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Spinning Out Greentech Start-ups

Adam Swetloff*

Abstract: The Paris Agreement has made combating climate change a priority and has incentivised innovation for the greentech industry. Higher education institution[s] (HEI[s]) play an important role in fueling this innovation by developing disruptive technologies and support the creation of start-up companies that take the risk to bring these technologies to the market. The successful spinning out of such start-ups relies on the HEIs nurturing an ecosystem with multiple actors as well as internal mechanisms to transfer such technologies to the start-up. HEIs have dedicated offices involved in technology transfer (TTO) that provide an interface between all the different actors (inventors, founders, start-up, investors, *etc.*). The TTO of an HEI also plays a central role in the technology transfer by providing the licence agreements granting start-ups the rights to use a technology developed by the HEI. This review summarises the role of a TTO and the practice of making the licensing process as transparent as possible for start-up founders and investors.

Keywords: Greentech · Start-ups · Technology transfer

Dr. Adam Swetloff is a technology transfer professional at EPFL managing intellectual property and technology transfer agreements, with extensive experience dealing with start-ups focused on greentech. He holds a PhD in biochemistry and an LLM from the University College London.

1. Introduction

The Paris Agreement provides an international framework to limit greenhouse gas emissions to contain global warming, emphasizing the role of technology development and transfer to meet such goals.[1] The incentivization of research and innovation is a key pillar of the strategy, which in turn represents a unique opportunity for job creation and economic development.[2,3]

The green technology spectrum of innovations is large and encompasses solutions that range from weaning our societies off fossil fuels (*e.g.* solar cells, fuel cells, osmotic energy, energy storage, geothermal, nuclear fusion, production of fuels and chemistries of non-fossil origin, *etc.*), promoting a circular economy (*e.g.* sustainable packaging, smart grids, carbon capture, recycling/upcycling of plastics, *etc.*) or optimising existing infrastructures (smart grids, green buildings, reducing ICT carbon footprint, sustainable agriculture, *etc.*).[4] The European Patent Office has even created a dedicated classification for patents covering green technologies.[5]

Higher education institutions (HEIs) have an essential role to attain the aims of the Paris Agreement and that of a more sustainable green economy as their mission typically encompasses pushing the boundaries of science and technology through research, promoting the dissemination of knowledge through publications and above all educating the next generation of skilled work force and citizens. Many HEIs have also added technology transfer and innovation to their core missions, increasingly aware that excellent research and technological solutions can only translate into a benefit for society if such solutions can be developed into a product or service that is put on the market by an industrial actor.[6] For that purpose, HEIs may rely on intellectual property, and in particular on the patent system whose main function is to foster technological innovation by i) incentivising investments in research and development through the grant of exclusive rights in inventions,[7,8] while ii) allowing the publication of the invention to encourage follow-on innovations.

Depending on the maturity of the technology, HEIs can translate groundbreaking research into innovations through collaborations with companies, licensing of intellectual property, or the combination of both.[9,10] However, disruptive technologies are also the riskiest and often will not fit in the R&D priorities of large companies until they have reached a certain development stage (technological readiness level/TRL) in the form of a first prototype. In the innovation landscape, the raison d'être of start-ups is to embrace such risk and thus represents the vehicle choice for developing disruptive technologies.[2,11]

2. Spinning Out Start-ups

2.1 *The Incubation Phase*

Start-up projects are generally supported by faculty members and driven by enthusiastic young scientists that have an entrepreneurial spirit and the know-how of the technology. A large proportion of start-ups spun out from HEIs are in fact founded by the inventors of the technology.[12] It is also not unusual for HEIs to have in place internal programs and incubators to accelerate start-up projects prior to the incorporation of the company; this is typically done by providing funding and expertise to enable a proof of concept of the technology that goes beyond laboratory-bench scale.[13-15] This is even more relevant for chemistry-based technologies where the questions of scale up and feasibility beyond the laboratory bench and the associated techno-economic considerations are of paramount importance for industrialization. This need has also been recognized by national/regional agencies that now offer different funding instruments to bridge that gap,[16-19] as well as mentorship to equip founders with basic business skills and to mature their business plan. Some HEIs go even further by creating the start-up teams, injecting substantial investments to kick-start the company, and providing incubators to launch the start-ups until they receive their first significant investment.[20,21] Fig. 1 summarizes the different stages of development of a technology from basic research to the commercial launch of a product and the funding sources available. The start-up companies will generally start the development of a technology to demonstrate its

*Correspondence: Dr. A. Swetloff, E-mail: adam.swetloff@epfl.ch
EPFL Technology Transfer Office, EPFL, CH-1015 Lausanne

feasibility with a first prototype in the target environment beyond laboratory conditions.

2.2 *The Licence Agreement*

After the incorporation of the new venture, the founders of an HEI spin-out will need to conclude a licence agreement with the HEIs who owns the intellectual property covering the technology of interest, typically one or more patents and/or software. A licence agreement is a contract between the HEI and the start-up that grants the start-up certain rights to exploit an intellectual property for the purpose of developing and commercialising product and/or services against certain considerations, whilst preserving the HEIs ability to continue research. This is reminiscent of renting a property from the HEI and sharing the proceeds balancing the value of the intellectual property and the risk that the start-up has to take to create commercial value with the property. The terms need to provide flexibilities to adapt to the pivoting business models and commercial needs of the start-up while imposing some form of performance diligence to ensure that the intellectual property is used. Most HEIs will request a business plan to tailor the terms of the licence agreement taking into account that business plans are written by young entrepreneurs which often tend to have an overoptimistic view of the roll-out of their business. A licence agreement will normally last for the life-time of the licensed intellectual property, unless terminated earlier, so it often happens that the agreement will be amended multiple times - for example, to add further intellectual property from the HEI, to change financial terms, or to consider new business realities.

The typical financial terms of an exclusive licence to a start-up will revolve around financial considerations such as: i) some equity position for the opportunity cost of the exclusivity or benefiting from the ecosystem and name of an HEI, ii) running royalties on sales and sublicensing income, and iii) the external expenses for maintaining and defending the intellectual property. The equity position taken by universities for start-up licences may be in the form of shares, warrants, options for share, or exit fees. The amount of equity may also vary.[23] For example, some HEIs may request higher equity because they have heavily invested in the incubation of the start-up or have invested in the company.[18] The running royalties represent a percentage of the income received by the start-up from the sale of products/services covered by a licensed IP or from the grant of a sublicence to a third party. There are many methods to calculate running royalties but these should be benchmarked against comparable deals in the same industry rather than only being based on the start-ups business plan.[22,23]

2.3 *The TTO and the Licensing Process*

HEIs have set-up specific offices or external companies controlled by the HEI to establish such licence agreements with the start-up. These offices may have different names such as Technology Transfer Office (TTO) or Technology Licensing Office (TLO). The generic term TTO will be used here to refer to all entities controlled by an HEI to commercialise and licence technologies from HEIs. The interfaces of a TTO with the actors needed to spin-out a start-up from an HEI are summarized in Fig. 2. The TTOs of HEIs are at the forefront of the licensing process may have different standards that reflects the ecosystem they evolve in. Negotiations can quickly become emotional if the rationale of the terms of the licence is misunderstood.[24] The licensing process therefore needs to be transparent so that despite certain specificities of the business, the founders have the certainty that all start-ups in the ecosystem are treated fairly and in the same way by the university granting the licence. The licences should be short and readable by the entrepreneurs but legally clear for investors. Some HEIs have gone one step further by proposing guidelines summarizing the terms and publishing their start-up licence boilerplate, for example: EPFL,[25] the University of Stanford,[26] MIT[27] or the University Spin-out Investment Terms[28] provided by a consortium of leading universities and investors.

3. Conclusions

The Paris Agreement represents an international landmark recognizing the impact of anthropogenic climate change and taking a concerted multilateral action. The United Nations 2030 Agenda for Sustainable Development also incorporates the urgency of the climate change in its goals (in particular UN Sustainable Development Goals 13). In Europe, the European Commission set-out 'The European Green Deal' in 2019 as a framework to tackle the urgency of the climate change, as now enshrined in the 2021 European Climate law.[29,30] The European Green Deal defines eight policy areas for: i) increasing Europe's climate change action, ii) supplying clean, affordable and secure energy; iii) mobilising industry for a clean and circular economy, iv) accelerating the shift to sustainable and smart mobility, v) accelerating the shift to sustainable and smart mobility, vi) designing a fair, healthy and environmentally-friendly food system, vii) preserving and restoring ecosystems and biodiversity, viii) eliminating pollu-

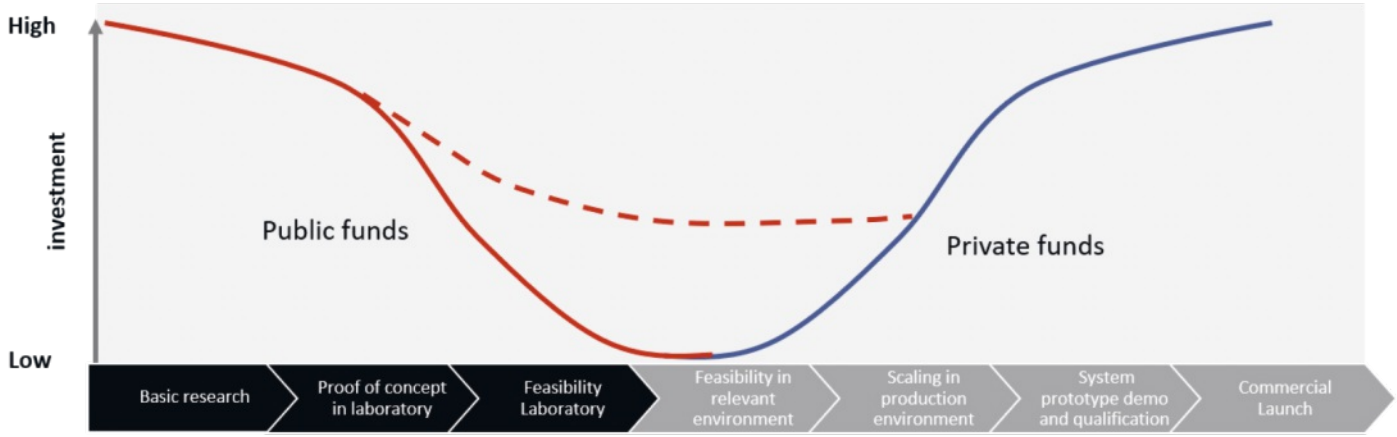

Fig. 1. The bottom part of the figure shows the phases of development of a technology (TRL) from basic research up to the commercial launch of a product. The TTOs of HEIs are usually involved in the phases highlighted in black. The upper part of the figure shows the level of investment from public funds (red) and from private funds (blue) according to the phase of development of the technology. Many sources of public bridge funding (broken red line) are now available - whether to HEIs or to start-ups - to support the development of a first prototype that functions in a relevant environment (*i.e.* to bridge the classical gap between public funds for research and attracting private funds).

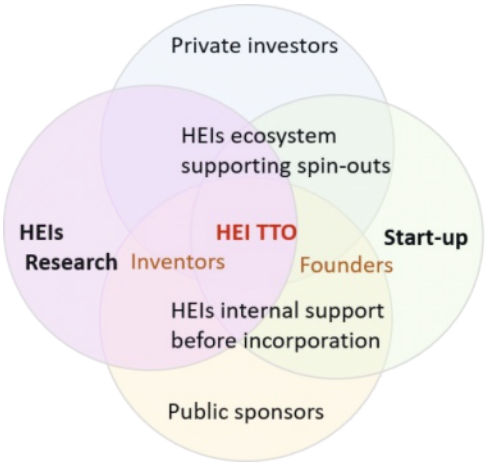

Fig. 2. Summarizes the main actors involved in the spin-out from HEIs of a start-up company and how the TTOs of HEIs interface with these actors. Some HEI TTOs will combine internal funding support for the incubation of start-up projects before incorporation of the company. Some TTOs will focus only on the licensing of the technology to the start-up.

tion ambition for a toxic-free environment. The changes in policy and legislation is expected to promote technology development to fight anthropogenic climate change but also to build a more sustainable economy *i.e.* where economic growth is decoupled from resource use.

The change in laws and political context has therefore reached a tipping point that is conducive to encouraging the green technology market. The increase in investment in green technology start-ups in Europe[31] or more globally[32] already reflects this and expected to accelerate. The HEIs represent an important source of disruptive technologies[11] and have a central role to play by continuing to nurture their startup ecosystems to enable and streamline the transfer of these technologies to benefit society at large.

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