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Determinants of Policy Risks of Renewable Energy Investments

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ABSTRACT

Policy or regulatory risks represent one of the major barriers for renewable energy investments, especially against the background of several retrospective reductions of support schemes in Europe. This paper aims to contribute to the literature by offering a categorization of major risk drivers and determinants of policy risk associated with renewable energy projects in developed countries. Based on a narrative (traditional) review of the academic literature and supported by industry studies regarding cases of support scheme cuts in Europe (from the end of 2010 until the end of 2013), the paper derives determinants of policy risks of renewable energy investments. As a main result, the paper offers a concise categorization of major risk drivers of policy and regulatory risks associated with renewable energy investments in developed countries along with potential indicators. The derived categorization of major risk drivers as well as the set of indicators are of high relevance for risk management and risk assessment of renewable energy investments, where understanding the underlying risk drivers is vital.

Keywords: Renewable energy, regulatory risk, policy risk

1. INTRODUCTION

With the introduction of the Europe 2020 targets, the European Union has set high environmental objectives for its European member states, where greenhouse gas emissions is to be reduced by 20% (compared to 1990 levels), the share of renewable energy should be increased to 20% of total energy consumption, and energy efficiency is to be increased by 20%.[1] To achieve these environmental goals, considerable investments are needed to establish a corresponding adequate European renewable energy infrastructure, whereby private and institutional investments are expected to be the most relevant sources of finance.[2] To provide

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[1] See EU (2009, p. 46).

[2] See EWEA (2013, p. 21).

incentives for the required private and institutional investments, governments typically grant subsidy payments and policy incentives during the life span of the renewable energy projects by means of support schemes such as feed-in tariffs.[3] However, such policy support schemes for renewable energy investments generally come with some degree of uncertainty with respect to their future stability and thus introduce future risks. In Spain and the Czech Republic, for instance, the guaranteed feed-in tariffs have recently been reduced retrospectively[4] for photovoltaics, thus implying a considerable reduction in investors' returns. Hence, such policy (or regulatory) risks play a major role for investors when evaluating investments in infrastructure and renewable energy and should be taken into account when establishing risk models and when deriving risk-return profiles.

The aim of this paper is thus to study policy risks of renewable energy investments in more detail by identifying relevant drivers and determinants from the academic literature and supported by industry studies, taking into account cases of policy risks in several European countries to assess the actual relevance of these drivers. The resulting concise set of drivers for policy and regulatory risks of renewable energy investments is intended to provide central insight for risk management, i.e., monitoring, mitigation, risk assessment, whereby the latter can be done via expert assessments and the application of fuzzy numbers based on the relevant risk determinants.[5]

In the literature, there are various definitions of policy or regulatory risks,[6] which often considerably differ and which we comprehensively discuss in the Section 2.[7] Empirical analyses of specific aspects of policy and regulatory risks as well as risk drivers can be found in Alesina and Perotti (1996), Hitzeroth and Megerle (2013), Holburn (2012) as well as in Lüthi and Wüstenhagen (2012), who present an empirical survey on stated preferences among photovoltaic project developers and derive their willingness-to-accept (in terms of an investment decision) for certain policy risks of their potential photovoltaic investments. In addition, insights regarding policy and regulatory risks for specific countries with focus on a

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[3] See Lee and Zhong (2014, p. 761), Turner et al. (2013, p. 6).

[4] While the terms "retroactive" and "retrospective" are often used as synonyms, we differentiate between them following the definition in EREC (2013, pp. 3-4): "Retrospective changes are changes brought upon by laws - in this case - to renewable energy support schemes which, while taking effect only from the date of publication, change existing rights and obligations of RES producers and investors", while "retroactivity means that a law is applied to facts that have occurred before the publication of the law. Thus, a certain transaction has been completed before the new law was published and thus the legal consequences of the law applicable at the time of the transaction are invalidated. Therefore, the legal terminology regarding changes of renewables support schemes is "retrospective changes"."

[5] See, e.g., Gatzert and Vogl (2015), Sachs et al. (2008), Thomas et al. (2006).

[6] In this paper, we use the terms "regulatory risk" and "policy risk" as synonyms, which is mostly consistent with the literature, see also Section 2. Similarly, "determinants" and (risk) "drivers" are used synonymously.

[7] See, e.g., Brink (2004), Fitzpatrick (1983), Smith (1997).

modeling approach can be found in Boomsma et al. (2012), for instance. With respect to the drivers of regulatory risks, Holburn (2012) focuses on the autonomy of the regulatory agency (low, high) and the policy-making process (flexible, rigid) as relevant regulatory risk indicators based on a conceptual framework and two case studies. He concludes that regulatory risks are lower in jurisdictions where regulatory agencies have greater autonomy and where energy policies are executed more rigid. In general, several papers emphasize that policy, or regulatory, risks are among the most relevant risks for investments in infrastructure and renewable energy projects.[8] Thus, while policy risks associated with renewable energy projects in the sense of retrospective changes of support schemes have been studied in various ways in the literature before, drivers and determinants of policy risks have either not been in the focus so far with the exception of Holburn (2012) (but without a detailed categorization of industry-specific drivers), for instance, or have focused on specific aspects only (type of technology, focus on specific countries, etc.) and typically without addressing potential indicators for the respective determinant, even though understanding these risk drivers and determinants is of high relevance for risk management.

Against this background, we first present and briefly compare various definitions of the terms political, regulatory and policy risks in Section 2. Subsequently, focus is specifically laid on policy risks associated with renewable energy projects in developed (European) countries, e.g., the risk of a retrospective reduction of policy support schemes for wind or solar parks (e.g. feed-in tariff). Based on the academic literature, we offer a first categorization of drivers and determinants of policy risks in Section 3, thereby also drawing on current political risk indices as well as political risk assessments by rating agencies. In addition, to gain more insight into the practical relevance of these risk drivers identified in Section 3, we make use of industry studies regarding retrospective reductions of politically incentivized support for renewable energies, which further support and illustrate the identified drivers. In this regard, we also consider the overall macroeconomic developments (e.g., unemployment rate, public debt, ratings) in selected European countries (e.g., Greece, Spain) to obtain more in-depth information regarding specific risk drivers. Our paper thus offers a concise categorization of major risk drivers of policy risks associated with renewable energy investments in developed countries along with potential indicators. Understanding these underlying drivers of policy and regulatory risks is vital for risk management and in particular for risk assessment as laid out above. We conclude with a summary in Section 4.

[8] See, e.g., Gatzert and Kosub (2015), Micale et al. (2013).

2. DEFINITIONS OF POLITICAL, POLICY, AND REGULATORY RISK

Before focusing on the drivers and determinants of policy risks in particular, we first conduct a narrative (traditional) review of the literature to provide a brief overview of different selected definitions of the terms political, regulatory and policy risks as shown in Table 1, which are often not clearly distinguishable.

Smith (1997), for instance, defines *traditional political risks* as the risks related to expropriation, currency convertibility and transferability, as well as political violence. In contrast, the author defines *regulatory risks* as the risks arising from the application and enforcement of regulatory rules, both at the economy and the industry (or project) level, including rules contained in contracts with governments, in laws, and in other regulatory instruments. Brink (2004) analyzes *political risks* and distinguishes political risk drivers depending on economic, political and social factors. With focus on *regulatory risks* frequently occurring in infrastructure and renewable energy projects, Bond and Carter (1995) differentiate two cases: (1) tariff adjustments are not permitted or timely made (e.g. in case of inflation or devaluation). However, the authors point out that companies can hedge against such risks by the implementation of automatic contract adjustments, but that they still need to take into account that such rules are subject to government (or state owned enterprises) decisions; (2) regulatory changes, such as possible changes in environmental regulations affecting infrastructure companies and its investors.

Table 1: Overview of selected definitions and descriptions of political, policy, and regulatory risks in the literature

Author(s)	Definitions
Alesina and Perotti (1996)	*Political instability*: i) executive instability ("propensity to observe government changes" of either constitutional or unconstitutional nature) (p. 1205) or ii) indicators of social unrest and political violence (p. 1206)
Bond and Carter (1995)	*Regulatory risk* of infrastructure projects often observed in two ways i) tariff adjustments that are not permitted or timely initiated (e.g. in case of inflation; partly hedgeable by contract design) or ii) regulatory changes (e.g. environmental regulations) (p. 970)
Boomsma, Meade, and Fleten (2012)	*Regulatory uncertainty* as the uncertainty regarding a change of support scheme by the government (e.g. replacement of competitive tendering in the UK with tradable certificate trading) (p. 225)
Brink (2004)	*Political risk* as "the probability that business will either earn less money, or suffer losses in profit as a result of stakeholders within a political system's (in)actions or reactions to events, decisions and policies" (p. 18)
Bunn and Mustafaoglu (1978)	*Political risk event* as "any outcome in the host country which, if it occurs, would have a negative impact on the success of the venture" (e.g. sudden or creeping expropriation, adverse tax changes, civil disorder, war, production restrictions, repatriation limitations, domestic price controls, devaluation risk, and export restrictions) (p. 1558)
Butler and Joaquin (1998)	*Political risk* as "the risk that a sovereign host government will unexpectedly change the "rules of the game" under which businesses operate"; a definition of political risks with sole focus on negative outcomes of political events is inadequate; distinguish diversifiable and non-diversifiable political sources of risk (this is of relevance for cost of capital of investments for market-related political risks) (pp. 599-600)
De la Torre and Neckar (1988)	*Political risk* as i) "the involuntary loss of control (generally meaning property rights) over specific assets located in a foreign country, typically without adequate compensation." (e.g. expropriation, nationalization, civil war); ii) "the loss in the expected value of a foreign-controlled affiliate due to discriminatory actions taken against it, either because of its foreign nature or as part and parcel of a general tightening on free-market prerogatives" (e.g. "discriminatory controls and restrictions imposed by governments in times of domestic crisis", "limitations on access to factor markets (financial, labor or raw materials) and on outputs (e.g., on prices or diversification possibilities), changing rules on domestic value added, taxation or export performance requirements") (pp. 221-222)
Fitzpatrick (1983)	*Political risk* (based on a literature review) i) in terms of government or sovereign action and its negative consequences (most common definition); ii) as politically motivated events or constraints (e.g., expropriation or discriminatory taxation); iii) as discontinuities in a business environment, negatively affecting business operations or goals; iv) based on the political environment in general (pp. 249-250); the author criticizes that political risk mainly refers to political event risk and does not include slower changes over time (p. 250)
Holburn (2012)	*Regulatory risk* with respect to renewable energy projects as "the risk that regulatory agencies will change policy decisions" (p. 654)
Micale et al. (2013)	i) "*Prospective policy risk* refers to the overall uncertainty and instability of the regulatory framework (i.e. frequent, unpredictable, and irregular changes in the policy), which negatively influences the planning of new projects, resulting in higher rates of return required by investors." ii) "*Retroactive policy risk* refers to policy or regulatory changes which adversely affect the financial stability of existing projects." (p. 4)
Reuter et al. (2012)	*Regulatory uncertainty* arising from the variability in different scenarios of future CO2 price paths (p. 250); uncertainty regarding a cancellation or re-introduction of the FIT by the government (p. 253)
Sachs, Tiong, and Wagner (2008)	*Political risks* as arbitrary or discriminatory actions by the government, political groups or even individuals, adversely impacting trade or investment actions (p. 80)
Smith (1997)	Traditional *political risks* as expropriation, currency convertibility and transferability, or political violence (pp. 21, 62). *Regulatory risks* comprise risks from application and enforcement of regulatory rules, economy wide and industry specific; including rules from laws, contracts with the government or other regulatory instruments (pp. 22, 62). Third, *quasi-commercial risks* comprise the risks of "contractual nonperformance by the government or government entities in their capacity as suppliers to or purchasers from private infrastructure projects." (p. 62)

As can also be seen in Table 1, the term *political risk* thus typically covers a broad variety of risks associated with political action[9] such as, e.g., the intervention of politics into financial markets, expropriation, protectionism[10] or civil disturbances, which in generally only relates to renewable energy projects in developing countries. Furthermore, particularly "traditional" *political risks* often comprise actions of political violence, such as war, riots or corruption that may influence the political stability of a government and its regulation.[11] However, some authors also define political risks in a more general way, e.g. as the negative consequences on businesses due to (unexpected) political changes[12], which is also of relevance for renewable energy investments. In contrast to political risks, *policy and regulatory risks*, which are often used as synonyms, rather refer to law and order issued by the state or a supranational authority, which regulates national or international affairs such as, e.g., patent protection laws, policy support schemes for renewable energy projects or minimum equity capital requirements in the financial industry. However, the definition of what is denoted as regulatory or policy risk varies considerably across the literature as can be seen in Table 1.[13] For instance, Boomsma et al. (2012) define regulatory uncertainty as a change of support schemes by the government, resulting in an adapted environment for renewable energy projects, while Micale et al. (2013) refer to policy risk as the overall uncertainty and instability of a regulatory framework due to (e.g. unpredictable) prospective and retroactive changes, impacting the investors' returns. Similarly, Reuter et al. (2012) focus on regulatory uncertainty arising from the variability of price paths, e.g. due to a cancellation or re-introduction of feed-in tariffs. In short, (traditional) political risks thus rather refer to severe actions by or against the government, whereas policy and regulatory risks generally represent less violent changes of a government's regulations and policies, affecting businesses and their investment environment.

Although much of the literature in this broad field of research focuses on developing countries, in what follows, we specifically focus on policy risks associated with investments in renewable energy projects in developed countries (Europe). In this case, many traditional political risks, such as expropriation or war are unlikely to happen and are thus not our main focus. Policy risk can thus be defined as the risk of a retrospective or non-retrospective adverse change of subsidies such as a reduction of a feed-in tariff for renewable energy

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9 See, e.g., Bunn and Mustafaoglu (1978), De la Torre and Neckar (1988), Fitzpatrick (1983), Smith (1997).

10 Protectionism refers to political or state actions aiming to protect national companies from foreign firms entering the local market, e.g. by imposing restrictions on the import of goods (see, e.g., http://www.worldbank.org/depweb/english/beyond/global/glossary.html, access 06/23/2015).

11 See, e.g., Alesina and Perotti (1996), Bunn and Mustafaoglu (1978), Fitzpatrick (1983), Smith (1997).

12 See, e.g. Brink (2004), Butler and Joaquin (1998), Fitzpatrick (1983), Sachs et al. (2008).

13 See, e.g., Bond and Carter (1995), Boomsma et al. (2012), Holburn (2012), Micale et al. (2013), Smith (1997).

projects or other regulatory changes affecting the profitability of renewable energy investments, which may be caused by different underlying risk drivers.

3. Determinants of Policy Risk: Insights From the Academic Literature and Industry Studies

3.1 Insight from the academic literature

To identify major determinants and drivers of policy risk with focus on renewable energy support schemes, we consider drivers presented in the literature as summarized in Table 2, again based on a narrative (traditional) literature review approach.

Regarding the general categorization of risk drivers, we thereby follow Holburn (2012), who distinguishes between industry-specific determinants and institutional determinants (autonomy of regulatory agencies, type of policy making process), whereby he focuses on the latter in his case study and conceptual framework. This distinction is particularly suitable as a starting point for a more detailed categorization, since the industry-specific point of view generally reflects actual policy decisions and the kind of policy decisions or actual changes that have been implemented, while the institutional determinants rather refer to the question of how policy decisions are made, which also influences the likelihood of policy changes. In regard to the industry-specific determinants of policy risks, we further develop the general categorization in Holburn (2012) by additionally and more specifically distinguishing between economic stress (and uncertain economic situations, e.g. due to budget constraints), costs of grid management, technology and technological progress, type and size of financial support scheme, control mechanism, national targets, as well as a category including ideological change, socio-political uncertainty, moral hazard, and acceptance risks. Regarding the institutional determinants, we follow Holburn (2012) and consider the autonomy of regulatory agencies and the type of the policy making process. In addition to describing the determinants, we also discuss potential indicators, which are of relevance for risk management in terms of monitoring, implementing preventive measures, and investment decision-making. Note that the different determinants may be interrelated in their effect on various policy risks, which is why possible interactions should be taken into account. For instance, public and political acceptance of renewable energy can be affected by a combination of some of these drivers (e.g., the public does not accept the high returns for investors, which are provided by national subsidy schemes).

Table 2: Determinants of policy (regulatory) risk associated with policy support schemes for renewable energy investments: Insight from the academic literature

Determinant / driver	**Potential indicator**
I. Industry-specific determinants	
Economic stress situation, costs of grid management (Boomsma et al., 2012; Holburn, 2012; Lee and Zhong, 2015, p. 292; Ramamurti, 2003; S&P, 2011)	Costs of support schemes and tax incentives for government compared to budget and debt (S&P, 2011, p. 4); GDP growth; credit rating; interest rate; currency movement, foreign direct investments, unemployment rate; Analyze cost structures of regulatory authorities
Technology and technological progress (Holburn, 2012; Ramamurti, 2003; S&P, 2011)	Strong decrease in costs of technology (along with inappropriate subsidy levels) (Holburn, 2012, p. 654); Technological progress, resulting in a change in regulatory priorities towards more efficient ones
Type and size of financial support scheme, control mechanism (inflexible support schemes; cap on installed capacity), national targets (Boomsma et al., 2012; Holburn, 2012; Lüthi and Wüstenhagen, 2012; Stokes, 2013, S&P, 2011)	Share of financial support for respective renewable technology of total subsidies; gap between FIT - market costs (e.g. prices paid by end users); Costs of support scheme for the general public / consumers (as opposed to costs for the government); Control mechanisms (e.g. cap) implemented or not - number of unexpected policy changes in the past for the respective country (or in Europe in general); Distance to achieving national targets
Ideological change, socio-political uncertainty, moral hazard, acceptance risks (Alesina and Perotti, 1996; Boomsma et al., 2012; Hitzeroth and Megerle, 2013; Holburn, 2012; Ramamurti, 2003; Stokes, 2013)	Time to next election and likelihood of potential change; Political risk indices; Income inequality (Alesina and Perotti, 1996); World Governance Indicator for Government Effectiveness; Past experience regarding acceptance depending on regional characteristics; depends on preventive risk management measures (communication etc.) (Hitzeroth and Megerle, 2013, p. 582); Perceived high returns for well-established low-risk projects may imply high regulatory risk due to erosion of public support (S&P, 2011, p. 4)
II. Institutional determinants	
Autonomy of regulatory agencies (Holburn, 2012)	See categorization in Holburn (2012) (low, high); Euromoney Country Risk Index component "Institutional risk" (measure of the independence and efficiency of state institutions)
Type of the policy making process (Holburn, 2012)	See categorization in Holburn (2012) (flexible, rigid); Euromoney Country Risk Index component "Regulatory and policy environment" (measure of the quality of the regulatory environment and how well policy is formulated / implemented); World Governance Indicators for Regulatory Quality

Economic stress situation, costs of grid management

One driver for policy and regulatory risk in regard to financial support schemes is economic uncertainty, where governments may be willing to renegotiate contracts or implement regulatory changes.[14] Economic uncertainty may materialize as an economic stress situation, especially if governments can no longer afford a financial support scheme. According to S&P (2011, p. 4), countries where subsidies represent a larger proportion of the GDP generally exhibit a higher risk of regulatory changes, which thus at the same time represents one relevant indicator. This policy risk is further intensified if the country faces budgetary constraints, e.g. after a financial crisis. Under such circumstances, governments may cut governmental support for renewable energies to lower government expenditures.[15] Furthermore, a change in political or economic priorities (possibly also due to budgetary reasons) may cause governments to adjust support scheme subsidies.[16]

As potential indicators for economic uncertainty and potential economic stress (causing policy and regulatory risk to materialize), one can consider country credit ratings or the government's spending on support scheme or tax incentives as compared to governmental budget and debt.[17] Further indicators may include interest rates, a country's currency movement, foreign direct investments or unemployment rate.[18]

Furthermore, the costs for grid management and regulation increase with a growing number of decentralized power generating plants, as e.g. ineffective management requires costly back-up energy supplies. To cover such costs of inefficient grid management or increasing efforts, regulatory authorities may reduce subsidy schemes or other financial incentives to compensate for their expenditures.[19] To timely anticipate such changes, investors can study the cost structures of regulatory authorities (see also *type and size of financial support scheme, control mechanisms, national targets*) and determine the amount of regulatory efforts for grid management for the respective countries.

Technology and technological progress

Different types of technology typically imply different production costs, different regulation and different support schemes, thus also implying different levels of policy risk for each respective renewable energy type depending on the level of sustainability as pointed out by S&P (2011, p. 7). In particular, technological progress along with a maturing technology can lead to decreasing production costs of renewable energy hardware prices, thus increasing the profitability for investors in case of a fixed support scheme, for instance. At the same time,

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[14] See Ramamurti (2003).
[15] See Boomsma et al. (2012, p. 225), S&P (2011, p. 4).
[16] See Holburn (2012, p. 654).
[17] See S&P (2011, p. 4).
[18] See Lee and Zhong (2015, p. 292).
[19] See S&P (2011, p. 4).

technological innovations can also lead to new (alternative) types of renewable technologies with a more promising future in regard to successfully achieving political objectives such as national renewable energy targets, for instance. These developments may consequently imply policy or regulatory changes in order to lower subsidies for outdated technologies and increase subsidies for alternative renewable energy technologies (if using the feed-in tariff support scheme, for instance).[20] In this context, the problem of sunk costs and moral hazard arises as described by Ramamurti (2003, p. 262), where governments offer adequate subsidies ex ante, but may try to reduce them ex post (e.g. due to more promising technologies) after investments have been made and the investor's costs are sunk. Therefore, technological progress (support of the most efficient technology) as well as economies of scale for certain technologies (e.g. decreasing hardware prices) can imply considerable political pressure on policymakers to lower federal support, as has been observed in the case of photovoltaics in Spain (uncontrolled growth due to declining hardware prices in comparison to fixed subsidy payments).[21]

Potential indicators for regulatory and policy changes due to technological progress include a strong decrease in technological costs along with inappropriate subsidy levels for this type of renewable energy.[22] In addition, a large share of financial support for a certain renewable energy technology may serve as an indicator. Furthermore, technological progress has to be considered, as governmental support may shift from less efficient to more efficient types of technology.

Type and size of financial support scheme, control mechanisms, national targets

Type and size of a financial support scheme can be another crucial driver for policy and regulatory risks as already mentioned previously in the context of governmental budget constraints and economic stress. This particularly concerns financial incentives (such as feed-in tariffs) that are considerably higher than the corresponding actual market costs (the difference is typically carried forward to the general public), thus potentially causing an (adverse) change in public support.[23] In this regard, Boomsma et al. (2012, p. 233) state, based on European data from 1997 to 2006 (Commission of the European Communities, 2008, p. 7), that fixed subsidy payments (e.g. feed-in tariffs) may imply a higher probability of a support scheme switch from one support scheme to another. This may be explained by

[20] See Holburn (2012, p. 655), S&P (2011, p. 4).

[21] See Watts (2011, p. 11), also http://becquerelinstitute.org/2014-pv-european-back-2009-levels/, access 06/24/2015, and http://www.economist.com/news/business/21582018-sustainable-energy-meets-unsustainable-costs-cost-del-sol, access 06/24/2015.

[22] See Holburn (2012, p. 654), S&P (2011, p. 4).

[23] See Holburn (2012, p. 654), S&P (2011, p. 4).

the fact that in case of inflexible support schemes, policymakers face a tradeoff between high and stable subsidies, resulting in a possible decline of policy acceptance and support by the public, versus low and unstable subsidies, making renewable energy projects less attractive for investors, as pointed out by Stokes (2013, p. 498), based on a case study on feed-in tariffs in Ontario, Canada. Important indicators for policy risk resulting from these determinants can thus be the volume of the subsidy (e.g. measured by the feed-in tariff minus market costs; national energy prices levels) or overall costs of a support scheme for the general public and consumers (also discussed in the context of the category *ideological change, socio-political uncertainty, moral hazard, acceptance risks*).

Secondly, also dependent on the type and size of financial support scheme is the achieved growth of renewable energy. To counteract an uncontrolled growth of renewables and its corresponding subsidy payments, governments may implement control mechanisms such as caps on the total installed national capacity or limit governmental support with respect to the subsidy level as has been done retrospectively in Spain or the Czech Republic.[24] Therefore, the risk of an (unexpected) cutting of support should be lower in the presence of such controls, while a reduction of subsidies will be even more likely if national targets regarding the share of renewable energy (e.g. according to the EU2020 targets) are almost achieved and no control measures are available.[25] Therefore, it is advisable for investors to closely analyze the specific support schemes (type and size) in detail, to take into account whether control mechanisms are implemented and well-defined, and whether there has been a considerable number of (unexpected) support scheme changes in the past.[26] In addition, the achievement of national targets concerning the share of renewable energies as outlined in the National Renewable Energy Action Plans, for instance, should also be considered.[27]

Ideological change, socio-political uncertainty, moral hazard, acceptance risks

Ideological uncertainty represents a driver of policy risk in case of a shift in the political environment in general (along with changing priorities affecting renewable energy subsidies, for instance) or after the election of new political leaders and thus in case of an ideological political change.[28] Indicators for investors when assessing and monitoring political or

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[24] See S&P (2011, p. 4), also http://www.pv-magazine.com/news/details/beitrag/shock-for-spains-solar-industry--pv-magazine-told_100000577/#axzz3dzEJeHEu, access 03/01/2015.

[25] See S&P (2011, p. 4).

[26] See Boomsma et al. (2012, p. 233), Lüthi and Wüstenhagen (2012, p. 1004).

[27] See Lee and Zhong (2014, p. 766), S&P (2011, p. 5). For National Renewable Energy Action Plans of the European countries, see https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans, access 05/25/2015.

[28] See Boomsma et al. (2012, p. 225), Ramamurti (2003, p. 253).

ideological change and uncertainty may include the time to the next election as well as the likelihood of a potential change of the ideological mindset, for instance. In addition, a country's political stability can be monitored based on political risk indices such as the BERI Political Risk Index (PRI) or the World Governance Indicator for Political Stability (both using expert panels to evaluate political risk).[29] In this regard, the Political Risk Index focuses on measuring socio-political changes (six internal and two external causes of political risks as well as two symptoms), for instance, the fractionalization of the political spectrum, social conditions, and societal conflicts. Considering social conditions, Alesina and Perotti (1996) further empirically show that income inequality results in social dissatisfaction negatively affecting socio-political stability, which in turn may influence a governments political ideology and decision-making when it comes to support schemes (also relevant for *acceptance risks*).

As mentioned previously, governments may renege previous contracts (e.g. due to technological progress), leaving investors with sunk costs (due to high initial fixed costs), knowing that investors are typically willing to continue operating their renewable energy plants as long as marginal operating costs are covered.[30] Indicators for the relevance of moral hazard may be obtained by analyzing previous unexpected policy changes in the past (see also *type and size of financial support scheme, control mechanisms, national targets*) for the respective countries or by taking into account the World Governance Indicator for Government Effectiveness, for instance, which measures the quality of public and civil services and its independence from political pressure as well as the credibility of government commitment.[31]

Acceptance risks are caused by various underlying risk drivers such as the *type and size of financial support scheme, control mechanisms, national targets* as presented previously, for instance. Therefore, a reduced public or political acceptance needs to be considered as a relevant first indicator towards potential policy or regulatory changes. The interaction of type and size of financial support for renewable energies with changing acceptance of the general public is discussed in Holburn (2012, p. 655), for instance. The author finds that particularly the adjustment of the pricing of utility services which are consumed by the general public may offer an opportunity for governments to gain short-term popularity and thus public acceptance by reducing or increasing support in favor of meeting the public opinion. Furthermore, local communities and residents may interfere with governmental plans to build renewable energy

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[29] See http://info.worldbank.org/governance/wgi/index.aspx#reports, access 05/07/2015. Most political risk indices are generally based on expert opinions, which partially also includes the assessment of macroeconomic data (e.g., GDP, unemployment rate, real interest rates, inflation, etc., see Brink, 2004).

[30] See Holburn (2012, p. 655), Ramamurti (2003).

[31] See http://info.worldbank.org/governance/wgi/index.aspx#reports, access 05/07/2015.

plants, e.g. by lobbying against such projects due to its impact on local housing prices, health or the value of land, compelling the government to change initial plans.[32] In this context, Hitzeroth and Megerle (2013) find that particularly long-term projects require general acceptance by all concerned parties. Thus, risks associated with a (potential) change of acceptance need to be monitored carefully (especially as this often occurs shortly before starting to build the project, see Hitzeroth and Megerle, 2013) and preventive risk management including communication measures should be applied, as general non-acceptance of all involved parties (e.g. public) may harm the successful completion of the project.

Autonomy of regulatory agencies and type of policy making process

Based on a conceptual framework supported by two case studies in the U.S. and Canada, Holburn (2012) finds that the regulatory risks are higher in jurisdictions where regulatory agencies have lower autonomy and where energy policies are executed in a more flexible way. In particular, regulatory agencies with more autonomy are more likely to withstand political pressure and do not easily change regulations. In addition, a more rigid ("hard-wired") policy making process decreases the risk of regulatory changes as compared to policies that are implemented using a more flexible process (e.g. policies set by agency or ministerial orders).[33] Potential indicators to assess these qualities could thereby be the Euromoney Country Risk Index component of "Institutional Risk", where the regulator's independence and efficiency is measured on a scale from 0 to 10 (10 = "institutions are extremely efficient and totally independent"; 0 = "state institutions are non-existent").[34] Regarding the rigidity of the policy making process, an individual analysis of the respective country and regulatory agency is recommendable as well as the consideration of index data such as the Euromoney Country Risk Index for "Regulatory and policy environment" (10 = "extremely consistent, well-enforced regulatory environment and benevolent government policies"; 0 = "no regulatory environment exists") or the World Governance Indicators for Regulatory Quality focusing on the "ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development".[35]

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32 See Holburn (2012, p. 656).

33 See Holburn (2012, pp. 654, 657).

34 See http://www.euromoneycountryrisk.com/Methodology, access 05/07/2015.

35 See http://www.euromoneycountryrisk.com/Methodology, access 05/07/2015, and http://info.worldbank.org/governance/wgi/index.aspx#reports, access 05/07/2015.

3.2 Insight from industry studies

We next consider selected industry studies with real-word occurrences of policy and regulatory risks in order to assess the practical relevance and importance of the identified drivers and determinants derived from the academic literature. Toward this end, we study various European countries where regulatory changes have occurred that affected renewable energy investments as described in the industry studies of EPIA (2013) and EREC (2013) that list a multitude of adaptions from the end of 2010 until the end of 2013. While the considered industry studies may also reflect lobbyists' interests and we only focus on selected cases and countries, they still offer insight regarding the general causes of policy risks and serve to provide real-world examples and support for the determinants derived based on the academic literature. In what follows, we thus apply our categorization of policy risk determinants from Section 3.2 and in Table 3 provide selected publicly stated reasons (by the governments or as argued by industry experts) for adjusting renewable energy regulations for each category of policy risk determinants.

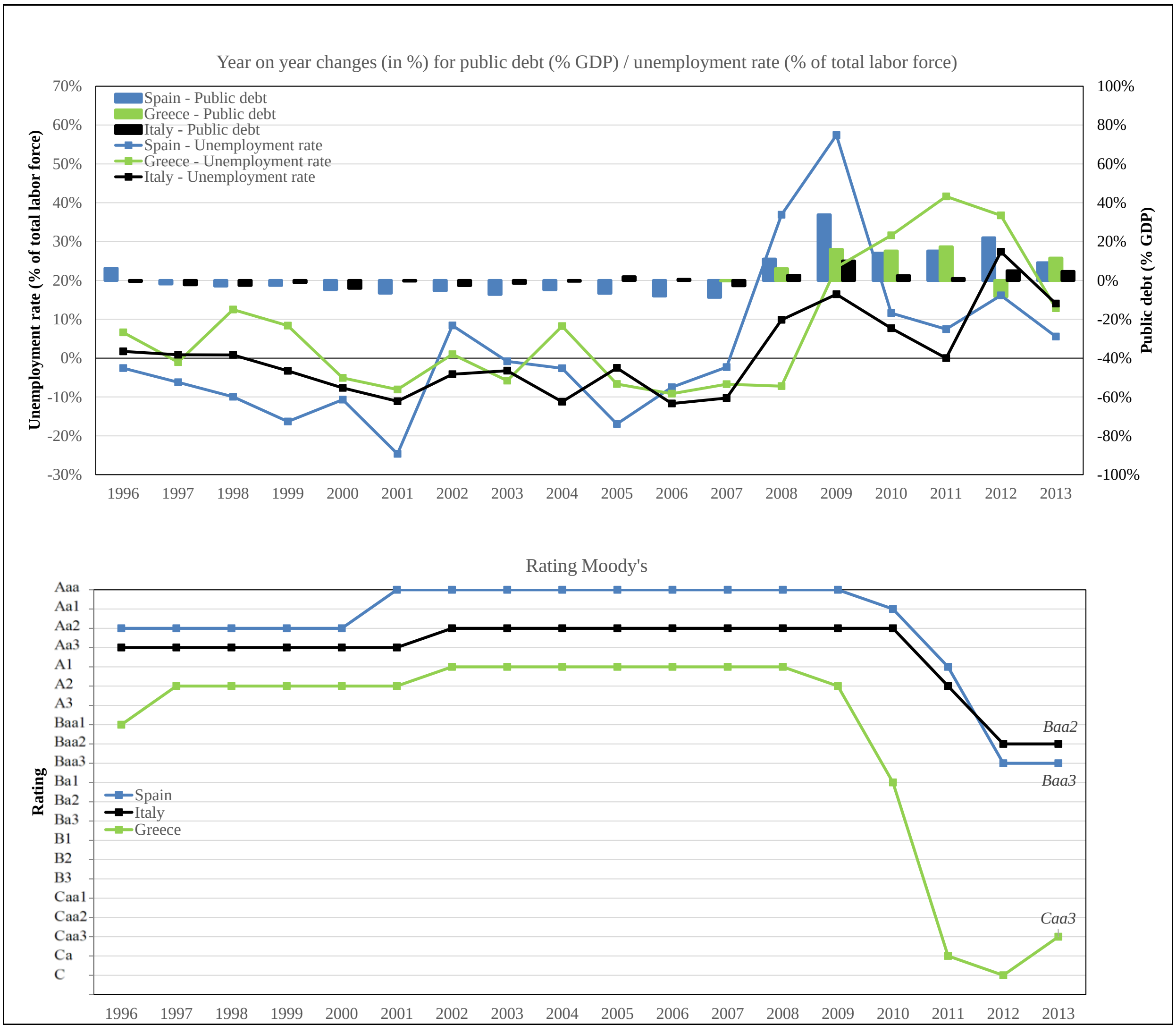
Regarding the category *economic stress situation, costs of grid management*, Table 3 lists three exemplary cases from Spain, Italy, and Greece. In Italy and Greece, for instance, subsidy schemes were adjusted to cover the increased expenses of the Italian Manager of Electricity Services and the Greek Electricity Market Operator (LAGIE), and in Greece and Spain, fiscal austerity measures had to be implemented to increase financial stability, thereby also reducing policy support schemes for renewable energy. To gain additional insight regarding the indicators for this policy risk determinant, Figure 1 displays the previously outlined potential indicators for the three countries, including unemployment rates, public debt ratios (in percent of GDP) and country ratings by Moody's from 1996 to 2013. It can be seen from Figure 1 that unemployment rates for Greece and Spain were strongly increasing after the financial crisis in 2008, still exhibiting high rates in 2013. At the same time, public debt ratios strongly increased (especially in case of Greece) and credit ratings decreased for both countries, overall suggesting that regulatory changes were also driven by an economic stress situation (need to reduce "tariff deficits" in Spain; need for fiscal austerity measures in Greece; political shift of priorities to reduce unemployment rate, ensure social benefits), which is also consistent with the drivers and indicators identified from the academic literature.

Table 3: Cases of regulatory adjustments of renewable energy support in selected European countries provided by EPIA (2013) and EREC (2013) on industry-specific determinants

Year / Country	**Description**	**Reason**	**Determinants / Drivers**
Economic stress situation, costs of grid management			
01/2012 / Spain	Moratorium on feed-in tariffs for new renewable energy / PV installations (EPIA, 2013, p. 20; EREC, 2013, p. 18)	As a reaction to the financial crisis in the Mediterranean country, the new Spanish government, under Prime Minister Mariano Rajoy, has approved a new law, by which the current system of remuneration for renewable energies will be discontinued." ([1])	Abolishment of feed-in tariffs for new installations as reaction to financial crisis
07/2012 / Italy	Introduction of a 0.05 cents / kWh fee for self-consumed energy from incentivized (feed-in tariff) photovoltaic installations (EPIA, 2013, p. 15)	"cover the cost for the Manager of Electricity Services (GSE) for management, monitoring and control activities." (EREC, 2013, p. 14) "with the official aim to cover the costs of the “Manager of Electricity Services” (GSE) for management, monitoring and control. This measure is another unjustified discrimination against self-consumption." (EPIA, 2013, p. 15)	Fee to cover the cost of Manager of Electricity Services for management, monitoring and control
11/2012 / Greece	Taxation of renewable energy revenues (25-42% for photovoltaics; 10% for other renewables) (EPIA, 2013, p. 13; EREC, 2013, pp. 11-12); only rooftop photovoltaics below 10kWp and photovoltaics installed after January 1st, 2013 are exempt	"part of a package of fiscal austerity and economic reform measures. It aims at reducing the continuously growing deficit of the Greek electricity market operator by unilaterally cutting the operator’s payment obligations to the RES producers for three (2+1) years." (EREC, 2013, pp. 11-12) "supposedly to contribute to the deficit reduction of the Greek Electricity Market Operator (LAGIE)." (EPIA, 2013, p. 13)	Fiscal austerity measures / financial stability of Greek Electricity Market Operator
Technology and technological progress			
05/2011 / Bulgaria	Ban on construction of photovoltaics on more than 40 % of Bulgarian agricultural land (Protection of Agricultural Lands Act) (EPIA, 2013, p. 7)	"According to him (Minister of Agriculture and Food Dr. Miroslav Naydenov), electricity produced from photovoltaics is 20 times more expensive than that from biomass plants."([2])	Photovoltaics more costly than biomass
01/2011 and 01/2013 / Czech Republic	Abolition of tax breaks, changed depreciation, requirement of remote power control on renewable energy installations, non-proportionate fees for the recycling of photovoltaics; e.g. the solar tax decreased feed-in tariffs by 26% (EPIA, 2013, p. 10; EREC, 2013, p. 10; [3])	"The government argued that solar panel prices had fallen significantly and the laws did not allow integrating this fall into the purchasing prices for electricity from solar power plants. Thus, the state had argued, the number of new solar PV plants and consequently the subsidies paid to them increased sharply." ([4])	Falling hardware prices
Type and size of financial support scheme, control mechanism, national targets			
08/2012 / Belgium	Cut in support for PV green certificates (EPIA, 2013, p. 5; EREC, 2013, p. 7)	“The Government, fearing that it could conduct to disproportioned return” (EREC, 2013, p. 7) “excess of green certificates” (EREC, 2014, p. 1)	Too rapid growth / excess of green certificates
08/2012 / Greece	Moratorium on authorization of new photovoltaic installations (EPIA, 2013, p. 12; EREC, 2013, p. 12)	"Greece stopped all authorization procedures for new PV projects as the number of applications exceeded the planned PV national target for 2020 from the National Renewable Energy Action Plan (NREAP)." (EPIA, 2013, p. 12; EREC, 2013, p. 12)	(Indicative) National targets as set by the National Renewable Energy Action Plan have been exceeded (too rapid growth)
Ideological change, socio-political uncertainty, moral hazard, acceptance risks			
05/2011 / Bulgaria	Ban on construction of photovoltaics on more than 40 % of Bulgarian agricultural land (Protection of Agricultural Lands Act) (EPIA, 2013, p. 7)	"protection of farmland" ([2])	Protection of arable land for farmers
11/2011 / Belgium	Implementation of new wind turbine noise limitations (EREC, 2013, p. 7)	-	Limit noise of wind turbines

References:
[1] http://www.pv-magazine.com/news/details/beitrag/spain-suspends-fits_100005605/#axzz3TtGlSU8G, access 04/01/2015.
[2] http://www.mzh.government.bg/mzh/home/11-02-08/-3243841488.aspx, access 04/01/2015.
[3] http://www.pvgrid.eu/national-updates/czech-republic.html, access 04/01/2015.
[4] http://www.pv-magazine.com/news/details/beitrag/czech-republic-ends-fit-program--extends-solar-tax-_100012748, access 04/01/2015.

Figure 1: Unemployment rate, public debt and Moody's credit rating in selected European countries with regulatory changes[36]



The determinant *technology and technological progress* is supported when considering the adjustment of subsidy schemes in various European countries (e.g. Bulgaria, Czech Republic, Spain, UK) after a strong decrease of hardware prices with focus on photovoltaic modules. The exemplary cases listed in Table 3 include the Czech Republic's government, who argued that falling hardware prices need to be taken into account in national subsidy schemes, thus lowering government spending on renewable energy subsidies. While the reason referred to renewable energy in general, the price decline specifically affected photovoltaics as prices for photovoltaic modules dropped strongly from 76.67 USD per Watt in 1977 to 0.74 USD per Watt in 2013,[37] whereas costs for wind energy remained stable from 2004 to 2012 at

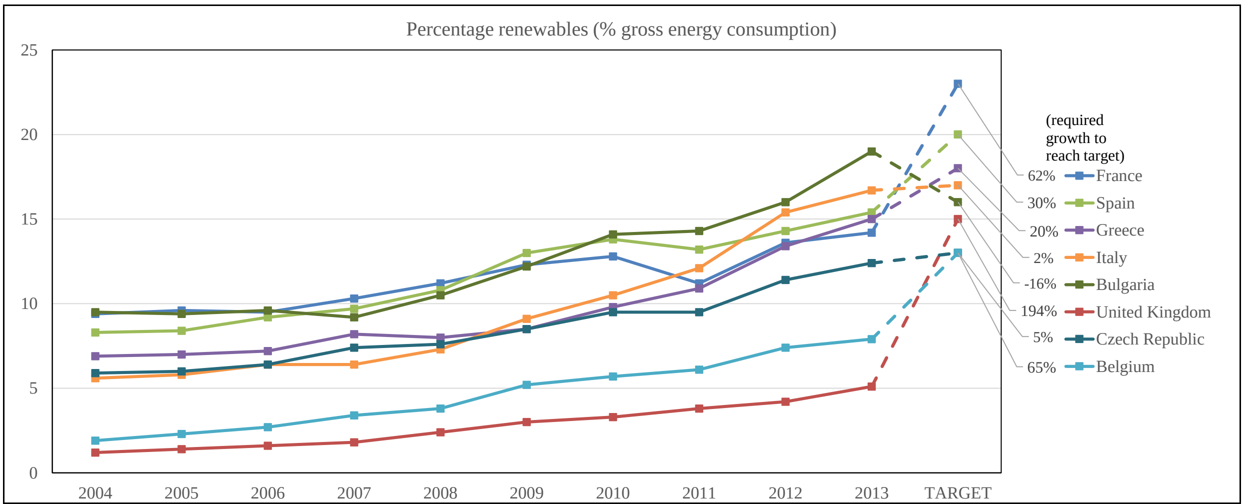
[36] Unemployment rate: http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS, access 03/01/2015, public debt: http://ec.europa.eu/eurostat/ (Code: tsdde410), access 03/01/2015, rating Moody's: https://www.moodys.com/, access 03/01/2015.

[37] See http://www.economist.com/blogs/graphicdetail/2012/12/daily-chart-19, access 05/12/2015.

approximately 1.40 USD per Watt.[38] As a second example, the impact of a political prioritization of certain types of technology can be seen from the development in Bulgaria, where the government reduced subsidies of photovoltaic modules, arguing that biomass is less expensive then photovoltaics.

With respect to the category *type and size of financial support scheme, control mechanism, national targets*, the industry studies indicate "uncontrolled growth and governmental mismanagement" as one frequently stated reason for regulatory support scheme cuts or changes of renewable energy regulations, especially in regard to photovoltaics (e.g., in case of Belgium, Bulgaria, Czech Republic, France, Greece, and Spain). In Belgium, for instance, the government decided to reduce support for photovoltaic green certificates to counteract the rapid growth and excess of green certificates. Similarly, in Greece, a moratorium on newly built photovoltaic installations was issued to limit further growth of renewable energies (in particular photovoltaics) as the (indicative) national target set by the National Renewable Energy Action Plan has been reached. Approaching national targets or even reaching them thus seems to represent one main driver for adjustments of renewable energy subsidies in order to slow down uncontrolled growth, which we also identified previously as a relevant determinant in the literature. Figure 2 provides further support for this indicator by showing the development of renewables in percent of the national gross energy consumptions from 2004 to 2013 in selected European countries as well as the remaining required growth to reach the respective national overall target in regard to renewables. As can be seen, national targets in Italy were also almost reached in 2013, and Bulgaria even exceeded its targets, thus also representing potential drivers for the regulatory changes that occurred in these countries.

Figure 2: Share of energy from renewable sources in Europe (2004-2013 and 2020 target)[40]



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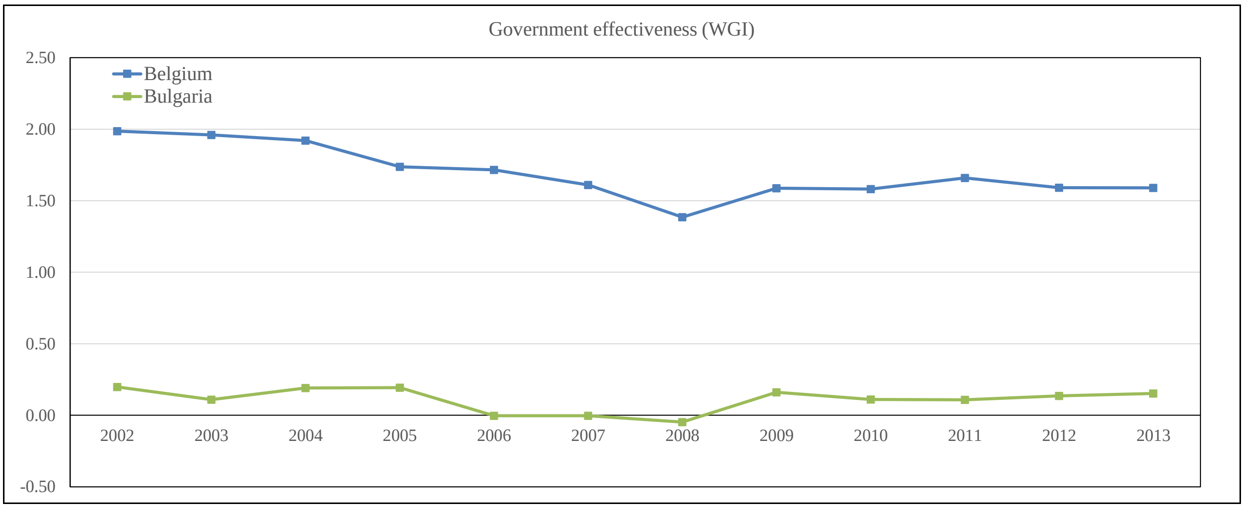
38 See 2015 Renewable Energy Cost Analysis - Wind Power, http://www.irena.org, access 05/12/2015.

40 See http://ec.europa.eu/eurostat/ (Code: t2020_31), access 03/01/2015.

Regarding the category of policy risk determinants referring to *ideological change*, *socio-political uncertainty*, *moral hazard*, *acceptance risks*, we exemplarily consider historical cases of regulatory changes in Bulgaria or Belgium. In Bulgaria, for instance, the protection of arable land for farmers, where ground-mounted photovoltaic modules reduced the total amount of arable land, was one stated reason for policy support adjustments (i.e. due to a change of governmental priorities), Belgium (Wallonia) implemented noise regulations for wind turbines, affecting the productivity and thus the profitability of wind parks, thereby also emphasizing the government's efforts to increase public acceptance. To obtain further insight, we consider the government effectiveness as one of the "World Governance Indicators" in Figure 3, which shows a low level of governmental effectiveness in Bulgaria in general and a decline in case of Belgium from 2002 until 2008, remaining at a level of approximately 1.6 since 2009.

Figure 3: World Governance Indicators: Government effectiveness[41]



3.3 Summary of identified drivers and determinants for policy and regulatory risk

Overall, the real-world examples for renewable energy support scheme cuts in several European countries presented in the considered industry studies thus support the determinants identified based on the study of the academic literature. In Table 4, the findings are summarized again as a concise set of relevant drivers, which may be applied by potential investors to assess policy and regulatory risks associated with renewable energy investments.

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[41] The index is to be interpreted as follows: „Government Effectiveness - Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.". The "Governance Score" is measured on a scale from approx. -2.5 to 2.5, where higher values correspond to more effective governance (see http://info.worldbank.org/governance/wgi/index.aspx, access 03/01/2015).

However, one has to take into account that these risk drivers and determinants can be highly interdependent, as, for instance, the shift of political priorities may result from economic stress and its affordability of financial support schemes or alternatively from political change due to new elections. Therefore, the determinants and drivers need to be assessed in one holistic risk assessment approach, addressing the interconnectedness of each driver. Regarding potential indicators to assess and measure policy and regulatory risk, we refer to the discussion in Section 3.1 (right column in Table 2).

Based on these identified risk drivers, investors can further apply own quantitative approaches for risk assessment that include this categorization of policy risk determinants as a first starting point. Quantification can then be done by using fuzzy numbers, for instance, along with an expert assessment to estimate the likelihood of these drivers of policy risk as well as the severity of the consequences.[42] As a subsequent step, these insights may be applied to the construction of an investment index for renewable energies, as presented by Lee and Zhong (2015), for instance.

Table 4: Summary of determinants and drivers of policy and regulatory risk

Economic stress situation, costs of grid management

- Affordability of financial support (e.g. fiscal austerity measures are needed)
- Changing government fiscal, economic (also political) priorities
- Effectiveness of grid management (e.g. costs of regulatory agencies)

Technology and technological progress

- Selection of most promising technology (implying subsidy cuts for previous and less efficient technologies)
- Decrease in production costs / lower hardware prices

Type and size of financial support scheme, control mechanism, national targets

- Size of financial support and incentives
- Flexibility of feed-in tariff (tradeoff public acceptance vs. high level of subsidies)
- Cap on installed capacity (controlled growth and incentives)
- Achievement of national targets

Ideological change and socio-political uncertainty, moral hazard, acceptance risks

- Political change or shift of political priorities (e.g. due to election of new political leaders, or economic uncertainty)
- Political instability and (traditional) political risks (e.g. war or expropriation)
- Moral hazard by government (e.g. exploiting investors' sunk costs)
- Acceptance risks (e.g. noise limitations of wind turbines), also national economic factors (e.g. protection of arable land, support of local photovoltaic industry)

Institutional determinants

- Autonomy of regulatory agencies (low, high)
- Type of the policy making process (flexible, rigid)

[42] See, e.g., Gatzert and Vogl (2015), Sachs et al. (2008), Thomas et al. (2006).

4. Summary

The aim of this paper was to study drivers and determinants of policy and regulatory risks associated with renewable energy investments in developed countries with focus on Europe. Toward this end, we first briefly compared various definitions of the terms political, policy and regulatory risks before specifically focusing on policy and regulatory risks of renewable energy investments (e.g. risk of reduced support schemes). We derived a categorization of major risk drivers along with potential indicators by focusing on determinants that are addressed in the academic literature. Second, to gain insight into the actual practical relevance of these identified risk drivers, we additionally studied selected real-world cases of policy and regulatory risks in several European countries based on industry studies, where policy and regulatory changes affected the investors' profitability due to partly severe cuts in renewable energy support schemes. We found the empirical examples from the industry studies and the considered indicators (e.g. unemployment rates, ratings, public debt, achievement of nation targets) to be highly consistent with the determinants derived from the literature, thus reinforcing our findings. Drivers and determinants for policy and regulatory risk thereby include an *economic stress situation*, *costs of grid management*; *technology and technological progress*; *type and size of financial support scheme, control mechanism, national targets; ideological change, socio-political uncertainty, moral hazard, acceptance risks* and *institutional determinants*. While these drivers already appear to reflect empirically observed examples of policy and regulatory risks associated with renewable energy investments, these determinants can just serve as a first basis for risk management and each investment should evaluated individually. More research is necessary to identify further potential determinants which may adversely impact support schemes, e.g. by means of a survey or interviews among experts and investors.

References

Alesina, A., and Perotti, R. (1996): Income Distribution, Political Instability, and Investment, *European Economic Review*, 40: 1203-1228.

Bond, G., and Carter, L. (1995): Financing Energy Projects: Experience of the International Finance Corporation, *Energy Policy*, 23(11): 967-975.

Boomsma, T. K., Meade, N., and Fleten, S.-E. (2012): Renewable Energy Investments Under Different Support Schemes: A Real Options Approach, *European Journal of Operational Research*, 220: 225-237.

Brink, C. H. (2004): Measuring Political Risk, Ashgate Publishing, Dorchester.

Bunn, D. W., and Mustafaoglu, M. M. (1978): Forecasting Political Risk, *Management Science*, 24(15): 1557-1567.

Butler, K. C., and Joaquin, D. C. (1998): A Note on Political Risk and the Required Return on Foreign Direct Investment, *Journal of International Business Studies*, 29(3): 599-607.

Commission of the European Communities (1998): The Support of Electricity from Renewable Energy Sources, Accompanying document, Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources, Commission Staff Working Document SEK/2008/0057.

De la Torre, J., and Neckar, D. H. (1988): Forecasting Political Risks for International Operations, *International Journal of Forecasting*, 4: 222-241.

Ernst&Young (2011): Renewable Energy Country Attractiveness Indices, RECAI, Issue 28, February 2011, http://www.ey.com, access 05/12/2015.

European Photovoltaic Industry Association (EPIA) (2013): Retrospective Measures At National Level and Their Impact On The Photovoltaic Sector, http://www.epia.org, access 11/11/2014.

European Renewable Energy Council (EREC) (2013): Policy Paper On Retrospective Changes To RES Legislations and National Moratoria, October 2013, http://www.keepontrack.eu, access 11/11/2014.

European Renewable Energy Council (EREC) (2014): Belgium, Key Trends in the RES Sector 2014, http://www.keepontrack.eu, access 07/07/2015.

European Union (EU) (2009): DIRECTIVE 2009/28/EC, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:de:PDF, access 10/24/2014.

European Wind Energy Association (EWEA) (2013): Where's the Money Coming From? Financing Offshore Wind Farms. Report by the European Wind Energy Association, http://www.ewea.org/, access 06/30/2014.

Fitzpatrick, M. (1983): The Definition and Assessment of Political Risk in International Business: A Review of the Literature, *Academy of Management Review*, 8(2): 249-254.

Gatzert, N., and Kosub, T. (2015): Risks and Risk Management of Renewable Energy Projects: The Case of Onshore and Offshore Wind Parks, forthcoming in: *Renewable and Sustainable Energy Reviews*.

Gatzert, N., and Vogl, N. (2015): Evaluating Investments in Renewable Energy under Policy Risks, Working Paper, Friedrich-Alexander University Erlangen-Nürnberg.

Hitzeroth, M., and Megerle, A. (2013): Renewable Energy Projects: Acceptance Risks and Their Management, *Renewable and Sustainable Energy Reviews*, 27: 576-584.

Holburn, G. L. F. (2012): Assessing and managing regulatory risk in renewable energy: Contrasts between Canada and the United States, *Energy Policy*, 45: 654-665.

IRENA (2015): Renewable Power Generation Costs in 2014, http://www.irena.org, access 09/29/2015.

Lee, C. W., and Zhong, J. (2014): Top Down Strategy for Renewable Energy Investment: Conceptual Framework and Implementation, *Renewable Energy*, 68: 761-773.

Lee, C. W., and Zhong, J. (2015): Construction of a Responsible Investment Composite Index for Renewable Energy Industry, *Renewable and Sustainable Energy Reviews*, 51: 288-303.

Lüthi, S., and Wüstenhagen, R. (2012): The Price of Policy Risk – Empirical Insights from Choice Experiments With European Photovoltaic Project Developers, *Energy Economics*, 34: 1001-1011.

Micale, V., Frisari, G., Hervé-Mignucci, M., and Mazza, F. (2013): Risk Gaps: Policy Risk Instruments, Climate Policy Initiative, http://www.climatepolicyinitiative.org, accessed 10/17/2014.

Ramamurti, R. (2003): Can Governments Make Credible Promises? Insights from Infrastructure Projects in Emerging Economies, *Journal of International Management*, 9: 253-269.

Reuter, W. H., Szolgayová, J., Fuss, S., and Obersteiner, M. (2012): Renewable Energy Investment: Policy and Market Impacts, *Applied Energy*, 97: 249-254.

Sachs, T., Tiong, R. L. L., and Wagner, D. (2008): The Quantification and Financial Impact of Political Risk Perceptions on Infrastructure Projects in Asia, *The Journal of Structured Finance*, 13(4): 80-104.

Smith, W. (1997): Covering Political and Regulatory Risks: Issues and Options for Private Infrastructure Arrangements, in: Irwin, T. et al. (Ed.), Dealing with Public Risk in Private Infrastructure, World Bank: 81-97.

Standard & Poor's (S&P) (2011a): Why Regulatory Risk Hinders Renewable Energy Projects in Europe, http://www.standardandpoors.com, access 10/30/2014.

Stokes, L. C. (2013): The Politics of Renewable Energy Policies: The Case of Feed-In Tariffs in Ontario, Canada, *Energy Policy*, 56: 490-500.

Thomas, A. V., Kalidindi, S. N., and Ganesh, L. S. (2006): Modelling and Assessment of Critical Risks in BOT Road Projects, *Construction Management and Economics*, 24: 407-424.

Turner, G., Roots, S., Wiltshire, M., Trueb, J., Brown, S., Benz, G., and Hegelbach, M. (2013): Profiling the Risks in Solar and Wind, Bloomberg, Swiss Re, http://about.bnef.com/, access 06/30/2014.

Watts, C. (2011): Managing the Risk in Renewable Energy, A Report from the Economist Intelligence Unit Sponsored by Swiss Re.