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From sector coupling to sector symbiosis

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The growing number of environmental implications has motivated an increasing amount of research and practical implementation to help reach the goal of a more sustainable society, including climate change mitigation, sustainable use of resources, circumvention of waste, etc. In order to achieve these goals a number of different concepts were brought forth, such as the ñlow carbon economyò or ñcircular economyò. These concepts are in turn employed through a growing number of tools ranging from relatively straight forward efficiency and effectivity gains, through industrial symbiosis to industry 4.0. In light of the ñEnergiewendeò (engl. energy transition) in Germany an additional tool has been introduced termed ñSektorkopplungò (engl. sector coupling). This tool is broadly understood as the coupling of different energy sectors, such as heat, gas, or transport with the electricity sector, where the electricity generation is based on renewable sources. However, this approach has a number of shortcomings, as it is limited to renewable electricity as the only ñcoupling mediumò and entails a number of other uncertainties regarding the underlying methodology.

Therefore, the authors propose a new tool termed sector symbiosis, essentially combining industrial symbiosis and the still relatively new ñSektorkopplungò. This combination broadens the applicability of both tools. Unlike industrial symbiosis, sector symbiosis is not bound to individual companies with physical proximity, as it allows for the exchange of energy and materials on a larger scale and independent of entrepreneurial structures. It also widens the scope of ñSektorkopplungò, by including other means of coupling (beside electricity) such as a coupling via materials and substances (e.g. CO_2). The authors propose a structured application, where individual industrial sectors (based on NACE nomenclature) [1], supplemented by additional not included sectors such as individual transport and households, can be analyzed with regard to alternative resourcing. For example, the transport sector in Germany needs to substantially reduce CO_2-Emissions. Within the transport sector road freight and aviation pose particular challenges, as to this day there are no alternatives to the currently used combustion engine technologies. However, synthetic fuels, such as CCU-fuels via power-to-fuel technologies are a promising way to ensure the stability of the road freight and aviation sector, while at the same time curbing emissions. Using sector symbiosis as a tool, allows to identify applications where the coupling of different sectors e.g. via power-to-fuel technologies and CO_2 as feedstock pose a sensible alternative.

Sector symbiosis includes different sector coupling mediums, such as electricity, CO_2 as feedstock and other material flows that can be used to couple a variety of different sectors, including the e.g. electricity supply with transport sector, chemical sector and others. Thus, application possibilities and possible overall benefits of CO_2-utilization technologies can be analyzed and documented in a structured manner. That way sector symbiosis combines the benefits of sector coupling and industrial symbiosis, providing a structured approach that helps predict environmental benefits and contributions to an increasingly low-carbon and circular economy.

References

[1] Europäische Kommission, & Statistisches Amt. (2008). *NACE Rev. 2 statistische Systematik der Wirtschaftszweige in der Europäischen Gemeinschaft*. Luxemburg: Amt für Amtl. Veröff. der Europ. Gemeinschaften.