SOCIAL LIFE CYCLE ASSESSMENT OF RENEWABLE NATURAL GAS

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INTRODUCTION

Systems based on biogas generation from waste and subsequent upgrading to **renewable natural gas (RNG)** have gained attention as a relevant option in the path towards a global sustainable energy system. This has gone hand in hand with the development of technical, economic and environmental evaluations to measure the performance of those systems [1]. In contrast, social analysis of RNG has not yet been thoroughly addressed. This work uses the **Social Life Cycle Assessment (S-LCA)** methodology along with a robust **supply chain protocol** to evaluate the social performance of RNG from a system including manure fermentation and biogas methanation with electrochemical hydrogen in Spain.

DEFINITION OF THE CASE STUDY

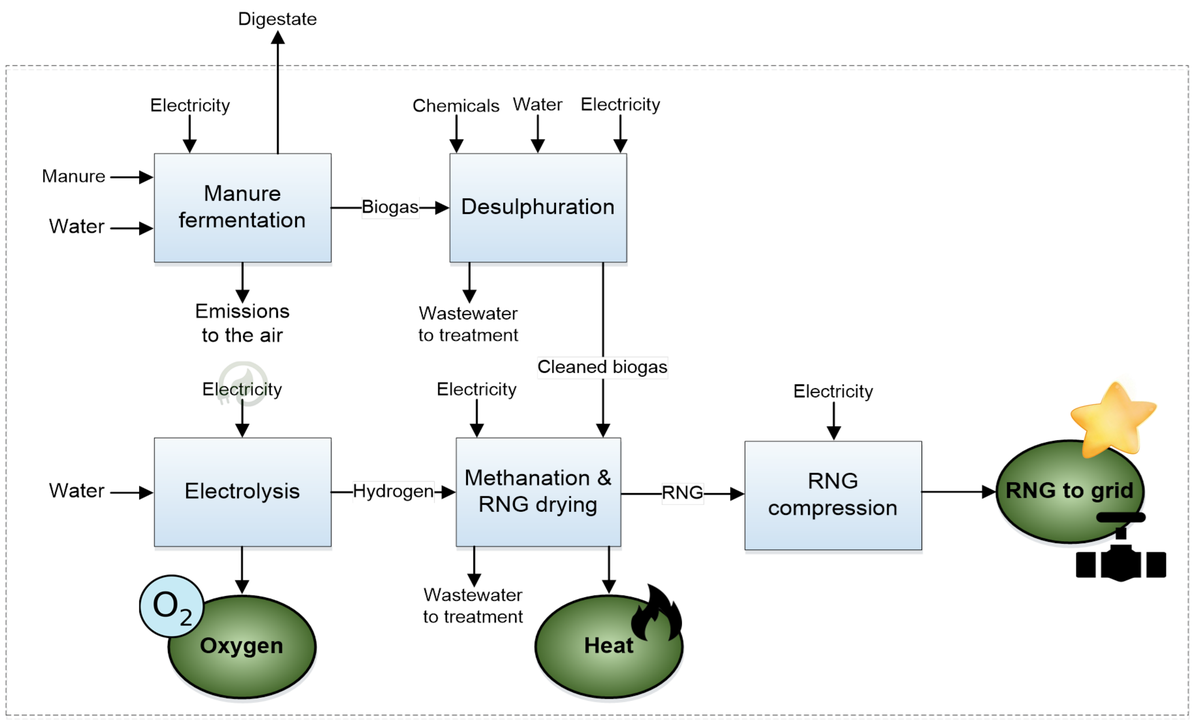

Figure 1: Diagram of the RNG system.

- The **system** is composed of five main technological installations in Spain: biomass fermentation plant, biogas cleaning unit, electrolysis unit, methanation unit, and RNG compression unit (Figure 1) [1]. A polymer electrolyte membrane (PEM) electrolyser powered by renewable electricity was considered for hydrogen production.
- The representative **supply chain** of the RNG system presents a three-tier structure with more than 30 unit processes. This was built by a combined use of life cycle inventory and trade databases [2].
- **Social life cycle inventory data** of the RNG system derive from techno-economic assessment [1] (economic flows and working hours of foreground processes) and the PSILCA database [3] (working hours of background processes).
- The **functional unit** of the study is 1 kg of RNG.

RESULTS AND DISCUSSION

- Six **social life-cycle indicators** (child labour, drinking water coverage, gender wage gap, health expenditure, illiteracy, and women in the sectoral labour force) of the RNG system were evaluated using the **PSILCA method** [3].
- **Four social hotspots** were identified (Figure 2): construction and maintenance of the facility in Spain (regarding, e.g., women in the sectoral labour force and gender wage gap, respectively), production of titanium plates in Senegal for electrolyser manufacturing (regarding, e.g., child labour), and crude oil extraction in Russia associated with diesel as a heat source in methanation reactor assembly (regarding, e.g., drinking water coverage).

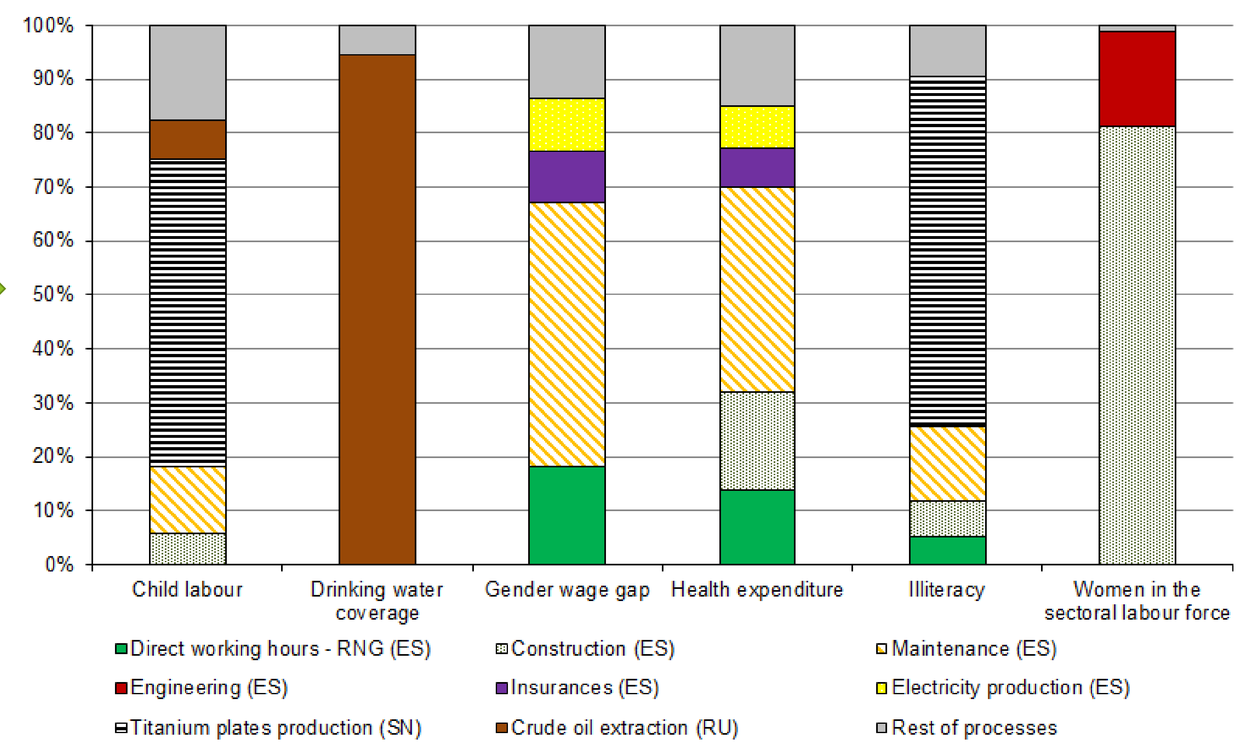

Figure 2: Process contribution to the potential social impacts of the RNG system (the label "rest of processes" includes those processes with individual contributions below 5%).

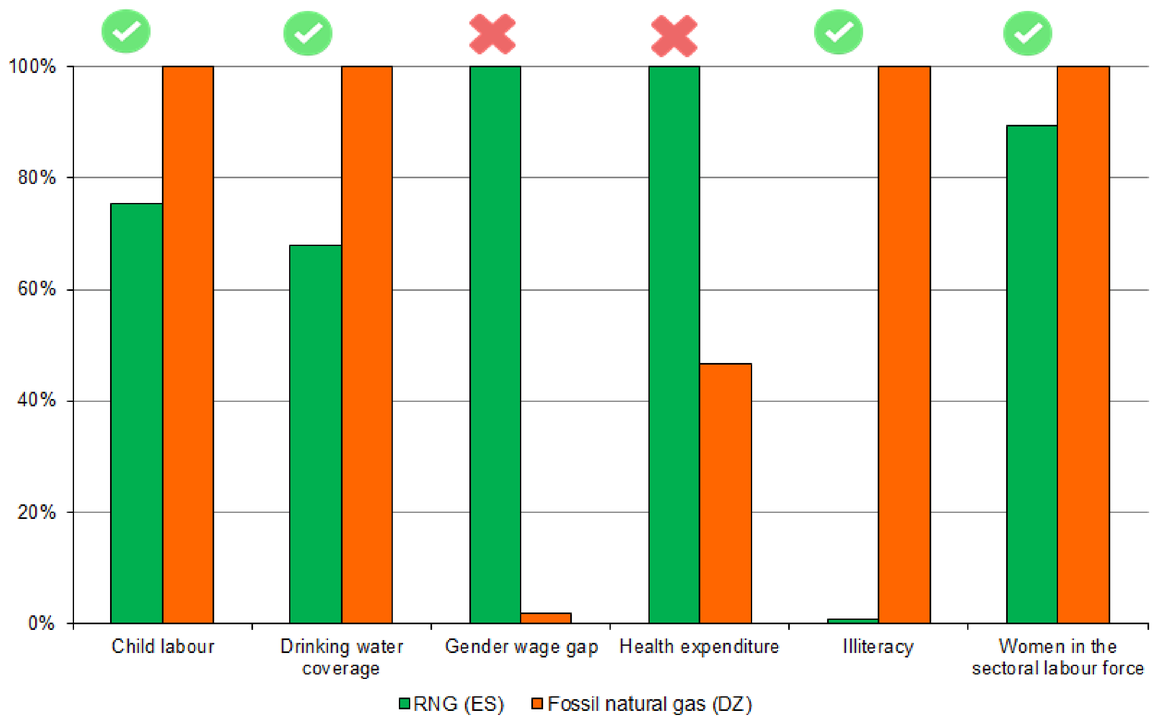

Figure 3: Social life-cycle benchmarking of RNG against fossil natural gas.

- When comparing the social life-cycle profile of RNG with that of **fossil natural gas produced in Algeria**, the identification of the most appropriate system was found to be highly dependent on the specific indicators under consideration (Figure 3).
- For the selected set of life-cycle indicators, **RNG** would involve a **better social performance** than conventional natural gas in four out of six indicators.

CONCLUSIONS

Results suggest a high potential for a favourable social performance of RNG once measures oriented towards an increased overall process efficiency are implemented.

REFERENCES

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