

# MULTI GAS SENSOR

A REAL TIME TOOL TO MONITOR AND OPTIMIZE  
ONBOARD AIR QUALITY ?

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Public

# AGENDA

1 THE CONCEPT

2 THE REASON

3 THE PROJECT

4 THE CONNEXION WITH VIAQ “STAGE 4”

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## 1 THE CONCEPT

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# AQS

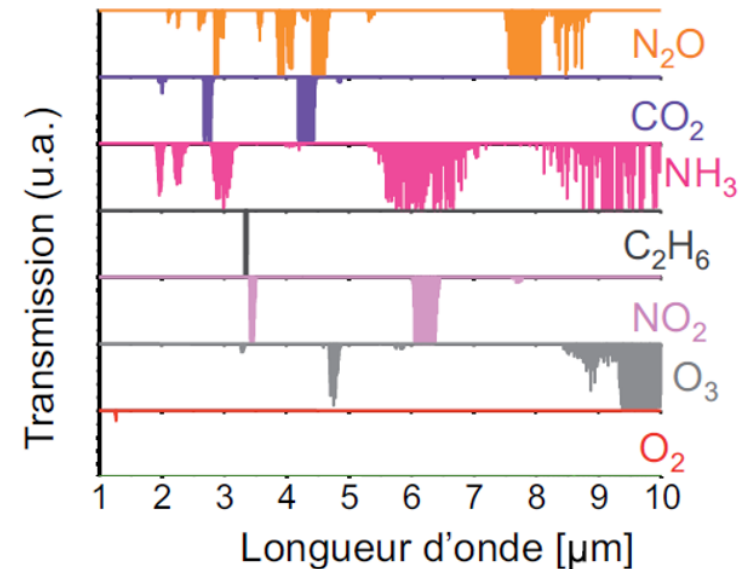
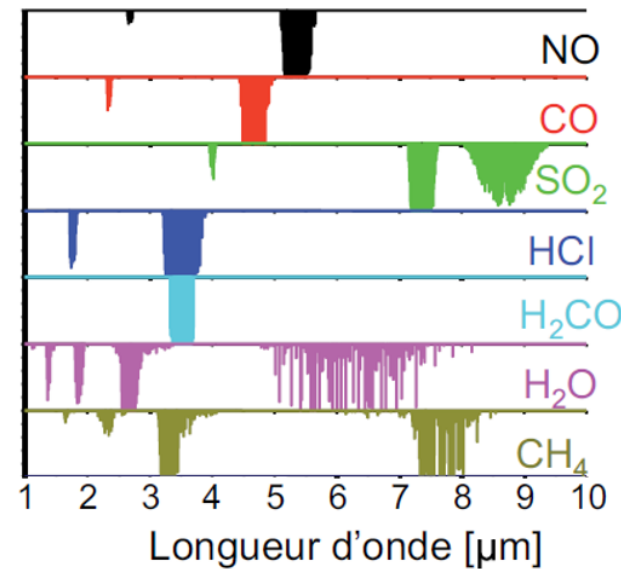
## THE CONCEPT

### Optical spectroscopy

- ✓ molecular absorption spectroscopy based on Beer Lamber law
- ✓ absorption bands specific to each target species

### Mid Infrared range (from 2.5um)

- ✓ relies on molecule “fundamental” vibration
- ✓ exhibits strongest absorption level: X10 to X100 vs NIR



- ✓ **Multi gas measurement capabilities**
- ✓ **Specific measurement**

# AQS

## TARGET SPECIFICATION (ANALYTICS)

LLD: Lower Limit of Detection

Gas	Range		Sensitivity (LLD)	Accuracy
CO (ppm)	2	500	2	+ -1
CO2 (ppm)	250	15000	250	+ -125
NO2 (ppb)	20	400	20	+ -10
NO (ppb)	20	800	20	+ -10
Formaldéhyde (ppb)	40	500	40	+ -20
O3 (ppb)	30	150	30	+ -15
H2O* (%)	0.1	5	0.1	TBD

\*: Absolute concentration

✓ Sensitivity values derived from Health WW recommendation related to long term exposure (1 year)

# AQS

## TARGET SPECIFICATION

Parameter	Number
Ambiant temperature	$-40^{\circ}\text{C} < T_{\text{amb}} < +85^{\circ}\text{C}$
Relative Humidity	$5\% < H_{\text{rel}} < 95\%$
Voltage	$9\text{V} < V < 16.5\text{V}$
Power	$< 1\text{W}$
Interface	LIN or CAN
Dimension	10cmX5cmX5cm
Response time	$< 1\text{s}$
Number of operating hours	10 000 H
Number of measurement	100 000
Lifespan	10 year

✓ Power and response time are correlated to measurement accuracy and sensitivity

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## REASON / MOTIVATION



✓ Visible Trend in awareness of cabin-air-quality



✓ No reliable device to monitor and compute an AQI „Air Quality Index“

✓ Reliability:

- ✓ Absolute
- ✓ Specific
- ✓ Sensitive

$$a_i = \left( \frac{\text{MAC}_{\text{CO}_{\text{amb}}} \times \text{MAC}_{\text{CO}_{\text{w.zone}}}}{\text{MAC}_{\text{i.amb}} \times \text{MAC}_{\text{i.w.zone}}} \right)^{\frac{1}{2}} = \sqrt{\frac{60}{(\text{MAC}_{\text{i.amb}} \times \text{MAC}_{\text{i.w.zone}})}}$$



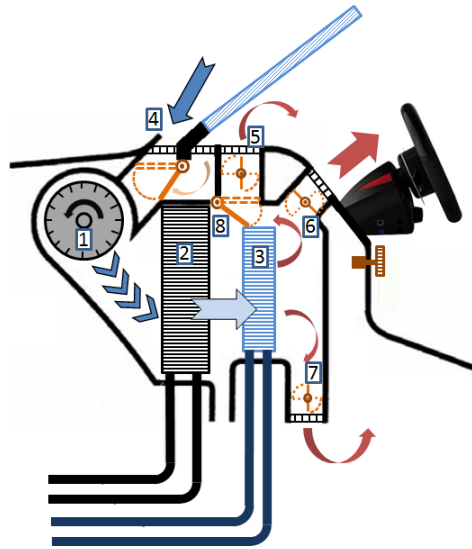
✓ Opportunity to combine existing sensor (CO2 + Humidity) including extra measurement features (pollutants)



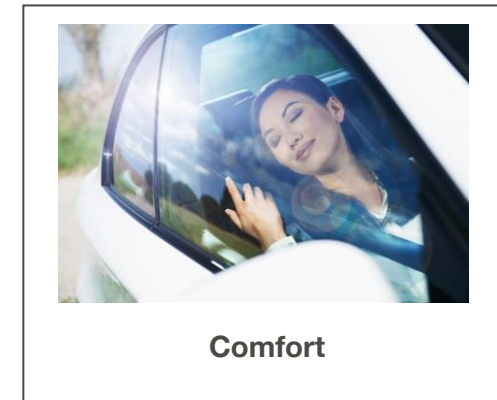
# AQS

## USE CASES

### « WHY USING A MULTI GAS SENSOR ? »



HVAC Control



### « WHY USING A MULTI GAS SENSOR ? »

	Health Management		Comfort		Mobile station
Pollutants	CO2, Humidity	NO2, O3, CO, SO2	CO	Odor detection NH3, O3[, ...]	CO, NO2, O3, SO2
Benefit	Energy saving Exposure limitation	Energy saving Exposure limitation	Comfort Rule enforcement	Comfort	Public health Revenue for CaaS
System impact	Recirculation flap	Recirculation flap Air purifier, Ioniser	Recirculation flap	Perfume dispenser	Connectivity

Caas: Container as a service

**KEY QUESTION: IS IT WORTH FITTING CAR WITH A SOPHISTICATED MONITORING TOOL?**

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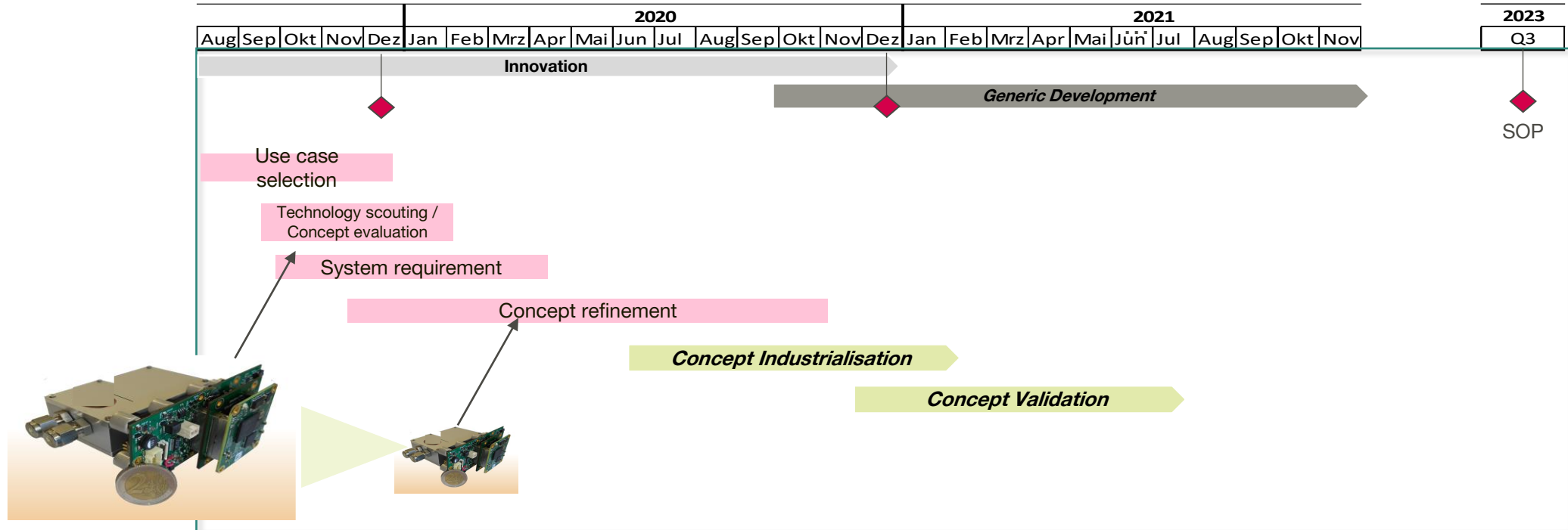
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## DEVELOPMENT SCHEDULE



Available gases:  
NO, NO2, CO, CO2, NH3,  
Formadelhylde, Humidity

SOP: Start Of Production

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CONNEXION WITH « STAGE 4 »

## « Monitoring of indoor Air Quality »

**Proof of concept (15X10X10 cm<sup>3</sup>) devices available for in-situ / real time measurement**

**Key questions « sensor relevant » to be addressed:**

- > Which achievable trade-off: « fuel economy vs harmful substances exposure? »
- > Do active purification system request a close loop control on pollutants?
- > Is proposed sensor specification sufficient to address envisioned use cases?
- > Which upcoming regulations or rules ?

**LET'S  
DISCUSS!**