The Clean Investment Monitor: Methodology

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Center for Energy and Environmental Policy Research

Introduction

The Clean Investment Monitor (CIM) is a joint project of Rhodium Group and MIT's Center for Energy and Environmental Policy Research (CEEPR) that tracks investments in the manufacture and deployment of covered technologies that reduce GHG emissions in the US. All analyses are made publicly available at **cleaninvestmentmonitor.org**. This document details the methodology used in the CIM.

In 2021 and 2022, the US passed three major pieces of legislation that fund public investment and provide incentives for expanded private investment in the manufacture and deployment of greenhouse gas (GHG) emission-reducing technology in the US: the Inflation Reduction Act (IRA), the Infrastructure Investment and Jobs Act (IIJA), and the CHIPS and Science Act. **Rhodium Group projects** that these investments will accelerate the pace of net GHG emission reductions in the US to 29-42% below 2005 levels by 2030. Other independent analysts **have reached similar conclusions**. If federal legislation is complemented with federal regulatory action and new policy at the state level, Rhodium projects US net GHG emissions will decline to 45-51% below 2005 levels by 2030, putting the US 2030 commitment under the Paris Agreement within reach.

Rhodium Group and MIT's Center for Energy and Environmental Policy Research (CEEPR) have launched the Clean Investment Monitor (CIM) to provide a comprehensive, real-time source of information on investments in the manufacture and deployment of technologies that reduce GHG emissions in the US, with data made publicly available at **cleaninvestmentmonitor.org**, as well as through Rhodium Group and Breakthrough Energy's ClimateDeck platform. To create a historical baseline against which to assess recent clean investment developments in the US, the CIM includes all investments since 2018. The CIM enables real-time assessment of the impact of the IRA, IIJA, and CHIPS and Science Act on investment activity and GHG emissions in the US, as well as broader assessments of investment trends.

The CIM reports both quarterly and annual investment amounts for manufacturing and deployment of covered technologies. As outlined below, investment amounts are distributed temporally and presented in real dollar terms to provide a comparable time series. The CIM database is updated on a quarterly basis.

The CIM also reports estimated federal investments in covered sectors via tax credits, grants, loans, and loan guarantees. These estimates are reported as a quarterly time series, corresponding to the quarter in which activity eligible for a tax credit took place, or to the quarter in which federal outlays corresponding to grants, loans, and loan guarantee programs are made.

Covered Technologies

There is a wide range of technologies that have the potential to reduce GHG emissions, and each of those technologies has a wide range of input components. For analytical tractability and comparability of investment data over time, the current version of the CIM includes investments in the manufacture and deployment of GHG emission-reducing technologies that are eligible for tax incentives under the IRA. Most of these technology categories are also eligible for grants, loans, or loan guarantees funded through the IRA, the IIJA, or the CHIPS and Science Act. The CIM tracks all public and private investments in these covered technology categories.

When the Bureau of Economic Analysis (BEA) reports **overall investment trends for the US economy**, they capture both investment in structures and equipment (like factories) as well as the purchase of durable consumer goods (like automobiles). We take a similar approach with the CIM for comparability to BEA aggregate investment data. We break out clean investment into three "segments": investment in the manufacture of GHG emission-reducing technology ("Manufacturing") and investment in the deployment of that technology, both to produce clean energy or decarbonize industrial production ("Energy and Industry"), and through the purchase and installation of that technology by individual households and businesses ("Retail").

Manufacturing

For investments in new manufacturing capacity to produce emission-reducing technology, the CIM includes all technologies eligible for the IRA 45X tax credit (a new tax credit available to all eligible technologies) and most technologies eligible for 48C (an existing program with $10 billion in additional funding provided in the IRA). To receive a 48C tax credit, companies **must apply** to the Department of Energy (and be approved by the Department of Treasury/IRS) to participate in one of two award rounds. Once the first round of awards is announced, if there are major gaps in CIM

coverage, we may expand our coverage (including historical baseline data) to include 48C-eligible technologies not listed below.

Technology	Subcategories	Relevant Tax Credits
Solar	Modules, Cells, Wafers, Polysilicon, Torque Tubes, Structural Fasteners, Polymeric Backsheets, Inverters	45X, 48C
Wind	Blades, Nacelles, Towers, Offshore Foundations, Related Vessels, Distributed Wind Inverters	45X, 48C
Batteries	Electrode Active Materials, Cells, Modules	45X, 48C
Critical Minerals	All Eligible for 45X Credits	45X, 48C
ZEVs	BEVs, PHEVs and FCVs	48C
Electrolyzers	PEM, Alkaline, SOEC and AEM	48C
Fueling Equipment	EV Charger Equipment	48C

Energy and Industry

For investments in the deployment of technologies that reduce GHG emissions in the bulk production of energy or industrial goods or capture ambient carbon dioxide, the CIM uses the eligibility criteria from a range of tax credit provisions in the IRA. As of the Q3 2024 release, we expanded the scope to include emerging industrial decarbonization technologies for cement, iron, and steel that decrease emissions using novel processes beyond carbon capture, utilization, and storage (CCUS). We also break out ethanol and pulp & paper production facilities performing carbon capture and storage (CCS) because of their increasing number of developments.

Technology	Subcategories	Relevant Tax Credits
Solar	Solar PV, Concentrating Solar Power	45, 48, 45Y, 48E
Wind	Onshore Wind, Offshore Wind	45, 48, 45Y, 48E
Nuclear	Retention of existing and construction of new nuclear	45U, 45Y, 48E
Other Clean Electricity	Geothermal, Landfill Gas, Hydroelectric, Biomass	45, 48, 45Y, 48E
Storage	Batteries, Pumped Storage, Long-Duration Storage	48, 48E
Hydrogen	PEM, Alkaline, SOEC, AEM, Oil w/ CCUS, NG w/ CCUS	45V
Carbon Management	CCUS, Direct Air Capture	45Q

Sustainable Aviation Fuels	Hydroprocessed Esters and Fatty Acids, Alcohol to Jet, Biomass using Fischer-Tropsch technology, Power to Liquid	40B, 45Z
Clean Fuels	Ethanol with CCUS	45Q, 45Z, 48C
Cement	CCS, Low Carbon Ordinary Portland Cement (OPC) or OPC Alternatives	45Q, 48C
Iron & Steel	Direct Reduced Ironmaking (DRI) with or without CCS, Blast Furnace with CCS, Electrochemical Approaches, Cold-Agglomerated Iron Ore	45Q, 48C
Pulp & Paper	CCUS	45Q, 48C

The clean fuels tax provisions of the IRA currently cover more than just hydrogen and sustainable aviation fuels (SAF). We will expand our coverage to include other qualifying categories in future versions of the CIM. Also, for carbon management, the CIM currently includes investment in capture, but not CO_2 pipeline or sequestration investment. We will seek to include these investments in the future.

Retail

For investments in the retail purchase (and installation where applicable) of GHG-reducing technologies by households and businesses, the CIM includes the following categories listed below.

The current version of the CIM does not include residential building efficiency investments outside of heat pump installations, even though some are eligible for tax credits under the IRA. Available sources of information on such investments are currently too limited. We will include these investments in future versions of the CIM if data availability improves. The CIM currently includes investment in electric vehicle charging manufacturing but does not include investments in the deployment of clean vehicle refueling infrastructure due to data limitations, but we intend to add this to future versions.

Technology	Subcategories	Relevant Tax Credits
Zero Emission Vehicles	Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles, Fuel Cell Vehicles	30D, 45W
Heat Pumps	Ducted ASHP, Ductless ASHP, Geothermal Heat Pumps, ASHP Water Heaters	25C

Distributed Electricity and Storage	Distributed Solar, Wind, Hydro, Fuel Cells and Storage	25D, 45, 48, 45Y, 48E

Decarbonization Sectors

As of Q3 2024, we include a mapping between clean technologies and the sectors where they drive emissions reductions, which we refer to as decarbonization sectors. We hold the manufacturing of clean technology as a separate category and only include deployment of the technology in the decarbonization sectors.

Decarbonization Sector	Segment	Technologies
Clean Tech Manufacturing	Manufacturing	All
Power	Energy & Industry	Solar, Wind, Storage, Nuclear, Other
	Retail	Distributed Electricity and Storage
Transport	Energy & Industry	Sustainable Aviation Fuels, Clean Fuels
	Retail	Zero Emissions Vehicles
Industry	Energy & Industry	Hydrogen, Cement, Iron & Steel, Pulp & Paper, Carbon Management: Refining and Natural Gas Processing
Buildings	Retail	Heat Pumps
Carbon Removal	Energy & Industry	Carbon Management

Sources and Methods

This section provides detail on how investments and direct jobs in covered technologies are identified and how investment amounts are calculated. All investment figures on cleaninvestmentmonitor.org are in 2024 US dollars, adjusted using Bureau of Economic Analysis (BEA) price indices. We use the nonresidential fixed investment series for investment in manufacturing, energy, and industry facilities, durable goods for ZEVs, and residential fixed investment for heat pumps and distributed generation.

Investments are tracked through each of the following stages:

- **Intended (I):** These are company announcements of an intent to invest in a new or expanded facility, but without a specific location listed, or for CCUS, hydrogen, or SAF projects, where the project is still in pre-FEED (Front-end Engineering Design) stage. These announcements are recorded in the CIM database, but not displayed on cleaninvestmentmonitor.org until they proceed to the next stage.
- **Announced (A):** This is the announcement of a new or expanded facility with a specific location determined. In the case of utility-scale electricity, this includes all facilities listed as "Planned" on the EIA 860 survey. In the case of CCUS, hydrogen, or SAF projects, this includes facilities that have both entered or completed the FEED stage of development and where a specific location, investment amount, and/or project timeline has been announced.
- **Under Construction (U):** Construction on the new or expanded facility has begun.
- **Operating (O):** Construction has been completed, and the new or expanded facility is operating.
- **Cancelled or Closed (C):** An announced facility has been canceled before completion or closed after entering operation.

Announced vs. Actual Investment

For the Manufacturing and Energy and Industry segments, we report both announced and actual investment. **Announced** investment is the total reported or estimated investment amount for a facility or project.

Actual investment is the real dollars spent in the given quarter on retail purchases or new facility construction. We estimate actual investment by distributing the total investment proportionally over the construction window, based on either reported completion time (when available) or modeled completion time based on the average of past investments in that technology category. We conservatively assume a facility advances through construction stages only when we can identify evidence of a groundbreaking. If evidence is lacking, facility timelines are adjusted accordingly, with start dates pushed back. With our Q2 2025 update, we incorporated explicit construction pauses that had occurred at a select few number of facilities into our actuals estimation, effectively pausing associated spending for the quarter.

The boundary conditions for investment in the CIM are comparable to how the BEA defines capital assets in the National Income Product Accounts:

fixed assets (structures and equipment) and durable consumer goods (e.g. vehicle purchases). The CIM does not, however, include intellectual property products, which are counted as capital assets by BEA.

Manufacturing

For covered manufacturing investments, the CIM combines information from the following sources:

- **DOE Solar Manufacturing Map**
- **Solar Power World list of US solar panel manufacturers**
- **SEIA Solar & Storage Supply Chain Database**
- **DOE Wind Manufacturing and Supply Chain**
- **NYSERDA Offshore Wind Supply Chain Database**
- DOE, NREL, and LBNL supply chain reports
- State Offshore Wind RFPs
- **NAATBatt Lithium-Ion Battery Supply Chain Database**
- **American Clean Power's investment database**
- Company announcements and securities filings
- News reports

Investment, production capacity, and employment values are captured for individual facilities where available. These values are used to estimate investment or production capacity values for other facilities when primary information is not available. Where needed, we use information from the National Renewable Energy Laboratory (NREL) on average capacity and relative cost of different components of covered technologies to improve our model.

Energy and Industry

For deployment investments in the bulk production of clean energy or decarbonization of industrial production, our sources and methods vary by sub-category.

Solar, Wind, Nuclear, Other Clean Electricity Generation and Utility-Scale Storage

All data on announced and actual new clean electricity generation facilities are sourced from the Energy Information Administration (EIA)'s **monthly 860 data,** which provides the location, technology, owner, and capacity of every electric power sector generating asset in the US and state-wide distributed generation capacity totals. Investment costs for each facility are estimated using overnight capital cost figures from the NREL **Annual**

Technology Baseline (ATB). The time horizon of each facility's investment is estimated using reported construction periods in the EIA860M data. Where this data is unavailable or incomplete, the per-technology average construction time was used, where this average is estimated using plants with a full construction record that started after January 2017 and completed prior to May 2023.

Solar resource classes are assigned using annual average global horizontal irradiance (GHI) for solar PV and direct normal irradiance (DNI) for concentrating solar thermal from NREL's **National Solar Radiation Database**. Wind resource classes are assigned based on wind speed at various hub heights, depending on the resource definitions in the ATB. Average wind speed data is from the NREL **WIND Toolkit** and the **Renewable Energy Atlas**, and water depth for offshore plants is estimated from the **GEBCO 2023 Ice/Surface Elevation Grid**. Hydro cost and performance data are assigned based on three cases: (1) if the new generator is being added to an existing hydropower facility, the lowest-cost ATB profile is used; (2) if the generator is being added at the site of an existing non-powered dam identified in the NREL **Renewable Energy Atlas's** Hydro NPDs dataset, the nearest hydro cost & performance profile is used based on the total planned facility capacity; (3) remaining generators are matched to resource data in the ORNL **Hydropower Potential from New Stream-Reach Development** dataset, and ATB profiles are assigned based on stream head and planned capacity. Planned nuclear generators use the small modular reactor ATB profile for facilities smaller than 600MW; otherwise, the AP1000 profile. Geothermal plants found in the NREL **Geothermal Prospector** dataset's Operating Geothermal Powerplants or Developing Geothermal Projects datasets are directly mapped to ATB profiles; new projects are assigned profiles based on nearest potential geothermal reservoir temperatures and modeled required technologies found in the Geothermal Prospector's USGS Isolated Geothermal Systems dataset. Biomass facilities are mapped to the single ATB dedicated biopower profile. The ATB does not provide waste-based electricity generation cost and performance data; we use the ATB dedicated biopower profile for planned waste incineration facilities and the F-Frame natural gas combustion turbine profile for landfill gas combustion. All planned utility-scale battery storage facilities are assumed to have 4 hours of storage.

CARBON MANAGEMENT

For carbon capture, utilization and storage (CCUS) investments in industrial sources, we start with two databases—the **CCUS Projects Database** from the International Energy Agency (IEA) and **the US Carbon Capture Activity and Project Table** from the Clean Air Task Force (CATF). We complement this with information from company announcements, securities filings, and news reports. We apply consistent capacity and process-adjusted capital cost estimates from Rhodium Group's ICAP model to all projects to determine investment value. In the current version of the database, we only include investments in point source capture (or atmospheric removal), not pipeline transport or geologic sequestration. We intend to add these in future versions. Hydrogen projects that include CCUS are listed as hydrogen projects (see below), not CCUS projects.

For carbon dioxide removal (CDR) investments, we start with two databases—the **CCUS Projects Database** from the IEA and the **US Carbon Capture Activity and Project Table** from CATF. We complement this with information from company announcements, securities filings, and news reports. We apply consistent capacity and process-adjusted capital cost estimates from Rhodium Group to all projects to determine investment value.

HYDROGEN

For clean hydrogen investments, we start with the **Hydrogen Projects Database** from the IEA. We complement this with information from company announcements, investor filings, and new reports. When investment figures are not available, we use capacity and process-adjusted capital cost estimates from Rhodium Group to determine investment value.

SUSTAINABLE AVIATION FUELS

For sustainable aviation fuel (SAF), we use investment figures from company announcements, securities filings, and new reports. When these are missing, we estimate investment values based on the capital cost information available from other SAF projects. Investment amounts are for the overall project, even though many are producing a variety of low-GHG transportation fuels, not just SAF.

Currently, we do not include facilities that produce low-GHG fuels outside of hydrogen or SAF, like renewable diesel or cellulosic ethanol (unless these facilities are installing CCUS, in which case the CCUS-related investment is captured and categorized as CCUS). We intend to expand coverage to include all fuels that qualify for 45Z in future versions.

Retail

Distributed Electricity and Storage

Monthly distributed solar cumulative capacity estimates are from the **EIA861M** "small scale PV" estimate for US states and DC. Estimates are converted from capacity in DC to AC using 0.8256 as a conversion factor following the method used in 861M. Capacities for other eligible distributed generation technologies and storage are estimated from the Net Metering and Non-Net-Metering datasets from the same source. Capacity additions are estimated from cumulative capacity by taking the monthly difference from a rolling maximum of the state and sector time series. Cost estimates for installations come from the **NREL ATB**. EIA does not include information about energy storage capacities in the 861M report; we assume battery installations include 4 hours of storage at the peak discharge rate.

Zero-Emission Vehicles (ZEVs)

As a proxy for new purchases of battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell vehicles (FCV), we use our previously published investment data up to Q1 2025 and in subsequent quarters apply growth rates, which vary by vehicle type, based on a combination of averaged monthly and quarterly EV sales data from Argonne National Laboratory (ANL) and Kelley Blue Book (KBB).

Heat Pumps

To estimate investment in the purchase and installation of heat pumps by homes and businesses, we combine a range of publicly available data sources. For air-source heat pumps (ASHP) used for space heating, we use **monthly shipment data** from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI). To estimate purchase and installation cost, we use **estimates prepared by Guidehouse** for the Energy Information Administration for incorporation into the National Energy Modeling System (NEMS). For ground-source heat pumps (GSHP) we use **annual shipment data from EnergyStar** and **cost data from Guidehouse/EIA**. For electric heat pump water heaters, we use **monthly shipment data** for all electric water heaters from AHRI, and then estimate the share of those water heaters that are heat pumps using **annual shipment data from EnergyStar**. Purchase and installation costs come from **Guidehouse/EIA**. To downscale these national estimates to the state level, we use state/regional stock estimates from the EIA's **Residential Energy Consumption Survey** (RECS).

Outstanding Investment

In 2025, we introduced analysis leveraging our detailed facility-level tracking to report investment and jobs data at the state and congressional district level (mapped to the 119th Congress). For each state and district, we provide the sum invested since Q3 2022, the number of facilities completed during that time, and the direct jobs created by those completed facilities, separately reporting construction and operational jobs totals.

We also report outstanding investment—reflecting the amount of announced project value not yet spent—as well as the number of associated facilities and direct jobs tied to those future facilities. Outstanding investment is calculated using overnight capital costs for manufacturing, utility electricity, and industrial facilities that have been announced but are not yet operating. This figure reflects the expected investment if those facilities proceed. Some facilities contributing to outstanding investment are under construction; others have not yet started. Data for all states and congressional districts, including investment, facility counts, and jobs, is available for public download.

Direct jobs

Reported Jobs

Employment values (i.e., construction and operational jobs) stated by a company are captured for individual facilities, where available. These figures are typically sourced from company announcements, press releases, or websites. We attribute jobs to the specific facility and project phase described in the source material where possible, but we note that company-reported jobs data can vary in scope and precision. The completed jobs data are associated with construction and permanent operational jobs for facilities that are operational [or retired]. The outstanding jobs data are associated with construction and operational jobs for facilities that are actively under construction or have not yet broken ground.

Our reported employment values may differ from official sources when jobs estimates are divided between project phases, technologies, or multiple facilities. For example, a company may report jobs associated with both an initial announcement and a later expansion, or for a single

plant that produces multiple technologies (e.g., internal combustion engine vehicles and electric vehicles). In other cases, companies may report aggregate jobs across several facilities, without site-specific detail.

We have identified reported operational jobs for 70% of manufacturing facilities and 30% of industry facilities in our tracking. Construction jobs are reported far less frequently; 5% of facilities across both segments have reported construction jobs. For energy, we have no reported data because our EIA 860M source does not include jobs, so all values are estimated.

ESTIMATED JOBS: MANUFACTURING & INDUSTRY

For most facilities that lack company-reported jobs information, we estimate construction and operation employment using a model-based imputation approach. This approach is used for manufacturing facilities, as well as carbon management, sustainable aviation fuel, and hydrogen. We calculate operational and construction jobs per million dollars of capital expenditure from facilities with company-reported data. We then model the relationship between investment amount and jobs with a log-log regression, then use the model to estimate missing jobs values based on investment amount and technology type. For operational jobs, we use technology-specific models for all technology categories. For construction jobs, we use technology-specific models where data availability supports it and a general model for facility types where data is constrained.

For clean fuels, cement, iron & steel, and pulp & paper, we use internal Rhodium Group analysis of operational and construction jobs for emerging climate technologies.

ESTIMATED JOBS: ENERGY

For electricity generation facilities, we estimate direct jobs based on labor intensity per megawatt, using technology-specific base multipliers that we scale by reported nameplate capacity. For most generation technologies (solar, wind, geothermal, hydro, and biopower), we derive our base jobs multipliers from the operational and construction jobs estimates in the **NREL Jobs and Economic Development Impact (JEDI)** models. For nuclear, we relied on reported data for Vogtle Units 3 & 4. For battery storage facilities, we divide the total number of utility-scale storage jobs from the National Solar Jobs Census (**Interstate Renewable Energy Council, September 2024**) by the megawatts of utility-scale battery storage

installed in 2023 from EIA. We also assume minimal (0.01) operational jobs per megawatt for batteries.

As facility size increases, economies of scale naturally reduce the number of jobs per megawatt. To account for this, we apply a smooth scaling factor using an exponential function. This adjustment gradually decreases the jobs multiplier to roughly half its original value by the time a project reaches gigawatt scale, an approach that prevents overestimating labor requirements at very large sites, while still reflecting the relatively higher labor intensity of smaller-scale projects.

Estimation of Federal Clean Investment

Estimation of Federal Tax Credit Expenditures

OVERALL APPROACH TO BONUS CREDITS

Prevailing Wage & Apprenticeship Bonus: We assume that all facilities qualify for the 5x bonus for facilities meeting prevailing wage and apprenticeship requirements. Given the magnitude of the bonus, there is significant financial incentive to qualify. We chose to assume 100% of projects will qualify based on informal conversations with market participants and a general lack of public reporting on companies being unable to recruit qualifying apprentices. We will continue to monitor the landscape and will re-evaluate this assumption as new information is available.

Energy Communities Bonus: For large-scale (>1MW) utility electricity generation facilities for which we know the precise latitude & longitude location, we determine whether the facility falls into an energy community based on the coal closure community and fossil fuel employment designations, using shape definition files from the US Census Bureau. For offshore wind, we assign the nearest relevant geographic unit (census tracts for coal closure communities and BLS MSAs for fossil fuel employment) to the project location. The IRS is still finalizing guidance on how eligibility for the energy community bonus will be determined for offshore wind projects, and the actual eligible tax breaks available to these facilities will depend on these final rules. If we do not know the precise location of a facility—specifically, if the EIA does not provide the latitude and longitude in the EIA860 data—then we assume the facility is not in an energy community.

Domestic Content Bonus: We estimate the domestic content bonus for large electric generators by calculating the total eligible production from US manufacturing facilities for solar and wind components, assume all this production is taken as an ITC 10% credit, and allocate this credit among facilities beginning construction in that year. The allocated credit itself is then taken in the year the facility is placed into service. If facilities were to claim this credit as a PTC, the credit would be significantly lower in the place-in-service year, as the value would be spread over 10 years.

We estimate that for most wind and solar facilities, the current mix of capital costs and resource availability prefers the PTC absent bonuses, while the ITC is preferable for facilities able to take advantage of the energy community, low-income community, or domestic content bonus credits (and especially if an installation qualifies for two or more of these credits). That is because while these credits increase the value of the PTC by 10% or 20%, they increase the total ITC credit by 10 or 20 percentage points, a 33% or 50% increase in the credit value. This differential fractional impact on the two incentives pushes the economics more strongly in favor of the ITC for eligible facilities.

Each facility's resource quality, tax situation, cost of financing, discount rates, credit resale prices, inflation, and other project-specific factors will play a role in the decision to take the ITC or PTC, and we cannot account for or predict all these factors.

OVERALL NOTE ON FACILITY CONSTRUCTION TIMING

Critically, many tax credits introduced or expanded by the IRA are only available for facilities that began construction after the date the IRA was signed into law (August 16, 2022). We use the groundbreaking date (or announcements of construction start) as a proxy for the construction start date when assessing eligibility for incentives, both under the IRA and in calculating incentives that would have been in place prior to the IRA's passage. In reality, the tax code specifies construction start is defined as the time at which "physical work of a significant nature" begins. The guidance established by Treasury and the IRS as to the implementation of this rule is complex and requires project-level information we do not have access to across all facilities we track, but it is possible that some facilities that we rule ineligible for IRA credits due to a too-early start date may in fact be eligible, and vice versa.

CREDIT ELIGIBILITY, TRANSFER, AND CARRY-FORWARD OF UNUSED CREDITS

When reporting eligible tax credits, we report the credits in the time period (quarter) in which the eligible activity takes place.

In some cases, taxpayers may not be eligible to claim credits due to insufficient tax liability. Eligible credits under 30D, 45, 45Q, 45U, 45X, 45Y, 48, 48C, and 48E allow credits to be sold to unrelated parties with sufficient tax liability. Therefore, for these credits, it is unlikely that significant eligible tax credits will go unused.

Homeowners claiming residential clean energy credits under 25D are eligible to defer some portion of the credits to future tax years. It is possible that a significant subset of these credits will be carried forward to future years if residential customers do not have sufficient tax liability (thus decreasing total credits due to installations during each year as they are shifted to future tax years), and that some amount of credits will be claimed in a given year from carried-forward credits for installations in previous tax years. We do not have information about the individual tax situation of distributed energy system owners and, therefore, cannot predict the rate of carry-forward. Therefore, actual federal tax outlays may be higher or lower than our estimates due to discrepancies in the carry-forward uptake rates.

Homeowners cannot defer or transfer energy efficiency credits under 25C or 45L.

Advanced Manufacturing & Advanced Energy Projects

48C: Qualifying advanced energy project credit

The IRA re-upped this program, initially created in 2009, with an additional $10 Bn to be distributed to advanced energy projects. The program is similar to a grant program in that eligible applicants can apply for credits, which are awarded based on DOE's discretion.

DOE, Treasury, and the IRS have allocated $4 Bn for an initial round of funding and are focusing on projects that "expand clean energy manufacturing and recycling + critical minerals refining, processing and recycling, and for projects that reduce greenhouse gas emissions at industrial facilities." Of this initial $4 billion award round, $1.6 billion will be dedicated to projects cited in designated energy communities with closed coal plants or mines. The recipients of this initial round will be notified before March 31, 2024, and facilities must be placed in service after the award determination is made. Because 48C credits are claimed in the year in which the facility is placed in service, 48C awards associated with the

IRA will be claimed for tax year 2024, with credits realized in the FY2025 budget at the earliest.

Therefore, we allocate $0 expenditures associated with this program for the current year.

45X: Advanced manufacturing production credit

Producers of certain wind, solar, and battery components and input materials are eligible for tax credits under 45X. These credits are applicable to any components sold after December 31, 2022, without regard to the construction or operating date of the producing facility.

For each facility we track which produces eligible goods, we track company announcements, investor materials, reporting, government datasets, and other sources to identify the production capacities or actual production rates where available. When these production volumes are not available, we estimate production volumes for facilities using other facilities in the same sector for which these values are known as a proxy. We assume the facility operates at capacity except where company statements or news reports indicate partial utilization or a ramp-up time. For large facilities with significant production ramps, we estimate a multi-step linear ramp-up between known production milestones or target future production dates.

For facilities producing critical minerals or electrode active materials (EAM), the credit is based on the operating cost. We looked for company SEC reports detailing operating costs (and separating out input costs, so we could exclude them). For facilities that did not provide public estimates, we used operating cost information on a per-ton basis from facilities producing the same materials or using similar processes as a per-capacity unit proxy.

Tax credits for advanced manufacturing facilities eligible for credits under section 45X are listed as “Advanced Manufacturing Tax Credits” under the Manufacturing heading in Clean Investment Monitor summary tables.

45V: Credit for the production of clean hydrogen

Clean hydrogen is generally produced using one of two major pathways. Either a fossil fuel is split into hydrogen (H2) and carbon dioxide (CO2) using a process called Steam Methane Reformation (SMR), and then the CO2 is

permanently sequestered, or water is split into H2 and O2 using electrolysis. H2 producers using electrolysis may claim the 45V credit for the production of clean hydrogen; producers using SMR with carbon capture utilization and storage (CCUS) may elect to claim a credit under 45V or the 45Q credit for carbon dioxide sequestration. The 45V credit is available for the first 10 years of operation for facilities for which construction began after the date of passage of the Inflation Reduction Act, August 16, 2022, and which were placed into operation after December 31, 2022.

We assume that SMR hydrogen production with CCUS equipment installed makes use of 45Q. On a capacity basis, over 99.9% of H2 production employing CCUS that are currently eligible for credits are existing facilities that had begun production before the passage of the Inflation Reduction Act. Operators who have at any point claimed a 45Q credit are no longer eligible to claim a credit under 45V for the same facility; therefore, it stands to reason that these facilities have claimed and thus must continue claiming 45Q, and only less than 0.1% of capacity which has come online since the IRA's passage actually has a choice. As more facilities go into operation, we will continue to evaluate this assumption.

Operators who do claim the 45V credit must meet a number of eligibility requirements and the level of the credit is based on a tiered credit system based on the lifecycle greenhouse-gas intensity of the produced hydrogen. Treasury guidance on the eligibility criteria is yet to be finalized, but preliminary rules outline a three-pillar system, requiring, among other things, that renewable electricity generation procured to power H2 equipment must be generated in the same geographic region, must be recently installed, and must have been generated during the same time period as the consumption for H2 production. For electrolyzer-based H2 production, we assume that facilities will be eligible for the full 45V credit, essentially assuming that they will be able to procure 100% new renewable generation. Because this is the most generous assumption possible for hydrogen producers, our estimate of the 45V credit represents a strict upper bound on a per-ton basis. Currently, 45V credits make up a small share of total federal credits, and the impact of this assumption on our estimate of state and total tax expenditures is, therefore, small. However, we will continue to re-evaluate this assumption as additional data is released detailing the uptake of 45V credits and eligibility rates for each credit tier.

We assume the facility operates at capacity except where company statements or news reports indicate partial utilization or a ramp-up time. For large facilities with significant production ramps, we estimate a multi-step linear ramp-up between known production milestones or target future production dates.

Based on current guidance, the electricity generators that produce the clean electricity consumed in electrolysis-based H2 generation may still claim the ITC or PTC credits under sections 48 or 45. Therefore, we treat these credits as independent from one another and do not deduct any electricity consumption implied by the production of H2 from those categories.

Tax credits for clean hydrogen under section 45V are listed as "Emerging Climate Technology Tax Credits" under the Energy and Industry heading in Clean Investment Monitor summary tables.

45Q: credit for carbon oxide sequestration

Operators of facilities with carbon capture or direct air capture capabilities may be eligible to claim credits under 45Q. The credits are available for the first 12 years after a plant is placed into service, for plants or retrofits placed into service after December 31, 2022 and beginning construction after August 16, 2022. The credit value scales with inflation and is higher for direct air capture facilities. Facilities utilizing CO2 for enhanced oil recovery (EOR) are eligible for smaller credits. Facilities placed into service in 2022 or earlier are eligible for 45Q credits as they were before the passage of the Inflation Reduction Act.

We assume that all CCUS plants operate at 100% capacity and that all CO2 produced at this capacity is eligible for a credit. We manually collect the type of capture and sequestration activity (point-source vs. direct air capture; EOR vs. sequestration) by reading company statements, reporting, and other public information about the facility. We track the specific vintage of plants and the different credit values available for different plants, whether they are eligible under IRA credits, Bipartisan Infrastructure Act of 2018 credits, or earlier. This 100% utilization rate assumption is applied to both H2 and other types of CCUS facilities.

Tax credits for carbon capture, utilization, and sequestration under section 45Q are listed as "Emerging Climate Technology Tax Credits" under the Energy and Industry heading in Clean Investment Monitor summary tables.

40B: Sustainable aviation fuel credit

Producers of sustainable aviation fuel are eligible for credits under 40B for all production after December 31, 2022. The credit is conditional on and scales with the reduction, over 50%, of lifecycle greenhouse gas emissions associated with the production of the aviation fuel.

We assume SAF facilities operate at capacity and assume that 100% of SAF produced is eligible for the full credit. This is a broad-stroke approach, but the small current production volumes of SAF limit the impact of any overestimation based on this assumption.

Tax credits for sustainable aviation fuel production under section 40B are listed as "Emerging Climate Technology Tax Credits" under the Energy and Industry heading in Clean Investment Monitor summary tables.

Note for CCUS and Sustainable Aviation Fuel Utilization Assumptions

The assumption of 100% utilization for CCUS and SAF facilities may be particularly aggressive, as many of these facilities have discretion about the share of production uptime that is spent capturing carbon or producing SAF. Many facilities with carbon capture equipment installed can maintain their core (non-covered) operations without running their carbon capture equipment, and this generally improves unit economics or even output quantities for their core operations (in the absence of the 45V or 45Q credit). Similarly, many refining operations capable of producing SAF can also produce other non-covered products, including other renewable and non-renewable fuels. The credits introduced by the IRA, which incentivize the production of SAF and the capture and sequestration of CO2, are large, thus improving the economics of maintaining a high utilization rate.

EPA does provide data on emissions and capture levels by facility for large emitters, but carbon capture for EOR is generally withheld as confidential at the facility level. Therefore, we do not know the historical operating rates for these facilities. Additionally, this data would only apply to existing facilities and, therefore, would not apply to new or currently proposed facilities operating under the new credit regime. In summary, we lack data on actual utilization rates at these facilities under the new credit regimes, so we have adopted a stylized assumption. The available data pertaining to this question may change over time; we will monitor the data, and as additional information becomes available, we will look for future method improvements.

Clean Electricity Tax Credits

45 & 48: Clean electricity production tax credit and investment tax credit

Large-scale generators (at least 1MW)

We use actual historical electricity generation for plants, which report monthly electricity generation to EIA 923M. For other plants and for future periods not yet reported to 923M, we use the capacity factor assumptions from NREL's annual technology baseline (ATB) 2019-2023 reports. We assume the plant's vintage and corresponding ATB profile is determined by each plant's construction start date.

We assume the value of the ITC scales with the inflation adjustment factor in the year of construction start.

For facilities that have the option of claiming either the ITC or PTC, we estimate the eligible credit stream that would be available under each tax credit regime and choose the optimal credit using a 7% discount rate on the real (2022 USD) value time series of the credits. This leads to an outcome where approximately 50% of PV currently placed into service opts for a PTC vs. the ITC, and 60% of wind opts for the PTC vs an ITC in our modeling.

Tax credits for large-scale generators eligible for credits under sections 45 and 48 are listed as "Clean Electricity Tax Credits" under the Energy and Industry heading in Clean Investment Monitor summary tables. Beginning in FY25, we will also track the tech-neutral tax credits (45Y, 48E) under this heading for facilities placed in service after 12/31/24.

Distributed generators (less than 1MW)

We have data on residential, commercial, industrial, and direct connected capacity at the state-by-technology level. Using this, we estimate the pace of new net capacity addition. We take this net positive additions figure as the pace of total additions. This underestimates the total new additions, as retirements also occur. However, calculating actual additions is not possible using this data, and given the pace of growth, the relative size of retirements to additions is small.

We assume all operators of small-scale commercial, industrial, and direct-connected solar and battery installations make use of the investment tax credit under section 48. Additionally, residential installations that are leased by homeowners but owned by another company fall under section 48. To estimate the share of residential solar installations that are leased, we use the latest national average solar leasing rate from LBNL's annual **Rooftop Solar Income and Demographic Survey**.

Due to the limited amount of deployment in distributed commercial, industrial, and direct-connected small-scale wind and qualifying fuel cells, we exclude incentives for these technologies.

We use NREL's **Annual Technology Baseline**(ATB) 2019-2023 reports to estimate the overnight capital cost for installed distributed generation assets. We assume the plant's vintage and corresponding ATB profile are determined by the interconnection date, as reported in **EIA's 861M**. This method does not include within-year variability in installation costs or local dynamics in procurement, construction, or installation pricing, as NREL's estimates do not include region- or resource-class differentiation of overnight capital costs for distributed generation assets.

Tax credits for small-scale commercial, industrial, and direct-connected systems eligible under section 48 are listed as "Non-residential Distributed Energy Tax Credits" under the Retail heading in Clean Investment Monitor summary tables. Credits for small-scale leased residential systems eligible under section 48 are listed as "Residential Energy & Efficiency Tax Credits" under the Retail heading in Clean Investment Monitor summary tables.

Bonus credits

We assume that all facilities qualify for the 5x bonus for facilities meeting wage and apprenticeship requirements. We use the method detailed above to estimate energy community and domestic content bonuses for large-scale generators only. We do not have precise locations for distributed generation facilities and, therefore, cannot determine precise rates of eligibility for energy community bonuses. Thus, for this assessment, we do not estimate eligible energy community bonuses for small-scale energy producers.

45U: Zero-emission nuclear power production credit

Conventional nuclear power plants that began operating prior to the passage of the IRA are eligible for a 0.3 cent per kWh production tax credit less a reduction amount based on the average revenues of the plant, beginning in 2023. Both values grow subject to inflation, and the final credit value is multiplied by a factor of 5 if prevailing wage requirements are met.

We approximate plant revenue using **average operating cost data** reported by the Nuclear Energy Institute (NEI). Additionally, we approximate subsidy values using a set of **states and subsidy values** reported by EPA. We adjust both for inflation and calculate the reduction amount for each plant.

Residential Clean Energy Credit

We have data on residential connected capacity at the state-by-technology level. Using this, we estimate the pace of new net capacity addition. We take this net positive additions figure as the pace of total additions. This underestimates the total new additions, as retirements also occur. However, calculating actual additions is not possible using this data, and given the pace of growth, the relative size of retirements to additions is small. We then exclude leased rooftop solar installations from eligibility under 25D, instead using the method detailed under section 48 (see above).

We use NREL's annual technology baseline (ATB) 2019-2023 reports to estimate the overnight capital cost for installed distributed generation assets. We assume the plant's vintage and corresponding ATB profile is determined by the interconnection date, as reported in EIA's 861M. This method does not include within-year variability in installation costs or local dynamics in procurement, construction, or installation pricing, as NREL's estimates do not include region- or resource-class differentiation of overnight capital costs for distributed generation assets.

Certain provisions in 25D place eligibility restrictions on specific technologies. For example, swimming pools and hot tubs may not be claimed as energy storage devices, even when used as a thermal reservoir for a geothermal energy system or thermal battery. Additionally, battery systems must be at least 3kWh of energy capacity. We do not have information about the individual systems installed and assume that all geothermal heat pump sales and distributed battery generation (reported to utilities for interconnection) are eligible for the tax credit. In reality, some portions of systems may not qualify. However, the presence of these credits is a significant incentive to meet the eligibility criteria, and we believe it is unlikely that ineligible installations represent a significant share of the total.

25C & 45L: Residential energy-efficient home improvement and new energy-efficient home credits

We use total heat pump sales data to estimate investments and eligible tax breaks on residential energy efficiency improvements in existing and new buildings. We then estimate residential heat pump sales by applying data from residential and commercial use surveys to the sales data. Under 25C, each heat pump is eligible for up to $2000 per unit, or 30% of the unit cost, whichever is lower. We use average appliance costs for models profiled by EnergyStar to estimate the unit costs of ducted heat pumps, ductless

heat pumps, and heat pump water heaters. Only ducted heat pumps qualify for the full $2000 credit; ductless systems and heat pump water heaters are not expensive enough, on average, to qualify for the full credit, so we use 30% of our estimated sales price for these technologies.

45L entitles contractors of new builds up to $2500 or $5000 for Energy Star and "zero-energy ready" qualifying homes, respectively. Because we are already crediting all residential heat pump sales with the $2000 max heat pump credit, we are awarding a portion of the eligible 45L credit. We do not have any information yet about the share of new builds that qualify, so we exclude the rest of the credit. We will continue to look for information on uptake and activity in this space.

25C is uncommon among IRA provisions in that it offers a large credit value as a non-refundable, non-transferable, non-deferrable tax credit in a mature sector where leasing is uncommon. Because of this, there may be a non-trivial share of qualifying activity by individuals and households who cannot take advantage of the tax credit. To account for this dynamic, we reduce the total 25C claimed value by the national average share of individuals who do not pay any income tax, using **Tax Policy Center** estimates.

While technologies other than heat pumps and building envelope improvements also qualify for 25C and 45L, we do not currently have a means of estimating consumers' expenditures on those home improvements. By limiting our analysis to heat pumps, we may be undercounting the full expenditures under sections 25C and 45L.

Tax credits for residential heat pump sales eligible under sections 25C and 45L are listed as "Residential Energy & Efficiency Tax Credits" under the Retail heading in Clean Investment Monitor summary tables.

Zero-Emission Vehicles

Tax credits for ZEV sales eligible under sections 30D and 45W are listed as "Zero Emission Vehicle Tax Credits" under the Retail heading in Clean Investment Monitor summary tables. We use our previously published estimates of investments and eligible tax credits across 30D and 45W up to Q1 2025, which includes detailed vehicle registration counts. In subsequent quarters, we take the weighted average sales growth across models in KBB and ANL sales data, and apply it to our historical breakdown of 30D and 45W.

For 30D, purchasers of certain ZEVs are eligible for tax credits that vary based on the date of purchase, the location of final assembly, the location of battery manufacturing, and the source of the critical minerals. Vehicles must also meet a minimum battery size and maximum price (which depends on the vehicle class), and the purchasers must be below a specific income cap.

The income cap is $300,000 for married couples filing jointly, $250,000 for a head of household, and $150,000 for single filers. Unfortunately, we do not know the marital status of the vehicle purchaser. Additionally, the highest income bracket available to us is "$250,000 or more." As an approximation, we assign zero ZEV purchase credits to households making $250,000 or more. We assume that all other purchasers do take the eligible credit.

To determine 30D credit amounts and eligibility by vehicle, we use published lists of qualifying vehicles released by IRS and EPA.

Vehicle leases, along with fleet purchases by corporations, qualify for the 45W credit. This credit is a much simpler credit, offering a fixed percentage, up to a cap, of a vehicle's price. We, therefore, allocate the credit to all leases, accounting for the variable incentive by vehicle.

Comparison to Joint Committee on Taxation Estimates

To provide a baseline against which to measure our projections, the table below compares our estimates of federal tax expenditures on energy-related tax credits for technologies in the CIM scope to the latest annual estimate of detailed tax expenditures published by the Joint Committee on Taxation (JCT) from December 2023. The JCT's estimates of annual tax expenditures are a useful comparison as they estimate all federal expenditures on tax credits at a relatively granular level. Because JCT estimates total expenditures associated with each tax credit, it provides a useful baseline as we, too, model total clean energy investment rather than the amount of federal investment induced by the Inflation Reduction Act alone.

Our topline estimates for in-scope federal tax expenditures in FY2023 (October 1, 2022, through September 30, 2023) are in line with JCT's ($35.5 billion vs JCT's $33.1 billion). As outlined in our Q4 report, results for certain specific tax credits differ. As the JCT continues to release its

annual estimates and the federal government releases its own estimates, we will continue to pressure-test our own results against these sources.

FY2023 CIM vs. December 2023 FY 2023-2027 JCT Report
using JCX-59-23. All values in CY Billion USD.

		2023 Total	
Function	**Tax code section(s)**	**JCT 2023**	**CIM 2023**
Energy			
Residential clean energy credit	25D	3.6	4.2
Residential energy efficiency credits	25C & 45L	4.1	2.7
Credits for alternative technology vehicles	30D & 45W	4.8	7.0
Credit for production of clean hydrogen	45V	0.1	[2]
Clean fuel production	45Z		
Renewable energy ITC & PTC	45, 45Y, 48, 48E	12.4	14.8
Credit for carbon oxide sequestration	45Q	[2]	0.2
Advanced manufacturing production credit	45X	5.5	6.5
Advanced manufacturing investment credit [1]	48C & 48D	2.6	0.0
Zero emission nuclear power production credit	45U		0.0
Other sections we are covering:			
Sustainable aviation fuel credit (through 2024)	40B		0.1
FY TOTAL		33.1	35.5

Notes:
[1] Awards for 48C were not yet awarded prior to the end of FY2023; therefore, FY 2023 cannot have any associated costs. The 48D Advanced Manufacturing Credit pertains to semiconductor manufacturing and is not in scope of the CIM.

[2] Positive tax expenditure of less than $50 million.

Expenditures on Federal Grants, Loans, and Loan Guarantee

IIJA and IRA appropriated funding to support the manufacture and deployment of GHG-reducing technologies through direct federal investment, primarily in the form of grants, loans, and loan guarantees.
The programs we determined are in-scope received $131 billion in appropriated funding from IIJA and IRA ($46 billion from IIJA and $85 billion from IRA). To consider actual, rather than announced, investment, we focus our analysis on outlays, or the actual disbursement of funds from the U.S. Treasury to the grant or loan recipient. Loans and loan guarantees are assessed at their estimated net-cost to taxpayers, i.e., their subsidy cost, not their face value.

DIRECT FEDERAL INVESTMENT METHODOLOGY

We estimate the outlays, or actual expenditures, of federal grants, loans, and loan guarantees that incentivize the manufacture and deployment of in-scope technologies using existing public datasets. Tracking expenditures ensures the data is conceptually parallel to actual private investment in these technologies. Most of the expenditure data is gathered from datasets published by the Office of Management and Budget (OMB). Because the line items in the OMB datasets are often not granular enough to capture only in-scope activities, we estimate the portion of those line items that constitute in-scope activities (see Appendix A for the full list of in-scope programs).

In-scope programs

First, we identified the federal programs intended to support the manufacture and deployment of in-scope GHG-reducing technologies in IIJA and IRA. Those programs account for just over $131 billion in cumulative appropriations between the two laws; although, a share of those funds have since been rescinded or repurposed as part of subsequent legislation.

In this instance, a "program" is considered a provision in statute that appropriates spending for a particular purpose. The Biden Administration created "guidebooks" for each law (see **IIJA** and **IRA**) that serve as a "roadmap to the funding available under the law, as well as an explanatory document that shows, in as much detail as currently available, program-by-program information." We reviewed each individual program's description and eligible uses to determine if a primary effect of the program is to incentivize the manufacture, deployment, or demonstration of GHG-reducing technologies and tagged it by one of the three CIM segments accordingly.

These programs cover a range of incentives and recipients, from demand-side support for individual consumers and government procurement, to direct support for firms. For programs whose scope is broader than supporting the manufacture, deployment, or demonstration of in-scope technologies, we included the program when we felt confident that most of its expenditures would focus on the relevant technologies. We continue to refine our set of in-scope programs as additional data becomes available on program guidance and award recipients—including, for example, for programs where the primary recipient differs from the ultimate recipient.

Outlays estimation

We collect actual outlay data for the relevant IRA and IIJA programs from monthly expenditure reports that agencies submit to the Department of Treasury and are consolidated and published by OMB in their so-called **SF133 reports**. We do so by matching the line-item appropriations in the IRA and IIJA laws with line items in the SF133 reports using Treasury account information detailed in the annual **Appendix to the President's Budget** and Congressional Budget Justifications produced by each agency.

Because some SF133 line items include multiple IRA or IIJA programs, we identify the percent of the line item's appropriation that can be attributed to in-scope activities for those line items that capture both in-scope and out-of-scope activities. This percentage is used to estimate the share of an account fund's relevant outlays for the given program.

For a small minority of in-scope programs we use other sources to estimate outlays. We choose to use other sources only when the SF133 reports are insufficient to collect those outlays (e.g. if a program's account fund is not included in the reports) or when another publicly available source provides more granular information that can reliably be used to collect in-scope spending. For the Low or No Emission Vehicle Component Assessment Program, the SF133 data is not detailed enough to identify its outlays at a similar level of specificity to the other programs. Therefore, to estimate the program's outlays, we apply the Congressional Budget Office's estimated rate of spending for the Federal Transit Administration to the program's appropriated amounts in the **original CBO estimate** for IIJA. Alternatively, the US Postal Service Clean Fleets program, which is accounted for within the Postal Service Fund, is not tracked in the SF133 reports. For that program we gathered outlay information using the annual **Combined Statement** released by the U.S. Treasury for each fiscal year and estimated quarterly disbursements.

We exclude from our totals $20 billion in Greenhouse Gas Reduction Funds which were disbursed from the US government in late 2024. Most of those funds have yet to be delivered to final grant recipients due to legal challenges, and therefore do not fit our criterion for actual federal investments in the deployment or manufacture of clean technologies.

Finally, we use a unique method for the five in-scope programs that appropriated amounts to the Department of Energy's Loan Programs Office (LPO). LPO maintains a **public site** that shows each loan it issues, with

information about the purpose of the loan, the borrower, the face value of the loan, and the loan's issuance date. Because of the specificity of that information, we chose to estimate LPO outlays using that resource in lieu of the SF133 reports. We estimate the subsidy cost of each reported loan using reported program wide subsidy rates published in the annual **Credit Supplement to the President's Budget**, which are shown as a percent of the face value of the loan, for the year that it is issued. We credit the entire outlay of the subsidy portion of the loan at the time the loan is disbursed.

Geographic estimation

Estimating the geographic distribution of grant, loan, and loan guarantee outlays for in-scope programs requires geo-coded data with program-level granularity. The best available source with this combination of data was the Biden Administration's "Investing in America" tracker of announcements. We assume that the geographic distribution of outlays is consistent with the geographic distribution of in-scope announcements on Invest.gov to arrive at an estimate of the geographic distribution of in-scope outlays.

As additional data becomes available on program-level outlays and awards, we will continue to evolve our methodology.

Appendix A. List of in-scope programs for grants & loans

Name of program	Law	Appropriated Funding	Guidebook Description
Energy Infrastructure Reinvestment Financing	IRA	$5,000,000,000	To guarantee loans to projects that retool, repower, repurpose, or replace energy infrastructure that has ceased operations or that enable operating energy infrastructure to avoid, reduce, utilize, or sequester air pollutants or anthropogenic emissions of greenhouse gases. IRA places a total cap on loan guarantees of up to $250 billion and appropriates $5 billion in credit subsidy to support these loans under section 1706 of the Energy Policy Act of 2005.
Rural Energy for America Program (REAP) - Underutilized Renewable Energy Technologies	IRA	$303,817,500	To provide guaranteed loan financing and grant funding to agricultural producers and rural small businesses for underutilized renewable energy technologies.
Rural Energy for America Program (REAP)	IRA	$1,721,632,500	To provide guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements. Agricultural producers may also apply for new energy efficient equipment and new system loans for agricultural production and processing.
General Services Administration Emerging Technologies	IRA	$975,000,000	To support emerging and sustainable technologies and related sustainability and environmental programs, as part of the Federal Buildings Fund.
Empowering Rural America (New ERA)	IRA	$9,700,000,000	To fund the construction of electric distribution, transmission, and generation facilities for rural electric cooperatives, including system improvements and replacements that achieve the greatest reduction in greenhouse gas emissions in rural areas, as well as demand side management, energy conservation programs, and on-grid and off-grid renewable energy systems.
Biofuel Infrastructure and Agriculture Product Market Expansion (Higher Blend Infrastructure Incentive Program)	IRA	$500,000,000	To provide grants through the Higher Blend Infrastructure Incentive Program, which has the goal of significantly increasing the sales and use of higher blends of ethanol and biodiesel by expanding the infrastructure for renewable fuels derived from US agricultural products and by

			sharing the costs related to building out biofuel-related infrastructure.
Tribal Electrification Program	IRA	$150,000,000	To provide financial and technical assistance to Tribes to increase the number of Tribal homes with zero-emission electricity.
Tribal Energy Loan Guarantee Program	IRA	$75,000,000	To support Tribal investment in energy-related projects by providing direct loans or partial loan guarantees to federally recognized Tribes, including Alaska Native villages or regional or village corporations, or a Tribal Energy Development Organization that is wholly or substantially owned by a federally recognized Indian Tribe or Alaska Native Corporation. The Inflation Reduction Act increased the total loan authority from $2 billion to $20 billion and provides $75 million to carry out the program.
US Postal Service Clean Fleets	IRA	$3,000,000,000	To purchase zero-emission delivery vehicles and to purchase, design, and install the requisite infrastructure to support zero-emission delivery vehicles at US Postal Service facilities.
Powering Affordable Clean Energy (PACE)	IRA	$1,000,000,000	To provide partially forgivable loans to renewable-energy developers and electric service providers, including municipals, cooperatives, and investor-owned and Tribal utilities, to help finance large-scale solar, wind, geothermal, biomass, hydropower projects and energy storage in support of renewable energy systems.
Funding for Department of Energy Loan Programs Office	IRA	$3,600,000,000	To support the cost of loans for innovative clean energy technologies. IRA provides $40 billion of loan authority supported by $3.6 billion in credit subsidy for projects eligible for loan guarantees under section 1703 of the Energy Policy Act of 2005. This loan authority is open to all currently eligible Title 17 Innovative Clean Energy technology categories, including fossil energy and nuclear energy, and new categories of activities, including critical minerals processing, manufacturing, and recycling.

Advanced Technology Vehicle Manufacturing Loan Program	IRA	$3,000,000,000	To provide loans to support the manufacture of eligible advanced technology vehicles and components under the Advanced Technology Vehicles Manufacturing Loan Program (ATVM), including newly authorized uses from the Bipartisan Infrastructure Law. Expanded uses include medium- and heavy-duty vehicles, locomotives, maritime vessels including offshore wind vessels, aviation, and hyperloop. IRA removed the $25 billion cap onATVM loans and appropriates $3 billion in credit subsidy to support these loans.
Domestic Manufacturing Conversion Grants	IRA	$2,000,000,000	To provide cost-shared grants for domestic production of efficient hybrid, plug-in electric hybrid, plug-in electric drive, and hydrogen fuel cell electric vehicles.
Advanced Industrial Facilities Deployment Program	IRA	$5,812,000,000	To provide competitive financial support to owners and operators of facilities engaged in energy intensive industrial processes to complete demonstration and deployment projects that reduce a facility's greenhouse gas emissions through installation or implementation of advanced industrial technologies and early-stage engineering studies to prepare a facility to install or implement advanced industrial technologies.
Fueling Aviation's Sustainable Transition – Technology (FAST-Tech)	IRA	$46,530,000	To provide grant funding for eligible entities to carry out projects that develop, demonstrate, or apply low-emission aviation technologies, which are technologies that significantly improve aircraft fuel efficiency or reduce greenhouse gas emissions during the operation of civil aircraft.
Fueling Aviation's Sustainable Transition through Sustainable Aviation Fuels (FAST-SAF)	IRA	$244,530,000	To provide grant funding for eligible entities to carry out projects relating to the production, transportation, blending, or storage of sustainable aviation fuel (SAF), with the goal of accelerating the production and use of sustainable aviation fuel and reducing greenhouse gas emissions from the aviation sector.
Greenhouse Gas Reduction Fund - Solar for All Program	IRA	$7,000,000,000	To provide up to 60 grants to States, Tribal governments, municipalities, and nonprofits to expand the number of low-income and disadvantaged communities that are primed for residential and community solar investment—enabling millions of families to access affordable, resilient, and clean solar energy.

Greenhouse Gas Reduction Fund - National Clean Investment Fund	IRA	$14,000,000,000	To provide grants to 2–3 national nonprofit financing entities to create national clean financing institutions capable of partnering with the private sector to provide accessible, affordable financing for tens of thousands of clean technology projects nationwide.
Greenhouse Gas Reduction Fund - Clean Communities Investment Accelerator	IRA	$6,000,000,000	To fund two to seven hub nonprofits with the plans and capabilities to rapidly build the clean financing capacity of specific networks of public, quasi-public and non-profit community lenders—including community development financial institutions (including Native CDFIs), credit unions, green banks, housing finance agencies, and minority depository institutions—to ensprovide grants to 2–7 hub nonprofits that will provide funding and technical assistance to specific industry networks of public, quasi-public, not-for-profit, and nonprofit community lenders, supporting the goal that every community in the country has access to the capital they need to deploy clean technology projects in their homes, small businesses, schools, and community institutions. These community lenders could include community development financial institutions (including Certified Native CDFIs), credit unions, green banks, housing finance agencies, minority depository institutions, and other types of lenders.
Assistance for Federal Buildings	IRA	$250,000,000	To convert GSA facilities to high-performance green buildings, as part of the Federal Buildings Fund.
National Laboratory Infrastructure - Office of Science	IRA	$1,550,000,000	To support science laboratory infrastructure improvements and projects across seven Office of Science programs.
National Laboratory Infrastructure - Office of Fossil Energy and Carbon Management	IRA	$150,000,000	To support infrastructure improvements at the three complexes at the National Energy Technology Laboratory.
Idaho National Laboratory Infrastructure Investments	IRA	$150,000,000	To support infrastructure improvements across the Idaho National Laboratory (INL). On October 25, 2022, the Department of Energy announced that this funding will support nearly a dozen projects at INL's Advanced Test Reactor Complex and Materials Fuels Complex, both of which have been operational for more than 50 years and serve an instrumental role in advancing nuclear technologies

			for federal agencies, industry, and international partnerships.
National Laboratory Infrastructure - Office of Energy Efficiency and Renewable Energy	IRA	$150,000,000	To support infrastructure improvements at three campuses at the National Renewable Energy Laboratory.
Clean Heavy-Duty Vehicles	IRA	$1,000,000,000	To provide funding to offset the costs of replacing heavy-duty Class 6 and 7 commercial vehicles with zero-emission vehicles; deploying infrastructure needed to charge, fuel, or maintain these zero-emission vehicles; and developing and training the necessary workforce.
Green and Resilient Retrofit Program - Elements Cohort	IRA	$68,000,000	To provide gap funding to HUD-assisted multifamily housing properties in the midst of a recapitalization transaction in order to incorporate utility efficiency, renewable energy, carbon emission reduction, and/or climate resilience measures.
Green and Resilient Retrofit Program - Leading Edge Cohort	IRA	$160,000,000	To provide funding to owners of HUD-assisted multifamily housing properties with ambitious plans involving carbon reduction, renewable energy generation, use of building materials with lower embodied carbon, and resilience goals through achieving an advanced green certification.
Green and Resilient Retrofit Program - Comprehensive Cohort	IRA	$609,500,000	To provide funding to properties with a high need for investment in utility efficiency and climate resilience. Property owners need no prior experience with recapitalization transactions or green construction, as support will be provided to commission assessments and develop the property's recapitalization plan.
Home Energy Performance-Based, Whole-House Rebates	IRA	$4,300,000,000	To award grants to state energy offices to develop a whole-house energy saving retrofits program that will provide rebates to homeowners and aggregators for whole-house energy saving retrofits.
High-Efficiency Electric Home Rebate Program	IRA	$4,500,000,000	To award grants to state energy offices and Tribal entities to develop and implement a high-efficiency electric home rebate program.

Assistance for Latest and Zero Building Energy Code Adoption	IRA	$1,000,000,000	To provide grants to states or units of local government to adopt updated building energy codes, including the zero energy code.
Environmental and Climate Justice Block Grants: Environmental Justice Collaborative Problem-Solving (EJCPS) Cooperative Agreement Program	IRA	$30,000,000	To assist recipients in building collaborative partnerships to help them understand and address environmental and public health concerns in their communities.
Environmental and Climate Justice Block Grants: The Environmental Justice Government-to-Government (EJG2G) Program	IRA	$70,000,000	To provide funding to governmental entities at the state, local, territorial and tribal level to support and/or create model government activities that lead to measurable environmental or public health results in communities disproportionately burdened by environmental harms and risks.
Environmental and Climate Justice Block Grants: Environmental Justice Thriving Communities Grantmaking Program	IRA	$550,000,000	To fund up to 11 entities to serve as grantmakers to community-based projects that reduce pollution.
State Energy Program	IIJA	$500,000,000	To provide funding to States to support electric transmission and distribution planning as well as planning activities and programs that help reduce carbon emissions in all sectors of the economy, including the transportation sector and accelerate the use of alternative transportation fuels and vehicle electrification.
Energy Improvement in Rural or Remote Areas	IIJA	$1,000,000,000	In consultation with the Department of the Interior, to provide financial assistance to improve, in rural or remote areas of the US, the resilience, safety, reliability, and availability of energy, as well as environmental protection from adverse impacts of energy generation.
Marine Energy Research, Development, and Demonstration	IIJA	$70,400,000	To fund research, development, and demonstration activities to improve marine energy technologies.

Solar Energy Research and Development	IIJA	$40,000,000	To fund research, development, demonstration, and commercialization activities to improve solar energy technologies.
Electric Drive Vehicle Battery Recycling And 2nd Life Apps	IIJA	$200,000,000	To expand an existing program at the Department of Energy for research, development, and demonstration of electric vehicle battery recycling and second-life applications for vehicle batteries.
Solar Recycling Research & Development	IIJA	$20,000,000	To award financial assistance to eligible entities for research, development, demonstration, and commercialization projects to create innovative and practical approaches to increase the reuse and recycling of solar energy technologies.
Rare Earth Security Activities	IIJA	$127,000,000	To conduct a program of research and development to improve the security of rare earth elements.
Carbon Dioxide Transportation Infrastructure Finance and Innovation Program	IIJA	$2,100,000,000	To establish and carry out a carbon dioxide transportation infrastructure finance and innovation program.
Wind Energy Tech Recycling Research & Development	IIJA	$40,000,000	To award financial assistance to eligible entities for research, development, and demonstration, and commercialization projects to create innovative and practical approaches to increase the reuse and recycling of wind energy technologies
Carbon Utilization Program	IIJA	$310,140,781	To establish a grant program for State and local governments to procure and use products derived from captured carbon oxides.
Carbon Storage Validation and Testing	IIJA	$2,500,000,000	To establish a program of research, development, and demonstration for carbon storage.
Hydropower Research, Development, and Demonstration	IIJA	$36,000,000	To fund research, development, and demonstration activities to improve hydropower technologies.
Bioproduct Pilot Program	IIJA	$10,000,000	Determine the economic, social, and environmental benefits of using materials derived from agricultural commodities (bioproducts) in the development and manufacturing of construction or consumer products.
Critical Material Innovation, Efficiency, And Alternatives	IIJA	$600,000,000	To conduct a program of research, development, demonstration, and commercialization to develop alternatives to critical materials, to promote their

			efficient production and use, and ensure a long-term secure and sustainable supply of them.
Critical Material Supply Chain Research Facility	IIJA	$75,000,000	To support construction of a Critical Materials Supply Chain Research Facility.
Pre-Commercial Direct Air Capture Prize Competitions	IIJA	$15,000,000	Reauthorization of program to advance research, development, demonstration, and commercial application of carbon capture technologies.
Rare Earth Elements Demonstration Facility	IIJA	$140,000,000	To demonstrate the feasibility of a full-scale integrated rare earth element extraction and separation facility and refinery.
New Solar Research & Development	IIJA	$20,000,000	To award financial assistance to eligible entities for research, development, demonstration, and commercialization projects to advance new solar energy manufacturing technologies and techniques.
Enhanced Geothermal Systems and Pilot Demonstrations	IIJA	$84,000,000	To support a program of research, development, demonstration, and commercial application for enhanced geothermal systems.
Wind Energy Technology Program	IIJA	$60,000,000	To fund research, development, demonstration, and commercialization activities to improve wind energy technologies.
Clean Hydrogen Electrolysis Program	IIJA	$1,000,000,000	To establish a research, development, demonstration, and deployment program for purposes of commercialization to improve the efficiency, increase the durability, and reduce the cost of producing clean hydrogen using electrolyzers.
Clean Energy Demonstrations on Current and Former Mine Land	IIJA	$500,000,000	To demonstrate the technical and economic viability of carrying out clean energy projects on current and former mine land. Up to five 5 clean energy projects are to be carried out in geographically diverse regions, at least 2 of which shall be solar projects.
Hydroelectric Production Incentives	IIJA	$125,000,000	Provides incentive payments for electric energy generated and sold by a qualified hydroelectric facility during the incentive period, to the owner or authorized operator of such a facility. Incentive payments for qualified facilities are based on the number of kilowatt-hours (kWh) generated in calendar year which Department of Energy

			determines, at a rate of 1.8 cents/kWh with a total ceiling of $1 million per facility
Advanced Energy Manufacturing and Recycling Grants	IIJA	$750,000,000	To provide grants to small- and medium-sized manufacturers to enable them to build new or retrofit existing manufacturing and industrial facilities to produce or recycle advanced energy products in communities where coal mines or coal power plants have closed.
Battery Manufacturing and Recycling Grants	IIJA	$3,000,000,000	To provide grants to ensure that the US has a viable domestic manufacturing and recycling capability to support a North American battery supply chain.
Battery Materials Processing Grants	IIJA	$3,000,000,000	To provide grants for battery materials processing to ensure that the US has a viable battery materials processing industry. Funds can also be used to expand our domestic capabilities in battery manufacturing and enhance processing capacity.
Battery and Critical Mineral Recycling	IIJA	$125,000,000	To award grants for research, development, and demonstration projects to create innovative and practical approaches to increase the reuse and recycling of batteries.
Energy Efficient Transformer Rebates	IIJA	$10,000,000	To provide rebates to industrial or manufacturing facility owners, commercial building owners, multifamily building owners, utilities, or energy service companies for the replacement of a qualified energy inefficient transformer with a qualified energy efficient transformer.
Lithium-Ion Recycling Prize	IIJA	$10,000,000	To provide a prize for recycling of lithium ion batteries and convene a task force on battery producer requirements.
Maintaining and Enhancing Hydroelectricity Incentives	IIJA	$553,600,000	To make incentive payments to the owners or operators of qualified hydroelectric facilities for capital improvements.
Pumped Storage Hydropower Wind and Solar Integration and System Reliability Initiative	IIJA	$10,000,000	To provide financial assistance to eligible entities to carry out project design, transmission studies, power market assessments, and permitting for a pumped storage hydropower project to facilitate the long-duration storage of intermittent renewable electricity.
Section 243 Hydroelectric	IIJA	$75,000,000	To incentivize upgrades to hydroelectric facilities to increase their efficiency.

Efficiency Improvement Incentives (Sec 40332)			
Commercial Direct Air Capture Technology Prize Competition	IIJA	$100,000,000	Reauthorization of program to support large-scale pilot projects and demonstration projects and test carbon capture technologies.
Front-End Engineering and Design Program Out Activities Under Carbon Capture Tech Program 962 Of EPA (Sec 40303)	IIJA	$100,000,000	Expands the Department of Energy's Carbon Capture Technology program to include a program for carbon dioxide transport infrastructure necessary to deploy Carbon Capture Utilization and Storage technologies.
Civil Nuclear Credit Program	IIJA	$6,000,000,000	To establish a Civil Nuclear Credit (CNC) Program to prevent premature retirements of existing commercial nuclear reactors due to economic factors. The CNC Program will: certify nuclear reactors for program eligibility; establish a process to accept sealed bids for credits from certified nuclear reactors; allocate credits to certified nuclear reactors; and conduct periodic audits, with possible recapture of credits.
Advanced Reactor Demonstration Program	IIJA	$2,477,000,000	To fund two large demonstrations of advanced nuclear reactors for electricity generation.
Carbon Capture Demonstration Projects Program	IIJA	$2,537,000,000	To establish a carbon capture technology program for the development of 6 facilities to demonstrate transformational technologies that will significantly improve the efficiency, effectiveness, costs, emissions reductions, and environmental performance of coal and natural gas use, including in manufacturing and industrial facilities.
Carbon Capture Large-Scale Pilot Programs	IIJA	$937,000,000	To establish a carbon capture technology program for the development of transformational technologies that will significantly improve the efficiency, effectiveness, costs, emissions reductions, and environmental performance of coal and natural gas use, including in manufacturing and industrial facilities.
Energy Storage Demonstration and Pilot Grant Program	IIJA	$355,000,000	To enter into agreements to carry out 3 energy storage system demonstration projects.

Four Regional Clean Direct Air Capture Hubs	IIJA	$3,500,000,000	To establish a program under which the Secretary shall provide funding for eligible projects that contribute to the development of 4 regional direct air capture hubs.
Industrial Emission Demonstration Projects	IIJA	$500,000,000	To fund demonstration projects that test and validate technologies that reduce industrial emissions.
Long-Duration Energy Storage Demonstration Initiative and Joint Program	IIJA	$150,000,000	To establish a demonstration initiative composed of demonstration projects focused on the development of long-duration energy storage technologies.
Regional Clean Hydrogen Hubs	IIJA	$8,000,000,000	To support the development of at least 4 regional clean hydrogen hubs to improve clean hydrogen production, processing, delivery, storage, and end use.
Clean Hydrogen Manufacturing Recycling Research, Development, and Demonstration Program	IIJA	$500,000,000	To provide Federal financial assistance to advance new clean hydrogen production, processing, delivery, storage, and use equipment manufacturing technologies and techniques.
Battery Recycling Best Practices	IIJA	$10,000,000	This investment will promote the safe handling of used batteries and improve battery recycling programs. The Environmental Protection Agency will develop best practices that may be implemented by State, Tribal, and local governments with respect to the collection of batteries to be recycled in a manner that to the maximum extent practicable, is technically and economically feasible for State, Tribal, and local governments; is environmentally sound and safe for waste management workers; and optimizes the value and use of material derived from recycling of batteries. The Environmental Protection Agency will develop the best practices in coordination with State, Tribal, and local governments and relevant nongovernmental and private sector entities.
Energy Efficiency Revolving Loan Fund Capitalization Grant Program	IIJA	$250,000,000	To provide capitalization grants to States to establish a revolving loan fund under which the State shall provide loans and grants for energy efficiency audits, upgrades, and retrofits to increase energy efficiency and improve the comfort of buildings.

Low Income Home Energy Assistance Program	IIJA	$500,000,000	The Low-Income Home Energy Assistance Program assists eligible low-income households with their heating and cooling energy costs, bill payment assistance, energy crisis assistance, weatherization and energy-related home repairs.
Weatherization Assistance Program	IIJA	$3,500,000,000	To increase the energy efficiency of dwellings owned or occupied by low-income persons , reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, the handicapped, and children.
Energy Efficiency and Conservation Block Grant Program	IIJA	$550,000,000	To assist States, local governments, and Tribes in implementing strategies to reduce energy use, reduce fossil fuel emissions, and improve energy efficiency.
Grants for Energy Efficiency and Renewable Energy Improvements at Public School Facilities	IIJA	$500,000,000	To provide competitive grants to make energy efficiency, renewable energy, and alternative-fueled vehicle upgrades and improvements at public schools.
Assisting Federal Facilities with Energy Conservation Technologies Grant Program	IIJA	$250,000,000	To provide grants to Federal agencies that they can leverage with private capital to make energy and water efficiency upgrades to Federal buildings.
Funding to Address Air Pollution: Mobile Source Grants	IRA	$5,000,000	To identify and reduce diesel emissions resulting from goods movement facilities and vehicles servicing goods movement facilities in low-income and disadvantaged communities to address the health impacts of such emissions on such communities.
Climate Pollution Reduction Grants: Implementation Grants	IRA	$4,750,000,000	To provide grants to Tribes, states, air pollution control agencies, and local governments to develop and implement plans for reducing greenhouse gas emissions. The statute allocates $250 million for planning grants and $4.750 billion for implementation grants.
National Marine Energy Centers	IIJA	$40,000,000	To provide financial assistance for the establishment of new National Marine Energy Centers and the continuation and expansion of the research, development, demonstration, testing, and commercial application activities at the existing Centers.

Low or No Emission Vehicle Component Assessment Program	IIJA	$26,169,974	The Federal Transit Administration will provide funds to two qualified institutions of higher education to conduct testing, evaluation, and analysis of low or no emission components intended for use in low- and zero-emission buses used to provide public transportation. The Low and No-Emission Component Assessment Program (LoNO-CAP) is intended to test items that are separately installed in and removable from a low- or no-emission transit bus.
Industrial Research and Assessment Centers	IIJA	$150,000,000	To provide funding for institutions of higher education-based industrial research and assessment centers to identify opportunities for optimizing energy efficiency and environmental performance at manufacturing and other industrial facilities.
Industrial Research and Assessment Center Implementation Grants	IIJA	$400,000,000	To fund upgrades for small- and medium-sized manufacturers that have been recommended in an assessment from an Industrial Assessment Center, Combined Heat and Power Technical Assistance Partnership, or an approved third-party performing an equivalent assessment.

ABOUT THE CLEAN INVESTMENT MONITOR

The Clean Investment Monitor (CIM) is a joint project of Rhodium Group and MIT's Center for Energy and Environmental Policy Research. The CIM tracks public and private investments in manufacturing and deployment of climate technologies in the United States. Through this data and analysis, the CIM provides insights into investment trends, the effects of federal and state policies, and on-the-ground progress in the US towards net-zero greenhouse gas emissions.

Website: **www.cleaninvestmentmonitor.org**

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