Franz Knecht, Managing Partner
Markus Althausen, Partner

White Paper
Global Megatrends & Risks

- **WEF Global Risks 2015**
- **EU EEA SOER 2015**
- **PWC Trends**
- **KPMG Trends**
- **WBCSD Trends**
- **WWF Threats**

In July 2014 the CO2 content in the atmosphere surpassed the critical value of 400ppm for the first time since observations began in 1958 (at 350ppm). Scientists recommend limiting the CO2 content in the atmosphere to a maximum of 450ppm in order to keep the expected increase in global temperature below the +2°C target.

In the meantime carbon emissions from the previously dominating emitters – the US and Europe – continue to decrease. The US emissions decline due to the switch from coal & oil to natural gas, primarily because of the fracking boom. EU emissions decrease mainly because of the economic difficulties in Europe.

Six recent publications[1] by international organizations and major consulting companies have produced significant insights into global risks & megatrends for the coming decade (see graph on page 2). **CONNEXIS** has analyzed and condensed the different perspectives and their impact on financial institutions into one concentrated report.

Most of the analyzed risks & trends are beyond the control of financial institutions, but they do have significant impacts on their portfolios. As these risks & trends evolve over the coming years it will be critical for financial institutions to

- Identify their individual exposure to each megatrend and risks,
- Price them correctly and
- Adapt policies accordingly

Moreover, financial institutions should implement their own individual radar process to identify new & additional risks as they evolve.

Megatrend 1: Climate Change

Climate Change is the key common risk equally identified by all six analyst teams.

Negotiations and Politics

Since the end of the Kyoto Protocol in 2012 politicians have been struggling to agree on a new international climate change treaty. The negotiations revolve around binding emissions targets for all participating countries (developed and developing nations alike) and financial support for developing nations.

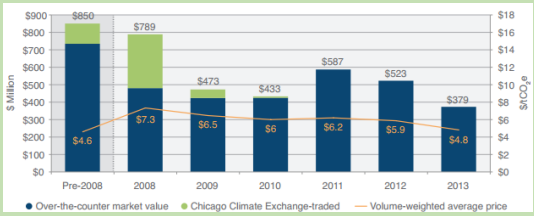
In November 2014 the two largest carbon emitters, the US & China, announced a new strategic agreement under which the US will reduce its carbon emissions by at least 25% by 2025 and China will curb its emissions in 2030 [2]. This agreement was the first official target that China has accepted since the beginning of climate change negotiations.

The Compliance Carbon Market

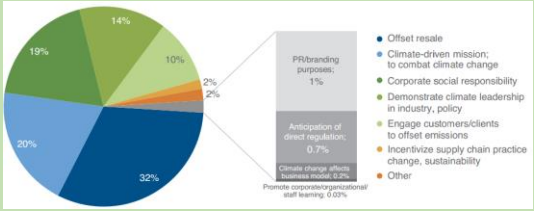
The dominating international compliance allowance and offset market (European Union Trading Scheme, EU ETS) has suffered severe setbacks with prices[4] as low as €6.8 (EUA) and €0.4 (sCER) in Q1 2015. The key reason for this price decline has been an oversupply of allowances and a weakened demand, primarily due to the economic crisis in Europe since 2008. At the same time domestic (in Mexico, China, California, Switzerland, Korea etc.) and regional cap-and-trade markets (Regional Greenhouse Gas Initiative, Alberta Greenhouse Gas Reduction, Quebec Cap and Trade etc.) have emerged in the past years[5].

Voluntary Carbon Markets

While compliance markets have suffered severe price cuts and setbacks in the past years, the voluntary markets have remained comparatively strong. Prices registered under the Gold Standard have reached average prices of over US$8 per tCO2e in 2014[3].



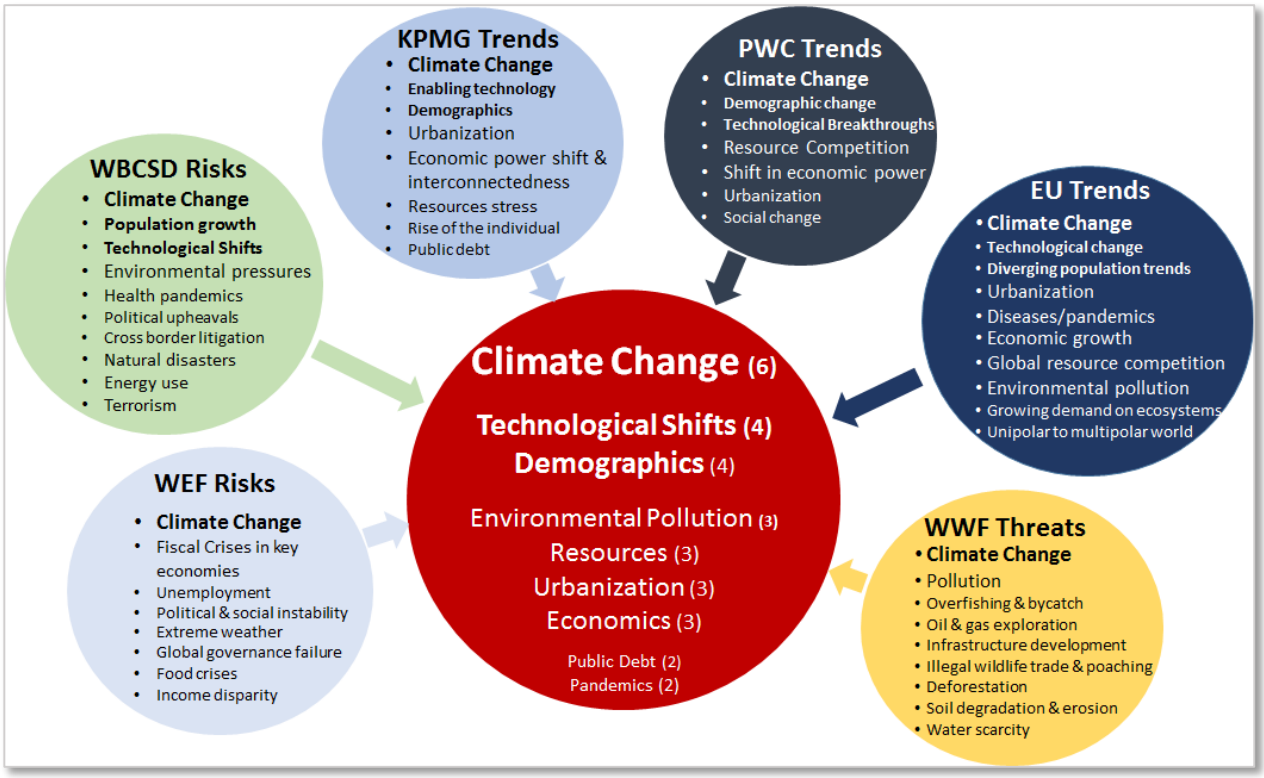
Almost 70% of voluntary buyers have primarily non-commercial motivations (CSR, fighting climate change, etc.) to purchase voluntary carbon offsets[3].



Climate Change - The Road to Paris

Over the past three years negotiators have worked on closing the gap between the positions of developed countries & their

CONNEXIS AG, Sustainability Consulting
St. Jakobs-Strasse 108, 4052 Basel, CH
www.connexis.ch



developing partners. The Conference of the Parties in Paris in 2015 (COP 21) is expected to deliver a new global climate change agreement[6].

Based on the recent agreement between the US and China international observers agree that hopes have not been higher for a new agreements since COP 15 in Copenhagen. By end of November the world will hopefully have a new binding climate change treaty.

Implications for Financial Institutions

Through their loan and investment portfolios as well as their insured risks financial institutions are constantly exposed to climate change risks in many direct and indirect ways (regulation, weather extremes, customer behavior, impact on BES - biodiversity & ecosystem services, water shortage, impact on collateral etc.).

At the same time financial institutions are expected to an in many cases can exercise strong influence on their customers' decisions by pricing climate change risks into their risk management models and decisions.

However, as the primary regulatory pressure on banks is on financial stability and not (yet) on contributing to environmental or social sustainability, many financial institutions continue to ignore climate change as a major underlying risk in their portfolios.

Given the broad recognition of Climate Change as *the* key risk by all six reviewed reports this approach seems to be a potentially costly mistake.

Financial institutions should therefore consider to systematically analyze their existing portfolios for climate change risks and build climate change into their risk management tools.

Not only will such an approach begin to address existing climate change risks in their portfolios and correctly price climate change risks into new engagements. It will also have a direct and lasting influence on the investment decisions by bank customers and thereby begin to fight climate change itself.

Megatrend 2: Technological Shifts

Technological shifts refer to unexpected fundamental technological leaps that impact specific applications and can sometimes change entire industries. In some cases one company can be responsible for technological game changers in more than industry, like Apple has demonstrated in the digital music market (iTunes), the mobile telephone market (iPhone) and the computer market (iPad).

These technological shifts can directly influence individual companies (Nokia, Blackberry). Often these technological shifts can change entire

Global Megatrends as seen by the EU (SOER 2015)

Diverging Population Trends	Developed world ages & shrinks, LDC populations grow rapidly
Urbanization	2015: 50% live in cities; 2050 67% live in cities
Disease Burden, New Pandemics	Mobility, climate change, poverty & trade increase risks for new pandemics
Technological Change	Radical & possibly disruptive changes from nano-, bio-, information- & communication technologies
Economic Growth	Continued economic expansion in LatAm+Asia, w/ growing consumption & resource use
Unipolar to Multipolar World	Previously: economic power in Europe+US; Future: Europe, US, Asia, BRICS, G20, etc
Global Resource Competition	Growing economies need more resources, renewable & non-renewable
Growing Demands on Ecosystems	Population growth+consumption patterns=more food & energy needs, biodiversity loss, ecosystem degredation
Consequences of Climate Change	Food security, drought frequency, rising sea levels, extreme weather
Environmental Pollution Load	Human activities, population growth + consumption patterns drive critical pollution levels

countries or industries. Recent examples are the decline of CD sales and the music industry as a result of the development of the mp3 compression algorithm or the collapse of the German solar PV manufacturing industry after China entered solar PV manufacturing.

In 2015 we are in the middle of another major technological shift, possibly the most profound since the industrial revolution in the 19th century[7].

Four (WBCSD, KPMG, PWC & EU) of the six reviewed reports consider technological shifts and their implications and consequences as a key global megatrend and/or risk.

Over the past 18 months some of the greatest computer and AI experts

- Stephen A. Hawking (Nobel laureate)
- Bill Gates (Microsoft co-founder)
- Elon Musk (PayPal/Tesla co-founder)
- Steve Wozniak (Apple co-founder)

have warned about potential technological shifts as well as possibly dramatis developments in AI and Big Data.

AI, Biotech and Renewable Energy

Artificial Intelligence (AI), Big Data & Robotics

In 1965 Gordon Moore, co-founder of Intel observed that the number of transistors per square inch had doubled every two years since the integrated circuit had been invented[8]. Moore's Law predicted that this trend would continue into the future and his prediction is still correct in 2015.

This exponential growth in computing power has already led to widespread automation of large parts of human life. Recently, the combination of

- More computing power,
- Better software algorithms and
- Faster telecom infrastructure

has increasingly allowed automation to also enter higher value applications.

The same "e-discovery" software that was initially developed to identify illegal copying in academic papers is now being used to analyze complex documents in the US legal system, more and more replacing entry level positions in law firms[9]. Partially self-driving cars are expected to be available for purchase as early as 2017, with fully autonomous vehicles expected from 2020[10].

In parallel *Big Data* is beginning to revolutionize marketing/sales/CRM as well as the content industry (TV, publishing etc.).

Over the past 30 years the perceived advances in hardware development (primarily *Robotics*) have been seen as incremental. Today robots are still not able to perform the simplest everyday tasks fully autonomously. However, in combination with rapid increases in computing power and exponentially growing amounts of available data shared on a global scale, many experts see a fundamental technological shift looming around the corner.

Biotechnology

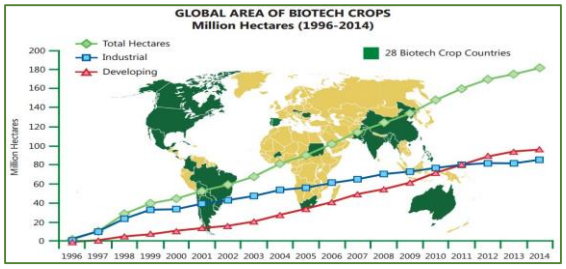
Biotech companies are now using individual genomic profiling to develop individualized cancer treatments that can substantially increase survival rates. New biotech drugs for Hepatitis C now provide a cure for the previously untreatable deadly diseases. Around 185MM people are infected with the disease worldwide. Up to 500,000 people are estimated to die from its consequences annually. The latest treatments developed by biotech companies like Gilead and AbbVie can cure patients within 12 weeks, but cost up to US$1,000/day (US$84,000 per patient)[11]. In the US alone Hepatitis C treatment costs are expected to exceed US$20bn/year.

The additional costs of these new biotech treatments are so high that healthcare providers and insurance companies worldwide are struggling to offer these options to patients. The decision by public health insurers in countries like the UK and Austria to delay the introduction of the new Hepatitis C drugs - citing high costs – have drawn strong criticism from stakeholders. This fundamental shift in healthcare may put the very essence of health insurance into question.

Global Risks of Highest Concern as seen by the World Economic Forum

No.	Global Risk
1	Fiscal crises in key economies
2	Structurally high unemployment/underemployment
3	Water crises
4	Severe income disparity
5	Failure of climate change mitigation and adaptation
6	Greater incidence of extreme weather events (e.g. floods, storms, fires)
7	Global governance failure
8	Food crises
9	Failure of a major financial mechanism/institution
10	Profound political and social instability

In agriculture the use of genetically modified organisms (GMOs) can substantially increase productivity. In 2010 the FAO's ABDC-10 conference[12] concluded that '*agricultural biotechnologies can help to alleviate hunger and poverty, assist in adaptation to climate change and maintain the natural resource base*'.



However, it is also feared that biotechnology and GMOs may make farmers permanently dependent on GMO providers and significantly endanger biodiversity and ecosystem services.

From Fossil Fuels to Renewables

In 2014 the LCOE (Levelized Cost of Electricity) for biomass, hydro, geothermal and onshore wind reached grid parity. In many countries it is now the cheapest form of electricity[13]. As a consequence, since 2012 more investment has flown into renewable than into fossil generation[13].

In parallel LCOE for solar PV has halved between 2010 and 2014 and is expected to reach grid parity in the early 2020s[13].

Base-load power & storage remain challenges for solar PV & wind, but improvements in battery & smart grid technologies look promising.

The accelerating shift to renewable & decentralized power generation has a substantial impact on the global power generation & distribution sector The fact that renewables currently only make up 19% of global generation illustrates how massive the impact of the transition to renewables will be in the coming years. Especially for owners & investors in traditional energy industries.

Electricity LCOE
(in US$/MWh$_{el}$)

Fossil Fuel US$ 45-140

Renewables
- Hydro US$ 40-120
- Wind onshore US$ 50-150
- Wind offshore US$ 90-220
- Solar PV US$ 80-400
- Solar CSP US$ 180-280
- Geothermal US$ 40-110
- Biomass US$ 50-180

Source: IRENA[17]

Implications for Financial Institutions

AI, Biotech and Nanotech will fundamentally change the way we live over the next 10 years as well as the next 30 years.

The shift from fossil to renewable power generation is expected to accelerate in the coming years. At the same time renewable energy generation is not without its own risks.

The direct commercial rewards (winners) and risks (losers) of these fundamental developments are already in the books of financial institutions today. In many cases however, they are neither identified nor priced accordingly.

One Step Further

Additionally financial institutions need to look beyond immediate direct commercial impacts in order to identify future risks and opportunities in their existing portfolios as much as new engagements.

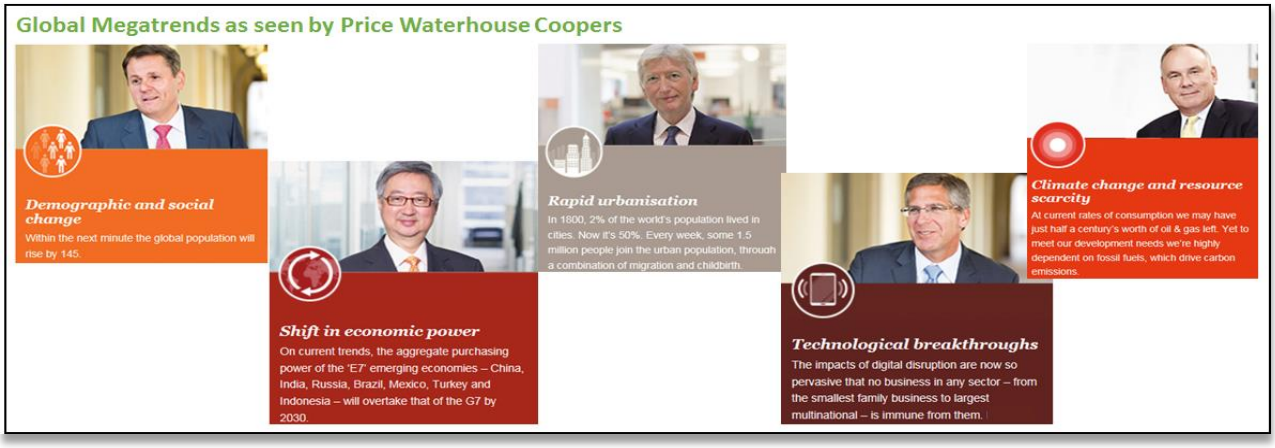
Radar Process

Ideally Financial Institutions integrate scouting systems (specific Advisory Boards, stakeholder engagement) into their organizations to

- detect technological shifts at an early stage &
- distinguish real signals of change from noise

Building Resilient Organizations

Ultimately the best risk detection and management system will only be as effective as the organization itself. With their constant and simultaneous indirect exposure to almost all industries Financial Institutions are particularly challenged to develop resilient organizations, i.e. organizations that will autonomously return to a sustainable equilibrium after a shock. This may depend more on the training & mindset of human personnel than on computerized expert systems based on algorithms and math.



Megatrend 3: Environmental Pollution & BES

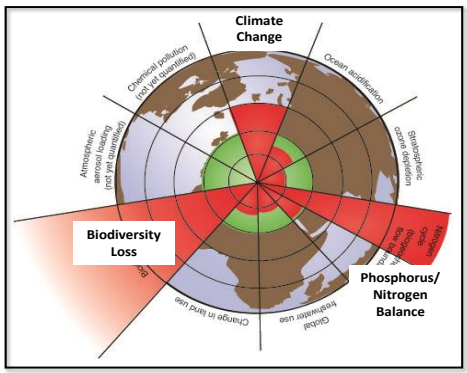
By damaging or even destroying habitats environmental pollution has a direct negative impact on Biodiversity and Ecosystems Services (BES), which form the very foundation of human life. Several key industrial sectors (e.g. food production/distribution, forestry/paper, tourism, etc.) are already highly at risk by BES challenges

In its SOER 2015 report the EEA (European Environment Agency) states that[14]

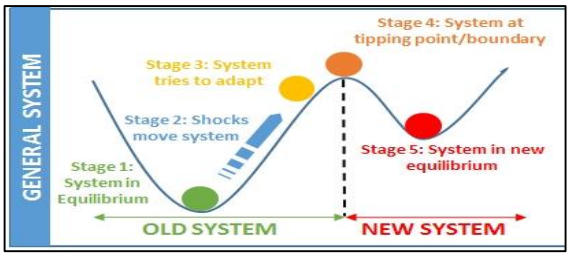
> "*Despite many successes of EU environmental policies since the 1960s, we struggle with addressing long-term systemic environmental challenges.*"

In the meantime environmental pollution resulting in wide ranging destruction of BES in key emerging economies (e.g. China, India, Brazil, Indonesia etc.) are becoming increasingly visible to the broad public & entering general awareness.

In a recent report[15] the Stockholm Resilience Center (SRC) concludes that mankind has crossed significant thresholds in three (biodiversity loss, climate change, phosphorus/nitrogen balance) of nine so called *Planetary Boundaries*.



The SRC concludes that by crossing these critical tipping points we may push the planet's ecosystem beyond its point of resilience into a new undesired equilibrium (e.g. higher average temperatures & sea levels, widespread desertification, etc.)



Implications for Financial Institutions

Environmental pollution and its impact on BES is a serious & fundamental risk in several key industries.

Awareness – Identification – Pricing or Deselection

Financial institutions need to be aware of these strategic risks to their existing and future portfolios in order to be able to

1. Identify & quantify their individual exposure
2. Integrate these risks into their risk management policies and procedures
3. Price these risks correctly & transparently
4. Mitigate the consequences of these risks
5. Enable the customer to understand his own risks

Prices Change Behavior

Primarily this market approach will help financial institutions limit the consequences of environmental pollution and BES risks on their own portfolios.

Additionally the pricing mechanism will send a clear signal to polluters as well as industries at risk that their actions have a direct quantifiable impact on their own business model and not 'only' on the general public.

As a positive side effect financial institutions will also be able to point to such a market-based approach as a very effective tool in their own

Megatrend 4: Global Resource Competition

In 2010 the European Commission defined ***14 Critical Raw Materials***[16] that are

- Non-renewable resources with a
- High risk of shortage over the next 10 years & of
- Key importance to the EU value chain

Nine of these fourteen critical raw materials are located in China, with Chinese market shares between 51% (Gallium) and 91% (Niobium). In Rare Earths Chinese market share is currently 95%.

Many of these critical raw materials are essential to such industries as electronics (cell phones, computers, etc.) or wind turbines and lasers (Neodymium). Some of these raw materials (e.g. Rare Earths, Neodymium) are produced under strong environmental pollution impacting heavily on local and regional biodiversity through negative systemic effects on local and regional ecosystems – demonstrating the interconnections between several global megatrends.

Since the world food price crisis in 2007-08 *land grabbing* & related *water grabbing* by foreign investors especially in the Southern Hemisphere has grown substantially. Food supply security is often cited as one primary reason. While China has 20% of the world population it has only 8% of the arable land and only 6% of the planet's fresh water reserves. Land grabbing is also associated with deforestation for biofuel production, a key motivation behind transnational land transactions.

14 EU Critical Resources

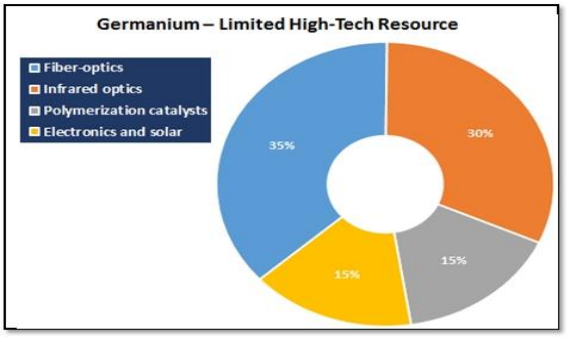
- Antimony (PRC 84%)
- Beryllium (USA 90%)
- Cobalt (DRC 55%)
- Fluorspar (PRC 63%)
- Gallium (PRC 51%)
- Germanium (PRC 68%)
- Graphite (PRC 70%)
- Indium (PRC 57%
- Magnesium (PRC 86%
- Niobium (BR 71%)
- Platinum (RSA 74%)
- Rare Earths (PRC 95%)
- Tantalum (MOZ 34%)
- Tungsten (PRC 85%)

Source: EEA[16]

As economic power shifts more towards Asia, its strongly growing economies require more resources to satisfy the strong growth in domestic & international consumption.

At the same time Asia and the EU remain net raw material importers[16] (e.g. EU imported 57% of metal ore & 58% of fossil fuels in 2012). While the dependence on fossil fuels can be reduced through the shift towards renewable energy sources, most of the 14 critical raw materials can currently not be replaced.

Even in advanced technologies the EU is critically depended on imports. Germanium is an essential raw material in advanced industries such as fiber- & infrared optics, polymerization or electronics & solar PV. However, China controls 68% of the world Germanium production.



At the same time EU wind industry is becoming more and more dependent on Neodymium for direct drive wind turbines, while China controls 90% of global Neodymium production.

Implications for Financial Institutions

Most financial institutions are indirectly affected by global resource competition. Their portfolios contain large numbers of customers who will be strongly impacted by the changes in global resource streams.

Identifying the Portfolio Risk

Just like the EU Commission has identified the 14 most critical raw materials for its economic development, financial institutions should develop a *catalogue of critical resources* with substantial effects on their portfolios. This catalogue should be integrated in the financial institutions' risk management policies as well as in their risk evaluation and pricing.

Influencing the Customer

Financial institutions cannot directly influence the forces behind global resource competition. As a consequence they need to focus on the mitigation of impacts by influencing customer behavior.

Lending banks for example can engage with their customers in the EU wind industry to ensure that borrowers become less dependent on Neodymium from China (through innovation, design changes, alternative supply chains etc.). For wind industry companies who continue to single-source their raw materials from China lending banks can increase the risk factor in their internal risk management.

Systemic, Inter-connected Risks

Many of the risks analyzed in this report are single system risks that can develop into systemic risks thru inter-connectedness.

Population growth & income rise

Population growth in combination with a trend towards urbanization & a global increase in purchasing power drive demand on ecosystems as much as environmental pollution, pressure on BES & global resource competition.

Technological Shifts are the Big Unknown

Technological shifts in AI & biotechnology may fundamentally change the way the growing world population develops & lives in the coming decade(s).

For financial institutions it will be critical to

1. Detect trend signals as risks or opportunities at an early stage
2. Separate signals from noise

With true signals identified financial institutions can

1. Quantify the impact of these signals on a range of tangibles: costs, value of collateral, own portfolios, customer assets and last but not least reputation threats.
2. Adapt their risk management & policies
3. Price these risks accordingly & transparently

As a positive side effect these measures will influence customer behavior to better understand their own risks and act accordingly.

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Glossary of Terms

AI	Artificial Intelligence
BES	Biodiversity & Ecosystem Services
BR	Brazil
BRICS	Brazil, India, China, South Africa
CDM	Clean Development Mechanism
CO2	Carbon Dioxide
COP	Conference of the Parties
CRM	Customer Relationship Management
CSP	Concentrated Solar Power
CSR	Corporate Social Responsibility
DRC	Democratic Republic of Congo
EEA	European Environmental Agency
EUA	European Union Allowance
EUETS	European Union Trading Scheme
FAO	Food and Agriculture Organization
GMO	Genetically Modified Organism
IRENA	International Renewable Energy Agency
LCOE	Levelized Cost of Electricity
LDC	Least developed countries
MM	Million
MOZ	Mozambique
MWh_{el}	Megawatt hour electric
ppm	Parts per million
PRC	People's Republic of China
PV	Photovoltaic
PWC	Price Waterhouse Coopers
RSA	Republic of South Africa
sCER	Secondary Certified Emission Reduction
tCO2e	Tons of CO2 equivalent
SOER	State of the Environment Report & Outlook
SRC	Stockholm Resilience Center
WBCSD	World Business Council on Sustainable Development
WEF	World Economic Forum
WWF	World Wide Fund for Nature

About the Authors

Franz Knecht *(lic. iur.) works with financial institutions in sustainable development since 1991. As corporate representative of SBC (today UBS) he was active in WBCSD workgroups & participated in many trend studies. Latest, in 2014, he participated in the SOER 2015 of the EU.*

Markus Althausen *(MSc) is Partner at Connexis focused on climate change & renewable energy. He was previously an investment banker for RIAG, a strategy consultant with KPMG and VP Operations at AgCert plc.*

Contact us at info@connexis.ch to start a conversation about the trends, risks & responses in your portfolio.