Industrial View
Optical Gas Sensing in Switzerland

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Present Landscape

- **ECO PHYSICS**
  - NO$_x$ by chemiluminescence

- **ABB**
  - Industrial Analyzers from UV to IR

- **aXetris**
  - Laser Gas Detection (NH$_3$ / CH$_4$ / HF / ...)

**Past:**
- Aritron (integrated into MSA)
- Omnisens (changed product)
Example: LGD Sensors by Axetris

Initial target:

Low-cost gas sensors for Japanese households $\text{CH}_4 / \text{CO}_2 / \text{CO}$, no x-sensitivity to ethanol, $\$50$ at $500k$ p.a.

Approach:

- LGD is highly selective and sufficiently sensitive to CO
- Lasers (VCSEL, DFB) at $500k$ p.a. should be $< \€5$
Example: LGD Sensors by Axetris

Re-Adjusted Target: Ammonia Sensors for Safety

- Annual market around 30k
- Electrochemical sensors drift and die
- Better performance & longer lifetime should allow price premium
- Significant interest from 2 biggest gas sensor manufacturers
- Promising results from proof-of-concept
Example: LGD Sensors by Axetris

A Long Road from Feasibility to Product

1. **Proof-of-Concept**
2. **Detection limit 1 ppm NH₃ in the lab**
3. **Detection limit 1 ppm from -40°C to 60°C**
   - Optical interference noise >> measurement range
   - Laser packaging, optical components, thermal stabilization, calibration routines
4. **Detection limit 1 ppm from -40°C to 60°C for every sensor built**
Example: LGD Sensors by Axetris

A Long Road from Technology to Market

- There is no price premium for safety sensors
- Laser prices stay high as long as volumes are low
- Temperature stabilization excludes portable sensors
- No USP, no sale: turning towards process control
- Adding sampling technology / application-specific know-how
- Second source for key components
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Example: LGD Sensors by Axetris

A Long Road from Technology to Market
Example: LGD Sensors by Axetris

Typical Application: SCR Efficiency
Lessons Learned

- Optical sensors always carry a premium on price & power consumption
- The premium brings non-contact, stability, selectivity, speed
- Where the customer needs the added value?
- Safety sensors don’t sell – there is always a cheaper one around. Nobody cares about performance.
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Gas Sensor Pyramide

- Automotive / Cabin Air Quality
- Building / HVAC / Boiler Control
- Safety (Point)
- Safety (Perimeter)
- Lab
- CEM

Costs:
- €1
- €10
- €100
- €1’000
- €10’000
- €100’000

January 2015
Volume Opportunities for Optical Gas Sensor

- $\text{NO}_x$ on diesel engine exhaust (all markets)
  - Surface sensors don’t last and are $x$-sensitive
- $\text{O}_2$ in controlled atmosphere containers
  - 10 years lifetime, no drift
- Ethylene for commodities
  - No $x$-sensitivity to ethanol
- $\text{H}_2\text{S}$ in refineries, gas wells (point & perimeter)
  - Desert climate runs electrochemical sensors dry
- $\text{SO}_x/\text{CO}_2$ on marine diesel engines
  - Massive legal pressure
- Dissolved gas on power transformers
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Gas Sensor Pyramide

- Dissolved Gas
- O₂ Contr. Atm.
- NOₓ
- SOₓ/CO₂ Marine
- Ethylene
- Building / HVAC / Boiler Control
- Automotive / Cabin Air Quality
- Safety (Perimeter) H₂S (Perimeter)
- Safety (Point) H₂S (Point)
- Lab

Price Range:
- €100’000
- €10’000
- €1’000
- €100
- €10
- €1

January 2015
What Does it Take to Access Volume Opportunities?

- **Market Approach instead of Technology Approach**
  - USP is absolutely essential
  - The sensor needs to solve an existing problem
  - It must enable the customer to reduce costs, or to increase turnover
  - Customers care about value and price, not about technology
  - There is no such thing as « nice to have »

- **Limited Customization**
  - Gas sampling technology is another know-how than gas sensing
  - Customization is expensive and/or eats margins
What Does it Take to Access Volume Opportunities?

- **Low-Cost Light Sources (and Detectors)**
  - Light sources need to be supported by other markets (i.e. UV-LED’s for water desinfection)
  - «Fancy» light sources lead to chicken & egg situation → no chicken, and no egg
  - Second source for key components, stability of suppliers

- **Simple & Robust Calibration**
  - Significant cost factor
  - Single point or span & slope
  - Make sensors interchangeable
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Bottom Line

- Optical Gas Sensors in Switzerland is a small environment
- Large community of suppliers for key components
- OGS for volume applications not established yet
- Price is not an USP
- OGS need to provide significant added value
- There are volume applications potentially accessible for OGS