Feasibility study for the construction of a new power plant in Pervomaisk, Ukraine

Project background

Name of applicant	LLC research and production association 'Thermosystems'
Project info/Project name	Feasibility study for the construction of a new grid-balancing 100 MW power plant in Pervomaisk, Kharkiv region, Ukraine
Contractor	AFRY Finland Oy
Project duration	April-October 2021
Contract value	EUR 120,000

Project summary

1 **Project summary**

The project was to prepare a bankable Feasibility Study (FS) for the private company Thermosystems for the construction of a new 100 MW grid-balancing power plant in Pervomaisk, Kharkiv region.
There is a need for new flexible balancing capacity in Ukraine: the Ukrainian energy grid does not currently comply with the requirements for adequacy of generation capacities. Ukrenergo has also confirmed an additional need for 2 GW of flexible generating capacities across Ukraine.

The Ukrainian company Thermosystems is planning to implement a new project with a 100 MW balancing power plant near Pervomaysk, Kharkiv region, consisting of 10 gas engines (ICE) produced by Wärtsilä. The gas engine technology provides agility and flexibility combined with high efficiency over the whole load range, which makes it suitable for balancing, peaking and reserve power applications. Another plant configuration option is to combine gas engines with a battery energy storage system (BESS). This option includes 5 x 10 MW engines and 50MW/50MWh BESS.
A special purpose company (SPC) has been established for the project. The SPC has started permitting for the project. AFRY was tasked with conducting a feasibility study for the project. Comprehensive financial modelling resulted in the following conclusions:

Optimal scenario for ICE under the following assumptions:
- The 'Pure balancer' scenario providing for operation on the balancing and ancillary services markets is optimal;
- Partial operation on the Day Ahead Market (DAM) reduces the profitability of the ICE operations;
- Even under the most efficient 'pure balancer' scenario, operation of the ICE under current market conditions is not profitable and requires some form of state support.

Optimal operation for BESS under the following assumptions:
- Operation of BESS under current market conditions is profitable if BESS operates on the ancillary services market with the profit maximisation strategy to work as a Frequency Containment Reserve (FCR).
- 1-hour BESS is not appropriate for the arbitrage strategy. Longer duration BESS may be appropriate for this.

The combined operation of ICE and BESS is not profitable as the profit-earning BESS component is insufficient to compensate for the lossmaking ICE component without state support.

2	**Project conclusions**	Ukraine's strategic documents both effective and under preparation determine decarbonisation of the United Energy System (UES) as the priority, as well as the important role that RES power plants have in achieving this goal. The increasing amount of RES creates demand for balancing capacity to ensure the security of supply of the power system. Currently, the inadequacy of balancing capacity is leading to curtailment of RES, shortage of power supply, increased costs and lower efficiency of power generation. TSO has confirmed the demand for flexible power generation capacity as well as battery storage capacity in the Ukrainian power system. At the current stage, the project is not bankable. Bankability can be achieved after the related changes in legislation are in place, a tender process for flexible generation is held and there is an agreement on the sales of electricity and ancillary services. As a result of the scenarios, the calculation demonstrates: - Under the assumptions used for the financial model calculation, none of the operating modes of the ICE are profitable without additional state support because of the general electricity market conditions in Ukraine; - To approach profitability of the project requires maximisation of ICE participation in ancillary services and the balancing market and/or financial support from the state for the investment payback. One of the options – conclusion of the long-term contract for ancillary services provision with a specified auction price accepted for the entire tenor of such a contract and/or support of the ICE as a new power-generation facility upon results of the respective auctions for the period of investment payback. - The operation of BESS is profitable under the assumptions used in the financial model. However, the profitability of BESS is not enough to offset the lossmaking operations of the ICE. As the calculations demonstrate, the scenario with a combined ICE and BESS configuration providing ICE operation as a pure balancer and BESS operation as a pure FCR provider is the most profitable of all the scenarios, approaching the breakeven point for the combined ICE+BESS capacity; - The projected CO2 price growth increases the project's profitability as the growth of electricity prices more than offsets the additional cost of the CO2 emissions fee for the ICE.
3	**Impact on Human Rights and the project's Sustainable Development Goals (SDGs)**	The social and environmental benefits to be achieved by the implementation of the project are related to the following impacts: - New employment opportunities (36) for people; - Improved stability of the electricity network allowing more opportunities to integrate additional renewable capacities into it. The adverse environmental impacts of the project are mostly related to emissions to air and noise produced at the plant. Other environmental impacts are anticipated to be minor. Based on the nature of the project, noise at the nearest residential houses is the key concern for community health and safety, especially at night. The project concerns the following SDGs: 
4	**Project deviations**	During the inception phase, it was decided that the BESS and combined ICE&BESS options would be included in the study.
5	**Project lessons learnt**	**Lessons learnt** The project demonstrated the importance of a proper legislative framework in the electricity market. Despite the proclaimed liberalisation of the electricity market, it is still heavily regulated by state authorities. There are no specific regulations for balancing and peak power plants, but their operation in the electricity market is governed by the electricity market rules on a general basis. The main challenges of the current set-up of the power market are the price restrictions (price caps) set by the regulator. Therefore, incentives to invest in a flexible capacity that would be needed to make it possible to add more renewable capacity are missing. Based on current market prices for electricity and balancing services, no financial bankability for the project can be achieved.

Benefit of the project
The project contributed to the following FUTF targets:

a. Consultation on policy – the very comprehensive analysis of Ukrainian energy markets, and current legislation concerning balancing markets in particular, showed gaps and deficiencies that hinder the development of balancing markets. The big benefit of the study is that it revealed the problems and presented proper financial modelling of the typical balancing power plant.

b. Consultations of the technology solutions – the study included a typical gas motor-based solution and a modern battery energy storage system, as well as a combined alternative.

c. New technology introduction – the BESS solution is a rather new solution that proved feasible already now.

d. Training and transfer of expertise and experiences in the power-balancing sector.

Effectiveness of the project
The assignment was implemented successfully, and project deliverables complied with the FS targets, as well as FUTF objectives including promoting cooperation between Finland and Ukraine and identifying opportunities for exports.