4th International RETech Conference on 'Climate and Resource Protection through Environmentally Compatible Collection and Recycling of Biogenic Waste'

4th & 5th November 2021, Berlin

German RETech Partnership
Recycling & Waste Management
Made in Germany

Status of the Collection and Treatment of Biogenic Waste in Greece

Dr. Mihalopoulos Christos, Mechanical Engineer, National Technical University of Athens

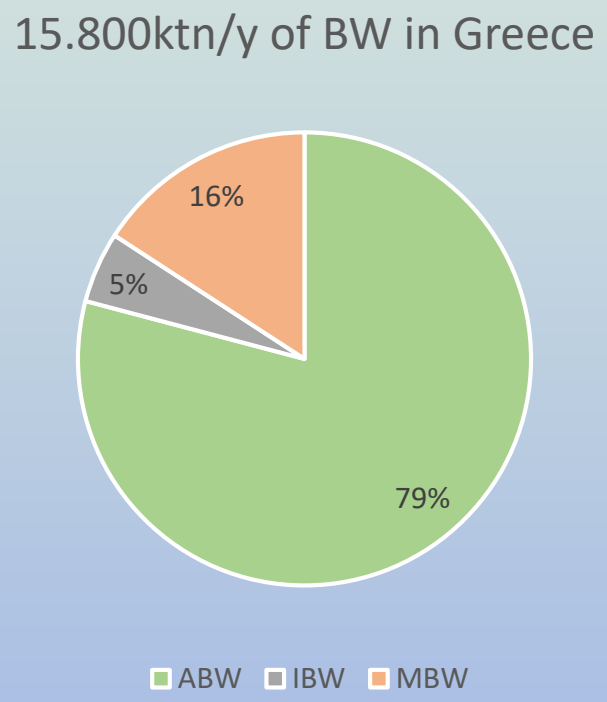
Scientific Associate – Researcher at Industrial Process System Engineering Unit

School of Chemical Engineering – NTUA

IPSEN
Industrial Process Systems Engineering Unit

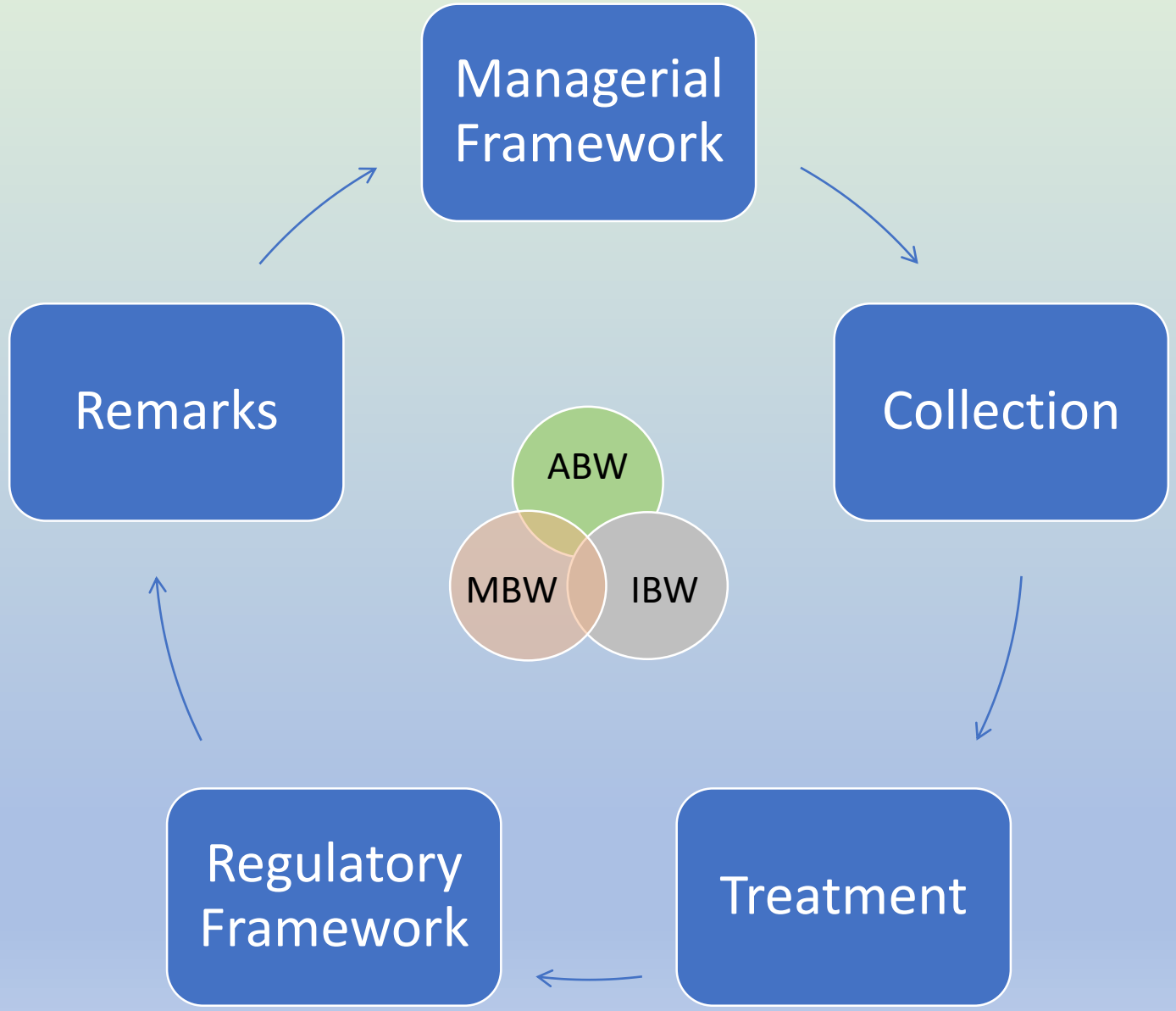
Biogenic Waste in Greece

- Agricultural Biogenic Waste (ABW)
  - Origin: Crops' cultivators & livestock breeders (incl. Cat II ABPs)
  - Appr. 12.500ktn/y* (~40% of all waste flows)
- Industrial Biogenic Waste (IBW)
  - Origin: Waste Water Treatment Plants (WWTPs), food & beverage processing industries (incl. Cat III ABPs) & timber industry
  - Appr. 800ktn/y** (~2,5% of all waste flows)
- Municipal Biogenic Waste (MBW)
  - Origin: Households, HORECA Entities, Food Products' Commercial Stores & Green Areas
  - Appr. 2.500ktn/y* (~45% of total MSW, ~8% of all waste flows)



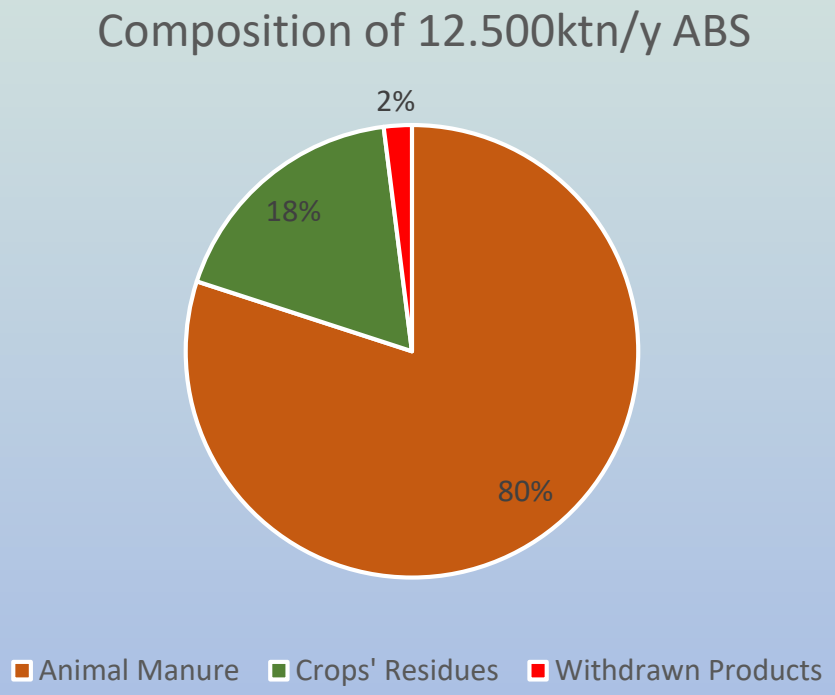
* Referred to year 2018, National Waste Management Plan (NWMP) 2020

** Referred to year 2018, Hellenic Statistical Authority


Managerial Framework
Collection
Treatment
Regulatory Framework
Remarks
ABW
MBW
IBW

ABW: Managerial Framework

- Cultivators and livestock breeders are numerous and highly dispersed across the whole countryside of Greece
- ABW quantities generated by livestock breeders are predominantly animal manure
- As many livestock breeders are also crops' cultivators, a common practice of animal manure (often mixed with animal bedding biomass) management includes:
  - Layout outdoors in exposed piles,
  - Physical bio-decomposition,
  - Dispersion at the crop's soil as fertilizer
- Crops' Residues Common Managerial Practices:
  - Valorization as animal feed (mostly for annual crops e.g. cereals and for rejected fruits & vegetables)
  - Burning on-site (mostly for perennial crops' cultivations e.g. grapes, peaches, olives etc.), during harvesting periods or crops' maintenance works (plot preparation for upcoming growing period)



ABW: Collection & Treatment

- A total of appr. 12.500ktn (NWMP, 2020) of ABW is divided in:
  - 10.000ktn of Cat II ABP (predominantly animal manure), where appr. 35% (±25%) is considered collectable as generated from stabled livestock farms (cattles, pigs and poultry)
  - 2.350ktn of biomass generated from crops' cultivation, where appr. 60% (±15%) is considered collectable
  - 150ktn of rejected fruits and vegetables
- ABW generated from primary productive sectors are not officially recorded, therefore, there are no accurate data related with each treatment option (raw material for animal feed, burning on-site, WtE or other)
- Currently, a small part of ABW (mostly animal manure) is valorized through:
  - 18 decentralized biogas plants (along with IBW) with an installed capacity of appr. 15MWel (26% of the total installed capacity countrywide)
  - Private composting plants
- Based on Center of Renewable Energy Sources (CRES, 2018 reference data) they have been issued:
  - 32 licenses for the development of biogas plants treating ABW with a total installed capacity of appr. 88MW
  - 37 licenses for biomass combustion plants with a total installed capacity of appr. 295MW

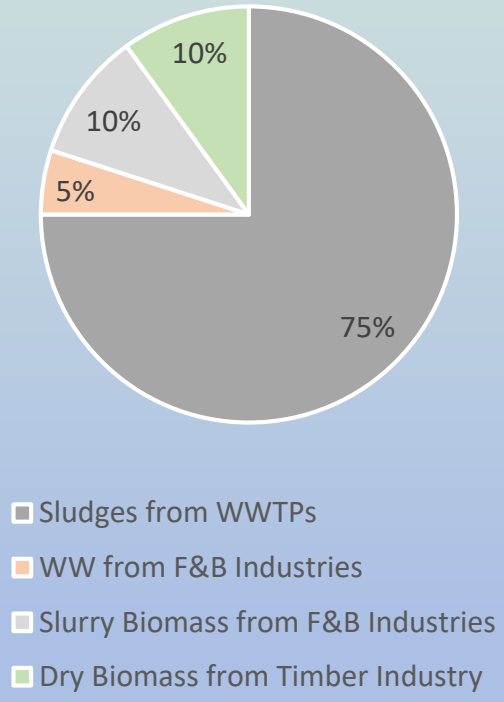
ABW: Regulatory Framework & Remarks

- The 'polluter pays' principle is not imposed by law to crops' cultivators and/or livestock breeders
- ABW producers are not subjected to declaration of produced quantities at National Waste Management Registry Platform
- Existing legislative framework for ABW management – Code of Good Agricultural Practices for the Protection of Water Recipients against Nitrate Pollution (MD 1420/82031, valid from 2015) in relation with the:
  - Management of animal manure from livestock farms
  - Surface deposition and dispersion of biologically stabilized animal manures at soils
- Challenges for ABW management according to NWMP 2020:
  - Recording and monitoring of annual produced quantities
  - Development of an effective collection network (stakeholders' contractual agreements)
  - Guidelines for valorizing crops' residues as animal feedstock
  - Co-processing of crops' residues with MBW for compost production at MBT plants
  - Technological support of livestock breeders for pre-treatment of animal manure prior delivery their at biogas plants
  - Development of value chains for exploiting dry biomass at combustion plants (locally and/or regionally)

IBW: Managerial Framework

- Management of IBW (incl. sludges) generated from municipal WWTPs and F&B processing industries is subjected to the 'polluter pays' principle:
  - Plants' owners are responsible for IBW management (incl. declaration of produced quantities at National Waste Management Registry Platform).
  - Terms and conditions on IBW management are regulated based on their environmental license (approval decision of environmental terms)
- Sludges derived from municipal WWTPs, domestic septic tanks and F&B processing industries are not considered as a municipal waste stream
- WWTPs serving municipal sewerage networks (appr. 320 plants countrywide) are owned by municipal water supply and sewerage companies while, reciprocal fees are paid by residential owners (e.g. households) through water supply bills
- Medium-sized & large enterprises are regularly inspected from regional environmental authorities as for their compliance with the imposed terms based on their environmental license
- SMEs are inspected from regional environmental authorities only upon formal complaints for environmental violations

Composition of 800ktn/y IBW



IBW: Collection & Treatment

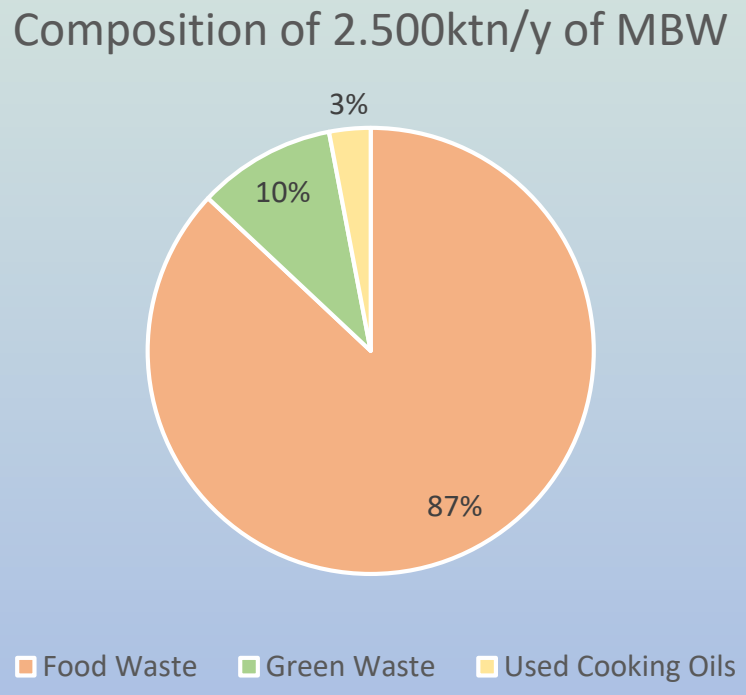
- Countrywide and at full coverage, collection of municipal WW is taking place either directly (through sewerage network connected with WWTPs), either indirectly through the evacuation of domestic septic tanks by properly authorized tank trucks
- Based on NWMP, during 2018, appr. 115ktn of dehydrated sludges derived from municipal WWTPs were treated as follows:
  - Soil fertilizer for cultivation purposes: 30% / Raw material for energy recovery (biogas and/or cement plants): 30% (inside Greece) & 10% (exported) / Disposal at sanitary landfills and/or temporary storage: 30%
- At 10 municipal WWTPs there are in operation biogas plants with a total installed capacity of appr. 13MWel (22% of the total installed capacity countrywide), while 7 more licenses (CRES, 2018 data) have been issued for 17MW
- Predominant technology for the treatment of solid / slurry state IBW (and ABW) from F&B processing industries (crops' residues): Appr. 18 decentralized biogas plants with an installed capacity of appr. 15MWel (appr. 26% of the total installed capacity countrywide)
- Concerning other treatment options for IBW, several cases of agro-industrial symbiosis have been met:
  - Grapes stalks and marcs as soil fertilizer at vineyards (case of wineries)
  - Oil pomace as raw material for kernel oil production (case of oil mills)
  - Woody biomass from timber industry as fuel at boilers for industrial (steam production) and/or domestic (heating) purposes

IBW: Regulatory Framework & Remarks

- Treatment of municipal and industrial WW is regulated through JMD 5673/400 (valid from 1997, as amended):
  - Owners of F&B processing industries are obliged to operate WW pre-treatment units prior their disposal on water recipients or their delivery at municipal WWTPs
  - Medium-sized & large enterprises as well as large touristic accommodations are operating on-site WWTPs for the treatment of WW
- Quality standards for the valorization of sludge generated from municipal WWTPs as soil fertilizer for crops' cultivation is regulated through JMD 80568/4225 (valid from 1991)
- Quantified targets for the recovery (composting and/or WtE) of municipal WWTPs sludges: 95% by 2030
- Specific terms and conditions for the management of slurry / solid state IBW generated from F&B processing industries are valid only for:
  - Oil mills as regulated by JMD 127402/1487 (valid from 2016)
  - Slaughterhouses as regulated by PD 211 (valid from 2006) in relation with the management of Cat III ABS
- For IBW of solid / slurry state generated from F&B processing industries, besides legislation on environmental protection, it is promoted the adoption of Best Available Techniques, while financial incentives are offered through periodical published Laws for regional and economic growth (Development Laws)

MBW: Managerial Framework

- Municipal authorities are responsible by law for:
  - Collection of MSW / pre-sorted MBW & Implementation of source separation schemes
  - Declaration of MSW quantities electronically through the National Waste Management Registry Platform at Ministry of Environment
  - Charging at an ex-post basis reciprocal fees on residential owners (e.g. households) for the provision of all services related with MSW / pre-sorted MBW management
  - Fees are paid by residential owners through electric power supply bills along with other services offered
- Regional Waste Management Associations – RWMAs (public or private sector non-profit bodies consisted by representatives of each region's municipalities) are responsible by law for:
  - Management and operation of Waste Transfer Stations – WTS
  - Management of commingled MSW and pre-sorted MBW treatment plants (incl. landfills) which are operated (at most cases) by private companies through Public – Private Partnership (PPP) contractual agreements
  - Charging at an ex-post basis reciprocal fees charged on municipalities for the provision of all services related with MSW / pre-sorted MBW management, except collection.



MBW: Collection

- Current Status on Separate Collection of MBW (estimations based on NWMP 2020 references and recent progress):
  - 90% (2.250ktn) of MBW are collected commingled with MSW (kurbside collection)
  - 10% (250ktn) of MBW are source separated (mostly through kurbside brown bins)
- Actors on MSW / pre-sorted MBW Collection:
  - Predominant: Public services (municipal authorities)
  - Minor: Private fleet owners in supporting collection during summer periods (at coastal and/or insular municipalities) or for specific pre-sorted MBW streams (e.g. used cooking oils)
- Applied Equipment on Collection:
  - Rear loader garbage trucks' for commingled MSW / pre-sorted MBW and dump trucks and/or skip loaders for green & bulky waste
- Current Status on Waste Transfer:
  - A network of appr. 100 WTS countrywide is serving municipal fleets
  - From WTS, MSW / pre-sorted MBW waste are directed to treatment or final disposal plants at a prefectural and/or regional level
- Applied Equipment on Waste Transfer:
  - Trailer trucks with press containers owned by RWMAs or municipal authorities and rarely by individual transporters (upon contractual agreement with RWMAs)

MBW: Treatment (1)

- Currently, appr. 75% of unprocessed MSW directed to sanitary landfills: At largest landfill sites (e.g. Athens and Thessaloniki), the produced biogas from the AD of compacted organic fraction is valorized through energy production units (mostly CHP), with a total installed capacity of appr. 30MWel (52% of the total installed capacity countrywide)
- Predominant Technology for the Treatment of MBW: Centralized Mechanical – Biological Treatment (MBT) Plants:
  - Biological treatment (composting only or AD and post-composting of digestate) is part of the main plant where MBW are treated separately either as organic fraction extracted from MSW, either as pre-sorted MBW
  - Each MBT plant is accompanied by a landfill site for the final disposal of residues
- Status on the Development of MBT Plants (able to treat also pre-sorted MBW):
  - Currently in operation: 7 with overall processing capacity of appr. 820ktn/y MSW
  - Under construction: 5 with overall processing capacity of appr. 400ktn/y MSW
  - Under public tendering process and/or scheduled: 25 more until 2030
- Status on the Development of Biological Treatment Plants (composting) for the Treatment of Pre-Sorted MBW:
  - Currently in operation: 1 with overall processing capacity of appr. 6ktn/y MBW
  - Under construction: 1 with overall processing capacity of appr. 4,7ktn/y MBW
  - Scheduled: 40 more until 2030

MBW: Treatment (2)

- Based on NWMP (data from 2018 & recent progress), appr. 350ktn of MBW (14% of MBW in total) were considered recycled (diversion from landfills) as follows:
  - Compost production from MBT plants: 290ktn
  - Home composting: 10ktn
  - Biodiesel production from used cooking oils: 50ktn
- Outputs from MBT and Composting Plants in relation with MBW Treatment:
  - Biogas, Compost-Like-Output (CLO) and/or Compost (directly or as treated digestate)
  - Based on legislative imposed quality standards (JMD 56366/4351/2014) Class A compost (from separated organic fraction of MSW) can only be used for landscaping at restoration sites (inactive mines, quarries and/or uncontrolled landfills)
  - CLO (non-compliant with quality standards) is considered as a residual fraction of MBT plants
  - Currently, there are no legislative imposed quality standards for compost produced from the treatment of pre-sorted MBW
- NWMP 2020 introduces the Valorization of Combustible Residual Fractions (RDF & SRF incl. CLO) as raw material for WtE, through:
  - Existing plants (e.g. cement industries)
  - Greenfield investments

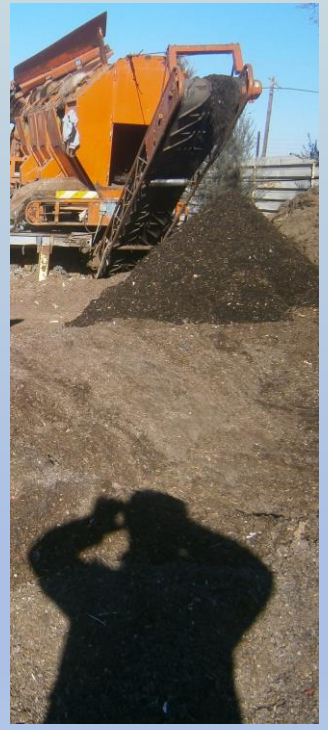
MBW: Regulatory Framework

- Law 4819 (valid from July 2021) and JMD 90439/1846 (valid from October 2021) incorporated into national legislation Directives (EU) 851/2018, 852/2018 and 850/2018 respectively
- Mandatory diversion of unprocessed MBW from landfills until 2023 through:
  - Source-separation schemes (kurbside collection – brown bins) and home composting (applied mostly at decentralized rural and/or insular areas)
  - MBT and stand-alone composting plants (separation of MSW organic fraction)
- Mandatory implementation of MBW source separation schemes until 2023 by municipalities, HORECA entities and food products' commercial stores
- Quantified targets set on separate collection:
  - 46% (54%) of MBW to be collected separately from MSW until 2025 (2030)
- Quantified targets set on treatment and final disposal:
  - Recycling targets for MBW and packaging waste: 55% (60%) by 2025 (2030)
  - Final disposal target for unprocessed MSW: less than 10% by 2030 (MBT plants' residual fraction is excluded from this target)
  - Landfill gate fees will be gradually increased to 55€/tn (from 2027 and for the years after) and will be charged cumulatively for both unprocessed MSW and plants' residual fraction
- Progressive implementation of PAYT schemes from 2023 and beyond for MBW focused primarily to HORECA entities and food products commercial stores, as well as, promotion of MBW prevention measures through economic incentives (tax exceptions for donations)

MBW: Remarks

- MSW (& pre-sorted MBW) treatment plants' development is scheduled to be expanded in forthcoming years across all Regions countrywide
- At present, priority has been given (in terms of valorizing economic instruments) on the development of centralized treatment plants
- Regional Waste Management Plans (RWMP) are fully determining the number and processing capacity of MSW (& pre-sorted MBW) treatment plants
- At present, RWMP are prepared based on NWMP guidelines by prioritizing processing of MSW (& pre-sorted MBW) against final disposal
- Existing & forthcoming challenges related with MBW management are including:
  - Rewarding citizens and municipal authorities according to performance indicators on the achievement of targets related with separate collection
  - Bringing public awareness campaigns at the foreground
  - Rationalization of landfill gate fees on behalf of treatment plants' competitiveness
  - Upgrading of MBT plants' performance (towards the minimization of residual fraction)
  - Maturation of landscapes where new plants will be implemented (land use permissions and social acceptance issues are key factors)
  - Development of sustainable markets for secondary materials (incl. compost) based on waste management hierarchy principles
  - Leverage financial resources for private investments on decentralized treatment plants

German RETech Partnership
Recycling & Waste Management
Made in Germany



Thank you for your time!!!

Dr. Mihalopoulos Christos, Mechanical Engineer NTUA – IPSEN

Mail: cmihalo75@gmail.com & cmihalo@mail.ntua.gr

Website: http://ipsen.ntua.gr/

IPSEN
Industrial Process Systems Engineering Unit