

# **Development of enhanced energy data portal for India**

**Final Report - May 2021**

**Prayas (Energy Group)**

Final report of the research study on "Development of enhanced energy data for India" sanctioned through letter no. O-15012/29/17-Research dated 30<sup>th</sup> November 2017 from NITI Aayog.

The study was carried out with the financial support of NITI Aayog, Government of India and conducted by Prayas (Energy Group), Pune



Prayas (Energy Group)

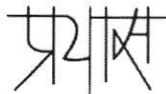
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## Project duration

December 2017 to December 2019

## Timeline of deliverables

December 2017	First tranche of grant amount received by Prayas (Energy Group)
August 2018	Submitted first progress report indicating initial design decisions
October 2019	Progress update to Additional Secretary (Energy), NITI Aayog
December 2019	Enhanced Dashboards development completed and ready for hand over
January 2020	Handover and technical training conducted by Prayas (Energy Group) for Energy Division, NITI Aayog and NIC
May 2020 – April 2021	Support to NITI Aayog and NIC for undertaking security audit and importing recent year data
April 12 2021	Public launch of enhanced India Energy Dashboards by Vice Chairperson, NITI Aayog

## Disclaimer

Prayas (Energy Group), Pune, has received the financial assistance under the Research Scheme of NITI Aayog to prepare the report. While due care has been exercised to prepare the report using the data from various sources, NITI Aayog does not confirm the authenticity of data and accuracy of the methodology to prepare the report. NITI Aayog shall not be held responsible for finding or opinions expressed in the document. This responsibility completely rests with Prayas (Energy Group), Pune.

## 1. Introduction and purpose

Availability of official data in the public domain is crucial for formulation, analysis and research of public policy. In addition to policy making, data availability is crucial for decision making in businesses and investment firms.

This is particularly true of the energy sector, where technical complexity is high and hence less accessible to the general public. In addition, given the globally interconnected nature of the sector and wide uncertainties in future trends of availability and price of energy commodities, availability of energy data in the public domain helps democratise the sector. Such data includes information such as available reserves, trends in production and prices, patterns of consumption, and statistics related to energy access.

The energy sector in India is administered by multiple ministries and departments at central and state governments. At the central government, there are different ministries responsible for coal, oil and gas, power, renewable energy and nuclear energy. Yet there are inter-linkages between the different sub-sectors and this has a bearing on how data is collected and organised. At the same time, some of the administration is concurrent in nature between Centre and the states, most prominently in the case of electricity. Given these considerations, collection and dissemination of energy data is a rather complex activity and requires coordination across multiple levels. On the consumption side, data is available from supply side ministries, household and enterprise consumption surveys and from various ministries dealing with various consuming sectors dealing with transport and industry.

The 'India Energy Dashboards' portal hosted by NITI Aayog (henceforth referred to as the Dashboards) was developed to make official energy data, available from multiple data agencies, accessible in one place through an intuitive interface. The first version of the Dashboards was launched in May 2017 and has been received well by Indian government agencies, analysts, researchers, modellers, businesses and the general public<sup>1</sup>.

Keeping in view this positive feedback, Prayas (Energy Group) undertook the development of enhancements to the Dashboards with the support of a research grant from NITI Aayog (vide sanction order no. O-15012/29/17-Research dated 30<sup>th</sup> November 2017). These enhancements include adding more data to the Dashboards, developing a workflow system to help maintain the Dashboards, improving the download features on the Dashboards and providing a forum for data users to interact.

The period of this research grant runs from December 14, 2017 to December 13, 2019. This is the final report describing the enhancements developed under the research grant.

## 2. Enhancements proposed

The following enhancements were proposed under the aforementioned research grant:

1. Data at **sub-yearly frequencies**: currently the Dashboards only provide data on an annual basis

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<sup>1</sup> The Dashboards has consistently received about 30 visits a day, of which 80-85% are from within India.

2. A **discussion forum** for data users to facilitate discussions among data users regarding data available on the Dashboards
3. A semi-automated **workflow/ issue-tracking system** for managing periodic updates to the Dashboards by NITI Aayog
4. Addition of **technical and financial data of electricity utilities** available from the regulatory documents in one state
5. **Enhanced data download**: a cleaner, more intuitive way will be provided for downloading data from the Dashboards

These features are described in greater detail below.

### 3. Sub-yearly data

Two types of sub-yearly data – published monthly data and live data from some apps and portals maintained by government agencies – have been added to the Dashboards.

#### 3.1. Monthly data

This data is sourced from the monthly reports that are regularly published for the electricity, petroleum and natural gas sectors. Since monthly reports for the coal sector are not published, they have not been included in the Dashboards. Table 1 lists the monthly data<sup>2</sup> added to the Dashboards.

**Table 1: List of monthly data added to the Dashboards**

Sector	Category	Description	Source
Oil	Production	State-wise crude oil production	MopNG
Oil	Production	Domestic production of petroleum products	PPAC
Oil	Consumption	Domestic consumption of petroleum products	PPAC
Oil	Import/export	Import/export of crude oil and petroleum products	PPAC
Natural gas	Production	State-wise natural gas production	PPAC
Natural gas	Import	Import of LNG (liquefied natural gas)	PPAC
Electricity	Capacity	State-wise, ownership-wise and source-wise installed capacity	CEA
Electricity	Production	Energy generation, plant load factor and imports	CEA
Electricity	Supply	State-wise peak and energy power supply position Report	CEA

#### 3.2. Data from live government portals

In addition to published monthly reports, live data is published at daily, monthly and yearly frequencies through various dashboards and mobile apps, primarily by central government organisations. With the proliferation of such dashboards in recent years, they have become a rich source of data in the energy sector. It would be useful to provide access to data from these portals in one place. However, this requires publicly accessible APIs for programmatically sourcing the data on

<sup>2</sup> Note that monthly data is provisional in nature. Hence monthly data reported on the Dashboards will be provisional. This will be indicated on the Dashboards.

a regular basis. NITI Aayog had written to the respective authorities for all available energy sector portals, and APIs have been provided for four of them – Saubhagya, UJALA, PRAAPTI and Vidyut PRAVAH – and the associated data has been added to the Dashboards. Table 2 lists the portals for which APIs are available along with a description of the data that is added to the Dashboards.

**Table 2: List of portals whose data is added to the Dashboards**

Sector	Category	Portal (website)	Description
Electricity	Access	Saubhagya ( <a href="https://saubhagya.gov.in/">https://saubhagya.gov.in/</a> )	Monthly state-wise progress of intensive household electricity connections drive under the Saubhagya program that was active from October 2017 to March 2019 <sup>3</sup> .
Electricity	Efficiency	UJALA ( <a href="http://ujala.gov.in/">http://ujala.gov.in/</a> )	Dashboard containing state-wise energy efficient appliance sales data under the 'Unnat Jyoti by Affordable LEDs for All' (UJALA) program.
Electricity	Generation	PRAAPTI ( <a href="https://praapti.in/">https://praapti.in/</a> )	Dashboard with monthly status of payments pending from DISCOMs to Generators. Full form: Payment Ratification And Analysis in Power procurement for bringing Transparency in Invoicing of generators (PRAAPTI).
Electricity	Distribution	Vidyut PRAVAH ( <a href="http://www.vidyutpravah.in/">http://www.vidyutpravah.in/</a> )	State-wise daily peak demand and nation-wide shortage at the time of peak demand. Although the Vidyut PRAVAH dashboard contains zone-wise price every 15 minutes, this data has not been made available through the API.

#### 4. Regulatory data

Detailed performance and financial data is available on an annual basis from regulatory documents such as tariff petitions filed by distribution and generation companies, and the orders issued by regulatory commissions. As part of this project, regulatory data from the state of Maharashtra,

<sup>3</sup> With the completion of household electrification, data under Saubhagya has not been updated since March 2019.

specifically for the area served by the state-owned distribution utility – MSEDCL – has been added to the Dashboards. Following is the list of data items added.

Category	Description	Data
<b>Power Purchase</b>	Long term and medium term power purchase by ownership (state, central, private) and fuel/technology (coal, solar etc). Some details such as source-wise disaggregation of renewable energy generation are not available.	Capacity (MW) Generation (MU) Fixed Charge (Rs/kWh) Variable Charge (Rs/kWh)
<b>Power Purchase</b>	Short-term purchases	Quantum (MU) Average Cost (Rs/kWh)
<b>RPO</b>	Solar and non-solar RPO	Obligation (%) Met (%)
<b>Sales</b>	Consumer category-wise	No. of consumers, Sales (MU), Revenue (Rs Cr) and Average billing rate (Rs/kWh)
<b>Consumption</b>	Open access consumption by duration and source	No. of consumers, Total connected load (MW) and Total consumption (MU)
<b>Sales</b>	Sale of surplus energy	Quantum (MU) and Average realised rate (Rs/kWh)
<b>Losses</b>	Transmission and distribution losses	Inter-state transmission losses (%) Intra-state transmission losses (%) Distribution losses (%)
<b>Expenditure</b>	Expenditure broken down under various heads	Total power purchase costs (Rs Cr) Distribution capital expenditure (Rs Cr) Distribution operating expenditure (Rs Cr) Distribution other expenses (Rs Cr)
<b>Subsidy</b>	Subsidy booked and received from government	Category-wise subsidy received (Rs Cr) Total subsidy booked (Rs Cr)
<b>Revenue</b>	Revenue broken down under various heads	Revenue from tariff (Rs Cr), Non-tariff income (Rs Cr), Sales migration (Rs Cr), Sale of surplus (Rs Cr), Subsidy receipts (Rs Cr), Revenue Gap/Surplus for the year (Rs Cr), Rate of carrying cost (%)

Indicators	Summary indicators derived from the above parameters	Consumer category-wise: Average power purchase cost (Rs/kWh), Average cost of supply (Rs/kWh), Average billing rate (Rs/kWh) and Cross-subsidy (Rs/kWh)
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## 5. Renewables menu

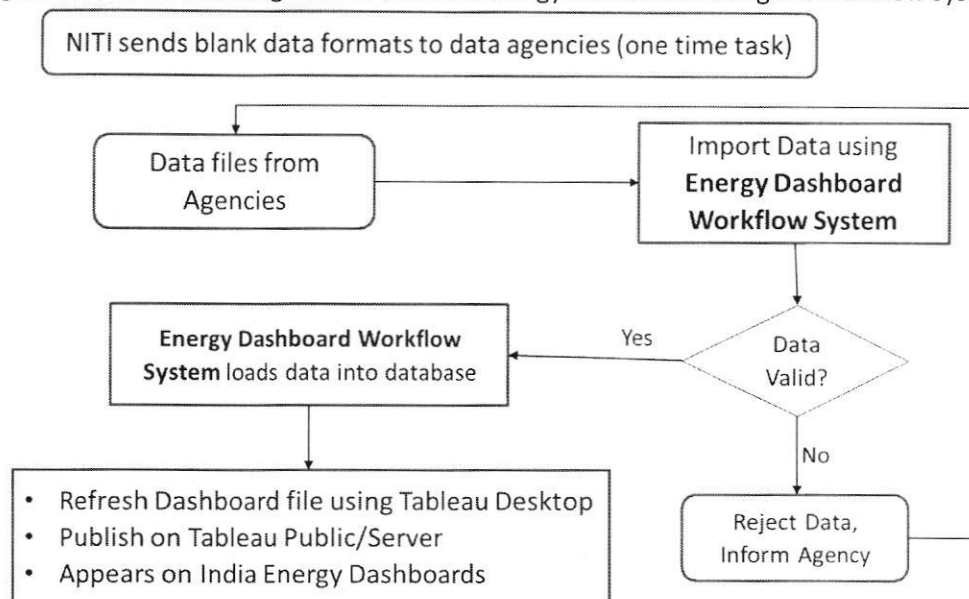
Given the increasing importance of renewables based electricity in the Indian energy system, it was felt during a review meeting with NITI Aayog management that a separate menu item for renewables should be added to the Dashboards. Based on this, a new menu item was created, and dashboards and charts relevant to renewables have been added to this section.

## 6. Workflow system

Ongoing maintenance of the Dashboards is an important task and is necessary for keeping the Dashboards up-to-date and relevant. A semi-automated workflow system has been developed to help NITI Aayog put in place robust processes to assist in maintaining the Dashboards going forward. Routine tasks for updating or adding data can be tracked through this system. The workflow system performs basic validation checks thus helping avoid incorrect data entry on the Dashboards. The system also provides for multiple users with different privileges and responsibilities, thus providing NITI Aayog management effective oversight over maintenance of the Dashboards. This system will be deployed on NITI Aayog's internal network. NITI Aayog staff would be provided hands-on training for how to use the workflow system to add new data and approve it so that it appears on the Dashboards.

The following flowchart shows the process of using the workflow system to periodically update the Dashboards.

Figure 1: Process of adding data to the India Energy Dashboards using the workflow system



Following are a few screenshots of the workflow system.



## 6.1. Search page or home page

The landing page of the workflow system is a search interface which provides the user status regarding which data items have been imported into the database, and which are pending. The search results provide templates as well as sample past data that can be used to import pending data. A snapshot of the search page is shown in Figure 2.

Figure 2: Search page

The screenshot shows a web interface for searching data. At the top, there are navigation tabs: Home, Import, Import Log, Masters, Meta Data, Download Data, Flow Balance, APP Data, and User Admin. Below these is a 'Home Search' section with a 'Design Spec' and 'Help' button. The search filters include 'Domain', 'Category', 'Subcategory', and 'Financial Year', each with a dropdown menu. Below the filters are radio buttons for 'Import Status': All (selected), Pending, Provisional, Final But Not Approved, and Final Approved. A 'Search' button is located to the right of the radio buttons. Below the search filters is a 'List' section with a 'Show 10 entries' dropdown and a search input field. The main content is a table with the following data:

Domain-Section	Element	Period	Status	LastImport	
Coal - Consumption	<a href="#">Coal Consumption</a>	2018-19	Pending		<a href="#">Template</a>   <a href="#">Import</a>   <a href="#">Sample</a>
Coal - Consumption	<a href="#">Coal Consumption</a>	2017-18	Pending		<a href="#">Template</a>   <a href="#">Import</a>   <a href="#">Sample</a>
Coal - Consumption	<a href="#">Coal Consumption</a>	2016-17	Pending		<a href="#">Template</a>   <a href="#">Import</a>   <a href="#">Sample</a>
Coal - Consumption	<a href="#">Coal Consumption</a>	2015-16	Provisional	13/09/2019	<a href="#">Template</a>   <a href="#">Import</a>   <a href="#">Data</a>

## 6.2. Data import

The data import page allows the user to upload a file in .csv format consisting of data for the corresponding year or month in the supplied template (see Figure 3). The imported data is checked for correctness of categorical data such as states, generation sources and consuming sectors. If these checks fail, the user is provided a report of the reasons for failure, based on which the user can re-import after correcting the data or adding new categories in the 'Masters' page. In addition, there are configurable checks for the actual parametric data that is being imported, such as installed capacity, quantity produced and quantity consumed. If these checks fail, a warning is raised which can either be overridden by the user. If the data is determined to be wrong, it can be corrected and re-imported.

The data that is imported can either be marked "Provisional" or "Final". "Provisional" data can be overwritten multiple times, but "Final" data cannot be overwritten. The import of both "Provisional" and "Final" data needs to be approved by a user with suitable privileges.

Figure 3: Data import page

### 6.3. Import log

The history of data imported to the database can be seen on the 'Import Log' page. This page provides a search facility to narrow down the history to specific sector and sub-sector. The search results indicate the period for which data was imported, when the data was imported, whether it is final or provisional, and which user imported the data (refer to Figure 4).

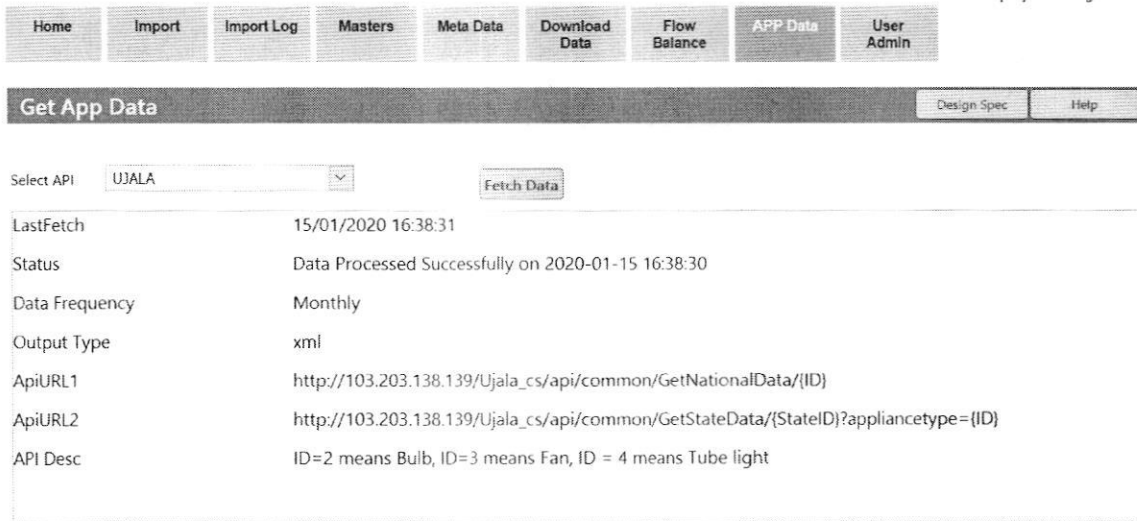
Figure 4: Import Log

Domain	Section	Element	User	Year	Month	Final	Import Date	ImportStatus	
Electricity	Electricity Monthly	Electricity Capacity Monthly	prayas	2019	6	p	30/07/2019 15:34:05	Data imported with warnings	<a href="#">Details</a>
Electricity	Electricity Monthly	Electricity Capacity Monthly	prayas	2019	5	p	30/07/2019 15:33:49	Successfully Imported	<a href="#">Details</a>

### 6.4. Fetching data from live government portals

As mentioned in Section 3.2, data from live government portals has been added to the Dashboards. This data is accessed through the APIs that have been provided. The trigger for fetching the data is provided through the workflow system under the tab 'APP Data' (see Figure 5). When the portal is chosen and 'Fetch Data' button is clicked, the data is fetched from the respective portal and added to the database. This data is then available for download through the data download interface described in Section 7.

Figure 5: Fetching live portal data



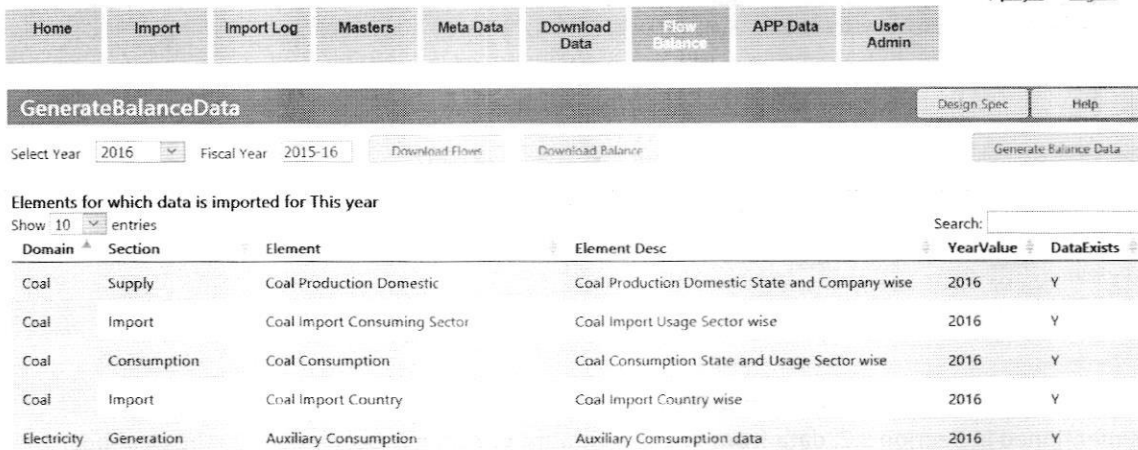
Select API: UJALA [Fetch Data]

LastFetch	15/01/2020 16:38:31
Status	Data Processed Successfully on 2020-01-15 16:38:30
Data Frequency	Monthly
Output Type	xml
ApiURL1	http://103.203.138.139/Ujala_cs/api/common/GetNationalData/{ID}
ApiURL2	http://103.203.138.139/Ujala_cs/api/common/GetStateData/{StateID}?applianceType={ID}
API Desc	ID=2 means Bulb, ID=3 means Fan, ID = 4 means Tube light

### 6.5. Generating the Energy flow (Sankey) and Energy balance tables

One of the important features of the Dashboards is to provide energy flow (Sankey) diagrams and energy balance tables for the years for which final data is available. The workflow system provides the ability to inspect if all yearly data is available for a particular year, and if the data exists, allow for the energy flow diagram and energy balance table to be generated using the data. Figure 6 has a snapshot of the same.

Figure 6: Generation of energy flow Sankey diagram and energy balance tables



Select Year: 2016 Fiscal Year: 2015-16 [Download Flow] [Download Balance] [Generate Balance Data]

Elements for which data is imported for This year

Domain	Section	Element	Element Desc	YearValue	DataExists
Coal	Supply	Coal Production Domestic	Coal Production Domestic State and Company wise	2016	Y
Coal	Import	Coal Import Consuming Sector	Coal Import Usage Sector wise	2016	Y
Coal	Consumption	Coal Consumption	Coal Consumption State and Usage Sector wise	2016	Y
Coal	Import	Coal Import Country	Coal Import Country wise	2016	Y
Electricity	Generation	Auxiliary Consumption	Auxiliary Consumption data	2016	Y

### 6.6. User administration – ‘User admin’ page

Accounts in the workflow system are assigned one of four roles – user, approver, user admin and developer admin – with a hierarchical set of privileges. User accounts can upload data while the approver accounts can approve the uploaded data and make changes to the master tables in addition to uploading data. The user admin role can add, change or remove user accounts. The developer admin account can undertake certain maintenance and development tasks such as updating the meta-data and queries for data download. An ‘Energy Data Portal and Application Overview’ document shall be provided at the time of deployment. This document consists details of privileges accorded to each of the above roles.

## 7. Improved data download

The first version of the Dashboards provides a way to download data in csv format through the “Download” button at the bottom right corner provided by the Tableau® data visualisation software with which the charts are created. Data thus downloaded is not always clean, in that it may consist of intermediate data used to produce the visualisations within Tableau. In addition, this download facility does not provide the user the ability to choose the category of data in line with the structure of the Dashboards. As part of the current enhancements, a cleaner, more intuitive way of downloading data from the portal is provided.

The improved data download interface can be accessed by NITI Aayog staff from the workflow system and by the general public through the India Energy Dashboards portal (the blue button seen in Figure 7). The user can choose the sector and category of data as organised on the India Energy Dashboards. When the ‘Download’ button is pressed, the data is downloaded in a csv format. The user can choose the level of detail by selecting either aggregate or itemised detail (see Figure 8).

The public version of the data download application will be enabled on the Dashboards when the necessary IT security clearances are received from NIC.

Figure 7: Download data button on the Dashboards (top right corner, next to the help button)

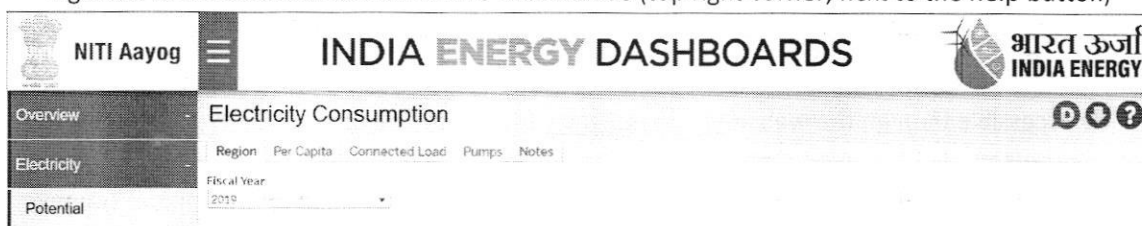


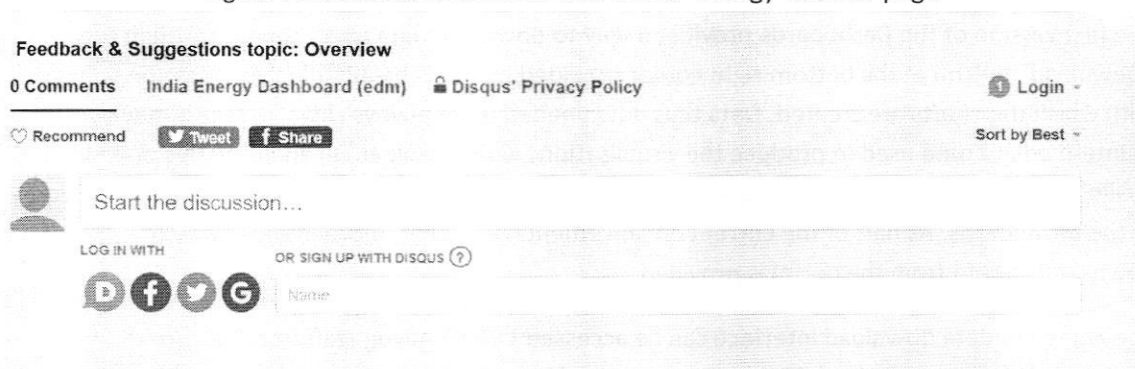
Figure 8: Data download application interface

The image shows a form titled 'Download Energy Data'. It has two columns of input fields. The left column contains 'Domain' (set to 'ELECTRICITY') and 'Category' (set to 'Electricity Monthly'). The right column contains 'Subcategory' (set to 'Electricity Monthly - Demand & Availability of Power'), 'Download Data Option' (with radio buttons for 'Aggregate' and 'Itemised', where 'Aggregate' is selected), 'Fiscal Year' (set to 'ALL'), 'Region' (set to 'ALL'), and 'State Name' (an empty text box). A 'Download' button is located at the bottom right of the form.

## 8. Feedback forum

The energy data user community could be engaged to help improve the quality of the data and interface of the Dashboards. A feedback forum has been added to the Dashboards in order to facilitate feedback from data users (see Figure 9).

Figure 9: Feedback forum interface on the 'Energy Balance' page



The feedback forum consists of separate sub-forums for each domain listed in the left hand side menu on the Dashboards – Overview, Electricity, Coal, Oil, Gas, State and References. This level of granularity reduces clutter so that the feedback is relevant for the domain being viewed while also ensuring that feedback is easier to track.

The feedback forum will be moderated by a respected energy sector researcher/analyst identified by NITI Aayog. Dr Rangan Banerjee, Professor, IIT Bombay, has agreed to moderate the forum.

## 9. Deployment and support

The enhanced Dashboards and the workflow application was deployed on NITI Aayog servers and is publicly accessible through the web at <http://niti.gov.in/edm>. The Dashboards were launched by the Vice Chairperson, NITI Aayog on April 12<sup>th</sup> 2021. The underlying database and Tableau® dashboards were handed over to NITI Aayog and NIC staff for future maintenance and feature addition. Training was provided to NITI Aayog and NIC staff at the time of hand over, and the various features were explained along with a walk through of a typical workflow process.

Prayas (Energy Group) assisted NITI Aayog staff over phone/audio conferences on an as needed basis from May 2020 to April 2021. During this period, recent years' data has been incorporated into the Dashboards by NITI Aayog and data is available up to 2019-20, and in some cases up to 2020-21.

## 10. Future work

NITI Aayog should institutionalise the data update activity so that the Dashboards continues to remain relevant by having the latest available data.

In addition, there is scope for significantly enhancing the amount of data and visualisations available through the Dashboards. Following are some suggested areas of future work.

- Regulatory data can be expanded to more states and DISCOMs using the provided formats
- More live portals can be added by requesting for public APIs
- The energy data user community can be engaged and based on the feedback received
  - any data inconsistencies can be fixed and
  - new data and dashboards can be added to India Energy Dashboards.
- NITI Aayog can consider a quarterly newsletter in which updates made to India Energy Dashboards are communicated.