the International water association

WATER CHALLENGES IN XXI CENTURY: ROLE OF ECONOMICS, STATISTICS AND ASSET MANAGEMENT

LIVORNO, 11-13 SEPTEMBER 2017

Horizon2020 SMART-Plant and European Innovation Deals to overcome barriers to deliver circular economy

Francesco Fatone and the SMART-Plant Consortium

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Coordinated by: UNIVERSITÀ POLITECNICA DELLE MARCHE

Water in the Sustainable Development Goals: water challenges one of the top priorities for humankind

- At the global level, water has never been so visible. That it is listed as one of the 17 top priorities for humanity is a significant moment.
- **It presents an opportunity for a breakthrough**. Not just to accelerate the unfinished task of universal access to safe water and sanitation; but to **transform the water sector to become sustainable, resilient and a driver of the circular economy**.

Source: IWA, 2016

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From SDG to …business as usual…

Worldwide, the **annual capital expenditures on water and wastewater infrastructure** by utilities have been estimated at **US$ 100 billion and US$ 104 billion**, respectively

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UN WATER

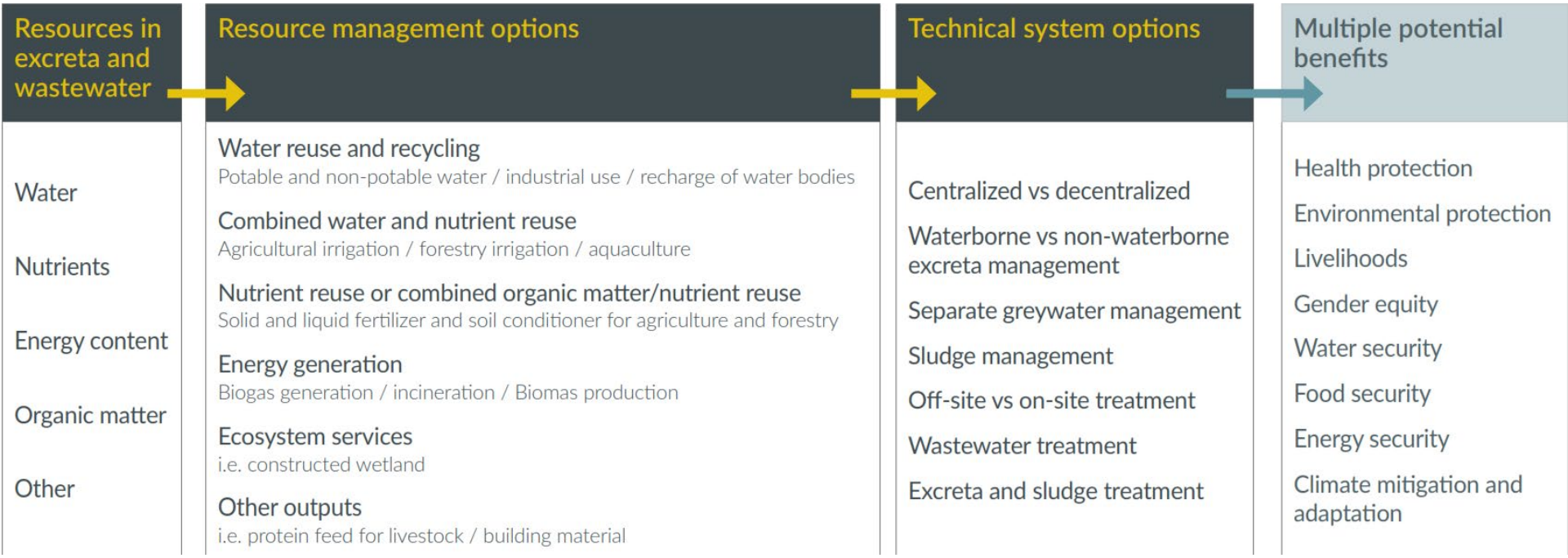
Report

The United Nations World Water Development Report 2017

WASTEWATER
THE UNTAPPED RESOURCE

WWDR
2017

Framing wastewater management from a resource perspective



Andersson et al. (2016) in WWRR2017

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Resources embedded to municipal wastewater

Parameter	Value
Reusable water (m^3/capita year)	80-120
Cellulose (kg/capita year)	5-7
Biopolymers; PHA (kg/capita year)	2-4
Phosphorus in P precursors (kg/capita year)	0.5-1.5
Nitrogen in N precursors (kg/capita year)	4-5
Methane (m^3/ capita year)	12-13
Organic Fertilizer (P-rich compost) (kg/capita year)	9-10

Verstraete et al. (2009) *Bioresource Technology* 100, 5537–5545
Salehizadej and van Loosdrecht (2004) *Biotechnology Advances* 22, 261–279

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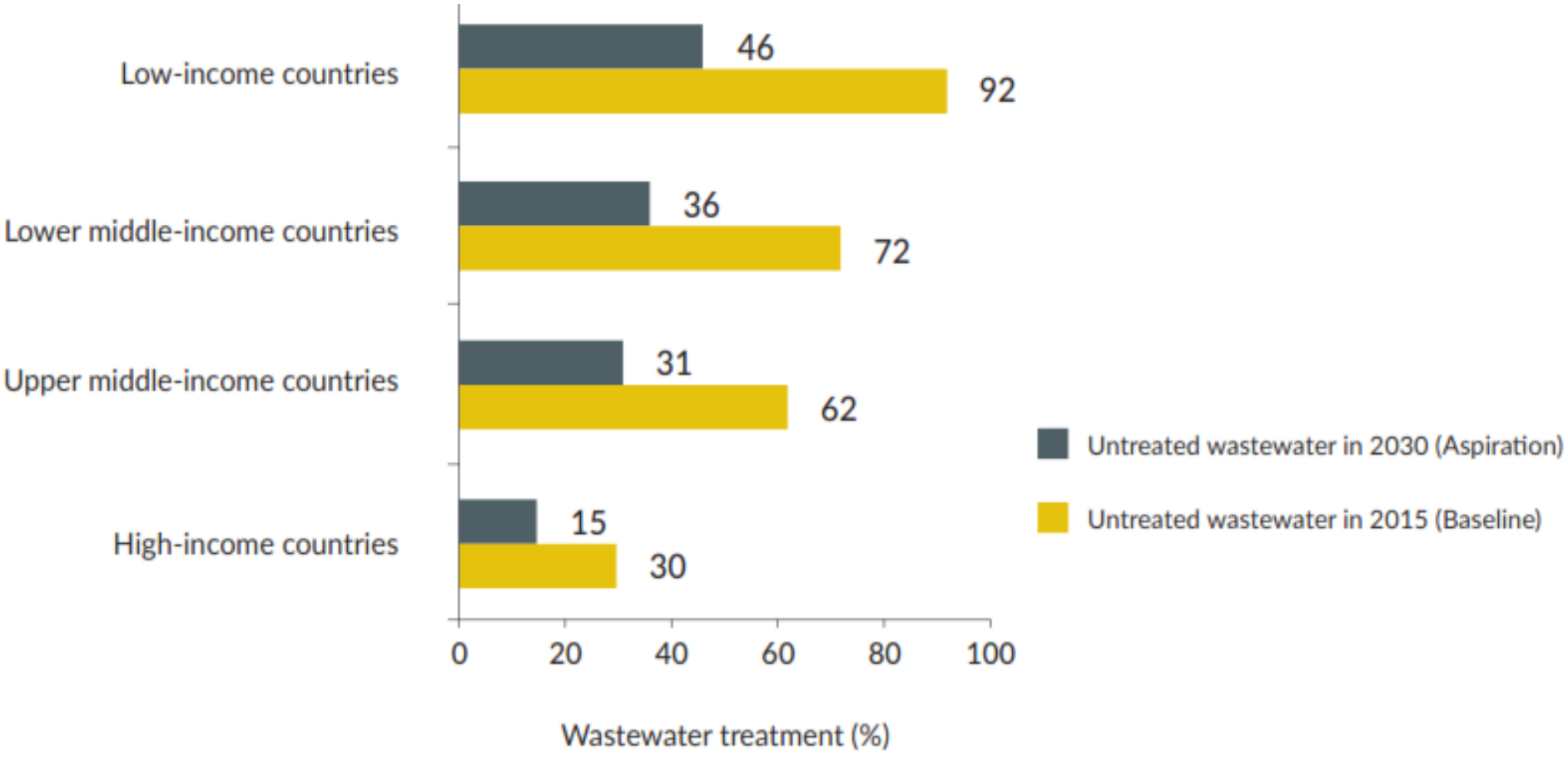
However, still long way to go



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Is water central in the "Circular Economy Package"?

Circular Economy Package mainly aim at <u>facilitating water reuse</u> - this will include a legislative proposal on **<u>minimum requirements for reused water, for example for irrigation and groundwater recharge</u>**

Source: https://www.eip-water.eu/water-%E2%80%9Ccircular-economy-package%E2%80%9D

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What about R&D&I in EU?

- **H2020 WATER INNOVATION: BOOSTING ITS VALUE FOR EUROPE (2014-2015):** Need of scale-up to demo, first application and market replication
- **H2020 WATER IN THE CONTEXT OF CIRCULAR ECONOMY (2016-2017)**: recovery and (re)use of nutrients and large demos for alternative water source, use and reuse

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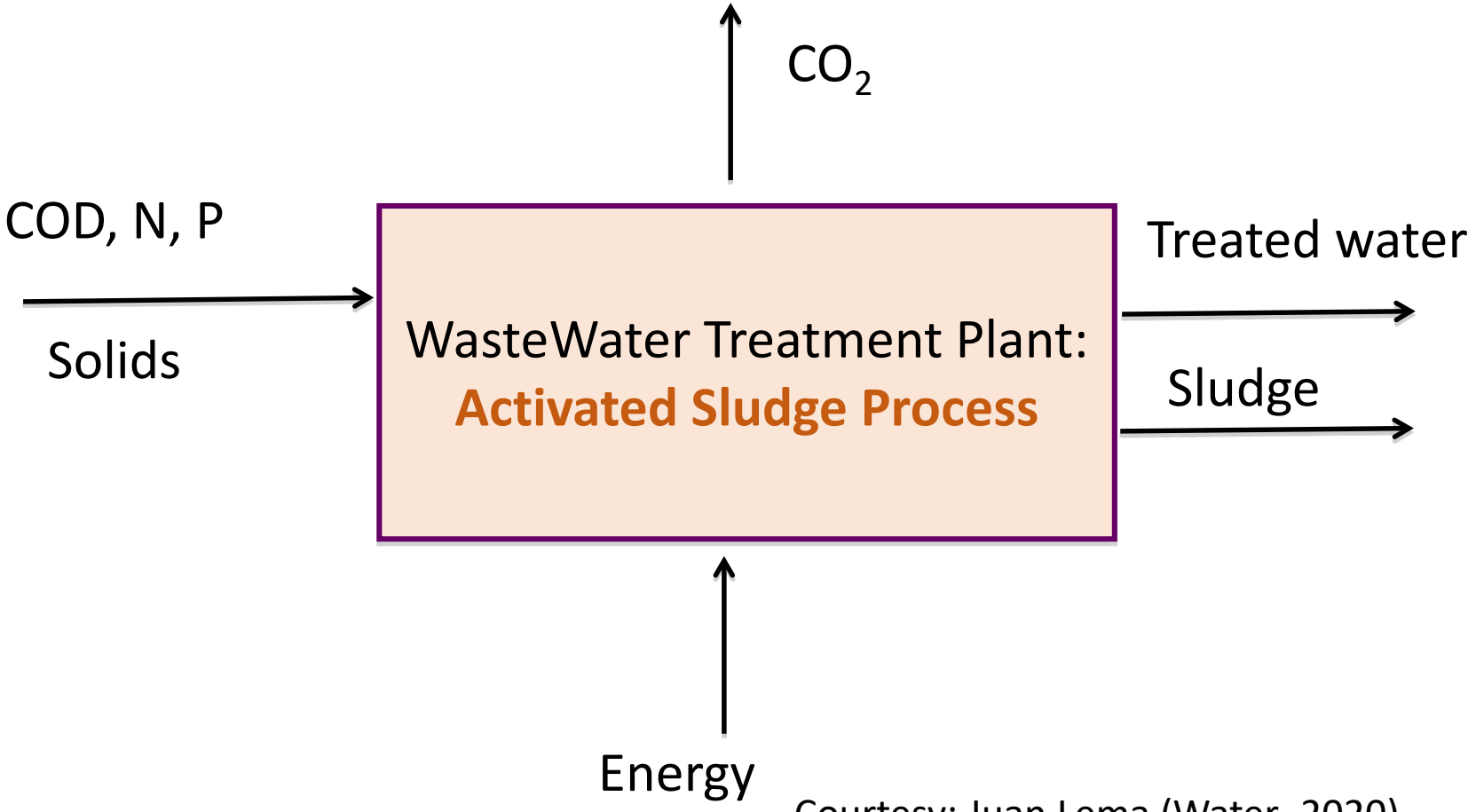
Current wastewater treatment: Is this right for the next 100 years?



Courtesy: Juan Lema (Water_2020)

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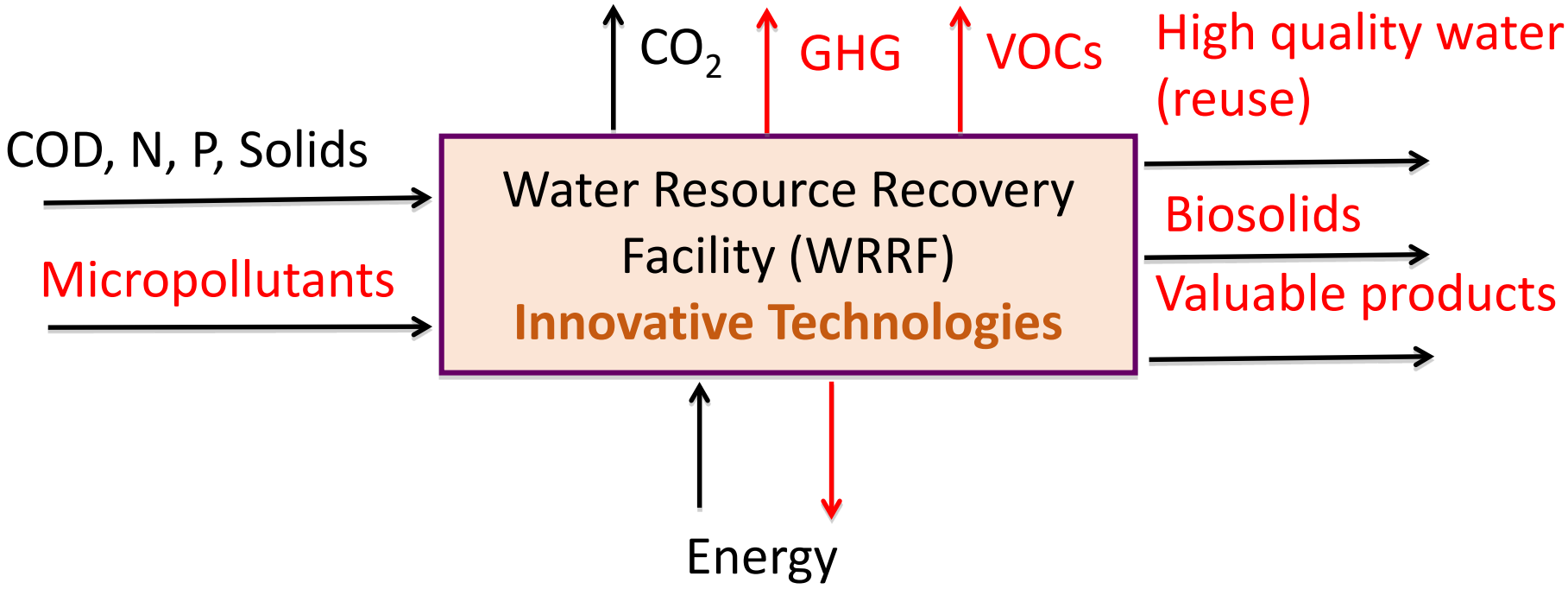
We want to move from WWTP to WRRF, how and when?



Courtesy: Juan Lema (Water_2020)

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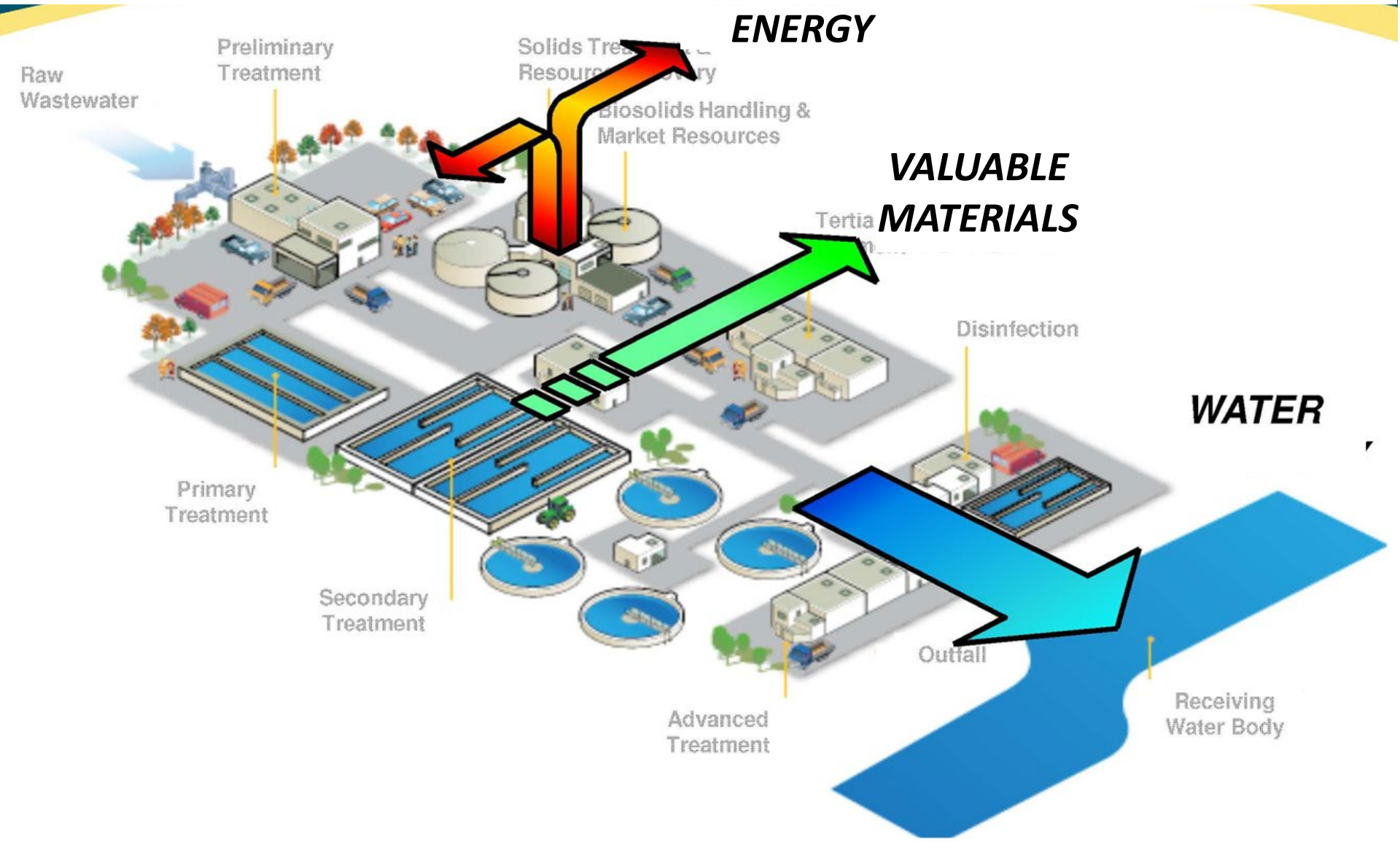
THREE MAIN PATHWAYS TO DELIVER CIRCULAR ECONOMY



The correct analysis: according to the Technology Readiness Level

TRL 0: **Idea**. Unproven concept, no testing has been performed.

TRL 1: **Basic research.** Principles postulated and observed but no experimental proof available.

TRL 2: **Technology formulation**. Concept and application have been formulated.

TRL 3: **Applied research**. First laboratory tests completed; proof of concept.

TRL 4: **Small scale prototype** built in a laboratory environment ("ugly" prototype).

TRL 5: **Large scale prototype** tested in intended environment.

TRL 6: **Prototype system** tested in intended environment close to expected performance.

TRL 7: **Demonstration system** operating in operational environment at pre-commercial scale.

TRL 8: **First of a kind commercial system**. Manufacturing issues solved.

TRL 9: **Full commercial application**, technology available for consumers.

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Materials pathway: H2020 SMART-PLANT

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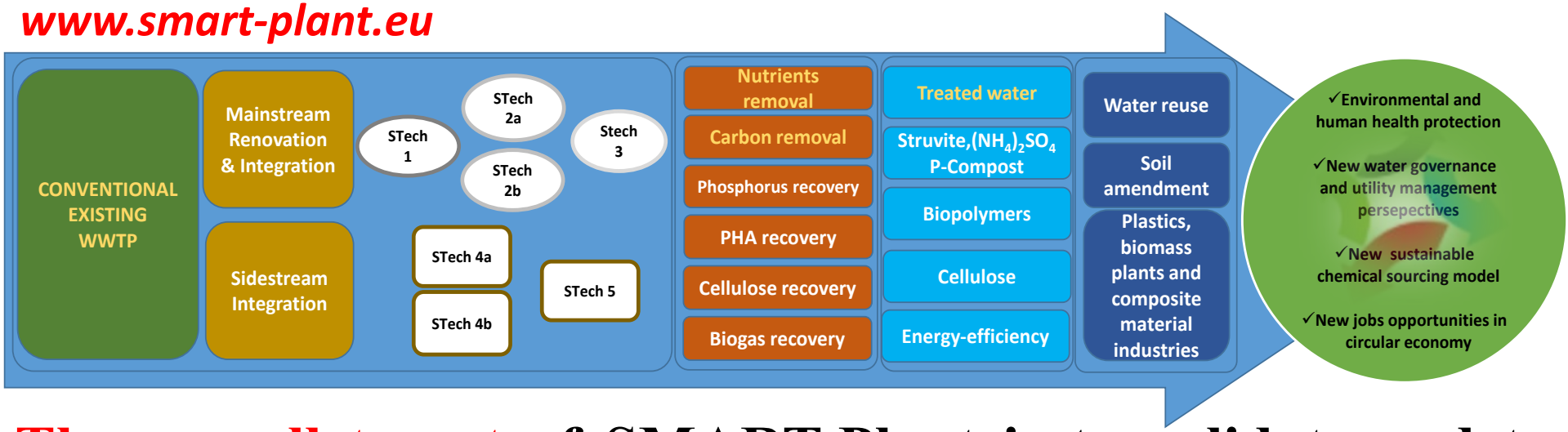

The overall target of SMART-Plant is to validate and to address to the market a portfolio of SMARTechnologies that, singularly or combined, can renovate and upgrade existing wastewater treatment plants and give the added value of instigating the paradigm change towards efficient wastewater-based bio-refineries.

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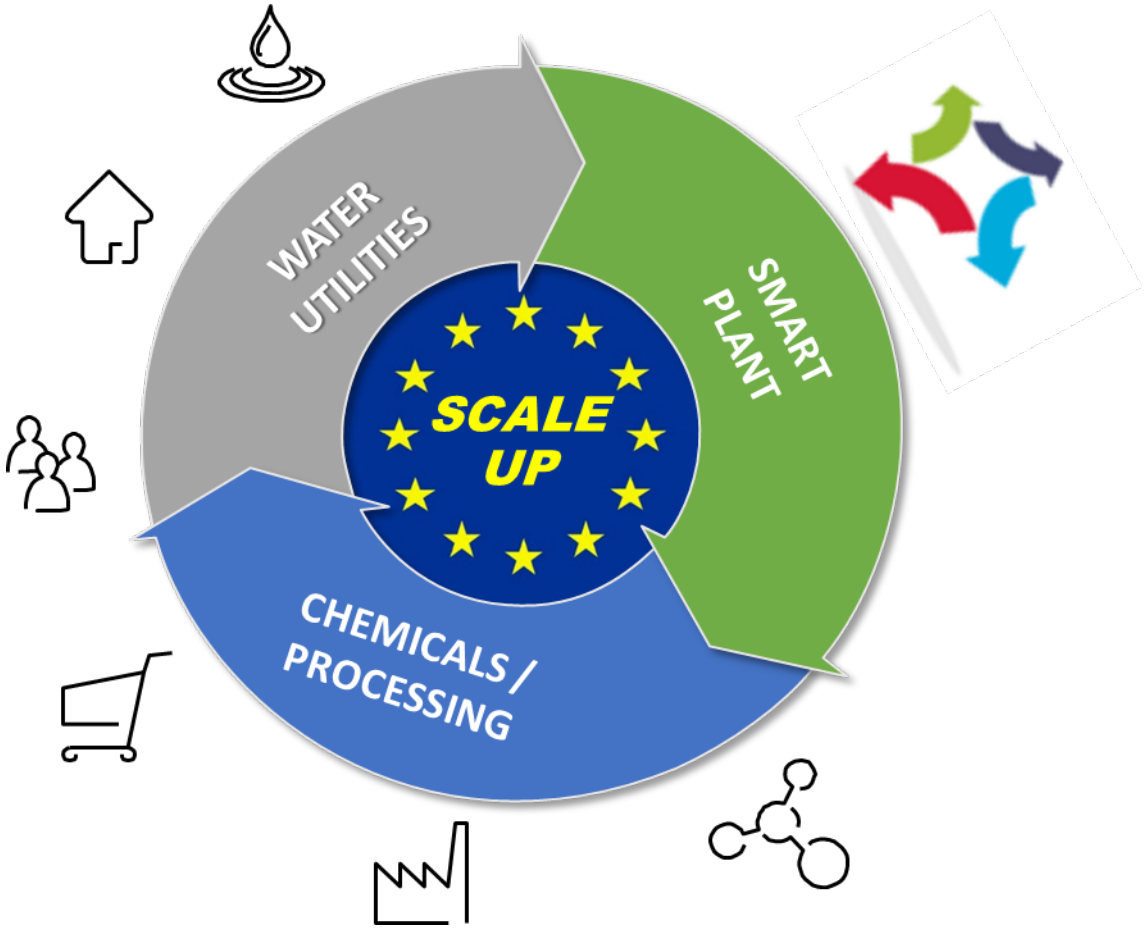
Demonstration of the full inter-sectorial value chain



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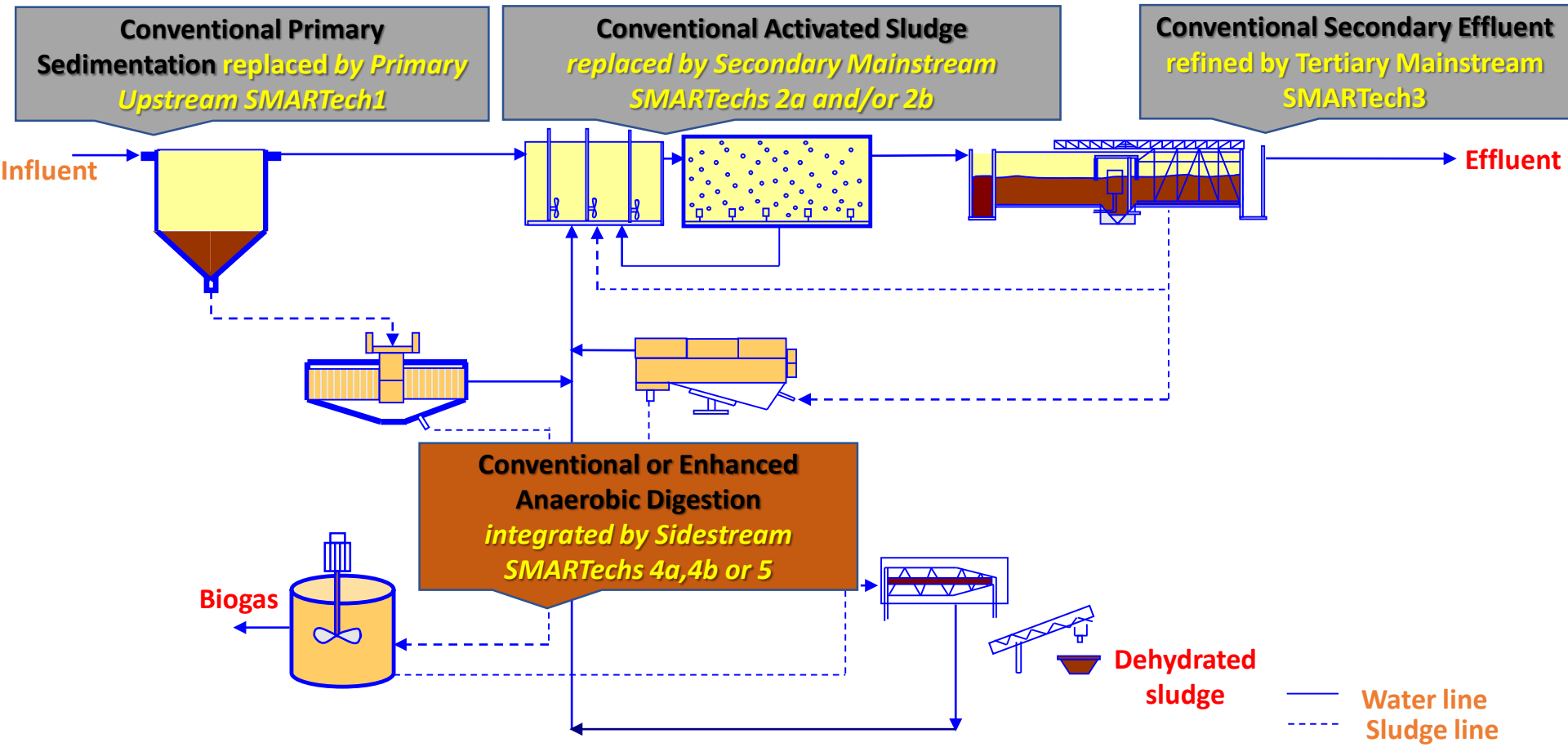
Energy efficiency is the water market entry strategy, materials recovery is the added value



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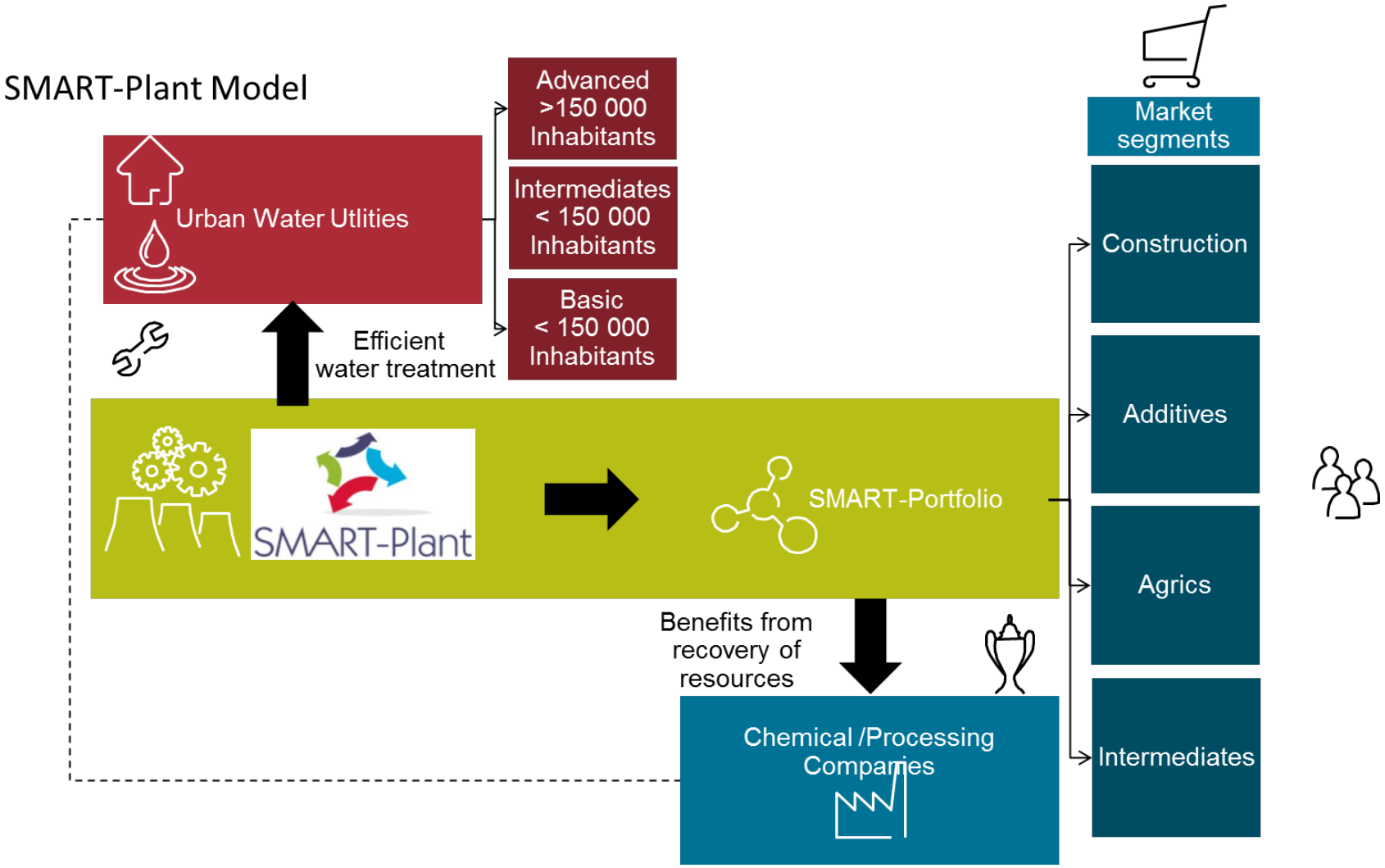
The SMART-Plant integrated WRRFs

SMARTech	**Site**	Key enabling process(es)	**SMART-product(s)**
1	**Geestmerambacht (NL)**	Upstream dynamic fine-screen and post-processing of cellulosic sludge	**Cellulosic sludge, refined clean cellulose**
2a	**Karmiel (Israel)**	Mainstream polyurethane-based anaerobic biofilter	**Biogas, Energy-efficient water reuse**
2b	**Manresa (ES)**	Mainstream SCEPPHAR	**P-rich sludge, PHA**
3	**Cranfield (UK)**	Mainstream tertiary hybrid ion exchange	**Nutrients**
4a	**Carbonera (IT)**	Sidestream SCENA+conventional AD	**P-rich sludge, VFA**
4b	**Psyttalia (GR)**	Sidestream SCENA+enhanced AD	**P-rich sludge**
5	**Carbonera (IT)**	Sidestream SCEPPHAR	**PHA, struvite, VFA**
Downstream SMARTechA	**London (UK)**	Formulation of recovered cellulosic and PHA materials+extrusion	**Biocomposite (Sludge Plastic Composite – SPC)**
Downstream SMARTechB	**Manresa (ES)**	Dynamic composting of P-rich sludge using minerals as bulking agents; bio-drying of cellulosic sludge	**P-rich compost, enriched with minerals; fuel for biomass plants**

SMART-Plant Business plan and market deployment strategy



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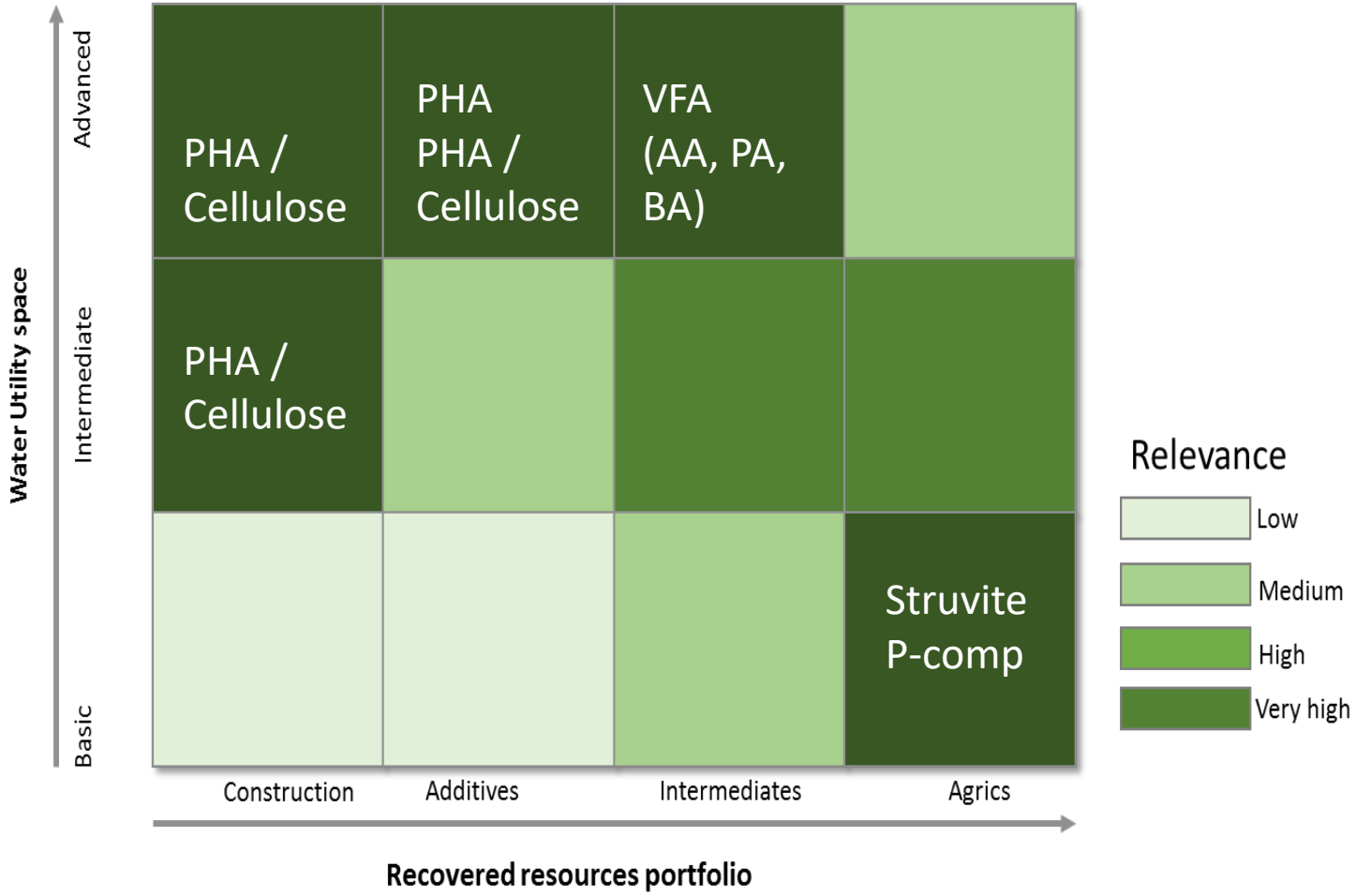
End use for recovered resources fit to water utility plants



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Barriers…and solutions?

- No quality standard = **No market** → REACH? END OF WASTE?
- No quality standard = **No market** → CEN JWG11?
- No customer acceptance = **No market** → Incentive-based policy? Impact on water pricing?
- No competitive price = **No market** → (for instance) use of PHA-rich sludge?
- No utility interest = **No market** → energy efficient integration of WWTP (to WRRF)?
- No regulation = **No market** → Innovation deal?

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The WATER PATHWAY (to deliver circular economy)

TRL = 8-9

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Water Recovery
NEWater - Singapore

Five NEWater plants produce total of 550,000 m^3/d

Source: Mc Carty – IWA-AD13

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Orange County Water District 2008
Wastewater Reuse (190,000 m^3/d)

Tertiary treatment using microfiltration, reverse osmosis, and ultraviolet/peroxide treatment

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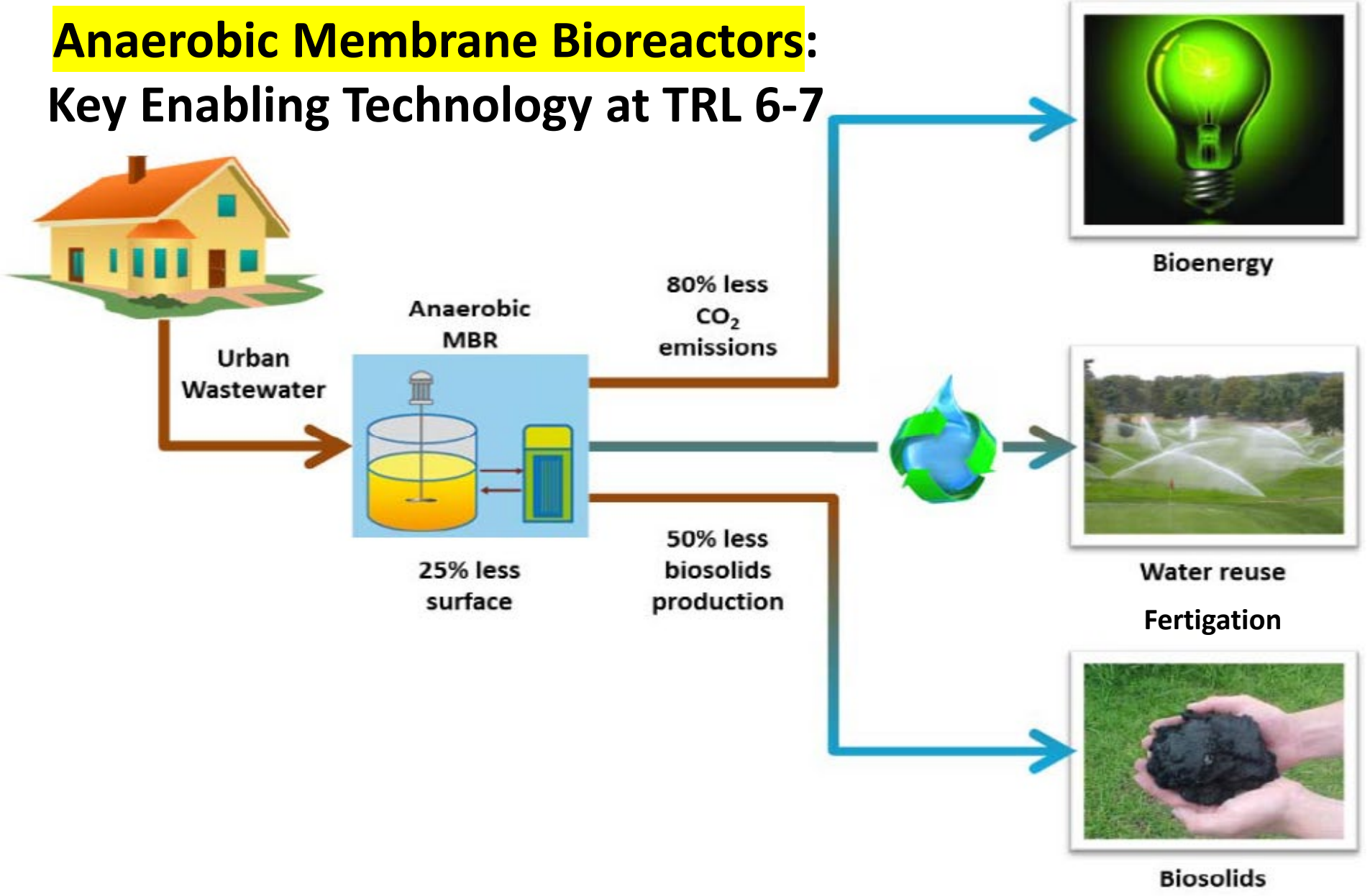
Anaerobic Membrane Bioreactors:
Key Enabling Technology at TRL 6-7



Source: Aurora Seco (2016)

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Innovation Deal for Circular Economy:

"Sustainable Wastewater Treatment Combining Anaerobic Membrane Technology and Water Reuse"

GOBIERNO DE ESPAÑA
MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO
CONFEDERACIÓN HIDROGRÁFICA DEL JÚCAR

GENERALITAT VALENCIANA

UNIVERSIDADE NOVA DE LISBOA

iem Institut Européen des Membranes

ÁGUAS DE PORTUGAL

EPSAR
ENTITAT DE SANEJAMENT D'AIGÜES

Lbe INRA

VNIVERSITAT DE VALÈNCIA

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ecofilae

SEWCU

WATER SERVICES CORPORATION

LEGAL BARRIERS AND BOTTLENECKS

- Benefits and feasibility of AnMBR technologies for UWW treatment have already been reported by the Action Group.

BUT…

- Current legislative framework keeps two main barriers for the reuse of AnMBR effluents:
  - ✓ Who is going to pay for water treatment, as Directive 2000/60/EC states the principle of recovery of the costs of water services.
  - ✓ Who is responsible for the health and environmental risks related to water reuse (as some regulation, e.g. RD 1620/2007 in Spain, establishes that end-users are responsible for the water quality).

Farmers and end-users of treated water should be considered not as potential consumers of the effluents, but as active participants of the wastewater treatment and its valorization.

- **National/Regional/Local authorities**
  - Confederación Hidrográfica del Júcar (Spain): National Authority in charge of river basin management of Júcar River.
  - Conselleria de Agricultura, Medio Ambiente, Cambio Climático y Desarrollo Rural (Spain): Regional Government Department of Valencia Region in charge of environmental, agricultural and water management.
  - Entidad Pública de Saneamiento de Aguas Residuales de la Comunidad Valenciana (Spain): Public Company of Valencia Region in charge of wastewater management.
  - Águas de Portugal (Portugal): Public Company which manages water supply and wastewater sanitation systems in Portugal.
  - The Energy and Water Agency (Malta): National Agency in charge of implementing government's national policies in the energy and water sectors.
  - Water Services Corporation (Malta): Public Company responsible for the complete drinking and waste water cycle in the Maltese Islands.

Innovation deals: partners

- **Universities**
  - Universidad Nova de Lisboa (Portugal)
  - Universitat Politècnica de València (Spain)
  - Universitat de València (Spain)
- **Research Centers**
  - Institut Européen des Membranes (France)
  - Laboratoire de Biotechnologie de l'Environnement of INRA (France)
- **Innovators**
  - H2020 SMART Plant Project consortium

Innovation deals: partners

- **SME/Consultancy**
  - ECOFILAE (France): this company develops solutions that will help stakeholders to assess and implement levers to cope with water scarcity and develop sustainable water reuse projects.
- **End-Users**
  - Canal de Riego del Río Turia (Spain): irrigation organization in Valencia.

Innovation deal objectives

Objective 1

- To promote a shift in the concept of water treatment facilities from Wastewater Treatment Plants to Water Resource Recovery Plants through the implementation of AnMBR technology, in line with the EU Action Plan for the Circular Economy.

Objective 2

- To promote the reuse of AnMBR effluent in agriculture by considering irrigation as part of the water treatment due to its nutrient removal capacity.

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Innovation deal: tasks

To identify legal barriers and obstacles for the reuse of water.

To promote coordination between entities and stakeholders involved in water management and use.

To disseminate results and conclusions to society.

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Thank you for your attention

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