

## **Application of CPCE for the new generation of super-efficient hydrogen based fossil power plants**

The CPCE, Carbon Power and Chemicals Economy process of EVISA Engineering leads in its acme to the new generation of fossil power plants, which outpaces other existing fossil power plants and also surpasses the way of nuclear power generation by economic and technological reasons as well.

This kind of very compact power plants is referred to as CPCE's super-efficient hydrogen based ultra-clean fossil power generation in PolyGen arrangement for poly generation of power and commodity chemicals (e.g. gasoline, ethanol, methanol, DME as well oxygen as LOX & GOX, ammonia/nitrogen based fertilizers) with number of transformational advantageous e.g. ca. 35% lower costs for electricity and hydrocarbons manufactured, specifically very short return of investment.

The super-efficient power plants of CPCE excels with the overall thermal efficiency in margin of 85%, which outstands the best available thermal combined cycle power plants based on the combination of Brayton-Rankin cycles with about 62% efficiency. It surpasses also the nuclear power plants with an efficiency of around 55% by far. This kind of power plants are based on high pressure gasification of primary carbon-rich carbonaceous feed material (coal, petcocks, crude oil, natural gas, LNG with respect to rich carbon constituent).

Most poignant features of CPCE super-efficient power plants can be summarized as follows:

1. Capture and re-use of CO<sub>2</sub> and its integration for poly-generation of high end hydrocarbon final products
2. Zero-Carbon Emission due economical benefit for re-use of CO<sub>2</sub> as the new alternative fossil energy resource with virtually zero value (so far the Carbon Tax is not excised yet).
3. Optionally, combination of this kind of PolyGen power plants with an existing Stationary CO<sub>2</sub> plant for additional supply of CO<sub>2</sub>
4. Embarking of the waste energy streams (typically wasted into the atmosphere through cooling tower and chimney) as the primary CPCE process energy with zero value
5. Capability to sets the reversal trend in growing global CO<sub>2</sub>, as GHG in the near term future
6. Preservation of existing fossil energy resources for crude oil and coal, due to re-use of carbon dioxide as a new resource
7. De facto zero emission for fossil power generation in terms of pollution NO<sub>x</sub>, SO<sub>x</sub>, sooth ("Black Carbon"), mercury, antimony, radioactivity (emitted from fossil energy resource e.g. coal into the atmosphere), because this kind of power plants no longer implement the chimney
8. No loss of thermal energy through the chimney (typically 3% to 5%)
9. All undesired residues and by-products are separated as the non-leachable slag which can be used in construction
10. Abatement of expensive nuclear power generation entirely
11. No employment of the huge cooling tower that dilapidates significant part of the thermal energy, typically in the margin of 45% to 47%, depending of the kind of power plant, region and the season
12. No dissemination of Legionnaire bacteria through the cooling tower into the atmosphere
13. Compact size and foot print of this kind of power plants
14. Availability of short-term added electricity to the grid on the basis of retrofitting of the existing power plants with CPCE

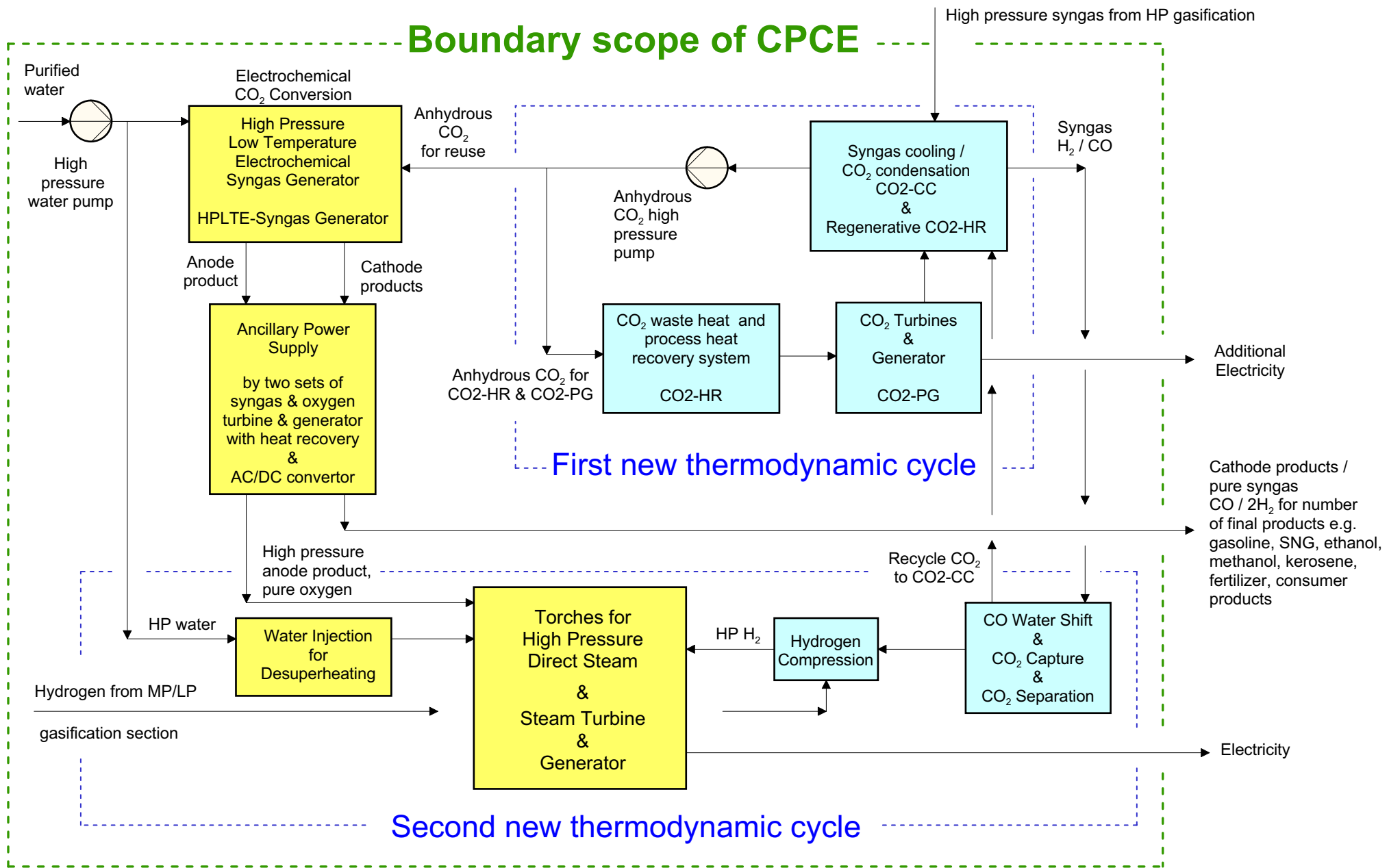
The CPCE's super-efficient power plants deletes number of expensive plant sections, costly equipment and also provides a new commercially advantageous way for oxygen supply. These aspects can be listed:

15. No installation of heavily costly gas turbine for new plants
16. No need for huge steam generation building with extensively large size of heat exchanger tube banks
17. No need for the entire Acid Gas Removal plant Island for retaining the carbon dioxide
18. No longer need for Air Separation Plant Island for supplying of oxygen for gasification as well as for the generation of ultra-superheated Direct Steam
19. No need for large scale Plant Island for the treatment of Black Water for effluents

The CPCE's super-efficient power plants encompass the following main sections:

- a) Carbon Capture of syngas stream downstream of HP gasifier via CO<sub>2</sub>-CC section for liquid carbon dioxide
- b) CO<sub>2</sub>-HR and CO<sub>2</sub>-PG, carbon heat recovery and carbon power generation by the operation of 1. Bairamijamal cycle
- c) Purified water treatment for electrochemical conversion of CO<sub>2</sub>
- d) HPLTE-Syngas Generator reactors for high pressure, low temperature electrochemical conversion of liquid carbon dioxide and water to high pressure cold gaseous syngas and oxygen
- e) Heat recovery integration for syngas and oxygen, obtained from HPLTE-syngas Generator prior to each stage of syngas and oxygen turbine
- f) AC/DC power backup for electrolysis from the CO<sub>2</sub> cycle, syngas and oxygen turbine
- g) Combustion of hydrogen (obtained from the gasification process) with the oxygen (in part obtained from anode of HPLTE-syngas Generator) via primary torches for high pressure ultra-superheated Direct Steam generation in close distance upstream of the HP section of the steam turbine (by operation of 2. Bairamijamal cycle)
- h) Secondary combustion torches for hydrogen/oxygen for reheating and re-superheating of steam for IP/LP section of the steam turbine (by operation of 2. Bairamijamal cycle)

# Super-efficient hydrogen based fossil power plants with HP gasification



The pure oxygen from anode, comprises the oxygen supply to gasification and sequential combustion with hydrogen only.