

Funding the energy transition's hardware revolutionaries

*To transition to clean energy at the speed and on the scale required, we need to back the engineering companies developing these projects at the growth stage. Asper's **Luigi Pettinicchio** and **Sarah Ivory** of the University of Edinburgh explain how and why*

Throughout the COP26 climate conference in Glasgow last year, we heard messages from heads of state and other leaders along the lines of: “Our addiction to fossil fuels is pushing humanity to the brink. We face a stark choice: Either we stop it – or it stops us...” (UN Secretary-General António Guterres); “There’s no more time to hang back or sit on the fence or argue amongst ourselves. This is a challenge of our collective lifetimes” (US President Joe Biden).

It is clear that rhetoric has boarded the climate train. However, still on the platform all too often are the practical considerations of such change: to what extent do societies need to transform? Which technologies need to go mainstream? At what pace does this need to happen? How can the transition be financed?

Although the scale and urgency of the challenge facing our industry and infrastructure are unprecedented, this type of systemic change is not new. Whether driven by one specific machine (the steam engine), a new form of energy (oil), or a new idea (universal suffrage), our societies have a proven ability to drive and ride waves of radical change. Indeed, the digital/software revolution started with microchips and is still profoundly changing our world today.

The parallels between this ‘software’ revolution of recent years and the ‘hardware’ revolution on the near horizon are striking. In this article, we discuss the merits and limitations of these, before concluding with some reflections for the key players in the infrastructure industry: private equity investors, institutional investors, project developers and policymakers. We aim to bring into focus the practicalities

of the energy transition and provide a bridge between the grandiose rhetoric we hear and the real change we need to see in the field.

Hardware and software revolution

The digital/software revolution that emerged at the end of the last century, and the energy/hardware revolution we need to achieve by the middle of this one have an obvious similarity: scale. The digital revolution has been going on since the 1970s and is broadly sized by a few sources in the \$15 trillion to \$20 trillion range.

In comparison, a 2021 report from Goldman Sachs calculated that the capital needed for the energy/hardware revolution was \$56 trillion by 2050 to keep our planet heating below 1.5C. While different analyses will deliver different numbers, the key point here is the order of magnitude – both are

about mobilising tens of trillions of dollars in just a few decades.

This points to a second, deeper similarity in the dynamics of the software and hardware revolutions: both are initially triggered by technological innovation, and then rolled out to scale by commercial success.

In both cases, innovation most often starts in a lab. Many know that transistors were invented in the US Bell Labs; it is less well known that solar cells were also conceived there. Government funding often stands behind these efforts – from the Arpanet cradling what became the internet, to NASA’s contributions to hydrogen fuel cell technology, to the plethora of public incentive schemes for sustainable energy technologies that started in the 1970s.

But while public funding can and should support R&D for new technologies, it cannot (and arguably should not) support their full deployment at the huge scale mentioned earlier. Private capital, on the other hand, has the firepower for such scale and has a proven ability to use it when the conditions are right. However, private capital needs commercial viability and success, it needs sales and growth, it needs value creation from scale economies and network effects.

We think the pattern around technology trajectory and commercial success is vital because it influences how the financial system supports both revolutions. And as history teaches us, the financing of revolutions is key to their achievement.

The role of the financial system

During the digital revolution, a typical software company growth trajectory had three phases, each requiring a distinct type of financial support. First, the R&D phase when funding may start with public support such as military, university or grant funding, or sometimes with seed/angel investors. Then, once the product is developed, a growth phase follows where the focus shifts to the customer. The product is



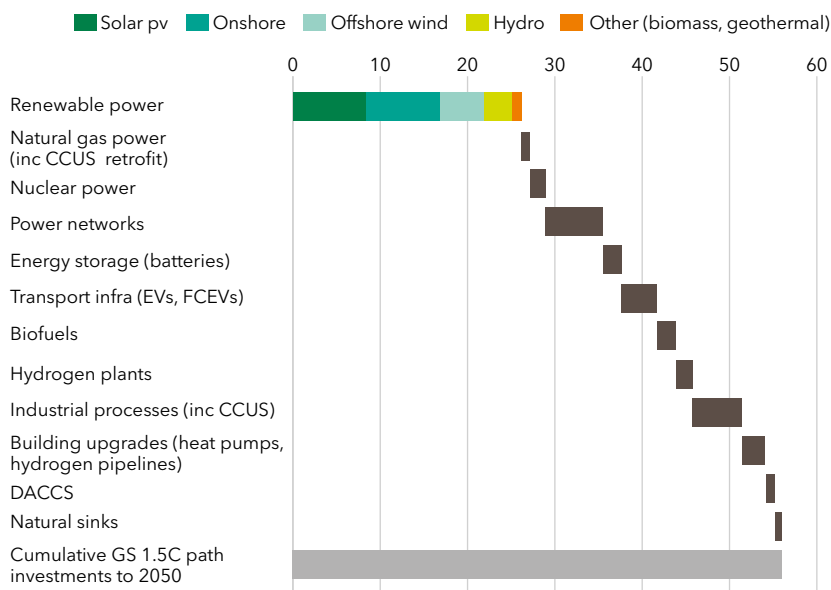
“Green money’ is not funding the transformations needed, just purchasing their results”

fully functional and in commercialisation: value can be created by marketing and sales.

In this stage private equity played – and still plays – a crucial role in the digital revolution. A global investor community has developed and supported tech companies for decades through a mix of strategies ranging from venture capital to growth equity and mid-market investment. The most successful companies then move on to the third stage, where their product has achieved a prominent market position and equity financing shifts towards the public markets or large-cap buyouts.

While this three-stage trajectory is simplified and each company will have a unique journey, it is still useful in allowing us to draw parallels with the phases we are beginning to see with typical energy/hardware revolution companies. The first phase is quite similar: taxpayers will often fund the initial R&D of the technologies involved. The third phase is also similar – once a technology has been rolled out to scale, companies can access mainstream sources of funding such

Goldman Sachs’ path to 1.5C (\$trn, investments by 2050)



Source: Carbonomics: Introducing the GS net-zero carbon models and sector frameworks, June 2021. Courtesy of Goldman Sachs.

as public markets, core infrastructure funds or direct investments from large-scale financial institutions.

The series of wind and solar portfolio IPOs in the early 2010s are a well-known example of this; less known but equally meaningful has been the rise of sustainable district heating from a niche to 'core' infrastructure status in the past four to five years.

Where things get interesting is in the middle – the growth phase. In particular, it is far less obvious how the financial system is supporting infrastructure companies that are working with established technologies but are at the early stage of the sales/construction roll-out. By understanding who these 'hardware revolutionaries' are, and by distinguishing the needs from their software revolutionary cousins, we can identify key implications for investors and policymakers looking to contribute to the energy transition.

Hardware revolutionaries

A revolutionary is typically someone who advocates for and drives systemic and often dramatic change. We use this word to describe sudden, historically pivotal movements such as the French Revolution or the life and ideals of individuals, for instance, Emmeline Pankhurst's part in the fight for female suffrage. As well as change, the word also carries a connotation of struggle, of fight.

When it comes to challenges and struggle, hardware revolutionaries are no exception. They are typically small-scale engineering companies with the skills to identify, design, obtain the permits and manage construction of large sustainable infrastructure projects. However, they have limited scale, even fewer financial resources and face significant and specific challenges.

New project developers face a sudden, steep wall of capital needs as soon as their first project approaches construction phase. Even sooner, they may need to show substantial balance sheet support and corresponding corporate

stance when they prepare for tenders or submit their first requests for planning consent.

Small, revolutionary companies used to managing funds in the hundreds of thousands suddenly face a need for tens of millions. Moreover, they need to work with investors, banks and other companies used to managing these sizes of sums. This creates a resource and attention drain for the entrepreneurs, as well as a potential culture clash between developers and their financiers.

Developers also face complex stakeholder management issues that are inevitable when promoting new construction. If the archetypical software revolutionaries were coding alone in a basement, our hardware revolutionaries are likely to be standing on a windy rural hillside negotiating with a landlord, or in an urban setting primed for talking about district heating to sceptical neighbours, wading through complex planning legal arguments or waiting nervously for the uncertain results of an expensive environmental impact study that could make or break their business.

Given we need more such revolutionaries to achieve the scale of change required, how can such early-stage developers be better supported to unleash

their potential and, given the important role of financing in this revolution, what needs to change to support this?

Reflections for key industry players

Our comparison of the software versus the hardware revolution and diverging challenges clearly indicates the problem – the financial industry has not yet evolved to properly support infrastructure development companies in the early stage that precedes the mainstream roll-out. This may sound counterintuitive since we have heard for years about the 'wall of green money' pouring into sustainable assets.

However, this is largely available for assets that are built, fully contracted and cash-yielding. Such 'green money' is not funding the transformations needed, just purchasing their results. Moreover, while some niche private equity firms are increasingly supporting emerging developers, the scale and liquidity of this pool of capital is not even close to matching the upcoming needs.

The first reflection focuses on private equity investors. The hardware revolution needs a different type of private equity support. Such investors need to possess certain characteristics:

Supporting hardware revolutionaries

Asper Investment Management demonstrates how a piece of legislation in the Netherlands served as a springboard for private capital to back the country's energy transition.

In the Netherlands, each municipality was obliged to draw specific plans by the end of 2021 to decarbonise heat in their region. This simple but clear-cut government legislation helped smaller independent heat project developers enormously – suddenly they had the undisputed attention of small-medium size towns that fell below the radar of big incumbents and had a natural inclination to deal with local companies.

Asper Investment Management identified the opportunity to back an entrepreneurial developer focused on this subsector. This led to the launch of the dedicated Asper Dorothea fund, backed by the European Investment Bank and Dutch pension fund manager APG, among others. This type of vigorous investment from private equity capital enables small-scale hardware revolutionaries to boost the Dutch energy transition.

understanding the inherent risks in infrastructure development and the business model of small project developers; accepting that certainty is often not possible; and avoiding irrelevant or unanswerable questions adapted from other investment categories. Moreover, they need to be proactive supporters of the developers and build their own toolkit, expertise and networks.

As is often said of the best software VC firms, growth-orientated infrastructure investors should be contributing more than just capital. The hardware revolution needs private equity investors who can roll up their sleeves and help with execution, mobilise and manage lenders, help grow an organisation and fortify its processes, and who can share field experience from having supported similar developers on their journey.

The second reflection is for the vast institutional investment industry, and its role in financing this revolution. While most portfolio managers in pension funds and other similar institutions have significantly increased their allocations to established or core infrastructure, many are exploring expansion into greenfield projects.

By this, they typically mean taking some additional risk from construction or even development of new projects in exchange for some kind of IRR premium. However, while the funds might be welcome, such institutions rarely have the resource, boots on the ground and experience necessary for a successful investor-investee relation in such early-stage ventures.

The third reflection is for developers themselves: our potential hardware revolutionaries. It is often said of entrepreneurs that the key resource they need is not funding, it is customers. Whether by buying wind power through a private power purchase agreement, or sustainable heat through a hot water network, ultimately, customers will decide which technologies deserve to become part of the new system.

Because many developers start



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from an engineering or technology background, they often comprise a mix of technical expertise and passion for the ‘kit’ core to the infrastructure build-out. But this is not sufficient. Developers need to shift very quickly to developing customers, typically by significantly boosting their sales teams. This almost always pays off and provides potential investors with a clear pathway to commercialisation, even when development and build challenges are still to be overcome.

Our final reflection turns to the role of regulators and lawmakers. They have the challenging job of levelling the playing field for new infrastructure development while balancing the needs of other stakeholders. Over the past decade, we observed that when doing this, a lot of their attention has gone towards mobilising the lowest cost private capital. This is probably because the first inklings of the hardware

revolution coincided with the world economy’s emergence from the global financial crisis, meaning governments were keen to keep costs low (public budgets were tight) and focused on cost of capital, since there was abundance of private liquidity.

However, given our reflection on the growth trajectory for project developers, it is not this mature third stage where government contribution is most needed: private markets are very well equipped to make those capital allocation decisions. Governments should focus on helping the system shift gears from evolution to revolution by increasing the clarity and speed of new legislation or auctions, which are too often delayed and prone to last-minute changes because of political wrangling.

While utilities can afford lobbying departments and have the balance sheets to absorb delays, earlier stage developers can easily be thrown out of business by a postponed auction or a ‘black swan’ piece of legislation. Governments can also help by giving clear and consistent planning guidelines, establishing processes that promote responsible development, showing decisiveness in mandating change and cutting support to fossil fuels. These actions would remove obstacles and provide support for the hardware revolutionaries on whom we rely.

Ultimately, the financial system will only be driving the energy transition if it contributes to a hardware revolution.

Greening a portfolio by buying existing ‘renewable’ assets or project financing a fossil fuel incumbent’s glacial change to renewable energy does not make a revolution. The new hardware revolutionaries need a financial system to enable them to unleash their energy, technical skills, local knowledge and relationships. And they need support now. ■

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