NO-WASTE

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Utilization of Industrial by-products in Environmental Protection

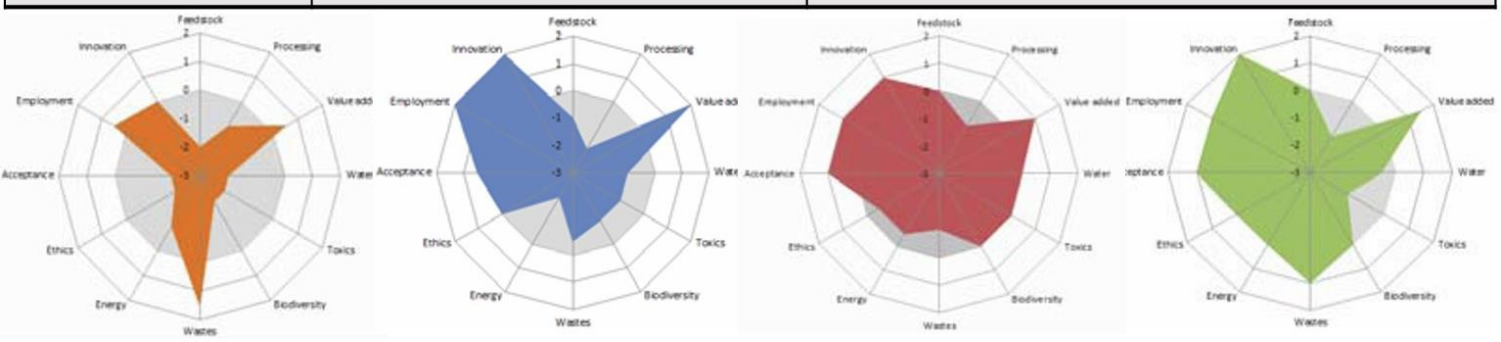
NEWSLETTER 2

Triple bottom line approach in production processes sustainability assessment

Within the process industry, concepts such as eco-efficiency, green chemistry and green engineering are available: **An eco-efficient process generates more products or services, but less waste and pollutants** from a reduced amount of resources, while principles of green chemistry (by Anastas & Warner 1998) and green engineering (by Anastas & Zimmerman 2003) set a framework to engineers for the development of more efficient and environmental friendly chemical processes.

Sustainability of production processes may be explained by the wider concept also known as the "triple P" (people, planet and profits) and including the economic, environmental and social aspects. This means that **production processes should be environmentally responsible, economically profitable and socially acceptable generating well-being for the society**. In practice, these three aspects usually overlap each other without any clear borders.

Economic impacts	Environmental impacts	Social impacts
Feedstock price	Biodiversity and land use change	Customer acceptance and social dialog
Processing costs	Hazardous and toxic material usage	Ethicality and competing demand of raw materials
Value added	Emissions (*e.g.* GHG)	Employment effects
	Energy	Health and safety issues
	Wastes vs. by-products	Innovation and education potential
	Water consumption	



Crop biomass: corn

Non-edible crop: straw

Food by-product: whey

Wood-based biomass: saw dust

Niemistö J, Saavalainen P, Pongrácz E & Keiski RL (2013), Biobutanol as a potential sustainable biofuel - Assessment of lignocellulosic and waste-based feedstocks. Journal of Sustainable Development of Energy, Water and Environment Systems 1(2) 58–77.

The evaluation of sustainability is complex and challenging. In order to choose the relevant indicators representing the impacts and enabling comparable results, harmonization and widely accepted application-specific criteria and guidelines are needed. In the case of biofuel production, in the life cycle assessment (LCA), greenhouse gas (GHG) emissions and land use as environmental indicators have been commonly accepted. It is however very important to take also economic and social aspects into consideration in process design. The figure on the left is an example of sustainability assessment of the raw materials for biobutanol production.

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WP 1 Hydrogen and synthesis gas production from waste
University of Poitiers

WP 2 Valorisation of wastes from olive and argan production
University of Chouaib Doukkali

WP 3 Production of valuable chemicals from CO_2 and organic gases
University of Oulu

WP 4 R&D on the HTC technology to valorize industrial by-products and wastes,
Federal University of Applied Sciences, Goiania

WP 5 Utilisation of methane originating from coal mining
Dalian Institute of Chemical Physics

WP 6 Research on the HTC process: Product design
Trier University of Applied Science

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Newsletter by University of Oulu, FINLAND

Environmental pollution is a global problem. Unsustainable production of goods, improper treatment of waste, emissions to air and water, and inadequate legislation cause growing problems to human beings and nature. The urgent need for reducing environmental load coming from industry, agriculture and communities demands for novel ways of thinking. NO-WASTE collaboration will attack to this current problem by developing environmentally sound and sustainable possibilities to utilize and valorize different wastes and emissions. **The aim is to create valuable new products and renewable energy to minimize the waste as well as emissions to air and water.** The frame of operation of NO-WASTE allows a great number of green chemistry related possibilities to create networks of knowledge between the scientists of different fields (science, engineering, economy, health) in different countries.