CLIMATE CHANGE
TECHNOLOGY TRANSFER
CENTRES IN EUROPE
AND LATIN AMERICA

CELA

TRANSNATIONAL STRATEGY FOR THE ESTABLISHMENT OF TECHNOLOGY TRANSFER CENTRES ON CLIMATE CHANGE

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Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

1918 TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

ALFA

UCC

UNIVERSIDAD Galileo Guatemala, C. A.

ET LUX IN TENEBRIS LUCET MCMXVII
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

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Acronyms

ALFA III: Program of the European Union Cooperation between universities in Europe and Latin America
BCU: Bolivian Catholic University
CC: Climate change CCTTC Technology Transfer Centers on Climate Change
CELA: Universities project between the European Community and Latin America
CO_2: Carbon Dioxide
EU: European Union
NOAA: Agency for management of the oceans and the atmosphere of the United States of America
ICTs: Institute of Electronics, Informatics, Telematics and Automation of the Pontifical Catholic University of Peru
INTE: Environmental Research Institute of the Catholic University of Peru
IPCC: Intergovernmental Panel on Climate Change.
IISEC: Socio-Economic Research Institute of the Catholic University of Bolivia.
JELARE: Renewable energy project involving several universities that are in the project CELA
HAW: University of Applied Sciences Hamburg
NGO's: Non- Governmental Organization
PUCP: Pontifical Catholic University of Peru
TUT: Tallinn University of Technology
RT2C2: Center for Research and Technology Transfer in Climate Change, Galileo University
UGAL: Universidad Galileo
VCCTTC: Virtual Center for Technology Transfer on Climate Change

Executive summary

Recent publications reaffirm and warn of impending risk that is causing climate change as a result of accelerated rates of greenhouse gas emissions. Among them are the concerns of the Security Council of United Nations to "the possibility of adverse effects of climate change could aggravate certain long-term threats to peace and international security." Also an international team of researchers from Stockholm University, in collaboration with various institutions have suggested that the carbon released from thawing Arctic is ten times greater than we thought so far and may reach 44 million tons per year. While NOAA Laboratory, Muna Observatory in Loa Hawaii, announced that CO_2 concentrations in the atmosphere increased from 379.76 ppm in 2005 to 389.78 ppm in 2010. In this context, the World Bank has commissioned a study called "Turn Down the Heat: Why a 4 °C Warmer World Must be Avoided" which summarizes the main consequences of the current trends in greenhouse gas emissions worldwide and its devastating effects across the geography of the Planet.

As the Earth warms, it is revealed new risks arising from the behavior of the global climate (atmosphere system, biosphere, oceans, geosphere and cryosphere), which will become apparent across the globe, demonstrating through close relationship **between the impacts of climate change, including climate variability and its relation to disasters. Together with the above**, the special report commissioned by the IPCC called SREX, providing new insights into the adaptation, risk management and reducing emissions are the main strategies to reduce threats and tackling climate change which is characterized as changing risk, and that will involve the use of multiple strategies to address risks still unknown, such as: face, adapt and learn.

The term **technology transfer has evolved over time from a narrow definition to a broader terminology including intangibles organizations, as is knowledge**. In recent years a number of activities related to technology transfer and knowledge, among which the following can be listed:

- ✓ Collaboration between companies and knowledge centers (universities, research institutes and technology centers).
- ✓ Strategic alliances and cooperation around I + D, technology and innovation.
- ✓ Knowledge and technology centers and saturation in certain areas or regions.
- ✓ Business creation, science and technology base.
- ✓ Patent applications and grants, as well as royalty payments for licenses.
- ✓ Internationalization (globalization) of I + D, high technology, knowledge and innovation.
- ✓ Relevance of technology on business competitiveness (technology innovation).

- ✓ Outsourcing business processes to services I + D + i „turnkey“ highly specialized.
- ✓ Standardization and certification of I + D + I activities.
- ✓ Corporate Events with contents of I + D, technology and innovation.
- ✓ Emergence of the concept of I + D, technology and innovation in the mass media.
- ✓ Availability of public funds for I + D + i and technology transfer.
- ✓ Specialized staff in managing managers I +D + i technology transfer.
- ✓ Entities and intermediate agents in the science, technology and society system.
- ✓ Designated innovate and interact in I + D, technology and innovation in both face (parks, cluster ...) and virtual (networks, portals ...).
- ✓ Technology transfer macroeconomic-level (between countries and development cooperation).

But adaptation technologies have the enormous challenge ahead that they tend to be very specific to climate change impacts, and environmental and social characteristics of the place where the impact occurs. Therefore, in adapting to climate change, priority should be the bottom-up approaches, both in the creation of knowledge, as in the transfer of technology.

The project CELA is a good practical example of how to successfully run a process of technology transfer, where universities act as nodes in the transnational network of technology transfer in the service of society in each country. Thus all CELA project partners developed in their respective countries, research on research needs and the role of research and technology transfer, and each partner published his results, which have provided support for the future actions of the National Centers on strategy development, Capacity Building, development of specific activities (pilot projects for Latin America) and other actions.

A brief analysis of the findings of each country shows geography-specific differences, but also similarities in terms of common lack of knowledge on the impacts of climate change and the importance that is given to the research centers and technology transfer on climate change. **On these pillars, all Research Centers specialize in research, development, technology transfer, capacity building, dissemination and knowledge networks on climate change in various sectors such as energy, water, early warning systems, assessment risk or virtual knowledge tools.** All partners have developed their local strategies and have established their centers based on a study of strengths, opportunities and threats which allowed determining strategic direction, according to the experience and expertise of each center. **On this basis it has been developed a transnational strategy based on a set of**

activities, services and products. This network is supported by a commitment to each of its members to contribute to the global challenge of climate change. Each of the partners has built their local strategies defining their vision and key strategic areas, which constitutes the backbone of the transnational network.

CELA Network is a growing network. All partners are involved in building local networks with other government entities, universities and NGOs. Parallel also have developed three or more international seminars on capacity building and each partner has developed its own events local capacity building through various activities. This strategy demonstrates the viability of CELA the project as an alternative where they join efforts, will, knowledge and experience between universities in Europe and Latin America to meet the challenges of adaptation to climate change through the networking of research and technology transfer.

Part 1: Introduction

1. Introduction

The Climate change humanity is facing nowadays, caused by high concentrations of greenhouse gases, is already an indisputable fact from the scientific point of view (IPCC, 2007). While the concern of the international community focuses on resolving the uncertainties of human capacity and available time to adapt to the effects of rising global temperatures (Milán, 2012).

Recently the UN Security Council adopted a resolution showing the “concern“ of that body to “the possibility of adverse effects of climate change could aggravate certain long-term threats to peace and international security.“ It also stresses “the possible security implications that may have for some States territory loss caused by rising sea levels, particularly for low-lying island states.“ (EFE. 21.07.2011).

Every day brings new evidence of the rapid pace of change. For example: An international team of researchers from Stockholm University in collaboration with various institutions as the Catalan Institute of Climate Sciences (IC3) has studied the rise of average temperatures in the Arctic and its data provide worrying figures. “The carbon released from thawing Arctic is ten times greater than we thought so far and may reach 44 million tons per year.“ That study was published in the prestigious journal Nature shows that rising temperatures in the Arctic is causing a great loss of permafrost, soil that is frozen for longer in summer and reaching greater depths. While CO_2 concentrations in the atmosphere increased from 379.76 ppm in 2005 to 389.78 ppm in 2010, (NOAA, 2013,), for its part, the European Union hopes to see in Bangkok “substantial work“ to advance adopt to achieve an international agreement to reduce $C0_2$ emissions in 2015 to enter into force in 2020 and to identify options to achieve “more ambitious reductions by 2020“ to meet the goal of keeping global warming below 2 degrees centigrade (EUROPA PRESSES 29th Aug. 2013).

Meanwhile, environmental organizations such as Greenpeace and Oxfam warned the Association of Southeast Asian Nations (ASEAN), which plans economic integration planned for 2015 will not be possible without addressing before the effects of climate change, as countries in Southeast Asia can not afford to tackle climate change, whose impacts “increase economic disparities within and among these, representing an obstacle to integration“ and “destabilizing markets and precipitating prices up above projected increases structural up to 100 percent in basic foods such as corn over the next 20 years”. (EFE 31st Aug. 2012).

Other highly relevant evidence is revealed by the report commissioned by the World Bank, called Turn Down the Heat: Why a 4 °C Warmer World Must be Avoided which summarizes the main consequences of current trends in emissions of greenhouse gases to worldwide. The main findings of this report indicate (THE WORLD BANK, 18th Nov., 2012):

- In many regions there will be extreme heat waves over nearly all summer, phenomena that in the absence of global warming would be expected to occur once every several hundred years. The effects would not be uniform. The greatest warming would occur in terrestrial and vary between 4 °C and 10 °C. In the Mediterranean, North Africa, Middle East and parts of the United States would expect increases of 6 °C or more than the monthly average temperatures during the summer.
- It is likely that the sea level rise of 0.5 m to 1 m by 2100, and it is possible that this increase is greater. Some of the most vulnerable are in Mozambique, Madagascar, Mexico, Venezuela, India, Bangladesh, Indonesia, Philippines and Vietnam.
- The most vulnerable regions are in the tropics, subtropics and pole ward, where it is likely to combine multiple impacts. It is likely that agriculture, water resources, human health, biodiversity and the services provided by the systems be severely affected. This could cause a displacement of populations on a large scale and have consequences for human security and economic systems and trade.
- Many small islands may not be able to sustain its inhabitants.

2. Impacts of climate change and climate variability and its relation to disasters

As the Earth warms, will reveal new risks arising from the behavior of the global climate (atmosphere system, biosphere, oceans, geosphere and cryosphere), which will become apparent worldwide. This is evidenced by the Special Report on the Risk Management of Extreme Events and Disasters in Latin America and the Caribbean (SREX), commissioned by the Intergovernmental Panel on Climate Change (IPCC)

The key findings of this report for Latin America indicate that:

- Even without taking into account climate change, disaster risk will continue to increase in many countries as more vulnerable people and assets are exposed to extreme weather events.
- Based on data available from 1950 onwards, the evidence suggests that climate change has varied since the magnitude and frequency of some extreme weather and climate events in some macro-regions of the world.

- High levels of vulnerability, combined with exposure to weather and climate events more severe and frequent, may make it more difficult to live and work in parts of the region.
- Measures to risk management need improvement, as many countries are poorly adapted to current for extreme events and risks, so that they are not prepared for the future.
- Any delay in mitigating greenhouse gases will probably lead to climate extremes more severe and frequent in the future and more likely to contribute to disaster losses.

3. Adaptation and disaster risk management

According to the IPCC (2007) it defines adaptation as “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits opportunities“. The concept of adaptation, along with disaster risk management is the fundamental pillars of responses, with a risk that arises due to three factors. They are:

- Exposure.
- Vulnerability.
- Weather and climate events, which in turn are caused by natural variability and anthropogenic climate change.

The learning of SREX IPCC special report warns that the risk of disaster caused by climate change is changing because:

1. The exposure and vulnerability are dynamic and depend on economic, social, demographic, cultural, institutional, and governance.
2. Individuals and communities are also differentially exposed due to factors such as wealth, education, gender, age, class/caste, and health. Lack of resilience and capacity to anticipate, cope with and adapt to extreme events are important factors of vulnerability.
3. A changing climate leads to changes in the frequency, intensity, duration and territorial extent of weather and climate extremes, and can generate unprecedented extremes.

These elements help understand some challenges for adaptation to climate change from managing disaster risks, such as:

1. The rapid and widespread reduction of emissions of greenhouse gases.
2. Confront, adapt and learn. These actions recognize that there is no

universal recipe for yet unknown diseases, this is maximize learning research and emphasize the importance of problem solving action-oriented.

3. Integrating disaster risk management, climate change adaptation and sustainable development with bottom-up approaches, from the grassroots and administrative divisions closer to the population, and the value of holistic and comprehensive.

Along with that, Mannke, F.,(2011), states that there is a growing scientific consensus on a number of factors that are seen as generic building resilience to climate change, including: the free flow of ideas, knowledge and technology, schemes governance and social development policies and political capital and human capacity building, and a fairer distribution of resources.

4. Technology transfer on climate change

The term "technology transfer has evolved over time from a rather narrow definition, it does not refer to tangible items but to a broader terminology including intangible elements of organizations, the called tacit knowledge, that is, the knowledge embedded in people and processes. (Mannke, F., 2011, Camacho, L. 2012)

The concept also refers to "the transfer (sale, donation, exchange, etc.) systematic knowledge for the manufacture of a product, the application of a process or providing a service." (Camacho, L, 2012)

There is a perception that the technology transfer concept is evolving towards knowledge transfer and includes:

- More dimensions of transfer, such as social or cultural transfer, one that refers to knowledge of native peoples.
- More technology transfer objects such as intellectual property protection, publications etc.
- More transfer mechanisms, in addition to licensing, research contracts or business creation, as staff training or mobility.

The transfer of knowledge and technology transfer are often used interchangeably, but both terms imply highly interactive activities that serve different purposes. "Knowledge transfer involves a broader and more inclusive construction that is directed more towards understanding the whys for change. By contrast, technology transfer is a narrower and specific that usually embodies certain tools to change the environment. Engineering Management, IEEE Transactions on (2004)

Developments in recent years of a number of activities related to technology transfer and knowledge “shows that they are more and more important, and have a greater impact and are a growing trend“. Some of these activities are as follows (Hee Jun Choi, 2009):

- ✓ Collaboration between companies and knowledge centers (universities, research institutes and technology centers).
- ✓ Strategic alliances and cooperation around I + D, technology and innovation.
- ✓ Knowledge and technology centers and saturation in certain areas or regions.
- ✓ Creating scientific and technological enterprises.
- ✓ Patent applications and grants, as well as royalty payments for licenses.
- ✓ Internationalization (globalization) of I + D, high technology, knowledge and innovation
- ✓ Relevance of technology on business competitiveness (technological innovation).
- ✓ Process outsourcing I + D + i services business to „turnkey“ highly specialized.
- ✓ Standardization and certification of I + D + i.
- ✓ Corporate Events with content I + D, technology and innovation.
- ✓ Emergence of the concept of I + D, technology and innovation in the mass media.
- ✓ Availability of public funds for I+ D + i and technology transfer.
- ✓ Specialized personnel managers in managing I +D + i and technology transfer.
- ✓ Entities and intermediate agents in the science, technology and society system.
- ✓ Designated innovate and interact in I +D, technology and innovation in both face (parks, cluster ...) and virtual (networks, portals ...).
- ✓ Technology transfer at macroeconomic level (between countries and development cooperation).

In relation to climate change, lists of technologies for mitigation (emission reduction, clean energy sources, improved monitoring capabilities, etc.) have prevailed. But adaptation technologies have the enormous challenge ahead that these tend to be very specific to the impacts of climate change and environmental and social characteristics of the place where the impact occurs. Therefore, in adapting to climate change priority should be the bottom-up approaches, both in the creation of knowledge, as in the transfer of technology.

5. CELA Project

The CELA project (Network of Centers for Technology Transfer on Climate Change between Europe and Latin America), funded under the European Commission under the ALFA III program, which involved a consortium of universities in Europe and Latin America, it is a good practical example of how successful can operate a process of technology transfer, where universities act as nodes on the network transnational technology transfer oriented objectives:

- Improving the quality of research and technology transfer in the field of climate change in Latin American universities.
- Strengthen the role of higher education institutions in Latin America in the sustainable economic development taking into account the socio-economic impacts of climate change.
- Promote research on climate change and cooperation of technology transfer in the field of climate change between higher education institutions in Latin America and Europe.

Since the project's inception in 2011, there were several different local research activities (countries) and transnational (network), in parallel with other capacity building activities and promote the creation of national networks.

5.1 Study and research needs of local technology transfer

During 2011 all CELA project partners in their respective countries developed a research on the needs of research and the role of research and technology transfer.

The research method was based on a sample of interviews by a model whose universe is defined by three types of stocks:

1. Private companies in the field of agriculture and other sectors, as two separate strata.
2. Institutions of Higher Education, teachers and/or researchers.
3. Decision makers in public institutions and NGOs.

Each country reported its findings, which have provided support for the future actions of the National Centers on strategy development, Capacity Building, Development of specific actions (pilot projects for Latin America) and other actions.

Under the leadership of Guatemala, the report of that transnational research was published, which provides a brief summary below by country.

The results shown below have been selected from the strategic point of view by country, from the study by the partners and the team led by Galileo University in Guatemala. For more information on the results of the needs assessment, consult the literature cited.

Bolivia

Private Companies

- A high% considers that CC is a business priority for their economic and social consequences.
- Extreme weather events affecting their operations.
- Increased demand for recruiting qualified managerial and executive staff in CC, and have difficulty finding.
- Require legislation to clarify the framework for action on CC.
- Lack of technical capacity to use carbon markets and these can benefit the mitigation and adaptation projects.

Teachers and administrators in higher education

Training needs and interest of teachers.

- Use and optimization of energy and water.
- Need to enact policies to adapt and promote economic development use of alternative and renewable energy.
- Support the establishment of Center of Research and Technology Transfer in CC.
- Improving infrastructure university mainly laboratories to promote the fight against CC.
- They need immediate strengthening university actions on the CC.
- Cooperation Work Practice industry-university-government.
- Promoting Research in CC.

Decision makers in Universities, Public Institutions and NGOs

- The level of awareness of the problem in CC is high in institutional leaders.
- Research and technical assistance activities are most important and are around them that require further development.
- The creation of a Centre for Research and Technology Transfer in CC represents an advantage for the acquisition of knowledge by these institutions, which would be increased technical capabilities at a low cost.

Estonia

Private Companies

- The problem with CC is temporarily on the agenda of the company, but not a decisive issue.
- The most important areas where CC is considered are: the overall business strategy, investment planning and corporate reputation.
- It is expected that the most important challenge in the CC is the growing demand for new products or services by consumers.
- Do not expect major impacts of climate change in Estonia that the known.
- The primary missions of CCTTC consider the following:

    1. Search for better solutions for businesses.
    2. Using research to assess the real situation.
    3. Make prioritize actions and resources needed.

Teachers and administrators in higher education

- CC‘s priority has to be very high, being always on the agenda, but usually as part of broader issues.
- The roles of Transfer Centers are important in knowledge transfer CC. Major topics include: the transfer of technologies for mitigation and adaptation, general education on the subject of climate change, the development of climate change adaptation and environmental protection technologies.
- Important need even reinforcement, where there is CC issue in the curricula of universities. Training and lifelong development of competencies for university lectures are also very important.
- It is considered that the main missions of the CCTTC are:

    1. Capacity building.
    2. Consulting on water issues.
    3. Policy development related to water resources.
    4. Formation in curriculum development.
    5. Patent Generation.

Decision makers in Universities, Public Institutions and NGOs

- In general, the CC issues are given a medium priority.
- Respondents were quite skeptical about creating CCTTC. However, its primary mission should be:

1. Design and implementation of cleaner technologies.
2. Development of adaptation measures.
3. Development of accounting system greenhouse gases.

Germany

Private Companies

- They consider aspects related to CC and water management and energy are important strategic issues that are included in their policies in companies.
- Not considered as severe climate change impacts.
- The impacts can be perceived in mobility and logistics.
- In companies reported a good level of knowledge sufficient CC issues to expert. The main actions are aimed at mitigating and adapting, both operationally and strategically. (GEI measurement and monitoring, resource consumption, management systems).

Teachers and administrators in higher education

- Water and energy are important and strategic issues.
- They believe that the level of knowledge in CC is sufficient to expert.
- There is an opportunity to organize and offer courses that integrate CC issues related to the administration and business management. In this respect the role of the university is required to integrate these issues into the curriculum.
- The technology transfer centers can serve as a valuable intermediary organization. The activities of these centers should focus mainly to transfer knowledge to a practical approach oriented to problem solving.

Guatemala

Private Companies

- The incorporation of these issues is a challenge comparable to Corporate Social Responsibility. In the short term there is an emerging demand for knowledge, technology and products that can improve the control of climate events, primarily focused on disasters (excessive rain, flooding, high and low temperatures).
- Employees have a limited perception and understanding of the risks and problems of CC.
- There are requirements of laws and regulations on CC; however, they are concerned that these regulations have an impact on their costs and the

exploitation of natural resources if these regulations have a negative approach towards the company.
- Agricultural companies have shown greater awareness of CC than industrial companies.
- It is necessary to intensify the processes of adaptation and resilience to CC.

Teachers and administrators in higher education

- They consider the issue of CC is still marginal in programs and courses as well as in defining strategic within their organizations.
- Interdisciplinary programs are needed to investigate the effects of disasters and vulnerabilities in Guatemala and Central America.
- They consider it necessary to give importance to the efficient use of water, new farming techniques and development of new genetic varieties.
- There is an unmet need for training in risk management, industrial management and development policies, the latter as a cross.
- The technology transfer centers are seen as necessary, but the idea provokes skepticism among teachers.

Decision makers in Universities, Public Institutions and NGOs

- The topic of CC is marginal in their strategic plans and have few funds allocated to them, they also indicate that they do not have sufficient monitoring and evaluation initiatives in the field.
- The lines of action for the work of the centers of technology transfer are:

1. Joint efforts to link companies, universities, public sectors and NGOs.
2. Agreements and multiple collaborative projects.
3. Strategic alliances based multiple objectives that can do networking in each field of interest.
4. Creating temporary positions (internships or practical) for college students to immerse themselves in the needs and problems of the various sectors.
5. Provision of technical services to the private sector universities, the public sector and NGOs.
6. Planned development of patents obtained from the research work of all participating entities.

Nicaragua

Private Companies

- There is a gap in the urgency to respond effectively to the threats and opportunities of the CC.
- It privileges the operating cost reductions and efficiency to the challenges of CC.
- Companies qualifying as medium to high priority on its agenda the CC threats to people and assets.
- Employers stated that the issue of CC is not a national priority; they see it as a vision related to sectorial NGOs and universities.
- It is difficult to find qualified human resources in the CC area, so they suggest including the topic in university education, especially in engineering, agriculture and business studies.
- They need to create partnerships between universities, public and NGO.
- We need to develop capacity building programs on CC to know and identify the CC risks and potential damage impact.

Teachers and administrators in higher education

- Respondents consider that the issue of CC is not a priority in their institutions.
- They suggest including the topic in university education, especially in engineering, agriculture and business studies.
- Only 58% of teachers believe lead some activity in research.
- There is little research in Nicaragua on CC and the main source of information is the Internet.
- They consider important to create technology transfer centers in CC, being in their opinion, the universities that have to develop them.
- They need to create partnerships between universities, public and NGOs.

Decision makers in Universities, Public Institutions and NGOs

- They need to create partnerships between universities, public and NGOs
- They consider important to create technology transfer centers on CC, being in his opinion, the universities that have to develop them.

Peru

Private Companies

- Peru is a net importer of technology, but 60% of employers said that universities should be the main source of technology for adaptation, mitigation and CC.
- Companies would like to have a clear conceptual framework regarding the CC. They believe that there are opportunities such as carbon credits, certification processes, etc.
- Businesses are open to collaborate with universities. They also consider that the issue of CC is essential and must be taught in all academic areas, mainly engineering, business administration and agronomy.
- Companies require CC courses, environmental conservation, clean development mechanism, better management of water and energy resources

Teachers and administrators in higher education

- University professors are interested in cooperating in projects with companies; however 30% of them have serious difficulties with CCTTCC and believe there is little chance of success.
- The university staff is interested in receiving training and information on financial opportunities in the development of projects on CC.
- Teachers identify that they should have more knowledge about issues of water reuse and renewable energy.
- The researchers believe that mitigation is an issue which has less knowledge than adaptation
- The 20% of public institutions and NGOs have significant financial resources that can afford training programs on CC.

Decision makers in Universities, Public Institutions and NGOs

- They require urgent action from the universities of Lima to pay more attention, support troubleshoot CC in regions of the Andes and the Amazon, where skilled human resources are lacking.
- They believe that universities in Lima should support regional governments to produce public investment projects and organize capacity building workshops with other universities in Peru.

5.2 Local strategies

Based on national realities, there have been designed a set of local strategies developed by the Research and Technology Transfer, which mark the route of strategic actions. The specific needs of each center were identified from the study above, which evaluated the available resources and other variables that are studied through an analysis of strengths, weaknesses, opportunities and threats in each region studied.

Each center developed its own local strategy, and the definition of the expertise of the Center helping to create a truly powerful and transnational network. In this network, each member knows and also feedback from the experiences of individual centers, a characteristic of a transnational network power.

The following table describes the specialties of the partners that make up the network of technology transfer and climate change as well as the types of specific pilot projects each develops.

Table 2: Specialization Centers as local strategies and areas of the pilot projects

Partner CELA	Specialization according to local strategy	Pilot project area
Bolivia	Promote research and dissemination of knowledge on climate change and technology transfer.	Implement a permanent training center on sustainable agroforestry.
Estonia	Specializations in water systems, water quantity and quality.	Not applicable.
Germany	Virtual Climate Technology Transfer Center in five categories of technical elements, climate change and society, the political aspects of climate change education and awareness about climate change. View: *www.climatetechcenter.net*	Not applicable.
Guatemala	Research, Development, technology transfer, capacity building, dissemination and knowledge networks in climate change.	Research, Development, technology transfer, capacity building, dissemination and knowledge networks in climate change.
Nicaragua	Climate Risk Assessment Research and technology transfer Capacity building. View: *www.cambioclimaticonicaragua.org*	Climate Risk Assessment Research and technology transfer Capacity building. View: *www.cambioclimaticonicaragua.org*
Peru	Center on development of information systems for climate change decision making, led by a market-oriented and technology transfer approach.	Center on development of information systems for climate change decision making, led by a market-oriented and technology transfer approach.

Taken from: CELA, (2012)

The following chapter provides an overview of the local strategies of each partner.

Part 2: Local strategies

Bolivia

Background: The local strategy is aimed at creating Virtual Center on Climate Change and Technology Transfer.

The Virtual Climate Change Technology Transfer Center is a web-based information, collaboration and knowledge transfer platform hosted by the Socioeconomic Research Institute (IISEC) at Bolivian Catholic University. It functions as a hub for Researchers and stakeholders from business, government and civil society from Europe and Latin America. The VCCTTC is an information channel that specializes in technology transfer (TT) and adaptation and mitigation in climate change (CC).

Vision: The VCCTTC pretends to be the point of reference on knowledge, research, networking and other resources related with climate change in Bolivia and Latin America.

Main strategic axes:

Promotion

- It is necessary an active promotion of the website through another similar site on the web.
- It is also necessary to take advantage on networking and the synergies that can be created between institutions on the climate change field.
- The use of the channels open for the BCU and channels of communication open for similar projects of the IISEC (like JELARE) is a key action to foster image.
- The direct bonds with institutional leaders on the climate change field and its support to increase the visibility of the VCCVTTC depend on the retribution from the site for this institution (through promotion of events in particular, or the establishment of expert contacts).

Contents of Virtual Technology Transfer Center Library

- Assure the qualification of experts working on the project.
- Establishment of quality indicators over the contents of the library.
- Qualification grades for administrators and users to help select the best contents and papers for the library.
- Establishment of administrator tasks to assure the constant actualization of the contents at the library, the events, jobs and internship offers.

- Periodical External evaluations led by the CELA team and mechanism to improve the project based on feedbacks.
- Provide easier access to papers (direct internet/download links) and a powerful search engine.

Synergies

- Strong networking with relevant actors: organizations, companies, public institutions, research groups at universities or private research institutes working in the field of climate change research.
- Internal workshops with stakeholders to foster the use of the website as a relevant communicational channel for experiences exchange and as an important platform for experts contact and job opportunities.
- Concrete offers of services to companies (trainings, workshops, consulting).
- Establish a synergy with students on the BCU to create activities to improve the website based on feedbacks.

Estonia

Background: The major criterion of the CCTTC strategy selection comes from the specific area of activities of the Department of Environmental Engineering at TUT; it is an impact assessment about the climate change on surface waters.
Other strategic criterion includes the possibility to make collected information more available for the students.

Estonian CCTTC specific focus is research the climate change impact on surface water, its quantity and quality as well as measure and technology development for mitigation and adaptation to the changing climate conditions.

Provide collected comprehensive information for interested target groups and foster networking cooperation between researchers, students, and other university staff from TUT as well as other universities and stakeholders from business, government and NGOs in Estonia.

Vision: The general objective is achieving the goals set up by the CELA project.

- Continue with the selected thematic focus/specialization on water systems, water quantity and quality.
- Promote the established CCTTC at TUT in order to increase climate change awareness and synergy among the final uses, particularly within the research community, NGOs and business sectors.

Main strategic axes: The most crucial success factors for the future:

- Make CTTC interesting and useful for experts who provide their technical knowledge.
- Active CCTTC promotion.
- Provide needed consultation and trainings for all interested parties.
- Keep CCTTC running costs as low as possible.
- Keep and promote sustainability during post-project period.
- Keep and develop new contacts with people from universities, companies, ministries, NGOs working in the field of climate change research.

Germany

Background: Several reasons why it was decided to create a VCTTC at HAW Hamburg with global and local dimensions:

a) Vulnerability: Hamburg is vulnerable to several aspects of climate change (SLR, flooding, urban hot islands) and therefore it deserves scientific assistance as a metropolitan area striving to adapt to climate change.
b) Favorable decision-making environment: Hamburg's administration + decision-makers engaged towards climate and environmental protection, renewable energy and energy efficiency.
c) Vast technical knowledge climate bundled in one place: A great number of institutes, research Centers, NGOs and excellent research groups at universities, working on different aspects of climate change – on Nature and Applied Sciences as well as in Humanities.
d) Sustainable structures: HAW benefits from recent experience with transfer centers: in 2007, the Research and Transfer Centre Applications of Life Sciences (FTZ-ALS) was created at HAW. A 2nd technology transfer center specialized in developing countries and renewables is hosted by the FTZ-ALS, too. Similarly, the VCTTC will become an integrated Sustainable structure and an integrated part of HAW Hamburg after the closure of the CELA project.

Vision: The overall ambition is provide a unique knowledge repository and a worldwide link to climate change technology practice.

Main strategic axes: For future VCTTC operations, the most crucial success factors are:

- Active project promotion (qualitative and quantitative).
- Qualification/technical knowledge of experts working on the project.

- Actuality of entries (events, jobs, internship offers).
- Sufficient financial means and personnel resources.
- Strong networking with relevant actors: organizations, companies, public institutions, research groups at universities or private research institutes working in the field of climate change research.
- Concrete offers of services to companies (trainings, workshops, consulting).

Guatemala

Background: Research Center Strategy and technology transfer on climate change focuses on four areas, they are: Research, Technology Transfer, Capacity Building and Dissemination and networking, based on internal alliances (UGAL‘s Research Departments, faculties, etc.), National Alliances (REDFIA, Public Sector, Private Sector, NGO‘s) and International Alliances (CELA-Network of 6 universities)

Vision: Exchange advanced knowledge and technology by means of RT2C2 (Center for Research and Technology Transfer on CC). Foster this process, the center will have Agreements with national and international cooperation as well as with other Institutions to Develop conferences, seminars, technology transfer to promote Institutions and Academic Programs.

Main strategic axes:

Research

- Strategic Goal No. 1: Design and implement CC research process at UGAL´s units to transfer through RT2C2 (Center of Research and Technology Transfer on Climate Change).
- Strategic Goal No. 2: Generate steadily, advanced knowledge through research in all UGAL specialized units in collaboration with CIT2C2 and other universities.

Technology Transfer Area

- Strategic Goal: Exchange advanced knowledge and technology by means of RT2C2 (Center for Research and Technology Transfer on CC). Foster this process, the center will make agreements with national and international cooperation institutions and develop conferences, seminars, technology transfer to foster institutions and academic programs.

Capacity Building

- Strategic Goal 1: Enhance adaptation capacity and reduce CC vulnerability through Capacity Building workshops addressed to the different stakeholders in the targeted communities.
- Strategic Goal 2: Organize a Capacity Building Program to all stakeholders on the Coyolate River basin, especially in high risk communities at Santa Lucia Cotzumulaguapa and Nueva Concepción. Foster the SAT GAL system.

Dissemination and Networking

- Strategic Goal: Foster networking to disseminate ideas, requirements, proposals, technology and share experiences and other multidisciplinary and multi-sectorial efforts in order to raise awareness about risks, vulnerability and adaptation to weather extreme events.

Nicaragua

Background: Emissions of greenhouse gases in Nicaragua just enter the global statistics, accounting 0.01% of total cumulative emissions of the highly developed countries. However the country is already suffering the effects of climate change and climate variability.

The Center for Research and Technology Transfer on Climate Change is in the Commercial Sciences University of Nicaragua. It has worked in the second component of CELA project which involves making an assessment of research needs and technology transfer market oriented.

The investigation is identified by sectors, this is the gap in knowledge related to climate change impacts. It also identifies what the potentials and restrictions on the issue are, which supports the need for capacity building in knowledge and research on climate change and it also creates cooperation mechanisms and exchange with different sectors of society in Nicaragua in order to reduce vulnerability and build resilience to climate change.

Vision: The Research and Technology Transfer on Climate Change is an entity specialized in the evaluation of climate risk in Nicaragua, developing new knowledge and technological tools for determining risk levels at local and national levels, which will be used to implement adaptation plans to climate change and variability.

Main strategic axes:

- Evaluation of climate risk
- Research and technology transfer
- Capacity building

Strategic Priorities on Climate Risk Assessment

1. Building methodology for achieving local climate risk scenarios and demonstrate its usefulness in the face of adaptation, by implementing a pilot project.
2. Establishing a service mechanism on climate risk assessment to be made available to the private sector and other sectors.
3. Manage resources and work on joint projects that allow replication and synergies of the results.

Strategic priorities in research and technology transfer

1. Build and operate a network of specialized Nicaraguan Universities Research and Technology Transfer in Climate Change that works through specialized nodes by universities.
2. Promote opportunities and mechanisms to raise awareness of technological development in climate change adaptation in economic sectors related to water resources and energy.

Strategic Priorities for Capacity Building

1. Developing a core program of capacity building on climate change, which allows understanding of the national problem and action courses in the graduate level, in different forms: classroom, e-learning and bi-learning.
2. Promote a national campaign to build a university undergraduate curriculum on climate change and risk management.

Peru

Background: PUCP has developed two projects concerning the environmental protection and climate change, so far:

1. An awareness climate change campaign called Climate of Changes, *http://www.pucp.edu.pe/climadecambios/*

Creation of INTE in 2010 (Environment Research Institute). However, most of the groups that now are part of it have more than 20 years working on subjects such as renewable energies, applied geography and biochemical analysis. CCTTC will complement the two previous initiatives. The CCTTC pretends to cover the deficiency of technology in the current PUCP proposal.

- CCTTC aims to introduce ICTs (electronics, informatics, telematics and automation) to generate information system about climate change.
- A. Ospina & R. Geeks from the CDI at Manchester U., suggest that ICT provides a strong support to the process of information gathering, decision making, implementation and evaluation of the adaptation at the national level. Some ICT applications allow the execution of specific actions on adaptation related to poverty alleviation, water supply, agriculture, food safety, health, land & marine planning and natural disaster management.

Vision: PUCP CCTTC became the Latin American leader center on development of information systems for climate change decision making, led by a market-oriented and technology transfer approach.

Main strategic axes:

1. Update of a portfolio of current transferable technologies.
2. Concrete offers of services to companies.
3. Foster applying for funds to SNIP calls (Peruvian National Public Investment Office).
4. Closely follow national plans and programs related to climate change.
5. Participation on decision making round tables.
6. Increase influence on decision making at national level.
7. Improve organizational structure through capacity building on TT.
8. Introduce climate change subject into engineering schools curricula.

Part 3: Making transnational strategies – the backbone of a transnational funtioning network

Under the CELA project, the network of research centers and technology transfer on climate change (project CELA) has developed a transnational strategy based on a set of activities, services and products. This network is supported by a commitment to each of its members to contribute to the global challenge of climate change. The main common characteristics of the network and its partners are:

1. All research partners developed in their respective countries on the needs of research and technology transfer in Climate Change. This research allowed all partners identify key criteria to develop the profile of the centers in each country.
2. All partners have established (physical or virtual) FS Technology Transfer Centers in each country.
3. All partners have developed their local strategies and have established their centers based on a study of strengths, opportunities and threats which allowed determining strategic direction, according to the experience and expertise of each center.
4. All partners are involved in building local networks with other government entities, universities and NGOs.
5. Parallel three international seminars have been developed on capacity building and each partner has developed its own local events on capacity building through various activities
6. The CELA network has reached international visualization through various mechanisms of publications, websites, and exchanges with partners and other networking activities.
7. It also defined the mechanism of monitoring and evaluation for each of the work packages and set in the program as a component part of the project, which allows continuous improvement.

A review of the views of members on their centers can be seen in the following graph shown on page 30.

Picture 1: CELA Project partners overview

As seen in the vision centers, each focuses on local strengths, such as the cases of Germany and Bolivia that specialize in the provision of information and technology through the use of Information Technology and Communications (ICT) through virtual knowledge centers, which are available to all members and the general public. Similarly Estonia brings expertise from their field of expertise focused on water systems, water quantity and quality. For its part, Peru, Guatemala and Nicaragua orient their actions to the creation, development of new knowledge and technology transfer decision-making in climate change adaptation and market oriented strengthening local networks and at short-term.

These local visions are opportunities of transnational strategy.

Part 4: Conclusions

1. This transnational strategy recognizes that anthropogenic climate change and natural climate variability are uncertain facts and reaffirms the international concern about the threat that this phenomenon represents.

2. As the weather warms up will reveal new risks, so we can say that climate change poses risks change over time and that any delay in mitigating leads to increased danger of future climate.

3. Recognizing the need to address climate change adaptation as a set of actions to fight, adaptation and learning, with effects that may be unfamiliar so it is essential to maximize learning research and emphasize problem solving oriented action.

4. Based on the above, technologies for adaptation have the enormous challenge ahead that these tend to be very specific to the impacts of climate change and environmental and social characteristics of the place where the impact occurs, therefore, in adaptation to climate change it should be a priority of bottom-up approaches, both in the creation of knowledge, and in technology transfer.

5. The project CELA is a good practical example of how successful can operate a process of technology transfer, where universities act as nodes in the trans-national network of technology transfer in the service of society in each country.

6. The needs assessment research and transfer of technology developed by the partners and their transnational report have provided support for the subsequent actions of the National Centers on strategy development, Capacity Building, Development of specific actions (pilot projects for Latin America) and other actions.

7. All partners have built their local strategies based on their strengths and local realities, which strengthened the transnational network, allowing international empowerment and visualization.

8. This strategy demonstrates the feasibility of the project CELA as an alternative to face the challenges of adaptation to climate change through the networking of research and technology transfer.

9. Development of a number of activities in recent years, related to technology transfer and knowledge “shows that they are more and more important, they have a greater impact and are a growing trend“. Some of these activities are:

- Collaboration between companies and knowledge centers (universities, research institutes and technology centers).
- Strategic alliances and cooperation around I + D, technology and innovation.
- Knowledge and technology centers and saturation in certain areas or regions.
- Business creation science and technology base.
- Patent applications and grants, as well as royalty payments for licenses.
- Internationalization (globalization) of I + D, high technology, knowledge and innovation.
- Relevance of technology on business competitiveness (technology innovation).
- Process outsourcing I + D services business to „turnkey“ highly specialized.
- Standardization and certification of I + D + i.
- Corporate Events with contents of I + D, technology and innovation.
- Emergence of the concept of I + D, technology and innovation in the mass media.
- Availability of public funds for technology transfers I +D + i.
- Specialized staff in managing managers I + D + i technology transfer.
- Entities and intermediate agents in the science, technology and society.
- Designated innovate and interact in I + D, technology and innovation in both face (parks, cluster ...) and virtual (networks, portals ...).
- Technology transfer macroeconomic-level (between countries and development cooperation).

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