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- Renewable energy market
- Long term future use of gas grids
- New concepts and their needs for metering
  - Power to Gas (P2G)
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- Conclusions
Elster Precision Solutions
Elster Precision Solutions – Skid and Stations for Oil and Gas

Gas & Liquid Metering Skids
- Skid mounted fiscal metering systems for:
  - LNG metering
  - Border stations
  - City gas distribution
  - UGS systems
  - Industrial client connections
  - Calibration Facilities
  - Power plant metering skids

PRMS – Biogas - CNG Station
- Pre-packaged metering & pressure regulation stations:
  - Fiscal metering skids
  - CNG filling installations
  - Fuel Gas Conditioning Systems for power plants
  - Bio Methane grid injection systems

Loading and Blending Skids for Terminals
- Products and systems for tank terminal operations:
  - Volume provers
  - Blending systems
  - Loading systems
  - Additive injection
  - Tank gauging
  - Sampling solutions
  - Custody transfer management
  - Terminal management system

Advanced Applications
- Smart solutions for optimizing process and enterprise Processes:
  - MeterSuite™
  - Meascon™, Continuous Meter Diagnostics
  - Advanced alarm management
  - Asset Sentinel
  - Uniformance PHD (Historian)
  - Mobility Solutions

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Comprehensive Portfolio

Controllers, PLC, RTU, Safety Shutdown systems

Loading gantries, skids & controllers

Engineering & Support Services

Oil & Gas Suite:

Process Safety
- Alarm Management
- Shut-Down Analysis
- Safety Valve Analysis
- Barrier Testing

Equipment Effectiveness
- Equipment Integrity
- Transmitter Monitoring
- Control Valve Performance
- Corrosion Prediction

Production Excellence
- Operations Management
- Integrated Planning
- Production Management
- Operator Competency
- Process Control & Optimization

Operational Data
- Process History & Analytics

Production Surveillance
- Well Test Validation
- Well Surveillance
- Well Test Management

Operational Performance
- Enterprise Collaboration
- Performance Management

Flow computing and analysers

Meter provers, valves sensing, corrosion

Solutions to Improve Safety, Productivity & Reliability
Gas & Liquid Metering Applications – Installed base

- Gas flowmeters: >500,000
- Regulators: >250,000
- Stations and Skids: >4,000
- CNG stations: >180
- Bio methane Injection: >150

> 500,000 industrial meters & > 4000 Skids and stations

> 300 Trillion m³ gas measured

Total measured m³ of gas in last 20 yrs
> Global gas production in 2015

> Global gas production in 2015
> 300 Trillion m³ gas measured
Ethane Metering Skid for Hess Tioga, USA

Supplied scope

• Dense Phase Ethane Meter skid
• Honeywell Calibron Prover
• MeterSuite on Experion
• Honeywell Field Instruments
• Honeywell F&G detectors
• Skid in a Shelter with HVAC system

Delivery model

• Application design by Honeywell
• Manufacturing design by Approved Fabrication Partner
• Fabrication by approved partner in Houston – staging by Honeywell
• Project Management & Consulting by Honeywell
We provide Modular skid-mounted, pre-packaged solutions or complete PRMS Stations & metering Skids integrated with scalable control systems and advanced meter data management to help customers manage their gas supply.

A One shop stop solution provider for

- Pressure reducing skids
- Metering skids
- Other Station equipment like Filters, Heaters, Odorizors
- Honeywell Elster designs, engineers and manufacture every type of pressure reducing station: high pressure, medium and low pressure, above and underground.
- Fabrication and Testing
- International approvals
- Global Integration and service capability

High availability, Compact design and Precise measurement solutions.

Honeywell ELSTER® Precision Solutions
Go Beyond Metering, Optimize with Precision
Renewable Energy Market
Market Drivers

Growing global demand for Energy

Climate Change

Security of Supply

Cost for Energy
(Renewable) Energy Trends

Global Demand

- Renews, Growth

- Renewables in Electricity Generation


- Very mature form of renewables in different stage of development cycle as most other modern renewables

- ‘Informal’ energy use for cooking/heating in underserved communities (e.g. small scale biogas)

Source: REN21; Renewables 2016 global status report
COP21 Paris Climate Agreement

- Keep global warming < 2 °C efforts to limit it to 1.5 °C
- Green house gas emissions to peak a.s.a.p.
- Developed/rich countries to share burden
- Need to limit losses due to climate change for vulnerable countries
Honeywell & Renewables / Alternative Fuels

- Bio Methane/Hydrogen/Unconventional gas - Grid Injection Systems
- CNG Filling Stations*
- Windmill/Solar park Automation Systems
- Environmental Friendly Refrigerant ‘Solstice®'
- Green Diesel™
- RTP™ Technology for Biomass Conversion
- Renewable Jet Fuel

* Still no mainstream fuel for transport therefore considered here as ‘alternative fuel’
Future of the Natural Gas Grids
Long Term Future Perspective of Gas Grids

National Grid’s Vision for a Sustainable Gas Network

- Conventional gas
- Unconventional gas (e.g. Shale)
- LNG
- Bio Methane (Renewable Natural Gas)
- SNG (Synthetic Natural Gas from e.g. gasification processes)
- Hydrogen or CH₄ from Power to Gas

Source: Renewable Gas - Vision for a Sustainable Gas Network - A paper by National Grid
Long Term Future Perspective of Gas Grids

Needs to accommodate this new trend:

- **New legislation and standards**
  - Gas quality must be guaranteed
  - Risk of non compliant gas in the grid minimized
  - Effects of Hydrogen in the grid

- **Incentives** to promote the development of renewable energy production sites

- **Long term: solve safety issues related to hydrogen transport**
  - Odorization
  - Leakage / pipeline integrity
  - Flame detection

- **Metering and control systems** ensuring safe access to the gas grid
Power to Gas
Power To Gas

• Electricity Grid limitations result in Access electricity that can not be fed into the grid

• Access electricity from renewable sources require storage

• Most conventional storage principles are not suitable or have too limited capacity

• Power to Gas converts electricity into Hydrogen by Electrolysis

• Several ways to use Hydrogen and to store it
Power to Gas – Hydrogen Economy

Green hydrogen economy in the Northern Netherlands
Green Hydrogen (H2) will play an important future role in a sustainable energy system:

- For worldwide transport and storage of large scale low-cost renewable energy.
- To supply a green feedstock to the chemical industry.
- To supply a green fuel to the transportation sector.
- To balance the electricity system, seasonally and weekly, from local to national level.

Source: ‘Noordelijke Innovation Board’
Metering Needs (P2G - process example)

1. Process Metering Analytical systems (gas chrom.)
   - CH₄ 0-x %
   - CO₂ 0-x %
   - H₂ 0-x %

2. CH₄ to Grid metering system:
   - Flow
   - Composition

3. Car Filling Station LNG/CNG

98,5 % CH₄, 1,5 % CO₂

Gas Grid
Compressed Natural Gas (CNG) - Filling Stations
CNG Filling Stations

• What is it?

CNG is Compressed Natural Gas.
Natural Gas engines emit the lowest level of greenhouse gases (Vs gasoline, diesel, electric, hybrid, fuel cells engines) and are the most efficient ones (consume the least amount of energy); CNG engines will:
  • Reduce oil demand 8% by 2020
  • Improve security of energy supply
  • Balance oil price
  • Reduce greenhouse gases by 25%

Honeywell for CNG includes:
• Consultation & design
• Manufacturing of the full CNG filling stations, including Gas Compression, storage, filling systems.
• Gas Regulation Stations
• On-site installation
• Commissioning
• Turn-key package
CNG Filling Stations

The CNG station consists essentially of:

- Inlet system suction side
- Compressor
- Dryers as well as condensate and oil separators
- High pressure storage
- Filling control
- CNG- Dispenser
- PLC technology
- Card reader or POS system (optional, depending on application)
Working Principle of CNG Filling Station

Selection Valves Filling Pressure

- Filters and Dryer
- Gas Compressor
- Condensate removal, moisture meter, temp sensor
- Cooling Fan's

Outlet sections to dispenser 1…n with safety devices and Coriolis flow meters

High pressure buffer
Med. pressure buffer
Low pressure buffer
Points off Data Acquisition

Data points:
- Flow
- P & T
- Corrected flow
- Other...

Data points:
- Pressure
- Temperature
- Storage volumes
- Oil level
- Etc.

Data points:
- POS information
- Nr. of Batches
- Corrected flow
- Etc.

1. Controlling Geographically dispersed equipment
2. SCADA System
3. On-Process (Real Time)
4. Private Cloud Hosted

Telco Network

Virtual Network

Firewall

VPN Gateway

Experion Servers

Gas Grid

Gas metering system

CNG system

Dispenser
Bio Methane Grid Injection
Bio Methane Grid Injection

**yesterday**

Raw Biogas
Conversion to electricity and heat with local CHP's

- **electricity**
- **CHP** (combined heat & power)

60% CH₄
40% CO₂

- Heat can not be used on many locations

**today**

98 % CH₄
2% CO₂

Bio methane
Upgrading = removal of CO2

Gas grid
- electricity
- heat
- fuel

**Grid Injection is the More Efficient use of Biogas**
Bio Methane Grid Injection

- Fiscal measurement (billing)
- Quality control
- Cv control (e.g. propane addition)
- Pressure reduction
- Odorisation
- Compression
- System control/telemetry of data
Schematic Diagram of Grid Injection Solution

Isolation valve + Filter
Optional sampling point + flow meter
Propane injection + mixer
Liquid sensor Gas Quality sampling GC
P and T sensor
Electrical Ball valve
Main Flow Meter
Pressure reduction + Non Return Valve
Manual sampling point

- P<10 bar → Propane Vaporizer
- P>10 bar → Liquid propane addition
- Propane flow meter

Grid Entry Unit - metering room

Optional
Standard

Return Line – off spec. gas

Control and telemetry system

Biomethane

Gas Grid

Separate compartment
Odorant injection
Remote Operable Valve (grid owned)
Bio methane Grid Injection

- +---+  
| Buffer |  
+-------+  
        |  
        v  
        +---+  
        | Pressure Reduction |  
        +-------------------+  
               |  
               v  
               +---+  
               | Flow Metering |  
               +-------------+  
                      |  
                      v  
                      +---+  
                      | Supervisory system |  
                      +-------------------+  
                             |  
                             v  
                             +---+  
                             | Gas Analysis (Fiscal) |  
                             +-------------------+  
                                   |  
                                   v  
                                   +---+  
                                   | Telemetry |  
                                   +-----------+  
                                          |  
                                          v  
                                          +---+  
                                          | ROV |  
                                          +-------+  

- +---+  
  | Grid operator |  
  +-------------+  

Biomethane supplier
Biomethane to Grid Injection Systems
Gas Quality Parameters / Cv measurement

- EnCal 3000 Biogas
- EnCal 3000 THT
- Moisture sensor

Gas Quality Metering Key to ‘Safe’ Grid Injection

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>EnCal 3000 Biogas</td>
<td>Gas chrom.</td>
<td>N₂, CH₄, O₂, CO₂, CO, H₂ (optionally), H₂S, COS</td>
<td>0 - 16 %, 60 - 100 %, 0 - 4 %, 0 - 8 %, 0 - 5 %, 3 ppm &lt; 1 %, 5 ppm &lt; 1 %</td>
<td>50 ppm</td>
<td>0.03 %</td>
<td>0.2 %</td>
<td>2 minutes</td>
</tr>
<tr>
<td>EnCal 3000 THT</td>
<td>THT</td>
<td>Ethane, Propane, n-Butane</td>
<td>0 - 12 %, 0 - 6 %, 0 - 3 %</td>
<td>5 ppm</td>
<td>0.03 %</td>
<td>0.2 %</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Michell Easidew Pro</td>
<td>Infrascale hygrometer</td>
<td>Water dew point</td>
<td>-100 to +20°C</td>
<td>7.9 mg/m³</td>
<td>0.5 °C</td>
<td>3 °C</td>
<td>&gt; 5 min.</td>
</tr>
</tbody>
</table>
The Intelligent Gas Solutions Across The Gas Value Chain

**Reduced risk** through field-proven technology within many installations to certified global energy standards

**Improved accuracy** of measurement under with no carrier gas / burner air or special calibration mixtures

**Improved measurement confidence** as verified by NMi

**Improved performance** of your process through faster measurements

**Improved reliability** through state of the art sensors and electronics

Proven Technology. Superior Performance
GasLab Q2: correlative energy measurement

All in one analyzer
- Built in sample system
- Modular setup
- Graphical touch display.
- Built-in web server for remote front panel
- Data storage of 1 year possible
- Modbus serial and TCP/IP.
- MID approved by NMi (Class A) acc. to OIML R140
- FM / ATEX / IECEx approved
- CSA pending

Fully Compliant with North American Market Needs
Bio Methane Grid Injection

Highly Integrated / Standardized Solution

- Flow computation
- Valve control
- Blending control
- Data transfer
- HMI

- Flow metering
- Pressure/Temp.
- Valves for grid access/rejection
- Gas Sampling
- LPG addition

- Last port to the grid
- Operated by gas Network owner

- Gas composition
  - CV/H2S/O2
  - H2O dewpoint
  - Odorisation system
  - Gases (GC)

- Gas data telemetry
  - Landline/GSM/satellite
  - SCADA in cloud

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GRdF Solution (France)

1. Control System + telemetry
2. Odorization
3. Metering + Analyzer system
   - 50-1000 m3/hr
   - Up to 16 Barg standard, or High pressure for Transmission grids including compressors
Conclusions

• Renewable Industry Growth Requires New Metering Solutions

• Traditional Gas Companies Are Investing In De-Carbonisation Of Their Operations

• Honeywell Has Extensive Experience In The Renewable Gas Market (Bio Methane) And Is Well Equipped For New Markets Like Power to Gas (PtG)

• Decentralized Energy Production and Dispersed Metering Assets Require New Approaches Like SCADA In The Cloud (Experion Elevate)

HONEYWELL ELSTER PRECISION SOLUTIONS
YOUR PARTNER FOR METERING IN RENEWABLES