I. Non-technical summary

Registration data.
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Investment location
ul. Trzecieskiego 14, 38-460 Jedlicze

The business activity of ORLEN Południe S.A. focuses on the main product segments related to the production and sale of biofuels and bio-components, paraffins, and solvents. The consistently developed technologies, emphasis on the development of know-how and a number of
optimisation activities are the basis for the development of ORLEN Południe into a biorefinery. Its offer is supplemented by products obtained during processing of crude oil and oil regeneration. The products offered by ORLEN Poludnie S.A. can be divided into 5 basic groups (including the most profitable products):
1) Biofuels (methylesters)
2) Fuels (petroleum distillates, fuel oils, raw gasoline)
3) Chemistry (solvents, base oils, glycerin, potassium sulfate)
4) Paraffins (Cristal, Semi-paraffins, Mixes, special wax)
5) Regeneration (Used oils).

The Company's business mission

To be a modern company in the strategic and forward-looking oil industry, perceived as an important partner on the fuel market. On a regional scale - to be the key partner of the local community's.
development through economic and cultural patronage.
To earn the reputation of a recognized employer by investing in employees and their life passions. To become the guarantor of the harmonious development of employees and their families.
To work for the natural environment of the region through the renovation of post-industrial areas and the reduction of own emissions to water, soil and air.

The Company's social mission

To act as the key partner for the development of the local community and the economic, and cultural patron of the region
To be a company of high social trust, to gain the reputation of a renown employer, to invest in employees, their talents and life passions.
To enjoy being an enterprise whose economic success is not a value itself but serves those who have developed it, their families and the region in which they live and work.

The operating area of ORLEN Poludnie S.A., and particularly the southern Poland region, are excellent for the development of this sector. The effect consisting in the application of a new technology

will contribute to the improvement of energy security through the diversification of energy sources in the micro scale. The project will give rise to new technologies and installations, which will be applied in the industry.
The subject installation will be located in a fenced, enclosed area belonging to Orlen Południe S.A. Jedlicze Plant which, as planned by the former JEDLICZE Petroleum Refinery, was to be the location for new refinery investments.

Figure 1. View of the ORLEN Południe plant.

The investment planned consists in the construction of a complex of installations for the production of second generation bioethanol

Biofuels are classified in terms of the type of raw material used and the technology of its processing into 1st, 2nd and 3rd generation biofuels.
The former includes fuels produced out of raw materials obtained from plant-based biomass or from plant and animal fats (biodiesel, bioethanol, biomethanol, biofuels which are produced out of waste cooking oil).
Second generation biofuels are manufactured out of raw materials which are otherwise unfit for consumption by humans and animals, as well as out of waste substances.
Third generation biofuels are biofuels manufactured out of algae and other microorganisms.
Production of biofuels as an alternative to traditional fuels will significantly contribute to reducing the greenhouse effect. Used as a component of gasoline for combustion engines, it generally does not impact the degree of consumption of crude oil and natural gas resources.

After a relatively short period of popularity of first generation fuels (2000-2007), political decision-makers concluded that, despite the undoubted benefits that are drawn from them, such as a reduction in carbon dioxide emissions due to their limitation to the production cycle and arrival at partial independence from fossil fuels, obtaining biofuels from products which could be alternatively used to manufacture food, raises controversies.
In result, the governments of countries and international organizations started to implement legal tools to obligate the scientific and industrial environments to search for new sources of raw

materials for the production of biofuels with relatively small changes to the existing production infrastructure. These actions resulted in coining the term of “second generation biofuels”, which stand for fuels manufactured on the basis of lignocellulosic raw material and waste materials of natural origin, which are not classified as food.
The investment involves the construction of a second generation bioethanol system, constituting advanced biofuel, using lignocellulosic material as raw material for production.
An analysis conducted for the investment, including the analysis of available technologies and the economic and financial analysis indicated grain straw as the main raw material, which in Polish conditions is the most available raw material. Other suitable materials which could be utilized in the installation include lignocellulosic waste from agriculture, forestry or energy crops according to Annex IX part A of Directive on the promotion of the use of energy from renewable sources (RED II). The consultants participating in project implementation determined the size of the system at an optimal level of 25,000 tons of ethanol per year. The installation will manufacture ethanol with parameters conforming to the requirements of EN 15376. The ethyl alcohol manufactured will be a biocomponent for car petrol blending to meet the National Indicative Target by PKN ORLEN S.A. The regulations which will take effect in the European Union after 2020 force manufacturers to include a share of advanced biofuels in transport fuels at minimum 1% (in the overall energy ratio) by 2025 and minimum 3.5% (in the overall energy ratio) by 2030.

The second generation bioethanol installation complex will comprise the following installations/units:

1. Lignocellulosic bioethanol production installation out of biomass - cereal straw, with the capacity of 25 000 Mg/annum together with a raw material storage and preparation unit and product storage and shipment unit;
2. The CHP Plant installation based on lignin and biogass with two boilers fueled by natural gas as basic fuel and fuel oil and C4 fraction as supplementary fuel,
3. Biogas plant using leachate (syrup) from the bioethanol production installation,
4. Biological wastewater treatment plant for sewage from the production installation,
5. Auxiliary infrastructure required for the correct functioning of the second generation bioethanol installation complex together with electrical, power and water-sewage connections,

Ref. 1 Bioethanol production installation
The planned lignocellulosic ethanol production technology is based on the process of fermenting simple sugars obtained from waste agricultural mass - cereal straw. The first stage consists in loosening the structure of lignin, which is carried out in the pre-treatment installation.
The next phase is the enzymatic hydrolysis of the released complex sugars to the fermented simple sugars. As a result, we receive a digestate with lower ethanol concentration than in the conventional ethanol production process.
The digestate is then distilled, rectified and dehydrated. As of the fermentation process, the production of 2nd generation ethanol is similar to that of 1st generation ethanol.

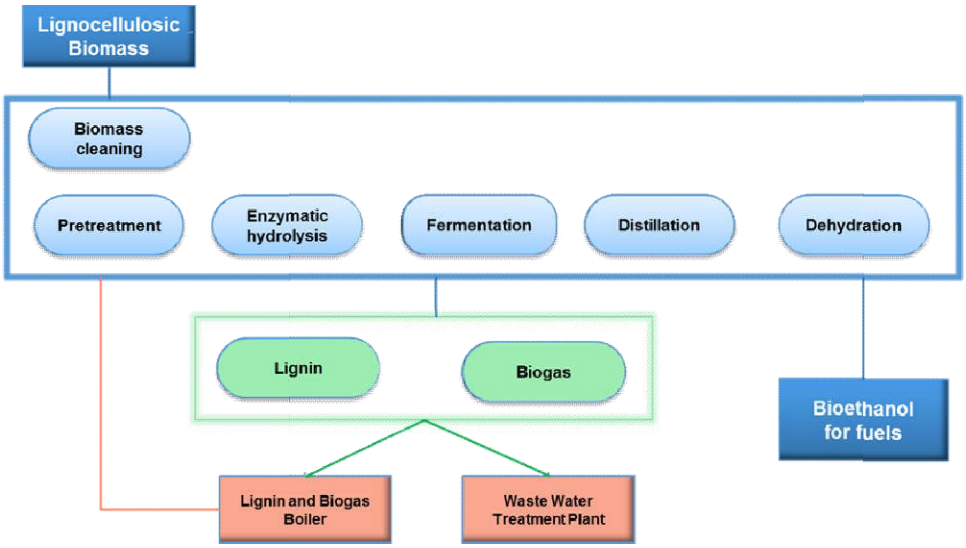

Figure 2. Technological process diagram

The resulting lignin fraction which is a by-product of the production process is a very important element in the production process of 2nd generation bioethanol. The fraction is obtained through the filtration of the digestate. Apart from lignin
(non-fermentable part of the biomass), the lignin fraction contains water (40% of the weight fraction) and small amounts of ethanol and sugars. The content of ethanol and sugars in the lignin fraction will be subject to optimisation while minimising the extraction of these components from the process line with a measurable impact on the yield of alcohol production. The installation will also produce biogas which will be subsequently used to produce energy.

The current cellulose ethanol production capacity is ca. 100 thousand m3 in Europe and successive investments in the production of cellulose ethanol in Europe are planned - estimated for ca. 200 thousand m^3.

The second generation ethanol production technology is a new one and the designed installation at Orlen Południe S.A. Jedlicze Plant would be one of few installations dedicated to the production of IIG on the industrial scale.

Ref. 2. Heat and power plant installation
As a result of the bioethanol production process, such aforementioned side products
as lignin (by-product of the bioethanol production process) and biogas (obtained from the processing of the by-product - syrup) will be produced; these by-products are planned to be used as fuel for the CHP unit; this unit will replace the CHP Plant of 61.6 MWt, currently in use.

The project assumes the construction of a new CHP unit in the Jedlicze Plant; its purpose will be to produce process steam, heating steam and electricity in a turbine and photovoltaic units installed on the roofs of individual structures of the bioethanol installation complex for own purposes and to be sold to external companies supplied by Orlen Południe S.A. with heating, process steam and electricity the Jedlicze Plant.
A biomass boiler with a capacity of approx. 48 MW will become the basic unit in a new power unit. It will be used to burn lignin containing 60% dry mass and biogas generated at the biogas plant from the by-product (syrup) obtained from the IIG bioethanol installation. Selected power
of the biomass boiler (max 48 MW) At the same time, two peak load steam boilers with capacity of approx. 10 MW each will be installed in the power unit designed.
Each will have burners fueled by natural gas and the C-4 fraction and with burners for burning fuel oil. The biomass boiler operating in cogeneration will cooperate with a max 5 MWe turbine to produce electricity utilized by the on-site production installations.

Photovoltaic modules of max 2.5MWp will guarantee uninterrupted power supply.

Before the implementation of the investment, the production capacity of ORLEN Południe S.A. in Jedlicze is 61.6MW (reference date 26.05.2019)
After the implementation of the investment, the production capacity of ORLEN Południe S.A. in Jedlicze will be 68MW.

The detailed objectives of power engineering are:
- substituting the current energy fuel (primarily based on coal dust and fuel oil) with renewable energy sources
- using the lignin and biogas produced as part of the second generation bioethanol production process for energy purposes. The estimated quantity of lignin obtained from the production process to be used for energy purposes is 90 thousand tons a year.
- limiting the emissions of greenhouse gases and other contaminations, including among others CO_2 by approx. 30 thousand tons

Re. 3. Biogas plant
The biogas plant is a production installation applying the methane fermentation process which is common in nature. Biogas and digestate are the end products of the methane fermentation process in the biogas plant. Biogas is recognised as one of the sources of renewable energy, whereas digestate is used as a high-performance organic fertilizer. The biogas plant is a production installation applying the methane fermentation process which is common in nature. Biogas and digestate are the end products of the methane fermentation process in the biogas plant. Biogas is recognised as one of the sources of renewable energy, whereas digestate is used as a high-performance organic fertilizer.
In industrial practice, there are several types of anaerobic reactors used for treating high-loaded wastewater. For instance, these are full CSTR reactors (described above, for the biogas plant), fluidised bed reactors such as UASB (Upflow Anaerobic Sludge Blanket) and various developments of the technology with the granular bed, such as EGSB (Expanded Granular Sludge Bed reactors) or IC (Internal Circulation reactors).
The project assumes the use of a CSTR anaerobic reactor. The land development plan has secured sufficient space for 3 fermentation chambers of approx. 5000 m^3 in total capacity each,
Digestate will be stored in 3 tanks of V 5000m^3.
The by-product from the bioethanol plant in the amount of max 9 tons/h will be directed to the biogas plant.
The expected biogas production is 1100 Nm3/h.

Figure 3. Process diagram of the biogas plant.

Re. 4. Biological wastewater treatment plant.
The project consists in a system based primarily on an anaerobic reactor, followed bya cycle of regereneration/ nitrification/ final sedimentation tank. Since the wastewater profile allows relatively simple treatment, the system ensures the correct functioning of the entire installation and guarantees that the desired level of wastewater purification will be reached. Excess sediment will be dehydrated in a decanter centrifuge. Treatment of wastewater from the bioethanol plant at max 20t/h.
Pre-treated wastewater will be fed to the existing mechanical treatment plant.

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Re. 5. Auxiliary infrastructure
Auxiliary infrastructure required for the functioning of the installation includes, among others:

- Process pipeline connections;
- Energy media connections;
- Sewage, water and hydrant networks;
- Upgrading of the power system (plant distribution network) at HV (110kV), MV (30kV or 15kV and 6kV) and LV - for supplying the bioethanol plant complex and auxiliary facilities;
- Teletechnical networks;
- Ground tanks for storing bioethanol and the by-product (syrup);
- Filling rail front along with modernisation of the surrounding railway track;
- Railway and truck facilities for unloading raw material;
- Land development, including car parks, roads, entrance gates;
- New trestle sections or the reinforcement of existing process and cable trestles.

The second generation bioethanol installation complex situated in ORLEN Południe S.A. Jedlicze Plant will be located possibly closest to agricultural areas with a high biomass supply potential.