

Recent Developments in Chlor-Alkali Technology

12th November 2024

Technology Developments & Growth Scenario in Chlor-Alkali Industry
(Global and Indian Perspective)

Organized by Indian Institute of Chemical Engineers
New Delhi

Taisuke Nakamura



Who am I?

Name

Taisuke Nakamura

Company

Asahi Kasei Corporation

Job

Sales & Marketing

Career

Sales & Marketing of Chlor-Alkali electrolyser & Ion Exchange Membrane (2021.4 - Present)

Educational
Background

Master's degree in Biotechnology, University of Tokyo

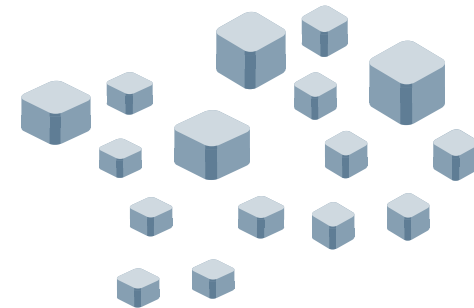




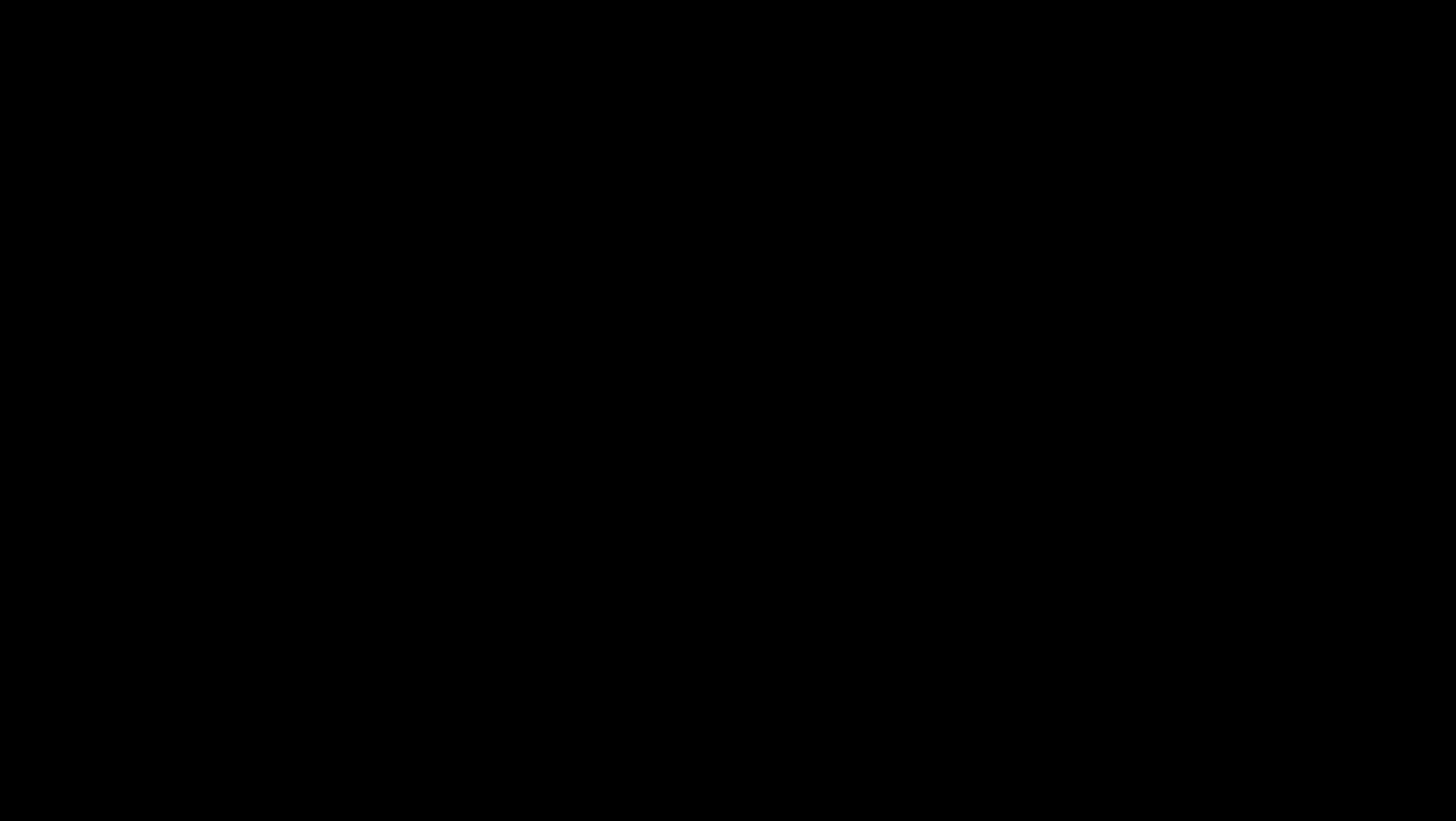
Today's topic

1. History of our innovation
2. New developments
 - Membrode™
 - New Acilyzer™ NC40Z
3. New website

1. Our history of Innovation



Asahi Kasei as unique total supplier

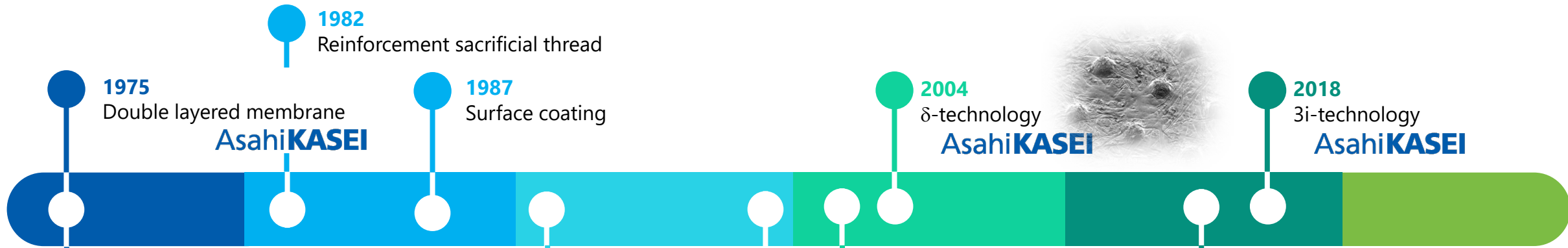


Asahi Kasei as unique total supplier

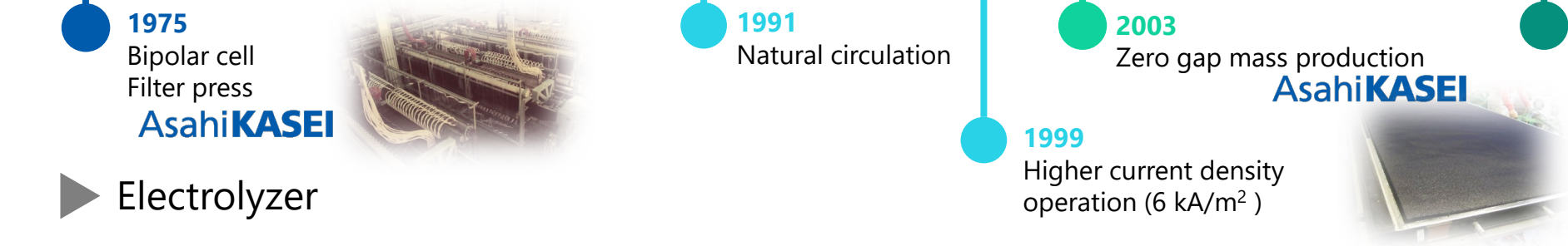


History of our innovation

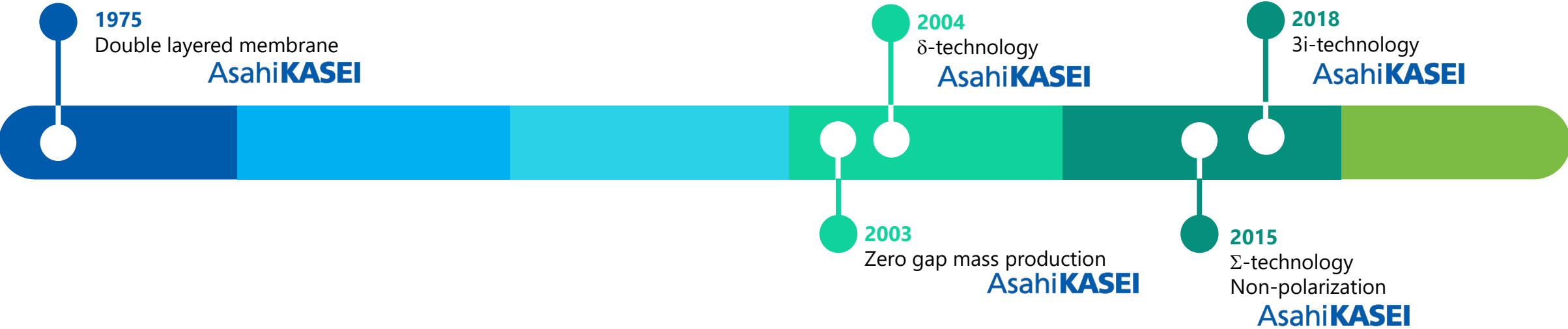
▶ Membrane



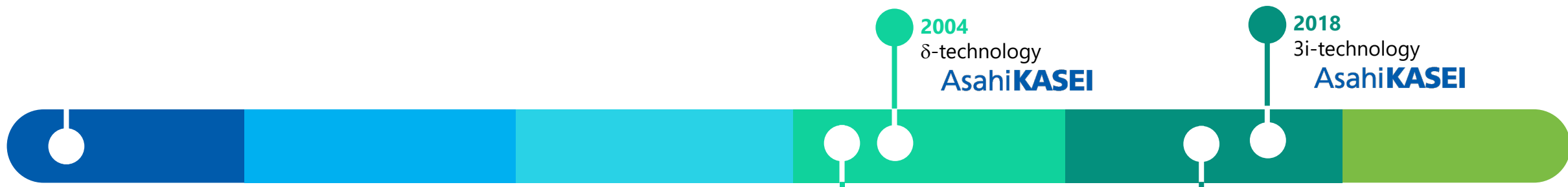
▶ Electrolyzer



History of our innovation



History of our innovation

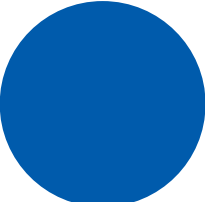


2004
 δ -technology
AsahiKASEI

2018
3i-technology
AsahiKASEI

2003
Zero gap mass production
AsahiKASEI

2015
 Σ -technology
Non-polarization
AsahiKASEI

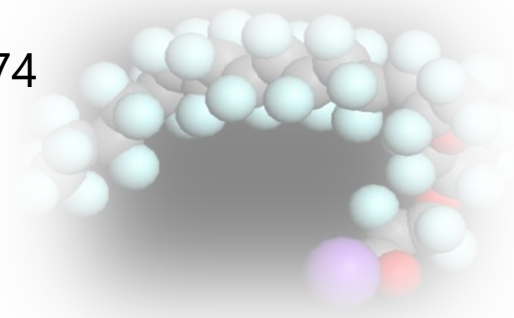


1975

Double layered membrane

AsahiKASEI

The effect of carboxylate ion-exchange site was found in 1974 contributing higher current efficiency

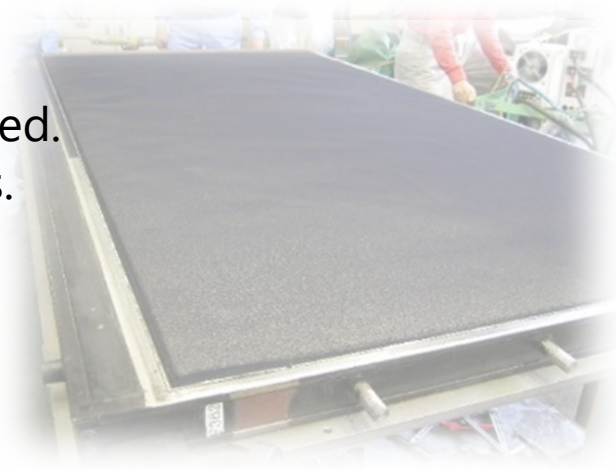


History of our innovation



2003
Zero gap mass production **AsahiKASEI**

Power consumption and cell voltage was drastically reduced.
Asahi kasei has produced more than 95,000 zero gap cells.



History of our innovation



1975
Double layered membrane
AsahiKASEI

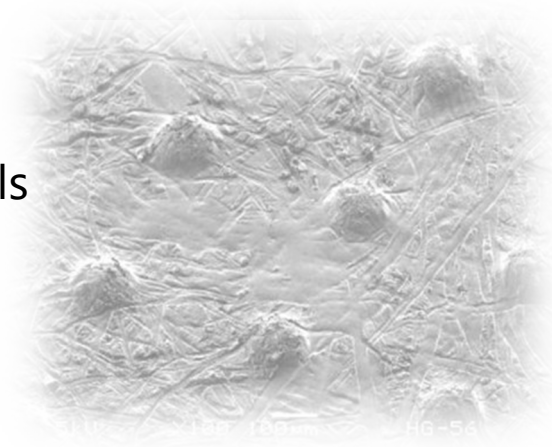
2003
Zero gap mass production
AsahiKASEI

2018
3i-technology
AsahiKASEI

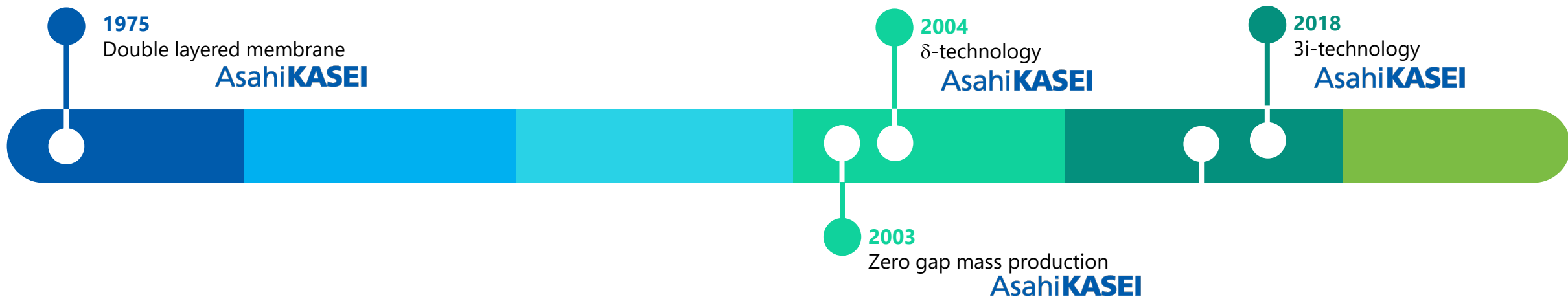
2015
 Σ -technology
Non-polarization
AsahiKASEI

2004
 δ -technology
AsahiKASEI

Unique membrane surface topography contributes to stable operation in high current density and zero gap cells



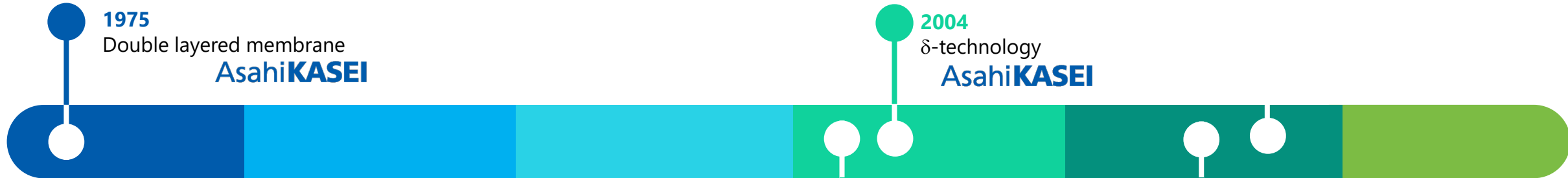
History of our innovation



2015
Σ-technology AsahiKASEI

Polarization is not required during shutdown enabling long-term stable operation

History of our innovation



1975
Double layered membrane
AsahiKASEI

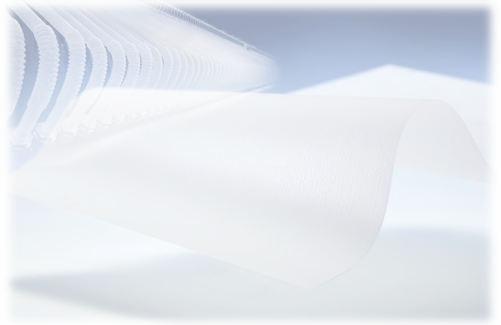
2004
 δ -technology
AsahiKASEI

2003
Zero gap mass production
AsahiKASEI

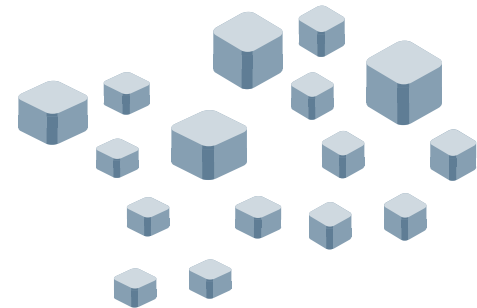
2015
 Σ -technology
Non-polarization
AsahiKASEI

2018
3i-technology
AsahiKASEI

ion channel control, improved coating, improved structure contributed to low power consumption.



2. New developments



Benefit of New Developments

New Development

Improvement

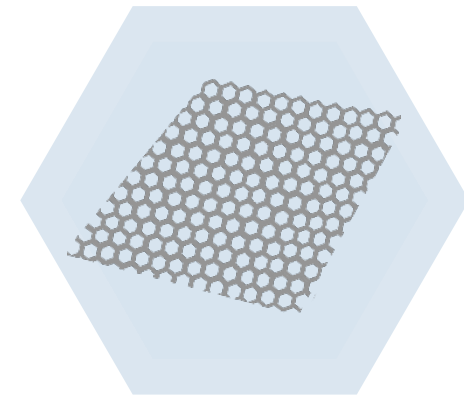
Membrode™

**Easier & Faster
Electrode
renovation**

**New Acilyzer™
NC40Z**

**Larger
effective area
on the same
footprint**

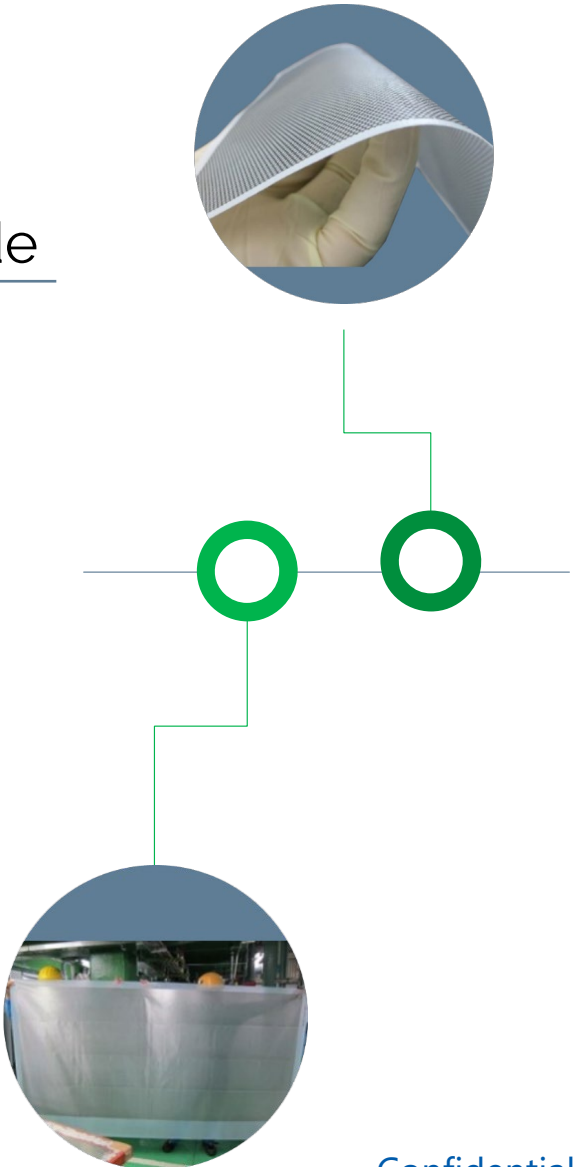
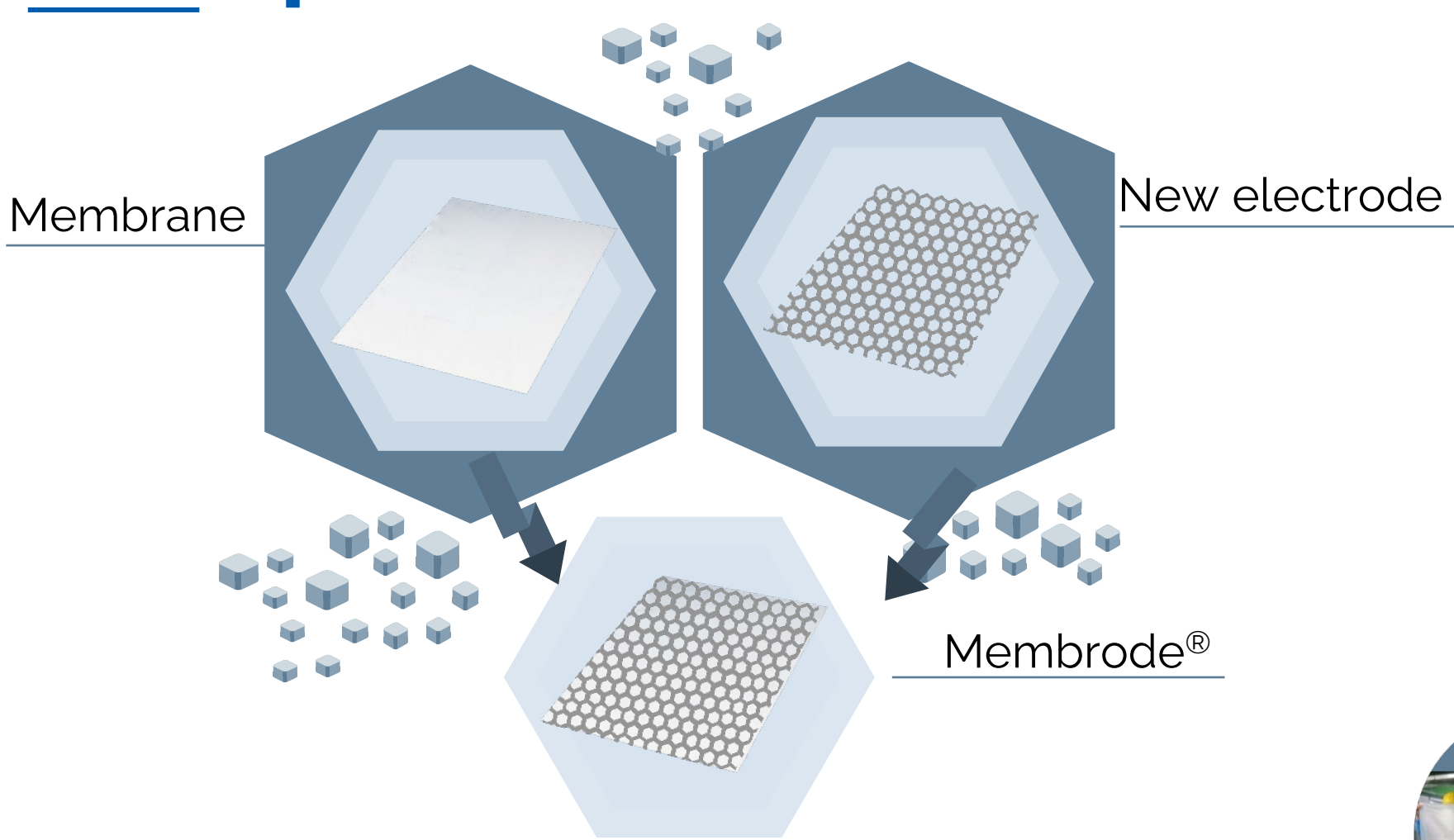
2-1. Membrode™



Concept of Membrode™



Concept of Membrode™



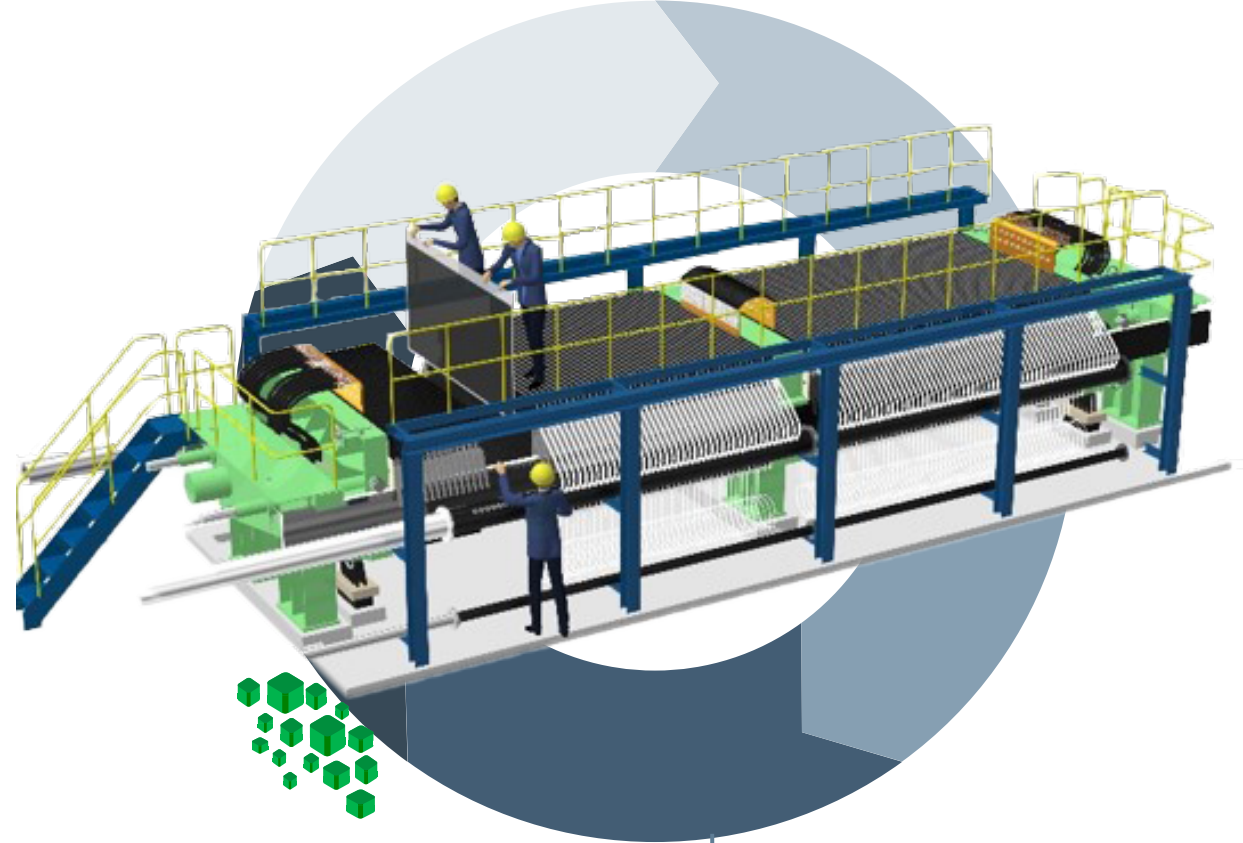
Concept of Membrode™

Today



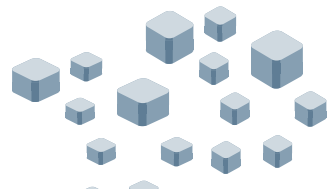
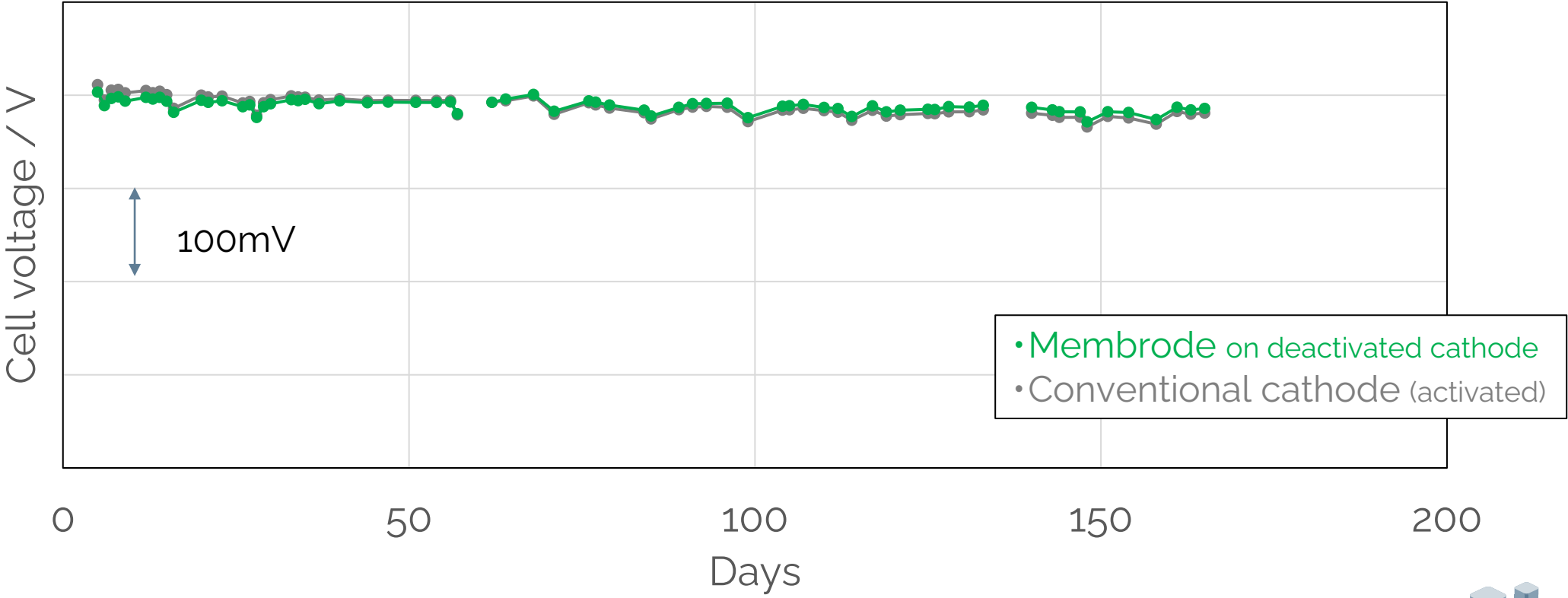
Long time

Future with Membrode™

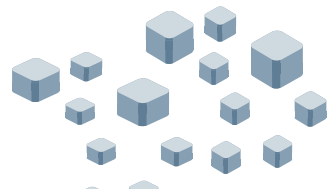
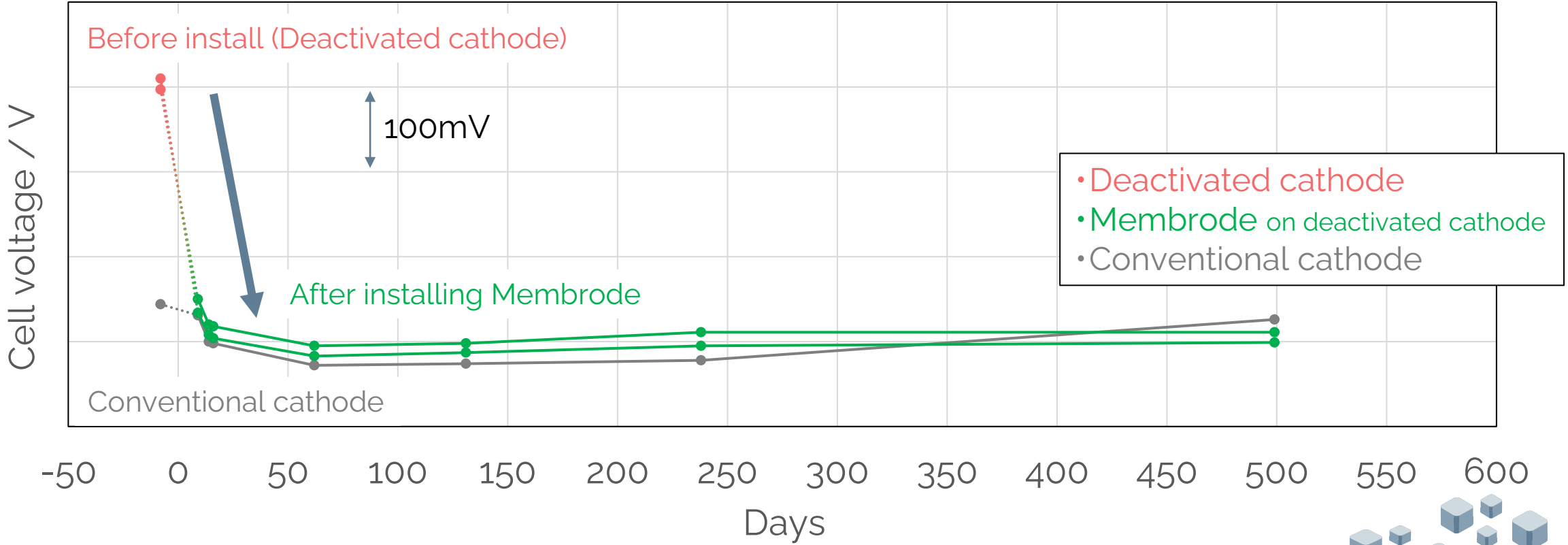


Short period

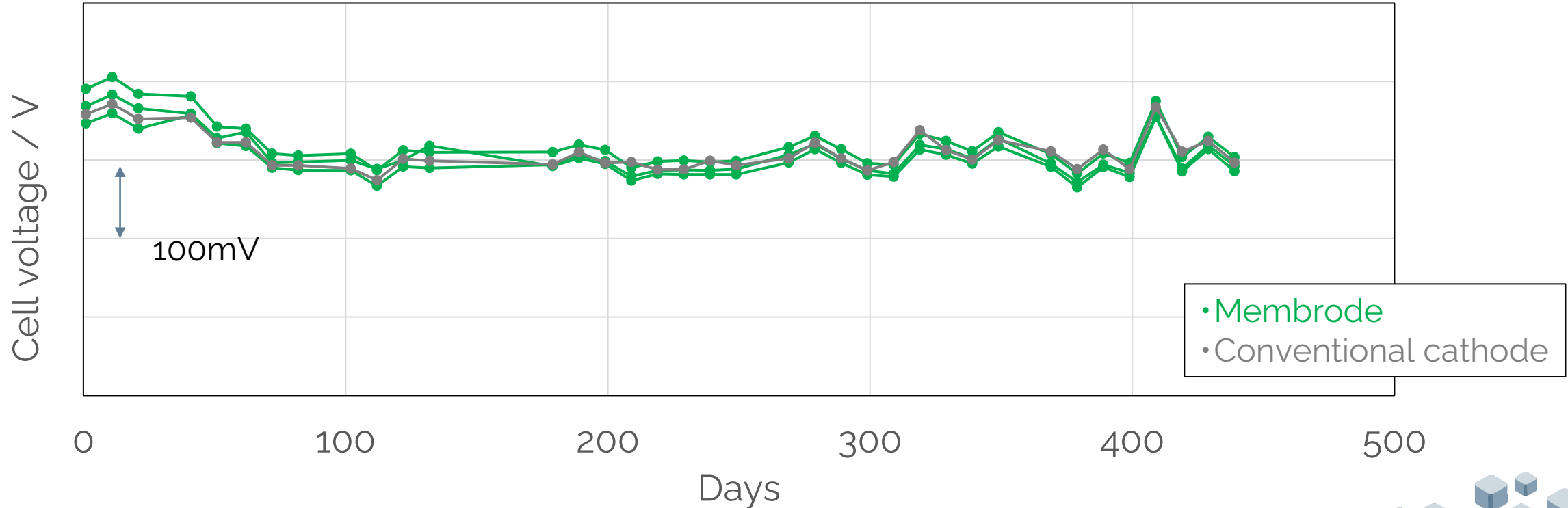
Evaluation of Membrode™



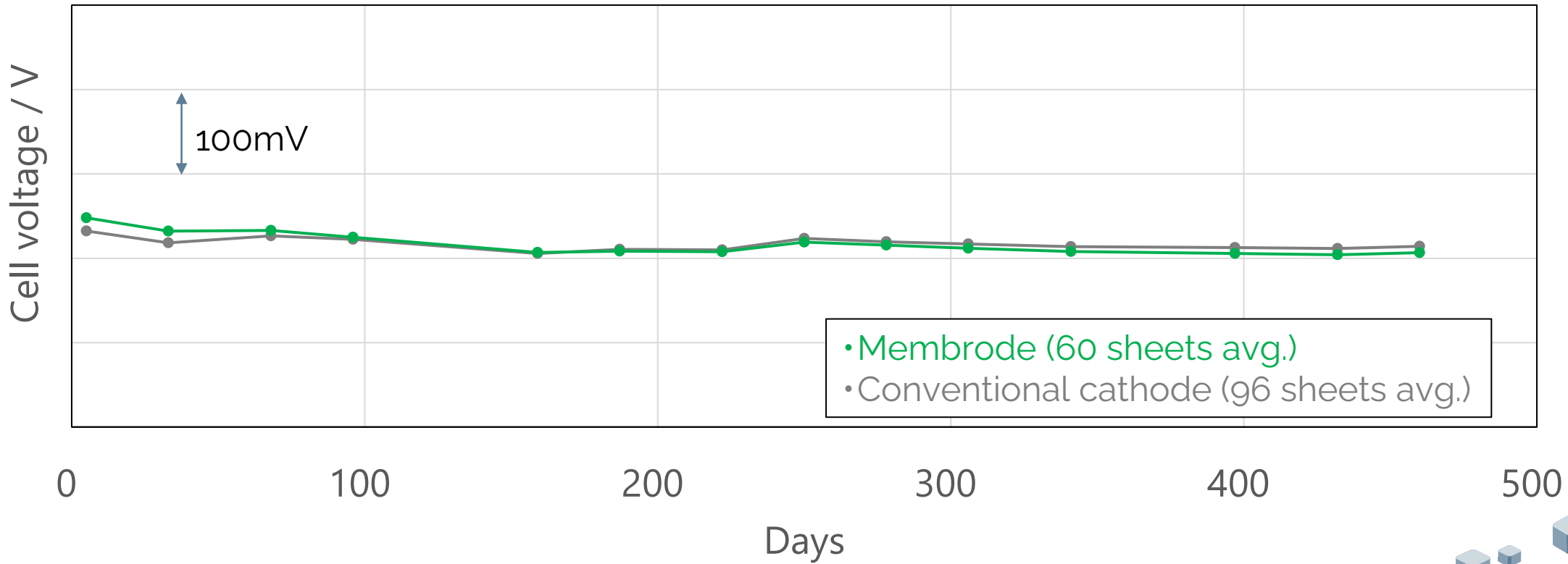
Evaluation of Membrode™



Evaluation of Membrode™



Evaluation of Membrode™



Summary of Membrode™

- Membrode

Potentially reduces the time for cathode remeshing/recoating significantly

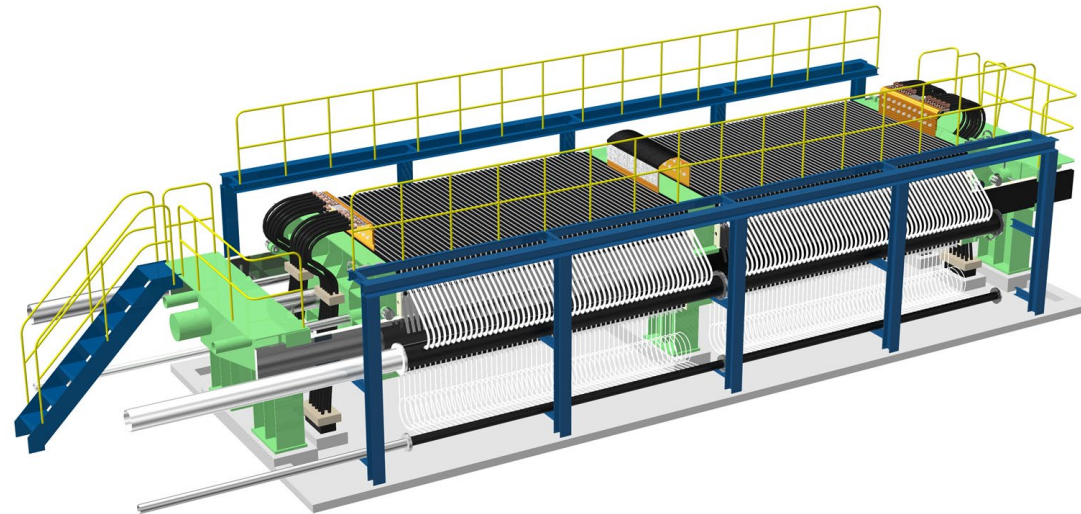
- Cathode Membrode

under evaluation in several customer's plant

- Anode Membrode

under the research and development

2-2. New Acilyzer™ NC40Z (5 ft x 8 ft cell element)



New Acilyzer™

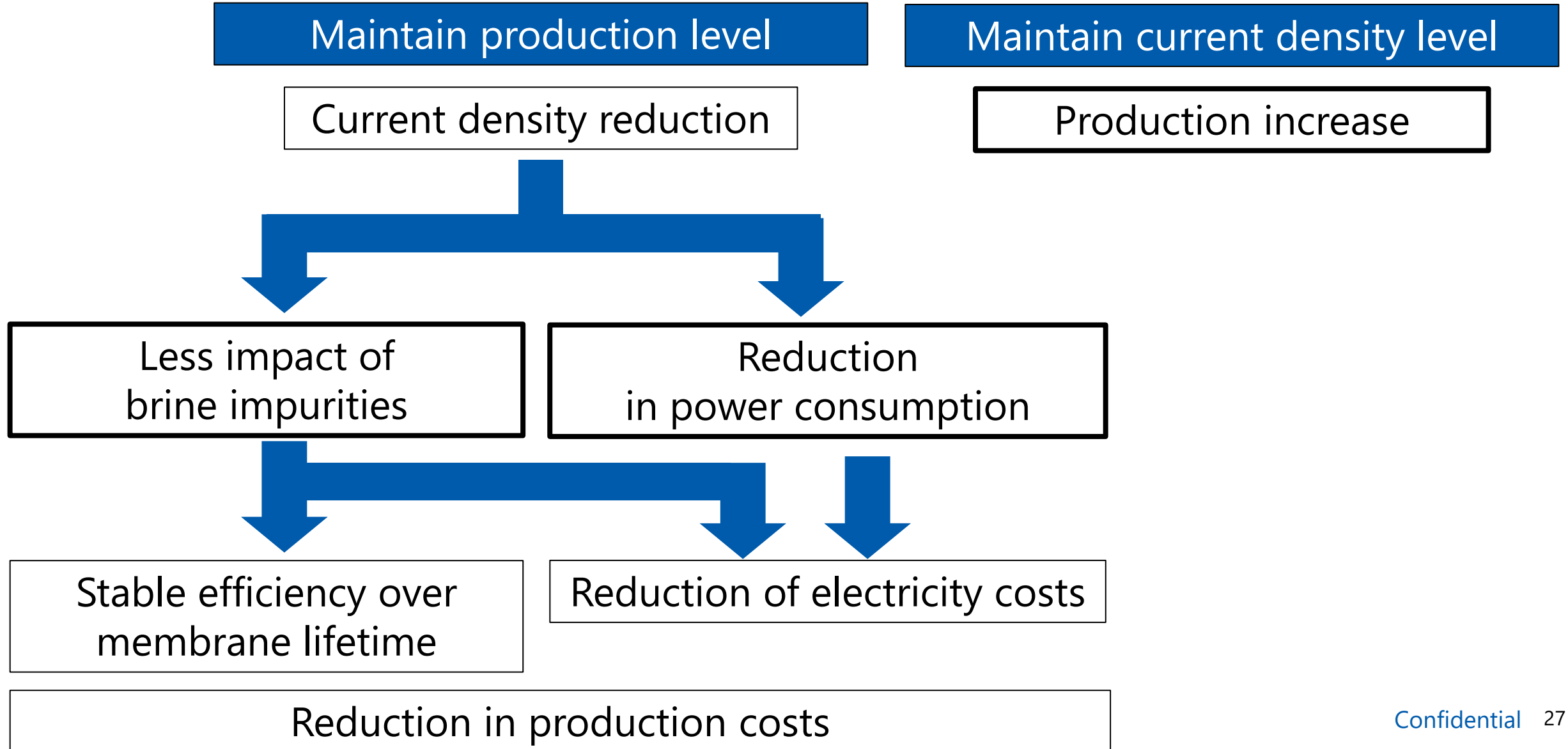
New
NC40Z

Conventional
NC32Z

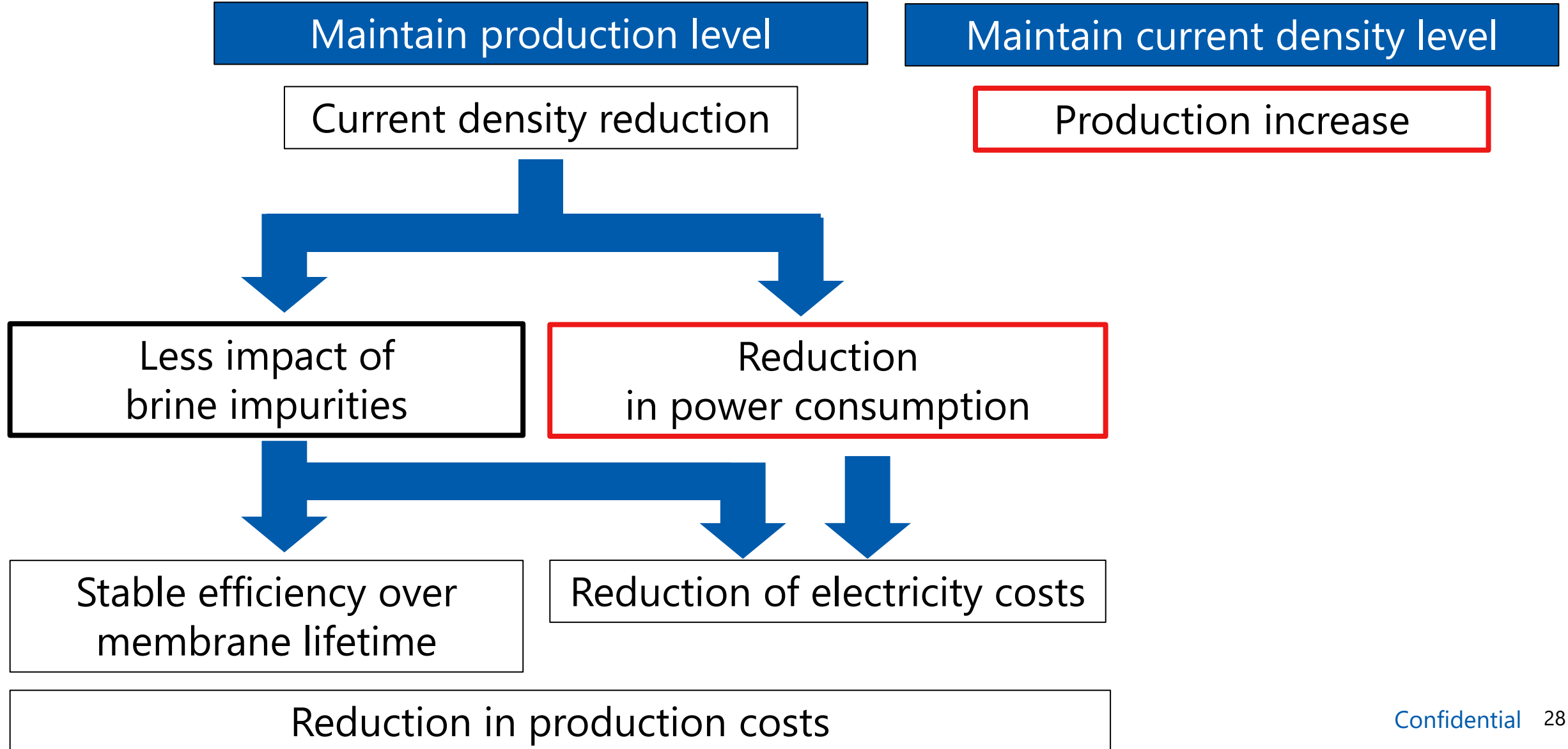


- ✓ Decrease current density while maintaining the same production level
- ✓ Increase production value while maintaining the same current density level

Benefit from New Acilyzer™ NC40Z (3.4m²)



Benefit from New Acilyzer™ NC40Z (3.4m²)



Performance comparison table

- Case1 Maintain production volume; P·C reduction of approx. 70 kWh/t-NaOH
- Case2 Maintain current density; Production volume increase of approx. 25%

	NC32Z-Σ Conventional	NC40Z-Σ New Case1	NC40Z-Σ New Case2
Cell size	4feet×8feet	5feet×8feet	5feet×8feet
Effective area for each cell (m ²)	2.7	3.4	3.4
Current density (kA/m ²)	6.0	4.8	6.0
Power consumption (kWh/t-NaOH)	-	-70	Same
Production volume	-	-	25% up

P·C reduction of 70 (kWh/t-NaOH)
or 25% increase of production volume

*Representative value. Not guaranteed.

Benefit from New Acilyzer™ NC40Z (3.4m²)

Maintain production level

Maintain current density level

Current density reduction

Production increase

Less impact of brine impurities

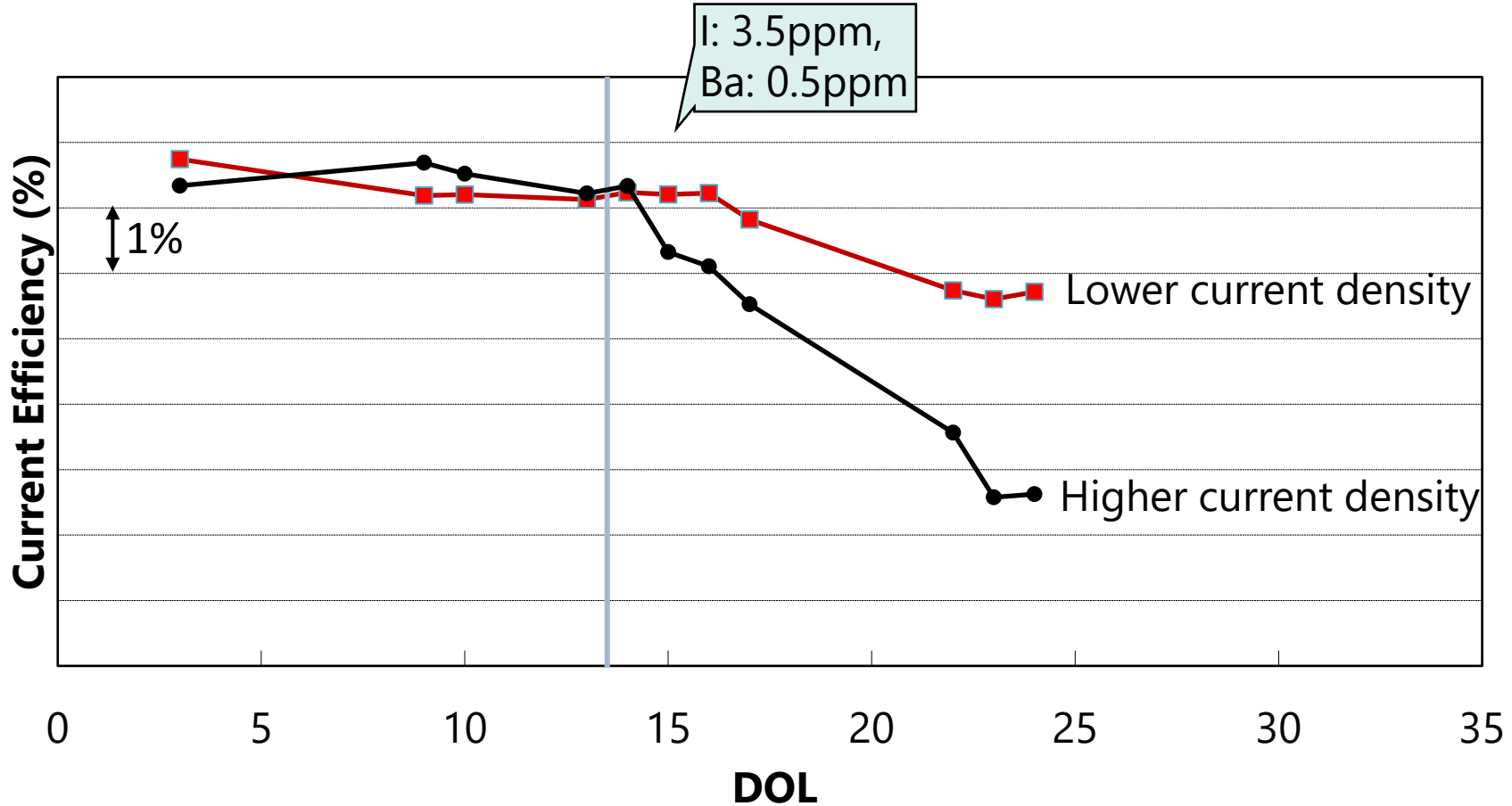
Reduction in power consumption

Stable efficiency over membrane lifetime

Reduction of electricity costs

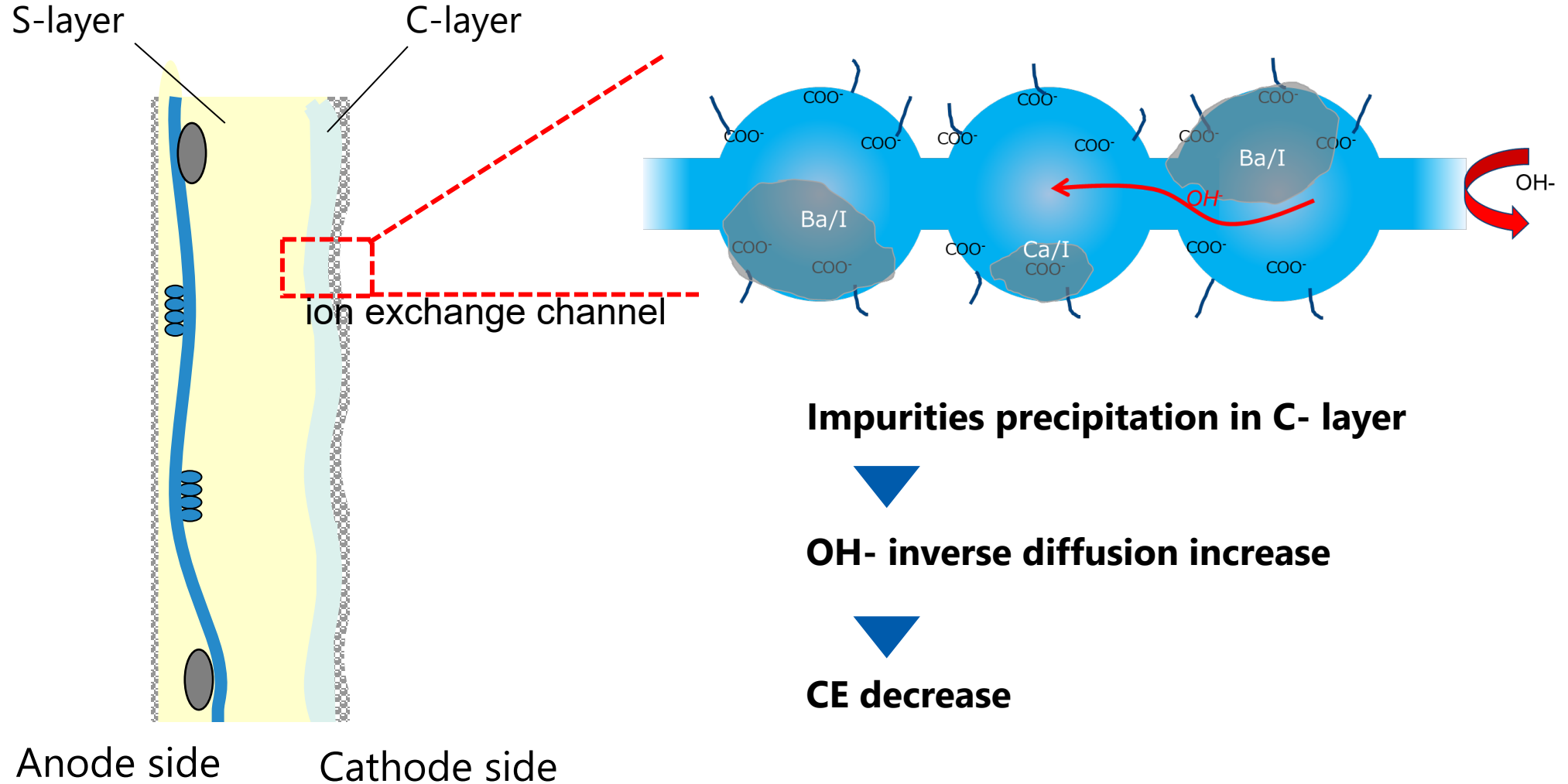
Reduction in production costs

Prevention of CE decline with lowering C.D.

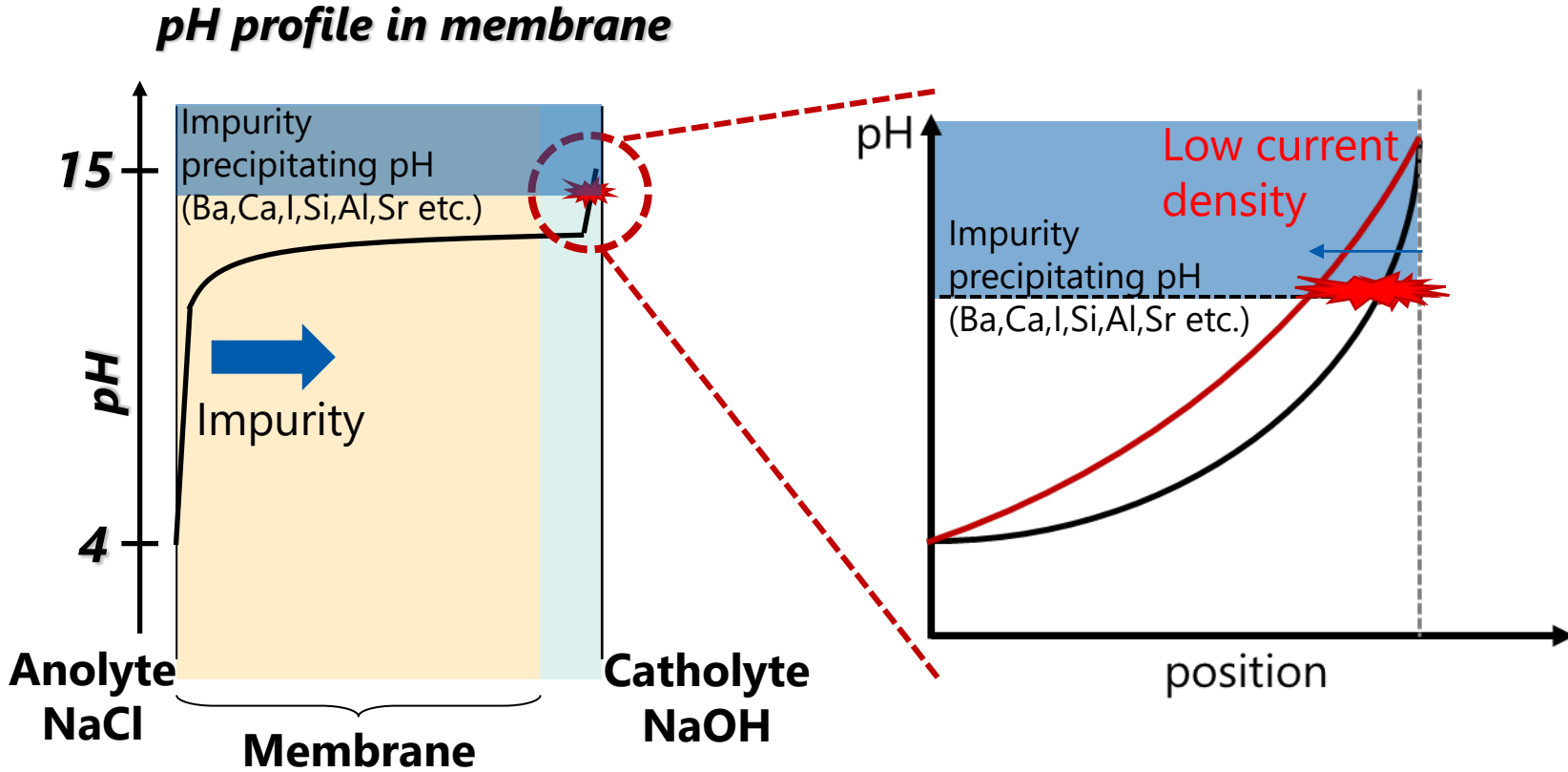


Improved CE stability against impurities with lower current density

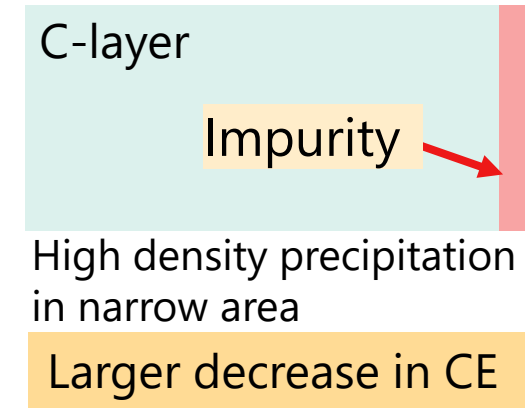
Mechanism of CE decrease by impurity



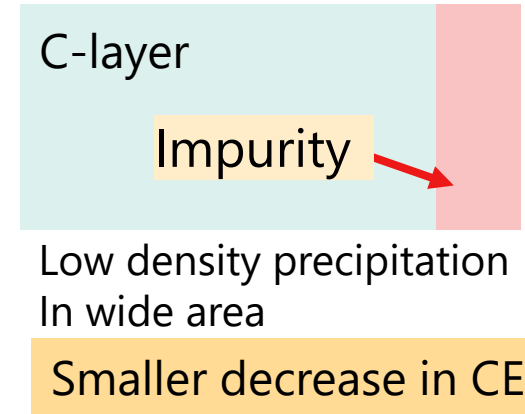
Mechanism of CE decrease by impurity



High current density

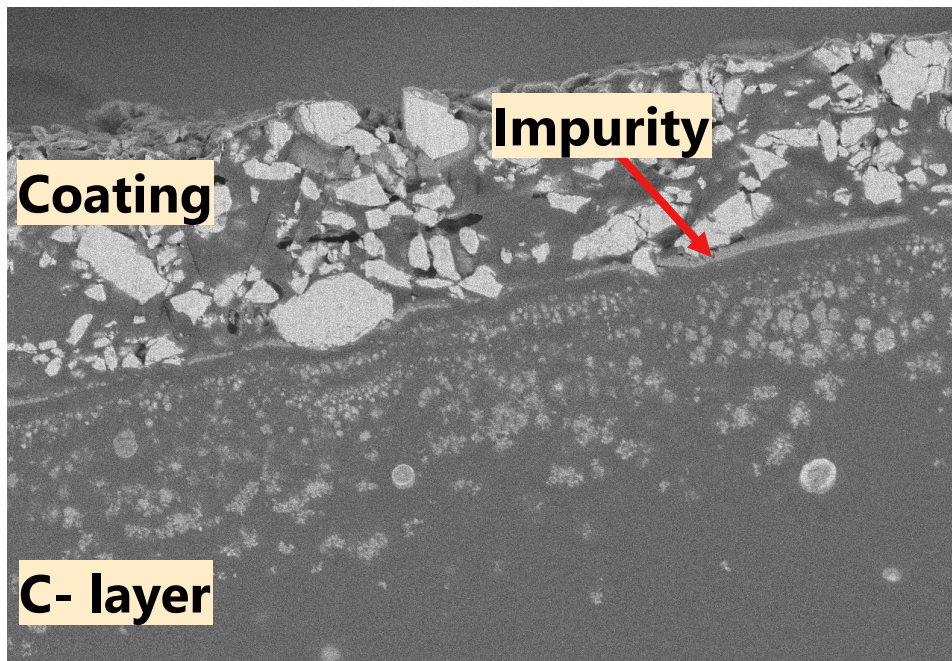


Low current density

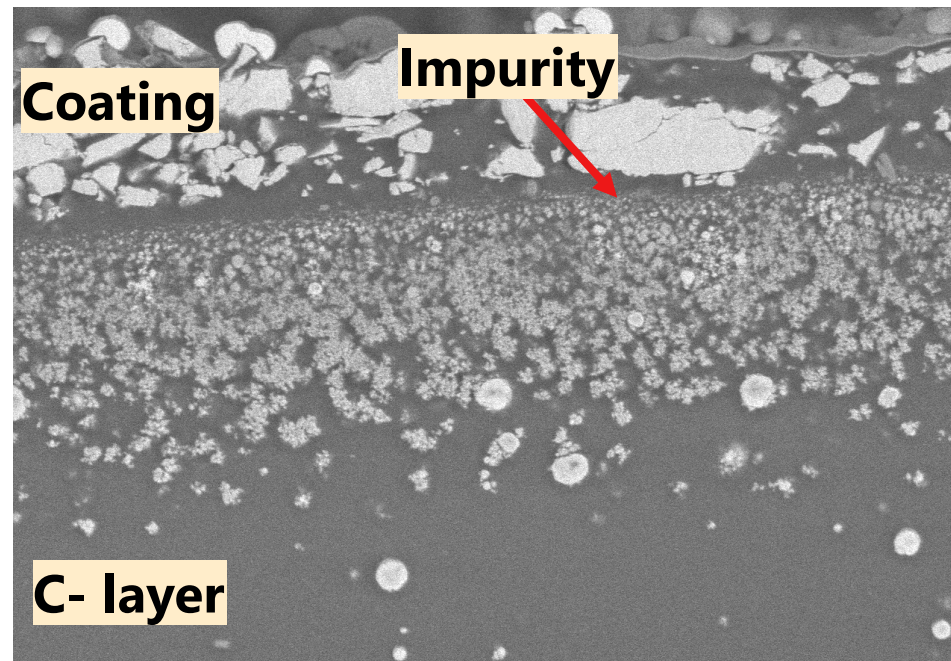


Mechanism of CE decrease by impurity

Lower C.D.



High density accumulation of impurity at film/coating interface



Lower density accumulation of Impurity at wide range

It is possible to reduce membrane degradation by impurities with keeping production volume by NC40Z

Benefit of New Developments

New Development

Improvement

Customer benefits

Membrode™



**Easier & Faster
Electrode
renovation**

Minimizing down time
occurred by
electrode renovation/recoating

**New Acilyzer™
NC40Z**



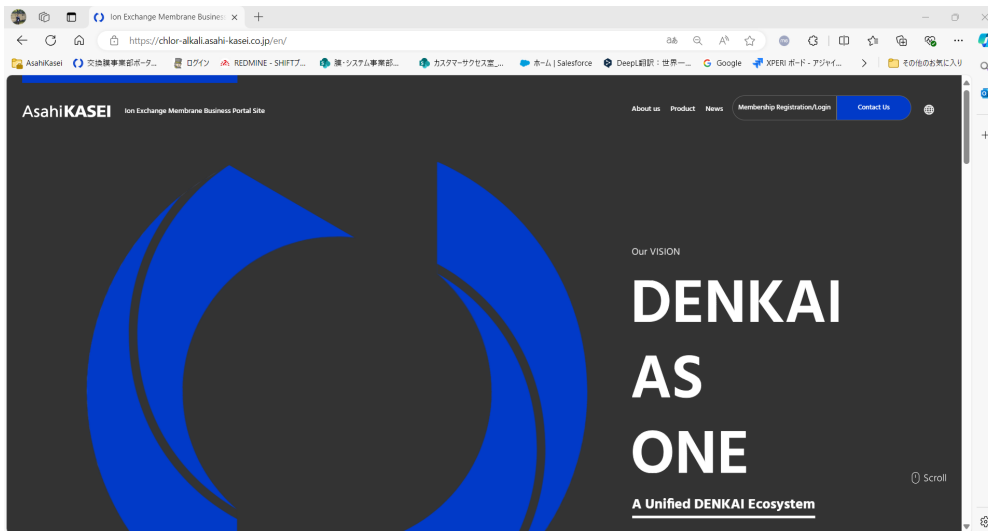
**Larger
effective area
on the same
footprint**

Larger production or
Less power consumption
(Higher stability)

3. New website

Recent activity – New website

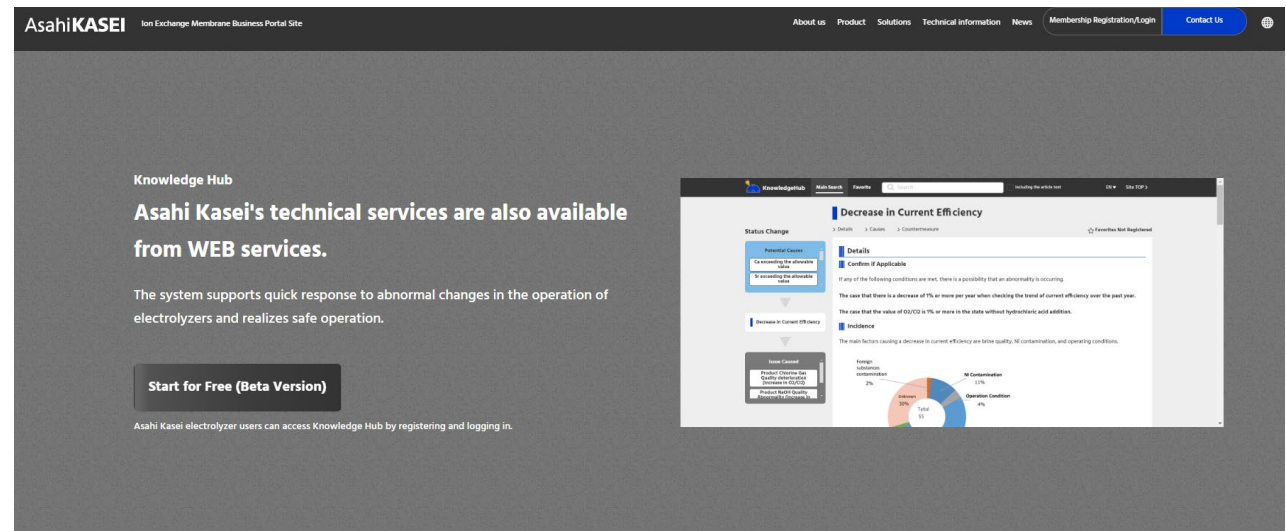
<https://chlor-alkali.asahi-kasei.co.jp/en/>



What' New?

- New branding design
- Membership system
- Introduction Movie
- Document download
- **Knowledge Hub**

What's Knowledge Hub?



What's feature?

- Reduce cause identification time
- Prevent anomaly escalation
- Implement mechanism-based solutions
- Streamline internal reporting

Recent activity – New website

Knowledge Hub image

Search for Symptoms

The screenshot shows the Knowledge Hub interface. At the top, there is a search bar with the text "Search" and a checkbox for "including the article text". Below the search bar, there is a "Search by Equipment" section with categories like "Brine Purification (14articles)", "Electrolysis Process (33articles)", "Dechlorination (1articles)", and "Gas Process (24articles)". The main content area is titled "Articles" and contains a grid of six symptom articles. A red box highlights the search bar and the grid of articles. A red arrow points to the search bar with the text "Search for Symptoms".

Symptom	Confirmation Time	Latest update
Rapid voltage increase	A few hours	2024.10.21
Decrease in Current Efficiency	A few days	2024.10.21
Cathode coating depletion due to reverse current	A few hours	2024.10.18
Depletion of cathode coating due to hydrochloric acid leakage	A few hours	2024.10.18
Poor brine replacement during Electrolyzer shutdown	A few hours	2024.10.18
Cathode coating depletion due to C-DCDS Failure	A few hours	2024.10.18

Select Relevant Symptoms from Options

Symptom transition chart

The screenshot shows the "Membrane Pinholes" article. At the top, there is a "Status Change" section with a flowchart. A red box highlights the flowchart, and a red arrow points to it with the text "Symptom transition chart". The flowchart shows a transition from "Potential Causes" (Electrolyzer differential pressure abnormality) to "Membrane Pinholes" and then to "Issue Caused" (Decrease in Current Efficiency). Below the flowchart, there is a "Details" section with a "Confirm if Applicable" sub-section. A photograph of an anolyte outlet hose is shown with blue arrows pointing to the hose and a red arrow pointing to a membrane pinhole. The text next to the photo indicates that the normal color is yellow (Cl2) and the color at a membrane pinhole is transparent (O2).

Potential Causes
Electrolyzer differential pressure abnormality (excessive & reverse differential Pressure)

Membrane Pinholes

Issue Caused
Decrease in Current Efficiency

Details
Confirm if Applicable

The impact on current efficiency decrease due to membrane pinholes occurs when large membrane pinholes develop. It is detected when the nitrogen leak amount exceeds 10L/Hr/Cell, which is the replacement standard for membranes, during the Membrane Leak Test (MLT). When membrane pinholes occur, the color of the chlorine gas outlet hose during Electrolyzer operation changes from the usual yellow chlorine gas color to white or transparent. Additionally, the voltage of each pair may change by +/-100mV from the normal value (mainly decrease). The hydrogen gas concentration in the chlorine gas increases. (This phenomenon does not occur unless the membrane pinholes are considerably large.)

Anolyte Outlet Hose Color:
Normal Yellow(Cl₂)
Membrane pinhole: Transparent(O₂)

Contents



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Creating for Tomorrow

