating power plants owned by a specific utility company, identifying power plants using specific technology, determining power plants in a given district or state, or any other similar information.

The output of text-based query is tabulated with the information on name of power plant, utility company name and installed capacity. The output of query is also linked to the map, thereby opening the feature information of the selected record from the query output. The selected power plant is shown by a unique symbol on map ( ).

Figure 33 shows coal power plants containing the text-keyword ‘vin’ to locate ‘Vindhyachal Thermal Power Plant’ in Madhya Pradesh state.

Text-keyword based search may also be used to select all power plants operated by a particular utility company. Figure 34 lists all coal power plants operated by NTPC.

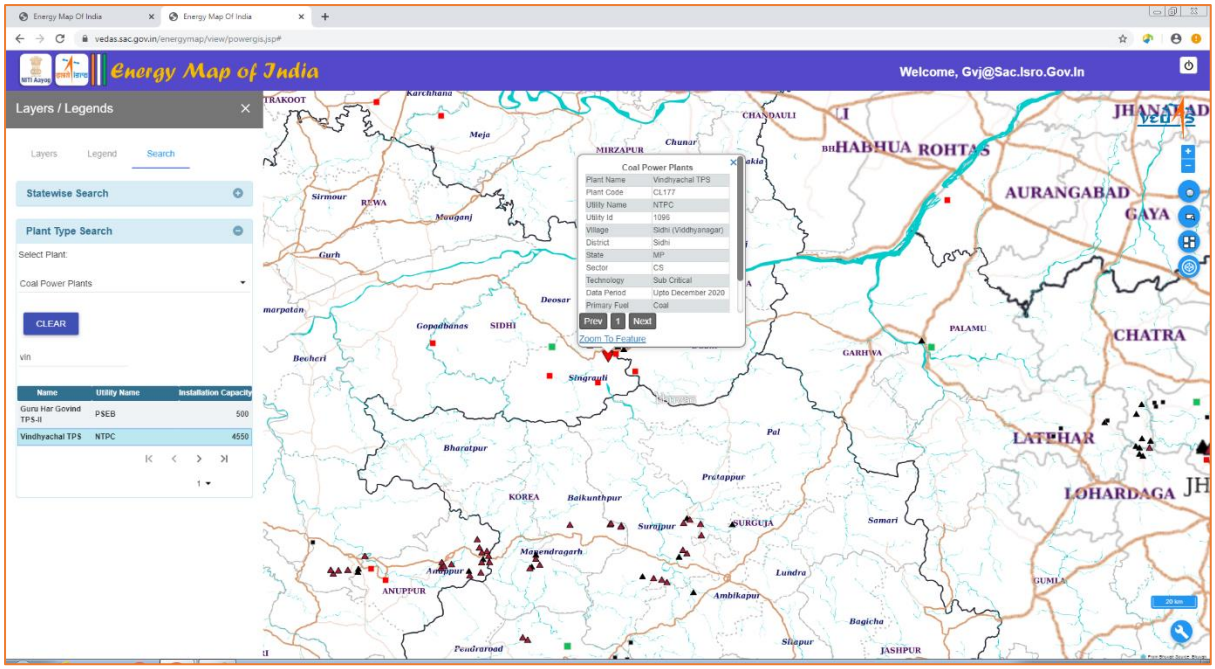


Figure 33: Search Power Plants by Text

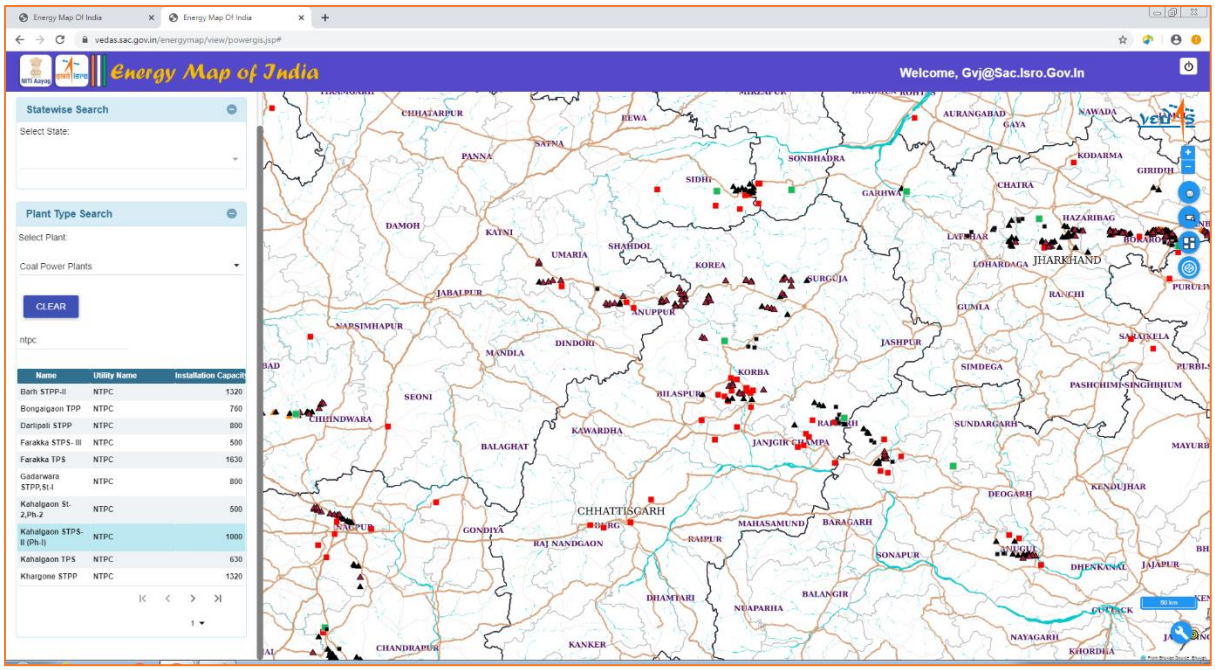


Figure 34: Search Power Plants Operated by NTPC

The state-wise energy map query masks all states other than the selected state, and zooms the map to the selected state. The list of states is populated in the dropdown list.

The query retains visibility status of all other thematic and reference layers. This type of query will be useful for preparing state-level energy map. Figure 35 shows geographic distribution of conventional power plants in Maharashtra state.

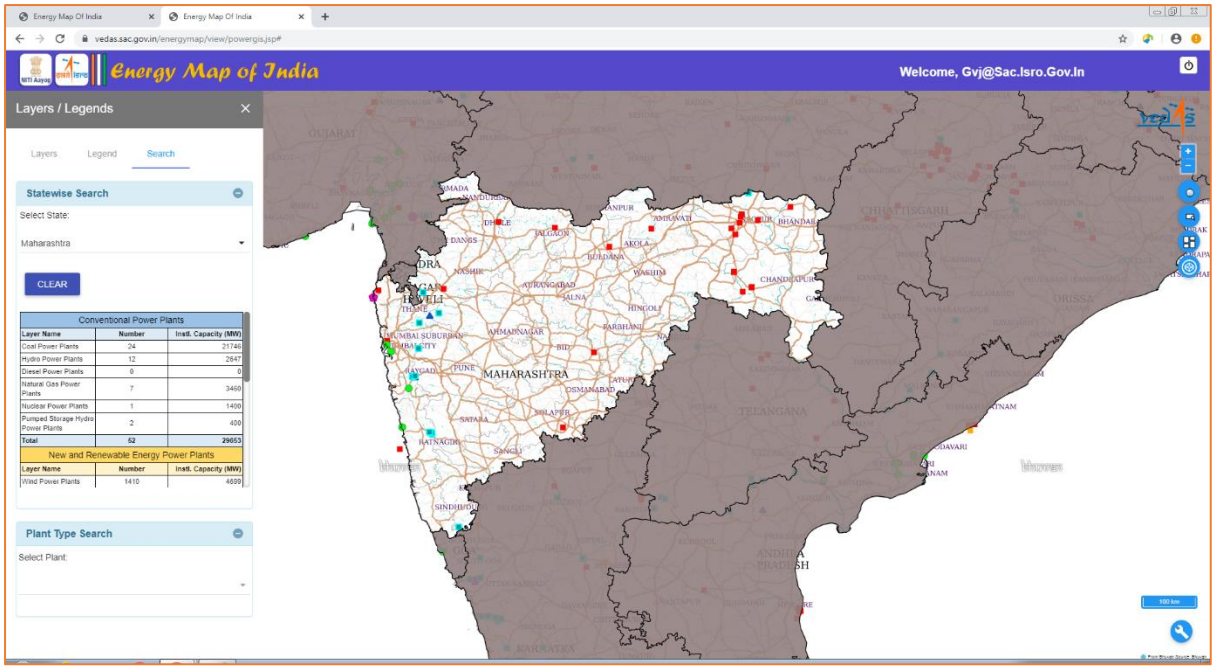


Figure 35: State Energy Map Query

3.4 Additional Tools

The energy portal provides a set of additional tools that may be useful in performing various geographic tasks on the map canvas. The icon ( ) at bottom right side of the map canvas shows (or hides) these tools as listed in table below.

List of Additional Tools

Icon	Tool
	File Upload
	Download Drawing Canvas
	Draw Polygon
	Draw Line
	Draw Point
	Measure Area
	Measure Length
	Zoom to Full Extent
	Zoom to Box
	Show / Hide Grid

The file upload tool enables adding of a KML or GeoJSON file to the map. These files may be created using any GIS software like QGIS, ArcGIS etc., computer programs like Google Earth, or by GPS applications, including mobile phone devices.

Figure 36 shows the popup window opened for uploading KML or GeoJSON file, while figure 37 shows the uploaded KML file containing user information on the energy map. It is assumed that the KML and GeoJSON files are in geographic projection with WGS 1984 datum. This

feature can be used for adding new information, such as upcoming power plants and infrastructure facilities, to the energy map. It may also be used to add any missing information to the map, or to check the location of new data prior to insertion in database.

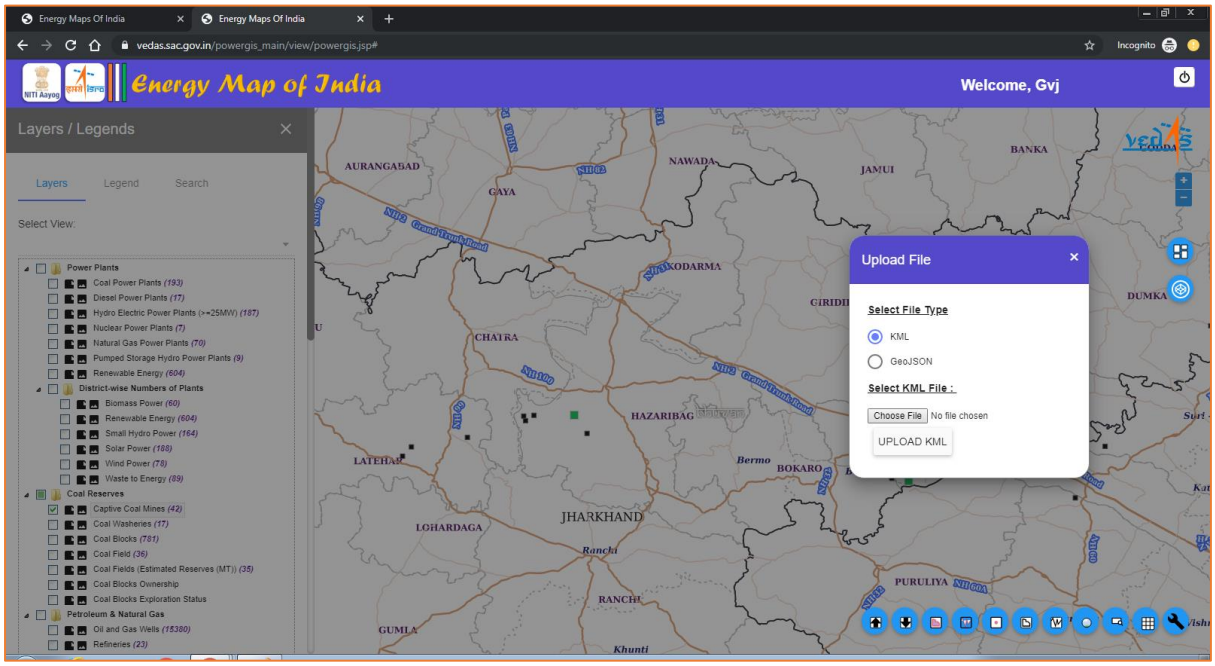


Figure 36: Upload KML or GeoJSON Geometry Files

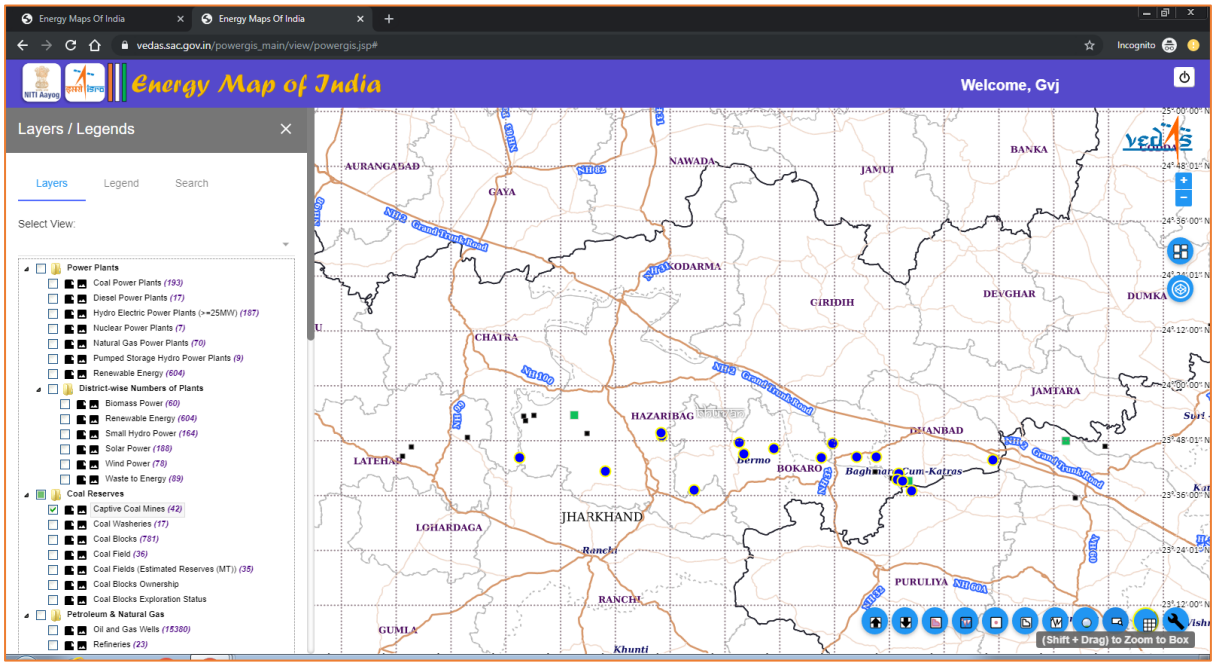


Figure 37: Uploaded File on Energy Map

The energy portal provides tools for drawing point, line or polygon features on the map canvas. As the map uses very high resolution satellite images as base map, drawing tools may be used to create location maps of proposed infrastructure projects, mapping assets and for marking additional details on the map. The download tool can be used to subsequently retrieve these

added features in KML or GeoJSON format (figure 38) for further analysis in other GIS software.

Figure 38: Drawing Tools

The measurement tools enable computation of area (in square km) and distance (in km) on map canvas (figure 39).

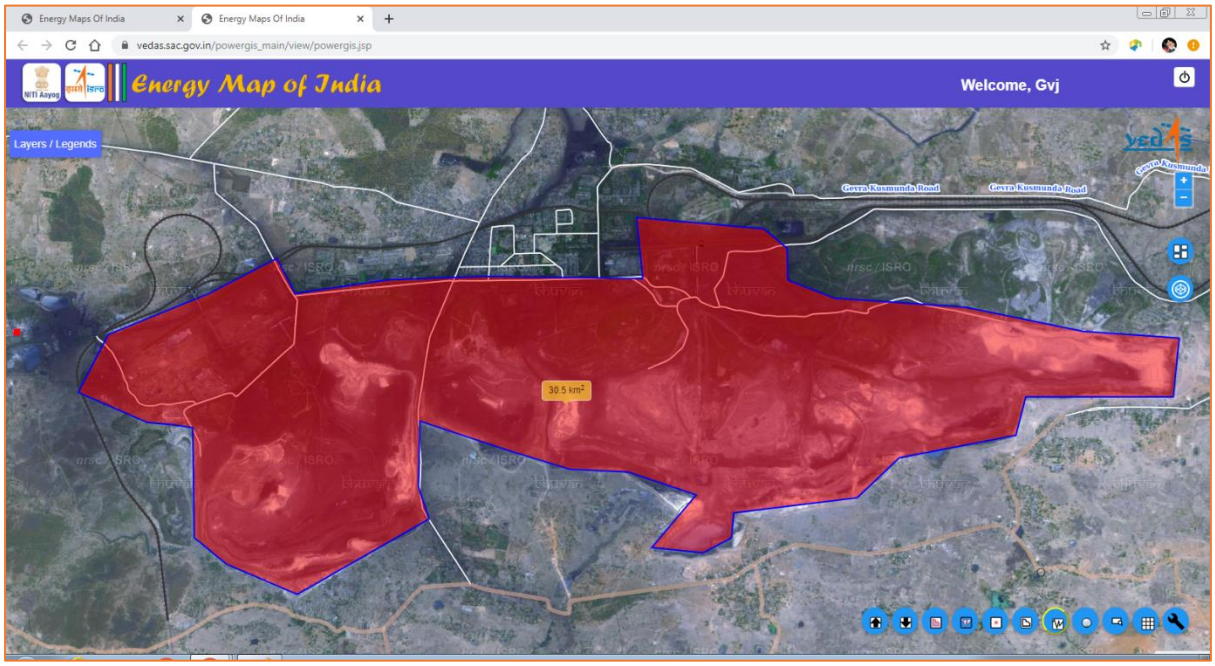


Figure 39: Measurement Tools

The tool box also provides navigation tools for zooming to full extent of India and zooming to an area defined by a user-drawn box. A rectangular graticule grid with a scale-defined spacing interval can be drawn on map for reference.

3.5 Updating the Attribute Data

The access to energy map is currently provided at three levels of privileges, viz. ‘edit-user’, ‘nodal officer’ and ‘administrator’.

The ‘administrator’ will have access to edit all thematic layers in the energy map. The ‘nodal officer’ and ‘edit-user’ are permitted to edit only the relevant layers. Thus, ‘edit-user’ and ‘nodal officer’ from Ministry of Power, for example, can edit all layers pertaining to conventional power plants except nuclear power plants.

The update icon (▪▪) as shown in figure 40, is provided to ‘edit-user’, ‘nodal officer’ and ‘administrator’, who are authorized to edit the data. This will provide access to the attribute tables of thematic layers available for editing to a particular type of user.

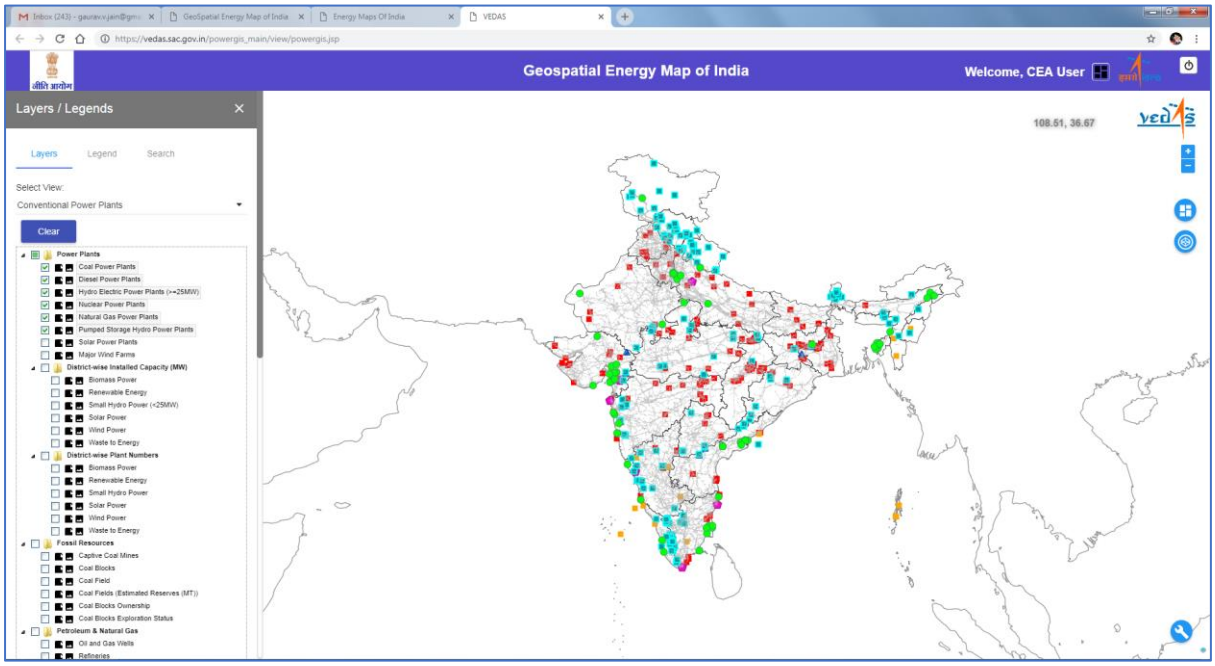


Figure 40: Initiating Attribute Data Editing

An ‘edit-user’ can select the layer for editing, which will open corresponding attribute table (figure 41). Filter may be applied to select any particular record in the attribute table using text-keyword based search.

The table row that needs to be edited can thus be selected and necessary changes be applied and submitted for approval (figure 42). Users with privileges of ‘nodal officer’ and ‘administrator’ may also edit attribute tables in similar manner. The changes made by ‘edit-user’ are submitted to ‘nodal officer’ for review.

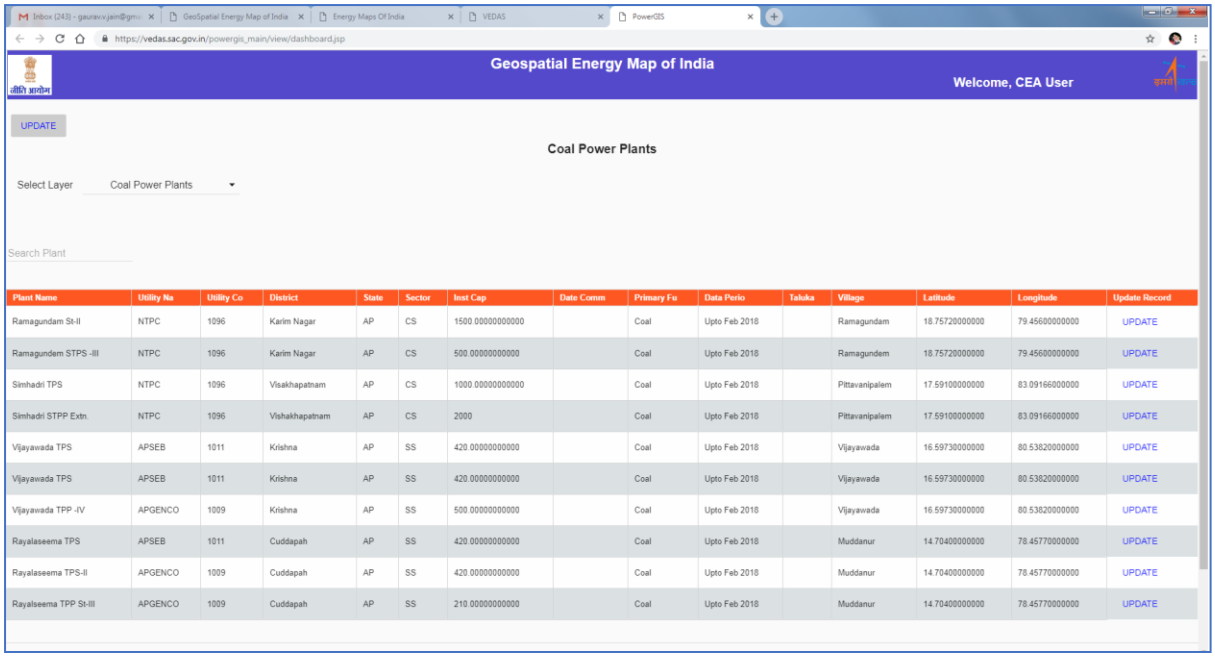


Figure 41: Layer Selection for Update

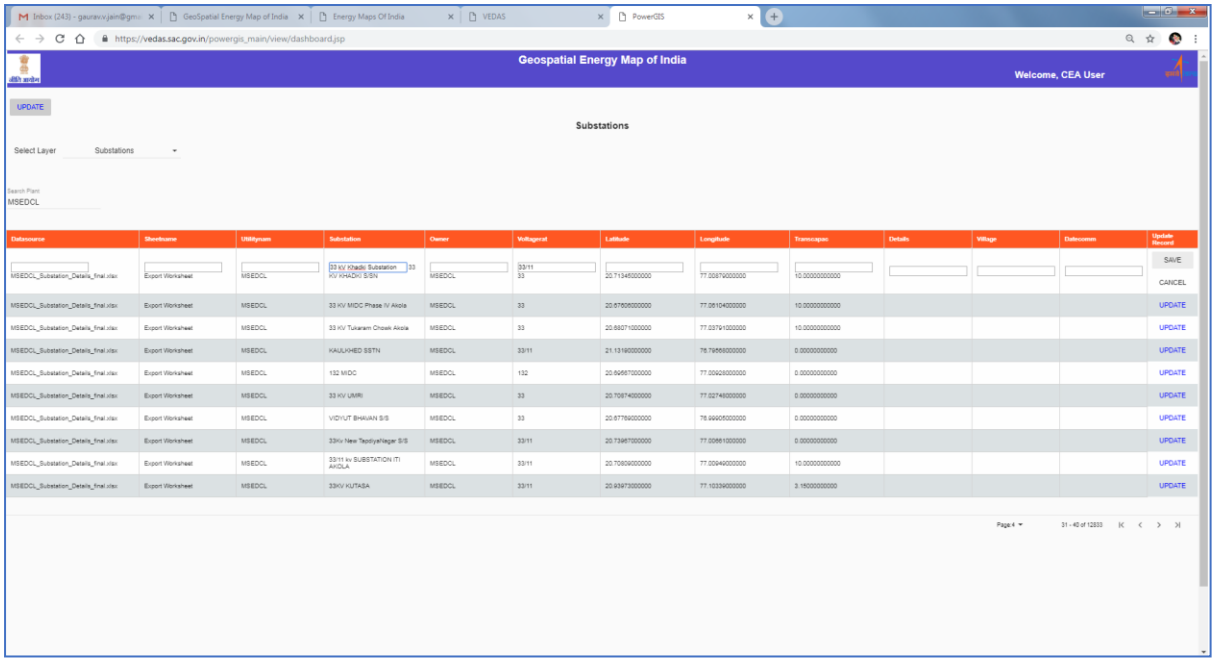


Figure 42: Select Record to Update

The 'nodal officer' may accept or reject such changes to attribute table in the database after review and recording of observations (figure 43).

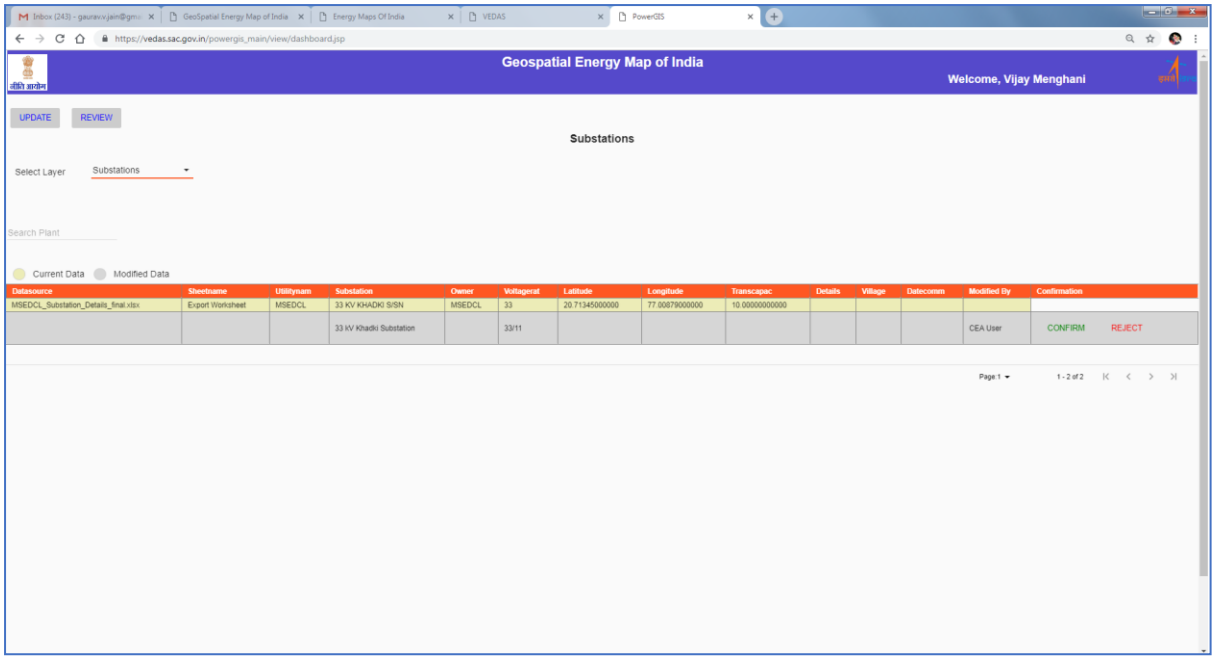


Figure 43: Rejection of Data Update by Nodal Officer

The changes by 'nodal officer' will be forwarded to the 'administrator' for review and approval. The changes approved by 'administrator' are incorporated in the energy map. Figure 44 shows changes in coal power plants, approved by the 'nodal officer' being accepted by the administrator.

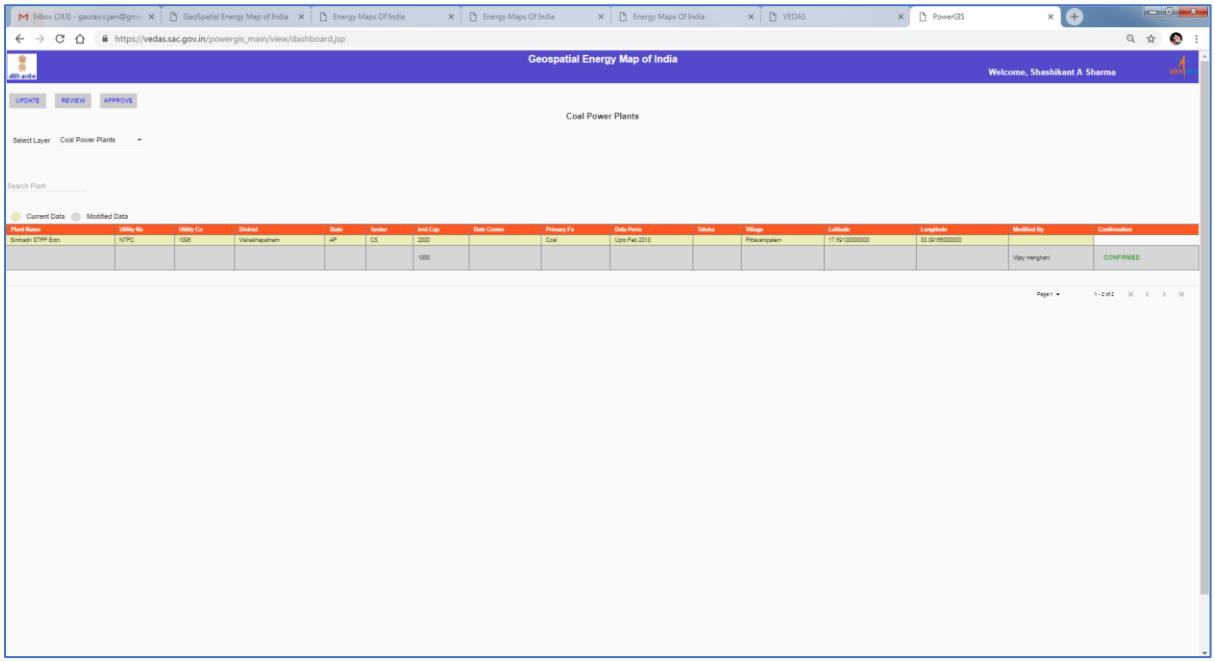


Figure 44: Acceptance of Update by Administrator

The changes in installed capacity of a power plant from 2000 MW to 1000 MW are reflected in the data table and map immediately (figure 45).

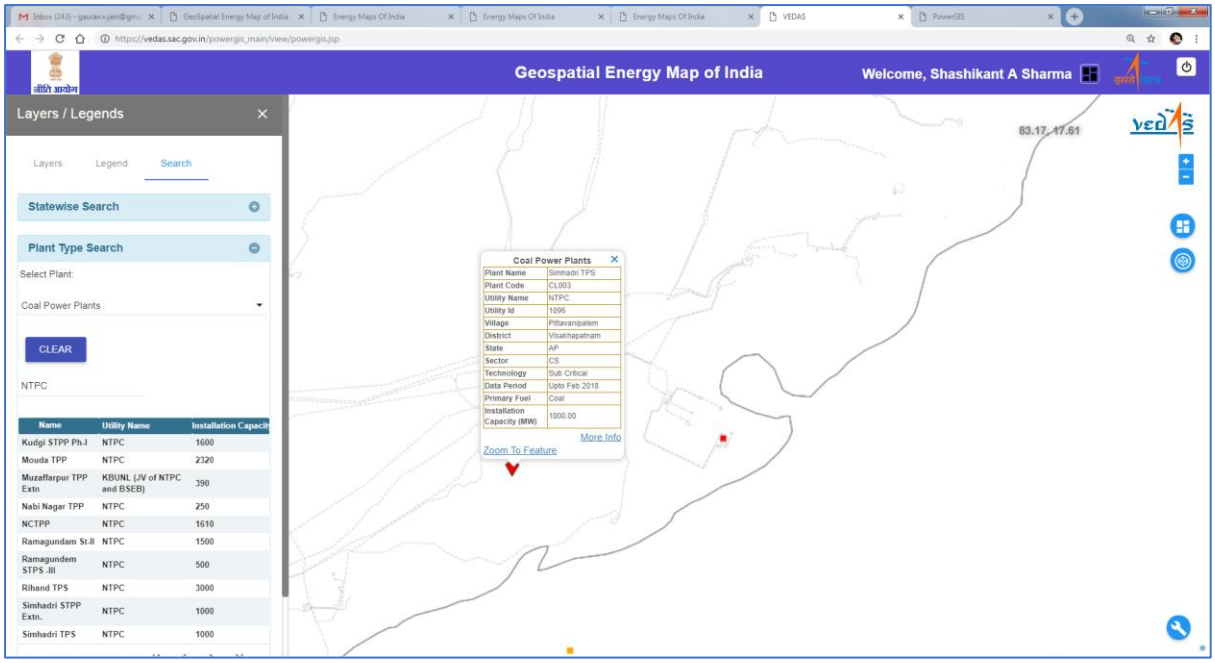


Figure 45: Updated Feature Information on Map

-x-