

# Needs Analysis of Master of Engineering in Renewable Energy in Bhutan

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## Abstract

Renewable energy education has been recognized as the key for development and promotion of clean and efficient energy systems in the world. This paper presents need analysis of Master of Engineering in Renewable Energy with options to specialize in energy efficient technologies and energy efficient building design techniques in Bhutan. In order to study the need for this programme, a survey was conducted using purposive sampling method. A total of 89 samples were collected from both government and private sectors. Information about the organization, their needs, requirement and competencies, general position about the master programme and general comments were gathered. It was found that both government and private sectors in Bhutan look forward to the Master of Engineering in Renewable Energy and the majority opined that proposed programme is the need of the hour.

**Keywords:** Renewable Energy, Energy Efficiency, Master Programme, Needs Analysis.

## 1. Introduction

Bhutan, sandwiched between India and China has a wide range of school education centres and tertiary institutes. The tertiary education mainly comprises of two decentralised universities, the Royal University of Bhutan and the Khesar Gyalpo University of Medical Sciences of Bhutan along with colleges under it which are located across the country. The Royal University of Bhutan was launched in 2003 and today it has 12 member colleges (RUB, 2018). Among other colleges at present, there are two engineering colleges, Jigme Namgyel Engineering College (JNEC) and College of Science and Technology (CST). The former focusses more on Diploma level programmes while the latter offers Bachelor's degree programme in Architecture, Civil Engineering, Electrical Engineering, Electronics and Communications Engineering, and Information Technology. As of 2017, there was no postgraduate programmes in either of the engineering colleges.

The Royal Government of Bhutan considers development of hydropower as a key to its socio-economic development. As of today, a total of 1614 MW run-off hydropower plants has been installed (NSB, 2018) and another 720 MW will be commissioned in January 2019 (Dorji, 2018). Other alternatives like solar and wind energy technologies are not pursued with same vigour as that of mega hydropower plants due to economic reasons. While the future of Bhutan's socio-economic development is dependent on the successful implementation of mega hydropower plants, Bhutan recognises the fact that diversification of energy supply mix is imperative to prepare for uncertainties of mega hydropower plants due to impending climate change. One of the methods to diversify energy supply mix is through use of other renewable energy technologies. However, there is lack of skills and expertise in the field of renewable energy. Renewable energy education has been recognized as the key for development and promotion of clean and efficient energy systems in the world. Therefore, CST proposed to launch Master of Engineering in Renewable Energy with options to specialize in energy efficient technologies or energy efficient building design. In order to support and promote renewable energy in the country, CST had established the Centre for Renewable and Sustainable Energy Development and aim to introduce Master of Engineering in Renewable Energy from Autumn 2017. This programme is intended to train human resource on renewable energy technologies amongst others.

To support CST in its endeavour, a consortium of universities comprising of Lund University, Sweden; University of Innsbruck (UIBK), Austria; Tallinn University of Technology (TUT), Estonia; Kathmandu University, Nepal; Tribhuvan University, Nepal was formed to assist CST to develop Master of Engineering in Renewable Energy. The consortium was funded by the Erasmus+ Programme of the European Union. The overall objective of the consortium is to develop curricula for Interdisciplinary Master Courses in Energy Efficient Building Design in Nepal and Bhutan (CIMCEB). To understand the feasibility and potential of implementing the master program, a survey was conducted to ascertain the demand of the graduates of the Master of Engineering in Renewable Energy.

## 2. Survey Method

In order to ascertain the need of the Master of Engineering in Renewable Energy and Energy Efficient Building design, a survey was conducted using purposive sampling method. To obtain a good mix of samples, a total of 89 organizations from government and private sectors participated in the survey. The survey was conducted using mix of open and close ended questionnaire. Respondents comprised of employees holding various

positions in the organisations, chief executive officers, chief engineers, general managers, architects, monitoring officers, project engineers, building owners, private contractors and private consultants. The questionnaire was adapted from European Union funded project MAPEC (Master Program of environmental engineering and climate change) which comprised of 5 broad headings (Hauer & Streicher, 2011).

- Information about the organization/company
- Needs
- Requirement and competencies
- General position about new master programme
- General comments

### 2.1.1 Information about the organisation

This was intended to collect data on type of organisation, number of employees and position of the respondents. These data were required to ensure right respondents were included in the analysis.

### 2.1.2 Needs

This was intended to find out demand of the graduates of Master of Engineering in Renewable Energy, number of employees working in the field of renewable energy and energy efficient buildings, and plans to recruit graduates of renewable energy over the next five years.

### 2.1.3 Requirement and competencies

In this the respondents were asked to identify the competencies that organisations look for when they recruit graduates in renewable energy and energy efficient buildings.

### 2.1.4 General position about new master programme

This was intended to find out if the proposed Master programme is relevant to the organisation and if they are willing to cooperate by providing internships to the students.

### 2.1.5 General comments

The respondents were also asked if they have any other suggestions or general training needs which the college could plan to offer in near future.

## 3 Results and Discussion

### 3.1 Information about organisation

A total of 89 responses was received comprising of both government and private organisations. The respondents include majority of industries such as hydropower sectors, cement industries and private sector companies which play crucial role in the economy of the country. The survey also included adequate number of government agencies which work for the policy framework development. Figure 1 represents types of organisations that responded to the survey. As shown in Figure 1, almost 47% of the respondents are under others category which include corporations, non-governmental organisations, autonomous agencies, hydropower construction, residential buildings, hotels, resorts, financial institutes, electrical utility, carbide chemicals and housing sectors. About 36% of the respondents were from the government institutions. Out of 89 respondents, 55% have more than 100 employees, 7% between 51-100 and 38% less than 50 employees.

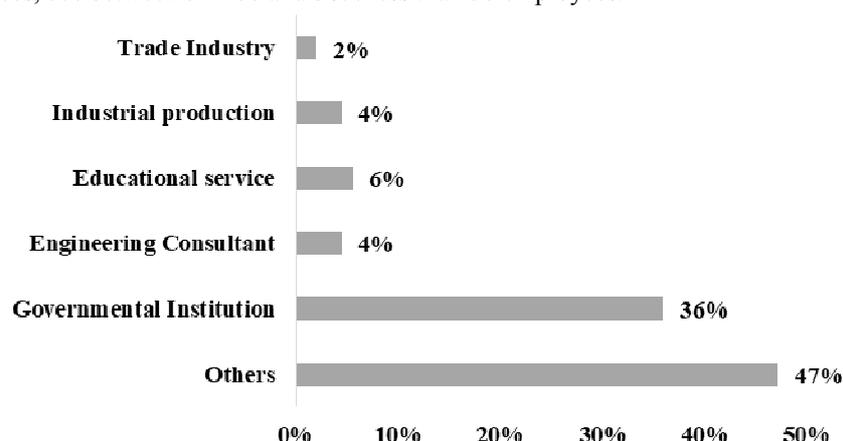


Figure 1. Type of Organization

### 3.2 Need of Master of Engineering in Renewable Energy

The first question was “how many employees are actually working in different fields”. From Figure 2, it is apparent that majority of the organizations have more employees working in energy systems than in building energy efficiency. The overall data shows that there is least amount of employees who are qualified or has an expertise in the field of energy efficient buildings in Bhutan. More than 78% of the respondents surveyed doesn't have employees working in the energy efficient buildings whereas 56% of the respondents doesn't have

expertise in energy systems.

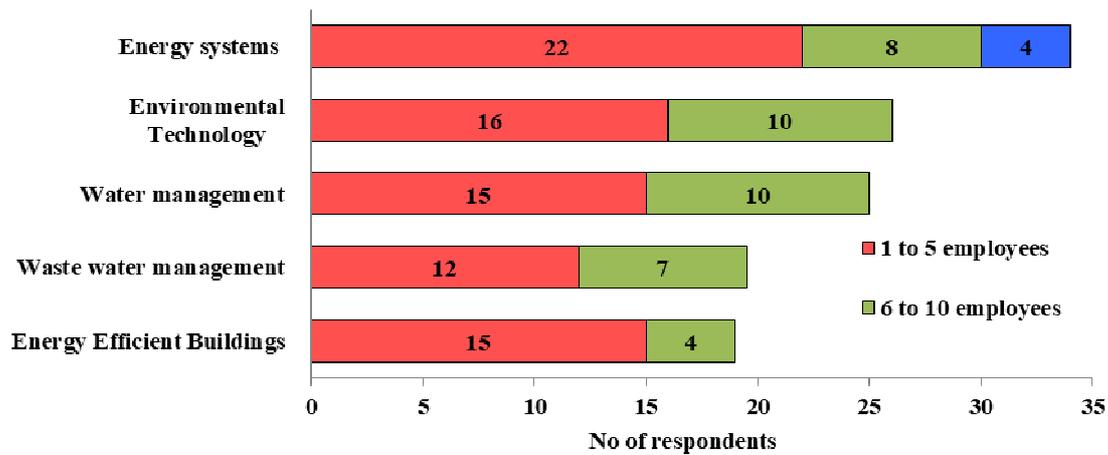


Figure 2. Number of employees in different field

### 3.2.1 Need of graduates in different fields

The situation of having very less employees or no employees at all in the field of energy systems and energy efficiency of the buildings were mainly attributed to the lack of experts in those fields. The respondents were asked if their organisations have urgent need of graduates in the field of Energy Efficiency, Renewable Energy, Environmental Engineering and Climate Change. More than 60% of the organisations had difficulty in getting the experts in the field of energy efficiency and nearly same percentage of the respondents had difficulty in getting renewable energy experts. The respondents opined that there is scarcity of graduates skilled in energy systems (Figure 3). Over the time, need for skilled people in the field of energy efficiency, renewable energy, environmental engineering and climate change is likely to increase (Figure 4). About 33% of the respondents feel that experts in the field of building energy efficiency are important whereas 74% in the field of renewable energy. The organisations are aware of the rapid developments taking place in the country and feels the need of such skills in the near future.

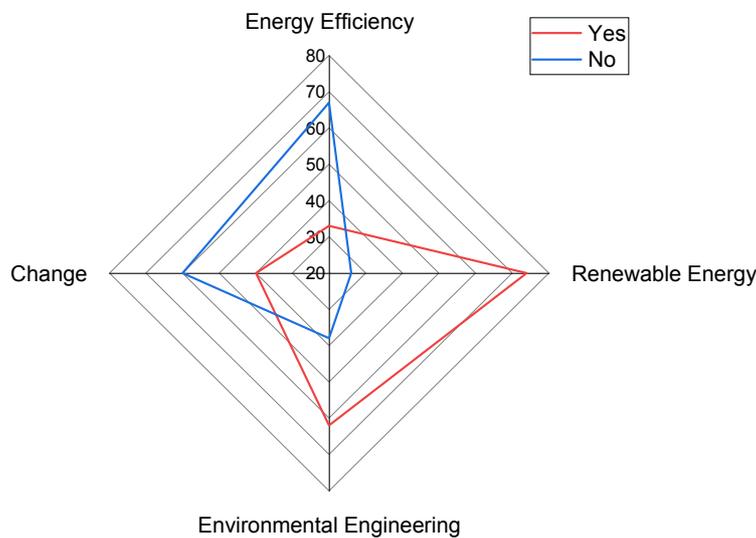


Figure 3. Needs of different experts

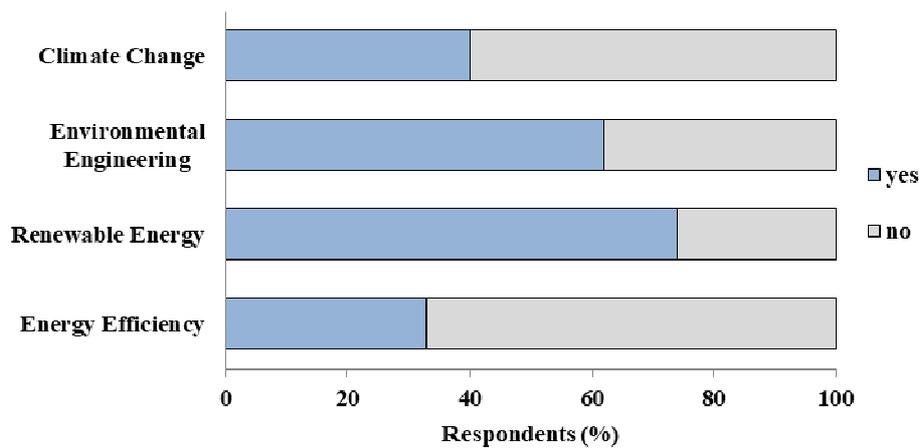


Figure 4. Difficulty in getting the experts in different fields

### 3.2.2 Number of new positions planned in different fields

The sustainability and the progress of the Masters programme would depend on the job market for the graduates. For this it is important to know job market in Bhutan in the next five years. Figure 5 presents requirement of the organisations for the next five years. The figure shows that more number of positions has been planned in the field of energy systems and energy efficient buildings compared to others. This indicates that the requirement for experts in energy systems and renewable energy are likely to increase over the years and hence demand for the proposed programme.

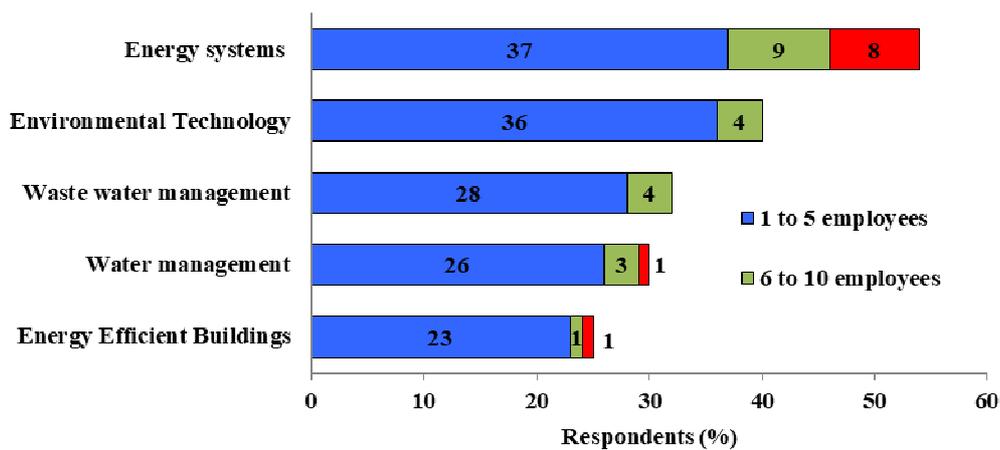


Figure 5. Planned positions for next 5 years

### 3.2.3 Relevance of proposed master programme

The analysis of the survey result shows that more than 69% of the respondents have interest in the development of master program at CST. The remaining 31% were least interested as their organisation has very little significance to the use of renewable energy technologies.

## 3.3 Requirement and competencies

### 3.3.1 Professional competencies

The competencies need of the graduates in the organisations show that majority (44%) prefer their employees to have applied technical knowledge (Figure 6). Applied technical knowledge includes courses on renewable energies, heating, ventilating, air conditioning and building physics, hydraulic engineering and environmental engineering. The survey also shows that the organisations find difficult in getting employees who are ready to work in the field of energy efficiency, renewable energy, environmental engineering and climate change. The majority of the organisations also show that they have urgent need of employees in the above field.

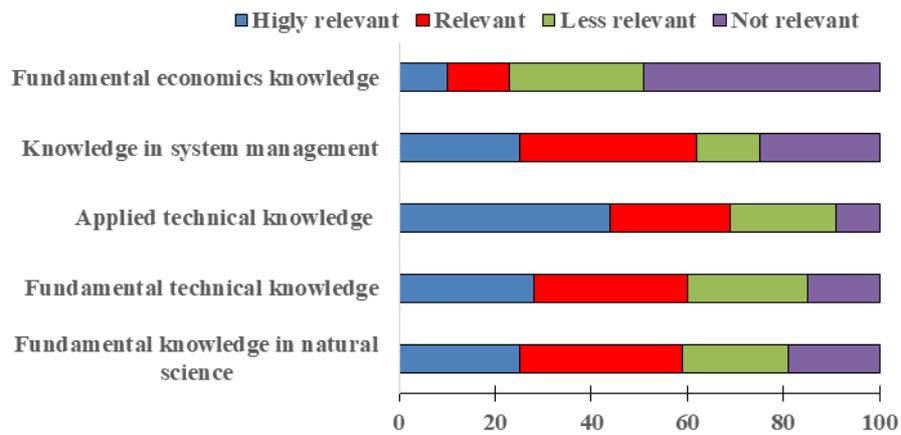


Figure 6. competencies need of the graduates

### 3.3.2 Methodical competencies

To determine the methodical competencies expected from the graduates of the proposed programme, a question was asked to choose one from four categories as shown in Figure 7. Majority (34%) of the respondents have chosen thermal simulation and another 23% building physics and moisture simulation. These responses correlate with the findings from the preceding questions that the respondents are likely to pursue such courses which will form part of the proposed programme. From the list of personal competencies of the graduates, team work, communication skills and presentation techniques were found to be very relevant over negotiation skills, social skills and flexibility.

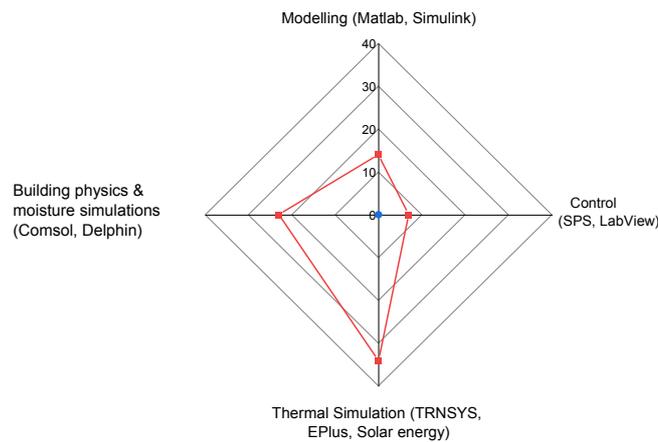


Figure 7. competencies need of the graduates

### 3.3.3 Type of skill scarcity

To determine the type of skills that are lacking in the organisations, a question was asked “Are there skills that are lacking in your company/ Organisation”. It is apparent from the response that there is dearth of experts in the energy systems and energy efficient buildings than other fields as shown in Figure 8. This indicates that the demand for the proposed master programme is higher than other programmes.

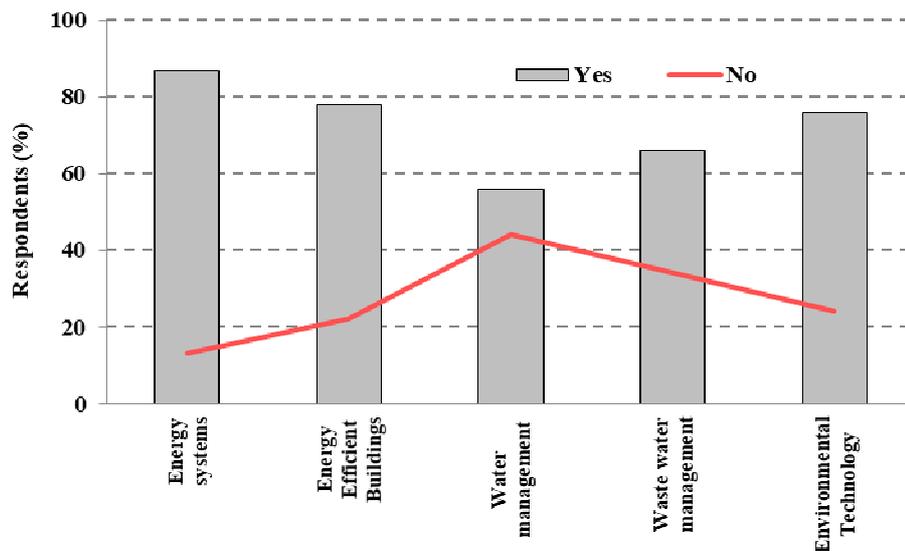


Figure 8. Response to lack of skills in various field

The results from Figure 8 show good correlation with Figure 5 planned new positions over next five years and Figure 3 need for different experts. From these figures, it can plausibly be concluded that demand for graduates of the proposed programme would increase over the next few years.

### 3.3.4 In-house training

Presently due to construction boom in the country the majority of the trainings institutions offer are in the field of electrical, civil, mechanical and building construction. m work and communication skills. When asked if the respondents conducted any training on energy efficiency of buildings and renewable energy. More than 61% didn't offer any training to their employees in the field of energy efficiency of buildings and renewable energy due to the lack of an institution where such courses are being offered. The organisations also opined that due to the lack of experts, they have not planned any new business in the field of energy efficient buildings and renewable energy. More than 75% of the organisations have not planned any new business and the remaining 25% are facing difficulty in getting the experts in the field of energy efficient buildings and renewable energy.

### 3.3.5 Demand of graduates

As stated by majority of the organisations, experts in energy efficient buildings and renewable energy are difficult to find. Therefore, the demand for such graduates are likely to increase drastically in the future looking at the scenario of the country (Figure 9). More than 85% of the respondents feel that demand for experts in the field of energy systems and energy efficient buildings will increase in the future.

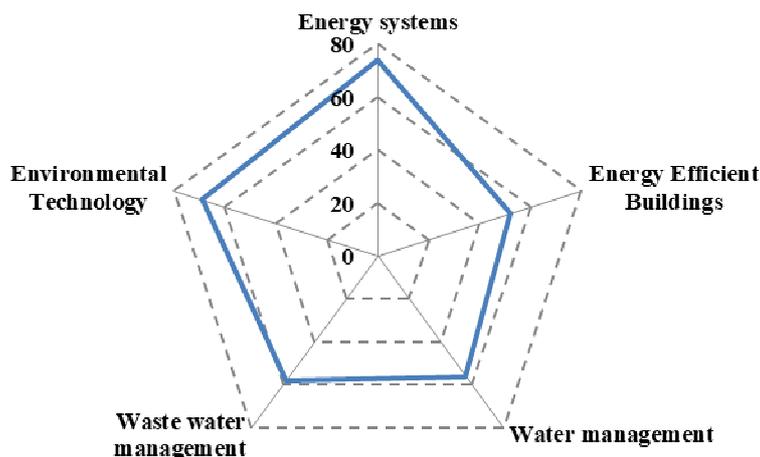


Figure 9. Demand in coming years

The respondents are optimistic that the programme can produce graduates with expertise in the field of energy efficient buildings and renewable energy who will be employed in various organizations. Some of the courses recommended by respondents are:

- Energy efficient renewable energy system.
- Solar engineering and Design.

- Wind power Design.
- Energy efficient technologies in buildings.
- Fundamental knowledge in Natural Science.
- Applied Technical knowledge.
- Knowledge in System Management.
- Environmental engineering.
- Climate change.
- Biogas supply Technologies.
- Passive heating and cooling technologies
- Biogas and Biofuel technologies
- Solar thermal technology
- Energy efficient building design
- Smart grid
- Power Electronics for Renewable Energy
- Hybrid Renewable Energy Systems

### 3.4 General position about new Master Programme

The respondents were asked if the proposal to introduce Master of Engineering in Renewable Energy is right step towards labour market in the country. More than 80% (Figure 10) of the respondents agree that it is important step to meet future needs in the labour market. An equal number of respondents stated that they would rather take specific modules than the master's degree. Therefore, there is need for the college to explore possibilities of offering short term courses.

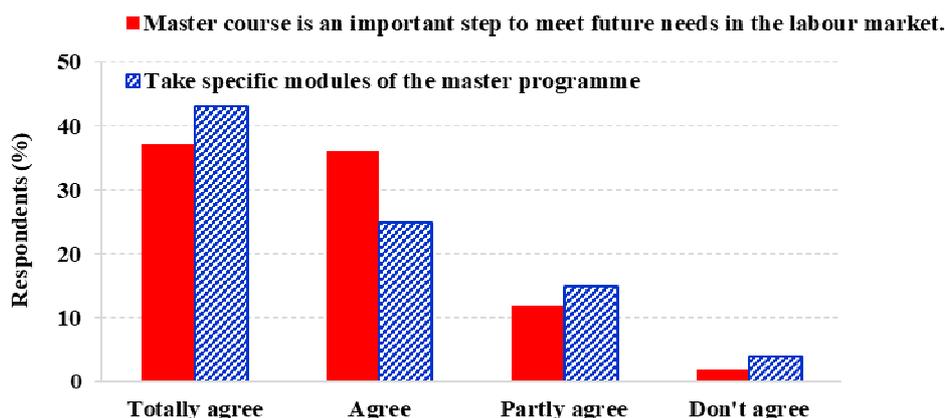


Figure 10. Response to general position of Master programme

#### 3.4.1 Support for internship

From the survey, it was found that nearly 77% of the respondents is positive about the proposed master programme and are willing to support and provide internship to the students. Such opportunities would benefit both the parties, the students and the organizations.

### 3.5 Expectations of the organizations

According to the response from the surveyed organisations, the requirements from the proposed master programme vary. However, most requirements are related to renewable energy and energy efficient systems in different sectors. The information gathered through this survey was used to develop master programme that will meet the demand and expectations of the stakeholders in Bhutan. Among the various needs of the stakeholders, the respondents would like master programme to realise the following objectives:

- Analyse and evaluate environmental, social, and economic impacts of renewable energy infrastructure.
- Evaluate constraints and commercial risks related to renewable energy.
- Initiate, plan and design new renewable energy infrastructure.
- Evaluate options for energy supply and appraise environmental sustainability of renewable energy systems.
- Evaluate and optimise renewable energy systems using modelling techniques.
- Assess range of problems related to renewable energy and apply new emerging technologies to solve these complex problems.
- Identify areas of unexplored questions and recognize different approaches to problems.

- Enhance innovation and entrepreneurship in renewable energy.
- Demonstrate a critical awareness of theoretical design concepts and their practical implementation within renewable energy system.
- Advise clients on renewable energy projects.
- Understand the national, regional and global energy supply systems and their interrelationship with the environmental problems.
- Analyse the current technologies used for these resources conversion to useful energy.

#### 4. Conclusions

After analysing the results of the survey and taking adequate note of the comments and recommendations, it can be concluded that both government & private sectors in Bhutan are looking forward to Master of Engineering in Renewable Energy program to meet their skill shortages. Based on the trend of development, dearth of people with expertise in the field of renewable energy and other associated fields, the demand for the proposed programme is likely to increase. Most of the organisations are also willing to support the college in its endeavour to launch the master programme. Therefore, the proposed master programme in Renewable Energy with embedded courses on energy efficient building design is important and relevant to ongoing Bhutan's development activities. Based on the findings of this study, CST in collaboration with consortium partners have designed and launched Master of Engineering in Renewable Energy in spring 2018.

#### 5. Acknowledgement

This study was funded by the Erasmus+ Programme of the European Union. The authors would like to thank the members of consortium from Lund University, Sweden; University of Innsbruck (UIBK), Austria; Tallinn University of Technology (TUT), Estonia; Kathmandu University, Nepal; Tribhuvan University, Nepal for their support in conducting the need analysis of the proposed programme.

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