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MARKET BARRIERS TO THE INTEGRATED PLASMA GASIFICATION COMBINED CYCLE PLANT IMPLEMENTATION - ROMANIAN CASE -

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Articolul prezintă o analiză a barierelor pe care piața locală a energiei electrice le poate pune unui proiect care are în vedere realizarea unei Centrale Integrate de Gazeificare prin Plasmă în Ciclu Combinat a deşeurilor (urbane şi industriale), cu obținerea de energie electrică, în principal, şi a numeroase sub-produse. Pe plan mondial, un astfel de proiect este considerat un salt tehnologic în domeniul centralelor în cogenerare şi România este pentru prima oară luată în considerare ca posibilă locație pentru acesta, inclusiv ca şi o soluție alternativă de producere de energie electrică. Problema tratată este cât de dorită ar putea fi o astfel de centrală pe o piață de energie, în particular pe cea românească, în condițiile a două restricții: atitudinea față de un astfel de proiect şi finanțarea unui astfel de proiect.

This article proposes an analysis of the barriers which the local electricity market set against to the project of an Integrated Plasma Gasification Combined Cycle Plant (IPGCCP). The Romanian location is assessed for the first time. The main characteristic of the project is the duality: dual plant – integrated plants, dual aspects of energy produced, dual operational aspects – separate assets management by operational management, dual ownership – non-profit and business, dual cash-flows and, moreover, dual impact on the Power System: as a "new technology" plant to replace obsolete plants and "too non-typical" plant to be accepted easily by the Power System.

Keywords: plasma gasification, co-generation, electricity market, energy efficiency, waste to energy

1. Introduction

It could be necessary an IPGCC Plant in Romania in the existing conditions? It could be feasible such a Project? If so, which could be the barriers against the project implementation [1]?

The energy-efficient technologies are currently low adopted by the Romanian market. Even more, this type of technology – plasma gasification [2] – seems to be reluctant. Together with their ignored potential, significant amounts

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of energy could be saved cost effectively through investments in this equipment. The main reasons are that the financing and the energy operating costs of this category of technologies are below the energy costs of currently installed equipment, as example for the present co-generation plants [3]. The main cause: Romania could accept nowadays that an IPGCC Plant is an exotic source of energy and only the currently unsolved problem of waste could bring into attention this type of Project [4]. The main problem: financing such a huge Project [3]. In the theory, investors should be equally willing to invest in options offering the same expected return for the same levels of risk and liquidity. To explain investors' apparent unwillingness to do so, some commentators point to "(market) barriers to energy efficiency." [5]. However Romania has to re-think the next steps in its Power System further development and energy sources searching.

The efficiency gap could be understood as an underinvestment in energy efficiency at market prices for energy versus underinvestment in energy efficiency because of the mis-pricing of energy resulting primarily from negative environmental externalities and regulatory failure [1].

2. IPGCCP

The IPGCCP block diagram is presented below. [2]

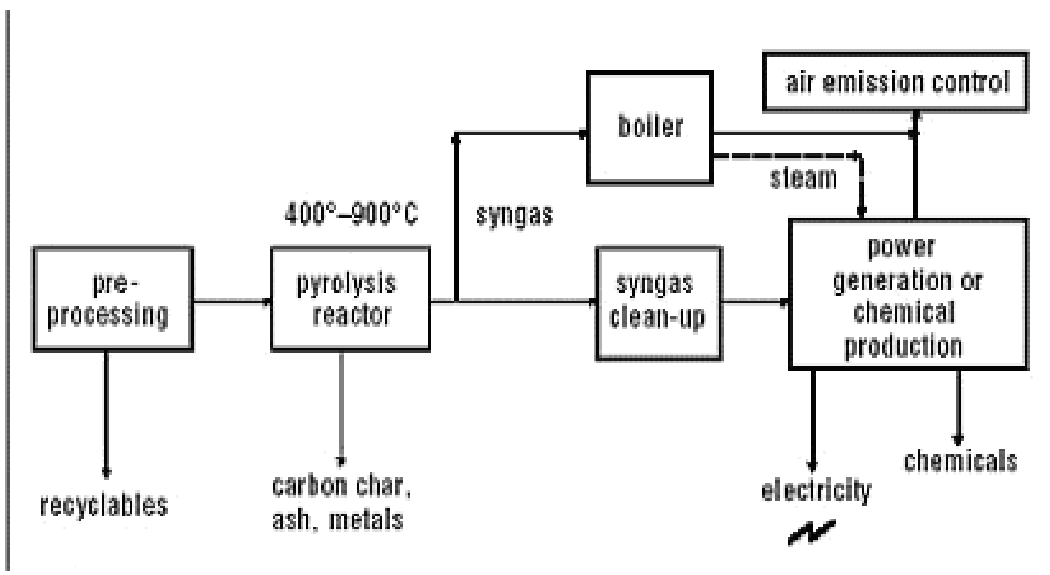

Fig. 1 - IPGCCP block diagram

Below, there are presented the main feasibility characteristics for this type of Plant:

Table 1.

Main Feasibility characteristics of an IPGCC Power Plant in Romania

EXPECTED INCOME		EURO PER METRIC TONNE - MARKET PRICE	WASTE STRUCTURE – AS FOR ROMANIA - % OF TOTAL	WASTE-TO-ENERGY TOTAL INCOME - EURO PER YEAR-
Processing tax	Municipal waste, incl. Waste from logistic activities [6]	8 – 19 (to be increased to 9 – 20)	42 – 65	
	Industrial waste incl. Waste from Construction activities	20 – 50	8 – 10	
	Electric and Electronics. Disposal.	20 – 100	5 – 6	
	Food industry and related waste	20 – 30	15 – 18	
	Toxic waste incl. expiated food and goods	50 – 150	2 – 3	
	Chemical waste incl. dangerous waste: military waste, expiated fireworks and related, guns	100 – 150	2 – 3	
	Medical waste incl. hospital waste incl. pandemic waste [7]	100 – 300	3 – 4	
	Low radioactivity waste	300 – 1.000	0 – 0.000001	
	Other incl. decontamination	20 – 200	1 - 2	
	Legal Import	100 – 150	0,1	
	TOTAL			6.800.000
Electricity produced		50 euro per MWh	1 MWh per 1 metric tonne of waste	14.500.000
Ingots of metal - output		100 euro per metric ton	20% of TOTAL	5.900.000
Vitrified material	Vitrified material to be used as: - pebbles; - construction	1 euro per metric ton as pebbles Average of	Up to 40 % of processed waste	1.800.000

EXPECTED INCOME		EURO PER METRIC TONNE - MARKET PRICE	WASTE STRUCTURE – AS FOR ROMANIA - % OF TOTAL	WASTE-TO-ENERGY TOTAL INCOME - EURO PER YEAR-
	material	110 euro per metric ton for high quality materials for construction		
Acids	HCl mainly			2.800.000
Liquefied gases	Oxygen Carbon dioxide – Food industry and beverage Nitrogen – used in the cooling process of the reactors Other			
	TOTAL			1.500.000
Ethanol / Methanol			5% of waste processed x 20 euro per metric ton	300.000
Distilled water to be sold or recycled into local river or other purposes	10.000 tone per day			3.000.000
Thermal energy		Up to 22 euro per Gcal. Unit cost: 5 euro per Gcal	1 Gcal per 1 metric ton of processed waste d x 5 euro per Gcal (social support)	1.500.000
TOTAL INCOME PER YEAR – ESTIMATION				38.100.000
EMISSIONS TRADING				3.500.000

Below, there are presented the main capital expenses characteristics for this type of Plant:

Table 2.

Main capital expenses characteristics for an IPGCC Power Plant in Romania (€)

IPGCC POWER PLANT – COMPLETE PROCESSING CONFIGURATION	335.000.000	
Payback period	25 years	
Financial expenditures - additional		15.500.000

Below, there are presented the main operational and additional cost for this type of Plant:

Table 3.

Main Operational Cost and Additional cost for an IPGCC Power Plant in Romania (€)

	EURO PER METRIC TONE	ADDITIONAL COST
Waste management	7	
Operational cost Including additional gas consumption and including torch consumption of power.	12	
Maintenance	3	
Marketing	1	
TOTAL	23	6.800.000
Financial expenditures related to capital incl. credits		15.500.000
TOTAL Operational and additional		22.300.000
Gross Profit – estimation		15.800.000
Gross Profit including profit from emissions trading		19.300.000
Unit Cost - estimation	23 euro/MWh 38 euro/MWh	IPGCCP complete functionality IPGCCP producing only electricity, gases and additionally thermal energy

So, these being the figures, why it's so difficult to implement this type of Project in Romania? [1]

3. Barriers to IPGCC implementation in Romania.
3.1. Misplaced Incentives

The main benefit could be considered as a social benefit – the local community.

Misplaced, or split, incentives are transactions or exchanges where the economic benefits of energy produced by IPGCC do not accrue to the persons and/or organizations who are trying to implement such project. There is little or no incentive for the owners of the plants to increase his or her own expense to acquire/build efficient plants, because the owner does not bear the burden of the operating costs and will not reap the benefits of reducing those costs. This misplaced incentive is believed to extend to the IPGCC, especially because an IPGCC project should be supported by Local Authorities [8].

The solution to overpass this barrier is that the project will be implemented within a special financial scheme. This scheme separates the “owners” of such plant [9]: 1) a non-profit partnership between a Local Authority and an Asset Management organization and, on the other hand, 2) a business oriented operation of the plant. In these terms, the partnership builds a turn-key plant upon a non-profit scheme and “lends” the operational activities of the plant to an Operator.

3.2. Financing [1]

The financing barrier, sometimes called the liquidity constraint, refers to significant restrictions on capital availability for potential borrowers. An IPGCCP implies huge capital availability, i.e. about $3 million per MW [9] – net power capacity. It could be observable that some potential borrowers, important ones, are frequently unable to borrow at any price as the result of their economic status or “credit-worthiness.” This lack of access to capital inhibits investments in energy efficiency by these classes of consumers. An IPGCCP however could overpass such barrier. However we talk about lack of enough capital.

The capital that may be available through does not distinguish between purchases or investments and is, generally, very costly compared to other forms of credit. If a consumer wishes to purchase an energy-efficient piece of equipment, its efficiency should reduce the risk to the lender. However, the project must be split into two sub-projects essentially with the same source of financing but having two separate financial schemes:

1) capital disbursement for the IPGCC Power Plant – managed as an asset as part of a investment portfolio by the capital owners. This financial scheme is based upon the fact that the penalties related of non-placed capital is more less beneficial than the minimal profit of a placed capital. In terms of such Project, the penalties are, by far, more significant than the minimal Operational Profit of

Plant. This is quite similar to an offset financial scheme. This scheme also includes social related subprojects to be funded by capital dividends, if any.

2) the second scheme is the commonly financial scheme of cost and income related to the Plant operations. This is oriented to the Operational Profit.

In such circumstances, the market value of the Plant is the main financial characteristic of such Plant.

3.3. Regulation

The regulation barrier referred to mis-pricing energy forms (such as electricity and natural gas) whose price was set administratively by regulatory bodies. These procedures and the cost structure of the industries typically result in different prices, depending on whether they are set based on average costs (the regulated price) or marginal costs (the market price). Historically, the price of electricity, as set by regulators, was frequently below the marginal producing cost. This mis-pricing was claimed to create an incentive to over-consume electricity relative to conservation or efficiency. This shift has given rise to contentions that the price of electricity now provides an incentive to over-invest in energy efficiency.

For the project of an IPGCCP this barrier could be non-beneficial. However, the Plant has a special income: the revenues for processing the waste relating the principle “the Polluter must pay!”. This revenue has as source a waste processing tax and is part of the agreement between the asset manager and Regional/Local Authorities.

3.4. Inseparability of features

IPGCCP main product is the electricity; the other product is, in fact, a collection of features, each of them may be seen as individual goods themselves. Although some features are clearly separable (electricity, power capacity, thermal energy and so on) many others are not, either because of technological limitations or producer decisions. As a result, buyers may be forced to purchase unnecessary/undesirable features in order to acquire energy efficiency or to settle for less efficient equipment. The examples of steam and/or thermal energy could be useful. [8]

3.5. Risk, Discount Rates, and Modelling the Investment Decision

High discount rates are, in fact, warranted given the risk-ness of energy efficiency investments. The first is framed in terms of the diversification options available for these investments. The second is framed in terms of the illiquidity of the investments.

The first argument starts with the observation that although engineering/economic analyses assume known and certain future conditions such as energy prices and device lifetimes, in fact such future conditions are uncertain and impose risk on the potential investor. Potential investors, it is argued, will increase their discount rates to account for this uncertainty or risk because they are unable to diversify it away. The capital asset pricing model (CAPM) is invoked to make this point.

The second argument observes that, unlike an investment in a liquid or saleable good, an investment in efficiency must be held by the initial investor regardless of the performance of the investment or the investor's changing needs. Thus, as the rated lifetime of equipment increases, the uncertainty and the value of future benefits will be discounted significantly. The irreversibility of most energy efficiency investments is said to increase the cost of such investments because secondary markets do not exist or are not well-developed for most types of efficient equipment. This argument contends that illiquidity results in an option value to delaying investment in energy efficiency, which multiplies the necessary return from such investments.

3.6. Imperfect Competition

There is a very important monopoly of an IPGCCP which could influence the market. The IPGCCP has the monopoly of negative costs management. An IPGCCP produces energy and sells energy. However, the energy is pre-paid (the waste producers and transporters pay to process the waste) and is over-paid also by the sub-products sold separately. There is a costs portfolio and profit portfolio. In most cases the amount of profit from waste processing and the profit from energy producing overpasses the energy operational costs even we talk about the same final product.

4. Conclusions

As pointed above, an IPGCCP is a special project. It implies or even could create many market barriers. Some of these barriers are informational and decisional. Other barriers are technological. But most arguments are economical.
In order to implement an IPGCCP project in Romania many difficulties should be solved:

- Decisional aspects. The main decisional aspects involve the partnerships to be settled and made functional.
- Financial scheme of the capital expenditure. There is a special financial scheme to be approved and supported. We talk here about a mixture

between a profit oriented project and non-profit project.

- A new technology is to be accepted. An IPGCCP implies new definitions for energy efficiency vs. economic efficiency. That is, an IPGCCP is separately efficient: energy efficiency does not imply economic efficiency and is not necessary to do so. For example, the capital expenditures are too important and imply a huge amount to follow the classical way of payback models.

More analysis should be considered and many steps should be followed in order to implement such project. It was a trial to construe a model in order to bring together the main characteristics of such project. This model should be a Romanian answer to the original model that is not fully applicable in our conditions.

There are some interesting results using some non-classical assumptions. The aim was to overpass the market barriers creating a "virtual market niche" for this IPGCCP Project:

- We could have a more general measurement unit for the efficiencies analysis, i.e. for both efficiencies analysis: energy efficiency related to the economic efficiency. This measurement unit which could be proposed is the energy-money unit.
- The non-profit portfolios of activities/products and profit-oriented portfolios of activities/products could be put together as the characteristics of a generic product: the "reiterated" energy (waste-to-energy).
- An IPGCCP should have a special model associated: the model of a transformer of energy.

The work will continue. The major aim of this work is to support the implementation of this type of technology and this type of plant in Romania.

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