Investing in Climate Change

Mark Fulton
Global Head of Climate Change Investment Research
Scarce resources and rising demand...

Global population set to grow from 6.5bn to over 9bn in 2050

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP per Capita in $ Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>1.65</td>
</tr>
<tr>
<td>1950</td>
<td>2.52</td>
</tr>
<tr>
<td>2000</td>
<td>6.00</td>
</tr>
<tr>
<td>2006</td>
<td>6.50</td>
</tr>
<tr>
<td>2010</td>
<td>6.80</td>
</tr>
<tr>
<td>2020</td>
<td>7.60</td>
</tr>
<tr>
<td>2030</td>
<td>8.20</td>
</tr>
<tr>
<td>2040</td>
<td>8.80</td>
</tr>
<tr>
<td>2050</td>
<td>9.20</td>
</tr>
</tbody>
</table>

Source: Population Reference Bureau, 2008

World Energy Demand – Reference Scenario

CAGR = 1.8%

Oil Price

Source: EIA, 2008
...results in carbon and climate change

The Greenhouse Effect

1. Solar radiation passes through the atmosphere and warms the surface of the Earth
2. Infrared radiation is given off by the Earth
3. Most infrared radiation escapes to outer space, cooling the earth
4. Some infrared radiation is trapped by greenhouse gases, thus reducing the cooling

Under BAU much bigger disruption is coming

Last time T was 2°C above 2900 level was 130,000 yr BP, with sea level 4-6m higher than today.
Last time T was 3°C above 1900 level was ~30 million yr BP, with sea level 20-30m higher than today.

Note: Shaded bands denote 1 standard deviation from mean in ensembles of model runs

Source: IPCC, 2007

CO2 dates back 800,000 years

Source: Nature Journal, DeAM analysis.
Global water use is increasing sharply

Source: FAO Aquastat, UN, 2008

Global agriculture production projected to grow

Source: FAO, 2008

Significant amounts of capital in cleantech


2050: Renewables 46% of world energy demand

$45 trillion needed for "a new global technological revolution which would completely transform the way we produce and use energy."

Source: IEA, 2008
Climate change: An integrated framework

Climate Change
- Temperature rise
- Sea-level rise
- Precipitation change
- Droughts and floods

Impacts on human and natural systems
- Food and water resources
- Ecosystem and biodiversity
- Human settlements
- Human health

Emissions and Concentrations
- Greenhouse gases
- Aerosols

Socio-economic development paths
- Economic growth
- Technology
- Population
- Governance

Orange arrows: cycle of cause and effect
Blue arrow: societal response to climate change impacts

# Climate Change Investment Universe

## Clean Energy
- **Power Generation**
  - Solar
  - Wind
  - Clean coal (sequestration, infrastructure)
  - Other clean power generation (Geothermal, hydro, biomass, wave/tidal, methane capture, nuclear)
- **Cleantech Infrastructure**
  - Infrastructure management
  - Supply chain management
- **Power Storage Technology**
  - Battery technology and fuel cells
- **Transport & Sustainable Biofuels**
  - Low carbon transportation
  - Bio-diesel, ethanol

## Environmental Resource
- **Water**
  - Desalination/Purification
  - Wastewater treatment
  - Distribution and management
- **Agriculture**
  - Irrigation innovation
  - Clean pesticides
  - Consumer food purity
  - Seeds
  - Timberland
- **Waste Management**
  - Recycling
  - Toxin management
  - Energy from waste
  - Land remediation

## Energy & Material Efficiency
- **Advanced Materials**
  - Advanced coatings
  - Lightweight substitutes
  - Solvents and biodegradable
- **Building Efficiency**
  - Building management incl. green data centre mgmt
  - Heating & cooling systems
  - Lighting systems
  - Insulation
  - Micro generation/micro CHP
- **Power Grid Efficiency**
  - Transmission (including smart grids)
  - Smart metering
  - Storage
  - Infrastructure

## Environmental Services
- **Environmental Protection**
  - Land conservation
  - Environmental restoration
  - Timberland
  - Forestry
  - Sea defenses
  - Carbon
- **Business Services**
  - Insurance
  - Logistics
  - Green focused banking
  - Microfinance
  - Consultancy/advisory
  - Intellectual property
  - Weather
The ‘Four Pillars of Climate Change’ investment

- Government environmental policy and regulatory drivers
  - Science
  - Voters
  - Low Carbon Prosperity
  - Energy Security
- Carbon and energy prices
- Corporate response: competitive response and risk mitigation
- Low carbon technologies and services

The scientific evidence base

Source: Team analysis
Carbon productivity must rise three times as fast as labor productivity did during the Industrial Revolution.

Source: Contours of the World Economy 1 – 2030 A.D., Maddison, 2007; McKinsey analysis.
There are three broad groups of policy available to climate change regulators on a geographic level:

- **Traditional regulation**
  - Mandated standards
  - Public education

- **Carbon pricing**
  - Carbon taxes
  - Cap-and-trade

- **Innovation policy**
  - Knowledge management
  - Adjustment assistance
    - Technology transfer
    - Publicly funded research
    - Industry research consortia
    - Direct subsidies
    - Feed-in tariffs
    - Tax credits
    - Concessionary financing

*Note: These will vary by geography*

Source: DeAM analysis
Global Political Support

"And it is absolutely critical that we understand this is not just a challenge, it's an opportunity, because if we create a new energy economy, we can create five million new jobs, easily, here in the United States. It can be an engine that drives us into the future the same way the computer was the engine for economic growth over the last couple of decades." – US Senator Barack Obama, Democratic Presidential Nominee, September 2008

"Climate change tests our ability to open a new chapter in economic development which will, in turn, pose entirely new challenges....we can experience a win-win situation if we decide to invest in new ways – in research and technology, in new structures to secure our opportunities and thereby securing jobs in the long term." – Angela Merkel, Chancellor of Germany, May 2008

“All our needs of the country, all our goals as an economy point in exactly the same direction – to tackle climate change, to improve energy security, to create jobs and to stimulate business to growth.” – Gordon Brown, Prime Minister of the United Kingdom, June 2008

“We can move forward, and clean up our climate, and develop green technologies, and alternate – alternative energies for – for hybrid, for hydrogen, for battery-powered cars, so that we can clean up our environment and at the same time get our economy going by creating millions of jobs.” – US Senator John McCain, Republican Presidential Nominee, September 2008
Cap and trade policies

- Carbon markets are policy driven and policy momentum is intensifying internationally.

- Renewed policy impetus is set to take value of global market from $30bn in 2006 to $100bn by 2010 and $500bn-$1,000bn by 2020.

- The emerging policy framework has three tiers:
  - UN: Bali Summit committed world to achieving a Post-Kyoto deal by end 2009.
  - EU: Unilateral target to cut GHG emissions by 20% by 2020.
  - Other regional schemes.

- We see the EU continuing to lead the world with tougher limits and higher prices than those of other jurisdictions, not least because it wants to become the global leader in the low-carbon technologies of the future.

Source: Mark Lewis, Deutsche Bank.
Uptake of policy levers in 60 countries in 2007

Renewable Energy Policy Choices in 60 Countries
(37 Developed / 23 Developing)

Percent of sample using policy

Policy

- Feed-in tariff
- Capital subsidies, grants, rebates
- Investment or other tax credits
- Sales, energy, excise, or VAT tax concession
- Public investment loans or financing
- Tradable renewable certificates
- Public competitive bidding
- Renewable portfolio standard
- Net Metering
- Energy production payments or tax credits

Existing technologies to play a key role in stabilizing emissions

Renewable Electricity & Fuels

CO2 Capture Storage

Forests & Soil

Stabilization Triangle

Energy Efficiency & Conservation

Fuel Switch

Nuclear Fission

2004

2054

14 GtC/y

7 GtC/y

Note: GtC/y = Giga-tons of carbon per year
### Technology development process

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Early research / proof of concept</td>
</tr>
<tr>
<td>2</td>
<td>Lab testing</td>
</tr>
<tr>
<td>3</td>
<td>Demonstration</td>
</tr>
<tr>
<td>4</td>
<td>Commercial with refinements needed</td>
</tr>
<tr>
<td>5</td>
<td>Commercial</td>
</tr>
</tbody>
</table>

### Example technological pipeline: Solar

- **Organic PV**
- **Amorphous silicon**
- **HCPV**
- **CIGS**
- **Cadmium Telluride**
- **Heliostat E&D**
- **Solar Stirling E&D**
- **Frensel Mirror E&D**
- **Parabolic mirror E&D**

### Investment opportunities

1. **Government / Academic**
2. **VC / Corporate VC**
3. **PE**
4. **Public equities**

### Source


1. **HCPV** – High Concentration Photovoltaics
2. **CIGS** – Copper Indium Gallium Selenide Solar
3. **E&D** – Efficiency and Density
Possible CCS methodologies

Source: IPCC Special Report on Carbon Dioxide Capture and Storage, 2005
Climate change mitigation and energy markets

Energy Supply / Demand

- Energy Efficiency
- TOTAL DEMAND
- Low Carbon: RENEWABLES + Nuclear
- FOSSIL FUEL BASELOAD OF ENERGY SUPPLY

Time

Climate Change Mitigation

- Efficiency optimizes demand
- Renewables lower carbon footprint
- Fuel switch to lower carbon footprint
- Clean energy – carbon capture & storage
Commercial Breakeven – Electricity Grid Parity with and without carbon pricing and subsidies for a specific opportunity

- Cost of alternatives
- Learning rates
- Incentives to make technologies economically viable diminish over time
- Cost of fossil fuel production (oil, gas, coal prices)
- Carbon price

1. Commercial breakeven with subsidies without carbon pricing e.g: some US states
2. Commercial breakeven with carbon pricing and subsidies e.g: EU
3. Commercial breakeven with carbon pricing without subsidies
4. Commercial breakeven without carbon pricing or subsidies
5. Beyond Breakeven

Source: Team analysis
Corporate action will drive climate change

KEY DRIVERS:
- Competitive advantage
- Reputation
- Litigation

BALANCE SHEET AND P&L
- Operating Costs
- New Products / Services
- Regulatory Requirements

MANAGING RISKS
- Insurance and physical impact
- Corporate Social Responsibility

Source: The Carbon Trust
Climate change: A secular trend with cyclical overlay

- Weather related events
- Regulatory events
- Public education

Drivers

IPCC Reports

Gore & Stern

Event 3

Investor Interest

Cyclical / Market Cycles

Source: DeAM analysis, 2007, For Illustrative Purposes Only
## Climate Change Universe Asset Class Fit

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>Listed Equity</th>
<th>VC / PE</th>
<th>Infrastructure</th>
<th>Hedge Funds</th>
</tr>
</thead>
</table>
| Attributes  | Broad opportunity set for diversification across universe | Emerging technology cycles | Established sectors with:  
- Solid cash flows  
- Low volatility  
- Large capital requirements  
- Government supported | Access to all asset classes including progressive (i.e. carbon, weather) |

### Relevant Sectors
- Clean Energy
- Environmental Resource Management
- Energy and Material Efficiency
- Environmental Services
- Policy and regulatory support for many sectors

- Diversified large companies where climate change is making an impact
- Pure play established companies
- Emerging micro-cap from VC/PE cycle
- Invest along the value chain e.g.  
  - Solar  
  - Biofuels  
  - Smart grid  
  - Batteries  
  - Etc.
- Public transport  
- Pipeline, e.g. water and CO₂  
- Electricity grids
- Utilize high volatility for upside and downside profit
- Derivatives and other instruments
- Hedging index / commodities where applicable
Climate change listed equity performance vs. World Index, as of October 2008

Source: Bloomberg, DeAM Analysis.
Historical P/E:
DWS Climate Change Alpha Pool vs. MSCI World

Price / Earnings, with 12 month trailing earnings

Source: Bloomberg, DeAM Analysis.
Climate change can enhance a portfolio

Target Portfolio

With Alternatives

Efficient Frontier

Expected Return

Risk-Free Asset

Risk

Source: DeAM analysis, 2008, For Illustrative Purposes Only
Important notes

DB Advisors is the brand name for the institutional asset management division of Deutsche Asset Management, the asset management arm of Deutsche Bank AG. In the US, Deutsche Asset Management relates to the asset management activities of Deutsche Bank Trust Company Americas, Deutsche Investment Management Americas Inc. and DWS Trust Company; in Canada, Deutsche Asset Management Canada Limited (Deutsche Asset Management Canada Limited is a wholly owned subsidiary of Deutsche Investment Management Americas Inc); in Germany and Luxembourg: DWS Investment GmbH, DWS Investment S.A., DWS Finanz-Service GmbH, Deutsche Asset Management Investmentgesellschaft mbH, and Deutsche Asset Management International GmbH; in Australia, Deutsche Asset Management (Australia) Limited (ABN 63 116 232 154); in Hong Kong, Deutsche Asset Management (Hong Kong) Limited; in Japan, Deutsche Asset Management Limited (Japan); in Singapore, Deutsche Asset Management (Asia) Limited (Company Reg. No. 198701485N) and in the United Kingdom, RREEF Limited, RREEF Global Advisers Limited, and Deutsche Asset Management (UK) Limited; in addition to other regional entities in the Deutsche Bank Group.

This material is intended for informational purposes only and it is not intended that it be relied on to make any investment decision. It does not constitute investment advice or a recommendation or an offer or solicitation and is not the basis for any contract to purchase or sell any security or other instrument, or for Deutsche Bank AG and its affiliates to enter into or arrange any type of transaction as a consequence of any information contained herein. Neither Deutsche Bank AG nor any of its affiliates, gives any warranty as to the accuracy, reliability or completeness of information which is contained in this document. Except insofar as liability under any statute cannot be excluded, no member of the Deutsche Bank Group, the Issuer or any officer, employee or associate of them accepts any liability (whether arising in contract, in tort or negligence or otherwise) for any error or omission in this document or for any resulting loss or damage whether direct, indirect, consequential or otherwise suffered by the recipient of this document or any other person.

The views expressed in this document constitute Deutsche Bank AG or its affiliates’ judgment at the time of issue and are subject to change. This document is only for professional investors. This document was prepared without regard to the specific objectives, financial situation or needs of any particular person who may receive it. The value of shares/units and their derived income may fall as well as rise. Past performance or any prediction or forecast is not indicative of future results. No further distribution is allowed without prior written consent of the Issuer.

The forecasts provided are based upon our opinion of the market as at this date and are subject to change, dependent on future changes in the market. Any prediction, projection or forecast on the economy, stock market, bond market or the economic trends of the markets is not necessarily indicative of the future or likely performance.

For Investors in the United Kingdom:
Issued in the United Kingdom by Deutsche Asset Management (UK) Limited of One Appold Street, London, EC2A 2UU. Authorised and regulated by the Financial Services Authority. This document is a “non-retail communication” within the meaning of the FSA’s Rules and is directed only at persons satisfying the FSA’s client categorisation criteria for an eligible counterparty or a professional client. This document is not intended for and should not be relied upon by a retail client.

When making an investment decision, potential investors should rely solely on the final documentation relating to the investment or service and not the information contained herein. The investments or services mentioned herein may not be appropriate for all investors and before entering into any transaction you should take steps to ensure that you fully understand the transaction and have made an independent assessment of the appropriateness of the transaction in the light of your own objectives and circumstances, including the possible risks and benefits of entering into such transaction. You should also consider seeking advice from your own advisers in making this assessment. If you decide to enter into a transaction with us you do so in reliance on your own judgment.

For Investors in Australia:
In Australia, Issued by Deutsche Asset Management (Australia) Limited (ABN 63 116 232 154), holder of an Australian Financial Services License. An investment with Deutsche Asset Management is not a deposit with or any other type of liability of Deutsche Bank AG ARBN 064 185 162, Deutsche Asset Management (Australia) Limited or any other member of the Deutsche Bank AG Group. The capital value of and performance of an investment with Deutsche Asset Management is not guaranteed by Deutsche Bank AG, Deutsche Asset Management (Australia) Limited or any other member of the Deutsche Bank Group. Investments are subject to investment risk, including possible delays in repayment and loss of income and principal invested.

For Investors in Hong Kong:
Interests in the funds may not be offered or sold in Hong Kong or other jurisdictions, by means of an advertisement, invitation or any other document, other than to Professional Investors or in circumstances that do not constitute an offering to the public. This document is therefore for the use of Professional Investors only and as such, is not approved under the Securities and Futures Ordinance (SFO) or the Companies Ordinance and shall not be distributed to non-Professional Investors in Hong Kong or to anyone in any other jurisdiction in which such distribution is not authorised. For the purposes of this statement, a Professional investor is defined under the SFO.

For investors in MENA region
This information has been provided to you by Deutsche Bank AG Dubai branch, an Authorised Firm regulated by the Dubai Financial Services Authority. It is solely directed at wholesale clients of Deutsche Bank AG Dubai branch, who Deutsche Bank AG Dubai branch is satisfied meet the regulatory criteria as established by the Dubai Financial Services Authority.