TAMPERE UNIVERSITY OF TECHNOLOGY

TUISKU PELKONEN

MEDIA COVERAGE AS A DESCRIPTOR OF RENEWABLE ENERGY DIFFUSION

Master of Science Thesis

Prof. Saku Mäkinen and research fellow Aija Tapaninen have been appointed as the examiners at the Council Meeting of the Faculty of Business and Technology Management on November 9th, 2011.

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Tämä diplomityö vastaa tutkijoiden esittämään tarpeeseen kehittää teknologioiden ennakointimenetelmiä. Kehitystyötä on tehtävä etenkin uusiutuvien energioiden osalta, jotta tukitoimenpiteitä voidaan suunnata oikein. On keksittävä uusia keinoja selvittää uusiutuvan energian tulevaisuuden suuntauksia ja eri uusiutuvien energiamuotojen tarjoamaa potentiaalia.

Teknologioiden diffuusiota on tutkittu aikaisemmassa tutkimuksessa bibliometrian avulla, mutta tietolähteinä on käytetty pääosin patentteja ja tieteellisiä julkaisuja. Sanomalehtien ja muun valtamedian käyttö diffuusiotutkimuksessa on ollut vähäistä, vaikkakin niiden sopivuus tietolähteiksi on tunnustettu etenkin sovellusvaiheessa olevia teknologioita tutkittaessa. Tämä työ pyrkii täyttämään tutkimuksessa havaitun aukon.

Diplomityössä selvitetään, voidaanko bibliometristä uutisdataa käyttää kuvastamaan uusiutuvien energioiden tuotantoa. Tutkimuskysymys on: *”Onko medianäkyvyyden ja uusiutuvan energian tuotannon välillä yhteyttä?”* Tutkimuskohteiksi on valittu kolme maata – Saksa, Irlanti ja Yhdistynyt kuningaskunta – ja kolme uusiutuvaa energiamuotoa – tuulienergia, aurinkosähkö ja vesivoima – ja aikajakso 1995 – 2008. Analyysi on tehty laskemalla aikasarjojen välille Spearmanin korrelaatiot, ja tilastolliseksi merkitsevyystasoksi on valittu 1 %.

Tulokset osoittavat, että tuulienergian osalta medianäkyvyyden ja primäärienergian tuotannon välinen korrelaatio on tilastollisesti merkitsevä kaikissa tutkituissa maissa. Aurinkosähkön kohdalla korrelaatio on myös tilastollisesti merkitsevä Saksan kohdalla, mutta kahden muun tutkittavan maan osalta tuloksia ei saatu datan pienten arvojen vuoksi. Vesivoiman osalta korrelaatiot olivat heikkoja kaikissa kolmessa maassa.

Tutkimuksen tuloksista voidaan päätellä, että medianäkyvyys kuvaa tutkittujen energiamuotojen diffuusion vaihetta, mikäli teknologia on diffuusion alkuvaiheissa. Tulokset ovat yhdenmukaisia aikaisemman, patenteilla ja tieteellisillä julkaisuilla tehdyn tutkimuksen kanssa, ja niitä voidaan jatkossa hyödyntää teknologioiden ennakoinnin menetelmien kehittämisessä.

ABSTRACT

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Technology foresight scholars have addressed a need to further develop the methodology in the field. Especially in the field of renewable energy (RE) new tools to figure out the potential and future directions of different RE forms has to be further developed for the polity to be able to aim the promotion schemes correctly. This thesis aims to serve avenues for future technology foresight method development in RE field.
A gap in research exists, as bibliometric studies using media as a descriptor of the diffusion of RE technologies has not been made, even if newspapers are acknowledged as a suitable data source in the application phase of a technology. Previous bibliometric diffusion studies have used patents and scientific publications as data sources. This thesis aims to fill the research gap.
In this thesis the use of bibliometric newspaper data as a reflector of RE production is examined, and the research question is: *Does a connection between media coverage and RE primary production exist*. Research is made using three countries – Germany, Ireland and the UK – and three renewable energy forms – wind, solar photovoltaic and hydroelectric energy – as research subjects, and the examination period is 1995 – 2008. The analysis is performed using Spearman correlation with 1 % significance level.
The results show that statistically significant Spearman correlations between media coverage and primary energy production exist on part of wind energy in all three countries, and also on solar photovoltaic energy in Germany. The data was not appropriate for analysis on part of solar photovoltaic energy in Ireland and the UK, thus results on these subjects were not gained. The results on part of hydroelectric energy showed weak correlations in all three countries.
Results suggest that the examined RE technologies' media coverage describes their diffusion level, if that technology is in the early phases of diffusion. The results are consistent with the previous research made using patents and scientific publications as data sources, and can be used to further develop the foresight methodology.

PREFACE

This thesis has been a learning process, as many aspects of the thesis work have elaborated through the journey. The topic has evolved from a few sketches on a paper and a leap of faith to solid analysis and results. Even though the process has involved countless dead ends as different alternatives of research subjects, data sources and theoretical perspectives are went through, the past eleven months have greatly developed my patience and logical thinking – features valuable to a future scholar. Examining such a challenging topic has also been very rewarding, and this thesis will serve as a basis of my dissertation.

I would like to thank my examiners, Professor Saku Mäkinen and research fellow Aija Tapaninen, and my boss, assistant professor Marko Seppänen for guiding me during the process and giving me insight on the topic. Especially Aija has encouraged me during the process and has always had time for my questions. I would also like to thank my colleagues Henri Suur-Inkeroinen and Ozgur Dedehayir, who have helped me with some of the challenges I encountered. John Shepherd and Sibylle Kingelin from the Language Centre of our university also gave some assistance with the definition of search terms, so I want to thank them as well. Finally, I would like to thank the contact persons in different European statistical offices who assisted me in the data collection, even though at the end of the day these data were not used in the analysis.

In Tampere on November 11th 2011

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ABBREVIATIONS

CLEEN	The Finnish Cluster for Energy and Environment.
EFMN	European Foresight monitoring Network.
FIT	Feed-in-tariff. A direct price-driven policy instrument used to stimulate the deployment of RE electricity.
IEA	International Energy Agency. An Autonomous organization which provides research, statistics, analysis and recommendations. At the moment IEA has 28 member countries.
kTOE	Kilotonne(s) of oil equivalent. Unit of energy. 1 kTOE equals approximately 42 gigajoules.
NGO	Non-governmental organization.
RE	Renewable energy.
RO	Renewables Obligation. A support scheme in use in the UK that is based on a tradable certificate system (see TGC below).
RPS	Renewable portfolio standard. A direct quantity-driven policy instrument used to stimulate the deployment of RE electricity. This is a tradable certificate system mostly used in the US and Japan, and in Europe these kind of systems are better known as tradable green certificates (TGCs).
SEAI	Sustainable Energy Authority of Ireland. Ireland's national energy authority.
SGEM	Smart Grids and Energy Markets. A research program within the Finnish Cluster for Energy and Environment (CLEEN).
Solar pv	Solar photovoltaic(s). As solar electricity is produced through solar photovoltaic systems, the term photovoltaics

	is used to distinguish the production of solar electricity from the production of solar heat energy.
TGC	Tradable green certificate. A direct quantity-driven policy instrument used to stimulate the deployment of RE electricity in Europe. In the US and Japan these kind of tradable certificate systems are better known as renewable portfolio standards (RPSs).

1. INTRODUCTION

In recent years the field of technology foresight has developed on part of both methodology (Miles 2010, p. 1448) and data processing capabilities (Linstone 2011, p. 71). Scholars have addressed a need to take use of these advances to further develop the methodology and to meet the challenges brought by technological development (Martino 2010, p. 86). This thesis builds on the work done on the field of technology foresight by analysing three renewable energy (RE) forms by using a foresight method called bibliometrics. Bibliometric analysis is about analysing publications – such as patents, scientific papers or newspaper articles – by their attributes or interrelations and thus gaining more understanding on the studied topic (Okubo 1997), p. 6). Bibliometrics can be used to draw inferences from the development phase of a research field or technology, and the directions it may be heading to in the future (Martino 2003).

Selecting RE as a research subject is justified, as the importance of renewables is growing increasingly. There is a need to replace the production of energy from non-renewable sources with renewable energy forms for reasons such as the climate change, the nations' will to be more self-sufficient in their energy supply, and the limited availability and accessibility to 'traditional' forms of energy, such as crude oil and natural gas. Also, for the polity to be able to better aim the promotion schemes for RE, tools to figure out the potential and future directions of different RE forms have to be further developed.

The purpose of this thesis work is to gain understanding on the use of media coverage as a reflector of RE production. Media coverage is a useful indicator of the emphasis and expectations set on a certain topic. In previous studies, scholars have examined media coverage by studying subjects such as the coverage itself (Boykoff 2008; Liu et al. 2008), its influence on other factors (Bartels 1996; Sampei & Aoyagi-Usui 2009) and its use as a foresight tool (Watts & Porter 1997). Also, bibliometrics has been used to determine the diffusion level of technologies using publications such as patents (Campbell 1983; Chang et al. 2009; Daim et al. 2006; Ernst 1997; Järvenpää et al. 2011) or scientific publications (Chao et al. 2007; Mingers 2008; Mingers & Burrell 2006). However, it appears that a gap in research exists, as applying bibliometric analysis using newspaper and other 'general' media data in studying technology diffusion has been neglected in the RE field, even though newspapers are acknowledged as a suitable data source in the application phase of a technology (Martino 2003, p. 720-721).

This thesis work aims to fill the existing research gap. The research problem of this thesis is: *Does a connection between media coverage and RE primary production exist*.

The determination of this connection will bring new aspects to the development of RE forecasting methods, and the methodology can be applied in other fields as well. This thesis is carried out as a part of the SGEM (Smart Grids and Energy Markets) research program conducted by the Finnish Cluster for Energy and Environment (CLEEN 2011).

One must understand that media coverage can only be a measure to predict changes in the production of energy, as the connection between the two is assumed to be indirect. In this thesis it is assumed that the media influences RE production indirectly through RE policy in the EU. While the production of RE is significantly influenced by the energy policy on both the EU and national level, there are also a multitude of other influential factors, such as market forces, exploitable energy sources and the competence of associated technologies. However, the limited scope of the thesis restricts the examination into chosen subjects – media, policy and RE production – thus other factors are left out of the examination. These three subjects can be seen to form a triangle. Two sides of the triangle, the connection between media and policy and the one between policy and RE production, are covered by previous research. But as stated before, there is a research gap concerning the third side of the triangle, which is the connection between media coverage and RE production.

There are multiple different factors influencing RE production and their actual impact is difficult to measure. Therefore media coverage may be a justified tool in forecasting the development of RE production. The objective of this thesis is to determine the connection between the media coverage and the RE production. This is done by collecting quantitative data on both and analysing the data by means of Pearson correlation analysis. Also quantitative data on RE policy measures is collected, but they are not used in the statistical analysis. The quantitative data on policies is only used to deepen the understanding of the studied phenomena and to bring up a significant influential force taking effect on RE production. The connection between the media coverage and the RE production is examined by studying three RE forms – wind energy, solar photovoltaic (solar pv) energy and hydroelectric energy. These energy forms are studied within three EU member countries – Germany, Ireland and the UK. The selection of three samples instead of two on part of countries and energy forms increases the validity of the thesis. The subjects are studied during the period of 1995 – 2008. The grounds for selecting these particular energy forms, countries and time period are a result of both the objectives and the limitations of the research, which are explained later in this work. The null hypothesis in this thesis is, that there is no correlation between the media coverage and primary energy production of RE. With the statistical analysis the null hypothesis is pursued to be rejected and thus the existence of the connection between media and production proven to be true. The correlation is measured with Spearman’s rho, using 1 % statistical significance level.

The thesis begins with presenting the used theories in chapter 2. The theoretical section represents the research field of technology foresight in general and after that, the sides of the previously mentioned triangle are examined. The connection between media and RE production has not been covered before, but the previous research in the technology foresight field using similar analysis is presented, and the grounds for using the media data in analysing RE production. Then, the connection between media and energy policy is discussed using two different approaches: First, the factors influencing media's political agenda setting power are introduced and then, the course of communication between media and polity is discussed through the Circuits of Culture model by Carvalho & Burgess (Carvalho & Burgess 2005). The third side of the triangle – the connection between the policy and the RE production – is covered by representing the most common energy policies used in the EU and their effectiveness. In chapter 3 the used research methods and material are presented. The characteristics of the data and the methods of collecting them are explained and also, the use of Spearman correlation as a statistical analysis method is described. In chapter 4 the data used in this study are described and the results of the analysis represented. In chapter 5 the results are discussed by comparing them with the theory, and in chapter 6 the contents of the thesis are concluded and further study needs stated.

2. THEORETICAL BACKGROUND

This thesis work is based on the idea of triangulation. Eskola & Suoranta (2005) state that in triangulation one uses multiple data sets, theories and/or methods in the same study. It is an especially favourable technique, when it would be hard to make up a comprehensive understanding of the research subject by using only one research method. (Eskola & Suoranta 2005.) In this thesis the idea of triangulation is carried out by examining the research subjects from three perspectives. Although the objective in this thesis is to define the connection between media coverage and RE production, also the influence of RE policy is taken under consideration. This chapter discusses the linkages between 1) media and RE production, 2) media and RE policy, and 3) RE policy and RE production (see figure 2.1).

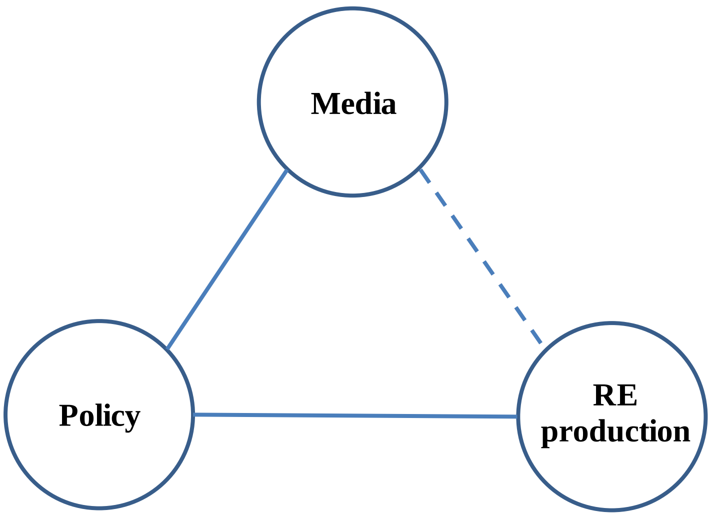


Figure 2.1. *The linkages between media, policy and RE production. The dash line describes the research gap in the technology foresight research.*

The chapter starts by presenting the research field of technology foresight in general. After that, the connection between media and RE production is examined by representing previous research in the technology foresight field, and the grounds for using the media data in analysing RE production are explained. Then, the connection between media and RE policy is described by explaining the media's political agenda setting power and the course of communication between the media and the polity. Finally, the connection between RE policy and RE production is discussed by representing the most common energy policies used in the EU and their effectiveness.

2.1. Technology foresight

The term foresight was first used in connection with science and technology in 1983 (Martin 2010). The most cited definitions for the term *foresight*, or more specifically in the context of technology management, *technology foresight* can be summed up by saying that technology foresight is systematically looking into the future in long-term and in collaboration with experts to identify technologies that would bring the greatest economic and social benefits (Georghiou 1996; Martin 1995; Smith & Saritas 2011). Technology foresight must not be confused with another close term, *technology forecasting*, which is about predicting the characteristics of future technologies.

Even though the term *technology foresight* was first brought up during the 1980s, the roots of the field are in the preceding century. Linstone (2010) has defined three technology foresight eras, all of which mirror the societies of their time. The first era took off in the beginning of 1900th century, and was very much in connection with the industrial world of that time. In the 1950s and 1960s foresight methodology started developing in the US, when the first quantitative (such as trend extrapolation and growth models) and qualitative (scenarios and Delphi) were introduced. The second foresight era started in the beginning of 1970, spurred by the first era, and is projected to continue till year 2025. (Linstone 2011, pp. 69-71.) The second era is also known as the information technology era, and the advances in information and communications technology have made it possible for example to simulate and model complex systems and networks and search vast databases (Porter et al. 2003, p. 11). The concept of technology foresight has also caught public exposure since the 1990s as more and more countries have started launching national foresight programmes (Miles 2010, p. 1452). The third foresight era, which is estimated to start in 2025, will be empowered by developments in molecular science and nano- and biotechnology (Linstone 2011, p. 73).

Foresight methods can be classified by making distinctions between quantitative versus qualitative, exploratory versus normative, predictive versus open and creativity- versus evidence-based foresight methods (European Commission 2011). Exploratory methods look into the future based on the current technological capabilities and normative approaches look back from the future to the present (Porter et al. 2003, p. 3; Bengisu & Nekhili 2006, p. 836). The most common methods used in the field of technology foresight are presented in figure 2.2. The method used in this thesis, bibliographic analysis, is an evidence-based and explorative method usually used to increase understanding on the examined topic (Porter et al. 2003, p. 4; Smith & Saritas 2011, p. 85).

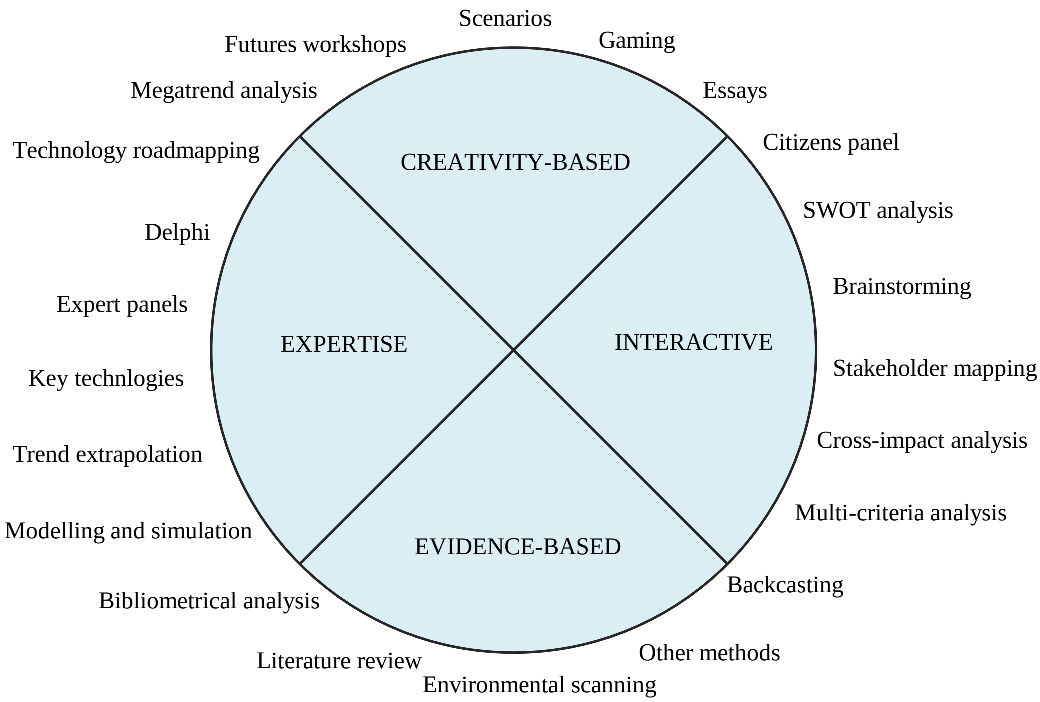


Figure 2.2. *Classification of foresight methods (Popper 2008, in European Commission 2011).*

Foresight methods can be used to develop models that model the real-world phenomena. The use of models can be justified by two functions they offer: With them a) one can draw real-world predictions using an abstract mathematical model, or b) they can function as an abstract thinking aid, not by representing the world realistically but revealing some aspects of the system's behaviour or by giving new insight. (Linstone 1999, in Porter et al. 2003, pp. 5-6.) Even though the analysis in this thesis does not reach the level of model development, the examination serves as a basis for future work in RE foresight.

2.2. The connection between media and RE production

In the following, the connection between media and RE production is analysed. More precisely, bibliometrics as a technology foresight method is explained, theory on technology diffusion S-curve presented, and the previous research combining these two tools introduced. Also, the justification of analysing the research gap between media and RE production using these methods is stated.

2.2.1. Bibliometrics

Bibliometrics or *bibliometric analysis* is an exploratory method, which is used to create understanding on the studied subject (Porter et al. 2003, p. 4; Smith & Saritas 2011, p. 85). Bibliometrics is based on analysing publications by their attributes – for example article titles, authors, origin of country or date. The publications can be examined by the information they contain or by the linkages, co-occurrences and networks between them. (Kostoff et al. 2001, p. 223; Gupta & Bhattacharya 2004, pp. 4-5.) The studied topic can be also visualised to see for example who the leading authors are, how the terminology has developed or how the research on the field is related to other fields (see for example (Su & Lee 2010). When making a bibliometric study, one has to take into account that the changes in terminology over time, or noisy or lagging data may deteriorate the validity of analysis (Watts & Porter 1997, p. 14).

Bibliometrics can be used to determine a specific technology's position on its life cycle. Martino (2003) states that as a new technology is in it research phase, it starts appearing in scientific articles. When the technology is further developed it is featured in patent databases, and the as technology evolves into application-level and starts causing social impacts the focus of discourse is shifted into newspaper and press articles (see figure 2.3). (Martino 2003, pp. 720-721.)

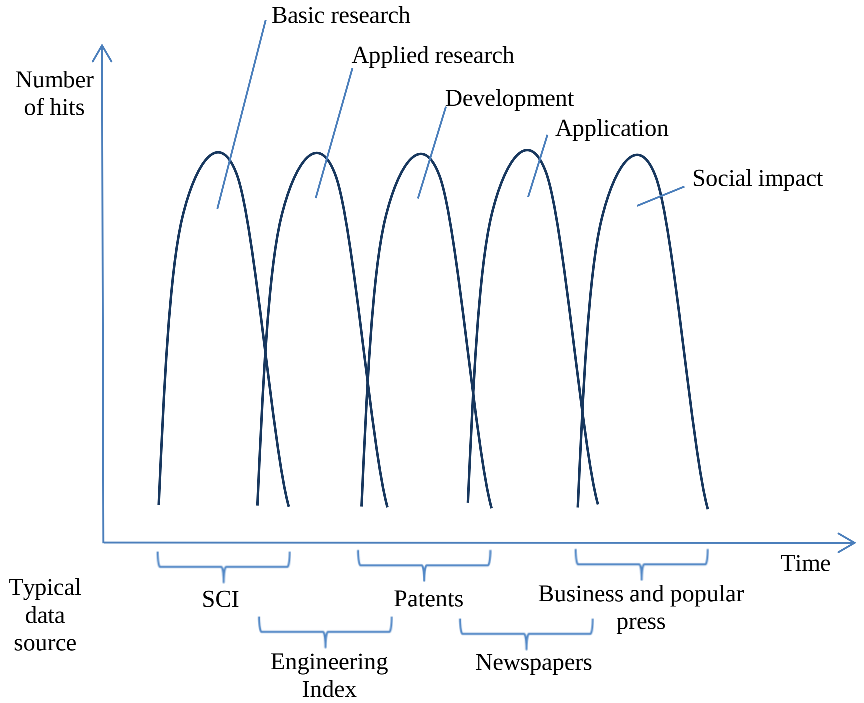


Figure 2.3.*Selecting the data source in a bibliometric study according to the stage of innovation (adapted from (Martino 2003 , p. 720-721).*

Hence, when making a bibliometric study, the selection of data source depends on the development phase of the innovation or technology studied. In the case of this thesis, the studied RE technologies have already been developed into applications, so newspaper and other press articles are appropriate data sources.

2.2.2. Technology diffusion S-curve

Diffusion is the spread of new ideas (Rogers 2003, p. 6). Diffusion of technology can be examined using different models. Geroski (2000) has divided models into four categories: epidemic, density dependent growth, information cascades and probit

(Geroski 2000). Also, the models can be viewed from three theoretical approaches: epidemic, rank and game theory approaches (Bocquet et al. 2007). In this thesis the diffusion S-curve (Rogers 1967; Rogers 2003) – an epidemic model widely used in diffusion research – is used to examine the diffusion of RE production. S-curves are characterised by an early period of slow growth, followed by relatively rapid adoption and an ending of slowly approaching the saturation level (see figure 2.4). S-curves are rather rarely symmetrical in actual innovation diffusion, as the later stages progress much slowly than the initial phase (Geroski 2000, p. 604 & 609).

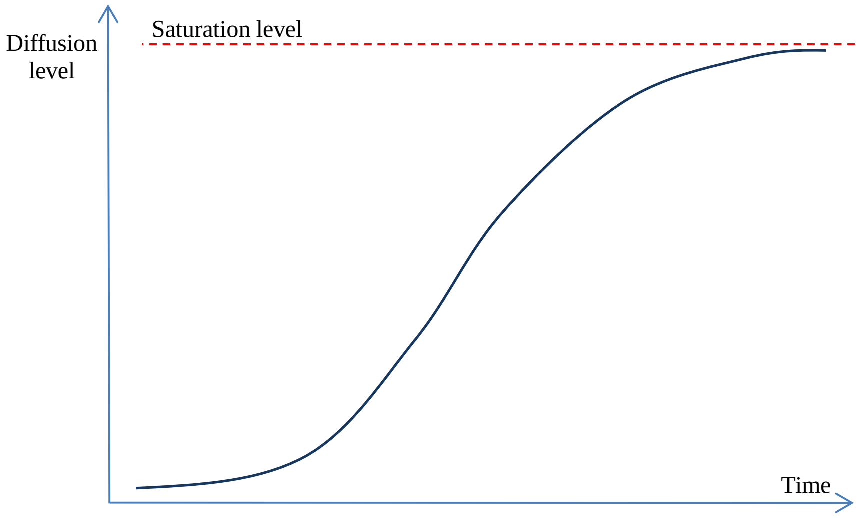


Figure 2.4.*Technology diffusion S-curve (adapted from (Rogers 2003).*

The most common S-curves are logistic, such as Fisher-Pry, and Gompertz models, which follow the natural phenomenon of growth (Porter et al. 1991, p. 175). The use of models is not however discussed in this thesis, as the emphasis is on the use of diffusion S-curve in bibliometric applications.

2.2.3. Bibliometrics in technology diffusion research

The growth of scientific knowledge is a social influence process, and a phenomenon similar to diffusion of innovations (Gupta et al. 1997, p. 508). In previous research scholars have discovered that bibliometric analysis can be used to reveal the diffusion level of an innovation. Especially patenting activity as a descriptor of a certain technology's diffusion process has been widely studied. Authors such as (Campbell 1983; Chang et al. 2009; Daim et al. 2006; Ernst 1997; Järvenpää et al. 2011) have argued that the patenting or patent citation activity of a technology generally follows an S-shaped growth pattern. The studies focusing on the use of scientific journals and their citations have brought similar results (Chao et al. 2007; Mingers 2008; Mingers & Burrell 2006). Newspapers are also acknowledged as an indicator of technological activity (Okubo 1997, p. 24), but their use as data source in technology diffusion research has not been as extensive as the use of patents and scientific publications.

2.3. The connection between media and RE policy

In this chapter the connection between the media and the policy is examined. First, the study between these two is briefly presented and also, the concept of agenda setting is defined. Then the reciprocal connection of the media and the polity is discussed using two different approaches: The factors influencing the media's political agenda setting power are examined through the agenda setting model of Walgrave & Van Aelst (2006) and after that, the Circuits of culture model by Carvalho & Burgess (2005) is used to shed light on the course of communication between the media and the political actors (Carvalho & Burgess 2005; Walgrave & Van Aelst 2006).

Previous research suggests that the media may not influence the political agenda directly, but rather through public opinion. The media, the public and the polity all have an impact on each other (Van Noije et al. 2008, pp. 455-456). The scholars agree on the media's essential role in framing the public opinion, and also argue that the political actors do not react to media coverage itself, but on the presumed public opinion presented by the media (Walgrave & Van Aelst 2006 , p. 89 & 100). As Hall (1993) phrases, "The press is both a mirror of public opinion and a magnifying glass for the issues that it takes up", he states that the media is one of the "transmission belts" between the state and the society (Hall 1993, p. 288). But, before further discussing the topic, the concept of political agenda setting is first to be defined.

2.3.1. Political agenda setting

In comparative research the study of the connection between the media and the political agenda has evolved from two separately developed viewpoints; media communications research and political science (Walgrave & Van Aelst 2006, pp. 88-89). The concept of agenda setting is defined differently in these two research branches. In communications research, the concept of agenda setting is defined as the mass media determining the issues of the political agenda, as they force attention to certain issues (McCombs & Shaw 1972, p. 176). As stated by Cohen (1963), the media "may not be successful much of the time in telling people what to think, but it is stunningly successful in telling its readers what to think about" (Cohen 1963, p. 120). The authors in this field have approached the subject by examining how the communication between different interest groups (such as the public, the media and the polity) influences the political agenda (Hilgartner & Bosk 1988; McCombs & Shaw 1972; Protess et al. 1987). In the field of political science, agenda setting is defined as the impact of the media's issue framing on what people, for example the public or the government officials, think about the topic (Baumgartner et al. 2011, p. 4). The media outlets frame the understanding of issues and in that way set the policy agenda. The authors in this field have mainly focused on political agenda setting from the viewpoint of endogenous factors (Walgrave & Van Aelst 2006, p. 89). They have studied for example how and why the politicians take on or ignore certain matters, and what factors influence their behaviour on political issues (Baumgartner & Jones 1991; Cobb & Elder 1971).

Even if authors agree on the media framing the public opinion and that the polity is concerned with this opinion, they have had have had difficulties in reaching consensus whether the media actually has any impact on political behaviour or not (Mondak 1995, in Barabas & Jerit 2009, p. 74; Walgrave & Van Aelst 2006). Sometimes politicians take on the agendas set by the press, and sometimes they do not (Walgrave & Van Aelst 2006). All in all, media's influence on the political agenda has been studied rather sparsely, and most of the study on the field is focused in the United States (Green-Pedersen & Stubager 2010, p. 663). Walgrave & Van Aelst (2006) have summed up the research on the field and found out the reason for the inconsistent results of the previous studies: The results depend on for example, which mass media outlets and what issues are studied. They state that the media's impact to the political agenda is conditional, and in their paper they present a collection of factors that influence whether political actors take on the agenda set by the media or not. They present a contingency model of media's political agenda setting power, which is based on the previous research of 19 authors from years 1977-2004. (Walgrave & Van Aelst 2006, pp. 88-90.) Their model is chosen to be presented in this thesis to shed light on the multiple factors influencing the interactive connection between the media and the policy regime. The model is from the viewpoint of media influencing policy agenda, although the authors are aware of the reciprocal connection between these groups.

The contingency model contains factors of two types: The ones arising from the media itself and the ones placed within the political context (Walgrave & Van Aelst 2006, p. 104). These factors contribute to the level of political adoption of the issue – that is, whether the polity reacts to the subject presented by the media or not. The contingency model is presented in figure 2.5.

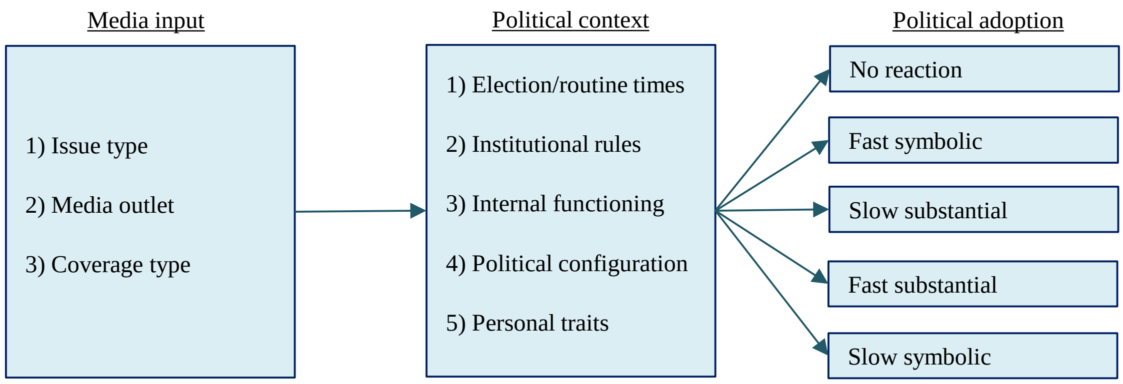


Figure 2.5. *A contingency model of media's political agenda setting (Walgrave & Van Aelst 2006, p. 104).*

In the contingency model Walgrave & Van Aelst (2006) state that on part of media, three factors – 1) issue type, 2) media outlet, and 3) coverage type – influence whether polities adopt the media's agenda or not. The first factor, issue type, is the remarkableness and newsworthiness of the issue presented. The more obtrusive the issue is, more likely it will be taken on by the polity. The second factor, media outlet, is the type of the medium. The authors state that newspapers have a more powerful influence on policy agenda than television. Thirdly, coverage type is the tone of the news, which can differ from positive to negative. Negative news cause the polity to react more likely than positive ones, while they usually require some sort of solution. (Walgrave & Van Aelst 2006, p. 93, pp. 102-104.)

On part of political context, the factors influencing political adoption are 1) election/routine times, 2) institutional rules, 3) internal functioning, 4) political configuration, and 5) personal traits. The first factor, election and routine times, is based on the fact that both the media and the politicians act differently on times of election: The politicians are not as influenced by the media as in non-election times, but rather pursue to provide the content for the media. This factor could not, however, be confirmed in a further study made of Belgian parliament (Vliegenthart & Walgrave 2011, p. 338). The second factor, institutional rules, entails the periodisation and institutional procedures of the policy regime. The media should try to impact the political regime within a particular timeframe when the topic is current in the political arena, if they want to get their issues through. The third factor is the internal functioning of political actors, which includes the informal and internal decision making practices. Internal rules also force the politicians to talk with others before making any decisions, which reduces the individual politicians' dependency on media. This, consequently, diminishes the media's impact on the polity. The fourth factor is the political configuration, which is the government-opposition array, as these two groups react differently to media pieces. The final factor, personal traits, is the level of specialization and the media-savviness of a certain political actor. The personal traits affect a politician's propensity to react to media's agenda and also, the more specialized the politician is, the more quality and specialized media he or she follows. The specialist politicians are also less affected by media coverage than the generalist ones. (Walgrave & Van Aelst 2006, pp. 102-104.)

The model presents five different levels of political adoption, which differ from no reaction to the media's agenda to symbolic and substantial reactions. Symbolic reactions are the ones that bring no concrete results, but rather tell the public the politician is interested in the subject. Substantial reactions are something concrete, that lead for example to a change in legislation. The authors state that media influences the symbolic agendas more than substantial ones. (Walgrave & Van Aelst 2006, pp. 102-104.) The political reactions examined in this thesis are laws concerning RE production, which can be concluded to be of slow substantial type.

The examination of the factors influencing the media's agenda setting power is important to understand the reasons for politicians taking on the agendas set by the media, but also another view is needed to examine the connection between the media and the polity. Therefore this connection is next analysed using the Circuits of culture -model by Carvalho & Burgess (2005), adapted from the one by Johnson (1986). The model is presented in figure 2.6. The model perceives the concept of reflexivity: Our surroundings change over time, as our knowledge and understanding of different issues develop. The authors conclude that the political actors have been the most influential in changing the climate change in the public sphere, but their messages have always been mediated through each newspaper's ideological standpoint. (Carvalho & Burgess 2005.)

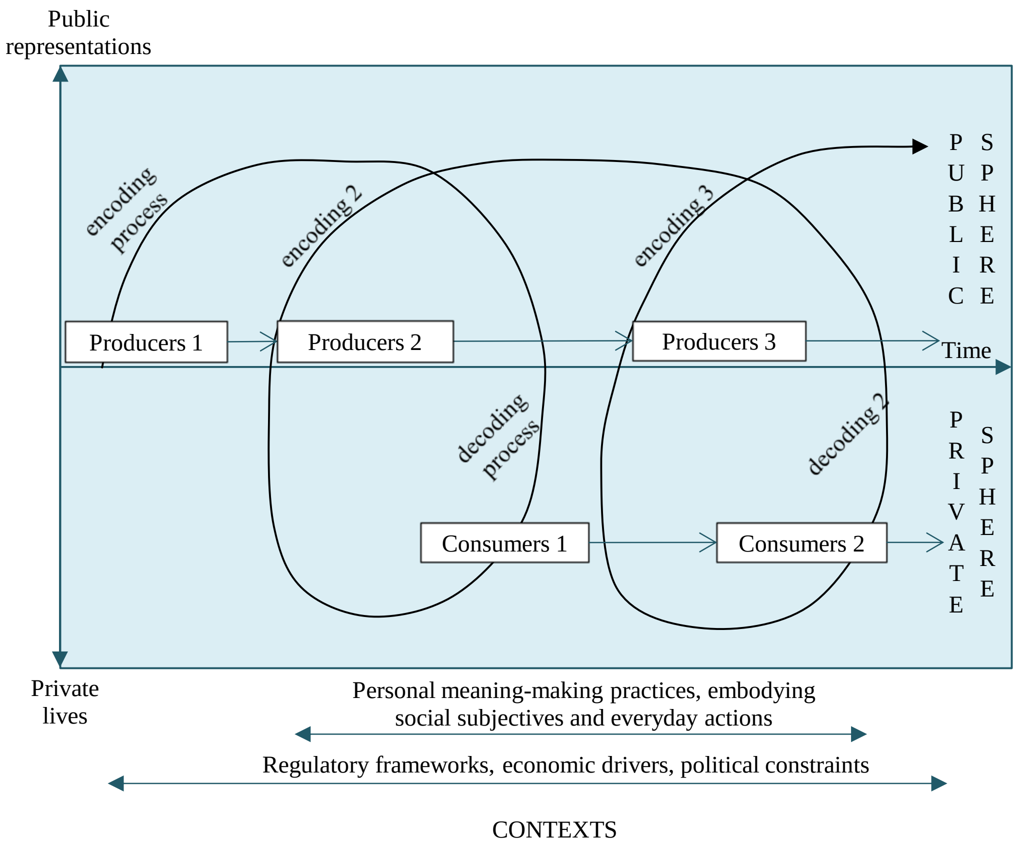


Figure 2.6. *Circuits of culture -model (Carvalho & Burgess 2005, p. 1459).*

The Circuits of culture -model is based on the idea that different discourses travel in our surroundings within the public and private sphere. The public sphere consists of for example political, economic, institutional, social and cultural landscape and the private sphere of individual people (Boykoff & Roberts 2007, p. 9). Carvalho & Burgess (2006) state that the model contains three phases of communication: production, textual analysis and consumption. The first phase, the production of media texts, is performed by media professionals. They encode the events within our surroundings into news and have a very influential role in shaping the media agendas and discourses, especially in complex scientific issues such as climate change. (Carvalho & Burgess 2005, p. 1458). The challenges the journalists meet in the encoding process are different sorts of pressures and influences, such as asymmetrical power relationships, journalistic norms, time strains and economic constraints (Boykoff & Rajan 2007, p. 9; Boykoff & Roberts 2007, p. 209).

The second phase of the Circuits of culture -model takes place on the interface of public and private spheres. In this phase the encoded messages are disseminated into the public arena through different forms of communication (for example television, radio, newspapers and the Internet), and then analysed and decoded by the individuals in the public sphere. (Carvalho & Burgess 2005, p. 1459.)

The third phase in the Circuits of culture -model is the consumption of media texts, and it takes place in the private sphere. In this third phase the public discourses converge with the individuals' experiences and attitudes, and have an impact on their personal behaviour and understanding (Boykoff & Roberts 2007, p. 19). The audiences consume media pieces, but they are also capable of resisting the media's interpretations (Corner 2000; Myers & Macnaghten 1998, p. 1459). The individuals in the third moment have different levels of power to influence the media discourses, of which especially specialists, such as scientists and journalists are the most influential (Carvalho & Burgess 2005, p. 1460). The consumption of the media pieces in the third moment serves as a foundation for a new circuit of production, analysis and consumption.

2.4. The connection between RE policy and production

The EU is increasingly responsible for the environmental policy making in Europe, while it sets legal acts that the member countries are obliged to apply in their national legislation (Knill & Lenschow 2005, p. 114). According to the union (European Union 2011) the union's legal acts consist of regulations, directives, decisions, recommendations and opinions. Of these, regulations, directives and decisions are binding. Regulations must be applied in their entirety across the EU, and directives on the other hand are goals that all EU countries must achieve. Decisions are also binding, but only to those to whom they are addressed (for example, to a company or a single member country). Recommendations and opinions are non-binding instruments that do not impose any legal obligations on those they are addressed. (European Union 2011) On national level, the EU legislation is applied through the environmental policy of each member country. The member countries decide autonomously the policies they want to use in energy regulation.

The reasons for regulating RE production are multiple. Within the union, one of the leading ideas behind the regulation is the motivation to reach the targets set by the EU (Haas et al. 2011a, p. 1004). The latest directive the European Commission has set on the use of RE is from April 2009 (Directive 2009/28/EC). In the directive the target for the union is stated; a mandatory share of 20 % of RE in overall EU energy consumption by year 2020. This target is further broken down into national targets for the share of RE in gross final consumption of energy. For Germany this has been 5,8 % in 2005, and the target for 2020 is 18 %. For Ireland the corresponding figures are 3,1 % and 16 %, and for the UK 1,3 % and 15 %. (EUR-Lex 2009.)

EU member countries have also other motives to practise environmental policy and regulation. They for example pursue climate change mitigation, hedging against price volatility and price increase of fossil fuels in long-term, reducing the pollutants and other risks arising from the use of other, especially fossil energy sources, and developing the local employment (Philibert 2011, p. 9).

In the literature RE policies have been described from different viewpoints and through different units of analysis: For example on global (Saidur et al. 2010; Solangi et al. 2011) and national (Toke 2011) level, on RE forms in general (Reiche & Bechberger 2004) and specifically (Lewis & Wiser 2007), from investors' (Bürer & Wüstenhagen 2009; Dinica 2006) and governmental processes' (Foxon & Pearson 2007) perspective, and also on cultural (Lenschow et al. 2005; West et al. 2010) and technology diffusion (Jacobsson & Lauber 2006; Rao & Kishore 2010) viewpoints. Also, the reasons behind choosing a policy have been studied (Böcher [In Press]), as well as the barriers hindering policy implementation (Valentine 2010).

With regard to this thesis work, the most relevant view on the connection between RE policies and production is the one examining the effectiveness of the policy instruments. According to the United Nations Environment Programme (UNEP), the European Environment Agency (EEA) has defined policy effectiveness as the performance of a policy in meeting its objectives (UNEP 2011). In the following literature these objectives are mainly based on the energy production targets set by the union. All in all, the core objective of the strategies in use in the EU, according to Haas et al. (2004), is the substitution of sustainable energy use with non-sustainable energy forms, and in that way, a wider deployment of RE capacities. The major focus is to set off new RE capacity but at the same time, the maintenance, upgrading and improvement of existing capacities has to be taken care of as well. (Haas et al. 2004, p. 834.)

On part of RE forms, policy effectiveness has been under growing interest during the past decade. On the level of EU, authors such as Haas et al. (2004), Harmelink et al. (2006), Held et al. (2006), Agnolucci (2007), Lipp (2007), Haas et al. (2011a) and Haas et al. (2011b) have studied the subject. In the following, the work of these authors is briefly presented.

In their paper Haas et al. (2004) summarise the major conclusions brought up in an energy forum held in June 2002 in Budapest. They present the prevailing energy policies in the EU and discuss the recommendations for policymakers. They conclude, that if any additional measures for the support of RE will not be brought up, the EU targets will not be met. Also, there is no single best policy instrument to use to support RE production. The best results stem from using a combination of appropriate mechanisms for the needs of each country and RE form. The policies should be developed along with the technology, and the level of development of each RE form should be taken into consideration. For example, wind energy is almost competitive in the mass market, while pv and biomass are viable in the niche markets. The crucial factors for a successful RE support mechanism are long-term stability, easy access to electric grid and clear building codes. To reduce the possibility of their misuse, the promotion systems have to also take into account whether the RE capacity is existing or new. The authors also state that the empirical evidence has shown that for a mature technology such as wind power, a carefully designed dynamic feed-in-tariff (FIT) is the most preferable instrument. (Haas et al. 2004, p. 833, 838-839.) Harmelink et al. (2006) use a monitoring protocol to assess whether the direct policy instruments (these aim at the immediate stimulation of RE sources, while indirect instruments aim to improve the framework conditions in long term) in use within the EU are effective enough to meet the RE production targets set by the union, and conclude that additional policies are needed to meet the them. (Harmelink et al. 2006.) Held et al. (2006) also evaluate the success of different policy strategies in the EU. They state that the deployment of RE technologies should take place at as low cost possible to the society. They conclude that a well-designed FIT system has brought about the fastest deployment of power plants at the lowest cost. Also, they conclude that policy strategies with low policy risks have lower profit requirements for investors and thus cause lower costs to society. The effectiveness of a policy instrument depends significantly on its credibility for potential investors. The risks must be in proportion to the profits expected. The FIT system has serious advantages over TGC (tradable green certificates) while it brings low risks and profit expectations, and thus the additional costs finally paid by the customers are lower. TGC instruments contain greater risk, which is why the financial risks to the investors are also higher. (Held et al. 2006, pp. 1-2, 18-19.) In his paper, Agnolucci (2007) studies wind electricity policies in Denmark: He examines their effectiveness and the factors motivating their introduction, such as financial support, policy certainty and planning constraints. He concludes that the Danish government has chosen the right instrument – the feed-in-law – to stimulate the wind sector, but the uncertainty of the financial incentives has not stimulated the investors to set up new RE capacity. The author states that according to Lauber (2002) the Danish government has caused an atmosphere of insecurity among potential investors (see (Lauber 2002). This was seen as a slump in new capacity building in 1991-1994. (Agnolucci 2007, pp. 951-952, p. 958 & 962.) Lipp (2007) investigates the effectiveness of two main instruments, the FIT and the renewable portfolio standard (RPS) in achieving multiple objectives, such as energy security, CO_2 reduction and economic development. She uses the policy experiences from Denmark, Germany and the UK as the base of her research. She concludes that according to the evidence from the studied countries, FIT is more cost effective than RPS in RE development, even if the national context is considered. She suggests that other countries could heed the lessons from these three leaders in defining their policy features. (Lipp 2007, p. 5481 & 5494.) Haas et al. (2011a) review the main types of promotion strategies for RE electricity, and they put special emphasis on the efficiency and effectiveness of promotion schemes. They define (economic) efficiency as the absolute support level for RE electricity compared to the actual generation costs for its generators. An example of efficiency is the costs per new installed RE electricity. Effectiveness on the other hand measures, according to them, how well the policy instruments lead to the deployment of capacities from electricity from RE in relation to the additional potential, for example deployed RE electricity (kW) per year and capita. With the term additional potential the authors describe the estimated potential of the technologies. In the paper, they also make a commendable classification of the policy instruments in use in the EU, which is later presented in this second chapter. (Haas et al. 2011a, p. 1004, 1025.) In another article by Haas et al. (2011b), the authors compare the efficiency and effectiveness of two types of policy instruments, which are quantity-driven (such as tradable green certificates or TGCs) and price-driven (such as feed-in-tariffs or FITs) systems. They conclude that currently a well-designed FIT system provides a certain deployment of RE electricity in shortest time and at lowest costs to society. The main drawback in TGC systems is that a large enough, liquid market must be ensured for the trade of certificates, which may be difficult in small countries. The formation of an artificial market also causes additional policy costs that will be paid by all the electricity customers. The market mechanisms seem to fail in TGC systems, and also, the high producer profits even on low levels of production may lead to windfall profits for the owners of existing plants. This could be eliminated by making sure that the existing or at least fully depreciated plants are not given support through the quota system. (Haas et al. 2011b, p. 2186, 2188 & 2192.)

The RE policies in use in Europe are presented in the following using a classification system by Haas et al. (2011a). Their system is chosen to be presented in this thesis, as it is very recent and describes the characteristics of different policy types extensively. The classification is an extended version of the one by Haas et al. (Haas et al. 2004, p. 834), and it is presented in table 2.1.

Table 2.1. *The fundamental types of RE electricity promotion strategies (Haas et al. 2011a, p. 1012).*

		Direct		Indirect
		Price-driven	**Quantity-driven**	
Regulatory	**Investment focused**	Investment incentives Tax credits Low interests/soft loans	Tendering system for investment grant	Environmental taxes Simplification of authorisation procedures Connexion charges, balancing costs
	Generation based	(Fixed) feed-in-tariffs Fixed premium system	Tendering system for long term contracts Tradable green certificate system	
Voluntary	**Investment focused**	Shareholder programs Contribution programs		Voluntary agreements
	Generation based	Green tariffs		

In their classification system, Haas et al. (2011a) categorise the policy instruments applied in Europe by making a fundamental distinction between direct and indirect ones. Direct policy measures aim to stimulate RE electricity immediately, while indirect instruments focus on improving framework conditions in the long term. Policy approaches can be also distinguished from each other by their compulsion: There are both regulatory and voluntary policies in use within Europe. Further classification criteria are the driver of support (price or quantity) and the focus of support (investment or generation based). (Haas et al. 2011a, pp. 1011-1012.) Haas et al. (2004) explain the differences of price driven and quantity-driven instruments by stating that both approaches aim at the same target (which is, as said before, the substitution of sustainable energy use for non-sustainable energy forms and in that way, a wider deployment of RE capacities), but in the price-driven system the price is set and the quantity is decided by the market. In the capacity-driven model on the other hand, the quantity is set and the price is set by the market. (Haas et al. 2004, p. 834.)

Regulatory price-driven strategies function in a way that RE generators gain financial support from the government on the basis of capacity installed or energy produced and sold. The policy types within this category are investment focused and generation based strategies. Investment focused strategies are grounded on financial support for capacity investments, given as investment subsidies, soft loans or tax credits, and usually per unit of generating capacity. In generation based strategies financial support is a fixed regulated FIT or a fixed premium that an authority is obliged to pay to eligible RE electricity generators. Within the category of generation based systems, the difference between FITs and premiums is that for FIT systems the total feed-in price is fixed, and for premium systems the amount to be added on top of the electricity price is fixed. The total price received by the producer is less predictable in premium systems because of the volatility of electricity prices. (Haas et al. 2011a, p. 1011.)

Regulatory quantity-driven strategies are based on governments defining the desired level of RE generation or market penetration. The most notable policy types are tendering or bidding systems and tradable certificate systems. The former consist of invitations for tenders or bids, which are launched for predetermined amounts of capacities. The producers bid for the contracts and the winners are then guaranteed to receive a tariff for a specified period of time. Tradable certificate systems on the other hand, are instruments in which the parties of the energy producing supply chain are obliged to supply or purchase a certain proportion of electricity from RE sources. The price for the certificates is set on the market, for example NordPool. Certificates may be obtained in three ways; by generating RE electricity on their own, by purchasing RE electricity and associated certificates from other generators, and/or by purchasing certificates from a generator or a broker. (Haas et al. 2011a, p. 1011-1012.)

Voluntary approaches are based mainly on the consumers' willingness to pay a premium price for RE electricity for example for environmental concerns. Investment focused voluntary approaches contain for example shareholder programs, donation projects and ethical input. Generation based voluntary approaches on the other hand consist of instruments such as green electricity tariffs with and without labelling. (Haas et al. 2011a, p. 1012.)

Indirect strategies differ from direct strategies by promoting RE dissemination indirectly. They aim to improve the long-term framework conditions, and the most important instruments in this category are eco-taxes for electricity from non-RE sources (such as coal), taxes or permits on CO_2 emissions, and removal of subsidies formerly given to fossil and nuclear generation. The indirect promoting of the RE sources with taxes can be done in two ways: Either with an exemption from taxes or their (partial or whole) refunding. (Haas et al. 2011a, p. 1011-1012.)

In the following sections of this chapter the main support strategies for the RE electricity production in the subject countries (Germany, Ireland and the UK) are presented. All of these countries have multiple instruments in use, and they belong to different categories of the classification system by Haas et al. (2011a). The generalisation by Haas et al. (2011a) is a good tool for understanding the policy trends in each subject country. One must still remember, that in addition to the policy instruments presented in the following, there are also other, less significant instruments in use in the subject countries, and as a whole these instruments form the RE promoting strategy. In the following, these strategies and their effectiveness are explicated.

In Germany, the main system for the promotion of RE electricity is a fixed FIT system, which has been in force since 1991, when the 'Electricity Feed-in Act' was established. FIT is, as mentioned before, a regulatory price-driven system in which the government sets the price for the electricity and quantity is then decided by the market. The government is obliged to pay a fixed feed-in price to eligible electricity producers for the electricity they feed into the power-distribution network. Important advancements of the system were made in 2000, when a policy called the 'Renewable Energy Act' took the place of the former policy. The most important advancements the new act brought were uncoupling of the tariff level from electricity price and setting the new tariffs based on actual generation costs of electricity. Thus, the tariffs were differentiated on technology level and also within technologies. In practise this meant for example decreasing the tariffs for onshore wind power and wind power in bad wind locations, and increasing the tariffs for geothermal electricity, small-scale biomass and solar pv. Also, bonuses for innovative technologies were granted and the refurbishment of large-scale hydro plants was included into the support system. On top of the FIT system, worth mentioning is also the German-based '1000 Roofs program', that was the first international solar pv -program. The program ended in 1994 but was expanded in 1999 by '100 000 Roofs Program', in which low-interest loans were provided for the installation of solar pv panels. When the interest rate was raised and a favourable tariff set in 2000, the amount installations expanded. It cannot be stated, however, which instrument of the two used ones – the cheap loans or FIT – had more influence on the increased rate of solar pv installations. All in all, the German system has been a success story – The effectiveness of the country's RE electricity policy scheme has been the second best of all the EU member states in 1998 – 2005. Only Denmark's policy scheme is better than Germany if measured in effectiveness. (Haas et al. 2011a, p. 1015, 1018-1019, 1024 & 1027.)

In Ireland, a tendering system was in use till 2005, when a FIT system was introduced. A tendering system is otherwise similar as the FIT, but the quantity is set by the government and the price is then formed in the market. The reason, why many European countries switched their policy from tendering system to either feed-in-tariff (for example France) or renewables obligation (the UK), was the poor effectiveness of tendering systems. In Ireland, the effectiveness of the policy scheme has been mediocre in 1998 – 2005, less than one third of Germany's. It has still succeeded better than its neighbour, the UK, mainly for choosing FIT instead of for example renewables obligation. (Haas et al. 2011a, p. 1015, 1020, 1027.)

The UK has not been successful in its RE electricity policy. A tendering system, as in Ireland, was in use till year 2002, and it was replaced by a renewables obligation (RO) system, also known as quota obligation or TGC (tradable green certificate). The system is otherwise similar to tendering schemes, but instead of bidding the contracts to produce electricity as in tendering system, the producers and other parties of the electricity supply chain are obliged to buy certificates from a spot market or alternatively, buying a certain proportion of electricity from RE sources from other producers. The cons of the RO system are the high prices of the certificates and the fact that the set quota has not been fulfilled so far. A positive feature of the system in the UK is that there are penalties in use for the producers that do not meet the obligations. These are paid to a central fund, which is distributed to the suppliers that have met the obligation. All in all, the effectiveness of the UK's policy schemes has been low in 1998-2005. (Haas et al. 2011a, p. 1015, 1020-1021, 1027.)

2.5. Synthesis

The emphasis of this thesis work is on examining the connection between media and RE production. However, to better understand the topic a major influential force on RE production, the RE policy, was involved into the examination. This chapter discussed the linkages between these three.

In this chapter, the field of technology foresight was first introduced. Then the connection between media and RE production was discussed by representing the use of bibliometrics in technology diffusion analysis. It was noticed that previous studies have not used newspapers and other media data as a data source in diffusion studies, even though they are acknowledged as appropriate data sources in the application phase of a technology. A conclusion was drawn, that newspapers can be used as a data source when studying the diffusion level of a technology using bibliometrics.

The connection between media and RE policy was discussed by explaining the media's political agenda setting power and the course of communication between the media and the polity. The theories explained that the media does have some influence on the political agenda, depending on the media input and political context. The level of polity's agenda adoption can vary from no reaction to symbolic or substantial reactions, and the reactions can occur slowly or fast. The course of communication between the media and the polity was discussed using the Circuits of culture -model. The reason for presenting these two models was to shed light on the reciprocal relationship between the media and the polity.

Finally, the connection between RE policy and RE production was covered by representing the most common energy policies used in the EU and their effectiveness. In Germany, RE energy is promoted using a fixed FIT system since 1991. Ireland and the UK used tendering systems, but both have changed them. Germany changed the promotion system into FIT in 2005, and the UK into renewables obligation (RO) system in 2002. The research has shown that fixed FIT is the most effective system in promoting new capacity formation, and the RO the least effective. Consequently, the German system has been a success, and the UK has struggled in its RE policy.

The theory review suggests, that the media data should describe the diffusion level of the studied renewable energy forms, as they are in the application level of technological development. Also, the effectiveness of the RE promoting system each country has chosen to use may have an effect on how well the media data describes each technology's diffusion level. The previous research has not considered this.

3. RESEARCH METHOD AND MATERIAL

In this chapter, the characteristics of the used data and the grounds for selecting the research subjects are explained. Also, the methods of the data collection are written down and finally, the used analysis tools are described.

3.1. Data used in the study

According to Bryman & Bell (2007), data analysis can be either primary or secondary (Bryman & Bell 2007). In this study the research is based on data from four different secondary sources. The sources are considered reliable, as they are either public authorities or trusted service providers whose data is widely used in scholarly work.

Three kinds of data are needed to carry out the research: Media coverage data, primary energy production data and data on RE policies and measures. The media coverage data are collected from Nexis UK, a database portal owned by Reed Elsevier Inc. This service is only available for a subscription. (LexisNexis 2011) The second data type, the primary energy production data are collected from two sources, Eurostat and the SEAI. The former is the statistical office of the European Union (Eurostat 2011) and the latter the energy authority of Ireland (SEAI 2011). Most of the primary production data are collected from Eurostat, and the statistics on SEAI’s web page are utilised to complement them on part of the solar photovoltaic data on Ireland. The third data type, the RE policies and measures data are collected from IEA (International Energy Agency), which is an autonomous energy organisation (IEA 2011).

The examined countries are chosen based on the limitations and the objectives of the thesis. The media coverage data is searched in each examined country’s native language to provide as valid search results as possible. Also, countries that are leaders in the production of RE within the EU are first considered as research subjects. In the EU, such countries are Austria, Germany, Spain, France, Finland, Italy, Sweden and the UK (Haas et al. 2011a, p. 1007). Of these, Norway, Sweden and Finland cannot be studied because their native languages are not available in Nexis UK’s search portal. Other countries, as Spain, Italy and France on the other hand do have their native languages available in Nexis UK, but there are not sufficiently data on them – the amount of news hits is rather small for any solid conclusions to be drawn. After ruling out some of the countries on the bases above, Germany, Ireland and the UK are chosen under research.

The data is gathered from the time period of years 1995 to 2008. This time period is chosen because of the limitations of the used data sources. On part of Nexis UK, it could not be confirmed whether there was sufficiently data available on years before 1995. Also, the production data on Eurostat's web-page was only available up till year 2008, during the time when the data was collected in January and March 2011.

3.1.1. Media coverage data

The search of the media coverage data is the most time consuming part of the data collection. The data are collected on monthly level for possible future research needs, which makes the amount of searches a towering 3024. For the purposes of this thesis only, the amount of the searches needed is 252. This amount encompasses fourteen years, three countries, three RE forms and two content options. Only quantitative data are needed in this thesis, but for the use of future research the publications are downloaded in full text as well.

The search terms are built in a way that the searches would bring results as relevant for the research as possible. In searches concerning Ireland and the UK the search terms are written in English and naturally, when searching data on Germany the search terms are in German language. The terms are selected on the grounds for being collective and representing the energy production of each RE form in general. Therefore, for each RE form search words *energy* and *power* are used. Similarly, for each RE form, the basic terms are tracked down by making a general view on the articles of the field and also by consulting the English and German lecturers, John Shepherd and Sibylle Kingelin in Tampere University of Technology. It was decided that only the basic forms of words are to be used, although the nouns inflect in German. This decision is made to keep the construction of the search clauses simple. Between every search term the Boolean connector OR is used. The used search terms are presented in Table 3.1.

Table 3.1. *The used search terms in the media coverage data collection in Nexis UK.*

	Ireland and the UK	**Germany**
Wind energy	wind energy OR wind power	windenergie OR windkraft
Solar pv energy	solar energy OR solar power OR photovoltaic energy OR photovoltaic power OR pv energy OR pv power	sonnenenergie OR sonnenkraft OR solarenergie OR solarkraft
Hydroelectric energy	hydro energy OR hydro power OR hydroelectric energy OR hydroelectric power	hydroenergie OR hydrokraft OR wasserenergie OR wasserkraft

The steps for reproducing the searches on finding out the amount of publications listed in Nexis UK portal are listed in the following:

1. Go to Nexis UK's web page: http://www.lexisnexis.com/uk/nexis/home/home.do.
2. Sign in to the service with your ID and Password.
3. Click the Search tab located on top of the page.
4. Click the News tab under the Search tab.
5. Add search terms on the Search terms field. (The used search terms contain information on which part of the text search words are sought for and which Country/Region and time period is chosen. The instructions for constructing all the search terms are in the Appendix 1. The used search terms were constructed in a way that they contain as much information as possible. This way the search process could be done more fluently and the amount of work done by hand could be reduced.)
6. Do not add any Index terms on the Index terms field. That is, leave the Industry, Subject and Country/Region fields as they are, that is all industries, all subjects and all countries selected.
7. Choose the language of the news on the Sources field. When searching data on
    a. Germany, choose German language news.
    b. The UK, choose All English language news.
    c. Ireland, choose All English language news.
8. Do not select the Exclude newswires and Exclude non-business articles options.
9. Put duplicate options on by selecting On – High similarity on the Duplicate options field. (With this selection Nexis UK makes similarity analysis to the search results by identifying documents that have similar content and groups the similar documents together. When using this option you get both the amount of all documents and the document count after the similarity analysis.)
10. Leave the Specify date field as it is, all available dates selected.
11. Click Search button.
12. Nexis UK gives you the search results. Now you have to type the amount of results into an Excel file. Type both figures; the amount of all documents and the amount of documents after similarity analysis.
13. After this, click the Download delivery icon on the upper right of the results page.
14. A pop up window, where you can choose how you want your results to be downloaded, opens up.
15. Select Text on the Format field.
16. Select Full Text on the document view field.
17. Select All documents on the document range field.
18. Do not select the Deliver in two columns option.
19. Do not add any page options.
20. Click Download.
21. Save the downloaded file on your hard disk or memory card.

3.1.2. RE production data

Here the steps for reproducing the searches on RE production are described in a similar way as in the preceding. First, the collection of data from the SEAI's web page is described:

1. Go to SEAI's web page: http://www.seai.ie/.
2. Click Statistics on the bottom of the page.
3. Click Energy statistics data bank tab.
4. Click Energy balance statistics.
5. Click Primary energy production (ktoe) by Fuel type and Year.
6. On the Fuel type field, select Solar.
7. On the Year field select years 1995 to 2008. To select multiple years at a time, press down the control key on your keyboard.
8. Select Excel file (.xls) as the format of the data.
9. Click Get data.
10. Click Download.
11. Save the downloaded file on our hard disk or memory card.

In the following, the collection of the rest of the data, gathered from the Eurostat's web page, is described:

1. Go to Eurostat's web page: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home.
2. Click the Statistics tab on the top of the page.
3. Click Browse/Search database on the menu left.
4. On the data navigation tree take the following path:
    - Database by themes
    - Environment and energy
    - Energy (nrg)
    - Energy Statistics – Quantities (nrg_quant)
    - Energy Statistics – Supply, transformation, consumption (nrg_10)
    - Supply, transformation, consumption – Renewables (hydro, wind, photovoltaic) – Annual data (nrg_1072a)
5. A data explorer tool opens up in a pop up window.
6. In the data explorer, click Select data tab on the top of the page.
7. On the data selection page there are five criteria through which you can define your search. These are geography, indicator, product, time and unit. The searches must be done in three parts – one search per each energy form. The criteria for each search are described below.
    a. Hydroelectric energy
        - Geography: Germany, Ireland, United Kingdom
        - Indicator of energy: Primary production

- Product: Hydro power
- Time: Years 1995 – 2008
- Unit: Thousand tonnes of oil equivalent (TOE)

b. Wind energy
- Geography: Germany, Ireland, United Kingdom
- Indicator of energy: Primary production
- Product: Wind Energy
- Time: Years 1995 – 2008
- Unit: Thousand tonnes of oil equivalent (TOE)

c. Photovoltaic energy
- Geography: Germany, United Kingdom (Data on Ireland not available)
- Indicator of energy: Primary production
- Product: Photovoltaic Power
- Time: Years 1995 – 2008
- Unit: Thousand tonnes of oil equivalent (TOE)

8. When finished with 7a, click Update. The requested data appears in a table on the right side of the page.
9. Click Download on the top of the page.
   a. The data is downloaded in Excel format: Select Short description, Full extraction and Flags and footnotes on the separate sheets.
10. Click Download in Excel format.
11. Save the downloaded file on your hard disk or memory card.
12. Do the above procedure with 7b and 7c.

3.1.3. RE policy measures data

Here the steps for reproducing the searches on RE policy measures are described:

1. Go to IEA's web page: http://www.iea.org.
2. Click By Country on the top of the page.
3. Click Germany.
4. Click Related Country and Regional Information.
5. Click Global Renewable Energy Policies and Measures Database.
6. A result table opens up. Copy the table on an Excel spreadsheet.
7. Do the above procedure for Ireland and the UK as well.

3.2. Analysing the data

According to Agresti & Finlay (1997), correlation analysis is about studying the connection between two quantitative variables. With correlation analysis one can investigate whether an association exists between the two variables, the strength of the association, and the form of the connection. (Agresti & Finlay 1997, p. 303.)

In this thesis the quantitative data, that is the media coverage and the RE production data, is analysed by means of correlation analysis. Although multiple factors have all their impact on energy politics and in this case, on the production of wind, solar pv and hydroelectricity, the scope of the master's thesis provides only a limited analysis. Therefore the connection between media coverage and RE production only is studied.

Before introducing correlation analysis in more detail, the characteristics of the quantitative data used in the thesis is first described. In this thesis the quantitative data is measured as a function of time. The observed values form two separate time series, which are placed on a time period between years 1995 – 2008. Thus, the amount of data points in this study is n=14. According to Mellin (2006), a time series is a sequence of data points of variable *x*

$$x_1, x_2, \dots, x_n$$

where

$$x_t = the\ observed\ value\ of\ x\ at\ time\ t$$

and the time index

$$t = 1,2, \dots, n$$

refers to the successive times. In a time series x_t $(t=1,2,\dots,n)$ the successive times that correspond with the time index values $1,2,\dots,n$ form the observation period. The time series x_t is discrete, as it consists of separate observations. (Mellin 2010, pp. 9-11.)

Presenting the data visually reveals the trends in it and gives a general view of the studied phenomenon. Mellin (2010) declares, that the graphical representation of a time series is a dot diagram, where the ordered pairs of numbers

$$(t, x_t), \qquad t = 1,2, \dots, n$$

are presented as points in a plane. In a time series diagram, the successive points

$$(t-1, x_{t-1}), (t, x_t), \qquad t = 2,3, \dots, n$$

are usually connected with each other with line segments. (Mellin 2010, p. 28.) The visual representations of the quantitative data can be found in Chapter 4.

Mellin (2010) states that time series analysis is often done by converting the data into logarithmic form. This is because the relative variation of the variables is usually more informative than the absolute variation. Also, if the trend in a time series is exponential, the data can be linearized by converting it into logarithmic form. (Mellin 2010, p. 42.) The logarithmic representations of the quantitative data are also in Chapter 4.

The descriptive statistical parameters calculated for the data are minimum and maximum values, mean and standard deviation. For variables *x* and *y* mean is calculated with the formulae

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

Sample standard deviation is calculated accordingly for *x* and *y*, as follows (Weisstein 2011a):

$$s_x = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

and

$$s_y = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

3.2.1. Correlation analysis

To analyse the connection between two quantitative variables, one must use correlation analysis to see, whether a connection between the variables exist. Though, one must be aware of the fact that correlation between the variables does not imply causality (Bryman & Bell 2007, p. 361). In this thesis only the correlation between media and RE production is analysed, and the examination of causality is thus regarded irrelevant. The correlation analysis is performed using SPSS.

According to Mellin (2006) the dependence between two (or more) quantities can be

1. exact if the values of the other variable can be derived exactly from the values of the other variable.

2. statistical if the dependency between the variables is not exact but the values of the other variable can be used to predict the values of the other variable (Mellin 2006, p. 240).

In this study the latter – the statistical dependency between the variables – is examined to find out whether there is any correlation between media coverage and RE production. In the field of statistics the statistical dependence between two variables is usually called correlation (Mellin 2006, p. 240).

The method for measuring correlation has to be selected according to the data used. Pearson correlation is a standard correlation measuring method, but in this study its use is not appropriate. The reason for this is that the used data does not meet the assumptions the Pearson correlation makes – the major one of these is that the data is not following Gaussian distribution. A more suitable method in the case of this thesis is Spearman correlation, also known as Spearman's rank order correlation. Spearman correlation is a nonparametric (distribution-free) rank statistic, which measures the monotone association between variables (Weisstein 2011b). To use Spearman correlation, the variables must have a monotonic relationship. A monotonic relationship means that as the one variable increases (decreases), the other increases (decreases) as well (Laerd Statistics 2011). The monotonicity of the data used in this thesis can be perceived in Appendix 3.

The data has to be ranked before the Spearman correlation can be calculated. Ranking means arranging the variables from smallest to greatest and scoring them accordingly. If there are no tied ranks – no identical values in the data – the formula for calculating Spearman correlation is

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where d_i is the difference in paired ranks and *n* the number of cases. However, if there are tied ranks, the Spearman correlation is calculated with the formula

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$$

where i is a paired score and $\bar{x}$ and $\bar{y}$ are the means of variables *x* and *y*. (Laerd Statistics 2011.)

The statistical number that measures correlation, that is the significance of statistical dependency, is called a correlation coefficient *r* (Mellin 2006, p. 240). In the case of Spearman correlation, the coefficient is denoted as ρ (rho). For correlation applies $-1 \leq \rho \leq 1$. If the variables are negatively related, then $\rho < 0$. If they are positively related, then $\rho > 0$. If $\rho = 0$, there is no correlation between the variables. Hence, if

$\rho = \pm 1$, the correlation between the variables is perfect. (Agresti & Finlay 1997, p. 320.)

To draw inferences from the connection between the variables, one must state a null hypothesis and see, if the results of the correlation analysis allow its rejection. One can only reject the null hypothesis or fail to reject it - The null hypothesis can never be proved to be true. (Agresti & Finlay 1997, pp. 326-327.) In this thesis the null hypothesis is "H_0: No correlation between media coverage and primary production exists". Accordingly, the alternative hypothesis is "H_a: A correlation between media coverage and primary production exists". The null hypothesis H_0 can be rejected if the calculated p-value is less than the significance level α. The significance of a test is the probability of incorrectly rejecting the null hypothesis H_0 (Agresti & Finlay 1997, pp. 326-327). In this thesis the significance level is chosen to be α=0,01. This means that only 1 % of the strength of the correlation may have happened by coincidence.

4. RESULTS

In this chapter the collected data are explicated. The chapter is divided into three parts, each part containing one RE form – Chapter 4.1 covers wind energy, Chapter 4.2 solar pv energy and Chapter 4.3 hydroelectric energy. These subchapters are further divided by country. In this thesis the collected data are both of quantitative and qualitative type – The media coverage data and the primary energy production data are quantitative and the data on RE policies and measures are qualitative. The quantitative data are represented on line charts and through descriptive statistics, and then examined with correlation analysis. The qualitative data of the political measures are only represented visually to illustrate their type and extent.

The grounds for using only the quantitative data in the analysis are that the quantification of qualitative data in this thesis was found to be very challenging. Multiple ways of quantifying the data were considered, but none of them was appropriate for this thesis. One way to quantify the political measures data is to compare the time periods of the political measures being in force with the RE production trends. However, this is not considered as an option, as there are no any special peaks in the political measure setting as can be seen in the following figures representing the political measures concerning each RE form in each subject country. Another way to quantify the data is to examine the RE policy budgets. However, they are quite a poor measure in this context, as the governments' RE budgets are very small compared to the investments made by companies and also, their effectiveness may not be comparable with each other. On top of this, the money spent to promote RE is not the only factor that contributes to the changes in RE production. The changes are influenced by multiple variables, such as the market forces, the competitiveness of each RE technology and the production of non-renewable energies. Besides, the policy measures examined in this thesis consist of many forms of support, for example investments, tax reliefs, R&D programs and even education programs. The measurement of different policies is thus challenging. Thus the qualitative data on RE policies are only presented to deepen the understanding how the media and RE production may or may not be related with each other, and this data can be further used in future studies.

After representing the data visually and through descriptive statistics, correlation analysis on the qualitative data is performed using Spearman's rho. Unfortunately the data can be analysed only on part of those subjects, whose data is eligible for that. Some of the data are inadequate, as the values of the variables are too small for any solid conclusions to be drawn. The data on solar pv in Ireland and the UK are not eligible for the analysis as the values of RE production are too small, only one to three tonnes of oil equivalent during the whole examination period. On part of hydroelectric energy, the data is usable on all other parts but on headline level hydroelectric energy in Ireland.

When analysing the data, one must take into account that the development of the amount of all media publications over time has not been taken into consideration. Also, it is worth considering that the relative share of RE of all primary energy production differs between the examined countries a good deal, but in all these the relative shares of RE production have increased. In Germany, the share of the production of the three examined RE forms of all primary energy production have risen from 1,4 % to 4,2 % between 1995 and 2008, while at the same time the overall primary energy production has declined over 7 %. In Ireland the relative share of the examined RE forms has increased greatly, from 1,5 % to 19,3 %, while during this time the primary energy production has decreased over 60 %. In the UK the examined RE have witnessed only a slight relative increase – from 0,2 % to 0,6 %, while the primary energy production decreased more than 30 %. All in all, the proportion of primary energy produced through RE forms have risen in the EU, while the amount of all primary energy produced has decreased between 1995 and 2008. This can be seen in figure 4.1. (Eurostat 2011; SEAI 2011) The data could have been refined by normalising it, as by removing the trends of general media coverage and energy production. This was chosen not to be done, as the normalising could have caused uncertainty in the data analysis. So, the data was decided to be held as intact as possible.

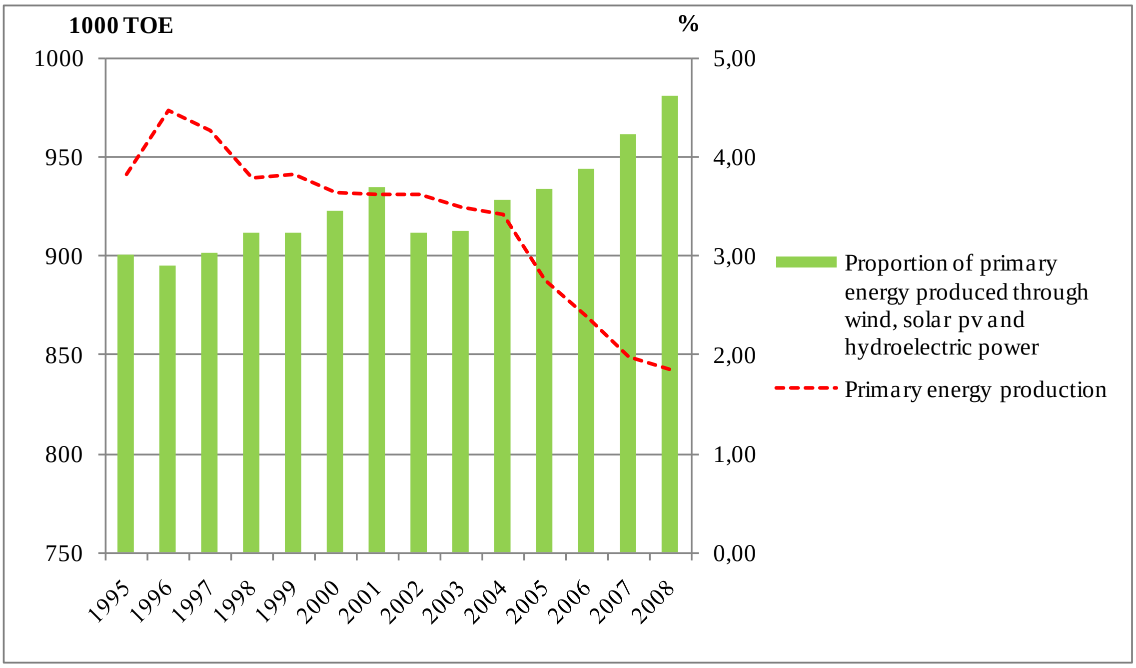


Figure 4.1. *Primary energy production and the proportion of major renewables in EU (27 EU member countries) between 1995 – 2008 (Eurostat 2011; SEAI 2011).*

Another thing to be noted when analysing the data, is to realise that the comparison of media coverage rates between countries in absolute values is not reasonable. This is because it cannot be assured whether the used data source, Nexis UK, has covered the publications of different countries and languages in the same extent. It is possible that there are more English than German language news available in Nexis UK. Comparing the trends in media coverage and RE production between countries and energy forms is however admissible.

4.1. Wind energy

Wind energy is the most produced energy form of the three examined RE forms. Its production has been most extensive in Germany throughout the whole examination period, and Ireland and the UK have a production capacity of a similar scale with each other (see figure 4.2). The greatest relative growth in primary production capacity during the examination period has been in Ireland. While wind energy is the most produced energy form of the three examined ones, it is also the one with the most extensive media coverage.

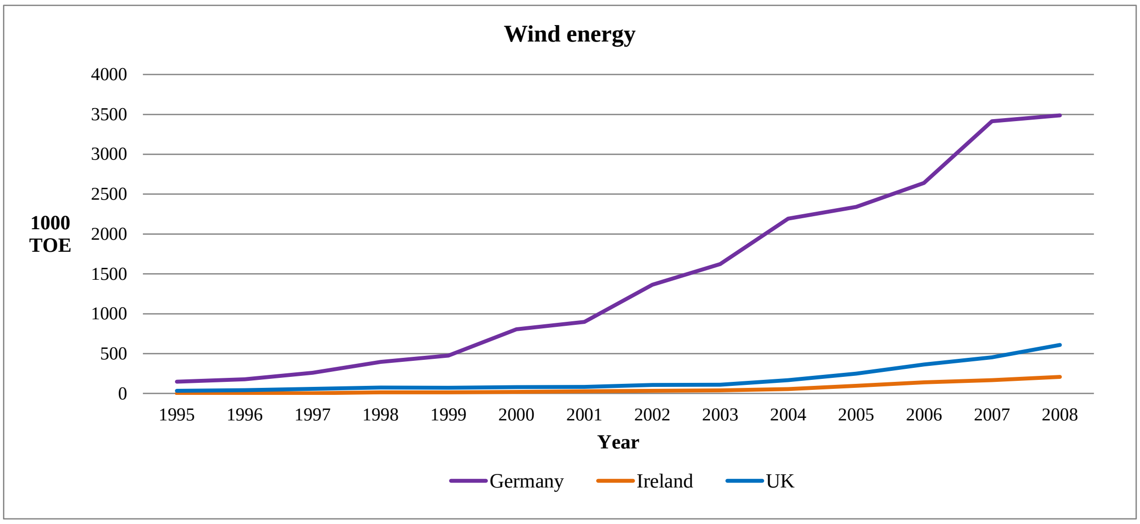


Figure 4.2. *Primary production of wind energy in subject countries in years 1995 – 2008 (Eurostat 2011).*

Wind energy can be placed in the early adopters or early majority -phase in the technology diffusion S-curve. This estimation is based on production trends in figure 4.2 above and the assessment made by Haas et al. (2011a). The authors state that in the EU (EU-15 countries) the additional potential by year 2020 for onshore wind is about two thirds and for offshore wind even more. Offshore wind is projected to become as widespread as onshore wind, but its growth has not yet properly started. (Haas et al. 2011a p. 1009.)

4.1.1. Germany

Of the three examined countries, the production of wind energy is the most extensive in Germany. Also, in absolute values the greatest growth in the production has been there, the production has grown more than 3300 kilotonnes of oil equivalent (kTOE) during the examination period, from 147 to 3489 kTOE. This is a growth of almost 2300 %. On headline-level media coverage the relative growth has been almost the same as in the primary production, 2320 % (from 16 to 387 news hits). The media coverage on the whole document level has increased relatively more than the production, more than 4500 % (from 118 to 5479 news hits). The media coverage and the primary production of wind energy in Germany are represented in figure 4.3.

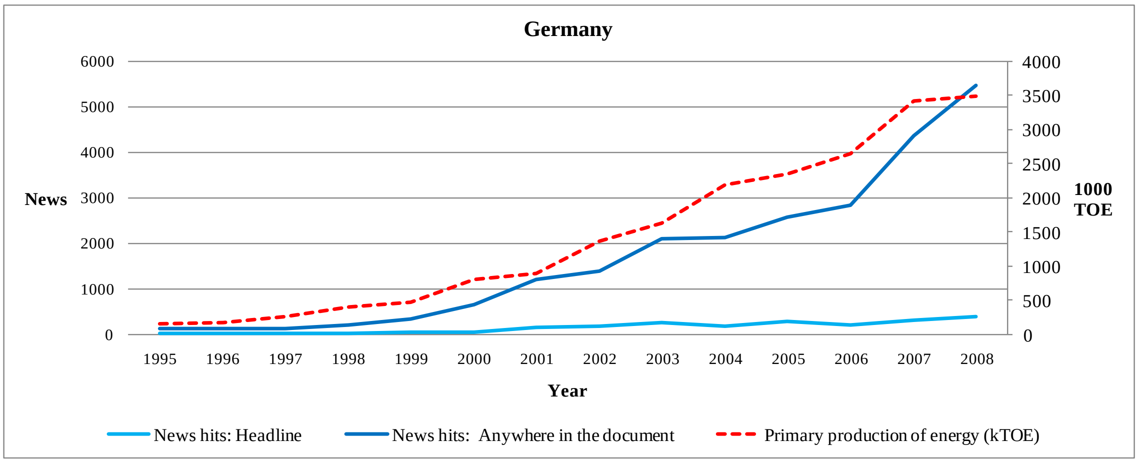


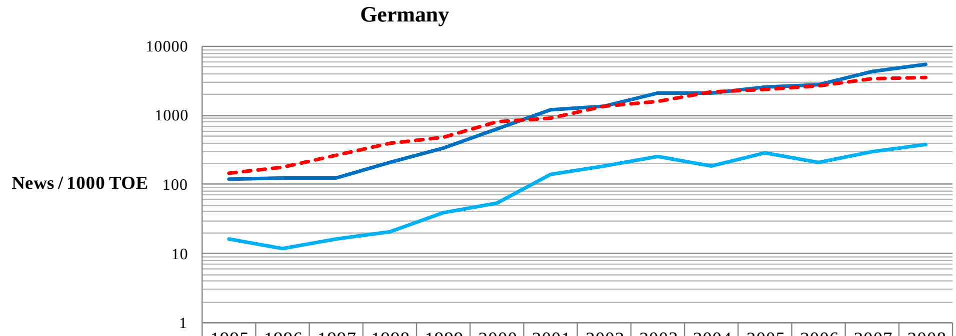
Figure 4.3. *The development of media coverage and primary production of wind energy in Germany between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Selected descriptive statistics – the range of variables, mean and standard deviation – for Germany's wind energy are shown in table 4.1. The exact values of the variables can be found in Appendix 2.

Table 4.1. *Descriptive statistics for wind energy in Germany.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	12	118	147
Maximum value	387	5479	3489
Mean	151,14	1685,21	1444,57
Standard deviation σ	126,66	1682,19	1187,48

In figure 4.4 below the same data as presented in figure 4.3 are illustrated on a logarithmic scale. When the data is presented in a logarithmic form, the growth rates of each variable can be conveniently compared. The average annual growth rate for media coverage both on the whole document level and on the headline level slightly more than 35 %, while the primary production has experienced an average annual growth of 29 % during the reference period.

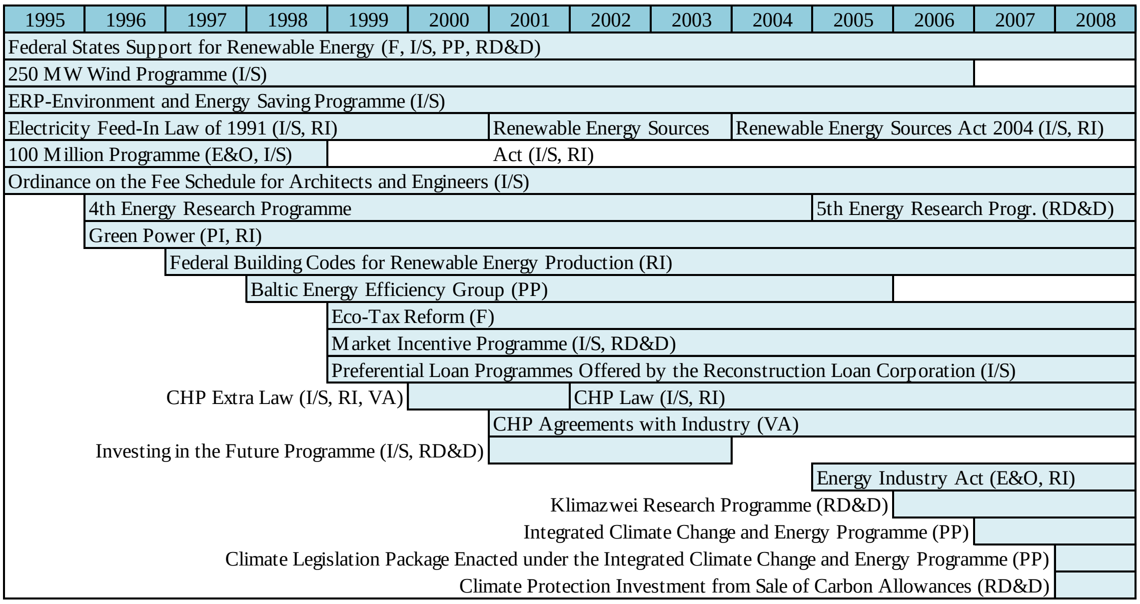


	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	16	12	16	21	39	54	142	187	259	186	282	212	303	387
News hits: Anywhere in the document	118	125	122	206	340	638	1196	1378	2103	2122	2572	2832	4362	5479
Primary production of energy (kTOE)	147	179	261	395	475	804	899	1363	1622	2193	2341	2641	3415	3489

Figure 4.4. *The development of media coverage and primary production of wind energy in Germany between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

In figure 4.4 one can see that the growth of the primary production has been exponential, but on part of the media coverage the growth has been stronger than the average between years 2000 and 2003. During this time there were all in all 15 RE policies concerning wind energy in force in Germany (see figure 4.5), which is more than in the earlier years during the examined time period. This may have had an impact on the increased growth in the media visibility of wind energy. But overall, during the examination period, the policies concerning wind energy have been set steadily. Some of the policies that have been in force in the beginning of the reference period have been put into effect before the year 1995: The Federal States Support for Renewable Energy - policy has been put in force in 1985, 250 MW Wind Programme in 1989, Environment and Energy Saving Programme in 1990 and Electricity Feed-In Law in 1991.

One must notice that the magnitude or the budget of each policy is not included in figure 4.5. Only the information on the time period the policy being in force is depicted. As said earlier in this thesis, the RE policy data is represented only to deepen the understanding on the studied subject, and this data is not used in the analysis as the qualification of the data in a valid way was found to be difficult.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.5. *Renewable energy policies targeting wind energy in Germany between 1995 – 2008 (IEA 2011).*

The results for the correlation analysis for Germany's wind energy data are represented in table 4.2. The Spearman's correlations are calculated between both types of media coverage (headline level and whole document level) and RE production. The correlation between media coverage on headline level and RE production is strong (0,961) and statistically significant, as the p-value is less than alpha (α=0,01). The same applies to the data between media coverage on the whole document level and RE production, as the correlation is almost perfect (0,996) and the result is statistically significant (p-value is $1{,}03 \times 10^{-13}$).

Table 4.2. *Spearman's correlations and statistical significances for wind energy in Germany.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	,961**
	Significance (2-tailed)	.	4,33E-08
	N	14	14
RE production	Correlation coefficient	,961**	1,000
	Significance (2-tailed)	4,33E-08	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	,996**
	Significance (2-tailed)	.	1,03E-13
	N	14	14
RE production	Correlation coefficient	,996**	1,000
	Significance (2-tailed)	1,03E-13	.
	N	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

The results the correlation analysis thus reveal that during the reference period the production of wind energy in Germany is strongly correlated with both the headline and the whole document -level media coverage.

4.1.2. Ireland

Even if Germany has experienced the greatest absolute growth in the primary production of wind energy during the examination period, in Ireland the relative growth of production has been most extensive. This is because in 1995 there was only almost a zero capacity in Ireland: Till year 2008 the production has grown from 1 to 207 kTOE, which is a growth of 20 600 %. During the same time the media coverage has increased from 50 to 1541 news hits on the whole document level (a growth of almost 3000 %) and from 2 to 106 on the headline level (a growth of 5200 %). Therefore the production has increased relatively much more than the media coverage. The media coverage and the primary production of wind energy in Ireland are represented in figure 4.6 and the full time series are in appendix 2. The general descriptive statistics – the range of variables, mean and standard deviation – for the data are presented in table 4.3.

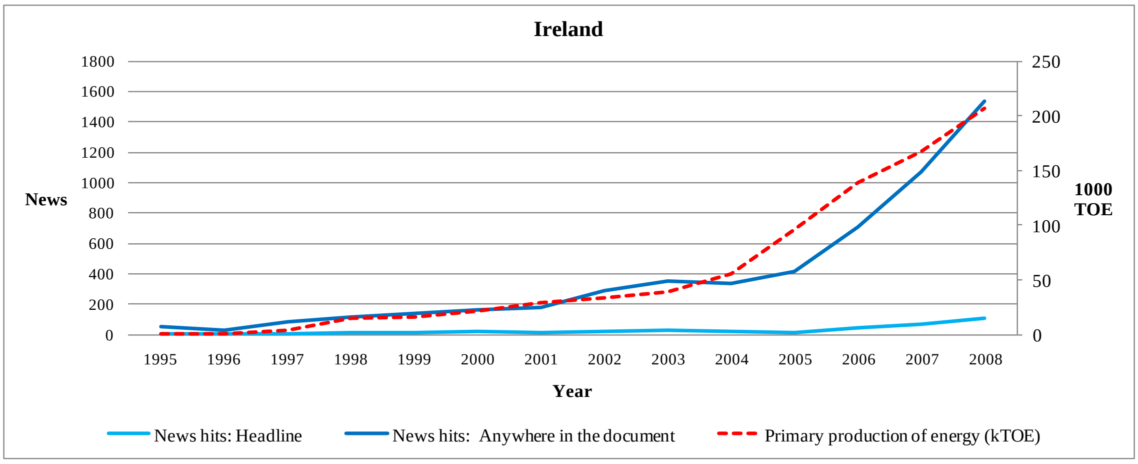
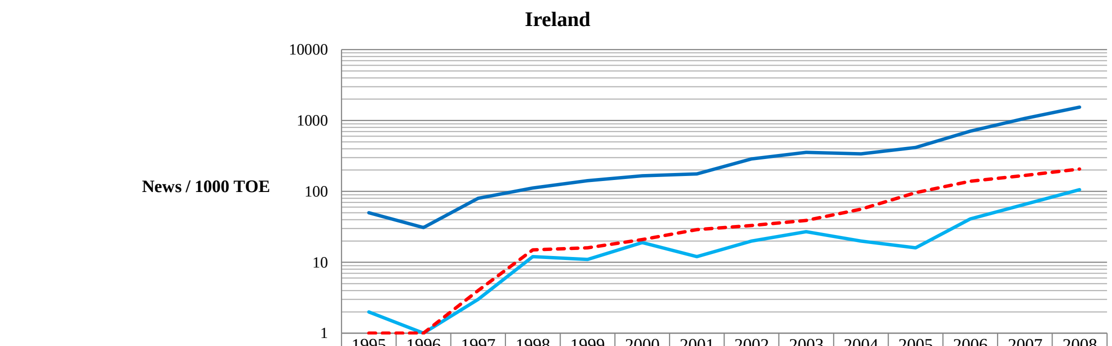


Figure 4.6. *The development of media coverage and primary production of wind energy in Ireland between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.3. *Descriptive statistics for wind energy in Ireland.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	1	31	1
Maximum value	106	1541	207
Mean	25,43	390,86	58,93
Standard deviation σ	28,81	436,31	67,09

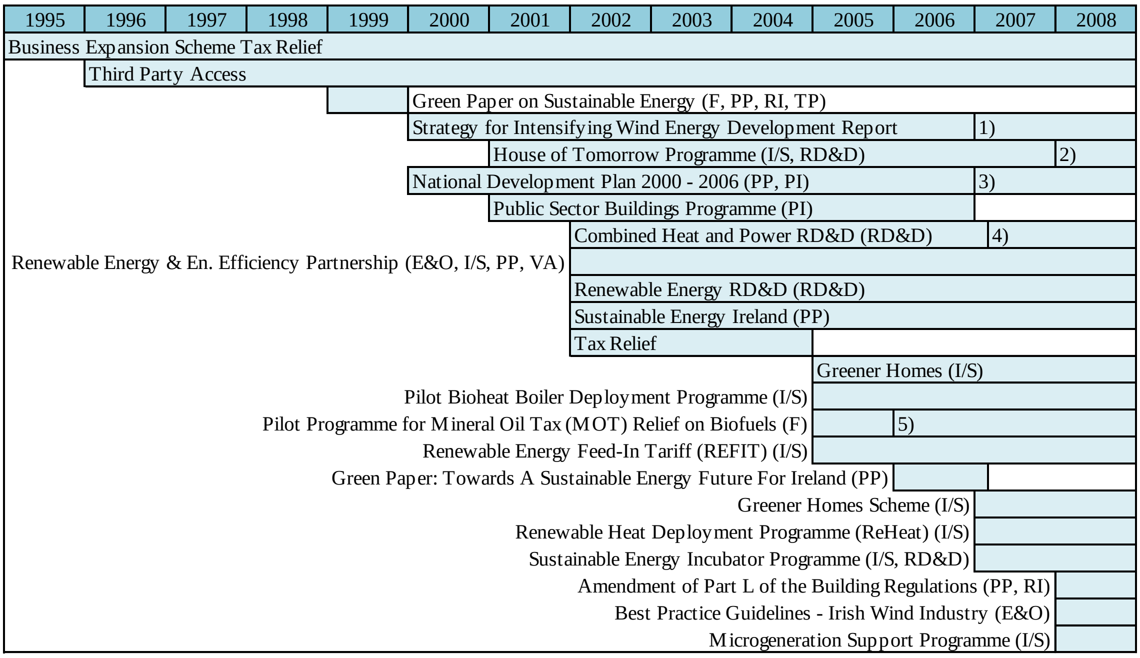
In figure 4.7 the preceding data are illustrated on a logarithmic scale. The average annual growth rate for media coverage on the whole document level is almost 37 % and on the headline level 62 %, while the primary production has grown annually an average of 68 %. But, as seen in figure 4.7, the growth rate graphs are very much in parallel with each other.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	2	1	3	12	11	19	12	20	27	20	16	41	66	106
News hits: Anywhere in the document	50	31	80	112	142	166	177	288	355	339	416	707	1068	1541
Primary production of energy (kTOE)	1	1	4	15	16	21	29	33	39	56	96	139	168	207

Figure 4.7. *The development of media coverage and primary production of wind energy in Ireland between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

In figure 4.7 one can also see that the growth rates of all three parameters have increased in 1996 and 1997 more than in other years. There were not many policies in force in that time but after year 1999 multiple new measures were put in force (see figure 4.8). The planning phase of these may have triggered both the media visibility and new capacity building of wind energy. Of the policies presented in figure 4.8, the policy called Business Expansion Scheme Tax Relief is put in force before the reference period, in 1984.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

1) White Paper: Delivering a Sustainable Energy Future for Ireland (PP)
2) Low Carbon Housing Programme (I/S)
3) Sustainable Energy Component of the National Development Plan 2007-2013 (PP)
4) CHP Deployment Programme (I/S)
5) Biofuels Scheme II Programme for Mineral Oil Tax (MOT) Relief on Biofuels

Figure 4.8. *Renewable energy policies targeting wind energy in Ireland between 1995 – 2008 (IEA 2011).*

The correlation analysis results are in table 4.4. The media data is strongly correlated and statistically significant with the production data on both the headline and the whole document level, and of these the correlation between the production and the whole document -media coverage the correlation is almost perfect.

Table 4.4. *Spearman's correlations and statistical significances for wind energy in Ireland.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	,928**
	Significance (2-tailed)	.	1,67E-06
	N	14	14
RE production	Correlation coefficient	,928**	1,000
	Significance (2-tailed)	1,67E-06	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	,995**
	Significance (2-tailed)	.	3,95E-13
	N	14	14
RE production	Correlation coefficient	,995**	1,000
	Significance (2-tailed)	3,95E-13	.
	N	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

4.1.3. The UK

In the UK the primary production of wind energy has increased from 34 to 610 kTOE during the examination period, which is an increase of almost 1700 %. The media coverage has experienced a growth of 4700 % (from 215 to 10 325 news hits) on the whole document level and a growth of almost 3600 % (from 11 to 405 news hits) on the headline level. The media coverage and the primary production of wind energy in the UK are represented in figure 4.9. The major statistical numbers for the data are represented in table 4.5.

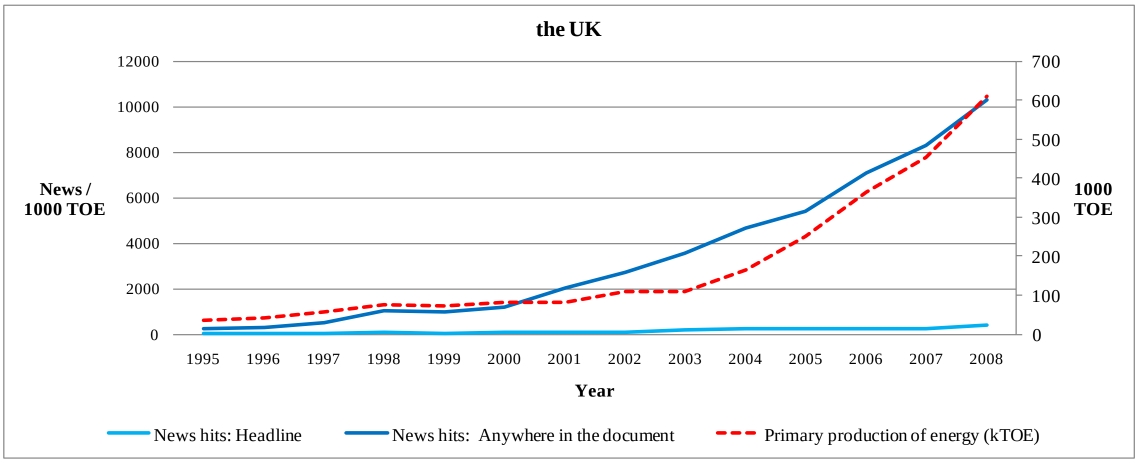
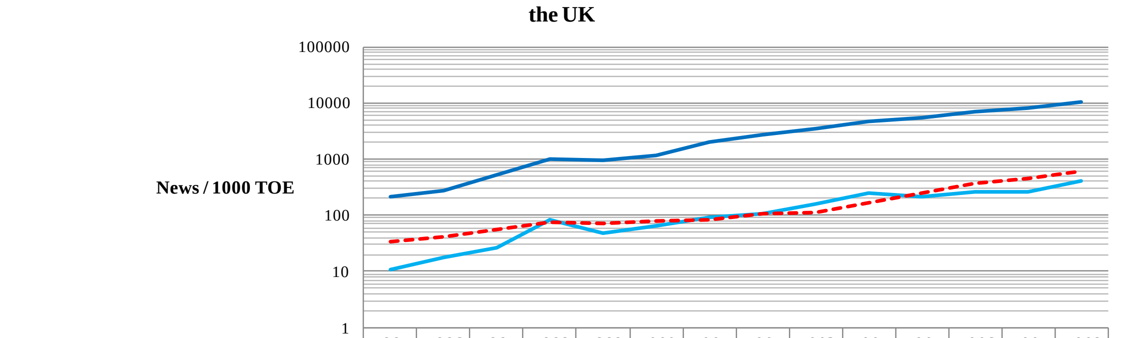


Figure 4.9. *The development of media coverage and primary production of wind energy in the UK between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.5. *Descriptive statistics for wind energy in the UK.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	11	215	34
Maximum value	405	10325	610
Mean	143,64	3444,93	178,93
Standard deviation σ	118,82	3261,66	176,56

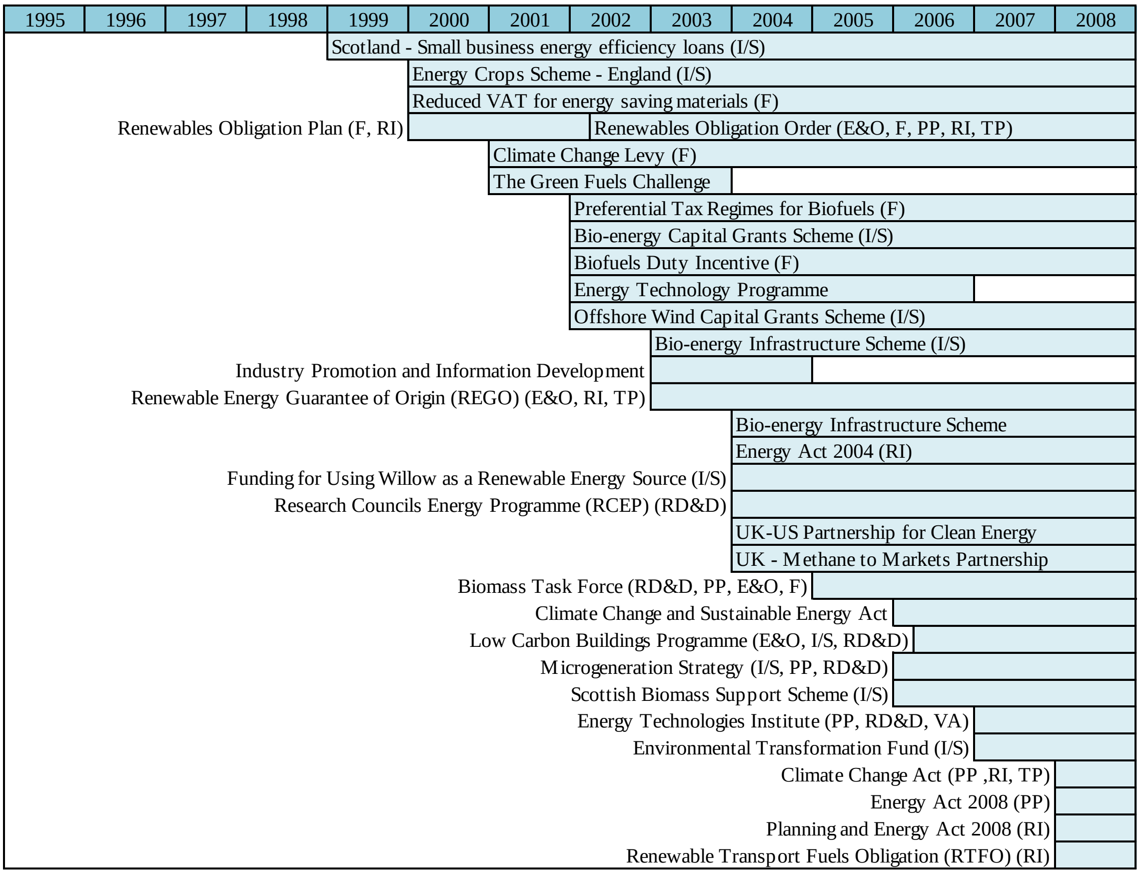
The same data as in figure 4.9 are represented on a logarithmic scale in figure 4.10. The figure shows that the growth rates of the media coverage on both the whole document and on the headline level are congruent with each other, and they have also been above the average in 1998. On part of primary production the growth rate has been lower than the ones of the media coverage in the beginning of the reference period, but it has risen to the level of media's after year 2003.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	11	18	27	83	48	64	94	106	163	253	218	257	264	405
News hits: Anywhere in the document	215	274	523	1025	955	1163	2044	2704	3543	4646	5427	7101	8284	10325
Primary production of energy (kTOE)	34	42	57	75	73	81	83	108	110	166	250	363	453	610

Figure 4.10. *The development of media coverage and primary production of wind energy in the UK between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning wind energy in the UK are illustrated in figure 4.11. The policies enacted before year 1999 were not available in the web page of IEA, but on part of the policies that were available it can be said that they have been put in force in a steady pace. However, in years 2002 and 2004 they were more policies put in force than in other years, but this is not reflected in the production or the media curves.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.11. *Renewable energy policies targeting wind energy in the UK between 1995 – 2008 (IEA 2011).*

In table 4.6 the results of the correlation analysis are represented. The media data is highly correlated with the production data on both the headline and the whole document level, and of these two the correlation on the latter is stronger.

Table 4.6. *Spearman's correlations and statistical significances for wind energy in the UK.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	,991**
	Significance (2-tailed)	.	6,54E-12
	N	14	14
RE production	Correlation coefficient	,991**	1,000
	Significance (2-tailed)	6,54E-12	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	1,000**
	Significance (2-tailed)	.	.
	N	14	14
RE production	Correlation coefficient	1,000**	1,000
	Significance (2-tailed)	.	.
	N	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

4.2. Solar photovoltaic energy

Among the examined countries, solar pv energy is most widely used for primary energy production in Germany, and Ireland and the UK are small players compared to it (see figure 4.12). In the beginning of the examination period the primary production was close to zero in all three countries. Solar pv energy is placed in the early parts of the technology diffusion S-curve – the production capacity is still rather small compared to other RE forms, even though the technology has been available already for a while. There are many factors that have restrained the diffusion. The production of solar pv energy is very expensive compared to wind and hydroelectric energy (Haas et al. 2011a, p. 1011), and the technologies concerned (for example solar cells, solar panels and energy transmission) must be advanced for solar pv to become a financially competitive option in RE production. Also, the solar pv systems are dependent on the sun's radiation, and in the examined countries the radiation levels are not that high – only 1000-1200 kWh/m^2, compared to for example Spain's radiation of 1600 to over 2200 kWh/m^2 (European Commission 2007).

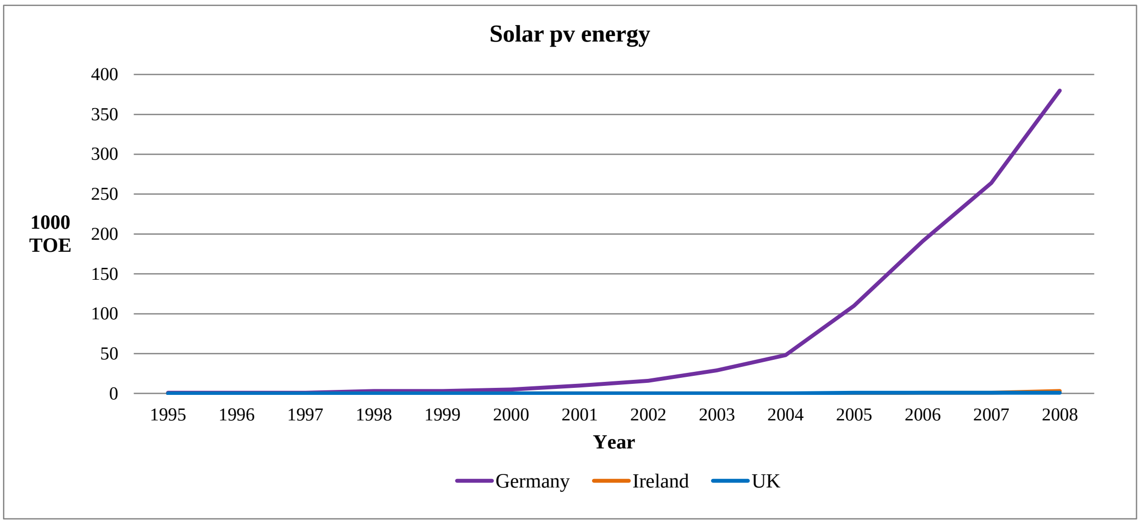


Figure 4.12. *Primary production of solar pv energy in subject countries in years 1995 – 2008 (Eurostat 2011).*

4.2.1. Germany

In Germany, the primary production of solar pv energy has developed from 1 to 380 kTOE, which is a growth of almost 1700 %. The media coverage has increased from 106 to 2516 news hits on the whole document level (a growth of almost 2300 %) and from 10 to 196 on the headline level (a growth of almost 1900 %). Therefore, the production capacity and the media coverage have increased quite similarly when measured relatively. The media coverage and the primary production of solar pv energy in Germany are represented in figure 4.13. The descriptive statistics for all three data forms are shown in table 4.7.

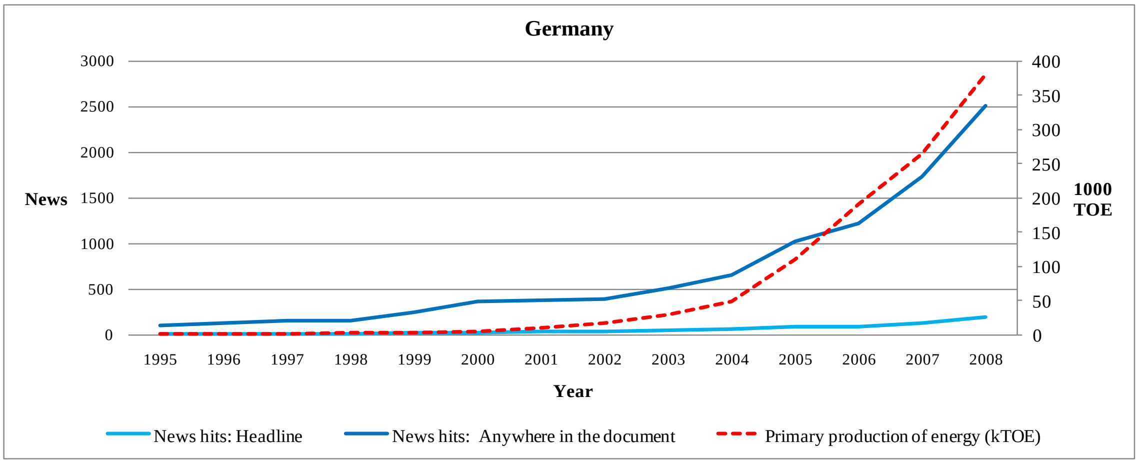
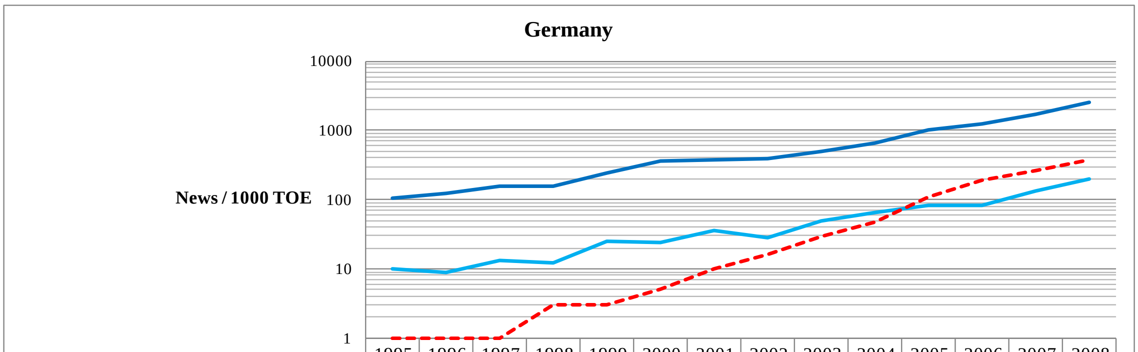


Figure 4.13. *The development of media coverage and primary production of solar photovoltaic energy in Germany between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.7. *Descriptive statistics for solar photovoltaic energy in Germany.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	9	106	1
Maximum value	196	2516	380
Mean	54,64	682,86	75,86
Standard deviation σ	54,15	712,24	119,51

In figure 4.14 the data are represented on a logarithmic scale. The figure illustrates that growth rates of the media coverage on both on the whole document and headline level have developed in a similar way, both in average of 30 % annually. The primary production has developed faster than the media, on average 66 % annually.

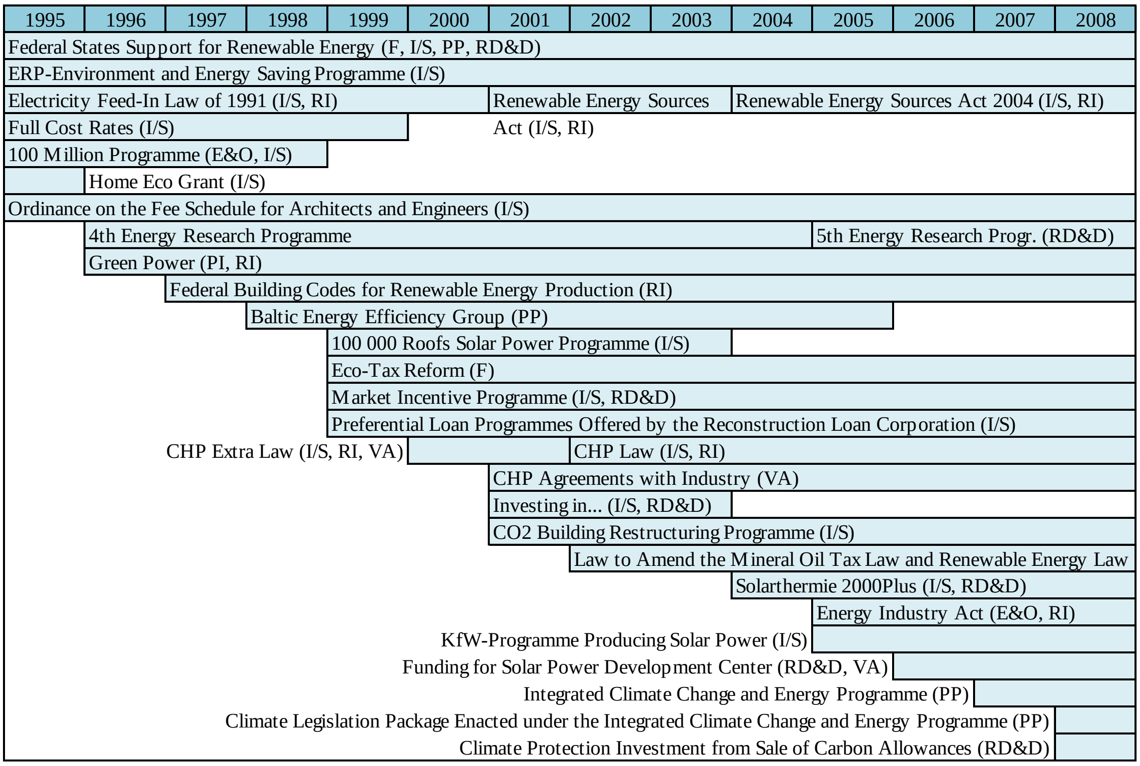


	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	10	9	13	12	25	24	35	28	50	66	84	82	131	196
News hits: Anywhere in the document	106	125	158	155	243	357	370	388	503	654	1026	1223	1736	2516
Primary production of energy (kTOE)	1	1	1	3	3	5	10	16	29	48	110	191	264	380

Figure 4.14. *The development of media coverage and primary production of solar photovoltaic energy in Germany between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning solar pv energy in Germany are illustrated in figure 4.15. Policies have been enacted in a steady rate throughout the whole examination period. Some of the policies presented in figure have been put into effect already before 1995: The Federal States Support for Renewable Energy -policy in 1985, Environment and

Energy Saving Programme in 1990, Electricity Feed-In Law in 1991 and Full Cost Rates in 1993.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.15. *Renewable energy policies targeting solar photovoltaic energy in Germany between 1995 – 2008 (IEA 2011).*

In table 4.8 the results of the correlation analysis for the data are represented. The media data is strongly correlated with the production data on both the headline and the whole document level, as the p-values of Spearman’s correlation are close to one in both cases: 0,968 on part of headline level and 0,983 on the whole document level. The results are also statistically significant, as the significances are below alpha (α=0,01).

Table 4.8. *Spearman's correlations and statistical significances for solar photovoltaic energy in Germany.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	,968**
	Significance (2-tailed)	.	1,45E-08
	N	14	14
RE production	Correlation coefficient	,968**	1,000
	Significance (2-tailed)	1,45E-08	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	,983**
	Significance (2-tailed)	.	2,87E-10
	N	14	14
RE production	Correlation coefficient	,983**	1,000
	Significance (2-tailed)	2,87E-10	.
	N	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

4.2.2. Ireland

In Ireland the primary production of solar pv energy has grown from zero to three kilotonnes of oil equivalent during the examination period, and the production of this energy form is started in 2006. The media coverage has grown exponentially, from 31 to 994 news hits on the whole document level (a growth of over 3100 %) and from zero to 30 news hits on the headline level. The media coverage and the primary production of solar pv energy in Ireland are represented in figure 4.16. In table 4.9 the descriptive statistics for Ireland's solar pv energy are presented.

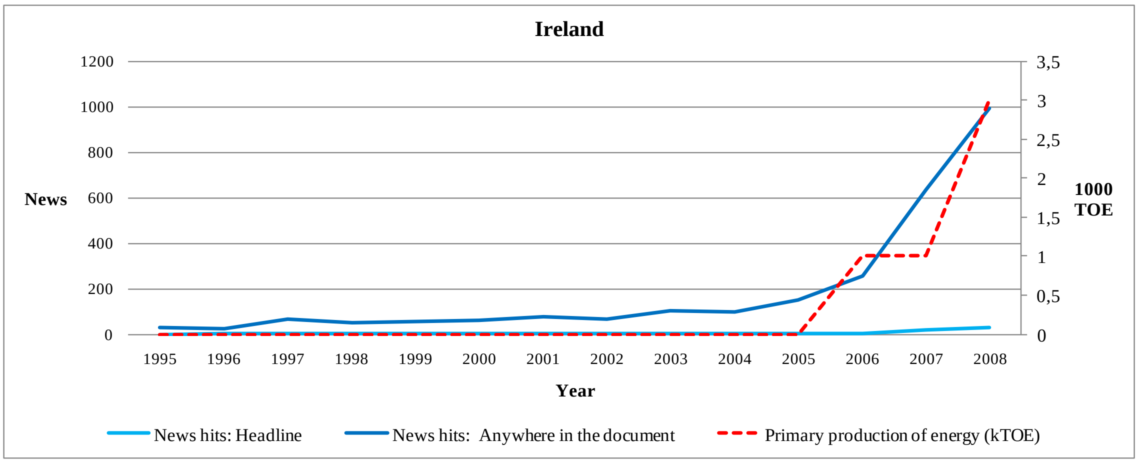
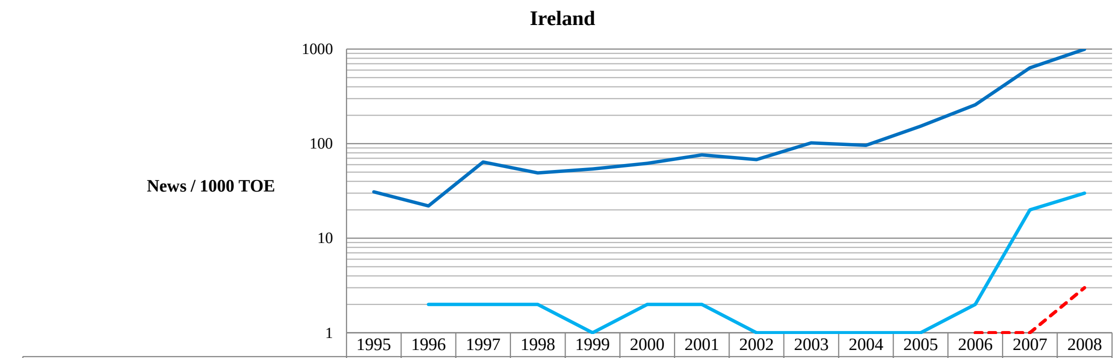


Figure 4.16. *The development of media coverage and primary production of solar photovoltaic energy in Ireland between 1995 – 2008 (LexisNexis 2011; SEAI 2011).*

Table 4.9. *Descriptive statistics for solar photovoltaic energy in Ireland.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	0	22	0
Maximum value	30	994	3
Mean	4,79	190,29	0,36
Standard deviation σ	8,81	279,98	0,84

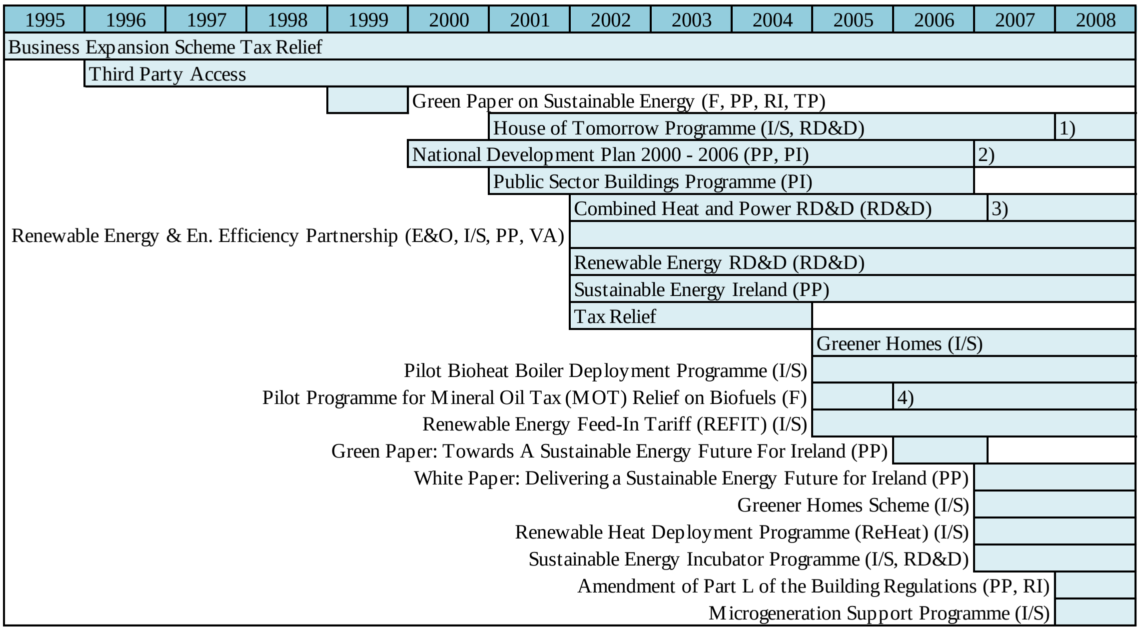
In figure 4.17 the data from figure 4.16 are represented on a logarithmic scale. The zero values are not shown on this scale, so two of the graphs are discontinuous. In the figure one can see that the media coverage growth rates are rather similar. The growth rates are not constant, but they fluctuate quite a bit. The average annual growth rate for media coverage on the whole document level is 42 %. The growth rates for the examination period for other two parameters could not be calculated because of their zero values in year 1995.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	0	2	2	2	1	2	2	1	1	1	1	2	20	30
News hits: Anywhere in the document	31	22	64	49	54	62	76	68	102	96	153	258	635	994
Primary production of energy (kTOE)	0	0	0	0	0	0	0	0	0	0	0	1	1	3

Figure 4.17. *The development of media coverage and primary production of solar photovoltaic energy in Ireland between 1995 – 2008 on a logarithmic scale (LexisNexis 2011; SEAI 2011).*

The RE policies concerning solar pv energy in Ireland are illustrated in figure 4.18. The first one of the policies – the Business Expansion Scheme Tax Relief – has been put in force already in 1984.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D=Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement
1) Low Carbon Housing Programme (I/S)
2) Sustainable Energy Component of the National Development Plan 2007-2013 (PP)
3) CHP Deployment Programme (I/S)
4) Biofuels Scheme II Programme for Mineral Oil Tax (MOT) Relief on Biofuels

Figure 4.18. *Renewable energy policies targeting solar photovoltaic energy in Ireland between 1995 – 2008* (IEA 2011).

Unfortunately the data on solar pv energy in Ireland is not adequate for deeper analysis, as the values of two out of three time series were so low. Thus, correlations could not be calculated.

4.2.3. The UK

In the UK the primary production of solar pv energy has been very minor during the reference period. The production has risen from zero to one kilotonnes of oil equivalent in year 2005 and has stayed on the same level till year 2008. In spite of this the media coverage has grown exponentially, from 217 to 5946 news hits on the whole document level (a growth of over 2600 %) and from seven to 131 on the headline level (a growth of almost 1800 %). The media coverage and the primary production of solar pv energy in the UK are represented in figure 4.19. The descriptive statistics for the time series are presented in table 4.10.

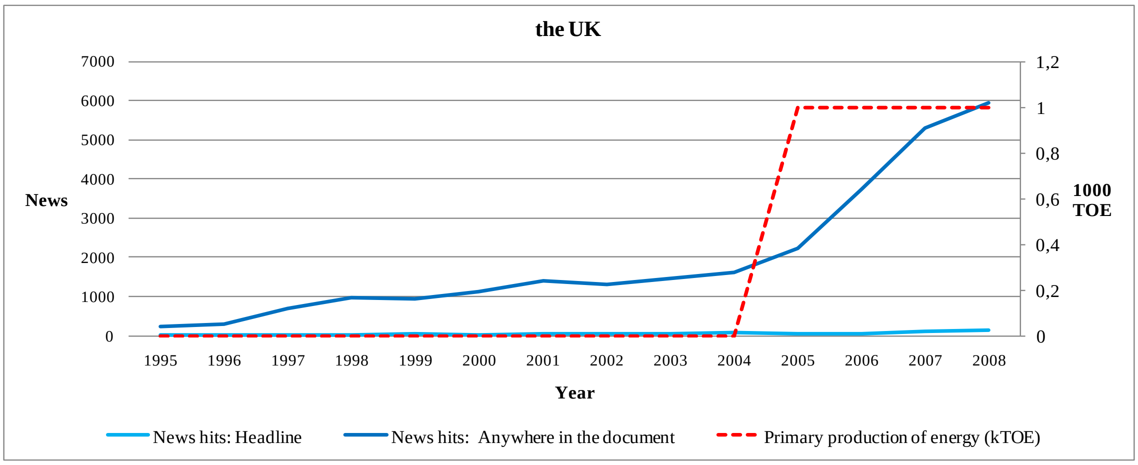


Figure 4.19. *The development of media coverage and primary production of solar photovoltaic energy in the UK between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.10. *Descriptive statistics for solar photovoltaic energy in the UK.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	7	217	0
Maximum value	131	5946	1
Mean	51,07	1944,36	0,29
Standard deviation σ	33,74	1786,80	0,47

In figure 4.20 the solar pv data are presented on a logarithmic scale. The figure shows that the media coverage rates have developed in a similar way throughout the whole examination period. Not much can be said about the energy production, as it has just begun in year 2005.

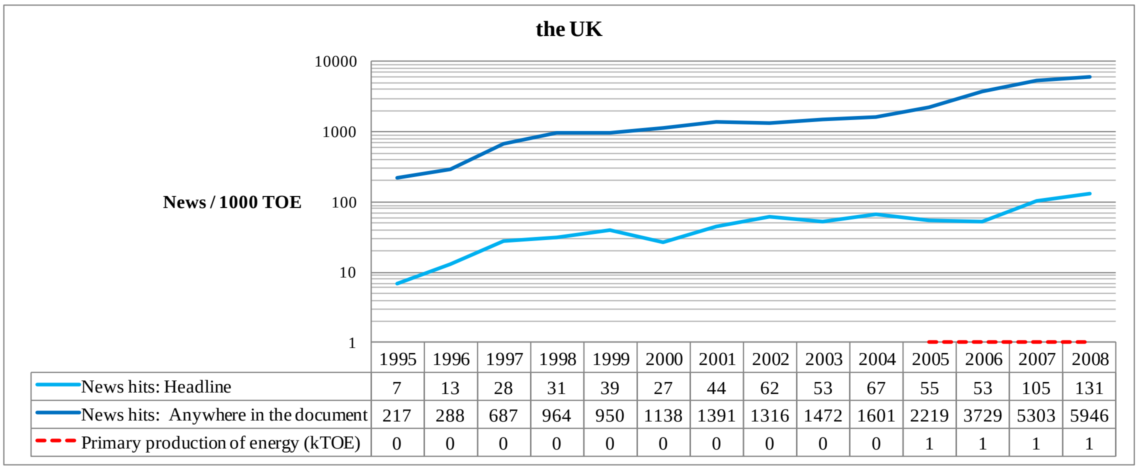
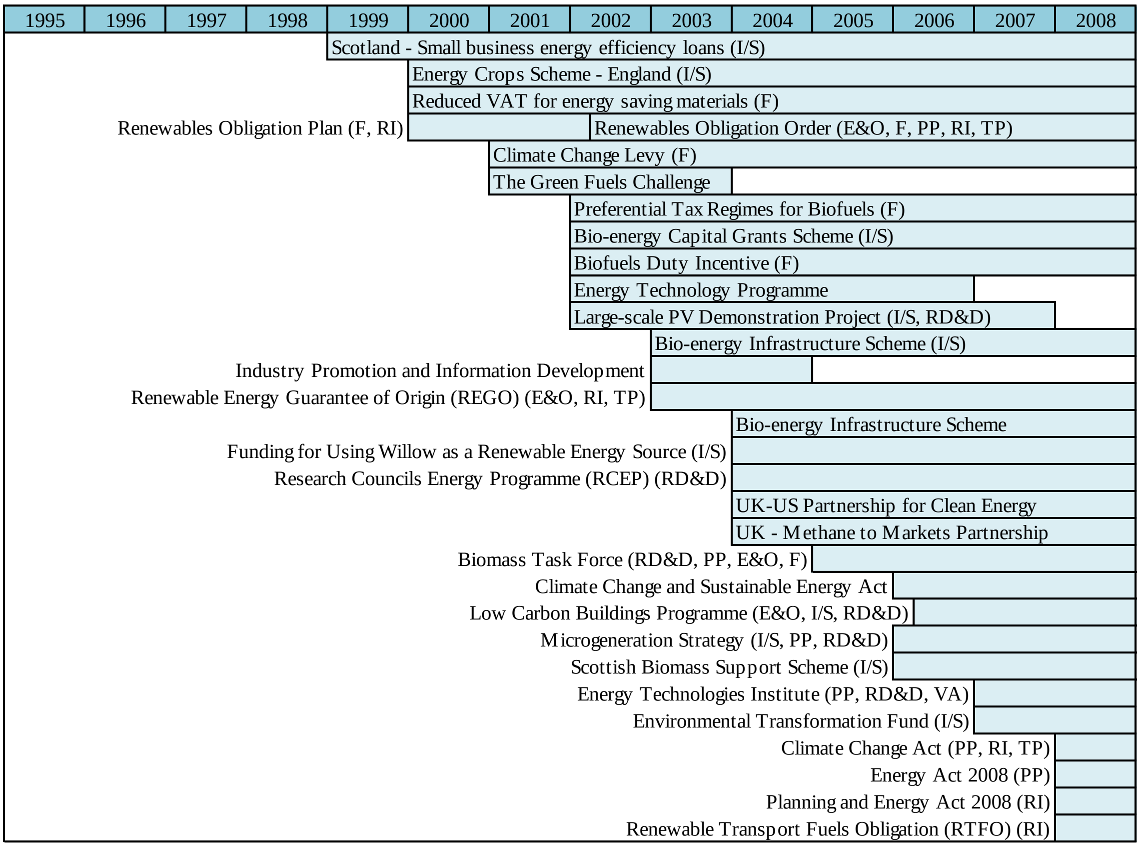


Figure 4.20. *The development of media coverage and primary production of solar photovoltaic energy in the UK between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning solar pv energy in the UK are illustrated in figure 4.21. In the used data source, the web page of IEA (IEA 2011), the policies put in force were only available from year 1999, and thus the previous political measures cannot be presented here. In 2002 and 2004 more policies were put in force than in other years examined, and this may have triggered the beginning of the solar pv primary production in 2005.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.21. *Renewable energy policies targeting solar photovoltaic energy in the UK between 1995 – 2008* (IEA 2011).

As with the solar pv data on Ireland, the data was not sufficient for the use of correlation analysis and therefore the correlations could not be calculated.

4.3. Hydroelectric energy

Germany is the biggest producer of primary hydroelectric energy of the three examined countries, and Ireland the smallest (see figure 4.22). The production of hydroelectric energy is experiencing quite considerable seasonal fluctuation, but it has not been increasing during the reference period. The reason for the fluctuation is that hydroelectric energy is often used as a reserve power to even out the supply and consumption peaks in the power grid. Also, the seasonal changes in the water resources influence changes in energy supply. Hydroelectric energy in its current, 'traditional' form – power derived mainly from rivers and rapids – can be placed at the end of the technology diffusion S-curve. Some growth of the capacity will be gained by year 2020 (Haas et al. 2011a, p. 1009), but the traditional resources cannot however provide major growth in the future. This is because the inland waterways available for power generation are already mainly in use. Growth of capacity can be gained by upgrading existing facilities and developing new ones – the technologies that can provide new capacity in the future are for example pumped storage systems and technologies utilising ocean energy (Barnes 2009).

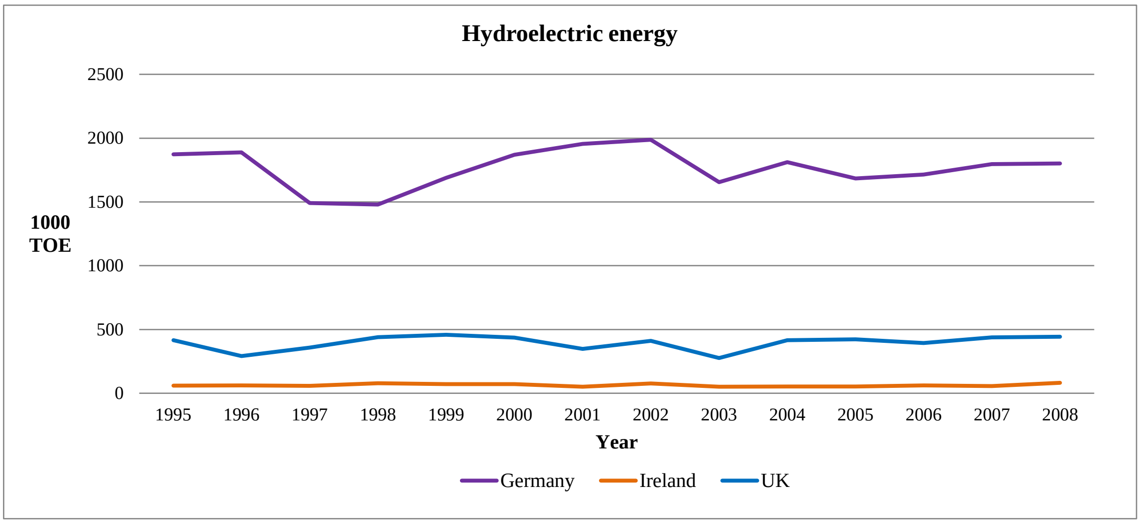


Figure 4.22. *Primary production of hydroelectric energy in subject countries in years 1995 – 2008 (Eurostat 2011).*

4.3.1. Germany

In Germany the production capacity is much greater than in other two countries, and has been varying between approximately 1500 and 2000 kTOE. The media coverage has grown exponentially, from 72 to 1700 news hits on the whole document level (a growth of almost 2300 %) and from 1 to 37 news hits on the headline level (a growth of 3600 %). The media coverage and the primary production of hydroelectric energy in Germany are represented in figure 4.23.

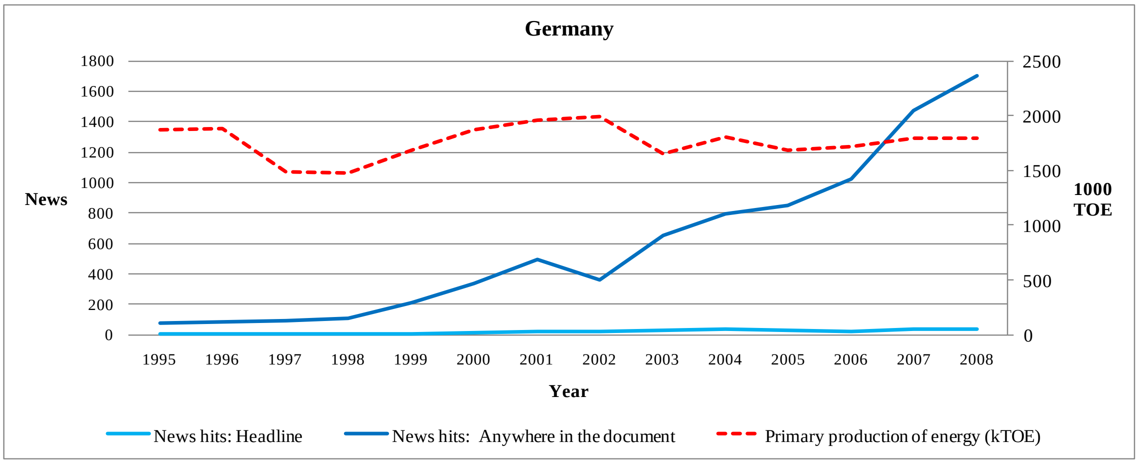


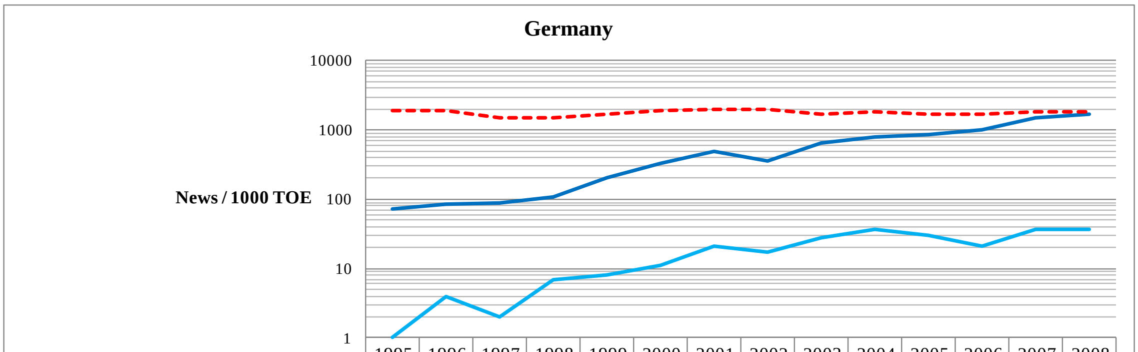
Figure 4.23. *The development of media coverage and primary production of hydroelectric energy in Germany between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

The major statistical parameters for the Germany's hydroelectric energy data are presented in table 4.11.

Table 4.11. *Descriptive statistics for hydroelectric energy in Germany.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	1	72	1480
Maximum value	37	1700	1988
Mean	18,50	589,00	1764,14
Standard deviation σ	13,24	526,46	154,55

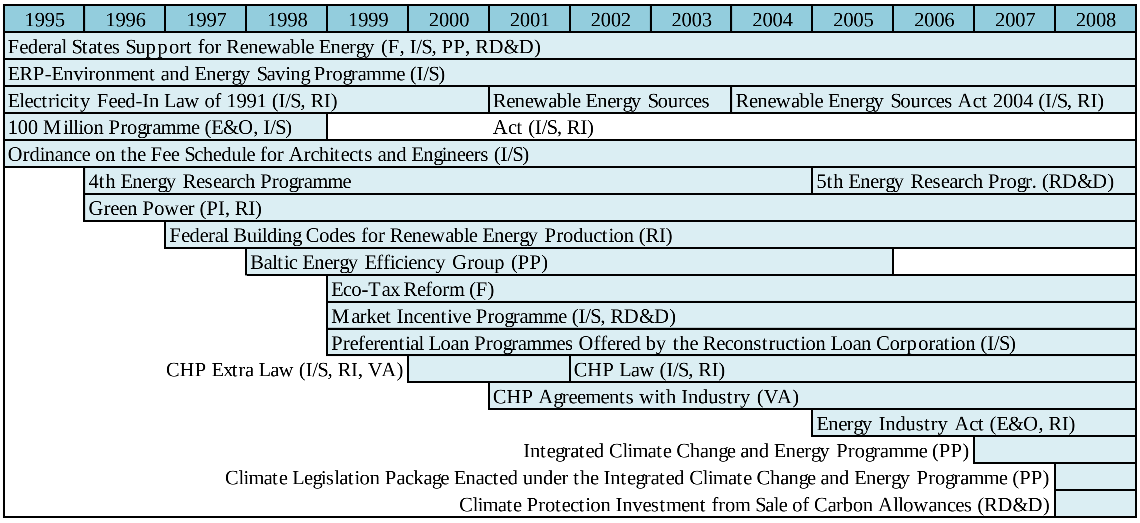
In figure 4.24 the data are presented on a logarithmic scale. The media coverage rates have developed similarly with each other, and their average annual growth rates are 32 % on part of the whole document and 57 % on part of the headline level.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	1	4	2	7	8	11	21	17	28	36	30	21	36	37
News hits: Anywhere in the document	72	85	88	107	207	333	498	357	655	798	847	1022	1477	1700
Primary production of energy (kTOE)	1873	1888	1492	1480	1689	1869	1955	1988	1656	1812	1684	1714	1797	1801

Figure 4.24. *The development of media coverage and primary production of hydroelectric energy in Germany between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning hydroelectric energy in Germany are illustrated in figure 4.25. Policies have been enacted in a steady pace, except in year 2003 when no new policies were introduced. The policies that are put in force before 1995 are the Federal States Support for Renewable Energy -policy (1985), Environment and Energy Saving Programme (1990) and Electricity Feed-In Law (1991).



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D=Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.25. *Renewable energy policies targeting hydroelectric energy in Germany between 1995 – 2008 (IEA 2011).*

The correlations and their statistical significances are shown in table 4.12. Both are low, so the production of hydroelectric energy does not correlate with the media coverage. This was expected, as the primary production of hydroelectric energy does not have a growing trend in time, as the both types of media coverage do.

Table 4.12. *Spearman's correlations and statistical significances for hydroelectric energy in Germany.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	-0,009
	Significance (2-tailed)	.	0,976
	N	14	14
RE production	Correlation coefficient	-0,009	1,000
	Significance (2-tailed)	0,976	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	-0,086
	Significance (2-tailed)	.	0,771
	N	14	14
RE production	Correlation coefficient	-0,086	1,000
	Significance (2-tailed)	0,771	.
	N	14	14

4.3.2. Ireland

In Ireland the primary production of hydroelectric energy has been varying between 51 and 83 kTOE. The media coverage has grown from 36 to 468 news hits on the whole document level (a growth of 1200 %) and from zero to four news hits on the headline level. The media coverage and the primary production of hydroelectric energy are represented in figure 4.26. The major statistical parameters for the data are shown in table 4.13.

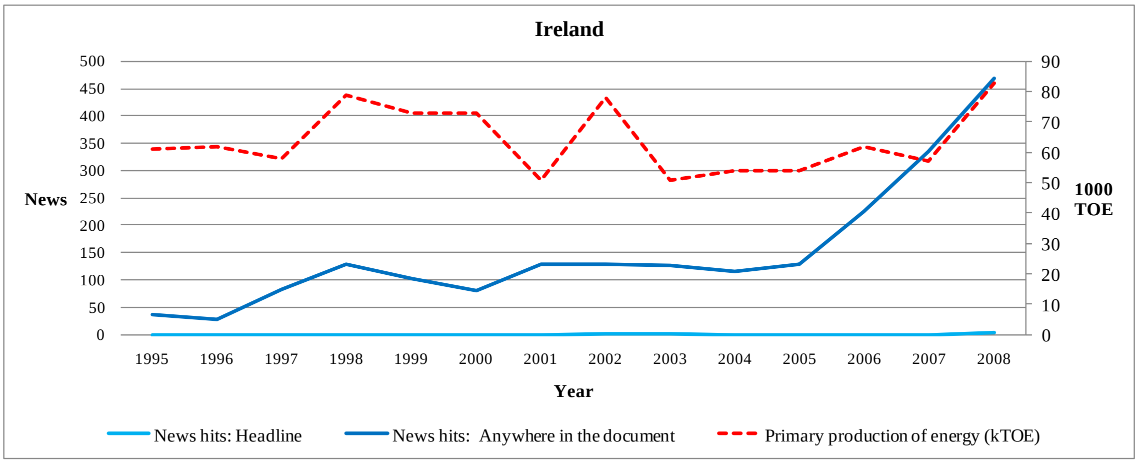
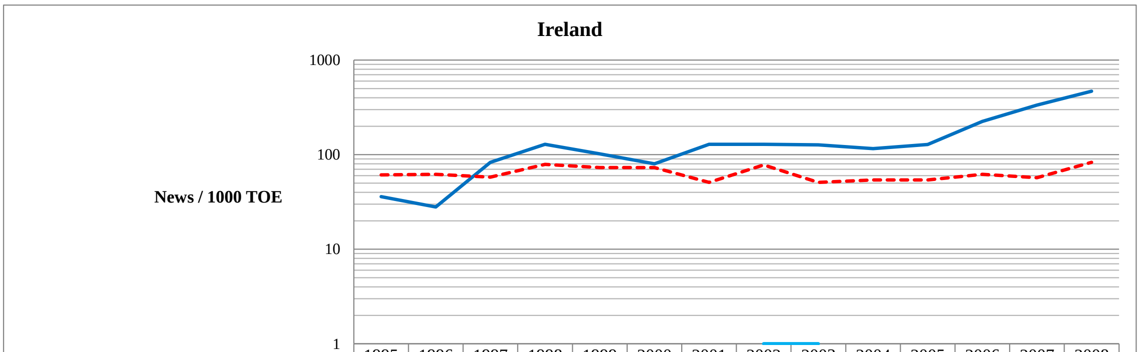


Figure 4.26. *The development of media coverage and primary production of hydroelectric energy in Ireland between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.13. *Descriptive statistics for hydroelectric energy in Ireland.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	0	28	51
Maximum value	4	468	83
Mean	0,43	151,00	64,00
Standard deviation σ	1,09	118,86	11,04

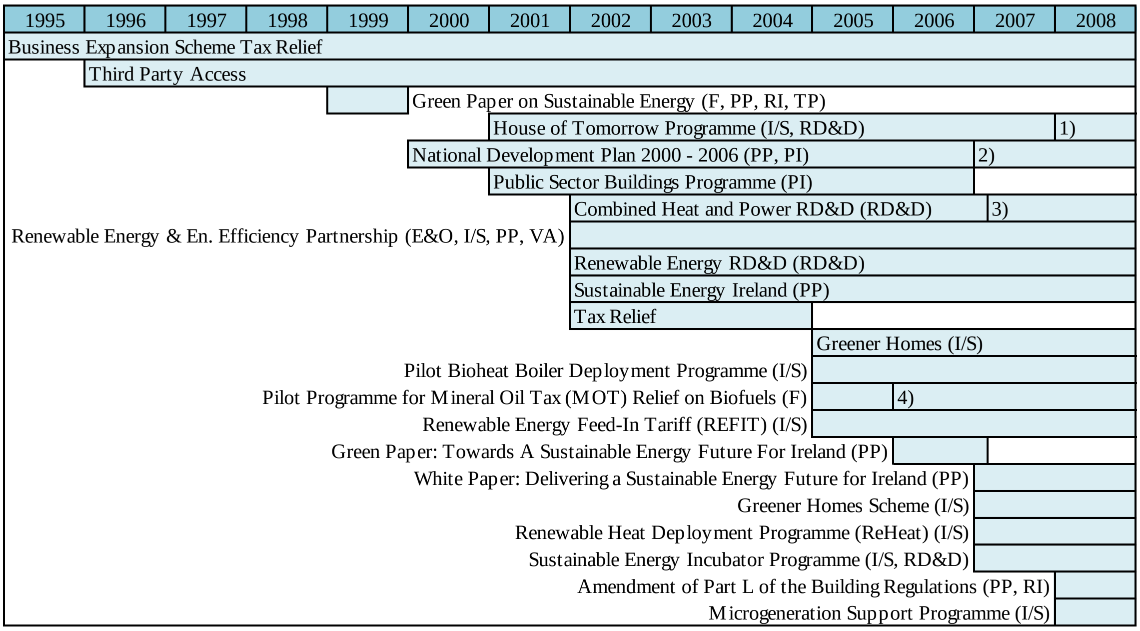
In figure 4.27 the data are presented on a logarithmic scale. The figure shows that the primary production has been stable, but the media coverage has increased slightly on the whole document level. The graph on the media coverage on headline level is not continuous because of the zero values.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	0	0	0	0	0	0	0	1	1	0	0	0	0	4
News hits: Anywhere in the document	36	28	83	129	102	80	129	129	127	116	128	225	334	468
Primary production of energy (kTOE)	61	62	58	79	73	73	51	78	51	54	54	62	57	83

Figure 4.27. *The development of media coverage and primary production of hydroelectric energy in Ireland between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning hydroelectric energy in Germany are illustrated in figure 4.28. Policies have been enacted in a steady pace and especially in year 2002 there were many policies put in force. The Business Expansion Scheme Tax Relief is put in force before the examination period, in 1984.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement
1) Low Carbon Housing Programme (I/S)
2) Sustainable Energy Component of the National Development Plan 2007-2013 (PP)
3) CHP Deployment Programme (I/S)
4) Biofuels Scheme II Programme for Mineral Oil Tax (MOT) Relief on Biofuels

Figure 4.28. *Renewable energy policies targeting hydroelectric energy in Ireland between 1995 – 2008 (IEA 2011).*

The results of the correlation analysis on part of hydroelectric energy in Ireland are represented in table 4.14. As the media data on headline level is not sufficient for the analysis, correlation analysis is conducted only between the whole document level media data and energy production data. The correlation between these two is very weak and statistically insignificant.

Table 4.14. *Spearman's correlations and statistical significances for hydroelectric energy in Ireland.*

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	0,135
	Significance (2-tailed)	.	0,645
	N	14	14
RE production	Correlation coefficient	0,135	1,000
	Significance (2-tailed)	0,645	.
	N	14	14

4.3.3. The UK

In the UK the primary production of hydroelectric energy has been varying between 277 and 459 kTOE. The media coverage has grown, from 1059 to 4391 news hits on the whole document level (a growth of only over 300 %) and from 6 to 58 news hits on the headline level (a growth of only close to 900 %). The media coverage and the primary production of hydroelectric energy are represented in figure 4.29. The media coverage on the whole document level varies from all the other media coverage trends, as a clear peak in the amount of news hits arises between years 1997 and 1999. This peak is visible also in the headline level media data in the figure 4.30, where the data are presented on a logarithmic scale. In table 4.15 the major statistical parameters for the data are presented.

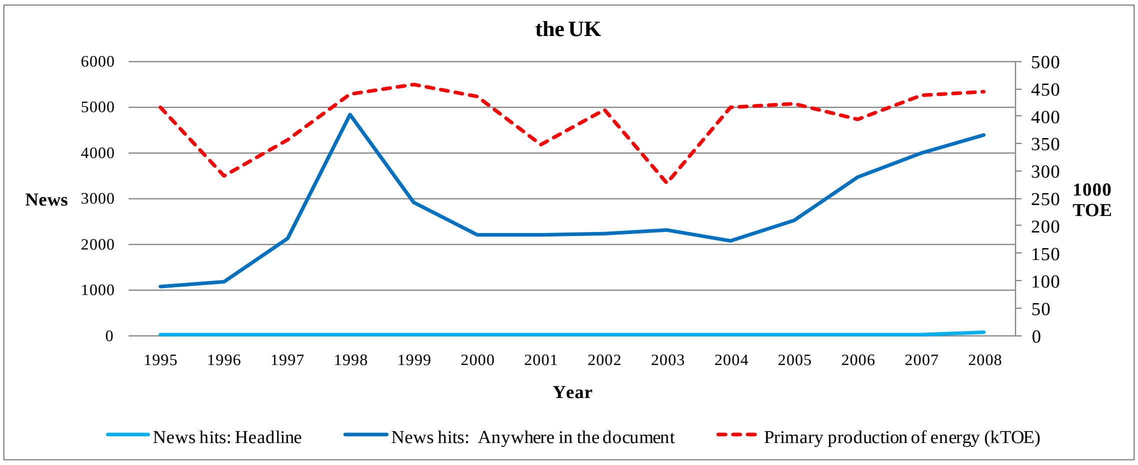
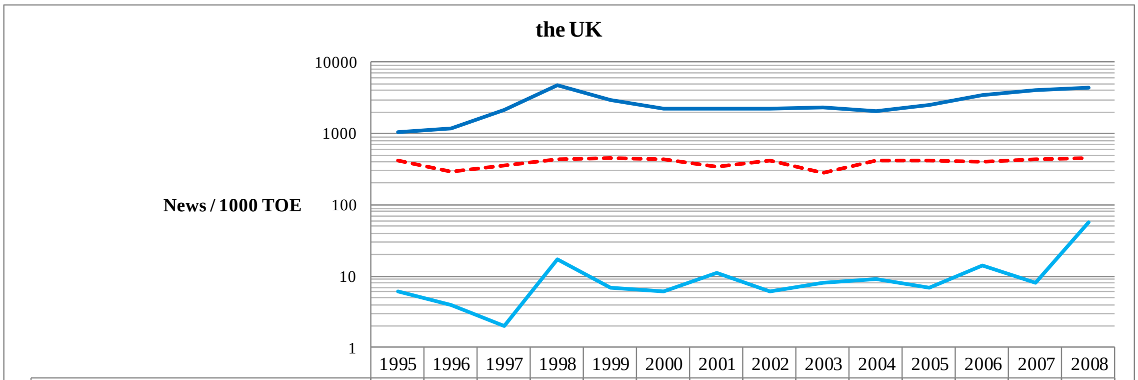


Figure 4.29. *The development of media coverage and primary production of hydroelectric energy in the UK between 1995 – 2008 (Eurostat 2011; LexisNexis 2011).*

Table 4.15. *Descriptive statistics for hydroelectric energy in the UK.*

	Media: Headline	Media: Anywhere	RE production (kTOE)
N	14	14	14
Minimum value	2	1059	277
Maximum value	58	4848	459
Mean	11,64	2680,00	396,86
Standard deviation σ	13,89	1124,74	56,88

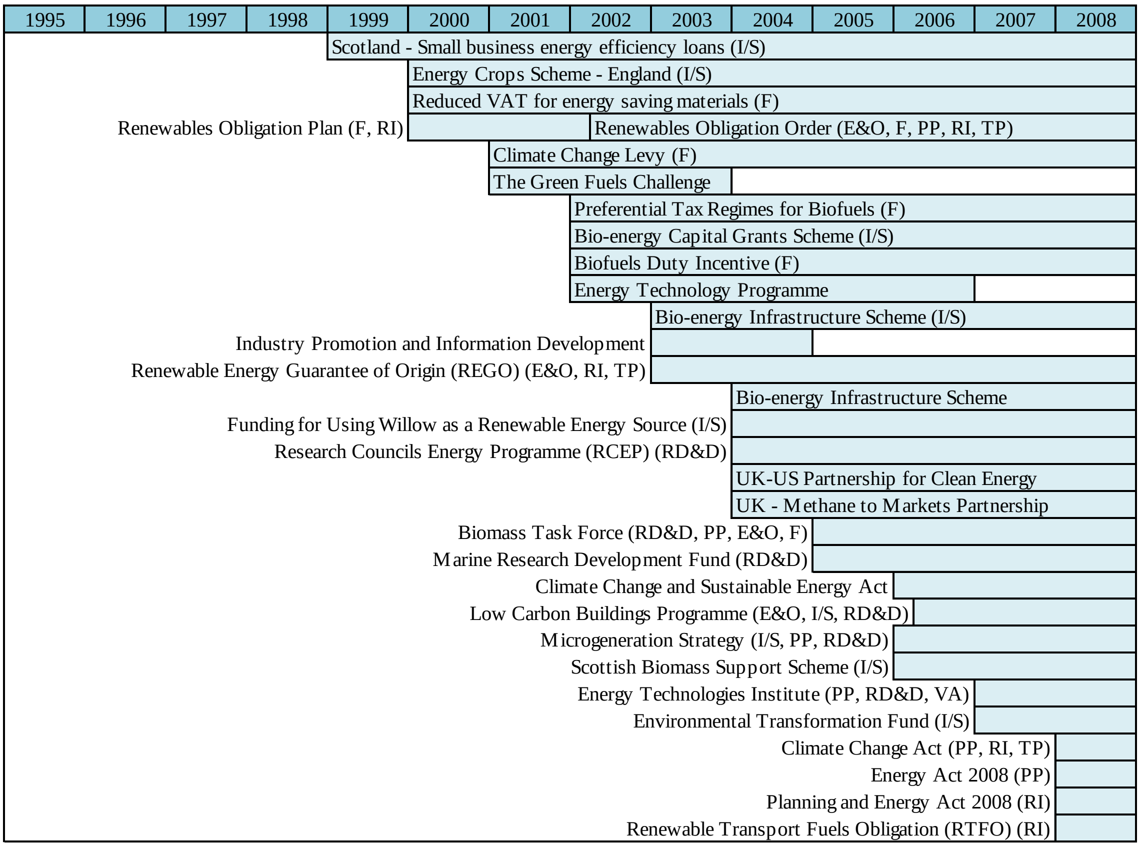
In figure 4.30 one can see that the primary hydroelectric energy production is stable, as in other countries as well. The media coverage trends are not growing as much as in other countries, but they are still quite congruent with each other. The peak in year 1999 is visible in both types of media data.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
News hits: Headline	6	4	2	17	7	6	11	6	8	9	7	14	8	58
News hits: Anywhere in the document	1059	1166	2120	4848	2910	2202	2213	2241	2310	2080	2509	3473	3998	4391
Primary production of energy (kTOE)	416	292	358	440	459	437	349	412	277	416	423	395	438	444

Figure 4.30. *The development of media coverage and primary production of hydroelectric energy in the UK between 1995 – 2008 on a logarithmic scale (Eurostat 2011; LexisNexis 2011).*

The RE policies concerning hydroelectric energy in the UK are illustrated in figure 4.31. Policies have been put in force in a very steady pace, and because of the limitations of the data provided by the IEA, the political measures implemented before year 1999 are not shown in the figure.



Type of Policy: F=Financial, I/S=Incentives/Subsidies, E&O=Education &Outreach, PI=Public Investment, PP=Policy Processes, RD&D= Research, Development & Deployment, RI=Regulatory Instruments, TP=Tradable Permits, VA=Voluntary Agreement

Figure 4.31. *Renewable energy policies targeting hydroelectric energy in the UK between 1995 – 2008 (IEA 2011).*

The correlations calculated are presented in table 4.16. As with the hydroelectric energy in other countries as well, either types of media coverage do not correlate with the production.

Table 4.16. *Spearman's correlations and statistical significances for hydroelectric energy in the UK.*

		Media: Headline	RE production
Media: Headline	Correlation coefficient	1,000	0,319
	Significance (2-tailed)	.	0,27
	N	14	14
RE production	Correlation coefficient	0,319	1,000
	Significance (2-tailed)	0,27	.
	N	14	14

		Media: Anywhere	RE production
Media: Anywhere	Correlation coefficient	1,000	0,552
	Significance (2-tailed)	.	0,04
	N	14	14
RE production	Correlation coefficient	0,552	1,000
	Significance (2-tailed)	0,04	.
	N	14	14

4.4. Synthesis

In this chapter 4 the collected data was presented and correlation analysis was performed on them. The purpose of the correlation analysis was to find out if there is a connection between media coverage and RE production. The results of the data analysis revealed that on part of all three energy forms and in every three subject country the media coverage trends have increased in a similar way, exponentially. The only exception was hydroelectric energy in the UK, where a sharp peak appeared in 1998 in the whole document -level media coverage. As for the primary production trends, they have differed substantially between energy forms and countries during the reference period. Considerable resemblance within energy forms was seen, and based on the data each RE form can be positioned in different phases of the technology diffusion S-curve.

On part of wind energy, both the energy media coverage and the primary production trends behaved in a similar way: They have developed steadily, and the growth has been exponential. The examined countries were also equally active in policy making. Wind energy was slightly further on the S-curve as solar pv, which is in the early phases of diffusion, as the wind energy capacities have started to increase during the reference period and additional potential is expected to be built in the future. For wind energy, the both types of media coverage had strong correlations with primary production. The correlations calculated with Spearman's rho were high, over 0,90 on part of each subject country. The results were also significant as the calculated p-values were all less than alpha (α=0,01).

In solar pv production, Germany is well ahead of the other two countries, and there the production has also grown faster than the media coverage. In Ireland and the UK on the other hand, the media coverage trends are a great deal ahead of the energy production – solar pv is discussed in the media, especially in the UK, but the level of its production is low. When comparing the solar pv media coverage trends between the three countries, they have developed in a similar way in each one of them. Solar pv energy is in the early phases of diffusion. One of the reasons for this is that producing electricity through solar energy is very expensive compared to other examined RE forms, which has limited the diffusion of solar pv systems. Also the availability of the radiant energy from the sun is dependent on the latitude of the geographical location, and in the examined countries the solar radiation levels are not that high. On part of solar pv energy, the Spearman correlations could not been calculated for Ireland and the UK, as their solar pv productions have only started in the end of the reference period. But for Germany, where the production of this energy form has taken off, the both types of media coverage correlated strongly with primary production and the results were significant with significance level α=0,01.

Hydroelectric energy was noticed to be in the end of the technological diffusion S-curve, as the production did not increase during the reference period. The distinctive characteristic of hydroelectric energy compared to other two RE forms was, that its production underwent serious seasonal fluctuation. The reasons for this are the seasonal nature of hydrological resources and the fact that hydro energy is often used as a power reserve to even out the supply and consumption peaks in the power grid. While the energy production capacities have not expanded, the media coverage trends have grown exponentially during the examination period in all three countries. The results of the correlation analysis on hydroelectric energy expressed that there was no correlation between media coverage and primary energy production. The results of the correlation analysis for all studied RE forms are compiled in table 4.17.

Table 4.17. *The results of correlation analysis (Spearman's rho) and statistical significance testing.*

Wind energy		Between Media (Headline) and Production	Between Media (Anywhere in the text) and Production
Germany	Correlation coefficient	,961**	,996**
	Significance (2-tailed)	4,33E-08	1,03E-13
Ireland	Correlation coefficient	,928**	,995**
	Significance (2-tailed)	1,67E-06	3,95E-13
the UK	Correlation coefficient	,991**	1,000**
	Significance (2-tailed)	6,54E-12	0,00
Solar pv energy			
Germany	Correlation coefficient	,968**	,983**
	Significance (2-tailed)	1,45E-08	2,87E-10
Ireland	Correlation coefficient	-	-
	Significance (2-tailed)	-	-
the UK	Correlation coefficient	-	-
	Significance (2-tailed)	-	-
Hydroelectric energy			
Germany	Correlation coefficient	-0,009	-0,086
	Significance (2-tailed)	0,98	0,77
Ireland	Correlation coefficient	-	0,135
	Significance (2-tailed)	-	0,64
the UK	Correlation coefficient	0,319	0,552
	Significance (2-tailed)	0,27	0,04

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the results of the analysis it can be stated that the media coverage and primary energy production correlate with each other, if the concerning RE form is being used in large scale energy production and it has achieved a certain level of diffusion, but is still in the phases of growth.

5. DISCUSSION

The research problem of this thesis is, whether a connection between the media coverage and the RE production exists. While there are no previous studies that would answer this question, the existence of the connection had to be tested by collecting data and analysing it. On the basis of the correlation analysis conducted on the quantitative media coverage and RE production data, it can be stated that on part of some studied subjects the connection exists. With wind energy the connection is obvious: The media coverage and the RE production are very strongly correlated in all three examined countries. On part of solar pv energy, only Germany could be studied by means of correlation analysis, as the other two countries' data was not sufficient. On part of solar pv energy in Germany, the results were similar the ones with wind energy: The media coverage and energy production were strongly correlated, but no conclusions could be drawn from the lagged correlation analysis. The analysis conducted on hydroelectric energy on the other hand, gave no significant results, as the production of hydroelectric energy had not been increasing along with the media coverage in the subject countries. Thus, it can be stated that for hydroelectric energy the media coverage is not correlated with primary hydroelectricity production.

The characteristics of the examined energy forms are well seen from the collected data. Wind energy is the most produced energy form of the tree examined ones, and it is also the one that is discussed the most in the media. Wind energy has established its place in the EU in energy production, while solar pv energy is still in the earlier phases of diffusion. However, solar pv energy is the second most produced energy form, and also the second in the volume of media discussion within the examined countries. Therefore, hydroelectric energy is the least one of the three, in both the media coverage and the energy production. Hydroelectric energy is mainly produced with mature technologies, and new reserves are difficult to take on. There are only a certain amount of rivers that can be harnessed to energy production. New capacity in the form of for example tidal power is possible to be built, but the concerning technologies are not yet highly competitive compared to other energy production technologies.

Even though the previous technology foresight studies have not utilised newspaper and other 'general' media data in describing the diffusion level of technologies, the results of this analysis are in line with the similar studies made using patents and scientific publications. In previous studies patents and scholarly publications are used to describe the diffusion level of technologies, which are in their development phase. Newspapers and other press publications are acknowledged as proper data sources for technologies that are in the application phase of technological development, but they have not been used as a data source in studying technology diffusion in the renewable energy field. The theory review suggests, that the media data should describe the diffusion level of the studied renewable energy forms, as they are in the application level of technological development. The results of the analysis showed that media data can be used to describe the diffusion level of technologies on some conditions: The RE form has to be in the early parts of diffusion, but the production has to be taken off properly. As one has to look back – that is, have enough history data – to foresight technological diffusion by means of the methods used in this thesis, the lack of data restricts the possibilities to make predictions. The same applies to media data: Enough data has to be available, or the analysis cannot be performed.

In the theoretical section the RE policies in use in the subject countries were represented, but based on the analysis the type of RE promotion system does not have an influence on the correlation between media coverage and RE production. Of course, the FIT system used in Germany is the most effective of the examined countries' systems, but the effectiveness of probably has more of an influence on how much RE is produced in Germany, and in general, hint that Germany is a forerunner in renewable energy promotion in the European level.

The objective of this thesis is to determine the connection between the media coverage and the RE production. The objective is fulfilled well, as the connection is analysed as planned, and the results show that the media and the RE production are correlated on part of wind energy in all three examined countries and solar pv energy in Germany. Other research subjects did not give any useful results, as the solar pv data from Ireland and the UK could not be used in correlation analysis, and the results of analysing hydroelectric energy were not statistically significant.

The significance of the results in this thesis is substantial for the scientific community, as the viewpoint of analysing the connection between the media coverage and the RE production is new. Similar analysis should be applied on other energy forms and other countries as well, to see if the analyses bring corresponding results.

6. CONCLUSIONS

This thesis rose to the challenge of developing the methodology in the field of technology foresight. To predict the future directions and the potential of different technologies, the already existing tools have to be advanced and new tools developed to meet the challenges set by technological development and the possibilities brought by the capability growth in data processing. Methods have to be developed especially for the use of renewable energies, as their importance in future energy production is, or at least should be notable.

This thesis built on previous technology foresight research of using bibliometric analysis in technology diffusion research. Bibliometrics is about analysing publications, their attributes and linkages between them, and using this information to increase understanding on the studied topic. Bibliometrics can also be used to determine a technology's position on its life cycle. Previous studies have used bibliometric data – such as patents and scientific publications – to describe the technology's diffusion level in its early development phases. In an application phase of a technology, newspapers are acknowledged as an appropriate data source for analysing technology diffusion, but studies examining renewable energy technologies using news data have not yet been made. Hence, a gap in research was discovered.

This thesis pursued to fill the research gap by examining the connection between media coverage and primary energy production. The study was carried out by studying three renewable energy forms – wind energy, solar pv energy and hydroelectric energy – in three EU member countries – Germany, Ireland and the UK – on an examination period of 1995 – 2008. Three types of data on the chosen research subjects were collected: Media coverage data, primary energy production data and data on RE policies and measures. Quantitative media data was collected from a database portal called Nexis UK, quantitative production data from Eurostat's and SEAI's web pages, and qualitative RE policies and measures data from IEA's web page. Even though three types of data were collected, the statistical analyses were performed between the two quantitative data sets; media coverage and production data. The qualitative data on renewable energy policies were used to deepen the understanding of the connection between media coverage and energy production, and to bring up a focal influential force – energy policy – that takes effect on renewable energy production.

The research problem of the thesis was: *Does a connection between media coverage and RE primary production exist*. The connection was analysed using Pearson correlation with 1 % significance level. The null hypothesis was, that there is no correlation between the media coverage and primary energy production of RE. With the statistical analysis the null hypothesis was pursued to be rejected.

The theoretical section in chapter 2 started with explaining the field of technology foresight in general, and then the linkages between media, RE policy and RE production were discussed. The connections between these three were examined individually. The connection between media and RE production was discussed by representing the use of bibliometrics in examining technology diffusion. It was stated that bibliometric data follows a pattern similar to diffusion S-curve. The connection between media and RE policy was then described by explaining the media's political agenda setting power and the course of communication between the media and the polity. After these, the connection between RE policy and RE production was discussed by representing the most common energy policies used in the EU and their effectiveness. Based on previous research, it was expected that a correlation between media coverage and RE production exists. Also, it was suggested that the effectiveness of the RE promotion system each country uses, may have an influence on the connection between media and RE production.

The third chapter consisted of describing the used data, the data collection procedures and the use of Spearman correlation as an analysis method. The results of the correlation analysis, presented in chapter 4, showed that strong, statistically significant correlations exist between media coverage and RE production in wind energy in all three examined countries. Solar pv media coverage and primary production were also strongly and statistically significantly correlated in Germany, but for Ireland and the UK the correlations could not been calculated for shortage of data. The analysis conducted on hydroelectric energy gave no significant results, and it could be stated that the media coverage is not correlated with primary hydroelectricity production.

Based on the results of the analysis it could be said that the media coverage and primary energy production correlate with each other, if the concerning RE form is being used in large scale energy production and it has achieved a certain level of diffusion, but is still in the phases of growth. The results of the analysis were in line with similar studies made using patents and scientific publications, as they revealed that media data can be used to describe the diffusion level of technologies on some conditions: The RE form has to be in the early parts of diffusion, but the production has to be taken off properly, so enough history data is available for the analysis. The same condition applies to media data: Enough data has to be available, or the analysis cannot be performed. The results did not show, that the type of RE promotion system use in each subject country would have any influence on the correlation between media coverage and RE production

The objective of this thesis was to determine the connection between the media coverage and the RE production. The objective of the thesis was fulfilled, as the connection between the media coverage and RE production was analysed as planned, and the results showed that the media and the RE production are correlated on certain conditions. Similar analysis should be applied on other energy forms and other countries as well, to see if the analyses bring corresponding results.

In further studies the examination of the connection between the media and the RE should be deepened, and there are many ways to do so. First, other countries and energy forms could be studied to see, how the media coverage and energy production data are correlated in them. Second, the possibility to use other data sources should be investigated, as the sources used in this thesis brought some limitations. The greatest limitations were that there was no sufficiently media data available on Nexis UK in other languages than English and Germany, and that the energy production data could not be collected on monthly level. Also, the analysis could have been done with a longer examination period to get a more comprehensive view on the subject. The third possibility to further examine the connection between the media and the RE production, is to study other forms of energy than primary energy production, for example heating or transportation. The fourth way to further research the topic, would be to include data on the growth potential of each energy form to see, whether this influences the connection. Of course, the higher the growth potential is, the more useful the results would be for practical purposes. The fifth possible way to examine the topic is to conduct content analysis on the media coverage data and include qualitative analysis. Finally, the analysis could be conducted on a technology-specific level to bring more valid results. The analysis made in this thesis was from the viewpoint of an energy form, and for example hydroelectric energy can be produced with multiple technologies.

The validity of the results of this bibliometric study may be hindered by lagging or noisy data, or variation in terminology. Also, it cannot be verified, how much the increase in the amount of media publications or the quality of data offered by Lexis UK causes measurement error. However, the diligence in conducting the analysis should prove reliable results. In this thesis the RE technologies are viewed mainly from a technical perspective. The RE technologies' historical production trends are analysed using diffusion growth curve, the media data are analysed using bibliometric analysis and these two data sets are finally examined by means of Spearman correlation. In further studies, the analysis could accommodate also other types of methods to increase the validity of results.

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APPENDIX 1: SEARCH TERMS IN NEXIS UK

When searching for publications regarding For example wind energy in Germany in January 1995 the search term is:

((HEADLINE(windenergie OR windkraft)) and ((#GC318#)) and DATE(>=1995-01-01 and <=1995-01-31)).

The search term contains different elements. First, it contains information on from which part of the text search words are sought for; from the whole text and its attributes such as Subject, Industry and so on, or only the headline. Second, the search term contains the country code for which Country/Region the search is for, and finally the time period from which the documents are sought for. If documents are searched on headline level they are built as follows:

((HEADLINE('search words')) and ((Country/Area code)) and DATE(>=YYYY-MM-DD and <= YYYY-MM-DD)).

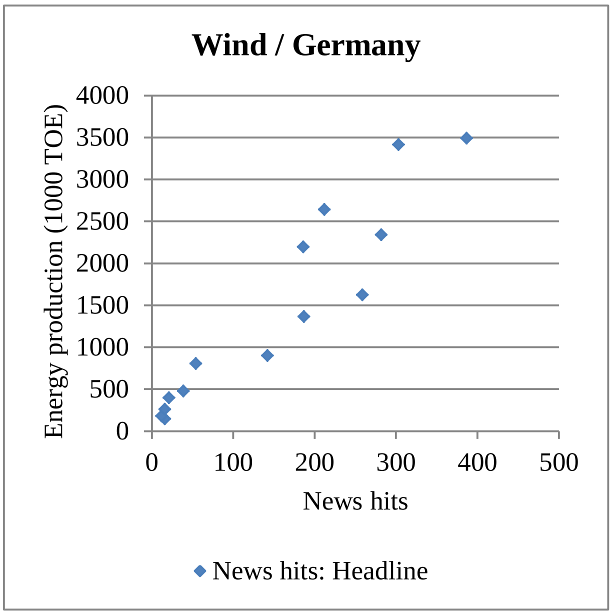
If they are searched in a way that the search words are scanned from the entire document, the search is done the same way as above, just the HEADLINE-attribute must be left out from the search clause.

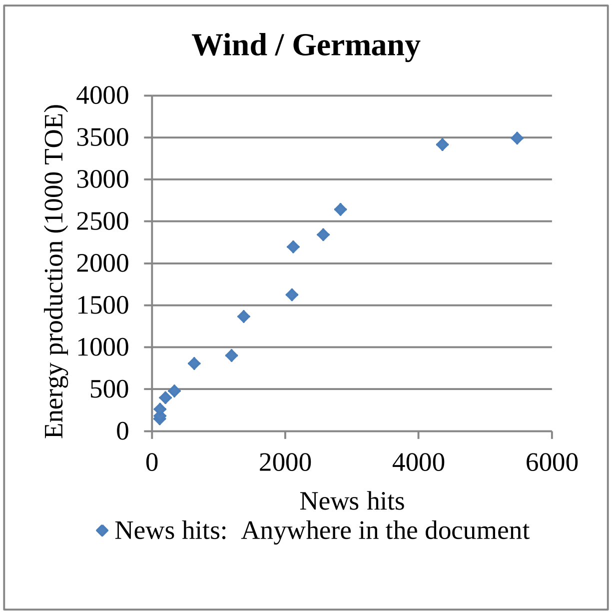
APPENDIX 2: SEARCH RESULTS DATA

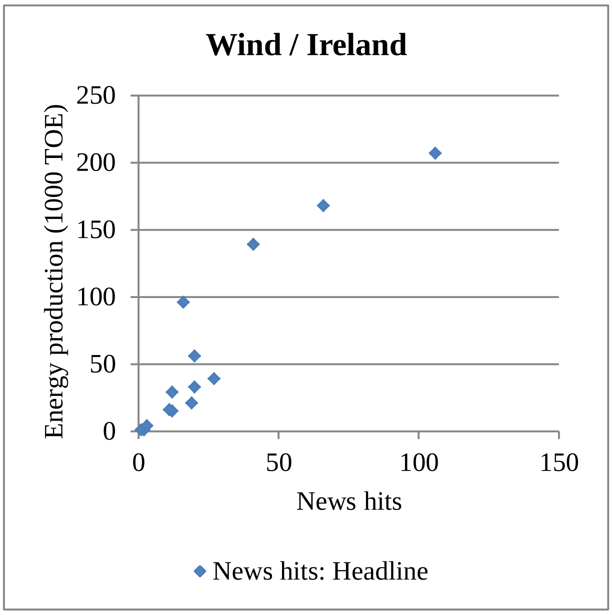
No duplicate analysis			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Wind	Germany	News hits: Headline	16	12	16	21	39	54	142	187	259	186	282	212	303	387
		News hits: Anywhere in the document	118	125	122	206	340	638	1196	1378	2103	2122	2572	2832	4362	5479
		Primary production of electricity (kTOE)	147	179	261	395	475	804	899	1363	1622	2193	2341	2641	3415	3489
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Ireland	News hits: Headline	2	1	3	12	11	19	12	20	27	20	16	41	66	106
		News hits: Anywhere in the document	50	31	80	112	142	166	177	288	355	339	416	707	1068	1541
		Primary production of electricity (kTOE)	1	1	4	15	16	21	29	33	39	56	96	139	168	207
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	UK	News hits: Headline	11	18	27	83	48	64	94	106	163	253	218	257	264	405
		News hits: Anywhere in the document	215	274	523	1025	955	1163	2044	2704	3543	4646	5427	7101	8284	10325
		Primary production of electricity (kTOE)	34	42	57	75	73	81	83	108	110	166	250	363	453	610
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Solar	Germany	News hits: Headline	10	9	13	12	25	24	35	28	50	66	84	82	131	196
		News hits: Anywhere in the document	106	125	158	155	243	357	370	388	503	654	1026	1223	1736	2516
		Primary production of electricity (kTOE)	1	1	1	3	3	5	10	16	29	48	110	191	264	380
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Ireland	News hits: Headline	0	2	2	2	1	2	2	1	1	1	1	2	20	30
		News hits: Anywhere in the document	31	22	64	49	54	62	76	68	102	96	153	258	635	994
		Primary production of electricity (kTOE)														
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	UK	News hits: Headline	7	13	28	31	39	27	44	62	53	67	55	53	105	131
		News hits: Anywhere in the document	217	288	687	964	950	1138	1391	1316	1472	1601	2219	3729	5303	5946
		Primary production of electricity (kTOE)	0	0	0	0	0	0	0	0	0	0	1	1	1	1
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Hydro	Germany	News hits: Headline	1	4	2	7	8	11	21	17	28	36	30	21	36	37
		News hits: Anywhere in the document	72	85	88	107	207	333	498	357	655	798	847	1022	1477	1700
		Primary production of electricity (kTOE)	1873	1888	1492	1480	1689	1869	1955	1988	1656	1812	1684	1714	1797	1801
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Ireland	News hits: Headline	0	0	0	0	0	0	0	1	1	0	0	0	0	4
		News hits: Anywhere in the document	36	28	83	129	102	80	129	129	127	116	128	225	334	468
		Primary production of electricity (kTOE)	61	62	58	79	73	73	51	78	51	54	54	62	57	83
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	UK	News hits: Headline	6	4	2	17	7	6	11	6	8	9	7	14	8	58
		News hits: Anywhere in the document	1059	1166	2120	4848	2910	2202	2213	2241	2310	2080	2509	3473	3998	4391
		Primary production of electricity (kTOE)	416	292	358	440	459	437	349	412	277	416	423	395	438	444

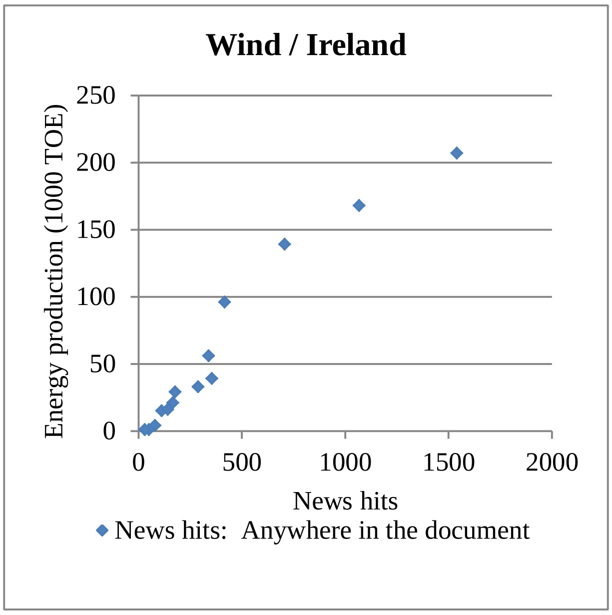
(Eurostat 2011; LexisNexis 2011; SEAI 2011)

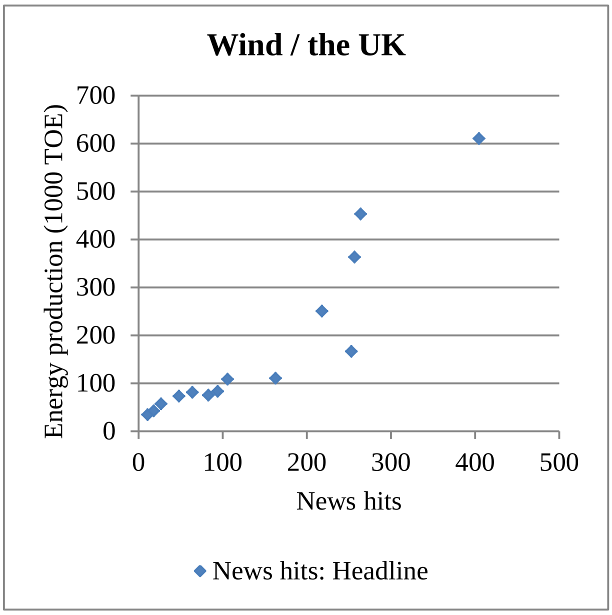
APPENDIX 3: MEDIA COVERAGE AND PRIMARY PRDUCTION DATA IN SCATTERPLOT FORM

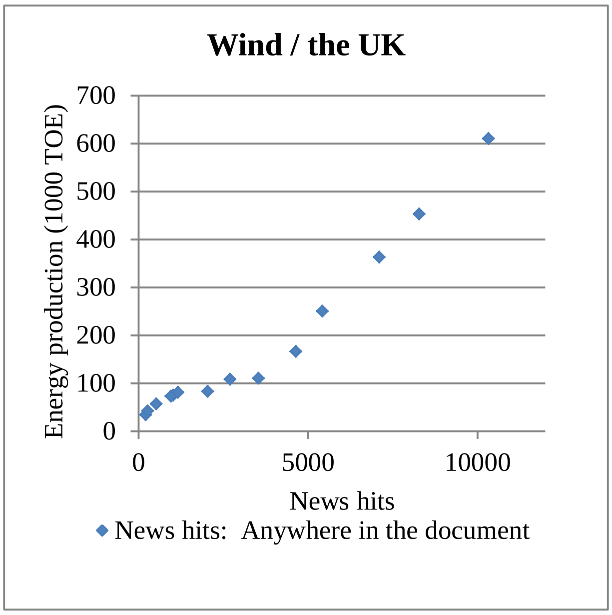


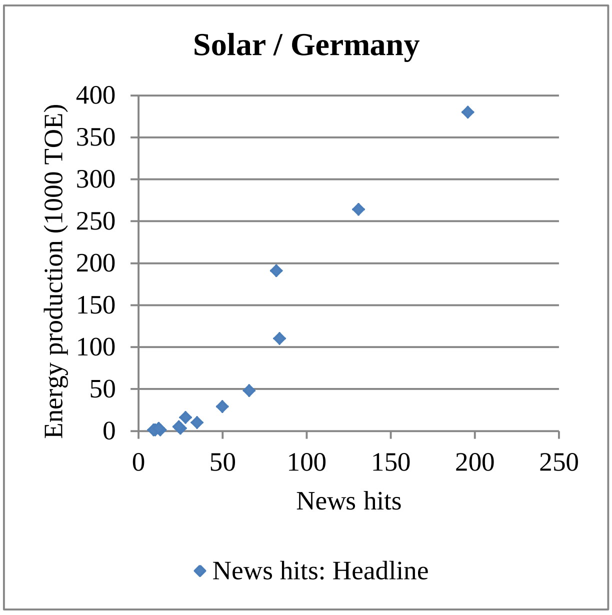


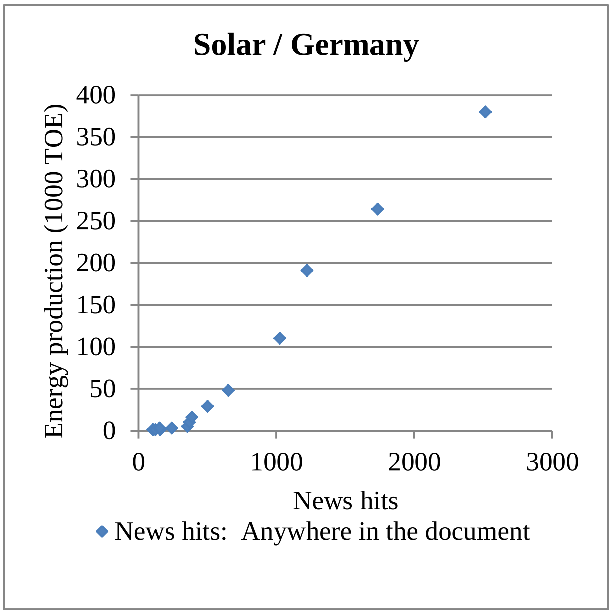


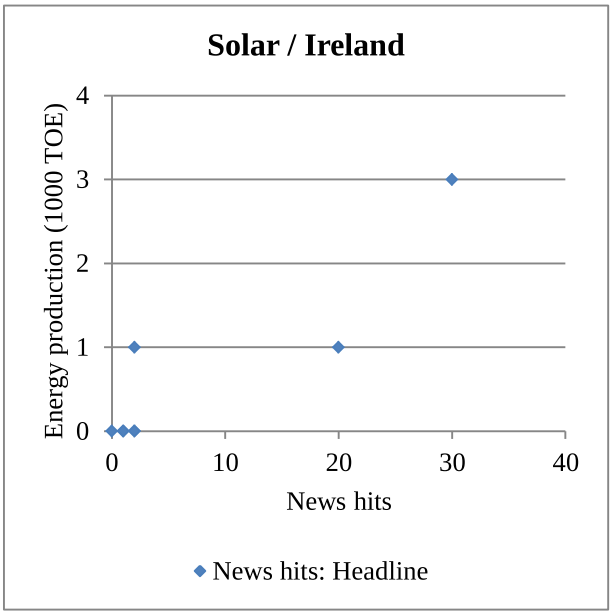


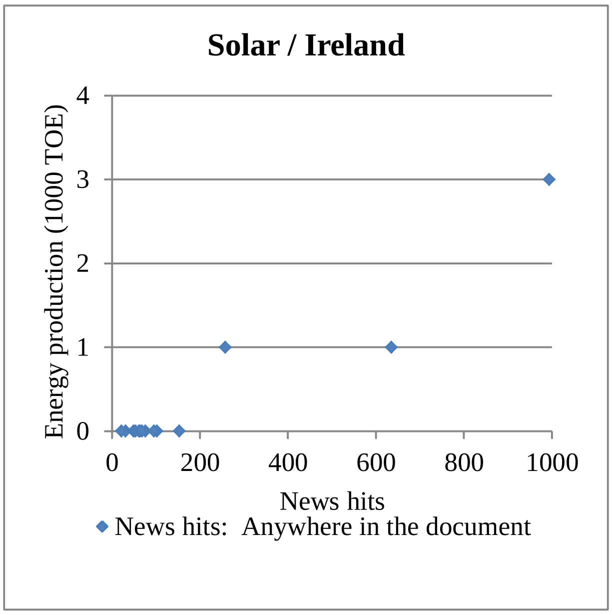

Wind / the UK
Energy production (1000 TOE)
700
600
500
400
300
200
100
0
0
100
200
300
400
500
News hits
News hits: Headline

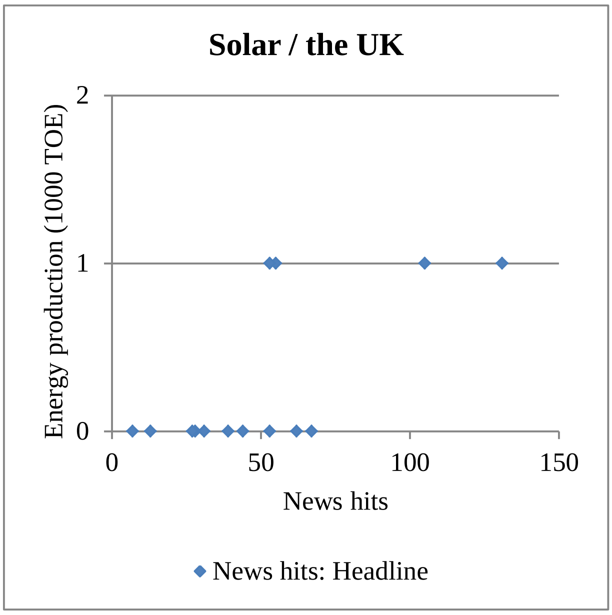

Wind / the UK
Energy production (1000 TOE)
700
600
500
400
300
200
100
0
0
5000
10000
News hits
News hits: Anywhere in the document

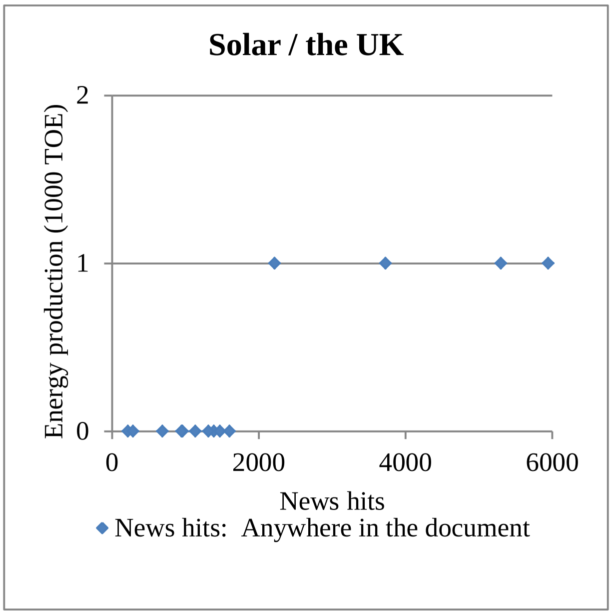

Solar / Germany
Energy production (1000 TOE)
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
News hits
News hits: Headline

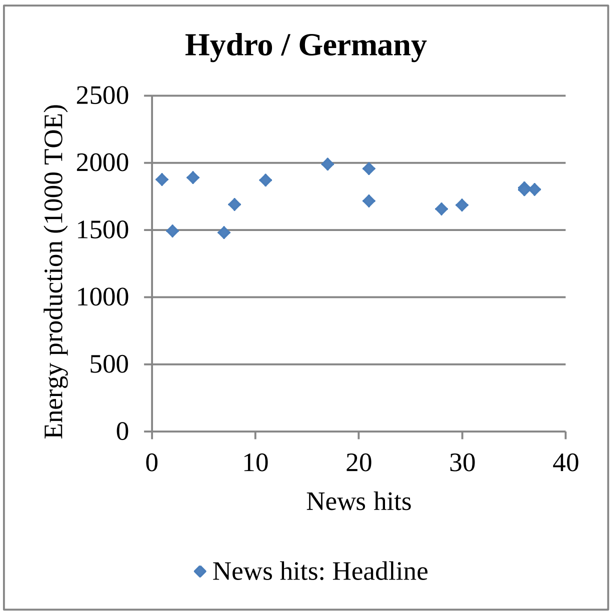

Solar / Germany
Energy production (1000 TOE)
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
News hits
News hits: Anywhere in the document

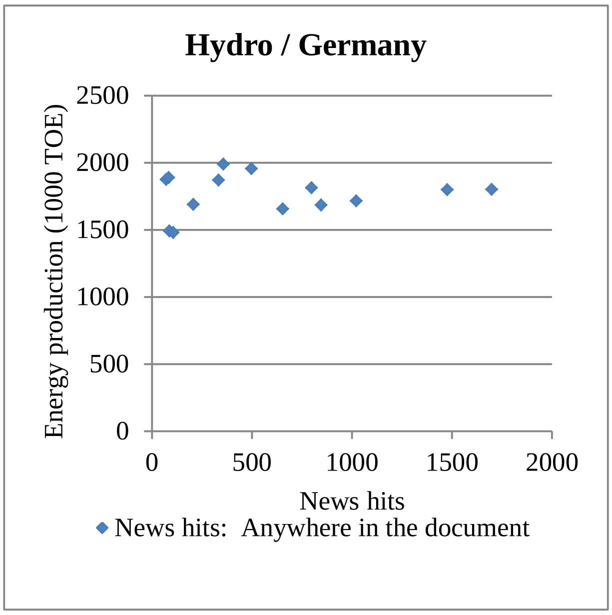

Solar / Ireland
Energy production (1000 TOE)
4
3
2
1
0
0
10
20
30
40
News hits
News hits: Headline

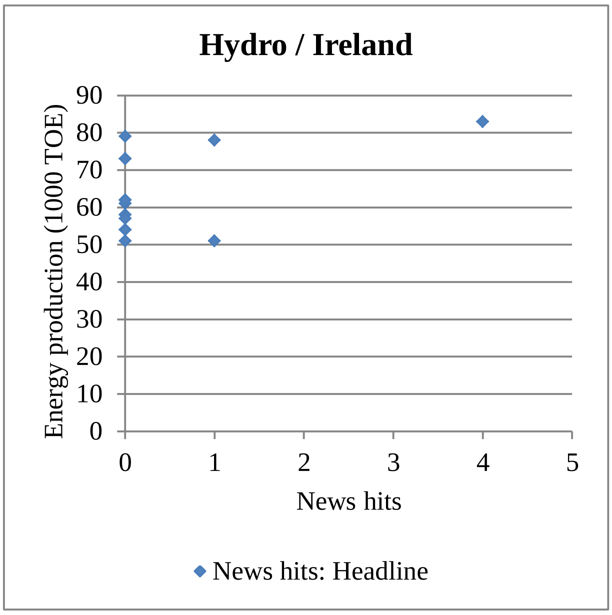

Solar / Ireland
Energy production (1000 TOE)
4
3
2
1
0
0
200
400
600
800
1000
News hits
News hits: Anywhere in the document

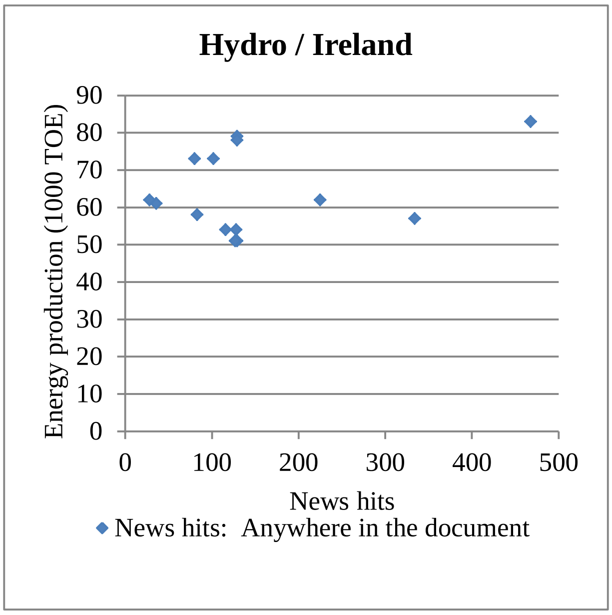

Solar / the UK
Energy production (1000 TOE)
2
1
0
0
50
100
150
News hits
News hits: Headline

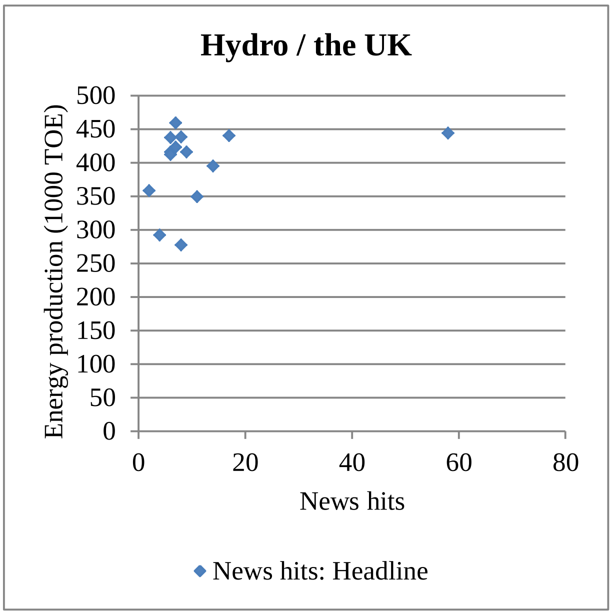

Solar / the UK
Energy production (1000 TOE)
2
1
0
0
2000
4000
6000
News hits
News hits: Anywhere in the document


Hydro / Germany
Energy production (1000 TOE)
2500
2000
1500
1000
500
0
0
10
20
30
40
News hits
News hits: Headline

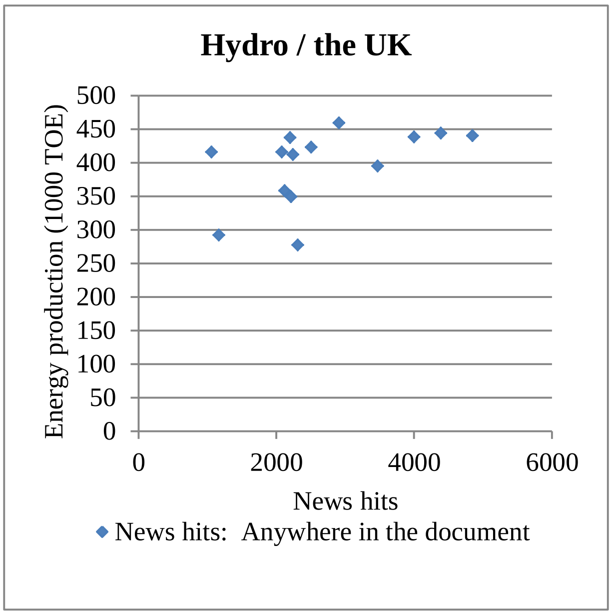

Hydro / Germany
Energy production (1000 TOE)
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
News hits
News hits: Anywhere in the document


Hydro / Ireland
Energy production (1000 TOE)
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
News hits
News hits: Headline


Hydro / Ireland
Energy production (1000 TOE)
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
News hits
News hits: Anywhere in the document



Hydro / the UK
Energy production (1000 TOE)
500
450
400
350
300
250
200
150
100
50
0
0
20
40
60
80
News hits
News hits: Headline



Hydro / the UK
Energy production (1000 TOE)
500
450
400
350
300
250
200
150
100
50
0
0
2000
4000
6000
News hits
News hits: Anywhere in the document