FINANCING THE 'CLEAN BILLION'

THE ROLE OF INVESTORS AND POLICYMAKERS IN SOLVING THE CLIMATE INNOVATION PUZZLE

2° Investing Initiative

ABOUT 2° INVESTING INITIATIVE

The 2° Investing Initiative [2°ii] is a multi-stakeholder think tank working to align the financial sector with 2°C climate goals. Our research work seeks to align investment processes of financial institutions with climate goals; develop the metrics and tools to measure the climate friendliness of financial institutions; and mobilize regulatory and policy incentives to shift capital to energy transition financing. The association was founded in 2012 and has offices in Paris, London, and New York City.

AUTHORS: Jakob Thomä (2°ii), Stan Dupré (2°ii), Anuschka Hilke (2°ii),

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1. INTRODUCTION

1.1 FINANCING CLIMATE RD&D – THE MISSING PIECE IN THE LOW-CARBON TRANSITION PUZZLE

From shifting the trillions to addressing the billions. There is a growing narrative and traction among investors around contributing to financing the transition to a low-carbon economy. While partly motivated by questions around financial risk, this narrative is driving a number of commitments around investing in the low-carbon economy.

This narrative has focused equally on divesting from the high-carbon assets and mobilizing the "clean trillion". Largely missing in the debate, however, has been the role of investors in financing and scaling new zero carbon innovation technologies. Such investments in innovation require much lower overall levels of financing – billions rather than trillions. According to a study from Accenture (2011), development capital related financing needs was only about 1/5th that of procurement capital (e.g. asset finance, etc.) for the 2010-2020 period in financing European cleantech (FIG. 1.1).

While financing needs are lower for low carbon innovation, their role is no less crucial in achieving the 2°C goal (e.g. CCS, electrification of transport, alternative cement, etc.) (FIG. 1.2). In relative terms, the gap between current levels of financing and financing needs may be even higher than for deployment. Many climate-relevant sectors have high levels of RD&D due to their competitive nature. For instance, the automotive sector, about 3% of the MSCI World's market capitalization, is responsible for around 16% of listed RD&D, with industrials not far behind (FIG. 1.3).

Lifting the veil on RD&D. Low-carbon deployment and zero carbon innovation should not be seen in competition. However, recent success in low-carbon deployment (e.g. dropping solar PV prices) may be taking emphasis away from the challenge of developing immature zero carbon technologies. Unaddressed, a risk may exist of reaching a decarbonisation 'glass floor' where zero carbon technologies are missing that are needed to achieve the desired limitation of global warming to 1.5-2°C, as endorsed by the governments in the COP21 Paris Agreement.

Achieving full decarbonisation. The IEA's 2°C scenario emphasizes the need for new technologies in order to fully decarbonize the economy post 2050. Under this scenario, emissions increase until 2020, then sharply decrease between 2020 and 2050, largely using existing technology, and are negative after 2070, requiring currently uncommercial technology. To achieve these goals, RD&D expenditure is required today to allow time for development and large-scale deployment post-2050.

FIG. 1.1: SOURCES OF CLEANTECH FINANCING IN EUROPE 2010-2020 (SOURCE: ACCENTURE 2011)

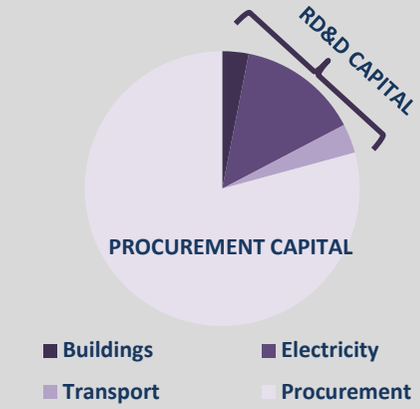


FIG. 1.2: CUMULATIVE CO_2 REDUCTIONS BY SECTOR AND TECHNOLOGY IN THE 2°C SCENARIO BY 2050 (SOURCE: IEA 2015)

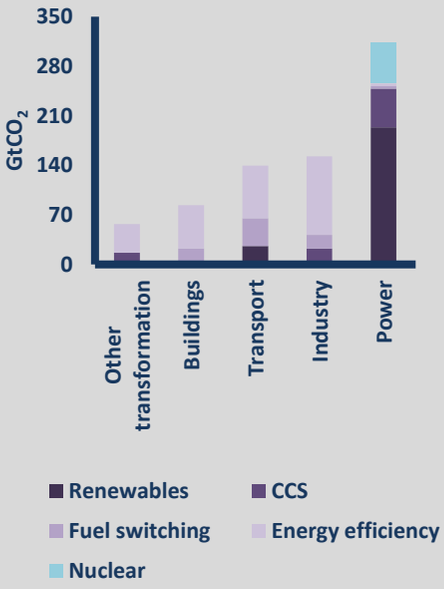
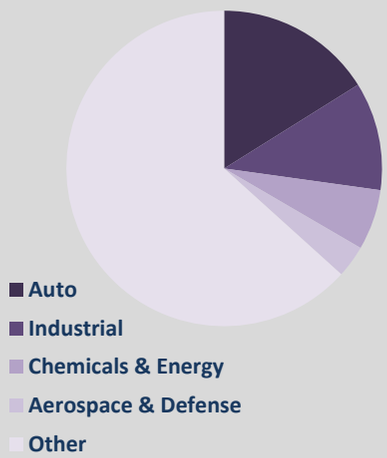


FIG. 1.3: PRIVATE SECTOR RD&D BY SECTOR (SOURCE: STRATEGY& 2015)



1.2 RD&D AND THE 2°C CLIMATE GOAL

Research and development contributes through three pathways in realizing a realistic and affordable transition to 1.5-2°C:

Costs. RD&D reduces deployment costs. While such costs are also driven by "learning by doing", RD&D plays an important role. Thus, the costs per kWh of electric vehicle battery packs have dropped by two-thirds in 8 years, despite relatively limited deployment (FIG. 1.4).

Efficiency / Productivity. RD&D improves technical efficiency / productivity, a part of deployment costs. For example, several technologies are in development to greatly increase the current 11-15% technical efficiency of solar cells.

New technologies. Naturally, RD&D can also involve the inventing of entirely new technologies or products for which no current low- or zero-carbon solution exists. Examples here include the development of new 'flying wind drones' and alternative cement that does not rely on clinker.

1.3 RD&D, INNOVATION AND FINANCIAL PERFORMANCE

Overview. RD&D and innovation is not just about climate, but also financial risk. RD&D spending and innovation of companies can influence the revenues, profits, and market capitalization. The existing academic literature, however, provides no consensus view on how RD&D impacts these indicators. This may be partly explained by the difficulty of quantifying RD&D and innovation and the fact that many sectors produce very little in the form of new product innovations. For example, in the highly regulated power sector, little to no important technological breakthroughs have been developed over arguably half a century prior to the energy transition. Despite this lack of consensus, there are some stylized facts:

- **Quality over quantity.** Research on over 1,000 companies by Strategy& (2015) suggests that while high RD&D 'spenders' outperform their peers in revenue and EBITDA as % of revenue, they slightly under-perform in terms of market cap growth. Moreover, they always under-perform lower RD&D spenders that are classified as 'Innovators' despite their low R&D spend (FIG. 1.5).

- **Laggards lose.** While high RD&D spenders may not over-perform, some evidence exists that low RD&D spend appears to under-perform, according to the same sample of companies (FIG. 1.6).

FIG. 1.4: COSTS OF ELECTRIC VEHICLE BATTERY PACKS (SOURCE: NYKVIST ET AL. 2015)

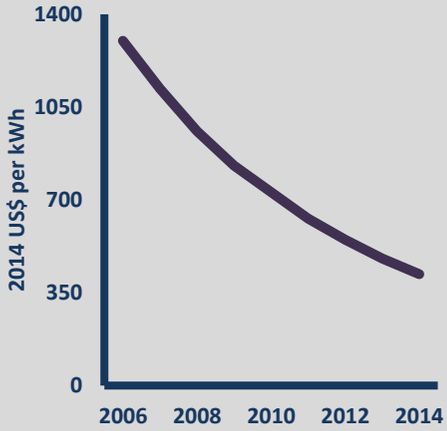


FIG. 1.5: FIVE-YEAR CAGR PEROFRMANCE OF RD&D "INNOVATORS" VERSUS "SPENDERS" (SOURCE: STRATEGY& 2014)

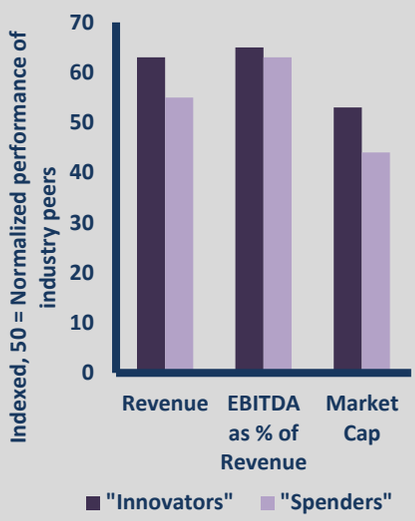
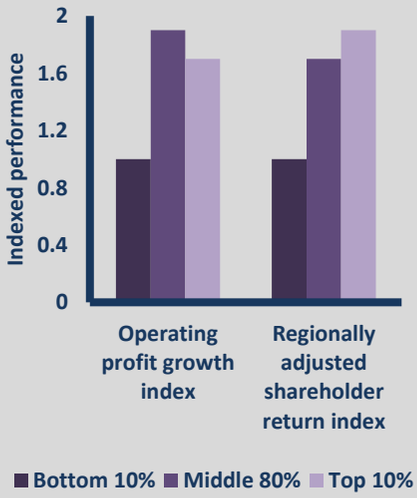


FIG. 1.6: THE PERFORMANCE DISADVANTAGE OF LOW RD&D SPENDERS (SOURCE: STRATEGY& 2014)



1.4 DISTINGUISHING INVESTMENT OBJECTIVES

Increasing exposure to low carbon RD&D investment opportunities can be associated with two investment objectives (Portfolio Carbon Initiative 2015):

- **Transition risk.** A low-carbon economy may create financial risks and opportunities for portfolios, which investors may seek to manage. To this end, a company can manage some of its transition risk by looking to innovations focused on climate change mitigation. Companies that are not involved in this innovation process may lose out when disruptive innovations hit the market. Similarly, companies involved in innovation may win market share in the context of the transition to a low-carbon economy.

- **Climate friendliness.** Investors may actively seek to contribute to reducing GHG emissions and accelerate the transition to a low-carbon economy for other reasons (mandate, public pressure). RD&D, given the current investment gap, its prominence in less liquid markets (e.g. venture capital), and its outstanding role in achieving the 2°C goal, may be one of the most effective ways for investors to contribute to this objective.

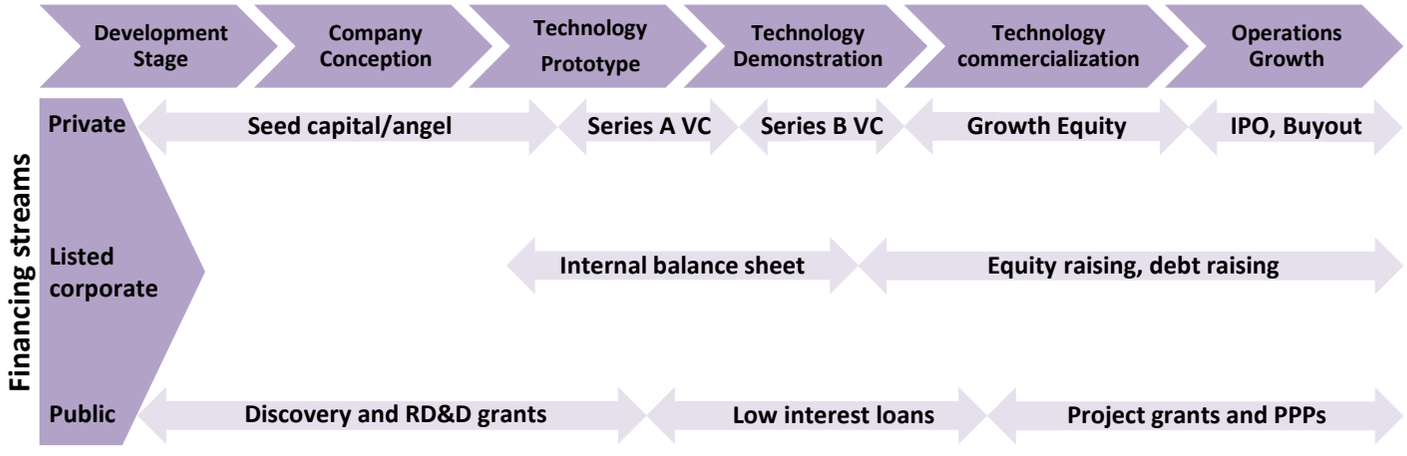
While these strategies can potentially both inform investment decisions, it is important for investors to distinguish between these two objectives as they may require different approaches in terms of focus technology and the asset class used to gain exposure (e.g. bonds vs listed equity).

1.5 THE RD&D INVESTMENT GAP AND INNOVATION CYCLE

The RD&D investment gap. The IEA last quantified and highlighted the gap between actual and required public RD&D investment across low carbon technologies in 2010. This public investment gap alone amounted to a total of $40-90 billion (USD) annually in research, development and demonstration spending. The gap is still relevant in 2015 with the IEA stating the current investment falls short of long term climate goals. Specifically, public expenditures on low carbon RD&D have been increasing in absolute terms since the late 1990's however the share in total RD&D has fallen from a peak of 11% in 1981 to about 3-4% since 2000.

The innovation cycle and financing instruments. Different financing mechanisms are better suited for each stage of the innovation cycle given the nature of the investment. The figure below (FIG. 1.7) shows the cycle and the financing mechanisms generally used for each of these stages. Bridging the RD&D investment gap requires addressing potential financing gaps across financing streams as well in the engagement with listed companies.

FIG. 1.7: THE INNOVATION CYCLE AND FINANCING MECHANISMS (SOURCE: ADAPTED BY AUTHORS FROM BARCLAYS 2011)



This paper seeks to explore the challenge of financing climate innovation – particularly from the perspective of institutional investors. It provides a first mapping of the relative sources of financing for climate innovation and the scaling of associated products and services. The financing mapping helps to identify pathways – and barriers – for investors to finance this type of innovation and help contribute to overcoming the decarbonisation 'glass floor'. The paper suggests that from a climate impact perspective, financing innovation may be one of the most impactful pathway for investors to influence the transition to a low-carbon economy. It also suggests that this pathway may in some instances be easier than 'shifting trillions' of procurement capital.

FOCUS: INNOVATION AND THE EMISSIONS GLASS FLOOR

The decarbonisation glass floor. In the context of a transition in line with the IEA 2DS, both incremental and disruptive innovations will be important across key sectors. At the same time, the adoption of only an incremental approach by an industry could create a decarbonisation 'glass floor' due to two challenges:

- **Target blindness.** If an investor or company only measures annual CO_2 reduction, they may be blind to the extent to which they are on a trajectory that leads to a "glass floor" due to technical limitations of "easy wins". The figure provided (FIG. 1.8) illustrates this idea, where two decarbonisation trajectories can deliver very different results in the short-term compared to the long term. In the short term an investor looking at only efficiency metrics may realize greater GHG reductions however over the long term this approach reaches an efficiency glass floor as each additional efficiency measure has a relatively smaller impact on GHG intensity. Investing in zero carbon technology, on the other hand, while not having an immediate impact will enable full decarbonisation over the long term. Visibility for an investor on their exposure and financing of disruptive technologies is thus key.

- **Limitations of incremental technologies.** Beyond the investor portfolio, incremental technologies will not deliver the full decarbonisation needed under a 2°C scenario. For example in the transport sector, while the IEA suggests that efficiency carries the bulk of the decarbonisation burden, this still only equates to about 50% of decarbonisation, with at least another 30-50% related to fuel switching associated with disruptive technologies (e.g. electric vehicles, fuel cells, etc.), and the "other" related to avoiding and transport mode switching (FIG. 1.9).

FIG. 1.8: THE ILLUSTRATIVE DECARBONISATION GLASS FLOOR UNDER TWO SCENARIOS (SOURCE: 2°ii)

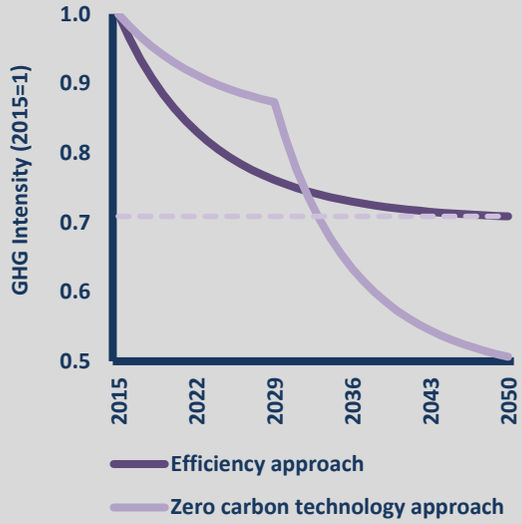
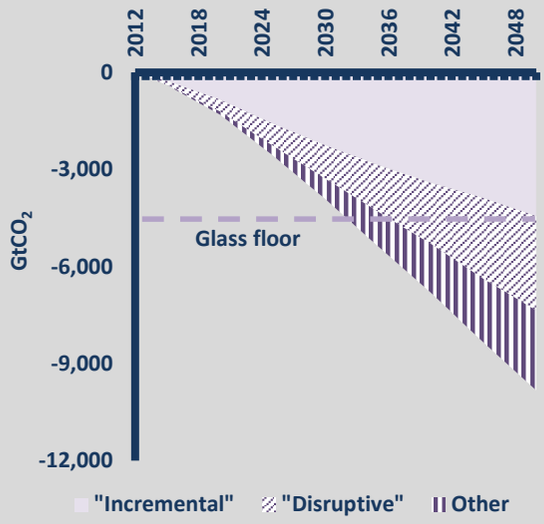
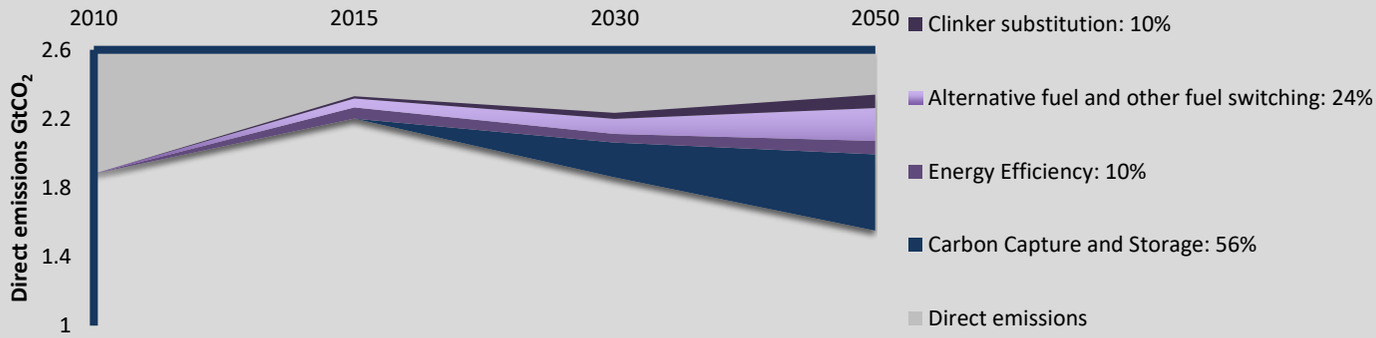


FIG. 1.9: CO_2 REDUCTIONS FROM A 6°C to a 2°C SCENARIO BY SOURCE (SOURCE: 2°ii, BASED ON IEA ETP 2015)



Example cement industry. The cement industry contributes 2.3 Gt of CO_2 per year and accounts for about 4.8% of total global CO_2 emissions. According to the figure below (FIG. 1.10), employing efficiency measures will enable CO_2 reductions to 2030 which will then level off. Up to 62% of direct CO_2 emissions from the cement industry come from process emissions of which carbon capture and storage (CCS) will begin to handle the bulk of emissions. However, even with CCS, full decarbonisation is not achieved showing the need for the implementation of disruptive technologies such as cement alternatives to fully decarbonize the industry.

FIG. 1.10: CO_2 REDUCTIONS IN THE CEMENT SECTOR BY TECHNOLOGY (SOURCE: IEA TECHNOLOGY ROADMAP CEMENT, 2009)

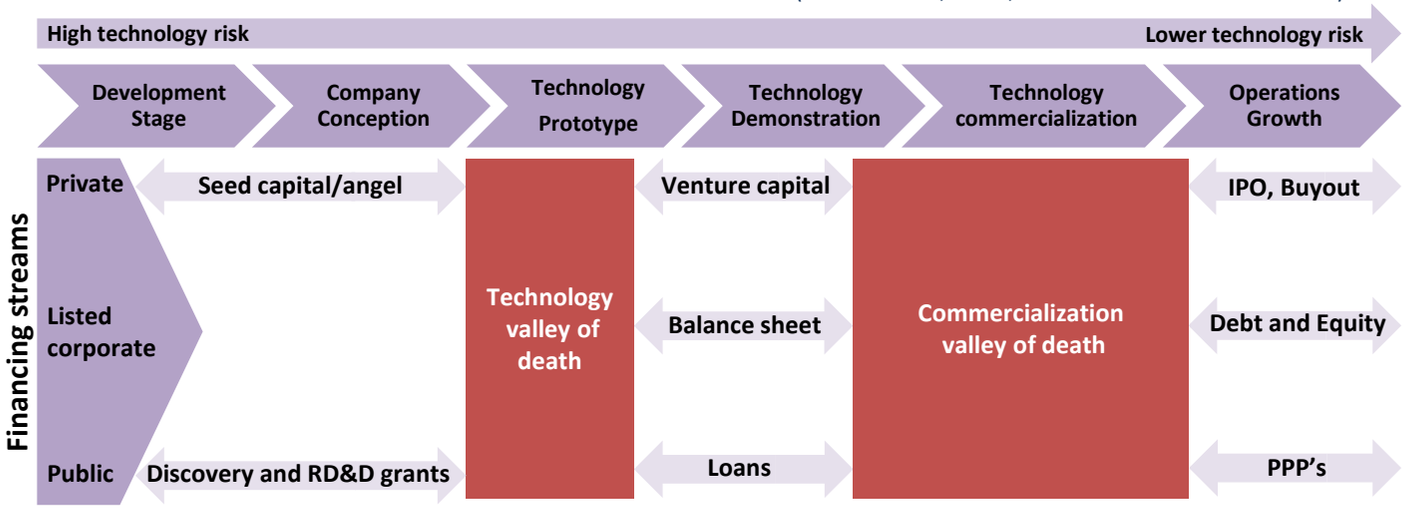


2. FINANCING CLIMATE FRIENDLY INNOVATION

2.1 THE FINANCING VALLEYS OF DEATH

The development of new innovations is by its nature a risky process. As financiers seek to limit their risk and optimize returns, two distinct funding gaps appear for clean energy technology innovation: first during the prototype development stage and then at the commercialization stage (FIG. 2.1). The funding gap between the angel investment round of funding and that of venture capital is known as the "technology valley of death". Research into the gap has indicated that venture capitalists are opting for less risky investments further down the innovation cycle. The commercialization valley of death occurs during the growth stage and market entry of a clean energy technology. This occurs as the capital requirements for commercializing clean energy technologies is beyond the risk tolerance and timelines of most existing debt and equity markets (BNEF, 2010). Funding mechanisms such as public-private partnerships (PPPs) have been found to help in reducing this gap.

FIG. 2.1: THE INNOVATION CYCLE AND FINANCING VALLEYS OF DEATH (SOURCE: 2°ii, NREL, US DEPARTMENT OF ENERGY)



2.2 SOURCES AND VEHICLES OF FINANCING FOR LOW CARBON INNOVATION

Overview. Low carbon innovation is financed by a range of actors across both the public and private sectors. This report has identified three broad categories of actors who are involved in the financing of low carbon innovations at different stages of the innovation cycle and through different financing vehicles:

Public financing. Governments play a large role in low carbon innovation both in Europe and in the United States but often have different technology priorities depending on the country and policy context. For example, according to the OECD in 2013, France spent 50% of the public energy RD&D budget on nuclear and 14% on energy efficiency. The UK on the other hand spends 29% on energy efficiency and only 16% on nuclear. One interesting note across most developed country RD&D programs is that very little of the budget is spent on fossil fuel RD&D (generally <10%). Governments are often involved in very early stage financing in areas and technologies that the private sector is either not involved or or that they consider to be a high priority. The IEA estimates that the public sector will be responsible for roughly 50% of low carbon innovation. For capital-intensive technologies that require rapid scaling, such as CCS, their contribution is likely to be even more.

Public RD&D is either done by public agencies or by external agencies financed through public sector grants or loans. Grants are often used to fund very early stage RD&D through demonstration technologies. The public sector may also finance innovation through public financial institutions loan or loan guarantee/derisking programmes. On the other hand, some public financial institutions like the World Bank specifically prohibit RD&D financing.

Investors can hypothetically support public RD&D through sovereign bonds. However, given the limited share of RD&D in public sector budgets (<1%) and the limited role of sovereign bonds in financing these budgets (~<5%), this may not a be a relevant avenue to explore.

Listed corporate finance. Listed companies finance innovation programs both internally and externally. Internal RD&D programs are often focused on improving the core business of a corporation and gaining a competitive advantage over their rivals. External programs often involve engagement with universities, start-ups and governments through low carbon innovation partnerships as an avenue to expose themselves to cutting edge technology without having to absorb all the risk and cost of developing an innovation from start to finish.

- **Balance sheet.** Balance sheet financing is the most common form of innovation financing in the listed corporate space. Companies such as Toyota, Siemens and GE fund extensive RD&D programs off their balance sheets to the tune of billions of dollars each year. These investments are recorded as an expense in the year incurred and are reported in annual reports. This provides an investor with some insight into any low carbon technologies a corporation is investing in. However, granularity on dollar figures per technology are difficult to ascertain and are rarely provided by corporations due to the competitive nature of such data.

- **Debt issuance/corporate bonds.** Debt may be issued by a corporation in order to raise capital for RD&D activities. This is often in the form of short term bonds that can be used to fund specific RD&D projects. They can provide an investor exposure to specific

- **Stock issuance.** Listed companies can issue shares to investors as a way to raise capital for RD&D programs. For example, Toyota issued shares in 2015 of which the funds "…are earmarked largely for infrastructure investment and RD&D of next-generation technologies." The shares issued can come with specific terms and target a specific investor base. Again using the Toyota example, the shares come with a transferability restriction of 5 years and are targeted at *"*long-term investors willing to patiently wait for Toyota's investments to bear fruit*".*

Non-listed private companies. The non-listed private sector is mainly involved in early stage financing when innovations are still in their development and pre-commercialization phase. Angel/seed, venture capital and private equity investors are all involved as are some larger corporations that operate small venture capital arms of their business. Such subsidiaries (e.g. BP Ventures LLC) looking to invest in innovations that they may be able to absorb into their business in the future.

- **Seed/angel.** Very early stage private investors may provide seed investments to startups to enable pilot versions of a technology to be developed. These are often small amounts but are crucial to the development of new low carbon innovations. In 2015 global seed financing in energy related start ups was was over US$42 million (i3 Data).

- **Series A, B or venture capital.** Venture capital financing occurs before technology commercialization. In 2015 global venture capital financing of energy related start up companies was over US$530 million (i3 Data).

- **Growth equity.** Growth equity is used in later stages of the innovation cycle, often during the demonstration phase and just before full commercialization. In 2015 global growth equity in energy related start ups was over US$1 billion (i3 Data).

The main sources of funding and the focus technologies for innovation will vary according to the contextual situation of the country or region. The financing vehicles will also vary depending on the sector to be financed. An example is given on the next page of the energy sector in the USA and Europe (UK, France and Germany) and highlights the difference in funding sources for low carbon innovation. An investor should be aware that the regional or country context will play a role in the financing vehicles they use to gain exposure to RD&D investments.

FOCUS: SOURCES AND VEHICLES OF FINANCING - EXAMPLE POWER SECTOR

The power sector is the largest emitter of CO_2 within the energy sector and will require emissions reductions in the magnitude of 320 $GtCO_2$ to 2050 under the IEA's 2DS. This will involve the financing of low carbon innovations today that could be commercialized in the future. The figures below (FIG. 2.2 & FIG. 2.3) seek to provide an illustrative breakdown of the sources of financing for low carbon innovation related to the power sector in the United States and Europe (limited to France, Germany, and UK at this stage). The point of these charts is to provide an overview of the financing vehicles available to investors looking to expose themselves to low carbon innovations in the power sector. In order to gain gross figures of investment from these sectors data was used from the OECD, IEA, i3 and 2014 EU RD&D Scorecard. Ratios of financing low carbon power technologies were then applied to gain an insight into the financing vehicles used by these main actors. A full list of ratios used and explanations can be found in the Appendix. Crucially, the figures presented here are designed to be illustrative based on existing databases for electricity sector related technologies. They should thus not be seen as absolute conclusions. Further research is needed, in particular on the activities of listed companies to provide a more conclusive picture.

Public financing. Governments utilize tax payer funds to finance external third parties through government grants and other financing mechanisms. It is important to note that bond finance makes up only 3% of RD&D financing mainly due to the inherent risks in developing new innovations and also the long time horizons of technology development that may be longer than the term to maturity of the bond.

Listed corporate finance. To estimate the figures from energy utilities and energy suppliers (oil and gas, coal, alternative energy) the authors used only the listed energy related companies found in the 2013 EU Innovation Scorecard from the USA, UK, France and Germany. The charts show that the listed corporate sector plays a much larger role in RD&D in Europe than in the United States, both in relative as well as absolute terms. One important point is that while in large-cap companies equity issuance may be a minor source of financing, this may be more prominent for mid-caps or small-caps which were not found in the innovation scorecard list.

Non-listed private. The figures for non-listed private have been determined from the i3 database which records a majority of investments made in clean tech companies by source and financing stage or vehicle. As the focus of this report is pre-operations growth of the innovation cycle, only venture capital (series A & B), seed and growth equity were used to determine these figures. Non-listed private finance plays a large role in the United States, thanks at least in part to vibrant venture capital and private equity markets found in Silicon Valley. Small- and medium-sized enterprises that may deliver innovation, like German Mittelstand companies, are not captured in this data, given their lack of interaction with venture capital / private equity or capital markets financing. These areas may thus deliver a significant part of the innovation without necessarily being linked to financial markets.

FIG. 2.2: LOW CARBON FINANCING IN THE POWER SECTOR – All FIGURES IN €MILLIONS (SOURCE: 2°ii)

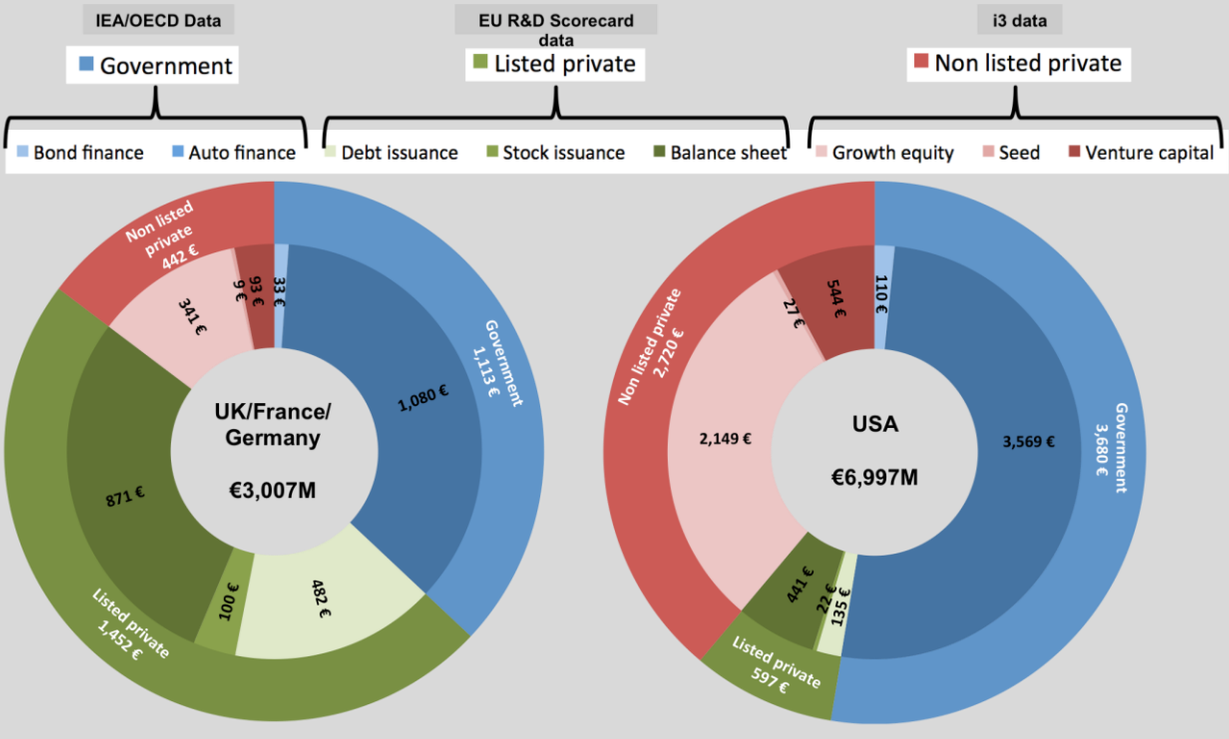


FIG. 2.3: EUROPE EARLY STAGE FINANCING BY TECHNOLOGY
(SOURCE: 2°ii, BASED ON i3 DATA)

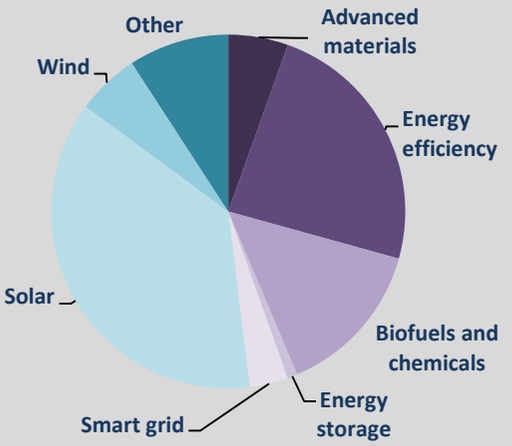


FIG. 2.4: LATE STAGE FINANCING 2013 -2014 FOR SELECTED TECHNOLOGIES*
(SOURCE: 2°ii, BASED ON i3 DATA)

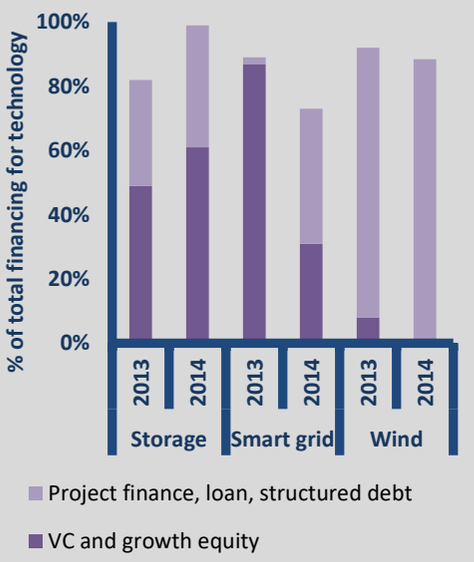
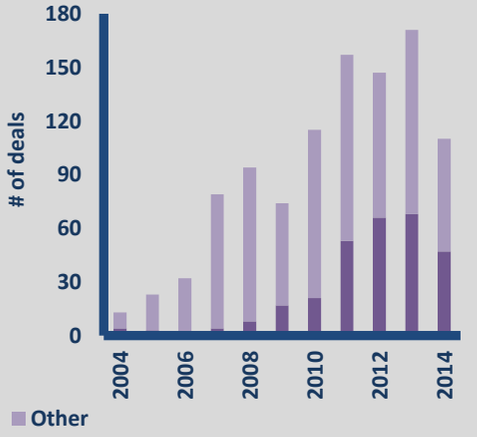


FIG. 2.5: FINANCING TRENDS FOR SOLAR PV BY NUMBER OF DEALS
(SOURCE: 2°ii, BASED ON I3 DATA)



2.3 FINANCING BY TECHNOLOGY

Different financing for different technologies. The figures on the previous page provided a broad overview of the different financing sources for climate innovation. The exact nature and type of financing, however, will differ significantly both across technologies/sectors and for the same technology/sector over time.

This is largely a function of the maturity of the technology in terms of development, but may also relate to the idiosyncratic characteristics of each technology that can dictate the best suited form of financing. For example, while wind and solar arguably are at similar stages of maturity in Europe, 68% of the $5.5 billion of tracked investments for solar PV was project finance, versus only 29% for wind (based on $7.5 billion of deal flow). Wind in turn placed a higher emphasis on structured debt.

Levels of financing. Moreover, levels of financing will also differ. There will always be a difference in the level of financing for specific technologies. The provided chart (FIG. 2.3) shows that early stage financing flows are focused on solar and energy efficiency technologies in Europe which is a similar situation in the US. Within Europe however there is variation by country with French investors focusing relatively little on solar but more on energy efficiency so investors should be aware of changing country contexts. It is important for an investor looking to expose themselves to low carbon energy technology innovations to understand the financing focus of the various technologies along with the financing vehicles (see p. 8 & 9) that enable access to these technologies.

Financing instruments. In order to identify appropriate financing instruments, understanding the actual financing deal flow by instrument is key. For example, FIG. 2.4 shows the share of growth equity investments and project finance for energy storage, smart grid and wind technologies in 2013 and 2014. In order to access investments in energy storage and smart grid solutions in 2013, an investor would most likely have been involved in growth equity investments.

However, quick shifts in the level of adoption of technologies can mean that the financing tools can also change. For example, in the case of smart grid technology, the ratio of project finance to growth equity finance increased significantly from 2013 to 2014. This could be the start of a broader financing trend as the technology matures, with an increase in adoption, number of projects, and project size. A similar trend could be seen for solar (FIG. 2.5)**.** While early stage financing tools such as growth equity and venture capital are still important, there is a clear trend towards late stage financing tools as technology matures.

FIG. 2.6: RD&D INTENSITY FOR A SAMPLE OF AUTOMOBILE MANUFACTURERS (SOURCE: 2°ii, BASED ON EU RD&D SCOREBOARD 2015)

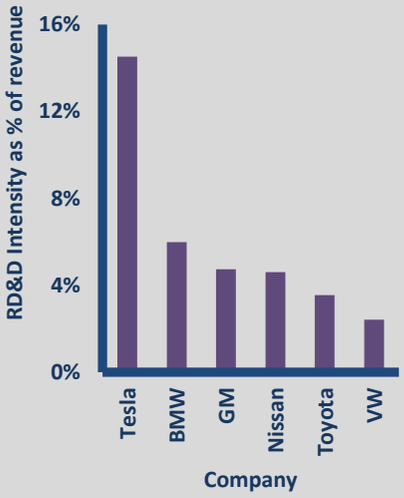
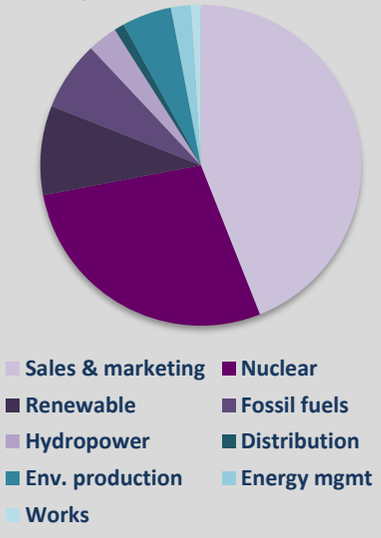


FIG 2.7: 2008 EDF BREAKDOWN OF RD&D FINANCING (SOURCE: 2°ii, BASED ON EDF 2009 ANNUAL REPORT)



FOCUS: DISCOVERING RD&D

One of the key challenges related to RD&D is identifying the companies expected to deliver the innovation. In the car sector for example, suppliers like Bosch are investing in building a new generation of solid fuel batteries for cars. More intuitively, it is companies like Boeing and Airbus rather than Lufthansa that are focused on delivering next generation airplanes. At the same time, some innovation may also take place outside the traditional sectors, as seen in the involvement of companies like Apple and Amazon in driverless cars. Finally, similar to the logic of listed / non-listed, disruptive technologies may both be more prominent and more present in the mid- and small-cap space.

2.4 FINANCING RD&D THROUGH STOCK MARKETS

Overview. Listed companies are responsible for a significant share of private sector RD&D, partly by default, given their size. The five largest US companies by RD&D expenditure had a higher RD&D budget combined than the *entire* US venture capital investment in 2015 (~$50 bi). While listed companies spend more on RD&D, their RD&D intensity (e.g. RD&D/sales) is significantly lower than that of the average SME (FIG. 2.6).

As outlined above, perhaps a third of RD&D expenditure in listed markets takes place in climate-relevant sectors. Naturally, not all of this RD&D is climate-related or 'climate-friendly'. These numbers do speak, however, to the importance of RD&D for these sectors, notably the automobile sector.

Which company does the RD&D? One challenge in the listed equity space is the question of where the RD&D actually takes place, given different supply chains (cf. Focus: Discovering RD&D):

- The utility sector is among the sectors with the lowest RD&D intensity, this is largely because the sector is a consumer of generation technology rather than a producer. Innovation in solar PV is thus unlikely to come from large utilities.

- According to a study from the European Commission from 2012, automobile suppliers typically engineer around 75% of a vehicle and account for 50% of all RD&D spending. RD&D spending for automobiles may thus equally not solely take place with automakers.

Discoverability of RD&D in listed markets. Given the volume of RD&D that takes place in listed markets, this asset class is important from a climate innovation perspective. Equally, there are significant challenges for investors in terms of discovering climate innovators. Reporting on RD&D is inconsistent across companies. Even where quantitative reporting exists, this does not inform on whether this RD&D relates to climate innovation or perhaps even RD&D in climate harmful technologies, but for a few exceptions (FIG. 2.7). Finally, as highlighted earlier (p. 5), spending volume does not necessarily speak to innovation.

Despite these challenges, some visibility doe exist. Automobile manufacturers with a higher RD&D intensity for example are also more likely to be involved in sustainable propulsion technologies. Public announcements, like those of Toyota and Volkswagen recently, may speak to innovation. Innovation rankings like those published by some consultancies can also signal. Finally, engagement can naturally help inform this debate as well.

FIG.2.8: PUBLIC SECTOR ENERGY RD&D BY TECHNOLOGY (SOURCE: 2°ii, BASED ON OECD DATA)

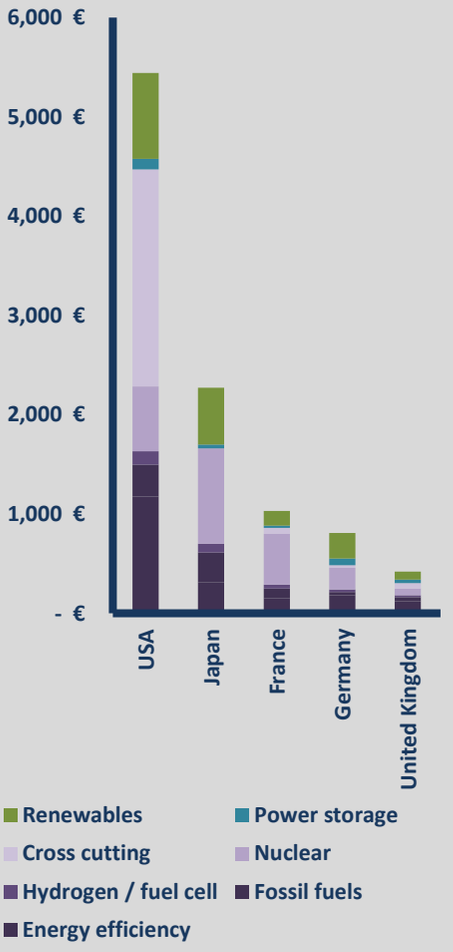
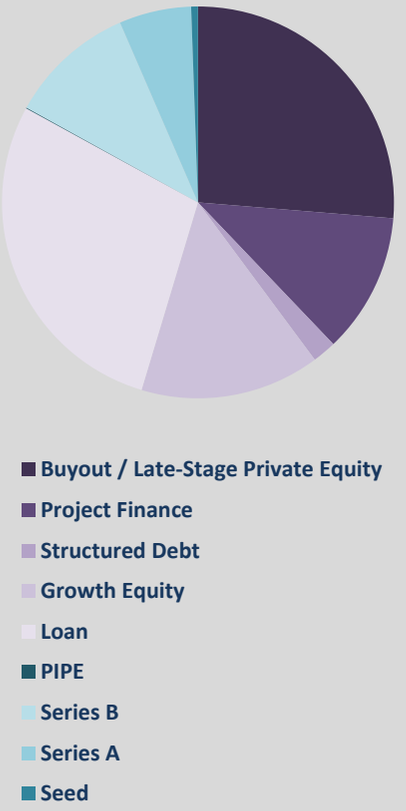


FIG. 2.9: STAGES OF FINANCING OF SMART GRIDS (SOURCE: 2°ii, BASED ON i3 DATA)



2.5 FINANCING RD&D THROUGH FIXED INCOME

Fixed income is a broad category, including asset backed securities, corporate bonds, agency bonds, and public sector bonds issuance. For corporate bonds, except where proceeds are earmarked, the challenges around discoverability of RD&D may be even higher than for listed equity, unless the bond issuer is listed.

Interesting in the bond space are also sovereign bonds. The OECD provides granular data on energy-related RD&D by technology and country for OECD countries, allowing investors to distinguish leaders and laggards (FIG. 2.8). This data can then be normalized by size of government expenditure. It suggests for example that in 2013, US energy RD&D (including nuclear and fossil fuels) would have made the US government the largest corporate energy RD&D spender. Germany is second among German companies, and France and the UK third respectively (although the companies ahead of these countries may actually lag, since their RD&D could not be broken down by energy and non-energy RD&D).

Another actor with huge potential for financing RD&D is public banks, a significant play in the bonds market. Many public banks however do not finance RD&D and may even, like the World Bank, be barred from it.

2.6 INNOVATION IN PRIVATE EQUITY/VENTURE CAPITAL

Smaller companies in the unlisted space have higher RD&D intensity and thus may as a whole be more innovative. This is key in particular in the context of the need for disruptive climate innovation. There is a significant body of literature on the venture capital 'cleantech' industry.

This type of financing has suffered in the past years. Clean tech financing in venture capital in Europe shrank from a high of 55% in 2010 to around 14% in 2014. While this is partly a function of the explosive growth of venture capital more generally, this type of financing has actually contracted in real terms over this timeframe.

Despite this contraction, private equity and venture capital will likely be a key piece in the puzzle for inventing and developing zero carbon technologies. Their characteristics as more RD&D intense, innovative, and potentially more disruptive companies are important.

One of the key advantages for investors in the private equity and venture capital space is that discoverability is very high. The i3 database for example comprehensively identifies climate-related investment opportunities by technology. This allows investors to see the relative financing and maturity stages of technologies. For smart grids for example, project finance is still only 12% of financing, with significant share of financing related to seed, Series A & B, and loans (FIG. 2.9).

FOCUS: ROLE OF THE PUBLIC SECTOR IN RD&D

"Governments can play a critical role for promising technologies by ensuring stable, long-term support in all stages of innovation – i.e. from basic and applied research through to development, demonstration and deployment phases."

(IEA Energy Technology Perspectives 2015)

Both direct and indirect public support programs are important for low carbon innovation. As a direct investor, the public sector is mainly involved in early stage research funding of low carbon RD&D projects through grants and loan sharing arrangements. These are usually aimed at university RD&D programs, but will also extend to the private sector. Indirect public support programs for RD&D programs include tax incentives, patent programs, guaranteed loans, and insurance used to encourage increased private sector funding of low carbon innovation. In order to reach the required investment level in low carbon RD&D, both direct funding and indirect public policy programs will be required.

Direct public funding. The IEA estimates that at least 50% of RD&D needs in the 2°C scenario must be provided through public RD&D spending. However for energy technologies where the primary motivation is environmental or associated with direct public policy objectives (e.g. CCS), this share rises dramatically and may be well over 80%. Currently governments do not appear to have RD&D budgets aligned with the required energy related RD&D. The figure (FIG. 2.10) below shows the low energy RD&D intensity of some select focus countries. Another figure (FIG. 2.11) shows the UK energy RD&D budgets compared to the defence budgets. Independent of the merits of defence RD&D, the data illustrates that government energy RD&D expenditure is not a priority choice for many governments.

FIG. 2.10: Energy RD&D intensity as % of total government expenditure

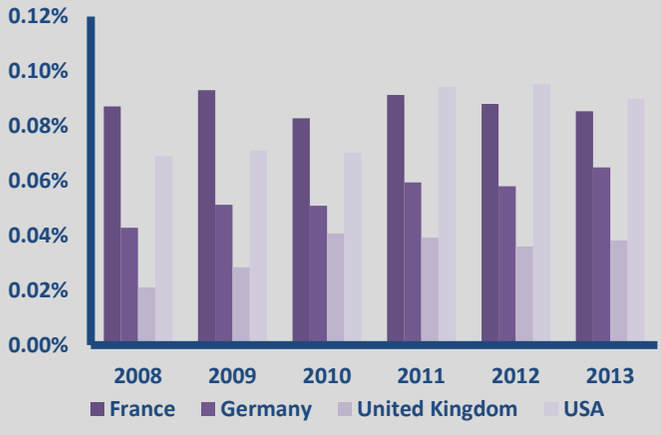
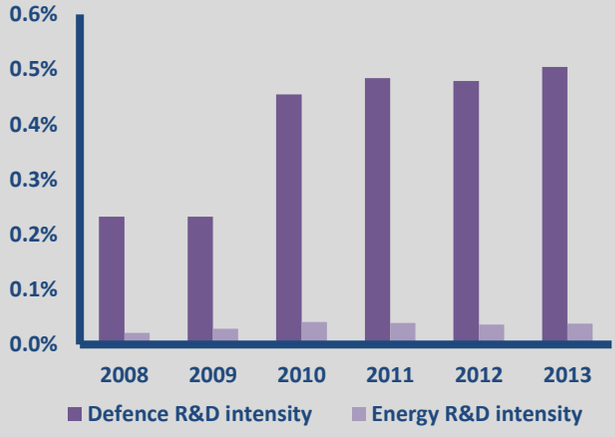


FIG. 2.11: UK RD&D intensity for defense and energy as % of total government expenditure



Indirect programs. Beyond direct financing, indirect public policy programs such as tax incentives and regional RD&D targets and roadmaps equally play a key role and can be linked directly to climate goals. These establish the right market conditions to allow innovators to establish the least cost options. Having clear, targeted policies in place can build the confidence needed to mobilize private investment in low carbon innovation (IEA 2015).

'Green' tax incentives. Governments utilizing their tax systems to encourage low carbon innovation has been one of the more popular and effective policy options of governments (KPMG, 2013). In many cases, tax systems offer preferential treatment to low carbon RD&D (KPMG 2013). The French system in particular has been touted as one of the best for encouraging low carbon RD&D (OECD). The French government offers a 30% tax credit on eligible environmental research expenses up to EUR 100 million and 5% on expenses over EUR 100 million.

Targets and roadmaps. Without a sufficiently strong long-term innovation policy signal, it is unlikely that investors will align parts of their portfolio with low carbon innovations. Solid climate innovation targets, roadmaps and tracking need to be implemented by regional and national governments to encourage low carbon innovation. The EU for example has established an RD&D intensity target of 3.0% of GDP by 2020. As part of this they have established an Strategic Energy Technology Action Plan for moving to a competitive low carbon economy.

3. INVESTOR STRATEGIES FOR MOBILIZING CLIMATE RD&D

3.1 CHALLENGES OF FINANCING RD&D

Overview. Mobilizing capital for innovation is a key challenge in the context of achieving the 2°C climate goal. There is growing transparency around how this innovation will likely need to be financed. At the same time, there are a number of visible barriers for investors seeking to increase their exposure to this innovation.

The tragedy of the horizon. Innovations can often take many years to develop and commercialise however investors are driven by incentives that gauge performance mostly in the short term. In the context of low carbon innovation this means there is little financial incentive for decision makers to invest in radical innovations that may not be commercialised for many years after a CEO, fund manager, or asset manager has left a firm.

Discoverability of innovations. Even though low carbon innovation is nothing new, it is still difficult to attain detailed information on innovators and innovations. There is a lack of transparency on who should be doing the innovating (e.g. downstream or upstream) and how it will be financed. New databases and web based platforms are seeking to address this by connecting investors with investees operating in the low carbon innovation space.

Getting fooled by the numbers. While some figures on low carbon RD&D investment may look impressive, it is important for investors to view these within the larger context of a company. For example, Airbus has released figures on RD&D investment in electric planes of €20 million. This needs to be seen in the context of their €3.4 billion yearly RD&D expenditure (FIG. 3.1).

Success probability. Due to scientific uncertainty, there is no fully satisfying way to anticipate the success of individual RD&D programmes or the ability of a new innovation to reach commercialisation. A multitude of difficult factors come into play particularly during early stage investment that may see even the most novel innovation ideas fail to reach full commercialisation. Conservative investors will likely be turned off by the vagaries of much of early stage innovation.

Volume vs. innovation. As has been discussed earlier (p. 5) it is not only about the amount of money spent on RD&D, but also, or even more, about the quality of innovation that is produced.

Investor constraints. Liquidity constraints and asset allocation rules may restrict the amount an investor is able to be exposed to low carbon innovation asset classes.

FIG. 3.1: AIRBUS TOTAL RD&D SPEND VERSUS SPEND ON ELECTRIC PLANE (SOURCE: 2°ii, BASED ON AIRBUS ANNOUNCEMENT AND 2014 ANNUAL REPORT)

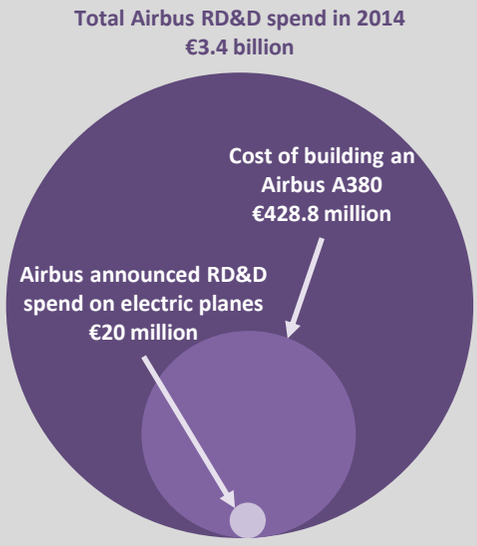
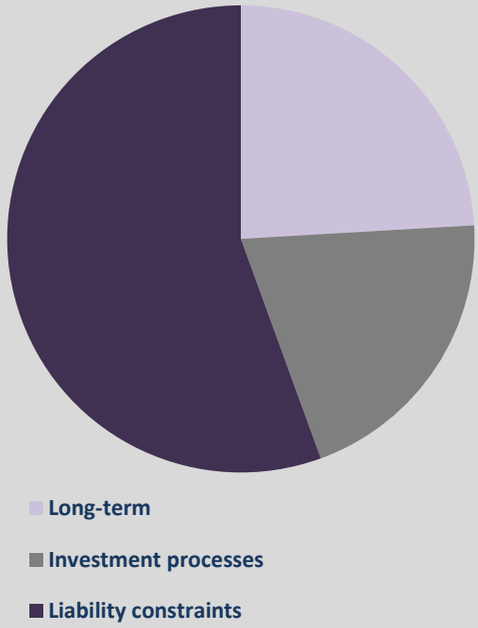


FIG. 3.2: ILLUSTRATIVE TIME HORIZON CONSTRAINTS OF INVESTORS (SOURCE: 2°ii, BASED ON WEF 2011)



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APPENDIX

The following ratios and explanations were used to determine the figures found on page 10 and 11.

In order to develop the figures of listed companies firstly the authors identified companies for inclusion from the EU innovation scorecard 2014 which ranks the top 2500 listed companies in terms of amount spent on RD&D in the year 2013. Only companies within the the utilities and energy supply sectors (i.e. Coal mining, oil and gas and alternative energy) from USA, UK, France and Germany were used as this is the focus of the 2°ii world.

Listed utility low carbon weights:

The ratio for low carbon weight for the utility sector in each country was determined by using the ratio of government low carbon RD&D investment in the energy sector compared to RD&D investment in conventional fuels. While the number of companies may appear low, after analyzing the annual reports of the top 20 energy utilities based on weight in the MSCI World Index, it was found that low carbon RD&D spending is either very low or non-existent across the industry.

Country	Number of companies	Total RD&D spend 2013 (€millions)	Low carbon weight
France	5	1404.70	0.36
Germany	3	382.90	0.91
United Kingdom	2	204.30	0.76
USA	2	136.30	0.81

Listed energy low carbon weights:

Companies were again determined form the EU 2014 RD&D Scorecard. The low carbon weight within the listed utility space was determined using an estimate that 10% of total RD&D spending in the coal mining and oil & gas sectors was used for low carbon RD&D purposes. For alternative energy this was given a low carbon weight of 100%.

Region	Sector	Number of companies	Total RD&D spend 2013 (€millions)	Low carbon weight
France/Germany/UK	Alternative Energy	3	183.30	1.00
	Coal mining	2	121.10	0.10
	Oil and Gas	4	2472.80	0.10
USA	Alternative Energy	1	97.40	1.00
	Coal mining	1	35.50	0.10
	Oil and Gas	4	1521.90	0.10

APPENDIX

Listed energy company financing ratios:

The financing ratios have been determined using ratios from Bloomberg New Energy Finance that are on average used by listed corporations to finance research and development activities.

Financing	Alternative energy	Mining	Oil and Gas	Power/utilities
Debt issuance	0.37	0.49	0.14	0.37
Stock Issuance	0.08	0.15	0.01	0.08
Self finance	0.55	0.36	0.85	0.55

GLOSSARY OF TERMS

Innovation – A process by which ideas are developed into technologies that can be put into practice and continuously improved through design, testing, application, and feedback from users.

Low carbon research and development (R&D) – Knowledge generation through directed activities (e.g. evaluation, screening, research) aimed at developing new or improving on existing technologies that emit less CO_2 in comparison with conventional sources from all sectors (buildings, industry, power and transport).

Research, development & demonstration (RD&D) – A commonly used grouping of the main pre-commercial stages of the innovation cycle.

Commercialization – The stage of the innovation cycle in which a new technology is introduced to the broader market.

Radical/disruptive innovation – A novel technology that strongly deviates from prevailing norms and thus entails a disruptive change from existing commercial technologies and for associated institutions.

Incremental innovation – An improvement in performance, cost, reliability, design etc. to an existing commercial technology without any fundamental change in end-use service provision (OECD, 2011).

Emissions glass floor – The theoretical limit of emissions reductions that will be reached across industries without the adoption of disruptive technologies.

Early stage innovation development finance – Financing of an innovation that occurs before commercialization, when the technology still requires development capital (Series A and series B venture capital, seed capital)

Late stage development financing – Financing of an innovation just before and during commercialization (Growth equity, private equity buyout, project finance etc.)

Seed/Angel Investment – Very early stage private finance for companies usually from company inception to developing the technology concept.

Venture Capital – A form of private capital typically provided for early stage, high potential growth companies.

Growth Equity – A form of private equity funding that occurs at the intersection between venture capital and a controlled buyout before or during product commercialization. Usually an investor takes a minority equity stake that enables the company to grow and develop their product further.

IEA Scenarios

450 Scenario (450S) – Sets out a path with the goal of limiting the global increase in temperature to 2°C by limiting the concentration of greenhouse gasses in the atmosphere to around 450 parts per million CO_2.

2 Degree Scenario (2DS) – Describes an energy system consistent with an emissions trajectory that recent climate science research indicates would give an 80% chance of limiting the average global temperature increase to 2°C. It sets the target of cutting energy related CO_2 emissions by more than half in 2050 (compared to 2009 levels) and ensuring that they continue thereafter.

The 2° Investing Initiative (2°ii) is a non-profit company set-up to produce research on pathways for aligning the financial sector with climate goals. Its research is provided free of charge and 2°ii does not seek any direct or indirect financial compensation for its research. 2°ii is not an investment adviser, and makes no representation regarding the advisability of investing in any particular company or investment fund or other vehicle. A decision to invest in any such investment fund or other entity should not be made in reliance on any of the statements set forth in this publication. The information & analysis contained in this research report does not constitute an offer to sell securities or the solicitation of an offer to buy, or recommendation for investment, in any securities within the United States or any other jurisdiction. The information is not intended as financial advice. The research report provides general information only. The information and opinions constitute a judgment as at the date indicated and are subject to change without notice. The information may therefore not be accurate or current. No representation or warranty, express or implied, is made by 2°ii as to their accuracy, completeness or correctness. 2°ii does not warrant that the information is up to date.

Contact:

Email: contact@2degrees-investing.org

Website: www.2degrees-investing.org

Telephone: +331 428 119 97 • +1 516 418 3156

Paris (France): 47 rue de la Victoire, 75009 Paris, France

New York (United States): 205 E 42nd Street, 10017 NY, USA

London (United Kingdom): 40 Bermondsey Street, SE1 3UD London, UK

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