Irving Fisher Committee on
Central Bank Statistics

BIS

IFC Satellite Seminar on "Sustainability data issues and central banks' experience"

4 October 2025

Bridging ESG data gaps: a global initiative integrating the LEI into the global energy ownership tracker

Anna Mowat,
Global Energy Monitor

Alexandre Kech,
Global Legal Entity Identifier Foundation

Bridging ESG Data Gaps: A Global Initiative Integrating the LEI into the Global Energy Ownership Tracker

4 October 2025

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Agenda

1. **Who is Global Energy Monitor?**
2. **What is the Global Energy Ownership Tracker?**
3. **Who is GLEIF and what is the LEI?**
4. **Integrating LEIs with the Ownership Tracker**
5. **Opportunities from Data Interoperability**

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Monitor

Background on GEM

GEM began in 2007 as a project to support the anti-coal movement in the US by developing freely shared data on a custom wiki platform. The organization now has ~90 staff in 13 countries.

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GEM has a large library of energy, heavy, and extractive industry trackers

GEM developed its "tracker" methodology for coal plants. It now has over 25 trackers covering coal, gas, oil, renewables, heavy industry, finance, and ownership.


Global Integrated Power Tracker


Global Energy Transition Tracker


Global Coal Plant Tracker


Global Coal Mine Tracker


Global Oil Infrastructure Tracker


Global Oil and Gas Extraction Tracker


Global Coal Project Finance Tracker


Global Coal Terminals Tracker


Global Oil and Gas Plant Tracker


Global Gas Infrastructure Tracker


Global Methane Emitters Tracker


Global Solar Power Tracker


Global Bioenergy Power Tracker


Global Geothermal Power Tracker


Global Hydropower Tracker


Global Wind Power Tracker


Global Nuclear Power Tracker


Global Steel Plant Tracker


Global Blast Furnace Tracker


Africa Energy Tracker


Global Energy Ownership Tracker


Private Equity Tracker


Portal Energético para América Latina


Asia Gas Tracker


Europe Gas Tracker

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The Global Energy Ownership Tracker covers ownership research for several asset classes

Long term aspiration is to cover ownership for all other trackers

Global Energy Ownership Tracker

Global Oil Infrastructure Tracker

Global Coal Mine Tracker

Global Gas Infrastructure Tracker

Global Cement and Concrete Tracker

Global Iron Ore Mine Tracker

Global Iron and Steel Plant Tracker

Global Integrated Power Tracker

Global Bioenergy Power Tracker

Global Coal Plant Tracker

Global Oil and Gas Plant Tracker

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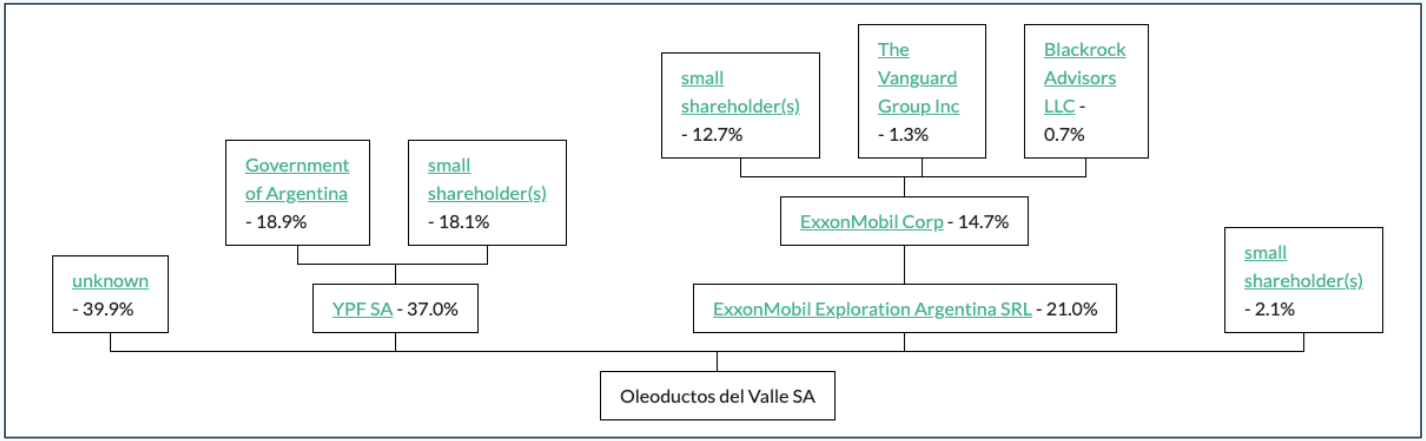
We map each level of the chain from the direct owner up to the highest-level ultimate parents

Oldelval Oil Pipeline (Argentina)



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GEM publishes a network format of entities...

A unique GEM Entity ID is assigned to each entity in our network.

GEM Entity ID	Full Name	Name Local	Name Other	Abbreviation	Entity Type	PubliclyListed	Home Page	Registration Country	Registration Subdivision	Headquarters Country	Headquarters Subdivision	Global Legal Entity Identifier Index
E100001014315	1832 Asset Management LP				legal entity	FALSE		Canada		Canada	Ontario	5493000GV3I1S3MMF497
E100001016594	1947 Trust				legal entity			Singapore		Singapore		
E100000120000	24 Hour Mining and Industry Co Ltd		24 Hour Mining & Indu		legal entity	FALSE		Myanmar		Myanmar		not found
E100001010786	24R Advisory Services Pvt Ltd				legal entity	FALSE		India		India		not found
E100000000393	27 municipal utilities and regional energy suppliers				legal entity			Germany				not found
E100002002888	3A Capital Services Ltd				legal entity			India		India		
E100001013982	3Bear Energy LLC				legal entity	FALSE		United States	Delaware	United States	Colorado	not found
E100001010780	3B Power Sdn Bhd				legal entity	FALSE		Malaysia		Malaysia		not found
E100000002360	3-Energoortalyk JSC	АО 3-Энергоорталык			legal entity	FALSE	https://ww	Kazakhstan		Kazakhstan		not found
E100000120001	3S Enerji ve Maden Üretim				legal entity							
E100001001188	4C Acquisition LLC				legal entity	FALSE		United States		United States		not found
E100000131204	4th Gen Fuels LLC				legal entity	FALSE		United States		United States	Kentucky	not found
E100000002168	8 Rivers Capital LLC				legal entity	FALSE	https://8ri	United States	Delaware	United States	North Carolina	not found
E100002003905	9404-5515 Québec Inc				legal entity	FALSE		Canada	Quebec	Canada	Quebec	not found
E100000131205	99 Thuwanon Co Ltd				legal entity	FALSE		Thailand		Thailand	Krung Thep Maha Nakh	not found
E100000120002	A1 Group Inc				legal entity	TRUE		United States		United States	California	not found
E100000000602	A2A SpA				legal entity	TRUE		Italy		Italy	Brescia	81560076E3944316DB24
E100000003925	A2A Airport Energy SpA		SEA Energia [former]		legal entity		https://a2a	Italy		Italy		8945009PO0HAVTAPVZ51
E100002003519	A2A Calore e Servizi SRL				legal entity	FALSE		Italy		Italy		not found
E100000002361	A2A Energiefuture SpA				legal entity	FALSE		Italy		Italy	Milano	not found
E100002016402	AAA Capital Management	АО "ААА УПРАВ	AAA Upravlenie Kapita		legal entity	FALSE	https://aaa	Russia		Russia		253400MD780G2CR8BM30

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Entity ownership connections…

Subject Entity ID	Subject Entity Name	Interested Party ID	Interested Party Name	% Share of Ownership	Data Source URL
E100000001789	Centrais Elétricas Barcarena	E100000001265	New Fortress Energy	100	https://www.globenewswire.com/news-release/2019/10/21/1932637/0/en/Golar-Power-awarded-PPA-for-605MW-LNG-to-Power-Project-in-Barcarena-Brazil.html,https://ir.newfortressenergy.com/node/7571/html,https://www.reuters.com/article/energia-gas-terminalgnl-idBRKBN2931E5-OBRBS
E100000001790	Companhia Energética de Minas G	E100001011531	State of Minas Gerais	17.04	https://ri.cemig.com.br/governanca-corporativa/composicao-acionaria
E100000001790	Companhia Energética de Minas G	E100001011532	FIA Dinamica Energia	15.9	https://ri.cemig.com.br/governanca-corporativa/composicao-acionaria
E100000001791	Canindé Energias	E100000003074	Gastrading Comercializadora de Energias		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001792	Centrais Elétricas de Pernambuco	E100000001794	Eletricidade do Brasil		https://www.fitchratings.com/research/pt/infrastructure-project-finance/fitch-afirma-rating-aa-bra-da-1a-emissao-de-debentures-da-epesa-perspectiva-estavel-21-02-2018,https://ebrasilenergia.com.br/quem-somos/,https://repositorio.simplificpavarini.com.br/Banco%20de%20Arquivos/DebenturesRegistro/ELETRICIDADE%20DO%20BRASIL%20SA%20-%20EBRASIL%20-%202%20E%20-%201%20S/6%20-%20EGAS%20-%203%C2%AA%20AGE%20-%20Aprova%C3%A7%C3%A3o%20da%20CF%20+%20Poderes%20REGISTRADA%20(JUCEP%2030%2001%2018....PDF
E100000001794	Eletricidade do Brasil	E100001011475	DC Energia e Participações	100	https://contracts.justia.com/companies/new-fortress-energy-llc-6251/contract/249094/
E100000001798	Faixa Preta Investimentos	E100002000335	Mercurio Holding		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001801	Grupo Neoenergia	E100000000975	Iberdrola	100	https://www.iberdrola.com/conocenos/sociedades-grupo,https://www.neoenergia.com/en-us/about-us/energy-future/Pages/our-history.aspx
E100000001803	Litos Energia	E100002000969	Mitsubishi Power		https://power.mhi.com/media/366921/download
E100000001804	Natural Energia Participações	E100000123261	natural person(s)		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001804	Natural Energia Participações	E100002000591	Fox Energy Servicos de Energia		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001804	Natural Energia Participações	E100002000592	Martins Empreendimentos, Engenharia e Participacoes		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001804	Natural Energia Participações	E100002000593	Newlima		https://solucoes.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_Solicitacao.asp
E100000001806	Ponte Nova Energia	E100000123261	natural person(s)		
E100000001809	Prumo Logistica	E100000001086	Mubadala Investment Company	50	https://www.gna.com.br/a-gna/nossos-acionistas,https://www.prumologistica.com.br/en/prumo/,https://www.upstreamonline.com/energy-transition/prumo-signs-deal-for-offshore-wind-and-green-hydrogen-in-brazil-s-acu-port/2-1-1323504
E100000001809	Prumo Logistica	E100000001197	EIG Global Energy Partners	50	https://www.gna.com.br/a-gna/nossos-acionistas,https://www.prumologistica.com.br/en/prumo/,https://www.upstreamonline.com/energy-transition/prumo-signs-deal-for-offshore-wind-and-green-hydrogen-in-brazil-s-acu-port/2-1-1323504

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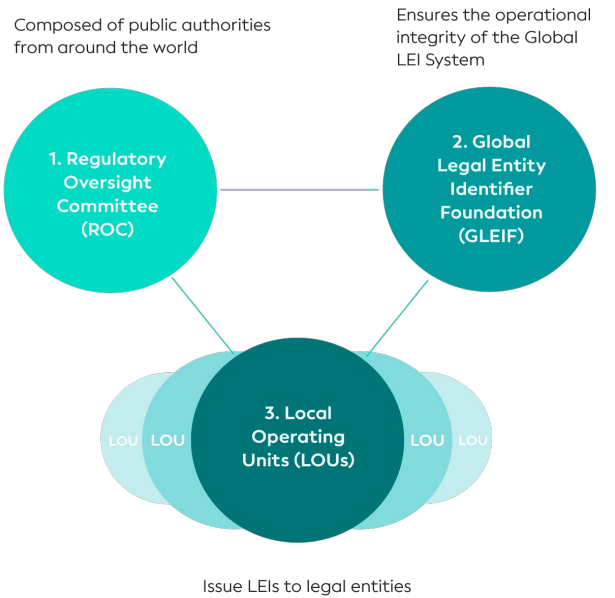
And a parent company-first format.

Parent GEM Entity ID	Parent	Project	Share	Ownership Path	Status	Capacity (MW)
E100000000339	Energetický a průmyslový holding AS	Kilroot power station GT5	100	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> Kilroot power station GT5 [100.0%]	operating	340
E100000000339	Energetický a průmyslový holding AS	Fiume Santo power station GT1		Energetický a průmyslový holding AS -> EP Power Europe AS [100.0%] -> EP Produzione SpA [100.0%] -> Fiume Santo power station GT1 [unknown %]	mothballed	40
E100000000339	Energetický a průmyslový holding AS	Ballylumford power station B2	100	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> Ballylumford power station B2 [100.0%]	operating	60
E100000000339	Energetický a průmyslový holding AS	Komorany power station K7	69	Energetický a průmyslový holding AS -> EP Infrastructure AS [69.0%] -> EP Energy AS [100.0%] -> United Energy AS [100.0%] -> Komorany power station K7	announced	35
E100000000339	Energetický a průmyslový holding AS	South Humber Bank power station 2	100	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> South Humber Bank power station 2 [100.0%]	operating	580
E100000000339	Energetický a průmyslový holding AS	Tynagh power station GT1	80	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> Tynagh Energy [80.0%] -> Tynagh power station GT1 [100.0%]	cancelled	299
E100000000339	Energetický a průmyslový holding AS	Provence power station ST1	100	Energetický a průmyslový holding AS -> Provence power station ST1 [100.0%]	operating	49
E100000000339	Energetický a průmyslový holding AS	Tavazzano power station 6	100	Energetický a průmyslový holding AS -> EP Power Europe AS [100.0%] -> EP Produzione SpA [100.0%] -> Tavazzano power station 6 [100.0%]	operating	385
E100000000339	Energetický a průmyslový holding AS	EP Energy Developments power station GT1	100	Energetický a průmyslový holding AS -> EP Energy Developments Ltd [100.0%] -> EP Energy Developments power station GT1 [100.0%]	pre-construction	350
E100000000339	Energetický a průmyslový holding AS	South Humber Bank power station 1	100	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> South Humber Bank power station 1 [100.0%]	operating	810
E100000000339	Energetický a průmyslový holding AS	Enecogen power station U10		Energetický a průmyslový holding AS -> EP Netherlands BV [100.0%] -> Enecogen power station U10 [unknown %]	operating	435
E100000000339	Energetický a průmyslový holding AS	Enecogen power station U20		Energetický a průmyslový holding AS -> EP Netherlands BV [100.0%] -> Enecogen power station U20 [unknown %]	operating	435
E100000000339	Energetický a průmyslový holding AS	Tavazzano power station GT8	100	Energetický a průmyslový holding AS -> EP Power Europe AS [100.0%] -> EP Produzione SpA [100.0%] -> Tavazzano power station GT8 [100.0%]	retired	320
E100000000339	Energetický a průmyslový holding AS	Ballylumford power station C32	100	Energetický a průmyslový holding AS -> EP UK Investments Ltd [100.0%] -> Ballylumford power station C32 [100.0%]	operating	300
E100000000339	Energetický a průmyslový holding AS	Ostiglia power station OS5, timepoint 1	100	Energetický a průmyslový holding AS -> EP Power Europe AS [100.0%] -> EP Produzione SpA [100.0%] -> Ostiglia power station OS5, timepoint 1 [100.0%]	pre-construction	890

Who is the Global Legal Entity Identifier Foundation (GLEIF)?

- GLEIF is a not-for-profit Swiss foundation, founded by the Financial Stability Board (FSB)
- GLEIF is overseen by the Regulatory Oversight Committee (ROC) with
  - 70 regulators and
  - 19 observers
  - from 50 countries
- GLEIF Board has 18 independent directors
- 38 accredited partners for LEI issuing (LOUs) and growing
- > 3 million LEIs as of today, available as open data without IP or copyright protection

The Financial Stability Board (FSB) and the Group of Twenty (G20) have endorsed the LEI, Global LEI System and GLEIF.



Legal Entity Identifier (LEI) and Key Reference Data
Who is who? Who owns whom?

"Level 1"

LEI Code G5GSEF7VJP5I7OUK5573

(Primary) Legal Name	BARCLAYS BANK PLC
Registered At	Companies Register (Companies House) Companies Register (Companies House) England and Wales, United Kingdom of Great Britain and Northern Ireland RA000585
Registered As	01026167
Jurisdiction Of Formation	GB
General Category	GENERAL
Entity Legal Form	Public Limited Company (en) Cwmni Cyfyngedig Cyhoeddus (cy) B6ES
Entity Status	ACTIVE
Entity created at	1971-10-04 01:00:00+01:00
BIC Code	BARCGB22XXX
MIC Code	BPLC

- EntityID & Authoritative source, Mappings, Address information (…)

"Level 2": Parents, children & fund relationships

Parents — Published Relationship · Lapsed Relationship · Reporting Exception

BARCLAYS PLC (Direct Parent)

BARCLAYS PLC (Ultimate Parent)

Direct children (85) — Published Relationship · Lapsed Relationship

BARCLAYS BANK PLC

- 台灣巴克萊證券股份有限公司 (Direct)
- BARCLAYS OCIO SERVICES LIMITED (Direct)
- ISLE OF WIGHT HOME LOANS LIMITED (Direct)
- NORTHWHARF NOMINEES LIMITED (Direct)

Managed Funds (40) — Published Relationship · Lapsed Relationship

- INSIGNIA 80% PROTECTED EQUITY FUND (Managed Fund)
- SHILLER US SECTOR INDEX FUND (Managed Fund)
- BARCLAYS US EQUITY INTRADAY MOMENTUM FUND (Managed Fund)

Branches (3) — Published Relationship · Lapsed Relationship

- BARCLAYS BANK PLC PARIS BRANCH (Branch)
- Barclays Bank PLC (Branch)
- 英国巴克莱银行有限公司上海分行 (Branch)

- GLEIF API: https://api.gleif.org/docs
- LEI Search: https://search.gleif.org
- Golden Copy: https://www.gleif.org/en/lei-data/gleif-golden-copy

GEM already has LEIs integrated into its own data and is working to integrate GEM Entity IDs into GLEIF.

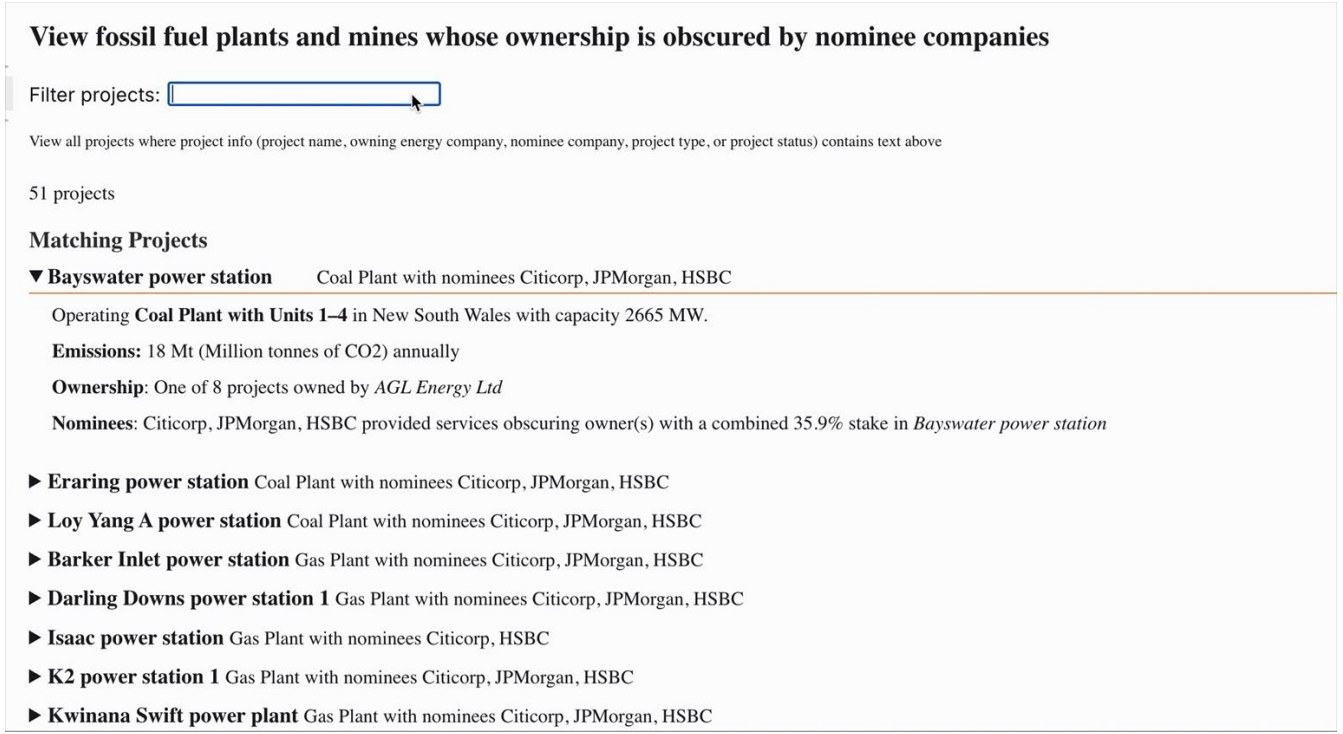
- GEM Entity ID to be added to GLEIF entity pages
- Crosswalk document will be published and available for download on the GLEIF website
    - Updated roughly once a month (or whenever a GEM asset tracker has a new release)
- Links to each relevant GLEIF entity pages embedded in GEM Ownership tracker dataset

GEM Entity ID	Full Name	Global Legal Entity Identifier Index
E100002005185	Akçansa Çimento Sanayi ve Ticaret AŞ	789000E4UZB42H2HX767
E100000002141	Akenerji Elektrik Üretim AŞ	7890006JO4YATIQAG941
E100001014067	Aker BP ASA	549300NFTY73920OYK69
E100001014068	Aker Capital ASA	5493004SEKKPH2GS1D50
E100001000634	Akfen Yenilenebilir Enerji AŞ	984500C9EC85457B3E55
E100001000635	Akkan Enerji ve Madencilik AŞ	894500OLC7T8S2AR9O59
E100001011231	Akkök Holding AŞ	789000NHYUUC7523GX39
E100002005195	Akmenes Cementas AB	549300PNKQ2BHZ2TI065
E100002003740	Akora Resources Ltd	213800G8DFDRQAASP451
E100000002409	Aksa Akrilik Kimya Sanayii AŞ	789000OKY3ICX0Y2NY41
E100000002411	Aksa Enerji Uretim AŞ	789000KQC5JTW1S3JG98
E100000000735	Akzo Nobel NV	724500XYIJUGXAA5QD70
E100000002418	Alabama Power Co	0RL818ELFOHP5JHOFU19
E100002016488	Alaska Permanent Fund Corp	DFKMC7AUPF2H39L1JO20

Opportunities from Data Interoperability

- **Asset-level Data**
- **Independent Verification of Financed Emissions**
    - GEM is the ownership data lead at the Climate TRACE coalition
- **Increased ownership data granularity**
    - All levels of ownership (subsidiaries, SPVs, etc.)
    - 5% threshold
    - Citations and most recent research date included

You can search from a company-first or an asset-first perspective



View fossil fuel plants and mines whose ownership is obscured by nominee companies

Filter projects:

View all projects where project info (project name, owning energy company, nominee company, project type, or project status) contains text above

51 projects

Matching Projects

▼ **Bayswater power station** Coal Plant with nominees Citicorp, JPMorgan, HSBC

Operating **Coal Plant with Units 1–4** in New South Wales with capacity 2665 MW.

Emissions: 18 Mt (Million tonnes of CO2) annually

Ownership: One of 8 projects owned by *AGL Energy Ltd*

Nominees: Citicorp, JPMorgan, HSBC provided services obscuring owner(s) with a combined 35.9% stake in *Bayswater power station*

▶ **Eraring power station** Coal Plant with nominees Citicorp, JPMorgan, HSBC

▶ **Loy Yang A power station** Coal Plant with nominees Citicorp, JPMorgan, HSBC

▶ **Barker Inlet power station** Gas Plant with nominees Citicorp, JPMorgan, HSBC

▶ **Darling Downs power station 1** Gas Plant with nominees Citicorp, JPMorgan, HSBC

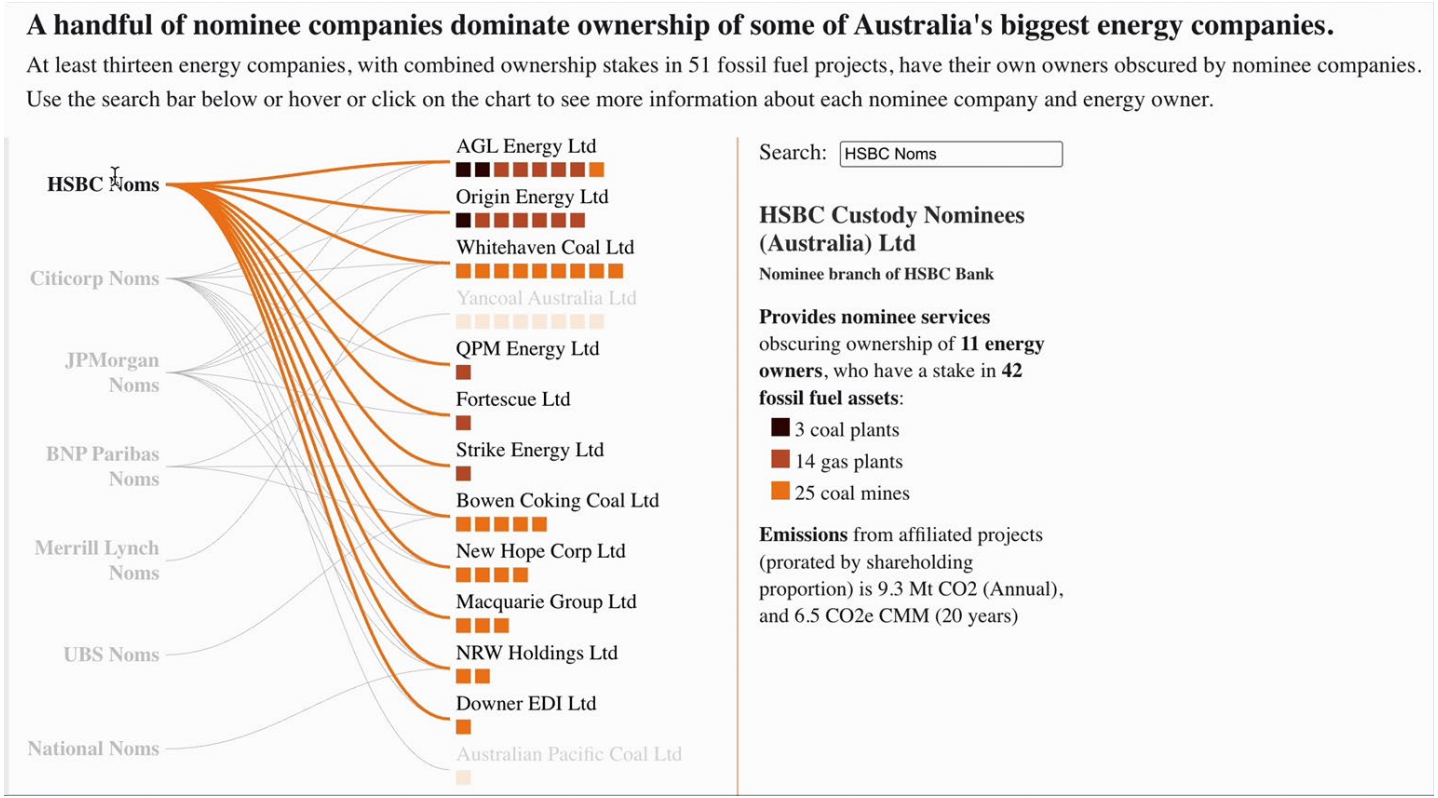
▶ **Isaac power station** Gas Plant with nominees Citicorp, HSBC

▶ **K2 power station 1** Gas Plant with nominees Citicorp, JPMorgan, HSBC

▶ **Kwinana Swift power plant** Gas Plant with nominees Citicorp, JPMorgan, HSBC

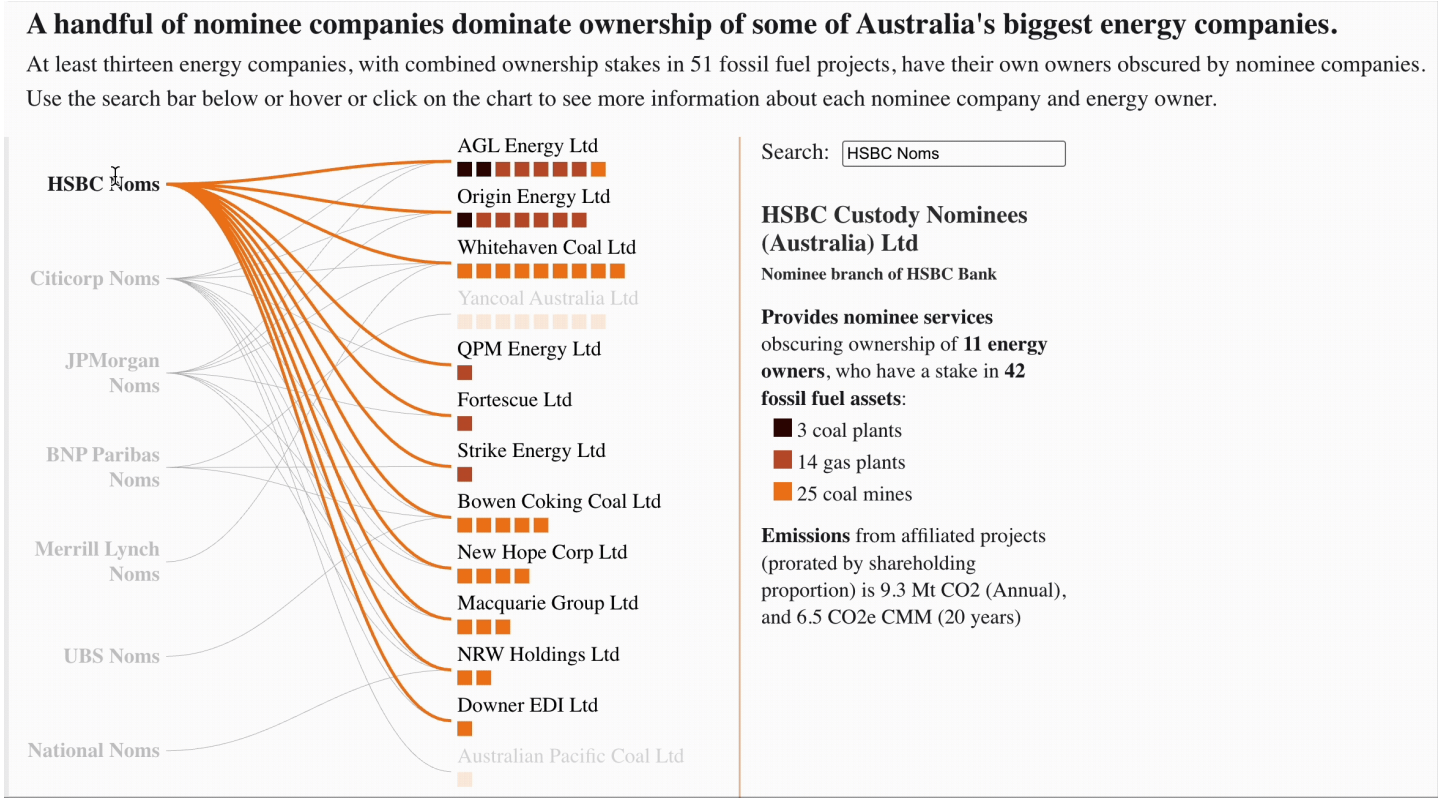
* Example from recent GEM report on Australian nominee companies

Emissions can be aggregated up from any asset to any parent



* Example from recent GEM report on Australian nominee companies

Emissions can be aggregated up from any asset to any parent



* Example from recent GEM report on Australian nominee companies

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Thank you

Climate TRACE Ownership Information: Global Energy Monitor Methodology for Ownership Data

Anna Mowat*, Gabriel Louis, and Maisie Bird
All authors affiliated with Global Energy Monitor and Climate TRACE
***Contact** Ownership Sector Lead: anna.mowat@globalenergymonitor.org

1. Introduction

As part of a collaboration with Climate TRACE, Global Energy Monitor (https://globalenergymonitor.org/), referred to as GEM, has contributed technical and ownership data sets for combustion power plants (i.e., burning coal, gas, oil, and/or bioenergy), steel plants, coal mines, iron ore mines, oil pipelines, natural gas liquids (NGL) pipelines, gas pipelines, concrete and cement plants, and small oil "teapot" refineries in China. GEM's technical data includes detailed information on the various assets such as plant capacity, location, and operating status. GEM's ownership data includes information on the project-level ownership for various projects and the interested party that owns the project-level owner. This information is described in more detail in our Methods section.

With the exception of the teapot refineries in China, GEM releases these data sets as stand-alone trackers, which are spreadsheets with project-level data:

- Global Coal Plant Tracker
    - The Global Coal Plant Tracker (GCPT) provides information on coal-fired power units around the world generating 30 megawatts and above. The tracker catalogs every operating coal-fired generating unit, every new unit proposed since 2010, and every unit retired since 2000.
- Global Oil and Gas Plant Tracker
    - The Global Oil and Gas Plant Tracker (GOGET) is a worldwide dataset of oil and gas-fired power plants. It includes units with capacities of 50 megawatts or more (20 megawatts or more in the European Union and the United Kingdom). The tracker catalogs every oil and gas power plant at this capacity threshold of any status, including operating, announced, pre-construction, construction, shelved, canceled, mothballed, or retired.
- Global Bioenergy Power Tracker
    - The Global Bioenergy Power Tracker (GBPT) is a worldwide dataset of utility-scale bioenergy power facilities. It includes bioenergy units with capacities of 30 megawatts or more. The tracker includes every bioenergy unit at the 30

megawatt capacity threshold for operating, announced, pre-construction, and in construction power station units.

- Global Coal Mine Tracker
    - The Global Coal Mine Tracker (GCMT) is a worldwide dataset of coal mines and proposed projects. The tracker provides asset-level details on ownership structure, development stage and status, coal type, production, workforce size, reserves and resources, methane emissions, geolocation, and over 30 other categories.
- Global Steel Plant Tracker
    - The Global Steel Plant Tracker (GSPT) provides information on global crude iron and steel production plants and includes every plant currently operating with a capacity of five hundred thousand tons per year or more of crude iron or steel.
- Global Oil Infrastructure Tracker
    - The Global Oil Infrastructure Tracker (GOIT) is an information resource on crude oil and natural gas liquids (NGL) transmission pipeline projects and their development. Currently, GOIT attempts to include all global crude oil and NGL transmission pipelines of any status, though availability on this infrastructure varies across countries and regions, and some are researched more completely than others.
- Global Gas Infrastructure Tracker
    - The Global Gas Infrastructure Tracker (GGIT) is an information resource on natural gas transmission pipeline projects and liquefied natural gas (LNG) import and export terminals. Currently, GGIT aims to include all LNG terminals regardless of threshold, as well as all global gas transmission pipelines over predetermined size thresholds.
- Global Cement and Concrete Tracker
    - The Global Cement and Concrete Tracker (GCCT) will provide information on global integrated and grinding plants including all plants that have been proposed or under construction since 2018 and retired or mothballed since 2021. The GCCT will provide asset-level data on ownership, operating status, annual clinker and cement capacity, and production methods including relevant green cement technology. Its first release is currently scheduled for July 2025.
- Global Iron Ore Mine Tracker
    - The Global Iron Ore Mines Tracker (GIOMT) provides information on global iron ore mines, and includes all operating, proposed, shelved, retired or mothballed mines since 2023. The GIOMT provides asset-level data on ownership structure, development stage and operating status, annual production since 2022, and design capacity for each mine.
- Global Cement and Concrete Tracker
    - The Global Cement and Concrete Tracker (GCCT) provides information on global integrated and grinding plants, including all plants that have been proposed

or under construction since 2018 and retired or mothballed since 2021. The GCCT provides asset-level data on location, ownership, operating status, annual clinker and cement capacity, and production methods including relevant green cement technology.

The data GEM contributed on China's small oil refineries is released by Climate TRACE as part of the Fossil Fuel Operations sector, in the subsector Oil Refining.

GEM has enhanced, updated, and expanded the ownership data in the trackers above. In revamping this data, we have organized the data following Open Ownership's Beneficial Ownership Data Standard, or BODS (Open Ownership, 2024; https://www.openownership.org/en/topics/beneficial-ownership-data-standard/). We adopted BODS because it is considered the only widely used standard for organizing data on ownership structures. The data has been enhanced by adding missing ownership data, bringing other ownership data up to date, making the ownership data consistent across the trackers listed above, and adding additional details on entities, as described below.

GEM also preprocesses entity names received from other Climate TRACE coalition members before integrating them into the Global Energy Monitor (GEM) PostgreSQL database and assigning entities unique GEM Entity IDs. The preprocessing ensures consistent and accurate matching of entities across datasets, facilitating reliable data ingestion and analysis.

2. Methods

The terminology used here conforms with BODS whenever relevant. Accordingly, by "entities," we are referring to companies, governments, government agencies, and other bodies that are involved in ownership.

GEM's ownership data is stored in a custom PostgreSQL database, which allows for representation of hierarchical relationships between various entities involved in ownership of projects, such as power plants, pipelines, or coal mines. Other sources may refer to our term "projects" as "assets"; we consider the two terms to be equivalent.

Each piece of GEM's ownership data pertains to one of two types of relationships:

- Immediate owners of projects: GEM records each entity that directly owns a project (such as a power plant) and the percentage that entity holds in the project's ownership structure when available.
- Higher-level ownership: GEM additionally records the entities that own the immediate owners of projects, including the higher-level entities' percent share when available. We

trace ownership structures up to the highest level owner(s) identifiable in open sources. These highest level owners include:

- Publicly traded companies,
- The highest privately held entity in any given ownership branch,
- State bodies or governments, and
- Actual persons (not a company), who we refer to as "natural person(s)"

Each project's ownership tree thereby includes immediate, intermediate, and ultimate ownership, as applicable.

As in BODS, the GEM database refers to a lower-level entity as the "subject" and the higher-level entity as the "interested party."

In addition, the database stores various attributes of the entities, as described below. This additional data helps to provide unambiguous identification of the entities and can also enable certain types of analyses.

2.1 Types of Entities

In the database, each entity is assigned a type, as either a legal entity, state, state body, anonymous entity, natural person, unknown entity, or arrangement, following the definitions in BODS.

2.1.1 Legal Entity

As defined by BODS, a legal entity is an organization created with a memorandum of incorporation or similar registration documents, and which is registered by a government. There are many types of legal entities, including Corporation, Limited Liability Company, and Company Limited. For GEM's ownership work, we define "legal entity" in line with BODS terminology.

In addition, in GEM's database, we differentiate privately owned and publicly traded companies (also known as a publicly held company, publicly listed company, or listed company). This is in line with BODS schema for marking publicly listed companies. Another reason we differentiate is because in some jurisdictions, such as the United States (U.S.), public companies are required to publish audited financial statements and information on beneficial ownership over 5% (Securities and Exchange Commission, 2023). Identifying public companies is also useful for guiding research, since publicly traded companies tend to disclose ownership information in their annual reports or in filings made with the stock exchange on which they are traded.

2.1.2 State

The entity type "state" refers to national, subnational, and local governments. In BODS terminology, it is a country, nation, or community with legal sovereignty within a territory. In GEM's dataset, we follow a convention for naming states:

- National governments: "Government of X."
- State/regional governments: "State of X" or "Province of X" (for example), depending on the name of the type of country subdivision.
- City governments: "City of X" or "Municipality of X."
    - U.S. Cities: follow the same pattern as well as adding the state where the city is located in parentheses.
        - For example, "City of Chicago (Illinois)" for the city government in Chicago, Illinois, United States.

2.1.3 State Body

In BODS terminology, "state body" refers to a core administrative or legislative body within a state's apparatus. For example, these could be ministries or government agencies. State bodies are entered in GEM's dataset as distinct from the state (the government) to make the ownership data as specific as possible.

When labeling state bodies in our dataset, we use the official name of the government agency or ministry as the entity name. In cases where ministry or government agency names are similar to government agency names in other countries, we enter the country name in parentheses at the end of the entity name—for example, "Ministry of Energy (Iraq)."

2.1.4 Arrangement

For other cases of ownership that do not fit into any of the categories above, we have applied a general category "arrangement," based on advice from Open Ownership's staff. We apply the category of "arrangement" to entities that meet the following criteria:

- Joint ventures that are not registered in a government business registry
- Other entities, such as trusts, universities, and certain general partnerships, that are not registered in a business registry and are found to hold ownership in a project or subject
- Business groups that are described in online sources as holding ownership of a project or subject but for which a principal registered legal entity (i.e., a parent or holding company) could not be identified in online sources and no other information regarding the ownership of the asset or subject is available

2.2 Sources and Datasets employed

The availability of data on ownership varies widely between countries, and GEM relies on the most authoritative open data that is available at the time of this work. This includes diverse sources, such as state business registries, government data sets, company reports, news articles,

stock exchanges, and other sources. On GEM.wiki, GEM publishes data for each project (e.g., power plant) which shows the ownership data as well as the data sources whenever available.

Examples of the government data sets that GEM uses to compile ownership data include Form EIA-860, which is a United States government agency electricity dataset from the U.S. Energy Information Administration (EIA, 2023). Additionally, GEM gathers ownership data from various company reports, such as annual reports and financial statements, which may identify the subsidiaries of a company and/or the projects owned by a company. In some cases, GEM obtained ownership information from news articles from accredited sources (such as Reuters, Bloomberg, and S&P Global), and press releases from company websites.

2.3 Entity Data Structure

For each entity, GEM stores data in the following data fields, as available and as relevant:

- **Entity Type:** The options follow the definitions in BODS, as described above, with the most common types being:
    - Legal entity
    - State
    - State Body
    - Arrangement
- **Legal Entity Type:** This field is used only when the "Entity Type" is a "Legal entity." The entries are standardized in their abbreviated forms; for example, a Limited Liability Company is standardized as "LLC."
- **Entity Status:** This field is used if the entity is dissolved or amalgamated.
- **Publicly Listed:** This indicates whether a company is "listed," that is, it has stock listed on a public stock exchange. (Such companies are also referred to as publicly traded or publicly held.) This option is available only for the entity type "legal entity."
- **Abbreviation**: The abbreviation of the entity name (if any), based on its primary name. This can be an acronym or other shortening of the name.
- **Name local**: The name of the company in the local language (e.g., for a Chinese company, the name in Chinese).
- **Name other**: Multiple names can be added, in English and/or other languages. When an entity was previously referred to by another name, we enter former names with "[former]" appended at the end. For example, "Anergi International Ltd" has the entry "Applied Energy Services [former]."
- **Registration Jurisdiction—Country & Subdivision.** For legal entities registered with a federal business registry, the country is listed. For legal entities registered with a provincial or state registry only, the subnational division is additionally listed.
- **Headquarters Jurisdiction—Country & Subdivision.** The location of the headquarters can be listed by country and by subdivision, as available.

- **Organization Identifiers:** This indicates an ID for an entity and is most commonly available only for legal entities. The ID systems currently in use in GEM's data set are listed below, with the short identifiers in parentheses as assigned by org-id.guide.
    - Global Legal Entity Identifier Index (XI-LEI)
    - Refinitiv PermID (XI-PID)
    - UK Companies House (GB-COH)
    - China's Unified Social Credit Identifier (CN-USCI)
    - China's State Administration for Industry and Commerce (CN-SAIC)
    - IDs assigned by the US Energy Information Administration, as published in Form EIA-860, for entities that own power-generating projects
    - S&P Capital IQ - SPCIQ: Can be found on companies pages in your S&P IQ account
    - India's Corporate Identification Number (Ministry of Corporate Affairs) (IN-CIN)
    - Russia's Uniform State Register of Legal Entities of Russian Federation (RU-INN)
    - Brazil's National Registry of Legal Entities (Federal Revenue Service) (BR-CNPJ)

Figure 1 shows a subset of tables in GEM's relational database that pertain to data on entities, with the data fields for each. For more information about the database structure, please contact the methodology authors at GEM.

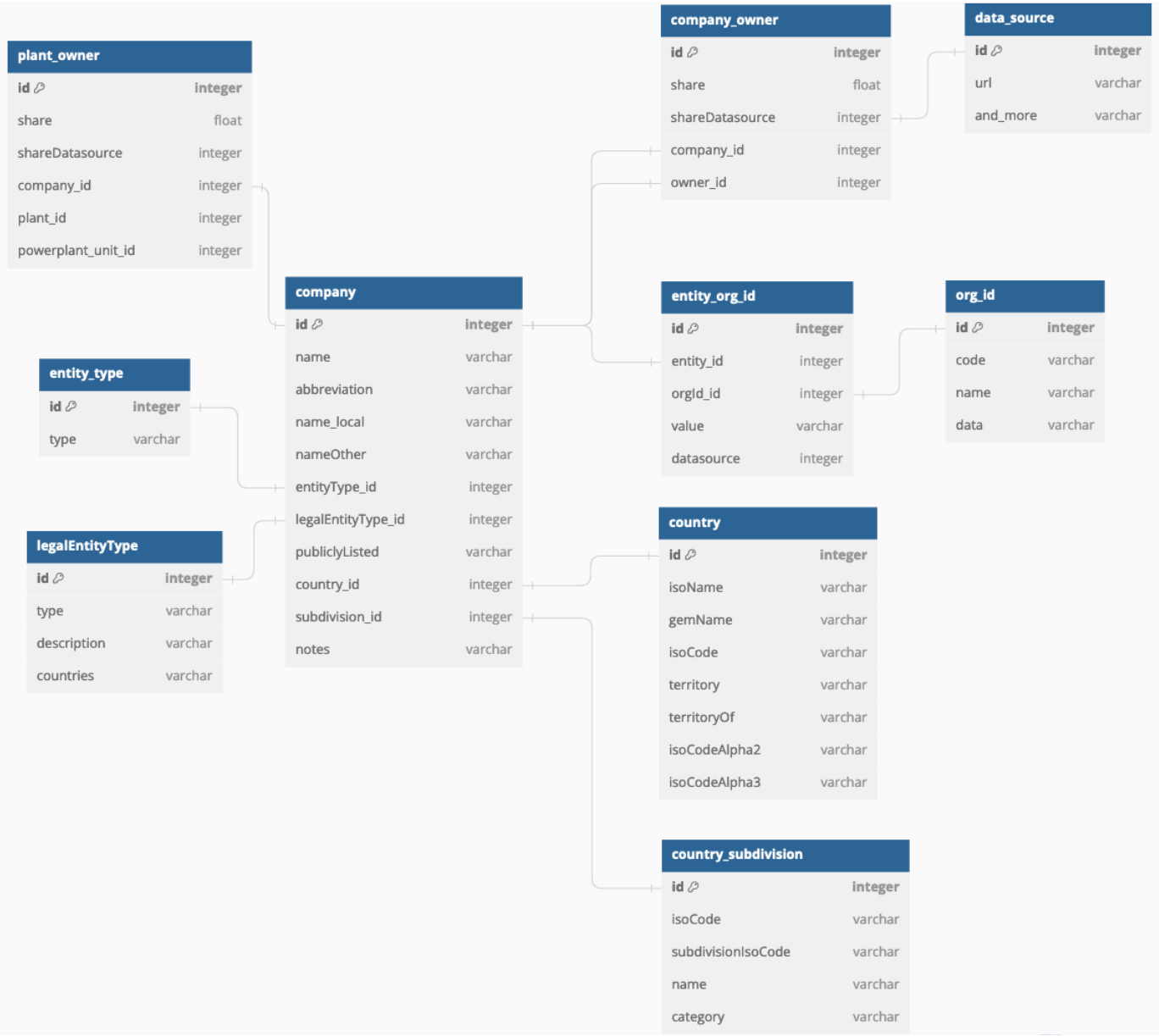

Figure 1 Diagram of a subset of tables in GEM's relational database, containing data on entities.

3. Research Practices

3.1 Assigning owners

When adding new entities to our database, GEM identifies the immediate owner reported for each project in GEM's trackers, and compares it against GEM's database of entities to avoid duplicating entities under different names.

To ensure that GEM does not create duplicate entities for entities, GEM relies on the collection of various information including: company name in English, company name in local language,

company abbreviation, entity type, legal entity type, publicly listed status, previous company names, location of registration and/or headquarters, and several organization identifiers such as the Legal Entity Identifier (LEI) issued by the Global Legal Entity Identifier Foundation (GLEIF), the Refinitiv Permanent Identifier (PermID), and national registration numbers. These identifiers and other information about the entities help GEM identify when one entity is being referred to in different ways.

The owners reported in authoritative data sources may not always be the immediate owner of a project. Many projects' immediate owner is a special purpose vehicle (SPV), a type of company that is often set up to own one particular project (such as a power plant).

However, GEM's focus is on tracing ownership "upward" to the level of ultimate parent entities (as defined below), in order to show how ownership aggregates. GEM does not trace ownership "downward" to identify any lower-level owner that may be below the owner reported for a particular project.

3.2 Ownership trees

Starting from the immediate owners of projects (as reported by our sources), GEM researchers add additional data as available on the higher-level interested parties of these starting subject entities. This terminology follows BODS, in which each relationship between two entities has a lower-level "subject" and a higher-level "interested party."

In the GEM database, the levels of ownership for an entity are displayed in an ownership tree. The ownership tree of an entity provides a visual representation of the different levels of ownership for a given entity.

An example is shown in Figure 2 in the following section for the ownership of JERA Co Inc., a Japanese power generation company.

3.3 Parents

To aggregate data at a high-level, GEM has created a particular definition for the ultimate parent entities, referred to below as simply the "parent(s)." Within each ownership tree (or tree branch), GEM defines a parent following the rules described below:

- The lowest-level publicly listed company, if any.
- If there are no publicly listed companies, then the highest-level state-owned enterprise, if any. That is, the parent is not assigned to a state or state body if there is a lower-level legal entity.
- If there are no listed companies or state-owned enterprises, then the ultimate parent is assigned to the highest-level privately owned company. Natural persons are not assigned as parents, as long as there is available data on lower-level entities. In certain cases, in

which the highest-level owners are general investors, such as major banks, then we define the parent as the highest-level energy company in that tree or tree branch.

- One exception is for the case of China, in which certain entities are designated as central enterprises by the central government. The State-owned Assets Supervision and Administration Commission of the State Council (SASAC) has named 98 companies as central enterprises (SASAC, 2023). The Ministry of Finance has named an additional 27 companies as central enterprises (MOF, 2021). If an ownership tree (or tree branch) reaches one of these designated central enterprises, then that central enterprise is listed as the ultimate parent for that tree branch.

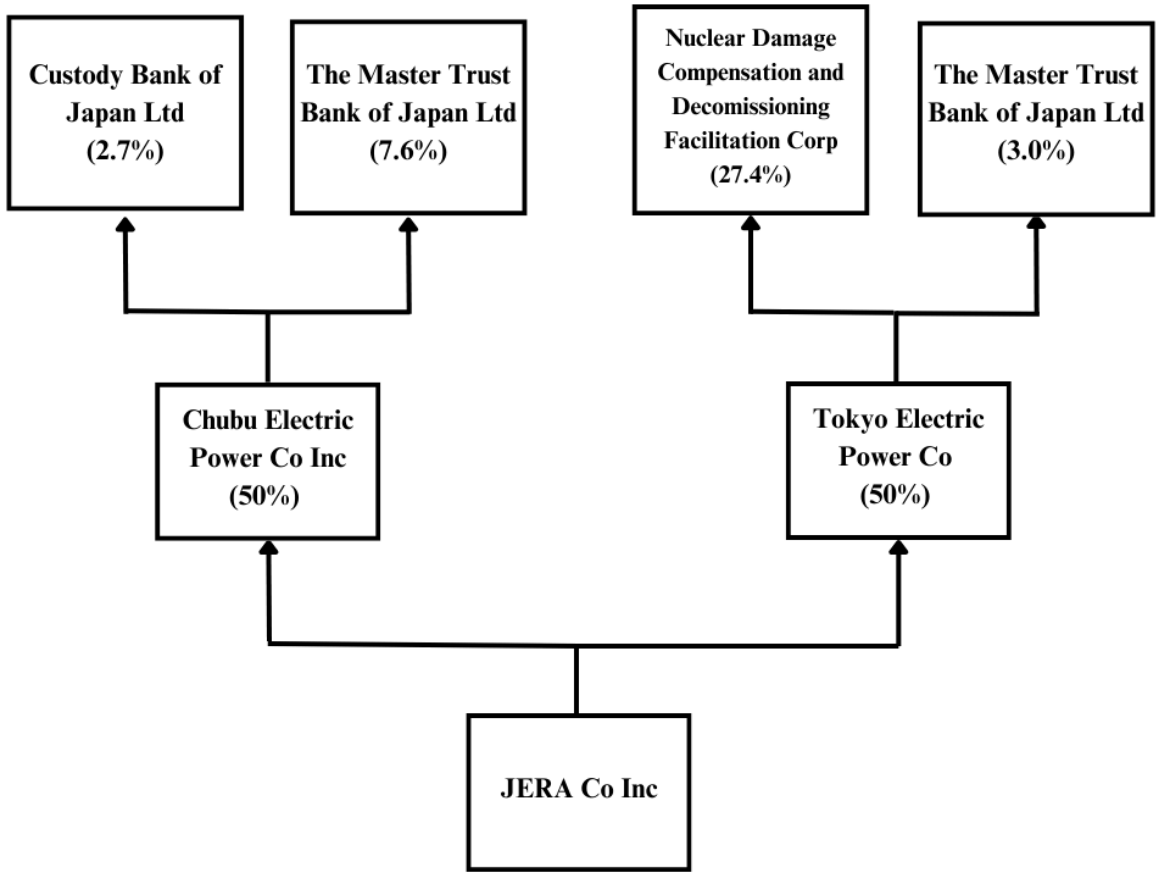

Figure 2 Ownership Tree of the first two ownership levels above JERA Co Inc, starting from the bottom to the top of the figure. The higher-level owners display the next level of ownership and the percent of indirect ownership of JERA Co Inc. This figure is paired down since GEM's full ownership tree for JERA has 5 layers of ownership and 17 unique entities holding direct or indirect ownership. The remaining interested party ownership for Chubu Electric and Tokyo Electric is attributed to small shareholders and natural persons.

In the example ownership tree shown in Figure 2 for JERA Co Inc, the immediate interested parties are Chubu Electric Power Co Inc and Tokyo Electric Power Co Inc, which each hold 50% of JERA Co Inc. The next level of ownership displays the interested parties of these two entities. The Master Trust Bank of Japan Ltd and Custody Bank of Japan Ltd are the interested parties in the subject Chubu Electric Power Co Inc, and thus have indirect ownership of JERA Co Inc. The same can be said for Nuclear Damage Compensation and Decommissioning Facilitation Corp and The Master Trust Bank of Japan Ltd, which are the interested parties of the subject Tokyo Electric Power Co, and thus have indirect ownership of JERA Co Inc. However, Chubu Electric Power Co Inc and Tokyo Electric Power Co are both publicly listed companies, and therefore, following GEM's definition of parents, each of them is defined as a parent of JERA Co Inc., each owning 50% of JERA Co Inc.

In tracing ownership trees upward from the reported owners, GEM stores data on all entities involved as long as they own at least 5% of a project or a subject entity. We have decided to track ownership of at least 5% to follow the practice of the US Securities and Exchange Commission (SEC), which requires individuals or entities with at least 5% beneficial ownership in a public company to file this through a Schedule 13D form. By storing data on ownership of at least 5%, GEM is providing a nearly comprehensive view of ownership, going beyond the entities that have controlling interests in a project or a subject entity.

GEM's parent designations do occasionally list states or state bodies if there weren't any lower-level entities in a given ownership tree (or tree branch). An example of this is Bharat Aluminium Co Ltd (see the description in Figure 3).

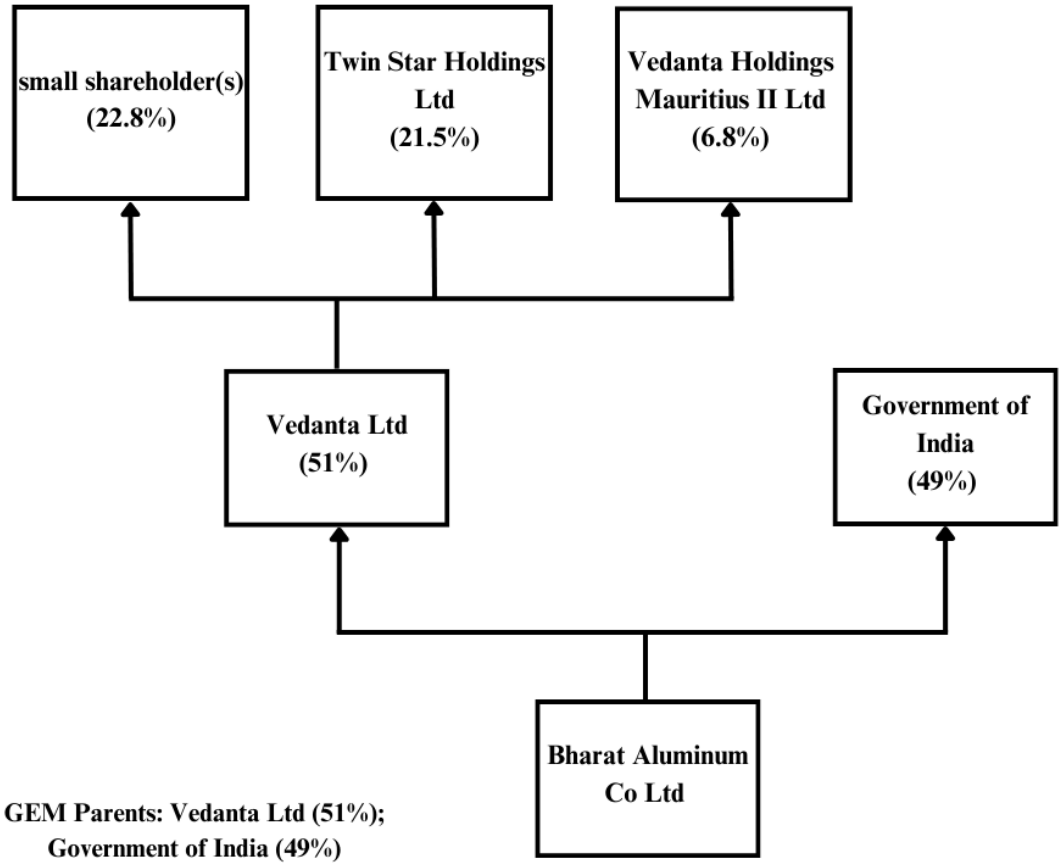

Figure 3 Ownership Tree of the first two ownership levels above Bharat Aluminum Co Ltd, starting from the bottom and to the top. The percent value refers to the entity's direct or indirect ownership of Bharat Aluminum Co Ltd. For assigning the parents of Bharat Aluminium Co Ltd, the Government of India is listed as one of the parents, because there isn't any other legal entity to report as the parent on that branch of the ownership tree. This figure is paired down since GEM's full ownership tree for Bharat Aluminum Co Ltd has 7 layers of ownership and 9 unique entities holding direct or indirect ownership.

Similarly, if the lowest-level owner in a particular ownership tree is a natural person, then a designation for "natural person(s)" in general is reported, rather than listing names of individual natural persons.

3.4 Mergers and acquisitions

Mergers and acquisitions fall into the three following scenarios:

1. Acquisition (change in ownership): the entity's legal status did not change; its name may or may not have changed, but it is still registered as its own legal entity. It is not dissolved or amalgamated.

In the case of a corporate acquisition, we have labeled the company that is the acquirer as the interested party and the acquired company as the subject (following the BODS terminology for relationships between entities).

2. Amalgamation: the entity has been amalgamated into another entity and is therefore no longer active.

When a company has been amalgamated into another, the company's previous legal identity becomes defunct, and it is no longer active. In this case, we label the companies entity status as "amalgamated" and link its subject companies to the entity that it amalgamated into.

3. Merger: the entity has merged with another entity and the entities combined their identities (e.g., ExxonMobil).

In the case of a merger between companies, if one company survives and the other does not, we have mapped the subjects of the acquired company to the acquiring company and labeled the acquired companies entity status as "amalgamated". We also update the name of the acquiring entity to its new name.

For example, in the ExxonMobil merger in 1998, Exxon was technically the acquirer, while the Mobil name was retained as a brand name within the combined company. Therefore, Mobil Corp. was amalgamated into Exxon Corp., and Exxon Corp. became renamed as ExxonMobil Corp.

4. GEM Ownership data provided to Climate TRACE

In total for 2025, GEM contributed 27,737 unique entities to the Climate TRACE database, an increase from last year's total - 19,588 entities - a ~30% increase The immediate and parent ownership to source-level emissions for the following sectors:

- Coal plant sector - 8,309 entities
- Gas plant sector - 8,810 entities
- Bioenergy plant sector - 4,149 entities
- Coal mine sector - 6,653 entities
- Iron Ore mine sector - 988 entities
- Steel plant sector - 2,250 entities
- Oil, Gas, and NGL pipeline sector - 2,314 entities
- Cement and Concrete sector - 3,189 entities

For a breakdown of ownership by asset count see the Summary of Asset Count by Operating Status 24 Oct 2025.csv. Note that some counts may be unit level and some are plant level. Legal Entity Identifiers, PermIDs, and UK Companies House ID are included in the summary sheet for better data interoperability.

Some entities repeat across sectors, so the sum of the individual sectors is greater than the total 27,737 entities.

Refer to each sector's methodology on the Climate TRACE GitHub repository to understand how these assets were incorporated into each respective sector.

5. Preprocessing Entity Names for Climate TRACE Data Integration into the Global Energy Monitor Database

This section outlines the standardized process used to preprocess entity names received from other Climate TRACE coalition members before integrating them into the Global Energy Monitor (GEM) PostgreSQL database. The preprocessing ensures consistent and accurate matching of entities across datasets, facilitating reliable data ingestion and analysis.

This preprocessing pipeline ensures that entity names from Climate TRACE coalition members are systematically cleaned, normalized, and matched against the Global Energy Monitor database. By combining geolocation enrichment, exact and fuzzy matching, and manual review, the process maintains high data integrity and supports scalable ingestion workflows.

- The Global Energy Monitor database maintains a comprehensive set of energy-related entities.
- Preprocessing is implemented via a Python notebook named `database_preprocessing`, hosted in the `ClimateTRACE_ownership` GitHub repository found in the GEM GitHub.
- This approach is modular and adaptable for other teams or projects ingesting data into the GEM database.

Preprocessing Workflow

5.1. Data Acquisition

- Receive CSV files containing entity data from Climate TRACE data engineers at WattTime.
- These files include a `location` column specifying point locations related to the asset the entity owns.

5.2. Location Normalization

- Extract all unique locations from the `location` column.

- Use the Python `geopy` library with the Nominatim geocoding service to resolve each unique location to its corresponding state and country.
- Append the resolved state and country information back into the dataframe, enriching the location data.
- Note: Efforts are ongoing to encourage teams to include state or country information directly in parentheses within city names for improved accuracy.

5.3. Immediate Owner Name Standardization

- Filter for media owners whose names start with "City of".
- Apply targeted transformations to standardize these names for consistency.
- GEM uses the standardized city name approach of “City of Jacksonville (Florida)” to avoid user confusion.

5.4. Entity Data Retrieval from GEM

- Query the GEM PostgreSQL database to pull the current list of entities.
- Create two temporary columns for matching purposes:
    - Temporary full name: Concatenation of the entity's name and legal entity type, cleaned by removing spaces, converting to lowercase, and replacing ampersands (`&`) with "and".
    - Temporary name: Similar cleaning applied to the name column alone (without legal entity type).

5.5. Exact Matching

- Perform two exact merges between the preprocessed immediate owner names from the Climate TRACE data and the GEM entities:
    - Match against the temporary full name.
    - Match against the temporary name.
- Transfer the GEM entity IDs into the Climate TRACE dataframe for matched rows.

5.6. Fuzzy Matching for Unmatched Entities

- Identify rows in the Climate TRACE data without matched GEM entity IDs.
- Apply a fuzzy matching algorithm using **Levenshtein distance** to compare unmatched immediate owner names against GEM entity names.
- Levenshtein distance is preferred for its effectiveness with short strings (1-2 words).
- Filter matches with a similarity score ≥ 0.9 (on a 0 to 1 scale).
- Manually review these high-confidence matches.

- Use a running dictionary (crosswalk) to map alternate names to the correct GEM entity IDs.

5.7. Handling New Entities

- Entities that do not match after fuzzy matching are sent to GEM data engineers.
- GEM engineers add these new entities directly into the GEM PostgreSQL database.
- This process generates new entity IDs for previously unmatched entities, enabling future matches.

6. References

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6. Securities and Exchange Commission. (2023). *SEC Adopts Amendments to Rules Governing Beneficial Ownership Reporting* [online]. Available from: https://www.sec.gov/news/press-release/2023-219 [Accessed 8 November 2023].

The Global Energy Ownership Tracker provides information on the chain of ownership for various energy projects. The data maps each level of the chain from the direct owner (as in, the lowest-level identified owner in the chain of ownership) up to their highest-level ultimate parents (e.g., corporations, investment firms, and governments). Ownership links are reported with the percentage of ownership, including owners that have controlling interest as well as those with minority, non-controlling interests (if over a threshold of 5% ownership).

This asset ownership data set covers nine of GEM's trackers:

- The Global Coal Plant Tracker
- The Global Oil and Gas Plant Tracker
- The Global Coal Mine Tracker
- The Global Iron & Steel Tracker
- The Global Bioenergy Plant Tracker
- The Global Iron Ore Mines Tracker
- Natural Gas Transmission pipelines from the Global Gas Infrastructure Tracker
- Crude oil and natural gas liquid transmission pipelines from the Global Oil Infrastructure Tracker
- Global Cement and Concrete Tracker

Details about how each tracker identifies their assets and what methodologies they follow can be found on each of their respective pages of the GEM website linked above.

The Global Energy Ownership Tracker is updated after each new release of these underlying trackers. The most recent release of this data was in September 2025 and contains ownership data for Coal Plants, Oil and Gas Plants, Bioenergy Plants, Iron and Steel Plants, Coal Mines, Iron Ore Mines, Cement and Concrete Plants, and Natural Gas Pipelines.

To learn about the various components of each GEM tracker, read About GEM's Trackers. To receive notifications from this project, please sign up for our mailing list. If you have questions about this project, please contact the Project Manager, Anna Mowat.