Strategies for collecting renewable energy data

Joint 34th Meeting of APEC Expert Group on Energy Data and Analysis (EGEDA) and
58th Meeting of the APEC Expert Group on New and Renewable Energy Technology (EGNRET 58)

Lejla Villar, Team Lead
April 4, 2023 | Honolulu, Hawaii

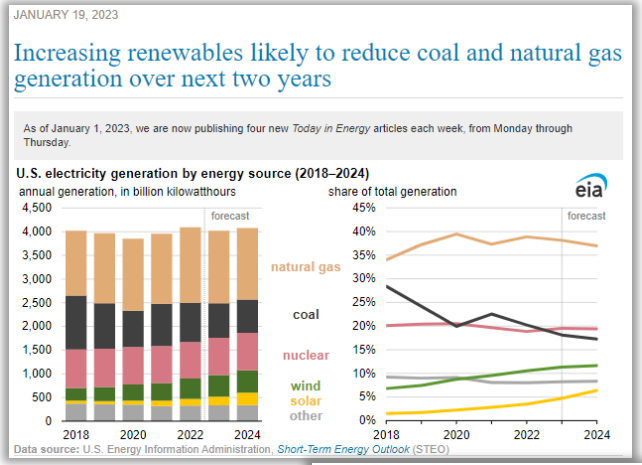
Independent Statistics and Analysis

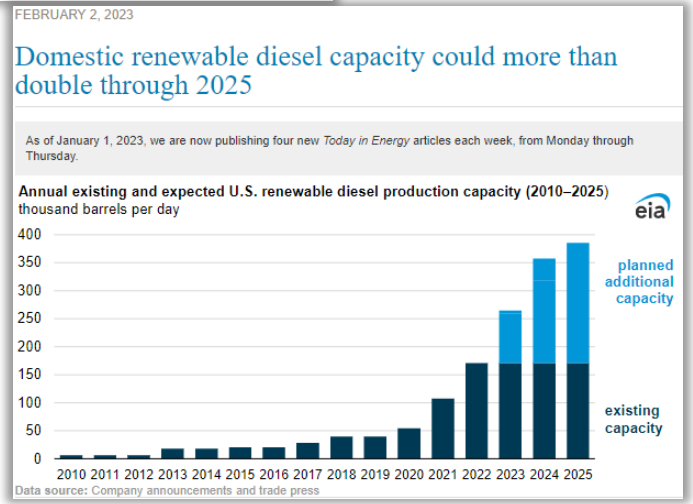
U.S. Energy Information Administration

The U.S. Energy Information Administration (EIA) collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment.

EIA's role is unique — by providing an unbiased view of energy markets, EIA increases transparency and promotes public understanding of important energy issues.

EIA has expanded its program in recent years to provide a growing customer base with coverage of increasingly complex and interrelated energy markets.





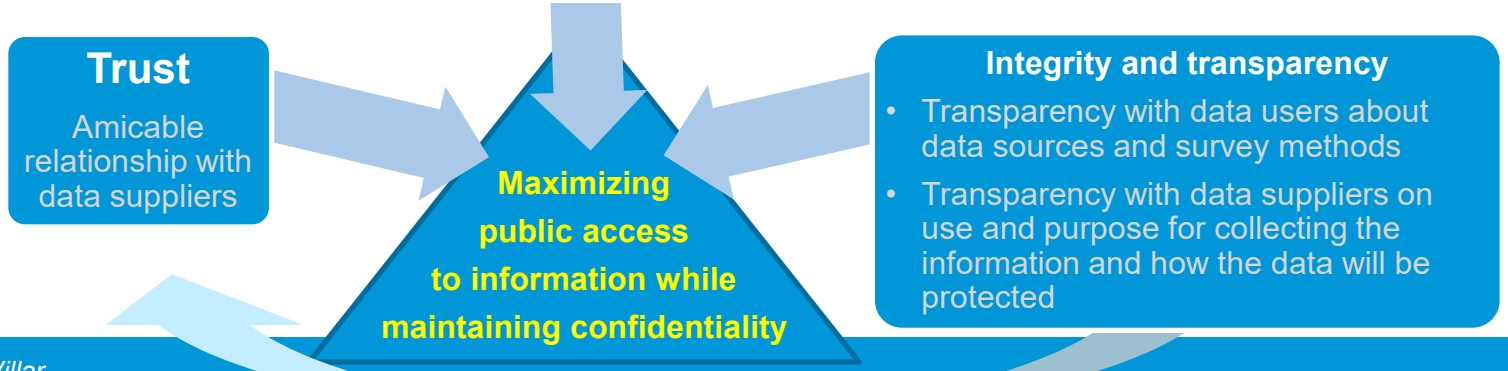
EIA's Statistics programs rely on mandatory, but negotiated, collection authority

Legal rights to collect

- Federal Energy Administration Act of 1974 (Public Law 93-275)
- Department of Energy (DOE) Organization Act of 1977 (Public Law 95-91)
- Other legal mandates

Legal obligations to protect

- Confidential Information Protection and Statistical Efficiency Act (CIPSEA), Title V of the E-Government Act of 2002 (Public Law 107-347)
- Freedom of Information Act, 5 USC. 552, exemptions 3, 4, and 6
- Paperwork Reduction Act, 44 U.S.C. 3501
- Information Quality Act, P.L. No. 106-554; H.R. 5658, Section 515(a)

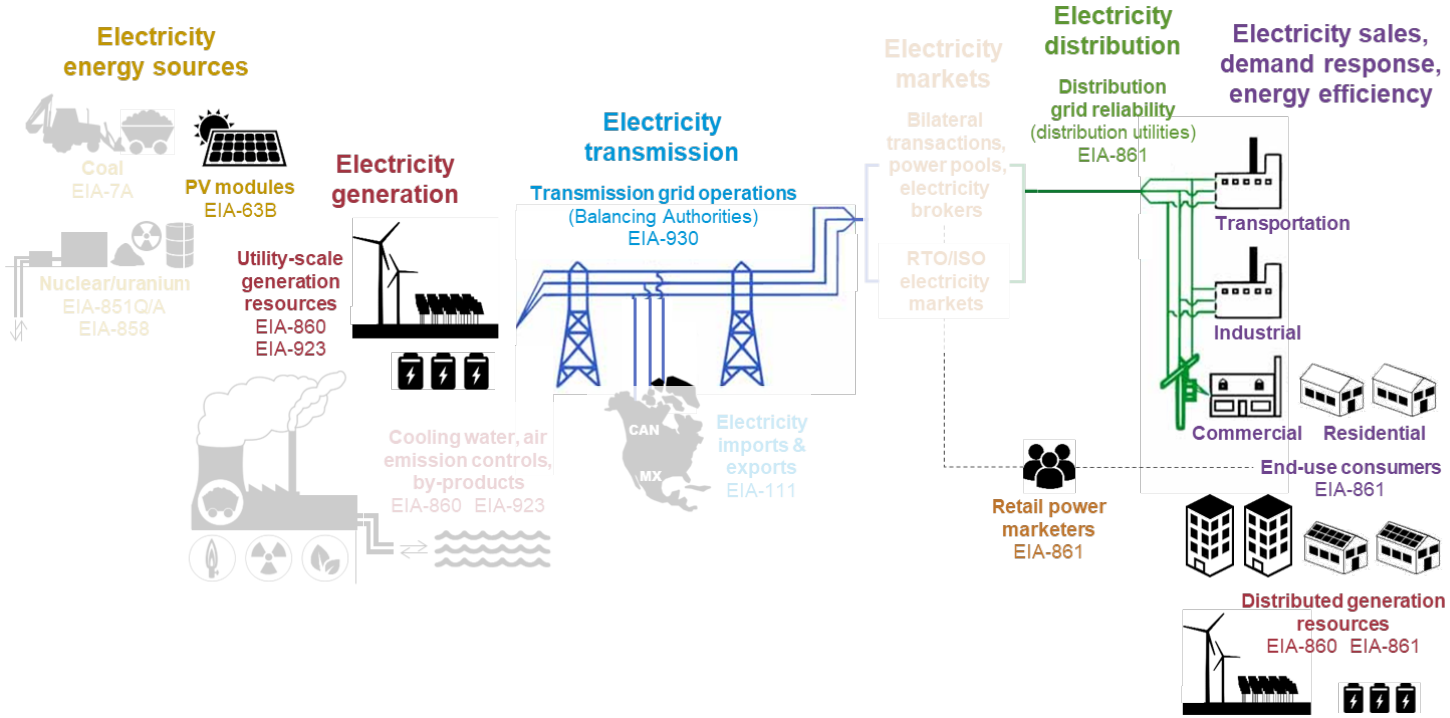


Session objectives

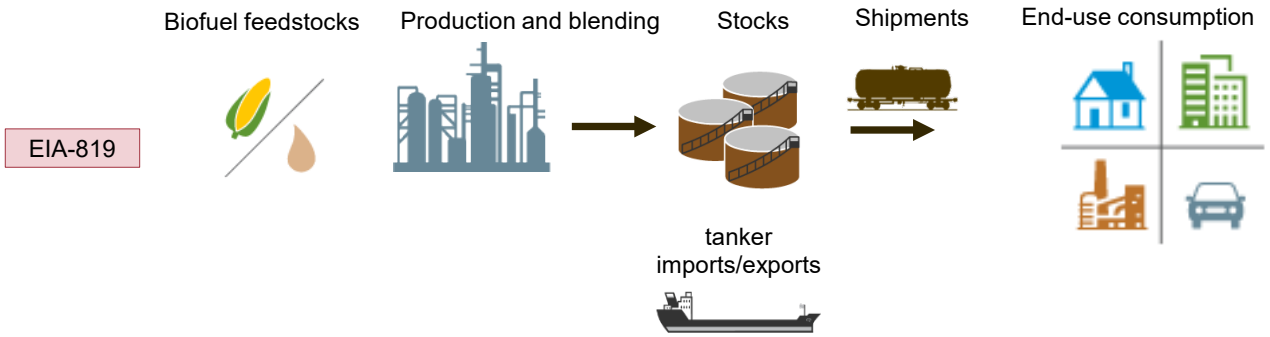
- How has EIA adjusted its survey methods and data cleaning, compilation, and reporting procedures to adapt to the dramatic increase in renewable energy production and consumption?
  - Modified established survey forms to better understand key drivers of renewable activity
  - Developed new survey forms to fill data gaps
  - Developed models to cover areas that are impractical for survey
- In addition to electricity-based participation, how has EIA handled non-power renewable energy?
  - Developed surveys specifically designed for biofuel production
- Goal is to support discussion among all the delegates about challenges and workable solutions with respect to renewable energy data

U.S. renewable energy data

The electricity industry in the U.S. developed over 90 years under regulatory oversight and many of the existing survey instruments were developed in service to that oversight



Biofuels and biomass surveys have been added to support policy and industry analysis



EIA collects and produces extensive renewable energy data: biofuels, biomass, electricity from renewables and more…

- Much of EIA's renewable data is from surveys, some of which are specifically designed for renewables others are inclusive of all energy sources
- Identification of planned and existing production facilities is critical comprehensive coverage of industry activity
- Efficient outreach to respondents, data collection, processing and publication systems are also important

Expand to see publications

Infrastructure maps

Source: https://www.eia.gov/renewable/data.php

Frame identification and maintenance is critical

- The *Electric Power Annual* provides counts of generators and capacities
- When new facilities and technologies enter the market, they are added
- Plus, we publish large amounts of detailed data https://www.eia.gov/electricity/data/detail-data.php

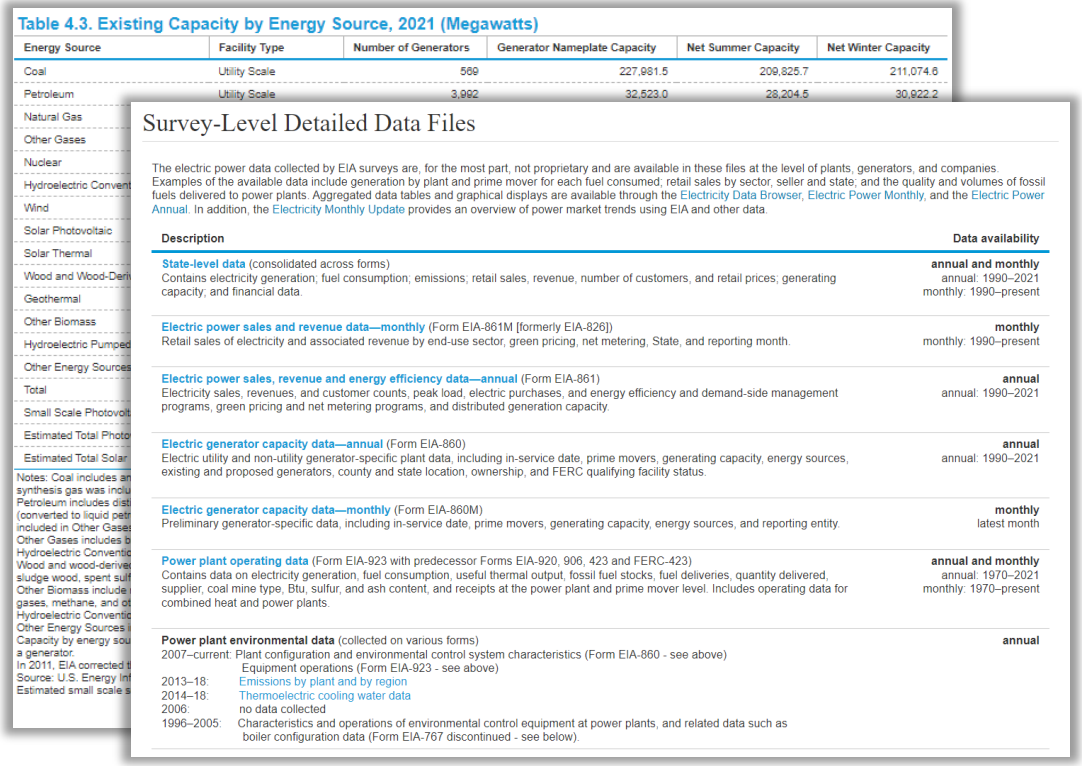


Table 4.3. Existing Capacity by Energy Source, 2021 (Megawatts)

Energy Source	Facility Type	Number of Generators	Generator Nameplate Capacity	Net Summer Capacity	Net Winter Capacity
Coal	Utility Scale	569	227,981.5	209,825.7	211,074.6
Petroleum	Utility Scale	3,992	32,523.0	28,204.5	30,922.2
Natural Gas					
Other Gases					
Nuclear					
Hydroelectric Convent					
Wind					
Solar Photovoltaic					
Solar Thermal					
Wood and Wood-Deri					
Geothermal					
Other Biomass					
Hydroelectric Pumped					
Other Energy Sources					
Total					
Small Scale Photovolt					
Estimated Total Photo					
Estimated Total Solar					

Notes: Coal includes an
synthesis gas was inclu
Petroleum includes dist
(converted to liquid petr
included in Other Gases
Other Gases includes b
Hydroelectric Conventic
Wood and wood-derive
sludge wood, spent sulf
Other Biomass include
gases, methane, and ot
Hydroelectric Conventic
Other Energy Sources
Capacity by energy sou
a generator.
In 2011, EIA corrected t
Source: U.S. Energy Inf
Estimated small scale s

Survey-Level Detailed Data Files

The electric power data collected by EIA surveys are, for the most part, not proprietary and are available in these files at the level of plants, generators, and companies. Examples of the available data include generation by plant and prime mover for each fuel consumed; retail sales by sector, seller and state; and the quality and volumes of fossil fuels delivered to power plants. Aggregated data tables and graphical displays are available through the Electricity Data Browser, Electric Power Monthly, and the Electric Power Annual. In addition, the Electricity Monthly Update provides an overview of power market trends using EIA and other data.

Description	Data availability
State-level data (consolidated across forms) Contains electricity generation; fuel consumption; emissions; retail sales, revenue, number of customers, and retail prices; generating capacity; and financial data.	**annual and monthly** annual: 1990–2021 monthly: 1990–present
Electric power sales and revenue data—monthly (Form EIA-861M [formerly EIA-826]) Retail sales of electricity and associated revenue by end-use sector, green pricing, net metering, State, and reporting month.	**monthly** monthly: 1990–present
Electric power sales, revenue and energy efficiency data—annual (Form EIA-861) Electricity sales, revenues, and customer counts, peak load, electric purchases, and energy efficiency and demand-side management programs, green pricing and net metering programs, and distributed generation capacity.	**annual** annual: 1990–2021
Electric generator capacity data—annual (Form EIA-860) Electric utility and non-utility generator-specific plant data, including in-service date, prime movers, generating capacity, energy sources, existing and proposed generators, county and state location, ownership, and FERC qualifying facility status.	**annual** annual: 1990–2021
Electric generator capacity data—monthly (Form EIA-860M) Preliminary generator-specific data, including in-service date, prime movers, generating capacity, energy sources, and reporting entity.	**monthly** latest month
Power plant operating data (Form EIA-923 with predecessor Forms EIA-920, 906, 423 and FERC-423) Contains data on electricity generation, fuel consumption, useful thermal output, fossil fuel stocks, fuel deliveries, quantity delivered, supplier, coal mine type, Btu, sulfur, and ash content, and receipts at the power plant and prime mover level. Includes operating data for combined heat and power plants.	**annual and monthly** annual: 1970–2021 monthly: 1970–present
Power plant environmental data (collected on various forms) 2007–current: Plant configuration and environmental control system characteristics (Form EIA-860 - see above) Equipment operations (Form EIA-923 - see above) 2013–18: Emissions by plant and by region 2014–18: Thermoelectric cooling water data 2006: no data collected 1996–2005: Characteristics and operations of environmental control equipment at power plants, and related data such as boiler configuration data (Form EIA-767 discontinued - see below).	**annual**

Source: https://www.eia.gov/electricity/annual/html/epa_04_03.html

Some of the more relevant survey forms

- Electricity
  - EIA-860, Annual Electric Generator Report
  - EIA-861, Annual Electric Power Industry Report
  - EIA-923, Power Plant Operations Report
  - EIA-63B, Photovoltaic Module Shipments Report
  - EIA-930, Hourly and Daily Balancing Authority Operations Report
  - A Guide to EIA Electric Power Data
- Liquid biofuels and solid biomass
  - Production, capacity and feedstocks
  - EIA-819, Monthly Report of Biofuels, Fuels from Non-Biogenic Wastes, Fuel Oxygenates, Isooctane, and Isooctene
  - Monthly petroleum surveys
    - EIA-810, Monthly Refinery Report (details of products at refineries)
    - EIA-815, Monthly Bulk Terminal Report
  - EIA-63C Densified Biomass Fuel Report

Broad data collection considerations

Options for gathering and producing energy information

- At any point in the supply chain, but that is huge and often disperse
- Facilities or major infrastructure locations (e.g., power plants)
- Companies
- Regional organizations (e.g., State governments, RTOs and ISOs)
- Administrative data that companies are required to make public
- Third-party purchases
- Models

Objectives and considerations

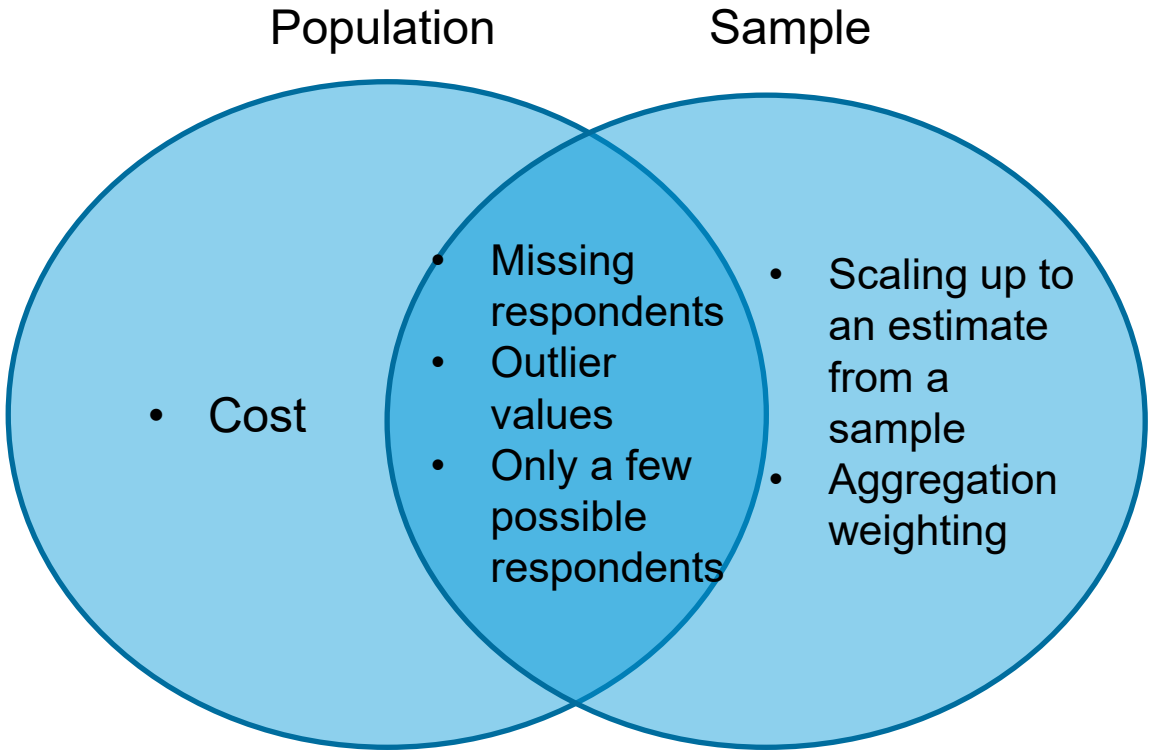
- Completeness
- Timeliness
- Effectiveness (do the data even exist)
- Cost (to respondents and tax payers)
- Supporting efficient energy markets
- Policymaking

How many respondents do we need to survey?

- Everything (i.e., population census)
  - Refineries = 130
  - Electricity generation plants = more than 13,500 and growing
  - Electric utilities (3,300)
  - Gas utilities (1,800)

- Sample
  - Still need to know the size and distribution of census (i.e., frame)
  - Typically first identify minimally acceptable geographies (e.g., states, industry territories)
  - Then categories of facilities (e.g., truck stops as opposed to service stations)
  - Often focus on largest market participants

Both census and sample surveys present challenges

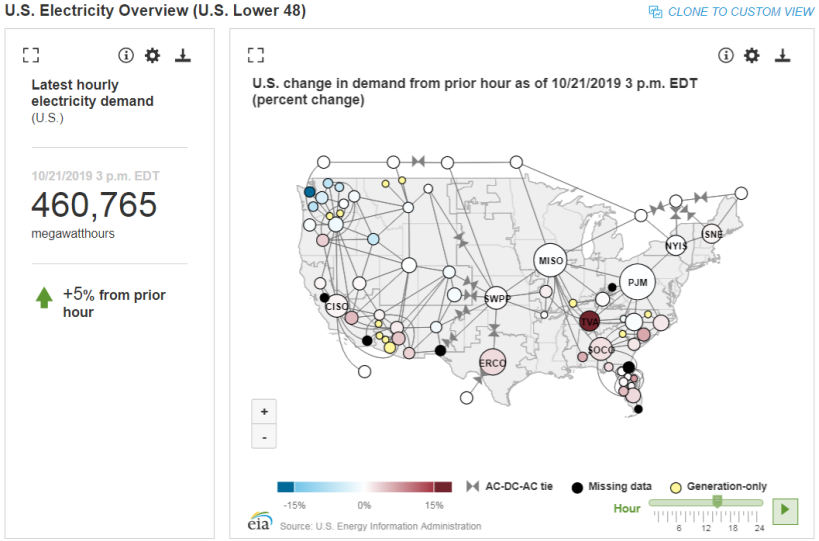


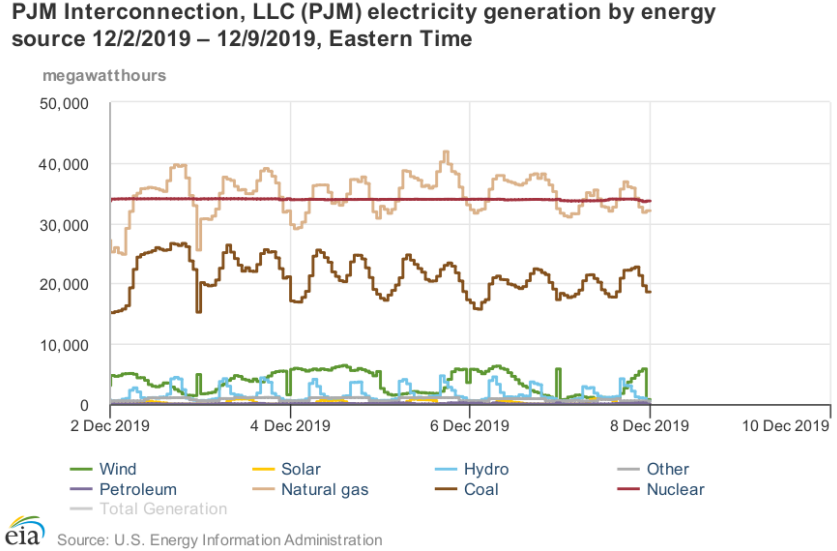
Expanding into administrative data and models

- Sometimes the data exist and just require gathering and cleaning
  - EIA-930 survey collects operational data from electricity system operators
  - U.S. Customs collects imports and exports data for the Census Bureau
- Modeling of data
  - Small scale solar estimates are modeled from annual and monthly retail sales and generation
  - Electric vehicle (EV) charging (coming soon) is modeled on vehicle sales, driving patterns and temperature data
- Third-party data published by private entities

Electricity and the energy transition

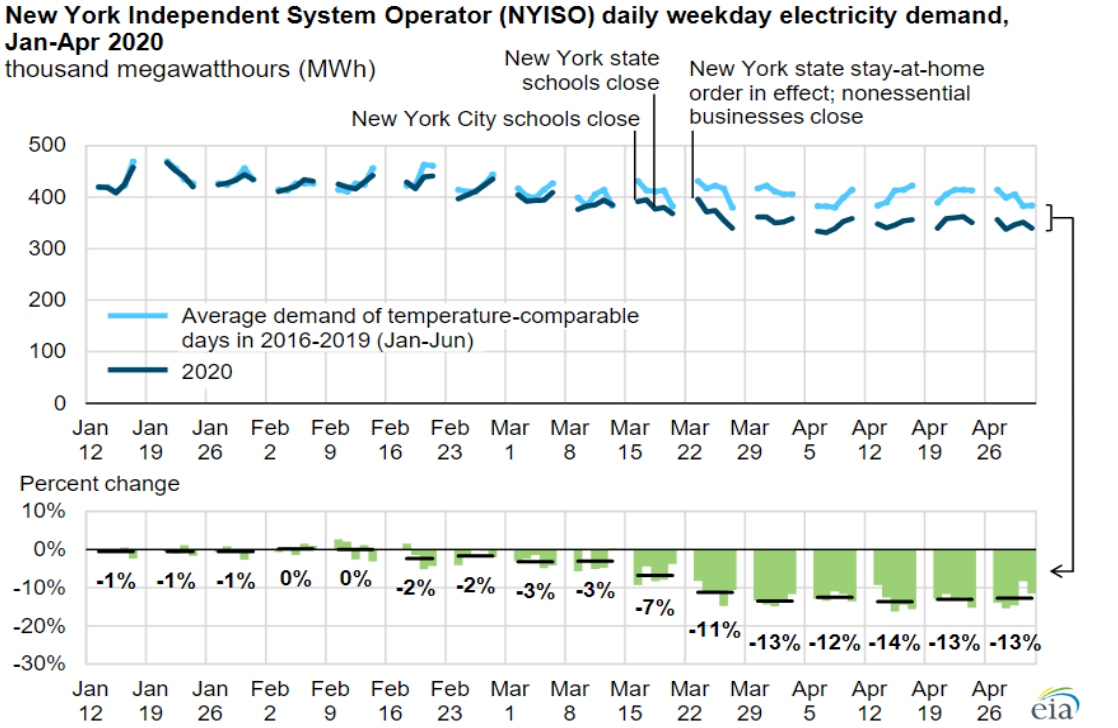
EIA's *Hourly Electric Grid Monitor* tool lets analysts track load, interchange, and generation by source by hour





Sources: U.S. Energy Information Administration, Hourly Electric Grid Monitor

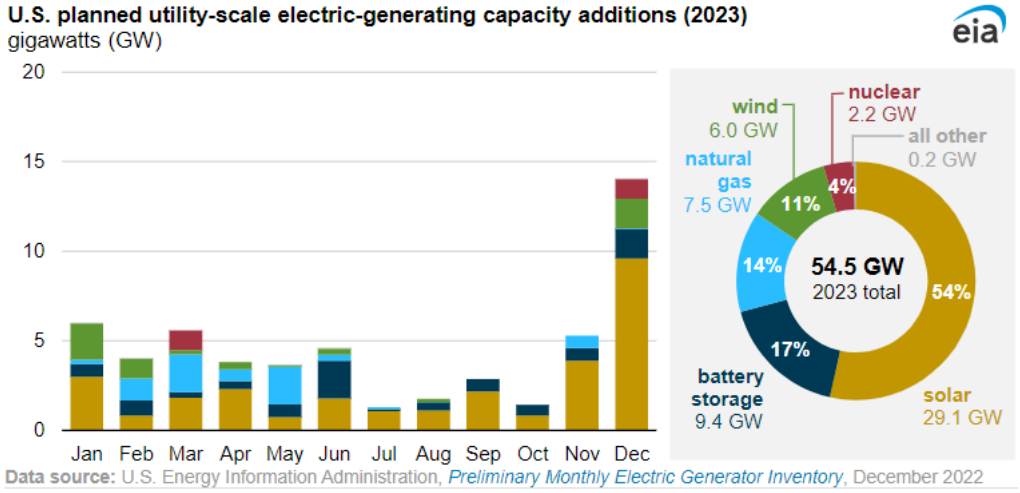
EIA's *Hourly Electricity* data enabled quick analysis of COVID-19 shutdown



Source: U.S. Energy Information Administration, *Hourly Electric Grid Monitor*; National Oceanic and Atmospheric Administration, Aviation Weather Center and National Centers for Environmental Information

More than half of new U.S. electric-generating capacity in 2023 will be solar

Developers plan to add 54.5 gigawatts (GW) of new utility-scale electric-generating capacity to the U.S. power grid in 2023, according to our *Preliminary Monthly Electric Generator Inventory*. More than half of this capacity will be solar power (54%), followed by battery storage (17%).



Source: https://www.eia.gov/todayinenergy/detail.php?id=55419

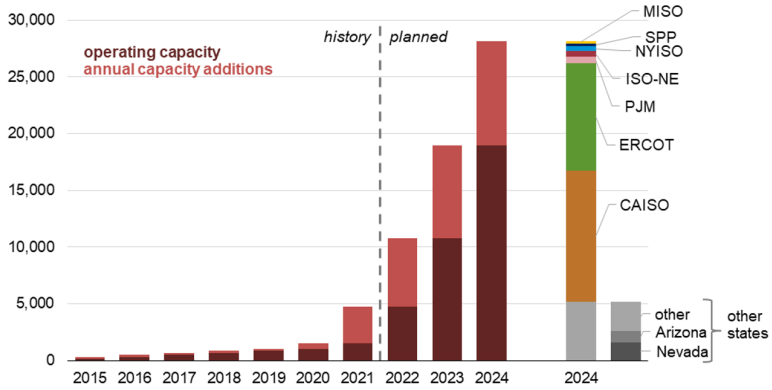
Battery storage is also growing rapidly

Electric power markets in the United States are undergoing significant structural change that we believe, based on planning data we collect, will result in the installation of large-scale battery storage with the ability to contribute an additional 23,000 megawatts to the grid between 2022 and 2024— 5 times the 4,712 megawatts available in 2021.

Figure ES.4. Large-scale battery storage cumulative power capacity, 2015–2024

power capacity

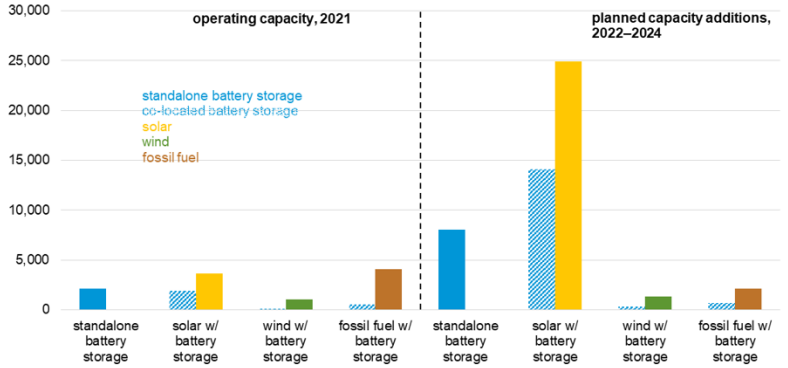
megawatts



Data source: U.S. Energy Information Administration, Dec 2020 Form EIA-860M, *Preliminary Monthly Electric Generator Inventory*

Figure ES.3. U.S. large-scale battery storage power capacity additions, standalone and co-located

megawatts



Data source: U.S. Energy Information Administration, Dec 2020 Form EIA-860M, *Preliminary Monthly Electric Generator Inventory*

Note: Solid yellow, green, and brown bars indicate generating total capacity of solar, wind, and fossil fuels that have battery storage on-site.

Source: https://www.eia.gov/analysis/studies/electricity/batterystorage/

International renewables data

International data collection approach differs from the U.S. data collection

- We rely on third party data sources for renewables data outside of the United States
  - IRENA, IEA, UN, government-reported statistics, and various international associations
- Generally, data reported for renewables data are reliable and fairly consistent
  - Challenges exist when attempting to capture privately-owned, roof-top solar installations globally and biomass (wood) consumption in developing countries
  - Data timeliness is also a challenge.
- Internally, we ensure data quality and consistency by constructing energy balances for each country

For more information

U.S. Energy Information Administration home page | www.eia.gov

All reports | www.eia.gov/reports/upcoming.php

Hourly Electric Grid Monitor | www.eia.gov/electricity/gridmonitor

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

State Energy Profiles | www.eia.gov/state

State Electricity Profiles | www.eia.gov/electricity/state/

International Energy Portal | http://www.eia.gov/international/overview/world

Additional material

Where does EIA renewable energy data come from?

- A great place to start is the footnotes in Chapter 10 of *Monthly Energy Review*
  - Major categories include: wood, biomass inputs for liquid biofuels and resulting products, electricity generation from hydropower, wind, solar, geothermal, biomass and municipal solid waste
  - All sectors are included
  - Distinguishes between utility-scale solar (larger than 1 megawatt) and small-scale solar
  - See also (https://www.eia.gov/totalenergy/data/monthly/pdf/flow/renewable-spaghettichart-2021.pdf)
  - And the Appendices
- The survey forms are also very useful https://www.eia.gov/survey/

Statistical Governance

The U.S. Statistical System is operationally decentralized

- Three Branches of Government: Executive, Legislative, and Judiciary
- Executive Branch – 15 Departments
- 190 “statistical units” within 15 Departments
- But only 90 of these “agencies” conduct statistical collections
- And only 14 of those 90 are Principal Federal Statistical Agencies
- EIA is among the 14

Common characteristics of Principal Federal Statistical Agencies:

- Produce objective data that are relevant to policy issues
- Achieve and maintain credibility among data users
- Achieve and maintain trust among data providers
- Achieve and maintain a strong position of independence from the appearance and reality of political influence and control

The Office of Management and Budget (OMB) approves survey data collections based on public review process

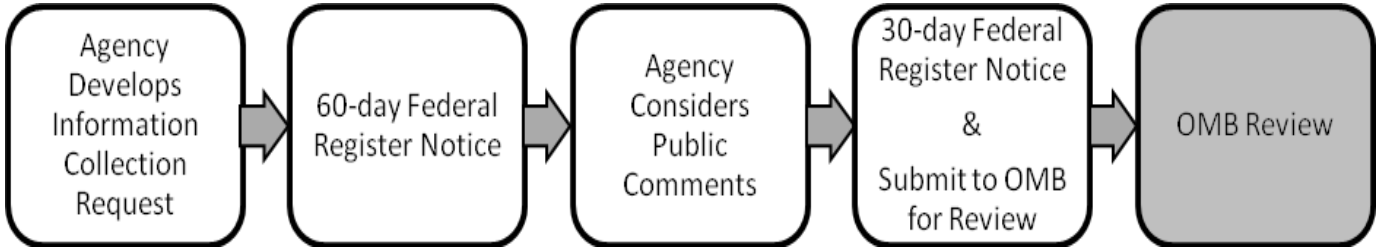
Step 1: EIA prepares Information Collection Request (ICR)

Step 2: EIA prepares and posts 60-day Federal Register Notice (FRN)

Step 3: EIA considers public comments

Step 4: EIA prepares and publishes the 30-Day Federal Register Notice

Step 5: OMB reviews and makes determination on whether or not to approve submission



Currently, 57 surveys are subject to OMB clearance

Category / Number of surveys	Hourly (real time) & daily	Weekly	Monthly	Quarterly	Annual	Quadr-ennial	Standby/ On occasion	Total *
Petroleum		10	14		4			28
Natural gas		1	6		3		1	11
Coal				1	2		2	5
Uranium and nuclear fuel				1	2			2
Alternative fuel			1		1			2
Renewables			1		1			2
Electric power	1		3	1	4			7
Energy consumption						3		3
Finance/environment/other							1	1
Total *	1	11	23	3	15	3	4	**57**

** Some surveys span multiple categories and collection frequencies; details are available at http://www.eia.gov/survey/*

Total EIA Burden

- 56 active surveys
  - Includes burden requested for emergency surveys
  - Includes burden requested for previous data collections for CBECS, RECS, and MECS
  - Excludes four surveys conducted for the Department of Energy (reimbursables)

- 427,970 total annual responses estimated to OMB

- 766,537 total burden hours estimated to OMB across all 56 active surveys