Management and Business Administration Doctoral School

THESIS BOOKLET

Roland Madácsi

Project finance in Hungarian electricity sector

Effect of feed-in tariff system onto GCHP small power plant investments

Ph.D thesis

Supervisor:

Dr. Miklós Virág
Professor

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Department of Enterprise Finances

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I. Research background and the rationale for theme selection

I have selected project financing as the theme of my doctoral thesis as my diploma dissertation also focused on the same subject and also because I have found employment in this field; therefore, I have frequently come across this form of finance. In addition, the media gave extensive coverage to the feed-in tariff system[1] and the situation of small GCHP power plants[2] from 2011 but no actual analysis has ever been made about these market actors. Thus I undertook to produce real research results through a practical analysis of project financing for the relevant market players and the competent regulatory authority.

In order to present the theoretical underpinnings of project financing, I first have to return to the basics of corporate finance. Therefore, after introduction in Chapter 2 I touch on the most relevant key theories – classical capital market theory, neo-institutional theory and classical-traditional descriptive theory – followed by a descriptive table summarising sources of finance (internal and external sources of finance) and the types of finance (equity and debt), which can help make sense of the different forms of financing.

Chapter 3 constitutes the backbone of the thesis in that it gives a detailed introduction to project financing. In delving into the theoretical foundations, I give a historical overview of the evolution of project financing, its generic features and fields of application. In the next step, I analyse the actors and special documents involved in project financing. Drawing a parallel with Chapter 2, I later present what forms of finance are available to an investing company. Given the special nature of project financing, I also have to discuss risk factors, pricing issues and the elements of a system of assurances applied in similar investments. The study of the theoretical background then continues with listing the specialties of project financing, a comparison with traditional corporate finance, and an introduction to the benefits and drawbacks of this form of finance. The chapter closes with a collection of the success factors of project financing, which also played a lead role in the later part of the research.

Chapter 4 presents the domestic energy market in general terms. That is necessary because in the research I looked at the extent of use of project financing in the domestic electricity market and so I considered it important to cover the characteristics of this market segment as well. In doing so, I give a historical overview of the development of the domestic energy market and look at the decision-making criteria of electricity market decisions. Before

[1] Tariff-in system was introduced in order to support renewable and other effective methods (e.g. gas-based) electricity production.
[2] GCHP small power plant: possessing lower than 50MW built-in capacity, gas-based cogeneration power plant – which produces electricity and heat power in the same time.

getting to the chapter on the research itself, I thought it important to introduce the feed-in tariff system and the features of cogeneration; for, the focus of my research was power plant investments implemented within the scope of the latter.

In Chapter 5, I present the research itself covering the hypotheses to be verified as well as the key research parameters and findings. Considering that feed-in tariff system changed in case of GCHP small power plants from 1st July 2011, my research focuses on this kind of investments.

II. Methods applied

A. Universe and sampling

My research primarily focuses on the domestic energy sector, in particular electrical power generation; therefore, the universe can be represented by all those companies which have domestic power generation capacities. Based on the databases assembled in my research, as of 1st July 2011 there were 21 large power plants[3] and 256 small power plants[4] operating in the territory of Hungary. Given that Ministerial Decree 56/2002 (29 December) GKM[5] was primarily designed to support small power plants through the feed-in tariff system and that the majority of large power plants also existed before 2002, I will focus on small power plants in my research.

The 256 small power plants can be divided into two categories: renewable energy power plants (using solar, wind, hydro, geothermal, biogas and biomass energy) and gas-fired cogeneration plants. Since Ministerial Decree 56/2002 (29 December) GKM as amended and effective as of 1st July 2011 excluded these latter small power plants from the feed-in tariff system, my research centres on GCHP plants. In order to minimise the statistical error stemming from sampling, I will seek to analyse the entire sample in my research, i.e. I will study all GCHP power plants that were still in operation on 1st July 2011.

[3] Power plant possessing more than 50 MW built-in capacity.
[4] Power plant having maximum 50 MW built-in capacity.
[5] Ministry of Economy and Transport

B. Methods of data gathering

Data collection in the research can be divided into two large stages: definition of the universe and obtaining financial and other information about it.

Since in the research I was to examine the entire universe of GCHP plants, as a first step I had to put together that list. However, no similar list is published either by MAVIR[6] or the Hungarian Energy Office; therefore in the primary data gathering phase I had to check the Hungarian Energy Office website to identify, one by one, each GCHP plant that was in possession of an operating licence on 1st July 2011. The second step was to complete the list by adding the type of technology installed in the GCHP plants; it can be grouped basically into five categories: combined cycle gas turbine; gas engine; biogas/biomass; wind energy and solar power. From the table prepared in this manner it can be seen that as of the aforesaid date 256 small power plants were in possession of operating licences, of which there were 4 combined cycle gas turbine (CCGT); 138 gas engine; 86 biogas/biomass; 22 wind; and 6 hydro power-based small power plants. Given that in the entire list 142 (4 CCGT and 138 gas engine) small power stations qualify as GCHP plants, it is this universe that is in the focus of my research.

As a next step, I had to examine the GCHP companies[7]. From the list of GCHP power plants it can be clearly seen that in many cases the same company invested in several GCHP plants – based on this list, the 142 GCHP plants were constructed by 86 different companies, i.e. they constitute the universe.

With regard to the hypotheses, I also had to collect financial statements concerning the universe. Based on existing accounting regulations, all businesses using double-entry book-keeping must publish their annual reports by depositing them with the Court of Registration to make them available to the general public at a later stage via the Electronic Reports Portal operated by the Ministry of Public Administration and Justice (KIM). With the help of this website, I have been able to collect the annual reports of GCHP companies for the business years of 2010, 2011 and 2012.

I also needed for my research the given companies' company extracts, which include the exact date of incorporation, as well as the main parameters of their bank borrowings, if any. I had access to the businesses' company extracts via KIM's free Company Information

[6] Hungarian Independent Transmission Operator Company
[7] Companies which are the investors of GCHP small power plants.

Service website and relied on the supplementary annexes to their published annual reports for accurate information about external financing.

C. Analytical methodology

Given that the analytical methodology varied by hypothesis, how the analysis was performed in practice can be described as follows, with the indication of individual hypotheses.

H1: The majority of GCHP small plants still in operation on 1st July 2011 were implemented in a project financing model, since the feed-in tariff system created more favourable conditions for the wider use of project financing in the case of these power plants before 1st July.

With this hypothesis I examined how the preconditions of project financing were put in place in the case of GCHP plants. In addition, I sought to find an answer to the question of whether GCHP plants still in operation on 1st July 2011 had actually been implemented by way of project financing. For that I needed the date of foundation of the GCHP plants and the exact date from which external financing, if any, was available for the investment.

My point of departure in verifying this hypothesis was the practice of domestic commercial banks whereby only companies with closed annual reports for at least two entire years were eligible for bank loans under corporate finance. If, therefore, less than two years passed between incorporation and the use of external financing, the given investment must have been realised within the scope of project financing.

H2: The feed-in tariff system ceasing to function as of 1st July 2011 substantially undermined the monetary position of GCHP companies.

This is perhaps the most complex hypothesis of all as in this case I looked at the trends of GCHP companies' financial performance via their monetary positions determined earlier by Virág, Hajdu and Jávor.

I analysed the members of the universe with the use of different gearing; liquidity; profitability; turnover rate; and cash-flow indicators for the years 2010, 2011 and 2012. After calculating the above indicators, I applied principal component analysis and cluster analysis to determine the monetary positions of GCHP companies. In view of the fact that I performed the analysis for three consecutive years (2010, 2011 and 2012), the study of time series data also revealed changes in the monetary position of the universe over the years.

H3: The discontinuation of the feed-in tariff system as of 1st July 2011 led to impairing GCHP companies' cash-flow generation capacity to such an extent that called even their debt servicing capability into question.

In project financing, the cash-flow generation capacity plays a key role as the EBITDA made by the business provides coverage for the debt service linked to financing. Therefore, as part of the analysis I had to determine the EBITDA values of the businesses concerned and also their debt service. In the EBITDA's case the situation was simple as I all had to do was to adjust the company's operating profit with annual depreciation. In determining the annual debt service, I could rely on the supplementary annex to the GCHP company's annual report, more specifically the cash-flow statement in it. To determine at the annual debt service I had to add up the annual principal repayment and interest payable.

After that, what I had to examine was how the EBITDA values realised by the companies related to their annual debt service. Since the feed-in tariff system was discontinued as of 1st July 2011, it made sense to look at all three relevant years. That is because while the feed-in tariff system remained unchanged in 2010 and made its effects felt for half a year in 2011, GCHP plants had to sell the electrical power generated without the feed-in tariff system in 2012.

H4: The transformation of the feed-in tariff system taking place on 1st July 2011 is not an ideal form for project financing purposes in the case of GCHP plants, which is why no single GCHP plant investment has been implemented by means of project financing since 1st of July.

Similarly to Hypothesis H1, with this hypothesis I looked at how the set of conditions for similar investments changed after 1st July 2011, taking into account the theoretical premises of project financing. In addition, this hypothesis posits that after the said date no more GCHP plant investments were implemented by means of project financing.

In the analysis I had to consult the Hungarian Energy Office website for GCHP plant operating licences issued after 1st July 2011. Afterwards, I followed the methodology defined in Hypothesis H1, i.e. compared the GCHP company foundation date with the date of the start of external financing. If less than two years passed between the two dates, the given investment had in all likelihood been implemented within the scope of project financing.

III. The results of the thesis

A. H1 hypothesis

The scrutiny of Hypothesis H1 can be divided into two parts. Firstly, I will look at what conditions were in place for relying on project financing prior to 1st July 2011 in the case GCHP plants, and then I will compare the foundation dates of GCHP companies with the dates of their bank borrowings, if any.

In view of the fact that in theoretical section I already covered the theoretical premises of project financing, I only have to present the relevant parts of that chapter in respect of GCHP plant investments.

- *Long-term provision of raw materials necessary for the project*.
  Given the nature of the technology, the primary raw material of GCHP plants is natural gas. Prior to 1st July 2011, access to natural gas and its price was officially fixed under Ministerial Decree 96/2003 of the Ministry of Economy and Transport (GKM). Pursuant to the said decree, the regionally competent gas suppliers were not only obliged to supply gas to GCHP plants but also the gas price was determined by GKM.
- *Securing markets for products and services resulting from the projects*.
  A GCHP plant generates electrical power and thermal power as basic products. Electricity also used to be subject to administered pricing and compulsory takeover provisions laid down by Ministerial Decree 56/2002 of the Ministry of Economy and Transport. Subject to this decree, locally competent universal suppliers were obliged to take over electricity produced by GCHP plants at a fixed price. This price was adjusted annually by the CPI (with a 40% weight) published by the Central Statistical Office (KSH) and by the official gas price index (with a 60% weight). In respect of the sale of thermal energy, the GCHP company had to enter into a separate contract, which was not regulated by the competent

authority, except in the case of public institutions. Other than that, hot steam generated by GCHP plants was usually purchased by the locally competent district heating company – at a price which again was determined based on a formula defined in Ministerial Decree 56/2002.

- *Elimination of risk of budget overrun and late performance.*
  The GCHP companies usually concluded contracts with the company implementing the investment on a not-to-exceed basis. As a consequence, the predetermined price was only paid after timely contractual fulfilment – which amount may have been reduced by penalty charged for late performance, if any. That way, cost overruns could be avoided in implementing GCHP plant investments.
- *Well-grounded feasibility study and financial forecasts.*
  Since, based on the above, revenues from electricity and heat sales and the gas cost, the most important cost item, related to GCHP plant investments were equally fixed regarding to the future, it was possible to make sound financial forecasts in relation to the entire term of the GCHP plant project. Bearing in mind that in addition to the gas cost there were only some other minor cost items such as operating and maintenance costs to reckon with, financial forecasts had a high degree of reliability.
- *Compliance with regulations and environmental requirements.*
  A building permit for a GCHP plant was only issued after a competent authority had verified compliance with the relevant regulatory provisions and environmental requirements. Since it was not until it was completed that the actual financing of the project had begun, the GCHP plant investment also met that precondition.

The above list shows that GCHP plant investments indeed created favourable conditions for the spread of project financing. Even so, it is possible that these investments were not realised in this form after all. That is why we must also take a look at the second part of Hypothesis H1.

In the section on data gathering I already mentioned that 142 GCHP plant investments were carried out by 86 GCHP companies, i.e. in this case I analysed 86 businesses. In the research I compared the foundation dates of GCHP companies and the dates of bank borrowings, if any, by the same companies. Of 86 GCHP companies, in the case of 51 companies the difference between these dates was less than two years, i.e. these firms were assumed to be project companies. In addition, it should be mentioned that of the 86 GCHP companies only 7 operated without any external financing.

That concluded the study of Hypothesis H1 and the hypothesis was confirmed. Based on the foregoing, prior to 1st July 2011 not only were the theoretical premises of project financing fulfilled but of 86 GCHP companies 51 were considered project companies. In other words, nearly 60% of GCHP companies relied on project financing to implement their GCHP plant investments.

B. H2 hypothesis

For examining Hypothesis H2, I had to determine GCHP companies' monetary position, for which I will apply the methodology worked out by Virág, Hajdu and Jávor.

As a first step, I had to set up a database by operationalising the 2010, 2011 and 2012 annual reports of the 86 GCHP companies. It was not until I populated the database that I had realised that the year 2012 annual reports of 6 companies in the universe were not available and so they had to be excluded from the sample. Furthermore, in studying the universe I identified 7 large enterprises that had implemented GCHP plant investments linked to their core businesses, which were other than electric power generation. Given that the inclusion of such large companies would significantly distort the average actual monetary position of GCHP companies, I decided to exclude these firms from the sample as well. As a result, the final sample contains 73 GCHP companies, on which I will test Hypothesis H2.

In the second step, I populated the database with the main items of the balance sheet and income statements for the years of 2010, 2011 and 2012. Following that, from the above data I calculated gearing; liquidity; profitability; turnover rate; and cash-flow indicators used by financial analysis literature. In determining the 13 different indicators I sought to make sure that each indicator was a ratio and that the higher value meant a more favourable financial position in each case. To this end, I used the inverse value of the original formula of the indicator in 3 cases.

Next, I examined the above indicators in respect of the years 2010, 2011 and 2012. Of the indicators, in three cases – long-term liabilities, net sales revenues and interest payable – it happened that with some GCHP companies the denominator had "0" value, whereas division by "0" cannot be interpreted. Since I did not want to narrow the sample any further, in these cases I replaced the original "0" with "1" as by doing so the actual value of the given financial indicator was only modified to a very limited degree.

Apart form the aforesaid modification, in calculating the Return on Equity[8] I was also confronted with having negative values both in the numerator and in the denominator in some cases but the result became a positive number, which would have been misleading in subsequent analysis. I solved the problem by using in these cases the worst RoE value in the given year instead of the original ratios. That way I avoided the problem of losing yet another sample item while I also observed requirements in that a GCHP company that had its own negative equity and posted negative results also stood the closest to the worst possible negative RoE value in reality.

Following that, I performed principal component analysis for 2010 with the help of the above 13 financial indicators. Since I had previously classified the financial indicators into 5 groups (gearing; liquidity; profitability; turnover rate; and cash-flow), in the analysis I sought to identify 5 factors, which was also consistent with the chosen methodology[9].

[8] Hereinafter RoE.
[9] Virág – Fiáth – Kristóf – Varsányi (2013)

The results of principal component analysis performed by the SPSS programme for the year 2010 are as follows:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,310	33,154	33,154	4,310	33,154	33,154	2,539	19,527	19,527
2	2,147	16,519	49,674	2,147	16,519	49,674	2,311	17,773	37,300
3	1,782	13,710	63,383	1,782	13,710	63,383	2,200	16,920	54,220
4	1,322	10,170	73,553	1,322	10,170	73,553	2,037	15,667	69,888
5	1,061	8,163	81,716	1,061	8,163	81,716	1,538	11,828	81,716
6	,888	6,833	88,549						
7	,561	4,318	92,867						
8	,477	3,672	96,539						
9	,240	1,846	98,385						
10	,110	,850	99,235						
11	,097	,748	99,983						
12	,002	,017	100,000						
13	9,656E-008	7,428E-007	100,000						

Extraction Method: Principal Component Analysis.

a

	Component				
	1	2	3	4	5
T1	,245	,069	,826	,025	-,171
T2	,135	,138	,920	,157	-,074
T3	,263	,516	,667	,151	-,046
L1	,836	,081	,203	-,030	-,149
L2	,798	,298	-,025	,135	,061
L3	,851	,185	,197	,085	,012
J1	-,152	-,954	-,145	,049	,092
J2	,070	-,243	-,087	,048	,811
J3	,000	,059	-,120	-,024	,873
F1	-,523	,085	-,242	,026	-,198
F2	,152	,954	,145	-,049	-,092
CF1	,055	-,028	,095	,989	,010
CF2	,054	-,031	,117	,988	,010

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

The 5 factors created on the basis of principal component analysis explain nearly 82% of the dispersion of the 13 financial indicators. From the study of the sets of indicators it can be concluded that the first principal component is of a liquidity type, the second responds sensitively to both profitability and the turnover rate, the third one is a gearing-type indicator group, the fourth one is related to cash-flow while the fifth to profitability.

Performing the same principal component analysis for 2011 yields the following results:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,835	37,196	37,196	4,835	37,196	37,196	3,590	27,616	27,616
2	2,826	21,735	58,931	2,826	21,735	58,931	2,312	17,787	45,403
3	1,300	9,996	68,927	1,300	9,996	68,927	1,819	13,994	59,397
4	1,245	9,579	78,506	1,245	9,579	78,506	1,670	12,850	72,246
5	,751	5,774	84,281	,751	5,774	84,281	1,564	12,034	84,281
6	,690	5,308	89,588						
7	,540	4,153	93,741						
8	,367	2,822	96,563						
9	,245	1,881	98,444						
10	,138	1,058	99,502						
11	,055	,422	99,924						
12	,010	,076	100,000						
13	5,277E-007	4,059E-006	100,000						

Extraction Method: Principal Component Analysis.

a

	Component				
	1	2	3	4	5
T1	,624	,464	,231	,228	-,006
T2	,691	,249	,064	,558	,070
T3	,002	,120	-,021	-,014	,924
L1	-,101	,014	,953	-,004	,005
L2	,021	-,362	,302	,167	,739
L3	-,007	-,149	,722	,414	,233
J1	,937	,230	-,180	-,026	,051
J2	,881	,049	,010	,105	-,084
J3	,348	,003	,026	,830	-,083
F1	,195	,052	-,381	-,636	-,290
F2	-,845	-,355	,232	-,030	-,022
CF1	,216	,955	-,072	,006	-,047
CF2	,371	,878	-,059	-,029	-,039

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

The above findings suggest that the 5 principal components explain nearly 84% of the dispersion of the 13 financial indicators. Taking a closer look at the 5 principal components we find that they are more difficult to identify than in the case of 2010. The first set of indicators respond sensitively to profitability and the turnover rate, the second one is a cash-flow-type group, the third one is of a liquidity type, the fourth group responds to profitability and the turnover rate to almost the same extent, and the fifth indicator group is sensitive to gearing and liquidity.

Continuing the testing of Hypothesis H2, I also carried out principal component analysis for 2012 with the results below:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,567	27,441	27,441	3,567	27,441	27,441	2,802	21,556	21,556
2	2,350	18,076	45,516	2,350	18,076	45,516	2,193	16,866	38,422
3	2,153	16,562	62,078	2,153	16,562	62,078	2,143	16,483	54,905
4	1,810	13,921	75,999	1,810	13,921	75,999	2,016	15,509	70,414
5	1,124	8,644	84,643	1,124	8,644	84,643	1,850	14,229	84,643
6	,651	5,009	89,652						
7	,446	3,432	93,084						
8	,417	3,206	96,290						
9	,311	2,389	98,678						
10	,154	1,183	99,861						
11	,017	,130	99,991						
12	,001	,006	99,997						
13	,000	,003	100,000						

Extraction Method: Principal Component Analysis.

a

	Component				
	1	2	3	4	5
T1	,347	-,067	,339	,014	,824
T2	-,014	,534	,036	,001	,771
T3	-,799	,136	-,015	,113	,404
L1	,894	-,162	,129	-,045	,267
L2	,760	,344	-,088	,018	,089
L3	,763	,300	,039	,148	,244
J1	-,079	-,004	,050	,993	,051
J2	-,030	,800	,245	,056	-,152
J3	-,017	,757	-,065	-,033	,454
F1	-,262	-,655	,052	,077	-,135
F2	-,084	,036	-,054	-,989	,036
CF1	,030	,054	,982	,051	,096
CF2	,021	,057	,981	,054	,115

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 11 iterations.

Similarly to the preceding years, the 5 principal components explain close to 85% of the dispersion of the 13 indicators. Analysing the indicator groups we can conclude that the first principal component is sensitive to gearing and liquidity, the second group responds to profitability and the turnover rate to nearly the same extent, the third principal component is of a cash-flow type, the fourth one is sensitive to profitability and the turnover rate while the fifth one is of a gearing type.

The above principal component analysis clearly reveals that in the years 2010, 2011 and 2012 differences between the 73 GCHP companies were explained by the 5 sets of indicators, whose explanatory power did, however, change from year to year. These principal components proved adequate in every year, as they explained at least 80% of the dispersion of the 13 indicators from year to year.

The next step in the scrutiny of Hypothesis H2 was to determine the monetary positions of the GCHP companies for the above three years. To this end, each GCHP company's indicator group-based value, calculated by the SPSS programme, had to be weighted by the variance value representing the importance of the given indicator group. After that, I assigned the monetary positions of the companies to 5 clusters with the use of the K-means clustering algorithm. Since the cluster analysis produced homogenous groups, the results showed the extent of similarity between the monetary positions assumed by GCHP companies. In addition, with the help of cluster analysis it was possible to find a centroid GCHP company in each year, whose monetary position most approximated the "0" value – which, at the same time, was the predicted value of the companies' monetary position. To confirm the hypothesis, I then only had to compare the 13 financial indicators of these 3 GCHP companies, since Hypothesis H2 posits that the indicators must assume decreasing values in the consecutive years.

	GCHP company	MP	T1	T2	T3	L1	L2	L3	J1	J2	J3	F1	F2	CF1	CF2
2010	Pannon-Kogen Kft.	0,00063	0,84	0,38	0,59	0,81	0,36	-0,08	0,09	0,07	0,17	2,10	0,59	5,31	5,31
2011	Perkons Kft.	0,08059	0,57	0,34	0,47	0,52	0,28	-0,26	0,03	0,01	0,03	1,24	1,56	0,52	1,11
2012	Kazinc-Therm Fűtőerőmű Kft.	0,04997	0,06	0,04	0,08	0,85	0,45	-0,08	-0,08	-0,09	-2,13	2,52	0,47	0,03	0,11

In examining the financial indicators I made an interesting conclusion, since gearing, profitability and cash-flow indicators clearly reflected the tendency outlined in the hypothesis, namely that the relevant indicators of the centroid GCHP companies would show a declining trend from year to year, i.e. assume a lower value. By contrast, liquidity and turnover rate indicators showed a mixed picture and, in addition, there were differences even within individual indicators. As a consequence, I had to dismiss Hypothesis H2, since the monetary position of GCHP companies did not deteriorate on the basis of all factors in the period 2010-2012; that statement was only correct for the gearing, profitability and cash-flow positions of those companies.

C. H3 hypothesis

In relation to Hypothesis H3, I studied the trends of GCHP companies' cash-flow generation capacity, regardless of their worsening monetary positions. For, according to the hypothesis, after the termination of the feed-in tariff system even the debt service payment capability of these companies could be questionable.

Using the procedure defined in the analytical methodology I calculated each GCHP company's EBITDA value, which is treated in financial analysis literature and applied in commercial banking practice as a relevant indicator of cash-flow generation capacity. In performing this step, all I needed to do was to adjust the operating profit realised by the GCHP company with annual depreciation. The next step was to determine the annual debt service, whereby using the cash-flow statement in the annual report's supplementary annex as a basis I took principal repayment and interest payable for the given year, as the sum of these two figures corresponds to the annual debt service. Finally, all I had left to do was to look at whether EBITDA exceeded the value of annual debt service in the individual years.

Given the fact that the feed-in tariff system for GCHP companies was discontinued as of 1st July 2011, I considered it important also to examine the years 2010, 2011 and 2012. That is because in 2010 the feed-in tariff system operated smoothly; in 2011 its impact was only felt for half a year; while in 2012 GCHP companies had to operate without it throughout the whole year. In other words, if we look at the time series for the period 2010-2012, we can gain more information about changes in the cash-flow generation capacity of these companies.

Studying the time series leads us to conclude that the EBITDA realised by 10 of the 73 GCHP companies could no longer cover the annual debt service in as early as 2010; however, that figure only represents about 14% of the entire sample. The further scrutiny of the time series reveals that in 2011 there were as many as 48 GCHP companies (or 66% of the sample) that were no longer able to cover their annual debt service, while in 2012 there were already 52 GCHP companies, or 71% of the entire sample, facing a similarly difficult situation.

The above conclusions have therefore confirmed Hypothesis H3, since the debt service capacity of GCHP company's sharply deteriorated from 2010; by 2012, as many as 71% of them could no longer generate sufficient cash-flow from their core activities to meet their actual debt service obligations.

D. H4 hypothesis

The study of Hypothesis H4 can be divided into two steps. Similarly to Hypothesis H1, as a first step, I analysed the theoretical premises of project financing, and in the second step I examined operating licences issued by the Hungarian Energy Office to GCHP plants after 1st July 2011. After that all I had to look at was how many of the GCHP plant investments, if any, implemented subsequent to 1st July 2011 relied on project financing.

Of the theoretical premises listed under Hypothesis H1, changes after 1st July 2011 affected the following ones:

- *Long-term provision of raw materials necessary for the project*.
  In consideration of the fact that the primary raw material of GCHP plants is natural gas, the provisions of the relevant Ministerial Decree 96/2003 of the Ministry of Economy and Transport are worth examining. The analysis reveals that as from 2008 gas pricing was gradually shifted to a market basis as the Government later primarily intended to subsidise households. As a consequence, the formerly used price formula was no longer applicable; instead, the price of gas used by GCHP plants was principally determined by supply and demand. This was most evident from the fact that these power plants had to reckon with ever increasing gas prices and, in addition, the gas price could no longer be fixed for a longer term, only for one year ahead at maximum.
- *Securing markets for products and services resulting from the projects*.
  The price of thermal energy produced by GCHP plants remained unchanged after 1st July 2011 as it was not regulated by an underlying decree. However, Ministerial Decree 56/2002 GKM on the electric power generated did not apply to GCHP plants as of 1st July 2011, and so electricity did not have to be taken over by the locally competent universal supplier on a compulsory basis, nor its price was subsidised any more. In an effort to subsidise the sale of electricity generated by GCHP plants, MAVIR Ltd put the GCHP companies affected in a so-called cogeneration balance group and thereby emerged on the supply side of the domestic electricity exchange. However, MAVIR Ltd’s support was only of a technical nature; the actual electricity price was formed on the electricity exchange and was considerably lower than the former feed-in tariff – e.g. on 1st July 2011 the daily average price on the electricity exchange was about 50% lower than the feed-in tariff a day before. Thus, from that moment on, neither the amount of electricity sold nor its price was possible to predict any more for the future.

- *Well-grounded feasibility study and financial forecasts.*
  1st July 2011 saw a significant change compared to the previous situation. Following amendments to the Ministerial decree 96/2003 GKM, GCHP companies could no longer base their calculations on the gas price. Furthermore, the future price of the electricity generated was also uncertain as Ministerial Decree 56/2002 GKM was no longer in effect for GCHP plants. As a consequence, what used to be simple financial forecasting now became impossible, even though experts kept assuming increasing electricity prices.

The above brief outline illustrates well how three basic theoretical premises were violated after 1st July 2011, which made project financing impossible to use any further for domestic GCHP plants. Accordingly, I have confirmed the first part of Hypothesis H4 and what I have left to do now is to examine whether after such violation of those premises there were any GCHP plant investments after 1st July 2011 – and if so, whether they relied on project financing.

After studying small power plant licences issued by the Hungarian Energy Office it can be stated that there were altogether 6 GCHP plant investments after the 1st July 2011 modification of the feed-in tariff system until 31st October 2013 inclusive. Following the earlier research methodology, I compared the foundation dates of the given GCHP companies with the dates of their starting to use external financing, if any.

Of these 6 GCHP companies, 2 firms are considered large enterprises, 2 companies are GCHP companies that had already implemented GCHP plants prior to 1st July 2011, and the remaining 2 firms are newly founded companies that did not borrow from any commercial banks. Based on this list the second part of Hypothesis H4 has also been confirmed since even though 6 GCHP plants were constructed after 1st July 2011, neither relied on project financing.

Having examined the above hypotheses we can rightly ask the question of what long-term effect such withering away of project financing can have on GCHP plants. For, in the opinion of some experts this tendency threatens to undermine domestic electricity production since, according to the available forecasts, power plants representing a total installed capacity of 4,100 MW will be decommissioned by 2025, while the resulting capacity gap should be filled. However, this latter issue is beyond the scope of this Ph.D thesis. Even so, I recommend that the conclusions from the above hypotheses should be considered by the competent regulatory authority so that they inform the drafting of new electricity legislation. Furthermore, I believe that the relationship between the project financing's loss of ground and supply security in the domestic electricity market can be a suitable avenue of research to be explored by Ph.D students having an interest in the field.

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