Climate Change

Communication and Collaboration

Translating Awareness into Collective Action

European Support Centre

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Editors: Matthew Aversano-Dearborn, Thomas Schauer

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More information about the CCC project: www.modul.ac.at/nmt/triple-c/

Introduction

Stakeholders in the area of climate change are often divided by differing worldviews, goals and agendas. They have a unique perspective on adaptation and mitigation strategies and a varied means to promote and implement them– depending on their mission, constituency, and research focus. The Climate Change Collaboratory (Triple-C) project will harness and amplify the collective resources of these stakeholders.

Triple-C is a two-year research project funded by the Austrian Climate and Energy Fund. Project partners are MODUL University Vienna, the Club of Rome European Support Centre, the Wegener Center for Climate and Global Change of the University of Graz, and the Vienna University of Economics and Business. The project's aim is to encourage and study discourse and critical debate that lead to a shared understanding of climate change issues on all political levels, ranging from communication between individuals and local communities to global campaigns and treaties. By investigating communicative strategies and processes that function between disciplines and stakeholders, the Triple-C project seeks to unearth hidden assumptions and misconceptions about climate change, contribute to a mutual understanding of existing problems, and suggest priorities for research and policy development.

The Climate Change Collaboratory will utilize new media technology and is developing an online portal that builds upon the award-winning technology behind Media Watch on Climate Change and that will serve as both a platform for effective communication and collaboration as well as a means to translate awareness and knowledge into coordinated action. To achieve this, Triple-C will gather and annotate documents from multiple sources and enrich data from Austrian and international associate partners with third-party material from scientific archives, news media, corporate publications, and environmental blogs. Additionally, it will implement innovative survey instruments in the tradition of "games with a purpose"—which will enable the creation of shared meaning and the leveraging of networking platforms in order to capture indicators of environmental attitudes, lifestyles and behaviors. The results of the online portal will thus facilitate the management of a large repository of expert knowledge, assist networking with leading international organizations, bridge the science-policy gap and promote rich, self-sustaining community interaction.

The Triple-C project was kicked-off at a workshop entitled "Climate Change Communication and Collaboration: Translating Awareness into Collective Action", which took place on June 16th, 2010 in Vienna, Austria. The articles included in the following pages emerged from the rich discussions that took place during that workshop and were written by several of the experts who participated in the event.

Communicating the Challenge of Climate Change

Helga Kromp-Kolb
Center for Global Change and Sustainability, BOKU – University of Natural Resources and Life Sciences, Vienna
Member of the Board, Austrian Chapter of the Club of Rome

In the Report to the Club of Rome "Limits to Growth" Meadows et al. (1) pointed out that in a confined system exponential growth leads to overshooting and then to the collapse of the system. This early warning that resources are limited had immense impact on the thinking of a whole generation. For many a wake-up call, it also led to controversies reaching into the present. Thus, one of the frequent comments nowadays is: Meadows proved to be wrong; none of the shortages he predicted came true. The scenario approach was and apparently still is not understood by many – one reason for the controversies. Another reason is that the implications – if taken seriously – are more far reaching and deeper cutting than many want to accept. Communication problems are enhanced by the fact that only few read the original report, but many read critical comments and media reactions. Recently van Vuuren and Faber of the Netherlands Environmental Assessment Agency (2) compared the results of the 1972 standard run (business as usual) with the real world development over the past 30 years and found that the results of the comparatively simple World III model simulated reality with astonishing precision.

There are many similarities in this discussion with that on the climate change issue. The understanding of the basic processes leading to climate change dates back to scientists of the 19th century: Fourrier (green house effect, 1824), Tyndall (CO_2 and H_2O as green house gases, 1863) and Arhennius (the role of coal burning, 1896). The first quantification of the climate effect was made by Callendar in 1938, and Keeling started his measurements on Maona Loa in 1958. Since then climate science has accumulated a wealth of additional information and has greatly enhanced understanding of the processes and their interaction and this has led to increasing confidence in the basic assertion: that global climate change is happening now and that it is largely due to human input of green house gases into the atmosphere. New knowledge and understanding also shows that climate change will accelerate (3) and may, if significant mitigative action is not taken very rapidly, soon be beyond human control (4). Different scenarios for drivers of climate change (global population, choice of energy carrier and technology, etc.) serve to discuss need and options for action.

To limit temperature rise to 2°C within this century no more than an additional 750 Gt of CO_2 may be introduced into the atmosphere. This limit would be reached if all the reserves of conventional oil and gas were exploited and used and coal was completely phased out by 2025 (5). Emissions would need to drop from the current 10 to 20 t of CO_2 per person and year in the industrialized world to about 1 t of CO_2 person and year (6).

Although there are large uncertainties in the chain of models supporting these projections and the quantification of mitigation needs, the climate models are able to reproduce the general features and some significant details of past climate developments. This and the fact that no other hypotheses explain nearly as much of the real world observations justifies the confidence put in climate models.

But even if scientific evidence were less convincing, simple risk management would demand action on climate change (7). In a matrix of four fields defined by climate theory being wrong or right on the one hand and taking action or not on the other, the analysis of the worst consequences when taking action prove to be possible limited damage to the economy. The worst consequences when not taking action could be enhanced extreme weather events, loss of land, famine, and, after crossing the tipping points, the possible loss of humanity. This makes taking action the obvious choice from a risk point of view.

Why, then, is the debate on climate policy still on? Dennis Meadows compares the climate change debate to the reaction to “Limits to growth”: Critics first claimed there is no climate change, then that it is far away. When proof of global climate change became undeniable, hope turned to technological fixes, primarily nuclear power. However – apart from all the known problems such as safety, waste disposal or costs – the nuclear option proves to be too slow, too limited by the availability of uranium 235 or too close to military and terrorist use and therefore to surveillance needs endangering democracy when based on uranium 238 in what is called the 4^{th} generation of nuclear power plants (8). Other technological fixes suffer from other drawbacks or, as in the case of renewables, limitations in penetration rates or availability of non-renewable resources. In the next phase help is expected from markets – they are claimed to be designed to solve scarcity problems. When neither technology nor markets solved the problem, adaptation became the slogan. The Stern Report 2006 made clear that this also was no viable option. Some critics are now back to technology, but on a larger scale: geo-engineering. Placing mirrors in space or sulfate aerosols into the stratosphere to reflect unwanted solar energy input (9), capture of carbon dioxide from the air or from flue gases and storage in depleted gas, oil and coal reservoirs, in aquifers or the deep ocean (CCS) are just two of the options discussed at present. All involve unproven technologies and entail risks that have not been properly assessed. As in the case of “limits to growth”, anything seems more attractive than the necessary.

However, all these options address at best the climate problem. Important though it is, it must be seen as just one symptom of a deeper lying problem: overuse of resources. Recently, Rockström et al. (10) showed that humanity has left the safe operating space of the planet in at least three of eight studied domains: climate change, the nitrogen cycle and biodiversity loss, with the phosphorus cycle very close to the limit. The global ecological footprint also indicates that 1.25 earths would be needed to make our present global resource use sustainable; the resource use in the industrialized world the world over would require 3 to 5 earths. Thus the challenge is to address the root problems, not just the carbon dioxide emission into the atmosphere.

One of the drivers of ever increasing resource use is the paradigm of economic growth. Any growth expressed in % per year implies exponential growth. The 3% growth claimed to be necessary to sustain our standard of living is coupled to a doubling of resource use approximately every 24 years. By 2035 industrial nations would have doubled their resource use, and in countries in transition, such as China or India, with growth rates of 7 or 9%, resource use would have increase by at least a factor of eight! This takes us back to "Limits to growth": in a confined system exponential growth leads to overshooting and then to the collapse of the system.

It is becoming increasingly clear that the development of the world population and of affluence must be addressed, if impacts on the global ecosystem are to be reduced. The last requires deep cutting structural and societal changes: a cultural change or the "end of the world as we knew it" (11). This can be seen as an enormous opportunity, because what may appear to require doing without, could prove to lead to increased quality of life.

But how can democratic societies overcome the strong structural and psychological obstacles to the necessary changes? Possibly only through individuals and societies taking on more responsibility. Traditional values need to be reviewed regarding their affordability – e.g. compound interest or quantitative economic growth – and more long-term thinking needs to be restored (12). Only with public support will politicians be able to change the rules of the financial, economic and political game in a manner that will make sustainability an integral part of success. Rather than wait for the lifestyle changes nature will impose on us, we should set out to shape them to meet the requirements of humanity within the boundaries of the resilience of nature. The required change in paradigm is exciting: it is the chance to gain in quality of life!

Climate Change Communication and Collaboration – Translating Awareness into Collective Action

Arno Scharl
MODUL University Vienna
Department of New Media Technology

Motivation

Despite credible forecasts and warnings from the scientific community about anthropogenic climate change, greenhouse gas emissions have continued to grow. Scientists studying the issue predict more adverse consequences unless stronger actions are taken. However, from the policy-making level down to personal voting and purchasing decisions, the observable actions have not been commensurate with the threat of climate change. We remain far short of undertaking the emission reductions that scientists say are required to forestall dangerous interference in the climate system on which our civilization depends (1). Although public concern about climate change has risen in the past few years, a much smaller percentage is actually taking action. Reasons for this discrepancy include:

1. On the *micro level*, the widespread perception of climate change as a risk that will predominantly impact geographically and temporally distant people and places; and the lack of personal efficacy (belief that one's own actions will make a difference and one's voice will be heard), a critical motivating factor in behavioral change that can be supported by Web-based applications to share knowledge and coordinate action.
2. On the *meso and macro levels*, a gap between policies and research needed to promote and support adaptation and mitigation efforts, and what is currently available (2). The overarching goal of Triple-C is to build capacity among policy makers, scientists, educators, environmental NGOs, news media and corporations to close this gap and translate increased awareness into behavioral change on the local, regional, national and international levels.

Technology Platform

The collaboration platform will draw upon the lessons learned from building the *Media Watch on Climate Change* (3), a public Web portal available online at www.ecoresearch.net/climate. This award-winning news aggregator provides geographic and semantic visualizations based on multiple coordinated view technology. It will be extended by a context-aware editor to collaboratively author inter-individual messages, memos, blog postings, project reports, and scientific papers. The editor will provide multi-language support and a layered security model to distinguish public from private information. Geographic mapping will play a central role, using the virtual globe technology of NASA World Wind to integrate various types of documents, and put them into a regional context.

Analyzing the full text of each document contained in the knowledge repository allows fully automated annotation and contextualization. Thereby, the system supports individual authors or project teams working on joint publications in different stages of the authoring process. Relevant documents from different sources (news articles, recent publications from colleagues, blog posts) are listed on-the-fly in a separate window, without the need to query for them explicitly. Similarly, the automated detection of associations between documents is very helpful to streamline collaboration processes; e.g. in the case of public outreach programs that try to link bad news about climate change threats with good news about the efficacy of mitigation efforts (neither is especially effective without the other), or when initiating a discourse about adaptation as a steppingstone to mitigation, considering that when people come to appreciate climate change risks they will support efforts to minimize them (4).

Applications

Triple-C will assist the core and associated project partners in their efforts to enhance public climate change knowledge and build awareness about the interdependency of ecological, economic, and social issues when assessing adaptation and mitigation strategies. The developed models and technologies will facilitate the shift from broadcast to interactive communication and promote a shared understanding of system complexity, uncertainty, and risk (5). Benefiting from the continuing transition to a knowledge-based economy, the collaboratory will create a range of entrepreneurial and educational opportunities:

- *Awareness and Participatory Decision-Making.* Public awareness contributes to informed personal choices and is an important prerequisite of participatory strategies (6). Triple-C will increase awareness, create shared meaning, and help assess various policy and consumer options. Thereby, the project answers calls for cooperative approaches to environmental governance (7).
- *Environmental Education.* Environmental education through traditional educational institutions, advocacy organizations, and the media are indispensable for achieving sustainability (8). Triple-C provides access to accurate and timely information from multiple sources required by environmental educators (9).
- *Science Communication.* The environmental sciences have superior expertise in their focal activities and specific means of disseminating information. At the same time, lack of awareness regarding scientific expertise continues to jeopardize good intentions. Triple-C will create a repository of accessible and

intuitively understandable climate change information to increase transparency and give coherence and credibility to masses of scientific information (10).

- *Public Outreach Activities.* By providing important feedback on outgoing and incoming flows of information, Triple-C will improve the effectiveness of public outreach programs, which depend on the quality, professional representation and credibility of communicated content.
- *Stakeholder Coordination.* The competition for budget, jurisdiction and influence increases the insularity of organizations. Triple-C will address this problem and balance stakeholder interests by enabling stakeholders to scrutinize each other in collaborative, consensus-building processes (11).
- *Corporate Sustainability.* Environmental collaboration platforms can spark interest in redistributing environmental costs more fairly throughout society. Fueled by increasing environmental awareness and the global financial crises that hit most economies in 2008, there is a growing trend towards accountability and stakeholder engagement across all levels, functions, and operations (12).

Summary and Conclusion

Triple-C is an interdisciplinary initiative to encourage and study discourse and critical debate that lead to a shared understanding of climate change issues on all political levels, ranging from inter-individual communication and local communities to global campaigns and treaties. By investigating communicative strategies and processes that function between disciplines and stakeholders, the Triple-C project aims to unearth hidden assumptions and misconceptions about climate change, contribute to a mutual understanding of existing problems, and suggest priorities for research and policy development. Participants of Triple-C will benefit from pooled resources, flexible and non-hierarchical modes of cooperation, and the dynamic maintenance of shared knowledge.

Environmental Web resources such as documents and best-practice examples are often being created through processes of cooperation and social exchange. Triple-C recognizes and supports the social construction of meaning via distributed information services that aim to improve the quality of decisions, build trust and help resolve conflicts among competing interests. It will provide a range of Web-enabled communication and collaboration tools. Facilitating the collaboration between stakeholders will require a tight integration of heterogeneous services. System connectivity, contextualization and semantic interoperability to achieve this integration are at the core of the Triple-C initiative.

Climate Change Communication Strategies for Public Audiences

Tom Bowman
Bowman Global Change

Scientific understanding of climate change has far outstripped society's capacity to use that knowledge to make informed and timely decisions (1). While carbon emissions and global temperatures rise, climate change lags so far behind other priorities in the U.S. that it cannot gain traction in Congress or in public conversation (2, 3). Moreover, Americans are being victimized by toxic political rhetoric and an intentional disinformation campaign aimed at destroying their motivation (4, 5, 6). Under these conditions, the outreach strategies employed by the climate science community, informal educators, and their funding institutions have proven inadequate to help the public manage the climate threat successfully. Given the urgency and high stakes involved, the public deserves better. The time has come to recognize that informing the public has become a competitive enterprise that requires strategic approaches based on lessons learned in other fields of communication practice, plus funding that enables communicators to work across traditional academic boundaries and institutional stovepipes.

Why Communicate with the Public?

The most important step in any communication program is defining appropriate goals. Yet we often focus on *what* and *how* we want to communicate without clarifying *why* or understanding *why audiences might care*. Making this mistake can blind us to valuable opportunities, such as targeting specific audience segments with specific information that they would consider helpful. We can, and often do, end up communicating with ourselves better than with the public, using language that audiences do not understand, and delivering messages through channels that audiences do not trust. In the competitive "marketplace of ideas," such missteps let other actors control public perceptions, sometimes in intentionally misleading ways.

Consider, for example, how the uncertainties inherent in climate modeling have been exploited to cast doubt on the validity of settled scientific conclusions. Or consider the breakdowns that often occur when environmental experts try to engage minority and low-income communities (7). Since these communities tend to be concerned about local environmental justice, messages about global issues that are delivered by outsiders can fall on deaf ears. When, in another example, the National Oceanic and Atmospheric Administration (NOAA) joined forces with the Association of Science Technology Centers to host its first Community Conversation about Climate Change, NOAA came prepared to discuss its core offering: scientific evidence of climatic change. To their surprise, they met an audience that was already somewhat familiar with the science and wanted to talk about solutions instead (8). Communication should be a two-way street, and understanding one's own purpose at the outset can help communicators identify audience needs more clearly.

An appropriate goal for engaging the public, which is a somewhat different enterprise than formal climate science education, might be stated this way: *"Americans are actively making informed decisions about the risks and opportunities of climate change."*

This is an active agenda: the communicator wants to encourage and inform. Educating people without urging them to consider their options would be insufficient. Conversely, people should be encouraged to consider scientific evidence when making choices, and they should be provided with information and perspectives that fully support the choices they are being urged to consider. Unfortunately, some of the information that people need in order to manage climate risks is still missing from public debate.

An active outreach agenda stands on the premise that science should serve the public interest, and the results of climate research present society with choices about managing serious risks to public health and safety, the economy, civil order, and global security, in addition to the welfare of natural ecosystems. A critical timeframe for making decisions encompasses the next few years—less than a decade—if we want to maximize society's options. Delay has significant consequences, so people should be encouraged to make informed choices now.

Because of these factors, giving average Americans the specific information that builds their decision-making capacity is a top priority. Unfortunately, the current climate science literacy agenda is not designed to achieve this near-term goal. Recognizing this reality does not undermine climate literacy education, but demonstrates the need for a companion strategy to build public decision-making capacity quickly. This agenda deserves appropriate funding and organizational support (9).

Addressing this concern means providing information about at least three issues: 1) a graduated scale of climate impact risks correlated to atmospheric greenhouse gas concentrations and global temperatures, along with the probable timing of impacts in the United States and abroad; 2) information about future energy demand, potential pathways to climate stabilization at various temperatures, and projected tradeoffs; and 3) information about the sources, financing, and rationale behind the disinformation campaign that is undermining the public's understanding of climate science results. People need to know the risks, whether and how they can manage those risks, and who is trying to confuse them and why.

Education vs. Advocacy

Society depends on the science community for objective, unbiased information. But the fact that climate science presents evidence of serious risks, and that these risks drive the communication agenda, can put scientists in a bind by giving the appearance of policy advocacy. In truth, an active agenda that both informs and encourages people to make choices before options disappear is not neutral. Since delay amounts to choosing an increasingly warmer world, an active agenda assumes that there is merit in, and probably a preference for, early carbon emissions abatement. It is not the job of scientists to prescribe warming limits or policy preferences, but they should present and defend their relevant findings. For example, scientists can, and probably should, estimate the probability that various emissions pathways will avoid various unsavory climate impacts. Such links between emissions pathways and their consequences are not evident to most Americans. Meanwhile, communicators should help the public understand the scale of effort and tradeoffs involved in holding global average temperatures below various thresholds, along with historical evidence about the efficacy of approaches to curbing other types of pollution.

With a few controversial exceptions, the science and informal learning communities have taken such a cautious approach to separating science from advocacy that the public would be hard-pressed to recognize key pieces of information. As Schellnhuber once noted, the Intergovernmental Panel on Climate Change (IPCC) process "is inherently tuned for burying crucial insights under heaps of facts, figures, and error bars" (10). Statements that lead with uncertainties before making the point, or with natural variability before identifying the all-important human contributions, and graphic figures that obscure the probabilities of overshooting statistical means actually hide the underlying risks from people who lack science training (9). Recognizing that people inevitably simplify (11), communicators need to facilitate the simplification process appropriately by illuminating the most important insights and placing them in the proper contexts. Unfortunately, too much complexity can paralyze non-experts and lead to irrational choices (12, 13).

One of our challenges, therefore, is to select and clarify the information that people absolutely must consider when making choices about climate risks, and this requires a new focus on the domains covered by IPCC Working Groups II and III. For example, what kind of world are we likely to create if nations successfully cap warming at 2°C? What are the odds that we can stabilize the climate system below 2°C, or at higher temperature targets? How would we do so? Global warming remains a low priority in America, in part, because so few people are convinced that effective, affordable solutions exist (14). People cannot be expected to make rational choices if the options are too hard to see, and we must recognize that vested and ideological interest groups are exploiting and enhancing these doubts.

At some future time, experts might embrace specific warming targets, emissions pathways, and behavioral recommendations, just as experts in other fields have done with smoking and other health-related risks. We are not there yet, but perhaps this is why the U.S. Environmental Protection Agency's finding that CO_2 emissions endanger public health and welfare is so controversial. The EPA is opening the door to prescriptive recommendations. While few science communicators are ready to walk through that door now, we need to help people see the risks and evaluate appropriate opportunities.

Who is the Public?

Experiences in environmental communications to disadvantaged communities, and with the Community Conversations, demonstrate that audiences can come to the question with wide ranging concerns. Since the public we hope to inform and encourage is not monolithic, communicators need to decide 1) which segments of the public are most amenable to education, 2) what their preconceptions and circumstances tell us about how to engage them in effective learning, and 3) which segments are most likely to help disseminate what they learn to others.

A social group's most trusted informants can be important educational allies in this endeavor. Such informants may include scientists, cultural institutions, policy planners, educators, journalists, weather broadcasters, clergy, business and labor leaders, local community members, artists, and the one-in-ten Americans who provide informal opinion leadership to their peers (15). Most of us interpret climate science information through interactions with these mediators, so their perspectives can be persuasive.

Collaborating with such mediators is likely to bring supplemental information from other fields into the learning process. For example, we have already seen that low-income communities tend to view global challenges through a local environmental justice lens that emphasizes concerns about health, economic opportunities, and transportation. Failure to localize climate change impacts for these audiences might be a mistake. In a different situation, business middle managers have been shown to have difficulty integrating environmental science information into their workflow until they are also provided with metrics for weighing their everyday decisions (16). In yet another domain, clergy can help their congregations evaluate the moral dimensions of climate risks and its priority in their lives. In other words, collaborating with informants and experts in these and other disciplines is a multi-faceted educational enterprise, but one that can help people interpret the results of climate science more effectively. This process of reinterpreting climate change information in practical terms might eventually take place on its own, but we are crossing emissions and temperature thresholds so rapidly that it would be unwise to wait and see.

A Call to Action

Informing the public about climate-related risks and opportunities has become a competitive proposition, in which well-funded actors are working to discredit climate scientists and their results, and deceive Americans. The current science communication agenda, on its own, is poorly suited to meet this challenge, yet the nation needs well-informed citizens who can make informed choices before the best opportunities pass them by.

The tools needed to wage this kind of rapid public education campaign are already well-known in other, more entrepreneurial fields of communication practice, such as public health, social marketing, and commercial marketing. They involve, among other things, targeted messaging based on clearly defined objectives, careful audience segmentation, collaboration with trusted informants, and delivery of information that is currently missing. In the climate change debate, this missing information includes an understanding that climate change is already well underway, how risks escalate as temperatures rise, the scale of effort required to stay below various temperature thresholds, and information that supports decision-making about alternative courses of action. Therefore, science communicators and funding institutions should focus attention on translating information about these issues, particularly information covered by IPCC Working Groups II and III, and recent National Research Council reports on climate and energy choices. This information is a prerequisite for informed decision-making, so its effective dissemination should be a top priority.

Yet science, alone, cannot be expected to help society decide on appropriate policy responses to the climate threat. If humanity picks a warming limit, science can respond with corresponding emissions pathways, but selecting a limit and associated public policies necessarily reaches beyond the limits of scientific expertise and professional practice. Therefore, a concerted effort should be made to bring scientists together with trusted informants and experts in social science, decision science, and communication practice, plus other disciplines that support decision-making about environmental risks, such as public health, religion, ethics, law, economics, business, energy, agriculture, forestry, environmental justice and, possibly, others as well. Working together, they should develop coherent, rigorously accurate messages based on the best available evidence, and translate that information for non-scientist audiences. They should also design, test, and implement a diverse array of delivery strategies.

Unfortunately, this work requires collaboration that falls outside of everyone's job descriptions, and reaches beyond funding institutions' core missions. In a very real and tragic sense, helping Americans respond to the climate challenge—especially in the face of a well-funded disinformation campaign—is nobody's job, and the lack of financial resources leaves some of the best communication practitioners, mentors, and researchers sitting on the sidelines.

By now, it should be clear that society will not meet the climate challenge successfully if everyone just does the best that their job descriptions and institutional boundaries allow. We need to encourage and fund entrepreneurial leadership in climate change education and communication. The critical question—the one that the future probably depends on—is who will rise to the challenge and support this interdisciplinary effort.

Living Labs for Promoting Collective Action on Climate Change

Jesse Marsh
Atelier Studio Associato

Living Labs are "user-centric open innovation ecosystems", a research and development (R&D) methodology that originates in the field of Information and Communications Technologies (ICT). Living Labs are proving increasingly successful in speeding up the pace and quality of innovation by increasing user acceptance, reducing time to market, and in general producing more effective ICT products and services.

In recent years, a more "policy-driven" approach to Living Labs has emerged (1), which aims to steer user-driven ICT-based innovation in the direction of the main social and environmental challenges. Here, Living Labs are seen not only as beneficial to the ICT R&D sector and thus industrial competitiveness, but also as a transversal instrument that can support goals of sustainable development in a far broader way. The key to this reasoning lies in the distinguishing feature of the Living Lab approach itself: by taking research out of the laboratory and into an area's socio-economic fabric, they directly affect the territorial dynamics that all regional policy initiatives attempt to act upon.

At the heart of the Living Lab approach is the "co-design" concept, through which user-citizens participate in the R&D process from the outset, in a partnership that includes key actors from the community where it is set up. The scope of innovation thus includes not only the technological sphere within which new products and services are developed, but also the application domains addressed – agriculture, environment, tourism, manufacturing, etc. – and ultimately the structures, organizations and way of life of the community itself.

In this context, Living Labs can prove particularly relevant to the objective of promoting collective action on Climate Change, from a range of different standpoints such as:

- increasing the effectiveness of ICT systems for the monitoring and management of the environment;
- promoting virtuous individual and collective behaviors that lower the impact of human activity; and
- co-designing innovative ways of taking care of the environment with the direct participation of citizens in public services.

In the following paragraphs, EU research projects that illustrate each of the above approaches are presented. The first of these is "HABITATS: Social Validation of INSPIRE Annex III Data Structures in EU habitats", a project funded by the CIP ICT Policy Support Programme, Objective 6.2 "Geographical Information" (2). HABITATS uses the Living Lab methodology to improve the process of formulating standards for habitats-related spatial data in line with the EU's INSPIRE Directive, which lays the foundation of a common infrastructure for spatial information in Europe in order to support policies and activities that have an impact on the environment.

The adoption of common standards is a significant commitment for a myriad of local authorities, so it is very important that the proposed models have undergone robust validation procedures. To date, this has occurred in an unstructured way, mainly through consensus-building processes among actors in different EU Member States. Particularly the harmonization of relevant data structures for habitats-related information involves different and distinct entities responsible for planning, environment, coastal management, natural reserves, marine reserves, cultural and landscape heritage, etc. (even within the same region), which adds further complexity to the overall effort and uncertainty to the time agenda.

HABITATS addresses these issues by introducing a participatory approach to "co-design" and validates proposed standards with real citizens and businesses in a wide range of usage scenarios, demonstrating their added value in real-world environments. This process unfolds in a number of pilot settings that involve those who will actually use spatial data information because they need it in their daily work and lives. Each pilot is therefore built on: a) existing concrete services currently carried out by some project partners, b) an analysis of the potential of data access through network services and c) enhancement of this potential through usage scenarios developed by the user communities themselves.

The pilot settings include: Wild Salmon Monitoring (IE); La Palma Protected Marine Area (ES); Hiking Trip Planner (IT); Soria Natural Reserve (ES); Sheep and Goat Herd Management (IT); Economical activity at marine coastal benthic habitats (LV); and the Czech National Forest Programme (CZ). HABITATS thus aims to build a bridge between INSPIRE and real and concrete user communities to introduce a "demand-pull" drive to its standardization processes.

The second example is "SAVE ENERGY" a European Project (CIP-ICT-PSP-238882 PROJECT) (3) that addresses the challenge of behavior transformation through the use of ICT (serious games and real time information) as an enabler of energy efficiency in public buildings in five European cities– Helsinki, Leiden, Lisbon, Luleå and Manchester.

Information and communication technologies (ICT) are recognized as enablers for economic growth and higher energy efficiency. The main objective of the SAVE ENERGY project is to make use of ICT to transform the behavior of users of public buildings regarding energy efficiency through serious games and real time information from sensors and actuators. SAVE ENERGY builds upon the Living Labs methodology to provide an engaging virtual environment for users, citizens and policy makers to gain awareness, understanding and experience associated with energy saving attitudes.

Pilot implementation follows the Living Lab methodology at both the local and the cross-border interaction level. SAVE ENERGY users are totally engaged in the co-creation of new processes and behaviors, such as the case at schools where young students, teachers, staff and parents are emotionally engaged in designing ways they can work together to save energy. This systemic approach involves all relevant stakeholders from the very beginning, with new ideas and concepts creating the motivation to share, discuss and take ownership of experiences and expectations.

At the end of the SAVE ENERGY project it is expected that energy savings of up to 20% will be achieved from consumer behavior transformation. SAVE ENERGY pilots will provide clear and motivating best practice cases for European adoption in public and private buildings. The knowledge and experience gained with the understanding of new socio-technical aspects related to energy saving behavior transformation using user-driven open innovation environments (Living Labs) will lead to new ICT-based services, new business models and recommendations for Energy Efficiency public policies.

The third example involves a take-up action within the FP6 "Wear-It@Work" project (4), which used the Living Labs approach to design, test and validate a mobile/wearable solution for handling reports on wild fire breaks in extensive and impervious territories. Occasional droughts coupled with large-scale criminal attacks to forests, have led to countless, systematic (small- to mega-) fire events, that burn millions of hectares of forest. The economic loss, social disruption and environmental damage runs into billions of Euros. ICT tools for wild fire prevention, assessment and extinction include satellite observations, IR cameras both on the ground and in the air, wireless sensors, detailed and updated risk maps, complex modeling tools, and central "Situation Rooms". While these tools have reached a good level of maturity, the costs of installation and use in wide rural (forest or mountain) areas is usually prohibitive, also for the trivial reason that 9 out of 10 smoke alarms received by government call centers are in fact false alarms.

Paradoxically, this has paved the way for a re-evaluation of the role of people as compared to the "sheer" deployment of technologies, a trend that also applies to this pilot project as carried out in the Tuscany region. A broad Living Lab alliance between local Government, civic communities and private enterprises was formed to co-design a "turnkey" solution based on GPS-enabled mobile devices, which could improve on the current ICT solutions for fire prevention.

The innovative approach developed centers around local "Farmer-Rangers" in a new partnership for environmental stewardship. Farmers are in fact stable occupants of the farthest and most disperse rural and mountain areas, where the risk of fire is no less present than in the more urbanized locations, and they know their territory very well, so they can provide reliable information on the exact size and location of fires. Since farmers are usually well integrated into their local communities, their actions serve as a model for others.

The Living Lab approach thus led to the identification of an innovative role for local citizens – here, the so-called "Farmer-Rangers" – far beyond the scope of the technology trial itself. Savings reported with respect to a "sheer" deployment of ICT infrastructures in both territorial coverage of fire monitoring activities and the handling of false alarms, amount to an astonishing 90% of received calls.

The above examples illustrate the relevance of the Living Lab approach for contributing to climate change strategies in a variety of ways. Achieving the effective mobilization of collective action, however, requires the establishment of broad institutional partnerships that can disseminate these approaches and coordinate energies and strategies in a stable manner. For this, the Living Lab community has established the European Network of Living Labs (ENoLL), formed through the Finnish EU Presidency's Helsinki Manifesto in 2006 and since grown to include 212 participating Living Labs throughout Europe and the world (5).

The overall objective of ENoLL is to contribute to the creation of a dynamic, multi-layer and multidimensional future European innovation ecosystem, supporting co-creative, human-centric and user-driven research, development and innovation in order to better cater for people's needs. The ENoLL network facilitates cooperation and the exploitation of synergies between members and groups by accessing different user communities, thus supporting the "Innovation Lifecycle" for all actors in the system: end-users, SME's, corporations, the public sector, NGOs, academia and wider research communities.

ENoLL thus constitutes the ideal framework through which to establish an operational alliance to apply the Living Lab approach in efforts to address climate change. In a related initiative, ENoLL has recently signed a Memorandum of Understanding with the UN's Food and Agriculture Organization for the joint implementation of rural development projects. A similar arrangement could be explored with the Club of Rome and other key players to mobilize action by using the Living Lab approach to develop innovative ICT products and services, transform individual and collective behaviors, and involve businesses and citizens worldwide in the co-design of concrete and effective climate change initiatives.

"Carbon Calculators" and their Contribution Towards Sustainability

Petra Bußwald and Franz Niederl
Akaryon (1)
Sascha Nick
CO2-monitor (2)

Considering latest scientific reports (e.g. IPCC's fourth assessment report (3, 4)) and strategic policy documents like "The Austrian Strategy for Sustainable Development" (5), energy efficiency and climate protection are cultural techniques which we all will need to learn very quickly in order to support the transition to a sustainable world society. The aim of this paper is to analyze the possible contribution of carbon calculator IT tools to this transition process.

For most people, learning to live sustainably is a long-term, potentially difficult process. The scope of required change from the average "western" lifestyle is significant, in areas of transportation, housing, consumption and nutrition. Most sustainability improvements go against the dominant culture of high consumption and constant mobility, fueled by ubiquitous advertising and at least some social pressure. In terms of CO2, getting from the current 10-20 tons per person and year to a reasonable level of 1-2 tons might require 20-30 or more years – how can carbon calculators best support and maybe even accelerate this process?

Types of carbon calculators

Carbon calculators usually consist of one or more forms with questions to answer resulting in a final estimation of the total CO2 equivalent. This estimation is based on a mathematical model and emission factors for different activities to be assessed. The quality of the estimation is thus determined by the level of detail of the questions and the corresponding model and the availability of local values for different users (e.g. emission factor for electricity could be at the EU level or at national or even regional levels).

Generally speaking there are two types of carbon calculators – personal calculators and regional calculators, the first type addressing individuals mostly calculating yearly greenhouse gas emissions of one person or household covering emissions caused by housing, mobility, and food and electricity consumption. Regional calculators address communities estimating greenhouse gas emissions caused by activities in a region (6) ranging from emissions caused by local administration, inhabitants, business and agriculture.

Targets of carbon calculators

First carbon calculators mostly tried to raise awareness by showing the climate impact of different lifestyles comparing resulting CO2 equivalents. Meanwhile companies have also started including indication of climate impacts of their products or services in their product declarations or marketing tools. For instance, the Austrian Railway Company and other public transport companies calculate the reduction of carbon emissions for each ticket sold and print it on the ticket. The question is, how many people notice this information service?

In recent years calculators have been acquiring more functions that provide possibilities to save greenhouse gas emissions, build scenarios, compare climate protection measures and as such are evolving into a form of personal emissions accounting system. One calculator that is very advanced in this aspect is the CO2-monitor. Here all activities are stored with specific dates and it is foreseen that individual users set and control emission targets over years.

The problem of insufficient user orientation

Obviously, today sustainable lifestyles do not reach all segments of the population and all aspects of life to trigger the necessary effects: Some population segments prove to be more sustainable in some respects and maybe compensating in others. For instance, according to "Umweltverhalten, Umweltbedingungen 2007" (7), people with a well-educated background have a high sustainable performance regarding buying organic products (which means saving up to two-thirds of greenhouse gas emissions (see 8, 9, 10), but account for much higher greenhouse gas emissions for their mobility than less-educated parts of the population. Mobility behavior is also linked with economic background.

The German diploma thesis „Perspektiven für eine zielgruppenorientierte Kommunikation der bayerischen Umweltbildung - Untersuchung aus der Sicht von sozialen Milieus als Grundlage für ein zukunftsgerichtetes Marketing" (11) analyzes how environmental education reaches different sinus milieus (a marketing-related concept describing not only the segmentation variables geographic, sociodemographic and behavioral, but also the ever more important variable psychographic) and shows that educational institutions reviewed in Bavaria above all address upper social classes. So called "problem milieus", often attributed to lower social classes, are not reached that well (12). Problem milieus in this study are defined as noticeable by negative environmental behavior as well as by a lack of environmental awareness.

According to Coyle (13), climate change behavior of individuals can be segmented as follows: Only 11% of the population can be attributed to the segment of "Climate Champions", who are generally well-informed and equipped with tools ahead of the mass market, e.g. solar collector on the roof. They are also the prime user group of free carbon calculators on the web. The second segment, the “Observers”, account for 41% of the population. They are generally interested, slightly confused by complexity, and from time to time they undertake some (symbolic) actions such as utilizing a few efficient lights or flight carbon compensation. The rest of the population (48%) are called the “Deniers”, who neither care nor think that there is anything they could effectively do. They still think that “[c]limate change is nothing but natural temperature variability” and that “[w]e are too small - the problem should be solved in China”. In spite of these insights, climate/energy policy is very much based on a non-existing “average culture” and also carbon calculators introduced throughout recent years do not sufficiently take differences into account. One exemption is an Austrian calculator dedicated to pupils (www.co2-rechner.at), which is also integrated into environmental education in schools. Another attempt at more user orientation in respect to easier user interface is the series of carbon calculators issued by Umweltamt Graz under the title “Familie Grazer”.

These calculators do not rely on forms to be completed – the whole interface is integrated into an interactive graphical based format with items to be changed, for instance raising the temperature by clicking on a thermometer. This attempt may attract new user segments, as it makes data input a lot more fun. Secondly, the tools concentrate on special topics/cases (first for heating, second for mobility), which can also interest more people in different circumstances, thereby allowing them to discover the effect of the different possibilities in a certain situation where they need to take decisions (e.g. where to go for holiday and which means of transport to take). Regional calculators probably need to take into account the needs and realities of different types of communities: i.e. small villages are not the same as big cities. The problem of insufficient user orientation could be overcome by developing diverse versions for different user segments, which needs a bulk of socio-economic and psychological oriented basic research on these segments and budgets to finance research and implementation – both not widely available, as funding schemes focus very much on technological development. With more specific approaches the total number of users could probably be raised, but still the question remains, if the tools would be able to trigger adequate action.

The problem of lack of touch with real life and communities

The second problem we have identified observing development and use of carbon calculators is the fact that they are only rarely connected sufficiently and continuously with real life and community building. Most carbon calculators are not embedded in long-lasting campaigns motivating people to participate and make use of the functions. It is evident that solely existence on the internet is not enough. Linking and integrating with popular platforms might help but still is not enough.

CO2-monitor's use model tries to overcome this problem by addressing companies as contracting partners providing the service of a personal CO2 account on CO2-monitor to all employees. Launching campaigns in the companies, integrating CO2-monitor in the activities of the sustainability team of the company, presenting CO2-monitor in media, launching contests etc. significantly helps to raise interest and use of the tool.

Some facts and figures

The Austrian carbon calculator for schools has reached the following user statistics since its relaunch in October 2008: More than 14,000 users (around 20 per day) have started the carbon calculator, more than 75% of those have clicked through several forms, entered their lifestyle data and reached the final results. After eliminating discordant values, the following median values are delivered by these users: Around 1,500 kg of CO2 for the household (heating etc.), 3,000 kg for mobility, 1,000 kg for nutrition and 3,000 kg are added as a consumption lump sum, resulting in a total of 8,500 kg, which matches perfectly with figures reported on average values for Austria. All values are given in kg CO2 equivalent per person and year. CO2-monitor is currently used by more than 4,500 participants from more than ten large companies/ institutions.

In companies with a certain focus/orientation towards sustainability CO2-monitor can reach up to 30% of the employees, in others at least 8%, which is very good compared with use figures of free web-based carbon calculators. By the regional carbon calculator of Klimabündnis Austria more than 140 Austrian communities have calculated their regional greenhouse gas emissions. Analysis shows that the results range from 4.7t/capita to 21.7t/capita, with the average at 10.5t/capita and the median at 9.4t/capita. The tool is appropriate for use by communities of less than 10,000 inhabitants, which is confirmed by effective user analysis – the communities range from 468 to 90,145 inhabitants (but only 2 communities are beyond 25,000 inhabitants). The average inhabitant number is 5,728 and the median is 2,744.

Summary

Finally, we conclude that only concerted action by multiple players and tools can effectively contribute to the big change. It will be essential to start evaluating their impact, continue their development and provide more user orientation and embedding into campaigns. Tool development should be performed in cooperation with environmental psychology experts (14, 15, 16).

Furthermore, tools can only be effective if tightly integrated in a long-term process based on communication, community building, monetary and/or other rewards. For participants, this process must be rewarding, interesting, fun, and ultimately lead towards building new social norms.

A Worldwide Platform for Children Fighting for Climate Justice

Juliane Krüger and Andreas Huber
Plant-for-the-Planet Foundation

The student initiative Plant-for-the-Planet was launched in January of 2007 and had its origins in a school paper of the then 9-year-old Felix Finkbeiner about the climate crisis. At the end of the presentation of his paper, Felix envisioned a future in which children could plant a million trees in every country on Earth and protect our climate from ever-increasing CO2 levels. During the following three years, Plant-for-the-Planet became a global movement and it now has high international and political recognition. Particularly important is the children's commitment to the idea of climate justice, in the sense of an overall reduction of greenhouse gas emissions, as well as a fair distribution of these emissions for all people, especially given the fact that the consequences of the climate crisis have much harsher effects on developing countries. The student initiative is an international network of children who see themselves as world-citizens and are actively taking their future into their own hands.

IT tools are an essential element of the campaign. The Plant-for-the-Planet Foundation supports the children's activities and aims to provide a platform where the children can show their activities and get in touch with other active children. At the worldwide website www.plant-for-the-planet.org children or adults may sign up as a supporter. This enables them to inform others about their own activities or start a plantgroup. Users and visitors of the website can filter activities for each country or region. Events such as academies or speeches, upcoming and past ones, are shown and listed too. The main goal is to bundle all activities on one platform and to create a feeling of one worldwide family in which every human being counts the same and has the same emission rights. Each tree planted is a symbol for climate justice.

Furthermore, the Plant-for-the-Planet Foundation uses social media networks such as the German "SchülerVZ" and "Facebook" both to connect and attract more students (SchülerVZ) and to spread the word. Twitter is used to start a dialogue with mature participants regarding an event such as a conference. Participants using mobile devices to discuss and report live from the conference are approached and informed about activities of the children at the specific conference, for instance a photo shooting of the award winning "Stop talking. Start planting" Campaign of the children. Later the participants get informed again about reports or photos of the event that was attended together.

Youtube and Flickr accounts serve as tools to embed videos and photos. All activities aim to increase traffic on the website www.plant-for-the-planet.org.

The Potential of ICT for Collaboration in Climate Change Issues

Lisa Maurer
Graz University of Technology, Austria
Aline Chiabai
BC3 – Basque Centre for Climate Change

Information and Communication Technologies (ICT) have become indispensable in the last decades and also play an important role in environmental research and different environmental application areas. Since the 1960s computer systems have been used for measuring environmental data and since the 1980s the first generation of environmental information systems has been applied (1). In recent years the increasing interactive exchange of information and the opportunities for the public to actively contribute via the internet have added a completely new dimension. Mobile devices are offering uncomplicated ways to collect and distribute up-to-date information and crowd-sourcing applications such as Ushahidi (www.ushahidi.com), which facilitate collection, visualisation and interactive mapping of information posted via mobile phones.

The wide range of ICT application therefore ranges from data collection issues and using sensors and monitoring systems, to data processing, information and knowledge management, simulation and modelling tools, semantic technologies and communication technologies and networks. Especially in the area of communication and education not only researchers and professionals are typical users of ICT but also the open public is strongly involved through the use of email, internet and through different information platforms and online communities. The importance of these communication channels has for example been stated by Paas & Creech (2) who indicate that ICT play a significant role in advancing education for sustainable development in two ways: "By increasing access to educational materials about sustainability (...)" and "by helping to promote new ways of interacting (...)" which facilitates learning that not only focuses on knowledge, but on choices, values and actions.

The FP7 support action ICT-ENSURE (3) – Information and Communication Technologies for Environmental Sustainability – focused on examining the limitations and potential of ICT in the field of environmental sustainability with a special focus on the area of climate change. As diverse as the information and communication technologies applied are, this analysis was accompanied by intensive community and network building activities to link and involve experts in various environmental fields, to involve a wide range of users and application areas. Detailed surveys to discover the state of the art concerning ICT applications for environmental sustainability were combined with a number of questionnaire surveys in order to identify more specialized issues and to finally validate the results from the different studies. A number of workshops and conferences provided the arena for the discussion of the results and to develop a collection of current user requirements and research demands.

One of the main achievements of ICT-ENSURE lies in the created expert network that started with the extension of the person-to-person network to the organisation of the different conference events. The new extended expert network was then put on an online platform basis (3) to also continue the co-operation between experts in the future. This was supported by two information systems providing access to a wide scope of related literature and research programmes.

The results of ICT-ENSURE showed clearly that information and communication technologies are being applied by a wide range of users: by scientific experts from environmental and technological backgrounds, experts from industry, different involved stakeholders, decision makers and the open public. In the area of climate change it is clear that while data collection issues are mainly relevant for different experts groups, especially information processing and communication issues are of high relevance for transferring climate change information and knowledge to stakeholders, decision makers and the open public.

Chiabai et al. (4) analysed the use of ICT tools in different sectors and research areas using survey-based methods, within the ICT-ENSURE project. In the climate change sector, results have shown the higher frequency of use (40%) for the category "electronic and microsystems" (automation, robotics, control systems, sensors and monitoring systems) mainly used for observation and monitoring of climate. The second most frequently used ICT categories are represented by "information systems" (database management, data processing and data mining, simulation, knowledge management, semantic technologies, advanced systems architecture, etc.) (24%) and "media/content" (publishing, digital content, information filtering, statistics, visualisation, GIS, virtual reality) (23%), the first mainly used in the modelling research area and the latter in the observation area. The ICT category with the lowest percent of use is the "communication technology and networks" (internet services, broadband technologies, mobile communications, network technology, grid computing, computer-supported cooperation) (12%), mainly used for observation of climate.

The survey also showed that the research areas where ICT is used the most include observation and modelling of climate, as well as capacity building and cooperation which embrace stakeholders' participation in decision-making (e-governance), promotion of public awareness, education and learning processes. The climate change sector, if compared with other environmental sectors, presents a substantial use of ICT in the capacity building area (4).

To fully make use of this potential it seems necessary to bridge the still existing gap between scientists and the different involved actor groups by supporting a multi-disciplinary stakeholder community aimed at “co-designing” new approaches to integrate the respective user-requirements with the scientific developments. Examples for climate change information applications that aim at supporting participation and understanding include for example: Stop CO2 Euskadi Initiative (www.stopco2euskadi.com), as an example for a regional application (Basque country fighting against climate change), or for instance carbon.to (www.carbon.to) which aims at improving the understanding of carbon dioxide information.

One of the main limitations still impeding the use of ICT is the technological and educational gap between scientific experts and decision-makers, stakeholders and the open public. Many of the technologies are costly and require a high degree of training as the intuitive usability is low. One of the major issues concerning both experts and “non-experts” is related to the fact that data of high quality and high resolution is often not freely accessible and that especially compatibility aspects still need to be improved (5). Also modeling and simulation tools, together with Decision Support Systems could prove to be of high value (6), but usability issues need to be solved first in order to make applications and tools accessible to different stakeholders and target groups without specific technological training.

So while information and communication technologies are frequently used and are still becoming more important for collaboration issues in the area of climate change, there are still disciplinary gaps that impede the information flow to and interaction with involved stakeholders and actor groups. Still, it seems that ICT are evolving rapidly and to be moving in the necessary direction of dealing with large quantities of data, de-specialization of sophisticated tools and towards social engagement and innovation.

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