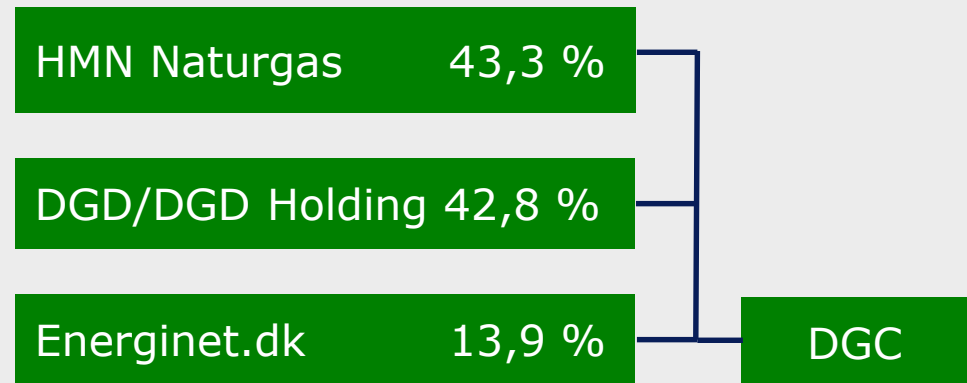




DGC and R&D

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DGC

- R&D on behalf of owners
- Focus on value for gas customers, DSO or TSO
- Laboratory with up to 2 MW fired capacity
- Accredited gas quality lab with several GC for detailed gas analysis





DGC R&D Projects overview

- Energy system research
- Technology development
- Gas quality work
- Methane emissions
- Hydrogen

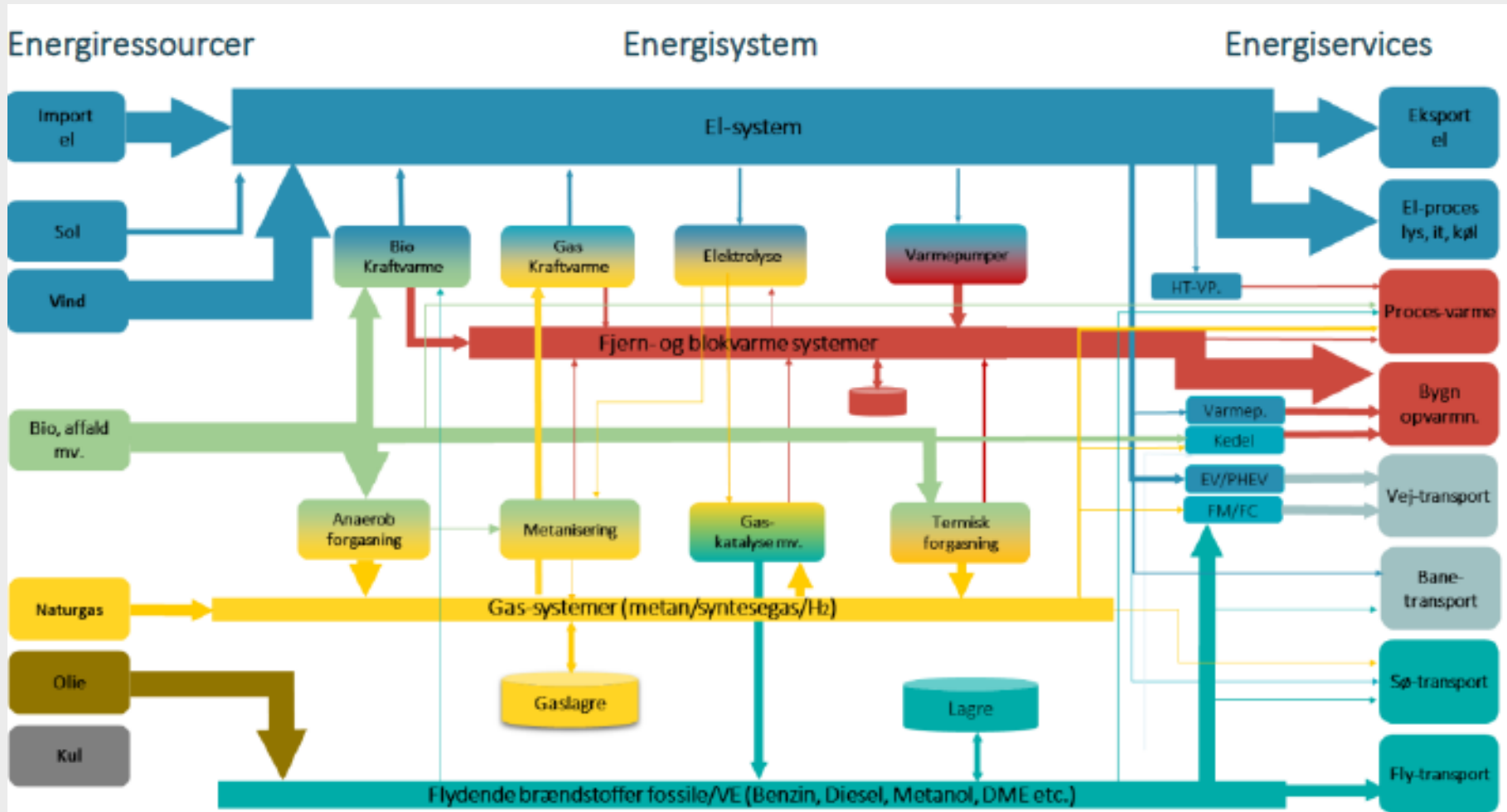
SEMI (Sustainable Energy Market Integration)

- Model of DK energy system
- Power system TSO grid (some 50 node points/DSO transfer)
- District heating system (18 areas/types)
- Gas system (M/R stations level)

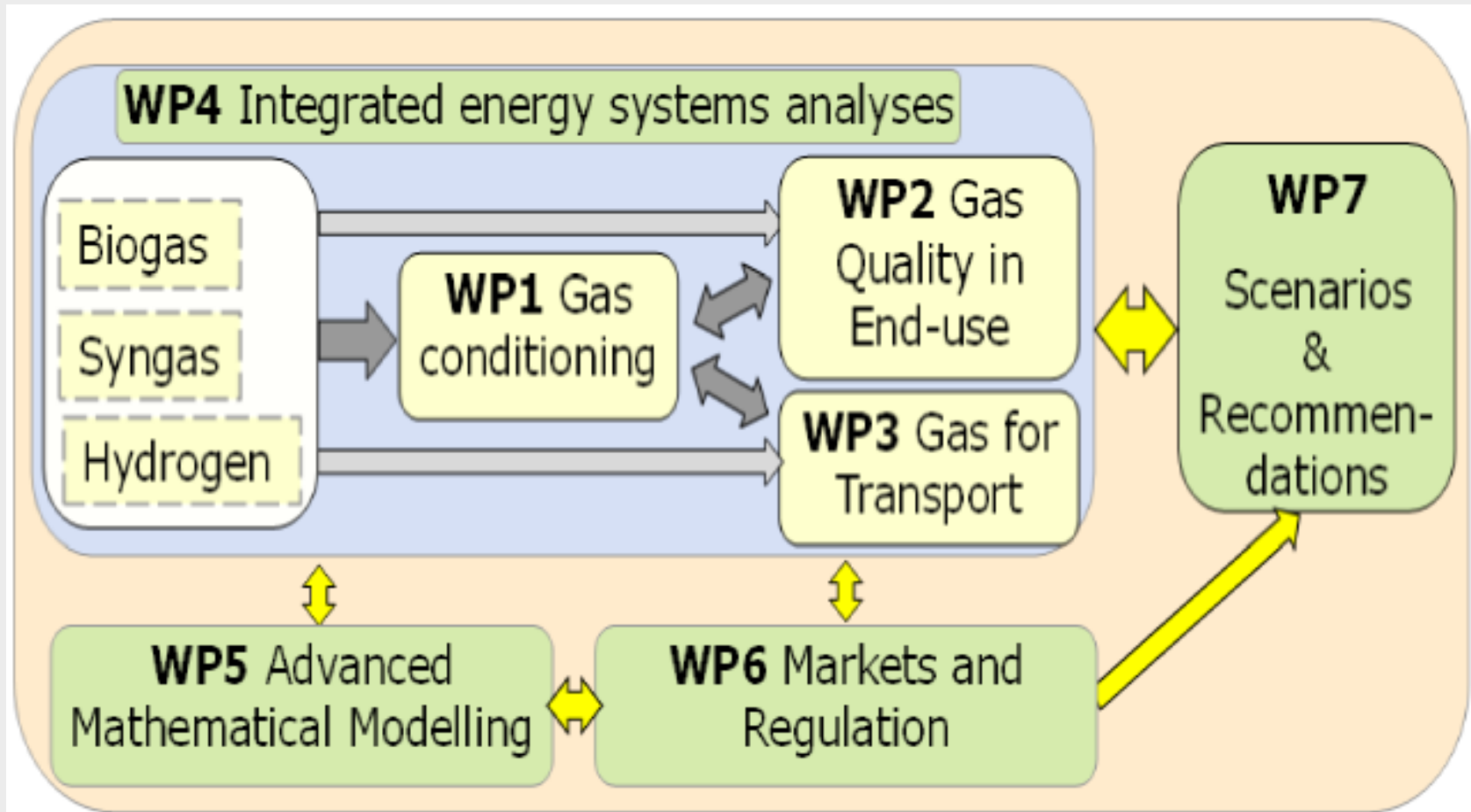
- Purpose - simulate energy market response to
 - technological development
 - price development
 - cost of emissions
 - policy changes
 - taxation changes

- Find the best way for society to integrate renewable resources

Possibilities for gas



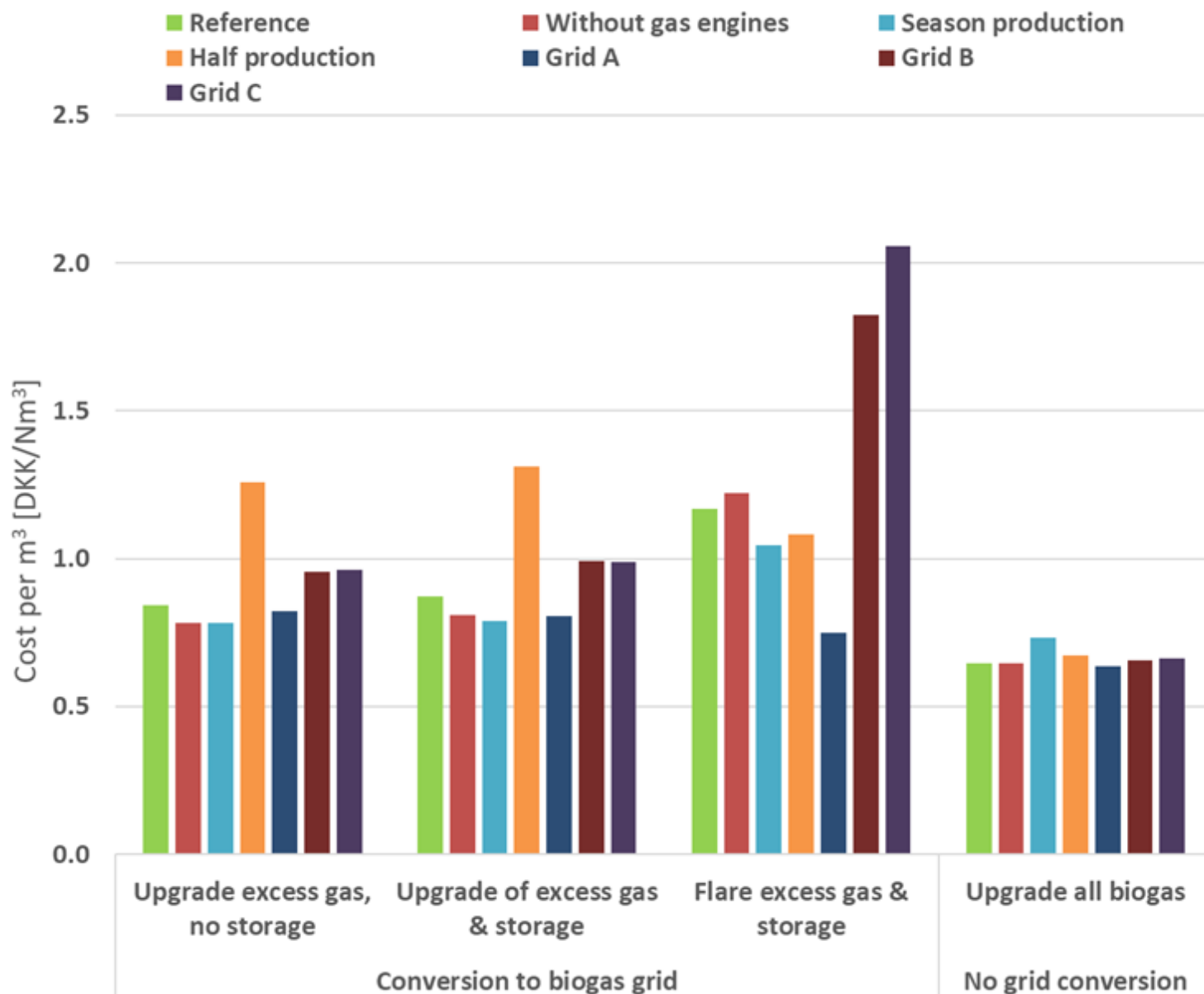
Future gas





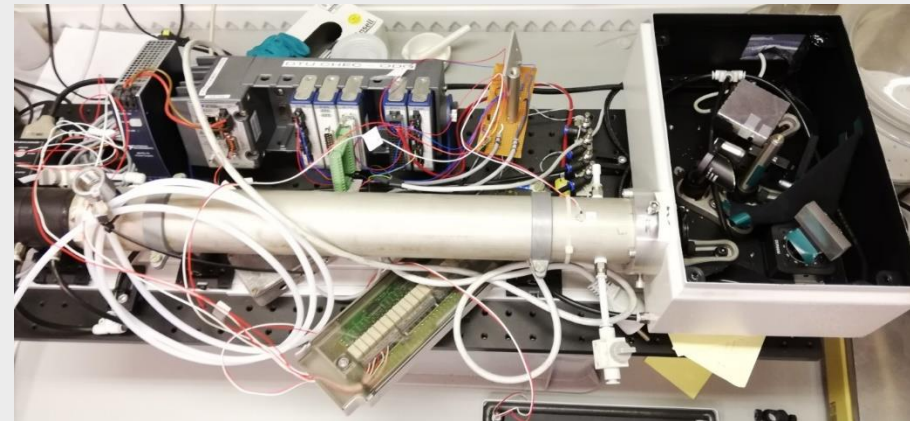
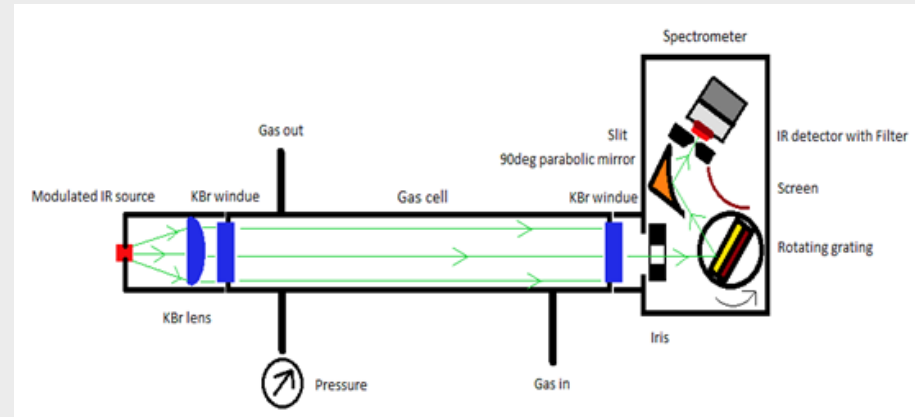
Future gas results

Analysing transformation of distribution grid from natural gas to biogas



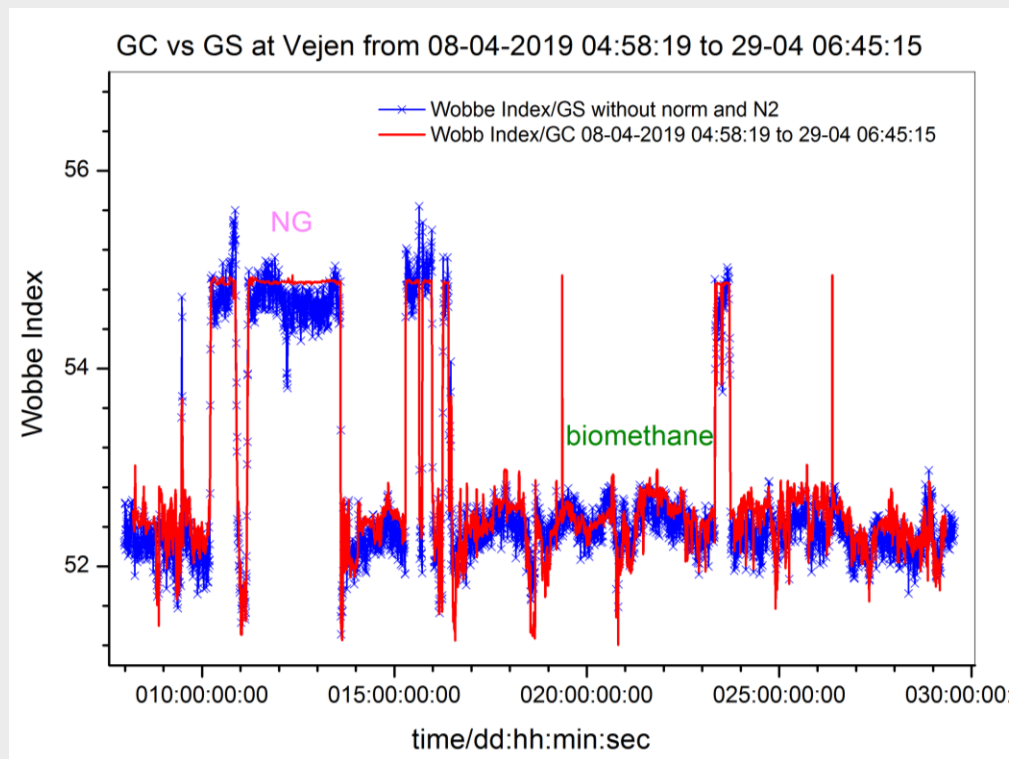
IR gas quality sensor

- The development of the IR gas sensor is built on laser technology
- Light is passed through the gas and a special designed optical filter before detection
- The gas sensor measures the concentration of C_1 - C_5 and CO_2 , and the gas composition is used to calculate heating value and Wobbe Index
- The response time is currently 20 seconds for one full loop through all seven components



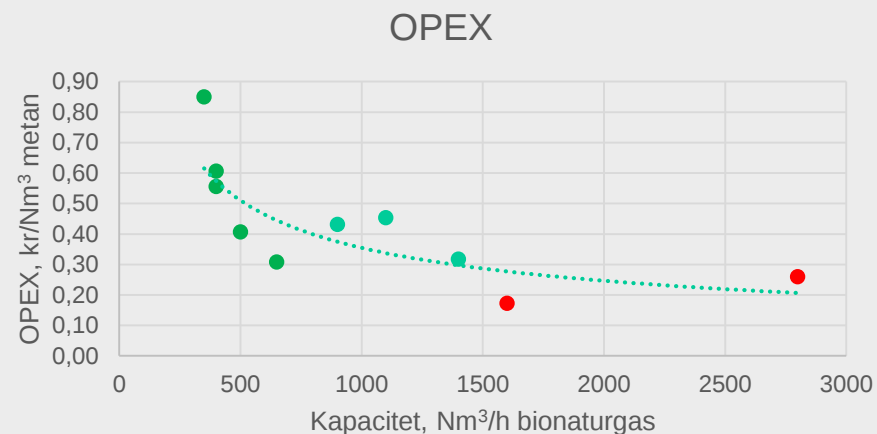
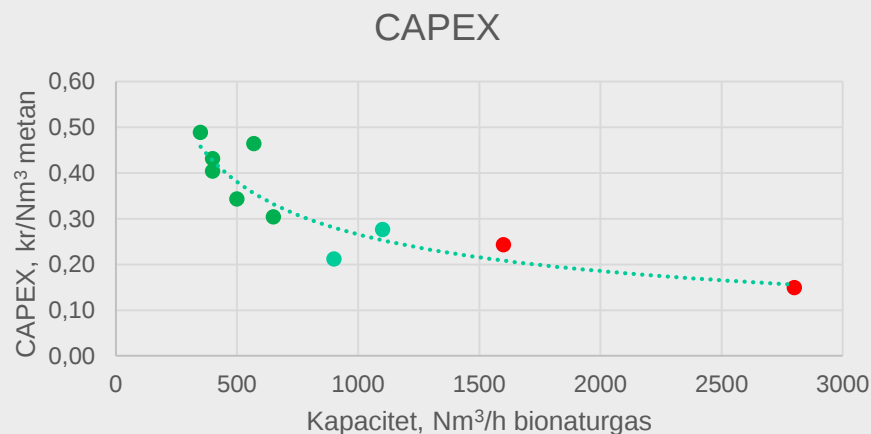
IR gas quality sensor

- Field measurements have been performed at the M/R station in Vejen for 6 months
- The test went smooth without any technical problems
- The results have been compared to a standard GC
- The accuracy is 0.7 % for heating value determination and 1.0 % for Wobbe Index
- Further development potential exists for better accuracy and faster response time





Bio CO₂



- Can biogas upgrading be made at lower cost?
- Can the CO₂ be used?

Bio CO₂

- Joint research project with industry, biogas plants, university
- Improve amine process
- Research and demonstration in pilot scale
- Purify CO₂ to food quality
- Budget 2 million euro, 4 years

Synferon



From wood to biogas – a small scale demonstration

Objective:

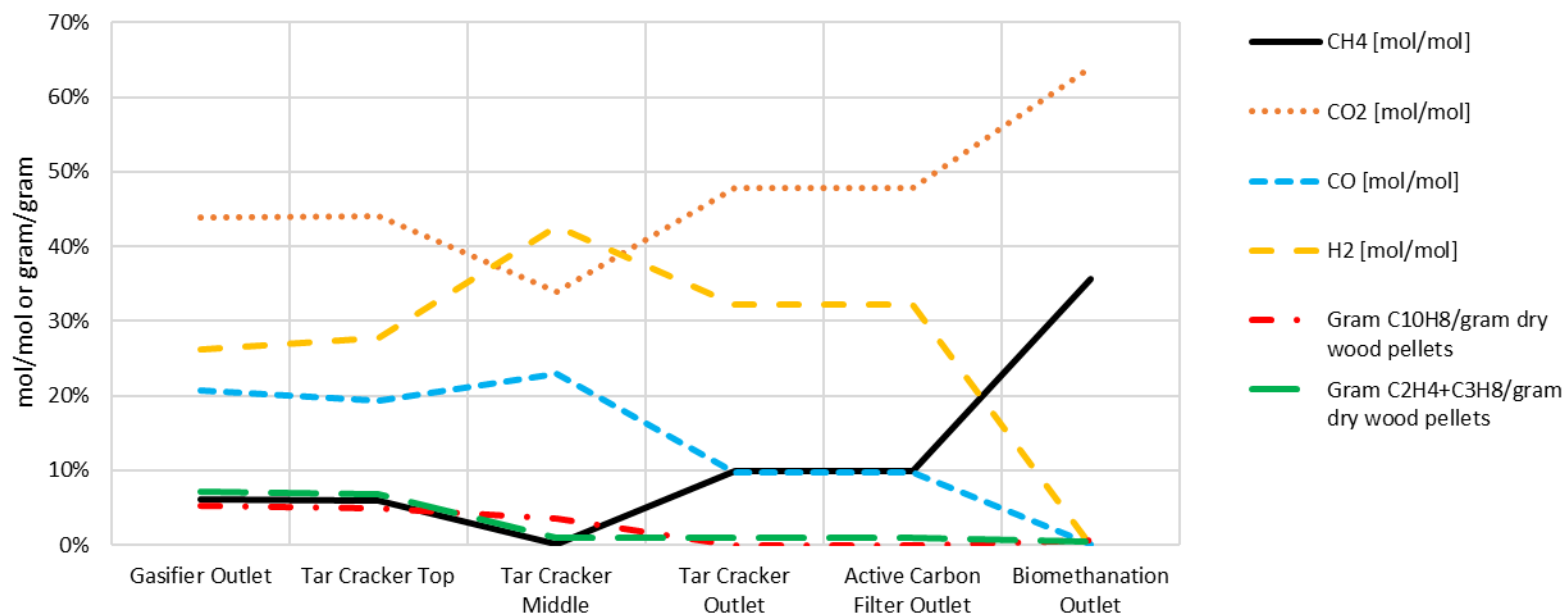
- *Convert wood to biogas in a quality which is ready for upgrading to natural gas*
- *Using bio-methanation of syngas for producing the biogas*



Input: wood pellets, CO₂ for flushing, steam for gasification

Gas components	CH ₄ (mol/mol)	CO ₂ (mol/mol)	CO (mol/mol)	H ₂ (mol/mol)	Tar as C ₁₀ H ₈ (W/W _{fuel})	C ₂ H ₄ +C ₃ H ₈ (W/W _{fuel})
From gasifier (%)	6	44	21	26	5	7
From tar cracker (%)	10	48	10	32	0	1
From bio-methanation (%)	36	64	0	0	0	0

Dry Gas Composition & Hydrocarbon Content



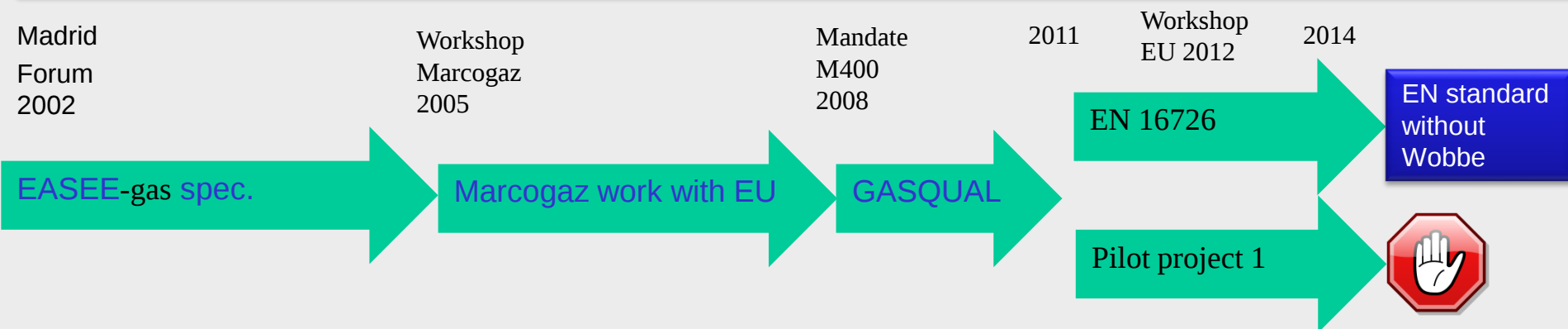


Gas quality work

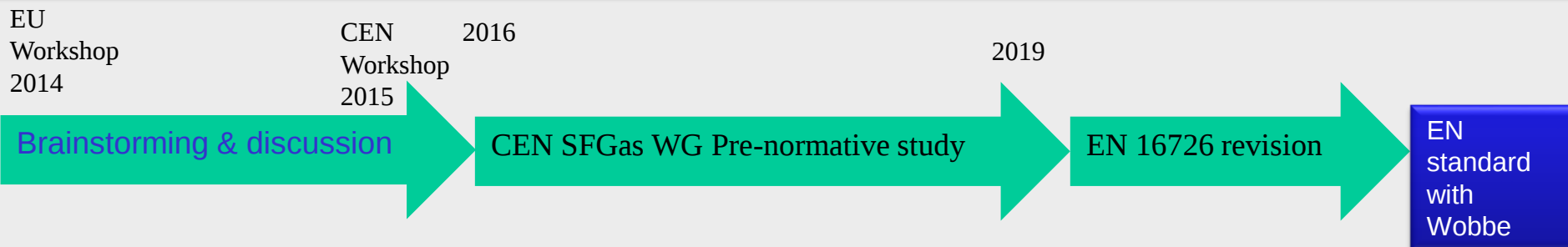
- Gas quality lab with accredited GC
- All HC and trace components in natural gas and biogas
- Gas quality harmonisation work
- Test with H₂ mixtures upcoming

Harmonisation timeline

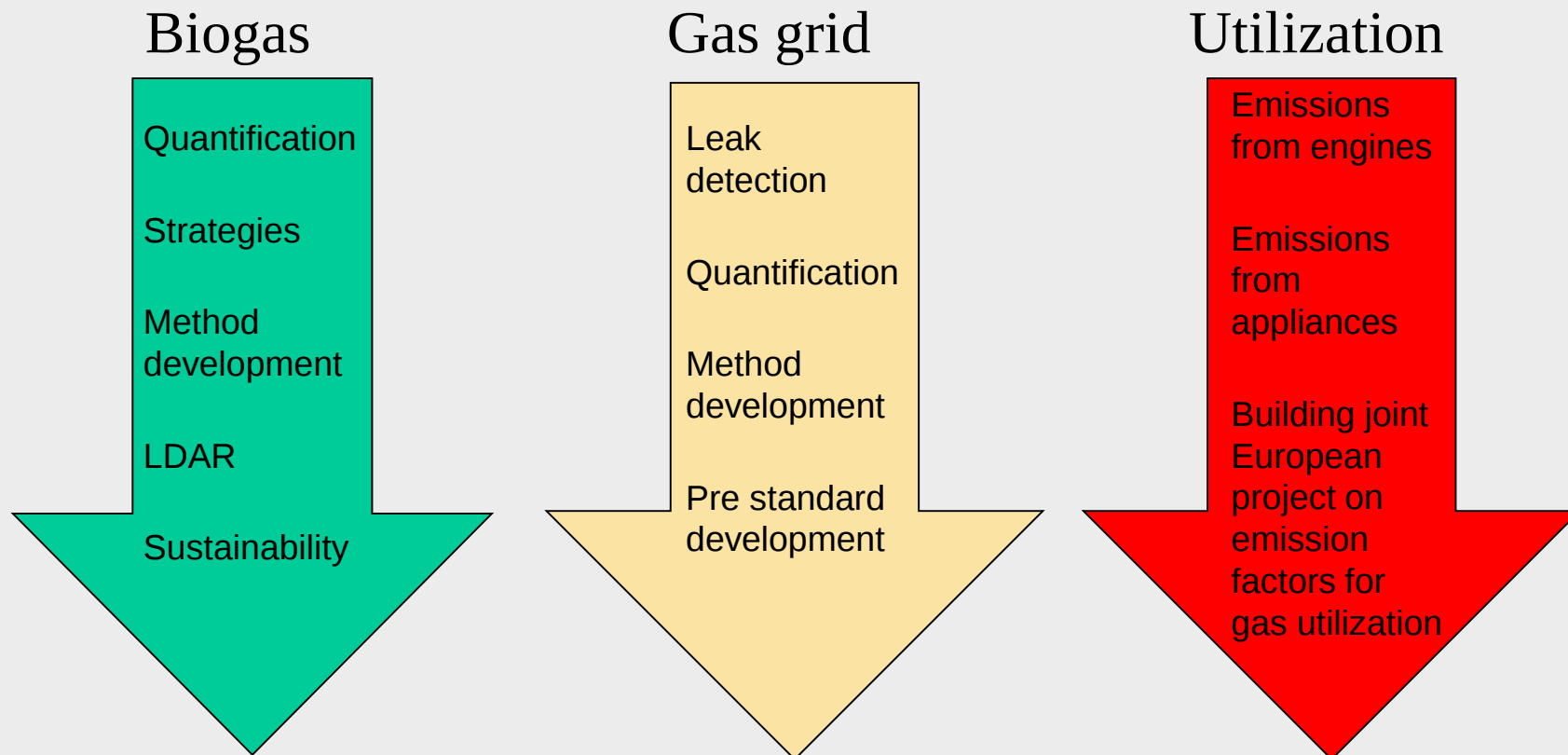
Part 1: Harmonized standard with out Wobbe (2002-2014)



Part 2: Harmonised standard with Wobbe (2015-2019)



Methane emission work



Purpose: For gas to remain a part of the energy solution



Hydrogen

- Numerous projects with hydrogen or hydrogen/natural gas mixtures
- Pipeline tests for several years
- Systems test on M/R stations
- Consumption level test and analysis



Possible DGC participation in R&D Projects

- Focus on value for gas customers, DSO or TSO
- Financial support from DGC owners
- Typical part financial from industry, research programs, EU for R&D projects
- Ask me today or later at pgk@dgc.dk