The theme of the Annual Meeting of the New Champions 2011, referred to as the “Summer Davos”, was Mastering Quality Growth. Discussions focused on four themes: Embracing Disruptive Innovation, Pursuing New Frontiers of Growth, Sustaining a Creative and Entrepreneurial Culture and Shaping New Business Models and Policies.

In view of the great emphasis at this year’s Meeting on science, technology, innovation and new business models, it was particularly appropriate that the inaugural Innovation Summit of the World Economic Forum be launched at the Annual Meeting of the New Champions. The Summit will take place within the context of each Annual Meeting of the New Champions and involve industry leaders and chief innovation officers from Industry Partner companies, Technology Pioneers, Young Scientists, public figures and global experts.

Both the official and private programmes offered a wide spectrum of innovation-related issues. The private session on Emerging Industries, Energy and Managing Resources, and a Ministerial Meeting on Science and Technology were the focal point of the Innovation Summit. A related private session held outside the Summit concerned The Move to Innovation: China and India. A complete list of related sessions is provided in Annex 3.

Emerging Industries, Energy and Managing Resources

- As mandated at the December 2010 Industry Partners Meeting in Beijing, the World Economic Forum announced at the Annual Meeting of the New Champions 2011 its platform to address biorefineries, biotechnology and bio-energy issues, in partnership with the China Petroleum and Chemicals Industry Federation (CPCIA) and the World Council on Industrial Biotechnology.

- The chemicals industry enables well over 47% of global GDP, as does the IT Industry. Emerging technologies promise to increase this figure.

- It is expected that, by 2050, “cleaner tech” may account for 34-40% of global GDP.

- Emerging technologies have enabled those with expertise in these fields to create new value chains and networks of emerging industries, particularly in biotechnology and nanotechnology (e.g. food flavouring companies now produce biofuels, and textile manufacturers use carbon fibres to produce vehicle parts for mobility, sports equipment or wind turbines).

- Emerging industries may also spring from existing industries, e.g. shale gas or “cleaner coal”.
Alongside the emerging industries, combining emerging technologies is also leading to new solutions and to the rise of secondary emerging industries.

The World Economic Forum will continue to explore the concept of emerging industries and further enable them, as well as contribute lessons learned in future gatherings such as the Annual Meeting in Davos-Klosters.

The following dimensions were addressed at the Summit:

- Emerging industries and their impact (on energy, manufacturing and mobility)
- Nanotechnology, biotechnology and biorefineries
- Advanced coal technologies, shale gas and existing industry innovation
- Advanced materials for mobility, renewables, building and energy efficiency
- Recycling and management of resources

Discussions investigated the opportunities and potential benefits, and key challenges and hurdles that must be overcome to facilitate their implementation. Also considered: how emerging technologies and industries will combine and reinforce one other to contribute new solutions, products and industries.

China’s recent 12th Five Year Plan, finalized in March 2011, makes significant reference to many areas of science, technology and innovation and to emerging strategic industries. All can provide solutions to some of the world’s mega-challenges, namely climate change, increasing demand for energy and a sustainable, clean environment.
Emerging industries and new energy are considered essential, as is the need for innovation, to change development patterns and institutional and economic trends. Today, 91% of China’s power comes from fossil energy. Policy is needed to stimulate change in areas such as solar, nuclear, wind and hydro power. It should include carbon trade and carbon tax mitigating the environmental cost. Such policies will be developed in China, and are already in place in other regions.

It was highlighted that, in China:

- On average, wind is twice the cost of coal, solar energy four times the cost, and a carbon tax on coal will cover new energy development and expansion.
- Only 10% of wind-generated energy is coming onto the grid today. There is a strong need for a smart grid, energy storage and building efficiency.
- Partners, Young Scientists and thought leaders will all be key to this transition.

Japan and South Korea have a higher R&D spend than the United States. China is poised to become a leader in R&D investment. Furthermore “frugal innovation” will be key.

Bio-based materials and energy cooperation will be crucial in the US$ 2.3 trillion chemicals market. Furthermore, the impact of biotechnology will be huge on “cleaner tech”. Energy efficiency will be improved through upgraded materials and wind energy will also benefit.

New and emerging technologies will create new and emerging industries. The chemicals industry enables well over 47% of global GDP. It is expected that IT and new technologies such as nanotechnology and biotechnology will enable GDP further. One estimate suggests that by 2050, “cleaner tech” will account for 30-40% of global GDP.

This will be essential if humans are to be a “benevolent species” rather than a “rebel organism” that consumes resources too quickly for the planet’s biosphere to rebalance and so destroys the planet in this anthropocene era.
How Biotechnology will Combine with Nanotechnology and with Innovation Solutions in Existing Industries

There is an emerging industry converging around biotechnology, illustrated by the advent of biorefineries. The World Economic Forum’s Collaborative Innovation project and White Paper on The Future of Industrial Biorefineries were highlighted. Companies that have mastered biotechnology but are not involved in traditional petroleum and oil-based refinery move more easily into this new value chain.


The impact is such that a bio-based economy is beginning to develop in a move away from a pure fossil-fuel-based economy.

Biomass is highly localized, with implications for necessary logistics and technologies to make movement more efficient. This can encourage localized biomass processing/conversion and also large-scale operations for cost efficiency. This also presents an opportunity for small-scale gasification CHP (combined heat and power) of local biomass for renewable energy for local homes and commercial buildings.

Biotechnology, which is cost effective, should lead to all products possible whereas an expensive technology should concentrate on high-value products.

Technology exists to enable more efficient carbon fixation (more efficient biomass) and to make production from biomass more efficient, such as “sugar boosters” (increasing the sugar production in plants for greater conversion to liquid fuels or chemicals).

One newly emerging technology takes CO$_2$ gas and uses solar energy to convert directly to diesel. Whether or not this should be classed as a biofuel is currently the subject of political debate.

According to some, there is enough biomass globally to meet needs comfortably and not impact negatively on food production and consumption. Estimates put supplies at 170 billion tonnes of biomass per year.

The ecological footprint is extremely important to consider – not just land use, climate change and water, but also issues such as biodiversity and ecosystem services.
The food versus fuel argument should not be an issue beyond first generation biofuels, but this is also a policy and ethical issue. New technology exists for converting agricultural waste – and waste in general – to useful chemicals.

Thomas Nagy, Executive Vice-President, Novozymes A/S, Denmark; Sue Riddlestone, Co-Founder and Chief Executive Officer, BioRegional Development Group, United Kingdom; and Lee Sang-Yup, Chairman Global Agenda Council on Emerging Technologies, Distinguished Professor, Director and Dean, Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea

Biotechnology can also be applied to reduce human dependence on food in the form of bio-based nutrition to help reduce meat consumption through more efficient crop growth, and increasing protein content in plants. Biotechnology can also alter cell phenotypes without genetic engineering.

However, there was no agreement on whether there is any single economically feasible way to use biotechnology for all its potential.

Companies engaged in this field include DuPont, Nature Works, Metabolix, Novozymes, Joule Unlimited, Dow Chemical, Exxon, Chevron, Solazyme, Eievo, Mascoma, Amyris, DSM, BASF, LS9, Genomatica, BioRegional Development Group.
Combining biotechnology with nanotechnology can yield many useful products, including better drug delivery systems, encapsulating nanoparticles in a biomaterial or making biodegradable nanoparticles and nano-materials. There is also the potential – already manifest – of bio-based synthesis of nanoparticles. Nano-based devices include improvements in the fields of diagnostics, lab-on-a-chip (assays and reactions) and therapeutics.

Nano-bioconversion is establishing a much more efficient synthesis of many useful new molecules and materials, and can combine biotechnology and nanotechnology in a stepwise process, e.g. bio-synthesis followed by use of a nanocatalyst.

Quantum dot television screens are a future consumer application for the market, but are already developed and said to be of superior quality to plasma screens.

Biotechnology combined with nanotechnology is also offering many solutions to emerging shale gas industries, including enhanced rock porosity, replacement of polluting chemicals and water treatment if contaminated. In “cleaner” coal technology, micro-organisms offer direct conversion to fuels or hydrogen.

There remain many more as-yet-unexplored applications as this emerging industry truly takes off. The potential is immense and promising.
Initial discussions centred on how nanotechnology is defined, with a focus primarily on hydrogen and fuels cells. Nanotechnology could create new industries, for example in IT and drug delivery.

Barriers identified to the adoption of nanotechnology include:

- Efficiency
- Cost
- Safety
- No established production chain
- Time and investment required (high)
- Inertia in established industries (e.g. automotive).

They need and accept change, but their approach to change moves very slowly. New fuel cells could have a real impact outside the car industry, but are stuck in ‘car industry’ development.

Discussions considered which new actors and industries are developing, and how barriers to adoption of nanotechnology can be lifted. There was consensus on the need for new players, since long-established companies will not readily innovate.

A sustainability agenda could provide impetus and it would also be useful to show that nanotech reduces costs. It is clear that there will be an impact on many industries, particularly energy, healthcare, drug delivery and imaging, and that value will be added to the entire value chain.

Through use of carbon fibres, nanotechnology has made it possible for producers of textiles to shift to making vehicles for aviation, automotive and other types of mobility industries as well as wind turbines and sports equipment. It has also enabled far more efficient photovoltaic (PV) solar panels and has the potential to develop much further still, especially when combined with biotechnology. Photo-sensitive nanomaterials are one example.
This technology is also producing new nano-enabled battery materials and batteries for smart grids, EV and nanoporous materials for new cathodes – rechargeable batteries with cations other than Lithium are being developed. Nanocatalysis is an ultimate energy-saving technology and reducer of CO₂ emissions. It is also enabling and reducing the cost of carbon capture.

More efficient building materials and more durable clothing are being created from nanomaterials. Specialized nanosize additives are improving the properties and/or degradation of plastics.

Key to this development will be:
- Researchers
- Ambassadors from different communities, namely from academia and business
- Better and multidisciplinary education systems that encourage creativity and out-of-the-box thinking

The question of the financing of nanotech adoption was raised – but will it be financed solely by venture capital and public funding?
Shale Gas and Existing Industries: How Nanotechnology and Biotechnology Build Solutions

New industrial techniques are developing rapidly and spinning off emerging industries from existing ones.

In the case of shale gas and “cleaner coal”, for example, absorbents which use nanotechnology and porous materials can produce advanced separation systems that are particularly promising for coal in particular, but also for gas.

New methods have introduced the conversion of shale gas to a feedstock for chemicals rather than for combustion/energy. This is not a cost issue – shale gas extraction is indeed cost effective. The main difficulty is, and has been, water contamination. Chemical innovation could remove much of the risk of contamination and could offer one response to France’s ban on shale gas extraction for reasons of potential water table contamination and earthquakes. In the United States, this innovation is welcomed by property owners, who receive royalty payments as incentive, whereas no such incentive exists in France.

Shale gas transformation into a new type of feedstock for both energy and chemicals/materials will be crucial to the success of this emerging industry.

The main barriers to full implementation of this emerging industry of shale gas in water include:
1. water scarcity
2. water contamination
3. local transport and pollution
4. capture
5. challenge of waste
6. the quality of cleanliness of products like sulphur and the liquefaction process

Shale gas promises to bring significant improvement to water management and, by introducing nanotechnology, barriers can be lifted to application to ocean water. The current value chain is inefficient and presents high risks such as major damage to the earth. Incentives are needed to promote shale gas extraction, e.g. favourable tax incentives.
Shale gas was not considered economically viable until recently. Pulling through solid media instead of liquid was historically challenging as was use of carbon capture for shale coal. One driving factor has been that the United States uses so much more natural gas and needs still more. Some of these needs could be met with resources on the bottom of the ocean.

The potential to capture coal bed methane is extensive, but presents many technical challenges in practice. Coal bed methane accounts for only 20% of emissions capture, and half of that is burned. Consequently, up to 90% of methane is emitted, and this is a significantly more powerful greenhouse gas than carbon dioxide. Methane can be captured from the bottom of the ocean: this has already led to the Bermuda triangle theory of methane release causing unusual events.

A large amount of coal underground cannot be mined and is a potential source of underground gasification. Tests are being done in China and Australia. Initially developed in the 1960’s and 1970’s, there has been little investment in this field in recent years.

One biotech innovation for coal introduces new micro-organisms capable of converting coal to hydrogen, chemicals or liquid fuel. Coal can also be converted directly to chemicals, hydrogen or methane and can be combusted underground using biochemical control. In addition to the issue of methane capture potential, this will require monitoring and control of any adverse effects on the water and water table.

Barriers to further development include integration of such technologies in existing plants, developing technology that can capture the volume of emissions produced today, and a lack of economic incentives for technologies that can capture the volume. This is crucial in China, where the coal reserves are massive. Other technical barriers exist to the development of localized burning methods, transport post-extraction and separation of CO₂.

Key players in these fields are oil majors with considerable gas R&D. In coal gasification, major coal companies need gas majors to address certain development issues. However, the former are not interested in coal, hence no joint ventures have yet been formed.

For both shale gas and coal, the water contamination issue calls for serious attention by all parties concerned and much work is needed. For usage and treatment there is a need to bring in biotechnology or nanotechnology for solutions development.

Comparing coal versus gas issues such as H₂ storage and contamination, access to shale gas, the US issue with “fracking”, and ageing extraction and power generation equipment all must be considered. Most notably, water scarcity and pollution risks must be resolved with respect to shale gas. As for coal, gasification combustion can be advanced via nanotechnology and biotechnology.

Collaboration between the private and public sectors is essential to interface with these areas.
Suggested solutions included favourable tax incentives and green marketing incentives.

Other potential sources of energy generation in the future will include:
- Solar
- Wind
- Storage – a whole new area of discussion of growing importance.

It will also be crucial to consider consumer behaviour and to motivate the consumer to think differently. Negative public perception of any technology can severely hinder its use. Such consumer and public issues around consumption include supply – eco-demand.
Emerging technologies are creating emerging industries: many new applications of these technologies have been developed, yet the potential for further development is still great, particularly where these technologies are combined. They are also enabling emergent industries around existing industries such as shale gas and "cleaner coal" technologies. The World Economic Forum will continue to explore, map out and promote this development.
## Annex 1

### List of Participants

**Introductory Remarks**

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<th>Name</th>
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<th>Institution/Company</th>
<th>Location</th>
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**Industry Partners**

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Annex 2
Related Private Programme sessions
Innovation Summit

The Move to Innovation: China and India
Thursday 15 September 2011

Key Points
- The momentum of innovation is already shifting towards Eastern countries; the question is how will the West cope
- Win-win solutions are possible, but not guaranteed and will require careful management
- The biggest opportunities and markets are at the bottom of the pyramid; China and India are well-positioned to adapt innovation to the needs of these new consumers

Synopsis
The centre of gravity in global innovation is shifting towards China and India, as measured by the siting of R&D centres, filing of patents and growth of the innovation value chain in developing markets. While China and India are prioritizing indigenous innovation at government level, incentives for bottom-up innovation are growing as well. These can be complementary: India is introducing a national broadband policy to bring internet access to hundreds of thousands of villages and promoting innovation-focused universities and business clusters, while Chinese cities offer favourable tax incentives to foreign multinationals to open R&D centres.

Previously, products were conceived by Western multinationals for Western markets, technical work was outsourced to China or India, and the product was then sold primarily to Western consumers. Chinese and Indian consumers, with less average buying power, were considered a secondary market. Now products might be conceived in India or China with a mind towards local markets, but if a durable and inexpensive good is produced, any consumer in the West will want it as well. Today, products might be conceived, developed and sold in any region of operations, resulting in a model of polycentric innovation.

Multipolarity of innovation is growing in both directions: Western firms expand into China and India to tap talent, cost advantages and markets in those countries, Chinese and Indian firms hire Western talent and site R&D facilities to take advantage of Western infrastructure and regulatory environments. Western firms have designed, developed and commercialized product lines in entirely Indian or Chinese contexts, building new brands in the process. Chinese and Indian firms, such as Huawei and Tata Motors, are enjoying success and brand-building opportunities in Western markets, as well as emerging consumer bases such as Africa.

Three major scenarios are identified for the future development of multipolar innovation: a “rising tide lifts all boats” outcome; a “wasted” opportunity outcome in which Western and Eastern firms fail to capitalize on each other’s respective potential; and a “zero-sum” outcome, in which national and regional-bloc competitiveness makes technological sharing and cross-market opportunities difficult, leading to more fragmentation and no clear net win.

The first option was considered most accurate by some, contending that globally integrated innovation practices can create large structural opportunities, not only bringing products to consumers, but undertaking solutions to social burdens that result from consumer behaviour, such as carbon emissions.

Amid ongoing crisis and tightening financial resources in traditional centres of innovation investment in the West, all multinationals must optimize their global value chains and recalibrate business models to acknowledge the reality of where future market growth is likely to occur. Companies with one brand identity in developed countries might create entirely new brands and initiatives on a large scale suitable to large markets like China and India’s emerging middle classes; Western corporations will have to compete with local firms to stay profitable, but effective and scalable solutions can bring huge rewards.

Beyond emerging middle classes, Eastern and Western firms alike should recalibrate their product development and marketing to start treating the “bottom of the pyramid” as potential consumers and not merely aid recipients. This market is anticipated to be 3 billion people strong over the next 10 years. Shifting innovation resources towards China and India and local engineers will push the process of innovation towards products better suited to local conditions. One medical product developed by a major multinational in India, for instance, was half the weight and one tenth the price of its equally effective Western-developed counterpart; such innovations can feed back into Western markets.
Some considered the “zero sum” option misleading, as competitiveness could continue to drive innovation and Western firms would not necessarily feel their interests threatened by Chinese or Indian growth; it was even noted that Chinese and Indian firms could compete over supplying affordable quality-of-life innovative products to Africa, without Western firms necessarily in the picture.

It was also pointed out that thus far, missed opportunities in innovation outnumber positive developments. Locally hired engineers and other staff in a multinational are not in adequate communication with counterparts in other markets, offices and headquarters, missing opportunities to leverage cross-cultural and cross-market information. To remedy this, improved humanities and arts education were advocated alongside engineering-heavy curricula typical in developing-nation academic systems. Singapore government policy has promoted improved creativity and lateral thinking through the humanities.

From the perspective of a former investment banker, while the “rising tide lifts all boats” option would be ideal, it is more realistic to remember how protective and competitive countries and corporations can be of proprietary technology; often, fear of losing a technological edge trumps the desire to capitalize on advantages of siting technological work overseas. Siting R&D facilities can be a political sop to local governments eager to be seen as innovation centres, while a corporation’s actual goal will be to increase market access.

A distinction was drawn between organic innovation – the incremental improvement of products and processes with slight benefits – and breakthrough innovation, which must occur close to the consumer. Ideas can spring from any location, one example of this being an innovation from a team in Korea which is now the backbone of the company’s infrastructure.

Most discussions had focused on innovations in products, but it was also stressed that social innovations must be prioritized in an era when high connectivity allows value-capture from large, disparate groups of innovators, and competition between cities rather than countries is an increasing driver of innovation. The ability to aggregate the efforts of many physically distant individuals is increasing the speed of innovation, though disunified patent law regimes continue to drag down the pace somewhat.

To maximally harness cross-border innovation potential for collaboration, corporations need to have confidence in a stable global order of intellectual property protection; harmonizing laws and safeguards that will increase willingness to send technology and talent abroad.

Breakout groups emphasized several key points. American firms which have diversified their innovation resources abroad seem to have been more successful than those which kept to traditional strengths at home. Technology differs so greatly from sector to sector that there cannot be any single formula beyond rotating management and lower-level staff alike through international postings. One successful strategy involved the formation of a South-South innovation advisory committee outside the centralized management structure of a Western firm, giving independent advice and an alternative viewpoint on developing-world innovation alternatives and frugal innovation ideas for top management seeking to diversify. Diasporas were identified as a key human capital resource.

Cultural differences between China and India were also discussed, the latter being identified as more individualistic, though both share common difficulties in regulatory and educational obstacles to cultivating innovative talent. Lack of an international patent regime, such as a “Patent WTO”, was identified as a major obstacle to cross-border innovation processes. However, Western practices for approval of products such as medical devices may make less sense for developing countries where potential lower-income customers have fewer treatment alternatives. Short-term tax incentives are one way for governments to take initial steps to foster innovation that supports policy priorities; other instances of government initiatives leading to private-sector action include Singapore’s encouragement of water-management innovation.

Key Quotes
“Protectionism is a risk, but given growth potential and age demographics, there is space for everyone.”

“We run our company more like a jazz band than a symphony orchestra – we do our own thing and improvise, but still make music together.”

“If the notion of social innovation becomes part of your core business model, then you won’t see the different between what is social and what is corporate. Good for society is good for your bottom line.”
Annex 3
Related Sessions in the Official Programme

All session summaries can be downloaded on pdf under this link:
http://www.weforum.org/events/annual-meeting-new-champions-2011?idsessions=97933

IdeasLab with Georgia Tech: Connectivity and Social Interaction
Embracing Disruptive Innovation
Insights from Emerging Markets: Urban Development
Global Shapers Community: Meet a Technology Pioneer
Charting a Low-carbon Route to Growth
Breakthrough Buildings: Chinese Architecture
Innovating in Intellectual Property
IdeasLab with Nature Magazine: Disruptive Innovation
From the Frontier: Solar Energy
Insights from Emerging Markets: Frugal Innovation
From the Frontier: Advanced Materials
IdeasLab with Scientists: Recharging Science in Society
Hardwiring Innovation
New Solutions: Resource Scarcity
IdeasLab with McGill University: Food Security through Innovation
IdeasLab with the University of Oxford: Technology for Society
From the Frontier: High-end Manufacturing
Growth through Science
Arts at the Centre of Quality Growth
The New Energy Architecture in Emerging Markets
Technology without Borders
From the Frontier: Information Technology
Technology Pioneers: Taking Innovation to Market
Ensuring further collaboration in North-East Asia
New Sustainability Champions
Future of Urban Development Project Meeting
Closing of Private Programme: Transformation and National Competitiveness
Unlocking Creative Potential
New Frontiers of Consumption
Entrepreneurial Excellence
New Realities, New Champions
Entering the Hybrid Age: The Future is Now
Scientific Solutions to Global Challenges
Innovate to Compete
Mastering Quality Growth: Passing the Test of Technology
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