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**Globalisation, Natural Resource Constraints
and Scales of Sustainable Pathways**
Workshop, CIRED, 23 May 2013

Editors:

Christophe Cassen

Thierry Brunelle

Henri Waisman

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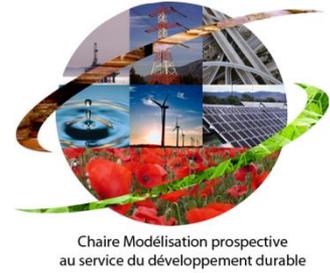
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ENPC & CNRS (UMR 8568) / EHESS / AGROPARISTECH
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**45 bis, avenue de la Belle Gabrielle
F-94736 Nogent sur Marne CEDEX**

Tel : (33) 1 43 94 73 73 / Fax : (33) 1 43 94 73 70

www.centre-cired.fr



Workshop on Globalisation, Natural Resource Constraints and Scales of Sustainable Pathways CIRED, 23 May 2013

Editors: Christophe Cassen (CIRED, cassen@centre-cired.fr), Thierry Brunelle (CIRED, Brunelle@centre-cired.fr), Henri Waisman (CIRED, waisman@centre-cired.fr). The editors also acknowledge the Ubiquis company for the transcription of the main contributions of this workshop.

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Présentation du colloque

L'accès équitable aux générations présentes et futures aux ressources rares constitue un enjeu central du développement durable qui nourrit des débats intenses entre disciplines scientifiques. L'accélération de la mondialisation des échanges et le rattrapage économique des pays du Sud a en effet accru les pressions sur les ressources naturelles, à l'origine de sources potentielles de tensions socio-économiques majeures. L'objectif de ce colloque organisé par le CIRED est d'analyser dans quelle mesure la mondialisation accentue ou au contraire atténue les tensions sur les ressources naturelles en dépit des incertitudes sur les dynamiques de long terme. Il se concentre plus précisément sur les dynamiques énergétiques, qui sont au cœur des politiques d'atténuation du changement climatique, mais également sur la production agricole et alimentaire qui représente un des principaux enjeux du développement global. Les présentations s'inscrivent dans une approche multi-échelle, mêlant analyses qualitatives et quantitatives. Une partie des travaux ont en particulier été conduits dans le cadre du projet européen [GLOBIS](#) (7^e programme cadre) consacré à l'analyse des interactions entre mondialisation et développement durable au XXI^e siècle et ont reçu le soutien de la [chaire modélisation prospective au service du développement durable](#).

Short presentation of the workshop

Guaranteeing a fair access of current and future generations to scarce resources is a central challenge of sustainable development that fosters intense debate in different scientific disciplines. In this debate, the effect of the rapidly evolving socio-economic context, characterized by an accelerating Globalization process, on the use of natural resources is one of the main points of contention. Against this background, this workshop seeks to determine whether the tensions on natural resources are exacerbated, or on the contrary mitigated, by the ongoing Globalization process in a context of uncertainties. The workshop focused on the energy as the core issue in relation to climate change mitigation, and agriculture and food sector as one of the basic challenges for the global development. It also provides multiscale perspectives and confronts quantitative and qualitative works. These works have been conducted in the framework of the EUFP7 [GLOBIS](#) project and were also supported by the [chair long term modeling for sustainable development](#).

Main Messages

Globalization represents a large process of economic transformation and greater interconnection among countries which strengthens the magnitude of intertwined issues such as climate change, energy access, land use tensions and food security. In so doing, globalization creates challenges and opportunities for sustainability and low carbon development. Against this background, five main points emerge from the presentations and discussions of the workshop:

By fostering economic growth and the convergence of development styles between developing and developed countries in both the energy and the agricultural and food sector, globalization worsens the tensions on natural resources. Indeed, rapid urbanization and the rising middle class trigger higher energy needs in emerging countries, mainly in China and India at the moment followed by Africa in the next decades. In addition to the energy security issues, higher energy consumption raises environmental concerns (air pollution and climate change impact). Diet convergence is also a critical driver of the tensions on land-use, as it directly influences the land-intensive consumption of animal products. The FAO projection of food availability amounts to +60% over 2005/2007-2050 because of shifts in diet and increases in wealth in the different regions.

The availability of natural resources at the global scale is highly uncertain. Rough scale assessments conclude that large reserves of arable lands are available. However, when considering constraints at a smaller scale, the amount of land available is much more limited. The availability of lands depends on specific socio-environmental trade-offs at the local scale. Local and regional governance, land laws but also water availability and the impact of land degradation are also key components of land availability. Yet, some energy resource potentials exist, especially in Africa, but the region suffers from scarcity in infrastructures strengthened by a lack of skills, capital and governance capacity.

Globalization can mitigate the tensions on natural resources by propelling well oriented investments and trade flows. In particular, this could trigger low carbon infrastructures in particular in the transport sector (a high energy intensive sector characterized by high inertias). Yet, shifts in the transport sector are likely to be sensitive to patterns such as trade flows and capital market although they are currently poorly captured by quantitative models in long term scenarios. The impact of foreign investments on land is more debatable. First, its exact magnitude may be overestimated, as there is a discrepancy between statements and effective deals. Also, none of the land investments to date have contributed to close the yield gap in the considered area. International trade is also often considered as a way to compensate land scarcity, but it cannot solve the problem of accessibility of rural poor people.

Intertwined issues related to globalization require an integrated and multi-scale policy approach. Modelling exercises point out that high energy intensive sectors such as transport represents a nodal point in long term development pathways. Its decarbonisation is a much more complex issue that cannot be resolved only through pricing instruments/market prices instruments. This sector is indeed characterized by a strong path dependency of options, by the influence of non-energy determinants in the collective and individual behaviors and by the dependence upon long-lived infrastructure investments. Integrated policy answers at the international and regional level is necessary, in particular at the urban scale. These complementary measures have to be articulated with a carbon price which stabilises Investors' confidence and climate friendly finance devices in order to maximize the synergies between instruments and objectives. This is a key challenge in Europe considering the current atonic state of the EUETS and the objectives of the 2030 Green Paper. The land-use sector is confronted with strong interactions between food consumption and other land-use policies such as biofuel production or forest preservation. The detrimental side

effects of such policies depend on the existing tensions in the agricultural system, these tensions being larger when the proportion of animal calories in food diets is high. Finally, regarding the energy and the land-use sectors, it is necessary to take the local conditions into account for promoting ownership and enhancing effectiveness.

Research on OECD and non OECD countries cannot be disconnected considering that these issues are so intertwined at a global and regional scale. Further analysis have to be conducted on the global impact of diet changes on OECD and non-OECD countries, land acquisitions, the impact of investments on yields (does it lead to more food and more income?) and new value added chains triggered by the transition toward a Low Carbon Society (LCS). A multi-scale policy approach to these issues is also confronted to intense debates around the co-benefits of climate policies (how accounting the effects of public policies with multiple benefits in terms of environment, employment, growth...?). A division line between North and South researchers is particularly pronounced in the framework of the IPCC group III dedicated to the study of Greenhouse Gases mitigation policies. Europe can act as a bridge between the two sides. The European Overseas assistance through for instance the Europaid program could strengthen its support to current initiatives of constructive dialogue among research teams (networks, bilateral exchanges) with also policy makers. This may also be a chance at end to overcome deadlocks in the international negotiations.

Introduction

Jean-Charles Hourcade

CIRED, chaire MPDD

The Globis project is an European research consortium between Lund University (Sweden), CIRED (France) and the Fraunhofer ISI (Germany) funded by EU 7th Framework program that was launched to bring together work on sustainable development and work on globalisation – two dimensions that have historically been quite disconnected. The emergence of global environmental issues on the political agenda goes back to the Stockholm conference in 1972 in an attempt to provide a political answer to the alarm by the Club of Rome about the “Limits to Growth” in a context of a finite ecosystem. The political interest was focused essentially on issues raised by the exhaustion of non-renewable resources, especially fossil energies, in line with the emergence of geopolitical tensions about oil, as illustrated by Richard Nixon’s State of the Union Address in 1970. The Stockholm conference recognized the legitimacy of concerns about the interface between growth, environment and resources and the concept of ‘ecodevelopment’ introduced in 1972 by Maurice Strong stressing the need to adopt development patterns respecting natural ecosystems

was an attempt to go one step further. The interest in the tradeoffs between economic, social and environmental dimensions across generations evolved in the late 80's with both the emergence of climate change on the political agenda and the introduction of the concept of 'sustainable development' in the 1987 Brundtland Report 'Our Common Future'. Sustainable development has become a key concept in international governance since the Earth Summit of Rio in 1992. It is evidently not accidental that this interest in sustainability issues reappeared at the same time with renewed concerns about geopolitical conflicts for the access to cheap oil and gas. However, twenty years after Rio, the recent Rio+20 conference has demonstrated the difficulty to lay out a coherent roadmap forward for addressing global challenges in the framework of sustainable development.

The concrete objective of the Globis project are threefold: (i) to create a better understanding of how these processes can inform the European policy process (ii) to work on selected thematic policy areas to identify concrete synergies and conflicts (iii) to engage in a dialogue with stakeholders in order to find creative solutions to identified problems.

Yet, modelling studies have been conducted on energy issues on one side and land use, agriculture and food issues on the other side. Sustainability is critical for the energy debate, and the energy market is increasingly globalised. Food production, which used to be a human activity closely linked to a particular territory, is also a globalised activity today. The following sessions will present the main results from these studies. They will be complemented with presentations of experts in the transport sector, the analysis of lands use on the ground and food security challenges.

I will now pass the floor to our first speaker, Yacob Mulugetta, who will open the morning session.



Sustainability, Globalisation and the Energy Sector

Session 1: Global Resource Constraints in a Globalised Economy: Issues for a Sustainable Energy Transition

Chair: Céline Guivarch

CIRED, chaire MPDD

Our first session will consider the issue of global resource constraints in a globalised economy. Yacob Mulugetta is senior researcher in the Centre for Environmental Strategy at the University of Surrey. He has just spent two years in the African Centre for Climate Policy. He is lead author of the current IPCC Report and is also part of the core writing team for the next IPCC Report.

1) Perspectives from Developing Countries

Yacob Mulugetta, University of Surrey: ([See the presentation](#))

The discussions around globalisation and sustainability have remained disconnected, with conversations taking place in the two separate settings with no real link between them. The issue of land use is critical for food issues, and is critical for regions such as Africa. In particular, energy in developing countries have seen significant changes in the past few decades – both with respect to energy consumption and with respect to the way technologies are evolving and being used.

1) *Economic Transformation in Developing Countries as a Result of Globalisation*

If we look at a chart showing where Wal Mart obtains its products, we can see the increasing interdependency of countries and regions, and the shifts in the importance of certain regions. If we compare GDP per capita in a globalisation index, we can see there are issues as to what types of energy policies and what types of energy systems characterise various countries. A shift in terms of world economic growth has appeared over the past 10 years, marked by huge resurgence of growth in non-OECD countries. This highlights the significance of globalisation to non-OECD countries. If we compare India and China in terms of their economic transformation, in China industrial activity has become quite significant. In contrast, the service sector has increased in its share in the Indian GDP. This gives us an idea of where countries are putting their efforts in the context of globalisation.

Africa's exports to India and China are also increasing, which is starting to prop up economies across sub-Saharan Africa. In recent years, six of the ten fastest growing economies across the globe are based in Africa, and much of that is due to the interaction between Africa and

India/China. A new emerging middle class in Africa is also becoming an important economic actor across the region.

2) *Effects on the Energy Sector*

Economic globalisation has ushered in growth, with poverty reduction outcomes in some countries, the rise of a new wave of consumers and a rapid urbanisation in emerging economies, as predicted by Arthur Lewis in the 1960s.

Since 1965, non-OECD energy consumption has increased and even overtaken that of OECD countries in recent years. This has also led to an intensified use of fossil fuels. 70% of China's energy mix comes from coal and 75% of the 1,200 new coal power stations being built are located in India and China. Between 70% and 80% of India and China's primary energy requirements are imported. In this context, there are three main priorities with respect to energy security:

- Aggressive energy efficiency programmes (and not carbon reduction);
- Diversification of energy resources by the development of alternative clean energy resources;
- Diversification of energy suppliers at the global level.

3) *Opportunities and Challenges for Low Carbon Development*

Climate change is a global challenge, especially for developing countries which are dependent on climate sensitive sectors. They have a low adaptive capacity to respond effectively to the vagaries of climate change, and their geographical location is characterised by vulnerable areas. The current trends show that we are on a collision course between climate change and economic activity. This represents a threat, clearly, but also a new opportunity for mitigation actions. One-third of CO₂ emissions are linked to goods and services that are consumed in European countries and the US. We therefore need a different way of looking at these issues – not only from the production side but also from the consumption side.

Countries are locked into a development pathway characterized by tensions between climate actions and development. There is a tremendous momentum for de-carbonising the energy sector and at the same time, developing countries face the long-term challenge of broadening access to energy services. 1.6 billion people still have no access to electricity, and many populations still depend on bio energy. The question of access and its relationship to poverty is gradually starting to surface on the world agenda.

With respect to renewables, costs have declined in the recent past, and further reductions can be expected in the future. Nevertheless, renewable prices remain higher than existing energy prices. This represents a challenge for developing countries in meeting their low carbon objectives. In some situations, renewable energies of course have a number of competitive advantages.

4) *Focus on Africa's Energy System*

The picture here is quite alarming. Large numbers of the population have no access to electricity. The average across Africa is approximately 20% but countries such as Burundi have only 2% electricity access. At the same time, this offers many opportunities. Africa benefits from high growth due to higher commodity prices, internal investment, and Foreign Direct Investment (albeit starting from a very low base). Economic transformation is essential for sustaining development, and energy and infrastructure are central to that goal. As most of the infrastructures are still to be built in Africa, this means that most of African countries are not yet locked into carbon intensive technologies and there is room for the establishment of alternative energy sources.

What opportunities exist? First, new thinking and models in regulations and practices are emerging. For example, feed-in tariffs are being tested in a handful of countries. Second, Africa has

huge energy resource potential: hydro, wind, solar, geothermal, and biomass. There is also significant potential for energy exports. The aim here is to create inter-connections across Africa as for example the South African power pool, which is already relatively well developed or the East African power pool, is under development.

Nevertheless, a dilemma remains. While there is an abundance of natural resources in Africa, the region suffers from scarcity in skills, capital, and governance capacity. That inhibits progress in both policy development and in the implementation of projects on the ground. Some countries are able to capitalise on their comparative advantages, for example, a major rail infrastructure project is already underway in Ethiopia.

5) *Suggestions for Energy Transformation*

It is necessary to recognise the country specific conditions for low carbon development. Ethiopia, for example, has huge hydro capacity. Mozambique has just discovered huge gas resources. The low carbon thinking has to fit into each country's development priorities.

It is necessary to have fit-for-purpose policies, with realistic and achievable targets and mid-term reviews. How policies are formulated is also critical and the involvement of a range of stakeholders is necessary through policy dialogue and policy coalitions. Space must be given to both centralised and decentralised options. All of this requires a robust but flexible institutional landscape.

Knowledge institutions must be strengthened. Yet much can be learnt from the bio energy programme in Brazil, for example, which is based on very strong interactions among institutions.

Finance is fundamental to energy transformation. Countries in Africa tend to rely on external finance and it is necessary to unlock domestic finance through innovative regulatory systems.

I will conclude with the title of a book written by African energy experts 10 years ago, "Think Big and Act Fast" – a book urging much higher levels of ambition for the African continent.

6) *Discussion*

Yacob Mulugetta, University of Surrey

I agree. That is certainly one of the challenges faced by Africa which has remained quite closed to that type of investment in contrast to China, India or Brazil and the obvious benefits they have consequently obtained. The difficulty in Africa is that the necessary human resources are still quite low, due in part to the brain drain. Nevertheless, African countries are beginning to open up. Some countries, such as Kenya, are already very open; others like Ethiopia are less so - choosing to move cautiously. Gradually this is beginning to take shape and the discussions around foreign direct investment are underway. There is also a perception that African countries represent a risk for foreign investment but new business models are emerging that could help resolve those risks.

Joachim Oliveira Martins, OECD

You stated there was no energy lock-in to date in African countries. However, setting up alternative energy systems will require significant **technology transfer** from other countries. When it comes to low carbon alternatives, what are the incentives for OECD countries to transfer their technology and to invest heavily in Africa?

Yacob Mulugetta, University of Surrey

For investors who are willing to take the risk, there are pockets of opportunities throughout Africa. The wider challenge is to create a low-risk environment for investors. This is an area where huge efforts are being made by various countries. Another issue is that China and India are moving

to a different type of economy, with a greater proportion of domestic investment. More foreign investment funds will therefore be looking for new areas in which to invest.

Joachim Oliveira Martins, OECD

Are you therefore saying that technology transfer should be based on differences in marginal returns on investment or capital?

Yacob Mulugetta, University of Surrey

That is correct.

Nathalie Girouard, OECD

You stated that large structural and economic transformations are needed in Africa, and that these should be integrated in the development plans of these countries. However, to what extent are these **green growth policies** being developed by ministries of economy or finance rather than by environment ministries, which obviously carry less weight in driving the economic transformations that are needed?

Yacob Mulugetta, University of Surrey

The situation is quite different in the different countries. In Mali, for example, the policies were being pushed through by the environment ministry, which was quite powerless. In Rwanda or Ethiopia the green agenda is being pushed by the Prime Minister's office, which is much more powerful and should provide a good role model for other countries. However, by and large, this agenda has remained in the hands of the environment ministries. There is a certain reluctance to engage on these issues which promise much but which have not yet delivered in a meaningful way. In some countries, the green agenda is not very high up on the list of priorities.

II) Transition Toward a Low Carbon Society and the Globalisation Process: A European Perspective

Christophe Cassen, CIRE/**chaire MPDD** ([See the presentation](#))

I will present the work conducted by CIRE as part of the Globis project. That work tackles the interaction between sustainability, globalisation and the energy sector, all of which is considered in the European context.

There are two global challenges for sustainability:

- Resource depletion , in particular, oil related to the debate on peak oil;
- Climate change which is currently confronted with a gap between international objectives (the 2°C target) and the policies adopted by individual countries or regions.

In parallel, economic globalisation, international trade, and integration of financial markets and also energy markets are accelerating. Europe is a key actor in this globalisation process and as an energy importer is highly dependent on energy markets. Yet, economic globalisation is and will be a decisive driver in the transition towards sustainability development patterns.

1) The modelling approach

The methodology is based on a numerical assessment of the macroeconomic interplay between technical change, growth drivers, globalisation patterns, and environmental effects. To do that, we used the IMACLIM model developed by CIRE. It provides a consistent vision of economic

and energy trajectories in yearly steps over 2010-2100 through the recursive succession of a top-down *annual static equilibrium* providing a snapshot of the economy at each yearly time step, and *bottom-up dynamic modules* informing on the evolution of technical parameters between two equilibria. It is a hybrid model which combines a sectoral analysis coherent with a macroeconomic approach. Thanks to its hybrid nature, it measures the structural change between changing technologies, consumption styles and localisation of activities. It also measures the endogenous deviations with respect to exogenous natural growth.

2) Description of the scenarios

We assessed different assumptions with respect to globalisation. First, on the basis of a preference for local goods (M0) or a preference for an international diversity of goods (M1). We also had assumptions for capital markets: an assumption of the persistence of capital imbalances (K1), and an assumption of the correction of capital imbalances (K0). By crossing these four assumptions, we end up with four scenarios, which we deliberately decided not to name. Yet, we assess (a) what impact each scenario will have on long term oil market trajectories, and (b) how scenarios will impact Europe.

We now investigate the economic impact of oil trajectories calculated by the model. To do that we use a specific indicator, the natural growth, and we compare it to the effective growth rate calculated by the model. For those who are not familiar with the natural growth rate, it is given by population and labor production growth for only one sector (perfect allocation of factors). We use this indicator to assess the sustainability of growth patterns in the sense that an effective growth remaining close or lower than its natural rate is the sign that constraints affect the economy and prevent from exploiting the productivity potentials, causing unemployment and losses of purchase power. Indeed, it captures that it is then impossible to absorb the total labor force at constant wages due to particularly important adaptation difficulties in sectors or regions below the average growth.

- Scenario K1M1 (Preference for international diversity of goods/Persistence of capital imbalances) is largely an extrapolation of current trends. We observe a deep economic crisis following the peak in oil in 2030 to 2050. A recovery phase (2040-2050) is induced by a post-crisis catch-up with a temporary acceleration of economic growth once the economy has adapted to high oil prices. In the long term, the economy follows a smooth path in absence of new shock. Europe follows qualitatively the same trends but with lower absolute values of growth rates as a developed region
- We then compared the K0M1 (Preference for international diversity of goods/Correction of capital imbalances) and K1M0 (preference for local goods/correction of capital imbalances) scenarios to the K1M1 scenario. The comparison between K0M1 to K1M1 showed that, in the short-term, you have less capital availability and therefore less energy efficient capacities. In the long-term, this results in less cumulative learning-by-doing. When we compare K1M0 with K1M1, we see that large wage adjustments are required to export after the oil peak in a context of preference for local goods. In the longer-term, there will be however lower dependency on transport and long-term oil markets.

3) Climate Change policies

The second global challenge is climate change. Here we used an exogenous carbon emission trajectory compatible with a 2.5°C increase in temperature from which the model calculates a world level carbon price. The European emission trajectory follows the official reduction emission objectives (a 80% reduction in CO₂ emissions by 2050). During the first years of the climate policy (2010-2040), we need a moderate level of carbon price to tap most mitigation potentials in power, residential and industrial sectors, which represent the core of emissions reductions at that medium-term stage of the climate policy. After 2040, a steep increase of carbon prices is

experienced (from around 50 \$/tCO₂ in 2040 to 500\$/tCO₂ in 2060) to ensure the 40% reduction of carbon emissions over this twenty years period. After 2060, the continuation of emission reductions makes it necessary to reach the high-cost mitigation potentials in the transportation sector, and a further increase of carbon prices up to 1000\$/tCO₂ is necessary. These very high carbon prices are needed to ensure the decrease of oil-related carbon emissions despite the poor sensitivity of transport activity to energy prices and the low oil prices at this time horizon (below 60\$/Barrel) permitted by the cumulated low oil technical and structural changes fostered by the climate policy.

Consequently, in the long-term, complementary measures are required to de-carbonise the transport sector.

4) Conclusion

The IMACLIM model was used to assess the impact of globalisation on long-term development in a context of resource constraints and climate change. A number of specific mechanisms emerged:

- The interaction between technical change and capital fluidity
- The interaction between competitiveness and preference for local goods
- The critical impact of the transport sector for the transition to a low oil and carbon society

Going forward, the key challenge considering different globalization scenarios for Europe is therefore to orient investments toward low carbon infrastructures (transport, building). This has to be done in the current adverse financial context and the atonic state of the EUETS¹. This study hence concludes on the necessity to articulate complementary measures to foster low carbon infrastructures and carbon pricing policies to avoid carbon and energy lock in.

Following improvements to the model can be envisaged. First, the model could be improved to represent infrastructure networks and behaviors associated to the building and transport sectors. Second, to go further into this analysis of globalization patterns under energy constraints, the model could be improved by representing explicitly all determinants of capital allocation to analyze the conditions of an allocation of investments in accordance with energy sustainability objectives.

5) Discussion

Dominique Chauvin, Consultant

Thank you for that extremely interesting presentation. I agree that improvements could be made to the model in the future. I am also interested in going beyond investment in energy in order to produce more energy, and **investment in the vectors of energy** in order to produce high performance energy. (This obviously includes aspects such as energy efficiency.) For example, I recently tested the new Tesla electric vehicle, which has an autonomy of up to 400 km. That represents an extension of the electricity vector and could lead to a rupture in the need for oil in transport. Such a development could drastically change the scenarios going forward regarding the price of oil, CO₂ emissions, GDP etc. The key question for me is therefore how to better invest in the vectors of energy. How could this be taken into account in your model?

¹ The EU emission trading system is the cornerstone of the EU's policy to combat climate change. However, the current price of emission allowances is around 5€/t CO₂. Indeed, the excess of allowances and the economic crisis have resulted in a low and volatile carbon price, which does not give investors sufficient incentives to develop low-carbon projects.

Christophe Cassen, CIRED

You are saying that, as well as investing in infrastructure, we could import new technologies that are more energy efficient and less carbon emitting. We could introduce a new technology to the model.

Henri Waisman, CIRED

I am less optimistic than you are regarding electric cars as it will still be necessary to produce electricity. This therefore comes down to whether or not you use alternative energy sources to produce that electricity. It is not that obvious that the electric vehicle will solve all of these issues.

Dominique Chauvin, Consultant

It is not a question of optimism; it is a question of computation. If the added value in terms of reduction of energy and energy efficiency is relatively significant, why not push investment in that direction?

Patrick Meyfroidt, University of Louvain

Your model assumes that oil resources are limited. Do you have a limit on the extent to which oil can be replaced by substitutes such as biomass or renewables?

Christophe Cassen, CIRED

We have limits for each substitute, but it is clearly possible to play with those limits.

Joachim Oliveira Martins, OECD

The idea that there is a difference between domestic tradable produced goods and imported tradable produced goods is less and less relevant. The Armington assumption was questionable in the past but is even more of an issue today. Most trade is now concerned with trade in intermediate goods that are assembled elsewhere. How will you capture this new feature of international trade? For me, the opposition between tradable and non-tradable sectors is of greater interest.

Christophe Cassen, CIRED

That is a good suggestion that is challenging but feasible. We are also seeing a trend towards the production of complex goods not in one country but in one region. A challenge for our project is to be able to make policy recommendations that are based on the work.

Session 2 Local Implications of Global Problems: The Urban Dimension of Sustainable Energy Transitions

Chair: Florent le Néchet

LVMT (Laboratoire Villes Mobilité Transport)

This session will be devoted to the local implications of global issues, with a focus on urbanisation.

1) Highlights from the foresight programm: Reconsidering cities in a post carbon society

Eric Vidalenc, Ademe ([See the presentation](#))

This presentation highlights insights from the French Foresight Programme that was launched in 2008, and which adopted a territorial or spatial approach to energy forecasts.

1) *Lessons from Technological and Economic Forecasts*

There are two main types of models used in energy-climate forecasts: (a) Top down models based on economic models which represent macro-economic consistency but encapsulate a limited description of technologies and (b) Bottom up models or technical models which give the priority to a detailed description of technologies and sectoral systems in order to provide energy services. The scenarios developed for the World Energy Outlook by IEA (international Energy Agency), for example, are based on an Bottom up model. Some attempts have been made over the last ten years to hybrid models, such as the IMACLIM model described earlier. By integrating a large range of technologies to decarbonize the energy system, results from some models can appear relatively pessimistic about the cost of the decarbonisation of the energy system.

However, very few models in 2008 at the starting of the project we launched integrated the representation of spatial issues (urban area or rural area). This is a key challenge when we try to assess the role of cities in the transition toward a low carbon society.

2) *The Territory and Spatial Approach to Energy Forecasts*

In 2008 we therefore decided to work on long term perspectives about spatial issues , as this issue was emerging within the research community. For the first time in 2008 the IEA in its World Energy Outlook included a chapter on cities. At the French level, this dimension appears in new research programmes launched by institutions, and in laboratories such as LEPII (Laboratoire d'Economie de la Production et de l'Intégration Internationale), CIRED, CMA (Centre de mathématiques appliqués), CERNA (Centre d'Economie Industrielle) and IDDRI (Institut du Développement durable et des relations Internationales). In addition, forecast exercises were carried out by city or by region at local level.

The 2008 World Energy Outlook provided the following information on cities. Two-thirds of all energy is consumed in cities, and 50% of the world's population lives in cities. Urban inhabitants consume more coal, gas and electricity and less oil compared to their rural counterparts. 87% of energy will be consumed in cities in the US by 2030.

3) *Rethinking Cities in a Post Carbon Society*

The programme was structured in three main parts:

- A workshop to build contrasted transition scenarios
- Seminars opened to stakeholders and researchers on specific topics concerning post carbon cities such as transport, biomass, or housing.
- Research projects: (a) thematic research on governance, lifestyles, social and territorial inequalities... and (b) local forecasts to develop post/low carbon transition at the urban scale (in Mulhouse, Tours, and Plaine de France) and other territorial researches with Lille, Grenoble, Fontainebleau.

Why are cities vulnerable to climate and energy issues? First, although there is no real consensus on the date of peak oil will occur, it is clear that we will have to deal with this issue before 2050. Second, the adoption of greenhouse gases mitigation policies; France has adopted the ambitious target of reducing emissions by a factor of 4 by 2050. Third, the adaptation to climate change; even if we reach this target, we do not know what the future climate and extreme events might be (with at least a average of +2°C at the end of the century, and probably more in France). The transition toward a post carbon society is a combination of these three issues. It is important to note that we need to work on the three issues at the same time – which represents a paradigm shift. It is a particularly ambitious challenge because it is necessary to deal with short-term issues such as the peak oil (problem of availability, fuel poverty...) and long-term issues such as mitigation, we have to consider at the same time resilience and sustainability.

The Workshop developed six transition paths with over 20 experts from local authorities, energy producers, NGOs, etc.

- Smart waiting (soft climate and energy plan)
- Carbon creativity (carbon tax)New energy and climate infrastructure (new efficient building, infrastructures and retrofitting)
- Bio city (energy decentralisation and biomass)
-
- Maintained city (management of urban sprawl and land rent)
- Sober/lean city (sustainable lifestyles)

We then set up 15 key variables – context variables, cross-cutting variables, and thematic variables – and developed different assumptions for each variable. This resulted in a detailed, narrative description of six transition paths.

4) *Research Highlights*

Researchers proposed different results to build each pathways and more consistent scenarios. For instance, on the economic scenarios, the ID&S team worked on the role of Greentech in the US. The CIRED team worked on a quantitative macro evaluation of the scenarios. The AURT (Agence d'urbanisme de l'Agglomération de Tours) team explored the drivers for reducing greenhouse gas emissions by four at the local scale of the metropolis. The EIFER (European Institute for Energy Research) and CLIP (IDDRI) teams worked on sustainable urban lifestyles and their carbon footprints.

5) *Conclusion*

Cities can act on the economic framework, on infrastructures, and on lifestyles. As such they can be the basis for coordination between stakeholders in order to deal with sustainability and

resilience, which is still quite a challenge today. For example, the penetration of Electric Vehicles will require both the adoption of economic incentives and a change in lifestyles. Acting on the three drivers (economic, infrastructure and behaviour) has to be the core of future interesting research programmes.

The city is also a multi-scale actor, a level to link the global (international networks) with the local (citizens and communities). It is in the same time a public actor (leading by good example), a policy maker (governing private urban actors) and a coordinator of initiatives at the urban scale (with an integrated approach between).

The Foresight report will be published in French in the second half of 2013. [See the final report](#)

6) Discussion

Yacob Mulugetta, University of Surrey

Cities can play the role of **custodians of transition** to a low carbon future. Are there any useful examples that illustrate the kinds of opportunities and challenges that characterise this? Cities around the world operate in very different contexts. Are you able to reflect the richness of that and move good examples to a wider scale?

Eric Vidalenc, ADEME

One research project tried to analyse the transition process in three major cities (London, Paris, and Stockholm). Some cities were able to act directly on energy production, while others were not. It is also necessary to consider the legal framework in each country. If we consider only the French case, we tried to develop long-term scenarios with 3 French cities, and we showed that it was possible to have ambitious targets even at the local level. But the possibility to act depends partly of the skills and laws at the local level.

Joachim Oliveira Martins, OECD

There is an argument that the low carbon city needs to be a more **compact city** – less transportation is required and therefore less energy and fewer emissions. However, the IMACLIM model showed that the relationship between density and use of transportation is quite tenuous. Some statistics show that doubling city density leads to only a 10% reduction in the use of transportation. In addition, if you want to introduce renewable energies into cities, you actually need more space. Have you done any work on the compact city concept?

Eric Vidalenc, ADEME

We have seen with the territorial researches quoted that in order to reach ambitious targets we need to stop urban sprawl. Nevertheless, it is possible to produce, or use, renewable energy even in a compact city. For example to promote biomass use in cities, it is preferable to introduce district heating and to get more efficient district heating, it is preferable to have a compact city. Another example, to develop the efficient electric vehicle, carsharing is one of the best way to do it (because it reduces the investment for each user), and in order to develop car sharing you need a certain density, and not urban sprawl. In fact, another way to do it is to produce solar electricity on roofs of houses, but in such a case, the new electricity production will totally be consumed by the need of mobility created by

Compact city is not THE solution but some solutions are more efficient in a dense context; polycentrism is probably another part of the solution particularly in some existing urban context.

Andreas Schäfer, UCL

The introduction of the **congestion charge** in London is a good benchmark. However, you would need to increase the density of a city significantly in order to achieve a reduction in car usage.

Nathalie Girouard, OECD

For Mulhouse and Tours, were you able to identify the **specific policy options** above the price of carbon? Were there any specific sectors that should be prioritised?

Eric Vidalenc, ADEME

We worked on the basis of a bottom-up approach and did not consider variables like carbon pricing. We tried to work only on local policies that we could actually influence. In Tours, we tried to control urban sprawl, install district heating etc, using the drivers that were available to local authorities.

But we financed the thesis, coordinated by Cerna and IDDRI, of Mathieu Saujot who worked on MACCs in a territorial approach, with the Tranus model, on the case of Grenoble.

André Gessalin, LVMT

I would note that many cities are in fact quite empty with much unoccupied housing. That is an issue in those types of cities. **Coherence in policy** and governance is also an issue that came through in all papers on post-carbon cities.

Sofia Espinosa, IEDES

Do you consider where the food and other goods that enter our cities actually come from?

Eric Vidalenc, ADEME

For each of the research projects, we considered the global footprint including flows of goods and other items into the cities. But we don't focus on food production and consumption.

II) Cities: Transportation in a Climate Constrained World

Andreas Schäfer, Energy Institute University College ([See the presentation](#))

I will extract some of the key messages that have already been made and pool them together in the context of the transportation sector.

1) *Characteristics of the Transportation Sector*

The transportation sector is extremely vast, with 700 million light duty vehicles and 100 million heavy duty vehicles around the world, consuming 20 billion barrels of oil per year. If we were to substitute the oil consumption of light duty vehicles with hydrogen produced through nuclear power, we would need 900 nuclear power plants for the US alone. In addition to its already great size, the sector is also growing extremely fast.

Within transportation we are seeing a shift to ever faster means of transport. On average, people around the world spend 1-1.5 hours per day in transport. The richer we are the more we travel and the faster we travel. At the same time, there are limits on how far this can go due to the diminishing returns on travel.

Achieving significant greenhouse gas mitigation in the transportation sector is expensive but necessary for meeting climate targets in the long run.

The transportation sector is extremely capital intensive. Companies face enormous risks and address this through incremental technological changes causing long-time constants before technology can make a big difference. Can we engineer our way out of this? If we look at US freight railroads we observe a significant drop in energy intensity with the shift from coal to diesel. We

need a similar game changer for transportation in the future. However, we do not yet know what form that might take.

The transportation sector has many interdependencies with other sectors, in particular, with the power production sector. If we consider the CO₂ intensity of electricity generation, we can see that a plateau has been reached in de-carbonising electricity production.

There is no silver bullet in the transportation area. If we compare the energy intensity of freight transport with the average load being moved, there is a straight line relationship for all modes (aircraft, railways, ships and trucks). This means that, with respect to trucks, load size determines energy intensity. As we move to a more service economy we move back to smaller loads and higher energy intensity.

Climate policies leave demand for transportation largely unaffected.

2) *The Need for Disruptive Technologies*

Fuels could be produced synthetically from cellulosic biomass or via hydrogen. But the future of all this is very uncertain. We desperately need energy storage in the form of high energy density batteries. We are also seeing proposals for hybrid electric propulsion systems for aircraft.

Technology alone may not make a difference. If we want to achieve ambitious CO₂ reduction targets, we desperately need behavioural changes. Today, urban traffic accounts for 50-67% of total domestic transportation energy use.

In terms of the mitigation of urban scale greenhouse gas emissions, we need a relaxation of technology constraints (electric vehicle range anxiety, second generation biofuels). We also need a larger number of alternative modes such as non-motorised transportation and telecommuting. We need more policy measures and simpler governance structures in order to introduce policies. Overall, we need more degrees of freedom, although some interdependencies will always remain.

3) *Discussion*

Dominique Chauvin, Consultant

How many **nuclear power stations** would you need to shift to electric vehicles, and how much money would you save?

Andreas Schäfer, UCL

I provided figures on the estimated number of nuclear power stations needed to replace fuel. In addition, the capital requirements for building the plants would be extremely significant.

Jules Schers, CIRED

Many of the alternative options could work in the context of more regulation and policy without the need for new pricing mechanisms on transport and fuels. Do you think that regulation and policy are sufficient or do we also need **pricing mechanisms**?

Andreas Schäfer, UCL

In theory you can regulate anything – you could have a law that prohibits all use of transportation systems but that would not be efficient. Each policy measure has advantages and disadvantages, and it is very unlikely that only one measure would be used. It is also unlikely that the existing measures would disappear.

Chad Boda, Lund University

Have you considered the dynamics of social change and **behavioural change**? Have you brought this factor into the equation or are you simply making an assumption on rationality and market mechanisms?

Andreas Schäfer, UCL

From an academic perspective, I would try to understand how people have behaved in the past. In order to induce change you need to offer alternatives. However, what may be obvious for London or Paris might not be obvious for the US.

Chad Boda, Lund University

In California, having a car is a cultural rather than a rational issue. You therefore need to bring a **sociological perspective** to the question of behaviour.

Andreas Schäfer

It is also a matter of having an alternative. In the areas you are talking about, the public transport systems are not highly developed.

Chad Boda, Lund University

It is a chicken and egg dilemma. In any case, there is clearly a need to bring more stakeholders into the process.

Joachim Oliveira Martins, OECD

We also have to deal with the fact that having a car is a social status symbol. Cars represent a major investment but are only used 20%-30% of the time. You also referred to the need for **simpler governance structures**. How do you reconcile that with the need to involve many different layers and many different stakeholders?

Andreas Schäfer, UCL

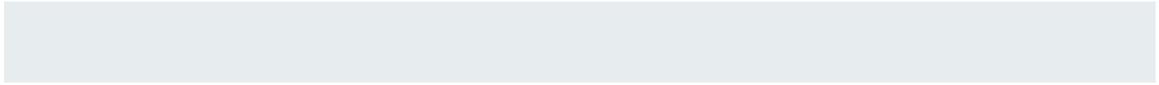
Curitiba is always cited as an example where one mayor was able to introduce such dramatic changes that car usage dropped dramatically, despite a relatively wealthy population. Ken Livingstone's introduction of the congestion charge in London is another such case. Such examples all involve a charismatic personality that knows how to deal with resistance to change. However, it remains a hypothesis.

Nathalie Girouard, OECD

We have become more efficient in moving goods and people, which has in turn triggered greater globalisation and **greater de-localisation** of production. Are we not shooting ourselves in the foot?

Andreas Schäfer, UCL

That is absolutely right. Ultimately, I would hope that the disruptive technologies I referred to will emerge. If that is not the case, I am quite pessimistic about the future.



Globalisation, Land Use Constraints, Food Security

Session 1: Global Resource Constraints in a Globalised Economy: Issues for Food and Agriculture

Chair: Paul Weaver
Lund University

We will now shift from the morning's focus on energy and transportation to a focus on land use, forest, grasslands, agricultural land, etc. In particular, we will look at the various aspects of the competition for land, in the context of globalisation and at a time when available land resources are increasingly scarce and needed for more and more purposes. The following two presentations are very complementary. They both address mechanisms in globalisation that may complicate the issues relating to competition for land.

1) [The Impact of Globalisation on Agriculture: Diet Convergence Scenarios](#)

Thierry Brunelle, CIRED/LSCE ([See the presentation](#))

I will provide a number of framing elements for factors that fuel tensions in land use. One of these elements is food consumption, as shown in the evolution in dietary habits in the past four decades in 12 regions of the world. The charts provided in slide 3 measure the plant food calories and animal calories *available* to the relevant populations between 1961 and 2007.

Total food consumption in the global orchestration scenario (in terms of available kcal/day/capital) converges to 2050. However, in terms of the consumption of animal products alone, there is a much higher level of specificity among the different regions considered. Africa and the Middle East, in particular, have a relatively low consumption of animal products.

The figures show an increase of consumption of plant food calories by 25% over the relevant period, and a 37% increase in the consumption of animal calories.

1) *The Role of Globalisation in the Principal Global Food Projections to 2050*

Four different food projections are assessed, selected among the main recent food foresights. First, the Millennium Ecosystem Assessment (2005) which considered four criteria: reactive, proactive, globalisation, regionalisation. This led to four potential scenarios: global orchestration, technogarden, order from strength, and adapting mosaic. The globalization is seen as an explicit determinant of future food consumption. There were however some difficulties to agree on its exact definition (e.g., restricted or not to international trade between poor and rich countries), which was at the root of some disagreements on its expected consequences for ecosystems.

Second, Tilman (2011)², who has projected food consumption to 2050 on the basis of the Kuznet Curve for projecting GDP. This shows a certain degree of convergence among nations, with a catch up by developing countries in the future.

Third, for FAO (2012)³, population and income are still seen as the two main drivers. A relative convergence in per capital incomes is assumed, as is a slowdown in the livestock revolution. Developing countries will be slow in adopting Western lifestyles, due to taboos on beef in India or on pork in the Middle East. For example, India's growth in economic wealth has not led to an increase in food consumption.

Fourth, Agrimonde (2009)⁴ was carried out by CIRAD and INRA on the basis of two contrasted scenarios: the MEA global orchestration scenario and the Green scenario

A fifth scenario – US Convergence – with all regions converging to food consumption levels in the US is also provided.

The increase in production implied by the five scenarios begins at a level of +50% for the first scenario and +150% in the fifth scenario.

2) *The Impact of Food Scenarios on Agriculture*

The food scenarios were then integrated into the nexus land use model on the basis of biophysical parameters (potential yield, for example) and economic behaviour (cost minimisation). The world calorie price reflects both economic sustainability and the environmental context. The five scenarios depict a wide range of possible futures from +1.3% per year for Agrimonde and +3.4% for MEA-AGO/Tilman. The US Convergence scenario would lead to a +6.4% increase in world calorie prices by 2050.

We can also consider the yield gap which shows how far we are from the potential yield. When the yield gap is at zero, actual yield is equivalent to potential yield. When it is 100%, the actual yield is equivalent to minimum yield. Under the Agrimonde scenario, the yield gap is higher in 2050. Under the US Convergence scenario, we are very close to potential yield, particularly in some countries (the US, Canada, Europe, China, India and Rest of Asia).

3) *Interaction of Food Scenarios with Land Use Policies*

We considered the annual evolution of the world calorie price in the five scenarios to test the sensitivity of our results to alternative assumptions on land-use policies. We firstly considered the addition of 50 EJ of bioenergy, that is, first generation biofuel. We can see that the impact on world calorie prices is higher as we move to higher food consumption scenarios (notably the US Convergence scenario). In contrast, in the Agrimonde scenario, the impact on price is negligible. We also tested the assumptions with respect to deforestation. When there is no deforestation at all, the impact on price is once again higher in the US Convergence scenario. Thus, this analysis brings light on the strong interactions between food consumption and the other land-use types affecting the agricultural sector.

In order to reduce this land use tension, improving nutrient use efficiency is also seen as a possible solution. If improved by 20%, the world calorie price is significantly reduced under all scenarios.

² Tilman, D., Balzer, C., Hill, J., and Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences*, 108(50):20260-20264.

³ Alexandratos, N. and Bruinsma, J. (2012). World agriculture towards 2030/2050. The 2012 revision. Technical report, FAO. ESA Working paper No. 12-03.

⁴ Dorin, B. and Paillard, S. (2009). Agrimonde. agricultures et alimentations du monde en 2050 : sc_enarios et d_e_s pour un d_developpement durable. Technical report, INRA. CIRAD. 2e Edition.

4) Conclusion

Globalisation and economic convergence are explicit determinants of all food projections to 2050. They predict a wide range of possible futures according to the degree of convergence, with an even wider range of impacts on agriculture. Globalisation and convergence assumptions have a significant impact on diet and agriculture in terms of food price and the yield gap. There were also strong potential interactions with other land use policies.

5) Discussion

Valentin Bellassen, CDC Climate

How do you calculate maximum yield and minimum yield? With the technology currently available, could we still double yield in the US and Europe?

Thierry Brunelle, CIRED/LSCE

Maximum yield is the potential crop yield calculated using the crop model. Minimum yield results from the model calibration. Doubling the yield gap doesn't mean doubling yield. This means doubling the gap between the maximum and the minimum yield.

Christian Castellanet, GRET

Am I correct in saying that each category of land within each sub-region is taken into account? Some regions practise multi-cropping while others do not.

Thierry Brunelle, CIRED/LSCE

Land is indeed classified according to its production yield. Multi-cropping is taken into account in the figures of potential yield. It is indirectly accounted for by changing some surfaces. Here the main input is fertiliser. In some scenarios the consumption of fertiliser needed to reach potential yield is quite unrealistic in environmental and economic terms.

Dominique Chauvin, Consultant

What would be the impact if the surface area was reduced? What would be the impact if the surface area was increased, for example through the vegetalisation of towns?

Thierry Brunelle, CIRED/LSCE

We assumed a level of deforestation that is in line with past trends. In the FAO projection, the increase in crop land is quite low because the FAO believes that major crop expansion will not be possible. In terms of the vegetalisation of towns, this is a very interesting subject that we have only just begun to explore. Nevertheless, vegetalisation of towns will never represent a large scale expansion of crop land.

Chad Boda, Lund University

Does your model take export subsidies into account?

Thierry Brunelle, CIRED/LSCE

Subsidies are indirectly taken into account in the calibration of export elasticities. However, we also consider food security considerations that act as a constraint on international trade. This is not an entirely flexible figure.

Nathalie Girouard, OECD

How do you deal with biofuel? Your figures are provided per year. However, we are seeing forecasts in the press of **increases in food prices** that are much more dramatic.

Thierry Brunelle, CIRED/LSCE

In the Tilman and Global Orchestration scenarios there is a 3.4% price increase each year, which is in fact huge when considered over 50 years. In our study, this should be seen as a maximum as we have considered exogenous – and thus price inelastic – food scenarios.

Paul Weaver, Lund University

It would therefore seem that this is a much more worrisome issue than appears in the presentation.

II) Globalisation of Land Use Change: Economic Globalisation and Looming Land Scarcity

Patrick Meyfroidt, University of Louvain: ([See the presentation](#))

Research linking globalisation to land use change has recently been enhanced by the convergence of several research streams (industrial ecology, land change science, political ecology, and economics).

1) Status and Trends in Global Land Use

About one-quarter of the world's land surface remains wilderness (forests and unproductive land). Some other land remains unused, by permanent intensive agriculture. There is an increased demand for land to be used in agriculture and forestry. Potentially available croplands are moderately to highly productive lands that are not already under intensive use, that are not legally protected or that are not under mature forest cover. Where is that land and how much do we have? Typically the question is addressed using relatively coarse scale data. For example, Russia is supposed to hold tremendous amounts of these land reserves, especially in the form of abandoned crop lands. However, when one considers the constraints to this use (accessibility, labor force), the amount of land actually available is much more limited.

It is of course also necessary to evaluate the social and environmental trade-offs involved in the use of that land. There is therefore much less land available than we think, and any use of that land comes with costs.

We all know that there is a growing demand for agricultural and forestry products. Most of that demand will be met through intensification although some land use expansion can also be expected.

2) Multiple Pathways of Commodity Crop Expansion

I will take the example of the Vietnam Central Highlands, an area of coffee production. The main changes occurring in the landscape are deforestation due to shifting cultivation and the conversion of agricultural land to perennial (coffee) production. Over time, coffee expansion displaces shifting cultivation, and the new areas of shifting cultivation appear in land that is increasingly located on steeper slopes and more marginal soils.

We tried to collect the same kind of data on the pathways of commodity crop expansion in other areas used for soy bean, pineapples, bananas, etc. What share of deforestation is due to these commodity crops and what share comes from other forms of agriculture (for example,

subsistence or local markets)? The dynamics are quite different across the different cases, and the variety of patterns are dependent on a number of factors including the physical scarcity of land, whether or not land use policies control the expansion of agriculture into forests, or whether land markets allow for agricultural lands to be re-allocated to different farming purposes.

3) Conclusion

On a less gloomy note, deforestation is occurring in many places in the world, but there are other areas where reforestation is also underway. How can we upscale that to a global level while addressing growing food demands? We will have to continue to increase the supply of food through intensification – hopefully through *sustainable* intensification. However, we know that that it will not be sufficient and must also be combined with the means to limit and control the degradation and expansion of natural ecosystems. In our globalised world, this is increasingly likely to result in displacement of pressure from one region to another. It will therefore also be crucial to control and modify demand through diet, consumption patterns and waste.

Globally, there is a growing demand for agricultural and forestry products. There is less available land for future expansion than expected, and every expansion will involve social and environmental trade-offs. The paths of growth of commodity crops vary greatly. Sometimes they involve displacement and marginalisation; at other times they involve land sparing and the rebound effect. Ultimately, we will have to find solutions that both combine supply side and demand side approaches.

4) Discussion

Dominique Chauvin, Consultant

You referred to a reserve of 25% of unused land. That 25% could be shifted to crop land or it could be used for factories that produce food through **microalgae**. Such factories represent a much higher level of productivity and efficiency in food production than cropland.

Patrick Meyfroidt, University of Louvain

The 25% I referred to is unproductive land that includes tropical forests or deserts. That is not the pool of land that could be used for such factories. The pool of land that could be used is what we call land that is already under some use (grazing, fallow, etc.). That land can only be used for other purposes if social and economic trade-offs are made.

Jean-Christophe Bureau

Do you take into account the **productivity of the land** in terms of yields? For example, land in Australia is not very productive. It is quite difficult to take the different gradients of activity into account.

Patrick Meyfroidt, University of Louvain

You are right: this is a gradient. We take that into account when we refer to "productive" land and is one of the reasons why the volumes of land available for expansion are much lower than we might think. The truth lies somewhere between the IASA projections and the much more pessimistic projections made by other organisations.

Sofia Espinosa, IEDES

Have you also taken into account other potential uses of land, such as **flower growing**?

Paul Weaver, Lund University

I would add to that by noting that not all crops are sources of food. They can also be used as stimulants (tobacco) or fibre (cotton), etc.

Patrick Meyfroidt, University of Louvain

The projected trends in demand for land are based on current demand, and that includes demand for commodities such as coffee or flowers. Many of the commodity crops that are expanding in demand are not necessarily food items.

Chad Boda, Lund University

It would be of interest to see where land grabbing – the subject of the next session – is occurring. I suspect there will be overlaps with the charts on available land that you have shown.

Jean-Charles Hourcade

It is also important to consider the impact of diet which is related to questions of cultural habits. I have never, for example, been able to finish a meal in a US restaurant! Changes and transformation in diet occur relatively quickly – over 2 or 3 decades. Significant changes could therefore be expected in the coming years.

Paul Weaver, Lund University

It is also necessary to consider the impact of globalisation, with wealthy countries being able to buy up available land and command resources in poorer countries.

Session 2: Local Implications of Global Problems: Land Grabbing, Land Scarcity and Food Security

Chair: Patrice Dumas

CIRAD

1) Insights on the Land Grabbing Issue

1) *Definition of Land Grabbing*

Jean Jacques Gabas, CIRAD: ([See the presentation](#))

My presentation will cover, first, the concept of land grabbing. Second, it will present the actors that are involved in land grabbing (investors and countries). Third, it will provide an overview of the principal literature on the land grabbing issue.

The Land Matrix was initiated by the International Land Coalition consortium of which CIRAD is a partner. It consists of a method of documenting all transactions over 200 hectares and focuses on land grabbing for agricultural purposes.

The method involves graduating all of the deals documented by assigning them a reliability ranking. The reliability of data communicated by the press is zero, while a known deal allows us to be sure that the deal was effective and covered by a contract leading to a change of rights between the actors involved.

There are no global figures detailing large-scale land grabbing. Since 2012, the focus has been on agriculture and 1217 deals have been documented. These deals have involved 83 million hectares, a quarter of which are covered by signed contracts.

The global distribution of these land grabs shows that Africa is the primary place of investment with 55 million hectares, followed by Asia, Latin America and Europe and Oceania.

It appears that 70% of the transactions documented are concentrated in 11 countries, 7 of which are in Africa. Certain countries, such as Sudan and Mozambique have significant discrepancies between the surface areas concerned and the number of effective deals identified. In sub-Saharan Africa, West Africa represents 1.7 million hectares, East Africa 1.9 million hectares, Central Africa 0.3 million hectares and Southern Africa 2.3 million hectares.

2) *Actors of land grabbing*

The principal investor is China. However, there is a marked discrepancy between announcements and reliable data. Investors come from Asia, the Gulf countries and OECD countries, but are also linked to an African intra-regional strategy, such as South Africa or Cote d'Ivoire.

From a regional point of view, China invests primarily in Asia, in palm oil, soya and cotton to satisfy the needs of its own food industry. In sub-Saharan Africa, the actors are different. China, for example, is not a major investor in the agriculture sector. This result from the Land Matrix has been provided in the form of a database. The largest investors in Africa are the United Kingdom, India, Saudi Arabia, South Africa and Singapore.

The main areas covered by the literature and research are:

- Research on deals;
- The destination of these investments;
- Institutional arrangements;
- Impact analysis;
- Codes of conduct analysis.

A second version of the Land Matrix will be published on 15 June, with a more refined definition of land grabbing.

In addition, work is being done on the discrepancies between the actual deals transacted and the facts reported by the press.

It is interesting to study China, whose investment in the forestry sector is underestimated. In Africa, China is involved in small-scale land grabbing, through projects that are little known about, including by the authorities. The purpose of these projects is not to export food products but to satisfy a domestic market. Nevertheless, larger-scale production does exist, in particular for methanol in Sierra Leone and Benin.

Another research theme focuses on the nationality of the actors involved. The blending of industrial capitalism with financial capitalism results in complex international structures. The second version of the Land Matrix will provide a refined analysis of the actors involved.

The situation is changing rapidly. Many actors retain land for reasons other than its exploitation. Indeed, many ambitious projects come up against multiple obstacles and fail. It is interesting to analyse the reasons for these failures.

3) Overview of the literature on land grabbing

The concept of land availability is analysed through the work of geographers and economists who question the concept of availability calculated from an absolute point of view without taking account of the rights or social relations of the people living on that land. A work published by NEPAD in the Rural Futures series on the concept of land availability is useful for analysis of what can be mobilised.

The destination of direct foreign investment appears to be correlated to the actors involved. Nevertheless, it is not solely a question of seeking resources, but also markets. Actors seem to be more interested in satisfying their domestic needs.

In the context of land grabbing, in reality multiple agricultural production models exist. In Mozambique, there are seven contractual models. In Burkina Faso, it would appear that the impact of jatropha on food security and the organisation of its industrial structures are very different from the initial idea that we had of them. In other words, an industry can develop without the State playing a role in it.

Given time constraint, I will not go into research on the efficiency of land grabbing models compared with the results that farmer systems could have obtained using identical means.

Yacob Mulugetta, University of Surrey

Thank you for an extremely fascinating piece of research. A few years back one of our students attempted to do this in Ethiopia but obtaining the relevant data was extremely difficult. We could also consider the issue of water grabbing, especially with respect to investors from Saudi Arabia. The term "land grabbing" has very negative connotations in Africa. You therefore might want to consider a different title for your work when published.

Jean Jacques Gabas, CIRAD

It is indeed very difficult to obtain data, especially from China. However, the greatest challenge we faced was in obtaining data from the pension funds.

Paul Weaver, Lund University

It is not surprising that Britain is seen as a highly active player in this area given that it is one of the world's financial centres. You would therefore expect it to be present even though the actual investors may not be British. Second, there are other ways of obtaining access to land, for example forward contracts on commodities, another emotive topic especially with respect to its **speculative aspects**. There may be a need for further research on this topic in the context of globalisation.

Chad Boda, Lund University

The organisation, GRAIN, recently released a report based on information obtained from **Wikileaks**. These land deals are often very well hidden. How much attention is given to finding out which *sector* the money is coming from rather simply stating the country it comes from?

Jean Jacques Gabas, CIRAD

We are not sure that the data coming from GRAIN is fully reliable, as the data has not been cross-checked.

Chad Boda, Lund University

Nevertheless, GRAIN has gained a significant amount of legitimacy. This may be a difference between taking a scientific perspective as compared to an **activist perspective**. However, it would be valuable to gain access to the objectives behind the investment.

Jean Jacques Gabas, CIRAD

Our information in the database was obtained from the actors.

Jean-Charles Hourcade, CIRED

There would appear to be a **significant gap** between the information provided by investors, and what you actually see on the ground.

Jean Jacques Gabas, CIRAD

That also comes down to a question of dogma or ideology.

II) From Land Scarcity to Food Security

Vincent Gitz, FAO, Coordinator, High Level Panel of Experts on Food Security and Nutrition (HLPE) ([See the presentation](#))

The issues of land scarcity and food security are highly relevant to the debate on globalisation. This raises not only a question of food production, but also of the production of income, jobs, access to food, etc.

1) *Food Security*

There are four dimensions of food security: availability, accessibility, utilisation, and stability. All of these aspects are complex and require a multidisciplinary approach.

The FAO Hunger Map 2012 shows that most of the hungry people in the world are in fact farmers in Africa and Asia. There is of course a problem of urban food insecurity but rural food insecurity is often a less visible part of the equation – and this is where land use is a critical issue.

2) The Importance of Land in Food Security

The FAO projection of food availability amounts to +60% in 2050 because of shifts in diet and increases in wealth in the different regions. This is based on a constant use for biofuel. Biofuel has to be included in the picture. Biofuels have increased 5-fold in the past decade, with over 100 billion of biofuel now produced per year. At the same time, agricultural trade has tripled in 20 years.

Is land abundant or scarce? This can be considered, first, as a question of agronomic suitability. Some argue that there is much more land available than is necessary for the increased demand to come. What is "available" land? This has to take into account the competing demands on land: food production, feed/grazing, biofuels, biomass for energy, environmental objectives. In reality, when land is available in one dimension it is often already being used in another dimension. To assess such competition, determine the margins for manoeuvre and the need for trade-offs it is necessary to explore the local scales.

In terms of land distribution and imbalances, poorer countries have less cultivated land per capita, and vice versa. Water availability is also a key component of land availability. An abundance of land is meaningless from a food security point of view if there is no water available. Irrigated land produces much more food than rain-fed land: 20% of land is currently under irrigation and that land is responsible for 50% of all crop production. Critical areas in terms of water include Northern Africa (where withdrawals of water for irrigation already exceed renewable resources). China, India and the United States account for 40% of the use of non-renewable water resources in the world. Western, Central and Southern Asia already use more than half of their water resources for irrigation. By 2030, it is estimated that the demand for water in India and China will exceed their current supplies.

The issue of land degradation must also be explored, for example, with respect to land salination. 34 million hectares of land are subject to salination today, just over 10% of all irrigated land. The FAO's projections do not take into account climate change but this can be expected to exacerbate scarcity. In Morocco, for example, production of rain-fed crops are expected to be no longer be possible by 2050.

It is also necessary to consider the farm. How can farm populations live off the land they have? In the past 30 years in France, there has been an 3-fold decline in the number of farms. The opposite has occurred in India, with a significant increase in the number of small farmers.

When we compare availability and demand, we often forget that it is also necessary to have income to buy food. If food and land prices increase, one part of the world population may not be able to participate in trade at all. Some developing countries have turned into net importers of agricultural products. The least developed countries are less and less benefiting from the trade in agriculture, even though this is the most important part of their economy. When it comes to the EU, the EU exports a significant volume of food but (virtually) imports much land and water.

With respect to land acquisitions, who wins and who loses? Does investment lead to increased yields? Does it lead to more food and more income? If so, for whom? There is a yield gap in Africa in maize, for example, in some cases from 1 to 5. However, none of the land investments to date have contributed to breaching that gap.

3) Options for Managing Land Scarcity for Food Security

Land scarcity is often the result of other scarcities such as water or knowledge. It is necessary to compensate for land scarcity through abundance in other dimensions.

A global approach is not sufficient in managing land scarcity, and it is also necessary to look at systemic differences at the local scale. Globalisation can lead to global availability of food but it cannot solve the problem of accessibility for the rural poor. The idea that land scarcity in one region can be compensated for by other regions can only work if other conditions are met, for example having enough income to buy food. The globalised vision works for the well-endowed. The globalisation of markets means that local prices are more dependent on global prices, which are in turn primarily dependent on the behaviour of rich countries and consumers.

In terms of finding solutions, it is necessary to optimise land use in the different aspects of food security, taking into account a farm or systemic approach that is linked to realities on the ground. To do that it is necessary to have data on the comparative advantages of farming systems in those aspects and in the local context.

4) Discussion

Dominique Chauvin, Consultant

Food conservation is another matter than has to be considered. Between food production and consumption, there is a need for good **food conservation**. Poorer countries need more energy to improve their food conservation. Land scarcity is therefore not the real problem; the real problem is energy scarcity.

Vincent Gitz, FAO

When it comes to food issues, the consumption side of the problem is not new. However, it is only now getting onto people's agendas and managing unsustainable diets has become a priority. Food waste amounts to approximately 30% of consumption in developed countries. In developing countries the same amount (30%) is lost at the production stage. An upcoming HLPE report on Biofuels and Food Security will call for the integration of food security and energy security strategies.

Christophe Bureau

How can you argue that **trade** destroys food security? That is totally unsubstantiated.

Vincent Gitz, FAO

I have not really said that. This is a debatable issue. While it provides options, trade also replicates existing imbalances. Trade is necessary but it should not be forgotten that there are winners and losers in trade. The Committee on World Food Security has not yet directly discussed trade. However, even if it is a WTO matter, it has relations with food security which the CFS might want to consider.

Wrap-Up and Conclusions

Jean-Charles Hourcade

I would like to ask our panel members to provide a few thoughts on today's discussions.

Véronique Sauvat, AFD

For the AFD (*Agence Française du Développement*), the issues of energy and land are highly relevant to development. *The Big Shift*, a book by Jean-Michel Severino, former Director General of the AFD, starts with the reminder that, for centuries, natural resources were abundant and easily available while human resources were scarce. Today, natural resources are scarce and we have an abundance of human resources. This has significant consequences for the way we see development and the way we deal with the human dimensions of development.

The AFD used to finance transportation and energy production. Today, the new environmental context has changed our role in development and we now work on three main aspects of the energy transition:

- The development of production capacities in developing countries and emerging countries.
- The de-carbonisation of energy production.
- The development of access to energy, in particular, in rural Africa.

Today, our investment in the energy sector represents two-thirds of all our investments.

On the land issue, the amount of investment by AFD in agriculture has decreased sharply in the past two decades. We now try to focus on three aspects of agriculture: raising the productivity of production, addressing the scarcities in water and land, and addressing the human dimension. That third dimension is probably the most difficult one we face.

As to the role of research, we believe that it is not possible to separate out research on OECD countries from research on non-OECD countries in such a complex field. We believe that while it may be difficult to see the direct impact of research on decision making or on actions, there is a cumulative effect of research that brings changes in the way we see programmes, projects, and financial instruments.

Joachim Oliveira Martins, OECD

The overarching theme that emerged for me from all the different areas covered was the need for a more integrated approach. Initially, climate change policies were concerned with sending a strong price message. We are now coming to understand that this is a much more complex issue that cannot be resolved only through pricing. The idea of policy integration is therefore very important. For example, when we began working on "green growth" at the OECD we were very optimistic. However, in many cases, the push for renewable energy through subsidies generated distortions. In addition, the policies were often parachuted into a region and the local population felt no ownership of the concept. At the end of the day, the process was not sustainable. If we are to be serious about promoting green growth, it is necessary to take the local conditions into account.

In this area, the complementarity of policies goes beyond mere coherence. The policies of one ministry have to be reinforced with policies from another ministry, and it is necessary to construct that complementarity through an appropriate governance system.

When it comes to urbanisation, we are at a unique moment in our history. For OECD countries, the impression is that most of the urbanisation has already been done. However, a new OECD

database enables us to see that urbanisation is still taking place in OECD countries, mainly on the periphery of existing cities. For non-OECD countries the burning question is density. People want more space and they want to be more mobile. Will developing cities shift towards a US model or a European model? Most of the recommendations on compact cities come from urban planners and input from research such as the IMACLIM model which was presented is missing – a further demonstration of the need for integration. Doubling density could in fact be counter-productive to the issues we face and we need greater dialogue between the two communities.

On the globalisation side, we saw that the work on global value added chains is poorly captured in the models. In reality, there is no longer a match between one country and one product. To address this new reality, which has a very strong impact on international trade, the OECD has set up a common database with the WTO.

Another point of interest was the presentation on investment opportunities. Here we are talking about the interaction between business, climate and investment – a complex matter, in particular in Africa. In Africa, cities could be used to demonstrate how things could be done. In that way, cities could become forums for policy experimentation that could then be implemented in other regions and other countries.

With respect to land use, this is not an area in which the OECD is doing much work today. From the macroeconomic point of view, we need to rediscover land as a factor of production. The OECD aims to develop indicators and understand the link between policies and objectives. That will be quite a daunting task in the area of land use given that land is one of the most regulated sectors, much of which is done at the level of the municipality. Producing positive indicators of the regulatory framework of land use will therefore be a complex task.

Christian Castellanet, GRET

I will try to provide a civil society perspective on today's discussions. To what extent is modelling useful in helping to solve the problems we face at the global level? There are many areas where research could have a very strong relevance to important issues being discussed at the international level.

One such issue is that of international regulation and negotiation. We spoke about biofuels, a controversial topic. Decisions in this area have been made on the basis of models, assumptions and hypotheses. It is therefore very important that research is carried out rapidly that will provide relevant information to governments as well as to citizens and civil society bodies. In these international forums, citizens and civil society are trying to play a democratic role in the process.

Another aspect is the role of land grabbing or the role of foreign investment in developing agriculture and food security. Depending on the model used this will have an impact on the farmers who still represent half of the working population of developing countries. That means that a huge number of people are affected by these decisions and yet they have very little voice at their country level or at the international level.

As to consumer attitudes, the models show that what you eat for lunch can have important consequences for the next generation. That type of discussion should be put out to the general public.

There is a need for greater links between research models and society. It is necessary to take the time to explain how the models work and what value they bring. It is also necessary to provide a link to local reality. For example, when it comes to land use, we can quibble about the actual figures but, in any case, we will never triple the amount of available land. What appears from a satellite picture to be available land turns out not to be available land in fact. This demonstrates the need to integrate local level observations into our global models.

There is a contradiction between the fact that the models show the linkages that exist between food, energy and land, and the fact that the results are always based on economic growth

as measured by GDP. However, GDP is no longer a meaningful indicator today. If a person spends 3 hours per day commuting to work, that will not show up in the GDP figures for a country and yet it has a real impact on quality of life.

Finally, I regret that no mention was made of the current financial and economic crisis, which clearly has an impact on all the issues we have been discussing.

Jean-Charles Hourcade, CIRE

I agree that there is a need to make the models understandable for the general public. However, the reality is that academic careers are not built in this way. It would, for example, be relatively easy to build the new value added chain into our models but that would not be elegant; nor would it provide a theorem. In addition, policy makers like simple messages. Academics therefore have a certain responsibility in this area.

Regarding intellectual deadlocks, we now have a controversy on the legitimacy of co-benefits. All of the speakers noted the linkages between issues. However, nothing was said about finance. There is a need to reduce the investment risk in certain sectors and in certain regions. That is a very important issue, as is the issue of who invests where and for what purpose.

Dominique Chauvin, Consultant

You noted the need for greater Integration. I believe that what is needed is greater "**hybridation**". By combining integration and hybridation in our systems, we can have significant improvements in efficiency. For example, when the hybrid car concept first emerged, most experts tried to prove that it would never work. Exxon's Annual Report at the time actually called it a gadget for the happy few. Today, Toyota has reached the 5 million sells with its hybrid car. That example applies to many other areas. I do not believe that increasing city density will increase congestion as other phenomena will arise to counteract the problem. It would be of great value if we were able to include hybridation in the models, as it would allow us to make better investment decisions.

Joachim Oliveira Martins, OECD

I agree but we may need a more integrated policy approach in order to promote hybridation.

Jean-Charles Hourcade, CIRE

I would now like to close our Workshop and thank you all for a lively and productive debate.