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A European Industrial Policy

Preparing the ground for innovation

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Introduction

Guillermo Passas Varo
Editor

The European Commission is set to invest more than €95 billion in research and development in the next multi-annual financial framework 2021-27 and has announced an investment of €1.95 billion for the Digital Europe Programme. Yet, there is not a single EU-based company in the world's Big-Tech top 12. The EU's lack of competitiveness against the emerging powers, such as China and India, or the ever-dominant US, is apparent in fields such as the digital economy or startups.

Despite being the oldest contemporary theoretical and political family on the continent, liberalism has consistently been the most innovative, precisely because our background is not composed of rigid dogmas or outdated theories: we like evolving as fast as our society does, and that is, plain and simply, the cornerstone of our success.

This publication is the result of several months' work, bringing together work done by researchers, policy experts and industrial stakeholders during an online hackathon organised by the European Liberal Forum, in cooperation with the European Dialogue Program of the Friedrich Naumann Foundation for Freedom. Participants discussed future solutions for bottom-up innovative entrepreneurship and top-down funding for innovation during two breakout sessions.

Based on these first policy proposals, the following papers from Ines Holzegger, international officer at LYMEC and expert on digital policy, Imad Uddin Ahmed (The Paddy Ashdown Forum) and D'Maris Coffman (Professor at University College London) highlight the potential steps to creating a more competitive environment for startups, as well as sustainable funding options via an innovation fund for the EU.

The strength of liberal ideas with regards to innovation is highlighted by their adaptability to new situations, technologies and challenges. Only by opening our minds, drawing on liberal best practices in other countries and providing bold proposals can we foster growth, progress and a modern society of Europeans ready for the 21st century.

European startups – Unachievable ideal goal or potential innovation engine?

Ines Holzegger
Outreach & Cooperation Officer, LYMEC

"Is Big Tech becoming too big to sustain?"[1], "EU steps up Big Tech crackdown with in-depth probe of latest Facebook deal"[2], "Vestager vs. Cook: New Apple charges reignite old standoff"[3]: these are just a few recent examples of a vast number of headlines around the relationship between the European Union and big-tech companies. One of the major differences between the European and US markets concern their respective innovation environments, namely the issue of the massive US prevalence in Big Tech.

This paper seeks to highlight the values European startups should ideally be based on and the main factors that distinguish the European startup culture from other environments such as the US or Israel. Also, the current legislative situation will be outlined, including barriers for innovation. Finally, some best practices for innovation and potential solutions to creating an innovative environment for European startups will be given.

What goals should the EU pursue and therefore aspire to in its policies? What can we learn, for instance, from the recent accessions to unicorn status, currently a hot topic?

Unicorns on everybody's lips

When talking about success stories of startups, one cannot avoid the term "unicorn". The term first was coined by Aileen Lee in 2013 describing a tech company that valued above $1 billion. Nowadays, the term – while still describing a startup valued at over $1 billion – has made its way into many political speeches, especially on a European level. In 2021, more than 80 new unicorns have been reported in Europe so far.[4]

The Digital Decade communication, released by the European Commission in March 2021, describes how the EU should shape its (digital) policy in the next decade to achieve more prosperity.[5] Two concepts are pointed out as central for EU businesses: sustainability and competition. Sustainability is strongly connected to plans of promoting greener practices and products with a lower environmental footprint. Open competition and fairness are key factors as well,

1 VideoWeek (2021)
2 Van Dorpe (2021)
3 Manancourt (2021)
4 Dealroom.co (2021)
5 European Commission (2021a)

especially in ensuring a level playing field. This goes hand-in-hand with providing strong and European-values-based rules. Competition within the internal market is therefore seen as a main driver of innovation.

Every once in a while, when new allegations regarding one of the US Big-Tech companies are disclosed or a verdict in one of the many antitrust cases the European Commission pursues gains media attention, the question arises – asked by politicians as well as civil society representatives – why there is no European counterpart to the GAFAM[6]. Is this an indication of a lack of innovation? And furthermore, is there actually the necessity to enable the same kind of enterprise structure and culture that so many European politicians are vocal against. Or is/should there be a different understanding of enterprise and startup that's specifically European. Are there barriers within Europe that inhibit innovative startups to achieve scale – is scalability even desired in a European context? And how could we make Europe a haven for innovation – or is Europe already on track to being one?

Many questions to which there are no easy answers. There are significant disadvantages for the EU in its innovation capabilities in comparison to others. In Europe, governments are still unwilling to give up certain member-state prerogatives in order to foster innovative integration by getting rid of fragmentation in the internal market. The US on the other hand, while being a federal state with strong state rights, has a very large, integrated market which brings many advantages, namely no fragmentation and new startups and firms do not have to worry about different barriers to entering the market.[7]

A further difference between the US and the European market concerns innovation models. While the US innovation is "strongly driven by grassroot market forces", the EU is governed by strong industry structures, big R&D and sectoral development programmes, and overarching "goals of making Europe the most competitive knowledge-based economy in the world while at the same time promoting territorial cohesion".[8]

Therefore, European businesses and especially startups should have the following key drivers:

- *Being competitive* – on a level playing field with international competitors, being able to adapt to the rules of the market;
- *Being sustainable* – not only in terms of lasting longer than a few months therefore having a sound business plan, but also in environmental matters;

6 GAFAM: Google, Amazon, Facebook, Apple, Microsoft
7 Rodríguez-Pose and Crescenzi (2008)
8 Rodríguez-Pose and Crescenzi (2008)

Preferably *rely on local ecosystems* – in line with the European Commission's push for more sovereignty[9] meaning that ideally, most of the production steps should be based in Europe;

- *Combine innovation and research for future growth* – meaning that not only the businesses profit from success, but in consequence also the European population and society as a whole.

What is the current situation start-ups face and what is planned in the EU?

To enhance innovation, European legislation plays a crucial role for digital companies. Currently, the most important legal framework for digital services is the e-Commerce Directive by the European Union. The main function of the e-Commerce Directive is to harmonise the rules for digital services, including requirements for transparency and mandatory consumer information, online contracting, and commercial communications. It was a key step towards further internal-market harmonisation, as it signaled that the European internal market needed to also include the digital sphere.[10] However, it came into force in 2000, at a time when digital services, social-media platforms and also e-commerce were either barely developed or non-existent. Thus, the rules in place are no longer state-ot-the-art and particularly in the ever-changing digital sector, that can leave a lot of uncertainty.

For that reason, the European Commission is working on further legislation to update the partially outdated e-Commerce Directive:

- **Digital Services Act (DSA):**
  The Digital Services Act targets online intermediaries and platforms such as social-media platforms or marketplaces, but also online travel and accommodation platforms and aims to put in place mechanisms against illegal goods, services, or content online and sets measures for increased transparency including for recommender systems based on algorithms.[11] One of the benefits for startups and small and medium-sized enterprises (SMEs) stemming from this new legislation could be increased fairness of competition. Many SMEs are dependent on larger platforms and their recommender systems, and when their goods or services are not ranked high due to the bias of an algorithm or unfair competition, this would be transparent for the SMEs and startups.[12]

9 European Commission (2021a)
10 European Commission (2021b)
11 European Commission (2021c)
12 European Commission (2020)

- **Digital Markets Act (DMA):**
  The Digital Markets Act sets rules that target large online platforms, so-called gatekeeper platforms. Gatekeepers are defined as large online platforms that are active in multiple EU countries and have a strong intermediation position for many businesses and users. Due to this position, they are the bottlenecks between businesses, customers, and services and play a crucial role in a lot of smaller companies' operations.[13] The DMA could increase the access of smaller and newer companies to their customer data from the gatekeeper platforms. It would then also be easier to switch from gatekeepers' services or products or combine them more seamlessly.[14]

- **Artificial Intelligence (AI) package and sandboxes:**
  A new technology that will shape our society as much as the business world is Artificial Intelligence. It is no longer a simple buzzword, as blockchain was a few years ago but the basis of various new startups as well as large digital companies. With this technology here to stay, the European Commission has proposed a package including rules for the use of AI, while at the same time enabling further research.[15] Sandboxes are also mentioned as a way to encourage innovation of AI solutions. The European Council defines these regulatory sandboxes as follows: "Concrete frameworks which, by providing a structured context for experimentation, enable where appropriate in a real-world environment the testing of innovative technologies, products, services or approaches – at the moment especially in the context of digitalization – for a limited time and in a limited part of a sector or area under regulatory supervision ensuring that appropriate safeguards are in place."[16]

Sandboxes – the case of Japan

"In 2017, the Japanese Ministry of Economy, Trade and Industry (METI) set up a regulatory sandbox. The aim is to develop an environment in which companies can carry out demonstration tests and pilot projects for new technologies and business models that are not provided for under the applicable regulations. The aim is to ascertain how the technology in question fits into the current regulation and which changes may be necessary. The regulatory sandbox is open to all types of technologies and topics, with a particular focus on the areas of financial services, health care, mobility and transport."[17]

13 European Commission (2021c)
14 European Commission (2020)
15 European Commission (2021d)
16 European Council (2021)
17 Leimüller (2020)

All these initiatives aim at making digital markets more transparent and less prone to abuse of dominant powers by leveling the playing field and opening it to innovation.

Which barriers to innovation do startups face?

While a strong asset of the EU is the Single Market, it remains highly fragmented. One example consists of attracting skilled workforce from outside the EU. Particularly in the digital and tech sector, skilled workers are needed to drive innovation. Given the demographic pressure and insufficient educational system in the tech sector, the EU falls short of covering this requirement itself, resulting in a lack of highly skilled workforce. Against this background, the Council just adopted the reform of the EU Blue Card directive, a scheme that facilitates contract-based employment within the EU of non-EU workforce. "More flexible admission criteria, a lower threshold for the minimum salary that must be earned [...] to qualify and more rights for beneficiaries and their families" are some of the changes in order to tackle labor shortages.[18]

Apart from the persisting fragmentation of the market, the behaviour of European citizens is another hurdle with regard to innovation. Research suggests that there are different technology adoption types among consumers. The first category are the innovators, a small percentage of people that are the first to adopt a new technology, therefore also taking the risks and uncertainties these new innovations might bring. Next there is the group of early adopters, a larger percentage than the innovators, but still the second smallest. These people can be considered as opinion leaders and after the innovators, are second to adopt new technologies. After the early adopters, the two equally sized groups of early majority and late majority start using the new technology. These are the biggest group and are significantly more reluctant towards adopting new innovations than the former two. Finally, the so-called laggards are the last to adapt to what the rest of the population has already. They are not considered to have a vast amount of opinion leadership and are rather averse to change.[19] Potentially, there are more Europeans that belong to the last three categories in comparison to China, Japan or the US. The effect on the market is significant. If the demand curve for new technologies takes off slowly, technology innovation and supply are discouraged.

"While a strong asset of the EU is the Single Market, it remains highly fragmented."

18 Council (2021)
19 On Digital Marketing (2015)

How can we promote "EU startups" and create an innovative environment?

As the elaboration of the main barriers and problems might suggest, there is no simple answer or silver bullet on how the EU can become a startup haven. However, the case of Estonia's e-Residency program gives important insights on how European unicorns could be encouraged early on, as a best practice example for other countries. So, why does Europe often seem so slow in innovating and creating success stories? Maybe this is the wrong question after all. There are many success stories in Europe. According to some reports, Europe's unicorns have outnumbered even the Chinese with 296 unicorns created since 1990 (August 2021).[20] Could it be that the focus of reporting is simply not pushing startup success stories as much into the broader public attention?

Recently, more has been reported about successful up-and-coming European startups, among others the vastly expanding grocery delivery service "Gorillas", the Swedish fintech company "Klarna", or "Bitpanda", an Austrian cryptocurrency startup. Are these companies specifically European? Not necessarily. Would they have made it on the US market? Potentially.

However, we can neither pinpoint their success to just one specific factor that could be replicated to other startups, nor is it simply one economic sector. What we can see through these successful companies is though, that it is possible to succeed globally or at least on a broader scale, as a European startup.

Current initiatives and best practices for innovative startups

Estonia's e-Residency[21]

In Estonia, it is fairly easy to register a new enterprise – it can be done 100% online, even from abroad. All that is needed is (among others) a government-issued ID, a motivation statement, and a small fee. After being granted e-Residency, an Estonian contact person and legal address can be obtained from the official marketplace. After that the company structure has to be registered at the e-Business registry and a bank has to be found (fintech options are provided through the official marketplace). The aim of carrying out all of the processes online is to limit bureaucracy and unnecessary visits to various administrative entities.

Obtaining e-Residency not only enables new businesses to enter the Estonian but also the whole EU market. The businesses can be operated

20 Kanetkar (2021)
21 E-Residency (2021)

from anywhere in the world digitally, minimising the costs and paper used for business matters.

Another key advantage of e-Residency, pointed out by the Estonian government, is the broad, global network of e-resident entrepreneurs and the strong community that is built around the program.

Israel's startup mentality

Israel can be considered one of the innovation hubs in the world. The number of new unicorns is particularly high and even surpasses China, being only 2nd to the US. The specifics of the Israeli market relate "to the agility of the Israeli ecosystem and its skill of building significant companies in sectors that need disruption, even without the specific background required for that domain". Furthermore, the majority of the Israeli unicorns are still managed by their original founders – and 50% of the CEOs are located in Israel, resulting in not shifting vital company branches in the destination market as digitalisation enables new operational models and means to better manage a companies' output.

The European Startup Nations Alliance (ESNA)

In March 2021, ESNA as new entity was established by 26 EU member states and Iceland to ensure "the best conditions to grow at every stage of [the startup's] life cycle." They focus on eight main standards:

- "Fast startup creation and smooth market entry (e.g. setting up a new company within one day)
- Attracting and retaining talent (e.g. an accelerated visa process for tech talent from outside the EU)
- Stock options (e.g. no taxes for stock options before being cashed in)
- Innovation in regulation (e.g. regulatory sandboxes allowing startups to experiment)
- Innovation procurement (e.g. removing administrative impediments that would put startups at a disadvantage)
- Access to finance (e.g. increasing the amount and diversity of growth capital)
- Social inclusion, diversity and protecting democratic values (e.g. incentives to hire on diversity of gender, ethnicity, age and religion)
- Digital-first (e.g. all interactions between authorities and startups via digital interfaces)"

The success of this initiative is still to be seen but it can be considered a step in the right direction, as many of the barriers that startups currently face are being targeted.

"the EU should draw on these bast practices and promote projects fostering innovation by creating a positive startup environment"

To conclude, the EU should draw on these bast practices and promote projects fostering innovation by creating a positive startup environment in order to make Europe a startup hub. To reach the goal of the European Commission stating that "[w]hile Europe is creating already as many start-ups as the US, it needs to create more favorable conditions and a truly functioning Single Market for rapid growth and scale-up"[22], the EU should:

- *Establish a clear legislative basis:* Not just on a European level but also national legislation should be streamlined so startups can expand seamlessly within all EU member states without having to face ever-changing, new barriers;
- *Enable fair competition:* Especially when it comes to taxation, the European Commission needs to ensure that the European startups do not have a disadvantage in comparison to Big Tech companies who can afford to secure the best taxation arrangements;
- *Create and support more innovation hubs:* Enabling startups to profit from European research while also testing out new innovations in sandboxes could be a way to encourage more companies to innovate while at the same time giving European consumers more security to adopt new technologies earlier.

22 European Commission (2021a)

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The case for a European innovation seed fund

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Background

Europe has several funds to support technological and business process innovation geared towards combatting climate change. Since these largely came about through bureaucratic processes that largely circumvented political debate, we will make the case for a European innovation seed fund in a political forum, and will argue for slightly different mandates and investment theses from what has been provided. But before we do that, we will present a brief overview of Europe's existing innovation funds.

The European Commission recently established an Innovation Fund that made its first call for small scale and large-scale investments in 2020 and launched its second call in October 2021. The Innovation Fund was established under the revised EU Emissions Trading System (ETS) Directive 2003/87/EC, supporting the European Commission's strategic vision for a climate neutral Europe by 2050, as outlined in its communication "A Clean Planet for All" of 28 November 2018 and in the European Green Deal Investment Plan (European Commission, 2019c, no date b).

The Innovation Fund's aim is to offer financial support low-carbon technology demonstration projects in energy-intensive industries, renewable energy, energy storage and carbon capture, use or storage in all Member States until 2030 (European Commission, 2019a). The fund will offer this support while adapting to market needs and projects' profiles, and while attracting additional public and private resources. It will fund projects with high innovation and business potential and provide synergies with other European Union programmes (European Commission, 2019a). The Innovation Fund is financed by revenues from the auction of emission allowances from the EU's Emissions Trading System (European Commission, 2021a) and with a projected budget of EUR 25 billion by 2030 (assuming a carbon price of EUR 50/tCO2e). It is implemented by the European Climate, Infrastructure and Environment Executive Agency (CINEA), while the European Investment Bank provides the project development assistance to promising projects that are not ready for full application (European Commission, 2021a).

While the Innovation Fund aims to support innovation from pilot to pre-commercial-scale up, another European institution, Horizon Europe, supports technological solutions cross the "valley of death" to the market.

Like the Innovation Fund, the Horizon Europe programme aims to tackle climate change, as well as help achieve the UN's Sustainable Development Goals and boost the EU's competitiveness and growth by funding research and innovation. It has a budget of EUR 95.5 billion and is focused on supporting innovations with disruptive potential but which may be too risky for private investors; 70% of the budget is earmarked for small and medium sized enterprises (European Commission, no date a). To pursue these purposes, the Horizon Europe programme set-up the European Innovation Council earlier this year together with the dedicated equity fund, the European Innovation Council Fund (European Commission, 2021b).

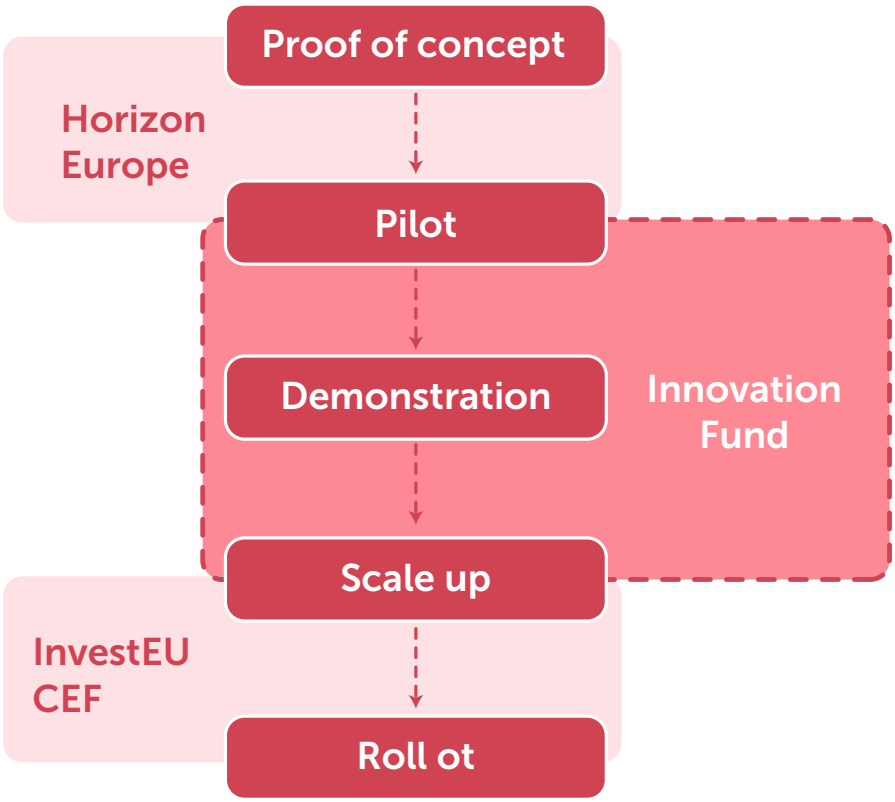

Figure 1 EU institutions funding innovation

Source: European Commission, 2019b

Besides these two sources of funding for innovation targeted at reducing greenhouse gas emissions, increasing climate resilience and reducing inequalities in Europe, the

- European Investment Bank runs the InnovFin Energy Demo Projects fund which provides loans, loan guarantees or equity-type financing typically between €7.5 million and €75 million to innovative demonstration projects in the fields of energy system transformation (European Investment Bank, 2021);
- Connecting Europe Facility promotes growth, jobs and competitiveness through targeted energy, telecommunications and transport infrastructure at the European level (European Commission, 2021c);
- InvestEU Programme aims to trigger a new wave of more than €372 billion in public and private investments using an EU budget guarantee of €26.2 billion to boost investment, innovation and job creation in Europe over the period 2021-27 (European Union, no date);
- the Modernisation Fund is dedicated to supporting 10 lower-income EU Member States in their transition to climate neutrality by helping them modernise their energy systems and improve energy efficiency (European Commission, no date c);
- European Parliament is considering a Just Transition Fund to support 'territories most affected by the transition towards climate neutrality' and to avoid regional disparities growing (European Commission, 2020).

The case for an innovation seed fund

Whether the policy objective is to facilitate the low carbon transition or is merely to build a fairer, more equal society in the wake of the COVID-19 pandemic, innovation can be a driver of value in the real economy. It may, as in the case of the rapid development of mRNA vaccines, enable timely and robust responses to a public health emergency. But equally, innovation is necessary if society is to rise to the challenges of rapid decarbonisation to meet Net Zero targets by mid-century. An innovation seed fund is one of several policy instruments European governments must use to steer humanity towards climate resilience. Technological advances are necessary to reduce or mitigate greenhouse gas emissions, to adapt to rising median global temperatures (which are inevitable even if emissions reached Net Zero tomorrow) and to remediate or repair anthropogenic climate change in human time scales.

As Europeans, we also need to care about innovation taking place in Europe. Europe's increasing dependence on the financial sector at the expense of

manufacturing is a recipe for increased economic bubbles followed by financial crises, deskilled workforces, growing inequality and a loss of politically liberal and democratic values. Not only is there space for a public investment fund to seed innovation in Europe, but also there is a need for one if Europe is not to cede productivity in the face of increasing free market competition through new generation trade and investment partnerships with East Asia, India and North America.

Moreover, not only does public investment not crowd out private investment, but also private investors are rarely incentivised to invest adequately in innovation as often the social benefits outweigh the private benefits accruing to large breakthroughs due to uncaptured and dispersed positive spill-overs, impatience and risk aversion. In general, private firms will invest in low-risk, low expenditure incremental change, where returns can be quickly recovered, but where value-addition gains are relatively small.

The public sector can and does stimulate innovation through various policy instruments, including procurement, regulation, consumption taxes for undesirable outputs, tax waivers for desired outputs, as well as through the legal creation and protection of intellectual property. In an open free-trade economy, these policy instruments promote innovation globally rather than promote innovation locally. At the same time, the effect of these enabling policies is partially negated by policies that promote competition.

To ensure that the economic benefits of innovation are enjoyed as fully as possible domestically, European governments should also

- intervene by helping attract top global scientific, mathematical, engineering and administrative talent;
- provide world-class education to their populations;
- fund university research;
- nurture research hubs and collaboration between universities and the private sector; as well as
- directly fund, and mobilise private funding for specific innovation outputs and outcomes.

Why we care about innovation

The reasons why we care about innovation are numerous. In our daily lives, we care about innovation because of the benefits that accrue to us as consumers; and we care about innovation because we care about employment, wages and

a high standard for ourselves and for people sharing our democracy. We care about innovation as consumers and as global citizens because of the welfare effects it brings.

Medical innovation has helped us live longer and healthier lives. Innovation in communicating knowledge – from the creation of written scripts and printing press to the creation of a network that allows us to access information anywhere in the world, to the creation of handheld devices that convert microwaves containing data into readable languages – have helped us live less ignorant and more fulfilling lives. Innovation has made our domestic housebound lives less labour intensive with vacuum cleaners and washing machines; allows us to become more worldly by allowing us to travel further from our homes faster.

Innovation can also help us address the causes and consequences of climate change. Indeed, there is an imperative for technological solutions to the climate crisis. In addition to

- regulating greenhouse gas emissions,
- inducing behavioural changes among consumers and corporations, and
- investing in nature based solutions to sequester greenhouse gases and to build resilience against climate events,

European governments need to invest in emissions mitigation and resilience innovations where they believe that market forces and their other interventions are not going to mobilise as much private capital as is required.

We have very little time left to drastically reduce our greenhouse gas emissions before we cause irreversible biodiversity loss and ultimately imperil human societies. Research published by the Intergovernmental Panel on Climate Change in 2018 suggested that earth had a carbon budget of approximately 10 years (given humanity's rate of greenhouse gas emissions) before a point of no-return in triggering Earth system feedback effects which would exacerbate the adverse effects of climate change (IPCC, 2018, p. 108; Liberal International, 2021). These irreversible system feedback effects include the thawing of permafrost in the Arctic releasing methane; weakening of the land and sea to act as carbon sinks and instead acting in the opposite way with increased forest fires and increasing bacteria in the ocean producing more CO2 (Berners-Lee, 2019, p. 272; Liberal International, 2021). What this means for Europeans is increased frequency of droughts, floods, increased food insecurity, increased diseases and bacteria, greater risks of injuries and deaths owing to more intense heatwaves and fires, and greater migration to Europe as the poor become poorer in low income

countries or altogether lose their nation states under water (Biermann and Boas, 2017; IPCC, 2018, pp. 234, 238, 240–241, 244; Liberal International, 2021).

We have already been using technologies that allow us to weather some effects of climate change. Examples of such technologies thus far in operation include curvatures on roads and rooftops that allow water to run towards drains that run to the sea, weather and hazard forecasting systems, sophisticated flood control systems that protect London and Amsterdam.

We also are already using technologies that reduce our societal greenhouse gas emissions. Examples of such technologies and processes include

- pumped hydropower; geothermal power; solar photovoltaic panels that harness the sun's energy into electricity and thus displace some amount of fossil fuel driven energy (at least during sunlight hours);
- electric vehicles, which if used extensively, are responsible for fewer emissions than vehicles that run on fossil fuels on a lifecycle basis;
- heat pumps which extract warmth from the air or the ground, or from water and which heat buildings;
- the sharing economy which, in the case of cars, reduces the stock of cars and hence embedded carbon on the road; and
- the circular economy which maximises the use of minerals and materials whose extraction, production and transportation emitted greenhouse gases.

But we require more innovation in both scientific discoveries, its practical application and in the way we do things if we are to achieve the drastic reduction in greenhouse gas emissions required. Further innovations on the horizon that are in the ideation stages or pre-commercial stages include

- carbon dioxide removal technologies such as carbon capture utilisation and storage of greenhouse gas emissions from thermal power generation and industrial processes;
- green hydrogen production so that hydrogen can be used as a cheap, climate resilient and dispatchable source of energy;
- adapting transportation to run on hydrogen; and
- solar radiation management solutions with cloud seeding or space mirrors;
- nuclear fusion and next generation nuclear fission;
- zero-carbon cement and steel;
- plant and cell-based meat and dairy.

With energy used in industry, transport and buildings; agriculture, forestry and land use change; industry; and waste being the main emitters of greenhouse gases, innovation must focus on making these sectors of the economy both more energy efficient and less carbon intense.

Why we care about innovation in Europe

China and the USA have been climate technological innovation leaders, but as Europeans, it is in our own interest to not rely on their continued leadership. By investing heavily in scaling solar PV production capacity, China has done much of the heavy lifting to make solar production commercially competitive. So why bother investing European taxpayers' money into innovation when we can free-ride on the investments of others' tax investments?

Answering this question requires a recognition that public spending in Europe has generally been devoted to counter-cyclical policy responses to crises either in the form of direct subsidies and transfer payments (in the wake of COVID-19) or policies like the Juncker Plan which supported European integration in the wake of the Eurozone debt crisis. Yet for all the investment in new infrastructure, much existing regional infrastructure languished and the spatial spill-over effects were not always positive, as rural communities may have been excluded from positive network effects that resulted from better connected, larger cities. Investment in innovation can be an adjunct to industrial policy and infrastructure policy, as decarbonising transport through making road networks suitable for electric vehicles entails improvements to existing infrastructure alongside the buildout of new infrastructure. There is a lot of evidence that these kinds of investments have better welfare outcomes than standalone, new infrastructure investment in capturing the benefits of innovation.

Relying on foreign innovation is not free-riding. Yes, we too benefit from the emissions abatement thanks to the Chinese solar industry. But we are also supporting Chinese investors and workers, rather than developing our own Greentech industries. We are not investing in our productivity, in our economic resilience and in equality between our labour and capital. By neglecting to do so, we are also not investing in our own political resilience.

Asymmetric trade with a technologically advanced economy kills the most advanced economic sectors in the less advanced country. This is known as the Vanek-Reinert effect, and is what happened when the Central and Eastern European (CEE) and newly independent countries from the former Soviet Union

(NIS) integrated into world markets after the fall of the Berlin Wall in 1989. In all countries but Hungary, industrial employment fell from 1990 to 2001. In the least developed economies (Armenia, Azerbaijan, Bulgaria, Kyrgyzstan, Romania), the surplus labour from deindustrialisation moved into agriculture, lowering agricultural productivity. In the relatively more developed countries (Czech Republic, Estonia, Latvia, Poland, Russian Federation, Slovakia, Slovenia), the surplus labour moved into the service sector (Reinert and Kattel, 2019).

In the absence of state support for innovation, investment in R&D will naturally flow into sectors with high short-run profitability such as financial services. This scenario risks misallocating investment away from manufacturing industries that have enabled social democracy to flourish in Europe by providing higher productivity and therefore higher wages to a broader base of society, who with greater financial power, have secured greater political power resulting in a broad consensus around a multigenerational social contract.

There is an opportunity post-pandemic to use innovation policy and an innovation seed fund to help facilitate structural change in an economy where sectors such as retail, hospitality, tourism and commercial office space are ripe for disruption and may undergo such radical change as to re-emerge in ways that render them virtually unrecognisable. If we are to Build Back Smarter, and Build Back Better, and operate more broadly in circular economies, we need to accelerate innovation in Web 3.0 in ways that feed through to the real economy. Today, most of the interest in Web 3.0 has been around applications to financial services.

As it stands, increasing investment in financial services and away from manufacturing has contributed to rising inequality. Those not employed in finance will deskill and real wages will fall as income and wealth inequality will rise between those in finance and those not.

Why we can't leave innovation to the private sector in our current vision of capitalism

In our current vision of market capitalism, private investors will invest less than what is socially and economically optimal in innovation. Private investors will underinvest because

- They do not want to cannibalise their own products. This happened, for example, when Radio Corporation America decided not to fund the development of liquid crystal technology of its researchers because managers were concerned that development of a rival liquid crystal

display technology would undermine its highly profitable cathode ray tube television business and royalties received from licenses. (The Japanese multinational Sharp purchased the patent license for LCD, thus spelling the beginning of the end of US market dominance in television manufacturing sector.)

- The benefits of their research are not fully internalised within the company; indeed, competitors benefit. Xerox PARC invested heavily in research that benefited others. Bill Gates reportedly said to Steve Jobs, that it was as if they "both had this rich neighbour Xerox and I broke into his house to steal the TV set and found out that you had already stolen it (Hertzfeld, 1983)."
- They are highly impatient for returns. So long as high thresholds of Internal Rates of Return are socially acceptable, projects that require large capital expenditures and have long payback periods, venture capital will not invest in socially and economically valuable innovation projects. It will prioritise low capital expenditure projects with short payback periods, such as investments in software. The US Small Business Innovation Research (SBIR) serves as the first place many entrepreneurs involved in technological innovation go to for funding and supports five to seven times as many early-stage tech start-ups as does private venture capital (Gruber and Johnson, 2019). (Not that the two are in competition: a Phase 1 SBIR grant almost doubles the chances of a recipient receiving venture capital money (Howell, 2017)).
- They are risk averse. Left alone, multinationals will tinker with incremental innovation rather than finance game-changing but highly uncertain innovation. That is the merit of funding outsiders such as Tesla to disrupt the mature automobile market with electric vehicles. This is also why Treasuries of multinationals invest heavily in diversified portfolios of other companies' stocks rather than in their own innovation.

Good things happen when public funds invest in R&D

'Yes, the government will be somewhat inept—but the private sector is in general inept. How many companies do venture capitalists invest in that go poorly? By far most of them. And it's just that every once in a while a Google or a Microsoft comes out, and some medium-scale successes too, and so the overall return is there, and so people keep giving them money' – Bill Gates (Bennett, 2015). He calls on governments to quintuple their spend on energy and climate-related R&D (Gates, 2021, p. 200).

Many of the innovations that enrich our lives are the results of public investment in research and development. Consider that two-thirds of the most innovative

drugs trace their research back to the Human Genome Project, a government-sponsored collaboration across universities and research centres spanning the USA, UK, Japan, France, Germany, India and China, the "most significant undertaking [...] mounted so far in all of science", according to the then director of the US National Institutes of Health (Gruber and Johnson, 2019).

The instant access to information you have about your surroundings as well as the world at large in the palm of hand is also thanks to public funding. Html was written at the Conseil européen pour la recherche nucléaire (CERN), the internet and SIRI were funded by the US Department of Defence, GPS came about because of the US Navy, while we have touchscreen displays thanks to the CIA. A US National Science Foundation grant funded Google's algorithm (Mazzucato, 2018).

"Research has saved lives, increased our quality of life and helped us on our path to downsize our carbon footprint."

The US Department of Energy has helped make a transition to net zero emissions imaginable by funding nuclear, solar and battery innovations, and by funding the development of Tesla's Model S electric car when the company was yet a start-up. By prioritising renewable procurement, the European Investment Bank, have helped Chinese suppliers achieve economies of scale and make solar PV cost competitive on a produced kilowatt-hour of energy basis. The question arises as to why in the first place Chinese and not European manufacturers were ready to meet the European Investment Bank's demand. One reason is that since the Kyoto Protocol, European policy influencers and makers have been gaming carbon accounting by obsessing over Europe's territorial carbon production, rather than counting imported carbon. The quickest way to show a reduction in emissions is by pursuing policies that encourage the closing down of energy and carbon-intensive manufacturing, even though Europe still requires the manufactured products, and could have played a role in reducing the energy and carbon intensity of manufacturing processes (Helm, 2021).

Publicly funded research has had unintended benefits in addition to the intended benefits. Research has saved lives, increased our quality of life and helped us on our path to downsize our carbon footprint. It also generates economic growth, creates direct jobs, yields a return to private companies and stimulates private investment into R&D. Due to the increasing returns to scale, productivity explosions and linkages with the rest of the economy, investments in innovation

can theoretically have multiplier effects, resulting in more money returning to public purses through increased tax receipts than the value of the investment. This is because the euro of government investment generates more than a euro of returns on onward spending in the economy as the initial investment stimulates further investment through linkages in the economy. It is estimated that the Human Genome Project produced nearly $1 trillion in economic growth, and that US National Institutes of Health (NIH) funding on average yield three times their investment value for private firms on the stock market. The NIH itself captures 43% return on its investments and stimulates over eight times industry R&D (Gruber and Johnson, 2019).

Investment thesis for a European Innovation Seed Fund

Having made the case for a European innovation seed fund, we move onto defining its investment thesis. Innovations that should be prioritised are those that

- reduce the stock of greenhouse gases (GHGs) in the atmosphere in a manner that is safe;
- help climate vulnerable populations become more resilient to the effects of climate change;
- improve health;
- improve productivity in a low emission manner and create low emissions jobs.

The applicable discount rate for climate mitigation and resilience innovation projects ought to approach zero. Investors use discount rates to assess how quickly they need to be repaid. A high discount rate is associated with a high impatience level and a low threshold for risk. The UK Treasury uses a low discount rate for long-term infrastructure projects because the only risk it is worried about are catastrophes and because the intended benefits of infrastructure projects are meant to be spread over decades and generations. Nonetheless, it uses a positive discount rate because

i. underpinning its time preference assumption is that future generations will be more prosperous than us because of technological advancements, and

ii. the risk of a catastrophe occurring is unpredictable and could negate the benefits of its investments.

Neither of these assumptions are good for the purpose of evaluating projects that are intended to drastically reduce our emissions, remove the stock of GHGs in the

atmosphere and come up with ways to keep climate affected places habitable. First, precisely because we have lived carbon intense lifestyles with short-term perspectives, future generations are in danger of living much worse lives than us. We have borrowed at their expense, and it is time for us to pay back. Second, we are highly certain that catastrophes will occur if we do not invest in climate abating energy production and industrial processes.

The fund should not negatively discriminate against high capital expenditure projects with long payback periods, as these are the projects that would not be funded by private investors. On the other hand, the fund cannot favour such investments as this would induce innovators to propose longer payback periods and higher budgets than required. The fund should favour products over processes, however, to the extent that processes are lower risk investments that are likelier to be funded by private investors.

As we will seek to rectify the intergenerational imbalance through the fund's discount rate, we will also want to weigh more heavily the benefits conferred to lower income and more vulnerable populations. This is in order to promote greater parity in our society and to strengthen democracy. In addition, the fund appraisal process should assess multiplier effects, and so look at not only the direct economic benefits of a project if it is successful, but the indirect and induced effects to the extent possible (as well as, of course, the likelihood of success).

The fund should favour the lifecycle of ventures that are likeliest to be shunned by private investors: applied research should be the fund's majority sort of investment. A small portion of funding could be spared for "blue skies research" where the "real-world" applications are not immediately apparent, since scientific breakthroughs sometimes have more valuable outcomes than agenda-driven research. To the extent that it does this, it should carefully coordinate with existing initiatives and funding sources such as the European Science Foundation, CERN and universities to ensure that it offers additionality. It should however still invest in proofs of concept and to a lesser extent working prototypes where these are unlikely to be funded commercially in order that good ideas cross the "valley of death" to becoming self-sustaining profitable ventures that investors will flock to. It should avoid investing at stages where private investors are likely to come in, such as scaling as the technology becomes commercially viable, or where long-term or working capital loans can be made.

"We have borrowed at their expense, and it is time for us to pay back."

On the flipside, the fund should not seek to socialise risks and privatise profits, as was the case with US government investments made in Solyndra and Tesla. Where there is something to commercialise, investments should be structured as founder's equity, the dividends of which are reinvested into further innovation projects, or, in the absence of good propositions, are paid as dividends to taxpayers. If the investment is made into high-cost life-saving medicines, investment returns can be used to subsidise the costs of procuring those medicines to consumers, or used to buy patents outright in order to disperse the knowledge and introduce competition to reduce costs to patients. Where research funded is exploratory, it is appropriate to award grants.

While we have already made the point that in order to deliver additionality, a European innovation seed fund would seek to complement rather duplicate private capital, the same is true of existing sources of public capital. Appraisers should also look to synergies with sister European government institutions, universities and companies both at the European Commission level and at via national governments (Cerniglia and Saraceno, 2020), such as the European Climate Foundation, the European Science Foundation, CERN, European development finance institutions, and Fraunhofer-Gesellschaft and Innovate UK. The administrators of the innovation seed fund should be well-networked professionals who are capable of brokering relevant introductions for expertise.

Metrics to evaluate the fund's efficacy should be metrics that measure the intended outputs, such as:

- contributions to climate-friendly technologies
- potential for scalability
- network effects
- contribution to founder's equity.

More importantly, to keep an eye on the mission-oriented goals of the fund, there should be metrics to evaluate outcomes, such as:

- what has been the effect on the stock of greenhouse gas emissions?;
- how many people has the fund allowed to live a high quality of life where they are in climate-affected parts of the world?;
- how many quality-adjusted life years (QALYs) has the fund added?;
- how much higher are wages because of the fund?

The direct, indirect and induced multiplier effects should be measured to the extent that they can be credibly attributed to the fund.

The answers to most of these questions can be monetised to calculate economic and financial returns, with the exception of the last question:

- what would have been the economic and financial values of destruction at higher temperatures that the fund prevented?;
- what would have been the cost to the economy of receiving climate induced people had the fund not enabled them to become more climate resilient?;
- how much more productive are workers?
- how much more equal is society and resilient are our democracies?

Key takeaways

The European Commission has taken the initiative to set up Europe-wide mission-oriented public funds for the purpose of promoting innovation that will help decarbonise the economy. The effort is a welcome one as investment in innovation in the absence in public spending will be less than what is socially optimal.

Public investment in innovation has a long and storied history of success, and innovation will have an important part to play in the reduction of stock of greenhouse gases in the atmosphere and in helping communities adapt to climate change, as it has in the promotion of life-saving medical advances and in delivering efficient communication systems. Investment in innovation is also important to securing productive and higher paying jobs in Europe and therefore in promoting greater equality, social harmony and more functional democracies.

A modification we would suggest for the current system is to stop socialising costs and risks and privatising returns: public investments should, wherever possible, be made in exchange for partial state ownership, so that returns can be reinvested into further innovation, can be repaid to citizens as dividends, or be used to provide end-users with greater access at reduced costs.

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