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POLICY BRIEF

WHY THE NEW CLIMATE TECH FINANCE BOOM MIGHT END BETTER THIS TIME ROUND

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EXECUTIVE SUMMARY

While records amounts of venture capital are being invested in climate tech, we ask the question what is different now as compared to the investment boom of 10 years ago which by and large ended in bust. We find that we are in a better technological position than 10 years ago, mainly due to the success in bringing the cost of solar, wind and batteries down. However, financial barriers to massive deployment of these renewable assets remain. And more than half of the emission reductions needed for net zero needs to come from technologies that are not yet mature. While the innovation finance ecosystem is more mature now than 10 years ago, the EU is still lagging behind in venture capital. Public authorities are also more supportive now, but hard nuts regarding carbon pricing need to be cracked. These challenges come together in the case of decarbonisation of maritime shipping, which is one of the so-called hard-to-abate-sectors. In conclusion, although a repeat of the boom and bust of climate tech of 10 years ago is less likely, it cannot be excluded. Financiers, innovators and policy makers should act on the lessons learnt.

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INTRODUCTION

In 2021, record amounts of venture capital were invested in climate tech innovations. BloombergNEF reported a record $165 billion corporate finance investment in climate tech innovation, out of a record $920 billion total investment in energy transition.[1] Venture capital and private equity funds spent $53.7 billion in climate tech investments. At the same time, public funding in climate-related Research, Development and Innovation (R&D&I) is also increasing.[2]

Governments and capital markets seem to be playing their role and reallocating capital to new low carbon technologies, also in the development phase. But the world has been here before. Between 2006 and 2012, a mini-climate tech boom already happened. And it mostly ended in failure, leading some to write off the venture capital model for clean tech entirely.[3] Why would it be different this time?

The International Energy Agency (IEA) analysed a sample of 605 companies globally that received venture capital funding in 2010 and found that few were able to sustain the initial funding received.[4] The IEA arrives at three broad conclusions from that episode:

1. *"Venture capitalists did not stay the course as commercialisation timelines lengthened.*
2. *Globally, government policies to support early-stage, riskier technologies took longer than anticipated to be written into legislation.*
3. *Some start-ups overpromised and underdelivered."*

These observations echo the findings of Gaddy, Sivaram and O'Sullivan in their MIT working paper of 2016. According to them, cleantech companies were illiquid because 'working out the kinks in new science is time consuming', too expensive to scale, competing in commodity markets where margins are razor-thin and unlikely to be acquired by utilities and industrial companies.

These are useful observations to evaluate the current innovation investment context, especially given the new clean tech venture capital boom we are witnessing, which is expected to grow up to four times bigger than the last one. As the world has entered the make-or-break decade for achieving the Paris Agreement goals, it is indeed crucial we make the right investment choices. Can the technologies we need for net zero by 2050 get us there in time? What financing strategies are needed to mature and scale them? What is the technology strategy befitting a Paris-aligned financial institution? Those are the overarching questions that were debated in a High-Level Policy Dialogue, organised by the EIB Climate Policy Chair of the School of Transnational Governance. We derive five conclusions from these discussions.

1. WE ARE IN A BETTER TECHNOLOGICAL POSITION THAN 10 YEARS AGO

The good news is that most technologies needed to achieve net zero have been identified (see below). The even better news is that the broad investment goals are clear as well:

- Until around 2030 the challenge is to massify existing renewable energy and energy efficiency technologies and invest massively in the electrification of cars and homes and in the transport and storage of electricity.
- In parallel, increasing investment in decarbonisation technologies should bring the innovations to the market which will be needed between 2030 and 2050 to deliver net zero.

We owe this technological position to the extraordinary cost reductions in solar PV, wind energy and battery storage. It is safe to say that these cost reductions have created the possibility of transitioning the global energy system to net zero. Solar PV and wind are now

1 BloombergNEF, Energy Transition Investment Trends 2022: Tracking global investment in the low-carbon energy transition, January 2022
2 European Investment Bank (2021), Building a smart and green Europe in the COVID-19 era, Part II Investing in the transition to a green and smart economy, Chapter 4 Tackling climate change: Investment trends and policy challenges, p.141, INVESTMENT REPORT 2020/2021
3 Gaddy Benjamin, Sivaram Varun and O'Sullivan Francis (2016), Venture Capital and Clean Tech: The Wrong Model for Clean Tech Innovation, MIT Energy Initiative Working Paper, 2016-06
4 International Energy Agency (2021), Ten years of Clean Energy Start-ups: Tracking success and looking ahead to opportunities in emerging markets

the cheapest generation technologies in many parts of the world.[5] Without them, net zero pledges would simply be unattainable.

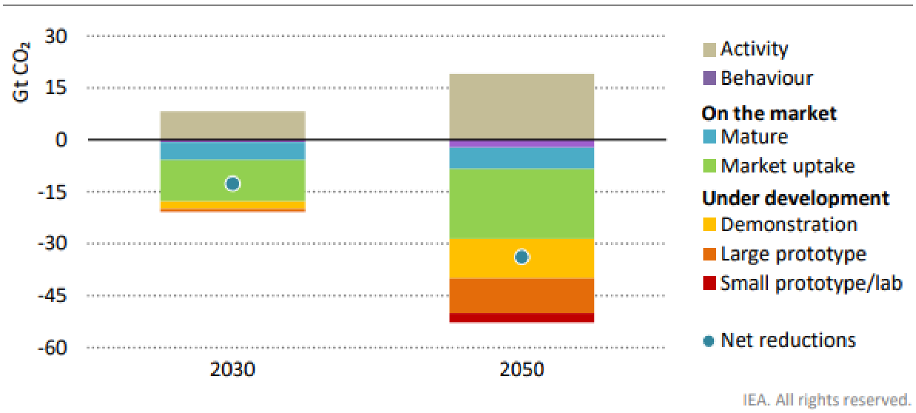
Moreover, recent research from the Oxford Institute for New Thinking have shown[6] that a fast transition to a renewable-driven future is likely to be cheaper than a slow or no transition. The authors modelled the learning curves of 50 energy technologies and forecast them into the future. They show that the cost reductions from clean energy technologies are likely to be greater than any of the 'optimistic' forecasts of classic energy system models, such as the ones used by the IEA. The key is to maintain the current growth rates of clean energy technologies. On the contrary, fossil-fuel and nuclear technologies show no sign of becoming less costly. Doubts are rising about the promise of fossil-fuels combined with carbon capture and storage and advanced nuclear to contribute substantially to decarbonisation.

However, 'cheap' solar and wind energy and batteries can only do half the job. The IEA Net Zero by 2050 report as stated that almost half of the emission reductions needed by 2050 must come from technologies that are still under development, notably those required for the decarbonisation of transport and materials. According to the IEA Net Zero by 2050 Roadmap, other low-carbon technologies, such as carbon capture and storage, modern bioenergy, hydrogen and synthetic fuels are needed. Only two out of 46 energy technologies and sectors are 'on track' with IEA's Net Zero Emissions by 2050 Scenario (solar and wind energy).[7] The IEA also shows that the time from first prototype to market introduction will need to be faster for these other technologies than was the case for solar and wind. Technologies needed to reduce emissions in hard-to-abate sectors like aviation and maritime transport are still in R&D or demonstration phase. Beyond energy, low-carbon materials and processes for infrastructure, food and life sciences will also be needed.

The need to move these technologies to the market through phases of demonstration,

FIGURE 1

Figure 4.22 ▹ Global CO_2 emissions changes by technology maturity category in the NZE



While the emissions reductions in 2030 mostly rely on technologies on the market, those under development today account for almost half of the emissions reductions in 2050

Source: Iea (2021), Net Zero By 2050, Iea, Paris

5 BloombergNEF (2021), Executive Factbook, slide 24
6 Rupert Way, Matthew Ives, Penny Mealy and J. Doyne Farmer (2021), Empirically grounded technology forecasts and the energy transition, INET Oxford Working Paper No. 2021-01
7 International Energy Agency (2021), Tracking Clean Energy Progress, https://www.iea.org/topics/tracking-clean-energy-progress

deployment and scaling up is recognised by the European Commission. The European Commission's Innovation Fund is becoming the biggest R&D&I fund in the world, with a methodology geared towards breakthroughs in emission reduction. The Innovation Fund aims to demonstrate and deploy the technologies needed for net zero, such as low-carbon steel. Other policy instruments and financing strategies will need to deliver the scaling-up, such as the European Commission-Breakthrough Energy Catalyst partnership. Four breakthrough technologies have been identified for targeted and guided investment: green hydrogen, direct air capture, sustainable aviation fuels and long-term storage. The Catalyst partnership aims to provide last-mile flexible funding to push these technological breakthroughs to the market.

The scaling up of low-carbon technology seems well under way in the energy sector in the form of investments in the cluster of renewables, storage, digital, flexibility. However, that only represents half of what is needed to reach the goals of the Paris Agreement. A major and urgent technology policy effort is required in particular in the so-called hard-to-abate sectors such as aviation and maritime as well as in low-carbon materials.

2. THE INVESTMENT APPETITE IS VERY STRONG, BUT FINANCIAL BARRIERS TO MASSIVE DEPLOYMENT PERSIST

If we consider first the mature technologies, like solar, wind and some energy efficiency technologies such as heat pumps, 2021 saw sustainable investment records broken, whether green debt or equity for sustainable ventures. And yet, the challenge to replace the asset base of the fossil-fuelled economy by new sustainable assets remains considerable. The financial system still faces barriers to the adequate re-allocation of capital to the massification of renewable energy.

Three examples of misalignment can be mentioned here. First, deployment of tested technologies still faces risk premiums that are not in accordance with the relatively low technological risk. The solution to that 'first time' problem, typically, is to structure investments so that a public investor or a dedicated climate fund takes first layer equity loss. First-loss capital allows the recipient to present a better risk-return profile to other investors, lowering the hurdle to attract capital. Institutional investors can then be drawn in with better solvency ratios and come fully on board for second and more rounds of financing.

Second, it is felt that the 'Basel III' and 'Solvency II' rules which were imposed after the financial crisis are not fully aligned with the Paris Agreement. These rules have increased the capital requirements, i.e. the capital that banks and insurers need to hold compared to the weighted risk of the assets they finance. The capital requirements were strengthened after the financial crisis and are now seen by the industry as an impediment to long-term capital investment. From the sustainable investment point of view, it appears that incumbent technologies with considerable climate or transition risks are too favourably weighted whereas investment in new sustainable assets are considered as greater risk, requiring larger capital buffers. Reform of these rules is urgent, in conformity with the taxonomies that are being put in place. The European Commission recognised this in the package of amendments to the Solvency II Directive, which was launched on 21 September 2021, in order to align better with objectives of the Green Deal. The proposals are now being discussed in the European Parliament. The proposals would create incentives for insurers to provide long-term capital funding and to integrate climate risks into their risk assessments. It remains to be seen whether this will be enough and whether investments that are aligned with the EU's taxonomy of sustainable investments, will benefit from effectively lower capital ratios.

Third, there is a need to apply existing practices, such as securitisation in the mortgage industry. Through securitisation, mortgage loans are packaged into a tradable financial product, allowing more capital to be raised. Hence, securitisation of a portfolio of new sustainable assets linked to the home, such as heat pumps, would allow for cheaper financing conditions and greater investment to be realised. The European Green Deal initiatives, in essence, aim to decarbonise the homes and cars of European households. These are the biggest asset investments households make. Sector regulation and carbon prices will steer households towards sustainable alternatives. But it is also necessary that retail finance enables and supports these choices by making the financing of these Paris-aligned investments financially attractive to households and individual consumers. European banks should step up their efforts in this regard.

Financial barriers to massive deployment of low-carbon investments need to be urgently addressed. The European Commission, the European banking and insurance sector and the supervisory bodies should take further steps to align financing practices with the objective of climate neutrality, integrating climate risks better and promoting low carbon investments.

3. THE INNOVATION FINANCE ECOSYSTEM IS MORE DEVELOPED, BUT THE EU IS STILL LAGGING IN VENTURE CAPITAL

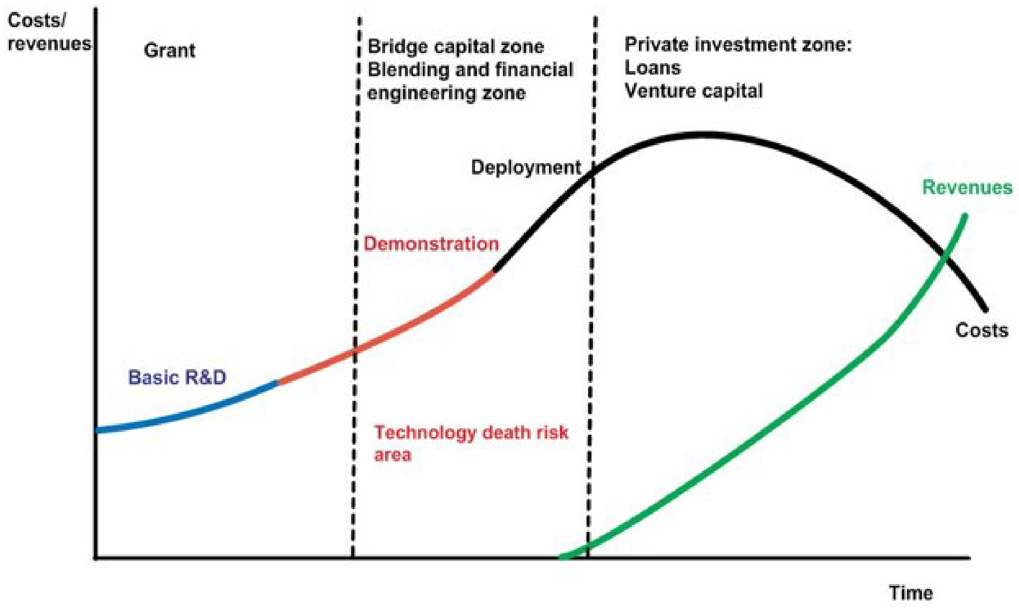
In this section, we turn to the financing of the innovations needed for net zero. In its Investment Report 2021, the EIB states that the EU is a world leader in green technologies but that the availability of finance for innovation remains a major obstacle. The same conclusion can be drawn from the report of the Cleantech Group, Seizing the EU's man on the moon moment. According to this report, EU cleantech scale-ups only attract 6.9% of global cleantech growth capital (compared to 32% for Asia, 54% for North America, and 4.8% for the UK alone). Hence, despite the venture capital wave going on, it remains a challenge to increase the availability and use of venture capital in Europe. The EU has the potential to become the world's climate technology hub but one trap needs to be avoided and two financing avenues need to be strengthened.

The trap to be avoided is an over-focus on public financing initiatives while forgetting the market-making. Most of the investments needed for net zero are private investments. They will not happen if the prices are not right. Venture capital investors need to see revenues on the horizon. The transition of technologies from the laboratory (using patents as an indicator) to commercial deployment is a danger-zone during which both public and private capital is required to ensure the survival of the project and its scaling up.

After that phase, two things need to happen: costs must fall with scale and revenues must rise. Otherwise, the technology risks remaining in the 'death risk area' (see figure below). The case of maritime decarbonisation serves as an example: there is a woefully inadequate business case for zero carbon shipping unless regulation creates one (by capping emissions) and a carbon price corrects the price of the fossil-fuels. The long commercialisation times, capital intensiveness and uncertain market will make it hard for venture capitalists to invest in maritime decarbonisation technologies. In the coming years, public-private collaboration will remain necessary.

Policies should focus on and strengthen two financing avenues. The first is nurturing proactively the small-scale climate tech ecosystem. Creating and growing businesses is difficult. It requires a supportive ecosystem, a lively technological competition, a sufficiently large talent pool - also attracting specialised foreign talent - and dedicated first time funds to provide seed money and support a new venture through their first financing rounds. The EU's R&D&I financing contributes to establishing an EU climate technology hub, just like ARPA-E (Advanced Research Projects Agency- Energy) is doing in the US. Greater entrepreneurship in climate tech could emerge from this, but it is not guaranteed and requires particular attention.

FIGURE 2



Source: Jorge Núñez-Ferrer, Christian Egenhofer & Monica Alessi, 2011

The second avenue is encouraging so-called venture debt, whereby climate tech start-ups are financed through loans and not equity, as is usual. Moreover, entrepreneurs are not always immediately willing to dilute their shareholding before scaling-up. Together with the dominance of bank financing in the EU financial markets, this pleads for greater use of the venture debt instrument. Use of venture debt would bridge or delay the next equity rounds while allowing entrepreneurs to maintain their stakes.

The EU should focus much more on venture capital and venture debt and avoid relying exclusively on public sector initiatives. The gap with the Anglo-Saxon world, and with emerging economies is striking… Further completion of the Capital Markets Union and alignment of European bank's loan practices with the Green Deal objectives is needed.

4. PUBLIC AUTHORITIES ARE MUCH MORE SUPPORTIVE, ALTHOUGH HARD NUTS REMAIN TO BE CRACKED

The European Climate Law, the ensuing legislative proposals, in particular the extension of the EU's Emissions Trading System (EU ETS) to new sectors and the legally binding sustainable finance rules, have maintained European leadership in climate policy. Climate tech entrepreneurs and green industry pioneers definitely do not lack moral support. Yet the example of Tesla forcing the whole EU automotive industry to catch-up is a reminder that technological breakthroughs are by no means an inevitable result of ambitious policies. And the current natural gas crunch in Europe highlights both the risk of continued dependence on imported fossil-fuels and the difficulty of weaning itself off those fuels sufficiently quickly. So even if government support for the introduction of low carbon technologies is stronger than ever, there is still a long transition ahead.

What is different now compared to ten years ago during the last climate tech boom is that the value of targeted industrial policy is recognised. The European automobile industry is counting on the Battery Alliance to create the European giga-factories for batteries in its attempt to catch up with Tesla. The steel and cement industries are counting on the massively EU sponsored clean hydrogen development to decarbonise. The policies, programmes and funds are in place to make this actually happen.

Through the creation of European industrial alliances, there is also a hope that more of the low carbon technologies will be designed and manufactured in Europe. This is partly both a consequence and a reflection of the success of solar and wind. The fact is that Europeans scaled these technologies up - with more than €70 billion a year in subsidies[8] - creating strong value chains. The Chinese solar production chains delivered huge cost reductions. For wind energy technologies, manufacturing is more evenly distributed between the EU and China. However, the EU-China dynamics that delivered cheap solar and wind energy are not viewed favourably by everyone, as it has led to a new dependency. So, there is a desire to replicate the renewables success for other deep decarbonisation technologies, while at the same time taking into account the objective of greater strategic autonomy.

Academic research on the value of 'knowledge spill-overs' seems to back the installation of targeted industrial policies.[9] It was found that UK sectors with an industrial policy in place produce greater spill-overs. The clean tech sector in general, and the carbon capture and utilisation, wind and tidal energy sectors in particular produces above average spill-overs. Based on this research, the case for public intervention via targeted industrial policy is compelling.

The second policy instrument that is deemed essential by sustainable asset managers is carbon pricing. From the perspective of innovation, carbon pricing adds three important aspects. First, compliance markets, and to a lesser degree, voluntary carbon markets, secure a price differential with fossil alternatives and hence, strengthen the revenue stream. Without a carbon price, the move from first deployment of low-carbon technologies to private investment simply becomes too big a jump because the long-term competitiveness of the sustainable alternative is less guaranteed. Our prediction is that commercialisation of many of the emerging low-carbon technologies will stall without an adequate carbon price. Countries and regions without carbon pricing will see a slower uptake of these new technologies. Second, the carbon price has systemic effects on innovation. Research by Imperial College London found that the EU ETS increased innovation by 10%.[10] Third, some of the technological innovation outside of the EU ETS covered sectors might benefit from an additional revenue stream in the form of carbon offsets, removals or certificates for additional investments. Generating carbon credits could add revenue in early-stage development.

The EU debate on industrial policy and strategic autonomy is a welcome development. This should include an open mind set on the opportunities global climate tech markets can offer. At the same time, solid and stable market incentives through the EU ETS should remain a key element of that industrial policy perspective, if only to avoid a raft of too detailed and complex technical regulations.

5. DECARBONISATION OF HARD-TO-ABATE SECTORS: THE CASE OF MARITIME

One of the biggest challenges for achieving net zero are the global, hard-to-abate sectors with great commercial repercussions, such as aviation and maritime. For shipping, the technologies for decarbonisation are mostly known: hydrogen-based fuels will need to replace maritime bunker oil. In the short-run, hybrid fuel vessels might be deployed and some smaller ships might be electrified. Hydrogen-based methanol is emerging as a quick win technology. But ultimately, ammonia seems to be winning the technology race for decarbonisation of long-range oceangoing ships because it is completely carbon free and in the long-term cheapest to produce.

8 European Commission (2021), Annex to the 2021 Report on the State of the Energy Union - Contribution to the European Green Deal and the Union's recovery

9 Guillard, Ch. ea (2021), Efficient industrial policy for innovation: standing on the shoulders of hidden giants, CEP Discussion Paper 1813

10 Raphael Calel and Antoine Dechezleprêtre, Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market, *The Review of Economics and Statistics* (2016) 98 (1): 173–191

However, ammonia-fuelled ships need to be purpose built so the pace of market entry will be determined by shipbuilding.

The problem is that all these fuels are two to eight times more expensive, so the commercial readiness is just not there. So, what could start and steer innovation in maritime decarbonisation? The same recipe as has worked for other climate tech technologies is valid here. Regulation (in the form of emission standards, emission intensity targets or renewable fuel mandates) are needed to create demand for emission reduction technologies. Scaling-up alternative clean fuel production and low-carbon shipbuilding should then bring the costs down. And once these technologies are commercially available, carbon pricing should further close the competitiveness gap. However, the global maritime business requires global agreement in the International Maritime Organisation (IMO) to get there. In anticipation of such a global agreement, the only way for the EU to start is to define 'green corridors' within Europe and test the business model innovation shielded from global competition. Bringing the cost of maritime decarbonisation down is essential to increase the appeal beyond EU jurisdiction and put pressure on IMO. EU companies control almost 40% of global shipping, but the EU only builds 1% of the ships.[11]

As with solar energy, if Europe pays for the learning and Asia builds it cheaply, the world might experience the breakthrough in low-carbon shipping which would give the world a better chance of achieving the Paris Agreement's goals.

CONCLUSIONS

Never before has so much capital been invested in renewable and low-carbon technologies. Moreover, the world is in a better technological position after the emergence of cost-competitive solar and wind energy, and battery storage. Massification of these technologies is the first investment goal for the next decade. The second is to replicate this success for other decarbonisation technologies needed for net zero. This can only be done with sufficient venture capital and a supportive policy framework, with targeted industrial policy and carbon pricing. Although the EU is pushing the boundaries on both fronts, the case of maritime decarbonisation illustrates that there is still a long journey ahead of us before achieving the goals of the Paris Agreement.

11 Most ships are built in China, South Korea and Japan. Marine engines are much more widely produced, including in Europe.

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