# The hydrogen hype: from ambition, promise and targets to action, delivery and reality

Amersfoort, January 2025



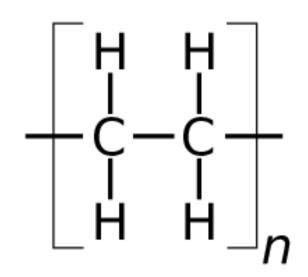


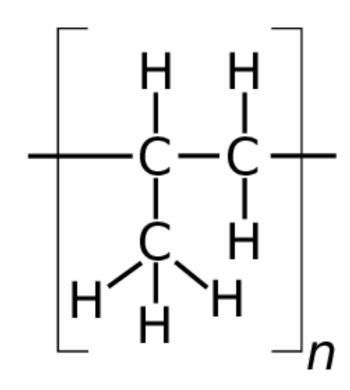




### Polyethylene and Polypropylene









# Vinyl Chloride Monomer (VCM) Polyvinyl Chloride (PVC)

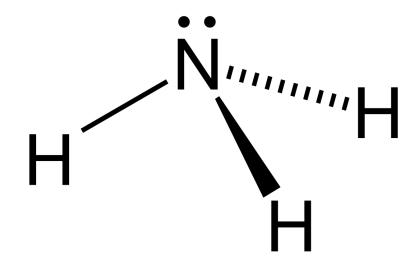


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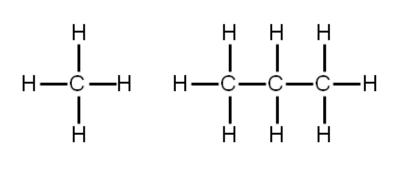


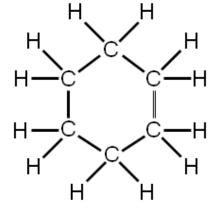
### Ammonia (NH3)

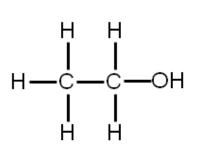




#### Aliphatics







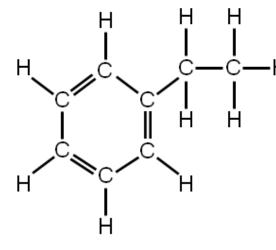
Methane

Propane

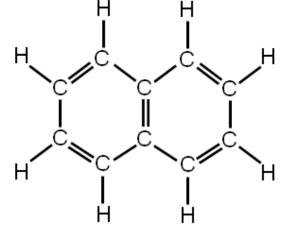
Cyclohexane

Ethanol

#### Aromatics



Ethylbenzene



Naphthalene













# Ambitions keep on building, with a market in uncertainty that is waiting for regulations (1)







EU proposes 90% GHG reduction target by 2040: Green hydrogen could meet up to 10% of energy demand



Hydrogen 'resilience' | EU moves forward with target for 40% of electrolysers to be made in Europe

European Parliament and Council reach provisional agreement on Net Zero Industrial Act

### EU 2040 emissions target outlines large role for hydrogen

HIGHLIGHTS

Up to 35 million mt production by 2040

Represents 10% of final energy demand

EU models just 3 million mt production in 2030

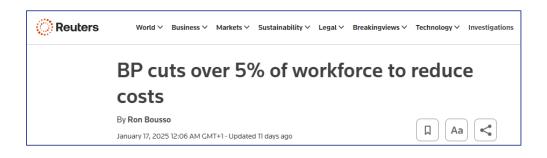
# Ambitions keep on building, with a market in uncertainty that is waiting for regulations (2)





Shell Implements Workforce Reductions and Refocuses Hydrogen Business in CEO's Overhaul Plan

OIL AND GAS NEWS



### Nyrstar to suspend Budel zinc operations in second half of January

#### Reuter

January 15, 2024 11:34 AM GMT+1 · Updated a month ago



LONDON, Jan 15 (Reuters) - Nyrstar will suspend its Budel zinc smelting operations in the Netherlands in

the second half of this month owing to high energy costs and market conditions, it said on Monday.

Nyrstar, which is wholly owned by trading and logistics company Trafigura, said it will put the operations

on "care and maintenance", which stops production but continues maintenance so it can reopen in the future.

"This decision follows a thorough and extensive review and is a direct response to ongoing and projected high energy costs as well as deteriorating market conditions," Nyrstar said.



Fuel cell manufacturer Nedstack, founded in 1998 as a spin-off from AkzoNobel, and world leader in the field of mission-critical high-power PEM fuel cell technology, was declared bankrupt on February 2, 2024 after a short moratorium of less than 2 days. This means that a Dutch pearl in the field of hydrogen technology will be lost.

#### The green hydrogen opportunity in perspective



There is a growing global momentum towards decarbonization and green hydrogen, but let us put the EU ambition of **20Mtpa** into a perspective.

The European Union now has an objective for Europe to produce 10 Mtpa and import 10 Mtpa, that is some ~200 GW of electrolysis up and running in 2030.

This is number for Europe alone, also other global regions are accelerating their decarbonization and hydrogen ambitions.

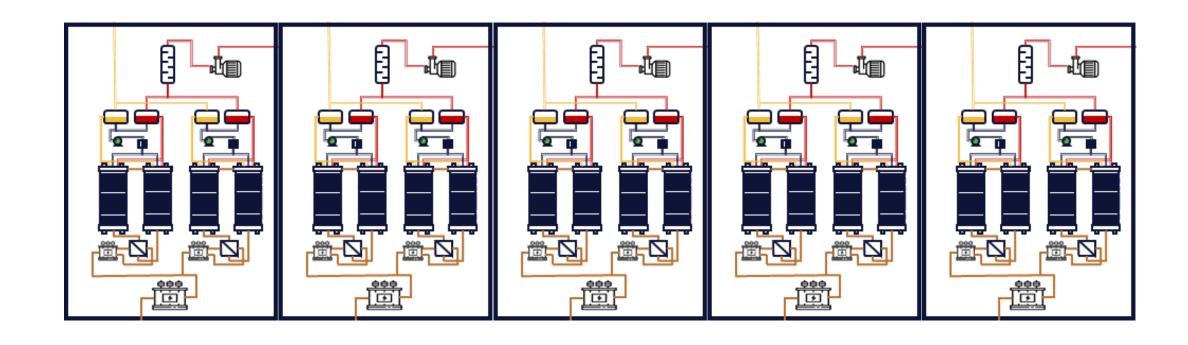
### 20 MW in practice





## What scale are we talking about, building a perspective: 20MW





## What scale are we talking about, building a perspective: 100MW



## What scale are we talking about, building a perspective: 500MW



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## What scale are we talking about, building a perspective: 1GW



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|                                       |              | 2 2   |                                       |                       |              |   |                       |                                       |                                       |              |              |                                       |                    |  | # #        |              |   |                                       |              |            |                |               |  |   |
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| and a                                 | <u>an</u>    |   | (m)                                   | (B)                   | <u></u>      | (8)   | (B)                   | r003                                  | (8)                                   | <u>ab</u>    | <u>ab</u>    | <u>a</u>                              | <u>a</u>           | (10)   | (B)        | <u>ab</u>    | · dib                                   | (db)                                  | <u>ab</u>    | (4)        | <u>a</u>       | <u>ab</u>     | <u>ab</u>                                    | <u>ab</u>                               |
|                                       |              |   |                                       |                       |              |   |                       |                                       |                                       |              |              |                                       |                    |  |            |              | 20 20<br>20 20<br>20 20                 |                                       | 1-4<br>22 22 |            | 20 20<br>20 20 |               |  |   |
|                                       |              |   |                                       | 77                    |              |   | 77                    |                                       |                                       |              |              |                                       |                    | <b>                                     </b> |            |              |   |                                       |              | 77         |                | 77            |  |   |
| <u>ag</u> ag                          | <u>09</u> 09 | <u>a</u> <u>a</u> <u>a</u> <u>a</u>   | <u></u>                               | <u>@</u>              | <u>69</u> 69 | <u> </u>  | <u> </u>              | <u>@@</u> @@                          | @ @@<br>                              | 20 E         | <u>80</u> 80 | <u>0</u> 0 00                         | <u>@</u>           | 00 00  | 00 00      | @@ @@<br>    | <u>a9</u> a9                            | 09 09                                 | <u> </u>     | 20 20      | <u> </u>       | <u>@</u>      | <u>0</u> 9 09                                | @@ @@<br>.m)                            |
| CHILE                                 | New          | Date.   | DMF                                   | PMM.                  | CHIL         | Diff  | Date                  | Little.                               | CHILL                                 | Date         | CHILL.       | PMF.                                  | CHIL               | (PRINT.                                      | Talle      | [MIL         | [MIL                                    | Date:                                 | (Mar-        | TABLE .    | CHILE          | THE           | LYNN   | (MM)                                    |

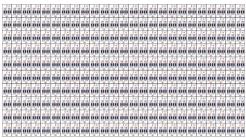
### What scale are we talking about, building a perspective: 5GW

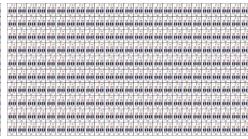


| r i   | 17 17   | 10 10        | 88           | 15 15                            | 15 15         | 12 12   | 10 10          | 10 10               | 10 10      | 20                     | 15.15   | 10 10  | 15 15  | 12 12   | 11 11        | 10 11  | 15 10       | 11.15  | 10 10              | 10 12         | 12 12 | 10.75         | 10, 10     | 15.1 |
|-------|---------|--------------|--------------|----------------------------------|---------------|---------|----------------|---------------------|------------|------------------------|---------|--------|--------|---------|--------------|--------|-------------|--------|--------------------|---------------|-------|---------------|------------|------|
| 100   | m je    | $H_{ij}^{M}$ | 10,70        | 10,10                            | 10,00         | 100     | $B_{\mu}^{B}$  | 15,74               | 10,10      | $H_{\mu}^{M}$          | 10,70   | 10,70  | 100    | 15.75   | $M_{p}^{pq}$ | 100    | 100         | 15.75  | 15,75              | 10,74         | 10.75 | $H_{\mu}^{H}$ | 10,00      | 100  |
| 12 12 | 25 25   | 10,10        | 12 12        | 10.10                            | 10.10         | 15.15   | 12 12          | 10.10               | 10.10      | 12.12                  | 15.35   | 10 10  | 10.10  | 55, 55  | 技能           | 10, 10 | 10,10       | 15.15  | 10.10              | 15.13         | 10.10 | 10.10         | 12, 12     | 12.1 |
| 99    | w       | 4,0          | 10,00        | 99                               | 10,00         | 200     | 11,11          | 11,11               | 4,74       | 10,0                   | 100     | 11,11  | 100    | 100     | 10,00        | 100    | 11,11       | 100    | 10,00              | 11/1          | 20,00 | 10,00         | 40,00      | 100  |
| FK    | F       | PK           | 14           | Fin                              | J-            | 15.6    | 54             | F-6                 | 14         | Fa                     | Fa      | Ja     | 15     | F-s     | 154          | 150    | 35          | 54     | 14                 | 5-4           | 54    | Pa            | 154        | J    |
| 00    | ÖÖ      | ÖÖ           | OO           | ÜÜ                               | ÖÖ            | 00      | ÖÖ             | ÖÖ                  | ÖÖ         | ÖÜ                     | ÖÖ      | ÖÖ     | 00     | ÜÜ      | ÖÖ           | OÖ     | ÖÖ          | 00     | ÖÖ                 | ÖÖ            | ñù    | ÜÜ            | ÖÖ         | Ü    |
| 10    | 150     | 14           | 100          | 100                              | 100           | 100     | Ex.            | 100                 | Tie.       | 10                     | 100     | 14     | 100    | 100     | 100          | 100    | 100         | 154    | 14                 | 100           | 100   | Ca.           | 100        | 1    |
| 2.2   | 17, 27, | 22           | 88           | 22                               | 10,10         | 2.2     | 22             | 17.12               | H.R        | 2.2                    | K.E     | 25, 25 | SE     | 22      | 22           | 20.00  | 25.10       | 25.25  | 17.15              | 22            | 22    | 22            | 25.25      | 2    |
| 20    | 8,8     | $M_{p}M$     | $B_{i}B_{i}$ | $\mathcal{O}_{\mathcal{A}}^{-1}$ | $B_{\mu}^{A}$ | 40.00   | $S_{\mu}^{AA}$ | $\alpha_{s} \alpha$ | $M_{\mu}M$ | $\partial S_{\mu}^{A}$ | 100,000 | 15 A   | 200    | MA.     | $B_{g}^{A}$  | 0,0    | $O_{g}^{A}$ | 0.0    | $\partial_{\mu} h$ | $B_{\mu}^{A}$ | 10.14 | $B_{\mu}B$    | $B_{\mu}B$ | 100  |
| 100   | 10.10   | 10 10        | 12 12        | 25 10                            | 20.10         | 10 10   | 10 10          | 15 10               | 10 10      | 10.70                  | 10.00   | 10 10  | 10.10  | 50 50   | 10 10        | 10.00  | 10.10       | 10, 10 | 10.00              | 10 10         | 10.10 | 10.10         | 10.10      | 120  |
| 00    | 99      | 00           | 00           | 00                               | 0.0           | 00      | OO             | 00                  | 00         | 00                     | 00      | 00     | 00     | OÜ      | 00           | (00    | 00          | 00     | 00                 | 00            | OÜ    | 00            | 00         | 0    |
| 1-    | T+      | T.v.         | 1.           | T+                               | 14            | 74      | 1+             | T+                  | 14         | 1.                     | 1-      | 14     | 14     | 1-      | 11-          | 10     | 114         | 14     | 1+                 | 14            | 1+    | E+            | 64         | Н    |
| ññ    | ññ      | ññ           | ññ           | ññ                               | 20.00         | 22      | ññ             | ññ                  | äñ         | ññ                     | ññ      | 88     | äñ     | ññ      | ññ           | ää     | ññ          | ññ     | ññ                 | ää            | ññ    | ññ            | ää         | ñ    |
| 200   | 20.00   | 100          | 15,76        | 15,76                            | 10,10         | 20.00   | 15,25          | 25,25               | 100,00     | 100                    | 100,00  | 15,10  | 100,00 | 700,700 | 200          | 10,15  | 100,00      | 20,25  | 25,25              | 100,00        | 10,15 | 15,00         | 20,76      | 100  |
| 10 10 | 12 12   | 12 12        | 12 12        | 10 10                            | 10 10         | 12 12   | 12, 12         | 12 12               | 10 10      | 12, 12                 | 12 12   | 12 12  | 12 12  | 12, 12  | 10 10        | 10 10  | 12.12       | 15 12  | 10 10              | 10 10         | 12 12 | 10 10         | 10.10      | 12   |
| uu    | m       | 00           | 00           | mn                               | DO            | uu      | m              | nn                  | nņ         | UU                     | DD      | D.D    | DD.    | m       | uu           | Di.    | mn          | m      | nn                 | 00            | nii   | ÜÜ            | m          | 10   |
| J-a   | F4      | 14           | J.           | J+                               | 14            | J.v     | F-4            | J's                 | F4         | 154                    | 150     | J.     | F4     | Î+      | 150          | 10     | 35          | J.s.   | J.s                | F4            | F4    | De.           | 100        | 13   |
| nn    | ññ      | nn           | mi           | mn                               | nn            | nn      | m              | m                   | 00         | nn                     | nn      | ññ     | nn     | nn      | nn           | nn     | nn          | nn     | nn                 | 00            | min   | nn            | nn         | ñ    |
| Y     | o'v     | es/o         | 0,0          | 100,00                           | 40,00         | 90      | 0,0            | 0,0                 | 90         | 0,0                    | 200     | 200    | 200    | 90      | 0,0          | 0,0    | 10,10       | 0.0    | 0,0                | 90            | 0,0   | 970           | 10,00      | 10   |
| 12.32 | 10.30   | 10,10        | 10,10        | 10 10                            | 20,20         | 10, 10, | 95 95          | 10.10               | 10.10      | 10.10                  | 10, 10, | 10 10  | 10.10  | 12 12   | 25, 35       | 20, 20 | 10, 10,     | 10.10  | 10.10              | 10 10         | 10 10 | 10.10         | 10, 10,    | 12   |
| Ų.    | ų,      | 8,0          | 100          | 8,5                              | 200           | 200     | 5,5            | 8,0                 | 100        | 100                    | 4       | 200    | 100    | 4       | 100          | 100    | 200         | 4      | 8,0                | 100           | 40    | 200           | 8,6        | 1    |
| F4    | 100     | 14           | Ja           | 10                               | JA.           | 114     | 100            | 15.00               | Fa.        | Ja                     | Ja      | 100    | 154    | F 4     | 100          | Pa     | 17.50       | Ja     | 16                 | J's           | I s   | J.            | 100        | J.   |
| ññ    | ññ      | nn           | nn           | nn                               | 00            | 00      | OO             | OO                  | 00         | 00                     | 00      | 00     | 00     | OO      | ÖÖ           | (00    | OO          | 00     | ÜÜ                 | 00            | nn    | ÖÖ            | OO         | ñ    |









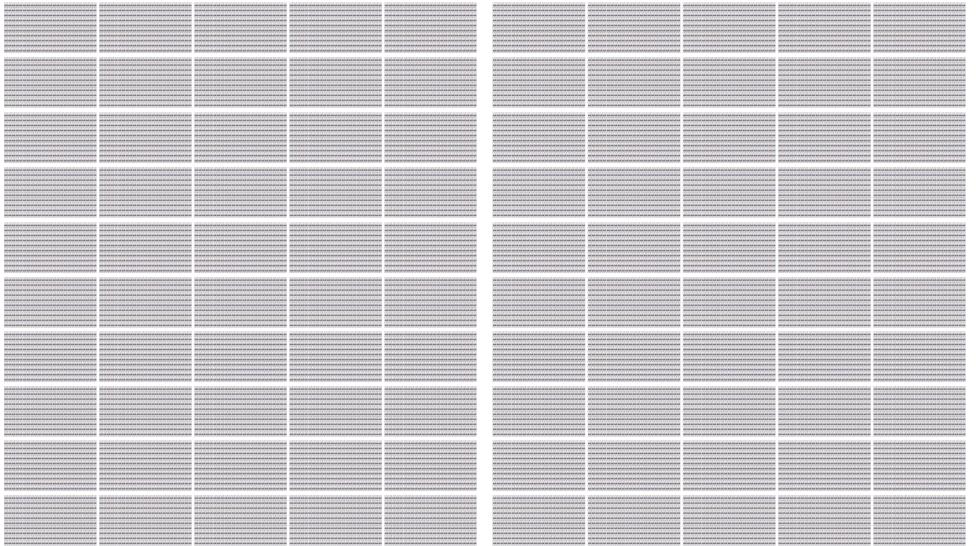
## What scale are we talking about, building a perspective: 10GW | HyCC



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# What scale are we talking about, building a perspective: 100GW HyCC

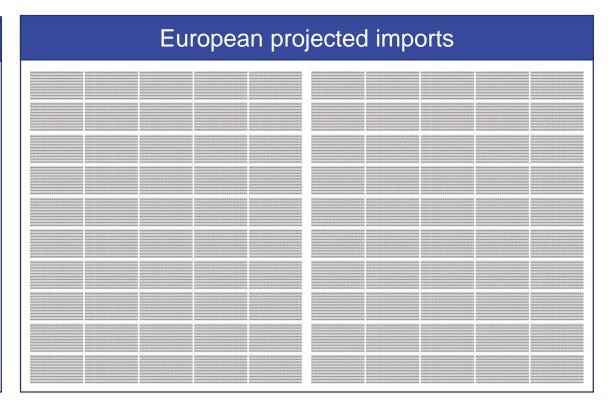




What scale are we talking about, building a perspective: 200GW, the European ambition on hydrogen for 2030 50% local production and 50% import.



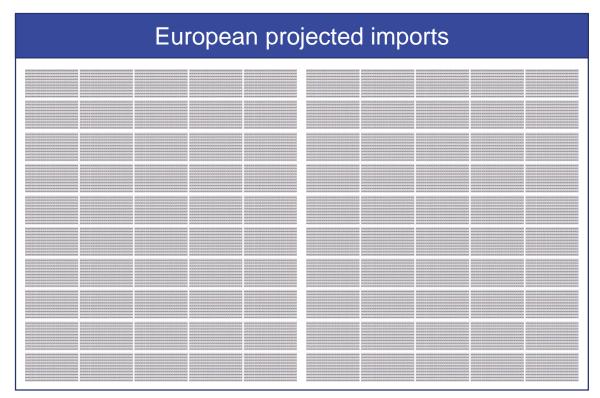
| E | European local hydrogen production |  |  |  |  |  |  |  |  |  |  |  |
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What scale are we talking about, building a perspective: 200GW, the European ambition on hydrogen for 2030 50% local production and 50% import.



| Ει | European local hydrogen production |  |  |  |  |  |  |  |  |  |  |  |
|----|------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
|    |                                    |  |  |  |  |  |  |  |  |  |  |  |
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This is only Europe!!

And is not including the renewables and hydrogen downstream activities!!







# From ambition, promise and targets to action, delivery and reality



Key concerns

Permitting timelines

Lagging and complex regulation

Value chain dependencies and financeability

People availability with capabilities

Technology readiness

Renewable energy availability

The support

Benefiting from 'low cost' renewable/low carbon electricity sources

Strong upcoming mandates/subsidies

Use of existing infrastructure (E and Natural Gas)

Customer willingness to pay

Integration into clusters/ecosystems (harbor and industry)

Potential for cost reductions through scale and industrialization

## Enabling emission free industries

#### **Our Vision & Mission**

To enable the full decarbonization of industry and the transition to a truly circular economy, by supplying safe, reliable and affordable green hydrogen supplies and circular chemistry solutions

