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

COST Action TD1105

WGs and MC Meeting at Cambridge, 18-20 December 2013

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 2: 1 July 2013 - 30 June 2014 (*Ongoing Action*)

Dr. Hans Martin (C.T.O.)

WG Member

SenseAir AB / Sweden

COST is supported by the EU Framework Programme

through a European Commission contract

Non-Dispersive Infra Red (NDIR) Gas Sensors Ready for Automotive Applications

Applications for CO_2 sensors

Life sciences Industrial Processes

Respiratory monitoring
Capnometry

Chicken Hatcheries

Incubators

Greenhouses…

Breweries, wineries

Mushroom farming…

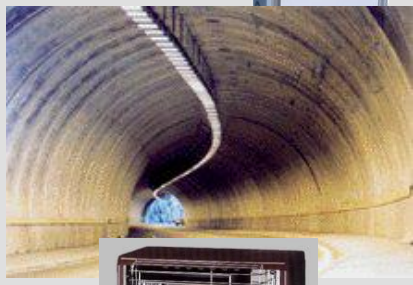
Life Support

Personal Safety

Gas distribution industry
Fire extinguisher storage
Cellar safety in pubs
Fast food restaurants

Climate Control in Confined Spaces

Submarines, Diving…



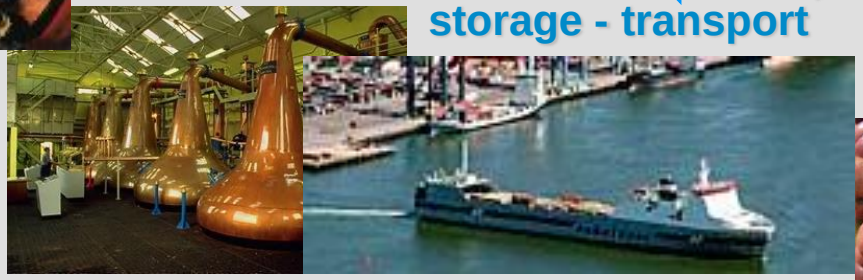
Exhaust Control

Garages, Tunnels…

Burners
Kerosene heaters

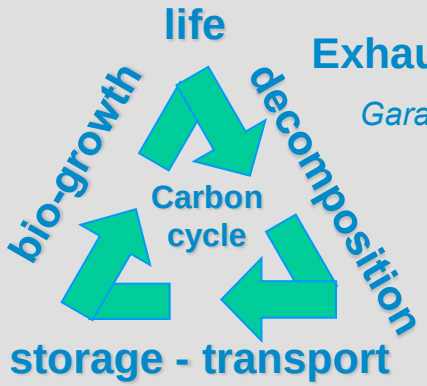
Bio-termination

Animal slaughtering
Food packaging
Water cleaning



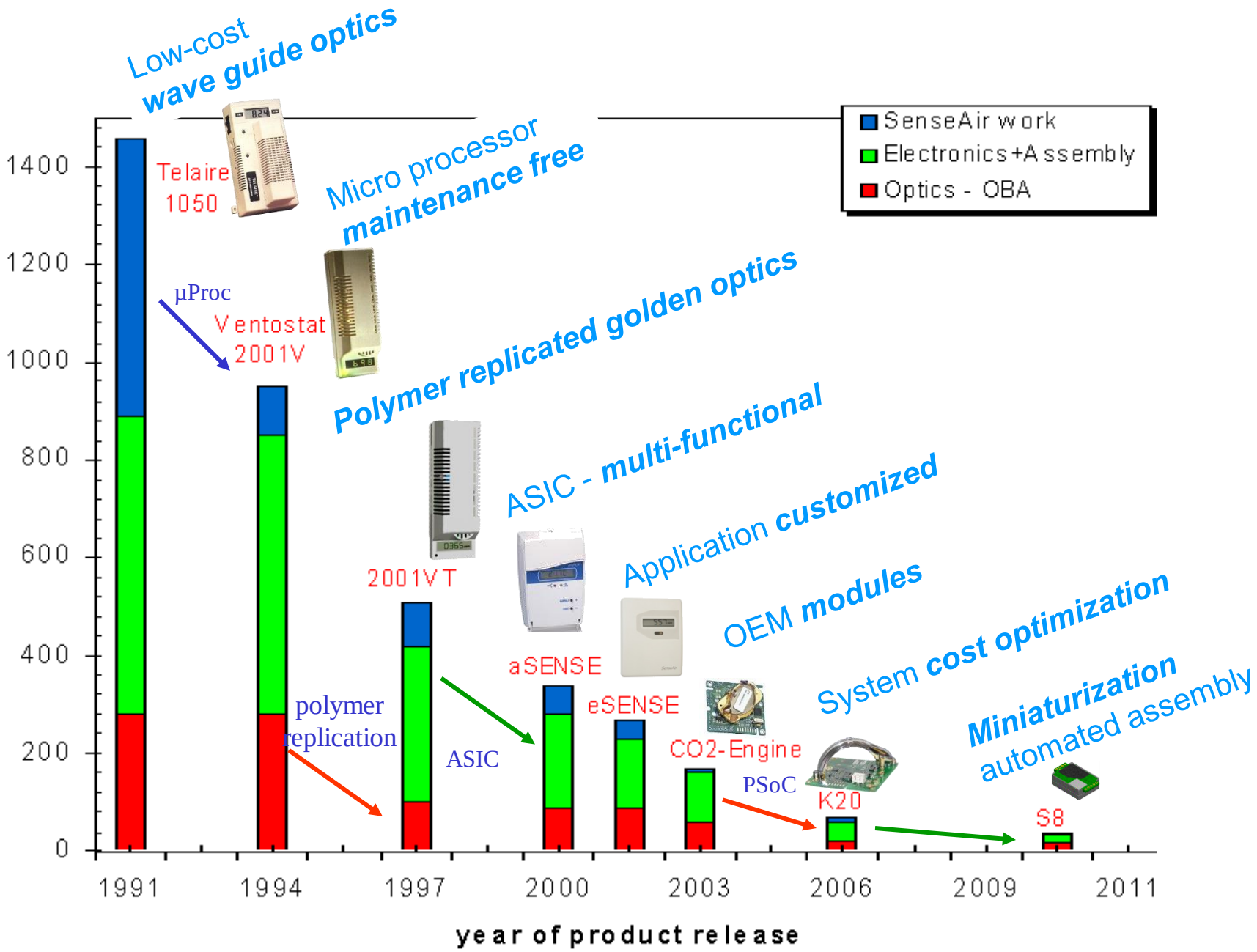
Food container transportation

Fruit storage…



20 years of NDIR CO_2 sensor development

SenseAir
Sensors for Life

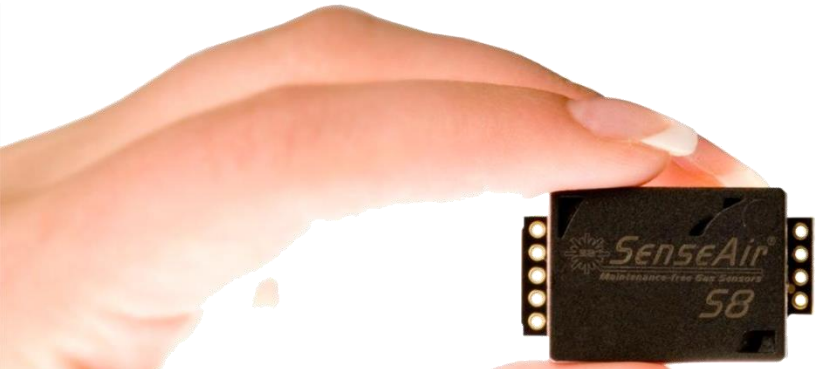


S8 miniature gas sensor

the smallest IR sensor in the world…

Design target:

- *Develop the lowest cost IR gas sensor possible*
- *Prepared for automated assembly / production*
- *Get the worlds smallest IR low-cost CO_2*
- *Yet not compromising with std sensor performance*



2011 FROST & SULLIVAN Product Innovation Award

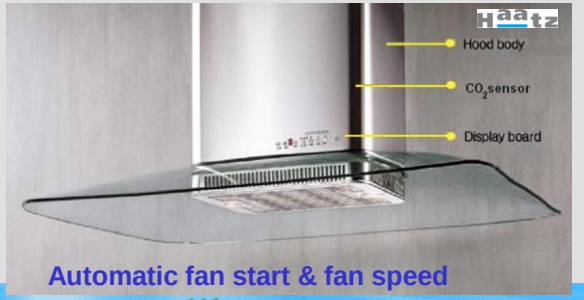
Consumer products using CO_2 sensors

Home appliances…

心脏

一无二的功能，就是“缺氧报
是二氧化碳(CO_2)传感器，是光
学仪器，它连续测量房间二氧化碳含量，以判断房间氧气含量。
人时刻吸进氧气，呼出二氧化碳。当房间不透风时，室内二氧化

Hitachi Appliances, Inc.



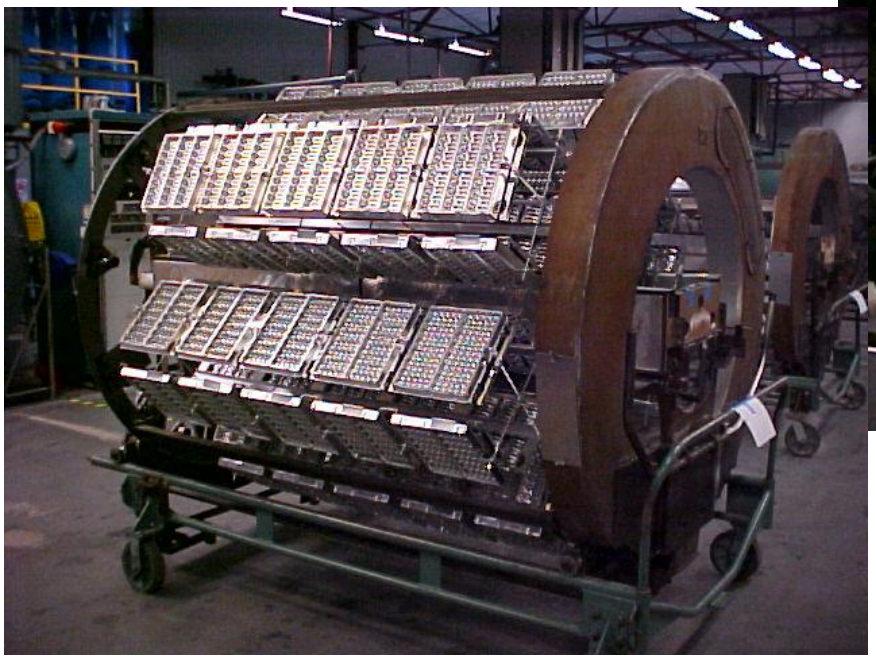
Automatic fan start & fan speed

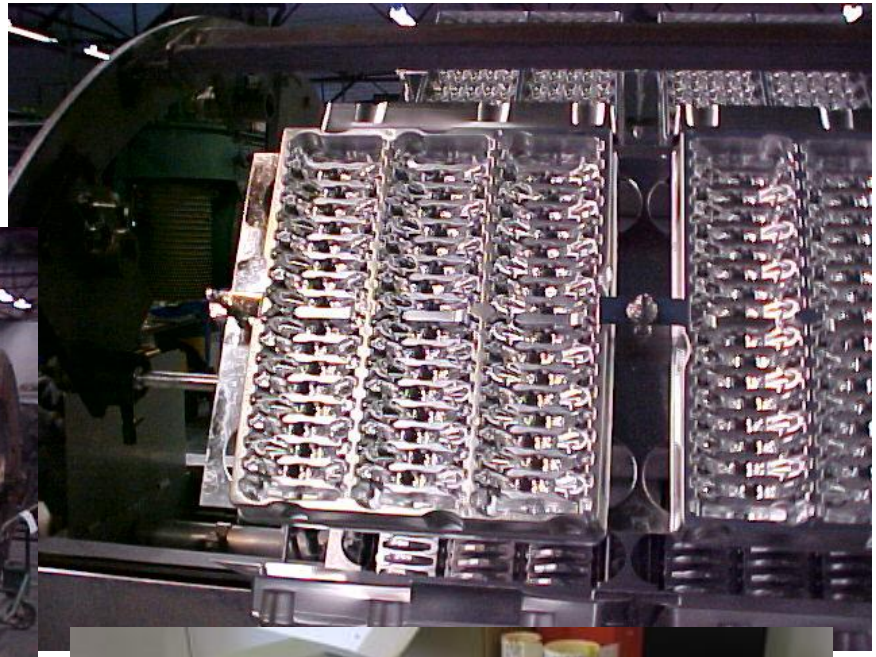
S8 Production Line 1

Production Capacity:
~ 2000pcs sensors / 6 hr

Process Innovations

Cost efficient manufacturing

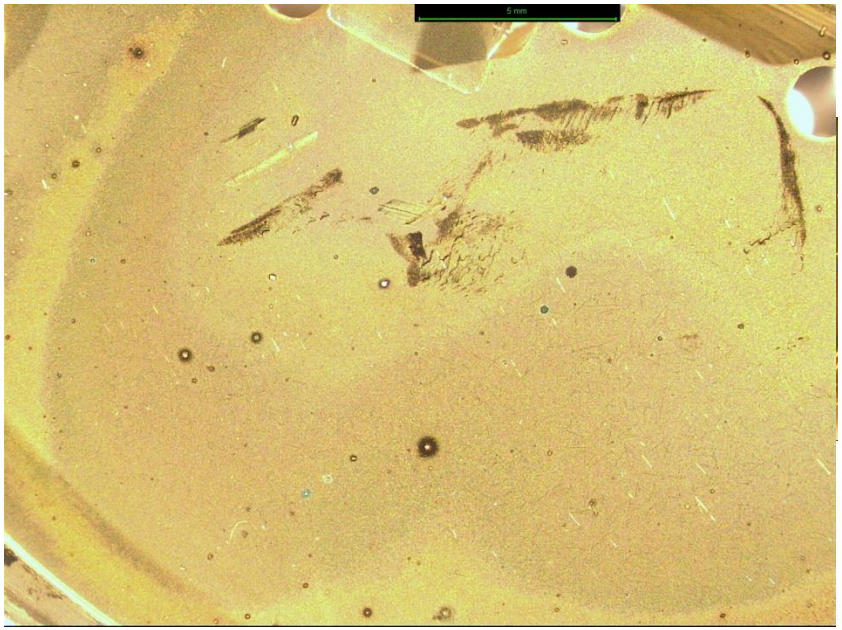




SenseAir

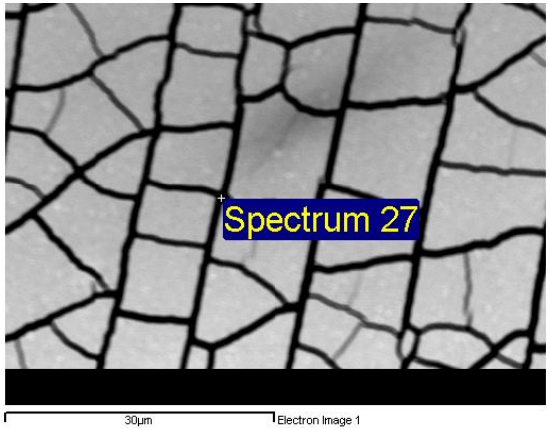
SEM investigations on optical surfaces

***Ingrid Bryntse**, Ph.D., Professor in Inorganic Chemistry*



The foggy surface causes a signal decrease. The precipitation is a hygroscopic inorganic compound formed from air pollution.

Detailed SEM study of optical cavity, which has lost a large part of the reflectance due to environmental corrosion processes:

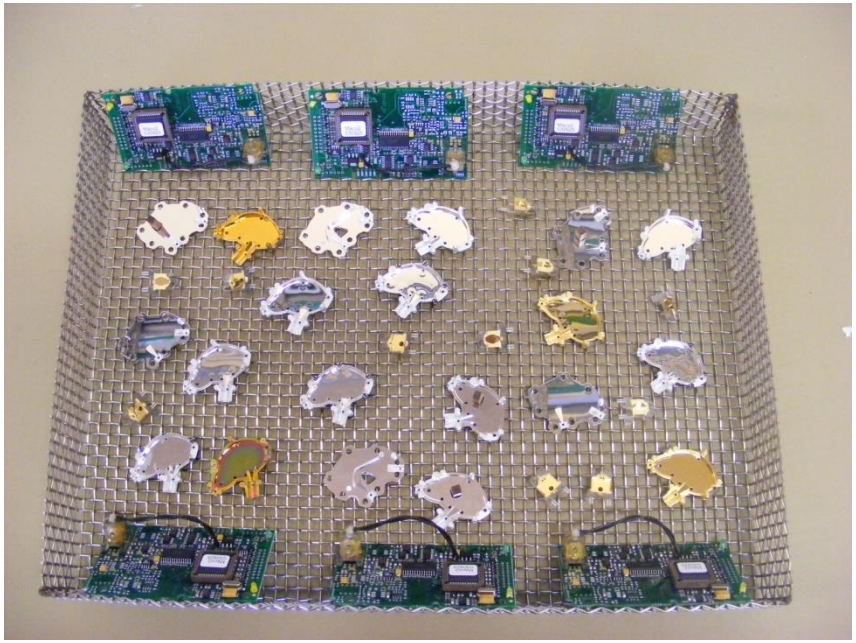


SenseAir

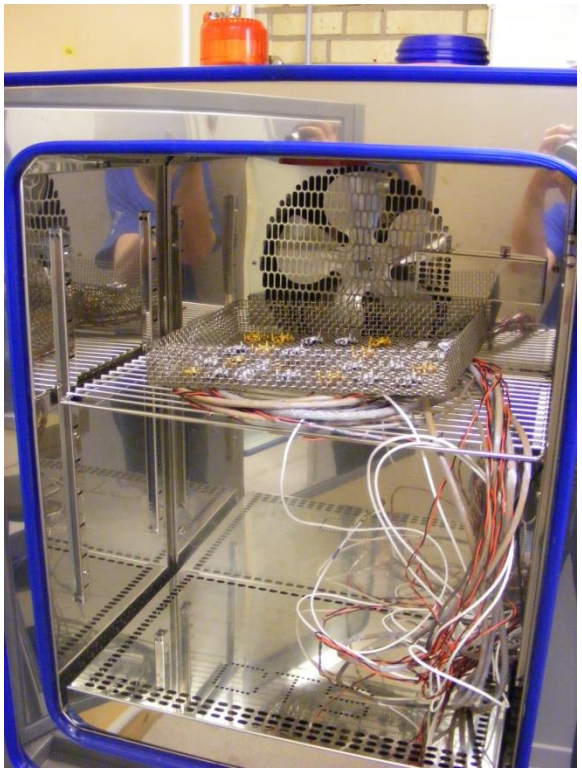
Mirror coating process development

***Ingrid Bryntse**, Ph.D., Professor in Inorganic Chemistry*

Climate testing, temp and moisture - cycled

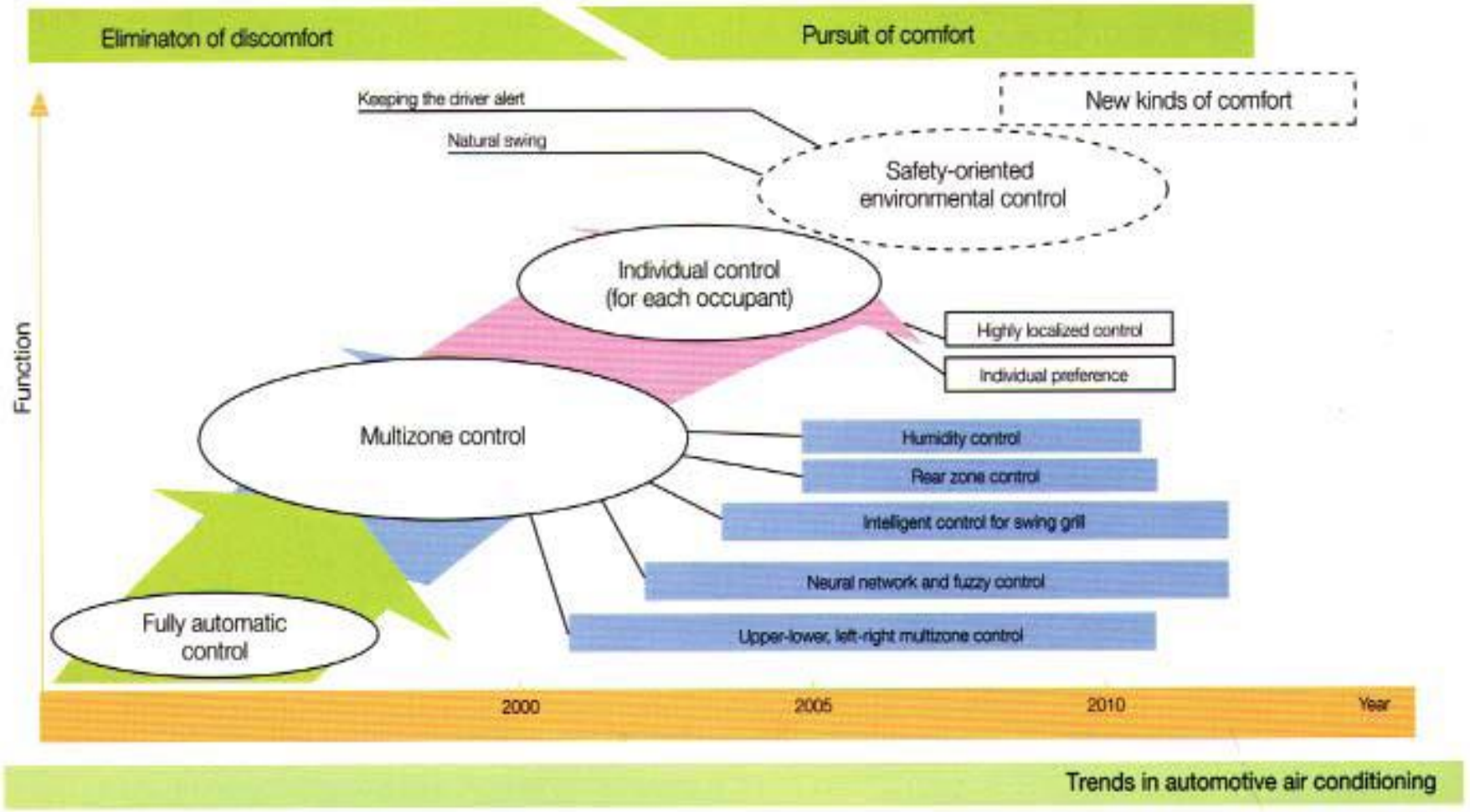


SenseAir climate testing
in our Analysis & Test laboratory.



Automotive Industry
Trends in automotive air conditioning

Still 40 years behind indoor air quality standards in buildings !!



IAQ and cabin ventilation

a study of PBDE and Ftalate softeners performed on 133 different 2000-2005 car models….
5 times worse than in office environments!

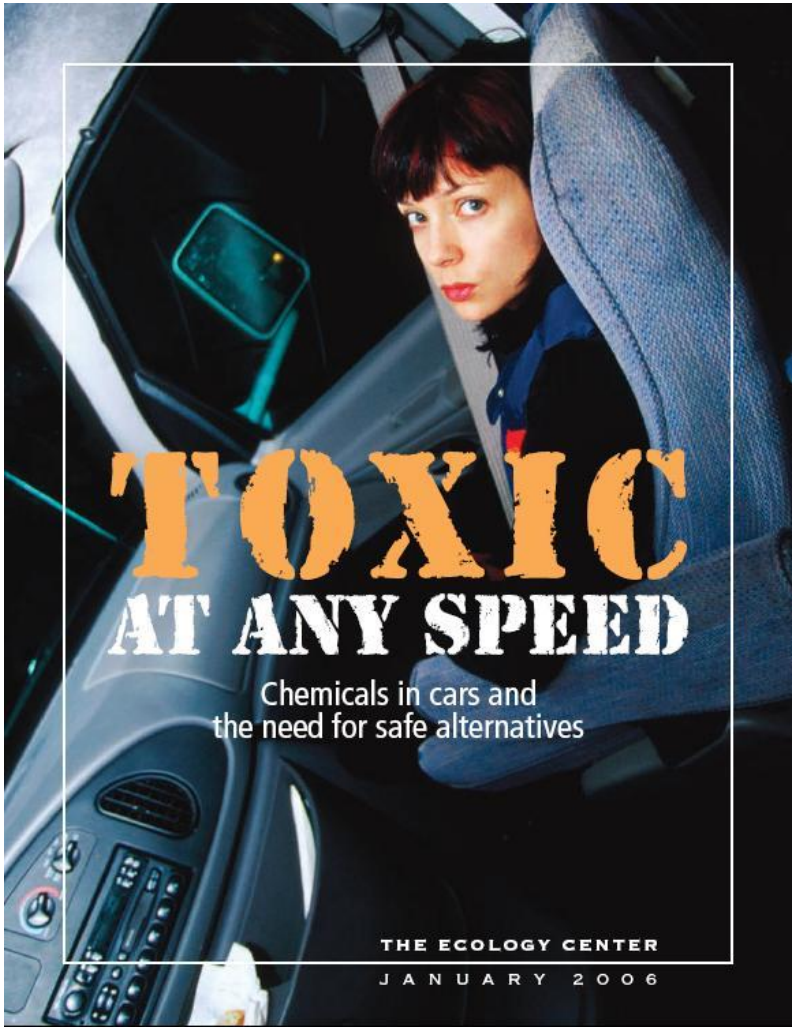


Table ES1: Ranking of Vehicles by Company (Windshield Film Concentrations)

Auto Company	Total PBDE, µg/m²	Auto Company	Total Phthalates, µg/m²
Hyundai	0.054	Volvo	3
Volvo	0.152	BMW	3
BMW	0.178	VW	4
Honda USA	0.193	General Motors	5
Ford	0.280	Toyota USA	6
General Motors	0.301	Honda USA	6
Toyota	0.323	Mercedes	6
Honda	0.351	Honda	7
VW	0.594	Subaru	7
Subaru	0.744	Chrysler	7
Toyota USA	0.936	Toyota	8
Chrysler	1.021	Ford	10
Mercedes	1.772	Hyundai	24

IAQ and cabin ventilation

In a car the potential danger is larger than in a house, because:

1. *The material in a car is more hazardous compared to in a building*
2. *The total polluting area per space volume in a car is much larger than in a building*
3. *In a car the occupant is sitting closer to the emission sources*
4. *…and the temperatures can be very much higher, that is more out-gasing!*

International well established and accepted IAQ standards:

5000 ppm *CO_2 TWA limit – Labour's safety organizations –* ***industry space***

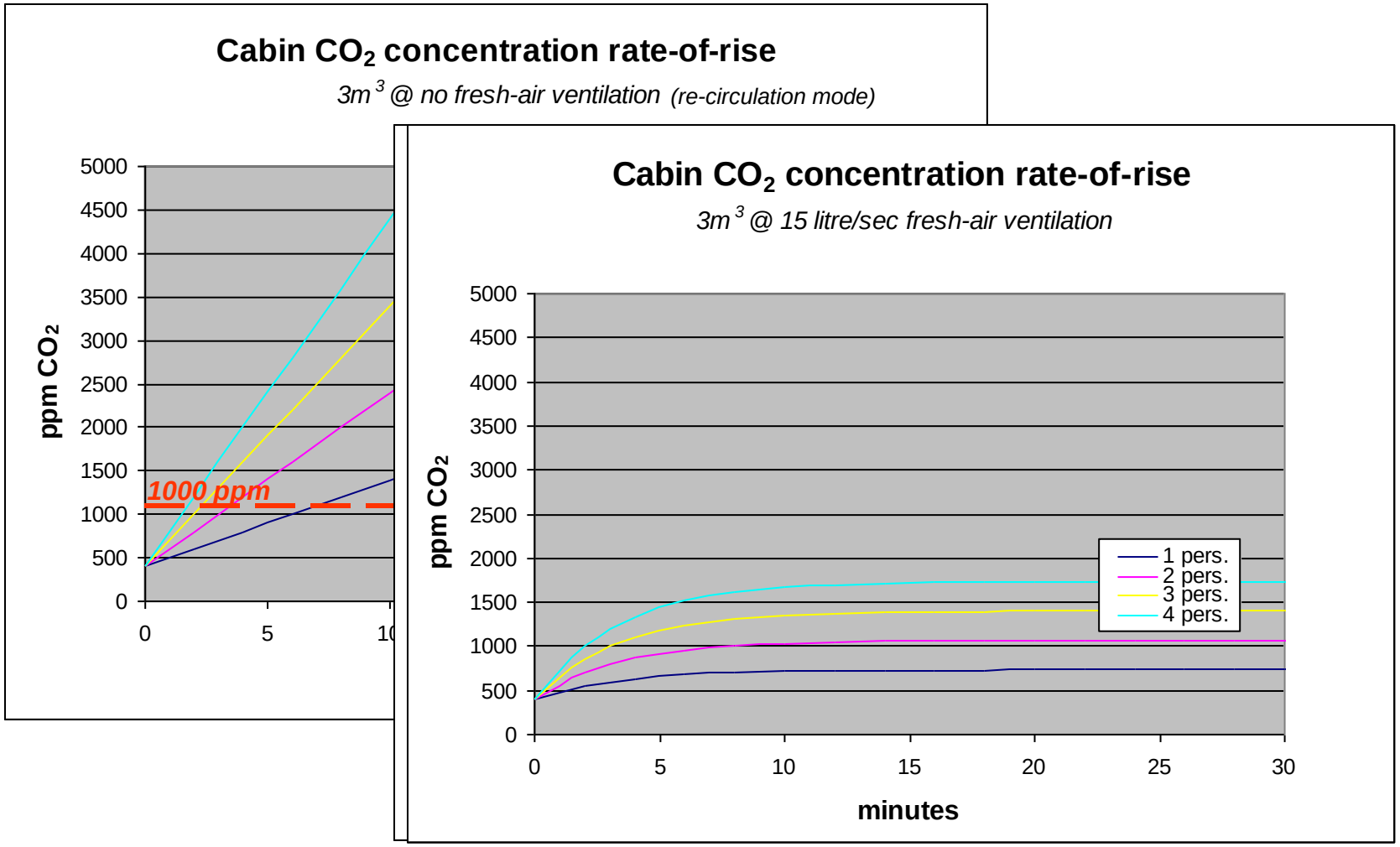
1000 ppm *CO_2 limit – WHO, ASHRAE Standard 62-2001 –* ***public space***

(+ many similar national organizations)

The purpose of ASHRAE Standard 62, as defined in Section 1, is to "specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects."

Automotive CO_2 sensor

ventilation rates & air quality …



Automotive CO_2 sensor applications

Vehicle Interior Air Quality

To monitor and control HVAC system in particular for build up when system in recirculation mode.

CO_2 HVAC system monitoring

Early warning for leakage of CO_2 into cabin from high pressure CO_2 AC system (R744).

Occupant Detection

To detect occupant or animal left in car via CO_2 build up and activate alarm, HVAC or window system

Hyundai Genesis to get anti-drowsiness CO2 sensor plus hand-and-foot-free Smart Trunk

By Seyth Miersma
Posted Oct 28th 2013 10:30AM

We're still recovering from the jetlag incurred on a trip to South Korea last week, where a cordial group at Hyundai showed us, among other things, the nearly completed 2015 Hyundai Genesis. There is still a bit of time stretching between now and when we're allowed to bring you our First Drive of the second-generation Genesis prototype, but we have been cleared to break off news of two heretofore unheard of features that will debut on the premium sedan.

The first, and arguably most interesting of the two, is a carbon dioxide sensor inside the cabin of the Genesis. The goal of the sensor is to measure CO2 outputted by the cars' human occupants (not the CO2 coming out of the tailpipe, which shouldn't make it into the cabin), as Hyundai tells us that high levels of the stuff help to increase occurrences of drowsiness while driving.

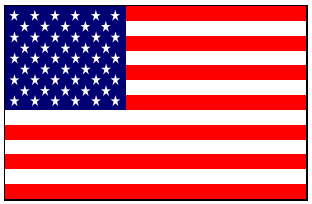
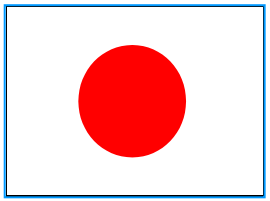
Conceived of by a Hyundai engineer who struggled with staying alert during his long commute home from Namyang, the system detects when in-cabin CO2 levels rise above 2,500 parts per million, then vents the compartment via the HVAC system when that threshold is reached. The CO2 venting system may be turned off, should a driver not want the cabin filled with fresh air – we're guessing this might be a good thing on really cold days.

Automotive gas sensors

Alcolock advanced sensor

Autoliv · Hot Hot instrument ab · VOLVO · SenseAir · VOLVO

Alcohol-related traffic fatalities:

			
50+ % of fatal = ***10500 persons/year***	*25% of fatal* = ***6500 persons/year***	*17% of fatal*	*10% of fatal*

dadss
Driver Alcohol Detection System for Safety

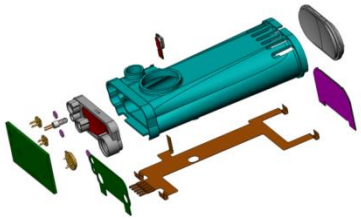
NHTSA www.nhtsa.gov

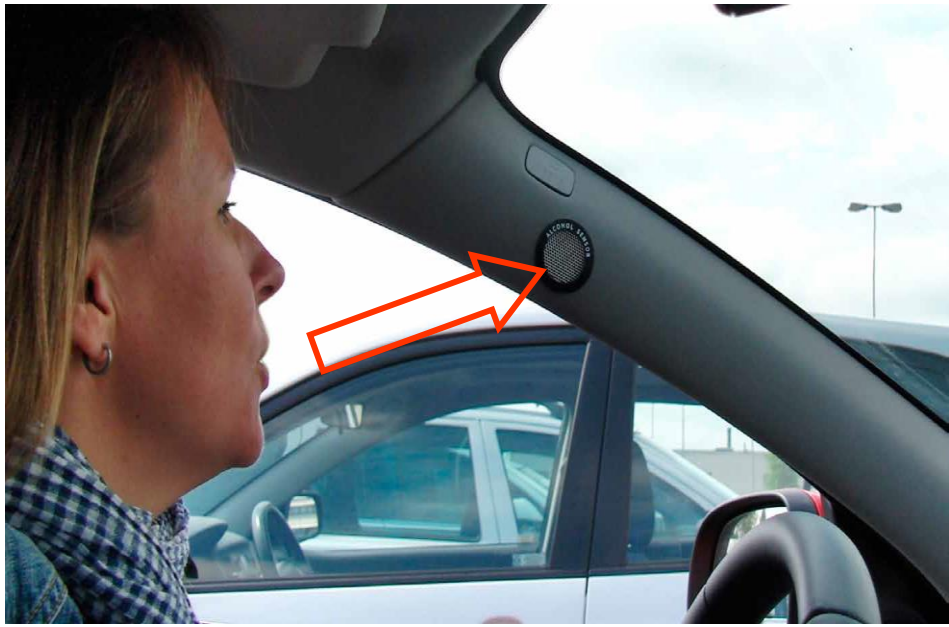
ACTS

Automotive gas sensors

Alcolock advanced sensor

Autoliv · Hot instrument ab · VOLVO · SenseAir · VOLVO





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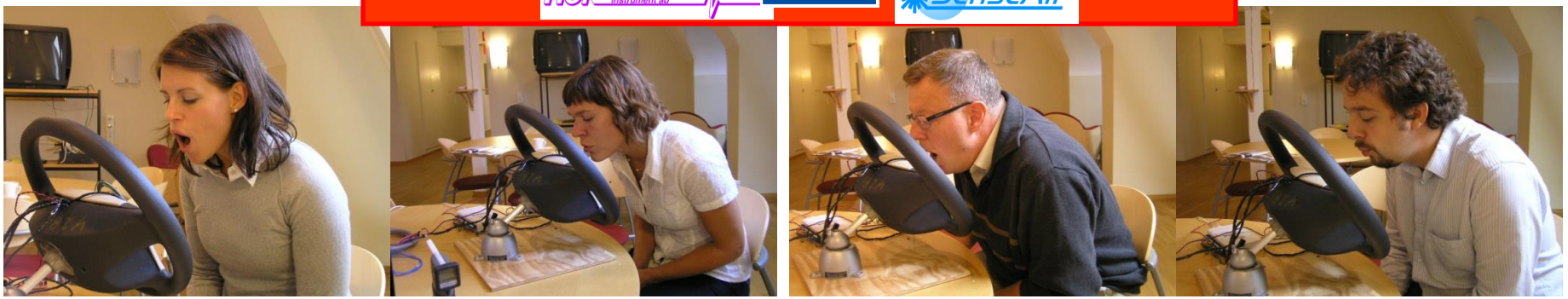

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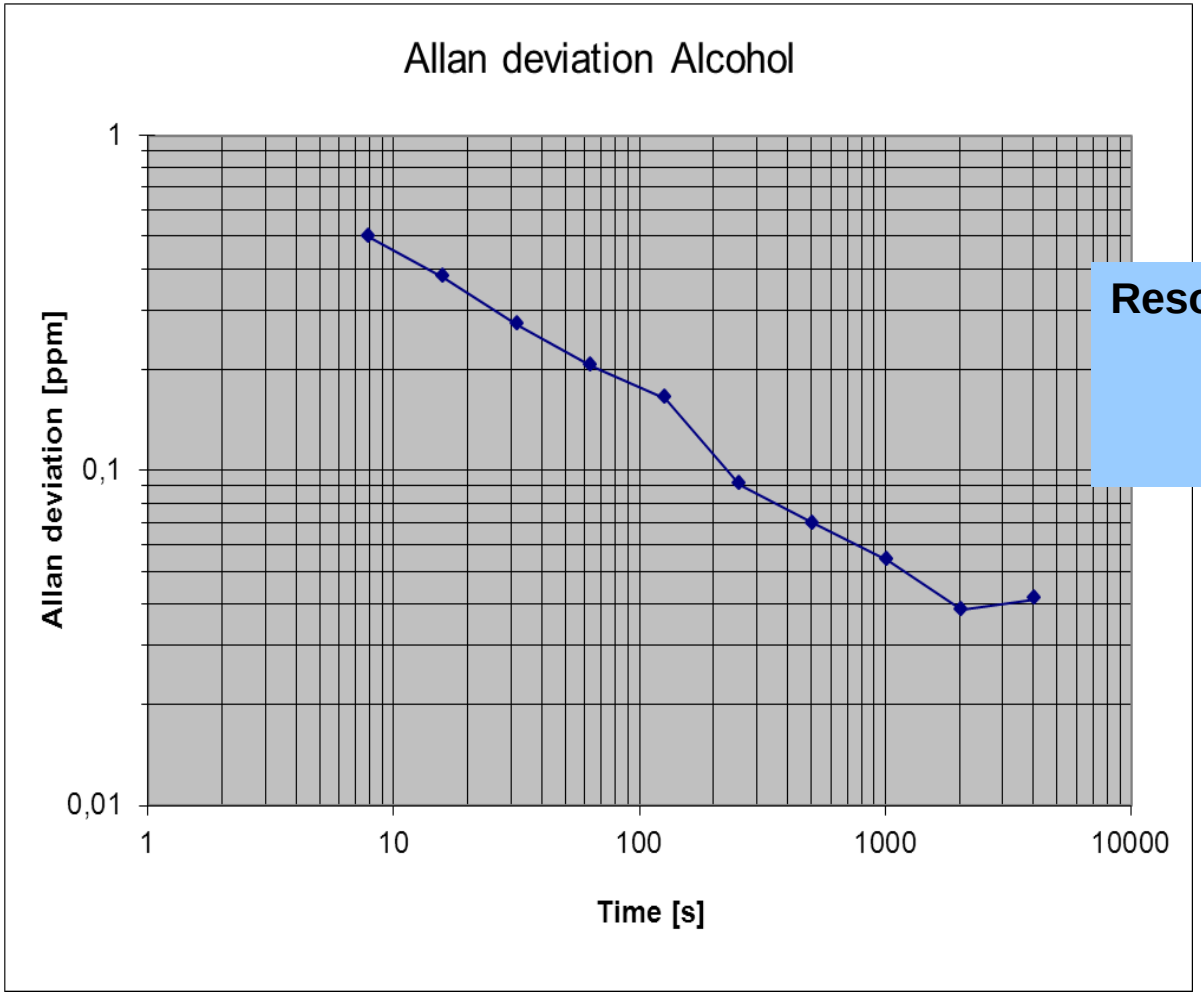
LPL platform - Ethanol performance



Resolution:

@ 2 sec. 1,0 ppm
@ 10 sec.0,5 ppm
@ 1 min. 0,2 ppm

The Evidenzer vs. Autoliv´s handheld prototype

9,7 kg
450 x 175 x 230 mm
0 to 40 degC
warm up time from
10 degC, <25 min

As good as, or even better, than the expensive Evidencer laboratory instrument!!!

200 g
150 x 80 x 60 mm
-40 to +85 degC
Warm up time from
10 degC, <10 s

Concept Validation automotive test results by Autoliv

~100 prototypes summary:

Accelerated ageing durability tests, 12 weeks (temperature cycling and 15000 power on/off): **OK** -No degradation in performance!

EMC. Emission and immunity (200 V/m). **OK**

Temperature –30..+85°C and humidity. **OK**

Air pressure (corresponding to 3000 m). **OK**

Arizona dust & salt spray. **OK**

Corrosive environment. **OK**

Human subjects testing **OK**

Start up time. **OK**

Automotive CO_2 Sensor

We are ready …

SenseAir S8

Cabin Air Guard
SenseAir S8-K84

Automotive CO_2 Sensor

We are ready …

Thank you for your attention!