

A win-win: Exploring mutual benefits of voluntary industrial flexibility through a case study on Zinc's flexible offtake potential

Integrating appropriately remunerated and voluntary flexible energy consumption into industrial processes – for those industries which have the technical and economic capabilities to do so - can move the needle in terms of a cost- efficient energy transition while enhancing overall competitiveness, offering significant system benefits.

The electricity and energy-intensive industries are already collaborating in this direction, taking joint actions to integrate renewable energy sources at large scale and secure competitive electricity prices for industrial consumers. Such collaboration enables consumers to maintain business operation and production capacity, while reducing their exposure to price spikes through an active contribution in the transition.

What has changed? Flexibility matching variability = competitiveness

The electricity system has entered a new paradigm where variability, agility and adaptability are essential. In 2024, in Europe net-zero generation sources accounted for almost 75% of the electricity production. By 2050, variable renewables alone are expected to make up between 75-82% of the power mix. This shift away from fossil fuels reduces the amount of firm, dispatchable electricity generation in the system. As we align with climate, affordability, and security goals significant adaptation efforts are being made both on producer and consumer ends. Flexibility is critical to address these trends. While batteries, hydrogen, storage hydropower, nuclear and remaining thermal assets can provide flexibility on the supply side, it is essential to leverage the potential of those industries which indeed can offer such flexibility on the demand side.

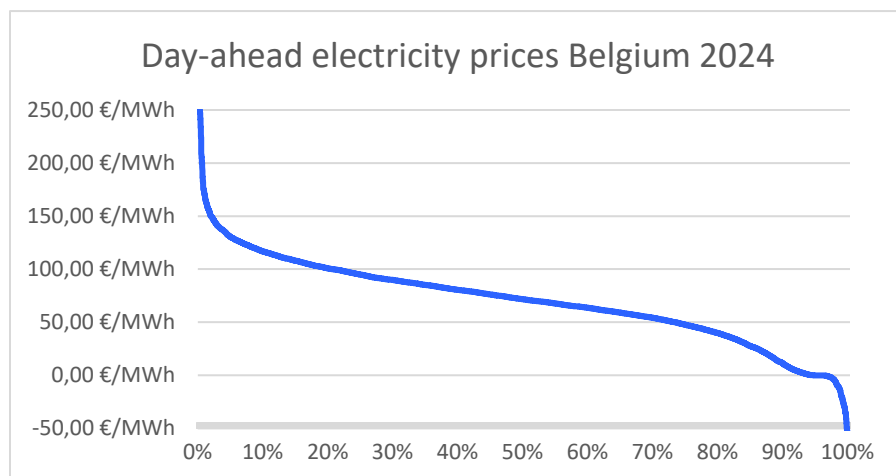
Zinc production through electrolysis is already a decarbonised and electrified energy intensive process. It is also one of the leading industrial production processes which can currently ramp up and down very quickly and very often, in line with renewable energy generation. While the electrolysis section of a zinc smelter can be switched down on short notice, any decrease of power means a change in production. This translates into output losses, impacting the economic viability of the plant. Yet, after investing in overcapacity and intermediate storage capacity, this flexibility service can be supplied at very low operational costs and with a limited energy efficiency loss, all while maintaining the production output.

Nyrstar's approach stands as proof of the flexibility potential and the value of system integration. The company is considering investing in a 'virtual battery' which will enable lower consumption in periods of high electricity demand or low renewable generation and higher consumption – and output – when renewable generation is high. For this, enabling support schemes and equal treatment with other flexibility technologies (such as storage, batteries) is necessary. This would allow this zinc producer to save money on its electricity bill, whilst maintaining the average production output necessary for its economy of scale and help bring down costs and indirect CO2 emissions for society at large.

The 'virtual battery' system would allow adaptation to fluctuations in energy supply, reducing their impact on total zinc production. A 300 kt/yr zinc smelter could provide a flexibility of up to 135 MW of power and around 7000 MWh of energy storage, provided the enabling financial support is in place.

What comes next? Moving away from the baseload paradigm to unlock cost savings

Between 2025 and 2050, the needs for daily, weekly and seasonal flexibility will at least double. Flexibility solutions will enable the system to manage periods of low renewable energy production while optimising surplus generation. It would also ensure that industrial consumers maintain or even increase their output (where technically possible), while actively engaging with the electricity market and tapping into its potential for cost-savings.



A case study in Belgium shows that consumers could reduce their electricity commodity cost by 12% in 2024 by avoiding the 10% most expensive hours in the day-ahead market. If 500 GWh of consumption could have been spread out over the 90% cheapest hours instead of over all hours of the year, the electricity commodity cost would have dropped from 70

euro/MWh to 62 euro/MWh, resulting in a saving of 4 mio euro. Further cost reduction can be achieved by arbitrating in the intraday market or by offering system services to the grid operator.

Flexibility could allow industrial energy consumers to lower electricity costs, but to unlock it, capital and/or operational expenditures are needed.

In light of this systemic transformation, Eurelectric and Nyrstar encourage:

- electricity generators and industrial consumers to assess if, where and how they can further increase system flexibility.
- system operators to continue to ensure grid security and flexibility through investments and grid development.
- authorities to activate the development of flexibility in the electricity markets, esp. of voluntary industrial flexibility, and to provide sound incentives for all technologies that allow to better integrate renewable production, such as demand-side flexibility of the industry, batteries or (hydrogen-ready) gas-fired power plants, in a cost-competitive way. Effective price signals from the market are essential in this context.
- policymakers to maintain the voluntary nature of investment in industrial flexibility, accounting for the technical potential and limitations of different industrial processes.

To accelerate the decarbonisation of our economy, electrification should always be encouraged and facilitated, including for baseload demand, when possible. Additional incentives to increase flexibility on a voluntary basis should come on top of the incentives for electrification.