

26th World Gas Conference

1 – 5 June 2015 – Paris, France



TS WOC 5-5

New Gas Quality Sensor for « Mass Market » Applications

Dr. Philippe Prêtre

MEMS AG, Switzerland



MEMS AG

- **M**atter **E**ngineering for **M**etering **S**ystems
alias
- **M**icro **E**lectro-**M**echanical **S**ystems
- since 2003
- Employees: 16
- www.mems.ch

- Gas measuring technologies
- Electronics developments

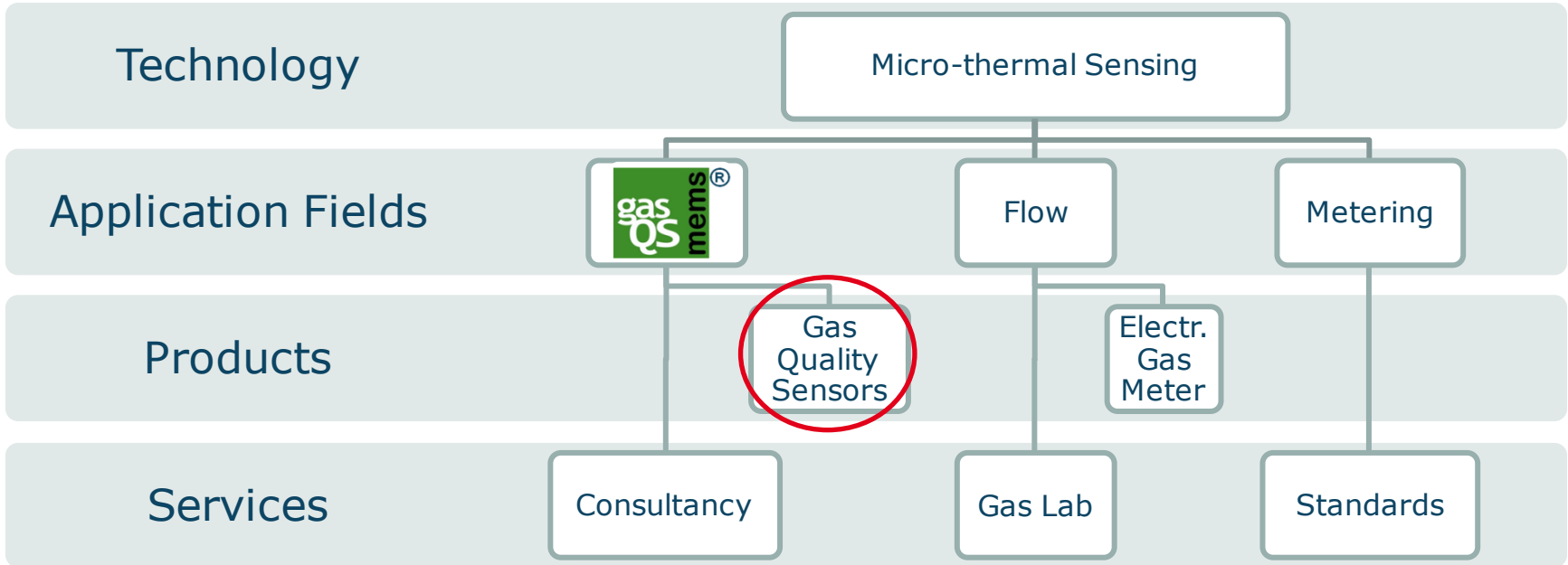


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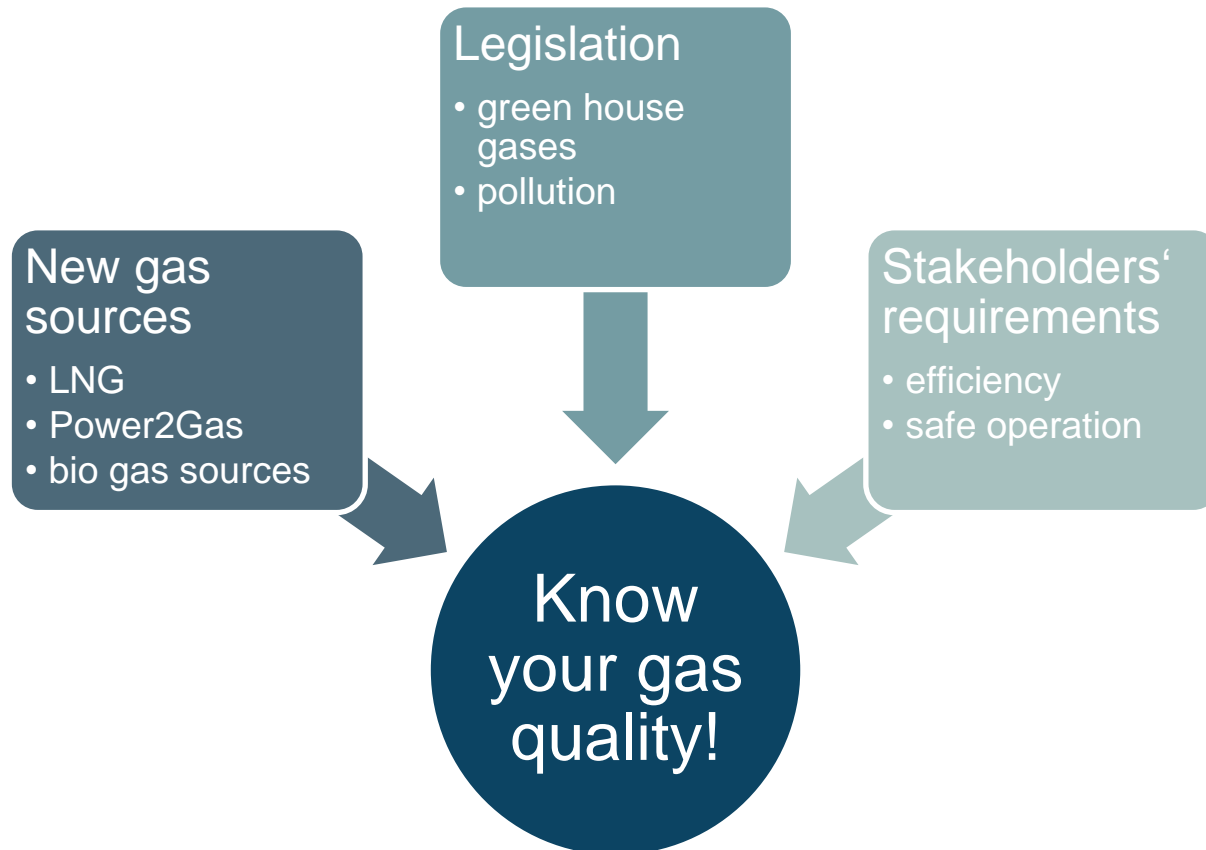


MEMS AG: Gas Measuring Technologies



Gas quality, a growing concern for end users?

- Why gas quality sensors for the gas industry?



Gas quality sensors today

- Prozess gas chromatograph
 - gas composition
 - re-calibration needed
 - slow, fragile, bulky
 - calibration gases needed
 - expensive, high maintenance costs
- Correlative type
 - physical sum parameters
 - higher (correlation) errors
 - fast, ruggedised
 - low maintenance costs



Source: ABB



Source: RMG Honeywell

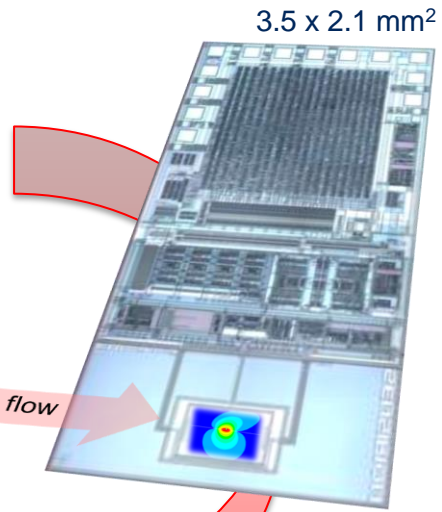
Available sensor technologies

Technology	Measured quantity	Pros +	Cons -	Costs	Main-tenance	Size	Robust-ness
Gas chroma-tographs	gas composition	high accuracy	not for all gas types	high	high	large	low
Calorimeters	Wobbe, calorific value	direct measurement, no limitation on gas quality	Only Wobbe, calorific value	high	high	large	low
Optical	gas composition	high selectivity	limited gas range	high	medium	medium	low
Correlative methods	physical sum parameters	response time	reduced accuracy	high	low	medium	medium
No devices available yet!				low	low	small	high

Micro-thermal chip technology

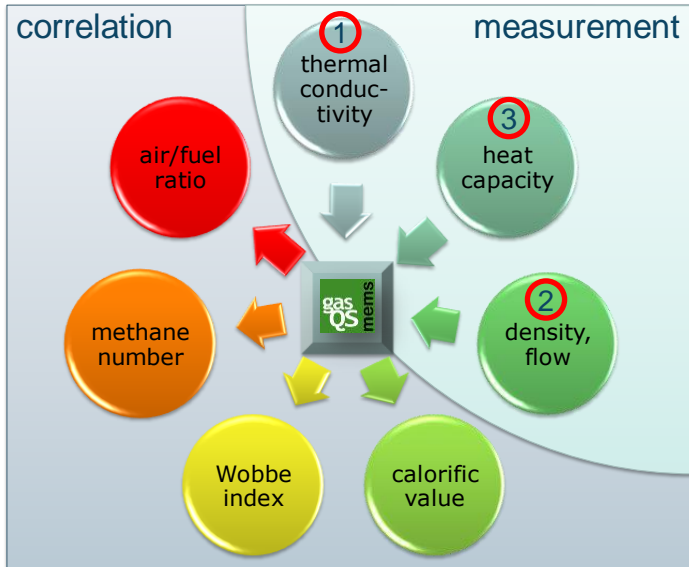
CMOS chip technology

- fully integrated hot-wire anemometer
- standard industrial production process
- potentially cheap



Gas quality sensing

- correlative measurement method
- IP owned by MEMS AG
- Technology registered as gasQS®



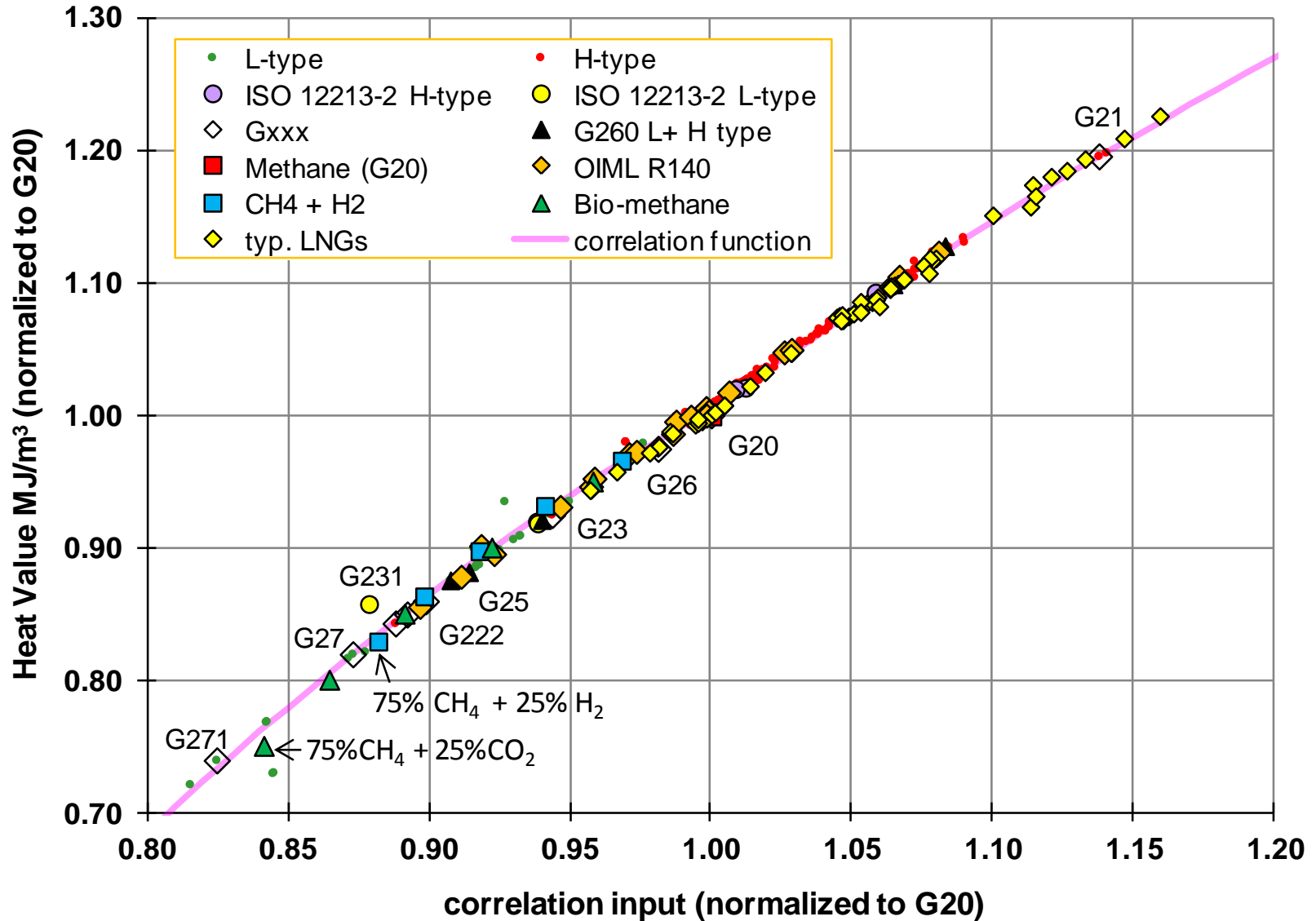
Advantages

- fast response
- compact size
- robustness
- low maintenance
- no re-calibration
- no reference gas
- ease of integration into a control system



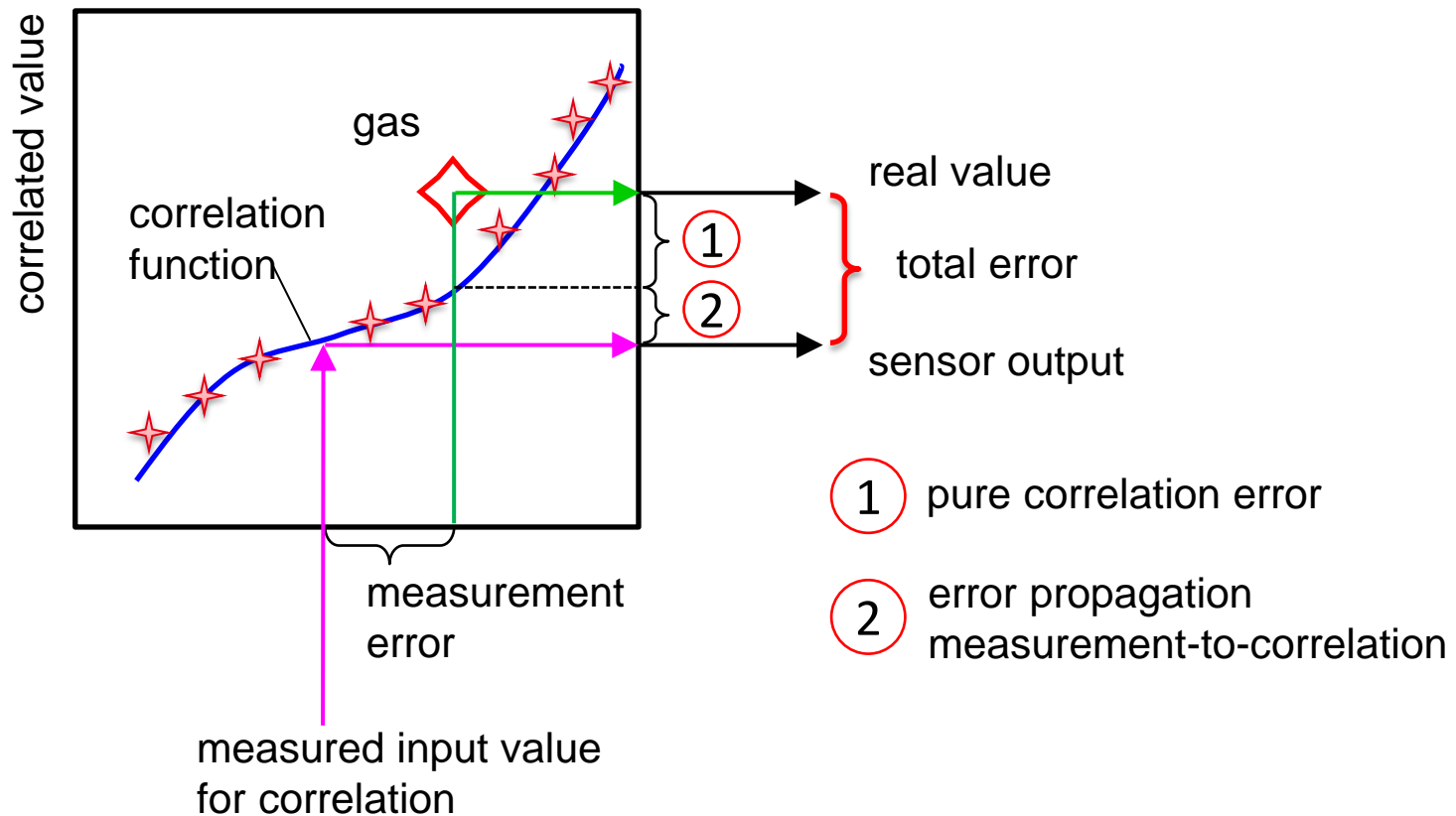
10 x 6 x 6 cm³

Correlation example: heat value



Error propagation

- Performance = correlation error + measurement error



Performance

Gas quality	Accuracy	Stability
Calorific value	2 % rel.	0.15% rel.
Methane number	+/- 3 abs	+/- 2 abs
Wobbe index	2.5% rel.	0.25% rel.
Density	1.5% rel.	0.15% rel.
Gas temperature	+/- 0.5 K	+/- 0.1 K
Thermal conduct.	1 % rel.	0.3 % rel.
Gas flow¹⁾		
Gas components²⁾		

- 1) technology is used elsewhere as electronic gas meter. Accuracy depending on turn down ratio, according to MID in case of the gas meter
- 2) binary mixtures are measurable to within 0.5-1% absolute concentration of each component (e.g. CH₄ content of bio-gas)

Correlative measurement methods

EMC500:
> 20'000 \$



Source: RMG Honeywell

Gas Lab Q1:
> 20'000 \$



Source: Elster

Correlative Measurement Principle		
Input 1	Input 2	Input 3
dielectric const.	c_{sound}	CO ₂ content
$c_{\text{sound}}(p_1)$	$c_{\text{sound}}(p_2)$	CO ₂ content
$\kappa(T_1)$	$\kappa(T_2)$	c_{sound}
κ	c_p	η
κ	IR absorption (non-dispersive)	
κ	IR absorption (λ_1)	IR absorption (λ_2)
gasQS		
κ	sonic nozzle	CMOS sensor



< 2'000 \$ → „mass“ market

Available sensor technologies

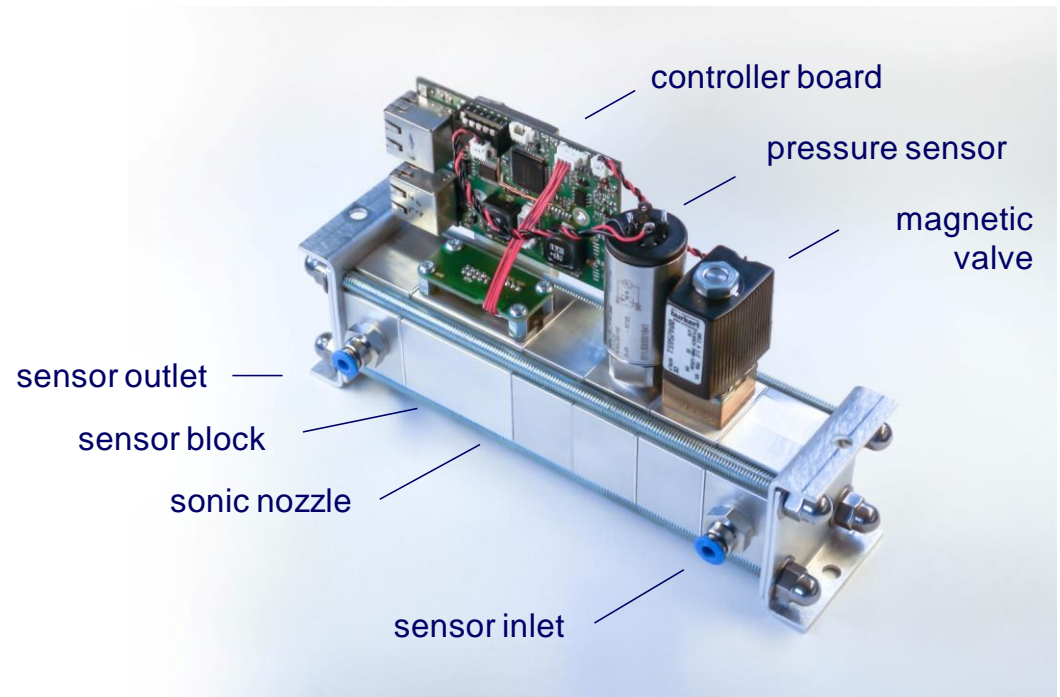
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Now available!				low	low	small	high



competitive positioning of the gasQS technology

Engineering samples

- Application specific engineering sample available @ MEMS



OEM sensor version

- Samples available @ MEMS
- compact (100 x 60 x 62 mm³)
- for field tests
- ease of operation
- support by MEMS
- service package: 25 k€



Application matrix

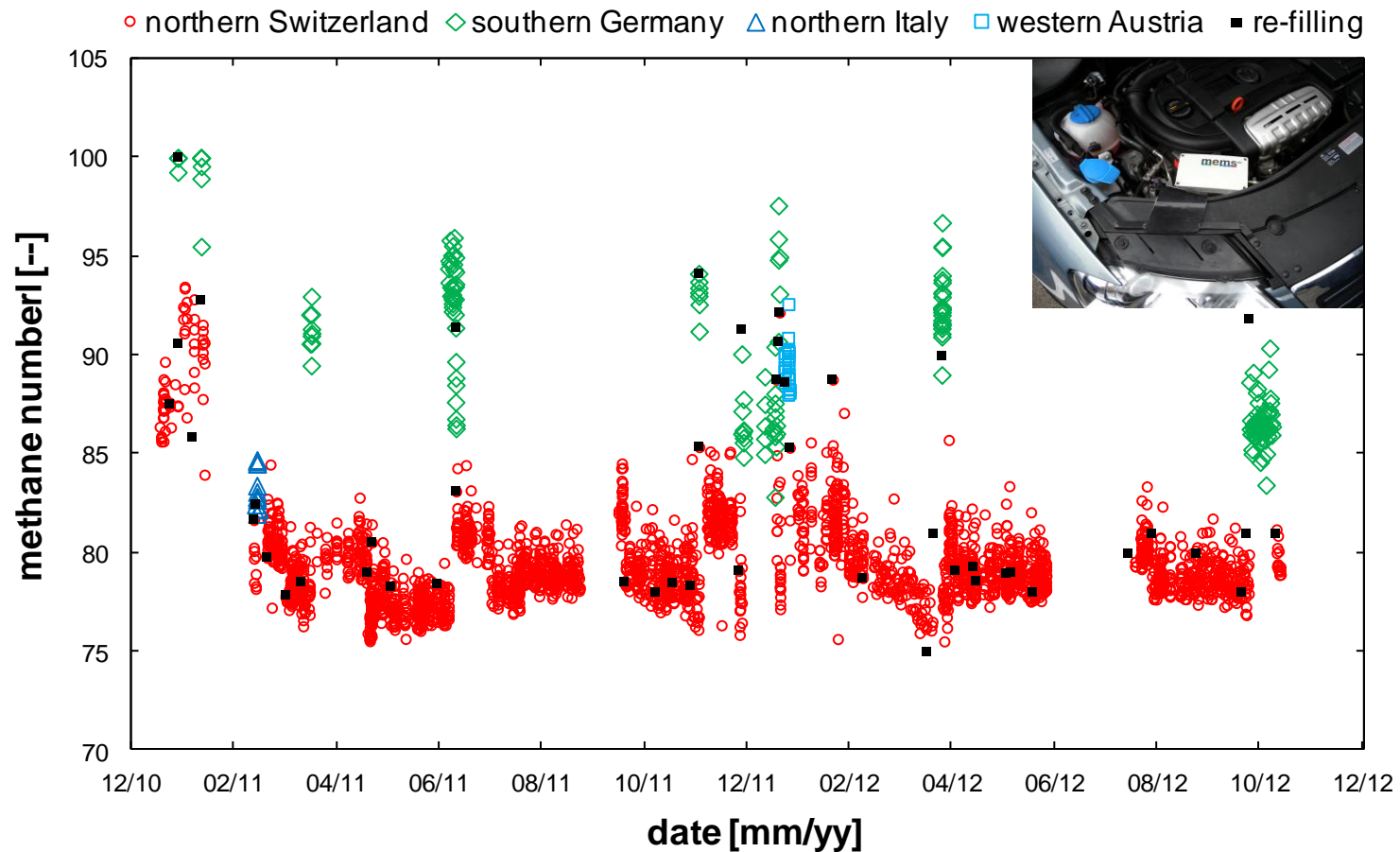
	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Customized	Flow
Research	X	X	X	X	X	X	X	X
Natural Gas Vehicles NGV								
• CNG	X			X				
• LNG	X			X				
Co-Generation	X		X	X				
Fuel Cells			X					X
Combustion								
• Boilers		X						
• Burners	X		X					
Bio Gas Plants	X					CO ₂ /CH ₄		
Power-2-Gas						H ₂ /CH ₄		
Gas Distribution Networks	X							
Instrumentation	X	X	X	X	X	X	X	X
OEM Products	X	X	X	X	X	X	X	X

X usually asked for in this application

X already implemented / tested by MEMS

Long term road test

- Hard to predict mixing effects after re-fuelling



gasQS for fuel cells

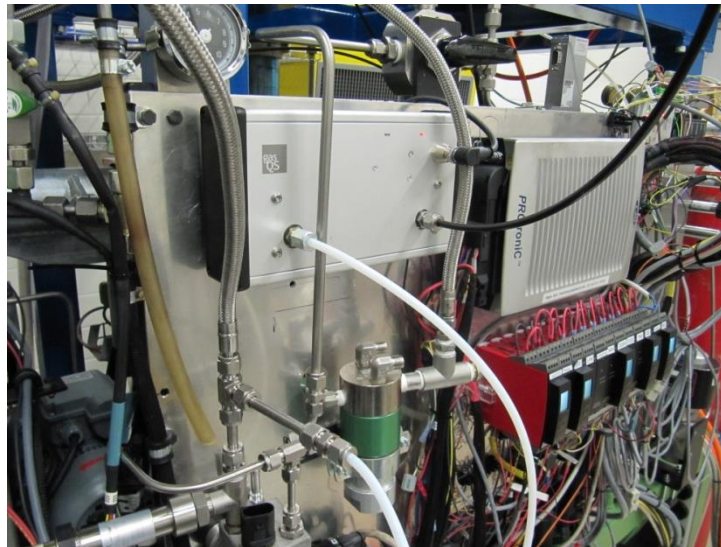


Source: Hexis

- Reformation of natural gas for fuel cells:
 - air number determination for different gas qualities
 - air/gas ratio control
 - improved efficiency, life-time extension

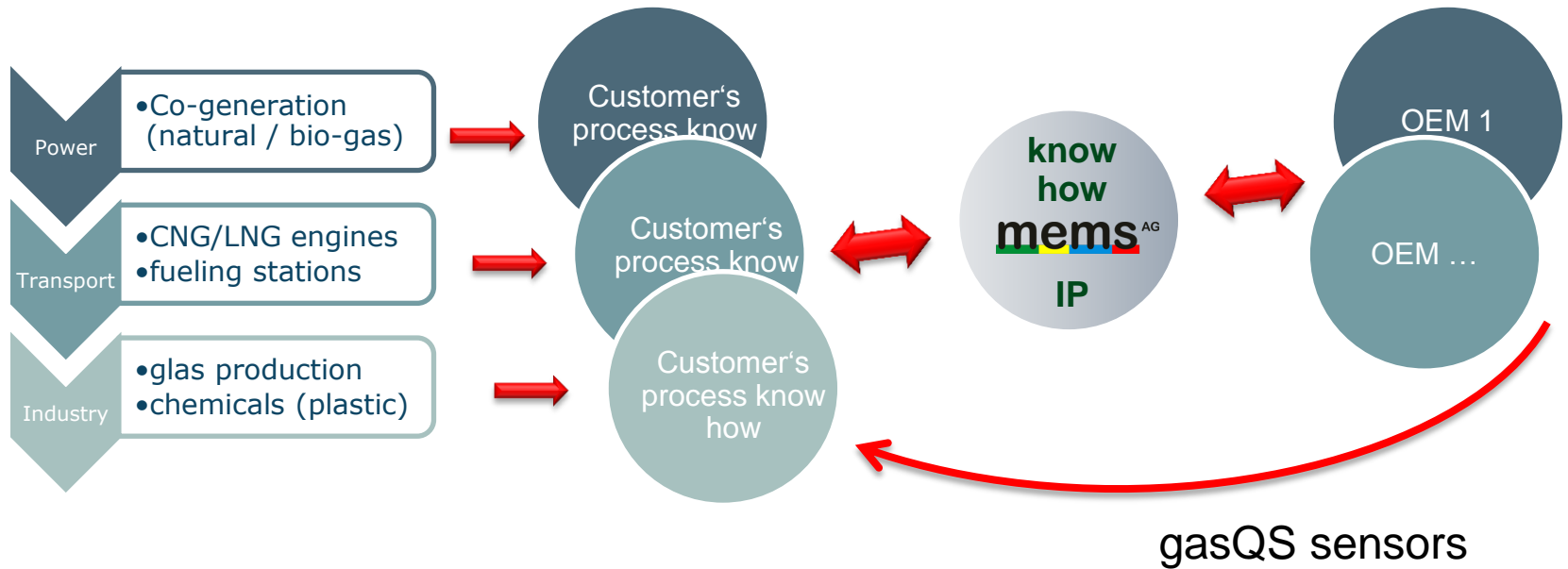
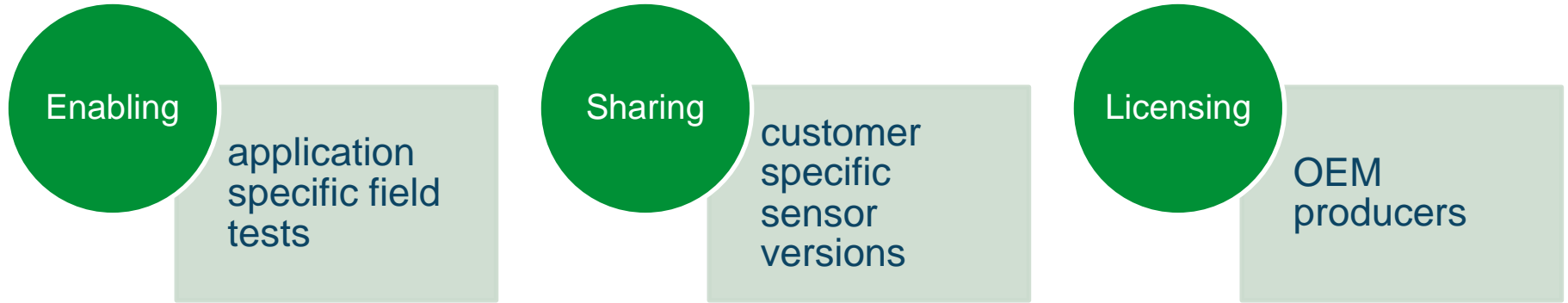
Research: gas quality vs. modern gas engine concepts

- Methane number as traditional gas quality indicator for knock:
 - does it reflect modern engine set-ups?
 - isn't there any better indicator for gas quality?
- Research program together with Empa, Switzerland



Source: Empa

Market penetration



- Come and visit us at booth K58!

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