Why are we here?

• We use 600-700 tons of titanium annually.
• We are a niche business.
• We have top line growth of 20% annually.
• Ti is one of our key strategic raw materials.
• Now Who are we?
DE NORA

- History - Gruppo De Nora was founded by Oronzio De Nora in 1923, who filed his first patent in the same year. Today Gruppo De Nora has over 175 active patent families originated in Italy, USA and Germany and extended worldwide.

- De Nora companies were involved in the development of the earliest commercial amalgam, diaphragm and membrane cells for Chlor-Alkali production.

- De Nora has grown with facilities and research worldwide, with strategic acquisitions and joint venture partnerships in electro-chemical systems.
INDUSTRIE DE NORA

- In the fall of 2005, Industrie De Nora acquired ELTECH Systems Corporation.
- In 2006, De Nora North America was merged into ELTECH.
- In 2007, ELTECH was officially renamed De Nora Tech, Inc., a new company to reflect its combined strengths and market leadership.
INDUSTRIE DE NORA S.p.A.

• Mission - “Become the world leading provider of key innovative electrochemical technologies combined with energy saving and environmental friendly processes”

• De Nora operates, directly or in joint ventures, 17 companies strategically distributed across Europe, Asia and the Americas.
INDUSTRIE DE NORA
World-Wide Organisation
1000 Employees Worldwide
DE NORA

- **DE NORA** is a matrix organization with Global Business Units supported by a team of international technicians and regional production facilities. Cross functional staff positions ensure consistent policy approach while Global Business Units allow for a focussed business approach.

- **DE NORA** managers have full control and accountability for the activities carried out in each operating unit. This means faster response to Customer needs, better service and a shorter lead time to market-trend changes.
INDUSTRIE DE NORA

- The world’s leading manufacturer of electrodes for electrochemical processes: DSA® Mixed Metal Oxide anodes and cathodes.
- Customized anode and cathode designs and coatings.
- Technical leader with patents for new anode designs and electrode coating formulas.
- Global industrial coating in excess 300,000m²/year in 7 manufacturing facilities (Europe 2 / U.S.A. / Brazil / China / Japan / India).
Why Titanium?

**Anodic corrosion properties**

- Most metals actively dissolve when anodically polarized in aqueous electrolytes.
- CP Titanium oxidizes (forms a thin surface oxidation film).
- Titanium oxides provide excellent corrosion resistance to the base metal in aqueous sulfate and chloride electrolytes.
- Surface oxidation prevents use of titanium independently as a anode without the addition of a catalyst.
DE NORA
Chlor-Alkali Business Unit (CABU)

• DSA® anodes and electrode coatings for every industry technology.

• The industry’s primary source for mercury and diaphragm cell technology for existing plants.

• Together with our partner companies, we provide complete Chlor-Alkali cells and spare parts.

• Leading developer of advanced membrane cell anode and cathode coatings.

• 42,000,000 t/y Cl₂ – 73% world’s production capacity.

• Global technical service and replacement parts supply.
DE NORA
Chlor-Alkali Business Unit (CABU)

Supporting the Traditional:
• The Chlor-Alkali industry relies on the De Nora Elettrodi Network as its primary source for all technologies.

Developing the New:
• Leading coating supplier to Chlor-Alkali technology companies.
• Leading developer of advanced membrane cell anode and cathode coatings.
• Providing lower cost techniques to recoat complex anodes and cathodes.
DE NORA
CABU — Membrane Cells

- Maintenance and reconditioning services for all Membrane cell types
  - DSA® anode coatings
  - Cathode re-activation
- 22.5 million t/y Cl₂ of world production
- Cl₂ production based on Gruppo De Nora related technology
  – 33% world production
- Manufacture of membrane electrolyser components
- Automated welding for precise and consistent cell assembly

Bayer AG - Germany
Laser Welding
DE NORA
CABU — Mercury Cells

• Complete mercury cell room support
• Energy saving program for mercury cells
  • Higher efficiency and lower power consumption
  • Less maintenance
  • Reduced Hg usage
  • Reduced (<1 g/t Cl₂) Hg emission into the air
• 7.5 million t/y Cl₂ of world production
  • 85% of world production anodes
  • SLM™ new advanced high performing anode for mercury cells
  • Runner® anodes for mercury cells
• Cell Components
  • End boxes, decomposers and side rails
DE NORA
CABU — Diaphragm Cells

• Energy saving DSA® anodes for diaphragm cells – Duplex, LVA™ and ESA™

• Recoating and upgrading existing anodes

• Maintenance and recoating services

• 20 million t/y Cl₂ – 85% of world Cl₂ production by diaphragm

• Complete cell room components for Glanor, MDC™ and H-type diaphragm cells

• Separators – SM-2™ (modified asbestos) and PMX™ (non asbestos) replacement
DE NORA
Chlor Alkali Business Unit (CABU) — Chlorate

- High performance DSA® anodes for the production of sodium and potassium chlorate
- Manufacturing of electrode packages
- Maintenance and recoating service special anodes for perchlorate electro-chemical production
- Over 60% of worldwide production on De Nora DSA® anodes

Solid Pt clad titanium

Chlorate anodic bundle
DE NORA
Oxygen and Specialties Business Unit (DNOx)

• DNOx pursues new trends and markets in electro-chemical technology beyond the application of Chlor-Alkali production.

• DNOx provides innovative Anode Technology in MMO’s and Pt Anodes for:

  Swimming Pool Chlorination - saltwater chlorinator anodes
  Environmental sectors - water treatment & metal recovery
  Hydrometallurgy - Electrowinning
  Electronics - Cu-foil, Al-foil, & Printed Circuit Board (PCB) plating
  Auxiliary Anodes - chrome plating
**DE NORA**
Oxygen and Specialties Business Unit (DNOx)

- DNOx is the industry leader, with a 90% market share, in anodes for **swimming pool chlorination**.
- DNOx pool anodes are the industry standard for quality.

**Plating activities** - chrome auxiliary anodes used to plate wheels, bumpers and other automotive parts.
DE NORA
Oxygen and Specialties Business Unit (DNOx)

DNOx – Consumer electronics

• DNOx anodes for Cu-foil, Al-foil, PCB & semiconductors cover a broad range of applications and are supported by strong technical service and R&D.

• A new anode coating, Synergy™, reduces additive consumption to the level of consumable anodes, but provides PCB manufacturers with better economics, quality and lower costs.

Copper foil anode
DE NORA
Oxygen and Specialties Business Unit (DNOx)

DNOx – Electro-galvanizing (EGL) Anodes

- Advanced products with plasma sprayed coatings
- Customized anode structures
- Decorative and hard electro-galvanizing
DE NORA
DNOx Business Unit

**LIDA® Cathodic Protection Anodes**
Mixed metal oxide titanium anodes for impressed current cathodic protection. *For pipelines, above and in-ground storage tanks, locks, dams and the like.* Soil / sea water / industrial installation.

**LIDA® TSA™**
Tensioned string anodes for protection of offshore oil platforms. 4 platforms, 40 tensioned strings, 20,000 Amps installed, 18 years life at Loango Field.
DE NORA
DNOx Business Unit

ELGARD® LIDA® CP Anodes
• Advanced MMO anodes for cathodic protection of steel in concrete.
• Specified by main engineering firms — proven technical and economic advantages.

ELGARD® LIDA® mesh & ribbon anodes
• Cathodic protection and prevention systems in reinforced concrete.
• 10 years of cathodic prevention at the Sidney Opera House.
DE NORA
DNOx Business Unit

- DSA® anodes for seawater and brine electro-chlorination
- Servicing and replacement of spent electrodes of any technology
- The range of treatment applications
  - Industrial seawater
  - Marine wastewater
  - Ballast water
  - Industrial brine
  - Municipalities water

Seaclor® electrode set
Seaclor®
Industrial Seawater Treatment

Sanilec®
Industrial Seawater Treatment

Omnipure™
Marine Wastewater Treatment
DE NORA R & D DIVISION
New Research & Development Activities

• Waste water purification from:
  • Metals
  • Organics / Inorganic pollutants
• Soil remediation by electrochemically reactive permeable barriers (ERPB)
• Energy conversion from renewable sources (solar, wind, etc.), focused on H$_2$ production by electrolysis
• Innovative electro-winning processes
Why Titanium?

Advantages over other valve metals like Ta, Nb, etc.

• Better Value
• Availability
• Ease of substrate preparation for catalyst application
• Ease of fabrication
• Good electrical conductivity
Thank you.

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