The new process for sustainable Clean Energy with Zero-GHG emission

Background

In the context of sustainable Clean Energy aiming at sustainable alternative fossil energy resource than coal, crude oil and natural gas, EVISA Engineering presents the transformational CPCE, Carbon Power and Chemicals economy. The CPCE performs the first-of-its-kind commercially profitable process that captures virtually zero-value waste carbon dioxide for re-use and waste heat and inexpensive purified water with additional natural gas as auxiliary feed stock in minor extent, while producing high-end four products, namely valuable syngas for manufacturing of any hydrocarbons (e.g. gasoline, methanol, ethanol, diesel or other commodity chemicals), liquid oxygen and electricity for dispatch, as well as gaseous oxygen to oxy-fueling, that leads to enhancement of overall thermal efficiency. Hence, CPCE provides Zero-Carbon Emission addressing the global warming additionally, while fulfilling all objectives of Clean Energy for energy independence, rather energy export. Because CPCE harnesses mainly waste material and waste heat, the products, both the hydrocarbons and electricity are attainable at 30% to 35% lower costs compared with state-of-the-art processes for fossil power via gas turbine and/or hydrogen via steam reforming as well conventional oxygen preparation.

The fundamentals of CPCE is grounded on two new thermodynamic cycles (1. and 2. Bairamijamal Cycle) and the high pressure, low temperature electrochemical conversion of the electrolyte -liquid carbon dioxide and water) to syngas ($C/2H_2$) and oxygen as GOX as well as LOX (gaseous and liquid oxygen). These features can be implemented in retrofitting of five groups of industrial plants (referred to as Stationary Carbon emitting plants for pre-combustion and/or post-combustion) as well can be installed for a new generation of fossil power plants based on Second Bairamijamal Cycle. The Stationary source of CO_2 encompasses a potential of about 65% of U.S. CO_2 and up to 75% of CO_2 globally (according to annual report of IEA International Energy Agency). It shall be highlighted that the re-use of Stationary CO_2 with water to syngas, is nearly equal to 2.4 times equivalent carbon balance to all imported crude oil in United States.

This kind of hydrogen based fossil power plants are referred to as super-efficient hydrogen based power plants with a margin of efficiency of 85% to 90% (depending on location and season). This kind of power plants conquers presently, the best available gas turbine combined cycle with around 62%, but also delete the way of nuclear power generation by economical reasons entirely.

The CPCE application for super-efficient power plant in combination with high pressure gasification delivers lower costs for investment; shorten the return of investment with low maintenance costs in a compact footprint. This new generation of power plant will distinguish from the state-of-the-art by number of innovative solutions, e.g. there is no longer cooling tower, chimney nor huge HRSG building, nor will costly high-gas turbine be in place. With the deletion of the chimney, there is also no longer sooth blowing, emission of pollutants into the atmosphere, for instance. Further on CPCE can be installed de-central in any location either adjacent to a chemical or power plant or on a green root site.

Process outline

CPCE comprises first the CO_2 separation from Stationary Source of CO_2 source (e.g. flue gas of power plants) via condensation, whereas the obtained liquid CO_2 is utilized as working fluid up to two CO_2 cycles that is integrated with the waste and process heat recovery. One CO_2 cycle, referred to as CO_2 power cycle according to First Bairamijamal cycle, consists of a multistage CO_2 turbine and generator for external power dispatch. This cycle converts the wasted thermal energy (e.g. lost else by cooling tower and chimney) down to nearly ambient temperature at 31° C. The second CO_2 cycle consists of a multistage CO_2 turbine, which drives the compressor (for Flue Gas or MP/LP syngas of a gasifier, for instance) and a generator for AC current. The cleansed flue gas is also of further subject to waste heat recovery prior to the off gas expander turbine, that contributes additional power on the driving shaft of this power cycle as well. The generator of this cycle performs power, which is needed for internal back-up for the electrochemical conversion of CO_2 with purified water to syngas ($CO/2H_2$) and oxygen.

The excess liquid CO_2 (referred to as Export CO_2) is further blended with purified water under high pressure, in order to provide a high concentrate aqueous CO_2-H_2O electrolyte. The concentrated aqueous CO_2 electrolyte is fed to the HPLTE-Syngas Generators (High Pressure Low Temperature Electrochemical Syngas Generator) that delivers high pressure oxygen stream from the anode and HP syngas stream in the composition of $CO/2H_2$ from the cathode compartment. The obtained gaseous product streams of HPLTE-Syngas Generator are also integrated in their own power cycle via multistage syngas turbine and multistage oxygen turbine, each one with multiple re-heater sections. The syngas and the oxygen turbine drives primarily AC generator that provides (after AC/DC converter) the back-up DC current needed for the electrochemical conversion.

Fundamentals of CPCE and benefits for commercial plants, carried out in two stages

The CPCE is respected as non-competitive process e.g. as regards to short return of investment. The operation of the first new thermodynamic CO_2 cycle is substantiated by sufficient technical available information at the present time ready for installation in the first stage. With regards to this section, the CO_2 turbine as well as syngas and oxygen turbine do not endorse any new field or areas subject matter of lengthily research. The primary field of research required for CPCE is for the development of a test rig for the HPLTE-Syngas Generator that is fed with high pressure liquid CO_2 and water for evaluating and determining the best kind of electrode material and determination of DC current efficiency for the electrochemical conversion. The scientific research for the electrochemical conversion of CO_2 is carried out at low pressure and CO_2 concentration in aqueous electrolyte (e.g. by George Olah) as well as under gaseous state (e.g. by C. R. Graves).

The second stage of CPCE comprises also special construction of two kinds of torches, one torch for primary high pressure Direct Steam generation (applicable for HP section upstream of the steam turbine), and the second torch for steam re-superheating (applicable for steam upstream of intermediary and low pressure sections IP/LP of the steam turbine).

Therefore, CPCE is applicable for all ten fields of applications, five typical Stationary Sources of CO_2, either one for upgrading of an existing plant and for new plants as well.

The ballpark calculation of CPCE application for the flue gas of an existing conventional 1000 MW coal power plant unveils an amortization time less than 4 years for an overall plant investment costs of 1,095.83 MM$ (corresponding to a syngas value at 0.1824 $/Nm³) without hydrocarbons manufactured from the syngas. This level of syngas generation costs conquers the existing state-of-the-art processes i.e. steam reforming of natural gas in around 30% to 35% lower costs.

Patent status and the security of CPCE uniqueness and novelty

CPCE is filed first for patent application in United States with registration code of US 61/850, 685 and the priority date of February 21, 2013. The international PCT application was entered to as of February 19, 2014. As of November 2014, the CPCE is deemed as unique, patentable process without any kind of interference or infringement to other few commercially processes. Thus as the same date, the CPCE is referred to a non-competitive process due the proven fact, that the few like-minded heralds of Clean Energy are not deemed as competitors. Name of those likeminded research and development persons can be outlined upon request.

Goals and objectives

EVISA Engineering pursues the commercialization of CPCE in building coalitions with recognized Clean Energy companies, universities, DOE and investors e.g. with fossil energy sector for chemicals manufacturing and power generating companies, as well as with renown engineering companies. In addition, collaboration is also sought with a jet engine manufacturer specialized with new H_2/O_2 jet engines (e.g. SABRE jet engine) for the CPCE's torches. The test rig for HPLTE-Syngas Generator (with ca. 10 kinds of electrode materials to be tested) and the two kinds of CPCE's torches requires ca. 1.5 to two years for design, construction, and commercial run.

By virtue of above security, the candidacy of the inventor for outstanding engineering and scientific prizes (e.g. Queen Elizabeth Prize, U.S. Energy Security Prize and others) is ongoing. Further publications for oil and gas, chemical and power plant magazines for international stage are in preparation.

Further CPCE detail descriptions for the process and for the two new thermodynamic cycles deployed therein and other information can be furnished upon request. The content of the patent can be downloaded via USPTO and WIPO official websites.

Enclosed:
(i) CPCE feed stocks-Products Block Diagram
(ii) Illustrated Chart of CPCE

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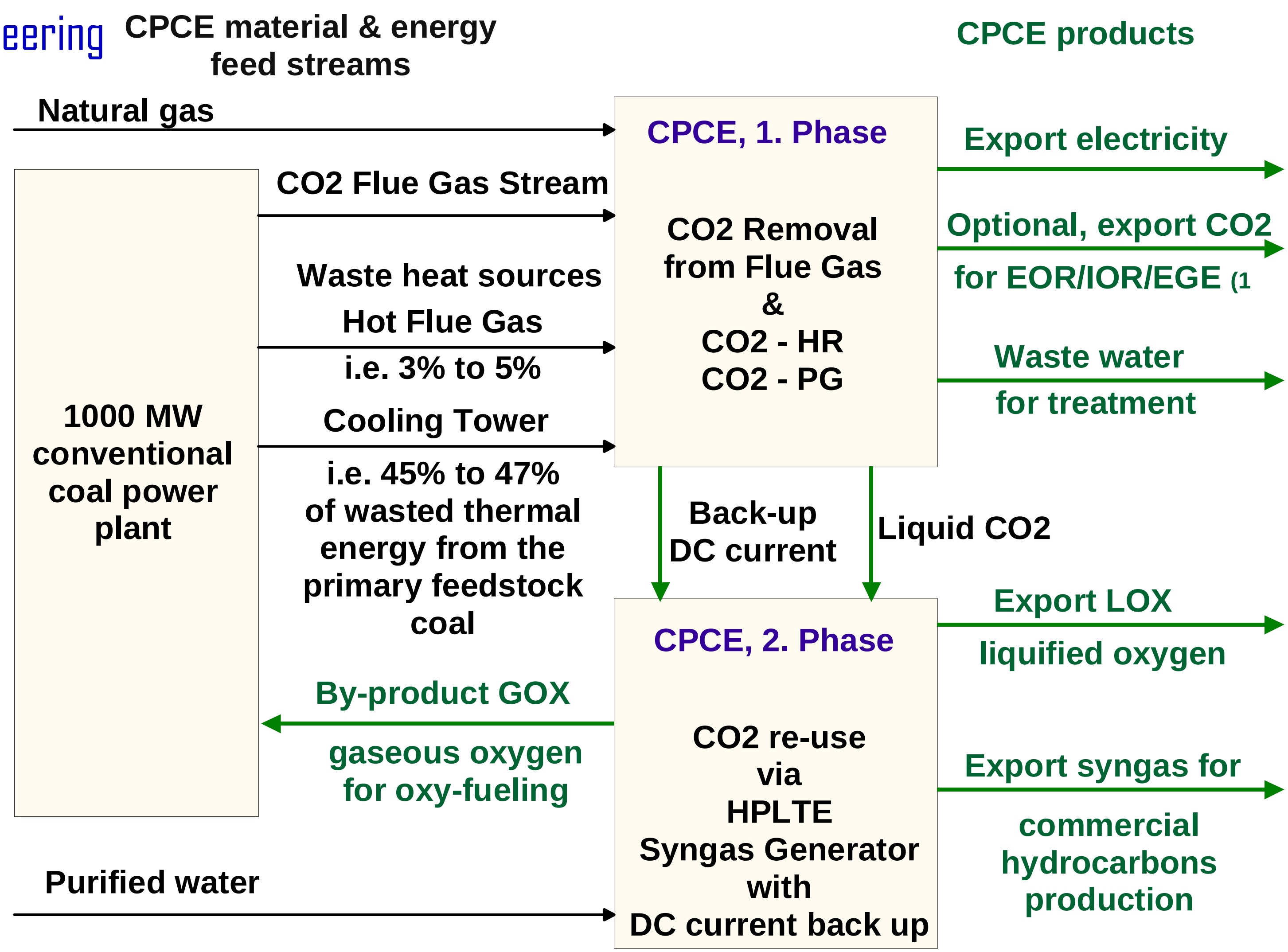
CPCE Feed Stocks and Products Block Diagram



1) Optional product of CPCE in the phase 1 as EGE, Enhanced Gas Extraction

EOR: Enhanced Oil Recovery
IOR: Improved Oil Extraction
EGE: Enhanced Gas Extraction
HPLTE: High Pressure Low Temperature Electrochemical
reactor for syngas and oxygen genertion

CO2-HR: CO2 Waste Heat Recovery
CO2-PG: CO2 Power Generation
LOX: Liquid Oxygen
GOX: Gaseous Oxygen

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