

Put Sewage in your Gas Tank



Why flush value down the drain when it can move your car? There is more energy in wastewater than it costs to dispose of it - we just have to break away from the tradition inherited from the Romans, that all of the water needs to be directed to the *Cloaca Maxima* (the Greatest Sewer).

FP7 All-gas car fleet

With the All-gas project up to 20 cars per hectare can be fueled.



Introduction

The implementation of the circular economy requires a shift in thinking to one in which the minimal input of resources, avoiding waste and eliminating energy losses must be at the heart of our management models.

The three R model (Reduce, Reuse and Recycle) should be expanded to accommodate a few more ideas - Recover, Redesign and Rethink, to reap the full potential used water has.

In the field of water services, companies like [Aqualia](#) have been working for years in the development of technologies that can transform wastewater into a useful resource and radically change the paradigm of produce-use-dispose.

Traditionally wastewater treatment involves high energy input and, conversely, minimum reuse of the potential that the inherent resources could provide. Projects led by Aqualia, like [FP7 All-gas](#), [LIFE Methamorphosis](#), [LIFE Memory](#), [H2020 Run4life](#) or [Cien SMART Green Gas](#) successfully demonstrate the sustainable transformation of wastewater into reuse water while at the same time producing bio-energy, bio-fertilizers and bio-plastics.

As projects undertaken by the R&D department of Aqualia mature, the zero energy consumption of water recovery facilities is quickly becoming a viable future. The Company is moving away from the traditionally intensive use of resources in wastewater treatment towards self-sufficient processes that can even become net providers of energy and value.

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biofuel and higher value products such as fertilisers and plastics.

Frank Rogalla, Director of Innovation and Technology, Aqualia

Aqualia participates in a dozen large projects within EU research and development programs, such as LIFE or Horizon 2020, geared towards sustainability and the circular economy. "We collaborate with more than 20 universities and research centres in both Spain and across Europe. At the moment, our main efforts are aimed at achieving the use of wastewater for biofuel and higher value products such as fertilisers and plastics. We accompany this new paradigm with a smart water initiative, an ambitious technological innovation project that is pioneering better ways of communication with customers for more efficient management of the integral water cycle" states Aqualia's Director of Innovation and Technology, Frank Rogalla.

Taking the waste out of wastewater

One major project of Aqualia is [All-gas](#), carried out under the EU FP7 program, which demonstrates, on a large scale, the sustainable production of algae bio-fuels using municipal wastewater. The complete process chain has been built with a cultivation area of 2 hectares, making wastewater treatment energy self-sufficient, capable of powering up to 40 cars, and recycling the nitrogen and phosphorus into microalgae biomass and bioenergy.

“ This is a true revolutionary moment, giving wastewater a wholly new perspective, by demonstrating for the first time in the world that cars can run exclusively on algae biofuel.

Frank Rogalla, Director of Innovation and Technology, Aqualia

"The FP7 All-gas project started in May 2011 and has reached its main objective at the beginning of December 2017: the first large demo plant, inaugurated by the EU Commissioner for Energy, Miguel Arias Cañete" said Mr Rogalla. "This is a true revolutionary moment, giving wastewater a wholly new perspective, by demonstrating for the first time in the world that cars can run exclusively on algae biofuel."

At full scale, the results show that algae biofuel is four times more efficient than the best conventional biofuels: sugar ethanol or palm oil diesel can only power up to 5 cars per ha, whereas with algae grown on wastewater, 20 cars per ha can be fueled and no fresh water, no arable land and no artificial fertilizers are used. On the contrary, wastewater nutrient removal and disinfection for reuse is achieved for free - while producing a sustainable fuel with a positive energy balance.

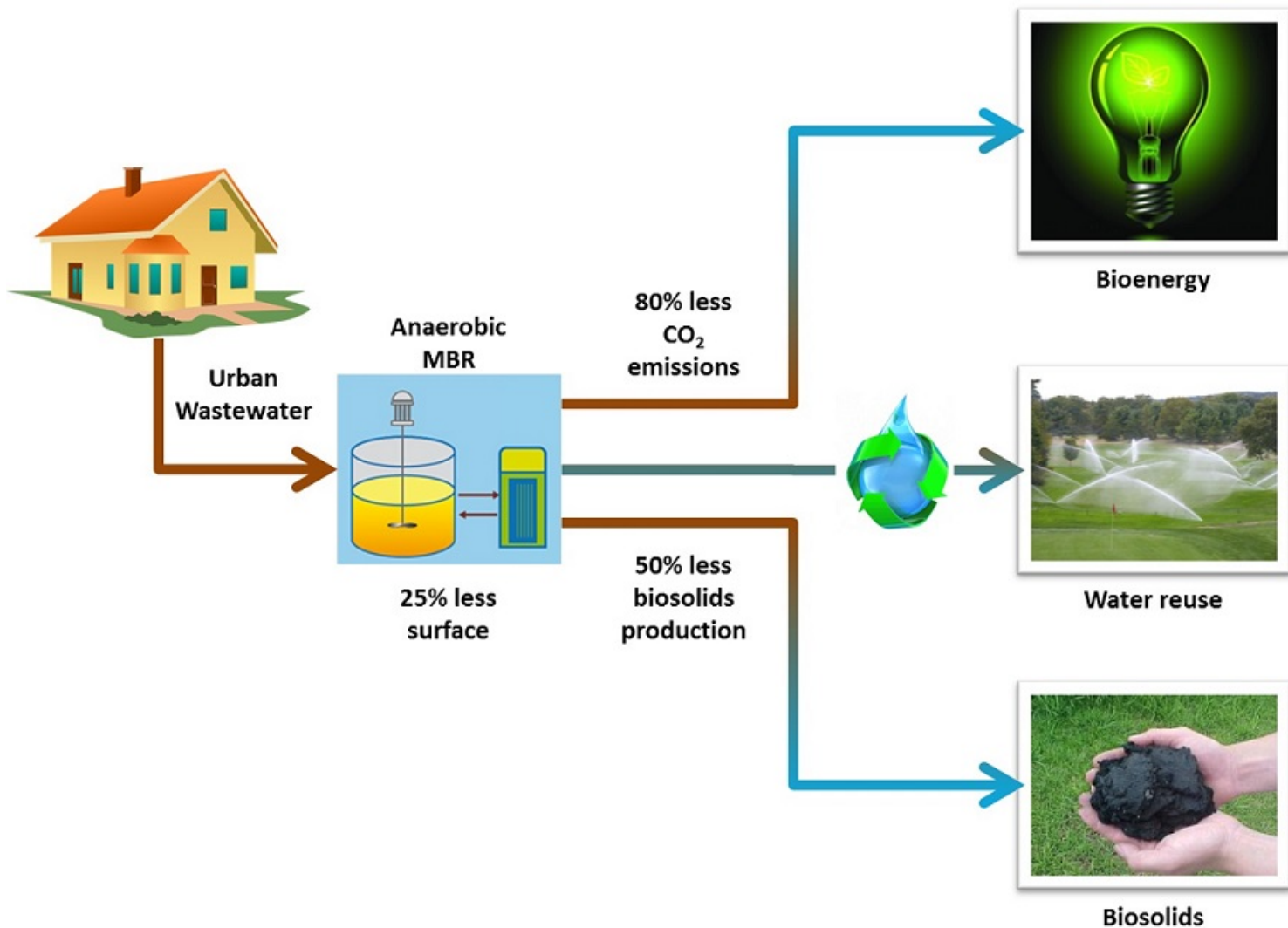


EU Commissioner for Energy, Miguel Arias Cañete, refueling a vehicle with wastewater biogas from algae at the inauguration of the first large demo plant.

Currently, as the last step of the project, a fleet demonstration is taking place, where 5 production CNG vehicles are clocking up more than 70 000 km to show that the wastewater biofuel from algae is meeting all vehicle standards for biomethane. The next algae plant is under planning with the new [H2020 project Sabana](#), where up to 5 ha of cultivation should yield biomass for a biorefinery, producing biomass for energy and biofertilizers.

Two other projects led by Aqualia, under the EU LIFE program patronage are [Methamorphosis](#) and [Memory](#). In them, AnMBRs (anaerobic membrane bioreactors) are at the core of converting wastewater into energy and getting a final effluent quality suitable for reuse with a positive energy balance and a zero carbon footprint.

All projects involve the **ABAD Bioenergy process**, a simple way to produce biogas ready to be used in vehicles. This technology, patented by Aqualia and deployed in three WWTPs in the **CIEN Smart Green Gas** project, is used to clean and refine biomethane for the local Aqualia vehicle fleet, providing an example of a new paradigm in transportation.



LIFE Memory Project flow chart.

“ The motto is ‘minimise impact, maximise return’, to get the most from the precious raw material that is water and waste.

Frank Rogalla, Director of Innovation and Technology, Aqualia

Another project where Aqualia is the major industrial partner, [H2020 Incover](#), displays three added-value plants that treat wastewater (municipalities, farms and food and beverage industries) at three demonstration sites. These 3 plants are implemented, assessed and optimised concurrently and will generate value from wastewater through the following three methods:

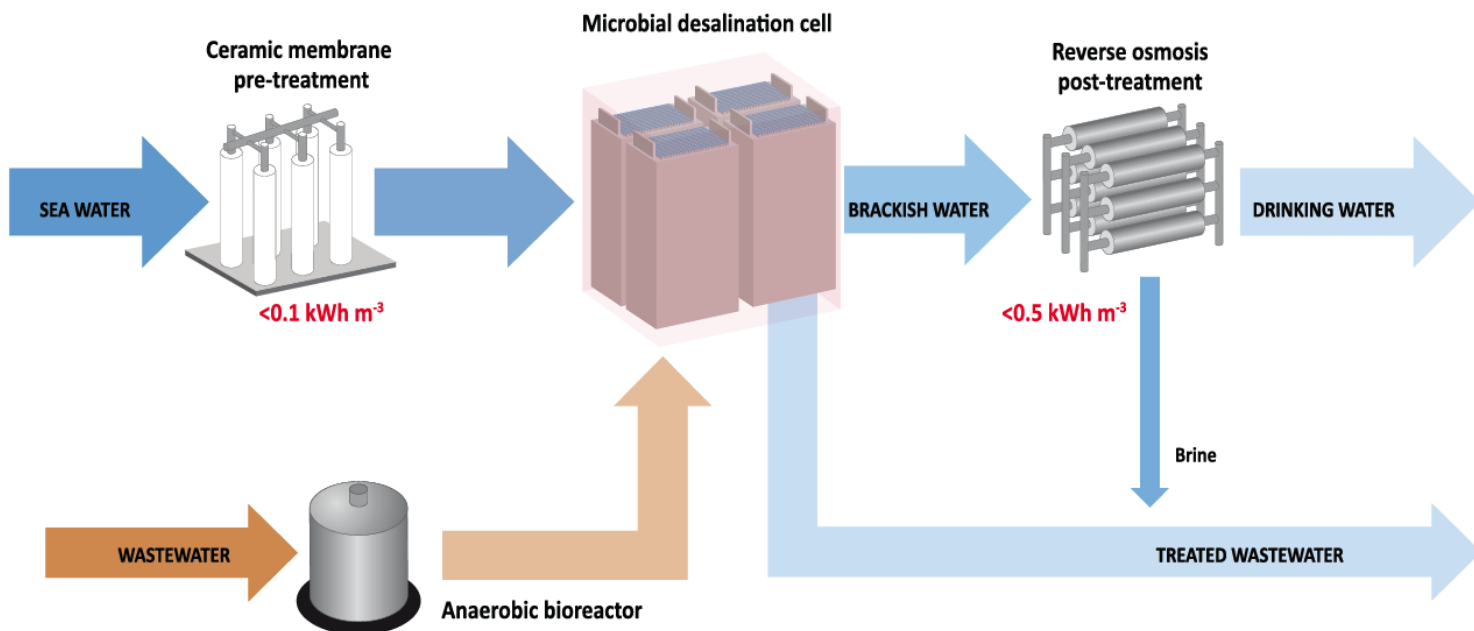
- 1) Bio-production (bio-plastics and organic acids) via microalgae/bacteria and yeast biotechnology
- 2) Near-zero-energy plant providing upgraded bio-methane via pre-treatment and anaerobic co-digestion systems
- 3) Chemical recovery (N, P) and reclaimed water via adsorption, biotechnology based on wetlands systems and hydrothermal carbonisation.

In June 2017, together with project partners in Sweden, The Netherlands and Belgium, Aqualia kicked off its latest project – [H2020 Run4Life](#) (Recovery and Utilisation of Nutrients for Low

Impact Fertilizers). The main objective of this particular project is to recover nutrients from domestic waste streams for applications in agriculture.

“Run4Life proposes an alternative strategy for improving nutrient recovery rates, based on a decentralised treatment of segregated black water (toilet wastewater), grey water (other domestic wastewaters) and organic kitchen waste,” explained Mr Rogalla. “Different innovative technologies are combined, such as new ultra-low water flushing vacuum toilets yielding highly concentrated black water, hyper-thermophilic anaerobic digestion as one-step process for fertilizer production and bio-electrochemical systems for nitrogen recovery.” The project will be slated to conclude in 2021.

Another revolutionary way to use wastewater as energy that Aqualia is helping develop is microbial desalination. The first prototype is under construction with the [H2020 project Mides](#), to be placed at the Reverse Osmosis plant in Denia (Alicante). In a process developed by the research institute Imdea, a microbial desalination cell uses the organic matter in effluents as energy for bacteria to move electrons, and achieves significant salt reduction without electrical energy or pressure. The prototype results show that the electricity need, typically 4 kWh/m³ in conventional reverse osmosis, can be lowered by up to tenfold, while simultaneously with desalinated water, produce reuse water from effluents.



H2020 MIDES Project flow chart.

Mr Rogalla emphasized that the focus within the research and development activities across Aqualia runs parallel with its sustainability scheme:

“The motto is ‘minimise impact, maximise return’, to get the most from the precious raw material that is water and waste.” To support this perspective, Aqualia has extended its R&D department in recent years and, thanks to the support of EU programs, the amount of investment in this area runs into millions of euros annually.”



Aqualia covers the needs of all parties, both private and public, along the complete water cycle, providing water for human, industrial and agricultural purposes and serving 22.5 million users of 1100 municipalities in 22 countries (in Europe: Spain, Italy, Portugal, Czech Republic, Poland, Romania, Montenegro, Bosnia, and Serbia; in the Americas: Mexico, Panama, Colombia, Ecuador, Chile and Uruguay; and in Northern Africa and the Middle East: Algeria, Tunisia, Egypt, Saudi Arabia, UAE, Qatar and Oman).

In 2018 Aqualia received the "IDA Exceptional Utility Leader in Water Reuse and Conservation Award" in recognition for its outstanding management of public and private services that have successfully implemented innovative water reuse and conservation projects.

How much
could you save
in phosphorus
removal?
Try our calculator!

kemira

The advertisement features a vertical image of a city skyline reflected in a body of water. The water is heavily covered in green algae. A small white sailboat is visible in the lower right corner of the water. The text is overlaid on the image in white, bold, sans-serif font.