


Energy determination when non-conventional gases are injected into gas networks

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OF THE EUROPEAN NATURAL GAS INDUSTRY

Dr. Stefan RICKELT

Chairman Marcogaz TF Conversion m³ to kWh

Co-Founder, Product Manager SmartSim GmbH

Energy determination

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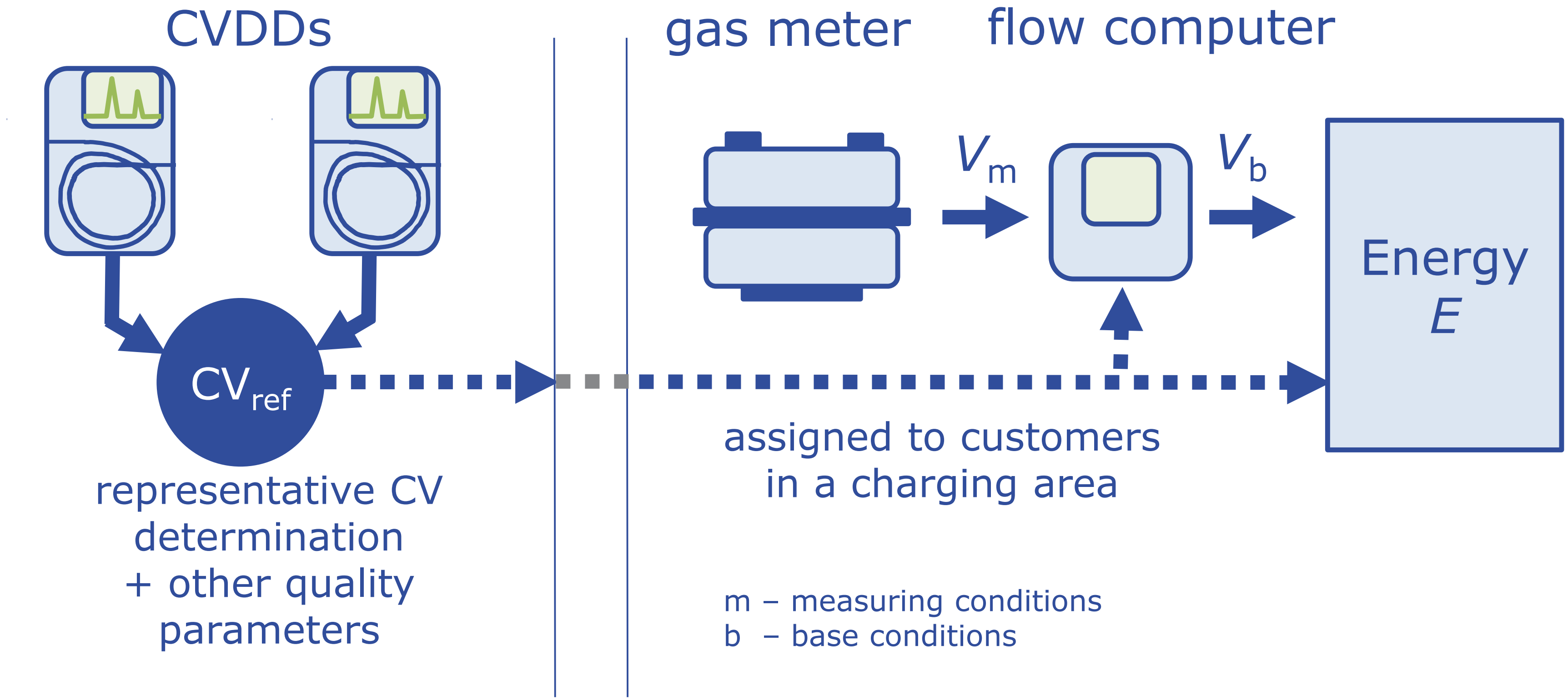

- Energy is determined from volume and energy content (GCV) at base conditions
- Volume is measured locally, not possible for GCV
- GCV is usually determined at designated locations in the grid e.g. entry points
- A representative GCV is determined and assigned to customers in a charging area

Non-conventional gases

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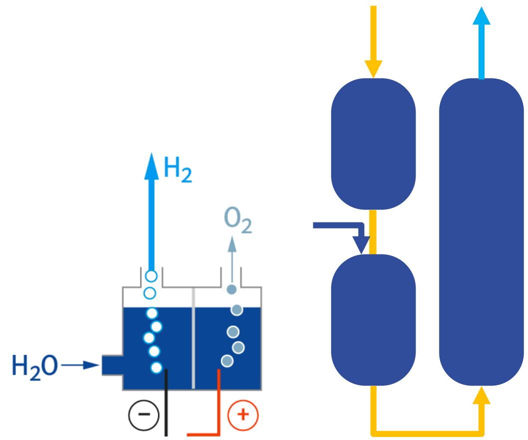
Biomethane

GCV:
~ 10.6 - 11.0 kWh/m³



Hydrogen
(mixed with natural gas)

GCV:
3.5 kWh/m³ (100 % H_2)
~ 10.2 kWh/m³
(20% H_2 / 80 % natural gas)

Syngases, (bio-) synthetic methane

GCV = ?

- Prerequisite: Non-conventional gases shall be interchangeable

→ Gross Calorific Value (GCV) differences of 6 - 15 % compared to typical natural gases

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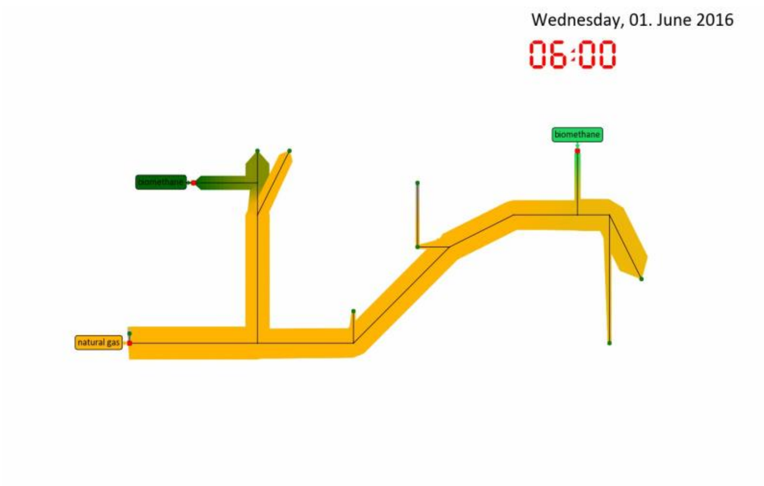
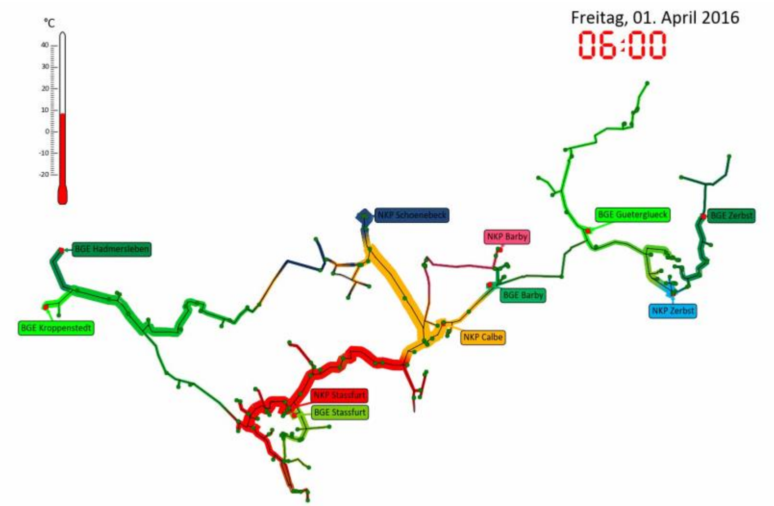
How are representative GCVs determined?

- This depends on differences in gas qualities, grid configuration and volumes injected
- Two examples with real data showing the different gas flows





→ Different networks may require different solutions

Marcogaz Taskforce

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- To address these questions, Marcogaz set up the

Task Force for conversion of m³ to kWh when non-conventional gases are injected in the gas network

Scope

- Account for the injection of non-conventional gases with different gas qualities in the networks
- Describe and compare different methods to determine CV and compressibility factor at each metering point
- Consider the cost effectiveness and the metrology aspects of each method, which may lead to various solutions for the different types of metering points.

See also 2006 Marcogaz "Guidance note on energy determination" GI-EM-06-05 to determine the consumed gas volume in energy

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I. What are gases of different qualities? Definition of criterion

- Perspective of the customer
- Recommended uncertainties for the representative GCV over the billing period assigned to a charging area

Accuracy Class	A	B	C
Representative GCV determination	0.60 %	1.25 %	2.00 %

- classes could be interpreted as: class A: City gates and large industrial use; class B: Industrial use; class C: Residential and commercial use
- **Recommended uncertainties are not allowable differences between the GCV of natural gas and the non-conventional gas**
- **Gas quality parameters are specified in corresponding standards, e.g. EN 16726 and EN 16723-1**

Differences in gas qualities when non-conventional gases are injected

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Consequences

If over the billing period, the differences between the average GCV and each entry CV

1. is smaller than the allowable uncertainty
   this average GCV can be applied as representative GCV

   → in this case the 2006 Marcogaz "Guidance note on energy determination" GI-EM-06-05 remains valid.

2. is larger than the allowable uncertainty
   measures need to guarantee that each customer receives a correct billing GCV within the uncertainty limits according to his class (A, B or C)

- Some customers (e.g. class A) may require additional measures, e.g. a local CVDD

II. Suggested Measures

1. Assign the same gas quality parameters to all exit points
2. Create local charging areas
3. Install additional CVDDs at appropriate points in the network
4. Computational Gas Quality Tracking
5. Match the GCV of the different gas sources by conditioning
6. Limiting the injection of a gas source

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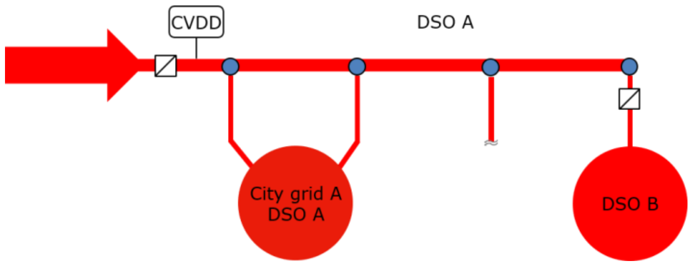
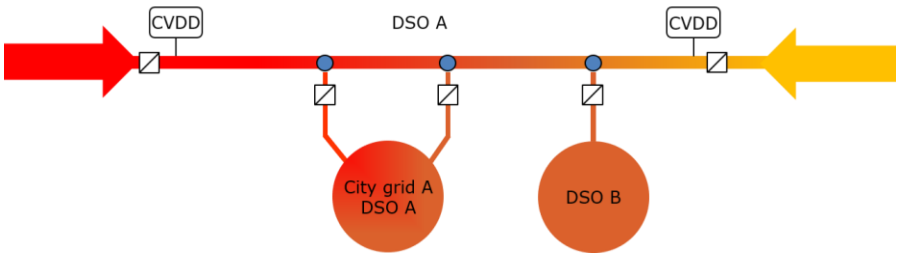
III. Definition of Use Cases

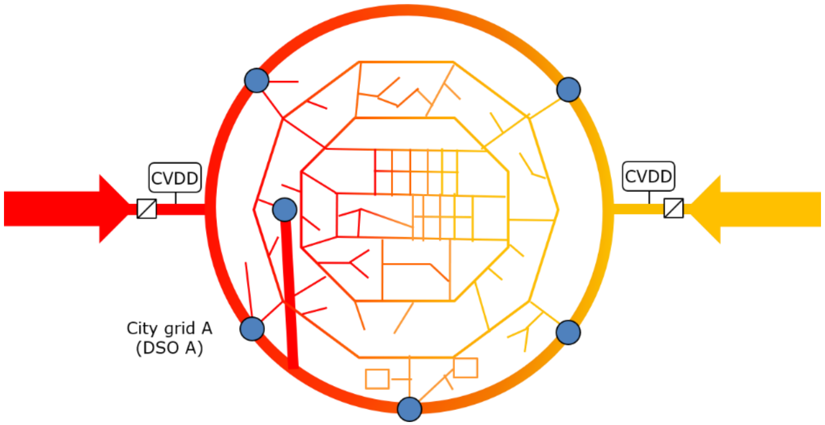
- 1: One entry



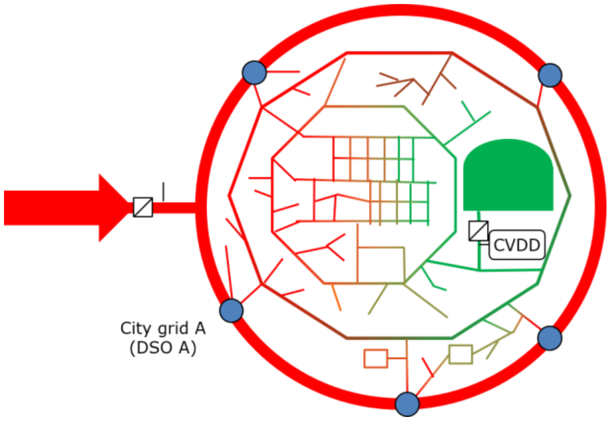
- 2:Several entries



- 3: High complexity meshed city grids



- 4: High complexity, meshed city grids with local non-conv. source



IV. Application of Suggested Measures to Use Cases

- Green: feasible
- Red: not recommended; difficult, expensive or impossible
- Yellow: potential feasible; case study required
- Grey: does not apply

T: technical feasibility
E: economical feasibility

Suggested Measures			Use Case 1	Use Case 2	Use Case 3	Use Case 4
Assign the same gas quality parameters to all exit points	Billing end-users with the lowest GCV	T	does not apply	potential feasible; case study required	potential feasible; case study required	potential feasible; case study required
		E	does not apply	not recommended	not recommended	not recommended
	Billing end-users with the average GCV	T	feasible	only possible if gas quality differences small (see Chapter 3 and footnote[4])		
		E	feasible			
Create local charging areas		T	feasible	potential feasible; case study required	potential feasible; case study required	potential feasible; case study required
		E	feasible	feasible	feasible	feasible
Install additional CVDDs at selected points in the network		T	does not apply	feasible	potential feasible; case study required	potential feasible; case study required
		E	does not apply	potential feasible; case study required	not recommended	not recommended
Computational Gas Quality Tracking		T	feasible	feasible	potential feasible; case study required	potential feasible; case study required
		E	feasible	feasible	potential feasible; case study required	potential feasible; case study required
Match the GCV of the different gas sources by conditioning		T	does not apply	potential feasible; case study required	potential feasible; case study required	potential feasible; case study required
		E	does not apply	potential feasible; case study required	potential feasible; case study required	potential feasible; case study required
Limit the injection of a gas source		T	possible, but could be in contradiction to the National Regulator's requirements			
		E				

Creation of local charging areas, installation of additional CVDD and use of computational Gas Quality Tracking may have to be combined to find a solution for Use Cases 3 and 4

Recommendations

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- Grid operators should pro-actively gather information on renewable gas projects and evaluate new projects jointly with the producer.
- A specialized team should be prepared to cope with injection requests.
- Detailed knowledge of grid behavior requires time, technical expertise and financial capacity. The grid operator should develop this knowledge in advance.
- Evaluation often requires a grid simulation software and a computational model of the specific grid. Timely attention should be given to all information systems, where input data resides:
    - GIS with up-to-date grid topology and condition, as well as valve and regulator settings;
    - energy data management and billing system. Such systems need to be capable of handling different charging areas;
    - interfaces between the different software systems need to be established.

Outcome

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- Injection of non-conventional gases in the natural gas grid increases gas quality variations.

- State-of-the-art solution to assign one representative GCV to all metering points may not be applicable with respect to allowable uncertainty limits.

- The right solution will depend on the network configuration, the location of the injection and the GCV differences → definition of Use Cases.

- A series of guidelines are suggested for these Use Cases, e.g.
  - charging areas and installation of GCs in grids with few stable zones;
  - gas quality tracking in grids with dynamic mixing zones;
  - matching of GCV when one the non-conventional source is small.

- The solution for complex grids will often require a combination of different measures.

- **Choice of the injection location could avoid major investment in additional measuring systems in the grid.**

Thank you !

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TECHNICAL ASSOCIATION
OF THE EUROPEAN NATURAL GAS INDUSTRY
Avenue Palmerston 4
1000 Brussels
BELGIUM
T:+32 2 237 11 39
www.marcogaz.org