



Waste Fired Power Plant

Designed for the Environment and Output



Waste-to-Energy Research and Technology Council
Columbia University

2006 Annual Meeting, October 19 and 20

Presented by Hendrikus A A M de Waart
On behalf of Dr. K. Daan van der Linde



Gemeente Amsterdam
Afval Energie Bedrijf

Waste & Energy Company, City of Amsterdam





Waste & Energy Company Amsterdam

- Public Utility Company
- Owned by the City of Amsterdam
- 125 Years MSW management
- 87 Years W2E experience
- Operated on commercial basis
- Mission:
 - Lowest cost to the citizens
 - Optimal environmental performance
 - Maximum recycling, zero discharge
 - Home-grown R&D



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4th Generation Waste Fired Power Plant (WFPP®)





Upon WFFP[®] completion

- World's largest and most efficient W2E facility
- MSW throughput > 1,500,000 MTPA
- WFFP[®] net electric efficiency > 30% (833 kWh/MT)
- Turnover > € 200 million
- Surplus ~ 10%
- Lowest tipping fees in the Netherlands; €70/MT
- Electricity generated >1,000,000 MWh/yr
- Avoided CO₂; 600,000 MTPA (CFPP)
- Recycling rate > 99%
- Emissions < European and Dutch standards



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Amsterdam Eco-port® ; AEB and neighbors





Amsterdam EcoPort®

- Ecological concept of the City of Amsterdam to maximize synergies between adjacent industries and neighboring residential areas
- Objectives; re-duce re-use, recycle, BPEO
- Priorities are sustainability and the environment
- AEB is corner stone in energy production and distribution and turning waste into products
- Other major participants:
 - Municipal sewage sludge facility
 - Windmill park
 - Municipal district heating facility
 - Steenkorrel BV, building materials

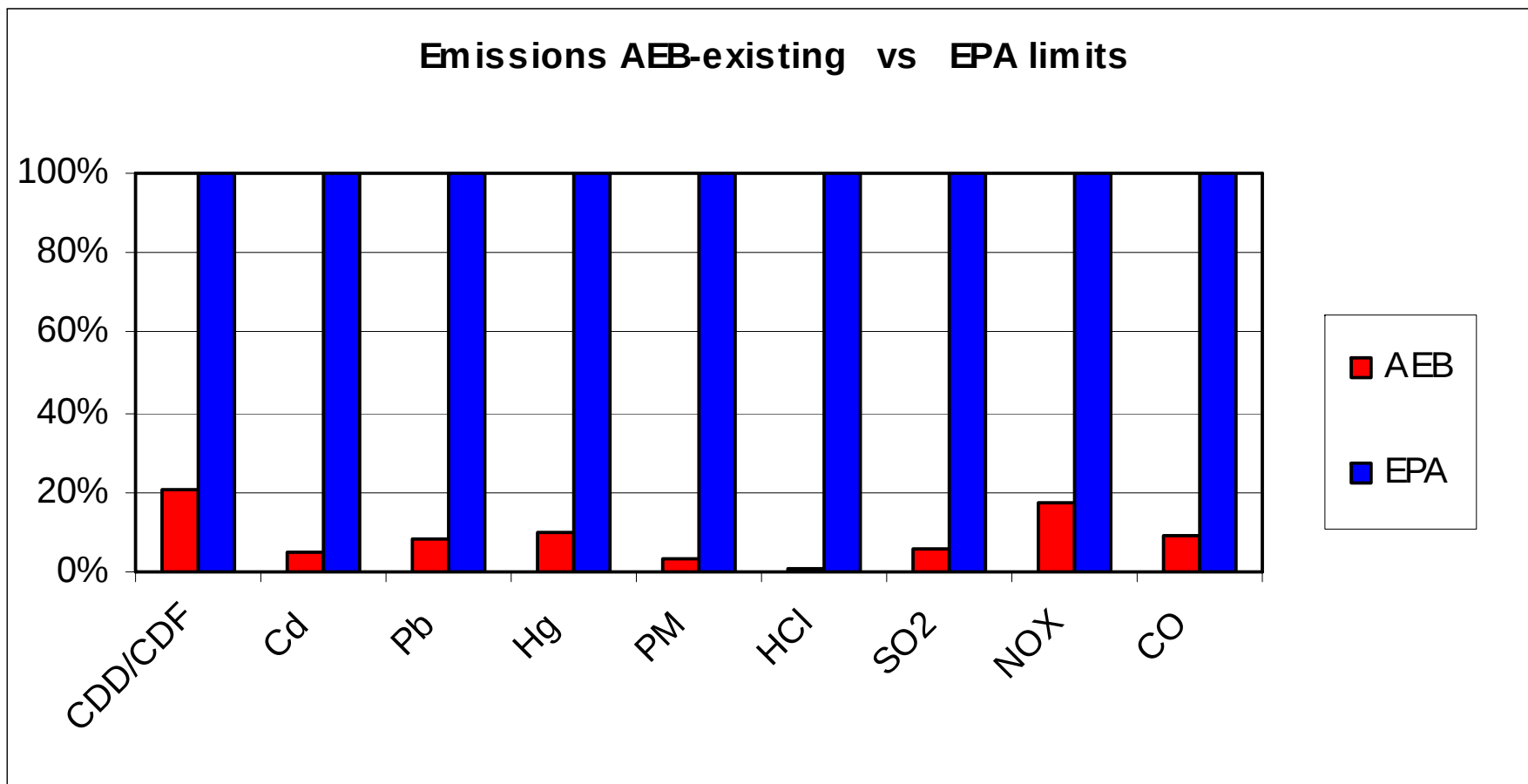


How did we accomplish this?

- Environmental responsibility
- Minimal nuisance
- Community relationship building
- Attractive architecture
- Efficient and economical operation
- Continuous improvement, in-house R&D
- Beneficial to the City, its residents and industry
- Dedicated and competent employees



Environment; stack gas emissions



■ Toxic emissions < 10 garbage trucks



Environment; other

■ Liquid discharge

- Zero

■ Solids discharge

- Presently > 1 % of ash produced
- AEB, concept to arrive a zero discharge

■ Noise

- | | | |
|-----------------|-------------|----------|
| ● Outdoor day | > 200 meter | < 55 dBA |
| ● Outdoor night | > 200 meter | < 45 dBA |

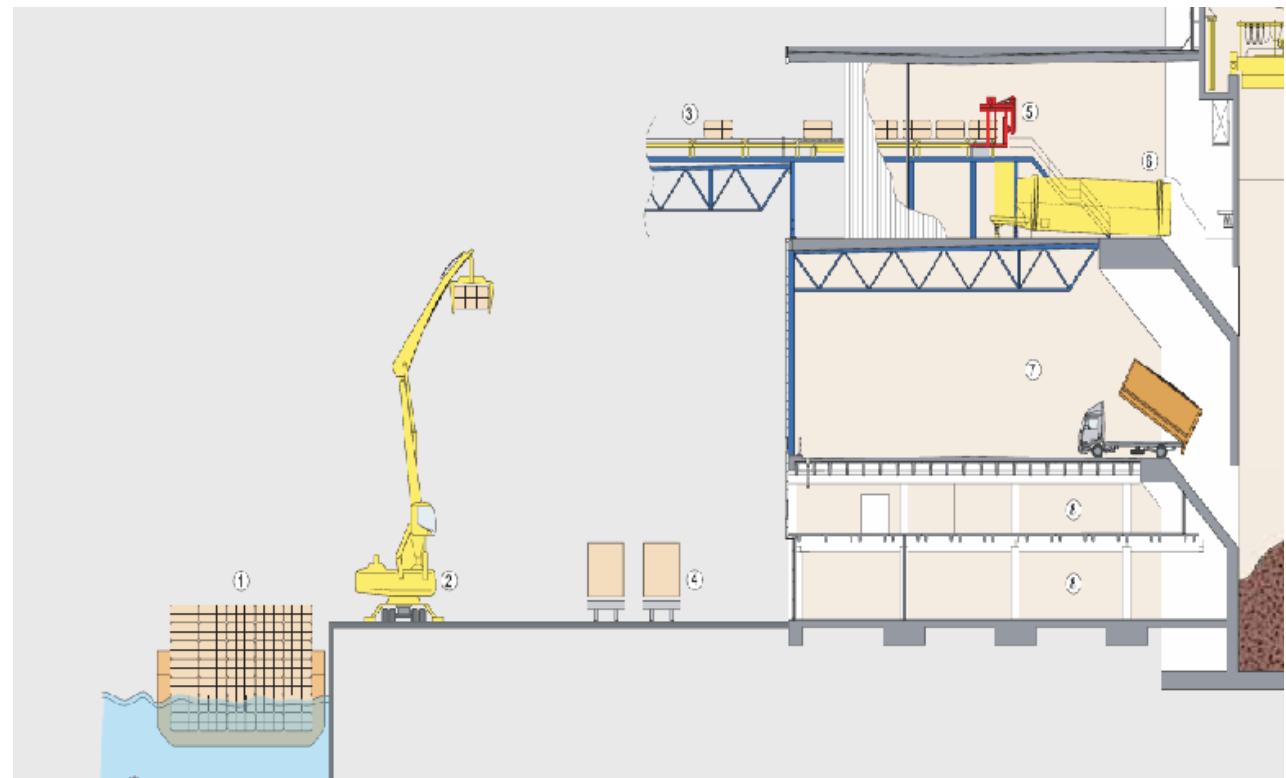


■ Odor

- None appreciable; plant under negative pressure

■ MSW delivery options:

- Road
- Rail
- Water





Excellent community relations

- Working plant, No problems in the past
- Involve citizens and NGO's
- Allowing sufficient permitting time
- Communicate in an understandable language
- Demonstrate benefits to City, citizens, industry



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AEB architecture





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Brecia





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Vienna, Professor Hundertwasser





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Hiroshima, Yoshio Taniguchi





Major patents and innovations

- Detergents in flue-gas cleaning for dioxins/furans reduction
- Salt factory for recycling residues from flue-gas cleaning
- Method and layout for reprocessing flue-gas residue
- Reheater concept for increasing the efficiency of W2E plants
- High-efficiency waste-to-energy plants.
- Flue-gas recirculation
- Use of bio-exhaust gas for improved drying and fuel efficiency

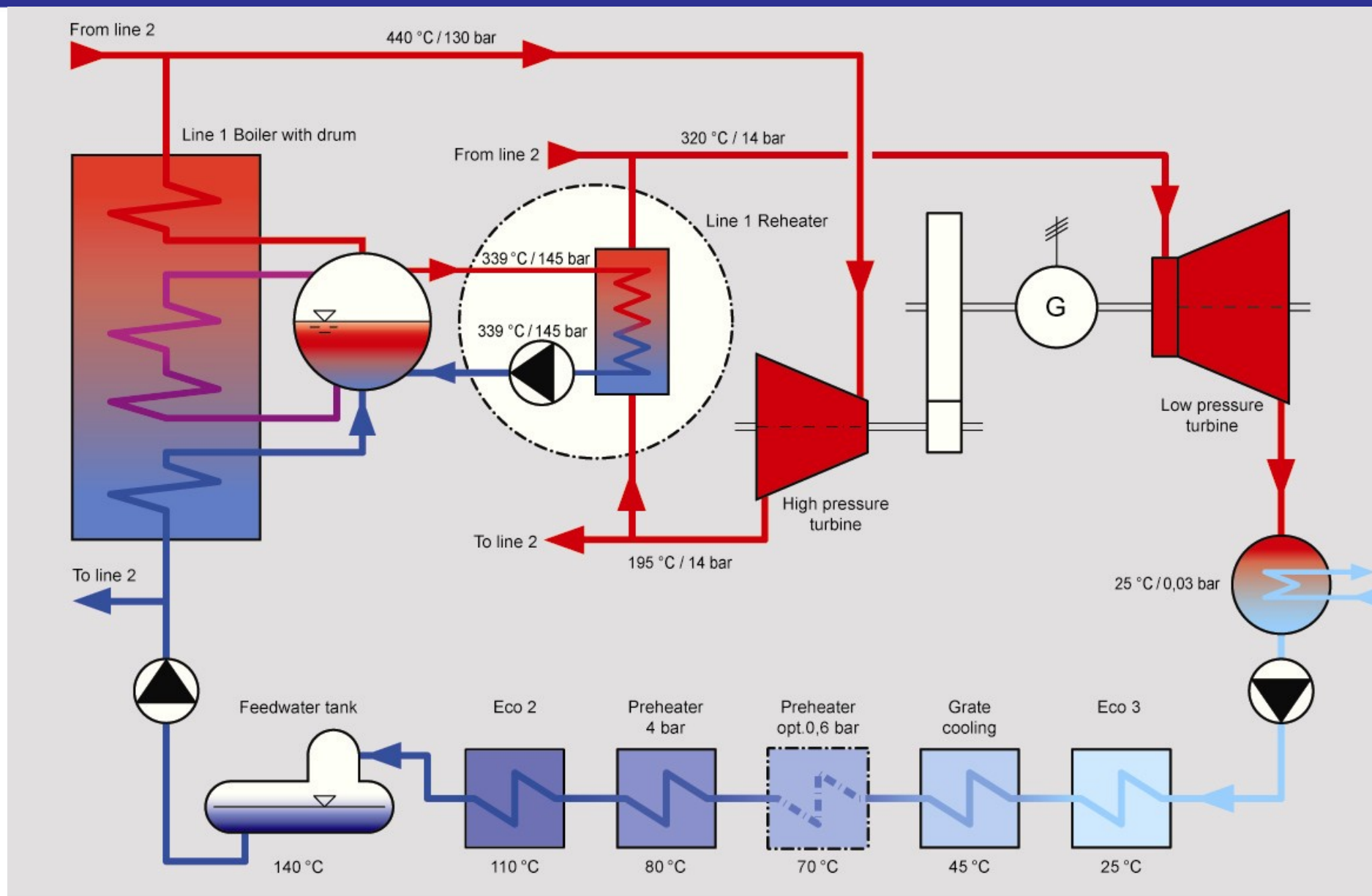


Major patents and innovations, cont'd

- Improved design of steam superheaters
- Linking a waste-to-energy plant to a waste-water purification plant
- Method and layout for cleaning waste water.
- Wet non-ferrous separation from bottom ash based on Magnus effect and density separation (three international patents in collaboration with Delft University of Technology).

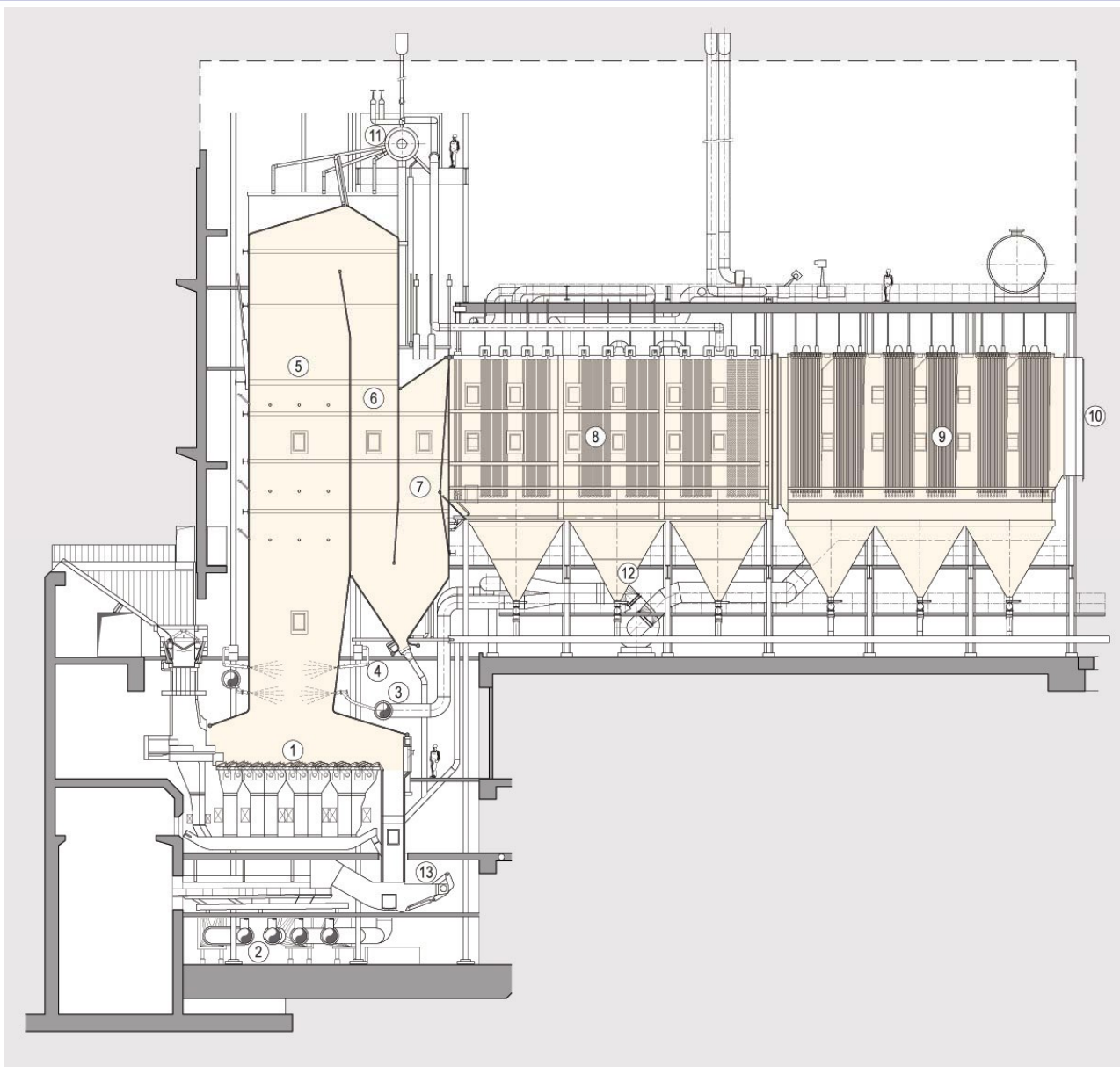


Efficiency; steam reheating



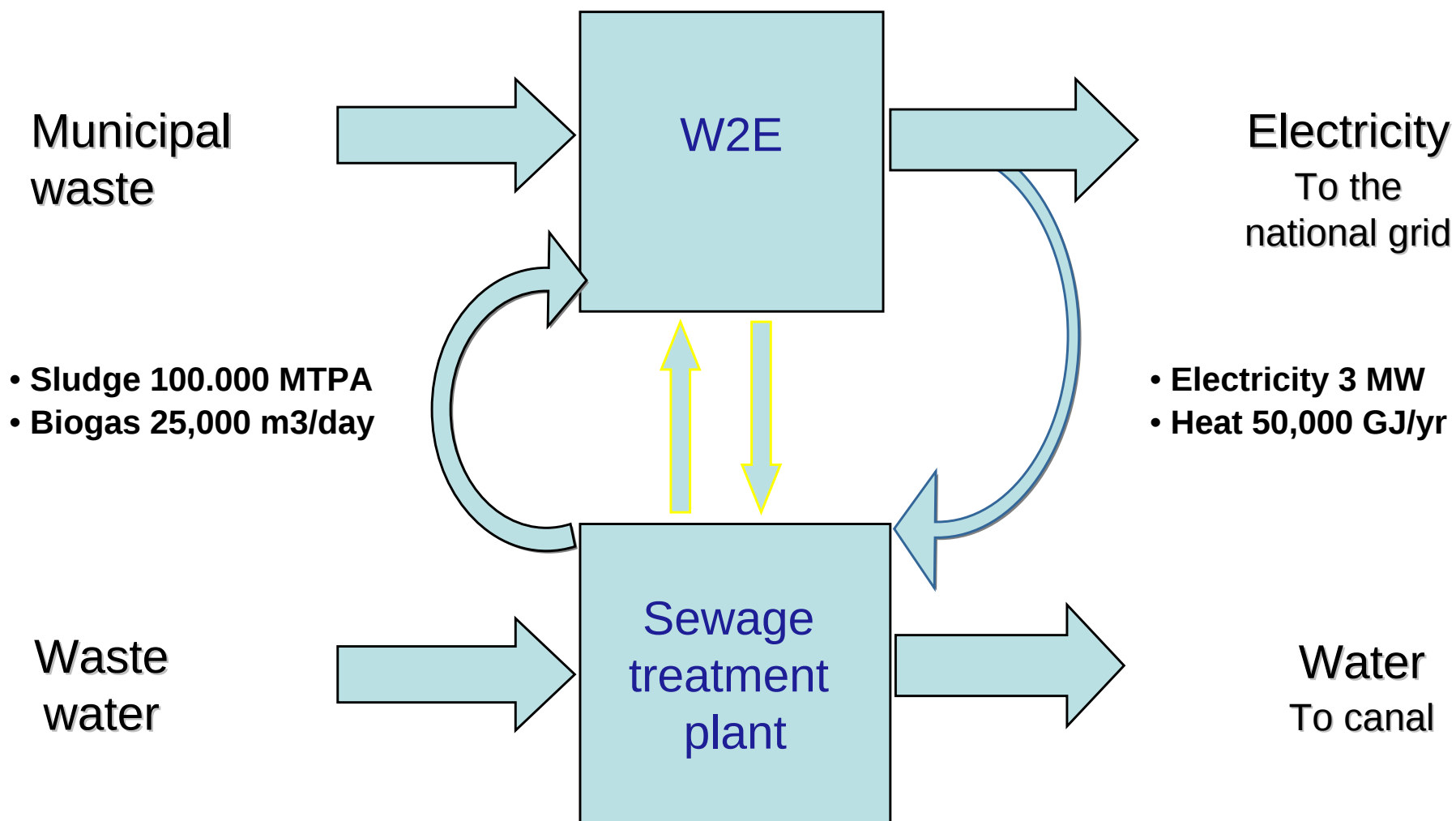


Availability; Boiler design





Synergy; W2E & Sewage treatment





Westpoort 400 TJ per year
Parkstad 1,300 TJ per year





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Recycling; ash processing





Recycling; products / MT MSW

■ Sand	85 kg	⇒ bricks
■ Granulate	110 kg	⇒ concrete
■ Iron	25 kg	⇒ trade
■ Metals Non-Ferrous	5 kg	⇒ trade
■ fly-ash	11 kg	⇒ filler in asphalt
■ CaCl_2 -salt	7 kg	⇒ industry, road
■ Gypsum	5 kg	⇒ construction
■ Residue (gas cleaning)	1 kg	⇒ disposal → vitirification



Recycling; non-ferrous metals





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Recycling; lime stone bricks





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Recycling; concrete





Recycling; metal recovery pays for itself

■ Metals

- 10% Ferrous Metals
- 2,4 % Non-ferrous Metals
- Silver content; 10% Dutch consumption.
- Copper content; higher than Chilean ore.

■ Minerals

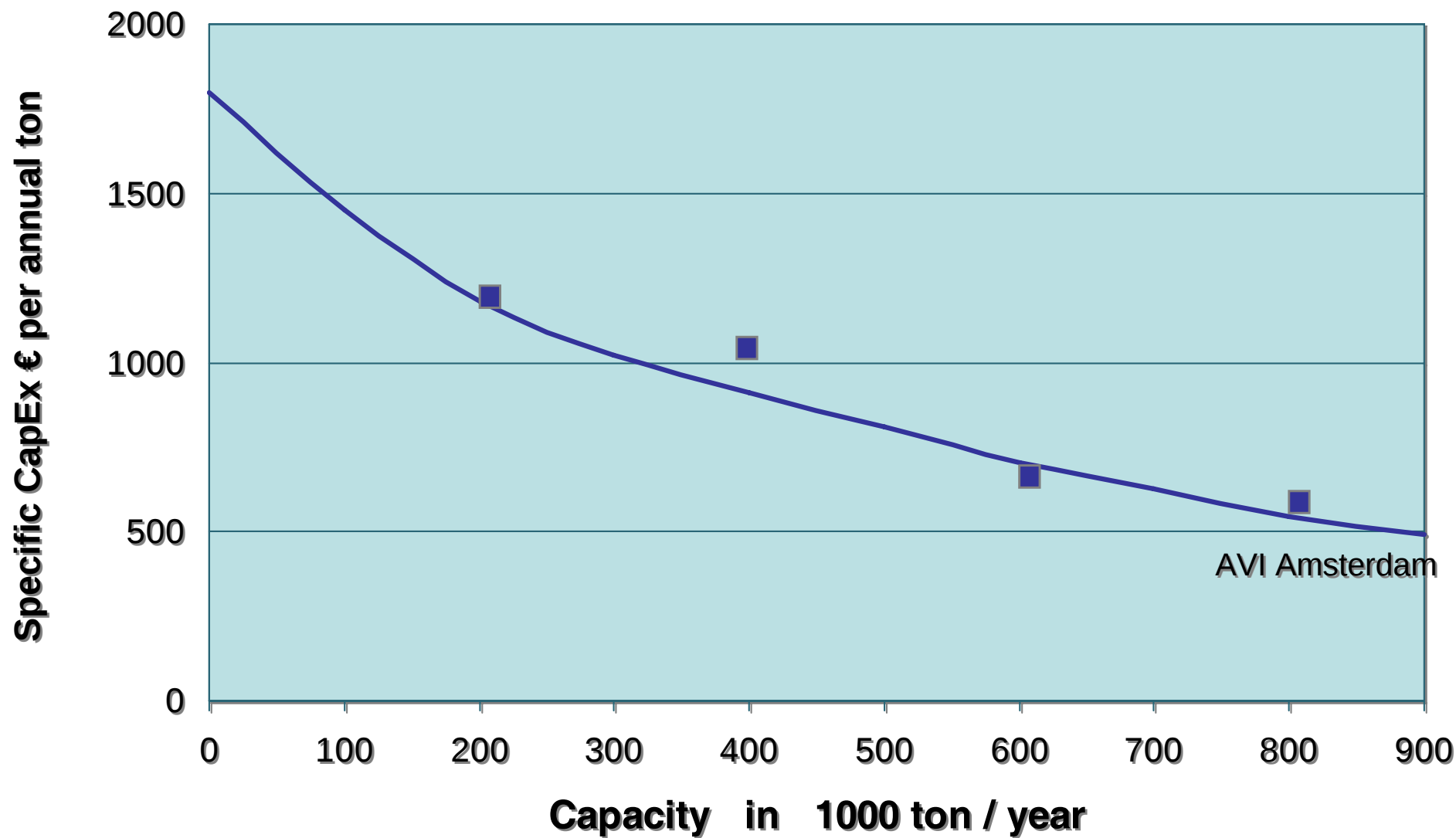
- 35 % Sand
- 45 % Granulate





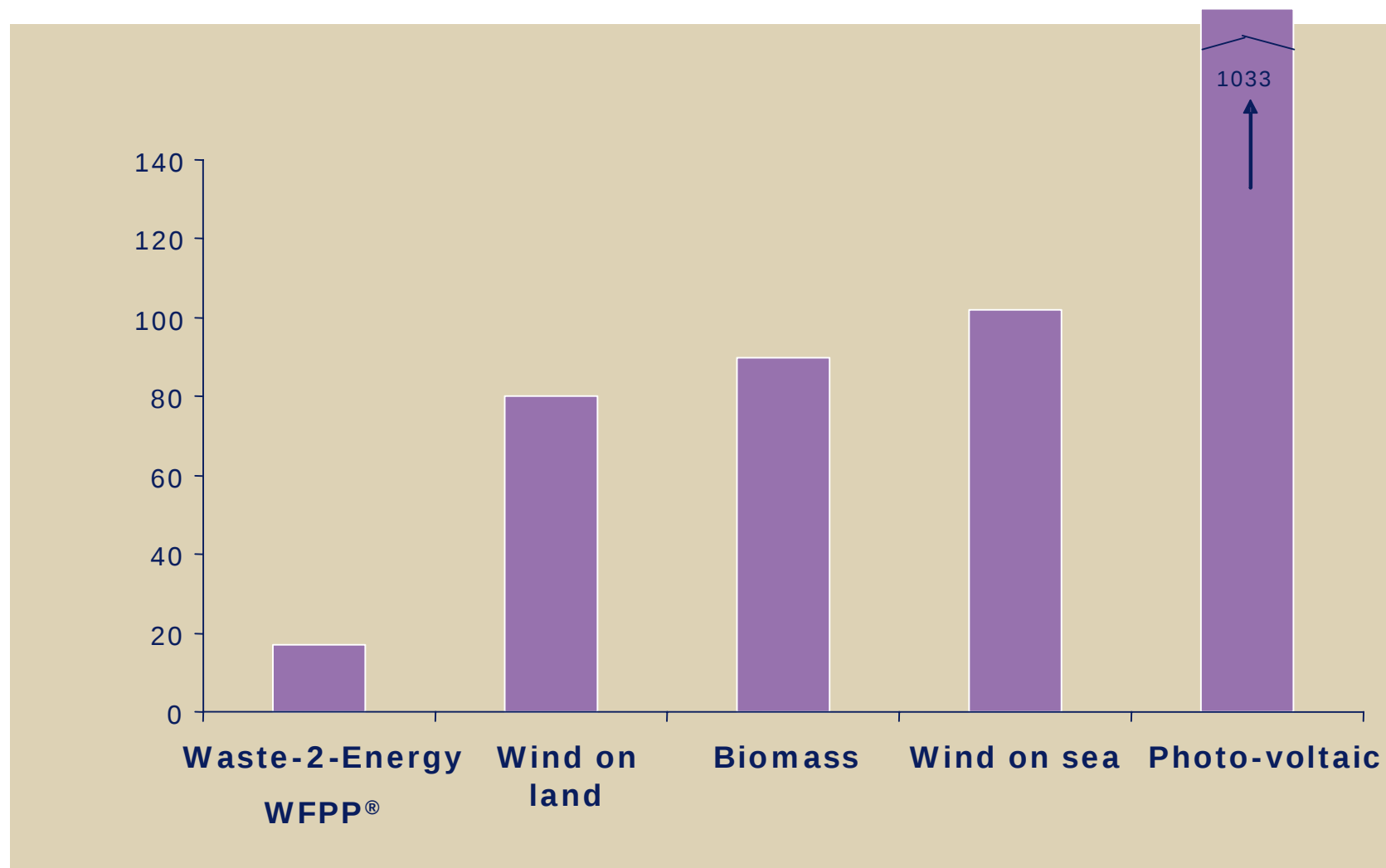
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Cost; size matters





WFPP® compared to other renewable options

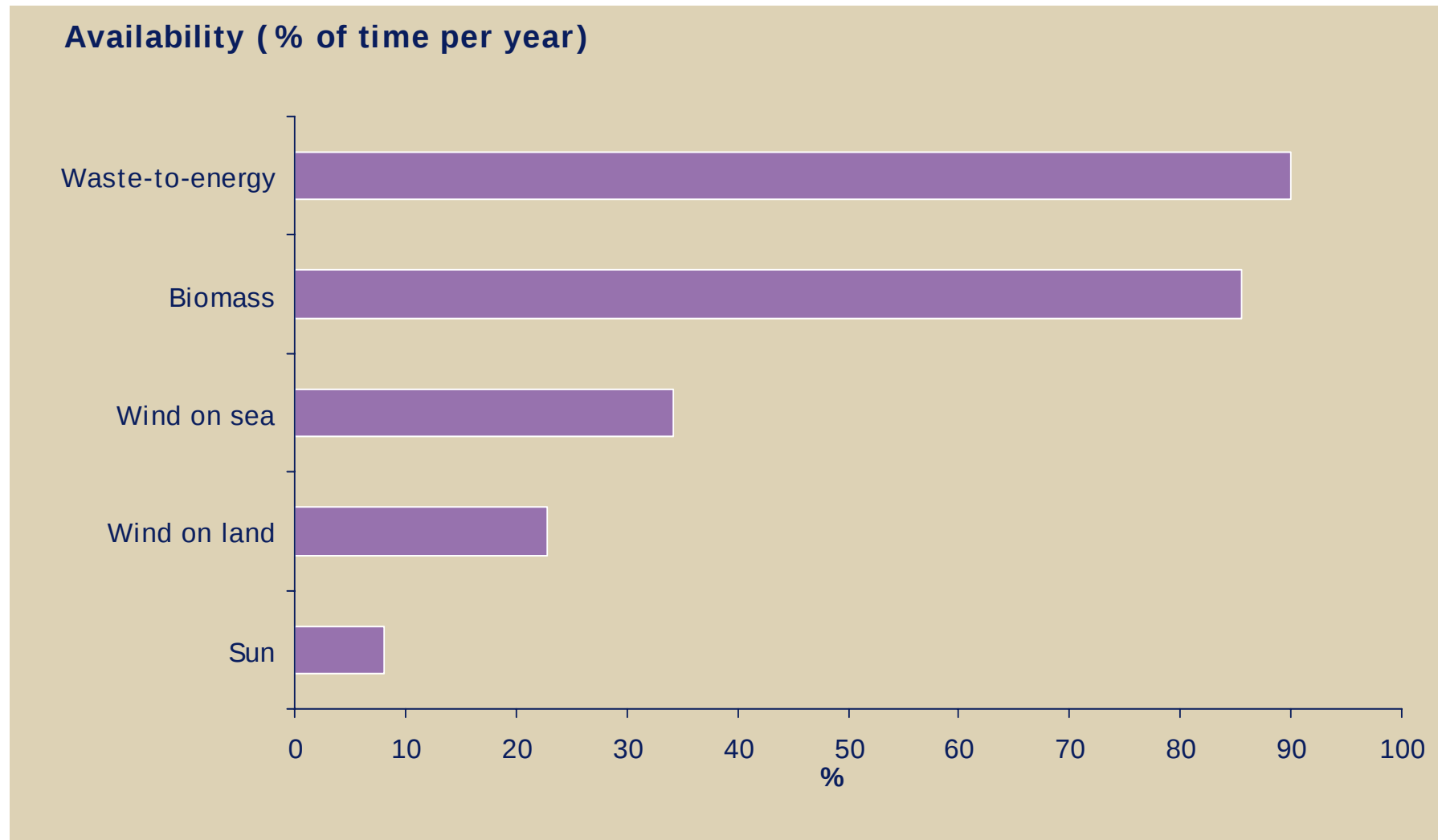


Sources: EZ, Regeling subsidiebedragen milieukwaliteit elektriciteitsproductie; VROM, personal communication, ECN, 2002, Duurzame Energie en Ruimte, M. Menkveld; analysis Deloitte



WFPP® compared to other renewable options

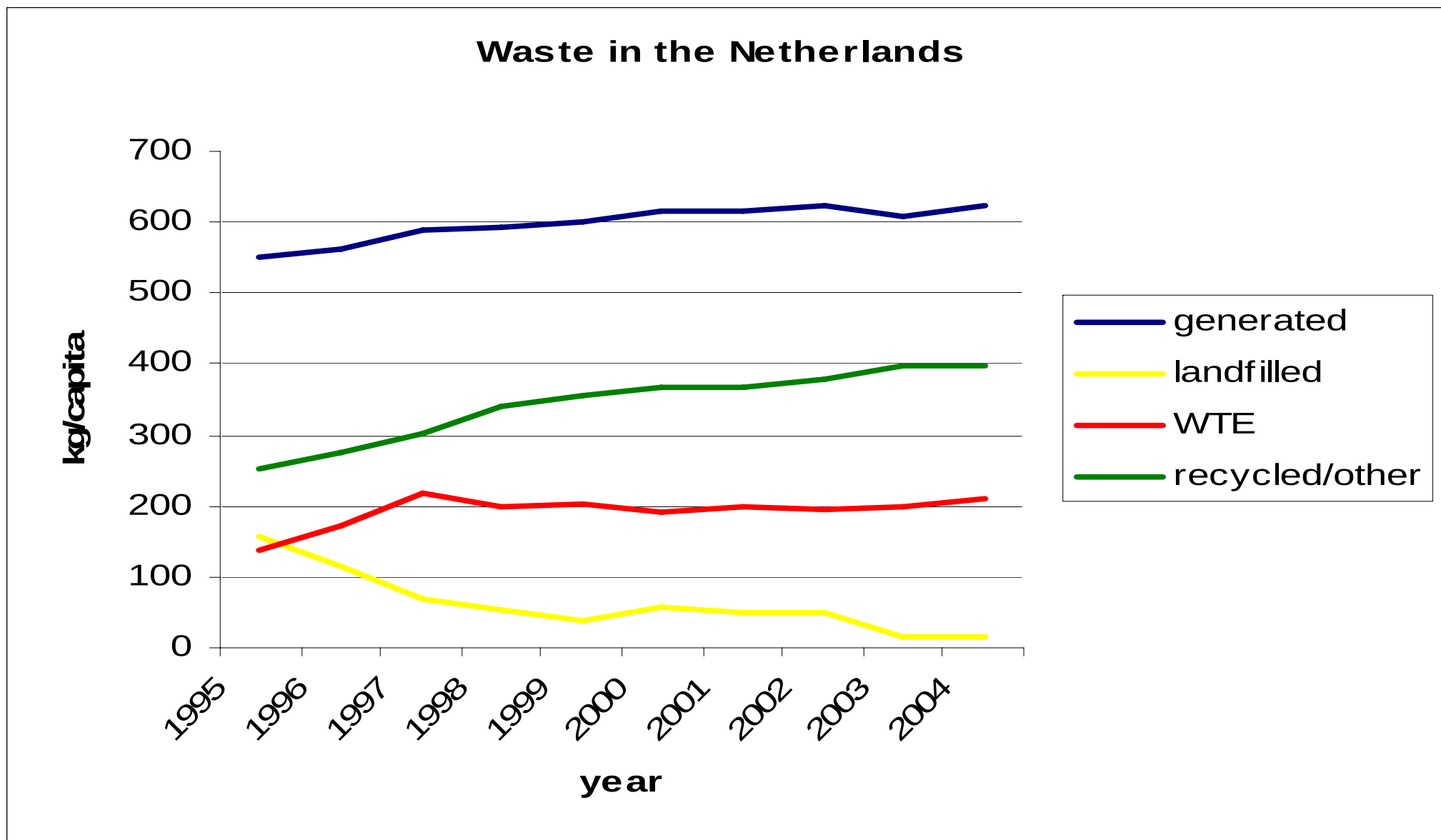
And highest availability; Availability in %



Sources: EZ, Regeling subsidiebedragen milieukwaliteit elektriciteitsproductie; VROM, personal communication; ECN, 2002, Duurzame Energie en Ruimte, M. Menkveld; analysis Deloitte



Recycling and W2E





WFPP® in US; potential products

US MSW landfill @ 130 million tons

- Electric power; >13,000 MW, 12 million homes
- Metals: > 4 million tons
- Construction materials: > 25 million tons
- Gypsum 650,000 tons
- Salt: 900,000 tons

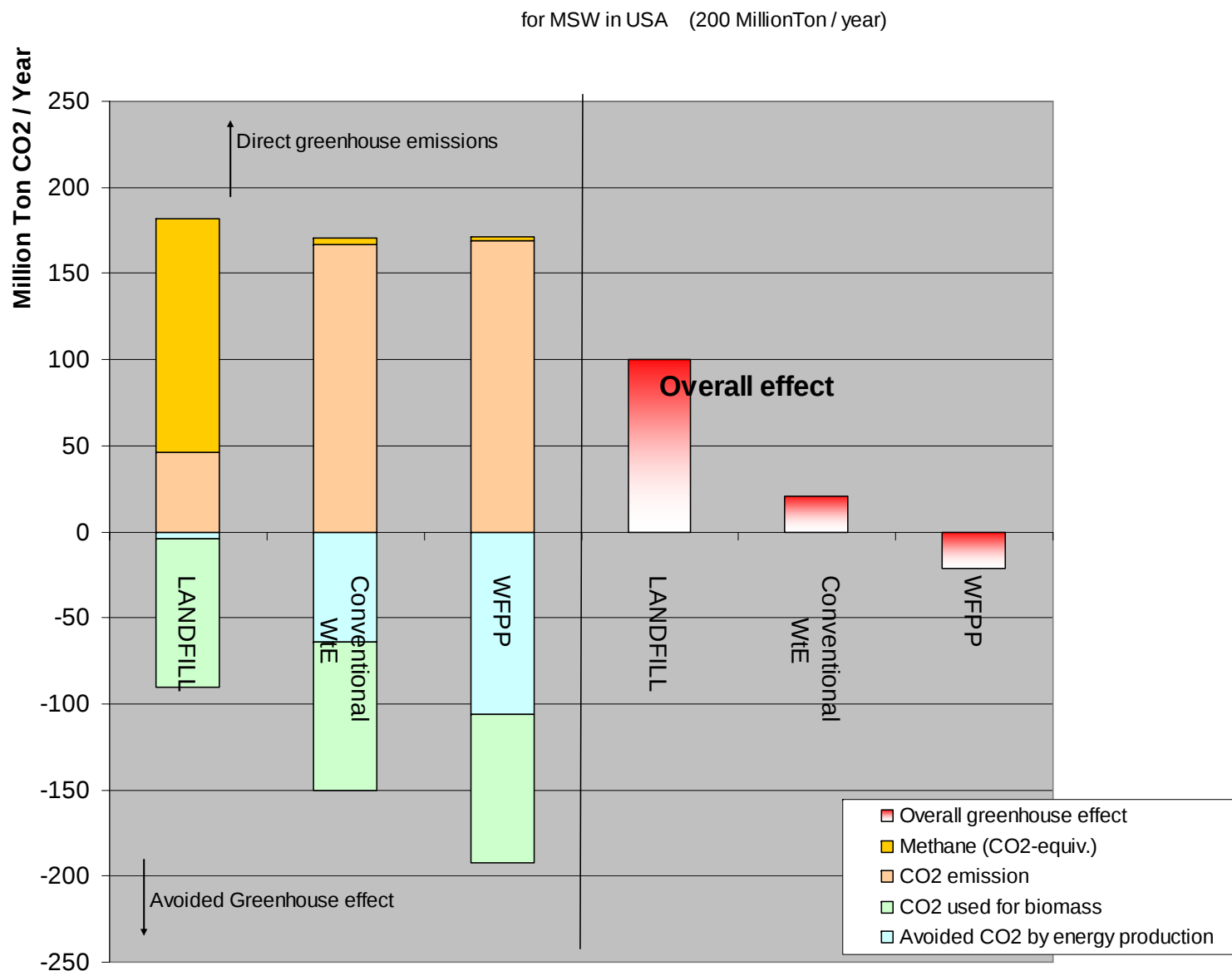


WFPP[®] in US; potential avoidance and savings

- CO₂ avoided; ~ 6 Tg
- Methane avoided; 131 Tg CO₂ Eq.
- Leachate
- Oil saved: > 170 million barrels
- Gas, landfill trucking cut 50 miles:
 - Gas saved 25 million gallons
 - Toxicants avoided



Greenhouse effect





WFPP[®] in US potential; conclusion

- Safe, highest environmental standards
- Low nuisance factor
- Within city limits
- Virtually zero discharge
- Maximum solids recycling after combustion
- Economical operation; guestimated tipping fees
 - 6/700 thousand tons <\$70/MT
 - 1.2/1,4 million tons <\$40/MT



AEB services

- Technology transfer, licensing
 - Conceptual WFPP[®] design
 - Specifications and basic design of major equipment
 - Complete design for standard WFPP[®] facility
- Services
 - Facilities planning
 - Assistance in permitting procedures
 - Assistance in project realization
 - Management and operators training
 - Interactive operational support
 - Trouble shouting and de-bottlenecking services



City to City services

- (Pre) FEED studies
- Evaluation proposed technologies
- International post-graduate course; “Environment and Technology
- Support in formulation of legislation/permits







On behalf of
Dr. Daan van der Linde
and AEB
Thank You



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