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Coatings innovations
sustainability and functionality

André van Linden – Consult@vanLinden

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Andre van Linden

- AkzoNobel 1986-2025, diverse functies in R&D en Marketing
- Werkzaam via Consult@vanLinden sinds 2025

- ❑ Voorzitter NVVT (Nederlandse Vereniging van VerfTechnici)
- ❑ Voorzitter Stichting Fatipec
- ❑ Board member Fatipec (Federation of Associations of Technicians for Industry of Paints in European Countries)
- ❑ Voorzitter ISO TC/35 Paints & Coatings, 2017-2026
- ❑ Voorzitter Topsector Chemie (ChemistryNL), Chemistry for Advanced Materials



1983	1986	1991	1995	1998	2008	2011	2018	2022	2025
Internship lab Deco Research (DDIR)	Researcher lab Deco Research	Lab Manager Deco Technical Support	Marketing Manager Representative Office Moscow	International Marketing Manager Deco Sassenheim	BU R&D Director Deco Northern & Eastern Europe (Warsaw)	Director Deco Wood, Trim, Specialties & Pre-Deco Research	Director Coatings Technologies	Director Scientific Academic Partnerships	

Sustainability is at the core of our identity

AkzoNobel

We produce durable solutions in a more sustainable manner

50% less carbon emissions in our **own operations**



41% 2024 — 50% 2030

100% circular use of materials in own operations driven by reduce, reuse, recycle



74% 2024 — 100% 2030

We help our partners to become more sustainable

50% less carbon emissions across our **value chain**



12% 2024 — 50% 2030

75% of suppliers meeting sustainability expectations*



67% 2024 — 75% 2030

We empower our communities and employees

100,000+ members of local communities empowered with new skills



100,000+ 2024 — 100,000+ 2030

30% female executives



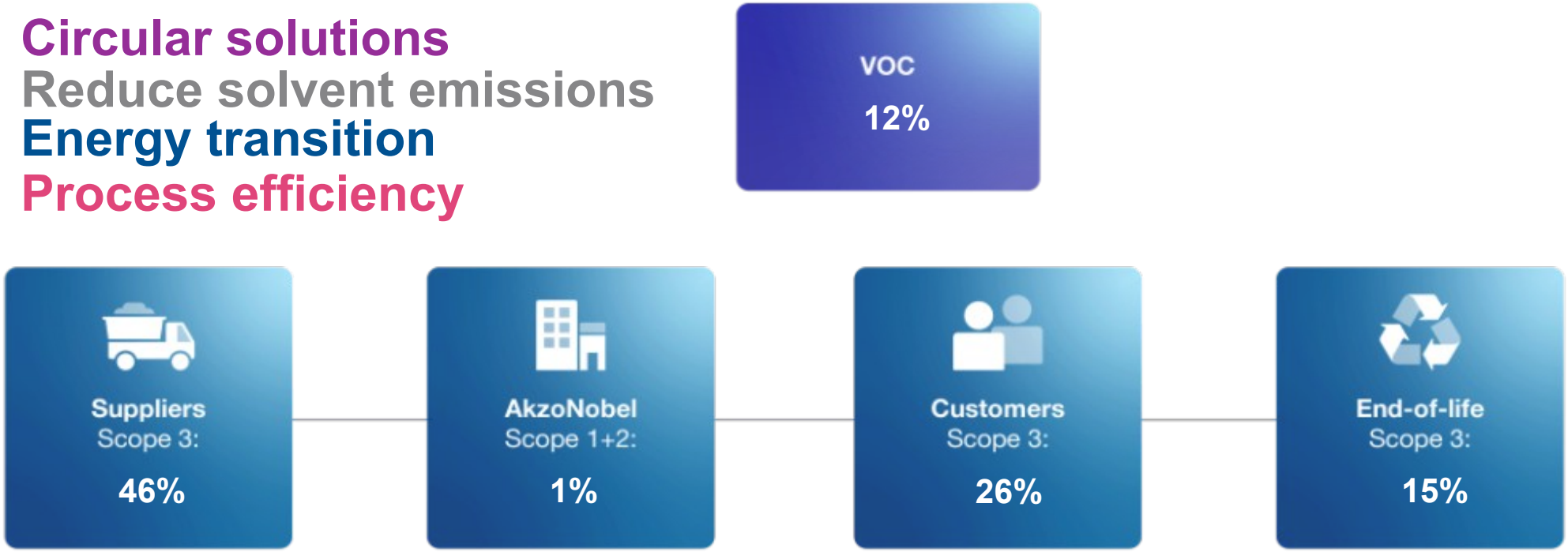
26% 2024 — 30% 2025

*75% of the suppliers in our sustainability program - covering over 1,500 customers with 84% of our global spend and 97% of our upstream carbon emissions.

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Four action areas for carbon reduction

Circular solutions
Reduce solvent emissions
Energy transition
Process efficiency



Proprietary information of AkzoNobel

Sustainability?

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Country Overshoot Days 2024
When would Earth Overshoot Day land if the world's population lived like...



- Direct customer (DIY) or Industrial customer?
- Carbon Footprint or Human Health?
- Earth Overshoot Day?
- Water, Metals or Carbon?
- Biodegradable or very long lasting?
- Metal or plastic packaging?
- Most efficient in functionality or lowest carbon footprint per liter?
- Are rework possibilities for substrates and left-over paint as important?
- Thermal management needs more (paint) materials but work on cooling or efficient heating
- Should it have a 'sustainability' label per product or per company?

→ Too many questions and too many choices?

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A recognized sustainability leader

Top 1% of all companies assessed by **EcoVadis** and **platinum medal** awarded





Multi-year ESG **leading** position in **MSCI**





Only **low risk** assessed company in paints and coatings industry by **Sustainalytics**



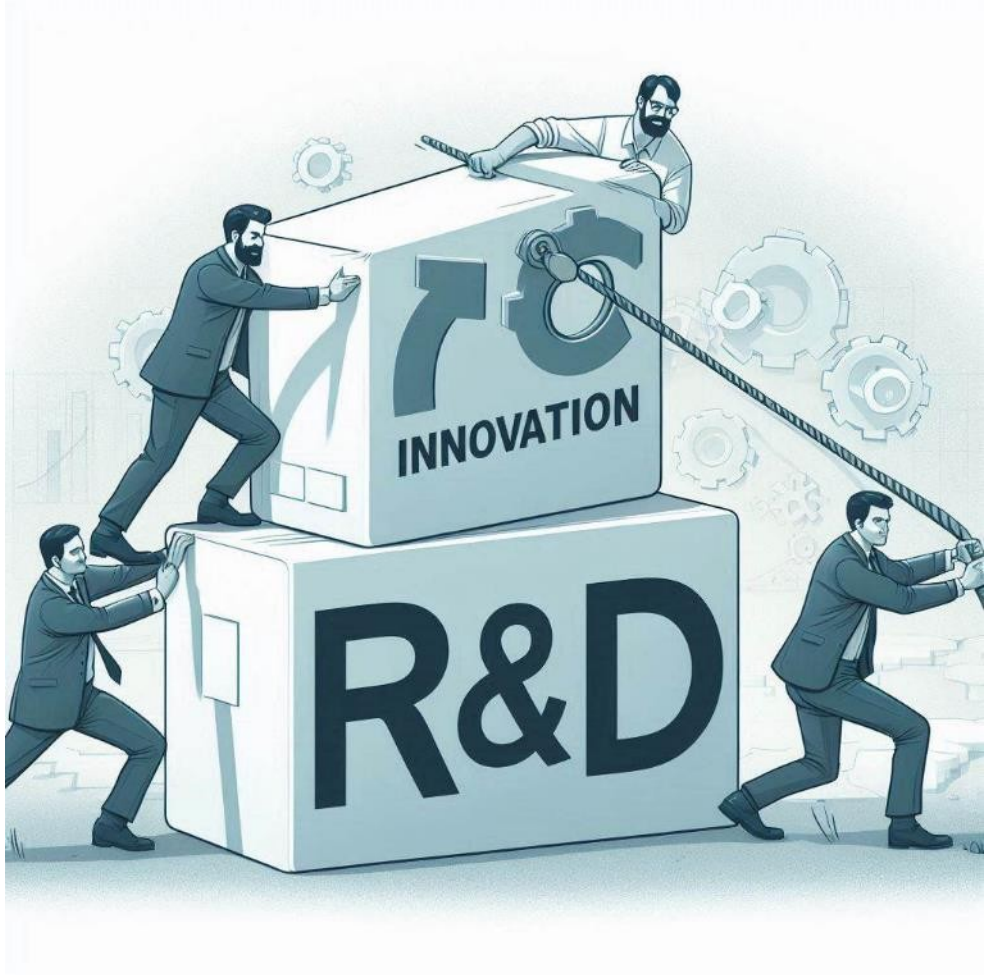




Push versus Pull Innovation

PUSH

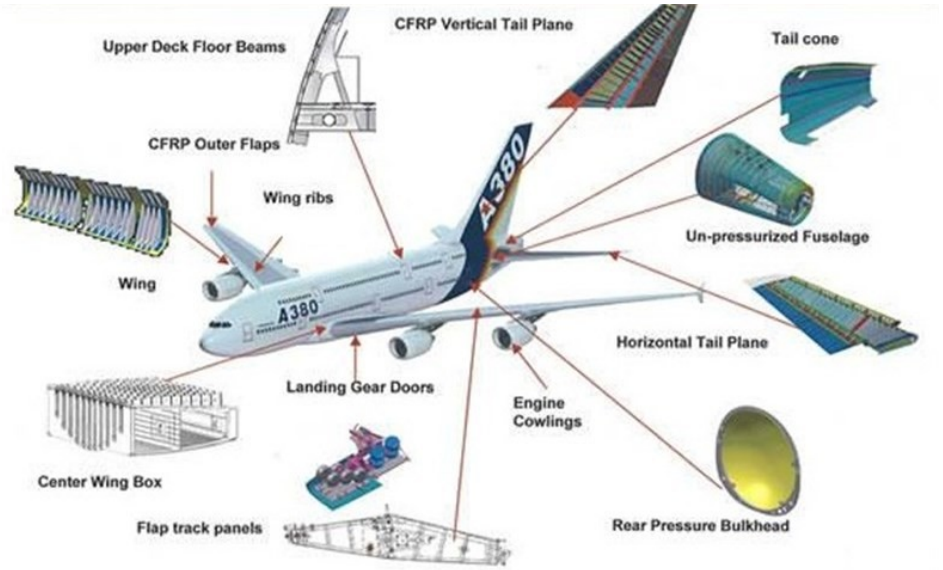
- ➢ Market Trends
- ➢ Unmet needs
- ➢ Unknown technologies
- ❑ Tomorrow's questions
- ❑ Radical innovation
- ► Demand to be created
- ► Convincing needed
- ► New business
- ► Longer lead time



PULL

- ➢ Market research
- ➢ Interviews
- ➢ Marketing questions
- ❑ Yesterday's questions
- ❑ Incremental innovation
- ► Customer demand iminent
- ► Direct business possible
- ► Existing business
- ► Shorter lead time

Nieuwe substraten hebben innovatieve coatings nodig



Coatings voor verschillende typen composieten voor vliegtuigen



Coatings voor composieten op decks en gevels



Duurzame coatings voor wind molens

* Source: ICCM proceedings (Jerome Pora, Airbus)

Circularity in the coatings world

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Contradiction or challenge?

Long life time, superdurable	⟷	Biodegradable (triggered?)
Perfect adhesion, protect substrate	⟷	Re-use of substrate, de-adhesion
Waterbased industrial coatings	⟷	Fast drying, low energy production lines
Fast crosslinking at ambient temperature	⟷	Totally non-toxic material (hardly reactive)
One time good in quality and color	⟷	Natural materials with its (small) variations
Optimal performance and functionalities	⟷	Optimal sustainability (MoC, CF, circulair)

Challenge to find optimal balance, but not impossible.

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Trends in coatings literature and conferences

1. Sustainability – Formulation ingredients

2. Sustainability – Use of Paints

3. Sustainability - Assesment and sharing

Trends in coatings industry

		Now	Soon	Later
1	Eco-friendly Formulations (incl MoC)			
2	Low VOC and Water-based Coatings			
3	Biobased and Circular Materials			
4	Eco-conscious innovation (incl radiation cure, low bake, application)			
5	Energy-efficient Coatings (incl solar-reflective, thermal management)			
6	High-performance and Long-lasting Coatings (in thin layers)			
7	Smart Coatings and Self-healing Technologies (incl adaptive responses)			
8	Biodegradable Materials			
9	New Substrates: Composites, (bio) plastics, 3D printed and alloys			
10	Enabling reuse / recycling of coated objects			
11	Sustainable Packaging			
12	Green Certification and Labeling			
13	Life Cycle Assessments or Sustainable Product Portfolio Assessments			
14	Digitalization, Machine Learning, Artificial Intelligence			
15	Collaboration and Knowledge Sharing			

A lot of work to do

Growing use

General practice

Combining towards breakthrough ideas

- **Biobased**
- **Circular (incl design for ..)**
- **High Performance**
- **Thin layers, long lasting**
- **Adaptive response**
  - **Self healing**
  - **De-adhering**
  - **Easier biodegrading**
- Alternative pigments (Reduce TiO2)
- (WB 1k) Ambient crosslinking (Avoid baking)
- Thermal management (Heating / Cooling)
- Super durable coatings (Life time extension)
- Etc.



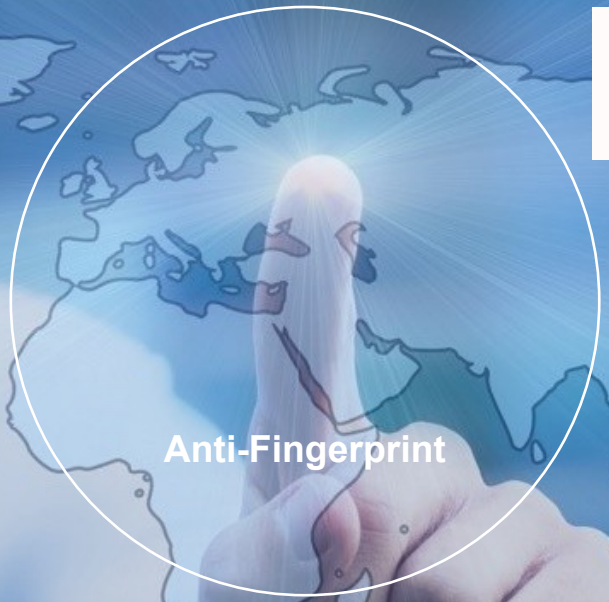
Bescherming en Verfraaiing
→ Functionaliteit

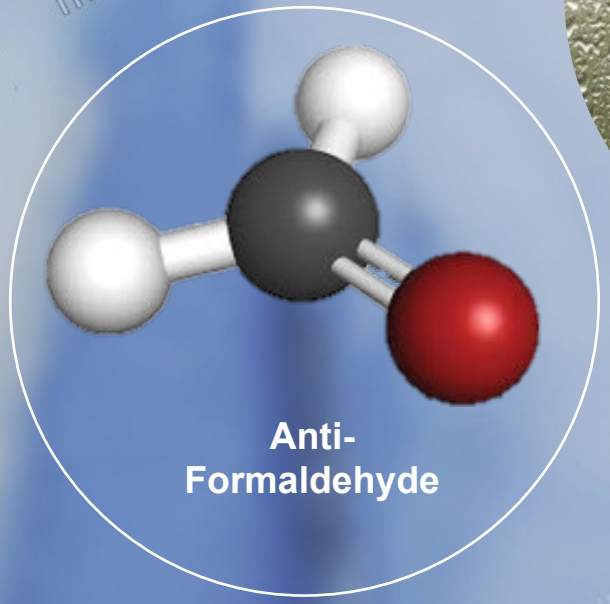
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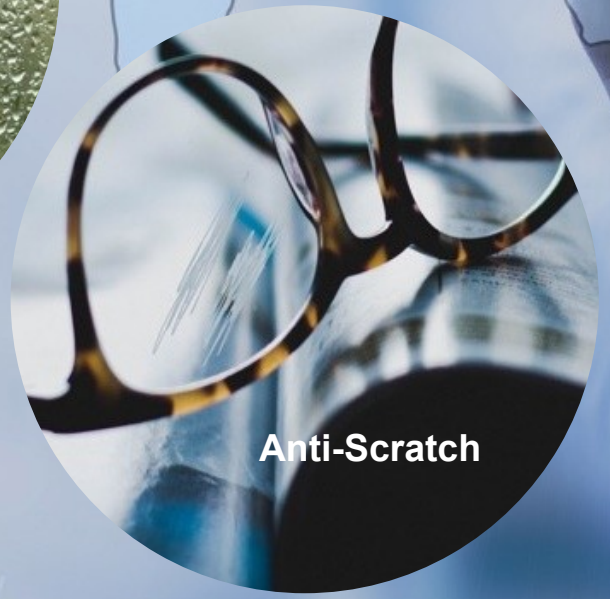
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Functional materials

Color and Appearance

- Structural color
- Anti-glare and anti-reflection
- Engineered opacity
- Soft feel
- Electrochromic
- Thermochromic
- Photochromic
- Fluorescing
- High reflectance



Functional Surfaces

- Ice release
- Anti-microbial and anti-viral
- Non-biocidal fouling control
- Anti-fingerprint
- Anti-graffiti
- Self-cleaning
- Anti-fog
- Drag Reduction

Radiation Control

- Radar transparent
- Radar absorbent
- Lidar reflective / translucent
- EMI/RF shielding
- Low solar absorption
- Solar / NIR absorbing
- Radiative cooling

Substrate Protection

- Self-healing
- Fire-resistant
- Fire-retardant
- Heat dissipation

Other Bulk Effects

- Air purifying
- Odor removal
- Thermal insulation
- Sound attenuation
- Electrically conductive
- Magnetic
- Thermoelectric
- Photovoltaic

Air cleaning (interior)

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Small molecules

Small (harmful) **molecules**
- Formaldehyde

- Carbon adsorption
- Catalysis
- Reactive additives

Carbon dioxide

- Lime
- Olivine

Big molecules

Big organic molecules
- Benzene, aryls

- Adsorption on carbon or polymers
- Catalysis via zeolites

Smelly molecules
- S and N compounds, several acids and aldehydes.

- Catalytic structures

Particles

Small particles
- PM10 and PM2.5

- No free movement, so no solution with paint

Aerosols
- Virus containing

- No free movement
- Once touched actives can work.

Air cleaning (exterior)



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Small molecules

Carbon dioxide
- Lime or Olivine
- Never at significant amounts

NOx
- See →

Big molecules

Big organic molecules and VOC
- Catalytic structures (zeolites)
- Slow and limited capacity

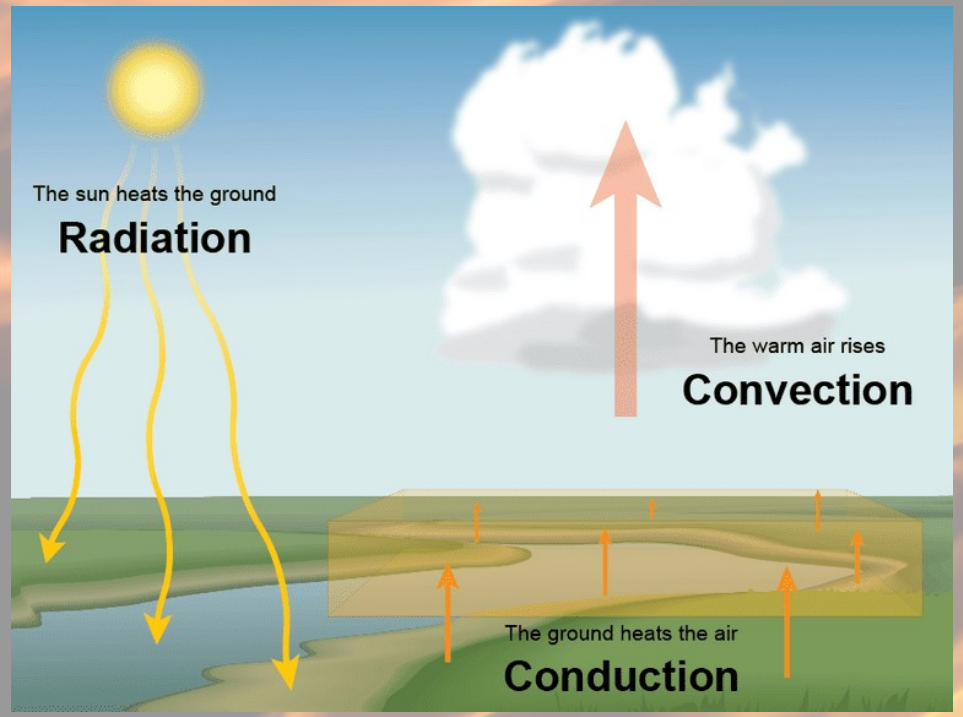
VOC
- See →

Particles

VOC, NOx and PM 10/2,5
- Photocatalytic (nano) Anatase TiO2 in stable matrix (inorganic)
- Outdoor effect very small due to wind
- Breakdown of any organic part of coating
- Formation of small molecules (formaldehyde) not favorable
- After failure in film nano particles in the air.

Heat Management

- Convection
  - Movement of air in the room
    - Not much paint can do
- Conduction
  - Direct transport through coating and substrate
    - A thick layers, preferably with low W/(mK)
    - For instance aerogels or glass bubbles in putty
- Radiation
  - Solar spectrum (UV, VIS, NIR) – a lot is already known
  - Thermal (mid) IR radiation through and by the substrate
    - IR reflecting layers (active or passive)
    - An aluminum like undercoat already does a lot
    - Use of special thermal radiating pigments
- Actual effect dependent on building insulation and constraints



- Anti –condensation
- Switchable coatings

Solar Heating

Use Solar direct to heat buildings





Optimized coatings maximize effect. In Netherlands:

- Solar panel generates ~ 0.7 GJ /m^2
- South facing thermal collector 4 GJ/m^2

Facade-mounted, wide variety of colors
Special pigments and resins

Requires additional hardware, heat pump and heat buffers
No sound, no ground drilling and outside equipment

Work ongoing to fit this into a standard prefab solution







*: ENergy harVesting by Invisible Solar IntegratiON in building skins

Projects FITS4E (NL), Envision (EU Horizon 2020), Sales presentation Emergo (2021)

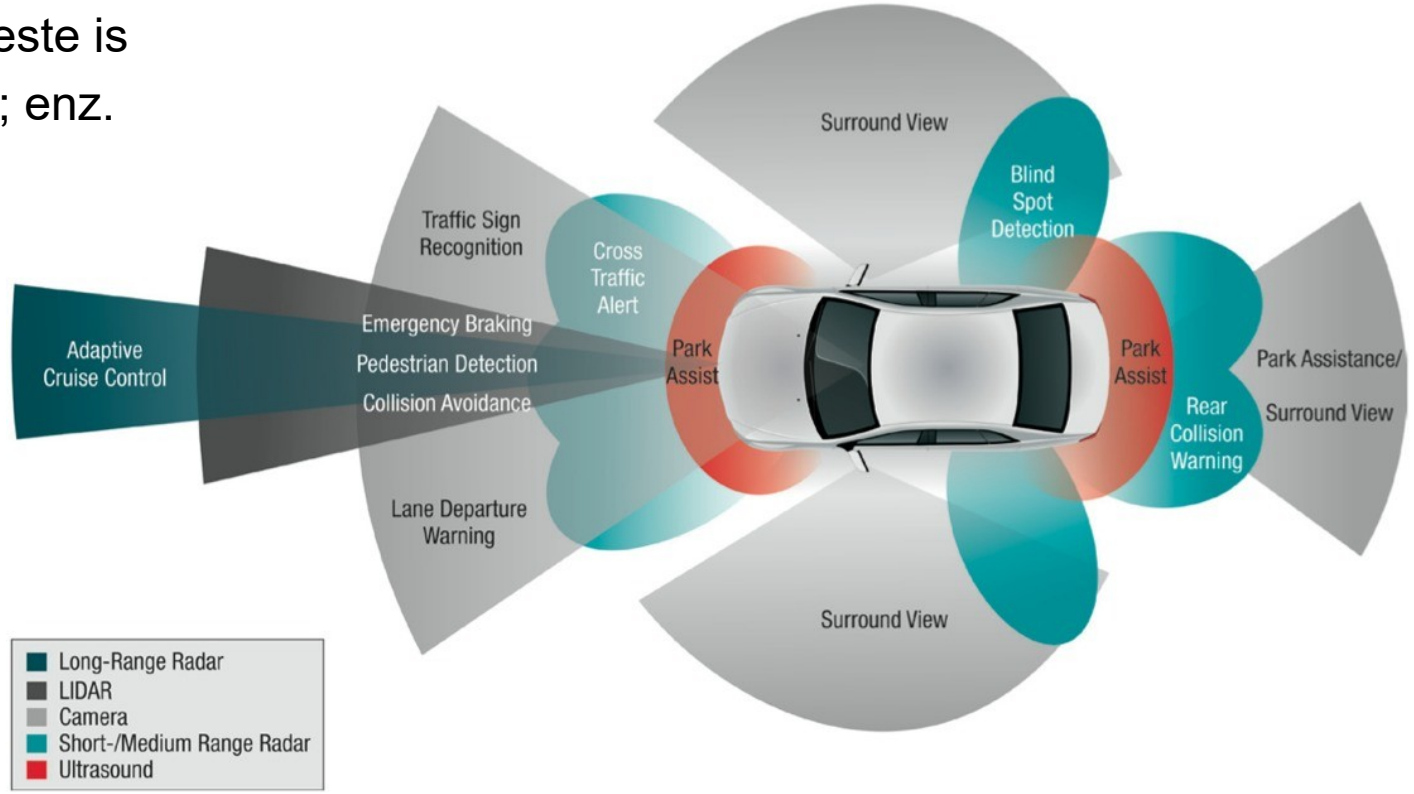
‘Zelf rijden’ Technologieen

A mix van sensoren: Radar; Lidar; Camera; Ultrasound
Niet duidelijk wat echt noodzakelijk en beste is
Verschillen in kosten; kleur; weer; bereik; enz.
Vb: Google wil Lidar, Tesla echt niet

Verf moet transparant zijn
(Maar hele systeem moet reflecteren)

Belangrijkste verf ingredienten:

- Metallic flake
- Laagdikte
- Vulstoffen
- Geleidbaarheid



Picture Michigan Tech research institute

https://www.mtu.edu/mtri/research/project-areas/transportation/sensors-platforms/benchmarking-sensors/

Sustainability en functionele coatings

Vrijwel alle functionele coatings geven duurzaamheids winst:

- Warmte management
  - Lage warmte absorptie
  - Zon/NIR absorptie
  - Koelen door straling
  - Thermische isolering
- Verminderen sleep weerstand boot
- IJs vorming tegen gaan

Maar ook voor langer gebruik

- Zelf herstellend
- Zelf reinigend
- Anti-graffiti
- (Vuur resistent en - vertragend)

2025, TKI Groene Chemie en Circulariteit

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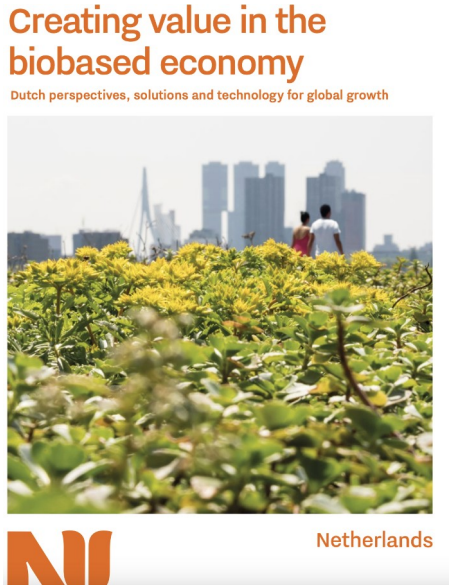












En wat doen we in Nederland?

- Quickscan Advanced Materials – TNO
  - Geavanceerde coatings
  - Dunne-laag-technologie
  - Materialen voor geavanceerde bewerking e.a.
- Dutch Materials Agenda 2026 – ChemistryNL
  - Functionele materialen
  - Soft en biomaterialen e.a.
- PPS-I 2026 Call Chemie en materialen voor Defensie
  - Coatings
  - Technische keramiek
  - Additieve manufacturing



Conclusie

- Innovatie in duurzaamheid is niet zwart/wit: altijd zoeken naar goede balans en beste compromis
- Focus op onderwerpen waar winst is te halen

- Behalve duurzaamheid en bescherming ook blik op nieuwe functionaliteiten
- Hele keten moet samenwerken (van grondstof leverancier tot nieuwe manier van aanbrengen)

- Veel nieuwe projecten van de overheid om te helpen

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Bedankt voor uw aandacht

Vragen?

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