

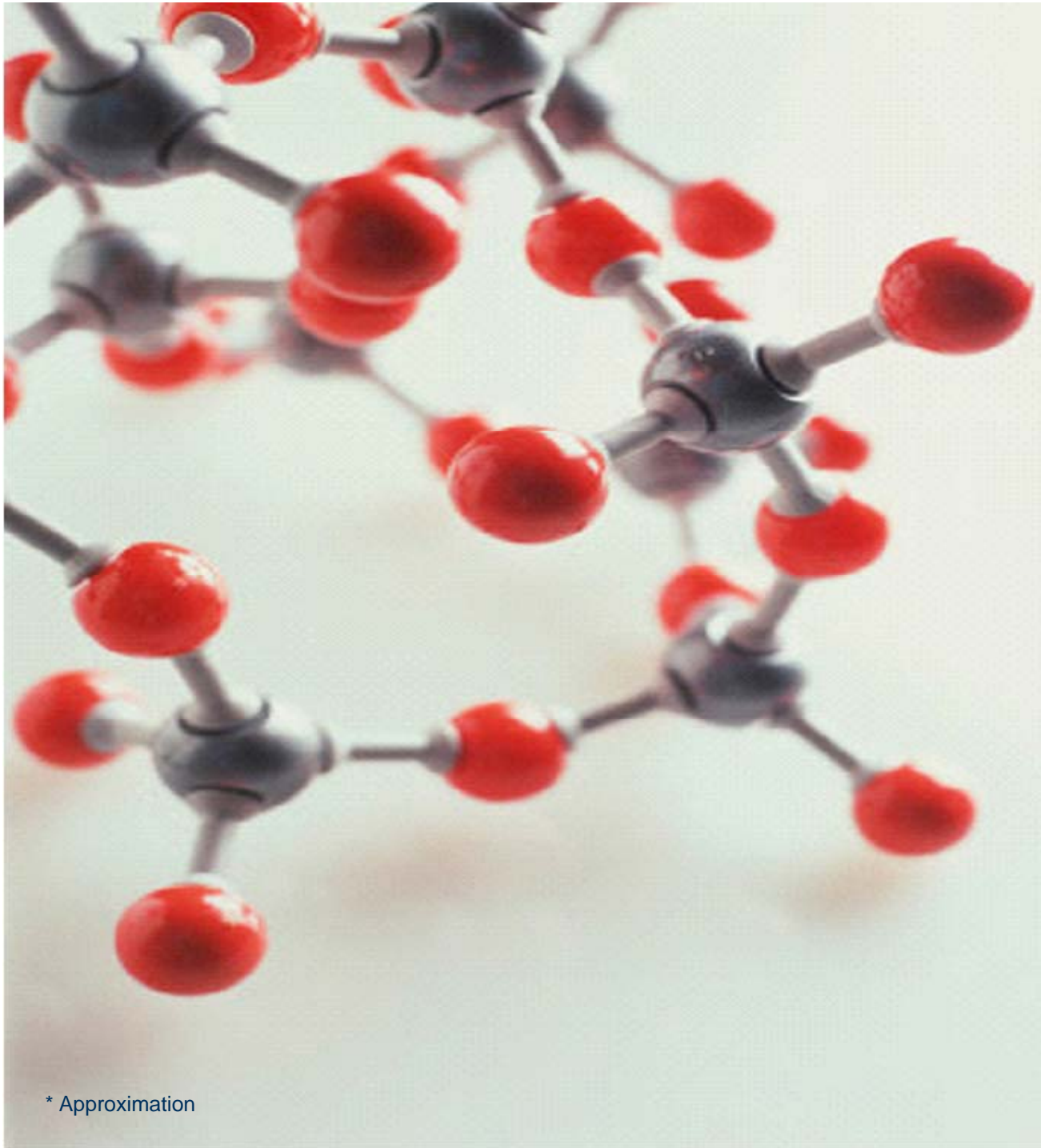


Clean Hydrogen A'Plenty

Leading.


THE LINDE GROUP

Markus Bachmeier



* Approximation

Water: H_2O

Methane: CH_4

Butane: C_4H_{10}

Ethanol: $\text{C}_2\text{H}_6\text{O}$

Sugar: $\text{C}_6\text{H}_{12}\text{O}_6$

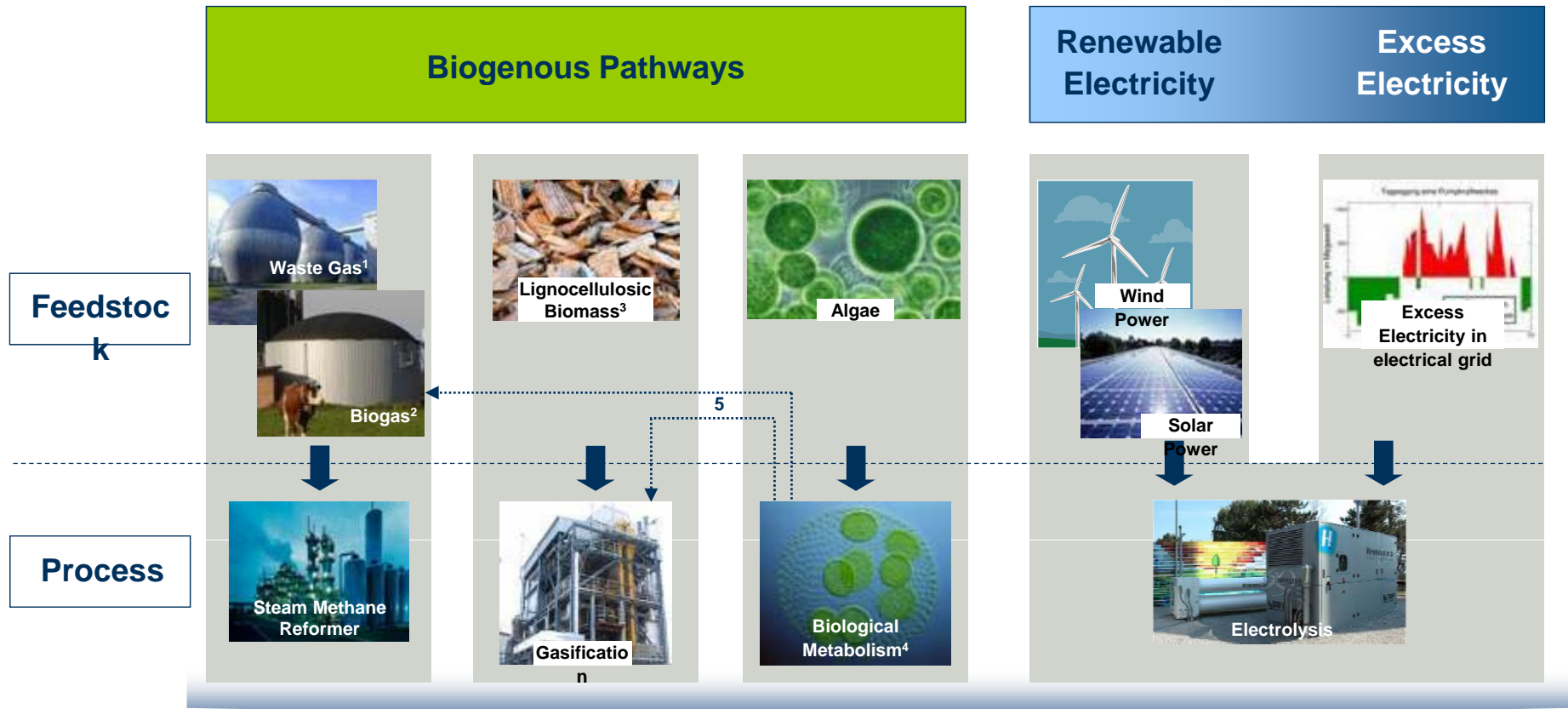
Wood: $\text{C}_{12}\text{H}_{22}\text{O}_{11}^*$

Petroleum: $\text{H}_{2n+2}\text{C}_n$

Coal: H_{96}

$\text{C}_{135}\text{O}_9\text{N}$

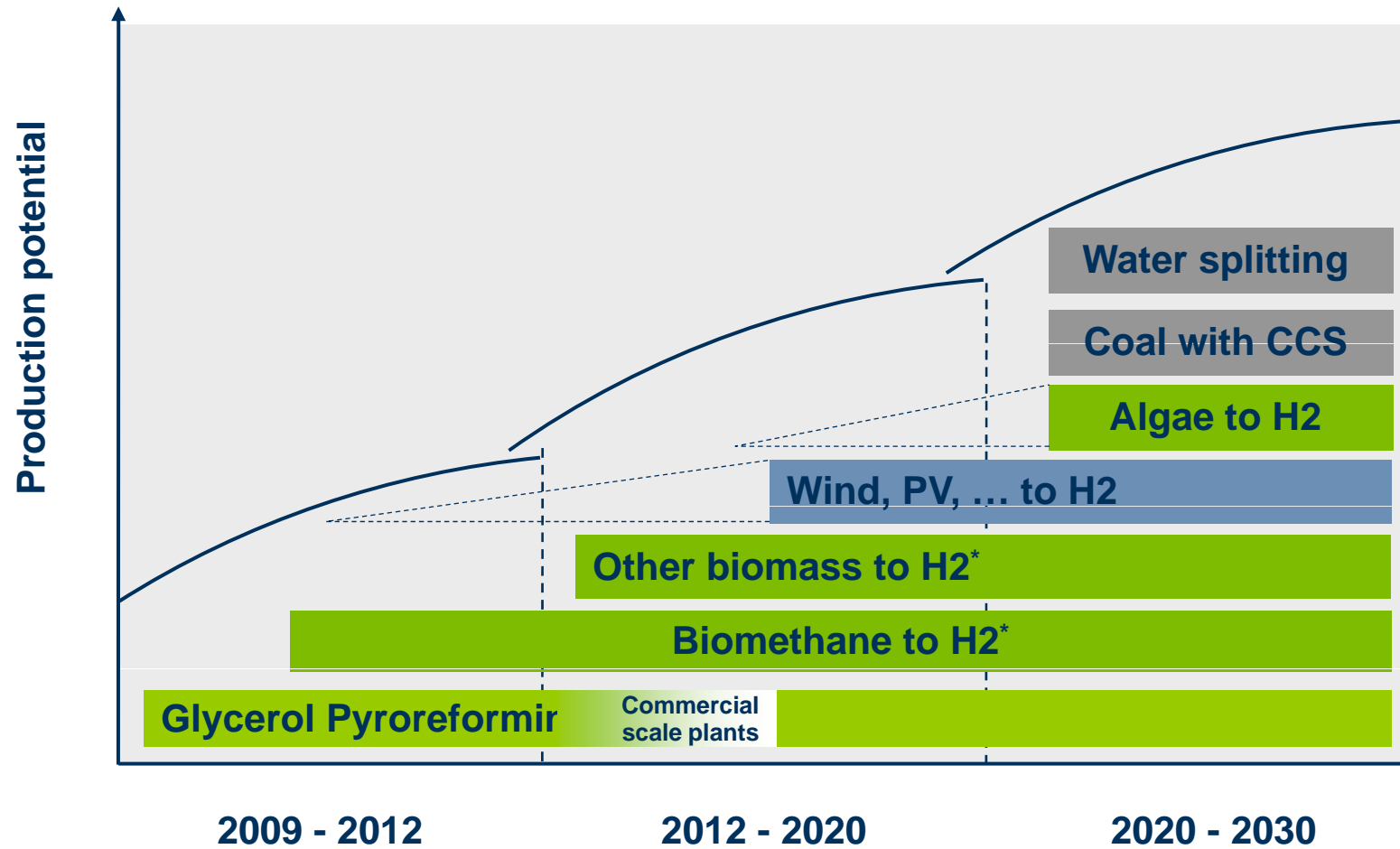
Exemplary pathways towards renewable hydrogen



¹ E.g. Sewage Gas, landfill gas, mine gas, etc
² With e.g. energy maize, liquid manure, etc. as feedstock for biogas production
³ Mainly solid biomass like woody biomass, straw, solid & lignocellulosic by-products
⁴ Either direct H₂ production or alternatively NH₃ generation as H₂ carrier
⁵ Algae biomass can be used as feedstocks for gasification and fermentation theoretically

Roadmap towards renewable hydrogen

From pilot plants to long term ideas

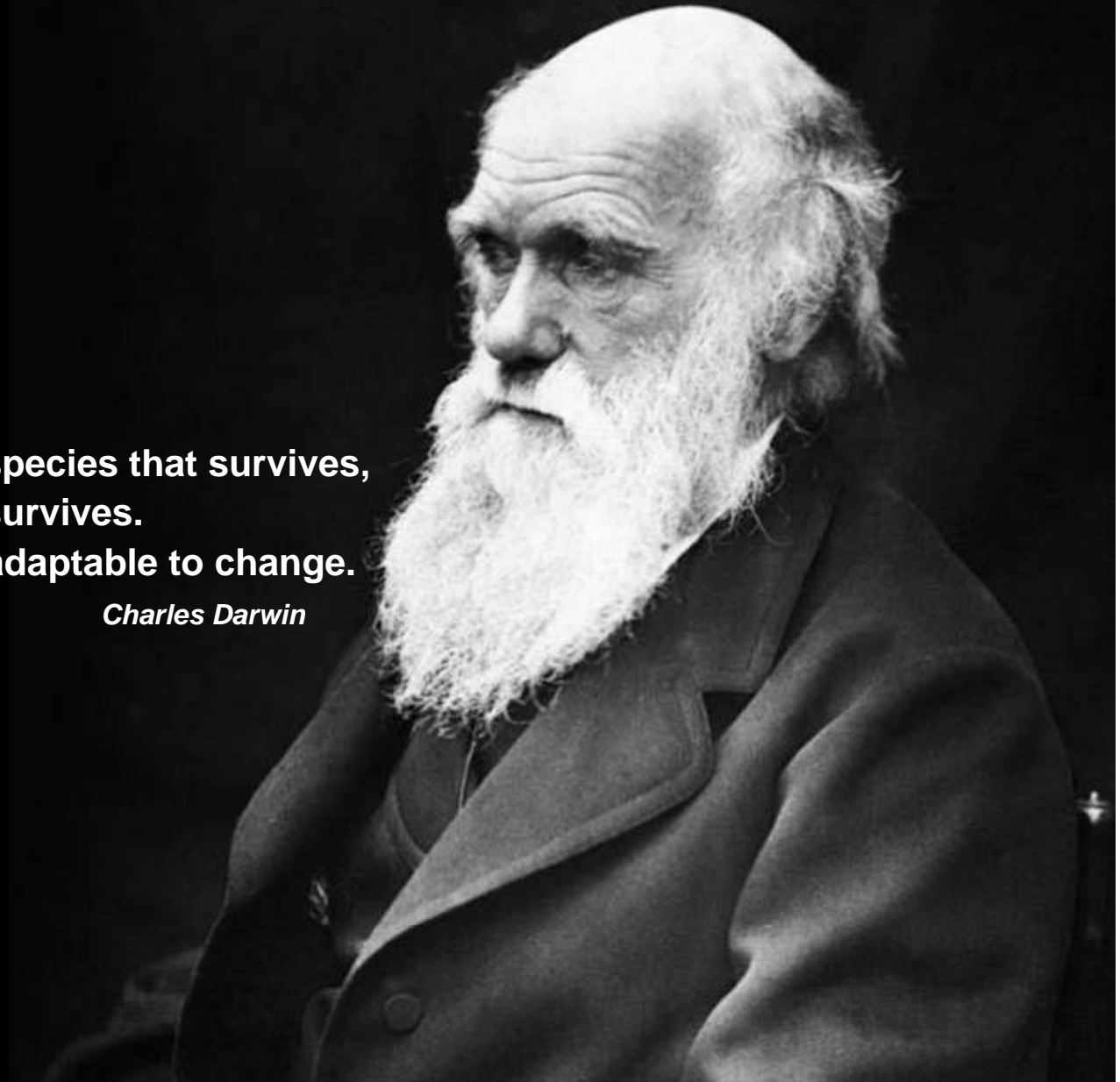




- Hydrogen is a **large and strongly growing** industrial gas market. **Production & handling** are well known.
- Hydrogen has the potential to be a **substitute for our crude oil based fuels**; in the medium and long-term **it can be produced from renewable sources**.
- **“Grey” and “green” hydrogen** have **identical properties**: Vehicle fleets and infrastructure build up should start before switching to 100% green hydrogen.
- **We will see a large variety of approaches in the next couple of years**

**It is not the strongest of the species that survives,
nor the most intelligent that survives.
It is the one that is the most adaptable to change.**

Charles Darwin



Discussion


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