



BBChina

*Master Program
on Bio-Based Circular Economy*

E.T.N.A.

Education and Training Needs Assessment

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Introduction

The project BBChina aims to help People's Republic of China fully exploiting its wide bioenergy and biobased products potential, through the implementation of a 120 ECTS equivalent Master Program on Bio-Based Circular economy in three Chinese Universities, i.e. Tongji University and East China University of Science and Technology, both from Shanghai, and Sichuan University from Chengdu. The exploitation of this high potential could help strongly decreasing the present use of fossil fuels in China that dramatically increases the local pollution as well as global warming at world level. In fact, declining fossil fuels availability and increasing environmental problems, including global warming and air pollution, are driving Chinese society to search for new sustainable sources of energy such as bioenergy and biofuels as well as biochemicals substituting petrochemical-derived materials. Biomass provides an ideal alternative to fossil resources; indeed, biomass is the only sustainable source of interest organic compounds and has been proposed as the ideal equivalent to petroleum for the production of fuels and energy.

As a first step of the process that will lead to the implementation of the Master Program, an Education and Training Needs Assessment (ETNA) has been performed. The present ETNA aims to create a definitive awareness of what kind of knowledge is not already available for both students and teachers, and in which proportion multidisciplinary topics will be exploitable in the target context.

A preliminary assessment has yet been partially undertaken at proposal submission stage in order to obtain a pre-screening of real needs of project's

stakeholders and target groups, and Partner Country Universities provided at that stage a lot of information about their present academic scenario and lacks in the Biobased Economy sector.

This document is considered as “still in progress” during the project implementation, in order to have the possibility to update it if deemed necessary for the sound implementation of the action and to support its sustainability.

A preliminary version (Version 1) of the present document has been submitted to the International Advisory Board of the BBChina project, whose feedbacks and comments have been used to improve the present version.

Furthermore, the results of the Panel on “*Higher Education and Training on Renewable Energy Topics: Open Issues, Present Status and Future Development*” held during the ICAE Conference 2018 in Hong Kong and co-organised by the BBChina, were also included in the present Assessment (Annex I).

Education & Training Needs in the Bioenergy, Biofuels and Biochemicals sector – Background

The “Bioenergy, Biofuels and Biochemicals” sector is becoming always more important for China in the last decades. Furthermore, it also became politically significant after the issuing of the “13th Five-Year Plan on Biomass Energy Development” (2016-2020) by People’s Republic of China government in March 2016. The Plan, in detail, aims to reach:

- the commercialization and large scale use of biomass energy is realized preliminarily.
- the amount of biomass energy used per year reaches an equivalent of about 58 million tons of standard coal.
- installed gross capacity of biomass power generation achieves 15 million kW (15 GW), with the annual energy output of 90 billion kWh (90 TWh);
- the amount of biogas used per year reaches 8 billion m³, liquid biofuel to 6 million tons per year and biomass briquette to 30 million tons per year.

Moreover, there are extensive biomass resources in China. The annual output of biomass is equivalent to about 200-400 million tons of standard coal. However, most of the biomass is not efficiently used.

Until now, the main limiting factors for biobased economy development in China are about economic and technical aspects.

THE PREFACE OF THE “13TH FIVE-YEAR PLAN FOR BIOMASS ENERGY DEVELOPMENT”

Biomass energy is an important renewable energy source. The development and utilization of biomass energy is an important part of the energy production and consumption revolution, and an important task for improving environmental quality and developing a circular economy. In order to promote the development and utilization of biomass energy, expand the market scale, improve the industrial system, and accelerate the pace of diversified industrialization of biomass energy specialization, the National Energy Administration has organized the “13th Five-Year Plan for Biomass Energy Development”. It is printed and distributed to you, please implement it carefully in light of the actual situation.

Present Status in the involved HEIs

The present status refers to the three Higher Education Institutions (**HEIs**) involved in the BBChina Project: Tongji University (Shanghai) from here on **TJU**, East China University of Science and Technology (Shanghai) from here on **ECUST** and Sichuan University (Chengdu) from here on **SCU**.

At the moment of starting the project implementation, there is not a specific Education Offer in the “Bioenergy, Biofuels and Biochemical” sector in the three involved Higher Education Institutions, except for Sichuan University, where there are some courses but not deep in a specific field.

Reasons for the implementation of Education and training in the Biomass-Based Sector

All of the three HEIs are convinced that a sound education offer in the Biomass-Based (BB) sector will guarantee that students, after graduation, will be exploitable in the labour market in China and outside China. Furthermore, at global/international level, the Chinese/European “One Belt, One Road” initiative promotes Chinese enterprises exploring the international markets in the countries involved in the initiative (Eurasia States). Thanks to the initiative, a workforce with appropriate training in the BB sector will be then able to compete in the job market at international level.

Apart from the global level, in the local market there is also a request of well-trained professionals in BB sector, both from public and private companies.

ONE BELT ONE ROAD

China proposed the Belt and Road Initiative (BRI) in 2013 to improve connectivity and cooperation on a transcontinental scale. The scope of the initiative is still being deliberated, but it involves two main components, each underpinned by significant infrastructure investments: the Silk Road Economic Belt (the “Belt”) and the New Maritime Silk Road (the “Road”). The overland “Belt” links China to Central and South Asia and onward to Europe. The maritime “Road” links China to the nations of South East Asia, the Gulf countries, East and North Africa, and on to Europe.

Obstacles to face and suggested improvements for a proper Education and Training implementation

The main reasons that keep difficult to teach about Bioenergy, Biofuels and Biochemicals in the involved Chinese HEIs are the following:

- an adequate Education and Training Offer is missing; as already pointed out, presently there is no specifically targeted and integrated Education and Training offer in the field;
- lack of adequate facilities (laboratory/digital services etc..) specifically equipped for Education and Training;
- lack of adequate and updated teaching materials;
- lack of practical examples on where apply students;
- there is not enough interest from University decision-making apparatus in the implementation of education and training activities in the field, although the opportunity given by the project implementation raised interest towards the action;
- there is a lack of students with enough basic competencies to face the specific argument.

About education methods in the scientific sector deemed effective to enhance student's skills the involved HEIs suggest the following three main points:

- use of e-learning tools;
- training on-field and job experiences for the students;
- use of case studies.

Education and training needs

In general, there is the need to prepare highly-skilled engineers and managers in the biomass to energy and bioproducts chain, who will be able to coordinate the design and implement solutions to solve challenges with respect to technical, economic, environmental, and ecological constraints. Therefore, it is necessary to implement a program covering the topics such as energy conversion technologies, including different biochemical routes, system design and optimization from both technical and economic perspectives, project management, legal restrictions and also aspects of climate change, pollution and the integration of renewable energies.

Entrepreneurship

Targeted training to improve and foster Entrepreneurial attitudes for Master students exist in all the three involved HEIs, but this training is given only for some specific master degree and not as a general offer. Tongji University establishes “Tongji Venture Valley” (<http://chuangyegu.tongji.edu.cn/>) and “Tongji Branch of Shanghai University Student Science and Technology Venture Foundation” to support Entrepreneurship of students. At ECUST the training in entrepreneurship is given only at the Business School, where there is a School of business innovation and Entrepreneurship of young leaders of Action Learning Forum. At SCU only some master degree courses are required to train the students in the entrepreneurship.

It is then necessary to set up a common targeted training activity all across the three HEIs.

Education Credits in China

The Chinese Credit System is not homogeneous across the different Universities. As a matter of example, the number of Credits to achieve the Master title in the three involved Universities differs. Furthermore, the conversion of Chinese Credits into European Credit Transfer and Accumulation System (ECTS) is not fully implemented within the involved HEIs, where it exists only for some specific Bachelor or Master Programmes. The implementation of a Transfer and Accumulation System like the European ECTS could ease the acknowledgement of the studying activities performed across different Higher Education Institutions in China and abroad. In fact, the European Credit Transfer and Accumulation System (ECTS) is a tool of the European Higher Education Area (EHEA) that was instituted in 1989, within the Erasmus programme, as a way of transferring credits that students earned during their studies abroad into credits that counted towards their degree, on their return to studying in their home institution.

Students with disabilities

About students with disabilities, the general office of the State Council formulated the special education promotion plan (2014 - 2016) in 2014, implementing the actions to help students with disabilities to study and achieve their professional targets. Currently, refuse of recruiting students due to their disabilities is not permitted at Chinese Universities. This should facilitate the provision of adult higher education for the disabled. Enhancement of the vocational training for the disabled and improve the ability of employment and entrepreneurship are required. The government also arranges a certain proportion of the disabled employment security fund and distribute it through all of the universities.

In detail, Sichuan University (SCU) took action for the students with disabilities that can obtain the highest level financial help setting for difficult students, and also Universities are setting up specialized courses for these students.

SWOT Analysis

On the basis of the collected information, a swot analysis has been performed, whose results are summarised in the following table.

	Helpful to achieve the objectives	Harmful to achieve the objectives
Internal	<p><u>Strengths</u></p> <ul style="list-style-type: none"> • The lack of a specific Education and Training offer within the involved HEIs leaves space and resources for the implementation of the new Master Program • Interest in the implementation of this new Programme from the side of the University administrations 	<p><u>Weaknesses</u></p> <ul style="list-style-type: none"> • Bureaucracy slows the correct implementation at University level • Some University decision-making apparatus are not enough interested in the implementation of such an Education and Training action • In some cases there is a potential lack of space for the implementation of the Lab platform • Students or teachers do not want to use the developed e-learning tool
External	<p><u>Opportunities</u></p> <ul style="list-style-type: none"> • Strong request of trained new graduates in the field in order to fulfil the job market request both at global and local level • Strong political commitment towards the implementation of the Biobased Economy and Activities (e.g. “13th Five-Year Plan on Biomass Energy Development”). • New Markets open through initiatives as “One Belt, One Road”. • Environmental policies support Renewable Energy Sources including biomass for energy 	<p><u>Threats</u></p> <ul style="list-style-type: none"> • No common Educational Credit System at National Level exists • Market for bio-based products and bioenergy is not yet fully developed • Lack of support from enterprises to activate sound internships activities

Guidelines for the BBChina implementation

On the basis of the previously pointed out Education and Training needs the following guidelines can be pointed out in order to implement the BBChina project in a sound and effective way.

The new Master Program must focus on preparing well-trained students to get into the job market both at local and global level.

The Program must train students making use of case studies and practical examples; this can be achieved also with proper implementation of the foreseen common lab platform equipment.

The Master Program target should be to prepare highly qualified engineers, managers, researchers and high-level operators in the field of biomass to energy and bioproducts, that will be able to complexly apply the acquired knowledge to form, assess and make effective decisions on biomass based projects, on the basis of scientific argumentations.

The Master graduate should be able to follow the complex biomass to energy and bioproducts chain, to optimise each step of the chain and choose the adequate technology for every different step. The graduate should also be able to select the best conversion route for each raw material considered as the starting point, and to deal with the technology, market and regulation issues and to operate within the green market.

For the training devoted to foster the entrepreneurship attitudes, the activity proposed for the BBChina at submission stage fits the needs. The foreseen learning activities are planned to focus on the development of all the necessary skills such as: self-branding, team building, creative thinking/analytical thinking, resilience, leadership, market, gaining the customer perspective, lean start-up, economic and financial planning, design thinking for start-up, how to prepare a pitch, patent, market, value proposition, and understanding the mechanisms of investment of a venture capital and grants.

In order to ease the acknowledgement of the studying activities performed during the implemented BBChina Master Programme, the workload could be planned from the beginning based on the equivalence with ECTS. The way to convert the Credits of each University into ECTS will be defined. One way it could be to use the front teaching hours as a conversion mean in between the different systems. At Tongji University in some cases where the conversion has been done, as a rule of thumb it has been considered as 2 ECTS equal to 1 TJU Credit, but this can not be applied as a general rule. In fact, as a matter of example, at Sichuan Universities in some previous cases 1 SCU Credit has been considered equivalent to 2.35 ECTS.

Regarding students with disabilities, as from the collected information, the Chinese Higher Education System already supports their full access to the University Programmes. For this reason, it will not be necessary the implementation of any specific action on this site.

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Annex I - Results from the Panel at ICAE

Here below the main results of the Panel on “*Higher Education and Training on Renewable Energy Topics: Open Issues, Present Status and Future Development*” held during the ICAE Conference 2018 in Hong Kong and co-organised by the BBChina, are presented. The panel, chaired by Dr. Enrico Palchetti, focussed on the Education and Training in the renewable energies (RES) sector, with a special attention to the problems and issues related to China. Here below the main results of the discussion, presented in the form of Question and Answer.

How is the state of the art of the Renewable energies in China?

The Chinese situation related to this issue is still very backward and even if the government is making many efforts to update teaching methods, it will take a few more years to bridge the gap. China is investing a great deal of resources in the RES sector and this involves a strong increase in requesting well-trained personnel to meet the growing demands. As a matter of example, within the 8.8 million new employees in the RES sector in 2017 at Global level, 3.8 million were hired in China (Figure 1).

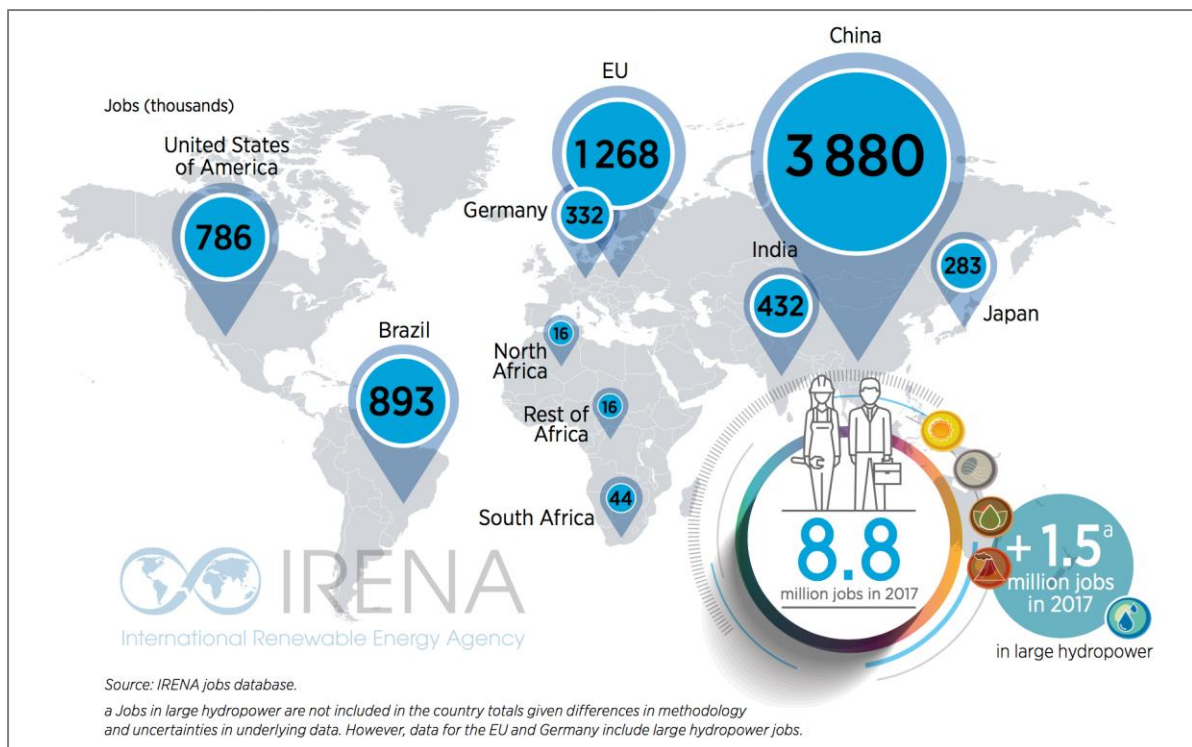


FIGURE 1: 1RENEWABLE ENERGY EMPLOYMENT IN SELECTED COUNTRIES (IRENA JOB DATABASE)

Moreover China is living an abundant increase in the RES utilisation, with a pro-capita consumption of 2.24 Tons of Oil Equivalent (TOE), a number that, if scaled to the population number, can give a rough idea of the future energy demand of this country and the impact that this number will have on the world global market of energy and labour.

A large part of this market will be covered by the RES sector due to its actual lack and deficiency (Figure 2).

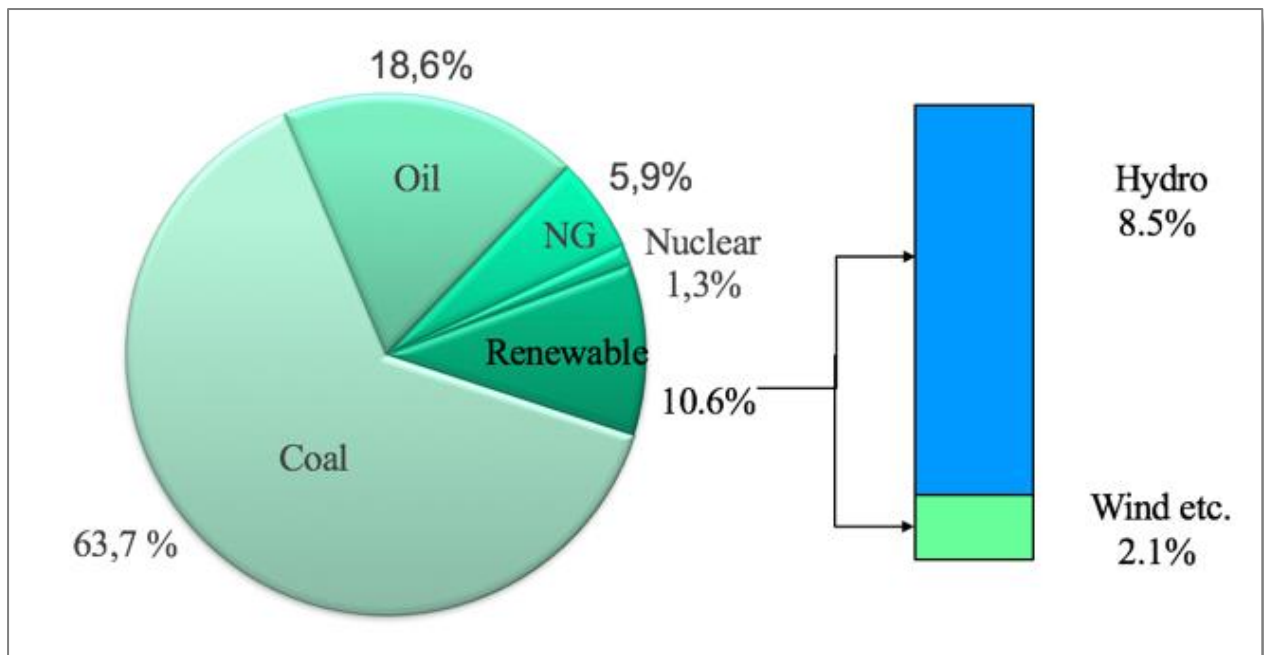


FIGURE 2: CHINA'S CONSUMPTION SHARE OF ENERGY

These facts, together with the new approach of the Chinese Government to face the pollutions issues and the environmental problems that stated the following points:

- Extensive development of fossil energy, particularly coal, has had a serious impact on the eco-environment.
- Air pollution: the emission of carbon dioxide (CO₂), sulfur dioxide (SO₂), nitrogen oxides (NO_x) and toxic heavy metals remains high, and emissions of ozone and particles smaller than 2.5 micrometers (PM 2.5) are increasing.
- Water and land resources are also seriously polluted.

How does the Chinese Authorities cope with the RES development?

All the different sectors of the RES production are foreseen in the Chinese National Program of Development following the points:

- Actively developing hydropower: more than half of non-fossil energy will come from hydropower development;
- Effectively developing wind power;
- Actively making use of solar energy;
- Developing and utilizing biomass energy and other types of renewable energy;
- Promoting distributed utilization of clean energy: 1,000 projects of natural gas in Distributed Energy Systems (DES).

Does the response to changes in higher education in the Chinese educational system try to meet the needs?

Developing several new engineering program initiatives, for examples:

- New energy science and engineering.
- Wind energy and power engineering.
- New energy materials and devices.
- Energy and environment system engineering.
- Energy engineering and automation.

These are part of the “New strategic undergraduate program initiative” launched in March 2010 by the Ministry of Education with the call “New Programs for Strategic New Industries” and approved in July 2010.

How do the Universities react to update their offers in Graduate education?

Regarding the question “How can Chinese university be changed?” can be evaluated several different actions at different levels.

- An University administration support is needed and mandatory: this point had been discussed at National level and many Universities have implemented the efforts to develop a new approach to the education.
- The Campus culture of energy: to support and to wrap the students with an increased sensitivity to the RES the new University campus are projected, realized or restored with sustainable criteria such as: waste recycling, energy saving, emission reduction, renewability of the construction material, etc.)
- Teachers: a new teacher class is needed to cope the target, several updating courses are on going for all the Faculties interested in the RES sector (Agriculture, Chemistry, Engineering, Architecture). Study visit of the teachers in other Universities abroad are stimulated and welcome.
- More courses for general education of energy: the suggestion is to widen the panorama of courses focused on the RES sector for all the faculties. A strong effort should be made to create multidisciplinary masters in the renewable energy sector.
- Extra-curriculum activities: Innovation and competition should be reinforced through the promotion of internship activities in private or public company involved at different level in the RES sector.

Are some problems still remaining in the RES sector in China?

Some constraints are present in the Chinese society to limit the development of the RES in the country, such as:

- Technology and policy readiness
- Renewable energy resources distributed mostly in the western region of the country.
- Long distance transmission and transportation remains a challenge.
- In-situ conversion of energy.
- Policy to support renewable energy development: Pricing, taxation and subsidy:
 - A reduced or exemption tax on companies for renewable energy development.
 - Subsidy companies for renewable energy development.

What Education problems are still present?

In the Chinese education system, however, there are still many limits for achieving an optimal level of student training in the field of RE, such as:

- No sufficient investment of laboratory.
- Insufficient faculty development.
- Insufficient job opportunities due to immature industry.
- Good practice in utilization of renewable energy should be brought into classroom.
- More international cooperation in education of renewable energy is expected.

Conclusions

The ICAE2008 conference represented a great opportunity to present the BBChina project to an international audience of scientists, educators and private companies.

During the panel on “Higher Education and Training on Renewable Energy Topics: Open Issues, Present Status and Future Development” we had the chance to exchange experience and to grasp suggestion for the future development of the Master Degree.

Also some constrains had been highlighted and therefore they will be taken into account for the next steps of the BBChina Project.