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## Impact of a cocktail of nanomaterials on the operation of wastewater treatment plant and the valorization of biosolids

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More than 1800 Engineered Nanomaterial (ENM)-enabled products are currently on the market<sup>1</sup>. The ENMs released will go down the drain to wastewater treatment plants (WWTPs). After water treatment, the residual sludge is valorized in digesters for biogas production and in agriculture, with land application of the biosolids. NanoSTEP program<sup>2</sup> addresses the behavior, fate and impacts of ENMs on the WWT operation and the energy recovery from biosolids through an interdisciplinary approach.

The ENMs were processed to mimic their lifecycle (combusted CeO<sub>2</sub>-based diesel additive<sup>3</sup>, sulfidized nanoAg, and two nanoTiO<sub>2</sub> used as photocatalyst and UV absorbant). ENMs were chronically added to an aerobic bioreactor supplied by wastewater. Sludge from the process then fed an anaerobic digester. The ENMs concentrations fitted the predicted environmental concentrations in WWTPs<sup>4</sup>. We monitored the operation parameters, wastewater treatment efficiency, microbial enzymatic activities and communities, and biogas production. We analyzed the partitioning of ENMs between the water and solid phases and the speciation of Ce and Ag in the biosolids.

<sup>1</sup> <http://www.nanotechproject.org/cpi/>

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<sup>3</sup> Auffan, M., Tella, M., Liu, W., Pariat, ... & Rose, J. (2017). Structural and physical-chemical behavior of a CeO<sub>2</sub> nanoparticle based diesel additive during combustion and environmental release. *Environmental Science: Nano*, 4(10), 1974-1980.

<sup>4</sup> Lazareva, A., and Keller, A.A. (2014). Estimating potential life cycle releases of engineered nanomaterials from wastewater treatment plants. *ACS Sustainable Chemistry & Engineering* 2, 1656-1665.