



Experience from 60 years of waste incineration in Austria

**Iskustvo od 60 godina spaljivanja
otpada u Austriji**

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Parentium Hotel
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Environmental Management and Engineering

Dr. Helga Stoiber

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Who we are

UVP Company Profile (1)

We are a **leading Austrian planning and consulting company** in the field of **waste management** and **environmental engineering**, located in Vienna.

We are a team of about 20 process engineers, civil engineers, and environmental engineers.

Our field of expertise is the development of **sustainable waste management options**.

Since the 1990s, we have successfully carried out many national and international projects.

UVP Company Profile (2)

➤ Waste Management Concepts & Treatment Processes

➤ Waste-to-Energy Plants:

➔ From the first Concept to Commissioning.

➤ Contaminated Sites:

➔ Exploration, Assessment, Remediation

➤ Landfill Sites:

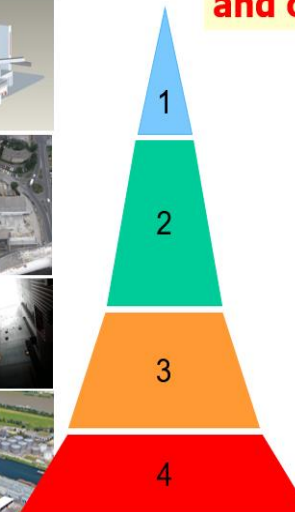
➔ Planning, Supervision, Remediation

➤ Energy Efficiency of Industrial processes

➤ Trainings, Workshops, Capacity Building:

For companies, civil servants, governmental authorities etc.

➤ Assessment, Expert Opinions, Publications



We cover the entire project cycle and co-operate with local partners.

- 1. Concept**
 - Analyses of Status-Quo and Prognosis
 - Master-Plan for Waste Management
 - General Concept for Project Design
- 2. Planning, Procurement**
 - Project Design
 - Feasibility Study
 - Environmental Impact Assessment
 - Basic Engineering
 - Tender Documents
 - Evaluation of Bids
- 3. Construction**
 - Detail Engineering
 - Project Control
 - Training of Operating Personnel
 - Supervision of Start-up
- 4. Operation**
 - Maintenance Supervision
 - Environmental Audit

UVP's White Books on Waste-to-Energy



AUSTRIA (1999, 2009, 2015)

https://www.bmk.gv.at/themen/klima_umwelt/abfall/Kreislaufwirtschaft/verwertung/studien/weissbuch.html

SLOVAKIA (2020)

<https://www.ewia.sk/wp-content/uploads/2021/03/biela-kniha.pdf>

Some References (1)

Concept, Feasibility Study, Basic Engineering, EIA Permitting



**RVL Lenzing 1K8
(1998)**

110 MW
300,000 t/a



**EVN Dürnrrohr 1+2
(2003)**

2 x 60 MW
360,000 t/a



**ENAGES Niklasdorf
(2003)**

40 MW
145,000 t/a

Some References (2)

General Planners in Construction Phase



**SKN Nettingsdorf
Black Liquor Boiler
(2020)**

177 MW

Concept, Feasibility Study, Basic Engineering and EIA Permitting



**RHKW Linz
(2012)**

76 MW
275,000 t/a



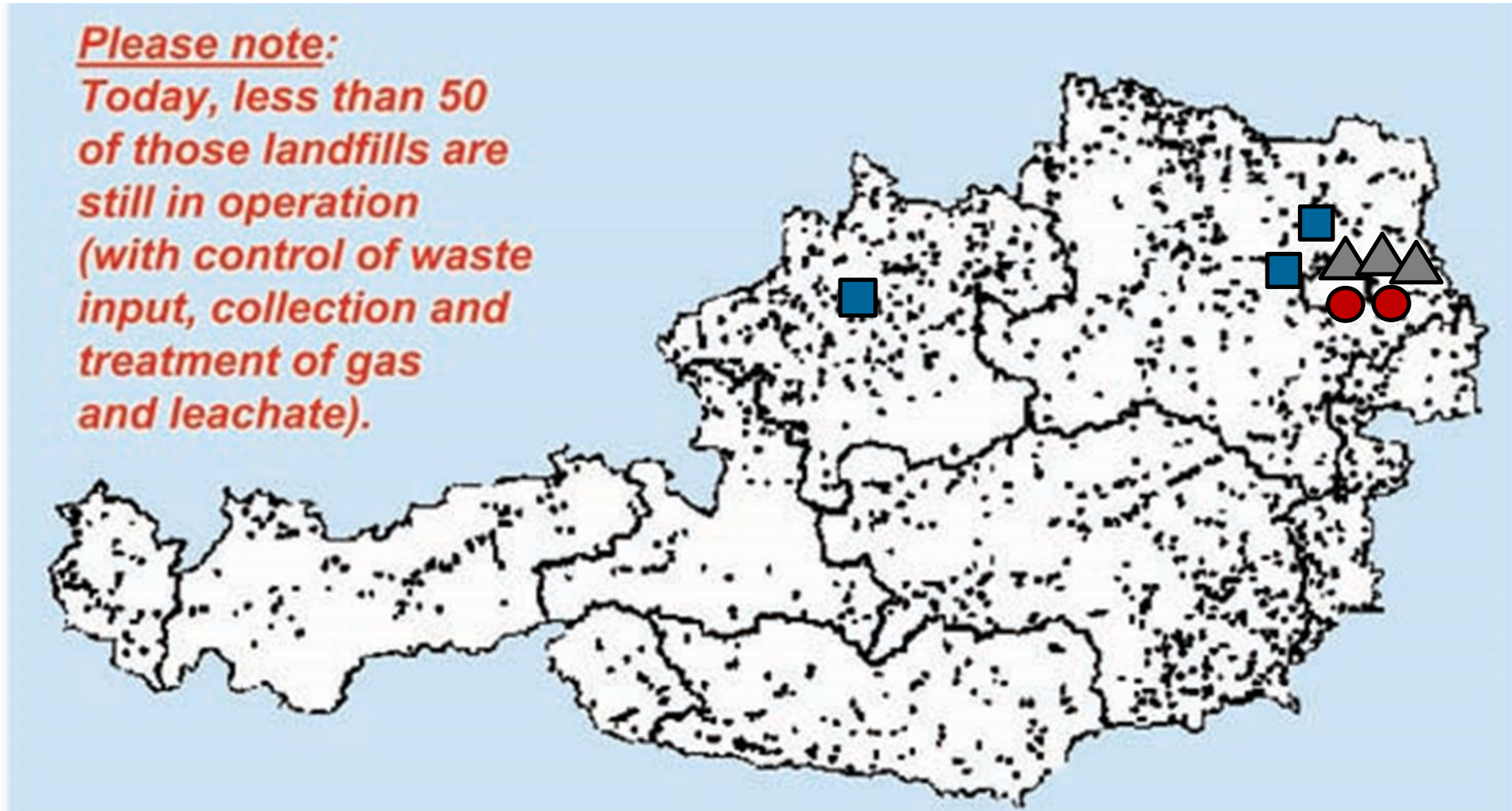
**Norske Skog K9
(2022)**

49 MW
250,000 t/a

History of Waste-to-Energy in Austria

Landfill & WtE in Austria - 1984

1.800 registered Landfill Sites + illegal Deposition



Landfill & WtE in Austria - 2015



Environmental Management and Engineering

62 Landfill Sites for „Residual Waste“ and „Mass Waste“ with control of incoming waste, landfill gas collection and energy production, leachate treatment

- Rostfeuerung
- △ Wirbelschichtfeuerung
- Drehrohrofen

- Siedlungsabfälle
- Gefährliche Abfälle
- Klärschlamm, mechanisch entwässert

Anlagen im Scope des BREF Waste Incineration.



(Quelle: H. Stoiber, UVP GmbH)

Tabelle 52: Thermische Behandlungsanlagen für Siedlungsabfälle

Thermische Abfallbehandlungsanlage	Feuerung/Abfalleinsatz	Kapazität [t/a]
Müllverbrennungsanlage Wien Spittelau	Rost (gemischter Siedlungsabfall)	250.000
Müllverbrennungsanlage Wien Flötzersteig	Rost (gemischter Siedlungsabfall)	200.000
Müllverbrennungsanlage Wien Pfaffenu	Rost (gemischter Siedlungsabfall)	250.000
Müllverbrennungsanlage Wels	Rost (gemischter Siedlungsabfall)	305.000
Müllverbrennungsanlage Dürnrohr	Rost (gemischter Siedlungsabfall)	525.000
Müllverbrennungsanlage KRV Arnoldstein	Rost (gemischter Siedlungsabfall)	96.000
Müllverbrennungsanlage Zistersdorf	Rost (gemischter Siedlungsabfall)	130.000
Wirbelschichtofen 4 Wien Simmeringer Haide	Wirbelschicht (Rückstände aus der mechanischen Abfallaufbereitung, Klärschlamm)	110.000
Reststoffverwertung Lenzing	Wirbelschicht (Rückstände aus der mechanischen Abfallaufbereitung, Rückstände aus der Altpapieraufbereitung, Klärschlamm)	300.000
RHKW Linz	Wirbelschicht (Rückstände aus der mechanischen Abfallaufbereitung, Klärschlamm)	255.000
ENAGES Niklasdorf	Wirbelschicht (Rückstände aus der mechanischen Abfallaufbereitung, Klärschlamm)	131.000
Gesamt (gerundet)		2,6 Mio.
<i>Datengrundlage: EDM (Datenstand Juli 2016)</i>		

(Quelle: Bundesabfallwirtschaftsplan 2017, Teil 1 - <https://www.bmnt.gv.at/...>)

Diverting Waste from Landfill (1)

- **Hazardous and Special Waste Management Act, 1983**, (first guideline on sanitary landfills for solid waste disposal in **1977** by the Environmental Ministry)
- **Federal legislation on the Environmental Protection Fund, 1983**
- **Guidelines for Waste Management in Austria 1988**
- Federal legislation on clean-up of landfills and contaminated sites, **1990** (including a **disposal tax on landfill operations** for clean-up activities)
- Decree on separate collection of **Bio-Wastes**, 1991
- Decree on separation of **Construction and Demolition** waste, 1991
- **Ban on disposal of hazardous wastes in landfills** by July **2001** (except of inorganic wastes encapsulated in closed salt formations)
- Decree on landfills including the **ban on disposal of wastes exceeding 5 % TOC (Total Organic Carbon) for new landfills by the beginning of 1997** and limitation for **existing landfills** until beginning of **2004** (limited exemptions until end of **2008**, and limited exemptions for stabilized residues from MBT)

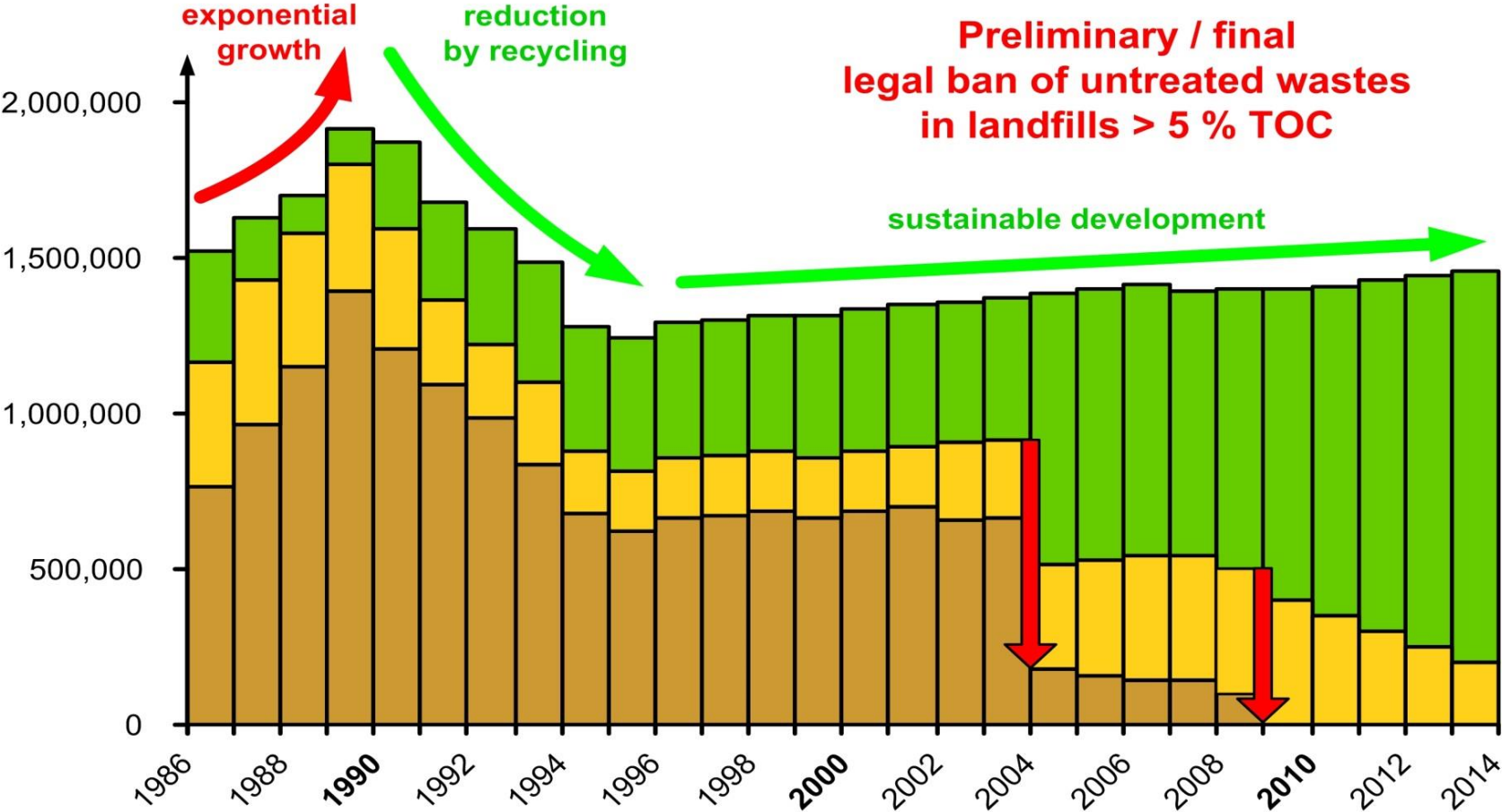
Diverting Waste from Landfill (2)



Environmental Management and Engineering

Residual Municipal Solid Waste collected in Austria
Figures in tons per year

- Waste incineration
- Mechanical biological treatment - MBT
- Landfill

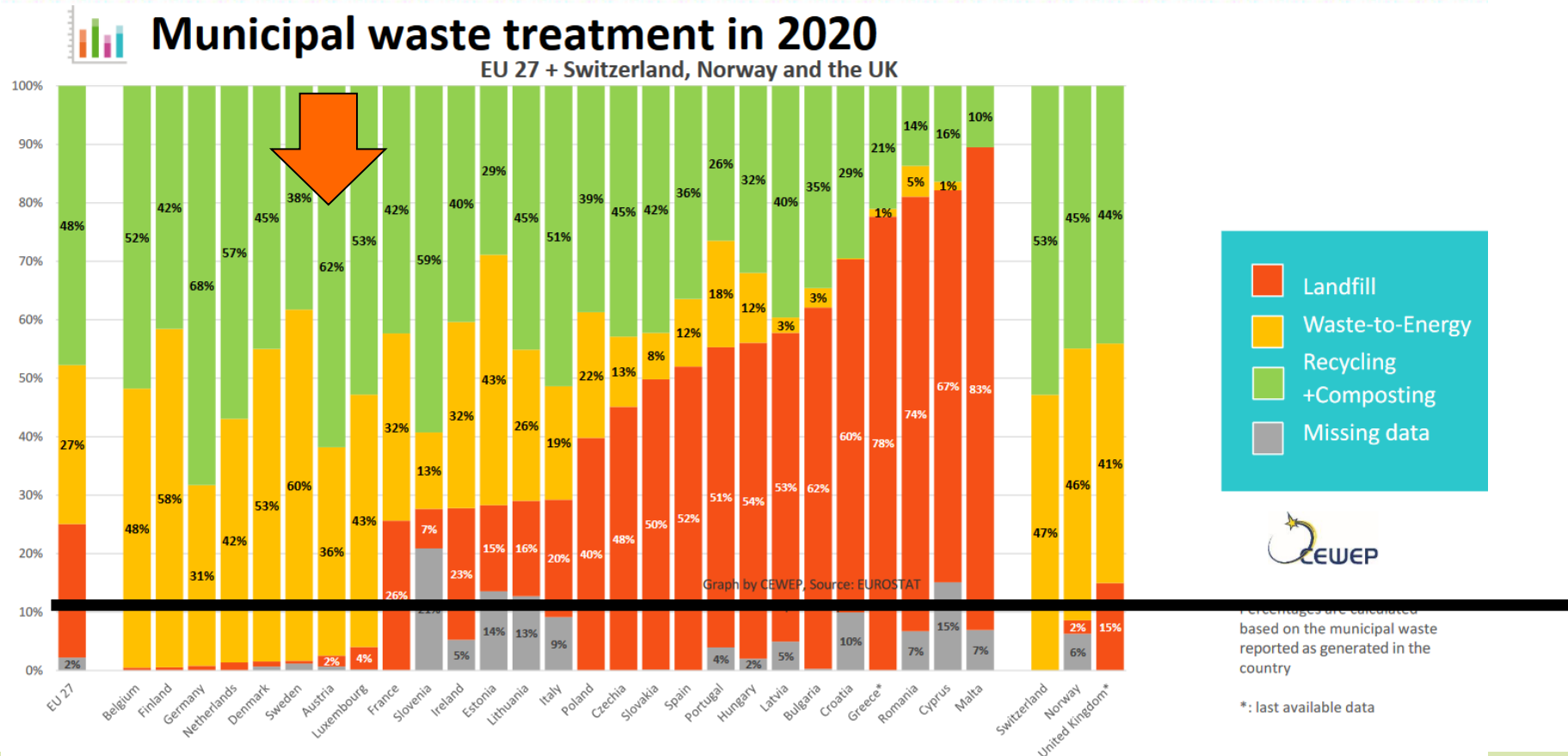


Source: Gerd Mauschitz, Klimarelevanz der Abfallwirtschaft IV, i.A.d. BMLFUW (2010)

Waste Incineration and Recycling Go Hand in Hand!

EU Landfill Directive 1999/31/EC, as amended by Directive (EU) 2018/850:

Member States must reduce the amount of municipal waste sent to landfill to 10% or less of the total amount of municipal waste generated by 2035.



Technology - Overview

Properties of Waste (1)

MSW Composition		Content
Carbon	C	20 – 25 %
Hydrogen	H	2 – 4 %
Oxygen	O	15 – 20 %
Nitrogen	N	0,3 – 1,0 %
Sulphur	S	0,2 – 0,5 %
Water	H ₂ O	25 – 35 %
Ash / Inert Material		20 – 30 %
Lower Heating Value (LHV)		8 – 12 MJ/kg

Further Chemical Elements

- P, Cl, F ...
- Na, K, Ca, Mg ... *
- Fe, Ni, Cd, Pb, Hg, Cr, As, Sb ... *

*) Partly as elements, mostly as **Ash**:
oxides, chlorides, sulphates, silicates ...

Heating Value (LCV) Range of Waste

- 3 MJ/kg (dewatered sewage sludge)
up to
- > 30 MJ/kg (plastic waste)
- **8-12 MJ/kg – typical LCV range of MSW**

Properties of Waste (2)

- **Unknown composition**
- **Heterogeneous**
- May contain contaminants and hazardous components, e.g.
 - Heavy metals,
 - Halogens,
 - Sulphur,
 - Persistent organic pollutants...

„Anything might come along.“ →

- Waste Incineration Technology must be
- **SAFE AND SOUND,**
- equipped with **BEST AVAILABLE ABATEMENT TECHNOLOGY,** and
- Designed and operated according to **BEST AVAILABLE TECHNIQUES (BAT).**

This is why waste incineration has the strictest regulations and lowest emission limit values of all industrial activities!

What comes in, gets out.
Always. Everywhere. In every Process.

PRINCIPLES OF WASTE INCINERATION

Relieve the big mass streams of pollutants – generate big amounts of

- purified flue gas
- purified waste water
- solid residues with very low pollutants levels to treatment and/or recovery

Concentrate the pollutants in small amounts of special waste
that are treated and/or disposed of in an environmentally safe and sound way.

Generate benefits & mitigate the environmental impact of our waste
by producing electricity, process steam, district heating/cooling, secondary materials.

Incineration Technology - Overview

➤ **Grate Firing**

Standard Process for MSW Incineration
(Pre-treated) MSW, various waste fractions

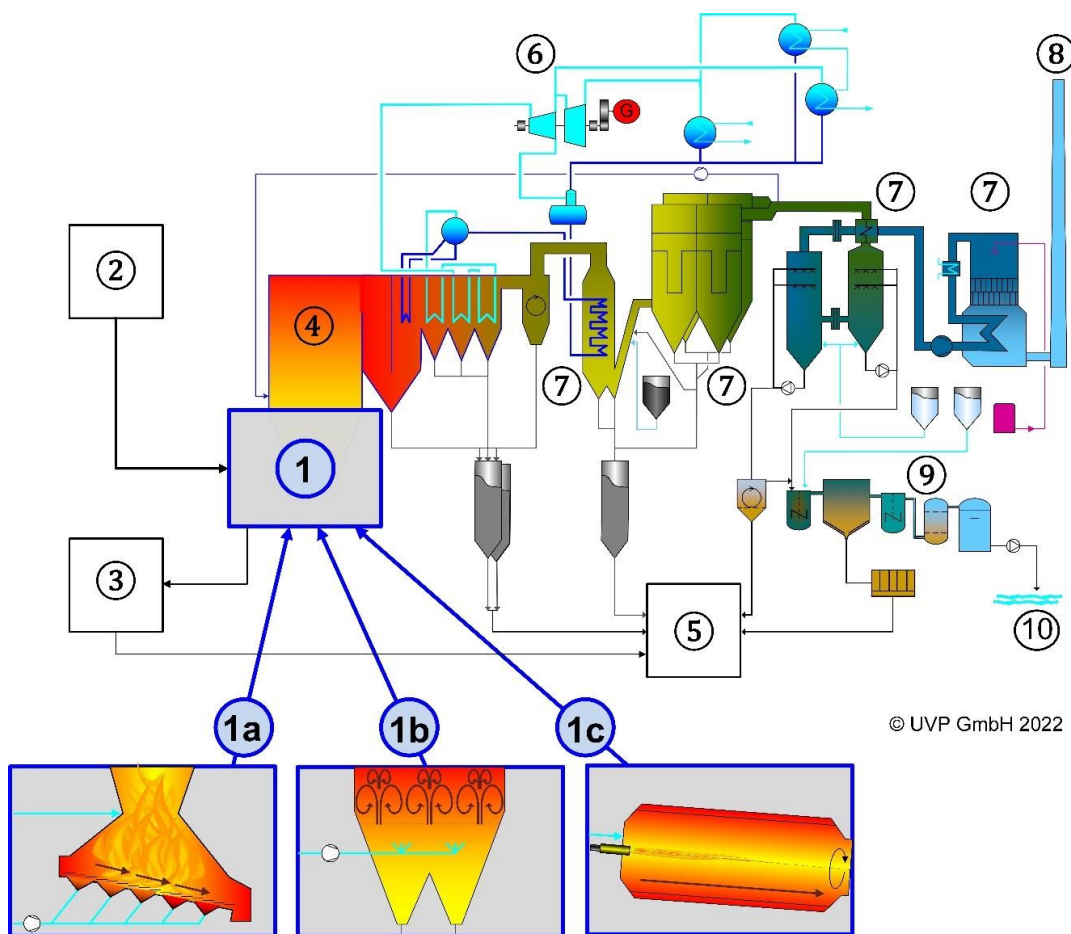
➤ **Fluidized Bed Reactor**

- Sewage Sludge
- Pre-treated MSW
- Pre-treated Waste in general

➤ **Rotary Kiln**

- Hazardous Waste

Waste Incineration & Flue Gas Cleaning



1. Furnace (1a. Grate, 1b. Fluidized Bed, 1c. Rotary kiln)
2. Storage and dosing of fuel and waste
3. Collection of solid residues from the furnace
4. Boiler for heat recovery
5. Various solid residues going to recovery and disposal
6. Combined Heat and Power Production (CHP)
7. Typical multi-stage system for (wet) flue gas cleaning
8. Stack for release of clean flue gas
9. Typical multi-stage wet waste-water treatment cleaning system
10. Release of clean water

Incineration Technology

Waste Type	Grate	Fluidized Bed	Rotary Kiln
Residual waste	well suited	pre-treatment required	suitable
Sewage sludge	limited in terms of quantity	well suited	suitable
Waste water rakings	suitable	pre-treatment required	limited suitability
Crushed plastics	limited in terms of quantity	well suited	limited suitability
Whole tyres	limited suitability	unsuitable	limited suitability
Shredder waste	limited in terms of quantity	well suited	limited suitability
Crushed waste wood	well suited	well suited	suitable
Lacquer and paint sludge	unsuitable	suitable	suitable
Hazardous waste in small containers (e.g. laboratory waste)	limited suitability	unsuitable	suitable

Benefits of MSW Incineration (1)

- **Volume Reduction ~ 90%**
- **Mass Reduction ~ 60%**
- **Destruction of Organic Components →**
 - Inertisation
 - Sanitation / Disinfection
- **Prevention of Emissions**
- Concentration and recovery of valuable substances / secondary raw materials → **Contribution to Circular Economy**
- **High Energy Efficiency for Combined Heat and Power Production**

Benefits of MSW Incineration (2)

Less specific greenhouse gas emissions than landfill:

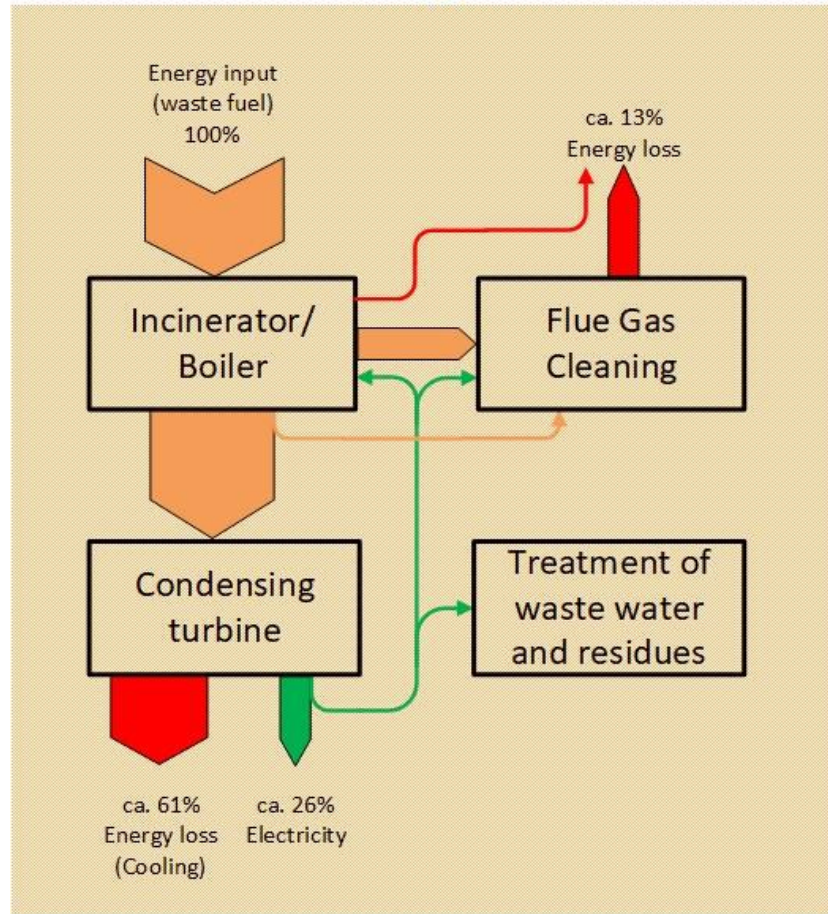
- Over 20 years:
Global warming potential of CH₄ is **84 times** higher than of CO₂
- Over 100 years:
Global warming potential of CH₄ is **28 times** higher than of CO₂
(Source: https://energy.ec.europa.eu/topics/carbon-management-and-fossil-fuels/methane-emissions_en)
- Waste Incineration is the „**State of the Art**“ in Thermal Waste Treatment, with numerous Reference Plants.

When Waste Incineration is carefully designed and operated:

- **Minimum Environmental Impact**
- **Reliable & quite easy to operate**

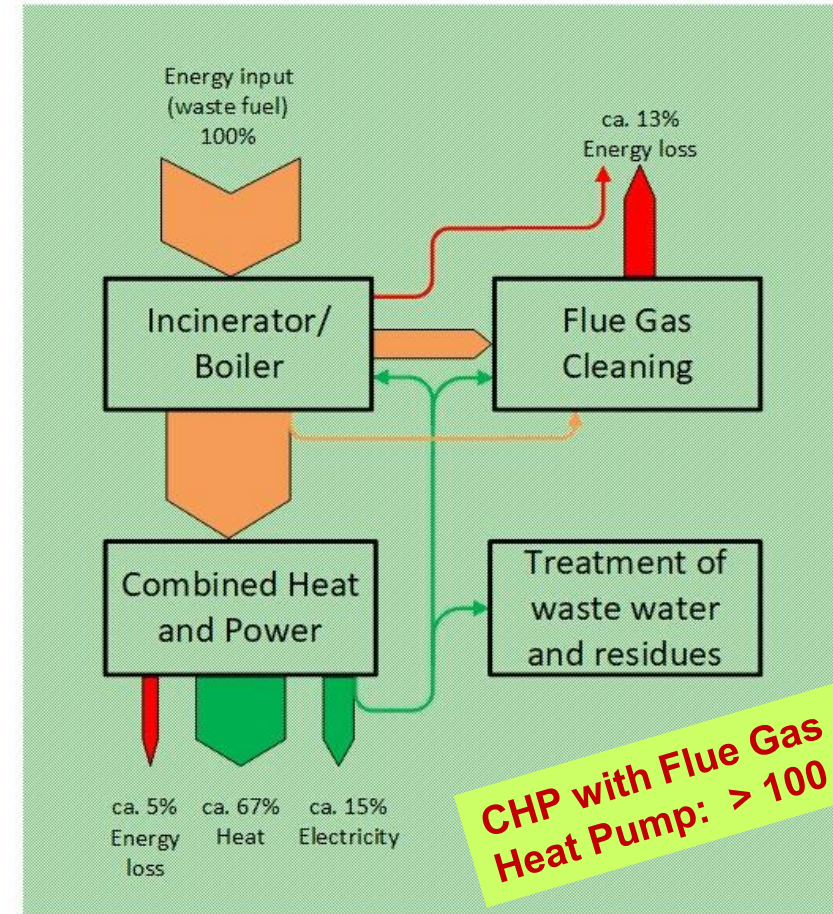
Energy Efficiency of Waste-to-Energy

Condensing Turbine



Total energy utilization: ca. 26 %

Combined Heat and Power (CHP)



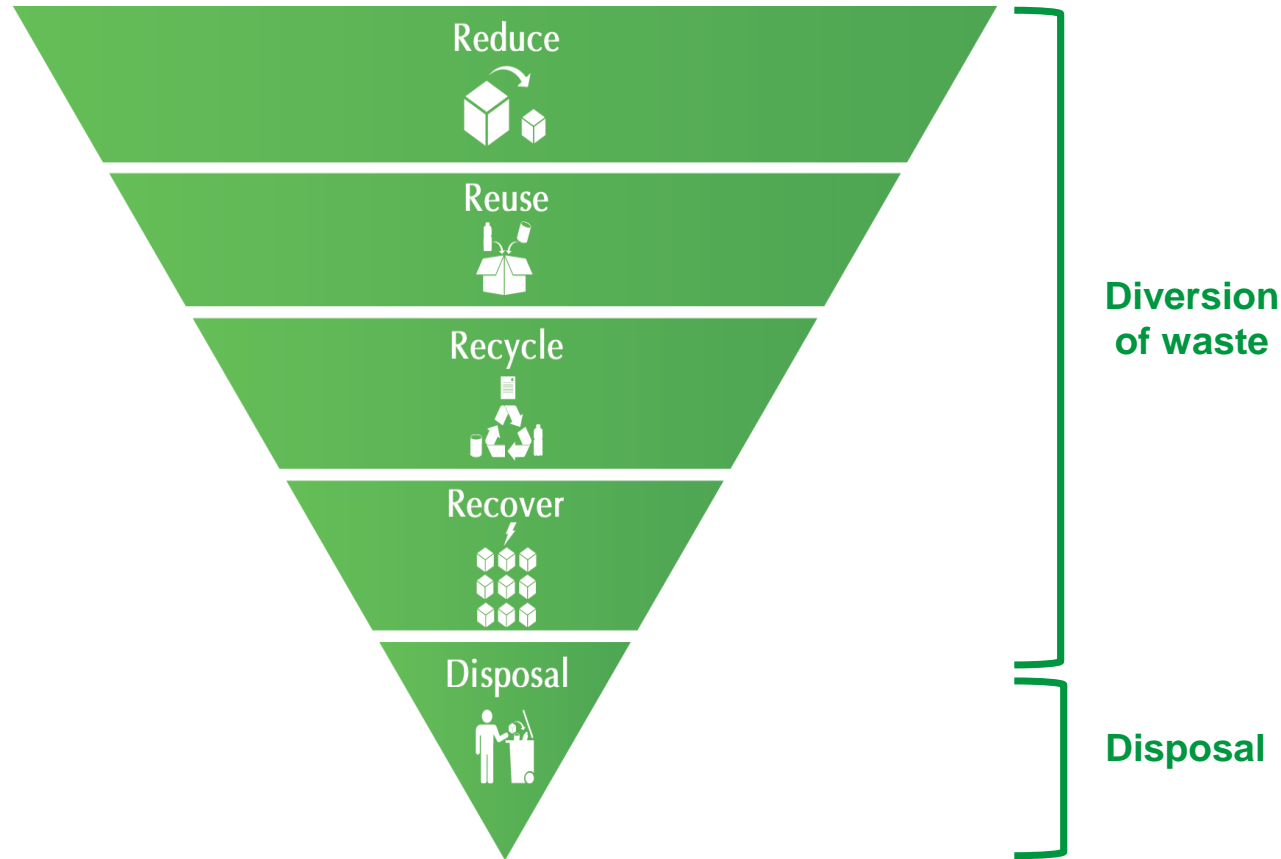
Total energy utilization: ca. 82 %

CHP with Flue Gas Condensation and Heat Pump: > 100 % are possible

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EU Legal Framework - Overview

Waste Hierarchy & Circular Economy



Source: EU Waste Framework Directive
(EU Directive 2008/98/EC)



EU Legal Regulations for Waste Incineration

- **Industrial Emissions Directive**
- **BREF WI**
Best Available Techniques (BAT) Reference Document on Waste Incineration
- **BAT Conclusions (BATC)**
- Waste Framework Directive
- Environmental Impact Assessment (EIA) Directive
- EU Emission Trading System (EU ETS)
- ...

Industrial Emissions Directive (IED) 2010/75/EU

➤ Chapter IV and Annex VI

Special Provisions for Waste Incineration and Co-Incineration Plants → applicable “from the first kg of waste incinerated” onwards

+ Additional provisions for IPPC Installations:

- **Integrated Pollution Prevention and Control (IPPC)** and the
- **BAT Reference Document on Waste Incineration (BREF WI)** apply for waste Incineration / co-incineration plants with capacities of
 - **> 3 tonnes per hour of non-hazardous waste**
 - **> 10 tonnes per day of hazardous waste**

IED Regulations for Waste Incineration (Examples) (1)

Waste Incineration complies with the strictest ELVs of all industrial sectors in the EU.

ELVs for Emissions to Air:

- Dust
- TOC
- HCl, HF, SO₂, NO_x
- CO
- NH₃
- 12 Heavy metals:
Hg; Cd + Tl; Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V;
- Polychlorinated dioxins and furans (PCDD/F)

IED Regulations for Waste Incineration (Examples) (2)

Waste Incineration complies with the strictest ELVs of all industrial sectors in the EU.

ELVs for Emissions to Water:

- Total suspended solids
- 9 Heavy metals:
Hg, Cd, Tl, As, Pb, Cr, Cu, Ni, Zn
- Polychlorinated dioxins and furans (PCDD/F)

IED Regulations for Waste Incineration (Examples) (3)

Strict regulations also for:

- **Waste acceptance**
 - **Operating conditions**
 - **Use of Best Available Techniques (BAT)**
 - **Reporting obligations**
 - **Other than normal operating conditions (OTNOC)**
 - **Information of the public**
 - **Site closure**
- etc. etc.

BAT Reference Document on Waste Incineration (BREF WI)

BAT 1	Environmental Management System
BAT 2 – BAT 8	Monitoring
BAT 9 – BAT 18	General Environmental and Combustion Performance
BAT 19 – BAT 20	Energy Efficiency
BAT 21 – BAT 24	Air Emissions - Diffuse Emissions
BAT 25 – BAT 31	Air Emissions - Channelled Emissions
BAT 32 – BAT 34	Emissions to Water
BAT 35 – BAT 36	Material Efficiency
BAT 37	Noise

Example: Vienna

MSW

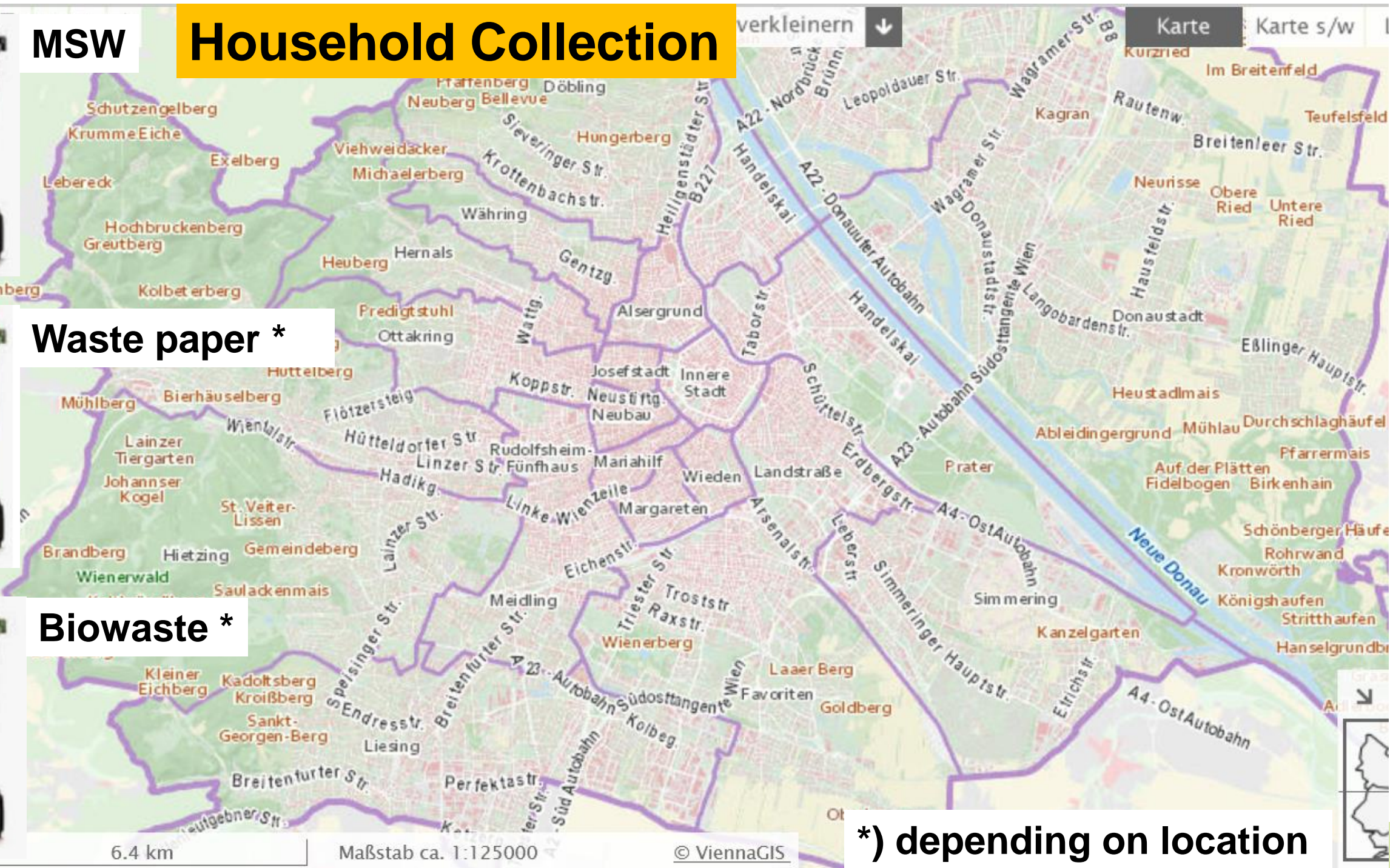
Household Collection



Waste paper *



Biowaste *



6.4 km

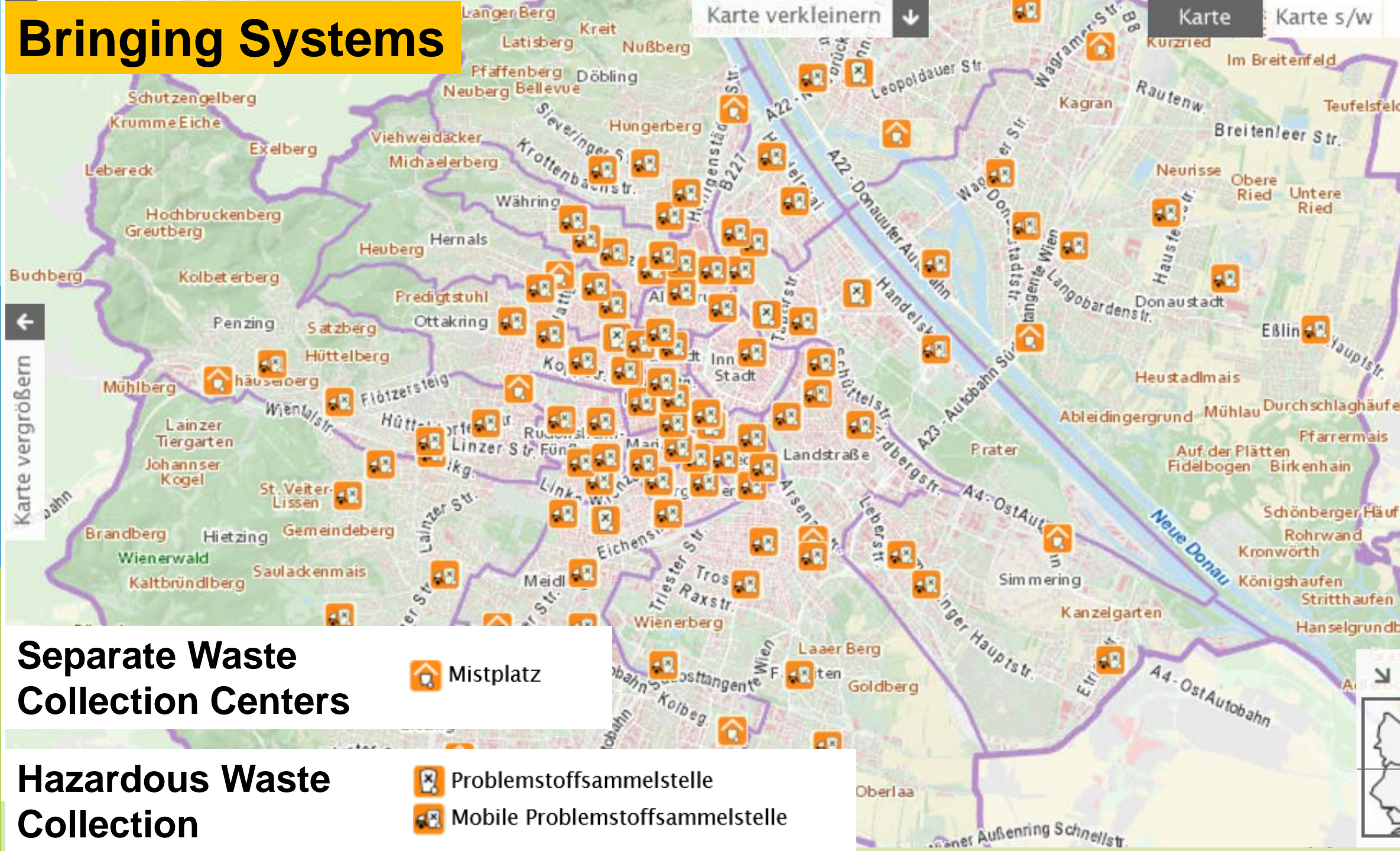
Maßstab ca. 1:125000

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***) depending on location**



Bringing Systems



**Separate Waste
Collection Centers**



Mistplatz

**Hazardous Waste
Collection**

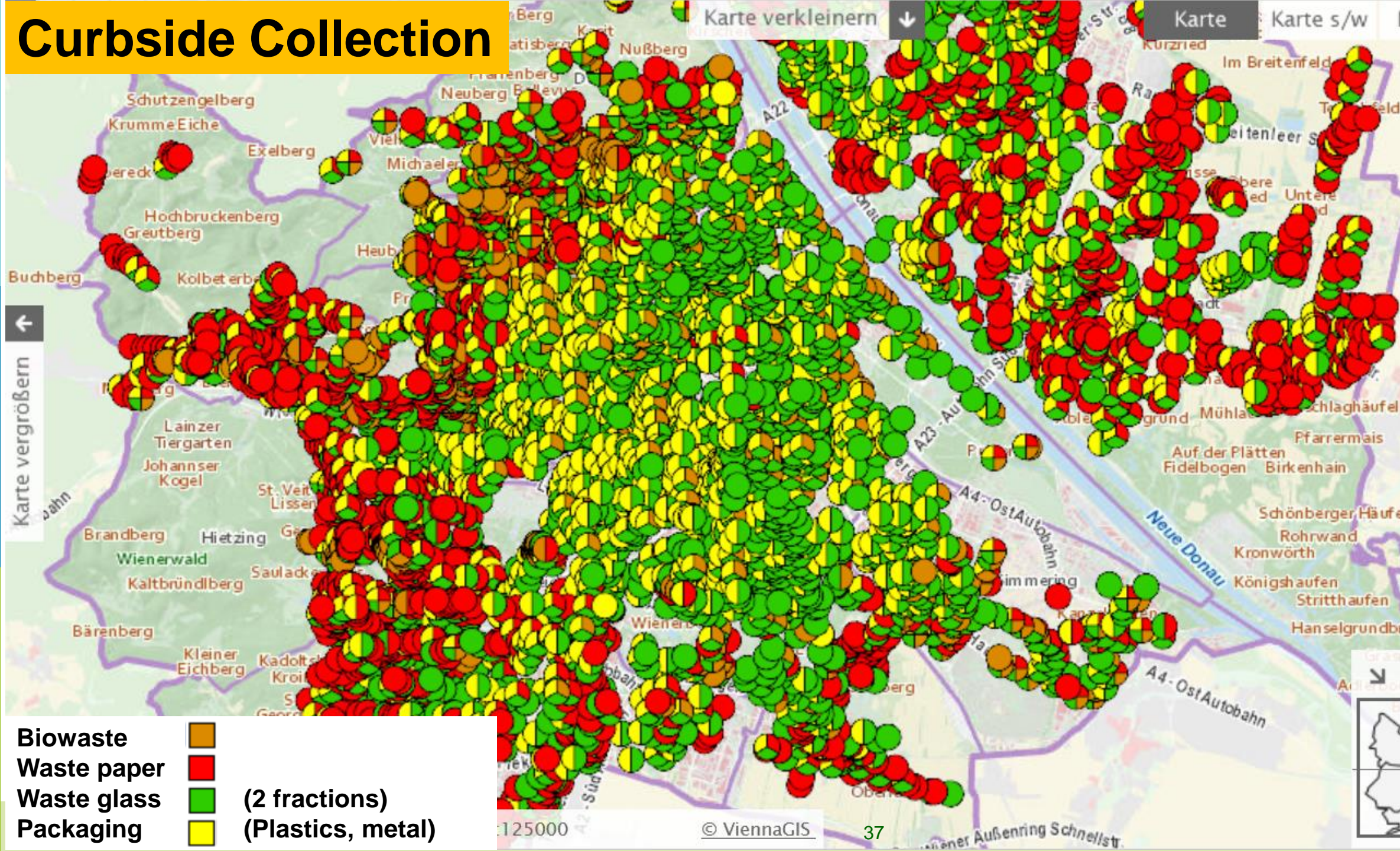


Problemstoffsammelstelle



Mobile Problemstoffsammelstelle

Curbside Collection



- Biowaste 
- Waste paper 
- Waste glass (2 fractions) 
- Packaging (Plastics, metal) 

1:25000

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37

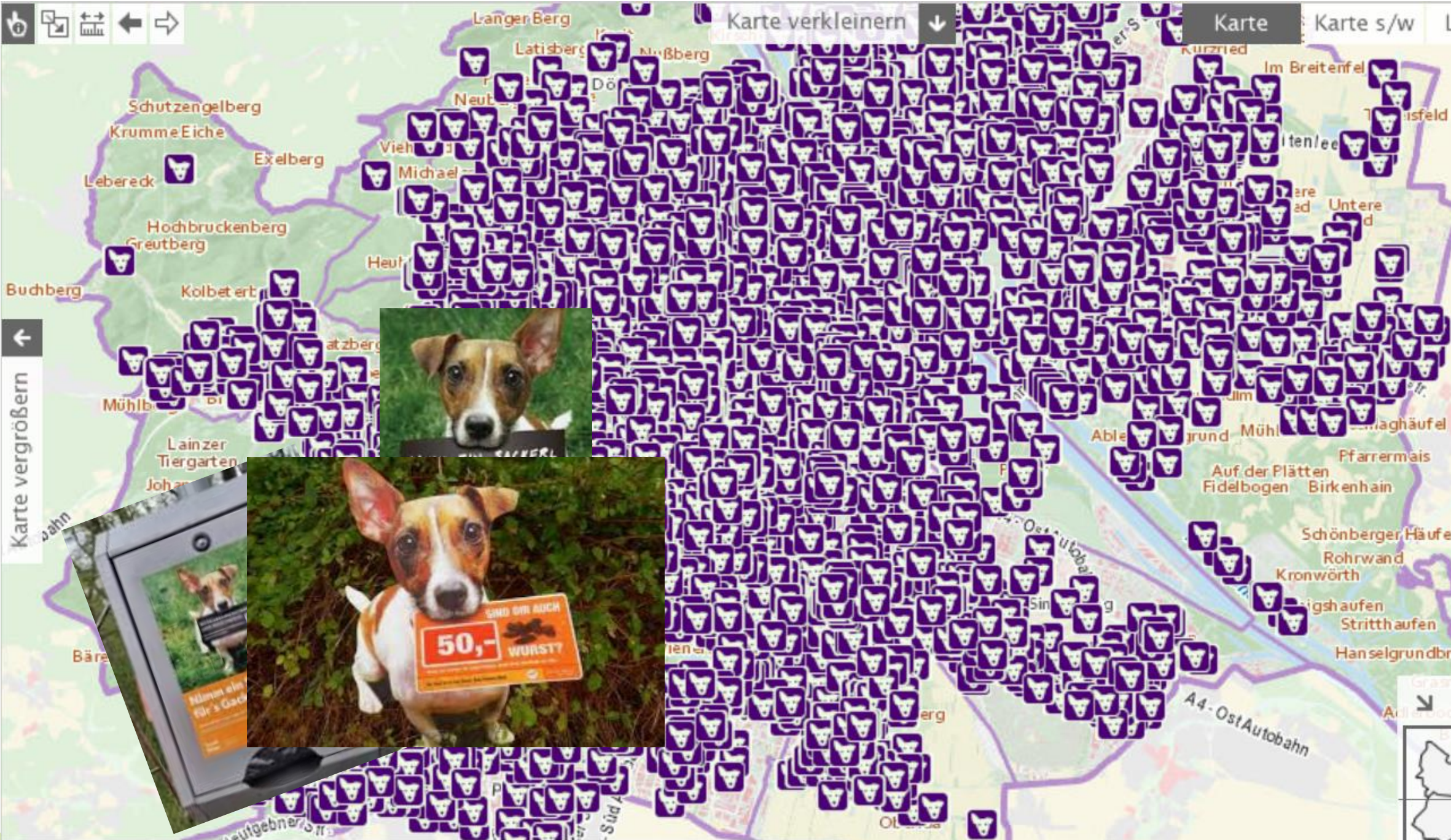


Karte verkleinern

Karte

Karte s/w

Karte vergrößern



6.4 km

Maßstab ca. 1:125000

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Vienna's Waste Incinerators (1)



Vienna's Waste Incinerators (2)

MSWI

Flötzersteig

- **1963** + adaptations
- Grate, 3 Lines
- 200,000 t/a
- MSW
- Wien Energie

MSWI Spittelau

- **1971** + adaptations
- Grate, 2 Lines
- 290,000 t/a
- MSW
- Wien Energie

MSWI Pfaffenua

- **2008**
- Grate, 2 Lines
- 250,000 t/a
- MSW
- WKU,
operated by Wien Energie

Simmeringer Haide

– Wien Energie

WSO1-3

- 3 BFB incinerators
- 1980 and 1992
- 65,000 t/a (total)
- Dewatered sewage sludge
- Recently adapted to new operating conditions at EbS sewage plant

DRO1-2

- 2 rotary kilns
- 1980
- 100,000 t/a (total)
- Hazardous waste

WSO4

- 1 BFB incinerator
- 2006
- 110,000 t/a (total)
- Mechanically pre-treated (municipal) waste, dewatered sewage sludge

Vienna's Waste Incinerators: Energy Utilization (2020)

All values are estimated and rounded.

	Flötzersteig	Spittelau	Simmeringer Haide & Pfaffenau	TOTAL
Waste Input (Actual input 2020)	200,000 tons	270,000 tons	360,000 + 250,000 tons	1,08 mio tons
District Heating	51 MW (55,000 HH)	58 MW (69,000 HH)	75 MW + 50 MW (52,000 + 50,000 HH)	234 MW (226,000 HH)
District Cooling	-	17 MW (4,860 AC)	-	17 MW (4,860 AC)
Electricity	-	14 MW (22,000 HH)	9 MW + 14 MW (0 * + 25,000 HH)	37 MW (47,000 HH)

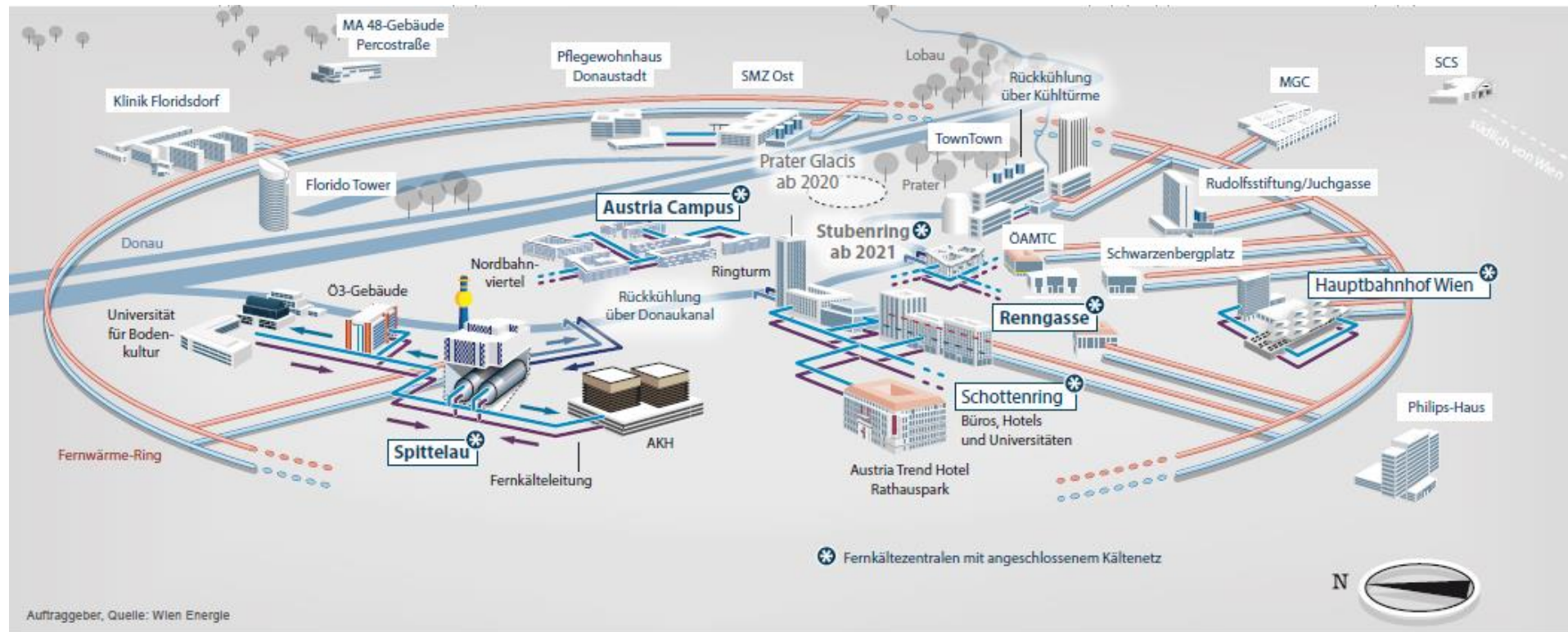
HH ... Households
AC ... Air condition device

*) Only for own consumption, no deliveries to households

1,250 km District Heating Network in Vienna (2020).
About 20% of district heat deliveries comes from combustible waste.

Sources:
Wien Energie Umwelterklärung (2022)
Österr. Bundesabfallwirtschaftsplan (2023)

District Cooling



- Since 2007
- Technology: Absorption Refrigerators
- Big Cooling Centers, e.g. at MSWI Spittelau → Cooling networks (6° C / 16° C)
- Decentralized Cooling Installations in big buildings without connection to cooling network → operated with district heating

Source: Wien Energie, Umweltbericht 2021 (2022)

Conclusions

Experience from 60 Years of Waste Incineration in Austria (1)

- **Waste incineration is a reliable, safe and proven technology, as long as it is carried out using Best Available Techniques (BAT).**
It has considerable environmental benefits.
It transfers pollutants into safe sinks.
- **Waste incineration is a good solution for treating waste that cannot be recycled.**
- **An elaborate system of separate waste collection is therefore one of the prerequisites for successful waste incineration projects.**
- **Waste incineration is an important part of the Circular Economy.**
- **Recycling and waste incineration go hand in hand.**
High incineration rates correspond with high recycling rates.

Experience from 60 Years of Waste Incineration in Austria (2)

- **In the EU, waste incineration is definitely **the most strictly regulated industrial branch** and has **the lowest emission limit values** of all industrial sectors.**
- **Waste incineration is a **good option to provide energy** to industrial customers and households.**
- **Site selection is crucial.**
High energy utilization requires an adequate neighbourhood of energy customers.
- **Combined heat and power production (CHP) in the form of **co-generation** or **tri-generation** should be applied,** as it has the highest overall energy utilization rates.

Experience from 60 Years of Waste Incineration in Austria (3)

Influencing factors for successful implementation of waste incineration projects:

- **Raising the general knowledge about waste incineration –** Explaining, answering questions, providing information and data...
- **Investing in solid, sound and safe engineering partners from the very start –** engineering costs less than 1% of the entire project costs over the installations life span, money well invested...
- **Practicing open communication from the very beginning and further-on -** „Glass factory“, being transparent and open, providing continuous information to the public, making measured values easily available (e.g. on the website), installing some kind of „Citizen Council“ as a board for information exchange etc.

Thank you for your attention!

Imate li pitanje?



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