Climate change and market based mechanisms

Jouni Keronen, PhD, MBA

The presentation was done as a private person and expert. Expertise gained in many development positions in the energy field, mainly in Fortum Oyj, as a docent (="adjunct professor") Lappeenranta University of Technology, as a Senior Advisor to Sitra – The Finnish Innovation Fund, as a founding member of the Stormwarning association and as a CEO of Here-to-There Consulting Oy.
By continuing living as today, we need more planets.

Between 1970-2009 gross world production grew 55 trillion USD (18-73)

In 1970 the Global Ecological Footprint was 100%. After that it has raised 50%. I.e. In parallel with 55 trillion GDP growth, Global Economical Footprint grew 50%.

If world GDP continues to grow 3.2%/y (2.5% economy + 0.7% population growth), it will be around 250 trillion in 2050.

If the ratio between the GDP and Ecological Footprint growth remains the same than during last 40 years, the Global Economic Footprint will grow more than another 150%, i.e. We would need the resources of 3-4 earths.

Source for GDP and PG growth estimates: P. Gilding; The Great Disruption; How the climate crisis will transform the global economy, Bloomsbury 2011
It is *virtually certain* that the upper ocean (0-700 m) warmed from 1971 to 2010, [...] . It is *likely* that the ocean warmed between 700 and 2000 m from 1957 to 2009.
Without more mitigation, global mean surface temperature might increase by 3.7° to 4.8°C over the 21st century.
International Energy Agency 10 June 2013

Today world is not on track to meet the target agreed by governments to limit the long term rise in the average global temperature to 2 degrees Celsius (°C). Policies that have been implemented, or are now being pursued, suggest that the long-term average temperature increase is more likely to be between 3.6 °C and 5.3 °C (compared with pre-industrial levels), with most of the increase occurring this century.

Increased use of fossil fuels has diluted the benefits gained by Efficiency improvements and renewables.

Figure illustrates that the share of low- or no-carbon energy sources is still small.
GHG emissions accelerate despite reduction efforts. Most emission growth is CO\textsubscript{2} from fossil fuel combustion and industrial processes.
... and the 2°C carbon budget is exhausted soon.

Note: the % in brackets are the chances of limiting warming to 2°C
Data: Budget - IPCC WGI AR5. Historical - Global Carbon Project
Note: assumes limited further non-CO2 forcings as per RCP 2.6 shrinkthatfootprint.com
Transition towards a Solar Economy

Solar Economy
Solar based production with high overall system efficiency

Sun
Wind
Ocean
Geothermal
Bio
Hydro

Advanced energy production
Energy efficient and/or low-emission production

Traditional energy production
Exhaustible fuels that burden the environment

Oil
Coal
Gas

CHP
CCS

Finite fuel resources
Large CO2 emissions

Infinite fuel resources
Emissions free production

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In order to avoid catastrophic temperature increase, we must stop the increase of greenhouse gas emissions and get them into decreasing trend in about 10 years.

Sources: IEA ETP 2008, Princeton University, Fortum
... via following or similar ways...(indicative examples)

**Efficiency**

- Halving emissions from all passenger vehicles
- Halving car mileage (600 million cars, 2 billion 2055)
- Use best efficiency practices in all buildings (Replacing all incandescent bulbs = 1/4 wedge)
- Doubling the efficiency of coal-fired power stations (Average efficiency 32%)

**Decarbonizing of power**

- Build 1400 GW of capacity powered by natural gas instead of coal (60% of current fossil fuel electric capacity)
- CCS at 800 GW coal electric plants (800 large plants, 3 projects on-going)
- Build 500 1500 MW nuclear plants by 2060 (rate of installation equal to the rate 1975-1990)
- Build 220.000 3 MW wind power plants
- Install 5,000 km2 (=12.5% Switzerland, Fortum estimate, 2GtCO2)

**Decarbonizing of fuel**

- Capture CO2 at H2 plants (H2 output from fossil fuels: 400 Mt)
- Capture CO2 at coal-to-synfuels plants (30 million barrels per day)
- Produce H2 by wind power (needs 4 m 1 MWp windmills)
- A bio crops plantation equalling of India (>3 200 000 km2)

**Forests and agricultural soils**

- Eliminate tropical deforestation or plant new forests over an area the size of the continental U.S.
- Use conservation tillage on all cropland, leaving the previous year’s crop residue on fields before and after planting the next crop, to reduce soil erosion and runoff (1600 Mha)

Sources: IEA ETP 2008, Princeton University, Carbon Mitigation Initiative, Fortum
New game: solar economy, gas revolution, storages, market models, large investment opportunities

- Solar Economy: Solar-based production with high overall system efficiency
- Wind- and Solargeneration in Germany: Spring 2011
- Transition towards a Solar Economy: Advanced energy production
- Traditional energy production: Exhaustible fuels that burden the environment
- Compressed Air Energy Storage (CAES)
- Pumped Hydro Storage (PHS)
- Hydrogen SNG

![Image of storage capacities and annual clean energy into $trillion by 2030]

**Table 1: Energy consumption and storage capacities in Germany (2008)**

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Electricity [TWh/a]</th>
<th>Natural Gas [TWh]</th>
<th>Liquid fuels [TWh]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>615</td>
<td>930</td>
<td>707</td>
</tr>
<tr>
<td>Average output</td>
<td>70</td>
<td>1062</td>
<td>81</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>0.04&lt;sup&gt;ii&lt;/sup&gt;</td>
<td>2174</td>
<td>250&lt;sup&gt;ii&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mathematical storage coverage&lt;sup&gt;iii&lt;/sup&gt;</td>
<td>0.6</td>
<td>2000</td>
<td>3100</td>
</tr>
</tbody>
</table>

Annual clean energy into $trillion by 2030
The investments and money flows define our future and today majority goes fossil fuels …

J Leggett, M Campanale, Grantham Research Institute on Climate Change and the Environment, London School of Economics / Unburnable Carbon 2013: Wasted capital and stranded assets

Over 1400 1000 MW plants, inv. Cost over 1 trillion

NEW INVESTMENT IN CLEAN ENERGY FELL 11% IN 2012
14 January 2013
overall global investment in 2012 was $268.7bn, down from a revised figure of $302.3bn in 2011.

Bloomberg
NEW ENERGY FINANCE

... but if we want to have only 2DS, we could burn only one third of the existing fossil reserves ....

Money flows 2011 ($billion)
- New fossil reserves $674
- Planned coal plants >$1000
- Subsidies $523
- Clean energy investments $269
- Subsidies $88
## Underlying drivers for energy investments

<table>
<thead>
<tr>
<th>Driver</th>
<th>Visibility for the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fundamental drivers and parameters</td>
<td></td>
</tr>
<tr>
<td>• Electricity demand; cost of capital; exchange rate</td>
<td>![Yellow] Medium uncertainty</td>
</tr>
<tr>
<td>2. Electricity price development</td>
<td>![Red] Large uncertainty</td>
</tr>
<tr>
<td>• CO2, uncertain future in carbon pricing</td>
<td></td>
</tr>
<tr>
<td>• Coal, oil, gas; uncertainty related to climate targets</td>
<td></td>
</tr>
<tr>
<td>3. Energy market dynamics</td>
<td></td>
</tr>
<tr>
<td>• Subsidies by governments, Market designs;</td>
<td>![Yellow] Medium uncertainty</td>
</tr>
<tr>
<td>4. Country risk</td>
<td></td>
</tr>
<tr>
<td>• Local taxes (windfall, property taxes etc.)</td>
<td>![Yellow] Medium uncertainty</td>
</tr>
<tr>
<td>5. Increased requirements for nuclear; uncertain future</td>
<td></td>
</tr>
<tr>
<td>6. Infrastructure not upgraded in sufficiently (transmission)</td>
<td></td>
</tr>
</tbody>
</table>

![Yellow] = medium uncertainty  
![Red] = large uncertainty
Decarbonisation requires European energy markets integration

Natural production areas of renewables:
- Hydro energy
- Wave energy
- Wind energy
- Bioenergy
- Solar energy

Transmission Needs:

Source: Fortum
We challenge decision makers to develop energy market integration and a predictable and strong carbon price.

- National RES and EE schemes
- National carbon price floors/taxes
- National capacity mechanisms
- ETS as the key driver
- Strong innovation policy
Success stories in emissions trading

- North America SO2 trading; Full success
  - Sulphur dioxide emissions down faster than predicted and at one-fourth of the projected cost
  - The Economist: "the greatest green success story of the past decade."

- EU Emission Trading System (ETS); Potential success
  - Largest operational system with 11,000 installations
  - Technically working as planned and delivering the emission reduction target
  - Current oversupply of allowances is a consequence from overlapping policies and economic downturn
  - Could be improved for full success for example via dynamic allowance supply adjustment mechanism.
Towards global carbon pricing

Carbon price
- Incentive for low-carbon investments
- Extra cost for high-carbon investments
- Internalises the external cost

Cap-and-trade
- Technology neutral
- Flexible and cost-efficient
- Enables global optimisation
- Enables technology transfer and capability building to developing countries

Global scope
- Climate change a global challenge
- Global solution and collective will required
- Competitiveness distortions to be avoided

The way forward
- Linking of regional trading schemes
- Economic cooperation organisations in a key role
Current and proposed emission trading schemes

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Source: IEA Redrawing the energy-climate map. 2013.
Investors waking up for carbon risks …

Table IV.1 | Public International Financiers of Coal-Fired Power Plants

<table>
<thead>
<tr>
<th>Public Financial Institution</th>
<th>Country of Origin</th>
<th>Total Financing (in million US$)</th>
<th>Number of Projects Financed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan Bank for International Cooperation (JBC)</td>
<td>Japan</td>
<td>8,138.05</td>
<td>21</td>
</tr>
<tr>
<td>World Bank Group (EBRD/VDB/FC/IDA)</td>
<td>Multilateral</td>
<td>5,215.40</td>
<td>29</td>
</tr>
<tr>
<td>Asian Development Bank (ADB)</td>
<td>Multilateral</td>
<td>3,912.95</td>
<td>23</td>
</tr>
<tr>
<td>US Export-Import Bank</td>
<td>United States</td>
<td>3,478.00</td>
<td>17</td>
</tr>
<tr>
<td>European Investment Bank (EB)</td>
<td>Multilateral</td>
<td>2,510.04</td>
<td>9</td>
</tr>
<tr>
<td>Nippon Export and Investment Insurance (NEXI)</td>
<td>Japan</td>
<td>2,085.48</td>
<td>6</td>
</tr>
<tr>
<td>Kreditanstalt für Wiederaufbau (KfW)</td>
<td>Germany</td>
<td>1,769.15</td>
<td>6</td>
</tr>
<tr>
<td>China Development Bank</td>
<td>China</td>
<td>1,680.00</td>
<td>3</td>
</tr>
<tr>
<td>KfW IPEX-Bank</td>
<td>Germany</td>
<td>1,174.14</td>
<td>6</td>
</tr>
</tbody>
</table>

Hedegaard urges development banks to divest from fossil fuels

From: Institute for Governance & Sustainable Development
Published September 5, 2013 04:10 PM

Obama gains allies for de-funding coal plants, expanding cuts in short-lived pollutants

Focus on heads of government critical for fast, near-term mitigation in Arctic, elsewhere

Leader focus also critical for success with UN climate treaty in 2015 treaty

Stop fossil fuel subsidies: Hedegaard

BY CONNIE HEDEGAARD
ABC Environment 10 Apr 2013

The World Bank has joined an expanding list of international bodies calling for an end to fossil fuel subsidies. The time is right for European banks to lead the way.

Washington, DC, 5 September 2013—During his visit to Sweden yesterday, President Obama gained allies in his effort to stop coal plants when the leaders of Denmark, Finland, Iceland, Norway, and Sweden agreed to join the U.S. “in ending public financing for new coal-fired power plants overseas, except in rare circumstances.” The leaders also agreed “to secure the support of other countries and multilateral development banks to adopt similar policies,” and “to continue their work, in all appropriate channels, to reduce the use of domestic fossil fuel subsidies globally.”

Norway’s oil fund to debate ending fossil fuel investments

By Richard Milne in Oslo

Norway is to debate whether the world’s largest sovereign wealth fund – funded by petroleum revenues – should stop investing in oil, gas and coal companies.

The two governing centre-right parties and two of their allies have agreed to set up an expert group to look into the $840bn oil fund’s investments in fossil fuels and report back in a year’s time.

Storebrand, one of Norway’s largest private investors, has excluded many fossil-fuel related companies from its funds on sustainability grounds and has urged the oil fund to do the same.
AP4 retreats from carbon

October 11, 2013 | 0 Comments | print

The $38-billion Fourth Swedish National Pension Fund, AP4, one of a group of five state-owned pension funds, plans to invest in a tailored emerging markets fund comprising companies that have both low-carbon emissions and low fossil-fuel reserves. AP4, which returned over 8 per cent in the first six months of 2013 buoyed by domestic and global equity particularly, has some of its largest foreign equity holdings in oil and gas companies held in passive mandates. If the latest initiative proves successful, exposure to these companies could begin to tail off, explains chief executive, Mats Andersson, who describes the process as trial and error but says the trend is clear. "If it works, we will increase our exposure so that hopefully it will be a much bigger part of our portfolio. We want to do this on a global basis. In 10 years time, carbon will be priced and valued in a different way so that companies with a high carbon footprint will perform worse. This sustainable approach isn't about charity, but about enhancing returns."

MAJOR PENSION FUNDS ASK FOR CLIMATE CHANGE STUDY

By KEVIN BEGOS — Oct. 24, 2013 10:13 AM EDT

Home » Business » Major pension funds ask for climate change study

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UN climate report balances science and politics

Report: Climate change is impacting California

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PITTSBURGH (AP) — Some of the largest pension funds in the U.S. and the world are worried that major fossil fuel companies may not be as profitable in the future because of efforts to limit climate change, and they want details on how the firms will manage a long-term shift to cleaner energy sources.

In a statement released Thursday, leaders of 70 funds said they’re asking 45 of the world’s top oil, gas, coal and electric power companies to do detailed assessments of how efforts to control climate change could impact their businesses.
Global energy use by wealth
Prof. Hans Rosling on IPCC event, Stockholm, 28.9.2013

Source: http://youtu.be/grZSxoLPqXI
We must be the change we wish to see in the world (Mahatma Gandhi)

Choose CO2 free energy …

eliminate unnecessary use of energy…

… improve efficiency of energy use…

… optimize the time of use…

… use renewables…

… reduce transportation emissions…

… and think what to eat.

… and compensate other emissions…
Market mechanisms should enable and speed up the change

- Integrate markets; physical and market rules
- Set price for carbon; preferably cap&trade
- Remove subsidies from mature technologies
- Take climate change and carbon risks into account
- Activate consumers for clean solutions and increased flexibility
- Focus investments into clean solutions and enabling infrastructure
- Do long term decisions
"It always seems impossible, until it's done." Nelson Mandela

Thank you!