

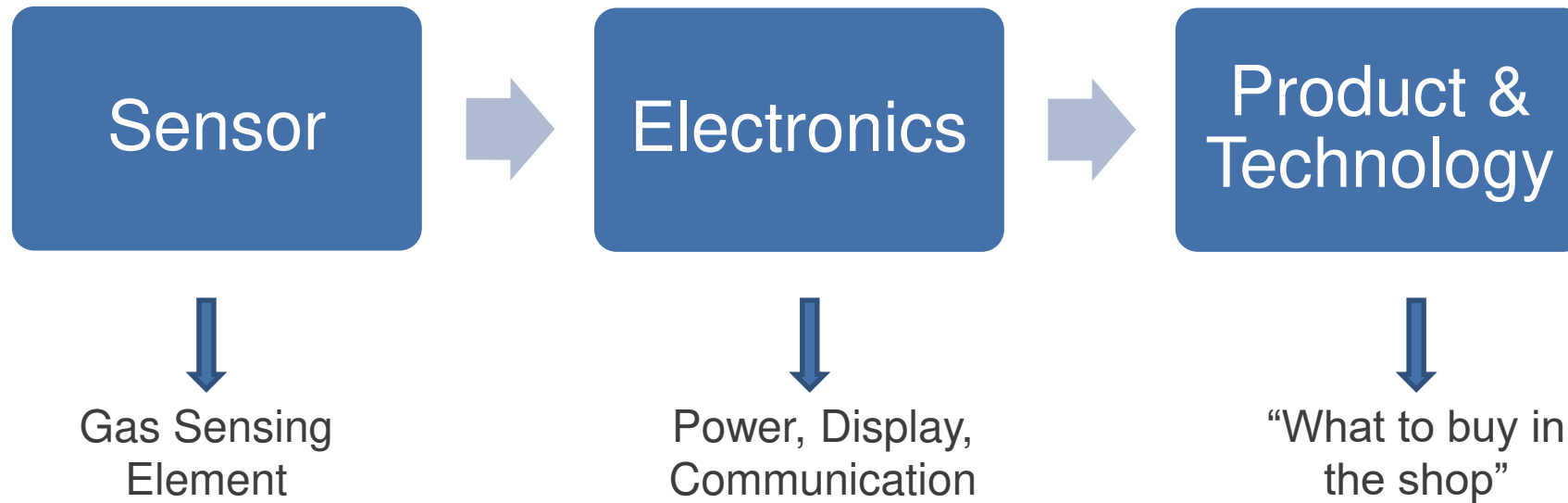
LUFTREINHALTER

VOM SENSORMODUL ZUM KLASSENZIMMERPRODUKT

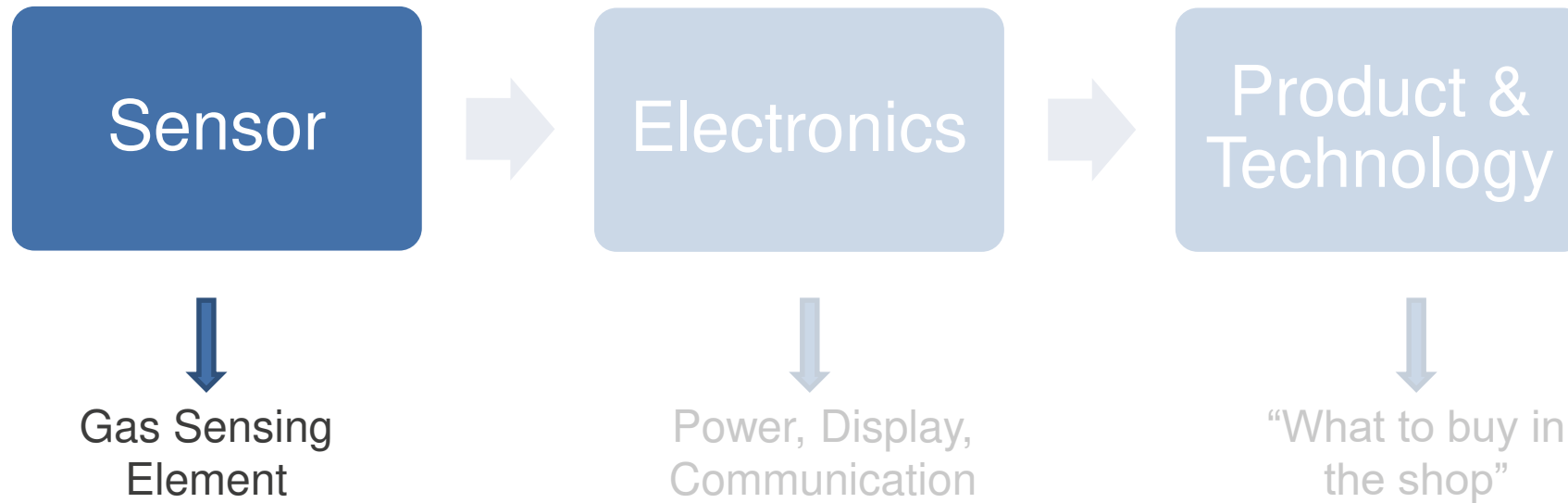
DR. CHRISTIAN MEYER

RENESAS ELECTRONICS GERMANY GMBH
DRESDEN, MAY 2022

AGENDA



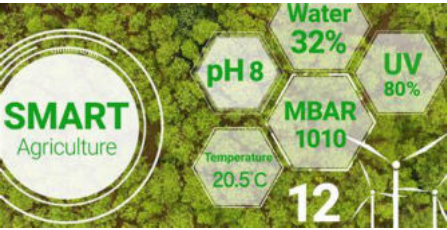
AGENDA



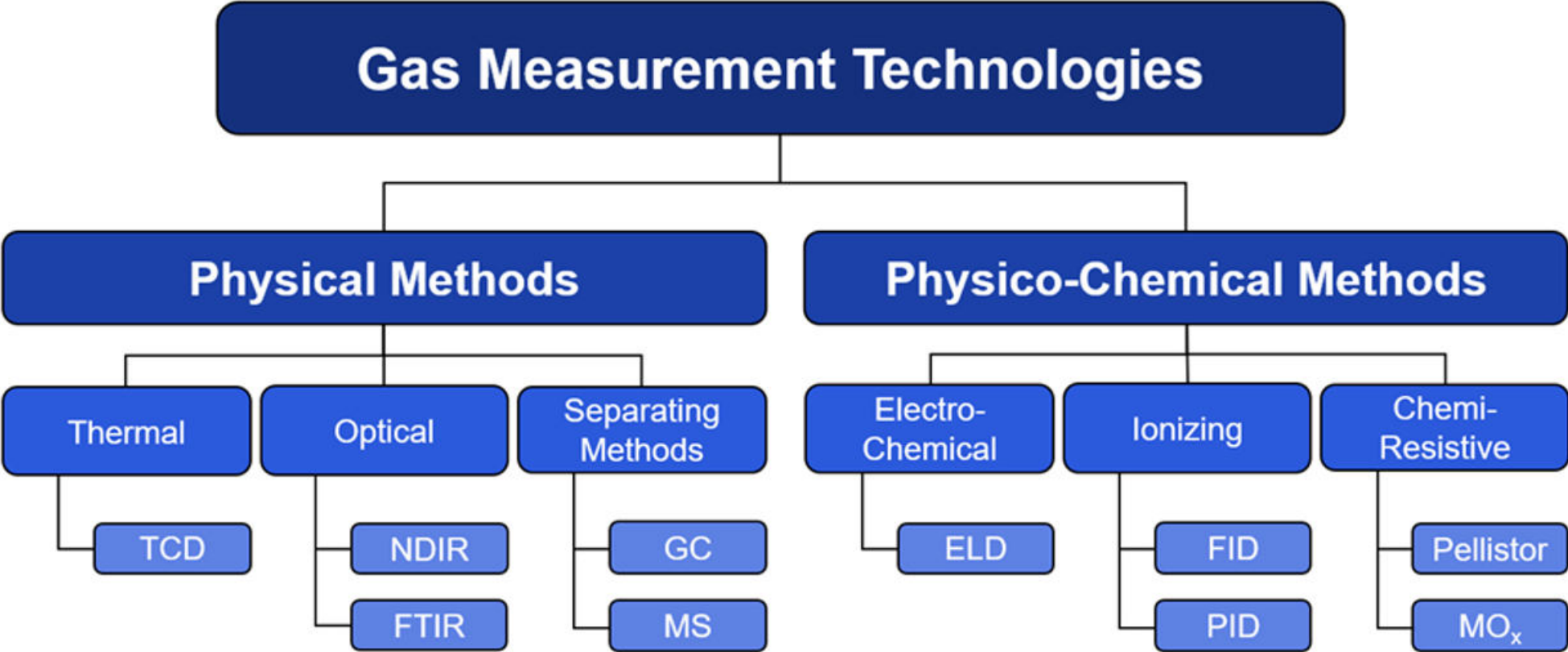
SENSOR APPLICATIONS



White Goods



SENSING PRINCIPLES



COMMON AIR QUALITY PARAMETERS

TVOC CO₂ RH & Temp Ozone / Nitrogen Dioxide

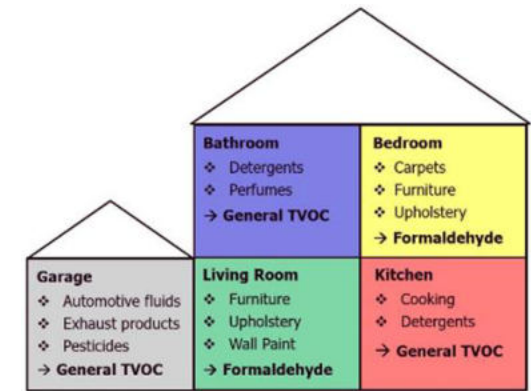
Indoor Air Quality

Outdoor Air Quality

| | | | |
|--------------------------|-----------------|------------|---------------|
| 0 – 1 mg/m ³ | 400 - 1000 PPM | 0% - 30% | 0 – 100 ppb |
| 1 – 3 mg/m ³ | 1000 – 2000 PPM | 30% - 60% | 100 – 200 ppb |
| 3 – 10 mg/m ³ | 2000 – 5000 PPM | 60% - 100% | 200 – 500 ppb |



CAUSES OF POOR INDOOR AIR QUALITY

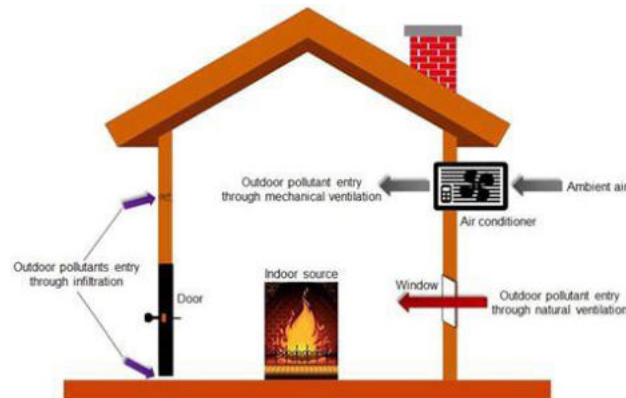


Gases generated Outdoors found Indoors

| Gases | Source |
|---------------------------------------------|-------------------------------------------------|
| NO₂ (Nitrogen Dioxide) | Vehicle emissions |
| | Factory emissions |
| | Home heating |
| | Power Plants |
| O₃ (Ozone) | NO _x + VOC + Heat & Sunlight = Ozone |

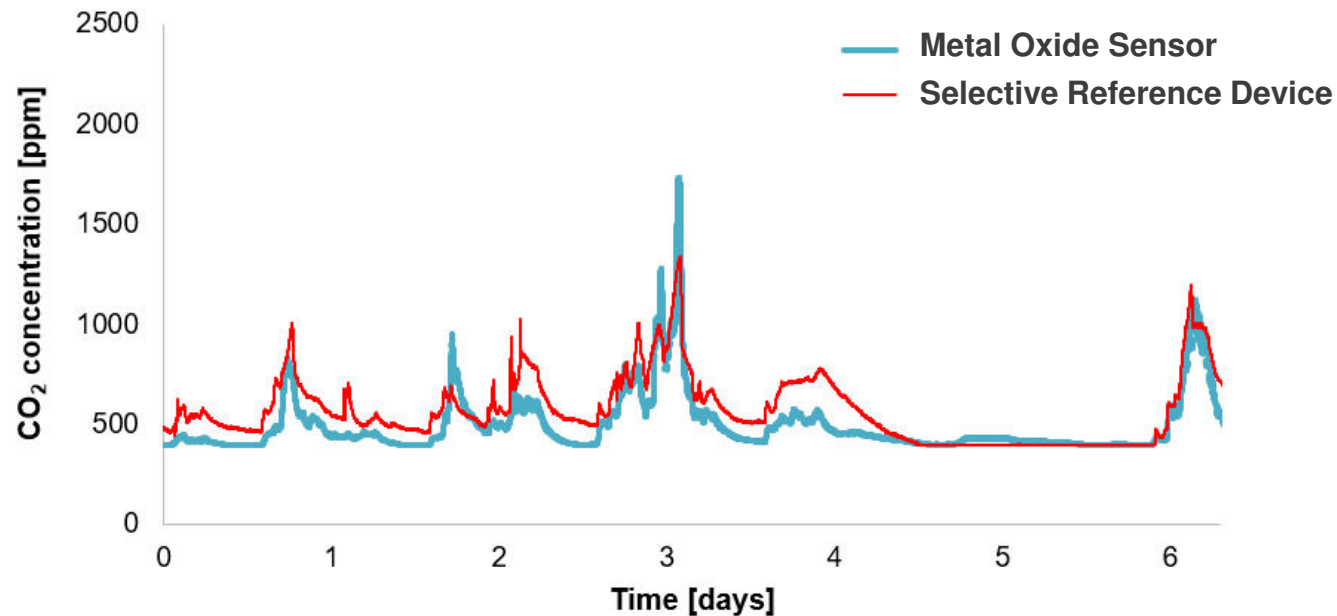
Gases found Indoors

| VOC Class | Examples | Source |
|--------------------|------------------------------------------------|---------------------------------------------------------------------------|
| Alkanes | n-Butane, n-Octane | Aerosol spray products, cosmetics |
| Alkenes | Isobutylene, Ethylene | Solvents, fruit ripening, pest control, rubber |
| Aromatics | BTEX, Naphthalene, Styrene | Tobacco smoke, moth balls, air fresheners, automotive exhaust products |
| Halocarbons | Methylene chloride, PERC, R125, R-410A | Dry cleaned clothes, refrigerant, dehumidifiers, urinal deodorizer block |
| Alcohols | Ethyl Alcohol, Isopropyl Alcohol | Cleaning agent, plasticizer, hair spray |
| Terpene | α-Pinene (pine odor), d-Limonene (citrus odor) | Cosmetics, citrus/orange oil, pine oil cleaners, fragrance additive, wood |
| Aldehyde | Formaldehyde, n-Hexanal | Disinfectants, upholstered furniture, carpets, plywood |
| Ketones | Acetone, Methyl Ethyl Ketone (MEK) | Nail polish remover, PVC cement and primer, various adhesives |
| Siloxane | Octamethylcyclotetrasiloxane (D4) | Cosmetics, soaps, defoamer, detergent, antiperspirants |



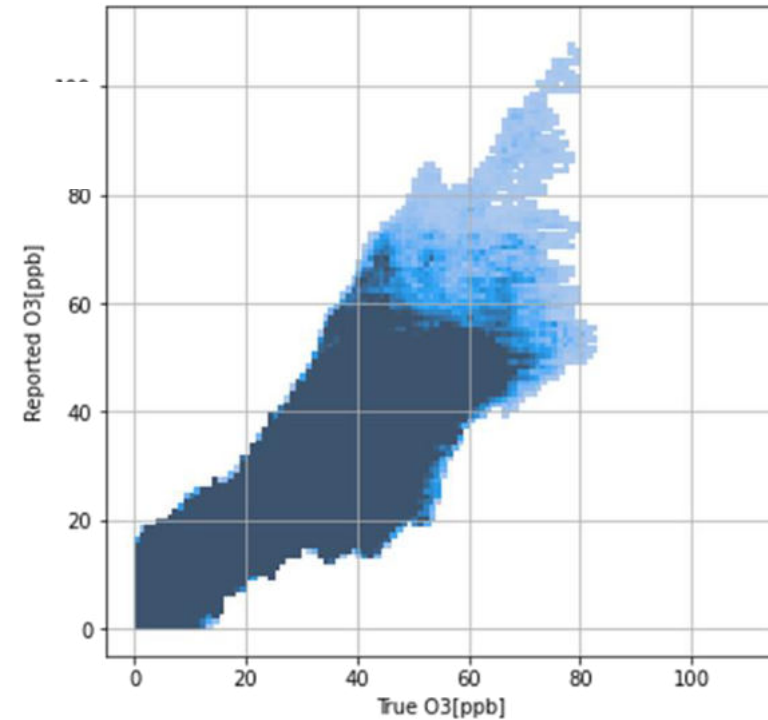
RELIABLE SENSOR PERFORMANCE

Indoor Air Quality



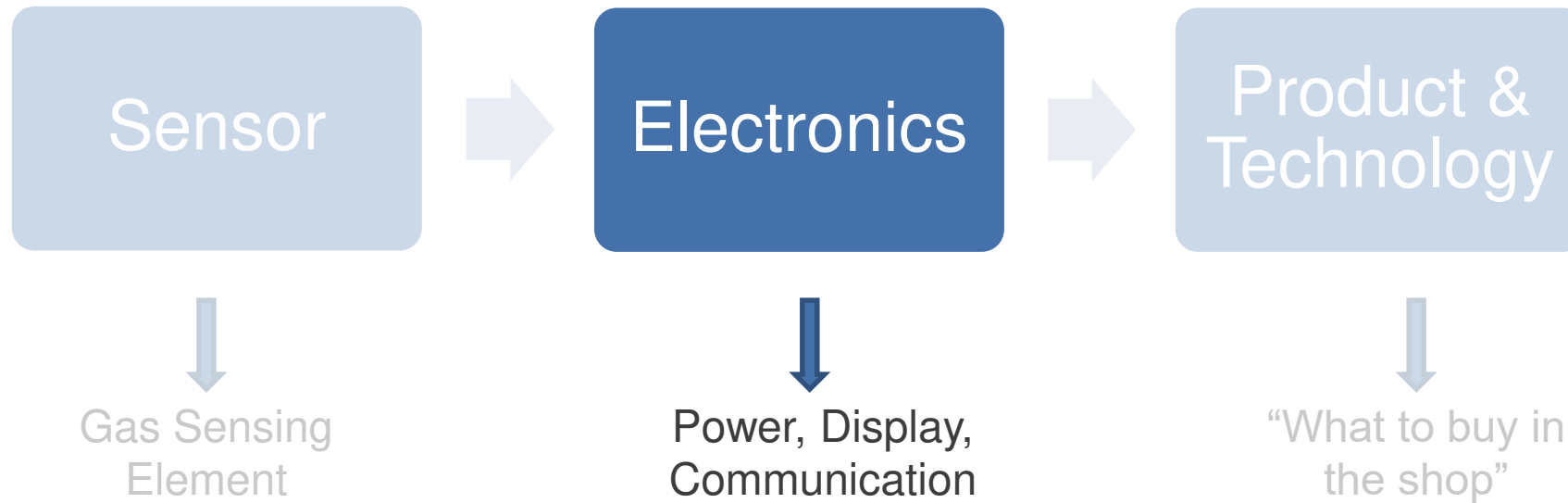
1 week of continuous data recording with 2 different sensors

Outdoor Air Quality



41.431.307 samples of 39 different gas sensor modules during 242 days in operation at measurement locations in Asia (Singapore), Europe (Germany) and America (USA)

AGENDA



ELECTRONIC PLATFORMS & COMMUNICATION

Plug-in Sensors

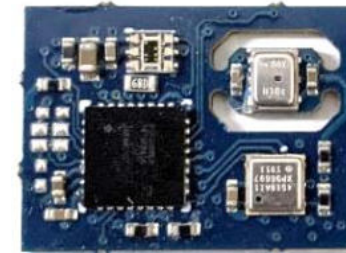
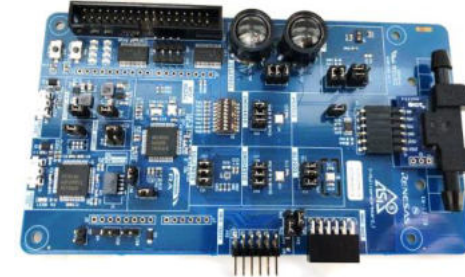
Connectivity Solutions

Integrated Easy-to-Use Software

humidity temperature

48.4
48.2
48.0
75.4
75.5

02:41 PM 09/22/2020 03:11 PM 09/22/2020



Supports third party device with PMOD interface



Air Quality Sensor Solution PoC

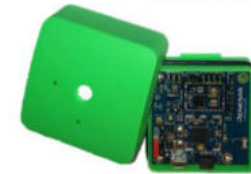
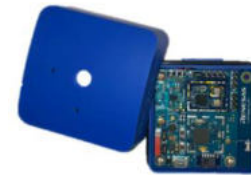
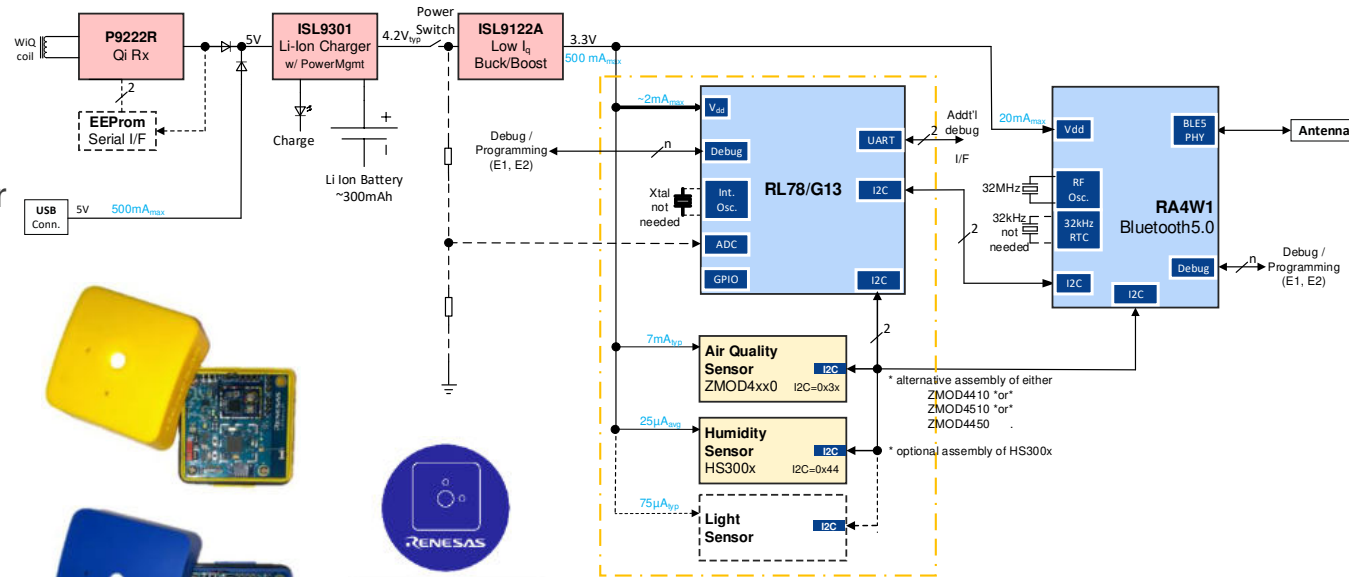
System Overview:

Air quality becomes more and more relevant. There are lots of applications around Home and Healthcare, but also professional building management. Recently a study found out that good indoor air quality can help reducing the risk of Covid19 infections and other diseases. Outdoors, air pollution is a relevant factor to be aware of, especially for sick people. In refrigerators sensors can pre-warn of rotten content (vegetables, milk, ...).

These three kits lets you evaluate all of them.

System Benefits;

- evaluate indoor, outdoor or refrigerator air quality / sensors right away
- easy-to-use App for iOS and Android Smartphones
- portable & water-proof
- single board / case with gas, humidity and temperature sensors
- dedicated MCU for AI-based powerful sensor data evaluation
- Bluetooth® 5 communication avoids cables
- integrated Li-Ion battery, ultra-low I_q DCDC and Qi-wireless charging
- colored case keeps water out by membrane & sealing
- **BLUE** → Indoor
- **GREEN** → Outdoor
- **YELLOW** → Refrigerator



| Device Category | P/N | Orderable P/N | Key Features |
|-----------------|----------|---------------|-----------------------------------------------------------------------------|
| MCU | RL78/G13 | R5F100BEAN | Low power MCU |
| | RA4W1 | R7FA4W1AD2CNG | BT5.0 MCU with ARM Cortex® M4 (4* Range, 2* Throughput) |
| Power | ISL9122A | ISL9122AIRN-Z | Ultra Low I_q Buck-/Boost Regulator |
| | P9222-R | P9222-RAZG18 | 5W Qi Wireless Charging Receiver |
| Analog | ISL9301 | ISL9301IRZ-T | Single cell Li-Ion Battery Charger w/ Power Management Path |
| | ZMOD4410 | ZMOD4410A11R | Indoor Air Quality Sensor (UBA, TVOC, eCO ₂) |
| | ZMOD4450 | ZMOD4450A11R | Alternative: Odor Sensor (e.g. refrigerator) |
| | ZMOD4510 | ZMOD4510 | Alternative: Outdoor Air Quality Sensor (NO ₂ , O ₃) |
| | HS3001 | HS3001 | Relative Humidity / Temperature Sensor |

USER INTERFACE

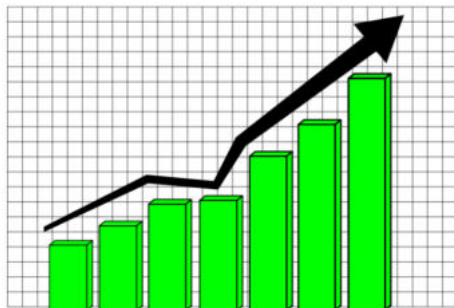
➤ Smiles



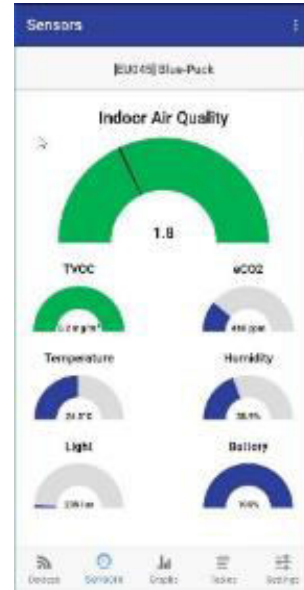
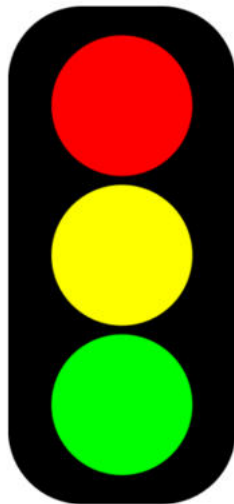
➤ Traffic Light



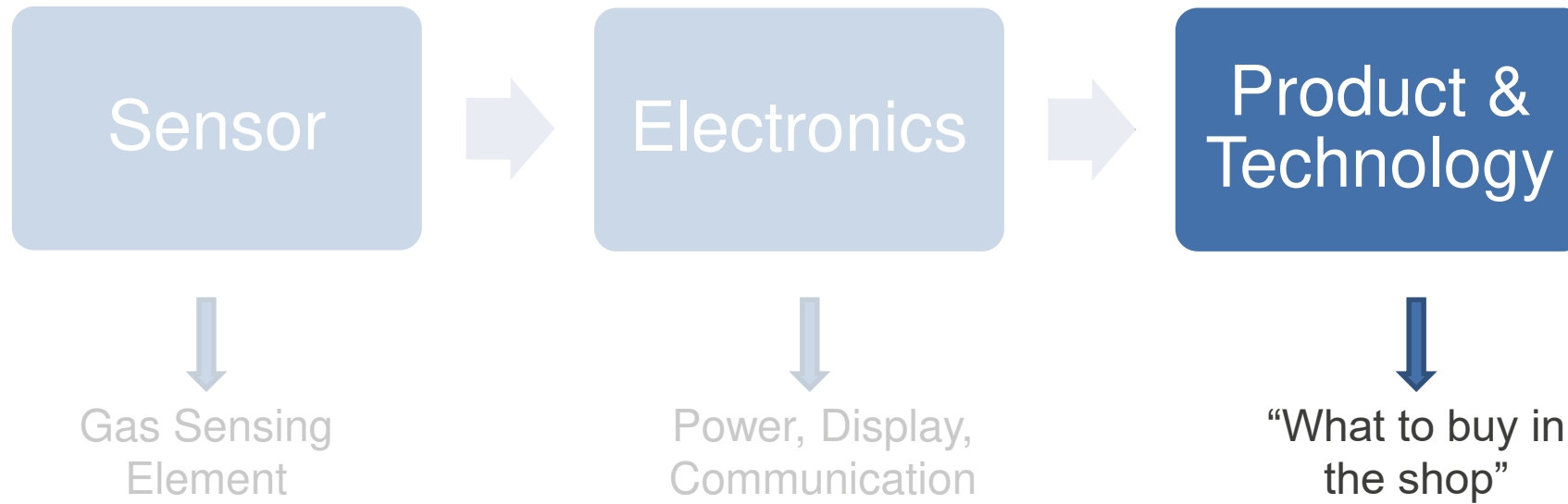
➤ Concentration Reading













➤ Bars



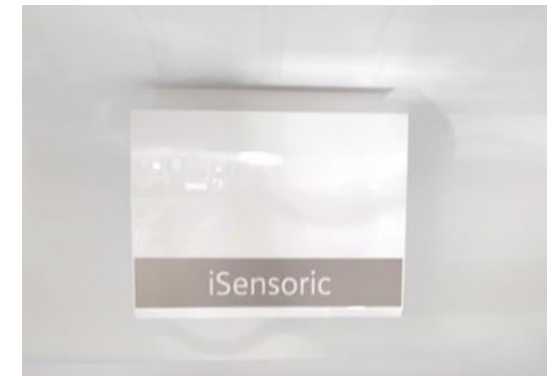
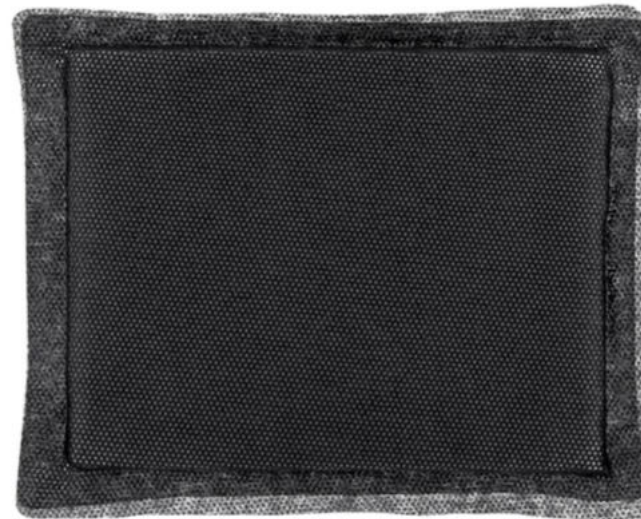
AGENDA



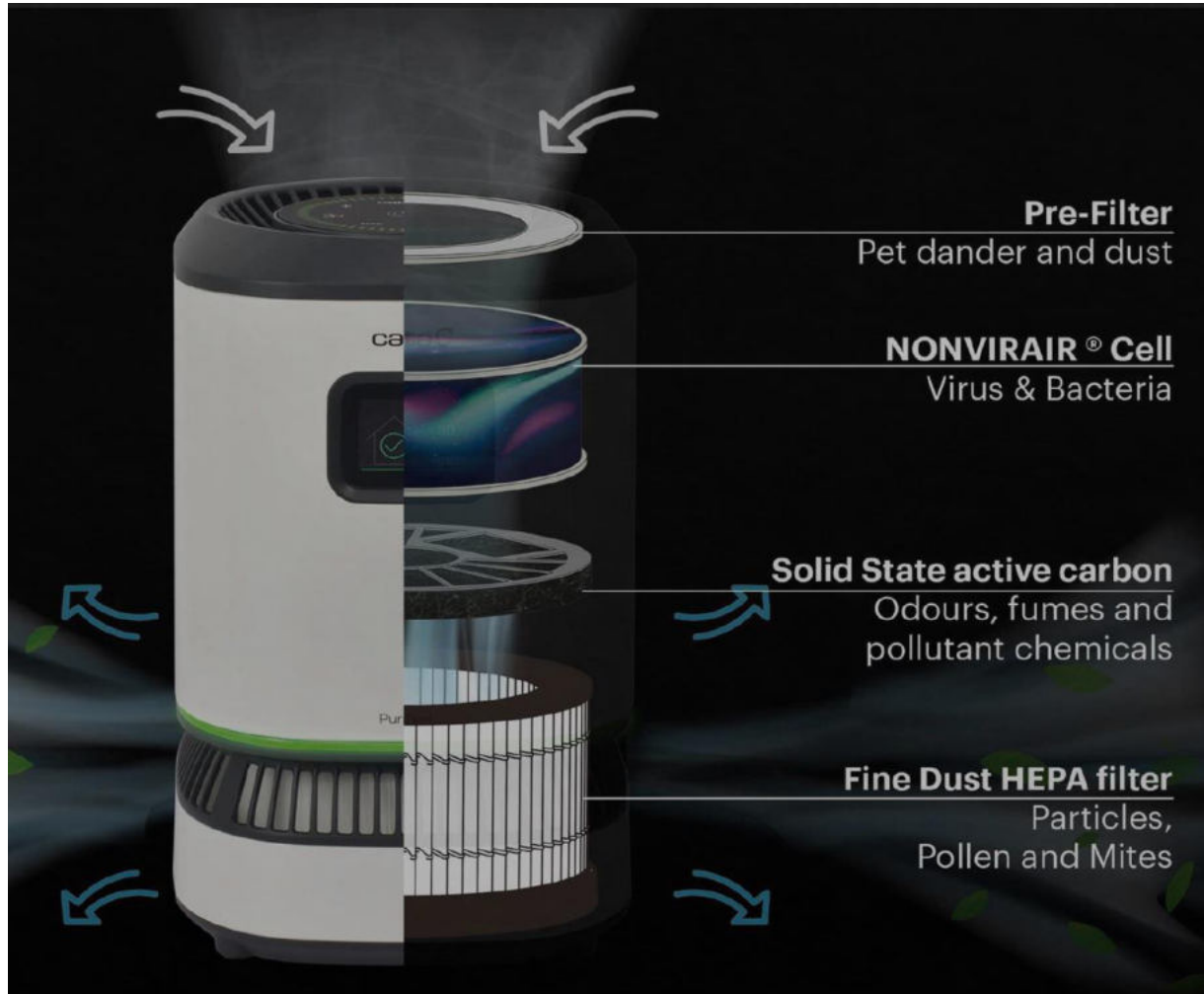
TECHNOLOGIES IN PURIFICATION

| Remediation Technology | Dust/Particles | Typical IAQ Gases |
|------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Active Coal |  |  |
| Filtration |  |  |
| Ionization/Plasma |  |  |
| Ozone |  |  |
| UV Light |  |  |

TECHNOLOGY IN REFRIGERATION



TECHNOLOGY IN AIR PURIFICATION



Breakdown of an air purifier by CATA/Edesa Germany using different filters and plasma technology.

Much lower ozone output found than on other air purifier devices but still measurable (low ppb).

SUMMARY

- Air quality gas sensors have become digital, cost effective, small and reliable for industrial and consumer applications.
- Ready-to-use electronic evaluation platforms are available with different communication options and cloud functions.
 - Barrier: No international standard for IAQ concentrations & display options
- Many new air quality monitor products (including air purifiers) are on the market within the last 2 years and use different technologies.
 - Barrier: Problem for many effective gas remediation technologies: Ozone

A combination of different technologies makes advanced air purification possible and safe

SHAPE THE FUTURE NOW

BIG IDEAS FOR EVERY SPACE

THANK YOU