JENBACHER

ENHANCING CRYPTO MINING PROFITABILITY

Unlock new revenue streams with decentralized energy solutions

Industry needs

Crypto mining profitability depends heavily on lowering electricity and cooling costs. As energy demand and price volatility rise, miners require reliable, cost-effective, and flexible power solutions—whether through power purchase agreements (PPAs) or on-site generation. Reducing operational expenses and carbon footprint is essential, while unlocking new revenue streams, such as providing grid services, offers an important competitive advantage.

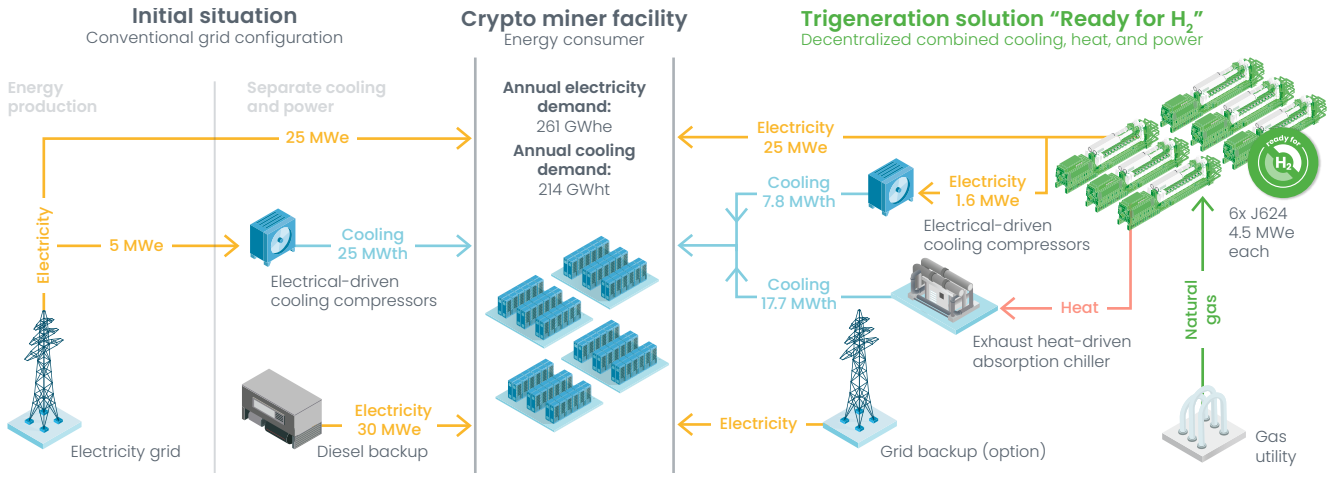
Business case simulation[1]

The exemplary business case presented is a simulation performed using dedicated simulation software.

The simulation considers installation sites in five different countries: U.S. (Nebraska), Kazakhstan, Australia, Argentina, and China (Hunan). It compares energy costs and CO_2 emissions across these regions.

This business case is illustrative only, and projects need to be evaluated on a case-by-case basis.

INNIO Group is pleased to provide individual business case simulations to explore customer-specific crypto mining projects.

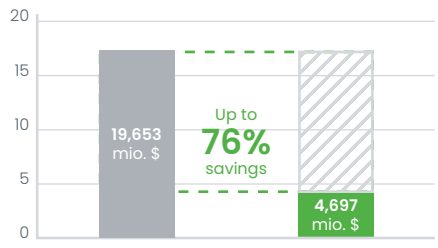


Business case simulation at a glance

Levelized cost of energy (in $/kWh)

Initial situation — With trigeneration

Annual energy costs (in millions of $)



Initial situation — With trigeneration

Amortization time

Up to **1-3** Years

CO_2 reduction

Up to **52%**

Assumptions

Reference case assumptions: cryptocurrency mining facility requiring 25 MW of electricity for IT devices, plus 5 MW for the cooling system (electric-driven chiller technology with a coefficient of performance (COP) of 5). Enhanced case assumptions: trigeneration configuration with six Jenbacher J624 cogeneration modules and 17.7 MWth of exhaust heat-driven absorption chiller capacity in addition to conventional electric-driven cooling compressors (5 x 1.56 MWth).

Why choose INNIO's Jenbacher technology for superior efficiency and cost savings in your crypto mining operations?

The cryptocurrency mining industry has experienced rapid growth, driven by the increasing value of digital currencies such as Bitcoin. This expansion presents both opportunities and challenges, as mining operations require significant energy for computation and transaction validation. Bitcoin mining alone consumes more than 100 TWh of electricity annually, exceeding the total electricity usage of some countries (see Figure 1). As highlighted by several academic studies, electricity costs are a key factor in determining mining profitability (see Figure 2).

Using natural gas, flare gas, biogas, or hydrogen, Jenbacher solutions deliver efficient and flexible energy for cryptocurrency mining. These systems provide reliable, cost-effective power and can be integrated with renewable energy sources to support lower carbon emissions. Well-suited for microgrid applications, Jenbacher generators offer stable power in remote or off-grid locations, helping to reduce reliance on traditional power grids and manage operational costs.

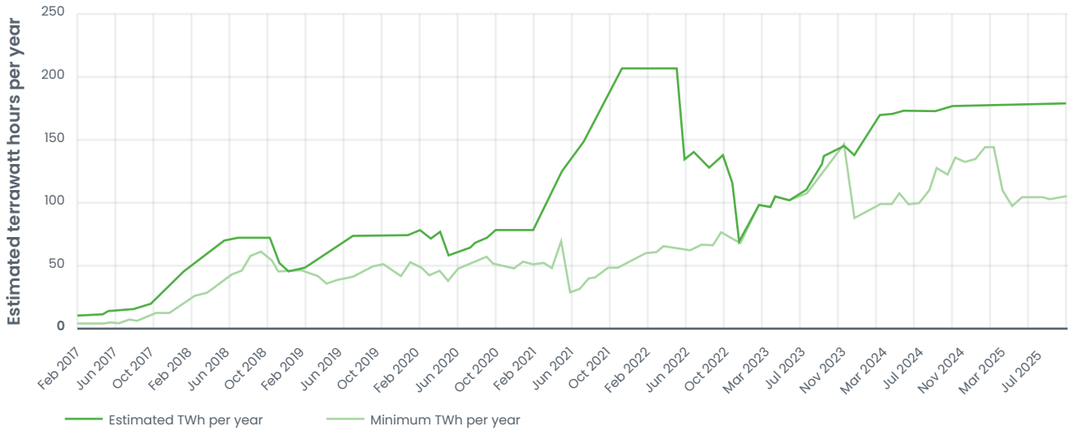


Figure 1: Bitcoin energy consumption worldwide
Source: statista.com/statistics/881472/worldwide-bitcoin-energy-consumption/

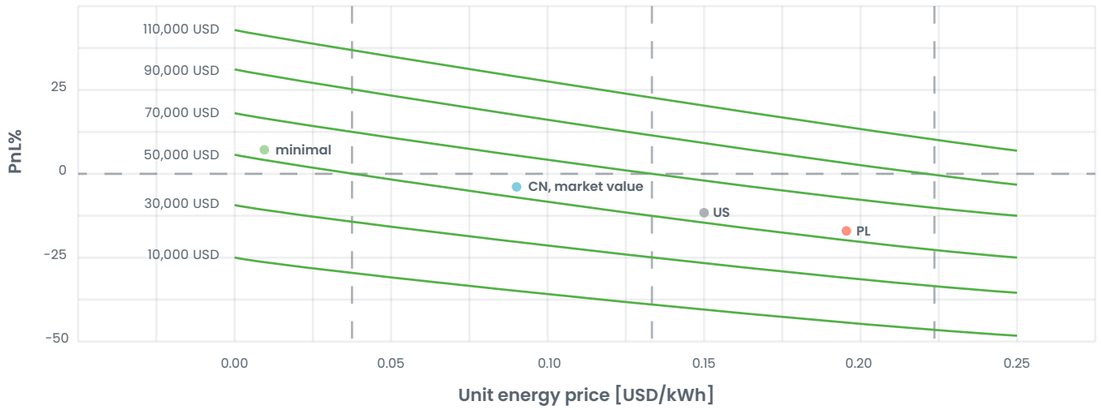
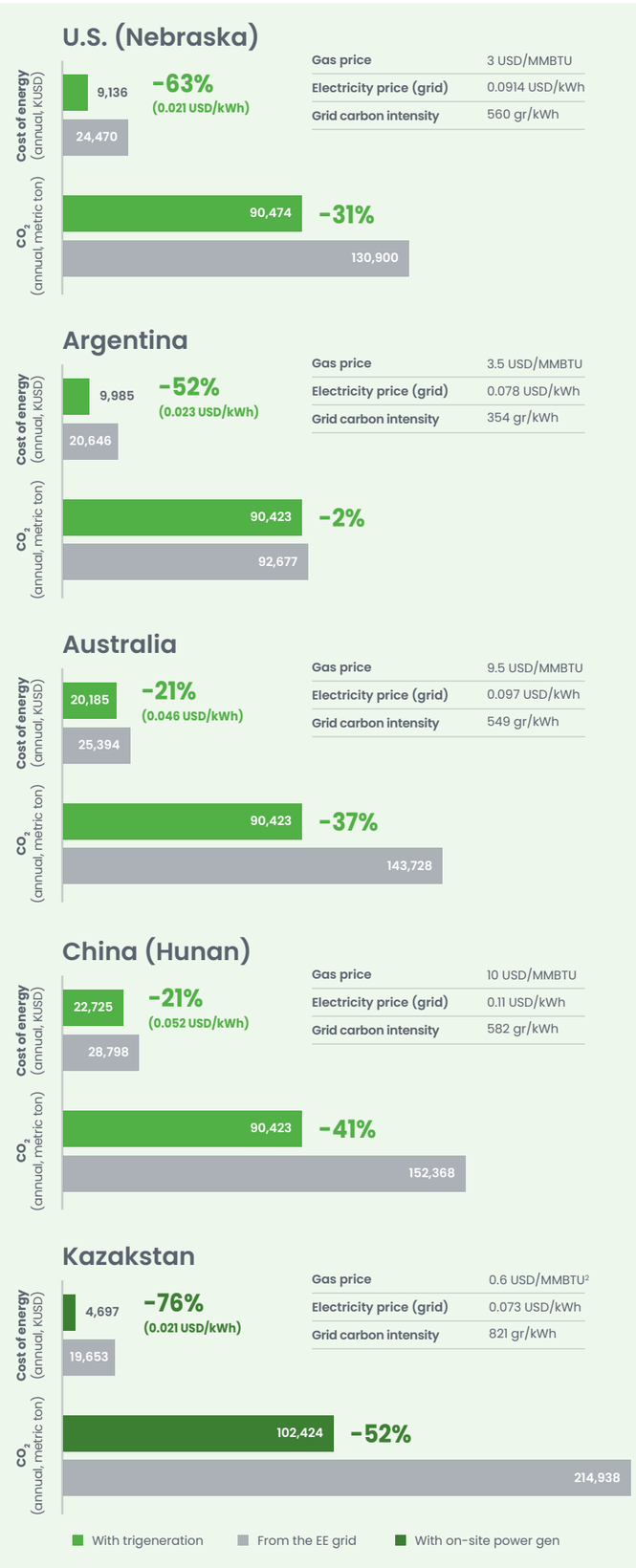


Figure 2: BTC mining profitability (PnL%) for different levels of unit energy price and BTCUSD price
Source: Energy and cost efficiency of Bitcoin mining endeavor; Jabłczyńska et al.; 2023

Using waste energy for cooling with trigeneration

In cryptocurrency mining, three main cooling systems are used today: air cooling, hydro cooling, and immersion cooling. Regardless of the chosen technology, a trigeneration system—featuring a gas engine, heat recovery, and an exhaust gas-driven absorption chiller—can significantly enhance overall efficiency. This setup reduces energy consumption by lowering air temperature for air cooling, water temperature for hydro cooling, and dielectric liquid temperature for immersion cooling.

The presented business cases on electricity and heat costs for cryptocurrency mining in selected countries demonstrate that this approach can significantly enhance operational efficiency while helping to reduce costs and carbon emissions.



The graphs on the left compare annual energy costs (in thousands of U.S. dollars) for a conventional solution (electricity from the grid) versus a trigeneration solution. They also illustrate the annual CO_2 reduction (in metric tons) achieved by each option for a 25 MW facility. In the trigeneration scenarios, energy costs include capital expenditure (CAPEX), natural gas procurement, and maintenance costs (OPEX) associated with the trigeneration system.

The simulation analyzes five different installation sites in selected countries, each with varying electricity and natural gas costs, as well as average grid CO_2 equivalent emissions.

In most cases, the trigeneration setup results in a significant reduction in annual energy costs.

Across all scenarios, the payback period for the investment ranges from one to three years.

Potential CO_2 reductions are especially notable in countries with higher average grid emissions, offering additional savings opportunities through mechanisms such as Emissions Trading Systems (ETS).

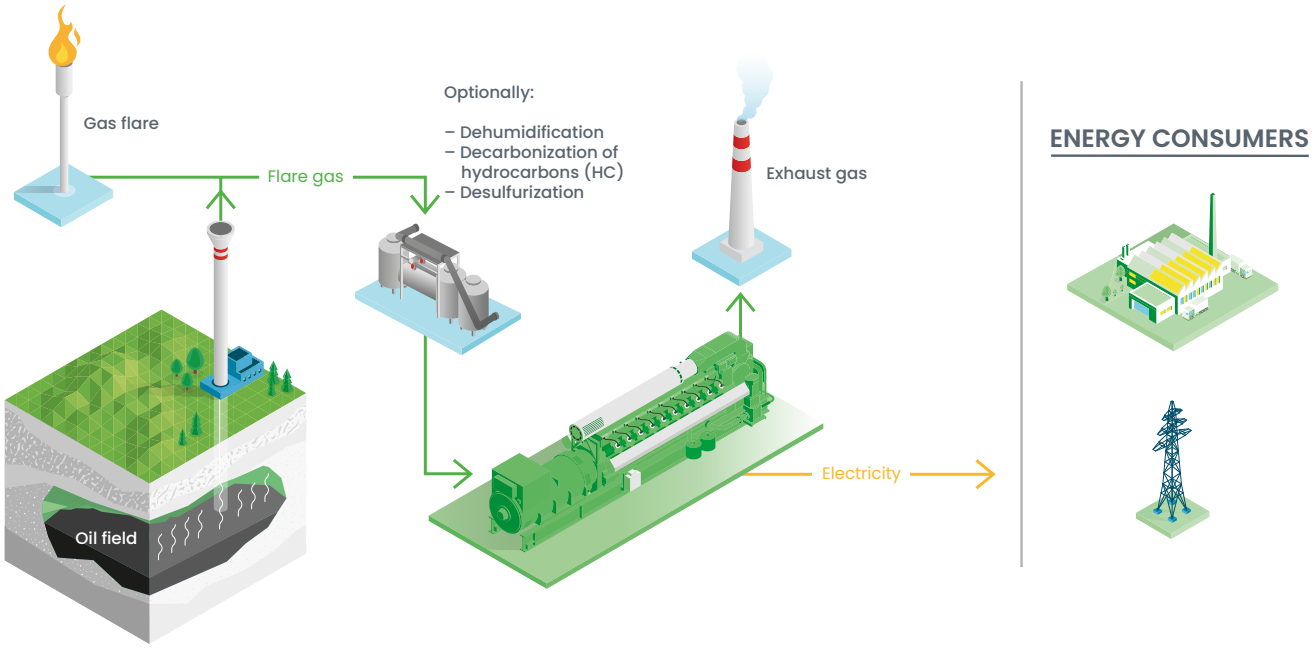
Figure 3: Comparison of annual energy costs for a conventional solution versus a trigeneration solution and corresponding CO_2 reduction potential for selected countries
Source: INNIO

When gas prices are exceptionally low, as shown in the Kazakhstan case study, the most cost-effective approach is to use electricity generated by on-site gas gensets to power the electric chiller.

[2] 0.6 USD/MMBTU equals 0.02 USD/m³

Flare gas: A cost-effective energy source for cryptocurrency mining

In the U.S., states rich in oil and natural gas have become particularly attractive for cryptocurrency miners. Flare gas, also known as associated petroleum gas (APG), is a byproduct of oil extraction. With Jenbacher engines, flare gas can be harnessed as an energy source.



Jenbacher technology has provided reliable energy solutions using APG since 1998, with more than 600 units shipped worldwide. In some U.S. states, using flare gas has become economically attractive. For example, North Dakota and Wyoming offer tax incentives for using otherwise flared gas in cryptocurrency mining. In New Mexico, regulations limit flaring to 2% of total gas production.

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