



NTNU – Trondheim
Norwegian University of
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Hydrogen: Key to flexible energy systems with CO₂ capture to balance variable renewables

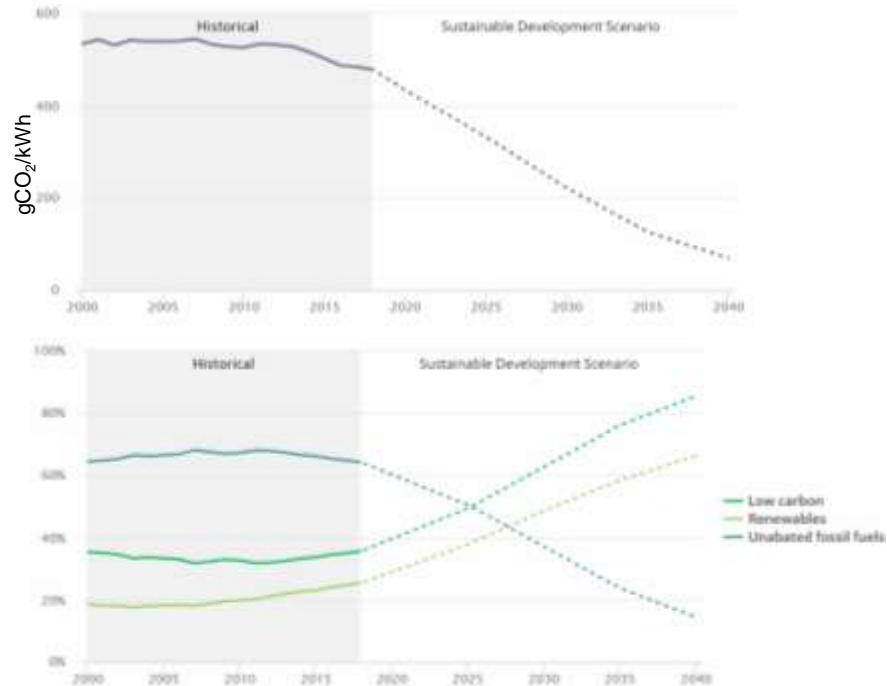
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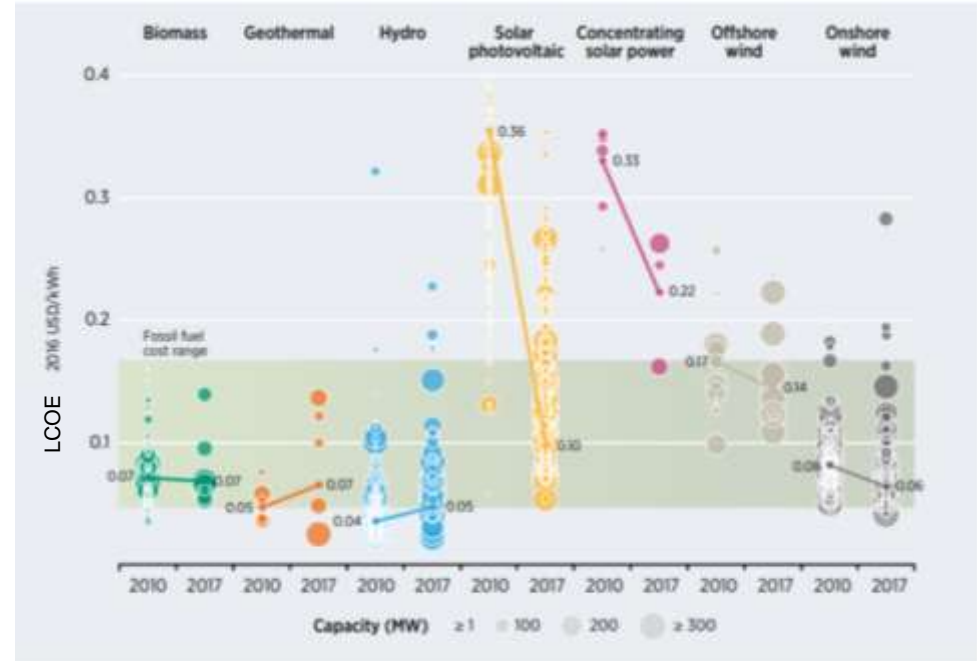
Project GaSTech consortium members: Ambrose Ugwu (NTNU), Jan Hendrik Cloete (SINTEF), Schalk Cloete (SINTEF), Abdelghafour Zaabout (SINTEF), Shahriar Amini (SINTEF/NTNU), Szabolcs Szima (Babeş-Bolyai University (UBB)), Szabolcs Fogarasi(UBB), Ana-Maria Cormos (UBB), Calin-Cristian Cormos (UBB)



Renewables in sustainable development scenario

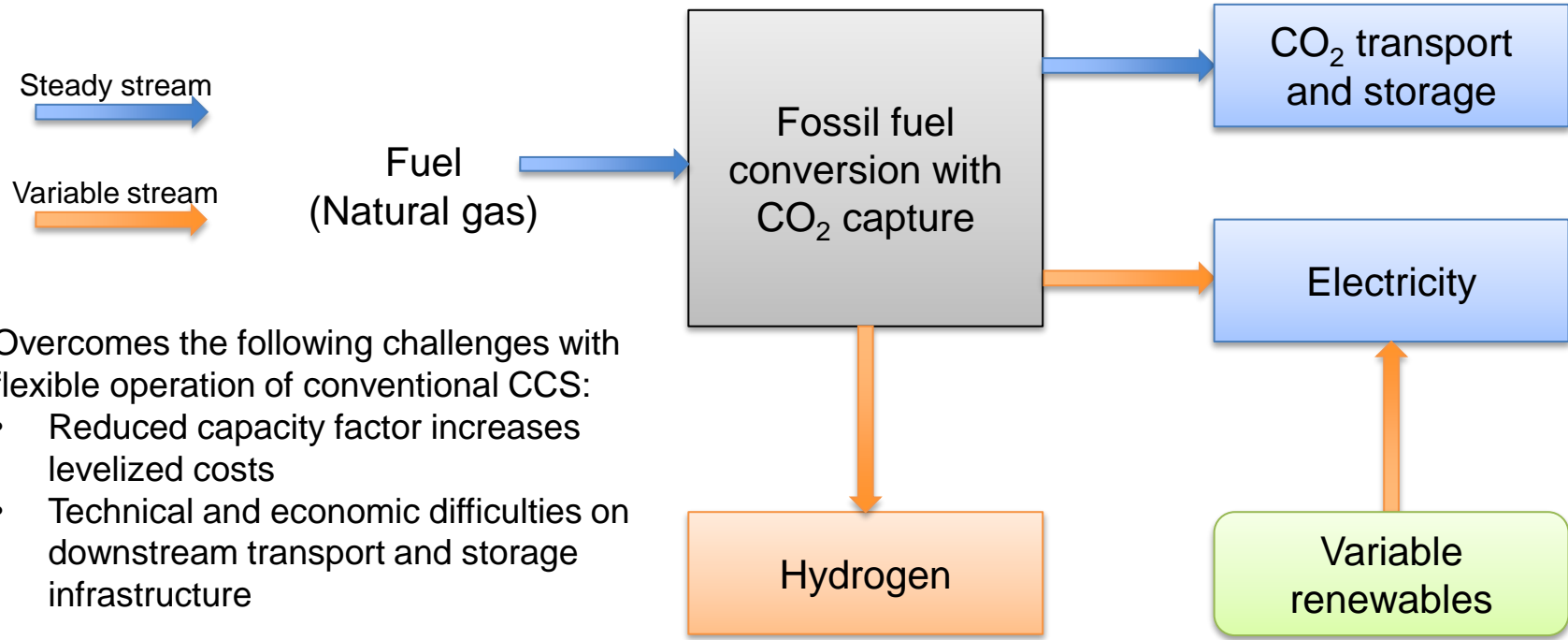


Source: IEA. Tracking clean energy progress. International Energy Agency; 2018
<https://www.iea.org/tcep/>. Accessed date: 12 June 2019.



Source: IRENA. Renewable power generation costs in 2017. International Renewable Energy Agency; 2018.

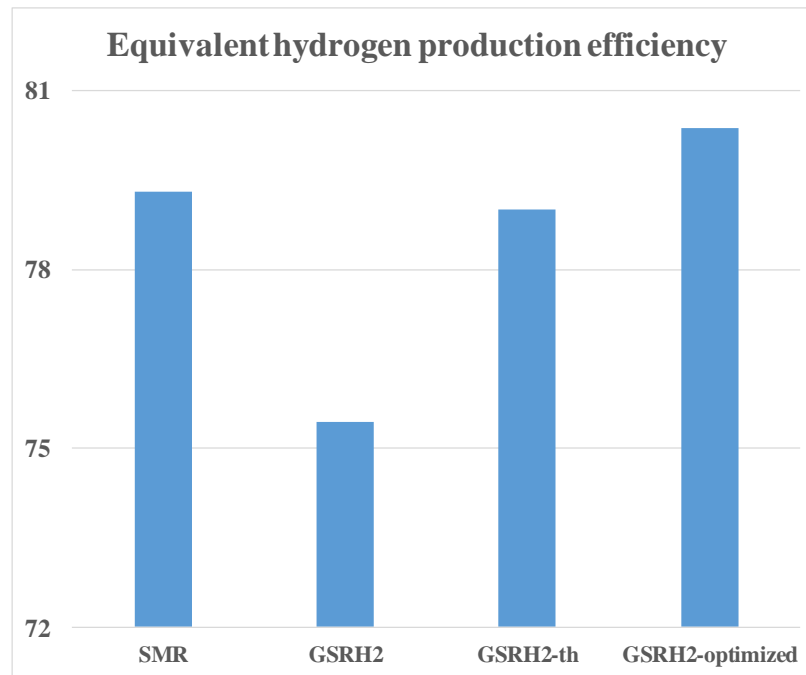
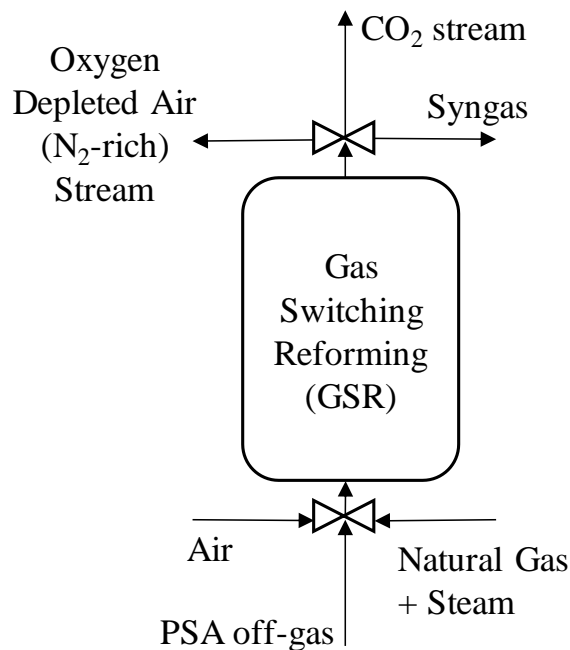
Hydrogen the key for flexible energy systems with CO₂ capture



Overcomes the following challenges with flexible operation of conventional CCS:

- Reduced capacity factor increases levelized costs
- Technical and economic difficulties on downstream transport and storage infrastructure

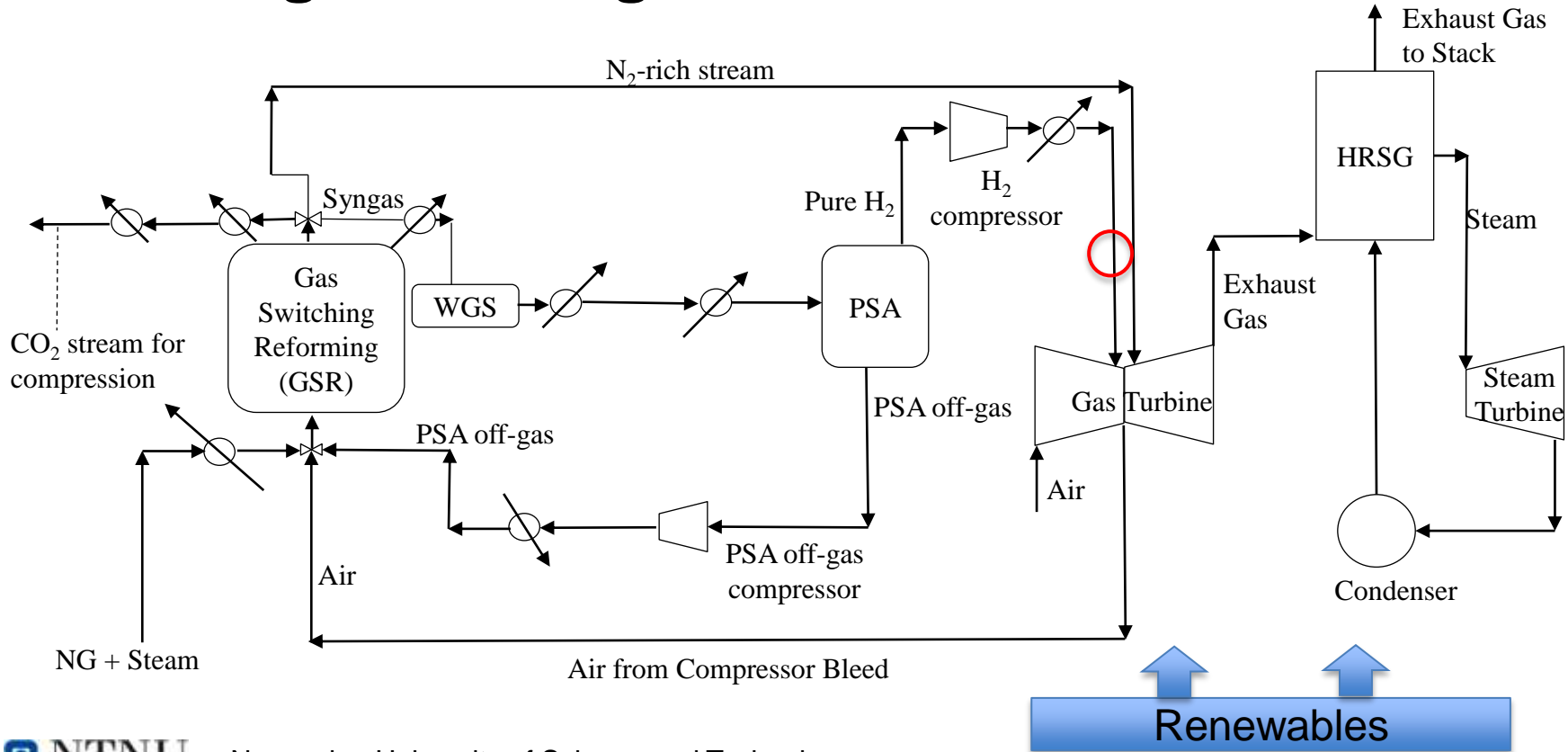
Hydrogen production from Natural Gas



Project: GaSTech

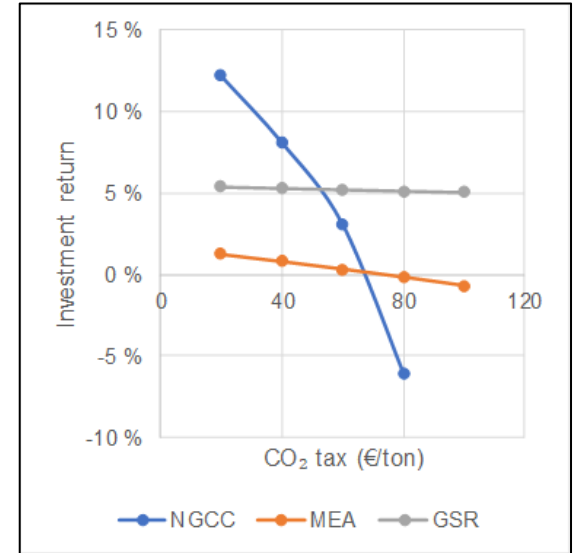
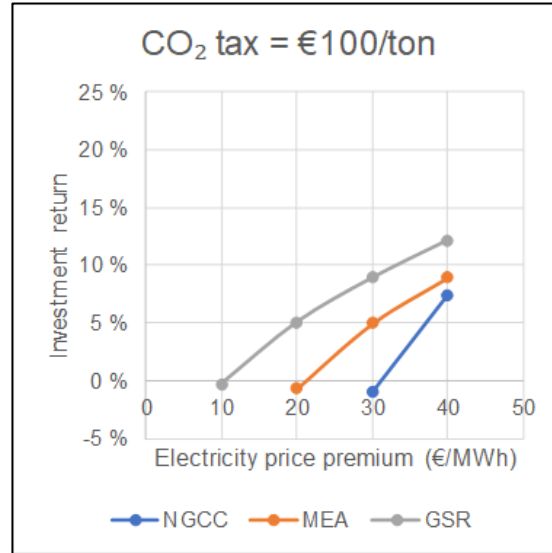
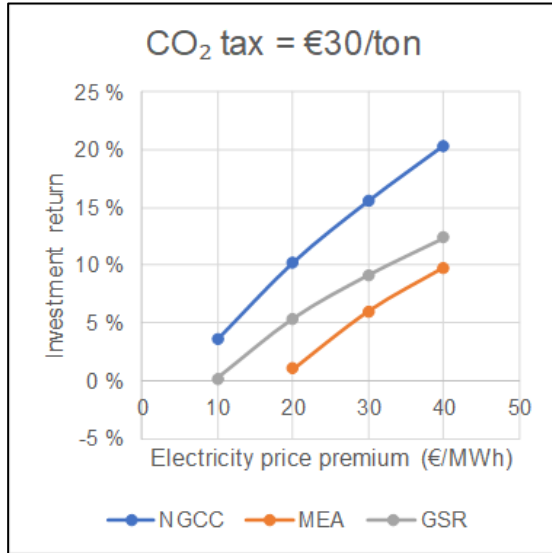
GaSTech - Demonstration of Gas Switching Technology for Accelerated Scale-up of Pressurized Chemical Looping Applications. Project No. 271511 under the Horizon 2020 programme, ACT Grant Agreement No 691712. <https://www.sintef.no/projectweb/gastech/>

Combined cycle power plant with gas switching reforming



Mid-load economic assessment

Annualized return on investment as a function of electricity premium and CO₂ tax



Reference: Szima, S., S. M. Nazir, S. Cloete, S. Amini, S. Fogarasi, A.-M. Cormos and C.-C. Cormos (2019). "Gas switching reforming for flexible power and hydrogen production to balance variable renewables." Renewable and Sustainable Energy Reviews 110: 207-219.

Thank you

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References:

1. Szima, S., S. M. Nazir, S. Cloete, S. Amini, S. Fogarasi, A.-M. Cormos and C.-C. Cormos (2019). "Gas switching reforming for flexible power and hydrogen production to balance variable renewables." *Renewable and Sustainable Energy Reviews* 110: 207-219.
2. Nazir, Shareq Mohd; Cloete, Jan Hendrik; Cloete, Schalk Willem Petrus; Amini, Shahriar. (2019) *Gas switching reforming (GSR) for power generation with CO₂ capture: Process efficiency improvement studies. Energy. Vol 167*
3. Nazir, Shareq Mohd; Cloete, Schalk Willem Petrus; Bolland, Olav; Amini, Shahriar. (2018) *Techno-economic assessment of the novel gas switching reforming (GSR) concept for gas-fired power production with integrated CO₂ capture*. *International journal of hydrogen energy*. vol. 43 (18).