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Energy-intensive industries: Innovative technologies toward climate neutrality

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Decarbonization. How?

Chemical sector
in the EU



- Strategic in the EU economy
- 2nd largest producer in the world
- 4th largest industry
- Employs 1.2 million highly skilled workers directly and 3.6 indirectly



3rd emitter of CO₂ in the region

The target



EU Green Deal to be climate neutral in 2050

The roadmap



- Electrification of processes
- Hydrogen with low-carbon footprint
- Biomass as alternative feedstock
- Waste reduction and reuse
- CCU & CCS
- Process and resources efficiency



The example



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What is hydrogen peroxide? Current context

- H₂O₂ is a widely used commodity chemical with a market evaluated at 3.6 billion € in 2020 and forecasted to grow to 4.7 billion € by 2026.
- Listed among the 100 most essential chemicals globally.
- The capacity in Europe reached 1.2 million tons in 2020, i.e. 35 % of the global production.
- Powerful, environment-friendly oxidant, produces only water as a by-product.
- Multiple applications:
 - Bleaching of pulp and paper, textile..
 - Disinfectant
 - Waste water treatment
 - Cleaning and etching electronic components
 - Chemical synthesis
 - Mining
 - ...



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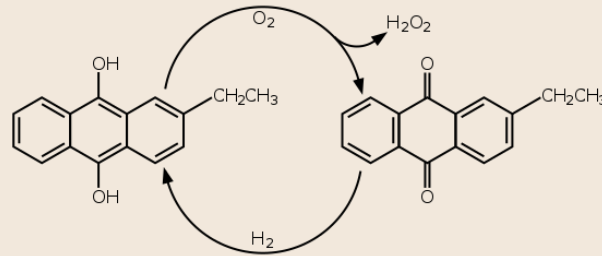
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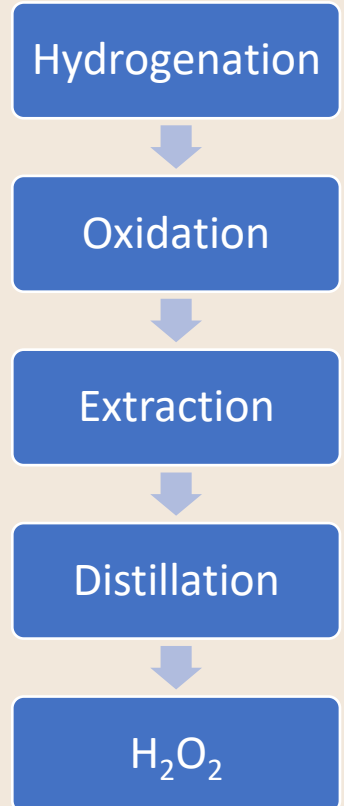
What is hydrogen peroxide? Current context

The current industrial production of H₂O₂ is based on the autoxidation process (AO)



- Sequential chemical steps of a mixture of organic compounds (solvents, quinones) and noble metal catalysts, followed by extraction and distillation.
- Hydrogen obtained generally by SMR → High CO₂ emissions
- Oxidation use compressors → High energy consumption
- Distillation use steam to concentrate → High energy consumption
- Purge of organics lead to waste generation
- Purge of gases lead to VOC emissions

Environmental
Challenge



Power2Hype



- A four-year project that will establish a new electrochemical production route for hydrogen peroxide.
- Using air and water, and driven only by renewable energy as the sole energy source, this new approach addresses an economically viable and green alternative to the classical anthraquinone oxidation (AO) process.
- Direct GHG emissions and indirect energy GHG emissions are almost entirely eliminated
- Project started in January 2023



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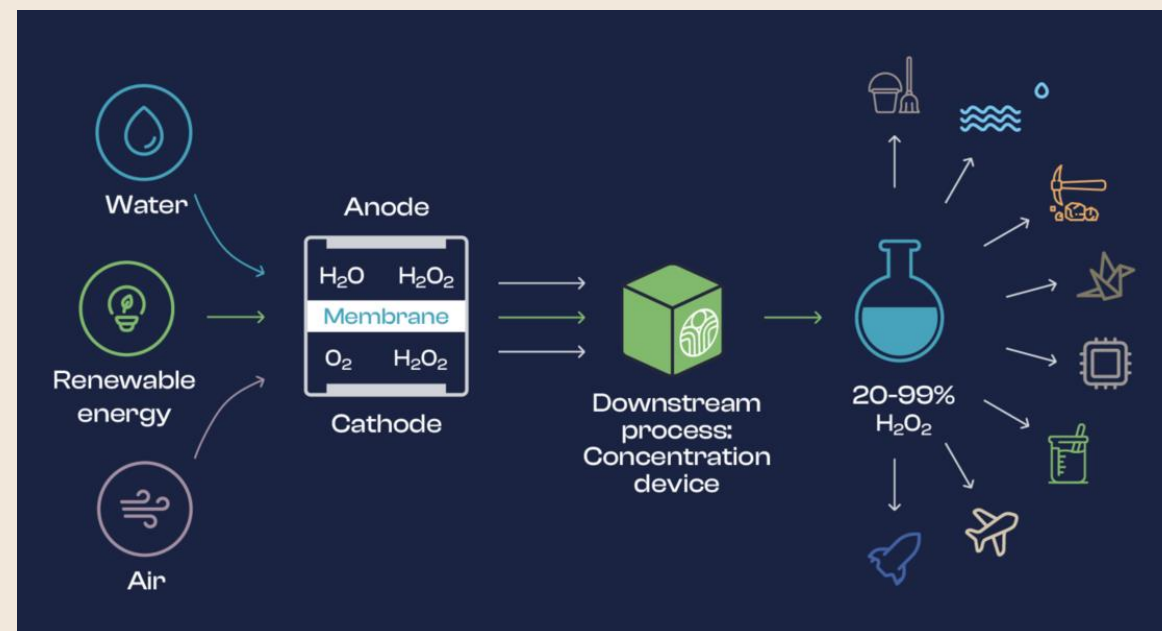
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Our approach

- Power2Hype aims to establish a sustainable route for hydrogen peroxide (H₂O₂) purely electrically-driven
- It will be synthesized through paired electrolysis simultaneously at anode and cathode, employing and innovative custom-made electrolyzer.
- Strives to electrify and decentralize H₂O₂ production, suitable to any required concentration for different market applications.
- Possibility to be generated on-site



Our R&I steps



The R&D activities include a 6-step process:

- **Material development.** Advanced and commercially viable materials and cell components for large-scale production:
 - Catalysts
 - Gas diffusion layers
 - Ion exchange membranes
 - BDD anodes
- **Cell design.** Integrate the complete stack and components. From 10cm² cells up to 200 cm² cells, stacked and integrated pre and post-reaction
- **Downstream processing.** To increase the hydrogen peroxide concentration in the product stream.
- **Pilot and demonstrate** the process viability. Certifying the components lifetime and integration over a long period of time
- **Energy load balancing.** Evaluate the feasibility for usage with different energy sources, focused on fluctuating renewable power supply
- **Digital twin and LCA** by experts will determine the environmental, societal, and economic potential of Power2Hype.



Our impact vs. AO process



- Achieving better overall energy efficiency. Targeting more than 25% energy savings
- Complete elimination of direct CO₂ emissions using green electricity
- Sustainable materials, leaving no subsequent generation of waste or side products
- Complete elimination of VOC emissions, since no organic compounds are used
- Using low-energy downstream process at any given concentration up to 99%
- Adapting to intermittent availability of renewable electricity
- Decentralize the production, eliminating transportation GHG emissions



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Thanks



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