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Delivering the Energy Transition:

Tipping Points and Points of Singularity

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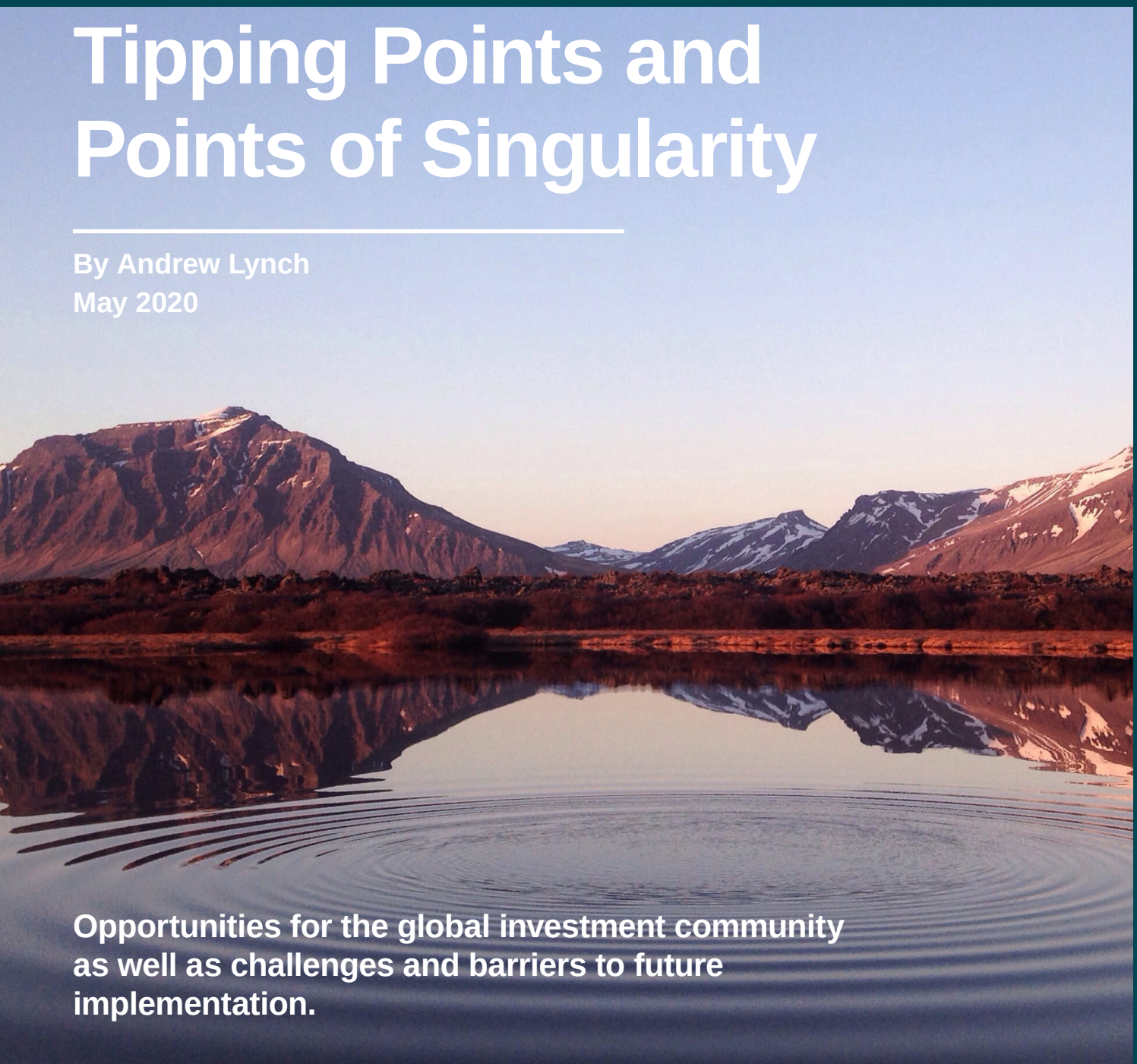

Opportunities for the global investment community as well as challenges and barriers to future implementation.

The energy transition is the name given to the process through which the global energy sector will transform from being primarily fossil-based to being zero-carbon, with a view to reducing CO_2 emissions to manage climate change.

This paper examines how we have reached a 'tipping point' in the global energy transition and explores the opportunity for the global investment community as well as challenges and barriers to future implementation.

- In 2016 the Paris Climate Agreement was signed by almost all sovereign nations agreeing to prevent global temperatures exceeding 2°C by 2050 by limiting greenhouse gas emissions.
- In 2019, for the first time since before the Industrial Revolution, the UK generated more of its energy from zero-carbon sources than fossil fuels.
- In a 2018 study, Wood Mackenzie identified 2035 as a 'point of singularity', predicting the world will shift permanently from oil & gas to renewable energy, defined by 20% of global power generated via solar or wind and approximately 20% of miles by cars, trucks, busses and bikes using electricity OR 50% of all new sales activity.

The above examples reference an irreversible change that will set the energy transition on a path towards a zero-carbon future as outlined in the Paris Climate Agreement. Notably, they are not all referencing the same 'tipping point' at the same time – it is simply a matter of perspective. In addition, it should be noted that sovereign states will make progress in achieving their goals at different rates, reporting back to the UN on their progress every 5 years.

EVOLUTION OF THE RENEWABLE ENERGY MARKET

Where once renewable energy was embraced by investors relying on government incentives and tariffs, now it presents viable and attractive investment opportunities in its own right. A lot has changed in the intervening period. Technological advances and economies of scale have been eroding the manufacturing and development costs resulting in improved performance, EBIT margins and returns on capital. As the industry has matured and scaled up, a plethora of self-supporting industries has emerged – utilities services, technology, logistics, manufacturing, the circular economy of waste to energy and recycling industries, EV and grid edge (or micro grid) technologies. Grid edge has seen the development of whole new business models with the end-user no longer just a consumer but an active player, generating and storing their own electricity. It offers a very different future to

centralised power, but in reality the two may come to exist together, offering more flexibility to the whole system. Beyond this still, is an ongoing attempt to reduce the carbon footprint and improve efficiencies across all walks of life, for consumers and businesses alike, with the secondary gain of lessening the load on power generation and hence reducing future greenhouse emissions.

THE BREADTH AND SCALE OF THE INVESTMENT OPPORTUNITY

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The International Renewable Energy Agency (IRENA) 'Roadmap to 2050' (REMap) refers to a US$120tn cumulative investment to meet the 2050 target with expected fossil fuel demand declining and renewable energy investment significantly growing – and yet it is the required growth of the energy efficiency sector that really catches the eye, almost doubling versus its reference case, to US$54tn of required investment.

IRENA's REMap also breaks the investment down by industry groups. The **transport** sector requires a US$14.2tn decarbonisation budget. It is a wholesale shift yet to materialise, with current fossil fuel usage at 96% and requiring a transition to renewable powered electrification from current levels of 1% to 33% in 2050.

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By 2050 75% of all passenger vehicles are predicted to be electric. The **buildings** sector also requires huge investment and change; whether fitting or retrofitting buildings, much of the emphasis is on energy efficiency gains through improving design and materials selection and requires a US$38tn cumulative investment until 2050. The broader **industrials** sector and the global **power** sector both require significantly more investment in renewable energy as well as energy efficiency.

Greentechmedia valued the **grid edge** M&A market as $4.3bn in 2016 with more than US$1bn in venture capital and private equity funding flowed into the sector and the market has continued to diversify and grow, with a range of stakeholders such as energy suppliers, grid operators, industrial manufacturers and software companies.

CHALLENGES, HEADWINDS AND OPPORTUNITIES

Given the scale of the opportunity, it is worth exploring the challenges – whether macro or micro in nature – that face investment communities over the coming decades as well as discussing potential solutions.

One important consideration for private sector investment, will be its ability to invest in 'whole ecosystem-type energy infrastructures' hence bringing the opportunity for scalable investments. Yoon Chong, Asia coverage MD at energy transition specialist and real assets manager Aquila Capital, explains:

"Whereas in the present/past, this was labelled as investing across the value chain (e.g. from LNG through to regasification, distribution and then retail supply) the bridge to effective & sustainable energy transition will involve offshore renewables technologies/infrastructure, battery storage, interconnectors, trading and localised grid….even before reaching the end-users."

Flexibility and connectivity

Building a new 'energy system' that leans heavily on naturally fluctuating supplies of solar and wind energy, will require significant improvements in storage and flexibility of the power supply. Natural gas will play an important role for some time, helping balance the rise of less flexible energies such as wind, solar and hydro until new provisions are established. Utility scale battery storage is one answer and further flexibility can be provided by 'Interconnectors' allowing cross-border power trading with neighbouring countries. Norway is a good example of where this works well, with neighbouring countries. The opportunity for growth is on a global scale, with potential development of 'solar rich' North African countries such as Tunisia and Morocco, establishing connections to the

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whole of Europe, via Italy. The current disadvantage of the system is that interconnectors are 'common carriers' and don't differentiate renewable generated electricity from other types.

Conversely, at the consumer level there is an opportunity to provide increased flexibility by harnessing grid edge or micro grid technology, feeding back via 'not in use' electric vehicles and properties with solar panels and battery storage. The upside of this is the provision of more flexibility to the overall system. The downside is it becomes more unpredictable in that individual or widespread issues cannot necessarily be addressed quickly.

Technological risks

Investors in the formative renewables industry struggled with the challenges of unproven technology, costs of manufacturing and predicting yields. Similar decisions and challenges exist for today's investors in modern economies, with industries such as waste to energy and carbon capture storage throwing up environmental or technological challenges which can undermine investment.

Battery storage is an interesting example where investment and technological progress has been rapid, given that less than five years ago it was perceived as expensive and an investment risk. Now the main risk is a lack of operational experience and track record. The UK electricity market and other markets that require the most flexibility, will have the highest demand for storage and will offer the most opportunity for investment in the sector. There is also the element of further de-risking through contractual arrangements.

Within the grid edge sector, there is the obvious risk of trying to pick winners from an array of technological innovation. With the potential for so many smaller, interacting companies within the same field, there is also an issue of scale. Similarly, the 'circular economy' can sometimes sit at a municipal and localised level, hence perceived as less scalable. There is a great opportunity for generating economies of scale and conglomerating related services. An example in the UK would be First Reserve's acquisition of Morrisons Utility Services in 2016, subsequently rebranded as 'M Services' – a buy and build exercise that created a diversified operations and maintenance provider to utility networks, smart meter installations, grid connections, utility scale battery projects and digitalisation of networks.

Political and legislative changes

One only has to examine the last 16 years of the Spanish renewables market to see the effects of legislative changes with government tariffs first promoting investment in 2004, then later retracted after the 2008 financial crisis, which led to the collapse of a nascent Solar PV market. Fast forward to 2020 and Spain has passed the Climate Change and

Energy Transition Laws, setting ambitious targets for Spain to transition from fossil fuels, with added training and support for those whose jobs could be adversely affected – but investors may feel a sense of déjà vu. In very different circumstances, the US Government has already initiated formal procedures to pull out of the Paris Climate Agreement, although the exit will not finalised until after the 2020 US election results.

Investing after the phasing out of Government feed-in tariffs

Many countries with mature renewables markets have now moved beyond the provision of government feed-in tariffs. In Asia, alternative types of incentive were introduced; effectively putting new projects up for auction with the benefit of governments paying fixed prices over the long term – a perceived incentive, as prices are likely to fall over time.

In countries with developed renewables markets, we see new dynamics coming into play. For example, as large institutional investors such as pension funds, insurance companies and sovereign wealth funds continue to directly invest in low risk renewable infrastructure assets such as solar and wind, increasingly there is the opportunity for them to sell energy to large corporates with high energy demands in the form of Corporate Power Purchase Agreements (PPAs). For a pension fund with long term liabilities, it is the kind of long term, stable, low risk solution which suits their needs and likely to be perceived as ethically sound. For the large corporate, it is perhaps essential PR, announcing their high energy demands are met by 100% renewable energy. Increasingly, we may see more large corporates and institutional investors tying up in this way.

Consistent international participation

Global warming affects a global population, but those countries currently interested in or actively investing in the energy transition are relatively few. In Asia, for example, there are comparably lower levels of activity beyond investing in conventional renewables. China has made startling progress in its investment in conventional renewable energy, but there is arguably less awareness of the broader definition of the energy transition and therefore the investment opportunities are less developed. But given the size of the market in Asia, the challenge will be to further unlock that market for investment.

Inter-generational momentum

Investment decisions are currently being made that will affect future generations – but to what extent are we engaging with the next generation to ensure they are philosophically, politically and economically invested? At present we assume their priorities will be the same, but we do not know that. One solution is to entrepreneurially harness the next generation, to ensure there is inter-generational momentum. In other words, we create mechanisms offering them the opportunity to invest in and profit from the policies, changes and investments of today.

The durability of global oil & gas demand

In some ways the most obvious and yet still underestimated or misunderstood aspect of the energy transition is the predicted longevity of global demand for oil & gas. Although the impact of Covid-19 is drastically affecting current energy prices (and we will discuss this later in more depth), it may be that a previously predicted long term trend will still occur – with global oil demand flat for the next 15 years and global demand for gas peaking in approximately 2035. This references the 'tipping point' scenario discussed at the outset – the timing of which depends on your point of view. Emerging economies will continue to drive growth in oil and gas demand for the next two decades, whilst developed economies will drive renewable energy demand over the same period as well as retaining some reliance on natural gas, which for the period of the transition will contribute to the buffer against natural fluctuations in renewable energy. What this means is the oil & gas industry as a whole will be better placed to defend its position in the global market over the next 30 years than many people realise. It will also be heavily focused on pursuing a leaner and more efficient model, reducing its carbon footprint via increased cost efficiencies, digitisation and autonomation.

The 'Major' oil & gas companies will only increase their research, development and investment into all forms of green energy. BP's 2017's investment in 'Lightsource' was a landmark transaction. Some would argue it was as much a signal of intent as it was a specific business opportunity. It planted BP's flag firmly in the Solar PV landscape with a view to significant growth: Lightsource BP has 400 industry specialists in 16 offices across five continents.

However, perhaps the significant conclusion regarding the oil & gas industry, irrespective of the political landscape, is that the Oil Majors in particular will retain significant levels of control over the rate at which the energy transition is made, through meeting the growing demand for continued fossil fuel in emerging economies, as well as increasing their own investment in green energy.

Impact of Covid-19 on the renewable energy industry and future investment

The oil price collapse in Q1 2020 has affected global energy prices – which in turn has left banks and investors in renewable projects struggling to price energy into potential long term financing agreements currently being considered. This is a problem which will only be resolved by achieving more stability in the energy markets. It is conceivable that the global pandemic may lead some governments to 'pause' or even reverse some green energy policies which become de-prioritised in the face of rising government debt.

Equally, one could argue that Covid-19 presents an opportunity for governments to further their commitments. In a recent report by the International Renewable Energy Agency, it is suggested investment in renewable energy could help kickstart economic growth with global GDP gains of almost US$100tn between now and 2050. The agency's Director General, Francesco La Camera, said the pandemic has exposed "the deep vulnerabilities of the current system…..by accelerating renewables and making the energy transition an integral part of the wider recovery, governments can achieve multiple economic and social objectives".

The International Energy Agency's recent Global Energy Review has drawn on data in Q1 2020 regarding the impact of the pandemic on energy production and demand. What is particularly significant is that whilst oil demand dropped by 8% in Q1 (mainly due to global road transportation usage down by up to 50% and aviation down by 60%) renewable energy was the only energy sector to post a growth in demand in Q1 and its 2020 forecast is predicting increased production and market share versus its 2019 figures. Q1 2020 saw an increase in renewable electricity generation of 3%. The reason for this is partly due to renewable electricity being prioritised over carbon-based electricity within the grid; when overall electricity demand drops as it did in Q1 2020, renewable electricity automatically gains market share. Also, over the past year several large scale solar and wind projects were completed and have come online, boosting global production.

According to the IRE's report, a faster economic recovery from the pandemic "would have a minimal impact on renewable energy production, though it would enable more new renewables-based projects to be completed. If recovery is slower, renewable energy would still increase".

The overall case for future investment in renewable energy is in some ways stronger now than before the current crisis began with renewable energy proving its resilience and sustainability in the face of a global crisis, whilst also increasing its market share.

CONCLUSIONS

Renewable electricity generation is at the very core of the zero-carbon solution. It cascades into so many of the other areas touched on in this paper. Other key areas of change are energy efficiency and the development of the grid edge sector. The opportunities for investment and change are quite diverse and range in scale accordingly from national,, regional and localised utility, through to end-user/ consumer level. Investment in technological innovation will help drive much of the change.

Historically, renewable investments tended to be the preserve of infrastructure or specialist green energy funds. However, there has been increasing convergence, with private equity and even venture capital moving into adjacent areas such as grid edge technology, circular economy industries where the investment criteria is clearly suited to private equity and debt investment as much as the infrastructure investment model. Equally, with their demonstrable long-term success in green investments, infrastructure funds are in a unique position to receive continued backing from their LPs to push out beyond their previous remits and differentiate themselves with future investment strategies.

The energy transition is shaping a renewable infrastructure ecosystem, linking the utility scale infrastructure with storage, trading, localised grids all the way through to the infrastructure for managing power at the end user level. This is providing an opportunity for the private sector to invest in something that is truly scalable and that which can be potentially replicated globally.

However, as technological innovation continues to drive much of the change and the opportunity exists for investments to continue to diversify, so the innovation should carry over and create new incentivised ways for investments to be structured at the community and inter-generational level – effectively tying in all stakeholders.

Whilst it is inevitable there will be some deviation from governments' political commitments to green investment over the next 30 years, there is a clear opportunity now for governments to crystallise their positions – and thus define the investment opportunity for the wider investment community. In addition to this, although the outcomes from the Covid-19 pandemic are still open to interpretation, there does seem to be mounting evidence that it is reinforcing what many already perceived to be a 'tipping point' for the required investment to drive the energy transition.

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