

ADAM DUŻYŃSKI\*

POWER ENGINEERING – THE MINISTRY-COMMISSIONED  
COURSE OF STUDY CARRIED OUT AT CZESTOCHOWA  
UNIVERSITY OF TECHNOLOGY FROM 2012 TO 2015

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KIERUNEK ZAMAWIANY ENERGETYKA,  
REALIZOWANY W POLITECHNICE CZĘSTOCHOWSKIEJ  
W LATACH 2012–2015

Abstract

This study discusses the progress of the engineers' studies in the Ministry-commissioned Power Engineering course conducted in the Faculty of Mechanical Engineering and Computer Science at Czestochowa University of Technology (FMECS, CUT) in the period 2012–2015.

*Keywords: engineering studies, commissioned courses, power engineering*

Streszczenie

W artykule omówiono dotychczasowy przebieg studiów inżynierskich na kierunku zamawianym Energetyka, realizowanych na Wydziale Inżynierii Mechanicznej i Informatyki Politechniki Częstochowskiej w latach 2012–2015.

*Słowa kluczowe: studia inżynierskie, kierunki zamawiane, energetyka*

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\* PhD. Eng. Adam Dużyński, Institute of Thermal Machinery, Faculty of Mechanical Engineering and Computer Science, Czestochowa University of Technology.

## 1. Introduction

Over the last twelve years or so, Poland has seen a disproportion between the number of graduates of liberal arts studies and people with scientific (technical, and mathematical and natural sciences) education. The labour market has become saturated with specialists in humanities, while the most desirable by employers have been science graduates, who could play a key role in stimulating the development of those branches of the economy which have a special influence on the improvement of the economic and social situation in Poland. A survey of the labour market has confirmed the growing demand for employees qualified in technical and scientific subjects. It is commonly known that the problem of the deficit of some professions and specialities is the consequence of the mismatch between the educational offer of the higher education institutions and the needs of the constantly changing labour market. In this situation, the Ministry of Science and Higher Education considered it necessary to take action aimed at enhancing the popularity of education in science and engineering faculties. This action was expected to contribute to a reduction of the existing mismatch – this was achieved by, for example, commissioning courses of academic studies essential for the development of a competitive and innovative economy. A pilot programme entitled ‘Commissioning the Education in Technical, Mathematical and Natural Faculties’ was carried out from 2007 to 2013. Its goal was to increase the number of graduates of commissioned courses of study up to 22% of the graduate population. The courses of study commissioned by the ministry have restored the social prestige to science and engineering courses of study, and it’s now time for another quality step – better training of competencies and skills essential in the labour market [4, 5].

## 2. Power Engineering – the new course of study at the FMECS, CUT

In the academic year 2011/2012, a new course of study, Power Engineering, was launched at the Faculty of Mechanical Engineering and Computer Science of Czestochowa University of Technology (FMECS, CUT).

The faculty offers the following options to future students:

- full-time (7 semesters) and extramural (8 semesters) engineering studies for a first degree in the speciality ‘Dispersed Power Engineering Systems’;
- full-time (3 semesters) graduate studies for a second degree in the specialities ‘Conventional Power Engineering’ and ‘Unconventional Power Engineering’.

Studies in the prestigious course Power Engineering, conducted in only a few universities in Poland, are intended to provide education corresponding to the needs of the sustainable development of the country and the growing role of issues relating to the ecological processing and distribution of energy. The graduates of this field of study acquire education based on the technical knowledge in the area of thermal engineering, electrical power engineering, computer science and economics. The students are given the opportunity to learn state-of-the-art technologies in the design and operation of both heating equipment and thermal machinery and engines (piston engines, steam and gas turbines, compressors, pumps), as well as modern technologies in the design and operation of refrigeration, air conditioning and ventilation equipment.

The University's unit holding the master's course in Power Engineering is the Institute of Thermal Machinery – a body that has been dealing with power engineering for over 50 years and has well-equipped specialised laboratories that help in the education of Power Engineering students.

Power Engineering graduates can be useful in the following areas: the diagnostics, safety and reliability of power engineering equipment and systems; stewardship in energy management; the control and automation of power engineering systems and equipment; the monitoring and supervision of companies' activity in environmental protection; waste disposal, etc. They can work in enterprises dealing with the operation of power engineering systems and in plants involved in the processing, transmission and distribution of energy. Municipal thermal-electric power stations, building companies and those involved in the manufacture and distribution of modern refrigeration, ventilation and air conditioning systems may also be interested in hiring Power Engineering graduates.

Those studying in the Power Engineering course at the FMECS, CUT, will have the opportunity to obtain 'Qualification Certificates' required by the 'Energy Law' for dealing with the operation of electrical power engineering, thermal and gas equipment, installations and networks on supervision and operation posts after completing an additional training course and passing an exam.

### **3. About the project**

Wishing to make the studies in the Power Engineering course more attractive, the Faculty of Mechanical Engineering and Computer Science of Czestochowa University of Technology (FMECS, CUT) made an application to the National Research and Development Centre in Warsaw, and since 1st July 2012 the project POKL.04.01.02-00-149/12 'Take the key to success – commissioned courses at the Faculty of Mechanical Engineering and Computer Science' has been carried out at the FMECS, CUT. This project is co-financed by UE resources within the framework of the EUROPEAN SOCIAL FUND (EFC), Priority IV 'Higher Education and Science' of the Human Capital (HC) Operation Programme (OP), Measure 4.1 'Strengthening and development of didactic potential of universities and increasing the number of graduates from faculties of key importance for knowledge-based economy' Sub-Measure 4.1.2. 'Increasing the number of graduates from faculties of key importance for knowledge-based economy – competition projects' [3].

One of the courses which has obtained funding is Power Engineering. The project 'Take the key to success – commissioned courses at the Faculty of Mechanical Engineering and Computer Science' is addressed to the full-time, first degree students at the Faculty of Mechanical Engineering and Computer Science of Czestochowa University of Technology. The primary goal of the project was to strengthen and develop the didactic potential of the FMECS by expanding the syllabi and making them more attractive. By joining the commissioned course of study programme, Czestochowa University of Technology wished to compete for students in an innovative manner using European funds, by offering the students forms of didactic classes and the University's cooperation with potential employers, which had been practically unavailable to them before. Thus, the students were expected to acquire skills essential in the labour market. The implementation of the project was supposed to

contribute to an increase in the quality of the teaching of FMECS students in fields important to a modern, innovative economy.

The project concerned the students who started their studies in the academic year 2012/2013. The application for co-financing made by the FMECS, CUT to the National Research and Development Centre (Narodowe Centrum Badań i Rozwoju) took third place in the ranking list of positively assessed applications (with a score of 120 points) among 260 submitted applications (of 126 positively assessed applications, as many as 93 had not obtained co-financing). The overall project budget amounted to over 6.5 million zlotys.

Table 1

**Basic project data according to the approved application [1]**

Project duration	01.07.2012 – 31.12.2015
Commissioned courses of study (number of participants in given subject)	– Power Engineering (40) – Computer Science (166) – Mathematics (50) – Mechanics and Machine Building (102) – Mechatronics (32)
Number of project participants	390
Number of project participants (Power Engineering)	40

Over the entire duration of their studies, the students of the commissioned courses took advantage of many attractions prepared by the FMECS, CUT, which included [1]:

- incentive scholarships – 50% of the best students will obtain scholarships of the amounts of 700, 800 or 1000 zlotys per *calendar* month;
- depending on their learning performance (over the 9 months of the academic year);
- compensatory courses in mathematics, physics and computer science for first year students;
- commissioned lectures delivered by invited outstanding domestic and foreign professors and national and international industry specialists;
- study visits to industrial partners;
- summer holiday international two- or three-month traineeships in renowned academic and scientific research centres and industrial plants;
- students' participation in national and international scientific and technical conferences;
- specialised training courses to obtain additional qualifications and competences, such as training courses in the AutoCAD, CATIA, SolidWorks, and Matlab-Simulink software programs;
- technical and business English courses;
- a training course for the 'Auditor of the Internal Integrated Management System' (ISO) – for TÜV, NORD certificates;
- support for disabled students, including psychological and professional counselling.

The awarding of scholarships and participation in optional classes is determined by ranking based on the scholarship indices (WS) from the previous semester – these are the sums of average marks (SRW) and the optional classes index (ZD).

#### 4. How we carried out the Project

Table 2 summarises figures showing the implementation of the project so far.

Table 2

##### The Power Engineering commissioned course in numbers (what has been completed thus far)

Description	Dimension	Semester/ number of participants					
		1	2	3	4	5	6
The number of project participants (of which, the number of women)	–	77 20	50 10	47 10	41 10	41 10	39 10
Scholarships <sup>1</sup> (of which, the number of women)	–	22 6	25 8	21 7	20 8	20 9	20 8
<b>COMPENSATORY CLASSES</b>							
Mathematics	30 hrs	52	–	–	–	–	–
Physics	30 hrs	30	–	–	–	–	–
<b>OPTIONAL LECTURE ON THE SUBJECT ‘ENTREPRENEURSHIP AS A SOCIAL COMPETENCE – THE PROFESSIONAL CAREER OF A CZESTOCHOWA UNIVERSITY OF TECHNOLOGY STUDENT’</b>							
MSc Ziemowit Słomczyński Remak Rozruch Opole	3 hrs	49	–	–	–	–	–
Prof. Włodzimierz Błasiak – Royal Institute of Technology (KTH), Stockholm	3 hrs	–	–	37	–	–	–
<b>COMMISSIONED LECTURES GIVEN BY FOREIGN PROFESSORS</b>							
Prof. Mirosław L. Wyszynski – University of Birmingham	10 hrs	–	–	–	–	33	–
Prof. Włodzimierz Błasiak – Royal Institute of Technology (KTH), Stockholm	10 hrs	–	–	–	–	–	31
<b>COMMISSIONED LECTURES GIVEN BY DOMESTIC PROFESSORS</b>							
Prof. Roman Domański – ITC, Warszawa University of Technology	6 hrs	–	40	–	–	–	–
Prof. Janusz Skorek – ITC, Silesian University of Technology	4 hrs	–	–	–	32	–	–
Prof. Wojciech Nowak – AGH, Kraków	4 hrs	–	–	–	–	28	–
<b>COMMISSIONED LECTURES GIVEN BY FOREIGN INDUSTRY REPRESENTATIVES</b>							
PhD Adam Luckos – Sasol Technology R&D (South Africa)	10 hrs	–	–	37	–	–	–
PhD Marek Sutkowski – Wärtsilä Finland Oy	10 hrs	–	–	–	33	–	–

Description	Dimension	Semester/ number of participants					
		1	2	3	4	5	6
<b>COMMISSIONED LECTURES GIVEN BY DOMESTIC INDUSTRY REPRESENTATIVES</b>							
MSc Kazimierz Gatnar – Jastrzębska Spółka Węglowa S.A.	4 hrs	–	39	–	–	–	–
PhD Jerzy Trzeszczyński Scientific & Technical Service Representative of PRO NOVUM Sp. z o.o. Katowice	4 hrs	–	–	–	–	29	–
<b>STUDY VISITS AT THE DOMESTIC INDUSTRY PARTNER</b>							
International Trade Fair of Environmental Protection Poleko 2012 in Poznań	–	22	–	–	–	–	–
P.P.U.H. Horus Energia at Sulejowek	–	–	23	–	–	–	–
PZL Sp.z o.o. in Mielec	–	–	4	–	–	–	–
PGE Górnictwo i Energetyka Konwencjonalna (Mining and Conventional Power Engineering) in Bełchatów	–	–	–	–	22	–	–
Oczyszczalnia Ścieków Warta S.A. (Warta S.A. Sewage Treatment Plant) in Częstochowa	–	–	–	–	23	–	–
Elektrownia Łagisza (Łagisza Power Plant) in Będzin	–	–	–	–	–	–	23
<b>ENGLISH LANGUAGE COURSE</b>							
Technical English	2 × 30 hrs	–	–	23	22	–	–
Business English	2 × 30 hrs	–	–	–	–	6	6
<b>AUTOCAD TRAINING</b>							
Basic	18 hrs	–	–	–	16	–	–
Advanced	18 hrs	–	–	–	–	14	–
<b>CATIA SOFTWARE TRAINING</b>							
For individuals starting working with the program	40 hrs	–	–	5	–	–	–
Hybrid programming training	16 hrs	–	–	5	–	–	–
<b>SOLIDWORKS SOFTWARE TRAINING</b>							
Basic – modelling of parts	12 hrs	–	–	–	–	8	–
<b>MATLAB-SIMULINK SOFTWARE TRAINING</b>							
Modelling of dynamic systems	10 hrs	–	–	–	–	2	–
<b>TRAINING COURSE FOR THE INTERNAL AUDITOR OF THE INTEGRATED MANAGEMENT SYSTEM – ISO</b>							
	32 hrs	–	–	–	–	–	5

Continue Table 2

Description	Dimension	Semester/ number of participants					
		1	2	3	4	5	6
NATIONAL SCIENTIFIC CONFERENCES (WITH A PAPER)							
The 18th International Scientific & Technical Conference on 'Preventing the pollution, transformation and degradation of the environment' Szczyrk 2014	-	-	-	-	-	3	-
The 8th International Scientific & Technical Conference Power Engineering, Wrocław 2014	-	-	-	-	-	1	-
INTERNATIONAL SCIENTIFIC CONFERENCES (WITH A PAPER)							
'Topical Problems of Fluid Mechanics 2015', Prague, the Czech Republic	-	-	-	-	-	1	-
TRAINING IN NATURAL ENVIRONMENT PROTECTION AND PRO-ECOLOGICAL SOLUTIONS IN THE PRODUCTION PROCESS							
	6 hrs	-	-	36	-	-	-
PURCHASES OF TEACHING STANDS							
A DeltaOhm HD52.3D P147-R ultrasonic anemometer with accessories, designed for the measurement of wind velocity and direction, solar radiation, relative humidity, temperature and barometric pressure with a measurement recording and visualisation capability							
Purchasing of a G.U.N.T. testing stand for the examination of, for example, liquid stream properties and the visualisation of Bernoulli's law							
Purchasing of a system for the control and automatic adjustment of thermal machines							

<sup>1</sup> Eight project participants have obtained scholarships over all the semesters to date.

The number of project participants, i.e. Power Engineering commissioned course students, in successive semesters are illustrated in Figure 1.

When looking at Figure 1, one could be astonished by the fact that as many as twenty-seven students dropped out after Semester 1 – the explanation is very simple. Some of them, of course, did not pass the semester because of poor performance, but the majority of them were the students of another course of study – so called 'fictitious people', who, free of charge, additionally applied to the commissioned course of Power Engineering lured with the opportunity for winning a relatively high scholarship based on high marks of their secondary school-leaving examination, without any effort being made in the first semester. Because the regulations that were in force at that time allowed such behaviour, 'scholarship-seekers' eagerly used that opportunity and grew in number, and ultimately, they made up as many as one third of all students taking scholarships in Semester 1 – this was met with protest from the students who regularly attended the classes. After Semester 1, a group of very active students formed – this group survived practically intact until the end of the engineers' studies. The project assumed that forty students would study in Semester 7, and exactly this number of students reached this semester.

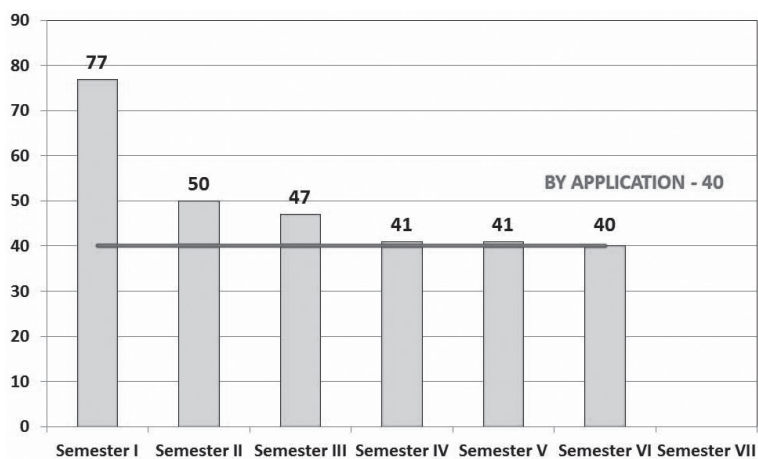


Fig. 1. The number of project participants, i.e. Power Engineering commissioned course students, in successive semesters



Fig. 2. Compensatory classes in physics and mathematics [2]



Fig. 3. The study visit at the International Trade Fair of Environmental Protection POLEKO 2012 in Poznań [2]

Figures 2–15 show some of the tasks already completed within Objective 3 ‘Implementation of new education forms for the students of the Power Engineering course’.

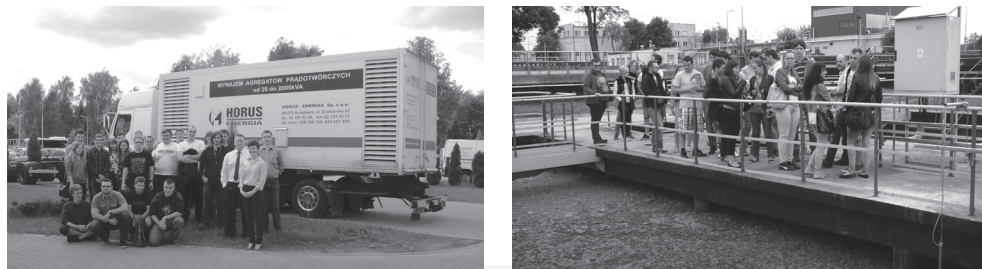


Fig. 4. The study visits at P.P.U.H. Horus Energia at Sulejówiek and at the WARTA S.A. Waste Treatment Plant in Częstochowa [2]



Fig. 5. The study visit at PGE Górnictwo i Energetyka Konwencjonalna (Mining and Conventional Power Engineering) in Belchatów [2]



Fig. 6. The study visit at Elektrownia Łagisza (Łagisza Power Plant) in Będzin [2]

At the end of Semester 5, the students were given the subjects for the engineers’ dissertations, the defences of which are planned for January 2016.

In the holiday break after Semester 6, two- and three-month industrial traineeships with potential employers were also conducted for twenty project participants. The basis for the traineeship qualification was the sum of average learning marks from five semesters (SRW).



Fig. 7. Optional lectures on ‘Entrepreneurship as a social competence – the professional career of a Częstochowa University of Technology graduate’: MSc Ziemowit Słomczyński and Prof. W. Błasiak [2]



Fig. 8. Commissioned lectures given by the foreign industry representative: PhD Adam Luckos and PhD Marek Sutkowski [2]



Fig. 9. Commissioned lectures given by the domestic industry representative: MSc Kazimierz Gatnar and PhD Jerzy Trzeszczyński [2]



Fig. 10. Commissioned lectures delivered by the visiting professors: Prof. Janusz Skorek and Prof. Wojciech Nowak [2]



Fig. 11. A commissioned lecture delivered by the visiting professor – Prof. Roman Domański [2]



Fig. 12. Commissioned lectures delivered by the foreign visiting professors:  
Prof. Mirosław L. Wyszynski and Prof. Włodzimierz Błasiak [2]



Fig. 13. Training in the AUTOCAD software program [2]



Fig. 14. Training in the CATIA and SOLIDWORKS software programs [2]



Fig. 15. The training course for the Internal Auditor of the Integrated Management System – ISO [2]

Table 3

### Holiday industrial traineeships with potential employers

Traineeship	Number of trainees
MOTORTECH GmbH, Celle, Germany	4
The Institute for Thermomechanics, the Czech Republic	2
<b>FOREIGN COUNTRIES</b>	<b>6</b>
ENERGOMONTAŻ-PÓLNOC BEŁCHATÓW Sp. z o.o., Rogowiec	2
Instytut Badań i Rozwoju Motoryzacji (Institute for Automotive Research and Development) BOSMAL Sp. z o.o., Bielsko-Biała	3
MOTORTECH Polska, Krzysztof Walicki i Wspólnicy Sp. Jawna, Charzyno	2
P.P.U.H. HORUS-ENERGIA Sp. z o.o., Sulejówek	1
Zakłady Remontowe Energetyki (Power Industry Repair Works) Katowice S.A., Katowice	2
Cementownia WARTA S.A. (WARTA S.A. Cement Mill), Działoszyn	1
Koksownia (Coking Plant) Częstochowa Nowa Sp. z o.o., Częstochowa	2
Oczyszczalnia Ścieków WARTA S.A. (WARTA S.A. Sewage Treatment Plant) in Częstochowa	1
<b>POLAND</b>	<b>14</b>
<b>TOTAL (FOREIGN COUNTRIES AND POLAND)</b>	<b>20</b>

### 5. Plans for Semester 7

For Semester 7, a Student Scientific Conference on Energetyka Przyszłości (The Power Engineering of the Future) was conducted for forty project participants, within the framework of which, a commissioned lecture will be delivered by Prof. dr. h.c. mult. T. Chmielniak from the Institute for Thermal Engineering of the Silesian University of Technology on



Fig. 16. Power Engineering commissioned course students at industrial traineeships with potential employers (MOTORTECH Polska) [2]

‘Contemporary Energy Technologies’ (the energy technologies of fossil fuels, the power engineering of renewable energy sources, the outline of nuclear power engineering) (Figs. 17–18).



Fig. 17. The proceedings of the Student Scientific Conference Energetyka Przyszłości (The Power Engineering of the Future)



Fig. 18. Student Scientific Conference on Energetyka Przyszłości (The Power Engineering of the Future) – Prof. T. Chmielniak and Students: K. Gajewska and K. Kaczyński [2]

The students of the Power Engineering commissioned course prepared 10 papers and presented them at the Student Scientific Conference 'Energetyka Przyszłości'. These papers have been included in the Conference proceedings, and are listed below:

- The Power Engineering commissioned course carried out at the Częstochowa University of Technology in the years 2012–2015;
- A review of solid fuel feeders for a single-family house water heater – energy consumption;
- The present state and the outlook for the development of the Polish wind power industry;
- The comparative analysis of the parameters of an engine performing the classic and extended-expansion cycles;
- Generator gas and its use for feeding internal combustion engines;
- The assessment of the potential of biomass for the generation of electric energy and heat in the coal co-combustion technology in Poland;
- Waste heat recovery from waste water;
- The methods of financing and the possibilities of investment return from the photovoltaic micro-system in the light of the new renewable energy sources law;
- The methane clathrate compound – a fuel of the future or a threat from the ocean depths?
- Algae as an energy fuel.

## 6. Summary

The curriculum on the commissioned course of Power Engineering enables a group of students to avail themselves to a more expensive, but better-quality course of engineering study, distinguished by a higher level, a variety of educational forms and greater emphasis on the practical aspects of education than before. As the coordinator of the course, the author of this paper has observed a smaller percentage of eliminations and resignations from the studies than before and higher average marks compared to other courses of study.

An undoubted strength of the implemented project was the possibility of enriching the engineers' studies through direct contact with industry through study visits to industrial partners, commissioned lectures delivered by outstanding domestic and foreign industry representatives, and two- and three-month industrial traineeships with potential employers. The students of the commissioned course of Power Engineering have highly valued the opportunity of obtaining various certificates confirming their participation at training – these were courses which were carried out, in their opinion, to a very high level. A confirmation of this fact can be the results of an evaluation survey summing up the engineers' studies in the commissioned course of Power Engineering given in Table 4 – these clearly show that the forms of education assessed highest by the polled students were those directly associated with practice, namely: laboratory and classroom lessons; study visits to industrial partners; industrial traineeships with potential employers; training courses; commissioned lectures delivered by domestic and foreign industry representatives.

**An evaluation survey summing up the studies on the Power Engineering  
commissioned course with a sample of the questions**

For how many semesters did you take the commissioned course students' scholarship?	
Semester	Evaluation survey results [%]
1	15.8
2	7.9
3	5.3
4	2.6
5	5.3
6	15.8
7	18.4
Not applicable	28.2
Which form of teaching classes do you consider the most effective?	
Form of teaching	Evaluation survey results [%]
Lecture	5.3
Exercises	26.3
Labour	47.4
Seminar	18.4
How do you rate the organisation and scope of additional classes? (1 – very bad, 5 – very good)	
Rating	Evaluation survey results [%]
1	0
2	0
3	23.7
4	68.4
5	7.9
Which form of additional classes was the most interesting in your opinion?	
Form of teaching	Evaluation survey results [%]
Compensatory classes	0
Commissioned lectures by professors	5.3
Commissioned lectures by industry representatives	15.8
Courses, training	65.8
Study visits to industrial partners	18.4
Scientific conferences	13.2
Industrial traineeships	36.8
Would you make a decision to start studying in the Power Engineering course again?	
Decision	Evaluation survey results [%]
Yes	47.4
No	15.8
I don't know	36.8

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