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LAYMAN'S REPORT
ON THE IMPLEMENTATION OF THE PROJECT LIFECOGENERATION.PL

Energy from waste as the ecological vision of the future

PROJECT ACRONYM	**LIFEcogeneration.pl**
PROJECT TITLE	**Demo installation for electricity/heat COGENERATION with gasification of fuel based on municipal waste and sewage sludge.**
LIFE PROJECT NUMBER	**LIFE12 ENV/PL/000013**
DURATION OF THE PROJECT	**1st July 2013 – 30th September 2018**

COORDINATING BENEFICIARY

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Co-financing

European Commission

Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej

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Przegląd Komunalny

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BIZNES & EKOLOGIA

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Beneficiaries

Investeko S.A. was established in 2012 as a continuation of a limited liability company. The first years of operation included mainly consulting in the field of environmental protection with the main specialization in the waste management domain. In 2014, the company made its debut on the Warsaw Stock Exchange - NEW-CONNECT market. In the same year, the company won a competition organized by the European Commission under the LIFE program, receiving funds for the construction of a prototype installation of thermal waste treatment based on LIFEtec technology, which is designed to gasify the over-sieve fraction of municipal waste and sewage sludge. Investeko S.A. R&D Center which includes the installation based on LIFEtec technology and the research laboratory next to it are a real answer to the real market needs. It is also a demonstration of world-class technology. The company's personnel are mainly engineers with extensive experience, specialized in the field of environmental engineering.

TAKTYK
STRATEGIE DLA CIEBIE

Taktyk Sp. z o.o. - project partner. A company that monitors the project implementation progress and monitors the impact of the project on the environment.

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1. OBJECTIVES, BACKGROUND AND CONTEXT OF THE PROJECT

>> OVERALL PROJECT OBJECTIVE

Our overall objective in the LIFEcogeneration.pl project was **to design, build and demonstrate the first complete thermal waste treatment plant based on LIFEtec technology**. LIFEtec technology is based on the process of gasification of formed fuel and enables energy management of the over-sieve fraction of municipal waste and sewage sludge. Both waste streams are characterized by their fuel properties and are subject to a total landfill ban. LIFEtec is a model solution for locations where investment in a traditional incineration plant turns out to be unattainable due to insufficient amount of generated raw material.

The prototype erected in Świętochłowice, is the first installation in Poland agreed according to the new approach of thermal waste treatment as a "non-incieration plant" and is excluded from a number of regulations concerning waste incineration

>> SPECIFIC PROJECT OBJECTIVES

The specific objective set in the project can be divided in five groups:

1. **Construct a pilot-scale prototype** demonstration plant that integrates five units of the LIFEtec technology
2. **Test and validate** the technology at the demonstration scale in order to verify assumed specifications and functionality
3. Conduct **information activities to promote** the project and new waste2energy technologies
4. **Demonstrate** and widely present newly developed technology
5. **Increase public awareness** on the issue of novel methods in thermal treatment of waste

MUNICIPAL SOLID WASTE PROBLEM

>> Every EU27 citizen generates 520 kg of municipal waste a year.

>> Approx. 30-40% of MSW are the so-called energy fractions characterized by good fuel properties.

>> More than **105 million tonnes** of energy waste fractions is generated in the EU.

>> PROJECT BACKGROUND

The data indicate that in Poland and many EU countries, the amount of municipal waste and sewage sludge increases each year. Invariably the most common (and in many locations the only) method of their management is landfilling. The over-sieve fraction of municipal waste and sewage sludge have very good fuel properties and their energy potential is still not used. In accordance with EU Directives 2006/12 / EC or 199/31 / EC, disposal is in the last place in the waste management hierarchy - after prevention, minimization, re-use, recycling and energy recovery.

The National Waste Management Plan assumes complete abandonment of sludge landfilling. In Poland since 2016, landfilling of waste fractions containing a calorific value above 6MJ/kg is banned.

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At the beginning of 2019, the three-year period for the storage of these types of waste expires. At the same time, the Waste Act of December 14, 2012 ensures sorting of these high-energy raw materials, which enables preparation of fuel with standardized properties.

The implementation of the plan is particularly difficult for small and medium-sized cities. The amount of waste generated by them is not enough to make it profitable to build large waste incineration plants there. Therefore, smaller, scattered energy sources based on local waste streams are a potential solution.

There is a clear gap on the market for installations that will work locally, complementing and closing the existing waste management system with the energy waste utilisation element.

SEWAGE SLUDGE PROBLEM

>> The amount of sewage sludge generated in the EU equals **11,504,000 ton** of dry matter per year (about 17.7 kg of dry matter per capita /year)

>> constant increase of the generated amount of sewage sludge (due to the construction of new and modernization of existing sewage treatment plants)

>> limiting the possibilities of agricultural use of sludge, due to the increase of sewage pollution with hazardous substances

GASIFICATION is a process involving the transformation of a fuel with a high carbon content into gaseous fuel as a result of thermal decomposition in a controlled amount of oxygen or air.

>> WHY GASIFICATION?

As a result of energetic waste management in classic waste incineration installations, the main stream of recovered energy is heat. Heat is difficult to manage due to the seasonality of demand for this type of energy. For this reason, installations producing mainly heat are less profitable.

>> **Comparison of demo installation parameters.**
>> **Grant agreement vs. obtained results.**

	PLANNED IN THE GRANT AGREEMENT	ACHIEVED IN THE LIFECOGENERATION.PL
Maximum capacity	300 kg/h	300 kg/h
Gross electricity production	180 kW	300 kW
Total electricity consumption	Not given	~95 kW
Net electricity production	Not given	~205 kW
Heat recovery in cogeneration	250 kW	485 kW

One of the main assumptions of LIFEcogeneration.pl was the development of a technology that will allow for more efficient use of waste for the production of combined electricity and heat in a high-efficiency co-generation engine. The proposed technology can achieve a much higher share of electricity in relation to heat energy than in conventional incinerators. In addition, the LIFEtec technology allows for simultaneous processing of the most common problematic wastes (i.e. sieve fraction and sewage sludge), which in the local field can be important from both the environmental and economic point of view. One installation solves two problems at the same time. An important criterion was also the ecological safety of the process.

In a classic incineration plant, as a result of the thermal treatment of waste, highly contaminated exhaust gases, which require a multistage cleaning before they are discharged into the atmosphere. In the case of the designed technology, clean syngas is subjected to combustion. The syngas cleaning stage is one of the most important elements of the installation.

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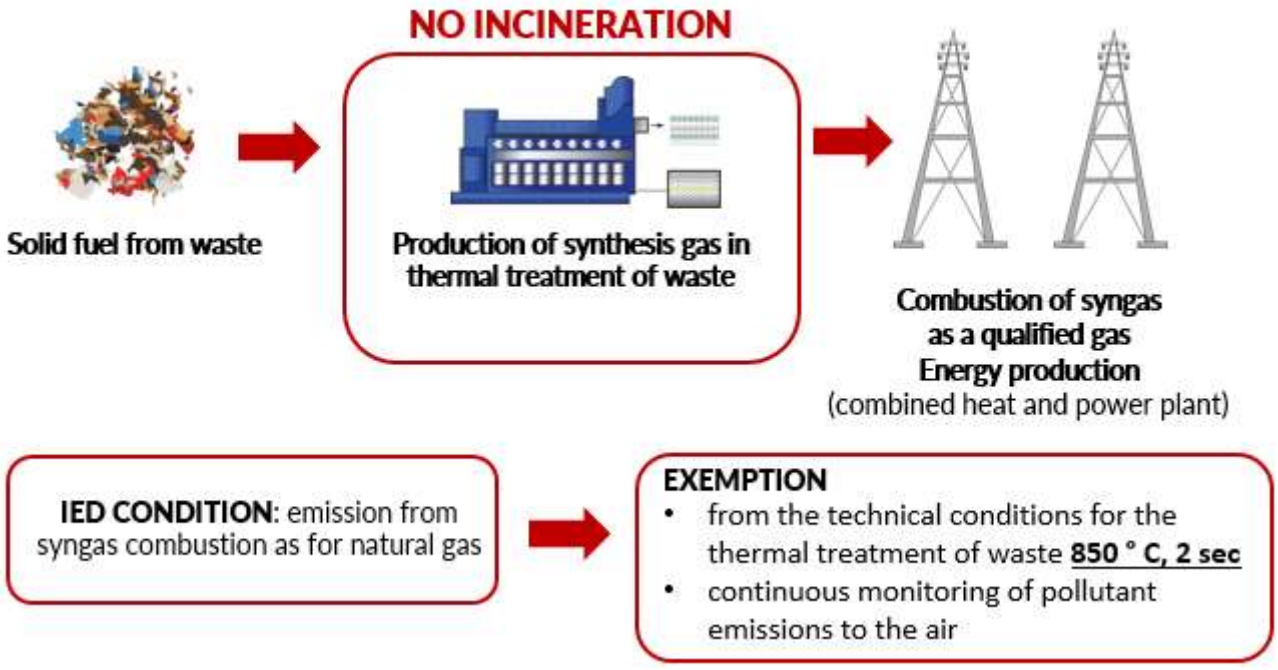
>> NEW APPROACH OF ENERGY MANAGEMENT OF WASTE

The European Commission, in the face of emerging doubts of member states and differences in interpretation, has officially published answers to the most frequently asked questions regarding the interpretation of art. 42 IED.

It is clear from the ruling that the gas obtained in the gasification process of (solid or liquid) waste, which is then purified to the extent that it has properties, similar to "natural gas" is to be considered **as a product and not as waste**. Combustion of such gas in a power plant cannot be treated as incineration or co-incineration of waste.



NATURAL GAS PARAMETERS

In Poland, the quality of natural gas is determined by two standards:
>> **PN-C-04752: 2002** Natural gas. Gas quality in the transmission network,
>> **PN-C-04753:2002** Natural gas. The quality of gas supplied to consumers from the distribution network.

Standards determine, among others:

- hydrogen sulphide content: **max. 7 mg/m3**
- total sulphur content: max. **40 mg/m3**
- mercaptan sulphur content: **max. 16 mg/m3**
- content of heavy hydrocarbons (condensable): **max. 30 mg/m3**
- mercury vapour content: **maximum level 30 µg/m3**

SYNGAS AFTER BEING CLEANED IN LIFETEC INSTALLATION IS CHARACTERIZED BY MUCH LOWER CONCENTRATIONS THAN THE ONES SHOWN ABOVE

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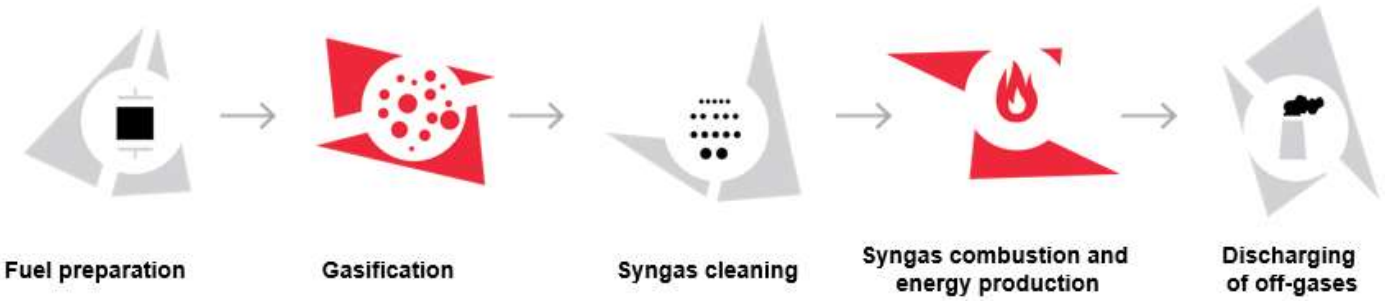
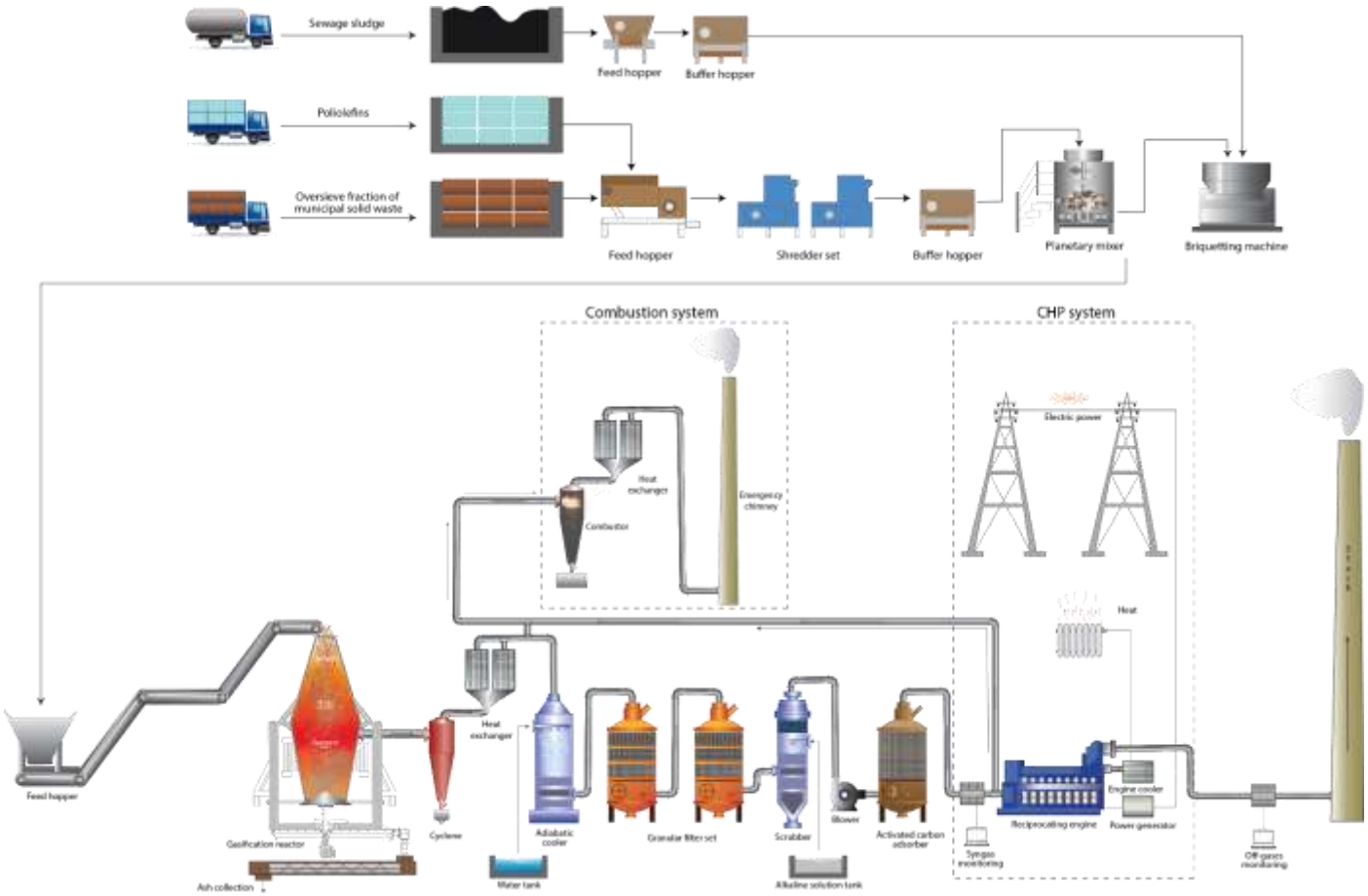
2. LIFEtec TECHNOLOGY

The installation that we have built in Świętochłowice consists of 5 technological units:

1. fuel preparation
2. gasification
3. syngas cleaning
4. syngas combustion and energy production
5. off-gases discharge



>> INSTALLATION SCHEMATIC DIAGRAM



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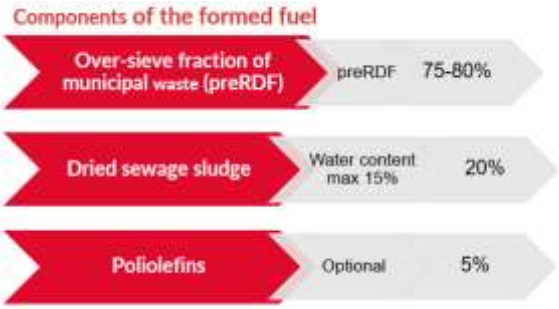
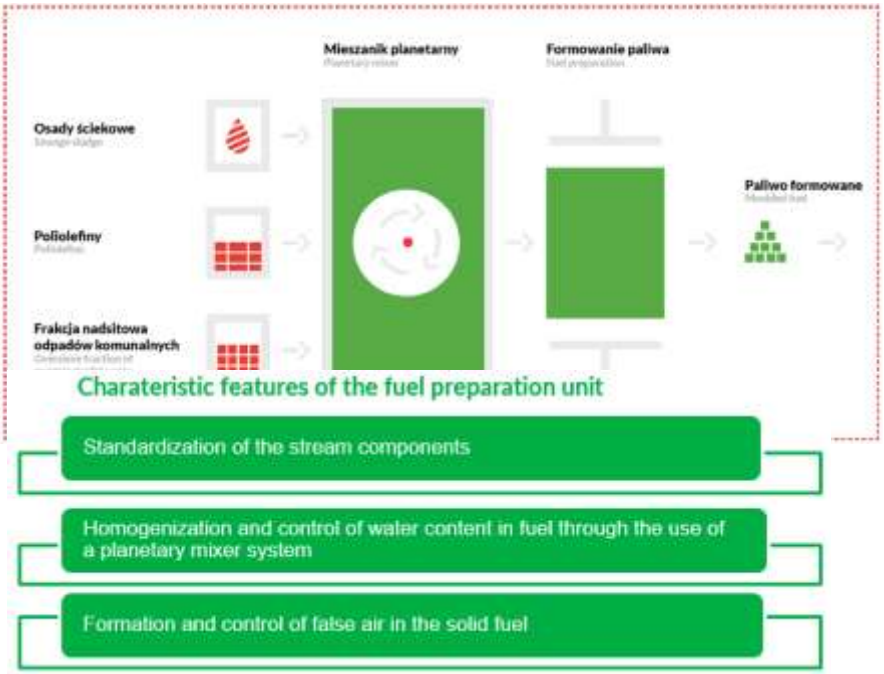
>> FUEL PREPARATION UNIT

The basic task of this unit will be to prepare a uniform, standardized fuel in the form of pellets, which will ensure stable operation of the gasification reactor. As a result, the process gas (syngas) obtained during the gasification process will be characterized by stable parameters (flammable components, impurities, calorific value).



In this unit is carried out the process of preparing the fuel from three types of waste: municipal waste with fuel properties (over-sieve fraction), stabilized sewage sludge and plastics (optional). The process ensures that homogeneous fuel is formed in terms of composition and purity by grinding, blending and removal of unwanted impurities that may be present in the supplied waste stream. The composition of the resulting fuel mixture guarantees the stability of the gasification process.



The unit consists of the following equipment: feed hopper of the over-sieve fraction of municipal waste and plastics, conveyor belt, magnetic separator, two-stage shredder, buffer hopper, sewage sludge dosing tank equipped with a feeder and planetary mixer, in which all fractions are combined into homogeneous fuel.

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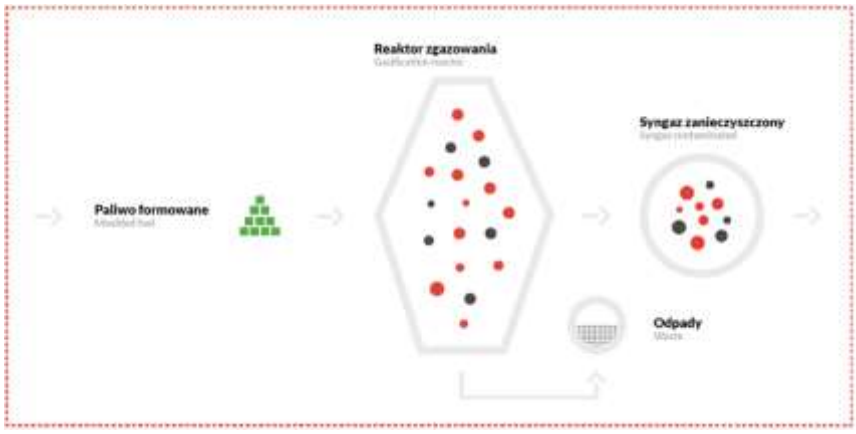
>> FUEL GASIFICATION UNIT

The fuel gasification unit consists of the following components:



FUEL SUPPLY SYSTEM

The prepared fuel is stored in the tank. From the storage tank, the fuel is fed into the lower hopper by gravity through the rotary dispenser, which, after receiving the signal from the fuel level sensor, transports the fuel to the upper hopper.

From the upper hopper, the horizontal screw conveyor discharges the fuel into the lock (buffer) chamber, closed from the top and from the bottom with knife gate valves, which ensure the tightness of the system.

Gasifying agent: **air**
Energy efficiency of energy conversion: formed fuel / syngas - **82%**
The calorific value of syngas: **5,6 MJ/Nm^3**

GASIFICATION REACTOR (GASIFIER)

The process of gasification of waste takes place in a downdraft co-current gasification reactor - Imbert type, with the participation of an oxidiser, which is atmospheric air. A 1.2 m2 chamber was designed, divided into pre-drying, pyrolysis and gasification zones. Gasification takes place on a segmented movable grate, enabling the supply of substrates to the reduction zone, a stable gasification process and continuous ash discharging. The residence time of the fuel in the gasification chamber is about 20 minutes, this is due to the dynamics of the processes taking place inside the reactor. The reactor chamber holds approx. 100-120 kg of substrates. The maximum temperature of the bed in the oxidation zone does not exceed **1100 °C**, and in the reduction zone 800-850 °C.

The syngas generated in the gasifier, is characterised by a calorific value of approx. **5.1- 5.3 MJ/Nm^3**.

Syngas main fuel components	
Hydrogen (H_2)	**up to 24%**
Carbon monoxide (CO)	**up to 18%**
Methane (CH_4)	**up to 3%**

ASH COLLECTION SYSTEM

Fly ash from the rotating grate of the reactor, as well as dust from the cyclone sink into the feeder with a water jacket (where they are cooled down), and then through the valve system are pneumatically transported to the high vacuum dust filters. Dedusted process air is discharged into the atmosphere, whereas, dust and ash fall into sealed storage tanks.

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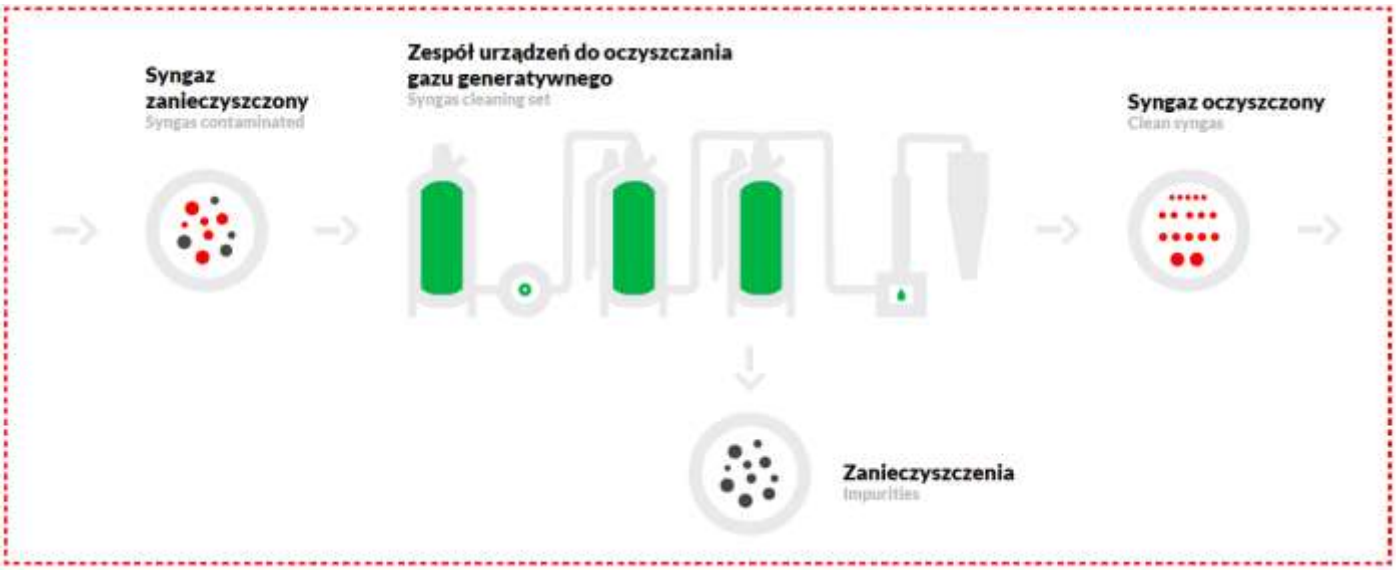
>> SYNGAS CLEANING UNIT

The process of gasification of organic substances is a series of many reactions, reductions and synthesis, which as a result generates combustible components of the syngas such as CO, H_2, CH_4 and impurities such as high-molecular-weight hydrocarbons, organic acids, ammonium compounds and others that are tar and liquor components. The syngas purification unit will remove undesirable chemicals, tar residues and heavy metals.



This unit comprises the following main elements:

- **DUST REMOVAL CYCLONE** - pre-separation of solid particles before cooling,
- **GAS/AIR EXCHANGER** - also performing the role of a preliminary tar removal, where, due to the cooling of the syngas, the tertiary condensation process begins, the vapours flow down the walls of the exchanger into a sealed container,
- **ADIABATIC COOLER** - here the syngas is cooled to a temperature of about 110 °C by evaporating the injected water,
- **FILTERS WITH GRANULAR LAYERS** - two filter sets filled with a granular layer (gravel or coke) operate independently. Each set consists of two filters, i.e. a coarse filter (10-25 mm grain) and a fine filter (5-10 mm grain). The task of the filters is to remove dusts and tars which have not been caught in the cyclone and in the tar separator,
- **ALKALINE SCRUBBER** - main function is to purify the gas from suspended pollutants, such as chlorine and sulphur compounds, tar and liquor residues, dust, organic acids, ammonium compounds and silane. As a sorbent substance will be used sodium hydroxide solution.
- **ACTIVATED CARBON ADSORBER** - whose task is to capture contaminants (mainly residues of alkali and mercury vapours) that have not been separated in the cyclone, gravel filters and scrubber. As the filtration material, is used activated carbon, which has high adsorptive capacity, due to very big surface area per unit of mass it can adsorb a lot of particles.

The syngas purification unit has been designed in a way that guarantees obtaining syngas of the purity required by a modern gas engine and fulfilling the condition of art. 163, paragraph 2a of the Waste Act of 14 December 2012: the provisions of art. 155-162 shall also not apply to installations for gasification or pyrolysis of waste, if the gases resulting from the gasification or pyrolysis processes are cleaned to such an extent that they are no longer waste before combustion and cannot cause emissions greater than the combustion natural gas.

The designed syngas purification system guarantees compliance with the above parameters. In addition, thanks to the use of a number of mutually complementing components of the syngas purification system, such as: dust removal cyclone – tar separator- grainy filters - scrubber - carbon filter, combustion of purified generator gas in the engine, does not cause emission of pollutants at a level higher than the emission that would take place as a result of burning natural gas. The system eliminates all impurities characteristic of waste gases from waste incineration processes.

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The extensive system of syngas cleaning from dust and tar, consisting of the pre-stage (cyclone and desalinizer) and the precise (granular bed filters), is characterized by high efficiency. Thanks to the use of wet cleaning in the scrubber, there are no impurities in chlorine, fluorine, bromine or any of their compounds, as they absorb very well even in the water itself. The efficiency of purifying gas from sulphur compounds (mainly hydrogen sulphide) is also high. Other pollutants such as: organic acids, ammonium compounds, silanes and alkali metal vapours are also absorbed on the liquid droplets. An additional carbon filter traps residual contaminants on dust and micro-droplets.

The formation of dioxins and furans has already been limited in the gasification process itself - gas passing through the reduction zone reaches a temperature of 900 – 1000 °C, which effectively destroys these compounds. Secondary formation of dioxins and furans can take place at 450 – 200 °C, in particular when gases and dust are kept at this temperature for a long time. In the case of LIFEtec installation this situation does not take place, because after passing through the adiabatic column, the gas is be cooled down to about 110 °C. The gas flow continues to gradually lower its temperature while passing through subsequent stages of purification.

AFTER CLEANING IN ACCORDANCE WITH THE REGULATIONS, SYNGAS CEASES TO BE WASTE AND IS CONSIDERED A PRODUCT

CHARACTERISTIC FEATURES OF THE SYNGAS CLEANING UNIT

- Combined method of "dry-wet" purification
- Tar separation by means of a combined cooling system and two-stage filtration
- Separation of acidic gaseous substances in basic absorption
- Purification and stabilization of the signal quality in the adsorption process
- Small amount of industrial wastewater from the purification process
- Continuous quality control of the syngas at the cogeneration system inlet

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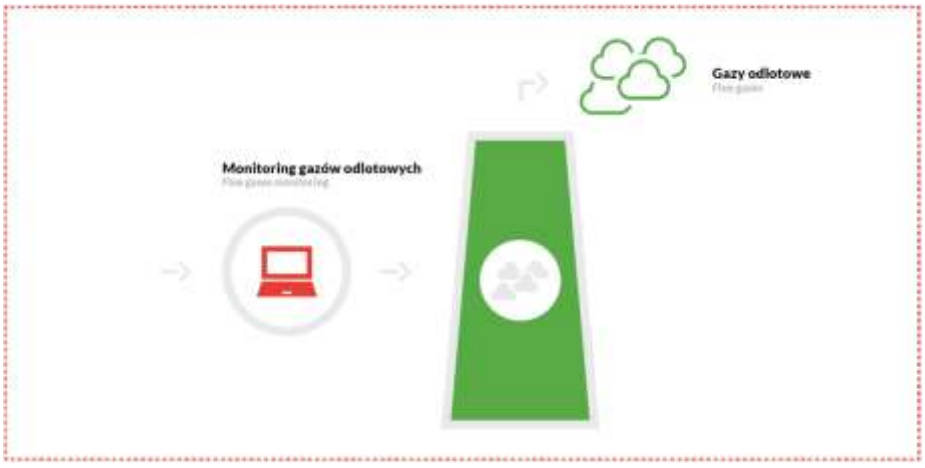
>> SYNGAS COMBUSTION AND ENERGY PRODUCTION UNIT

The unit is a high-efficiency cogeneration unit (CHP) - a combustion engine for syngas with a catalytic converter, an electric generator and a heat recovery module.
A PETRA 380 type cogeneration unit with a Guascor SFGLD 240/55 engine and a Marelli type generator with a nominal electrical power of approx. 304 kWe and nominal thermal power of approx. 414 kW and efficiency: electric - approx. 34.3%, thermal - ca. 46.6%, total - about 80.9%. The cogeneration unit is equipped with a gas analyser (continuous measurement of CO, CO_2, CH_4, H_2, O_2). In operating conditions deviatin from normal (such as start-ups and shut-downs) and in emergency situations, process gas, which cannot be burned in the engine, is burnt in an additional post-combustion chamber with a capacity of 1250 kW, equipped with a gas burner (propane) heating power 35-140 kW.

>> OFF-GAS DISCHARGE UNIT

Before combustion in the engine, the process gas will no longer contain any impurities that are characteristic of the waste incineration process, therefore the exhaust purification unit has been limited to the use of a catalyst built into the exhaust system of the cogeneration engine. The combustion gases from the syngas combustion process in the engine will be discharged to the emitter located at the end of the technological line. A **continuous exhaust monitoring system** was installed in the plant. The scope of exhaust monitoring covers all pollution that is characteristic of pollution generated during natural gas combustion. In addition, instantaneous measurements are carried out in the area of other pollutants.



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3. PROJECT IMPLEMENTATION STAGES

>> PREPARATORY MEASURES

A1 Installation technical concept

Work on the first implementation of our technology began with the preparation of a technical concept. The formulation of the concept included the development of technical solutions, the preparation of spatial assumptions for locating individual modules of the technology line in the production hall, determining the mass and energy balance for individual processes and modelling the approximate syngas composition. The concept was the starting material for the elaboration of detailed project and environmental documentation, including an environmental impact assessment report of the planned installation.

A2 Environmental Impact Assessment

Planned project prior to issuing the building permit required obtaining a decision on the environmental conditions of the project. A project information sheet was also prepared for the installation, followed by a report on the environmental conditions.

The detailed analysis of EIA report on individual components of the environment showed that the installation will not impact the environment in an excessive way. Analyses have shown compliance with emission standards at every stage of operation, both in terms of air cleanliness, noise, water quality and waste management.

The environmental decision agreeing the environmental conditions for the implementation of the project was issued on July 3rd, 2014.

In addition, it was required to obtain partial permits for the emission of pollutants into the air for the operation of the installation (permit to discharge gases and dust into the air - decision of 18/03/2018 and waste management (waste production and waste processing licence - decision of 18th of May, 2017).

>> IMPLEMENTATION MEASURES

B1 Construction Project

Design work lasted from December 2013 to September 2014 and included the elaboration of a construction and a technical project for the planned technology. Initially, were conducted studies related to the construction project such as: a map for design purposes, geotechnical investigations of the ground and geological and engineering documentation. Detailed arrangements were made with utility managers: water supply, sewage system and electricity. In accordance with the adopted schedule, the project team made a technological project of the installation based on the conducted modelling of individual processes and the development of final implementation designs for all industries (construction, installation, assembly, automation, etc.). Simultaneously, between December 2013 and July 2014, the project team prepared a building design project, including construction, installation, electrical, architectural and road construction.

Building permit was issued on 9th September 2014.

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B2 Selection of General Contractor and Project Engineer

In measure B2, the general contractor and project engineer were selected.

B3 Construction of the prototype demo installation

Construction work began on 9th of September 2014. Deliveries regarding to technology elements were divided into nine stages and the final one took place on September 21, 2016. Parallel to technological deliveries in the reporting period, construction works were carried out at cubic buildings, formally completed with the acquisition of two separate occupancy permits for the building and the hall. On April 18, 2016, District Construction Supervision Inspector granted a use permit for the R&D Centre in Świętochłowice, and in less than a year later, on April 6th, 2017, was obtained the use permit for the LIFEcogeneration.pl technology hall. During the implementation of Measure B3, were obtained all licences and permits concerning LIFEcogeneration.pl installation, including in particular: ❶ Permit for emission of gases and dust to the air ❷Licence for waste processing. On May 16th, 2016, the project office was moved to the location of the project in Świętochłowice.

Technical parameters: hall + sheds	
Building area	1.143,14m^2
Total area	1.143,14m^2
Cubic capacity	9.186,87m^3
Length	64,90 m
Width	21,90 m
Height	10,67 m
Usable area	1.071,93 m^2

PHOTOGRAPHS FROM THE CONSTRUCTION SITE

B4 Testing of the prototype demo installation

As part of testing the installation in 2017-2018, studies and analyses were carried out at individual technological modules of the LIFEcogeneration.pl prototype installation, including in particular:

- **SAMPLE TESTING OF THE MOULDED FUEL** were carried out in order to determine the quality and parameters of the moulded fuel depending on the share of individual components in the mixture. The scope of laboratory tests included: cadmium, lead, zinc, chlorine, mercury, carbon, hydrogen, nitrogen, sulphur, total moisture, analytical moisture, ash, flammable and volatile parts, combustion heat, calorific value and temperature regarding sintering, softening, melting and flowing.

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- **ASH AND SLAG ANALYSES** were carried out in order to determine their parameters. The scope of laboratory tests included: grain composition, content of hazardous substances: arsenic, barium, cadmium, chromium, copper, molybdenum, nickel, lead, antimony, selenium, zinc, mercury, polycyclic aromatic hydrocarbons, bulk density, absorbability, frost resistance and sulphur content,
- **ANALYSIS OF SYNGAS PARAMETERS IN TERMS OF PROCESS STABILITY,** including syngas composition test and calorific value measurements
- **ENERGY BALANCE OF THE INSTALLATION**
- **OFF-GAS EMISSION TESTS** i.e. exhaust gas from the cogeneration engine in exactly the same range as for traditional waste incineration plants such as: total dust, sulphur dioxide, nitrogen oxides, carbon monoxide, hydrogen chloride, hydrogen fluoride, organic substances, oxygen, flue gas flow rate, flue gas temperature, static or absolute flue gas pressure, humidity, heavy metals, dioxins and furans.

Additionally, as part of Measure B4, the following activities were performed:

1. Corrections and adjustments of the demo installation
2. Analysis of installation work in various configurations
3. Elaboration of the operating instructions for the installation
4. Elaboration of the environmental impact assessment of the technology together with the estimation of the carbon footprint
5. Tests of the installation steering system and operation monitoring
6. Analysis of the possibility of combining LIFEtec technology with heat utilization system and energy production units (the possibility of using heat for drying sewage sludge at the entrance has been confirmed).

B5 Commissioning and validation of the prototype demo installation

Commissioning of the installation began in 2018. In the last months of the project a number of works related to the calibration and adjustment of the operation parameters of individual components of the installation were carried out, so as to guarantee stable operation and achieve the assumed effects. The activities began with the arrangements concerning the validation of the installation. The commissioning and validation plan assumed the start-up stages and the grading of the systems integration due to safety of work and the construction of appropriate procedures: start-up, emergency operation, stop procedures and optimization in the normal operating mode. The action plan assumed test runs and then validation according to the following scheme: ① commissioning of the fuel preparation unit ⇨ ② commissioning of the gasification unit with the combustion system ⇨ ③ commissioning of the gasification unit with syngas cleaning and combustion system ⇨ ④ in the last phase, commissioning and validation in full integration with 4th and 5th unit after working out optimal and stable quality of syngas production which is fed to the cogeneration system.

After project completion Investeko S.A., will carry out more start-ups and conduct further research on the integrated prototype.

Investeko S.A. R&D Centre in Świętochłowice is today an important hub for the development of new technologies for thermal treatment of waste in Poland.

>> MONITORING

C1 Monitoring of the impact of the project on the environmental issues

An important element of the project is a five-year monitoring of the project impact on the environmental issues, project stakeholders and its target audiences. To ensure the independence and objectivity of the research, the project partner, **Taktyk Company** carried out monitoring activities. Four parallel paths of measurement of key indicators regarding project impact on the environmental issues were undertaken.

>> PATH 1. Monitoring the project impact on target groups and stakeholders

Level measurement of (A) environmental awareness, (B) basic knowledge and (C) competence gaps on municipal waste management and sewage sludge among stakeholders and target groups. Surveys were conducted among public administration employees, municipal waste management enterprises, in the scientific and academic environment as well as among employees of local government organizations dealing with environmental protection.

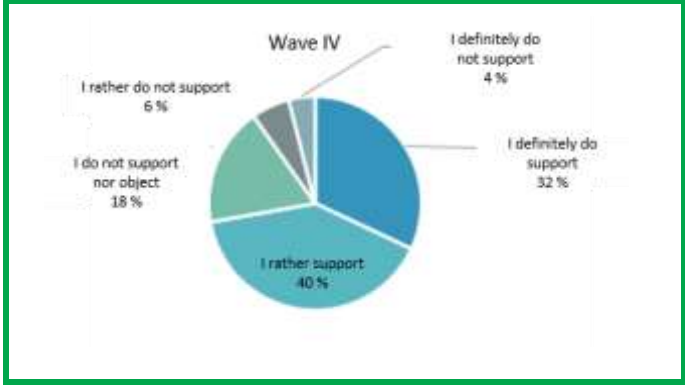
>> PATH 2. Monitoring the project impact on the awareness and attitudes of the local communities

In this path over the years 2013 - 2018, an external company specializing in market and public opinion survey has conducted five waves of survey on social awareness and attitudes. In every wave of the CATI survey a significant number of 500 randomly selected inhabitants of Świętochłowice and Silesia took part. The questions in the telephone survey concerned both awareness and knowledge on the thermal treatment of waste, but also examined the acceptance attitudes for new technological solutions in thermal processing.

Selected results of the CATI survey> 2017> Random sample> 500 residents of Świętochłowice, Silesia Voivodship (people living in the immediate vicinity of INVESTEKO S.A. R&D Center)

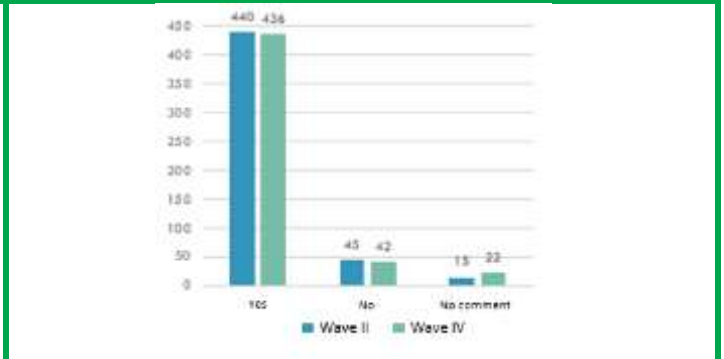
QUESTION:

What is your attitude towards replacing energy produced from fossil fuels, e.g. coal, with energy produced from waste?



QUESTION:

Would you accept the construction of "non-traditional" incineration plant for energy production from waste in your city/town, if you knew that it is more economical, safe for the environment and to a lesser extent affects the daily life of residents than the incineration plant?



In PATH 2, two waves of interviews with the residents of Świętochłowice as a target group were also conducted. In these studies, specialists from an independent institute conducted interviews in small focus groups with the residents about LIFEcogeneration.pl. As a result, we managed to get a lot of valuable information and first-hand feedback from people living in the vicinity of our Research and Development Centre.

>> PATH 3. Monitoring the assumed technological parameters of the demo installation

The essence of this monitoring path was making measurements and analyses of the defined operation parameters of the installation at individual stages of implementation activities.

>> PATH 4. Operational monitoring

In this path, a detailed analysis of the impact of external and internal factors on the investment and demonstration process was carried out.

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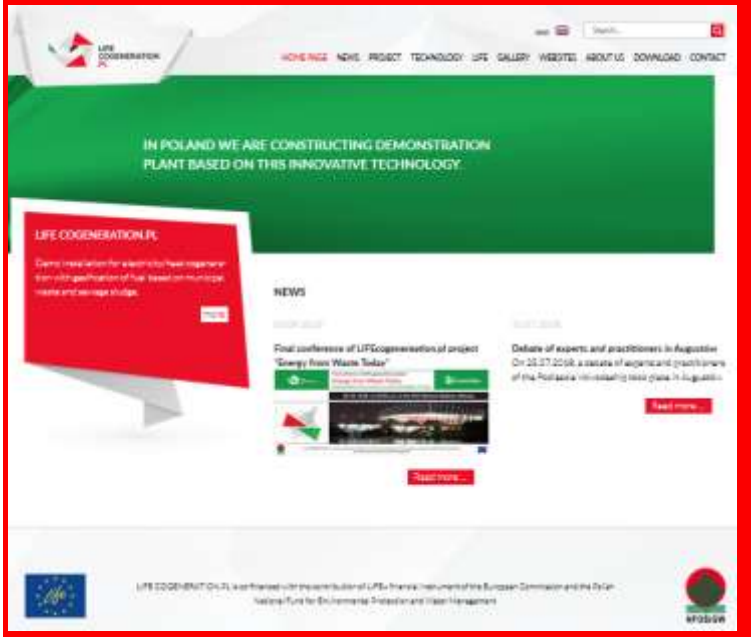
>> PROMOTION AND INFORMATION ACTIVITIES

D1 Website of the project, profiles on social networks

Immediately after the start of the project, we launched a bilingual website www.lifecogeneration.pl and profiles on social networks: facebook, goldenline, twitter and youtube. Throughout the project's duration, information about the project, the course of its implementation and the results obtained were provided there.

The website and profiles were used to thoroughly present the essence of the environmental issues associated with the management of municipal waste (especially energy fraction) and sewage sludge. The website and profiles include: information on current events, summaries of project implementation, reports on activities carried out under the project (information meetings, demonstration workshops, conferences, etc.). On the website - in the "Download" section, various documents created as part of the project were uploaded.

Front page www.lifecogeneration.pl



Even before the investment in Świętochłowice began, the project website contained an interactive 3D presentation demonstrating the assumptions of LIFEtec technology, operating parameters of the installation as well as economic and ecological benefits resulting from the dissemination of this technology. The 3D presentation in an accessible way guided the website users virtually through five technological units. The presentation played an important role in the promotion of the project before putting the demo installation into use.

Interactive presentation of 3d technology placed on the project website

Based on the statistics collected in the period 01/12/2013 - 31/08/2018, the www.lifecogeneration.pl service has recorded over **40,000 views** and over **10,000 new users**, which means over 700 hits and about 175 new users monthly: 13% are returning users, 87% are new users. 51% of visits to the website came from Poland, the remaining 49% were visits from other EU countries, but also the USA, Japan, Brazil, China and Russia.

Profiles on social networks allowed to create a real, active community of people interested in LIFEcogeneration.pl. On the same Facebook profile during the project implementation LIFEcogeneration.pl team placed over 200 posts related to the project. Most of them were actively commented, shared and marked by the website users. The majority of post had ranges exceeding 500 people.

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D2 Information labeling of LIFE+

Headquarters of all partners implementing the project are marked with information boards about the LIFEcogeneration.pl project. The boards contain not only information about the institutions co-financing the project, but also brief information about the project itself such as: LIFEtec technology, project objectives, project activities and expected results. In addition, a number of mobile markings were made that accompanied the team during external debates, fairs, conferences or workshops. At the Investeko R&D Centre in the hall are placed five boards informing about the processes taking place in five technological units of the installation.

Arkadiusz Primus (project coordinator) next to the prototype installation built as part of the LIFEcogeneration.pl project. September 2018.

D3 Inter-sectoral debates / information meetings

In the framework of LIFEcogeneration.pl project, we organized **17 cross-sectoral debates in each of the Polish voivodships and three international debates.** The key representatives of local governments, waste management centres, municipal economy enterprises, non-governmental organizations, the world of science, representatives of the energy sector and companies from the waste industry were invited to participate in the debates in each voivodship. The purpose of the debates was the presentation of the LIFE12 ENV/PL/000013 project and the promotion of LIFEtec technology and the potential of implementing technologies at full industrial scale. An important element of each debate was an open discussion of the participants in the field of the implementation of LIFEtec technology (i.e. the key result of the LIFEcogeneration.pl project) on commercial scale in each of the regions.

Arkadiusz Primus' speech on 26/03/2014 during the debate in Katowice (on the left) and in Rzeszów on 25/06/2014 (on the right)

Debates were elitist and closed (only invited persons participated in them). According to the project's assumptions, a closed group of the most influential, decision-making representatives of target groups in each voivodship were invited to participate in the debates. Among the invitees were senior managers, decision makers from MWMEs, WWTPs, environmental companies, city mayors, and representatives of city and commune offices, academia dealing with related topics to LIFEcogeneration.pl etc. Local media was informed for the majority of debates, interviews were given, and press materials sent to local editorial offices. On average, 20-30 people participated in each debate.

> *The idea of organizing cross-sectoral debates in each of the Polish voivodships has been spectacularly successful.* ***Debates have become an active platform for meetings and exchange of experience of experts in the regions.*** *Liveliness of the discussions was significantly enhanced by the deployment of the LIFEcogeneration.pl project subject in the context of numerous legislative changes concerning waste that took place in Poland in the years of the project implementation (2013-2018). The relationships established during these debates have significantly contributed to the dissemination of knowledge and experience gathered during the project.*

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D4 Participation in trade fair exhibitions

The essence of the D4 action was the preparation, organization and active participation of the LIFEcogeneration.pl project representation in significant trade fairs and industry events in order to network, disseminate information and promote the LIFEcogeneration.pl project and LIFEtec technology. In 2013 and 2018, the Investeko S.A. team presented the project at three international trade fairs in Poland and two foreign events (Prague and Bucharest). At each trade fair, the exhibition booth was rented in a very good location. An attractive stand equipped with multimedia was ordered, along with LIFE, NFOŚiGW and LIFEcogeneration.pl branding. At each fair, interactive equipment were used to promote the project: e.g. an interactive touch&take table or interactive presentation of the technological process using tablets. The participation of LIFEcogeneration.pl in the trade fairs has always met with great interest from the visitors. Participation success translated into a significant increase in the recognition of LIFEtec technology and key results of the LIFEcogeneration.pl project.

EVENTS IN WHICH THE LIFEcogeneration.pl PROJECT WAS PRESENTED
7-10/10/2013: **Poleko 2013**, Poznań, PL
16-19/09/2014: **For Waste & Water 2014**, Prague, CZ
14-17/10/2015: **ExpoEnergie 2015**, Bucharest, RO
11-14/10/2016: **Pol-Eco-System 2016**, Poznań, PL
28/02-01/03/2018: **Ekotech 2018**, Kielce, PL

D5 Demonstration workshops

The main activity was the organization of a series of workshops. The workshops in Measure D4 were a strategic and extremely important part of the whole project. In 2013-2018, Investeko S.A. regularly organized demonstration workshops aimed at **presenting LIFEtec technology, which is directly installed in the demo installation developed as part of the LIFEcogeneration.pl project.** Workshop participants could see the operation of the installation with their own eyes and witness the complete technological process. By the end of the project around 150 representatives of the project's target groups participated in the workshops. Due to their strategic importance for the company, demo workshops will be held regularly after the completion of the project.

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Demonstration workshops at the R&D Center of Investeko S.A. in Świętochłoiwce, Poland

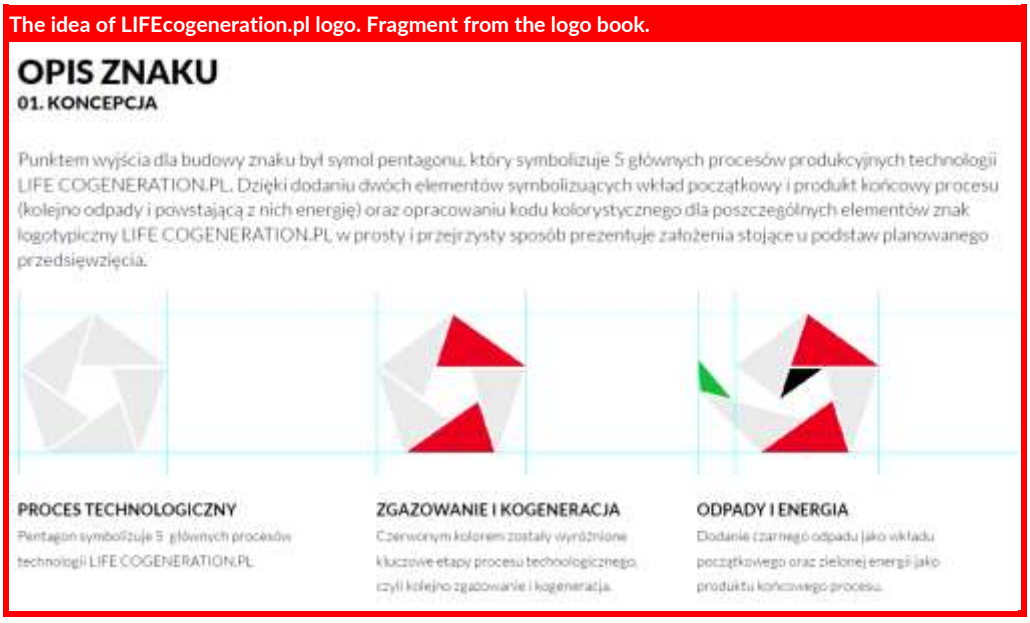
All workshops took place at the Research-Development Center of Investeko S.A. in Świętochłowice and have a similar formula. In the first part of the workshop, project employees welcome guests, present the LIFEcogeneration.pl project, LIFEtec technology, discuss the environmental issues, market potential and the legislative and economic context for the implementation of new technologies for thermal waste treatment and distributed renewable energy sources from waste. After the presentation, the time for discussion is left, and after that, guests are invited to the hall where the installation is located. There, the course of the technological process as well as the role and importance of individual apparatus and assemblies are discussed. In the last part of the workshop there is a time for questions from the guests. An additional attraction after the workshop is the opportunity to visit the historical complex of two towers of the Polish Mine (www.wiezekwkpolska.pl), which are directly adjacent to our installation (from the top of tower a great view of the entire project site and the panorama of Świętochłowice and Silesia can be seen).

Additionally, within the framework of Measure D5, the Investeko S.A. team implemented a number of information and promotion activities directed to the local community, such as **the LIFEcogeneration.pl Open Day, celebration of the 25th anniversary of the LIFE Program and a series of demonstration workshops.**

D6 Information and promotional materials

In this measure, for the purposes of project promotion, a creative line and key visual/logo book LIFEcogeneration.pl was created, and then information and promotion materials about the project, its objectives, activities and results were designed, produced and distributed. All measure objectives were met: **10,000 leaflets, 5,000 brochures, 3,000 booklets, 1,000 CDs/DVDs, 1,000 pcs of gadgets.**

The idea of LIFEcogeneration.pl logo. Fragment from the logo book.



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NFEPWM

D7 Publications about the project

The adopted plan assumed building a rich network of contacts with the media and its permanent maintenance. In this area, Investeko S.A. has achieved considerable success. Skilful contact with the media, building lasting relations with journalists, methodical PR activities implemented by the LIFEcogeneration.pl team allowed to build a very positive media image of LIFEtec as a Polish, safe, cost-effective and environmental friendly technology. Thanks to the constant efforts of the team and the impact of the media, the project significantly exceeded the indicators and results assumed in the grant agreement. The effort put into the implementation of Measure D7 is reflected in a huge interest of the project among the most widely read newspapers in Poland (e.g. Gazeta Wyborcza, Onet.pl, Portal Samorządowy, Puls Biznesu, First Million) and the regional newspapers (Dziennik Zachodni, Gazeta Wyborcza) as well as the most influential ecological media (e.g. Czysta Energia, Przegląd Komunalny, Biomasa). This interest is apparent in the quantity and circulation of appearing publications. Cooperation with the media was one of the significant factors contributing to the increase in the visibility of the project among interested parties and individual citisens. Each month were arranged, many individual meetings, interviews and presentations of project team members with journalists. **During the 5 year period of the project's implementation, the media has received more than 90 original publications.** Besides, publications mentioned above, Investeko ordered a number of sponsored publications, e.g.: ① Czysta Energia (06/2014) ② Gospodarka odpadami (06/2014), ③ Dziennik Zachodni (06/02/2015), ④ Dziennik Zachodni (22/04/2015), ⑤ Przegląd komunalny (10/2015), ⑥ Recykling (12/2015), ⑦ Magazyn Gospodarka Odpadami (10/2016), ⑧ Strefa Biznesu (11/2016).

Skilful contact with the media, allowed us to build a very positive media image of LIFEtec as a Polish, safe, cost-effective and environmental friendly technology.

Close communication was established with organizations, associations, entities operating in the waste and energy management sector: ① EFOE and Close to Environment Company ② Silesian Cluster of Waste Management (SKGO) ③ Silesian Ecological Cluster ④ W2E Cluster. These organizations are regularly provided with publications on the project, which are distributed among their members. The media patronage over the project was obtained from many journals/portals: www.zielonydziennik.pl, www.ecoportal.com.pl www.biznesiekologia.pl, www.odpady.net.pl www.teraz-srodowisko.pl.

Press materials are regularly sent to numerous publishing sites.
As part of Measure D7, the team of Investeko S.A. ordered the recording of various video materials concerning the project. The LIFEcogeneration.pl promotional spot is available here: https://www.youtube.com/watch?v=lYoC77s0tLU

A frame from the spot promoting the LIFEcogeneration.pl project

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D8 Layman's report

This non-technical language report (Layman's report) was written as part of D8 Measure.

D9 Inaugural, opening the demo installation and summarizing conferences

During the course of the project, we organized four large conferences promoting LIFEcogeneration.pl

LIFEcogeneration.pl CONFERENCES	
20/03/2014:	**INAUGURATION CONFERENCE** EuroCentrum, Katowice, PL
31/03/2016:	**WASTE TO ENERGY AS AN ECOLOGICAL VISION OF THE FUTURE** International Congress Centre, Katowice, PL
14-16/03/2017:	**ENERGY FROM WASTE organized in cooperation with publishing house Abrys** Hotel Diament Arsenal Palace****, Chorzów, PL
18/09/2018	**SUMMARY CONFERENCE OF LIFECOGENERATION.PL PROJECT "ENERGY FROM WASTE TODAY"** PGE Narodowy, Warszawa, PL

INAUGURATION CONFERENCE , EuroCentrum, 20th March 2014

Each of the conferences was carefully prepared by the team of Investeko SA. In the organization, every detail was taken care of. Many distinguished guests have appeared at conferences with lectures: doc. Lidia Sieja (Institute of Ecology for Industrial Areas), Andrzej Malara and Robert Potucha (MPGK Katowice), Dawid Kostempski (Mayor of Świętochłowice), Łukasz Tekieli (Marshal Office of the Silesian Voivodeship), Jerzy Swatoń (NFEP&WM), Radosław Domagała (NFEP&WM), prof. dr hab. Czesław Rosik-Dulewska (IPIŚ PAN). The agenda of the conference provided time for a discussion panel with invited experts. The conferences were moderated by well-known radio and television journalists (Michał Olszański and Aleksander Gortat). The substantive partners of the conference were: Institute for Chemical Processing of Coal (www.ichpw.pl), National Chamber of Commerce (www.kig.pl), RIPOK Council (www.radaripok.pl), PlasticsEurope (www.plasticseurope.org). Numerous honorary and media patrons have been obtained. All conferences attracted great interest from the industry and ended with a significant turnout success, networking and information.

"WASTE TO ENERGY AS AN ECOLOGICAL VISION OF THE FUTURE" CONFERENCE - International Congress Centre, Katowice, PL 31st of March 2016

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4. SUMMARY

LIFEcogeneration.pl project lifeline ends with great success. We managed to achieve all the goals we set and implement the planned activities in a timely manner. We are convinced that LIFEcogeneration.pl project is starting a new path in the systematic approach of reducing landfilled waste. It starts in Poland and in Central Europe, however, the problem concerns many EU countries. Our technology represents dispersed energy sources that are an important alternative to large power plants. This is a model solution for those locations that for economic and legal reasons are currently excluded from the waste management system, because it is not possible to build traditional incinerators there. The project confirmed that technology capacity can be easily adapted to the needs of locations interested in implementation. High-efficiency energy production in LIFEtec technology allows to effectively reduce the share of traditional fossil fuels in energy production. LIFEtec is a real answer to the current market needs - through effective management of the over-sieve fraction of MSW characterised by a calorific value above 6MJ/kg, which in Poland has been banned from landfilling since 2016. Business models clearly underline the feasibility of investment for plants with a capacity > 20 000 tonnes.

We are extremely pleased with the success of the LIFEcogeneration.pl project and the growing interest in LIFEtec technology. We are proud to finish this project and remain engaged with the next stage of work - the commercialization phase.

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