EXECUTIVE SUMMARY

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Executive Summary

The London Accord is a unique collaboration between investment banks, research houses, academics and NGOs. The London Accord has produced the first 'open source' research resource for investors in climate change solutions. The CD and website (www.london-accord.co.uk) set out the context for investments in climate change solutions, analyse individual opportunities and discuss the implications for the construction of investment portfolios.

Background

The IPCC shows that the world needs to act to avoid disastrous climate change, and act now[1].

The Stern review shows that the overall cost of strong early action is much less than the cost of inaction[2].

The International Energy Agency shows the changes in fuel mix and energy usage that are necessary to stabilise greenhouse gas concentrations at a safe level[3].

The UN Framework Convention on Climate Change shows how much money is required by region and by technology to realise a scenario that achieves stabilisation[4].

The UNFCCC report shows further that 86% of that investment has to come from the private sector. That equates to private sector investment through 2030 in excess of $600bn per year.

The London Accord report shows investors and policy makers by technology how attractive that private investment is at the end of 2007.

The papers in section A (the Review of the content and this Executive summary) give the overview. The papers in section B discuss the context, from public opinion to energy policy. In section C teams from leading investment banks and research houses present reports on individual technologies as investment opportunities. Section D deals with adaptation, and the impact of climate change on investments in the existing economy. Here we also present the legal aspects of investment in low carbon technology. Last but not least Forum for the Future discusses the wider sustainability considerations for investments. Section E is where we present commentary on more advanced issues, from the need for an international standard for the measurement of greenhouse gas emissions at product level, to the role of philanthropic investors and the arguments for and against cap-and-trade and carbon taxes as ways for governments to create economic incentives to encourage investment in low carbon solutions.

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[1] IPCC Working Group III Fourth Assessment Report, 2007

[2] Stern Review on the Economics of Climate Change, 2006

[3] IEA World Energy Outlook 2006 and World Energy Outlook 2007

[4] UNFCCC Investment and financial flows relevant to the development of effective and appropriate international response to Climate Change, August 2007

The remainder of this executive summary makes the case that investors should **pay attention** to the changing views of society about climate change, that they need to **have a view** about the likelihood and timing of changes, and that they need to **be realistic** about the implications for investments. We show that **picking winners and losers** is complicated, and fraught with uncertainty, but that it can be done. When investors are ready to **take action**, we show how to use modern portfolio analysis to generate attractive and robust portfolios. We show how portfolio construction is affected by strong assumptions about an individual technology. We **consider the policy implications** briefly before closing with the inevitable conclusion that **more work is required** as the science evolves, and as society responds. There is enough clarity to **act now** and put CASH IN a portfolio of investments to take CARBON OUT of the economy.

Pay Attention

In B2: **Forces of Change in the Energy Market**, Nick Butler states that "If we are fortunate the combination of security concerns, prices and technical progress will come together to offer viable answers to the challenge of climate change. The answer will not be simple, nor, in all probability, will it be singular." At the London Accord's launch conference in March 2007, the Rt Hon Chris Huhne MP warned that real solutions would be 'messy. In B1: **The State of the Debate**, Alex Evans and David Steven write: "[...]while climate change may have reached a tipping point of sorts in 2006 as far as perceptions of the problem are concerned, the same cannot be said for perceptions of the solution." In D4: **Investment in Low Carbon Technology - the Legal Issues**, Lewis McDonald concludes that "low-carbon technology is an area of intense activity and regulations to promote and control these technologies are developing at a fast pace."

These quotes represent a widely held belief that there is an emerging consensus that the world faces a serious problem that requires action now, but that there is no consensus about what to do. The London Accord report attempts to provide some clarity about the options for investors and how to express one's view and beliefs about the public and political will to act, the current and future solutions, and practical steps to react to both the risks and opportunities.

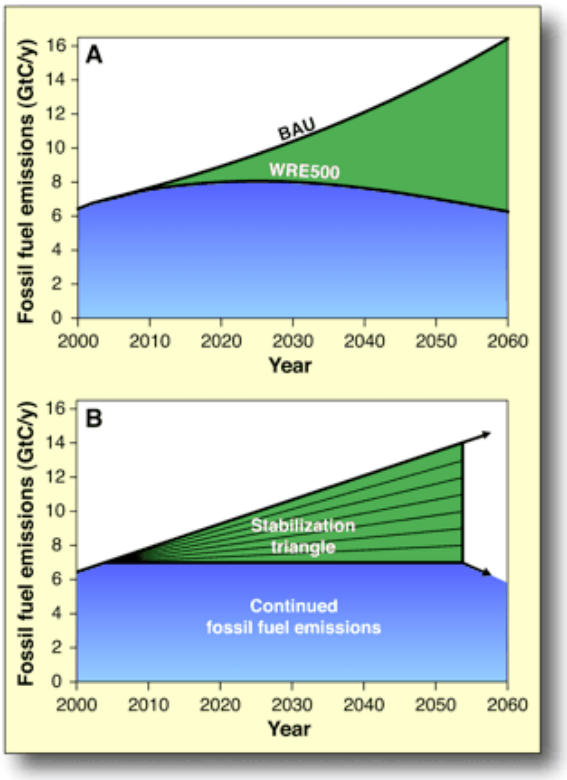
Have a view

If one believes the following three things, then climate change will materially affect future investment opportunities and returns:

- population growth is predictable: current demographic predictions are valid and imply a global population of approximately 9-10bn in 2050;
- energy intensity is predictable: that the long-term relationship between GDP per capita and energy demand holds true. This relationship, in turn, depends upon assumptions of lifestyle, consumerism and economic structure, e.g. the ratio of services to manufacturing. The London Accord's energy demand numbers are based on the IEA's, which extrapolate from the present on population and economic growth, and assume no discontinuities or unexpected large reductions in population growth;
- carbon emissions will cost emitters €30 to €40 per tonne: most economic scenarios seem to arrive at a similar range for the cost per tonne. Any cost per tonne above this range merely intensifies the argument. A cost per tonne below this range definitely softens investment decisions based on climate change. Current ETS trading is around €23, and the average over the past 12 months has been around €20.

There are valid reasons to question the three beliefs above. For instance, a communicable disease pandemic, changes in social values or a diminution of interest in climate change could all reduce the likelihood of these three beliefs. Preventing global warming requires massive changes in economics and human na-

ture within this decade, and perhaps human nature won't change in time. As Lord Howe once remarked, "Inertia can develop a momentum of its own". And the required changes are massive.



Socolow and Pacala at Princeton in 2004 identified 15 reasonable opportunities, called "wedges", that would each cut 1bn tons by 2054[5]. The diagram shows how these wedges bridge the gap between business as usual (BAU) and stabilization of greenhouse gas concentrations at 500ppm[6] (WRE500). One wedge – convert 250 million hectares to biofuels, 1/6th of the world's cropland. Another wedge – 2 million wind turbines on 30 million hectares, a Germany of wind turbines. We need at least seven of these megaprojects within the next 50 years. Each wedge costs more than the GDP of China.

And there are other priorities, e.g., to stop a million children a year dying of preventable HIV and measles, 1 million of malaria, 1.5 million of diarrhea? We are going to solve global warming, yet let 2.7 billion people live on less than $2 a day?

The Stern Review suggests committing 1% of GDP, somewhere between $350 billion and $480 billion each year to cut carbon emissions. By comparison Bjørn Lomborg claims that "Spending just a fraction of this [Stern Review] figure - $75 billion - the UN estimates that we could solve all the world's major basic problems. We could give everyone clean drinking water, sanitation, basic health care and education right now. Is that not better?"

The changes implied by serious mitigation scenarios are not just about new power generation or more intelligent power consumption, but also about lifestyle changes, including perhaps things such as:

- material direct payments from wealthy countries to poorer, perhaps of the order of a few hundred dollars per person per year in the wealthy nations;
- large scale transformation of housing stock;
- the end of oil and gas exploration;
- a deep and massive cut in air-travel and, thus, tourism.

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[5] Mark Pacala, S and R Socolow, "Stabilization Wedges: Solving the Climate Problem for the next 50 Years with Current Technologies", Science, August 13, 2004

[6] Throughout this document and all papers in the London Accord, we refer to greenhouse gas levels as equivalent to CO_2 concentrations measured in parts per million (ppm) with equivalent global warming potential

These points illustrate the scale and the difficulties of moving to a low carbon economy. There are good reasons to question the social commitment to halting greenhouse gas emissions.

So investors should not take for granted that the three beliefs we started this section with will inevitably lead to a move to a low carbon economy. Nevertheless, if an investor or policy maker accepts these three beliefs, then the consequence is a need to take them into account in investment decisions. The London Accord sees the essential decision for investors as choosing between a scenario of mitigation or business as usual. The London Accord hopes to help investors evaluate the realistic investment options for the mitigation scenario.

Be Realistic

The scale and complexity of investing in energy supply is staggering. A 2007 UNFCCC study states annual investment for global energy supply will reach approximately $750bn by 2030. Within that figure allocations for individual technologies can vary dramatically: coal-fired power generation under a 'Business as usual' scenario attracts $75bn but under the 'Mitigation' scenario only $24bn. In D2: **Modelling Carbon Intensity**, Valéry Lucas-Leclin writes "We believe that a view on the extent to which carbon cost is already materially embedded in the revenues and earnings of companies is a crucial issue for investors." According to Marc Levinson, in C6: **Carbon Capture & Sequestration**, "Carbon capture and sequestration [...] has the potential to develop into an extremely large industry..." before concluding that "Given these obstacles [a lack of price signals that could stimulate adoption of CCS], along with the fact that some key technological aspects remain unproven, CCS is unlikely to contribute to stabilizing atmospheric concentrations of CO_2 over the next decades." Success factors are not always obvious: Conor O'Prey notes in C2: **Investing in biofuels** that "supply agreements with good quality counterparties should be helpful in supporting a business case".

Alice Chapple reminds us in D3: **Investments to Combat Climate Change: Exploring the Sustainable Solutions**, that "The impacts of different options on wider sustainability need more sophisticated analysis. This is not only because this will ensure that they are commercially viable [...] It is also because the impacts on natural capital, people and communities will affect whether a particular option will in fact deliver the carbon reductions expected."

And that is just about mitigation; Christopher Bray points out (in D1: **Adaptation: Credit Risk Impacts of a Changing Climate**) that "climate changes are locked into the world's weather system and these changes may represent material risks (or opportunities) to business."

The scale and complexity of the climate change issue, and its impact on investment, is indeed staggering.

According to the IEA's mitigation scenario, which has 2030 emissions back at 2004 levels and falling, the key changes we need the following changes compared with the reference (business as usual) scenario:

- improve energy efficiency to reduce consumption by 15%;

- reduce coal's share of electricity generation from 40% to 26% (that means only 232GW of new capacity, instead of 1,723GW!);
- equip 70% of new coal and 35% of new gas capacity with carbon capture and storage (546GW and 494GW, respectively); and
- boost nuclear, hydro and renewables to about 17% each in the total power generation mix.

Those changes are challenging but many commentators believe they are technically and economically feasible. And so an investor who believes in the imperative to act and the political feasibility of policy changes that aim to achieve the IEA's mitigation scenario (or any set of similar changes), is confronted with a future of large scale infrastructure change.

A good example of the dilemmas and issues associated with large changes is the case of energy efficiency. It is a well documented phenomenon that potential efficiency savings are often not realized. Two papers deal with this important topic: C4: **Energy Efficiency: The Global Case for Energy Efficiency** and C5: **Efficiency: The Potential for Selected Investment Opportunities**, illustrate the potential.

Adaptation to climate change also is a large scale infrastructure change with its own threats ("Key industries […] affected include agriculture, forestry, fisheries, water, energy, health care and infrastructure") and opportunities ("[…]adaptation offers market opportunities for innovative technology[…]"; both from D4: **Investment in Low Carbon Technology - the Legal Issues**). "Companies that are dependent on government-owned transport infrastructure […] are particularly vulnerable to climatic risks, if the infrastructure is not designed to take account of climate risks"; D1: **Adaptation: Credit risks impact of a changing climate.**

There have been many large-scale infrastructure changes – canals, railways, electrification, road networks, telephony, airlines, computing or mobile telephony, to name a few. History teaches us this type of change leads to investment opportunities. Slides rules to electronic calculators. Fixed line to mobile/cell phones. The outcomes may look obvious in retrospect, but not at the time. Cars in 1910 used many different power sources, and petrol's eventual dominance was not assured: the Ford Model T could run on gasoline or ethanol. Change happens, it is unpredictable, and it happens fast.

Picking Winners and Losers

One problem – many solutions

Climate change is a global problem and the temptation is to look for a single global solution, or a few global solutions[7] but energy security suggests that fragmentation of energy supply sources is good.

In many countries national government targets and kudo's for big initiatives create a bias for single big solution, for 'backing the winner'. Policy is easier, it looks better, is has worked in the past. It is tempting to

[7] Solutions are generally defined as new technologies for power, transport and heat/cooling, plus adaptation. See UNFCCC process including Kyoto, G-8, etc.

aim for one solution for energy generation (nuclear or wind – or maybe fusion?), one or two for efficiency (incandescent lightbulbs, standby functions), one for fuels (biodiesel or ethanol). One type of economic incentive (cap-and-trade or carbon tax). Regulations can cover everything else including other energy efficiency measures and adaptation.

However, picking a winner is not that easy.

- Technology prospects are uncertain, and there are many (wind, solar in three flavours, tide, wave, geothermal in three flavours, waste to energy, biomass, etc.). The pace of creating scale is uncertain but limited (e.g. silicon supply). Those governments that feel a sense of urgency have a tendency to want to pick 'obvious' (?) winners (e.g., Germany: feed-in tariffs for solar; UK: post-combustion technology for carbon capture; several phasing out incandescent light bulbs) and not just rely on broad economic incentives. Biofuel feedstocks are varied and have many different characteristics (first and second generation, rapeseed, palm oil, jatropha, algae, …).

- Economic incentives are dependent on measurement (credits, allowances, multiple verification standards, emission and absorption measurements, …) which still lacks definition and history.

- Technology breakthroughs and advances are reported regularly (organic or nano thin-film solar, nano battery technology, plasma incinerators for waste-to-energy,…). Exaggerated past claims (fusion) have created skepticism about technology progress. Future expected cost reductions (performance curves) for many of the most promising technologies are uncertain and poorly understood.

- The historically limited longevity of policies (tax rates on energy, fuel; subsidies for solar) sits uncomfortably with the long term nature of the problem. A price for carbon isn't effective for early stage technologies. Regulations have unintended consequences: past regulations on waste may impede carbon capture and storage (quote HS). The sustainability impact of certain first generation technologies has been misestimated (biofuels, hybrids, hydropower) and is unclear for other technologies (ocean power, geothermal, second generation biofuels). Public acceptance is not automatic, anywhere (local planning problems). There is residual skepticism about the need to act urgently (e.g. WSJ) and the beginnings of eco-fatigue.

In addition, as pointed out in E6: **A Role for Philanthropy**, "the financial model for new technologies heavily favours high-profit investments at the top of their food chain.[...] Such an approach tends to dis-favour smaller, though potentially promising technologies...."

The difficulty in picking winners, for all the reasons discussed above, has important consequences for investors and policy makers.

Take Action

In every large-scale infrastructure change there are winners and losers. Early entrants with a portfolio of investment in the infrastructure change achieve high returns. The London Accord provides a combined appraisal of who these winners and losers might be.

The key is to realise that it is not about picking a single winner, but to create a portfolio that carefully matches technology with the natural and the regulatory environment (i.e., regional differentiation) and with public acceptance, that includes solutions for low carbon electricity generation both on- and off- grid as well as investments that have scope for greater efficiency. Monitor and adjust for developments in policies that create economic incentives. Defensive components (low carbon intensity, potential for efficiency gains, low adaptation costs) blended with opportunities (promising technologies).

The components of that portfolio need to be robust in the face of adaptation, and promote wider sustainability. Smaller solutions (those with small unit size of investment) are preferred over larger solutions. Enabling technologies (e.g., storage, transmission, heat exchangers) are potentially important components – remember railroad and internet booms.

The portfolio should largely be indifferent to the choice of incentive (tax or cap-and-trade). Incentives (esp cap-and-trade) create their own opportunities for investment (e.g., infrastructure around new markets including the need for new standards for measurement and reporting). A mixture of early and mature technologies is essential to create a balanced return profile over time. Boundaries and constraints result from existing legal and regulatory frameworks. Finally, a good portfolio needs a balance between existing/old sectors (screened for adaptation./carbon intensity/efficiency potential) and new sectors (solutions discussion in LA).

This approach creates robust portfolios that generate attractive returns under different scenarios. The same approach can be used to identify the investment that is consistent with a mitigation scenario that limits greenhouse gas concentrations to some acceptable level (e.g., 450ppm CO_2eq). From that 'reverse analysis' investors could identify the current gaps in incentives and opportunities - and so lobby effectively for policy changes to close those gaps. Such a dialogue is likely to be welcomed by policy makers including the UNFCCC and national governments.

How to create a portfolio

The London Accord papers provide the necessary ingredients for investors. Analysis of the individual solutions, their sustainability implications and the regulatory environment are presented, as well as papers showing the political backdrop for the policy debates. We also present a view of the methodology for constructing and analysing portfolios in D5: **A portfolio approach to climate change investment and policy**, from which the following conclusions are taken.

The underlying data is based on relatively low energy prices (oil ~$30/bbl). Under higher fossil fuel prices, renewables, efficiency look much better, and forestry and carbon capture and sequestration (CCS) look worse. The following are highlights from the analysis:

- The efficient frontier implies an abatement cost of about \$15/tonne CO_2. This suggests that either most estimates of marginal abatement costs are on the high side, or, more likely, that there is a lot of money to be made if an efficient portfolio is selected.
- The range of average abatement costs in portfolios is \$15 - 75/tonne CO_2, i.e. it is possible to construct very bad portfolios. For investors this implies rewards for careful portfolio construction. For policy makers it implies that trying to pick winners, rather than letting markets drive efficient investment, could result in unnecessarily high costs and risk erosion of public support and lower economic growth.
- Forestry is by far the biggest contributor to the portfolios near the efficient frontier, as it has the largest abatement potential. There is an unusually large spread for estimates of forestry's potential and costs; E5: **Carbon markets: The Forest Dimension** shows why.
- Nuclear is a proportionally big contributor in the small (by abatement size) efficient portfolios, reflecting that it is on cost parity with BAU case, however its scale is limited in the IPCC data reflecting the difficulties associated with new nuclear facilities.
- Solar, CCS, Geothermal are not big contributors in the frontier examples. This reflects IPCC estimates of costs; using different assumptions (e.g., those in C1: **Solar Energy**) can produce different portfolios so investors with better information and judgements can achieve greater returns.
- For small portfolios (those that generate low abatement) efficiency can be achieved with as few as 3 or 4 components. To generate large emissions reductions all efficient portfolios show more components, showing there is no silver bullet.

How to incorporate strong views on solutions

- Sarasin (C1: **Solar Energy**) have a much more optimistic view of the solar 2030 abatement cost and potential. They project a cost below break even with fossil fuels (with oil at or above current prices of ~\$100/bbl). Using this assumption produces a wider general distribution, with significant abatement portfolios feasible at better than break even.
- This demonstrates the importance of a view on technology development, or alternatively, of a diversified portfolio to manage risk resulting from such uncertainty in future development of low carbon technologies.

How to use the research papers

Although investors and policy makers will find their own use for the papers in this report, we suggest one possible approach. In our view, the following criteria for portfolio construction by judgement emerge from the papers:

- Technology risk
- Policy support or impediments

- Infrastructure changes
- Wider sustainability impact
- Cost

Of these, technology risk, the wider sustainability impact and cost are relatively indifferent to the geographic location of implementation. Policy support and the need for infrastructure change are very dependent on the geographic location, with economic incentives and regulations varying dramatically around the world. D4: **Investment in Low Carbon Technology - the Legal Issues** provides a good overview; the following table gives an example for renewable energy only. Winners can be selected based on their scores against these five criteria and be grouped into three categories:

- Dead certs: low technology risk, no regulatory impediments, no need for large scale infrastructure changes, no sustainability concerns, economically viable to low/medium CO_2 price
- Good bets: requiring one technological breakthrough that has been identified already, one policy change to allow deployment at scale, no large scale infrastructure change, no sustainability concerns, economically viable at medium/high CO_2 price
- Long shots: more than one technological breakthrough required, complex multinational policy changes required, large scale infrastructure change, serious sustainability concerns, viable at high CO_2 price only

In practice investors need to take into account the specific national or regional policy and infrastructure aspects, but the table below gives an indication of the more geography-indifferent aspects.

Assessment	Technology	Policy	Infrastructure	Sustainability	Cost
Biofuels	Certain technologies proven, others not	Supportive, including mandatory volumes	Few changes required	Major concerns	High
Biogas	Largely proven	Neutral to supportive	Few changes required	Some concerns	Low - competitive now
Biomass	Largely proven but some new processes	Neutral to positive	Existing	Some concerns	Low
CCS	Unproven at industrial scale	Supportive but with problems	Large challenges for storage component, distances to power stations	Moderately negative	High
Earth energy	Proven	Neutral	Local generation	Positive	Low
Geothermal - wet	Proven	Neutral - 'overlooked'	Local generation	Positive	Low

Assessment	Technology	Policy	Infrastructure	Sustainability	Cost
Geothermal - HDR	Not yet proven but high potential	Neutral - 'overlooked'	Suitable for grid	Positive	High - break even 2017
Hydro - run of river	Proven	Neutral to positive	Local generation, some for grid	Positive	Competitive
Hydro - large	Proven	Mixed	Suitable for grid	Major concerns	Competitive
Ocean: thermal	Unproven	Negative to neutral	Substantial challenge due to remote locations	Some concerns	High
Ocean: wave & tidal	Unproven	Negative to neutrel	Substantial challenge due to remote locations	Some concerns	High - break even 2015 - 2020
Solar collectors	Proven	Supportive	Depending on location	Some concerns	High but potential for major reductions
Solar PV	Proven	Supportive	Depending on location	Some concerns	High but potential for major reductions
Solar thermal	Proven	Supportive	Few challenges	Few concerns	Moderate - break even 2010
Wind	Proven	Supportive	Supportive	Few concerns	Low - close to competitive with fossil fuels

This table summarises wider sustainability in a single score. From D3: **Investments to combat climate change: Exploring the sustainable solutions** the following summary table shows more detail.

	NATURAL	HUMAN	SOCIAL	MANUFACTURED	FINANCIAL
Biofuels	Very high resource use and waste Negative biodiversity impact	Limited potential for smallholder farmers	- Inflationary impact on food prices, can undermine food security	- Aligns with existing fuel infrastructure	- Lower upfront investment need but ongoing input costs
Solar	Some toxic materials in 2nd gen PV Energy intensive manufacturing	- Installation & maintenance skills	- Potential for robust off-grid rural power solutions	- Complex inputs & manufacturing processes	- Very low operating costs but high initial investment
Nuclear	Mining, use & disposal of radioactive materials	- Tested technology with strong skills base - But shortage of / ageing skills	Security risks for many sites Catastrophic hazard potential	Long lead times for construction Planning & location issues	Very high economic costs Unlimited potential decommissioning liability
Wind	Low resource use, some land take Limited visual, noise & wildlife impacts	Established skills base	Some negative impacts on rural communities	Long grid connections for rural and offshore sites	Onshore wind competitive installation & operation costs

	NATURAL	HUMAN	SOCIAL	MANUFACTURED	FINANCIAL
Carbon Capture & Storage	Untested long-term impacts of seepage Reduces fuel efficiency	Scientific & engineering skills for carbon storage not yet available	Limited disruption to existing lifestyles	Can be retrofitted to existing plant Highly complex technology process	Cost effective low carbon fossil fuel energy with CCS unproven
Geothermal	Potentially renewable resource Limited local pollution But possible water impacts	Limited impacts	Limited disruption to existing lifestyles	Relatively simple technology, uses existing drilling & turbine knowledge	Cost effective in appropriate regions
Avoided deforestation	Maintains ecosystem services	Enable continued livelihoods Or lack of livelihood skills for affected individuals	Could preserve indigenous peoples' way of life Or could undermine land rights, displace native populations	Limited impacts	May need conservation financing vehicles Some secondary economic impacts
Carbon markets	Impact dependent on carbon price	Existing origination & trading skills base	Markets do not generally effectively work for the poor	Depends on technologies used, but generally minimal impact	Fragile markets with unclear pricing, validity & consistency

Sustainability	Very positive	Positive	Neutral	Negative	Very negative

But this investment will not fully enable the changes necessary to achieve a low carbon economy. Two areas remain bottlenecks: R&D and early deployment. Unconventional investors can help directly with the first (funding research) and second (funding risk reduction). Davida Herzl writes "Another option for philanthropic capital would be to seek methods that minimize risk. Incubators are one useful model. But there is another option: funding risk reduction directly." (E6: **A role for philanthropy**)

Consider the Policy Implications

Just as investors need to face up to the reality that there is no single winner, no silver bullet, so should policy makers. The papers in the London Accord indicate no great need for government subsidies or direct support, although many of them indicate that a carbon price above a minimum level is required to produce attractive investment returns. The need to build portfolios that are robust under different outcomes means that the move to a low carbon economy should be encouraged with policies that are technology neutral.

The London Accord papers do, in many cases, identify policies and regulations that could be helpful, or are indeed required, to produce attractive investment opportunities. D4: **Investment in Low Carbon Technology - the Legal Issues** identifies many, as to the individual reports in section C. An example: CO_2 is often classified as waste, under EU and OECD definitions, based on the holder's intent to discard the CO_2. And "[present waste transportation] obligations are likely to be incompatible with the sort of arrangements likely to be favoured for CO_2 storage." Thankfully, "we expect that the draft EU CCS Directive will contain proposals to exclude from the definition of 'waste' CO_2 captured and transported for the purposes of geo-

logical storage." And: "Current regulatory frameworks, especially in Europe, are not fit for purpose and confusing. […] under the UK's biofuel arrangements, [suppliers] will effectively be able to buy their way out of the obligations by paying 15 pence per litre." But also: "It seems likely that from 2011, the UK will reward biofuels which produce the greatest savings in GHG emission." (C2: **Investing in biofuels**)

The policy framework is a movable feast. Summarising the policy implications and recommendations is a near-impossible task and any attempt is bound to leave out important aspects. Nevertheless a few key themes emerge.

First and foremost is a commitment to a transparent and credible mechanism for a greenhouse gas emission price. Second is a streamlining of existing regulations, such as planning and waste management, that can create unnecessary and costly uncertainty and delays. Third are regulations that address behavioural inertia, particularly in efficiency measures, where the economic incentives already exist but are not having the desired effect.

In a few cases the cumulative investment, money and time, in research, development and deployment until commercial parity is achievable seems so large relative to prospective returns that more direct support measures such as targets or subsidies may be called for. The biofuels experience shows, however, that this approach has problems and can lead to a 'lock-in' for a technology (or in the case of biofuels, a feedstock bias) that is not right from a climate and sustainability perspective.

Biofuels and large hydro projects are also examples of the way uncertainty about full life cycle benefits can damage investment returns and technology prospects. Government endorsement and support for standards in measurement and reporting of emissions data across the economy would enable business and consumers to avoid mistakes and pick solutions that work financially and for the environment. E2: **Toward a Product Level Standard: Life Cycle Analysis of Greenhouse Gas Emissions**, and E3: **A Commentary on the Product Level Standard** discuss what is required and what would be achieved with such a standard.

More Work is Required...

This qualitative assessment and the portfolio approach show the current state of analysis for making investment decisions on broad criteria. But these use largely static, snapshot assessments of the technology. E1: **The Dynamics of Technological Development in the Energy Sector** discusses the way costs reduce with accumulated production. The paper shows how different technologies have more or less rapid cost reductions. This creates particular problems in constructing portfolios as modern portfolio theory assumes constant (relative) costs. "[…]when the parameters are uncertain. In this case one needs to make a trade-off between diversification and concentration. Too much diversification is bad, diluting individual investments so that no technologies make substantial progress. Too much concentration is also bad, as it is likely to result in lock-in to a poor choice."

Forestry shows high abatement potential for very low costs, but with great uncertainty about costs, abatement and returns. In order to construct more rigorous portfolio analysis, all three need to be better under-

stood. To clarify forestry's abatement potential seems a matter of urgency before investors can be expected to commit large sums of money.

But Act Now!

The papers in the London Accord show that attractive and sensible investment opportunities exist. Modest technology improvements and policy changes will create more opportunities. The portfolio analysis shows there are good reasons to believe attractive returns are available for portfolios near the 'efficient frontier'.

Infrastructure changes can happen quickly and have repercussion throughout the economy. Savvy investors may want to act now. The London Accord report provides a starting point for the construction of investment portfolios by investors who believe that demographics, climate science and other factors are leading to significant prices of greenhouse gas emissions.