EUAS HYDROPOWER PLANT PRIVATIZATIONS INVESTMENT CONSULTANCY

APLUS ENERJİ

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FOREWORD

The privatization process in Turkish Electricity Market, which started with electricity distribution companies, followed by small HEPP portfolios and lignite power plants; has now reached another important step; the privatization of the second group of EUAS HEPPs. There are 16 Hydroelectric Power Plants to be privatized in total and those are being privatized in eight different groups with a total installed capacity of 842.79 MW.

When the tenders for the privatization of EUAS HEPP portfolio is completed, the total installed capacity share of private generation companies will increase from 59% to 60% while EUAS share will drop to 26.6%. However, it is obvious that a detailed technical and financial feasibility study of these power plants is necessary due to worn-out equipment, even though there is a significant gain in the investment cost of state-owned electricity generation power plants which have ready infrastructure. In addition to this, the excess supply caused by water level reaching normal levels at reservoir dams in 2015 increased the significance of evaluating the EUAS Hydroelectric Power Plants to be privatized.

In today's conditions, risk factors such as hydrology, market structure and regulations are being discussed intensively. In this frame, this explanatory document does not only describe our approach for a technical evaluation study of a HEPP, but also contains information on services which we provide on market modelling, dispatch optimization and financial modelling studies.

As APLUS Enerji, with our expertise in market forecasts, dispatch optimization and feasibility studies since 2009, we would be pleased to support you – esteemed investors – during EUAS' HEPP assets privatization process. Please note that APLUS Enerji works on an "exclusivity" basis and we have already signed exclusivity agreement for the EUAS Portfolio Groups 5, 7 and 8. For the remaining portfolio groups, we are happy to deliver our consultancy services from technical part to market and dispatch modelling.

For further details regarding the remaining portfolios that APLUS Enerji is still offering services to investors, please see the pre-evaluation study material for EUAS Portfolio Groups 1, 2, 3, 4 and 6.

Table 1. EUAS Privatization Portfolio

No	Power Plant	Installed Capacity (MW)	Type	Bid Submission Deadline	Availability of APLUS Enerji
Portfolio 1					
1	Şanlıurfa	51.8	Canal	18.02.2016	Available
Portfolio 2					
2	Tortum	26.2	Lake	29.02.2016	Available
Portfolio 3					
3	Kemer	48	Reservoir	10.03.2016	Available
3	Adıgüzel	62	Reservoir		
Portfolio 4					
4a	Kesikköprü	76	Reservoir	Awaiting Public Announcement	Available
4a	Derbent	56.4	Reservoir		
4b	Yenice	37.89	Reservoir		
Portfolio 5					
5	Almus	27	Reservoir	Awaiting Public Announcement	Exclusivity Agreement in Place
5	Köklüce	90	Reservoir		
5	Çamlıgöze	32	Reservoir		
Portfolio 6					
6	Seyhan 1	60	Reservoir	Awaiting Public Announcement	Available
6	Seyhan 2	7.5	Run-of-River		
6	Yüreğir	6	Canal		
Portfolio 7					
7	Kılavuzlu	54	Reservoir	Awaiting Public Announcement	Exclusivity Agreement in Place
7	Menzelet	124	Reservoir		
Portfolio 8					
8	Çamlıca 1	84	Run-of-River	Awaiting Public Announcement	Exclusivity Agreement in Place

ENERGY CONSULTANCY SERVICES

APLUS Enerji provides various services, from technical & financial feasibility studies to market and regulation research, to local and international investors who are active or willing to be active in electricity generation, distribution and trade sectors.

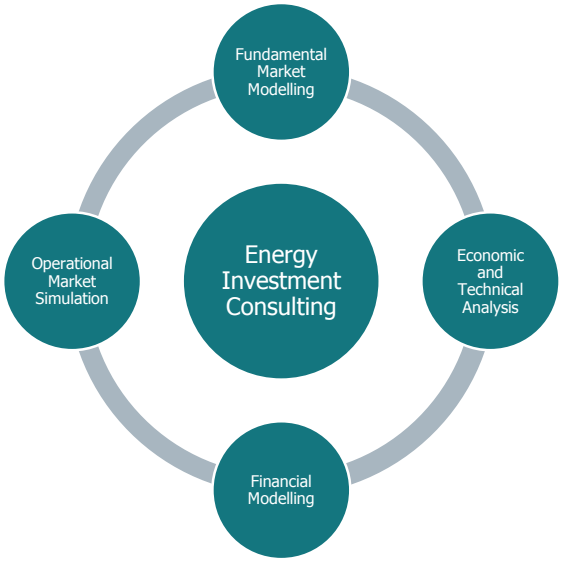


Figure 1 Energy Investment Consulting Services

APLUS Enerji executed investment consulting services for various institutions and organizations in Turkey and abroad.

Our selected services for power plant investment projects include;

- *Energy market modelling studies,*
- *Techno-economic assessment,*
- *Hydrology assessment for HEPPs,*
- *Financial feasibility consulting,*
- *Lender's engineering studies,*
- *Tender consultancy for hydroelectric and thermal power plants of EUAS.*

Fundamental Market Modelling:

AVIEW | MARKETSIM is an energy market price forecasting software developed by R&D department of APLUS Enerji. The model obtains all required assumptions and data as a result of integration with AVIEW | EMDB (Energy Market Database).

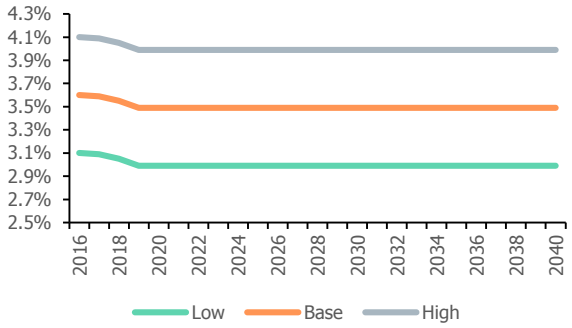


Figure 2 GDP Growth – Low, Base and High Scenarios

AVIEW | MARKETSIM generates mid- and long-term price forecasts under various scenarios and does not only provide Day-Ahead Market Price forecasts to users but also predicts fuel prices, economic growth and gross electricity demand in a given period of time.

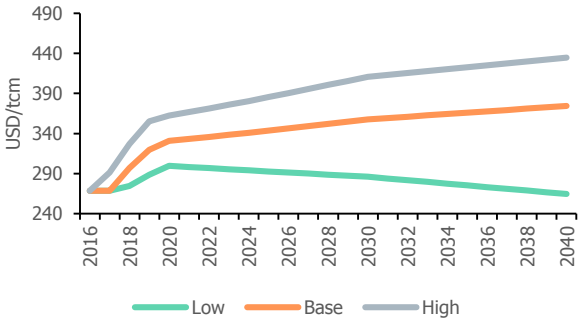


Figure 3 Natural Gas Prices – Low, Base and High Scenarios

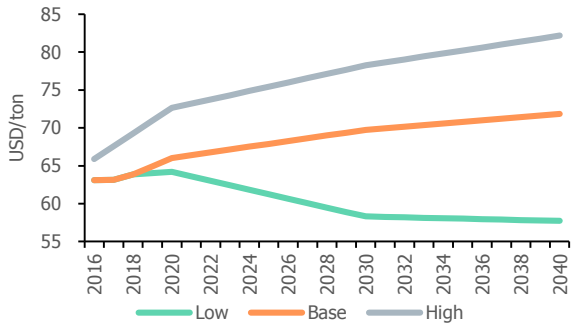


Figure 4 Imported Coal Prices – Low, Base and High Scenario

AVIEW | MARKETSIM generates "merit order curve" for each hour by using all power plant data provided by AVIEW | EMDB. Future merit order curve results of selected power plants can be examined annually, monthly and hourly basis by using the results of market model.

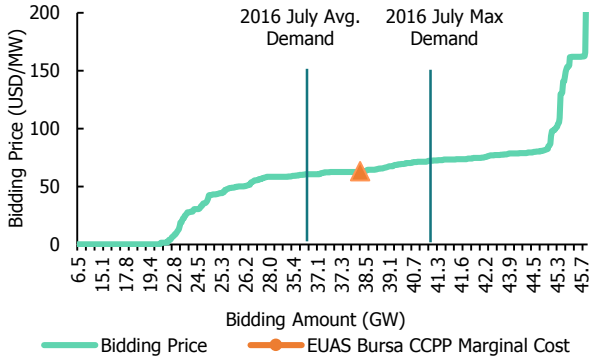


Figure 5 Merit Order Output

AVIEW | MARKETSIM enables the electricity generators, retail and wholesale companies and the investors to foresee the future development of Turkish Electricity Market.

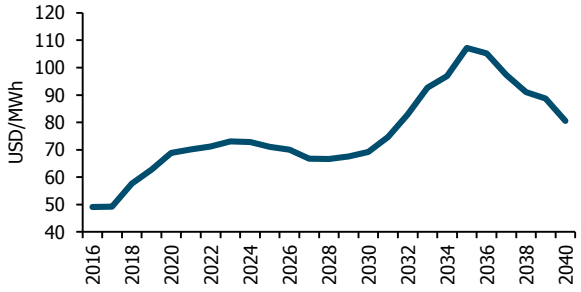
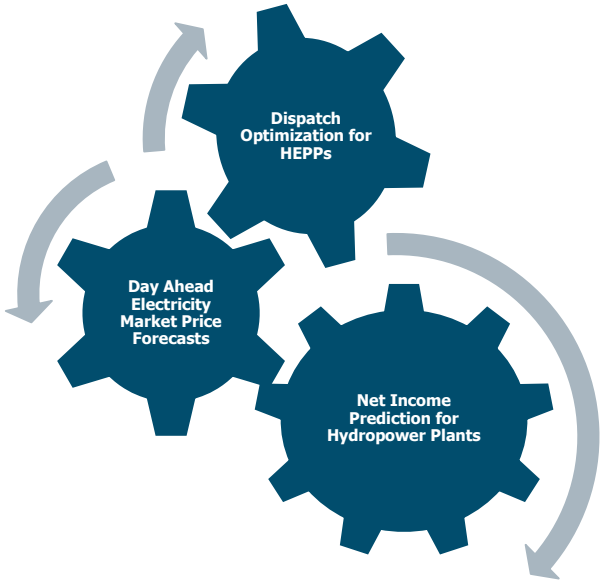


Figure 6 Average DAM Price Forecast 2016-2040

Operational Market Simulation:

By using various fuel and electricity price forecasts generated by AVIEW | MARKETSIM, power plants' potential revenues from Day-Ahead Market is calculated with the models and analyses which are developed by APLUS Enerji.



Activities of HEPPs in Day-Ahead Electricity Market is simulated by using a dispatch optimization software; AVIEW | HYDROSIM which is a product developed by R&D team of APLUS Enerji.

AVIEW | HYDROSIM is a software that provides operation regime optimizations for HEPP operations and investments. With in-house developed algorithms, various flow and precipitation data is used for the deterministic hydrology forecasts. By using these deterministic forecasts and plant constraints, operation optimizations are carried out for hydropower plants in a cascade basin.

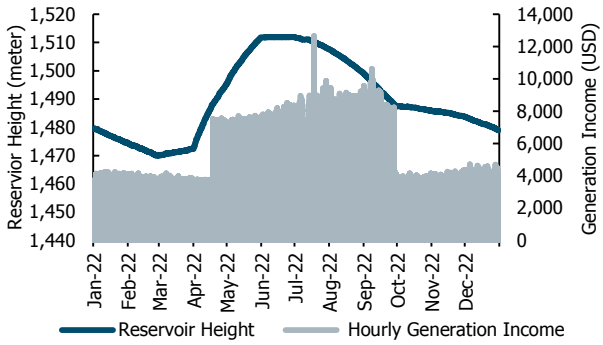


Figure 7 Reservoir Height vs. Generation Income

AVIEW | HYDROSIM supports the decision making process for water retention or generation and also ensures water usage with the highest utilization for the HEPPs in the same basin.

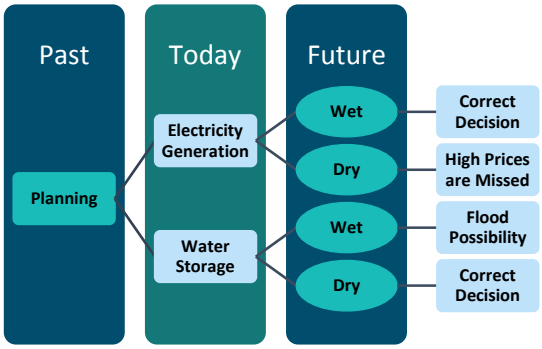


Figure 8 Algorithm of AVIEW l HydroSim

AVIEW | HYDROSIM helps investors for the establishment of financial models and provides optimum pricing strategies during the operation period and thus conducts income and expense simulations for the Day-Ahead Electricity Market.

Economic and Technical Analysis:

As APLUS Enerji, we have completed various numbers of pre-feasibility & feasibility studies as well as evaluations in techno-economic context for power plants. In these studies, various turbine brands and types, operation and maintenance costs, maintenance characteristics, and performance data have been examined.

As a result of the dispatch optimizations and techno-economic analyses, the most appropriate technology in terms of technical and economic aspects is provided to the potential investor. The result of these economic analyses are used as assumptions and inputs for the financial model.

Financial Modelling:

Financial models are formed for the evaluation of financial viability of power plant investments through financial parameters obtained by APLUS Enerji's experience and income and expenditure results of Operational Market Simulations and Economic Analysis studies.

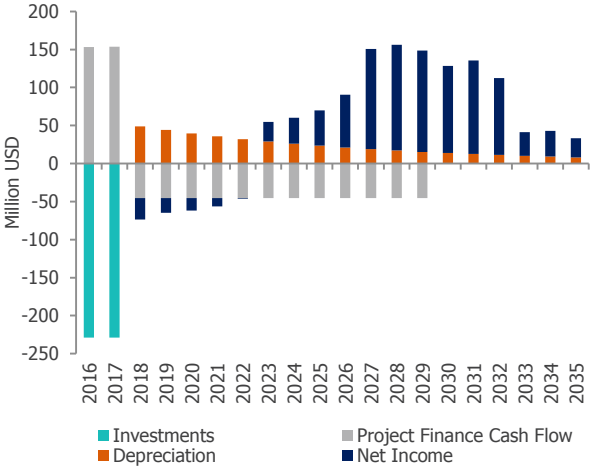


Figure 9 Detailed Equity Cash Flow Analysis

Within the financial modelling sensitivity, analyses are performed for investors in order to suggest the most accurate decision.

Financial Results	Unit	Value
Project Payback Time	Year	8
Project IRR	%	11,88
Project NPV	USD	56.028.709
Equity Payback Time	Year	11
Equity IRR	%	13,01
Equity NPV	USD	67.501.498

In sensitivity analysis studies, the impact on investment probability is examined in case of any changes in plant's income – expenditures, capital expenditure, and financial parameters. As a result of these analyses, risk matrices of investors is created in order to facilitate the decision making process of investor. In conclusion, knowledge on potential risks and the decision on the best possible investment is provided.

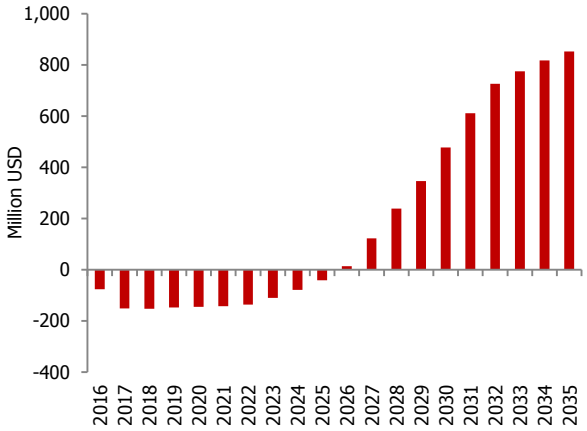


Figure 10 Equity Cash Flow Analysis

Selected References:

Project Description: Turkish Energy Market Fundamental Market Simulation Software

Country:	**Client:**
Turkey	EMRA

Project Status:

Completed

Project Aim: Development of AVIEW | MARKETSIM energy market fundamental market simulation software for Energy Market Regulatory Authority (EMRA).

Project Result: All the requirements have been fulfilled and the software has been delivered to EMRA.

Project Description: Lender's Engineering Services for Devecikonağı Dam and HEPP

Country:	**Client:**
Turkey	Commercial Bank

Project Status:

Completed

Project Aim: Monitoring of construction process of Devecikonağı Dam and HEPP in Bursa on behalf of the Lender.

Project Result: All research and inputs were submitted to the Lender via periodic progress reports.

Project Description: Technical and Economic Evaluation Reports for the Privatization of Run-of-River type Hydropower Plants owned by EUAS

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim: Technical and economical evaluation report, short- and long-term electricity price forecast, dispatch optimization, OPEX estimations, financial model and recommended tender strategy for various scenarios delivered to Client.

Project Result: Client used all inputs provided by APLUS Enerji for the evaluation of HEPPs and determination of its tender strategy.

Project Description: Technical and Economic Evaluation Reports for the Privatization of Run-of-River type Hydropower Plants owned by EUAS

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim:

Technical evaluation report, short- and long-term electricity price forecast, dispatch optimization, OPEX estimations, portfolio based financial models and recommended tender strategy including tender price for 4 portfolio groups which are formed by 10 run-of-river HEPPs delivered to Client.

Project Result: Client used all inputs provided by APLUS Enerji for the evaluation of HEPPs and determination of its tender strategy.

Project Description: Long-Term Hydrological Forecasting Model for Turkey

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim:

Establishing a long-term hydrological forecasting model for important river basins in Turkey in order to generate scenarios for monthly water volume received by large reservoir HEPPs until 2040.

Project Result: The hydrology model and its outcome were submitted to the Client.

Project Description: Market Modelling, Feasibility Study and Financial Modelling

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim: Market modelling, feasibility study report and financial modelling for a reservoir-type HEPP with an installed capacity of 100 MW. In the scope of study, AVIEW | HYDROSIM dispatch optimization tool owned by APLUS Enerji was used.

Project Result: Financing agreement is in evaluation phase by Lender.

Project Description: Market Modelling and Techno-Economic Portfolio Assessment

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim:

Within the scope of a re-financing project, technical and economic evaluation report, dispatch optimization, short- and long-term electricity price forecast, OPEX estimations, long-term income modelling for a generation portfolio consisting of hydro power and thermal power plants were submitted to Client.

Project Result: Re-financing was accepted by Lender and financing was provided to the energy company.

Project Description: EUAS Privatization Process Tender Evaluation

Country:	**Client:**
Turkey	Confidential

Project Status:

Completed

Project Aim: Technical and economical evaluation report, short- and long-term electricity price forecast, dispatch optimization, OPEX estimations, financial model and recommended tender strategy for various scenarios delivered to Client.

Project Result: As result of the study, the investor decided not to participate in the privatization tender for the selected portfolios.

Ozan Korkmaz
Founding Partner

After completing his undergraduate studies in METU Civil Engineering in 2003, Ozan Korkmaz studied for his Master's Degree concentrating on Hydropower Feasibilities in METU Civil Engineering. He has been continuing his Ph.D. degree in ITU Energy Institute concentrating on Hydropower Feasibilities. During his doctorate studies, he researched on applying Artificial Neural Networks on stochastic hydrological data and published articles.

He has been working on feasibility analysis, hydrological and meteological evaluations, forecasting models, distribution and retail tariff modelling of electricity generation projects.

Erdem Sezer
Manager, Consultancy

Erdem Sezer pursued his undergraduate education on a scholarship and graduated with honours in 2010 from Bahcesehir University with a double major in Political Science and Economics. His graduation Project was on liberalization of the Electricity Market. He completed his Master's Degree in the University of Dundee with a scholarship in 2011 concentrating on Energy Financing. He has been studying in Yeditepe University for his doctorate studies in Financial Economics.

He works on financial modelling, long-term forecasting models, and management consultancy as the Manager in Consultancy Department.

Can Hakyemez
Senior Consultant

After completion of his Master's Degree of Economics in the University of Windsor, Canada, Can Hakyemez studied for his Ph.D. degree in Economics in Carleton University. Can Hakyemez holds a Bachelor Science degree in Civil Engineering from the Technical University, Istanbul.

Following a Canadian based experience for seven years in macroeconomic analysis, Can Hakyemez is working on econometric modelling of the energy market, analyses of impacts / scenarios on market participants, feasibility analyses, sectoral analyses, financial analyses, long term price and demand forecast, and reporting in the consultancy department.

Uğur Kurban
Senior Consultant

After completing his undergraduate degree in Trakya University Mechanical Engineering with honours, Uğur Kurban has two years of experience in the Energy sector.

He works on analyses and preparation of reports with respect to the Turkish Energy Market, dispatch optimization model development for electricity generation plants, development of financial models, preparation and reporting of feasibility and pre-feasibility studies for plant investment projects as a part of APLUS Enerji Consultancy Department.

Volkan Yiğit
Senior Consultant

Volkan Yiğit completed his undergraduate studies in the Civil Engineering Department of Yıldız Technical University. During his undergraduate studies, he spent two semesters at University of Portsmouth in United Kingdom. He is currently completing his master thesis studies in Istanbul Technical University's Energy Science and Technologies (MSc) Program. Having started his career in construction project management, Volkan then moved to energy business with a strategy and market analysis role in a leading utility company.

Since joining APLUS Enerji, he focuses on market research & analysis, feasibility studies, privatization studies and periodical reports.

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