European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*
COST Action TD1105

INTERNATIONAL WG1-WG4 MEETING on

New Sensing Technologies and Modelling for Air-Pollution Monitoring
Institute for Environment and Development - IDAD
Aveiro, Portugal, 14 - 15 October 2014

Action Start date: 01/07/2012 - Action End date: 30/06/2016 - Year 3: 2014-15 (*Ongoing Action*)

INDOOR AIR QUALITY SENSING - AN INDUSTRY PERSPECTIVE

Oliver von Sicard

Erhard Magori, Roland Pohle, Aleksandar Duric

Function in the Action: Invited Expert

Siemens AG / Germany

SIEMENS

Covered Topics

- **The Building Industry**

- **Fire Detection using Gas Sensors**

- **Indoor Air Quality – VOCs vs. CO2**

- **Outdoor Enviromental Monitoring for HVAC**

- **New Ventilation Strategies**

- **Fire Detection vs. Outdoor Air Quality**

The building industry

… is …

Author: User:Dnalor 01; wikimedia commons; (CC-BY-SA 3.0)

Author: Bobak Ha'Eri; wikimedia commons; **(CC BY-SA 2.0)**

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The building industry

… is CONSERVATIVE!

- Colosseum (70–80 AD)

- Pyramids (starting from 2600 BC)

- Life time of Residential buildings in Germany: 80yrs

- Life time of Hospitals: 30yrs

- Many historic buildings still in use

Air Quality Sensors are new…

Author: User:Dnalor 01; wikimedia commons; (CC-BY-SA 3.0)

Author: Bobak Ha'Eri; wikimedia commons; (CC BY-SA 2.0)

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Ventilation is not new

- ## Natural ventilation

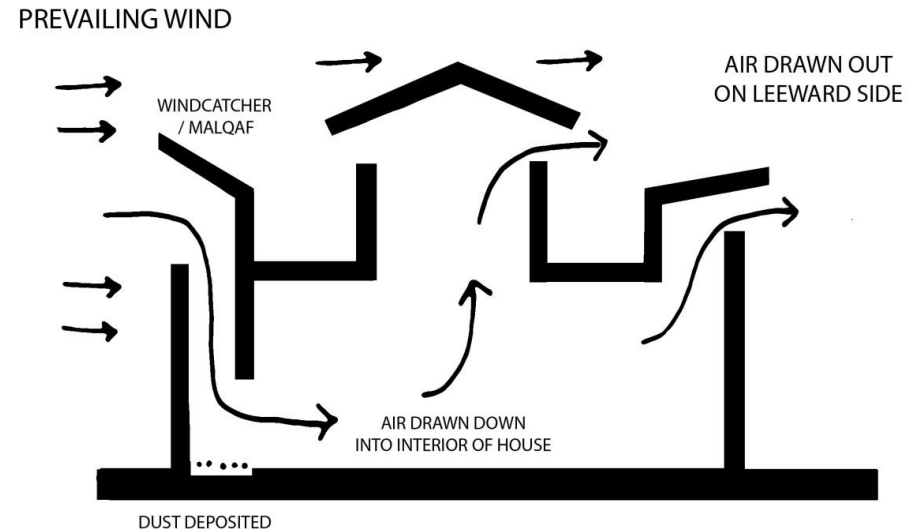 - Ventilation gaps (right photo)
  - Windcatchers (bottom pictures)

What drives industry?

PREVAILING WIND

WINDCATCHER / MALQAF

AIR DRAWN OUT ON LEEWARD SIDE

AIR DRAWN DOWN INTO INTERIOR OF HOUSE

DUST DEPOSITED

What drives industry?
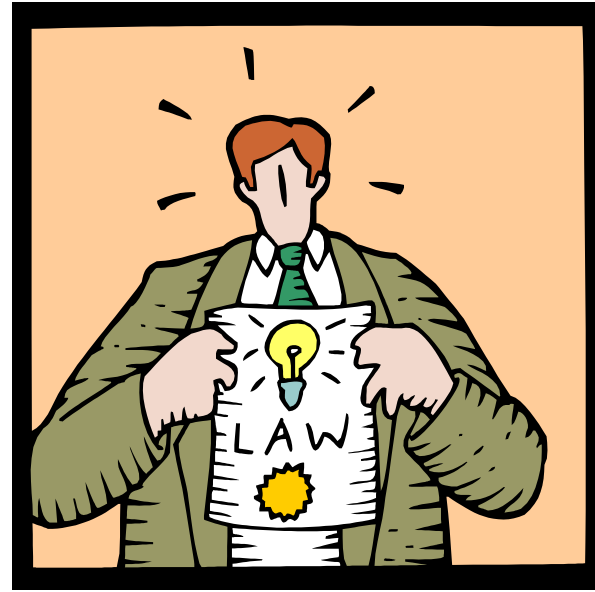
- Benefit for the customer
- Unique selling point / being better than the competition
- Save energy
- Save maintenance costs / total lifecycle costs
- Fulfill domestic & international laws

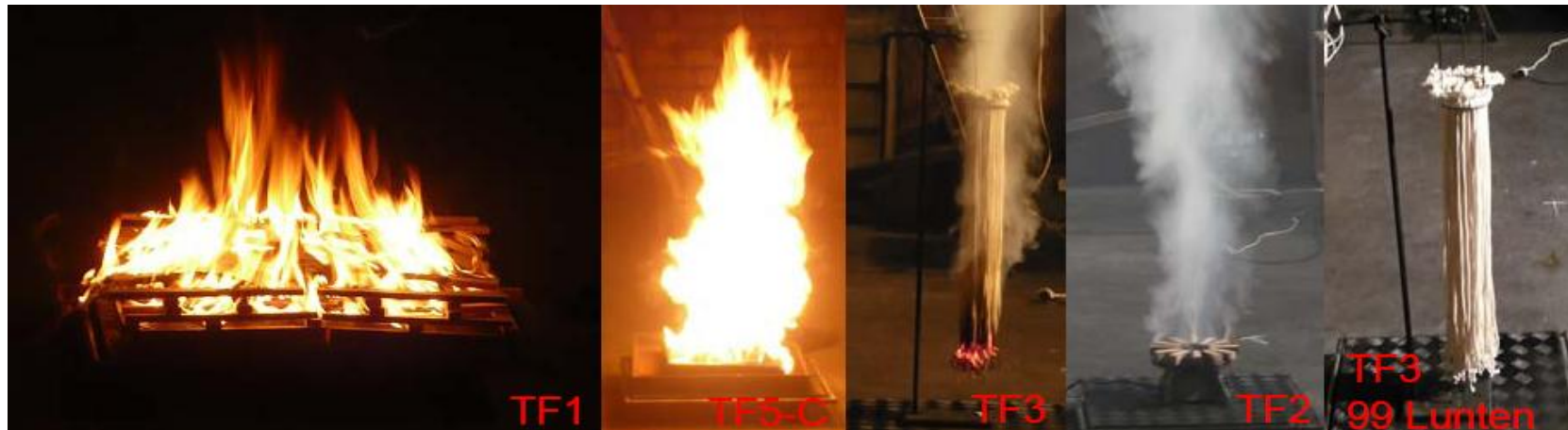**Industry is driven by money and regulations**
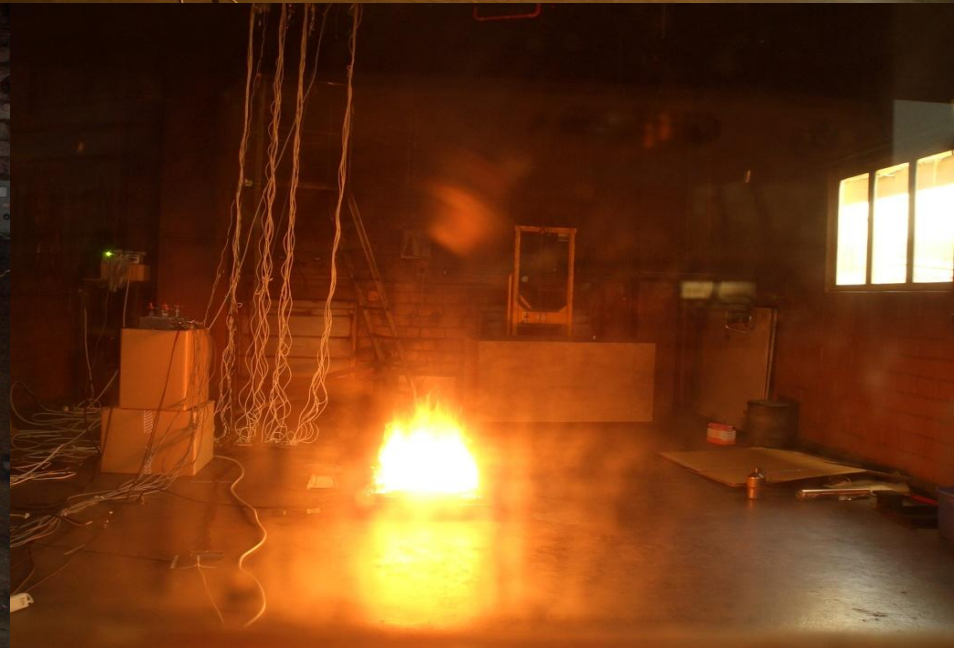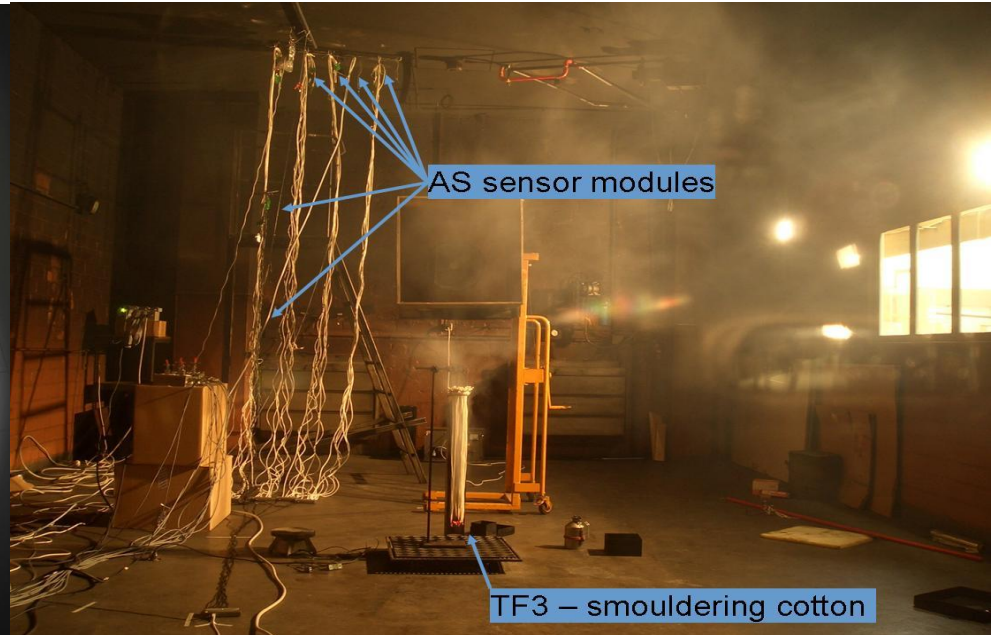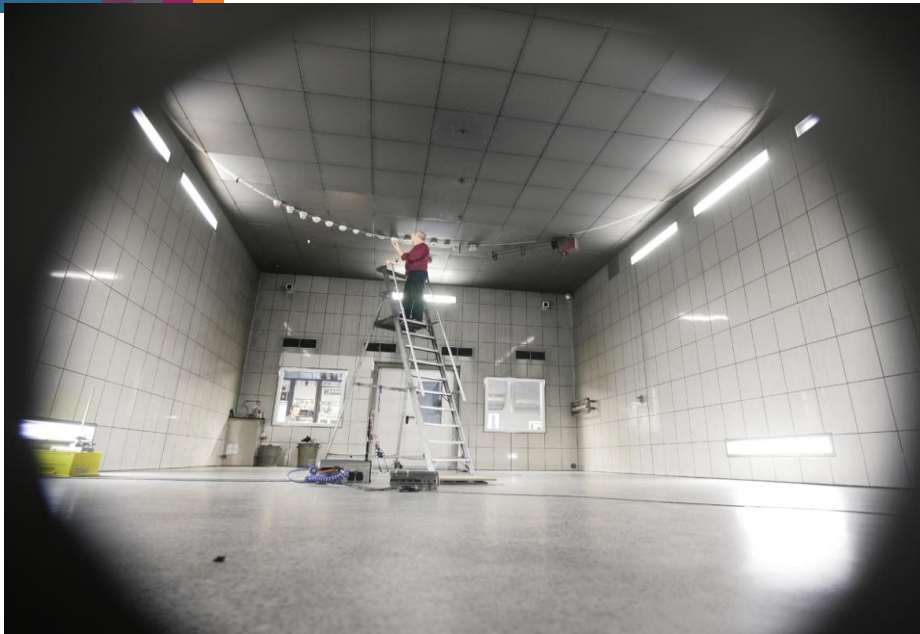
Regulations – fire detection

- UL217 (Single and Multiple Station Smoke Alarms)

- UL268 (Smoke Detectors for Fire Alarm Systems)

  - → Positive voting on both standards regarding inclusion of multi criteria detectors using CO

- EN 54-26 (use of CO only)

- EN 54-30 (Multi-sensor fire detectors combining CO + T)

- EN 54-31,(Multi-sensor fire detectors CO + T + smoke)

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

→**Setting up new standards for use of gas sensors in fire detection**

TF1   TF5-C   TF3   TF2   TF3 99 Lunten

Fire tests - impressions

AS sensor modules

TF3 – smouldering cotton

New ways in fire detection

Known guiding gases in fires: H, CO, NO2, CO2…

At the moment: CO-measurement in fire detectors (to adapt sensitivity of detector)
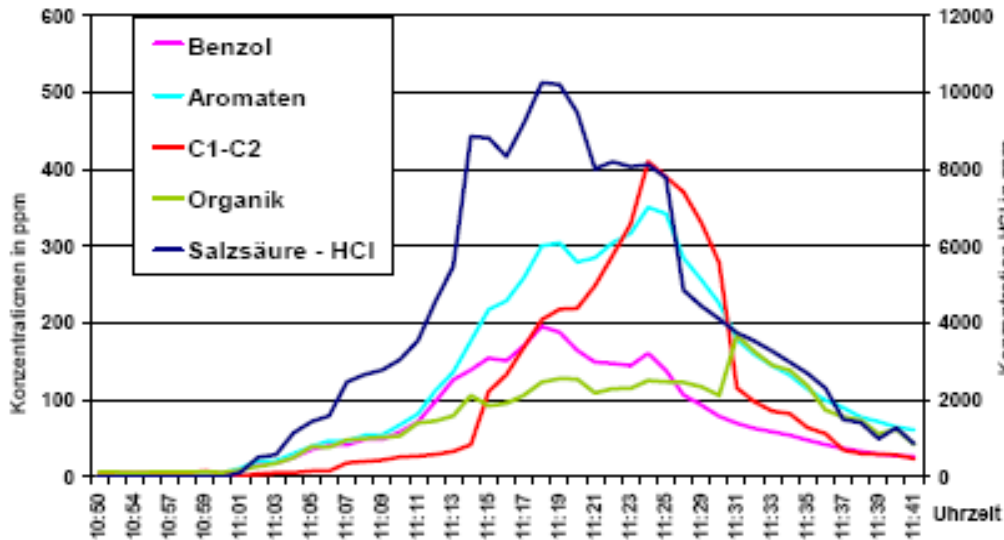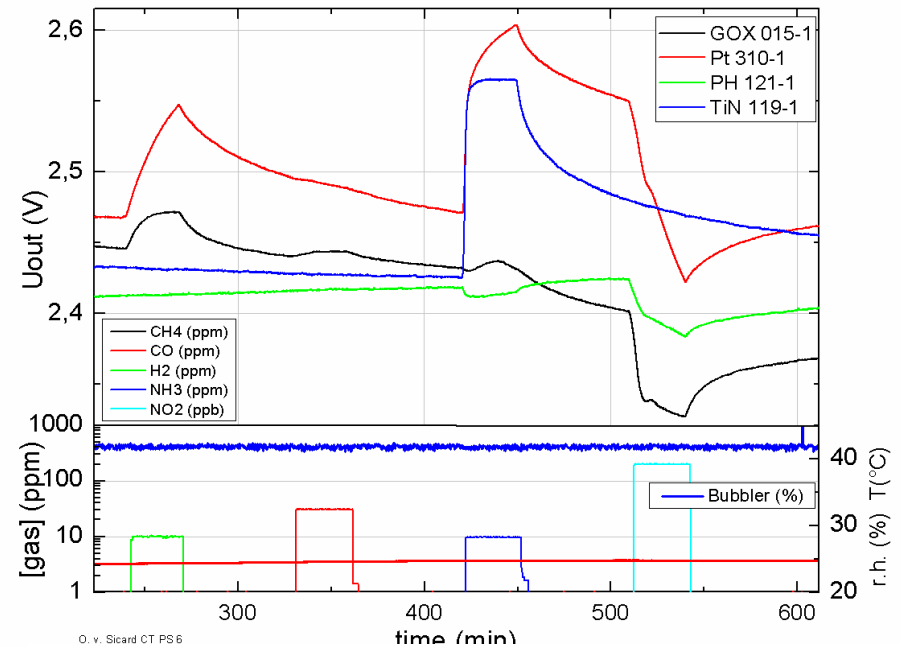
→ Safesense (EU funded)

Figure 5.1: Gases arising during a cable fire.
Quelle: *Messung des Giftgascocktails bei Bränden Dipl.-Ing. (FH) Peter Basmer (Forschungsstelle für Brandschutz, Universität Karlsruhe) Dr. Gerhard Zwick (Ansyco GmbH, Karlsruhe)*

Different sensing layers on Micronas GasFET

VOCs could provide a more robust very early fire detection

Use of sensor arrays necessary?

Lack of regulations - IAQ

- Only few guidelines for VOCs (ASHRAE handbooks)

- Only very few regulations (e.g. formaldehyde in Europe)
- Harmfull VOCs in low concentrations (ppb, ppt)
  - → unrealistic to detect with low-cost sensors

- VOC-sources often deliver constant background (mould, carpets, paint)
  - → difficult to detect with typical low-cost sensors (calibration?)
  - → High specificity required

→ VOC-sensors are used only as supporting input (e.g. LED indicator), but not for HVAC control (by Siemens)

CO2 – main control input

CO2 is used as an input for HVAC control

→ Stay below Pettenkofert limit (1000ppm CO2)

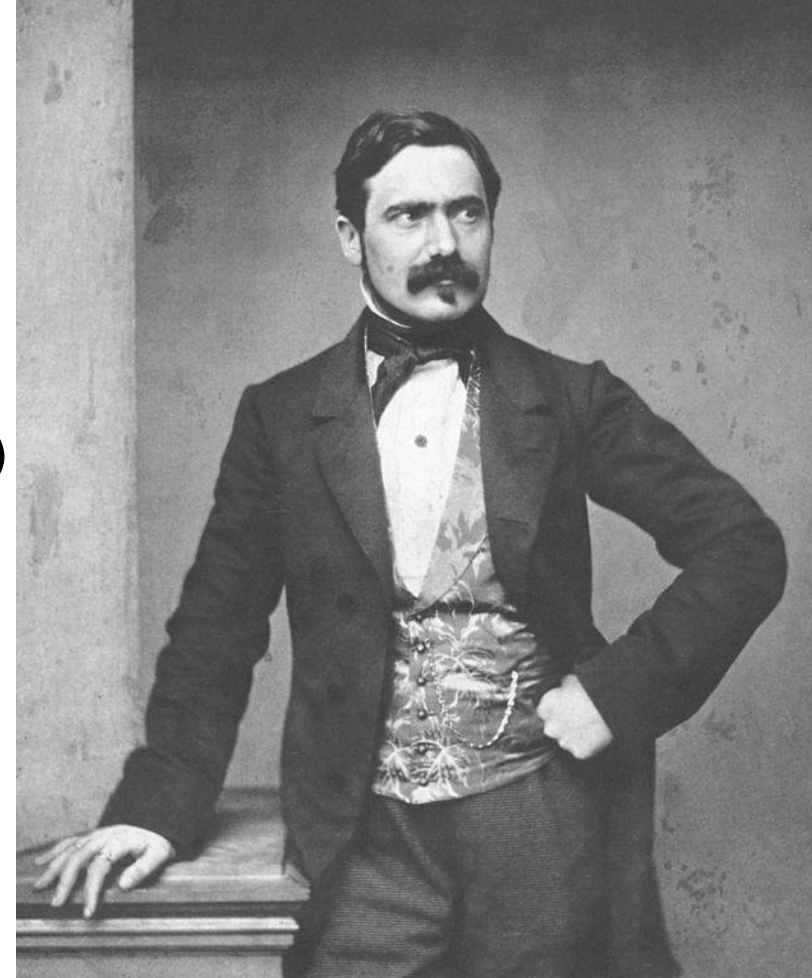„comfort application"

+ efficiency,

- tiredness

CO2 is measured using optical sensors (NDIR)

high price, high energy use, big size

→ application limited to duct-systems

- +-50ppm accuracy
- no calibration / recalibration necessary
- 10 years stability
- 15 years lifetime

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Energy Consumption of buildings

Energy used for Heating Ventilation Air Conditioning (HVAC) makes up 20% of total energy consumption in Europe

40% of European energy consumption used in buildings

50% of energy requirements relate to heating / cooling

60% of Europe's building stock is over 25 years old

Huge potential for energy savings if technologies are applied properly.

Source: Clear-Up

Outdoor Enviromental Monitoring (OEM)

A building is no sealed bubble
• Filters in HVAC systems can filter out particles, but not gas molecules
→ Maintanance costs for filters increase when filtering strongly polluted air

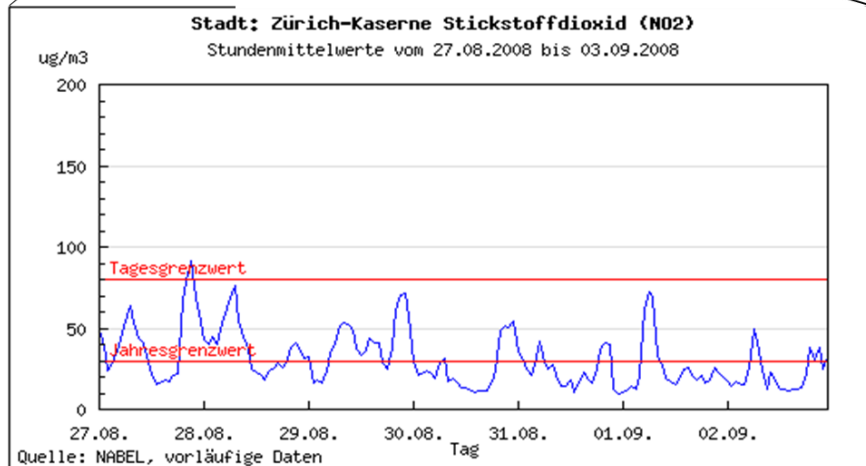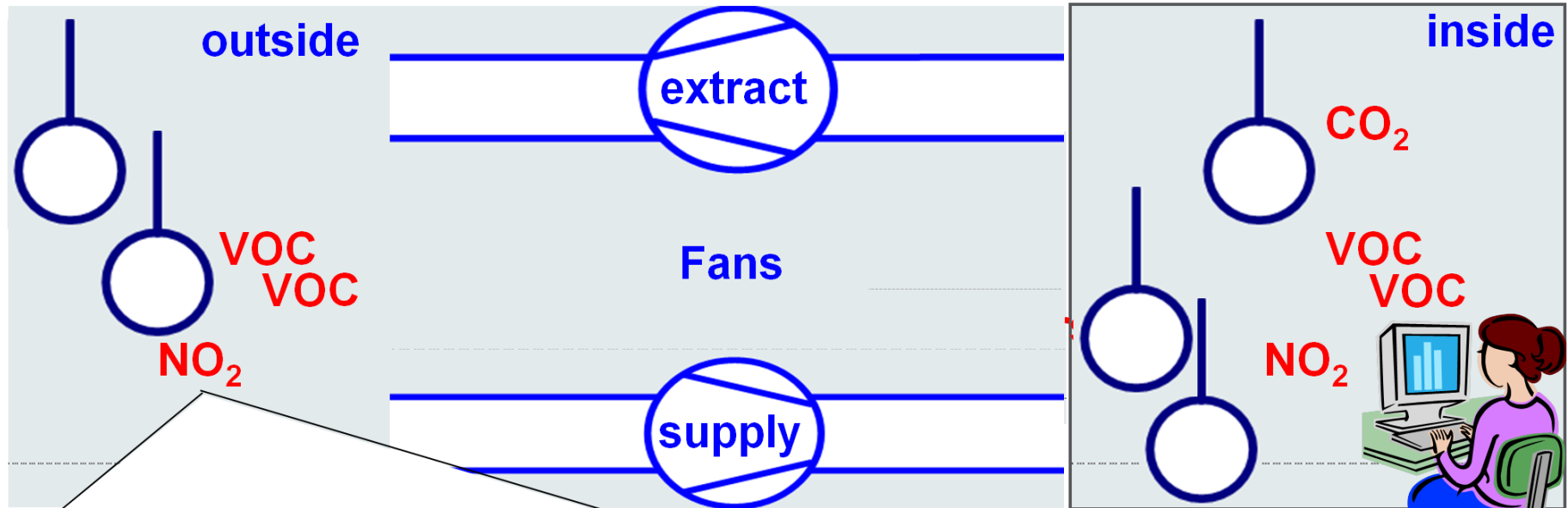When would you open the window?
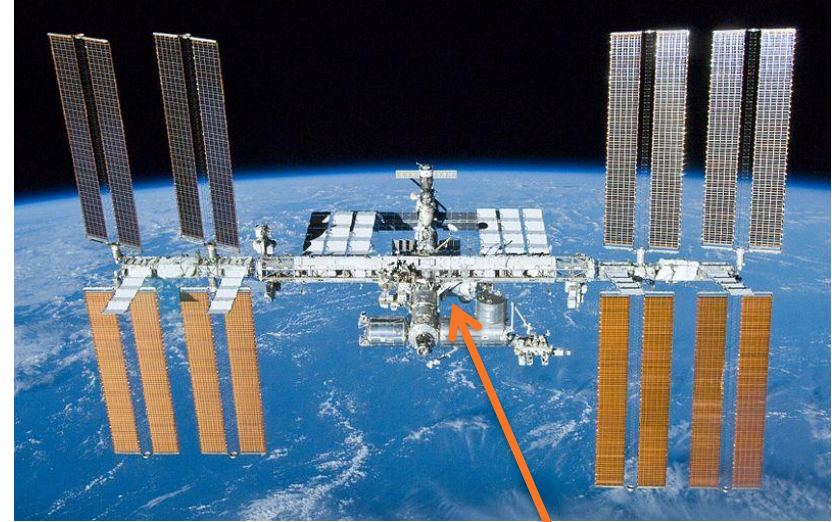
Source: Nasa

Non-standard building with non-standard ventilation

OEM for HVAC → makes a lot of sense

OEM for HVAC

outside

extract

inside

CO_2

VOC
VOC

NO_2

Fans

VOC
VOC

NO_2

supply

Stadt: Zürich-Kaserne Stickstoffdioxid (NO2)
Stundenmittelwerte vom 27.08.2008 bis 03.09.2008

ug/m3
200
150
100
Tagesgrenzwert
50
Jahresgrenzwert
0
27.08.   28.08.   29.08.   30.08.   31.08.   01.09.   02.09.
Tag
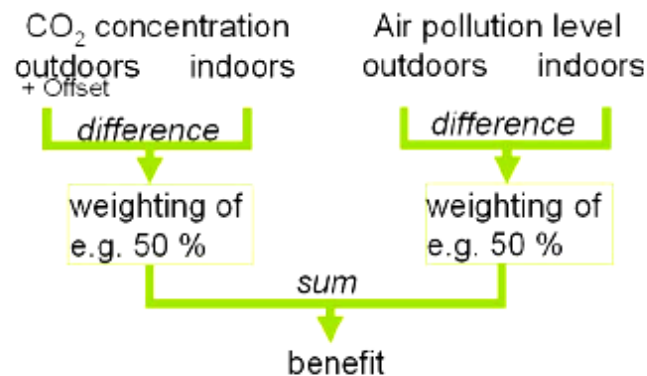Quelle: NABEL, vorläufige Daten

Simple Rules…

1) Check outside air quality
2) Switch on ventilation only when outside air is clean

… need reliable sensors

New Strategies for HVAC

Ventilation Control "Max Benefit"
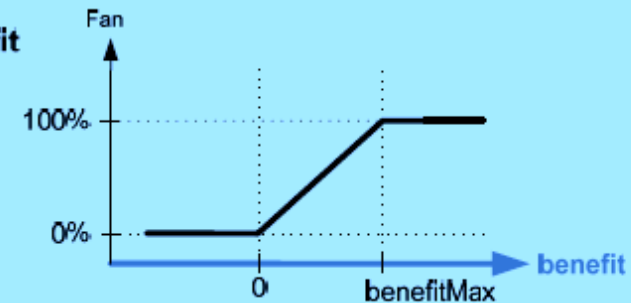
Source: ClearUp

Learning from Fire Safety Sensors

- **Data (signal) availability and reuse:**
  fire sensors → other systems
  HVAC, security, and other sensors
  →fire sensing
- **Connectivity**
- **Reliability and information validity**
  (Alarm suppression?, Control signals ?)
- **Sensor positioning**

  …
- **Standardization**
- **Standardization**
- **Standardization**

Management station

Fire | Intrusion | Access | Video | Time | Evacuation | Scanning

EXIT

Ventilation | Heating | AC | Light | Water | Power

Fire safety & Security

Energy & Comfort
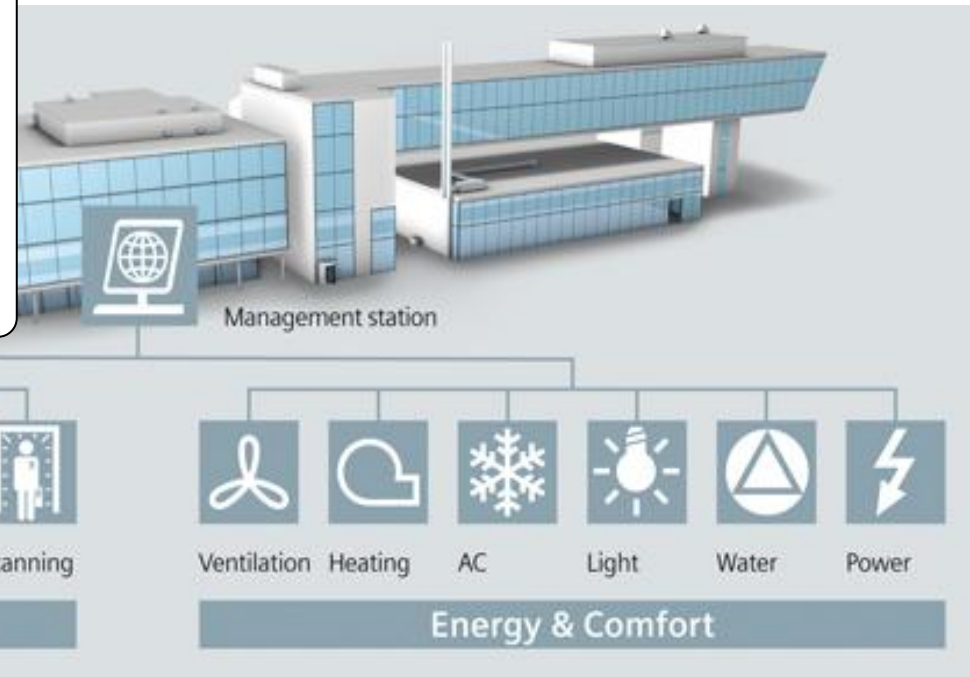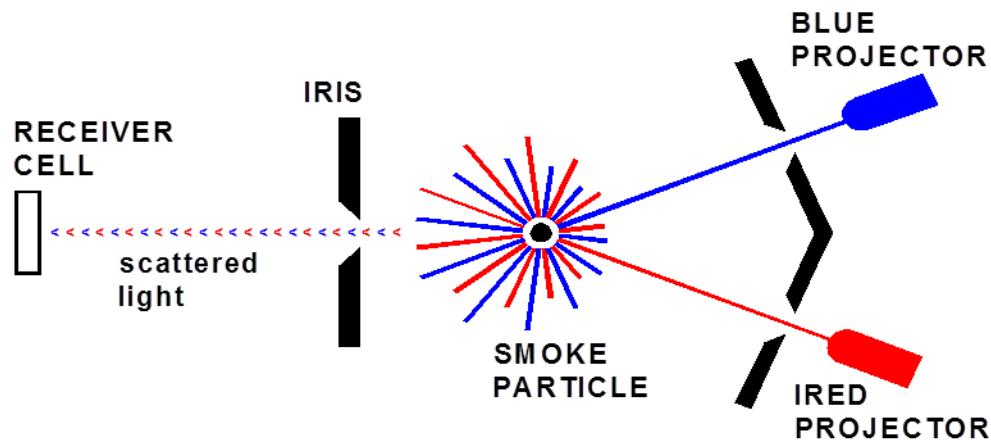
Aspirating Smoke Detectors

Aspirating smoke detectors (ASD) combine
- a highly sensitive detector (optical)
- a pump
- a tubing system that can cover large areas

Air/smoke particles are transported towards the detector through small holes in the tubes
→ Localization of particle source is possible by smart pump use
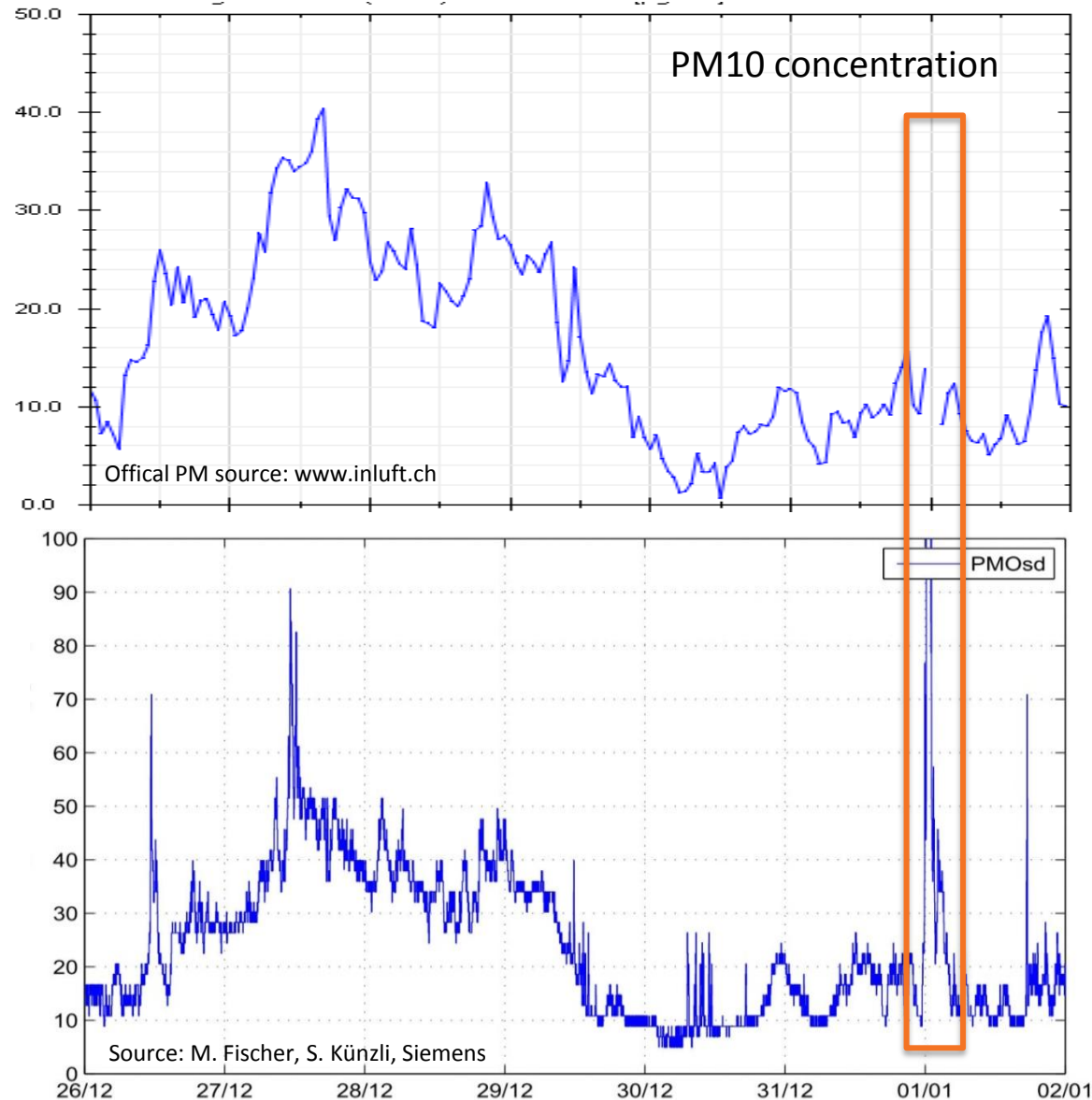There is a standard (EN 54-20)

Aspirating Smoke Detector with IR + blue light sources
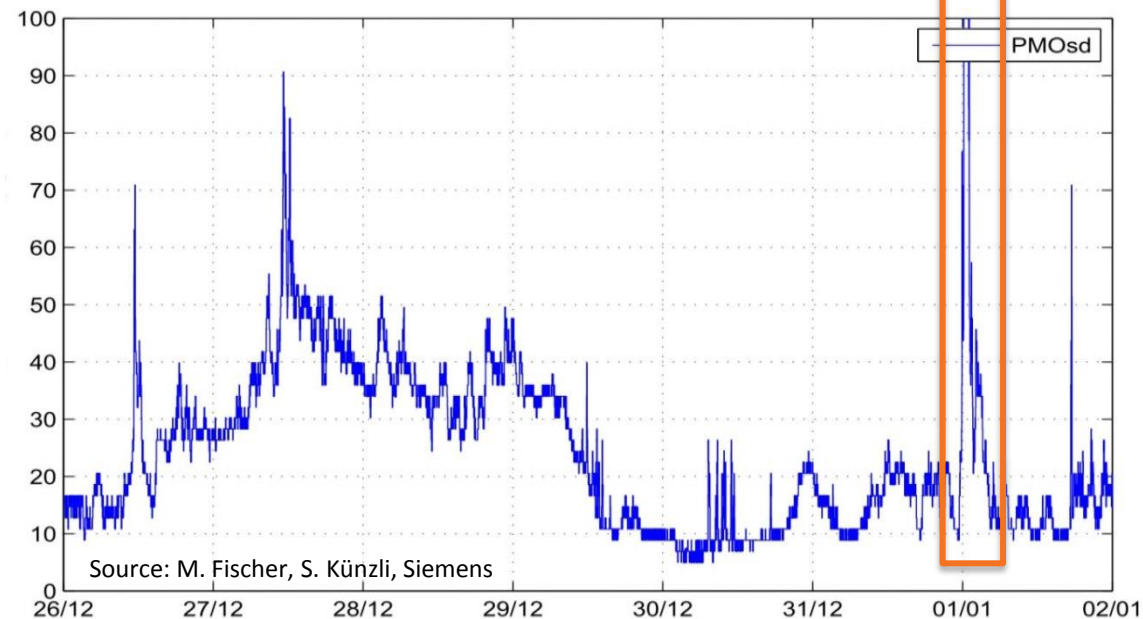

Siemens ASD

ASD vs. Official PM10 Measurements

• ASD correlates well with measurement from official sources (Amt für Umweltschutz, Switzerland)

• **special event on 01/01**
Missing values from official source and very high values from ASD

PM10 concentration

Offical PM source: www.inluft.ch

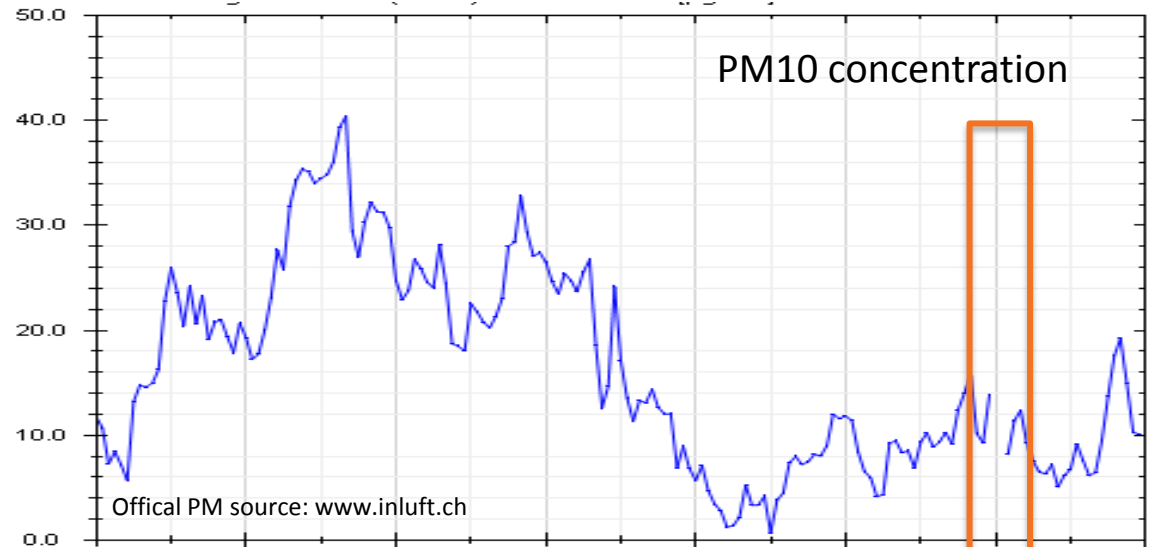Source: M. Fischer, S. Künzli, Siemens

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Offical PM source: www.inluft.ch

PMOsd

Source: M. Fischer, S. Künzli, Siemens

CONCLUSIONS

- Integration of sensors already takes place, both on:

  - Physical level (HW)
  - Information (signal) level

- Companies offering broad building automation portfolios predestined to be key drivers in the sensor integration in automated buildings, both in:

  - technology and
  - Standardization

Stricter regulations for limiting energy consumption of buildings are approaching!

→ **industry will be forced to use new technologies to reach that targets**
→ **sensors enabling energy savings will become more and more important**

Thank you for your attention!

Still time for questions?