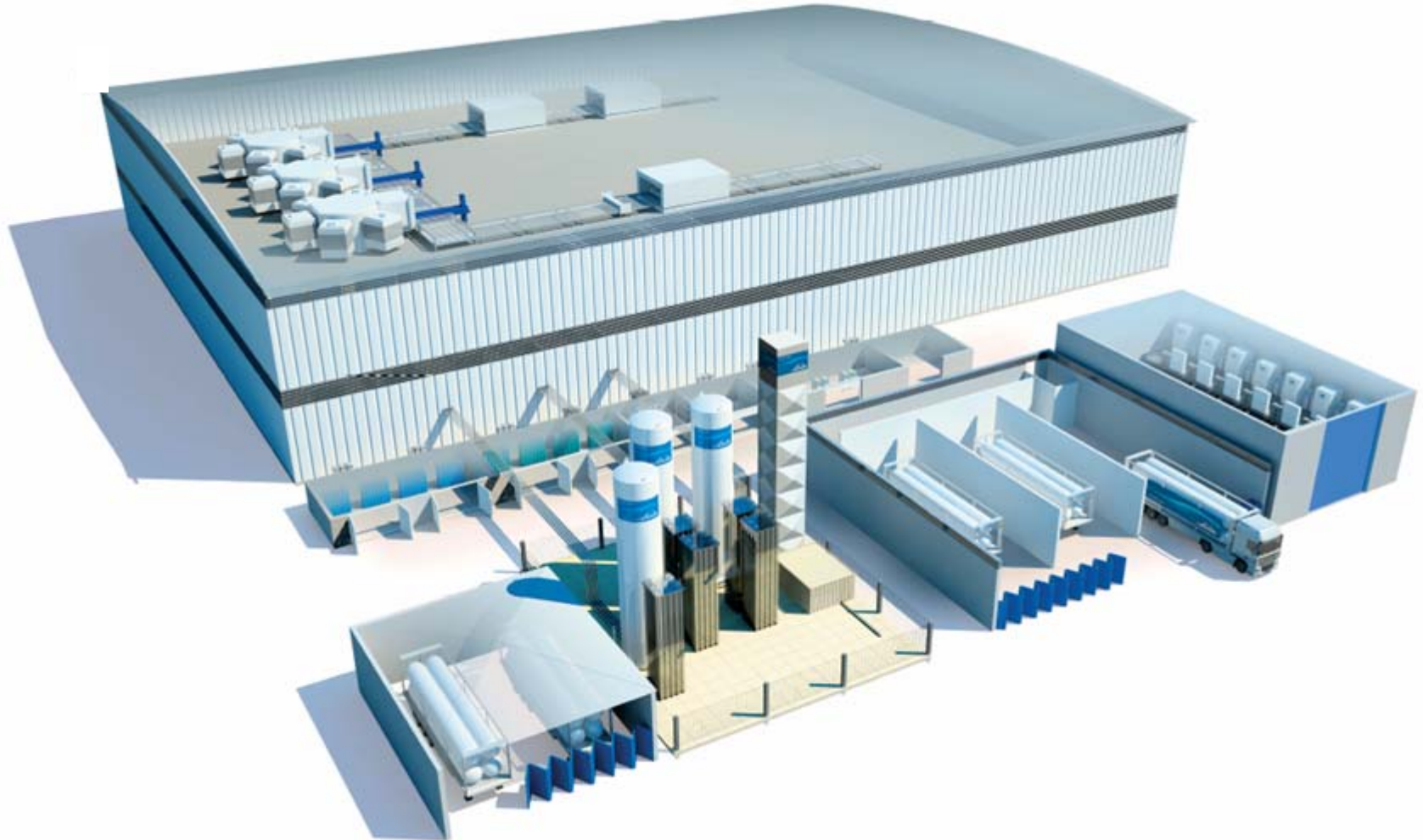


Sustainability from a Gas Suppliers Perspective

Andreas Weisheit
Head of Business Development – Solar



- Process gas optimization
 - Replacing greenhouse gases
- Material recycling
- On-site plant design
 - Energy efficiency
 - Emissions reduction & avoidance
- Gas supply engineering
 - On-site dopant blending
 - Purge gas treatment
- Supply chain management
 - Logistics & CO₂ footprint
 - On-site specialty gas production



Taking a deeper look Greenhouse gas replacement

NF₃, the greenhouse gas missing from Kyoto

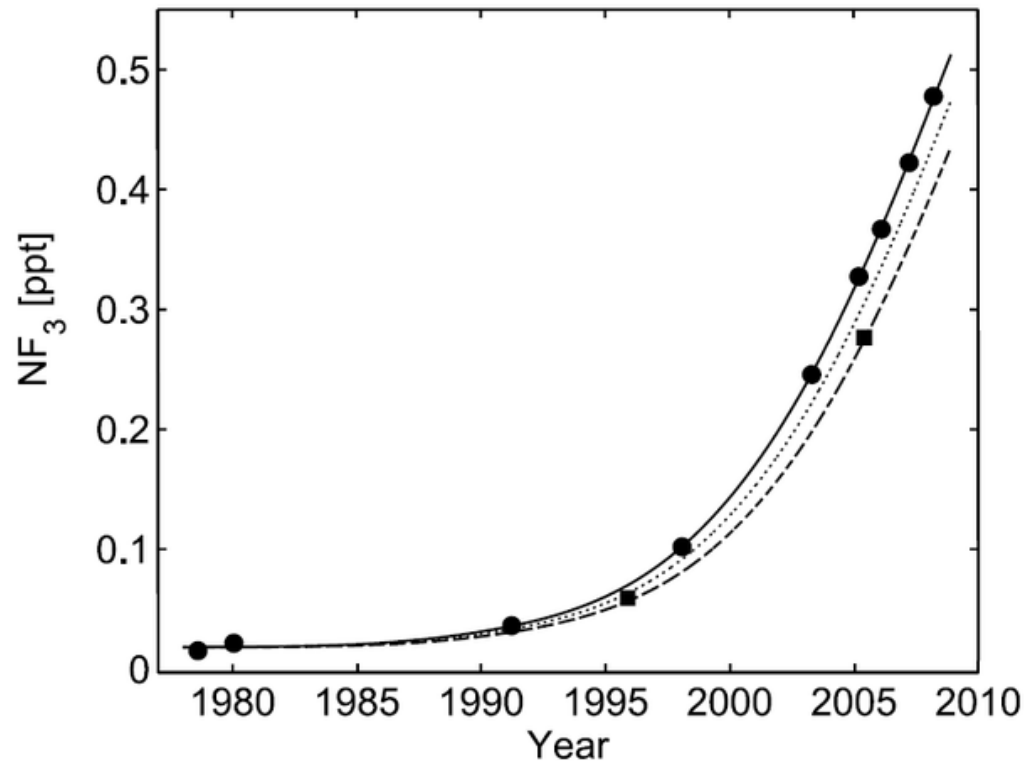
Michael J. Prather, Juno Hsu

Earth System Science Department, University of California, Irvine, California, USA

New study finds atmospheric levels of GHG NF₃ at least 4x higher than previously estimated

Scripps Institution of Oceanography/UC San Diego

Clean Gas	Atmospheric Lifetime (years)	Global Warming Potential (GWP) ₁₀₀
CF ₄	50000	6500
C ₂ F ₆	10000	9200
C ₃ F ₈	2600	7000
SF ₆	3200	23900
NF ₃	740	17200
F ₂	0	0





Spectra N Nitrogen Plants

- Best in Class, worldwide Linde patented process yields a significant reduction in power consumption compared to conventional designs.
-40% electricity consumption
< 0,2 versus 0,33 kW/nm³ GAN

Hydrogen on-site generation

- Steam methane reforming
 - Most common and most economic process for large plants
 - By-product: CO₂ (Carbon Capture & Storage)
- Electrolysis
 - Economic for small scale plants
 - High electricity consumption
 - Option: renewable energy feed (Hydro)
- Green Hydrogen
 - Biomass feed
 - Algae
 - Efficiency improvements needed

Taking a deeper look On-site gas blending

THE LINDE GROUP

Linde



CO₂ Footprint benefits

- Transportation
- Off-site filling / handling
- Cylinder change / purge
- Gas usage / heels

Conclusion

- Cost and CO₂ footprint are complimentary in most areas from a gas suppliers point of view
- Both need to be addressed for a truly sustainable development

