

Transition and Global Challenges towards Low Carbon Societies

Synthesis Report of Sixth Annual Meeting

International Research Network for
Low Carbon Societies

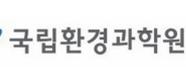
1-2 October 2014
Rome, Italy

Host

Italian National Agency for New Technologies,
Energy and Sustainable Economic Development (ENEA)

Italian Ministry of the Environment and Protection of
Land and Sea (MATTM)

Municipality of Rome, Italy



IIMA

ICAR

IIT Delhi

IIT Bombay

IITM

Contents

Preface	ii
Key Findings	1
Session Key Findings	3
Session Reports	5
Participants List	29
Table of Presentations	31
Acknowledgements	33

Presentations

Please refer to the LCS-RNet website at: http://lcs-rnet.org/6th_annual_meeting_presentations/

Preface

The International Research Network for Low Carbon Societies (LCS-RNet) was established in 2009 on the initiative of the G8 Environment Ministers' Meeting (G8 EMM). At their 2008 meeting in Kobe the G8 Environment Ministers recognised the need for each country to develop its own vision of a low carbon society (LCS) and how such transition might be achieved. This vision would aim to cut global greenhouse gas emissions by more than 50% by 2050, in order to prevent average global temperatures rising above 2 degrees Celsius and avoid dangerous impacts on Earth's major eco-systems. The G8 Ministers initiated LCS-RNet as a strong endorsement of this pathway towards LCS.

The sixth Annual Meeting of LCS-RNet was held over 1-2 October 2014 in Rome, Italy, and was co-hosted by Italy's National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), the Ministry of the Environment and Protection of Land and Sea, and the Municipality of Rome, Italy.

The meeting addressed low carbon society and energy policy goals, including security and affordability, common challenges in resource efficiency improvement and low carbon and resilient investments, and low carbon resilient development pathways.

It also considered future plans and expectations of the LCS-RNet in the run-up to the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention for Climate Change (UNFCCC) in Paris. The authors hope that an international agreement on climate change will be agreed in 2015, national policy frameworks will then be developed over the next five years and implemented from 2020. However, we acknowledge the challenges this will involve and will use this network to inform discussions under the UNFCCC.

This Synthesis Report was drafted by the session chairs and rapporteurs of the Annual Meeting together with the LCS-RNet Steering Group. We have also compiled the meeting proceedings as a Special Issue of the ENEA Journal.

Sincere thanks go to the contributions and support provided by Dr. Roberto Morabito of ENEA as well as Dr. Shuzo Nishioka, Dr. Mikiko Kainuma, Ms. Tomoko Ishikawa, Ms. Michiko Inoue and Ms. Takako Wakiyama of the LCS-RNet Secretariat.

We would also like to express our special appreciation to Italy's Ministry of the Environment and Protection of Land and Sea for its generous support of LCS-RNet activities. We greatly value the support and recommendations provided by governments and LCS-RNet contact points. Particular thanks are due to all the Italian research institutes involved—the Fondazione Eni Enrico Mattei (FEEM), the Euro Mediterranean Center on Climate Change (CMCC) and ENEA, and the Municipality of Rome—for their strong leadership in planning the meeting and for their hospitality in Rome.

LCS-RNet Steering Group

LCS-RNet Steering Group Members

Sergio La Motta

Italian National Agency for New Technologies, Energy and Sustainable Economic Development / Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA), Italy

Jim Watson

UK Energy Research Centre (UKERC), and University of Sussex

Jean-Charles Hourcade

International Research Center on Environment and Development (CIRED) / Centre International de Recherche sur l'Environnement et le Développement, France

Toshihiko Masui

National Institute for Environmental Studies (NIES) / 国立環境研究所, Japan

Stefan Lechtenböhmer

Wuppertal Institute for Climate, Environment and Energy / Wuppertal Institut für Klima, Umwelt, Energie GmbH, Germany

Authors of the Synthesis Report

Jim Watson (UKERC), Rosella Viridis (ENEA), Stefan Lechtenböhmer (WI), Sergio La Motta (ENEA), Andrea Bigano (CMCC), María Yetano Roche (WI), Roberto Morabito (ENEA), Satoshi Kojima (IGES), Manfred Fishedick (WI), Laura Cutaia (ENEA), Vincent Viguie (CIRED), M. Peronaci (ENEA), Tomonori Sudo (JICA), Christophe Cassen (CIRED), J.C.Hourcade (CIRED), Daniela Palma (ENEA), Oscar Amerighi (ENEA), Toshihiko Masui (NIES), Ioanna Ketsopoulou (UKERC), P. R. Shukla (IIMA), Koji Fukuda (UNDP), Kentaro Tamura (IGES), and Takeshi Kuramochi (IGES)

Edited by Sergio La Motta (ENEA), Jim Watson (UKERC), Lucy Hayes (DECC), Matthew Aylott (UKERC), Shuzo Nishioka (IGES), Mikiko Kainuma (IGES/NIES), and Takako Wakiyama (IGES) with the help of J.C.Hourcade (CIRED), Stefan Lechtenböhmer (WI), Jim Watson (UKERC), Toshihiko Masui (NIES), Satoshi Kojima (IGES), Koji Fukuda (UNDP), and Tomoko Ishikawa (IGES)

Key Findings

The sixth LCS-RNet Annual Meeting considered how a low carbon society could be brought about within a complex socio-economic context in order to avoid the most dangerous impacts of climate change over the medium- to long-term. The 6th annual meeting addressed low carbon societies and energy policy goals, including security and affordability, common challenges in resource efficiency improvement and low carbon and resilient investments. All of these issues must be addressed in coming to an international agreement on climate change at COP21 in Paris. The key findings are summarised below.

Energy security, affordability and efficiency as energy policy goals

Climate change mitigation is not the only energy policy goal for many countries. Strategies to reduce emissions also need to account for impacts on the other two parts of the ‘energy trilemma’, namely energy security and affordability. Whilst some strategies can meet more than one of these goals, there are often trade-offs between them. For example, whilst investment in renewable energy could help to reduce the vulnerability of a country to fossil fuel price shocks, especially if prices are high, some renewable technologies could lead to more complex electricity systems that require new strategies to operate them reliably. Similarly, it is not sufficient to implement policies that good for energy security and affordability alone, since these policies may not deliver lower emissions.

In recent years renewable electricity generation has made substantial progress worldwide and is now seen as a vital component of a low carbon energy system. Technological improvements continue to drive down renewable electricity costs and in some cases these are now cheaper than fossil fuels. However, implementing this transition is linked to technological (grid stability etc.) as well as institutional (markets etc.) challenges. In spite of the rapid rate of development, policy has to be carefully designed to avoid distributional effects on low income households and energy intensive industries. In the longer term, renewable energy policy can also address these issues, so it is essential to coherently pursue a low carbon transition with a strong emphasis on renewable energy integration.

Energy efficiency policies should be a priority since they are likely to address all three policy goals within the ‘energy trilemma’. A ‘package’ of energy efficiency policies is often required to address the multiple barriers identified by research, and to address the needs of different consumers. This package could include a combination of price incentives, standards and targeted investment programmes (e.g. to upgrade the housing stock). Whilst measures to increase energy prices could provide incentives for more energy efficiency, they are unlikely to be sufficient on their own – and they will have distributional impacts on low-income consumers and energy intensive industries that need to be mitigated. Policy evaluations and assessments should therefore focus on the impact of ‘policy packages’ rather than on single policies.

Low carbon transition through innovation, integration and behaviour change

Energy transitions are unlikely to be achieved without public consent and social change. It is already clear from the experience in some countries that there is significant potential for opposition to some technologies, and for debates about policy goals or the most desirable means to meet these goals. Public engagement is therefore an essential component of any energy transition to ensure that low carbon strategies take public values into account.

A low carbon society will come about through a transition that will inevitably produce winners and losers. The economic and social impacts of this transition need to be better understood and anticipated, and the negative factors will require special attention, particularly at the country level. At the city level too, more consistency needs to be apportioned to transition processes in terms of both time and geographical scope (short, medium, long term; from individual to global level).

Actual improvements towards LCS will emerge from remodelling the present paradigm of production and consumption, and involve tailored strategies for materials and basic material production systems. Changes in modes of consumption will require system transformations, since consumption is affected by technology, behaviour, infrastructure, social norms and values, culture, laws, regulations and standards, as well as knowledge.

Co-benefits and adaptation under climate change agenda

As noted above, low carbon societies also need to take into account other policy goals such as energy security, affordability, air quality improvement, health protection and the enhancement of comfort and well-being. Where possible, synergies between these goals should be exploited – and climate change measures that also help to meet other policy goals should be prioritised. To inform the prioritisation process, co-benefits need to be assessed and measured.

Integration of adaptation and mitigation policies should be mainstreamed within urban planning. The climate change agenda will require adequate financial flows in order to support mitigation and adaptation efforts, as well as the low carbon development of emerging and new economies.

Enhancement of resource efficiency and circular economy

Resource efficiency is a priority both for the environment and the economy. It requires a framework for policies to support the transition to a resource-efficient, low carbon economy. The main objectives must include boosting economic performance, while reducing resource use and ensuring strategic and critical resource supply security, and to achieve a ‘recycling society’.

Whilst energy efficiency is very important, it is not the only answer. A broad set of mitigation options beyond energy efficiency measures are required, including emissions efficiency, material use efficiency, recycling and re-use of materials and products, product service efficiency, and demand reductions. Initially, these measures need to be pursued in parallel, while acknowledging that some of them are inadequately addressed by policy and also suffer from weak economic drivers.

Adequate financial flows to support mitigation and adaptation

Low carbon development will require significant changes to the way that economic and financial systems operate, for example by rerouting public spending and private investment, modifying the procurement system, and greening energy use. It also requires a low carbon and climate-resilient infrastructure (‘hardware’), related laws and regulations (‘software’) and domestic and international capital flows (finance). Climate finance should emphasise the re-orientation of existing ‘mainstream’ financial flows so that they support climate change actions across economies.

More risk-sharing structures, involving both public and private stakeholders, are required to foster long term investment and innovation processes entailed by the transition to a low carbon economy.

Laying the path to low carbon resilient development

Technology transfer to developing countries can only provide short- and medium-term solutions. Improving the capacity and skills for low carbon innovation in these countries is critical for long term transformation. Funding for such developments cannot be evaluated using typical metrics such as dollar/tonne of CO₂ abated. This means that new frameworks are required to assess the impact of capacity building initiatives – and the extent to which they have helped to underpin low carbon development.

Session Key Findings

Plenary 1: Energy security and affordability p.5

Some trade-offs between climate mitigation and energy security goals are inevitable, but many can be addressed if a ‘systems’ perspective is adopted for both the short term and long term in policy design.

There are security benefits from shifting to low carbon societies that reduce the use of fossil fuels. These benefits include reduced exposure to potential high fossil fuel prices. However, low carbon societies could mean new energy security risks that could, for example, affect resource availability (e.g. of bioenergy or scarce materials) or electricity system reliability. New strategies to mitigate these risks and strengthen energy system resilience will be required.

Parallel 1-1: Innovative solutions to power system needs p.7

Recent advances in technology coupled with developing markets have together fostered low carbon energy systems in which electricity plays a major role. Future development needs and intensified international cooperation in technology development and deployment policies, as well as significant upfront investment in renewables and low carbon systems, will all have large co-benefits and realise reduced expenditures on fossil fuels.

These systems will also contribute to other goals—energy security and reduced pollution for example.

Parallel 1-2: Energy use and behaviour p.9

The current frontier of research is to assess co-benefits, synergies and trade-offs in energy efficiency. Policymakers and communicators need to focus on the multiple gains realised by energy efficiency (for consumers and investors alike). More research is needed to quantify such benefits.

The involvement of consumers in policy and product design, and the potential of energy sufficiency (as opposed to efficiency) initiatives are examples of fields being pursued offering future potential in policy.

Plenary 2: Common challenge in resource efficiency improvement p.11

Historical key transformations have contributed to substantial economic development but also greatly increased resource intensity. A further transformation to a more sustainable social and economic system must take place.

A wide range of economically attractive low carbon measures are available which could lead to significant reductions in energy use and carbon emissions. Concurrently, transition to a circular urban economy cannot be realised within the current economic paradigm; a deeper transformation involving the main drivers is required.

Parallel 2-1: Resource efficiency improvement in the industrial sector, as part of the joint transition to LCS and green economy framework p.13

Energy efficiency and technology improvements alone will not achieve the LCS goals. Thus, resource efficiency and a circular economy are keys to a low carbon society.

For developed countries, transition to low carbon in the industrial sector can significantly affect long-term global mitigation efforts through technology development and transfers. The global policy response needs to be geared towards transforming rather than preserving industry.

Parallel 2-2: LCS and related resource efficiency improvements in territories management p.15

At the city scale, cookie-cutter solutions don’t work: understanding local characteristics is paramount (e.g., cultural heritage and tourism in Rome are a huge constraint) and leads to differing policy opportunities and GHG measurement choices (the choice of GHG accounting scope depends on city characteristics). Urban climate policy design requires a bottom-up vs. top-down approach.

In order to promote low carbon urbanisation, a combination of technical and social innovation changes of behaviours and lifestyles, as well as fundamental methods, pragmatic databases and tools, and harmonised protocols and streamlined accounting are required.

Plenary 3: Utilise low carbon and resilient investments as leverage to renovate economies in crisis p.17

Attaching a price to carbon alone does not efficiently spur transition towards LCS—specific policies aligned with the paradigm shift initiated by the Cancun Agreement (adapted to national circumstances and taking into account potential resistances) will aid this transition.

Considering the perverse/adverse effects of previous policies (e.g., regarding urban planning/energy dependency of households) in terms of social acceptability of Green tax reforms, climate finance for stimulating investments in low carbon projects could make taxes more palatable.

Parallel 3-1: Barriers and opportunities of financing/investing in mitigation and adaptation p.19

Public funding mechanisms to support mitigation and adaptation efforts have been shown as ineffective in satisfying the short-term climate change agenda.

Climate change policies at all levels of intervention need to be disambiguated to clarify actual climate-change goals, i.e., what needs to be financed and in which sectors.

Parallel 3-2: Building consensus to support climate change policies: genuine public engagement & bottom-up local low carbon initiatives p.21

A broad participatory approach to develop climate action plans based on an iterative process is one way to integrate expert know-how, to maximise transparency, acceptance and public engagement, to create an appropriate implementational culture, and to stimulate new cooperation schemes and joint approaches. This process could produce concrete mitigation measures (policy instruments) and offers additional political and communication benefits beyond the implementation of selected measures.

The public is affected by how energy systems are configured. How publics envision future energy systems will contribute to the overall vision on a sustainable future. Identifying the underlying social values that inform public attitudes to energy presents an opportunity to develop energy systems that maximise the potential for public engagement and consent.

Parallel 4: A big ‘win-win’ in shaping low carbon resilient development p.23

Technology RD&D is the key to a low carbon transformation. However, taken alone it is inadequate—significant institutional and behavioural changes are also needed.

To support the popular view that technology transfer can occur between developed and developing countries if enabling conditions are in place, adequate financial flows are needed. Creative solutions are also required, and collaborative agreements should benefit all parties involved.

Parallel 4-1: Challenges in developing countries p.25

The research community can catalyse low carbon development in developing countries by serving as provider of tools and guidance to make informed decisions.

The research community can also support capacity development in developing countries by providing fora for knowledge exchange and peer-to-peer learning.

Parallel 4-2: How can emission pathway modeling contribute to raising ambition levels of nationally determined contributions (NDC)? p.27

Both the top-down approach, such as allocation of global carbon budget based on equity indicators, and bottom-up approach, such as technology-based energy system modeling, can serve as important sources of information in comprehending INDCs. Early planning and action is essential to achieve deep, long-term decarbonisation toward 2050.

Total energy-related CO₂ emissions for deep decarbonisation pathways from 15 major economies accounting for 70% of global CO₂ emissions could realise a 45% reduction between 2010 and 2050. However, further emissions reduction is required in order suppress the rise below 2°C.

Session Reports

Plenary Session 1: Energy security and affordability

Chair: Jim Watson, UKERC

Rapporteur: Maria Rosa Viridis, ENEA

Speakers:

Takashi Hattori, International Energy Agency (IEA)

Jessica Jewell, International Institute for Applied Systems Analysis (IIASA)

Can low carbon societies deliver on energy policy goals including security and affordability?

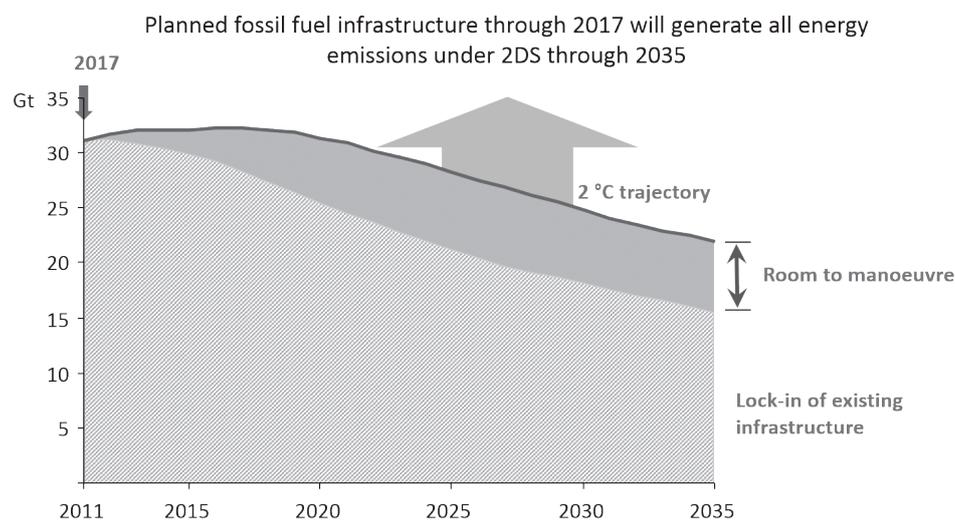
Low carbon societies can deliver on energy policy goals including security and affordability, especially if energy efficiency measures are pursued vigorously. For integration of energy and climate objectives and policies, actions are needed for a transformation towards a low carbon society while integrating a plurality of policy goals such as energy security, environmental protection and continued economic growth. While the actions that lead to global emissions consistent with a sub-2°C temperature increase are broadly known (efficiency improvements in power generation, end-use fuel switching, use of renewable energy sources and nuclear energy, deployment of CCS, end-use fuel and electricity efficiency), bending current trends in CO₂ emissions or CO₂ intensity of the global energy supply requires robust policies. Cross-disciplinary synergies must be found and exploited as GHG abatement policies have impacts on energy security and air quality and often improve health, comfort and well-being. The positive impacts on macroeconomic variables (output, employment, prices, energy balances and trade) from low carbon energy investment and from energy savings should also be stressed in the balance of cost and benefits. Consistency of short-term energy measures with long-term decarbonisation goals and an integrated view of energy systems will deliver more sensible policies.

Another aspect of integrating energy and climate objectives and policies is the complex relationship between climate policies and energy security—for instance, assessing the impacts of the 2030 EU energy and climate targets, and of climate stabilisation on energy security, both within and outside the EU. The concept of energy security can be qualified and reformulated as ‘the need to lower to an acceptable level the vulnerability of an energy system’. Energy vulnerability is felt much more acutely on the individual country level within a larger region. Furthermore, energy dependence should be considered both for the short and long term. Analysis by Jewell (IIASA) shows that for EU countries the 2030 climate targets increase security with respect to oil dependence, while the impact is more uncertain for gas dependence. At the global level, climate stabilisation goals enhance energy sovereignty (as they reduce the need for trading energy), extend the life of energy resources (by reducing extraction rates) and tend to increase energy diversification. The question of whether energy security (or energy independence) would have a positive impact on climate stabilisation is less clear-cut. Achieving the goal of energy independence involves substantially lower costs than achieving climate stabilisation, but unfortunately the former only marginally improves the latter.

Concrete steps for low carbon transformation

- **Instigate simple measures** to substantially reduce emissions growth in the medium term at no net economic cost and make much headway along the 2°C path. The chief measure is energy efficiency policies, and another key one is limiting the use of inefficient coal power plants. Control and reduction of methane releases from upstream oil and gas together with removal of fossil fuel subsidies further contribute, and these measures take on greater relevance for low income countries.
- **Invest heavily to achieve LCS.** Higher levels of investment are required compared to BAU scenarios—and, to reduce lock-in, investments earmarked for the short term in fossil fuel-based technologies should be redirected towards low carbon technologies.
- **Release existing high-carbon emission assets.** This could be done by: early retirement of, at minimum, those that are least efficient; prioritising the cleanest power plants; retrofitting of coal plants for CCS, or refurbishment to increase efficiency and co-firing with biomass. These actions can be achieved through regulation of plants and performance standards or via pricing mechanisms.

“Lock-In” of 2 degree Emissions



Source: Hattori, IEA, Presentation in Plenary 1

Reference: IEA (2013) World Energy Outlook, OECD/IEA, Paris.

Parallel Session 1-1: Innovative solutions to power system needs

Chair: Stefan Lechtenböhmer, WI
Rapporteur: Sergio La Motta, ENEA

Speakers:

Hans Martin Henning, Fraunhofer ISE
Paolo Deiana, ENEA
Christine Krüger, WI

What kinds of innovative solutions to respond to the needs of the power system are available?

Low carbon energy systems can be tailored to individual countries according to national circumstances and specific policies. A low carbon energy system with no nuclear or CCS has been investigated via “Holistic modelling” for Germany. The main characteristics of such system were revealed to be: (i) greatly bolstered energy efficiency, (ii) transition to a highly flexible electricity generation and load system, (iii) large scale generation of heat and gas (mainly H₂ for mobility) from electricity and (iv) extensive energy storage for heat, gas and electricity (stationary batteries and batteries used in electrical vehicles). Analysis of the costs of such a system shows that they don't surpass those of the conventional energy system used presently. These findings are also highly applicable to other highly industrialised countries in moderate climates.

For countries wishing to decarbonise their fossil fuel-based power sector through CCS, an overview of the state of the art in R&D in Europe and the current

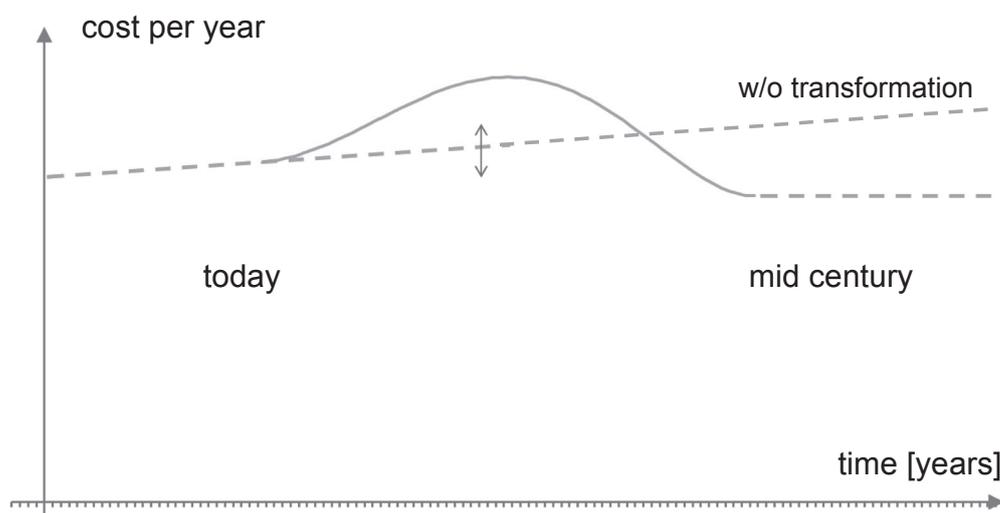
challenge of project financing due to reduced ETS prices reveal a high potential for these technologies. Further challenges identified are to gain operational flexibility for plants adopting CCS due to increased fluctuation in generation as well as the application of CCS to industrial sectors (e.g., steel, cement, lime, chemicals, refining) which is expected to deliver half of the global emissions reduction from CCS by 2050.

Improvements in electric and thermal energy storage are essential for low carbon energy systems. An overview of existing and future storage technologies for both thermal and electrical energy shows that technological solutions, including combining sectors such as heat, electricity and mobility (to exploit new options for balancing energy demand and supply), are in abundance. Storage of electricity will attain higher significance with increasing proportions of fluctuating renewable energy in the system. In order to incentivise development and deployment of technologies, respective market mechanisms need to be created.

Concrete steps for low carbon transformation

- **Decarbonise electricity generation.** The energy system, particularly electricity generation, is the route to decarbonising economies, and technologies are there to deliver. Analyses by AR5, the IEA and research presented show that, thanks to ongoing technological advancements, low carbon (renewable) electricity is already feasible, and that significant technology learning has already resulted in significant cost reductions of many technologies and further advances are also possible. Research, development and deployment, particularly but not solely in energy storage, must be ramped up, however. These developments indicate low carbon electricity will displace traditional segments in the heating and transport sectors.
- **Ramp up international cooperation** in technology development as well as joint initiatives in technology deployment to spur innovation in the sector. These measures can maintain the momentum of recent gains in reduced costs e.g., of new renewable supply technologies.
- **Expand the electricity sector** to increase energy security due to lowered reliance on oil and gas in transport and heating sectors.
- **Instigate an asset transformation.** The entire energy/electricity system needs to undergo a fundamental transformation of assets, obligating significant institutional changes and high upfront investment in energy efficiency, low carbon technologies such as RES, and others as well as in the expansion of electricity grids and electricity storage. Investment in fossil fuel extraction and conventional power plants would consequentially be significantly reduced.
- **Maintain investment in low carbon energy.** This would provide further dividends on buying down costs but would involve the need to finance high upfront investment costs. As these will provide a return over time and have significant co-benefits they represent attractive targets for investment.

Qualitative trend in total annual costs of transforming the energy system compared to business as usual



Source: Hennings, Fraunhofer ISE, Presentation in Parallel Session 1-1

Parallel Session 1-2: Energy use and behaviour

Chair: Andrea Bigano, CMCC
Rapporteur: María Yetano Roche, WI

Speakers:

Dario Chello, ENEA
Julia Nordmann, WI
Stefan Thomas, WI

How can energy use behaviour be changed in order to achieve a low carbon transformation?

Despite the clear economic case for energy efficiency, homeowners and businesses have historically displayed little sensitivity to signals that could lead to improvement in energy efficiency—hence the so-called “energy efficiency gap”. Energy use in residential buildings in particular holds a large untapped potential and is seen as one of the most cost-effective means of curbing emissions. One relatively longstanding research has revealed a range of barriers—informational, motivational and financial—hindering energy efficient behaviour, as well as various unintended consequences such as rebound effects. Barriers, and the means to overcome them, are actor-specific and can be addressed by various levels of policy: from the broader governance framework (e.g., targets such as “making energy efficiency the norm”), through to specific instruments (voluntary agreements, audits, etc.).

One particular barrier, often overlooked, is the functioning of the retail energy market. For example, in some EU member states energy tariffs include charges which are unrelated to actual energy use. More knowledge is needed of the impacts liberalised electricity and gas markets have on end user behaviour,

and how deeper reforms can address them.

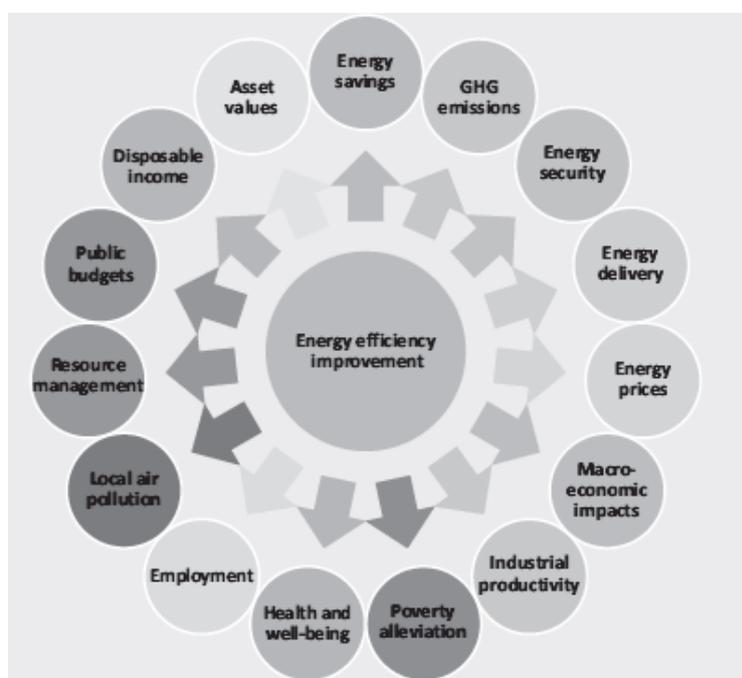
Quantification of the co-benefits that energy efficiency could bring is currently attracting much attention due to the potential it holds in making energy efficiency a more attractive option for both consumers and policymakers. A recent study by the IEA (2014) estimates that large-scale energy efficiency programmes would result in a GDP growth rate of 0.25 to 1.1% per year, create jobs and bring about significant energy cost savings. Health and well-being impacts could quadruple the economic savings.

An emerging area of research is looking at the involvement of the consumer in the innovation process in order to maximise the success of energy efficiency innovations. For example, the Sustainable Living Lab project in North-Rhein Westphalia (Germany) is a real-life experiment which has piloted an “open innovation process”, where the usage of efficient space heating systems is monitored, revealing patterns of user behaviour that can serve to optimise system design and therefore increase acceptance and correct modes of use.

Concrete steps for low carbon transformation

- Address the efficiency gap.** Experience has shown that energy efficiency policies and innovations relying solely on the behaviour of individual consumers are often bound to fail. Knowledge of how to address this energy efficiency gap, i.e., the multiple barriers that hinder energy efficient investments and behavior, is quite advanced in fields such as new buildings, building renovation and appliances (e.g., producer responsibility and labeling schemes); the focus in these fields should therefore shift to the design of policy packages that build on such knowledge. Other fields, however, are still in need of further analysis—as in the case of energy efficient behaviour in transport. Moreover, there are key fields about which little is known and where only a handful of policy packages exist across the world; for example, the integration of energy efficiency and material efficiency, and the further implementation of sustainable consumption and energy sufficiency concepts via policy are new frontiers of research.

Making use of the multiple benefits of energy efficiency



Source: Thomas, WI, Presentation in Parallel Session 1-2

Reference: IEA (2014) Capturing the multiple benefits of energy efficiency. OECD/IEA, Paris.

Plenary Session 2: Common challenge in resource efficiency improvement

Chair: Roberto Morabito, ENEA
Rapporteur: Satoshi Kojima, IGES

Speakers:

Derk Loorbach, Dutch Research Institute for Transitions (DRIFT)
Sarah Colenbrander, University of Leeds

How can we synergise the low carbon transition and improve resource efficiency?

Key historical transformations (industrial transition, mobility transition) have contributed to economic development but also to substantial increases in resource intensity. Now a new transformation to more sustainable social and economic system is required, which can be attained by shifting three drivers: from centralised control mechanism to distributed panarchy based on guidance and facilitation; from fossil fuels and exhaustible resources to renewable resources; and from a linear system to a circular system. The current sustainable development policies and targets focus on decreasing the negative impacts and improving efficiency. Instead, emerging alternatives create the possibility for a radical shift to a low-carbon and resource-efficient society. Such shift from 'optimisation' to 'transformation' in order to exploit emerging alternatives would also, however, cause uncertainty, conflict and resistance. We therefore need to accept conflict, chaos, and uncertainty as collateral damage in the process in achieving sustainability. Both bottom-up social innovation and new top-down mechanisms are needed to realise transformation—one

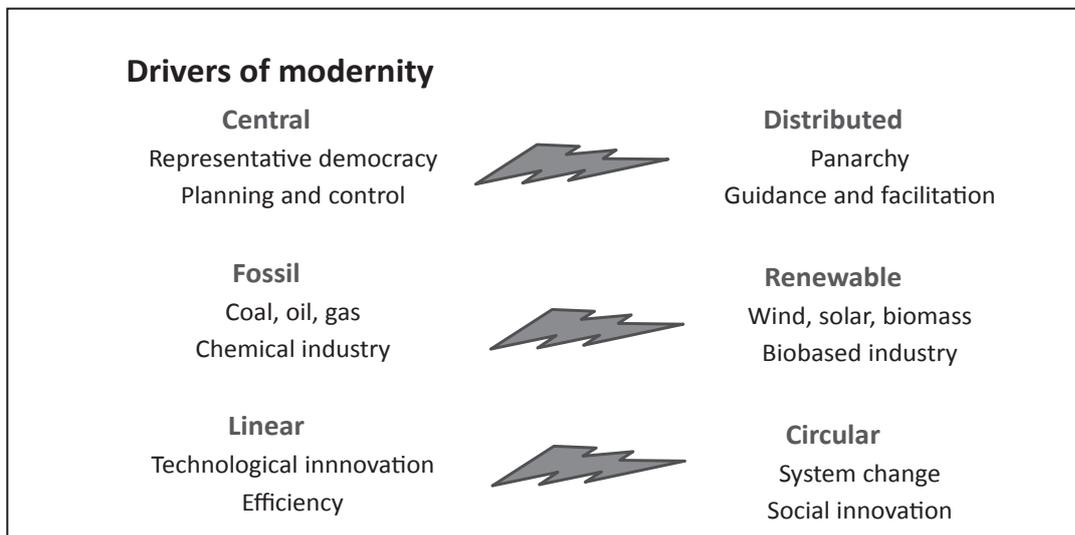
of the latter being a phase-out strategy from fossil fuel and exhaustible resources-based systems.

Studying cities as units in learning how to synergise LCS and resource efficiency improvement is also important, as cities consume 75% of natural resources and 67–76% of energy. Particularly as regards urban populations, which are accelerating especially in developing countries, it is imperative to realise transformation from a linear to a circular urban economy. Case studies of five cities demonstrate the economic case for low carbon investment, in terms of positive net economic benefits of such investment. At the same time it is clear that transformation to a circular urban economy cannot be achieved merely by exploiting economically attractive carbon-saving options. Still, the presence of a compelling economic case can help build momentum and capacities for more transformative change and for synergising a low carbon transition and resource efficiency improvements.

Concrete steps for low carbon transformation

- **Implement economically attractive low carbon options** (based on case studies in five target cities) that can improve energy efficiency, unlock financial resources and build human capital to promote a local circular economy.
- **Implement economically attractive carbon-saving options**, as they can help build momentum and capacities for more transformative change.
- **Promote transdisciplinary science.** Sustainability cannot be achieved simply by improving efficiency—it requires a new transformation. To this end, transdisciplinary science must be promoted to create new realities, identify breakthrough points, mobilise and empower alternatives and disempower regimes in order to realise transformation.

Towards a New Transformation



Source: Loorbach, DRIFT, Presentation in Plenary 2

Parallel Session 2-1: Resource efficiency improvement in the industrial sector, as part of the joint transition to LCS and green economy framework.

Chair: Manfred Fischendick, WI
Rapporteur: Laura Cutaia, ENEA

Speakers:

Max Ahman and Lars Nilsson, Lund University
Magnus Bengtsson, IGES
Claudia Brunori, ENEA

How can we synergise the low carbon transition and improve resource efficiency in the industrial sector?

Energy-intensive industry (EII) produces basic materials such as steel, cement, aluminium, paper and pulp, and basic plastics. Going beyond 15 to 30% emission reductions will require the development of breakthrough technologies and technology shifts in core processes. EII is capital-intensive, involves long investment cycles and requires tailored deployment strategies. Mitigation options offer few, if any, co-benefits and often lead to much higher production costs. This need not be an economic problem since the cost share of basic materials in finished products is generally small, but it threatens international competitiveness.

Carbon leakage has been very limited to date but such risk will increase in the long-term if EII becomes exposed to much higher carbon costs. Although carbon leakage is sometimes regarded as a minor problem due to EII's small contribution to GDP (2% in the EU), there are several arguments for maintaining production capacity of basic materials within the EU/G8. One is that geographical proximity in integrated valued chains assists innovation.

In addition, since energy is cheaper than human labour, this is a strong incentive to replace humans with energy-consuming machines. However, conversely, although industry is getting better at increasing output with fewer people, it is less successful at producing output using fewer resources and less energy. There are two options: to reduce the amount of work in the economy or to drastically change investments from 'labour-saving' to 'reduced-resource intensity'. In such contest, the role of the individual consumer is often overrated, emphasising the need for consumer education and information provision to consumers.

But a transition to SCP requires collective decisions and policies. Moreover, consumers are exposed to two conflicting messages: 'more-is-better' consumption to bolster the economy and 'less-is-best' consumption for sustainability. The question is: where we are willing to go? There is a need for a coherent and engaging vision.

As other avenues available for industry to transit to LCS, reuse and recovery of raw materials and industrial symbiosis can be cited.

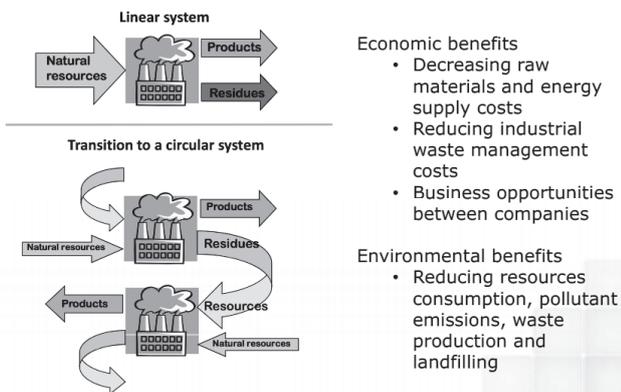
In recent years the European Commission has launched several initiatives by approaching raw materials issues at the EU level, the main objective of which is to contribute to medium- and long-term security of sustainable raw materials supply to meet the fundamental needs of present day, resource-efficient European society. The raw materials cost component over sale price is significant: from 55% for the manufacturing sector (on average) to 65% for basic metal production.

Product and process eco-innovation represent the main pillars in achieving efficient resource use; however, there is also a strong need for integrated management solutions that allow for connection between production cycles and their territories. Tools for such should include the following approaches: business to business (B2B) bottom-up approach (e.g., implementation of industrial symbiosis for preventing the generation of waste and raising resource use efficiency) and business to consumer (B2C) (e.g., urban mining implementation through the development of strategies for increasing rates of collection and recycling in territories where waste is produced).

Concrete steps for low carbon transformation

- **Boost the use of low carbon materials and low carbon basic materials** (by the adoption of specific measures).
- **Tailor strategies for all materials produced** by energy intensive industry.
- At the policy level a clear strategy for SCP is needed (that doesn't entail the 'consume-more/consume sustainably' contradiction).
- **Enhance resource efficiency and circular economy** with both B2C and B2B approaches.
- **Boost circular economy in the industry sectors and local areas** through adoption of industrial symbiosis strategies while boosting circular economy at the urban level via the systematic valorisation of urban mines and stakeholder input along the value chain.
- **Adopt radical changes in innovation, investment patterns and carbon pricing.**

Resource efficiency



Source: Brunori, ENEA, Presentation in Parallel session 2-1

Reminder: Oil is Extremely Cheap (Compared to Human Labour)

OIL

One barrel of oil (159 litres)
Cost: US\$97

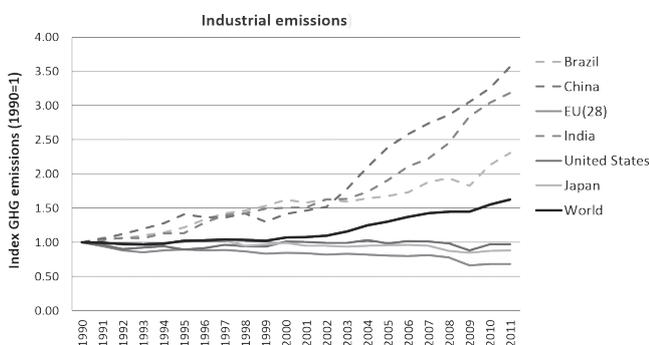
Same amount of energy

12 labourers working for one year
Cost: ?????

➤ Strong incentives to replace humans with energy consuming machines

Source: Bengtsson, IGES, Presentation in Parallel session 2-1

The effects of climate policy so far...



Source: Adapted from : WRI, CAIT 2.0, 2014. Climate Analysis Indicators Tool: WRI's Climate Data Explorer. Washington, DC: World Resources Institute. Available at: <http://cait2.wri.org>

Source: Adapted from : WRI, CAIT 2.0, 2014. Climate Analysis Indicators Tool: WRI's Climate Data Explorer. Washington, DC: World Resources Institute. Ahman and Nilsson, Lund University, Presentation in Parallel Session 2-1

Parallel Session 2-2: LCS and related resource efficiency improvement in territories management

Chair: Vincent Virguie, CIRED
Rapporteur: Marcello Peronaci, ENEA

Speakers:

María Yetano Roche, WI
Antoine Riviere, French Ministry of Ecology, Sustainable Development and Energy (MEDDE)
Claudio Baffioni, Municipality of Rome

How can we realise resource efficiency improvements in territories management?

Cities and territories will play a crucial role in transitioning to LCS as an increasing proportion of the world's population will be urban—by 2050 urban population will be double that of rural, opposite to the situation in the mid-20th century.

Although what exactly defines “urban territories” varies from country to country, highly complex systems are involved as almost all human activity takes place within them. The main sectors to be considered are: environment, resource management (waste cycle, water cycle, etc.), economy, energy, logistics, mobility, social and cultural aspects, and buildings. Other horizontal sectors that must also be considered are the roles of ICT, training and public awareness.

The main actors involved in any management strategy or policy implemented covering such areas are central and local public authorities, private industrial and tertiary sectors, public-private research institutions or bodies, financial institutions and citizens.

Further, any process that aims at improving territories management must also consider economic crises, even if they have differing effects on countries worldwide.

Therefore, in order to realise improvements in resource efficiency in territories management, it is crucial to follow a holistic approach—similar to the “Smart

Cities” strategy—while defining and implementing strategies, policies, action plans, ad-hoc legislations, etc., so that all sectors cited above may be mutually included and improved, in view of transitioning towards LCS.

Eco-innovation is a key factor this transition—eco-innovation in single technologies and in methodologies in all sectors cited above, but also eco-innovation of systems.

Another key factor in improving resource efficiency is urban mining: the process of reclaiming compounds and elements from products, buildings and waste used in our cities. Innovative technologies in this context must be implemented to recover primary and secondary materials as well.

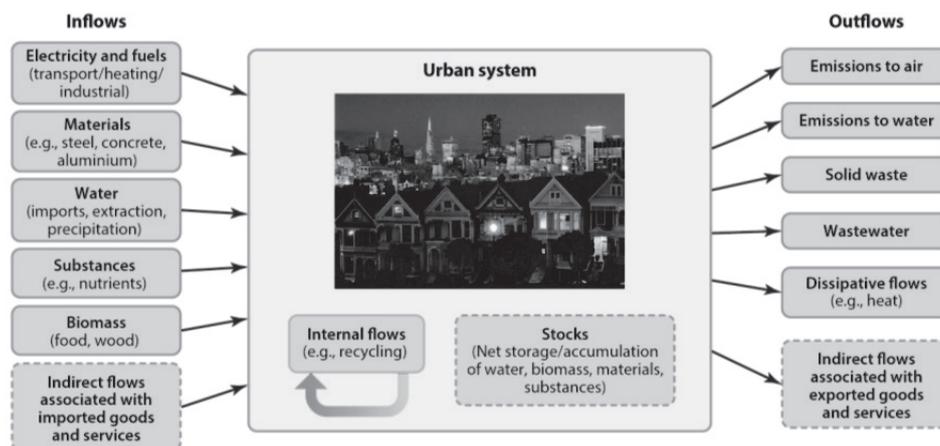
A further crucial issue is the involvement of citizens at different levels, as public acceptance is at the very heart of any action in which the public can play a part, particularly when changes in lifestyle are required.

It is worth mentioning that at least 254 cities in the world are implementing actions to reduce GHG emissions and/or to adapt to climate change. For example the Municipality of Rome has subscribed the EU's Covenant of Mayors initiative, and produced the first Sustainable Energy Action Plan (SEAP) in 2011

Concrete steps for low carbon transformation

- **Improve/innovate/harmonise/co-ordinate models, methodologies, technologies, etc.** in all sectors listed above.
- **Investigate different sector solutions or improvements via a holistic approach,** particularly for management of territories by public authorities when planning strategies, policies, legislations, etc.
- **Foster cooperation among all the stakeholders and actors** potentially involved (central, local governments/decision-makers, industrial sectors, public and private research institutions/bodies, financial institutions, citizens).
- **Taylor any strategy/policy/action plan developed to actual urban contexts in question.**
- **Carry out ex-ante ex-post analyses** of strategies, policies and action plans with the aim of modification or fine-tuning.
- Support, stimulate and award, in the highest international context, local initiatives towards low carbon societies

Urban metabolism – a reemerging field



Source: Yetano Roche et al. (2014) Concepts and Methodologies for Measuring the Sustainability of Cities. Annual Review of Environment and Resources, vol. 39: 519–47

Plenary Session 3: Utilise low carbon and resilient investments as leverage to renovate economies in crisis

Chair: Tomonori Sudo, Japan International Cooperation Agency (JICA)
Rapporteur: Christophe Cassen, CIRED

Speakers:

Jean Charles Hourcade, CIRED

Aldo Ravazzi, Italian Ministry of the Environment and Protection of Land & Sea

How can we leverage low carbon and resilient investments to renovate an economy in crisis?

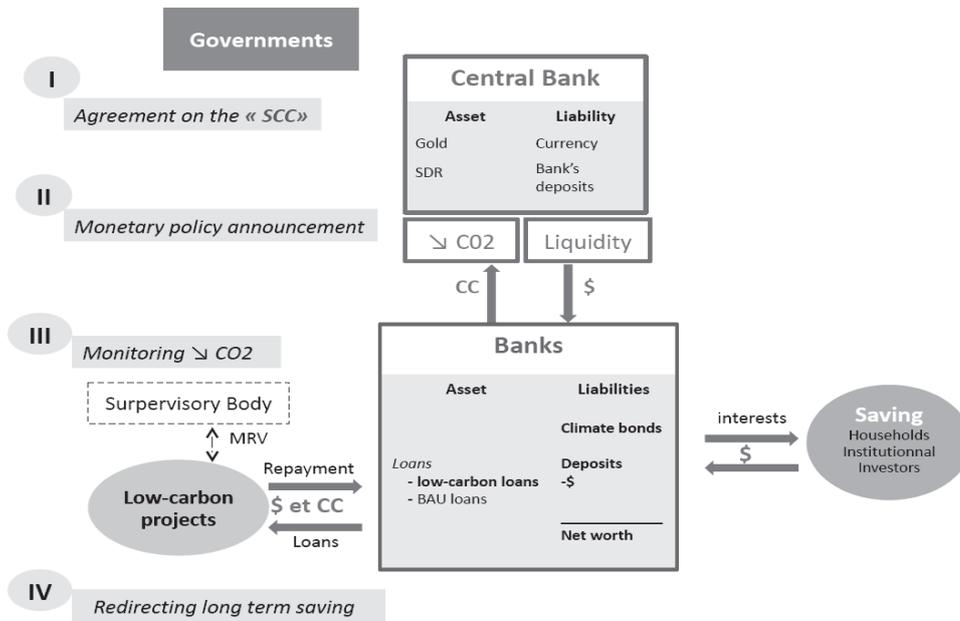
How can we transform the economic system towards a low carbon society in adverse contexts of economic crisis, common public debt (most OECD countries), environmental urgency and climate negotiations on a future climate agreement? As attaching a price to carbon alone does not efficiently spur transition towards LCS, one solution is to envisage a new financial mechanism able to redirect the funding of investments towards low carbon projects (LCP). This proposal, which is in essence a reorganisation of carbon financing, should be incorporated as part of general reform of the financial system. Climate policies for their part can stimulate sustainable and inclusive climate finance, in line with calls for a paradigm shift in climate negotiations in the Cancun Agreement. Indeed, funding low carbon investments requires significant upfront cost that could discourage investors. However, while the initial redirection of investments may at first appear costly, the incremental costs of low carbon investments (LCIs) are relatively low. In light of the world's glut in savings specifically earmarked for prudent investments, the mechanism proposed utilises carbon pricing (based on an agreed notional price) to trigger a wave of low carbon investments throughout the world and release such savings, thus providing the lever for equitable access to development for developing countries and for a green economy in developed ones. In this system, the Central Bank offers credit lines for commercial banks backed by the social value of carbon, which are then used to parry the risk of investing in LCIs. A future agreement

in Paris should support this type of mechanism.

This new financial system could be complemented with implementation of environmental fiscal reform to foster the low carbon transition and more inclusive growth. It would also require a paradigm shift from traditional economies, in the sense that economic systems should be considered as being within, rather than outside an ecological system. This option is supported by OECD, which focuses on the implementation of green tax reforms (new taxes, modification of existing taxes). Green tax reform is ideally fiscally neutral—it should not increase the total amount of taxes and should be balanced by reductions in other taxes or public debt, depending on political decisions (as seen since 1990). A green tax reform can provide benefits in the form of a double dividend (improvement of environment and efficiency), and potentially a triple dividend (environment/efficiency/employment), or even quintuple dividend (innovation and competitiveness in addition). However, past experience in such field shows that implementation of a green tax reform is confronted with potential obstacles specific to national contexts—such as an “allergy” to taxes—and vested interests. Considering the perverse/adverse effects of previous policies—for instance regarding urban planning (energy dependency of households)—in terms of the social acceptability of green tax reforms, climate finance stimulating investments for low carbon projects could make such taxes more palatable.

Concrete steps for low carbon transformation

- **Initiate a redirection of investment** to ensure transition towards a low carbon society; incremental costs are relatively low but the overall redirection of investments is costly.
- **Use climate policies to stimulate sustainable and inclusive climate finance**; future agreement in Paris could provide a framework for this new system of financing.



Source: Jean Charles Hourcade, CIRED, Presentation in Plenary 3

Parallel Session 3-1: Barriers and opportunities of financing/investing in mitigation and adaptation

Chair: Jean Charles Hourcade, CIRED
Rapporteur: Daniela Palma, ENEA

Speakers:

Tomonori Sudo, JICA
Vincent Viguie, CIRED
Giulia Galluccio, FEEM/CMCC

What kinds of barriers and opportunities for financing/investing in mitigation and adaptation exist?

Adequate financial flows are urgently needed in the near future to support mitigation and adaptation efforts in order to meet the 2°C stabilisation target. Although public finance is considered essential to implement climate change policies, public funding has proved largely insufficient, with major gaps in developing countries; actual amounts to be financed under climate change actions have also yet to be clarified. Problems have been encountered at all scales of intervention, calling for the need to identify effective public funding mechanisms tailored to the specific requirements of climate change policy. In this respect the cross-sectoral nature of climate change—which also involves other social and economic goals—can be addressed as a key aspect to devise suitable climate change approaches likely to become win-win strategies.

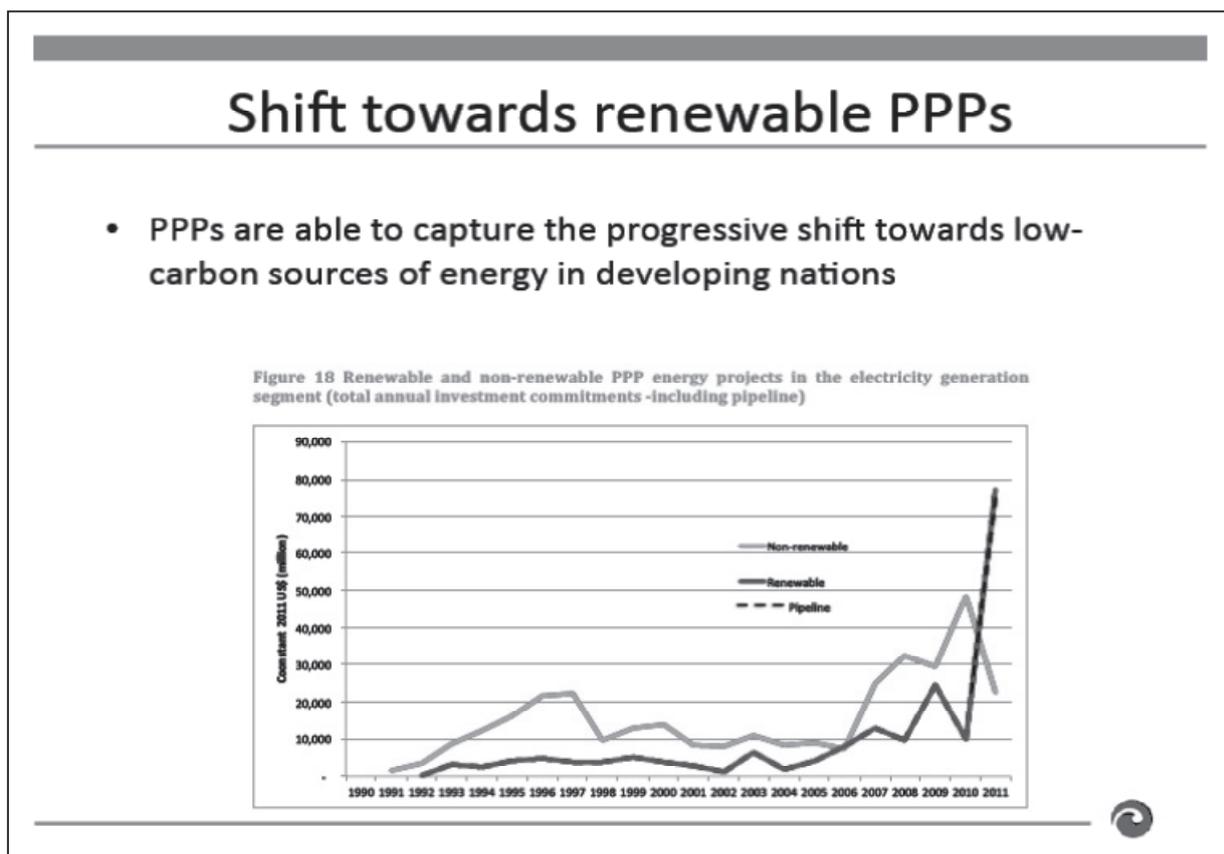
Climate agreements are still key drivers of investment but effective policy implementation cannot be viewed as a mere reaction to regulatory pressure. The forms of

funding policies can be derived from are established financing structures, but of overarching importance is to mainstream climate change considerations into sectoral policy and decision making. Furthermore, projecting effective finance mechanisms for climate change policy implementation goes far beyond the sum total of individual actions aimed at meeting specific environmental objectives. Non-linearity entailed as a consequence of a given policy mix must always be considered, assessed and evaluated. This becomes a complex process—at times with conflicting objectives—in which interactions between public and private stakeholders and the financing sources at stake play a critical role. In this framework models such as those of the Public-Private Partnership (PPP) type can act as building blocks for comprehensive risk-sharing structures so as to convey additional private funds aimed at fostering innovation over the long term, for a sound transition to a low carbon economy.

Concrete steps for low carbon transformation

- **Set up new forms of climate change finance** in order to identify major gaps in public funding and to assess the balance of private financial flows needed to support investment in mitigation and adaptation.
- **Mainstream climate change considerations into sectoral policy and decision making** so as to orient the extant financial structures to the needs of climate change actions.
- **Promote public-private partnerships in the form of risk-sharing structures** so as to convey additional private funds aimed at fostering innovation over the long term, for a sound transition to a low carbon economy.

Effectiveness of Public- Private Partnership in fostering investments in mitigation and adaptation



Source: Galluccio, CMCC, Presentation in Parallel Session 3.1

Parallel Session 3-2: Building consensus to support climate change policies: genuine public engagement & bottom-up local low carbon initiatives

Chair: Jim Watson, UKERC
Rapporteur: Oscar Amerighi, ENEA

Speakers:

Patrizia Lombardi, Politecnico di Torino (POLITO)
Manfred Fischedick, WI
Karen Parkhill, Bangor University

How can we build consensus to support climate change policies via genuine public engagement & bottom-up local low carbon initiatives?

Building consensus to support climate change policies and the required energy system transition process can follow different paths or approaches.

Policies and measures can be designed and implemented based on broad, innovative participatory approaches aimed at maximising transparency, acceptance and public engagement. Beyond the wide-scale definition and implementation of the selected strategies and measures, this participatory process offers important political and communication co-benefits in terms of, e.g., awareness-raising for different perspectives throughout the stakeholders and confidence-building between stakeholders and policymakers.

Climate change and energy policies can also be shaped based on underlying public values, which express preferences over future energy system configurations. Since the public is deeply implicated in how energy

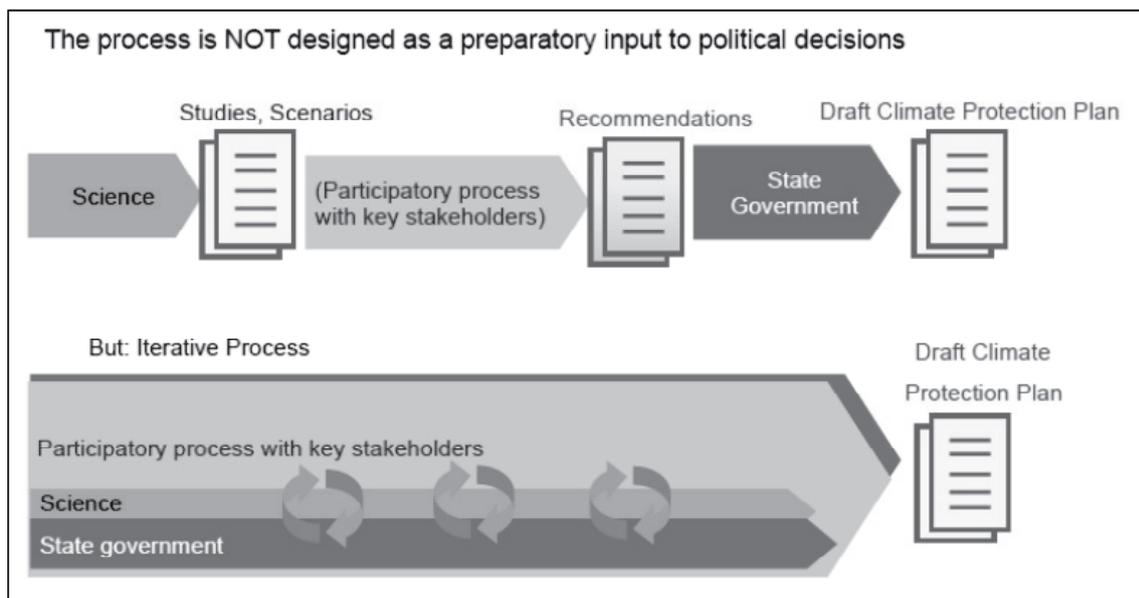
systems are configured, it is fundamental to be aware of shared public values as they can provide insight into ambivalent preferences and form the basis of policies responsive to public values.

Endogenous bottom-up processes built via interlinked actors can result in the formation of consensus. This requires participatory decision-making based on negotiation, ongoing communication and a strategy of institutionalisation. Examples of local low-carbon initiatives containing (some of) the basic features of a broader and more complex transition to environmentally sustainable ways of producing, consuming, and distributing energy within Europe (the so-called “Anticipatory Experiences”) show that a system of risk management is crucial in dealing with the myriad forms of opposition, conflict, tension and resistance that can emerge in the energy transition process.

Concrete steps for low carbon transformation

- Building consensus to support climate change policies and the required energy transition process can follow different paths or approaches. Policies and measures can be designed and implemented based on broad and innovative participatory approaches aimed at maximised transparency, acceptance and public engagement, or shaped based on underlying public values expressed as preferences in future energy system configurations. Alternatively, consensus can result from an endogenous process from the bottom up, constructed by actors and their interrelationships. This requires the activation of participatory decision-making, based on negotiation, ongoing communication and institutionalisation.
- Building consensus to support climate change policies can start from a ‘whole energy system’ viewpoint—either through defining desirable energy futures based on a set of shared social values or by involving stakeholders already in the planning phase of the current energy system reorganisation. On the other hand, anticipatory experiences of energy transition at the local level can be considered as parts of the energy system transformation process and represent real world situations where public engagement arises endogenously within community boundaries.

General concept of the participatory process



Source: Ministry for Climate, Environment, Agriculture, Nature Conservation and Consumer Protection of Northrhine-Westphalia (NRW) - Concept for the participatory approach for the development of the climate protection plan NRW (2013). Fishedick, WI, Presentation in Parallel Session 3-2

Plenary Session 4: A big 'win-win' in shaping low carbon resilient development

Chair: Toshihiko Masui, NIES

Rapporteur: Ioanna Ketsopoulou, UKERC

Speakers:

P.R. Shukla, Indian Institute of Management, Ahmedabad (IIMA)

Gabriel Blanco, Universidad Nacional del Centro Argentina

How can the scientific community help align climate policies with economic development in order to realise a low carbon resilient development path?

Building the relationship between science and policy and strengthening such linkages is one of key factors in order to set the global development path on a low carbon resilient trajectory. There is a discussion on science-policy nexus: that science must be capable of providing policy-relevant answers in order to overcome the tension between scientific and policy communities in terms of timeframe—specifically, that research tends to look at global, long-term issues whereas policymakers tend to focus on national or local issues in short- or medium-term timeframes.

In order for science to be effective in driving low-carbon resilient development, its agendas need to be directly linked to those of economic development. This implies research insights might need to be reframed from numerical data and geared to end-to-end solutions, real policies and societal problems. While science has already made significant contributions in developing climate policies, due to the evolving nature of policy, new scientific approaches are called for. The new research context should be one of knowledge-sharing and cooperation. Policymakers have expressed interest in research knowledge networks and will continue to support them as long as scientific contributions are relevant to their needs.

As another aspect to realise a low carbon resilient development path, focus can be put on the potential

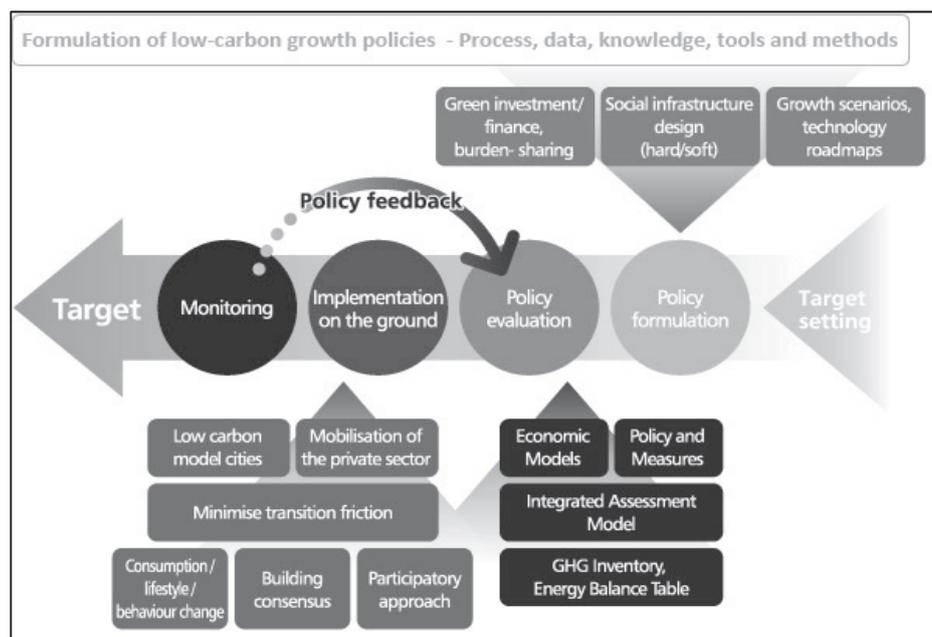
role and direction of RD&D, particularly in relation to the UNFCCC Technology Mechanism (TM). As outlined in the 5th Assessment Report by the IPCC, a technological transformation will be required in order to achieve a pathway consistent with the 2°C target. Energy efficiency, renewable energy technologies and the integration of such with existing infrastructures, as well as agriculture technologies and practices should be prioritised in relation to technology RD&D. Prof Blanco highlighted the fact that technological improvements themselves are inadequate in counteracting the effects of underlying climate change drivers, which can be influenced by policy instruments; institutional and behavioural breakthroughs are necessary. Therefore, a shift in research mindset is needed towards a more collaborative approach, in combination with effective engagement towards policymakers, industry, the media and society at large.

The TM was set up to foster cooperative RD&D at the international level and promote knowledge-sharing among participating countries. For TM to be effective, links with financial institutions need to be in place. In the context of COP21, supporting TM could act as a springboard for cooperation and knowledge-sharing between different countries, over the N-S and S-S axes or in other triangular schemes.

Concrete steps for low carbon transformation

- **Usher in a new approach to research.** Shifting policy and development contexts demand a new research approach, which should be effectively linked with development policies.
- **Undertake research with the goal of utility and traction for policymakers,** such as in providing end-to-end solutions for policy-relevant issues instead of mere numerical insights.
- **Continually update the scientific community.** It must stay abreast of policy needs as they emerge or evolve, so that research remains policy-relevant, and also must engage in effective outreach with policymakers over all geographical levels—national, regional and local—to ensure efficacy.
- **Engage with the general public.** In addition to policymakers, engagement with the public is crucial. Science must empower and educate the public on available development pathways so that informed decisions can be made.
- **Create a more collaborative, open-minded, cross-discipline/cross-field outlook** in the scientific community in order for science to be in a position to meet policy needs.

Policy and Science Nexus: What & How?



Source: LCS-RNet. Shukla, IIMA, Presentation in Plenary 4

Parallel Session 4-1: Challenges in developing countries

Chair: P.R.Shukla, IIMA

Rapporteur: Koji Fukuda, United Nations Development Programme (UNDP)

Speakers:

Bernard Zymła, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Christine Wörten, Arepo Consult

Ho Chin Siong, Universiti Teknologi Malaysia (UTM)

What kinds of challenges confront big win-wins in shaping a low carbon resilient development path in developing countries?

What are the actual challenges and opportunities in gearing developing countries towards the low-carbon resilient development pathway? What are the potential niches and means for research communities to respond to the challenges posed and bridge the research-implementation gap? As an undertaking support initiative for the low-emission development strategies across different developing countries, the common and major challenges are: national capacity constraints for implementation; policy gaps, including limited mainstreaming of climate change agenda into the existing policy framework; juxtaposition and incoherence among existing policies and targets; limited predictability associated with changes in political leadership; and coordination complexity concerning a wide range of stakeholders (the low-carbon agenda generates diverse interests of multiple actors, both domestic and international). Many of the observed challenges were attributed to the cross-cutting nature of low carbon agenda, which requires facilitation of a multi-sectorial dialogue many countries are ill-equipped to deal with. In addition, a shared reluctance to re-invent the wheel by undergoing a hasty transition to the low carbon resilient-development paradigm was also noted.

Other challenges are associated with consumer behaviours in the energy efficiency appliance market, in the context of realising market transformation.

Responding to the question at hand—why energy consumers fail to adopt climate-compatible behaviour (fail to achieve high energy efficiency) when presented with opportunities—the presenter underscored the perceived bottlenecks to be a general lack of awareness of energy-efficient products, lack of motivation and expertise to effectively harness them, and their low accessibility and affordability. In particular, the accessibility and affordability barriers are considered more prevalent in the context of developing countries.

On the other hand, in a case study of Malaysia's experience with low carbon resilient development at the city level (focusing on Iskandar State), some progress has been observed in designing a climate blueprint and associated action plans. This case study revealed political aspiration and 'buy-in' as critical elements for promoting the climate mitigation agenda. The presence of a national climate mitigation target (40% reduction in CO₂ intensity by 2020), and engagement of the regional development authority in adopting a green-focused agenda and climate change mainstreaming into local spatial planning all set the stage for a blueprint-to-action plan. This practice of blueprint followed by action plan in Malaysia supported the research community at it made use of a low carbon model to develop scenarios and emission projections.

Concrete steps for low carbon transformation

Having identified a wide spectrum of practical challenges, lessons and good practices throughout the session, the following concrete steps were extrapolated for the research community to respond to the needs and address the observed challenges:

- **Design and develop tools** to guide developing countries into undertaking robust policy-making processes and support the design of an implementation framework via simple, easily reproducible manuals, checklists, training curricula, knowledge-exchange platforms, and projection models. Accumulate success stories of the tools and guidance to demonstrate effectiveness and build confidence.
- **Strengthen the scientific basis for national low carbon planning** by supporting established robust datasets and scientific analyses to create emission projections and PAMs to enable informed decisions on the low-carbon pathway.
- **Support capacity-development in developing countries** at all levels (from individual to institutional) through transfer of knowledge, skills, and experience, and facilitation and provision of fora for knowledge exchange and peer-to-peer learning.

Lessons learned from ongoing projects

The exchange between the projects showcased the existence of certain generic *success factors*

Key Success Factors	Key Pitfalls
<ul style="list-style-type: none"> • Top-level commitment and leadership • Integration into national devel. Planning and priorities • Strong data basis& scientific analysis • Transparency in approach and assumption • Stakeholder participation and engagement • Acceptance of techn. assistance and use of peer-to peer learning • High flexibility in implementation process • Functioning Interministerial coordination structure 	<ul style="list-style-type: none"> • Capacities for implementation are low • Contradictory policy targets • Poor integration in national development strategies (energy, agriculture, transport...) • Lack of information for prioritization and further financing oportunities • Change of governments leads often to change of priorities and persons • Handling of different interests

Source: Zymła, GIZ, Presentation in Parallel Session 4-1

Parallel Session 4-2: How can emission pathway modeling contribute to raising ambition levels of nationally determined contributions (NDC)?

Chair: Kentaro Tamura, IGES
Rapporteur: Takeshi Kuramochi, IGES

Speakers:

Bundit Limmeechokchai, Thammasat University
Mikiko Kainuma, IGES/NIES

How can emission pathway modeling contribute to raising ambition levels of nationally determined contributions (NDC)?

Emission pathway modelling could play a key role in raising ambition levels of NDCs. The 25–40% reduction by 2020 from 1990 levels for Annex-I countries, as well as the deviation from BAU emissions for non-Annex-I countries, to achieve the 2°C target indicated by the IPCC AR4 served as an important benchmark range upon the development of 2020 mitigation targets. However, the so-called “emission gap” still remains. For the post-2020 period, the additional volume of scientific knowledge related to Nationally Determined Contributions (NDCs) to achieve the 2°C target is not necessarily smoothly communicated to national and international policymakers.

The emission pathway modelling research community can contribute to raising the ambition levels of NDCs. There are two main modelling approaches to set medium- and long-term national mitigation contributions, which can complement each other in formulating NDCs: (i) “top-down” approach, i.e., global carbon budget consistent with the 2°C target

is allocated to countries based on equity indicator(s), and (ii) the “bottom-up” approach, i.e., based on technology-based energy system models which underpin the techno-economic feasibility.

In the Thailand case study, mid- to long-term modelling analysis plays an important role in NDC development. Long-term modelling analysis up to 2050 has shown that Thailand has to peak out at around 2040 to reduce its GHG emissions to half of BAU levels by 2050. To achieve this, it was emphasised that early planning and action is crucial. It was clarified during the discussion session that rather high GDP growth rates of 4–5%/yr were assumed up to 2050.

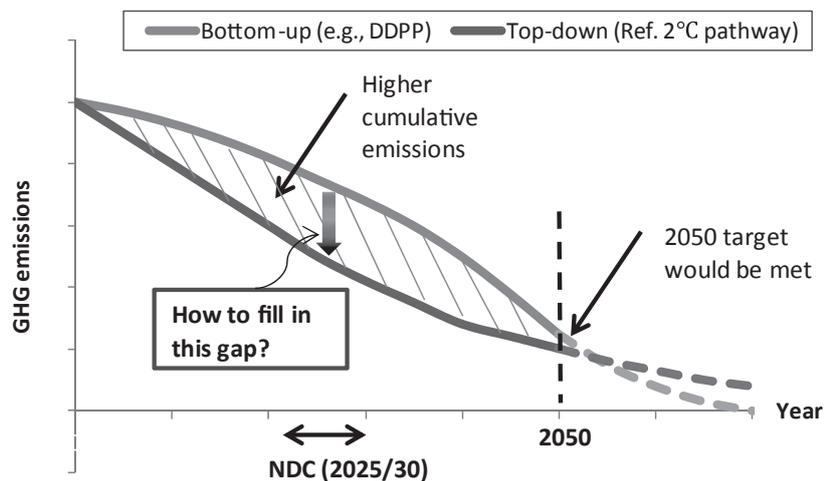
As other modelling analyses, according to the Deep Decarbonisation Pathways Project (DDPP), total energy-related CO₂ emissions from the 15 preliminary DDPs result in a 45% decrease between 2010 and 2050. Although the aggregate DDP is already very substantial, further emissions reductions are required in order to maintain the sub-2°C level.

Concrete steps for low carbon transformation

- **Plan early.** For countries to follow long-term DDPs consistent with the 2°C target or to meet aspirational long-term targets, early planning is essential so that the required economy or energy system transformations can be thoroughly communicated among stakeholders.
- **Comprehend NDCs.** The first key step toward raising ambition levels for the post-2020 agreement is to obtain the broad understanding of the intended NDCs (INDCs) of each party, which are slated for submission in the first quarter of 2015. Modelling provided by the research community can help better communicate the INDCs of parties to stakeholders by providing a “narrative”—information on underlying macroeconomic drivers, mitigation potentials and other national circumstances.

Developing a country’s long-term low carbon pathways using a domestically-developed modelling tool would invigorate the national mitigation policymaking process. Although the international community has supported capacity-building activities on energy and climate modelling, further support for such activities will become increasingly important toward the post-2020 period.

Schematic of an “emission gap” to be filled by raising ambition levels of NDCs



Source: Tamura and Kuramochi, IGES, Presentation in Parallel Session 4-2

Participants List

Ahman, Max Lund University, Sweden	Galluccio, Giulia CMCC, Italy	Lombardi, Patrizia POLITO, Italy
Amerighi, Oscar ENEA, Italy	Hamanaka, Hironori IGES, Japan	Loorbach, Derk DRIFT, the Netherlands
Borrelli Gaetano ENEA, Italy	Hamdi-Cherif, Meriem CIRED, France	Masui, Toshihiko NIES, Japan
Baffioni, Claudio Municipality of Rome, Italy	Hattori, Takashi IEA	Morabito, Roberto ENEA, Italy
Barbarossa, Vincenzo ENEA, Italy	Hayes, Lucy Department of Energy and Climate Change, UK	Nilsson, Lars J Lund University, Sweden
Bengtsson, Magnus IGES, Japan	Henning, Hans-Martin Fraunhofer ISE, Germany	Nishioka, Shuzo IGES, Japan
Bigano, Andrea CMCC-FEEM, Italy	Ho, Chin Siong UTM, Malaysia	Nordmann, Julia WI, Germany
Blanco, Gabriel Universidad Nacional del Centro Argentina, Argentina	Hourcade, Jean-Charles CIRED, France	Orsini, Raimondo Sustainable Development Foundation, USA
Brunori, Claudia ENEA, Italy	Iannetta, Massimo ENEA, Italy	Oteri, Maria Grazia ENEA, Italy
Cassen, Christophe CIRED, France	Ishikawa, Tomoko IGES, Japan	Palma, Daniela ENEA, Italy
Colonna, Nicola ENEA, Italy	Jewell, Jessica IIASA, Austria	Pasqualini, Simonetta ENEA, Italy
Caminiti, Natale Massimo ENEA, Italy	Kainuma, Mikiko IGES/NIES, Japan	Peronaci, Marcello ENEA, Italy
Chello, Dario ENEA, Italy	Ketsopoulou, Ioanna UKERC, UK	Ravazzi Douvan, Aldo Italian Ministry of the Environment and Protection of Land & Sea
Colenbrander, Sarah University of Leeds, UK	Kojima, Satoshi IGES, Japan	Rivière, Antoine French Ministry of Ecology, Sustainable Development and Energy, France
Cutaia, Laura ENEA, Italy	Krüger, Christine WI, Germany	Shukla, Priyadarshi R IIMA, India
De Lillo, Anna ENEA, Italy	Kuramochi, Takeshi IGES, Japan	Skea, Jim Imperial College London, UK
Del Ciello, Roberto ENEA, Italy	La Motta, Sergio ENEA, Italy	Thomas, Stefan WI, Germany
Deiana, Paolo ENEA, Italy	Lavergne, Richard Ministry of Ecology, Sustainable Development & Energy, France	Stefanoni, Marco ENEA, Italy
Fischedick, Manfred WI, Germany	Lechtenböhmer, Stefan WI, Germany	Sudo, Tomonori JICA-RI, Japan
Fukuda, Koji UNDP	Limmeechokchai, Bundit SIIT- Thammasat University, Thailand	Tamura, Kentaro IGES, Japan

Tsukamoto, Naoya
IGES, Japan

Viridis, Maria Rosa
ENEA, Italy

Yetano Roche, María
WI, Germany

Vanga, Giuseppina
ENEA, Italy

Wakiyama, Takako
IGES, Japan

Zymla, Bernhard
GIZ GmbH, Germany

Viguiè, Vincent
CIRED, France

Watson, Jim
UKERC, UK

Vallocchia, Stefano
Municipality of Rome, Italy

Wörlen, Christine
Arepo Consult, Germany

Table of Presentations

Day 1	
Welcome and Opening Chair: Mikiko Kainuma, National Institute for Environmental Studies (NIES), Japan	
	Welcome and opening Chair: Sergio La Motta, ENEA
	Welcome addresses Roberto Morabito, ENEA
	Introduction of the Meeting Shuzo Nishioka, LCS-RNet Secretariat / IGES
	Messages for policymakers from IPCC and the added value of LCS-RNet Jim Skea, Imperial College London
Plenary Session 1: Energy security and affordability Chair: Jim Watson, UKERC/Rapporteur: Rosella Viridis, ENEA	
	How to deliver better policies integration? Takashi Hattori, IEA
	Energy security and climate policies: An unequal and transient marriage Jessica Jewell, IIASA
Parallel Session 1-1: Innovative solutions to power system needs Chair: Stefan Lechtenbohrer, WI/Rapporteur: Sergio La Motta, ENEA	
	From Theory to Reality – the Response to Climate Change H. M. Henning, Fraunhofer ISE
	Enabling decarbonisation of the fossil fuel based power sector through CCS Paolo Deiana, ENEA
	Improvements of electric and thermal energy storage Christine Krüger, WI
Parallel Session 1-2: Energy use and behavior Chair: Andrea Bigano, CMCC/Rapporteur: María Yetano Roche, WI	
	Benefits for whom? Energy efficiency within the efficient market Dario Chello, ENEA
	User-integrated innovation in Sustainable Living Labs: Improve energy efficiency through behavioral change? Julia Nordmann, WI
	Governance and communication for energy efficiency Stefan Thomas, WI
Plenary Session 2: Common challenge in resource efficiency improvement Chair: Roberto Morabito, ENEA/Rapporteur: Satoshi Kojima, IGES	
	The transitional theory: clustering LCS, water and waste management, circular economy in order to achieve a wider transition towards LCS Derk Loorbach, DRIFT
	Exploring the economic case for low carbon cities: building momentum for a circular urban economy Sarah Colenbrander, University of Leeds
Parallel Session 2-1: Resource efficiency improvement in the industrial sector, as part of the joint transition to LCS and green economy framework Chair: Manfred Fishedick, WI/Rapporteur: Laura Cutaia, ENEA	
	Basic materials in a LCS-transition Max Ahman and Lars Nilsson, Lund University
	Transitioning to a low carbon society: Thoughts from an SCP perspective Magnus Bengtsson, IGES
	Reuse and recovery of raw materials, material flow (industrial symbiosis) Claudia Brunori, ENEA
Parallel Session 2-2: LCS and related resource efficiency improvement in territories management Chair: Vincent Vigué, CIRED/Rapporteur: M. Peronaci, ENEA	
	Urban GHG emissions and resource flows: methods for understanding the complex functioning of cities María Yetano Roche, WI
	Rethinking cities in a post-carbon society– A French perspective Antoine Riviere, MEDDE
	Rome as a low carbon & resilient city Claudio Baffioni, Municipality of Rome

Panel discussion: What the climate decision makers need from the research sector?	
Chair: Hironori Hamanaka, IGES	
	Raimondo Orsini, Italian States General of the Green Economy
	Lucy Hayes, UK Department of Energy and Climate Change
	Richard Lavergne, French Ministry of Ecology, Sustainable Development and Energy
	Stefan Lechtenbohmer, WI, Germany
	Naoya Tsukamoto, IGES, Japan
Day 2	
Plenary Session 3: Utilise low carbon and resilient investments as leverage to renovate economies in crisis	
Chair: Tomonori Sudo, JICA/Rapporteur: Christophe Cassen, CIRED	
	A “paradigm shift” in the climate affair Jean Charles Hourcade, CIRED
	Environmental Fiscal Reform for promoting Low Carbon Economies Aldo Ravazzi, Italian Ministry of the Environment and Protection of Land & Sea
Parallel Session 3-1: Barriers and opportunities of financing/investing in mitigation and adaptation	
Chair: J. C. Hourcade, CIRED/Rapporteur: Daniela Palma, ENEA	
	Barriers and opportunities for the cities Tomonori Sudo, JICA
	Trade-offs and synergies in urban climate policies – The case of Paris Vincent Viguie, CIRED
	The role of PPPs in scaling up financial flows in the post-Kyoto regime Giulia Galluccio, CMCC
Parallel Session 3-2: Building consensus to support climate change policies: genuine public engagement & bottom-up local low carbon initiatives	
Chair: Jim Watson, UKERC/Rapporteur: Oscar Amerighi, ENEA	
	Local experiences in energy transition Patrizia Lombardi, POLITO
	The participatory process to a low carbon economy in the German state of North Rhine-Westphalia Manfred Fishedick, WI
	Public values for energy system change Karen Parkhill, Bangor University
Plenary Session 4: A big 'win-win' in shaping low carbon resilient development	
Chair: Toshihiko Masui, NIES/Rapporteur: Ioanna Ketsopoulou, UKERC	
	How can research serve international policy-making towards low carbon development path? Looking forward P. R. Shukla, IIMA
	Potential of the UNFCCC’s technology mechanism to foster RD&D towards realizing low carbon development Gabriel Blanco, Universidad Nacional del Centro Argentina
Parallel Session 4-1: Challenges in developing countries	
Chair: P. R. Shukla, IIMA/Rapporteur: Koji Fukuda, UNDP	
	GIZ’s approaches: low-emission development strategies – Need for support from research Bernhard Zyma, GIZ
	The Theory of No Change – a tool for analyzing capacity building needs for low carbon development Christine Wörlen, Arepo Consult
	Role of research community in developing countries implementation of low carbon societies concept – The case of Iskandar Malaysia Ho Chin Siong, UTM
Parallel Session 4-2: How can emission pathway modeling contribute to raising ambition levels of nationally determined contributions (NDC)?	
Chair: Kentaro Tamura, IGES/Rapporteur: Takeshi Kuramochi, IGES	
	How can emission pathway modeling contribute to raising ambition levels of nationally determined contributions (NDC)? – Modeling the roadmap of Thailand’s NAMAs and raising ambition levels of INDCs Bundit Limmeechokchai, Thammasat University
	Emission pathway modeling to analyze national ambition levels of decarbonization Mikiko Kainuma, IGES/NIES
Panel discussion on the future plan of LCS-RNet towards COP21 in Paris	
Chairs: Sergio La Motta, ENEA / Jean Charles Hourcade, CIRED	
	Aldo Ravazzi, Italian Ministry of the Environment and Protection of Land & Sea
	Jim Watson, UKERC
	Naoya Tsukamoto, IGES
	Stefan Lechtenbohmer, WI
Closing	

Acknowledgements

This Synthesis Report was developed with the aim of highlighting cross-cutting conclusions that emerged through the panel discussions held during the Sixth Annual Meeting of LCS-RNet, Rome, Italy, 1-2 October 2014.

Six years have passed since LCS-RNet was proposed at the G8 Environment Ministers' Meeting in Kobe. This year, scientists and policymakers gathered in Rome fully aware of the need to discuss issues such as energy security and affordability, resource efficiency improvement and low carbon investment to pursue transformation to a low carbon society. This report summarises the key findings of the discussions in Rome and looks ahead to future development of the LCS agenda. I believe this report will aid in LCS research and assist policymakers and other stakeholders.

This year, LCS-RNet entered its second phase after five years of operations. In this phase our network is focused on adaptation with the goal of making significant progress in low carbon society research. As a further objective we intended to announce proposals from the scientific community ahead of COP21. We opted to hold the 6th annual conference in Rome as a forum for discussion of this goal; the 7th conference is planned for spring 2015 in Paris with the intention of sending a strong signal prior to COP21 in Paris at the year's end.

Finally, I would like to express gratitude to all of the chairs at the Rome meeting, as well as to those who have contributed to this report. I would like to express my heartfelt thanks to the governments of steering member countries—Italy, France, Germany, UK and Japan—for their continued support of network activities. The steering members extended much effort in structuring the program, which has led us here to the current 2nd phase of activities under the strong leadership of this meeting's co-chairs: Sergio La Motta of ENEA and Jean-Charles Hourcade of CIRED. I would also like to thank all of the participants at the meeting in Rome for their contributions.

Shuzo Nishioka



Secretary General
LCS-RNet Secretariat

Published by the Institute for Global Environmental Strategies (IGES) on behalf of the International Research Network for Low Carbon Societies (LCS-RNet)

© International Research Network for Low Carbon Societies (LCS-RNet) 2014

Referencing this report:

Transition and Global Challenges towards Low Carbon Societies; Synthesis Report of LCS-RNet sixth Annual Meeting 2014

Prepared by the LCS-RNet (eds). Published: IGES, Japan

All rights reserved. No part of this publication may be reproduced or transmitted for commercial purposes in any form or any means, electronically or mechanically, including photocopying, recording or any information storage or retrieval system, without prior written permission from the publisher or a licence permitting restricted copying.

LCS-RNet Secretariat

c/o Institute for Global Environmental Strategies (IGES)
2108-11, Kamiyamaguchi, Hayama, Kanagawa, Japan, 240-0115

Website: <http://lcs-rnet.org>

Email: lcs-rnet@iges.or.jp

