Petten
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The European Clean Investment Monitor

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Overview and motivation

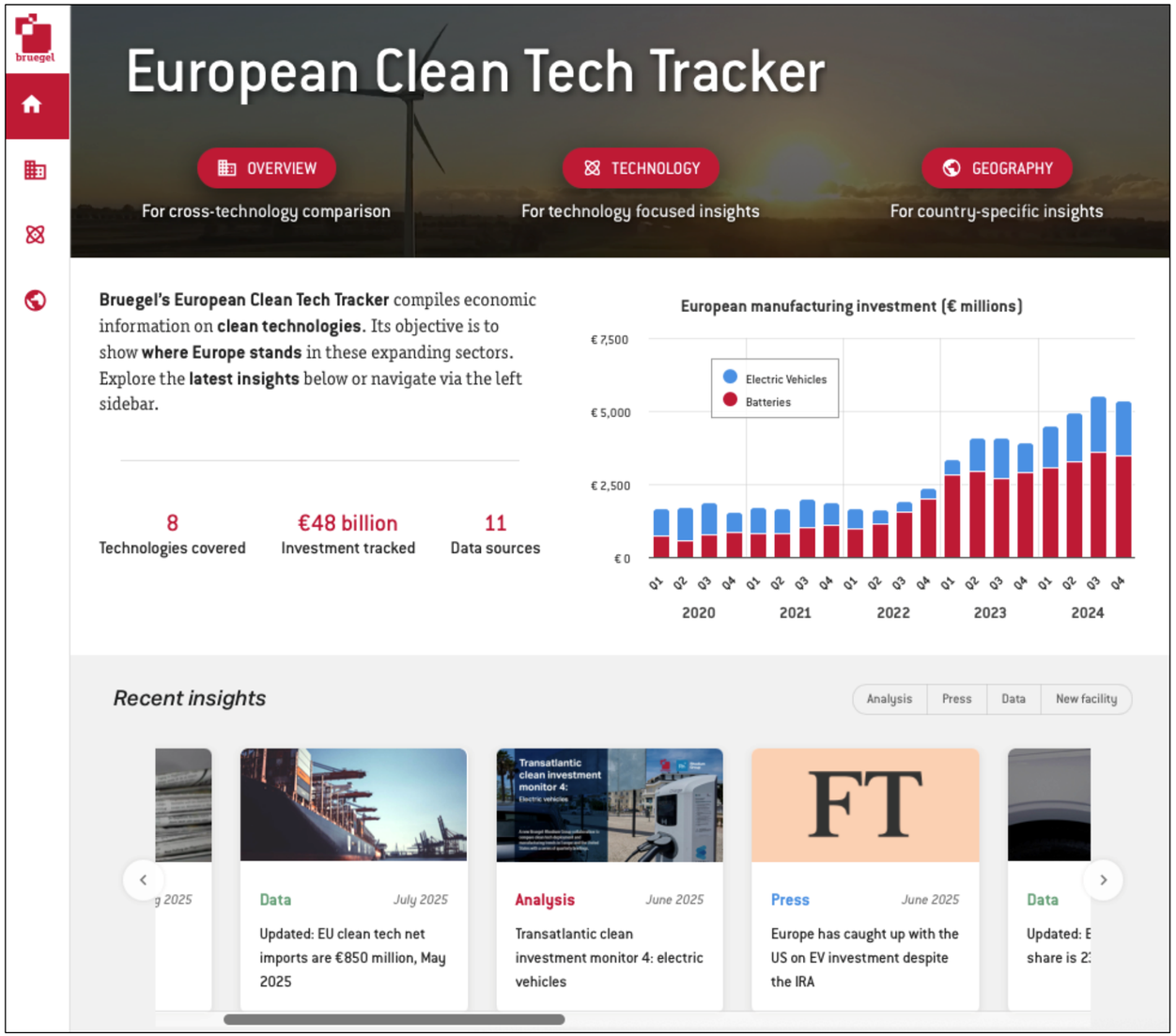
Climate targets are not politically sustainable without an accompanying clean industrial transformation

Clear information allows more stakeholders to participate in debate & reduces ability of special interest groups to lobby

The **European Clean Tech Tracker** – an initiative by Bruegel to build a repository of the best available clean tech data

The **European Clean Investment Monitor** is one component within (to be launched next week)

- Methodology
  - The data challenge
  - An investment ontology & graph framework
  - Back-and-forward with the LLM
- Results



Methodology

The Challenge: Translating unstructured text to digestible data

Enel Green Power signs EU grant deal for solar gigafactory in Italy

By **Reuters**

April 1, 2022 1:00 PM GMT+2 · Updated April 1, 2022

ProLogium picks northern France for new battery gigafactory - sources

By **Gilles Guillaume** and **Elizabeth Pineau**

May 9, 2023 7:01 PM GMT+2 · Updated May 9, 2023

Stellantis invests $41 million in Italy to make EV engine parts

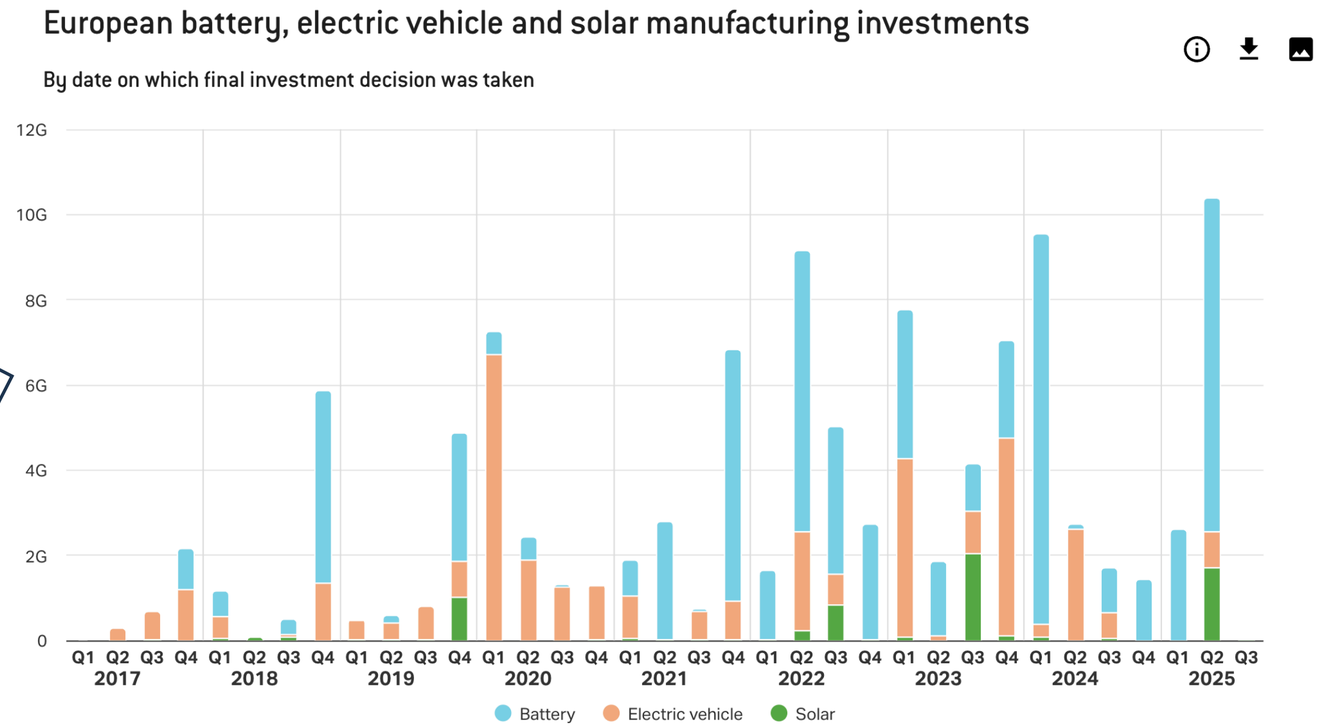
By **Reuters**

March 17, 2025 1:15 PM GMT+1 · Updated March 17, 2025

China's CALB to invest $2.09 billion in EV battery factory in Portugal

By **Reuters**

February 21, 2025 6:08 PM GMT+1 · Updated February 21, 2025

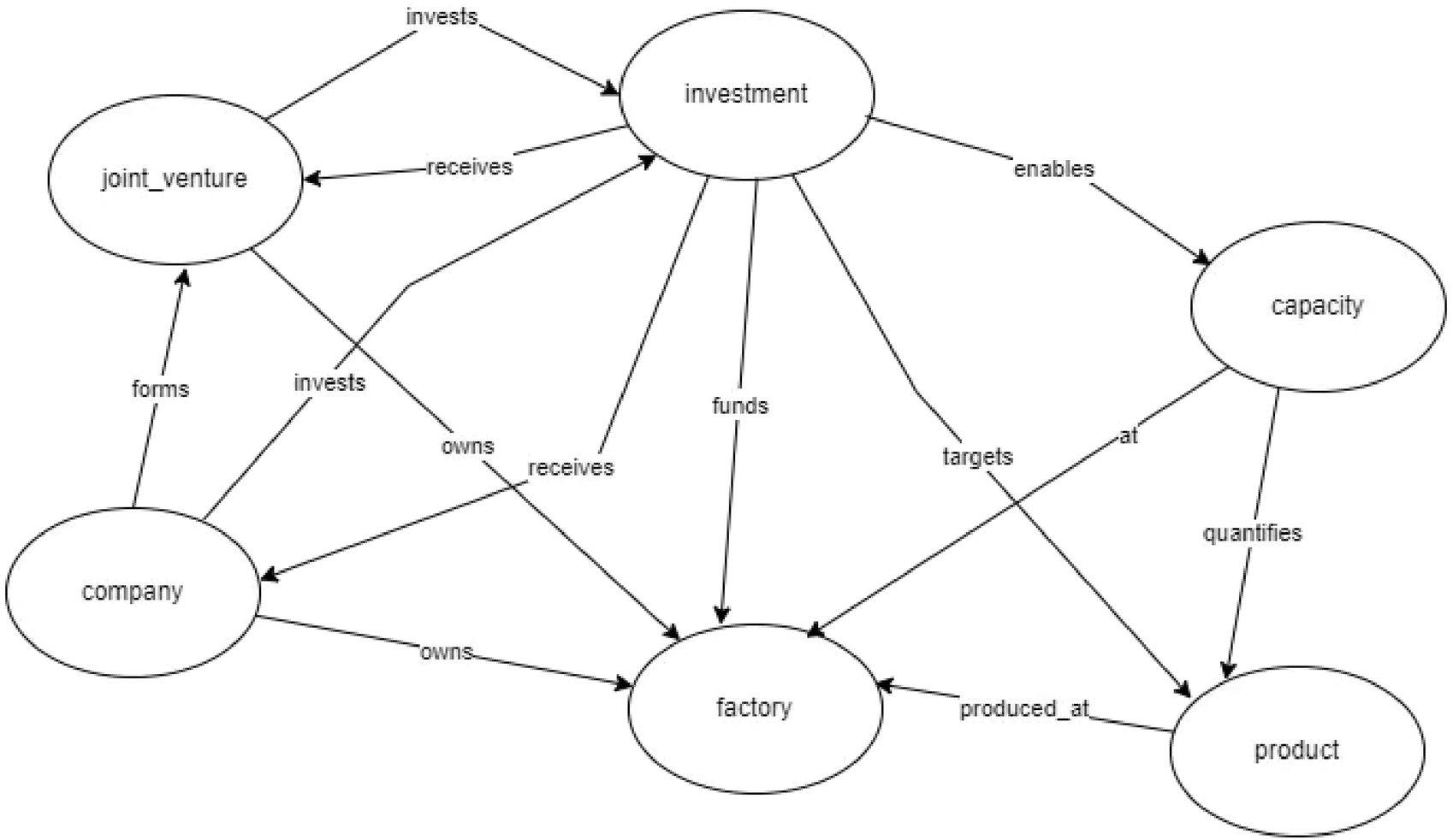


The end goal: An investment framework

Relevant text information is coded into an investment ontology – using a knowledge graph framework

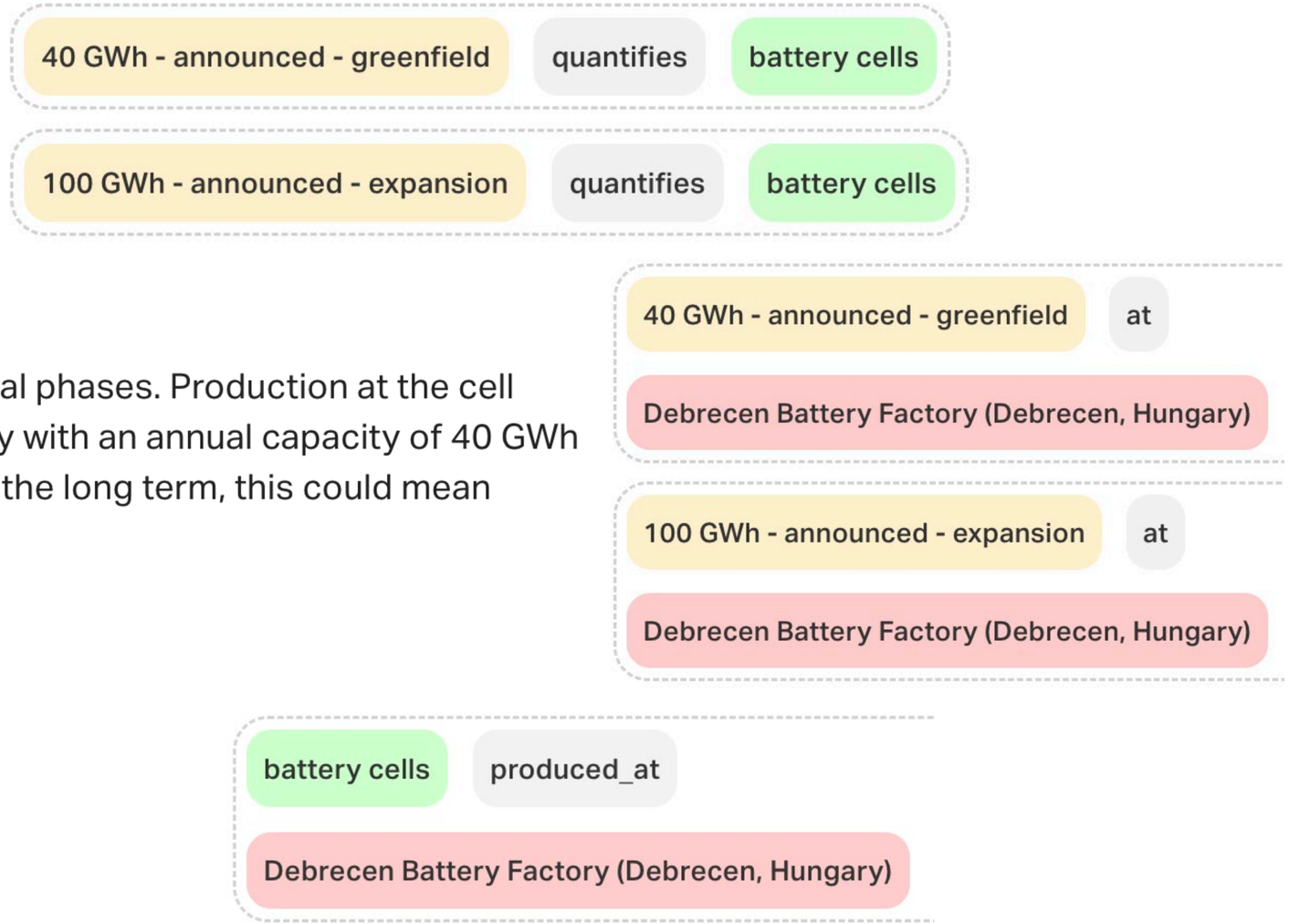
Who is making investments, **where** are they making them, **when** are important decisions being made, **what** is being produced

Text fragments are transposed into collection of relationships triples



Text to relationship triples #ex1

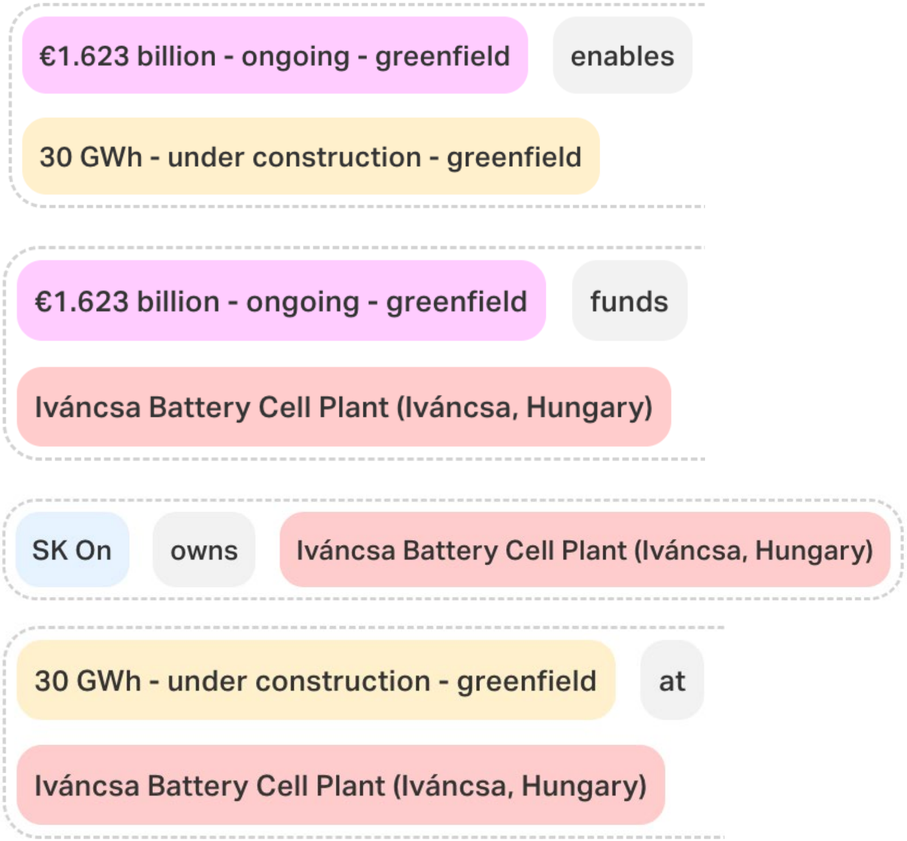
The construction of the entire factory is taking place in several phases. Production at the cell factory is expected to start in the second half of 2025, initially with an annual capacity of 40 GWh (gigawatt hours), which will later be expanded to 100 GWh. In the long term, this could mean



Text to relationship triples #ex2

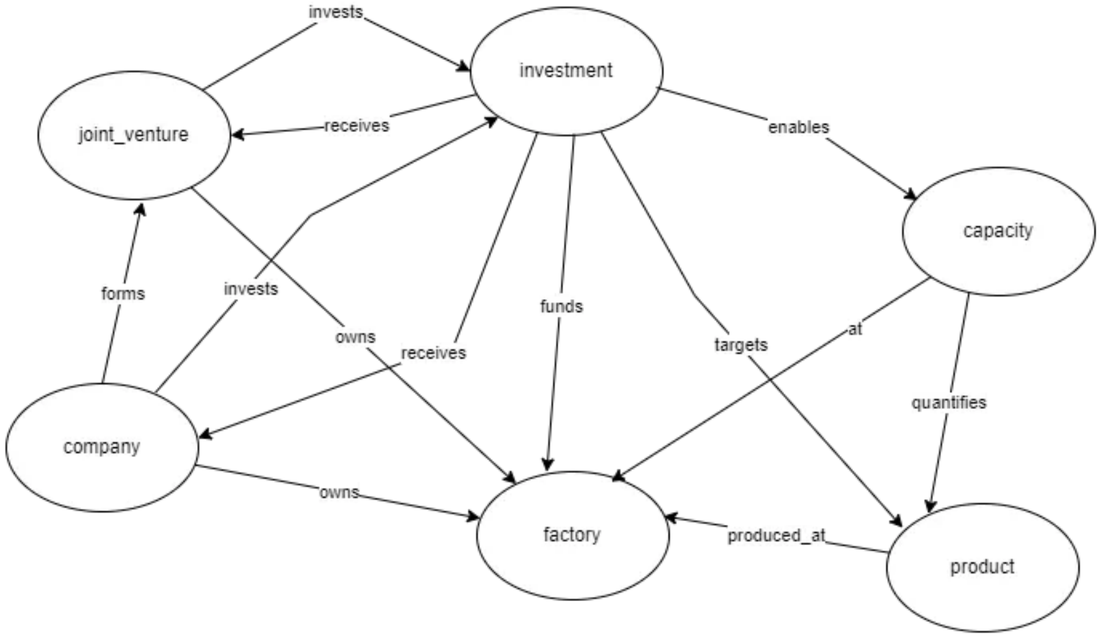
The plant is to be built in Iváncsa in the Közép-Dunántúl region. According to the information from the EU Commission's communication, it will have an annual capacity of 30 GWh and provide at least 1,900 direct jobs. With this, the EU confirms the information provided by SK On when the plans for the plant were published inJanuary 2021. According to the information at that time, the final expansion is to be reached in 2028.

SK On Hungary applied for aid in the amount mentioned in December 2021. The company itself will invest a total of €1.623 billion in the project, which started in early 2021. The subsidy will "contribute to the development of this area and the creation of jobs without unduly affecting competition", as the EU Commission justifies its decision.



Back-and-forth with the LLM

- We scrape tens of thousands of articles and company press releases
- First knowledge graph instances are produced by one-shot prompting an LLM (gpt-4o-mini)
- Develop a feedback loop. User corrects LLM output & these corrections are used to finetune the LLM
- Run a series of finetuned LLMs (gpt-4o-mini) on data
- Importance of the feedback loop – conversion of text to relationship triples is subjective. Many edge cases which we discuss in team and deepen our *codebook* over time (this is where value lies)



From single KGs to complete investment timelines

Each article generates a unique knowledge graph

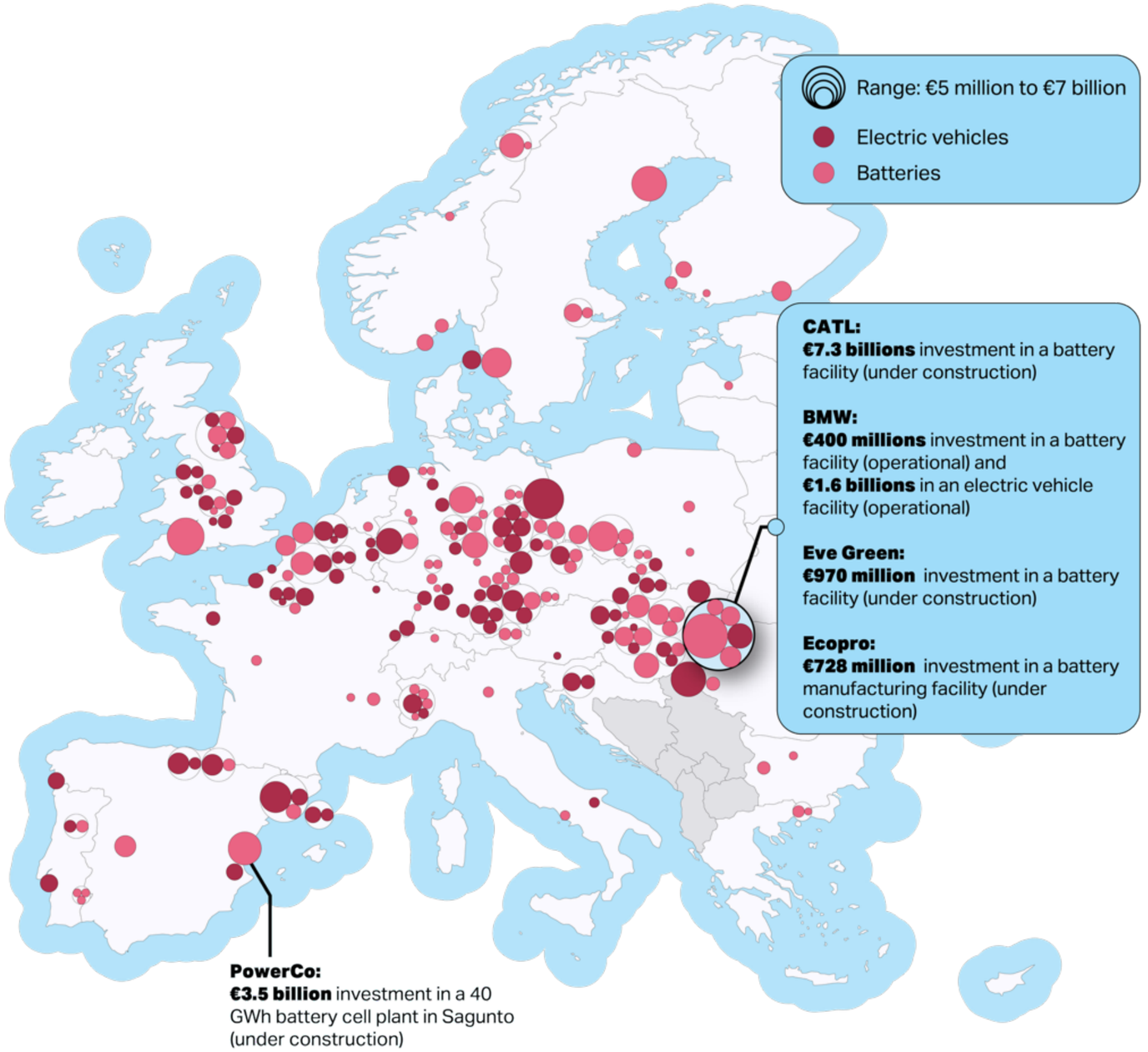
Reconcile these over time through a set of rules

Flexible to permit reporting differences across media whilst noting **chronological milestones**, like when projects reach FID and complete construction. Or move between investment phases.

Results

Overview: ECIM

- > €80 billion investment since 2017
- Battery: 172 investments across 125 facilities.
- Solar PV: 102 investments across 80 facilities.
- Electric vehicle: 121 investments across 89 facilities.

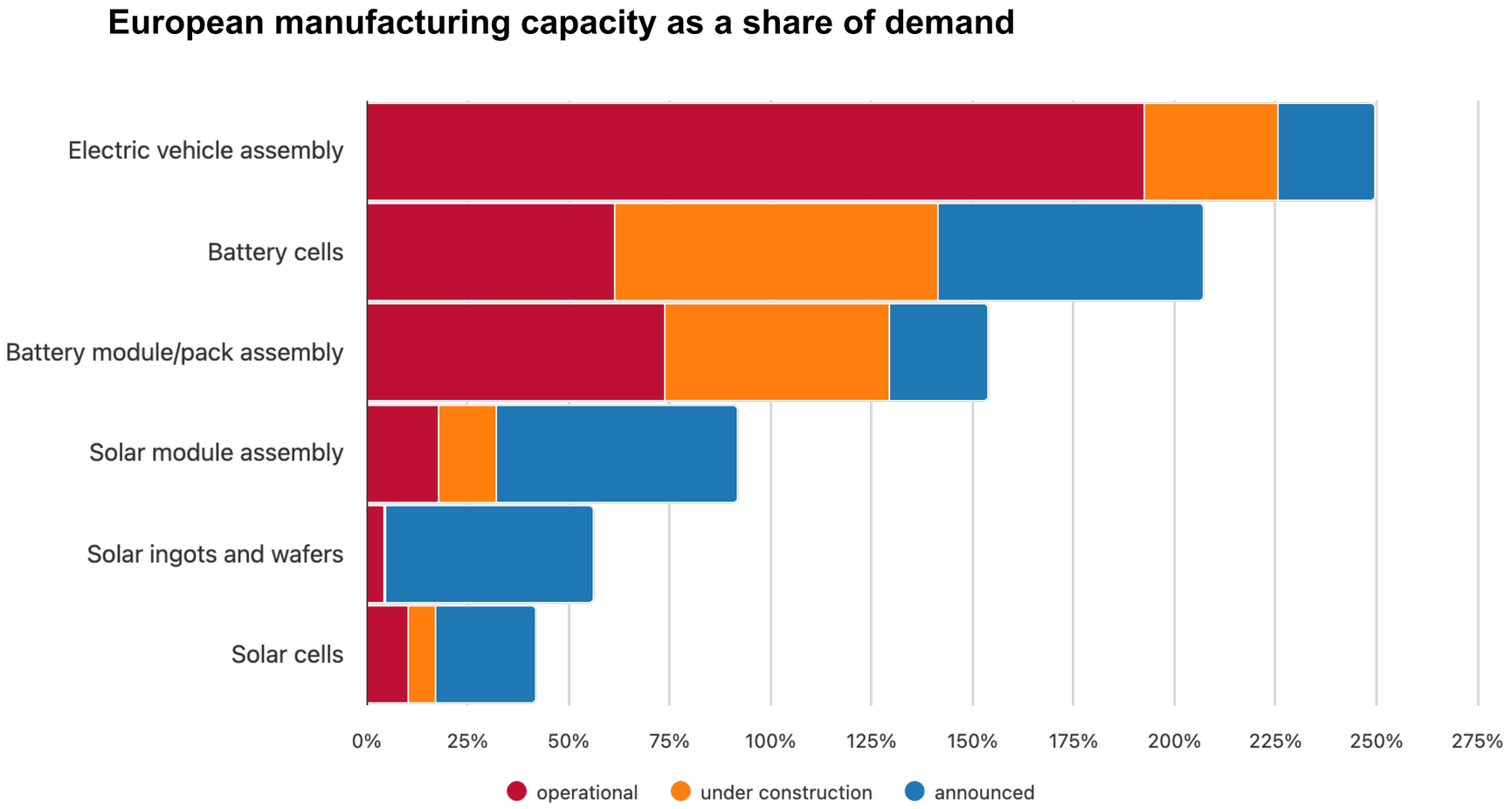


Supply and demand balances

Europe has the capacity to assemble around 4.5 million EVs annually, compares to 2.5 million demand.

And the capacity to produce 250 GWh battery cells (a little more module assembly) vs annual demand closer to 400 GWh

Capacities across the solar value chain are far more modest

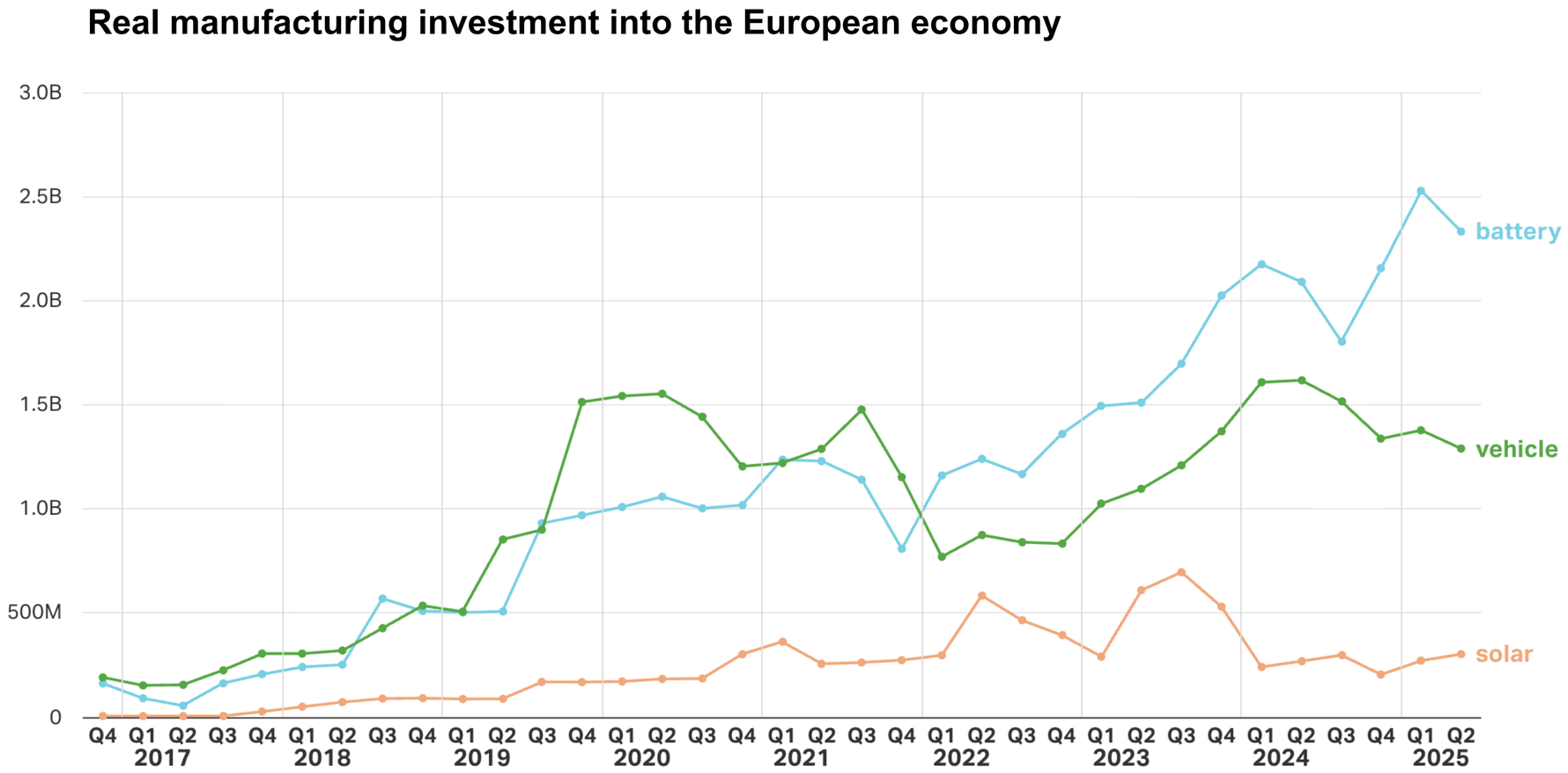


Investments growing over time

Battery investment up from €200 million quarterly in 2017 to over €2 billion quarterly by 2025

Electric vehicle grew until 2020, Tesla relevant, and then has steadied.

Solar investments more modest

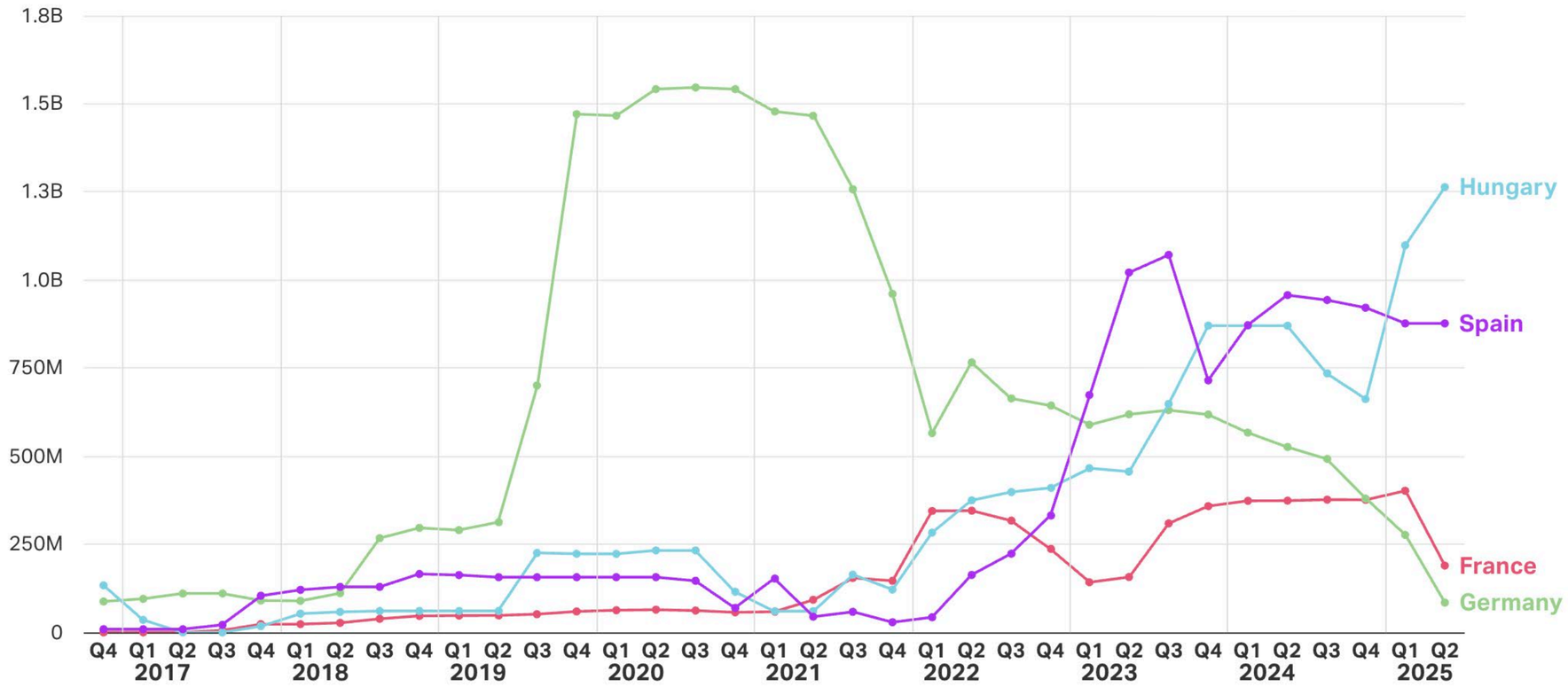


An evolving industrial geography

Germany attracted a lot of early manufacturing investment

Hungary and **Spain** are the hotspots today. Much Hungarian investment is Chinese FDI whilst Volkswagen group drives investment in Spain

Real manufacturing investment into the European economy

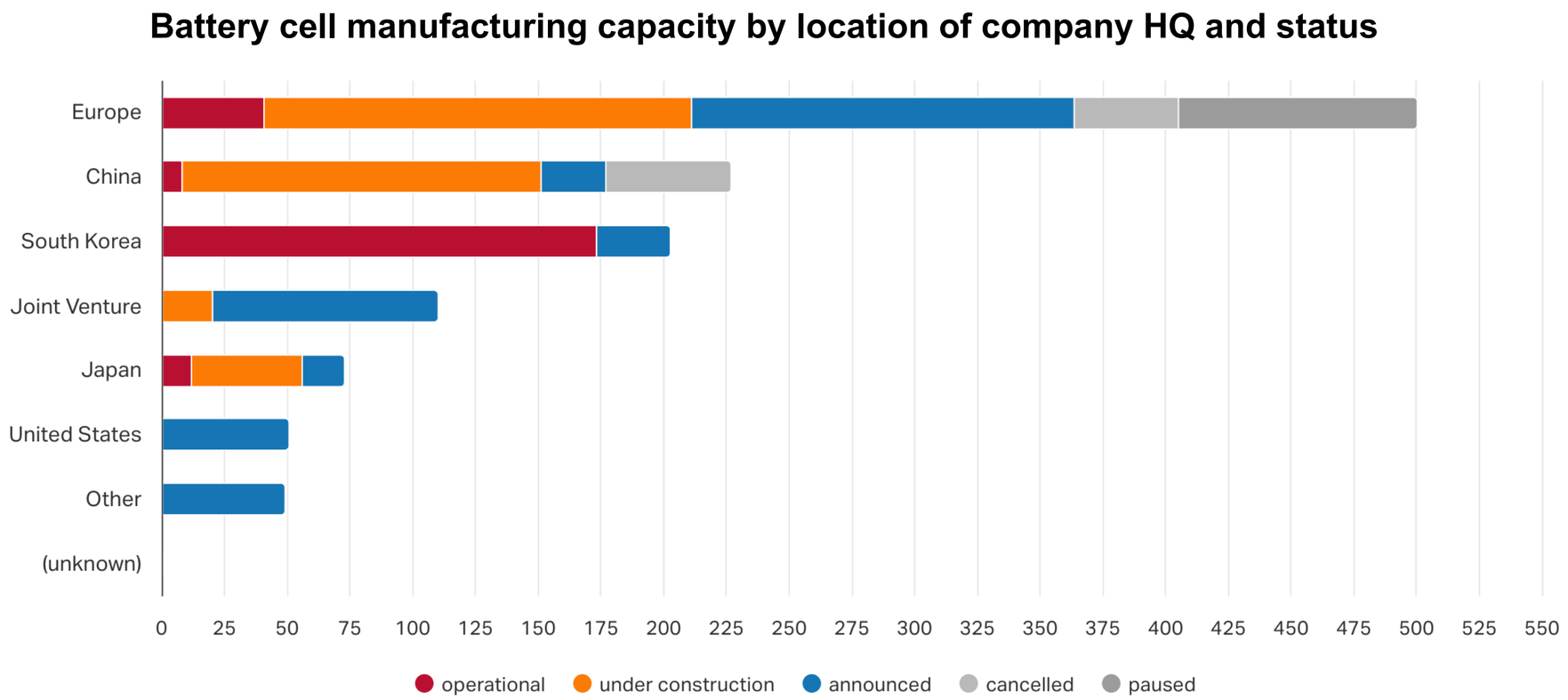


From Korean to Chinese FDI

South Korean FDI (LG Energy, Samsung SDI, SK Innovation) drove early European battery investment

Efforts to create homegrown champions (Northvolt, Verkor, ACC)

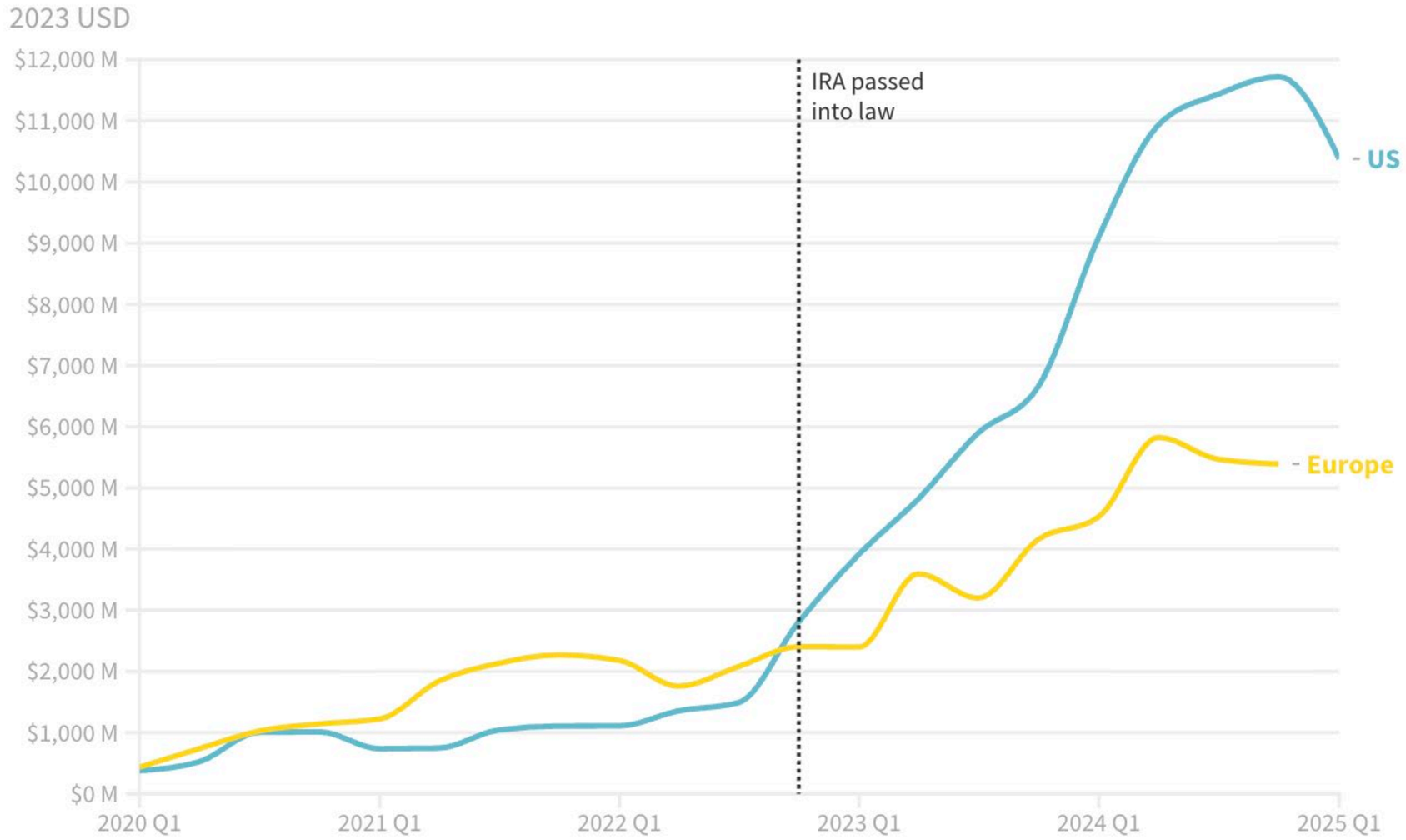
Fresh wave of Chinese FDI ongoing today



Comparison with the US

Joint effort with Rhodium Group who run the Clean Investment Monitor

US **battery** investment turb—charged by IRA. Typically translated into less capacity. And slowing since Trump (not shown on graph yet)



Annex

ECTT methodology

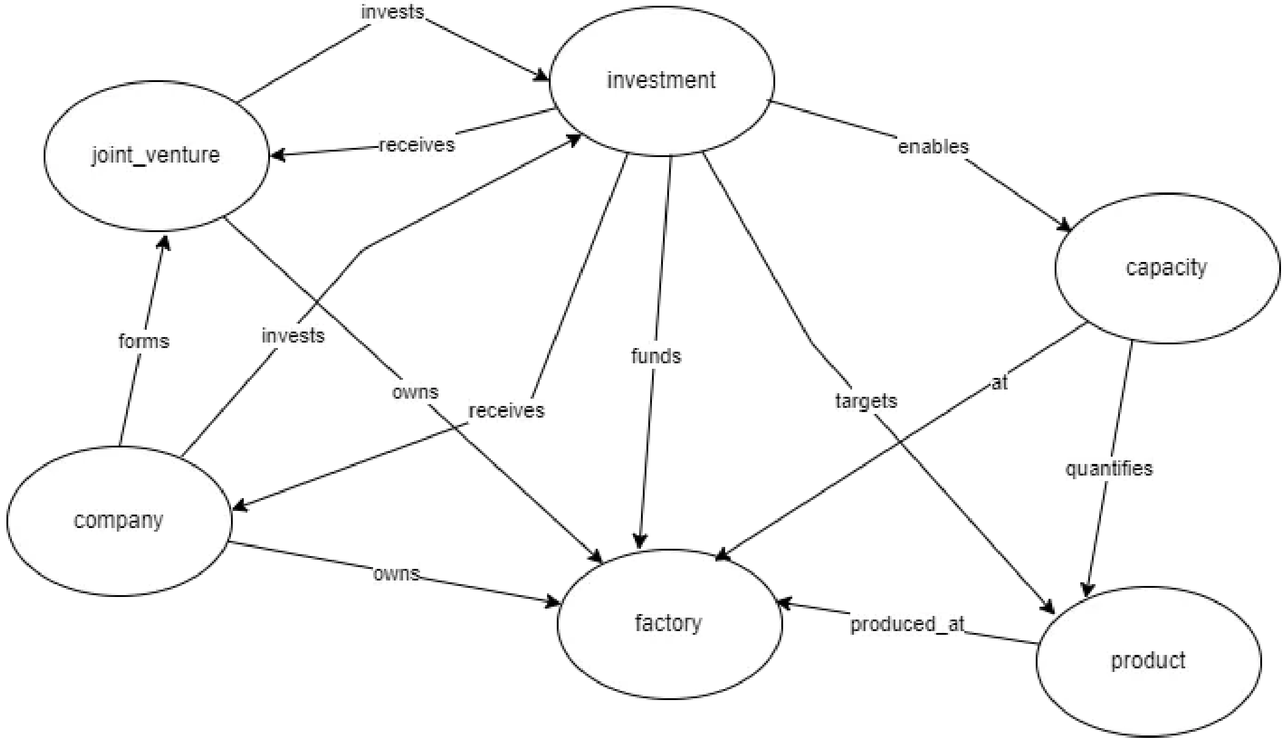
ECTT compiles information on deployment, trade and jobs from 11 sources (e.g., IEA, Eurostat, Ember, business associations, etc.)

Manufacturing and investment data come from Bruegel Clean Investment Monitor, developed in collaboration with Rhodium's [USA Clean Investment Monitor]

The Monitor stores information about clean technology investment in a knowledge graph structure (opposite). A knowledge graph comprises entities (nodes) and relationships (edges) between them. In this context, nodes correspond to companies, joint ventures, factories, investments, declared production capacities, and specific technology products (e.g., lithium-ion cells, electrochemical reactors). Edges capture the semantic ties - ownership, investment flows, capacity-to-product mapping - that bind these entities together.

Most information is processed from text (such as newspaper reports and press releases) into this structure. A series of gpt-4o-mini models are finetuned with human feedback for this purpose. Bruegel researchers use an internal web application to browse the database and make any necessary adjustments.

Bruegel Clean Investment Monitor: database ontology



Thank you!

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