



DE NORA Services in Membrane Chlor-Alkali Technology



ELECTROCHEMISTRY AT YOUR SERVICE™

CHLORINE & CAUSTIC INDUSTRY

ELECTRONICS & SURFACE FINISHING

POOLS & ELECTROCHLORINATION

SPECIALTIES & NEW APPLICATIONS

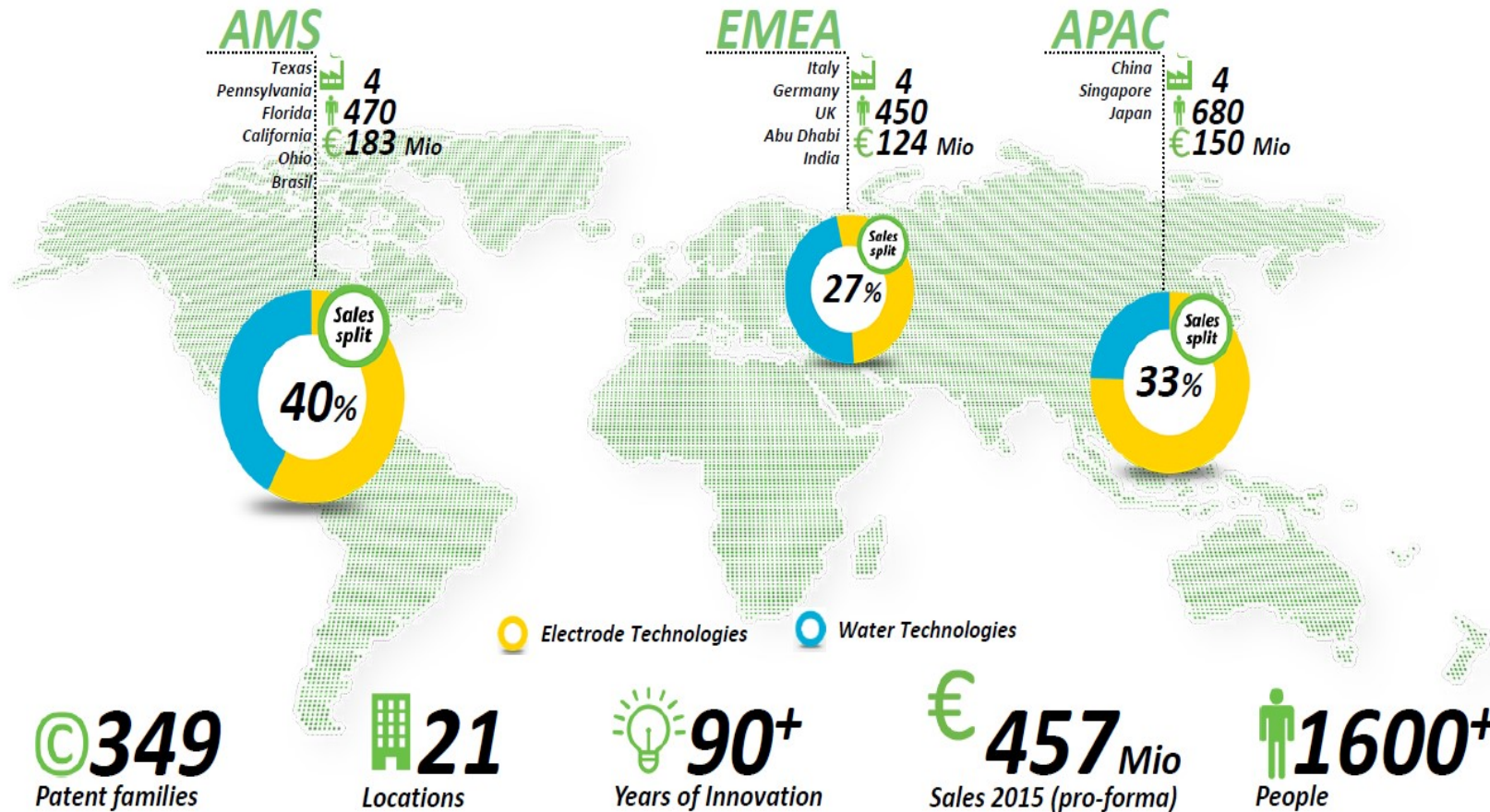


DE NORA identity

Our daily activities are driven by our values



DE NORA at a glance



Our commitment

Delivering innovative products and solutions to diversified industries to address customers' needs

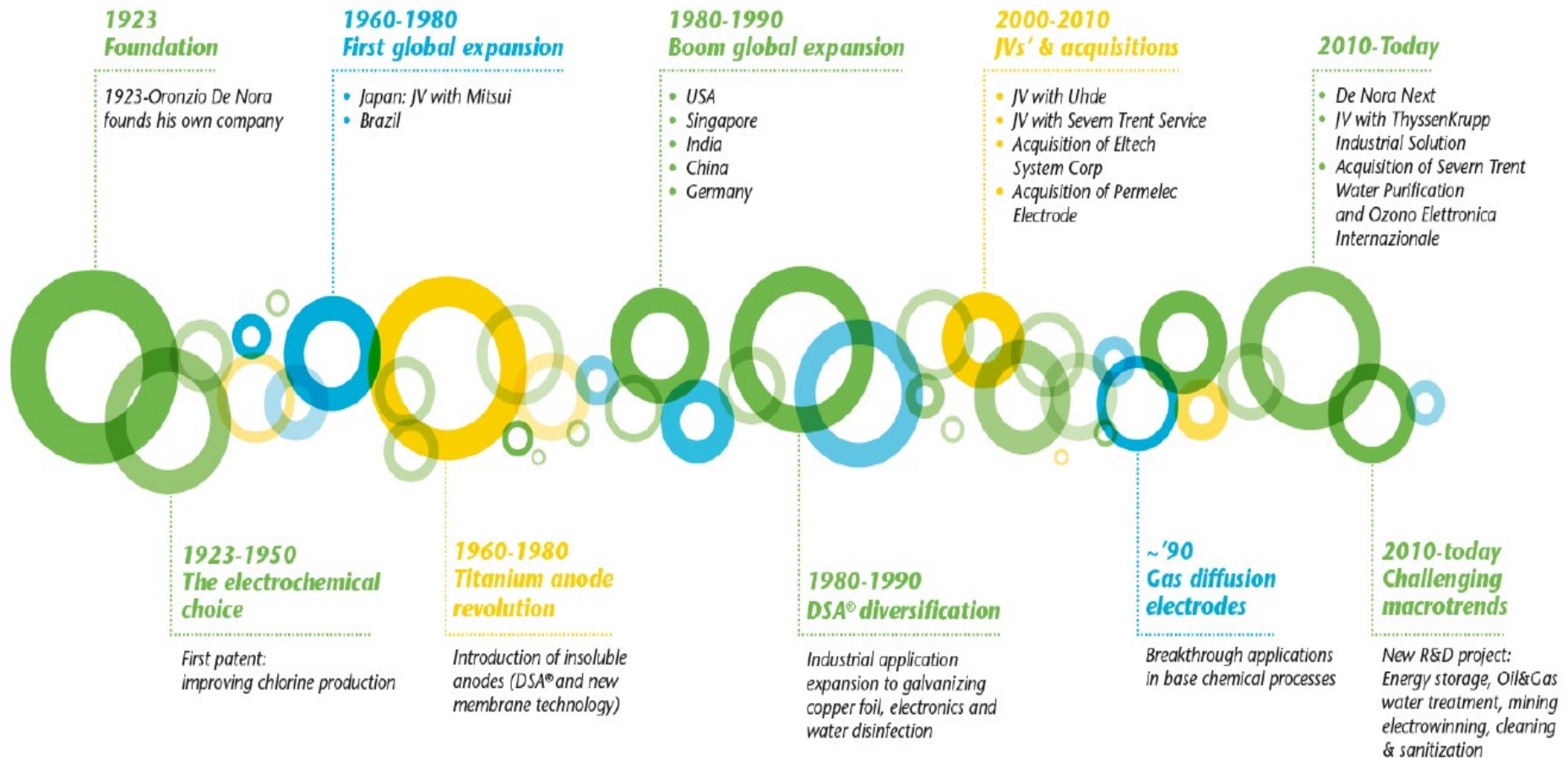
ELECTRODE TECHNOLOGIES ELECTROCHEMISTRY AT YOUR SERVICE



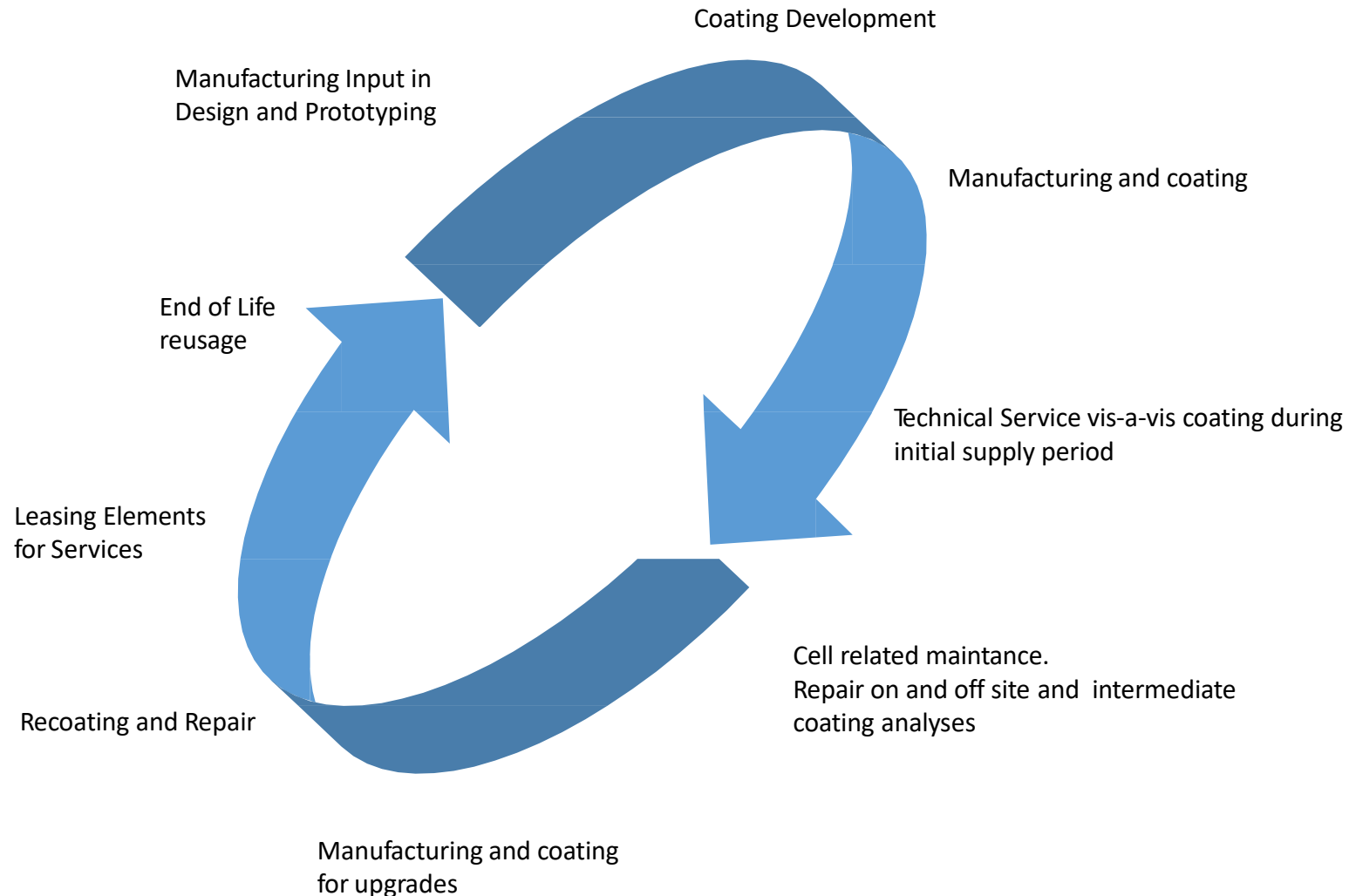
WATER TECHNOLOGIES WATER MADE EASY • NEXT CARE TECHNOLOGY



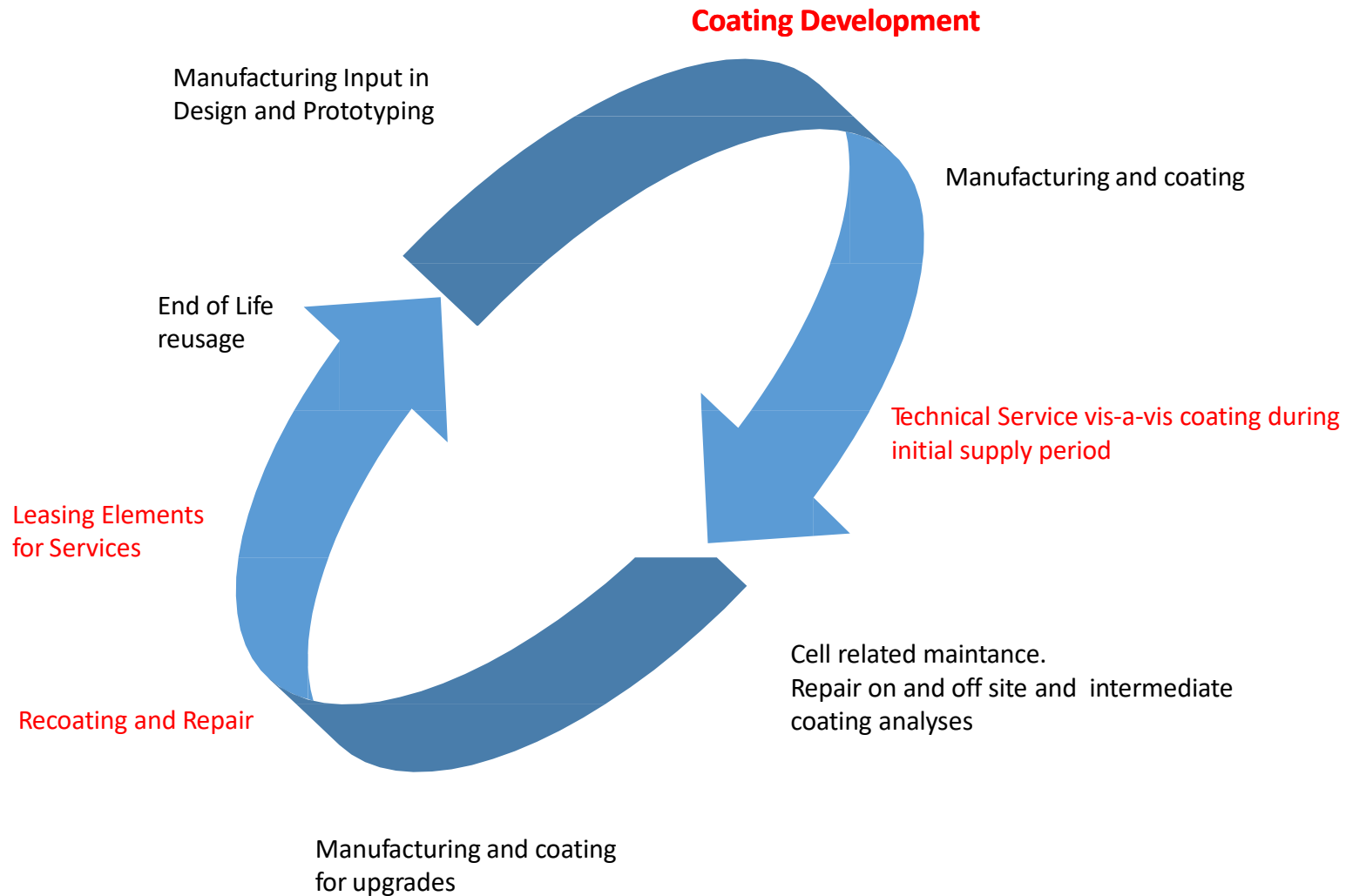
A sparkling journey of an entrepreneurial family



De Nora Services in Membrane Chlor- Alkali Technology



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Coating Development

De Nora - Research & Development

- Working to ensure a steady development of the **best solutions, aiming at satisfying markets needs**, and at the research and study of innovative projects.
- Within R&D, two different Technical Divisions have been created:
 - Applied Research and Development Division (AR&D)
 - Basic Research and Scanning Division (BRS)



Lab



Coating Development

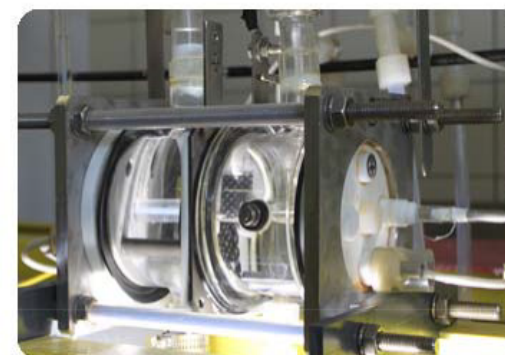
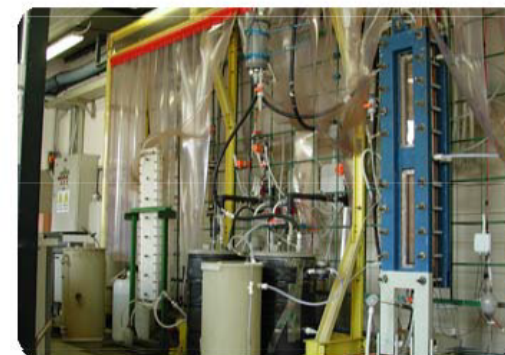
Backbone of De Nora's Leadership Electrode

catalyst development:

- ✓ Focus on fundamental research
- ✓ Customized to licensor, customer & market need
- ✓ Performance, stability & life
- ✓ Balancing noble metals composition – costs vs. benefit

Gas Diffusion Electrode development:

- ✓ Brine electrolysis
- ✓ Hydrochloric acid electrolysis



Chlor-Alkali business segment

IEM – Technology for the future

Advanced Anode & NRG family of cathode coatings
Retrofitting with Zero Gap solutions Manufacturing,
Refurbishments & Spare parts
Gas Diffusion Electrodes
Coating for HCl-ODC technology



DIAPHRAGM – Environmental & economic solution

Advanced generation of Cathodes, DSA[®] anodes,
coatings & other components
SM-2 and PMX[®] Plus (non asbestos) diaphragm
Enhanced cell technology upgrade – total solution



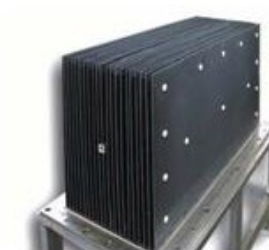
MERCURY – Environmental & economic solution

Enhanced cell technology upgrade – total solution
Energy saving program (ESP)
✓ SLM[™] & Runner[®] - high performing
anodes
✓ Higher performing components



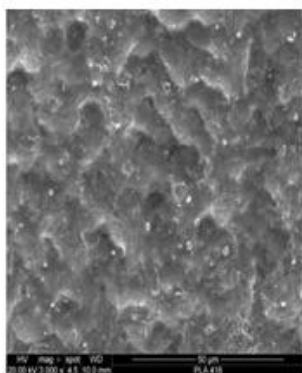
CHLORATE – Environmental & economic solution

Advanced generation of DSA[®] anodes, coatings &
components
Manufacturing, refurbishment & total servicing of
electrolyzers of all technologies



Coatings for IEM ChlorAlkali Technology

- 1 New anode coatings (development)
- 2 Engineering services



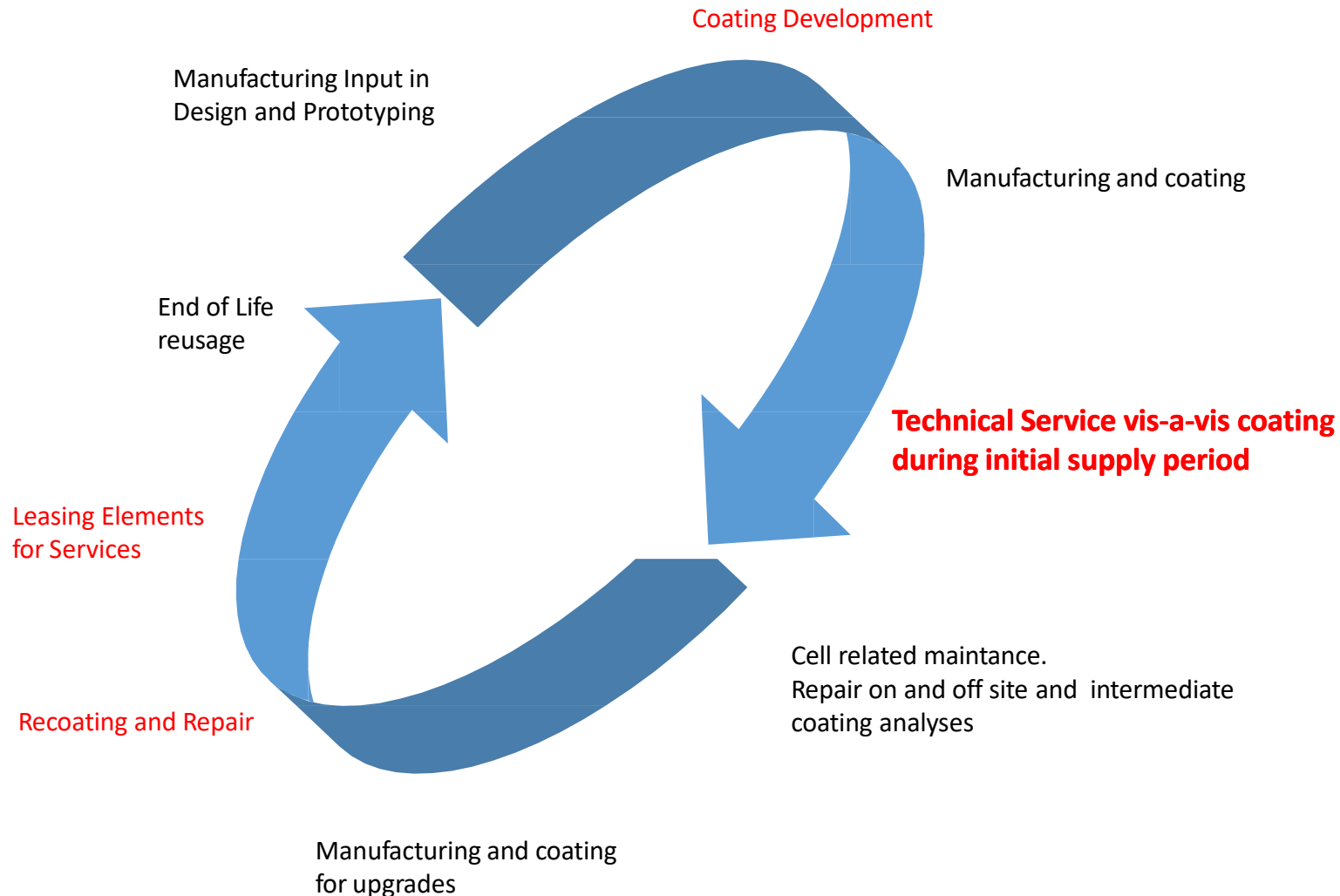
Development: New anode coatings

- Project goal: introduce a new portfolio of anode coatings capable to cover all customer's needs
- Destination market: new plants, recoating
- Development status:
 - "Low Chlorate" coating for recoating market: tailored for post-sales market, robust and long lasting at competitive price. Low subproduction of chlorate. Market launch phase
 - "Low Chlorate" coating for new plants: right mix between performance (voltage, chlorine purity) and price for the majority of the customers that do not require tight specification on O₂ content. End of the development phase
 - "Energy saving" coating: high edge coating characterized by low cell voltage for all those customers sensitive to energy saving. Approaching Field Validation

Engineering Services

- Electrolyzer FEA modeling (stray currents)
- Mechanical design services

De Nora Services in Membrane Chlor- Alkali Technology



Technical Service vis-a-vis Coating during Initial supply period

- Residual Coating Measurement and Coating Analysis.
- Repair and root cause analysis of any issues in cooperation with tk UCE.
- Support for estimation of most appropriate timing for recoating.
- Recoating and Repair.
- Electrode potentials w.r.t to cell voltage behaviour / coating analysis prior to remembraning.

Technical Service - residual coating measurement

Residual Coating Measurements - RCM

RCM during operation:

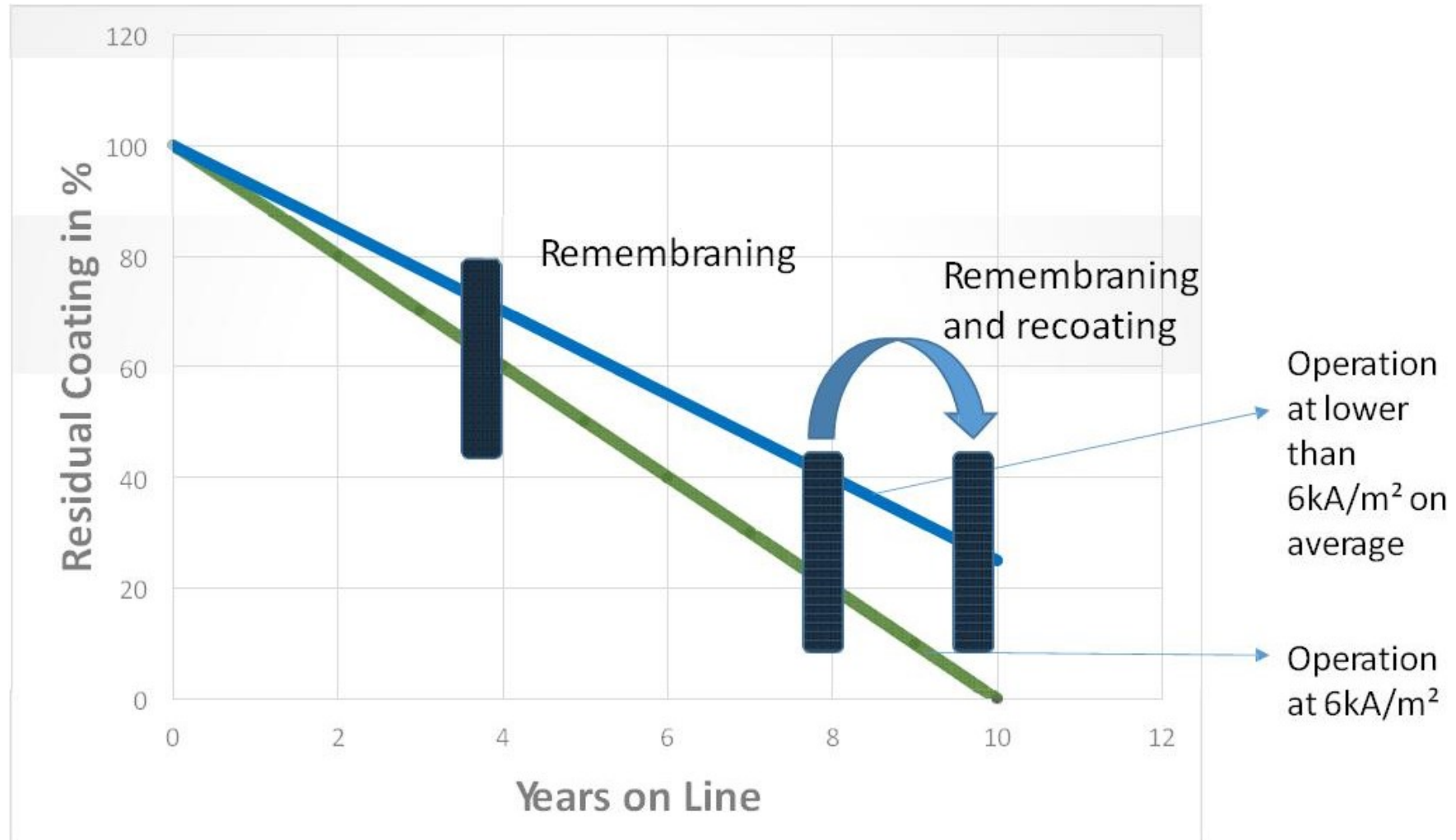
Correct Calibration is essential

Daily monitoring of reference piece- supplied as service is essential during measurements

Accuracy of measure is +/- 5 %.



Technical Service - residual coating vs. years on line



How to determine residual coating status

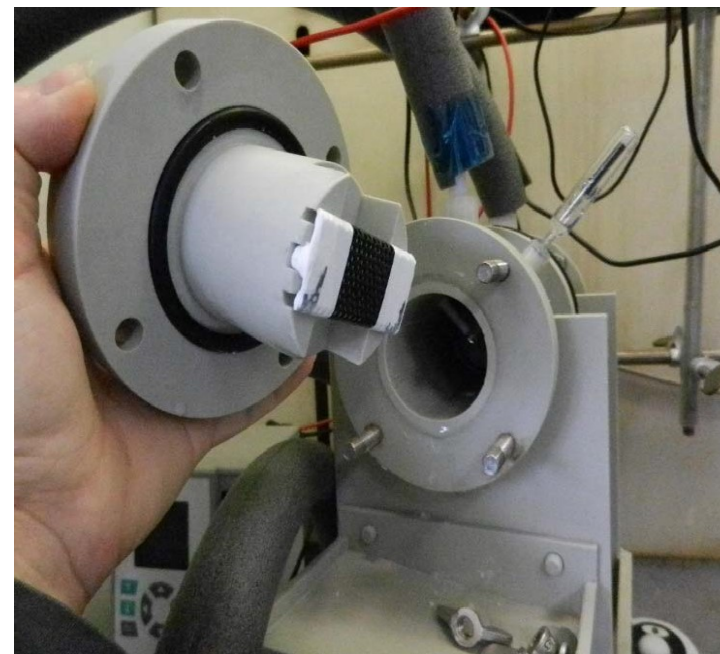
Residual Coating is a good indicator of the “health” BUT...

Through removal of representative samples and the analysis of the sample in a Mini Cell, the functionality of the coating should be tested in parallel.

Samples should

- a) reflect any deviations in cell voltage behaviour.
- b) Avoid any local issue related to possible membrane damage.
- c) Be carefully removed to avoid cutting damages.
- d) Be from representative positions within the cell.

Test method for residual coating

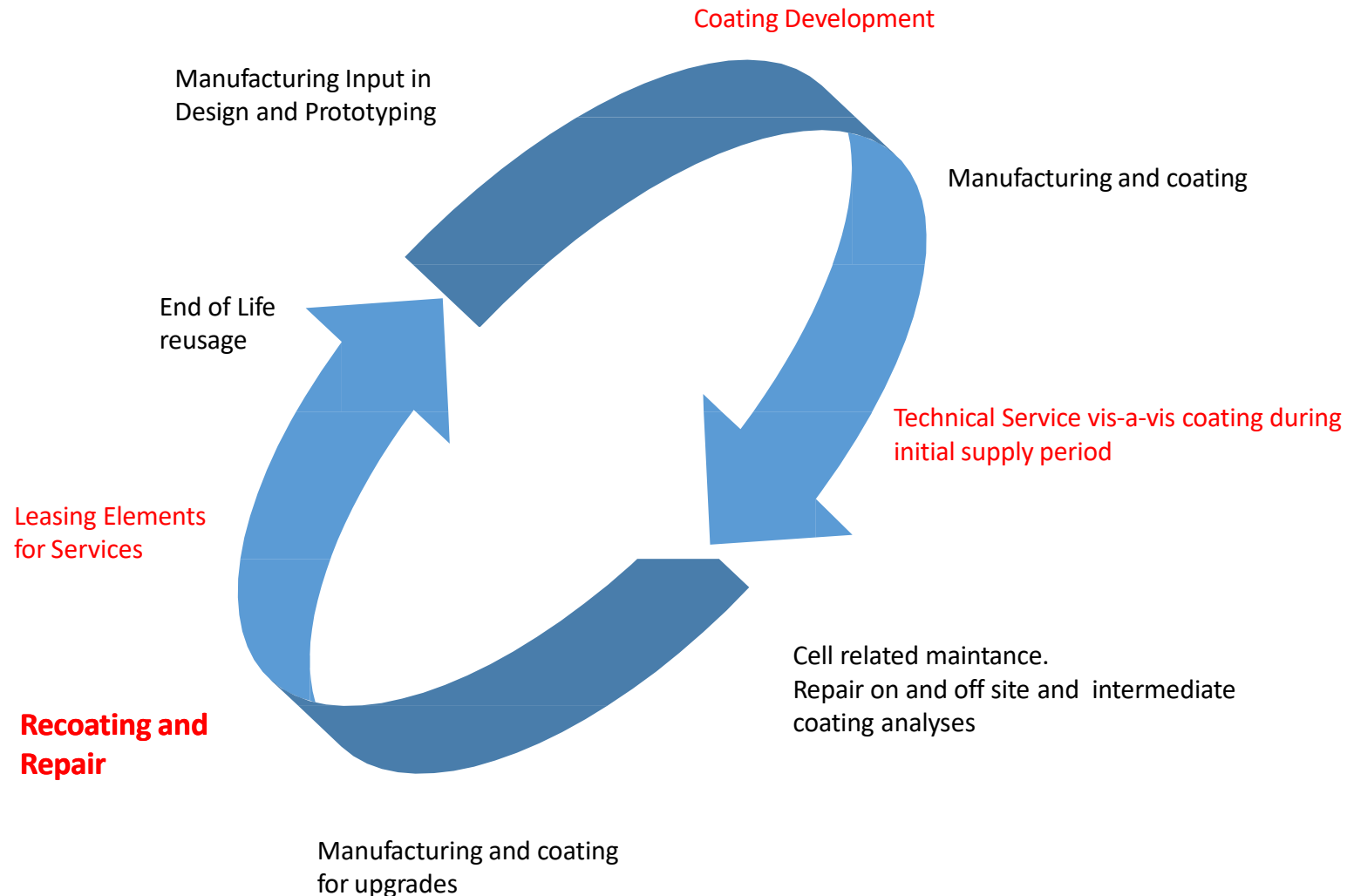


Mini Test Cell

Operating Conditions are : 80°C, 18% W NaCl, pH2, 32% W NaOH 80°C

Reveals Anode and Cathode Electrochemical Activity independent of membrane and counter electrode effects

De Nora Services in Membrane Chlor- Alkali Technology



Repair and Recoating.....manufacturing within De Nora



www.denora.com

DE NORA production, repair & recoating service capabilities

New Cell Manufacturing Sites

Rodenbach, Germany
Okayama, Japan
Shanghai, PRC

New Cell Coating Sites

Rodenbach, Germany
Fujisawa, Japan
Suzhou, PRC
Milan, Italy

Service & Recoating

Rodenbach, Germany
Okayama, Japan
Fujisawa, Japan
Suzhou, PRC
Shandong, PRC
Goa, India
Sorocaba, Brasil
Chardon, USA

Repair on Site or Shipment

Criteria for selection of options

- Cost of Shipment
- Difficulty of Repair, number of cells and on site infrastructure
- Requirement for dedicated equipment, both repair and subsequent QC
- Import Export complexities

Mobile on site repairs are possible to organise (also at "short notice" but have to reflect the criteria above)

Sorocaba / São Paulo – Brazil



- Establish at 1974 in Cubatão (SP), main chemical and petrochemical centre in São Paulo State
- At 1992 De Nora do Brasil Ltda moved to Sorocaba, an industrial city at 80 km west of São Paulo city
- De Nora do Brasil Ltda facilities was build in an area of 45,000 square meters of land

Sorocaba Plant



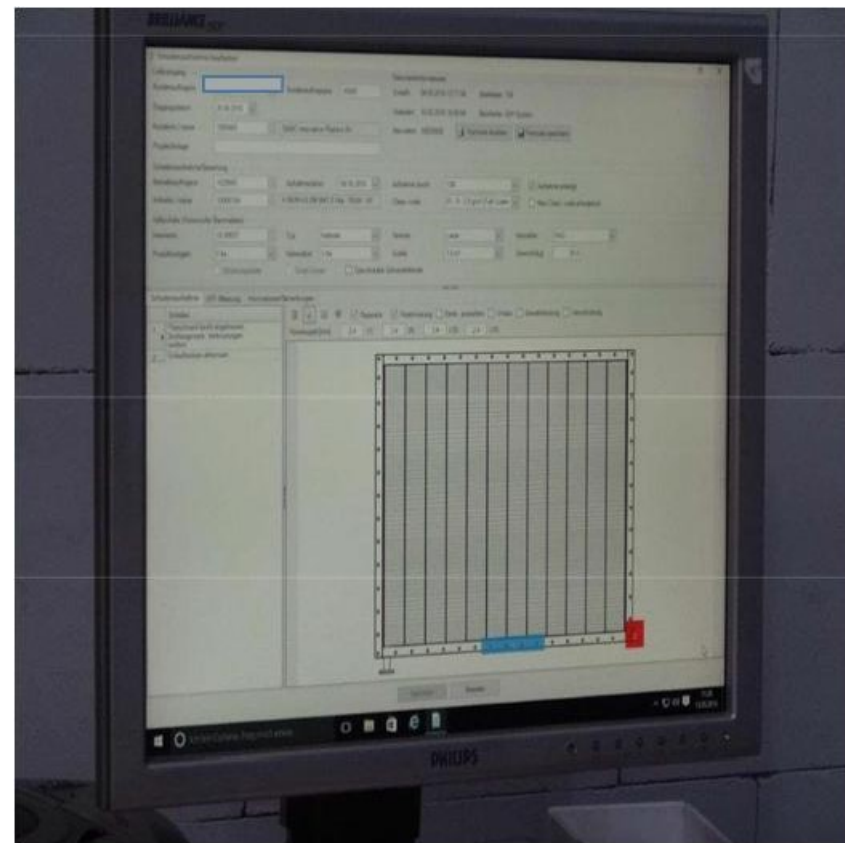
Total area: 45.000 m²

- for mechanical activities: 1.800 m²
- for coating activities: 1.700 m²
- administration: 900 m²
- for warehouse: 300 m²
- others: 100 m²

Sorocaba Plant



Incoming Inspection and repair Analysis



Repair and Recoating area



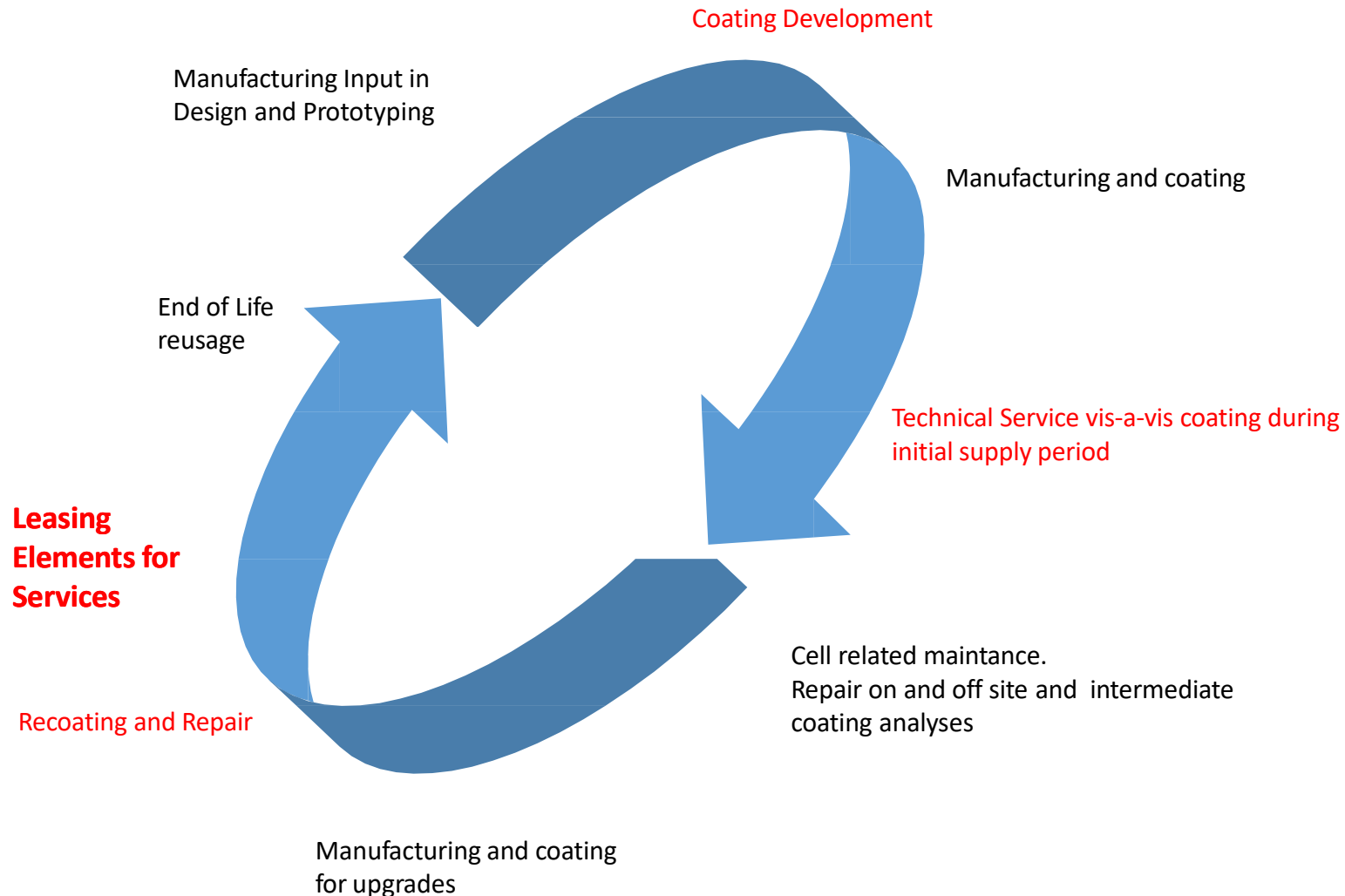
Production Capacity

De Nora do Brasil Ltda is prepared to apply anodic and cathodic coating up to 30/35,000 m²/year of activated surface.

Our facilities is available to manufacturer and apply coating in:

- ◆ *Membrane Cells – anodes and cathodes;*
- ◆ *Chlorate Cells – Refurbishing and modernizing of cells;*
- ◆ *Diaphragm Cells – anodes, cathodes and NAD diaphragms ;*
- ◆ *Mercury Cells – anodes, ACPD Systems and Plastics components;*
- ◆ *Electro galvanizing Cells – anodes;*
- ◆ *Hypochlorite Generators – Posiclor / Clortec / Seaclor;*
- ◆ *Cathodic Protection – Lida (R) .*

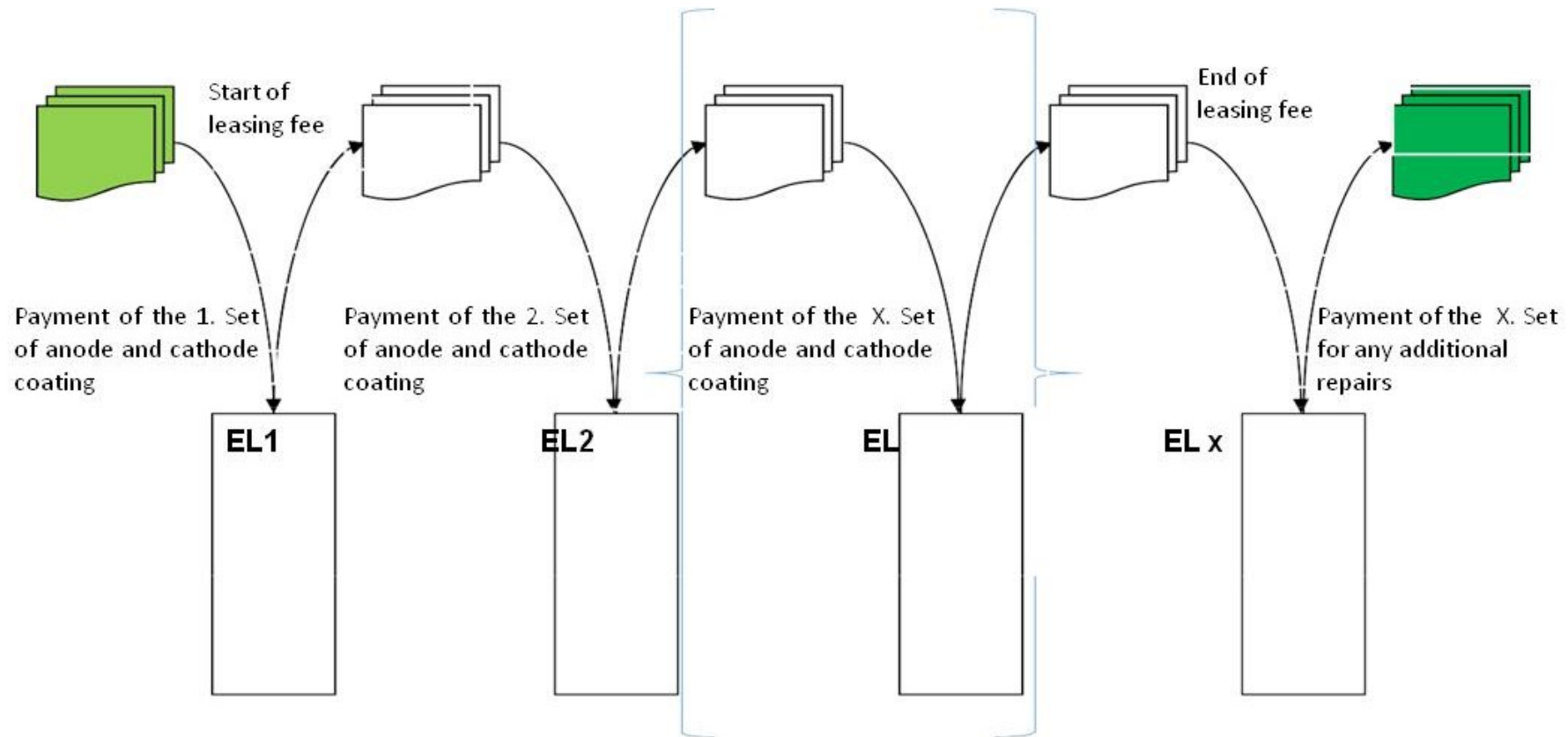
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Leasing Elements for Services.... an old offer worth repeating...

Shipping
Date of
leasing Structures from
De Nora to Customer

Shipping date of leasing
structures or return from
customer to De Nora



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THANK YOU!



QUESTIONS

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