# Analysis of the labour market and training needs in the field of Thermal Power Systems (TPS) for cleaner environment: evidences from the ASIAXIS Erasmus+ Project

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## ABSTRACT

This paper presents the results of the survey on the labour market and training needs in the field of Thermal Power Systems carried out in the context of the ASIAXIS Erasmus+ European Project. The goals of this project are to align quality of courses on Thermal Power Systems in the Chinese, Russian and Kazakh partner Universities with EU requirements and to increase the employability of graduates across partner countries and EU. The first step while designing a Student Centred Study Program is the identification of the educational needs by consulting relevant industries, labour market organisations and other stakeholders. Hence, a survey on the labour market training needs has been realized by the consortium and about 60 organisations interviewed. The analysis has shown that the main fields requested are Internal Combustion Engines and Combined Heat and Power while the topics of more interes are: control and automation, data analysis, predictive maintenance, structural analysis and CFD modeling.


**KEYWORDS:** Erasmus+; higher education; quality assurance plan; bologna process; student centered learning; market needs; internal combustion engines; thermal power systems;

## INTRODUCTION

The ASIAXIS project, funded under the Erasmus+ programme, is a cooperation of EU (Italy, UK and Spain) and Asian Universities with the aim to provide enhanced professional knowledge and skills for students in Thermal Power Systems Engineering at Bachelor, Master and PhD levels in Asian Universities and aligning their educational standards with European level requirements.

The partners involved in the project are: the coordinator Università Politecnica Delle Marche (Italy), Universitiy of Northumbria (UK), Universidad de Castilla - La Mancha (Spain), Beijing Institute of Technology and Harbin Engineering University (China); Seifullin Kazakh Agro Technical University and Pavlodar State University (Kazakhstan); South Ural State University and Bauman Moscow State Technical University (Russia).

The project addresses the topical theme of higher education teaching on “thermal power systems (TPS) for clean environment” with particular focus on internal combustion engines (ICEs). TPS and ICEs are very topical both at global and local scale. Indeed, at global scale, efficiency improvement of thermal power system contributes to a sustainable development and to the reduction of global warming; at local scale, the improvement of efficiency of thermal power systems, and in particular of internal combustion engines, will also highly improve the quality of air in cities by reducing emissions from cars. Harmful smog, very often of a very severe intensity, can be observed in all major cities in China, Kazakhstan, Russia and many other countries. One of the reasons for that is the sharp rise in a number of automobiles being exploited. A significant number of vehicles is equipped with Internal Combustion Engines (ICEs) having technical and ecological performance inferior to that deployed in EU, US etc., since regulations in partner countries are less demanding and rigid. Moreover, the quality of the fuels used in the partner countries is not so high as that in the EU fuels, since no standards exist or much more relaxed quality is required. It is also remarkable the low share of biofuels, which could partially mitigate the above commented pollution and they could also increase the country economic development by exploiting autochthonous resources. Regarding this latter aspect, the partner Countries have a significant biofuels production potential which it is not enough used for internal purposes or it is exploited to provide fuels to other Countries.

A switch to modern TPS and ICE designs, similar to that deployed in the developed countries, requires a new type of specialists with a deep knowledge of the state-of-the-art and technological advances in this area.

Often the knowledge and skills gained at University level do not fit with the practical needs of the industries thus enlarging the adaptation and formation period of the new employees and decreasing the consequent cost-benefitt ratio. For these reasons, educating new engineers and workers to develop and promote in TPS and ICEs technologies with technical, professional and managerial abilities to satisfy the energy demand in a sustainable way is among the mission of many university programmes worldwide.

According to the Bologna process, the first step while designing a Student Centred Study Program is the identification of the educational needs by consulting relevant industries, labour market organisations and other stakeholders. Therefore, the modernized teaching methods to be implemented in the ASIAXIS project have at their focus the satisfaction of the current and future market needs for highly qualified Engineers to lead the advancements in Thermal Power Systems industry (and internal combustion engines in particular) during their employment by industrial companies, public and private organisations and NGO across partner countries and EU. Hence, a survey on the labour market training needs for specialists with enhanced knowledge and skills in cleaner thermal power systems has been conducted in some EU and Asian countries and some of the results are reported in this paper.

## METHODOLOGY

The Bologna Process requires the achievement of six objectives that can be 'linked' as follows: 1) the adoption of a system of easily readable and comparable degrees; 2) the organisation of the system in three main cycles; 3) the measurement of the students' workload in credits; 4) the quality assurance of the system in a credibile way, 5) the promotion of students' mobility 6) the necessary European dimensions in higher education. In order to successfully achieve these objectives the promotion of the European system of higher education world-wide represents a key pillar.
In order to be really comparable other than comparable duration (credits) and quality, study programs must have also comparable "programs learning outcomes" (PLOs). According to the Bologna process in order to define PLOs, the first step while designing a Student Centred Study Program is the identification of the educational needs by consulting relevant industries, labour market organisations and other stakeholders. This paper presents the results of the survey on the labour market training needs carried out in the context of the ERASMUS+ ASIAXIS Project.
The survey is divided in 3 main sections:

1. Information about the stakeholder market and employees: market sector of interest (e.g.: Power Transmission & Distribution; Sales and Marketing; Design & Engineering development; Research & Development, Policies & Economics…); Employee qualifications, background and knowledge;
2. Stakeholder attitude towards labour market: Information about willingness to hire new graduates students in terms of qualification (Bachelor, Master Science or Phd.); importance of enhanced knowledge in TPS and required knowledge, competences and skills;
3. Engagement of the stakeholder in the Consortium: willingness to host students for internships, to cooperate in enhancing teaching and to participate in the project network.

## RESULTS

More than 100 institutions have been identified for the survey. Despite the survey is still going on, more than 60 organisations have already replied so far 48 of them being Chinese. In terms of employees, the composition of the 60 organisation is the following: 59.3% of the organisations have more than 500 employees, 15.2% were in the range of 100 to 500 employees, 6.78% between 50 and 100, 10.2% from 10 to 50 and finally 8.5% have less than 10 employees. Despite, these percentages change significantly from Country to Country, such percentages could be considered representative of the business sector especially in China where exist many big manufacturing companies. The reference market of the organisations interviewed it is mainly focused at national and international levels (44.1% and 40.7%, respectively).

With reference to the type of activity in the thermal power systems sector, the overall result of the analysis has shown that the majority are involved in 'Research & Development' and 'Design & Engineering Development' as reported in Figure 1 below.

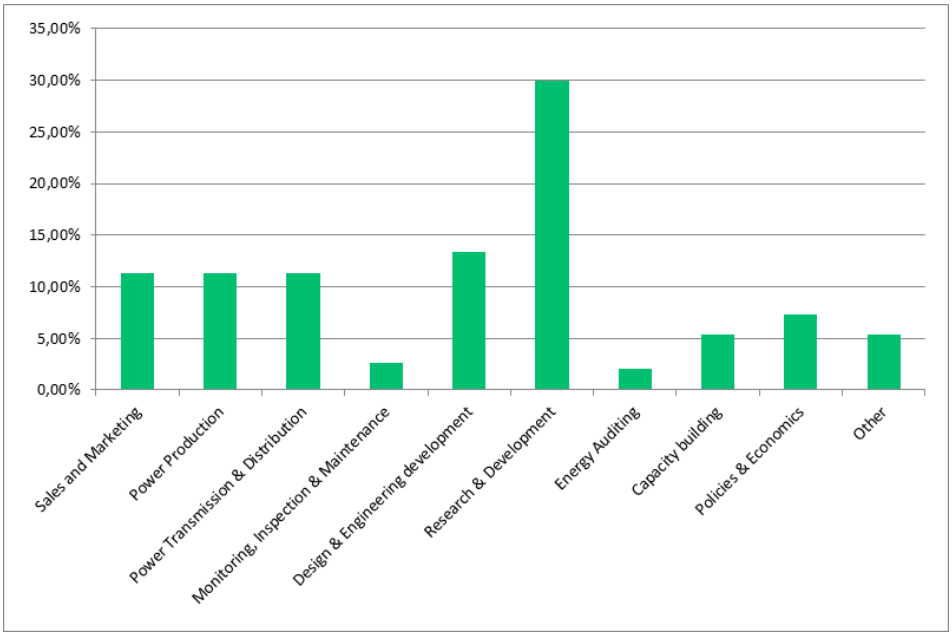


Figure 1. Type of activity on thermal power systems of the organisation

In terms of employees' qualification, these organisations hire employees with different levels of qualification as reported in Figure 2.
Figure 2 shows that more than 97% of employees has a degree: 31.5% has a bachelor, 38% has aa master, 27.8% has a Ph.D; only 2.7% does not have a degree.
Despite, most of the organisations hire employees with bachelor degree the level of their knowledge in thermal power systems is considered poor (Figure 3) thus confirming the soundness of the ASIAXIS project.

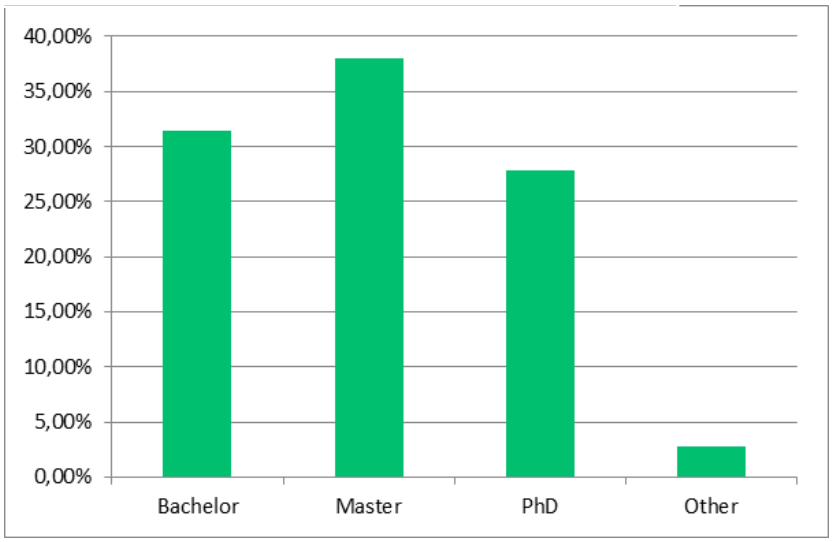


Figure 2. Range of qualification of the present employees of the organisation

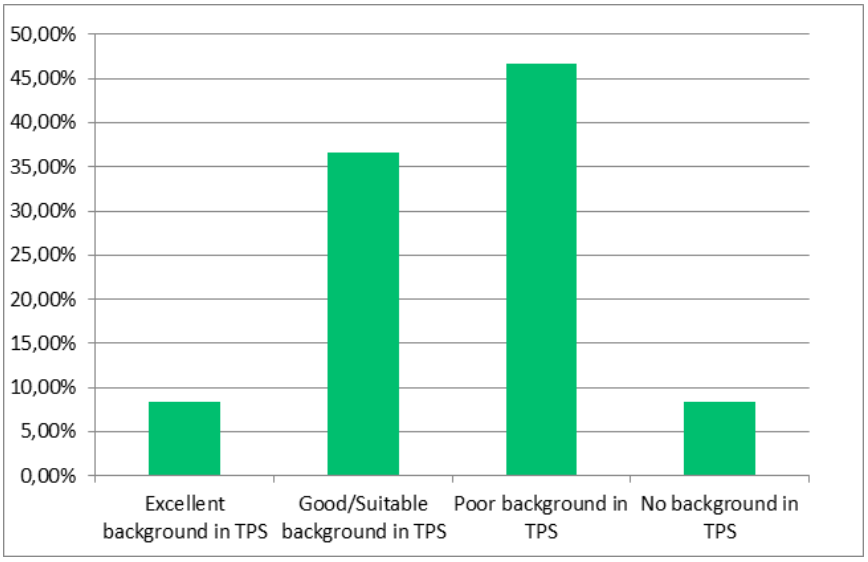


Figure 3. Knowledge on TPS of employees with bachelor degree

With respect to the knowledge on Thermal Power Systems of the employees the survey has shown that it is mainly related to internal combustion engines, control and automation and Combined Heat and Power systems as reported in Figure 4.

The second part of the survey, was aimed at evaluating each organisation's interest in i) recruiting new engineers/skilled workforce in the near future, ii) the field of their expertise and iii) their willingness to participate to the project at different level of involvement. In general, more than 88.5% of the companies/organisations interviewed have shown their interest in employing new engineers in the next three years. In particular, almost 80% of them are interested in recruiting engineers with enhanced knowledge and skills in TPS thus underlining the potential impact of the project on the market.
In terms of level of education, the organisations declared to be more interested in engineers with master degree (1239, in total). In any case, a significant amount of bachelor engineers (1106, in total) and PhD engineers (468, in total) are requested as well (Figure 5).

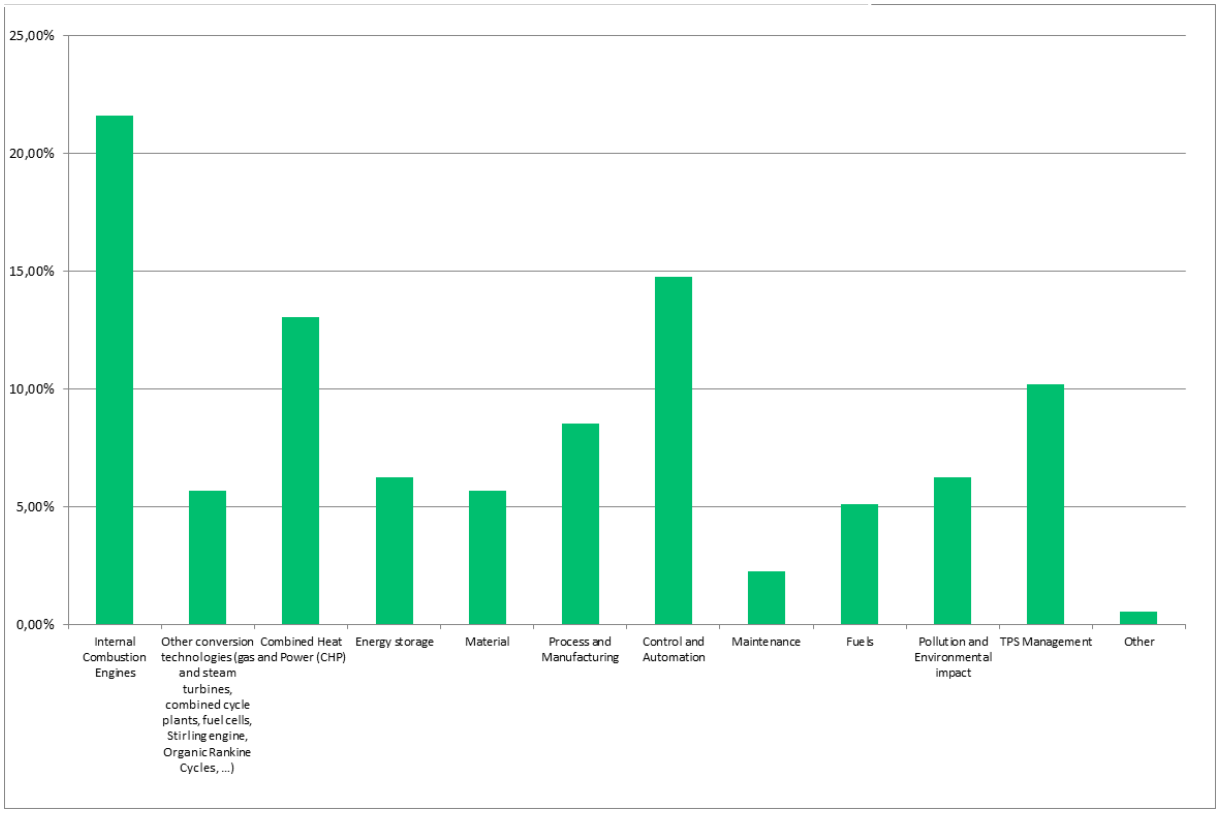


Figure 4. Knowledge of the present employees on TPS

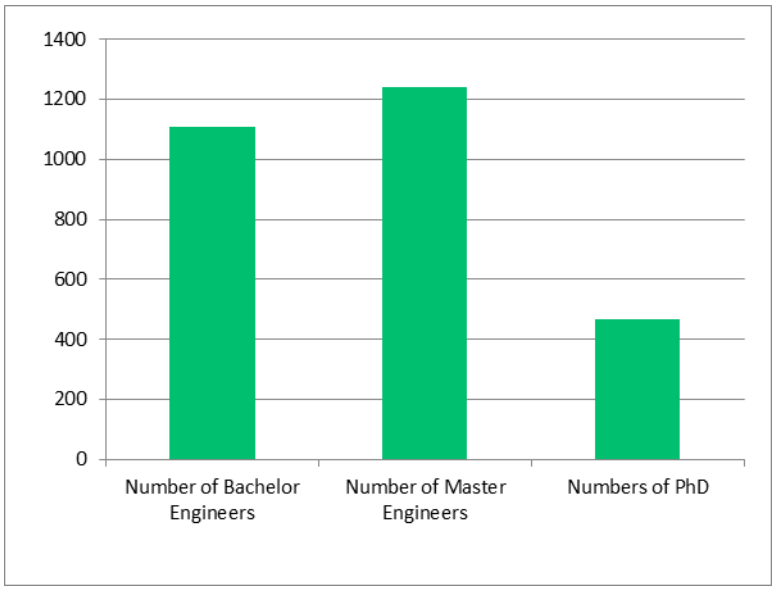


Figure 5. Amount of future engineers with enhanced knowledge on TPS requested by the organisations

In terms of field of expertise, the organisations proved to be more interested in engineers with enhanced knowledge in Internal Combustion Engines, Combined Heat and Power Systems, Control and Automation and TPS Management as reported in Figure 6.

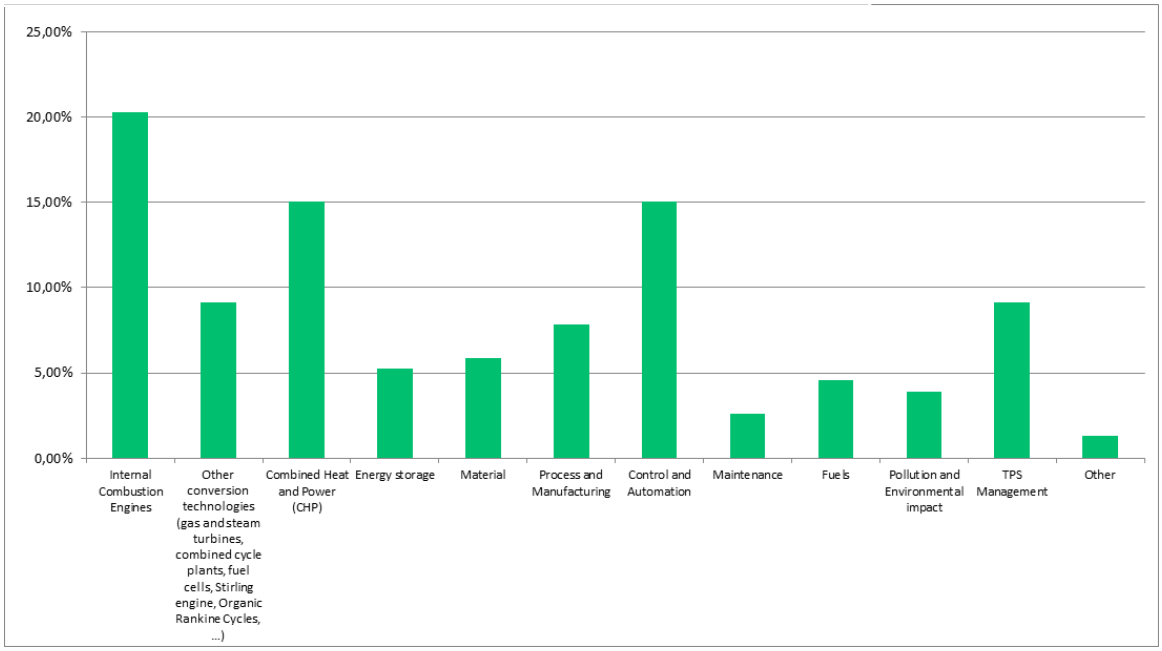


Figure 6. Knowledge of the future employees on TPS

In particular, with respect to ICE and other conversion technologies automotive application and heavy duty engines are considered the most interesting field of application (Figure 7).

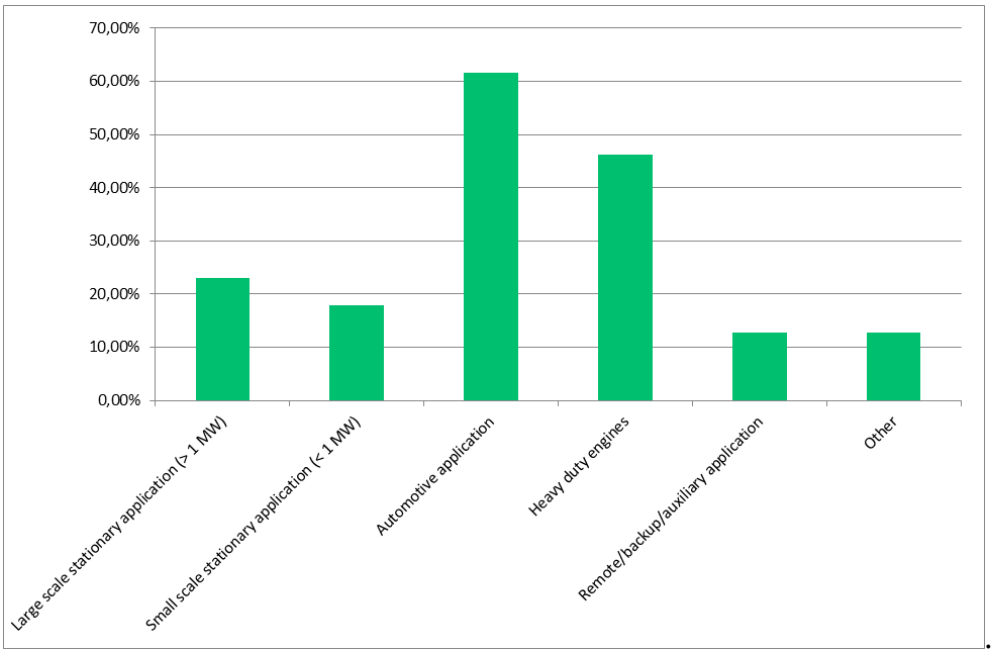


Figure 7. Most interesting applications for ICE and other conversion technologies

Figure 8 shows the expertise most required to new engineers, namely: on control and automation, structural analysis, CFD modelling and data analysis and predictive maintenance.

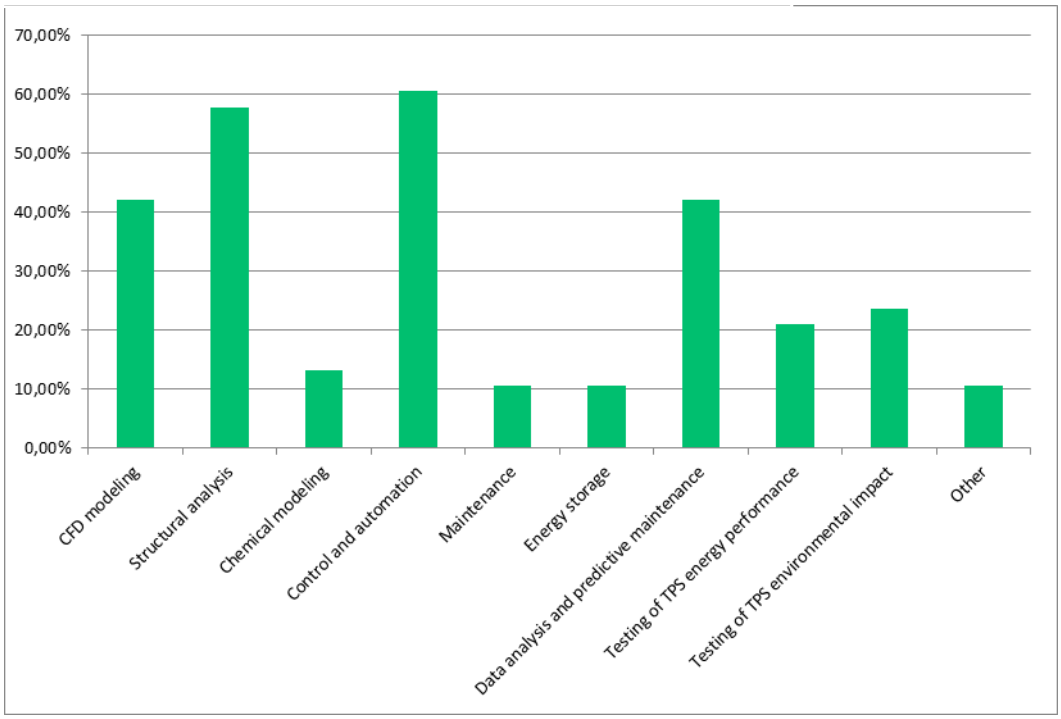


Figure 8. Expertise required on ICE and other conversion technologies

Finally, the organisations also provided useful insights into the main challenges to be faced in the next years by the TPS market. The majority of them believes that engineers/workers with enhanced knowledge will be of strategic importance for the society and almost 60% that they will be strategic also for their organisation success.
In terms of future challenges, most of them recognized the need for hybridization of the thermal energy systems in order to meet the more severe environmental and pollution constraints set out (Figure 9).

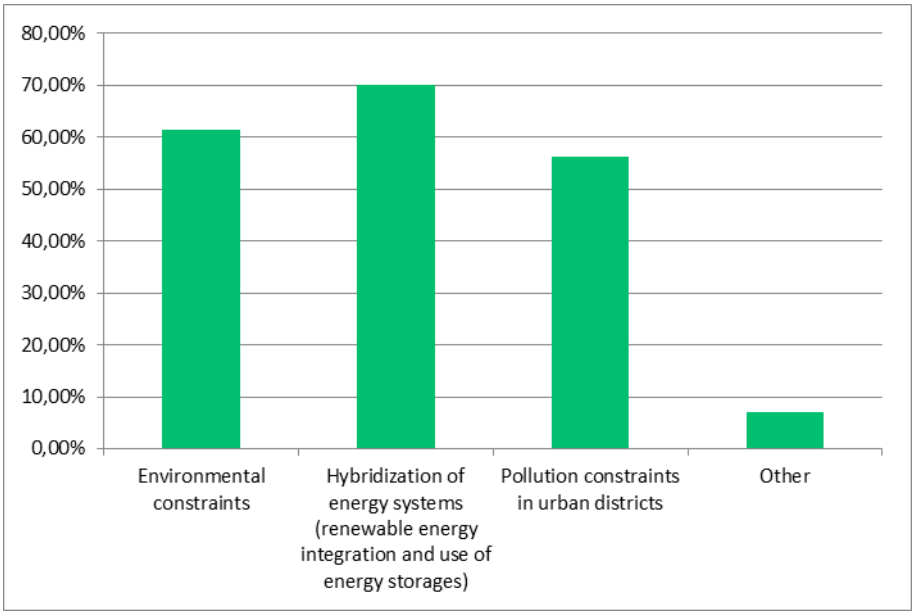


Figure 9. Main challenges that TPS market is going to face in the next years

As regards the involvement in the project, 37 of 60 institutions affirmed to be interested in being part of the ASIAXIS Project Network. Even more (42 of 60) would accept students with enhanced knowledge on TPS for internships period and the same would be willing to cooperate with local and international universities in enhancing teaching of TPS.

## CONCLUSIONS

In the context of the ASIAXIS Erasmus+ European Project a survey on the labour market and training needs in the field of Thermal Power Systems has been carried out. More than 100 institutions have been identified and more than 60 organisations have already replied so far, 48 of them being Chinese.

In general, most of the organisations consider the knowledge in thermal power systems of bachelor degree engineers poor. The survey has confirmed the interest of the market for engineers with enhanced knowledge on Thermal Power Systems (TPS). The results also highlighted the relevant perspectives of employment for engineers with enhanced knowledge at all University levels (Master degree in particular), thus confirming the objectives of the ASIAXIS project.

The organisations participating to the survey have a significant number of employees and an international market (40.7%). This is a peculiarity of the field of investigation (TPS and ICE) that is characterized by big players at global level. The international level is also reflected in the competences required by the organisations that are almost the same identified by the stakeholders of EU Universities.

More in details, enhanched knowledge on internal combustion engines and combined heat and power systems are considered of major interest. In particular, the most required topics are control and automation, data analysis, predictive maintenance, structural analysis and CFD modeling.

## ACKNOWLEDGEMENTS

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