Alternative Feedstock for the Chemical Industry – Carbon Utilization

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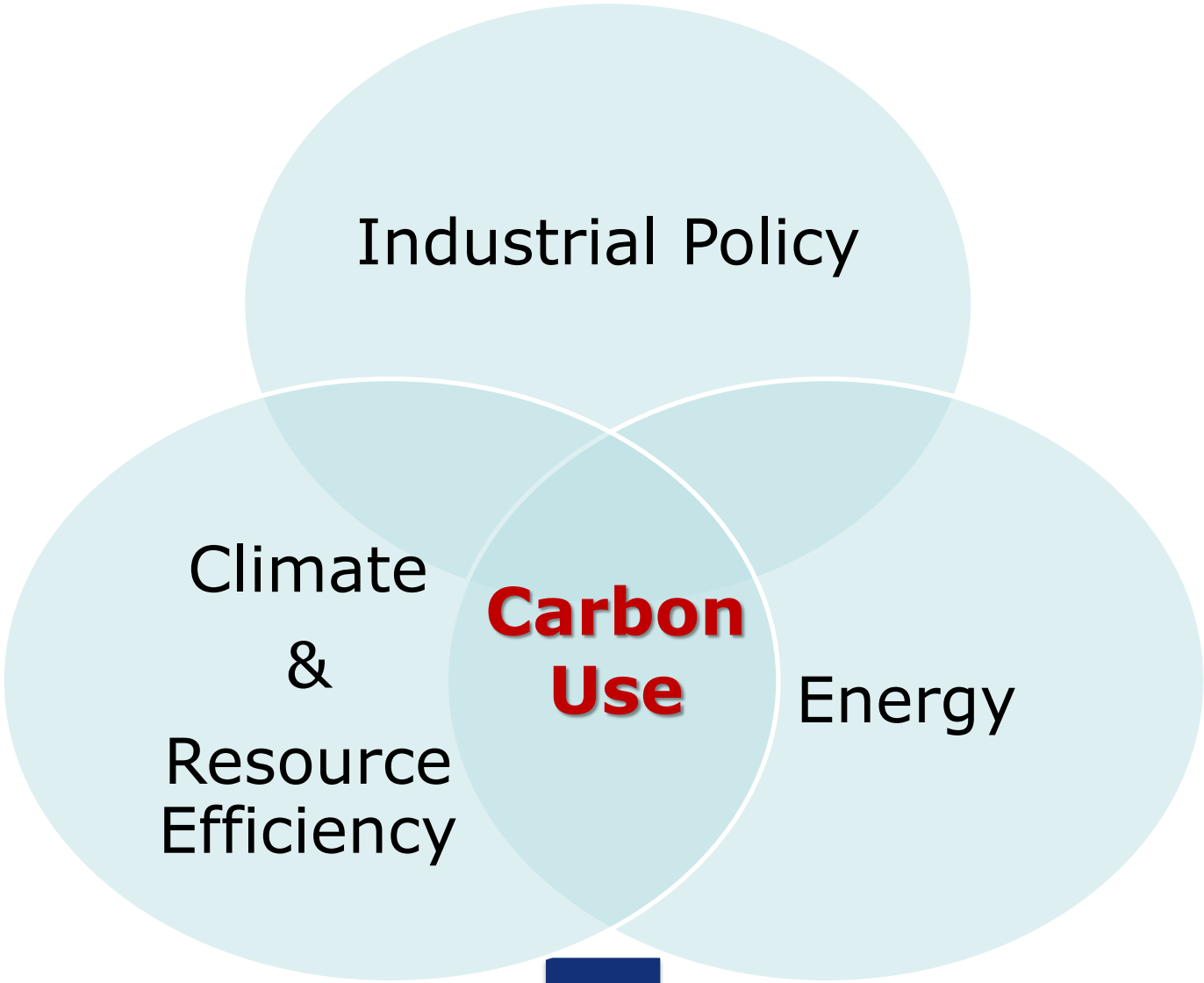
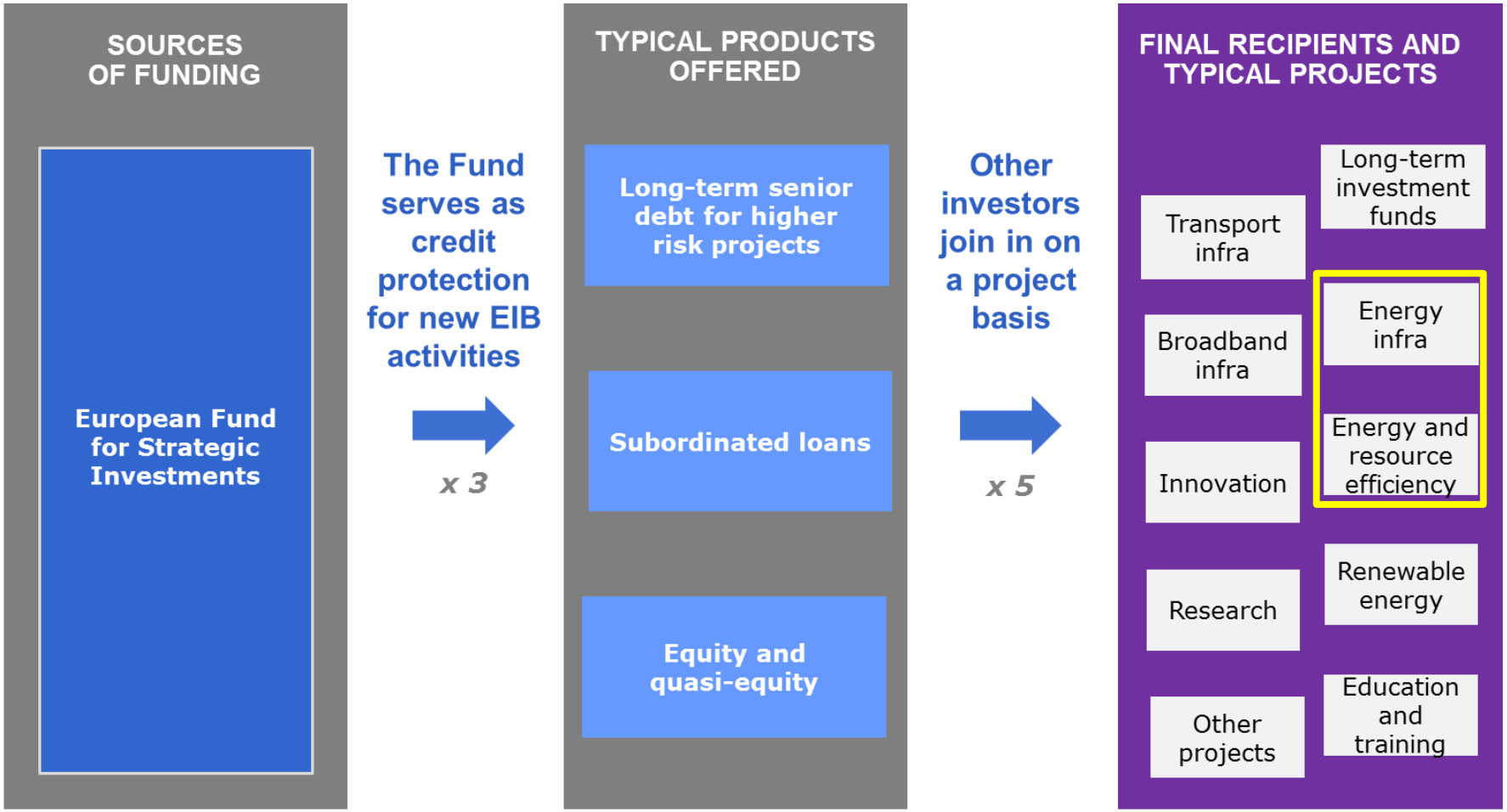
Brussels,
10 December 2015

** The views expressed in this presentation are personal and may not necessarily reflect those of the European Commission.*

The Political Context



Investment Plan for Europe



EUR 1 of public contribution => circa EUR 3 of financing => circa EUR 15 of total investment

The Political Context

Energy Union Package Communication *"A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy"* **calls for** *"A forward-looking approach to carbon capture and storage (CCS) and* ***carbon capture and utilization (CCU) for the power and industrial sectors, which will be critical to reaching the 2050 climate objectives in a cost-effective way****. This will* ***require an enabling policy framework****, including a reform of the Emissions Trading System and the new Innovation Fund, to increase business and investor clarity, which is needed to further develop this technology." -* http://ec.europa.eu/energy/sites/ener/files/publication/FOR%20WEB%20energyunion_with%20_annex_en.pdf

The Resource & Climate Context

- Globally, a third of oil reserves, half of gas reserves and over 80 % of current coal reserves should remain unused from 2010 to 2050 in order to meet the target of 2°C; &

- There is at least a 50 % chance of keeping warming below 2°C throughout the twenty-first century, however, the cumulative carbon emissions between 2011 and 2050 need to be limited to around 1,100 gigatonnes of carbon dioxide (Gt CO2) (Christophe McGlade and Paul Ekins (2015) in Nature - see http://www.nature.com/nature/journal/v517/n7533/full/nature14016.html).

Carbon Use versus CCS

Carbon Utilization *NOT* to be mixed up with **Carbon Capture and Storage (CCS):**

- CCS is defined in the Directive 2009/31/EC of the EP and the Council on the geological storage of carbon dioxide as the ***"'geological storage of CO2' means injection accompanied by storage of CO2 streams in underground geological formations***".

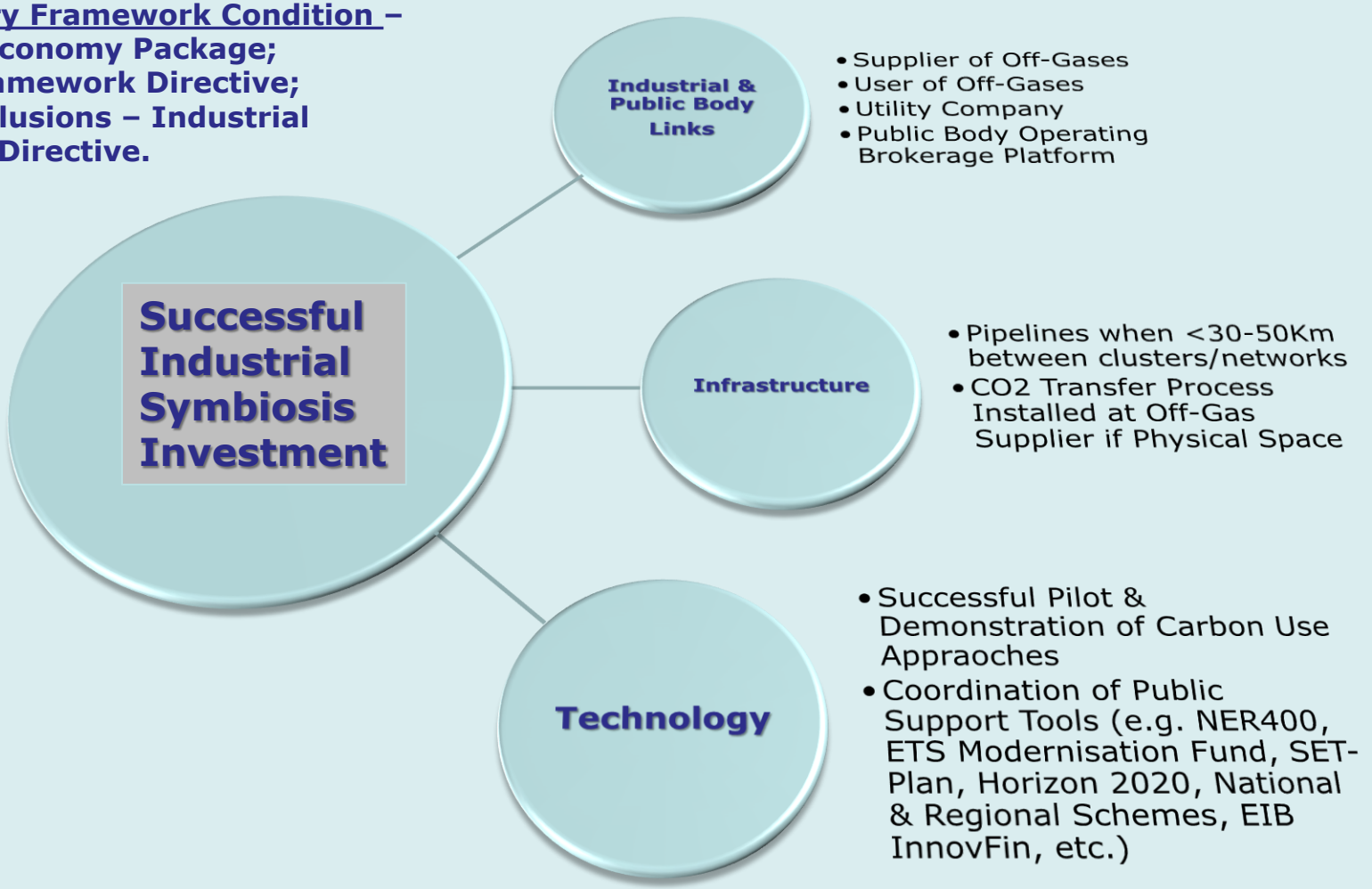
- Carbon Use means the use & re-use of CO2 as:

(a) An **alternative feedstock for the chemical industry as an alternative carbon source**, through repetitive recycling **CO2 may be stored** & **generated CO2 emissions during recycling can serve as secondary raw material;**

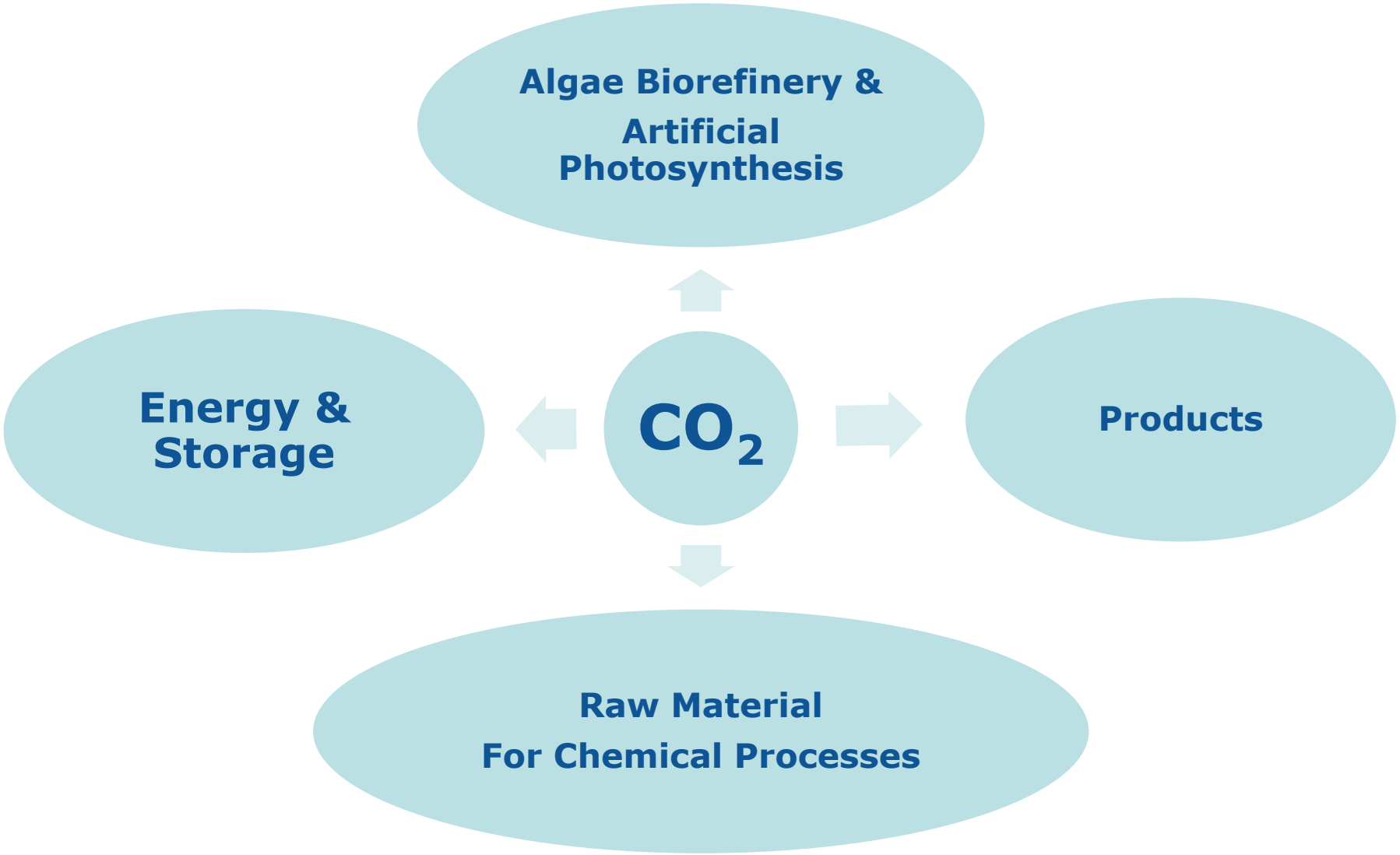
(b) An **intermediate substance generating of NH3, CH4, fuels including methanol, ethanol =>** serving as substance based **energy carriers** or **substance energy storage.**

Carbon Utilization – A Systemic Approach

Regulatory Framework Condition –
Circular Economy Package;
Waste Framework Directive;
BAT-Conclusions – Industrial Emission Directive.



Different Uses of CO_2



How to make Carbon Use work at the Industrial Scale & Facilitating Successful Investments ?

- Artificial photosynthesis is by far in the research phase, encompasses design & assembly of devices including their components for the direct production of solar fuels, photoelectrochemistry & its application in fuel cells, engineering of enzymes (industrial biotechnology) & photoautotropic microorganisms for microbial biofuels, synthetic fuels & bio-hydrogen production using it lateron for manufacturing of syngas plus other building blocks**.**

- Build on national, regional activities & projects including research, innovation, pilot & demonstration activities in NL, NO, FR, BE & DE for new Carbon Uses activities**.**

- Technology providers facilitate gases/substances transfer into other chemical building blocks on industrial sites where additional infrastructure such as pipelines are not feasible**.**

Estimation of Ecologic Potential in Using Carbon

- UK based Carbon Dioxide Utilisation Network reports rate at which CCS projects are currently deployed & its emissions reductions may be insufficient to reach the 80% reduction in global CO2 emissions required by 2050. Hence, serious consideration need to be given to alternative & complementary technologies such as carbon utilization.

- Detailed realistic estimations of ecologic impact for the European economy (for example until 2020 and 2030) do so far not exist -> National & Horizon 2020 Projects.

- Demonstrated industrial biotech type process to transfer off-gases from, e.g., steel manufacturing to ethanol & subsequently manufacturing can offer:

=> up to 70 % GHG emission reduction compared to petroleum gasoline on a wheel-to-wheel energy basis;

=> globally up to ~150Mill. t CO2 emissions avoided;

=> allowing ~>85% reduction of pollutants.

⇒ ***For carbon utilization an overall mapping & ecological impact assessment is needed.***

Estimations of the Economic Impact Using Carbon

- Detailed realistic estimations of economic impact for the European economy (for example until 2020 and 2030) do so far not exist -> National & Horizon 2020 Projects.
- Possible global reduction of up to ~150Million tonnes of CO2 emissions transferring off-gases from steel mill into ethanol & allowing for manufacturing of polymers => €1Billion to €4.5Billion reduction*.
- Converting carbon rich gasses from steel manufacturing & combining it with the hydrogen by-product from a cracker generating syngas => total of ~800,000t/y CO2 & equivalent to a €~5.6Million to €~24Million gain*.

⇒ ***For carbon utilization, an overall mapping & economic viability assessment is needed.***

*carbon price range from ~7-8€ (current carbon price – July 2015) to ~30€ per tonne of CO2.

Regulatory Bottlenecks – Public Support Tools

- Coordination of public support tools involving SET-Plan, NER 400, Horizon 2020, Modernisation Fund of ETS & InnovFin of EIB.
- Carbon Use in Circular Economy as CO2 storage in novel products.
- Revise either "*by-products*" or "*end-of-waste criteria*" in Waste Framework Directive allowing recognition of recycling of gases.
- Recognise CCU as BAT in respective BREFs & BAT-Conclusions within Industrial Emission Directive.
- Official recognition of positive effects of Carbon Use by counting it against agreed climate & energy targets.

Thank you for your kind attention!