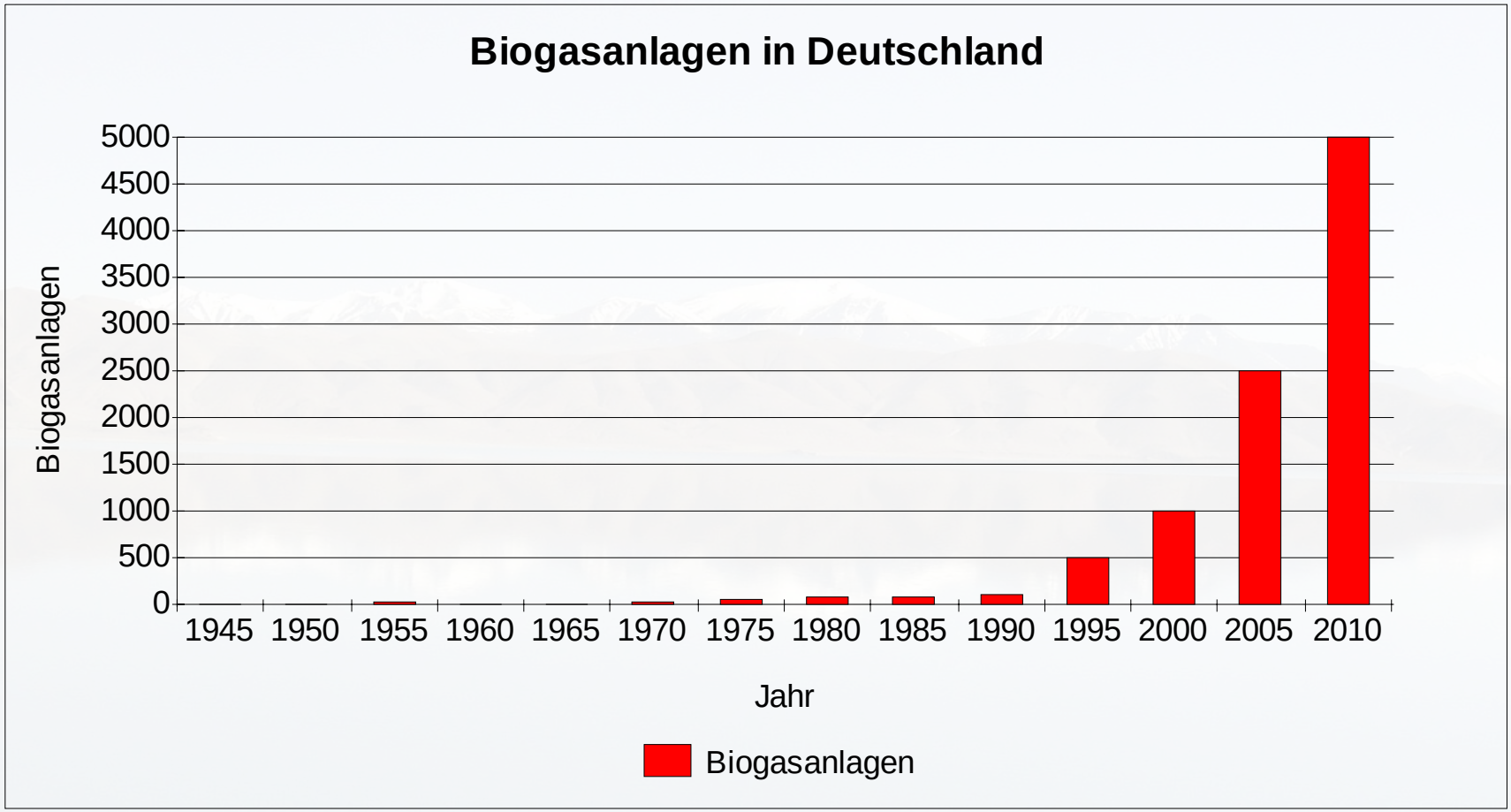
Biogas - Biomethane - LNG

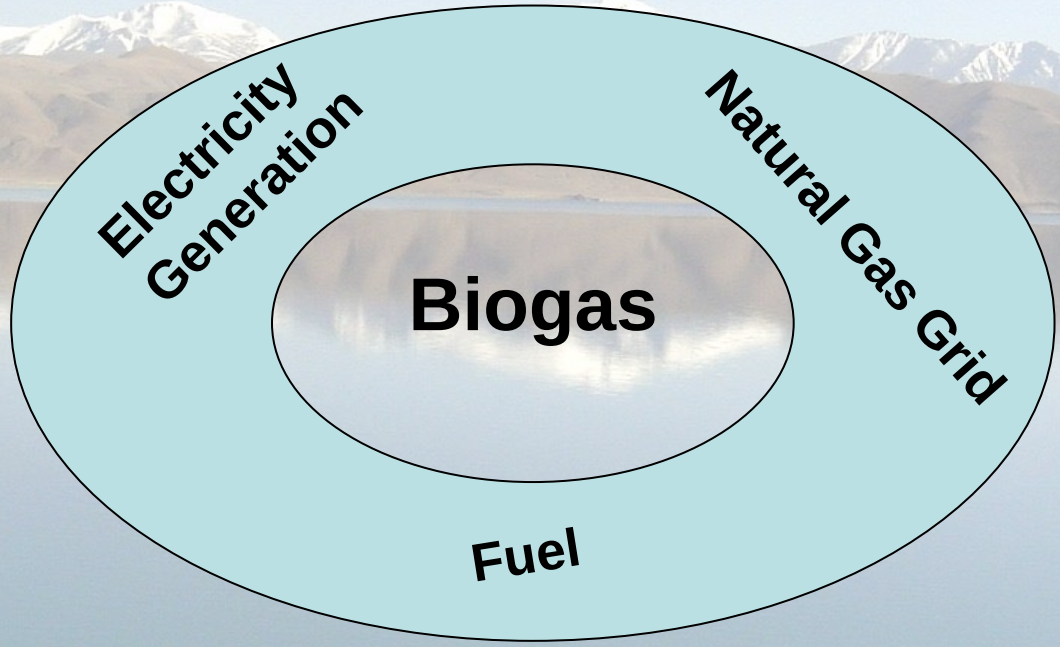
A sustainable strategy of energy supply for the future.

Development of German Biogas Industry



Political Framework

- 1992 Stromeinspeisegesetz
- 2000 Erneuerbare-Energie-Gesetz EEG



Bioenergy from Acreage

Form	Acreage (ha)	Yield / Product (t/ha)	(t/a)	Product (m^3/t)	(m^3/a)
Biodiesel 75%	1.162.500	1,4	1.627.500		
Bioethanol 13%	201.500	2,5	503.750		
Biogas 12%	186.000	50	9.300.000	230	2.139.000.000
Sum	1.550.000		11.431.250		

Form	*Theoretically* Hu kWh/m^3 (kg)	Energy (TWh/a)	Current (TWh/a)	*Specifications Capacity* TWh/a	2007/08
Biodiesel	10,33	16,81			5.000.000
Bioethanol	7,44	3,75			
Biogas	5,9	12,62	4,8	5,28	
Sum		33,18			

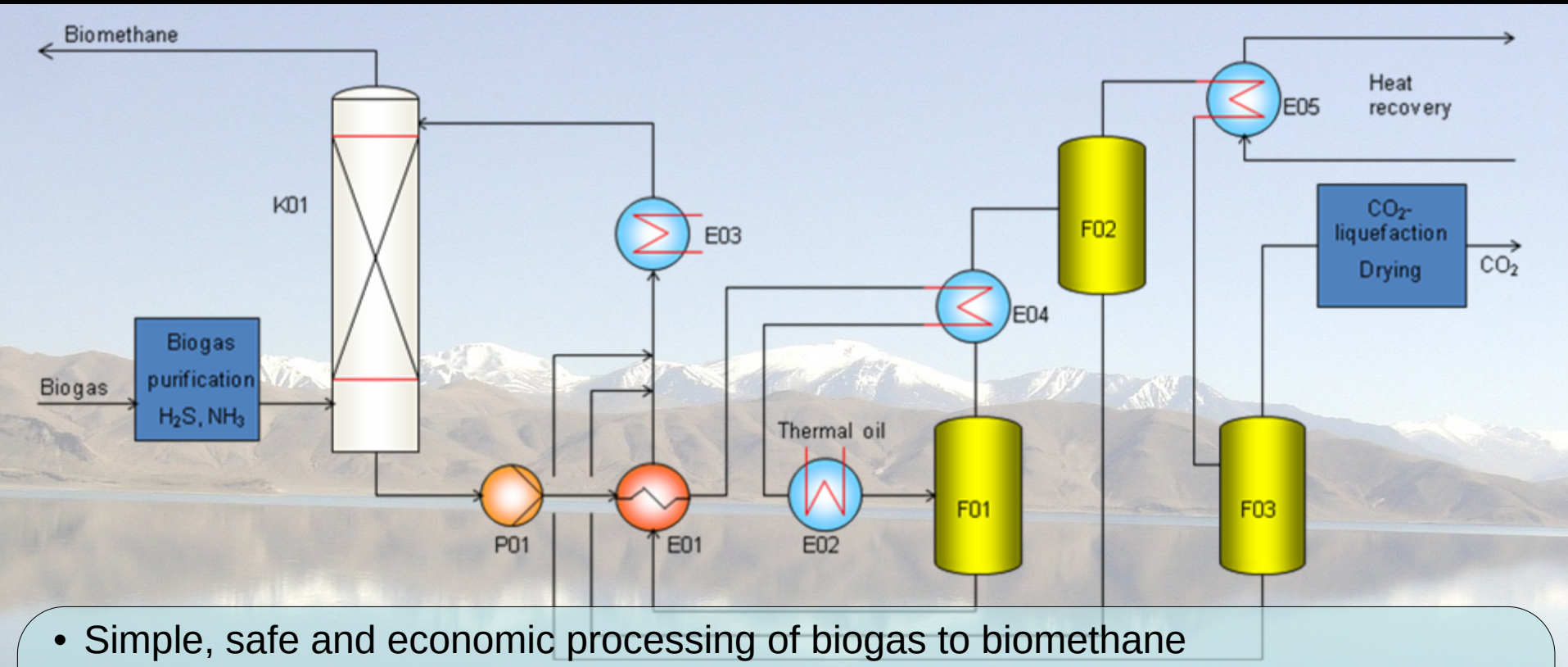
Fuel Emissions

Material	Quantity	Emission g CO_2	CO_2	CO	Fine dust	HC	NO_x
Petrol	1 l	2.380	+25%	+75%		+60%	
Diesel	1 l	2.660	+5%	+50%	+99%	+80%	+70%
Natural gas	1 kg	2.480	1	1	1	1	1

Only by use of natural gas or biomethane, the emissions can be lowered lastingly. This cannot be achieved with biodiesel and bioethanol.

→ Starting-point of the R&D work of DGE GmbH

BCM-Method for Biogas Processing



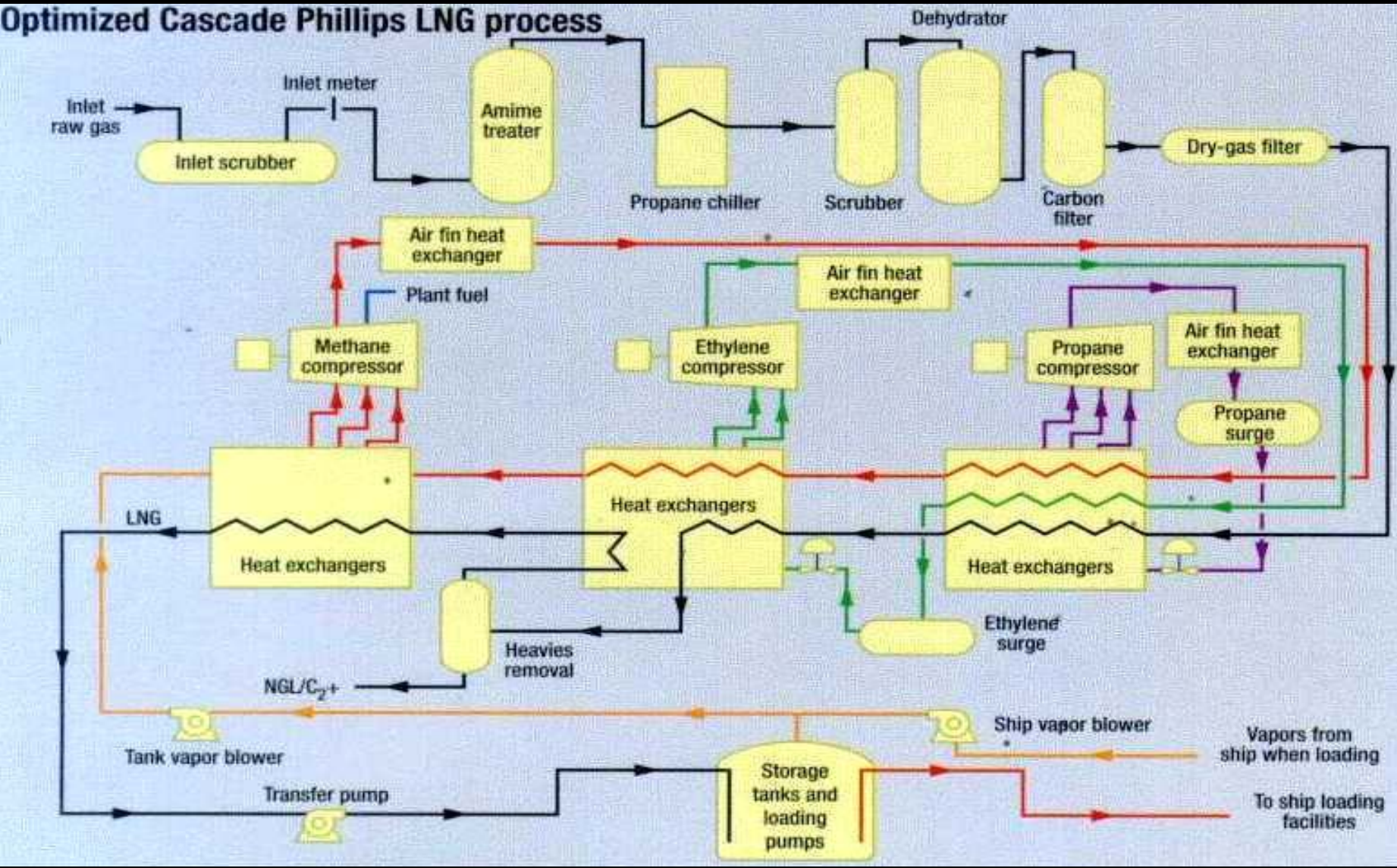
- Simple, safe and economic processing of biogas to biomethane
- 8 international protected rights
- Licensing in Europe and North America
- 3 plants after the BCM-method in Europe
- End of 2008: approx. 10 plants with a total capacity of 100 Mio. Nm^3/h biogas

Gas compositions for LNG-production

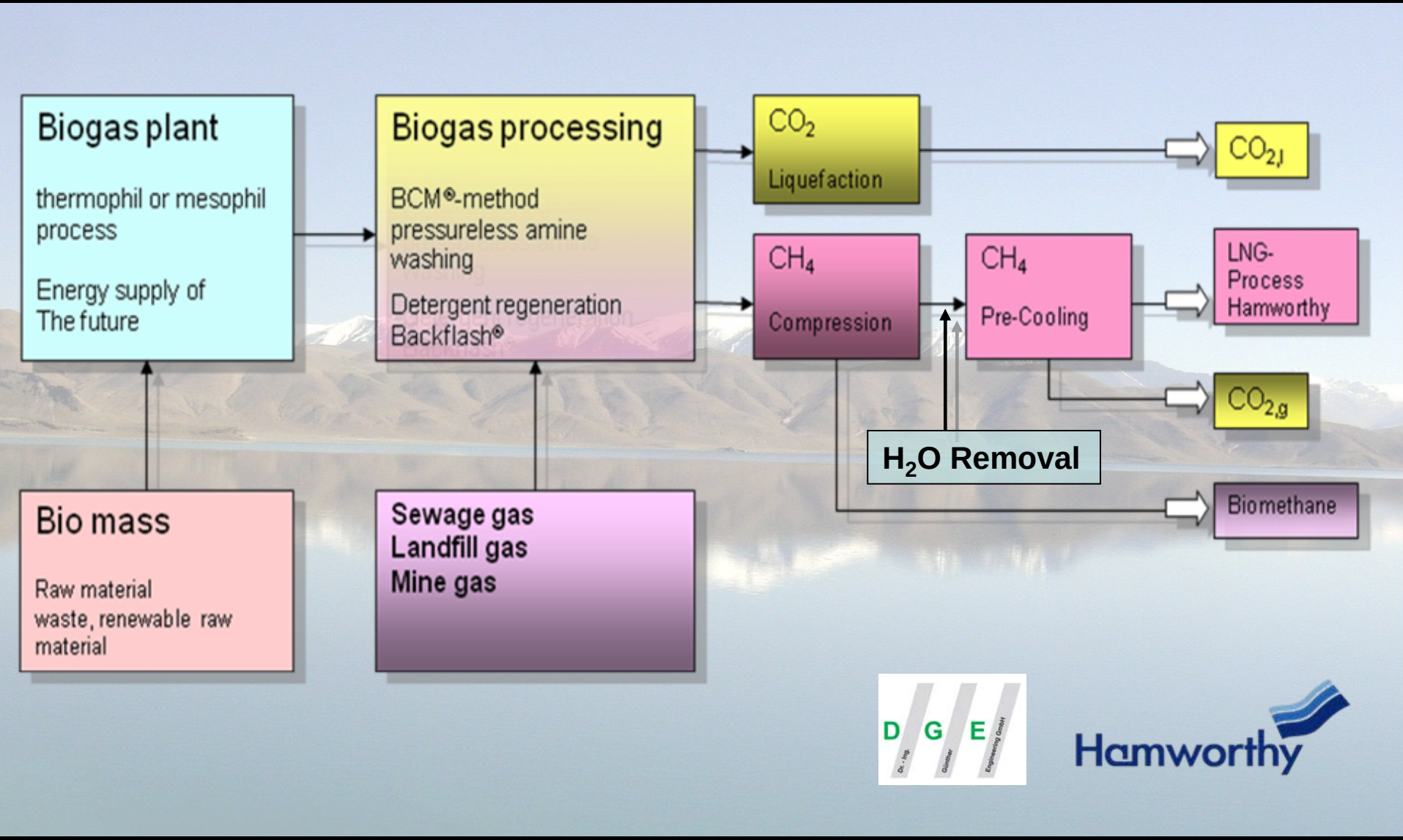
Gas Type		Natural Gas	Flare Gas	Biomethane BCM
CH_4	Vol.%	80-95	60-90	98-99,5
C_2H_4	Vol.%	0-2	0,5-2	
C_3H_6	Vol.%	0,5-1	0,5-2	
C_3H_8	Vol.%	0,5-5	0,5-8	
C_4H_8	Vol.%	0,5-1	0,5-2	
C_4H_{10}	Vol.%	0,5-5	0,5-6	
C_5H_{10}	Vol.%	0,5-1	0,5-2	
C_6H_{12}	Vol.%	0,5-5	0,5-6	
Other HC	Vol.%	0-2	1-5	0-0,1
CO	Vol.%	0-0,2	0-0,2	0,05-0,1
H_2	Vol.%	0-0,2	0-4	0,05-0,1
H_2S	ppm	3	1000-7000	1
Sulphur, total	ppm	5	1200-10000	1
N_2	Vol.%	0-8	0-10	0,2-1,0
O_2	Vol.%	0-2	0-0,5	0,1-0,3
CO_2	Vol.%	0,1-6	0,5-4	0,005
H_2O	ppm	50	0,5-3	50

→ Biomethane is a processed biogas with constant and ideal conditions for the production of LNG

Conventional production of LNG from natural gas



Modern LNG-Technology



Pre-Cooling Process for Biogas (DGE GmbH)

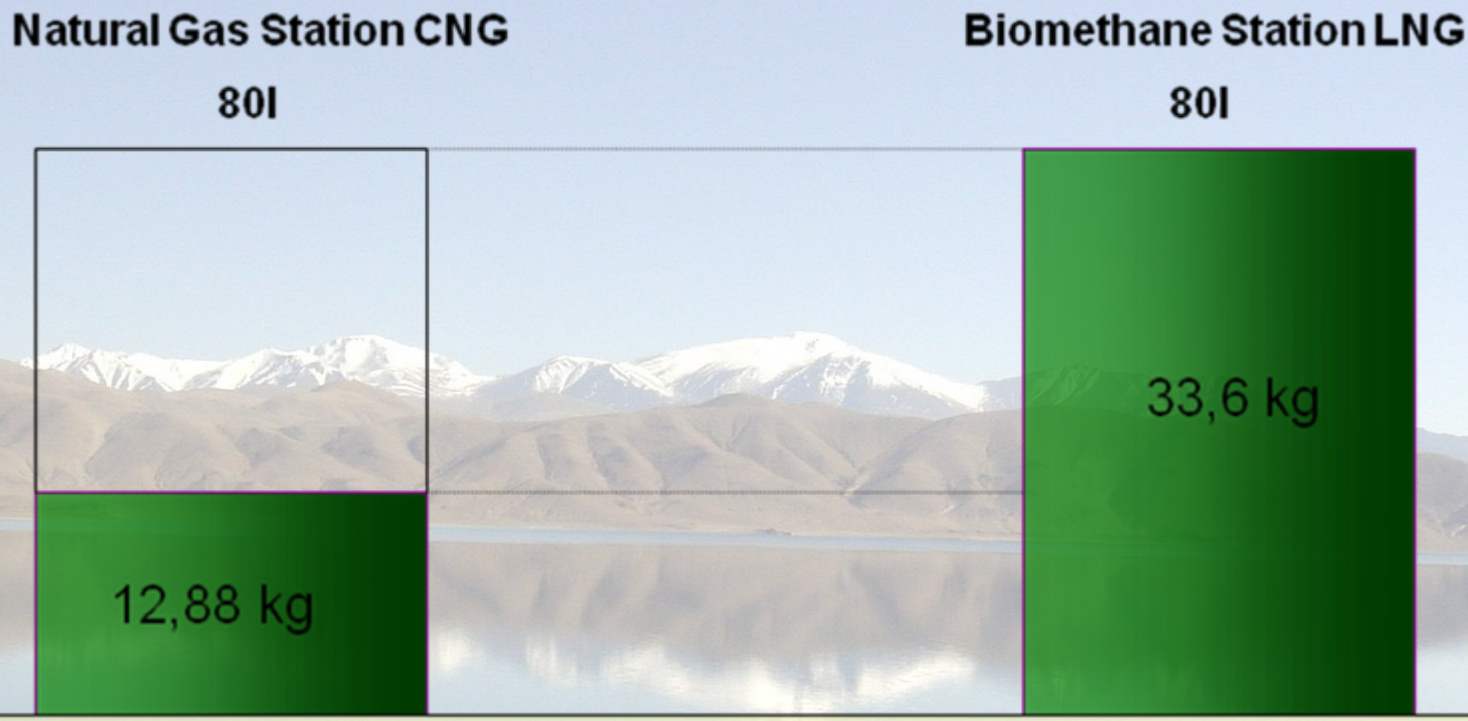
Decentralized LNG-Production from Biogas

- First container plant for 600 Nm^3/h biogas.
- The LNG-Container shall stand beside.

DGE

MT-ENERGIE
Biogas-Technologie

New Dimension for Automobile Engineering



World novelty from Central Germany

Opposite to CNG, a 2.6 fold larger biomethane output can be stored in the same storage size with the new pre-cooling process of the DGE GmbH Company as well as the MiniLNG™ of the Hamworthy Gas Systems Company for the production of LNG.

Decentralized LNG-Production from Biogas

- 50% savings in compression performance
- LNG has 2.6-fold higher density compared to compressed natural gas
- 2.6-fold mileage

Conclusion: Change at the assessment of alternative fuels is overdue!

One industrial sector cannot face that alone, it must be carried out industry-wide and cross national!

Thank you for your Attention