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Financing the circular economy: a response to industrial and environmental challenges

Report by the Circular Finance Coalition on four strategic sectors: lithium-ion batteries, waste heat, titanium and copper

The members of the Circular Finance Coalition:

BNP PARIBAS · GROUPE BPCE · Crédit Mutuel Alliance Fédérale · CA · LA BANQUE POSTALE · EDF

Supporter by RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité · ADEME AGENCE DE LA TRANSITION ÉCOLOGIQUE

Supporter by MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE, DE LA BIODIVERSITÉ ET DES NÉGOCIATIONS INTERNATIONALES SUR LE CLIMAT ET LA NATURE Liberté Égalité Fraternité

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In support of this report



Sébastien Soleille
Sustainable Finance Director
FÉDÉRATION BANCAIRE FRANÇAISE

"For a great many companies, the circular economy is a key way to increase their resilience and competitiveness and reduce their risks and costs, particularly by decreasing their reliance on imported resources. It is therefore a key issue for companies and the banks that finance them. However, more circular business models sometimes require changes in how their profitability is assessed and how they are financed. With this in mind, a collective effort involving companies, their value chains, and banks is very helpful in facilitating the financing of more circular practices."



Baptiste Perrissin-Fabert
Deputy Director General
RÉPUBLIQUE FRANÇAISE
ADEME

"The circular economy has proven its worth: the question now is how to scale it up, and financing is one of the key drivers. Public policy can kickstart and mitigate risks, but it is the partnership between public and private financing that will enable us to build the supply chains our industrial sovereignty requires. By bringing together banks, manufacturers, and public sector actors, the Circular Finance Coalition is fostering this shared culture: ADEME is proud to support this work and to be actively involved alongside its members."



Jules Coignard
Co-founder
Circul'R

"We launched this coalition with one conviction: the circular economy will only scale up if it secures funding. Two years later, the support we've received from five major French banking groups and EDF confirms that this is a strategic issue. Batteries, waste heat, titanium, copper: the projects exist, and some are already funded. For these successes to become the norm, we must now solidify the business models, establish a common framework for assessing risks, and develop tailored financing tools. Thank you to our members and partners for their trust and their strong commitment."

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Executive summary

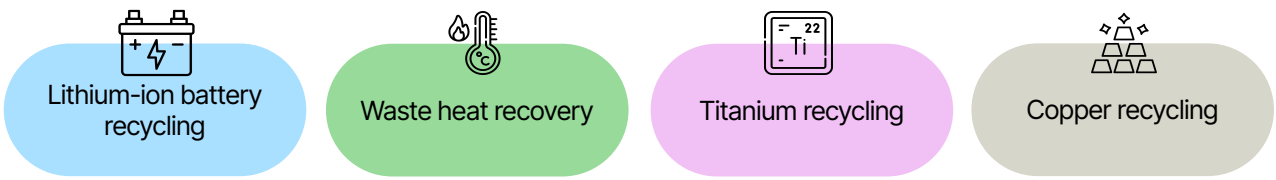
Amid growing pressure on resources, financing the circular economy is becoming a strategic issue for industrial and energy resilience.
The proliferation of geopolitical, economic and environmental crises highlights the vulnerability of supply chains to resource pressures, whether for metals, energy or water. These dependencies expose companies to risks of supply disruption, price volatility and loss of competitiveness, risks which also concern their financiers.

The circular economy is a major lever for addressing these challenges, by reducing dependence on virgin resources, making use of the materials and energy available locally and securing industrial value chains. Its large-scale deployment, however, requires significant investment in new industrial capacity and infrastructure, as well as the mobilisation of appropriate financing solutions.

Despite growing investment, circular economy financing remains far below what is needed. According to the *Circularity Gap Report Finance* (2025), only **2% of commercial investments recorded worldwide between 2018 and 2023** were directed towards companies engaged in the circular economy.[1]
A study by the European Investment Bank and the European Commission (2026) estimates annual investment in the circular economy within the EU at **€120bn**, 93% of which is private. It nevertheless identifies **an additional need of €82bn per year between 2025 and 2040** to meet current European ambitions.[2]
In this context, and as the European Union steps up its sovereignty and reindustrialisation ambitions, notably through the *Critical Raw Materials Act*, the proposed *Industrial Accelerator Act* and the forthcoming *Circular Economy Act*, **accelerating financing is a central issue in supporting the scale-up of circular sectors**.

Four strategic sectors at the heart of the Circular Finance Coalition's work

The second year of the **Circular Finance Coalition**, led by Circul'R, bringing together as members **BNP Paribas, Groupe BPCE, Groupe Crédit Agricole, Crédit Mutuel Alliance Fédérale, La Banque Postale and EDF**, and **supported by ADEME and the French Ministry for Ecological Transition,** made it possible to explore in depth the financing opportunities and challenges of four sectors:



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Notes: 1. Circle Economy, Circularity Gap Report Finance, Circle Economy, 2025; 2. Transitioning to a Circular Economy: Closing the Investment Gap in Europe, EIB and European Commission, 2026

By bringing together industrial companies, project developers, financial institutions, experts and public stakeholders, the work pursued a twofold objective: **to strengthen financial players' understanding of these sectors**, particularly their business models, investment needs and risks, and **to identify the levers likely to facilitate the financing and scale-up of projects**.

Four key lessons for accelerating the financing of these sectors

1. Public and private financing is already supporting the development of circular projects.

The projects studied illustrate the diversity and complementarity of the financial instruments mobilised: equity, industrial loans, structured finance and grants. The R-PAS heating network (over €40M) and EcoTitanium (€48M) reflect this momentum, bringing together, depending on the project, banks, private investors, industrial companies and public stakeholders. These achievements show that financing solutions exist and can be mobilised to support the development of these sectors.

2. Scaling up requires significant investment in strategic industrial links and infrastructure.

Needs are concentrated in particular on lithium-ion battery refining, heat transport infrastructure and metal preparation, recycling and refining capacity - notably to limit the export of secondary materials due to a lack of sufficient local recycling capacity. For example, a secondary smelter contributing to copper recycling represents an estimated investment of €3-5bn per unit, for a capacity of around 400 kt/year. Developing this capacity is a financing opportunity for financial players, while contributing to the local recovery of resources and to European industrial and energy sovereignty.

3. Project bankability depends heavily on securing business models and managing industrial risks.

Despite sector-specific features, the four sectors share several challenges: high upfront investment, price volatility and sometimes limited visibility on supply and markets, against a backdrop of intense international competition for access to secondary raw materials. For financiers, securing material or energy flows, long-term contractual commitments and revenue predictability are decisive in assessing risk and facilitating the mobilisation of capital.

4. Accelerating financing requires stronger cooperation between financial, industrial and public stakeholders.

Scaling up depends on economic, industrial and regulatory conditions that go beyond the remit of financiers alone. Financial players nevertheless have an active role to play, by supporting project structuring and working with other stakeholders to develop appropriate financial solutions, notably public-private co-financing, guarantee and risk-sharing mechanisms.

Collectively accelerating circular economy financing

Scaling up the circular economy requires both **strengthening the economic viability of projects** and **mobilising appropriate financing solutions.** Financial players have an active role to play, in cooperation with industrial companies and public authorities, in creating the conditions for new investment. This report aims to share the lessons learned by the Circular Finance Coalition and to **support this collective mobilisation in favour of financing circular sectors**.

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Acknowledgements

The Circular Finance Coalition would like to thank all contributors for the quality of their expertise in producing this report.

We would particularly like to thank the **members of the Circular Finance Coalition**: BNP Paribas, Groupe BPCE, Groupe Crédit Agricole, Crédit Mutuel Alliance Fédérale, La Banque Postale and EDF for their participation, as well as **ADEME and the French Ministry for Ecological Transition** for their support and participation throughout the coalition.

We would also like to thank those who shared **their valuable expertise**: **the Institut Mobilités en Transition (IMT-IDDRI)** for lithium-ion battery recycling, **ADEME** for waste heat, **OFREMI** for titanium recycling and **CEA** for copper recycling.

We also wish to thank the organisations that took part in our workshops: Aerometal, A.J.S.R., Alstom, Aubert & Duval, Banque des Territoires, Batribox, Battri, Bpifrance, Dalkia, Dassault Aviation, Direction Générale des Entreprises (DGE), Ferinox, Forécreu, Forum pour l'Investissement Responsable (FIR), France Titane, GAIA (a The Future is Neutral entity), Legrand, Mecaware, MTB Recycling, Prysmian, R-CUA, Safran, SOVAMEP, Thales, Veolia, Verkor and Vinci.

Thanks to their involvement, **this report aims to be a significant step towards better financial support for circular business models,** thereby facilitating their scale-up.

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Presentation of the coalition

Why “circular” finance?

Since the industrial revolution, the global economy has developed according to a linear model: we extract raw materials, turn them into products that we use and then, finally, throw away.

Yet this model is increasingly exposed to major risks, including:

- **pressure** on ecosystems and natural resources, **particularly critical materials**
- **economic fragility of supply chains** (geopolitical uncertainty, volatile raw material costs)

To anticipate these risks and respond to regulatory changes - such as the Critical Raw Materials Act (CRMA) and the Packaging and Packaging Waste Regulation (PPWR) - new business models and value creation opportunities are emerging. They belong to **the circular economy**: an economy that **limits the use of natural resources and the generation of waste**, while working towards **organisational resilience.**

According to the ISO 59004 standard, the circular economy is defined as an ‘**economic system that uses a systemic approach** to **maintain a circular flow of resources** (stocks and flows), by **recovering**, **retaining** or **adding to** their value’[1].

Today, only 6.9% of the global economy is circular[2]; **the transition is therefore essential** to face future economic and environmental challenges.

This circular transition depends in part on the **ability of financial institutions to grasp its structural challenges and translate them into relevant financing mechanisms.**

Funding the circular economy means **supporting business models that make better use of resources and limit the risks associated with their supply.**

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Notes: 1. For a complete and detailed view of this definition, refer to the ISO 59004 standard; 2. The Circularity Gap Report, Circle Economy, 2025

Some key figures

GHG emissions linked to the extraction and processing of resources accounted for more than **55% of total emissions in 2022[3].**

In France, the government estimates that the ecological transition could affect nearly 8 million jobs and **create a net 200,000 to 550,000 jobs by 2030** in "key sectors" (industry, energy, etc.)[4].

The European Commission identified 34 critical materials in 2023, and selected **in October 2026 46 new strategic projects** (including 5 in France) for local extraction, refining and recycling (in addition to the 47 strategic projects of 2025, with a total capital investment need estimated at €22.5bn) **to secure access to raw materials in the EU[5,6].**

For example, the **total stock of batteries to be recycled** in Europe will almost **triple in less than 10 years**, rising from 53 GWh of residual energy potential in 2026 to around 156 GWh by 2035, driven by the growth of electric vehicles[7].

A coalition to create the conditions for financing the circular economy

The Circular Finance Coalition, led by Circul'R, brings together as members **BNP Paribas, Crédit Mutuel Alliance Fédérale, Groupe BPCE, Groupe Crédit Agricole, La Banque Postale and EDF**, and is **supported by ADEME and the French Ministry for Ecological Transition**. The objective of the coalition, launched in 2024, is to help create favourable conditions for financing the circular economy.

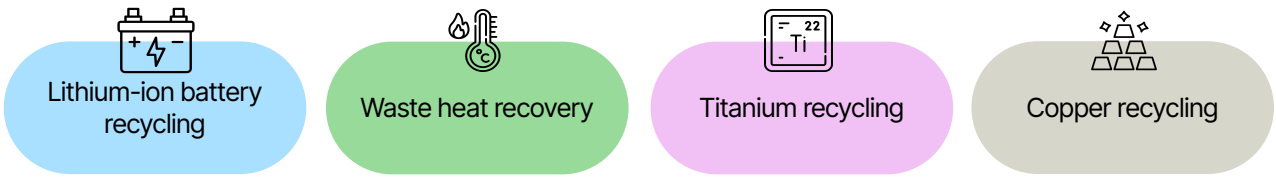
The first year made it possible to diagnose the barriers to developing the circular economy and to identify initial solutions based on concrete use cases. The key lessons can be found in the report Financement de l'économie circulaire : freins et opportunités.

The objective of the **second year** was **to identify and analyse financing opportunities related to Industrial Symbiosis** and **critical materials**, and to connect priority project developers with financiers.

Notes: 1. For a complete and detailed view of this definition, refer to the ISO 59004 standard; 2. The Circularity Gap Report, Circle Economy, 2025; 3. Global Resources Outlook, UNEP, 2024; 4. Planification écologique : 8 millions d'emplois concernés, 2024; 5. La Commission sélectionne 47 projets stratégiques visant à sécuriser et à diversifier l'accès aux matières premières dans l'UE, European Commission, 2025; 6. La Commission sélectionne 46 nouveaux projets stratégiques pour renforcer l'approvisionnement de l'UE en matières premières critiques, European Commission, 2026; 7. Circul'R analysis based on the coalition's work.

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Within this framework, 4 themes were prioritised by the members:



Dedicated workshops **brought together the main players in the ecosystems of the themes studied** (industrial companies, project developers, financiers, technical experts and public institutions) in order to **jointly assess the financing challenges** of each sector:

- project financing needs and their structuring;
- the maturity of projects and their business models;
- the main risks and barriers to scaling up the sector;
- the levers likely to facilitate the financing and deployment of recycling capacity.

Objectives of this report

Following these workshops, a **shared conclusion emerges: accelerating the financing of the themes studied depends on levers that go beyond the remit of the Circular Finance Coalition alone.** Some fall to financial players, but others involve action by public decision-makers, industrial companies, contracting companies, sector stakeholders and organisations engaged in complementary initiatives.

This report aims to summarise the key takeaways from these discussions, and to make them public in order to contribute to the collective discussion.

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1. Financing lithium-ion battery recycling

Overview and financing challenges

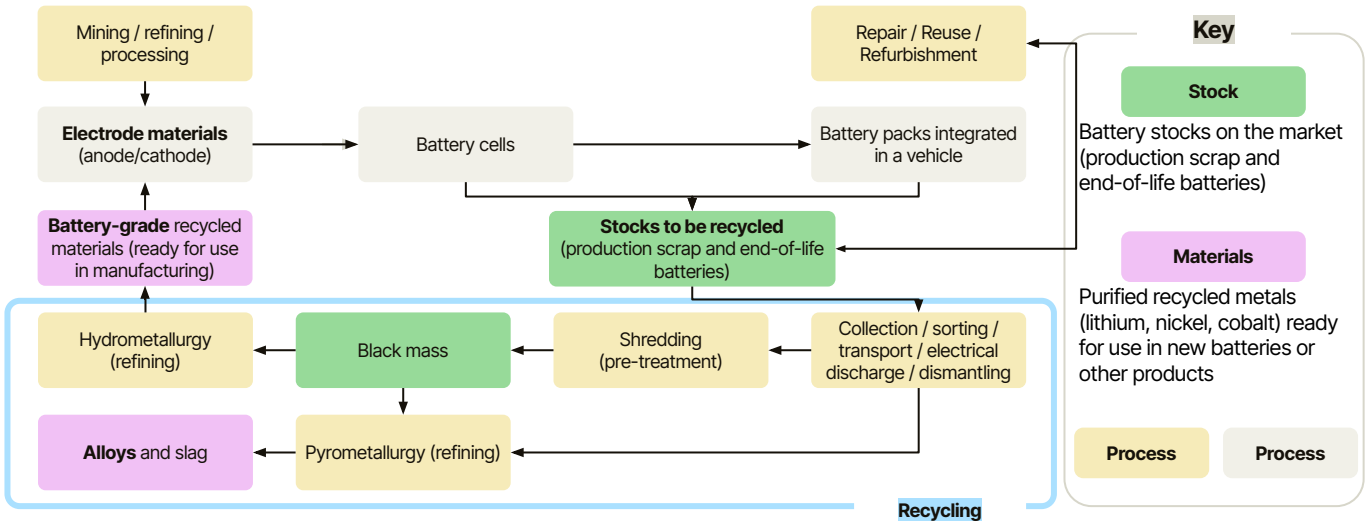
Battery recycling is an environmental issue and a matter of European sovereignty.

Lithium-ion batteries are highly strategic, both for **European industrial sovereignty and for the success of the energy transition**. Rich in **lithium, nickel, cobalt and manganese**, they contain **high concentrations of critical materials** that are technically recyclable. For Europe, which is highly **dependent on imports**, the stakes are high; recycling appears to be a key lever for reducing its critical dependence on strategic metals such as cobalt, lithium, manganese and nickel[1].

Car batteries will account for around 70% of battery volumes by 2050 and **currently account for 30 to 40% of the production cost of an electric vehicle** (EV), as well as 40 to 60% of its manufacturing carbon footprint [2].

30 to 40% The share of **battery costs** in the total **production** cost of an **electric vehicle.**

Battery recycling value chain[2]



Notes: 1. Regulation concerning batteries and waste batteries, European Commission, 2023; 2. Circul'R analysis based on the coalition's work

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Recycling recovers critical materials to produce new batteries.

The industrial recycling process is structured around **three key stages** involving multiple players:

- **Collection and dismantling**: organised by producer responsibility organisations (e.g. Batribox, Ecosystem and Recycler mon véhicule).
- **Pre-treatment (shredding)**: transformation of cells into "black mass", a powder concentrating critical metals (e.g. Battri).
- **Refining (hydrometallurgy)**: purification of metals (nickel, lithium, cobalt) to achieve "battery grade" quality (e.g. Mecaware and Veolia).

The sector relies on two types of input:

- **Production scrap** (scraps): currently the main source, from "Gigafactories" (up to 40-50% scrap during the industrial ramp-up phase).[1]
- **End-of-life batteries**: a fast-growing stock, expected to account for ~70% of volumes by 2050.[1,2]

Recycling relies on **two main business models**: tolling (the manufacturer retains ownership of the material) and buy-and-resell (the recycler buys the waste and sells the purified metals).

However, the **diversity of battery chemistries**: NMC (nickel, manganese, cobalt) and LFP (lithium, iron, phosphate) **splits available volumes across technologies**, slowing the ramp-up and profitability of sites. Furthermore, Asian dominance of the value chain, particularly in the manufacture of cells and pCAM/CAM electrode materials[3], makes it harder to close the recycling loop locally.[1,4]

A European market taking shape, facing strong Asian competition and challenges in scaling up industrial projects.

The European battery recycling market is entering a phase of rapid industrialisation but faces a **paradox**: **pre-treatment overcapacity**, **refining undercapacity**, **massive exports of *black mass*** and **strong competitive pressure from Asian players.**[5,6,7,8] However, the development of refining capacity comes up against **high CAPEX requirements**[9], **long payback horizons** and **uncertainty about the volumes and composition of incoming flows**. One of the main challenges is therefore to **close this refining gap** and secure the industrialisation of the strategic links in the battery value chain in Europe.

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Notes: 1. Circul'R analysis based on the coalition's work; 2.Accompagner la filière auto dans la mise en œuvre de ses objectifs en matière d'économie circulaire, PFA & Strat Anticipation, 2025; 3. pCAM: Precursor Cathode Active Material and CAM: Cathode Active Material; 4. A Circular Battery Plan for Europe, IMT, 2026; 5. Benchmark Minerals Intelligence, 2025; 6. Battery Recycling in China and Korea, Strat Anticipation, 2026; 7. China reduces import tariffs for recycled black mass, Benchmark Minerals Intelligence, 2026; 8. Europe's Black Mass Evasion, IFRI, 2024

A European market undergoing rapid industrialisation…

5.2 times — **more batteries** (by weight) to be recycled (end-of-life, to be replaced or scrap) in Europe by 2035.[1,4]

… supported by the EU Batteries Regulation, with key obligations to limit the resource footprint.

16 % — **EU minimum recycled content target for cobalt** by 2031[2] (6% for lithium, 6% for nickel), with collection and stakeholder accountability supported by EPR.[4,7]

80% — **EU target recovery rate** for lithium from waste batteries by the end of 2031.[2]

but an imbalance in European industrial capacity persists…

8 times — **more shredding** (pre-treatment) **capacity in China** than in Europe, even though Europe is already in overcapacity (78%).[3,4]

57 times — **more refining** (hydrometallurgy) **capacity in China** than in Europe, while China is in overcapacity. [3,4]

80 % — **Share of European black mass exported outside the EU** (lack of competitive local outlets), bought by China at **very low prices**, where electrode and battery manufacturing capacity is located.[3,4,5]

… and the industrial scale-up of recycling projects involves very high investment needs.[6]

€20-50M — Cost of a **pre-treatment plant.**[4]

€200-500M — Cost of a **hydrometallurgy plant.**[4]

€500M — Cost of a **CAM/p-CAM plant** (electrode materials).[4]

Examples of financed projects

Public and private financing is already supporting the first European industrial lithium-ion battery recycling projects. The examples below illustrate the complementarity between **public de-risking mechanisms** supporting the sector and **private financing** (structured debt, growth capital, industrial loans, etc.). This momentum nevertheless needs to be amplified to enable **the scale-up of the sector.**

Notes: 1. Accompagner la filière auto dans la mise en œuvre de ses objectifs en matière d'économie circulaire, PFA & Strat Anticipation, 2025; 2. Regulation concerning batteries and waste batteries, European Commission, 2023; 3. A Circular Battery Plan for Europe, IMT, 2026; 4. Circul'R analysis based on the coalition's work; 5. Battery Recycling in China and Korea, Strat Anticipation, 2026; 6. Europe's Black Mass Evasion, IFRI, 2024; 7. Batteries, French Ministry for Ecological Transition, 2017

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Examples of financed projects

Project	Description
European Commission[1]	• Of the 46 new European strategic projects selected in October 2026, **7 are linked to lithium-ion battery recycling**, covering battery recycling, the refining of secondary materials and their reintegration into the production of battery materials: ○ France: Neomat-PCAM, Emme ○ Germany: Cylib, Pure Battery Technologies pCAM, AMG Lithium ○ Netherlands: Back to Battery ○ Romania: Eco Life Style
Cylib[2]	• **Announced** extension of its **hydrometallurgy plant** (recycling of NMC and LFP batteries) in Dormagen, which will raise the plant's processing capacity to **60,000 tonnes per year** (140,000 electric vehicle batteries). • **Secured** more than **€140M** since its **creation** in 2022: **€55M Series A** equity round (World Fund, Porsche Ventures, Bosch Ventures, etc.), **federal grant** of €63.4M and **European funding** of €26.1M (ERDF/JTF programme).
Umicore[4,5]	• A €350 million loan from the EIB (2024, over 8 years) to partially finance its European R&D on battery materials and the recycling of electric vehicle batteries at its research centres in Belgium, Finland, Poland, and Germany. • The Hoboken (Belgium) facility with a capacity of 7 kt/year uses a "pyro-hydro" process.
Battri[3]	• Opening of its **first lithium-ion battery dismantling and shredding plant** in the heart of the **"Battery Valley"** (Hauts-de-France), for a **total investment of €20M** and "profitability from the first year"[6]. • **Processing capacity**: **15,000 tonnes per year**, with a planned ramp-up to 35,000 tonnes.
Emme[7]	• Establishment of an **industrial and technical site** in Nouvelle-Aquitaine dedicated to **refining nickel** and **cobalt**, as well as **recycling used batteries**. • With operations scheduled to start in 2028, the site requires a **total investment of €500M**, with initial investments already secured (French State "strategic project guarantee", Naco regional fund, international and French banking pool), and a **financing round** expected to close at the end of 2026.

Lithium-ion battery recycling in Europe has its first concrete footholds for development. Despite persistent industrial, economic and regulatory barriers, several projects have already mobilised public and private financing. This encouraging momentum must now translate into scale-up, particularly of refining capacity.

Several levers could support this ramp-up: securing local supply and offtake through long-term industrial partnerships, as well as discussions **on price stabilisation mechanisms** and on a framework promoting the recovery of black mass in Europe.

Notes: 1. European Commission, 2026; 2. Cylib website, 2026; 3. Battri website, 2026; 4. Umicore website; 5. Umicore website; 6. BATTRI : La revanche industrielle française par le recyclage des batteries. Bpifrance Le Hub, 2024; 7. Emme website, 2026.

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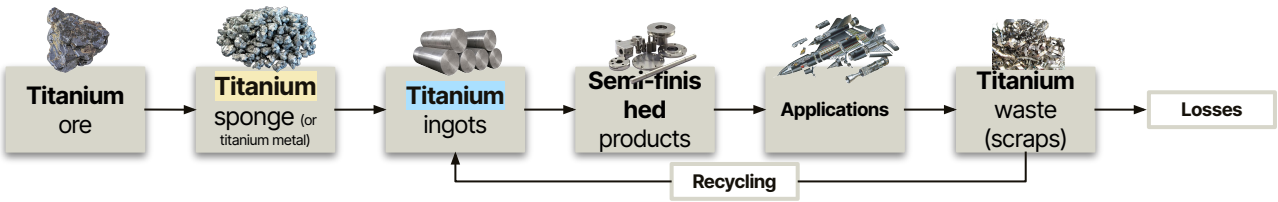
2. Financing titanium recycling

Overview and financing challenges

Titanium is a critical and strategic resource, with a European competitiveness gap to be addressed.

Unlike titanium ore, which is abundantly available, **titanium sponge is a critical and strategic resource** for the European aerospace, defence and nuclear sectors, with annual global consumption of ~130 kt[2,3] in 2023. This low-volume niche market is **highly critical and strategic** for **Europe,** as it has no titanium sponge production capacity, making it **dependent on imports**. This dependence is all the more pronounced as the global market is dominated by a limited number of suppliers. In light of this bottleneck, recycling "new scraps" (machining losses) appears to be a **lever of resilience for European sovereignty.**

The titanium value chain faces a structural bottleneck in the **production of sponge** and **ingots**, a **challenge** that **can be partly addressed through recycling.**



Titanium sponge production relies on the "Kroll" process, a complex, **CAPEX-intensive** (€1bn per industrial unit) and **energy-intensive technology**[1]. **Only 5 countries in the world master this production** on an industrial scale (more than 15 kt/year): China, Japan, Russia, Kazakhstan and Saudi Arabia[2,3]. Given this colossal level of investment, it is difficult to establish a titanium sponge production unit in Europe, reinforcing its dependence on producing countries for its supply.

Notes: 1. Circul'R analysis based on the coalition's work; 2. Titanium metal in the EU: Strategic relevance and circularity potential, Joint Research Centre (European Commission), 2025; 3. Fiche substance Titane, BRGM, 2024

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Titanium offcuts ("new scraps") are **generated during the final machining of parts**. With a **"Buy-to-Fly" ratio that can reach 80/20** in aerospace, **producing a 20 kg finished part requires 100 kg of titanium ingot** and thus generates up to **80 kg of chips** ("scraps")[1,2]. Currently, **most of these European** and British scraps **are exported to the United States** (14,500 t in 2025) due to a lack of local processing capacity[1].

Titanium ingot production is achieved by **melting a mix of primary titanium sponge** and **titanium** offcuts ("scraps") in furnaces. French ingot production capacity amounts to around 5 kt of ingots/year in 2025[1].

Titanium recycling offers **three main benefits**:

1. **Economic benefit**: there is a **large material resource** (machining scraps) due to the 80/20 buy-to-fly ratio and the **presence of major European industrial players** (e.g. Safran, Airbus, Dassault)[2]. In addition, recycling creates and **captures local value** for recyclers and ingot producers. Finally, closing the loop locally **reduces exposure** to **dollar** fluctuations, as the scrap market is priced in USD.
2. **Strategic and sovereignty benefit**: closing the recycling loop locally makes it possible to retain the chips generated in France and **to secure supply** for critical sectors by reducing our dependence on titanium sponge imports.
3. **Environmental benefit**: **recycling uses 3 to 8 times less energy** than the Kroll process[2,3] and **Europe has a more decarbonised energy mix** than ingot-producing countries[4].

A structural need for recycling finance to reduce Europe's dependence.

The financing needs for accelerating European recycling are **concentrated on two main players: recyclers and titanium ingot producers**.

- **For recyclers**, the main financing need lies in **local scrap degreasing and cleaning capacity**. This processing is carried out in particular in plants that recover, sort and degrease chips contaminated with cutting oils. Much of this stage is currently subcontracted to the United States.
- **For ingot producers**, the main financing need lies in **new melting furnaces** (PAM - Plasma Arc Melting or VAR - Vacuum Arc Remelting). These activities are carried out by metallurgists such as Aubert & Duval (with EcoTitanium and Timet), which melt the cleaned scrap with virgin titanium sponge to produce ingots.

Notes: 1. Circul'R analysis based on the coalition's work; 2. Titanium metal in the EU: Strategic relevance and circularity potential, Joint Research Centre (European Commission), 2025; 3. Bilan énergétique de la fabrication du titane : état des lieux et perspectives pour une réduction de l'empreinte carbone – Journée technologique titane, France Titane and Dumas, O, & Sadin, V., 2025; 4. Energy Systems of Asia Pacific, International Energy Agency (IEA), 2023

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Financing titanium recycling faces structural challenges.

1. **Standardisation requirements:** integrating recycled material into titanium ingot production requires absolute traceability and complex cleaning processes (de-oiling, removal of impurities). Without rigorous control of these stages, recyclers struggle to reassure financiers about the value and cleanliness of the material.
2. **The contractual barrier to accessing the resource**: the recycling business model rests on a fragile balance; it depends on a long-term supply of scraps and on securing offtake for the ingots produced. Although Europe and the United Kingdom generate around 20,000 tonnes of scraps per year[1], access to this resource is hindered by existing export contracts to the United States, thereby limiting the availability of the resource for the local sector in the short term.
3. **Competitiveness of recycling against low-cost virgin resources**: the accumulation of costs (scrap purchase, sorting, cleaning and degreasing, processing) undermines its competitiveness against low-cost imported virgin titanium sponge. This situation is exacerbated by the exclusion of titanium metal from the scope of the CBAM (Carbon Border Adjustment Mechanism).

Examples of financed projects

Several European titanium recycling projects have already mobilised public and private financing, combining, depending on the case, equity, loans and grants. The examples below illustrate this diversity of financing structures, as well as the recognition of strategic projects under the CRMA, without any guarantee of financing. These first achievements contribute to the development of local industrial capacity, which still needs to be strengthened to structure the European sector.

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Notes: 1. Circul'R analysis based on the coalition's work

Examples of financed projects

Project	Description
European Commission	• Of the **46 new European strategic projects selected in October 2026**[1]**, 3 concern titanium metal recycling**: LUERN – Aubert & Duval (France), CRM4Defence – Leonardo (Italy, France, Poland and United Kingdom) and Titanium Alloys Made in Europe – Isabellenhütte (Germany).
EcoTitanium	• **€48M investment** supported by three types of financing: shareholders, a European loan and public grants. • The European Investment Bank provided a **€30M loan** via the European Fund for Strategic Investments (EFSI)[2].
IMET Alloys	• On taking over the plant in 2022, IMET Alloys announced an **investment of €15M,** in several phases: €10M to install processing lines for titanium and superalloys, and a second phase of €5M dedicated to increasing titanium processing capacity (including the creation of 20 to 30 additional jobs)[3]. • Investment financially supported by the **Fonds d'accélération des investissements industriels (Industrial Investment Acceleration Fund)** (France Relance)[4].
Aerometal	• Inaugurating in 2026 its **new plant north of Chalon-sur-Saône**, for which it is receiving a **loan from Bpifrance** to finance part of the €10M investment[5].

The development of titanium recycling in Europe still faces several structural obstacles, notably the export of a large share of machining offcuts outside Europe and the competitiveness of recycling against imported virgin material. Recovering this resource locally requires investment in pre-treatment and melting capacity, as well as control of quality and traceability requirements.

Securing long-term supply and offtake is an essential lever for strengthening the economic viability of projects and facilitating their financing. In addition, discussions on investment support mechanisms and on a regulatory framework promoting the recovery of scraps in Europe could contribute to scaling up the sector.

Notes: 1. CRMA Strategic Projects 2026, European Commission, 2026; 2. France : FEIS - la BEI finance la première usine de titane aéronautique par recyclage en Europe, EIB, 2017; 3. IMET Alloys détaille ses plans pour la reprise de l'usine Borgwarner à Eyrein, Le Journal des Entreprises, 2022; 4. 11 nouveaux lauréats du Fonds d'accélération des investissements industriels dans les territoires en Nouvelle-Aquitaine, Prefect of the Nouvelle-Aquitaine region, 2022; 5. Ambitions stratégiques 2026 - 2030, Bpifrance, 2026

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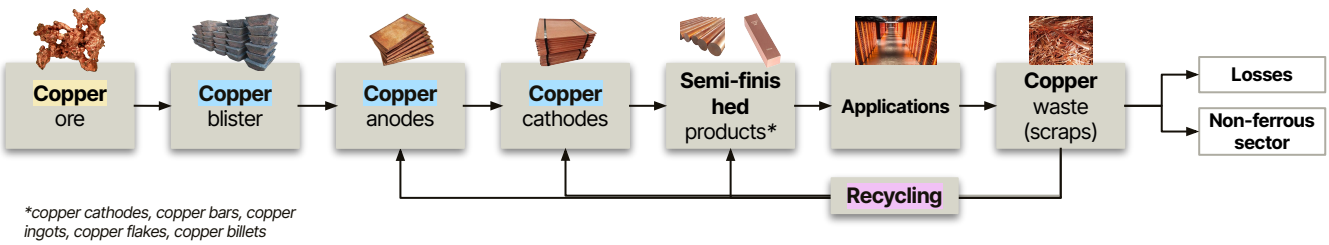
3. Financing copper recycling

Overview and financing challenges

Copper is a strategic resource, with European industrial dependence.

Unlike copper ore, which is available in large quantities underground, **the actual availability of mining concentrates faces major structural** pressures, while copper is an **underlying strategic resource** for the energy and digital transitions. With global consumption of **~28 million tonnes**[1] of copper cathode in 2025, expected to **grow by nearly 11 million tonnes by 2035**, this market faces a **major risk of shortage**, with an average deficit estimated at 6 million tonnes by 2035[2]. Lacking sufficient refining capacity to meet its needs, Europe suffers from **critical dependence on imports**, particularly from China. In this context, the **capture** and **recycling** of **secondary resources** (scraps) are among the **priority levers** for **autonomy** and **resilience** for Europe.

The copper value chain faces a double structural bottleneck in ore extraction and refining, challenges that **can be partly addressed through recycling**.



copper cathodes, copper bars, copper ingots, copper flakes, copper billets

Copper mining is characterised by **abundant geological reserves** (5,000 Mt identified compared with 700 Mt consumed since the industrial era[3]), but faces a **continuous decline in ore grades** (200 tonnes of rock to obtain 1 tonne of copper), with **extremely long lead times** for opening **mines** (17 years on average). To meet rising demand, mining companies would need to commit **$150bn of investment by 2032, investment that is currently not guaranteed**[2].

Copper refining relies on a two-stage process (smelting **blisters** into **anodes** and then refining into **cathodes** purified to 99.99%). This **key stage is dominated by China**, which controls **55% of global production** of refined copper (2022) and is home to **13 of the 20 largest refineries** in the world[4]. Given this high concentration of refining capacity, Europe finds itself in a situation of **major structural dependence** for its **supply** of purified copper.

Notes : 1. ICSG Copper Bulletin, ICSG, 2026 ; 2. Avec une fourchette entre 1 et 13 millions de tonnes selon les scénarios, Situation du cuivre en 2035 : Quel positionnement de l'OFREMI ?, OFREMI, 2024 ; 3. Raw Materials Profiles - Copper, Commission européenne, 2026; 4. Rapport CyclOpe, CyclOpe, 2023

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Recycling new scraps (manufacturing scrap) **and old scraps** (end-of-life products) limits **dependence** on **virgin material**, either through **direct melting** to make **semi-finished products**, through **electrolytic refining** (an electrochemical process that isolates impurities and precious metals to obtain 99.99% pure metal) to turn scraps into **cathodes**, or through **mechanical recycling** to obtain **granules** that can be **processed directly**. Although **Europe** has a **high incorporation rate** (50% of processed copper comes from recycling, i.e. 1.7 Mt/year[1], compared with 32% globally), its sovereignty remains threatened by **massive resource leakage**. With **significant overcapacity**, foreign smelters **aggressively outbid** others for **European scraps**, leading to the **export** outside the EU of more than **600,000 tonnes[1] of copper waste** every year.

Copper recycling offers **three main benefits**:

1. **Strategic and sovereignty benefit**: reincorporating secondary material locally helps curb resource leakage and **directly supply critical European and French industries**, **reducing dependence** on **Chinese primary refining**.
2. **Environmental benefit**: copper recycling requires **up to 85% less energy[2]** than primary extraction and processing, while preserving the water needed for the mining process.
3. **Economic benefit**: the **significant and recurring domestic source of copper** derived from industrial waste and demolition debris offers **potential for local value creation that remains underutilized.**

A structural need for recycling finance to reduce Europe's dependence.

For the French and European ecosystem to fully **recover** its copper **resource** and **limit leakage** of **scraps** to third-country markets, financing needs (CAPEX and working capital) are concentrated on **two main industrial links**:

- **Preparers-recyclers**: plants that collect, strip, shred, sort and characterise cables and machining offcuts to produce high-purity granules or scraps. They face **stagnating new manufacturing offcuts** and **a shift** in the **resource** towards more dispersed post-consumer **products**. Financing should primarily **target technological innovation** (optical sorting, R&D on recovering fine powders from WEEE circuit boards) in order to properly **characterise** the different types of copper **waste** and **direct** them to the right **recovery pathway.**

- **Refiners and reincorporators**: **refining sites**, which are **highly capital-intensive** - hybrid / secondary smelters, electrolytic refining units (~€3-5bn per unit, for a capacity of ~400 kt/year[3]), or plants developing electrolytic hydrometallurgical processes, such as COMET in Belgium[4] - determine the **capacity** of the continent to **turn secondary material** into wire rod, billets or certified 99.99% cathodes. Another challenge in France is to support **reincorporators** capable of directly integrating high-purity shot (99.5%) into their processes. This short route bypasses the investment wall of refining to produce semi-finished products at lower cost.

Notes: 1. Circularity and Recycling in the EU, International Copper Association, 2026; 2. The World Copper Factbook 2025, International Copper Study Group, 2025; 3. Circul'R analysis based on the coalition's work; 4. Mieux Exploiter Nos Déchets Stratégiques, Oliver Wyman, 2024.

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Overview and financing challenges

Financing copper recycling faces major structural challenges.

1. **Massive resource leakage and foreign overcapacity**: **France** is in a situation of **paradoxical dependence**, with high copper needs but massive exports of its resource (76%, i.e. 206 kt/year[1]). Although the **majority of exports are intra-European** (82%), the absence of refining capacity in France poses a **national sovereignty risk**. Moreover, Chinese overcapacity **threatens to dry up the supply of European recyclers** through potentially aggressive financial outbidding on scrap to feed their smelters.
2. **Limited visibility regarding deposits and qualification requirements for recycled copper**: classified as "non-ferrous metals" in **customs nomenclatures**, the actual French resource (~600 kt/year[2] including imported finished products) is underestimated by official data (272 kt/year[2]), which hampers the **strategic sizing** of **national industrial** capacity. In addition to this opacity, there is a **regulatory and cultural barrier**: **industrial standards** require the use of **"primary copper"** in **specifications**, whereas **secondary copper** has **identical physical characteristics once refined** - its effective integration requires prior **industrial testing** phases to convince **specifiers**.
3. **Lack of visibility on downstream demand**: consuming sectors (automotive, construction, data centres) do not systematically enter into long-term purchase agreements for their copper supply. Without **long-term supply contracts** (offtake agreements) guaranteed by major **contracting companies**, project developers cannot **secure** their **cash-flow** forecasts or meet the **bankability conditions** required for private financing.
4. **Capital intensity**: setting up electrolytic refining infrastructure requires **very substantial capital** (~ €3-5bn per site[2]) and **high working capital requirements**. The accumulation of costs in the local value chain penalises recycled material against international pricing that is disconnected from environmental footprint and available supply.

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Notes: 1. Bilan national du recyclage 2012-2021, ADEME, 2024; 2. Circul'R analysis based on the coalition's work.

Examples of financed projects

The **consolidation** of **copper production capacity** relies on an **essential** complementarity between **European public financing** and **private capital**. At EU level, the European Investment Bank (EIB) plays a structuring role by financing the **processing** and **recycling** capacity needed to **strengthen** the **critical raw materials supply chain** and achieve the objectives of the **REPowerEU**[1] plan.

Private financial players are also at the heart of this deployment, mobilising a **variety of investment tools** - syndicated loans, innovation funds and fundraising - to support the **R&D** of industrial companies, **de-risk projects** and **accelerate** the **scale-up** of the sector.

Project	Description
Aurubis[2]	• EIB loan of **€200M to Aurubis** to strengthen its **copper recycling** and **production activities.** • Support for two of the group's investment programmes: expansion of its Bulgarian site to **increase** its **production** of **refined copper**, and **an increase** in **capacity** for **processing recycled materials** in Germany.
Nexans[3]	• EIB financing of **€250M to Nexans** to support **R&D** and **industrial investment.** • Covering part of Nexans' **€90M investment** in a **new melting furnace** in Lens, developing a capacity of up to **80 kt/year of recycled copper** to produce **wire rod.**
Recupere Metals[4]	• **€5M fundraising** from various investors (January 2026). • Development of **production capacity** based on its R&D, to **turn copper waste** directly into electrical wires, **thus avoiding** the costly stages of **smelting** and **refining.**

The growing demand for copper in Europe represents a major opportunity to expand local recycling. Since a significant portion of copper scrap is currently exported, strengthening Europe's processing and refining capacities would make it possible to **better utilize these resources within the region and capture their added value.** Financing for this new, particularly capital-intensive infrastructure depends largely on **securing a steady supply of secondary raw materials and having clarity on long-term market opportunities.**

Several factors can help structure the sector and facilitate its financing: better knowledge of available sources, the evolution of industrial standards to promote the incorporation of recycled copper, and the development of long-term commercial commitments. At the same time, exploring **co-investment mechanisms among industrial players could help strengthen Europe's recycling and refining capacities.**

Notes: 1. REPowerEU, European Commission, 2026; 2. Rapport sur l'impact de la BEI dans le monde en 2025-2026, European Investment Bank, 2026; 3. EIB website; 4. Recupere Metals website, 2026

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4. Financing waste heat recovery

Overview and financing challenges

Industrial waste heat recovery is a critical lever for decarbonisation, with a large but under-exploited French resource.

Waste heat - residual heat from an industrial process that is not recovered and is lost in flue gases or steam - represents a **significant and under-exploited energy resource in France**. Waste heat recovery contributes directly to reducing the industrial carbon footprint and to the objectives of the PPE3 (French Multiannual Energy Programme)[1], notably **by supplying district heating networks and reducing their reliance on fossil fuels**[2].

From 3.9 TWh to 21-29 TWh

Energy injected in 2022 vs. **the target set** by the PPE3 for 2035[1]

Waste heat can be divided into **several recovery pathways**: **internal** (reuse of the heat directly at the emitting site), **external** (injection into a district heating network), or **electrical** (production of electricity from heat).

This report focuses on **the external recovery of industrial waste heat into district heating networks** (DHNs), a segment where **major financing challenges are concentrated**[3]. By setting, in the PPE3 published in 2026, **a trajectory of 21 to 29 TWh/year of waste heat delivered to district heating networks by 2035**, compared with 3.9 TWh in 2022[1], the State is sending a strong market signal, which translates into a massive need for infrastructure investment[1]. This objective implies an **investment need** estimated at **€19bn**[3]. The market is relatively mature, but it must change scale to meet these objectives.

The **current French industrial resource** (2026) is estimated at **66 TWh**, mainly concentrated in the **Hauts-de-France**, **Grand Est** and **Auvergne-Rhône-Alpes regions**, in direct proximity to areas of high opportunity (with commercial buildings with needs > 300 MWh)[3,4,6].

66 TWh

French industrial waste heat resource (2026)[7]

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Notes: 1. Programmation Pluriannuelle de l'Energie 2026-2035, French Ministry for the Economy, Finance and Industrial, Energy and Digital Sovereignty, 2026; 2. Enquête annuelle des réseaux de chaleur et de froid, FEDENE, 2023; 3. Circul'R analysis based on the coalition's work; 4. La chaleur fatale, ADEME, 2017; 5. Bilan du Fonds Chaleur 2025 : 1 200 projets d'aide pour sortir des énergies fossiles, ADEME, 2026; 6. EnZero : identification des potentiels de développement des réseaux de chaleur et de froid, CEREMA, 2023; 7. Guide chaleur fatale, ADEME, forthcoming

The potential reduction in ADEME Fonds Chaleur grants makes private capital essential for the deployment of waste heat.

€800M **Fonds Chaleur budget** in 2026

In terms of financing, **industrial waste heat projects are mainly financed by public funds** (Banque des Territoires, ADEME, local authorities, energy savings certificates - CEE).

ADEME operates the **Fonds Chaleur (Heat Fund)**, the main source of financial support in France, with a budget of **€800M for 2026**, and finances on average 30% of a project's CAPEX[1,3]. This represents a public support cost of around **€10/MWh of RE&RE** (Renewable Energy and Recovered Energy) **over a 20-year period**[1].

Although waste heat recovery generally remains **more competitive per MWh than other thermal technologies** such as shallow geothermal or solar thermal, **project profitability** is **highly dependent** on the **temperature of the sources** and the **structure of the networks**. Injecting waste heat into DHNs faces a technical constraint: **highly heterogeneous plant outlet temperatures** (<40°C to >500°C) often require a heat pump to reach the 90°C required by urban networks, resulting in **additional CAPEX and OPEX costs**[1,2]. Furthermore, connecting a heat source to a network is only viable if the heat density is sufficient. ADEME sets a grant eligibility threshold of 1.5 MWh per linear metre, but operators' experience shows that **below 2.5 MWh per linear metre, a network is not profitable**[1].

With the potential decline in ADEME Fonds Chaleur support, the **financing of this infrastructure** now relies more heavily **on private capital**.

The deployment of industrial waste heat recovery faces several funding challenges.

The large-scale deployment of waste heat faces not only technological barriers, but also an important financial challenge: its **structural bankability**, built around **four main issues**:

1. **CAPEX / OPEX asymmetry and timing of financing**: heat transport infrastructure (pipes, civil engineering) requires **high CAPEX** for low OPEX. **Payback periods are structurally long** (often more than 15 to 20 years), beyond the maturities of conventional corporate financing. Longer-term infrastructure financing exists, notably from Banque des Territoires (up to 40 years), but requires a controlled risk profile.
2. **Limited coverage of industrial default risks**: there is a significant **lack of standardised industrial precedents** and **consolidated statistical data** on the failure rates of waste heat sources. **Specific guarantee and risk-sharing mechanisms are under study**, while ADEME repayable advances can already be mobilised for some projects.

Notes: 1. Circul'R analysis based on the coalition's work; 2. La chaleur fatale, ADEME, 2017; 3. Bilan du Fonds Chaleur 2025 : 1 200 projets d'aide pour sortir des énergies fossiles, ADEME, 2026

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3. **High variability of the upstream resource**: the **amount of waste heat available** is structurally **dependent on the vagaries of the** emitting industrial activity (production fluctuations, slowdowns, closure). The continuity of the resource is never guaranteed over the term of the bank financing. Commercial banks are therefore cautious in the absence of clear visibility on the recurrence of cash flows, which are essential to secure debt repayment.

4. **Single offtake risk due to the single-partner model**: unlike urban networks interconnected with thousands of subscribers, **industrial projects** rely **on an asymmetric "single-supplier" and/or "single-customer" model.** The risk of dependence on a single player is very high. If this industrial company closes or relocates its operations, the entire network becomes obsolete, with no possible diversification or reuse of the pipes.

The market is technically mature, but **requires a structural shift**. Unlike conventional infrastructure, **the energy source** (industry) **and the consumer** of the heat **may fluctuate** in their supply and demand. **Banks identify an important risk:** an industrial **closure or slowdown** could make the infrastructure obsolete before it is depreciated. To limit this risk and protect investors, **public guarantee mechanisms are being considered**, such as a national fund that could cover a portion of financial losses in the event of default by an industrial heat supplier. This development could be accompanied by the **creation of distributed and interconnected networks**, allowing risks to be shared rather than relying on a single industrial site. **The combination of these solutions with appropriate public and private financing would facilitate the sector's scaling up.**

Examples of financed projects

Waste heat recovery projects mobilise **a variety of financing structures**, combining, depending on the case, **public grants**, **European funding**, **private investment** and **local authority participation**. The examples below illustrate this diversity and show that financing solutions exist but require structures adapted to the industrial and territorial specificities of each project.

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Examples of financed projects

Project	Description
KARNO	€2.97M was released by the EIB through InvestEU funds to support KARNO in developing heating networks from decarbonised sources (including waste heat) in Belgium and Luxembourg[1].
Aurubis	Aurubis received support from the European Regional Development Fund (ERDF) under the EU cohesion policy to connect the waste heat from its copper plant to the district heating network of the city of Hamburg[2].
R-PAS (2021)	• Created in 2021 in Strasbourg to scale up energy recovery while pooling risks and benefiting from load diversity. • **Public-private partnership** 82% owned by energy company R-CUA, 10% by the Port Autonome de Strasbourg and 8% by Banque des Territoires[3]. • Relies on heat from the paper manufacturer Blue Paper; a second interconnection was completed with the industrial company Trédi (Séché Global Solutions group) in early 2024. • Investment: over €40M, including €6M from ADEME's Fonds Chaleur, €10M provided by the R-PAS company, and €3M from the paper manufacturer Blue Paper[4,5].
ArcelorMittal in Dunkirk	• A long-standing heat source since 1985, supplying 100 MW of waste heat, with several TWh of energy available. • Connected in 2020 to the Dunkirk district heating network, operated by Dalkia[6]. • Connection requiring €14.8M of investment, with financial support from ADEME and the European Regional Development Fund (ERDF)[7], and financing provided by the local authority through a public service delegation (DSP).
ArcelorMittal & Schneider Electric in Saint-Chély-d'Apcher	• Waste heat recovery and utilisation (2017) • **Public and private financing structure**: total investment of €5.6M provided by Kyotherm (an investment company that closed a €45M fundraising in 2022[8]) and by grants from ADEME and the Occitanie Region[9].

The main challenge in financing waste heat lies in securing projects over the long term. The infrastructure requires significant investment, depreciated over some twenty years, while the availability of heat depends on the continuity of industrial activity. This dependence, which is particularly strong when the network relies on a single supplier or customer, is an obstacle to project bankability.

Developing interconnected networks, diversifying sources and offtakers, and contractual and financial risk-sharing mechanisms are levers for strengthening project viability and fostering larger-scale deployment.

Notes: 1. Réseaux de chaleur : le développeur belge KARNO va bénéficier d'une subvention européenne pour développer 82,5 millions d'euros d'investissements décarbonés, EIB, 2026; 2. Germany: industrial waste heat supplies climate-neutral district heating in Hamburg, EC, 2026; 3. R-PAS : récupération de chaleur fatale industrielle pour alimenter le réseau de chaleur local, CLE Port de Strasbourg; 4. R-PAS : au Port de Strasbourg, les entreprises vont améliorer leur bilan carbone et fournir la chaleur aux quartiers voisins, Groupe PAS; 5. Blue Paper, pionnier du réemploi de la chaleur fatale, Strasbourg Eurométropole, 2024; 6. Les hauts fourneaux d'ArcelorMittal chauffent Dunkerque, Dalkia; 7. ArcelorMittal annonce la création d'un nouveau réseau de chaleur à Dunkerque, ArcelorMittal, 2019; 8. Kyotherm lève 45 millions d'euros auprès d'Andera Partners et de ses investisseurs historiques afin d'accélérer son développement, Bpifrance, 2022; 9. Kyotherm réalise le financement d'un projet de chaleur fatale, en partenariat avec ArcelorMittal et Schneider Electric, Kyotherm, 2017

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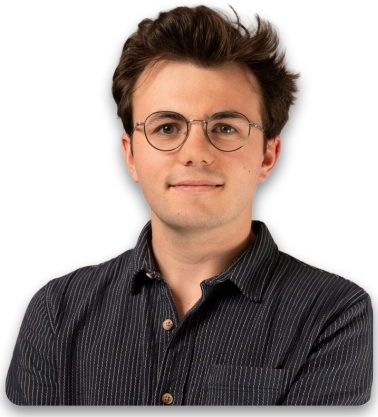
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