

Total Energy Measurement

Changes in natural gas market driver for gas quality measurement

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Product Manager Gas Quality



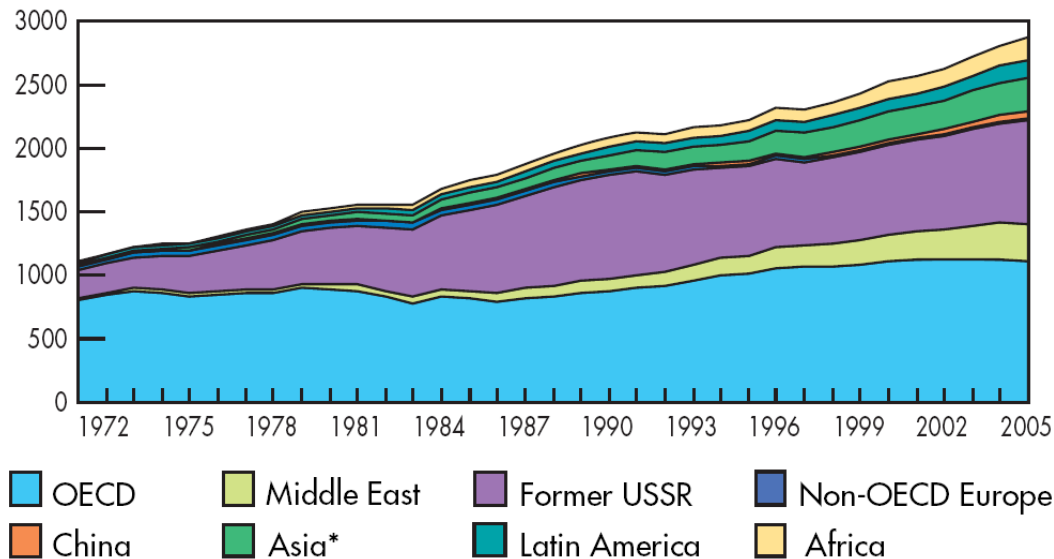
Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements

- Growth**

Natural Gas Production

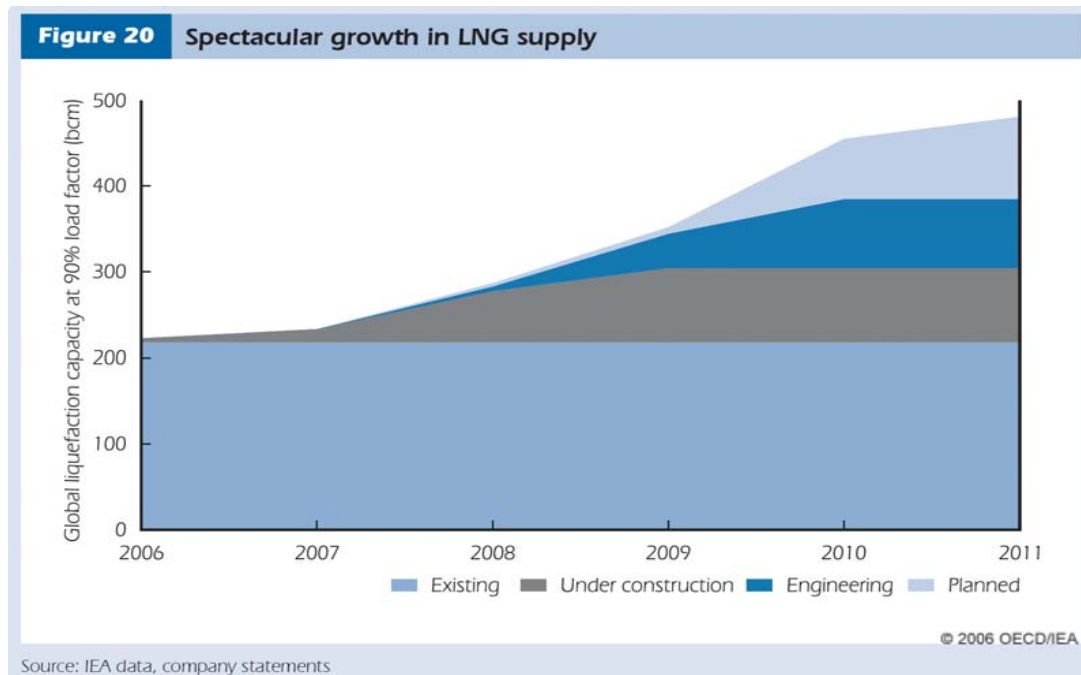
Evolution from 1971 to 2005 of Natural Gas Production by Region (Billion Cubic Metres)



Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements

- Growth
- **Globalization: World-wide gas trade**



Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements

- Growth
- Globalization
- **Liberalization**

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15.7.2003

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Official Journal of the European Union

L 176/57

DIRECTIVE 2003/55/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 26 June 2003

concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC

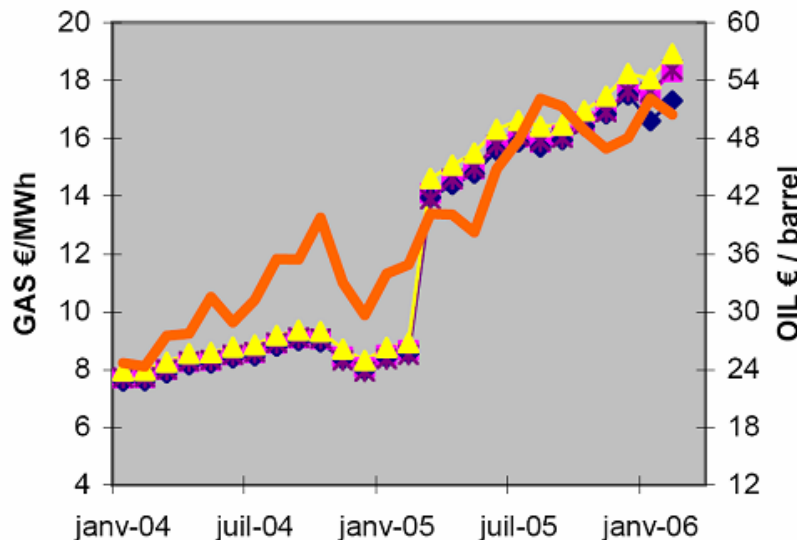
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be able to freely choose their energy supplier. The new European Regulators Group for electricity and gas will contribute to effective market opening in practice by promoting consistent approaches to market regulation throughout the Union”.

Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements

- Growth
- Globalization
- Liberalization
- **Rising Energy Prices**



Graph 7 Summary of border prices 2004-2006

- Germany (Norway/Russia)
- ◆ France (Norway/Russia)
- * Hungary (Russia)
- ▲ Italy (Russia/Algeria)
- Brent crude



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QUARTERLY REVIEW OF EUROPEAN
ELECTRICITY AND GAS PRICES

Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements

- Growth
- Globalization
- Liberalization
- Rising Energy Prices
- **Environmental Aspects (CO₂ Emission Certificates)**

Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements – Situation Denmark

Changes in the supply situation – Denmark may start import of natural gas from Germany

This is a non-binding translation prepared by Energinet.dk, the original document is written in Danish and prepared by DGC

An increase in gas supplied from other sources than Danish gas fields in the North Sea is expected. As a result of the liberalization of the gas market much of the gas flow will be controlled by market mechanism. In the short term this means that gas may be supplied from Germany to whom Denmark now exports gas.

ENERGINET/DK

July 2007

– Denmark may start import of natu-

erginet.dk, the original document is written in Danish

than Danish gas fields in the North Sea is expected. As much of the gas flow will be controlled by market gas may be supplied from Germany to whom Denmark

North German grid company, BEB, on the quality of an gas contains more methane than the Danish gas, lower than the gas supplied from the North Sea.

Based on the information from Germany, Energinet.dk has discussed the supply situation with The Danish Safety Technology Authority. From information received on variations in wobbe index and relative density The Danish Safety Technology Authority has concluded that there are no safety problems with regard to use of this gas in Danish gas consuming appliances. Later this year The Danish Safety Technology Authority will publish information on technical details describing the expansion of the wobbe index applied on the Danish market. The wobbe index expands from the current interval of 51.9 - 55.8 MJ/N³ to a new interval of 50.8 - 55.8 MJ/Nm³.

Gas Technology Centre (DGC) has prepared a memorandum German gas. DGC is of the opinion that introducing German gas to end users' safety. The necessity of preparing and updating will be evaluated by DGC. DGC also recommends that all information system operators working at the CHP plants and process companies are recommended to target all relevant information at

in the area from the Danish-German border to Egtved, and in gas supplied from the North Sea. Figures in the table below show density, upper calorific values, and methane numbers of the gas the North Sea and the gas that may be supplied from Germany. Energinet.dk - System operation / Gas quality - current information South will be available.

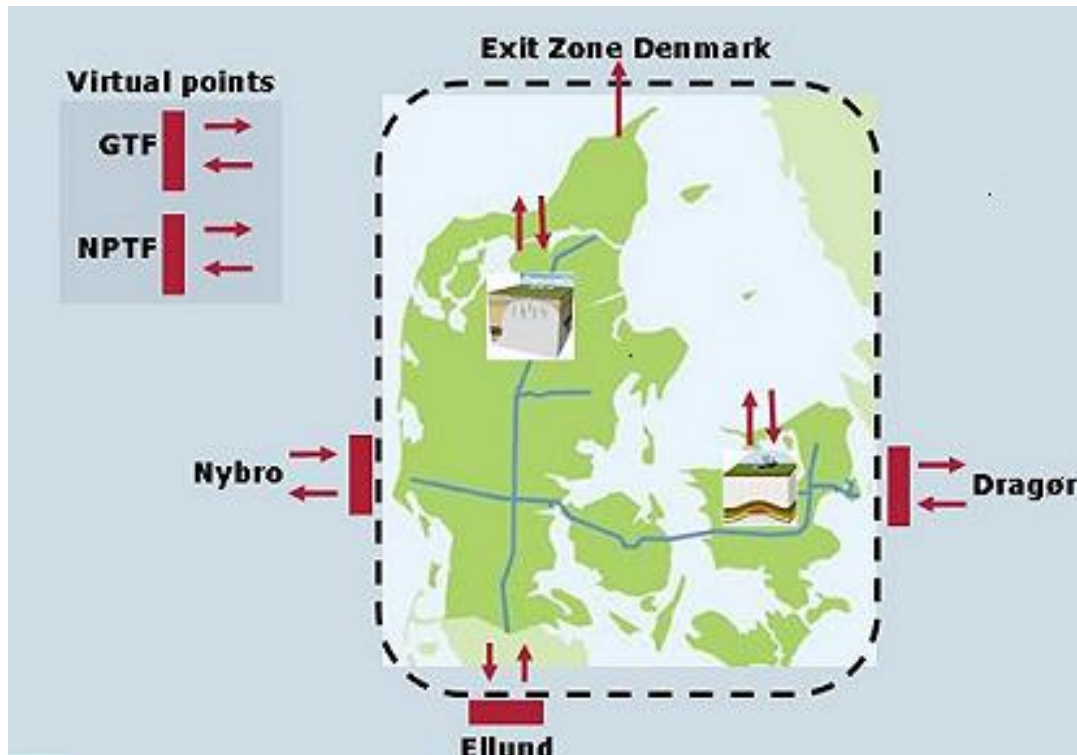
Danish gas 2006	Gas from North Germany (Heidenau)
– 55,8 MJ/Nm ³ – 15,5 kWh/Nm ³	50,8 – 53,6 MJ/Nm ³ 14,1 – 14,9 kWh/Nm ³
– 0,65	0,60 – 0,65
– 45,0 MJ/Nm ³ – 12,5 kWh/Nm ³	39,6 – 43,2 MJ/Nm ³ 11 – 12 kWh/Nm ³
72	80 - 85

Parameter	Danish gas 2000-2006	Gas from North Germany (Heidenau)
Wobbe index	54,0 – 55,8 MJ/Nm ³ 15,0 – 15,5 kWh/Nm ³	50,8 – 53,6 MJ/Nm ³ 14,1 – 14,9 kWh/Nm ³
Relative density (-)	0,63 – 0,65	0,60 – 0,65
Upper calorific values	43,5 - 45,0 MJ/Nm ³ 12,1 - 12,5 kWh/Nm ³	39,6 – 43,2 MJ/Nm ³ 11 – 12 kWh/Nm ³
Methane numbers (-)	68 - 72	80 - 85

For further information please contact:
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Increasing gas consumption and trade

Changes in gas market increase the need for energy measurements – Situation Denmark



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Increasing gas consumption and trade

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EASEE-gas - European Association for the Streamlining of Energy Exchange:

Parameter	Unit	Min	Max	Recommended implementation date
WI	kWh/m ³	[13.60]	15.81	1/10/2010
d	m ³ /m ³	0.555	0.700	1/10/2010
Total S	mg/m ³	-	30	1/10/2006
H ₂ S + COS (as S)	mg/m ³	-	5	1/10/2006
RSH (as S)	mg/m ³	-	6	1/10/2006
O ₂	mol %	-	[0.01]*	1/10/2010
CO ₂	mol %	-	2.5	1/10/2006
H ₂ O DP	°C at 70 bar (a)	-	- 8	See note **
HC DP	°C at 1- 70 bar (a)	-	- 2	1/10/2006

~ 49 – 57 MJ/m³

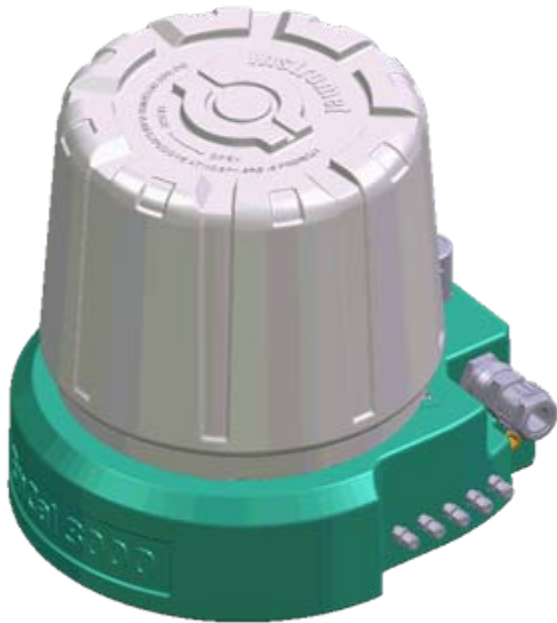
* EASEE gas have organised an oxygen measurement survey, which by end of 2005 will examine the maximum feasible limit equal to or at an alternative specified value below 0.01 mol%.

**At certain cross border points, less stringent values are used than defined in this CBP. For these cross border points, these values can be maintained and the relevant producers, shippers and transporters should examine together how the CBP value can be met in the long run. At all other cross border points, this value can be adopted by 1st October 2006.

Portofolio Gas Quality Measurement Devices

EnCal 3000: Gas Chromatograph
Highly accurate gas analysis, PTB-approval

gas-lab Q1: Correlative Measurement Device
Fast online gas measurement, good performance/price, PTB-approval



EnCal 3000



gas-lab Q1

EnCal 3000

- MEMS Technology applied
- Multi streams
- No controller required
- Small compact outdoor housing

Communication ports:

- 2 x Modbus RTU/ASCII
RS-232 or RS-485
- TCP/IP connection

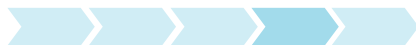


MEMS technology

By using Micro Electro Mechanical System components performance is improved



- Two analytical channels for parallel measurement of N_2 , CH_4 , C_2 , $CO_2 + C_3 \rightarrow C_6^+ \text{ or } C_9$
- EPC (electronic pressure control) maintains constant column head pressure
- Use of Micro Electro Mechanical System components results in unique stability



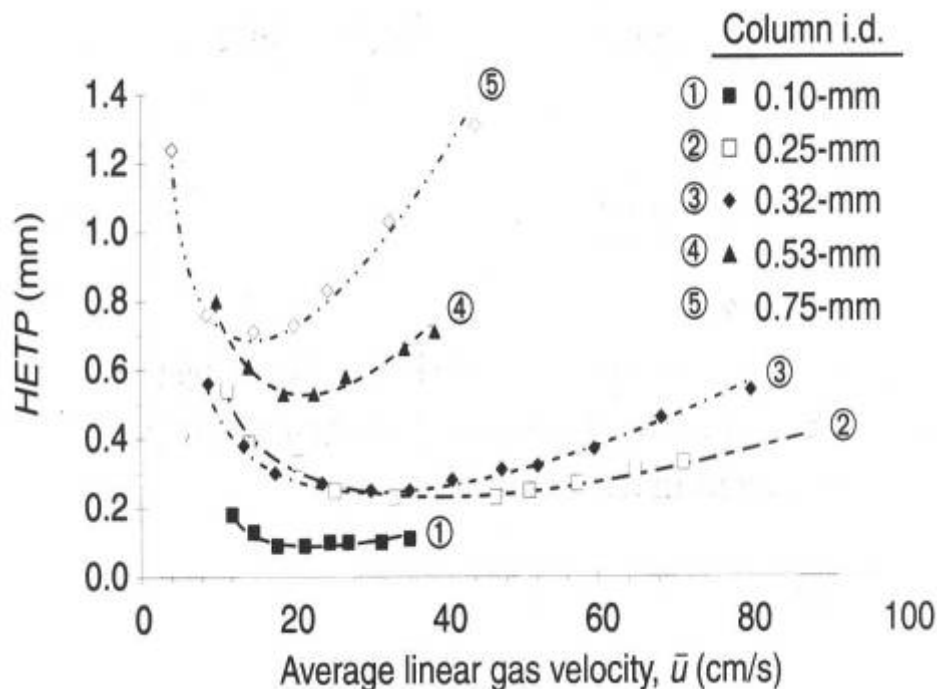
MEMS technology

By using Micro Electro Mechanical System components performance is improved

MEMS detector results in increased sensitivity and linearity

MEMS injector results in additional flexibility and high repeatability

Capillary column results in fast analysis with optimal peak separation



Low Helium consumption

Reduced internal volumes result in very low Helium consumption

Typical Helium consumption:

- Both Channels use about 8 ml/min each.
- Electronic pressure control uses about 2 ml/min.

Total consumption per year is approx. 10.000 Liter

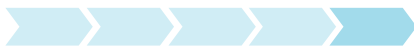
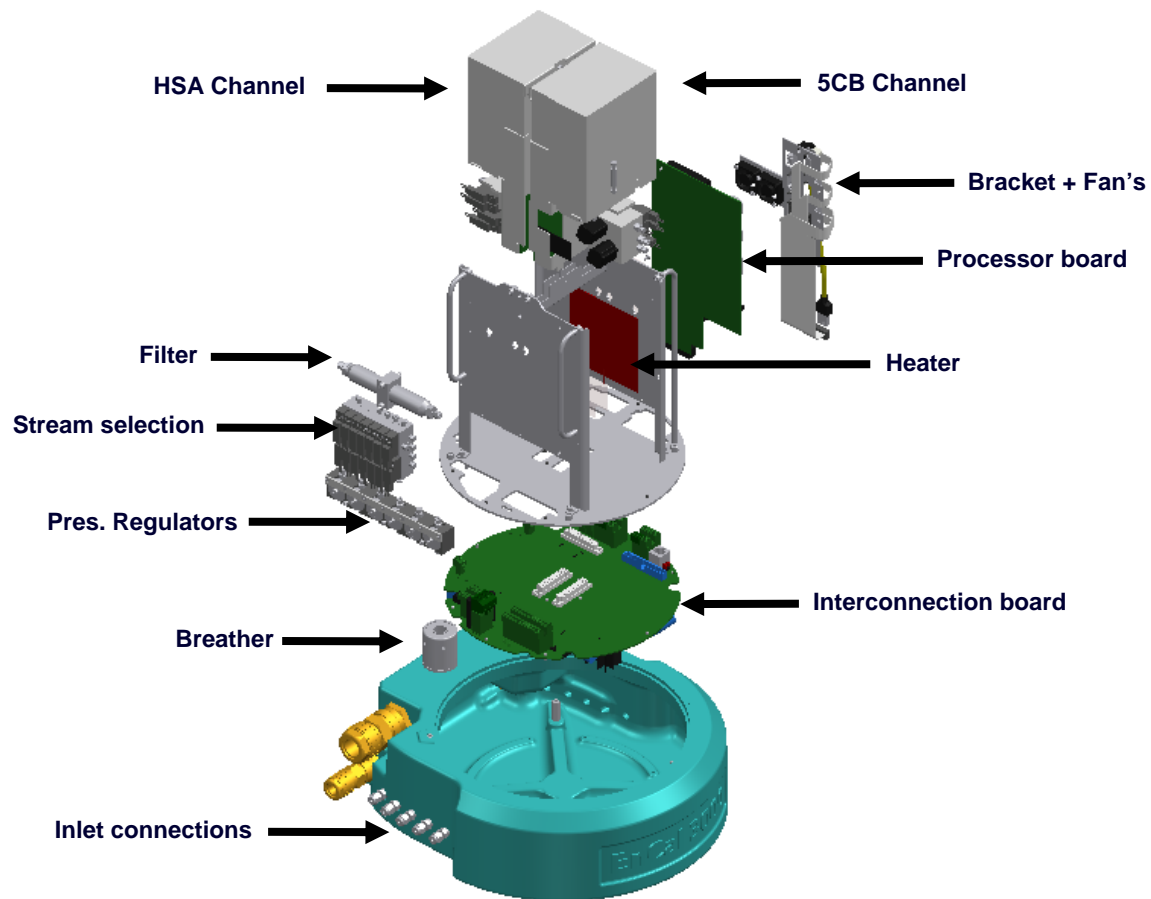
This equivalents approximately:

1 x 50L bottle @ 200 bar per year



Modular concept

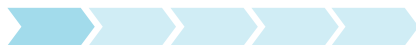
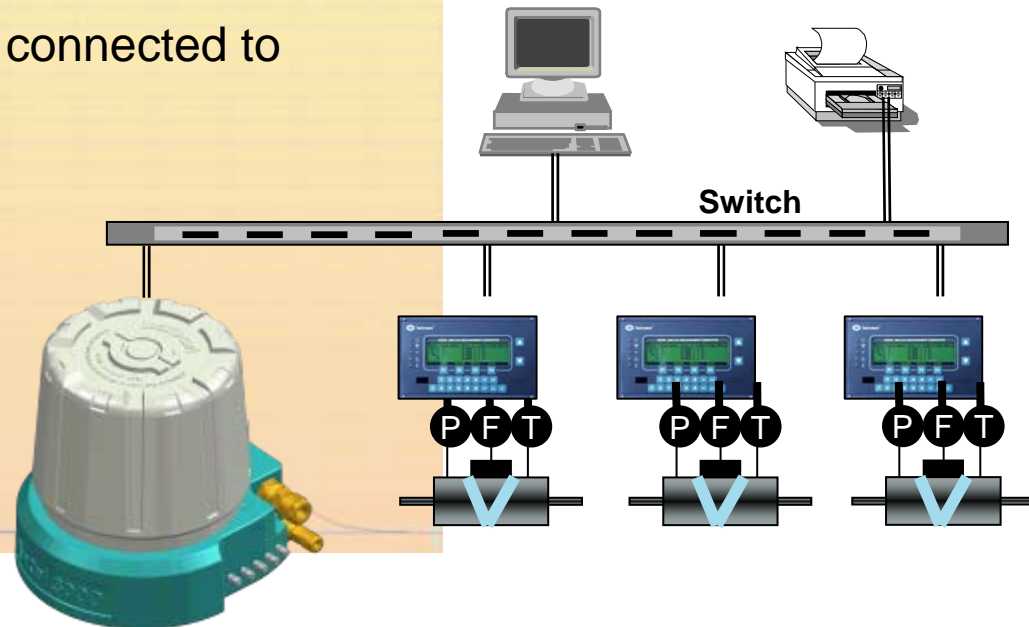
Easy replacement and reduced downtime because of modular concept of analytical hardware



TCP/IP connection

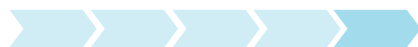
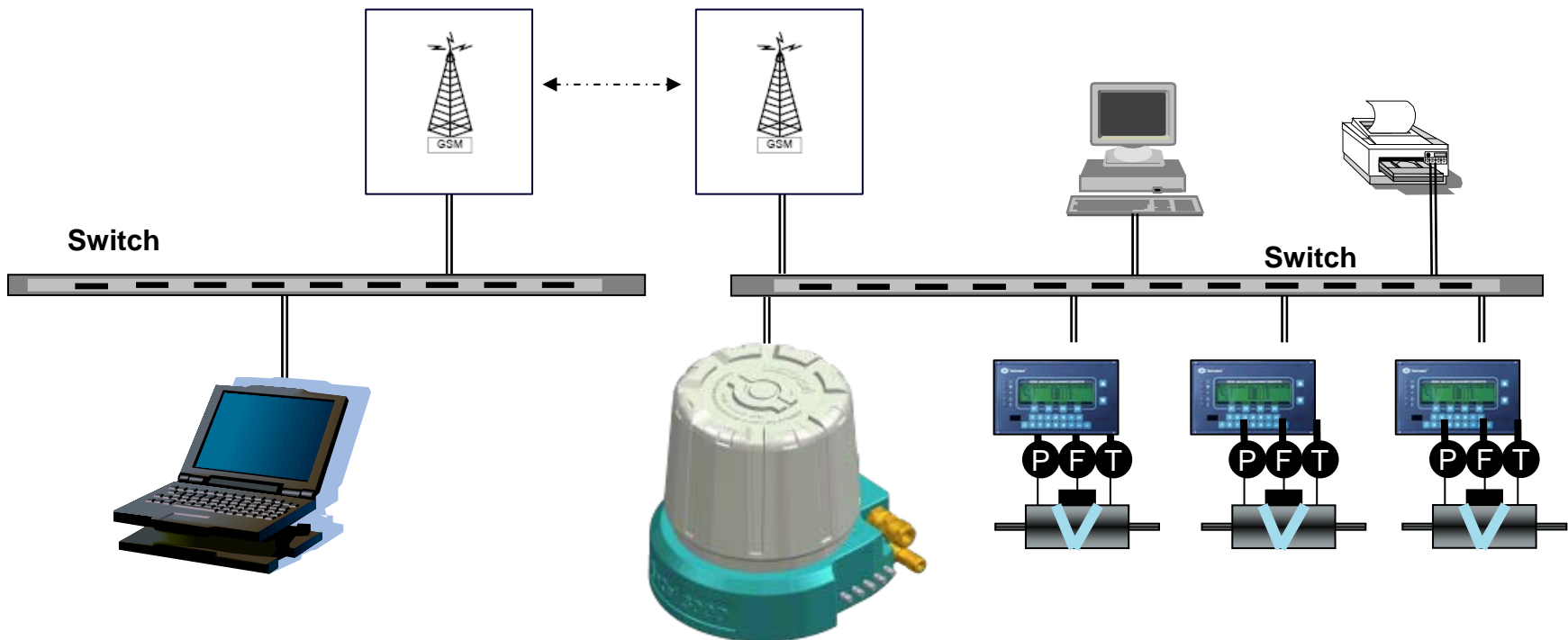
Ethernet connection reduces cabling cost and simplifies system architecture

- Full configuration via Ethernet
- No special connection needed, no additional wires
- Modbus over TCP/IP
- Multiple PC's can connect to one GC
- Multiple Flow Computers connected to the GC



Remote control / Network connectivity

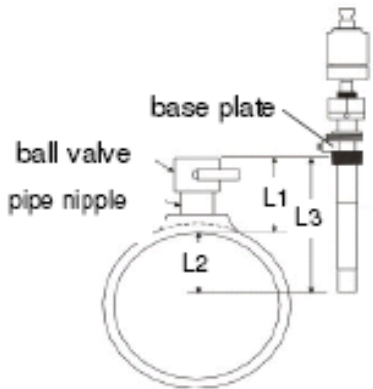
Remote service via the TCP/IP network connection reduces travelling and service costs and reduces downtime....



Small errors add up

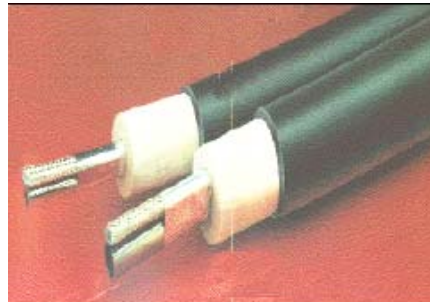
By reducing relatively small errors BIG savings are realised

Sampling....



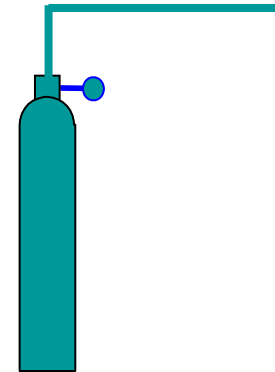
Error up to 0.10 %

Sample Transport and Conditioning



Error up to 0.10 %

Calibration gas....



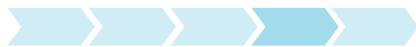
Error up to 0.20 %

The analyzer



Error up to 0.25 %

Total Error?



Small errors add up

By reducing relatively small errors BIG savings are realised

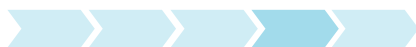
0.1 percent difference in Euro's

$$\begin{aligned}
 36''/25 \text{ bar} &\rightarrow Q_{\text{MAX}} &= & 1.625.000 \text{ nm}^3/\text{h} \\
 &Q_{\text{MAX}} &= & 14.2 \text{ E}9 \text{ nm}^3/\text{Year} \\
 &20 \% Q_{\text{MAX}} &= & 2.8 \text{ E}9 \text{ nm}^3/\text{Year}
 \end{aligned}$$

$$1 \text{ m}^3 = 11 \text{ kWh} \quad \rightarrow E = 30.8 \text{ E}6 \text{ MWh/Year}$$

$$\text{AT } 0,1 \% \text{ Deviation} \quad \rightarrow 30.800 \text{ MWh/Year}$$

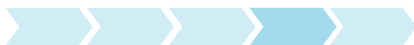
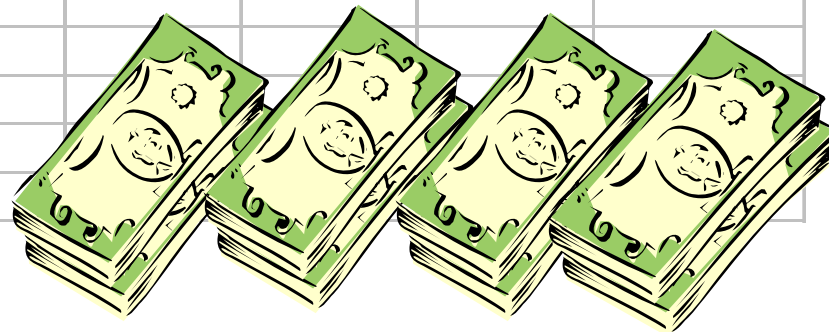
$$1 \text{ MWh} = 10 \text{ EURO} \quad \rightarrow 308.000 \text{ EURO/Year}$$



Small errors add up

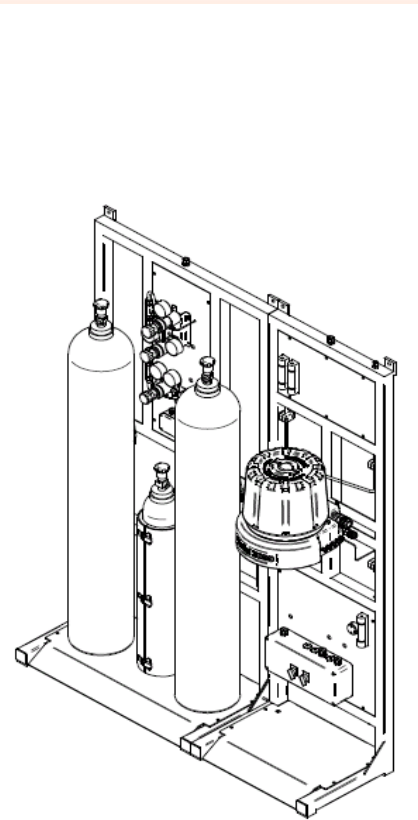
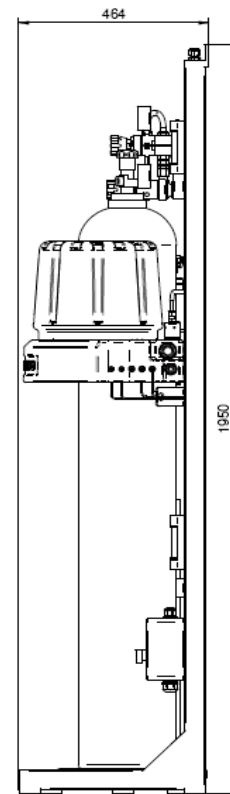
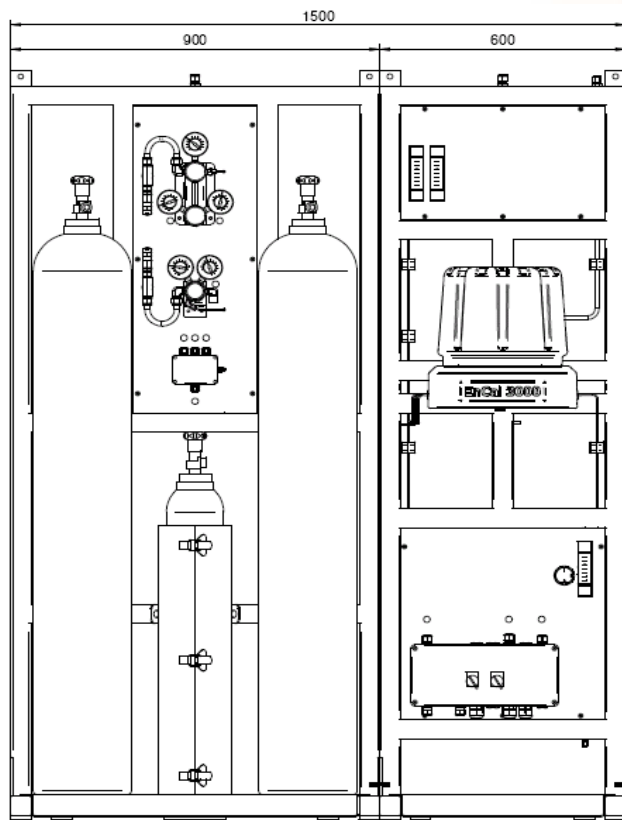
By reducing relatively small errors BIG savings are realised

		P (bara)					
Size (inch)	Q-max	16	25	40	50	60	96
20	19000	23.435	36.617	58.587	73.234	87.880	140.609
24	28000	34.535	53.962	86.339	107.923	129.508	207.213
30	45000	55.503	86.724	138.758	173.448	208.138	333.020
36	64000	78.938	123.341	197.345	246.682	296.018	473.629
42	85000	104.840	163.812	262.099	327.624	393.149	629.038
% Qmax	20%						
Mw/m ³	0,011						
Accuracy gain	0,1%						
Price per MW	4						



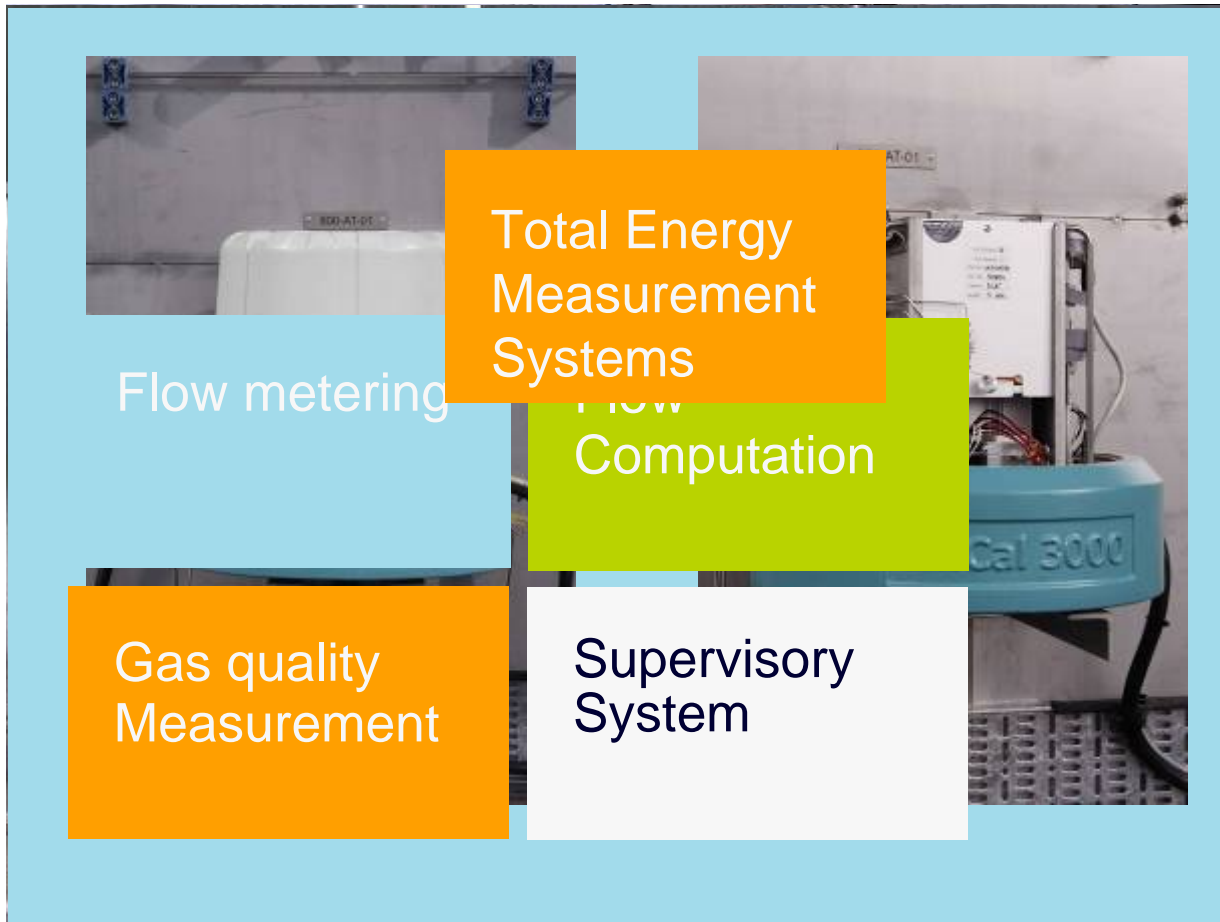
Complete analyzer skids

Analyzer skids including all accessories reduces installation time



One stop shopping

As a total system supplier Elster Instromet will be a single point of contact....



- Single contact
- Compatibility
- Diagnosis advantages through total energy measurement concept

Thank you

