



Environmental Experts.

The road to a zero-emission Sub-Fab

A WORLD OF TRADE OFFS

Presenter: Dr. Guy Davies



CONTEXT



Company	Year
Infineon	2030
OSRAM	2030
NXP	2035
Intel	2040
TSMC	2050
GF	2050
MICRON	2050
UMC	2050
TI	?
SK Hynix	?
SMIC	?
Samsung	?

What does the subfab have to do to become *carbon neutral*?

- ~~Switch to renewable energy~~ Little more complicated

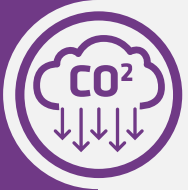
Is this the right Question?

What does the subfab need to do to become *emission free*?

- Much more complicated

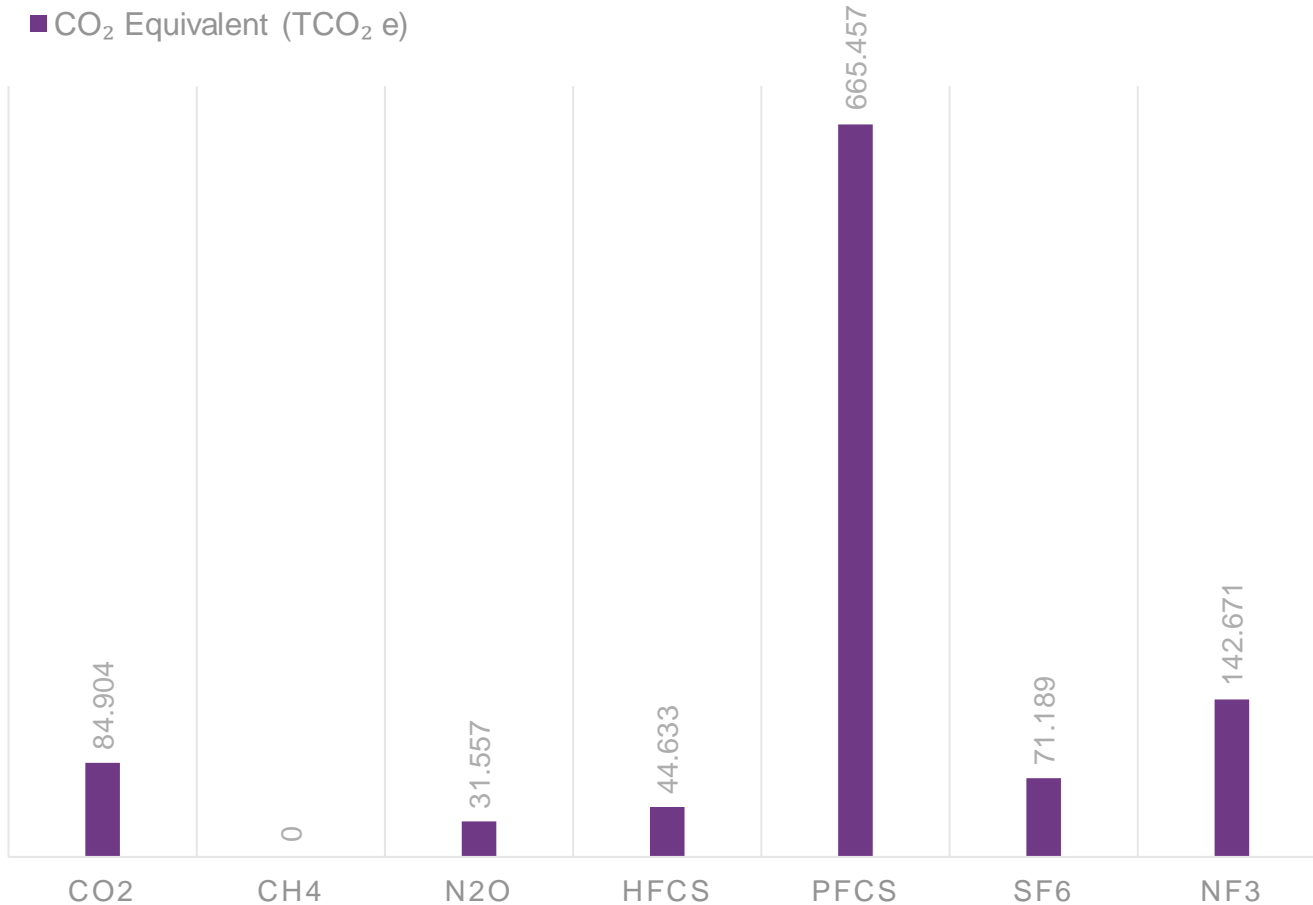


EMISSIONS



SCOPE 1 EMISSIONS

■ CO₂ Equivalent (TCO₂ e)



Typical data for a typical company:

CO ₂	GWP ₁₀₀ 1
CF ₄	GWP ₁₀₀ 7400
SF ₆	GWP ₁₀₀ 23500

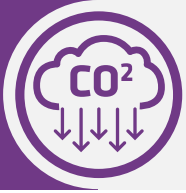
Effective (High) DRE for PFCs is essential.
 Less effective abatement is a false investment

What about other emissions?

NOx

VOCs

Dust



NO & NO₂

Formed as a byproduct of HIGH temperature combustion
Especially with Nitrogen containing compounds.

- very relevant to air pollution
- are often subject to strict site emission limits

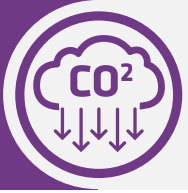
CF₄, SF₆, N₂O ... + O₂ Burner → **NO_x ...**

- Eliminating PFCs eliminates the need for O₂ burners/
high temperature burners and leads to a strong NO_x
reduction
- Reducing N₂ pump purges

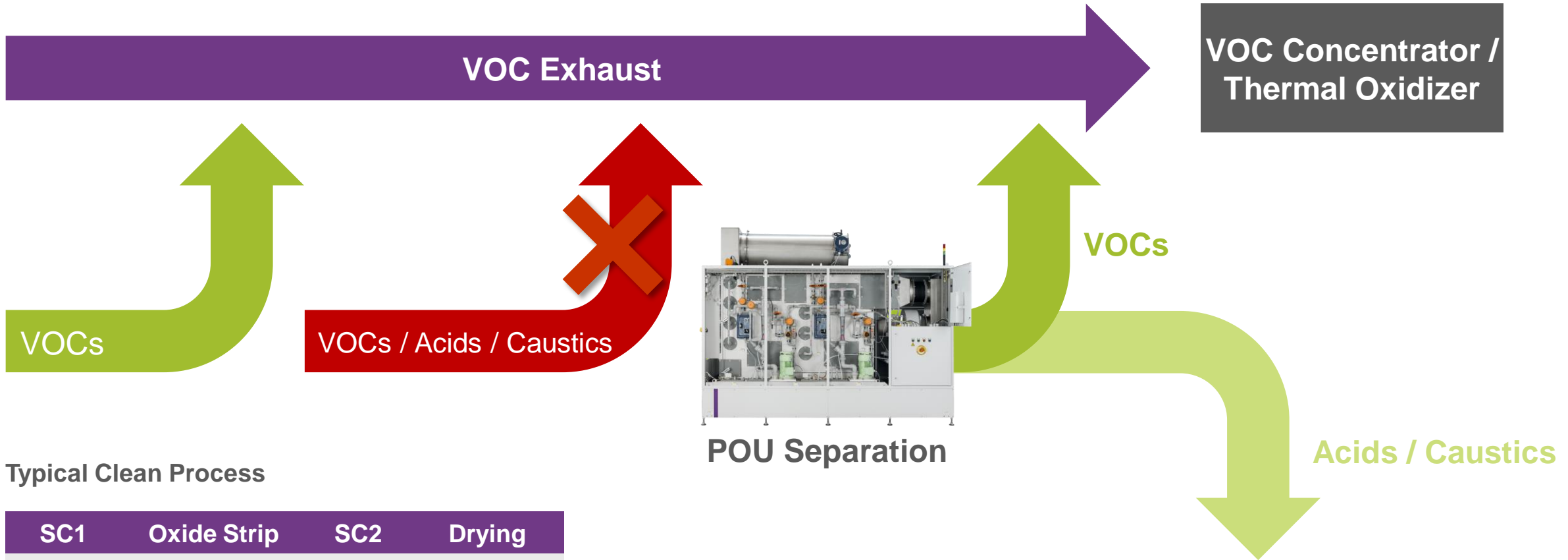
Alternative for today

- 2nd stage treatment of NO_x with a DRE of > 95%





Separation of volatile organic compounds

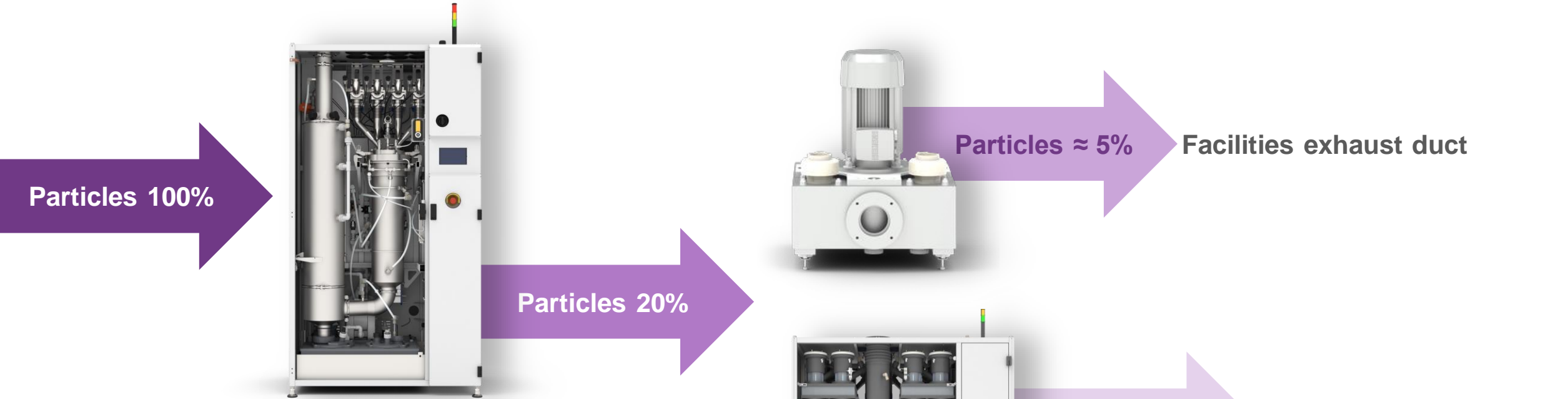


Typical Clean Process

SC1	Oxide Strip	SC2	Drying
H ₂ O	HF	H ₂ O	H ₂ O
NH ₃	-	HCL	IPA
H ₂ O ₂	-	H ₂ O ₂	-



Fine Dust in 1 slide



Deposition Process	Inert	Main Byproducts Water	Main Byproducts Gaseous
N ₂ O	-	-	N ₂ , NO _x
DCS (H ₂ SiCl ₂)	-	HCL, SiO ₂	SiO ₂
NH ₃	-	H ₂ O	N ₂
N ₂	Y	-	N ₂

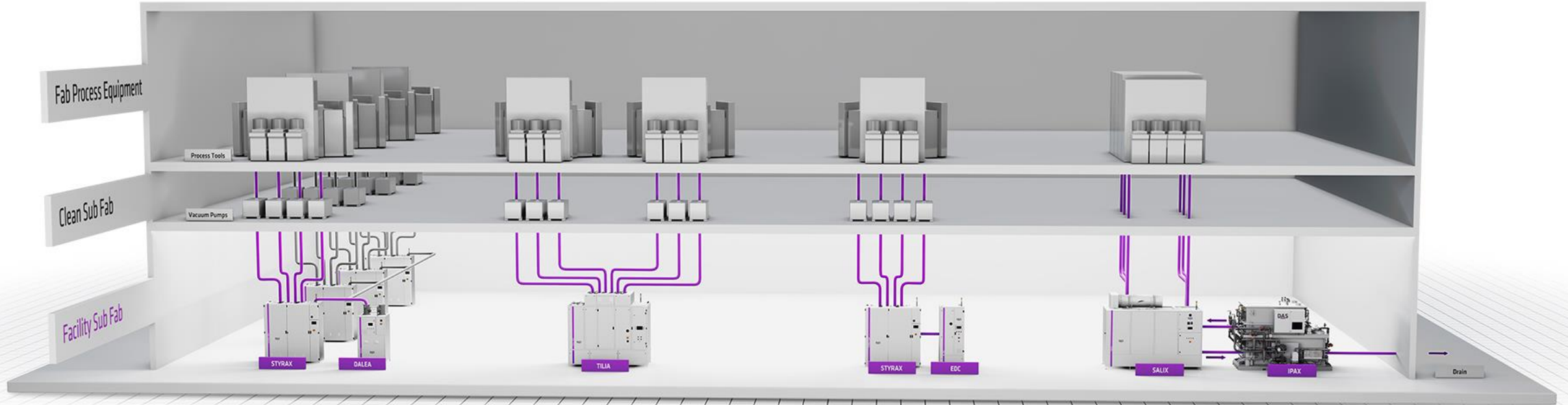
0.5 slm DCS = Approx 1.5 kg dust / day



SUB-FAB SYSTEMS



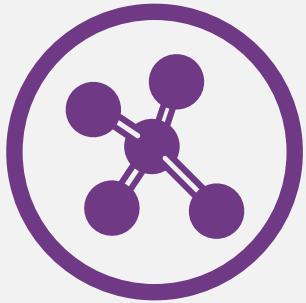
What is Sub Fab?



What is the Digitalisation Strategy?



Where are the trade offs?



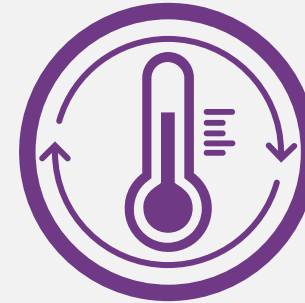
PFCs



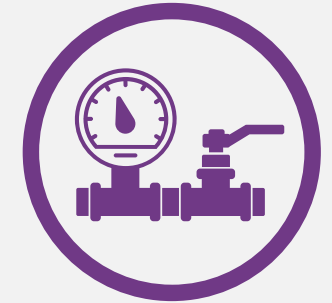
**ACID LOADS
NEUTRALIZATION
AND FLOURIDE
TREATMENT**



**SPARE PARTS AND
CONSUMABLES
VS. MEDIAN USAGE**



**HEAT
MANAGEMENT PCW
TEMPERATURE**

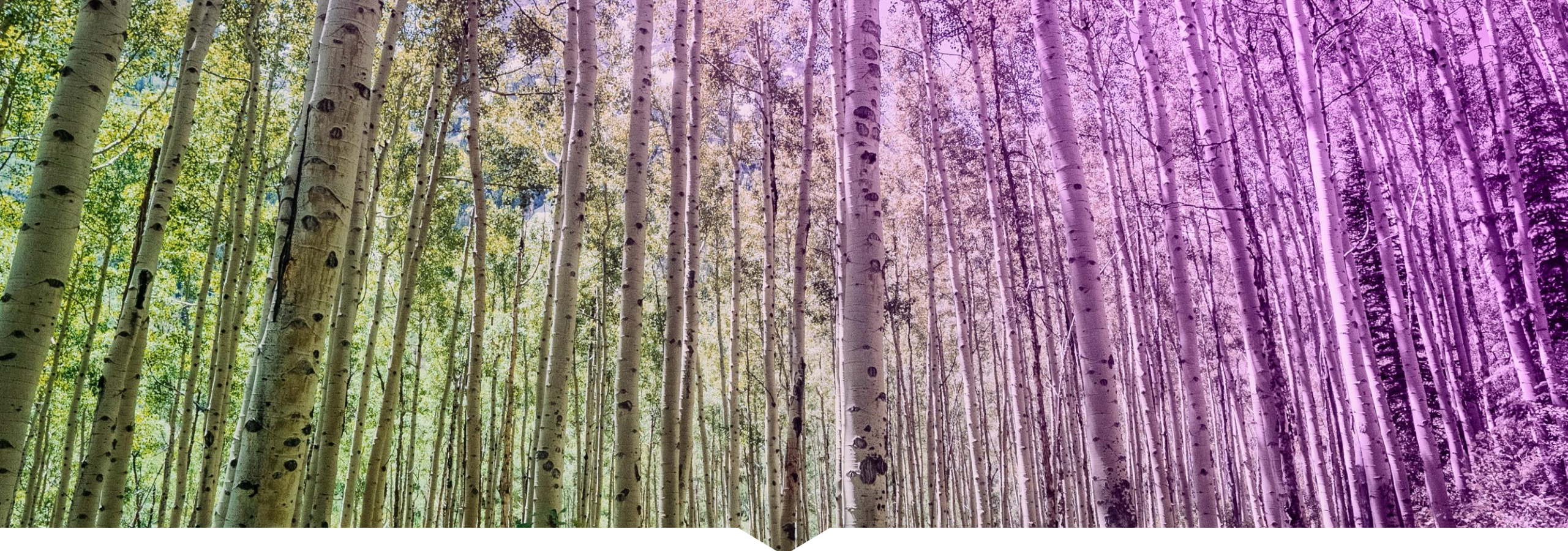


CDA PRESSURE



- There is no industry wide focus for sub fab activities.
- Facilities departments are not proactive more reactive
- What are Best Practices for the subfab?
- Do we build new fabs with the right infrastructure?

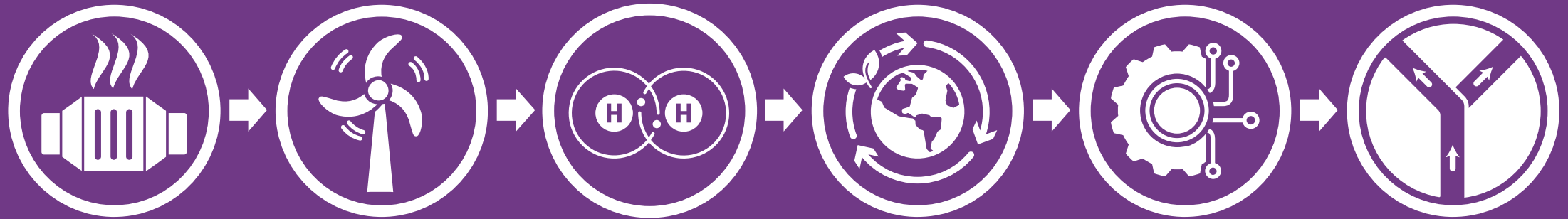




CONCLUSION



What does the future look like?



**SECONDARY
ABATEMENT**

**RENEWABLE
ENERGY**

**ALTERNATIVE
ENERGY
SOURCES**

**RECOVERY /
RECYCLE**

**ALTERNATIVE
ABATEMENT
TECHNOLOGIES**

**ALTERNATIVE
SEMICONDUCTOR
PROCESSES**



What has to happen?

For an emissions free sub fab today

- Highly efficient abatement systems,
- Renewable energy
- Extra stages of abatement necessary for all emissions

For an emissions free sub fab tomorrow

- Alternative Fuels
- Alternative technologies focused on Reuse and Recycle
- Integrated 2nd stage abatement

Effective Digitalisation strategy in the subfab with open interfaces → Get equipment talking to each other

Industry Sub Fab leadership need to be addressed




- What are Industry Best Practices and understanding of the trade offs in the subfab?



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PURPLE INNOVATIONS FOR
GREEN MANUFACTURING

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