Current situation of oil refinery in Bulgaria

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Abstract. This article deals with the classification approach for oil refineries in international practices. Criteria of refinery estimation group, including its financial status estimation, have been investigated. The analysis object is "Lukoil Neftochim Bourgas" AD (LNCHB) activity. This company is a leading enterprise in Bulgaria. The analysis of LNCHB operating: energy intensity index; index of operating costs and return on investment index have been performed.

1. Introduction

A comprehensive comparison of separate refineries status and their development dynamics in the last 25 years have being carried out by various international rating agencies. Participants receive final state assessment accounts annually, as well as analytical findings that help refinery management in further development processes. In order to ensure confidentiality of the investigation and comparative analysis results, standard peer groups (representative groups) are introduced. According to the same indicators investigated refineries are divided into four subgroups – quartiles. The first quartile includes 25% of all the participating refineries which showed indexes in this group, whereas the fourth quartile included 25% of the refineries with the worst indexes [1]. In case, when the number of participating refineries is not so great, division is 3 or even 2 quartiles. Standard group data comparison provides an opportunity for all refineries to understand what their index level is.

2. Materials and methods

This information provides enterprise managers with sustainable estimation of refinery problems being a matter of priority to shape plans and improvement measures.

The investigation structure involved a large number of indexes being divided into two main groups:
1) index of effectiveness;
2) index of competitiveness [2].

Index of effectiveness includes energy intensity index; maintenance cost efficiency index; personnel efficiency index; maintenance personnel efficiency index; non-maintenance efficiency personnel index; non-energy cost efficiency index; volume gain index; carbon emissions index.

Index of competitiveness includes OPEX - cash operating expenses; NEOPEX – non-energy cash operating expense; maintenance index; personnel index, working hours; PCI - personnel cost index; refinery process utilizations; capital investment index; net cash margin; ROI - return on investment.
Refinery grouping is carried out in two ways (Table 1).

Table 1. Refinery grouping methods in international practices

According to the graphic		According to the refinery scale and complexity	
BAL	Baltic Region (Denmark,	*	Viscracking and thermal

According to the graphic			According to the refinery scale and complexity	
		Sweden, Finland)		cracking
DNX	the Benelux (Belgium, Netherlands)		GOC 1	Refinery with integrated index of less than 6.9
GER	Germany			
FRA	France		GOC 2	Refinery integrated index ranging from 6.9 to 8
UKI	The UK and Ireland			
IBE	South-Western Europe (Spain)		GOC 3	Refinery integrated index in the range of 8 to 9.5
M	Mediterranean Europe (Italy, Greece)			
SEE	South-Western Europe (Bulgaria, Romania)		GOC 4	Refinery integrated index more than 9.5
CEU	Central Europe (Czech Republic, Poland, Austria)			

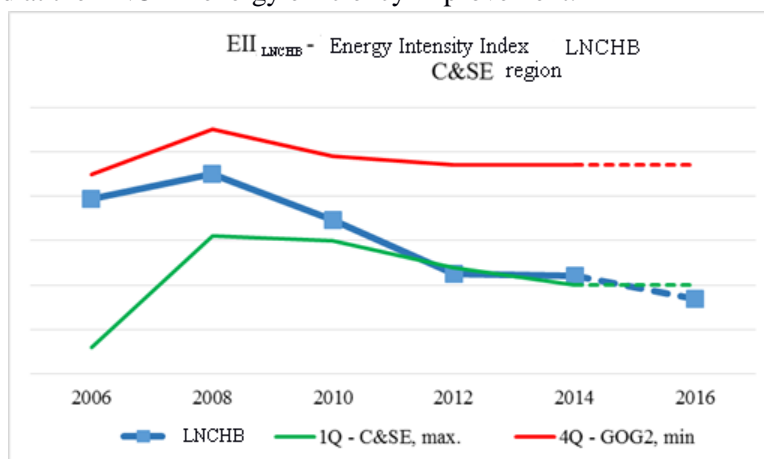An integrated indicator represents refinery process capacity as thousand barrels per day.

Leading Bulgarian refinery "Lukoil Neftochim Bourgas*"* AD (LNCHB) refers to the GOS-2 group (a refinery group with EDC -equivalent distillation capacity- of 1400-2199 thousand barrels per day) and C&SE region (Central and Southern Europe Region) [3,4].
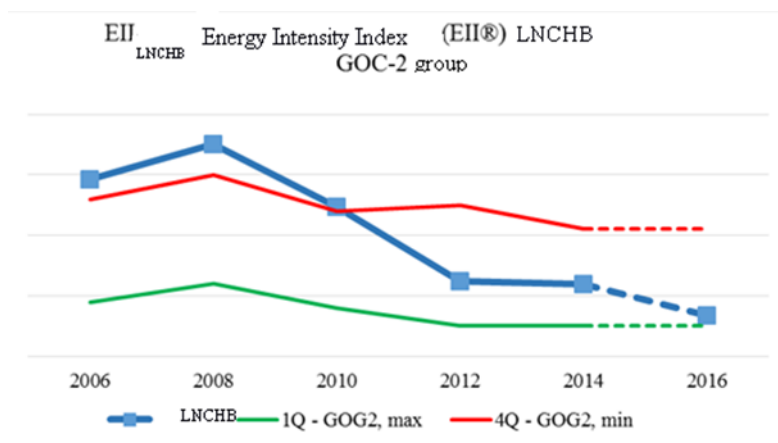
3. Results and discussion

Let's consider the basic LNCHB analysis indexes defining the refineries status from 2008 to 2014. Forecast cost for some 2016 indexes relevant to refinery development plans was calculated.

Energy Intensity Index is the percentage ratio of actual refinery process unit energy consumption to standard refinery process unit energy consumption. Standard energy consumption is determined by the refinery development, i.e. each process involves standard energy consumption per unit of useful efficiency.

The lower the index value, the more efficient the refinery energy consumption. Figures 1 and 2 show the LNCHB EII dynamic pattern comparable to Central and Southern Europe and GOC-2 refinery group EII. Both diagrams clearly demonstrate LNCHB energy efficiency improvement trend for the period from 2008 to 2014 [5]. In this case, the set of implemented activities and projects in this period, were aimed at the LNCHB energy efficiency improvement.

Fig. 1. LNCHB EII (Energy Intensity Index) dynamic pattern comparable to Central and Southern Europe refineries EII, %
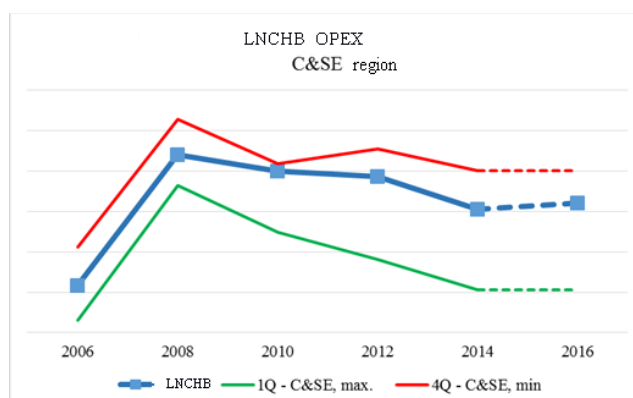
Fig. 2. LNCHB EII dynamic pattern comparable to GOC-2 refinery group EII, %

The diagrams depict that these implemented measures furthered the refinery from the third quartile to the first, as well as the Central and South-eastern Europe refineries from the fourth quartile to the second (for GOC-2 group) [6]. Despite the achieved energy efficiency results, the figures also show that the refinery implementation plans is to continue energy efficiency improvement in 2016. This would be possible due to the planned activities and implementation projects, such as:
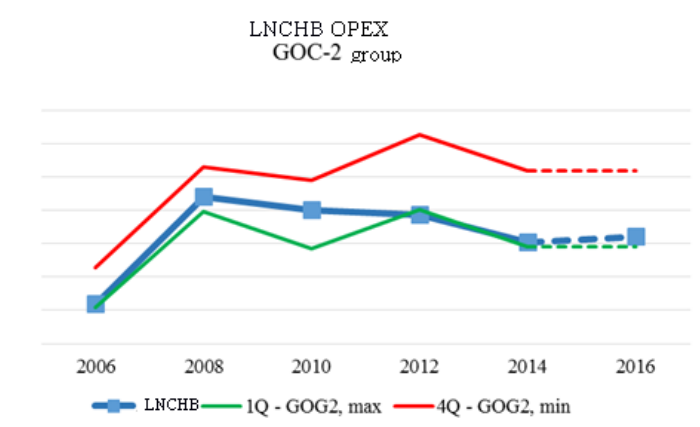
- high-radiative coating duplication via LNCHB furnaces (in 2015, the coverage produced in the furnace P-101 AHP-1 (CPF EURO) considerably reduced fuel consumption in the furnace));

- mono ethanolamine gas purification to MDEA solvent (after minor reconstruction) would save significant heat under conditions of hydrocarbon and hydrogen sulfide removal from gas;

- new furnace construction with HRSG (heat recovery steam generator), high efficiency on AD-4 installation (planned construction will be completed in the first quarter of 2017 and would significantly reduce fuel consumption at AD-4);

- other measures (included in the LNCHB energy efficiency program).

OPEX index shows the degree of rationality use of refinery operational costs [7].

Figures 3 and 4 show the LNCHB OPEX dynamic pattern comparable to Central and Southern Europe, as well as GOC-2 refinery group OPEX.

Fig. 3. LNCHB OPEX-index dynamic pattern comparable to refinery OPEX index of the Central and Southern Europe region
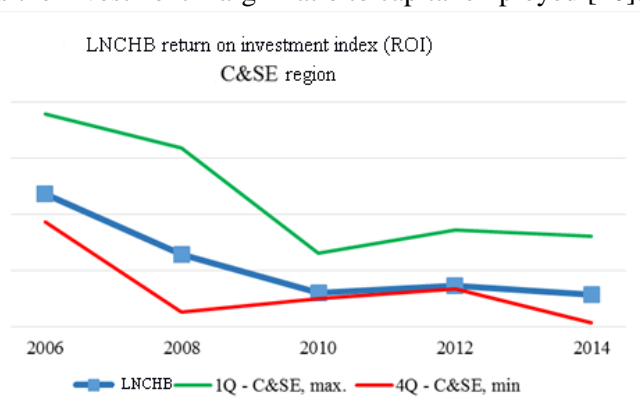

Fig. 4. LNCHB OPEX-index dynamic pattern comparable to refinery group OPEX-index of GOC-2
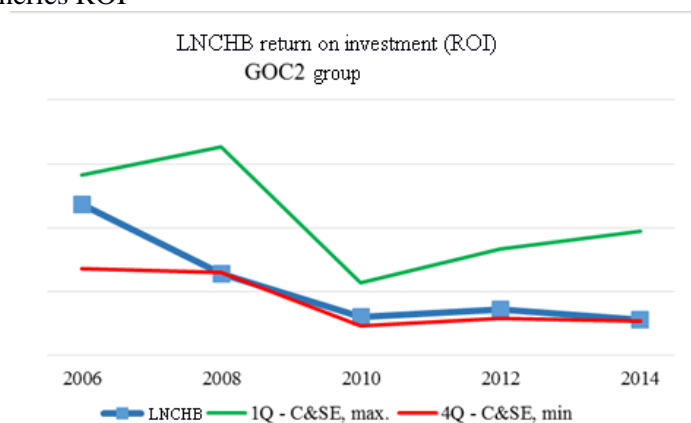
The figures clearly show the operating expenses increase in 2008 compared to 2006, for all analyzed participants, i.e. 1/3 energy resource rise in price (specifically for oil) being the major costs (about 2/3 of expenses) in 2008 compared to 2006. Both figures also depict a steady decline in the LNCHB operating costs in the period from 2008 to 2014 and this is most clearly observed in the GOC-2 group, where LNCHB is among the leaders (due to the first quartile OPEX) in 2012 and 2014.

The main reason for such a quartile difference of LNCHB in the GOC-2 group and Central and Southeast Europe Region is the energy sources price (mainly natural gas) [8]. It still continues to be higher in Bulgaria than in Western Europe and the Central and Southern Europe Region. The reduction of OPEX expenses in value (from 2008 to 2014) is due to implemented activities and projects on energy efficiency into the LNCHB, as well as the implementation of a number of measures to minimize hydrocarbons, steam, industrial and drinking water loss etc., related to introduced hydrocarbon vapor disposal technology for final products tank storage; fuel storage and interconnections optimization [9].

Figures 5 and 6 show LNCHB return on investment index (ROI) dynamic pattern comparable to the Central and Southern Europe refineries and GOC-2 refinery group ROI. LNCHB sustains the third quartile ROI level annually exclusively, (as well as for NCM index (net cash margin) comparable to the Central and Southern Europe and GOC-2 group refineries. This is due to the fact that the Return on Investment Index (ROI) is the investment margin ratio to capital employed [10].

Fig. 5. LNCHB index return on investment (ROI) dynamic pattern comparable to the Central and Southern Europe refineries ROI

Fig. 6. LNCHB return on investment (ROI) comparable to the GOC-2 refinery group ROI

Based on the above-mentioned methodology personnel efficiency index (PEI) is calculated as productive capability by the formula:

EDC = Σ ((PUC * Pc* PUpt) * Cm)

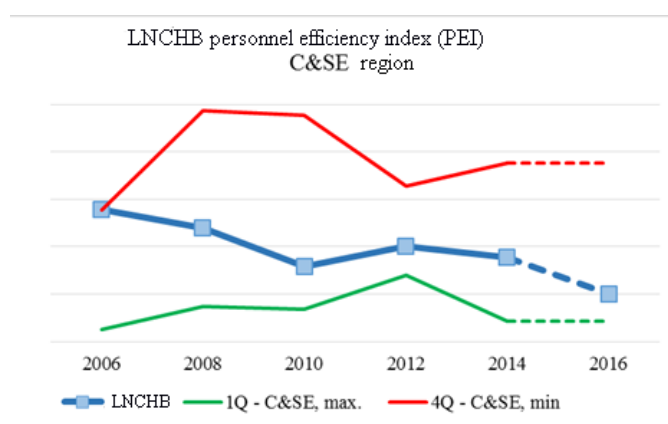where, EDCRPUC - equivalent distillation capacity of a refinery process unit;
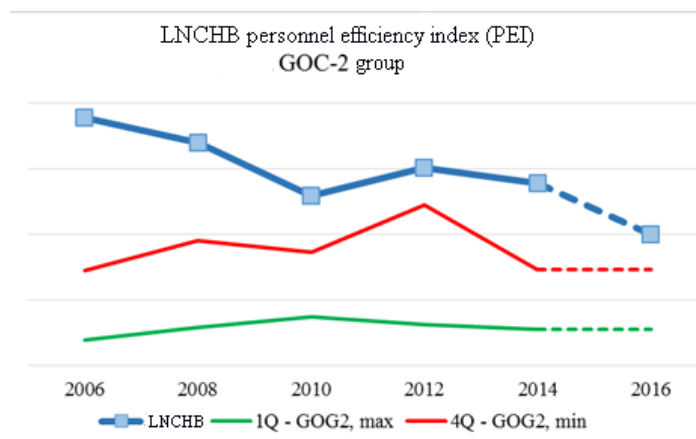   PUC - process unit capacity, ton per day;
    Cf - configuration factor;
    Cm - coefficient of multiplicity;
    Pc - proportionality coefficient, Pc = 0,01 PUpt
where, PUpt – process unit productive time,% per year.

Fig. 7. LNCHB personnel efficiency index (PEI) dynamic pattern comparable to Central and Southern Europe refineries PEI

Fig. 8. LNCHB personnel efficiency index comparable to the GOC-2 refinery group PEI

4. Conclusion

    It should be noted that it is economically unprofitable to downman personnel as it is the main development resource.

    The main difference of the LNCHB quartile in the GOC-2 and Central and Southern Europe group is low-level remuneration of labor in Central and Southern Europe regions.

References

[1] Out of more than 340 oil refineries, a half-dozen that stand out from the crowd [Electronic resource] URL: http://blogs.platts.com/2011/11/01/out_of_more_tha/, free, reference date 01.02.2016

[2] Romanyuk V B, Baitova Y S, Safronova E V and Pozdeeva G P 2015 *Regulatory framework of pricing and estimate standards in the petroleum sector* (Article number 012073) IOP Conference Series: Earth and Environmental Science. **Vol.** 27. pp. 1-5.

[3] Lukoil Neftochim Bourgas AD (LNHB) [Electronic resource] URL: www.neftochim.bg/ru, free, reference date 01.02.2016

[4] Lukoil Refining [Electronic resource] URL: http://www.lukoil.ru/materials/doc/Materials2014/Refining_FB_rus_56-58.pdf, free, reference date 02.02.2016

[5] World Population Prospects [Electronic resource] URL: http://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf, free, reference date 02.02.2016

[6] International Energy Agency [Electronic resource] URL: http://www.iea.org/Sankey/#?c=IEA Total&s=Balance, free, reference date 03.02.2016

[7] Vazim A A, Romanyuk V B, Akhmadeev K N and Matveenko I A 2015 *Associated petroleum gas utilization in Tomsk Oblast: energy efficiency and tax advantages* (Article number 012078) // IOP Conference Series: Earth and Environmental Science. **Vol.** 27. pp. 1-5

[8] Refining Sector Fitness Check Step 1. Solomon Databases [Electronic resource] URL: https://www.concawe.eu/uploads/Modules/Events/2.Symposium2015_Breakout2_REFIT_Solomon_Step1_FINAL.pdf, free, reference date 04.02.2016

[9] Tesla Motors [Electronic resource] URL: https://www.teslamotors.com/supercharger, free, reference date 05.02.2016

[10] Solarcity [Electronic resource] URL: http://www.solarcity.com/, free, reference date 05.02.2016