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EQUITY RESEARCH

ARVERNE GROUP ACT

INITIATION OF COVERAGE

BUY

TP 9.5€

Up/Downside: 140%

Lithium/Geothermal, the winning combination for the energy transition ?

We initiate coverage with a BUY opinion and a sum-of-the-parts target price of €9.5 per share, suggesting 140% upside in the stock. Investing in Arverne provides exposure to two very promising markets of the energy transition: geothermal energy and lithium, an essential component of batteries. We estimate that in the long term, geothermal lithium will benefit from a supportive environment, notably due to strong demand that should sustain prices and confirm the economic viability of Arverne's project after its significant investment phase.

The ambition to become a major European player in the energy transition

Arverne aims to become a major player in the energy transition by harnessing underground resources. Its expertise in drilling gives it a substantial competitive advantage to develop its activities in geothermal heat production from the subsurface (starting in 2026 through 2gré) and in the extraction, refining, and commercialization of lithium from geothermal brines (starting in 2028 through Lithium de France).

Geothermal lithium poised for sustainable and profitable long-term growth

Geothermal heat production will play a key role in Arverne's development, but we believe its stock performance will be primarily driven by the success of its lithium production. Notably, the pre-feasibility study (PFS) has just been completed, marking major progress towards the industrialization phase. According to our projections, lithium could account for about 80% of its revenue by 2029. With the growing demand for battery-grade lithium in Europe and efforts to reduce dependence on China, geothermal lithium stands out due to its lower environmental impact compared to conventional methods (mining or evaporation ponds). In the short term, pressure on lithium prices from Asian imports could affect investor sentiment. However, profitability for producers becomes unsustainable below certain price thresholds, and we expect strong long-term demand to support a rise in prices, rebalancing the market and reinforcing the viability of players in this sector.

Significant initial investment, but the project's sustainability seems achievable

We believe that Arverne has key assets to succeed in its project by 2031: its expertise in drilling and geosciences, its portfolio of 9 exclusive exploration permits ready for development, partnerships with Norwegian giants Equinor and Hydro, and a five-year supply agreement with Renault for batteries. The initial Capex required to achieve this is certainly substantial, but the project's sustainability seems achievable due to three factors: synergies between geothermal heat and lithium production, expected competitive operating costs, and the technical feasibility and economic viability demonstrated by the pre-feasibility study.

Highly attractive valuation in the event of project success

To reflect the specific risk profile of Arverne's various activities, we value the company using the SOP (sum of the parts) method, applying a WACC of 12.6% for geothermal heat and 15.9% for geothermal lithium.

TP ICAP Midcap Estimates	12/23	12/24e	12/25e	12/26e
Sales (m €)	10.1	12.4	20.8	28.2
Current Op Inc (m €)	-13.8	-19.0	-25.5	-28.5
Current op. Margin (%)	na	na	na	na
EPS (€)	-1.50	-0.46	-0.62	-0.21
DPS (€)	0.00	0.00	0.00	0.00
Yield (%)	0.0	0.0	0.0	0.0
FCF (m €)	-35.6	-63.0	-92.8	-119.9

Valuation Ratio	12/24e	12/25e	12/26e
EV/Sales	6.5	8.3	10.5

Source: TPICAP Midcap

Research partially paid by the Issuer

Key data	
Price (€)	4.0
Industry	Utilities
Ticker	ARVEN-FR
Shares Out (m)	34.787
Market Cap (m €)	137.8

Source: FactSet

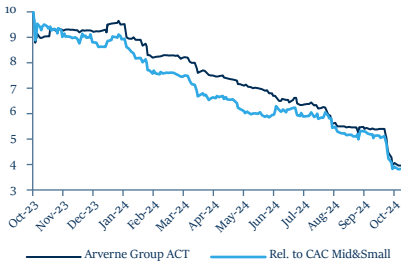
Ownership (%)	
ex-associés d'Arverne+Fondateurs	64.1
ADEME Investissement	9.3
Renault	8.3
Free float	18.4

Source: TPICAP Midcap estimates

EPS (€)	12/24e	12/25e	12/26e
Estimates	-0.46	-0.62	-0.21
Change vs previous estimates (%)	na	na	na

Source: TPICAP Midcap estimates

Performance (%)	1D	1M	YTD
Price Perf	0.0	-26.4	-58.3
Rel CAC Mid&Small	0.3	-26.1	-56.7



Source: FactSet

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Description

① Created in 2018 and listed on Euronext since September 2023 following a reverse merger with the SPAC Transition, Arverne has equipped itself with the means to achieve its ambitions of becoming a major player in the energy transition by capitalizing on the enormous potential of geothermal energy and lithium extraction from geothermal brines.
② Geothermal energy, which allows the capture of heat from the Earth's core, offers the advantage of being a natural, renewable, and decarbonized energy source (with very low CO2 emissions and a minimal land footprint). It is also non-intermittent, local (utilizing resources near where they are needed), and sovereign, contributing to France's energy independence.
③ Drawing on expertise acquired from drilling in the oil industry, the group has developed geothermal well drilling activities. These activities will enable the operation of geothermal plants in France by 2026, and by 2028, they plan to extract geothermal lithium, which will be used primarily in the manufacture of electric vehicle batteries.

What are the upcoming catalysts that could influence the stock's performance?
① Lithium price fluctuations: Direct impact on the profitability and valuation of the project.
② New commercial or technological partnerships.
③ Obtaining new PERs (Exclusive Research Permits): Expanding potential extraction zones, thereby increasing the project's development prospects.
④ Validation of the technical and economic performance of DLE (direct lithium extraction) on a large scale: The success of this phase would demonstrate the operational viability of DLE, enhancing the project's credibility and boosting investor confidence in the long-term economic potential.
⑤ The results of the final feasibility study (DFS) will be a decisive catalyst for Arverne, validating not only the CAPEX but also the project's main financial assumptions. Although the extraction technology is a key factor, it is only part of the overall challenge. Confirmation of these critical elements will bolster investor confidence and should support the stock's valuation.
⑥ Changes in electric vehicle demand projections, one of the main outlets for high-grade battery lithium (strengthening the group's revenue visibility).

SWOT Analysis

Strengths

- ① Strong shareholder base providing financial flexibility for the project. ② Local anchoring and support from local officials and authorities. ③ Well-diversified portfolio of permits.
- Partners providing technical credibility and financial strength.
- Long-term contract with Renault.
- Presence across the entire value chain of geothermal heat and lithium, including drilling.

Weaknesses

- Activities with very high capital intensity.
- Validation of the technical and economic performance of the direct lithium extraction method to be carried out on a large scale under real conditions.

Opportunities

- Potential partnerships with several automobile manufacturers for new projects.
- According to various analyses, the global lithium market could show a deficit of about 1 Mt (~ 25%) by 2030, while global demand is expected to quadruple by 2030 to reach 4 Mt.
- Favorable trends: economic sovereignty, reindustrialization, decarbonization.

Threats

- Increasing volatility of lithium prices with the entry of new capacities into the market.
- The Capex and Opex associated with geothermal lithium production may turn out to be higher than initial forecasts, leading to increased financing needs. The results of the definitive feasibility study (DFS) will determine the final costs.
- Risks of seismic activity and other geomechanical disturbances.
- Delays in executing the 2031 roadmap, postponing the realization of positive FCF.

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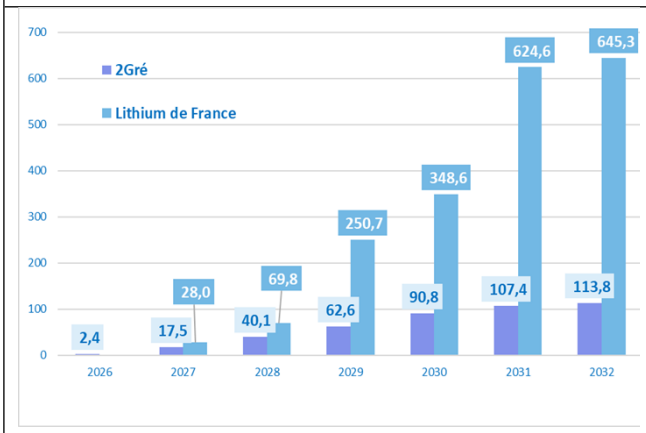
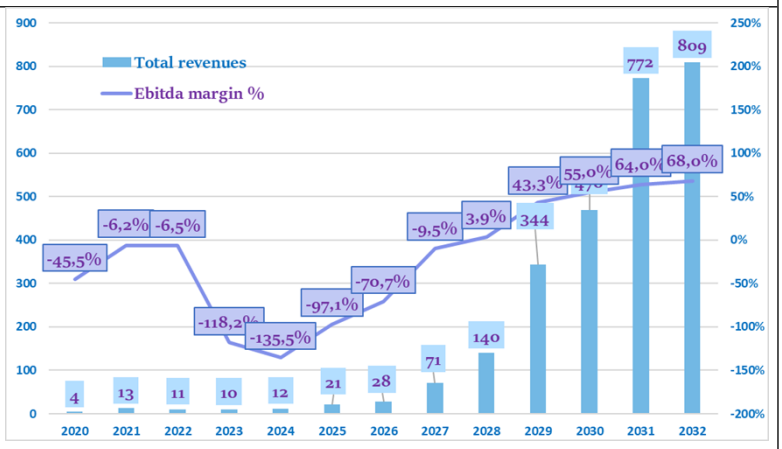
The company in 5 pictures

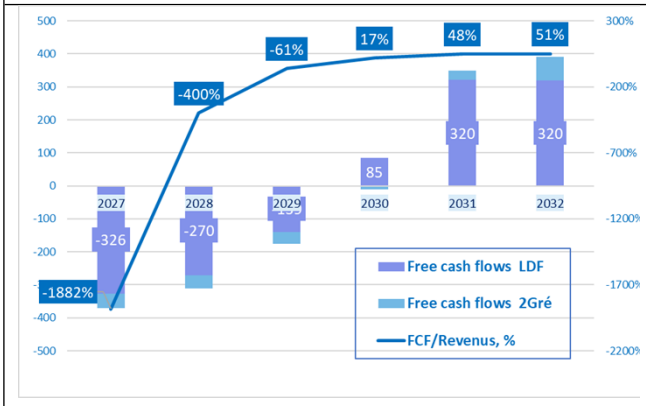
Dual Revenue Stream from the Sale of Heat and Geothermal Lithium



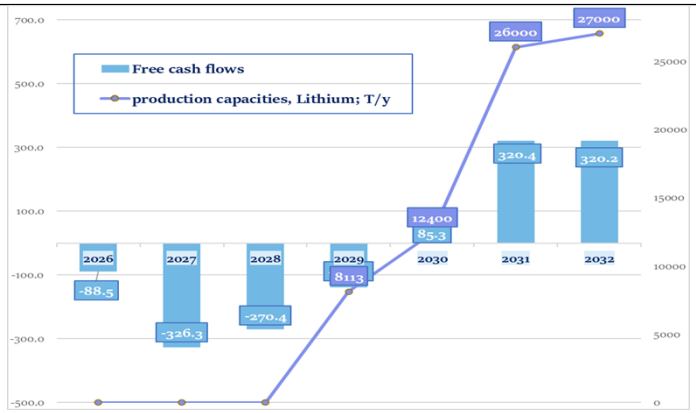
Revenus & Ebitda marge



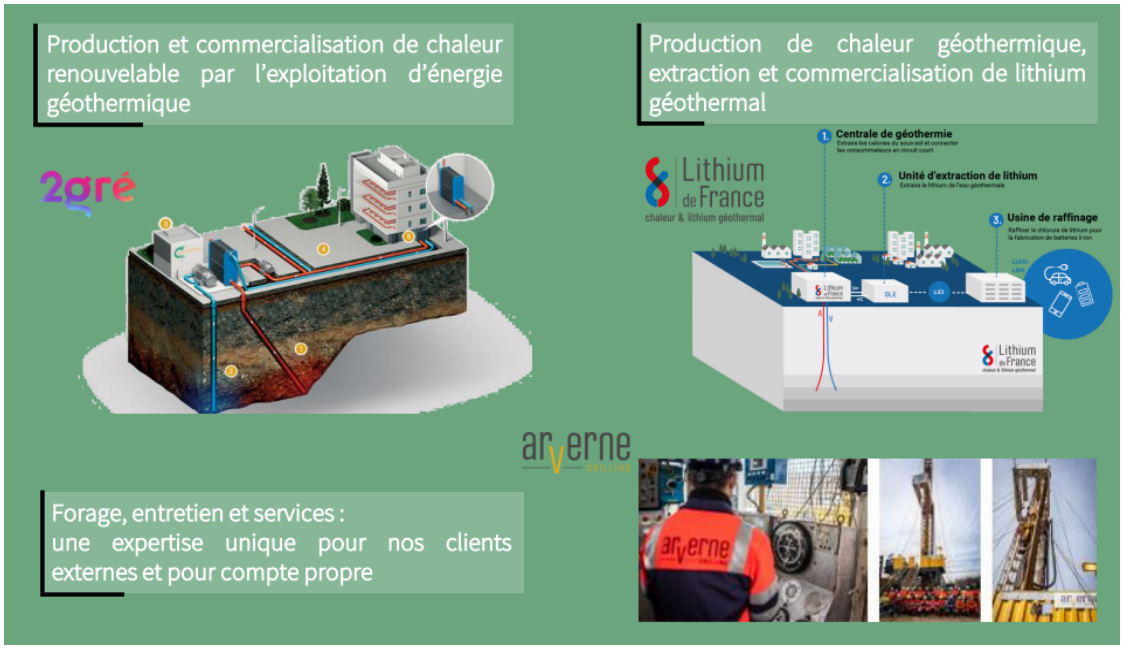
FCF/Revenus, %



FCF vs Li production capacities



Structured like an Integrated Factory



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I. The Rise of a French Champion in Geothermal Energy and Geothermal Lithium

A. The reverse merger with the SPAC Transition has brought in equity and new shareholders

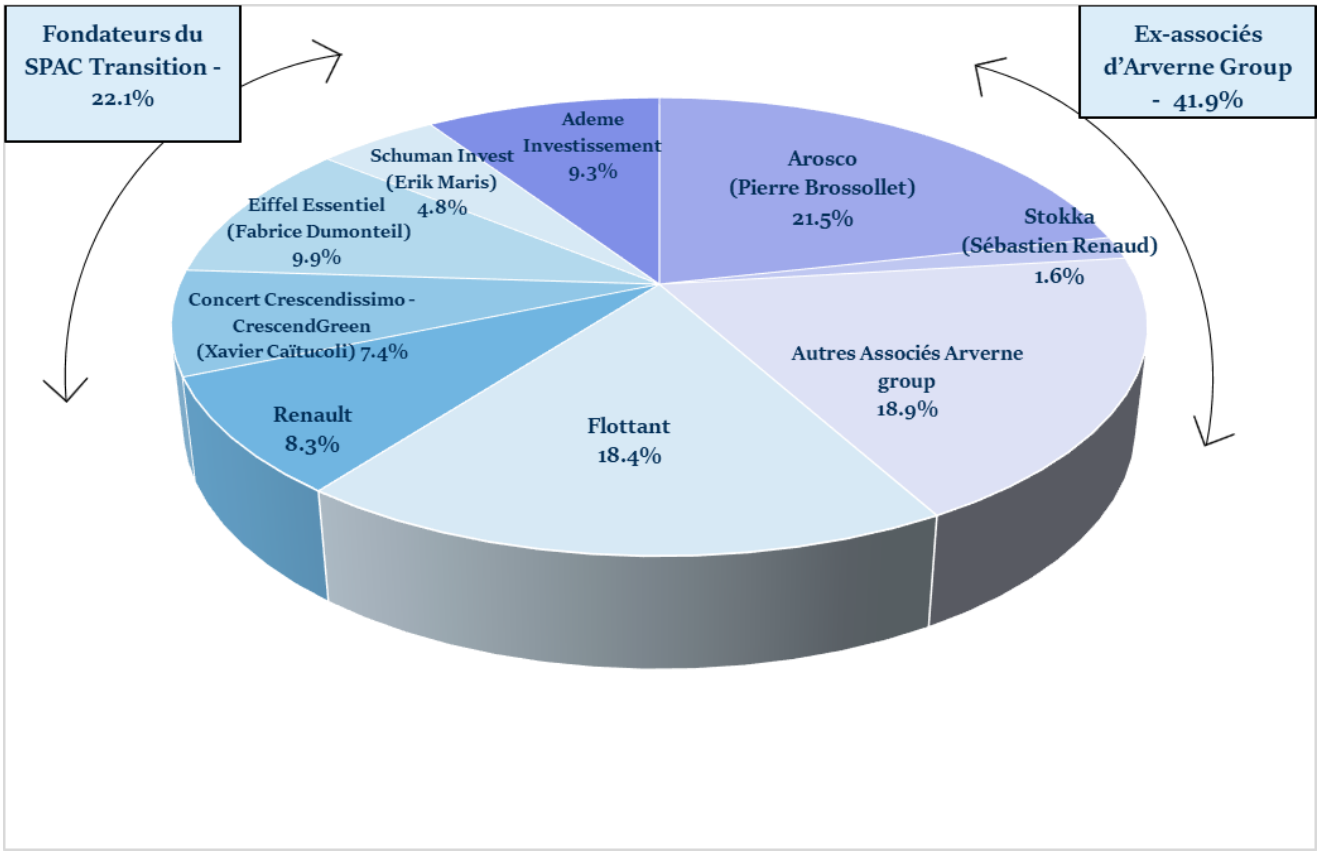
The Arverne Group, as we know it today, is the result of the reverse merger in September 2023 between the SPAC Transition—which was introduced on Euronext in June 2021 and raised €162 million at that time—and Arverne Group, a company specialized in geo-energy, founded in 2018 by Pierre Brossollet.

The purpose of the SPAC Transition, created by Xavier Caïtucoli (founder and former CEO of Direct Energie), Erik Maris (investment banker at Advent, former Lazard and Messier), and Fabrice Dumonteil (president of Eiffel Investissement Group), was to acquire one or more companies specialized in the energy transition.

After reviewing about ten proposals in the field—mainly in more traditional energy transition activities such as wind and photovoltaic energy—the leaders of Transition targeted Arverne Group due to its differentiated positioning (subsurface resources), whose ambitions address clearly identified strategic challenges and highlighted issues (energy sovereignty and decarbonization with geothermal energy, industrial sovereignty with lithium).

Discussions began in the summer of 2022 and lasted for eight months, concluding with an agreement in June 2023 regarding the aforementioned operation. Through this stock market operation, Arverne Group raised €162 million in cash and strengthened its shareholder structure with the entry of new strategic shareholders as part of a PIPE (private investment in public equity), including Renault, ADEME Investissement, Sycomore, and Crédit Mutuel Equity.

Figure 1 : Répartition du capital



Source : Société, TP ICAP Midcap

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B. A Clearly Defined Strategic Vision from the Start: Becoming a Major Player in the Energy Transition by Valuing Subsurface Resources

Arverne's strategic vision is to become a major player in the energy transition by leveraging the colossal potential of subsurface resources, including geothermal energy (as a source of heat) and lithium (as an essential raw material for batteries, particularly for electric vehicles). This vision aligns perfectly with the objectives of the French government and the European Union (decarbonization and energy and industrial sovereignty) and has been fully validated by the recent reaffirmation of geopolitical challenges (diversification of the energy mix, reducing dependence on China for the supply of critical metals, including lithium).

Geothermal energy has the advantage of being a natural, completely renewable energy source that is non-intermittent (unlike solar and wind) and recycles water extracted from the geothermal well by reinjecting it back into the well (only heat is extracted from the ground, not the water). Geothermal heat is produced using a doublet system.

In line with its total commitment to the energy transition at the local level, serving all stakeholders, Arverne changed its statutes in February 2022 to become a "mission-driven company" according to the provisions of the French PACTE law of 2019. Its mission is to "unlock the potential of geo-resources and value them sustainably for a pragmatic energy transition that serves the prosperity of the territories," driven by two objectives:

1. To act as a bold energy player to advocate for a pragmatic energy transition;
2. To promote a "virtuous" society by relying on the men and women within the company and the territories.

The group has been built as an integrated factory in stages, according to a well-established plan:

Startup

In March 2018, Pierre Brossollet founded AR Worldwide (Arverne Resources) in Pau, focusing on the exploration and production of natural resources found in the subsurface, with the goal of placing ecological aspects at the center of energy production. More specifically, it aims to rehabilitate mature hydrocarbon fossil fields in preparation for a decarbonized energy transition. The oil and gas expertise of its engineers in reservoir analysis and management is utilized for drilling, which is crucial for the production of geothermal heat and lithium.

Arverne Group was formally established in March 2019.

Capitalizing on Drilling Expertise to Scale Up Geothermal and Geothermal Lithium Projects

In February 2020, the group acquired Entrepose Drilling (40 employees and a fleet of 6 drilling units, formerly known as COFOR, a subsidiary of Vinci) from the commercial court and created the subsidiary Arverne Drilling to house these assets and capitalize on over 60 years of experience of the former COFOR in drilling (over 1,000 wells drilled worldwide) and well services (work-over, well abandonment, integrated services) to participate in major energy transition projects using geo-energies.

A significant part of Arverne's industrial expertise is located within Arverne Drilling, which aims to provide its resources and know-how to third-party actors as well as to its own activities. Arverne Drilling Services masters deep drilling techniques (from 200 m to over 5,000 m). In a bid for better organization and to meet customer needs more effectively, Arverne Group created DrillHeat in February 2022 (50% owned and consolidated through the equity method) for surface drilling in partnership with Eren, Lepton Développement, and Accenta. For deep drilling, the subsidiary DrillDeep was created in March 2024 in partnership with the German tunneling machine manufacturer Herrenknecht, which holds 26% of its capital.

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Launching the Geothermal Activity

In October 2020, Arverne created Arverne Géothermal (renamed Lithium de France in March 2021), a subsidiary based in Alsace (in Bischwiller) specializing in the exploitation of geothermal resources, aiming to produce geothermal heat that represents a huge, yet underexploited potential in France and is key to accelerating the energy transition. The heat extracted from geothermal hot waters is intended to meet the energy needs of industrial players, replacing gas, coal, or fuel oil as a source of heat.

In March 2023, Arverne acquired GéoRhin (formerly Fonroche Géothermie) from the commercial court and took over five exclusive exploration permits in France. GéoRhin was renamed 2gré in June 2023 and has since been responsible for all geothermal heat production projects without lithium.

Launching the Lithium Activity

This lithium will be sold to battery manufacturers and automotive manufacturers. To accelerate and enhance the credibility of this capital-intensive industrial project, Lithium de France opened its capital twice: in November 2021 during a Series A round of €8 million (pre-money valuation of €10 million), and then in March 2023 during a Series B round of €44 million (pre-money valuation of €100 million). Following these operations, Arverne holds 62% of Lithium de France's capital alongside Equinor (24%), Hydro (12%), and its teams (2%).

Obtaining Permits

In June 2022, Lithium de France obtained its first exclusive exploration permit (PER) for geothermal energy, "Les Sources," covering an area of 171 km^2 in Alsace. In 2023, Lithium de France obtained two new PERs for the sites "Les Sources Alcalines" (158 km^2 in Alsace, for lithium) and "Les Poteries" (366 km^2 in Alsace, for geothermal energy), and in 2024, one PER for "Les Poteries Minérales" (151 km^2 in Alsace, for lithium).

On its part, 2gré took over five exploration permits from GéoRhin for geothermal energy, namely Cézallier (587 km^2 in Auvergne), Val-de-Drôme (434 km^2 in Rhône-Alpes), Pau-Tarbes (442 km^2 in Aquitaine), Strasbourg (572 km^2 in Alsace), and Riom (495 km^2 in Auvergne). Finally, in addition to the nine valid PERs already obtained (seven for geothermal energy and two for lithium), two permit applications by 2gré are currently under review: La Plaine du Rhin (573 km^2 in Alsace) and Bassin de Limagne (707 km^2 in Auvergne). Furthermore, two new PER applications have been submitted by Lithium de France in 2024.

Production

2gré plans its first geothermal heat production in 2026, while Lithium de France plans its first geothermal lithium production in 2028. To ensure the availability of equipment, meet operational timelines, and avoid tensions related to access to drilling equipment, the group has invested in a fleet of proprietary drilling devices. This autonomy—guaranteeing agility in ramping up production as well as execution quality—allows the group to secure its position in the rapidly expanding geothermal and geothermal lithium production market.

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C. Reasons for the Credibility of Arverne Group's Projects

According to us, the credibility of the Arverne Group founders' project relies on several elements:

I. Capacity for Innovation

Lithium de France is working on a process for extracting lithium dissolved in geothermal brines using techniques known as DLE (Direct Lithium Extraction).

These extraction processes are renowned for their efficiency, allowing for the consumption of **150 times less water** and occupying **3,000 times less surface area** to extract the same volume of lithium compared to conventional methods, such as mining and large evaporation ponds, also known as salars.

- Numerous companies worldwide are developing DLE techniques. However, these processes require specific adjustments for each site based on the quality of the geothermal brine, its chemical composition, temperature, and pressure.
- Lithium de France collaborates with partners who already have DLE solutions, aiming to adapt them to Alsatian brines. Ongoing tests, conducted in partnership with Equinor at their Norwegian research center and combined with the results of the PFS (Pre-Feasibility Study), already confirm a recovery rate of up to **91%** (initial estimates placed it between **80% and 85%**).
- The results of the latest PFS have facilitated the selection of the extraction technology, which will employ an adsorption process. One of the main factors justifying this technological choice, in the context of their location in Alsace, is the ability of these technologies to significantly limit the use of reagents, thus minimizing capital expenditures while meeting local environmental constraints.
- The project aims for a strategic position in the lithium market to meet the anticipated growing needs of the battery sector.

II. Financial Viability of the Two Activities in the Long Term

While the initial investment is substantial, the financial sustainability of the project seems achievable through the combination of two factors:

- **Synergies between heat production and geothermal lithium production.** Each of these two activities is expected to generate profitable revenues autonomously, thereby mitigating financial risks.
- **Expected competitive operating costs.** The EBITDA margin at cruising speed is projected to be around **70%** for the geothermal activity in "stand-alone" mode and around **80%** for geothermal lithium activity. Operating costs would remain low due to minimal raw material expenditures and the advantages of brine sourced from geothermal sites. The DLE technique is tailored to the characteristics of the brine, significantly reducing energy requirements compared to conventional DLE operations, ensuring competitive operational costs. This integrated approach to natural preheating, along with the fact that **15%** of energy production will be self-consumed to power the industrial complex, allows for energy cost reductions of up to **30%**.
- The results of the PFS demonstrate that the project is not only technically feasible but also economically viable, with competitive costs. With an improved recovery rate of **91%** (versus **80-85%** previously) and an adjusted annual production of **27 Kt** of lithium carbonate, the project shows better profitability compared to initial assumptions. Operating expenses (OPEX) have been revised down from **€5,000/t** of lithium hydroxide to less than **€4,500/t** of lithium carbonate, enhancing the project's competitiveness in a rapidly expanding market.

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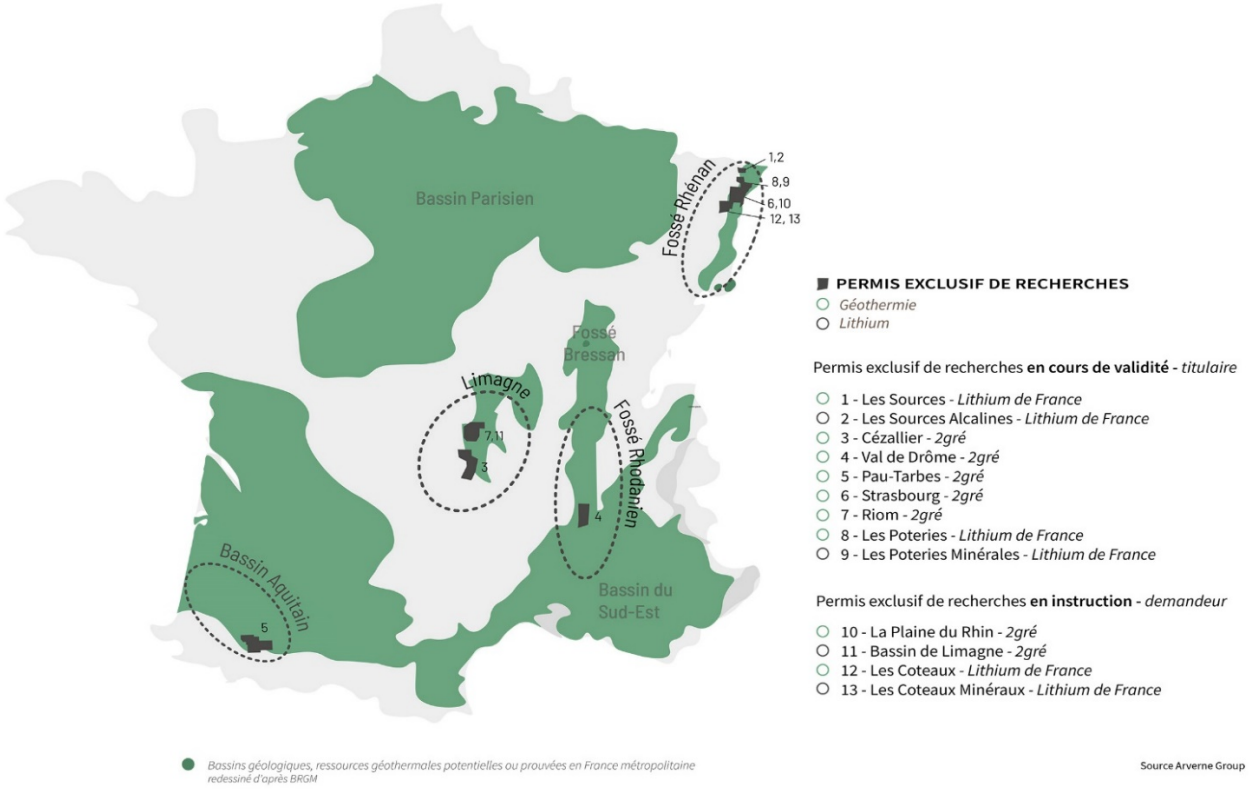
III. The Diversified Portfolio of Permits Providing a Unique Competitive Advantage (Strong Barrier to Entry)

Currently, there are **9 exploration permits (PERs)** that are valid (7 for geothermal energy and 2 for lithium), along with four additional PER applications that are currently under review.

Figure 2: Portfolio of Exclusive Research Permits (PER)



Source : Société, TP ICAP Midcap

Advancement towards the industrial phase is confirmed with key milestones being achieved: the completion of 3D exploration campaigns covering a total area of **310 km²**, advanced tests on the choice of DLE (Direct Lithium Extraction) technology, the submission of a first drilling permit application, and securing a drilling rig for initial drilling planned for late 2024.

It is worth noting that the pre-feasibility study (PFS) has just been completed, confirming the economic and technical viability of the project. Moreover, the group demonstrates its ability to rapidly deploy its model, particularly for faster permit acquisition and conducting 3D exploration campaigns (310 km² completed in 2 years).

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IV. Experience of Leaders and Teams in Drilling and Geo-Energies

- **Founder and CEO Pierre Brossollet** brings over **20 years of expertise** in well drilling. Before founding Arverne, Pierre Brossollet served as Deputy General Manager of SMP Drilling, responsible for business development (2016-2018), Operations Manager for Dubai Petroleum (2015-2016), Drilling Operations Manager at Maurel & Prom (2008-2015), and Drilling Engineer at Total (2001-2008). His field experience extends across **Argentina, Iran, France, Indonesia, Colombia, Gabon,** and the **United Arab Emirates**.
- All general managers of the subsidiaries bring solid experience gained in leading oil, parapetroleum, and industrial companies (TotalEnergies, Air Liquide, Schlumberger). These strategic and operational skills are complemented by profiles familiar with financing mechanisms and project management.
- The expertise inherited from the former COFOR and the oil industry in drilling and well maintenance has provided Arverne with the necessary credibility for resource access (people, machines, contracts), with over **50 geothermal wells** drilled between **1,000 and 3,600 m** deep, with bottom temperatures ranging from **70 to 280°C** in Alsace, Île-de-France, and Guadeloupe.

V. Solid Shareholding Base Providing Financial Agility to the Project

On one side, through the presence of **ADEME Investissement** in the capital (9.3%), the State views the group as:

- A vehicle for the industrialization of geothermal energy.
- An important player for building national sovereignty with the production of battery-quality lithium (digital passport for electric vehicle batteries marketed in the EU by 2026).
- A local tool for decarbonization.

On the other side, **Equinor** and **Hydro** (which own **38%** of Lithium de France) bring technological and industrial expertise that enhances the project's credibility and development. As major international players, these two groups also strengthen the financial investment capacity of Lithium de France.

Finally, **Renault** (8.3%) provides visibility to the activity as a shareholder of the project and a future customer of Lithium de France (commitment to purchase **5 kt** per year for **5 years**).

VI. Partnerships

- **Technological and Strategic Partnerships.** Lithium de France has established partnerships with Norwegians **Equinor** and **Hydro**, thus bringing technical credibility and financial power from two major energy groups. With these partnerships, the group, backed by its oil history, now covers all upstream project knowledge.
- **Technological Partnerships.** The deep drilling activities (DrillDeep) can rely on the presence of the German tunneling machine manufacturer **Herrenknecht** and its technical expertise for constructing drilling machines.
- **Commercial Partnerships.** The group signed a **5-year supply agreement** with **Renault** in 2023, enabling the automaker to secure access to **25 kt** of battery-quality lithium, approximately **20%** of Lithium de France's annual production capacity. Management, in line with its two industrial shareholders, is also considering other production sales strategies to account for the rising lithium prices in the medium and long term, as several studies point towards an increase in demand for battery-quality lithium. It is noted that Lithium de France's production capacity (27 kt/year) should supply approximately **700,000 electric vehicles**, representing one-third of the estimated forecasted needs.

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VII. A Structured and Innovative Commercial and Industrial Approach in the Competitive Landscape of Geothermal Energy

With an operational and under-construction fleet of drilling equipment, the group aims to have an industrial tool capable of meeting the internal needs of Arverne Group (geothermal energy and geothermal lithium production) as well as external projects.

- By making its drilling rigs available to third parties before launching its own activities, Arverne could deepen its experiences and expertise.
- The precise mastery of drilling, along with the availability of drilling machines, is essential for the success of geothermal projects.
- Indeed, the capital expenditure (Capex) related to doublets (2 wells) represents nearly half of project costs, while controlling the drilling tool (Capex **€15 M**) allows for increased agility and independence, mitigating any potential resource shortages.

VIII. Environmental Risks Associated with Conventional Lithium Supply Chains Justify the Importance of a Less Risky Alternative like Arverne's Project

- The group's project presents numerous environmental advantages, including low carbon intensity, limited land use, and the self-consumption of geothermal heat produced to operate the industrial processes necessary for geothermal lithium production.
- This model aligns perfectly with European objectives, in contrast to traditional mining operations that face local acceptability issues and long timelines for obtaining permits.

IX. Paradigm Shift in Lithium Demand in Europe, Seeking to Reduce Dependence on China

- The creation of Arverne Group responds to an urgent need to better secure national and European raw material supplies through local production development.
- In this regard, regulations are being implemented to ensure security of supply for strategic raw materials for the EU. Lithium is one of the **34 critical raw materials** listed by the EU under the recently adopted Critical Raw Materials Act (CRMA). It sets ambitious targets: **10% extraction, 40% refining, and 15% recycling** of key minerals by **2030**.
- Lithium is essential for producing batteries for electric vehicles and energy storage systems, addressing the EU's energy transition plan aimed at reducing greenhouse gas emissions by **55%** by **2030**.
- Global lithium demand is projected to increase **42-fold** by **2040**, according to the International Energy Agency, primarily due to its use in electric vehicles and renewable energy storage systems.
- According to **Wood Mackenzie** forecasts, projections indicate a demand for **800 GWh** of lithium-ion batteries in Europe by **2030**, representing an estimated need for about **800 kt** of lithium, while global markets provide only about **350 kt**. However, despite this momentum, the EU remains without local lithium supply capacity, posing a significant challenge to supply security and sovereignty.
- Furthermore, the control exerted by China over **80%** of the current global market raises concerns about Europe's dependence on this country for this critical resource.
- We believe that geothermal lithium produced in Europe will command a premium over the reference price, particularly due to its limited carbon footprint. In addition to environmental considerations, the European battery industry is expected to benefit from strong financial incentives to use locally extracted raw materials, notably Arverne Group.

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II. Two Pillars: Geothermal Energy and Geothermal Lithium

A. The Launchpad of Drilling for Developing Geothermal Energy and Geothermal Lithium

In 2023, drilling accounted for nearly all of Arverne's consolidated revenue (€9.8 million out of €10.1 million), a trend that continued from 2022 (€10.4 million out of €10.7 million).
Currently, this activity primarily serves external clients, but its future focus will shift significantly toward meeting the drilling needs of **2gré** and **Lithium de France**.

Arverne's current drilling projects for external clients are varied, including:

- **Geothermal Drilling:** A primary focus that aligns with the company's strategic vision.
- **Underground Storage:** Involves innovative projects like green hydrogen storage.

These projects allow Arverne to acquire essential expertise and experience in drilling techniques, which will be invaluable as the company scales up its geothermal and geothermal lithium initiatives.

During 2022 and 2023, Arverne has concentrated on restructuring its fleet of drilling equipment to meet the geothermal market's needs with modernized machinery. This reorganization is crucial for maintaining competitiveness and efficiency in future projects.

In 2023, the group generated the majority of its consolidated revenue from third-party drilling contracts, with **Storengy** representing a substantial 78% of this revenue. This was achieved through a demonstrative contract for green hydrogen storage in saline cavities at the Etrez site in the Auvergne-Rhône-Alpes region.

Over time, while Arverne expects to continue developing revenue from third-party drilling, especially through its subsidiaries **DrillDeep** and **DrillStore**, it envisions that a growing and eventually predominant share of drilling activity will be directed internally toward **2gré** and **Lithium de France**. This transition will lead to a significant dilution of drilling revenue from external clients in the consolidated revenue figures.

Deep Drilling (DrillDeep)[1] Capabilities

Arverne is among a select few companies in Europe capable of executing drilling operations at depths exceeding 3,000 meters. The market for deep drilling in Europe is currently underserved due to:

- **Shift of Drilling Expertise:** There has been a migration of drilling competencies toward more promising oil fields, such as those in the Middle East and West Africa.
- **Withdrawal of Major Oil Companies:** Many large oil companies are gradually exiting the onshore drilling sector, leaving a gap in the market that Arverne aims to fill.

Arverne Group, through its subsidiary **DrillDeep** and its four drilling rigs, shares the French deep drilling market with **Société de Maintenance Pétrolière (SMP)**, which operates two rigs. The demand in this sector is increasingly strained due to a shortage of deep drilling equipment.
The drilling fleet inherited from the former **COFOR** is being gradually upgraded. In September 2023, Arverne acquired a high-capacity **Herrenknecht** machine and has ordered another powerful unit from this partner, with delivery scheduled for 2024. As of June 2024, **Arverne Drilling Services** and **DrillDeep** will own three deep drilling rigs outright.

[1] *In deep drilling, an activity widely used in oil and gas exploration and extraction, the process involves drilling and maintaining wells deeper than 200 meters, reaching several thousand meters, referred to as doublets. These doublets consist of two wells connected in a closed loop, one dedicated to the production of hot water and the other for reinjecting the water, once cooled, back into the original aquifer. These are heavy industrial installations that require several months for assembly and disassembly, dozens of semi-trailers for transport, and teams working in shifts 24/7 to carry out the drilling.*

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Figure 3 : Deep drilling rigs

Source : Société

Well Drilling and Maintenance for Underground Storage (Arverne Drilling Services)

The well drilling and maintenance segment, which has been operational for over twenty years and employs around fifty people annually, primarily serves **Storengy**. This partnership represented the majority of Arverne Group's revenue in 2023.

Expansion Beyond Natural Gas Storage

Arverne intends to expand this business area beyond natural gas storage, given the strong potential demand for hydrogen storage and CO_2 sequestration. The goal is for **Arverne Drilling Services** to operate two units by 2030. The underground gas storage market in Europe remains underexploited but shows signs of growth, particularly in response to recent gas market tensions.

Surface Drilling[2] (Joint Venture DrillHeat)

In the surface drilling sector, Arverne, through its joint venture **DrillHeat**, is a leader in France, operating six workshops equipped with geothermal drilling rigs (up from three delivered in 2023). The company has a dedicated sales team to effectively target local authorities, administrations, residential managers, and businesses.

Competitive Landscape

Approximately 75 companies in France are authorized to perform surface drilling, with Arverne being the largest player. Most competitors are local or regional artisanal companies with one to three multi-purpose drilling workshops (for water drilling, decontamination, piling, and geothermal probes). Their growth is often limited to word-of-mouth and the personal networks of their leaders. Although foreign[3] players exist with over ten workshops, their market penetration in France is limited due to local demand constraints.

DrillHeat aims to scale its operations significantly beyond its current six workshops, with projections suggesting a rise to 42 by 2032. This ambitious target is supported by several key factors:

- **Growth Capacity:** DrillHeat is structured to accommodate the addition of several dozen workshops.
- **Operational Flexibility:** The joint venture can deploy one or multiple drilling workshops at the same site, depending on client needs. Currently, DrillHeat operates on projects requiring an average of 20-30 probes and has demonstrated the ability to manage operations with up to 60 probes at depths of 200 meters. This technical proficiency distinguishes DrillHeat among a select group of competitors, as most are limited to 100 meters.

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[2] In surface drilling (sonde geothermal), the activity involves drilling wells of less than 200 meters deep, inside which a loop of glycol water is cemented from the bottom to the surface. This water loop captures underground heat through thermal exchange and brings it to the surface via one or more heat pumps. This type of drilling addresses the needs for decarbonized production of heating, domestic hot water, and cooling for residences, businesses, and public services (offices, schools, hospitals, hypermarkets, warehouses, etc.).

3 Companies like 5 GeoTherma and Geo-Green in Belgium, Geotherm (a subsidiary of Kibag), Augsburger Geothermie (a subsidiary of Grisoni), and Orlatti in Switzerland, as well as BauGrund Süd (a subsidiary of Weishaupt) in Germany, are involved in this field

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- **National Reach:** Unlike competitors operating regionally, DrillHeat can deploy its workshops across France to reach depths of 200 meters.
- **Quality of Equipment:** DrillHeat designs and customizes its machines, allowing for better adherence to specifications and optimal performance for geothermal probes, whereas competitors typically purchase their equipment from abroad.
- **Rapid Response Times:** DrillHeat is known for its quick response times to client requests.

The combination of these capabilities gives DrillHeat significant economies of scale and positioning to address a diverse clientele, maximizing growth opportunities. However, a major challenge lies in managing development capacities in line with market growth, as high structural costs can pose entry barriers for smaller companies. DrillHeat appears particularly well-positioned to navigate this challenge, given its current structure that allows for integration well beyond six workshops. Feedback from DrillHeat management suggests a notable increase in project sizes compared to 2-3 years ago, indicating a positive growth trajectory.

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A. 2gré : Geothermal Energy for District Heating Networks and Industries

2gré Plans to Invest Up to €500 Million in Geothermal Energy by 2031

The subsidiary **2gré**, formed through the acquisition of GéoRhin in March 2023, is dedicated to developing geothermal heat production in France. 2gré manages all aspects related to the underground environment, focusing on technical and environmental constraints, timelines, costs, and quality. The subsidiary operates synergistically with drilling activities, as the latter will handle the drilling of 2gré's wells.

Key Points of 2gré's Operations

1. **Geothermal Exploration Permits (PER)**:
   - 2gré holds **five geothermal exploration permits** (PER), all inherited from GéoRhin.
   - Additionally, **two applications for lithium PER** are currently under review by 2gré.
2. **Focus on Development Projects**:
   - 2gré is intensifying its project development on sites that have obtained simple development authorizations, especially in the Île-de-France region.
   - These local authorizations are valid for **three years** and are easier to obtain than the PER, with a reduced review period of **12 months**.
   - The simplified process facilitates obtaining the necessary administrative permits for operation, including in forested areas, and allows for integrating drilling permits within this framework.
3. **SAF garanty for Deep Drilling**:
   - Deep drilling operations are eligible for the **SAF guarantee**, which covers up to **90% of the well cost** in case of project failure, specifically when drilling does not lead to the discovery of exploitable geothermal resources.
4. **Future Plans**:
   - The group plans to submit **three new drilling permit applications**, expanding its geothermal exploration efforts.

2gré is strategically positioned to enhance geothermal heat production in France, leveraging its expertise in managing subsurface projects and its synergies with drilling activities. By focusing on accessible development authorizations and securing financial safeguards, 2gré aims to foster sustainable energy solutions and capitalize on the growing demand for geothermal resources.

Figure 4 Portfolio of Exclusive Research Permits (PER)

nom du PER	superficie	département	date d'octroi initiale	date d'expiration	demande de prolongation en cours
PER de «Pau-Tarbes»	*442 km2*	*Pyrénées-Atlantiques et Hautes-Pyrénées*	*14/03/13*	*30/03/2023*	*demande de 2e prolongation en cours d'instruction*
PER de «Strasbourg»	*572 km2*	*Bas-Rhin*	*10/06/13*	*23/06/2023*	*demande de 2e prolongation en cours d'instruction*
PER de «Val-de-Drôme»	*434 km2*	*Ardèche et Drôme*	*18/03/13*	*27/03/2024*	*demande de 2e prolongation en cours d'instruction*
PER de «Cézallier»	*587 km2*	*Cantal, Haute-Loire et Puy-de-Dôme*	*16/07/13*	*24/07/2022*	*demande de 2e prolongation en cours d'instruction*
PER de «Riom-Clermont-Métropole»	*495 km2*	*Puy-de-Dôme*	*25/01/16*		*demande de 1re prolongation en cours d'instruction*
PER « Plaine du Rhin »		*Bas-Rhin*	*Ces PER sont superposés aux PER géothermie « Strasbourg » et « Riom-Clermont-Métropole »*		*en cours d'instruction*
PER « Bassin de Limagne »		*Puy-de-Dôme*			*en cours d'instruction*

Source : Société, TP ICAP Midcap

Once commissioned, each power plant operates as a heat exchanger, allowing heat to be injected into a district heating network or another circuit. It is a plate system where water circulates to facilitate heat exchange. There is no exchange of fluids, only a heat exchange. It should be noted that the heat produced cannot be transported over long distances.

Therefore, each geothermal production installation project must be studied on a case-by-case basis to be adapted to local network and resource constraints. To adapt to market developments and new customer demands, 2gré plans to add geothermal heat pumps (HP) to its plants to increase the installed capacity per doublet, operate for more hours in a year, and better control the output temperature.

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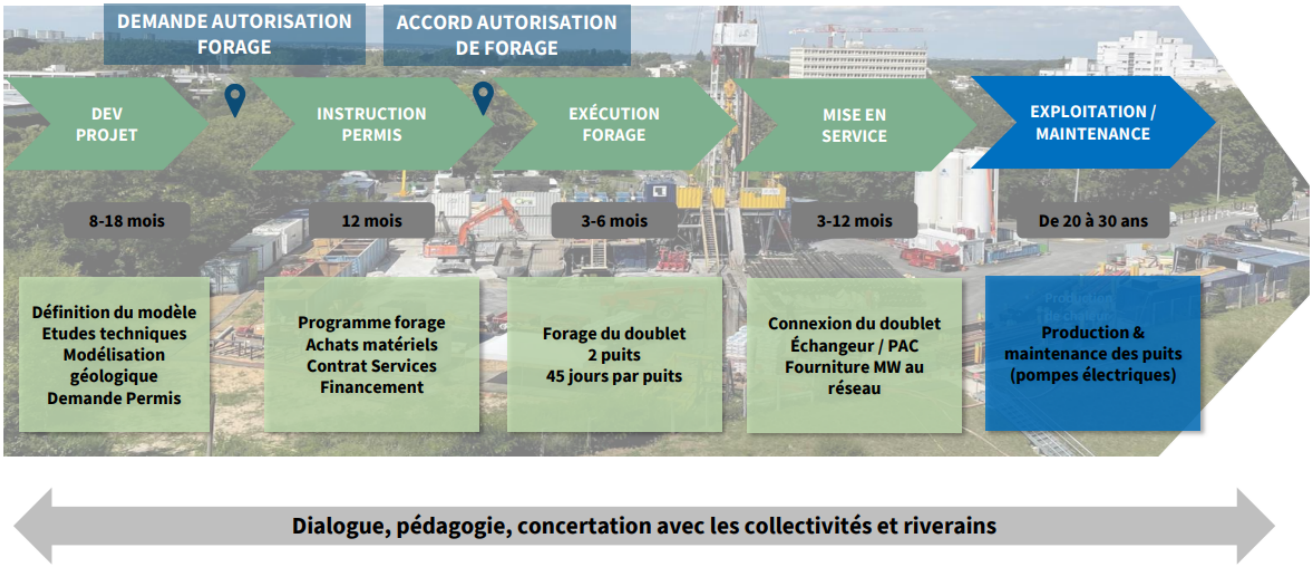
Figure 5: The Stages of a Greenfield Geothermal Project



Source : Société

Target Clients for 2gré

The types of clients targeted by 2gré are:

a. **District Heating Networks**: Operated by local authorities or private operators under public service delegation (DSP) to supply heat to public buildings and neighborhoods.

b. **Buildings Equipped with Gas or Oil Boilers**: These buildings will transition to heating, hot water, and air conditioning via surface geothermal energy coupled with heat pumps.

District heating networks (operating approximately 3,500 hours per year) are prioritized in 2gré's development strategy, while the building market will be addressed in the long term.

Current Competitive Landscape

At this stage, there is no real competitor to 2gré:

A. Most large district heating operators manage their own geothermal facilities (70 in France, including 50 in the Île-de-France region), while the drilling of wells is subcontracted to engineering firms (including BRGM itself via its subsidiary CFG Services) or drilling companies like Arverne. Therefore, these operators represent potential clients for 2gré.

B. Unlike 2gré, these operators are not pure-play geothermal companies, as they also utilize other decarbonized energy sources such as biomass power plants.

C. Électricité de Strasbourg (a subsidiary of EDF) operates two geothermal power plants in Alsace (Soultz-Sous-Forêts with a capacity of 1.7 MW and an annual production of 12 GWh, and Rittershoffen), while the Bouillante geothermal plant (Guadeloupe), with a capacity of 16 MW, is operated by Ormat Technologies.

Objectives of 2gré

The objectives of 2gré mainly focus on the potential with district heating operators:

- Arverne's goal for 2gré is to start producing and selling heat by 2026, aiming to reach an annual production of 1.8 TWh by 2031. To achieve this, 2gré plans to construct approximately 25 geothermal production units (doublet + geothermal power plant with a thermal capacity of 20 MW producing up to 70 GWh per year). This would require about €500 million in cumulative investments by 2031. Concessions are granted for periods of up to 30 years, with possibilities for renewal.
- The assumptions mentioned above take into account that 2gré's clients are currently mainly district heating operators (3,500 hours of operation per year, with a purely indicative and non-binding selling price modeled today at €65/MWh).

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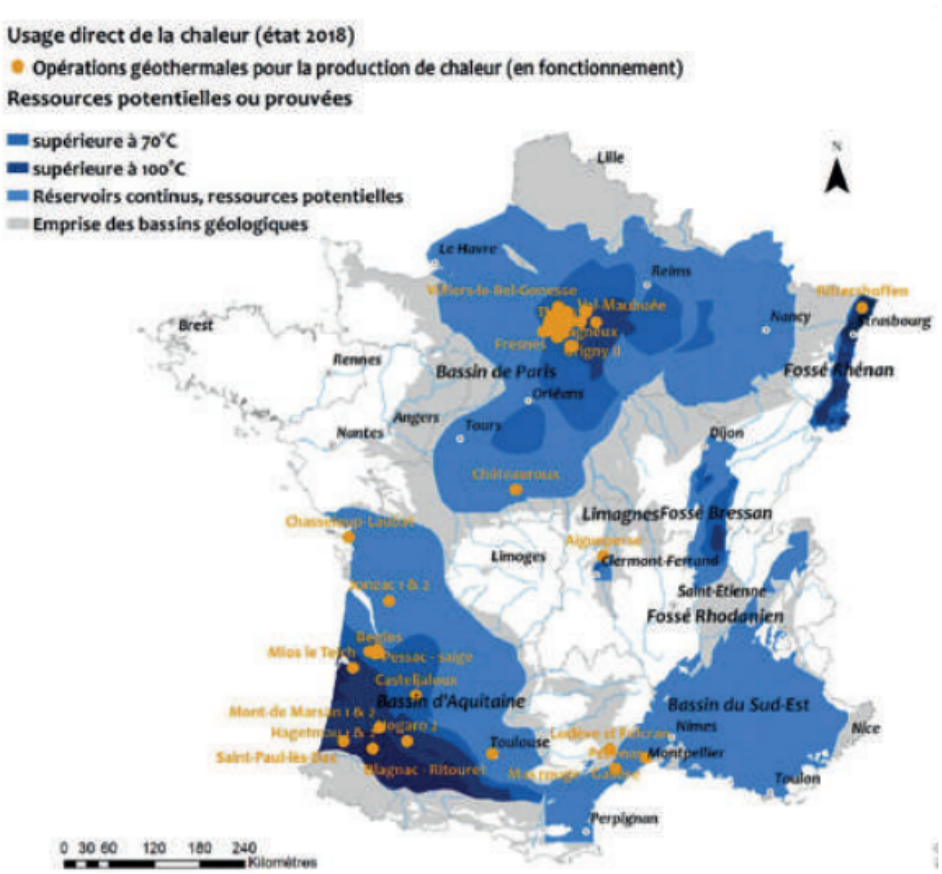
Promising geothermal potential but still underexploited in France

Geothermal energy represents a considerable potential in France, but it remains largely underutilized. Despite abundant geothermal resources, the country has not yet fully capitalized on this technology for several reasons, ranging from market maturity to the current economic and regulatory structure. Renewable heat accounted for only 4% of the energy mix in 2022 (6.7 TWh in total, with 2.1 TWh from deep geothermal and 4.6 TWh from surface geothermal), but according to the SER Geothermal Report 2024, it is expected to experience significant growth by 2030, with a threefold increase in production from deep geothermal and more than a doubling of surface geothermal production.

Furthermore, this transition aligns with the political will to develop district heating networks in France, in line with the objectives of the Energy Transition for Green Growth Act, which aims to increase the number of heating networks from 900 to 1,600 by 2030, with heat production rising from 30 to 40 TWh. Geothermal energy is becoming an attractive option for local authorities, in accordance with recent legislative developments favoring their ownership of energy assets. The potential and proven resources of high-temperature deep geothermal energy are concentrated in Alsace, Auvergne, Aquitaine, the Paris Basin, and the Rhône Valley.

Countries like Germany, Switzerland, and the United States have demonstrated that a mature market for geothermal energy is possible. They have established favorable regulatory frameworks, financial incentives, and awareness programs. France could adopt a similar model to develop its own market, especially since the European Union plans to invest $7.4 billion in this area.

Figure 6 : Mapping of Exploratory Targets for Deep Geothermal Energy in France



Source : « Bilan de la filière géothermie profonde pour la production de chaleur sur la période 2007-2018 », République française/ADEME/BRGM/Service géologique national

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c. Lithium de France: Building a French Lithium Champion

a) Very Ambitious Goals in Geothermal Lithium Extraction

The Lithium de France subsidiary aims to develop an integrated model that combines the exploration and exploitation of geothermal resources with the commercialization of heat generated from these geothermal resources (similar to 2gré) and the extraction up to the refining of lithium extracted from geothermal brines.

1. The lithium extraction techniques chosen by Lithium de France are known as DLE (Direct Lithium Extraction). Lithium chloride (LiCl) extracted from geothermal brine is processed in a refining unit.

2. These techniques have the advantages of being low in water consumption, "low-carbon," having a very high recovery rate, and offering a lower operating breakeven point compared to conventional processes such as hard rock extraction[4] and large evaporation ponds or salars[5].

The goal for Lithium de France is to implement a lithium extraction process from dissolved lithium in geothermal brines that consumes 150 times less water and occupies 3,000 times less surface area for the same volume of lithium extracted compared to conventional methods, knowing that the geothermal brine, once depleted of the extracted lithium, is reinjected into the underground, which limits the use of water resources.

The three DLE techniques studied by Lithium de France are adsorption, ion exchange, and solvent extraction.

Adsorption is the most established and advanced technique[6], with more than 15 projects worldwide, including three in production in China, while the other two are still experimental.
Lithium de France has opted for adsorption.

① **Adsorption** is the most widely used DLE technique. The adsorbent consists of ceramic beads with specific characteristics (size/pore structure, surface, porosity) and a particular chemical structure to capture or allow different molecules from the brine to pass through.

The lithium chloride molecules from the brine infiltrate and are captured in the interstices of the adsorbent, and then removed with warm water (>40°C) without chemicals. The resulting lithium chloride solution is washed twice to remove undesirable ions, allowing this technique to recover over 90% of the lithium present in the brine. Sodium carbonate is then used to convert lithium chloride into lithium carbonate. This process works even better in the case of geothermal brines because the water drawn from underground is naturally warm. Additionally, due to the lithium recovery rate exceeding 90%, adsorption can be used in brines with low lithium concentration. However, this technique is costly—it requires significant Capex and the purchase of expensive adsorbent—and carries the risk of obtaining lithium with more impurities than other techniques.

4 Preferred technique in Australia and, to a lesser extent, in China. This technique accounts for approximately 60% of the lithium volumes extracted worldwide
5 Preferred technique in Argentina and Chile due to the presence of very arid areas like the Atacama Desert. This technique accounts for approximately 40% of the lithium volumes extracted worldwide
6 The first adsorption process for the direct extraction of lithium—based on alumina—was invented in the 1970s by Dow Chemical. The first use of an adsorption process in lithium extraction was carried out by FMC (now Arcadium Lithium) in 1996 in Argentina. Finally, the first lithium deposits extracted on a large scale using adsorption began operations in China's Qinghai province between 2017 and 2019, coinciding with the time when electric vehicle sales began to become significant. The five new Chinese producers using this process are Lanke Lithium, Zangge Mining, Jintai Lithium, Minmetals Salt Lake, and Jwell New Materials

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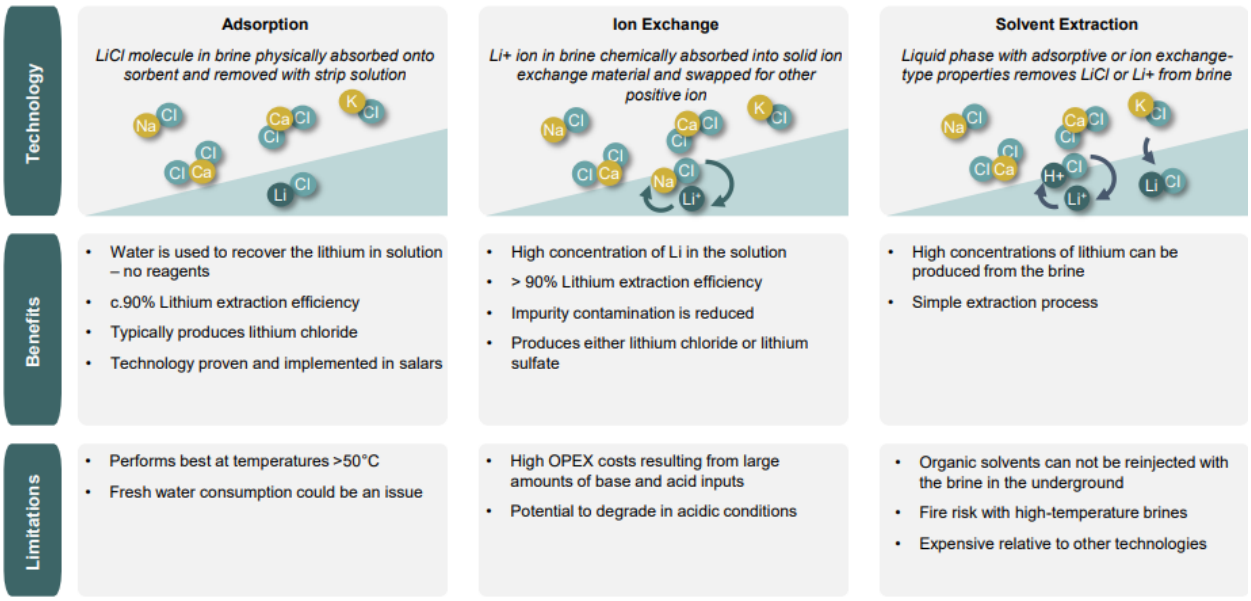
② **Ion Exchange** involves separating undesirable ions from the solution using a physico-chemical process that replaces them with other ions of the same electrical charge. The material used acts as an "ion sieve" with adjusted porosity that only allows lithium and hydrogen ions to pass through.

The sieve is then cleaned with an acidic solution that replaces lithium ions with hydrogen ions. Lithium recovery by ion exchange can change simply by adjusting the pH or temperature. Research conducted so far establishes a lithium recovery rate of 90% from the brine. The ion exchange technique limits the risk of impurities in lithium, and like adsorption, it can be used in brines with low lithium concentrations. However, it is costly in both Capex and Opex (base and acid, with additional costs related to storing highly hazardous and polluting products), and the acid can deteriorate the material.

③ **Solvent Extraction** uses an organic solution containing a solvent (kerosene) and an extractor to extract lithium from the brine (chemically or physically) and transform it into lithium chloride. This extraction theoretically allows for achieving lithium concentrations close to saturation and producing very high-quality lithium solutions for batteries.

This technique has the potential to produce lithium hydroxide (LiOH) and not just lithium carbonate. It is also low in Opex costs but is less suitable for brines with high impurity levels. However, organic solvents are polluting (in particular, the lithium-depleted brine cannot be reinjected underground without being decontaminated from solvents), difficult to store on-site, and highly flammable. Additionally, this technique requires higher Capex than for adsorption and ion exchange, primarily due to the faster corrosion of equipment.

Figure 7: Comparison of DLE Techniques for Lithium Production



Source : Société

Lithium de France tested several lithium extraction technologies in 2023 and 2024 at Equinor's research center in Trondheim, Norway, to determine the one most suited for Alsatian brine. The company has opted for adsorption with several technology suppliers.

- **Lithium de France** is expected to produce geothermal heat and lithium in two geographical areas in Alsace for which the company has obtained **PER** (two permits for "Les Sources" in 2022, "Les Sources Alcalines," and "Les Poteries" in 2023, and "Les Poteries Minérales" in 2024).
- **Lithium de France** controls the entire lithium production chain, from extraction to sale. As described in Fig. 8 below, in the DLE techniques for lithium production, brine is pumped from the underground and sent to a treatment unit where filters, membranes, or ceramic beads extract lithium from the brine in the form of lithium chloride (LiCl). The lithium-depleted brine is then reinjected into the aquifer. The lithium chloride obtained, which still contains ions (silicon, boron, magnesium, calcium), is subsequently refined in a plant with sodium carbonate, resulting in lithium carbonate (Li_2CO_3) that is free of impurities and ready to be shipped to industrial clients.

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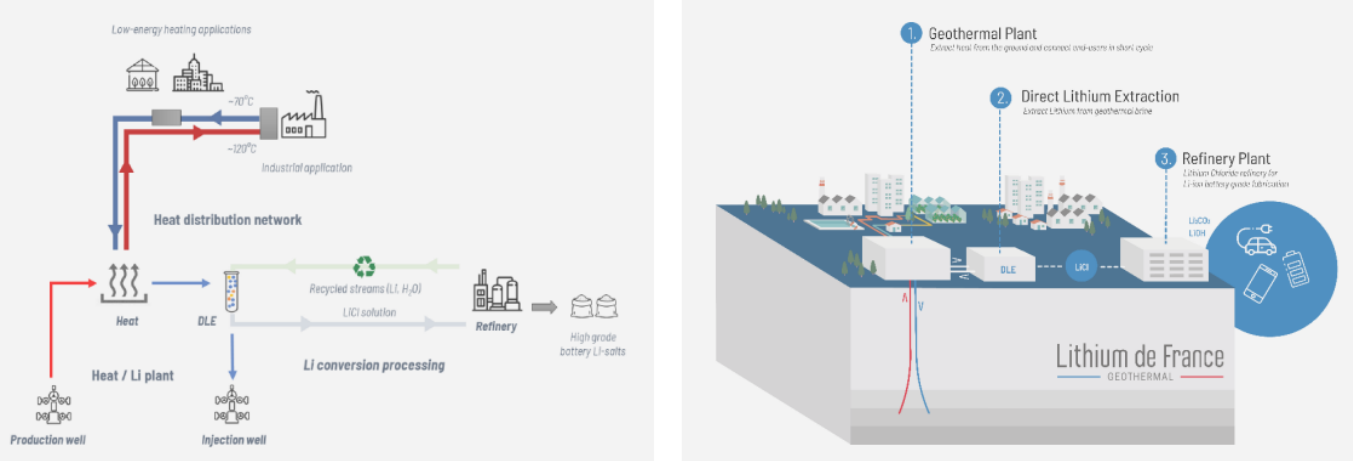
Figure 8: Lithium Production from Geothermal Brine



Source : Société

- **Lithium de France's Strategy**: Lithium de France aims to sell its battery-grade lithium production primarily through medium-term supply contracts with battery manufacturers and automobile manufacturers, while also seizing market opportunities. The company has already signed its first supply agreement with Renault in 2023 for the delivery of 25 Kt of lithium carbonate over five years.
- **Geothermal Heat Sales**: Unlike 2gré, Lithium de France plans to sell its geothermal production mainly to customers with constant heat needs throughout the year—specifically industrial clients—to optimize the lithium production process, which will be continuous.
- **Environmental Differentiators of DLE Techniques**: The environmental advantages of DLE techniques compared to traditional evaporation pond methods (salar) include faster production times (from hours or days instead of 9-18 months), the possibility of reinjecting the brine into the ground (significantly reducing water consumption), and utilizing smaller land areas (which facilitates local community acceptance).

From an economic standpoint, DLE techniques also hold favorable equations due to:

Lithium recovery rates ranging between 70% and over 90% (compared to 60-80% for hard rock extraction and 40-60% for evaporation in salars).

Annual operating and maintenance costs per ton produced are 15-25% lower than those from evaporation in salars, and DLE techniques are not weather- or climate-dependent.

Annual investment costs per ton produced are comparable to those of salars.

As a result, DLE techniques have a lower breakeven point compared to conventional methods, even though the total investment costs for DLE techniques can be significantly higher than for salars due to the increased productivity afforded by DLE methods.

- **PFS Results**: The results of the Pre-Feasibility Study (PFS) enabled Lithium de France to make decisions regarding technology, final product, production capacity, process efficiency, as well as investment and operating costs. The project shows improved profitability with reduced costs and increased efficiency. Specifically:

  - Before the PFS, the final product had not yet been determined between lithium carbonate and lithium hydroxide. After the study, the project is oriented toward the production of lithium carbonate.
  - Initially, the targeted annual production was 30 Kt of lithium hydroxide, equivalent to approximately 26.3 Kt of lithium carbonate. Following the PFS, the annual target production has been adjusted to 27 Kt of lithium carbonate, in line with new technical forecasts.
  - Prior to the study, the recovery rate was estimated between 80% and 85%. After the PFS, this rate was revised upwards to 91%, reinforcing the project's profitability and efficiency.
  - The technologies considered before the PFS included adsorption, ion exchange, or solvent extraction. The study selected the adsorption option as the most suitable for this project.

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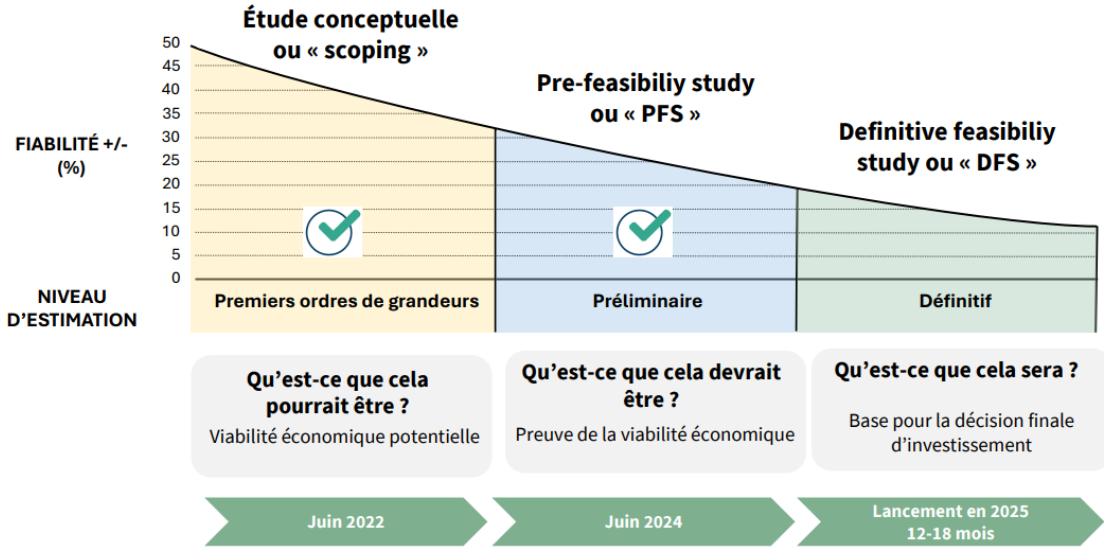
- The initial schedule projected heat production starting in 2026 and lithium production in 2027. However, after reevaluation, the new dates have been set for 2027 for heat production and 2028 for lithium production, to better synchronize the development phases.

Figure 9: Technical Progress Stages



Source : Société

- Lithium de France's goal for geothermal heat sales to third parties is 2.2 TWh/year. The total production capacity is closer to 3 TWh/year, of which 15% will be allocated to the operation of LdF's industrial facilities. The start of operations is scheduled for late 2027, with lithium production commencing in 2028, targeting 27 kt/year of lithium carbonate.

- Before updating the technical and financial assumptions for geothermal lithium production, the group planned to produce lithium monohydrate (30 kt/year ~ 26.3 kt/year lithium carbonate). The development of electric mobility will focus more on smaller vehicles (thus utilizing lithium carbonate batteries). This aligns with a genuine energy transition.
- According to preliminary estimates, this would require between €1.8 and €1.9 billion in Capex (including 15% contingency) depending on the phased approach adopted to reach full production capacity, with operating expenses of less than €4,500 per tonne of LCE and about €3.5 per MWh for geothermal heat production. This investment program could be partially financed through grants of up to 30% for the geothermal portion (Fonds Chaleur from ADEME).
- Arverne will also seek grants to fund lithium extraction. Under the French scheme, Lithium de France is potentially eligible for the Green Industry Investment Tax Credit (C3IV) as a producer of components for batteries. This tax credit applies a reduction of between 20% and 60% on the committed Capex and is capped at €200 million for the entire investment program.

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a) Colossal Stakes Surrounding Lithium

The lithium market is now the focus of colossal stakes on both economic and geopolitical levels:

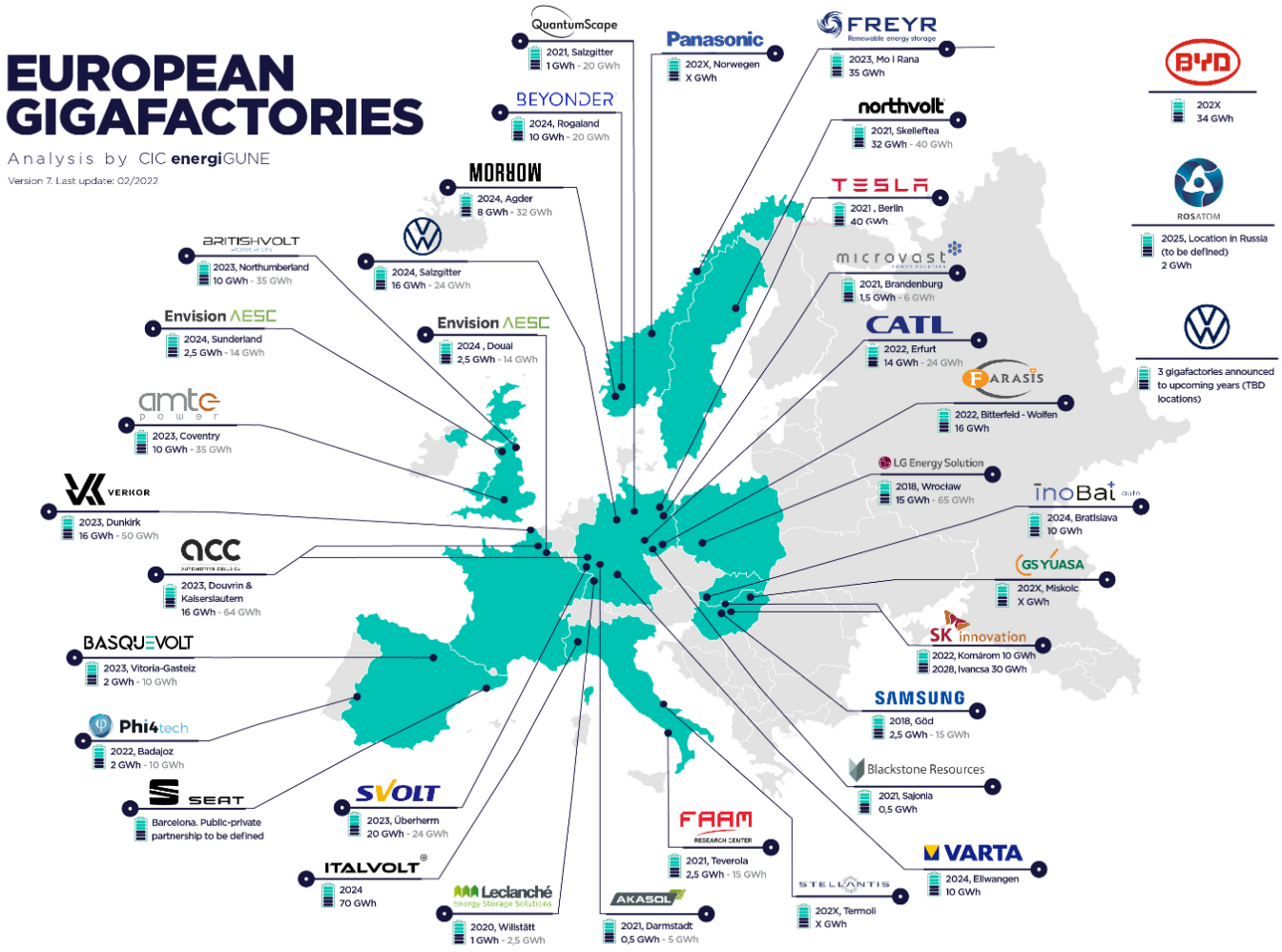
- **High Production Needs**: There is a significant emerging demand for lithium production in Europe due to the rapid establishment of battery factories to meet the automotive industry's needs, aiming to comply with the European directive to ban the sale of new internal combustion engine vehicles by 2035.

  Under these directives, the French government has set a target to produce over 2 million electric vehicles per year in France by 2030, which, according to France 2030, would require lithium extraction of 60-80 kt per year (500 kt per year for Europe).

  To achieve these objectives, four lithium-ion battery factories (the so-called "gigafactories") are planned in France with the support of the state and local authorities:

  - **ACC** (already opened for Stellantis, Total Énergies, and Mercedes, in Pas-de-Calais)
  - **Envision EASC** (planned for 2024 for the Chinese manufacturer Envision in Douai)
  - **Verkor** (planned for 2025 in Grenoble)
  - **ProLogium** (planned for 2030 in Dunkirk).

Figure 10 : Carte des usines de production de batteries en Europe



Source : CIC EnergiGUNE

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- **Automakers and Battery Manufacturers**: In Europe, automakers and battery manufacturers are anticipating the start of battery production through supply agreements with lithium producers, and even taking stakes in some of them. For instance, Renault has signed a supply agreement with Arverne (for 5 years) and Vulcan Energy (for 6 years) and has invested in Arverne. Similarly, Stellantis has signed a comparable agreement with Vulcan Energy (for 10 years) and invested in that company. Other major European manufacturers have also secured partnerships and supply contracts.

- G**eopolitical Context**: Amid ongoing geopolitical tensions, lithium production has become a political issue of sovereignty at the European level. Currently, all lithium produced, with 99% being imported, is extracted from deposits located in China (65%), Australia, Chile, and Argentina, while the refining of battery-grade lithium for manufacturing electric vehicle battery cathodes is carried out in China.

  In Europe, the goal is now to refine imported lithium within Europe or to extract and refine lithium directly in Europe to reduce dependence on imported refined lithium from China. In France, particularly in Alsace, the BRGM (Bureau de Ressources Géologiques et Minières) estimates the potential for lithium extraction from geothermal brine at over 10 million tonnes of equivalent carbonate (TEC), which could cover up to 40% of France's future lithium needs while simultaneously producing heat from a truly renewable, non-carbon, and non-intermittent source.

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b) Lithium de France stands out from the historical players in lithium

Lithium de France stands out from the historical players in lithium due to the geothermal nature of its lithium and its associated extraction method. To our knowledge, only Vulcan Energy employs similar methods in Europe—specifically in Germany.

- Aside from Arverne, a handful of companies have initiated lithium production projects from geothermal brines:
  - **Energy Source Minerals** and **Controlled Thermal Resources** in North America,
  - **Cornish Lithium** in the UK,
  - **Vulcan Energy** in Germany in the Rhine Basin (expected commissioning in 2025 of an extraction and processing plant capable of producing up to 25 Kt per year of battery-grade lithium hydroxide), and
  - **Eramet** in France (in partnership with Electricité de Strasbourg as part of a pilot research project in Alsace sponsored by the European Union, with the first samples of battery-grade lithium carbonate already produced, aiming to start lithium production in 2030 with a potential capacity of 10 Kt per year of lithium carbonate).
- Although dozens of companies worldwide are working on DLE extraction techniques, these must be tailored to each type of deposit.
  - At each site, extensive adaptation work is needed to account for the quality of the geothermal brine, its precise chemical composition, its temperature, and its pressure.
  - In this regard, Lithium de France collaborates with partners who already have DLE solutions and assembles them to utilize the DLE process best suited for the Alsace underground.
  - This process is currently being tested at Equinor's technology center in Norway. The results of these laboratory tests have been deemed positive by Lithium de France, which plans to soon test the processes on-site in Alsace.
- The major players in lithium extraction include **Albemarle**, **Pilbara Minerals**, **SQM** (Sociedad Quimica y Minera de Chile), **Tianqi Lithium**, **IGO**, **Jiangxi Ganfeng Lithium**, and **Mineral Resources**, collectively representing about 80% of the extraction market. Other national players exist, such as **Brasilian Lithium** in Brazil, **Bekita Minerals** in Zimbabwe, **Tolson Lithium** and **Galaxy Resources** in Australia, **Arcadium Lithium** in the United States, and **Grupo Mota** in Portugal.

However, all these companies extract lithium from hard rocks or large salars (brine evaporation basins), which are time-consuming, resource-intensive (notably in land and water), and highly polluting, and do not involve geothermal lithium at all. The main players in lithium refining are **Albemarle**, **SQM**, and **Tianqi Lithium** for lithium carbonate, and **Jiangxi Ganfeng Lithium**, **Albemarle**, and **Arcadium Lithium** for lithium hydroxide.

- Companies constructing lithium refining or conversion plants for imported lithium in Europe include **AMG Lithium** in Germany, **Rock Tech Lithium**, a joint venture of **Leverton/Helm**, and **Green Lithium** in the UK, **Galp**, and **Northvolt** in Portugal, and **Viridian Lithium** in France.
- Other companies are developing lithium extraction projects within Europe, from ore: **Keliber** in Finland, **European Metals** in the Czech Republic, **European Lithium** in Austria, and **Imerys** in France (Beauvoir site) and the UK (in Cornwall in collaboration with British Lithium).

The largest lithium mine in Europe was to be opened in Serbia (in Jadar), but the Serbian government halted the project and blocked the permit for Rio Tinto in 2022 following large protests.

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III. Business Model with High Operating Leverage

Summary of Objectives

In 2023, **Arverne Group** accelerated its investments, which significantly increased to **€21.7 million**, compared to **€5 million** in 2022. Excluding the acquisition of **GéoRhin (2gré)**, investments are distributed as follows:

- **€6.9 million** (vs. **€4 million** in 2022) in intangible assets, primarily for **Lithium de France**'s geothermal lithium extraction process development and the development of Lithium de France's exploration permits.
- **€2.5 million** (compared to **€0.6 million**) in technical installations, equipment, and tools mainly for drilling activities.
- **€12.2 million** (vs. **€0.3 million**) in other tangible fixed assets, primarily for the acquisition of additional drilling equipment and office buildings in Alsace for **Lithium de France**.

For 2024, **Arverne Group** aims for a gross activity volume of **€16-18 million**, considering **50% of DrillHeat's revenue** (approximately **€4 million** according to our estimates), and plans **€50 million** in capital expenditures, with **€9 million** already deployed in the first half of the year. The remaining **€40 million** will be dedicated to acquiring a rig (**€22 million**) and conducting seismic surveys. After accounting for these elements, we estimate the revenue target for **2024** will be between **€12 and €14 million**.

Management projects **Arverne Group** will achieve revenues of **€180-220 million** and an **EBITDA margin** of around **40%** by **2028**. For **2031**, they anticipate revenues of **€900-1,000 million** and an **EBITDA margin** of about **70%**, with cumulative capital expenditures (before subsidies) over the 2024-2031 period estimated at **€2.3 - 2.4 billion**. The detailed breakdown of activities is as follows:

1. **2gré**:
    - Begin heat production in **2026**, reaching an annual production of **1.8 TWh** by **2031**.
    - We estimate that to achieve this heat production goal, approximately **25 geothermal production units** (doublets + geothermal plant of **20 MW thermal producing 70 GWh per year**) will be required.
    - This will require approximately **€500 million** in cumulative investments by **2031**, or about **€20 million** per doublet.
    - The achievement of the heat production target is supported by a robust pipeline, which, as of September **2024**, includes:
        - **410 GWh** of projects under contract, fulfilling two conditions: surface qualification (land, future network, identified clients, ongoing prefeasibility) and affirmation of client interest, with cooperation and exclusivity agreements in progress.
        - **1,340 GWh** of projects in maturation: ongoing contractual and commercial discussions, with technical prefeasibility in progress.
        - **750 GWh** of targeted potential projects: ongoing geothermal potential studies, with high assurance of accessing geothermal resources.
        - **940 GWh** of identified prospective projects: client willingness to access geothermal energy, with potential geothermal qualification pending.
2. **Lithium de France**:
    - Produce **27 kt/year** of lithium carbonate by **2031** and approximately **2.2 TWh/year** of geothermal heat, with geothermal lithium production expected to start in **2028**, enabled by the installation of around **16 doublets**.
    - Our modeling is based on:
        - Operating expenses of less than **€4,500** per tonne of lithium carbonate.
        - **€3.5** per MWh in geothermal heat production costs, leveraging synergies on OPEX between lithium and heat production.
    - This would require **€1.8 - 1.9 billion** in Capex to reach full production capacity.
    - This investment program would be partially funded by subsidies, which can be as high as **30%** for the geothermal portion. However, it is noteworthy that the project would remain profitable even without the use of subsidies.
    - The significant organic growth implied by these objectives may be partially financed by potential third-party investor participation.

After the startup phase (2023 to 2027), characterized by capital expenditures (Capex), we estimate that operational balance will be achieved in **2028**. Capital raises remain a key aspect for the implementation of the zero-carbon project at **Arverne's** sites, while the funds needed for the initial phase remain relatively modest, at around **€50 million** in **2024**. We estimate a need for additional capital raises by the end of **2025 - early 2026** for approximately **€350 million** (with **€100 million** for **2gré** and **€250 million** for **Lithium de France**).

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Our forecasts for **Arverne** are based on the following assumptions and scenarios:

1. **Drilling**:
   - For **DrillDeep**, we anticipate that **DrillDeep** will increase from **4 rigs** at the end of **2024** to **6 rigs** by the end of **2026**, and we have conservatively assumed that the company will not invest in new drilling machines beyond **2026**.
     - The average estimated Capex for the purchase of two new drilling machines is **€22 million** per machine, and the rigs are amortized over **10 years**.
     - We estimate the annual maintenance revenue per drilling machine to be approximately **5%** of the purchase price of the machine.
     - The group currently has **3 deep drilling rigs**, with a fourth to be added in **2024**.
     - By **2027**, management aims to expand its fleet of drilling machines by adding one new machine per year.
   - For **Arverne Drilling Services**, we conservatively assume that the company will maintain its current contract portfolio (about **€10 million** per year at cruising speed).
   - For **DrillHeat**, we assume the company will remain equity accounted.
     - Therefore, its impact on the group's net income will only be visible in the results of equity-accounted companies.
     - We anticipate that **DrillHeat** will grow from **3 workshops** in **2023** to **42 workshops** by **2031**.
     - Revenue per workshop is expected to rise from **€1.5 million** in **2024** to **€2 million** in **2028**.
     - Operating expenses would represent **50-60%** of revenue, with overhead costs of **€300,000** per year per workshop.
     - The EBITDA margin is expected to range between **10% and 15%**.
     - In terms of Capex, we estimate **€1.2 million** per workshop.

2. **2gré**: For **2gré**, we have included the following assumptions in our model for revenue:
   - Heat production is expected to start in **2026**.
   - We believe that one rig can drill **3 doublets per year**. **2gré** will use **2 internal rigs** and **1 external rig** for doublet drilling, leading to an annual capacity to install between **6 and 9 doublets**.
   - An expected heat production of approximately **1.8 TWh** by **2031**, achieved with **25 doublets**.
   - Although there is potential for installing more doublets, our model assumes that **2gré** will not exceed **25 doublets**. All else being equal, the production target will be achieved.
   - A heat production price per doublet of **€65** per MWh for district heating networks, with a utilization rate of **87.5%**, an annual operating hour count of **3,500 hours**, and **70 GWh** produced, leading to a revenue per doublet of approximately **€4.55 million**. It is important to note that this is an indicative price, subject to updates based on market conditions at the time the geothermal plants become operational

2gré	2026	2027	2028	2029	2030	2031	2032
New : Doublet (2 wells) + Geothermal Plant	**2**	**4**	**5**	**6**	**5**	**3**	**0**
number of drill rigs required	1	2	2.5	3	2.5	1.5	0
Cumulated: Doublet (2 wells) + Geothermal Power Plant	**2**	**6**	**11**	**17**	**22**	**25**	**25**
Cumulative installed capacity, MW (20 MW per doublet)	**40**	**120**	**220**	**340**	**440**	**500**	**500**
Guidance, GWh produced						1800	
heat production, GWh	**37.4**	**268.5**	**617.5**	**962.9**	**1397.1**	**1652.8**	**1750**
heat selling price (€ /MWh)							
district heating network	65	65	65	65	65	65	65

Estimates TP ICAP

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In our model, we have incorporated the following assumptions regarding operational costs:

- **Drilling Rigs and Doublet Installation**:
  - Each drilling rig allows for the installation of **2 doublets per year**. To achieve our forecast of **25 doublets** by **2031**, we estimate that **2gré** will need **3 drilling machines**, including **one external rig**.
- **Operational Costs**:
  - We estimate the operational costs per doublet at **€20 per MWh**. This cost is associated with the integration of a **heat pump** into the solution, which entails additional expenses for the maintenance and operation of this system.

2gré	2026	2027	2028	2029	2030	2031	2032
Revenues	**2,4**	**17,5**	**40,1**	**62,6**	**90,8**	**107,4**	**113,8**
chg, %		617,9%	130,0%	55,9%	45,1%	18,3%	5,9%
OPEX/installed MW = 20 € /MWh	**0,75**	**5,37**	**12,35**	**19,26**	**27,94**	**33,06**	**35,00**
overheads	**2,1**	**3,4**	**4,7**	**4,9**	**5,2**	**5,2**	**5,3**
overheads by doublet	1,05	0,56	0,53	0,50	0,47	0,46	0,46
overheads as % of revenues	86,4%	19,3%	11,6%	7,9%	5,7%	4,9%	4,6%
EBITDA	**-0,4**	**8,7**	**23,1**	**38,4**	**57,7**	**69,1**	**73,5**
EBITDA margin	-17,2%	50,0%	57,6%	61,4%	**63,6%**	64,3%	64,6%
subsidies(30% of capex)	**12,0**	**24,0**	**30,0**	**36,0**	**30,0**	**18,0**	**0,0**
Annual recognition of subsidies	**0,6**	**1,8**	**3,3**	**5,1**	**6,6**	**7,5**	**7,5**
D&A	2,0	6,0	11,0	17,0	22,0	25,0	25,2
% of revenues	82,3%	34,4%	27,4%	27,2%	24,2%	23,3%	22,1%
EBIT	**-1,8**	**4,5**	**15,4**	**26,5**	**42,3**	**51,6**	**55,8**
Ebit margin	**-75%**	**26%**	**38%**	**42,3%**	**46,6%**	**48,1%**	**49,1%**
Debt cost - 60% of capex financed by debt (rate 5%)	**1,2**	**3,6**	**6,6**	**10,2**	**13,2**	**15,0**	**15,1**
Net income before taxes	**-3,0**	**0,9**	**8,8**	**16,3**	**29,1**	**36,6**	**40,7**
taxes (25%)	-0,8	0,2	2,2	4,1	7,3	9,2	10,2
RN	**-2,3**	**0,7**	**6,6**	**12,2**	**21,8**	**27,5**	**30,5**

Estimates TP ICAP

Finally, we have taken into account the following assumptions for the Free Cash Flow (FCF):

1. **Gross Capex** of **€20 million per doublet**, resulting in **€15 million net**, amortized linearly over a period of **20 years**.
2. **Subsidies** representing up to **30% of the Capex** related to the construction of doublets. For an investment plan of **€500 million**, the subsidies would amount to a total of **€150 million**. We have opted for a **20-year depreciation plan** for the subsidies (aligned with the amortization period of the Capex). We estimate a cash requirement of around **€100 million** post-subsidies and debt.

CAPEX	2026	2027	2028	2029	2030	2031
gross annuel Capex	**40**	**80**	**100**	**120**	**100**	**60**
capex cumulated	40	120	220	340	440	500
Guidance, M€ of CAPEX						500
net annuel Capex	**28**	**56**	**70**	**84**	**70**	**42**
net cumulated capex	28	84	154	238	308	350
Free cash flows	**-27,3**	**-44,4**	**-41,4**	**-36,5**	**-11,1**	**28,4**

Estimates TP ICAP

Once the investment horizon is reached, we achieve an EBITDA to FCF conversion rate of over **90%**.

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1. Lithium de France

For **Lithium de France**, revenue is divided into **heat sales (geothermal)** and **lithium sales**.

Geothermal Energy:

In our model, we have incorporated the following assumptions:

- **Heat production** would start in **2027**.
- The **installed power per doublet** would be equivalent to that of 2gré, i.e., **20 MW**, resulting in a production of **160 GWh per plant**, significantly higher than that of 2gré plants, given that geothermal plants associated with lithium production operate continuously throughout the year.
- An objective of **16 doublets** to be commissioned by the end of 2031, with an annual pace of 2 doublets in 2027, 5 doublets in 2028 and 2029, and 4 doublets in 2030.
- A **heat production of 2.2 TWh** in 2031, sold to industrial clients at **€45/MWh**, leading to revenue of **€7.2 million per doublet per year**. It should be noted that this price is indicative and non-binding, meaning it could change based on market prices. Additionally, **15% of the heat produced** will be self-consumed (approximately 384 GWh for 16 doublets annually), which will help reduce operating expenses.
- We estimate **operating costs per doublet** at **€3.5/MWh**.
- **Capex** is split into surface plant Capex (€15 million) and well Capex (€15 to €20 million), amounting to **€35 million** including piping and network connections.

Lithium:

For lithium, the following assumptions have been considered in our model:

- **Geothermal lithium production** would start in **2028**, ramping up to **27,000 tonnes** by 2032. For 2031, we expect **26 kt of lithium production**.
- Our assumptions suggest **1,700 tonnes of lithium per doublet** at full capacity, starting with **1,400 tonnes in 2027**.
- Our model is based on a **lithium price of €20/kg**.

Lithium prices have been volatile, as demonstrated between 2021 and 2023. There was a sharp increase in 2021, peaking at **€60,000/tonne in 2022**, driven by strong demand for battery-grade lithium as production capacities, particularly in China, expanded. In 2023, the price dropped to a low of **€10,550/tonne** due to decreased demand.

However, unlike the Chinese market—where the ecosystem is mature enough for the same buyers to contract with the same producers due to familiarity with lithium quality—there may not be a spot price for lithium produced in Europe initially. In the context of **European extraction ramp-up**, automakers and battery manufacturers are signing **offtake agreements** specifying quantities to be delivered.

For **Lithium de France**, we assume a **15% discount** on the lithium price compared to **€25,273/tonne** (the average price over 2017–2024), though this may be a conservative estimate. The lithium from Arverne's geothermal brine production is **battery-grade**, and the supply-demand balance may be different.

Relying on studies by lithium experts, we estimate that future prices confirm the viability of the Lithium de France project within the proposed timeline.

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Lithium de France	2026	2027	2028	2029	2030	2031	2032
PRODUCTION DE CHALEUR							
Nouveaux : Doublet (2 puits) + Centrale Géothermique		**2**	**4**	**5**	**5**		
Cumulés : Doublet (2 puits) + Centrale Géothermique		**2**	**6**	**11**	**16**	**16**	**16**
nombre de foreuses utilisées (2 internes et 1 externe)		1	2	3	3		
capacités installées, MW		40	120	220	320	320	320
facteur de charge		91,3%	91,3%	91,3%	91,3%	91,3%	91,3%
nombre d'heures de fonctionnement/an		8000	8000	8000	8000	8000	8000
					objectif so	2,2 TWh	
capacités de production post 15% autoconsommation, GWh		**50**	**622**	**1330**	**1926**	**2176**	**2176**
autoconsommation: 15% de la production, GWh		9	110	235	340	384	384
capacités de production, GWh		**59**	**731**	**1565**	**2265**	**2560**	**2560**
nouvelle capacité ajoutée		58,7	672,4	833,8	700,5	294,6	0,0
capacités de production en pleine régime sur l'année		320	960	1760	2560	2560	2560
prix de vente de l'énergie		45	45	45	45	45	45
				objectif société		27000	
Quantité de Lithium vendue, tonnes			490	8113	12400	26000	27000
prix de vente 1 tonne /Lithium, EUR			20218	20218	20218	20218	20218
production du Lithium T/doublet			1400	1475	1550	1625	1700
CA issu de la vente de chaleur		2,2	28,0	59,9	86,7	97,9	98,9
CA Lithium		0	10	164	251	526	546
CA total LDF		**2,2**	**37,9**	**223,9**	**337**	**624**	**645**

Estimates TP ICAP

The variable costs associated with producing one tonne of lithium are estimated to be less than **€4,500 per tonne**.

Lithium de France	2026	2027	2028	2029	2030	2031	2032
CA total LDF		**2,2**	**37,9**	**223,9**	**337**	**624**	**645**
cgt %				491,1%	50,7%	84,8%	3,4%
OPEX par MW installé = 3.5 € /MWh		0,21	2,56	5,48	7,93	8,96	8,96
OPEX = 4500 € /t carbonate de lithium		0,0	2,2	36,5	55,8	117,0	121,5
coûts de structure		17,6	50,7	71,5	72,8	72,8	72,8
% du CA		781%	134%	32%	21,6%	11,7%	11,3%
EBITDA		**-15,5**	**-17,6**	**110,4**	**200,8**	**424,8**	**441,5**
marge d'EBITDA		**-690,3%**	**-46,4%**	**49,3%**	**59,5%**	**68,1%**	**68,5%**
D&A	6,5	32,9	55,5	74,8	87,8	91,0	93,2
% du CA			146,5%	33,4%	26,0%	14,6%	14,4%
DA doublet subvention		0,6	2,4	5,7	5,7	5,7	5,7
EBIT		**-48,4**	**-73,1**	**35,6**	**113,0**	**333,8**	**348,4**
marge d'Ebit			*-193,0%*	*15,9%*	*33,5%*	*53,5%*	*54,0%*
coût de la dette (pour 62% des capex); taux 5%		9,8	17,7	25,0	27,6	27,8	29,2
Résultat avant impôts		-58,2	-90,8	10,6	85,5	306,0	319,2
impôts				2,7	21,4	76,5	79,8
Crédit d'Impôt Investissements Industrie Verte		17,5	28,0	17,5	82,2		
RN		**-40,7**	**-62,8**	**25,5**	**146,3**	**229,5**	**239,4**
minoritaires: 37 %		**-15,1**	**-23,2**	**9,4**	**54,1**	**84,9**	**88,6**
RNpg		**-25,6**	**-39,6**	**16,0**	**92,2**	**144,6**	**150,8**

Estimates TP ICAP

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Finally, we have taken into account the following assumptions for **Free Cash Flow (FCF)**:

- The total **net Capex**, including heat and lithium production, is estimated to be around **€899 million**. Additionally, **€150 million** will be added per refinery, with each refinery capable of processing approximately **10,000 tonnes of lithium**.
- Subject to a cap of **€200 million**, which we estimate will be reached by **2030**, the **Lithium de France** activity will be eligible for a **Green Industry Investment Tax Credit (C3IV)**. We also include subsidies for heat production activities (30% on doublets).
- We understand that the two Norwegian shareholders will cover the capex related to **Lithium de France**, accounting for **37% of the total capex** (estimated at **€1,900 million**). Based on these assumptions, we estimate a net cash requirement of approximately **€251.7 million** (post-subsidies and debt) for **Lithium de France**.

Gross capex	**1 900 M€**
Cash Flow Breakeven Point Over the Period:	1 450 M€
Equinor and Hydro's Share (37%)	
Arverne's Share (63%)	551 €
dont quote part Arverne (63%)	899 M€
Subsidies to Deduct (30% on Arverne's Share	269,7 M€
Financing on Net Capex After Subsidies (60%)	377,6 M€
Equity requirement	**251,7 M€**

Estimates TP ICAP

in EURm	Dec-26	Dec-27	Dec-28	Dec-29	Dec-30	Dec-31
NOPAT		**-48.4**	**-73.1**	**26.7**	**84.8**	**250.4**
Depreciation		**32.9**	**55.5**	**74.8**	**87.8**	**91.0**
CAPEX bruts		**540.0**	**500.0**	**500.0**	**260.0**	**64.0**
co-financement du Capex par les 2 actionnaires norvégiens		**199.8**	**185.0**	**185.0**		
Crédit d'Impôt Investissements Industrie Verte (restant)		**17.5**	**28.0**	**17.5**		
subventions / doublets		**12.0**	**36.0**	**66.0**		
Change in WCR		**0.1**	**1.8**	**9.3**	**5.7**	**11.8**
Free cash flows	**-88.5**	**-326.3**	**-270.4**	**-139.3**	**85.3**	**320.4**
cash conversion ratio					**42%**	**75%**

Estimates TP ICAP

Similarly to the case of 2gré, the conversion of EBITDA into Free Cash Flow (FCF) is expected to be high (estimated at over 70%) once the target operating level is reached.

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IV. Valuation : 9.5 € by share

- We have only considered one valuation method, the sum-of-the-parts approach, which we deemed most appropriate given the varying levels of risk across the group's activities.
- Based on the assumptions underlying the revenue, results, and capex projections detailed in the previous chapter, we arrive at a valuation of €9.2 per share.
- For our valuation of 2Gré, we applied a WACC of 12.6%, with the underlying assumptions presented in the table.
- For our valuation of LDF, we applied a WACC of 15.9%, with the underlying assumptions also shown in the table.

In building our model, we have incorporated conservative assumptions at various levels:

- A one-year delay in the company's target of 27k tonnes of annual lithium production, which would thus be reached in 2032 instead of 2031.
- For EBITDA margins, we project around 64% in FY 2031, whereas the group expects a margin of 70%. Regarding revenue for the same year, we estimate around €772 million, while management is guiding between €900 million and €1 billion. Our differences stem from lithium pricing (€20/kg in our model vs. €25/kg targeted by the group) and the ramp-up in revenue across the different activities.

The table below presents our model, leading to a valuation of €3.5 per share for the 2Gré business.

in EURm /2GRE	déc-26	déc-27	déc-28	déc-29	déc-30	déc-31	déc-32	déc-33	déc-34	déc-35	déc-36	déc-37	déc-38	déc-39	déc-40	déc-41
Sales	**2,4**	**17,5**	**40,1**	**62,6**	**90,8**	**107,4**	**113,8**	**120,0**	**124,2**	**130,4**	**136,9**	**140,6**	**144,2**	**147,8**	**151,2**	**154,6**
% chg			*130%*	*55,9%*	*45,1%*	*18,3%*	*5,9%*	*5,5%*	*5,1%*	*4,8%*	*4,4%*	*4,0%*	*3,6%*	*3,3%*	*2,9%*	*2,5%*
Operating profit before subsidiaries	**-1,8**	**4,5**	**15,4**	**26,5**	**42,3**	**51,6**	**55,8**	**60,0**	**65,6**	**71,5**	**70,0**	**72,4**	**74,7**	**77,0**	**79,3**	**81,5**
EBIT margin		***25,9%***	***38,4%***	***42,3%***	***46,6%***	***48,1%***	***49,1%***	***50,0%***	***52,8%***	***54,9%***	***51,1%***	***51,5%***	***51,8%***	***52,1%***	***52,4%***	***52,7%***
EBITDA Margin	***-17,2%***	***50,0%***	***57,6%***	***61,4%***	***63,6%***	***64,3%***	***64,6%***	***65,8%***	***67,4%***	***68,8%***	***70,0%***	***70,0%***	***70,0%***	***70,0%***	***70,0%***	***70,0%***
Theoretical tax (taxe rate 25%)		1,1	3,9	6,6	10,6	12,9	13,9	15,0	16,4	17,9	17,5	18,1	18,7	19,3	19,8	20,4
NOPAT	**-1,8**	**4,5**	**15,4**	**26,5**	**31,7**	**38,7**	**41,8**	**45,0**	**49,2**	**53,7**	**52,5**	**54,3**	**56,1**	**57,8**	**59,5**	**61,1**
Depreciation	**2,0**	**6,0**	**11,0**	**17,0**	**22,0**	**25,0**	**25,2**	**25,4**	**25,5**	**25,7**	**25,9**	**26,1**	**26,2**	**26,4**	**26,6**	**26,8**
as a % of sales	*82%*	*34,4%*	*27,4%*	*27,2%*	*24,2%*	*23,3%*	*22,1%*	*21,1%*	*20,5%*	*19,7%*	*18,9%*	*18,5%*	*18,2%*	*17,9%*	*17,6%*	*17,3%*
Annual depreciation of subsidies	***0,6***	***1,8***	***3,3***	***5,1***	***6,6***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***	***7,5***
gross annuel Capex	40	80	100	120	100	60	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
subsidies	12	24	30	36	30	18										
Capex net of subsidies	***28,0***	***56,0***	***70,0***	***84,0***	***70,0***	***42,0***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***	***3,5***
as a % of sales			*174%*	*134%*	*77%*	*39%*	*3%*	*3%*	*3%*	*3%*	*3%*	*2%*	*2%*	*2%*	*2%*	*2%*
WCR	**0,1**	**0,9**	**2,0**	**3,1**	**4,5**	**5,4**	**5,7**	**6,0**	**6,2**	**6,5**	**6,8**	**7,0**	**7,2**	**7,4**	**7,6**	**7,7**
as a % of sales	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*	*5,0%*
Change in WCR	0,12	0,75	1,13	1,12	1,41	0,83	0,32	0,31	0,21	0,31	0,33	0,18	0,18	0,18	0,17	0,17
Free cash flows	**-27,3**	**-44,4**	**-41,4**	**-36,5**	**-11,1**	**28,4**	**70,7**	**74,1**	**78,5**	**83,0**	**82,0**	**84,2**	**86,1**	**88,0**	**89,9**	**91,7**
Discounted free cash flows	**-21**	**-31**	**-25**	**-20**	**-5**	**12**	**27**	**25**	**24**	**22**	**19**	**18**	**16**	**15**	**13**	**12**

Sum of discounted FCF	89,0
Terminal value	132,2
Enterprise value	**221**
Net debt	100,0
Equity value	**121,3**
Diluted nbr of shares (m)	34,8
Valuation per share (EUR)	**3,49**

Risk-free interest rate	3,0%
Equity risk premium	7,5%
Beta	1,50
Return expected on equity	14,3%
Specific equity risk	2,5%
Interest rate on debt	5%
Tax rate	25%
Sales growth rate to perpetuity	2,5%
WACC	**12,6%**

Estimations: TP ICAP

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We conclude with a valuation of €6 per share for the LDF activity.

in EURm	dec-26	déc-27	déc-28	déc-29	déc-30	déc-31	déc-32	déc-33	déc-34	déc-35	déc-36	déc-37	déc-38	déc-39	déc-40	déc-41
Sales		2,2	37,9	223,9	337,4	623,6	644,8	665,7	686,3	706,4	726,0	745,1	763,4	781,1	797,9	817,9
% chg				*491,1%*	*50,7%*	*84,8%*	*3,4%*	*3,2%*	*3,1%*	*2,9%*	*2,8%*	*2,6%*	*2,5%*	*2,3%*	*2,2%*	*2,5%*
Operating profit		-48,4	-73,1	35,6	113,0	333,8	360,3	390,9	414,6	430,1	445,1	459,7	471,1	482,0	492,4	504,7
EBIT Margin				15,9%	33,5%	53,5%	55,9%	58,7%	60,4%	60,9%	61,3%	61,7%	61,7%	61,7%	61,7%	61,7%
EBITDA		-15,5	-17,6	110,4	200,8	424,8	453,5	481,5	504,6	519,4	533,8	547,8	558,6	568,9	578,7	590,5
EBITDA Margin			-46,4%	49,3%	59,5%	68,1%	70,3%	72,3%	73,5%	73,5%	73,5%	73,5%	73,5%	73,5%	73,5%	73,5%
Theoretical tax (taxe rate 25%)				8,9	28,3	83,5	90,1	97,7	103,7	107,5	111,3	114,9	117,8	120,5	123,1	126,2
NOPAT		-48,4	-73,1	26,7	84,8	250,4	270,2	293,2	311,0	322,6	333,9	344,8	353,3	361,5	369,3	378,5
Depreciation		32,9	55,5	74,8	87,8	91,0	93,2	90,6	89,9	89,3	88,7	88,1	87,5	86,9	86,4	85,8
as a % of sales			*146,5%*	*33,4%*	*26,0%*	*14,6%*	*14,4%*	*13,6%*	*13,1%*	*12,6%*	*12,2%*	*11,8%*	*11,5%*	*11,1%*	*10,8%*	*10,5%*
Capex nets		310,7	251,0	231,5	81,6	9,2	43,2	43,2	43,2	43,2	43,2	43,2	43,2	43,2	43,2	43,2
as a % of sales				*103,4%*	*24,2%*	*1,5%*	*6,7%*	*6,5%*	*6,3%*	*6,1%*	*6,0%*	*5,8%*	*5,7%*	*5,5%*	*5,4%*	*5,3%*
WCR		0,1	1,9	11,2	16,9	28,7	29,7	30,6	31,6	32,5	33,4	34,3	35,1	35,9	36,7	37,6
as a % of sales		*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*5%*	*4,6%*	*4,6%*
Change in WCR		0,1	1,8	9,3	5,7	11,8	1,0	1,0	0,9	0,9	0,9	0,9	0,8	0,8	0,8	0,9
Free cash flows	-88,5	-326,3	-270,4	-139,3	85,3	320,4	319,2	339,6	356,8	367,7	378,4	388,8	397,6	405,2	412,4	421,1
Discounted free cash flows	-74,5	-237,1	-169,6	-75,4	39,8	129,1	111,0	102,0	92,4	82,2	73,0	64,7	57,1	50,2	44,1	38,9

Sum of discounted FCF	289,3
Terminal value	290,8
Enterprise value	580,1
Net debt	251,7
Equity value	328,4
Diluted nbr of shares (m)	34,8
Valuation per share (EUR)	9,4
o/w Equinor (25%) & Hydro (12%)	121,5
Valuation per share (EUR)	3,5
Equity value	206,9
Valuation per share (EUR)	5,95

Risk-free interest rate	3%
Equity risk premium	7,5%
Beta	2
Return expected on equity	18%
Specific equity risk	5,0%
Interest rate on debt	5%
Tax rate	25%
Sales growth rate to perpetuity	2,5%
WACC	15,9%

Estimations: TP ICAP

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V. Lithium Prices: Short-Term Pressure, Long-Term Support

- ***In the short term, the benchmark price of lithium, based on Asian imports, may come under pressure and negatively impact investor sentiment***. *However, it should be noted that below a certain price threshold, the profitability of lithium producers becomes unsustainable, making this situation temporary.*
- ***The current volatility in lithium prices is largely due to a temporary destocking phenomenon.*** *The increase in production capacities, especially in Europe, does not represent a destabilizing factor given the high demand projections.*
- ***In the longer term, the strong expected demand for lithium should support higher prices, ensuring better economic viability for industry players***. *A rebalancing between supply and demand is anticipated, with necessary price adjustments to maintain producer profitability.*

The business model of Arverne is particularly sensitive to the evolution of lithium prices, which are currently showing **unfavorable short-term trends** (due to increased supply and stockpiling, especially because of the end of subsidies in China and the rise in production in Africa), **hovering around $10/kg, well below management's target of €25/kg. According to various sources, prices may remain low over the next two years**.
We anticipate that **lithium produced in Europe**, with a limited carbon footprint, will benefit from a premium compared to Asian benchmark prices. **European battery players will have a strong economic interest in favoring local sources, such as Arverne's, to meet environmental and sovereignty requirements (European battery passport).**

The start of Arverne's site, scheduled for late 2028, would coincide with a period where we anticipate a lithium price recovery, supported by several factors :

1) **Securing supply in the West for the critical resource that is lithium**. Europe and the United States are intensifying efforts to diversify and secure their supply sources, aligned with the IRA in the U.S. and the Critical Raw Materials Act in Europe.
   These policies will encourage investment in new local production capacities. France is expected to play a central role in European mining by 2030, with three operational sites (Beauvoir, Eugeli, and Les Sources de Lithium), representing 28% of European supply. In refining, Portugal and France are set to become major producers of lithium chemicals.
2) **Growing demand for electric vehicles (EVs). Global demand for lithium is expected to continue growing alongside increased EV production.** According to the International Energy Agency (IEA), **lithium demand could multiply by 42 by 2040.**
   Lithium remains a key element for electrification, especially for EV batteries, due to its exceptional lightness and conductivity. **While production capacities in China and Africa have rapidly increased at reduced costs, the scale of future demand will require substantial expansion of global supply.**
   For example, lithium-ion battery demand in Europe is expected to reach 800 GWh by 2030, requiring about 800 kt of lithium, while current global supply only exceeds 350 kt.

3) **Favorable long-term trends**. By 2030, **the rise of electric vehicles should support strong lithium demand, driving prices upward. However, new battery technologies could ease supply pressure**, with alternatives such as sodium-ion batteries. **In the long term, lithium prices are expected to rise to incentive levels necessary to stimulate investments outside China and Africa.** Some estimates suggest **the incentive price to ensure new production capacities could range between $19 and $23/kg. However, in China, prices may be lower**, around $15/kg, due to lower production costs. This trend will also depend on the implementation of protectionist policies and incentive programs, such as those in North America (IRA) or Europe (Critical Raw Materials Act), which may require even higher prices to cover the higher costs of lithium extraction and refining in Western countries.

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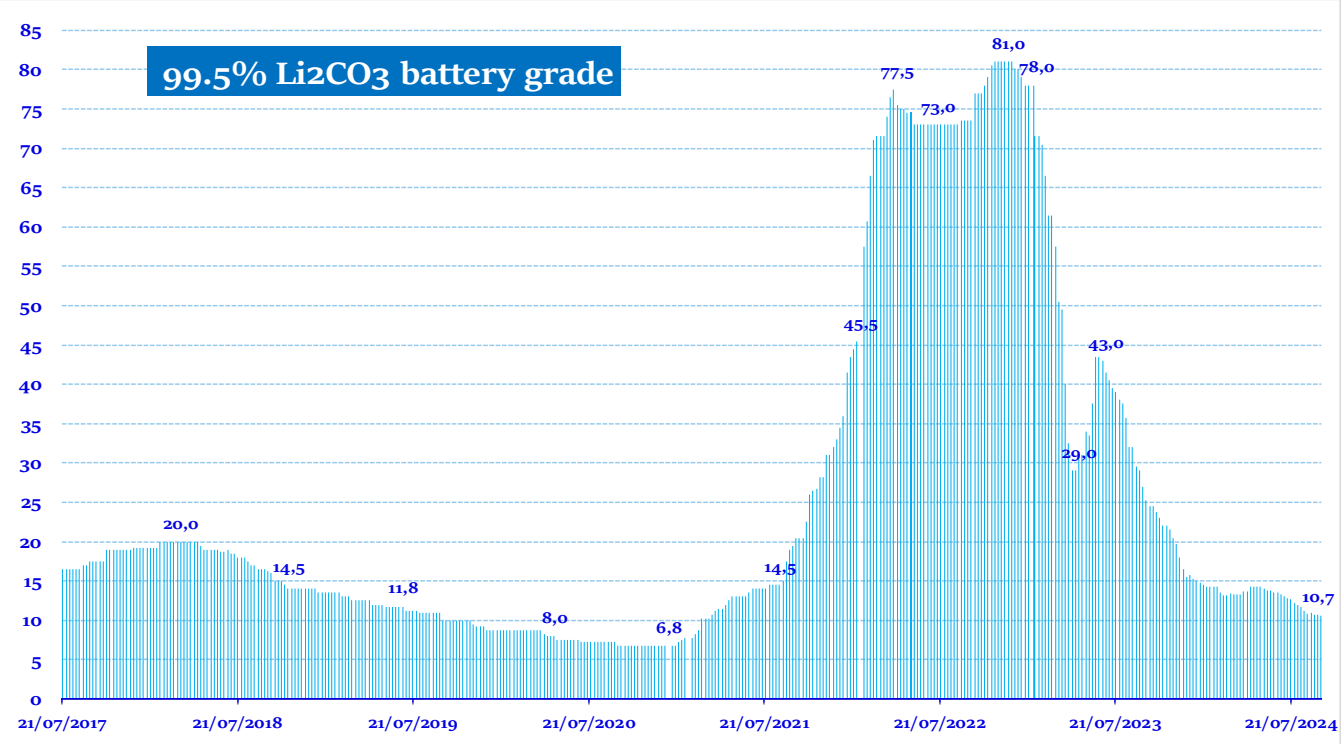
4) **Regional price differentiation. Lithium prices could vary regionally depending on local production capacities and supply chains.** Outside of China, prices could remain higher due to logistical costs and reduced volatility. **Although 16 new lithium extraction projects are set to launch in 2024, increasing global production by 90 kt of lithium carbonate equivalent (LCE), this additional capacity will remain insufficient to meet growing demand.** Indeed, **a long-term structural deficit is expected to maintain upward pressure on prices.** By 2030, lithium demand is expected to exceed available supply, reinforcing this upward trend.
In 2024, global LCE production is expected to increase by 26%, reaching 1.16 Mt, driven by these 16 new projects and three expansions, primarily in Australia, Argentina, and China. **This increase could result in a slight surplus of 10 kt in 2024, followed by a more significant** surplus of 100 kt **in 2025, before the market shifts into a deficit starting in 2029.** Hard rock deposits represent 63% of global production, with 31% growth expected in 2024. **Meanwhile, the European Union is striving to secure its supply through the Critical Raw Materials Act, though its objectives, particularly in refining, seem difficult to achieve.**

Market Dynamics: Key Phases in the Evolution of Lithium Prices

99.5% Li2CO3 battery grade, spot prices CIF China, Japan and Korea



Sources: Fastmarkets MB Lithium price, TP ICAP

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Période	Événements marquants
2013-2015 **Period of Relative Stability**	• Relative stability of prices around $6,000/ton for lithium carbonate • Moderate demand, primarily for rechargeable batteries for portable electronics
2016-2018 **First price boom**	• First price boom, reaching $17,000/ton in 2017 after surpassing the $10,000/ton mark in 2016. • This increase was driven by the anticipation of massive growth in demand for lithium-ion batteries for electric vehicles (EVs).
2019-2020 **Correction period**	• After the boom, prices underwent a correction due to an increase in supply and overproduction by some producers. • Price correction, dropping to around $8,000/t in 2020. • Overproduction and supply chain disruptions due to the paralysis of international trade resulting from lockdowns during the COVID-19 crisis.
2021-2022 **2nd price boom**	• In 2021, lithium prices soared again, reaching record levels. • Lithium carbonate prices reached approximately $70,000/t in 2022, while spodumene prices peaked at $6,000/t. • This increase was driven by a significant surge in demand for electric vehicles (EVs) and supply constraints exacerbated by logistical disruptions and production issues.
2023 **Decrease and stabilization**	• Prices decreased, with a 60% drop in lithium carbonate, while spodumene prices fell by 20%. • This decline was partly due to the end of Chinese subsidies for electric vehicles (EVs) and weaker demand. • Relative stability emerged, with spodumene prices fluctuating between $4,300/t and $4,850/t.

Source : TP ICAP

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FINANCIAL DATA

Income Statement	12/21	12/22	12/23	12/24e	12/25e	12/26e
Sales	12.6	10.7	10.1	12.4	20.8	28.2
Changes (%)	180.5	-15.0	-5.8	22.9	67.7	35.7
Gross profit	11.5	9.9	9.5	10.2	17.1	24.0
% of Sales	91.5	92.8	94.3	82.7	82.0	85.0
EBITDA	**-2.2**	**-1.7**	**-16.0**	**-20.7**	**-20.2**	**-20.0**
% of Sales	-17.4	-15.9	-158.7	-166.9	-97.1	-70.7
Current operating profit	**-2.4**	**-2.7**	**-13.8**	**-19.0**	**-25.5**	**-28.5**
% of Sales	-19.1	-24.9	-137.0	-153.2	-122.8	-100.8
Non-recurring items	0.0	0.0	0.0	0.0	0.0	0.0
EBIT	-2.4	-2.7	-13.8	-19.0	-25.5	-28.5
Net financial result	-0.0	-0.1	4.1	2.4	0.5	-4.2
Income Tax	-0.0	-0.0	1.0	1.5	3.5	4.4
Tax rate (%)	-1.6	-1.0	0.0	25.0	0.0	0.0
Net profit, group share	**-2.4**	**-1.6**	**-52.0**	**-16.0**	**-21.6**	**-7.4**

Financial Statement	12/21	12/22	12/23	12/24e	12/25e	12/26e
Goodwill	0.0	0.0	0.0	0.0	0.0	0.0
Tangible and intangible assets	8.8	11.2	58.6	105.3	172.3	263.7
Right of Use	0.0	0.0	0.0	0.0	0.0	0.0
Financial assets	0.3	0.0	0.0	-0.0	0.1	0.5
Working capital	1.3	-2.4	0.2	2.5	4.5	8.7
Other Assets	0.0	0.0	3.4	3.4	3.4	3.4
Assets	10.3	8.8	62.3	111.2	180.3	276.4
Shareholders equity group	3.1	-5.6	164.1	148.1	126.5	119.1
Minorities	0.1	0.7	14.3	12.2	11.6	-8.9
LT & ST provisions and others	0.2	0.0	2.2	2.1	2.1	2.1
Net debt	6.8	13.6	-123.8	-57.0	34.3	158.4
Other liabilities	0.1	0.0	6.1	6.4	6.4	6.4
Liabilities	10.3	8.8	62.3	111.2	180.3	276.4
Net debt excl. IFRS 16	6.7	13.6	-124.4	-57.6	33.7	157.8
Gearing net	2.1	-2.8	-0.7	-0.4	0.2	1.4
Leverage	-3.1	-8.0	7.7	2.8	-1.7	-7.9

Cash flow statement	12/21	12/22	12/23	12/24e	12/25e	12/26e
CF after elimination of net borrowing costs and taxes	-0.9	-0.4	-9.1	-15.3	-19.8	0.8
ΔWCR	0.6	-0.5	-4.5	2.2	2.0	4.2
Operating cash flow	-0.3	-0.8	-13.6	-13.0	-17.8	5.0
Net capex	1.7	5.1	22.0	50.0	75.0	124.9
FCF	-2.0	-6.0	-35.6	-63.0	-92.8	-119.9
Acquisitions/Disposals of subsidiaries	0.6	0.0	0.0	0.0	0.0	0.0
Other investments	0.0	0.0	0.0	0.0	0.0	0.0
Change in borrowings	-0.3	-1.2	-7.4	-14.6	-80.0	-95.0
Dividends paid	0.0	0.0	0.0	0.0	0.0	0.0
Repayment of leasing debt	-0.0	-0.1	-0.2	0.0	0.0	0.0
Equity Transaction	0.6	0.0	98.2	0.0	0.0	0.0
Others	1.0	2.8	0.7	4.0	5.0	6.0
Change in net cash over the year	-1.7	-6.4	52.7	-77.6	-172.8	-214.9

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1. DCF method: discounting of future cash flows generated by the company's operations. Cash flows are determined by the analyst's financial forecasts and models. The discount rate used corresponds to the weighted average cost of capital, which is defined as the weighted average cost of the company's debt and the theoretical cost of its equity as estimated by the analyst.
2. Comparable method: application of market valuation multiples or those observed in recent transactions. These multiples can be used as references and applied to the company's financial aggregates to deduce its valuation. The sample is selected by the analyst based on the characteristics of the company (size, growth, profitability, etc.). The analyst may also apply a premium/discount depending on his perception of the company's characteristics.
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4. Discounted dividend method: discounting of estimated future dividend flows. The discount rate used is generally the cost of capital.
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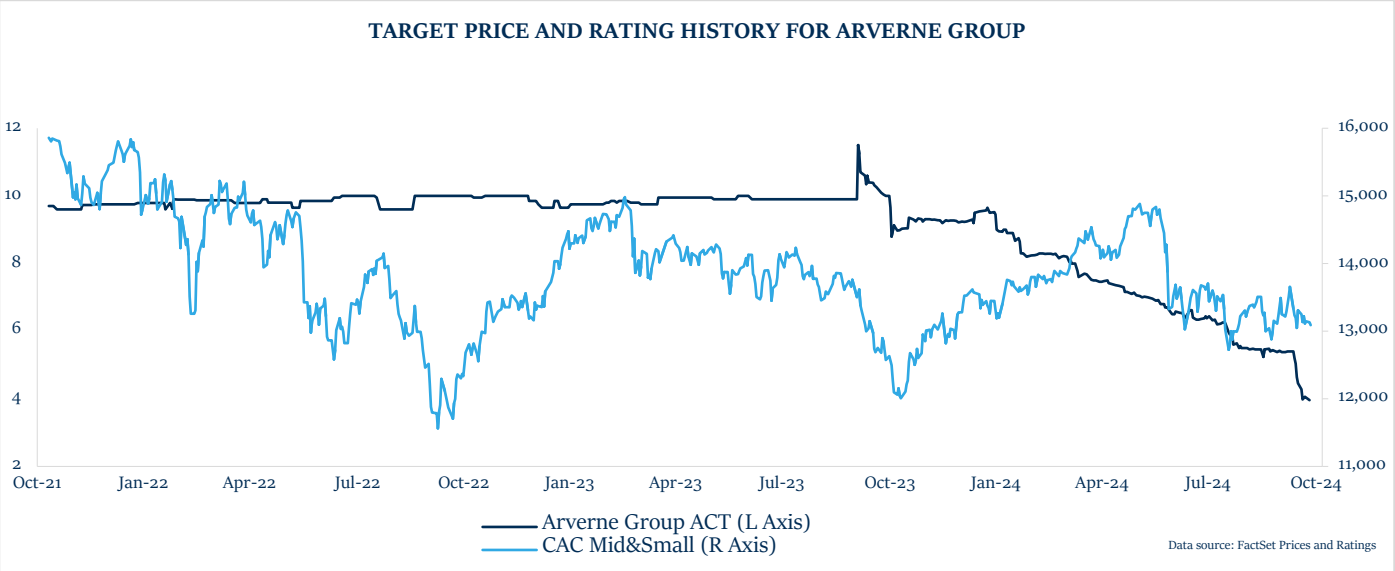

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