Report on Investor Survey

Summary of the Interviews of
Selected European Investors on Investments in
Renewable Energy Including the Reduction and Recycling of Carbon Dioxide

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1 Background

NEO-CARBON ENERGY (NCE) project[1] is one of the TEKES'[2] – the Finnish Funding Agency for Innovation – strategic research openings. It is by far the largest research project in Finland focusing on renewable energy and the associated global economy. The project is carried out in cooperation with Technical Research Centre of Finland VTT Ltd[3], Lappeenranta University of Technology LUT[4] and Finland Futures Research Centre FFRC at the University of Turku[5]. The Neo Carbon Energy project was established in 2014 and it continues to run until the end of 2017.

When it comes to renewables, namely wind, solar and hydro, the electricity price is mainly driven by the investment costs of production. The fuel costs bear no relevance, and the electricity price is therefore independent of fuel prices. Due to the fluctuating nature of renewable energy sources (wind, solar), the required capacity in the system exceeds the average consumption from time to time. Therefore storing energy (e.g. batteries, etc.) or the capturing and recycling (CCU) or storing (CCS) of CO_2 becomes necessary and viable businesses.

The investment costs, levelised cost of energy per MWh (LCOE), for renewable energy production, have already fallen below those for the fossil and nuclear energy production.[6] As a result, the higher level of renewable energies production is a big, rapidly emerging investment area in itself.

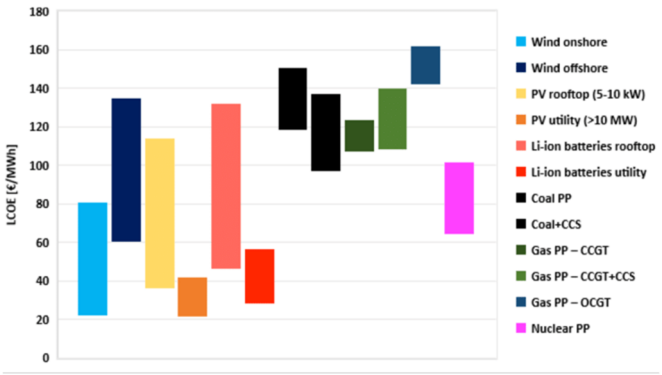

Figure 1. Range of levelled cost of electricity (LCOE) median values inclusive of external and greenhouse gas (GHG) emissions costs of different power generation technologies for the G20 in 2030.

[1] http://www.neocarbonenergy.fi/about/
[2] http://www.tekes.fi/en/
[3] http://www.vttresearch.com/,
[4] http://www.lut.fi/web/en/
[5] http://www.utu.fi/en/Pages/home.aspx
[6] https://www.researchgate.net/publication/318217005_Comparing_electricity_production_costs_of_renewables_to_fossil_and_nuclear_power_plants_in_G20_countries

The required investments in renewable energy will exceed hundreds of billions of euros. The change creates further demands for new approaches in energy production, grid management, energy storages, energy sales, energy services and finance as well as a variety of opportunities for completely new businesses. The requirements to reduce and nullify the CO_2 emissions in industries, cities, transport and agriculture will necessitate new investments in the reduction, capture and recycling of CO_2.

"*New Business Arising from the Energy Market's Strategic Change*", a subproject of NCE, evaluates the future business potential of new businesses emerging from the Energy Markets' Strategic Change. The analyses of the major players participating in the strategic change in energy markets will chart the firms, their strategies, actions and motives in terms of the adjustment that is taking place in the global energy markets.

2 Objectives of the Survey

The results of this survey shed light on the present investor intentions and provide indications concerning the direction of future investment and technology strategies. The purpose of the survey is to increase the understanding on the questions such as how fast will the changes take place in different sectors and what is the emerging business potential of different sectors. The main themes discussed in the interviews were electricity production, energy storages, mobility, industrial carbon dioxide (CO_2) capture and usage/storage (CCU, CCS), changes in the investment environment and potential uncertainties arising.

This report is a management summary. The more comprehensive research results will be published at the later date in scientific articles assessing the investor intentions.

3 Interviewee Characteristics

The survey was addressed to major global investors, although the focus of the majority of the interviewed investors is on Europe. The survey was based on semi-structured interviews with individual decision makers in the chosen firms.

The survey took place between November 2016 and February 2017. The interviewees represented institutional investors, renewable energy funds, infrastructure funds, and banks. The report is based on the transcript interviews of 19 interviewees. The majority of the interviews were carried out in London. The capital of the investors was coming from all parts of the world. The investments were predominantly directed to Eurozone or EU-27 area.

The total investment capital available for sustainable investments by the interviewed companies exceeded 740 billion euros. Some of the institutional investors had an allocation of approximately 1% of the total capital available. Some of them did not have any allocation. It many cases it was reported that sustainable investments were favoured within the company. The driving force in investment decisions is the management of the risk-return ratio so that risks remain low. Therefore, low returns over a long period are favoured.

4 Energy Production and Technologies

The shift in energy production from fossil fuels to renewables is taking place right now. The majority of the interviewees agreed that the turning point towards renewable energy has already happened. Renewable energy production is no more a marginal phenomenon, but actually a normal investment. Over the years the competitive advantage has shifted towards renewable energy due to the great productivity improvements in technology. Furthermore, the public opinion is increasingly in the favour of clean energy production.

The investments in renewable energy are not disclosed in the figures of listed companies. The utilities have not been the game changers. The investors in renewable energy and funds have predominantly been new players and unlisted companies such as pension funds, insurance firms and private equity funds.

4.1 Changes in Energy Production in Europe

In Europe, the regulation of renewable energy production was initiated by the introduction of the EEG. The EEG was preceded by the Electricity Feed-in Act (1991), which entered into force on 1 January 1991.[7] This law introduced the first green electricity feed-in tariff scheme in the world. The first version of the EEG, which comes from the German abbreviation for Renewable Energy Sources Act, came into force on April 1, 2000.[8]

For the most part, the renewable energy production that has been built relates to wind and solar. However, some investments have also been made in biomass projects[9].

Interviewees were in agreement that in the future wind power will be the major production technology for some time when it comes to the Central and Northern parts of Europe due to increasingly efficient turbines and falling MW prices. Solar PV capacity will increase due to a continuing improvement in efficiency and a reduced environmental impact especially in sunny areas.[10]

Low electricity prices are slowing down the investments in energy production. In the past, the change in electricity production has benefitted from subsidies but now it is suffering from the negative publicity associated with such subsidies. The new auction system will lower the costs of investments and energy, but will require new skills.

Funds are also moving into new areas of investment because institutional investors are increasingly making direct investments in renewable energy production.

[7] Nachhaltigkeitswissenschaften, Harald Heinrichs, Gerd Michelsen (2014), DOI 10.1007/978-3-642-25112-2

[8] 10 years Renewable Energies Act (EEG) – looking back on a success story, Dipl.-Ing. agr. (FH) Martin Bensmann, BIOGAS Journal, 4/2010. **https://www.kriegfischer.de/fileadmin/images/news/International_EEG.pdf**

[9] **http://www.sleafordstandard.co.uk/news/environment/sleaford-renewable-energy-plant-refinanced-in-150m-deal-1-8125536**

[10] Major part of the Solar capacity in Europe has been invested by prosumer level

None of the interviewed investors had considered investing in any nuclear projects. In general they were also avoiding investments in coal based production.

4.2 Energy Storage Solutions

Investments in energy storage are still rare. The only technology mentioned in the interviews was battery storage (in many cases). Hydro was also brought up, but it was not regarded as a viable investment option for new production in Europe.

In general, the interviewees were not familiar with other technologies. For instance methane synthesis (storage and LNG alike gas to substitute petrol) or production of ammonium were unknown. Based on the interviews and the subsequent IPFA conference in Amsterdam it became evident that battery technologies are considered the next major investment opportunity with regard to energy storage.

4.3 Mobility

The interview data indicates quite clearly that mobility is not really considered an exciting investment opportunity amongst the interviewed investors. However, the interviewees predicted that electric cars will be the dominant technology and other technologies (like gas, hybrids) will play a small role in the transition. Initially one of the main drivers in mobility is the air pollution in large cities, subsequently also the lower costs.

4.4 Industrial CO_2 Emission Reduction

None of the investors had come across any investment proposals on the reduction of CO_2 emissions. The capture and recycling of the captured CO_2 (CCU, for instance into flight petrol or methanol) is still in its infancy and is yet to become a viable investment opportunity. This view is also supported by recent studies.[11]

[11] For instance, Corporations on the road to low-carbon economy: institutional diffusion of carbon management, Henri Mikkola (2017), Masters Thesis. http://urn.fi/URN:NBN:fi-fe201705236834

5 European Investment Environment in Renewable Energy

The investments in sustainable energy and systems are growing. The interview data showed that the allocation into renewable energy investments was approximately 1% of the total institutional investor capital (equity) available. It became apparent that the intention is to increase the level of allocation nearer to 2%. This may not seem as a big increase, but it does actually mean that the existing level will be doubled and in monetary terms this equates to tens of billions of euros extra into sustainable investments.

It was clear from the interviews that institutional investors investing into funds seek a reduction in CO_2 emissions. The majority of the interviewed funds have strict rules not only on the projects in which they invest but also on the reporting of the abatement of CO_2 emissions. This is a self-amplifying phenomenon that is due to the investors' long-term, low-return policies and the lifetime of the funds.

5.1 Behavioural Change of Investors

The interviewees pointed out that the energy market has become more democratic as a result of the changes and it has opened up to a variety of investors. This was regarded as a welcome development, which increases competition.

Some fifteen years ago, the typical behaviour of the institutional investors was to make energy investments into listed utility firms. They then made investments into power generation. (See Figure 2.)

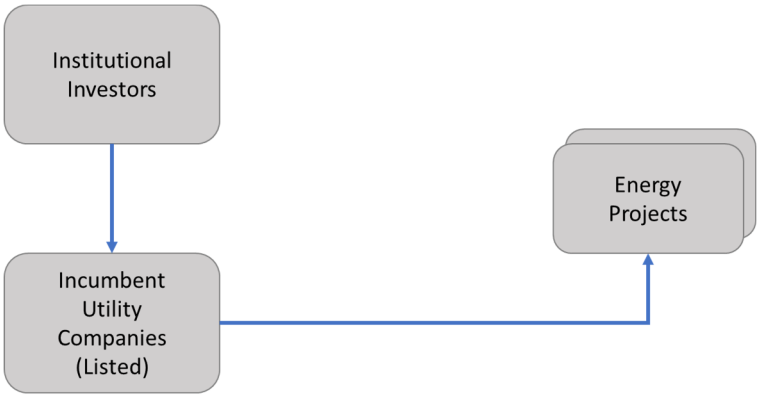

Figure 2. Traditional investment behaviour

When institutional investors and private equity started to steer their investments towards renewable energy, multiple dedicated funds were established in the early 21st century. With clear mandates they assured the allocation of their equity in renewable energy and sustainable technologies. The investments were steered through funds. (See Figure 2.). The funds were quick to develop the required skills for the investments and many of them were spin-offs from banks.

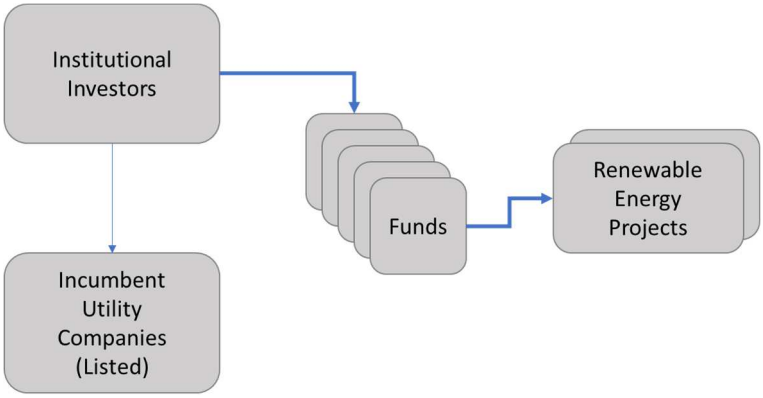

Figure 3. Move towards dedicated funds

Finally, as subsidies, energy prices, equity IRR, and interest rates have gone down, and renewable technology as well as energy policies have become more and more standardised, the institutional investors have started to make direct investments into renewable energy projects. (See Figure 4.)

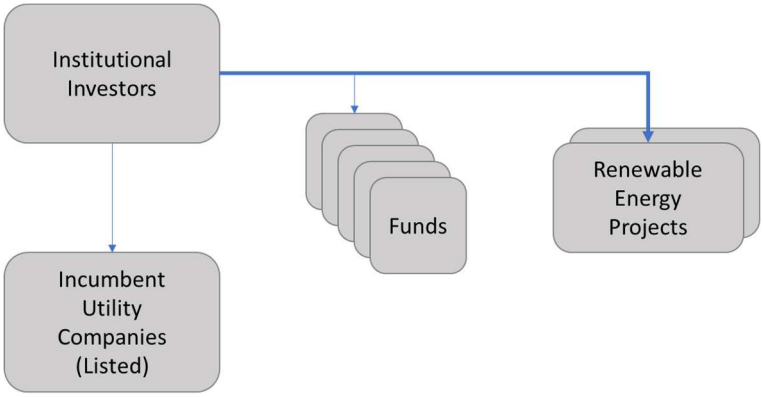

Figure 4. Investments directly to renewable energy projects

5.2 Investment Environment in Europe

The current set-up with very low interest rates and returns on equity are especially squeezing the funds to reinvent their business models. New strategies are for instance based on geographic expansion (like India, Africa, USA, Canada, etc.), integration into production processes and waste recycling, and investments into internet related growth areas. Investors are increasingly attracted to development of projects and new technology investments.

5.3 Uncertainties in Europe

During the interview period, the UK voted to leave the European Union. This was also discussed during the interviews. Mostly Brexit was considered to have an impact on funds, which are operating under the mandate to invest only in EU countries. Some interviewees told that investments, which were in the process of being made in the UK, were put on hold. The main concern was the legal impacts and costs for operating from the UK to Europe.

At the same time in the USA, President Trump was making statements and promises for radical changes that would potentially have an impact on investment returns and stability. This potential increase in instability in terms of investment environment was also highlighted in the interviews.

Any increase in uncertainty and a lack of vision for the future is negative from the investor's point of view.

5.4 Finland as Potential Investment Location

In general, Finland was regarded as a positive investment environment: euro country, stable society, and economically in a good shape. As a market Finland is small and remote from Central Europe. As a result, the larger European investors easily focus somewhere else. This gives some advantage to local investors.

The changes in wind power subsidy systems at the end of the period in 2016 irritated and caused uncertainty in some of the investors who were planning to operate in Finland.

6 Conclusions

The primary focus of the investors remains in renewable energy production. The main technologies are wind and solar from the maturity point of view. Lifetime of the technology is growing longer. Wind and solar have been accounted for a period of more than 25 years, but there has been discussion whether this needs to be extended into 30 years.

At present storage system investments are rare. However, there are already some funds that have been established for storage investments. The main technology is battery storages. Storage systems are tightly integrated into local electricity systems and require deep knowledge of electricity pricing. In the UK there has been an auction on storage capacity for the grid.

Neither Carbon Capture and Utilisation (CCU) or Carbon Capture and Storage (CCS) have become familiar and stable investment options.

Electric cars will be the dominant technology in the near future. As far as the investors are concerned, this was not seen as their field of business.

Returns in Europe are low and uncertainty is increasing. The investment environment is getting blurred. However, it is the same for all investors.

6.1 Sustainable Investments

The capital in sustainable investments is growing. Interviewees from institutional investors and banks claimed increases in their allocation or expressed a desire to invest in sustainable investments. The allocation of total capital available by the interviewed institutional investor was approximately 1%. The intent recorded was to increase the level of allocation nearer to 2%. This may not seem like a big increase, but it does actually mean that the existing level will be doubled, and in monetary terms this equals to billions of euros worth of extra funds into sustainable investments.

6.2 Institutional Learning and Future

There is a predictable trend on investor behaviour. The institutional investors like pension funds set their mandates so that they require abatement of emissions from the funds or their direct investments.

The development is irrevocable, due to the lifetime of the funds, which is frequently ten to twelve years. This is called institutional learning and it has long-lasting impacts. This development came out clearly in most of the interviews.

6.3 Funds

Funds develop new skills and competencies quickly. Funds have their investors' faith in their ability to make right risk-return investments. Usually the IRR demand is also higher, due to higher risks.

The renewable energy production is becoming a normal energy investment and therefore institutional investors have started to make direct investments into it. Funds are shifting towards more complicated, new technology investments or new market areas.

Funds play an important role in the implementation of new technology investments and they are therefore very beneficial for technology firms in terms of global competition.

7 Discussion

7.1 Global Renewable Energy Demand

Bloomberg[12] estimates that "global power demand grows by 58% between now and 2040, or 2% per year."

The need for electricity will increase. However, not only as a consequence of electrification in general, but also due to the increased demand for hydrogen that is produced by electricity from water in order to meet the requirements of capturing and recycling of CO_2 (CCU) in industries.

Bloomberg's estimate[13] does not take into account this additional need for electricity. When taking the electricity production in 2013 as a starting point, accounting the additional need for hydrogen production for industrial CO_2 recycling (CCU), including the efficiency improvements of electric vehicles and heating as well as the required production of synthetic fuels (like flight petrol) and other products, the additional need for clean electricity is around 50 000 TWh/a.

In comparison to the global non-emitting electricity production of 7500 TWh/a (2013), assuming that CO_2 emitting production also needs to be replaced and global consumption is not going up, the increase in new production should be over six fold. This is a very conservative estimate in comparison to the projected future demand growth in developing countries.[14]

7.2 Investment Opportunities Arising

Bloomberg expects new investments worth of 10.2 trillion USD in new power generation capacity worldwide by 2040, of which 72% goes to renewables (7.4 trillion USD). Solar takes 2.8 trillion and wind 3.3 trillion USD. "Investment in renewable energy increases to around $400 billion per year by 2040, a 2-3% average annual increase. Investment in wind grows faster than solar – wind increasing 3.4% and solar 2.3% per year on average. European investment in renewables grows by 2.6% per year on average out to 2040, averaging $40 billion per year. Total investment in renewables across Europe reaches almost $1 trillion over 2017-40. Europe's firm generating capacity shrinks by 29%, replaced by variable and flexible capacity."[15]

Moreover when taking into account the capture of the industrial CO_2, the investments required will be in the excess of the sum of 10.2 trillion USD estimated by Bloomberg.

[12] Bloomberg New Energy Finance: 2017 New Energy Outlook
[13] Bloomberg New Energy Finance: 2017 New Energy Outlook
[14] VTT Report, NeoCarbon Project: Petteri Laaksonen, Eemeli Tsupari; Strategic Roadmap - Future Electricity demand and CO_2 recycling (2017).
[15] Bloomberg New Energy Finance: 2017 New Energy Outlook

This will generate new investments in wind and solar production, energy storages, demand management, grids and service industries. The change will without question also create new business models.

7.3 Energy Market Competition and Competitive Strategies

This change has had an adverse effect on fuel suppliers: Coal producers are suffering badly and some big bankruptcies have taken place such as the world's biggest coal producer Peabody in the USA[16] in 2016. They are cutting down production and laying off mine workers like in China[17]. The price of the coal has been on a downward trend since 2012.

There are contradictory estimates on oil demand and production, but very many forecasts are based on the extrapolating of the past growth in its use. In real terms, the European fuel prices are on the same level as in around 1985.[18] The use of electric vehicles will have an impact resulting in a decline in the use of fuels and improvements in energy efficiency. Consequently the producers will currently attempt to pump as much oil as they can, because the price is better today than it is expected to be tomorrow.[19]

Figure 5. Thermal coal CAPP price[20]

[16] e.g.Peabody Energy: **https://www.theguardian.com/environment/2016/apr/13/worlds-largest-coal-producer-files-for-bankruptcy-protection**

[17] e.g. China to lay off five to six million workers: **http://www.reuters.com/article/us-china-economy-layoffs-exclusive-idUSKCN0W33DS**

[18] **https://www.eea.europa.eu/data-and-maps/indicators/fuel-prices-and-taxes/assessment-6**

[19] Dieter Helm, Burn Out: The endgame for fossil fuels, (2017), Yale University Press, for instance page 37

[20] **http://www.infomine.com/investment/metal-prices/coal/5-year/**

Many utilities are weak from the profitability and balance sheet point of view. Incumbent utilities have lived a secured life having had a long foresight into their investment horizon.

Obligation to reduce CO_2 emissions is causing problems due to non-depreciated investment into coal and other fossil based power generation. The change has been too rapid for them to adjust. Together with low electricity prices, the market has forced utilities to adopt a defensive position.

Utilities strategy is to collect returns on existing investment in fossil energy by slowing down the transition towards renewable energy (see Figure 4.) with few exceptions[21]. Incumbents are in transition towards new energy markets but only with the speed their balance sheet can bear[22]. Utilities benefit from the low coal prices, because this is directly reflected in electricity prices and therefore slows down investments in all energy production. Even the cash flows are lower, the total production is not increasing and this gives utilities time to prepare for the transformation of their business models.

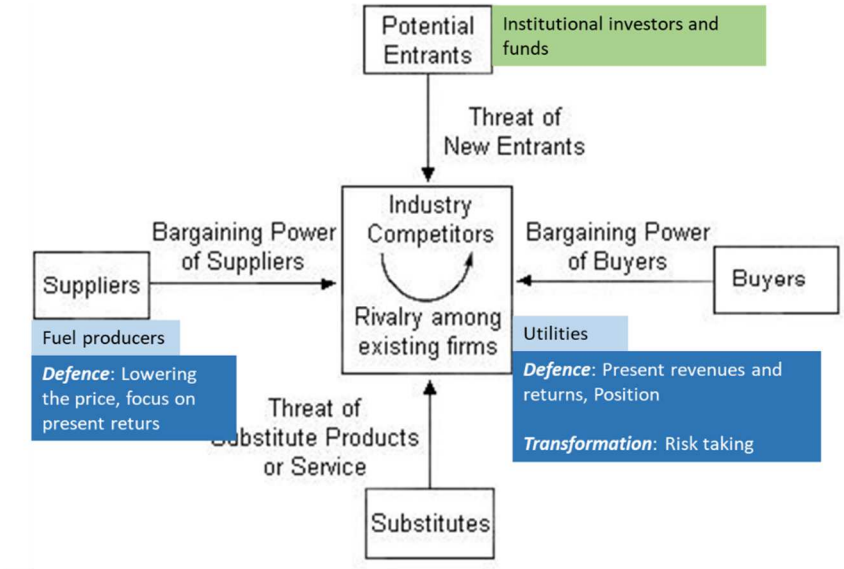

Figure 6. Porterian view on competition and competitive strategies in electricity production

[21] e.g. Vattenfall selling its coal power stations in Europe and Enel **https://www.enel.com/en/aboutus/a201608-vision.html**

[22] e.g. Fortum

7.4 Speed of Change in CO_2 Reductions

In 2016, the installed capacity of wind and solar in Europe was 255 GW. They produced 10.4% of the European electricity.

FIGURE 1

Cumulative power capacity in the European Union 2005-2016

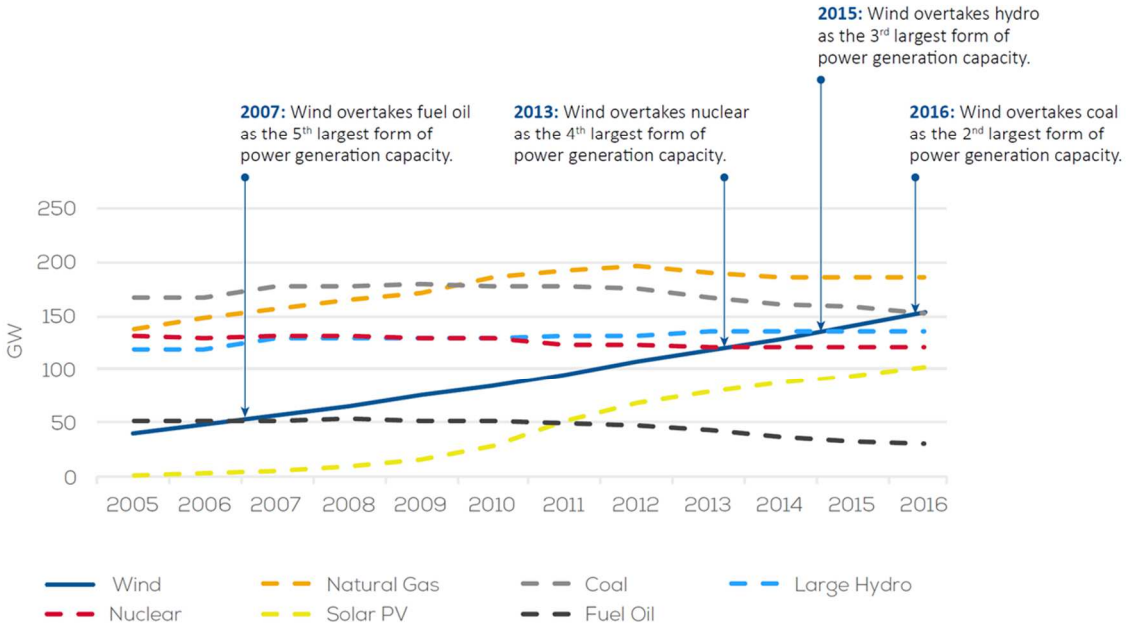

Figure 7. European power generation capacity[23]

In 2016, a total of 12.5 GW of new wind power capacity was installed and grid-connected in the EU. There was a decrease of 3% compared to the annual installations carried out in 2015. Out of this 10,923 MW were installed onshore, and 1,567 MW were installed offshore. Renewable energy accounted for 86% of all new EU power installations in 2016: 21.1 GW of a total 24.5 GW of new power capacity. With almost 300 TWh generated in 2016, wind power provided 10.4 % of the EU's electricity demand.

At present a lot of electricity and heat in Europe is still produced by coal. The majority of industrial CO_2 emissions are caused by energy production as well as steel and cement manufacturing. The investments into CO_2 capture (CCU/CCS) have not yet begun.[24]

[23] **https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2016.pdf**

[24] For instance, Corporations on the road to low-carbon economy: institutional diffusion of carbon management, Henri Mikkola (2017), Masters Thesis. http://urn.fi/URN:NBN:fi-fe201705236834

The mobility sector, especially cars, is moving rapidly towards electrification. The majority of the investors interviewed anticipated that fully electric cars will be the winning technology and the shift will take place at a fast pace. This obviously gives rise to a need to increase the level of sustainable energy production – there is no point of driving an electric car that runs on electricity generated by coal.

The total speed of this shift does not seem to be fast enough to reduce the global warming, and stronger actions are required to accelerate the process.

7.5 Further Action Proposals

7.5.1 European Regulation

Firstly, from the investor point of view it is important to have both stability and visibility. A stable investment environment lowers investor risks and decreases the cost of capital. Ultimately, this helps reduce investment costs and will eventually lead to cheaper products, such as cheaper electricity. See Figure 8:

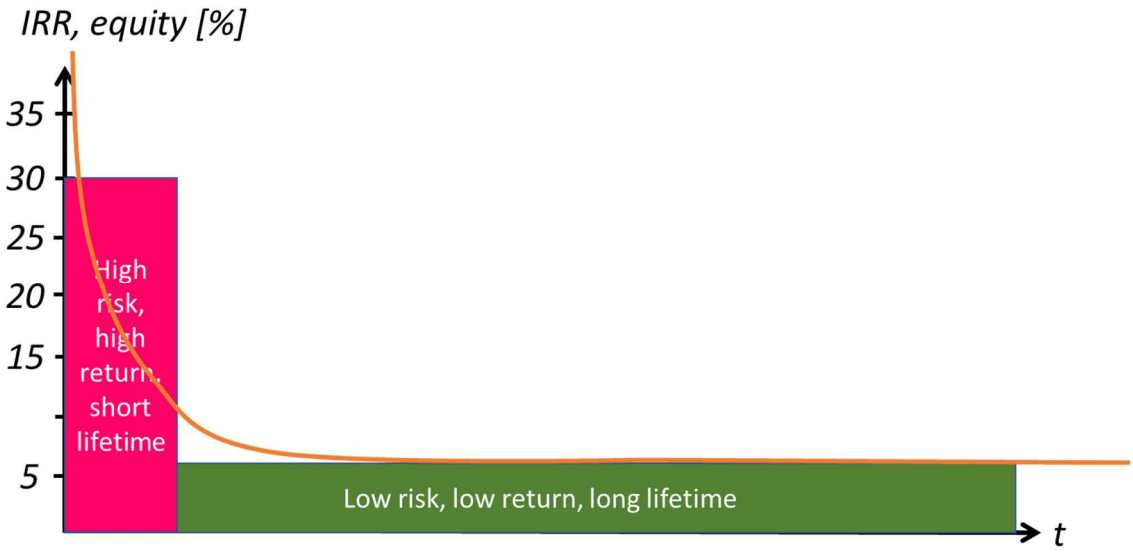

Figure 8: Balancing of investor risk and return

Unfortunately, this has not generally been the case in Europe. Each country has had its own subsidy schemes and some of the countries have even changed them retrospectively. In countries like Germany, where the investment environment has been held stable, and the visibility has been enhanced by providing advance information of renewable energy auctions, also the cost of capital has been the lowest.

In the big picture the regulation and subsidy systems in the EU and other European countries should be consistent. This would make the investments compete with each

other under the same rules and direct them towards efficient solutions. The present fragmented system creates competitive disadvantage within Europe. The need for subsidies cannot be attributed to the renewable energy production not being competitive enough in comparison to other new production investments, but the issue is the low price of electricity resulting primarily from cheap coal as well as direct and hidden subsidies allocated to fossil energy production. [25]

Subsidies should be allocated to new, clean technologies. Technologies must be proven in order to get the investors to accept them into their portfolios. For unproven technologies and pilots there should be funding available by the EU to absorb development risks.

Dedicated funds are the first ones to implement new technologies and therefore regulative bodies should increase dialogue with them. A strong and consistent link between research and finance should be established.

7.5.2 Incentives on Reduction of Industrial CO_2 Emissions

Secondly, it is clear that investments in industrial CO_2 reductions have not yet begun. Investors are not familiar with these technologies and none of the interviewees had been approached with such an investment proposal. Due to free CO_2 emission allowances, there is no need for industries to reduce their emissions. Despite the difficulties related to political decision-making, a wide consensus to increase the emission costs should be reached globally, but at least in Europe as soon as possible. The biggest industrial emitters of CO_2 are of course electricity production by coal, but also steel and cement industries.

7.5.3 New Sources for Taxation

Thirdly, if the collapse of the fossil fuel prices[26] takes place, there is a great opportunity for governments to collect extra funds in order to speed up the transition by increasing the taxation of coal, petrol and other fuels.[27]

7.5.4 Integration of European Electricity Market

Finally, the integration of European energy market would facilitate the market and private money to speed up the pace of this transition.

Building up grids for interconnections would improve the functionality of the European electricity market. Opening up the investments to private companies would definitely

[25] Present CO_2 emission cost per tonne is not adequate to cover for instance medical damages caused by burning coal and other fossil fuels.

[26] Dieter Helm, Burn Out: The endgame for fossil fuels, (2017), Yale University Press, for instance page 37

[27] See figure 5. If additional tax for coal would have been implemented in 2012 to keep the price level the same, in 2015 coal price would be on the level of 2012 but governments could collect 50% of the tonne price in taxes.

accelerate the process. This would require changes in regulation and protective actions by the countries in Europe.

Developing a standard for the demand side real-time automation and electricity trade would radically improve the demand side fluctuations. For example, enabling electric cars and heating/cooling to automatically participate in the real-time electricity market would reduce the need for extra capacity in peak hours. This kind of development would resemble the development of the GSM standard, enabling the global services on mobile Internet.