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A New Deal.

Lignite as Resource for the Chemical Industry in the Era of Renewable Energies and as Bridging Technology to the Bio-Economy.

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Ladies and gentlemen!

It is a great pleasure for me to see so many international experts in the field of carbon here in Cologne. With no doubt the Freiberg-Conference is a prominent venue for your sector. I am a social scientist without a technical background, so it is a great honour but an even bigger challenge for me as a Member of the Parliament of the State of North-Rhine Westphalia to contribute a few thoughts at this stage.

I would like to welcome you to Germany. Here in North-Rhine Westphalia you are close to the location were Franz Fischer und Hans Tropsch developed their ideas for coal liquefaction into a process in 1925.

After the Second World War, the carbon supply for the chemical industry in Western Germany was mainly based on petroleum. In contrast, in Eastern Germany, the use of coal has played an important ever increasing role.

Despite historically low prizes for oil on world markets, in Germany the question for a more intelligent use of lignite – other than heating water or running a turbine – has become a significant current subject.

In Germany, the renaissance of this topic is caused by the here initiated “Energy Revolution”. At the beginning of this year, the prime minister of North-Rhine Westphalia, Hannelore Kraft, called for a focus on the chemical utilization of lignite (Hannelore Kraft MdL Prime Minister of North-Rhine Westphalia in Handelsblatt, 19.01.2016):

> *"Today we are still talking about the use of lignite in the area of the ‘energy economy’, so about the combustion process in a power station. But some day it may be possible that its chemical use will become economically interesting. RWE promotes this research. We need to keep this option in mind."*

The parliament of the German state of North-Rhine Westphalia already addressed this. In 2013, a special committee was set up to study the question how the immensely important chemical industry in North-Rhine Westphalia must develop in the future. At this juncture, the opportunity for the use of lignite as a resource for the chemical industry was thoroughly discussed. The committee worked for two years and published its final results in a 450 pages report. The special feature here was that this report was passed in a unison decision of all parliamentary groups.

The main factor for this success was the methodology with which the parliamentarian committee of experts worked. In the beginning, we focused on the portfolio of technologies, the conversion of raw materials and energy use of the chemical industry in North-Rhine Westphalia. This is shown as the “current state” on the plot. After this, we pursued the question where the chemical industry could contribute the most to the big trends of development of our time.

Demographic change, urbanization, climate change, new mobility patterns and many others are megatrends which can be found in OECD, European Union and United Nations reports. On this basis, we developed several options how the chemical industry could contribute with these megatrends in mind (more than three options as shown on the sheet). After this, we assessed these options with sustainability criteria. This

means, we assessed these options not just ecological but in a more balanced way: economical, ecological and social. Finally, the recommendations for action were developed as a consequence of this assessment.

This report received much attention. It shows how the chemical industry in NRW could be part of the solution and not a part of the problem especially with respect to social challenges.

Here, you can see the structure of our report. In the first three chapters we have taken a closer look at the materials conversions. Furthermore, we have taken a closer look at the energy conversion and the portfolio of technologies of the chemical industry. We analyzed the utilization process for lignite as a raw material for the chemical industry.

It has to be emphasised that we succeeded in presenting a coherent document to the state parliament supported by all political parties. Usually this is not the case. Most often, there are majority- and minority votes or dissenting opinions. And usually, every political group insists on their view of the world.

Not this time. We presented a joint report, which can be used by the chemical industry as a strong political backing and a point of origin for future developments. At the end of this record, you can find 58 recommendations for action, which are supported by all political groups as well.

Now, let me focus on the utilization of lignite as a raw material for the chemical industry.

Initially, the committee of experts had to come to an agreement which products should alternately be generated. Is the process used to substitute energy for heating or to produce fuels? Or is the carbon really stored in products? This was an important issue for the committee of experts especially in light of the CO_2 balance.

Another important point for the committee was that the carbon conversion technologies should not only operate with lignite but also with other bio-based materials. This opens up new perspectives for renewable resources with a future bio-based economy in mind. Politically, this means that we must focus on technologies versatile enough to be suited for other raw materials as well.

The challenge of the gas processing step is to achieve a suitable carbon to hydrogen ratio required to generate the target products. As you may be aware, we are expanding significantly renewable energies as agreed within the scope of the German energy transition. As a result, we will generate excess electricity not needed for domestic power supply. If hydrogen should turn out to be a suitable option for chemical “energy storage”, it would be ideal for the shift-reaction and could be used to correct this carbon to hydrogen ratio in the gas processing step. This would further enhance the energetic and economic balances.

With the help of an expert report from the Technical University Bergakademie Freiberg, we pursued the question how such an amalgamation of mining and chemistry could look like in practice. At this juncture of course, it must be noted that the lignite deposits in the Rhineland are close to the main players of the basic chemicals industry. This is a distinct advantage other deposits don’t show.

Certainly, the crucial question is if lignite fits in these considerations as a suitable raw material for the chemical industry with the overarching objectives of the energy transition. Our answer is: Yes.

A vast majority of the German Federal Parliament decided for the German energy transition on 30th June 2011. My presentation outlines the decision in a very simplified way. The objective of the energy transition is the shutdown of the last German nuclear power plant in 2022. Furthermore, the plans for the energy transition contain the objective to generate about 80% to 90% of our power with renewable energies by 2050.

The German way of getting out of electricity from coal and nuclear power almost simultaneously is a very ambitious project for our nation. By no means, our European partners are going to pursue a similar way. For example, controversial nuclear power plants in Belgium are now remaining in use for much longer than initially decided. Great Britain decided to get out of the energy production from coal but simultaneously announced the construction of new nuclear power plants.

The special German way of the energy transition is an enormous challenge for the chemical industry in this country. The federal government has realized that the expansion of storage capabilities and the power grid extension lag behind the rate of expansion for renewable energies. Furthermore, we need to keep a critical eye on the price of electricity, which must not increase unduly. I will not go into more details at this point.

But you can clearly see that the amount of electricity from carbon sources is supposed to decrease in the next decade. For the combustion of lignite, we expect a decrease by 40% to 50% in North-Rhine Westphalia by 2030.

This opens up new possible uses for these deposits. Because simple combustion is avoided the chemical utilization of lignite could lead to a reduction of carbon dioxide. But it could also enable a systematical termination of surface mining that is in-line with economic requirements and thus avoids socially unacceptable structural interruptions. Hence, the committee of experts identified lignite utilization as a raw material for the chemical industry as a sustainable strategy.

Today in North-Rhine Westphalia, 100 million tons of lignite are extracted annually from the deposits. Just one-tenth of this production is needed as a significant alternative to generate chemical products as can be seen on this chart.

For lignite, it will be interesting to see if its chemical composition has specific advantages in comparison to crude oil. It must be our goal to evaluate this raw material where it may exhibit specific advantages to be considered also in an entrepreneurial way.

The crucial question remains if lignite will also be a profitable resource for the chemical industry. I was very much motivated by the Freiberg Conference held in Inner Mongolia in China. The parliament’s expert committee determined that lignite can be mined at a variable cost of 10 to 20 Euros per ton. Large parts of the conversion technologies are available on the global market. Specific adaptations to lignite and the resulting final products might be necessary.

It is clear that the economic efficiency is dependent on the special features lignite exhibits and of the development of raw material prices. The current low prices of crude oil and natural gas present a big economical obstacle to the use of lignite for "chemistry". It is not realistic to expect the current price levels will remain as they are. Hence, we can safely assume that markets may change very quickly.

The parliament's unanimous vote for the future conversion of lignite into syngas is certainly a strong political signal for the industry:

> *"The use of lignite widens the supply base of the chemical industry and decreases the dependence on imports. Furthermore, it supports one of the important industry sectors of NRW, which has a great (often just indirect) significance for the chemical industry. In particular, this applies to a safe energy supply at competitive prices."*

In 2011, the government of North Rhine Westphalia startet the innovation initiative "Innovationsregion Rheinisches Revier" (Innovation District Rhineland), which selected the best ideas for supporting the structural change in the lignite mining region during a project competition in 2015. The use of lignite as a chemical resource has been unanimously supported politically as a starter project for 2016. There is a booth with additional information material about the innovative region here at this conference.

Furthermore, the use of lignite as a raw material was added to the list of the latest key decisions for future lignite use in the Rhine region by the federal state government.

Since 2016, the German government supports a catalysis-pilot-plant at the power plant Bergheim-Niederaußem, which is also supposed to test Fischer-Tropsch catalysts.

If we seriously think across sectors, the German energy transition has the chance to become a huge opportunity, which can lift lignite to a higher value-added level and save CO_2 at the same time. How? Because 100% of carbon is turned into CO_2 during the combustion process to obtain electricity. If we produce chemicals from coal roughly half of the carbon is fixed. Hence, the CO_2 emissions will decrease by 50% in comparison to coal-fired power.

If renewable energies are going to provide 80% of electricity – as it is politically desired – they have to become more reliable especially at demand peaks. The storage options are also still an open issue and require further development. If electrolysis and hydrogen play a major role here, it would be ideal for the refinement of lignite. Through the integration of CO_2-emission free produced hydrogen, almost 100% of the coal's carbon can be bound in the chemical products. It is therefore possible to reach "0"-CO_2 emission when using lignite as a chemical raw material.

It is important to note that syngas conversion not only works with lignite but also for other bio-based input materials. This technology offers the access to a bio-based economy by using renewable resources of the second and third generation. The CO_2-descreasing effect of biomass is twice as high compared to simple combustion. The integration of hydrogen could even turn the use of biomass into a CO_2-low with these technologies.

An exciting question in Germany is going to be how these opportunities of using lignite could be integrated into the wider social discussion. As outlined earlier, this technology and its impact will fit very well with the German energy transition. However, the European emissions trading only knows lignite as an energy source. If the carbon is not turned into CO_2, it would be logical to not tax lignite for this use. This is something our politicians will have to work on.

To achieve social acceptance, it seems crucial to rediscover the intrinsic value of carbon for the people and our society. The term de-carbonising makes many people in Germany believe that carbon – or CO_2 – is a poison that should be banned entirely. The corresponding memoranda for the year 2100 in Elmau at the G7 summit are as undifferentiated as the Pope's encyclical Laudato Si. We have to recognize that carbon is a substance of life. All of us in this room are mainly made of this substance. So, let's use carbon more intelligently; let's design a functioning carbon cycle scheme. And let us see if carbon can be made into the raw material of the future.

That is why the decision of the climate summit in Paris, which does not pursue the term de-carbonisation but supports CO_2 neutrality, seems far more intelligent and informed to me.

As you can see, your knowledge, your know-how und the technologies which the Freiberg Conference debates are of great significance. I would like to thank you for your attention and as experts I wish you a fruitful stay in Cologne.

So I will end by the famous German Miner Greetings: "Glückauf"

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