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COMPARATIVE ANALYSIS OF VOCATIONAL EDUCATION SYSTEMS IN POLAND, THE CZECH REPUBLIC AND LATVIA

BIOGAS PLANT OPERATOR

EDUCATING EMPLOYEES FOR THE EUROPEAN BIOGAS SECTOR

AUTHORS:

UPEBBI: Magdalena Rogulska, Anna Różańska, Beata Matecka
CZBA: Lada Uskobova, Jan Stambasky
LBA: Baiba Brice, Kristine Vegere

upebbi

Unia Producentów i Pracodawców Przemysłu Biogazowego i Biometanowego

GBA Česká bioplynová asociace

LBA LATVIJAS BIOGĀZES ASOCIĀCIJA

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Union of Producers and Employers of the Biogas and Biomethane Industry UPEBBI
POLAND - LEADER

Czech Biogas Association CzBA
CZECH REPUBLIC - PARTNER

Latvian Biogas Association LBA
LATVIA - PARTNER

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1. Current status of the biogas and biomethane sector in partner countries

1.1 Czech Republic

1.1.1 Current status

The Czech Republic is, with its biogas production of 0.66 MWh per capita, one of the top biogas producing countries in Europe. When it comes to numbers, in 2022 there were 574 AD plants (ADP) providing 2,614 GWh of renewable electricity and 7 biomethane plants (BP) with a total yearly production of ca 1,300,000 m^3 of biomethane (13.3 GWh). All the biomethane produced is injected into the natural gas grid. Development of yearly electricity production from biogas and production of biomethane is shown in Figure 1 and 2.

Fig. 1: Development of gross electricity production from biogas. [1]

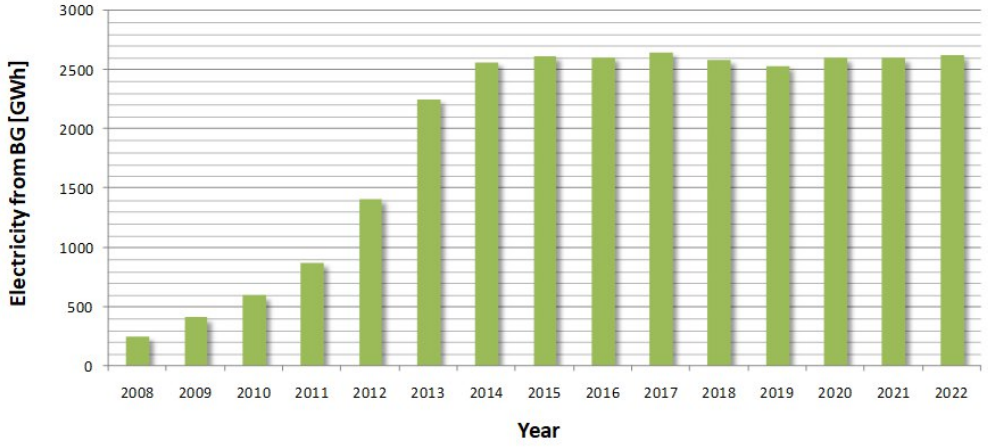
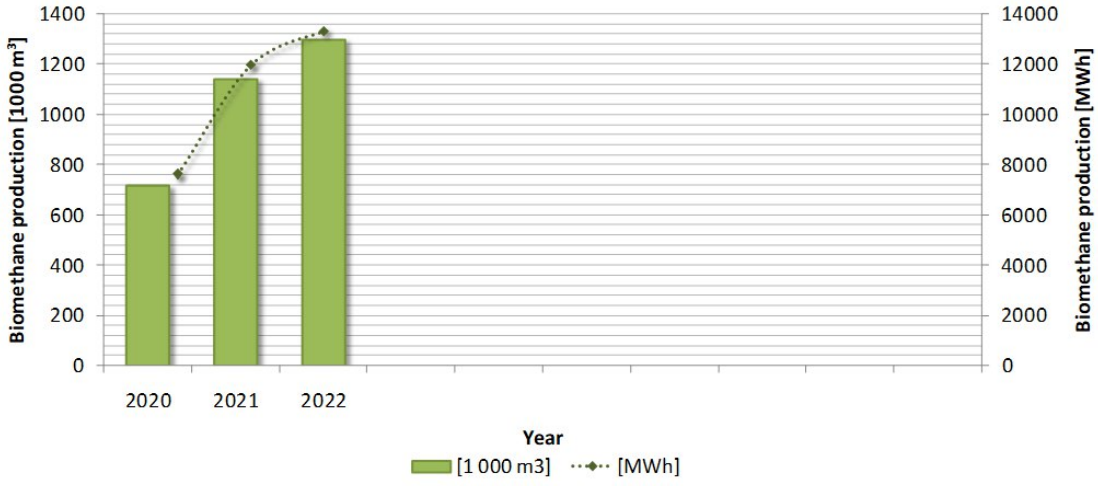


Fig. 2: Development of total biomethane production. [2]

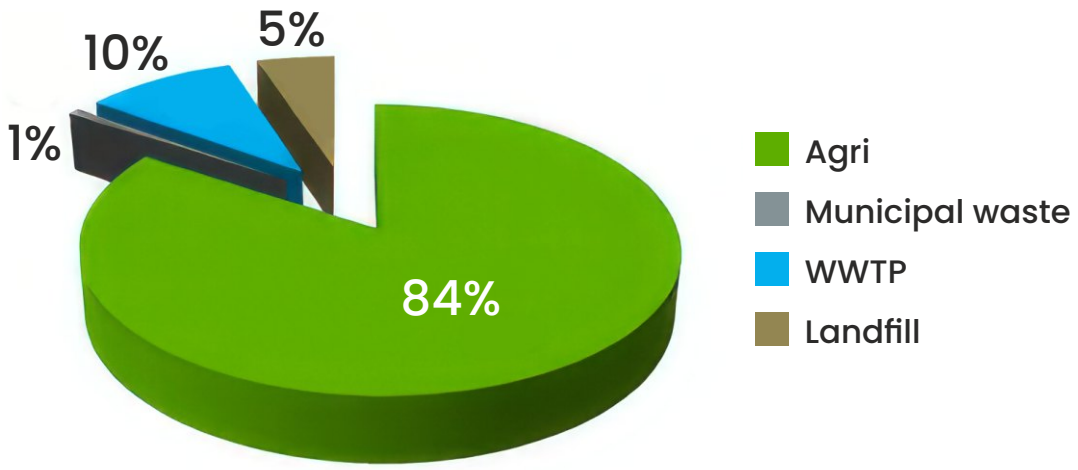


[1] Energy Regulatory Office, data from Yearly Reports on Operation of Czech Electricity Grid and Czech Gas System

[2] Energy Regulatory Office, data from Yearly Reports on Operation of Czech Electricity Grid and Czech Gas System

Large share of production comes from agricultural substrates (Figure 3), which is not compliant with current sustainability trends and EU Directive RED II. Also the biogas is currently used for CHP production, while heat is often wasted making the efficacy of the biogas production questionable. The biogas field therefore needs to be modernised and transformed towards further waste usage and better energy usage, where biomethane should play a major role.

Fig. 3: Share of installed electrical capacity of AD plants based on the processed substrates.



1.1.2 Development forecasts until 2030

Strategic documents of the Czech Republic such as the National Energy and Climate Plan or the National Action Plan for Clean Mobility foresee a relatively significant involvement of biomethane in transport. According to the documents the Czech Republic wants to meet the increasing requirements of the European Union for the share of renewable energy in the gross final energy consumption in this sector – for transport, the RED II legislative package (Directive (EU) 2018/2001) sets a target of 14% in 2030, with 3.5% for advanced biofuels (but with the possibility of double counting). The RED III proposal increases the share of biomethane and other advanced fuels (already without multiplier) to 2.2%, as reported on the European Parliament website.

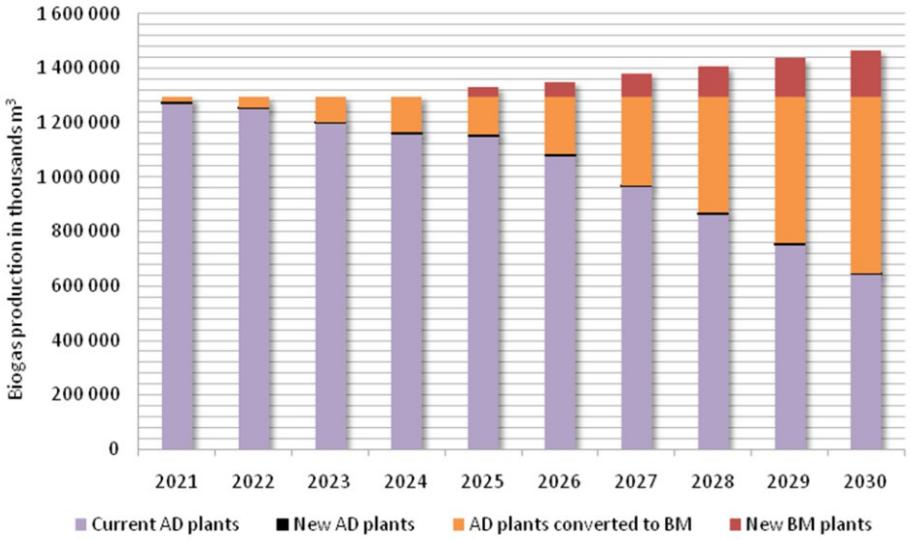
The NECP foresees that biomethane plants will produce just under 100 million m^3 of biomethane in 2025, with about a fifth of this production coming from new plants. For 2030, 400 million m^3 of biomethane production per year is projected, again with at least a fifth supplied by newly built sources (Figure 4).

[3] National Energy and Climate Plan, Ministry of Industry and Trade (2020) – https://www.mpo.cz/cz/energetika/strategicke-a-koncepcni-dokumenty/vnitrostatni-plan-ceske-republiky-v-oblasti-energetiky-a-klimatu--252016/

[4] National Action Plan for Clean Mobility, Ministry of Transport, Ministry of Industry and Trade, Ministry of Environment (2020) – https://www.mpo.cz/cz/prumysl/zpracovatelsky-prumysl/automobilovy-prumysl/aktualizace-narodniho-akcniho-planu-ciste-mobility--254445/

[5] Facts & Figures on the European Union, Renewable Energy, European Parliament (2021) – https://www.europarl.europa.eu/factsheets/cs/sheet/70/renewable-energy

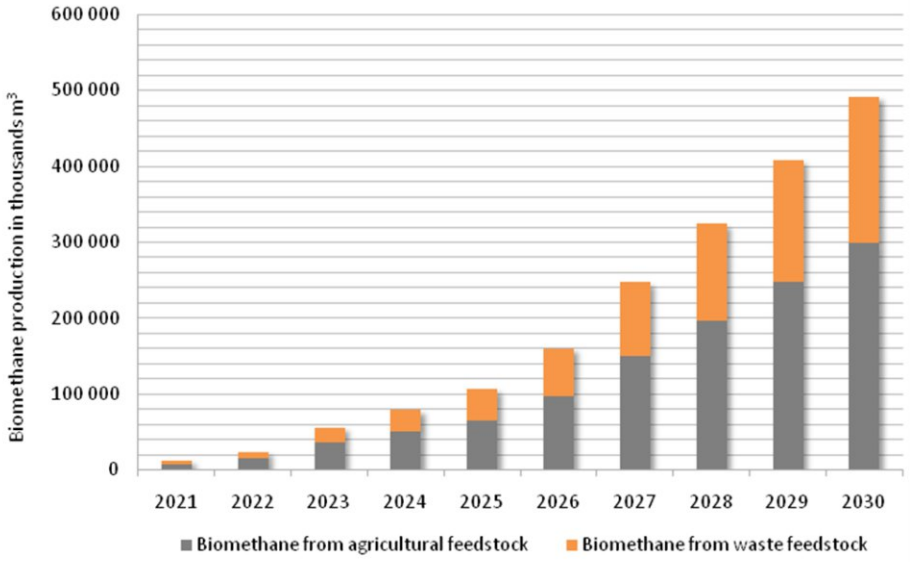
Fig. 4: Projection of development of biogas production according to the the NECP. [6]



Of this amount, less than half (190 million m^3) should be advanced biomethane from waste raw materials primarily for transport, while the remaining biomethane from agricultural raw materials should be used mainly in the heating and cooling sector (Figure 5).

Since landfill gas is technically unsuitable for biomethane treatment (impurities, uneven and low production) and for wastewater treatment plants, at most the largest ten of them can be considered due to minimal effective upgrade capacity and high self-consumption of the treatment plants, virtually the entire burden of advanced biomethane production lies on existing agricultural and municipal biogas plants.

Fig. 5: Expected biomethane production by source. [project Regatrace]



The biomethane from energy crops is expected to be consumed mainly in the heating and cooling sector as mentioned in The Czech Republic's National Energy and Climate Plan.

[6] Project REGATRACE; Study: Biomethane potential in the Czech Republic

In theory if all existing agricultural and municipal biogas plants will be switched to biomethane production, the Czech Republic would reach an annual biomethane production potential of 644 million m3. Including up to 300 million m^3 from new installations, biomethane could cover 10 % of natural gas consumption in the Czech Republic. And if all registered biodegradable waste (including 40 % of mixed municipal waste) were to be used exclusively for biomethane production, it would cover more than 100 % of the raw material needs (potential of 662 million m^3 of biomethane).

However, these are very rough, theoretical figures based on unrealistic assumptions. In reality, there are a number of barriers, either on the part of biomethane producers or on the part of raw material sources, which will not allow this potential to be realised. The real possibilities were investigated by the project CK01000131 Conditions for the real application of biomethane in transport, co-funded by the Technology Agency of the Czech Republic under the Transport 2020+ programme.

Conclusions

The national plan assumes that 1,416.1 TJ of advanced biomethane energy will be consumed in transport in 2025, representing 37.3 million m^3, and 6,554 TJ (172.5 million m^3) in 2030. However, current developments do not suggest these figures.

The Act on Supported Energy Sources (165/2012 Coll.) imposes in Section 47d an obligation on gas suppliers to ensure a minimum share of advanced biomethane in consumption, namely 0.5 % of the total energy in natural gas and biomethane delivered to pumping stations and dispensing units for transport purposes as of 1 January 2023, then 2 % as of 1 January 2025 and even 40 % as of 1 January 2030. For 2023 and possibly 2025, the current production of advanced biomethane was and will be sufficient, as total CNG consumption is less than 100 million m^3 per year.

Meeting the 2030 advanced biomethane production targets exclusively from domestic sources will require considerable effort and is far from certain. Sources in the form of biodegradable waste, agricultural waste and by-products are available to meet the above targets, but their production does not fully coincide with suitable biogas plants in terms of location, availability in terms of competition and waste ownership is an issue, and a major barrier is the reluctance of agricultural companies as BGP owners to enter the waste management sector.

1.1.3 Needs of the biogas and biomethane sector for vocational training graduates

Based on the forecast of the development of biogas and biomethane plants as given above, we can say that in the coming years there will be a high demand in the sector for skilled workers who will be able to perform the job of a biogas or / and especially biomethane plant operator. To meet the advanced biomethane production targets approximately 60 new biomethane plants will have to be built and around 280, ca. half of the existing AD plants, should be transformed to biomethane production sites. These numbers could of course vary depending on the production capacities of the sites. To make the prediction the numbers are based on an average production capacity of biomethane plant in 2022 in the Czech Republic. An average biogas / biomethane plant requires 2 operation employee, therefore we can assume there would be a need for ca. 680 qualified employees, skilled in tasks relevant to biogas as well as biomethane production.

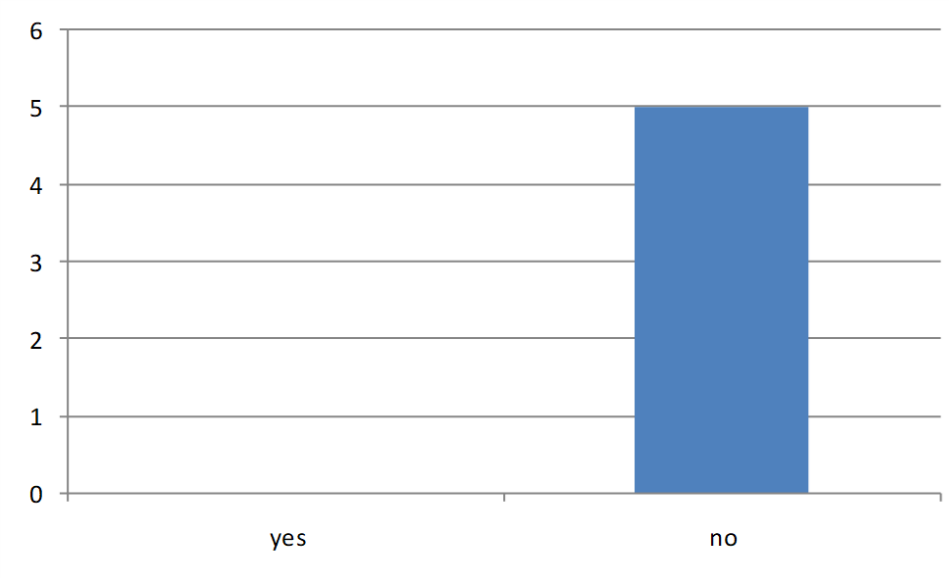
[7] Moeller, F., and Martinsen, L. Socio-economic evaluation of selected biogas technologies. Denmark: N. p., 2013. Web.

Although there is likely to be a need for more than 600 trained employees in the biogas industry and the National Occupational Classification already includes a National Occupational Standard - Biogas Plant Operator (see Section 2.1 for more information), no vocational school currently offers a comprehensive specialized programme for future biogas plant operators. For this reason, CzBA decided to collaborate on this project so that a comprehensive training programme could be offered to Czech vocational schools and their students.

For assessment of biogas sector needs for vocational trainings the 7-points survey was conducted in partner countries.

Results of the survey, CzBA

1. Do you know any state or private school providing comprehensive training for biogas plant operators



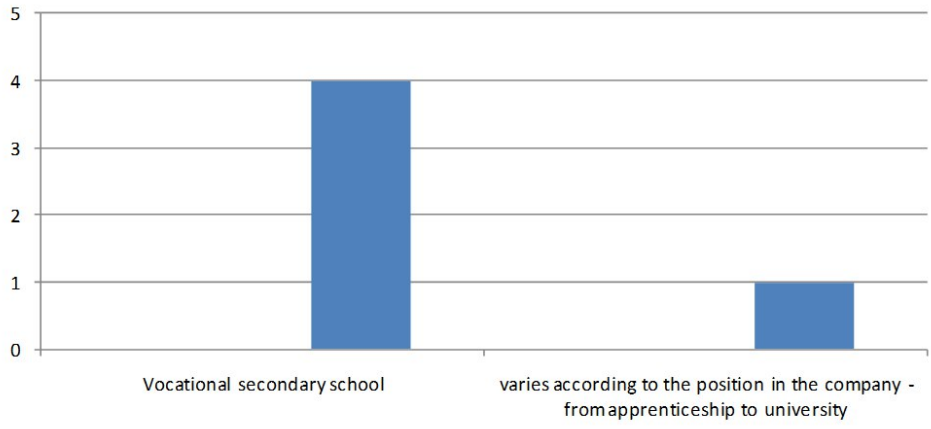
2. What percentage of your current employees is educated in any special biogas plant operator training, or any biogas-facility-related training at all?

3. How do you assess the possibilities of recruiting well-qualified staff for the biogas plant?

4. List the key competencies that, in your opinion, an employee in the position of "biogas plant operator" should have

- occupational safety, biology, technical education
- mechanic, electrician, servicing of heating equipment, servicing of gas equipment.
- engineering knowledge - Electronics (AC/DC) / mechanics, hydraulics, physics, chemistry
- biology, biological processes, organic chemistry, computer knowledge, technical knowledge and skills.
- good knowledge of Biology, basic knowledge of the technical construction of aggregates, as well as a little knowledge of electricity and plumbing. Must drive tractor equipment.
- microbiology, work safety with biogas equipment
- the composition of biogas, the peculiarity of its production, the basics, technical skills in servicing the gas industry.

5. What is the most common level of education of your employees?



6. What qualifications / competences should an employee in the position of "Biogas Plant Operator" have to start working immediately?

- electrician, machinist
- Knowledge of electrics, engine operation, at least a secondary school diploma
- Knowledge of AD plant operation, technically skilled
- min. secondary school diploma and interest to learn new things and good mental endurance
- Technical education (apprenticeship / graduation + OSH training, working in explosive atmospheres, working with dedicated gas and electrical equipment, operating pressure vessels, initial medical examination relevant to the job)

7. When creating an annual professional course for the position of "biogas plant operator", list the three main topics that, from the employer's point of view, should be discussed for the longest time.

- Gas safety, basic biological processes and gas engine maintenance
- Regular engine servicing, gas line care, AD plant pumping system
- servicing of technical equipment
- Knowledge of technology, orientation in reporting, manual dexterity
- Biological processes, technology, decree 50/electrical, OHS, Ex work, first aid, handling/machine licence, operation and servicing of equipment and technology.

1.2 Latvia

1.2.1 Current status

State of the art 2023

Biogas plants	43
Biomethane plants	1
Plants under construction	5

The development of biomethane as a sustainable energy resource in Latvia is currently at a rudimentary stage, with only one operational biomethane plant in the country. Unlike some other countries, Latvia lacks a comprehensive Feed-in Tariff (FiT) and Guarantee of Origin (GoO) system specifically designed for biomethane production and consumption. Consequently, the existing biomethane plant primarily produces biomethane for its own use as a transport fuel, while broader incentives for biomethane remain absent within the country.

It is worth noting that between 2007 and 2012, operators involved in biogas production could apply for FiT subsidies for electricity generation from renewable energy sources (RES). However, due to the adverse economic and social effects of increased electricity costs, these subsidies are gradually being phased out, however, only one plant remains operational within the FiT system. This transition away from FiT subsidies for biogas electricity production has had implications for the biomethane sector in Latvia.

The regulatory framework pertaining to biomethane in Latvia is currently undergoing substantial revisions. Despite the transport sector being one of the major contributors to greenhouse gas (GHG) emissions in the country, the development of the Law on Transport Energy in 2022 was still in progress.

In conclusion, the status of biomethane in Latvia presents both challenges and opportunities. While there is currently only one operational biomethane plant and no specific incentives for biomethane production and consumption, Latvia's national plans demonstrate a commitment to increasing the use of biomethane and advanced biofuels in the transport sector. By strategically promoting the use of biomethane and implementing supportive policies and regulations, Latvia can make significant progress toward a more sustainable and environmentally friendly energy landscape.

1.2.2 Development forecasts until 2030

Currently, Latvia does not have a comprehensive biogas and biomethane strategy in place. To assess the potential impact of national plans on biogas and biomethane production and consumption, it is necessary to review Latvia's sustainable development strategy, nationally defined bioeconomic principles, and waste management plans. The strategies being analysed include the National Energy and Climate Plan, the Sustainable Development Strategy of Latvia until 2030, the Latvian National Waste Management Plan 2021-2028, and the Guidelines for the Development of the Transport System for 2021-2027.

Currently, Latvia does not have a comprehensive biogas and biomethane strategy in place. To assess the potential impact of national plans on biogas and biomethane production and consumption, it is necessary to review Latvia's sustainable development strategy, nationally defined bioeconomic principles, and waste management plans. The strategies being analysed include the National Energy and Climate Plan, the Sustainable Development Strategy of Latvia until 2030, the Latvian National Waste Management Plan 2021-2028, and the Guidelines for the Development of the Transport System for 2021-2027.

Latvia has set goals to increase the share of renewable energy sources (RES) in the transport sector by 7% by 2030, as outlined in its plans under the Renewable Energy Directive II (RED II). To achieve this target, Latvia aims to enhance the utilization of advanced biofuels and biogas, with biomethane expected to account for at least 3-5% of the total transport energy consumption by 2030. Additionally, the use of electricity in the transport sector will be increased.

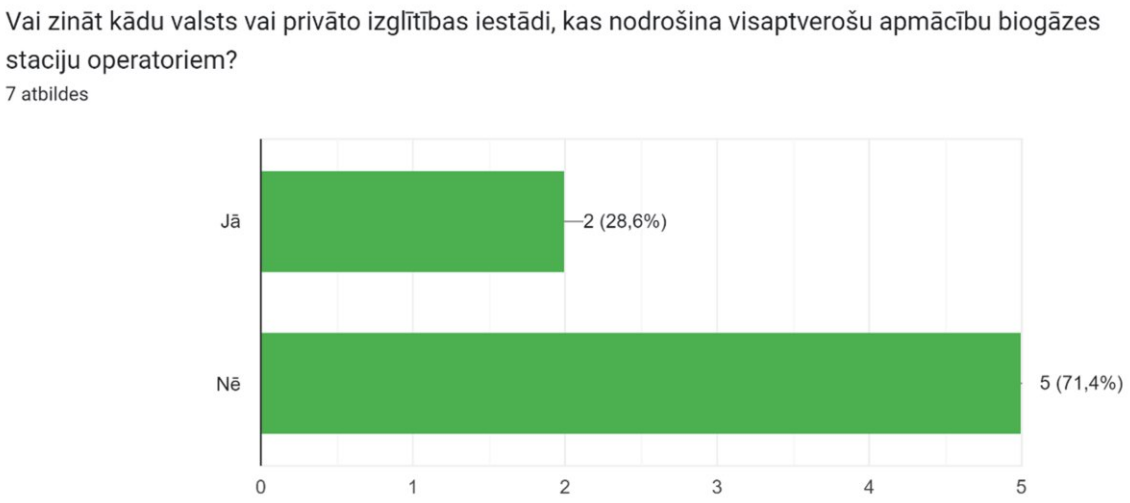
According to RED II plans, Latvia intends to ensure that the share of advanced biofuels in the transport sector reaches a minimum of 0.2% in 2022, progressively increasing to 3.5% by 2030. The National Energy and Climate Plan (NECP) outlines a specific goal for biomethane utilization, aiming to increase its use from the current level of 0.73 PJ to 1.56 PJ by 2030. However, these estimates are indicative and can also be achieved by increasing the share of advanced biofuels. It should be noted that other options may be less cost-effective, making the promotion of biomethane utilization a financially attractive strategy.

The Latvian Biogas Association is calling for a 1,0 TWh biomethane production capacity by 2030, based on current and future production capacities. Opportunities exist for the use of biomethane as a biofuel and the development of infrastructure to support the use biomethane in the form Bio-LNG and Bio-CNG.[8]

1.2.3 Needs of the biogas and biomethane sector for vocational training graduates

Results of the 7-points survey, LBA

1. Do you know any state or private school providing comprehensive training for biogas plant operators



[8] https://www.regatrace.eu/wpcontent/uploads/2022/05/REGATRACE-D6.3.pdf

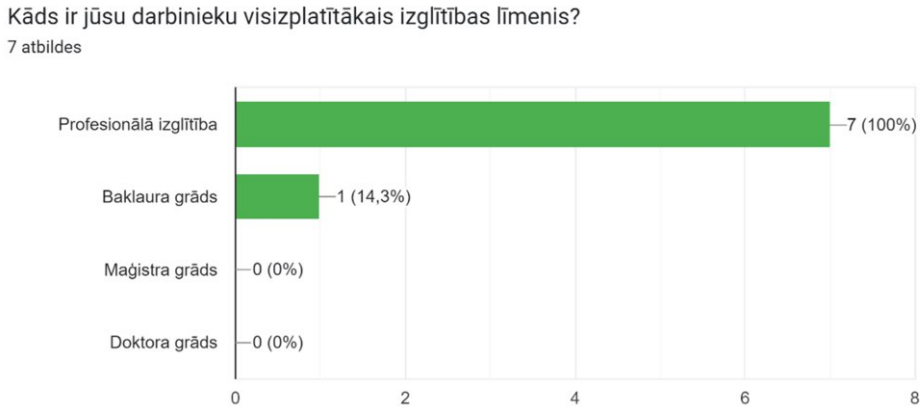
2. What percentage of your current employees is educated in any special biogas plant operator training, or any biogas-facility-related training at all?

3. How do you assess the possibilities of recruiting well-qualified staff for the biogas plant?

4. List the key competencies that, in your opinion, an employee in the position of "biogas plant operator" should have

- Occupational safety, biology, technical education
- Mechanic, electrician, servicing of heating equipment, servicing of gas equipment.
- Engineering knowledge - Electronics (AC/DC) / mechanics, hydraulics, physics, chemistry
- Biology, biological processes, organic chemistry, computer knowledge, technical knowledge and skills.
- Good knowledge of Biology, basic knowledge of the technical construction of aggregates, as well as a little knowledge of electricity and plumbing. Must drive tractor equipment.
- Microbiology, work safety with biogas equipment
- The composition of biogas, the peculiarity of its production, the basics, technical skills in servicing the gas industry.

5. What is the most common level of education of your employees?



6. What qualifications/ competences should an employee in the position of "Biogas Plant Operator" have to start working immediately?

- Technical
- Mechanic
- At least for professional education in engineering and completed courses at the manufacturer for the relevant equipment
- Computer literacy, technical knowledge and skills, fundamentals of biology and organic chemistry.
- There is currently no such qualification. In order to start working, the operator needs at least two weeks of training.
- Logical thinking
- According to qualifications, appropriate work tasks. When acquiring knowledge or qualification, it is necessary to know what skills a person has acquired.

7. When creating an annual professional course for the position of "biogas plant operator", list the three main topics that, from the employer's point of view, should be discussed for the longest time.

- Work safety, gas production process, technology.
- Equipment technical service, heating equipment service, gas equipment service.
- 1. Work safety with dangerous equipment (explosive danger, chemicals (CH4) etc.). 2. Mechanics (internal combustion engine, generator, pumps, etc.) 2. Electronics (information about AC/DC, sensors, control units, regulators, etc.)
- Biology, organic chemistry, basics of locksmith work.
- The very principle of biogas.
- Biology, mechanics, occupational safety
- Work safety, biogas production, equipment maintenance.

1.3 Poland

1.3.1 Current status

In 2021 natural gas made 17% of the total energy supply of Poland, out of which 84% (16.9 bcm) was imported. Production of 0.4 bcm of biogas made 1.8 % of gas supply; biogas was mainly used to produce electricity, either as electricity only or in CHP plants.[9]

Fig.6 Comparison of current natural gas supply, biomethane production and potential in PL (2021)
(sources: Eurostat: Energy Balances, 2022*; Guidehouse: Gas for Climate Report 2022**)[10]

Poland has ability to replace about 20% of current natural gas imports with biomethane which would be beneficial for both energy security and GHG emission reduction from energy sector. Industry estimates Poland's sustainable biomethane potential as 3.3 bcm (3.1 bcm from AD and 0.2 from gasification) by 2030. Poland has a large potential resulting e.g. from agri-food industry, the main supplier of the substrates for biogas plants. In addition, activating the society towards the selective collection of the biodegradable fraction of municipal waste may affect the rapid and intensive development of the market. Considering the potential, Poland could be among the top 5 biomethane markets the EU27 with strong impact on the national market[11].

Current status of biogas and biomethane in the national context

- At the end of 2023, there were **383 biogas installations** in PL with installed capacity of ca. 300 MWe, of which 168 were agricultural biogas plants. The current installed capacity of biogas installations is ca. 300 MW (154,99 MW agricultural biogas plants on 19th December 2023[12]).
- Presently, **there is no biomethane production** in Poland but there are several projects under development, first one plant should start production in 2024.
- **According to the Polish Energy Policy PEP 2040, 10% of gaseous fuels transported via gas grids should be renewable and low-emission ones in 2030 (1,98 bcm).**

[9] energy.ec.europa.eu/publications/2023-biomethane-country-fiches_en

[10] energy.ec.europa.eu/publications/2023-biomethane-country-fiches_en

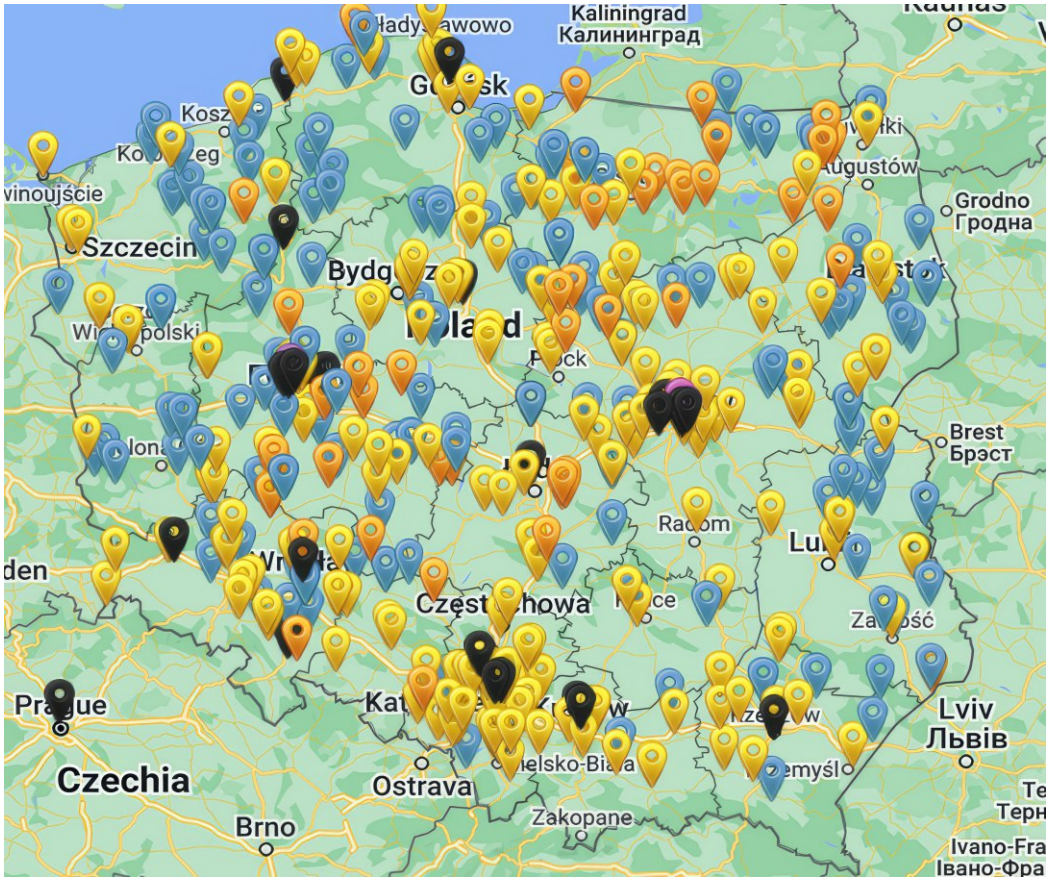
[11] www.gasforclimate2050.eu Gas for Climate report July 2022

[12] www.kowr.gov.pl KOWR (National Center for Agricultural Support)

Three types of **biogas installations** are distinguished in Poland: agricultural biogas plants, biogas plants operating at sewage treatment plants or landfills (using sewage sludge or landfill gas for biogas production) and biogas plants producing energy from mixed substrates (in that wastes). **Definition of agricultural biogas** is given in RES Act[13] (main regulation concerning renewable energy sources and agricultural biogas production); an agricultural biogas producer is required to use only substrates listed in the definition of agricultural biogas. (Article 2(2) of the RES Act).

In Poland in agriculture sector mainly mesophilic fermentation is carried out (32–42 °C); only in few agricultural biogas plants biogas is obtained through thermophilic fermentation (50–57 °C).

Fig. 7 Map of biogas plants
(source: https://magazynbiomasa.pl/mapa-biogazowni-rolniczych-w-polsce-sprawdz-koniecznie/)



Feedstock used in 2022

Currently, Polish agricultural biogas plants commonly use a mixture of several substrates, in a process called co-digestion. The waste material going to the biogas plant must not at any stage mix with other wastes than those resulting from the production profile.

In 2022 over **5,7 million tons** of raw materials[14] were used to produce agricultural biogas. The most important substrate was waste from distilleries (18,8 %), followed by manure & slurry (16,4 %), fruit and vegetable residues (15 %). Other substrates include e.g. sugar beet pulp and expired foods. Price of dedicated crops and changes in legislation stressing sustainability issues reduced significantly usage of purpose-grown biomass like maize.

[13] RES Act (Dz.U. 2023 item 1762)

[14] www.kowr.gov.pl KOWR reports

The use of waste imposes obligations on biogas installations under the Waste Law (Dz.U. 2021 item 779). Applying for a waste processing permit is obligatory for biogas plant. This is a decision issued by a competent public administration authority, which contains information on what waste codes the installation can process.

1.3.2 Development forecasts until 2030

In Poland one of the most important strategic document setting the policy framework is the Energy Policy of Poland until 2040 (PEP2040)[15], adopted by the Council of Ministers in February 2021. According to PEP2040, the share of renewable energy sources in the gross final energy consumption in 2030 is expected to reach at least 23%, whereas GHG emissions are to be reduced by ca. 30% (compared to 1990). The biogas sector will be playing an important part in increasing the flexibility of the new system as a means of gas storage, thereby increasing Poland's energy security. According to the this document 10% of gaseous fuels transported via gas grids should be renewable and low-emission ones in 2030. Actually amendment of PEP 2040 is under preparation. According to an update to Poland's Energy Policy, in 2040, about 73 percent of electricity will come from renewable sources and nuclear power.[16]

Regarding biogas and biomass, the head of the Ministry of Climate and Environment communicated that a capacity of 2.5 GW is expected in 2030, and in 2040 - 3.4 GW.

Presently, **there is no biomethane production** in Poland. There are over a dozen projects ready for implementation (at least 3 in final stage). PSG (Polish OSD) has received more than 100 applications for biogas connection to its distribution network. ORLEN Group is planning to produce 1 bcm of biogas (the equivalent of about 0.65 bcm of biomethane) in modern biogas plants till 2030. Gaz-System (Polish OST) has 26 active permits for biogas connection to its transmission network (in 2020 – it was 3).

Vision elaborated by biogas stakeholders within REGATRACE project[17] proposed following targets:

- **2030 targets:**
  10% biomethane share in the gaseous fuels market, with a 100 biomethane installations.
- **2050 targets:**
  30% share of biomethane in the gaseous fuels market, with 300 biomethane installations.

1.3.3 Needs of the biogas and biomethane sector for vocational training graduates

Results of the survey, UPEBBI [03.2024]

1. Do you know any state or private school providing comprehensive training for biogas plant operators

   Answer from all participants was negative.

[15] https://www.gov.pl/web/klimat/polityka-energetyczna-polski

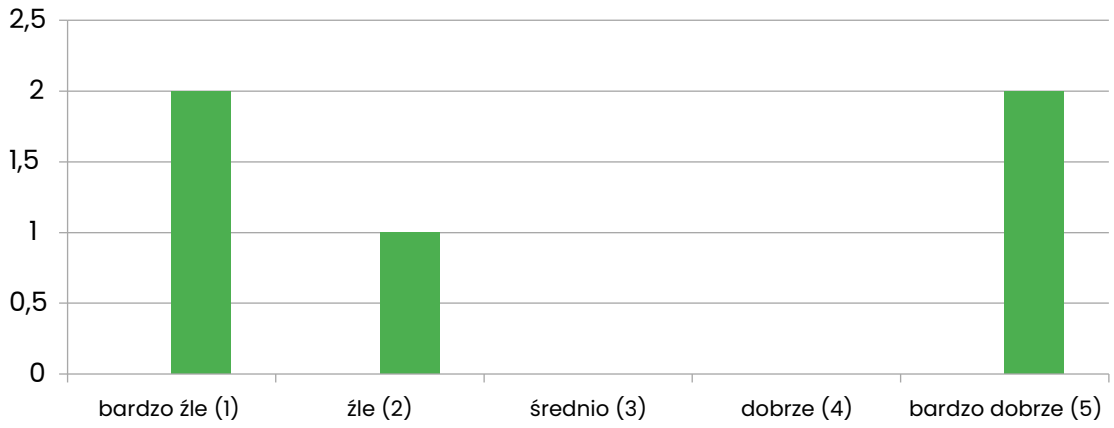
[16] https://www.money.pl/gospodarka/polityka-energetyczna-polski-73-proc-energii-elektrycznej-bedzie-pochodzic-z-oze-i-atomu-6883382351494048a.html

[17] Project REGATRACE www.regatrace.eu

2. What percentage of your current employees is educated in any special biogas plant operator training, or any biogas-facility-related training at all?

- 6 answers – 0%
- 1 answer: *„Training for operators is carried out by employees of our biogas plant with the greatest experience, we do not use external services"*

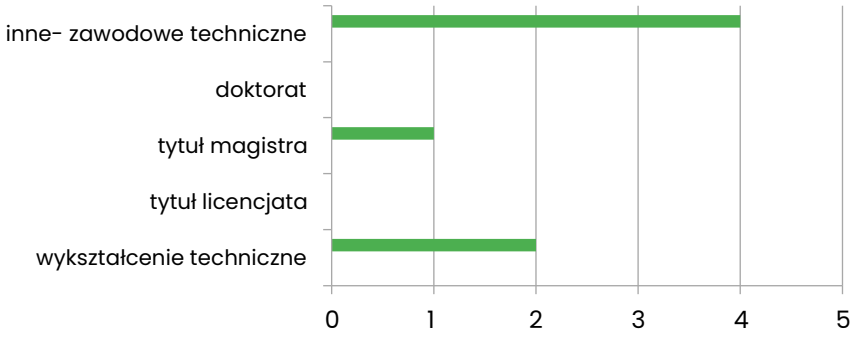
3. How do you assess the possibilities of recruiting well-qualified staff for the biogas plant?



4. List the key competencies that, in your opinion, an employee in the position of "biogas plant operator" should have

- willingness to learn and develop skills related to the position
- concept and initial orientation in the area of electrics and automation, desired "knack" for technical matters (e.g. passion for steering)
- accuracy and diligence in approaching the work performed
- positive attitude, commitment, learning ability, computer skills
- experience is the best
- knowledge of biology, chemistry, electrical engineering, mechanics, operation of low-speed vehicles (forklift, front loader, agricultural tractor)
- electrical and gas qualifications, driving license, basic computer operation, general hydraulic, electrical and mechanical knowledge, readiness to learn about the entire process taking place in a biogas plant

5. What is the most common level of education of your employees?



6. What qualifications/competences should an employee in the position of "Biogas Plant Operator" have to start working immediately?

- knowledge of electricity, automation and general principles of work of an agricultural biogas plant operator
- technical knowledge - e.g. Developing the ability to diagnose and remove mechanical faults within the plant (electrical, plumbing, automation)
- knowledge about possible threats and failures, including ways to counteract them and learning the desired procedures (standards of behavior) in situations when a given crisis situation occurs.
- technology and biology of the process
- process control automation
- energy issues

7. When creating an annual professional course for the position of "biogas plant operator", list the three main topics that, from the employer's point of view, should be discussed for the longest time.

- Fermentation processes with the ability to test pH: FOS/TAC, and the interaction of various types of raw materials on fermentation processes.
- Operation of electrical equipment (mixers, pumps, etc.) and energy equipment (cogeneration system)
- Threats to employees and continuity of technological processes
- Biogas plant from the mechanical and electrical side (dosing systems, mixers, roofs, pumping stations)

2. The current state of vocational training in the partner countries on RES, especially biogas

2.1 Czech Republic

The main body responsible for initial vocational education and training (IVET) is the Ministry of Education, Youth and Sports. Representatives of employers are involved in curriculum development and participate in 28 sector skill councils responsible for creation of occupational and qualification standards. VET is provided at lower and upper secondary, as well as tertiary level.

IVET is mainly school-based, but work-based learning (WBL) is an integral part of the programme (13-80% of instruction time). WBL may take place at companies' work-sites or in school workshops or facilities.

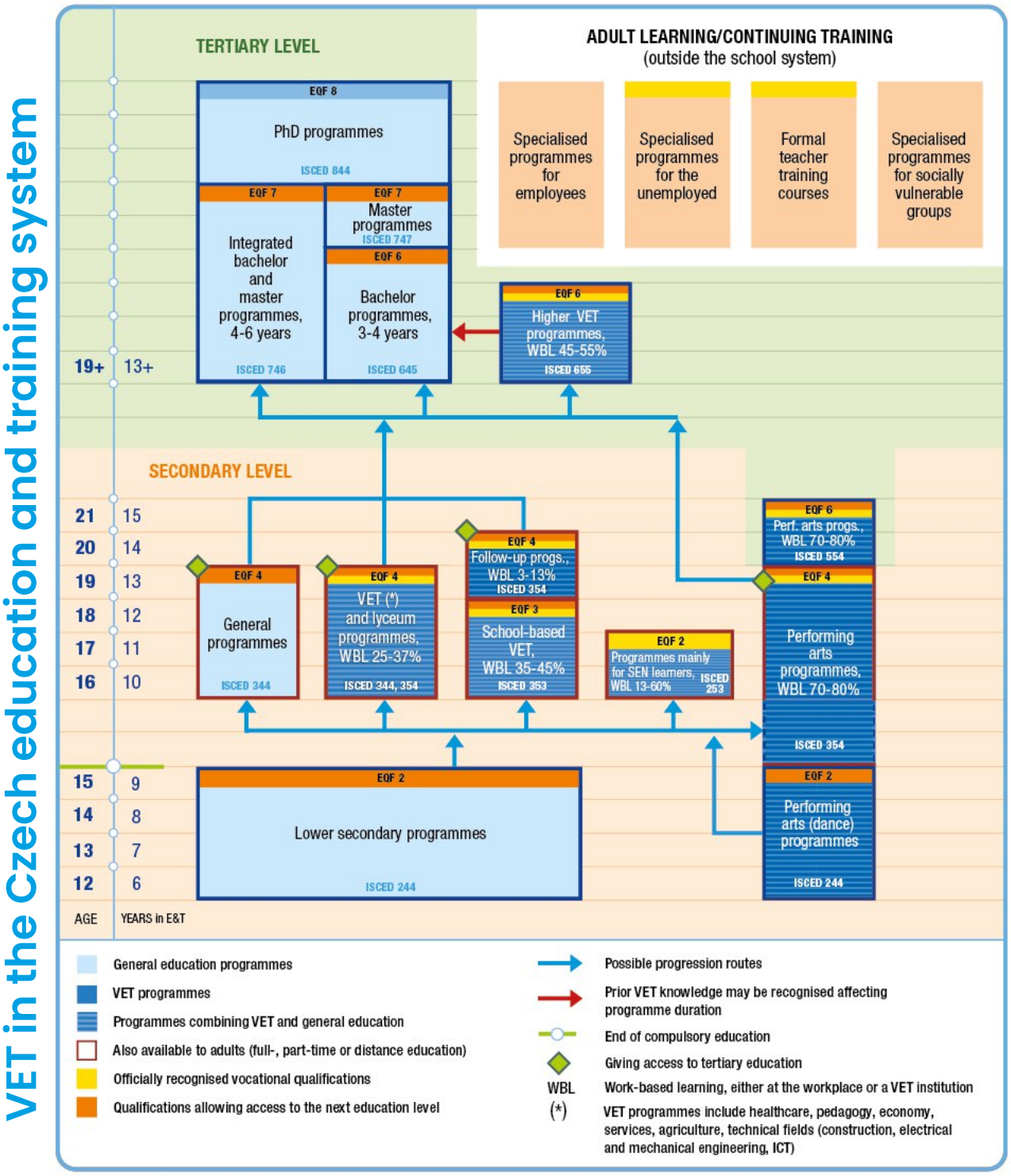
VET predominantly begins following completion of compulsory education. Secondary IVET programmes (European Qualifications Framework, EQF 2) last 2 years and are designed primarily for learners with special education needs. These programmes are completed with a final exam or with a 'VET certificate'.

Upper secondary level VET programmes (EQF 3-4) last 3 to 4 years. They include the following options:

- 3-year VET programmes at EQF 3 (completed by a VET examination leading to a VET certificate) enable graduates to enter the labour market directly and perform manual occupations (bricklayer, hairdresser, etc.). Graduates of these programmes can follow a 2-year follow-up programme (EQF 4) and take a maturita examination, which opens an access to higher education;
- 4-year VET programmes (completed with a maturita examination, EQF 4) enable graduates to continue learning in higher education or perform mid-level technical, business, service, health and other similar jobs (construction technician, travel agent, etc.);
- 4-year lyceum programmes with a high proportion of general education (up to 70% of the curricula) prepare their graduates for studies at higher education institutions or to enter the labour market;
- programmes offered by conservatories have a different setup, preparing for performance in demanding music, dance, singing and drama activities. Studies are completed with an absolutorium (3) (EQF 6), but learners may optionally take a maturita examination (secondary education, EQF 4);
- learners who have already completed upper secondary education have an option to acquire a (second) qualification in another field in the so-called shortened programmes. Those with maturita (EQF 4) can acquire a VET certificate or another maturita certificate in a relevant field; those with a VET certificate (EQF 3) can only acquire another VET certificate in a relevant field. Shortened programmes are suitable also for adults and last 1 to 2 years.

The scheme of education system in the Czech republic is shown in Figure 8.

Fig. 8 : Vocational education and training system chart[18]



NB: ISCED-P 2011.
Source: Cedefop and ReferNet Czechia, 2022.

Designing qualifications

In the past decade, important steps have been taken regarding defining and updating qualifications and the 281 national VET curricula to respond better to labour market needs. Key parts of the system have been developed, mostly through individual projects.

[18] Cedefop; National Institute for Education (2022). Vocational education and training in Europe - Czechia: system description https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/czechia-u2

The National register of qualifications (Národní soustava kvalifikací, NSK) was introduced in 2007. It includes descriptions of qualifications in the form of standards for the so-called:

- vocational qualifications;
- complete vocational qualifications.

These have been gradually developed. In August 2021, there were 1,396 standards of vocational qualifications and 211 standards of complete vocational qualifications publicly accessible in the register. All approved standards and related information are published in the NSK information system in Czech and English.

Labour market requirements described in the qualification standards have been considered during the creation and will be also taken into account during the revision of the national VET curricula.

Curriculum development (up to the upper secondary level)

Within the formal school system, curricula up to the upper secondary level are developed at two levels. At national level, national curricula (Rámcové vzdělávací programy, RVP) are developed under the responsibility of the education ministry, with the minimum requirements for State-regulated education programmes. There are 281 national VET curricula, one for each individual field of education (VET programme). They are focused mainly on learning outcomes and key competences. At local level, upper secondary schools design their own school education programmes or school curricula (školní vzdělávací programy), based on national curricula. The objective is to allow for a more flexible shaping of graduate profiles in line with regional needs, latest developments in the relevant field and the interests and capacities of learners.

The updated national curricula for upper secondary VET were launched by the education ministry in September 2020. These updates refer to the vocational component of education, linking them to the National register of qualifications (NSK). National curricula now include economic concepts in line with the updated financial literacy standards, approved by the Ministry of Finance.

Actors involved in designing qualifications

25 so-called field groups were established, consisting of experts from education, labour market and occupations. The field groups have been working for more than 20 years with the support of the education ministry to foster the creation of the national VET curricula, with objectives and contents in line with labour market needs. In 2020, field groups were transformed into eight field platforms.

Sector councils (sektorové rady, SR), have been operating since 2006 (during the last decade national), primarily in the process of defining occupation and qualification standards. They bring together representatives of key stakeholders, especially employers. Currently there are 28 sector councils consisting of 350 representatives of employers, educators and ministries. They work on labour market skill needs analysis and the development of qualification and assessment standards of vocational qualifications in relation to occupations defined in the national system of occupations. The activities of sector councils have become limited in recent years as their funding, through European Social Fund (ESF) projects, was terminated. Currently, the level of their engagement in qualifications development varies and is based mainly on individual initiatives.

The National Pedagogical Institute of the Czech Republic (NPI ČR) oversees the coordination and methodological accuracy of the curricula developed for upper secondary education. The NPI ČR submits

The fields of study in which the vocational training course for biogas plant operators could be implemented and the number of schools offering them are shown in Table 1.

Table 1: Fields of study that could implement specialised training for biogas plant operators.

Code	Field of study	Number of schools
16-01-M/01	Ecology and Environment	24
16-02-M/01	Industrial Ecology	4
41-45-L/51	Mechanization of agriculture and forestry	4
41-45-M/01	Mechanization and services	10
41-55-E/01	Maintenance work	23
41-55-H/01	Repairer of agricultural machinery	61
23-41-M/01	Mechanical engineering	73
23-43-L/51	Operating technology	41
23-44-L/01	Machinery and equipment mechanic	25
23-51-H/01	Mechanical engineer	119
23-51-E/01	Mechanical engineering work	35
23-45-L/01	Mechanic adjuster	57

2.2 Latvia

Vocational education and training (VET) in Latvia is offered at three levels: lower secondary (part of the national 'basic' education; integrated primary and lower secondary); upper secondary (secondary); and tertiary (professional higher) education. It includes practical training (50% to 65% of curricula) at schools and enterprises. In 2015, an apprenticeship scheme (called 'work-based learning' nationally) was introduced with alternating study periods at school and in an enterprise. The scheme is available for all VET programmes at EQF levels 2 to 4. To acquire a VET qualification at these levels, all VET learners take a State qualification exam at the end of the programme.

Basic VET programmes (one to three years, ISCED 254) lead to qualifications at EQF level 2. Learners must be at least 15 years old to enrol. Those without completed basic education are admitted to 3-year programmes (ISCED 254) that include a compulsory basic general education course.

At upper secondary level, VET enrols learners in:

- 3-year programmes (ISCED 353) leading to a qualification at EQF level 3. To enrol in higher education, graduates should attend an additional 1-year follow-up programme;
- 4-year programmes (ISCED 354) leading to a secondary VET qualification at EQF level 4. Graduation from the programme requires both the VET qualification and success in four State exams in general subjects, giving access to higher education;
- 1- to 2-year programmes (ISCED 351 and 453) leading to a qualification at EQF levels 3 and 4. These programmes are designed for 17 to 29 year-olds with or without completed upper secondary education. They focus on vocational skills, so they are shorter.

the proposals of the developed qualification standards to authorising bodies for feedback (there are 16 authorising bodies, usually ministries). The final approval of standards is the responsibility of the education ministry.

In 2016, the education ministry initiated an agreement between the key employer representatives (Czech Chamber of Commerce, Confederation of Industry of the Czech Republic, Czech Agrarian Chamber and Union of Employers' Associations of the Czech Republic), allocating responsibilities for specific IVET areas. These stakeholders have divided responsibilities among themselves for particular fields of education. For example, the Union of Employers' Associations of the Czech Republic is responsible for qualifications in the textile and clothing sector.

Current state of vocational training for biogas plants operators

National occupational standard – Biogas plant operator (code: 23-075-H) (level 3)

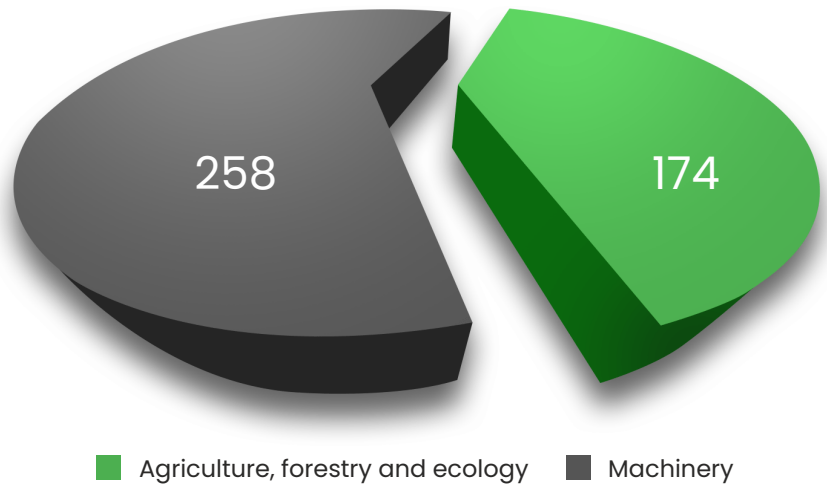
Description of the profession as it appears in the National Occupational Classification which is an open and accessible database of occupations managed by Ministry of Labour and Social Affairs of the Czech Republic.

"The biogas plant operator controls and implements regular processes in the biogas plant, assists in the delivery of raw materials and materials, ensures the delivery of materials to the fermenter, regularly checks measuring and control elements, operates automatic equipment of the biogas plant, reports malfunctions and non-standard conditions, carries out minor repairs and adjustments, assists in major repairs, helps to solve possible accidents[19] ."

Vocational education programmes on RES, especially biogas

Currently, no vocational school in the Czech Republic offers a specialised vocational training programme for biogas plant operators. However, there are 432 schools providing secondary education that could implement specialised training for them, especially schools specialised in the fields of agriculture, forestry and ecology and schools providing education in the field of machinery[20] (Fig. 9).

Fig. 9: Number of schools providing secondary education in the fields of agriculture, forestry and ecology and machinery



[19] https://nsp.cz/jednotka-prace/pracovnik-obsluhy-bioplyn

[20] data acquired from: https://www.atlasskolstvi.cz/

The Ministry of Education and Science is the main body responsible for the VET legal framework, governance, funding and content. Social dialogue and strategic cooperation are arranged through the national Tripartite Sub-Council for Cooperation in Vocational Education and Employment. Twelve sectoral expert councils ensure that VET provision is in line with labour market needs; they participate in developing sectoral qualifications frameworks, occupational standards, qualifications requirements, education and training programmes and quality assessment procedures. Since 2015, collegial advisory bodies, including representatives from employers, local governments and the supervising ministry – conventions – have been established at each VET school contributing to strategic development and cooperation with the labour market.

Initial VET is centralised and highly regulated by the State. Most vocational schools are owned and run by the State; half have the status of vocational education competence centres, receiving substantial investments in infrastructure and equipment with the support of EU funds since 2007. In addition to provision of vocational programmes, they validate non-formal and informal learning and offer lifelong learning and continuing teacher training.

Comprehensive reforms of VET content – the introduction of modular vocational education programmes, new occupational standards and sectoral qualifications frameworks – increase the responsiveness of VET to labour market needs and support the use of learning outcomes.

VET governance

The vocational education system is governed by the following institutions:

1) **The Cabinet of Ministers** (Ministru kabinets) defines policies and strategies for vocational education, State vocational education standards and sets procedures for the development of occupational standards, the organisation of work placements/apprenticeship-type scheme, and professional qualification exams. It regulates mandatory documents for vocational education provision, a list of mandatory occupational standards, activities of sectoral expert councils, licensing and accreditation procedure and the quality assurance of the examination centre. It sets the criteria for issuing State-recognised qualifications, and recognising foreign qualifications. It sets the price list for validation of informal and non-formal learning, it grants the status of 'vocational education competence centre' to providers, and it sets the procedure for distributing the State budget subsidies earmarked for provision of vocational education, teachers' salaries, and price lists for services in VET schools

2) **The Ministry of Education and Science** (MoES) develops the framework regulations for vocational education. It proposes allocation of funds from the State budget and finances the vocational education providers it has established. The ministry also organises the implementation of career education, ensures validation of informal and non-formal learning, approves regulations and appoints heads of vocational education institutions under its responsibility. MoES approves VET school development strategies, carries out monitoring of VET schools, approves curricula of VET schools, provides methodological support, plans and implements teacher training.

3) **Other ministries** (culture, welfare and interior) propose the allocation of funds for vocational schools under their responsibility, and organise continuing professional development for teachers. The ministries also organise continuing vocational education for adults, and professional development and training for the unemployed. They cooperate with MoES on designing occupational standards, ensuring quality assurance and other issues.

4) **The National Centre for Education** is under the supervision of MoES. It develops the content of basic, secondary and continuing vocational education, professional development and vocationally oriented education and interest education. It develops VET curricula and procedures for State exams and coordinates development of teaching and learning materials in line with the State vocational education standards. The centre also coordinates the development of occupational standards and the professional development of vocational education teachers.

5) **The State Education Quality Service** is under the supervision of MoES. It licenses general and vocational education programmes (at EQF level 1-4) and provides accreditation of VET schools and VET programmes. It also ensures quality assurance of vocational education (except professional higher), coordinates validation of learning outcomes of informal and non-formal learning (at EQF level 2-4); since 2013 it has coordinated the implementation of the common European quality assurance for VET (EQAVET) in Latvia.

6) **The State Education Development Agency** is under the supervision of MoES. It manages and monitors EU funds ex-post, it introduces EU education programmes, it supports the development of career education policy, arranges national-level professional skills competitions and ensures participation in international skills competitions.

7) **The Ministry of Welfare** develops labour market policies, including training interventions.

8) **The State Employment Agency** is under the supervision of the Ministry of Welfare. It implements labour market policies, including programmes for the unemployed, job seekers and employees at risk.

9) Local governments participate in the implementation of vocational education by managing their own VET schools, including school curricula. They promote business development in their territory, cooperate with employer organisations and help students find work placements.

Designing qualifications

Since April 2018, 15 sectoral qualifications frameworks reflect an agreement between educators and employers on qualifications required by the labour market. The sectoral qualifications frameworks serve as guidelines for developing occupational standards and implementing vocational education programmes, including modules leading to specialisations.

Vocational education programmes are designed in line with the State education and occupational standards or qualification requirements (if the occupation does not have a standard), and sectoral qualifications frameworks.

The content of vocational education programmes is defined by State vocational education standards. The standards include strategic aims, basic principles, mandatory content, ratio of theory and practice and evaluation procedures. Vocational education providers also ensure that specific skills and competences required in the occupational standards/professional qualification requirements are included in the programmes they offer.

Occupational standards and professional qualification requirements are elaborated by designated working groups comprising representatives of ministries, local governments, employers, employees, chamber of commerce and industry, NGOs and vocational education providers. The standards are endorsed by the National Tripartite Subcouncil for Cooperation in Vocational Education and Employment. They are reviewed at least once every five years.

Since 2007, occupational standards have to include necessary professional competences, skills, and knowledge to perform professional activities. There are 240 occupational standards and professional qualification requirements for all professional qualifications in 15 sectoral qualifications frameworks.

The modular approach for vocational education programmes includes use of learning outcomes, relevant teaching / learning methods and indicators of achievement. In 2017, the amendments to the Vocational Education Law set the legal framework for the modularisation of vocational education programmes. Modules are defined as parts of professional qualifications and are based on learning outcomes as an assessed and approved set of knowledge, skills and competences. Modular vocational education programmes lead to qualifications at EQF levels 2-4 and their professional content consists of a set of modules. After completing one or several modules recognisable in the labour market, but not proving acquisition of a qualification, vocational schools will have to issue a new type of certificate indicating the programme, module(s), achieved learning outcomes and their assessment. In 2017, modules have been included in the State vocational education standards.

The 332/2020 Regulations on State Vocational Education Standard define objectives, tasks, structure of vocational education curricula, parts of curricula, percentages of parts of curricula, Qualification exams that consist of theoretical and practical parts are designed in line with both occupational and State vocational education standards. Representatives from relevant sectoral organisations participate in the examination process.

Quality assurance.

The State Education Quality Service organises licensing and accreditation of vocational education programmes, and accreditation of vocational education providers and examination centres of State, local government and private entities. A licence is permission to implement a particular programme that meets all requirements of State vocational education and occupational standards or professional qualification requirements. Providers must ensure proper infrastructure and equipment and, if necessary, obtain an agreement from the relevant professional association. The State Education Quality Service issues a licence for an indefinite period and register the licensed VET programmes in the State Education Information System.

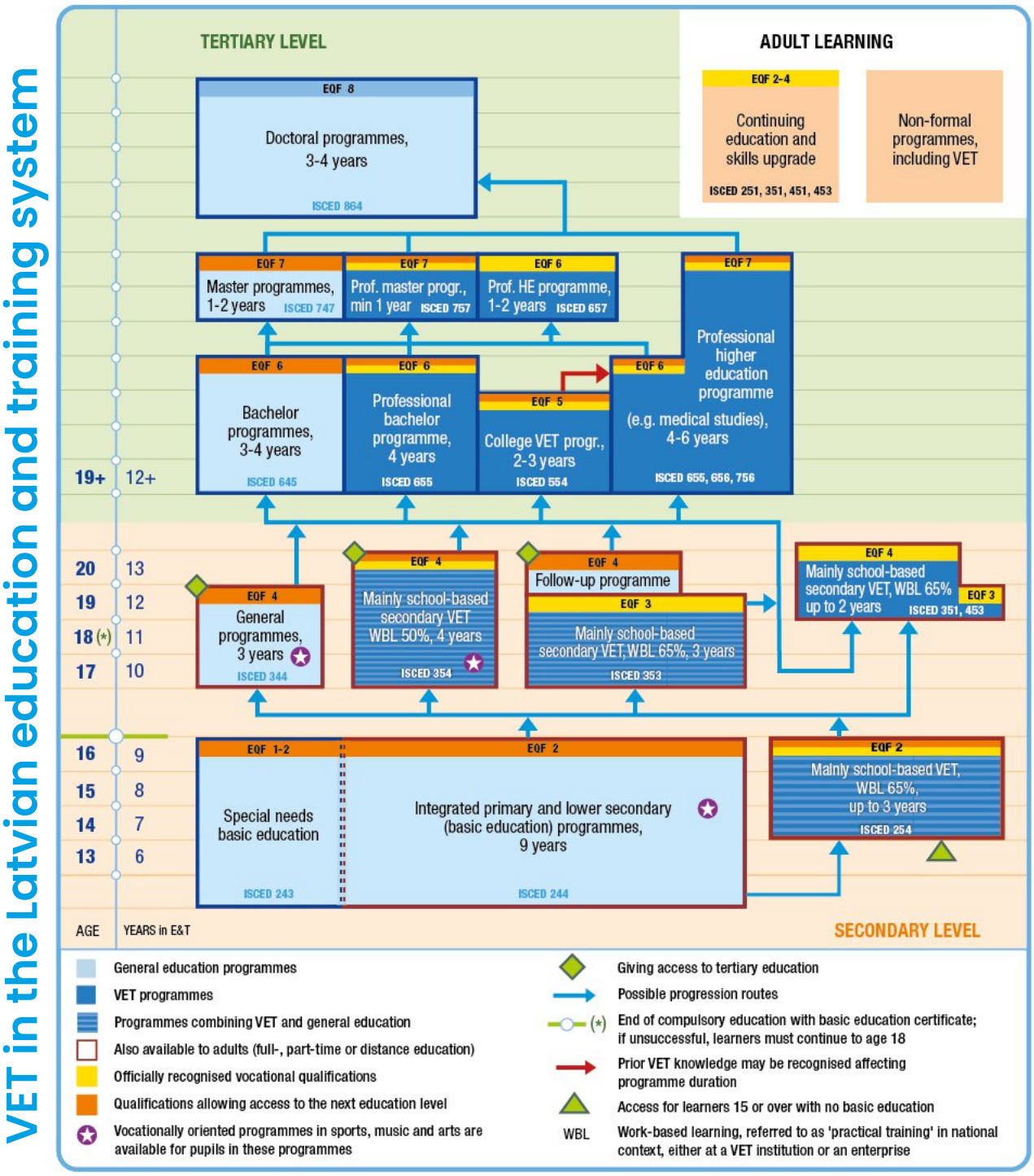
Accreditation is the evaluation of the performance of the relevant education provider and/or the quality of implementation of the education programme. As a result of accreditation, an education provider obtains a right for two to six years to issue a State recognised qualification for a particular programme. During the accreditation process, the quality of the implementation of an education programme is evaluated against criteria aligned to EQAVET.

All public continuing vocational education programmes (480 hours or more) and professional development programmes (160 hours or more) must be licensed and accredited by the State Education Quality Service. Providers of professional development programmes (159 hours or less) must obtain a licence from local government. Public providers can offer non-formal learning programmes without a licence.

The National Centre for Education ensures/coordinates the development of content for vocational education (except higher education) in compliance with the State vocational education standards, occupational standards and professional qualification requirements. It also ensures development and implementation of uniform content for vocational education State examinations, coordinates development of teaching/learning aids complying with State general and vocational education standards, and coordinates teachers' professional development.

The Higher Education Council is responsible for quality assurance of higher (including professional) education. The council takes decisions on accreditation of higher education institutions in general and submits them to the Ministry of Education and Science for approval.[21]

Fig. 10 : Vocational education and training system chart (source CEDEFOP)



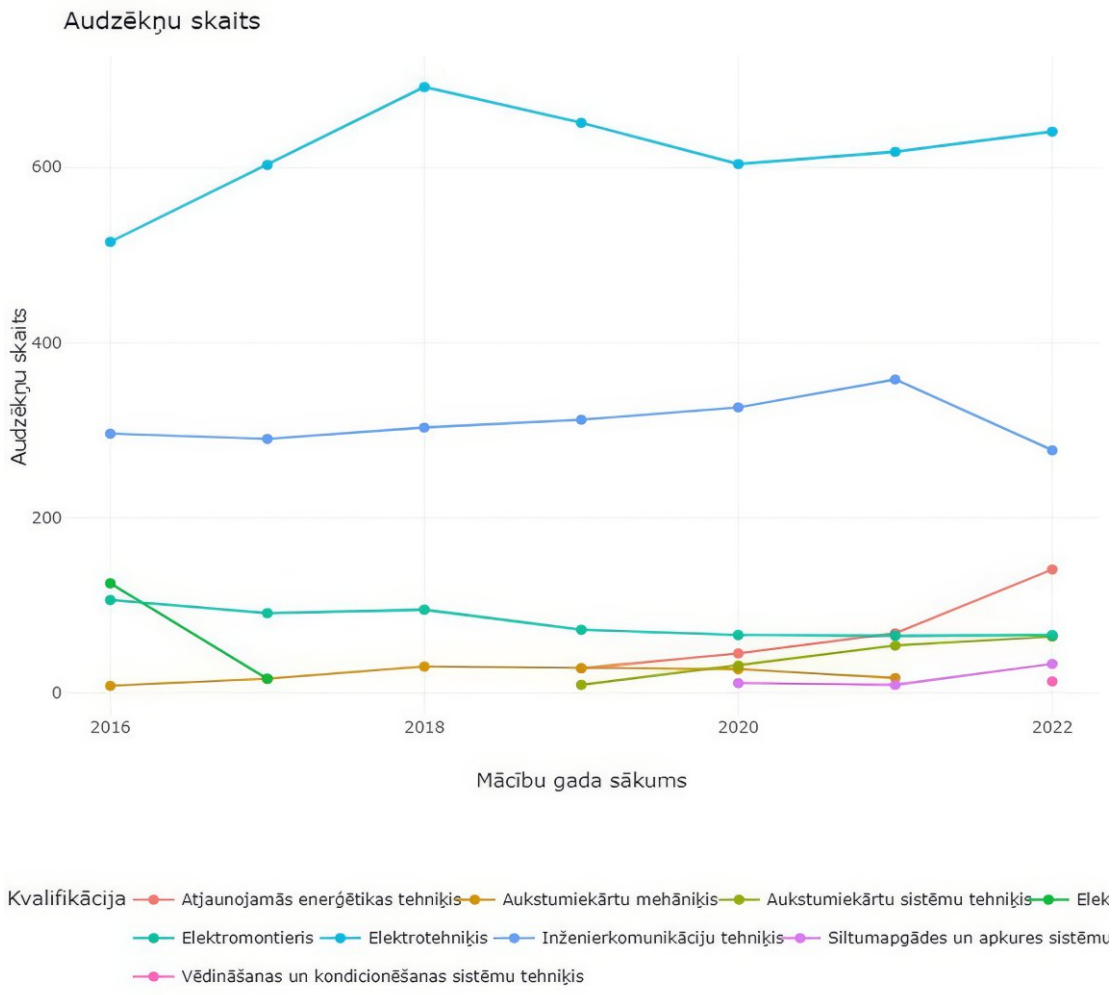
NB: ISCED-P 2011.
Source: Cedefop and ReferNet Latvia, 2022.

[21] Vocational education and training in Europe. Detailed description of VET systems in Europe. Latvia., https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/latvia-u2, accessed 30.01.2024.

Fig. 11: vocational schools statistics[22]

Vocational schools	2022	2023
Total number of vocational schools (programmes of vocational education and professional secondary education can be acquired)	54	53
..higher education institutions (programmes of vocational education or professional secondary education can be acquired)	10	10
..professional secondary education institutions (programmes of vocational education or professional secondary education can be acquired)	42	41
..secondary schools (programmes of vocational education or professional secondary education can be acquired)	2	2
Teaching staff of vocational schools (in main job)	2359	2344

Fig. 12: VET students with qualification in energy related sectors – orange line is renewable energy technician[23]



[22] https://stat.gov.lv/en/statistics-themes/education/vocational-education/8157-vocational-schools-students, https://stat.gov.lv/en/statistics-themes/education/vocational-education/8156-vocational-schools?themeCode=IGR, accessed 30.01.2024

[23] https://nep.lddk.lv/, acsessed 07.02.2024.

The qualification "renewable energy technician" can be acquired by 5 educational institutions covering all regions of Latvia:

- Daugavpils Tehnoloģiju un tūrisma tehnikums
- Liepājas Valsts tehnikums
- Rīgas Valsts tehnikums
- Valmieras tehnikums
- Vidzemes Tehnoloģiju un dizaina tehnikums.

Example - short description of the programme provided by the Liepājas valsts tehnikums:

Renewable energy technician is a specialization for the profession "Electrician".

The renewable energy technician plans, organizes and carries out the construction and monitoring of renewable energy equipment that uses renewable energy resources in the production of electricity and heat energy, plans and organizes the supply, placement, storage and disposal of production waste of materials, resources and equipment necessary for production, in accordance with the work assignment and /or the supervisor's instructions, attracting the necessary specialists.

Program content:

1) Basic processes of electric power and types of electrotechnical works
2) Fundamentals of electrical engineering and electrical measurements
3) Connection of electrical machines and equipment
4) Completing the electrotechnical documentation
5) Use of renewable resources in electricity production
6) Use of renewable energy for thermal energy production
7) Assembly and installation of renewable energy equipment
8) Operation of renewable energy equipment
9) Work in a live environment
10) Driving construction machines for the construction of electrical networks
11) Job/Internship opportunities

A renewable energy technician can work in various factories with hydro, thermal, atomic, wind or other types of energy electrical installations, electricity transmission and distribution companies, construction companies, utilities and public companies.[24]

[24] https://www.niid.lv/niid_search/program/26869?qy=&ct=los&tg=&level_1=4&subject_1=52&subject_2=522&qualification=Atjaunojam%C4%81s%20ener%C4%A3%C4%93tikas%20tehni%C4%B7is%404, accessed 07.02.2024.

2.3 Poland

Since September 2017, the Polish education system has been undergoing substantial restructuring, to be finalised in the 2022/23 school year. VET is provided mainly in school-based upper secondary and post-secondary programmes. Upper secondary programmes combine general and vocational education. Learners can acquire vocational qualifications in:

- 3-year first stage sectoral programmes (branżowe szkoły I stopnia, ISCED 353) leading to a vocational qualification diploma for a single-qualification occupation (after passing State vocational examinations). Graduates can enrol in the second year of general upper secondary programmes for adults or in a second stage sectoral programme;
- 2-year second stage sectoral programmes (branżowe szkoły II stopnia, ISCED 354), launched in the 2020/21 school year. These further develop the vocational qualifications attained in first stage sectoral programmes. General education is provided in full-time day or evening classes, or extramurally. Graduates can acquire an upper secondary school leaving certificate (matura) providing access to tertiary education;
- **5-year vocational upper secondary programmes (technika, ISCED 354) leading to a vocational qualification diploma for occupations consisting of two qualifications after passing State vocational examinations. Graduates can acquire an upper secondary school leaving certificate (matura) giving access to tertiary education;**
- 3-year special job training programmes (szkoły specjalne przysposabiające do pracy, ISCED 243) for special education needs (SEN) learners leading to a job training certificate;
- work preparation classes for SEN learners aged 15 and above already in primary school (oddziały przysposabiające do pracy).

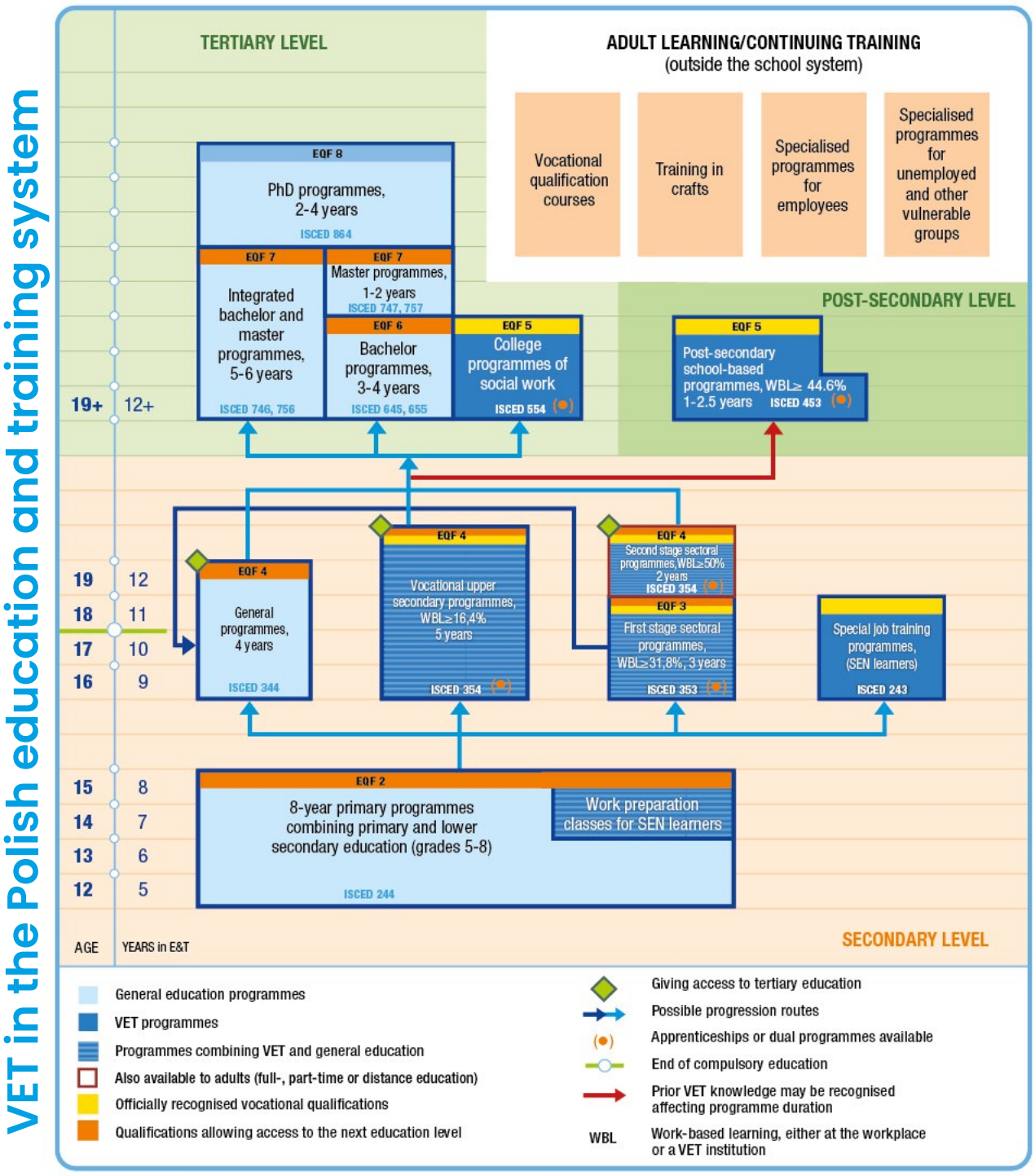
At the post-secondary non-tertiary level, vocational qualifications are acquired in 1- to 2.5- year school-based programmes (szkoły policealne, ISCED 453).

Work-based learning (WBL) is compulsory for all VET-oriented programmes. It takes place in school workshops, continuing education centres, vocational training centres or can be organised partially or fully by an employer, including apprenticeships. A distinctive form is on-the-job-training (traineeship) lasting 4 to 12 weeks, depending on the occupation; this is compulsory for vocational upper secondary, post-secondary and second stage sectoral programmes.

The key features of Polish VET are:

- flexibility, allowing changing pathways at any point;
- classification of occupations updated by various stakeholders in line with labour market needs. Each occupation consists of one to two qualifications that can be attained through IVET and CVET programmes, and is linked to a core curriculum. A VET qualification diploma can be issued only when all qualifications required for an occupation are obtained (via State vocational examinations) together with a school leaving certificate;
- autonomy of VET schools in developing core curriculum-based programmes, easily modified for labour market needs;
- uniform, centrally organised external vocational examinations;
- vocational qualification courses allowing adults to attain qualifications;
- validation of non-formal and informal learning via extramural examinations.

Fig. 13 : Vocational education and training system chart in Poland[25] (source CEDEFOP)



NB: ISCED-P 2011.
Source: Cedefop and ReferNet Poland, 2022.

The introduction of new occupations to the classification is regulated by the Education Law. The classification of occupations is determined by the education minister in cooperation with the relevant ministers responsible for a given sector of the economy, who can submit their requests to include particular occupations in the classification. To anticipate labour market needs, representatives of employers and employees are consulted during the development stage of the classification.

Professional associations, organisations of employers, sector skills councils, social partners and other stakeholder organisations can submit their proposals to the relevant minister to establish a new

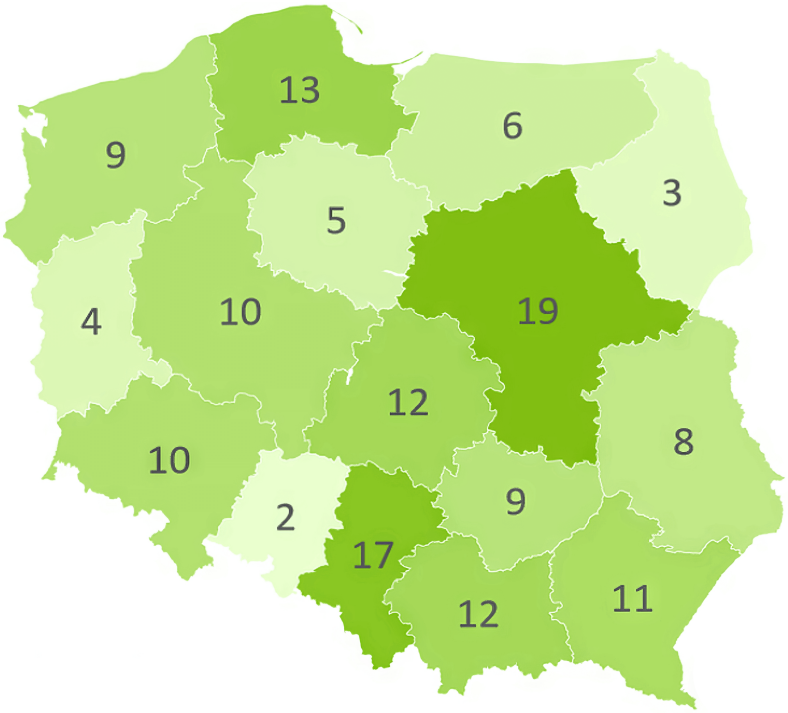
[25] https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/poland-u2#programme-146687

occupation; in this way they shape the educational offer of the formal VET system. After the proposal has been approved, the education minister includes the occupation in the classification and appoints a working group to design the core curriculum for vocational education for that occupation.

Currently, there is no practical vocational program for biogas and biomethane in secondary schools in Poland. Although there is a Polish curriculum for the profession "technician of renewable energy equipment and systems" as of 2019, the main emphasis of this program is on the design, installation and operation of ready-made equipment using renewable energy sources (solar panels, photovoltaics, heat pumps, solid biomass boilers). In the 2022/2023 school year, this program was implemented in 147 schools, with 9508 students, including 2739 in the first year class.[26]

What is missing, however, is a curriculum for a subject designed for implementation in secondary schools on the production and use of renewable gases (biogas, biomethane, hydrogen).

Fig. 14 Renewable energy equipment and systems technician - schools training in the profession 2019/2020[27]



2.4 Comparative analysis

Considering the potential, Poland could be among the top 5 biomethane markets the EU27 with strong impact on the national market[28]. The report "Biomethane in Poland. The growing role of biomethane in the energy transition" prepared by Strategy& in Poland[29] also points out that Poland has one of the largest resources of biogas-useful substrates in the European Union. However Poland is **using actually only about 3 percent of its biogas production potential**, the report's authors noted that Poland has a much larger capacity, potentially at more than 300 large and about 800 medium-sized installations.

[26] System Informacji Oświatowej 15-02-2023 r.

[27] https://rspo.men.gov.pl/

[28] www.gasforclimate2050.eu Gas for Climate report July 2022

[29] https://www.strategyand.pwc.com/pl/pl/publikacje/2024/biometan-w-polsce-perspektywa-strategiczna-i-inwestycyjna.html

Czech Republic has well defined strategy for biomethane market development based on upgrading of existing biogas plants, also **Latvia** is developing biogas and biomethane production. Co-operation among partners and exchange of experience in biogas and biomethane market development is very important for fulfilment of European REPowerEU targets. **But without education it will be difficult to develop biogas and biomethane market.**

Education system is similar in all partner's countries, in secondary schools in Latvia was introduced the qualification "renewable energy technician" and in Poland the profession "technician of renewable energy equipment and systems" but they are not dedicated to biogas and biomethane sector.

There is no practical vocational program for biogas and biomethane in secondary schools in Latvia and Poland, as well as in Czech Republic, however in the Czechia there is offered a specialized course for the biogas plant operators (EQF level 3) which can be implemented in schools providing secondary education in the fields of agriculture, forestry and ecology and machinery but it is rather a frame not practical offer for the education.

The needs of biogas and biomethane sector were identified (questionnaire and direct contacts with biogas sector stakeholders) and on that basis (as well as partners' experience) was elaborated proposal of qualification BIOGAS PLANT OPERATOR.

Comparative analysis of vocational education systems in Poland, the Czech Republic and Latvia

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Unia Producentów i Pracodawców Przemysłu Biogazowego i Biometanowego

GBA Česká bioplynová asociace

LBA LATVIJAS BIOGĀZES ASOCIĀCIJA