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**REEF 2W**

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

Ecomondo - 5th November 2019 - Rimini



**Integrated spatial and energy planning  
for wastewater based energy supply**



Georg Neugebauer



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Climate change is one of the great challenges of our time.

Heating (and cooling) has been and is expected to remain the biggest energy sector of the EU.

To achieve the energy goals climate friendly heating is essential.

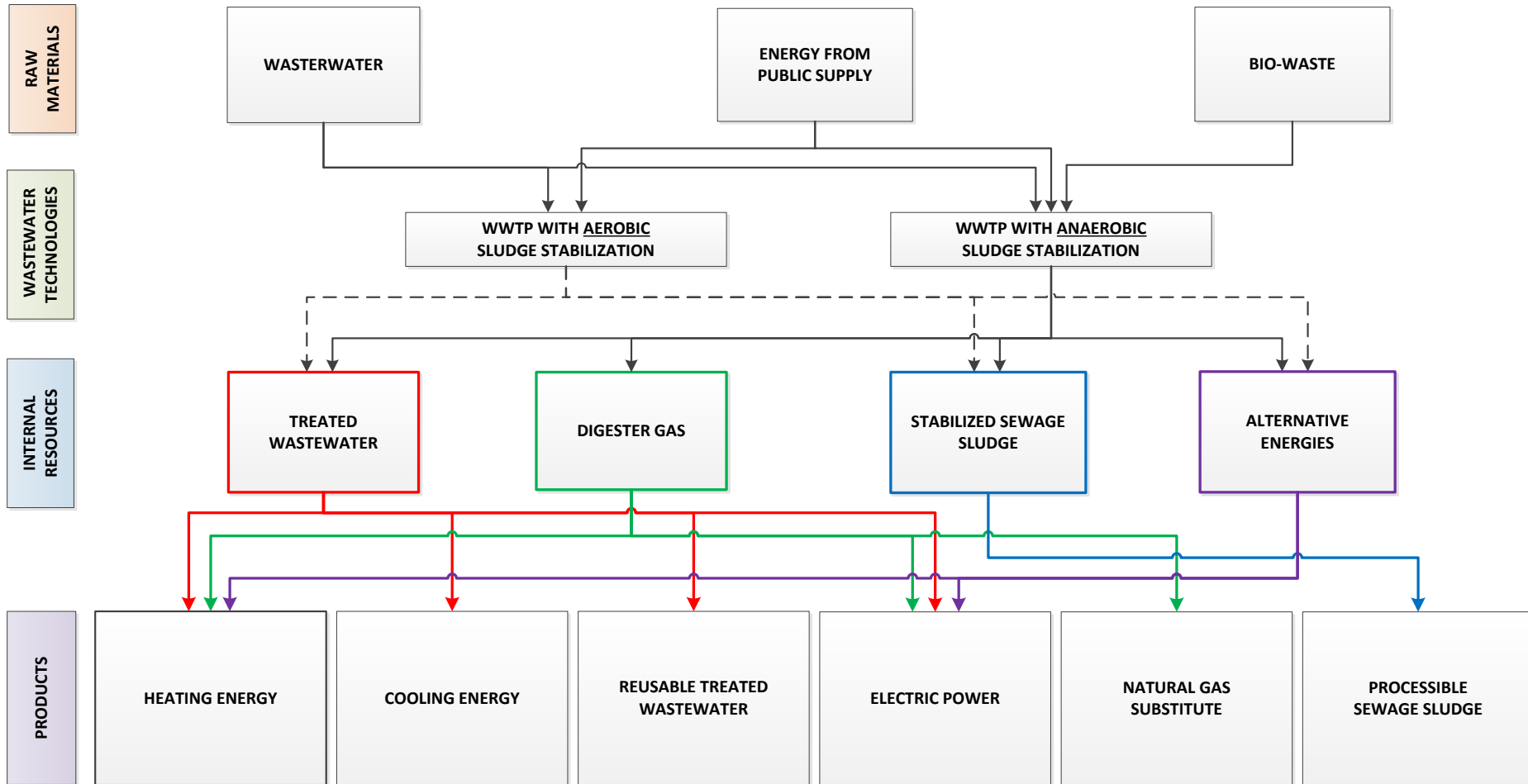


Most recently, wastewater as an untapped heat source has come more into view.

EU Directive 2018/2001 on the promotion of the use of energy from renewable sources (recast) now acknowledges wastewater as a renewable energy source (thermal energy content).



# WASTEWATER AS A SOURCE OF ENERGY



Kretschmer et al. 2015, adapted



## Degree of self-sufficiency regarding electrical and thermal energy

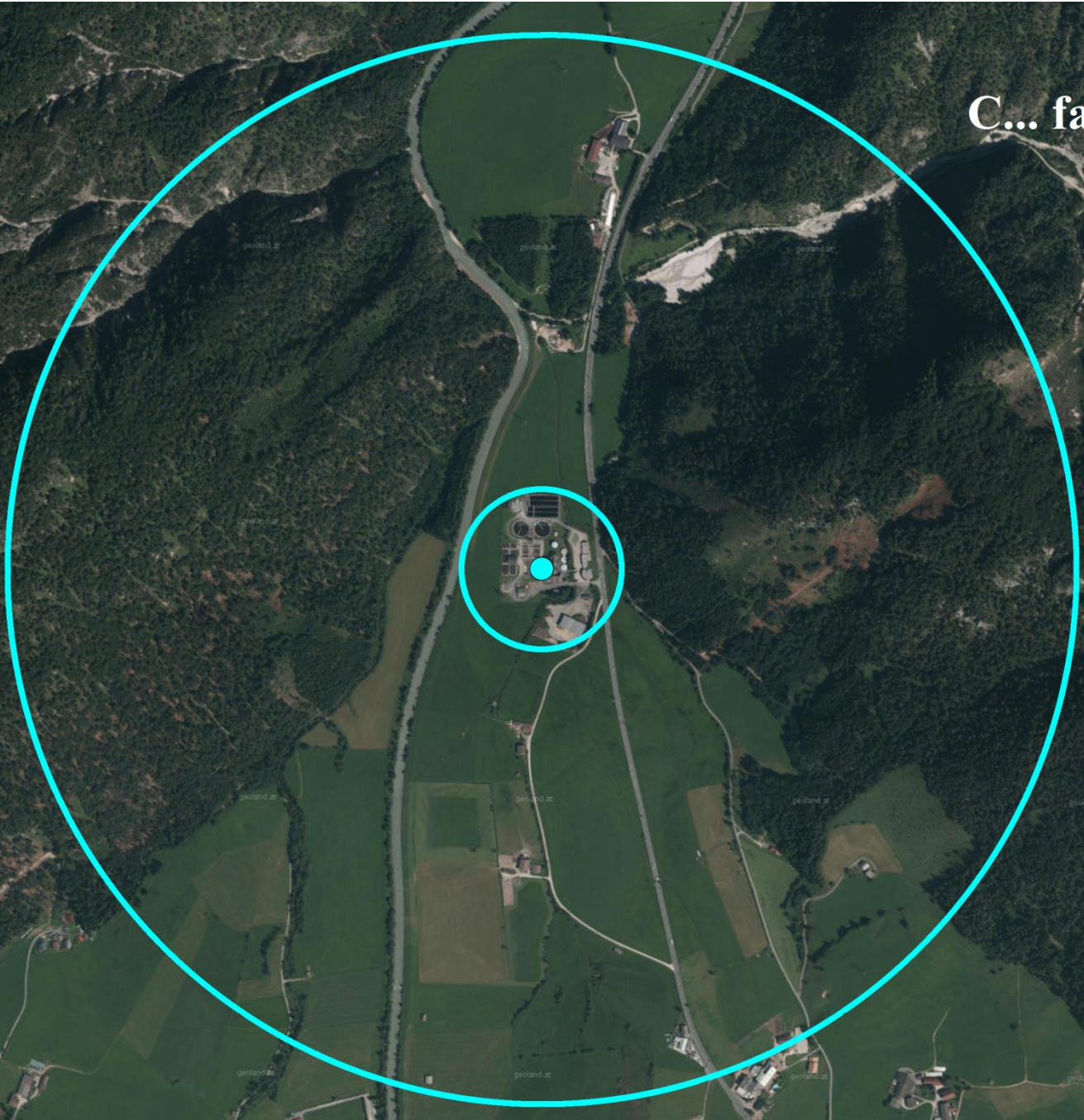
Degree of self-sufficiency [%]			
	Electric energy	Thermal energy	
		Excluding wastewater	Including wastewater
Average performance	40	200	<b>630</b>
Optimised performance	100	270	<b>840</b>

Kretschmer et al. 2016



# Spatial context

## C... far from the settlement



**Legend**

**Treatment capacity of the WWTP**

- 2000 - 5000
- 5001 - 50000
- 50001 - 150000
- > 150000

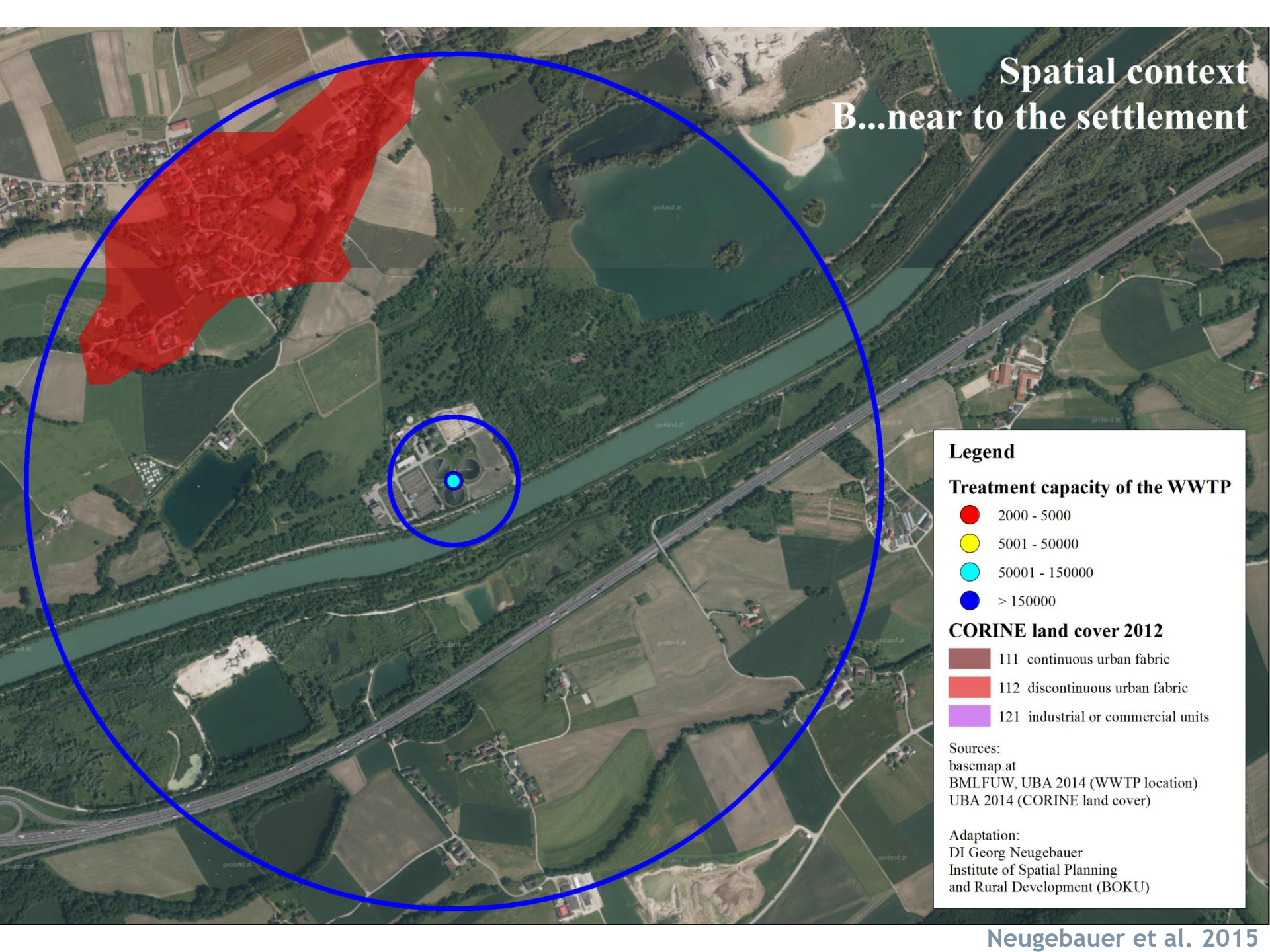
**CORINE land cover 2012**

- 111 continuous urban fabric
- 112 discontinuous urban fabric
- 121 industrial or commercial units

Sources:  
basemap.at  
BMLFUW, UBA 2014 (WWTP location)  
UBA 2014 (CORINE land cover)

Adaptation:  
DI Georg Neugebauer  
Institute of Spatial Planning  
and Rural Development (BOKU)

# Spatial context B...near to the settlement



## Legend

### Treatment capacity of the WWTP

- 2000 - 5000
- 5001 - 50000
- 50001 - 150000
- > 150000

### CORINE land cover 2012

- 111 continuous urban fabric
- 112 discontinuous urban fabric
- 121 industrial or commercial units

Sources:

basemap.at

BMLFUW, UBA 2014 (WWTP location)

UBA 2014 (CORINE land cover)

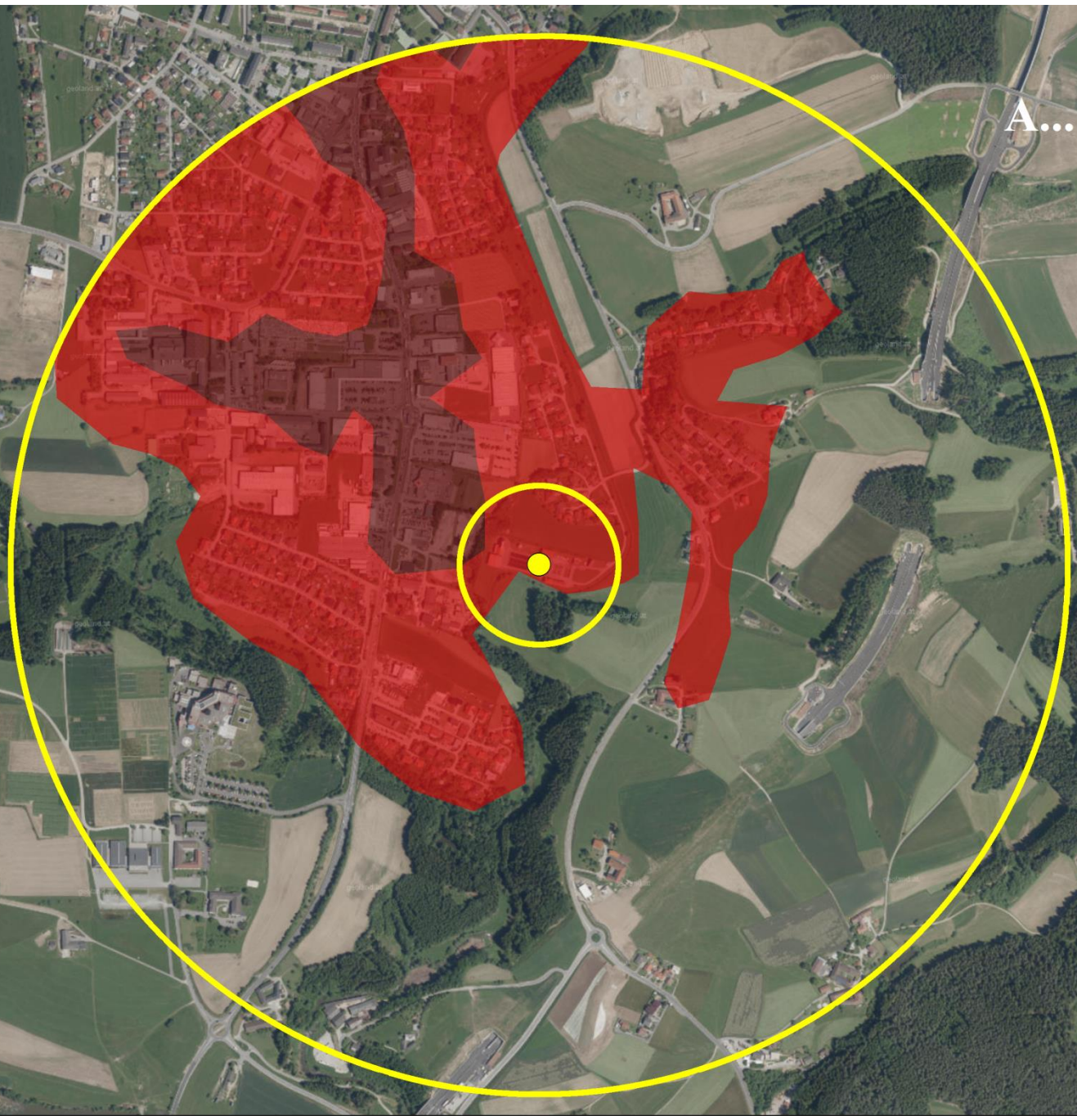
Adaptation:

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Institute of Spatial Planning

and Rural Development (BOKU)

# Spatial context A... within the settlement



**Legend**

**Treatment capacity of the WWTP**

- 2000 - 5000
- 5001 - 50000
- 50001 - 150000
- > 150000

**CORINE land cover 2012**

- 111 continuous urban fabric
- 112 discontinuous urban fabric
- 121 industrial or commercial units

Sources:  
basemap.at  
BMLFUW, UBA 2014 (WWTP location)  
UBA 2014 (CORINE land cover)

Adaptation:  
DI Georg Neugebauer  
Institute of Spatial Planning  
and Rural Development (BOKU)



Size Category			Spatial Context				Sum
			A	within the settlement	B	near to the settlement	
Heat power potential from wastewater (MW) <i>(amount of WWTPs)</i>	0	2000–5000 PE	8 (78)	7 (74)	8 (97)	23 (249)	
	1	5001–50,000 PE	81 (124)	41 (98)	51 (98)	173 (320)	
	2	50,001–150,000 PE	54 (25)	22 (8)	32 (14)	108 (47)	
	3	>150,000 PE	197 (11)	12 (2)	20 (3)	229 (16)	
	<b>Sum</b>		<b>340</b> (238)	<b>82</b> (182)	<b>111</b> (212)	<b>533</b> (632)	
Thermal energy from wastewater (GWh/a) <i>(amount of WWTPs)</i>	0	2000–5000 PE	45 (78)	44 (74)	48 (97)	137 (249)	
	1	5001–50,000 PE	489 (124)	244 (98)	306 (98)	1039 (320)	
	2	50,001–150,000 PE	323 (25)	134 (8)	189 (14)	646 (47)	
	3	>150,000 PE	1180 (11)	69 (2)	121 (3)	1370 (16)	
	<b>Sum</b>		<b>2037</b> (238)	<b>491</b> (182)	<b>664</b> (212)	<b>3192</b> (632)	
			suitable	conditionally suitable	not suitable		

# Integrated Spatial and Energy Planning

- integral part of spatial planning
- spatial dimensions of energy demand
- spatial dimensions of energy supply

ÖREK-Partnerschaft  
„Energieraumplanung“

ÖROK

Lead Partner Austrian  
Environmental Ministry

05.11.2019

# Integrated Spatial and Energy Planning

## spatial dimensions of energy demand

- energy efficient spatial structures
  - mix of functions
  - density
  - nearness
  - compactness

## spatial dimensions of energy supply

- securing of sites
- securing of resources
- mitigating land use conflicts
- energy efficient spatial structures

## Applying strategic planning tools considering spatial, economic and environmental issues

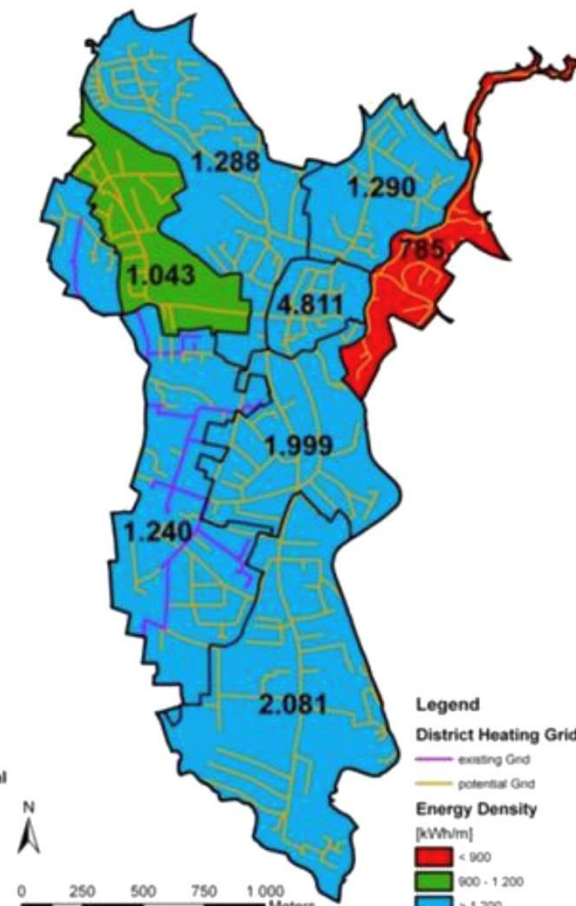
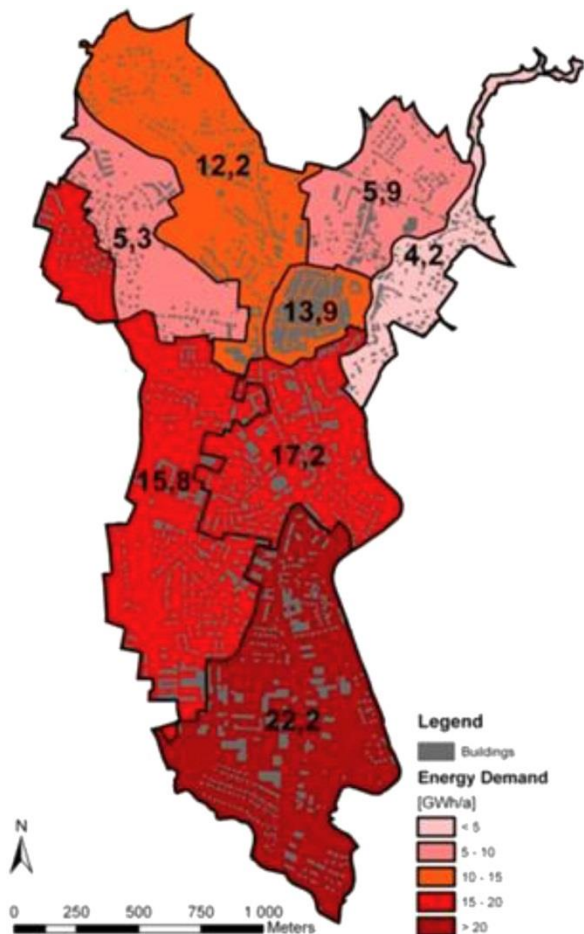
- Energy Zone Mapping (spatial analysis)
- Process Network Synthesis (PNS) (economic optimisation)
- Sustainable Process Index (SPI) (environmental appraisal)



Kollmann, Neugebauer,  
Kretschmer et al. 2017  
Stöglehner et al. 2016  
Bond, Morrison-Saunders  
and StoeGLEHNER 2012



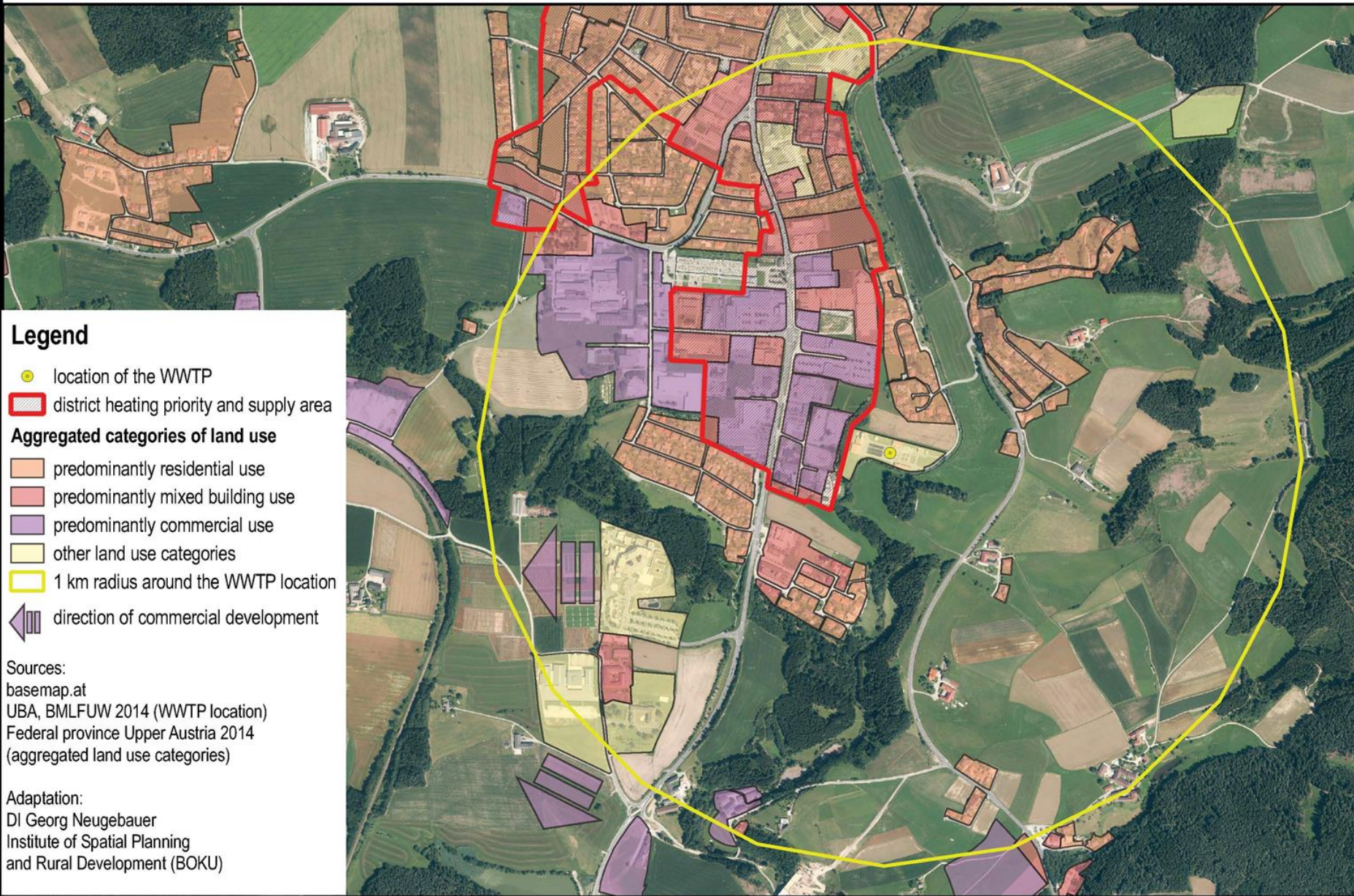
# ENERGY ZONE MAPPING



Stoeglehner et al. 2011



# Aggregated categories of land use in the surroundings of the WWTP Freistadt



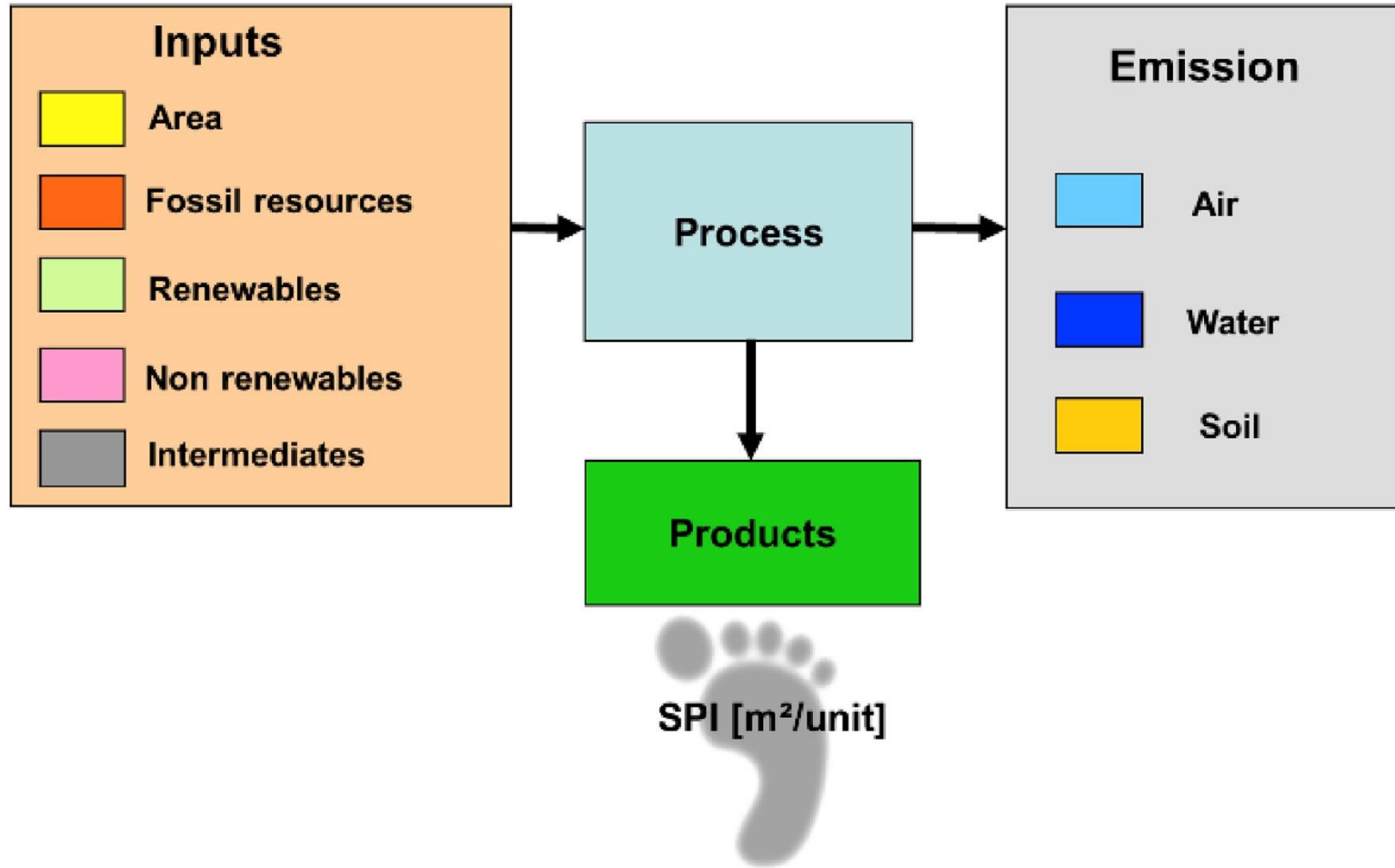
## Legend

- location of the WWTP
- ▨ district heating priority and supply area
- Aggregated categories of land use**
- predominantly residential use
- predominantly mixed building use
- predominantly commercial use
- other land use categories
- 1 km radius around the WWTP location
- direction of commercial development

Sources:  
basemap.at  
UBA, BMLFUW 2014 (WWTP location)  
Federal province Upper Austria 2014  
(aggregated land use categories)

Adaptation:  
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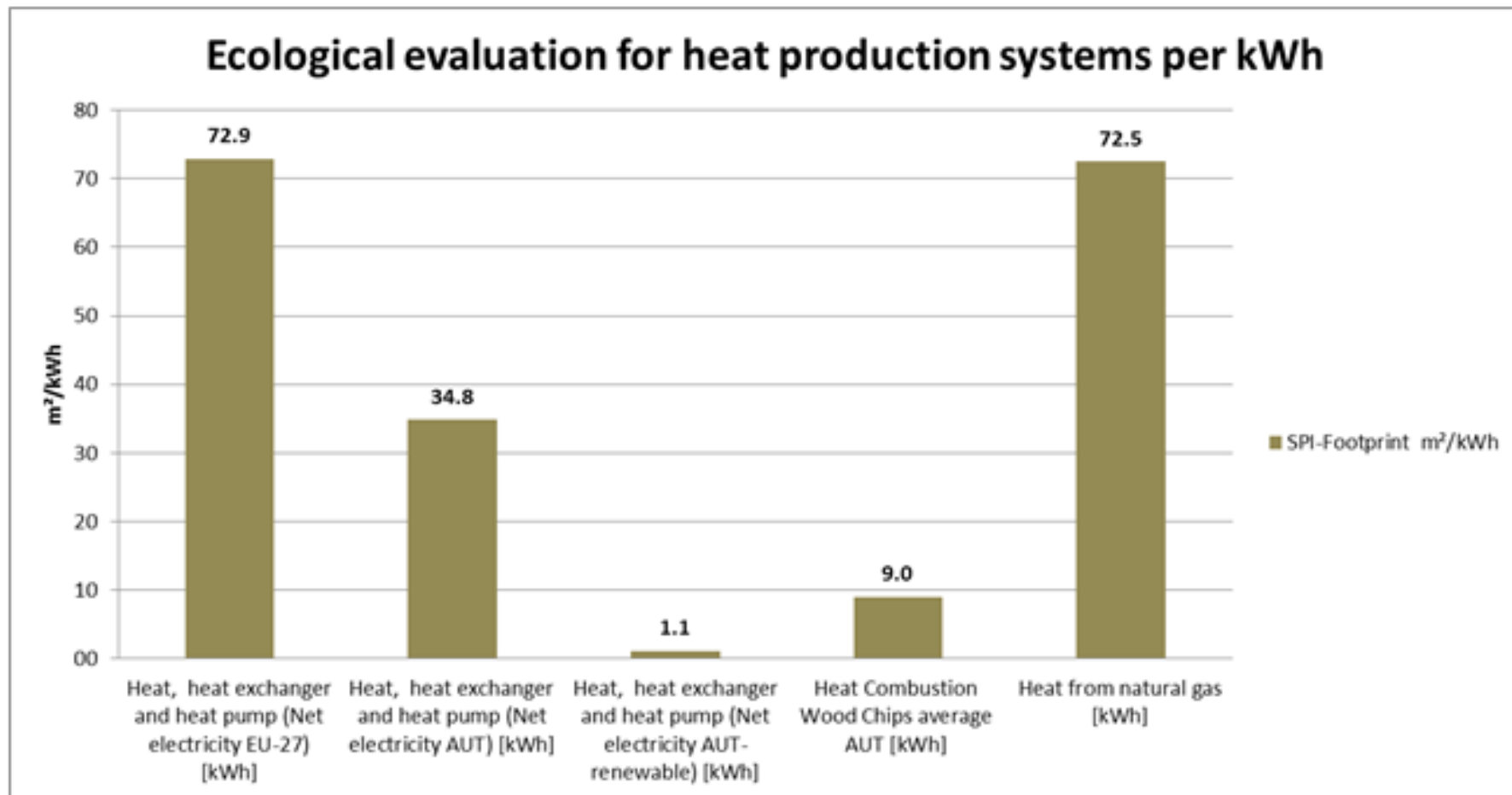
# SUSTAINABLE PROCESS INDEX (SPI)



<http://spionweb.tugraz.at/de/spi>, 2016

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# SPI FOOTPRINT FOR HEAT GENERATION



Neugebauer et al. 2015

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# TAKE HOME MESSAGES

- 1) Heat sector plays a key role in the energy turn.
- 2) Wastewater now acknowledged as a renewable heat source.
- 3) Experiences show, that wastewater can make a valuable contribution to future (urban) energy systems.
- 4) Appropriate institutional framework and stakeholder involvement is imperative.



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Project Acronym: REEF2W



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