

**R&D and sustainability concern in balancing power in the
Norwegian RE sector:
A content analysis of job advertisements**



A dissertation submitted in partial fulfilment for the degree of
Master of Science in Innovation and Entrepreneurship

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University of Oslo

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(May 21, 2017)

ACKNOWLEDGEMENT

This thesis work was carried out at University of Oslo, the faculty of Mathematics and Natural Science, Centre for Entrepreneurship, in a partial fulfilment of requirements for Master of Science Degree in Innovation and Entrepreneurship under the supervision of Tor Borger Hansen. First, we would like to take this privilege to express our profound gratitude to our supervisor Tor Borger Hansen for his invaluable guidance, constructive and meticulous supervision, and tones of encouragement throughout this thesis work.

We would like to express our sincere gratitude to Bjørn Arne Sivertsen and his team at NAV Service centre for invaluable effort in providing the data for the thesis work. We would like to express our sincere gratitude to all the interviewee for their valuable time and information during the interview process. We owe a debt of gratitude to Ersu Boncuk, Higher Executive officer at Centre for Entrepreneurship, for her support during the thesis work.

We wish to express our sincere thanks to all the faculty members of Centre for Entrepreneurship for their supportive work during the period. We are thankful to all my colleagues for their kind cooperation.

We show our heartfelt gratitude to our families and parents for their continuous devotion during the entire period of our studies. Their unfailing support constitutes the basis of our success.

Date:.....

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ABSTRACT

Renewable energy resources are highly desirable and inevitable choice from sustainability perspective. Norway, being rich in both the fossil fuel and renewable energy resources is positioned in policy dilemma which is characterized by its long energy policy transition. A significant challenge for RE actors is the policy inconsistency. In such scenario, exploring the activities of renewable energy stakeholders would contribute to evaluate the transitional policy and develop economically self-sustaining RE sector in energy transition.

Built as an extension on available literature, proposed hypotheses are tested by the quantitative data and discussed with the findings from qualitative data. Our findings showed that Norwegian CEER mode of R&D is gaining momentum while R&D Mode 1 is still prevalent in the RE sector. The solar energy sector dominates the R&D activities despite its less attractive domestic market. The association between energy mix, sustainability and energy efficiency was established by content analysis of the job advertisement published on public domain. The quantitative study showed that motive behind involvement of RE stakeholders in energy mix is diverse. The sustainability concern is one of the motivation while other factors is wind hydro energy mix was the dominant energy mix in production side adopted by most of the energy producers. With the sustainability and efficiency concern shown on RE sector by the stakeholders, Norway carries a huge potential to provide energy support to European region during the energy transition.

Keywords: Renewable energy, energy mix, sustainability concern, R&D

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ABBREVIATIONS

CCS	Carbon Capture and Storage
CEER	Council of European Energy Regulators
CEO	Chief Executive Officer
CIPD	Chartered Institute of Personnel and Development
CSR	Corporate Social Responsibility
EE	Energy Efficiency
EEA	European Economic Area
EU	European Union
FIT	Feed-In-Tariff
GHG	Greenhouse Gas
GNI	Gross National Income
GWh	Gigawatt Hour
IEA	International Energy Agency
IN	Innovation Norway
IRR	Internal Rate of Return
KPMG	Klynveld Peat Marwick Goerdeler
NAV	Norwegian Labor and Welfare Administration
NGO	Non- Government Organization
NPV	Net Present Value
NRC	Norwegian Research Council
NVE	Norwegian Water Resources and Energy Directorate
ODA	Official Development Assistance
PV	Photo Voltaics
RE	Renewable Energy
R&D	Research and Development
SINTEF	Stiftelsen for industriell og teknisk forskning
SME	Small and medium-sized enterprises
SND	National Industrial and District Development Fund
SSB	Statistics Norway
TMT	Top Management Team
TWh	Tera watt hour
VRE	Variable Renewable Energy
UNFCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION

1.1 Background

Reliable, secured, an affordable and continuous supply of energy is essential to attain socio-economic development of the society. Traditional energy sources based on fossil fuels are continually depleting, and environmental crisis caused by the combustion of fossil fuels proved that these sources are unsustainable. The extensive use of fossil fuel for past decades especially in transportation and industry sector gave birth to the issue of greenhouse gas emission. Realizing this concern Norway was the first country to establish the Ministry of Environment in 1972 which was able to attract the concern of world leaders (Trygstad & Fafo, 2009). To address this concern globally, the international commission, also called the Brundtland Commission, led by then Norwegian Prime Minister Gro Harlem Brundtland in 1987 presented a report "Our Common Future". The report showed a balanced analysis of political and environmental issues and challenges and put forth the agenda for change. The report urged the world community to embrace the sustainable energy pathway to overcome the foreseen crisis and pave the way towards sustainable development (World Commission on Environment, 1987). The signing of the Kyoto Protocol in 1997 was considered as a milestone towards sustainable development (United Nations, 1998).

Because of the development of science and technology along with public pressure for sustainability, renewable energy (RE) has become a choice for the future power source. The EU climate policy and a move toward sustainability by signing in the Kyoto Protocol have paved the path towards the green energy economy. Therefore, in pursuit of sustainability, renewable energy resources such as hydropower, biofuel, wind power, geothermal energy, solar photovoltaic energy (PV) were introduced into the mainstream power supply (Ma, Yang, & Ballabjerg, 2014).

At present, the renewable energy sector is playing a crucial role in total energy supply of the world. The European Parliament alone has targeted to use 20% of total energy demand from renewable sources as a part of promoting renewable energy by 2020 (The European Parliament and the Council of the European Union, 2009). After the declaration, there is an increased share of renewable energy in total energy production and consumption. However, the intermittent nature of VRE (Variable Renewable Energy) has created the essence of looking for stable energy supply from flexible energy resources. Thus, an appropriate renewable mix could provide a solution to intermittency and smoothen the European transition to RE. In this regard, the Nordic countries, and especially Norway could serve as a

green battery for continental Europe.

1.2 Renewable energy (RE) potential in Norway

Norway has the largest energy generation capacity in Europe from hydropower (96%) rest of the energy is generated from wind power and thermal power (Ministry of Petroleum and Energy, 2016). As of January 2014, Norwegian annual hydropower production was 131.4 TWh. NVE data show that there is a potential of producing an extra 31.5 TWh, excluding the production capacity from the restricted areas (Seljom & Tomasgard, 2017). The cancellation of restriction of these sectors could lead to an increase of hydropower production capacity to 80 TWh (Seljom & Tomasgard, 2017).

Besides, Norway has an enormous potential of untapped wind power resources with the possibility of 76 TWh, 2.6 times higher than its neighbour Denmark (Buen, 2006). Norway is connected externally to Sweden, Finland, Denmark, Finland, Russia and the Netherlands through electric power grids (Seljom & Tomasgard, 2017). NordLink and NorGer are the two proposed electrical cables connections between Norway and Germany (Gullberg, Ohlhorst, & Schreurs, 2014). This concept of a cross-border electric power grids is further backed by signing the green certificate agreement between Norway and Sweden in 2012 (Gullberg et al., 2014).

The scenario mentioned above shows that European countries have high expectation from Norwegian flexible hydropower production. Further, findings by Seljom & Tomasgard (2017) show that Norway along with Sweden is capable of integrating the intermittent electricity to the flexible/dispensable hydropower electric grid production.

On the other hand, Norwegian solar photovoltaics (PV) manufacturing industry has performed well in the past decade which was able to capture 10-20% of market share in various segments of upstream productions. Norway was the world's top producers of solar silicon cells and modules. Much of the effort has been put on R&D activities and other upstream processes rather than on deployment (Klitkou & Godoe, 2013).

Economic figures show that, as of 2014, the global PV market had an estimated value of 600 billion NOK of which Norwegian PV export accounted for only 0.3% (2-2.3 billion NOK) (Normann & Hanson, 2015). The upstream industry for silicon-based solar PV is at the European forefront of quality and innovation. A large amount of R&D funds has been allocated to this sector (Åm, 2015). Some researchers also argue that if technological improvement is not essential then including this area in the energy strategy becomes a political question. Thus, the Norwegian PV arena motivates towards improving energy

efficiency (Åm, 2015). Incorporating solar energy in district heating both on a large and small scale in combination with natural gas boilers is also one of the significant development in solar PV in Norway (Modi, Bühler, Andreassen, & Haglind, 2017).

From the scenario mentioned above, Norway has a huge potential in serving the European market via the wind and hydro power. Despite its unfavourable geo-climatic conditions regarding solar energy, more effort is given to solar research and development (R&D) activities. Upstream solar activities in Norway are recognized as one of the six major priority areas for development of renewable energy sector (Energi21, 2015). Norway is seen as the global leader in environment and sustainability (Innovation Norway, n.d.). Furthermore, desire to be a global leader in RE and sustainability is often expressed in some national and international forums, such as Brundtland Report 1983, the Paris agreement (United Nations, 2015), Norwegian ODA support, EEA funding etc. On the other hand, Norway is one of the largest producers and suppliers of hydrocarbon in the energy market. In this paradoxical scenario, Norway's desire to be pioneer in RE and sustainability remains questionable for many international stakeholders.

1.3 Purpose and Research Question

To understand Norway's stand, it is essential to analyse the activities of real actors operating in Norwegian RE sector. The activities of domestic stakeholders could provide a clear picture of Norwegian policy and sustainability concern. Their effort to innovation, sustainability and production efficiency in RE sector has barely been discussed in academia. As an attempt to fill this research gap, our study will explore the R&D activities, sustainability and efficiency concern of the stakeholders within RE sector, and balancing the power via energy mix by content analysis of job ads. Therefore, the following research questions are proposed.

How are R&D activities carried out in Norwegian Renewable energy sector?

Norway has developed effective policies and management system for efficient production of renewables. Policies are more focused on improved production through intensive R&D rather than on immature market penetration with subsidies. So, it is desirable to explore;

- a) What is the mode of R&D commonly practised in RE sector?
- b) Which is RE sector more prioritised for R&D?
- c) What role does subsidies play in R&D?

How the sustainability, efficiency and energy mix concerned are reflected by the RE companies?

- a) What is the relation between sustainability concern and balancing power?

- b) What is the relation between energy efficiency concern and balancing power?

Why RE stakeholders are involved in two or more RE sectors?

- a) What influences the RE companies to be in two or more types of RE production
- b) What is the most appropriate energy mix in Norwegian RE sector?

The existing literatures will be explored to propose the hypothesis based on the above research questions. By analysing the content of job ads and expert interviews in this area, their concern in RE and sustainability will be explored. The findings will be helpful in evaluating the applicability of policy instruments and contribute to solve social and environmental problems and at the same time be economically self-sustaining.

1.4 Disposition

This thesis report is organised as follows: The first part presented above is the introductory section that highlights the evolution RE sector, its current status, challenges and opportunities in Norway. The rationale, research questions and disposition are also presented in this section. The literature review is presented in second part of the report. It highlights the key points on governance of renewable energy in Norway, as well as R&D efforts, sustainability and efficiency concerns related to sustainable development of the RE sector. The third section describes the methodology, the research design adopted to conduct the research activities and pros and cons associated with chosen research methods. The methodology section is followed by the result and discussion section, which highlights the key findings of the research and presents the discussion regarding the implications for the RE sector. Limitations, recommendations, conclusion and references are presented in the final section of the report. Appendix is presented at the last part of the document which includes, List of research centres in Norway, interview guide, interview questions, SPSS output tables, and interview coding sheet.

2 LITERATURE REVIEW

2.1 Renewable Energy

Lund (2014) defines renewable energy as, "energy that is produced by natural resources such as sunlight, rain, wind, waves, tides, and geothermal heat that are naturally replenished within the span of few years". According to Lund (2014) renewable energy system deals with energy conversion (from natural resources to electricity/heat or electricity to hydrogen) and energy storage in different forms. Renewable energy is interchangeably used with the term sustainable energy. Lund (2014) argues that all renewable resources may not prove to be sustainable, e.g. biomass. On the other hand, nuclear and use of fossil fuel combined with Carbon Capture and Storage (CCS) may be regarded as sustainable but not renewable (Lund, 2014). He emphasizes three main political reasons that helped the commercial revolution of the renewable energy sector; energy security, economics and environment & development (Lund, 2014).

Ellabban, Abu-Rub, & Blaabjerg, (2014) defines renewable energy as the type of energy that is gathered from renewable resources, which are naturally granted to life on earth, such as sunlight, wind, rain, tides, waves, and geothermal heat. The renewable energy often provides energy in four different areas, power sector, heating and cooling sector, the transportation sector, and rural (off-grid) energy services (Ahmed et al., 2010) The renewable energy does not combine energy resources derived from non-renewable energy, waste products from fossil sources, or waste products from inorganic sources (Ellabban et al., 2014). Fig. 1 shows an overview of renewables.

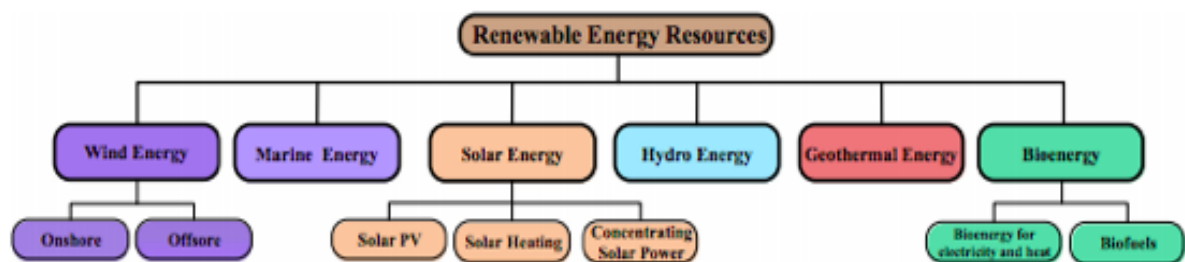


Figure 1 Overview of renewable energy resources Source:(Ellabban et al., 2014)

Though renewable energy resources are universally available, they are not universally applicable. These resources are widely distributed in nature thus they are produced in dispersed location based on the suitability and are expensive to concentrate. In contrast, brown energy is concentrated in nature and are costly to distribute (Twidell & Weir, 2015).

The renewable energy markets such as in power generation, heating and cooling and transportation have been growing sharply over the last five years. The implementation of established technologies, such as hydro, and newer technologies such as the wind and solar photovoltaic, has seen rapid growth, which has increased confidence in the technologies, clean environment, reduced costs, public health and opened new business opportunities (Ellabban et al., 2014).

2.2 RE production in Norway

In comparison to other countries across the globe, Norway is uniquely resourced with primary energy resources (Christiansen, 2002). It is a large producer of renewable energy where 98% of electricity generation is from renewable energy resources. As per Ministry of Petroleum and Energy, (2016) the data of 2013, hydropower accounts for 96.2% (129 TWh) of power generation followed by thermal 2.4% (3.3 TWh) and wind power 1.4% (1.9TWh).

Norway has set its ambitious target of increasing its overall renewable energy share in its energy mix to 67.5%, 10% in the transportation sector and 43% in heating and cooling. These targets are achievable and are supported by Norwegian renewable energy action plan of 2012 (Aarrestad & Hatlen, 2015).

2.3 Governance of RE production in Norway

Norway has actively developed policies and management systems that focus on efficient production and transmission of renewables. Norway is not only rich with petroleum, but also in renewables, 134 GWh of renewable energy is produced annually (SSB, 2015). It is a major importer and exporter of renewable energy, 10 and 15 GWh respectively (SSB, 2015). The share of electricity produced from renewables, mainly from hydropower, has varied between 95 and 98% for the last decades. According to Gullberg et al. (2014), Norway still has much-specialized potential to additional development of hydro and wind power. However, the scope of further development is minimum regarding the coverage of domestic electricity demand as the sector is already based on hydropower, and thus produces almost zero emissions. The development would mainly be for energy trade even though some renewable energy could be used to replace fossil fuels in the offshore petroleum sector, the road transport sector and for heating. Norway also plans to increase renewable energy consumption in these sectors. The focus of Norway's climate policy is more on global cooperation to reduce emissions overseas than on a further large-scale build-up of renewable infrastructure domestically (Gullberg et al., 2014).

According to Ministry of Petroleum and Energy, (2012) a common Norwegian-Swedish certificate market for renewable electricity production was established in 2012, with overall target for 26.4 TWh new renewable electricity production by the year 2020. The certificate scheme is an important measure in the strategy to reach Norway's national energy target, which is 67.5 % renewable energy by 2020 (IEA, 2015). The electricity certificate scheme implemented between two neighbouring countries is considered as the main policy instrument for the growth of renewable energy production in Norway (Klessmann et al., 2014).

As mentioned before, the Norwegian electricity production is entirely based on hydropower and its government has also emphasized an enormous potential for development of wind sector both on onshore and offshore, tidal, geothermal, as well as the production of bio-energy (Ministry of Petroleum and Energy, 2016). It is often said that Norway is poor in solar energy resources, but they are the world's top producers of solar silicon cells and modules. Norway has put much of its effort on R&D activities and other upstream processes rather than on deployment. Emphasizing possibility of solar energy, Associate professor at Norwegian University of Life Science UMB, claims that "The Nordic countries are well-suited to Solar Energy" (Christensen, 2012).

Norway is fuelling the globe with non-renewable hydrocarbons, at the same time it claims as one of the most renewable nations. This irony may raise some questions regarding RE governance in Norway (Michalena & Hills, 2013). Despite its potential of producing 20 times more energy needs, the wind power production lie around 2% of hydropower production and 1.4% of total RE (Ekra, 2014). It has been estimated that Norway has a technical potential for 76 TWh wind power production annually which is 2.5 times higher than that of Denmark 29 TWh (Buen, 2006). Besides, Norway is the fifth largest country in Europe, and its coastline and onshore topological conditions are expressed to be one of the best in Europe for harvesting wind energy potential.

Despite this fact, the Norwegian MNCs and energy giants are investing abroad (for example Statkraft in Sweden, Scotland, Germany, UK (Statkraft, 2012), Statoil in UK and USA (Kaufman, 2016). More than 15 countries in Europe have the greater share of wind power in their energy supply than Norway. It is often claimed that Norway is less attractive investment market due to lower electricity prices. However, Sørensen (2008) argue that the electricity price that was far below the European averages is now reaching the same level due to market liberalization. The tax benefits and subsidies are other factors that attract Norwegian energy giants to invest in the foreign market.

2.4 Opportunity for Norway in European power transition

The European Commission has set the target to meet its renewable energy generation share to 20% of EU consumption by 2020 and to 27% by 2030 (CEER, 2015). To meet the RE generation target, European countries are shifting their focus from traditional fossil fuels to RE. Denmark wants to replace its coal power plants with wind power, Sweden willing to replace its nuclear plants with wind power plants by 2020, Germany wants to close nuclear plants and the fossil fuel plants. Similarly, UK has planned to close its coal and gas plants to replace it with renewables. The targeted changes in energy system in European countries for the period of 2020 to 2050 has posed new challenges and possibilities to Norwegian energy system. Therefore, Norway has an enormous potential of contributing their energy transition in addition to changes in domestic energy market (Gabrielsen & Grue, 2012).

2.5 Norway as green battery during the RE transition

After 2009, the concept of green battery was first evolved and gained its momentum within few years. Now, it has been a hot topic of discussion. The European and Norwegian policy makers interpret this concept differently. The European countries emphasize pumped storage of hydropower in Norway by utilizing excess wind power from Europe, while Norwegian policymakers and stakeholders perceive this concept as an opportunity to contribute with balancing power. The various assumptions and scenarios are anticipated regarding the green battery concept. The balanced power, pumped hydropower storage, renewable energy export & production and pumped hydropower production for domestic purpose are the four different scenarios. Among these assumptions and scenarios, Gullberg, (2013) argues that RE export has its root to post-petroleum era. Therefore, a large-scale production and export of renewable energy which will take over the income source and employments provided by petroleum export as the Norwegian petroleum era ends.

The EU transition to renewables gives Norway a historic opportunity, challenges and responsibility. According to Gullberg, (2013) and Statkraft (n.d.), Norway possess 50% of Europe's entire storage capacity. Therefore, Norway has the potential to secure its strategic position in European energy market even after the demise of petroleum era (Piria & Junge, 2013).

According to Brown (2015) Norwegian hydraulic engineers are planning to use their surplus wind and solar power to boost their hydropower production which can be a potential source of electricity supply to European countries during their energy transition. Without building new hydropower plants, a well-designed mix of existing hydropower plants, solar and wind energy

could boost European supply, thus helping them to avoid instant to shift to fossil fuel to manage their transition.

As a member of the European Economic Area (EEA), Norway is committed to increasing its share of renewables in the energy mix. The nation is expected to continue to be a net electricity exporter as its electricity consumption is balanced while electricity production is increased. The country exports hydropower to the Netherlands, via NorNed (Jorge & Hertwich, 2013) and exchanges renewables with Sweden and Finland. There are plans for similar green trade with Germany, NordLink and NorGer interconnectors (Gullberg et al., 2014) and the United Kingdom NSN Link (Adomaitis, 2016) within the next five years. Norway imports Denmark's excess wind-generated power and sends hydro-generated electricity back when the wind isn't blowing, thus allowing Denmark to rely on renewables for about 40 percent of its electricity needs.

Norway has considerable electricity interconnection with other Northern European countries. The electricity interconnection capacity between Norway and the European Union is approximately 5.4 GW. According to Gullberg et al. (2014), a good cooperation was established between Germany and Norway towards a low carbon emission future. This collaboration has enhanced the stability in German electricity system and made many Germany stakeholders interested in renewable energy cooperation with Norway.

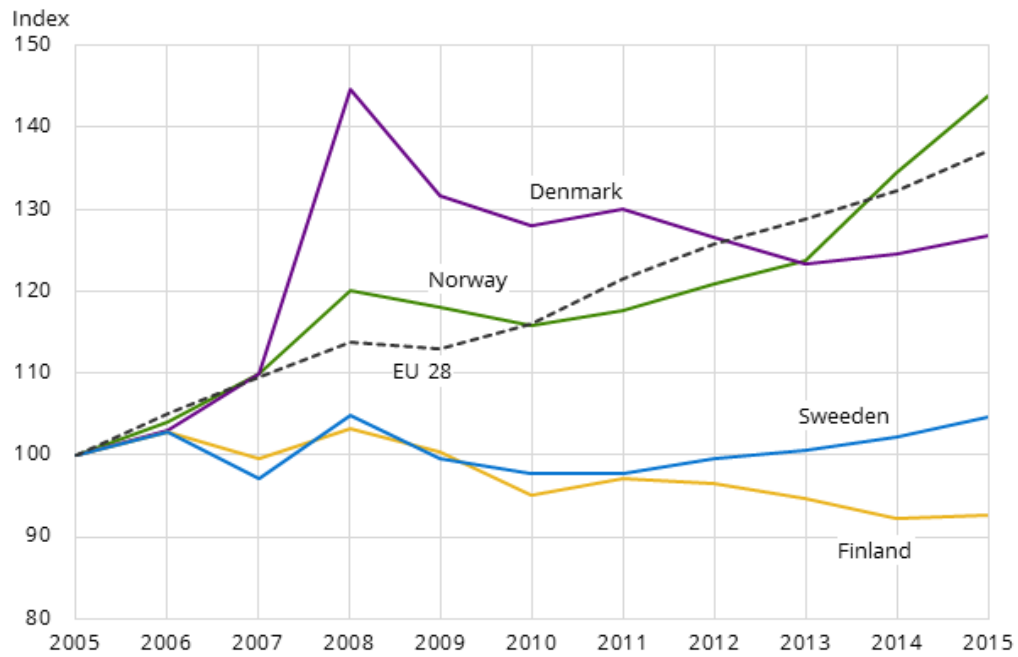
2.6 R&D in Norwegian RE sectors

Not all the technologies that are efficient are under use; they become efficient after they are adopted (Arthur, 1989). By this argument, Arthur (1989) tried to explain that learning by doing or learning by using process could help to obtain the optimum performance of any technological processes. The trade in tariff, green certificates, competitive bidding, quotas are some incentives given by governments to the renewable energy. Whatever may be the type of incentive, the role of public authorities is ultimately directed to stimulate the technological progress, to speed up the learning process and to leverage the renewable energy technologies to the competitive level with conventional energy. Therefore, the incentives are required for the progress of learning curves and finally the dynamic process of ultimate performance (Menanteau, Finon, & Marie-Laure, 2003).

The RE supplies are hindered by natural barriers (topography) or human-made barriers (improper orientation of buildings). The technological innovations are important factors for dissolving these barriers and lowering the costs. The government policies either address these barriers by the trade in tariff, green certificates, environment tax policies or via supporting the

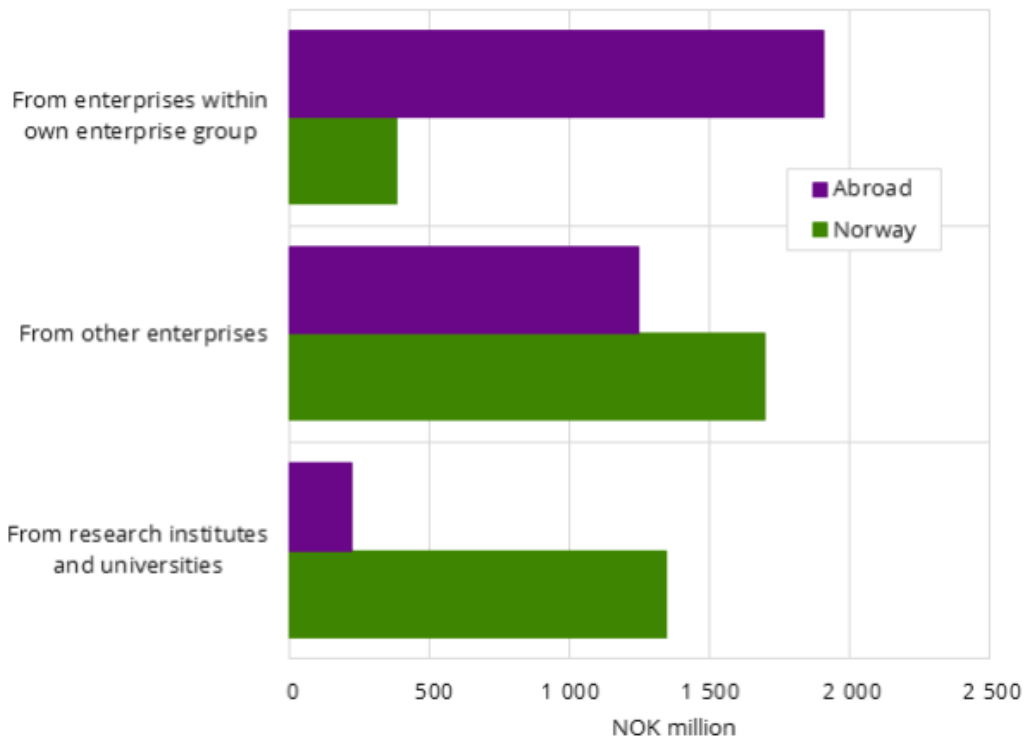
technological innovation which helps in lowering the cost. A study by Verbruggen, et al., (2010) on RE costs and barriers has shown that R&D activities are essential for reducing the energy cost to a certain level. Along with R&D activities, other economic motivations could prove effective for market penetration and establishment of technologies and thus to harvest the benefit.

The research centres act as driving force increase the efforts in areas where Norway can make a difference due to resources, industry and competence. These centres also provide a platform for taking R&D results to the market. The Norwegian R&D institutes aim for a more attractive partner for international collaboration. Over the last decade, there has been a tremendous increase in growth of R&D activities in Norway (SSB, 2015). This increment is higher in comparison to EU and other Nordic countries. The research institutes give a high priority in international collaboration to strengthen research quality, develop knowledge for solving global challenges and creating value for the industry. The nation has also increased its budgets for vital energy R&D programs and willing to support projects with international collaboration. As a common practice, R&D in innovation clusters happens in collaboration with country's leading industries, research institutes and universities. As per SSB (2015), most of the public R&D funding in Norway is directed through the Research Council of Norway, but the recent trend shows that funding from SkatteFUNN is more extensive of R&D for the business enterprise sector. According to (SSB, 2017), with 27.8 billion NOK, the business enterprise sector contributed to almost half of the NOK 60.3 billion spent on total R&D. This represents 1.9 percent of GDP.



Source: Eurostat

Figure 2 Comparison of R&D activities over the years within Nordic Countries (Source; SSB,2017)



Source: Statistics Norway

Figure 3 R&D expenditure in Norway, 2015 (Source: SSB, 2017)

2.6.1 CEER mode of R&D in RE sector

In 2008, the climate policy agreement was signed. The concerned parties agreed on promoting

RE resources as one of the major gateways towards the reduction of GHG emission. It is also evident from Norway's national R&D strategy on the energy sector (Energi21) that the nation has a potential to export both environment-friendly energy as well as energy-related technology. Thus, the Centre for Environment-friendly Energy Research (CEER) was established to achieve this objective (Vie, 2012). The CEER focuses more on transdisciplinary research which combines academic research with the application context. The mode of R&D is directed towards promoting cooperation between research communities and innovative users to enhance innovation and value creation (Vie, 2012). The major research partners in renewable sector in Norway are enclosed in table form in Appendix- 1.

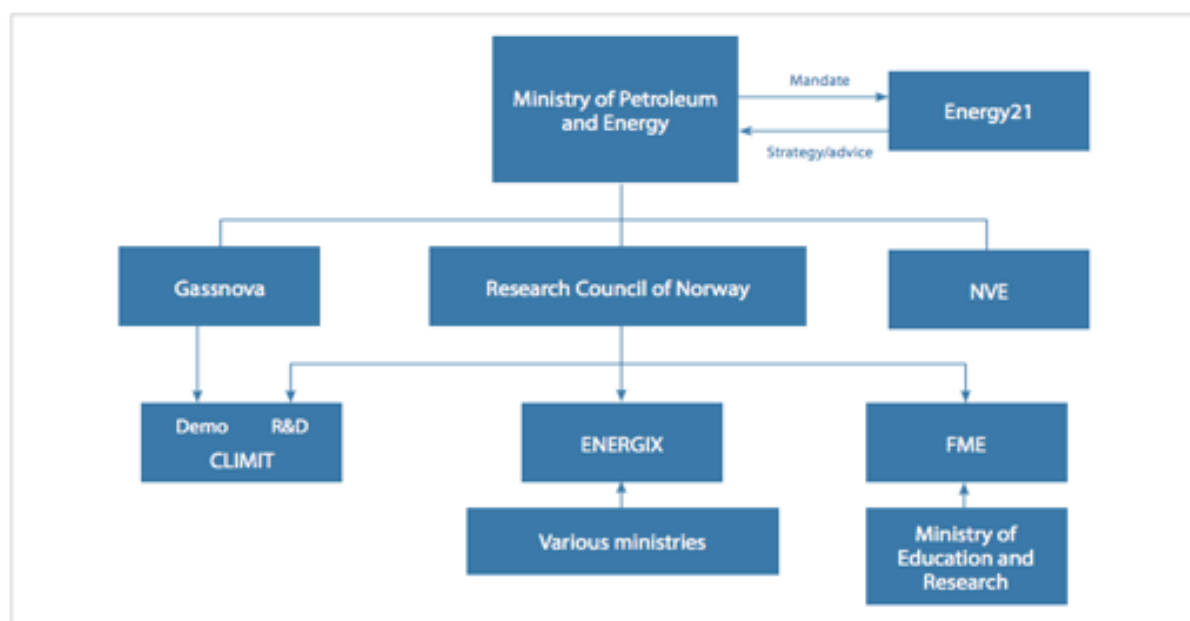


Figure 4 Organizational structure for energy research in Norway (Source: Ministry of Petroleum and energy, 2014)

2.6.2 R&D support to firms in Norway

A strong relation between investments in research and economic growth is often taken for granted, and regarding R&D grants many countries will have clear and ambitious goals. The involvement of government plays an important role in achieving such goals. The public R&D programs are designed to support commercial R&D projects with large expected social benefits but with low expected returns to private investors (Klette, Møen, & Griliches, 2000). The Hervik commission was introduced in a green paper for the Ministry of Trade and Industry which suggested the application of R&D tax credit to stimulate investments in R&D (Haegeland & Møen, 2007; Cappelen et. al, 2010). The tax incentives have become an increasingly popular policy tool over the last decades, and many countries now use the tax system to increase R&D in industry (Cappelen et al., 2010).

Norway has been the first Nordic country to introduce R&D tax credits where R&D subsidies can be given as R&D tax credits or as direct grants (Cappelen et al., 2010). There are mainly two types of R&D programs in Norway. These programs subsidize various kinds of private projects according to the phases in the project cycle. The first type of technology program supports companies with projects "far from the market" such as research activities, and the second type of R&D program supports companies with less uncertain projects "close to the market" such as development activities (Clausen, 2009).

The Norwegian General Tax Act includes regulations regarding tax allowances known as SkatteFUNN to support R&D projects (Haegeland & Møen, 2007). The SkatteFUNN R&D tax incentive scheme is a government program designed to stimulate R&D in Norwegian trade and industry. In the SkatteFUNN scheme, any business firms involved with R&D activities are eligible to apply to Research Council for the support for their projects. These R&D projects which applied under the SkatteFUNN scheme mainly focused at gaining new knowledge and develop the company in improvising the goods and services. The support for R&D projects is granted in the form of a tax deduction. The SkatteFUNN R&D tax incentive scheme is open to all companies. It is a scheme that provides a tax benefit for the costs related to a specified project. The main objective of SkatteFUNN is to encourage R&D companies to use development and research as a strategic tool to enhance innovation and competitiveness (NVE, Enova, Innovation Norway, 2007)

2.6.3 Importance of R&D over subsidies

According to Frondel, Ritter, Schmidt, & Vance, (2010) feed in tariff scheme in German renewable energy policy has failed to introduce the viable and cost effective introduction of the renewable energy in the country's energy industry. These findings are in line with Neij's (1997) findings. Large subsidies granted for technological advancement in RE especially in solar PV cells are far behind the theoretically estimated value (Frondel et al., 2010). During the period of 25 years (from 1975 to 2001) the efficiency of PV cells has increased to 25% while the commercial potential has changed from 5% to 15%. This suggests that increasing R&D effort could be beneficial rather than heavily investing in immature PV market penetration. From the economic perspective, R&D funding could bring positive outcome than by subsidising the immature PV technology to penetrate the market (Nemet, 2006). According to him, technological efficiency is the most important factor affecting the cost of RE. Though the premature market penetration triggers the learning by doing effect in RE deployment, these factors do not significantly increase module efficiency (Nemet, 2006).

Therefore, non-competitive technologies that are in early stage of development, investing in R&D funding is more cost effective than promoting the deployment, production and distribution on large scale (Fronzel et al., 2010). In addition, trade certificates could be other effective government intervention to harness the market failure. The Norwegian RE policy is in line with these arguments where the government is funding heavily on R&D activities rather than subsidizing the non-competitive technologies to penetrate the deregulated energy market. The CEER module of renewable energy R&D is directed towards translating the lab based energy efficiency to a commercial one.

On the other hand, Norwegian PV innovation system lacks the user-producer interaction which is essential for innovation activities. The policy focus mainly on R&D and funding part and less on market development and deployment activities resulted in shutdown of many upstream PV companies. In this case, Klitkou & Coenen (2013) suggested that policy should be directed towards market development and deployment activities rather than only on the supply side (funding of R&D). They recommend the policy change towards the producer-user interaction. Along with R&D, the market development and producer-user interaction have been important drivers for the development of the industry in other countries (Fronzel et al., 2010).

Hydropower dominance is a major barrier for the adoption of public schemes and conducive policy for other renewables including solar PV. Klitkou & Coenen (2013) argue that it is not sufficient for Norwegian policy to remain supply oriented via R&D funding to retain the know how developed in past years. The market development and support schemes are essential to facilitate the producer-user interaction.

2.6.4 R&D activities and carbon leak

Norway has a huge potential to serve as a green battery during the European energy transition (Gullberg, 2013). At the same time, Norwegian Labour Organisations pointed out the possibility of carbon leak if the strict environment-friendly national measures are applied to higher electricity prices. This would have a considerable human and economic cost for Norway. To overcome the challenge of carbon leak, it is essential to have production side innovation.

It is considered that the renewable energy subsidies are necessary policy instruments for combating climate change. However, international legal provisions are not designed to accommodate the subsidies. Therefore, one countries unfair subsidies policy harm the other nations trade environment. In the case of Norway, RE race is to provide the continuous green

energy supply to rest of the Europe. Therefore, technological advancement in RE production and supply of energy in lower possible price can easily overcome the subsidy and FIT issues. (Farah & Cima, 2015).

2.7 Sustainability concern RE sector

"Sustainable Development stands for meeting the needs of present generations without jeopardizing the ability of futures generations to meet their needs – in other words, a better quality of life for everyone, now and for generations to come. It offers a vision of progress that integrates immediate and longer-term objectives, local and global action, and regards social, economic and environmental issues as inseparable and interdependent components of human progress." (European Commission,2010).

Sustainable development is defined as *"a development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (World Commission on Environment, 1987).

Renewable energy resources such as wind, hydro, solar and biomass are core to the sustainable development and are considered as most effective and efficient solution (Dincer, 2000). A secure supply of energy is necessary but not sufficient requirement for advancement in societal development. For the sustainable development of the society reliable energy source should also be sustainable, reasonable cost without leaving an adverse impact on the community.

According to Dincer, (2000) sustainability of renewable energy can be justified by three major characteristics; namely, net zero environmental impact; reliable and indefinite supply; and decentralized, locally applicable and independent of the national network. Similar views were expressed by Bonini & Gorner (2011), sustainability is determined by three different parameters; environmental, social and economic sustainability. The highly-sustainable organizations were characterized by a governance structure that directly and explicitly considered environmental, economic and social performance of the company.

In a similar research, Eccles, Ioannou, & Serafeim (2012) found that highly sustainable companies pay attention in building a relationship with stakeholders, namely; employees, customers, NGOs, etc. In the energy sector, GHG emission is increasingly considered as the key parameters to measure sustainability in addition to costs, payback period and social aspects of RE generation.

2.7.1 Nature of RE and sustainability

The energy market is a unique field where the supply and demand should match at every moment. A secure and continuous supply of energy is essential for the sustainability of renewable energy sector (Bonini & Gerner, 2011; Dincer, 2000). The wind and solar are of intermittent nature whose output cannot be increased as per the demand. However, hydropower, biomass, geothermal energy and fossil fuels can be regulated as per the demand. Due to the growth in the subsidies and RE mandates, costs are declining, but they are still not in a competitive position with fossil fuels in all locations. The cost-effectiveness of RE is an active development, but Ritchie (2017) argue that the trend may reverse with increased role of Variable Renewable energy (VRE). VRE are non-dispatchable, they are not under the control of the operator. To ensure a secure supply, the electricity system must be able to accommodate the load as per demand. In this regard, Ritchie, (2017), emphasized that intermittent nature of VRE makes them more costly. A similar opinion is expressed by Tverberg, (2016) even if the VRE capital investment is not considered, the addition of these sources to the major electric grid is problematic unless an innovative electricity storage devices are introduced. Steve Kean, an energy expert from a pipeline company, has also shared the similar view regarding the intermittent nature of VRE. Borrowing the words of Steve Kean, Tverberg, (2016) in his article has mentioned that 100% renewable generation is not feasible in the absence of transformative innovation in this field.

Until recently, the cost of electricity generation is calculated in dollars per megawatt hour which includes capital cost, operation and maintenance costs and fuel costs. The network upgrade, integration and transmission are not considered, and these factors are much higher for VRE such as wind and solar. With the increase in the share of VRE in the total electricity supply the above factors should be considered. Ritchie (2017) also suggest a possible solution in this regard stating; the intermittency can be dealt by diversification, redundancy, storage and demand shifting. All these strategies require high cost which is the integration cost for the VRE. Furthermore, it must be balanced by other non-variable or dispatchable energy resources.

Therefore, energy diversity/energy mix can be the solution for intermittency (Timmons, Harris, & Roach, 2014). Even if European countries develop solar and wind power, the balance must be maintained by the stable source. In Norwegian context, the integration cost could be low because of abundant of geothermal and hydropower in a suitable location which is essential in lowering the integration cost (Ritchie, 2017). Therefore, Norwegian energy sector can assure the stable, uniform, secure and sustainable power supply via energy mix.

2.7.2 Energy Mix and sustainability

Across the globe, many countries are using available energy in different proportions to meet their energy needs is term as energy mix. Although, it varies significantly from one country to another depends on their available resources. These primary energy sources are used to generate electricity, provide fuel for transportation, and cooling and heating residential and industrial buildings. For any region or country, the design of energy mix depends on the availability of usable resources in that territory. The design is determined by various factors such as demand, policy, economy geopolitics, and many other socio-environmental factors. (Planete energies, 2015).

There is a worldwide discussion that we need a mixture of sources and technologies to supply energy for human production and consumption. However, no agreement has been made about the specific energy mix till date. Indeed, it is still unclear what type of energy mix would be the choice for greater energy efficiency and sustainable development. Over the last decade, the energy consumption has grown steadily, at the same time the energy production has also increased to meet the growing demand. According to European Union (EU) member states, with the development and promotion of renewable energy mix, we can solve the challenge of endangered security of supply due to high-energy dependency on fossil fuel imports, sustainable development and environment protection.

While studying Denmark as a case, Lund (2014) found that a 100% renewable energy supply is possible with a combination of renewable energy. The energy mix of different resources would be a solution to the large-scale integration of fluctuating renewable energy resources. This measure is to be seen in combination with other measures such as investment in flexible energy supply and demand systems and the integration of transport sector. This will address the challenge of designing integrated regulation strategies of a complex system of distributed power producers. The renewable energy sources must interact with the rest of the production units in the system to make it possible for the system to secure a balance between supply and demand. To avail the renewable energy technologies and their limitations in energy production an energy mix would be an optimal solution.

2.8 Energy Efficiency

Clough, (1999) defines economic efficiency as maximising outputs obtainable from a given set of inputs, or minimising inputs required to obtain a given set of outputs. The economic efficiency of renewable energy reflects two different scenarios. First, production of desired

output at lowest possible costs along with the geographical and technological limitations. Second, allocating existing knowledge and service to offer high valued service to the buyer. The efficiency of renewable energy network can be applied to different stages across the value chain from power generation, transmission, distribution to final consumption (Abolhosseini, Heshmati, & Altmann, 2014).

According to International Energy Association (IEA), (IEA, 2015) energy efficiency is one of the significant energy resources that ensures safe, affordable, reliable, secure and sustainable energy system for future generations. (Rosen, 1995) has argued that discovering of a new resource of renewable energy is not only the way towards sustainability. The efficient use of resources is essential to complement it. He also suggested that efficient use of energy can be achieved through cogeneration to meet the requirement of heat and electricity together. This concept of cogeneration has also been applied for maximising energy efficiency for sustainability (Rosen, 1995).

2.8.1 Norwegian RE and efficiency funding

Norway has significantly raised its Fund for Climate change, Renewable Energy and Energy Conservation to NOK 62.75 billion in 2016 which is more than Norwegian ambition of NOK 50 billion as per the climate agreement. This incremental leap in budget reflects the government's commitment to continue to be a global leader in a green shift. With this increment, Norwegian Government believes that increased fund encourages Norwegian businesses to develop environmentally friendly solutions related to renewable energy and climate technology (Ministry of Climate and Environment, 2014).

In addition to domestic funding on renewable technology, Norway has extended its helping hands across the globe. For the period of 2009-2014, it has provided EEA grant 993.5 million Euro (Norway 95.7%, Iceland 3.2%, Liechtenstein 1.1%) and Norway grants amounting 804.6 million Euro to Bulgaria, Greece, Hungary, Portugal, Romania, Latvia and Poland. For the period of 2014- 2021, EEA and Norway grants of total 2.8 billion Euro has been allocated. These grants are mainly focused on renewable energy, energy efficiency, National Climate strategy, energy saving and promoting renewable energy resources. In addition, the donor country believes that these funding will be helpful in reducing disparities in Europe, strengthen the bilateral relationship and face the shared challenge (EEA Grants - Norway Grants, 2017).

The renewable energy is an integral part of sustainable development and employment creation

in developing countries and least developed countries. The sustainable energy funding to developing world is managed by different organizations such as Norfund, Norad, the Ministry of Foreign Affairs and Norwegian Embassies. In 2015 alone, NOK 806 million was channelled to sustainable energy efforts of which Africa received the largest amount (55%), followed by Asia (18%), Latin America (1%) and other organisations and initiatives (27%). More than half of it was used in generation, transmission, capacity building of renewable energy (UNFCCC, 2016). In addition, the government has entered investment agreement of 2.8 billion on RE and sustainable development in 2016 via Norfund. In its white paper, the Norwegian government has proposed to double its funding for RE sector from NOK 495 million in 2017 to NOK 1 billion in 2019. In 2015, Norwegian ODA exceeded by 0.7% of GNI which reflects strong commitment to green shift as a global leader of sustainability (UNFCCC, 2016). According to Minister of Foreign Affairs Børge Brende, the government will increase the annual allocation to Norfund by 50% by 2021 (Ministry of Forestry, 2017).

2.9 Reflection of sustainability on RE job ads.

Many of the green jobs are at the heart of renewable energy technology. Norway, Denmark and Switzerland are the leading countries in green jobs. According to the Colijn (2014), only 3.25% of the jobs in EU are green. Thus, Colijn (2014) concludes that EU is in its very early stage of socio-ecological transition where Norway, Denmark and Switzerland are the leaders with sustainable component mentioned in their job ads. This suggests that the notion of sustainability in labour market is higher in these three countries while rest of the Europe is lagging.

However, in an analysis of green and non-green jobs, Norway is a green economy leader where 6% of the jobs are green, and 9% of the jobs are near the green. Thus, accounting 15% of employment advertisement reflect the sustainability concern. Thus, Norway is the leader in green job creation (Colijn, 2014). His findings showed the positive correlation between country's income per capita and generation of RE jobs. Denmark tops the list in increasing energy efficiency in its economy while Norway along with the Netherlands and Ireland underperform.

Colijn (2014) claims the fact might have occurred because of "Dutch disease" effect. This effect could be due to the exploitation of fossil fuel, or the difference might be due to the individual government policies on subsidies.

2.10 Job Advertisements and employer branding

Companies have significantly changed their design of recruitment advertisement strategy. As there is an increasing concern of the public and higher demand for corporate social responsibility, the advertisement design has changed to reflect the corporate image. Therefore, it is often opined that corporate image can be influential in attracting the suitable employee. Well-designed recruitment ads may influence the business image. As (Paddison, 1990) explains recruitment advertising as a part of corporate communication to the rest of the world which may have a significant effect on public perception towards the company. Similar is the view expressed by (Martin, 1987). He asserts that the recruitment ads can serve as the company's CV and the cover letter to the stakeholders (Ryan, Gubern, & Rodriguez, 2000).

The sustainable development issue must be integrated into the recruitment process to induce the new recruits in the corporate environmental culture. For this purpose, company's website in addition to company's job description should reflect the sustainability agenda. As a green employer, it may improve the company branding and be helpful in attracting the potential employees. In fact, becoming a green company can enhance employer branding and be a useful way to attract potential employees. According to the survey by British carbon trust on 1018 employees, 75% of considering that the firm should have greener policies (del Brío, Fernandez, & Junquera, 2007). Similar research by CIPD/KPMG on HR professionals found that 47% of HR feel that employee more green and sustainable policy whereas 46% stated that company's sustainability concern helps in attracting the potential employees.

An empirical study by (Wiedmann, 2005) in German energy market showed that differentiated branding could be helpful to escape the price pressure in energy market which emerged due to the liberalisation of the energy sector. Therefore, R&D concern, sustainability concern and efficiency concern of renewable energy company could be helpful in developing their unique brand and thus can be useful in retaining the customers and escaping from the price pressure due to liberalisation.

In the power industry, the final product is not a visible and familiar entity as compared to other sectors. Thus, the end product may not be the means for communicating CSR to its consumers. In such condition, communicating their green values, efficiency concern and sustainability concern through job advertisements could also strengthen the corporate branding (Heilmann, Saarenketo, & Liikkanen, 2013).

Therefore, job advertisements could be one possible way of communicating their CSR to the public. The CSR concern also reflects their reaction towards public pressure for sustainability.

3 HYPOTHESES

3.1 R&D activities within Norwegian RE sector

The Knowledge is key to value creation, competitive positioning and sustainable development of any firm. In the field of energy technology, R&D activities are central to know how creation. The universities, academic institutes, research institutes, companies are involved in the process of knowledge creation where society plays a vital role to give the commercial shape to the innovation (Vie, 2012). Traditional Mode 1 approach of research focuses on academic research and focuses on generating knowledge and filling the knowledge gap. The mode 1 research is purely theoretical where the research scientists and their host institutes have a dominant position (Novotny, Scott, & Gibbons, 2003). Similarly, the mode 2 approach focuses on R&D on application context. According to Novotny et al., (2003) knowledge generation in Mode 2 is socially distributed, transdisciplinary and application oriented. However, the Norwegian Research Council encourages CEER to work in the context of an application while including industrial, academic, research partners and public entities as active partners (Vie, 2012).

In the field of renewable energy, CEER aims to strengthen the relation between research communities and its social science aspects. From this objective, it is observed that Norway has adopted its own mode of R&D, a mixed type between Mode 1 and 2 which is labelled the Norwegian CEER mode (Vie, 2012). Therefore, we propose that:

Hypothesis 1a

The CEER mode of R&D activities is reflected in job advertisements.

3.2 Energy efficiency concern and R&D activities in the solar energy sector

Solar energy as a part of Norwegian renewable energy politics seems like a paradox because of the country's geo-climatic position. It is one of the six major focus areas as mentioned in the Energi 21 ambition put forward by the Norwegian Government (Energi21, 2014). The economic figures show that, as of 2014, global PV market had an estimated value of 600 billion NOK, of which Norwegian PV export accounts for only 0.3% (2-2.3 billion NOK). The upstream industry for silicon-based solar PV is at the European forefront in terms of quality and innovation. A large amount of R&D funds has been allocated to this sector; however, no support has been directed towards PV deployment (Åm, 2015).

Over the past few decades, Norway has developed its competence in R&D activities within the solar energy sector. A wide range of expertise has been developed in material and material

processing within solar PV. This competence base provides a platform for developing a new solar power industry despite its unattractive home market. A sound R&D environment has been one of the supporting pillars for this industry to flourish (Klitkou & Godoe, 2013).

Based on this competence, new business models have been developed, new spin-offs have been created, and new initiatives are taken. The concept of zero energy buildings, energy plus standard has increased the demand for localized energy production. This, in turn, sought for more energy efficient conversion capacity in PV cells. It is often argued that solar scientists are engaged in translation activities fought against, the hegemonic perception of the situation that solar energy is not appropriate for Norway. As some researchers also argue that if technical improvement is not essential then including this area in energy strategy becomes the political question. Thus, Norwegian PV arena is motivated towards improving energy efficiency. The efficiency in solar is intertwined with cost efficiency and radiation conversion efficiency. Finally, efficiency is linked towards material improvement, and Norwegian research scientists are involved in this. Despite this R&D inclination towards efficiency concerns, some argue that improving efficiency might be an insufficient strategy for implementing this technology in Norwegian geo-climatic conditions and argue for more radical innovation (Åm, 2015).

From the above arguments, we hypothesize that

Hypothesis 1b

Higher R&D activities are reflected in the solar industry in comparison to other RE industries in their job ads.

3.3 Energy mix VS efficiency and sustainability concern

Regarding the climate policy, the Norwegian government has proposed to reduce the global greenhouse gas (GHG) emission cut by 30% and a carbon neutral Norway by 2050 (Gebremedhin & Granheim, 2012a). It is a challenging task for the government in the present scenario where the electricity system is dominated by renewables which are itself cheap and clean resources. It is dominated by hydropower which is considered to cover almost 97-98% of total electricity demand in Norway. The Renewable energy production remains one of the unattractive investment areas for the investors. The economists argue that there is no need of production of new RE as the demand is met by the existing RE (Karlstrøm & Ryghaug, 2014). Further, Norway has adopted technology-neutral approaches to renewables (Karlstrøm & Ryghaug, 2014). The payback period, net present value (NPV), internal rate of return (IRR) for a variable renewable generation (VRE) are not in favour of investor because of the lack of

subsidies or policy support (Campoccia, Dusonchet, Telaretti, & Zizzo, 2009). The standalone possibility of the wind and solar PV is not yet feasible due to their intermittent nature of electricity generation. Thus, effective and large storage systems need to be discovered. In addition, the minimum value of new green certificate must exceed 75 EUR/MWh for land-based wind power and 180EUR/MWh for offshore wind power at the current level of technology in order to be an attractive investment area (Gebremedhin & Granheim, 2012).

Despite these hurdles, there has been significant progress in RE deployment activities especially in biomass, wind and thermal heating system. In addition, several companies are involved in more than one type of RE resource generation. A mix of renewable energy generation is prevalent. This situation raises the question that the investors are concerned about sustainability and efficient production of RE. Therefore, it is germane to test the association between efficiency and sustainability concern and mixed mode of energy generation. Therefore, we hypothesize that;

Hypothesis 2a

H0: there is no relation between energy mix and sustainability concern by companies expressed in job advertisements

H1: there exists a relation between energy mix and sustainability concern by companies expressed in job advertisements

Hypothesis 2b

H0: there is no relation between energy mix and efficiency concern by companies expressed in job advertisements

H1: there exist relation between energy mix and efficiency concern by companies expressed in job advertisements

3.4 Wind-Hydro industry mix for balancing the power

With the move towards sustainability and green energy, variable renewable generation is increasing. This increases the need for power system flexibility. The different level of variability demands a different level of production flexibility (Kiviluoma, Rinne, & Helistö, 2012). The Hydropower is considered as one of the most flexible sources of electricity production. From the economic perspective, a small-scale hydropower technology is suitable for the private investors operating independently and operating in rural areas. These power plants can serve as standalone energy system for rural power supply. Thus, a small-scale hydropower can serve significantly on energy security and sustainability. In addition, the

Norwegian government has been promoting small scale hydro and wind for the security of energy supply.

The introduction of pumped storage hydropower production increases the production and flexibility and offer the storage of excessive power production from large wind power. Thus stored energy be fed back into the grid and can support the power system during low wind (Cutululis et al., 2012). It has estimated that Norwegian storage capacity is approximately 50% of the total reservoir storage capacity in Europe. It is equivalent to 85 TWh which accounts for about 70% of average Norwegian annual energy production. A study performed by SINTEF has shown that Norwegian pumped hydropower storage capacity is 11.2 GW in a moderate scenario where as 18.2 in the best possible scenario.

A study by, de Boer, Grond, Moll, & Benders (2014) has shown that for large scale energy storage, pumped storage hydropower technique is more efficient and economical in comparison to compressed air energy storage and power to gas storage because flexibility of the system is in decreasing order. Thus, pumped storage hydropower more suited for optimizing the operational cost of the electricity.

Therefore, the Norwegian wind energy potential is high because of the long and windy coast which possess high potential for wind power production. On the other hand, the solar industry is more focused on R&D activities for cost effectiveness and on localized production, saturated and positive energy building business model.

The wind hydro mix has the potential to serve as a green battery for Europe as the percentage of variable generation increases in their energy mix if the grid barriers are solved (Heineman, 2011). The battery concept is equally important at the local level where a single company is involved in hydro and wind type energy production. Furthermore, the Norwegian government support to small hydro (<10 MW) and wind power generation to ensure more energy security provided the private investors to invest more in these two energy sectors.

Therefore, it is hypothesised as

Hypothesis 3

Energy companies involved in the production of RE from wind and hydro are dominant over other mixed modes of energy production.

4 RESEARCH METHODOLOGY

Research Methodology refers to the details that are being adopted for successful completion of research objectives. It is the process of collecting data and analysing it for finding the answers to research questions. The research method is a strategy of the investigation, which moves from the fundamental statements to research design, and data collection (Myers & Avison, 2002). This part gives the overview of the various research approaches as well as different research strategies and method of data collection. (Easterby-Smith, Thorpe, & Lowe, 2002) have pointed out four different types of triangulation viz; data triangulation, methodological triangulation, investigator triangulation and triangulation of theory. For this study, data triangulation is deemed to be applicable. Both qualitative and quantitative data is collected because it helps in reliability and validity of the data (Wilson, 2010). A parallel data gathering approach is made to which helps in comparing the data and have good control through out the analysis.

We choose the mixed method because it provides the opportunity for presenting a greater diversity of divergent views (Tashakkori & Teddlie, 2010). It maximises the strengths and reducing the limitations of single methods (Andrew & Halcomb, 2007). The purpose of mixed methods research is not to substitute either qualitative or quantitative research, but rather to extract the merits and diminish the demerits in both approaches within a single study. It is also important for a researcher to increase the validity of research approach (Creswell, 2012). To be able to conduct our analysis and studies we have relied on a variety of sources, such as academic books, books related to the issues of interest, research papers, scientific journals and first-hand interviews to solve the puzzles of our research questions. This means that both primary and secondary sources have been used.

First, we explain our research approach, research design of both research methods. Later, we address our data collection technique and present our interview guide and interview procedure. We also talk about our sampling, selection criteria and participants in the study. Furthermore, we explain how we deal with collecting, presenting and transcribing the data. Further, the chapter will round off with the merits and demerits of both the methods, validity and reliability of the research collected and resources used and research ethics.

4.1 Quantitative Approach

4.1.1 Sample definition, size and data collection

Recruitment advertisements published in public domain from January 2013 till April 2017 period in Norway within the field of renewable energy sector were the samples for the thesis. The popular job advertising sites such as Finn.no, Indeed.com, Nav.no were used to collect the currently published recruitment ads in the renewable sector. Our intention of including multiple sources of data is to increase the reliability and validity of our research. Furthermore, online resources are the ideal source when the longitudinal data are required (Yin, 2014). The advertisement from past years was obtained from NAV database upon request. Based on the classification of job categories by Statistics Norway (SSB), various codes are given to each job category. However, the renewable energy sector has not been recognised as a specific category within the system of classification. Therefore, job advertisements in the field of energy sector were requested to NAV with the specific codes of our requirement.

4.1.2 NAV job database:

The database includes all the vacancies announced publicly in Norway for all positions that the employer has published (NAV, 2017). The NAV job database follows specific guidelines to ensure the quality of job advertised. All the job advertised via NAV are authentic. Therefore, it serves as a reliable source of our data.

4.1.3 Sample size:

A total of 18,912 job advertisements were obtained, and all of them are related to energy sector. Out of 18,912 only 651 jobs were found to be related to the renewable energy sector.

4.1.4 Unit of analysis.

A brief company description and job description within the RE job announcement in Norway is the unit of analysis for our research.

4.1.5 Data processing and analysis

A total of 651 job advertisements published during 2013 until April 2017 were processed and analysed. A content analysis was applied as a primary tool to generate categorical data from the job ads.

4.1.6 Content Analysis:

According to (Zhao, 2015) content analysis is a primary technique to analyse information from online resources, and from websites. (Miller & Whicker, 1999) view content analysis as a research technique that is used to derive an inference from the already existing recorded text. (Yang & Miller, 2008) mentions that content analysis is the technique to analyse the body of the text where the text act as empirical entities. The elements or the text under analysis may range from words, idioms, sentences, papers or articles or larger forms. The content analysis allows the researchers to interpret and infer the specific message expressed within the body of the text. Similarly, (Holsti, 1969) explain content analysis as the process of making inference in an objective and systematic manner by identifying specific deliveries from the messages. Bowen and Bowen in (Yang & Miller, 2008) argue that this method of research can be used to answer wide varieties of questions ranging from the relation between the variables to the value orientation of the content.

Reliability of Content analysis coding:

(Neuendorf, 2002) suggests that when human coders are used in the content analysis, two coders should be used. The reliability of human coding is often determined using a statistical measure of intercoder reliability or "the amount of agreement or correspondence among two or more coders". The coding process involves classifying and assigning specific content to specific categories. According to Yang & Miller (2008), coding is critically important, and a high degree of minimum requirement for the coherence and accuracy is essential. They have emphasised the reliability to the coding of the content because it involves a high degree of eccentricity and subjective judgement.

According to Krippendorff (2004), reliability is represented by three individual elements namely, stability, reproducibility and accuracy where the author has emphasised on former two elements for content analysis. During the process of coding, each of the codes was defined, and the content analysis was performed individually. The reliability test was later performed by calculating Cohen's Kappa because the nature of data was of nominal type.

$$k = \frac{p_o - p_e}{1 - p_e}$$

Where,

P_o the proportion unit on which coders agree

P_e the proportion of units on which agreement is expected from the coders.

Cohen's Kappa coefficient is a statistic which measure the inter-rater agreement between two or more parties when dealing with quantitative (categorical) data (Yang & Miller, 2008).

4.1.7 Building the database:

The job description and company description were the major units of analysis. A clear understanding of the company type, the area of operation, mode of operation, their concern on efficiency and sustainability was studied. Any missing job description and company details were also obtained from their website. A database was thus created in Microsoft Excel which contains the information of 651 advertisements published in Norway during 2013 to 2017 April.

4.1.8 Statistical Analysis:

As per the nature of data obtained from the job advertisement content analysis. Simple descriptive analysis, cross tabulation and Chi-square test of significance were performed in SPSS 24. In addition, Kappa test for the reliability test of the coding by two coders was also performed. A Kappa test is performed between the coder A&B among these categories, the sustainability concern in company (coder A&B), sustainability concern in job ads (coder A&B), efficiency concern in company (coder A&B) and efficiency concern in job ads (coder A&B). The Cohen's kappa estimates = 0.925 [coder A and B], 0.933 [coder A and B], 0.86 [coder A and B], and 0.926 [coder A and B]. The results calculated from Cohen's kappa averaged between the two coders is 0.9, indicating almost perfect agreement according to the table of Landis & Koch, (1977) and (Yang & Miller, 2008).

4.1.9 Presentation of Findings:

The findings from the research were presented in graphs and tabular form for the clear visualisation of the outcome in result and discussion section.

4.2 Qualitative approach

4.2.1 Sample definition and size

The members of top management team (TMT) of RE companies are the potential samples of this qualitative research. More than 25 different companies operating in the field of diverse renewable energy sector have been approached as a potential sample for this qualitative study. Out of 25, only 6 companies came forward to give us the interview.

Interviews are one of the most common approaches in data collection in qualitative research (Kvale, 2007), (Yin, 2014). The aim of the interview as a method of collecting data was to enable us to use interviews because it allows us to access directly what people are doing and

what is happening in the world (Silverman, 2014) Accordingly, the interviews help us to explore best of the interviewee's perspectives, including emotions, stories, arguments, relationships and connections between incidents, to get a good understanding of stakeholder engagement.

To answer the research questions, we chose to conduct semi-structured interviews. The semi-structured interviews involves a set of pre-planned questions and topics which serve as a guideline (Berg, 2009). We see it as a strength to first let the interviewee tell their stories by answering general questions, e.g. "What kind of renewable energy technologies are available in Norway?" and then to ask tailored follow-ups questions. In this way, the interviewee is not lead in a certain direction which could influence the answers to some extent. A semi-structured interview will allow us to change directions during the interview (Berg, 2009). For instance, if the company is involved with only one energy sector in the process of generating renewable energy, we can ask the interviewee more detailed questions about the reasons to develop our understanding of sustainability and energy efficiency concern. A semi-structured questionnaire along with the well-designed interview guide will further enhance the effort of obtaining valuable information.

A detailed face to face interview with the CEO's, Senior Researcher and Senior Managers of renewable energy companies helped to get the valuable information on R&D activities, R&D funding, mode of R&D, sustainability concern, energy efficiency concern, employer branding, etc.

4.2.2 Selection criteria

We chose judgement sampling because of a limited number of people that have expertise in the area being researched (Deming, 1960). The major setback of using this sampling was the reliability and bias that accompanies with this technique. Unfortunately, there is typically no real way to assess the reliability of the expert. The best way to avoid sampling error brought by the expert is by choosing the best and most experienced person in the field of interest. And in our case, the TMT and Senior Researcher was the optimal choice. We focused on renewable energy companies which have maximum coverage of diversification. First, we choose all the Norwegian renewable businesses that are involved in business entities, which provide products and services for within renewable energy. The size of companies is from micro to medium sized ones. The second choice was researched institutes which are involved in research and development of renewable energy sector. All the interviews we conducted are among top management team (TMT) of RE companies and research institutes involved in the

renewable area. We consider our focus as a strength because it gives us the possibility to make better comparisons between the companies and research institute to study various renewable energy industries sustainable and energy efficiency concern in depth.

4.2.3 Interview guide

The questions in the interview guide were developed based on our literature review. We use a funnel-shaped interview (Kvale, 2007) which asks indirect questions first. The reasons were explained in the data collections. The research questions are formulated in theoretical language and are supposed to answer our research questions directly. In some situations, the interviewer questions were translated into an informal language which made easy to understand by the interviewees and can generate spontaneous and generous descriptions from them (Kvale, 2007) Furthermore, they help to keep the conversation going in a friendly and non-threatening tone (Yin, 2009). A write-up of the information conducted in the interviews can be found in Appendix 2

4.2.4 Interview procedure and data collection

The primary data is original data collected for a purpose. A range of primary data collection methods is available, such as interviews, questionnaires and observation. We used a survey method as face-to-face interviews and telephone interviews in collecting the primary data. The main advantage of using interviews as our tool was it allows you to test both verbal and nonverbal communication (Wilson, 2014). This will provide interesting observations of the respondent's feedback and their general behaviour. The other advantage was they are quick and straightforward. The major drawback with this tool was students lack interviewing skills, but we handled this by conducting few pilot interviews.

There was very limited academic research previously conducted on this topic. It has therefore been difficult to find relevant secondary data to use in this thesis. The secondary data have a pre-established degree of validity and reliability which need not be re-examined by the researcher. One of the disadvantages with secondary data is inappropriateness in the data, i.e., the data may be outdated or inaccurate The other main disadvantage could be a lack of control over data quality (Wilson, 2010). For example, government and other official institutions are often guaranteed of quality data, but it is not always the case.

The contacts for the interviewees were made via email and sent around 25 emails to all the RE companies which are in different regions of Norway, and our primary contact was Senior Researchers, top management, and Senior Managers. In the sent emails, the project details

and the author's background were written. The interview questions aren't sent well in advance because we believe it would make a disadvantage, the answers might not be given spontaneously and that the interviewee might be less inclined to listen to us and get biased in answering. For every question, there would be several follow-up questions to delve deeper into topics and designed the interview questions in a flexible way based on the interviewee's answer and flow of the conversation.

All participants answered all questions during the interview. There was no rush because every participant took enough time to answer our questions. The interviews were carried out in the English language, and both the authors of the thesis were present at the interviews. All the interviews were conducted face-face except one. This interview was done via phone due to the geographical spread between the interviewees, the long distance between us and the interviewee made us choose this method. The interviews were recorded by a mobile phone recorder for making the transcriptions afterwards. All the participants agreed on it. All the participant opted to be anonymous in the report and respected their privacy.

4.2.5 Transcribing the interviews

Our six interviews resulted in over 4.5 hours of recorded voice. Even though transcriptions are very time-consuming, we decided to make them on our own. As (Merriam & Tisdell, 2015) noted, transcribing is an excellent means of generating insights and hunches about the data. Our transcription consists of over 5000 transcribed words on 25 pages. According to (Curtis & Curtis, 2015) recommended noting verbal cues, such as sarcastic tone, strong emotions, nodding or shaking the head or giving a long silence. Therefore, it is important to consider the tone of voice, body language in filling words used by the interviewee is taken care in the transcriptions. Therefore, we made short notes when the interviewees expressed any such of emotions.

4.2.6 Data analysis and coding

Data collection and analysis is often a simultaneous process in qualitative research (Merriam & Tisdell, 2015). In order not to be overwhelmed with too much data after the interviews are finalised, we began with the analysis when the interviews were still conducted. We used the first transcriptions and recorded our entries for the latter. All these actions helped us to deal with the data when the interviews were finished. According to (Merriam, 2009) data can be coded with manually or with the help of software. The main reason why we decided to handle the data manually is that a computer program would have caused an uncomfortable distance

between us and the data (Creswell, 2013). Moreover, it would have taken us time to learn how to use it. Subsequently, we spent that time in developing our report.

The open coding method is used to analyse the empirical data. (Corbin & Strauss, 1990) have defined coding as the interpretive process by which data are broken down analytically. According to (Johns & Lee-Ross, 1998), it involves looking through the data to identify concepts. The Open coding is done by segmenting data into meaningful expressions and portraying them in single words or short description of words. Later, relevant comments and concepts are then attached to these expressions (Flick, 2011) When doing open coding, it's better to do in a group in the beginning. (Sarker, Lau, & Sahay, 2002) noticed that problems can occur if the team members do the initial coding separately.

To deal with a significant amount of data, researchers suggest creating different categories (Saunders, Lewis, & Thornhill, 2009). Therefore, we made categories/keywords according to the following themes which are very closely related to the research questions that we designed after the literature review. The keywords are identified before and during the data analysis. Finally, the findings from qualitative and quantitative approaches will be supported to draw the conclusion from this research. The coding sheet from the interviews is the Appendix 5.

4.3 Merits and demerits of research methods

4.3.1 Merits

Qualitative approach:

- Face to face interview provides the chance of recording the interview. Thus, the completion of the task is immediate and straightforward.
- A semi-structured questionnaire with well-designed interview guide will enhance the information seeking process.
- Furthermore, some information that is not available in written form could be accessed.
- Personal views, belief and attitude of elite players of RE industry can be obtained.

Quantitative approach:

- Helps in covering a wide range of data. Cross-border EE concern in RE sector.
- Differing HR practice, R&D trends with the size, location and government policy can be explored.

4.3.2 Demerits

Quantitative approach:

- Developing a database and analysing the data requires prior statistical knowledge.
- Cross-section data are easily accessible; availability of longitudinal data on job advertisement is highly questionable.
- R&D activities and renewable EE concern may not be clearly mentioned in the job description.
- The larger the sample, the more time it takes to collect data and more time takes to analyse the data and analyse results.
- It sometimes ignores a very important human element.

Qualitative approach:

- Access for elite interviews is a big challenge for students at the graduate level (Wilson, 2010a).
- Interviewing a native Norwegian speaker by non-Norwegian speaker could present some cross-cultural barriers. The interviewer may not properly understand the body language and other verbal expressions of respondents.
- Transcribing, coding and analysing the interview transcript is a tedious task.

4.4 Reliability and Validity

When a qualitative research is conducted, it is vital to consider the two concepts reliability and validity as they help to determine the objectivity of the research. Reliability and validity could be two different estimations instruments that explain the level of certainty and credibility of research. (Bryman & Bell, 2007) describes reliability and validity are discrete into internal and external concepts. When there are more than one researchers within the study group, and the observers come to an agreement mutually it is called internal reliability. When research is accomplished again and compared the results with the original study it is called external reliability. To achieve high external reliability, it might be difficult as the scenarios will be changing from time to time when compared with the original study. However, (Bryman & Bell, 2007) mentions a strategy of replicating the original research to present research without deviating from the similar role as engaged. Subsequently, to achieve high reliability in this thesis, this chapter describes the process of gathering data as well as how the interviews are performed. Also, all interview questions are distributed in Appendix 2. This detailed description helps the other researcher to imitate the study under similar conditions with comparable results which increase the reliability. (Yin, 2009) also stated by maintaining a chain of evidence increases the reliability. Reliability is also concerned with

repeatability (Wilson, 2010a).

Validity in the qualitative study means “suitability” of the processes and data. Regardless, the research question is valid for the desired outcome, the selection of methodology is appropriate to answer the research questions (Leung, 2015). The internal validity mentions to what degree the researchers can agree and make up to same conclusions i.e. if there is a suitable match between their observations and theoretical opinions that they develop throughout the research (Bryman & Bell, 2007). During the qualitative procedure, conclusions were drawn on mutual agreement basis which verifies internal validity of research.

On the other hand, the external validity is the extent to which the findings from research can be generalised to other cases (Wilson, 2010). It is seen as a problem within qualitative research since its findings can be applicable in other social conditions and qualitative researchers generally make use of small samples and case studies (Bryman & Bell, 2007). However, in this research the qualitative findings were discussed in relation with the quantitative results. Therefore, generalization of the qualitative findings is more simplified.

4.5 Ethical Considerations

According to (Wilson, 2010) in his book, states that researchers should act responsibly and be accountable to society when conducting research. Research ethics is complex (Punch, 1986) but it is important in business studies and social sciences in order not to "lose respect or credibility"(Pervez & Grønhaug, 2010) and to spoil the field for other researchers (Punch, 1986). Research ethics is concerned with what is permissible and acceptable when one is conducting research (Pervez & Grønhaug, 2010) suggest that ethical matters should also be considered by the researcher at an early stage, i.e. when the problem is formulated, and the purpose and topic are chosen. We have not only opted to shed more light on the Norwegian renewable energy industry their R&D activities, Sustainability concern and energy efficiency concern but also because we believe that research in this area could help society to become more sustainable and that stakeholder engagement for innovation could help to overcome societal and environmental challenges. Consequently, it was important to us that the purpose and topic of our study could help research and society to advance when we made our decisions at the beginning of the study. In addition, we formulated our research question in a way that it would not be an ethical challenge for us to receive and for the participants open on subjects.

Invading the privacy of (potential) participants in a study is a concern in research ethics (Punch, 1986) In order to get access to the interviewees, we did not invade their personal

space. For instance, we contacted the interviewee through emails which are provided on their website. Moreover, we did not ask any questions that could trespass upon their privacy during our interviews. Before the beginning of an interview, we asked the interviewee for permission whether we can record the interview session. In addition, we comply with the anonymity preference of the interviewees in the report.

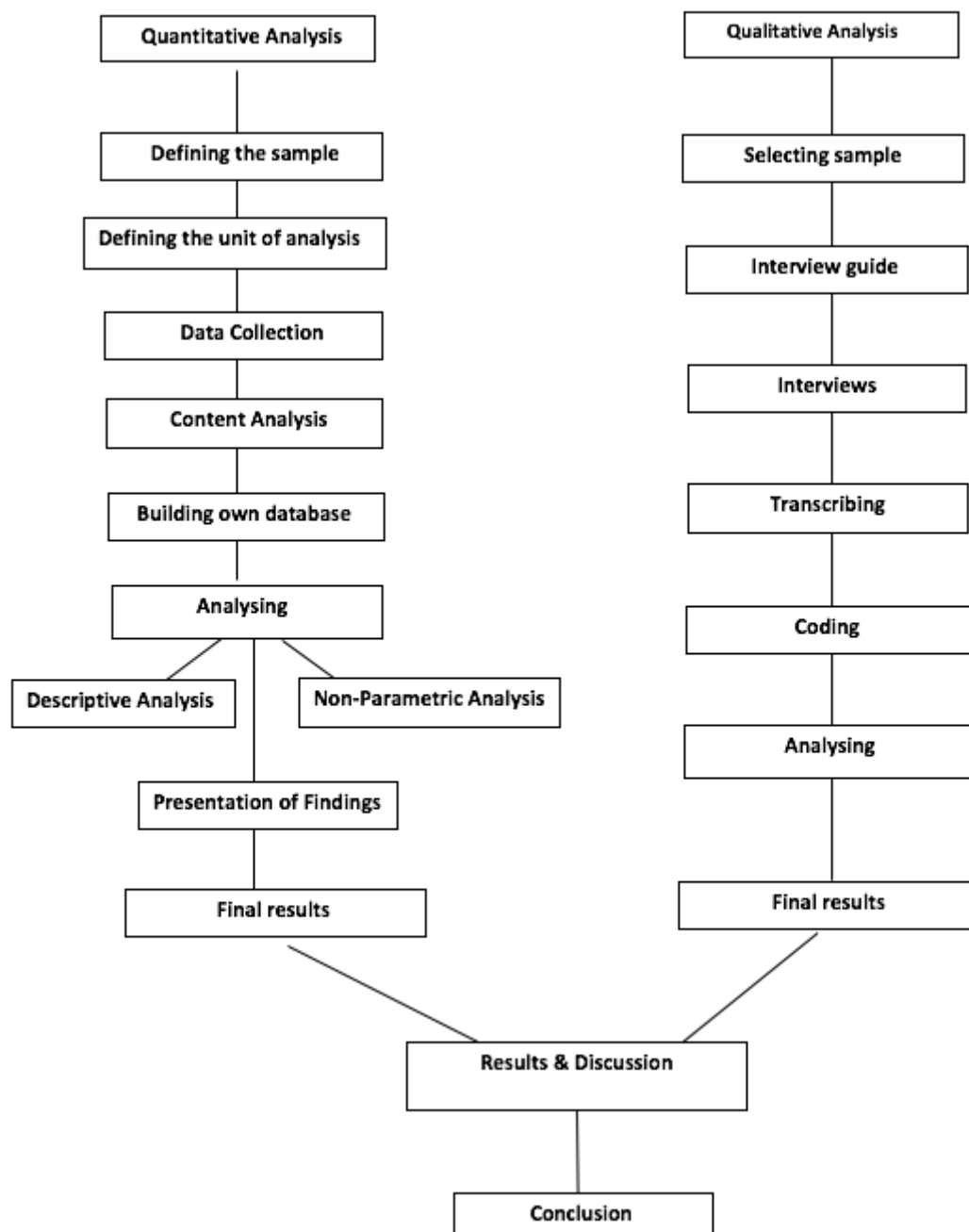


Figure 5 Flow diagram representing methodology

5 RESULT AND DISCUSSION

5.1 R&D activities in the Norwegian RE sector

Out of the total N=651 different job ads analysed, 13.36% (n=87) concern R&D activities. Figure 4 shows most of the R&D activities are on Solar (n=20) followed by CCS (n=15), the wind (n=10) and hydro (n=7). Other R&D jobs indicated in the figure 6 includes thermal heating, district heating, battery technology, petroleum, nuclear and all other ads where the industry sector is not specified within the advertisement content.

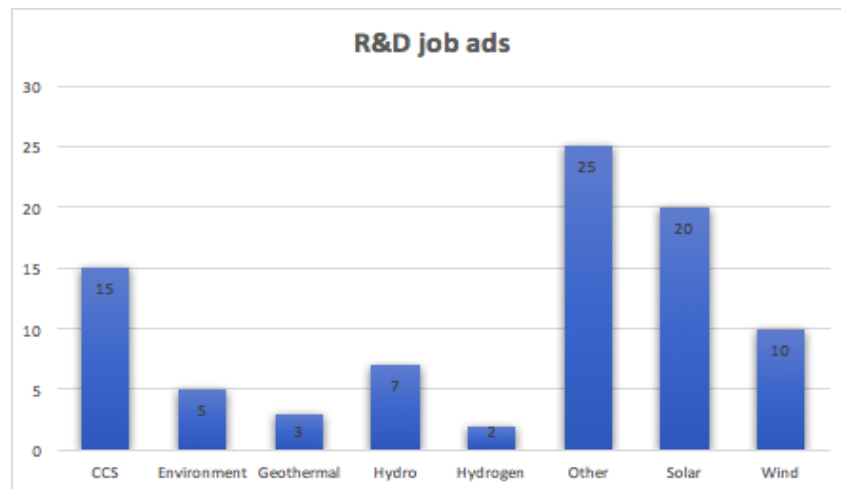


Figure 6 R&D job ads distribution by RE sectors

5.1.1 Mode of R&D activities

Figure 7 indicates that all three modes of R&D activities are prevalent in the RE sector. Mode 1 is the dominant mode of R&D (n=35) followed by 'mixed mode (Norwegian CEER mode n=32) and Mode 2 (n=20).

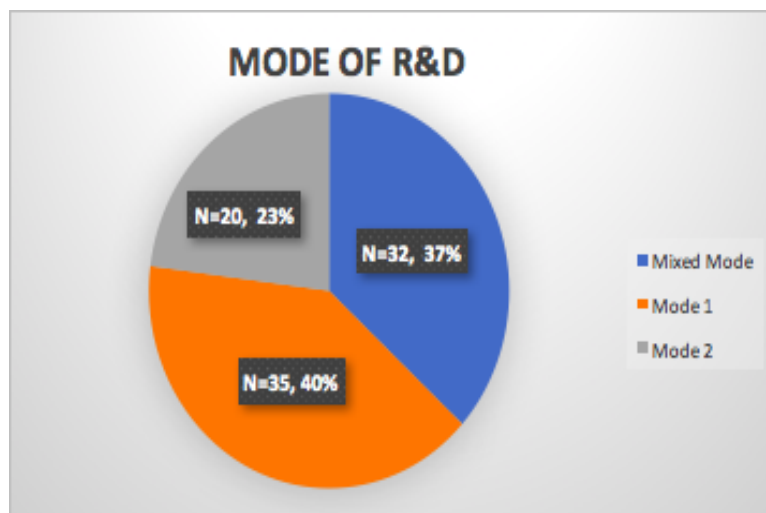


Figure 7 Mode of R&D in practice

5.1.2 Distribution of mode of R&D in various RE industry

Distribution of different mode of R&D by industry is as shown in figure 8. Only in wind energy sector, the Mixed mode counts higher than other modes of R&D, while in other sectors Mode 1 is dominant. Mode 2 module of R&D is prominent on hydro, environment & climate change and other industry such as thermal energy, district heating, etc.

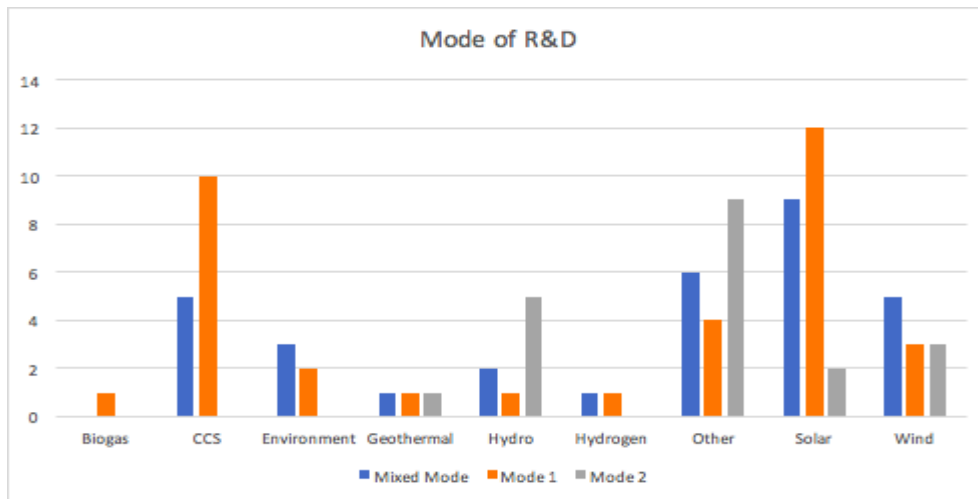


Figure 8 Mode of R&D in various RE sectors

Norway has put forth its ambitious target on reducing greenhouse gas emission. The renewable energy generation has been perceived as one of the most effective paths to meet those goals. In addition, it has been evident that Norway has a potential to contribute to energy and energy-related environment friendly technology to the outer world. Thus, Energi21 program highlights R&D activities as a core to national energy strategy. Thus, the mode of research recommended by CEER focuses knowledge integration as a collaborative effort among researchers, industries, policy makers and public. The collaborative efforts among the stakeholders enable effective commercialization of innovation (Vie, 2012).

According to SSB, (2017) R&D activities are often carried out in cooperation. Its data shows that 38% of R&D activities carried out in 2015 were in cooperation, the CEER mode in this context. The necessity of CEER mode of R&D and knowledge integration has been recognized by researchers. During our interview, Respondent 1 said that they had developed a more efficient technology. He further adds, "our technology can compete with traditional energy prices without market subsidies". He also mentioned that they are looking for an effective industry partner to scale up and commercialize the product. At the same time, they interacted with research council to take the product into the market. This case highlights the

applicability of Mixed Mode of R&D for effective commercialization.

Highlighting the status of R&D, Respondent 2 said; “renewable energy barely have their own R&D departments. They buy from vendors or institutions like us.” The effective translation of research output during the industrial scale up is important for effective commercialization of innovation. From the sayings of Respondent 1 & 2, CEER scheme of R&D is essential for effective commercialization of innovation. Respondent 6 says, “Mode of R&D depends on the research theme you are working on”. According to him, Mode 1 type of research activities are productive for material science, while module development and installation requires wide cooperation and demand for Mode 2 and Mixed Mode type of R&D.

5.1.3 Trend in mode of R&D

The recent trend shows that the practice of mixed mode of R&D is increasing steadily while a significant drop in R&D activities for both mode 1 and mode 2 modules was observed in the year 2015, (figure 9). Mode 1 module experienced a rapid increase in 2016 and also in the first quarter of 2017.

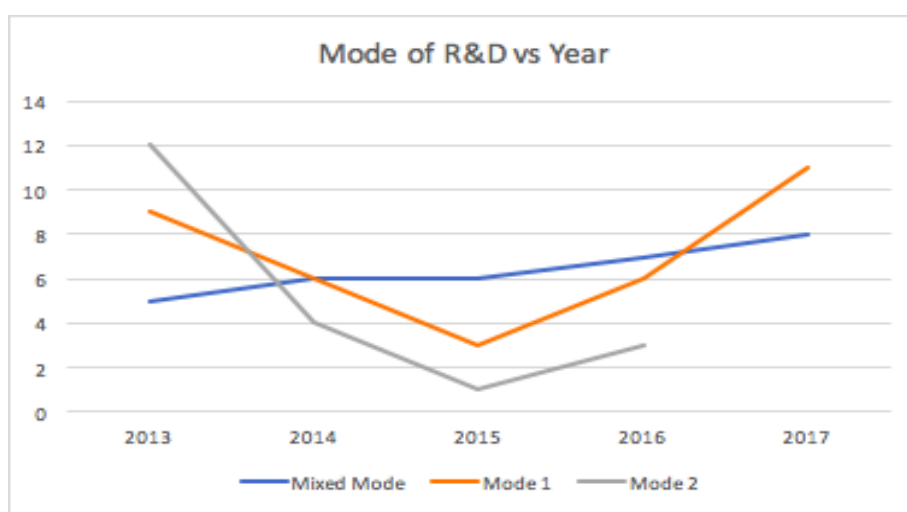


Figure 9 Trends in Mode of R&D in RE sector

The result presented above shows that the trend of Norwegian CEER mode of R&D is increasing and was least affected during 2015 when mode 1 and mode 2 research model were declining.

5.1.4 R&D activities and Solar PV.

From the job ads content analysis, solar sector was found to be more R&D intensive than other RE sectors. Fig 7 shows that R&D activities are higher in the solar industry 23% (N=87; n=20) in comparison to CCS 17.24%, wind 11.49% of total R&D activities in renewable energy sector. The results correspond to the effort of national energy strategy where R&D in

solar energy is one of the six highlighted areas.

The strategies employed in solar energy, especially on photovoltaic (PV) sectors indicates that solar scientists are more focused on improving energy efficiency. Assuming the current economic growth and sticking to carbon neutral policy, Eisenberg & Nocera (2005) warns that the world will face a daunting energy crisis. It will be a challenging task to fulfil 14–20 TWh energy deficit by 2050 even if other sources of renewables (hydro, wind, biomass, nuclear) are explored in full potential. Though other sources of renewable generation could be the short term energy mix, solar energy is essential to meet the long-term demand (Eisenberg & Nocera, 2005). Realising the global appetite for energy that could only be met by solar energy, the Norwegian energy strategy is R&D oriented in the solar sector. Despite the unfavourable domestic geo-climatic condition, R&D domination in solar energy in Norway is in line with the global trend where solar energy remains dominant in the R&D sector. This indicates that Norway is also in race of disruptive innovation to meet the global energy appetite via freely available solar energy.

Regardless of unfavourable domestic market, Norwegian REC company remained the second most valuable company in Oslo during 2007 with the value of over Euro 9 billion. This success story might be the motivational factor for R&D stakeholders that industrial dominance is also possible via tech-focused activities. This success of Norwegian PV industry is often attributed to its ability to match technology with market opportunities and exploiting global niche market for learning and legitimacy (Christiansen, 2002).

However, from the interviews, it was found that only one respondent emphasized the importance of R&D in solar. Respondent 1 said, “*R&D activities in solar has become very intense in recent times*”. Their primary focus is in R&D activities, solar panels, improving efficiency, modules and system. Respondent 6, emphasized on offshore wind energy as promising for Norwegian RE industry. He adds; “*R&D activities should be directed towards offshore wind and the subsidies for market penetration to Solar*”. Respondent 6’s opinion on solar sector subsidies requirement matches with Respondent 1 who claims that solar technology is developed enough to compete with other energy sector, however, the market penetration subsidies are essential. With the increasing share of VRE on energy consumption, importance of R&D on energy storage was emphasized by Respondent 3 & 5 during the interview, while all other respondent agreed on it. According to Respondent 3, solar and wind are ideal field, practical application lies on other sectors such as thermal, boilers, etc.

5.2 Sustainability and energy mix

The source of available RE varies significantly from one country to another. Many countries use available energy in different proportion to meet the energy demand. Depending on the availability of RE resources, energy mix is designed (Wall Street Journal, 2013). Consideration of sustainability issues is crucial for designing the energy mix from producers perspective in deregulated energy market in Norway. The content analysis of job ads from Norwegian RE sector shows the following results regarding energy mix and sustainability concern.

5.2.1 Sustainability concern vs energy mix

A chi square test was performed to test the null hypothesis of no association between the sustainability concern expressed by RE stakeholders in their company and the mix mode of energy production.

Table 1 Chi square test, sustainability concern by companies' vs energy mix

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.486 ^a	1	.000		
Continuity Correction ^b	14.319	1	.000		
Likelihood Ratio	17.621	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	651				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 20.02.

b. Computed only for a 2x2 table

Therefore, an association between the expression of sustainability concern by companies and energy mix was found χ^2 (d.f. =1, N = 651) = 15.486, $p < 0.001$ ¹. This shows that our null hypothesis of no association was rejected. Thus, there exist the significant association between the sustainability concern expressed by companies' energy mix mode of energy

¹ Where, χ^2 = Chi square; d.f.= Degree of freedom; N =Number of observations; P = probability (level of significance).

production at 0.001% level of significance.

Similarly, a Chi square test was performed to test the null hypothesis of no association between the sustainability concern expressed by RE stakeholders in their job advertisements and the energy mix mode of energy production.

Table 2 Chi square test, sustainability concern by companies in job ads vs energy mix

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.855 ^a	1	.028		
Continuity Correction ^b	4.386	1	.036		
Likelihood Ratio	4.987	1	.026		
Fisher's Exact Test				.029	.017
N of Valid Cases	651				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.09.					
b. Computed only for a 2x2 table					

Therefore, an association between the expression of sustainability concern in job ads and energy mix was found χ^2 (d.f. =1, N = 651)= 4.855, $p < 0.05^2$. This shows that our null hypothesis of no association was rejected. Thus, there exist the significant association between the sustainability concern expressed by companies' energy mix mode of energy production at 0.05% level of significance.

5.2.2 Efficiency concern and Energy Mix.

A chi square test was performed to test the null hypothesis of no association between the efficiency concern expressed by RE stakeholders and the mix mode of energy production.

² Where, χ^2 = Chi square; d.f.= Degree of freedom; N =Number of observations; P = probability (level of significance).

Table 3 Chi square test, efficiency concern by companies vs energy mix

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.808 ^a	1	.001		
Continuity Correction ^b	10.199	1	.001		
Likelihood Ratio	10.674	1	.001		
Fisher's Exact Test				.001	.001
N of Valid Cases	651				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 62.52.

b. Computed only for a 2x2 table

Therefore, an association between the expression of efficiency concern by RE stakeholders and energy mix was found χ^2 (d.f. =1, N = 651) = 10.808^a, $p < 0.001$.³ Thus, our null hypothesis of no significance was rejected. Thus, there exists a significant association between energy efficiency concern expressed by the companies and energy mix mode of energy production at 0.001% level of significance.

Similarly, a chi square test was performed to test the null hypothesis of no association between the efficiency concern expressed by RE stakeholders in their HR recruitment job ads and the mix mode of energy production.

³ Where, χ^2 = Chi square; d.f.= Degree of freedom; N =Number of observations; P = probability (level of significance)

Table 4 Chi square test, efficiency concern by companies in job ads vs energy mix

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	45.800 ^a	1	.000		
Continuity Correction ^b	44.679	1	.000		
Likelihood Ratio	45.667	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	651				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 94.39.					
b. Computed only for a 2x2 table					

Therefore, an association between the expression of efficiency concern in job ads and energy mix was found χ^2 (d.f. =1, N = 651) =45.800^a, $p < 0.001^4$. Thus, our null hypothesis of no association was rejected. There exist the significance association between energy efficiency concern expressed by RE stakeholders in their HR recruitment ads and the energy mix.

From the above test, it is found that there exist a significant association between energy mix and sustainability and efficiency concern by companies and the expression of that concern in job advertisements.

5.3 Necessity of energy mix in Norway

The concern on sustainable and efficient supply of energy for the stakeholders can be obvious as Norway has recently experienced power shortage of 2.3 TW in 2011. Norway was also a net importer in 1997, 1998 (Gebremedhin & Granheim, 2012) and in 1996 (Christiansen, 2002). Low rainfall and higher demand were the major reasons behind power shortage for Norwegian hydropower dependent RE sector. The surplus energy for domestic market is a primary concern. On the other hand, green battery potential of Norway has also been emphasized. Estimates have shown that Norway has technical potential of 20,000 (MW) production from pumped hydro (Gullberg et al., 2014). Since significant amount of RE production in continental Europe is focused on VRE, pumped hydro power potential of

⁴ Where χ^2 = Chi-square; d.f.= Degree of freedom; N =Number of observations; P = probability (level of significance)

Norway can contribute to solve the VRE intermittency in this regard. Thus, power security and stability can be enhanced through regional interconnectivity. The Norwegian RE potential are beneficial to continental Europe from the perspective of reducing fossil fuel combustion, climate and environment, and energy security (Gebremedhin & Granheim, 2012). Thus, generation of new renewable energy helps to meet the target of climate policy, meet the demand of domestic market even in severe dry winters and to serve as a green battery for continental Europe.

However, generation of energy mix from renewable energy producers cannot be wholly attributed towards their sustainability/energy efficiency concern. It has been observed that sustainability pressure force the industry giants to enter multiple RE sector and their expression of concern can be the part of employer branding or marketing of corporate social responsibility. For example, Norwegian energy giant Statoil invested in RE outside Norway due to the lack of subsidy policy within the country and viable business opportunity abroad (Kaufman, 2016).

This shows viable business opportunity dominates the sustainability and efficiency concern. As mentioned above, the RE policy of Norwegian government are unclear. During an interview, Respondent 3 commented on energy mix in the following way; companies are in two different sectors to secure their business during the policy transition. To borrow the words from Respondent 3, “The idea of energy mix is important in case of any changes in market (policy and economy). Commercialization and business are upfront.”. Respondent 2 said that companies are fighting for regulatory issues and trying to influence the regulation during the policy transition. Respondent 5 views mixed mode of energy production as a means of lowering the cost and increasing production efficiency. While Respondent 6, specified the location specific energy mix for economic and efficient production.

Power market deregulation in Nordic region has emphasized on their interdependency for energy. The market was deregulated several years back and it is well functioning even in present days with cross border trading. The newly signed agreement on common tradable green certificates between Norway and Sweden will of course play a vital role in the development of renewable energy in these countries in a broader system perspective.

Increasing share of variable RE resources increases the system demands for more flexibility. Iván Martén, therefore emphasize that there will not be any winning RE. Rather, a healthy mix based on regional characteristics is essential for sustainable and efficient energy supply, (Wall Street Journal, 2013).

In an effort to find the most sustainable way for technology and energy mix to meet the

Mexican climate change target by 2050, Santoyo-Castelazo & Azapagic (2014) have developed 11 different scenarios and 17 different sustainability criteria. Their findings show that, fossil fuels were regarded as most unsustainable sources whereas renewable energy mix is regarded as the most sustainable.

5.4 Wind-hydro energy mix

Wind energy resources is distributed across the globe which is enough to supply wind power to all continents. The technical potential for wind power production has been estimated to be 76 TWh annually (Buen, 2006). On the other hand, Norway is rich in hydropower resources. In such scenario, it is likely for RE stakeholders to be involved in energy production from wind and hydropower.

A content analysis of RE job ads in Norway showed the following results. Most of the energy producers (78%) are involved in production of RE from single resource while 22% of the producers are producing energy from two or more than two different resources. Among those producing from two or more than two resources, wind-hydro combination (17%) was more common in comparison to others which accounts only 5% of the total producers.

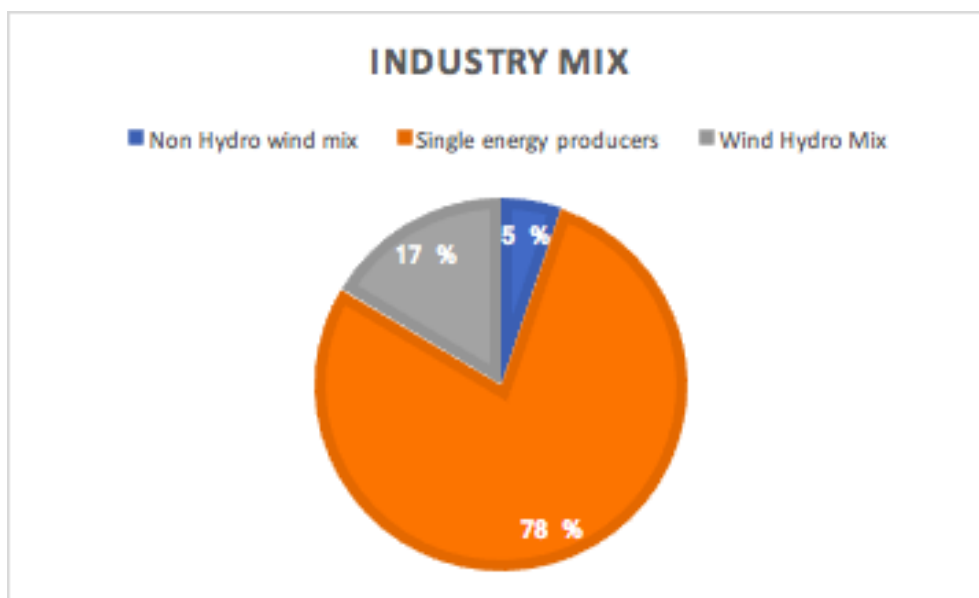


Figure 10 Industry mix for RE production

The variable nature of wind cannot be the stand-alone solution to energy demands. Balancing of power needs either a huge storage system or other type of RE in low wind power situations (Heide et al., 2010; Heide, Greiner, von Bremen, & Hoffmann, 2011). In addition, pumped hydropower potential of Norway has been estimated to be 20,000 (MW). In such scenario, the wind hydro energy combination in energy production serves as the sustainable solution to energy supply. The wind hydro combination in Norway is viewed from different perspective

by the RE stakeholders. Respondent 5 and 3 perceive that the wind hydro mix as the tool to cost efficient energy production while Respondent 4 view it as a stimulus of government policy towards power balancing. Respondent 6 emphasize on the location specific application of such energy mix. He adds, the wind and hydro combination is appropriate in western part of Norway while solar and hydro could be fruitful in eastern coast.

Whatever be the intention behind the engagement in energy production from more resources, it supports the government effort to reduce the global GHG emission cut by 30% and carbon neutral Norway by 2050 (Gebremedhin & Granheim, 2012),(Bruvoll & Larsen, 2004).

6 CONCLUSION

The purpose of this study has been to explore the R&D activities, sustainability and efficiency concern of RE stakeholders. In addition, the study was oriented towards identifying the current trends in R&D sector, role of subsidies in R&D, common and appropriate energy mix for Norwegian geo-climatic condition. Hence, this chapter aims to answer the research questions of the thesis. Conclusions are drawn based on the analysis and findings.

The findings from this study are the outcome of literature review, content analysis of the job advertisements and elite interviews in RE sector.

Though six major areas of R&D were identified in the National energy strategy, solar PV industry has gained the major attention in R&D activities. Along with the growing attention in solar PV R&D, user-producer interaction and subsidies for market penetration were found to be desirable because not all the efficient technologies are competent, they become competent when they are adopted (Arthur 1989). In addition, CCS, battery and technologies for localized energy production are also gaining attention in Norwegian R&D sector.

The CEER mode of R&D is directed towards promoting cooperation between research communities, industries and innovative users to enhance innovation and value creation (Vie, 2012). Being comparatively new in practice, R&D trends shows that CEER recommended mode of R&D is gaining momentum. The content analysis of job ads showed that it is in comparable position with traditional R&D Mode 1 leaving behind the Mode 2. Despite the fall in total number R&D job ads in 2015, CEER mode showed uniform growth while Mode 1 and Mode 2 showed a huge drop.

A Chi square test established the association between sustainability concern with energy mix. However, this association cannot be analyzed in isolation. The literature review and findings from our interviews showed that multiple factors are associated with energy mix apart from sustainability concern. Ultimately it contributes towards balancing power. The RE stakeholders are involved in two or more types of RE production to minimize the risk by diversifying investment and coping with transition. Some view energy mix as a tool to lower the production cost and increasing the production efficiency. However, during our study a member of TMT also revealed that sustainability issues comes from the board of Directors, employees are just following it.

Wind and hydro resources are widely distributed in Norway. Therefore, wind-hydro energy mix was the suitable and applicable mode of balancing power. However, at localized energy production and energy use are gaining more attraction (biogas, solar, geothermal, district heating in combination with hydropower).

To summarize, R&D activities in RE sector are carried out as per the government preference on competitive technology than the subsidies for market penetration. The CEER mode of R&D is widely accepted and adopted in short period of its introduction. The balancing power with energy mix production is associated with sustainability while multiple other factors provide stimulus towards energy mix which ultimately helps in balancing power. Finally, wind hydro mix is appropriate for large scale energy mix while the other energy mix are gaining attention at local level.

7 LIMITATIONS AND RECOMMENDATIONS

Our study was mainly on renewable companies which are in Norway. We see this has our limitation and recommend to explore the research in other countries of Europe and Scandinavia. Whether the differences in public policy, culture etc. could enrich the findings on Mode of R&D, R&D activities, the association of energy mix with Sustainability and energy efficiency.

In our study the data collection was from only one source (NAV) and our experts meetings were not many due to limited resources and time constraint. Our interviews were established from only one key person of each company; however, companies will have many other key person and the opinions of them could have given us more further insight in understanding the topic. We could have got the elite interviews. It could have enhanced the findings by involving exclusive respondents. Again, this is due to the time constraint and resources. Further, research could study the topic from perspectives of a various key members of a company.

Additionally, in the process of qualitative data collection we choose semi-structured interviews and this method could be a limitation to some extent because our findings from qualitative research are based on spoken words and the memories of the respondents.

Another limitation was the quality of quantitative data, as here we dealt with government authorities we experienced some delays in receiving the data on time. However, they guarantee on the quality of data, but it's not always the case. The recommendation would be a fool proof planning could avoid the delays.

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9 APPENDIX

9.1 Appendix 1: List of research centres in Norway

<p>BIGCCS Centre – International CCS Research Centre</p> <p>Project owner: SINTEF Energy Research AS</p> <p>Partners: Norwegian University of Science and Technology (NTNU), Aker Clean Carbon, ALSTOM AG, ConocoPhillips Norge, DNV, DONG Energy, Gassco, Hydro ASA, Schlumberger, Shell, Statkraft SF, StatoilHydro, TOTAL E&P Norge AS, British Geological Survey, Center for International Climate and Environmental Research – Oslo (CICERO), German Aerospace Center (DLR), Geological Survey of Denmark and Greenland (GEUS), Geological Survey of Norway (NGU), Resources for the Future, Sandia National Laboratories, Technische Universität München, and University of Oslo</p>	<p>Centre for Environmental Design of Renewable Energy (CEDREN)</p> <p>Project owner: SINTEF Energy Research AS</p> <p>Partners: Norwegian Institute for Nature Research (NINA), Norwegian University for Science and Technology (NTNU), Freshwater Ecology and Inland Fisheries Laboratory at the University of Oslo, UNIFOB., Norwegian Institute for Water Research, International Centre for Hydropower (ICH), Norconsult, SWECO., Multiconsult, HydroNet (CAN), The University of Life Sciences and Natural Resources (A), Royal Institute of Technology (S), Swedish University of Agricultural Sciences, National Environmental Research Institute (DK), Agder Energi, EBL, Eidsiva Vannkraft, Hydro, Sira-Kvina kraftselskap, Statkraft, Statnett, Directorate for Nature Management (DN), Norwegian Water Resources and Energy Directorate (NVE)</p>
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<p>Bioenergy Innovation Centre (CenBio)</p> <p>Project owner: Norwegian University of Life Sciences (UMB)</p> <p>Partners: R&D: Norwegian University of Science and Technology (NTNU), SINTEF Energy Research, Norwegian Forest and Landscape Institute, Norwegian Institute for Agricultural and Environmental Research (Bioforsk), and Vattenfall (S); Industry: Arena Bioenergi Innlandet, Norwegian Association of Forest Owners, Norwegian Forestry Association (NORSKOG), Agder Energi, Eidsiva Bioenergi, Hafslund, Trondheim Energi Fjernvarme, Vattenfall Heat Nordic (S), Norske Skog, Xynergo, Norsk Protein, Nord-Trøndelag Elektrisitetsverk, Norwegian Farmers' Union, Oslo Municipality Waste-to-Energy Agency (EGE), City of Amsterdam Waste and Energy Company (AEB) (NL), Waste Management Norway, Energos, Cambi, Jøtul, Bionordic, and Grant Kleber; Foreign institutions: Stanford University (USA), US Forest Service , University of Minnesota (USA), Finnish Forest Research Institute , Chalmers University of Technology (S), Abo Akademi University (SF), Technical University of Denmark, University of Copenhagen (DK), Vienna University of Technology (A), and Technical University Bergakademie Freiberg (D)</p>	<p>Norwegian Centre for Offshore Wind Energy (NORCOWE)</p> <p>Project owner: Christian Michelsen Research (CMR)</p> <p>Partners: Unifob AS, University of Bergen, University of Agder, University of Stavanger and Aalborg University (Denmark), with support from more than 20 industrial partners and organisations within energy production, offshore technology and wind power technology</p>
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<p>Norwegian Research Centre for Offshore Wind Technology (NOWITECH)</p> <p>Project owner: SINTEF Energy Research AS</p> <p>Partners: Norwegian University of Science and Technology (NTNU), Institute for Energy Technology (IFE), Norwegian Marine Technology Research Institute (MARINTEK), SINTEF Materials and Chemistry, SINTEF Information and Communication Technology, Statkraft, StatoilHydro, DONG Energy, Vestavind, Lyse, ConocoPhillips, Statnett, Umoe Mandal, Aker Solutions, SmartMotor, ScanWind, Devold AMT, SWAY, ChapDrive, Fugro OCEANOR, Vestas, DNV. Associated partners: National Laboratory for Sustainable Energy at the Technical University of Denmark (Risø DTU), Massachusetts Institute of Technology (MIT), National Renewable Energy Laboratory, Innovation Norway, and Norwegian Wind Energy Association (NORWEA)</p>	<p>The Norwegian Research Centre for Solar Cell Technology</p> <p>Project owner: Institute for Energy Technology (IFE)</p> <p>Partners: Norwegian University of Science and Technology (NTNU), The SINTEF Group, University of Oslo, Elkem Solar, FESIL Sunergy, Hydro, NorSun, Prediktor, REC, Scatec, Solar Cell Repower and Umoe Solar</p>
<p>SUBsurface CO2 Storage – Critical Elements and Superior Strategy (SUCCESS)</p> <p>Project owner: Christian Michelsen Research</p> <p>Partners: Institute for Energy Technology (IFE), Norwegian Institute for Water Research (NIVA), Norwegian Geotechnical Institute (NGI), Unifob, University of Bergen, University of Oslo, and University Centre in Svalbard (UNIS)</p>	<p>The Research Centre on Zero Emission Buildings – ZEB</p> <p>Project owner: Faculty of Architecture and Fine Art, Norwegian University of Science and Technology (NTNU) Partners: The SINTEF Group, Skanska, Maxit, Isola, Glava, Protan, Hydro Aluminium, YIT Building Systems, ByBo, Multiconsult, Brødrene Dahl, Snøhetta, Norwegian Defence Estates Agency, Directorate for Public Construction and Property, The Norwegian Housing Bank, Federation of Norwegian Construction Industries, Norwegian Technology, National Office of Building Technology and Administration</p>

9.2 Appendix 2: List of Interview Questions

Introduction questions

1. Can you give a short Introduction of your company and describe the various types of projects on which you work?
- 2.
3. What do think of Nature of energy market in Norway.
4. What level of growth has the sector experienced in the last few years?
5. What kind of renewable energy technologies are available in Norway? Which is most promising?
6. Which is the most efficient RE energy -- wind, solar, wave, hydro or other?
7. What are the biggest challenges when it comes to implementing and utilizing renewable energy technologies?

R&D related questions

8. In recent times, Which of the RE sector has gained more attention towards R&D activities.
9. In your opinion which sector should get more of R&D attention and why?
10. How your company is involved in R&D? Mode of R&D.
11. Who are the major actors in R&D activities- research institute , academics, industry or combinations/collaboration of R&D. in Norway.

Sustainability concern, Energy efficiency Energy Mix questions

12. Standalone RE production is not possible for in case wind/solar. Balance of power is essential for energy security. In your opinion which RE combination would better fit the energy mix in terms of sustainability and efficiency.and why. explain.
13. RE Companies are involved in energy mix. Is this due to sustainability concern, secure supply (energy security) /efficient production or is it viewed only from business perspective. Explain briefly.

14. How RE companies concerned about sustainability?
15. Is their concern on sustainability due to development in science or due to the external pressure. Explain briefly?
16. High cost of RE production is major barrier for market penetration.? Efficiency in production is essential for sustainability and business of this sector, how it is handled in your company?
17. How RE company concern on R&D, sustainability, efficiency reflects their CSR?
18. How often energy efficiency is discussed in your company? How it is reflected in R&D activities?
19. How often R&D efficiency concerns/ sustainability is reflected in job ads?
20. How the reflection of sustainability, efficiency concern and R&D activities affects the employer image.
21. What do think about the RE job trends increasing or decreasing? where?

Concluding questions

22. Which countries have the most progressive renewable energy policies? Inspirational policies of some other countries?
23. What role should the government play in crafting policies that encourage investment in and usage of renewable energy?
24. What's the one thing most people don't know and they must know about renewable energy?
25. What will the sector look like in about 20 years' time?

9.3 Appendix 3: Cohen's Kappa results

Below is the SPSS 24, Cohen's kappa test results.

Reliability test results for two coders: Coder A & Coder B	
Efficiency concern in Company	0.925
Efficiency concern in Jobs	0.933
Sustainability concern in Company	0.865
Sustainability concern in Jobs	0.926

9.4 Appendix 4: SPSS out results

Table 1 Sustainability Concern by RE company vs Energy Mix.

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SUS. CONCERN COM. * ENERGY MIX	651	100.0%	0	0.0%	651	100.0%

SUS. CONC COM. * ENERGY MIX Crosstabulation					
			ENERGY MIX		Total
			NS	Yes	
SUS. CONCERN COM.	NS	Count	42	7	49
		Expected Count	29.0	20.0	49.0
	Yes	Count	343	259	602
		Expected Count	356.0	246.0	602.0
Total		Count	385	266	651
		Expected Count	385.0	266.0	651.0

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.154	.000
	Cramer's V	.154	.000
N of Valid Cases		651	

Table 2 Sustainability Concern jobs vs Energy Mix.

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SUS CONCERN JOB * ENERGY MIX	651	100.0 %	0	0.0%	651	100.0%

SUS CONCERN JOB * ENERGY MIX Crosstabulation					
			ENERGY MIX		Total
			NS	Yes	
SUS CONCERN JOB	NS	Count	71	32	103
		Expected Count	60.9	42.1	103.0
	Yes	Count	314	234	548
		Expected Count	324.1	223.9	548.0
Total		Count	385	266	651
		Expected Count	385.0	266.0	651.0

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.086	.028
	Cramer's V	.086	.028
N of Valid Cases		651	

Table 3 Efficiency Concern jobs vs Energy Mix.

	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
EFF.CONCERN JOBS * ENERGY MIX	651	100.0%	0	0.0%	651	100.0%

EFF.CONCERN JOBS * ENERGY MIX Cross tabulation						
			ENERGY MIX		Total	
			NS	Yes		
EFF.CONCERN	NS	Count	312	186	498	

JOBS	Yes	Expected Count	294.5	203.5	498.0
		Count	73	80	153
		Expected Count	90.5	62.5	153.0
Total		Count	385	266	651
		Expected Count	385.0	266.0	651.0

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.129	.001
	Cramer's V	.129	.001
N of Valid Cases		651	

Table 4 Efficiency Concern by RE company vs Energy Mix.

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
EFF.CONCERN COM. * ENERGY MIX	651	100.0%	0	0.0%	651	100.0%

EFF.CONCERN COM. * ENERGY MIX Crosstabulation					
			ENERGY MIX		Total
			NS	Yes	
EFF.CONCERN COM.	NS	Count	289	131	420
		Expected Count	248.4	171.6	420.0
		% within EFF.CONCERN COM.	68.8%	31.2%	100.0 %
	Yes	Count	96	135	231
		Expected Count	136.6	94.4	231.0
		% within EFF.CONCERN COM.	41.6%	58.4%	100.0 %
	Total		Count	385	266
Expected Count			385.0	266.0	651.0

	% within EFF.CONCERN COM.	59.1%	40.9%	100.0 %
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Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.265	.000
	Cramer's V	.265	.000
N of Valid Cases		651	

9.5 Appendix 5: Coding sheet from the interviews

Interviewee	Category/ keywords	Properties	Statements from company representative
R1 (*R: Respondent)	R&D activities	R&D in Solar panels, efforts towards improving efficiency, modules and system.	<i>“R&D activities in solar has become very intense in recent times”.</i>
	Energy efficiency concern	Energy efficiency is the main focus	<i>“Strategies in RE solar cells are most important for us. We have competence and infrastructure”.</i>
	Sustainability concern	RE implementation is the biggest challenge	<i>“Product is ready but industry is not bigger enough to scale up these products”.</i>
	Mode of R&D	Strong collaboration with industry and academy/university	Research in silicon products, silicon particles and other, <i>“we have strong collaboration with industry and academy in knowledge transfer and shared resources”.</i>

	Energy Mix	-	-
	Competitive price	Competitive price in production side	<i>“RE prices are going down. It's cheaper than fossil fuels”. In Europe, price is competitive.</i>
	High in service costs	Maintenance and Installation costs are high	<i>“Maintenance and Installation costs are very high” when compared with Africa and Asia.</i>
	Branding	-	-
	Funding/Subsides	Role of government, Research council will support RE subsidies	<i>“We have interactions with Research councils taking our product to market”.</i>
R2 (*R: Respondent)	Energy mix	Policy meetings with universities, industry and government	The management has a clear strategy for growth through collaboration and sharing internal skills. <i>“We are mainly in geothermal energy and CCS”</i>
	RE efficiency concern	RE sectors don't have their own R&D department, they buy from vendors or institutions	<i>“Efficient translation of research output is essential during industrial scale production, which determines the costs of end product.</i>
	Sustainability concern	Adapting to new technology and regulations	<i>“Regarding sustainability, the companies are fighting for regulatory issues and trying to influence the regulations on their own favor”</i> It is desired to slowdown the use of fossil fuels and coal. More innovation happens in RE.
	Mode of R&D	Mixed mode of R&D is appropriate	RE sectors don't have their own R&D department, <i>they buy from external vendors and institution like us.</i>
	R&D activities		Geothermal and CCS
R3	Energy mix	The idea of energy mix is purely in business	<i>“The idea of putting two foot into two different RE sector is</i>

(*R: Respondent)		perspective	<i>significant to have inexpensive electricity</i> ".
	RE efficiency concern		We are more concerned on the EE at the utilization side. Sustainable use of energy through energy mix. (district heating, solar panels, boilers etc.) from commercial point of view, the idea of energy mix is important during the policy transition. Solar and wind industries are in Ideal stage.
	Sustainability concern	In case of any change in market scenario. Wind and Solar industries are still ideal in stage	<i>"The idea of energy mix is important in case of any changes in market (policy and economy)"</i> . Commercialization and business are upfront. <i>"Not much external pressure, but it is slowing get there"</i> .
	R&D activities	R&D activities should be more oriented towards energy storage technologies because the share of VRE is increasing	Battery technology and long term storage technology.
	Funding/subsides	Subsides are important for R&D.	Enova
	Branding	Corporate social responsibility (CSR)	CSR and branding through advertising is applicable to industry giants.
	Jobs in RE	Steady and small growth	<i>"I think it's quite steady and small growth"</i> .
R4 (*R: Respondent)	Energy mix	In a national grid, it's more government policy. Balance power is more traditional with energy mix.	Every countries has strategies in balancing the power. Energy mix is more government policy to meet the climate targets. The industrial players will be in production mix if the policy is favourable. Also due to technical issues energy mix happens.

	Sustainability concern	Privilege to be a company to be a company born in a sustainable space.	<i>“Yes, we are sustainable, not only concern we live in that direction”. “Sustainability is like work out of the company, being healthy gives benefits to the company”.</i>
	Energy efficient concern	EE is more supplier side, but it's important to be sustainable and care for environment	EE is very important, because more the efficient is the equipment, less installation is required to produce same amount of energy.
	R&D activities		We have no links with technical providers or n technical development. We operate in downstream of the value chain.
	Subsidies	Subsidies are required in some markets but not in all.	Prices in solar are dropping so much that you are competitive in the market.
	Jobs in RE	As per IRENA Statistics, 2015 says 8.1M jobs.	Installations jobs are increasing. In RE sector jobs are transferable, manpower from other industry can put here.
	CSR	Its integrated into your business model.	Yes CSR is an integrated part of sustainability. Owning sustainability comes from top management and board of directors
R5 (*R: Respondent)	Energy mix	Focuses lower cost of energy and cares for environment.	Yes, it's important. Focuses lower cost of energy and cares for environment. For Successful environmental company money is also important otherwise firm will die.
	Sustainability concern	Always look sustainability in different perspective.	Definitely, JA! Absolutely. We constantly working in sustainability both in the company, at work places, sites. We always look at other markets all the time, Ex: Sun and other RE resources towards future energy market.
	Energy efficient concern	Not so concern	EE is a more concerned topic for the suppliers
	R&D activities	Energy storing	Storing energy should get more

			R&D interest.
	Subsidies		
	Jobs in RE		Wind market has tough years, supplier side growing but product development side declining.
	CSR		Not Answered
	External pressure	Pressure can also be due to development.	It is not due to any external pressure, it's from our own hands. Workin for such long time we always look to care for environment.
	Big or small firms	Investors, government policy pressure	Big companies has lot of external pressure than small to go green and to be more sustainable.
R6 (*R: Respondent)	Energy mix		Depends on location, wind and Hydro is appropriate in western coast while solar and hydro on eastern coast. Norway has well developed energy grid. I think it should be updated with new RE resources.
	Sustainability concern		Yes, professional actors they concern about 100% energy security and no none accepts blackouts. In Norway all actors are mainly concern of CO2 footprint emissions of energy sources they using.
	Energy efficiency concern		Yes, Efficiency is discussed a lot in Solar sector.
	R&D activities		More on Offshore wind, we can employ Oil and gas knowledge in wind offshore.
	Subsidies		R&D requires a lot of subsidies in wind and solar. Also of installation its a newly develop product in Norway which requires subsidies.

			For Norway, R&D should be more for Wind for technology development and Solar should be subsidized to increase the share in the market.
	Jobs in RE		In Norway, Solar market is seen some growth, but internationally huge growth. It's a labour intensive industry.
	CSR		Expressing CSR values in job ads could be important. But advertising it's a solar company and dealing with environmental issues, people already expects that. Because it's a Solar company
	External pressure		For our company we don't feel pressure to be environmental conscious. But I think it's a big selling point which we discuss with our clients so that they already are aware of it.
	Mode of R&D		Depends on what are you involved with. For industries in module development and installation Mode 2 is feasible. For material research its Mode 1