

Waste-Water-Energy nexus: a feasible, sustainable approach in climate-change affected Mediterranean regions

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Waste and Wastewater: Issues or Resources?



Cortesia grafica di
prof. Raffaello Cossu

The issue of posing easy questions....



...is that then you expect simply answers,...

Before



After



...but often you do not get the right one
(or at least the complete truth)

Before



...Never



The mean quality of the information from media and the “miracles” it promises



This is **PAOLA**. She weighted 140 kg. She went to the doctor, started the diet and the gym and she lost 6 kg in 6 months. The girl next to her is her cousin **MARTA**



Context of disinformation, which should no longer be underestimated because if it is fed and continuously repeated

Waste does not exist



COVID does not exist



but which spherical are you talking about?.....



NO Masks No social distancing



....as much as folkloristic it may seem to us, it can create doubts to people (even against science)



Trump Rejects Science, Claims "Nobody Really Knows" If Climate Change Is Real

TRUMP

Because when a “likely” but fake new is repeated
and repeated and repeated



**THIS ELECTION
WAS STOLEN
FROM AMERICA**

**JOE BIDEN
IS NOT MY
PRESIDENT**

**OUR NATION
OUR VOTES
STOLEN**

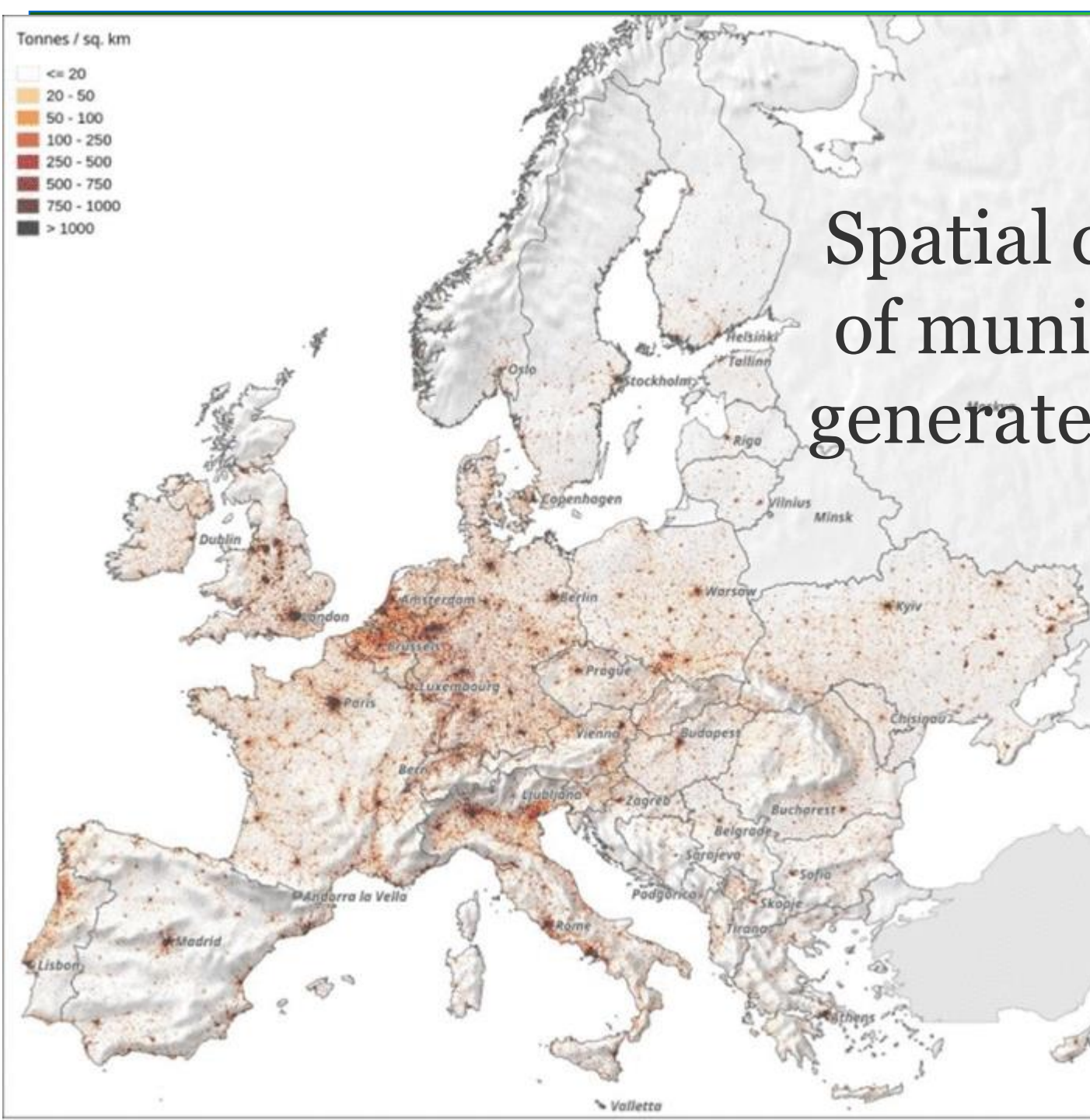


For many persons it may go over the evidence



And if the many are **MANY** the consequences
can be disastrous





Spatial distribution of municipal waste generated in Europe

**Scarlat et al.
2019 Status and
Opportunities
for Energy
Recovery from
Municipal Solid
Waste in Europe**

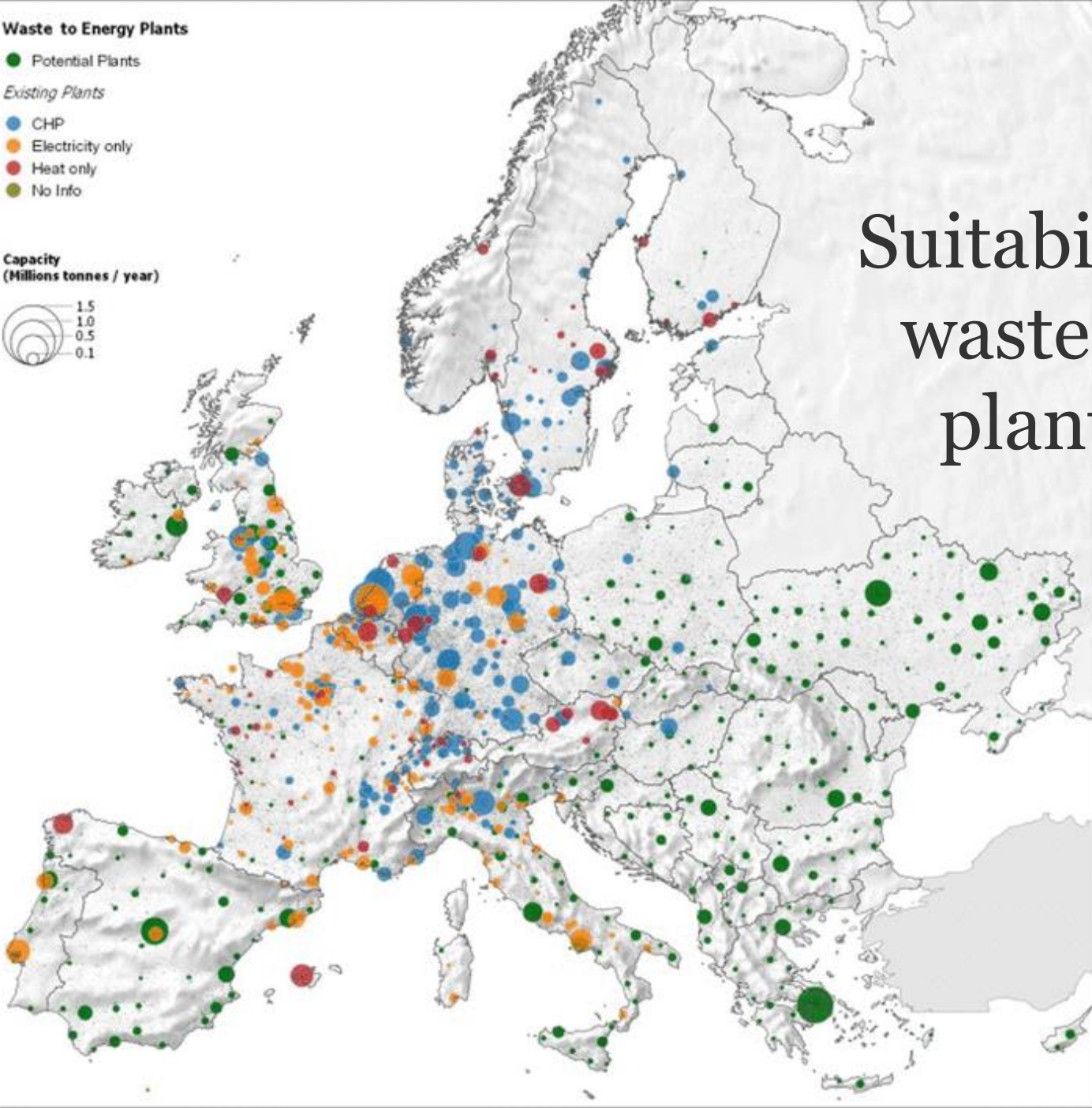
Waste to Energy Plants

Potential Plants

Existing Plants

- CHP
- Electricity only
- Heat only
- No Info

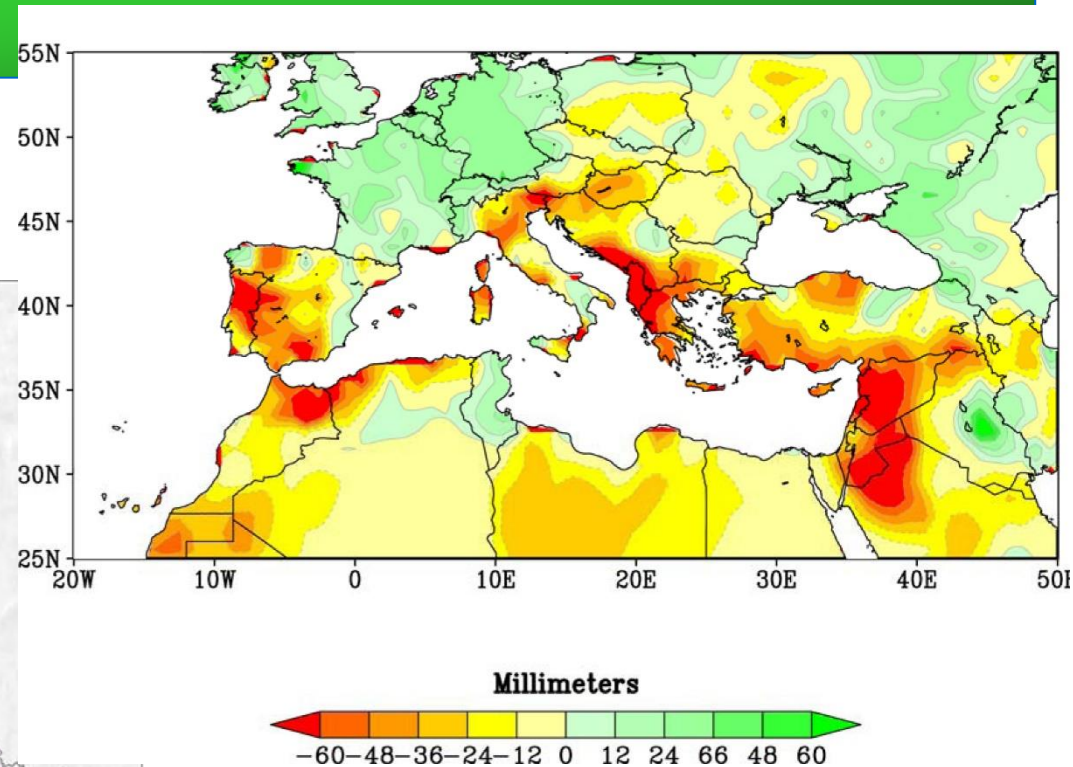
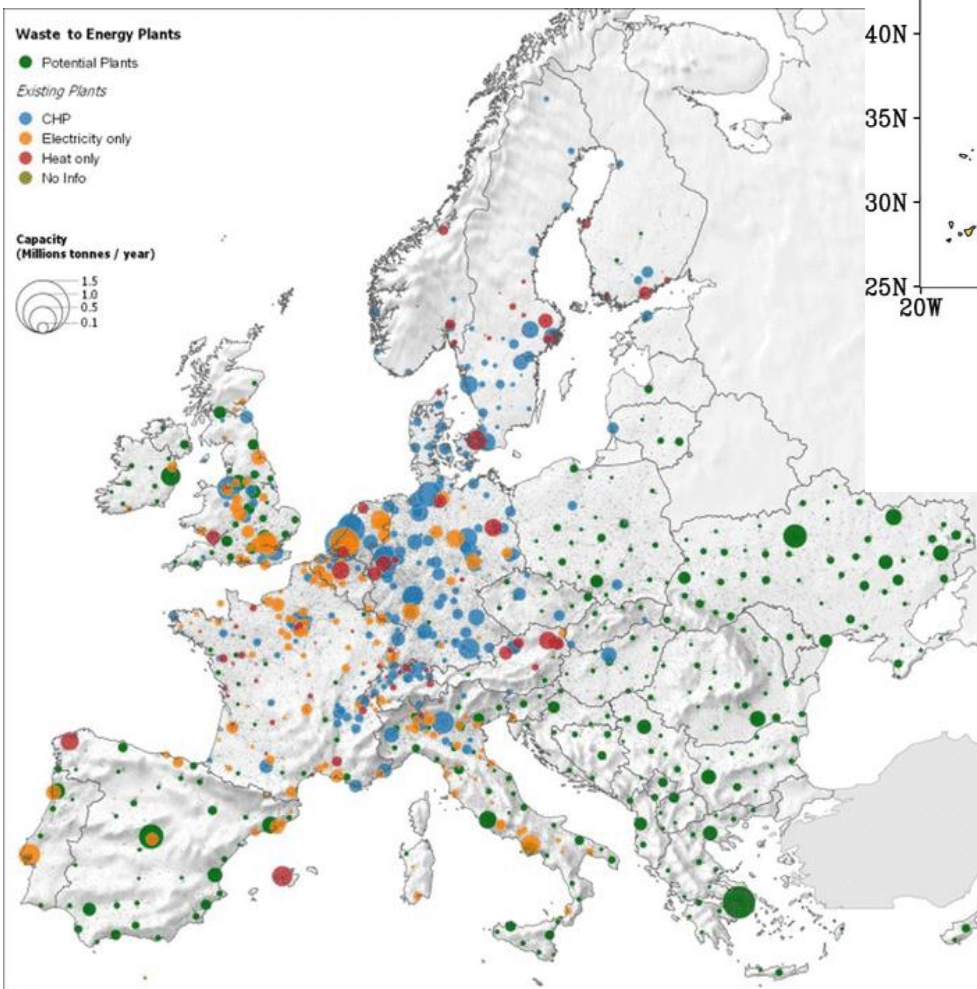
Capacity
(Millions tonnes / year)



Suitability map for waste-to-energy plant location

Scarlat et al.
2019 Status and Opportunities for Energy Recovery from Municipal Solid Waste in Europe

Mediterranean Drought conditions areas



Issue: the diffusion of uncompromising approach



End of an error?



TRUE: Nature doesn't know the term "waste"

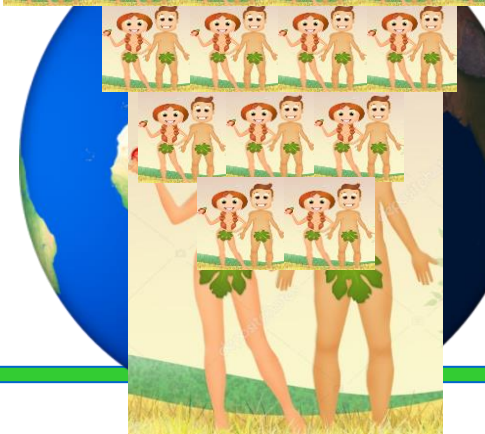
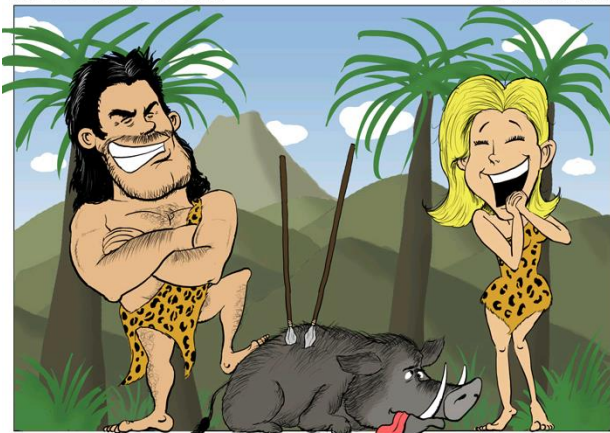


Issue: the world today is not more so simple and natural and it cannot be so simply reppresented



THE EVOLUTION OF MAN

BY C-SECTION COMICS



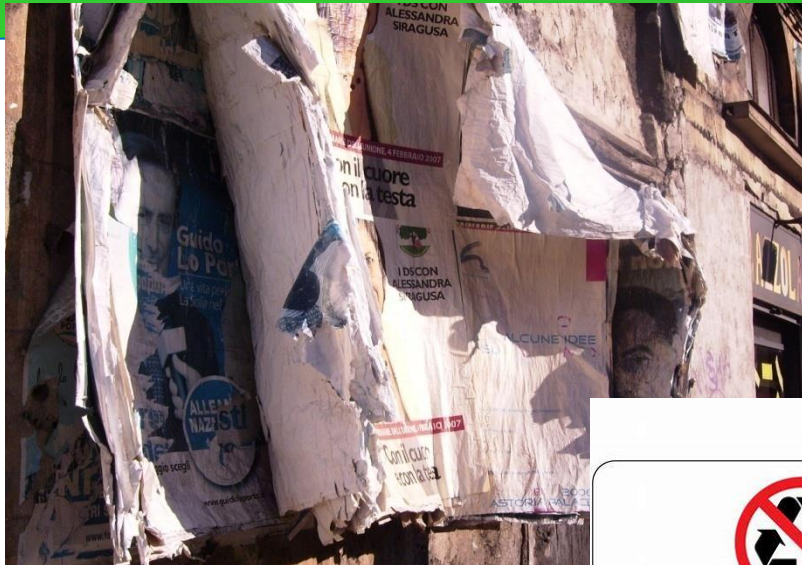
Refusal of any Waste treatment Plants (but WtE is first in line)



NO ALL'IMPIANTO A GIUGLIANO



Issue: Non Recyclable waste



Issue: Non Recyclable waste



Issue: Non Recyclable waste



Issue: how many cycles – some scientific and public (???) concern

The INDEPENDENT

acer explore beyond limits™ Aspire | V5 Touchscreen Notebook Få mere at vide

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Life > Health & Families > Health News

Health fears over recycled food packaging


BY JEREMY LAURANCE, HEALTH EDITOR | WEDNESDAY 09 MARCH 2011

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News in pictures

Home is where the toxins are - the hidden poisons we live with

Some houses can be susceptible to a buildup of formaldehyde created by cleaning products. Which other everyday items can leave a harmful chemical trail?



Forbes New Posts 4 posts this hour Most Popular How To Use Google Glass Lists Most Miserable Cities

340 Share

96 Tweet

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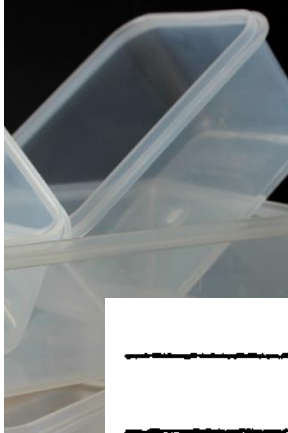
143 Submit

Amy Westervelt, Contributor
Innovation at the intersection of health and the environment
+ Follow (55) + Follow (180)

GREEN TECH | 8/27/2012 @ 11:51AM | 2,161 views

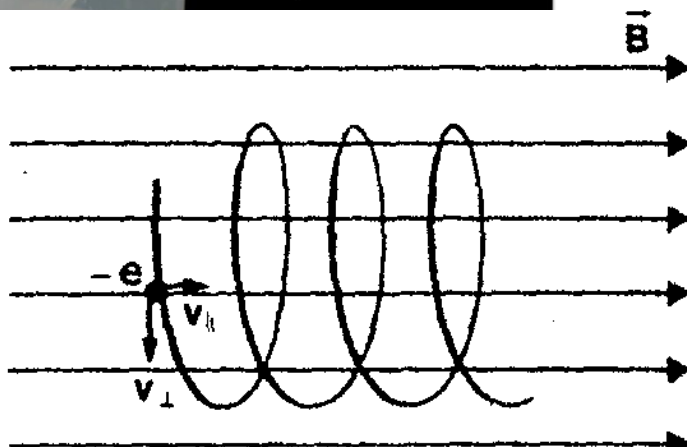

Report Finds Toxic Levels of Phthalates Lurking in Popular Back-to-School Items

3 comments, 1 called-out + Comment Now + Follow Comments

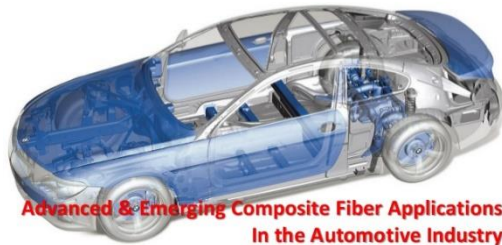
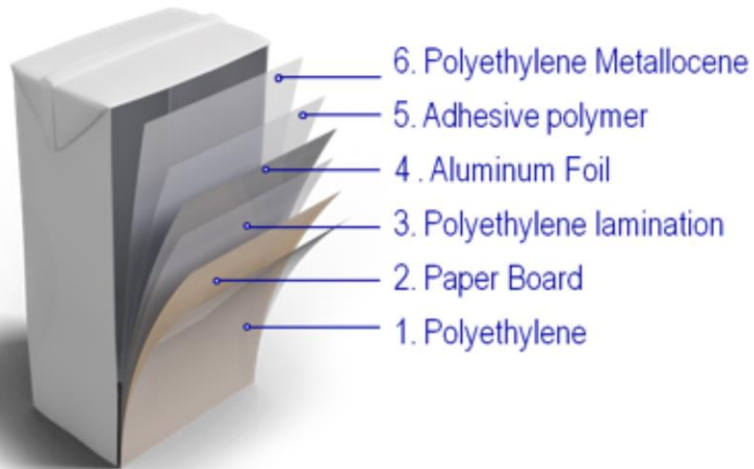


Is There POISON in your PLASTIC?

4 Ways to Avoid BPA



Issue: innovation in new composite materials versus potential recycling rate

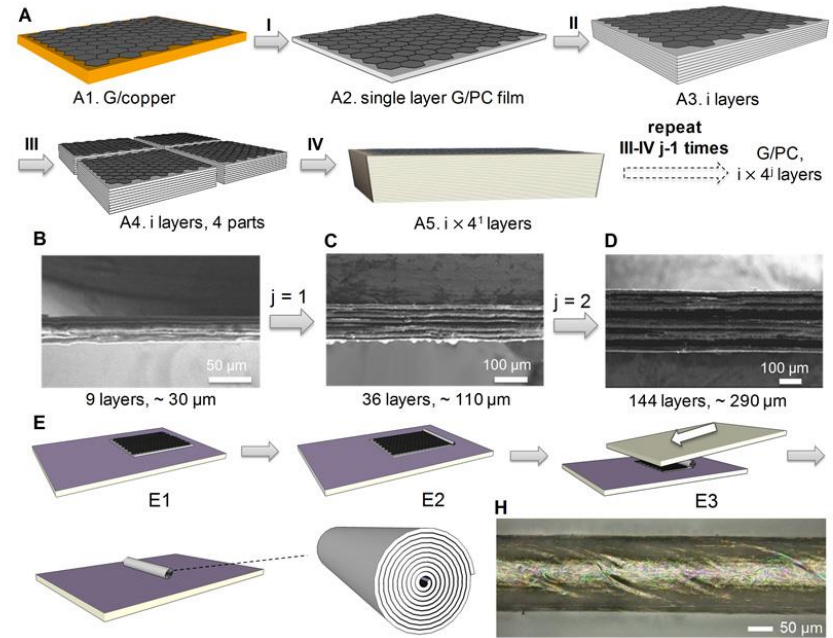


Advanced & Emerging Composite Fiber Applications
In the Automotive Industry

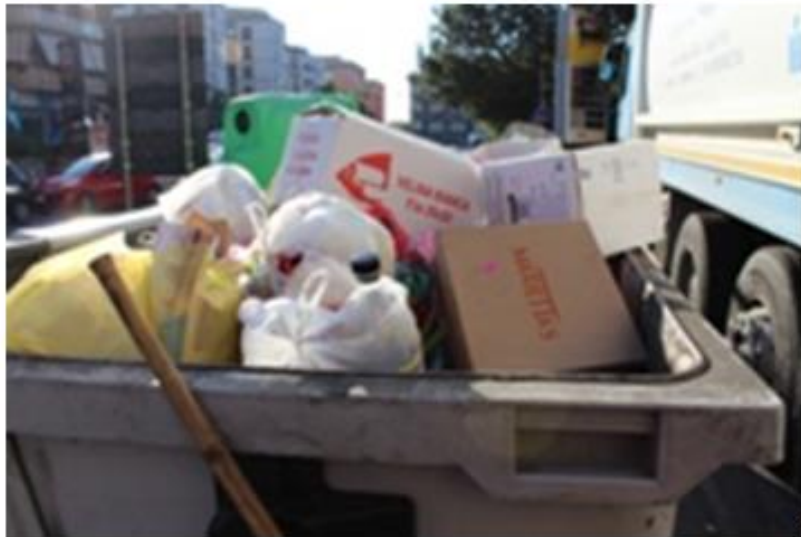
Ratna Chatterjee

Chief Consultant

AUTOMOTIVE R&D MANAGEMENT CONSULTING



Issue: 'Social behaviour'



Door to door collection (consierge+internal space)



Door to door (consierge+internal space)



social behaviour (waste migration and dispersion)



[Home](#) [Politiche 2018: risultati](#) [Comunali 2018](#) [Cronaca](#) [Eventi](#) [Voci della c](#)

Catania nord trasformata in discarica a cielo aperto: “A contribuire i pendolari dei rifiuti”



di [Lucia Murabito](#)

12 ottobre 2016

[Lascia un commento](#)

A denunciarlo è il consigliere comunale di Art.4 Giuseppe Catalano: San Giovanni Galermo e tutta la zona nord della città sono invase da mini discariche abusive e rifiuti abbandonati ad ogni angolo

Issue: scraps from plastic waste selection

up to 50%



Scraps from composting



Issues : we still have the unsorted waste ('social behaviour')



Circular economy is a fundamental part of the solution in waste management but.....



SUSTAINABLE
Circular
ECONOMY

Really sustainable



Once we made the perfect door to
door separate waste collection....



How far from the goal are we yet?



Two simple calculations: % Separate collection VS Recycling

SC 75-80%

(when???)



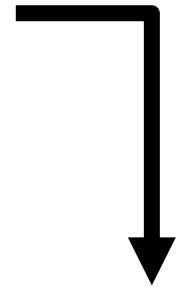
60-65% recycling



20-25%
(unsorted)



12-13%
(Scraps)



Two simple calculations: % Separate collection VS Recycling

SC 65-70%

(soon???)



50-60% recycling



+



30-35%

(unsorted)

40-48%



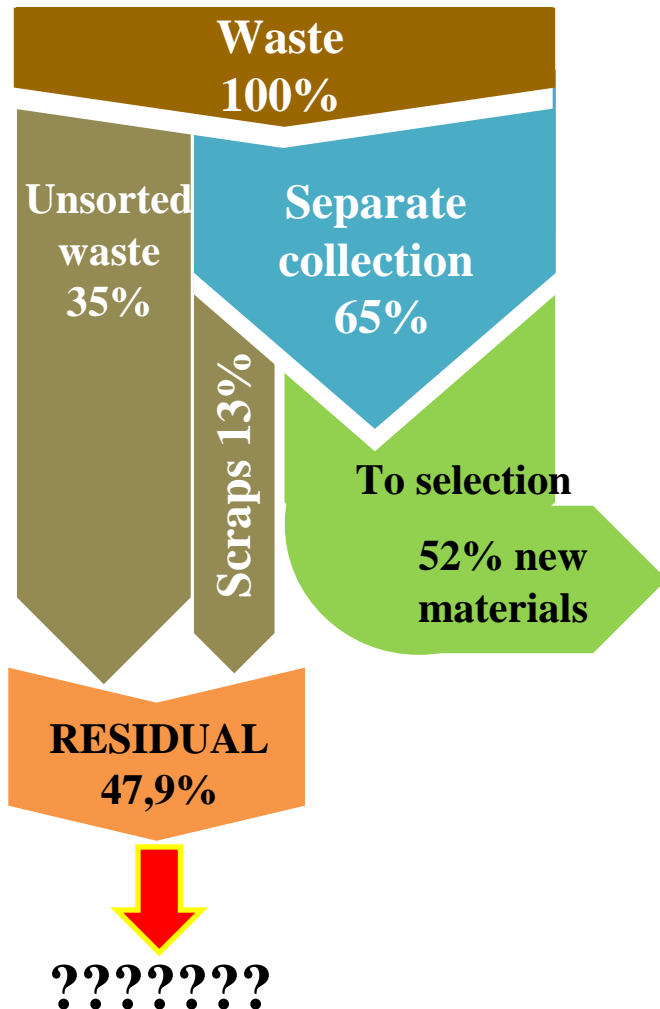
10-13%
(Scraps)



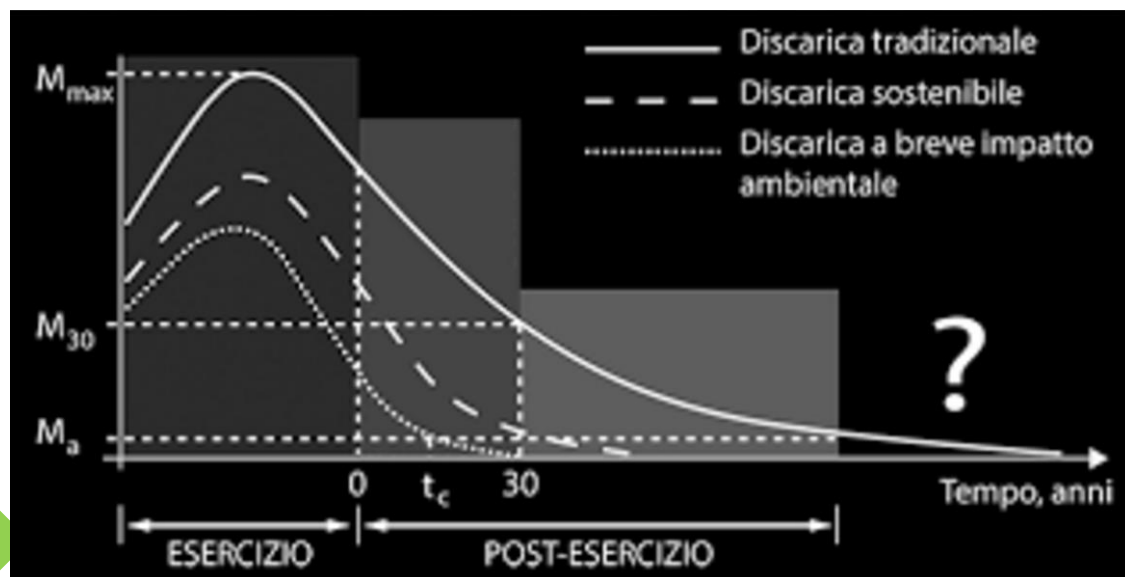
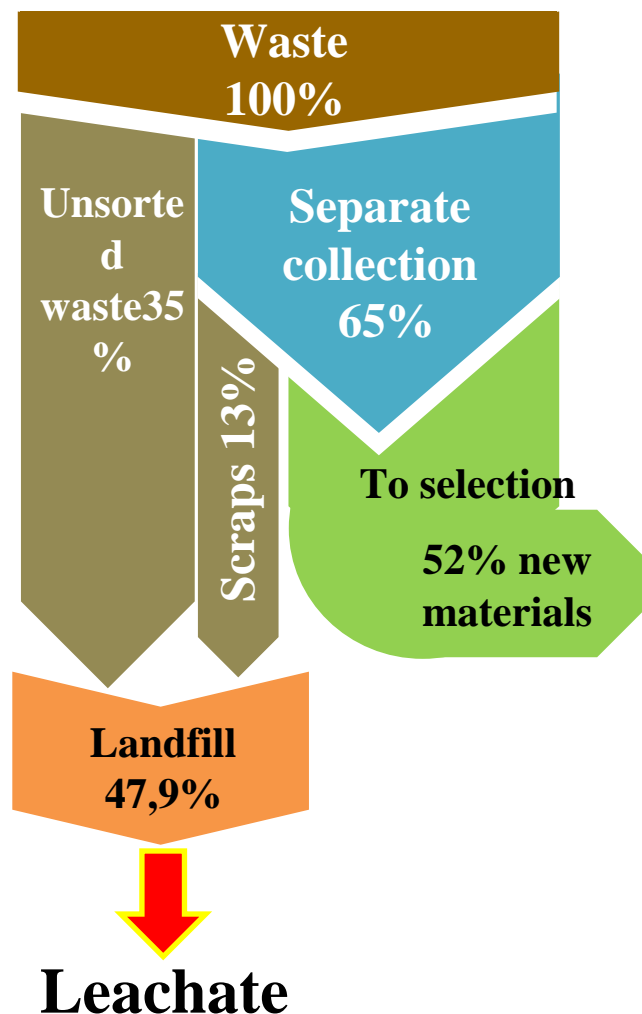


How to manage Residual waste (unsorted + scraps)????

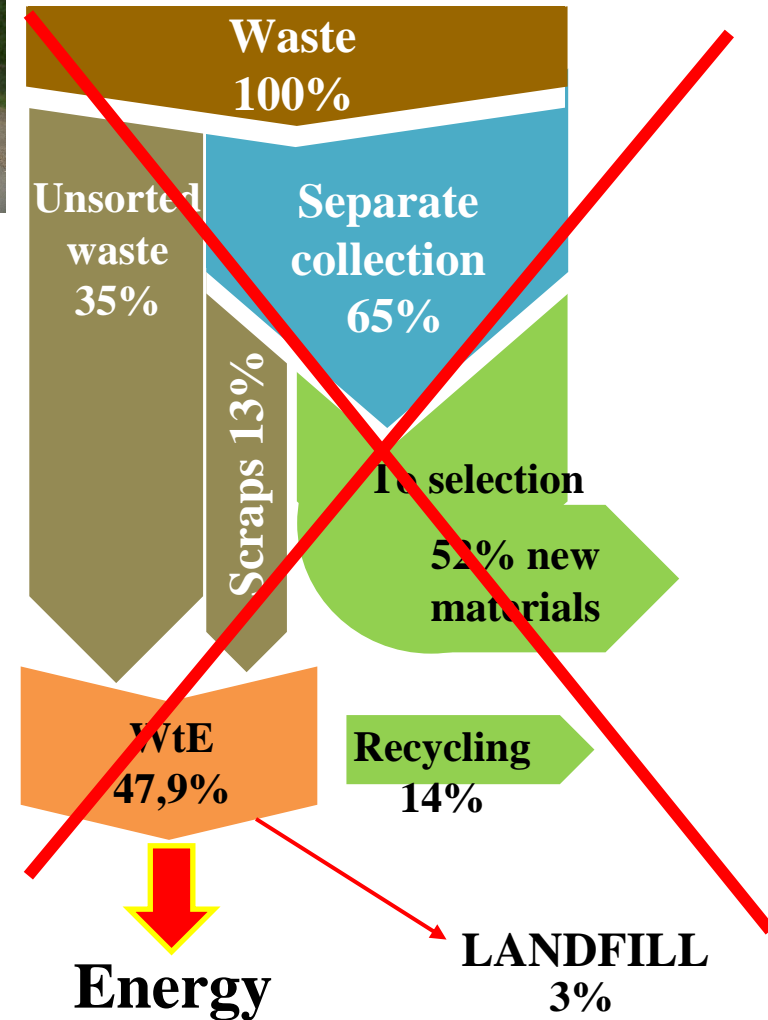
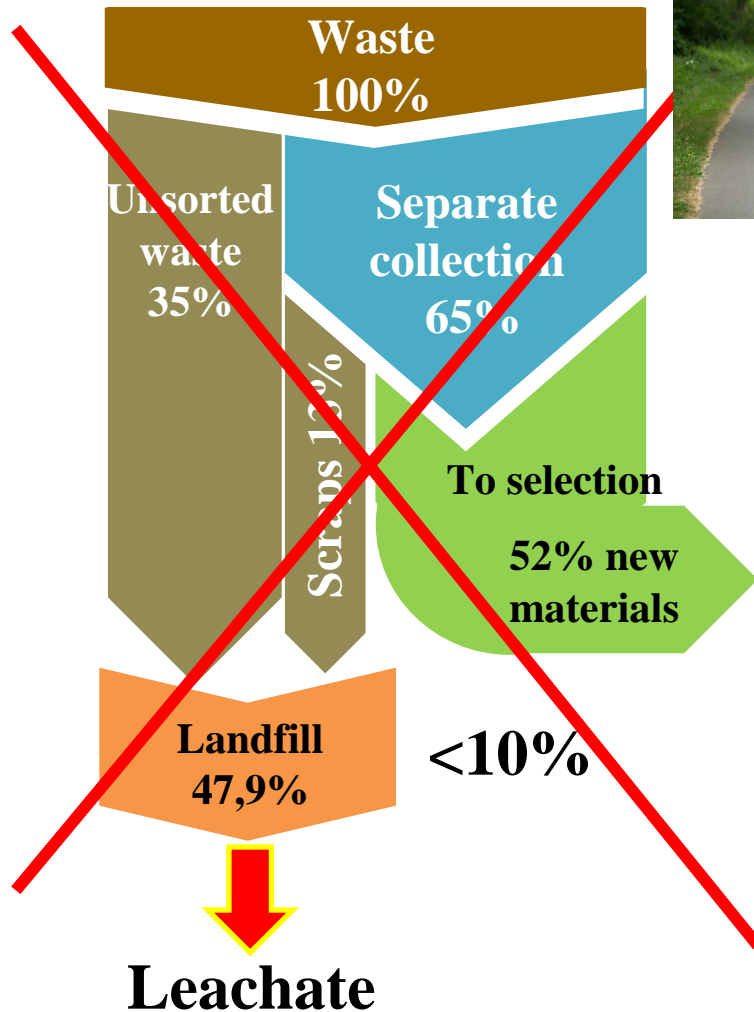
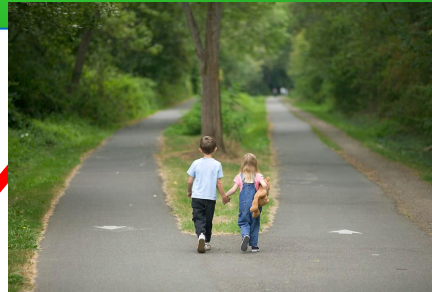
The first fork..



Residual waste to landfill (less than 10% al 2035)



Management Alternatives



NO WtE

NO Landfillis there any other way?



**Residual waste from
65%separate collection
48Kg over 100 kg
can go to.....**



The third way... abroad



Economic losses... and RESILIENCE losses

Context and open issues: climate change and drought



Europe | European Elections 2019

Italy drought: 11 regions poised for state of emergency

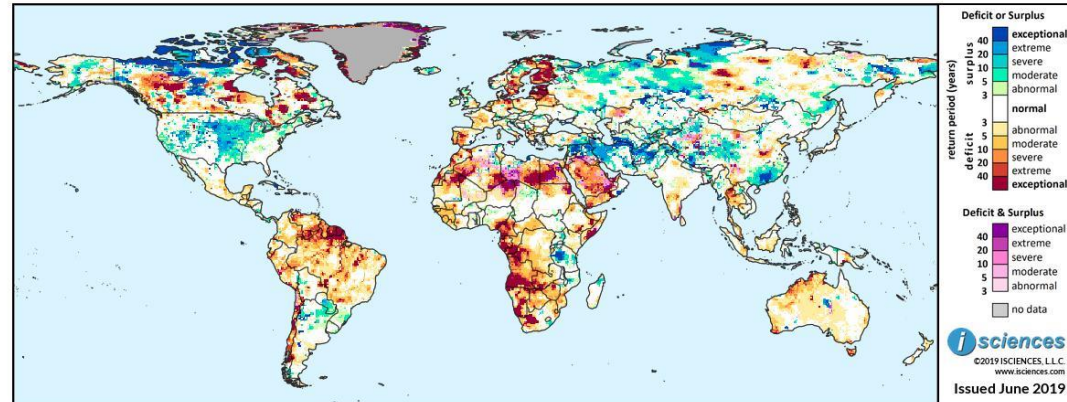
2 August 2017

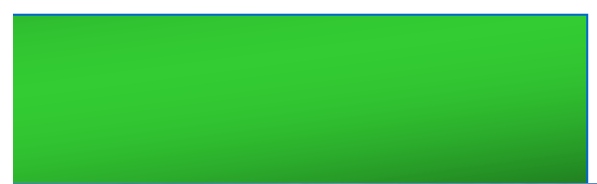


The River Po at Linarolo in Lombardy has shrunk considerably

Eleven of Italy's 20 regions are set to ask for a state of emergency to be declared in order to help tackle the ongoing drought.

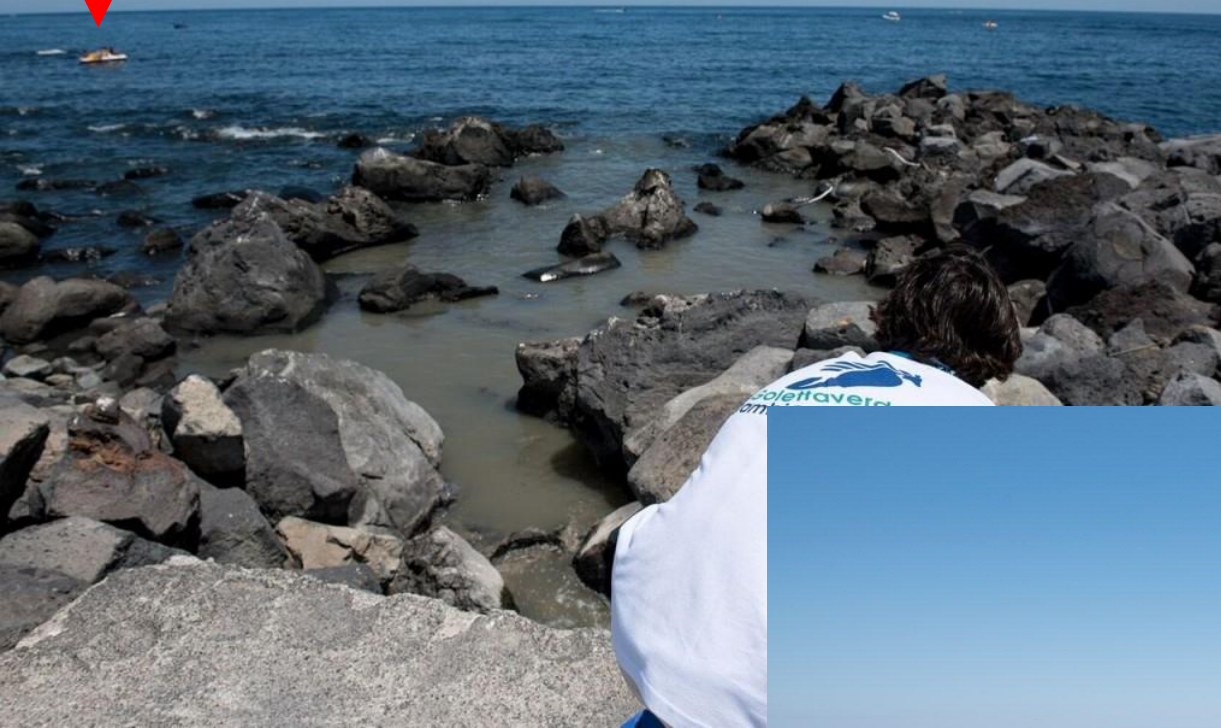
ISciences Water Anomalies Forecast: March 2019 - February 2020





**One of the most beautiful
coastal area of Sicily**

One of the most untreated wastewater discharge in the previous coastal area



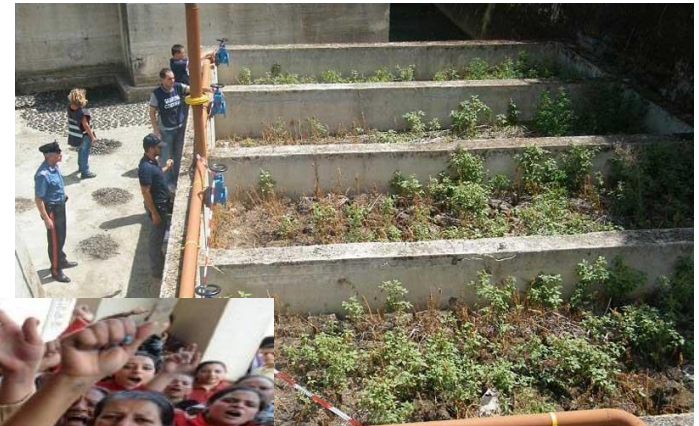
Context and open issues: High impacts from discharges and zero wastewater reuse



Context and open issues: sludge management



In summary,
we have... so many issues

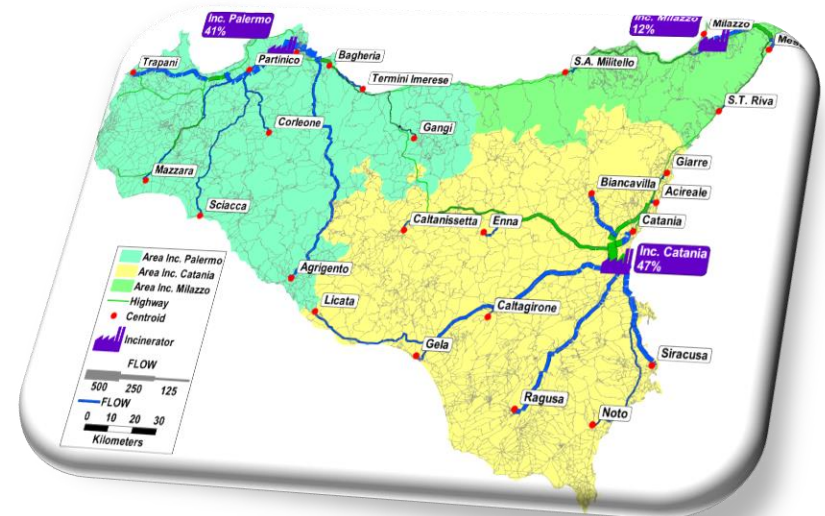


HOW to change the waste/wastewater management paradigm in SouthEurope regions?

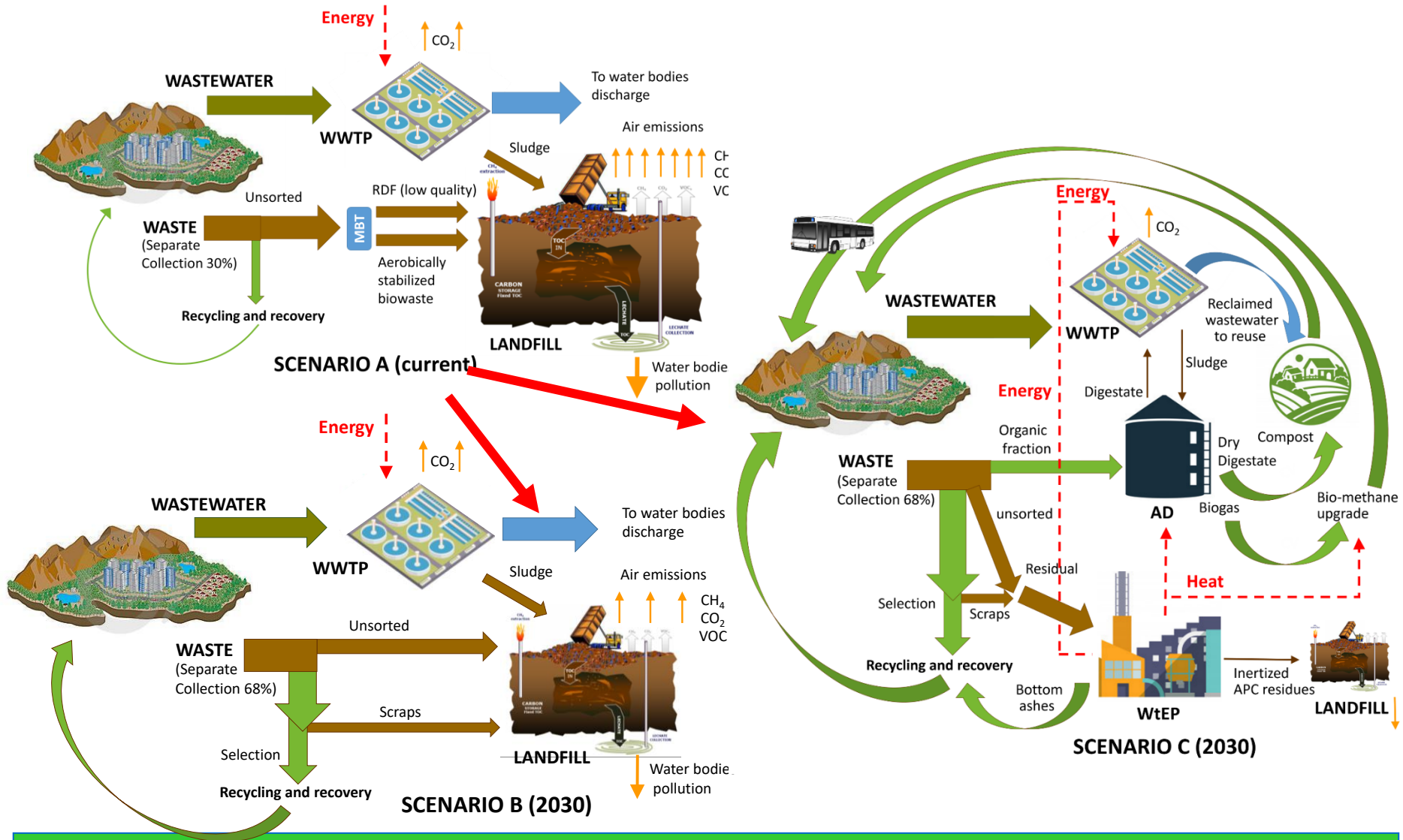


CASE STUDY

- The “Symbiosis Approach” is evaluated on the Metropolitan Area of Catania plus the provinces of Enna, Siracusa and Ragusa
- It considers 2 million p.e. in terms of waste production and 545,000 p.e. in terms of the WWTP capacity



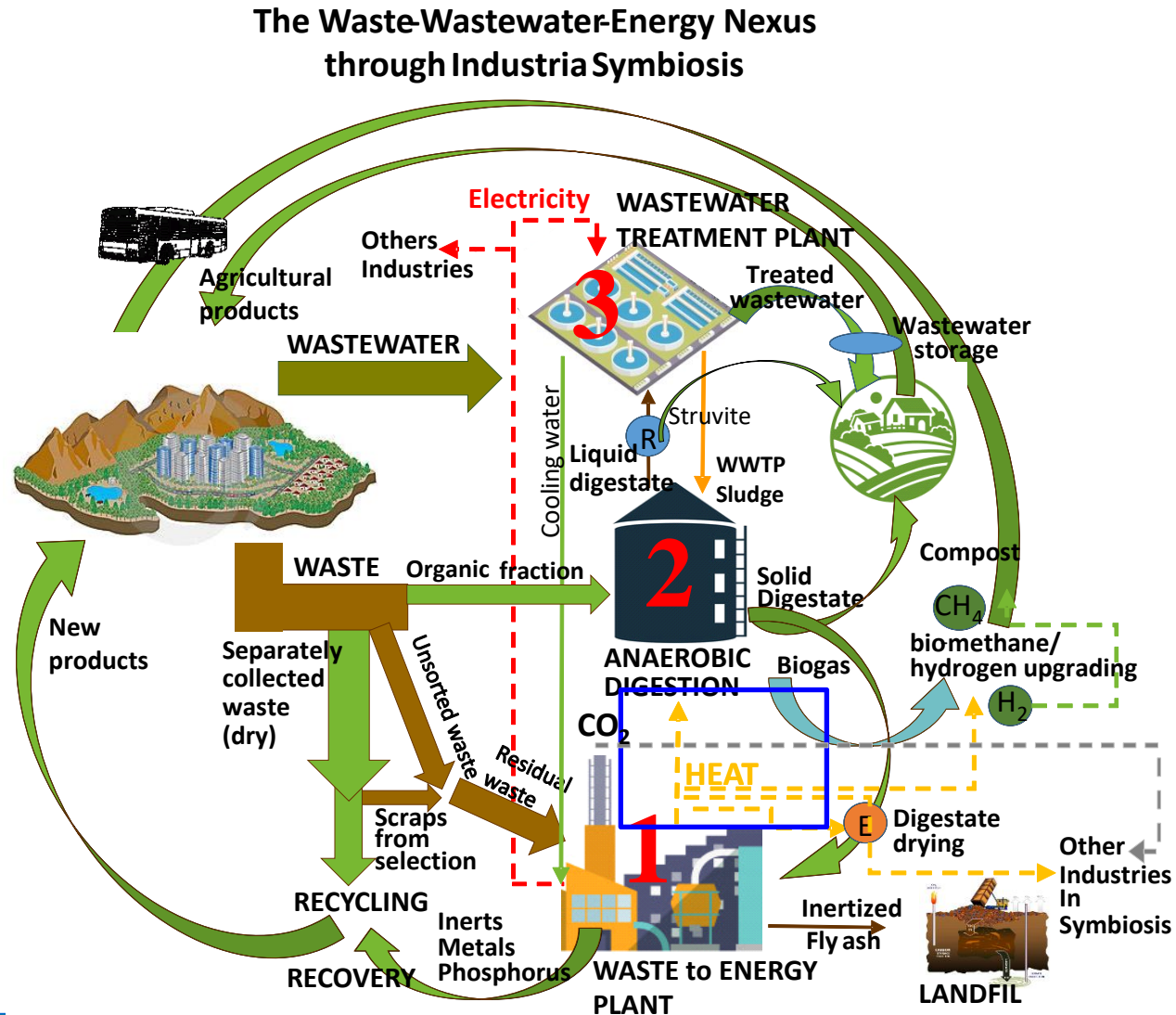
Comparison of three scenarios



Industrial Symbiosis scenario

Symbiotic exchanges

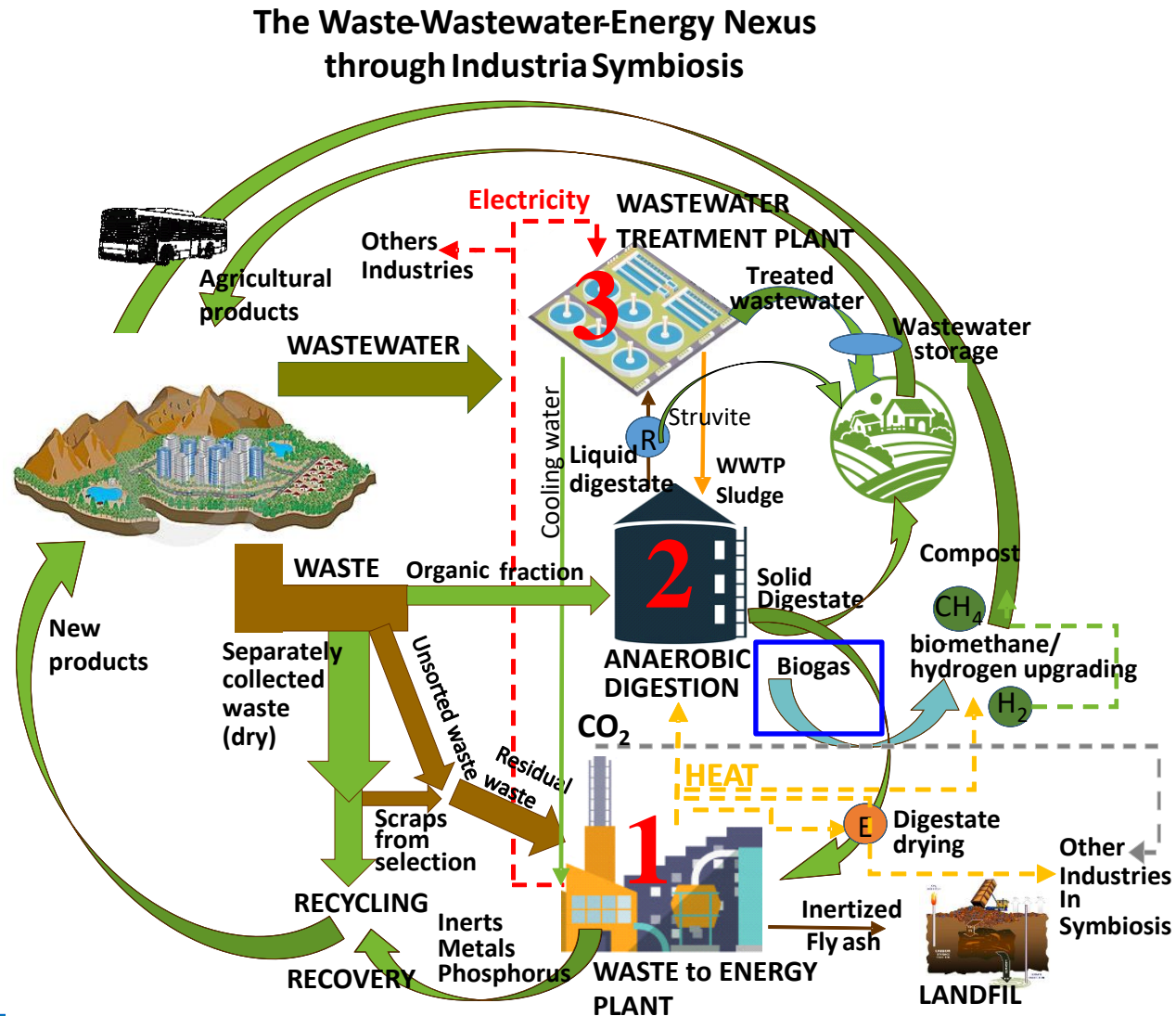
- Part of the **heat generated by waste-to-energy**, suitably commensurate through a well-dimensioned management of steam spills, can be used, also in **semi arid climate regions to carry out the AD in the thermophilic phase** reducing digestion times and volumes, increasing the biogas production yield with an advantage that also affects the **greater efficiency of sludge digestion** compared to more traditional mesophilic processes.



Industrial Symbiosis scenario

Symbiotic exchanges

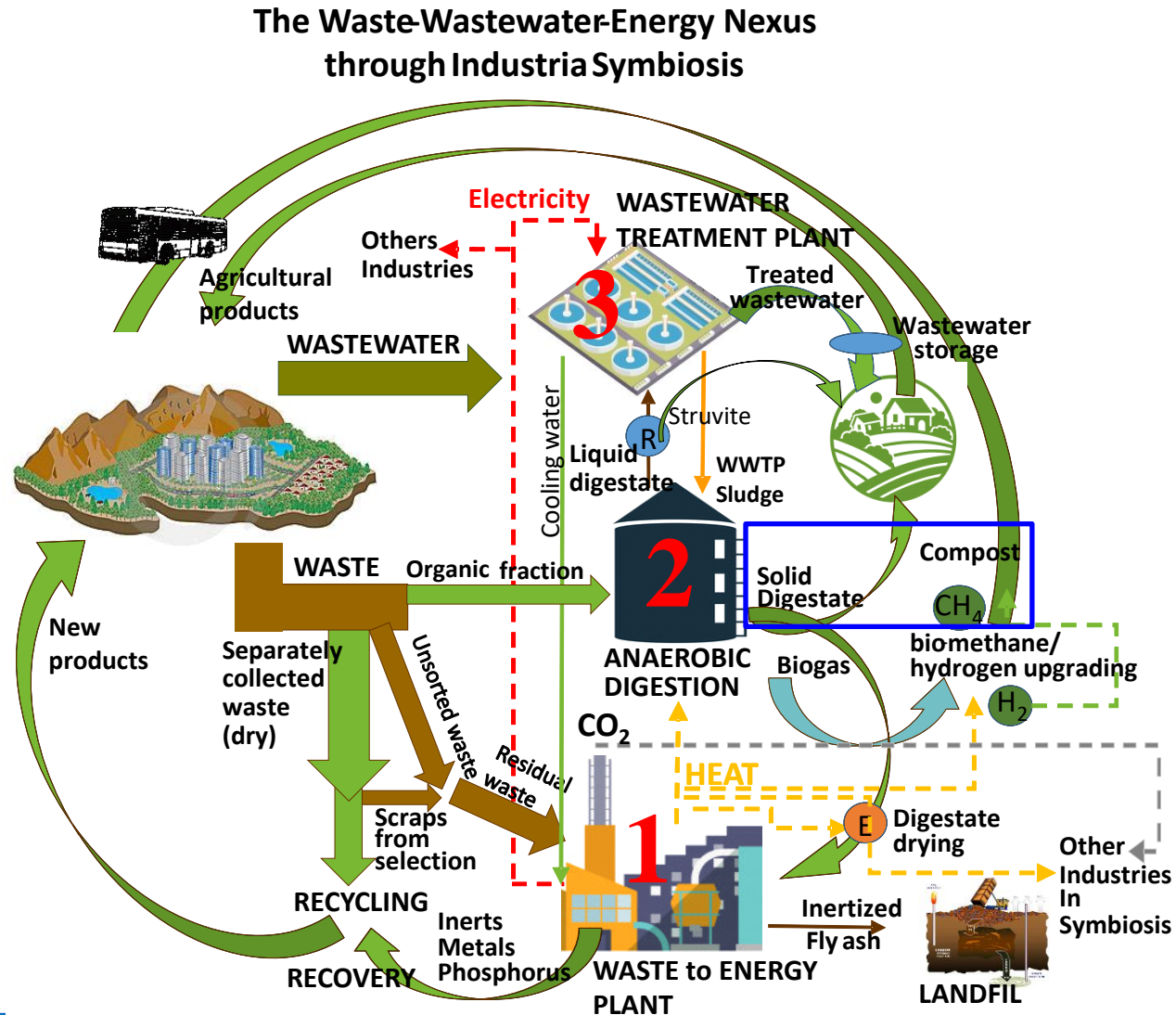
2. Also the recovery of the energy content of OFMSW is **maximized** as it is no longer necessary to burn, in the boiler, part of the biogas produced by the same process. **The heat is now supplied by** the treatment of the residual fraction of MSW in the WtE plant. **The biogas produced can be totally converted into biomethane** thus maximizing any economic incentives.



Industrial Symbiosis scenario

Symbiotic exchanges

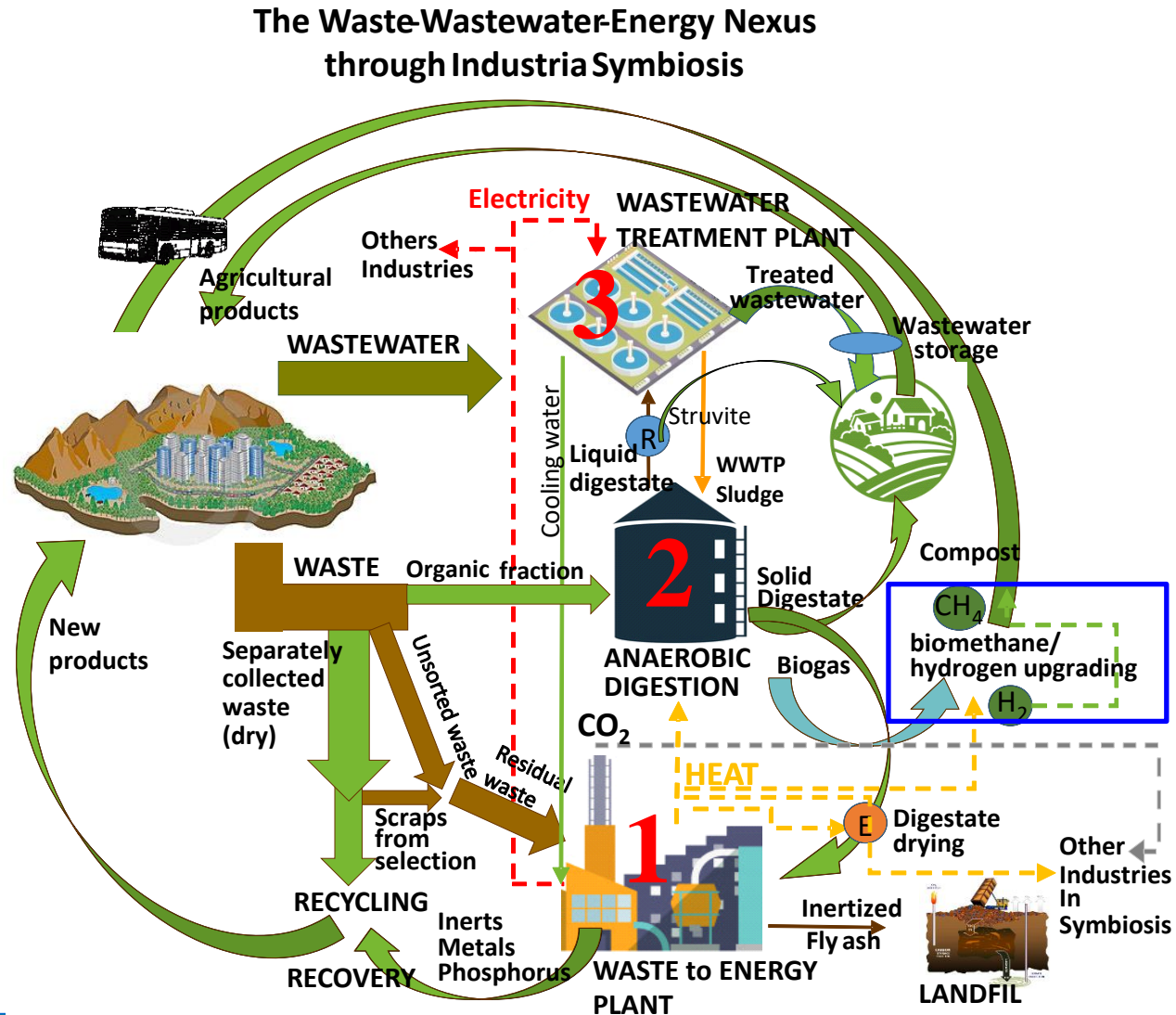
3. Energy demand for the treatment of OF waste is severely reduced, leaving only the minimum residual **maturation phase** to the much more expensive energy-consuming **composting** with an **advantage in terms of direct and indirect CO₂ emissions** (for energy production) while still producing quality compost.



Industrial Symbiosis scenario

Symbiotic exchanges

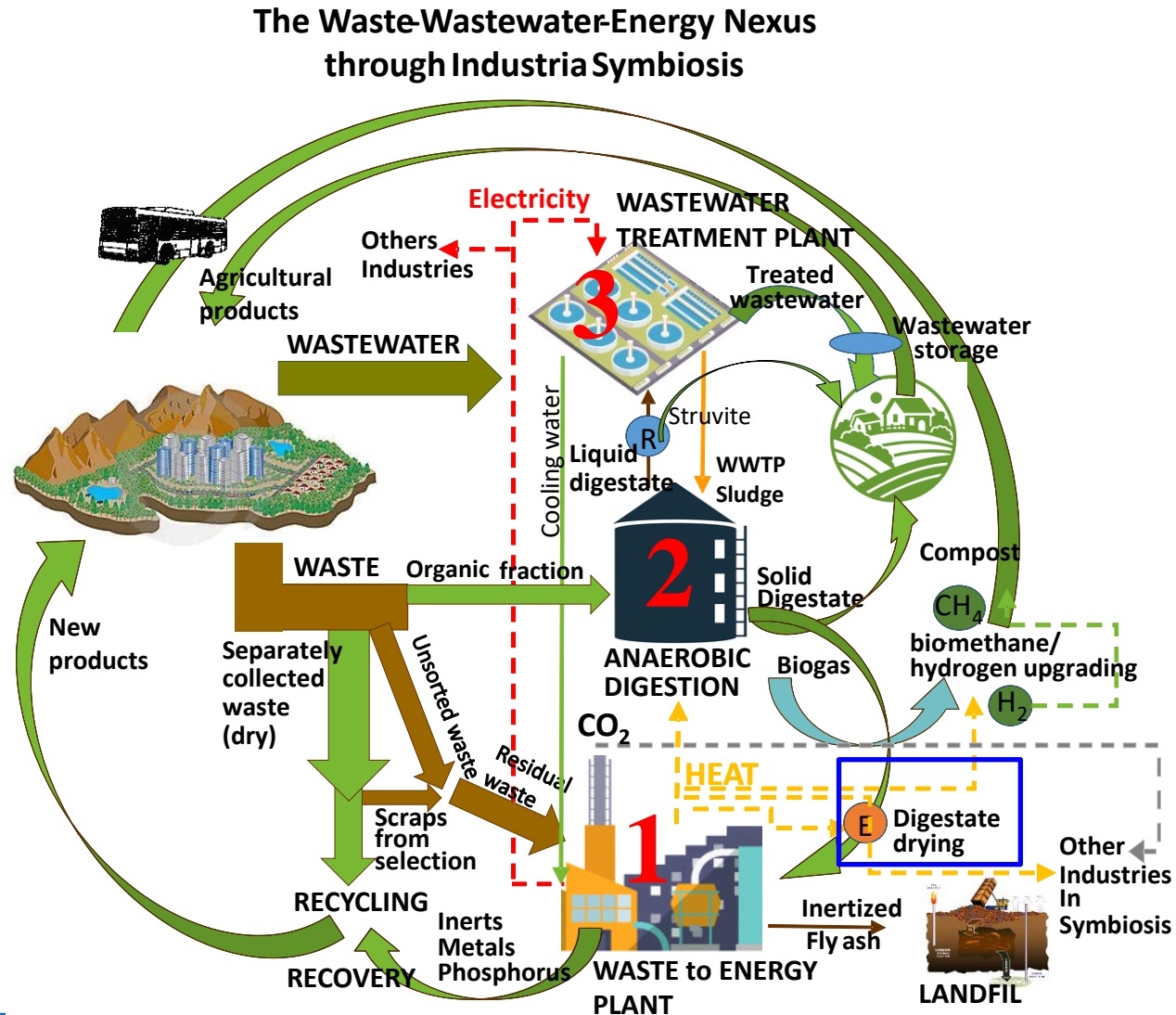
- Part of the **heat from waste-to-energy** could also be used in the process of **converting biogas into biomethane**, reducing the costs for its use in public transportation and waste collection trucks, increasing the **benefits of circularity for the territory** and further reducing GHG emissions;



Industrial Symbiosis scenario

Symbiotic exchanges

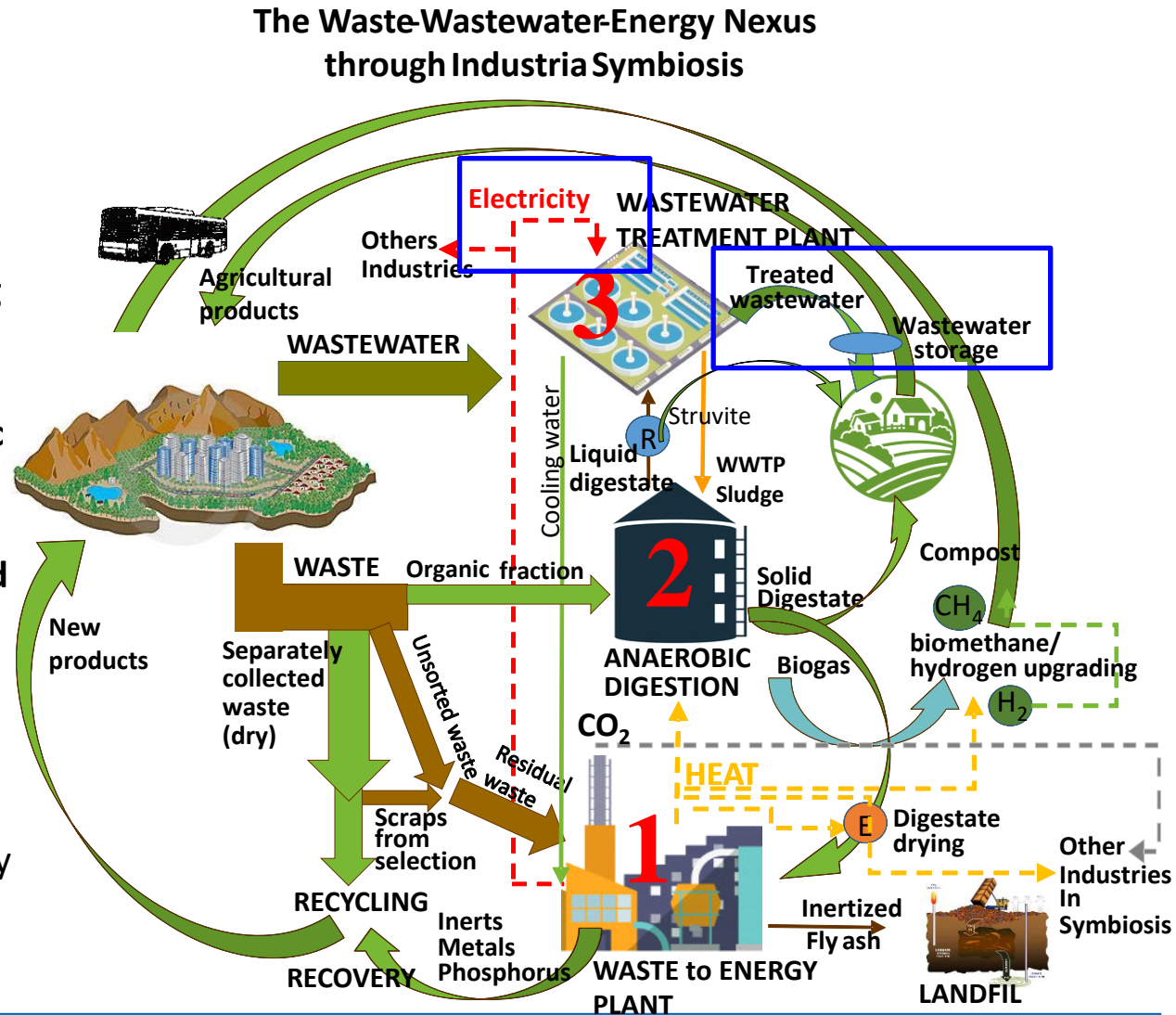
5. Part of the **heat from waste-to-energy** can be used to **pre-drying the dewatered digestates** (sludge of even **both**) with a view to their **energy recovery**, in a dedicated line of the waste-to-energy plant, which also collects **contributions from other smaller nearby plants**, to ensure **recovery of phosphorus from the ashes** and **eliminate the problem of final disposal (ZERO DISCHARGE)**.



Industrial Symbiosis scenario

Symbiotic exchanges

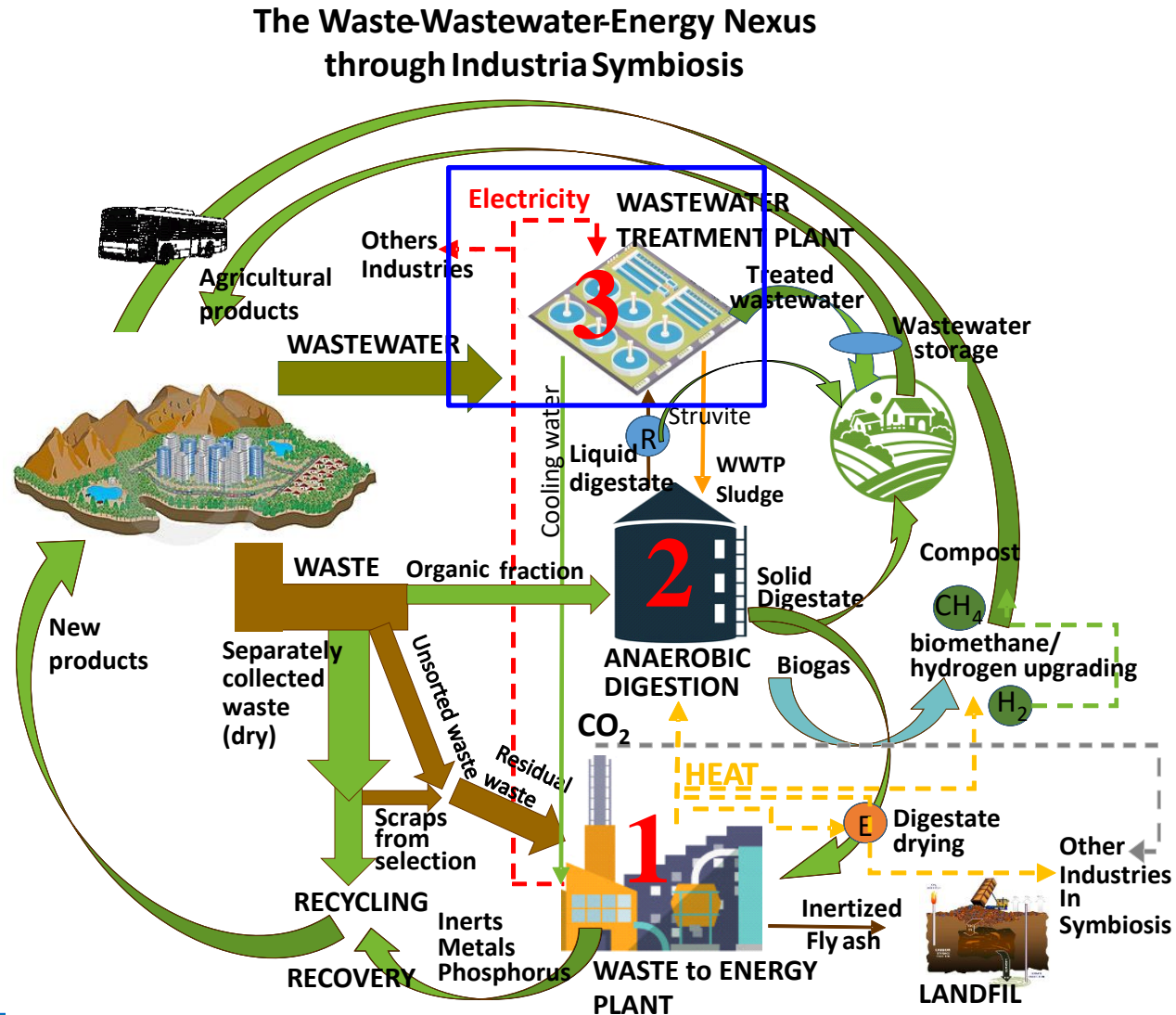
- The electricity produced by the WtE plant can be partially used (a few percentage units) to support the tertiary treatment phase and pumping of the treated wastewater to the agricultural areas in order to make the cost of the treated wastewater competitive, guaranteeing its full reuse avoiding that the concentrated load is discharged into water bodies with the related impacts, especially in islands and coastal areas (**ZERO DISCHARGE GOAL**). The huge amount of remaining electricity can go to the market.



Industrial Symbiosis scenario

Symbiotic exchanges

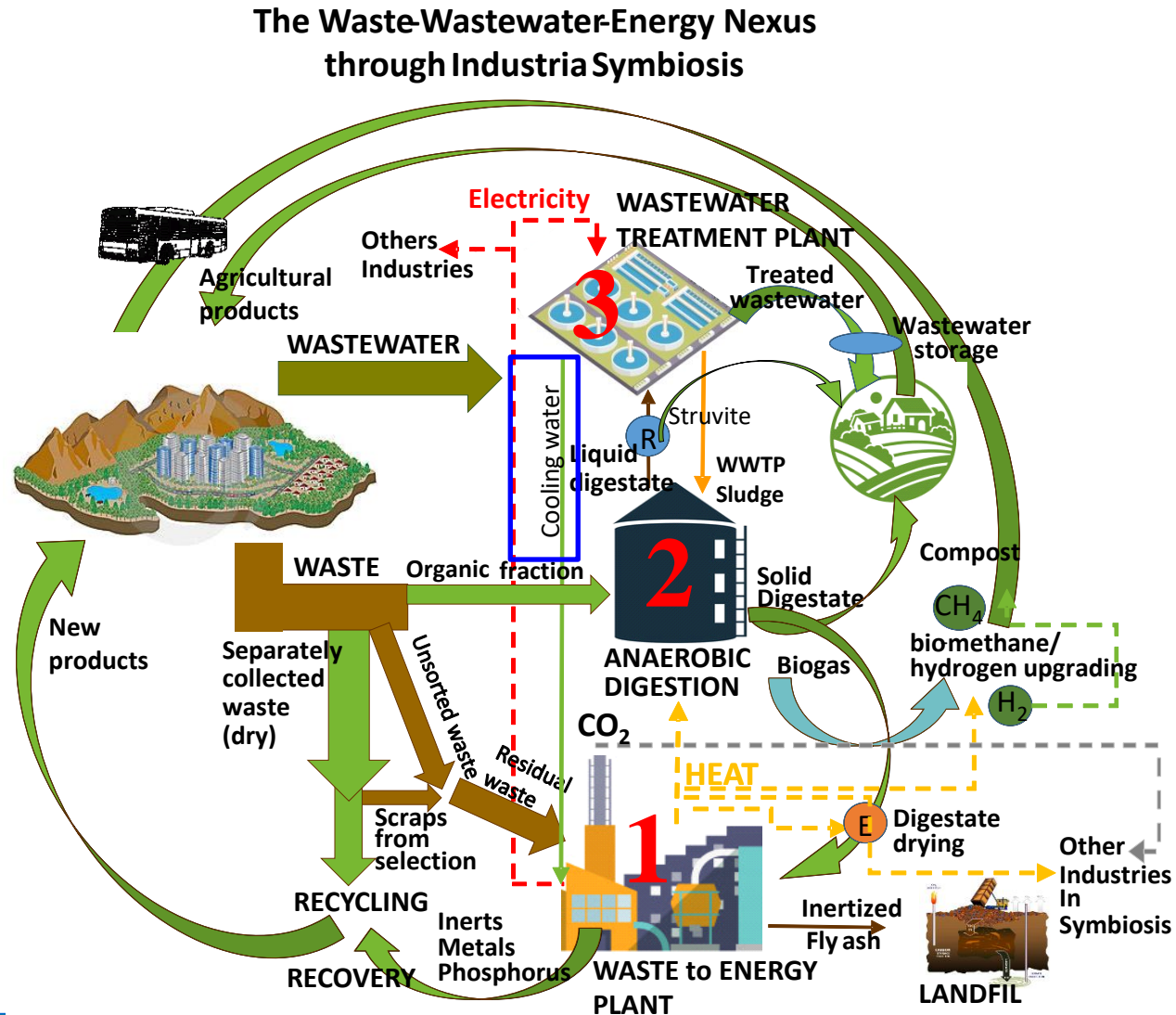
7. A further part of the **electricity produced by the WtE plant** could be used to **support the entire wastewater treatment process** in full view of industrial symbiosis (**Almost ZERO CO₂ Emissions Goal**).
- The oxidation phase in the water line should in any case be conducted as a classic scheme with a high load to minimize energy consumption, taking into account subsequent reuse also through a **limitation of denitrification**.



Industrial Symbiosis scenario

Symbiotic exchanges

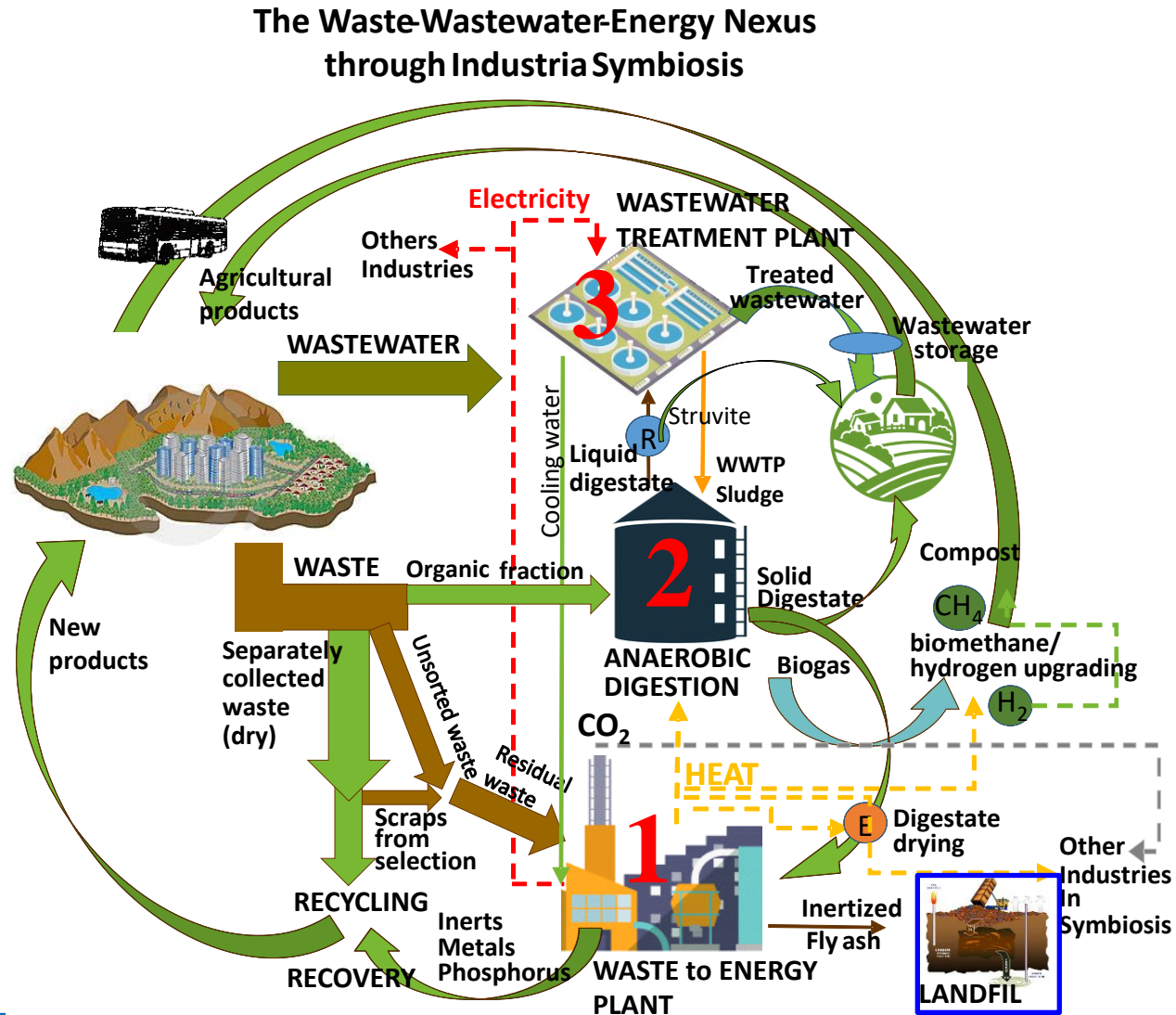
- Part of the purified effluent can be used as **cooling water for the waste-to-energy plant**, saving a precious resource for other uses and **increasing the overall circularity** of the proposed system.



Industrial Symbiosis scenario

Symbiotic exchanges

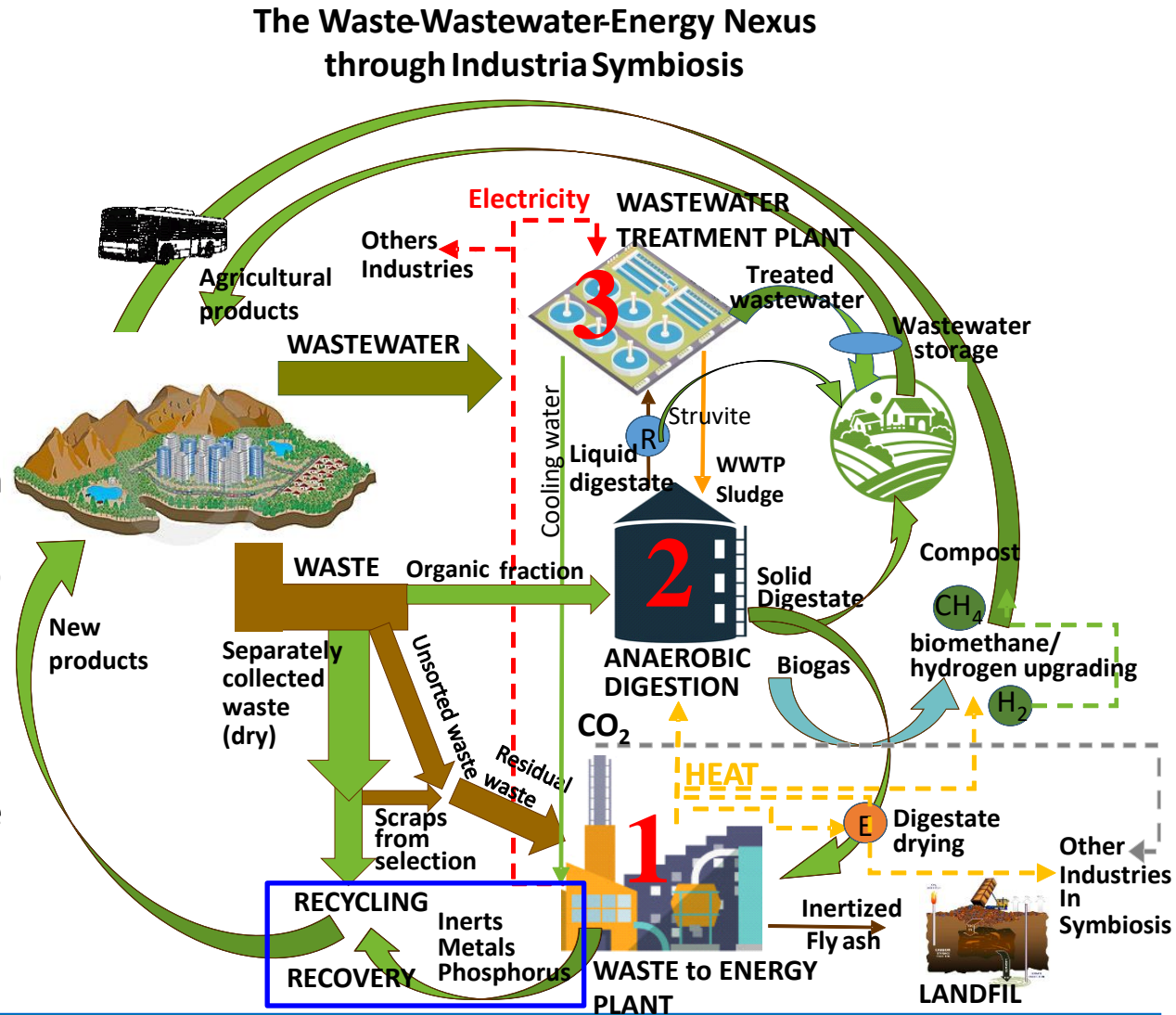
9. The residual fraction and non-recyclable waste are reduced in volume (about 10%) by reducing the landfill requirement and the consequent impacts.



Industrial Symbiosis scenario

Symbiotic exchanges

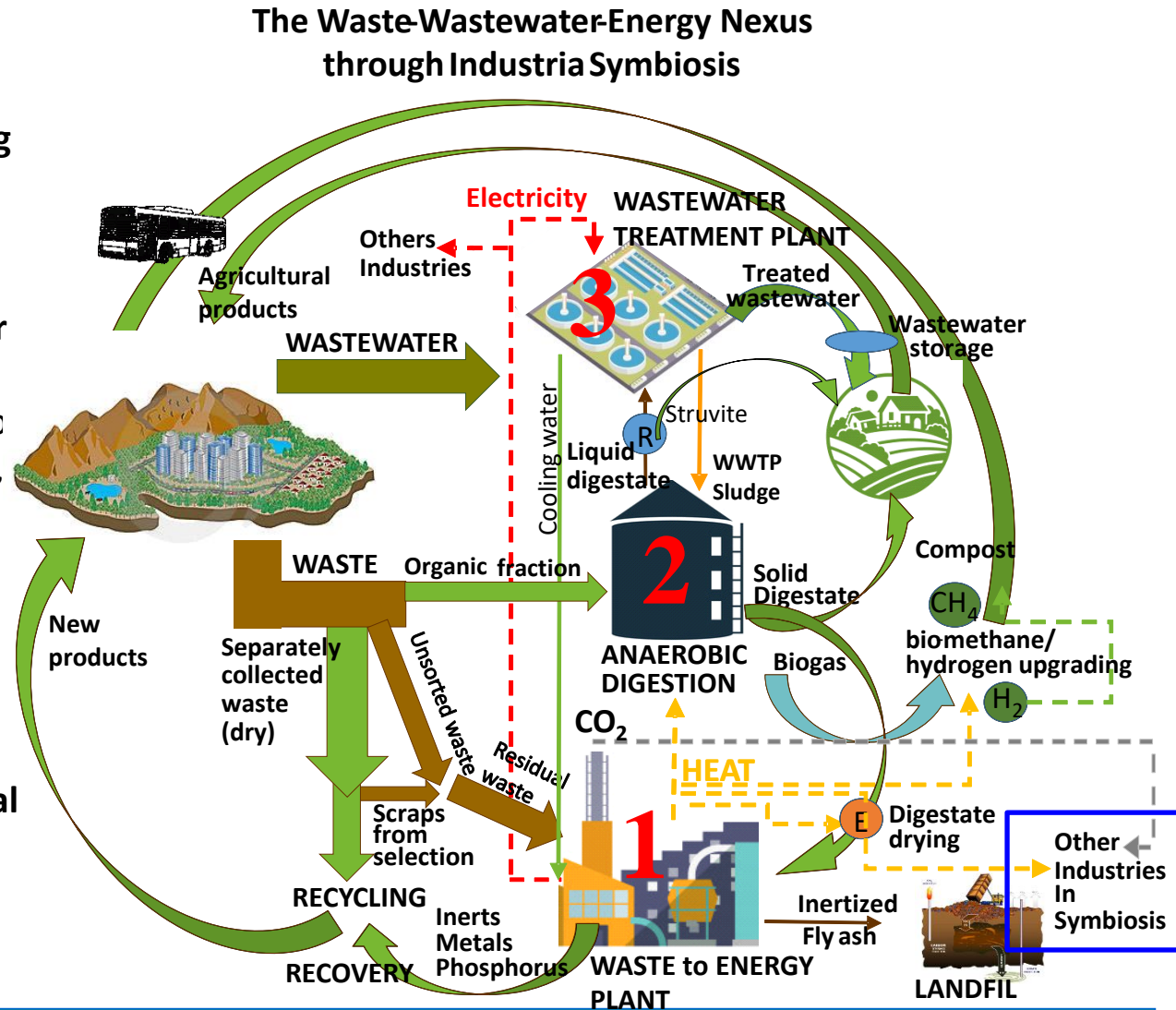
10. Thanks to the **recovery of bottom ashes** in construction materials, the **reduction of waste to be disposed of in landfills** could be further limited to only inertized fly ash (approximately 2-4% of the total waste, in full compliance with the **European directives** (which set the limit of 10% by **2035**). This allows to **increase the overall recycling of materials** (+5-10% of the total waste depending on the residual portion) - significantly increasing the circularity of the entire system **helping to respect Recycling EU Directives**.



Industrial Symbiosis scenario

Symbiotic exchanges

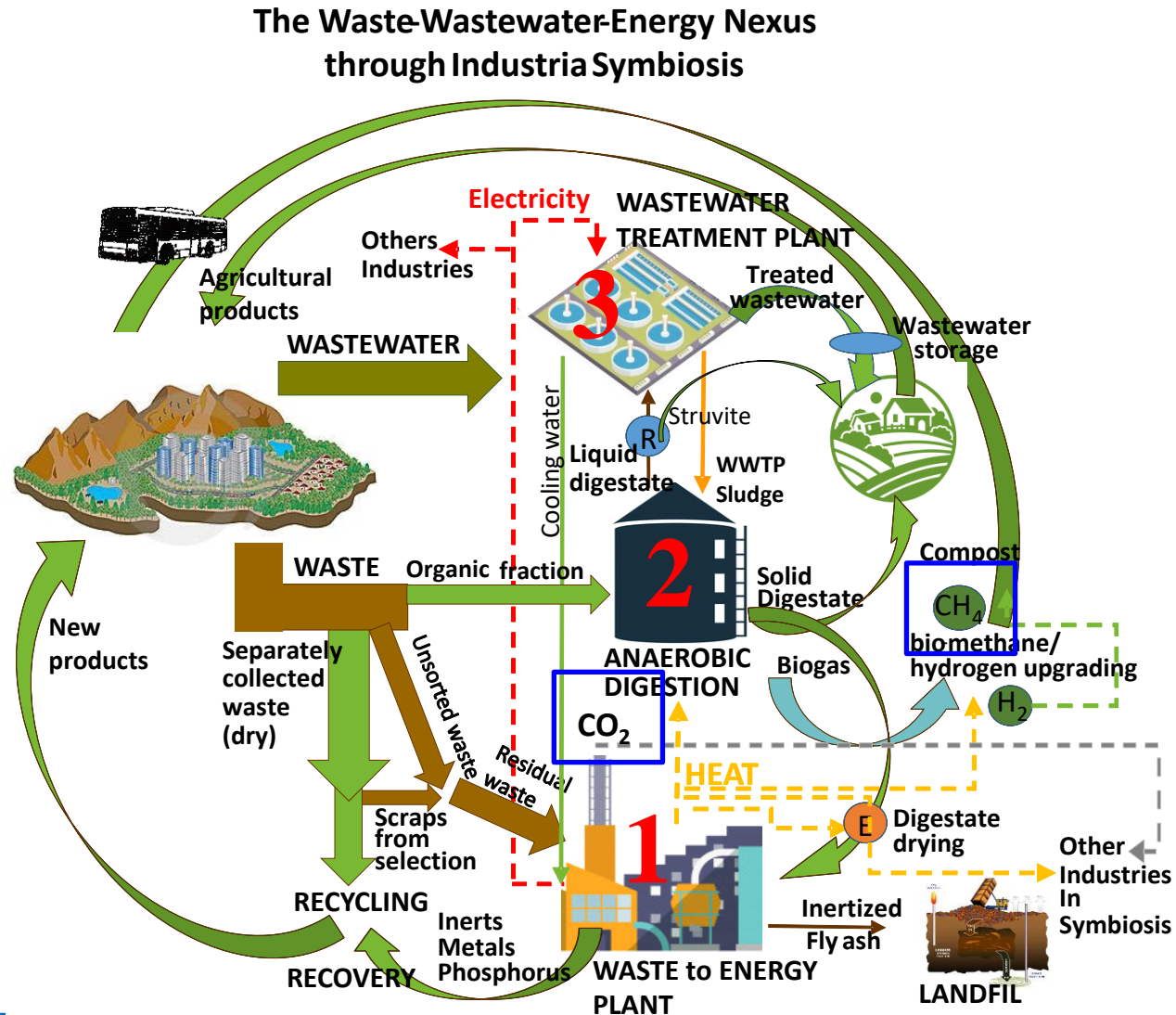
11. Part of the **heat from WtE** can be used to support **surrounding industries** (existing or wishing to enter the industrial district) by **exploiting the residual heat at advantageous conditions for their processes** (e.g. agri-food process industry), in addition to any **heating and cooling needs**, in full view of industrial symbiosis with a consequent reduction of their CO₂ emissions.
12. Part of the **heat from WtE** can also be used to **pre-drying biomasses from the agricultural sector** before their energy recovery in the same waste-to-energy plant, reducing disposal problems;



Industrial Symbiosis scenario

Symbiotic exchanges

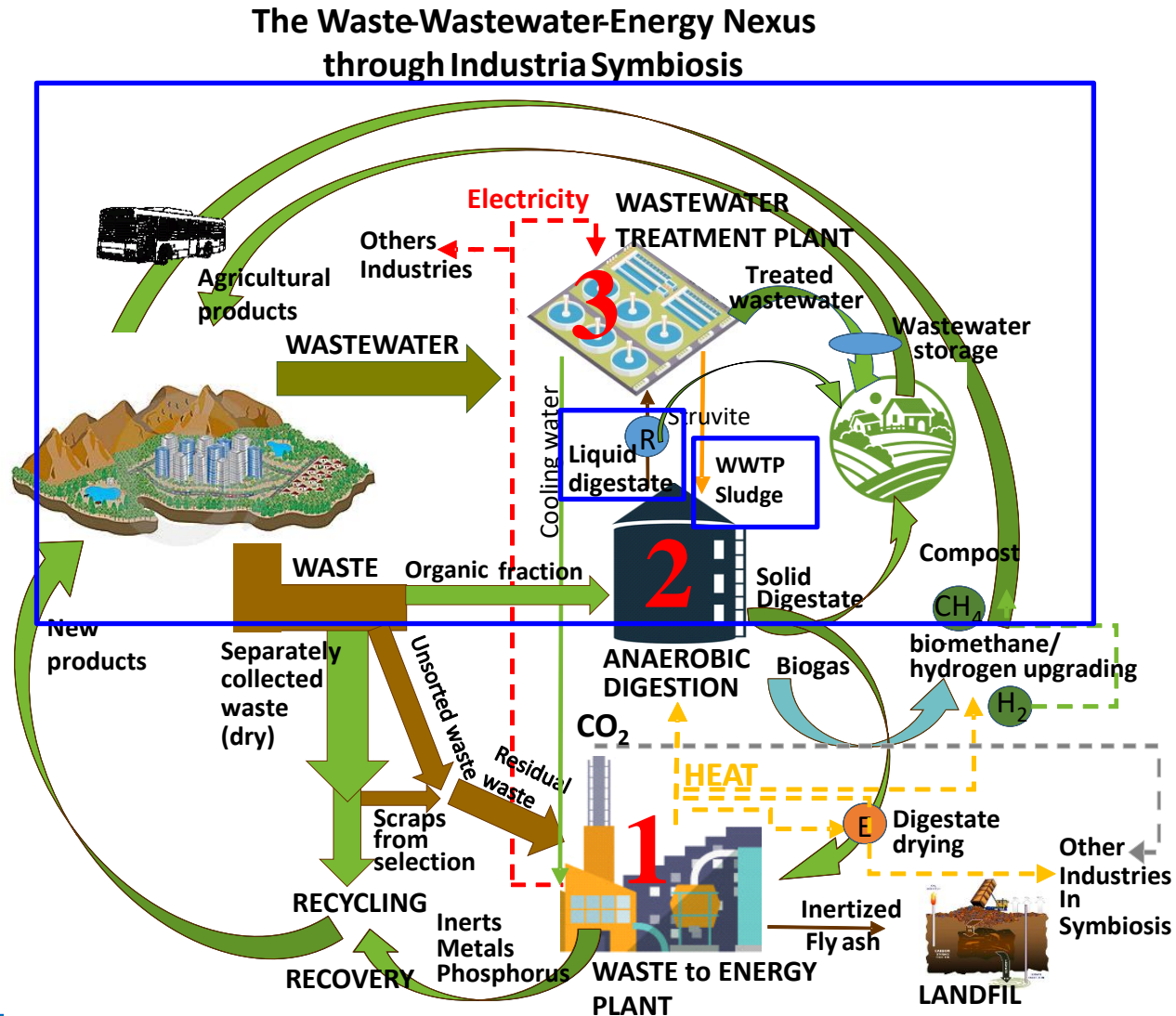
13. A part of the CO_2 produced by the conversion process into biomethane and/or contained in the fumes of the waste-to-energy plant could be recovered (e.g. converted into algal biomass to be used for high added value products).



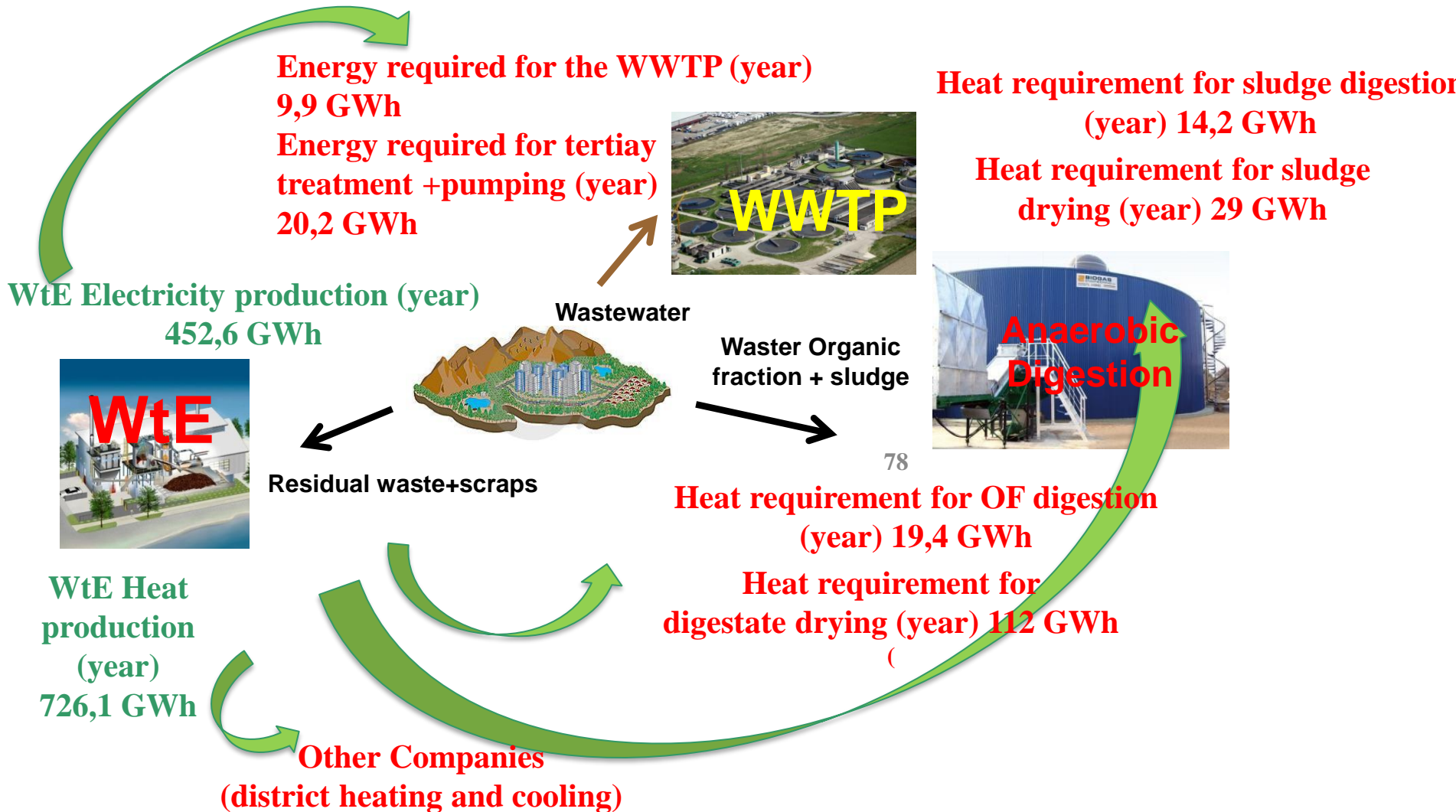
Industrial Symbiosis scenario

Symbiotic exchanges

14. The liquid fraction of the digestate can be recirculated to the WWTP as effluent, greatly reducing management costs (with direct/indirect recovery of nutrients)
15. The composted digestate and the wastewater contribute to increasing the agricultural yield by favoring a closure of the organic cycle.



A rough energy balance



Recycling, Recovery and (wastewater) Reuse are complementary to divert waste and sludge from landfill

~~TAKE HOME MESSAGE~~



TAKE HOME MESSAGE



**Environmental
Shamans**



**People
Stakeholders**

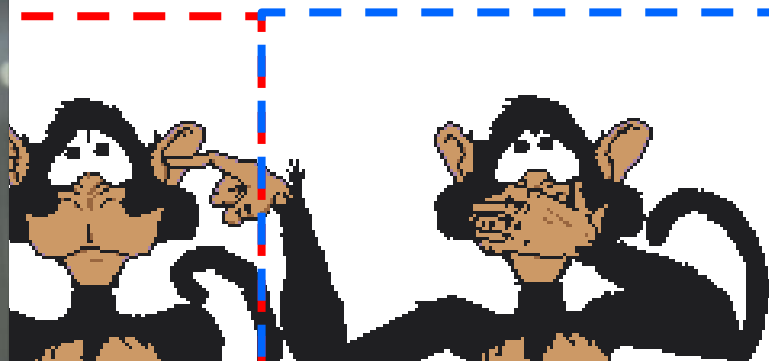


Scientists

Jacob Anthony Angeli Chansley (born 1988),^[1] also known under the name **Jake Angeli**, and as the **QAnon Shaman**,



TAKE HOME MESSAGE



- P
ak



And always be a paladine of the correct environmental information to people



Just a final thought fo Southern Europe regions (Sicily is mine)



“Change everything to not change anything”

Giuseppe Tomasi di Lampedusa: author of «The Leopard».



*“I don't want to live only for the future;
I want to live in the present;
And never forget that this present
is the future someone promised me.”*

Giuseppe Mancini March 2021