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Renewable Energies and the Policy Mix

An analysis of renewable energy support strategies from a policy diffusion perspective

Luis Enrique Gutierrez Tavarez

Under supervision of

Kirsten S. Wiebe

Gesellschaft für Wirtschaftliche Strukturforschung mbH
Heinrichstr. 30
D - 49080 Osnabrück

Kirsten S. Wiebe
Tel.: +49 541 40933 - 230
Fax: +49 541 40933 - 110
Internet: www.gws-os.com

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Address of the authors

Luis Enrique Gutierrez Tavarez

Jacobs University Bremen. Global Economics and Management Class of 2014. Mailbox 202, College Ring 1. 28759 Bremen, l.gutierrezreztavarez@jacobs-university.de

Kirsten S. Wiebe

Gesellschaft für Wirtschaftliche Strukturforschung (GWS) mbH, Heinrichstr. 30, 49080 Osnabrück, wiebe@gws-os.com

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TABLE OF CONTENTS

1 INTRODUCTION

Renewable energy technologies (RET) have come to the fore in recent decades as a sensible and rational alternative to ensure that energy requirements are met within the context of growing energy demand and resource conservation worldwide. The question of energy provision sits at the complex juncture between economics, politics and international relations. As such, the topic cannot be understood simply in economic terms; its study needs to incorporate insights from politics and policy making for a more comprehensive perspective.

This paper focuses on providing a more holistic picture of the varying impacts of policy decisions on the introduction of renewable energy technologies across different countries. In order to identify patterns and trends in the adoption of policy measures, this study makes use of the concept of Policy Mix, as proposed by Rogge and Reichardt (2013) and several concepts from innovation theory and policy diffusion.

The first section of this paper presents the three main components of the study: the IEA-IRENA Joint Database for Renewable Energy Technologies, as its main source of information; and the concepts of Policy Mix and Policy Innovation used to analyse renewable energy (RE) support policies. The second section discusses the relevance of policy as a driver for the widespread adoption of RE and outlines the link between the policies analysed and the frame provided by the policy mix. Section three is then dedicated to analysing the countries in terms of policy diffusion, building upon the concept of policy mix. Innovator countries are initially taken as reference case studies in order to analyse the different channels through which policy spreads. The fourth section assesses the advantages and limitations of applying the policy frame and is followed by the last section, which outlines further paths of research. By the end of the study it is expected that by integrating the concepts of policy mix and innovation diffusion into the analysis of renewable energies, it will be possible to achieve a better understanding of the effect policy structure and the reasons for policy implementation have on the efficacy of support mechanisms.

2 METHODOLOGY: IEA – IRENA JOINT DATABASE AND THEORETICAL FRAMEWORK

2.1 POLICY MIX CONCEPT

The seminal groundwork for this report comes from the concept of Policy Mix proposed by Rogge and Reichardt (2013). Their approach is particularly useful for the purposes of this analysis in that it provides a unifying framework to analyze the elements and the processes that make up different policy mixes. This framework breaks down national policy mixes into elements, processes and dimensions, which allows for more encompassing analysis of these, while retaining the comparability between policy structures. Thus, one of the main benefits of this framework is that it provides a concise baseline to compare

policy structure across different countries. This is relevant as the interchangeable uses of terminology seen in the existing literature make it difficult to transfer lessons learnt from one policy case study to the next. Additionally, the policy mix concept proposes a solution for two prevailing problems in the infant literature regarding renewable energy policy studies: On one side, it broadens the scope of otherwise narrow definitions of policy mix that often ignore crucial processes. Additionally, it addresses the lack of uniformity in terminology, thus facilitating policy assessments and comparisons (Rogge & Reichardt, 2013).

2.2 The IEA-IRENA Joint Policies and Measures Database

In order to ensure a high degree of uniformity in the collection of information of support policies, this study used the IEA/IRENA Joint Policies and Measures Database as its main source. The database "*provides information on the policies and measures taken or planned to encourage the uptake of renewable energy in all IEA and IRENA Member countries and signatories"* (OECD, IEA, 2013). This resource offers a great array of detailed information containing specific targets; funding in homogenized terms; and the possibility to track policies even after amendments or substitution. One of the main advantages of using this database is the relative increase in uniformity in terms of formatting and content.

Given the vast amount of countries and policies available in the database, the scope of this study has been narrowed down to 17 countries. The selection of countries is aimed at providing a comprehensive sample of geographic region, state of technology and time of policy adoption. These include 10 Western European countries: Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Portugal, Spain and the United Kingdom; 4 BRIC+ countries (Excluding Russia and South Africa due to lack of information); Japan; the US; and Egypt as a proxy for MENA countries. Under the umbrella of Project GRETCHEN, which aims to explore the effect of support policies on the adoption of renewables in Germany, only those entailing support for wind and solar technologies were included. As the clean energy technologies that have developed the most in recent years, both technologically and commercially they are the fields where the most data and policies are available. General RE support policies that included provisions for wind and solar technologies were also included.

2.3 Innovation Theory and Policy Diffusion

This paper draws on concepts from innovation theory and policy diffusion to understand the way in which different policy structures are adopted and the effect this has in the effectiveness of the renewable energy support policies. Diffusion, as initially explored by Rogers in 1962, is "*the process by which innovation is communicated through certain channels over time among the members of a social system"* (Rogers, 2003). In terms of this analysis, the implementation of renewable support policies will be seen as the innovation. The interactions between governments (actors) in the international context will be regarded as the social system in question. Following Rogers' initial categorization criteria, the 17 countries of the sample are divided into five types of innovators: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. The types of innovator are

determined relative to the time-span of the innovation. The first 2.5% to implement an innovation are called Innovator countries followed by the next 13.5% consisting of the Early Adopters. The following 34% in adopting an innovation are called Early Majority followed by the next 34%, which are classified as late adopters. The last 16% in adopting the innovation are classified as Laggard countries. It is important to note that when applying innovation theory to this policy analysis, the methodology to consider the time-frame was adapted due to the reduced sample size. Conventionally, the category boundaries would be drawn as percentages of the total number of adopters. In this case, the sample of countries is too limited to draw appropriate category boundaries. Additionally, this analysis does not consider all the countries that have adopted support policies so the time between first and last adoption was used to draw category boundaries. Ranging from 1974 to 2013 the boundaries are defined by percentiles based on the 39 years taken into consideration. **Table 1.3.1** below displays the countries according to their classification by innovator types. **Figure 1.3.2** provided in the appendix shows the distribution of policy adoption over time more clearly.

Table 1.3.1: Countries by Innovator Type

Adoption Stage	Country
Innovators: First 2.5%	US, Denmark, Germany
Early Adopters: 13.5%	France and Japan
Early Majority: 34%	Belgium, Italy, Netherlands, Spain
Late Majority: 34%	Austria, Brazil, China, India, Mexico, Portugal, UK
Laggards: 16%	Middle East

Source: Adapted from Rogers (2012) The Diffusion of Innovation.

Since the usual model of communication between individuals cannot be applied to the way States interrelate, this analysis will make use of the mechanisms of policy diffusion, as proposed by Shipan and Volden (2008). They propose four main policy diffusion mechanisms: learning, competition, coercion and imitation between countries (Shipan and Volden, 2008). Furthermore, they propose a set of hypotheses that explain the dynamics of diffusion beyond mere geographical proximity. **Table 1.3.2** below outlines their hypotheses in their original form as applied to cities. For our analysis, the concept of cities will be extrapolated to governments so as to be applicable to the process of policy making. As for the reference to big and small countries made by Shipan and Volden (2008), this can be understood in terms of political and economic influence when applied to governments as policy adopters.

Table 2.3.2: Conditional Policy Diffusion Hypotheses

Conditional Hypotheses	
Diffusion by learning:	Larger cities are more likely to learn from other cites
Diffusion by competition:	Larger cities are less susceptible to economic competition.
Diffusion by imitation:	Larger cities are less susceptible to engage in imitation.
Diffusion by coercion:	Larger cities are less likely to be coerced effectively.

Source: Shipan and Volden (2008) Mechanisms of Policy Diffusion.

3 Policy-Driven Introduction of Renewables: What About the Market?

In defining the best strategy to integrate a greater share of renewable energy technologies into the energy mix, there is great controversy as to whether it should be left to the market or if government participation is necessary. This study takes the view that renewable energies need to be backed by public policy in order to reach competitiveness against already locked-in fossil fuel technologies. The literature in this sense tends to back up the idea that due to higher costs, long investment horizons, and competition against highly subsidized fossil fuels renewable technologies will not achieve maturity without policy support (Gawel, 2013; Gross, 2010; IEA, 2013). This idea builds on the inherent limitations for investment in the electricity sector, which are usually constrained by risk-averse behaviour and policy uncertainty (Cramton, 2011; Neuhoff, 2004). Moreover, as will be discussed further, the introduction of renewable energies has to be understood as a direct response to political conditions in the 1970s and not so much due to technological maturity (Yergin, 2011). In this sense, governmental involvement, seen through policy measures, needs to be considered as an integral factor for the adoption of RE technologies.

3.1 Applying the Policy Mix Concept

As exposed previously, the Policy Mix concept provides the advantage of offering a common frame for policy evaluation by fitting the different aspects of each policy mix in three overarching levels: Elements, Dimensions and Processes. Since this study aims to categorize the 317 measures across the 17 different policy mixes (each country having its own structure) the focus will be placed in assessing how they fit within the ‘element’ level of the framework. Within the ‘Elements’ category, policy measures are subdivided into

Instrument Mix and Policy Strategy. Policy Strategy is then subdivided into Policy Objectives, entailing long term targets; and Principal Plans, consisting of long-term strategic plans, roadmaps or similar aimed at the realization of policy objectives (Rogge and Reichardt, 2013). Research and Development; Education; and Knowledge-Sharing fall under this category as they indirectly work to build an auspicious environment for renewable energies. Although emphasis is placed on analysing the Elements level of the Policy Mix, we also will draw on concepts of instrument type and purpose to address the way in which policy implementation has determined adoption of renewable energy technologies. **Table 3.1.1** below shows the criteria used to fit the 317 measures in the Policy Mix criteria.

Table 3.3.2: Types of Elements within the Policy Mix

Type of element	Measures included
Instrument Mix:	Measures related to the establishment of laws, financial and fiscal policies, content requirements, bans, and quotas, funds allocated for loans.
Policy Strategy	
Policy Objectives:	Long-term goals: installed capacity and course of action outlines
Principal Plans:	International or regional cooperation efforts, funds allocated for research and development, education and awareness programmes, communication efforts.

Source: Rogge and Reichardt (2013)

Since not all policy measures could be fitted to one category in particular, 6 additional hybrid categories were created and can be found in **Table 1.3.2** below. For the six hybrid categories, the names combine the acronym of two original categories, with the acronym of the most defining category placed first. For example, label 'IM / PO' would indicate the column for the measures that entail both Instrument Mix as well as Policy Objective attributes. Conversely, label 'PO / IM' presents the frequency of measures with the same components where the Policy Objective, that is the long term planning nature of the policy, supersedes the Instrument Mix aspect. An example of this would be setting a target to increase share of RE in electricity generation (PO), that entails government offices running on 100% electricity from renewable sources (IM).

From the analysis of policy distribution on its own it is not possible to see any effect on the outcomes of each policy mix, which are seen in installed capacity and/or share of electricity obtained from renewable sources. Additionally, categorization becomes particularly ambiguous when looking at Principal Plan elements. As elements that define the path to be followed in the deployment of renewable energies they make use of regulation and financial incentives that can be appreciated as elements of the instrument mix on

their own right. To address this problem, a further layer of analysis is applied in order to find the commonalities in terms of type and purpose of the policy. This analysis is complemented by the application of innovation theory concepts, such as country status along Rogers' (1962) innovator framework, and Shipan and Volden's (2008) policy diffusion mechanisms. Through the integration of Policy Mix concepts and innovation theory it is possible to see patterns in terms of the element types first implemented in each country.

Table 4.3.2: Policy Distribution by Country

Country	Total	Instrument Mix	Principal Plan	Policy Objective	IM / PP	IM / PO	PP / IM	PP / PO	PO / IM	PO / PP
Austria	*16*	7	3	1		2	1	2	--	--
Belgium	*25*	13	6	--	1	2	2	--	1	--
Brazil	*10*	3	3	--	1	1	--	1	1	--
China	*31*	17	4	3	3	3	1	--	--	--
Denmark	*25*	10	5	2	4	--	--	--	1	3
Egypt	*2*	--	--	1	--	--	--	--	1	
France	*28*	17	7	--	--	--	3	--	--	1
Germany	*29*	13	8	--	--	6	1	--	--	1
India	*13*	4	1	2	2	2	--	--	1	1
Italy	*26*	15	5	1	3	2	--	--	--	--
Japan	*20*	10	4	3	--	--	3	--	--	--
Mexico	*14*	5	3	--	1	1	1	3	--	--
Netherlands	*15*	8	1	--	3	--	1	2	--	--
Portugal	*14*	11	1	--	--	--	1	1	--	--
Spain	*25*	11	4	1	3	3	1	--	--	2
United Kingdom	*27*	12	6	1	1	2	4	--	1	--
United States	*59*	21	21	3	4	1	4	2	1	2

Source: Adapted from IEA-IRENA Joint Policies and Measures database: Global Renewable Energy.

4 COUNTRY GROUPING RESULTS

The following section is dedicated to comparing the initial implementation of policies supporting renewable energies in the countries in the sample according to their innovator status. The Policy Mix typology is applied in order to expose the different approaches taken by each country as opposed to the approach taken by the Innovator countries analysed previously.

4.1 POLICY RESPONSE AS AN INNOVATION

In analysing the kind of policies that are implemented when a country first adopts support policies for renewable energy we will first focus on the countries that fall under the Innovator category, namely Denmark, Germany and the US. Looking at these countries is particularly relevant in that it reinforces a key aspect of this analysis, the relevance of policy making and governmental support to advance the integration of renewables. In the case of these three countries, their initial efforts were a direct response to a series of political developments in the 1970s. The most important of these, were the oil crises triggered by the Arab embargoes in 1967 and throughout the 1970s. As another part of the phenomenon we could take into account were the 1979 Three-Mile Nuclear Incident in Pennsylvania and the publication of "Limits to Growth" by the Club of Rome in 1972. Altogether, these events brought about a paradigm shift that contrasted with the so far prevailing ideas about economic growth and progress. Altogether, the scene of energy politics changed dramatically during this decade as energy security and scarcity of resources propped the need for diversification and environmental restraint.

As the countries with the 'oldest' policy mixes in terms of renewable energies, Germany and the US have managed to remain as leaders in terms of installed capacity of renewables, being recently joined by China (REN21, 2013). The case of Denmark is also worth special attention. Despite not topping the ranks for total installed capacity due to its size, the country has lead a steady policy course aimed at integrating renewables both into its power and its heating mix. After progressively strict fossil phase-outs, the country currently aims at being 100% fossil fuel free by 2050 (Danish Ministry of Foreign Affairs, 2013).

Following along with the measure categorization based on Rogge and Reichardt's (2013) Policy Mix concept, it can be observed that at the initial stages of the deployment of renewable energies in innovator countries, the first instruments adopted were aimed at developing technology and can thus be considered as Technology-push instruments. Although the prescriptive nature of these measures in defining the path for technology development groups them under Principal Plans, the comparison between countries is more effective when considering the purpose of the instruments contained within them. The following **Table 3.1.1** presents the policy mix development at the initial stages in the innovator countries.

Table 3.1.1: Initial Policy Efforts in Innovator Countries

Year	Name of Measure	Classification
Denmark		
1976	Energy Research Programme	Technology Push & PS
1989	Modification to Energy Supply Act	Regulation for RE Grid Access: Instrument Mix
1997	Wind energy cooperative tax incentive	Fiscal Incentive: Instrument Mix
Germany		
1976	GROWIAN, Wind Research Programme	Technology Push & PP
1989	100MW Wind Programme	Financing: Instrument Mix
1991	Stromeinspeisungsgesetz: Electricity Feed-In Law	Regulation for Grid Access: Instrument Mix
2000	Erneuerbare-Energien-Gesetz (EEG)	Regulation: Instrument Mix
United States		
1974	Solar Energy Research Act	Technology Push & PP
1974	Creation of NREL	Technology Push & PP
1978	Public Utilities Regulatory Policies Act (PURPA)	Regulation: Instrument
1978	Energy Tax Act	Fiscal Incentive: Instrument Mix element

Source: Adapted from IEA-IRENA Joint Policies and Measures database: Global Renewable Energy

The first policies observed in Innovator Countries fall within the 'Policy Strategy' category when looking exclusively at Innovator countries. Table 3.1.1 above displays the first policies implemented by Denmark, Germany and The US. In Denmark this can be seen through the implementation of the Energy Research Programme in 1976. On the one hand, this measure is considered to be a Principal Planning element since it entails research aimed at building up knowledge of best-techniques as well as assessing the potential of

RE. On the other hand, while looking at the purpose and type of the instruments within the measure, these can be classified as technology push as they were aimed at building up the state of technology and expertise (Rogge and Reichardt, 2013). In the case of Germany the initial approach to improve knowledge and develop expertise can also be seen through the introduction of the GROWIAN Research Programme in 1976. The same approach can be observed in the United States with the introduction of the Solar Energy Research Act, and the creation of the National Renewable Energies Laboratory in 1974. A common element to these three countries' policy mixes is that they were all started-off with efforts in the field of Research and Development (IEA-IRENA). An additional country that is not in this sample, but also initiated its support for renewables at the same time is Sweden. In this case, the relationship of Innovator countries starting of with R&D efforts holds, with the introduction of the Energy Research and Development Programme in 1975 (IEA-IRENA).

The similarities in policy development in Innovator countries hold when looking at the measures that followed the initial efforts in research and development. In the United States the first measure that can be classified as an Instrument Mix element was introduced in 1978, the Public Utilities Regulatory Policies Act. This measure is classified as an Instrument Mix element because it includes grid-access provisions for renewables, which are determined by regulation. Utilities were allowed to buy power from renewable sources as long as they could produce power below the utilities' "avoided cost"[1]. In 1989, Germany and Denmark followed up on their original Principal Planning programmes by introducing Instrument Mix elements to their policy mix. In Germany, the first such measure was the 100MW Wind Programme, which provided grants of up to EUR102/kW and covering up to 60% of installation costs in order to encourage the installation of wind turbines, the programme was then expanded to 250MW in 1991 (IEA-IRENA). More noticeably, Germany implemented the Energy Feed-in Act (Stromeinspeisungsgesetz) in 1991, which provided grants and enhanced grid-access for renewable energies and is often lauded as the driver for the great expansion of renewable energy in the country (IEA-IRENA).

In the same manner, following its initial research efforts Denmark made modifications in 1989 to its electricity act to ensure grid-access for renewables and implemented the Wind-cooperative tax incentive, which provided a break from the usual energy tax for wind-powered generation. The measures adopted by Denmark, Germany and the US can be seen as what Vedung (2007) calls 'sticks' and 'carrots' since they provide regulations and economic incentives for the introduction of renewable energy technologies (in Rogge and Reichardt, 2013). By these criteria, the measures also qualify as Instrument Mix elements, thus allowing for the determination of a common structure of policy mix

[1] As used in the IEA-IRENA entry for the PURPA, July 19th, 2013 avoided cost equals the cost that would have been incurred in by the utility to generate additional power. (http://www.iea.org/policiesandmeasures/renewableenergy/index.php)

introduction in Innovator countries where Instrument Mix elements follow the introduction of Policy Strategy elements. This relation can be explained by the fact that it is first necessary to build technical knowledge before implementing wide-spread policies. As will be seen in the following cases, the strategies adopted by other countries differ from the Innovator approach by gradually veering away from R&D measures at initial stages. The combined use of innovation theory and policy mix will be instrumental in uncovering this relationship.

4.2 WHO FOLLOWED? AND HOW?

4.2.1 EARLY ADOPTERS

Table 4.2.1: Initial Policy Efforts in Early Adopter Countries

Year	Policy Name	Classification
France		
1980	Renewable Energy Development in Overseas French Islands	Technology Push (IM)
1995	Rural Electrification using RES	Instrument Mix / Principal Planning (IM / PP)
1996	Wind Energy Programme (WEP)	(PS) Principal Planning / Policy Objective
1999	Grants for installation and diffusion	Financing: Instrument Mix
Japan		
1980	Creation of New Energy and Technology Development Organization	Technology Push & PP
1994	New Sunshine Programme	Cost Efficiency R&D: Principal Planning
1994	Subsidies for Residential Photovoltaic Systems	Financing: Instrument Mix
1996	New Renewable Energy Target (NRET)	(PS) Policy Objective

Source: Adapted from IEA-IRENA Joint Policies and Measures database: Global Renewable Energy

4.2.1.1 Early Adopters: Analysis

Continuing with the innovator framework perspective, the next countries to be analysed are the Early Adopters, in this case France and Japan. As a transition stage between innovation and majority adoption, it is still expected to see elements of knowledge improvement, through Principal Plan measures, in combination with technology-oriented Instrument Mix elements. These elements can be distinguished more clearly from one another in the case of Japan but are common to France as well. In the case of the latter, the first efforts implemented: the programme for Renewable Energy Development Overseas in 1980 and the Rural Electrification Programme can initially be classified as Instrument Mix elements as they include direct financial and fiscal incentives; Vedung's (2007) carrots. Nonetheless, the fact that these programs are initially focused on remote areas signals at two important aspects. Firstly, they could be classified as experimental efforts, requiring for the use of the hybrid category IM / PP. This is because the policy is not only aimed at encouraging installation but also at drawing knowledge from practical applications, thus becoming Principal Planning element. A second aspect that calls attention in the French approach is that the distinction between regionalized policies, as opposed to nation-wide programmes evokes Rogge and Reichardt's (2013) distinction between Dimensions within the Policy Mix. This point, although not the focus of this study, could be a useful anchor for further studies. Different structures of policy Dimension in policy mixes could be studied to find their effect on policy effectiveness.

Comparing Japan to France, the initial implementation of research-oriented measures can also be observed, but in a more direct way. The creation in 1980 of the New Energy and Technology Development Organization and the 1994 New Sunshine Programme, both fall within the Principal Planning classification as they were aimed at fostering technological development in the field of renewables, and in the latter case, prioritized cost optimization. Another commonality that can be seen in the initial policy mix stages of Early Adopter countries is the introduction of Policy Objectives. Whereas in Germany, an Innovator country, the first clear Policy Objective was only seen twenty-four years after its first renewable-oriented measure, in Early Adopters, Policy Objectives came about after 16 years. In 1996 Japan adopted its first PO measure with the National Renewable Energy Target, the same year France set its long-term goals for wind development by way of the Wind Energy Programme.

The implications policy structure has, in the case of Early Adopters is, nevertheless, mixed. In terms of integration of wind and solar electrical generation into their national energy mix France and Japan have followed rather different trajectories. France on one hand, has embarked on a steady pro-Nuclear programme with the country's 58 Nuclear reactors accounting for 77% of electricity generation (NEA, 2012). Japan, on the other hand, despite having 50 nuclear reactors, providing 18.1% of its electricity in 2011 (NEA, 2012) also possesses the 5th largest installed capacity of PV generation worldwide (REN21, 2013).

In the case of Early Adopters, the importance of Nuclear Energy has to be stressed taking into account the Fukushima-Daiichi Nuclear disaster of 2011 and the current trend for denuclearization in Europe. For Japan, the painful and question of Nuclear Energy

means that policy efforts will need to be geared to replacing 18.1% of its electricity mix with either, domestically produced technology or cheaper fossil fuels imported from abroad. For France, denuclearization is an issue discussed at the political level, with incumbent President Hollande '*pledging to cut the country's reliance on nuclear power*' (Bloomberg, 2013) while recent polls point at a reduction in the proportion of French people opposing nuclear energy (Bloomberg, 2013). For both cases, future developments of the countries' electricity mix are promising in terms of studying policy-driven changes in the integration of renewable technologies.

4.2.2 EARLY MAJORITY

Table 4.2.2. Initial Policy Efforts in Early Majority Countries

Year	Policy Name	Classification
Belgium		
1983	Grants for Systems using RE	Financing: Instrument Mix
1990	Pre-Feasibility Studies in Wallonia	Technology Push & PP
1995	Wallonia Plan for Sustainable Development	RE Targets: Policy Objective
Netherlands		
1995	Green Energy Funds	Financing: Instrument Mix
1996	Energy Tax: Breaks for Renewables	Fiscal Incentives: Instrument Mix
2001	Emission-Free Government Operations	Targets: Policy Objective / Principal Planning
Spain		
1994	Royal Decree: Renewable Obligations	Regulation: Instrument Mix
1997	Energy Market Liberalization	Regulation: Instrument Mix
1999	Renewable Energy Targets for 2010	Targets: Policy Objective

Source: Adapted from IEA-IRENA Joint Policies and Measures database: Global Renewable Energy.

4.2.2.1 Early Majority: Analysis

When looking at the implementation approaches taken by the Early Majority countries, a shift in strategy can already be perceived. Considering that the measures presented above entail the first measures adopted by each country, it can be seen that Early Majority countries directly started off with measures that correspond to the Instrument Mix, but in the form of direct financial support. Belgium started in 1983 with a Grant System, followed by Spain in 1994 with a Royal Decree and The Netherlands in 1995 with its Green Energy Funds. Furthermore, long term Policy Objectives are introduced earlier on in the Policy Mix development. Spain adopted a system of Renewable Obligations by Royal Decree in 1994, which was followed by regulations to liberalize the electricity market, with support for renewable production in 1997. Both these measures consist of clear sets of regulations that had a direct effect on encouraging the introduction of renewable energy technologies (IEA-IRENA) and can be classified as elements of the Instrument Mix. In The Netherlands, the establishment of the Green Energy Funds in 1995, provided grants for installation costs, and tax breaks to support the generation with renewable in 1996. These measures, as fiscal and financial incentives, also fall into the Instrument Mix category. Drawing again on Vedung's (2007) terminology, the only difference in their use of instruments is that Spain used 'sticks' and the Netherlands used 'carrots'. In Belgium, financial instruments were also implemented via grants for systems using renewable energy technologies in 1983, a common element of Early Majority countries going straight into instruments. Nevertheless, subsequent policy developments call for particular analysis as they broke down into regional, rather than federal efforts.

Here is where an interesting instance of policy diffusion can be seen. Belgium's initial adoption of regional measures can be compared to France's approach alternating between regional and national dimensions. Although Belgium first adopted a nation-wide financial instrument, the French pattern of building expertise at a regional level can be observed by further measures first taking place in the French-speaking region of Wallonia. In the case of Wallonia, policy measures jumped from pre-feasibility studies (Principal Plans) in 1990, to the establishment of long-term Policy Objectives in 1995. This hints at diffusion through imitation, especially due to the low targets set: 3% from renewable energy use by 2000 and 5% by 2010. At the regional level within Belgium, a certain degree of diffusion through competition between the Belgian provinces can help understand the later implementation of support policies in the region of Flanders, namely the establishment of support for Renewable Energy (PP) in 1997. The earlier adoption of long-term Policy Objectives stands as a common element for the three Early Majority countries. In Spain, Renewable Energy Targets toward 2010 were introduced in 1999, only five years after the country's first renewable support policy. In the case of the Netherlands, its goal for government-free emissions came in 2000, six years after first policy. In Belgium it took 7 years for the Walloon Government to set its first target, the Plan for Sustainable Development of 1995 (IEA-IRENA).

In terms of the results obtained, Spain has been more effective than other countries in the same category. Obtaining 20.8% of its electricity only from Wind and Solar generation (IEA, 2013a), it has the third largest renewable installed capacity per capita and fourth

greatest installed capacity of wind power generation (REN21, 2013). The Netherlands and Belgium both obtain 12.05% and 12.29% of their energy from renewables, although only 5.06% and 5.75% are obtained from wind and solar resources respectively (IEA, 2013a). Taking their achievements as a reference it can be argued that Spain's policies, being more direct, were adopted because of more competitive reasons. Diffusion through imitation from larger Innovator and Early Adopters can explain the implementation of measures in Belgium and the Netherlands without far-reaching results. Nonetheless the case of Belgium goes to prove the benefits of concrete policy efforts, going from no considerable generation from PV in 2007 (IEA, 2013a), to being the third country in per capita installed capacity of PV (REN21, 2013).

4.2.3 LATE MAJORITY

4.2.3.1 Late Majority: Analysis

Aside from Austria, the Late Majority countries are those where the implementation of Principal Planning measures can be seen the least at initial stages of the Policy Mix. As an exemption to the rule, the case of Austria stands out. The country's complicated geography and abundance of thermal and hydro electrical resources can be said to have two effects on the implementation of renewable support policies. One is that it reduces the urgency of implementing more low-carbon technologies. The geographical conditions also require for special feasibility studies to fully understand the potential of wind and solar generation. Four years later, nevertheless, Austria adopted its first formal national strategy and targets, thus jumping straight into long-term planning, instead of exhibiting the experimental stages typical of innovating countries. This element of direct adoption of policy measures in Late Majority countries can be understood due to the beneficial availability of knowledge transfer. At this point in time, generally after 2000, industry maturity can be understood as a factor to ease technology transfer. This, in a way, saves Late Majority Governments the step of kick-starting renewable integration through R&D strategies. Nevertheless, it still requires to kick-start integration in the country through concrete instruments, thus stressing the importance of policy implementation. Once again, the mechanisms through which RE support policies diffuse make a difference for the outcomes of adoption. In the case of the Western European Late Majority countries, the enhanced availability of knowledge transfer allowed, diffusion through learning and to some imitation from other success stories, can be seen in the results obtained. As of 2012 Portugal was obtaining 23.18% of its electricity from Wind and Solar technologies (IEA, 2013a), most of it from Wind generation. In the case of Austria, the fact that only 4.34% of electricity comes from Wind and Solar, while 61.3% comes from hydroelectricity, hints at the implementation of policies as more of an issue of imitation, since lack of dependency on fossil fuels renders RE integration less urgent.

As for the BRIC+ countries, falling within the Late Majority category coincides with the direct implementation of Instrument Mix elements early on in the Policy Mix development. Nonetheless, different policy diffusion mechanisms act to yield different outcomes of policy effectiveness. In the case of China, greater influence of central plan-

ning allows for a greater degree of policy implementation to support the introduction of renewables.

Table 3.2.3 Initial Policy Efforts in Late Majority Countries

Year	Policy Name	Classification
Austria		
1996	R&D Budget Allocations	Technology Push (IM)
2000	National Climate Strategy & RE Targets	Policy Objectives
China		
1996	Remote Areas Electrification	Instrument Mix
2003	Wind Power Programme	Instrument Mix
2006	RE in 11th Five Year Plan	Policy Objectives
India		
2002	Government Assistance for Wind Power	Instrument Mix
2003	Electricity Act: RE Provisions	Instrument Mix / Principal Planning
Mexico		
2001	Grid interconnection contract	Regulation: Instrument Mix
2003	Service Charge Methodology	Regulation: Instrument Mix
Portugal		
1999	Tax Reduction for RE Equipment	Fiscal Break: Instrument Mix
2000	Decree Law for Wind and Solar Funding and Evaluation	Regulation: Instrument Mix

Source: Adapted from IEA-IRENA Joint Policies and Measures database: Global Renewable Energy.

The adoption of these policies hangs on the drive to maintain economic growth in the country so their implementation can be classified as diffusion through competition. Governmental involvement can be seen in the fact that support for renewables has been part of the national agenda since the 11th Five Year Plan. China is currently world leader in renewables, with and without hydroelectric generation, as well as wind generation (REN21, 2013). Mexico and India, on the other hand have been less successful in integrating renewables into their mix. Their implementation of policies can be seen to be limited by adopting policies on grounds of *imitation* and *coercion.* As discussed by Shipan and

Volden (2008) diffusion of policy through such mechanisms leads to 'suboptimal and inappropriate' policy choices (Shipan and Volden, 2008). Coercion in this sense needs not be assumed as a negative mechanism in itself, but more of misunderstood policy adoption induced by external pressure. This can be seen in trade practices often pushed by organizations like the UN or the International Monetary Fund, which encourage governments to meet common expectations and international benchmarks (Shipan and Volden, 2013). In the case of Mexico and India, Wind and Solar generation only represented 1.13% and 0.22% of total electricity generation as of 2012 (IEAb, 2013).

4.2.4 LAGGARDS: LATE-COMERS OR GAME-CHANGERS?

Taking MENA countries into account was an important part of this study. However, when looking at their policies it was found that they were very similar. Most policy mixes started after 2008 and were limited to two or three measures. This can be attributed to the similarities of the political structure in the region. Due to this, and to give greater focus to the analysis, it was decided to choose a proxy country. In this sense, Egypt was chosen due to its relative political stability prior to the political shifts of 2010.

Taking Egypt as a country representative of the region, the fact that policies were only introduced after 2008 places them in the category of Laggards. That is, the last 16% of adopters (Rogers, 2008). According to the hypothesis thus discussed, MENA countries still fit in that their policy efforts (and therefore their Policy Mix) all start off with the direct implementation of Policy Objectives. This, on the one hand, can be related to knowledge availability associated to learning through coercion, not so much to pressure from international bodies, but on associations and companies seeking to exploit the regions vast potential in wind and solar generation. Following along with Shipan and Volden (2008) this would hint at the eventual adoption of suboptimal policies. In this case, it must be mentioned that recent policy changes in the region point at future developments for which it is too early to make any assumptions. Over the last three years, the UAE, Morocco, and Saudi Arabia have all created agencies to study the potential of RE generation in their countries. The UAE's Renewable Energy Resource Atlas (2011), Morocco's National Agency for the Development of Renewable Energy and Saudi Arabia's King Abdullah City for Atomic and Renewable Energy hint at a reshaping of the policy mix, in which the RE development will be re-launched with Principal Planning elements. This resembles more of the Innovator countries' strategy of assessment followed by implementation. The Saudi Arabia's current plans to provide a third of its electricity with renewables by 2031 (K.A. Care, 2013), present an interesting path of independent policy development as opposed to the traditional polices driven by European initiatives. Morocco's recent change of plans towards individual generation rather than participation in Desertec reinforces the idea of renewable energies becoming a symbol of sovereignty and prosperity in the region. Regardless of whether policy develops along the traditional lines of policy innovation, the ultimate picture of integration of renewable technologies still remains to be shaped by policy and political circumstances.

5 Conclusions and Points for further Research

From the analysis carried out, it can be seen that applying concepts of innovation theory can be useful in taking the policy mix concept further. In this case, emphasis has been placed on exploring the differences in policy structure based on the time of implementation and diffusion mechanisms. While comparing the structure of the policy mixes of different countries it can be seen that there are two key determinant factors: the time of first adoption, explained through Rogers' (2003) diffusion mechanisms; and the main drivers for policy adoption as prosed for Shipan and Volden (2008). Taking the innovation framework as a starting point, it can be concluded that innovator countries are more likely to implement measures to improve the state of knowledge and technology through technology-push instruments embedded in principal plans. At later stages of policy implementation, countries will have the chance to draw upon an increasingly improved state of knowledge. As a result, their first support measures for RE contain mainly direct financing instruments as well as concise targets at earlier stages. In the case of laggard countries, however, their increased likeliness to start their support schemes with research and development programmes, points at a new stage in technology development and independent policy making. In regard to the reasons for policy adoption, Shipan and Volden's (2008) framework has been useful in explaining how coercion and imitation often lead to the rushed implementation of suboptimal support policies. Again, this becomes an interesting starting point for future research, especially in the case of laggard countries and late majority countries, as the full outcomes of their support policies remain to be seen. These insights can be useful for further comparative studies by providing an idea of the different approaches taken by countries, and the motivations behind these approaches.

This analysis, however, is not free from limitations; it could be argued that sorting measures under categories of Instrument Mix elements and Policy Strategy is subject to personal judgement. Different researchers could interpret policy measures as instrument elements rather than short-term strategies and so on. This, however, can be addressed by clearly outlining the categorization criteria as it was done in section 2.1 of this paper. The aspect of categorization also opens the way for new possibilities of qualitative research in terms of creating stricter boundaries to fit policies within the Policy Mix framework more effectively. Undoubtedly, the more this policy-fitting is fine-tuned, the greater the benefit will be for comparative political studies and development of the literature in the field of renewable energy. Based on the concepts exposed in this study, further research could branch out into issues of institutional strength or political culture and the effect these have on the policy strategy-to-outcome relationship. Other fields of research that could branch out from this study include studies on objective and agenda setting at the policy-making level. This would also provide further insight into the content of policy and what drives certain strategies in terms of goal orientation.

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APPENDIX

Figure 1.3.2: Distribution of Renewable Support Policies by Country from 1970 to date

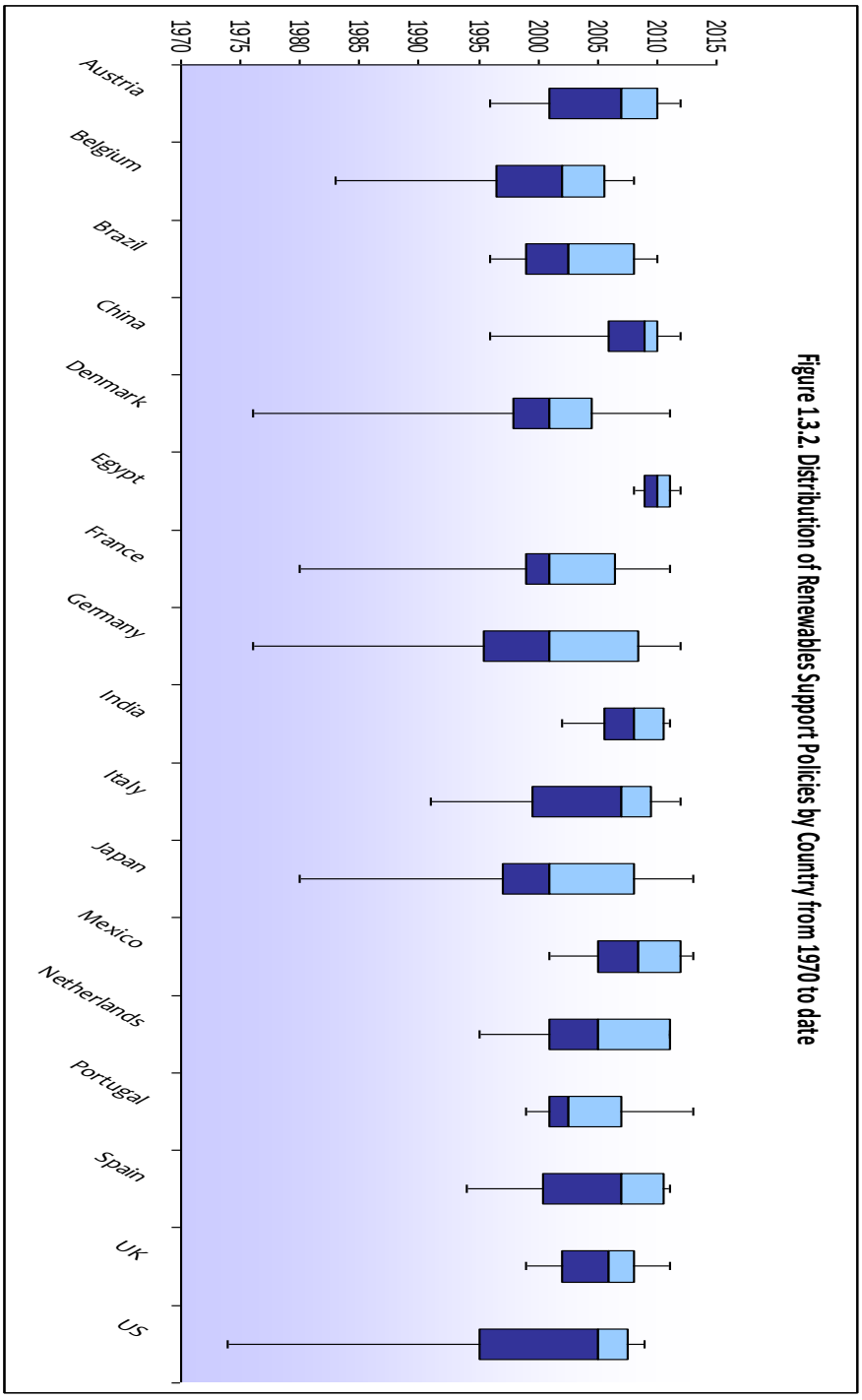
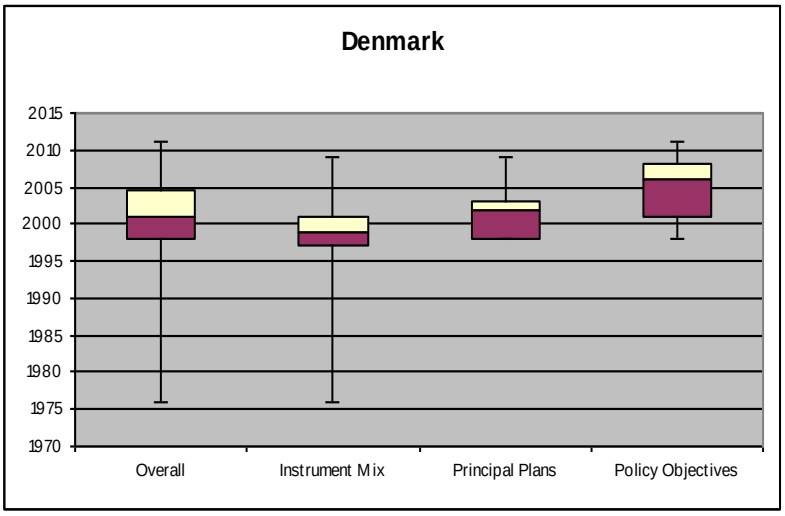
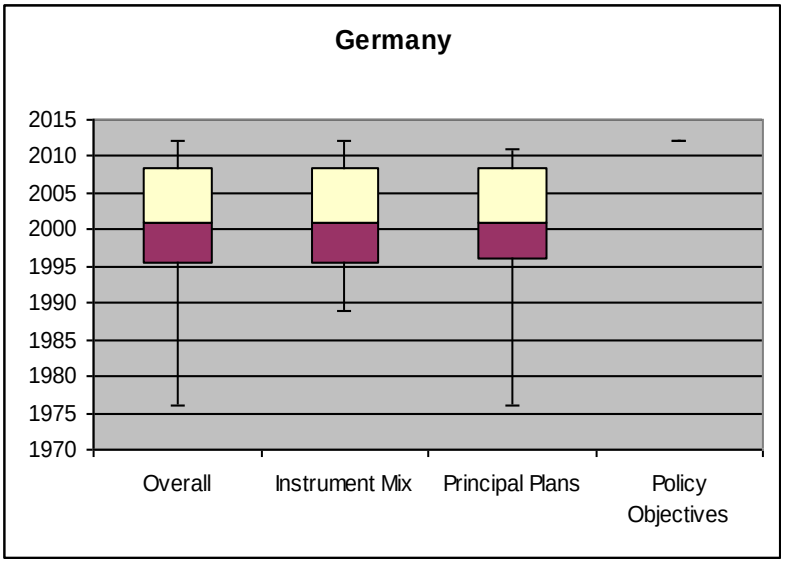


Figure 1.3.3: Distribution of Renewable Support Policies by Country: Innovators





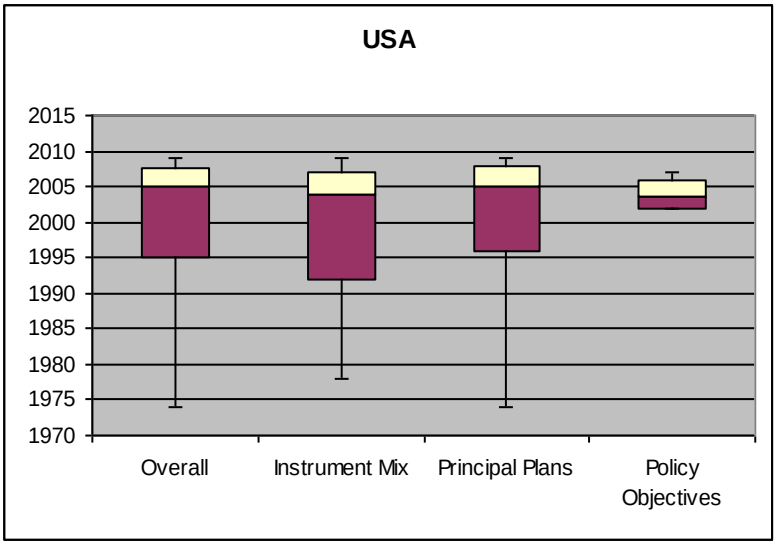
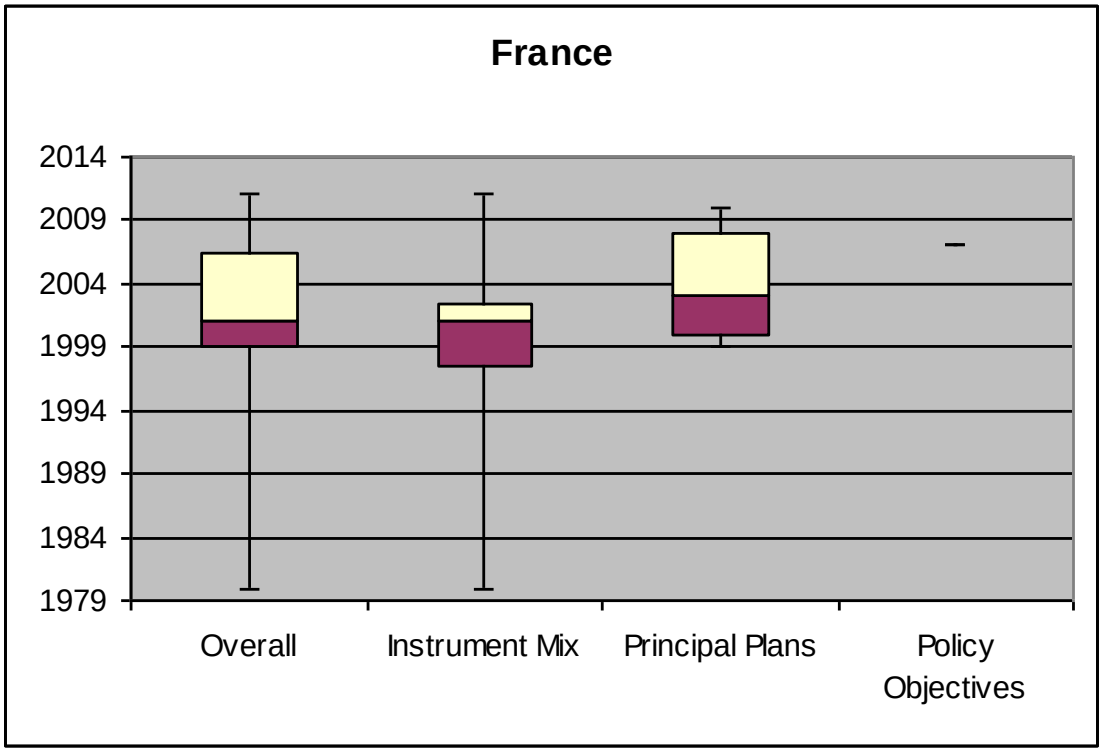


Figure 1.3.4: Distribution of Renewable Support Policies by Country: Early Adopters



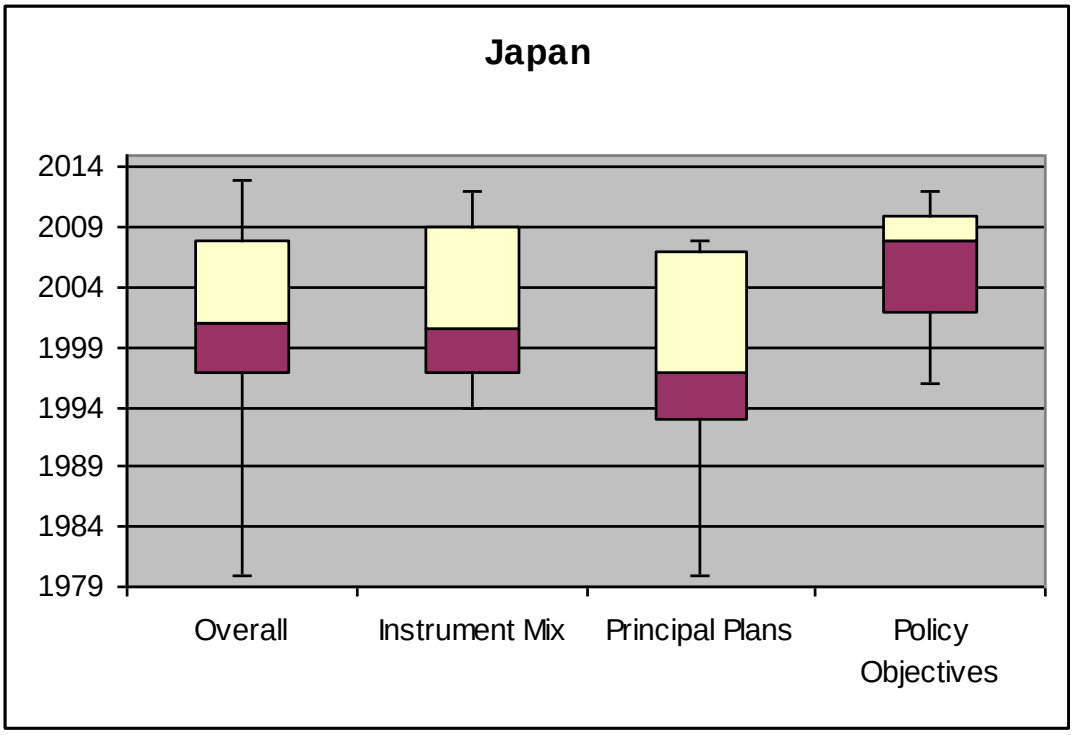
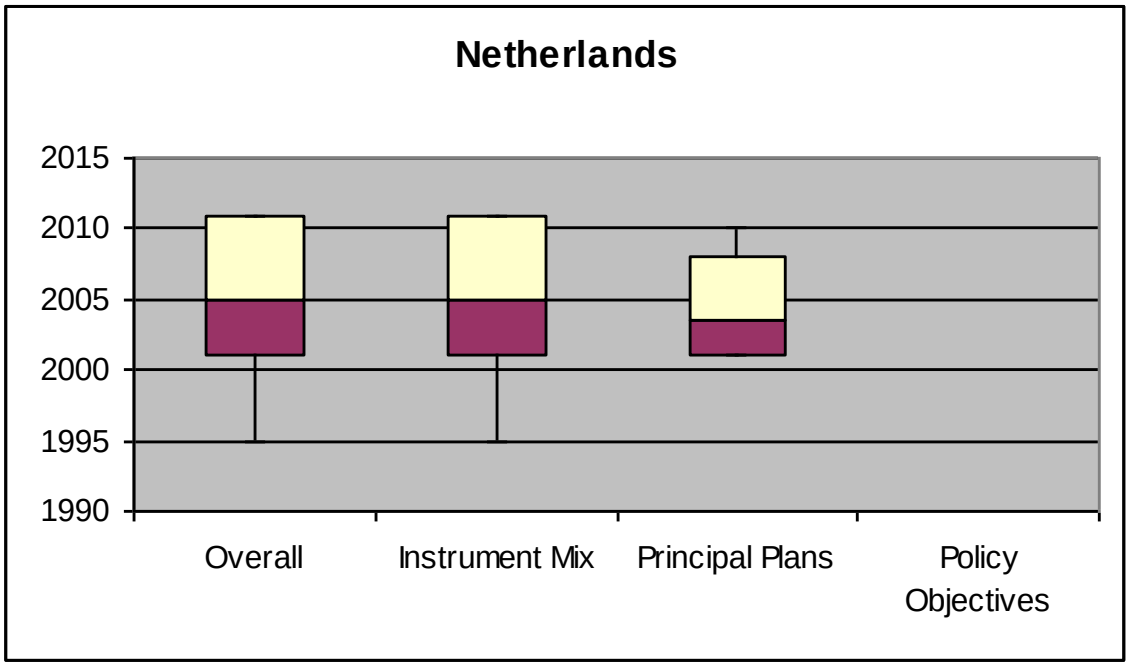


Figure 1.3.4: Distribution of Renewable Support Policies by Country: Early Majority



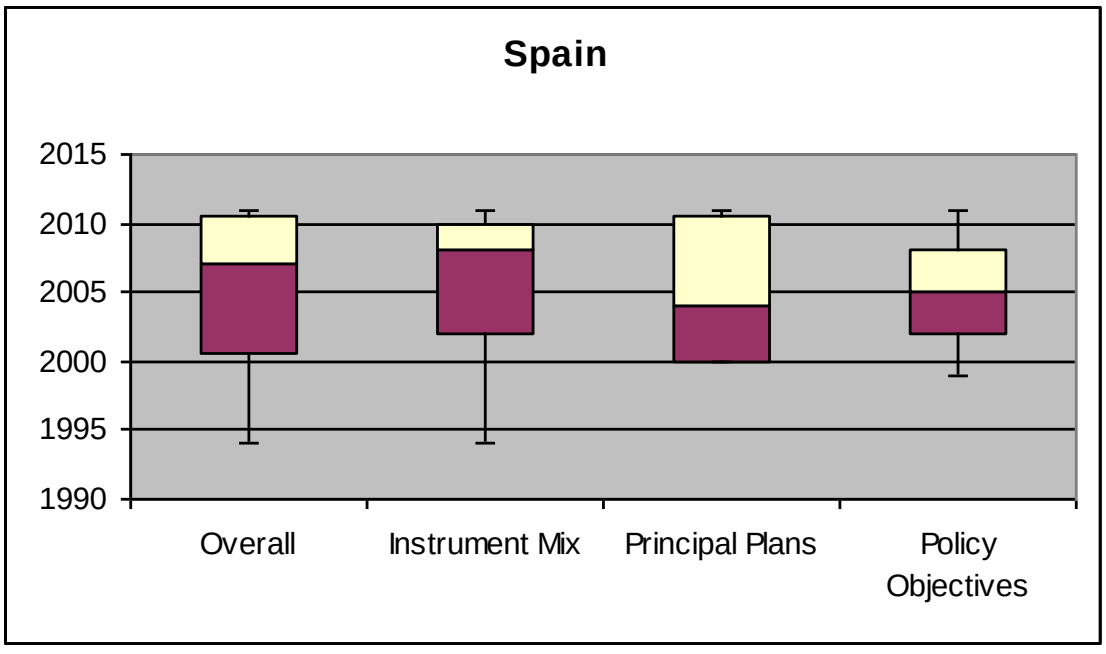


Figure 1.3.4: Distribution of Renewable Support Policies by Country: Late Majority