THE NEED FOR VIGOROUS ECONOMIC DEVELOPMENT FURTHER TO THE ARAB SPRING

The Arab revolutions express a demand for greater morality rather than merely for economic reconstruction. This demand concerns the structure of the State and the responsibility of the political classes just as much as the economic model of South Mediterranean countries. To satisfy it requires a new growth model capable of delivering more justice as well as a more inclusive and more socially responsible system. A new paradigm must replace the old one, which favoured unregulated growth, too precipitate international accession and asymmetrical regional integration.

Economic growth in itself is insufficient to ensure what is after all a political change, and this in turn implies a need for in-depth reform of the methods of public governance as well as of the private sector. In a nutshell, what people who are living through a transition to democracy require is a new social contract, in which economic progress would provide the means to achieve political and social restructuring.

By definition, a social pact implies a long term process. Indeed, it results from a debate on the mobilisation of the non-business sectors of the economy: what economic regulatory framework and what logic of wealth redistribution should be applied, and for what forms of solidarity – generational, social or territorial? The driving force of this evolution is clearly democratisation of the society as a whole, but there are also other aims, such as restoring confidence at two levels: internally, to encourage social dialogue and harmonise expectations, and also externally, to ensure the incoming revenues of the economies concerned, which are dependent on foreign investment, financial transfers for immigrants, tourism and services.

In this context, the following recommendations seem appropriate.

- The search for new social equilibria in countries undergoing a transition towards democracy should reconcile cultural roots with the preparation of the future. In such debates, the way forward will involve the concept of universities based on rationality and objectivity, in which the human material has its own cultural references, and such institutions will have a crucial role to play in accompanying the whole process. That is why the involvement of networks of scientists in the social dialogue is key to provide a practical roadmap for the various subjects being raised, since exchanging experience remains the best basis for objective decision-making.

- Since the transition to democracy is, by its very nature, a lengthy and somewhat irregular process, the organisation and protection of the civilian society in between elections seems essential, so as to avoid derailing of the process and so as to guarantee such basic principles as human rights, the impartiality of the State and social justice. Here again, scientists have a particular responsibility when it comes to structuring and participating in the social dialogue.

- In this context, the mobility of scientists and free circulation of knowledge must be ensured, as the best protection against misunderstandings on both sides of the Mediterranean, without which a new structure of North-South relations would not be able to emerge.

- Finally, restoring confidence in the economies of countries undergoing the democratic transition would benefit greatly from the active participation and support of the scientific diasporas concerned, since their intellectual influence carries with it both a spirit of objectivity and the best promise for the future.
WOMEN IN SCIENCE

Science has no gender and is enriched by the diversity of individuals, groups and cultures which carry it forward. The analysis of perspectives opened up by the “Arab Spring” movement in Tunisia leads to the following comments and recommendations:

1. The access of women to study and to scientific careers is an important component of Women’s rights in general. Science has no gender bias, and is enriched by all forms of diversity of individuals, groups and cultures.

2. The level of responsibility and career development of women in science is generally inadequate. To resolve this problem, it will be necessary to create and to support networks of women scientists and engineers, and also to encourage their promotion to decision-making posts.

3. Since Associations are crucial to development, it would be very useful to harness the potential offered by scientifically qualified persons to strengthen local structures by instituting projects to promote awareness and enhance training for this purpose.

4. Since partnerships between industry and universities are key to innovation and development, it is important to support young researchers and PhD’s, so that they find their place in socio-economic structures more smoothly and more effectively. Developing appropriate projects and structures to train them must be a priority.

5. Women scientists are strongly attached to their place of origin, and nearly always seek to return to it. This should be accepted as a fact and should be exploited as a structuring factor for regional development (for example, by creating a portal for digital development appropriate to graduates in their field, and by taking specific actions to correct disparities between regions.)

THE FUTURE OF NUCLEAR ENERGY AND ENERGY PROSPECTS FOR EUROPE

The nuclear accident due to the giant tsunami in Fukushima in the North-East of Japan on the 11th of March 2011 is the most serious since the accident in Tchernobyl (Ukraine) in 1986. The accident has had an important impact on public opinion and on energy policies throughout the world. In this context, it is necessary to stand back and formulate some objective comments and recommendations:

1. The involvement of an independent Nuclear Safety Agency (NSA) is becoming more widespread and is desirable also at the international level (IAEA, EU). It has already been proved very efficient in France. In March 2011, France and the EU requested an additional safety evaluation of every nuclear power plant, taking into account, beyond original specifications, dangers due to earthquakes, floods, cooling failure, interruptions of electric power and the management of serious accidents. Further to these checks, the NSA announced in January 2012 that the French plants are sufficiently safe to require no interruption in the operation of any of them. However, improvements would indeed be required over and above the original specifications. For example, where an earthquake of magnitude 6.2 had been known to occur in 1356, the design should allow for a magnitude of 6.5, i.e. five times as much energy. For reasons of safety, it should even be raised to 7.2 for the essential parts. i.e. 25 times the energy allowed for originally. Regarding flooding, if the planning of the present site considered water levels on a one-thousand year timescale, or else the
bursting of a dam, then even higher levels than that should be planned for. Similarly, improvements should be made to electricity and water supplies, for limiting leakage in case of accidents and for responses to crises. Safety testing on a European scale will be discussed in June at a meeting of the European Council.

2. The study of health issues following the events of Hiroshima-Nagasaki and – to a lesser extent – Tchernobyl provides a database to support recommendations concerning permissible radiation levels. We approve of the Japanese strategy for a long term follow-up of the health consequences following the accident at Fukushima.

3. It is absolutely necessary to pursue research on the mechanisms which take place in the period between receiving a radiation dose (Sv/year) and the biological consequences (especially as regards linearity or non-linearity and the presence or absence of a threshold). There is no reason to reappraise accepted norms under normal radiation levels (1mSv/year to 10mSv/year for professionals) which are based on a linear relationship with no threshold present. However, these should not be used as a basis for absurd interpretations (e.g. dividing the global radiation level by the permitted dose) or to absurd conclusions which contradict internationally recognized observations made over many decades (by ICRP, UNSCEAR, IAEA, WHO). These observations are indeed consistent with the absence of observed effects in regions of strong natural radioactivity, leading to radiation levels of 50 to 200mSv/year.

4. We underline the importance of unifying the concept of low-carbon energy (both nuclear and renewable) as presented by AREVA and the CEA.

5. As regards access to nuclear development of emerging nations, a number of preliminary conditions must be met (notably the implementation of: specialist training, safety authorities, a legal framework and research centres). Establishing such a basis can take up to fifteen years. Research on the future of Nuclear Energy must be pursued beyond the GEN IV concept to respond to the diversity of requirements with optimum safety at competitive prices. For example, one may consider small reactor design, the use of the thorium cycle, etc.

6. Because of the current economic crisis, energy prospects in Europe will depend on the cost of each supply line as well as on its level of safety. The cost of nuclear power must necessarily increase because of more stringent safety criteria. Fossil fuels (carbon, oil, gas) will continue to dominate the market, and their costs will increase owing to the re-assertion of requirements by international companies and the increasing energy demand from emerging countries. In addition, the reliability of supplies may be called into question, because of geopolitical instability in the production zones. Official public policies in Europe continue to state the objective of reducing by 80 percent the production of greenhouse gases by 2050. This target seems increasingly difficult to meet in view of the decision to stop nuclear power generation in several European countries, which necessarily implies a return to the burning of oil and gas. The priority given to intermittent sources of energy (such as solar and wind power) also requires more gas-fired plants as back-up, and this in turn implies a huge investment in plants whose economic viability as 'secondary' power generators is open to question. Other lines of attack such as energy savings in construction and in transport and 'smart grids' are certainly worth exploring in the medium term. We recommend an increased research effort in the whole field of energy – including especially its transport and storage – so as to find innovative solutions on a ten to twenty year timescale. Finally, we underline the importance, in any democratic society, of achieving a consensus around the energy strategy adopted. This concerns CO2 sequestration just as much as nuclear power, wind power or energy transport. Transparency and good communications, as well as raising the awareness of the general public, are essential requirements.
THE FUTURE OF FOSSIL FUELS AND RENEWABLE ENERGY

Renewable energies open up new horizons. To exploit their potential, we recommend:

A greater openness of institutions in charge of renewable energies to university training and research programmes is recommended. New training schemes should be provided, more feasibility studies should be performed and innovation should be encouraged.

Practical demonstrations and pilot-projects connected to industrial and agricultural applications would allow economic and social insertion of such projects in real life situations to be studied.

Future energy requirements would justify multiplying the number of demonstration projects of Concentrated Solar Power and other technologies for electricity and water production.

To stimulate innovation, researchers and operators of different countries should be able to exchange information. Their mobility should be encouraged, especially between the North and South sides of the Mediterranean.

Much more effort is needed to convince political decision-makers of the need to integrate renewable energy sources in the national energy programmes. The exchange of information and a common framework of reflection and structuring of the scientific community involved can lend a lot of weight to local recommendations.

RECOMMENDATIONS FOR PROVISION OF ENERGY IN AFRICA

- Access to electrification based on renewable energy sources lies at the convergence of the two main objectives of international solidarity which have mobilised the United Nations for the past two decades, namely
- the eradication of extreme poverty and
- the control of climate change.

The Copenhagen Conference and the Green foundation for climate have opened up a new approach, which was confirmed in Cancun and in Durban. The UN has declared that 2012 will be the year of access to renewable energy for all. Today, universal access to modern and durable forms of energy is regarded as an essential prerequisite for sustainable development in the poorest regions of the planet. Access to electric power, even in small quantities, allows the vicious circle of extreme poverty to be broken through:
- access to lighting; to modern communications; to clean water by pumping underground supplies; refrigeration of pharmaceutical products and of food; modernisation of agriculture; craft industries.
- hence access to education, to health, to economic development, to sustaining population in the countryside, at the hearth of objectives for the Millenium Development programme.

In this context, the situation in Africa is especially critical and calls for the following comments and recommendations:

1. It is on the African Continent and especially in the forty sub-Saharan countries that the main effort of international solidarity to achieve universal access to modern and sustainable energy supply should be concentrated.
2. In 2030, sub-Saharan Africa will contain half the population deprived of such access if nothing is done. At present, 1.6 billion people have no access to electricity in the world today, of whom nearly 600 million live in sub-Saharan Africa, where, the situation is deteriorating because population growth outstrips the pace of electrification, owing also to the lack of investment. The need is greatest in rural areas, where the level of electrification is generally lower than 20 percent. The
situation is deteriorating further because the birth rate outstrips the pace of electrification.

3. The electrification of rural areas is usually achieved from costly and polluting sources of energy. The transport and distribution costs are high. Where the consumers are too remote from the network, local generators are used to produce expensive electricity from diesel. The use of decentralised renewable energy sources presents a competitive advantage in regions with no network as compared to diesel generators which are both costly and polluting. In terms of finance, technical know-how and entrepreneurial skills, new partnerships are needed as well as new, innovative investment schemes over and above classical finance and carbon-related investments in order to bridge the existing gap.

4. Starting from scratch, without having to replace an existing conventional production and distribution network has the advantage of enabling the application of new technologies and is favourable to education and training of the local population in the use of renewable energy. This situation is a positive factor concerning the competition between conventional and sustainable energy sources (new technologies versus diesel). In terms of cost, the two are on a par in many cases.

5. Nonetheless, current levels of investment remain a lot lower than would be required to achieve universal electrification. The clean development mechanism (CDM) created by the Kyoto Protocol does not benefit the poorest: out of 3952 projects recorded by the CDM Board to date, only 85 concern Africa, and only a few of these relate to energy. Most of the electrification projects in advanced nations do not overcome the profitability threshold of private electricity providers required by financial markets. Additional new resources are required, with the participation of both national and international investors. The Climate Conference of Copenhagen in 2009 adopted the following objective: “Appropriate financial mechanisms, both novel and additional, adequate and stable, with improved access conditions must be made available for developing countries. The collective commitment of developed countries is to provide new resources of approximately 30 billion dollars over the period 2010 – 2012. Financing the transition to green electricity will focus on the most vulnerable of the developing nations, the small islands and the African continent [...] with the objective of reaching 100 million dollars per annum in 2020. This financing will come from a wide range of sources, both public and private, bilateral and multilateral, including alternative resources.

6. Even so, an industrial and administrative base is necessary to achieve these aims. Two inadequacies must be addressed:
   - financing;
   - technical competence and entrepreneurial skills (financing gap; capacity gap)

7. The electrification of rural areas in Africa is dramatically under-resourced. It should be made the responsibility of a new agency, which should catalyse the efforts of all available partners.

8. Amongst the actors dealing with electrification, ranging from national companies to public sector monopolies, humanitarian NGO’s, village communities, local entrepreneurs, etc., the one missing link is to include international energy providers. They are already involved in the privatisation of public sector electricity companies for developing countries which have followed the path of deregulation. However, they are not yet involved in rural electrification.
TRANSPORTING ELECTRICAL POWER USING SUPERCONDUCTORS

The concept of a D.C. grid based on the superconducting material MgB2 opens the way to the transport of very high power (of the order of 5GW) over very long distances (several thousand kilometres). A novel technology, derived from pipeline construction, would enable paths to be planned through areas where conventional methods (overhead lines, insulated cables or gas-insulated lines) are unsuitable, for either technical or environmental reasons, or simply because of cost. Examples include urban zones, cables under the sea, heavily cluttered areas, extreme meteorological conditions, etc.

The technological challenges are at the same level as the expected prize, i.e. highly ambitious (the risks attached to liquid hydrogen coexisting with high electrical power, the design of interfaces with the other materials of a grid, how to deal with de-couplings involving several GW, how to repair faults, etc.) We therefore wish to make the following recommendations. Such a project involves

- Ensuring close collaboration between the different partners of the project (suppliers of superconducting wire, cable manufacturers, cryo-engineers, electrical grid operators) from the very outset, so as to design a product well adapted to the needs of its users and to benefit from all existing expertise;
- Federating academic and industrial competence, because such a project involves as much research as development. In fact, the “Sharing knowledge “ conference in Tunis brought together around a table virtually all the expertise required, and we were able to define the key points of what should prove a promising adventure.
- Being ambitious, but also defining realistic objectives, bearing in mind that an industrial product must be the outcome. Analysing risk, projecting into the future and evaluating the resources and means which will be required.
- Determining the timescale as an objective in its own right, and avoiding any delays so as to maintain the momentum of all the partners. Making sure that the competition does not catch up, which could lead to the original team becoming spectators of a great idea being realised by others.
- Establishing a financial plan and finding the necessary funds, so as to extend the project beyond the technical prowess and natural enthusiasm generated by many projects involving superconductivity. Communicating successes.
- Solving technical obstacles by working with scale models and validating each part while applying the greatest care to interfaces. Proposing pertinent demonstrations to achieve support from industrial partners.
- Taking advantage of technical advances to develop other ancillary applications ( supra High Temperature Superconductors for lower power applications, superconductors with massive power for onboard systems, etc.)
- Prioritising sustainable development.
- Contributing to the reduction in the isolation which results from the large distances inherent in the African continent, improving interconnections with Northern countries, enabling a proper control of the high consumption nodes along an East-West axis.

INTERNET

The ASREN network (Arab States Research and Education Network) is an important basis for the development of education and research in the Arab world.

To reinforce the effectiveness of ASREN, we recommend:

1. Establishing NREN (National Research and Education Networks) in aal Middle-Eastern and Maghreb countries and connecting them to ASREN.
2. Obtaining political, financial and technical support to promote services and applications connected to research and education in the region.
3. Establishing the infrastructure and technology of CLOUD COMPUTING to respond to the massive increase in dataflow.
4. Encouraging the development of NTIC to improve e-science and e-accessibility, especially for handicapped persons.
5. Taking advantage of African cable connections (through GEANT and Ubuntunet) which are revolutionizing African science via such projects as the South African Radio Telescope and the Neutrino Observatory at Taza in Morocco.
6. Taking account of the recommendations of the CHAIN project for e-infrastructure and e-science in Africa concerning the reduction of the digital divide.

WATER – AN ESSENTIAL FACTOR FOR FOOD SECURITY

The sustainable management of water resources for agriculture is a crucial element of food security. 
- In fact, there can be no agriculture, and therefore no security of food supplies without water. Irrigation, which represents 70% of water usage in the world, enables 40% of worldwide food production to be achieved on 20% of the available farmland.
- In view of the increasing pressure on water supplies and of the ever increasing demand for agricultural produce, the objective must be to increase both food production and its economic value per cubic metre of water used.

It is important to recognize that the problems vary from region to region.
- In North Africa, the available water supply (from rainfall and surface flow) is structurally inadequate for local needs – this situation is due to a physical shortage of water. The challenge is thus to coordinate the management of ‘blue’ water (from rivers and from the underground water table) of ‘green’ water (rainwater stored in the soil) and of ‘virtual’ water (contained in the imported agricultural produce). Against this,
- in sub-saharan Africa, on the other hand, water resources are available but are not fully exploited, owing to a lack of investment in basic infrastructures.

On the African continent, small and medium size farms (from a few hectares to a few tens of hectares) should be given priority, as they represent the greatest potential for development, for the reduction of poverty and for increased water productivity. Support for such farms involves:

1. Increasing the awareness of innovation: agricultural practice for water conservation and soil husbandry (sowing directly onto organic cover, etc.) more economic methods of irrigation (drop by drop) and the selection of species resistant to drought.

2. Sustainable management of hydro-agricultural facilities: small water dams, anti-erosion structures, artificial lakes.

3. Support for professional associations of farmers, such a cooperatives and societies of irrigation specialists, who can assist in increasing awareness of innovation, in maintaining the standard of equipment and in achieving an efficient supply to local markets of agricultural produce such as cereals through cooperative ventures. Professional training is an important tool to develop.

In order to put these actions into effect, the coordination of public policy for water management and agriculture must be strengthened.
ALTERNATIVE WATER RESOURCES

Alternative water resources are increasingly being used by countries which are below the minimum scarcity level (1000 m3 per annum per person) or below the hydrological stress level of 500 m3 per annum per person. These are:

1. Desalination of sea and brackish water. The world’s desalination capacity has quadrupled between 2000 and 2012, from 2 Mm3 to 80 Mm3 per day (i.e. 900 m3/s: more than eleven times the average water flow of the Thames in London). It is interesting to note that this explosion of capacity has resulted from a number of publications in specialised scientific journals. In particular, the number of published papers originating from Middle-Eastern and North African countries has risen from 72 for the 10 year period 1966 to 1975 to 875 for the five year period 2006 to 2010. There now exists a significant community of experts in North African countries capable of exploiting such sophisticated technologies and adapting them to local needs. Outside the Gulf region, reverse osmosis is now the dominant technology as it is less onerous (0.5 euro/m3, of which 42% are energy costs). The utilisation of renewable energy is still somewhat too expensive to be the norm, but many research articles suggest that it will become so by 230. In Perth (Australia) a wind-farm has been created which provides 25 MW energy required for water desalination.

2. The re-use of water after industrial or domestic consumption. Technology for the re-use of water is essential both for treatment of effluents and for a stable water supply. Methods combine a wide range of techniques, extending from conventional sedimentation to very advanced approaches, such as biologically activated carbon filtration, ultra filtration and inverse osmosis. Applications range from non-foodstuff agriculture through to drinking water and also enable the reinjection of water into aquifers to combat incipient salination.

3. The improvement of water-productivity in agricultural and industrial applications, which should be systematically encouraged.

4. The reduction of water losses from the distribution network, which requires considerable investment.

One should also encourage the development of new technologies enabling a reduction of energy consumption, or techniques which are better adapted to special situations such as accidental water shortages. Access to a water supply under emergency conditions in isolated areas should be given as high a priority as access to electricity. New ideas will be necessary to find proper solutions to this problem at affordable prices.

FACTORS FAVOURABLE TO THE DEVELOPMENT OF AFRICAN AGRICULTURE

African agriculture comprises both strengths and weaknesses.

- African agriculture has an important potential due to plentiful earth and water resources, especially in the areas of the basin of the Niger, the Congo, the delta of Tana, and Kenya, as well as vast arable lands in the South of Sudan.
- It is in fact the main resource for export in several markets dealing in untransformed agricultural produce which unfortunately do not attract added value. As a consequence, Africa remains a net importer of agricultural produce, with a negative
commercial balance estimated at 1.9 billion US dollars in 2009, and faces local pockets of food insecurity.
- Exchanges of produce between African countries are sparse, owing to institutional barriers and to high transport costs.
Within this paradoxical context, the African continent also faces complex issues linked to the growth of its population, which will surpass 2 billion inhabitants by 2050, and to the consequences of climate change.
- The development of African agriculture requires innovative technologies to improve its productivity, an improvement in communication of information and more support for inter-African commercial exchanges.
- Information and Communication Technologies (TIC), which have gained ground in Africa in recent years, could well be applied to enhance agricultural development. In fact, the use of satellite technology to monitor land use and the development of mobile communications networks in Africa, with applications designed to assist farmers and to favour commercial transactions, have already contributed to greater efficiency and have improved the profitability of farming in many parts of the region.
Against this background, the following recommendations seem useful to reinforce agricultural development in Africa.

1. The development of local production chains, most notably through technology transfer and investment, so as to enable the transformation of produce in situ in the production zones, to reduce wastage, to avoid delays, and to meet demand with quality produce adapted both for the local market and for export (for example: cocoa and coffee production, fruit and vegetables, sugar, cotton, etc.)

2. The removal of barriers to the free circulation of goods and persons is necessary to encourage commercial exchanges between African countries. This requires the simplification of visa application procedures for business representatives, and smoother customs procedures for goods at import/ export so as to reduce the time spent in transport and the complexity of customs practice, which are currently very harmful to intra-African trade.

3. Better collaboration between African port authorities and those of Northern countries, to improve logistics and to set in place merchant shipping routes between African countries, so as to reduce the cost of transport, which remains a fundamental obstacle to intra-African trade.

4. Improving the access to and the circulation of commercial information, again by making use of the recent development of Information and Communication Technologies (TIC), most notably the mobile platforms already provided by most telephone operators in Africa.

5. Reinforcing the integration into Agricultural education and training programmes of Information and Communication Technologies (TIC) through research on their impact on agricultural productivity. Enhancing the awareness of decision-makers in the agricultural sector of the potential of TIC for the development of farming so as to speed up its integration into existing practice.

6. The search for innovative approaches to financing, so as to fund the introduction of TIC into the agricultural sector and ensure its long-term use.
REINFORCING LEVELS OF COMPETENCE

The demographic, economic and environmental challenges imply for Southern nations the need to define and structure for themselves a place in the knowledge-based society and in the competence-led economy. In consequence, these countries must take stock of the importance of training schemes enabling them to develop up-to-date competences (for example, schemes to train teachers of new skills, validation of expertise, etc.)

There is a need to increase the diversity of skills and qualifications, because a wide spectrum is required to achieve economic development. Too much concentration on the highest levels of training at the cost of intermediate levels can handicap overall efficiency.

Reinforcing practical skills, especially by making training courses more accessible, is a key ingredient of a successful educational plan.

A collective brainstorming to identify best practices and sharing of common experience as well as of the means required are recommended. This measure should enable more visible and efficient harmonisation of training and higher education systems. Speedier accreditation procedures and a more advantageous public-private sector partnership framework would provide an important direction to develop.

INTERNATIONAL RESEARCH PROGRAMMES

The Sharing Knowledge Foundation supports the actions of ICTP and CERN in favour of scientists from the MENA region (Middle-East and North Africa) to assist their participation in leading scientific programmes.

- It encourages ICTP and CERN to collaborate with the best universities to create education and training programmes in their fields of specialisation. It notes the interest expressed by Morocco in achieving the status of Associate Member of CERN and supports this initiative, which is bound to have positive repercussions for science, technology and industry in Morocco.
- It expresses the hope that a similar outcome may occur for Tunisia.

The SESAME Project (synchrotron radiation for experimental and applied science in the Middle-East) is capable of giving a new impetus to research and scientific training in the Middle-East.

- States which participate in SESAME have now allocated sufficient resources for the project to be completed to schedule.
- CERN has proposed to make its unique expertise available to the project as regards accelerator magnets.
- One can hope that the European Union will soon confirm its promised support for the project and that the United States will do likewise, since President Obama, in his Cairo speech, announced support for research in the MENA region.
- Morocco and Tunisia will be able to become full members of the SESAME project once their user communities have been organised.

The interest expressed by many African countries in the project for a digitised library augurs well. CERN and ICTP are invited to support this initiative by providing apparatus, software, training and technical support.