VEOLIA

Sludge Workshop

3rd April 2017 – Zagreb

Isabelle LEBLANC - isabelle.leblanc@veolia.com

WATER TECHNOLOGIES

Waste water treatment produce sludge

Typical city of 100,000 PE (France)

55 m^3/PE.year

Conventional wastewater treatment plant

Treated water
55 m^3/PE.year

20 kgDS/PE.year
2 m^3/PE.year (1%DS)
200 000 m^3/year

Dewatered sludge (20%DS)
100 kg/PE.year
= 10 000 t/year

Ten 20 ton trucks leaving the WWTP every week

What is sludge?

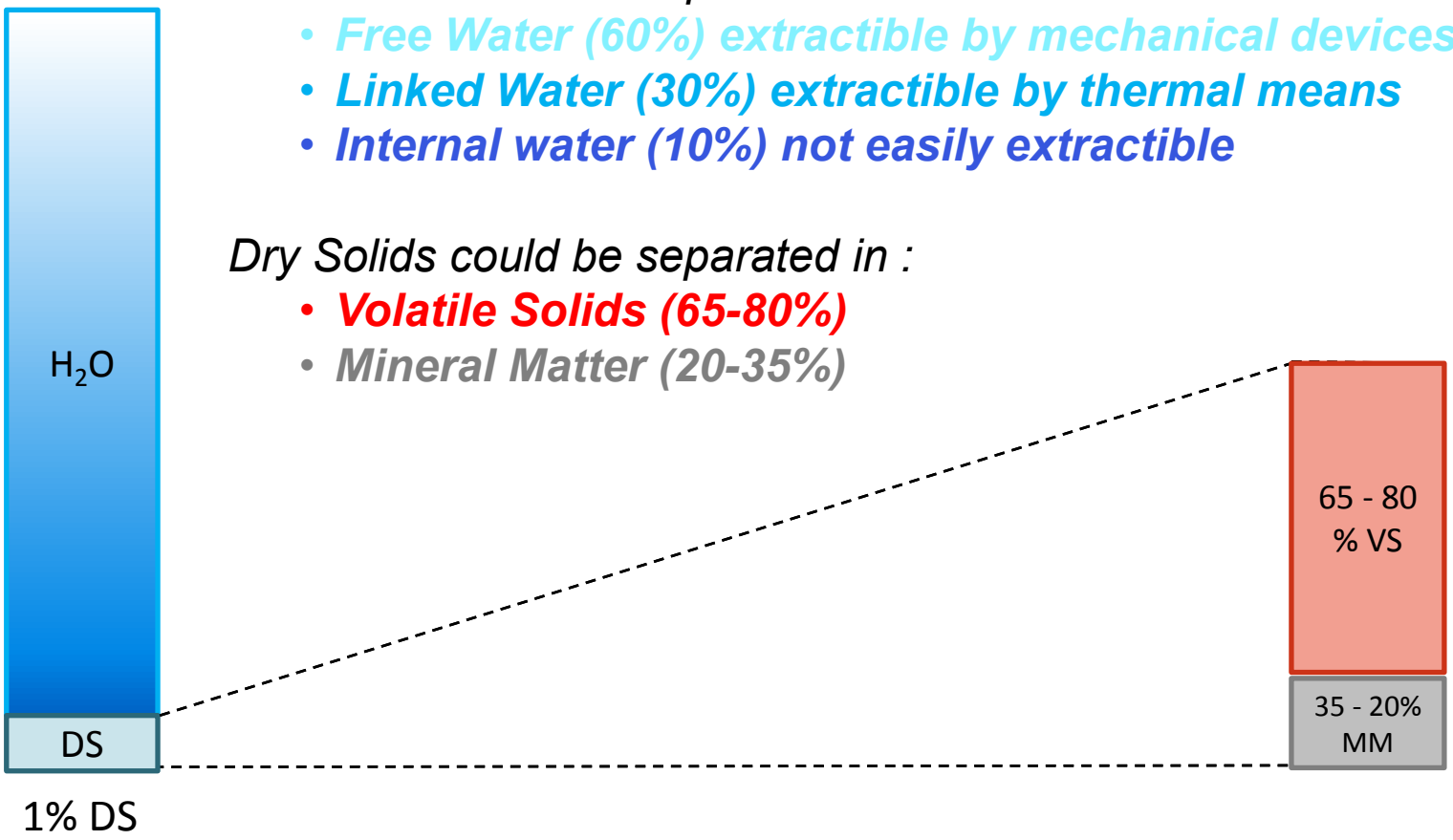
Sludge is essentially water (99%)

This water could be separated in :

- ***Free Water (60%) extractible by mechanical devices***
- ***Linked Water (30%) extractible by thermal means***
- ***Internal water (10%) not easily extractible***

Dry Solids could be separated in :

- ***Volatile Solids (65-80%)***
- ***Mineral Matter (20-35%)***



Sludge characteristics

- Main parameters
  - *Sludge DS content*
  - *Volatil solid content VS = +/- Organic content*
  - *µPollutants (heavy metals, PAH, PCB) and pathogens*
  - *Thermodynamics : LCV (low calorific value)*

LCV - sludge	Fuel-oil	Dry wood	City gas
6.7 kWh/ kgVS (= 4.7kWh/kgDS for sludge 70%VS)	12.4 kWh/kg (10.3 kWh/l)	5 - 6.5 kWh/kg	9.88 kWh/Nm^3

Sludge challenge

- *Volume increasing*
- *Public reluctance*
- *More stringent regulations*

Requirement for land application

- Lowering of the regulated limits (ex : French Regulation, dec 1997 & 1998)
  - *Heavy metals, PAHs, PCB and pathogens also considered*

micropollutant	Limit values (mg/kgDS)		Maximum flow cumulated within 10 years (g/m^2)	
• Heavy metals :				
Cadmium	10		0.015	
Chromium	1000		1.5	
Copper	1000		1.5	
Mercury	10		0.015	
Nickel	200		0.3	
Lead	800		1.5	
Zinc	3000		4.5	
Cr + Cu + Ni + Zn	4000		6	
• Organic micropollutants :				
	general	pastures	general	pastures
Total of 7 main PCB	0.8	0.8	1.2	1.2
Floranthen	5	4	7.5	6
Benzo(b)fluoranthen	2.5	2.5	4	4
Benzo(a)pyren	2	1.5	3	2

Requirement for land application

- Lowering of the regulated limits (ex : French Regulation, dec 1997 & 1998)
  - *Heavy metals, PAHs, PCB and pathogens also considered*
- Sludge shall not only be harmless but must also present an agricultural interest (e.g. nutrients : nitrogen, phosphorus)
- Traceability : sludge blending forbidden, screenings, fats and grits not allowed
- Storage manditory : 6 to 10 months (often out of the waste water plant)
- What if ? : alternative routes demanded

Landfilling for harmless wastes (sludge, MSW)

French order 09-sept 1997 relative to household wastes and related wastes storage centers

- Construction & operation
  - *Biogas and leachates have to be collected and treated*

- Waste checking prior to enter
  - *«Traceability »: no waste mixing, identification*
  - *Visual Control, no radioactivity*
  - *Sampling*
  - *DS > 30%*

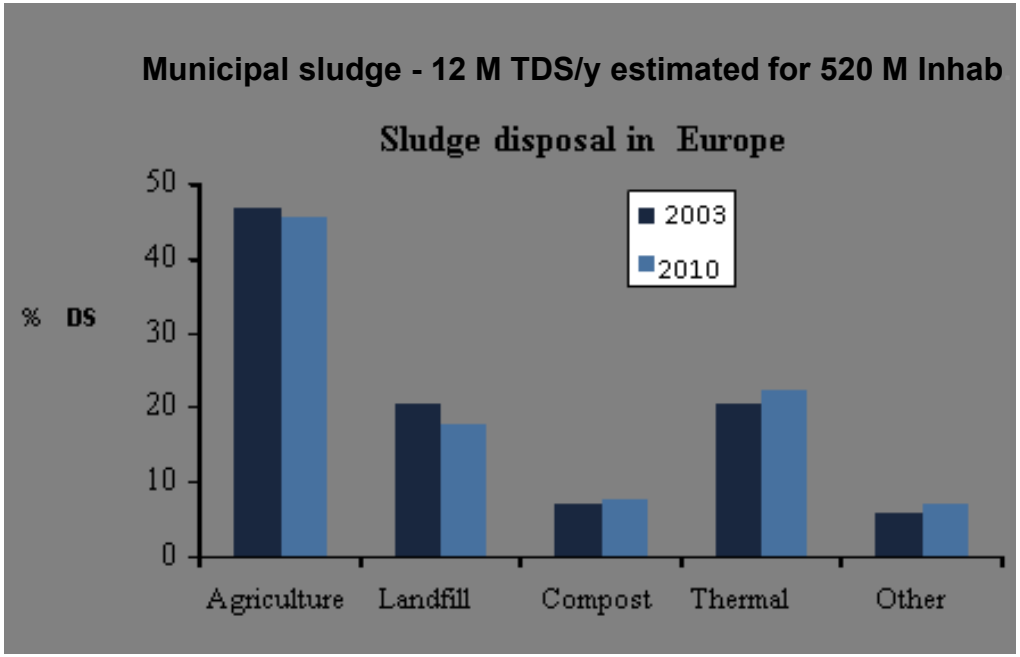
Sludge disposal routes in France

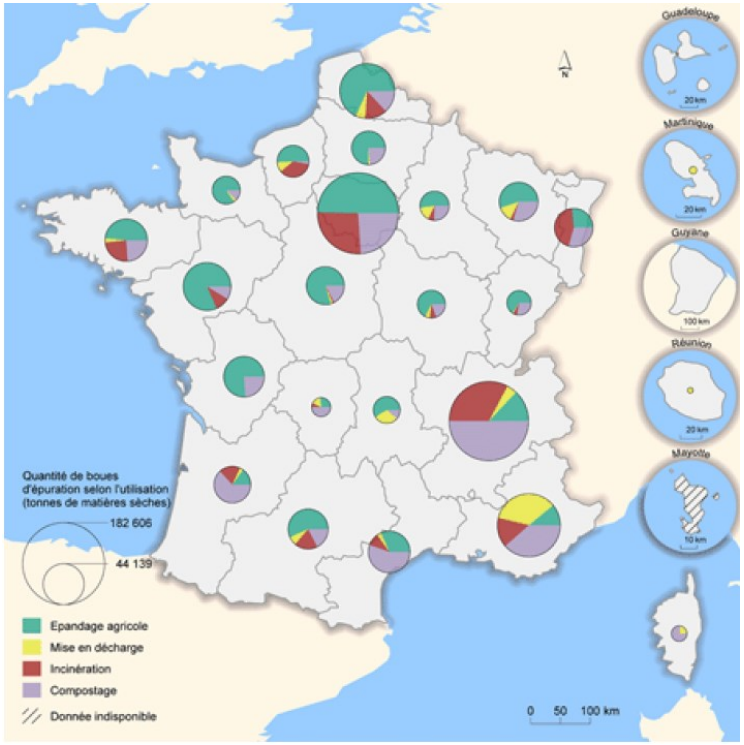
Sludge production in France : 1 300 000 TDS/y

- Land spreading : 45%
- Composting : 25%

} Agriculture

- Incineration : 20% (specific or co-incineration)
- Landfilling : 10%





Land spreading
Composting
Incineration
Landfilling

Disposal routes : costs and DS content

Disposal costs range in France

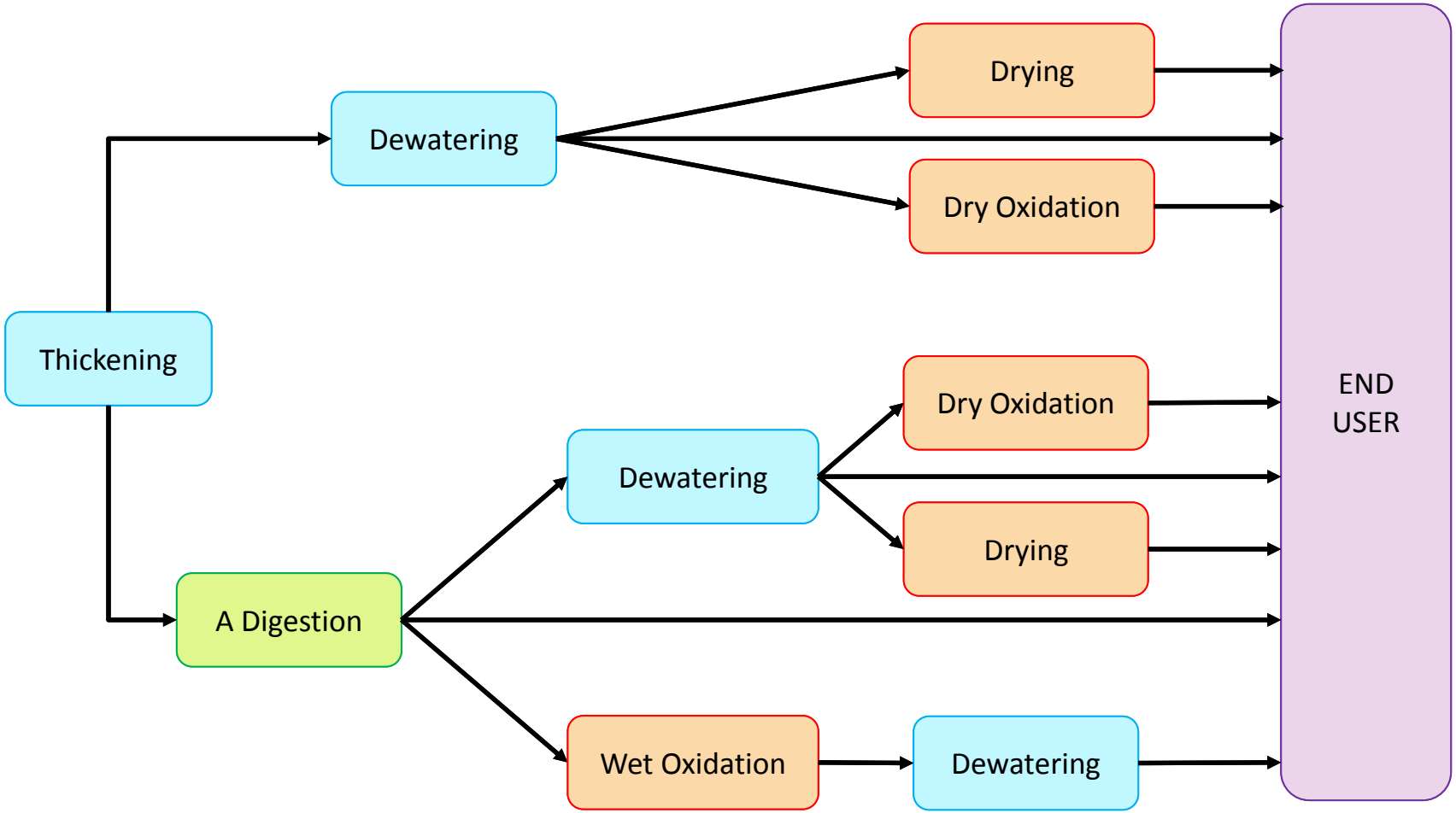
DISPOSAL routes	Landspreading	Composting	Incineration	Landfilling
DS content in sludge	20-25% Liquid sludge also accepted	20-30%	≥ 25%	≥ 30%
Disposal Cost* (€/wet T)	30 – 50	40 - 60	70 - 100	100 - 150

(*) Range of values depending on regional context.
Prices without transport. Transport cost ≈ 0,2€/wet T/kilometer

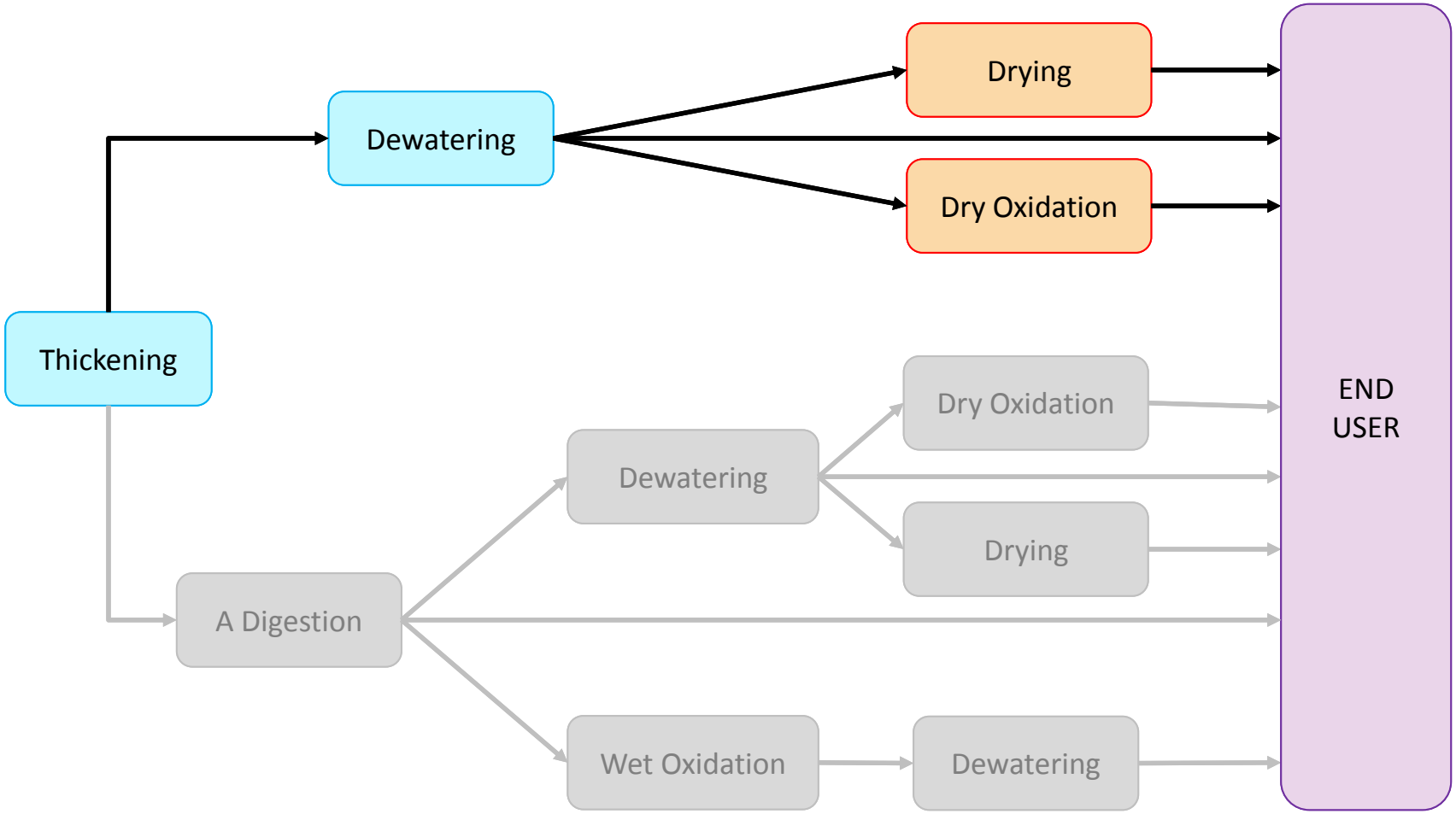
What can we do with this sludge?

- Reduce :
  - *Volume*
  - *Elimination cost*
  - *Disturbance*
- Recover value from :
  - *Energy*
  - *Products*

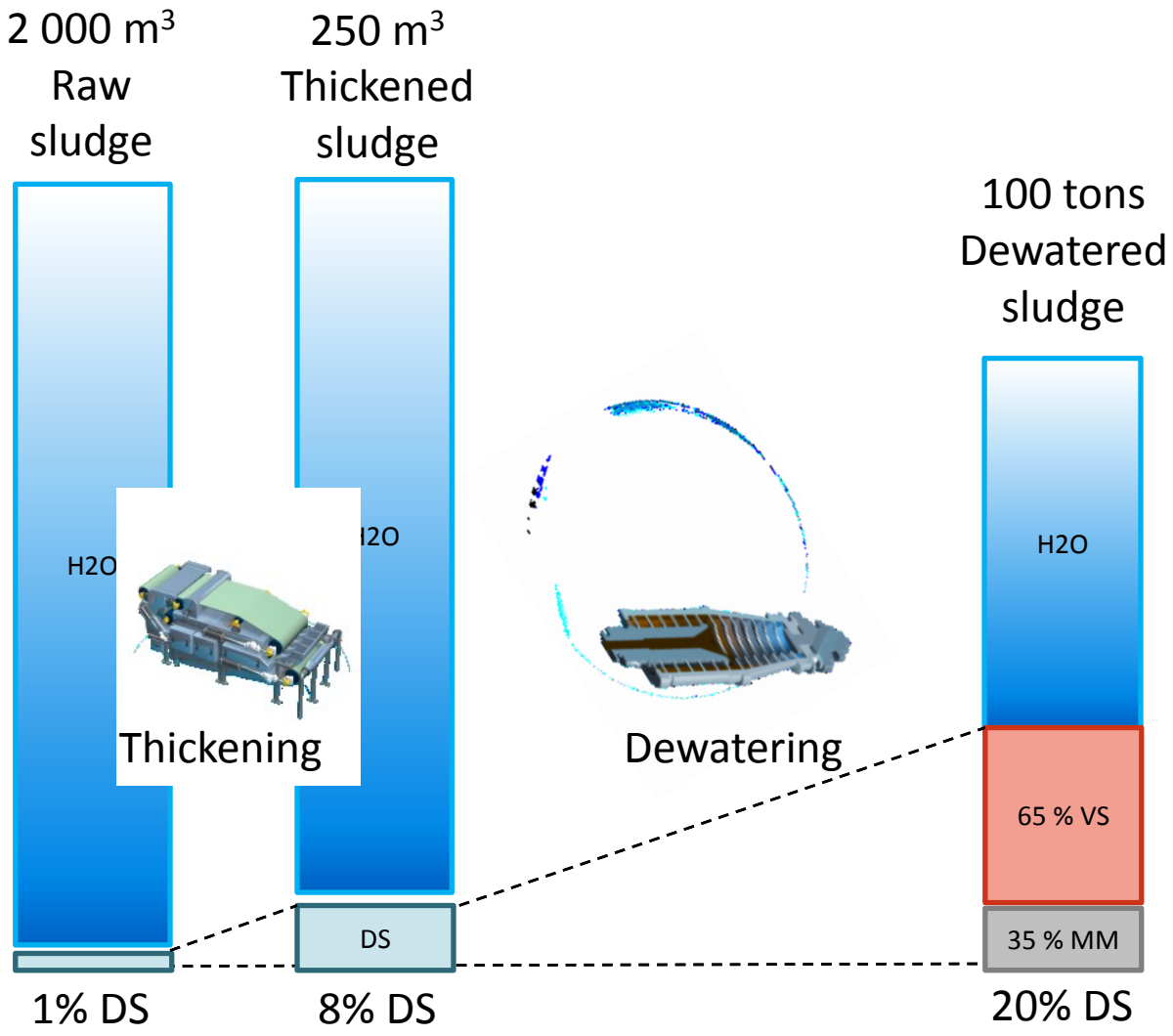
Different ways to answer client demand



Physical approach



Dewatered sludge for land spreading (Mass balance for 1 000 PE)



Classical solution for all size WWTP near rural area

When land spreading is allowed

Dried sludge for use off site (Mass balance for 1 000 PE)

2 000 m³ Raw sludge

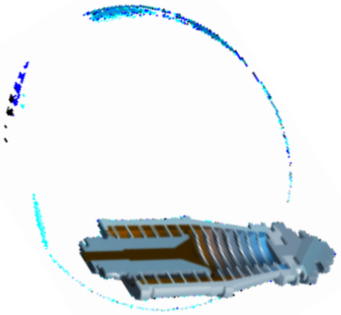
250 m³ Thickened sludge

H2O

H2O

DS

Thickening



Dewatering

100 tons Dewatered sludge

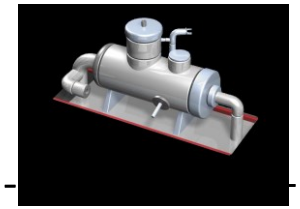
H2O

65 % VS

35 % MM

A solution for all size WWTP

Reduce transportation cost or increase energy content



Drying

22 tons Dried sludge

H2O

65 % VS

35 % MM

1% DS

8% DS

20% DS

90% DS

Oxidation for elimination on site (Mass balance for 1 000 PE)

2 000 m^3
Raw
sludge

250 m^3
Thickened
sludge

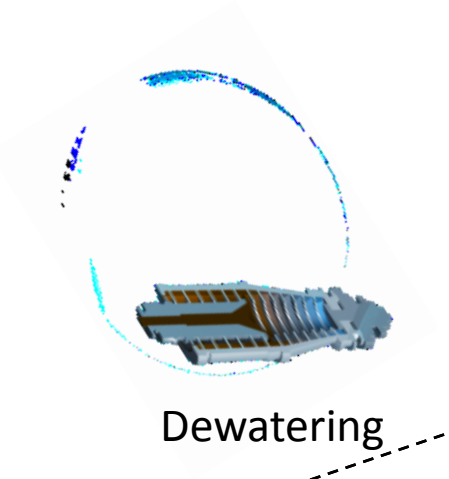
H2O

Thickening

DS

1% DS

8% DS



Dewatering

80 tons
Dewatered
sludge

65 % VS

35 % MM

25% DS

Ashes

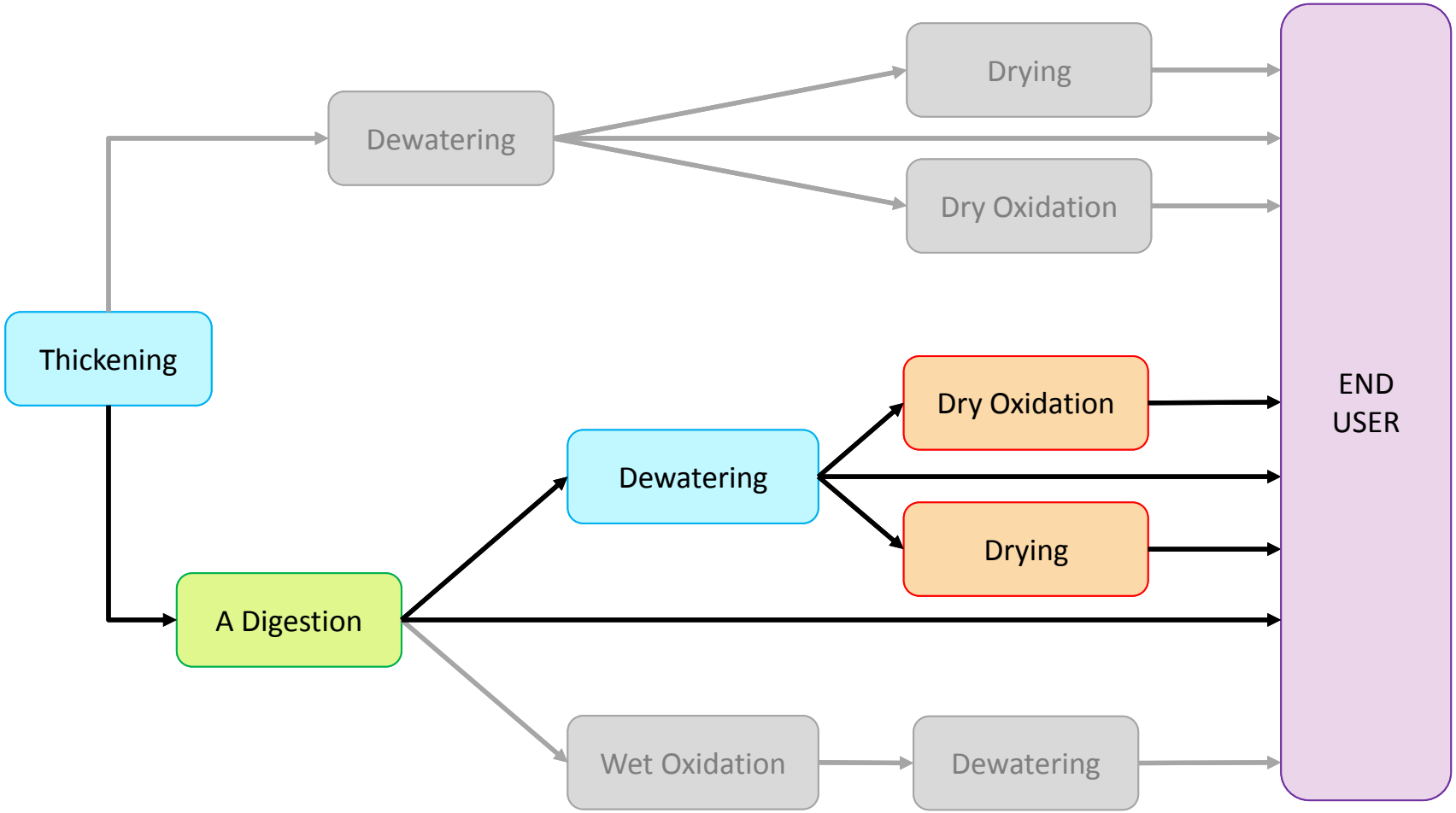
100% MM

100% DS

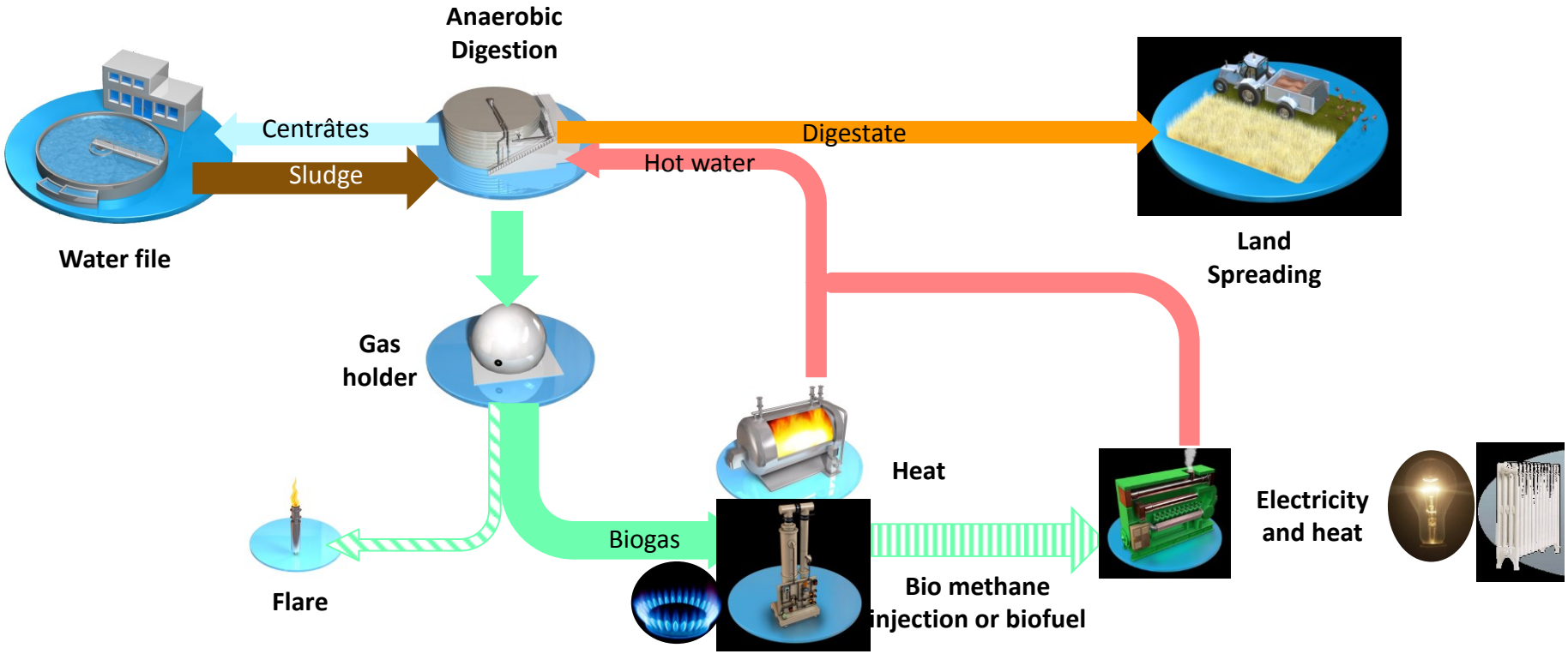
A solution for medium and large size WWTP

When land spreading is not allowed or possible

Biological approach



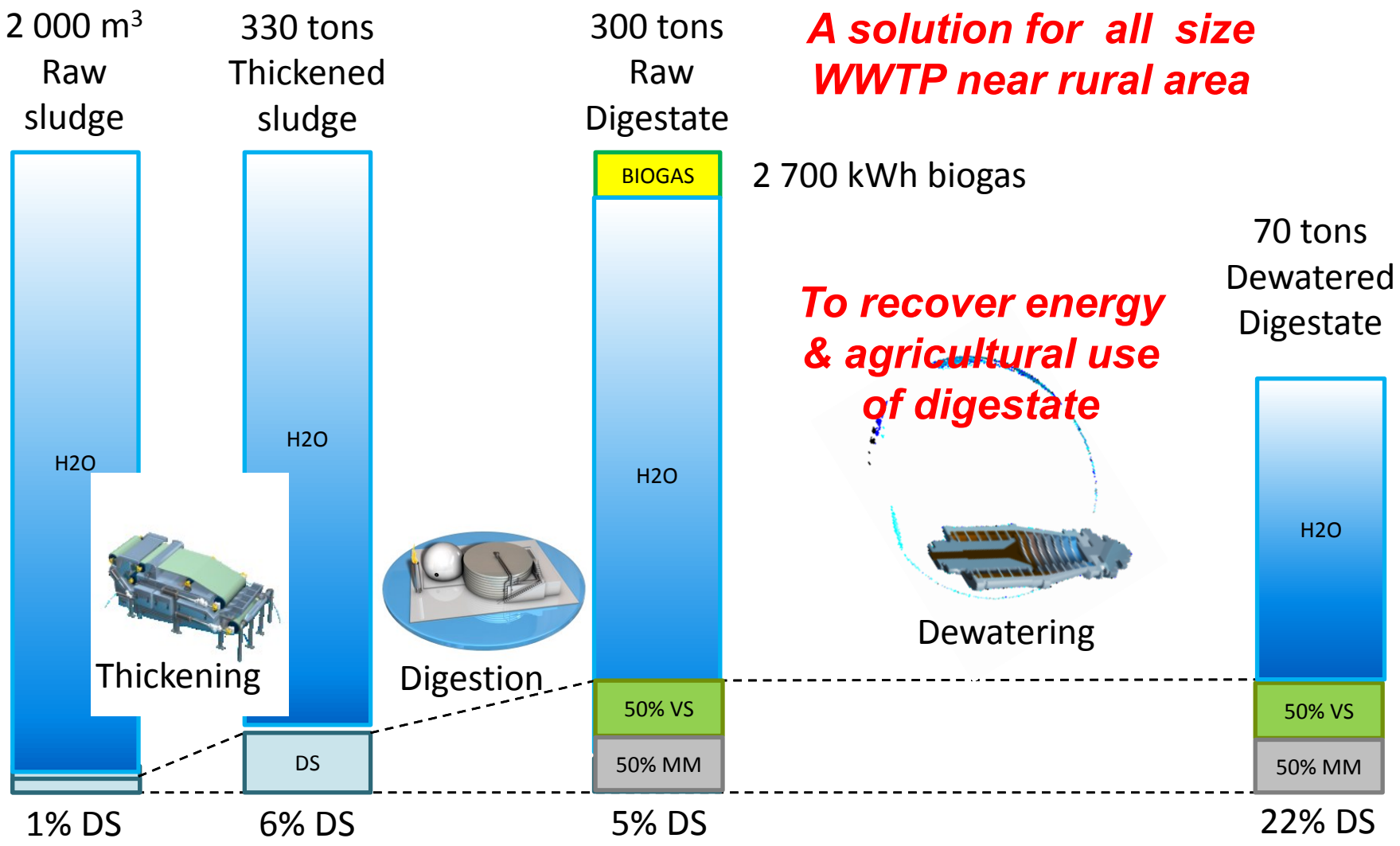
AD allows to recover value from Volatile Solids



Strong points

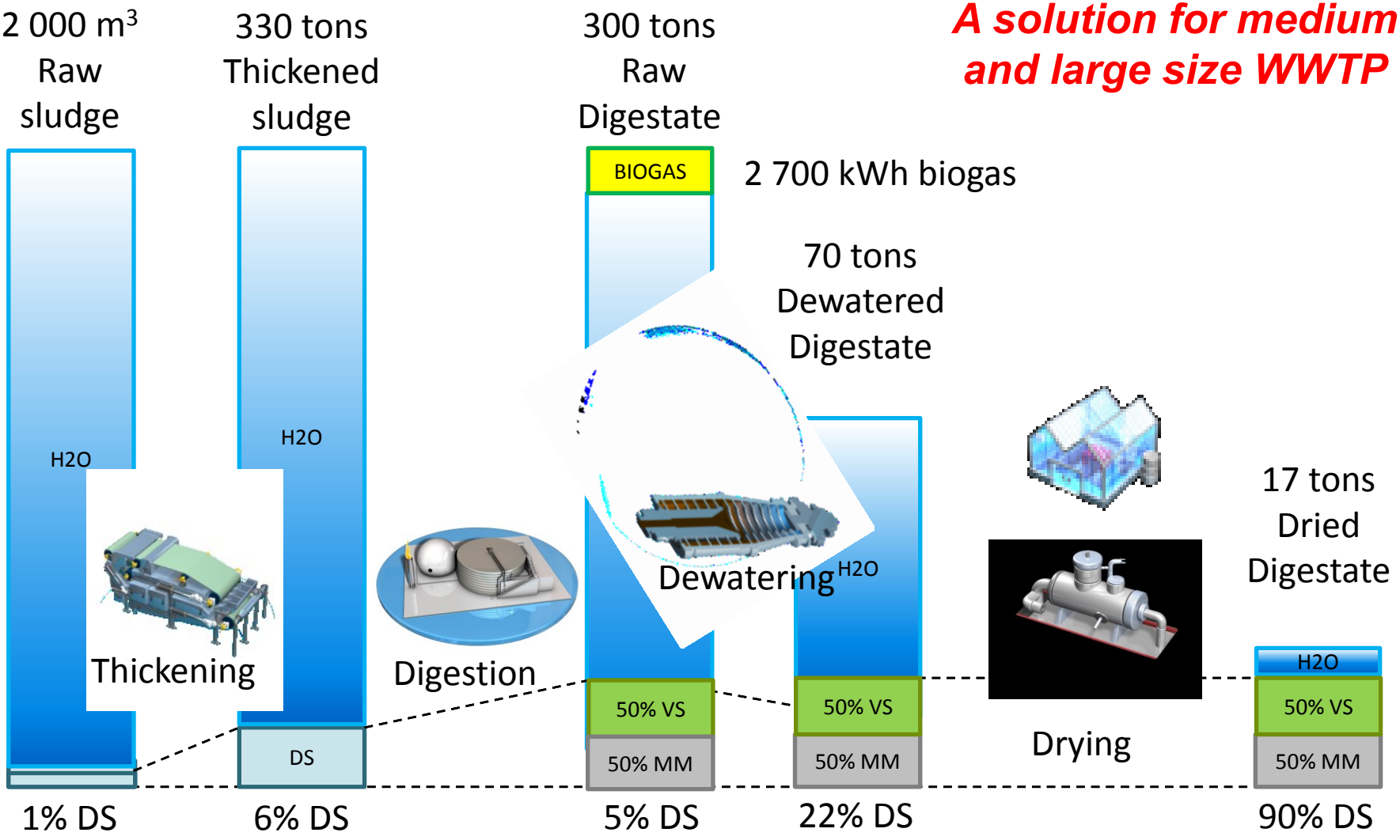
- ✓ The weight of residual sludge (digestate) is reduced
- ✓ Biogas could produce heat and electricity or heat and biomethane

AD to produce biogas & digestate (Mass balance for 1 000 PE)

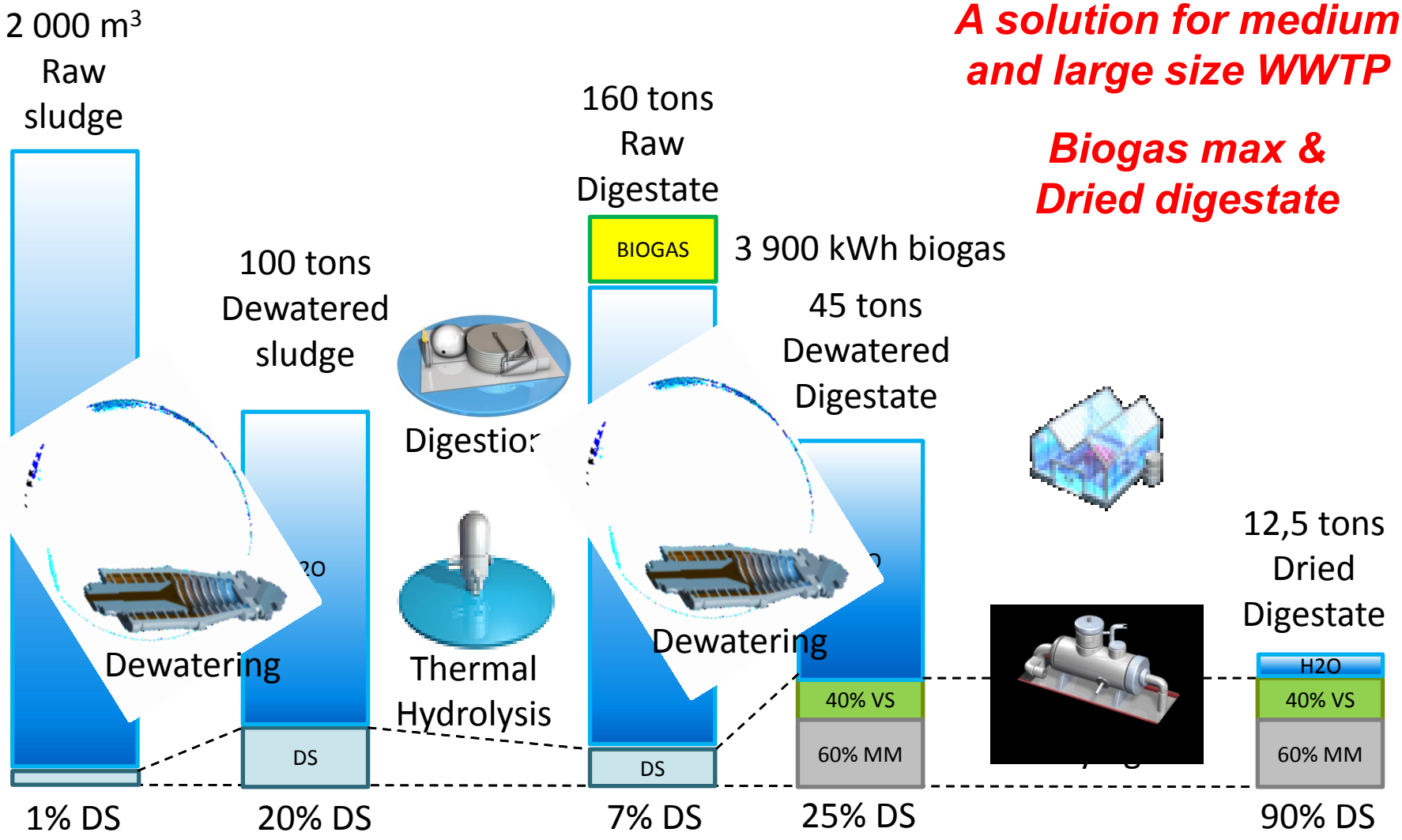


AD for biogas and dried digestate (Mass balance for 1 000 PE)

A solution for medium and large size WWTP



Thermal Hydrolysis, AD and Drying (Mass balance for 1 000 PE)



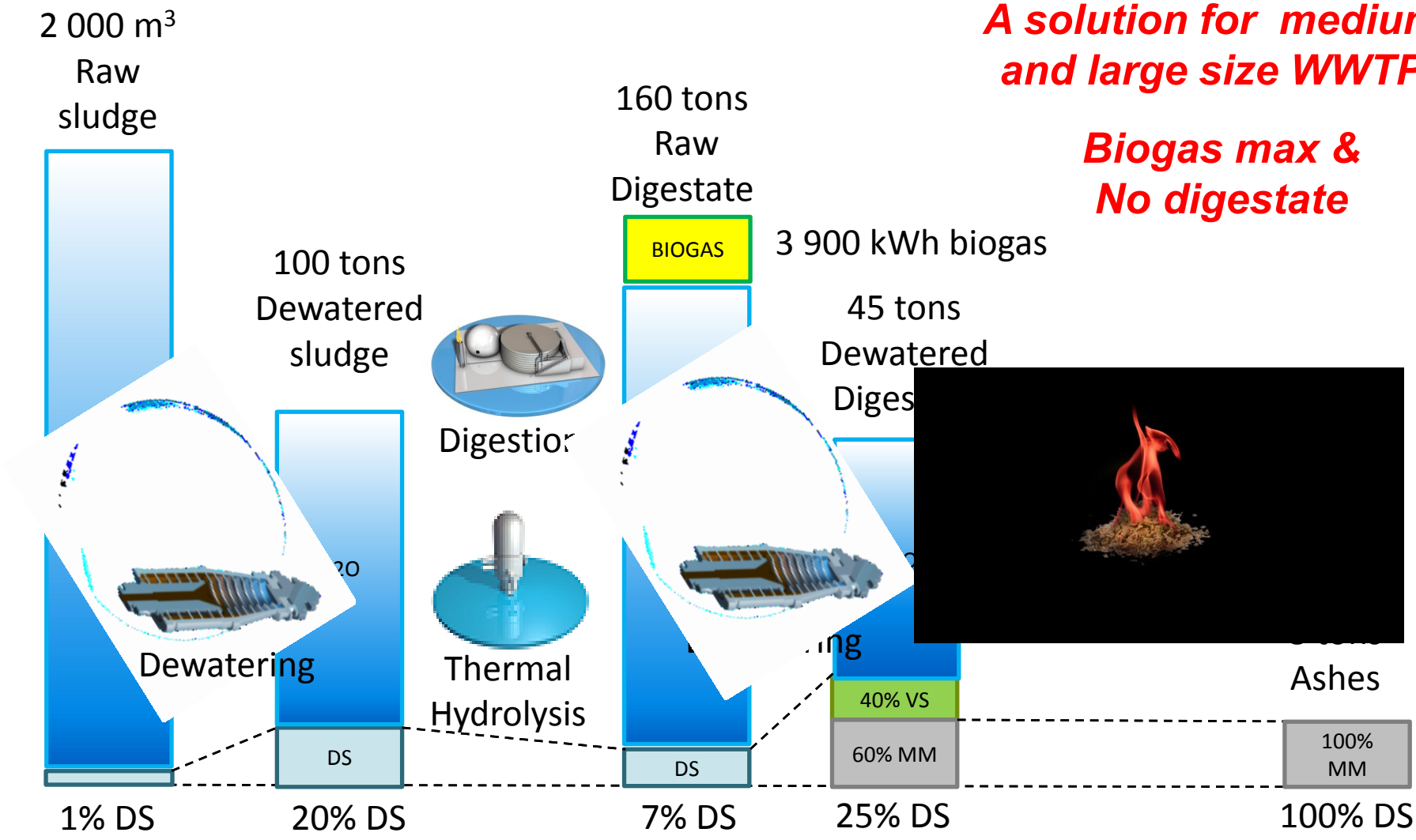
A solution for medium and large size WWTP

Biogas max & Dried digestate

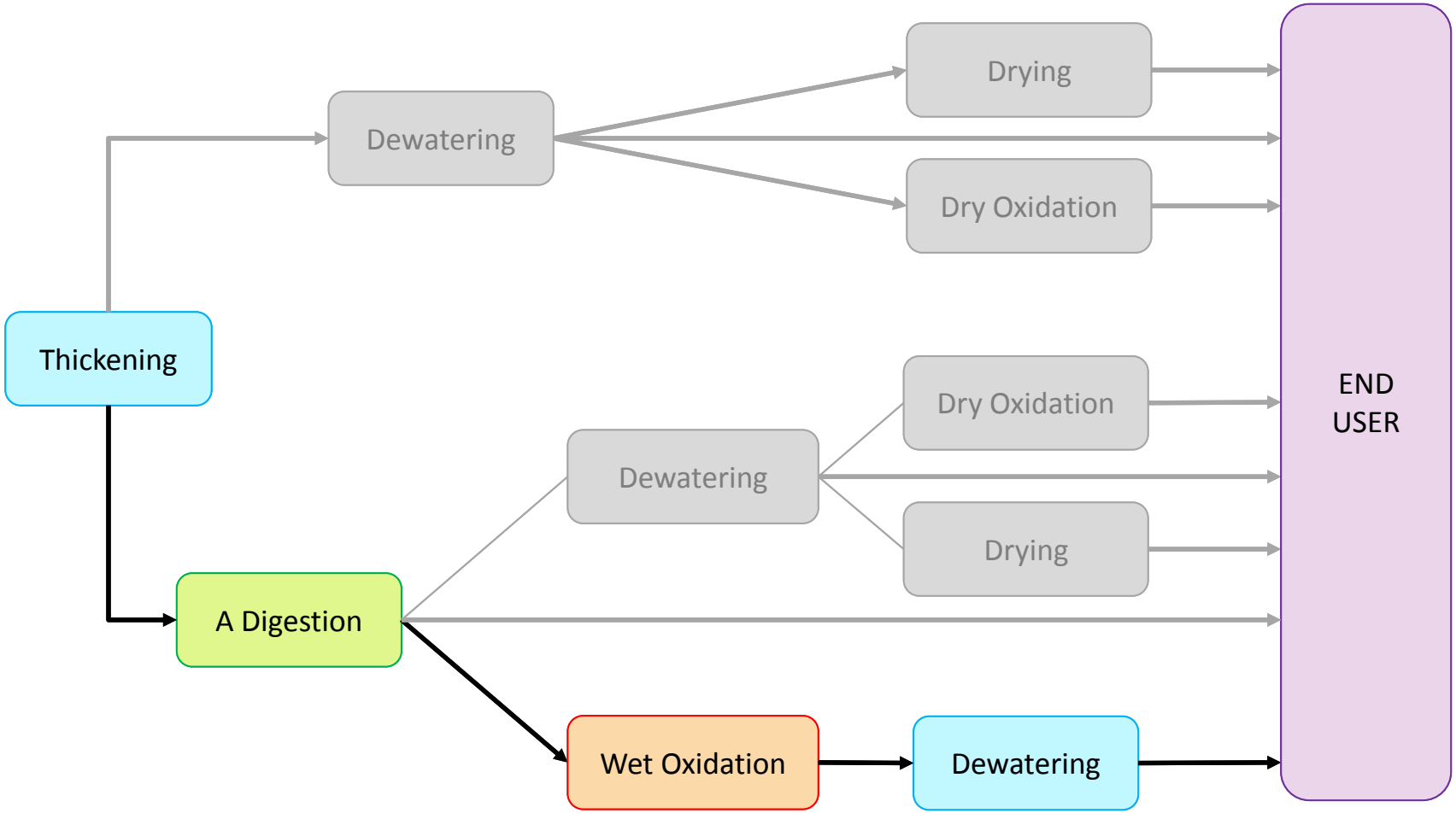
Thermal Hydrolysis, AD and Oxidation (Mass balance for 1 000 PE)

A solution for medium and large size WWTP

Biogas max & No digestate



Biological approach



Wet oxidation

- Oxidation of VS – T°C 250 = , Pressure = 50 bars, O_2

- Sludge is unsuitable for agricultural use
  - *Low fertilizer demand*
  - *High concentrations of pollutants*
  - *Long spreading distances*
- Landfill disposal or Incineration are not acceptable
  - *Restrictive regulations*
  - *Limited acceptability to customers and local population*
  - *Energy content of sludge is too low to allow auto thermal incineration*
- A local demand for mineral substrate exists

Devolving options depending on the type of residues

	Agriculture	Mineral reuse	Use as fuel	Waste storage installation
Thickened 	😐	No	No	No
Dewatered 	☺	No	😐	😐
Compost 	☺	No	No	☹
Dried  	☺	No	☺	☹
Dried digestate	😐	No	☺	☹
Technical sand 	No	☺	No	😐
Ash 	No	☺	No	😐

☺ Optimized cost ☺ Medium cost ☹ High cost

Sludge treatment : to answer the new challenges faced by cities

- Implementing solutions for components recovery
  - *Biogas, bio methane or carbon dioxide*
  - *Dried sludge or digestate as a solid fuel*
  - *Components in the sludge and centrates (nitrogen, phosphorus)*
- Benefiting from regulations offering incentives
  - *Subsidized energy purchase prices*
  - *Electricity or bio methane purchase requirements (in some countries)*
- Finding alternative solutions instead of direct incineration or landfilling
  - *Less costly*
  - *More acceptable to populations*
  - *Able to minimize the environmental impact*
- Managing their overall costs
  - *Investments and operating costs related to benefits*


VEOLIA
Many thanks for your attention
WATER TECHNOLOGIES