



# ELECTRODE TECHNOLOGIES

## Executive Summary



**Undisputed industry leadership**

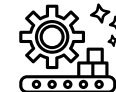
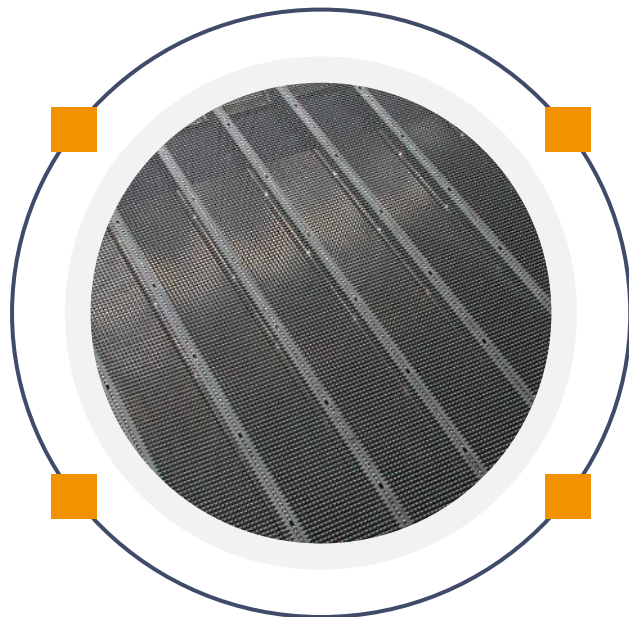
More than 50% share<sup>1</sup> in growing end markets



**Mission-critical solutions to multiple end markets**

Continuous technological innovation;

Building customer trust and granting access to new markets



**Largest electrodes producer globally**

With 9 manufacturing and assembling facilities and a global and balanced geographic footprint



**Substantial recurring revenues from a growing aftermarket business**

Long-term customer relationship (>20 years)

<sup>1</sup> Source: Roland Berger. Market shares in electrodes for chlor-alkali, copper foil, PCB, nickel, and cobalt electrowinning



# ELECTRODE TECHNOLOGIES

Addressing multiple industrial applications with a wide range of products



## KEY PRODUCTS

ANODES



CATHODES



CATALYTIC COATINGS  
GDE<sup>1</sup>



## MAIN ADDRESSED INDUSTRIES

Chlor-alkali



Electronics



Mining



## OTHER INDUSTRIES



Pulp & paper



Steel galvanizing



Automotive  
Chrome plating



Plumbing & furniture  
Surface finishing



Steel & concrete  
Corrosion protection

<sup>1</sup> GDE: Gas Diffusion Electrodes



# CHLOR-ALKALI

Electrodes at the core of the value chain with bespoke mission-critical solutions matching customers' needs



Value chain



Aftermarket services



Components suppliers

Equipment suppliers and EPC<sup>1</sup> players

### Electrodes

Several coatings matching all needs

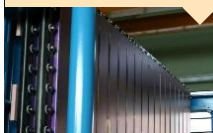
### Anodes



### Cell elements

>160,000 elements made for tk nucera

### Manufacturing



Electrolysers, cell room & basic design



### Complete plants



### Cathodes



Other OEM

EPC/  
construction companies

Chlor-alkali producers



Recoating & repairs



Cell refurbishment and performance upgrade



Spare parts

<sup>1</sup>Engineering, Procurement, and Construction.



# ELECTRONICS

Electrodes are deeply embedded in the copper foil production and PCB manufacturing processes



## Value chain



Electrode suppliers

OEM/ equipment suppliers

Producers

Anodes



Electro-deposited cells



Plating lines



Copper Foil



PCB



## De Nora aftermarket services



Electrodes recoating/replacement



Performance monitoring



Technology renovation/upgrade



Lithium Batteries



Rigid PCB



Flexible PCB



Semiconductors



HDI

<sup>1</sup> Electrodes for copper foil manufactured in 2021.



# ELECTROWINNING

De Nora's anodes and complete solutions are key in modern metals refining processes



Value chain



Ore extraction



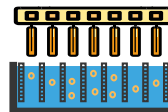
Handling



Transformation



Metal refining (EW)



DSA® anodes



Nickel (Ni)



Cobalt (Co)



Copper (Cu)<sup>1</sup>

De Nora services



Recoating & maintenance



Aftersales & spare parts



Technology upgrade

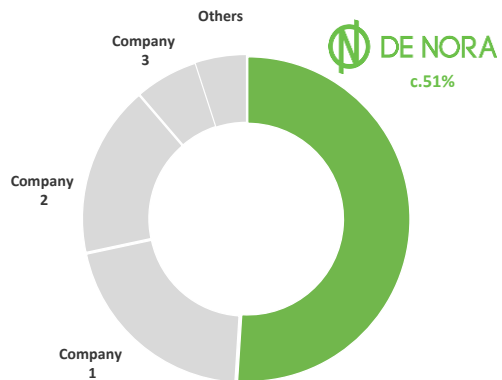
<sup>1</sup>De Nora is testing a technology to penetrate the copper electrowinning market.



## CHLOR ALKALI

### Global electrodes market share<sup>1</sup>

[m MT Cl<sub>2</sub>]<sup>2</sup>



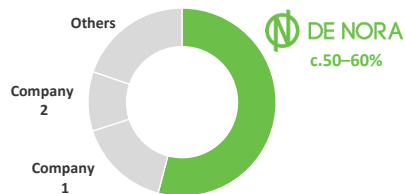
Partnership with tk nucera, key relationship with major licensor and many world class chemicals producers

## ELECTRONICS

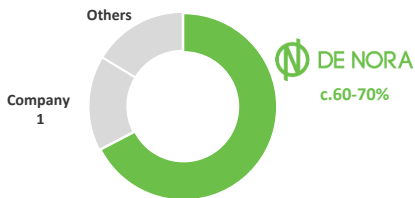
### Global electronics market share

[#installed cells]<sup>2</sup>

#### Copper foil



#### PCB



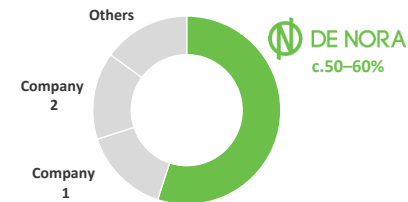
Leader in copper foil and PCB with significantly higher market share than competitors

## ELECTROWINNING

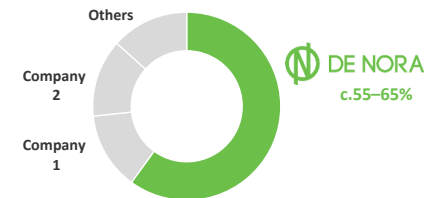
### Global metal market share

[# of installed titanium anodes]<sup>2</sup>

#### Nickel



#### Cobalt



States-of-the-art titanium anode for nickel and cobalt and testing ongoing to penetrate the copper market



# ELECTRODE TECHNOLOGIES

What makes De Nora's electrodes different?



One century of investments and technological breakthrough



Best-in-class manufacturing capacity in place



Superior performance in terms of energy consumption, efficiency, and durability

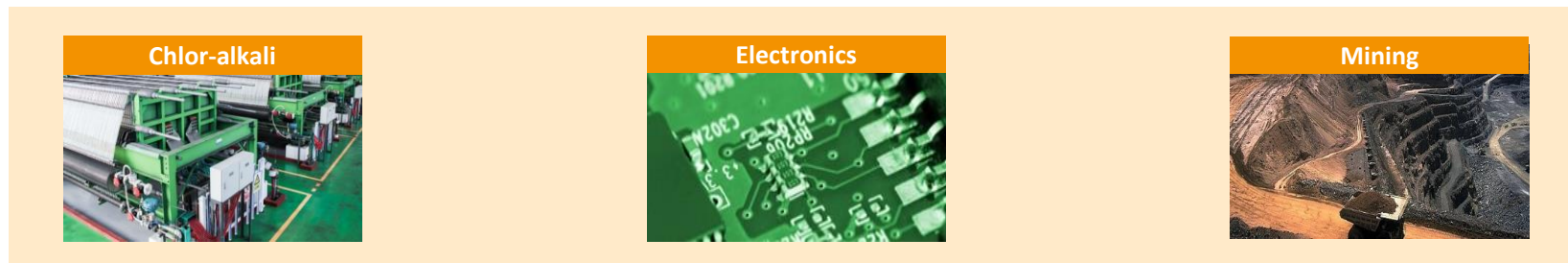
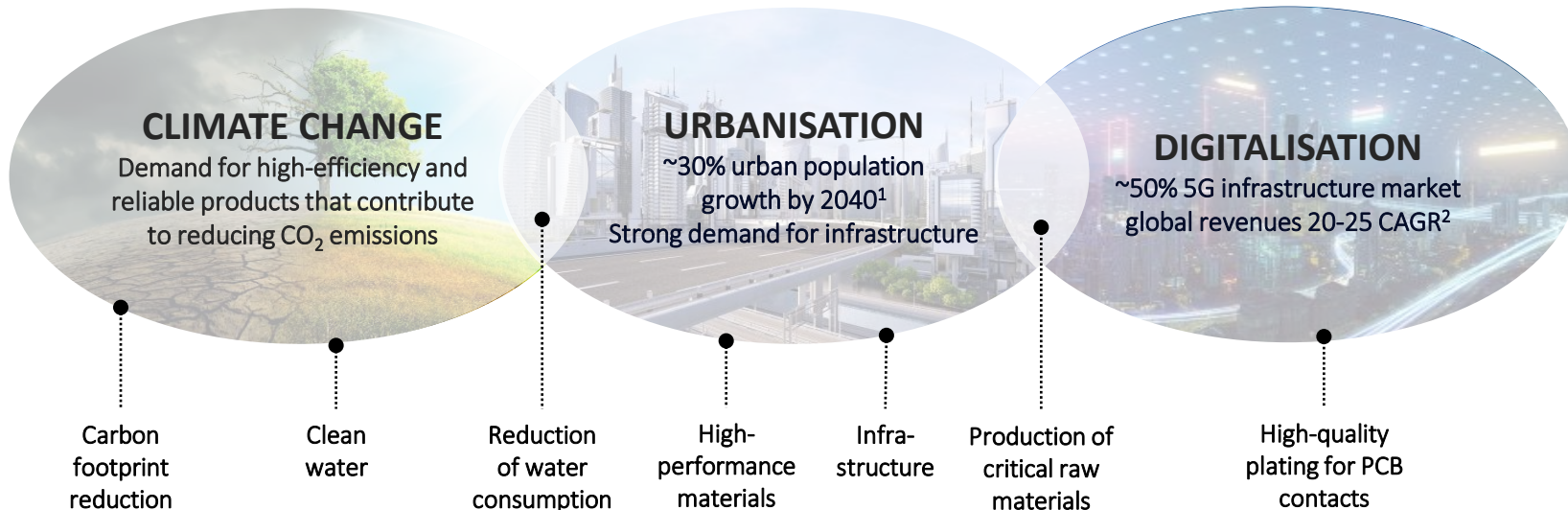


Outperforming for quality and range of aftermarket services





Demand for electrodes is being driven by well-established mega-trends



<sup>1</sup> The World Bank website as of 21 February 2022. <sup>2</sup> Mordor Intelligence (Global 5G Infrastructure Market).



«Continuously safeguard leadership position across products, industries, and geographies by leveraging strengths.»



MAINTAIN  
LEADERSHIP POSITION

Leverage **large offers**, **global footprint**, and **relations with key stakeholders**



EXPAND  
SERVICES

Exploit all **opportunities** coming from **large installed base**



OPERATIONAL  
EXCELLENCE

Strengthen **manufacturing setup** and **improve supply chain management**



INVEST IN TECHNOLOGY  
INNOVATION

Continuous **technological innovation** and **performance upgrade**



DE NORA

*discover more*

