2nd INTERNATIONAL SYMPOSIUM MINING ENERGETIC - ME 08



MODERN TENDENCIES IN THE DEVELOPMENT OF ENERGY MINING



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TARA
September 15-18, 2008

PROGRAMME OF THE SYMPOSIUM

15.09.2008 MONDAY

12.00-18.30	**Arrival and registration of participants**
18.30	**Welcome cocktail**

16.09.2008 TUESDAY

08.00-10.00	**Registration of participants**
10.00-10.15	**Official Opening Ceremony**
10.15-11.15	**Plenary Session**

- **Ristovic, I.,** Belgrade, Serbia: *Curent Situation and Development of Energy Mining in Serbia*
- **Grujic, M.,** Belgrade**,** Serbia: *Environmental Action Plans of Coal Mining*
- **Medved, M., Dervaric, E., Skubin, G.,** Velenje, Ljubljana, Dobrunje, Slovenia: *Electricity Power Demand and Supply in EU 27 and in Selected Countries of Eastern Europe*
- **Stanic, R.,** Pljevlja, Montenegro: *Coal As Energy Fuel in Montenegro – Possible Trends*

11.15	**Coffee Break**
11.30	**First Session**

- **Vizintin, G., Vukelic, Z., Vulic, M.,** Ljubljana, Slovenia: *Monitoring the Geothermal Potential of Deep Tertiary Aquifers in North-East Slovenia Using Old Abandoned Oil and Gas Wells*
- **Hinterholzer, S.,** Leoben, Austria: *HM150 formed Roller - Innovative Developments in Materials Handling*
- **Schroth, W.,** Bochum, Germany: *Securing of Coal Production by means of Modern Data Transmission Technologies*
- **Maksimovic, S.,** Belgrade, Serbia: *The Optimal Financial Distribution of Governmental Subsidize Modeling Processes of JP PEU Resavica at Economic Market Environment*
- **Fedorko, G., Molnar, V., Husáková, N., Grubai, L.,** Kosice, Slovakia: *Recent Situation in Application of the Pipe Conveyors in Slovak Republic*
- **Tosovic, R., Milovanovic, D.,** Belgrade, Serbia: *Elements of Budgeting in the Geomanagement Function*
- **Veljanovski, V.,** Belgrade, Serbia: *Founding Business Incubator – as a Opportunity of Solving Surplus Manpower in the Process of Restructuring Elektroprivreda Serbia*
- **Stojakovic, M., Kovacevic, A.,** Lazarevac, Belgrade, Serbia: *Modification of Standard Start-Up of Inclined Conveyor Belts*
- **Karovic Maricic, V., Danilovic, D., Lekovic, B.,** Belgrade, Serbia: *Modern Approach to the Hydrocarbon Reserves Classification and Methods of its Estimates*

13.00	**Lunch in the Wood**
16.00	**Presentations of Sponsors**
16.30	**Second Session**

- **Fedorko, G., Molnar, V., Grubai, V.,** Kosice, Slovakia: *Steel Ropes Designing in Cad and Possibilities of Their Analysis Using FEM*
- **Potocnik, D., Ganic, A., Vizintin, G., Vulic, M.,** Velenje, Ljubljana, Belgrade, Slovenia, Serbia: *Horizontal and Vertical Movement of the Ground Influenced by Mining Works*
- **Potocnik, D., Vulic, M.,** Velenje, Ljubljana, Slovenia: *Monitoring and Prognosing Degradation on the Surface*
- **Mayer, J., Cizmek, D.,** Velenje, Slovenia: *Modern Underground Roadway Construction in Difficult Geomechanical Conditions*
- **Dimitrijevic, S., Milutinovic, A.,** Belgrade, Serbia: *Spatial Information System of Haulage and Hoisting in Underground Mining*
- **Ignjatovic, M., Rajkovic, R., Mikic, M., Ljubojev, M.,** Bor, Serbia: *Possibility of Oil Shale Exploitation for Obtaining the Synthetic Oil on the Republic of Serbia Location*
- **Panov, Z.,** Stip, Macedonia: *Promotion for Underground Coal Gassification How Basic Clean Technologies for Production of Energy*
- **Jaksic, M., Nedeljkovic, B.,** Kosovska Mitrovica, Serbia: *Coal Deposit Mining Technology by the Method of Hydraulic Well Construction*
- **Djukanovic, D., Sankovic, C.,** Resavica, Serbia: *Possibility of Introduction of Technology of Remote Video Surveillance System in Mines With Underground Exploitation Coal*
- **Despodov, Z., Doneva, N., Mijalkovski S.,** Stip, Macedonia: *The Possibilities of Coal Seam Underground Excavation in Republic of Macedonia with High Productive Excavation Methods*
- **Grujic, M.,** Belgrade, Serbia: *Impact of Noxiousness Resulted from the Action of Transport Cargos on the Selection of an External Conveyance Method*
- **Trajkovic, S., Lutovac, S., Savic, Lj.,** Belgrade, Kosovska Mitrovica, Serbia: *Impact of Vibrations on Environment While Constructing and Utilising Transport Traffic Lines*
- **Ristovic, I., Djukanovic D., Sankovic, C., Grujic, M.,** Belgrade, Resavica, Serbia: *External Transport in Underground Coal Mines in Serbia*
- **Ristovic, I., Stojanovic, M., Stojanovic, S.,** Belgrade, Lazarevac, Serbia: *Identification and Assessment of the Significance of Environmental Aspects in Mining Facilities*
- **Malenovic Nikolic, J.,** Nis, Serbia: *Managing and Tracking the Transport of Mining - Energy Processes in Accordance with Sustainable Development by Using Environmental Monitoring and Indicators*
- **Milicevic, Z., Milic, V., Svrkota, I.,** Bor, Serbia: *Suggestion for Increase of Horizontal Mining Concentration at Soko Coal Mine*
- **Milicevic, Z., Milic, V., Svrkota, I.,** Bor, Serbia: *Extraction of Thick Coal Seams by Mechanized Short Walls*

17.09.2008 WEDNESDAY

09.00	Third Session

- **Crncevic, M., Maksimovic, S., Despotovic, V.,** Belgrade, Kostolac, Serbia: *The Possibility of Using the Natural Abundance Gas From the Gas Deposit Ostrovo at PP Kostolac*
- **Vizintin, G., Vukelic, Z., Vulic, M.,** Ljubljana, Slovenia: *Effects on Heat Transport of Pumping-Injecting Dublet Wells at Korovci in the Republic of Slovenia*
- **Vizintin, G., Vukelic, Z., Prkic, M., Vulic, M.,** Ljubljana, Slovenia: *Using Virtual Tools for 3D Oil and Gas Presentations*
- **Loncarevic, M.,** Novi Sad, Serbia: *About Restructuring and Privatization Process Oil Industry in Serbia*
- **Loncarevic, M.,** Novi Sad, Serbia: *About Possibilities to Development Oil and Gas Industry of Serbia*
- **Radule Tosovic,** Belgrade, Serbia: *Energetic Resources in the Function of District Heating System*
- **Skvareková, E.,** Kosice, Slovakia: *Determination of Quantity of Methane From Degasation of Brown Coal*
- **Pinka, J., Sidorova, M,** Kosice, Slovakia: *Technology of Drilling Deep and Extra Deep Wells in Slovakia and in Neighbour Country*
- **Stojanovic, R., Bejatovic, M., Levi, G., Martinovic, S.,** Novi Sad, Serbia: *Systems of Measures (MWD/LWD)Used in the Drilling Horizontal Wells in Naftagas*
- **Stojanovic, R., Savicic, M., Andjusic, S.,** Novi Sad, Serbia: *Possibility of Defining Current Oil-Water Contact in Piped-Up Wells in Low Salinity Conditions of Deposit Waters*
- **Komatina Petrović, S.,** Novi Sad, Serbia: *CO_2 geological storage – obligatory part of energy mining*

10.30	Presentations of Sponsors
11.30	Fourth Session

- **Druks Gajsek, P., Miklavzina, I., Bole, M., Mavec, M.,** Velenje, Slovenia: *Ecological Monitoring at Velenje Coal Stockpile*
- **Ivkovic, M.,** Resavica, Serbia: *Ecological Aspects of Work Underground Coal Mines in Serbia*
- **Vuckovic, M., Krstic, V.,** Lazarevac, Serbia; *Environment Features and Coal Exploitation in Open Pit C, Kolubara Coal Basin*
- **Radosavljevic, M., Gecic, B., Gigov, M., Zarkovic, M.,** Zemun, Lazarevac, Serbia: *Monitoring of the Air Quality in Vicinity of Kolubara Prerada Plant Vreoci*
- **Drljevic, N.,** Lazarevac, Serbia: *Impact of Mining Operations at Open Cast Mine Tamnava-West Field on Arable Land Reduction, and Necessary Activities for Land Restoration to Previous Use*
- **Nedeljkovic, B., Jaksic, M., Milentijevic, G.,** Kosovska Mitrovica, Serbia: *Impact of the Dump Slope Stability of Surface Pits on the Reclamation*
- **Fedorko, G., Kubin, K., Ivanco, V., Husáková, N.,** Kosice, Slovakia: *Pipe Conveyor – FEM Analysis*
- **Pástor, M., Budayová, M., Varga, A., Suchý, T., Fedorko, G.,** Kosice, Slovakia: *Analysis of Alternativ Fuel–Biomass Gasifying at Fluid Reactor*
- **Rakic, Z., Rakic, B.,** Novi Sad, Belgrade, Serbia: *Environmental Aspects of Energetic Efficiency for Heating and Cooling by Utilization of Energetic Potentials of the Country as a Renewable Resource*
- **Kostovic, M., Dimitrijevic D., Kostovic N., Simovic I.,** Belgrade, Ub, Zemun, Serbia: *Possibility of Fly Ash from Thermal Power Plant Kostolac B Utilization in Cement Production*
- **Drmanac, D.**, Kosovska Mitrovica, Serbia*: Study of the Conditions for the Application of Hidraulic Transport of Coal*

13.00	Lunch Break
15.00	Fifth Session

- **Lutynski, A., Lutynski, M.,** Gliwice, Poland: *Modern Conveyor Belts Manufactured by FTT Stomil Wolbrom SA*
- **Todovic, P.,** Lazarevac, Serbia: *Development Perspective of Electric Power Industry of Serbia – EPS and its Integration into the South-Eastern Europe Energy Market*
- **Jakovljevic, I., Subaranovic, T., Stepanovic, S.,** Belgrade, Serbia: *Digging Resistance Values in Terms of Parameters of a SRs 2000 32/5 Bucket Wheel Excavator Cut*
- **Vuckovic, B., Radovanovic, B., Bogdanovic, V.,** Lazarevac, Serbia: *Coal and Non-Metallic Resources Exploitation on Open Pit Field E Kolubara Coal Basin Serbia*
- **Rajkovic, R., Ignjatovic, M., Marinkovic, V.,** Bor, Serbia: *Determination of Mining Dynamics Using GEMCOM 6.1 Program*
- **Ristivojevic, D., Vukovic, S., Bliznakovic, Lj., Markovic, S.,** Lazarevac, Serbia: *Advantages and Disadvantages of an Insulated 6 KV Network In Conditions of Open-Pit Mines*
- **Radivojevic, V., Bliznakovic, Lj.,** Lazarevac, Serbia: *Adaptation Substation 110/35 KV Vreoci for Mining Company Kolubara*
- **Milovanovic, S., Arsenijevic, S., Leka, M.,** Lazarevac, Serbia: *Expansion of Open Cast Mine Field C – Eastern Dump*
- **Smiljanic, N., Vukadinovic, M., Ponjavic, M.,** Belgrade, Serbia: *Geomagnetic Studies on Eastern Kipa of Kolubara Basin*
- **Milenkovic, Z., Ivanovic, M.,** Lazarevac, Serbia: *Process of Coal Homogenization in PK Tamnava West Field*
- **Stevanović, N., Damnjanović, S., Dimitrijević, A.,** Lazarevac, Serbia: *Operation Impact of Large Mining Machinery in Open-Pit Mines Kolubara on the Electric Power Quality*
- **Helebrant, F., Fries, J., Jurman, J., Klouda, P.,** Ostrava, Czech Republic: *Measurement and Analysis of Results at Digging Wheel Excavator*
- **Helebrant, F., Fries, J., Jurman, J.,** Ostrava, Czech Republic: *Maintenance Management and Production Company Management*
- **Vukadinovic, M.,** Belgrade, Serbia: *Method of Radio-Wave Weatherization or Radio Shadow*

17.30	Closing Session

- **Conference conclusions and closing official part**

20.00	Official Dinner

18.09.2008 THURSDAY

09.00-14.00	Field excursion

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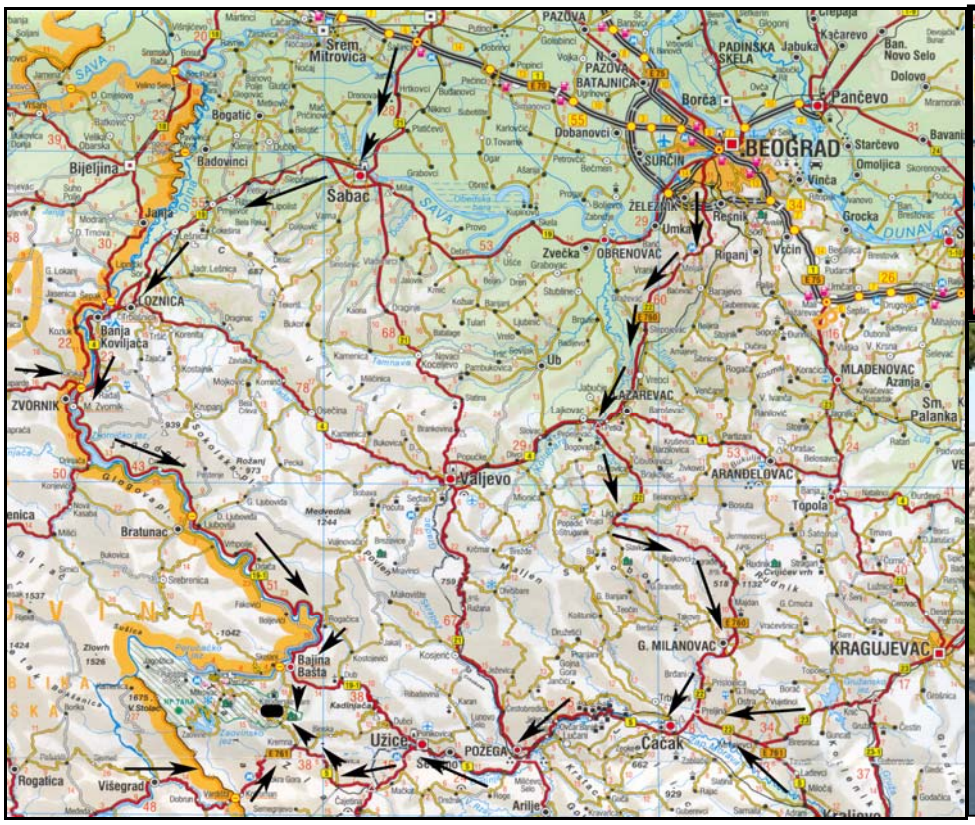
The fee for full lodging in the hotel OMORIKA on Tara, for this three day symposium amounts to RSD 16.000 (EUR 200) per person. In addition to hotel accommodation, this fee includes the welcome cocktail, solemn dinner, proceedings, conference materials and field excursion.

The participants are kindly asked to confirm their arrival, as well as the period of their stay not later than **September 5., 2008**, in order to be able to book a room. Applying, room booking and payments for services of participation in the symposium are to be made through the sales service of the SANI TURS agency, at: +381 11/3343-488 or +381 11/3342058, or by e-mail at: sanibg@EUnet.yu



PROMOTION FOR UNDERGROUND COAL GASSIFICATION HOW BASIC CLEAN TECHNOLOGIES FOR PRODUCTION OF ENERGY

Zoran Panov*

Abstract. Underground Coal Gasification (UCG) is a potential source of future energy production that is currently receiving an increased level of attention within business, academic and policy communities. The principle of UCG is to access coal which either lies too deep underground, or is economically unattractive to exploit for conventional mining methods. Coal gasification converts solid coal into a gas that can be used for power generation, chemical production, as well as the option of being converted into liquid fuels.

KEY WORDS: UCG, COAL, MINING, SYNGAS, ENERGY, CLEAN TECHNOLOGIES

INTRODUCTION

Traditional mining methods however are not suited to working offshore reserves, and development and infrastructure costs of new mines can render the exploitation of landward reserves uneconomical. Underground coal gasification (UCG) has the potential to provide a clean and convenient source of energy from coal seams where traditional mining methods are either impossible or uneconomical.

UCG is a method of converting unworked coal, deep underground, into a combustible gas, which can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or other chemicals. The gas can be processed to remove the CO_2 before it is passed on to end users, thereby providing a source of clean energy with minimal green house gas emissions. The energy is recovered directly from coal seams, avoiding mining related hazards and the handling of surface coal and post-combustion ash.

UCG include the injection of steam and air or oxygen into an underground seam of coal which is ignited, and reacts in the presence of the injected gases to form a combustible gas that can be used either as a fuel or as a chemical feedstock (Fig. 1).

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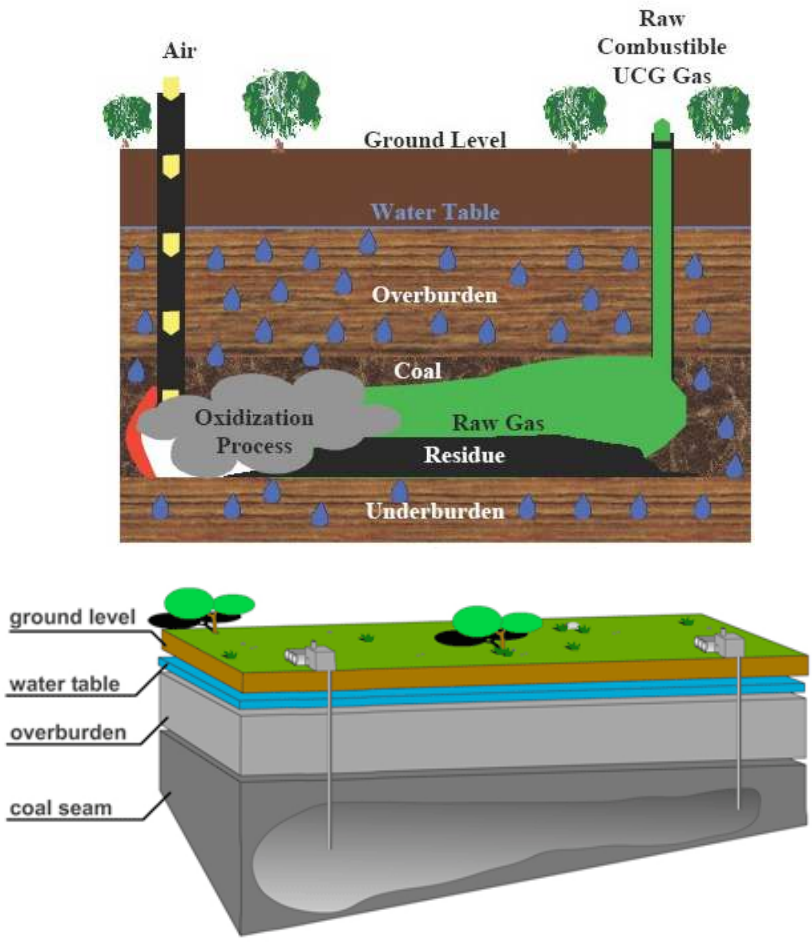

Fig. 1 UCG Production Process

UCG has an established history of operation the former Soviet Union since 1930s and experimental tries have been performed in other regions, most notably the USA during the 1970s and Western Europe during the late 1990s.

Advanced in drilling and gas processing technique in recent years have led to renewing interest in UCG due to the reduced costs of accessing the coal and improved efficiency of gas utilization that can now be achieved. However, as natural gas became abundant in the 1980s and evidence emerged in the USA that there could be environmental issues around UCG technology, in particular, the contamination of surface water by the gasification process, interest waned in the technology.

Nevertheless, in Europe studies and an initial trial in Spain suggested that deep seam UCG, using new oil and gas technologies, appeared to offer an alternative to conventional mining. The Spanish trial (1992-1998) confirmed that it was feasible to construct and operate wells in coal seams at depths of 550m and greater. The two key technologies to enable this were directional drilling and the use of moveable injection points along the borehole, providing control over the oxidants required for gasification.

Meanwhile, renewed interest in UCG was developing in China, where 12 pilot trials have been undertaken, and in Queensland, Australia, which was the base for the Chinchilla UCG trial. These use simple vertical boreholes, shallow coal seams and an air-blown system (instead of oxygen) for gasification, which are rather different technologies to those required for deeper seam gasification. In the light of the trials and the growing overseas interest in UCG, the UK embarked on an investigation to assess the long-term viability of UCG as a future method of coal exploitation. It examined the suitability of UK coal resources, the environmental risks and the economic viability of this technology compared to other energy sources.

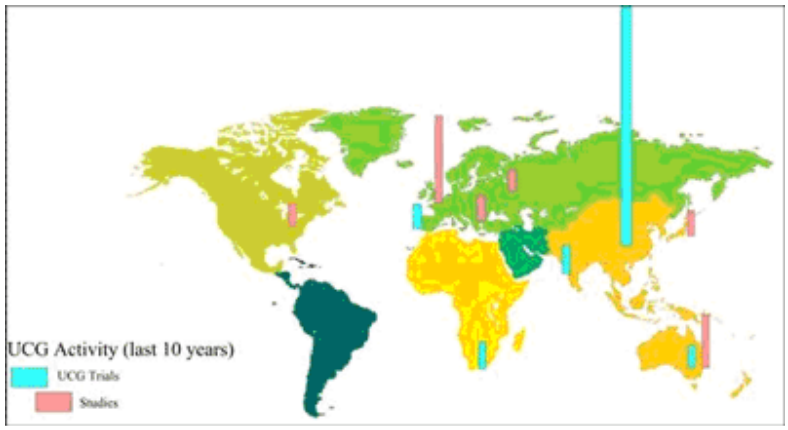

Fig. 2 World UCD Activity in last 10 years

There have been a number of recent developments that have helped to drive interest in UCG:
- Security of supply and cost advantages of coal. Coal is in plentiful supply: the European reserve alone is 130 billion tones; the South - East European reserve is about 15 billion tones; the Russian Federation is 157 billion tones; while the US reserve is 246 billion tones.
- Production cost estimates for UCG clean gas is substantially below the current price of natural gas;
- The rapid disappearance of cheap natural gas is also putting UCG in a prime position as an exploitation and conversion technology, taking advantage of recent advances in drilling, completion and exploration technology.
- Modern gas technology offers access to much deeper coal seams, where environmental challenges are easier to overcome.
- UCG offers improved safety for the extraction industry.

Coal gasification converts solid coal into a gas that can be used for power generation, chemical production, as well as the option of being converted into liquid fuels. Gasification exposes coal to temperatures that would normally cause the coal to combust but by carefully regulating the amount of oxygen in the gasified and adding steam, the coal does not burn but rather separates into syngas – a mixture of carbon monoxide and hydrogen. The syngas can then be shifted with the addition of more steam, to produce more hydrogen and to convert the carbon monoxide into carbon dioxide (CO_2). UCG uses a similar process to that used in surface gasification. The main difference between both gasification processes is that in UCG the cavity itself becomes the reactor so that the gasification of the coal takes place underground instead of at the surface. UCG

requires boreholes to access the coal, and three methods have been developed to connect between them, namely:

i) Air pressurization between vertical holes (Chinchilla, Australia, and the former Soviet Union);
ii) Man-built galleries in the coal (Chinese trials);
iii) Directional drilling in the coal seam with controlled injection (US and the European field trial).

UCG can be applied to coal and lignite deposits across the South East Europe. It has been estimated that in this Region there is about 10 billion tones of unmineable coal that is recoverable by UCG. This technology can be readily deployed today to at very competitive costs for a variety of reasons:

- Reduced capital expense: Unlike traditional surface gasification facilities, there is no need to purchase gasifiers or build ash and slag management facilities. Due to syngas stream continuity, there is also no need for gasifier redundancy.
- Reduce operating expense: Unlike conventional plants, there is no need to purchase, transport, store, or prepare coal. There is no need to re-brick the gasifier linings. Due to syngas stream continuity, plans have high capacity factors comparable to pulverized coal or natural gas plants, reducing down time.
- Reduced environmental management costs: Due to the gasification environment underground, UCG facilities produce no SOx or NOx. Particulate streams are half of their surface equivalents, and there is no production of ash. Roughly ½ of the mercury is generated compared to traditional plants. These present reductions in operational and capital costs, as well as increased ease of regulatory compliance and reduced environmental impacts.
- Fuel supply certainty: Because the supply of UCG syngas is local and continuous, operators are not faced with risks in terms of changes in fuel availability or supply costs. There is no risk of supply disruption, providing clear advantages in secure fuel supplies.

Environmental risk assessment for UCG has unique aspects, requiring consideration of a complex array of changing conditions, including high cavity temperatures, steep thermal gradients, and stress fields obtained during and after the burn process. In the context of the site stratigraphy, structure and hydrogeology, risk models must evaluate the permeability changes from cavity development and collapse as well as the effects of changes in buoyancy, thermal and mechanical forces on the transport of organic and inorganic contaminants.

RESSONS FOR PROMOTION OF UCG

A West Balkan region growth potential cannot be fully exploited unless local academic research competence is made more visible and accessible. This is true for all knowledge-intensive sectors, including the mining and environmental sector. Access to research competences will provide the industry with partners for research collaboration and UCG development. Without these partnerships, innovation leading to technology start-ups will be significantly hampered. They all face the same challenge of better exploiting research competences in their countries. At the same time, they need to increase the competitiveness of their countries in order to attract more

scientists, companies and the most important - investments. The final reason is to develop a joint marketing strategy for the application of UCG technology in this region.

Some Western Balkan Countries (WBC) have enormous coal resources that could potentially benefit from UCG commercialization. In particular, Macedonia, Serbia, Bosnia and Herzegovina have large reserves paired with rapid economic growth that has created unparalleled demands for energy including electricity, liquid fuels, and chemical feed-stocks. Simultaneously, these countries are coming to terms with rapid growth in pollution and global concerns with their CO_2 emissions. UCG provides unique opportunities to serve these rapidly evolving needs for both countries.

Results of the UCG will show the possibility of application and use of UCG in production of clean energy in WBC. Possibility of applications of UCG is consisted in following:
- Production of synthetic natural gas (CH4);
- High efficiency electricity through an UGC configurations;
- Production of liquid fuels (synthetic diesel fuel, methanol, Fisher – Tropsch liquid etc.);
- Production of hydrogen as one of the most clean and environmentally friendly fuel.

Results of the promotion will initiate further investigations in implementation of UCG in coal deposits in WBC. The big potential of coal in this region, will rise the possibility of development and application of UCG.

Classic surface exploitation of coal (surface or underground mining methods) produces: gas which contains atmospheric pollutants such as SOx, NOx, mercury etc., solid wastes such as fly ash or slags and direct environmental influence to the nature such as degradation of environment, acid main drainage etc. UCG faces none of these issues.

The results of the implementation of UCG will be confirm the following advantages:
- No SOx is produced (Sulphur in the coal is converted to H_2S or COS, which are easily getterd and converted to solid form);
- No NOx is produced (the gasification reaction takes place underground at relatively low temperatures, so no NOx is generated);
- No ash is produced (all the ash remains underground);
- Reduced mercury and particulate streams;
- Reduced plant footprint;
- Reduced environmental footprint.

These advantages provide the opportunities for lower capital cost, improved regulatory compliance, substantial emissions reduction of criteria pollutants, and reduced surface footprint and legacy.

CONCLUSIONS

Underground coal gasification is a method of converting unworked coal, deep underground, into a combustible gas, which can be used for industrial heating, power generation or the manufacture

of hydrogen, synthetic natural gas or other chemicals. The gas can be processed to remove the CO_2 before it is passed on to end users, thereby providing a source of clean energy with minimal green house gas emissions. The energy is recovered directly from coal seams, avoiding mining related hazards and the handling of surface coal and post-combustion ash.

A West Balkan region growth potential cannot be fully exploited unless local academic research competence is made more visible and accessible. This is true for all knowledge-intensive sectors, including the mining and environmental sector. Access to research competences will provide the industry with partners for research collaboration and UCG development. Without these partnerships, innovation leading to technology start-ups will be significantly hampered. They all face the same challenge of better exploiting research competences in their countries. At the same time, they need to increase the competitiveness of their countries in order to attract more scientists, companies and the most important - investments.

Added value of this paper is promoting and facilitating of WBC participation in modern trend in development and using of UCG. Second value is development research and innovation strategic in Trans – national and national technology transfer. Third value is dissemination of scientific information, education policy and training modalities.
Possibility of applications of UCG is consisted in following:
- Production of syntetic natural gas (syngas, CH_4);
- High efficiency electricity through an UCG configurations;
- Production of liquid fuels (syntetic diesel fuel, methanol etc.);
- Production of hydrogen how one of the most clean and ecological fuel.

Classic surface exploitation of coal (produce gas who contain atmospheric pollutants such as SOx, NOx, mercury etc., solid wastes such as fly ash or slags, and direct environmental concern such as degradation of environ, acid main drainage etc. UCG faces none of these issues.

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