

ITF Chip into the
FUTURE

AT **SEMICON
EUROPA**

Enabling climate aware process development for IC chip manufacturing

Emily Gallagher

POWERED BY **imec**

motivation

imec.**netzero** virtual fab
environmentally-aware development
communication

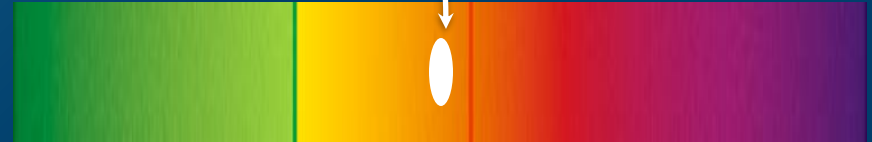
where we are



satellite view of Earth

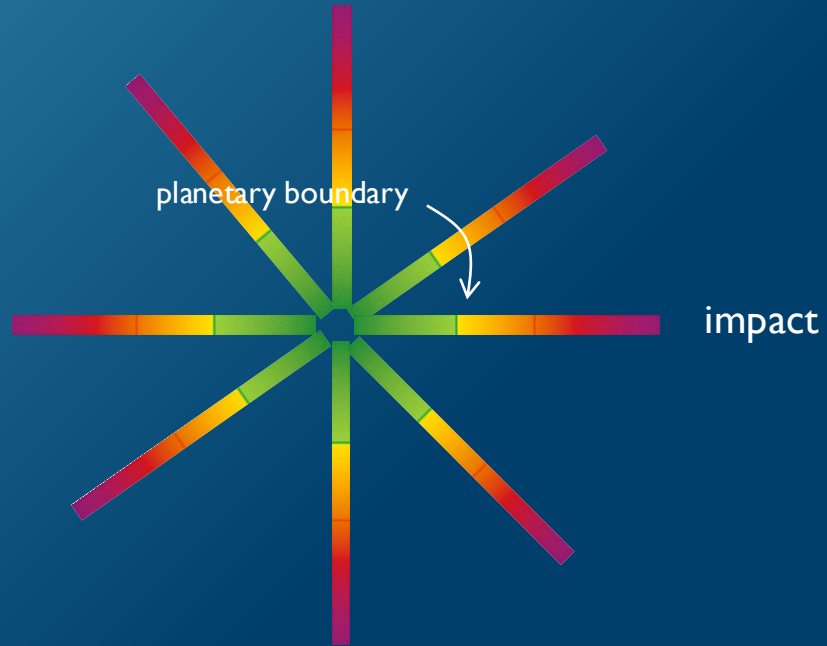
planetary boundary

high risk line

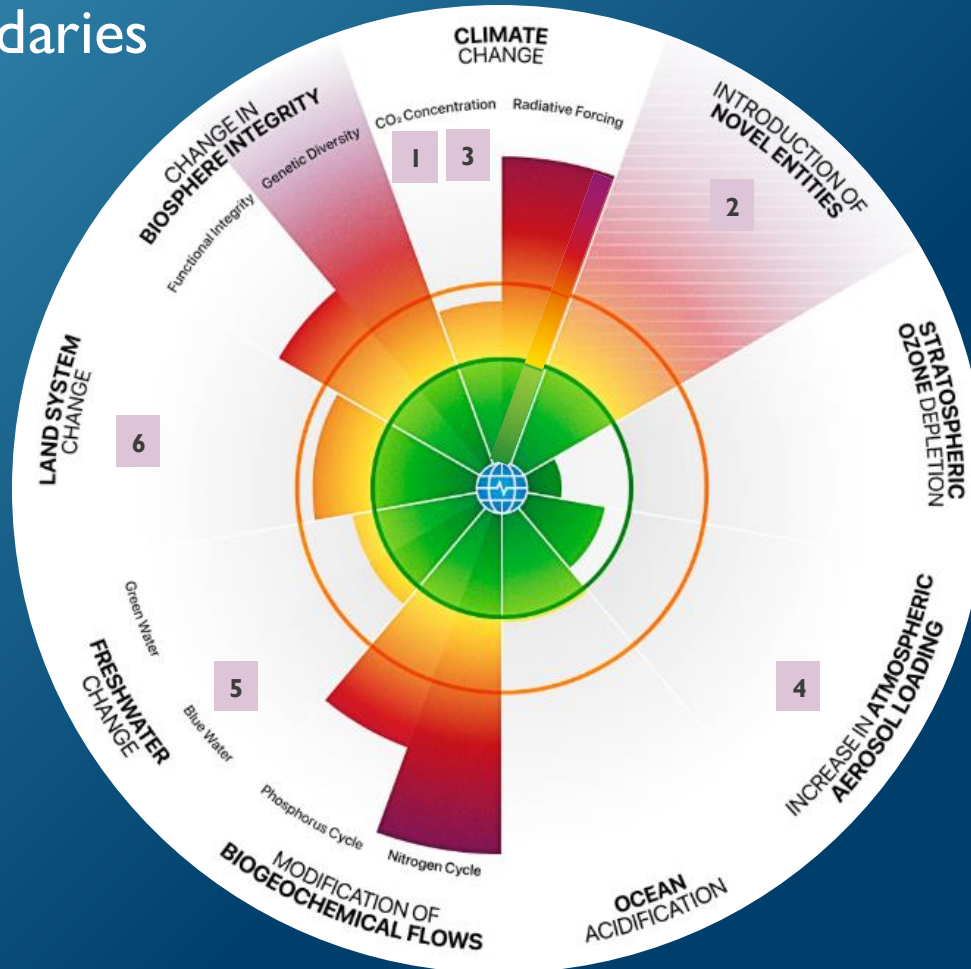


2025 planetary health at a glance

planetary boundaries



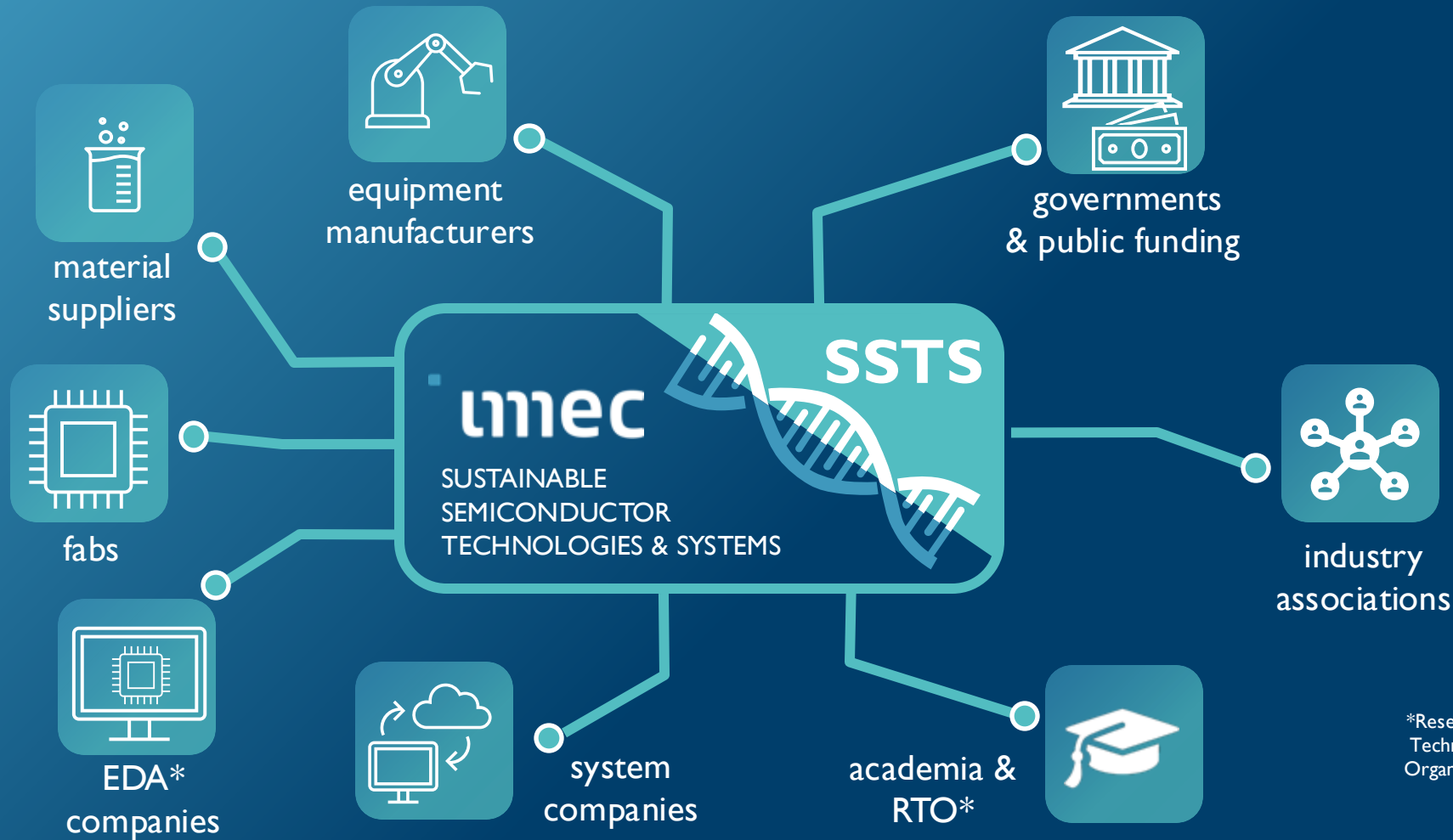
planetary boundaries



... and semiconductor
manufacturing role

Semiconductor fab adds to:

- 1 Emission of non-CO₂ GHGs
- 2 Release of synthetic chemicals
- 3 Fossil fuel burning
- 4 N₂O release
- 5 Industrial water use
- 6 Expansion of infrastructure



*Research & Technology Organization

motivation

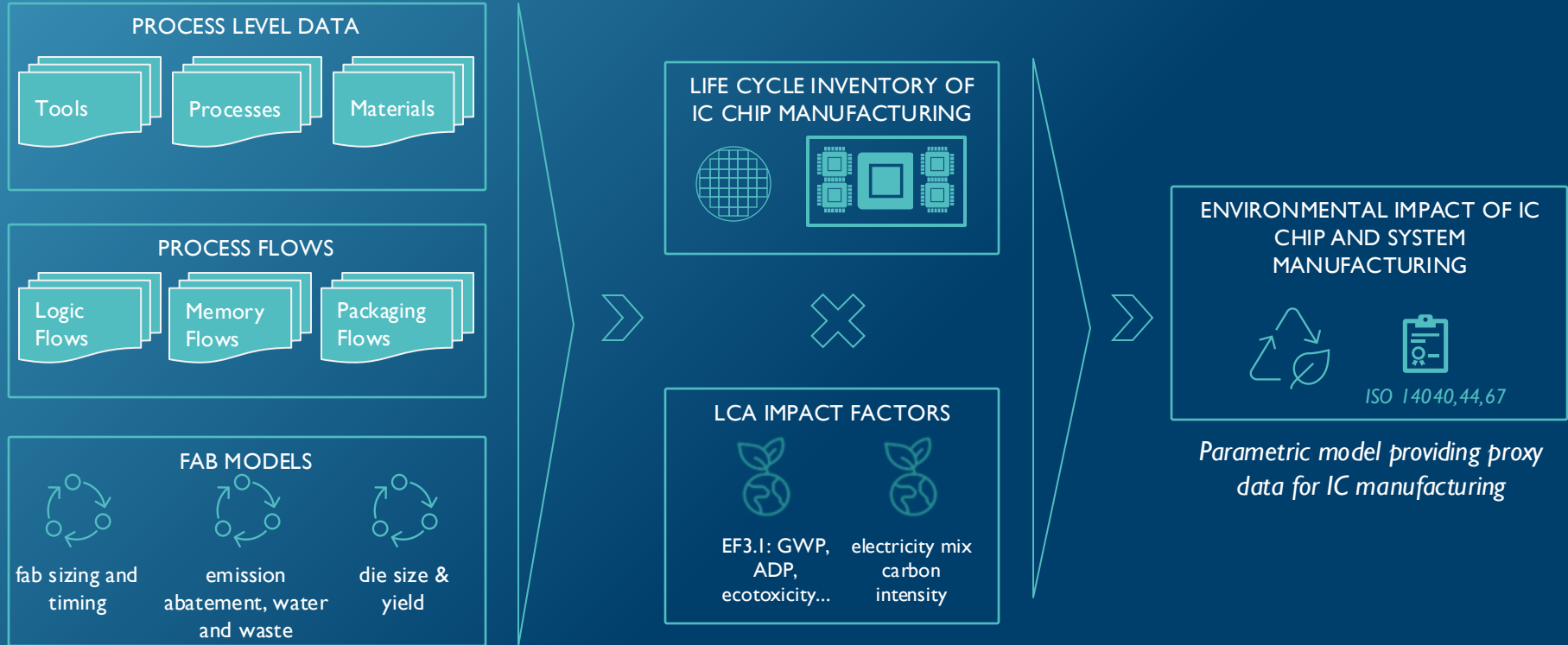
imec.netzero virtual fab

environmentally-aware development
communication

simplified life cycle of a chip



imec.netzero for life cycle analysis



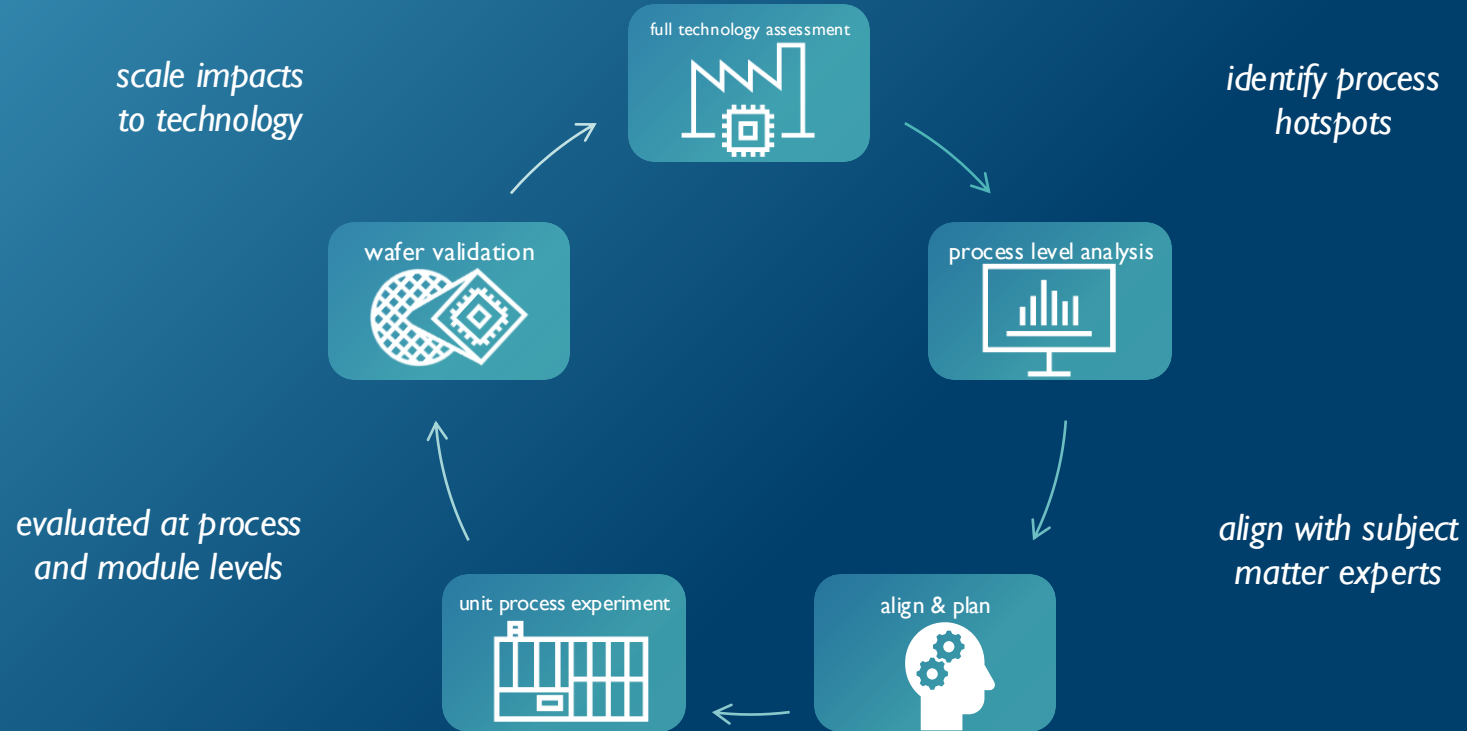
motivation

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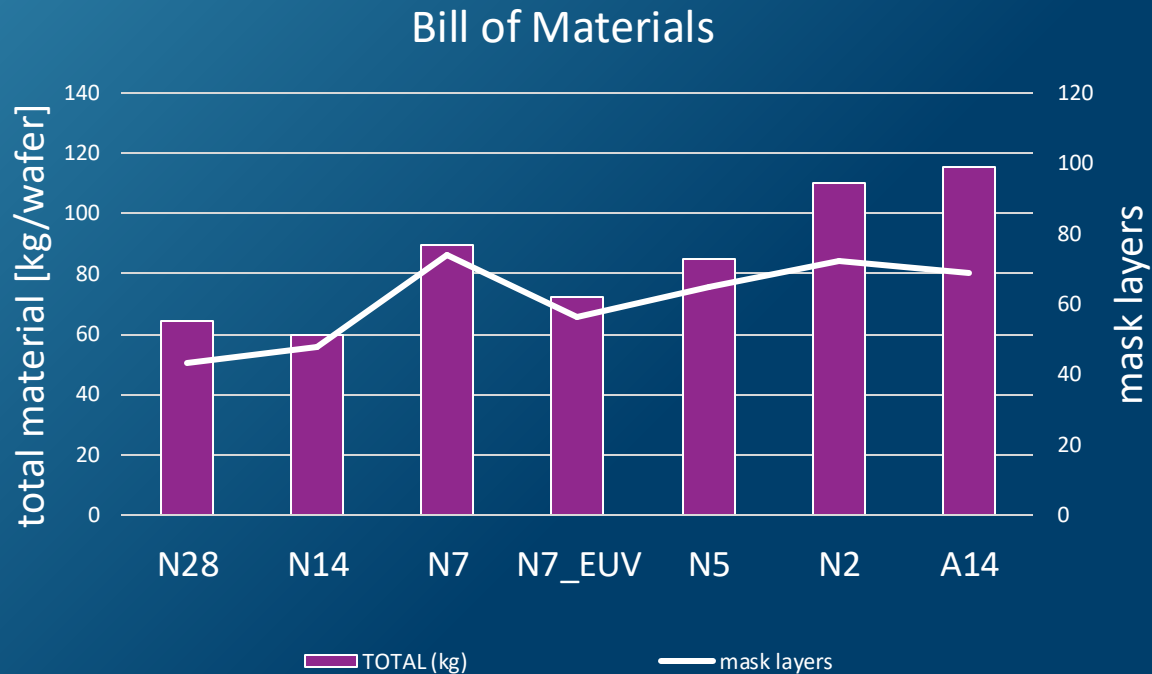
communication

climate aware process development





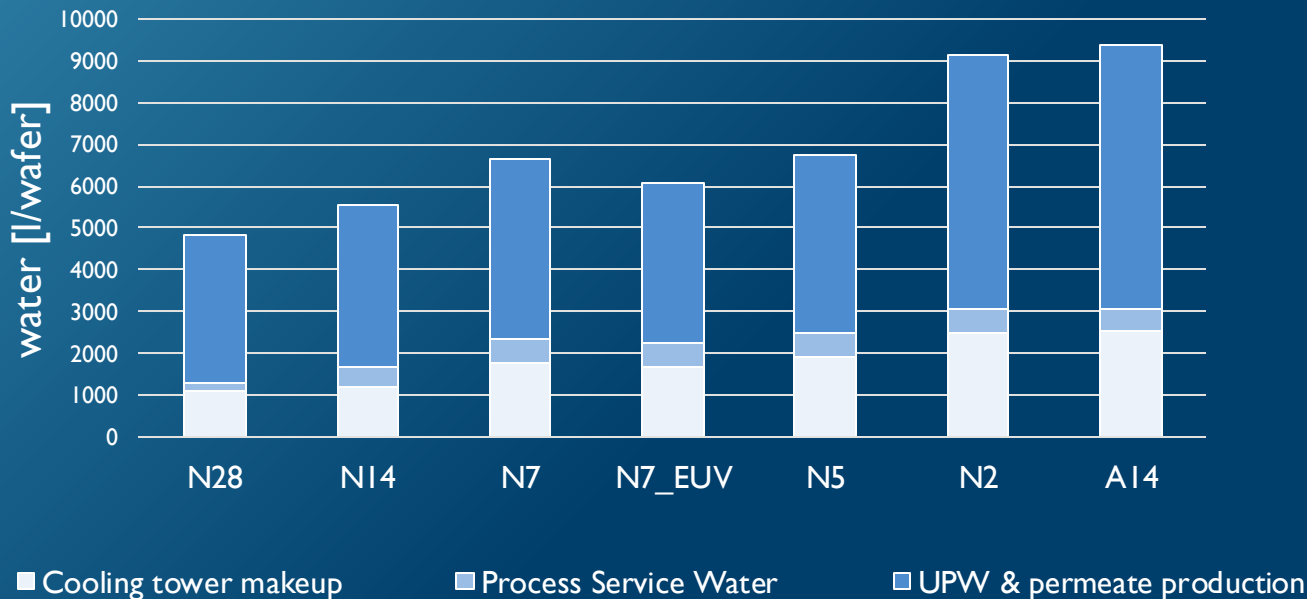
logic technology trends powered by imec.netzero





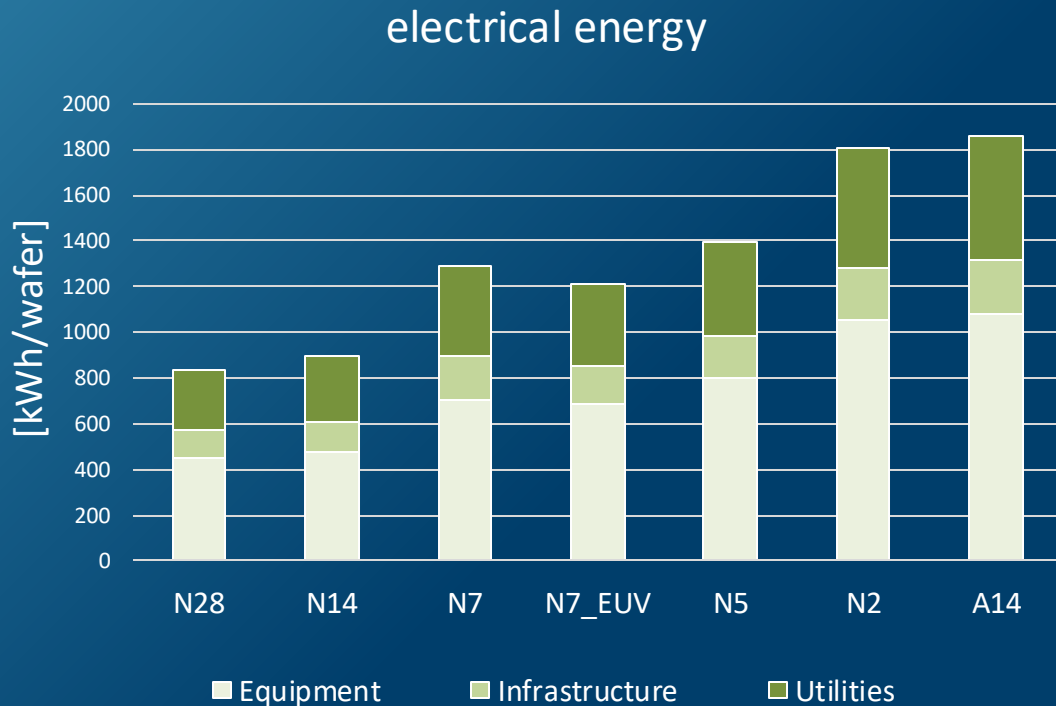
logic technology trends powered by imec.netzero

water drawn from network





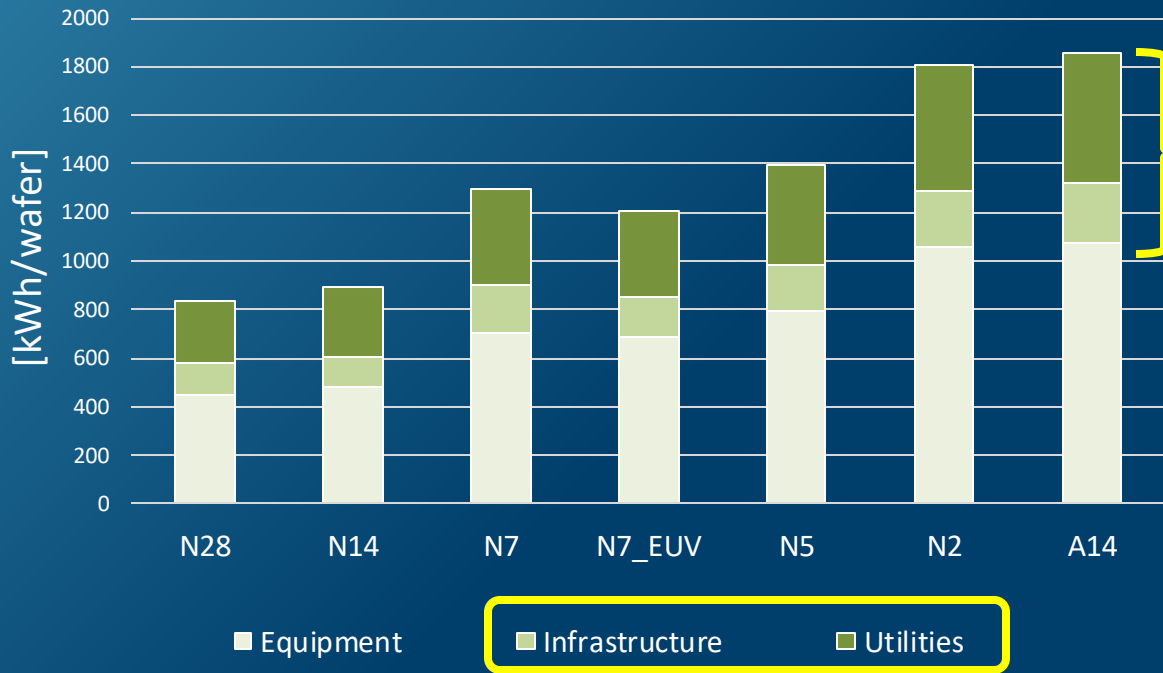
logic technology trends powered by imec.netzero





logic assessment powered by imec.netzero

electrical energy is not only from processes

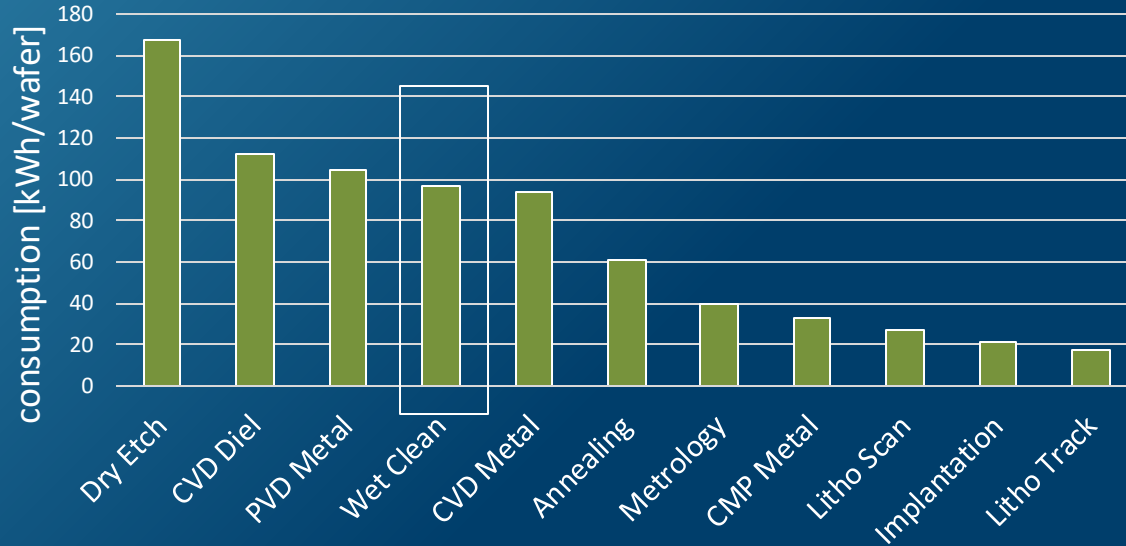


40-50% of electricity is NOT from process



climate aware process development

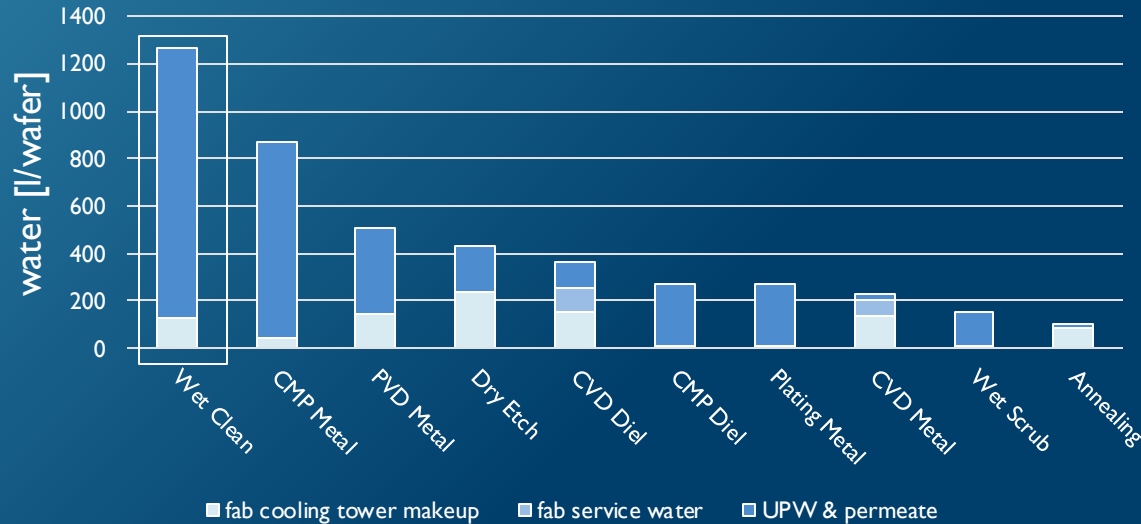
N28 logic: top process areas for electricity





climate aware process development

N28: top processes for water use





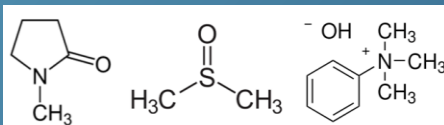
climate aware process development

traditional solvents

NMP n-methyl-2-pyrrolidone

DMSO dimethyl sulfoxide

TMAH tetramethylammonium hydroxide

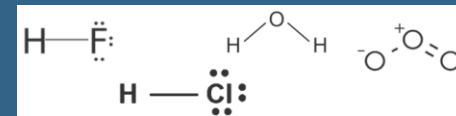


gas-enriched alternatives

FOM hydrofluoric ozonated mixture

HOM hydrochloric ozonated mixture

DIO3 ozonated water



Process of Record (POR) recipe



Cyclic process: oxidation & etching

Self-limiting etching ~ 1nm/cycle

Optimized recipe

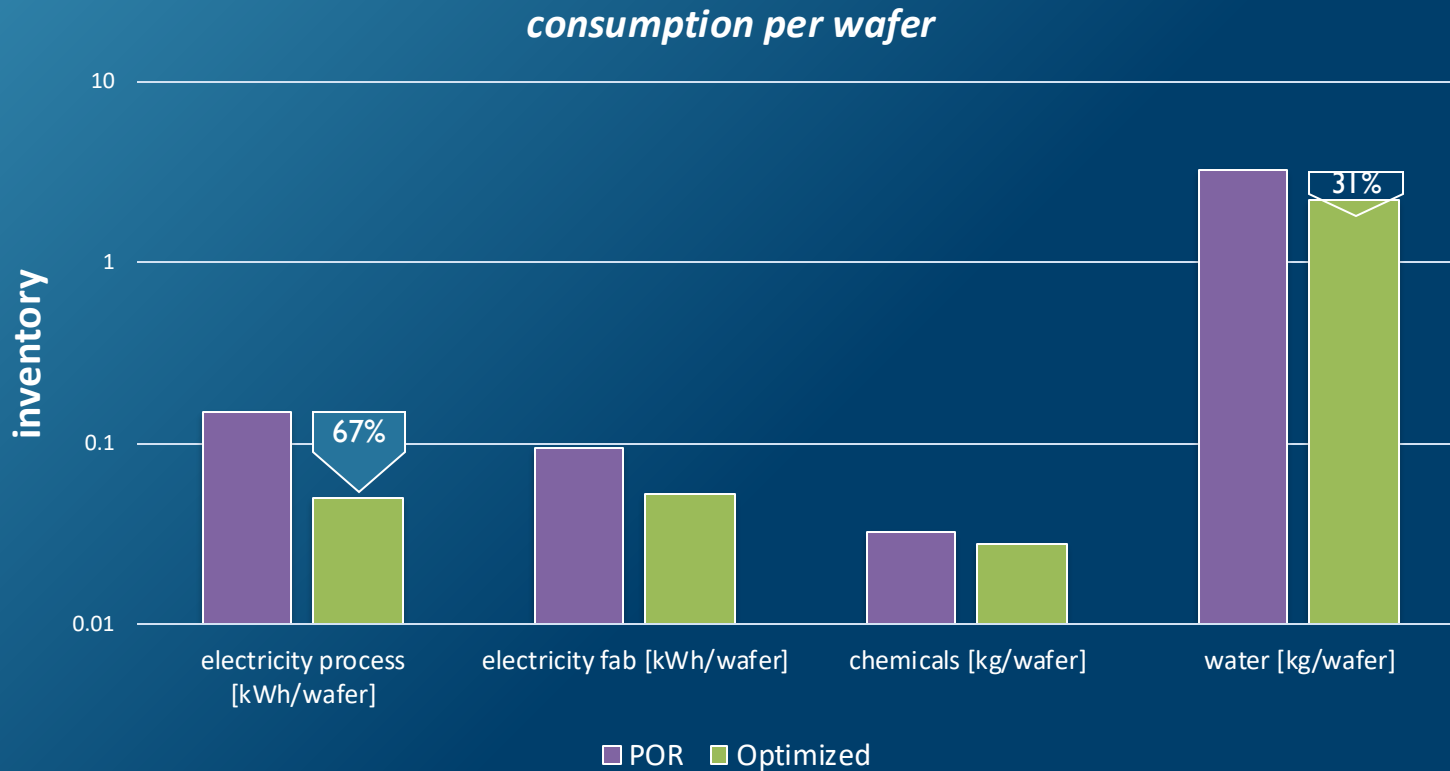


One-step process

Parameters control the process
(time, temp., concentration)

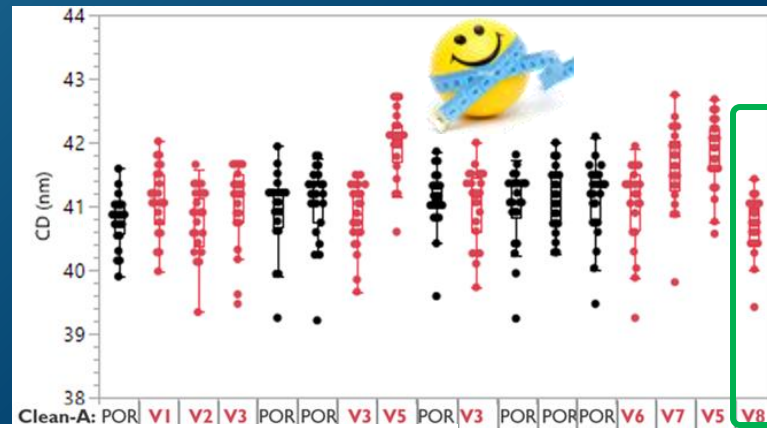
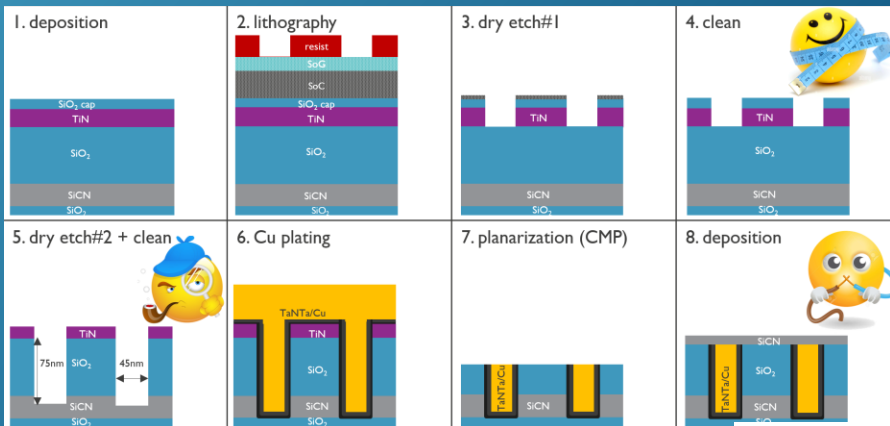


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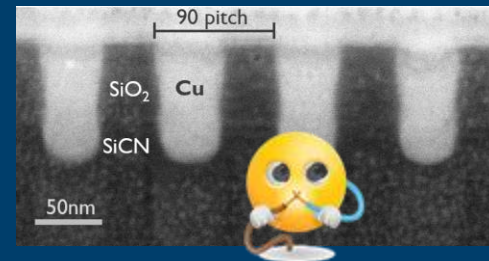
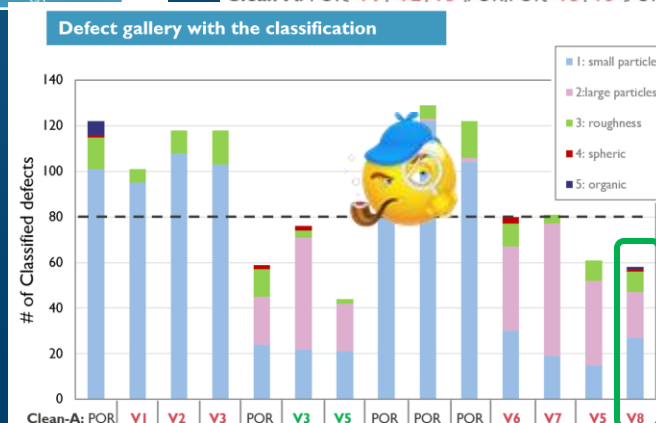




climate aware process must be capable



- ✓ CD metrology matched
- ✓ defects equivalent
- ✓ resistance comparable



motivation

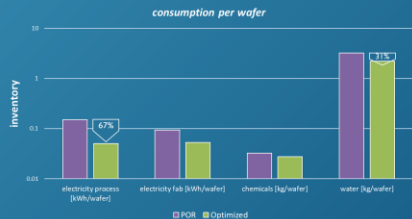
imec.**netzero** virtual fab

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communication

Communication

□ Scale improvements to technology level



saving/wafer/process × 10% of wet steps = savings per finished wafer

small fab is ~ 1 million wafers

□ Deploy language that resonates

- Electricity reduction → cost reduction
- Material reductions → supply chain resilience
- Throughput increase → capital avoidance
- Process improvement (never compromise yield)

N28 technology example



~6M kWh/year
could run a small data center



~40 million l/year
16 Olympic swimming pools

ITF Chip into the
FUTURE

AT **SEMICON
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Thank you for your attention.
..and to the entire SSTS team and partners

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