Experiences in Waste Incineration in Austria

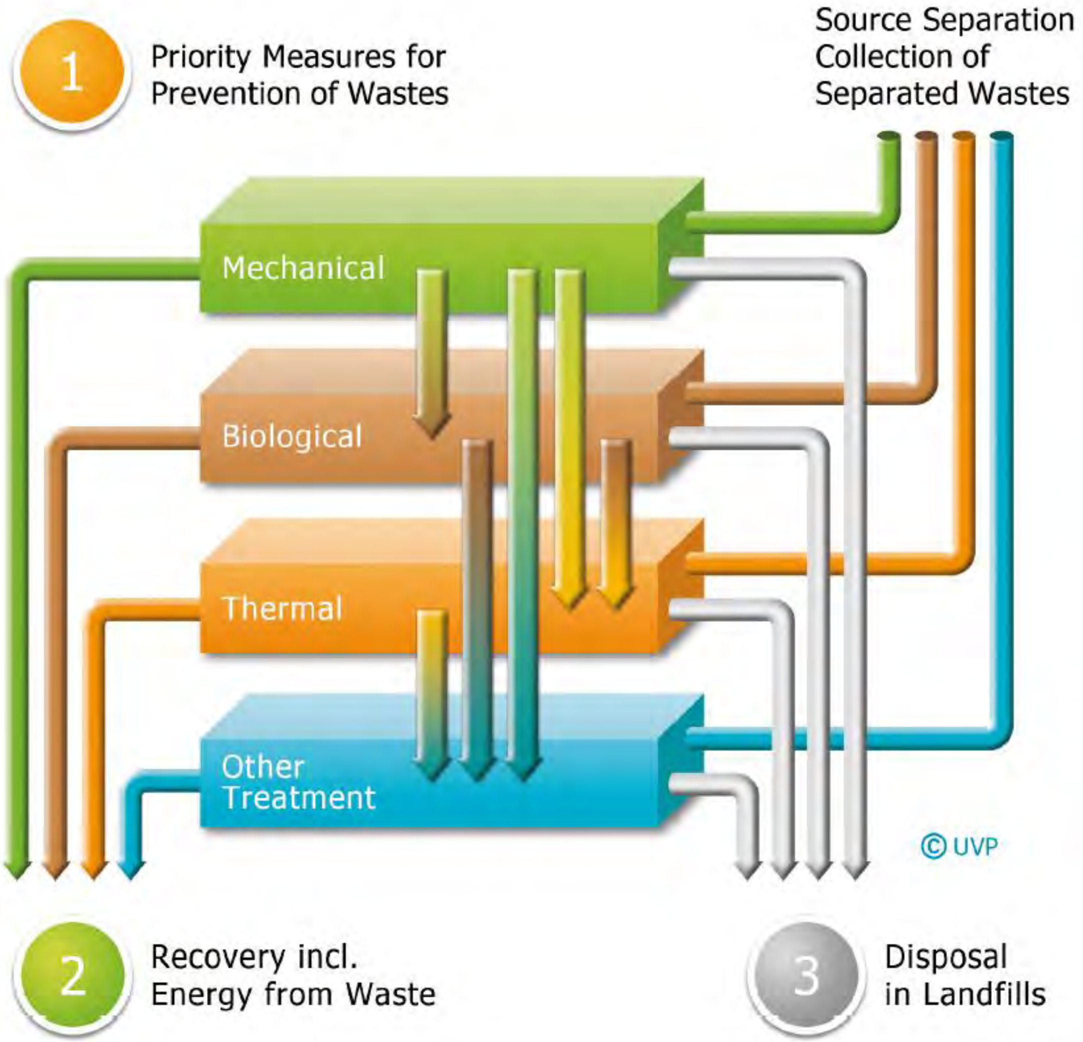
Summary of lessons learned in the past 50 years

⇒ avoid (expensive!) mistakes
⇒ cooperate efficiently

Franz Neubacher
Dipl.-Ing. Verfahrenstechnik (T.U. Graz, Austria)
M.Sc. Technology & Policy (M.I.T., USA)

UVP
Environmental Management and Engineering

A-1020 Vienna, Lassallestrasse 42 / 12a, Austria
Tel. + 43-(0)664-2106709, Fax + 43-1-2149520-20
franz.neubacher@uvp.at; http://www.uvp.at



Different technologies are needed for specific wastes in an integrated treatment system.

Successful project design must be based on 1st and 2nd Law of Thermodynamics !

Our project designs are profitable for our clients and good for the environment.

(UVP, since 1991)

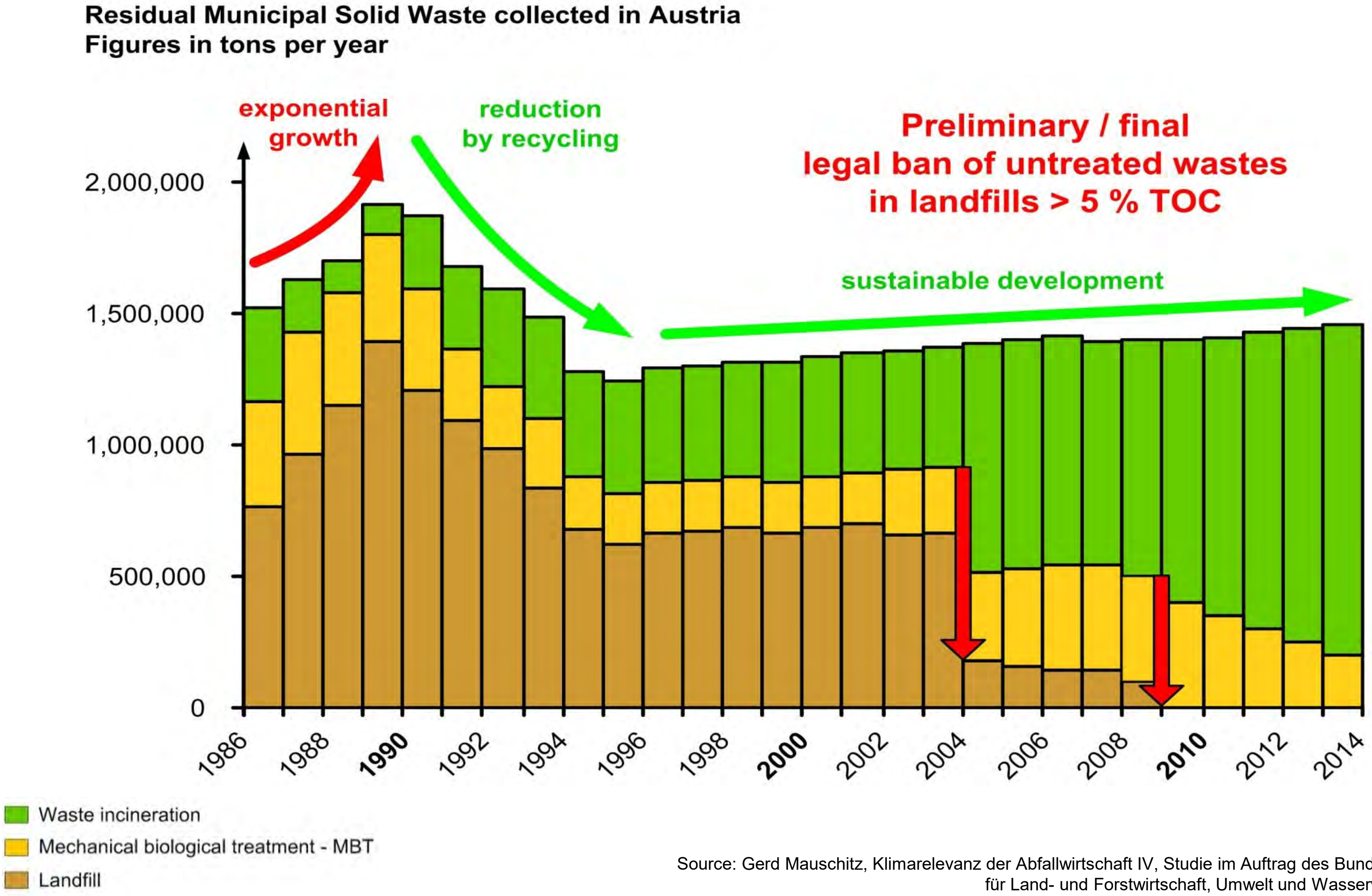
Public Education for Environmental Awareness and Prevention of Waste: “The beautiful River Danube starts here”

Treatment of Municipal Solid Waste in Different Countries within the European Union

	Municipal solid waste in kg per person	Treatment of municipal solid waste in 2014 (in %)			
		Land filling	Incineration	Recycling	Composting
Austria	578	*4*	37	24	35
Germany	617	*0*	35	47	17
Spain	449	*60*	10	20	10
France	530	*28*	34	21	17
Portugal	440	*50*	24	13	13
Italy	491	*38*	21	26	15
Greece	506	*81*	0	16	4
Bulgaria	432	*70*	2	25	3
Romania	272	*97*	0	3	0
Hungary	378	*65*	9	21	5
Slovenia	414	*38*	1	55	7
Czech Republic	307	*56*	20	21	3
Poland	297	*63*	8	16	13
Denmark	747	*2*	54	28	17

Source:EUROSTAT Press release of March 26th 2015

Energy Recovery and Disposal of Residual Municipal Solid Waste: 30 Years of Development in Austria

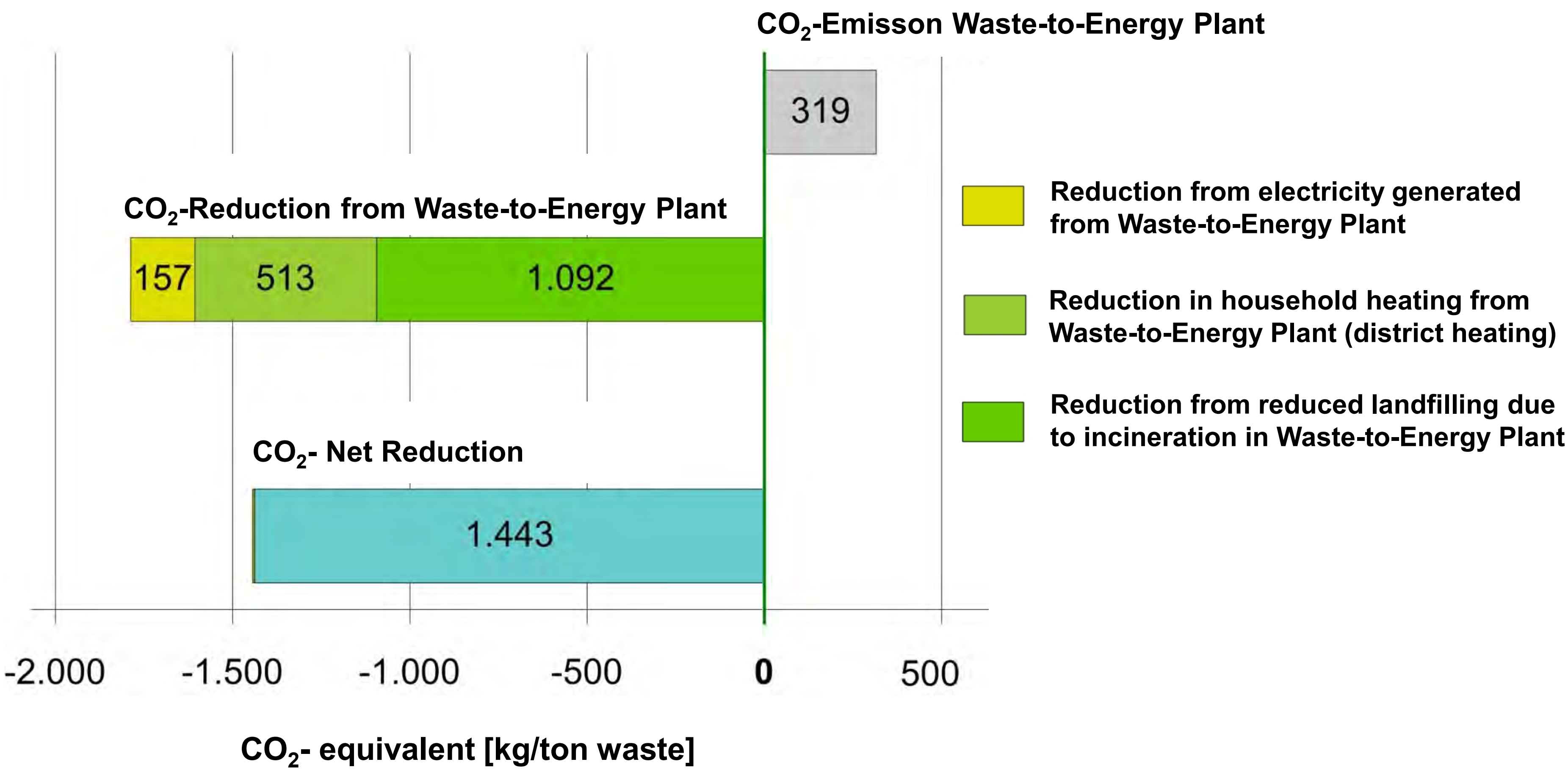


Source: Gerd Mauschitz, Klimarelevanz der Abfallwirtschaft IV, Studie im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 2010

Municipal Waste-to-Energy: Positive Example
The Municipal Waste Incineration Plant Spittelau, Vienna

Start of operation:	1971
(Re-) Start up:	1989
Re-vamping boilers:	2013/15
Site:	City of Vienna
Technology:	Grate firing
Fuel capacity:	2 x 44.5 MW
Efficiency:	approx. 76 % (co-generation of electricity and district heat)
Steam production:	2 x 60.5 t / h (40 bar, 400°C)
Average waste throughput:	250,000 t / a
Fuel:	residual municipal solid waste

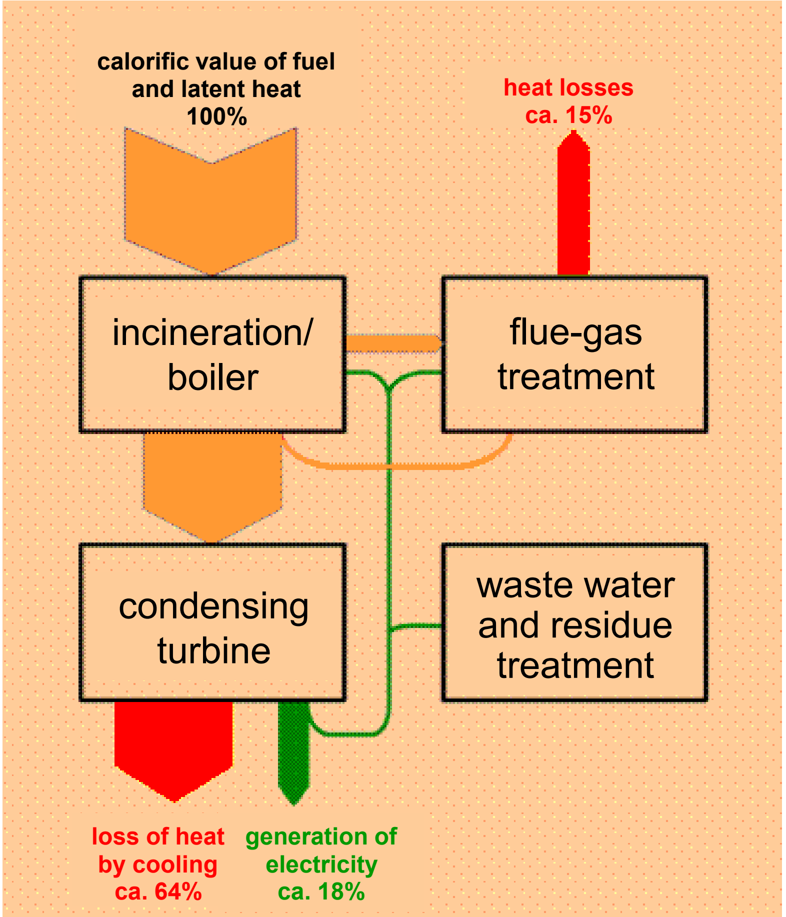
Reduction of Greenhouse - Gas Emissions by Municipal Waste Incineration in Vienna



Source: Kirchner, IIR Conference: Efficient future Waste Treatment Technologies, 2008

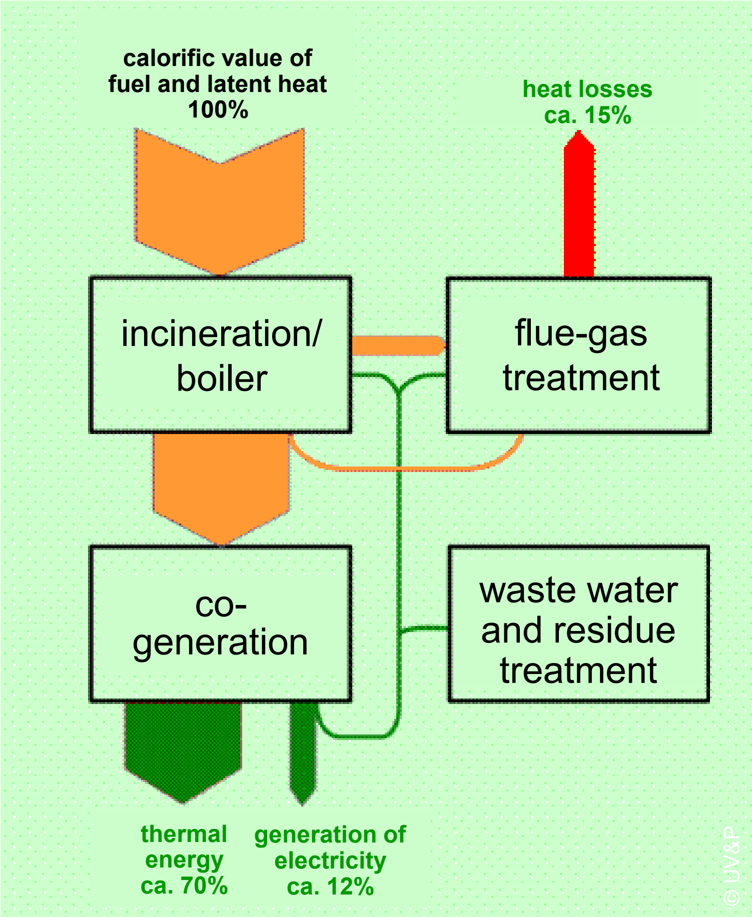
Energy Efficiency: Site-specific Options for Utilization of Energy
The 3 most important Criteria in any Real Estate: Site, Site, Site!

Condensing Turbine (electricity only)



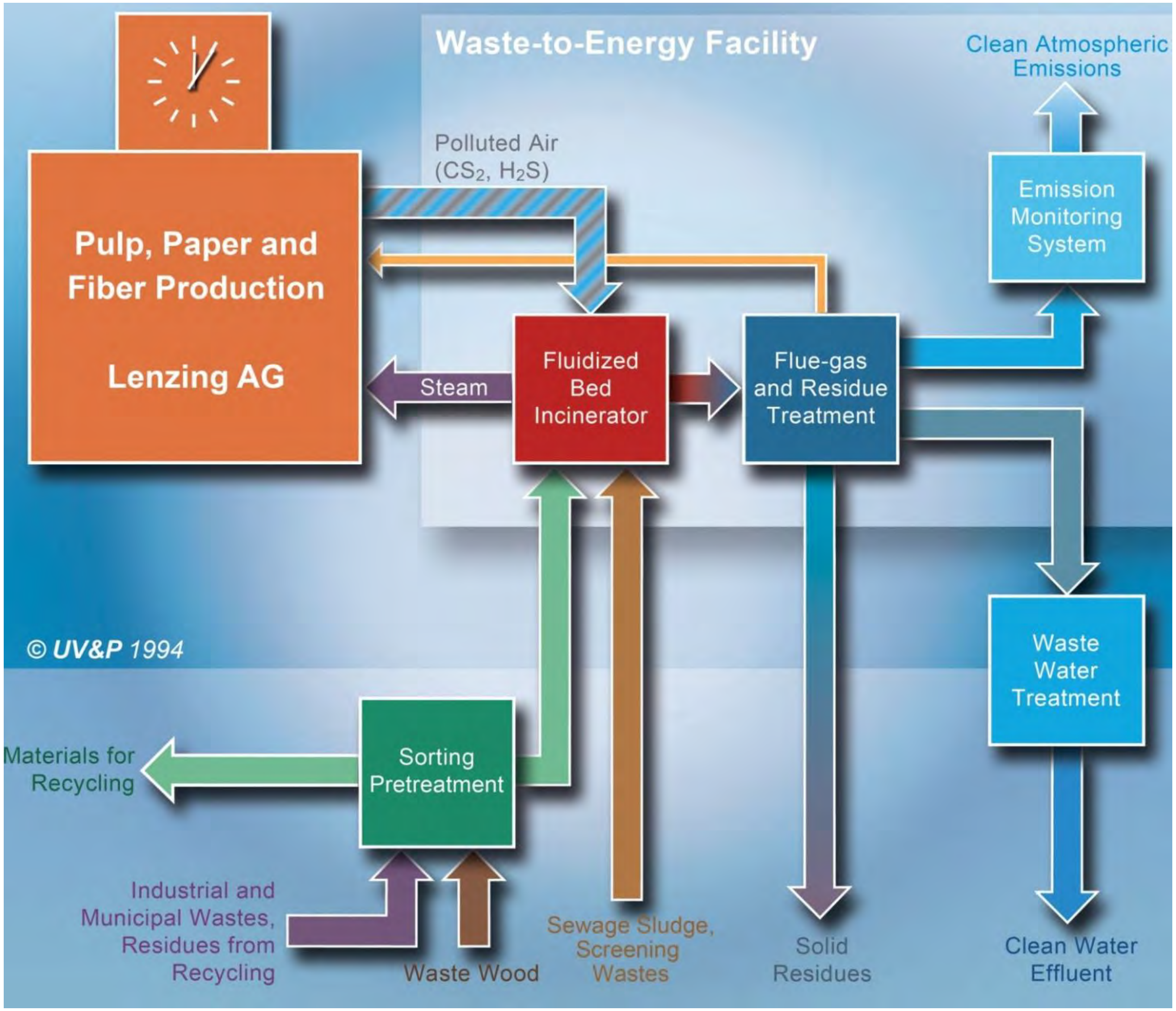
Energy utilization approx. 20 %

Co-Generation (electricity + heat)



Energy utilization approx. 80 %

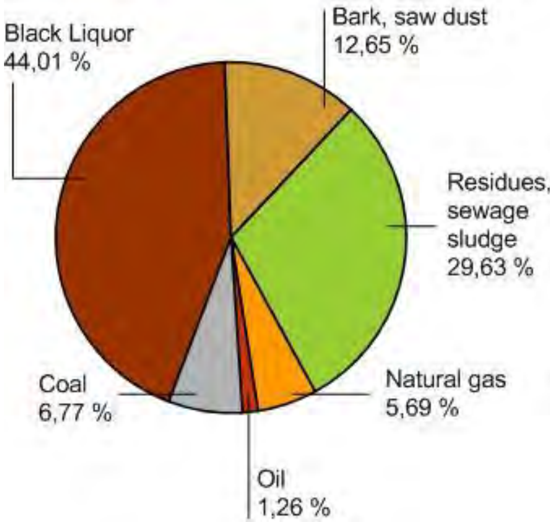
Example for Waste-to-Energy in Industrial Production: RVL Lenzing, Upper Austria



Planning (UV&P):	**1993/94**
Start Up:	**1998**
Technology:	**Fluidized bed**
Fuel capacity:	**110 MW**
Steam production:	**120 t / h**
	(80 bar, 500°C)
Waste throughput:	**up to 1,000 t / d**

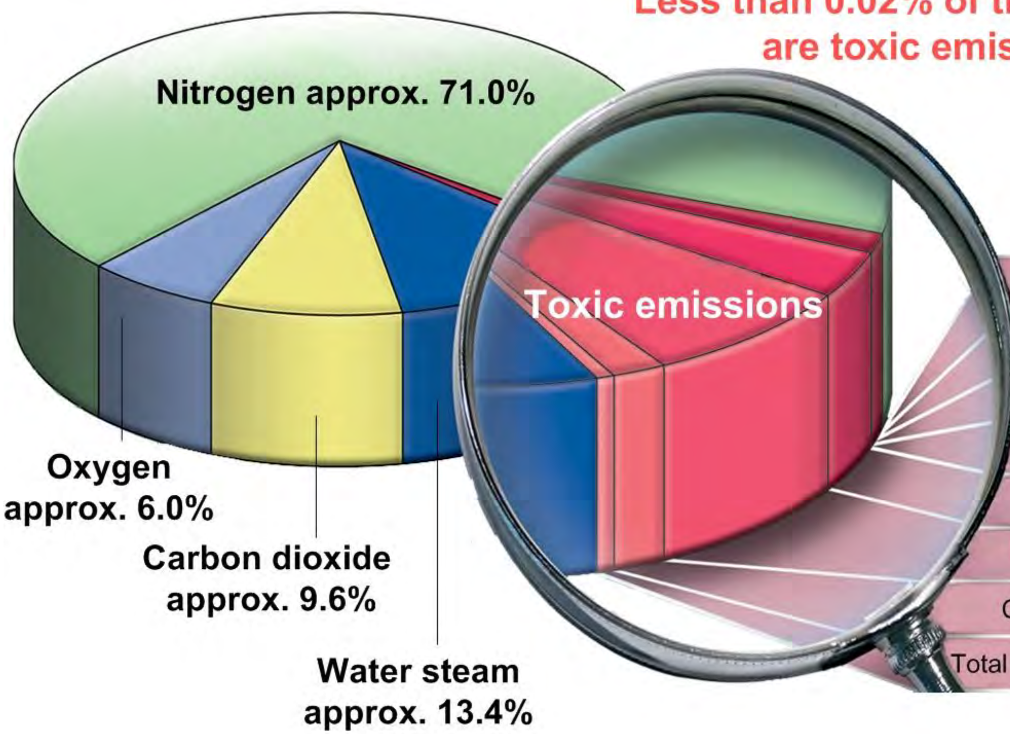
Fuel Mix in 2007 at Lenzing AG:

Fuel Input: 12,600,863 GJ / a



Control of Flue-Gas Emissions from Waste Incineration (Example: RVL Lenzing, in operation since 1998)

Less than 0.02% of the emissions are toxic emissions



Comparison of emission limits: Figures in mg/Nm³ (11 % O_2, dry)

	EU-Directive 2000/76	AVV BGBl. 389/2002	RVL Lenzing	
			Project 1994	Measured values 2002
Particulates	10	10	8	0.6
Mercury Hg	0.05	0.05	0.05	0.007
Hydrogen chloride HCl	10	10	7	0.8
Hydrogen fluoride HF	1	0.7	0.3	0.02
Sulfur dioxide SO_2	50	50	50	4.1
Nitrogen oxides NO_X	400	100*)	70	41.6
Carbon monoxide CO	100	100	50	2.3
Total organic carbon TOC	10	10	8	0.6

* if > 6 tons waste per hour

Integrated Waste-to-Energy in the Industrial Site of Lenzing within the Tourist Region Salzkammergut, Austria (1993/98)

Know-how for project development by UVP:

The waste-to-energy plant RVL is integrated in the industrial site of Lenzing, Austria – with advanced environmental technology to protect the natural environment (incl. organic farming) in the famous tourist region around Lake Attersee.

The 3 arguments:

1. Energy demand (90 MW)
2. Reduction of odour (H_2S. CS_2)
3. No landfilling (300,000 tons/a)

Development of Emissions from Thermal Waste Treatment

Atmospheric Emissions for thermal waste treatment in Austria and Switzerland:

Values given in mg/m^3_N (11% O_2, dry; for PCCD/F in ng/m³)

	Dust	Cd	HCl	SO_2	NO_x	Hg (=> 1/100)	PCDD/F* (=> 1/1000)
1970	100	0.2	1,000	500	300	0.5	50
1980	50	0.1	100	100	300	0.2	20
1990	1	0.005	5	20	100	0.01	0.05
2000	1	0.001	1	5	40	0.005	0.05

Source: Vogg (values for 1970 - 1990); RVL (values for 2000)

Legal Emission Standards 1994 in Austria compared to September 2011 Emission Guidelines for MSW in British Columbia:
(Bold numbers for ½-Hour Average, *cursive numbers for Daily Average values*):

AT 1994	**8**	**0.05**	**7**	**50**	**70**	**0.05**	**0.1**
BC 2011	**9**	**0.007**	*10*	*50*	*190*	*0.02*	**0.08**

Integrated Waste Incineration Plant at a Coal-fired Power Plant of EVN in Zwentendorf, Lower Austria

Planning (UV&P):	1999/2001
Start up line 1+ 2:	2003
Start up line 3:	2009
Technology:	Grate firing
Fuel capacity:	2 x 60 MW
	1 x 90 MW
Steam parameters:	50 bar, 380°C
Efficiency:	ca. 76 - 78 % (co-generation)
Average waste throughput:	approx. 500,000 t/a

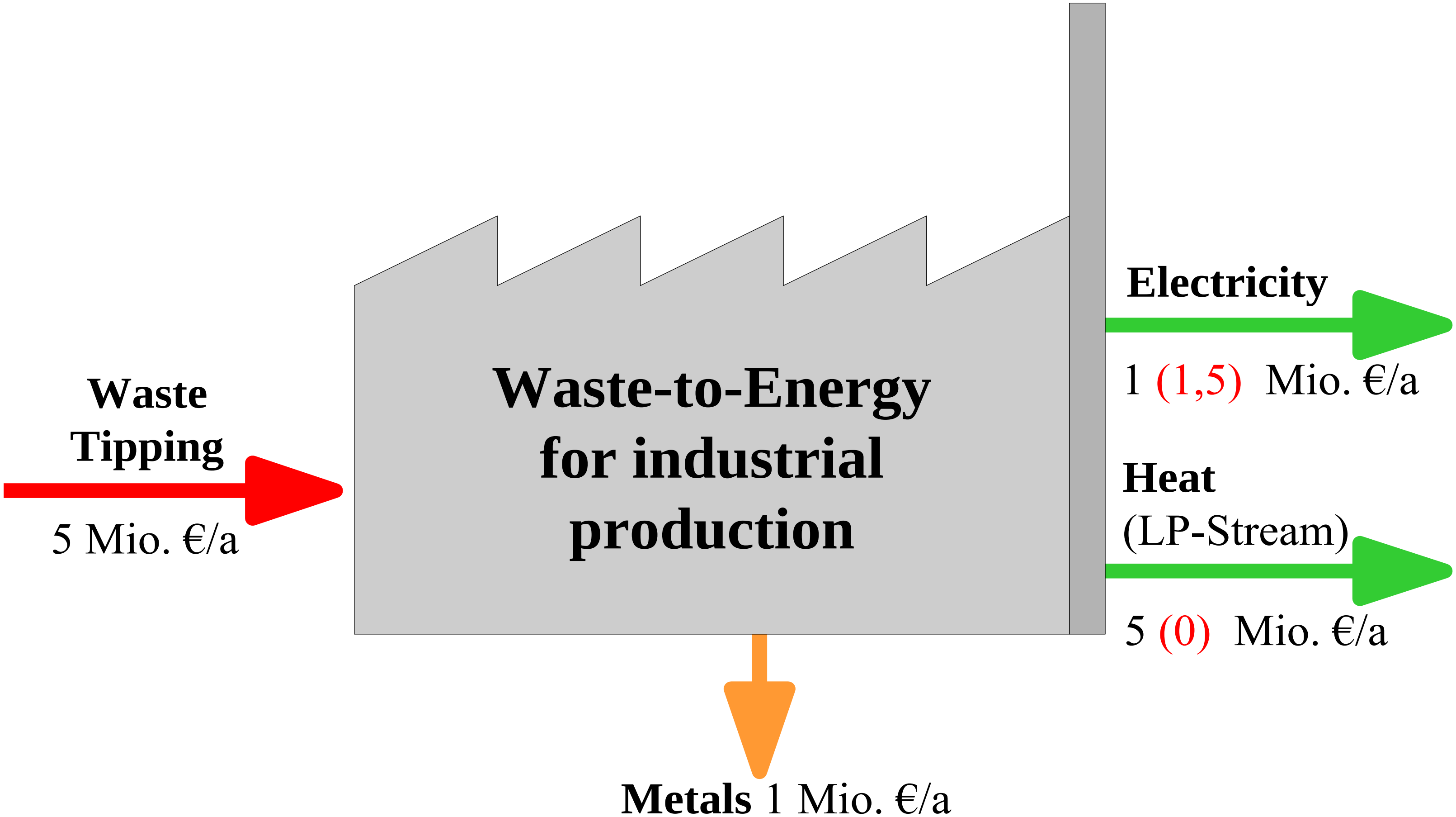
Please note:

Strictest Emission Standards for waste incineration in order to protect human health and the natural environment

Example for Waste-to-Energy Plant ENAGES: Integration within the Paper Industry Brigl & Bergmeister in Niklasdorf, Austria

Planning (UV&P):	1994/95
Start up:	2003
Technology:	Fluidized bed
Fuel capacity:	40 MW
Steam production:	46 Mg/h (40 bar, 400°C)
Average waste throughput:	approx. 100,000 Mg/a
Fuels:	RDF, municipal, commercial and production wastes, sewage sludge

Sustainable Revenues from Waste-to-Energy in a 40 MW BFB Boiler with Integration to an Industrial Site in Austria (in 2014)



The 3 most important criteria in real estate are: **site, site, site**

Source: Pusterhofer, October 2014

RHKW Reststoffheizkraftwerk in the City of Linz, Upper Austria: Co-Generation / District heating based on Waste Derived Fuel

stack (180 m – existing)

Mechanical waste processing and intermediate storage

Power plant including fluidized bed boiler

Pipe conveyor for waste transport from fuel storage to power plant

Planning (UV&P):	2006/07
Start Up:	2011
Technology:	Fluidized bed
Fuel capacity:	72 MW
Efficiency:	ca. 80 % (co-generation)
Steam production:	89 t / h (42 bar, 420°C)
Waste throughput:	up to 800 t / d
Fuels:	Municipal and commercial waste, sewage sludge, screening wastes

No public opposition in 2008 despite severe political conflicts with the "HTV" High Temperature Gasification 1989-91 and intermediate MBT 2004-12

Large Waste Incineration Facilities in Austria

Austria (approx. 8.5 Mio. people)

Hungary (approx. 9.9 Mio. people)

Large facilities for thermal treatment of waste in Austria:

- 15 fluidized bed incinerators
- 14 grate systems
- 3 rotary kilns (for hazardous wastes)
- 9 cement kilns with co-firing of waste fuels

Subtotal: **41 facilities in operation**

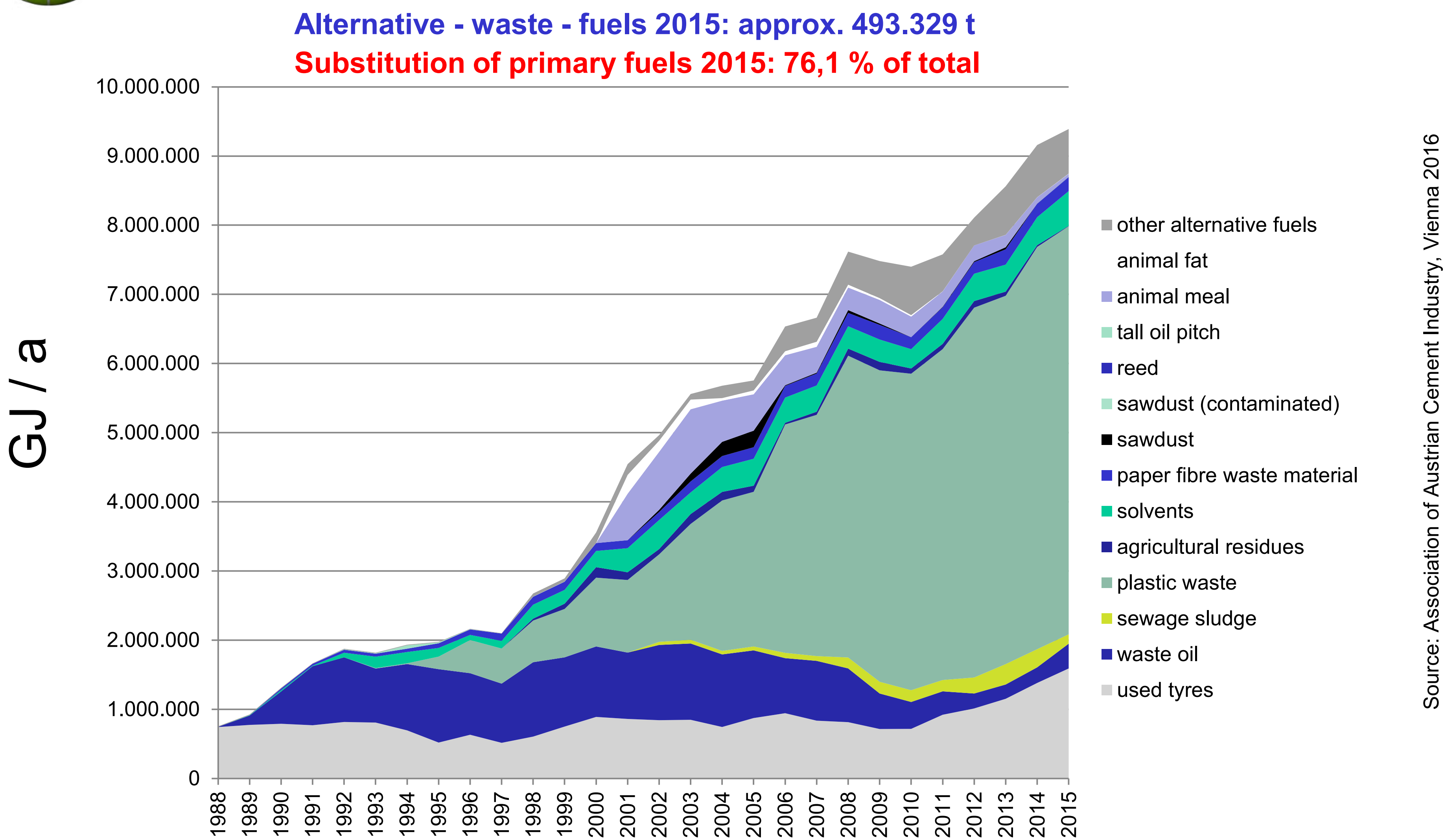
Planned projects:

- 5 fluidized bed incinerators
- 1 grate system

Subtotal: **6 facilities planned**

Total: 47 large waste incineration facilities and projects in Austria

Utilization of Alternative Fuels in the Austrian Cement Industry since 1988



Less than 10% of total waste incineration is for cement clinker production in Austria

Innovative Concepts for Cement Clinker Production with Best Emission Standards and Resource Efficiency in Austria

- **Minimum atmospheric emissions (incl. PM 10, VOC, NOx, CO, and continuous monitoring incl. Hg)**
- **Highest energy efficiency due to integration and waste heat export to regional district heating network**
- **Highest resource efficiency due to utilization of waste-derived alternative raw materials and waste-derived hazardous and non-hazardous alternative fuels**

Summary on Waste-to-Energy: Challenges and Opportunities for Municipalities and Businesses according to the EU-goals 2020/30

The importance of "Prevention" in Sustainable Waste Management must be complemented by "Recovery" of both energy & materials according to the 20-20-20 [40-27-27] Goals of the EU for 2020 [2030] toward a more "Circular Economy" and the vision of "Zero Waste"

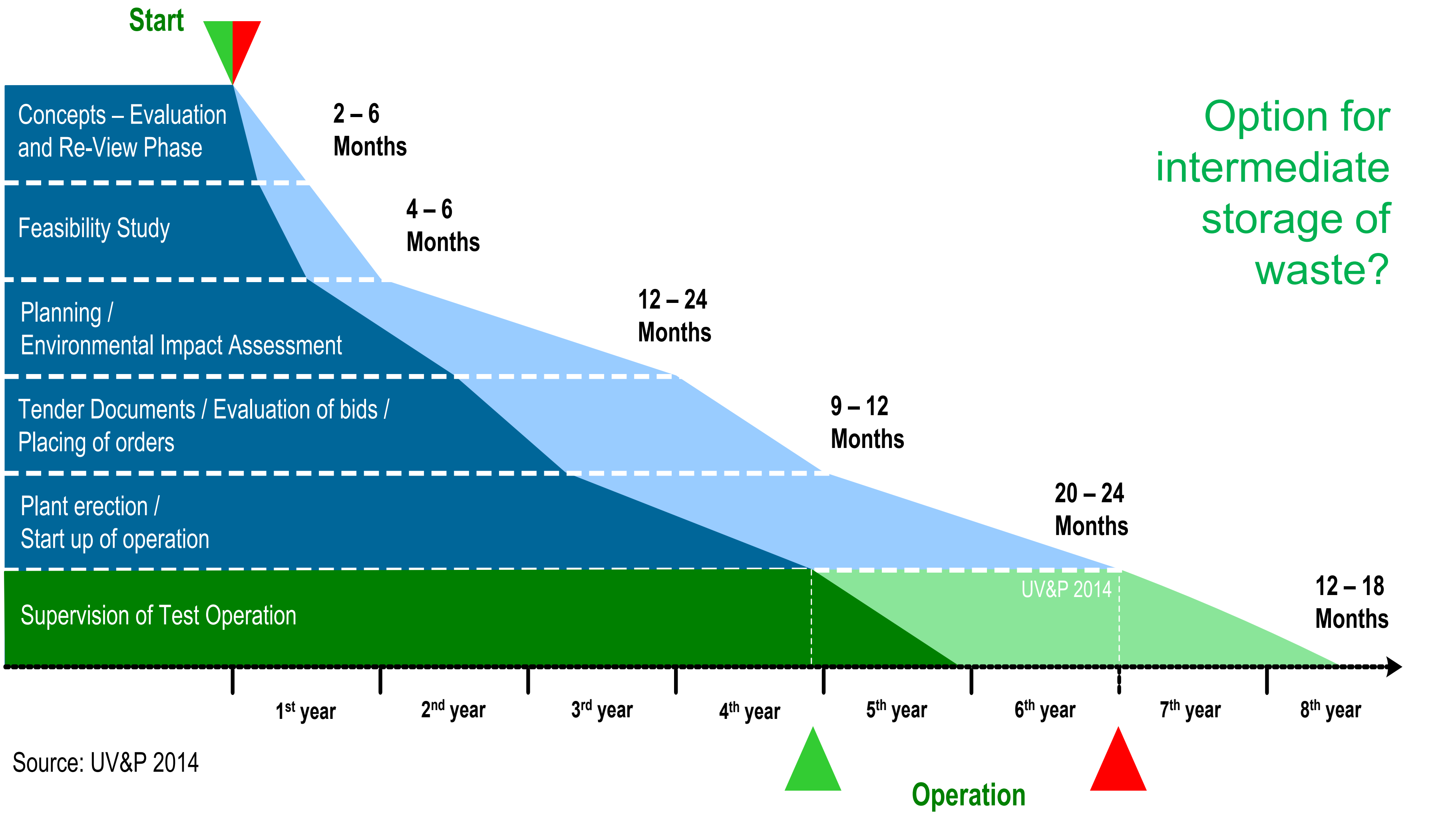
- **20% [40%] less GHG – Emissions**
- **20% [27%] more Renewable Energy**
- **20% [27%] more Energy Efficiency**

Prognosis for future perspectives:
In 2030 the CO_2 prices will be in the range of 87 to 190 €/ton and in 2050 in the range of 234 to 310 € per ton of CO_2 (Umweltbundesamt REP-0491, Vienna 2014)

WtE Spittelau saves approx. 1.5 tons of CO_2 per ton of MSW compared to sanitary landfill!
Austrian WtE (grate systems, FBC) saves approx.1 ton of CO_2 compared to MBT and RDF!

Activities and Time Schedule for Project Implementation of Large Waste Treatment Projects

Necessary time from project start until start-up of operation: min. 4 to approx. 6 years



Source: UV&P 2014

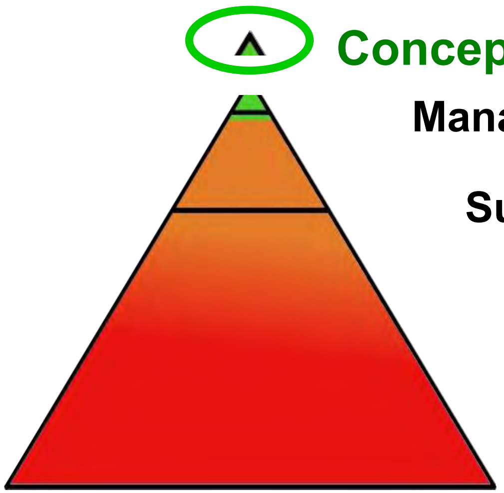
Project Development: Environmentally friendly non-hazardous Intermediate Storage of Solid Wastes in Plastic-wrapped Bales

Foto: W. Kletzmayr, 2006

The calorific value of 1 bale of RDF equals 2 to 3 barrels of crude oil

Overall Costs for Project Development, Implementation and 40 Years of Operation of a Waste-to-Energy Plant

Typical Cash-flow of large Waste-to-Energy Plants over Lifetime (e.g. RVL Lenzing, EVN Lower Austria, RHKW Linz)



Concept- and Feasibility Studies approx. 0.2 – 0.5 Million Euro

Management, Consulting & Engineering approx. 10 Million Euro

Supply and Construction approx. 100 – 200 Million Euro

Operation and Maintenance of Plant (approx. 40 years lifetime) approx. 600 – 1,600 Million Euro

Recommendation:
The determining factor for future success is the competent development and systematic evaluation of relevant technical alternatives and feasibility studies by independent expert teams in cooperation with local partners (costs < 0.01-0.1% of total)

KÖSZÖNÖM SZÉPEN !

Comments & Questions?

Think Globally • Work Locally

A-1020 Vienna, Lassallestrasse 42 / 12a, Austria
Tel. + 43-(0)664-2106709, Fax + 43-1-2149520-20
franz.neubacher@uvp.at; **http://www.uvp.at**

We always cooperate with local partners!