



# Trends in sensor technologies for the water industry

Dr. Corina Carpentier

Nationale Watertechnologieweek

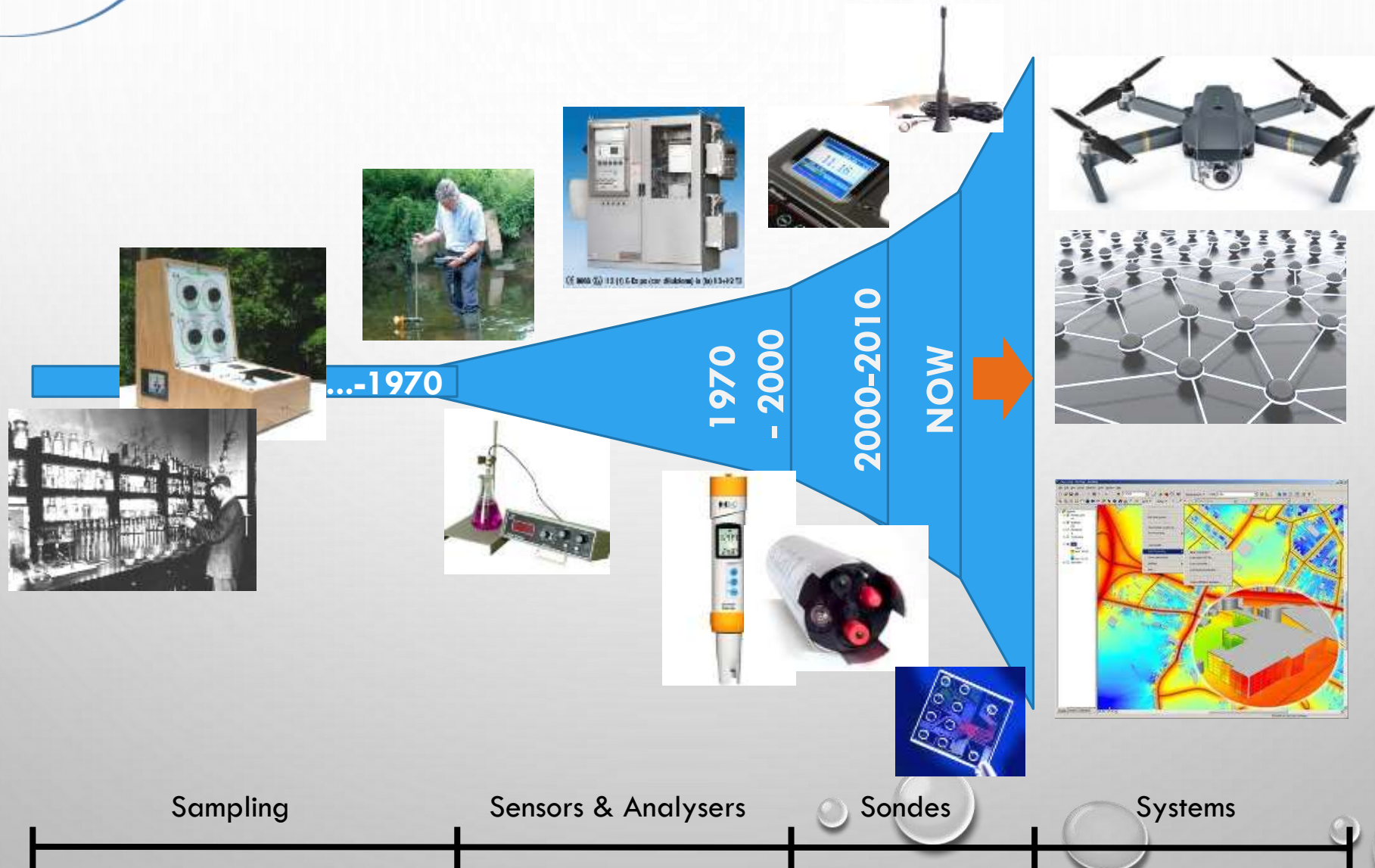
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# Drivers for the use of sensors

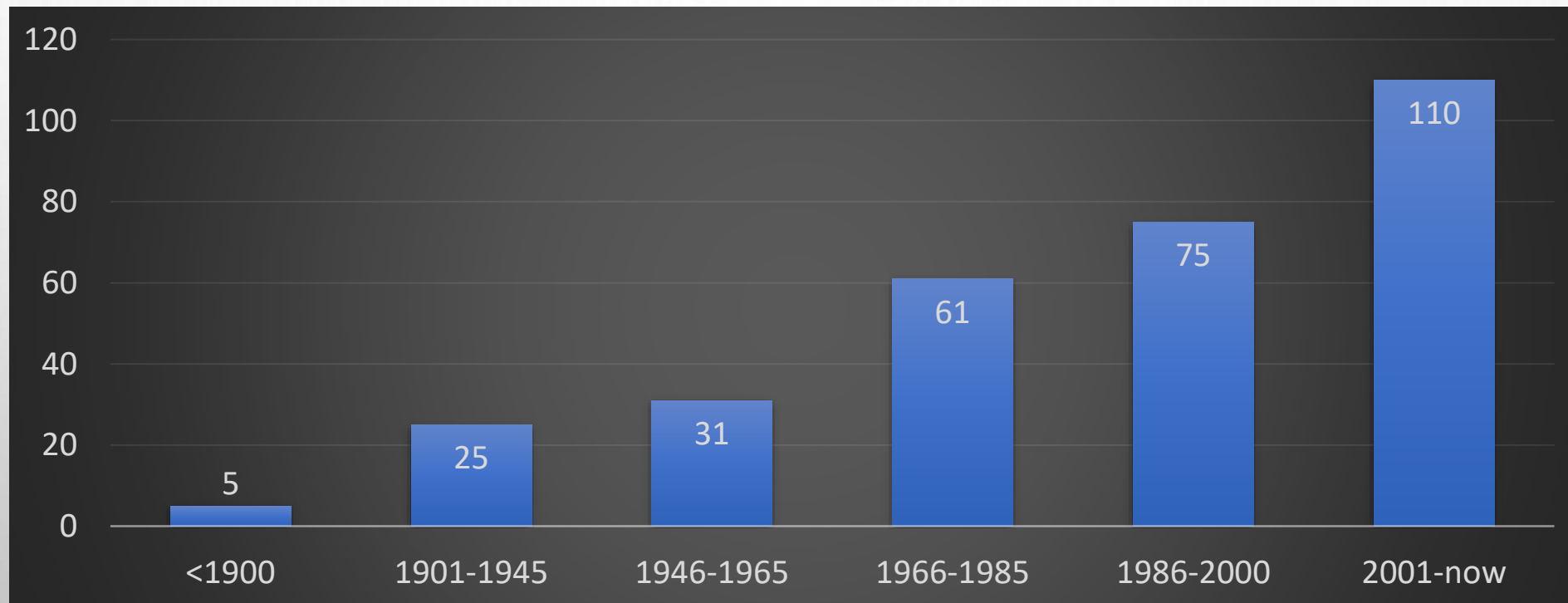
- Increasing possibilities for sensor applications:
  - Sensor technology developments
  - Additional technology developments
- Climate-change debate: reduce your own carbon footprint
  - Reduce energy consumption
  - Optimise (minimise) dosing of chemicals
- Regulatory obligations:
  - Risk-based monitoring of drinking water (EU-DWD)
  - Water Re-use Directive
- Desire for continuous process optimisation



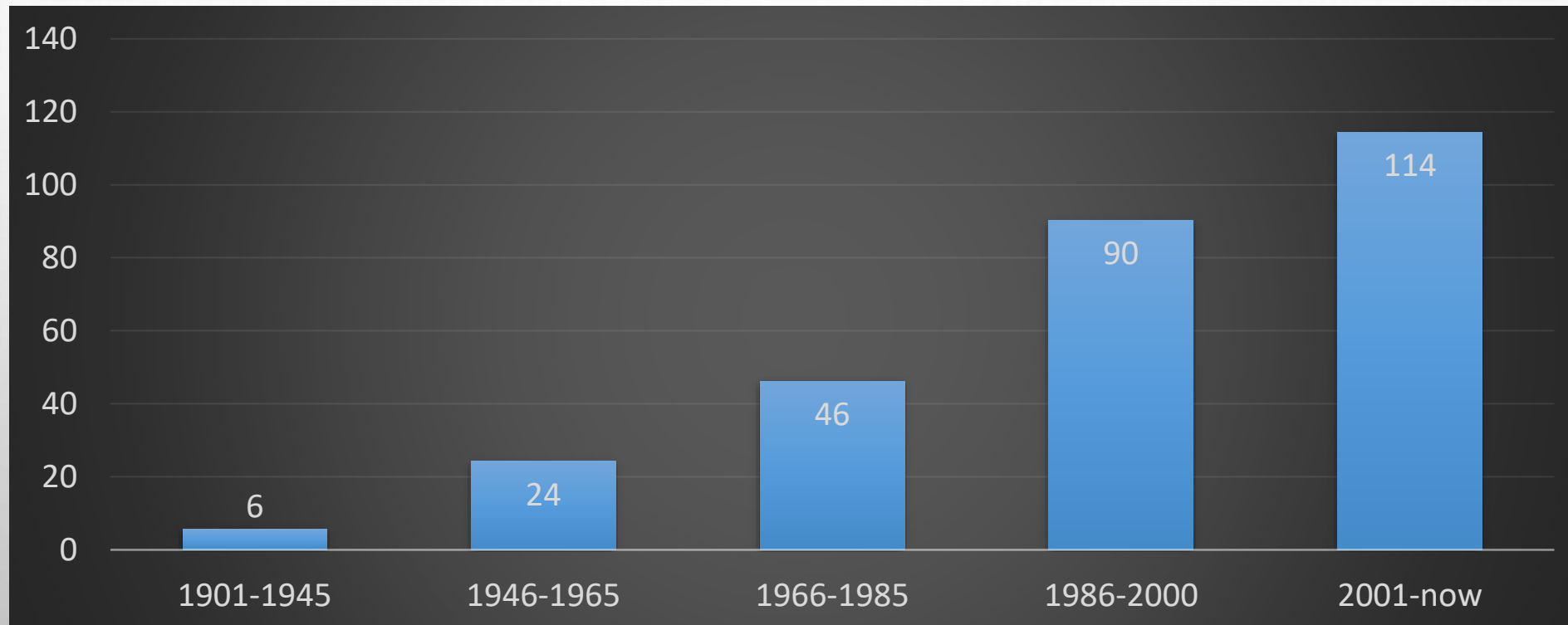
# A brief history...



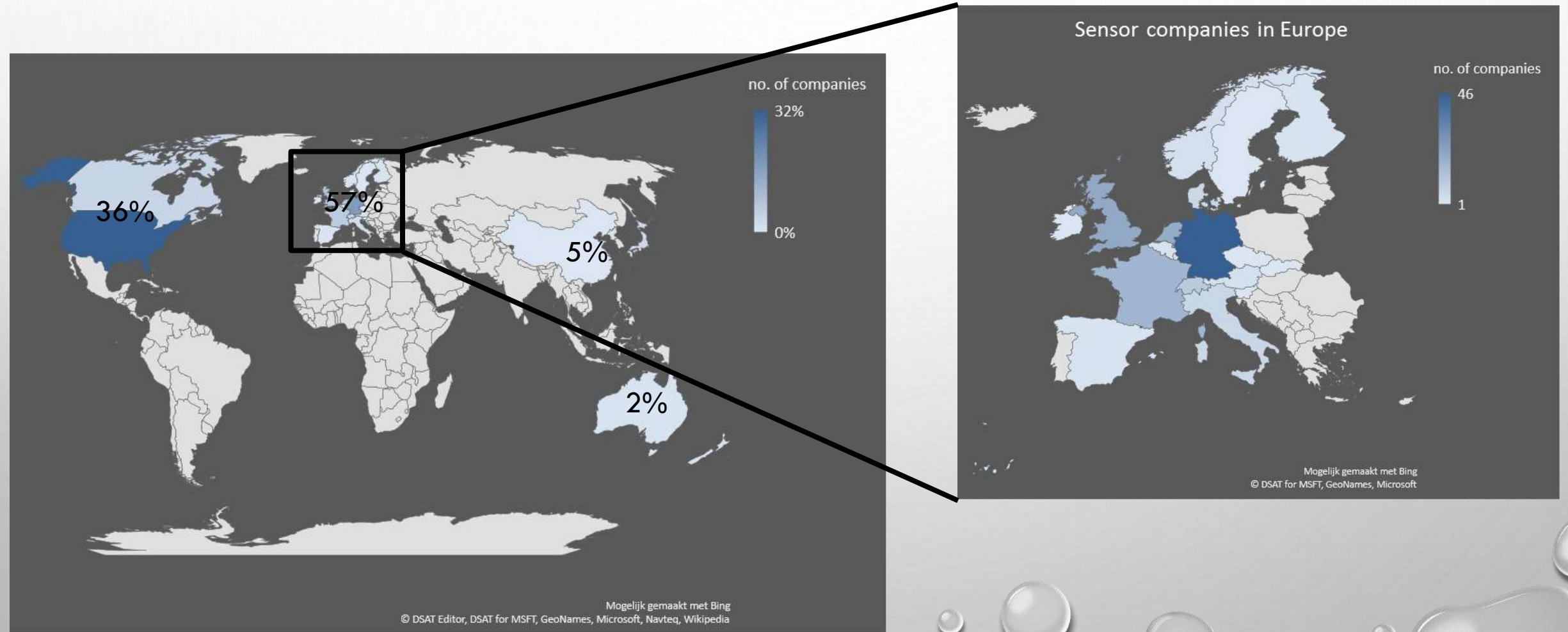
# More sensor manufacturers entering the market



# More sensor technologies entering the market each year

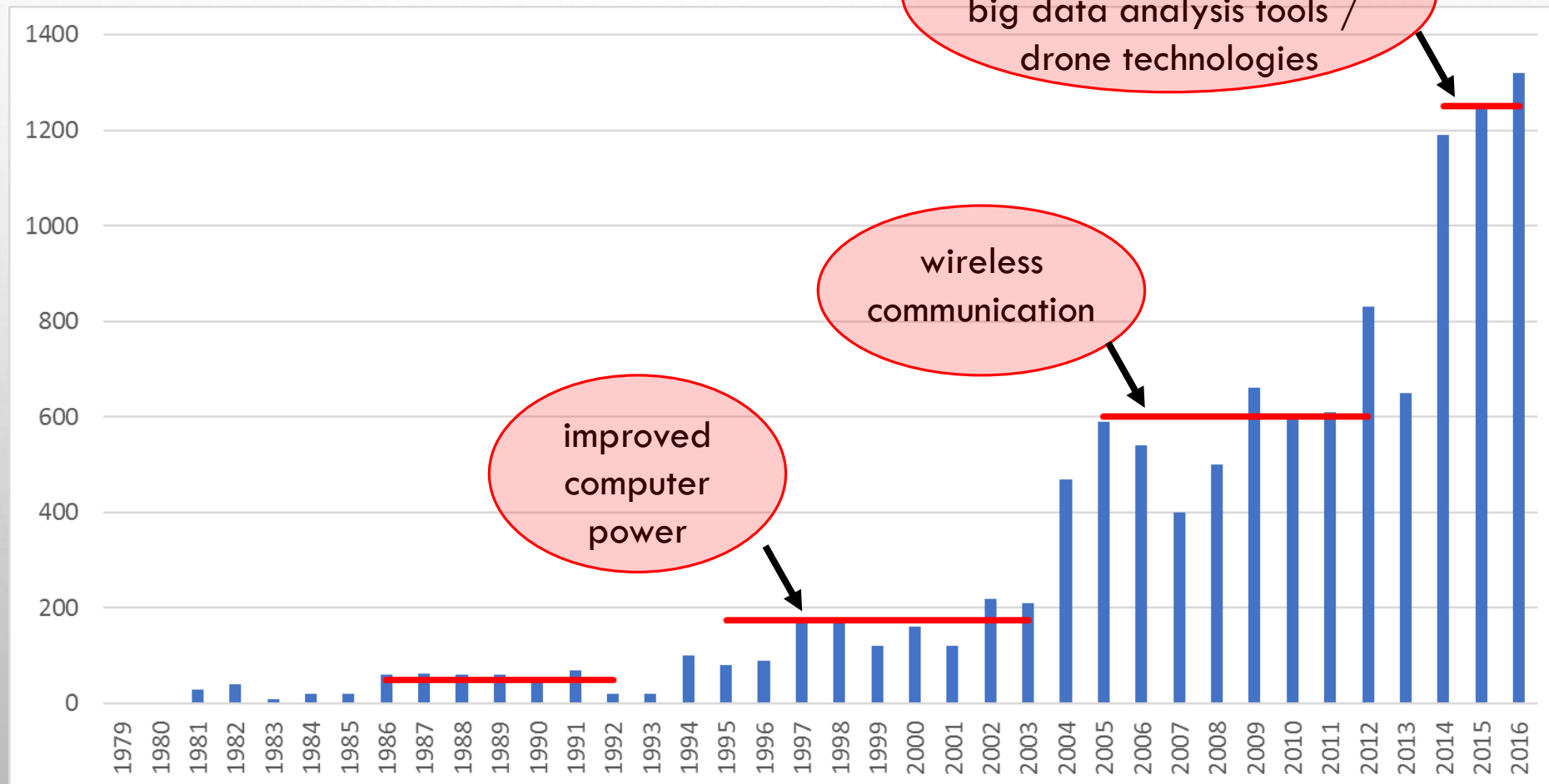


# Geographical spread of sensor manufacturers



# Why now? External developments boost sensor applications

Number of patents for optical sensors



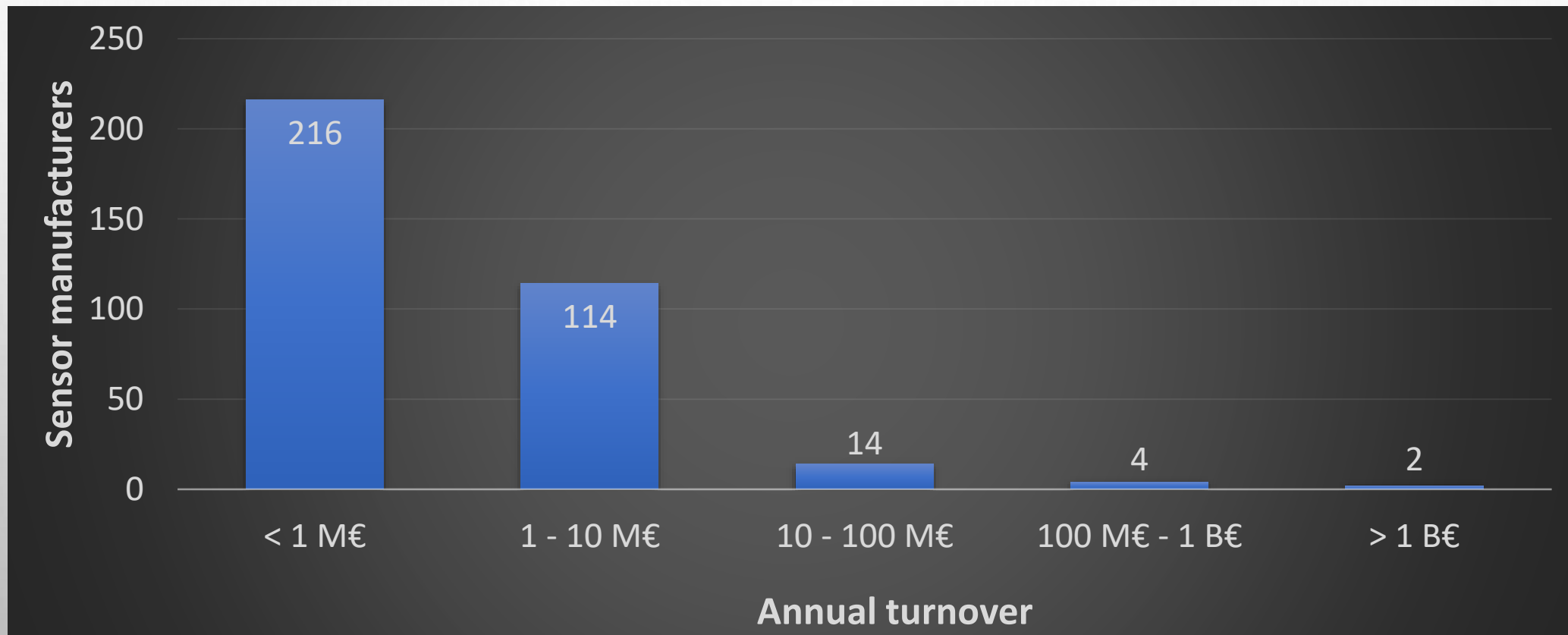
# Barriers/challenges for the use of sensors

- Operators lack time to investigate thoroughly
- “We are doing really well already” or “am I being replaced by technology?”
- Many technologies unknown to utilities
  - What is on the market?
  - How do these technologies perform?
  - Small suppliers: continuity?





# Mostly small companies, a few large ones





# Current trends and developments

- Technology:
  - New detection methods: Phosphate
  - New parameters: Online bacterial monitoring
  - Daas: Data as a Service
- Applications:
  - Drinking water: distribution network monitoring
  - Wastewater: footprint reduction
  - Surface water: mobile analysis points



# New detection methods: Ortho-P

- Conventional method: colorimetric analyser using
  - vanadomolybdophosphoric acid (yellow colour)
  - molybdenum blue
- New technologies in development:
  - Optical techniques:
    - (UV-)spectrometry
    - (chemi-)luminescence
    - fluorescence
  - Potentiometric ion-selective electrodes
  - Screen printed electrodes

# New parameters: Online bacterial monitoring

- Regulatory push:
  - Restrictions in chlorine use for disinfection (Europe)
  - Focus on E. coli and coliform bacteria
- Speed versus selectivity/sensitivity
- Technologies:
  - Enzyme assays
  - ATP assays
  - DNA/RNA assays
  - Immunoassays
  - Light scattering techniques
  - Flow cytometry / FISH
  - Raman spectroscopy
- Technology gap: Legionella





# Data as a Service

- Water laboratories:
  - Used to be in-house service of water utilities or agencies
  - Nowadays often independent organisations
  - Closely aligned to customers' processes
- Online monitoring:
  - Instrument ownership?
  - Data interpretation?
  - Align with actions

# Drinking water: distribution network monitoring

- 'Leakage' rates
  - UK: 30-40%
  - Ireland: up to 40%
  - Netherlands: ~ 5.4%
  - USA: Up to 50% is not unusual
- Quality issues
  - Generic parameters, indicators of change
  - Smart sensor networks



Flooding from a burst water main in Bristol. Photograph: Chapman/LNP/REX/Shutterstock





# Wastewater: footprint reduction



- Energy consumption per m<sup>3</sup> : x2 between 1990-2006 (Europe)

**Aim: reduce energy consumption of wastewater treatment plant**



**Advanced treatment to remove micropollutants**



# Example: WWTP Belgium - >20% energy savings

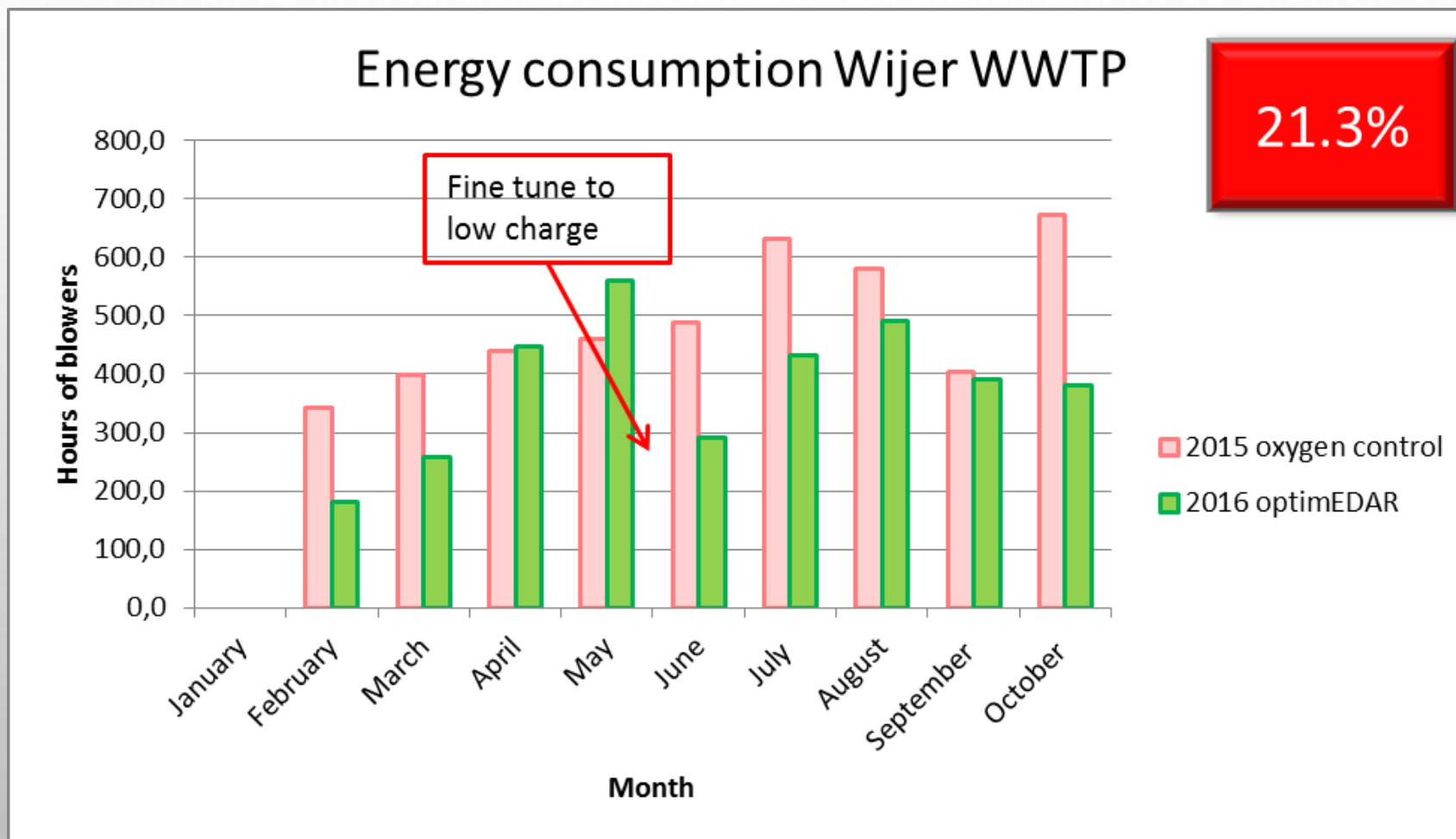


Image credit: Optimedar EU eco-innovation project





# Surface water: Mobile analysis points

- Cause-effect monitoring
- Spatio-temporal insight

Vito (BE)



Sampling drone (USA)



Indymo underwaterdrone (NL)



Sensor fish (USA)



Photo: [energyenvironment.pnnl.gov](http://energyenvironment.pnnl.gov)

The background features a light gray gradient with several realistic water droplets of various sizes scattered in the corners. The droplets have highlights and shadows, giving them a three-dimensional appearance.

[WWW.SENSILEAU.INFO](http://WWW.SENSILEAU.INFO)

CARPENTIER@SENSILEAU.INFO