New drivers of the renewable energy transition

Part 3: The critical importance of supporting and accelerating sustainable energy innovation

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This document is not intended for US audiences.

> "I'd put my money on the sun and solar energy, what a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."
>
> **Thomas Edison**, 1931

Setting the scene

The world did not have to wait until oil and coal runs out to see the aspirations of the visionary and innovator Thomas Edison fulfilled. Nearly a century after Edison's passing, solar power technology has today become a mature technology and a growing source of renewable power worldwide.

The concern over the finite nature of oil and gas resources has largely been replaced by the much more serious issue of climate change. The sustainable future for this planet is now in doubt unless corrective action is taken urgently, as described by the latest report of the Intergovernmental Panel on Climate Change (IPCC) issued in October 2018.[1]

The Paris Agreement on Climate Change in 2015 achieved quasi global consensus on the necessity for governments, industry players and people to act with the objective of limiting global warming to well below 2°C. This will not happen without a fast transition toward low-carbon technologies to mitigate the staggering pace of climate change.

Innovation must play a key role in the development of sustainable clean energy technologies as part of the endeavor to substitute carbon-emitting technologies that have become embedded in our everyday lives. Unlike solar and wind power, many clean energy technologies are not mature nor sufficiently cost-competitive enough to be deployed on a commercial scale in the current environment. The geographical, political and social disparities and availability of resources around the globe will likely require a broad range of different sustainable energy technologies to be developed.

Digitalization and the internet of things have acted as an unprecedented disrupter over the last decade. 'Agility' has become a buzzword for companies in a fast-changing, digital economy. A change of mind-set, which is manifested in the emergence of technology companies, start-ups and an innovation culture globally, has led companies and people to rethink behavioral patterns and has increased their willingness to adjust to a new paradigm.

There is a significant increase in interest and concern in relation to the climate agenda at all levels of society coupled with much greater emphasis on the importance of sustainability of business models. This has resulted in the

[1] Intergovernmental Panel on Climate Change (IPCC), 2018, Global Warming of 1.5 °C, http://www.ipcc.ch/report/sr15/

emergence of a new breed of energy innovators who believe that opportunities can arise from new sustainable energy hardware technologies, especially when combining them with digital solutions. This trend needs to be fostered and cultivated.

This point of view highlights the importance of deep-tech sustainable energy innovation for the global energy transition, the hurdles and opportunities that arise and the steps required to support this transformation process.

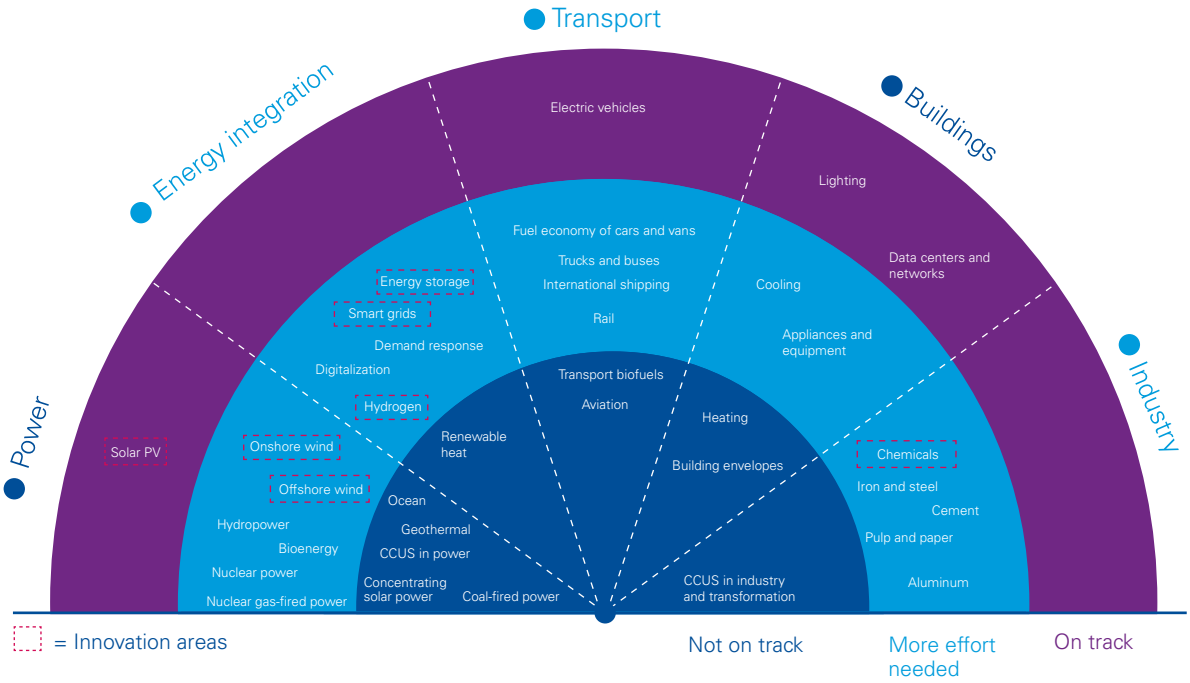
The role of sustainable energy innovation

Clean and sustainable energy technologies help reduce greenhouse gas emissions, either by decreasing greenhouse gas production, e.g. with low-carbon generation and fuel solutions, or by decreasing consumption, e.g. energy efficiency solutions.

According to an IEA study *Tracking Clean Energy Progress in 2017*, only 4 out of 38 clean energy technologies and sectors were on track to meet long-term climate, energy access and air pollution goals.[2] These technologies include solar PV, electric vehicles, storage, lighting and data centers, and networks. The study found that 11 technologies or sectors need significant acceleration to be on track with the climate goals. Some technologies, especially onshore wind, have fallen back against their deployment targets compared to 2016 and are thus not 'on track' anymore.[3]

Research and development (R&D) and innovation play a major role in getting technologies that have been lagging behind up to speed. However, the innovation process for clean and sustainable energy technologies is characterized by high technological risk. The risk is not only high in the early development stage but remains the case until after a product reaches commercialization, e.g. wind turbine technology, even though it is now a commercially competitive solution, requires ongoing R&D and improvement of the technology both in order to achieve production and installation cost digression and to increase the wind yield. This is particularly relevant in an era when tariff support for renewables is decreasing rapidly thus requiring ever greater efficiencies from existing technology solutions. Also, the costs to validate prototypes and demonstration models are much higher than for pure digital/software innovations, and currently, much longer periods are required to validate deep-tech sustainable energy products.

Radar of IEA's clean energy technologies and sectors



Source: IEA, May 2018, *Tracking Clean Energy Progress*.

[2] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep
[3] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep

Technology and sectors where innovation activity is high include:

— Hydrogen: development of hydrogen and other fuel cell ideas.

— Energy storage: development of small- and large-scale power storage facilities.

— Solar PV and wind: improved efficiency and cost digression.

— Smart grids: and other flexibility products like super grids.

— Chemicals: CO_2 reduction techniques, new radical solutions focused on carbon capture and sequestration, e.g. the ongoing work to develop graphene into an economically viable solution given its CO_2 reduction possibilities.

The types of participants active in the development of new deep-technology solutions can differ depending on the maturity of the underlying technologies. In the early stage of development, academia and research centers tend to partner with individual innovators or entrepreneurs. As technologies evolve, corporates and the public sector can offer strategic partnerships for scaling and for the commercial deployment of solutions. However, to date, despite international efforts to improve collaboration on a more global scale, innovation mostly takes place on a local or national level.

To learn more about industry innovation, technology and disruption, watch the Ted Talks To video blog series conducted by Ted Surette, Global Head of Power & Utilities, KPMG Australia. Click here to watch now or visit kpmg.com/energy.

Barriers to sustainable energy innovation

The nature of sustainable energy innovation — namely, the high technological risk, the financial cost and the strong commercial competition from established, low-cost (but high-emitting) products and solutions — represents the key systemic hurdles for the fast-track development of new innovations. As part of their new 'Innovation Tracking Framework', the IEA has identified 100 innovation gaps across the 38 clean energy technologies.[4] These highlight where hurdles for development are particularly high and more innovation activity is needed. Hurdles can be divided into two areas: financial and regulatory/institutional.

Financial

Sustainable energy innovation is a highly expensive endeavor. To help meet all the financing requirements, both private and public investment are needed. The reality is that innovators of early-stage sustainable energy solutions find that there is usually a significant financing gap and public and private funding are typically not well aligned to meet this need for various reasons.

Innovators often find very little financial support for research and demonstration even if it is groundbreaking. Cumbersome application and due diligence processes for funding put a heavy administrative and time-consuming burden on the limited resources of early-stage companies. Also, fears of early-stage equity dilution and concerns over the protection of their intellectual property cause some innovators to avoid promising funding opportunities.

Public sector investors have difficulties identifying the right innovators and determining the most appropriate projects in which to invest, which often need to comply with strict internal investment rules and return expectations. Furthermore, the public sector often lacks the commercial, financial and entrepreneurial skills to assess investment opportunities, and there is a lack of personal accountability for investment success. Private investors shy away from investing into this sector because of the high technological risk, which is often too great for the type of returns that can be delivered from investing into early-stage innovations.

[4] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep

Despite these issues, both the private and public sector are now showing increased interest in funding sustainable energy innovation, and it is important to capitalize on this trend for the benefit of the wider agenda.

For the public sector, investing into clean energy R&D is part of its national commitment to the global climate goals.[5] In 2017, global government expenditure for low carbon R&D increased by 13 percent compared to the previous year after a decline in 2016.[6] The surge in 2017 is mainly caused by increases in public spending in the US and on renewable energy research in China. The 5-year average nevertheless only shows a 2 percent increase in public spending.[7]

In the private sector, we see an increased interest not only from experienced and knowledgeable venture capitalists but also from a broader range of private investor groups into clean energy innovation. These include oil and gas companies, utilities, plant and equipment manufacturers, and technology companies. These corporates are responding to growing pressure from their clients and shareholders to become active across the sustainability agenda. These investors also have a strategic interest in identifying promising innovations and wish to play a part at a much earlier stage to profit from any potential first-mover advantage. Also, some of these venture capitalist-minded investors, realizing the need for climate change solutions, see sustainable energy innovation as a growth area with significant potential opportunities available notwithstanding the risks.

The reported R&D spending by firms in clean energy-related sectors totaled US$58 billion in 2017 and the 5-year average shows a 5 percent annual growth.[8] Two-thirds of clean energy R&D in 2017 is allocated to the automotive sector.[9] Car manufacturers spend on average 3.2 percent of their revenues on R&D, whereas oil and gas companies and electric utilities only spend around 0.25 percent; OEMs spend 2.5 percent.

Other private investor groups include family offices, high-net-worth individuals, asset managers and philanthropic organizations, all of whom are starting to show an interest.

On the other hand, given the risk involved in energy innovation, the long-term nature of investments and the fiduciary commitments to their underlying investors, we currently see little appetite from public and private institutional investors.

Regulatory/institutional

Aside from the financial challenges for innovations, favorable energy regulations, funding policies and institutions to foster innovation are vital in creating a fertile environment for sustainable energy innovation. Stable policies, independent of political cycles, play a major role in providing the necessary certainty for innovators and private investors. A lack of transparency and accountability for the public sector on funding opportunities, budget, timing, process and responsibilities represent a major hurdle for innovations. The right policies and positive signaling from the public sector, on the other hand, can provide a demand-side pull for unproven sustainable energy solutions. An ongoing lack of a common consensus on the future design of the energy landscape between national governments is leading to the phenomenon that most sustainable energy R&D is still performed on a local level with too little cross-country knowledge exchange and the loss of collaborative synergy potential.

The path forward to change the current landscape

In order to accelerate clean energy technology innovations, the financial, regulatory and institutional hurdles must be tackled through a globally coordinated approach. In reality, much comes down to better collaboration and coordination both at national levels — between private and public investors — and at an international level — in relation to government policies and the overall innovation agenda.

[5] Mission Innovation countries have committed to doubling their R&D expenses within 5 years, starting 2015. IEA, 2017, Tracking Clean Energy Progress, https://www.iea.org/.
[6] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep/innovation/
[7] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep/innovation/tracking-rdd/
[8] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep/innovation/
[9] IEA, 2017, Tracking Clean Energy Progress, http://www.iea.org/tcep/innovation/tracking-rdd/

1. Creating a secure funding environment

Access to sufficient funding remains a fundamental aspect in the development process of an innovative idea into a marketable product. Aligning public and private investment is key to secure the required funding, especially at critical stages of technology development.

One potential approach could involve creating financial mechanisms attracting and blending both private and public money. These public-private co-investment mechanisms are designed to reflect the risk profiles of different parties involved. This could be combined with structured funds who use portfolio approaches providing returns on the overall performance of all invested projects. Investors are thus not dependent on the performance of individual projects. Such frameworks help provide a secure and stable framework for innovators and can be complemented with technological and financial assistance. This approach has been used effectively to push the climate change agenda in the developing world. Examples include the Danish Climate Investment Fund and the Global Climate Partnership Fund. There is no reason it could not be used in a similar fashion for sustainable energy innovation.

2. Supporting start-ups on their development path

There are many different ways to support innovation start-ups other than just the provision of funding. For example:

— development of business strategy and shaping a comprehensive business plan for innovators

— identifying strategic business partners, particularly larger industrial concerns to test prototype and demonstration models

— helping innovators through the maze of intellectual property protection

— setting up the right organizational structures and processes right from the start so that the start-up can function like a proper business with appropriate corporate governance.

These responsibilities fall on accounting firms like KPMG member firms and others in the business of supporting innovation.

3. Supporting investors in their investment into innovative start-ups

One of the main challenges for private and public investors is to find the right projects to fund. For industry players, investing into innovative start-ups is a way to outsource the innovation process until ideas are demonstrated and tested enough to be incorporated into their core business. Other industry players, such as car manufacturers, choose another approach and like to keep most of the innovation process in-house. They often own large R&D centers to test and develop new solutions.

The investment process of industry players, such as utilities and oil and gas companies, into innovative start-ups can be a win-win process for both the investors and the start-ups. The due diligence approach must therefore reflect and take into account the insecurities and scaling potential of business cases of early-stage companies. Considering the restricted resources of these early-stage companies, a due diligence process should not obstruct the day-to-day business of start-ups. The findings of legal, tax and financial due diligences can be valuable insights for the start-up entrepreneurs, who take the due diligence process as an opportunity to improve their organizational structures, reporting and operations.

4. Creating awareness for the sustainability innovation agenda

An important part of the approach is effective communication with private and public sector clients to raise awareness of the increasing and pressing importance of the innovation agenda.

"For example, KPMG member firms use different tools, methods and workshop formats to support clients in achieving a change of mind-set toward innovation within companies with the aim of making R&D a part of their business strategy and raise their interest in investing in sustainable energy innovation. Industry players should embrace the many opportunities that new sustainable and digital solutions can offer for their business.

We see many different examples of this in practice including companies who are looking to have a 100 percent 'green' value (including going 100 percent renewable), a greater desire to change business models to low-carbon solutions, and focusing on wider sustainability issues including waste and energy efficiency."

— Thekla von Bülow
Manager, Deal Advisory, KPMG in Germany

Collaboration with the World Economic Forum *Partnering to Accelerate Sustainable Energy Innovation*

Since 2017, KPMG has been collaborating with the World Economic Forum on a project called: *Partnering to Accelerate Sustainable Energy Innovation.*

The aim of the project is to identify and tackle the financial, regulatory and institutional hurdles in the global energy innovation process and find solutions to improve public-private collaboration in this field. As a result of various interviews with global experts in energy innovation, six recommendations have been developed that are designed to reduce hurdles and improve public-private collaboration.

The six recommendations include:

1. Aligning public and private investment through automatic co-investment mechanisms.
2. Establishing an independent sustainable energy innovation fund (SEIF).
3. Increasing the role of strategic public procurement in energy innovation.
4. Developing and implementing energy technology road maps through public-private collaboration.
5. Creating national institutions for energy innovation.
6. Establishing 'super-transparency' of public R&D expenditure.

In order to turn the recommendations into implementation actions, the World Economic Forum and KPMG are currently discussing the recommendations with a broad range of stakeholders in the global energy innovation ecosystem, including investors and innovators as well as multilaterals and governments in the Mission Innovation member countries.

Mission Innovation is a global initiative comprising of 22 countries and the European Union, established following the Paris Agreement to accelerate public and private clean energy innovation to address climate change.

"One idea in particular is receiving a lot of attention — and this is the proposal to establish an international sustainable energy innovation fund. This proposal involves the use of a blended finance funding structure to attract both public and private investors and a more professional and technical approach to project evaluation and the ongoing oversight given to these projects, and the idea is that these features should overcome some of the inherent difficulties that currently prevail across the funding spectrum.

In addition to the specific work on the six recommendations, this project has helped raise the profile of sustainable energy innovation and its critical importance to the climate change agenda. This in turn, we hope, will encourage greater collaboration and interaction between the investment and innovation communities."

— Mike Hayes
Global Leader of Renewables, KPMG in Ireland

To learn more about accelerating sustainable energy innovation, visit kpmg.com/renewables or click here.

Concluding remarks

Sustainable energy innovation is of critical importance in achieving the global climate targets. More sustainable energy technologies need to be developed and commercialized faster. Breakthrough energy technologies with broad applicability and affordability are needed to substitute incumbent solutions and lifestyles. In order to tackle systemic hurdles in the energy innovation process, it is critical to foster a culture of policy discussion and to increase the involvement of both private and public stakeholders in the energy innovation ecosystem. Innovation as such is not new, but the necessary speed to develop technologies and the inherent pressure to act in this particular industry is. Luckily, we can build upon experiences and lessons learned from other industries and sectors. Financial mechanisms of co-investment attracting both public and private investors have, for instance, extensively and successfully been used in the context of development finance in emerging economies. Other industries, such as the telecommunications industry, has shown exemplary speed and foresight in developing new products and ideas. Where there is a market, there will always be a product.

However, we should also focus on the positives. We see sustainable energy innovation happening all over the world with some really interesting and exciting ideas beginning to emerge. The challenge for all of us who are committed to doing something for the climate change agenda is to recognize the importance of sustainability innovation and to actually do something to help make it a reality.

What's next?

This is the third publication in a series of articles discussing renewable energy transition. Stay tuned for the next publication in the series from KPMG's Global Energy Institute (GEI) on the impact of Green Finance. To read previous publications, click here or visit kpmg.com/renewables.

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There are significant changes underway in the energy sector and organizations must adapt and transform in order to survive and capitalize on the opportunities these changes present. As part of our online energy community, you'll be able to read today's most important topics, access content affecting your industry or organization, share your perspectives on critical business topics and industry issues, post comments, and more.
Visit us at **kpmg.com/linkedinenergy**

How KPMG can help

KPMG member firms support the objectives of the 2015 Paris Agreement on climate change and are passionately committed to making a contribution through our professional skills and expertise.

The world needs a clear path toward zero net emissions. The decarbonization of electricity systems and expansion of renewable energy across the world is a critical step toward this goal. This energy transition is underway and irreversible and, as a result, many of our clients are seeking to harness the opportunities it creates while grappling with the disruptive market forces it brings.

KPMG International's Global Renewable Network is here to help clients succeed in the energy transition. Our innovative and integrated portfolio of services covering financial, strategic and regulatory advice, tax and accounting support can achieve effective results for government organizations, developers, generators and the wider investment community.

Furthermore, KPMG's worldwide presence benefits member firm clients by combining valuable global insights with hands-on local expertise and an understanding of the unique challenges clients face in their individual markets.

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Mike is a Partner at KPMG in Ireland and has been actively involved in the renewable energy industry for the past 20 years. He has worked with independent developers, innovators, utilities and investment funds across all different technologies and has worked on renewable projects on all continents. Mike's key focus is to mobilize the firm to support the global transition to a low-carbon economy.

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Launched in 2007, the KPMG Global Energy Institute (GEI) is a worldwide knowledge-sharing forum on current issues and emerging industry trends. The GEI interacts with its members through multiple media channels, including thought leadership, webcasts, videos, white papers, newsletters and events. To learn more and become a member, please click here or visit kpmg.com/energy.

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