HyWays: Polish Vision

The new Central European Member States of the EU are somehow predestined to become important players in hydrogen economy development in the Enlarged Europe. The transition to hydrogen economy in such a country as Poland is to become reality only if major existing synergies and alliances with mature energy concepts and systems are tapped and implemented. According to stakeholders representing academia, industry and NGOs background, Poland could and should participate in the development of European hydrogen economy by utilizing its local resources, assets and areas of expertise.

In an economy in transition, where responding to the exponential energy demand is a key factor to stimulating sustainable development, timely implemented hydrogen economy may be a measure to encourage economic growth. By fostering hydrogen economy, the new EU Member States, and especially Poland may add a new dimension to the term "sustainable development" ascertaining that the future generations will never have to face an energy crisis. Therefore, hydrogen economy, within the context of Poland as a new European Union Member State, at the time when visions and roadmaps for designing new energy systems and modernizing the existing ones are being defined, should be clearly delineated as a powerful instrument of stimulating economic growth that enhances and complements the existing energy infrastructure. Additionally, the participation in the development of the European hydrogen economy may be also a means of integrating different stakeholders and regional interests for the common good, for example by incorporating cross border H2 economy promoting activities.

Due to the fact that a substantial part of the European reserves of solid fossil fuels is located on the territory of Poland; and that the dependence on other energy resources in Europe is most likely to grow, it appears plausible to regard Poland as an energy provider and a potential instrument of strengthening European energy security in the future. The contradiction between green energy and solid fossil fuels energy, especially based on hard coal, which is accentuated by the leading European political circles, does not necessarily mean that there are not any bridges to be built. The recent emphasis put on the development of green energy paths in Europe and the strong clean coal lobby may jointly become a major asset in fostering the transition to hydrogen economy. Today, it goes beyond any question, whether of a political, corporate or academic nature, that only balanced development of various types of energy technologies encompassing multifarious energy vectors will secure uninterrupted supply of energy in the coming decades. Therefore, such a country as Poland should exploit its own areas of "energy expertise" and specialize in tapping the possible synergies since particular **European Regions** will probably be compelled to develop different paths of implementing hydrogen economy of a multifaceted and complementary nature instead of energy monocultures based on a single energy carrier.

Regarding the natural assets and energy demand of the European Regions, only a scenario that demonstrates synergies between conventional and renewable energy systems might bring considerable benefits. The European deposits of solid fossil fuels, in particular hard coal located in Central and Southern Europe, as well as lignite from Germany and Poland, could provide essential sources for producing electricity and serve as an instrument of energy security. The scenario of the continuation of solid fossil fuel use in this part of Europe integrated with distributed sequestration of CO_2 assumes that the hard coal and lignite may be gasified to hydrogen and/or synthetic natural gas and the CO_2 emitted at a coal gasification plant sequestered in the vicinity of the mining site according to locally available capacities and techniques. Furthermore, the scenario could also assume the incorporation into the existing energy system a biomass enhanced one. The farming soils and mild climate of central and northern Poland could generate suitable conditions for biomass cultivation and are regarded as an area for development of energy self-sufficiency by means of the so-called

energy bio-refinery concept.[1] Within this approach, the recycle rate of energy from biomass and bio-waste could be maximized and combined with the delivery of hydrogen and a wide range of added value raw materials for local industries.

Furthermore, the development of a highly efficient, low-emission Polish coal energy sector based on the process of gasification could and should be combined with the generation of hydrogen for future European energy needs. The large quantity of carboniferous coal seams and lignite deposits make the region's participation in a Central European coal based hydrogen generation concept well-grounded and viable. Although, Polish coal based energy infrastructure reveals symptoms of aging, the necessary investment to upgrade it could pave the way for the future implementation of hydrogen economy. The idea of locating projects involving new coal-to-hydrogen energy systems in the broadly understood region of Silesia as a common trans-regional, for example: Polish-Czech-German, initiative could provide a feasible background for the inclusion of such a proposal within the EU energy policy. It is considered that energy and hydrogen generation combined with the sequestration of CO_2, for example in deep unmineable coal seams, might constitute a potential Joint Technology Initiative (JTI). An innovative way of combining together the ex-situ coal conversion to hydrogen and electricity combined with enhanced methane recovery and carbon dioxide storage in coal bed is presented in the figure below.[2]

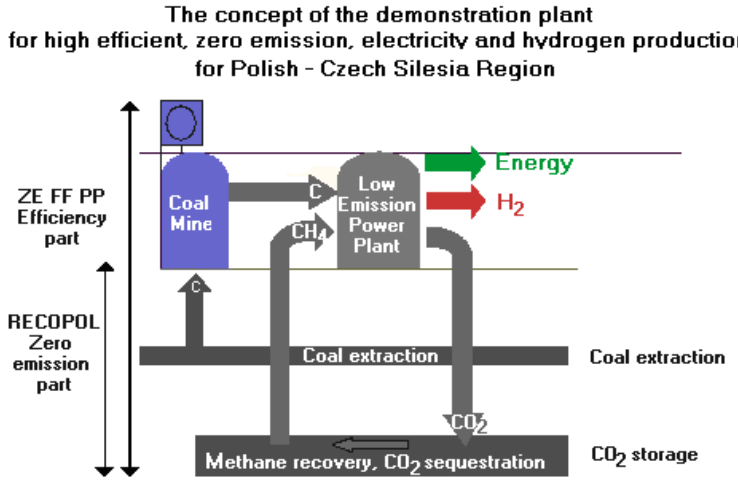

Fig.1 Integration of ex–situ coal conversion with in–situ carbon dioxide storage

Located in the South of Poland, the industrial region of Silesia seems to be predestined to foster the development of hydrogen economy on grounds of its abundance of hard coal seems and a long established mining industry as well as the concentration of research institutions and industrial infrastructure. In the period between 1960s and 1990s, the Central Mining Institute in Katowice carried on research on coal gasification to fuels in an

[1] According to the US Department of Energy E3 Handbook, bio-refinery is defined as "a an overall concept of a processing plant in which biomass feedstock are transformed and extracted into a range of valuable products on the basis of a petrochemical refinery." [2] German authors, (Kamm et al.1998) describe the term as "a complex system of sustainable, environment and resource friendly technologies for the comprehensive utilization and exploitation of biological raw materials in the form of green and residue biomass from targeted sustainable regional land utilization."[4]

[2] Krystyna Czaplicka, Józef Dubinski, Aleksandra Tokarz, Jan Rogut: Coal Mine of 21st Century: In Situ Producer of Energy, Fuels and Chemicals, International Mining Forum, February 2006

industrial scale test facility. The gasification technology is also currently used by the refinery in Płock, central Poland where hydrogen is produced by steam reforming of natural gas and by oxygen gasification of higher hydrocarbons and refinery waste products such as soft asphalts.

Additionally, the cokeries located in Poland, predominantly in the South of the country, offer the possibility to utilize the available, raw coke oven gas as a source of hydrogen supply. Only in 2004, Polish cokeries gave 4385 million of m^3 of coke oven gas. Having satisfied the needs of the cokeries and the associated with them steel mills, there was a coke oven gas surplus of 1363 m of m^3 ,of which 1275 m of m^3 was sold; the remaining 88 m of m^3 was burnt. It is estimated that commercial utilization of the coke oven gas generated at the two biggest Polish cokeries, ZK Zdzieszowice and Przyjaźń could yield approximately 1660 m of m^3 of hydrogen per annum. [3]

Another promising opportunity for Poland's participation in the development of European hydrogen economy might be the creation of the so called Hydrogen Communities, HyComs. The European Initiative for Growth concept of establishing a limited number of independent hydrogen communities (recreational, remote, marine, town or metropolitan) strategically located around Europe to generate hydrogen from various sources and to exploit all possible synergies between portable, stationary and transport applications initiated a debate on locating a few of the testing facilities in Poland.[4]

For example, Krakow, which is one of the most eagerly visited tourist attractions of Central Europe might be considered as a venue for the so-called recreational hydrogen community, with local H_2 production, stationary CHP for residential use, for instance in hotels or museums, as well as special vehicles for tourist purposes. The town of Krakow faces severe problems concerning low emission and the consequent deterioration of its historical and cultural heritage, so introducing into the town center FCVs instead of conventional municipal transportation and stationary CHP in public buildings could substantially improve the situation. Localized in Krakow's geographical proximity, the cokery of Sedzimir Steel Works could provide hydrogen to feed the fleet of FCVs introduced into the Old Town zone and at the same time mitigate considerably the Works environmental impact. A coke oven based H_2 filling station might be located next to the cokery. Consequently, Krakow would be promoted not only as a place of magnificent historic sights but also as a knowledge-based community where environmental and municipal challenges are addressed by means of cutting-edge solutions. Since Krakow hosts thousands of visitors from all over the world every year, the crucial objective of the project visibility and outreach could be easily achieved. What is more, the emerging technical infrastructure designed for storing and distributing separated and purified hydrogen might be also used for storing hydrogen generated form renewables and biomass, thus stimulating the local agriculture industry.

Another proposal encompasses locating the so called recreational hydrogen community in the Polish/Czech border town of Cieszyn/Tesin. A "coalition" of Polish and Czech scientists, NGOs representatives and local authorities generated the idea of locating one of HyComs in this town since Cieszyn/Tesin is characterized by several unique properties. Apart from the tangible economic benefits, such an initiative would also entail tapping expected synergies regarding its far-reaching societal aspects. Historically, the town of Cieszyn, once a single municipal entity, then, a thriving trading community under the Habsburg rule, was divided into Polish and Czech part with the national border along the river

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[3] A. Tramer, M. Sciążko, A. Karcz, *Przem. Chem.* 2005, 84, nr 11, 819

[4] Commission of the European Communities, Communication from the Commission: a European Initiative for Growth – Investing in Networks and Knowledge for Growth and Jobs, Final Report to the European Council, Brussels COM (2003) 690 final

Olza in 1920. Since that moment the town could not regain its former prosperity, which consequently led to severe recession. Interestingly, at the beginning of the 20th century, while still under the Habsburg rule Cieszyn/Tesin had a common public transportation system linking the Czech and Polish parts of the town. Today, when both Poland and the Czech Republic are EU Member States, the border has disappeared again. Hence, there arose an idea of re-establishing that system, this time operated by fuel cell vehicles. Such a small scale demonstration project would serve as a mutually beneficial integration tool for the Czech and Polish communities.

Due to the fact that the town of Cieszyn with the surrounding areas derives most of the revenues from the recreational and tourism industry, it is of top priority to maintain its natural environment unharmed. Therefore, while seeking opportunities of inter-regional and international cooperation, the town authorities place much emphasis on clean sustainable development and encourage novel and environmentally benign solutions to stimulate the local economy. [5] The concept of a hydrogen community is closely related to the notion of an EcoSite which is defined as a "demonstration site dedicated to innovation and knowledge transfer to promote environmental protection and equitable sustainable development."[2] The underlying objective of an EcoSite creation is to "allow real-life testing, hands-on training and seeing-is-believing education and information..." [2] Therefore, the pragmatic idea of locating in Cieszyn an EcoSite of hydrogen production from biomass and renewables would allow exploiting the synergies by not only supplying fuel for the planned bus fleet but also by facilitating public acceptance of hydrogen economy and attracting more visitors to the town. The arrangement of establishing in Cieszyn/Tesin a hydrogen community could certainly involve a range of stakeholders from different areas of expertise as well as the local people for the common good.

The third proposal to be taken into consideration is the idea of locating the so-called remote hydrogen community in Borne Sulinowo. The idea of a remote hydrogen community encompasses hydrogen production based on renewables, 1 filling station, stationary CHP for residential or community use in hotels, visiting centers or public buildings and 1 FC bus.[6] Situated in the north of Poland, Borne Sulinowo was first the German and next Russian military base until 1993. When the resident soldiers left the town, the local authorities began to seek ways of stimulating the local economy especially through developing tourist and recreational facilities since the town lies in the heart of Drawskie Lake District. The town's transformation from a former military base to a civilian municipal entity requires a novel and comprehensive approach; therefore participating in hydrogen and fuel cell activities seems to be quite a promising option. The geographical and socio-economic conditions lay good foundations for generating hydrogen on the basis of various sources.[7] Moreover, the fact that there is a good connection with Berlin, which is only 300 km away, is another argument. The local runway, a remnant after the town's military airport, could be an additional advantage

[5] The opportunity of creating new employment opportunities for the town inhabitants is also of paramount importance. With the population of approximately 37,000, Cieszyn has a 14% unemployment rate. 500 out of the 2,267 registered unemployed citizens have technical educational background. [1] Thus, various activities aiming at creating a hydrogen community could address one of the town's social concerns. Additionally, generating hydrogen from biomass would stimulate local agriculture industry, since each 100 hectares of biomass production could create 5 to 8 jobs and allow for the utilization of non-arable grounds.

[6] Commission of the European Communities, Communication from the Commission: a European Initiative for Growth – Investing in Networks and Knowledge for Growth and Jobs, Final Report to the European Council, Brussels COM (2003) 690 final

[7] With a population of 4,000, 54.7 % of Borne Sulinowo township is densely forested covering the area of 25,501 hectares, which opens the opportunity of utilizing the forest biomass, wood, under wood and waste wood processing as a source for generating hydrogen. Hydrogen could be also generated electrolytically based on wind and hydropower.

and support the idea of establishing in this place a center of international cooperation enabling hydrogen and fuel cell activities between the EU Member States.

In each of the above mentioned cases, the effect of synergy is achieved since the proposals combine numerous hydrogen community activities which address societal, economic and political issues. The idea of exploiting hydrogen economy concept as an inter-regional integration tool could be further evolved to encompass a larger area of Poland, the Czech Republic, Slovakia, and the South East Germany since these countries represent similar potential in terms of their economy, fossil fuel resources, industrial infrastructure and job markets.

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References

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