

WORLD CHEMICAL FORUM

**Chlor-Alkali Markets and Scenarios:
How past industry evolution may
determine the future state.**

September 12-14, 2023

Tom Taylor

Nouryon

Nouryon's Essential and Sustainable Solutions

Nouryon is a leader in specialty chemicals

- Specialty chemicals are **solutions that are offered based on their performance or function**
- They influence the **performance and processing of the customer's product**
- Nouryon's solutions are essential to countless everyday products that **help meet society's needs, today and in the future**

A selection of our industry-leading brands



Nouryon at a Glance

Key facts and financials



\$5.8 billion revenue
in 2022



Top-quartile performer
in **people safety**



Operating in over
80 countries



EcoVadis
Platinum rating¹



Approximately **8,300**
employees worldwide



34% of revenue from
Eco-Premium Solutions²



11 Innovation and
Application Centers
worldwide



77% of R&D product pipeline
focused on solutions with
sustainability benefits



¹Top 1% of companies rated by EcoVadis in 2022.

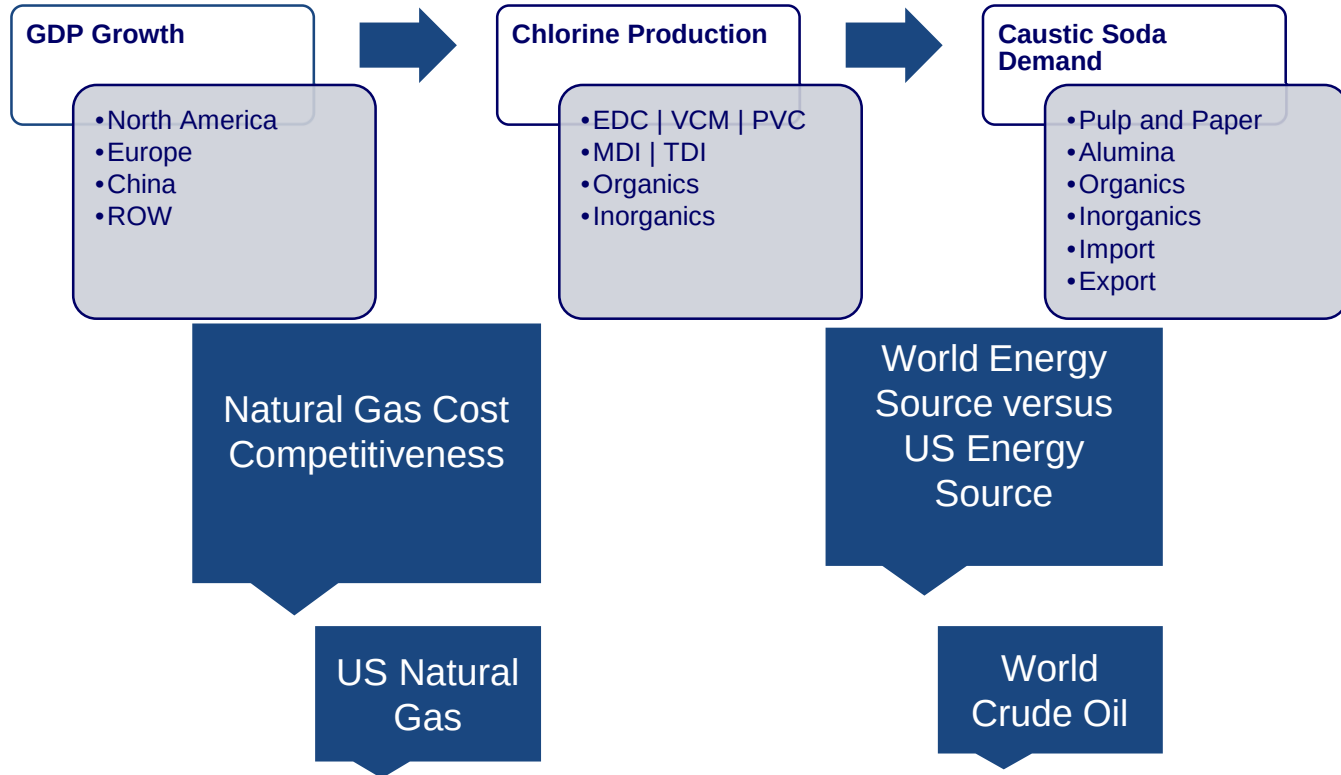
²Our Eco-Premium Solutions are products that offer significant sustainability benefits over mainstream alternatives in the market while providing the same or better functionality.

Chlor-Alkali Markets and Scenarios: How past industry evolution may determine the future state.

What I plan to cover today in today's discussion

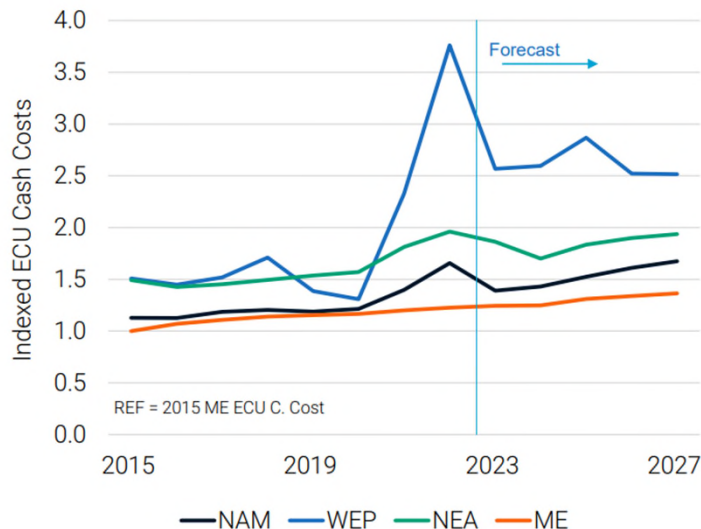
- Revisit some industry changes from 2000 till 2023
 - - Major developments
- How the changes from 2002 – 2016 shaped the market landscape today.
- Potential impacts for 2024 and beyond

Global Overview



Before we look at the past... *let's look at a projection...*

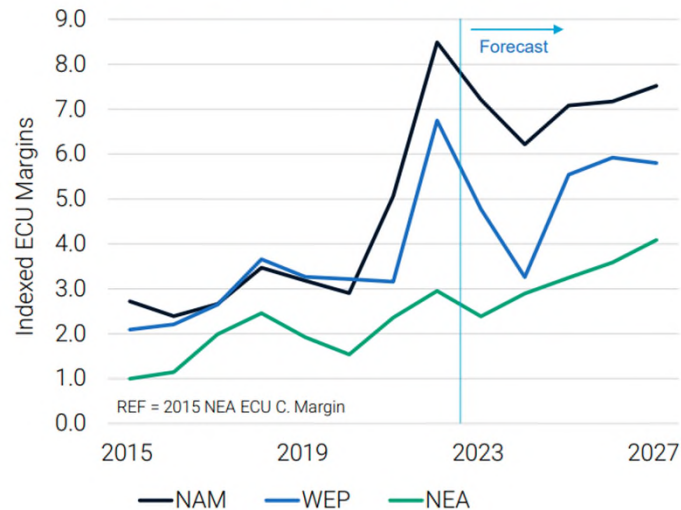
ECU Cash Costs



Source: Chemical Market Analytics by OPIS

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ECU Cash Margins (Weighted Avg Chlorine Value)

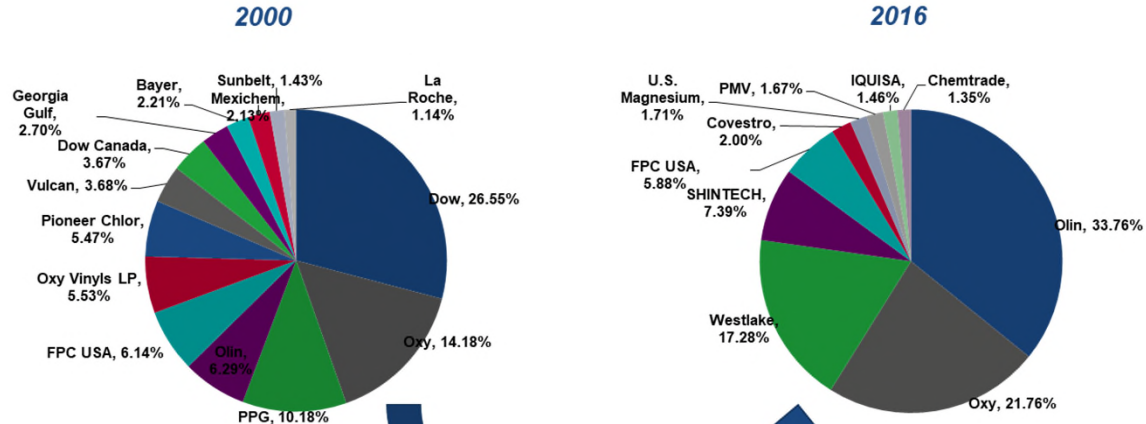


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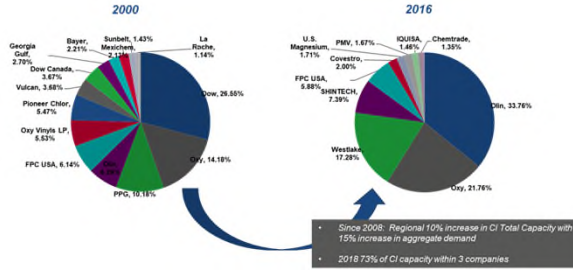
Now, Let's go back in time....

North America industry consolidation



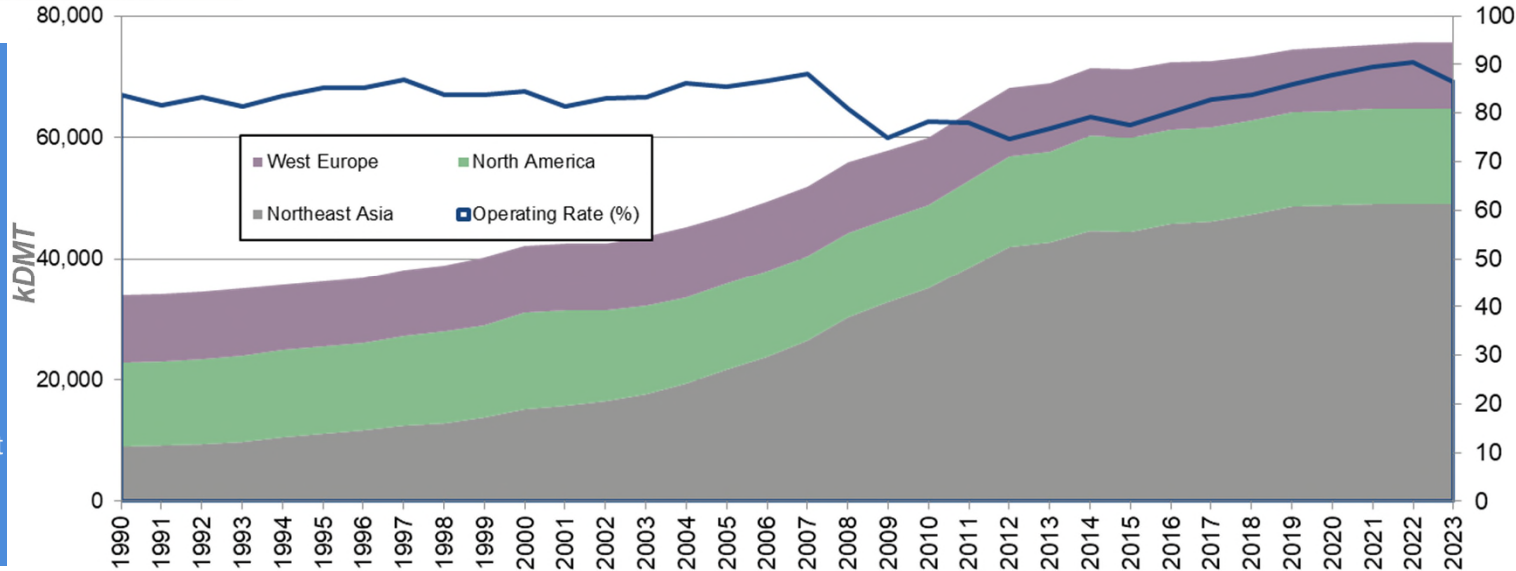
- Since 2008: Regional 10% increase in CI Total Capacity with 15% increase in aggregate demand
- 2018 73% of CI capacity within 3 companies

Now, Let's go back in time....

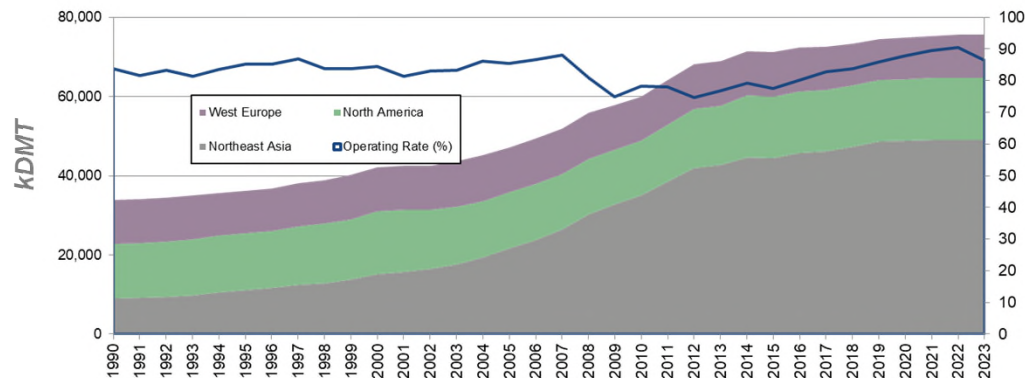
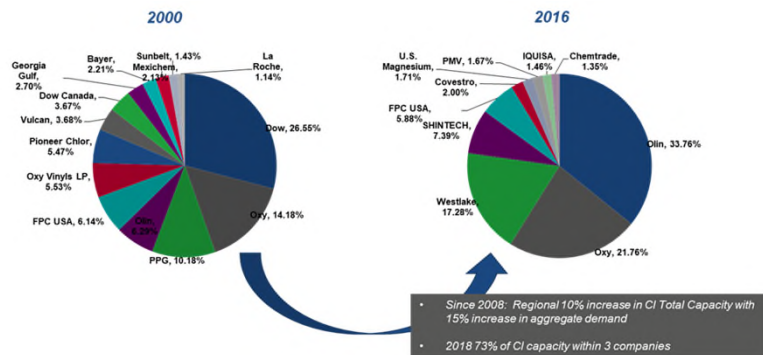


- 2000 - 2016
- China embarks on environmental protection policy.
 - Reset of exports and global trade flow as MEA and USGC become low cost producer regions
 - Global GDP resurgence (steady growth in PVC, Caustic and Alumina)
 - Capacity additions outside NEA are practically non-existent

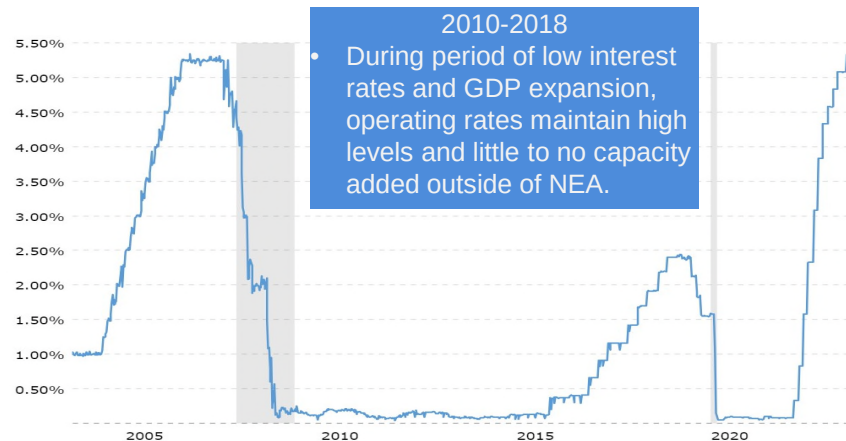
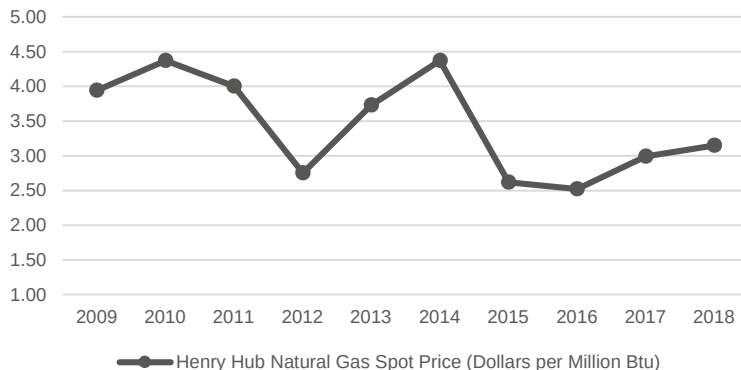
- Early to mid 2000s.. Accelerated GDP growth and housing growth lead to capacity issues followed by price spike in 2008.
- North America and Europe embarked on a period of producer consolidation
- NAM nameplate capacity reductions began in an effort to increase ROI.



Now, Let's go back in time....



US Henry Hub Natural Gas Price (Dollars per Million Btu)



2000 – 2016: Key Learnings..

- NAM production capacity running at near record operating rates. US producers will continue export of overcapacity to maintain balance. (Trade Flow Changes)
- Consolidation of NAM producers is fully realized creating more balanced, concentrated and disciplined supplier base.
- Global recovery looked to be underway, however, chlorine balance is struggling due to slow (but steady demand).
- Chlorine demand and Caustic demand are not consistent with geographical locations.
- EMEA mercury cell regulatory changes underway and market is maintaining balance, even after reduction of EDC and significant caustic capacity. 2M MTs Chlorine Capacity closed in EMEA
- Chinese environmental protection laws curtail chlorine demand and restructure governance of chlor-alkali industry. Operating rates increase and exports decrease, thereby changing trade flow expectations.
- After period of low interests, the Federal Reserve is beginning to tighten in an effort to slow GDP.....

2018 – 2023 : World sees major shift in all directions...

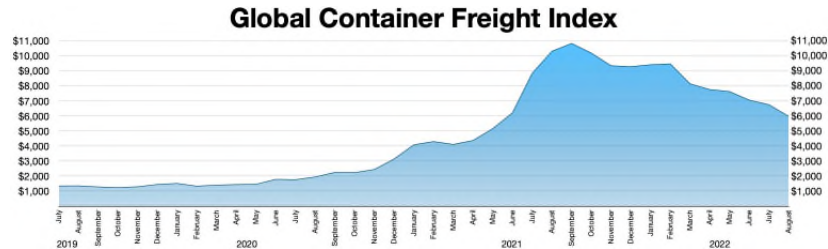
December 31, 2019 Covid Crisis

The World Health Organization (WHO) Country Office in China is informed of several cases of a pneumonia of unknown etiology (cause) with symptoms including shortness of breath and fever occurring in Wuhan, China. All initial cases seem connected to the Huanan Seafood Wholesale Market.

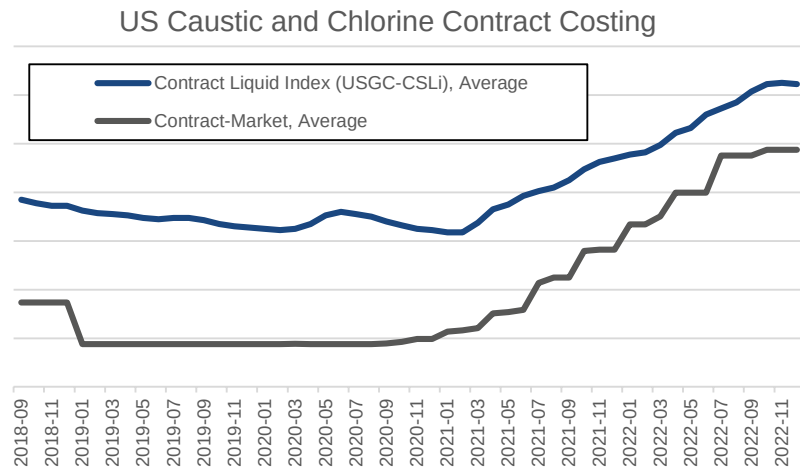
Texas Freeze. On February 11-20, 2021, a historical winter event occurred that set many records, including being the first billion-dollar weather disaster of that year. A deep freeze impacted parts of the continental United States (CONUS), remarkably engulfing the entire state of Texas.

Supply Chain Crisis 2021. mid-2021, major American ports became inundated with historic amounts of inbound cargo. Terminal staff lacked the bandwidth to process the cargo, leading to extended wait times. Container ships began to stall outside ports for days or weeks. This surge spread inland as rail and trucking services struggled under the increased load alongside a labor shortage. The United States trucking industry was already short on drivers before the pandemic....

The **Russian invasion of Ukraine** began on the morning of 24 February 2022,[240] when Putin announced a "special military operation" to "demilitarize and denazify" Ukraine.[241][242] Minutes later, missiles and airstrikes hit across Ukraine, including Kyiv, shortly followed by a large ground invasion along multiple fronts.[243][244] Zelenskyy declared martial law and a general mobilization of all male Ukrainian citizens between 18 and 60, who were banned from leaving the country.[245][246]

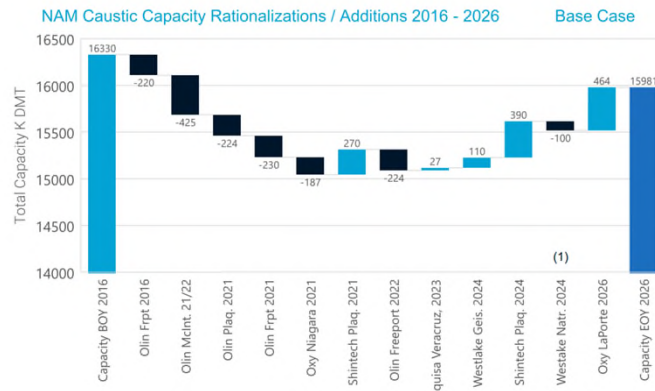


World has one major event after another...



- During Covid Crisis Caustic and Chlorine demand curtailed however pricing held relatively flat
- Ukraine Crisis initiated a steady increase in NAM market costing.

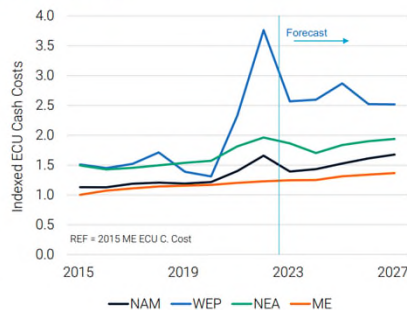
- Marked decline in net capacity since 2016. The reduction in region US operating rates can have dramatic effect globally on costing as the US export 20-30% of production.
- Projected capacity increases may if AD capacity is taken offline earlier than expected



Chlor-Alkali Fundamentals Moving Forward

Chlor-Alkali plants are constructed for chlorine production. Chlorine is the driver for capacity expansion and has limited capability to be transported in elemental form. Caustic is the fungible by-product with pricing driven mostly by supply demand economics.

ECU Cash Costs

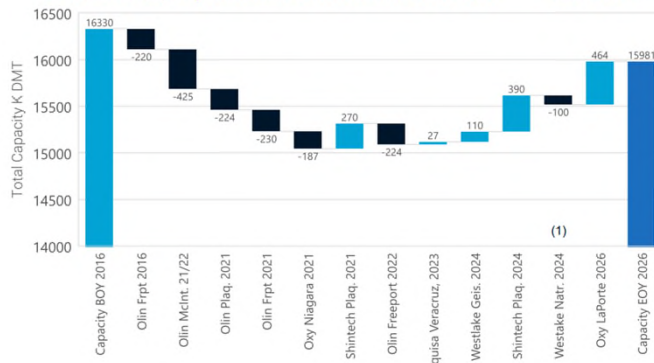


Source: Chemical Market Analytics by OPIS

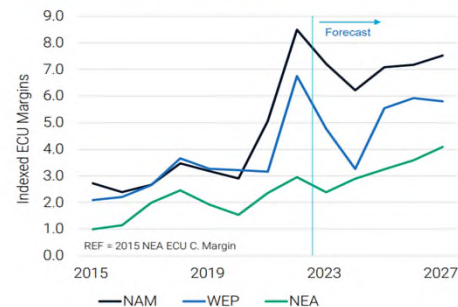
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NAM Caustic Capacity Rationalizations / Additions 2016 - 2026

Base Case



ECU Cash Margins (Weighted Avg Chlorine Value)



Source: Chemical Market Analytics by OPIS

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- NAM Region continues in tight second to ME region in cash cost equivalence.
- Low cash cost is a very favourable advantage to US regional producers.



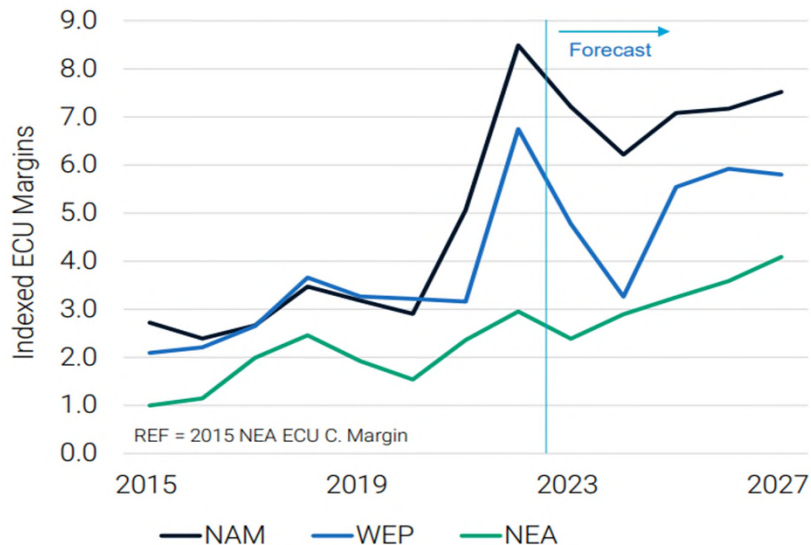
- Marked decline in net capacity since 2016. The reduction in region US operating rates can have dramatic effect globally on costing as the US export 20-30% of production.
- Projected capacity increases may if AD capacity is taken offline earlier than expected



- NAM producers are expected to maintain highest cash margins due to:
- Low cash costing
 - Ability to export and control domestic supply by adjusting operating rates

Forecast ahead is uncertain.. And scenarios are uncertain for the Buyer

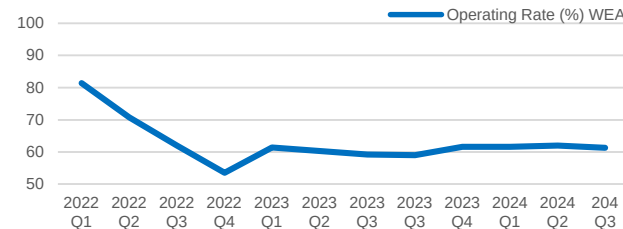
ECU Cash Margins (Weighted Avg Chlorine Value)



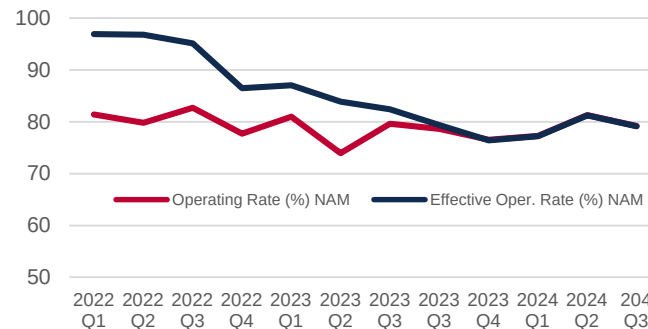
Source: Chemical Market Analytics by OPIS

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WEA Operating Rates



NAM Operating Rates



Forecast ahead is uncertain.. And scenarios are uncertain for the Buyer

(Real GDP, annual percent change)	PROJECTIONS		
	2022	2023	2024
World Output	3.5	3.0	3.0
Advanced Economies	2.7	1.5	1.4
United States	2.1	1.8	1.0
Euro Area	3.5	0.9	1.5
Germany	1.8	-0.3	1.3
France	2.5	0.8	1.3
Italy	3.7	1.1	0.9
Spain	5.5	2.5	2.0
Japan	1.1	1.4	1.0
United Kingdom	4.1	0.4	1.0
Canada	3.4	1.7	1.4
Other Advanced Economies	2.7	2.0	2.3
Emerging Market and Developing Economies	4.0	4.0	4.1
Emerging and Developing Asia	4.5	5.3	5.0
China	3.0	5.2	4.5
India	7.2	6.1	6.3
Emerging and Developing Europe	0.8	1.8	2.2
Russia	-2.1	1.5	1.3
Latin America and the Caribbean	3.9	1.9	2.2
Brazil	2.9	2.1	1.2
Mexico	3.0	2.6	1.5
Middle East and Central Asia	5.4	2.5	3.2
Saudi Arabia	8.7	1.9	2.8
Sub-Saharan Africa	3.9	3.5	4.1
Nigeria	3.3	3.2	3.0
South Africa	1.9	0.3	1.7
Memorandum			
Emerging Market and Middle-Income Economies	3.9	3.9	3.9
Low-Income Developing Countries	5.0	4.5	5.2

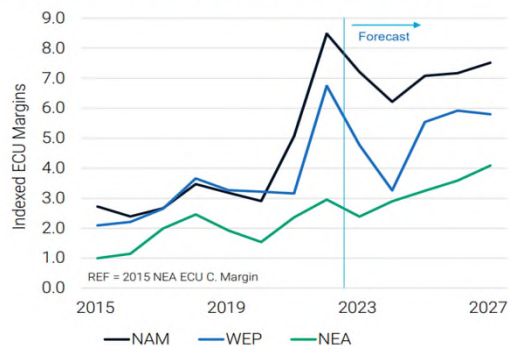
Source: IMF, World Economic Outlook, July 2023

- Enter time of higher interest rates,, barriers to market entry and ROI concern for all industries
- Several possibilities exist for a volatile market in the coming years.
 - Margins on NaOH and vinyls are distorted
 - Caustic and chlorine prices are falling simultaneously.. Never a good sign
 - Vinyl chain is very capital intensive with high barriers to entry.
 - HCl will be projected to remain snug over next several years with decreased burner capacity and projected market demand increase.
 - Chlorine derivatives market is weaker in regions with lowest costing.
- Geographical differences between production and end use locations make tariff and trade disputes more concerning for the coming years.
- IMF projecting flat GDP into 2024... however there will be increases in demand YoY 23-24 without capacity increases (industry already 80+% effective capacity)
- For 2028-2029.. The projection is for real capacity to outstrip demand

Main Take Aways...

- ❑ IMF projecting flat GDP into 2024... however there will be increases in demand YoY 23-24 without capacity increases.
- ❑ For 2028-2029.. The projection is for real capacity to outstrip demand
 - ❑ The timetable for real-capacity issues in the industry could creep up after the trough.... This will lead to several scenarios over the next few years...

ECU Cash Margins (Weighted Avg Chlorine Value)



Source: Chemical Market Analytics by OPIS

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- If merchant Chlorine values to continue to escalate in NAM, end users will off-shore or look for alternatives (EMEA scenario)
- CA producers will push markets to open regional small chlor-alkali units potentially
- EMEA region will move to consolidation if demand remains low and does not recover.
- Producers in USGC and Middle East will be able to control operating rates due to low cash cost and export potential
- Asia will move into the exporting region for PVC for growth regions

Thank you... questions