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A diverse and resilient financial system for investments in the energy transition

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Abstract
Diversity makes the financial system more resilient. In addition, there is a diverse investment demand to make the transition to a more sustainable energy system. We need, among others, investment in energy transition, circular resource use, better water management and reducing air pollution. The two are linked. Making the financial system more diverse implies more equity, less debt, more non-bank intermediation and more specialized niche banks giving more relation based credit. This will arguably also increase the flow of funds and resources to innovative, small scale, experimental firms that will drive the sustainability transition. Higher diversity and resilience in financial markets is thus complementary and perhaps even instrumental to engineer the transition to clean energy in the real economy.

Keywords: Financial markets, clean energy investments, diversity, public policy

JEL classification: G23, G24, G28, O33, O38

1 Introduction

The financial system has long been identified as giving direction to the development in the real economy. Its traditional role is to mobilize and transform savings into productive investments [1]. The latter crucially include investments in new ventures and technologies that an energy transition will clearly entail [2–4]. Yet, our overview of the evidence shows that the current financial system is not delivering. Decisions of financial intermediaries taken in a decentralized and competitive manner determine its course. Investors and their intermediaries look for projects with the most favourable risk-return characteristics and diversify their portfolios to eliminate idiosyncratic risk [5]. This reliability and predictability is very important as the financial sector is intertwined with all sectors in the real economy that depends on its functioning. This focus on stability and reliability is justified. But it also creates a bias in the type of ventures and projects the financial system can enable.

A ‘grand challenge’ facing humanity in the 21st century, perhaps the biggest challenge humanity has ever faced, is to manage the energy transition [6–8]. Technologically and energetically this transition is feasible and even economical [9–12]. Our modern economy has become completely intertwined and dependent on a reliable and predictable supply of heat, power and mobility. Fossil fuels still deliver 80% of that demand [13], which has to drop to 0% by 2050 to stay below the 2 degrees celsius increase in global temperature over pre-industrial levels [9]. The system to deliver energy is highly capital intensive and built upon a paradigm of centralized, linear supply model from wells to combustion. Transforming it into a more decentralized one, based on renewable energy sources will require a vast deployment of innovations [10,14]. Estimates for the total investment range from about 700 billion [15] to 1-2% of global GDP [11]. Despite global consensus at COP21 and ambitious targets being set, realization is lacking. A telling and puzzling figure is Figure 1 below [16].

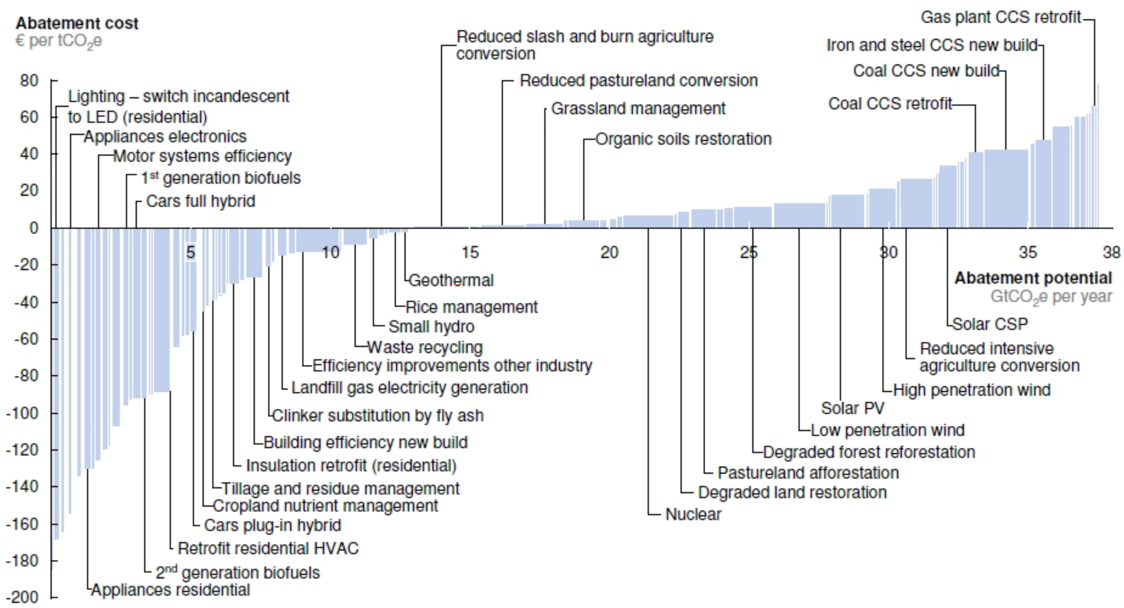

Figure 1: abatement options by cost price per ton of abated CO_2 equivalent Source: [16]

Many CO_2 abatement options are in fact net present value (NPV) positive and would *increase* the value of the firm undertaking the investment (Figure 1). This is a variation of the famous Porter Hypothesis that claims that strict environmental regulation may help firms tap new sources of competitive advantage [17,18]. Porter argues that firms, in violation of economists' common assumption of efficiency, do not implement existing technological solutions although, given current prices and interest rates, investments are attractive.

A possible reason for such investments not being made is offered by the 'energy paradox' literature [19,20]. Incentives and corporate governance structures of large, publicly traded companies explain this bias. This focus is typically on capital expenditure (CAPEX), while gains from clean energy investments come in the form of lower operational costs (OPEX). The short time horizon and high discount rates of most shareholders makes minimizing CAPEX more attractive than minimizing OPEX and maximizing long term profit. Any financial intermediary would be willing and able to finance these investments with debt. The collateral put up as security is high quality and OPEX reduction can cover interest payments and installments.

A second category of problems arises in projects where the NPV is lower or context-specific. Such specificity can arise from asset complementarity in systemic interdependencies, e.g. (hybrid) electric vehicles and charging infrastructure [21]. Thus, investors may shy away from otherwise perfectly functioning technologies. Overcoming such coordination problems requires a coordinated approach [22]. Typically, the government has a role in setting standards, building up infrastructures and reducing such risks [23].

The third, type of problem stems from deep uncertainty that characterises (radical) innovation. In such cases an NPV simply cannot be computed [24,25]. While financial intermediaries are specialists in managing risk through diversification and trading, non-calculable uncertainty cannot be managed using advanced risk management tools [26].

2 The financial system and the energy transition

Deregulation, globalization and consolidation waves in the financial sector since the mid-1980s have exacerbated a trend towards a homogenous financial system which culminated in the financial crisis of 2007 [27]. Haldane and May [28] and others [29,30] argue that part of the problem is the decline in diversity. It is not a problem per se that some intermediaries made mistakes and missed risks in their portfolio management strategies. A healthy ecosystem will simply flush out such faulty strategies through competition. The problem arises when all intermediaries start using the same strategies. Then risks, fully diversified at the micro level, become highly correlated across the system [31,32]. Moreover, a more diverse and therefore more competitive financial environment could actually reduce the capital costs of clean energy, given that capital markets function efficiently [33].

The crisis, however, caused a regulatory backlash prioritizing size and secure assets (e.g. highly-rated government or blue-chip obligations) over diversity and more equity-like risk bearing assets (e.g. Venture Capital (VC) in innovative startups) (see Figure 2 for an overview). Regulatory and supervisory entities have reacted to the crisis by banning or severely restricting complex financial products. They formulated stricter resolution mechanisms to reduce implicit public guarantees, requiring high reserves for assets deemed more risky and curbing perverse incentives such as excessive bonuses. Some of these tighter rules and regulations are particularly likely to adversely affect the flow of funds and intermediation to new ventures [34,35].

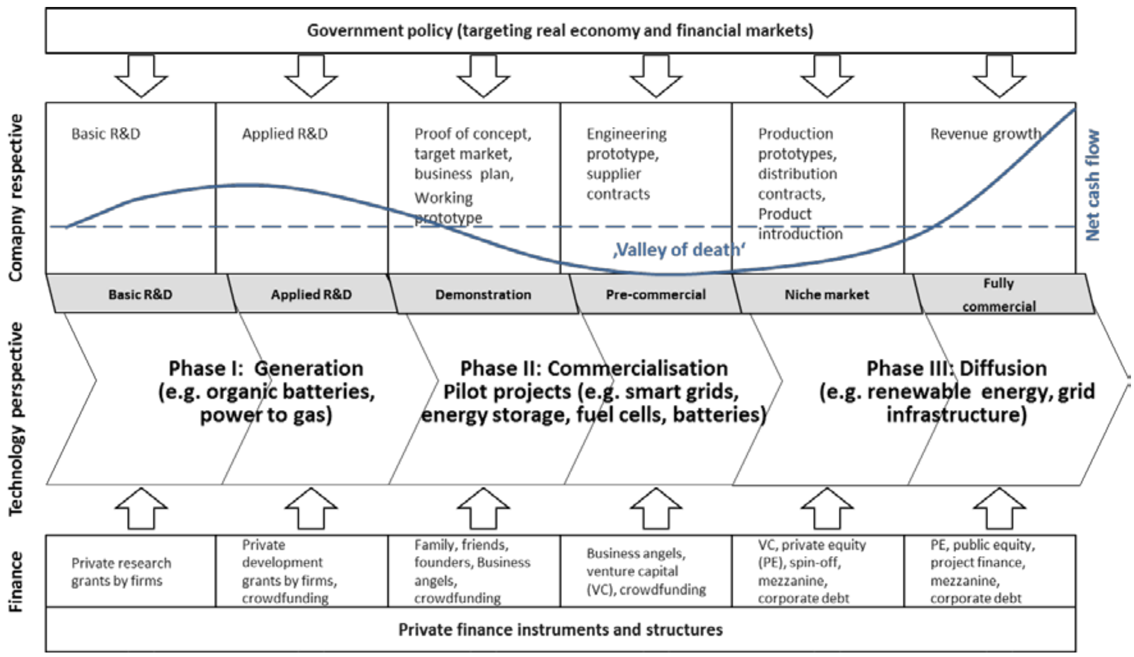

Figure 2: Financial instruments to finance clean energy innovation (Adapted from [5,36])

2.1 Financing early-stage clean energy innovation

In the early stages of the (clean energy) innovation cycle the challenges outlined above are partly overcome through R&D grants and early-stage investors (Figure 2). However, their numbers are comparably small given their importance in driving a transformation to clean energy (Figure 3) [37,38].

When it comes to early-stage finance, debt instruments are often simply not available due to lack of collateral and track record [39]. Innovative ventures often add market and technical uncertainty to the regulatory uncertainty. When investing in such ventures, intermediaries cannot rely on standard, modern risk management techniques [40]. Instead they must establish trust in the investee through soft information and relationships or alternatively, take a stake in the venture that also gives some control rights (e.g. sitting on boards). This is what venture capitalists and business angels but also friends and family do [41,42].

The problem with this model is that it cannot be easily scaled and involves large amounts of tacit knowledge in any single transaction. Moreover, the only countries in the world that can boast a significant VC and private equity (PE) market are the US, UK and Israel, where many complementary institutions support these sectors [40–42]. In particular Europe, with its highly concentrated and regulated, bank-dominated financial system, channels only a very small and declining fraction of its savings through these PE intermediation channels (to clean energy) [39]. While PE firms get their funds from institutional investors, the vast bulk of Europe's substantial savings surplus, is invested directly by institutional investors like pension funds, or more precisely, their asset managers and banks. These intermediaries are reluctant and even simply unable to engage with deep uncertainty, given their regulatory and fiduciary constraints and accounting practices.

Fintech solutions, such as crowd funding and peer-to-peer lending channel growing, yet relatively small fractions of savings into to early-stage investments [38,46], amounting to 317 €m [47] compared to 140 €bn in corporate debt in the Netherlands alone [48]. These funding platforms bring back the judgment call aspect of relationship banking and VC, but 'scale' the investment process through organizing the flow of information in a different, non-proprietary way [49]. In contrast to VC, investors do not try to gain an exclusive information position on the investees, but rather generate information by making their decision known to the rest of the investor community. Although the energy transition challenge seems too big to be funded through these emerging platforms, they seem promising according to the small-step logic of robust action [50].

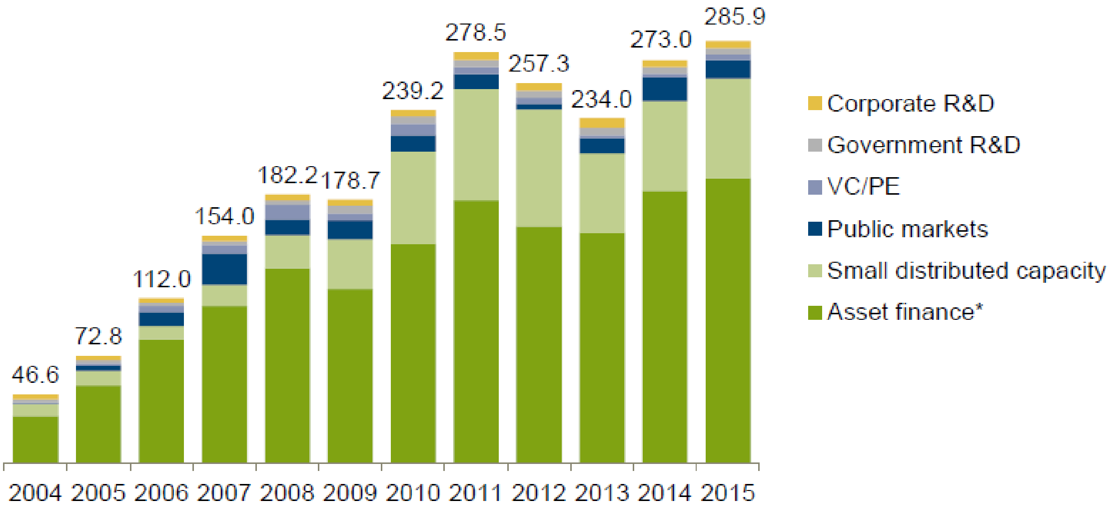

Figure 3: Global new investment in clean energy by asset class, 2004–15 ($BN) Source: [51]

2.2 Financing later-stage clean energy diffusion and infrastructure

In the later stage of the clean energy innovation cycle additional sources of finance are available as certain problems such as technological (and market) uncertainty and lack of collateral are overcome (see Figure 2). However, technology-specific problems such as long payback periods and policy uncertainty still prevail. The remaining regulatory uncertainty implies the default risk on any project is substantial and importantly, not calculable. This implies credit ratings are low or absent and only (private) equity or junk bonds can channel savings into these types of investments.

Corporate finance in the later stages mostly comes from insurances, banks or pension funds [51]. They finance larger, mature clean energy companies as well as projects and infrastructure with debt or equity. Debt investors do not receive dividends and do not benefit from higher profitability and cost reductions directly hence care about the downside much more than they do about the potential upsides. Faced with such opposition, the incentives for debtors are to reduce CAPEX and leverage to have a better credit rating and thus lower cost of capital, increasing the value of the stock in the short run. However also equity owners (institutional investors) have little incentives to push for OPEX-reductions, either, if such investments do not translate into (quick) capital gains.

The focus of the ecosystem for financing towards debt and later stages creates a bias towards calcuable risks in incremental innovation and maintenance of the capital stock in existing firms. They have high quality marketable collateral and established track records, but lack the incentive to introduce and diffuse true innovations as they cannabilize on existing profit flows [52].

3 Policies to stimulate investments into clean energy

Central governments arguably have the means to break the ‘lock-in’ problems which favour fossil-fuel-based energy technologies [53]. Mistakes, however, are terribly costly and can create new lock-ins for which politicians do not want to be held accountable. Sticking to the existing system may be more attractive, even at the country level, than running the chance of locking in to a losing technology.

3.1 Innovation policy

The obvious angle from which policy makers could approach the challenges for the energy transition is innovation policy [54]. Market-based incentives such as GHG emissions trading systems represent the theoretical optimum as argued by climate and energy economics since the early 1990s [55,56]. However, due to the lack of global mechanisms, second-best instruments are required. To accelerate the diffusion of clean energy and associated investments policy makers first could deploy technology-push mechanisms such as direct R&D investments, subsidies and tax-credits that target the early stages of the innovation cycle or early stage VC/PE [36,37,39]. Direct investments and co-funding also mobilise private early-stage finance [57,58]. Olmos et al. [37] suggest public loans, or guarantees provided by public bodies backing private loans, along with public investments in the equity of innovating companies to accelerate the commercialisation.

Second, research on clean energy diffusion and investment highlighted demand-pull policies mostly targeting the later stages of the innovation cycle [36,59,60]. Fiscal and financial incentives such as grants and subsidies [37,39,61] prove less effective than feed-in tariffs [62–66] that also target smaller distributed capacity investments [67]. To address network externalities and reduce private risks regarding complementary assets, public investments are suggested [68,69]. The (quality) regulation of the (clean energy) portfolio and emission standards advances deployment of more mature technologies [70,71]. Systemic policies such as longterm planning and policy support accelerate both early and later investments [5,39,72]. Especially consistency, stringency and predictability to reduce deep uncertainty and policy risk are deemed crucial [73,74]. Overall, a policy mix is suggested to make the transition [75]. Most of the policies actually favour mature established technologies appealing to the debt-based financial markets.

3.2 Financial market regulation

Unprecedented monetary policies in the Eurozone (Quantitative Easing) have driven the cost of debt finance to zero or below and flooded financial markets. But only very little of that monetary expansion finds its way into the real economy, let alone into clean energy [51]. Instead, these policies tend to entrench the existing linear, carbon based economy, as debt favours low-risk status quo. More equity and more specifically PE investments are needed to finance high uncertainty innovation. Hence, the second angle from which policy makers (and arguably at least equally important) could mobilise private investment for clean energy innovation and diffusion revolves around framework conditions and regulation of financial markets.

First, framework conditions for either debt- or equity based instruments influence their contribution to a clean energy transition, as a developed capital market is needed to channel resources [45,76]. Most importantly, a fiscal preferential treatment of debt finance should be avoided. Interest is deductable as costs while dividend payments only occur after tax. Hence a favourable tax policy could allow for tax deductability of early-stage company investments instead [77,78]. A less stringent bankruptcy and labour market legislation creates entrepreneurship and experimentation in sectors characterized by high uncertainty such as cleantech [79]. Securities legislation allows VC funds to sell parts of their investments [79].

Second, capital market regulation shapes Investment mandates, risk models and assessment, capital market rules and thus ultimately determines the feasbility and viability of investments into clean energy [80]. Regulation (e.g. Basel III, Solvency II), especially since the crisis, is almost exclusively geared towards stability and security

[78]. Consequently, they encourage or force deposits into 'safe' asset classes and calculable risks, such as rated (financial) firms, government debt and real estate. Institutional investors and their intermediaries are forced to stay away from risky asset classes such as VC/PE [34,81].

Alternative investments such as VC/PE have also become regulated, e.g. through Alternative Investment Fund Managers Directive (AIFM) directive, increasing reporting burdens and forcing funds to accumulate more capital to cover higher costs, hence reducing diversity in the system. Prospects for more VC/PE or even more traditional friends, family and fools financing is limited in the more egalitarian European welfare states as there are fewer wealthy private investors who can freely invest their wealth than in the US and UK [78].

New alternative finance such as equity and debt-based crowdfunding is also becoming more regulated in many countries [82]. Regulators abstain from clamping down on shadow banking and these new forms of intermediation, for example through a regulatory sandbox. It is more promising to be clear about the fact that such investments are not regulated and that investors willingly accept uncertainty and risk than to try and protect investors. But as we have argued above, the volumes to be expected from these emerging intermediation channels is limited.

While many clean energy investments projects are economical, the question is why even these are not funded under record-low interest rates. This problem stems from unintended consequences of stability-oriented regulation towards actors most favourable of long-term RE projects thereby stifling monetary easing and making it virtually ineffective. To alleviate this problem of diffusion, together with issues of innovation financing, a more coordinated approach of policy measures is warranted.

4 Conclusion

In this paper we show that in the discussion about mobilising private finance for clean energy innovation, the literature has neglected the structure and regulation of financial markets as potential determinants. In order to mobilize resources to break out of the fossil fuel technology complex and to finance radical and transformative innovations, we need intermediation to take different channels. While low risk debt is suitable to finance *diffusion* we need a shift to more expensive and uncertain equity to finance *innovation*. However, financial market regulations are currently 'boxing in' incumbents which is not responding to the financial requirements of a innovation-led energy transition (e.g. early stage risk capital etc.).

Financial regulatory reforms could free up the resources in banks and institutional investors for more uncertain and equity like intermediation. Regulators could also push for such higher equity ratios in banks and intermediaries themselves to justify taking higher risk. Implicit and explicit guarantees for deposits and other debt liabilities on the banks' balance sheets must be eliminated. This sets the necessary preconditions for a more diverse financial sector in which all varieties of intermediation can compete on a level playing field and implicit public support for banks no longer tilts the system towards cheap debt finance of status quo assets and allows for a transition towards clean energy.

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