Current Trends and Challenges in the Chlor-Alkali Service Industry

Euro Chlor 12th International Chlorine Technology Conference & Exhibition
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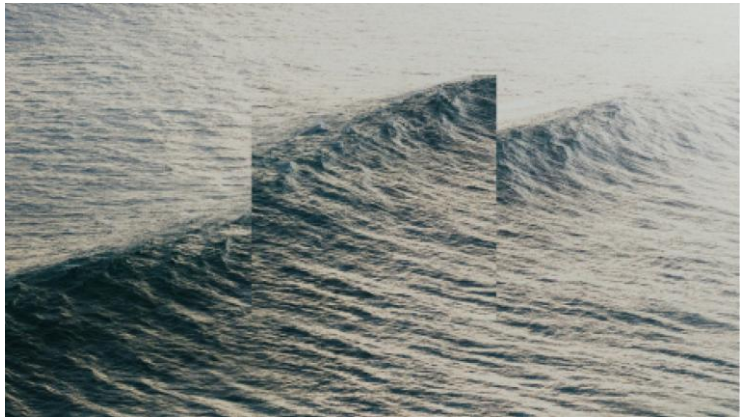
AGENDA

Threads

- Metal and precious metal market
- Energy Price development

Vision

- Optimization of plant load
- Adaption of production rates based on the fluctuations in energy prices
- Keep your plant flexible for future challenges



Realization

- With focus on cell upgrade, check the option for b32 installation
- Carry out de-bottleneck study

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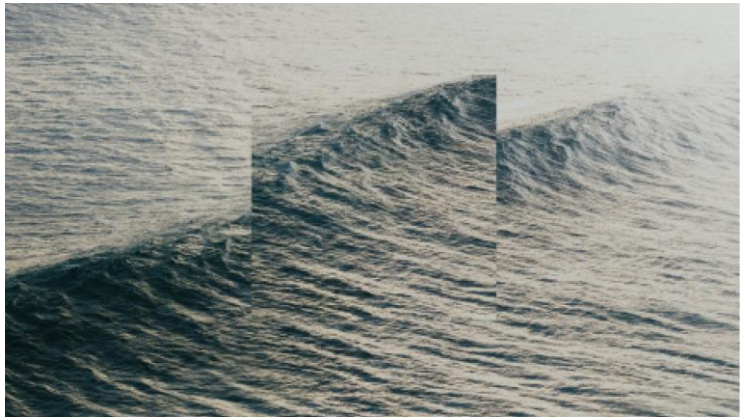

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Typical questions all C/A producers are nowadays dealing with!

Rising energy costs

Unsafety by noble metal price development

Higher share of renewable energy

Cell Upgrade or Recoating?

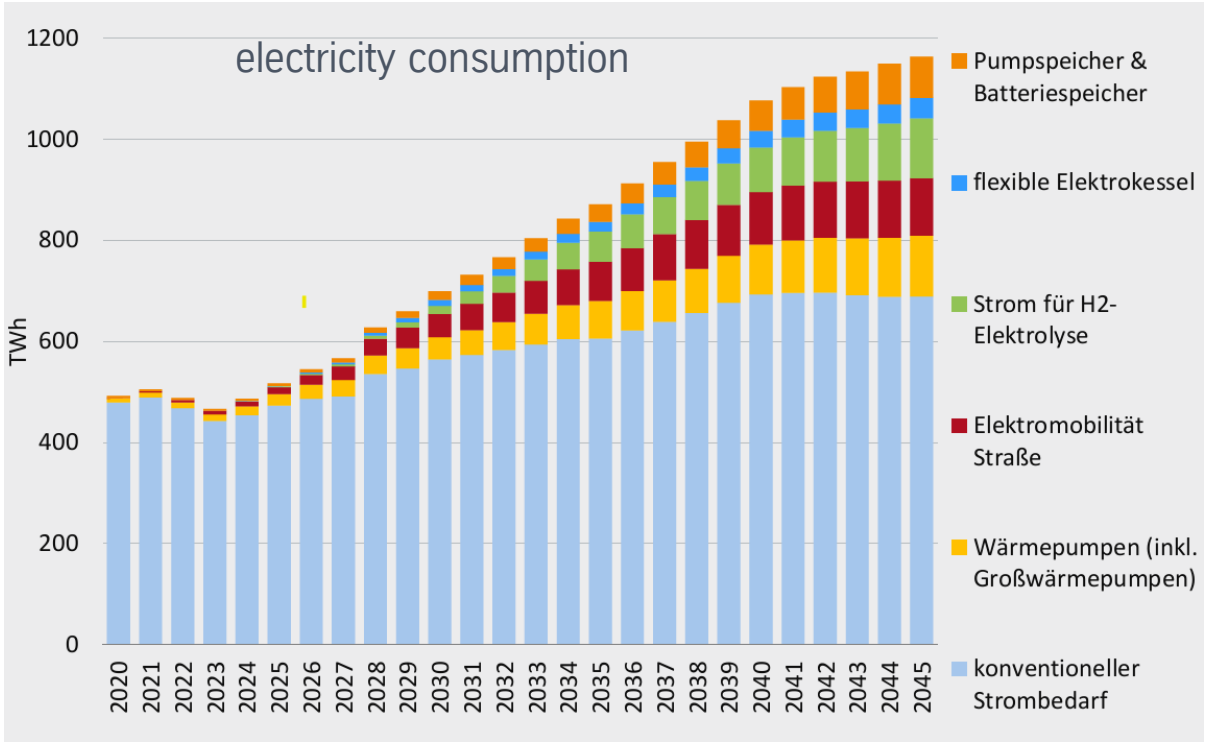
Is the plant design ready for the future?

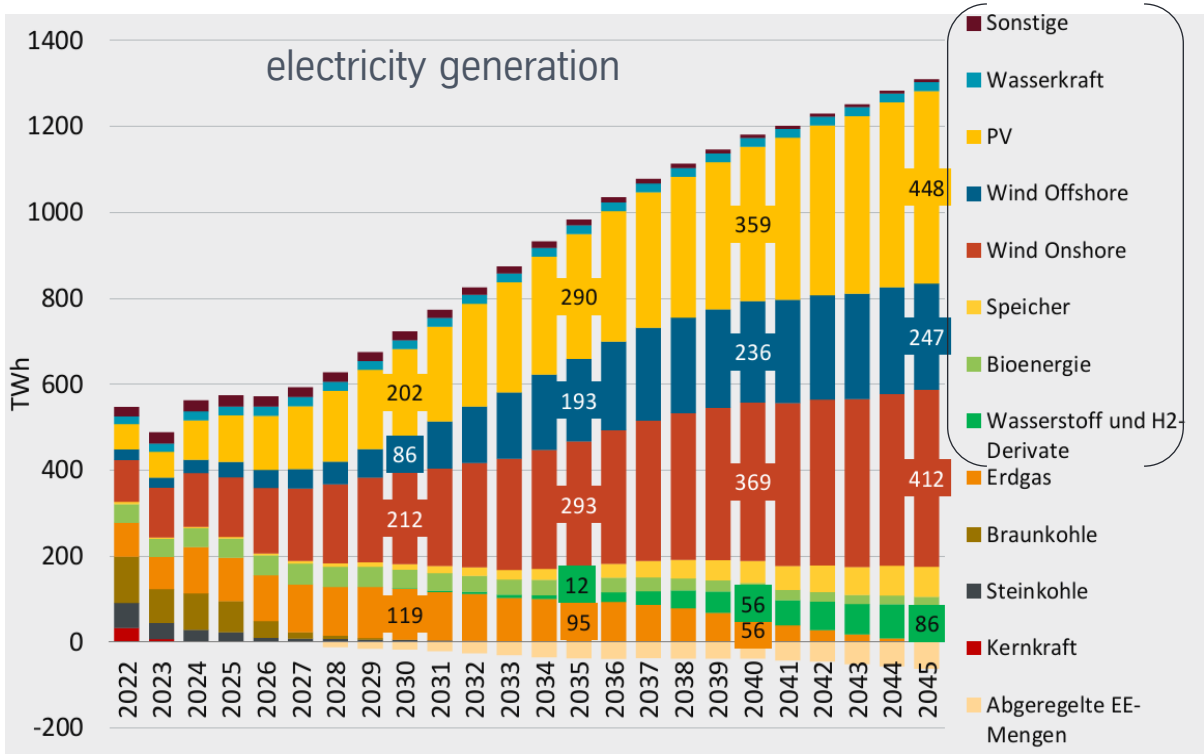
Maintenance schedule achievable?

Energy price development and fluctuations

Assumption: electricity consumption and result: electricity generation

Around 80% net electricity generation from renewable energies by 2030





Source: vbw Die bayrische Wirtschaft / Prognos AG

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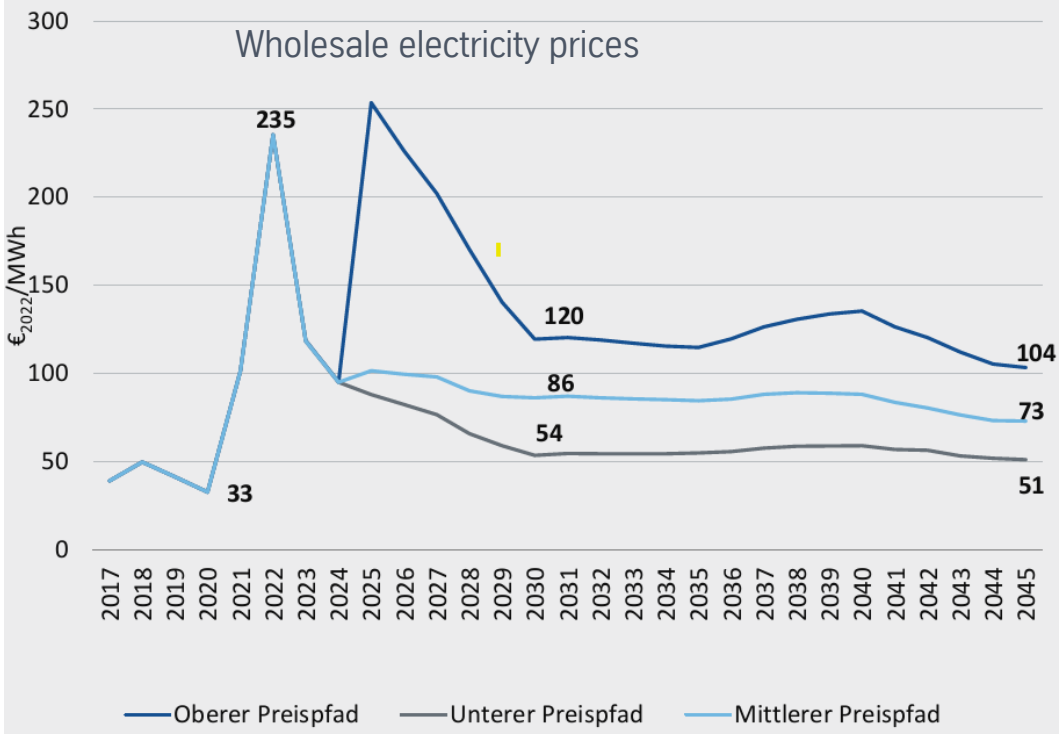
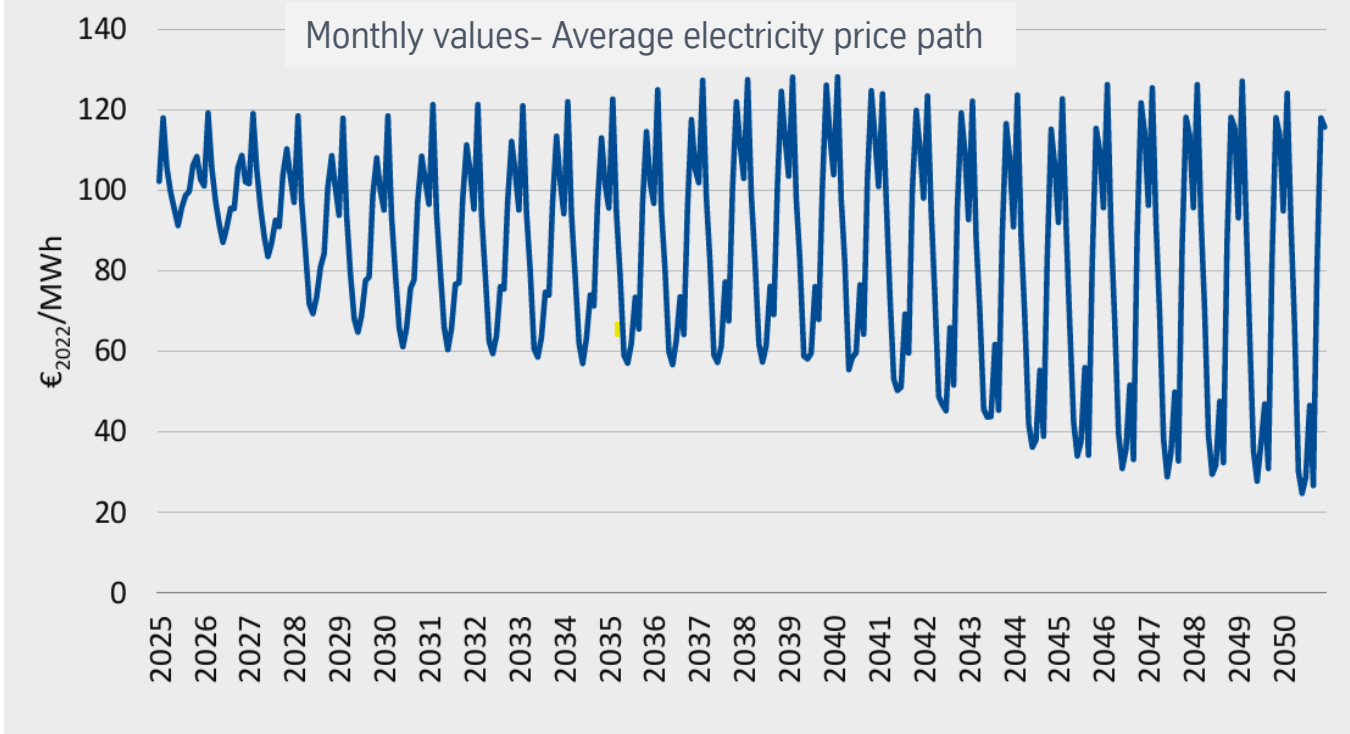
Energy price development and fluctuations

Forecast for wholesale electricity prices and increase in volatility



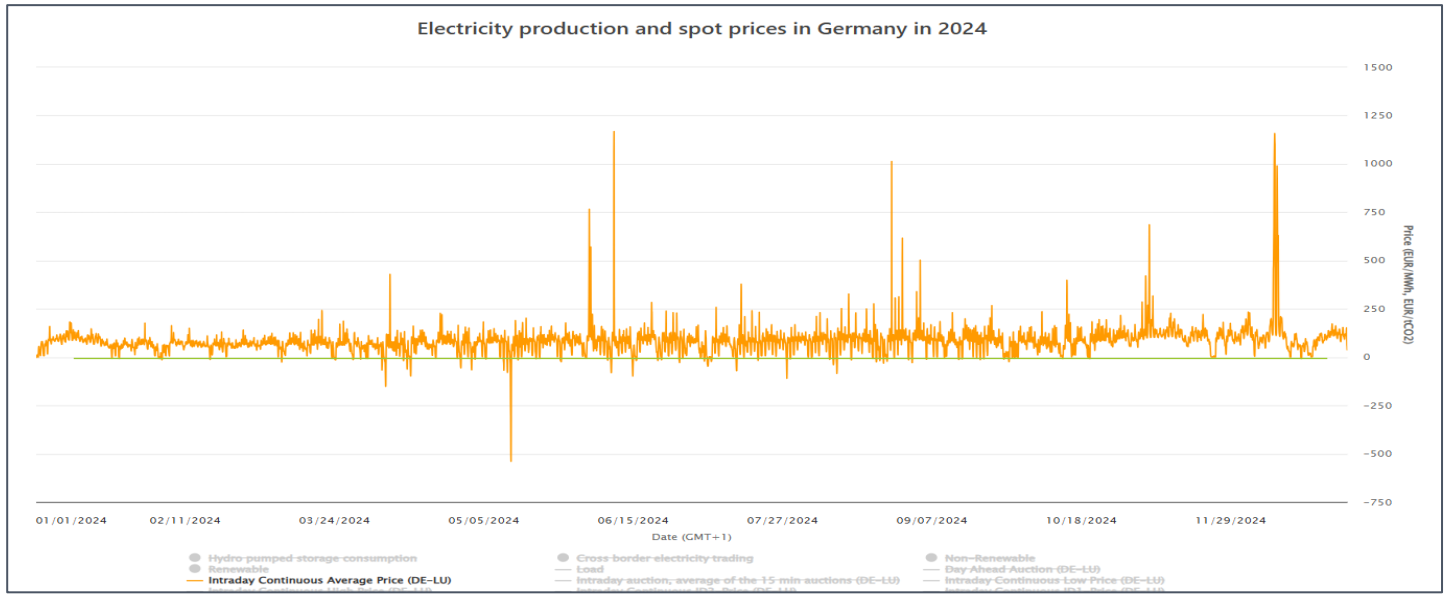


The development is subject to a high degree of uncertainty, differences between upper, middle and lower electricity prices

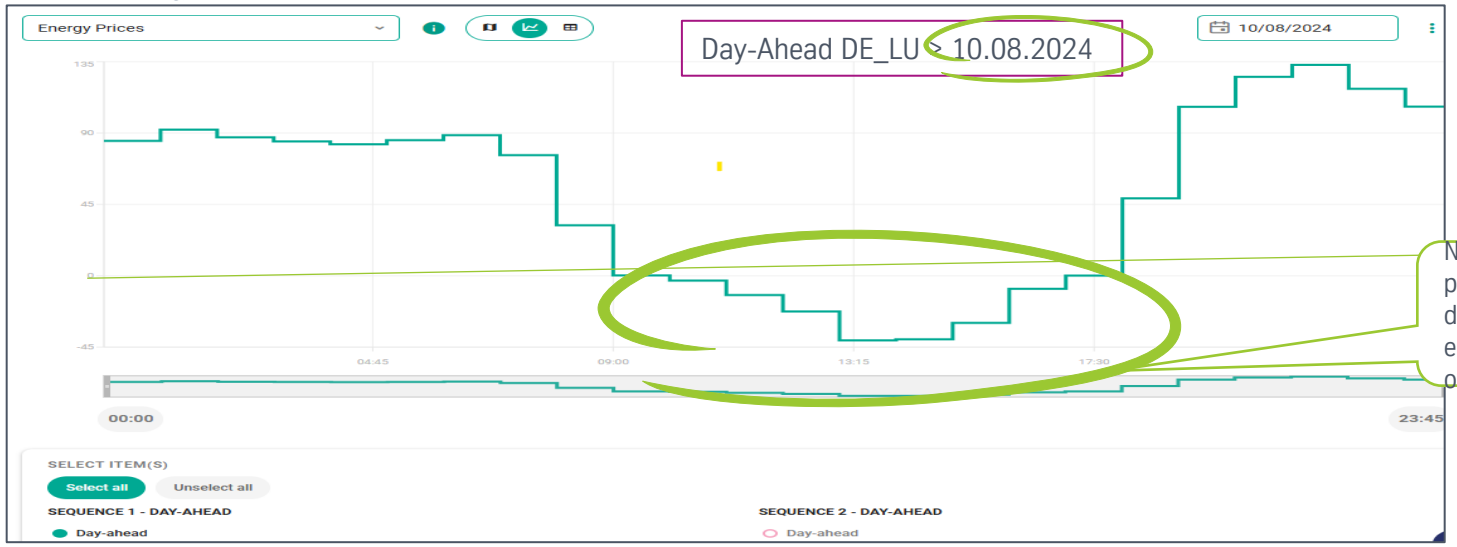
Fluctuation in monthly electricity prices is increasing
Reasons: Expansion of photovoltaics (increase in seasonality)
Prices in summer fall more sharply than those in the winter months

Source: vbw Die bayrische Wirtschaft / Prognos AG

Energy price development and fluctuations



Source: www. energy-charts.info



Negative electricity price on sunny days due to renewable energies (electricity overproduction

Source: www.entsoe.eu

Dynamic electricity price on the spot market

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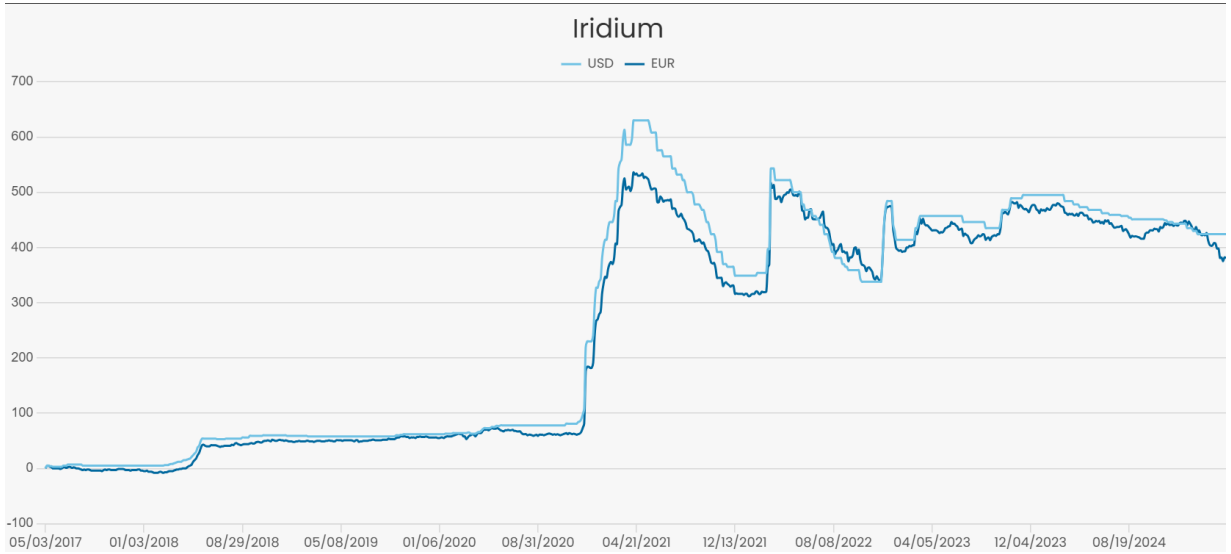
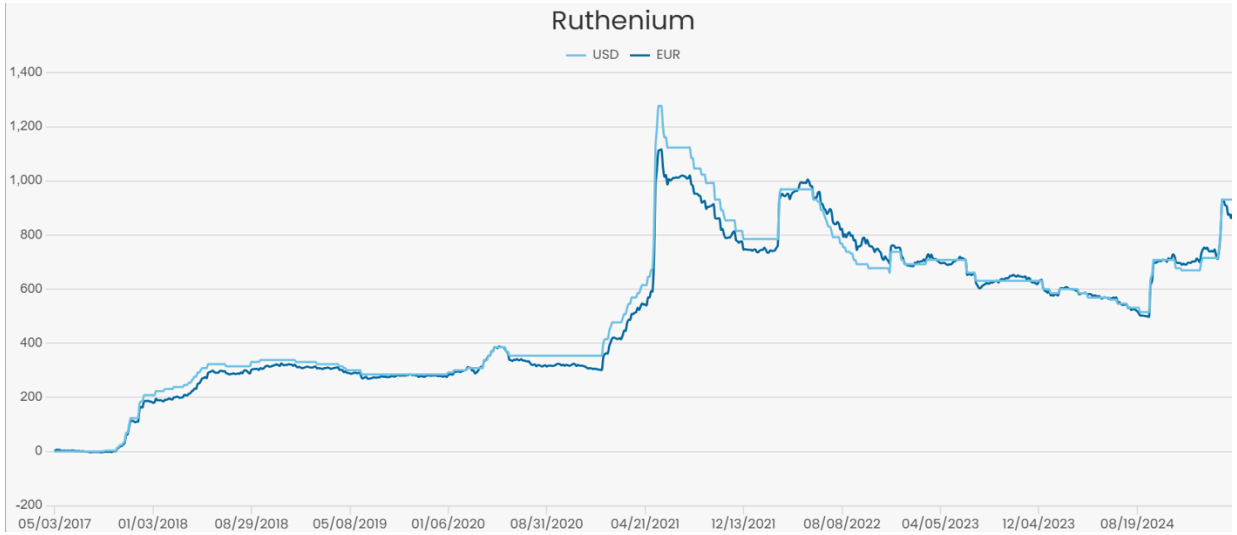
Precious metal market





Iridium (400%) and Ruthenium (900%) have stabilized on high price level resulting in high coating costs

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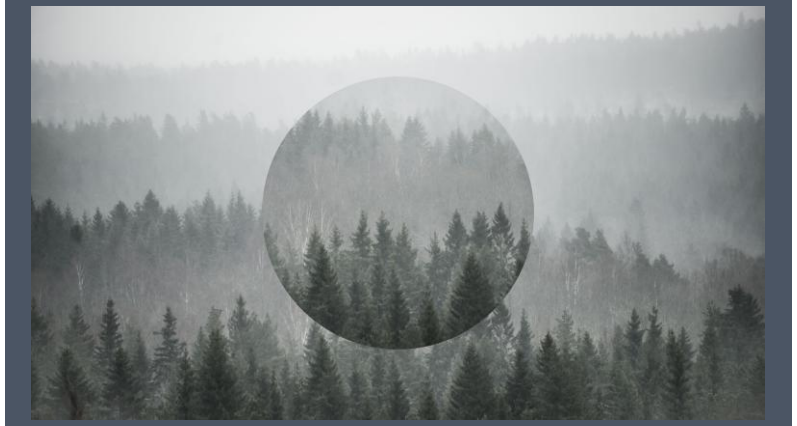

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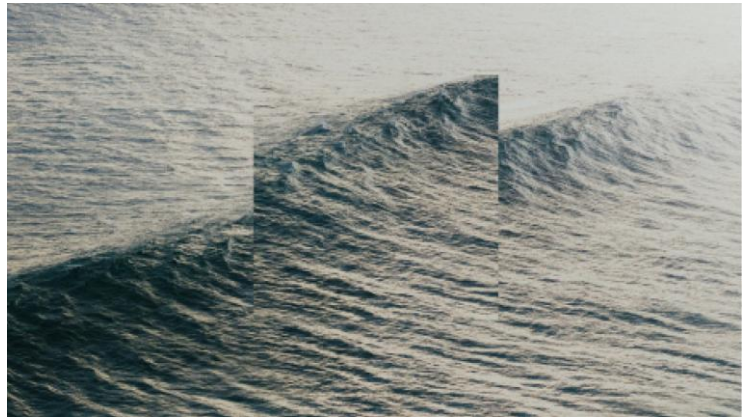

Realization

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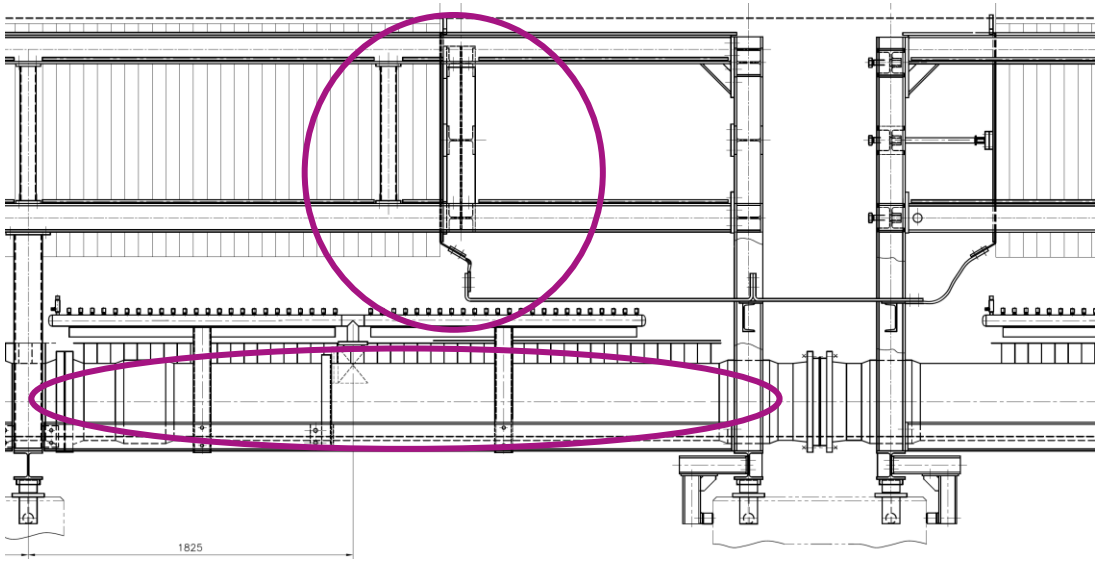
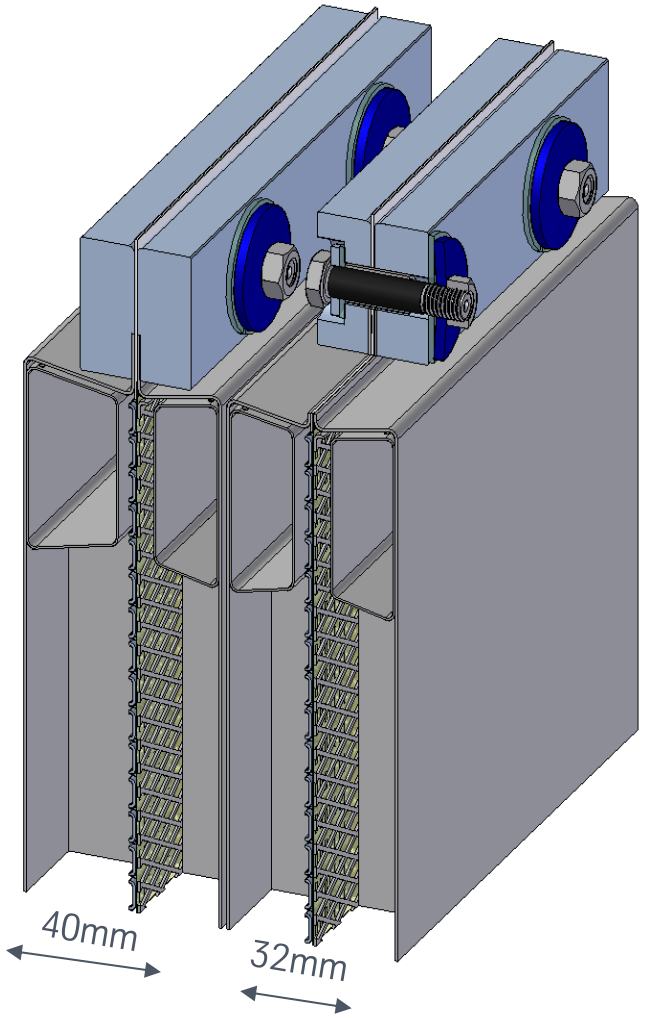
flexible options for now and the future with Intermediate plate

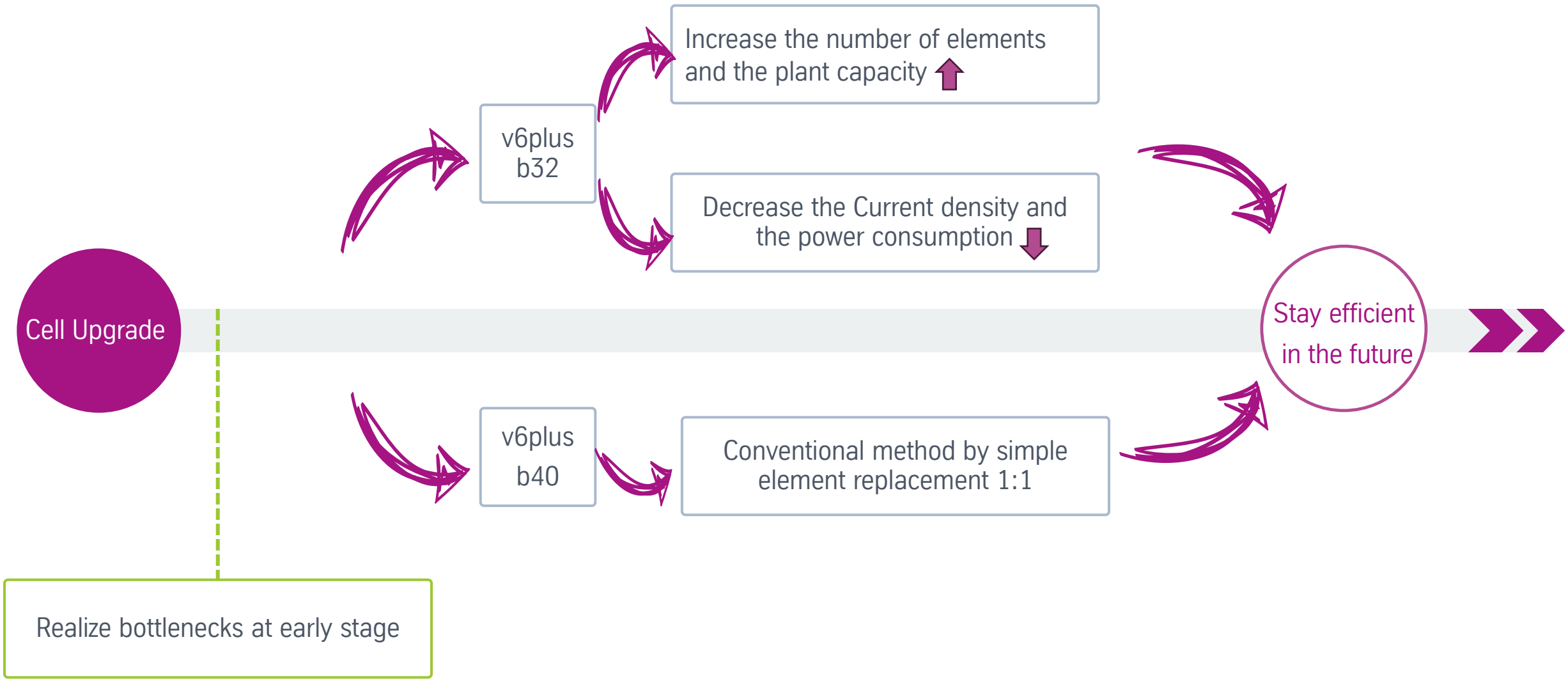
Intermediate plate

- Stay flexible in the future with b32 anodes and the combination of intermediate plate
- The upgrade to up to 12% more cells per electrolyzer is possible at any time





flexible options for now and the future with different strategies



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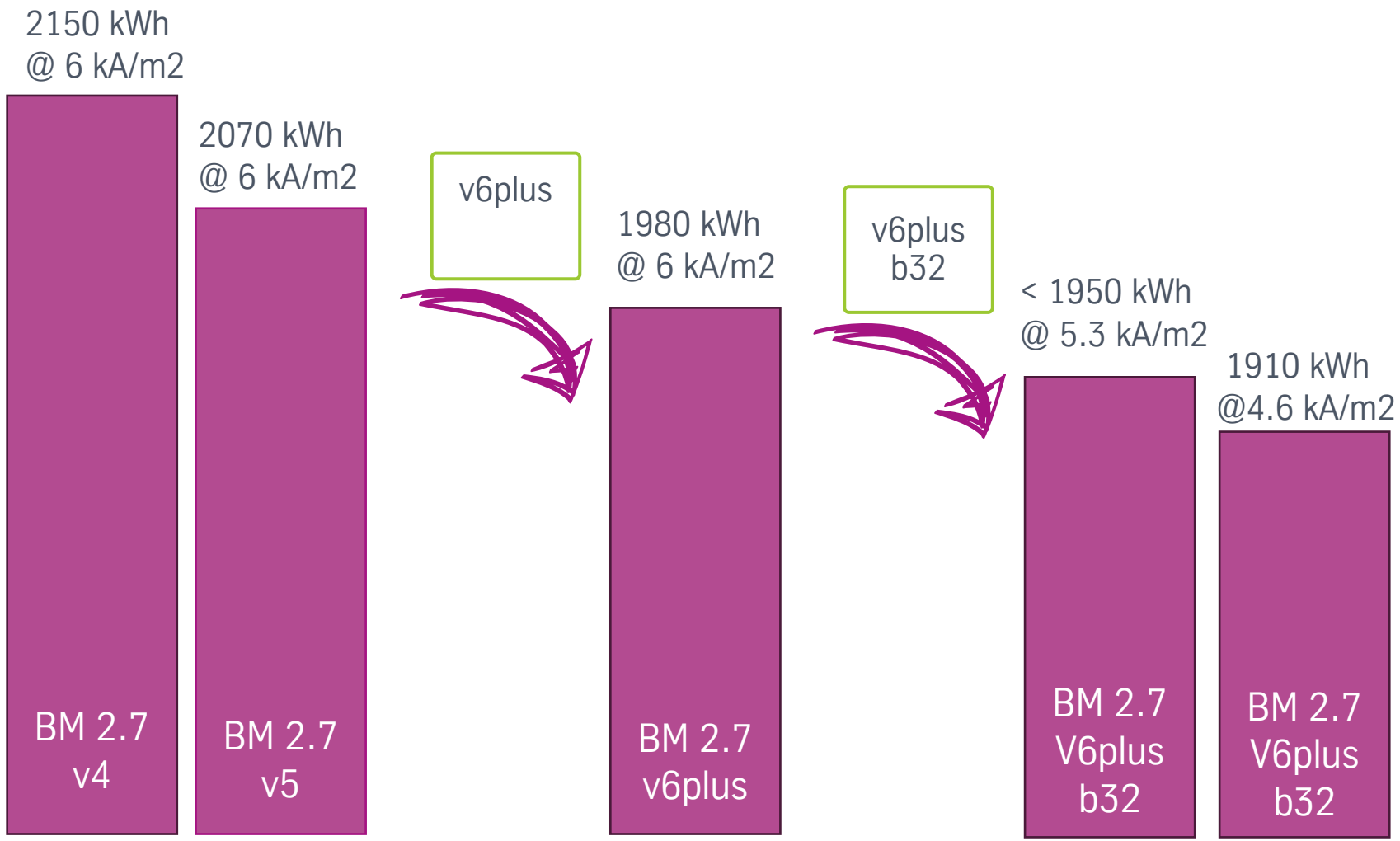
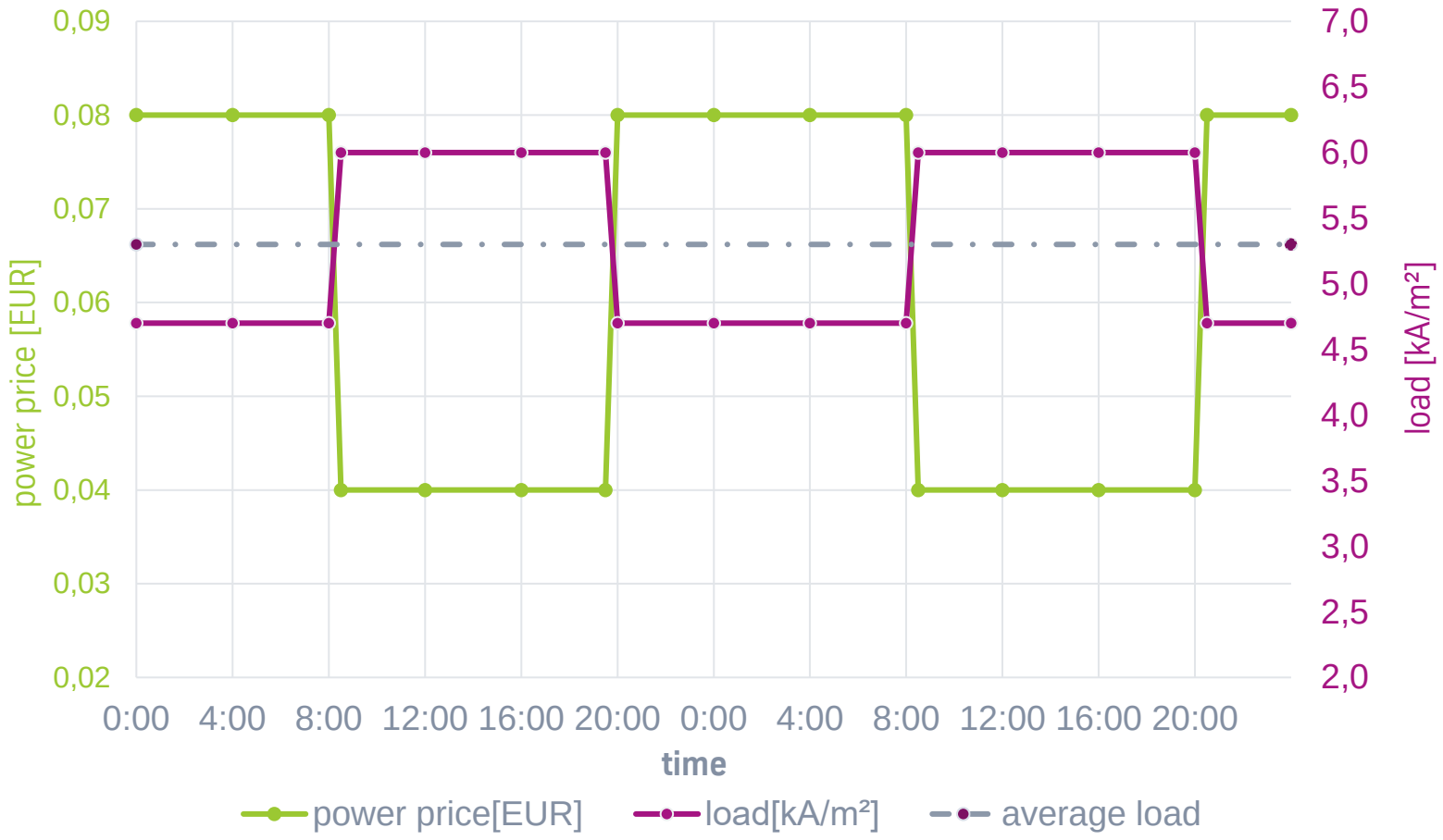


saving money with fluctuating operation



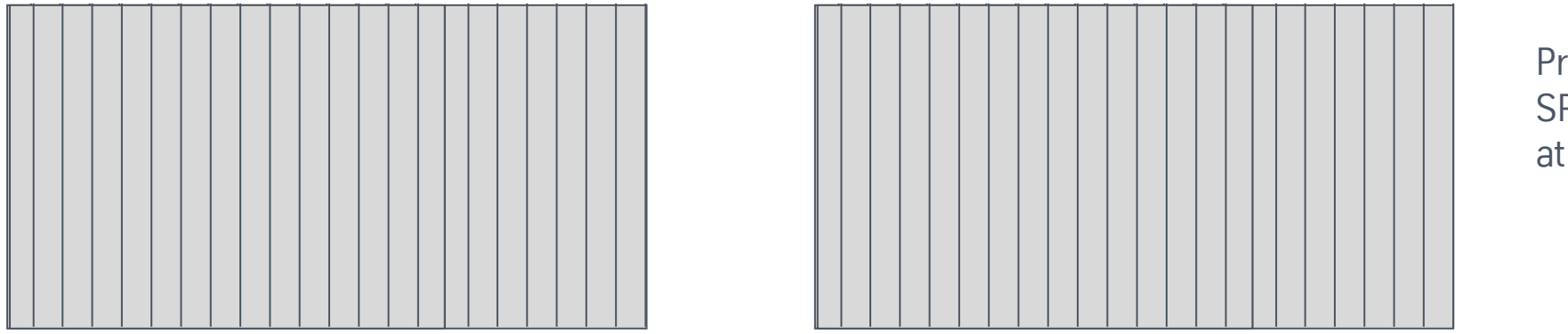
With the increase in renewable energies, the fluctuation in power prices is also rising

Adapting the plant load to the current power price saves up to 500€/elo every day (0.04€/kWh, 0,08€/kWh)

If the fluctuation increases in the future, the benefit gets even higher

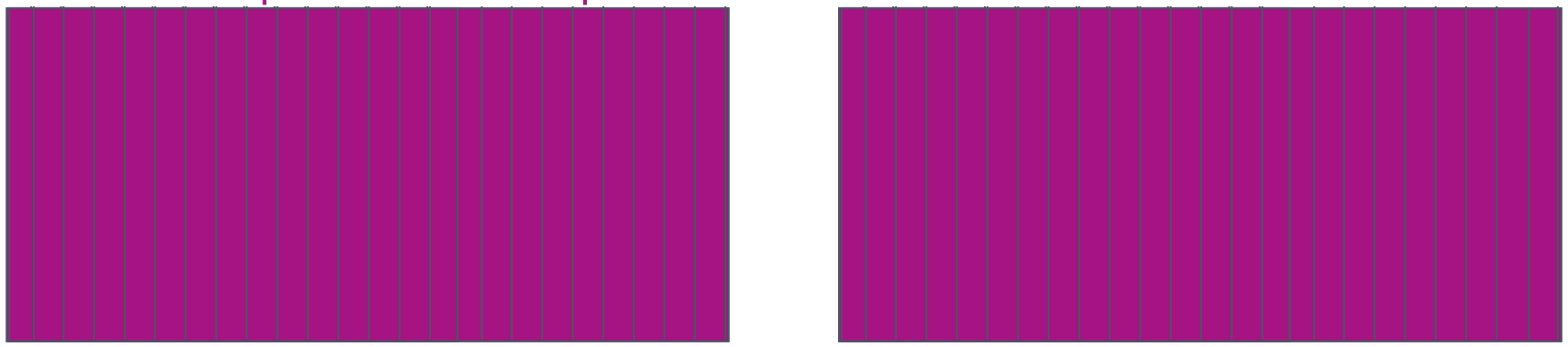
Anode width of 32mm and higher active area lowers OPEX at given operating current density and increases flexibility of production capacity

Existing Generation 4 - Anode depth 40mm



Production of 106 mtpd NaOH 100% with SPC of 2150 kWh/mt NaOH 100% at 6.0 kA/m^2 (16.3 kA) per electrolyzer

Generation 6plus – Anode depth 32mm

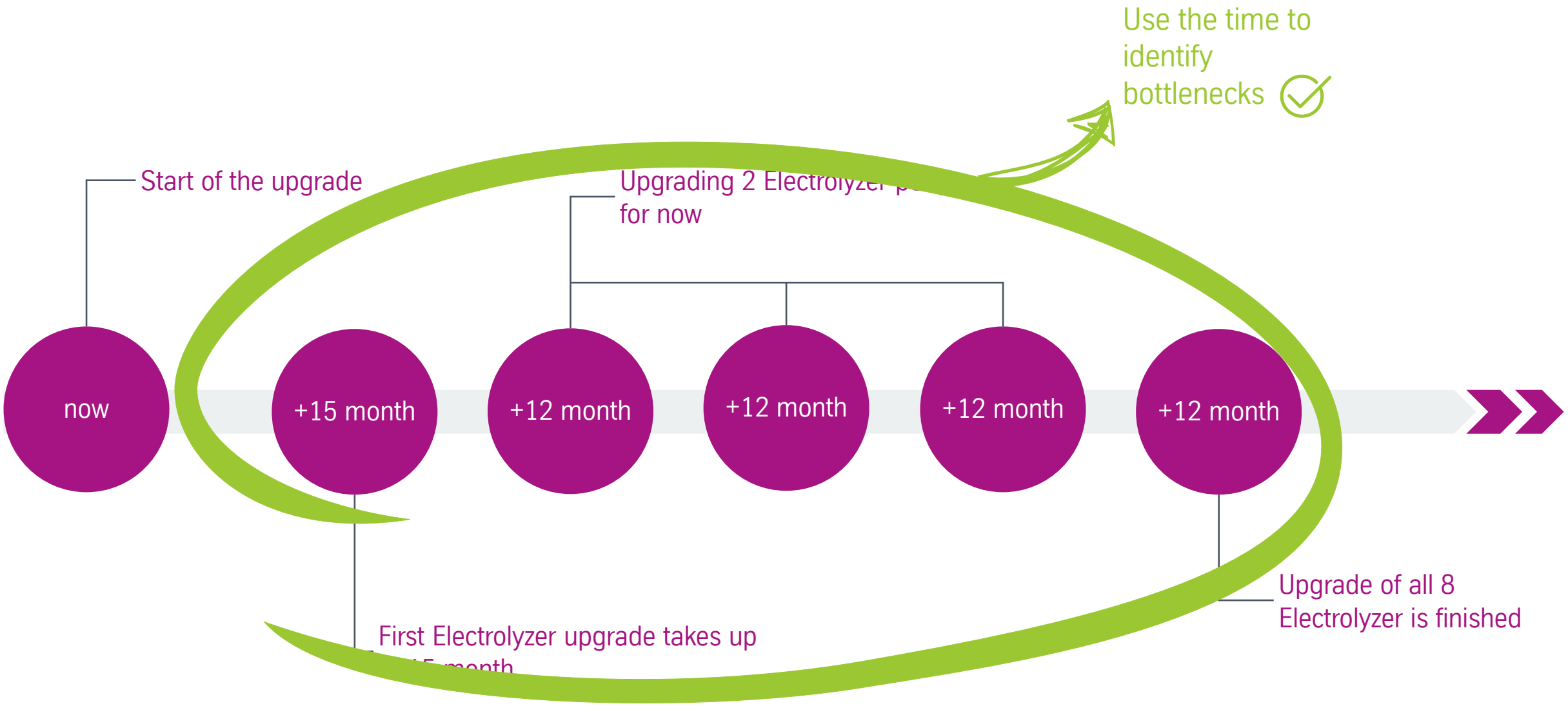


Production of 106 mtpd NaOH 100% with SPC of 1950 kWh/mt NaOH 100% at 5,3 kA/m^2 (15.1 kA) per electrolyzer

Production of 119 mtpd NaOH 100% with SPC of 1980 kWh/mt NaOH 100% at 6.0 kA/m^2 (17.1 kA) per electrolyzer

Generation 6plus offer savings of 10-13% of power costs to achieve same production as Generation 4

think about the future now



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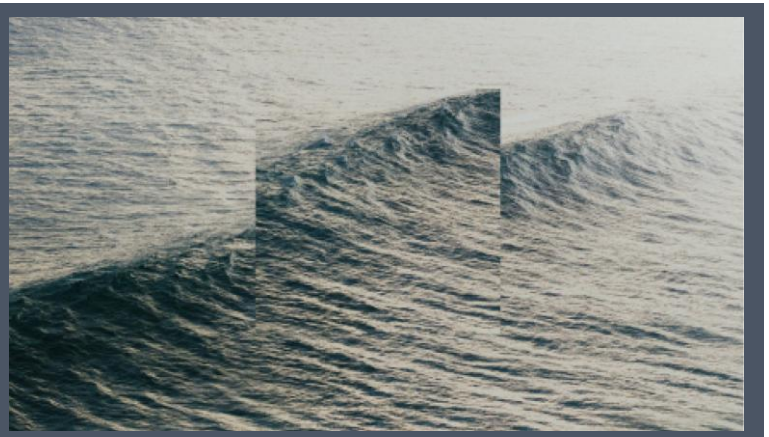

Realization

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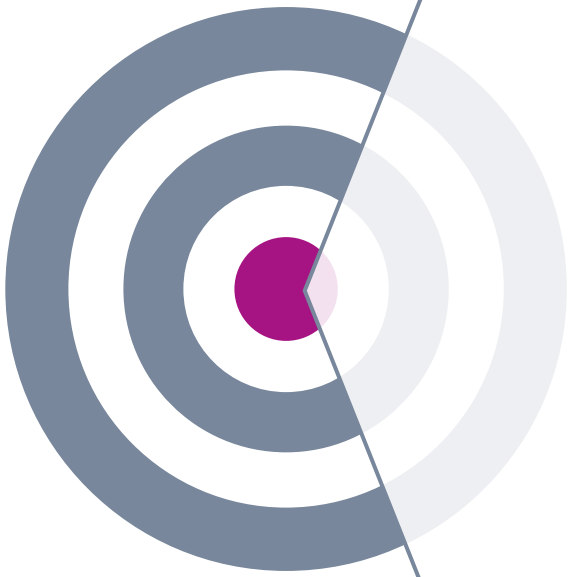
Why de-bottlenecking study?



- identify key areas of focus with respect to production capacity
- address constraints or bottlenecks in the production process
  - equipment
  - piping
  - electrical engineering
  - controls
  - operation
- helps planning refurbishment schedule and smart integration of measures
- be future-proof and open for all plant development options

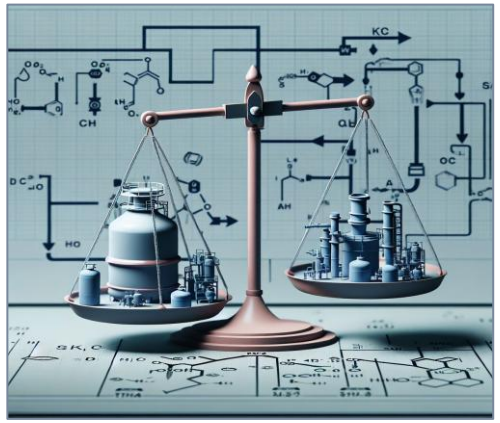
CONDUCT IN A TIMELY MANNER

De-bottlenecking study

– in case of higher production rate -

investigate

- record plant status quo
- check engineering documents
- conduct tests
- analyse DCS trends
- consider battery limit demands



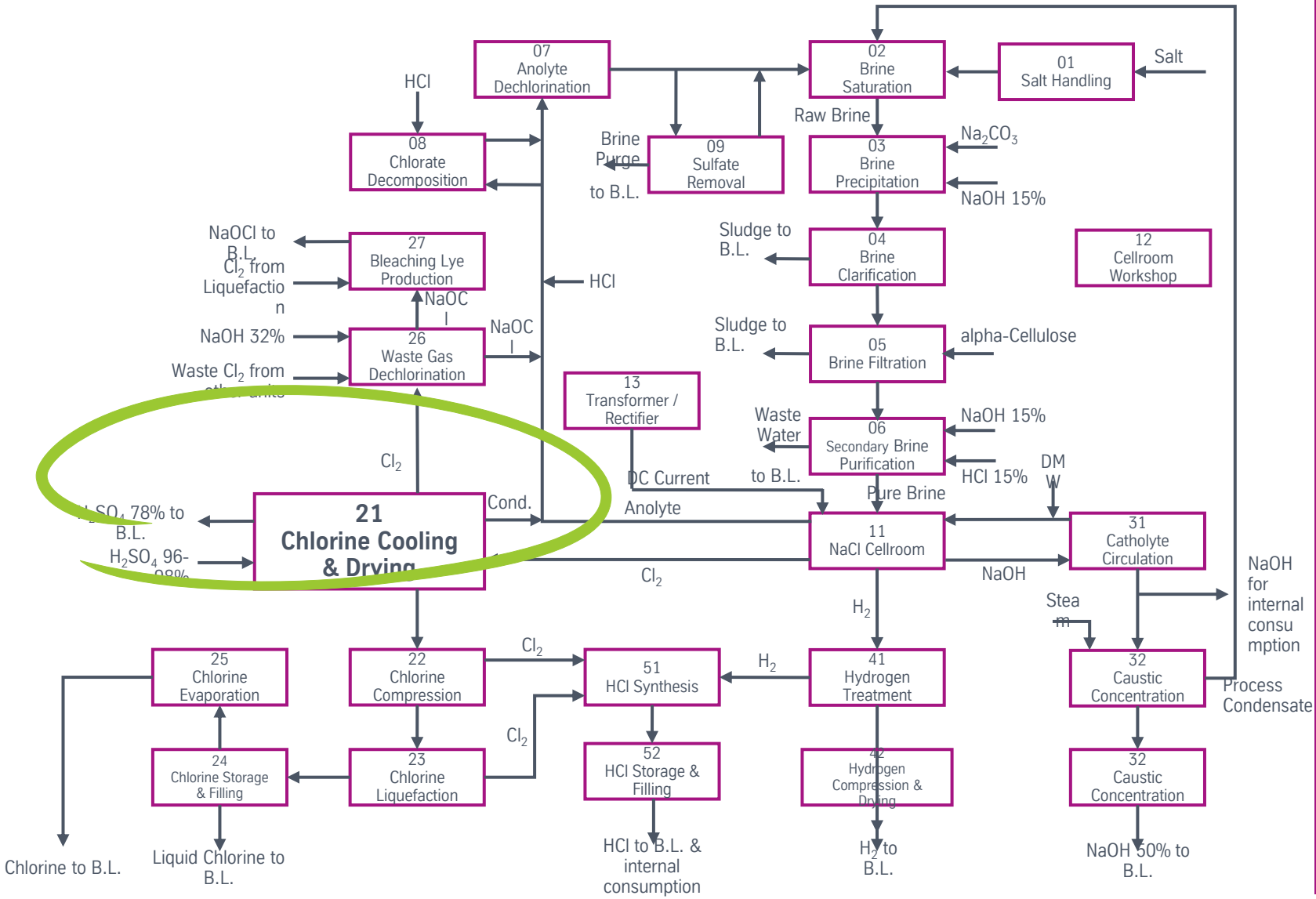
identify & evaluate

- re-calculate
  (mass & heat balance, sizes, hydraulics, etc.)
- product quality
- critical plant sections

determine measures

- adapt process parameters
- exchange, modify or add process equipment or piping
- optimise operation

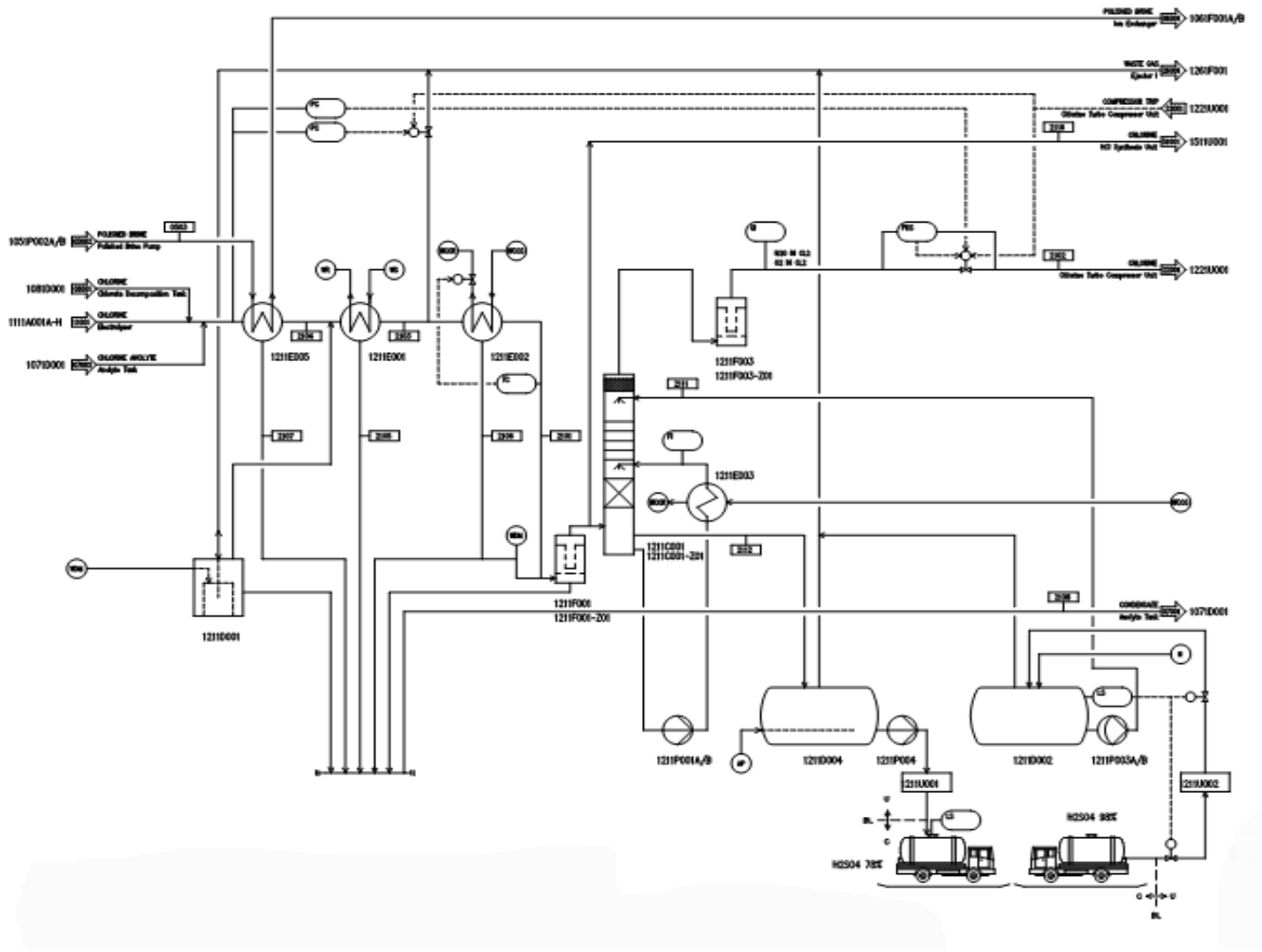
De-bottlenecking study



exemplary focus on key area

De-bottlenecking study

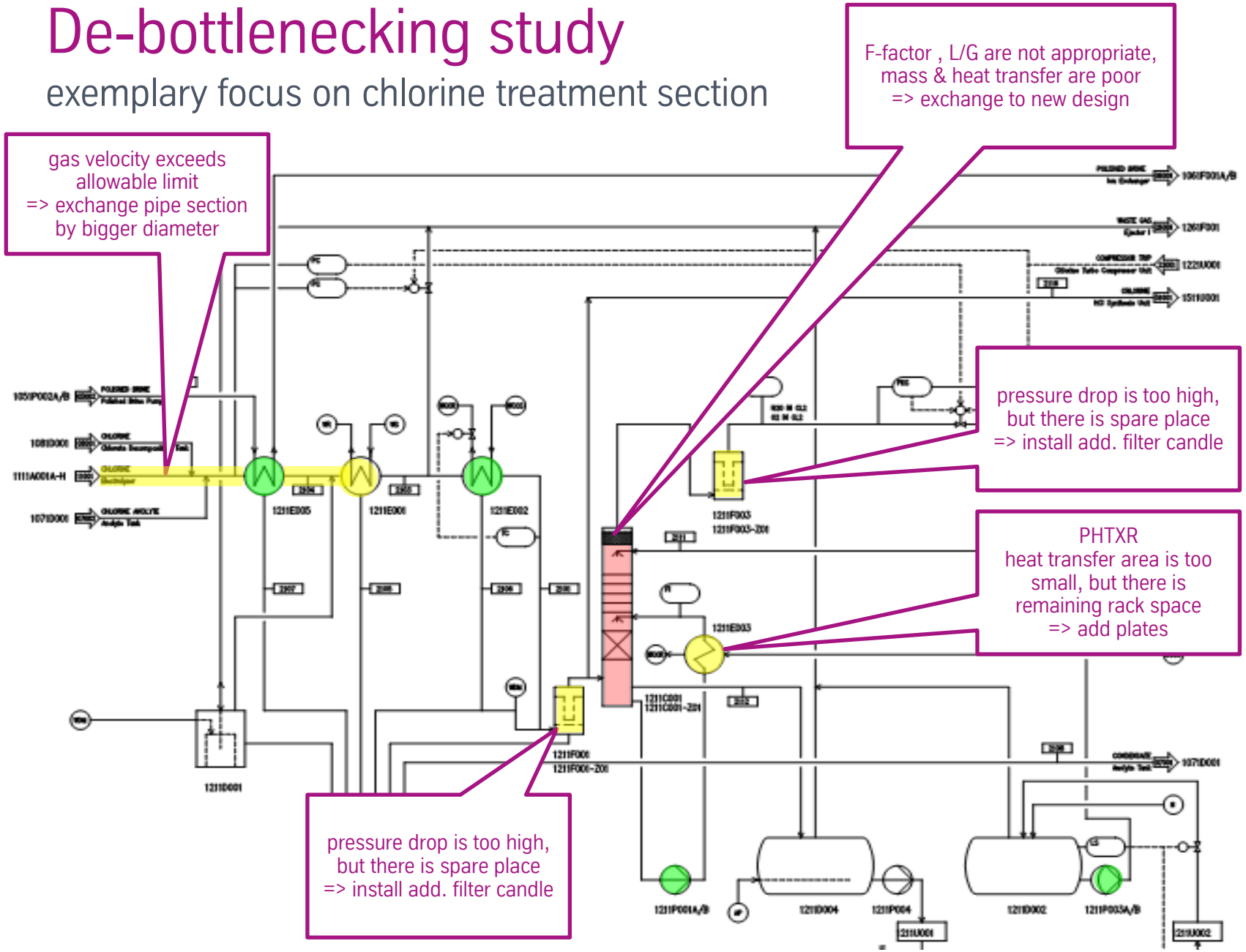
exemplary focus on chlorine treatment section



- Chlorine Drying Tower w. packing
- Chlorine Cooler I
- Chlorine Cooler II
- Chlorine Recuperator
- H2SO4 78% Cooler
- Wet Chlorine Filter w. candles
- Dry Chlorine Filter w. candles
- H2SO4 78% Circulation Pump
- H2SO4 98% Metering Pump

De-bottlenecking study

exemplary focus on chlorine treatment section



- Chlorine Drying Tower w. packing
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- H_2SO_4 78% Circulation Pump
- H_2SO_4 98% Metering Pump
- Piping system

De-bottlenecking study

exemplary focus on chlorine treatment section

Fundamentals	• chemical engineering	• mass & heat balance calculation • compare equipment specifications to fulfill new demands • chlorine cooling concept
Equipment	• chlorine drying tower • chlorine coolers • chlorine filters wet / dry with candles	• hydraulics: residence time, pressure drop, buffer volumes • thermal power • sizing
Piping	• chlorine gas lines • sulfuric acid lines • chlorine condensate lines	• hydraulics: velocity, pressure drop • line sizing • chlorine cooling concept
Rotating machines	• sulfuric acid pumps • chlorine compressor	• capacity, head, power, efficiency
Measurement & control	• differential pressure H2 / Cl2 • chlorine moisture content measurement • nucera Evaluator	• chlorine control valves A/B: opening and control range - • chlorine cooling temperature controls • measuring ranges, alarm- & setpoints

De-bottlenecking study

exemplary issues to be investigated or addressed in Chlor-Alkali process units

1 Electrical

- transformer and rectifier capacities [U, I]
- need for a booster rectifier ?
  in case of increased cell number
- bus bar dimensions
- alarm- and treshold values
- cooling water supply

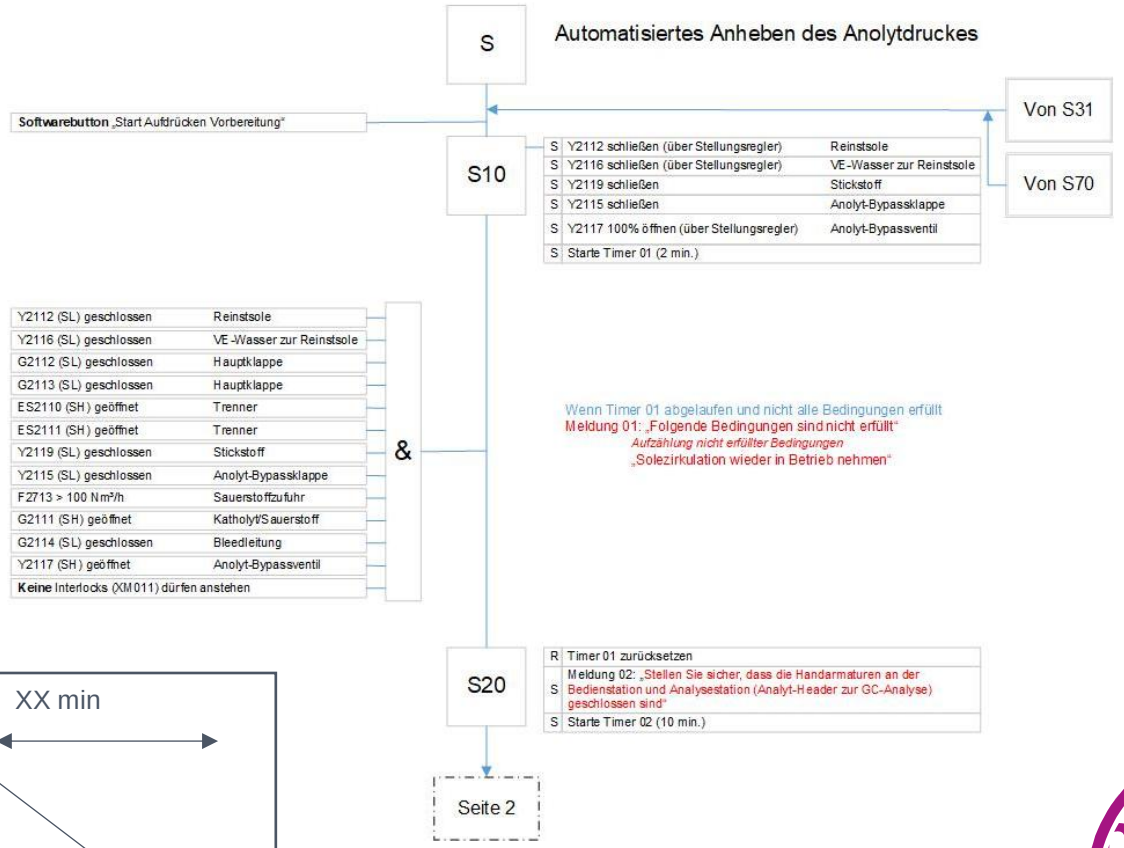
2 Brine / Anolyte Catholyte / Caustic

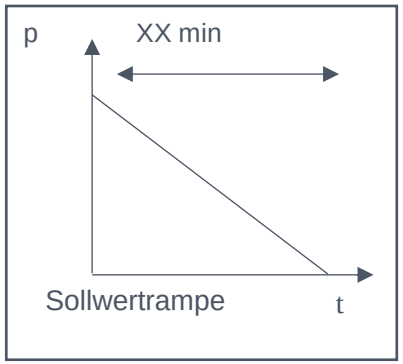
- quality
- hydraulics (Δp, diameter, volume, gravity flow,
- heater / cooler capacities,
- pump performance data
- control valves performance
- need for a separate piping in case of simultaneous operation of various cell generations?
- need for add. buffer / storage?
- emergency supply concept
  head tank vs. emergency power

3 Hydrogen

- options for untilisation of add. H_2
  - HCl synthesis
  - fuel gas
  - gasometer
  - other
- system pressure drop
- condensate discharge
- control valves performance

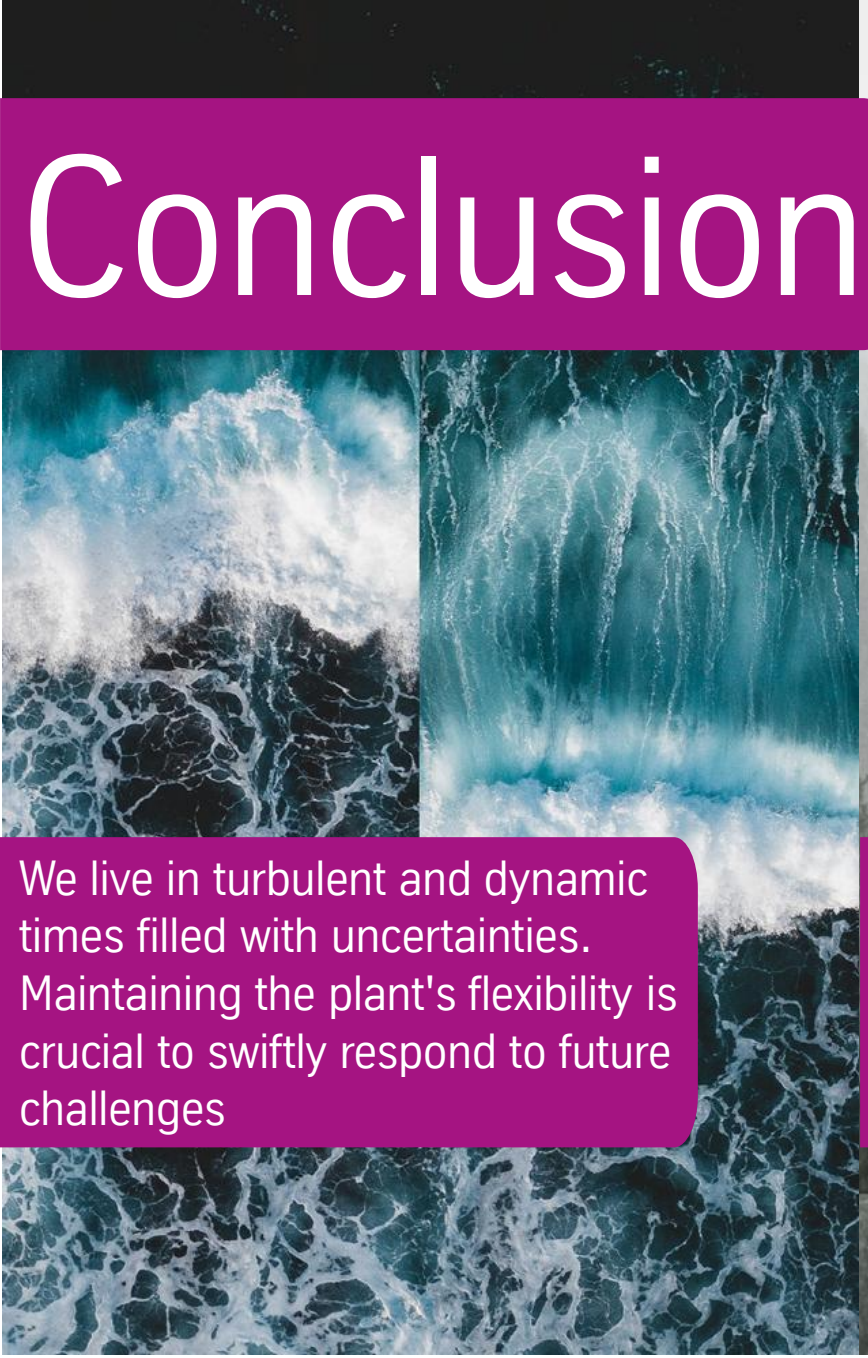
Plant operation Assistance by Automatation





- adaptation to load setpoint – ramp up/down
- de- / pressurising single elctrolyser (dis- / connect to main gas systems)
- customised degree of automation

Conclusion



We live in turbulent and dynamic times filled with uncertainties. Maintaining the plant's flexibility is crucial to swiftly respond to future challenges

The upgrade to v6plus b32 elements enables higher flexibility without significant costs. Operational flexibility is a key to cost reduction

Identify bottlenecks early in the maintenance strategy to minimize costs and enhance productivity

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Thank you for your attention