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COST BENEFIT ANALYSIS

RDF FIRED CHP PLANT IN SOFIA



RAMBOLL

**FEASIBILITY STUDY
RDF FIRED CHP PLANT IN SOFIA**

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APPENDICES

1. INTRODUCTION

The present Cost Benefit Analysis (CBA) and the associated feasibility study are prepared under PJ Framework Agreement between European Investment Bank and Ramboll: Review of the Feasibility Study (FS) and Financing Application Form (FAF): Energy Utilization Plant for Municipal Solid Waste at Toplofikacia Sofia EAD.

The project relates to the establishment of a modern system for RDF (Refuse-Derived Fuel) utilization, producing combined heat and power. Produced power will be sold to national power grid and heat will be utilized in Sofia for district heating network. The new system will be compliant with the EU and national legislation; it will allow Sofia municipality (SM) to achieve targets set by EU environmental acquis communautaire.

The project is included in Bulgarian Operational Programme "Environment" (OPE) 2014-2020. The project is presented in the programme by Sofia Municipality and as supporting the implementation of a waste-to-energy solution as a planned third phase of the Sofia integrated waste management project.

The construction of an installation for mechanical-biological treatment, which will treat all residual municipal waste generated in Sofia has been completed in the autumn 2015. One of the tasks of the installation is to produce RDF which could be used as alternative fuel in a co-generation facility.

This CBA is built on the Feasibility Study that identifies the best CHP plant technology and design and that shows that such plant is well justified over the best available non-CHP alternative. The Feasibility Study provides option analysis, estimation of OPEX and CAPEX and description of technical and financial feasibility. Hence these elements are not repeated in this document.

2. CBA REPORT STRUCTURE

This CBA for the RDF fired CHP plant in Sofia has been prepared in accordance with the principles set out in the EC's "Guide to Cost-Benefit Analysis of Investment Projects" (the Guide)¹. In line with the Guide the CBA is structured in seven steps:

1. Description of the context
2. Definition of objectives
3. Identification of the project
4. Technical feasibility & Environmental sustainability
5. Financial analysis
6. Economic analysis
7. Sensitivity and risk assessment.

First four steps have been thoroughly assessed in the *Feasibility Study – RDF Fired CHP Plant in Sofia*. Especially the Feasibility Study report contains option analysis and description of technical feasibility. Only the summary of these steps is included in the CBA report.

The financial analysis has been done in order to calculate the project's financial performance indicators as set out in Article 101 (Information necessary for the approval of a major project) of Regulation (EU) No 1303/2013. The financial analysis is based on an incremental approach comparing cash-flows of *with* and *without* project scenarios.

The economic analysis has been carried out to calculate the ENPV and ERR indices of the project as required by the Regulation (EU) No 1303/2013.

¹ Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020. European Commission. Page 27. December 2014.

3. FINANCIAL ANALYSIS

3.1 Approach to financial analysis

The financial analysis reflects recommendations in the updated Guide to Cost-Benefit Analysis of Investment Projects (published by the European Commission in December 2014) and takes into account methodological comments and remarks raised by JASPERS and the EIB.

The financial forecast builds directly upon the analysis of the recent financial performance of Toplofikacia Sofia EAD during the 2014 -2016 period.

In the financial analysis the consequences of the proposed investment programme, development of an RDF treatment facility, are analysed over the planning period 2018 – 2046.

The objective of the financial analysis is to determine the degree of financial sustainability of the investment programme, financial returns associated with the investment and to justify the level of EU funding assistance being sought.

Overall objectives of the Financial Analysis, in accordance with the EU CBA Guidelines, the financial analysis must address the following:

- estimate costs and revenues and cash flow implications associated with the investment measure;
- determine the funding gap of the measure (the degree to which own resources cannot cover the cost of the investment);
- calculate the eligible expenditure that can be co-financed by EU funds;
- define the project financing structure and its profitability;
- verify the adequacy of projected cash flow to ensure sustainable operation of the project and implementing entity during the entire planning period.

In line with the Guide to CBA (and as per agreement with Jaspers) the financial analysis is carried out from the point of view of Toplofikacia Sofia EAD. However, the investment loan for the project co-financing will be taken and repaid by Sofia Municipality. Therefore, separate assessment of debt capacity has been done for municipal budget.

3.2 Definition of Sustainability

Financial sustainability is defined as the utility's ability to meet its operating and maintenance costs, and costs associated with any debt service throughout the project period.

The analysis assesses financial viability/sustainability in connection with implementation of the proposed investment programme as well as in connection with necessary, on-going asset replacements and annual investments in physical capital and maintenance necessary to maintain the district heating system at a consistent standard throughout the project period.

Sustainability/Viability is not analysed based strictly on financing at full commercial terms; financial forecasts will include cash flows from sources of grant financing, including development supports from Bulgarian and EU sources.

1.1.1 Incremental approach

The proposed investment falls within an existing infrastructure, i.e. the district heating assets currently maintained and operated by Toplofikacia Sofia EAD. In keeping with the EU Guide to Cost Benefit Analysis, therefore, an incremental method is utilized which compares cash flows in a situation "**with the project**" with cash flows in a situation "**without the project**". The incremental approach is applied as follows:

- Cash flow projections are elaborated for the company in a situation without the project, accounting for all O&M costs and investments and revenues;
- Cash flow projections are elaborated for the company in a situation with the project, accounting for all O&M costs and investments and revenues;
- An incremental cash flow projection is elaborated, taking the year by year difference between the without project and with project scenarios;

- Funding gap calculations are made on the basis of incremental cash flows between the with and without project scenarios, accounting for investment costs and incremental revenue and cost differences between the scenarios.

3.2.1 Key assumptions

The **time horizon** applied for the calculations is 29 years (2018 – 2046) including construction period, this is in line with the recommendations of the Guide to CBA that set 25 – 30 years long time horizon for waste sector projects.

According to Article 19 (Discounting of cash flows) of Commission Delegated Regulation (EU) No 480/2014, for the programming period 2014-2020, the European Commission recommends that a 4% discount rate in real terms is considered as the reference parameter for the real opportunity cost of capital in the long term. Values differing from the 4% benchmark may, however, be justified on the grounds of international macroeconomic trends and conjunctures, the Member State's specific macroeconomic conditions and the nature of the investor and/or the sector concerned.

The long term discount rate applied in financial analysis is **5%** although the DG REGIO benchmark is 4%. According to Art. 19 of Reg. (EU) 480/2014, a different discount rate can be justified. Currently, the safe-harbour profit benchmark for swap rate proxies for the purpose of the SGEI Decision and SGEI Framework is 4.96% for Bulgarian currency (3.96%² plus 100 bps) . As the BGN inflation is around zero (Swap rates are based on average of daily observations from 01.03.2017 to 31.05.2017 excluding non-trading days, in May 2017 compared with February 2017 CPI rate was -0.1%³), the 5% discount rate is justified.

Since the VAT is not eligible for the EC funding financial model is carried out in the values net of VAT.

The exchange rate used in the analysis is **1.95583 BGN/EUR**.

3.2.2 Debt to Bulgarian Energy Holding (BAH)

The debt of Toplifikacia Sofia EAD to Bulgarian Energy Holding (for natural gas payments) at the end of 2015 amounted to **500,464,796 BGN (i.e. 256 million Euro)**. The agreement signed between Toplifikacia Sofia EAD (debtor) and Bulgarian Energy Holding (creditor) in December 2015 concludes that the debt will be repaid over a period of 20 years (including 5 years long grace period).

The financial analysis takes into account loan repayment to BAH in equal instalments amounting to 17.06 million Euro/year between 2021 and 2035. The interest on the outstanding principal amounts to 3.25%.

The agreement is attached to the CBA (Appendix 1).

3.2.3 Investment loan RDF fired CHP plant

The investment loan amounting to 65.724858 million Euro (in current prices) will be repaid between 2021 and 2035. An interest rate of 1.5% has been used in the CBA calculations as typical rates for EIB. As the Sofia Municipality will be an investment loan direct recipient, the conditions of on-lending of the loan to Toplofikacia Sofia EAD are assumed the same as between EIB and Sofia Municipality.

Natural gas savings as well as financial and economic gas prices have been elaborated in detail in the Feasibility Study.

The RDF fired CHP plant will significantly reduce natural gas expenditure. Tariff regulation in Bulgaria is based on a cost-plus principle and hence gas cost savings will result in lower tariffs. Therefore, change of natural gas prices will have no impact on funding gap rate.

² For comparison current Weighted Average Cost of Capital (WACC) applied by the state regulator for district heating operations for Toplofikacia Sofia EAD is 4.2%.

³ <http://www.nsi.bg/en/content/6084/inflation-rate-calculator>

3.2.4 RDF off-take by CHP plant

It is assumed that the RDF off-take price is zero. This assumption was already fixed during the preparation of the second phase of the Sofia Integrated Municipal Waste Management System (i.e. the preparation for the MBT facility).

3.2.5 ETS allowances

Currently Toplofikacia Sofia EAD benefits from the derogation from payment for CO₂ allowances as it is included in the National Investment Plan of the Republic of Bulgaria that provides the right for derogation under art.10c, paragraph 5 of Directive 2003/87/EC of the European Parliament and the Council. This derogation requires implementation of the investments contributing to lowering GHG emissions in the amount of EUR **19,650,990 between 2012 – 2019**.

According to the requirements of the derogation the amount of investment shall, as far as possible, be higher than or equal to the cost of allocated free-of-charge allowances, for the investments to be considered realized. In line with the National Investment Plan 2013-2020 the qualifying investments project of the company, by years, are as follows:

Table 1 The list of qualifying investments project in the National Investment Plan 2013-2020

Year	Project	Euro
2012	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0221	1,268,500
2014	Cogeneration installation in THP H.Dimitar - BG - \$ - 0080	1,192,500
	Rehabilitation of the heating network of TPP Sofia - BG - \$ - 0219	820,995
2015	Cogeneration installation in THP H.Dimitar - BG - \$ - 0081	2,587,500
	Upgrading of turbogenerator No.4 - BG - \$ - 0083	2,252,500
	Rehabilitation of the heating network of TPP Sofia- - BG - \$ - 0216	820,995
	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0222	890,000
2016	Cogeneration installation in THP H.Dimitar - BG - \$ - 0082	725,000
	Upgrading of turbogenerator No.4- BG - \$ - 0084	4,806,000
	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0214	890,000
2017	Upgrading of turbogenerator No.4- BG - \$ - 0085	1,360,000
	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0223	740,500
2018	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0215	740,500
2019	Replacement of network connections in the heating system of TPP Sofia- BG - \$ - 0220	194,000
	Rehabilitation of the heating network of TPP Sofia-East - BG - \$ - 0224	362,000

Natural gas consumption provided in the Program of Toplofikatsia EAD for the period 2015-2019 amounts to:

- 704,810 thousand cubic meters in 2017
- 724,839 thousand cubic meters in 2018
- 683,894 thousand cubic meters in 2019

The CO₂ emissions have been calculated applying emission factor of 0.198 tCO₂/MWh. The table below presents CO₂ payments in *with* and *without* project case and saving generated by RDF facility.

The CBA model assumes that the company will not pay for CO₂ allowances until 2019 and starting from 2020 the payment will be done for entire volume of CO₂ emissions.

Current price of the allowance amounts to 6.35 Euro/ton of CO₂ it was assumed that this price will increase between 2020 – 2030 starting form 10 Euro/ton to 30 Euro/ton.

According to information provided by Toplofikatsia EAD RDF fired CHP plant will be exempt from ETS. This will put a downward pressure on heat tariff in *with* project scenario.

Table 2 Calculation of reduced ETS payments

Item	unit	2021	2022	2023	2024	2025	2030
CO2 emissions - WITHOUT	tons	1 282 187	1 281 189	1 280 191	1 279 193	1 278 195	1 278 195

project (tons)							
CO2 emissions - WITH project (tons)	tons	1 169 584	1 167 185	1 164 773	1 162 347	1 159 907	1 153 902
Reduction of CO2 emissions in result of project implementation	tons	-112 603	-114 004	-115 418	-116 846	-118 288	-124 293
Price of CO2	Euro/ton	11,15	12,43	13,86	15,46	17,23	29,70
Reduced payment for allowances (WITH project)	Euro, 000	-1 256	-1 417	-1 600	-1 806	-2 039	-3 691

3.3 Heat and power production

The total heat demand forecast has been developed by Grant Thornton and Tolpofikacia Sofia in 2015 and is still seen as representative of the likely development of the heat demand over the project period. The forecast builds upon a number of assumptions regarding energy refurbishment and new connections. Overall a conservative approach is taken to the assumptions regarding new connections and unit demand in a growing economy where heating is likely to become more affordable over time.

Based on this the feasibility study and this CBA is assume a relatively stable level of heat production over the planning period (approx. 4.6 TWh/year).

Whilst heat production is the same in the *without* and the *with project* scenario there is slight increase in electric energy production in *with project* case (31000 MWh).

Table 3 Heat and electric Energy production and sales – WITHOUT PROJECT

	Item	Unit	2016	2017	2018	2019	2020	2021	2025	2030
1	HEAT production	MWh	4 493 222	4 805 358	4 740 957	4 676 556	4 612 155	4 608 572	4 594 242	4 594 242
	HEAT production with co-gen	MWh	3 268 927	3 093 498	3 052 039	3 010 580	2 969 122	2 966 815	2 957 590	2 957 590
	HEAT production boilers	MWh	1 224 295	1 711 860	1 688 917	1 665 975	1 643 033	1 641 757	1 636 652	1 636 652
	Own use	MWh	83 281	95 785	95 320	94 855	94 391	94 305	93 961	93 961
	Losses	MWh	1 043 400	808 281	763 281	718 281	673 281	673 281	673 281	673 281
	Sales	MWh	3 366 541	3 901 292	3 882 355	3 863 419	3 844 483	3 840 986	3 827 000	3 827 000
2	POWER production	MWh	915 125	989 288	976 029	962 771	949 513	948 775	945 825	945 825
	Own use	MWh	192 838	190 726	188 170	185 614	183 058	182 915	182 347	182 347
	El. Sales	MWh	722 287	798 562	787 860	777 157	766 455	765 860	763 478	763 478

Table 4 Heat and electric Energy production and sales – WITH PROJECT

	Item	Unit	2016	2017	2018	2019	2020	2021	2025	2030
1	HEAT production	MWh	4 493 222	4 805 358	4 740 957	4 676 556	4 612 155	4 608 572	4 594 242	4 594 242
	HEAT production with co-gen	MWh	3 268 927	3 093 498	3 052 039	3 010 580	2 969 122	3 093 151	3 078 633	3 084 778
	HEAT production boilers	MWh	1 224 295	1 711 860	1 688 917	1 665 975	1 643 033	1 515 421	1 515 608	1 509 463
	Including HEAT production from RDF	MWh	0	0	0	0	0	398 161	414 819	435 877
	RDF as fuel	ton						166 120	178 181	179 748
	Own use	MWh	83 281	95 785	95 320	94 855	94 391	94 305	93 961	93 961
	Losses	MWh	1 043 400	808 281	763 281	718 281	673 281	673 281	673 281	673 281
	Sales	MWh	3 366 541	3 901 292	3 882 355	3 863 419	3 844 483	3 840 986	3 827 000	3 827 000
2.	POWER production	MWh	915 125	989 288	976 029	962 771	949 513	980 953	974 923	976 400
	Own use	MWh	192 838	190 726	188 170	185 614	183 058	182 915	182 347	182 347
	El. sales	MWh	722 287	798 562	787 860	777 157	766 455	798 038	792 577	794 054

3.4 Investment costs and sources of financing (CAPEX)

The investment cost estimate is elaborated in detail in the Feasibility Study and it is based on a number of reference contracts for similar facilities where Ramboll has been involved and/or from where Ramboll has detailed knowledge.

Total net investment cost for the RDF Fired CHP plant amounts to **€157.54 Million in current prices**. VAT (amount of €31.508 Million) is not eligible cost for the EC funding. Total investment cost including VAT amounts to €189.046 Million.

The detailed investment plan with the breakdown of investment outlays is presented in the Feasibility Study. For the purpose of the financial analysis (and depreciation plan) the investment outlays have been aggregated in four groups: (1) buildings and premises, (2) objects of civil engineering, (3) boilers and machines, (4) contingency and (5) project preparation and management. The calculation in constant prices uses assumption of following CPI:

- 1.0% in 2017⁴;
- 1.75% in 2018;
- 1.91% in 2019⁵;
- 2.06% in 2020;
- 1.8% annually for further years⁶.

Table 5 Investment outlays for RDF fired CHP plant (Euro, Current prices)

Item	2018	2019	2020	Total
Buildings and premises	3 500 000	4 375 000	9 625 000	17 500 000
Objects of civil and marine engineering	2 080 000	2 600 000	5 720 000	10 400 000
Boilers and power machines	23 640 000	29 550 000	65 010 000	118 200 000
Contingency	1 000 000	1 000 000	1 000 000	3 000 000
Project preparation and management	2 682 456	2 916 667	2 838 889	8 438 011
TOTAL	32 902 456	40 441 667	84 193 889	157 538 011

Table 6 Investment outlays for RDF fired CHP plant (Euro, 2016, Constant prices)

Item	2018	2019	2020	Total
Buildings and premises	3 405 746	4 177 394	9 004 769	16 587 909
Objects of civil and marine engineering	2 023 986	2 482 566	5 351 406	9 857 958
Boilers and power machines	23 003 381	28 215 314	60 820 783	112 039 479
Contingency	973 070	954 833	935 560	2 863 464
Project preparation and management	2 610 218	2 784 929	2 655 952	8 051 099
TOTAL	32 016 402	38 615 037	78 768 471	149 399 909

Table 7 Sources of project co-financing (Euro, current prices)

Item	%	2018	2019	2020	Total
EU grant	49.54%	16 299 218	20 033 993	41 707 969	78 041 180
Domestic co-financing (grant)	8.74%	2 876 333	3 535 411	7 360 230	13 771 973
Total grant financing	58.28%	19 175 551	23 569 403	49 068 198	91 813 153

⁴ https://ec.europa.eu/info/business-economy-euro/economic-performance-and-forecasts/economic-performance-country/bulgaria/economic-forecast-bulgaria_en

⁵ <https://www.statista.com/statistics/375187/inflation-rate-in-bulgaria>

⁶ Due to lack of CPI forecast for further years it was assumed that it will equal to the average from previous years

Item	Rate
Land	0%
Buildings and premises	2.5%
Objects of civil engineering	2.5%
Boilers and power machines	3.8%
Project preparation and management	0%

The proposed depreciation rates does not exceed rules of SEWRC (regulator) and Bulgarian tax regulation and correspond to the lifetime of the project operation (26 years). This assumption is justified having in mind proper maintenance and reinvestments.

As accounting depreciation does not represent a cash expense, accounting costs are in accordance with the CBA guidelines, not included in the calculation of funding gap. However, cost based tariff formulas in the district heating sector in Bulgaria include a component for depreciation. Accounting depreciation will therefore have a direct impact on tariff levels and tariff revenues in both the with and without project scenarios.

3.4.1 Price formation – heat

Heat prices are subject to regulation and approval by the State Energy and Water Regulatory Commission (SEWRC). Detailed rules for setting heat prices are included in the Ordinance for Regulating the Prices of the Heat Energy. At combined production of heat and electric energy the necessary revenues (NR) for production of heat energy shall be equal to the difference between the necessary revenues of the producer and the prognosis revenues from sale of electric energy. Thus higher revenues from electricity sales reduce the price of heat (and vice versa).

Necessary revenues cover O&M costs; depreciation and return on capital. Rate of return on capital is determined by SEWRC based on Weighted Average Cost of Capital (WACC). The rate of return is expressed as real rate before taxation. WACC (2016) amounted to 4.2%, for future investments it is assumed at the same level and on the level of EIB loan interest rate for the project costs.

It has to be noted that despite of applying by SEWRC rules described in this section, Toplofikacia Sofia EAD is making loses in last three years while full application of the rules shall give a positive result (revenues should cover all costs including depreciation and WACC should generate profit). This situation is due to following reasons:

- changes of natural gas prices during the year, while prices of heat and electricity remain unchanged;
- changes of the surcharge for high-efficiency cogeneration during the year;
- not all cost categories of costs are included in the tariff calculation; For example the mandatory monthly contribution of 5% of revenues from electricity sold for Security of the Energy System Fund as of 1 July 2015 is not recognized by SEWRC in the pool of expenses recognized for the purposes of tariff regulation;

The planned actions aimed to reduce the cost of production, losses in the production and supply, as well as to improve collection cannot compensate entirely the serious reasons listed above that lead to a negative financial result.

For the forecast, it is assumed that the price is adjusted on time and all necessary costs categories are included in the calculation, thus leading that Toplofikacia Sofia EAD will be generating profit (costs including depreciation are covered and WACC represent the profit margin). It has to be emphasized however that, the same method is used for *with* and *without* project scenario. Thus, if for any reason including social affordability constraint, the price for heat is kept below the necessary revenues, such a situation has no impact on calculated results (except cash flow), including funding gap calculation. Also a sensitivity analysis for WACC rate (which is a proxy for a price constraint) was performed to confirm above.

The financial forecast assumes implementation of the cost recovery tariffs, but it is not possible to predict the regulator's specific future approach to the tariff formulation for the RDF CHP plant and it is noted that there is thus a regulatory risk associated with this project. Toplofikacija Sofia

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Investment loan	41.72%	13 726 904	16 872 263	35 125 690	65 724 858
TOTAL	100.00%	32 902 456	40 441 667	84 193 889	157 538 011

The CBA model (*with* and *without* project scenario) takes into account additional investments planned by Toplofikacia Sofia EAD between 2017 – 2023 with total cost of **165 MC**. The investment plan is presented in tables below:

Table 8 Investment plan Toplofikacia Sofia EAD 2017 – 2023 (Euro, 2016 prices)

	Item	2017	2018	2019	2020	2021	2022	2023
I	Planned Investments	22 307 705	38 360 461	25 619 796	25 393 077	17 702 974	17 389 954	17 082 470
I.1	Building and equipment	8 968 009	13 499 697	12 332 549	19 552 329	17 702 974	17 389 954	17 082 470
	Construction of cogeneration plant for HOBs Ovcha Kupel	891 116	3 941 053	3 867 190	0	0	0	0
	Construction of CHP for HOB Levski	0	0	976 397	956 689	0	0	0
	Co-generation installation-HP "Zemlane"	0	0	0	9 829 978	9 656 167	9 485 430	9 317 711
	Co-generation installation-HP Liulin	0	0	0	8 191 649	8 046 806	7 904 525	7 764 759
	Replacement of DH pipelines - Increase of heat transfer energy efficiency	7 188 460	8 685 491	6 346 578	574 013	0	0	0
	Extension of DHN in the area between „Al. Stamboliiski“ blvd., „Hristo Botev“ blvd., „Konstantin Velichkov“ blvd. and „Pirotska“ str.	455 607	447 771	585 838	0	0	0	0
	Heat supply to residential buildings in complex estate "Manastirski livadi"- between "Bulgaria" blvd. and "Todor Kableskov" blvd. and "Kostenski vodopad" str. and the ring road	432 826	425 382	556 546	0	0	0	0
	Commissioning	0	0	0	11 603 329	24 727 629	0	0
I.2	Machinery	12 074 122	23 616 956	12 066 750	4 644 887	0	0	0
	Modernization of turbine unit TG 3 at CHP Sofia East, with a new back pressure turbine	0	2 656 772	4 139 874	1 903 858	0	0	0
	Reconstruction and modernization of boiler units EK220 t/h No.7 and No.8 at CHP Sofia	8 884 876	10 672 524	4 760 227	0	0	0	0
	Upgrading of TG 4 at CHP Sofia East, with a new back pressure turbine	3 189 246	7 064 826	0	0	0	0	0
	Construction of NOx (nitrogen oxides) emission reduction system" in CHPs and HPs	0	2 487 615	2 440 992	2 391 722	0	0	0
	Construction of flue gas utilization installation for boiler unit EK220 t/h No.9 at CHP Sofia	0	384 964	381 966	180 929	0	0	0
	Flue gas utilization at HOBs	0	350 256	343 692	168 377	0	0	0
	Commissioning	0	0	10 254 072	24 317 626	17 831 017	0	0
II.3	Other	1 265 574	1 243 807	1 220 496	1 195 861	0	0	0

These investments are included both in *with* and *without* project scenario.

For the CBA model the assumption was made that **reinvestments** for the RDF Fired CHP plant will be cyclic every few years as described in the Feasibility study.

For the purposes of calculating Toplofikacia Sofia EAD's profit and dividend tax the income statement in calculation of costs includes depreciation of assets. Depreciation of existing assets is calculated on a straight-line basis according to the useful life of the assets.

Depreciation of the CHP facility based on RDF is performed on a straight line basis considering following rates:

Table 9 Depreciation rate applied in CBA

surplus for Toplofikacia Sofia EAD amounted to 19.4 Euro/MWh. No other support schemes have been indicated for future RDF-CHP (e.g. support to renewable energy sources).

Hence, in the absence of better information we have applied a total average electricity price of 53 Euro/MWh (including support to CHP).

3.5 Overview of financial statements

The objectives of the review of Toplofikacia Sofia EAD recent financial performance are:

- Gain an understanding of the company's existing revenues and costs structure and revenue and cost drivers
- Assess the company's recent solvency and liquidity
- Assess the level of any existing company debt and the company ability to service its debt
- Assess the company's performance with regard to revenue collection
- Assess performance with regard to on-going service of liabilities
- Identify issues which may pose financial risks in connection with the implementation of the priority investment programme, particularly issues that impose restrictions on the company ability to manage its cash flows

The table below shows a summary of the Income Statements of Toplofikacia Sofia EAD for the periods ending December 31, 2013-2016 and plan for 2017.

Table 10 Profit and loss statement (1000 Euro)

Item	2013	2014	2015	2016	2017
Revenue	305 256	265 950	259 649	192 743	191 476
Revenue from sales	285 986	248 414	217 669	177 965	176 802
Other income	19 003	17 181	41 586	14 395	14 316
Capitalized acquisition costs of assets	266	354	394	382	358
Other Revenue					
Costs	304 517	309 470	291 026	214 169	209 300
Material costs	243 664	227 270	191 893	124 588	119 006
Costs for external services	8 281	9 075	11 439	11 009	11 596
Staff costs	20 366	21 493	22 515	23 759	25 194
Depreciation costs	18 770	19 320	19 112	16 680	17 895
Allowances for impairment of receivables	6 088	11 662	20 863	19 034	7 669
Other cost	7 348	20 650	25 205	19 099	27 940
Financial result from operating activities	738	-43 520	-31 377	-21 426	-17 825
Financial income	253	243	63	2	77
Financial costs	351	216	192	134	192
Profit before taxation	640	-43 493	-31 505	-21 559	-17 940
Revenue from income tax	0	174	1 219	687	0
Tax	0	0	0	0	0
Profit / (loss)	640	-43 319	-30 286	-20 872	-17 940

Neither the revenues, nor the expenses summarized above contain VAT, though heat, electricity and other services sales are subject to VAT taxation under the Bulgarian legislation. The Company collects VAT and pays the difference between collected VAT and paid VAT to the tax authorities on a monthly basis.

The revenues of Toplofikacia Sofia EAD consist of revenues from the sale of heat, revenues from the sale of electricity and other revenues. The sales prices of heat and electricity are regulated by the State Energy and Water Regulatory Commission (SEWRC). The other revenues include

and Sofia Municipality should agree on the allocation of risks during the investment and operational phase. In particular, regulatory risk should be carefully considered by both parties.

The total annual necessary revenues from heat as defined by the Ordinance are calculated as follows:

$$\mathbf{TNR = E + (RBA \times RR),}$$

Where:

- **TNR** are total necessary annual revenues;
- **E** is the recognized annual expenses for the activity under the license;
- **RBA** is the approved regulatory base of the assets;
- **RR** – the rate of return of the capital for the regulatory period

Regulatory base of the assets (RBA) directly related to the licensed activity, shall be the recognised value of the assets, for which the energy enterprise receives rate of return from the invested capital, and it shall be calculated with the following formula:

$$\mathbf{RBA = A - D - G + TC + I,}$$

Where:

- **RBA** is the regulatory base of the assets;
- **A** is the recognised value of the assets, which are used and have useful life, determined on the grounds of their acquisition price;
- **D** is the depreciation, determined for regulatory purposes for the period of use of the assets for implementing the licensed activity;
- **G** is the balance value of the assets, acquired gratuitously;
- **TC** is the necessary turnover capital;
- **I** is the prognosis average amount of the investments, approved by the commission, which will be made during the regulatory period.

Necessary revenues for heat are calculated as:

$$\mathbf{NR_{(heat)} = TNR - R_{(el)},}$$

Where:

- **NR_(heat)** are the necessary revenues associated to heat production;
- **TNR** are total necessary revenues;
- **R_(el)** revenues from electric energy sales.

3.4.2 Electric energy prices and revenues

The question of the future electric energy prices has been elaborated in the Feasibility Study. No stakeholder in the market or international institutions appear to have a well-grounded view on the future electricity prices in Bulgaria.

Based on available data for bilateral agreements for purchase and sale of electricity the average price (base load) in 2016 was 33.75 Euro/MWh. In the analysis we assume a market price at 33 Euro/MWh.

There is significant uncertainty regarding future support schemes that might be applicable to RDF-CHP at Toplofikacia (both in terms of their applicability and the scale). Currently, the only known (existing) scheme is *dobavka* i.e. surplus given to the price of power produced in high-efficient cogeneration (CHP). The level of *dobavka* is approved each year by the Energy Regulator. In 2016 this

revenues from the sale of assets, interest income from overdue trade receivables (major part), grants from the Bulgarian state/international aid bodies, revenues from the sale and exchange of carbon emission quotas, revenues from heat metering services, etc.

For example the investment program for 2017 consider continuation of the investment co-financed by a grant awarded by the International Fund "Kozloduy" under Grant Contract 047 with the EBRD for the 2013-2020 period.

Other costs include paid penalties, and other smaller items.

Revenues are decreasing from 2013 and stabilized in 2017. This is due to pricing mechanisms that links energy fees (and revenues) with costs of services. Due to decrease of natural gas prices in recent years, a base for the electricity and heating fee, decreased and revenues decreased as well. Thus the revenues decrease is not alarming, more important is that company was making losses in past 3 years and is planning losses for 2017. This means however that regulator is setting prices below the full cost recovery level.

This situation is due to following reasons:

- changes of natural gas prices during the year, while prices of heat and electricity remain unchanged;
- changes of the surcharge for high-efficiency cogeneration during the year;
- not all cost categories of costs are included in the tariff calculation; For example the mandatory monthly contribution of 5% of revenues from electricity sold for Security of the Energy System Fund as of 1 July 2015 is not recognized by SEWRC in the pool of expenses recognized for the purposes of tariff regulation;

Table 11 Cash-flow statement (1000 Euro)

Item	2014	2015	2016	2016
Operating activities				
Receipts from customers	190 906	221 361	183 615	184 065
Payments to suppliers	-121 890	-182 740	-132 525	-130 160
Payments to employees and social security institutions	-21 878	-23 116	-24 664	-24 562
Other cash flows	-792	-3 723	-8 692	-614
Net Cash Flows from Operating Activities	46 346	11 782	17 733	28 730
Investment activities				
Acquisition of property, machinery and equipment	-7 801	-10 868	-16 160	-25 565
Interest received	148	63	2	102
Net Cash Flows from Investing Activities	-7 653	-10 804	-16 158	-25 462
Financing activities				
Payments on bank loans	-3 076	-3 076	-3 076	-3 076
Interest paid	-113	-58	-27	-192
Other income				
Net Cash Flows from Investing Activities	-3 189	-3 134	-3 103	-3 268
Change in cash during the year	35 504	-2 156	-1 528	0
Cash at beginning of period	16 770	6 669	4 462	2 934
Reclassification in "Restricted cash in CCB"	-45 605	-51	0	-377
Cash at the end of the period	6 669	4 462	2 934	2 556

The summary of Balance Sheet Assets, Equity and Liabilities of Toplofikacia Sofia EAD as of December 31, 2013-2016 and plan for 2017 is provided in the table below:

Table 12 Balance sheet – assets (1000 Euro)

Item	2013	2014	2015	2016	2017
Non-current assets					
Property, machinery and equipment	260 714	258 655	251 883	245 836	249 619
Intangible assets	562	382	157	403	511
Investment properties	338	330	322	315	307
Non-current financial assets	340	340	340	340	340
Other receivables	0	39 255	22 434	5 100	14 765
Total non-current assets	261 955	298 962	275 136	251 994	265 542
Current assets					
Inventories	11 243	15 133	13 746	14 879	10 226
Trade receivables	208 818	242 926	227 043	185 812	178 952
Other receivables	5 713	8 276	4 305	2 097	3 068
Cash and cash equivalents	16 770	6 669	4 462	4 462	2 556
Total current assets	242 544	273 004	249 556	207 251	194 802
Total assets	504 499	571 966	524 692	459 244	460 344

Table 13 Balance sheet – liabilities (1000 Euro)

Item	2013	2014	2015	2016	2017
Capital					
Shareholders' capital	55 040	55 040	55 040	55 040	55 040
Legal reserves	5 504	5 504	5 504	5 504	5 504
Revaluation reserve of non-financial assets	193 861	200 947	198 597	198 332	198 381
Other reserves	2 476	2 252	2 059	1 001	2 252
Retained earnings (losses)	-80 302	-123 576	-151 511	-172 118	-189 959
Total capital	176 580	140 168	109 688	87 758	71 219
Liabilities					
Non-current liabilities					
Long-term portion of loans	13 708	10 631	7 555	5 385	3 215
Trade liabilities	45 583	27 350	255 884	255 884	255 884
Pension obligations to the staff	1 222	1 180	1 229	2 120	1 227
Grants, provided by programs	30 516	31 541	30 113	29 867	30 371
Deferred tax liabilities	12 951	13 545	12 304	11 499	12 782
Total non-current liabilities	103 980	84 247	307 084	304 756	303 479
Current liabilities					
Current portion of bank loans	3 076	3 076	3 076	2 170	2 170
Trade liabilities	213 485	336 844	94 977	51 962	75 909
Payables to employees and insurers	1 732	2 101	1 791	1 782	1 892
Tax obligations	1 061	318	1 363	1 780	1 278
Other payables	2 701	3 329	4 828	7 133	2 556
Grants, provided by programs	1 883	1 884	1 884	1 905	1 841
Total current liabilities	223 939	347 552	107 919	66 731	85 647
Total Liabilities	327 919	431 799	415 003	371 486	389 125
Total capital and liabilities	504 499	571 966	524 692	459 244	460 344

Revaluation reserve of non-financial assets takes into account a fair value of assets. When evaluating the machines and equipment, the definition of the fair value is done by considering

the essence and specificity of the assets with a combination of methods for definition by acquisition costs and definition by analogue, corrected by the physical and moral wear.

3.6 Collection of Revenues

In the previous version of the feasibility study (2014), the major issue of the low collection rate of the company receivables, particularly from households, was highlighted. At the time, the problem was stated as follows:

"the collection rate from households is in the range of 52%. As a result, the amount of trade receivables from households reached 191 million BGN (almost 98 million EUR) at the end of 2012, which is approximately one third of the company annual revenues. This is an alarming number provided that household clients represent 93.3% of all customers of Toplofikacia Sofia. The low collectability of receivables has led to liquidity problems, such as the inability of the company to make timely payments for its natural gas supplies. The situation with natural gas supplies has been kept under control only thanks to the fact the main supplier of natural gas to Toplofikacia Sofia is the state owned company Bulgargaz."

One of the operational goals of the Optimisation and Improvement of Internal Activities project is the effective management of receivables and increasing their collection. The reduction of total receivables, as well as reducing the number of days for receivables turnover, is now recognised at the company as key to ensuring positive cash flow and maintaining the financial health of the company.

As stated previously in this report (see section 3.4), the company has undertaken concrete measures to improve revenue collection, such as the opening of a customer service information office in the city centre. Invoices were also changed visually, as the company began to notify of arrears or impending legal proceedings. Other measures undertaken to improve revenue collection and reduce receivables are outlined in the following lists; they are organised by category: visibility, employee incentives, and organisational and information streamlining.

Visibility measures

These types of measures raise the visibility of the company and its policies to customers. Among others, the following **visibility measures have been completed**:

- Collectors pay personal visits to customers
- Change in working hours for visiting teams to cover evening hours and weekends
- Allocation of regular sub-regions to particular teams
- Informing customers of the success rate of Toplofikatsiya in legal disputes with problematic payers (95%)
- Informing debtors of the costs related with the legal trials
- Informing debtors about how much their debt would increase because of the court fees in case of a legal trial
- Creation of specialized divisions responsible for various types of customers (i.e., businesses and budget organisations) with large debts and that takes individual actions against them
- Creation of a process for constant tracking of the legal state of the debtors (procedures for insolvency, distrains on commercial companies, etc.) so as to initiate timely actions for the collection of the receivables through court proceedings
- Transferring of business customers with limited size and amounts of debts to the call centre so as to increase the frequency of contact and to improve the collectability within 6 months of the first delay
- Creation of an automatic weekly reference of debts and payments of budgetary and individual customers so as to initiate individual actions by the management
- Using a courier company for delivering letters to private customers with delayed payments (future initiative).

Employee incentives

These types of measures involve incentives for employees for meeting specific collection objectives. Among others, the following **incentive measures have been completed**:

- Introduction of a bonus scheme that can connect the payment of the collectors/call center/case files with their achievements and their work ethic
- Feedback to the employees on the results of their job (measured and evaluated by the leaders) on a monthly basis.

Organisational and information streamlining measures

These types of measures are meant to improve work flow and information resources at the disposal of employees responsible for collection. Among others, the following **organisational measures have been implemented**:

- Shortening the period prior to compiling a case file in order to halt the accumulation of debt
- Introducing a system that automatically tracks which collector has visited the particular address and what were the results of the action (call, a promise for payment, etc.)
- Measurement of the effect on the collectability with different work load (amount of cases) for collectors/call centre
- Regional managers responsible for planning definite actions and final goals, or the suspension of such actions
- Creation of an evaluation process for the employees (including mutual assessment, top to bottom evaluation, bottom to top evaluation, evaluation from customers – 360 degrees) – initiated, not yet implemented.

Among others, the following **organisational measures have been initiated**:

- Streamlining approaches based on particular case and assigning knowledgeable and experienced call centre employees to difficult cases
- Methodology for determining the number of collectors to regions on the basis of the characteristics of each region (number of addresses, size and period of the delayed payments, etc.)
- Periodical specialized training to develop customer service skills
- Monitor call quality and effectiveness
- Automatization of allocation of addresses to be visited and determination of optimal routes
- Cataloguing success rates of various payment channels

These efforts have improved the overall situation with respect to the collection of receivables and made it possible to engage in more accurate planning of revenues. With respect to collections from heating customers, receivable turnover⁷ in days has improved over the past four years. The sales include the number of invoices issued for heating energy, including VAT, for the respective period. Commercial receivables are calculated as an arithmetic mean between the beginning and the end of the period. As it can be seen in following table, the average period of collections for the presented four-year period has decreased with a total of 37 days. Whereas the sales dynamics follow the heating price movement, the commercial receivables show a downward trend.

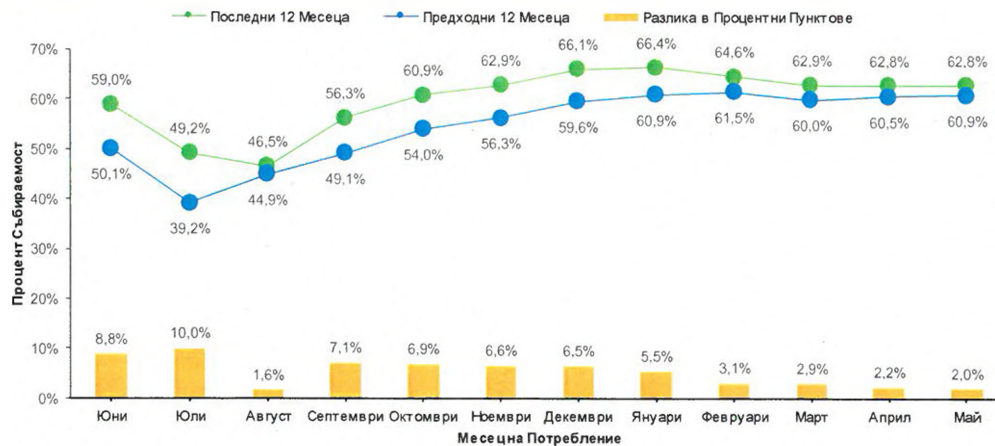
⁷ Average period of collection (presented in days) = $365 / (\text{Sales} / \text{Commercial receivables average})$

Table 14. Average collection period for heating bills

	Unit	2013	2014	2015	2016
Sales of heating (with VAT)	thou. BGN	369 290	347 065	374 755	305 318
Average commercial receivables for heating	thou. BGN	274 435	246 427	238 927	196 093
Sales / receivables ratio	-	1.35	1.41	1.57	1.56
Average period for collection of the receivables	days	271	259	233	234

The next chart compares the present connection rate from private customers in the last 12 months and the one for the same period of the preceding 12 months. The present collection rate, measured as the amount paid by estimated invoices in a period (until the end of the month following their issuing), is compared to the total amount of the issued invoices for the respective month. Practically, this represents the collections received from customers that has not been delayed (i.e., they within 30 days of receiving an invoice). This is both a measure of the cash flow as well as an indicator of the customers' trust. It can be seen that in all months, the collection rate was better than the analogous months from the previous year, with the difference from a low of 1.6% to a high of 10%.

Figure 1. Collection rate from private customers, current year and previous year



The changes in collections on electricity bills can be seen in the following table.

Table 15. Average collection period for electricity bills

	Unit	2013	2014	2015	2016
Sales of electricity (with VAT)	thou. BGN	308 447	235 493	154 345	114 583
Average commercial receivables for electricity	thou. BGN	56 078	101 595	84 323	27 866
Sales / receivables ratio	-	5.50	2.32	1.83	4.11
Average period for collection of the receivables	days	66	157	199	89

The average collection period on receivables for electricity from 2013-2016 was lowest in 2013 at 66 days. This is due to the highest sales and lower amount of commercial receivables. In 2014 and 2015, this indicator grew as a result of lower sales (lowering of the electricity price) and the increase in the amount of commercial receivables.

Finally, the next table shows the total collections and collection period for heating and electricity. The average collection period for 2016 compared to 2015 decreased by 28 days, after the 2013-2015 trend of gradual increase in receivable turnover days. In 2016, commercial receivables decreased significantly due to paid debts by transference on behalf of the NEC. This compensated the next decrease in the sales and reversed the trend from the last three years.

Table 16. Total collections, heating and electricity

	Unit	2013	2014	2015	2016
Sales (with VAT)	thou. BGN	677 737	582 558	529 100	419 901
- of heating	thou. BGN	369 290	347 065	374 755	305 318
- of electricity	thou. BGN	308 447	235 493	154 345	114 583
Average commercial receivables	thou. BGN	330 513	348 022	323 250	223 960
Sales / receivables ratio	-	2.05	1.67	1.64	1.87
Average period for collection of the receivables	days	178	218	223	195

3.7 Summary of the financial situation of the company

Toplofikacia Sofia EAD is a shareholding company with a single shareholder - the Sofia Municipal Council. The company has been registered under the Trade Law and, as a commercial entity, is expected to generate a profit for its shareholder. At the same time, all its main activities, namely the production of heat and electricity, are regulated by the State Energy and Water Regulatory Commission (SEWRC) and are subject to licensing by the SEWRC, which limits the company power to raise heat and electricity prices to a level where it will be more profitable. Both heat and electricity prices must be approved by the SEWRC in compliance with price regulations adopted by the Council of Minister of the Republic of Bulgaria. SEWRC has traditionally applied the cost plus method in setting the sales prices of heating utilities, including Toplofikacia Sofia. Consequently, heat prices have been heavily dependent on the cost of natural gas, which is the main fuel currently used by heating utilities.

Regarding the overall financial situation of the company, the financial statements show that revenues decreased from 2013 and stabilized in 2017. This is due to pricing mechanisms that link

energy fees (and revenues) with the costs of services. Due a decrease in natural gas prices in recent years, the base for the electricity and heating fee decreased and, consequently also revenues. Thus, the decrease in revenues is not the cause for concern as much as the fact that the company has generated losses in the past three years and is planning losses for 2017. The situation however is improving, the loss in 2014 was BGN 43.3 million, in 2015 BGN 30.3 million, in 2016 BGN 20.9 million and plan for 2017 is BGN 17.9 million. The planned loss in 2017 is about the magnitude of depreciation.

There are several reasons for losses in past years. The major cause is that regulator is setting prices below the full cost recovery level, especially that not all cost categories are included in the tariff calculation. In addition the changes of natural gas prices during the year are reflected in the tariff only in next year (prices of heat and electricity remain unchanged during the year). Company also caused losses through the changes of the surcharge for high-efficiency cogeneration during the year.

Analysis the cash flow shows that the company generates positive cash flow results and is able to cover it operations and to serve the debt. The level of receivables (about BGN 196 million at the end of 2016) and current liabilities is relatively high. The average period for collection of the receivables is around 200 days but it is improving. The company made many actions in order to implement effective management of receivables and increasing their collection. The reduction of total receivables, as well as reducing the number of days for receivables turnover, is now recognised at the company as key to ensuring positive cash flow and maintaining the financial health of the company.

In addition, Toplofikacia Sofia has implemented a sizeable investment program with the main purpose to improve the company energy efficiency and reduce its operating costs.

The company also provided evidence that it is not an undertaking in difficulty⁸. According to the European regulations on state aid and especially the Commission's Communication,⁹ Toplofikatsiya Sofia EAD is not in difficulty because for the last two years the:

- Debt to capital ratio is less than 7.5;
- EBITDA/interest coverage ratio is above 1.0.

The relevant data are presented in the following table:

Table 17. Key financial ratios for Toplofikatsiya Sofia EAD

	Unit	2015	2016
Total debt	thou. BGN	811 677	726 564
Company capital	thou. BGN	214 532	171 640
EBITDA	thou. BGN	16 816	27 945
Debts/Company capital	Benchmark = under 7.5	3.78	4.23
EBITDA/interest cover	Benchmark = above 1.0	63.94	74.52

The 2016 financial statement was audited and the general Auditors' opinion was positive. Also the auditors explained the grounds for evaluated reserve of non-financial assets and matching the Bulgarian tax and accounting legislation requirements.

⁸ In accordance with the European regulations for state aid and especially p. 20 of the Commission's Communication for Guidelines on State aid for rescuing and restructuring non-financial undertakings in difficulty (2014/C 249/01).

⁹ Page 20 of the Commission's Communication for Guidelines on State aid for rescuing and restructuring non-financial undertakings in difficulty (2014/C 249/01).

3.8 Financial Forecast Analysis

3.8.1 OPEX forecasts

The long term forecasts of costs and necessary revenues for both project scenarios are presented in tables below. It covers the entire time horizon 2017 – 2046. Whilst fixed costs remain unchanged in both the *with* and *without* project scenario, the variable costs are lower in *with* project case as a result of natural gas saving and lower payments for CO₂ emissions.

The operating costs of the company include the cost of materials, the cost of services used, the employee costs, bad debt expense, depreciation, and other operating expenses. It has to be noted that the cost of natural gas (to be found as part of the cost of materials), which is used as the main fuel in the production of heat and electricity, is by far the biggest operating cost of Toplofikacia Sofia EAD (natural gas accounts for approximately 70% of the total operating costs of the company). The operating costs of Toplofikacia Sofia EAD are analysed in further detail in the section on operating costs.

Annual fixed costs as well as assumptions for variable costs calculations are presented in the table below:

Table 18 Fixed and variable costs, Euro, 2016

Fixed costs		2016	2017
Materials	Euro/year	889 137	7 932 182
Hired Services	Euro/year	8 802 912	9 233 931
Other costs	Euro/year	18 312 941	6 189 188*
Repair Cost	Euro/year	1 556 372	3 331 578*
Personnel Costs	Euro/year	23 469 320	26 235 409
Taxes	Euro/year	3 383 218	3 022 758
Total fixed costs	Euro/year	56 413 901	55 945 046
Variable costs			
Natural gas price	Euro/1000 m3	193.27	146.54
CO2 allowance price (2016)	Euro/tCO2	6.35	
CO2 allowance price (2030)	Euro/tCO2	30	

* estimation

The forecast of CO₂ allowance price is based on study Revenues from ETS auctioning as source of financing for low-emission modernization in Poland, prepared in July 2016 by Forum for Energy Analysis. The proposed forecast start with 10 EUR/tCO₂ in 2020 and depending on scenario proposed increase to 20, 35 or 50 EUR/tCO₂. The conservative approach was used in this study thus it was assumed that the price will roughly reach 30 Euro/tCO₂ in 2030 and then will stabilize.

Table 19 CO₂ allowance price forecast, Euro/tCO₂, 2016

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO2 allowance price Euro/tCO ₂	10.00	11.15	12.43	13.86	15.46	17.23	19.22	21.43	23.89	26.64	29.70

It has to be noted that fixed costs are stable in last two years, thus as a base for further forecast, the actual data from 2016 was considered.

Regarding the variable costs, they consist of cost of natural gas. This was calculated as multiplication of the natural gas consumption, as defined in the Feasibility study and price of

natural gas. Toplofikacia Sofia EAD noticed a natural gas price decrease in recent years. In 2016 the average price was about 193 EUR/1000m³. For 2017 Toplofikacia Sofia EAD is planning that average natural gas price will be even lower and equal 286.60 BGN/1000m³ (146.54 EUR/1000m³). This is a starting point for the projection and proposed natural gas price forecast is presented in the table below.

Table 20. Natural gas price forecast (Euro/MWh, 2016)

Item	2016	2017	2018	2019	2020	2021	2025	2030
Natural gas price	30.63	23.22	25.14	27.05	28.97	30.07	34.50	35.04

The long term forecast for OPEX in *with* and *without* project scenario are as follows:

Table 21. OPEX, projections – without project (Euro, 2016)

Item	2018	2019	2020	2021	2025	2030	2040	2046
Fixed Costs	56 413 901	55 998 711	55 375 926	54 545 547	51 224 028	51 224 028	51 224 028	51 224 028
Variable Costs	167 438 662	177 756 930	200 561 117	209 041 077	244 746 510	264 167 423	265 056 638	265 056 638
Of which fuel costs	167 438 662	177 756 930	187 729 266	194 744 693	222 718 701	226 205 724	227 094 939	227 094 939
Of which CO2 emissions	0	0	12 831 851	14 296 385	22 027 809	37 961 699	37 961 699	37 961 699
Depreciation existing assets	16 677 830	16 677 830	16 677 830	16 677 830	13 363 125	13 363 125	0	0
Depreciation of future investments	0	1 025 407	3 921 303	7 186 084	9 993 965	6 044 221	4 261 119	2 807 881
Total costs	240 530 393	251 458 878	276 536 176	287 450 538	319 327 627	334 798 797	320 541 785	319 088 547

Fixed costs with project includes all fixed costs without project and additional costs of RDF installation as described in the Feasibility Study. This includes fixed costs of staff (0.80 M€/year), office and administration (0.35 M€/year), other costs (0.35 M€/year) and maintenance (excluding cyclic and re-investment) (2.0 M€/year).

The use of consumables (variable costs) for the CHP plant has been estimated based Ramboll's experience from similar plants. The variable cost is estimated for waste with a calorific value on 13.3 GJ/t and amounts 19.51 €/t.

Table 22. OPEX, projections – with project (Euro, 2016)

Item	2018	2019	2020	2021	2025	2030	2040	2046
Fixed Costs Toplo	56 413 901	55 998 711	55 375 926	54 545 547	51 224 028	51 224 028	51 224 028	51 224 028
Variable Costs Toplo	167 438 662	177 756 930	200 561 117	190 682 815	222 097 005	238 479 587	239 227 780	239 227 780
Fuel gas Toplo	167 438 662	177 756 930	187 729 266	177 641 958	202 107 709	204 209 312	204 965 319	204 965 319
CO2 emissions gas	0	0	12 831 851	13 040 857	19 989 296	34 270 275	34 262 462	34 262 462
Fixed Costs RDF Installation including maintenance	0	0	0	3 980 000	3 480 000	3 480 000	3 480 000	3 480 000
Variable Costs RDF Installation	0	0	0	3 137 633	3 268 904	3 434 854	3 442 124	3 442 124
CO2 emissions RDF	0	0	0	0	0	0	0	0
Depreciation existing assets	16 677 830	16 677 830	16 677 830	16 677 830	13 363 125	13 363 125	0	0
Depreciation of Planned Investments	0	1 025 407	3 921 303	7 186 084	9 993 965	6 044 221	4 261 119	2 807 881
Depreciation of Project and Replacement Assets	0	0	0	4 918 647	5 225 661	5 768 841	6 855 200	7 398 379
Total costs	240 530 393	251 458 878	276 536 176	281 128 555	308 652 688	321 794 655	308 490 251	307 580 193

Regulatory asset base and return on assets have been calculated assuming WACC of 4.2% for existing assets and for future modernization investments (excluding RDF Fired CHP). It has been assumed that return on capital will not be applicable for the grant financed assets.

Table 23 Regulatory Asset Base – regulated profit, WITHOUT project (Euro, 2016)

Item	2018	2019	2020	2021	2025	2030	2040	2046
RAB of Existing Assets	211 772 134	191 318 441	177 234 639	163 150 836	112 413 916	55 990 625	0	0

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RAB of Planned Investments	0	6 897 825	6 208 042	27 733 928	85 672 284	53 410 503	23 546 849	74 500 492
RoRAB on Existing Assets	8 894 430	8 035 375	7 443 855	6 852 335	4 721 384	2 351 606	0	0
RoRAB on Planned Investments	0	289 709	260 738	1 164 825	3 598 236	2 243 241	988 968	3 129 021
Total	8 894 430	8 325 083	7 704 593	8 017 160	8 319 620	4 594 847	988 968	3 129 021

Table 24 Regulatory Asset Base – regulated profit, WITH project (Euro, 2016)

Item	2018	2019	2020	2021	2025	2030	2040	2046
RAB of Existing Assets	211 772 134	191 318 441	177 234 639	163 150 836	112 413 916	55 990 625	0	0
RAB of Planned Investments	0	6 897 825	6 208 042	27 733 928	85 672 284	53 410 503	23 546 849	74 500 492
RAB of Project Assets	0	0	0	62 329 642	54 121 404	43 861 107	23 340 512	11 028 155
RAB of Replacement Assets	0	0	0	0	8 792 986	22 814 734	42 710 540	46 104 865
RoRAB on Existing Assets	8 894 430	8 035 375	7 443 855	6 852 335	4 721 384	2 351 606	0	0
RoRAB on Planned Investments	0	289 709	260 738	1 164 825	3 598 236	2 243 241	988 968	3 129 021
RoRAB of Project Assets	0	0	0	934 945	811 821	657 917	350 108	165 422
RoRAB of Replacement Assets	0	0	0	0	369 305	958 219	1 793 843	1 936 404
Total	8 894 430	8 325 083	7 704 593	8 952 105	9 500 747	6 210 983	3 132 918	5 230 847

3.9 Revenue forecasts

Revenue forecasts comprise revenues from heat and power sales. As mentioned the tariff formula works in the way that higher revenues from power sales place downward pressure on heat tariff/revenues.

As far as revenues from power sales are concerned we assume that by the time the RDF-WtE facility is constructed (2021), the electricity prices will be fully liberalized. It means that new facility will not apply current pricing methods anymore. The electricity prices will be determined by demand and supply forces. There is, however, significant uncertainty regarding pace of the liberalization process as well as the regulatory reforms in coming years.

The CBA model and the financial comparison of options in the feasibility study apply a total average electricity price of **53 Euro/MWh (including FIT) between 2021 and 2046**. Until 2021 the current pricing method is applied for determining revenues from electricity sales.

Due to the mentioned significant uncertainties both regarding to electricity price as well as future development of FIT the sensitivity test is run to observe the impacts of power price on heat tariff. The sensitivity test for total electricity price will be done in the range between $\pm 50\%$.

Table 25 Necessary revenues – WITHOUT project (Euro, 2016)

Necessary revenues	2018	2019	2020	2021	2025	2030	2040	2046
Necessary revenues - heat	187 068 617	194 837 971	213 180 577	254 877 126	287 182 887	298 929 284	281 066 393	281 753 207
Revenues - electric energy	62 356 206	64 945 990	71 060 192	40 590 572	40 464 360	40 464 360	40 464 360	40 464 360
Total necessary revenues	249 424 822	259 783 961	284 240 769	295 467 698	327 647 248	339 393 644	321 530 753	322 217 568
Rev. el./total revenues	25%	25%	25%	14%	12%	12%	13%	13%
Unit price								
Heat (Euro/MWh)	48.18	50.43	55.45	66.36	75.04	78.11	73.44	73.62
Power (Euro/MWh)	79.15	83.57	92.71	53	53	53	53	53

Table 26 Necessary revenues – WITH project (Euro, 2016)

Necessary revenues	2018	2019	2020	2021	2025	2030	2040	2046
Necessary revenues - heat	187 068 617	194 837 971	213 180 577	247 784 650	276 146 876	285 920 787	269 534 889	270 722 760
Revenues - electric energy	62 356 206	64 945 990	71 060 192	42 296 010	42 006 559	42 084 851	42 088 280	42 088 280
Total necessary revenues	249 424 822	259 783 961	284 240 769	290 080 660	318 153 435	328 005 638	311 623 169	312 811 040
Rev. el/total revenues	25%	25%	25%	15%	13%	13%	14%	13%
Unit price								
Heat (Euro/MWh)	48.18	50.43	55.45	64.51	72.16	74.71	70.43	70.74
Power (Euro/MWh)	79.15	83.57	92.71	53	53	53	53	53

3.10 Financial indicators and statements

The following table presents the financial statements and financial indicators. It has to be noted that forecast includes other revenue which represents depreciation of the grant.

Allowances for the impairment of receivables were taken from the financial statement (up to 2017) and further assumed proportional to the receivable's turnover.

Regarding the costs, except described above fixed and variable costs, a depreciation of existing and new assets were included. Also a financial income was planned on a stable level of 76 694 EURO/a.

Regarding financial costs, there were provided in 3 categories:

- Existing loans;
- EIB loan for the project;
- Cost of debt to Bulgarian Energy Holding;

The costs of existing loans was calculated proportionally to the amount of the long term loans in the balance sheet.

The costs of EIB loan were calculated as 1.5% of outstanding debt. The loan conditions were assumed as 14 years long repayment period including 3 years of grace period. The EIB loan will be taken directly by Sofia Municipality and further on-lended to Toplofikatsiya Sofia EAD. It is assumed that on-lending conditions between Sofia Municipality and Toplofikatsiya Sofia EAD will be exactly the same as between EIB and Sofia Municipality.

Cost of debt to Bulgarian Energy Holding were calculated 3.25% of outstanding debt since 2021 and stable amount of 8 316 214 EUR/a in 2018-2020.

The following tables present income, cash flow statements and balance sheet for the most critical years 2018-2025, while forecast for the entire time horizon is presented in annex.

Table 27 Income statement with project (Euro, 2016)

	2018	2019	2020	2021	2022	2023	2024	2025
Revenue	256 940 813	263 720 909	286 388 195	293 969 839	300 442 223	302 812 311	313 141 694	322 042 614
Revenue from sales	249 424 822	259 783 961	284 240 769	290 080 660	296 553 044	298 923 131	309 252 515	318 153 435
Other income	7 158 086	3 579 043	1 789 522	0	0	0	0	0
Capitalized acquisition costs of assets	357 904	357 904	357 904	357 904	357 904	357 904	357 904	357 904
Other Revenue	0	0	0	3 531 275	3 531 275	3 531 275	3 531 275	3 531 275
Costs	240 530 393	251 458 878	276 536 176	281 399 008	287 355 144	290 550 560	301 244 697	308 962 329
Material costs	167 438 662	177 756 930	187 729 266	180 779 591	186 969 011	193 131 810	199 267 756	205 376 613
Costs for external services	13 561 893	14 161 862	15 505 701	17 505 701	17 505 701	17 505 701	17 505 701	17 505 701
Staff costs	25 193 907	25 193 907	25 193 907	26 343 907	26 343 907	26 343 907	26 343 907	26 343 907
Depreciation costs	16 677 830	17 703 237	20 599 133	29 053 014	29 053 014	25 738 308	28 892 392	28 892 392
Allowances for impairment of receivables	6 435 442	6 020 252	5 397 468	4 567 088	3 113 924	2 075 949	1 660 759	1 245 569
Other cost	11 222 658	10 622 690	22 110 701	23 149 708	24 369 588	25 754 885	27 574 182	29 598 146
Financial result from operating activities	16 410 420	12 262 031	9 852 018	12 570 831	13 087 080	12 261 750	11 896 997	13 080 285

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	2018	2019	2020	2021	2022	2023	2024	2025
Financial income	76 694	76 694	76 694	76 694	76 694	76 694	76 694	76 694
Financial costs	136 664	81 594	0	0	0	0	0	0
Financial costs (existing loan)	122 952	332 446	722 430	985 873	920 148	854 423	788 698	722 973
Financial costs (EIB loan)	8 316 214	8 316 214	8 316 214	7 761 805	7 207 391	6 652 976	6 098 561	5 544 147
Profit before taxation	7 911 285	3 608 472	890 069	3 899 847	5 036 235	4 831 045	5 086 431	6 889 859
Revenue from income tax	0	0	0	0	0	0	0	0
Tax	791 128	360 847	89 007	36 857	150 496	129 977	155 516	335 858
Profit / (loss)	7 120 156	3 247 625	801 062	3 862 990	4 885 739	4 701 068	4 930 916	6 554 000

Table 28 Cash-flow statement (Euro, 2016)

Item	2018	2019	2020	2021	2022	2023	2024	2025
Operating activities								
Receipts from customers	256 940 813	263 720 909	286 388 195	290 438 564	296 910 948	299 281 035	309 610 419	318 511 339
Payments to suppliers	-181 000 555	-191 918 792	-203 234 967	-198 285 291	-204 474 711	-210 637 511	-216 773 457	-222 882 314
Payments to employees and social security institutions	-25 193 907	-25 193 907	-25 193 907	-26 343 907	-26 343 907	-26 343 907	-26 343 907	-26 343 907
Other cash flows (other costs excluding tax)	-12 013 787	-10 983 537	-22 199 708	-23 186 565	-24 520 084	-25 884 862	-27 729 698	-29 934 005
Other cash flows (working capital)	-380 587	450 761	-6 328 963	10 033 461	13 333 824	27 853 211	1 730 457	15 050 621
Net Cash Flows from Operating Activities	38 351 977	36 075 434	29 430 650	52 656 261	54 906 070	64 267 966	40 493 814	54 401 734
Investment activities								
Acquisition of property, machinery and equipment	-71 262 916	-66 061 462	-109 586 966	-17 702 974	-17 389 954	-27 344 018	0	0
Interest received	76 694	76 694	76 694	76 694	76 694	76 694	76 694	76 694
Net Cash Flows from Investing Activities	-71 186 222	-65 984 768	-109 510 272	-17 626 280	-17 313 261	-27 267 324	76 694	76 694
Financing activities								
Loans repayment (existing loans)	-2 169 923	-3 215 003	0	0	0	0	0	0
Loans repayment (EIB loan)	0	0	0	-4 381 657	-4 381 657	-4 381 657	-4 381 657	-4 381 657
Debt repayment to Bulgarian Energy Holding	0	0	0	-17 058 913	-17 058 913	-17 058 913	-17 058 913	-17 058 913
Interest paid	-8 575 829	-8 730 253	-9 038 644	-8 747 678	-8 127 539	-7 507 399	-6 887 260	-6 267 120
Other income	40 973 570	46 587 779	96 207 235	9 246 202	9 246 202	9 246 202	0	0
of which investment grant	19 175 551	23 569 403	49 068 198	0	0	0	0	0
of which KIDSF financing	8 071 114	6 146 112	12 013 346	9 246 202	9 246 202	9 246 202	0	0
Of which other loans	0	0	0	0	0	0	0	0
of which EIB loan	13 726 904	16 872 263	35 125 690	0	0	0	0	0
Net Cash Flows from Financing Activities	30 227 818	34 642 523	87 168 591	-20 942 046	-20 321 906	-19 701 767	-28 327 830	-27 707 690
Change in cash during the year	-2 606 428	4 733 188	7 088 969	14 087 936	17 270 903	17 298 876	12 242 678	26 770 738

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Item	2018	2019	2020	2021	2022	2023	2024	2025
Cash at beginning of period	6 218 690	3 612 262	8 345 450	15 434 419	29 522 354	46 793 257	64 092 133	76 334 811
Reclassification in "Restricted cash in CCB"	0	0	0	0	0	0	0	0
Cash at the end of the period	3 612 262	8 345 450	15 434 419	29 522 354	46 793 257	64 092 133	76 334 811	103 105 549

Table 29 Balance sheet – assets (Euro, 2016)

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Non-current assets									
Property, machinery and equipment	249 619 343	221 020 075	213 978 468	387 245 859	406 084 788	377 439 332	362 289 128	403 920 318	375 354 482
Intangible assets	511 292	362 228	335 563	308 897	282 232	255 567	234 201	212 836	191 470
Investment properties	306 775	283 623	262 744	241 865	220 986	200 108	183 379	166 649	149 920
Non-current financial assets	340 009	305 687	283 184	260 681	238 178	215 675	197 645	179 614	161 584
Other receivables	14 764 576	98 155 469	153 625 348	69 415 837	39 296 915	56 349 358	73 161 397	2 693 941	2 423 510
Total non-current assets	265 541 995	320 127 081	368 485 306	457 473 140	446 123 100	434 460 041	436 065 750	407 173 358	378 280 967
Current assets									
Inventories	10 225 838	14 387 484	15 274 101	16 130 993	15 533 829	16 065 666	16 595 216	17 122 459	17 647 374
	31	31	31	31	31	31	31	31	31
Trade receivables	178 952 158	211 840 260	206 403 695	202 472 876	174 843 138	121 871 114	81 896 748	67 781 373	52 299 195
	369	310	290	260	220	150	100	80	60
Other receivables	3 067 751	3 067 751	3 067 751	3 067 751	3 067 751	3 067 751	3 067 751	3 067 751	3 067 751
Cash and cash equivalents	6 218 690	3 612 262	8 345 450	15 434 419	29 522 354	46 793 257	64 092 133	76 334 811	103 105 549
Total current assets	198 464 437	232 907 757	233 090 997	237 106 039	222 967 072	187 797 789	165 651 849	164 306 395	176 119 869
Total assets	464 006 432	553 034 839	601 576 304	694 579 179	669 090 171	622 257 829	601 717 599	571 479 753	554 400 836

It has to be noted that Toplofikatsiya Sofia EAD has significant receivables, in 2016 and 2017 exceeding revenues from sale what means that turnover is higher than 365 days. This increase is partially caused due to decrease of the tariffs due to decrease of the price for natural gas while portion of receivables were accrued earlier when tariff was higher. Collection experts in Toplofikatsiya Sofia EAD are also actively working for the collection of late payments of non-household customers of the company.

To improve bills collection a new customer service information office was opened in the city center where the citizens can receive information on relevant questions and pay their bills. The invoices were changed visually, as the company began to notify of arrears or impending legal proceedings.

The following table presents the current structure of outdated bills.

Table 30 Information on unpaid heat energy liabilities by household customers at 14 Oct 2016

Item	Number of customers	Structure
Customers with no unpaid bills and with up to 2 unpaid bills	346,961	84.4%
Customers with 3 to 6 unpaid bills	40,701	9.9%
Customers with 7 to 11 unpaid bills	892	0.2%
Customers with unpaid bills from 1 to 2 years	803	0.2%
Customers with unpaid bills from 2 to 3 years	102	0.0%
Customers with unpaid bills for more than 3 years	21,526	5.2%
TOTAL receivables (principal)	410,985	100.0%

In 2016 continued the implementation of the number of measures to improve collections. Thus in the projection, it was assumed a decrease of receivables as presented in the table 23 Balance sheet – assets. The assumed decrease of receivables to 60 days in 2024 and then stabilize on this levels. This is a conservative approach as receivables of many companies are on the level of about 30 days. Similarly to the decrease of receivables, it was assumed that accounts payable will also decrease to the same level of 60 days from current nearly 212 days.

Table 31 Balance sheet – liabilities (Euro, 2016)

Item	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital									
Shareholders' capital	55 040 060	55 040 060	55 040 060	55 040 060	55 040 060	55 040 060	55 040 060	55 040 060	55 040 060
Legal reserves	5 504 057	5 504 057	5 504 057	5 504 057	5 504 057	5 504 057	5 504 057	5 504 057	5 504 057
Revaluation reserve of non-financial assets	198 381 250	198 381 250	198 381 250	198 381 250	198 381 250	198 381 250	198 381 250	198 381 250	198 381 250
Other reserves	2 252 241	2 252 241	2 252 241	2 252 241	2 252 241	2 252 241	2 252 241	2 252 241	2 252 241
Retained earnings (losses)	-189 958 739	-182 838 583	-179 590 958	-178 789 896	-174 926 907	-170 041 168	-165 340 100	-160 409 184	-153 855 184
Total capital	71 218 869	78 339 025	81 586 650	82 387 711	86 250 701	91 136 440	95 837 508	100 768 423	107 322 424
Liabilities	0	0	0	0	0	0	0	0	0
Non-current liabilities	0	0	0	0	0	0	0	0	0
Long-term portion of loans	3 215 003	0	0	0	0	0	0	0	0
Long-term portion of investment loans	0	13 726 904	30 599 168	61 343 201	56 961 544	52 579 887	48 198 229	43 816 572	39 434 915
Trade liabilities	255 883 691	255 883 691	255 883 691	255 883 691	238 824 779	221 765 866	204 706 953	187 648 040	170 589 128
Pension obligations to the staff	1 227 101	1 227 101	1 227 101	1 227 101	1 227 101	1 227 101	1 227 101	1 227 101	1 227 101
Grants, provided by programs	34 032 968	42 104 082	48 250 194	60 263 541	69 509 743	78 755 945	88 002 148	88 002 148	88 002 148
Investment grants to RDF CHP project	0	19 175 551	42 744 954	91 813 153	88 281 878	84 750 603	81 219 328	77 688 052	74 156 777
Deferred tax liabilities	12 782 297	12 782 297	12 782 297	12 782 297	12 782 297	12 782 297	12 782 297	12 782 297	12 782 297
Total non-current liabilities	307 141 060	344 899 627	391 487 405	483 312 983	467 587 341	451 861 698	436 136 055	411 164 210	386 192 365
Current liabilities									
Current portion of bank loans	2 169 923	3 215 003	0	0	0	0	0	0	0
Current portion of investment loans	0	0	0	4 381 657	4 381 657	4 381 657	4 381 657	4 381 657	4 381 657
Trade liabilities	75 909 460	119 014 064	120 935 129	116 929 707	103 217 001	67 224 563	57 708 907	47 511 991	48 850 918
	212	240	230	210	190	120	100	80	80
Payables to employees and insurers	1 891 780	1 891 780	1 891 780	1 891 780	1 978 132	1 978 132	1 978 132	1 978 132	1 978 132
	27	27	27	27	27	27	27	27	27
Tax obligations	1 278 230	1 278 230	1 278 230	1 278 230	1 278 230	1 278 230	1 278 230	1 278 230	1 278 230
Other payables	2 556 459	2 556 459	2 556 459	2 556 459	2 556 459	2 556 459	2 556 459	2 556 459	2 556 459
Grants, provided by programs	1 840 651	1 840 651	1 840 651	1 840 651	1 840 651	1 840 651	1 840 651	1 840 651	1 840 651
Investment grants	0	0	0	0	0	0	0	0	0
Total current liabilities	85 646 503	129 796 187	128 502 249	128 878 484	115 252 130	79 259 692	69 744 036	59 547 120	60 886 047
Total Liabilities	392 787 563	474 695 814	519 989 654	612 191 467	582 839 471	531 121 390	505 880 091	470 711 330	447 078 412

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Item	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total capital and liabilities	464 006 432	553 034 839	601 576 304	694 579 179	669 090 171	622 257 829	601 717 599	571 479 753	554 400 836

Table 32 Financial indicators

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035
Profitability											
Return on assets (ROA)	-3.87%	1.29%	0.54%	0.12%	0.58%	0.79%	0.78%	0.86%	1.18%	1.36%	1.76%
Return on sales (ROS)	-10.15%	2.85%	1.25%	0.28%	1.33%	1.65%	1.57%	1.59%	2.06%	1.91%	2.08%
Return on equity	-25.19%	9.09%	3.98%	0.97%	4.48%	5.36%	4.91%	4.89%	6.11%	4.52%	3.81%
Liquidity											
Current ratio (CR)	2.32	1.79	1.81	1.84	1.93	2.37	2.38	2.76	2.89	3.31	3.41
Quick Ratio (QR)	2.14	1.72	1.7	1.72	1.79	2.17	2.14	2.48	2.61	3.02	3.1
Cash ratio	0.07	0.03	0.06	0.12	0.26	0.59	0.92	1.28	1.69	2.09	2.15
Rotation (days)											
Receivables turnover ratio	369	310	290	260	220	150	100	80	60	60	60
Inventory turnover ratio	31	31	31	31	31	31	31	31	31	31	31
Trade liabilities turnover	212	240	230	210	190	120	100	80	80	80	80
Debt coverage											
Capital/total assets	0.15	0.14	0.14	0.12	0.13	0.15	0.16	0.18	0.19	0.3	0.46

3.11 Discounted net revenue, NPV and IRR

When the project complies with the requirements of the Commission Decision of 20 December 2011 (on State Aid and Services of General Economic Interest - SGEI) and it does not require notification to the European Commission's Directorate-General for Competition the 'funding gap method' is used to demonstrate the financing needs and proportionality of the state aid granted to the project. This is considered as an 'individual verification of financing needs in accordance with the applicable State aid rules' in the meaning of Article 61(8)(c) of Regulation (EU) No. 1303/2013.

The grant rate is calculated as the SGEI compensation equal to the SGEI net cost, in line with the requirements of Article 5 of the SGEI Decision. The net cost is calculated over the entrustment period based on the funding-gap approach, on the basis of the difference in Toplofikacia's discounted investment costs and discounted net revenues in the scenarios with- and without-project.

The funding gap rate (FGR) is calculated as

$$\text{FGR} = (\text{DIC} - \text{DNR}) / \text{DIC}$$

where:

DIC – discounted investment costs

DNR – discounted net revenue

The cash flows of with and without project scenario applied in funding gap calculation are as follows:

Table 33 Cash flow WITHOUT and WITH project scenario (Euro, 2016)

	Total	2018	2019	2020	2021	2025	2035	2046
Without project costs, incl.		240 530 393	251 458 878	276 536 176	287 450 538	319 327 627	320 541 785	319 088 547
Depreciation		16 677 830	17 703 237	20 599 133	23 863 914	23 357 089	4 261 119	2 807 881
Costs (without depreciation)		223 852 563	233 755 641	255 937 043	263 586 624	295 970 538	316 280 666	316 280 666
Without project revenues		249 424 822	259 783 961	284 240 769	295 467 698	327 647 248	322 132 701	322 217 568
CASH FLOW WITHOUT PROJECT		25 572 259	26 028 320	28 303 725	31 881 074	31 676 710	5 852 035	5 936 902
With project costs, incl.		240 530 393	251 458 878	276 536 176	281 128 555	308 652 688	307 947 072	307 580 193
Depreciation		16 677 830	17 703 237	20 599 133	28 782 560	28 582 751	10 573 139	10 206 260
Costs without depreciation		223 852 563	233 755 641	255 937 043	252 345 995	280 069 937	297 373 933	304 373 933
With project revenues		249 424 822	259 783 961	284 240 769	290 080 660	318 153 435	311 475 064	312 811 040
CASH FLOW WITH PROJECT		25 572 259	26 028 320	28 303 725	37 734 665	38 083 497	14 101 132	8 437 107
Residual value	88 524 652	0	0	0	5 853 592	6 406 788	8 249 097	2 500 206
NET REVENUE								
	130 958 987	31 043 331	37 660 204	77 832 910	0	0	0	0
Investment costs (project) excluding contingency	33 886 440	0	0	0	0	0	0	0
Reinvestments	88 524 652	0	0	0	5 853 592	6 406 788	8 249 097	2 500 206

The residual value was considered equal to zero while €7 million was considered as dismantling costs of the RDF installation after the life-time period. The estimated cost of decommissioning of the RFD-CHP plant is estimated on basis of Rambolls experience. Ramboll has performed numerous estimation on decommissioning cost on existing facilities with various size and capacity. Decommissioning cost comprises of cost related to decomposition of concrete and steel construction (building incl. foundation and electromechanical installations etc.), disposal of component with no scrap value, removal of underground installations like pipes and reestablishment of building area etc. The estimated cost assumes no significant soil contamination has occurred.

The calculation of the residual value takes into account that at the end of the project time horizon, the assets has some value, equal to the net value of the assets after depreciation. In case of decommissioning of the plant, the assets cannot be sold, thus their value equals to the value of scrap, captured by the decommissioning contractor (the contract may also say that the scrap belongs to TS while this will cause the increase of decommissioning costs).

Reinvestments are cyclic (thus not visible in the table above), every few years over the operation of the RDF installation, as described in the Feasibility study.

The funding gap and amount of eligible grant applicable in connection with the current project is calculated as follows:

Table 34 Grant rate calculation

DIC	€ 130 958 987
DNR	€ 54 638 212
Funding gap R = (DIC-DNR)/DIC	58.28%
Co-financing	85%
Co-financing rate (EU	49.5%

funds)	
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Table 35 FNPV and FRR

FNPV and FRR	
FRR(C)	-1.31%
FNPV(C)	€-76 320 774
FRR(K)	4.92%
FNPV(K)	€ -271 459

FNPV(K) was calculated for national capital. The result of FNPV(K) calculation are negative.

4. WASTE FEES, REVENUES AND COSTS OF WASTE MANAGEMENT IN SOFIA MUNICIPALITY

Solid waste management, street and park cleaning in Sofia Municipality are financed through the waste fee collected from residential and commercial property owners. The legal provisions on the waste fee are laid down in the Law on Local Taxes and Fees (1997, as amended). According to this Law, the magnitude of the fee is determined for each service separately: Waste collection and transportation, disposal and treatment in landfills or other facilities, and cleaning streets and public areas. The fee rate is calculated and approved each year by the city council.

Currently, the waste fee in Sofia Municipality is not linked to the type and level of service provided. Instead, it is collected from property owners based on property value (owners of higher value properties pay higher fees).

The fee is determined in an annual amount for each settlement in the service area by a Municipal Council Decision based on an approved waste account plan for each activity, including the necessary expenses for:

- Providing vessels for storage of municipal waste - containers, bins etc.;
- Collection, including separate, of municipal waste and transport to landfills or other facilities for their treatment;
- Research, design, construction, maintenance, exploitation, closure and monitoring of landfills or other installations or facilities for disposal, recycling and recovery of waste, including allocations for closures and aftercare;
- Cleaning of streets, squares, alleys, parks and other areas of settlements for public use.
- Despite numerous discussions, the Sofia Municipal Council has not yet changed the method for determining the waste fee. The fees for businesses are higher than the fees for private citizens.

In 2016 and 2015, the fee remained almost the same as for 2014 and 2013, as shown in the following table.

Table 36. Waste fee in Sofia Municipality from 2011 to 2016

	2011	2012	2013	2014	2015	2016
Fee as % of tax value of residential property. Of which for:	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
collection and transportation of municipal waste	0.60‰	0.61‰	0.58‰	0.60‰	0.60‰	0.59‰
disposal in landfills and other facilities	0.45‰	0.45‰	0.48‰	0.43‰	0.42‰	0.42‰
cleaning streets and public areas	0.55‰	0.54‰	0.54‰	0.57‰	0.58‰	0.59‰
Fee as % of tax value of business property. Of which for:	10%	10%	10%	10%	10%	10%
collection and transportation of municipal waste	3.7‰	3.8‰	3.6‰	3.7‰	3.72‰	3.7‰
disposal in landfills and other facilities	2.8‰	2.8‰	3.0‰	2.7‰	2.64‰	2.6‰
cleaning streets and public areas	3.5‰	3.4‰	3.4‰	3.6‰	3.64‰	3.7‰

The majority of revenues from waste fees come from owners of commercial properties (BGN 143 million, or approximately 70% of total waste fee revenues). Revenues from residential users constitute BGN 64 million, or approximately 30% of waste fee revenues.

For owners of residential properties, the waste fee amounts to 1.6% of property value while for commercial properties it amounts to 10%.

Table 37. Information on private properties and waste fee collected in 2016

Property value (in BGN)	Number of properties	Revenues from waste fee, BGN
BGN 5,001-10,000	27 202	302 978.46
BGN 10,001-20,000	57 776	1 311 689.06
BGN 20,001-30,000	89 652	3 403 757.99
BGN 30,001-40,000	91 162	4 817 773.82
BGN 40,001-50,000	78 543	5 341 919.86
BGN 50,001-75,000	124 430	11 533 055.02
BGN 75,001-100,000	71 757	9 205 728.63
BGN 100,001-250,000	110 261	21 604 914.18
BGN 250,001-500,000	11 962	4 465 232.07
BGN 500,001-1,000,000	1 848	1 274 824.40
Above BGN 1,000,000	327	502 010.07
Total	664 920	63 763 883.56

Table 38. Information on commercial properties and waste fee collected in 2016

Property value (in BGN)	Number of properties	Revenues from waste fee, BGN
BGN 0-5,000	12 094	205 964
BGN 5,001-10,000	7 293	411 732
BGN 10,001-20,000	11 624	1 149 060
BGN 20,001-30,000	9 497	1 245 671
BGN 30,001-40,000	6 640	1 171 719
BGN 40,001-50,000	5 212	1 174 486
BGN 50,001-75,000	8 430	2 700 098
BGN 75,001-100,000	5 815	2 655 729
BGN 100,001-250,000	13 891	11 838 207
BGN 250,001-500,000	5 716	11 521 895
BGN 500,001-1,000,000	3 366	12 733 679
Above BGN 1,000,000	3 904	96 827 281
Total	93 482	143 635 522

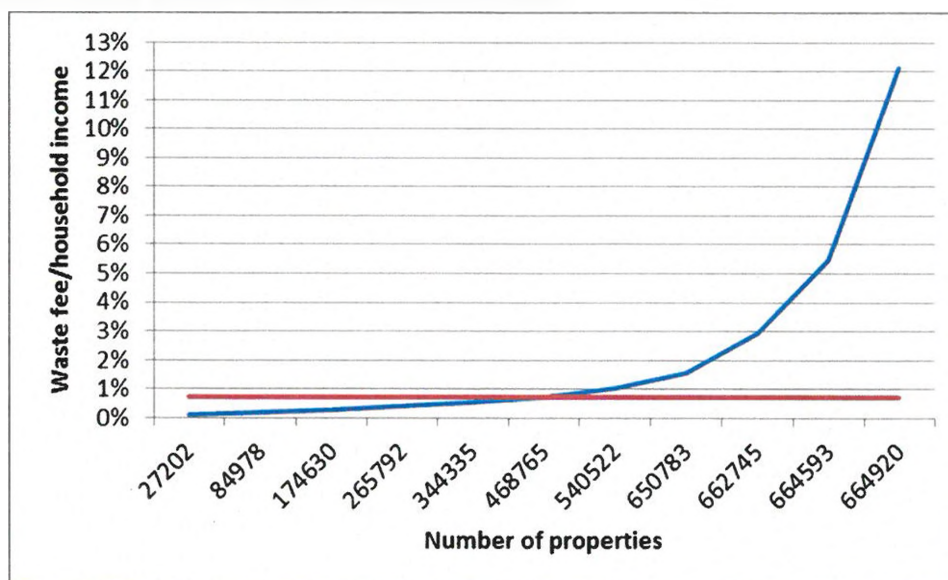
Regarding the tariff affordability, the average tariff per property was calculated and then compared to the average household income which was BGN 12666 in 2016 (according to National Statistical Institute, accessed page: <http://www.nsi.bg/>). The following table presents results of calculation:

Table 39. Calculation of the waste fee affordability in 2016

Property value (in BGN)	Number of properties	Average fee, BGN	Average fee, EUR	Average fee / household income, %
BGN 5,001-10,000	27 202	11.14	5.69	0.09%
BGN 10,001-20,000	57 776	22.70	11.61	0.18%
BGN 20,001-30,000	89 652	37.97	19.41	0.30%
BGN 30,001-40,000	91 162	52.85	27.02	0.42%
BGN 40,001-50,000	78 543	68.01	34.77	0.54%
BGN 50,001-75,000	124 430	92.69	47.39	0.73%
BGN 75,001-100,000	71 757	128.29	65.59	1.01%
BGN 100,001-250,000	110 261	195.94	100.18	1.55%
BGN 250,001-500,000	11 962	373.28	190.86	2.95%
BGN 500,001-1,000,000	1 848	689.84	352.71	5.45%
Above BGN 1,000,000	327	1 535.20	784.93	12.12%
Total	664 920	91.18	46.62	0.72%

It has to be emphasised that majority of properties i.e. 81.3% pays waste fee up to 1% of the households income and half of properties pay waste fee up to 0.5% of the average household income. The current fee however does not represent the full costs, especially that households pays significantly lower fee then commercial users.

Figure 2. Affordability of the waste fee in Sofia Municipality



The operating and capital expenditure of the waste management system in Sofia Municipality are presented in the tables below.

Table 40. Expenditures on waste management, operating costs of Sofia Municipality years 2012-2016, BGN

No	Type activity	2012	2013	2014	2015	2016
1.	Collection and transportation of household waste and transportation to landfills in other municipalities, including:	51 928 582	52 695 253	53 063 654	55 476 205	64 637 727
1.1.	• Household collection and transportation	50 449 478	51 672 989	52 963 938	55 476 205	64 637 727
1.2.	• Transportation of baled waste to the landfills in other municipalities	1 479 104	1 022 264	99 716	0	0
2.	Pre-treatment of household waste including:	18 760 501	18 472 214	20 542 498	22 820 121	23 562 810
2.1.	• Separation, transportation and utilization	18 760 501	18 472 214	17 842 498	16 320 121	3 340 810
2.2.	• Municipal Enterprises for waste treatment	0	0	2 700 000	6 500 000	20 222 000
3.	Disposal of household waste including:	6 243 309	4 196 798	6 255 661	6 563 819	3 535 977
3.1.	• Disposal of household waste	4 150 544	1 020 259	0	0	0
3.2.	• Disposal of baled waste in other municipalities	942 315	0	0	0	0
3.3.	• Deductions	1 150 450	3 176 539	6 255 661	6 563 819	3 535 977
4.	Summer and winter cleaning, including:	37 778 629	32 734 515	29 517 191	38 920 966	45 337 886
4.1.	• Summer cleaning:	17 355 635	19 405 720	22 380 277	22 133 060	28 581 877
4.2.	• Winter cleaning	20 422 994	13 328 795	7 136 915	16 787 905	16 756 009
5.	Others	4 762 816	5 537 878	5 600 000	5 800 000	6 178 598
	TOTAL:	119 473 837	113 636 657	114 979 005	129 581 111	143 252 998

Table 41. Expenditures on waste management, capital expenditures of Sofia Municipality years 2012-2016, BGN

No	Type activity	2012	2013	2014	2015	2016
1.	<i>Capital costs (not including objects financed by Operational Programmes)</i>	7 057 068	17 436 449	13 827 873	5 554 792	9 906 396
2	<i>Capital costs (objects financed by Operational Programmes)</i>	26 768 356	48 417 183	75 003 327	171 392 158	6 001 469

In recent years the waste fee revenues have generated operating surplus however capital operational costs that was steady for couple of years increased in 2016.

4.1 Opportunities for increasing RDF gate – affordability context

During the planning of the MBT facility - as the part of the second phase of Sofia Municipality Integrated Waste Management Project - it was due to affordability constraints for households decided to fix the RDF gate fee at 0 BGN/t. The EU grant in support of the MBT facility was also calculated and approved using this assumption.

Against this background and in accordance with the specific wish of Sofia Municipality a zero off-take price for the RDF to Toplofikatcia Sofia has been applied and assumed in the financial model for the project and for Toplofikacia Sofia.

Hence the funding gap has been calculated for this project using the 0 BGN/t gate fee assumption. In principle the calculated funding gap could be covered via the introduction of an RDF gate fee to be paid by householders via their waste management fee (only in principle – as the introduction of a gate fee due to the heat tariff regulations would lead to reduced heat tariffs and hence a new funding gap).

It is recognised that it is the decision of Sofia Municipality to set the gate fee (be it zero or otherwise). The purpose of this chapter is to make a high level verification of Sofia Municipality's view that an introduction of an RDF fee different from zero is only affordable until after the end of the project period.

Currently very significant cross-subsidies exist in the MSW management system. This was also shown in the feasibility studies and CBA conducted for the second phase of the integrated MSW management project in Sofia (2011) (see below).

Table 42 Cross-subsidies in MSW system in Sofia Municipality

No	Cross-subsidy between:	Description
1.	Commercial users and households	Commercial (legal) entities generate approx. 20% of MSW in SM, but their contribution to waste management and street cleaning budget amounts to 70%.
2.	Owners of properties with different tax valuation	Owners of more expensive properties pay higher waste fees than owners of less expensive properties. E.g. an owner of a property valued at Euro 25,565 pays Euro 41/year, and for a property valued at Euro 51,130 waste fee is Euro 82/year.
3.	MSW management and street cleaning activities	Effectively 100% of street cleaning costs is covered by commercial property owners.
4.	Waste fee revenues to general budget of SM	Unspent resources from waste fee are transferred to general budget of SM and are utilized for other activities (not related to MSW).

Source: 2011 CBA for second phase of the MSW management project

New national legislation that will be effective starting from 2017 will require Sofia Municipality to restructure the current tariff system and it is the policy of Sofia Municipality to gradually remove the mentioned cross-subsidies and introduce cost recovery tariffs. This is also in line with the EU's polluter-pays principle and full cost recovery. However, this can only be done gradually taking into account affordability constraints.

National guidelines regarding affordability of waste services specifies that household spending on MSW services should not exceed 1% of average disposable household income (only in a transitional period they can reach 1.5% of household disposable income). This has been assumed as the affordability limit.

Based on this the following steps in the affordability calculations are made:

1. Long term forecast of population/number of households and waste volumes (source: Feasibility Study);
2. Long term forecast of operating costs and assets depreciation in MSW system;
3. Calculation of the cost-recovery fee per household;
4. Calculation of the share of the waste fee/tax of average household income;
5. Determining the number of years that the share of waste fee/tax compared to the average households income does not exceed 1%.

The forecast of operating costs was made based on 2016 costs of MSW system as presented in previous section (Table 40). In 2016 total operating costs of MSW services including summer and winter cleaning amounted to BGN 143,252,998. In order to calculate the full cost recovery fee the depreciation of the existing assets (their total value amounts to BGN 298 million) are added. Currently municipality does not include depreciation of tariff in the waste tax calculation.

Assuming that the cross-subsidization is removed, currently the cost recovery waste fee for households constitutes 1.5% of average household income (according to the data provided by the Sofia Municipality the average household income for a family amounts to 12,666 BGN per year).

The projection of the future costs of Sofia's MSW system is broken down into: the **fixed operating costs** (not related to MSW volumes) and **variable costs** (linked with MSW volumes).

Fixed costs included in the model comprise in particular summer and winter cleaning and the depreciation (that reflects necessary reinvestments in the MSW system). The variable part relates to following categories: (i) collection and transportation of household waste and transportation to landfills in other municipalities; (ii) pre-treatment of household waste; (iii) disposal of household waste.

It is assumed that labour costs constitute about 40% of fixed and variable costs.

The model assumes a 2.7% increase (in real terms) of salaries. This applies both to average household income as well to labour costs in MSW system.

It is noted that the affordability calculation takes in to account the fact that the operating costs will be reduced by BGN 7.4 million, due to the saved cost of sending RDF to cement kilns when the RDF-CHP plant starts operation.

As in 2011 it is assumed that 80% of total MSW system costs are attributed to households and remaining 20% to commercial entities.

Based on the above approach and assumptions the full cost recovery fee per household is calculated and it is shown that an affordability level of 1,0% will be reached in the period 2038-2043 i.e. after 22-28 years. In years 29 and 30 the affordability level is projected to be 0,9%.

Table 43 Full cost recovery waste fee (BGN/household) and share of waste fee in household income (%)

		2016	2017	2018	2019	2020	2015	2030	2035	2038-2043	2044-2045
Full cost recovery fee	BGN/household	193	195	198	201	195	205	217	225	231-241	245-247
Share in disposable income	%	1.5%	1.5%	1.5%	1.5%	1.4%	1.3%	1.2%	1.1%	1.0%	0.9%

Source: Own calculations, based on information provided by Sofia Municipality

While it is seen that it may be possible to introduce a small payment for RDF treatment (and not exceed the 1% of average household income) during the very last years of the project it is noted that the requirement to increase recycling at source is expected to drive collection costs up over

the coming years. This will add to the affordability issue and due to this the 1% affordability limit is eventually expected to be reached after the end of this project.

Finally it should be noted that the method applied in the above calculation is high level and only indicative and a detailed affordability analysis following the waste tariff reform must be conducted in order to assess the feasibility of increasing household waste fee (as well as reducing cross subsidies).

5. ABILITY TO REPAY LOANS BY SOFIA MUNICIPALITY

Sofia Municipality budget revenues are increasing in last years. The majority of the budget increase comes from the increase of the own revenues what is illustrated in the table below.

Table 44. Structure of the SM revenues 2012-2016 and 9 months of 2017, thousand BGN

Budget revenues	2012	2013	2014	2015	2016	Execution 30.09.2017
VAT	2 612	2 316	2 061	2 148	5 026	3 181
Property taxes	206 339	223 251	228 212	254 527	278 697	228 626
Other taxes	56	57	65	30	15	22
Total tax revenues	209 007	225 623	230 337	256 704	283 739	231 829
Other revenues	32 617	33 038	34 400	36 242	32 080	26 739
Municipal taxes and fees	195 321	210 107	216 638	222 709	246 869	190 784
Revenues from sale of non-financial assets	6 983	6 735	8 374	25 807	22 685	11 826
Total non-tax revenues	247 344	261 340	275 133	300 181	324 277	242 191
Total own revenues	456 351	486 963	505 470	556 885	608 016	474 020
Transfers from CB	308 956	352 409	359 025	395 272	403 641	313 495
Other transfers	14 422	29 140	-17 058	-37 991	-9 735	-9 876
Temporary non-interest loans	-3 257	-1 153	-9 813	-17 176	18 142	-2 408
Total incomes	776 472	867 360	837 624	896 990	1 020 064	775 232
Total financial deficit (surplus)	36 520	-2 711	92 706	19 436	50 490	9 934
Total budget revenues	812 992	864 649	930 330	916 427	1 070 554	785 165
Total budget revenues with p. 95	804 448	848 133	921 805	932 725	1 058 427	684 955

Budget expenditures are also increasing and the significant part of the budget goes for salaries and related benefits and for other current expenditures. It has to be noted however that capital expenditures are also significant and exceeded 21% in 2016. The SM expenditure structure is presented in the table below.

Table 45. Structure of the SM expenditures 2014-2016 and 9 months of 2017, thousand BGN

Budget expenditures	2014	2015	2016	30.09.2017
Salaries and benefits	289 162	313 430	344 575	270 569
Current expenditures and maintenance	299 590	307 135	327 059	229 365
Taxes and fees	480	1 634	2 449	659
Scholarship	1 774	1 836	2 001	1 261
Current transfers, compensations and benefits for households	104 371	100 694	100 421	70 840
Subsidies	36 162	37 072	40 758	27 098
Other expenses	15 362	18 415	18 509	13 602
Capital expenses	174 904	152 509	222 655	71 561
TOTAL expenses	921 805	932 725	1 058 427	684 955

The current debt of the Sofia Municipality is estimated at BGN 643 million, the breakdown of which is shown in the following table.

Table 46. Structure of the Sofia Municipality's debt – as of end 2016, estimated

Name of liability	Debt [BGN]	Debt structure [%]
Bank of Japan – extension of the Sofia Metro	153 786 225	23.9%
Development Fund of the Council of Europe	185 545	0.0%
European Investment Bank (EIB) – metro	202 930 577	31.6%
EIB, streets A tranche	64 639 846	10.1%
EIB, streets B tranche	88 012 350	13.7%
EIB, waste A tranche	29 110 028	4.5%
EIB, waste B tranche	25 425 790	4.0%
EIB, Replacement of transport fleet	78 233 200	12.2%
Lease contracts	354 825	0.1%
Total	642 678 386	100.0%

The EIB loan proposed to co-finance this project will increase those liabilities by BGN 128 546 649 (€65 724 858, 41.7% of the total investment costs in current prices) to BGN 771 225 036.

The current debt service ratio, defined by Bulgarian legislation is not to exceed 15%¹⁰ of the total of own revenues and equalization subsidy, equals 6.11% at the end of 2016.

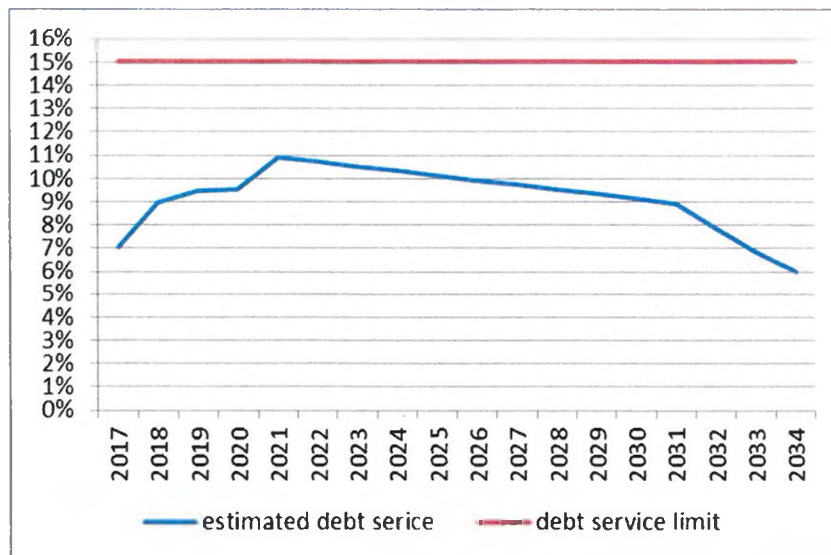
The following table provides an estimate of the debt service ratio including the new loan BGN 129 million. It is noted that the debt service will not reach the level of 11%. The estimation used a conservative assumption that own revenues and equalisation subsidy will not raise in the future. The repayment schedule of the EIB loan for RDF FIRED CHP PLANT IN SOFIA is provided in Table 8 in Annex 2.

Table 47. Estimation of debt service level for Sofia Municipality – BGN, critical years are presented

	2020	2021	2022	2023	2024	2025
Debt service (old debt) – interest rate, fees and instalments	51 795 742	51 465 016	50 455 116	49 445 215	48 440 042	47 425 415
Debt service (new debt) - interest rate, fees and instalments	1 412 951	10 497 976	10 369 430	10 240 883	10 112 336	9 983 790
Own revenues	556 885 413	556 885 413	556 885 413	556 885 413	556 885 413	556 885 413
Equalisation subsidy	1 412 951	10 497 976	10 369 430	10 240 883	10 112 336	9 983 790
Debt service %	9.53%	10.92%	10.72%	10.52%	10.33%	10.13%

¹⁰ Art. 32. (1) of the Public finance law says that the annual amount of the repayment of the municipal debt (principal, interest, fees) cannot exceed 15% of the average annual amount of own revenues and equalisation subsidy for the last three years, according to the annual reports of the municipal budget.

Figure 3. Estimated debt service ratio for Sofia Municipality



5.1 Conclusion

- Currently the Sofia Municipality debt is on safe level of about 6% of debt service to own revenues and equalisation subsidy.
- The planned debt service in next years, including new EIB loan for the RDF FIRED CHP PLANT IN SOFIA will raise the debt service level to more than 10% and will not exceed 11%.
- After 2021 the debt service level will be steadily decreasing;

6. ECONOMIC ANALYSIS

An economic analysis is carried out to demonstrate that the project contributes positively to society as a whole and is therefore worthy of funding support from the EU. The present value of the project's economic benefits must be demonstrated to exceed the present value of the project's economic costs over the defined planning period.

Positive net benefits are expressed as a positive ENPV, a Benefit/Cost (B/C) ratio higher than 1, or a project ERR exceeding the discount rate used for calculating the ENPV. In the case of the current project, a social discount rate of 5% is assumed.

While the financial analysis measures returns to the owner of the infrastructure, the economic analysis assesses the project's contribution to the economic welfare of the region or country. It relies on the fact that observed market prices of inputs and outputs do not fully reflect their social value (i.e., their social opportunity cost). The economic analysis also attempts to capture potential project impacts that have no direct market values, for example impacts on the environment or on people's health.

The economic analysis evaluates the project over the selected 29-year project horizon (2018-2046). The economic analysis is conducted based on adjusted cash flows from the financial analysis to take into account estimated external effects. In addition to this, qualitative environmental, health, social and wider economic benefits are outlined.

6.1 Introduction and Methodology

The economic analysis takes as a point of reference the cash flows developed in connection with the financial analysis.

As under the financial analysis, the economic analysis considers the incremental costs/benefits of the "with project" relative to "without project" scenario.

Adjustments are made to financial cash flows to account for social distortions and economic costs and benefits, in line with approach outlined in the European Commission "Guide to Cost-Benefit Analysis of Investment Projects. Economic appraisal tool for Cohesion Policy 2014-2020" (2014) (hereinafter: CBA Guide). Starting from the account for the return on investment calculation, the following adjustments are made:

1. fiscal corrections;
2. conversion from market to shadow prices;
3. evaluation of non-market impacts and correction for externalities

The following economic performance indicators are used to in an economic analysis:

- **ENPV** (economic net present value) – this indicator should be greater than zero (0). If it is less than zero, the project represents a net loss to society and should be rejected;
- **ERR** (economic rate of return) – this indicator should be higher than the social discount rate (5%);
- **Benefit-cost ratio** – the project should have a benefit-cost ratio greater than one (1). If it is less than one, the project represents a net loss to society and should be rejected.

6.1.1 Definition of "without project" scenario

If the project is not implemented, the major outcome will be that RDF from MTB will not be utilized by CHP facility. Sofia Municipality's new Mechanical and Biological Treatment (MBT) Facility has been set in operation in September 2015. The MBT facility produces an RDF which has been considered by Sofia Municipality already at the first stage of Sofia's municipal waste management project. In principle, there are three options for how to use the RDF, which are discussed in details in section 10 of the Feasibility Study:

- Option 1 – Landfilling of the RDF
- Option 2 – Co-combustion of the RDF in industrial firing;

The conclusion of the option analysis is that the best non-CHP option is that RDF is transported to cement factories.

There are three cement factories that shown an interest in RDF, have IPPC for RDF combustion and are currently incinerating RDF:

- „Devnya Cement“ JSCo
- "Holcim Bulgaria" JSCo
- „Zlatna Panega Cement“ JSCo

The transportation work involved is significant as the cement kilns are located from 110 to 450 km from Sofia.

Thus the "without project" scenario is defined as RDF transportation from MBT facility and combustion in cement factories. The "without project" scenario has the following weaknesses:

- Requires transportation over long distances, which generates additional costs, environmental hazards and GHG emissions;
- Although the economic benefit of utilizing RDF as fuel in the cement industry is assessed as avoided use of other fuels (natural gas) on 1:1 on energy basis, it has a significant drawback compared to the "with project" scenario that will use co-generation producing both heat and power and therefore saving more natural gas.

6.2 Fiscal corrections

Transfers include all taxes, fees, financial costs and subsidies. These are excluded from a CBA because they do not constitute a cost to society, but rather function as a tool for redistribution of income. They do not contribute to an increase or decline in social welfare. The project is not expected to involve negative tax aspects. All prices of inputs and outputs are net of VAT and other indirect taxes. Subsidies granted by a public entity to the project are pure transfer payments and are omitted from revenues under economic analysis.

6.3 Conversion from market to shadow prices

Costs based on domestic market prices are converted to be comparable with costs based on internationally traded prices. This is because internationally traded goods are assumed to reflect the actual economic value of the good, whereas domestic prices on goods can be distorted by market imperfections.

In cases where the difference between the cost of market prices (actually incurred) and the real economic cost to society was taken into account, a conversion ratio was used to convert the market prices into the calculation prices according to chapter 2.8.3 of the CBA Guide.

In the case of goods that are subject to international trade, the cost of their purchase and import (imported goods) or the value deriving from sales on the foreign market (for exported goods) should be accepted as their alternative value. Correcting indicators should take into account the possible difference between the value expressed in the above manner and the cost adopted in the financial analysis.

In most cases, the correction coefficients are equal to 1 (no specific conversion), as Bulgaria is an open economy (a member of the European Union and therefore has access to a common market and therefore does not have barriers to international trade) and market prices are assumed to reflect economic prices in Bulgaria.

Price corrections based on these mechanisms result in both increases and decreases in costs expressed in economic terms compared to the values included in the financial analysis. In situations where the economic cost is higher than the market price in the financial analysis, there are additional social costs associated with the financial analysis. When the economic cost is lower than the financial costs, the results of the financial analysis should be adjusted to reflect the magnitude of the additional benefits to society.

An analysis of the need for appropriate price adjustments and calculations of possible conversion factors related to them were made for each of the groups of investment expenditure and operating costs as follows:

- Wages - Wage distortions may be the result of the difference between the level of wages adopted in the financial analysis and the alternative cost, i.e. the social value of work. Skilled labour is considered a scarce resource and therefore adequately priced on the market in terms of opportunity cost; thus, no specific conversion is required. In general, the payroll included in the economic analysis is the highest possible remuneration that employees in the project under consideration could obtain elsewhere. However, given the unemployment rate (the assumed unemployment rate is 4%¹¹), the actual alternative labour cost may be lower than the wage rate possible. The corresponding taxes were assumed to be 10% (PIT rate in Bulgaria). The calculated conversion factor for unskilled labour is equal to 0.86 ($= (1 - 0.1) \times (1 - 0.04)$);
- Materials and energy - the price level adopted in the financial analysis corresponds to international prices, reflecting the alternative cost, so the conversion factor is 1 and no adjustment is required in this regard;
- Other costs (i.e. foreign services, etc.) - the price level adopted in the financial analysis corresponds to international prices reflecting the alternative cost, therefore the conversion factor is 1 and no adjustment is required;
- Investment expenditures (construction and assembly works) - the value of these works included in the financial analysis includes the purchase of materials, the labour cost of unskilled workers and the profit of the construction companies. This study assumes that the labour costs for unskilled workers are 10%, material and other costs 85%, and profit at 5%. The labour costs of unqualified workers have been adjusted using the wage coefficient. The actual cost of acquisition of materials is equal to the alternative cost (conversion factor equal to 1). Regarding the profit margin, the conversion factor is 0. Taking the foregoing into account, the conversion factor for investment expenditures used in the economic analysis is 0.94, calculated as $(0.10 \times 0.86) + (0.85 \times 1) + (0.05 \times 0) = 0.94$;

The following table summarizes the conversion factors used in the economic analysis:

Cost item	Correction applied	Remark
Technological equipment, construction materials	CF=1	Purchased through open, competitive, international tenders, adequately priced on the market. No correction required.
Construction and assembly works	CF=0.94	Described above
Wages	CF=0.86	Described above
Consumables in operations (materials and energy)	CF=1	Mostly adequately priced on the market. Natural gas used only in small quantities during start up. No corrections applied
Other operating costs	CF=1	Spare parts and external services used for asset maintenance/repair are adequately priced on the market.

¹¹ Current unemployment rate in Bulgaria is 6.9%

(<http://www.nsi.bg/en/content/15161/%D0%BF%D1%80%D0%B5%D1%81%D1%81%D1%8A%D0%BE%D0%B1%D1%89%D0%B5%D0%BD%D0%B8%D0%B5/main-labour-force-survey-results-first-quarter-2017>) while at the end of 2015 was 9.1% (https://infostat.nsi.bg/infostat/pages/reports/result.jsf?x_2=754). At the same time the unemployment rate in Sofia was 4.3% (<http://www.nsi.bg/en/content/11442/district-sofia-stolitza>) thus it was assumed that current unemployment rate in Sofia is about 4%.

6.4 External benefits and costs (externalities)

Environmental investment programmes, including investments in waste and district heating facilities, generate a wide range of benefits that cannot directly be valued as there exist no direct, market defined prices. The Commission Implementing Regulation (EU) 2015/207 of 20 January 2015 requires that the main economic benefits for waste management sector to be considered in the economic analysis are:

- (i) reduction of health and environmental hazards (reduced contamination of air, water, soils);
- (ii) reduction of landfill space/costs (for waste treatment facilities);
- (iii) recovery of materials, energy and production of compost (avoided cost of alternative production/generation, including externalities) ;
- (iv) reduction of GHG emissions;
- (v) reduction of visual disamenities, noise and odours.

For Energy/Renewable Energy Sources projects additional to above, the reduction of energy costs for substitution of the energy source e.g. by displacement of fossil fuels alternatives (expressed by the economic value of energy generated by likely displaced alternative, including externalities) shall be analysed.

From above, the reduction of health and environmental hazards and reduction of visual disamenities, noise and odours are discussed qualifiedly, while other benefits are valued.

The assumptions for valuation of external benefits and external costs are described in details in Section 11. "Comparison of the CHP and the non-CHP options" of the Feasibility Study.

The following table summarizes the social benefits and costs taken into account in the analysis.

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Social benefit/costs category	Social benefit/costs subcategory	Description of social benefit costs	Valuated/ non valuated	Remarks
External benefits				
Reduction of health and environmental hazards		Avoided pollution (CO, SO ₂ , NO _x , PM) from transportation of RDF to cement industry by diesel trucks and from higher emissions of air pollution from cement industry	-	
Reduction in waste management costs	Reduction in RDF transport costs	Avoided transport costs to cement plants	+	Avoided costs of transportation of MTB to cement plants (Zlatna, Holcim, Devnia)
		Transportation costs to RDF CHP plant	+	Minus the transport costs of RDF to the CHP facility (23km)
		Avoided RDF Gate-Fee at cement plants	+	Avoided payment of the gate fee at cement plants
Energy recovery		Avoided gas consumption, for H&P displaced at TS	+	
		Avoided long-run marginal cost for incremental power	+	Monetized benefit of electricity sold
	Reduction in gas-related Security-of-Supply externality	Avoided natural gas, Security of Supply (SoS) externality at TS	+	A key objective of the current project is diversification of the fuel base for energy production in Toplofikacia Sofia EAD and a reduction in reliance on natural gas.
		Avoided gas SoS externality for incremental power	+	
		Foregone reduction in gas SoS externality in cement industry	+	Minus the SoS of gas that has to be used at cement industry
Reduction in GHG		Avoided GHG from natural gas	+	

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emissions		displaced at TS		
		Avoided GHG emissions for incremental power	+	
		Avoided GHG from transport to cement plants	+	
		Add. GHG from transport to RDF CHP plant	+	GHG emissions from transporting RDF to the CHP facility are included in the economic analysis. The calculation was done using the same assumptions as for calculation of avoided GHG emissions from transport to cement facilities while applying the 23km distance between RDF and CHP facilities.
		Foregone reduction in GHG emissions in cement industry	+	
Other benefits		Social Benefits from increased employment	-	
External costs				
Increase in health and environmental hazards			-	Viewed to be negligible compared to other factors
Land opportunity costs			+	For the construction of the RDF fired facility there is a need for a plot of approximate 20.000 m2. In addition, during the construction period, there will be a need for additional 20.000 m2 for storage and preassembling of components. This additional space could be used in alternative ways. This costs were valuated.
Increase of visual disamenities, noise and odours		Noise and dust during construction	-	Disadvantages are of a temporary nature and it is assumed that normal mitigation procedures will be put in place to minimize the inconvenience within the service area

6.5 Not valuated social benefits

6.5.1 Reduction of health and environmental hazards

The project has a minor direct influence on reducing environmental hazards. This reduction is obtained due to incremental power production and thus reduction of natural gas combustion. However gas combustion causes limited emissions of pollutants.

The major benefit from reducing health and environmental hazards is due to the significant decrease of RDF transportation and from the difference in air pollutant emissions of RDF in cement industry and CHP.

The RDF transportation is provided by diesel-powered, which contribute to air pollution that poses major environmental and health risks to the population. Above all, diesel exhaust is a Group 1 carcinogen, which causes lung cancer and is positively correlated with incidence of bladder cancer¹².

Diesel engines emit the following pollutants (except GHG discussed later):

- Carbon monoxide – CO is a temporary atmospheric pollutant in some urban areas, chiefly from the exhaust of internal combustion engines. Carbon monoxide is absorbed through breathing and enters the blood stream through gas exchange in the lungs. It is toxic when encountered in concentrations above about 35 ppm.
- Nitrogen oxides – NO_x refers to the mixture of NO and NO₂. They are produced during combustion, especially at a high temperatures. Due to reactions and photolysis by sunlight, they are it is the main source of tropospheric ozone. NO_x may react with water to make nitric acid, which may end up in the soil, where it forms nitrate, which is of use to growing plants. NO_x in combination with other pollutants creates urban smog. High concentrations of nitrogen dioxide are harmful because they cause inflammation of the airways.
- Sulphur dioxide – SO₂ pollution from diesel mainly depends on the quality of the fuel. If the fuel contains more sulphur, the diesel exhaust will contain more SO₂. Sulphur dioxide emissions are a precursor to acid rain and atmospheric particulates. Inhaling sulphur dioxide is associated with increased respiratory symptoms and diseases, and difficulty in breathing.
- Particulate matter (PM) – the major pollutant that has negative health effects are is PM (2.5 and 10). Due to their small size, they can penetrate into reach the deep regions of the lungs. It is estimated that approximately 3% of cardiopulmonary and 5% of lung cancer deaths are attributable to PM globally. Exposure to PM_{2.5} reduces the life expectancy of the population by about 8.6 months on average¹³. The health effects of PM₁₀ and PM_{2.5} are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:
 - respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions;
 - mortality from cardiovascular and respiratory diseases and from lung cancer.

There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. The World Health Organisation Air Quality Guidelines values for PM in 2005 were as follows:

- for PM_{2.5}: 10 µg/m³ for the annual average and 25 µg/m³ for the 24-hour mean (not to be exceeded for more than 3 days/year);
- for PM₁₀: 20 µg/m³ for the annual average and 50 µg/m³ for the 24-hour mean¹⁴.

Introduction of modern Euro 6 engines significantly reduces amounts of pollutions from diesel engines however still such engines are polluting. In addition, new research has revealed that

¹² The Group 1 category is used when there is sufficient evidence of carcinogenicity in humans.

¹³ Lim, S. et al. (2012), "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010", The Lancet, Vol. 380/, No. 9 859, pp. 2 224 – 2 260. Available at: [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(12\)61766-8/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(12)61766-8/abstract).

¹⁴ WHO (2013), Health Effects of Particulate Matter Policy Implications for Countries in Eastern Europe, Caucasus and Central Asia, World Health Organization, Regional Office for Europe, Copenhagen. Available at: http://www.euro.who.int/__data/assets/pdf_file/0006/189051/Health-effects-of-particulate-matter-final-Eng.pdf.

normal and especially urban driving cycle, causes significantly higher pollution that set up by the Euro standard¹⁵.

Similarly, combustion of RDF produces emission of PM, NO_x, SO₂, CO and CO₂. In addition TOC, PCDD, PCDF and metals are produced. All above mentioned emissions appears in both when combusting MTB in the cement industry and in CHP however, the BAT in cement industry (Best Available Techniques (BAT) Reference Document for the Production of Cement, Lime and Magnesium Oxide, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), 2013) reports higher emissions.

6.5.2 Reduction of visual disamenities, noise and odours

Similarly to reduction of health and environmental hazards, the reduction of noise is related to the decreased transportation of RDF which is carried by trucks that typically generate significant noise on their routes.

6.5.3 Social Benefits from Increased Employment

Incremental labour impacts from the investment programme will be minimal. Additional labour will be required for the RDF facility (approximately 44 full-time equivalents). These jobs will likely not result in a net gain of employment for society as a whole as these skilled workers will likely be taken from other activities (and not from the pool of currently unemployed).

6.5.4 Consumer surplus

A principal benefit of the project is the substitution of natural gas (fossil fuel) with RDF. As the costs of RDF for Toplofikatsia EAD is equal to zero and the specific tariff formula for heat energy uses the cost-plus method net of revenues from electricity, the decrease in operating costs (by costs of RDF) will cause a decrease in revenues. The reduced revenues (i.e., the incremental revenues will be negative) are taken into account in the economic analysis and worsen the economic indicators. At the same time, however, the decrease in revenues is a gain to consumers because they are able to purchase a product for a price that is less than if the RDF were not used for heating. A reduction in tariffs may also affect overall demand; since RDF will cover only a part of the fuel mix, however, this influence is not significant and is not taken into account in the calculations.

6.5.5 General economic benefit

General economic benefit can be expected resulting from improved municipal services. The precise multiplier effect to be considered for the current project is difficult to assess, though it may be assumed to be somewhat marginal as the project does not involve an expansion of the service area and/or the overall heat demand to be met.

6.6 Not valued social costs

The investment programme will bring with it disadvantages typical of infrastructure development projects including dust, noise, and limited local impacts on traffic. These disadvantages are of a temporary nature and it is assumed that normal mitigation procedures will be put in place to minimize the inconvenience within the service area. No longer term negative environmental impacts or disadvantages are assumed to result from the project.

6.7 Calculation of social benefits

6.7.1 Reduction of landfill space/costs;

A major benefit of waste projects to be considered is reduced landfill space/costs. This benefit is, however, assumed to have been fully captured under the Sofia mechanical biological treatment

¹⁵ In 2014, the ICCT issued in 2014 a report on real-world exhaust emissions from modern diesel cars presenting. measurements of real emissions were measured and presented in the report. The analysis showed that real- world emissions of CO₂ and NO_x are higher than the limits on average by 40% and 70%, respectively (Franco, V. et al. (2014), Real-World Exhaust Emissions from Modern Diesel Cars. A Meta-Analysis of Pems Emissions Data from EU (Euro 6) and US (Tier 2 Bin 5/Ulev II) Diesel Passenger Cars, International Council on Clean Transportation, Berlin. Available at: http://www.theicct.org/sites/default/files/publications/ICCT_PEMS-study_diesel-cars_20141010.pdf.)

(MBT) project. It is true that the current CHP based on RDF facility will significantly reduce the amount of material by weight for final disposal at the landfill. However, it is assumed that the alternative destination for the RDF produced at the Sofia MBT is not the landfill, but rather an alternative energy/industrial facility (e.g. cement plant). Thus in case of this project, the relevant avoided waste management cost is the avoided transportation and treatment cost of RDF in cement factories.

6.7.2 Reduction in waste management costs

6.7.2.1 Reduction in RDF transport costs

Avoided transport costs to cement plants

In case RDF shall be used by the cement industry as fuel, the economic calculation shall take cost related to gate-fee and transportation of RDF into account as well as cost related to GHG emissions from transportation. The gate-fee and GHG emissions are included in the calculation of other social benefits thus only a costs of transportation are included here.

The average transportation cost is 21 €/tonnes (transportation of the empty lorry back to Sofia is included). The total transportation work in first year with approximately 161,000 tonnes of RDF is approximately 3.9·10⁷ tonnes·km.

Avoided transport costs to cement plants, and further discussed avoided RDF Gate-Fee at cement plants and avoided GHG from transport to cement plants are calculated net of lack of capacity of processing RDF. In years when the production of RDF exceeds treatment capacity, it is assumed that excess RDF is transported and treated by the cement industry. The calculation includes gate fee, transport costs and GHG emissions from transport to the closest cement facility.

Transportation costs of RDF to CHP plant

The transport costs of RDF to the CHP facility (23km) are not included in the financial analysis. Thus, they have been included in the economic analysis and amount to approximately 1.32 EUR/t.

6.7.2.2 Avoided RDF Gate-Fee at cement plants

In case RDF is used by the cement industry as fuel, the economic calculation takes the cost related to gate-fee and transportation of RDF into account as well as cost related to GHG emissions from transportation.

The average gate fee at the three cement facilities is 10.5 €/tonnes.

6.7.2.3 Energy recovery

Avoided gas consumption for CHP displaced at Toplofikacia Sofia EAD

Implementation of the project will bring the benefit of non-consuming natural gas, which will be replaced by RDF. Thus, in calculating economic benefits, the gas price and amount of avoided natural gas was used to calculate the benefit.

Implementation of the project will at full load increase the net power production at Toplofikatsia by approximately 31,000 MWh (incremental power production) and reduce the gas consumption by 630,000 MWh (see chapter 9 of the Feasibility Study on energy production with the optimal RDF CHP solutions for further). The total production of power from the RDF-CHP is 156,000 MWh and thus part of the existing power production on basis of natural gas is replaced by power production on RDF-basis. At partial load of the RDF-CHP plant decreases production and avoided use of gas is reduced proportionally.

Avoided long-run marginal cost for incremental power

The benefit of electricity sold, monetized at long-term marginal cost of production from alternative source (including externalities), was calculated as the value of incremental power (using the economic price of power).

Reduction in gas-related Security-of-Supply externality

Avoided gas, Security-of-Supply externality at Toplofikacia Sofia EAD

A key objective of the current project is a diversification of the fuel base for energy production in Toplofikacia Sofia EAD and a reduction in reliance on natural gas.

Supply security is particularly sensitive in Bulgaria due to reliance on imports from the Russian Federation via Ukraine – imports that in the past have been jeopardised by supply conflicts between Russia and Ukraine. Cultivation of alternative import sources and diversification of the fuel base is therefore a policy priority.

During the peak of the crisis in Ukraine, 5 billion cubic metres of gas were not delivered over a two-week period. Interruption of the gas flows from Ukraine in January 2009 during a peak period of demand caused a significant economic and social loss to the countries that did not have alternate security of supply measures in place.

Security of supply was monetized by using Jaspers value of security of supply for power production on RDF: 10 €/MWh power. By assuming 58% efficiency in power production from gas (Jaspers assumption), the SoS on avoided use of natural gas becomes 5.8 €/MWh gas.

Avoided gas SoS externality - incremental power

Economic benefit of security of supply (SoS) of incremental power production is calculated and included in total power price as well as avoided natural gas as previously explained.

In the “with project” option where there is both production of power and reduced use of natural gas, SoS is calculated as follows: The SoS on (only) the incremental power production plus the SoS on the total avoided use of natural gas. In this way, double accounting of SoS is avoided.

Foregone reduction in gas SoS externality in cement industry

In the “without project option”, involving only reduced use of natural gas at cement kilns, SoS is calculated as the avoided use of natural gas.

6.7.3 Reduction in GHG emissions:

Avoided GHG from natural gas displaced at TS

Incremental power production and avoided consumption of natural gas will also have a benefit of avoided GHG emissions from (avoided) natural gas. When natural gas consumption is reduced, the emission of greenhouse gasses (GHG) is also reduced, and the economic benefit of this is calculated with an emission factor on 198 kg CO₂/MWh natural gas (calculated based on actual composition of natural gas from Russia).

Avoided GHG emissions for incremental power

The incremental power production will reduce GHG emissions from the power industry. The calculation uses the value of 15 EUR/MWh of avoided GHG emissions from CCGT.

Avoided GHG from transport to cement plants

In case RDF is used by the cement industry, the transportation work involved is significant as the cement kilns are located from 110 to 450 km from Sofia. The transportation work is expressed as tonnes*km and the associated emission of GHG is estimated at 0.06 kg CO₂/(tonnes*km). GHG emissions are calculated based on truckloads of 30 t and with fuel consumption of 3 km/l of diesel and 2.7 kg CO₂/l diesel.

Additional GHG from transport to RDF CHP plant

GHG emissions from transporting RDF to the CHP facility are included in the economic analysis. The calculation was done using the same assumptions as for calculation of avoided GHG emissions from transport to cement facilities while applying the 23km distance between RDF and CHP facilities.

Foregone reduction in GHG emissions in cement industry

The MTB combustion in cement industry would also reduce GHG missions from displaced natural gas. Thus the economic benefit is net of this amount calculated with an emission factor on 198 kg CO₂/MWh natural gas (calculated based on actual composition of natural gas from Russia).

6.8 Calculation of social costs

6.8.1 Land opportunity costs

For the construction of the RDF fired facility there is a need for a plot of approximate 20.000 m². In addition, during the construction period, there will be a need for additional 20.000 m² for storage and preassembling of components. This additional space can be used in alternative ways. The costs of land preparation are included in the financial analysis, while the costs of land acquisition are not, as this will be contributed by the Sofia Municipality. As this land could be used for other purposes, the opportunity costs were included in the economic analysis. The opportunity costs were calculated taking into account the average cost of land of 50 EUR/m². This is rough estimate taking into account that:

- according to real estate webpages the value of 1 m² is approximately 255 EUR;
- according to consulting companies (working in the field of valuation) the value of 1 m² is approximately 55 EUR;
- according to actual real estate market deals, the value of 1 m² is approximately 38 - 55 EUR.

The opportunity costs were calculated for the first year of the analysis taking into account a need of 40.000 m² while after completion for the construction, 20.000m² will be returned (calculated as a benefit).

6.9 Economic Rate of Return and Net Present Value of the Project

Table 20 in the Annex contains a calculation of the economic rate of return (ERR), the economic net present value (ENPV), and the Benefit/Cost Ratio.

This table includes the results of the financial analysis that were corrected for transfers, external effects and price distortions on the factors of production.

The net cash flow balance was corrected for the social costs and benefits described earlier.

The calculation does not take into account the proposed grant because it is a transfer.

After making the above corrections, the surplus after corrections was calculated; this in turn was the basis for calculating the economic rate of return (ERR) and the economic net present value (ENPV).

The results of these calculations are summarised in the following table.

Table 48. Calculation of economic indicators

Item	Assumption/Result
Social discount rate (%)	5%
EIRR	11.18%
ENPV	€ 110 185 936
B/C ratio	1.44

The overall result of the Economic Cost Benefit Analysis shows a positive result for the project in that the EIRR exceeds the discount rate, the ENPV is positive, and the benefit-cost ratio is 1.44.

It should be noted that this result was obtained based on relatively conservative assumptions for the calculated benefits. Moreover, there are a number of benefits from the project that have not been quantitatively assessed.

7. SENSITIVITY AND RISK ASSESSMENT

7.1 Methodology

Toplofikacia Sofia EAD business activities are subject to a range of influences that could impact its business and the project.

However, many of these influences are interdependent and as such can give rise to errors in determining sensitivity if they are all used. Consequently, a simplified and aggregated approach has been taken here whereby the sensitivity of key output indicators to key input indicators have been assessed based on +/- variations of input variables.

The detailed outcomes of the analysis are provided in the Annex.

7.2 Identification of critical variables

The sensitivity analysis was conducted for eight potential critical variables. These variables were selected as having the highest potential impact on project performance.

Critical variables were defined as those whose variations, be they positive or negative, having the largest impact on the project's financial and/or economic performance. The analysis is carried out by varying one variable at a time and determining the effect of that change on the NPV. Variables are considered 'critical' if a variation of $\pm 1\%$ in the value adopted in the base case gives rise to a variation of more than 1% in the value of the NPV.

The following table illustrates identification of critical variables.

Table 49 Identification of critical variables

Variable	Variation of the FNPV or ENPV due to a $\pm 1\%$ variation					
	FNPV/C	Criticality	FNPV/K	Criticality	ENPV	Criticality
Project investment cost	1.75%	+	202.21%	+	-1.20%	+
RDF production	0.00%	-	0.00%	-	3.80%	+
Discount rate	0.31%	-	62.65%	+	0.00%	-
Natural gas price (financial)	0.00%	-	0.00%	-	2.36%	+
Natural gas price (SoS)	0.00%	-	0.00%	-	-0.01%	-
Price of electricity (financial)	0.00%	-	0.00%	-	0.00%	-
Price of electricity (economic)	0.00%	-	0.00%	-	0.34%	-
Economic price of CO2 allowance	0.00%	-	0.00%	-	-0.01%	-
RoE	-0.14%	-	-38.59%	+	0.00%	-

Source: Consultant calculations

7.3 Switching values

Switching values were also calculated. The switching value of a variable is the value at which a project's FNPV or ENPV becomes zero and indicates the amount by which an element of a project can change in an unfavourable direction before the analysis returns a negative outcome (i.e., negative FNPV or ENPV). The economic switching values for the critical variables are calculated in relative terms and presented in the following table.

Table 50 Switching values for critical variables

Variable	Switching values	
Project investment cost	Minimum decrease before the FNPV/C equals 0	57.1%
	Minimum decrease before the FNPV/K equals 0	0.5%
	Minimum increase before the ENPV/C equals 0	83.5%
RDF production	Minimum decrease before the FNPV equals 0	N.A.
	Minimum decrease before the ENPV equals 0	21.3%
Discount rate	Minimum decrease before the FNPV equals 0	126.2%
	Minimum decrease before the FNPV/K equals 0	1.6%
	Minimum increase before the ENPV equals 0	N.A.
Natural gas price (financial)	Minimum decrease before the FNPV equals 0	N.A.
	Minimum decrease before the ENPV equals 0	42.3%
	Minimum increase before the ENPV equals 0	N.A.
RoE	Minimum increase before the FNPV/C equals 0	728.5%
	Minimum increase before the FNPV/K equals 0	2.6%
	Minimum increase before the ENPV equals 0	N.A.

Source: Consultant calculations

Toplofikacia Sofia EAD heat tariffs are determined in accordance with a regulated cost-plus tariff formula net of electricity revenues. Variations in cost and electricity revenue variables will translate to off-setting adjustments to heat tariffs/revenues. The end result is that the overall levels of project financial and economic returns will remain largely unchanged on both natural gas prices and electricity tariff.

7.4 Scenario analysis

The sensitivity analysis was supplemented with a scenario analysis, which studies the impact of combinations of values taken by the critical variables. Two scenarios were analysed:

1. Changes in pessimistic values of variables that have the highest influence on FNPV: investment costs and discount rate;
2. Changes pessimistic values of variables that have the highest influence on ENPV: RDF production, natural gas prices and SoS and economic price of CO2 allowances.

1.1.1 Scenario 1

For scenario 1, the extreme (lower and upper) values of investment costs and discount rate were taken for analysis. In case of investment costs, the realistic change is up to 30%. In case of the discount rate it is 50%.

The following table presents the results of the scenario analysis for scenario 1.

Table 51 Scenario 1 analysis

Variable extreme change	FNPV	ENPV
-------------------------	------	------

Project investment cost +30%	-122 785 191	70 604 591
Discount rate +50%		
Base results	-76 320 774	110 185 936
Project investment cost -30%	-17 007 838	149 767 281
Discount rate -50%		

Source: Consultant calculations

1.1.2 Scenario 2

For the scenario 2 the extreme (lower and upper) values of RDF production, natural gas prices and SoS and economic price of CO2 allowances were taken for analysis. In all cases the realistic change was assumed up to 30%.

The following table presents the results of the scenario analysis for scenario 2.

Table 52 Scenario 2 analysis

Variable extreme change	FNPV	ENPV
RDF production, natural gas prices and SoS and RoE+30%	-73 177 932	283 282 502
Base results	-76 320 774	110 185 936
RDF production, natural gas prices and SoS and RoE -30%	-79 463 617	-95 701 971

Source: Consultant calculations

Although in the worst case the ENPV is negative, it has to be emphasised that the combination of negative changes in variables is unlikely to happen.

7.4.1 Results of sensitivity analysis on FNPV/C, NPV/K and ENPV

The flowing charts present the results of the sensitivity analysis on FNPV/C, NPV/K and ENPV.

Figure 4. Results of sensitivity analysis on FNPV/C

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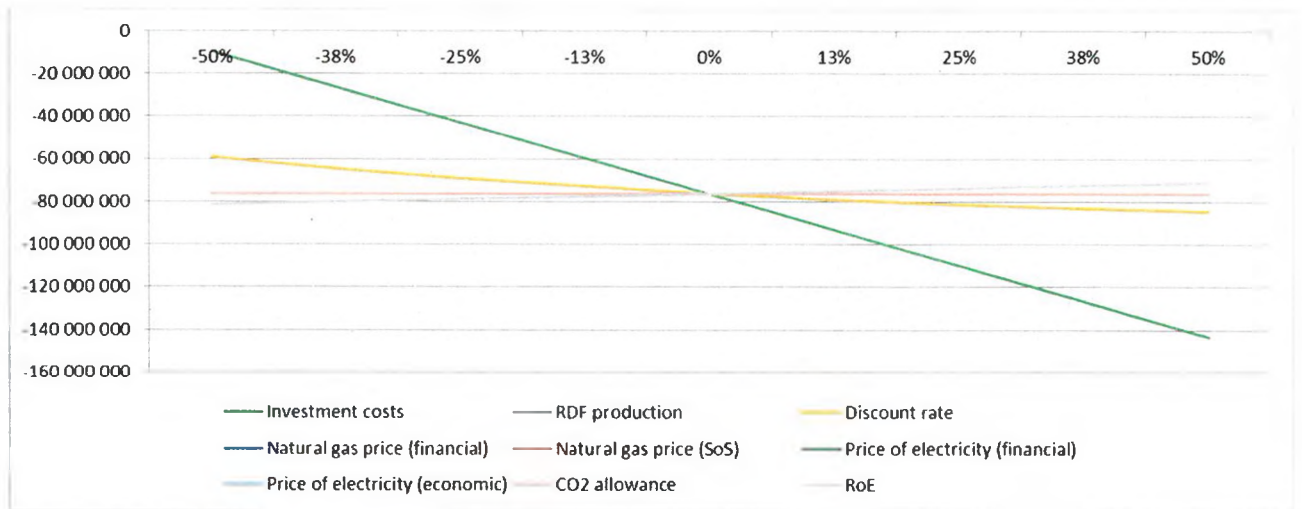


Figure 5. Results of sensitivity analysis on FNPV/K

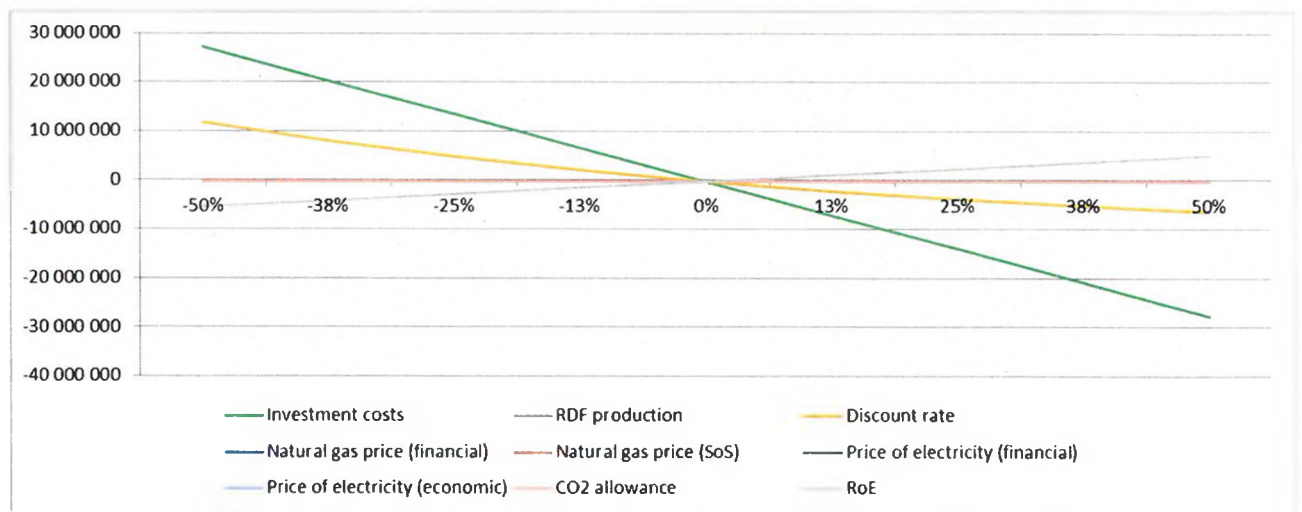
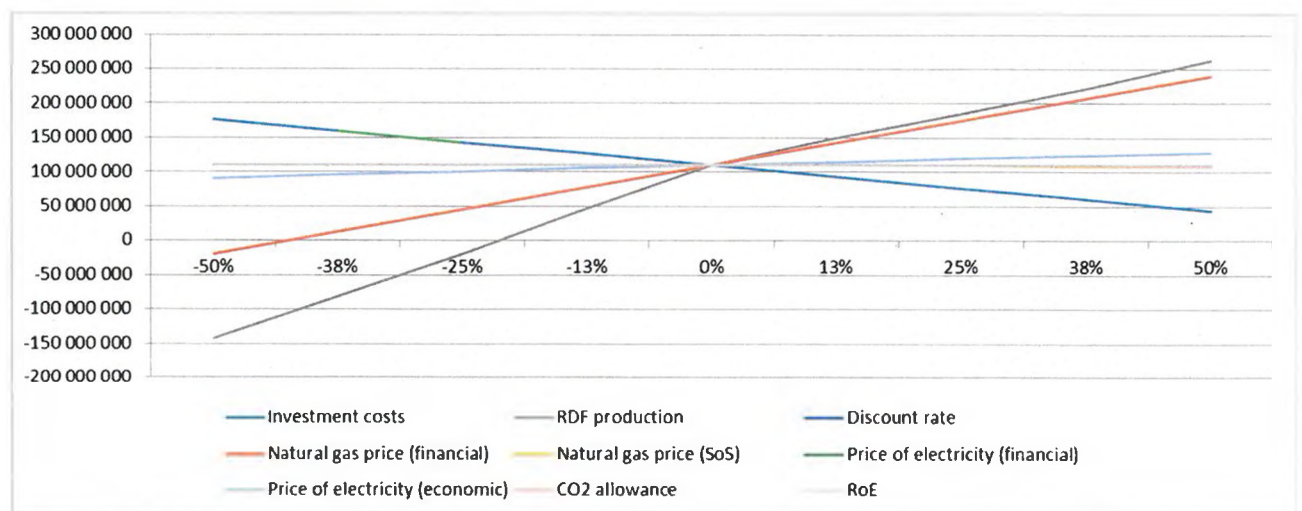


Figure 6. Results of sensitivity analysis on ENPV



7.5 Probability distribution for critical variables

A simplified risk analysis using Monte Carlo simulation was performed. The risk analysis used a simplified JASPERS approach¹⁶ to examine the following critical variables:

- Investment costs;
- O&M costs;
- Revenue (for FNPV/K);
- Benefits (for ENPV).

Because all variables apart from investment costs are aggregated, not all variables were analysed in the sensitivity analysis.

The simplified JASPERS risk analysis assumes that all critical variables have triangular probability distributions. These assumptions are presented in the following table.

Table 53 Assumptions for triangular probability distributions

	Investment	O&M	Revenue	Benefits
Minimum	70%	70%	70%	70%
Most Likely (Mode)	100%	100%	100%	100%
Maximum	130%	130%	130%	130%

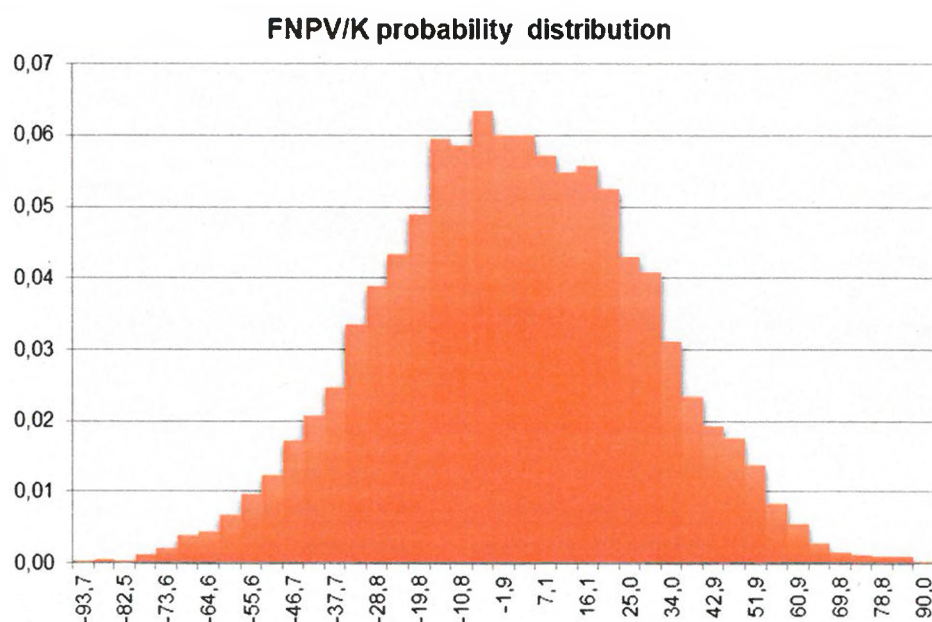
7.6 Results of risk analysis on FNPV/K

The table and figures below present the results of the Monte Carlo simulation (1000 iterations) on FNPV/K. The expected FNPV/K is €-0.2 million and standard deviation is € 27.76 million, whilst the probability that the FNPV/K is greater than 0 is 49.7%.

Table 54 Results of Monte Carlo Simulation – FNPV/K

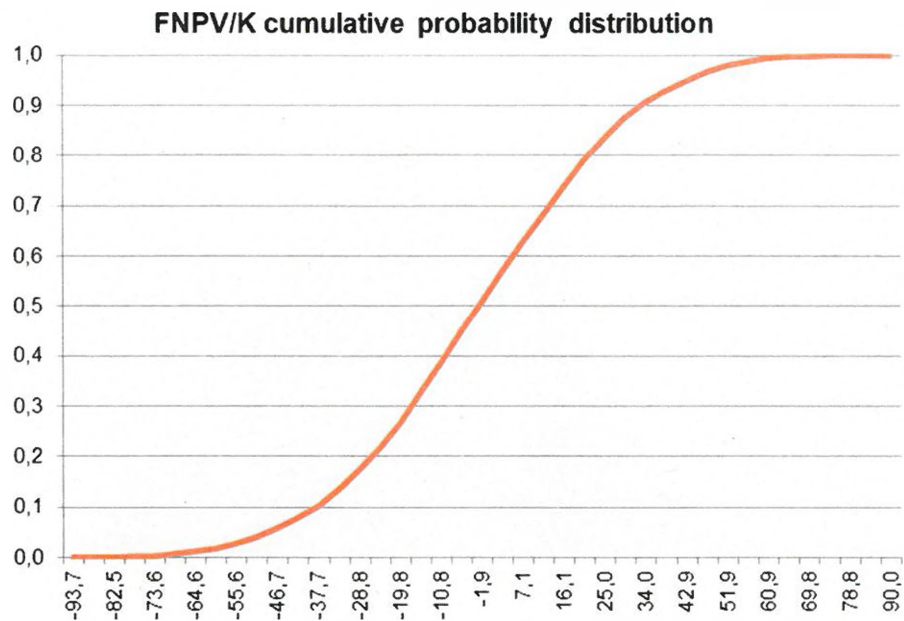
Results of Monte Carlo Simulation – FNPV/K					
Mean (Expected FNPV)	€ million	-0.20	Minimum	€ million	-93.74
Median	€ million	-0.28	Maximum	€ million	90.00
Standard Deviation	€ million	27.76	Prob. {FNPV/K>0}	%	49.7%

Figure 7. Results of FNPV/K probability distribution



¹⁶ <http://www.jaspersnetwork.org/plugins/servlet/documentRepository/displayDocumentDetails?documentId=223>

Figure 8. FNPV/K cumulative probability distribution



7.7 Results of risk analysis on ENPV

The table and figures below present the results of the Monte Carlo simulation (1000 iterations) on ENPV. The expected ENPV is €109.74 million and standard deviation is € 49.80 million while probability that ENPV is greater than 0 is 99.1%.

Table 55 Results of Monte Carlo Simulation – ENPV

Results of Monte Carlo Simulation – ENPV					
Mean (Expected ENPV)	€ million	109.74	Minimum	€ million	-51.45
Median	€ million	109.27	Maximum	€ million	273.30
Standard Deviation	€ million	49.80	Prob. {ENPV>0}	%	99.1%

Figure 9. Results of ENPV probability distribution

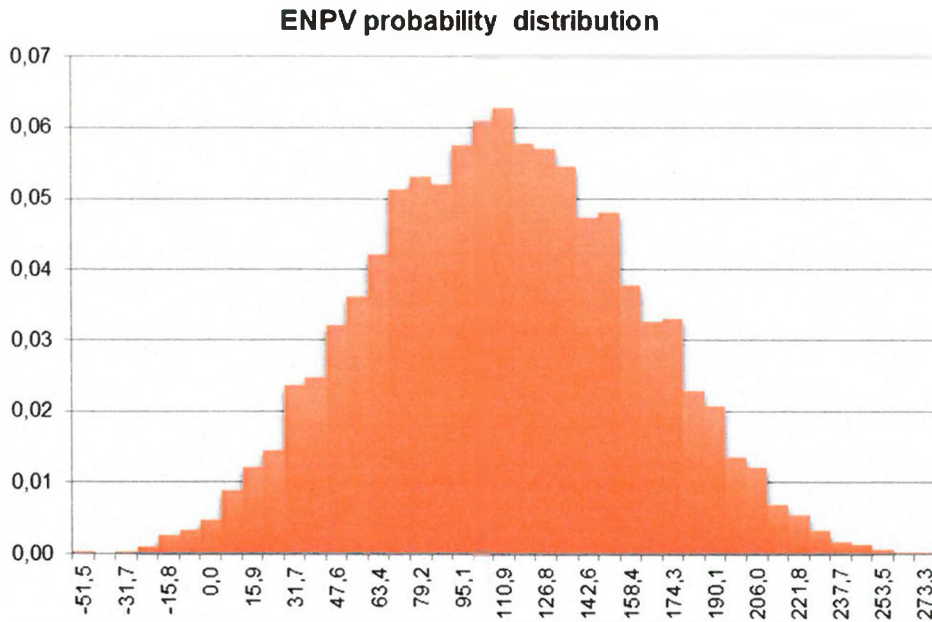
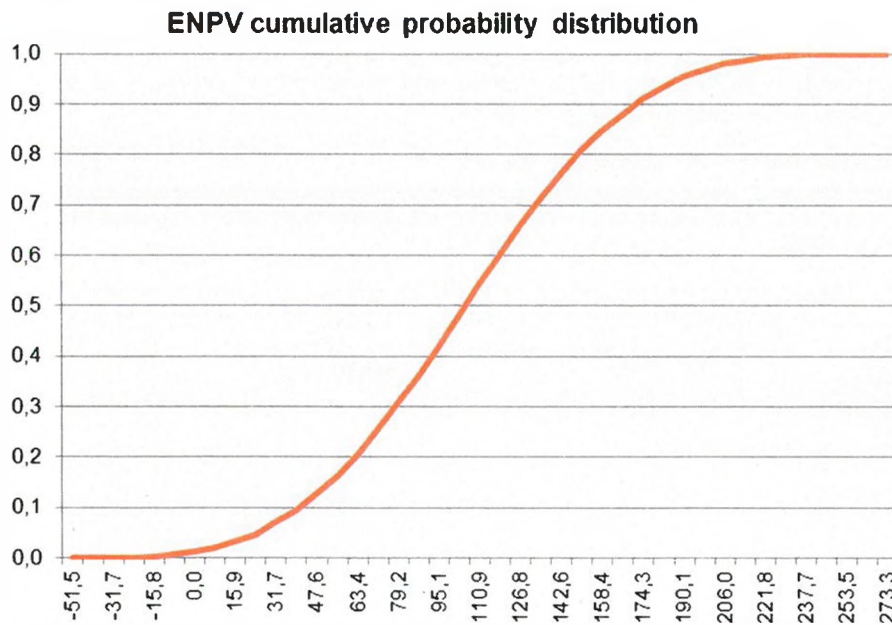


Figure 10. ENPV cumulative probability distribution



7.8 Qualitative risks

The qualitative analysis of risks is provided by the Feasibility Study and especially by a Table 13-5 Risk matrix on Waste Management and Energy.

APPENDIX 1
DEBT REPAYMENT TO BULGARIAN ENERGY HOLDING

AGREEMENT
БЕХ №71-2015

Today, 11.12.2015 in Sofia:

1. "Bulgarian Energy Holding" EAD (JSC) entered in the Commercial Register with UIC 831373560, with headquarters and management address: town of Sofia, Oborishte region, 16 "Veslets" street, represented by Zhaklen Joseph Cohen - Executive Director, hereinafter called "Creditor" on the one hand, and

2. "Toplofikatsia Sofia" EAD (JSC) entered in the Commercial Register with UIC 831609046,, with headquarters and management address: town Sofia, Krasno Selo region, 23B "Yastrebits" street, represented by Georgi Hristov Belovski - Executive Director, hereinafter referred to as "Debtor" on the other hand,

collectively called the "Parties" for the purposes of the present Agreement,

WHERE:

1. The Debtor has concluded with "Bulgargaz" EAD, UIC 175203485 (hereinafter "Bulgargaz") Contract №1/29.12.1998 for the supply of natural gas (hereinafter "Contract for gas supply from 1998"). According to the Contract for gas supply from 1998 Bulgargaz has undertaken to supply the Debtor with natural gas in minimal quantities and with quality and pressure as stipulated in Appendix I and Appendix II to the same contract and the Debtor has undertaken to pay the price of the delivered natural gas;

2. On 25.11.2002 Bulgargaz and the Debtor have concluded an Additional agreement to the Contract for gas supply from 1998 in which they settled their relations with regard to arrears owed by the Debtor for supplied natural gas, amounting to a total of 120 451 690.05 (one hundred and twenty million four hundred and fifty one thousand six hundred and ninety levs and five stotinkas) as of 31.08.2002. On 21.09.2007 Bulgargaz and the Debtor have signed a new Agreement to the Contract for gas supply from 1998, with which the Debtor has acknowledged that there are valid executable debts to Bulgargaz for delivered, but unpaid natural gas amounting to a total of 150 760 905.66 BGN (one hundred and fifty million seven hundred and sixty thousand nine hundred and five levs and sixty-six stotinkas). The Debtor was to repay the indicated debts to Bulgargaz within a period of 6 (six) years under a repayment schedule - Appendix №1 to the Agreement from 21.09.2007;

3. On 17.03.2009 Bulgargaz (assignor) and the Creditor (assignee) concluded Contract for cession № БГ86/БЕХ43, under which Bulgargaz transferred to the Creditor his claims against the Debtor for delivered but unpaid natural gas under Contract for gas supply from 1998, with a total value as of 30.11.2008 amounting to 214 962 759 BGN (two hundred and fourteen million nine hundred and sixty-two thousand seven hundred fifty-nine lev). The ceded receivables include:

- current receivables under the Contract for natural gas supply from 1998, with book value as of 30.11.2008 amounting to 95 862 759 BGN (ninety-five million eight hundred and sixty-two thousand seven hundred fifty-nine lev), including principal and interest for default. The receivables are formed by the deliveries of natural gas from Bulgargaz to the Debtor under Contract for gas supply from 1998 for the period from July 2008 until November 2008 inclusive; and
- outstanding deferred receivables of Bulgargaz against the Debtor under the concluded between them Agreement from 21.09.2007 amounting to 119 100 000 BGN (one hundred and nineteen million and one hundred thousand levs) as of 30.11.2008.

The receivables are transferred with all the privileges, securities and other accessory rights including the due contractual and moratory interest, as well as with the security, established in favour of Bulgargaz by Contract for pledging a claim on receivables from 15.02.2008, entered in the Central Register of special pledges on 06.08.2008. The Debtor has been duly informed of the

cession in accordance with Art. 99, para. 3 of the Law on Obligations and Contracts (hereinafter "LOC");

4. On 26.03.2010 the Creditor and the Debtor have signed Agreement №149/26.03.2010 (hereinafter "The 2010 Agreement"), by which the Debtor has expressly acknowledged that there are valid outstanding debts to the Creditor under Contract for cession №БГ86/БЕХ43, totalling 223 155 417.09 BGN (two hundred and twenty three million one hundred and fifty-five thousand four hundred and seventeen levs and nine stotinkas) as of 31.12.2009, distributed as follows:

- Obligation under Art. 1, item 1 of the 2010 Agreement amounting to 213 966 375.92 BGN (two hundred and thirteen million nine hundred and sixty-six thousand three hundred seventy-five levs and ninety-two stotinkas); and
- Obligation under Art. 1, item 2 of the 2010 Agreement amounting to 9 189 041.17 BGN (nine million one hundred and eighty-nine thousand and forty one lev and seventeen stotinkas).

According to Art. 3, item 4 of the 2010 Agreement, the principal is payable by the Debtor within a period of 6 (six) years from 01.07.2011 and the payments to the Creditors are to be made by instalments with payment periods and size according to the Repayment schedule - Appendix №1, forming an integral part of the 2010 Agreement;

5. On 28.12.2012 Bulgargaz and the Debtor have entered into a new Contract for the supply of gas №1-2013 (referred to as "Contract for gas supply from 2012"), under which Bulgargaz has undertaken to supply natural gas to the Debtor against which the Debtor has undertaken to pay the price of delivered natural gas. For the purposes of the present Agreement the referred to in this item 5 and in item 1 above two contracts for gas supply between Bulgargaz and the Debtor will be designated together as "Contracts for gas supply";

6. On 02.09.2013 Bulgargaz and the Creditor have entered into a second Contract for cession №62-2013/02.09.2013, under which Bulgargaz has transferred to the Creditor, against payment, receivables from the Debtor arising from the delivered but unpaid natural gas under the Contract for gas supply from 1998, with total amount of 129 123 396.58 BGN (one hundred twenty-nine million one hundred and twenty-three thousand three hundred ninety-six levs and fifty-eight stotinkas), including principal in the amount of 126 020 254 BGN (one hundred twenty six million twenty thousand two hundred fifty-four levs) and interest amounting to 3 103 142.58 BGN (three million one hundred and three thousand one hundred and forty two levs and fifty-eight stotinkas) as of 08.07.2013. The Debtor has been duly informed of the cession in accordance with Art. 99, para. 3 of the LOC;

7. On 29.11.2013 Bulgargaz and the Creditor have entered into a third Contract for cession №-84 2013/29.11.2013, under which Bulgargaz has transferred to the Creditor, against payment, receivables from the Debtor arising from delivered but unpaid natural gas under the Contract for gas supply from 1998, with total amount of 57 439 838.56 BGN (fifty seven million four hundred and thirty-nine thousand eight hundred and thirty eight levs and fifty-six stotinkas), including principal in the amount of 55 418 747.32 BGN (fifty five million four hundred and eighteen thousand seven hundred forty-seven levs) and interest amounting to 2 021 091.24 BGN (two million twenty one thousand ninety one levs and twenty-four stotinkas) as of 19.11.2013. The Debtor has been duly informed of the cession in accordance with Art. 99, para. 3 of the LOC;

8. On 26.03.2014 Bulgargaz and the Creditor have entered into a fourth Contract for cession № БГ432-2014/32-2014-BEX, under which Bulgargaz has transferred to the Creditor, against payment, receivables from the Debtor arising from delivered but unpaid natural gas under the Contract for gas supply from 2012, with total amount of 128 505 520.10 BGN (one hundred and twenty eight million five hundred and five thousand five hundred and twenty levs and ten stotinkas), including principal in the amount of 55 418 747.32 BGN (fifty five million four hundred and eighteen thousand seven hundred forty-seven levs) and interest amounting to 601

142.40 BGN (six hundred and one thousand one hundred and forty-two levs and forty stotinkas) as of 17.02.9.11.2014. The Debtor has been duly informed of the cession in accordance with Art. 99, para. 3 of the LOC;

9. On 22.04.2015 Bulgargaz and the Creditor have concluded an Additional Agreement to Contract for cession №БГ432-2014/32-2014-БЕХ, in which they have agreed that by the Contract for Cession №БГ432-2014/32-2014-БЕХ, Bulgargaz has transferred against payment to the Creditor only receivables from the Debtor under invoice №0000161838 of 04.02.2014, with a total nominal value as of 17.02.2014, as follows: principal amounting to 42 260 400.00 BGN (forty two million two hundred and sixty thousand and four hundred levs) and contractual interest amounting to 117 859.56 BGN (one hundred and seventeen thousand eight hundred fifty-nine levs and fifty-six stotinkas);

10. On 22.04.2015 Bulgargaz and the Creditor have entered into a fifth Cession contract № БЕ 501/БЕХ-30-2015, under which Bulgargaz has transferred to the Creditor, against payment, receivables from the Debtor arising from delivered but unpaid natural gas under the Contract for gas supply from 2012, with a total nominal value as of 17.03.2015, inclusive, of 83 160 133.74 BGN (eighty-three million stand and sixty thousand one hundred thirty-three levs and seventy-four s), including principal of 34 505 277.53 BGN (thirty-four million five hundred and five thousand two hundred seventy-seven levs and fifty-three stotinkas) under issued by "Bulgargaz" EAD invoice №0000168403 from 04.03.2015, principal amounting to 35 853 466.36 BGN (thirty-five million eight hundred and fifty-three thousand four hundred sixty-six levs and thirty-six stotinkas) under issued by "Bulgargaz" EAD invoice №0000167235 of 10.12.2014 and part of principal amounting to 12 801 389.85 BGN (twelve million eight hundred and one thousand three hundred eighty-nine levs and eighty-five stotinkas) under issued by ' Bulgargaz" EAD invoice №0000166877 from 02.12.2014. The Debtor has been duly informed of the cession in accordance with Art. 99, para. 3 of the LOC'

11. For the purposes of the present Agreement the referred to in this item 3, item 6, item 7, item 8 and item 10, five cession contracts between Bulgargaz and creditors will be designated together as "The Cession contracts";

12. As of the date of signing of the present Agreement, the Debtor has executed the following payments and deductions to the Creditor:

12.1. Under The 2010 Agreement and Cession Contract №БЕ 86/БЕХ 43:

- On 31.03.2010 an amount of 1 000 000 (one million) BGN paid into the bank account of the Creditor;
- On 04.03.2014 an amount of 100 000 (one hundred thousand) BGN paid into the bank account of the Creditor;
- On 29.01.2015, an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by seventh instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 27.02.2015, an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by eighth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 31.03.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by ninth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 18.05.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by tenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 19.05.2015, an amount of 382 662.35 BGN (three hundred and eighty-two thousand six hundred sixty-two lev and thirty-five cents), representing credit interest and late payment interest on the tenth instalment of The 2010 Agreement is paid into the bank account of the Creditor;
- On 29.05.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by eleventh instalment of The 2010 Agreement, is paid into the bank account of the creditor;

- On 30.06.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by twelfth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 06.07.2015 an amount of 367 134.12 BGN (three hundred and sixty-seven thousand one hundred thirty-four Levs and twelve cents), representing credit interest and late payment interest on the twelfth instalment of the Agreement;
- On 31.07.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by thirteenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 31.07.2015 an amount of 366 921.15 BGN (three hundred and sixty-six thousand nine hundred twenty-one lev and fifteen cents), representing credit interest and late payment interest on the thirteenth instalment of the 2010 Agreement, was paid into a bank account of the creditor;
- On 31.08.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by fourteenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 31.08.2015 an amount of 366 537.30 BGN (three hundred and sixty-six thousand five hundred thirty-seven levs and thirty stotinkas), representing credit interest and late payment interest on the fourteenth instalment of the 2010 Agreement, was paid into a bank account of the creditor;
- On 30.09.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by fifteenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 30.09.2015 an amount of 366 274.79 BGN (three hundred and sixty-six thousand two hundred and seventy-four levs and seventy nine stotinkas), representing credit interest and late payment interest on the thirteenth instalment of the 2010 Agreement, was paid into a bank account of the creditor;
- On 30.10.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by sixteenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 30.10.2015, an amount of 365 784.50 BGN (three hundred and sixty-five thousand seven hundred eighty-four levs and fifty stotinkas), representing credit interest and late payment interest on the sixteenth instalment of the 2010 Agreement, was paid into a bank account of the creditor;
- On 30.11.2015 an amount of 2 971 750 BGN (two million nine hundred and seventy-one thousand seven hundred fifty levs) representing principal by seventeenth instalment of The 2010 Agreement, is paid into the bank account of the creditor;
- On 30.11.2015, the amount of 366 149.37 BGN (three hundred and sixty-six thousand one hundred and forty nine levs and thirty-seven stotinkas), representing credit interest and late payment interest on the seventeenth instalment of the 2010 Agreement is paid the bank account of the creditor;
- On 02.12.2015, an amount of 366 863.37 BGN (three hundred and sixty-six thousand eight hundred sixty-three levs and thirty-seven stotinkas), representing credit interest and late payment interest on the eleventh instalment of The 2010 Agreement is paid into the bank account of the Creditor;
- By Protocols from 2011 and 2012, a statement for deduction reg. №П-7052/01-1709 from 30.11.2015 and statement for deduction reg. №П-7132/02-0690 from 03.11.2015 are deducted and repaid interest liabilities of the Debtor under The 2010 Agreement against liabilities of the Creditor for consumed heat energy totalling 87 322.35 BGN (eighty-seven thousand three hundred twenty-two levs and thirty-five stotinkas).

12.2. Under Cession contract № 62-2013/02.09.2013:

- On 02.10.2015, an amount of 703 465.18 BGN (seven hundred and three thousand four hundred and sixty-five levs and eighteen stotinkas), representing principal under invoice № 152424 from 04.10.2012, ceded by Cession contract № 62-2013 / 02.09.2013, is paid into the bank account of the Creditor; and
- On 02.10.2015, an amount of 71 701.94 BGN (seventy-one thousand seven hundred and one levs and ninety-four stotinkas), representing interest under invoice № 152424

from 04.10.2012, ceded by Cession contract №62-2013/02.09.2013, is paid into the bank account of the Creditor.

12.3. Under Cession contract №84-2013/29.11.2013

- On 17.03.2014 an amount of 10 000 (ten thousand) BGN paid into the bank account of the Creditor;

12.4. Under Cession contract № БГ432-2014/32-2014-БЕХ:

- On 28.03.2014 an amount of 10 000 (ten thousand) BGN paid into the bank account of the Creditor; and
- On 09.04.2014 an amount of 11 000 (eleven thousand) BGN paid into the bank account of the Creditor;

12.5. Under Cession contract № БГ 501/БЕХ-30-2015:

- No payments are made.

13. At present the Debtor has fallen into arrears on the implementation of his due monetary obligations to Creditor, arising from the Contracts for gas supply, the 2010 Agreement and the Cession contracts described in the Preamble of the present Agreement;

14. The parties entered into the present Agreement with the intention to settle their existing relations concerning the monetary obligations of the Debtor to the Creditor listed in the Preamble of the present Agreement, by mutually acceptable manner and according to the interests of both Parties and following a received authorization from the Minister of Energy in his capacity of exercising the rights of the state as the sole owner of "Bulgarian Energy Holding" EAD according to Protocol №Е-РД-21-51/17.09.2015 and by the Sofia Municipal Council in accordance with Decision №33 from 03.12.2015

THE PARTIES HAVE AGREED AS FOLLOWS:

Article 1. The Debtor acknowledges, fully and unconditionally, by grounds and in size, the following part of the Obligations to the Creditor, arising from the Contracts for gas supply, the 2010 Agreement and the Cession contracts described in the Preamble of the present Agreement, amounting to 500 464 796.20 BGN (five hundred million four hundred and sixty-four thousand seven hundred ninety-six levs and ten stotinkas) as of the date of signature of the present Agreement. The indicated obligations include:

- (1) Obligations under the 2010 Agreement and Cession Contract №БГ 86/БЕХ 43:
 - Obligation under Art. 1, item 1 of the 2010 Agreement - 147 994 559.95 BGN
 - Obligation under Art. 1, item 2 of the 2010 Agreement - 10 092 654.33 BGN
- (2) Obligations under Cession contract № 62-2013/02.09.2013:
 - Principal amount - 125 316 788.82 BGN
 - Interest - 15,490 242.18 BGN
- (3) Obligations under Cession contract № 84-2013/29.11.2013:
 - Principal amount - 55 408 747.32 BGN
 - Interest - 6 671 925.63 BGN
- (4) Obligations under Cession contract №БГ432-2014/32-2014-БГХ:
 - Principal amount - 42 239 400.00 BGN
 - Interest - 7 891 934.36 BGN
- (5) Obligations under Cession contract №БГ 501/БГХ-30-2015:
 - Principal amount - 83 160 133.74 BGN
 - Interest - 6 198 409.87 BGN

Article 2. (1) The parties agree that the liabilities amounting to 52 310 620.58 BGN (fifty-two million three hundred and ten thousand six hundred and twenty levs and fifty-eight stotinkas), representing the difference between the recognized by the Debtor under Art. 1, para. 1 of this Agreement obligation and the full amount claimed by the Creditor under the 2010 Agreement and Cession contract №БГ 86/БЕХ 43:, are controversial and will be subject to further agreement between the Parties.

(2) The parties agree and that with conclusion of the present Agreement the Debtor does not recognize in any way, the indicated above in paragraph 1 liabilities amounting to 52 310 620.58 BGN (fifty-two million three hundred and ten thousand six hundred and twenty levs and fifty-eight stotinkas), including the claimed by the Creditor under commercial case №1201/2015 docket of Sofia City Court /SCC/, Commercial division, VI-7 panel, receivables amounting to 3 338 522.17 BGN (three million three hundred and thirty-eight thousand five hundred twenty-two levs and seventeen stotinkas), of which 2 972 125.92 BGN (two million nine hundred seventy-two thousand one hundred twenty-five levs and ninety-two stotinkas) principal and 366 396.25 BGN (three hundred and sixty-six thousand three hundred ninety-six levs and twenty-five stotinkas) interest for late payment. The described liabilities are controversial and remain such until the eventual conclusion of a subsequent agreement between the Parties or the enacting of an effective judicial act by the competent state court.

Article 3 (1) The parties expressly agree pursuant to Art. 107 of the LOC to renew (novate) Obligations, totalling in the amount of 500 464 796.20 BGN (five hundred million four hundred and sixty-four thousand seven hundred ninety-six levs and ten stotinkas) on the date of signature of this Agreement.

(2) The Parties agree to replace the Obligations set out in par. 1 of the present article 3, with a new debt arising under this Agreement and payable under the new terms and conditions, covered by this Agreement.

(3) The Parties agree that the new debt of the Debtor to the Creditor under the present Article 3 is 500 464 796.20 BGN (five hundred million four hundred and sixty-four thousand lev seven hundred ninety-six levs and ten stotinkas) (called hereinafter "Principal") and will be paid by the Debtor to the Creditor within a period of 20 (twenty) years in monthly instalments, according to the terms and conditions set out in Appendix №1 - Repayment schedule, which forms an integral part of this Agreement. In Appendix №1 - Repayment schedule forming an integral part of this Agreement shall be referred the bank accounts in which the Debtor is obligated to make payments to the Creditor under this Agreement and as payment date shall be deemed the date of crediting the designated bank account of the Creditor with the due amount.

(4) The Parties agree that the Debtor shall not be due to execute principal instalments under Appendix №1 - Repayment schedule as of the present Agreement during the first 5 (five) years from the date of entry into force of the present Agreement (hereinafter "Grace Period"). For the avoidance of doubt, the Parties agree that the Debtor owes the Creditor payment of the interest under art. 4 below during the Grace period under the terms and conditions of Appendix №1 - Repayment schedule as of the present Agreement.

Article 4. (1) The parties agree that the Debtor owes the Creditor interest on the principal amounting to 3.25% (three point twenty five percent), determined on the basis of 360 days from the date of entry into force until the final repayment of the Principal. The interest will be payable on the remaining outstanding principal amount determined in accordance with Appendix №1 - Repayment schedule, which forms an integral part of this Agreement.

(2) The interest rate stipulated in par. 1 of this Article 4 shall be paid by the Debtor to the Creditor every month until the last day of the month for which it is due.

Article 5. (1) In the case of non-payment of one of the instalments in accordance with Appendix №1 - Repayment schedule to this Agreement, the Debtor owes the Creditor late payment interest on the unpaid portion of the overdue payment for each day of delay amounting to the base interest rate, set by the Bulgarian National Bank plus a surcharge of 10 (ten) points calculated on the basis of 360 days from the date following the due date of the respective instalment in accordance with Appendix №1 - Repayment schedule to this Agreement until the date of its final payment inclusive.

(2) For the avoidance of doubt, the Parties agree that the interest rate under para. 1 of this Article 5 is due by the Debtor on the unpaid portion of the relevant obligation in addition to and independently of the interest determined by Article 4 of this Agreement.

Article 6. The debtor can repay the Creditor amounts, larger than the due instalment under Appendix №1 - Repayment schedule to this Agreement. In this case, the overpaid amounts reduce the amount of the contributions under Appendix №1 - Repayment schedule to this Agreement in the following sequence:

- If there are other instalments, which have already matured - from the contribution with the oldest occurred maturity towards the contribution with the most recent maturity;
- If there are no instalments, which have already matured - from the contribution with the soonest maturity towards the next payable instalments.

Article 7. (1) For securing the fulfilment of all obligations towards the Creditor under this Agreement, with the present the Debtor established in favour of the Creditor, from the date of entry into force of the Agreement until the final repayment of all obligations of the debtor to the creditor under this Agreement, first in line special pledge under the Law on pledges (303) on the Debtor's claims from National electric company EAD, UIC 000649348, totalling 40 000 000 (forty million) BGN, with all due on these obligations interest (hereinafter "Special pledge").

(2) Additional collateral will be agreed under the terms of Article 9, item 3.

(3) The Debtor shall, within 10 (ten) business days from the date of entry into force of this Agreement, register the duly established Special pledge in the Central Register of Special pledges (CRSP) in favour of the Creditor.

(4) The debtor shall, within 2 (two) business days from the date of entry of the pledge in the CRSP under para. 2 of the present article 7, notify National Electricity Company EAD, UIC 000649348, in his capacity of debtor under the liabilities - subject of the Special pledge for the established Special pledge in accordance with Art. 17 from the Special Pledges Act /SPA/. The parties expressly agree that the notification of "National Electric Company" EAD. UIC 000649348 may also be performed by the Creditor, who is considered as authorized to do so under this Agreement and the applicable legislation.

(5) The debtor is obliged to properly and on time renew the pledge entered in the CRSP under this article 7 until the final repayment of all obligations of the Debtor to the Creditor under this Agreement.

(6) The parties agree that all the costs for the establishment, registration and renewal of pledge under this article 7 are borne by the Debtor.

(7) The debtor may not, without the prior express written consent of the Creditor, pledge in favour of third parties the pledged under this article 7 receivables until the final repayment of all obligations of the Debtor to the Creditor under this Agreement.

(8) If the Debtor does not perform its obligations under this Agreement, the Creditor is entitled to be indemnified by the pledged under this Article 7 receivables to the full amount of the Debtor's obligations under this Agreement, under the terms and conditions of this Agreement and the legislation in force.

Article 8. (1) The parties agree that in case of default of the Debtor's obligation to pay all or part of any instalment in the period under Appendix 1 - Repayment schedule to this Agreement, where the delay of the Debtor has lasted more than 60 (sixty) days from the due date of the respective obligation, the Creditor is entitled to declare the entire principal and interest under Article 4 of this Agreement for early executable claim and to proceed to enforced collection.

(2) The Parties agree that in the event of default by the Debtor, the latter owes reimbursement of all expenses incurred by the Creditor in enforcement of his claim under this Agreement.

Article 9. (1) In the event that a concession contract is concluded between Sofia Municipality and a third party for the services of public heating in the city of Sofia (hereinafter "Concession Contract"), the Parties shall, within 15 (fifteen) business days from the date of entry into force of the Concession contract enter into a written agreement amending this Agreement by which to modify the terms and conditions for payment of the principal set out in Appendix № 1 - Repayment schedule of the present Agreement (hereinafter "Agreement for amendment"). The Parties shall agree in the Agreement for amendment at least the following minimal content:

1. New initial instalment of not less than 200 000 000 BGN (two hundred million levs) payable directly by the concessionaire under the Concession contract to the creditor as execution of the Debtor's obligations under this Agreement (hereinafter "Initial instalment"). The Parties agree that the Initial instalment will be payable to the Creditor within no more than 120 (one hundred and twenty) days from the date of entry into force of the Concession contract. For the avoidance of doubt, the Initial instalment will be deducted from the total amount of obligations under the present Agreement in accordance with Art. 6 above;

2. New repayment schedule to repay the remaining amounts owed by the Debtor to the Creditor under this Agreement for a period not longer than the duration of the Concession contract from the date of signing of the Concession contract and at an annual interest rate under this Agreement not more than 3.25% (three point twenty-five) percent according to Art. 4, para. 1 above; and

3. The Debtor's obligation to establish, register and maintain security for the fulfilment of all obligations to the Creditor under this Agreement until their final pay-off in the form of a first special pledge under SPA on the concession payment of the Debtor under the Concession contract. In the event that the agreed total amount of the concession fee for the duration of the contract is equal to or greater than the sum of 40 000 000 BGN (forty million) levs, the Parties undertake to adopt the necessary for the cancellation of the established pursuant to Art. 7 of this Agreement special pledge on receivables from the Debtor from "National Electric Company" EAD within 30 days of the signing of the Concession contract.

(2) The Debtor shall, upon signature of the present Agreement provide the Creditor with a letter of commitment from Sofia Municipality in its capacity of sole shareholder of the Debtor's capital, according to which Sofia Municipality undertakes that the conditions under par. 1 of the present article 9, including the obligation for Initial instalment will be set as prerequisites to the concessionaire in the tender procedure for the concession of heating services on the territory of Sofia, and that these conditions will be part of the Concession contract.

Article 10. The present Agreement shall be governed by the law of the Republic of Bulgaria.

Article 11. All disputes arising out of this Agreement or related to it, including disputes arising from or concerning its interpretation, invalidity, performance or termination, as well as disputes about filling gaps in the Agreement or its adaptation to newly risen circumstances shall be resolved by joint efforts of the Parties. If the Parties do not reach an agreement to resolve the dispute, it shall be referred to the competent Bulgarian court.

Article 12. The waiving of rights under this Agreement from any of the Parties shall have effect only if it is made in writing and sent to the other party pursuant to Art. 14 of the Agreement.

Article 13. All Appendixes to this Agreement and/or any of its sections and parts are considered to be an integral part.

Article 14. (1) All reports, statements or other communications submitted by any of the parties to this Agreement to the other Party shall be made in writing by registered mail with return receipt to the address of the Party indicated above.

(2) Each party has the right to change its address for receiving messages / notifications under this Agreement and shall inform the other Party in written form, regarding such change. In the case of absence of acknowledgment of receipt of notification of change of address, any

correspondence sent to the addresses indicated above in this Agreement shall be deemed to be received.

Article 15. Any amendments and/or additions to this Agreement shall have effect only if made in writing and signed by the Parties to this Agreement.

Article 16. The failure of either Party, at any time, to enforce any provision of this Agreement shall not be interpreted as or deemed as a waiver from the Party of its rights under this Agreement, nor shall it affect the validity of the Agreement or parts of it, or shall impair the right of the Party to take further action.

Article 17. If any provision of this Agreement is invalid or could not be executed, the remaining provisions of the Agreement remain in effect when this provision could be replaced by mandatory law rules of the law or when it can be assumed that this Agreement would have been concluded and without the arrangements, as reflected in that provision.

Article 18. (1) This Agreement is prepared in two copies, which will be considered as the same agreement and each is considered an original.

(2) This Agreement is concluded with notarized signatures of the parties and represent a document based on which, in the case of default by the Debtor of his pecuniary obligations under this Agreement, the Creditor may request the issuance of an order for immediate enforcement and a writ of execution pursuant to Art. 418 in conjunction with Art. 417 of the Civil Code of the Republic of Bulgaria.

For "Bulgarian Energy Holding" EAD: signed, stamped with round blue seal of company
Zhaklen Cohen - Executive Director

For "Toplofikatsia-Sofia" EAD: signed, stamped with round blue seal of company
Georgi Belovski - Executive Director

On 11.12.2015 I, DIMITAR DIMITROV -Notary Public in and for the region of Sofia Regional Court, commission No. 117 of the Notary Chamber, do hereby certify the signatures placed on this document by:

Zhaklen Yosif Kohen, executive director of "Bulgarian energy holding" EAD with UIC 831373560
on one side - Creditor
with residence SOFIA
Reg. No. 1553

Notary fee: BGN

Stamp and signature of notary public: (signed and sealed)

On 11.12.2015 I, DIMITAR DIMITROV -Notary Public in and for the region of Sofia Regional Court, commission No. 117 of the Notary Chamber, do hereby certify the signatures placed on this document by:

Georgi Hristov Belovski, executive director of "Toplofikatsia Sofia" EAD with UIC 831609046 on
other side - debtor
with residence SOFIA
Reg. No. 1553

Notary fee: BGN

Stamp and signature of notary public: (signed and sealed)

Appendix 1- Repayment schedule to the Agreement between "Bulgarian Energy Holding" EAD and "Toplofikatsia-Sofia" EAD.

1. Repayment schedule during the Grace period

The parties agree that during the Grace period the Debtor is obliged to pay interest to the Creditor according to Art. 4 of the Agreement in equal monthly instalments due within the following deadlines:

APPENDIX 2
FINANCIAL AND ECONOMIC ANALYSIS CALCULATIONS

1.1. Maturity of the first monthly instalment in the amount of 1 355 425.49 BGN (one million three hundred and fifty-five thousand twenty-five leva and forty-nine stotinkas) - the last day of the calendar month in which the date of entry into force of the Agreement has occurred;

1.2. Maturity of the second and following monthly instalments in the amount of 1 355 425.49 BGN (one million three hundred and fifty-five thousand twenty-five leva and forty-nine stotinkas) each - the last day of the calendar month, following the month in which the date of entry into force of the Agreement has occurred;

2. Repayment schedule after the expiration of the Grace period

2.1. The Parties agree that following the expiry of the Grace period, the Debtor is obliged to pay the Creditor annual instalment of the principal under the Agreement amounting to 33 364 319.76 BGN payable in equal monthly instalments as follows:

2.1.1. Maturity of the first monthly payment of the Principal in the amount of 2 780 359.78 BGN (two million seven hundred eighty thousand three hundred fifty-nine leva and seventy-eight stotinkas) - the last day of the calendar month following the month in which the Grace period expired;

2.1.2. Maturity of the second and subsequent monthly instalments, each amounting to 2 780 359.98 BGN (two million seven hundred eighty thousand three hundred fifty-nine leva and ninety-eight stotinkas) - the last day of the respective month;

2.1.3. Maturity of the monthly instalments of interest under art. 4, calculated on the outstanding principal - the last day of the respective month

3. Bank accounts of "Bulgarian Energy Holding" EAD pursuant to Art. 3 (3) of the Agreement.

UNICREDIT BULBANK AD IBAN BG 96
UNCR 7630 1003 4665 19
BIC UNCRBGSF

For "Bulgarian Energy Holding" EAD: signed, stamped with round blue seal of company
Zhaklen Cohen - Executive Director

For "Toplofikatsia-Sofia" EAD: signed, stamped with round blue seal of company
Georgi Belovski - Executive Director

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2030
CO2 emissions - WITHOUT project (tons)	tons				1 283 185	1 282 187	1 281 189	1 280 191	1 279 193	1 278 195	1 278 195
CO2 emissions - WITH project (tons)	tons				1 283 185	1 169 584	1 167 185	1 164 773	1 162 347	1 159 907	1 153 902
Reduction of CO2 emissions in result of project implem	tons				0	-112 603	-114 004	-115 418	-116 846	-118 288	-124 293
Price of CO2	Euro/ton	6,35	8	9	10	11,15	12,43	13,86	15,46	17,23	29,70
Reduced payment for allowances (WITH project)	Euro, thousand	0	0	0	0	-1 256	-1 417	-1 600	-1 806	-2 039	-3 691