

**Interreg**




CENTRAL EUROPE

European Union  
European Regional  
Development Fund

**REEF 2W**

TAKING  
**COOPERATION**  
FORWARD

 REEF2W -Increased renewable energy and energy efficiency by integrating, combining urban wastewater and organic waste management system

 **Implementation of carbon footprint in the REEF 2W tool**

 Mehdi Habibi

**KOMPETENZZENTRUM**  
WasserBerlin

Environmental  
Assessment (EA)

Implementing of  
EA in REEF 2W

Selecting  
Scenarios for  
Berlin case study

Evaluation of  
Global Warming  
Potential for  
Berlin case study

Conclusion



## What is Environmental Assessment (EA)?

The environmental assessment is a procedure that ensures that the environmental implications of decisions are taken into account before the decisions are made

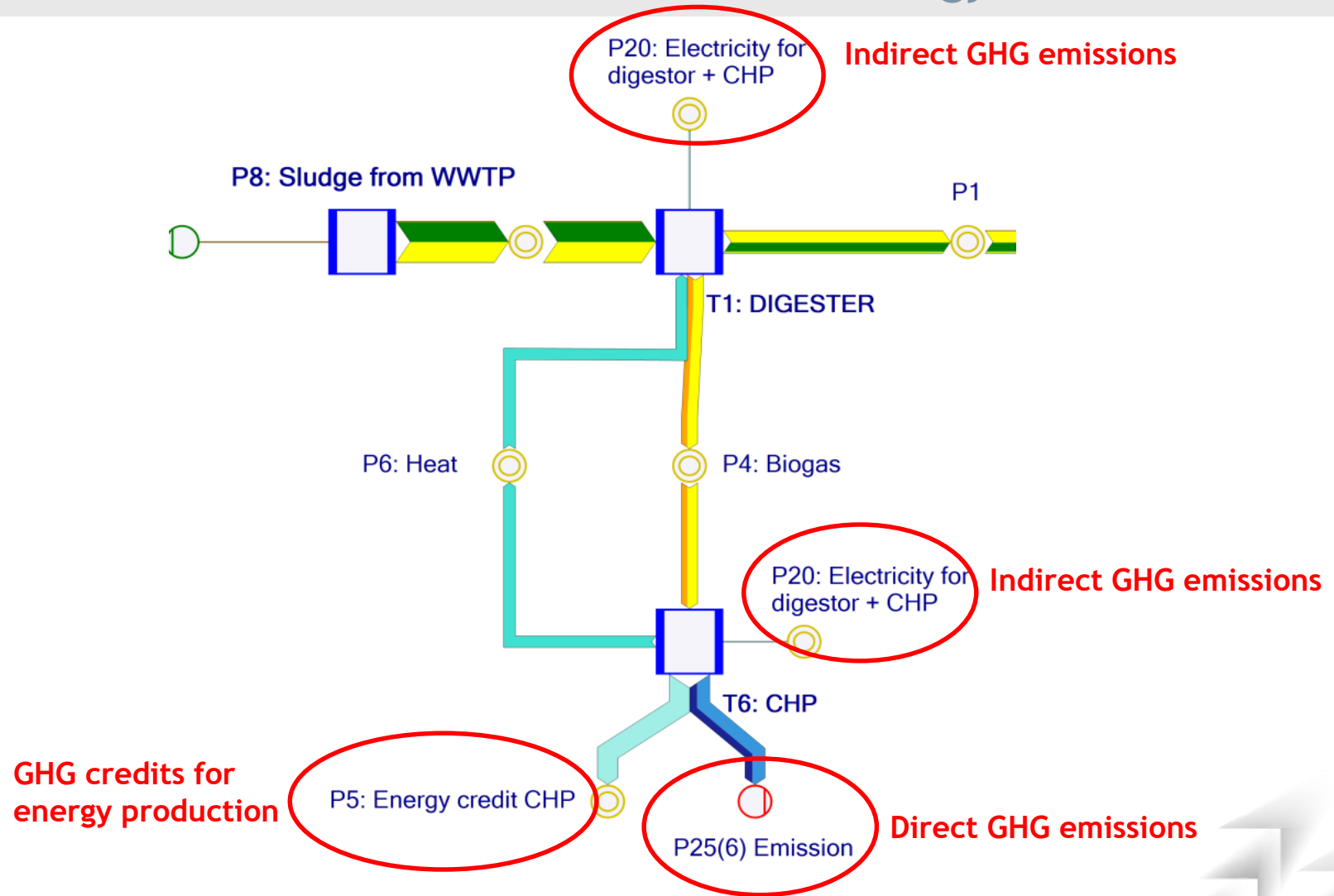
## How can EA be realized?

A suitable method to analyse the potential environmental impacts → Life Cycle Assessment (LCA, ISO 14040/44)

- Takes into account direct and indirect emissions (e.g. from electricity production in power plants)
- Internationally recognized for calculating carbon footprint



# Implementing of EA Software UMBERTO® NXT LCA - Mass and energy balance



# Implementing of EA GWP Factors used in REEF2W tool

## LCA database ecoinvent v3.4

Material / Process	GWP (IPCC 2013 for 100a)	Unit	Ecoinvent v3.4 dataset
Electricity mix EU	0,39	kg CO2-eq/kWh	market group for electricity, medium voltage [RER]
Electricity mix DE	0,627	kg CO2-eq/kWh	lectricity, medium voltage [DE]
Electricity mix AT	0,295	kg CO2-eq/kWh	market for electricity, medium voltage
Electricity mix IT	0,381	kg CO2-eq/kWh	market for electricity, medium voltage [IT]
Electricity mix HR	0,286	kg CO2-eq/kWh	market for electricity, medium voltage [HR]
Electricity mix CZ	0,69	kg CO2-eq/kWh	market for electricity, medium voltage [CZ]

## LCA studies and models of previous research projects

Material / Process	GWP (IPCC 2013 for 100a)	Unit	Description
<u>N2O from biological treatment</u>	2,5	kg CO2-eq/kg N in influent	Wicht 1996
<u>CH4 in sludge treatment</u>	0,017	kg CO2-eq/kg TS in digestate	Estimate for CH4 emissions at centrifuge
<u>CHP</u>	0,00347	kg CO2-eq/MJ CH4 in biogas	<u>Ronchetti et al. 2002</u>
<u>flare</u>	0,00347	kg CO2-eq/MJ CH4 in biogas	<u>Ronchetti et al. 2002</u>
<u>Carbon source acetate</u>	1,47	kg CO2-eq/kg acetate	<u>Based on chemical formula</u>
<u>Carbon source methanol</u>	1,375	kg CO2-eq/kg methanol	<u>Based on chemical formula</u>

- Calculation of global warming potential (GWP) for 100a (IPCC 2013) as important environmental impact of energy systems



# Implementing of EA

## Categories of GHG emissions

Two categories of GHG emissions are included in the REEF 2W tool:

- GHG emissions associated with the use of energy carriers (e.g. grid electricity, natural gas, heat, ...)
- GHG emissions of other relevant processes such as disposal of sludge, use of chemicals, or else.



# Implementing of EA

## Calculation of GWP in REEF 2W tool



Example:

$$1 \text{ MWh/a} \times 1000 \text{ kWh/MWh} \times 0,69 \text{ kg CO}_2\text{-eq/kWh} = 690 \text{ kg CO}_2\text{-eq/a}$$



# Implementing of EA

## Comparing status quo with REEF 2W scenario (= future)

CALCULATION	STATUS QUO	FUTURE SITUATION	
<b>ENERGY</b>			
Emission factor for energy from electrical grid	0,63	0,63	kg CO2-eq/kWh
Net_external_elec_energy_demand	10324157,40	1000,00	kWh
Carbon footprint elec. Energy	6473246,69	630,00	kg CO2-eq
Emission factor for external heat supply	0,23	0,20	kg CO2-eq/kWh
Net_external_th_energy_demand	0,00	10000,00	kWh
Carbon footprint th. Energy	0,00	2000,00	kg CO2-eq





# Implementing of EA

## Comparing status quo with REEF 2W scenario (= future)

REEF 2W Model

**Tool progress status:**

Status quo

Status quo


Report

Future situation

Future situation

Future situation

Report



Information about WWTP and Pla

**Environment Assessment**

**Type of thermal energy supply**

Natural gas

District heating

**Thermal Energy excess**

Do you export the thermal energy excess?

Yes

No

**Sludge use**

Mono-Incineration

Co-Incineration

Anaerobic digestion+HTC (\*)

Anaerobic digestion+Composting

Agricultural Use

Landfilling

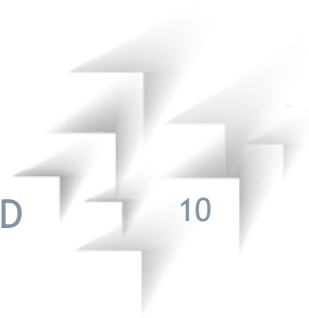
(\*) HTC Hydrothermal Carbonization

Reset

Ok Cancel ?

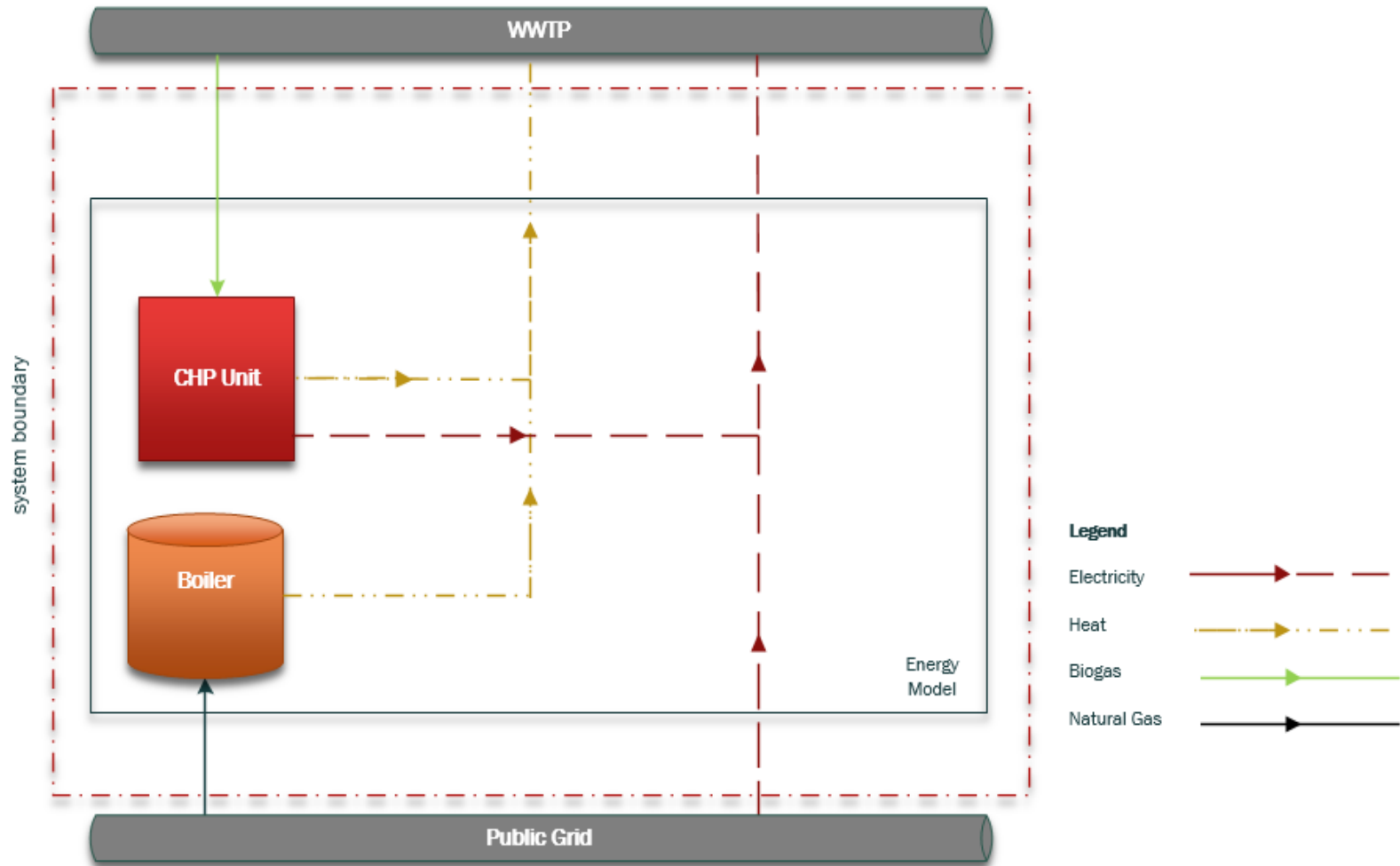


## Selecting Scenarios for Berlin case study

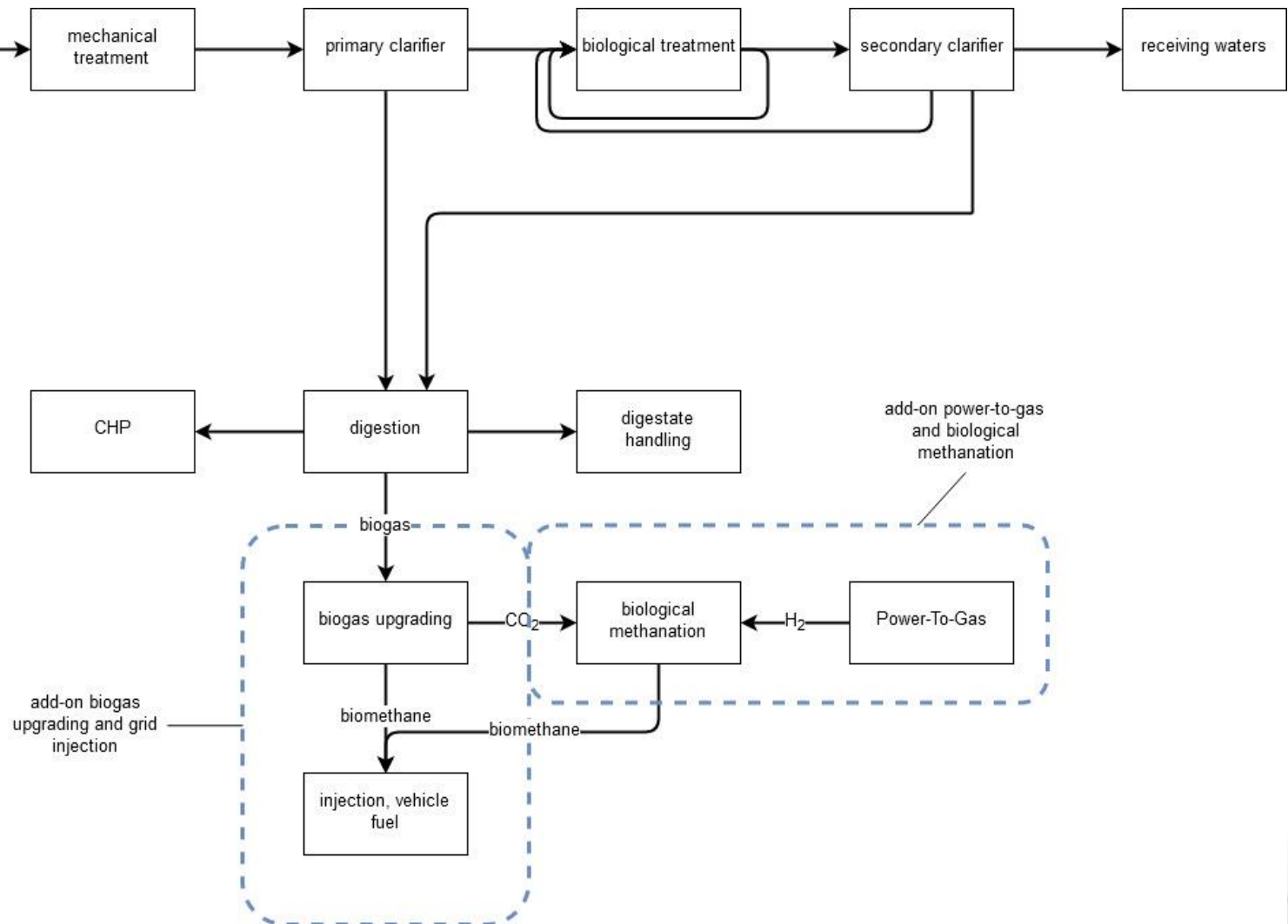


# Selecting Scenarios

## Status Quo of Berlin WWTP



# Pilot Site in Berlin WWTP: Scheme of the future scenarios



## Input data for scenarios in Berlin case study

Scenario	CHP	Biogas upgrading system	Electrolyser for PtG
Status quo (I)	6 MW	0 m <sup>3</sup> /h biogas	0 MW
Scenario II	0 MW	1800 m <sup>3</sup> /h biogas	0 MW
Scenario III	0 MW	1800 m <sup>3</sup> /h biogas	7.8 MW



## Results of Environmental Assessment for Berlin case study

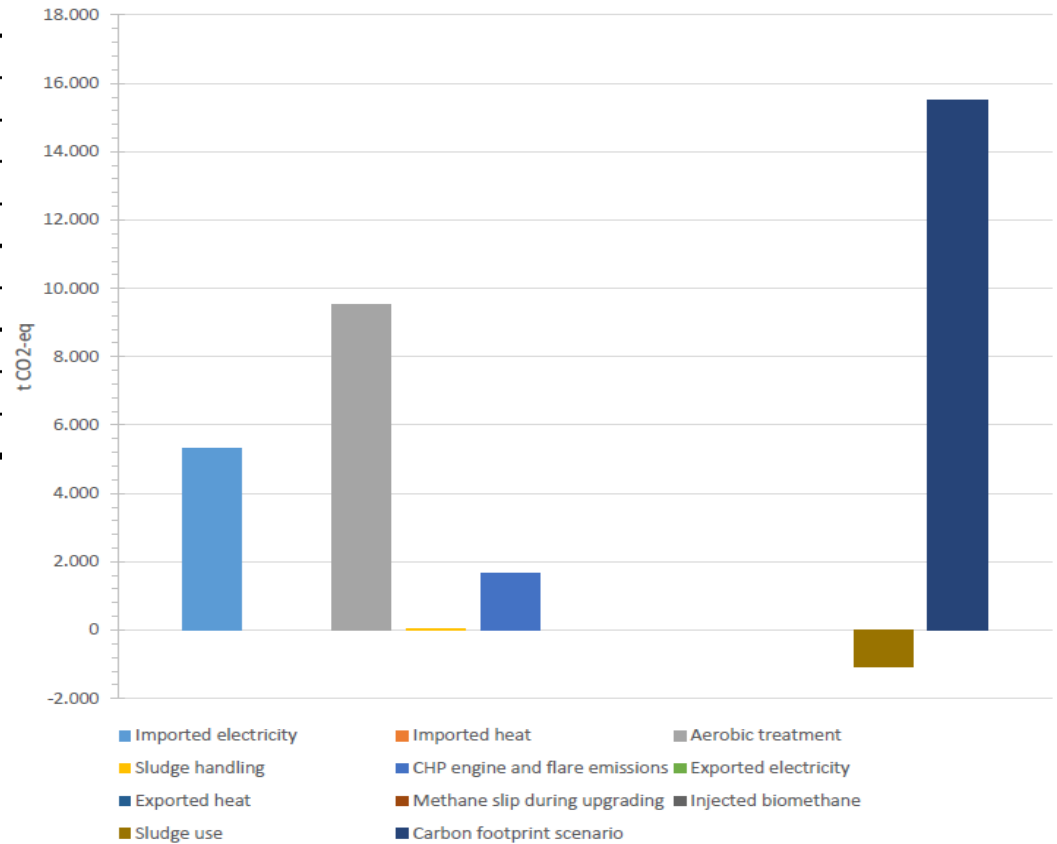


# Assessment of the Global Warming Potential Result

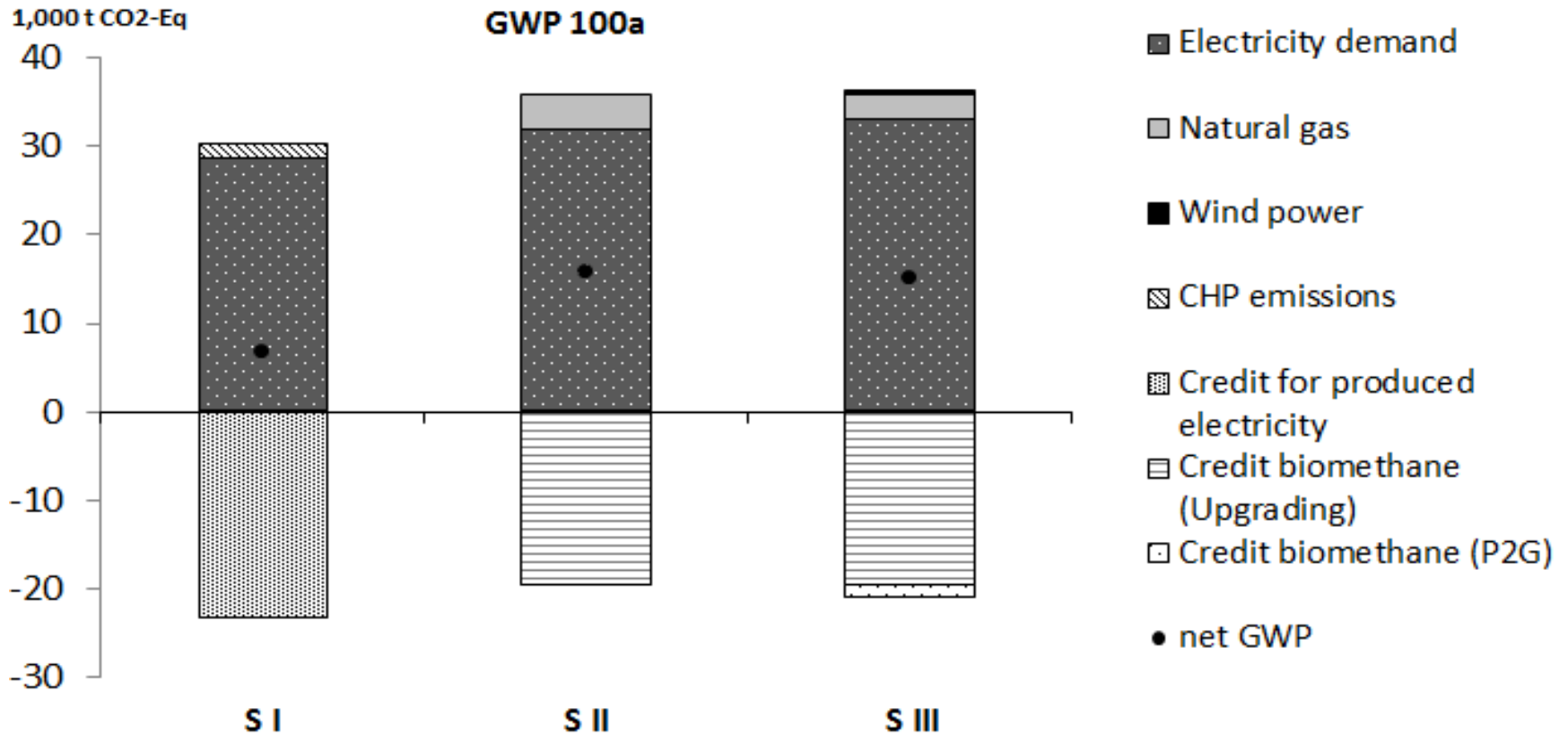
## Environment Assessment

Carbon footprint/credit for:

Imported electricity	5326,88
Imported heat	NA
Aerobic treatment	9535,63
Sludge handling	36,21
CHP engine and flare emissions	1665,60
Exported electricity	NA
Exported heat	NA
Methane slip during upgrading	NA
Injected biomethane	NA
Sludge use	-1065,00
<b>Carbon footprint scenario</b>	<b>15499,32</b>

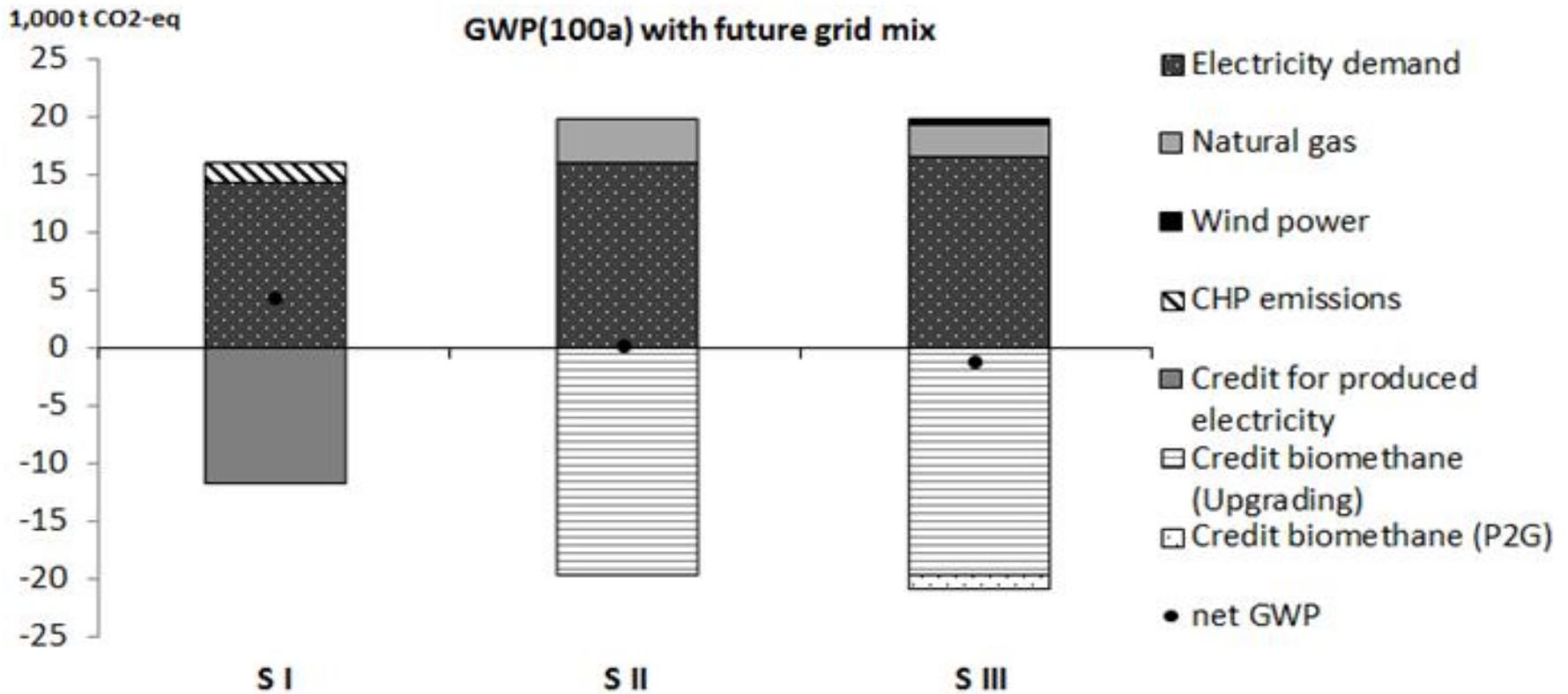


# Assessment of the Global Warming Potential with electricity mix of 2014





# Assessment of the Global Warming Potential with electricity mix of 2030



## Take Home Message:

### Biogas upgrading and injection in the gas grid :

- At the moment: no reduction of GWP, better to produce electricity with CHP and substitute current power mix with high GWP
- In the future: it can decrease the GWP if green electricity is in the grid

### Power to Gas:

- It can decrease the GWP (if PtG uses excess renewable electricity available in the grid)



# Contact details



Name : Mehdi Habibi  
Kompetenzzentrum Wasser Berlin gGmbH  
Project Acronym: REEF2W



[www.kompetenz-wasser.de](http://www.kompetenz-wasser.de)



[Mehdi.habibi@kompetenz-wasser.de](mailto:Mehdi.habibi@kompetenz-wasser.de)



Uff. +49 (0) 30 53653 - 820  
Fax +49 (0) 30 53653 - 888



[linkedin.com/MehdiHabibi](https://www.linkedin.com/MehdiHabibi)



# Partners



Unioncamere  
Veneto



Reinhalungsverband Trattnachtal  
Biogas Trattnachtal GmbH



UNIVERSITY OF  
CHEMISTRY AND  
TECHNOLOGY  
PRAGUE



REGIONALNA  
ENERGETSKA  
AGENCIJA  
SJEVEROZAPADNE  
HRVATSKE



ZAGREBAČKI  
HOLDING d.o.o.



# Evaluation of Energy Balance

