

**A STATE-OF-THE-ART ON ANAEROBIC
DIGESTION OF THE ORGANIC FRACTION OF
SOLID WASTE IN EUROPE**

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THE COMPANY

- **DRANCO DRY DIGESTION TECHNOLOGY FOR MSW DEVELOPED IN 1980-1985 AT U-GHENT**
- **OWS CREATED IN 1988: MORE THAN 20 YEARS EXPERIENCE IN ANAEROBIC DIGESTION OF SOLID AND SEMISOLID ORGANICS**
- **SALES: AROUND 20 MILLION DOLLARS**
- **70+ PEOPLE (SUBSIDIARIES OWS INC IN OHIO, USA; BES GMBH IN GERMANY)**

WHAT HAS BEEN THE CONTRIBUTION OF ANAEROBIC DIGESTION TO SOCIETY IN THE PAST?

- TYPICAL INTRODUCTION FOR STATE-OF-THE-ART
- HISTORY OF STREET LIGHTS IN LONDON OR TALE OF SWAMP FIRES BEING THOUGHT OF AS GHOSTS
- BUT: AD HAS HAD A MUCH MORE PROFOUND IMPACT ON HUMANITY THAN HAS SO FAR BEEN POSTULATED

THE STORY OF THE PROFOUNDDEST IMPACT OF AD ON THE HUMAN PSYCHE GOES AS FOLLOWS:

- **NORTH-AMERICA WAS RAPIDLY DEVELOPING
IN THE 1500 – 1600'S**
- **BUT THERE WAS A LACK OF GOOD FERTILE SOIL.
MANKIND HAD ALREADY REALIZED THE VALUE OF
MANURE TO IMPROVE AGRICULTURAL YIELDS**
- **SO MANY SHIPS FULL OF MANURE SAILED ACROSS THE
ATLANTIC**
- **PROBLEM WAS THAT MANY SHIPS SANK**
- **WHEN THE SAILOR WENT TO CHECK BELOW DECK ON THE
CARGO (THE MANURE) AND LIT A PIPE, THE SHIP BLEW UP**
- **THE MARINE COMMERCE DISCOVERED THAT THIS WAS
DUE TO DRY PILES OF MANURE THAT HAD GOTTEN WET
DURING TRANSPORT**

- **WE NOW KNOW 500 YEARS LATER THAT BIOGAS WAS FORMING IN THE SHIP WHEN THE MANURE HAD SUFFICIENT MOISTURE CONTENT**
- **THE MARINE INDUSTRY AT THAT TIME ALSO NOTICED THAT THE PILES OF MANURE THAT WERE KEPT DRY DID NOT CAUSE EXPLOSIONS BELOW DECK**
- **SO THEY ISSUED A NEW DECREE WITH REGARD TO SHIPPING MANURE ACROSS THE ATLANTIC. AT EACH PILE OF MANURE BEING SHIPPED, A SIGN HAD TO BE PUT UP WITH THE FOLLOWING WARNING:**





**THE PILES BECAME KNOWN BY THEIR ACRONYM
AS PILES OF S.H.I.T.**

**SO AD HAS HAD A HUGE IMPACT ON THE HUMAN
PSYCHE FOR MORE THAN 500 YEARS:
AD HAS PROVIDED MANKIND ALL OVER THE
WORLD WITH THE ABILITY TO OVERCOME
THE FRUSTRATIONS OF LIFE, BY YELLING
“*STORE HIGH IN TRANSPORT*” OR “*S.H.I.T.*”**

**SO WHEN YOU ARE FRUSTRATED NEXT TIME,
DO NOT SAY *S.H.I.T.***

BUT SAY “*THANK YOU A.D.*”

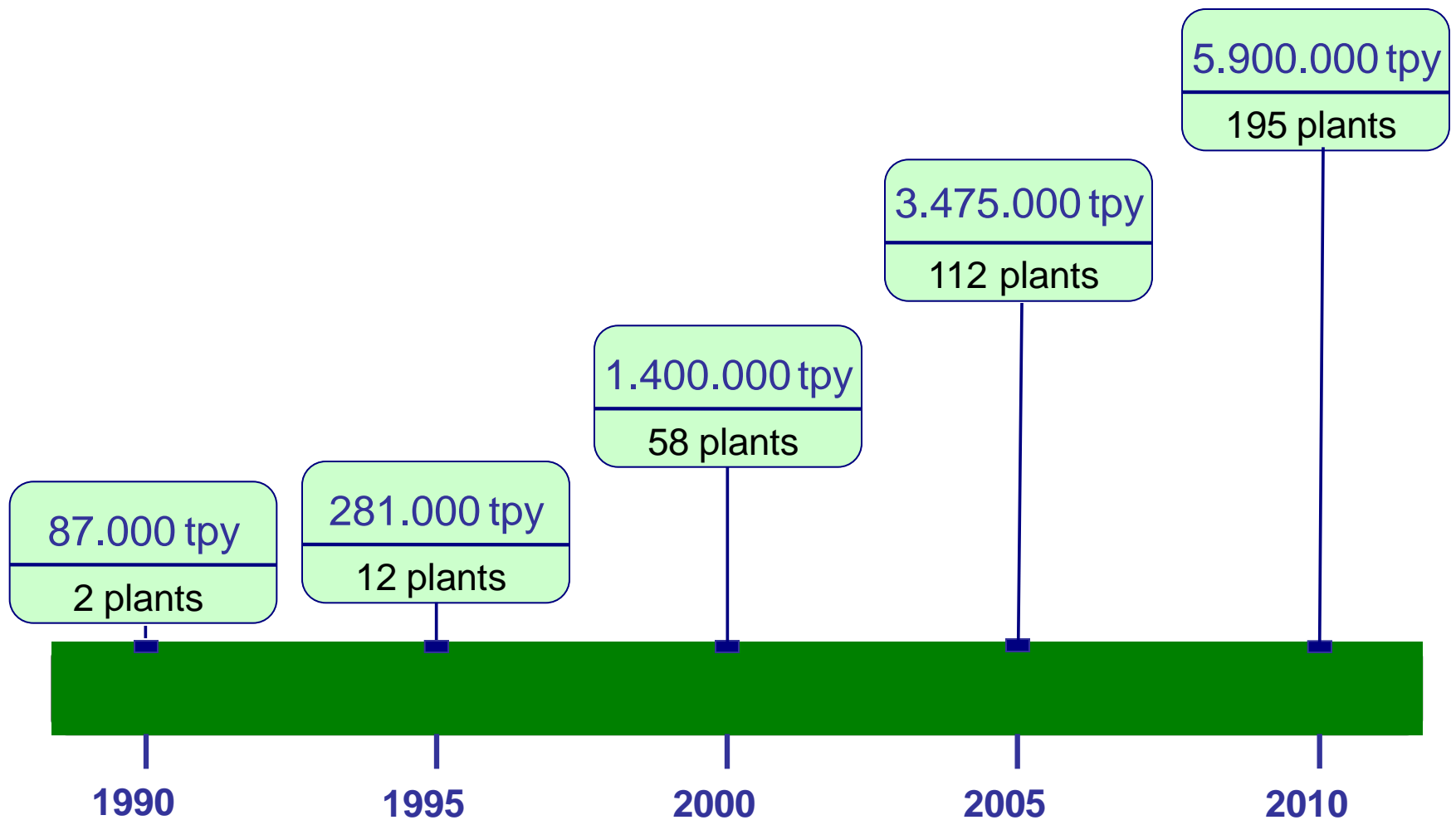
BUT NOW 500 YEARS LATER

**WHAT IS THE STATE-OF-THE-ART
OF ANAEROBIC DIGESTION
OF THE ORGANIC FRACTION
OF MUNICIPAL SOLID WASTE IN EUROPE
IN 2011?**

CRITERIA

- **NOT MANURE, SEWAGE SLUDGE, INDUSTRIAL SOLIDS, OR MARKET WASTES BUT HOUSEHOLD ORGANIC WASTE**
- **AT LEAST 10% ORGANIC SOLID WASTE FROM HOUSEHOLD ORIGIN**
- **MINIMUM SIZE: 3000 TON ORGANIC FRACTION PER YEAR**
- **DESIGNED CAPACITY, UNLESS SPECIFIED DIFFERENTLY**
- **CAPACITY NOT ELIMINATED IF OPERATION CEASED**
- **BIOWASTE: TOTAL CAPACITY**
MSW: CAPACITY GOING INTO THE DIGESTERS
- **SITUATED IN EUROPE**
- **AT LEAST UNDER CONSTRUCTION / CONTRACTED**

DIGESTION CAPACITY DEVELOPMENT IN EUROPE (1)

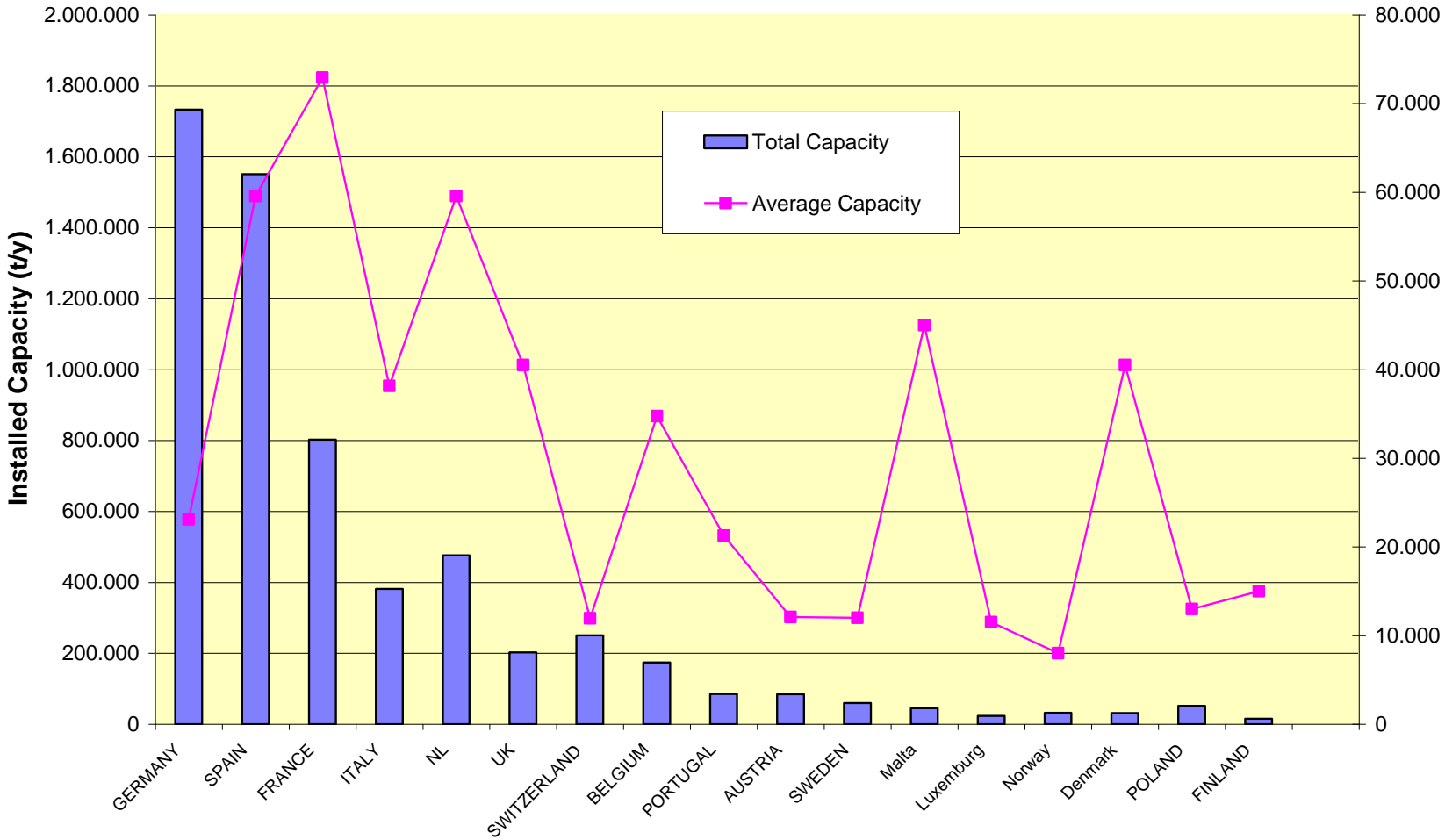


DIGESTION CAPACITY DEVELOPMENT IN EUROPE (2)

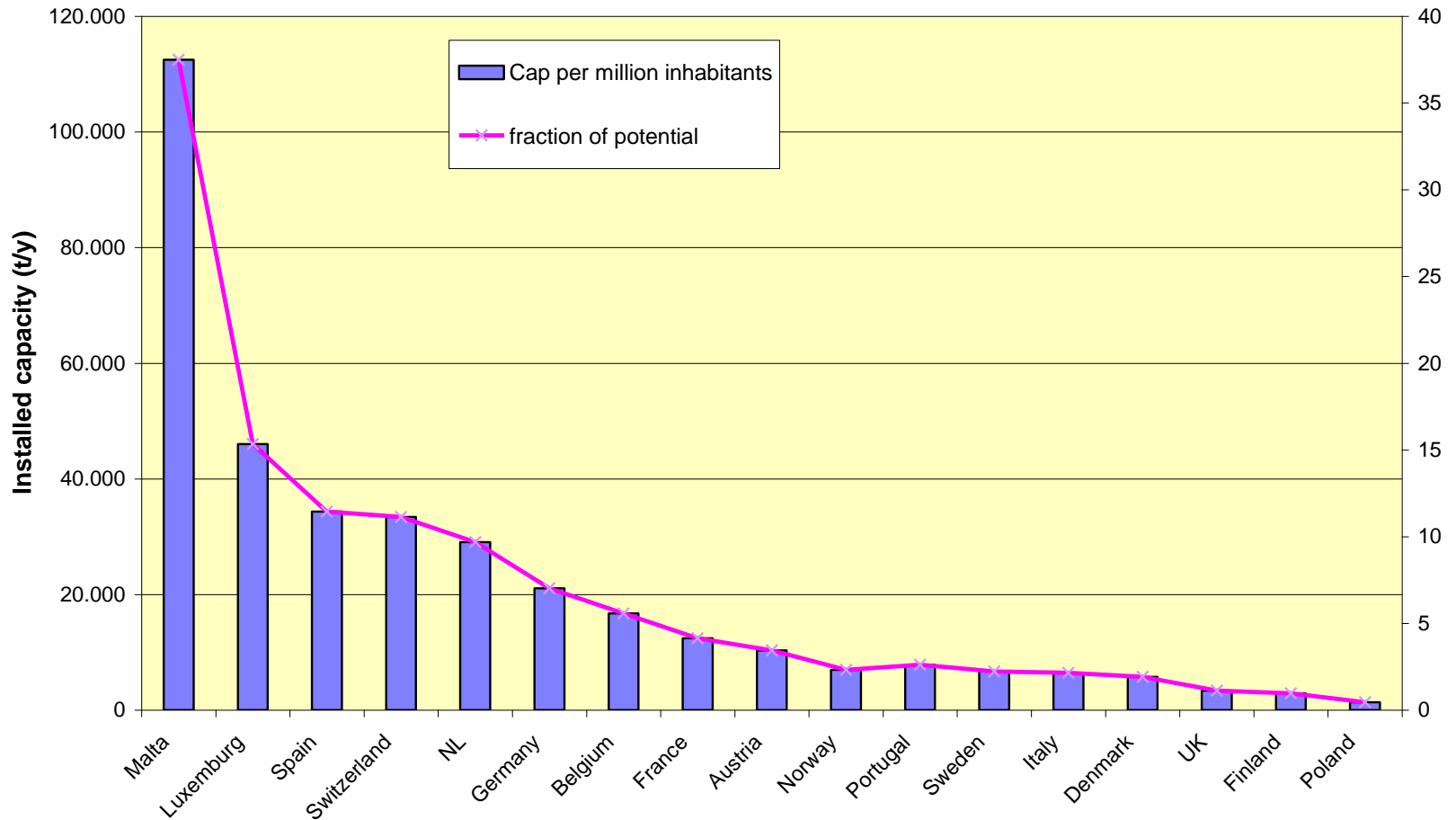
- **Capacity and size increase**

5 Year Development	1991-1995	1996-2000	2001-2005	2006-2010
# of plants installed	13	43	54	85
plants/y	2,6	8,6	10,8	17
capacity installed	194.000	1.117.500	2.077.950	2.479.450
capacity installed/y	38.800	223.500	415.590	495.890
average size of plant	14.923	25.988	38.481	29.170

CAPACITY PER COUNTRY



CAPACITY PER MILLION INHABITANTS AND PERCENTAGE OF POTENTIAL THEORETICAL CAPACITY



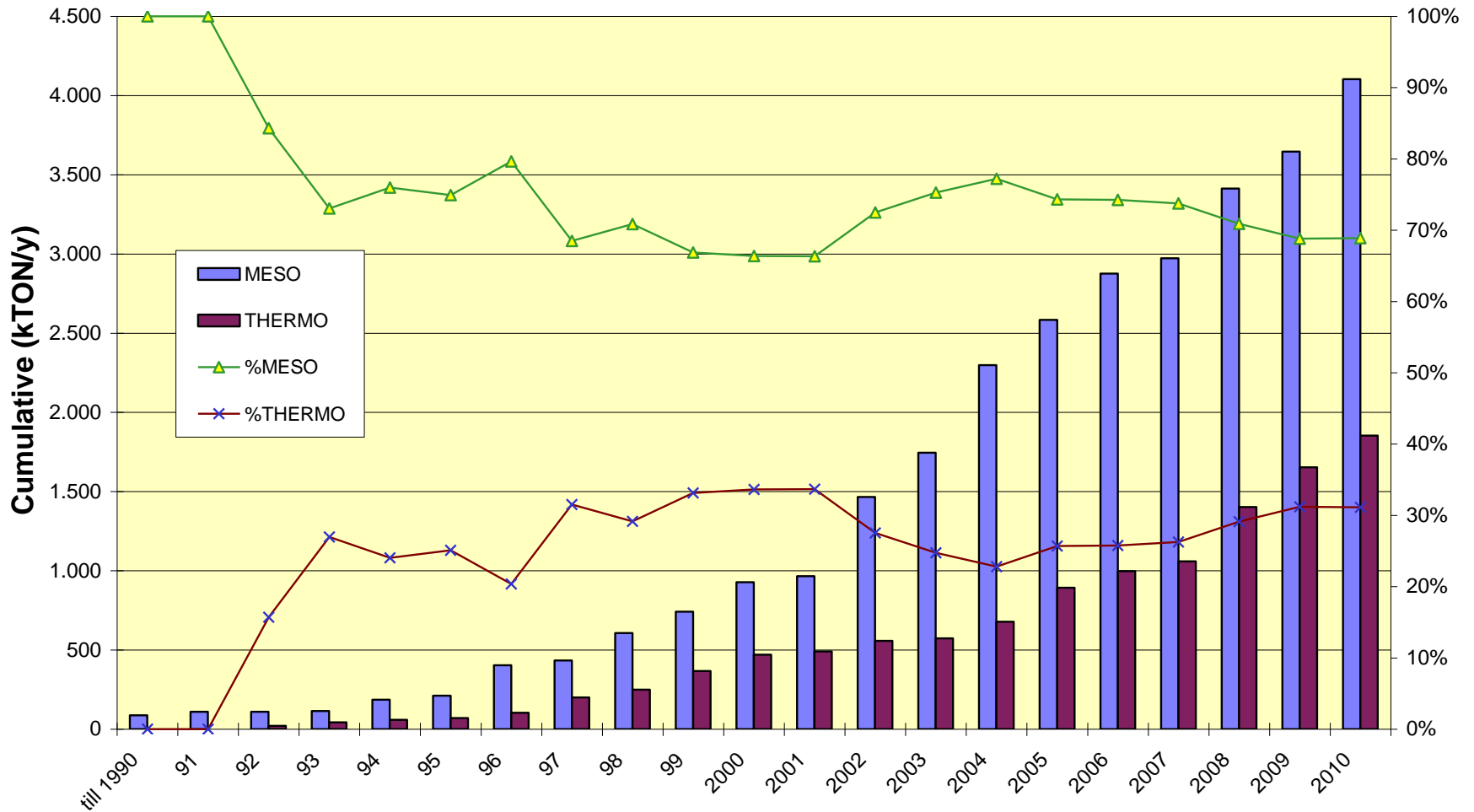
OVERALL STATUS OF AD OF MSW IN EUROPE

- **MSW TREATMENT IN EUROPE: 40% LANDFILL, 20% INCINERATION, 23% RECYCLING, 17% COMPOSTING (2% A.D.)**
- **ANAEROBIC DIGESTION TREATS THE HOUSEHOLD ORGANIC WASTE OF MORE THAN 60 MILLION EUROPEANS**
- **STEADY LONG-TERM GROWTH, ACCELERATING IN LAST 5 YEAR (UNLIKE OTHER BIOFUELS)**
- **PYROLYSIS AND GASIFICATION: VERY FEW PLANTS**
- **AD HAS BEEN THE ONLY ALTERNATIVE SOLID WASTE TREATMENT THAT HAS MADE A SIGNIFICANT CONTRIBUTION TO THE TREATMENT OF MSW**

ANALYSIS OF INSTALLED CAPACITY

- **MESOPHILIC (35-40°C) VS. THERMOPHILIC (50-55°C)**
- **DRY (> 15% TOTAL SOLIDS) VS. WET (< 15% TOTAL SOLIDS)**
- **TWO PHASE (ACIDIFICATION & METHANISATION) VS. SINGLE PHASE (COMBINED)**
- **CODIGESTION (SOLID WASTE + OTHER SUBSTRATES) VS. SINGLE FEEDSTOCK DIGESTION (ONLY WASTE)**
- **MIXED OR RESIDUAL WASTE (NO SEPARATE COLLECTION) VS. BIOWASTE (SEPARATE COLLECTION OF ORGANICS)**

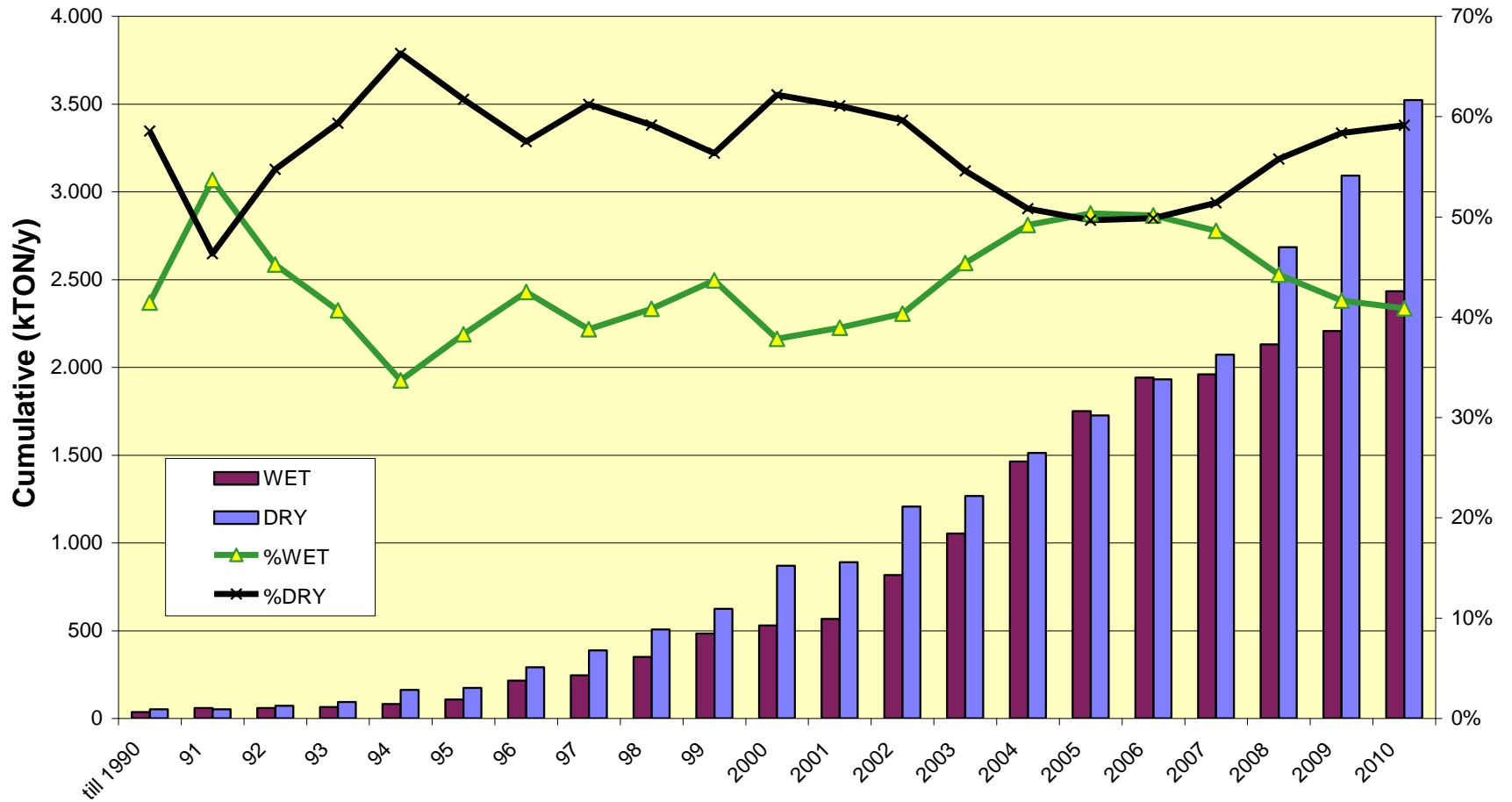
MESOPHILIC VS. THERMOPHILIC



MESOPHILIC VS. THERMOPHILIC

- **69% MESOPHILIC VS. 31% THERMOPHILIC IN 2010**
- **LAST 3 YEARS: 41% THERMOPHILIC**
- **54% OF MESOPHILIC CAPACITY = WET (IN 2010)**
>86% OF THERMOPHILIC CAPACITY = DRY (IN 2010)

WET VS. DRY



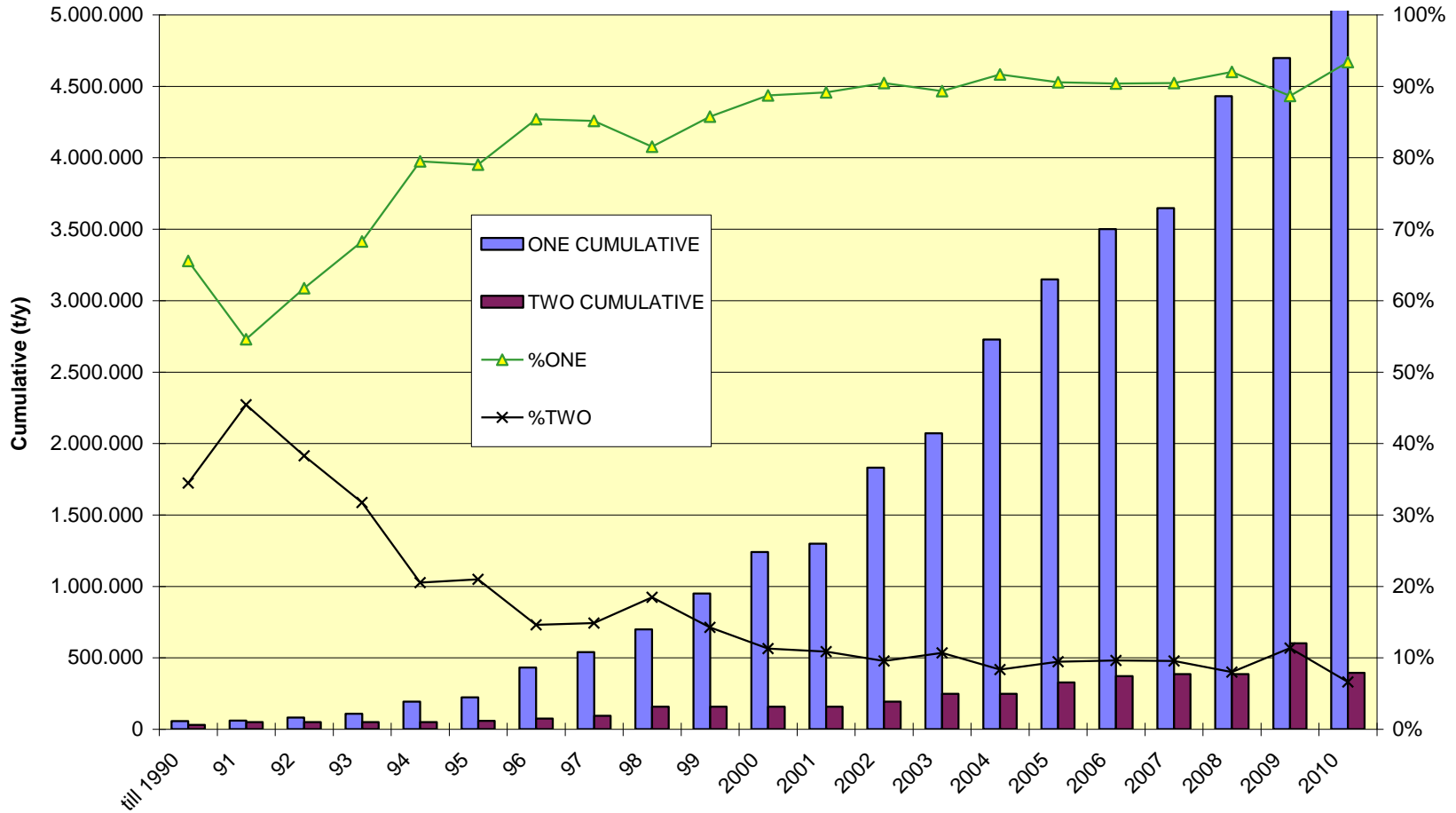
WET VS. DRY

5 Year Development	1991-1995	1996-2000	2001-2005	2006-2010
wet installed / 5 year	71.500	421.500	1.221.250	683.500
dry installed / 5 year	122.500	696.000	856.700	1.795.950
%wet	37%	38%	59%	28%
%dry	63%	62%	41%	72%

WET VS. DRY

- **59% DRY VS. 41% WET IN 2010**
- **LAST 3 YEARS: 75% DRY**
- **BATCH DRY FERMENTATION ON THE RISE IN LAST 5 YEARS**
- **BATCH DRY SYSTEMS OPERATE MESOPHILICALLY AND CONTINUOUS DRY SYSTEMS OPERATE MOSTLY THERMOPHILICALLY**

ONE PHASE VS. TWO PHASE



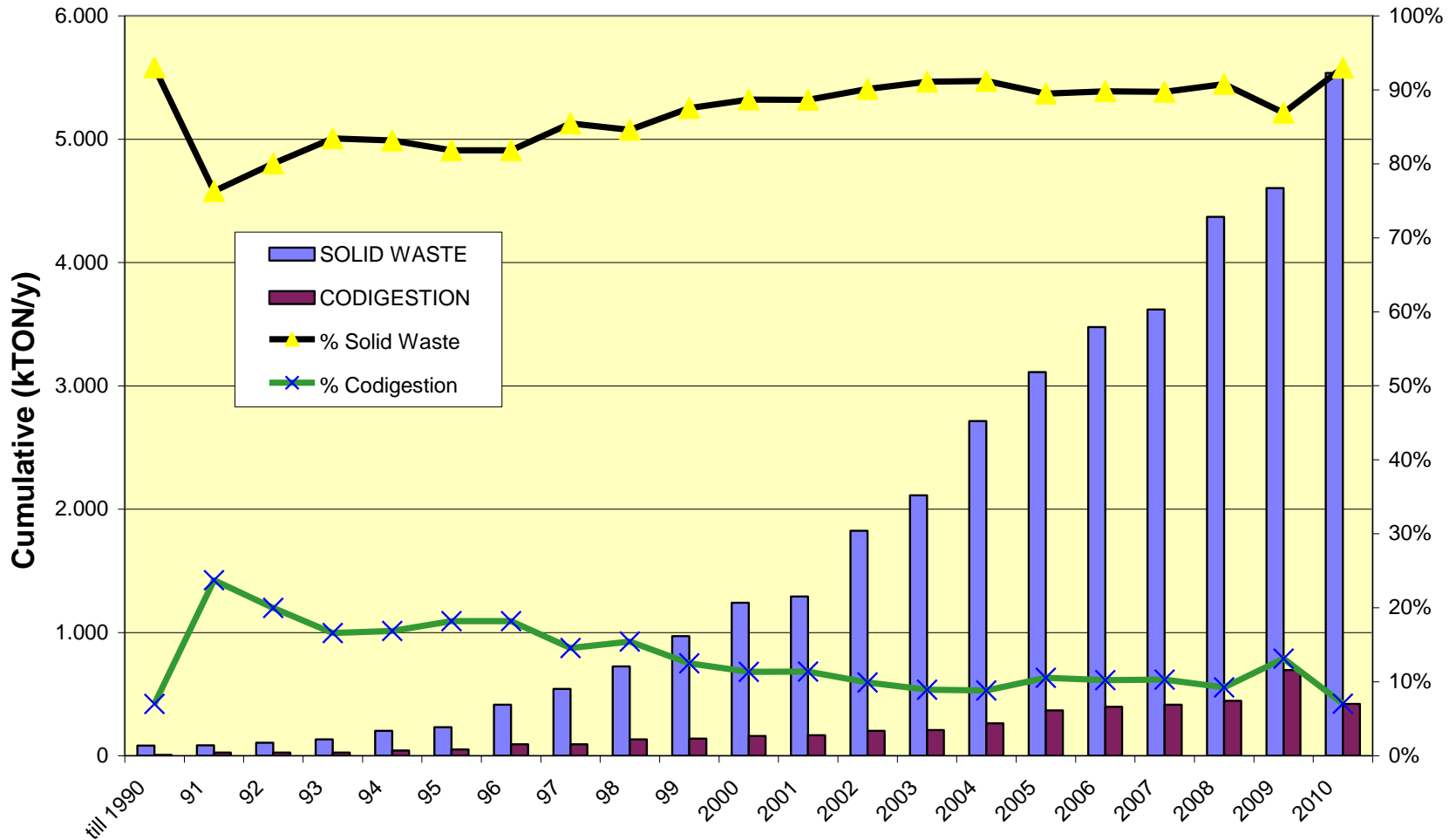
ONE PHASE VS. TWO PHASE

5 Year Development	1991-1995	1996-2000	2001-2005	2006-2010
one phase installed / 5 y	165.000	1.018.500	1.907.950	2.412.450
two phase installed / 5 y	29.000	99.000	170.000	67.000
%one phase	85%	91%	92%	97%
%two phase	15%	9%	8%	3%

ONE PHASE VS. TWO PHASE

- **6% TWO PHASE VS. 94% ONE PHASE IN 2010**
- **LAST 3 YEARS: <1% TWO PHASE**
- **TWO PHASE SYSTEMS DO NOT INCLUDE BATCH TUNNEL SYSTEMS THAT UTILIZE A UASB OR COMPLETELY MIXED DIGESTER AS A SOURCE OF INOCULUM FOR THE MATERIAL IN THE TUNNEL**

SINGLE FEEDSTOCK VS. CODIGESTION



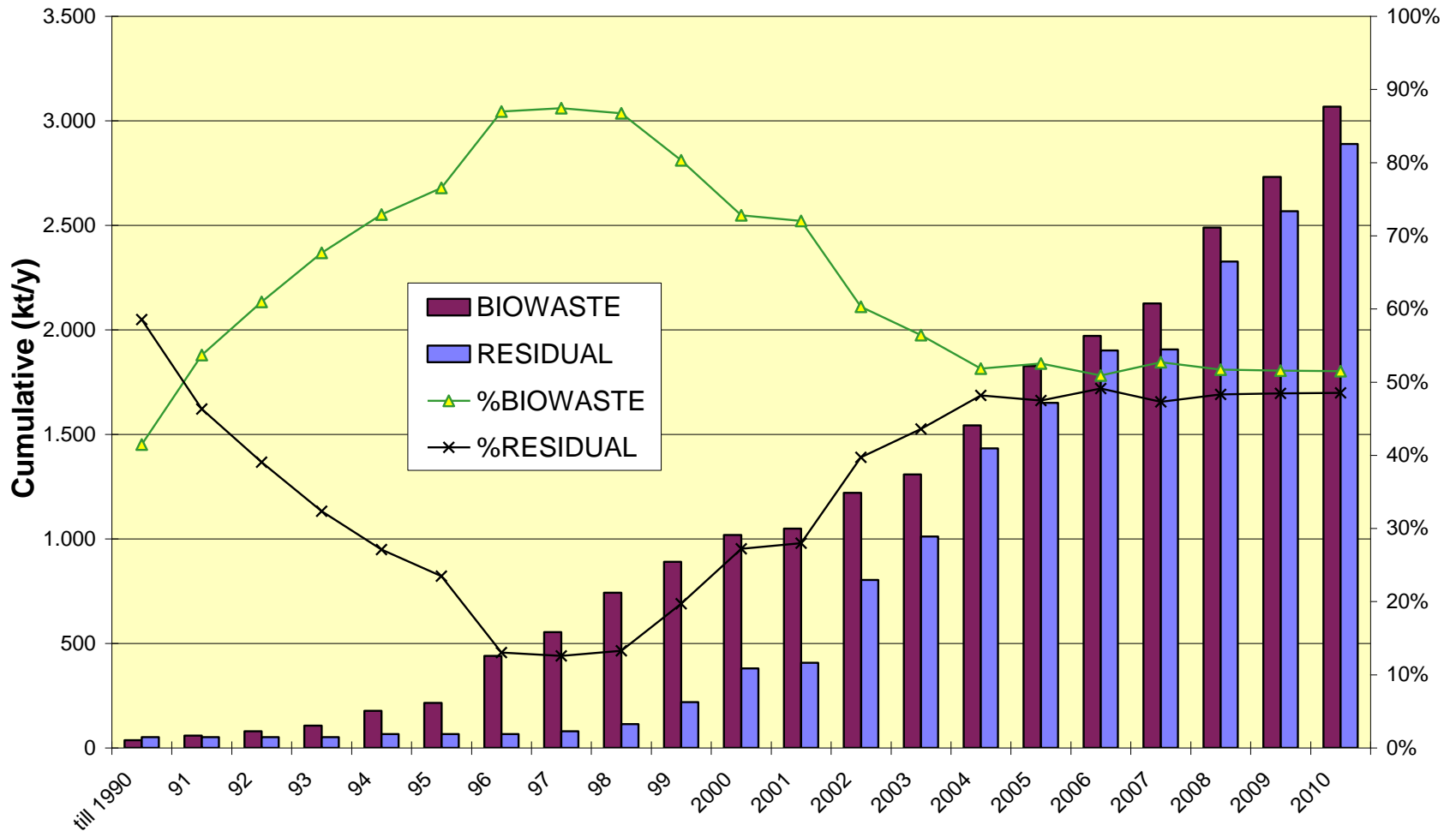
SINGLE FEEDSTOCK VS. CODIGESTION

5 Year Development	1991-1995	1996-2000	2001-2005	2006-2010
solid waste installed/ 5 year	149.000	1.010.000	1.870.200	2.426.950
codigest installed/ 5 year	45.000	107.500	207.750	52.500
%only waste	77%	90%	90%	98%
%codigestion	23%	10%	10%	2%

SINGLE FEEDSTOCK VS. CODIGESTION

- **7% CODIGESTION VS. 93% SINGLE FEEDSTOCK DIGESTION IN 2010**
- **LAST 3 YEARS: 1% CODIGESTION**
- **CAVEAT: MANY SLUDGE OR INDUSTRIAL WASTE DIGESTERS ARE BEING SUPPLEMENTED WITH A FRACTION OF ORGANIC WASTE SO THAT THE MINIMUM REQUIRED CONTENT OF ORGANICS FOR CODIGESTION WILL BE INCREASED TO 20%**

BIOWASTE VS. RESIDUAL WASTE



BIOWASTE VS. RESIDUAL WASTE

5 Year Development	1991-1995	1996-2000	2001-2005	2006-2010
Biowaste installed/ 5 year	179.000	803.000	808.250	1.240.450
Residual installed/ 5 year	15.000	314.500	1.269.700	1.239.000
%biowaste	92%	72%	39%	50%
%residual	8%	28%	61%	50%

BIOWASTE VS. RESIDUAL WASTE

- **52% BIOWASTE VS. 48% RESIDUAL IN 2010**
- **LAST 3 YEARS: 49% BIOWASTE**

DRIVING FORCES BEHIND THE GROWTH OF ANAEROBIC DIGESTION OF ORGANIC WASTE

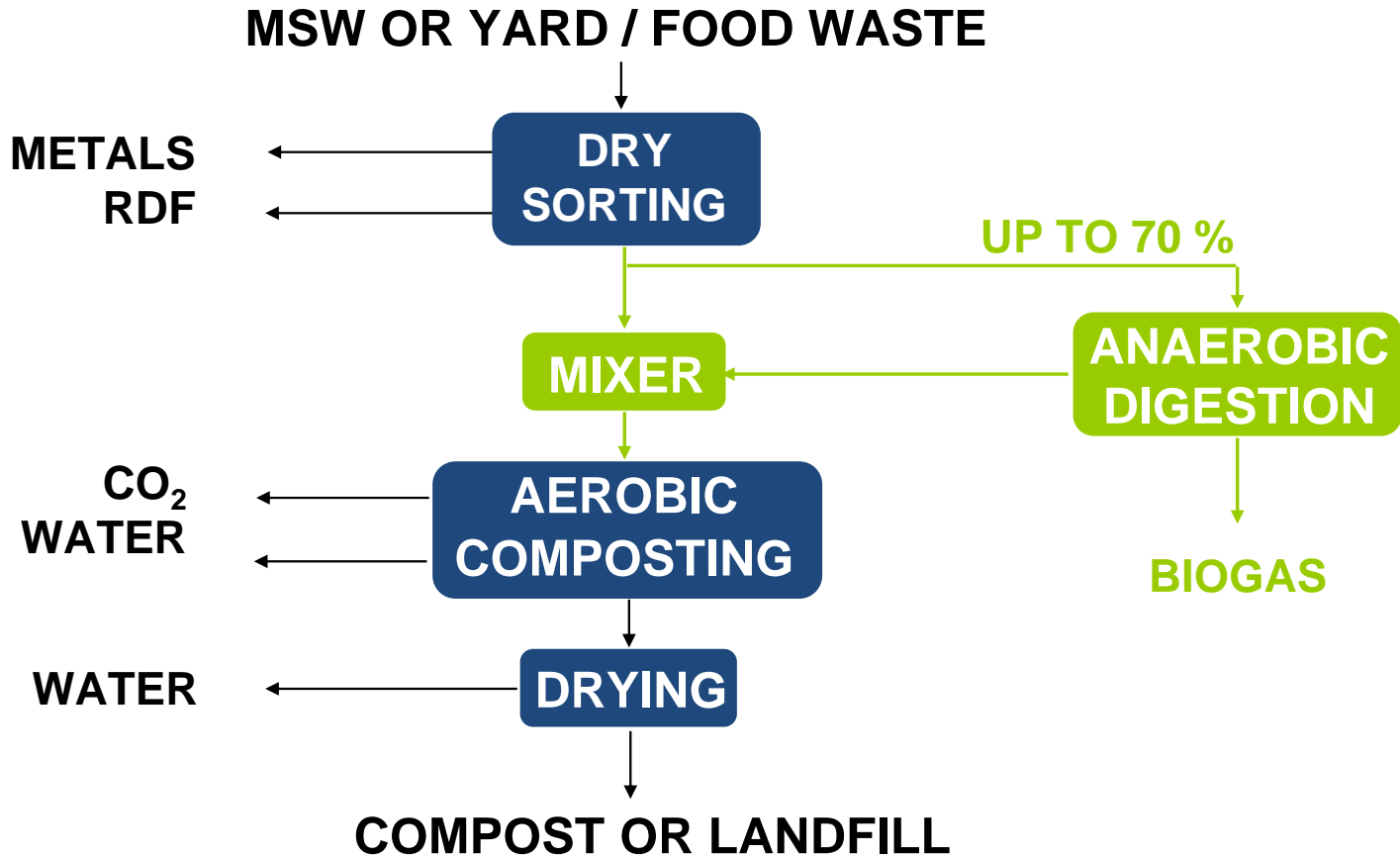
DRIVING FORCES FOR AD IN EUROPE

- **INTRODUCTION OF BIOWASTE COLLECTION (EU LANDFILL REGULATION)**
 - **INCENTIVES FOR PRODUCTION OF RENEWABLE ENERGY**
 - **ADVANTAGES OF AD COMPARED TO COMPOSTING:**
 - **MORE WASTE CAN BE TREATED ON THE SAME SURFACE AREA**
 - **REDUCTION OF ODORS**
 - **HYGIENIZATION: IMPORTANT FOR FOOD WASTE**
 - **HIGH FLEXIBILITY (NO BULKING MATERIAL NEEDED)**
- BUT DISADVANTAGE IS WASTEWATER TREATMENT**

PARTIAL STREAM DIGESTION (I)

- **ONLY PART OF THE ORGANICS IS DIGESTED (UP TO 70%)**
- **OTHER 30% OR MORE OF ORGANIC FRACTION IS BYPASSED AND IS NOT SUBJECTED TO DIGESTION**
- **DIGESTATE IS DIRECTLY MIXED WITH BYPASSED ORGANIC FRACTION WITHOUT DEWATERING**
- **NON-DIGESTED ORGANICS PROVIDE EXOTHERMIC ENERGY AND NEEDED STRUCTURE FOR AEROBIC POSSTREATMENT AND DRYING**

PARTIAL STREAM DIGESTION (II)



DRANCO PLANT TENNEVILLE (BELGIUM)



US-ADVANTAGES AND POSSIBILITIES

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- **LARGER FACILITIES: 100 000 TO 250 000 TPY (VS 30 000 TPY IN EUROPE)**
- **MORE VALUE/INFRASTRUCTURE FOR BIOMETHANE**
- **CAN LEARN FROM EUROPEAN MISTAKES**
- **MORE INTEGRATION POSSIBLE WITH LARGE ENERGY CONSUMERS**
- **LESS REGULATION REDUCES COSTS AS WELL**
- **GOOD MARKET FOR COMPOST**

CONCLUSIONS

➤ **STEADY AND STRONG GROWTH:**

2 (1990) < 58 (2000) < 195 (2010)

➤ **> 5.900.000T INSTALLED IN 2010 =
ABOUT 3% OFMSW IN EUROPE**

➤ **± 15% OF BIOLOGICAL TREATMENT
CAPACITY FOR ORGANICS DERIVED
FROM HOUSEHOLD WASTE**

CONCLUSIONS

FACTORS HAMPERING GROWTH:

- INVESTMENT AND OPERATING COST
- HYGIENIZATION REQUIREMENTS TO MEET ABPR
- NEGATIVE REFERENCES: DO NOT UNDERESTIMATE THE COMPLEXITY OF DIGESTION OF MSW ORGANICS

CONCLUSIONS

FACTORS STIMULATING GROWTH:

- REVAMPING EXISTING BIOWASTE (= GREEN WASTE+FOOD WASTE) COMPOSTING PLANTS
- LANDFILL DIVERSION OF ORGANICS
- EXTENDING TREATMENT CAPACITY OF EXISTING BIOWASTE COMPOSTING PLANTS => PARTIAL STREAM DIGESTION
- PRODUCTION OF RENEWABLE METHANE

**AD OF SOLID WASTE ORGANICS
IS HERE TO STAY**

**AND REMEMBER, SAY “THANK YOU A.D.”
INSTEAD OF “S.H.I.T.”**

THANK YOU!!!