ReNEW
Resource innovation Network for European Waste

Investing in Opportunities
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INTERREG IVB

Life cycle assessment of biobased chemical building blocks made from European waste streams

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Introduction

Many drivers exist to persuade EU businesses to embrace the opportunities of the circular economy. However, the challenges faced by companies, particularly among SME's, in the drive for resource efficiency include access to funding, knowledge and capability, and ability to implement cost-effective technological solutions. It was these factors that inspired the creation of the ReNEW network. **ReNEW, 'Resource innovation Network for European Waste'**, is a €5 million project funded by the Interreg IVB North West Europe scheme aiming to increase cooperation between research and business endeavours to create value from waste by optimising novel technologies for extracting materials from waste and their reuse in the supply chain. ReNEW also aims to inform local, national and European policy makers, and to share transnational best practice and improve specific support to meet the innovation needs of the waste sector.

Within the frame of this project, several technologies are investigated by partners to improve the valorisation of organic wastes in chemicals such as the production of **furfural** ($C_5H_4O_2$ - CAS 98-01-1) by the **chemical hydrolysis of contaminated/hazardous woody biomass.**

Materials and Methods

Goal definition

The aim of this study is to assess the environmental impacts of the production of furfural from (contaminated) woody biomass hydrolysed with formic acid.

Methods

- Life Cycle Assessment methodology, ILDC 2011 0
- ReCiPe 2008 (European hierarchist version 1.11, update 2014)
- This study is done in accordance with the ISO standards 14040 and 14044
- SimaPro 8.0.4 software (PRé-Consultant)
- Ecoinvent 3.1 database

The functional unit is 1 kg of furfural.

A model for the process is developed by the University of Limerick (IE) (project partner). The LCA is based on results obtained with Aspen-Hysis simulation software (Figure 1) (hypothesis: perfect energetic integration – complete heat recovery).

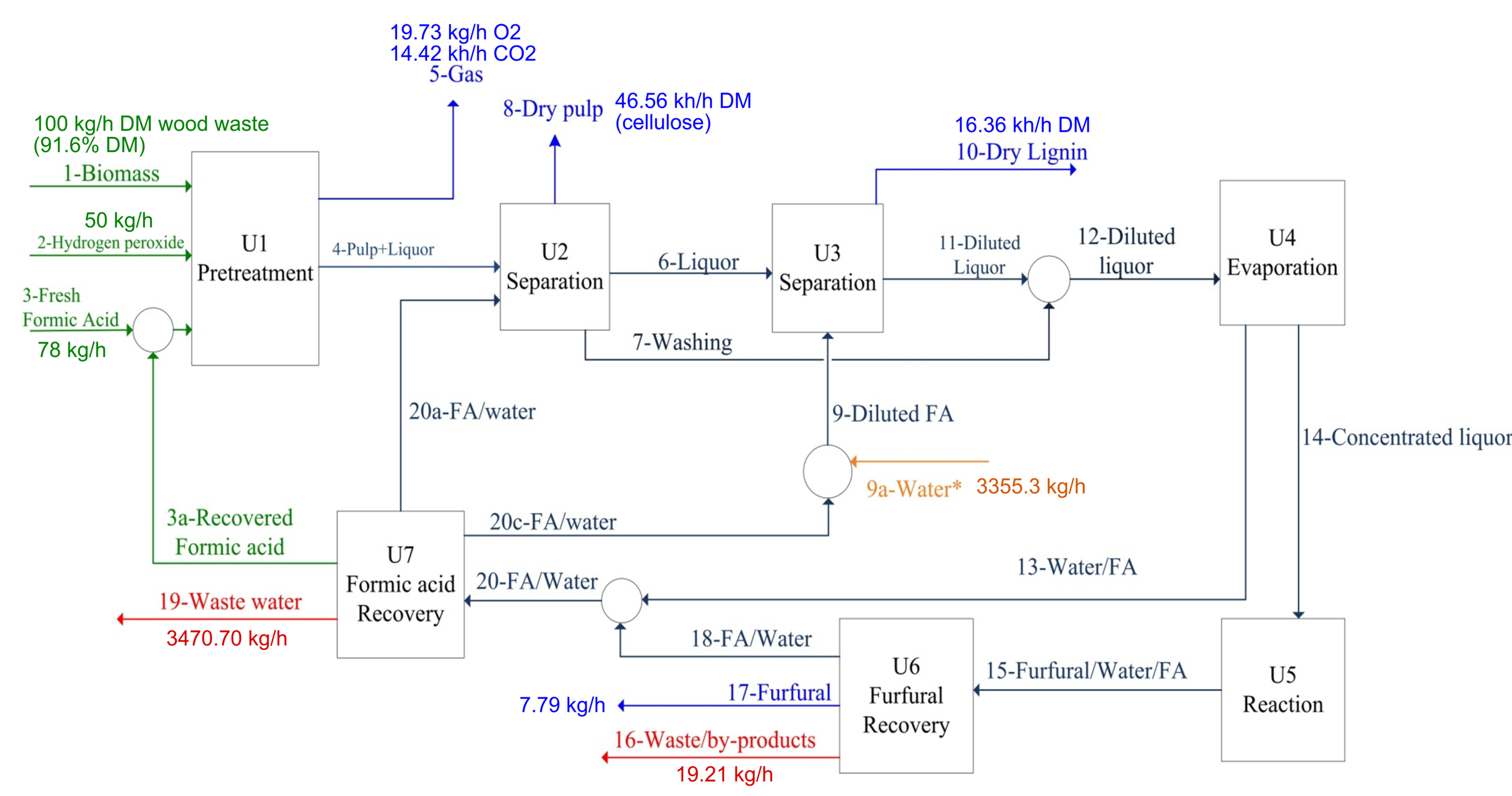


Figure 1. Furfural production from woody biomass

Inventory: included: chemicals, energy (heat supply/recovery, electricity), Ireland electricity mix (86.31% fossil fuels), wastewater treatment
excluded: wood grinding, reactors and columns vessels, pumps and other material

Results and Discussion

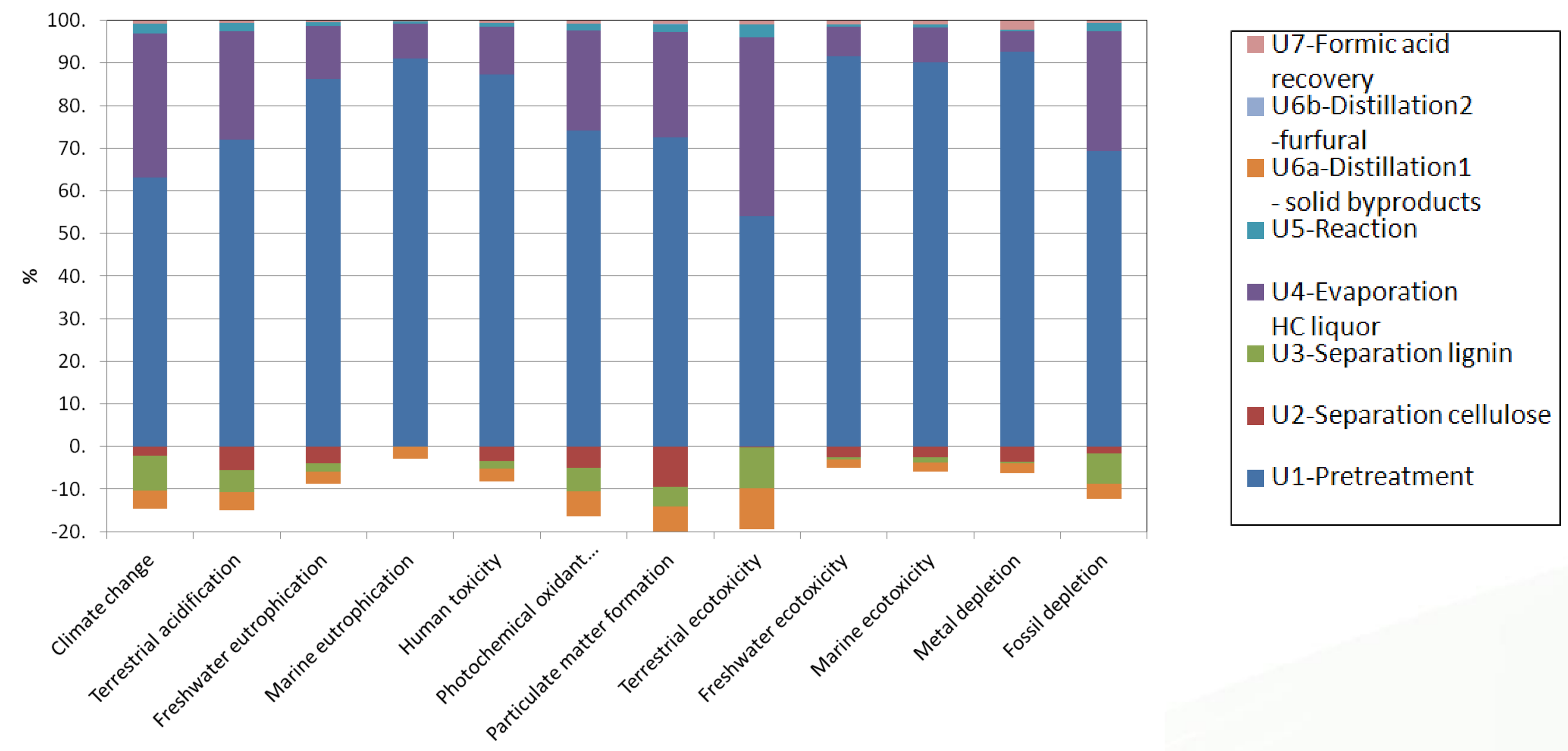


Figure 2: Relative contribution of each step of the production of 1 kg of furfural

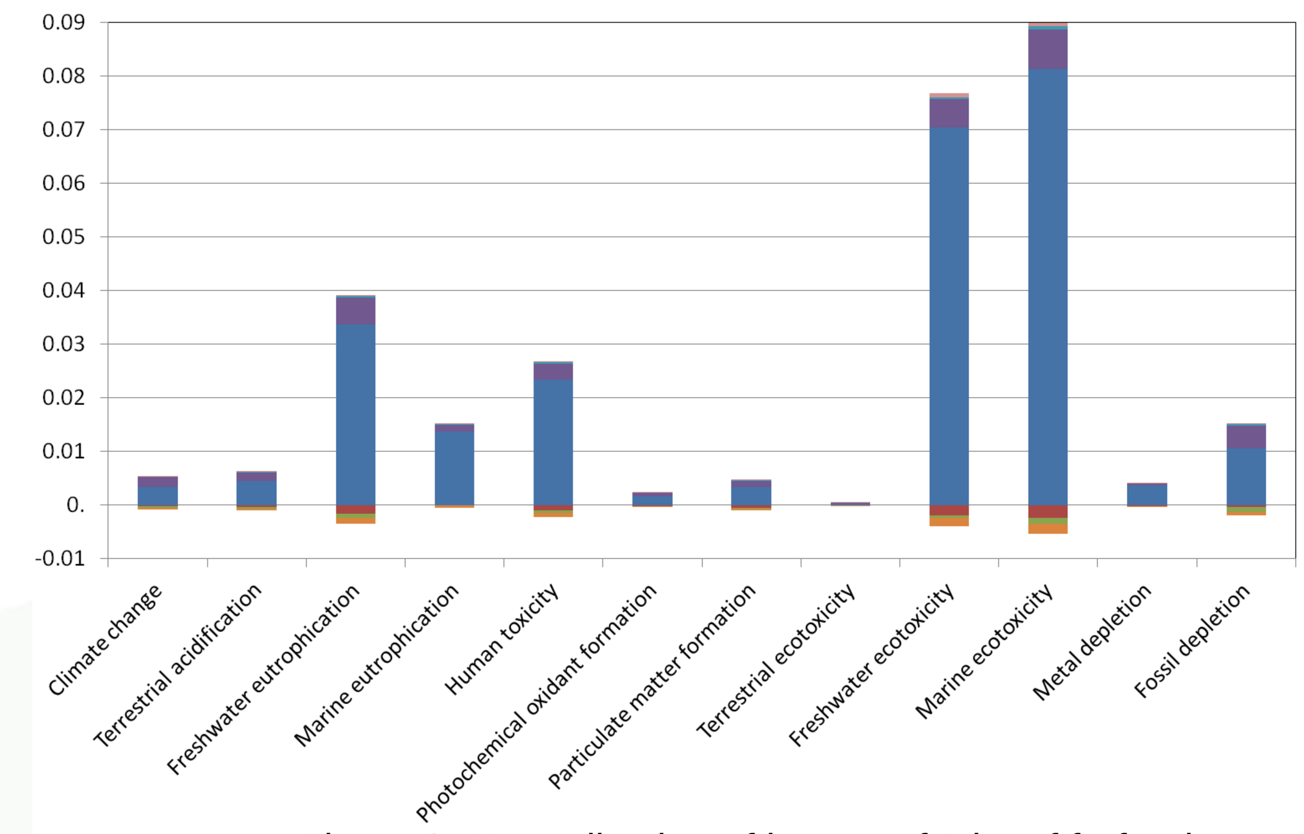
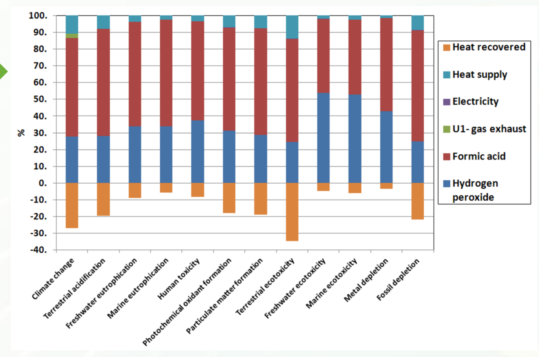


Figure 3: Normalisation of impact of 1 kg of furfural

- **Most impacting steps:** (Figure 2)
  - Unit 1: Pretreatment: use of formic acid and hydrogen peroxide
- **Negative impacts:** system boundaries expansion
  - Unit 2: separation of cellulose: avoided cellulose fibres
  - U nit 3: separation of lignin: heat from burnt lignin
  - Unit 6a - distillation n°1: solid by-products: heat (burnt)



- **Most impacted categories:** (Figure 3)
  - Ecotoxicity (fresh and marine water)
  - Eutrophication (fresh and marine water)
  - Human toxicity
  - Fossil fuel depletion (cf. IE mix)

Conclusions

A preliminary life cycle assessment of the production of furfural from (contaminated/hazardous) woody biomass is done. The most impacting part is chemicals consumption, especially formic acid. Major improvements have to be done to limit the environmental impacts on water (ecotoxicity, eutrophication).

The model has to be enhanced but it gives ways to optimise furfural production from lignocellulosic wastes, such as the use of biobased formic acid, and water recycling. The results will be compared to the business-as-usual route to produce furfural (to be calculated - data not available in common databases or literature).

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