Hydrogen from biomass with carbon capture

Project details	
Project title	High performance, nano-structured CO_2 sorbents to improve the selective generation of hydrogen from biomass fuels
Participant	University of Sydney, Australia

A breakthrough in commercial-scale hydrogen production that also avoids CO_2 emissions to the air is being pursued through E.ON's International Research Initiative.

In a new gasification technique, renewable biomass material and non-recyclable industrial waste would be used to create hydrogen, while the CO_2 would be captured for storage.

At the heart of the process is a novel, high performance, multi-cycle CO_2 sorbent, created with nanotechnology, which also catalyses more hydrogen production during gasification.

This research is targeting large-scale production of hydrogen as a clean-burning carrier of energy. It aims to enable sufficient quantities, from sustainable sources, to support development of a hydrogen economy with fuel cells, engines and burners that release energy with water as the only emission.

The approach differs from current hydrogen production methods, most of which use fossil fuels and involve the release of CO_2.

The project was formulated by the Laboratory for Sustainable Technology at the University of Sydney in New South Wales. It was put forward by the laboratory director, Dr Andrew Harris, who is the project manager, and Dr T. Church.

In preparing the proposal, the university discovered that research and studies into biomass gasification with carbon capture gave no comprehensive overview of all the variable factors involved in maximizing hydrogen production.

Additionally, work was needed to develop plant scale-up proposals and to optimize the factors for the conversion of both biomass and waste fuels, such as the proposed scrap tires and plastics.

The university identified the major barrier to the scale-up of the gasification and capture processes as being the need for a CO_2 sorbent that is highly active and chemically stable.

To meet this challenge, it will seek to improve sorbents, such as calcium oxide, where the physical characteristics have major impacts on CO_2 capture performance and lifecycles.

There are two targets for the project:

- To use nano-structuring to develop hybrid materials ¬– templates of aluminosilicate and silicon carbide to which the sorbent will be added. These will provide physical characteristics that improve performance and durability beyond what is possible with a sorbent made from a single component.

  Long-term viability in a biomass gasification and carbon capture process requires that CO_2 sorbents must keep a high level of activity even after 500 capture-and-release cycles.
- To enable the hybrid materials to double as catalysts in the gasification process. This will allow key stages in the network of complex gasification reactions to go-ahead with less energy. Achieving a more efficient process will result in more hydrogen per unit of fuel without increasing the overall energy input.

The research program involves laboratory and pilot-scale nanoparticle synthesis and hydrogen generation experiments. The hybrid materials showing the most promise as catalytic sorbents will be produced on a larger scale and tested in the university's fluidized bed gasification reactor.

Realizing the aims of the project could be an important step in an industry which is seeking a clean, safe, secure and economical energy solution as an alternative to fossil-fuel generation.

The results will further inform consideration of the potential for hydrogen to play a strategic role in future energy provision in a way that avoids CO_2 emissions, and utilizes a sustainable supply of renewable biomass material and waste that would otherwise require disposal.

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