MANAGING THE RENEWABLE ENERGY GRID INTEGRATION PROCESS: RISKS AND CHALLENGES

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Abstract:

The energy supply security is an essential condition for further economic and social strategic development hence renewable energy generation proves to get involved efficiently in solving this issue. As business-as-usual scenarios proved to be non-strategic for modern economies promoting clean energies, scientists are continuously seeking for new policies and management frameworks appropriate for renewable start-ups. Periodic paradigm shifts operating on energy markets drive impressive market transitions aiming to perform higher innovative approaches over the composite energy generation portfolios thus providing advanced managerial mechanisms for renewable energy strategic deployment inclusively. Thereby, the current study aims to reveal an updated insight over the risks and challenges arising under the energy markets deployments and to identify productive management maneuvers able to provide the appropriate grid integration of intelligent energies. In this purpose there are on their way of implementation different systemic methods of research, including scientific abstraction, deduction, analysis and synthesis, etc., in order to outline the running directives for the strategic transition towards green economies and its management peculiarities.

Key words: transition, innovating energy grids, de-risking renewables

JEL classification codes: D81, G32, Q21

Introduction

The renewable energy (RE) investment efficiency continues to attract much attention within the academic, managerial and policy making communities especially due to the remodeling attempts of economic theory, the involvement of sustainable models on the economic development cycles and the innovative caveats of market failures as a result of the 2007-2010 world economic crisis lessons. RE markets represent the perfect alternative for conventional energy markets in the global problems of mitigating climate change (Nordhaus, 2010) and consequently of preventing market failures due to the limited amount of externalities implied in the technological process of RE production. Risk-averse investors consider the innovative RE technologies with much skepticism and doubt preferring the mature and certified energy technologies (Komendantova et al., 2012). „Investing in natural capital" (Nordhaus, 2010) by financing start-ups based on RE technologies ensure energy production, reduction of GHG emissions and respectively mitigation of the climate change process, consequently, it would induce a targeted pressure on energy producers based on fossil technologies for a technological revolution to mediate energy production in terms of capturing their GHG emissions, so being able to meet the targets of a global warming to a maximum of 2ºC preindustrial levels (IPCC, 2007). The energy sector consisting both of RE and conventional energy markets records impressive transitions from one year to another, being submitted to a periodical "paradigm shift", given the technological progress, governmental initiatives, international organizations deployment directives, climate change pressures, market competition, etc. At the same time, as market failure risks theory suggest for modern markets to better efficiently allocate economic resources in production processes and to undertake risks calibration assessments, it is considered that RE projects are exposed to versatile risks and market barriers locking their further deployment.

Therefore, the current paper focus on peculiar RE risks identification and evaluation basing on theoretical and practical resolutions found in the specialized literature (Section 2) and forwards a set of public and financial incentives experienced in different countries and projects to limit the investment risks exposure (Section 3). Finally, the paper submit its conclusions and recommendations.

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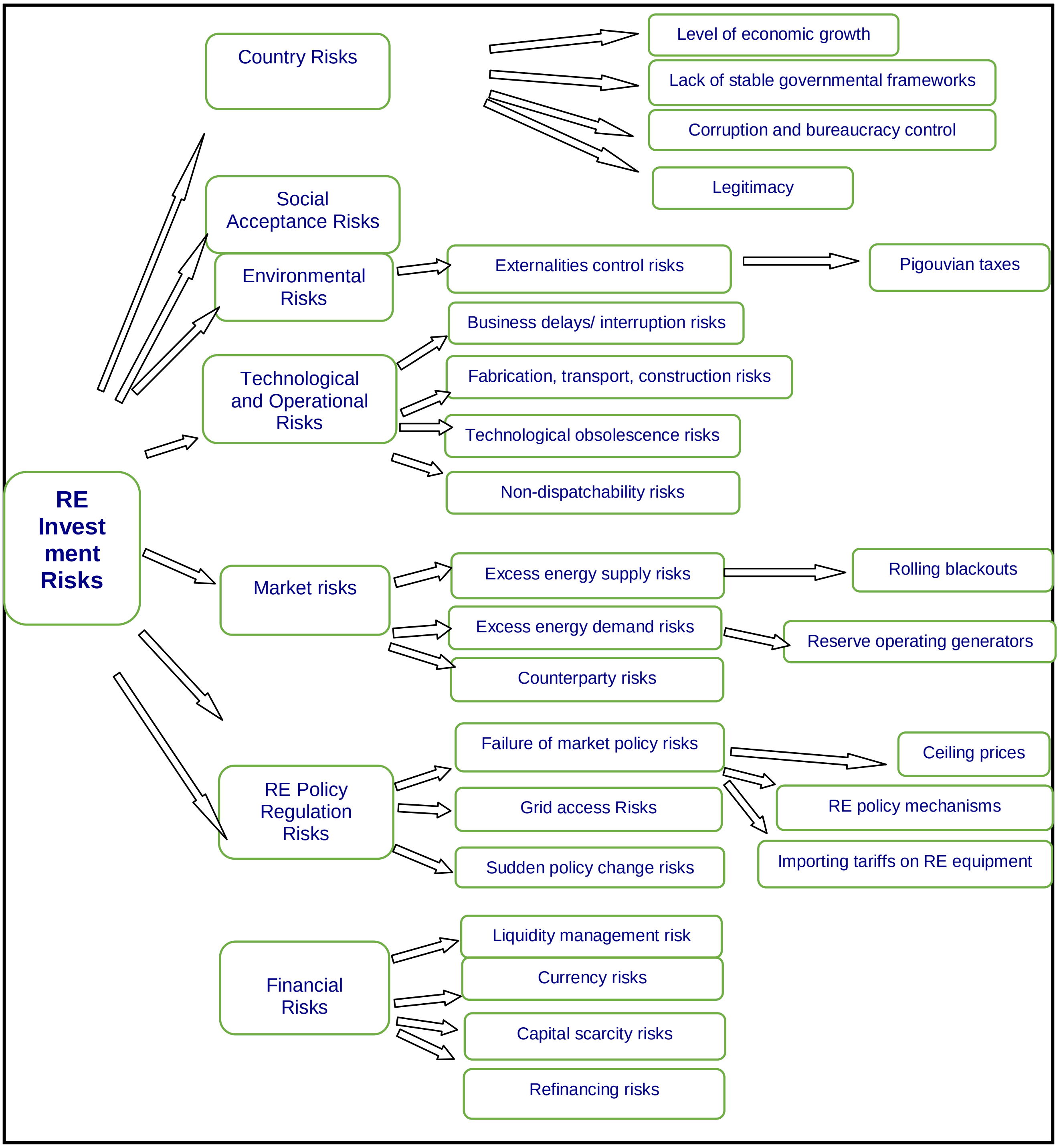
Assessing risks and barriers operating on RE markets

In the literature regarding the RE investment risks issues exist already well defined theories which require adequate attention and analysis to better put them in practice and manage. For instance, Paul N., De Jager D., Tesniere L., Roijen S. (2016) investigate the role of policy design in mitigating the risks in RE markets and forwards country risk profiles for EU member states. Wing and Jin's (2014) paper overviews the RE policy and investigate its deficiencies. Also important theoretic step changes to RE risks framing were made by Watts (2011), Kitzing and Weber (2015), Turner et al. (2013), Waissbein et al. (2013), Negro S.O., Alkemade F. and Hekkert M.P., (2012), etc. Basing on this grounds, I consider the following risks interfering on RE investment decisions (see Figure 1).

Figure 1 - RE investment risk categories and subcategories and their interrelations



Source: made by the author basing on the literature review

Assessing the above figure, it becomes obvious that investment flows in RE technologies are highly responsive to risk factors and policies that create the market conjunctures, thus, investors frequently prefer to direct their capitals to other reliable markets. It is well known that investors are liable to uptake riskier decisions if the rate of return increases equally yet the uncertainty risk incidence creates additional investment indecision thus blocking industry deployments and consequently interfering on detriment of strategic and sustainable progress. The countries management over the RE sector entail highly complex policy schemes which aim to mediating the increased RE investment flows thus assisting at the diversification of energy portfolios, supporting the emerging innovative technologies and absorbing market risks away from this projects. I identified seven main risk categories interfering on RE investments and fifteen descending risks labeled below.

Country risks- placing RE projects in strategic contexts

The country risks become more obvious when analyzing them in the context of globalized markets and can drive important shocks for the non-domestic large-scale RE projects. I consider country risks being the starting point in risk assessment made by investors basing on ascertainments assuming that the direct dependence between the countries political and economic development levels and the RE start-ups feasibility is highly perceived by business developers. Usually, country risk assessments are undertaken for each investment project and they try to establish the risk levels exposure coming from, for example, **level of economic growth**. It is well known that emerging economies are more risky than the mature ones due to the limited well-functioning national markets and its propensity to show degenerating reactions in situations of economic recession shocks. Consequently, investors could endanger their businesses to additional risk costs when investing in RE projects placed on emerging economies. A **lack of stable governmental frameworks** can be overseen under either democracy regimes or authoritarian counterparts. There are investors which secure their businesses from the continuous risks coming from the chaos of the democracy (changing policies under different governments) preferring the discontinuous risks coming from the stable dictatorships. Even though the dictatorship regimes are often accompanied by other economic risks such as bureaucracy and corruption, inefficient legal systems etc., so the dictatorship regimes prove to not be the right solution all the times. There are also opinions arguing that economic growths are not arising from the political institutions but that growths are determining countries to become more democratic (Glaeser et al., 2004). Basing a business on **corrupted and bureaucratic** grounds imposes side costs expressed through implicit taxes on income thereby indirectly reducing the rate of return to investors. The bureaucratic procedures and added corruption create a non-stimulating environment for further deployment of RE and increases the levels of uncertainty on markets. RE projects rely frequently on cooperation schemes (such as PPP) and under bureaucratic and corrupted structures the operational processes could be threatened. The dependency upon **legal policies** operating in different countries is perceived as first barriers for investment decisions as respecting property rights is essential for any project developer. Legitimacy entail the effectiveness of the system also, being considered that investors and project developers can't wait in legal delays for too long.

RE environmental risks – underlying the need to promote green growths

The cost of climate change caused by hidden social costs of externalities associated to conventional energy technologies, may harm seriously the modern economies given the markets remodeling transition processes (IAWG, 2010, pp.9), (Nasalciuc, 2016, pp. 11). Among RE policy makers and knowledgeable investors it is considered that the RE investment projects must start, in fact, from the **environmental assessments** and not from their economic feasibility, implying **cost-benefit** analyses for both investment and operational stages looking for private profit approaches and social benefit approaches, thus meeting the green targets of limiting the global temperature to a 2º rise (above preindustrial levels). It is worth emphasizing that in spite of their substantial investment costs and modest operational costs compared to lower investment costs of fossil-fuels and consistent operational costs, the big economic advantage of RE projects consists in their inessential externalities. Several scientific investigations estimated the mean levels of externality costs for RE technologies fixing a modest value of 5 eurocents/kwh damage with a variation of externality values of 0,29 $/kwh for onshore wind technologies, 0,69 $/kwh for solar technologies, 5,2 $/kwh for biomass technologies and 3,84 $/kwh for hydro projects (Sundqvist, 2004, pp. 1755). As we can notice, among the RE indicated externalities, biomass technologies prove to be the most expensive projects to society thus presenting substantially lower externalities than coal (14,87 $/kwh) or oil externalities (13,57 $/kwh). “In the context of addressing market failures, the research on externalities becomes imperative, primarily, from the perspective of the inability to **efficiently allocate the resources** in the economic processes respecting externalities the noninvasive manner of influence and because of the disqualification of economies to achieve the **Pareto optimum**.“(Nasalciuc, 2016 a, pp. 3). Internalizing the “**external diseconomies**” (Pigou, 1920) associated to energy technologies is performed through **pigouvian taxes** and attempts to counterbalance and recover the damage costs (externalities associated to CO_2 emissions, air pollution emissions and combustion and accidents mediating) imposed to society after production processes.

RE social acceptance risks – dealing with technology inconveniences

The social acceptance barriers arise because “renewable energy conversion tends to happen closer to where the energy consumer lives (the ‘‘backyard’’), thereby increasing its visibility and bringing the environmental impact closer to their residence.” (Wustenhagen, Wolsink and Jean Burer, 2007, pp. 2684). The “Not-In-My-Backyard” (NIMBY) habit of mind represents the contradiction of a general acceptance of public support for renewables and the individual resistance for establishing a RE project in the community’s direct vicinity. Withal, regional policies of promoting RE technologies are guided by the principles of solidarity and social cohesion so as to provide encouragement to disadvantaged "socio-economic rings" aiming to improve the living standards and economic development reliability. The RE social acceptance risks may interfere at different social levels:

1. **Socio-political acceptance- i**f the project is fundamentally strategic for community and country and there exist social resistance against investment decisions, governmental bodies could determine the project developers to introduce financial participation for directly involved stakeholders, afterwards this costs can be attracted from over regional beneficiaries which do not fall under the direct project impact (crowdfunding) taking the form of regional co-subsidizing or absorbed by governments through project subsidies costs. Other risks are referred to as ‘de-*legitimacy*’ barriers, meaning that competence institutions do not recognize the performances of RE technologies, their feasibility (technology costs) and their economic and technical potential (Negro, Alkemade, and Hekkert, 2012, pp. 3842).
2. **Community acceptance –** usually the RE projects follow a logic community acceptance U-curve registering in the sitting phase a decreasing NIMBY acceptance from high levels to low ones and in the running phase an increasing NIMBY acceptance (Wolsink, 2007). The U-curve scales varies depending on the community’s confidence referring to external stakeholders (investors, governmental bodies, policy makers etc.).
3. **Market acceptance –**are encountered in the literature under ‘*negative attitude of incumbent firms’* referring to energy generators based on fossil-fuel or renewable ones with well-established market shares, sometimes monopolized, making difficult the innovative technologies entrance (ex. in UK 80% of wind power installations are hold by large utility companies basing on aggressive market strategies absorbing independent RE developers) (Stenzel and Frenzel, 2008).

RE technological and operational risks – challenging innovations

The technologies entrained inside the RE business projects depict the future financial outcomes based on their market maturity and siting resource suitability. There are opinions arguing that RE technological risks and related uncertainties are being addressed through technology adoption decisions and consequently on investment decisions (Masini and Menichetti, 2013, pp.14). Technology choices come from proved overcoming of technology and cash-flow “valleys of death”, and most frequently refer to a five year testing in countries like Germany, Switzerland etc. Technological and operational risks are addressed as systemic breakdowns because of the employers, equipment or internal processes fail and entail substantial losses to investors. Accosting the RE technological constraints, investors consider the **non-dispatchability** and the **technological obsolescence risks** as other technological risks. While non-dispatchability risks refer to the inability of RE generators (ex. Wind, Photovoltaics) to produce more energy during the peak hours and consequently to benefit from “risk-premiums”, the obsolescence risks (innovation risks) refer to the outdated RE technologies facing difficulties in cost-competition with other up-to-date RE technologies entering the market.

Trailing a RE technology in its life cycle from deep “valley of deaths” to pre-commercial pathways require intensive and continuous national **research and development (R&D) programs** based on long term energy strategies (Negro, Alkemade, and Hekkert, 2012, pp. 3841). R&D investigations are seeking to design market scenarios developments following different RE technology innovations appropriate to existent resources. Stuck-in technologies can be propelled through appropriate market designs able to emancipate RE technologies. Seeking to control the technologic risks, governments can set requirements regarding **compliances for technological quality standards** – FIA represent an efficient tool for controlling the certified (from R&D stages) technological quality standards under which investors bend their businesses underwriting to subsidy programs. Thereby, governments implement programs of partial or full technologic guarantees for eliminating the technologic risks from markets (Michelez et al., 2011, pp.95). It is obvious that investors underwrite their RE projects to risks related to **fabrication, transport, and construction stages**. The first phase of project development is highly important for project developers given the risks of damages during transportation, installation and construction phase. Coming from the high costs of technologies involved in the RE projects, any additional equipment damage brings supplementary costs disadvantaging the developers. During transportation process it must be taken into account the weather conditions to avoid damages and during installation the good experiences presented by providers specialized in establishing RE technologies to avoid engineering failure. The risks related to **delays or damage during operational stages** is also related to technologic issues and assume natural disasters, as a consequence of vandalism and other unpredicted situations. This risks may imply additional costs to developers given the losses of plant’s breakdowns and the repairing periods implied in the process (out of orders).

RE market risks – striving to equilibrate the generation capacities

Market risks may impose considerable damages resultant from market maneuvers and the unpredictable productivity of RE plants given the dependency upon weather factors. Thereby, the lower capacity factors influence the stability of future incomes and rise fluctuant electricity sales which under inadequate market manipulations enlarge financial losses to investors. Assuming that governments strive to national economic growths (meaning the GDP levels) and innovative-technical advances, obviously that emerging economies must consider the excess **energy demand** concern given the dependency principles of this two indicators. “The more advance of a country, the more electricity demand of a country.” (Goh et al., 2014, pp.920). Consequently, given the non-storability and dependency upon weather conditions of energy generators, it is sometimes difficult for the existing generating capacities (renewable and conventional ones) to supply at any point in time the required levels of energy demand (high demand hours). In fact, the periodical few hours of commodity scarcity represent for energy investors the real opportunity to counterbalance their capital investments, but given the regulatory constraints of prices, ceiling prices do not allow the prices to get too high, thus stressing even more the volatility of market prices (Joskow, 2006). Therefore exist several governmental energy market maneuvers to ensure the ceiling price levels. Firstly, in the situation of excess energy demand, system operators are entailed to operate system voltage reductions seeking for promptly demand reductions. Secondly, it can be underlined that several countries have decided to entail an operating generating reserve (ex. SUA operates with an operating energy reserve of 10-15 %). Thus, it is considered that strategic energy markets should place the non-dispatchable energy producers (ex. PV, Wind, nuclear, hidro) as current operating capacities and exclusively the dispatchable conventional energy generators as operating reserve capacities(ex. oil-gas, coal, biomass etc.). **Excess energy supply** bring other constraints to RE developers, this performing as falling electricity prices and setting out the rolling blackouts. The lower established ceiling prices levels are, the higher risks of energy producers to get a rolling blackout notice from power off-takers. Even if RE generators set PPA and other guarantee contracts of the production trading facilities, there is always a risk of market glut threatening developers. Another concern regarding market risks is respecting to **counterparty risks** which may impose significant barriers for RE market trading. Counterparty risks address the risks of default and bankruptcy of the power off-taker bringing chain damages to RE project developers and investors.

RE policy regulation risks – key drivers to green investments

RE policy regulation is the key driver for decarbonized economies as countries choose to implement sustainable policies for deploying green energies ensuring thereby the strategic economic growths. Government industry assistance is a key factor for **setting strategic targets** for RE deployment and choosing the right policy regarding the promotion of certain RE technologies and their calibration this proving to be a challenging issue for ambitious governments given the technological progresses, innovative approaching frameworks and aggregating the composite energy portfolios. Actually, the RE policy regulations enjoy an enough diversity and maturity to be transferred on emerging energy markets and technologies and the risks associated with the **failure of market policy** are important enough to taking them into account. Governments set targets for aggregate RE generations designing national energy portfolios and adapting market mechanisms for reaching their missions. Currently, RE markets operate with various **policy mechanisms** which proof to be better or less advantageous for different scale market economies. Some policy instruments entail higher risks costs given the higher exposure and influence directly the RE levelized cost of energy (LCOE). In this paper I refer exclusively to feed in agreements policy instruments operating on RE markets, which proved their effectiveness in time and enjoy enough popularity, avoiding to analyze other policies like utility quota obligations and mandates, tradeable RE certificates or net metering.

Feed in Agreements (FIA) are the most common RE supply policy driver offering long term power purchase agreements (PPA) for off-taking RE electricity. The PPA can be fixed for 10-25 years and guarantee a determined price payment for each kilowatt-hour produced, dependent or independent of electricity market prices, basing on composite cost criteria like project scale and site, project technology type and resource quality. The FIA offer the possibility to policy makers to control national energy technology portfolios mix, to promote RE technological progress through de-risking policy instruments and to ensure the control of energy supply security. Thus, FIA can take the form of a **feed-in-tariff** (FIT) **payment system** or a **feed-in-premium** (FIP) **payment system** which assume different risk levels to reaching the rate of return assessments. As a FIT policy implies fixed price payment levels independent from the market prices fluctuations, it is considered to be less risky to investors than a FIP given the certainty of stable generation revenues thus avoiding to interact with the electricity spot markets and consequently keeping away from market risks. A FIP policy assumes a premium payment added to the spot market electricity price, thereby following the market electricity price fluctuations and providing less risk protection from market risks to investors. In what follows we will see the plurality of FIA FIT and FIP payment schemes according to Kitzing L., Mitchell C. and Morthorst P.E. (2012, pp.3), Couture T.D. et al. (2010) and Couture T. and Gagnon Y. (2010):

1. **Fixed FIT** – payments determined depending on technology group
2. **Time-dependent FIT**- assuming two-three categories of payments for different technologies deployed or different demand levels registered(day/night, peak/ off-peak)
3. **Target price FIT**- the payment scheme is starting from target prices and undertakes adjusting add-ons above market prices (it is known also as contracts for difference)
4. **Indexed FIT –** payment schemes are being set depending on national economic indicators as exchange rate to euro or price of natural gas which are uncertain at the investment.
5. **Constant FIP** – non-variable adder-on top of the spot market price remaining independent on electricity price increases.
6. **Sliding FIP** – premium payments which are dependent on market price being limited with an established premium cap and premium floor.

The RE policy plurality require careful government attention when attributing FIA to various technologies paying consideration to compatibility of national resources with innovative RE technologies, national/regional spot market deployment levels and social costs of RE. From all FIA categories constant FIP could be the most risky policy to society as during peak demand hours the spot market prices increase and the constant adder-on enlarge the total costs of RE generation. While, the fixed FIT assumes only the risk of decreasing updated value of RE generation revenues given the long technology lifetime and the unchanging stable payment commitments independent from inflation, spot market prices etc. it appears that indexed FIT solves this issue. Across countries there can be reported an outstanding experience regarding the FIA policies being adjusted and mixed in various forms, existing even countries which offer the opportunity to investors for choosing which FIA policy to apply to individual RE projects (ex. in Spain, Estonia, Slovenia, Czech Republic). Most European countries choose to implement FIT payment systems rather than FIP ones forasmuch eliminating additional risks (inflation, fossil-fuel energy prices, etc.)

and providing equity investment feasibility to project developers and due to its country's socially efficient costs.

Sudden policy change risks refer to '*stop-and-go*' policies marking the volatile deployments in market adjustments and subsidy systems (ex. policy changes in Netherlands between 1998-2001 years, also happened in UK, Sweden, etc.). Gaining higher confidence levels in long-term uninterrupted policy frameworks propelling large-scale RE projects, could drive to increased interest from investors, lenders, venture capitals and other stakeholders. There are opinions arguing that sudden policy change risks are more likely to take place on nascent markets than on emerging or mature markets (Noothout et al., 2014, pp.36), thereby investors assume higher costs for risks undertaken, and consequently energy generators provide higher prices to the wholesale markets.

Another key concern regarding the RE policy regulation risks is related to **grid access risks**, which refer to ensuring duly grid connection for new projects. These may perform important barriers to investors if the market liberalization level is low and the uncertainties regarding the grid access are detected at planning stages. In conditions of grid access imperfection and bureaucracy, investors may give up the RE investment initiatives or to price investment risks into the costs of financing. The future smart grids are expected to be technically adapted to increasingly fluctuating energy supplies from renewables, while the actual infrastructures quality prove to be regionally inappropriate for various RE technologies, thereby investors meet serious barriers for further project developments.

RE financial risks – aggregating the risks and their manageability

RE financial risks lie in aggregated risk levels from the above described market barriers being determined by their complexity and plurality manifested on RE investment environment. Investors and project developers aim high in-time incomes, burdening the capital distribution sharing process. High up-front investment costs still performs major barriers for RE projects requiring careful management for equity-debt capitals entailed under business development. Thereby, **capital scarcity risks** are addressed as first pressing barriers arising during planning stages even if business assessments prove feasible indicators in long-run, performing "limited availability of local debt finance" (IRENA, 2016, pp. 37). The most frequent capital bidders for renewables are venture capitals, private equities, asset financiers, public quoted companies, credit markets etc. The financial problems arising during operational stages of RE projects address **liquidity management risks** as low cash reserves reported to updated liability levels, thus emphasizing the business's vulnerability in short-term cash flows. RE liquidity management risks consider the systematic and unsystematic risks arising under FIT and FIP payment systems, high transaction costs and incidence of other financial interferences (ex. changes in fuel prices for biomass projects) or low cash back-ups during new investment operations, which bring liquidity constraints to investors(Kitzing and Weber, 2015, pp.119).The liquidity issues involve the low RE asset liquidity and pricing them in "liquidity premiums" thus enlarging the costs of capital for RE projects. **Refinancing project risks** arise "when the maturity of the loan is mismatched with the lifetime of the asset, and the borrower is unable to refinance the outstanding loan midway through the life of a project."(IRENA, 2016, pp.71). Otherwise said, refinancing risks refer to risks exposure during operational stages of indebted RE projects which can't afford to meet its liabilities and requiring a refinancing. This situation comes conjunctively with the liquidity risks given their interrelation and are undertaken basing on RE projects degree of diversification. The RE project's debt is shifted into long term finance, existing cases when the more attractive refinancing lead to lower LCOE. I consider **currency risks** as financial risks even if their framing refers rather to country risks (issues related to sovereign rates, foreign exchange rates and convertibility). Financial mismatches may arise when business's liability is backup by different currency assets (incomes) or when signing contracts in hard currency and the inability to pay-off the PPA price in hard currencies from the power off-taker.

De-risking RE grid integration –breaking down the drawbacks

When speaking about de-risking RE grid integration, it is essential to approach the issue referring to the entire system up-to-date operating instruments and technologies, arguing the recurrent policy redesign: "attention must be paid as when one instrument should give way to another and when a technology should be abandoned" (Connor et al., 2013, pp. 14). Further, the entire system barriers should be updated and addressed to innovative management strategies, considering theoretical approaches towards risks and their management, well known internal strategies and mechanisms able to mitigate and control the damage exposure. A best practice among managers is **diversifying activity portfolios** with positively correlated assets and establishing a portfolio management. The portfolio diversification for RE can be made with regard to geographic locations or regarding the technologies involved in the energy portfolio. There is also **scenario analysis approach** which establishes presumptive future outcomes considering the expected future alternative events. A scenario approach is applied for decision taking stages taking into account FIP, FIT schemes and risk/ return expectations. Accosting RE de-risking incentives and instruments require careful assessments of their effectiveness given the little experience of risk transferring and risk managing featuring the intelligent energy markets and designing "an approach that monitors the interaction between funding and regulation elements at different stages of the value chain" (Trumper et al., 2014, pp. 169). Currently, a big range of risks threatening RE markets are throw up on insurance markets and other risks damaging large-scale RE projects are absorbed by public finance institutions entrained to mobilize private capitals towards renewable investments (see Table 1).

Table 1

Managing the investment risks depending on de-risking levels

No.	Transferable risks	Manageable risks	Pertinent risks
1.	Country risks	Social acceptance risks	Environmental risks
2.	Counterparty risks	Refinancing risks	
3.	Failure of market policy risks	Capital scarcity risks	
4.	Business delay/ interruption risks	Technological obsolescence risks	
5.	Sudden policy change risks	Non-dispatch ability risks	
6.	Grid access risks	Price volatility	
7.	Currency risks	Liquidity management risks	
8.	Fabrication, transport, construction risks	Excess energy demand/supply risks	

Source: made by the author basing on the literature review

Examining the above table becomes obvious that most RE associated investment risks can be transferred to insurance markets (damages during plant construction, installation, transport, fabrication or operational phase; project delays etc.) or managed in appropriate ways avoiding and mitigating risks, thereby investors are free of part of the undue economic threatening. After all, RE investment risks are pointed through the **financial instruments** and **financial incentives** and their concordance of operating on regional/national markets. Accordingly, involving financial instruments and incentives could look for some governments expensive but their real economic value lies practically in the avoided costs of removed risks from RE markets (Schmidt et al., 2012). Fixing the total costs of the RE financial instruments may imply complex and highly aggregated data modelling process, but the total costs of a given financial incentive is even more difficult to evaluate due to the uncertain evolution of fuel prices, technologic progress and the anticipated investment costs for RE.

Investment risks/costs may be debated, as well, through the **policy de-risking instruments** (Waissbein, et al., 2013) operating on the market which either decreases risks (and accordingly diminishes the average cost of capital investments) or increases the returns for taking higher risks (through subsidies, premiums, grants, financial incentives etc.). FIA register twofold financial efficiency firstly given the facilities of accessing the grid and PPA and secondly given the guaranteed price payments over long periods (FIT) or premium payments above RE market prices (FIP).

In spite of the outstanding RE technological investment cost reductions, the financial project costs (equity and debt costs) continue representing an important barrier to large scale up-front allocations. Setting the RE markets risk/return profiles may reveal contradictory impacts to investors/society thus requesting to price the barriers on both sides. The high up-front costs issue and capital scarcity risks can be solved through interventional one-time direct and indirect public incentives like **capital subsidies**, **grants and investment tax credits and loans**. In developing countries the RE projects may be provided with the possibility to engage to **concessional loans** from public finance institutions entailing lower interest rates, expanded grace periods or prolonged loan tenors. Yet, project developers may imply also **flexible hybrid structures** combining two financial instruments improving the risk transfer and reduction. There is also the possibility to involve **partial loan guarantees** assured by development banks which could provide local banks with the reliability they need to issue loans the RE markets need, thereby, a part of the default risks are transferred to public actors (Waissbein et al, 2013, pp. 37). There are opinions arguing that in developing countries banks manage offering loans only on short-term basis creating additional challenges for RE projects that require, actually, long-term loans for their cost-competitiveness, thus justifying the high costs for energy. Consequently, low-income developing countries face more exposure to develop projects refinancing risks, because of short debt's lifetime (commonly 5-10 years) and the inconsistencies with the RE assets lifetime (commonly 20-25 years). Refinancing risks are known in advance thus their management is prevenient. Usually, RE projects undertake financial mitigating measures like **liquidity guarantees** or **put options** to manage this type of risks. Liquidity guarantees represent the assurance undersigned by financial institutions that a liquidity support will be provided to project developers in the case of cash scarcity.

The currency issues may be boarded coming from **hedging instruments** given the successful experience with **forward contracts and swaps**. A currency forward contract may remove risks of losses in value appearing during transactions by locking in the differences beforehand. In the case of currency swaps, the project developers can lend hard currencies from international financial markets at minimal or zero currency exchange risk. There exist also, **currency risk guarantee funds** which may solve the long-term issues of currency risks covering the differences in exchange transactions between hard currency and local currency. In other cases, developers entail political risk insurance in cases of exposure to currency risks. Coming from the complex operating system markets of renewables, the presence of liquidity risks is not surprising. Liquidity concerns may be mitigated by internal maneuvers which can include setting **debt reserves** for unexpected liquidity scarcities, using the surpluses from **debt service accounts** or establishing contingent equity to back-up RE projects. External instruments designed for limiting liquidity risks may take the form of the same **liquidity guarantees**. Unfortunately, liquidity risks are being referred in the current research to manageable risks given the limited financial instruments and incentives to fully transfer this risks.

Market risks assume the threatening arising from RE market conjunctures (energy demand and supply) witch influences the price levels and project revenues. Excess energy supply risks may be accosted through **futures contracts, derivative and forward contracts** aiming to better control the RE price volatility, while transferring this risks is not possible currently. Market risks can also be approached through the financial uncertainties associated with **weather derivatives** and the issues related to them. Thereby, weather derivatives are used to support the project revenue caveats associated to weather variability and its financial impacts over RE projects. There are also measures to address counterparty risks, implying instruments like **governmental guarantee**, **political risk insurance**, **partial risk guarantee** or through **export credit guarantee.** Government guarantees may assure the backstop risks of counterparty late payment or default by promising timely assistance in RE trading or by financially returning the project with the equivalent losses. Political risk insurance may also capture counterparty risks because there are still countries where power off-takers are acting on energy markets as state-owned entities, thus being directly interested in alleviating the market constraints from investors. Partial risk guarantee may intercede when exist counterparty risks "by enhancing public utility creditworthiness" (IRENA, 2016, pp. 56) while export credit guarantee may cover the liquidity and credit pressures arising under counterparty default. Existing this variety of instruments aiming to limit counterparty risks, I consider them as transferable risks.

Country risks and RE policy regulation risks imply direct dependency of each other and create market deployment backgrounds for renewables. For instance, FIA prove to be an efficient policy tool able to design the RE market policy, to ensure the grid access for electricity producers, to work properly against RE sudden policy changes and to solve some financial issues. Despite their strengths, FIA may perform as policy disincentives interfering on natural market processes through overpriced/underpriced FIT, unrepresentative contracts duration, grid access postpones, delayed payments, adapted FIT/FIP (i.e. active FIT cuts for Solar PV in Spain (Del Rio and Mir-Artiques, 2014)) and can easily rise the failure of RE market-based risks allocation mechanism. Both, country risks and RE policy regulation risks may be transferred through **governmental guarantees**, **political risk insurances**, **export credit**

guarantees and partial risk guarantees protecting RE projects from sudden policy change risks, failure of market design and grid access risks.

Overall technology and operation risks may be transferred away from investors through **insurance markets** and **product guarantees**. Commercial insurance option is used to transfer business delay/interruption risks and technology engineering failure or damage during fabrication, transport, installation and construction stages. In spite of all this, insurers often underline that "there is a limited understanding of most RE projects and associated risks" (UNEP, 2004, pp. 19) (excepting the well-practiced onshore-wind projects) and consequently the insurance products do not always fit completely the innovative RE technology projects. There is essentially important the accordance of product guarantee covering which sets some technologic or financial protection in case of product quality inconsistencies. Also, it is worth emphasizing that emerging technologies are well back-up by venture capitals so as investors may again beneficiate from risk transfers binding partnerships with them. There are situations when operation and maintenance (O&M) service providers may cover the losses from business interruption given the **agreed contracts**. Referring to technologic and operation risks we can underline the **partial credit guarantee** option for mitigating this type of risk or **export credit guarantee. Partial credit guarantees** may mitigate technology risks by enhancing their credit and export credit guarantee may back-up innovative technologies with financial standby guarantees in case of derivative failures. Technologic obsolescence risks may be managed through innovative approaches regarding the operational maneuvers of renewables or through attentive contracting procedures thus assuring the same trading levels after up-to-date technologies entering the RE market. Non-dispatchability risks may be only adequately managed and predicted using statistic data and market prevision, being nonexistent market instruments to work properly against this constraints.

The costs of social acceptance risks are being scored as the lowest share from the total risk assessment costs, however this is expected to change given the government's active promotion for RE and consequently the increasing pressure on communities under incidence. The best managing practice with regard to this risk types is considered the stakeholder participation under innovative democratic processes which involve interested parties in early stage, open dialogues concerning the RE project benefits to nearby communities. Enabling a financial participation to stakeholders prove to be a successful way for determining a better social acceptance level, but even so this risks can't be fully transferred. RE Environmental issues seem to be a pertinent risk for energy markets, ongoing projects engaging to environmental damages with constant or sometimes increasing externality levels dependent on technologic production processes. The low values of externalities associated to renewables allow us to neglect almost all environmental risks associated to different technologies, excepting biomass technology which prove to be the most environmentally riskier given the fuel interference in production process.

Conclusions and further approaches

The deep digging on RE investment risks revealed an imposing heterogeneity of barriers which are blocking the renewables market uptake and keep away investors from engaging in stepping the market process. There are risks which may be absorbed easily from RE investors through insurance markets and national public institutions and other risks which may be addressed through innovative management maneuvers according to up-to-date technologic approaches. I consider the only pertinent risk drawing back renewables and consequentially the strategic deployment of green economies is environmental concern which may be challenged for almost all RE technologies, assuming the case of biomass technology. Thus, I consider that the big problem of de-risking renewables process is concerned to a lack of insurance products, supposing that there may be under stimulation from RE project developers and investors for generating adapted insurance products from insurers. Consequently, I admit that periodic paradigm shifts operating on energy markets drive impressive market transitions so as to RE policy de-risking instruments and financial instruments and incentives fail to align with outstepping countermeasures. It is worth to be emphasized, that further research to be undertaken, could approach the reasons developers hesitate to step-in cooperation with insurers and public institutions so as to ensure a more reliable investment forecast.

Policy makers play a crucial role in amending the RE de-risking process by developing policies which bias the risks away from investors, mitigate misalignments between technologic transitions and market approaches, trace RE supply chain specific features and appropriate policy intercessions, works on cultivation of social cohesion mentality among citizens with respect to accepting and encouraging the RE project developers, manage the renewable energy grid integration process and governmental patronage towards green economies. The goal of this research is considered to be reached given the impartial overlook on RE investment risks issue and its attempt on targeting the investigation course implying de-risking measures and consequently contributing to a revolutionist understanding of the grounds which rise RE underinvestment and low renewable generation.

Bibliography

Connor P., Bürger V., Beurskens L., Ericsson K., Egger C., (2013), "Devising renewable heat policy: overview of support options", Energy Policy 59, pp. 3–16.

Couture T. and Gagnon Y. (2010), "An analysis of feed-in tariff remuneration models: Implications for renewable energy investment", Energy Policy 38, pp. 955-965

Couture T.D., Karlynn C., Kreycik C., Williams E., " A policymaker's guide to feed-in-tariff policy design", U.S. Department of Energy's Solar Energy Technologies Program and U.S. National Renewable Energy Laboratory, Technical Report NREL/TP-6A2-44849

Del Rio P. and Mir-Artigues P., (2014), "A Cautionary Tale: Spain's Solar PV Investment Bubble" International Institute for Sustainable Development., Geneva, http://www.iisd.org/gsi/spain-pv-bubble, (accessed March 15th 2016)

Glaeser, E.L., La Porta R., Lopez-de-Silane F., Shleifer A.,(2004), "Do Institutions cause Growth?", NBER Working Paper # 10568

Goh H.H., Lee S.W., Chua Q.S., Goh K.C., Kok B.C., Teo K.T.K., (2014), " Renewable energy project: Project management, challenges and risk", Renewable Sustainable Energy Reviews 38, pp. 917-932

Joskow P.L. , (2006), "Competitive Electricity Markets and Investment in New Generating Capacity", AEI-Brookings Joint Center for Regulatory Studies, Massachusetts

Kitzing L., Mitchell C. and Morthorst P.E., (2012), "Renewable energy policies in Europe: converging or diverging?", Energy Policy 51, pp.192-201

Kitzing L. and Weber C., (2015), "Support mechanisms for renewables: How risk exposure influences investment Incentives", International Journal of Sustainable Energy Planning and Management Vol. 07, pp. 117-134

Komendantova N., et al. (2012), "Perception of risks in renewable energy projects: The case of concentrated solar power in North Africa", Energy Policy 40, Austria, pp. 103-109

Masini A. and Menichetti E., (2013), "Investment Decisions in the Renewable Energy Sector: an Analysis of Non-Financial Drivers", Technological Forecasting and Social Change, 80(3),pp. 510-524

Michelez J., Rossi N., Blazquez R., Martin J.M. et al., (2011), "Risk Quantification and Risk Management in Renewable Energy Projects", report commissioned by IEA – Renewable Energy Technology Deployment, Altran GmbH&CO KG, Germany

Nasalciuc I., (2016), "Economic Aspects of Fossil Fuel Social Costs. Why Do We Subsidize and Mediate the Climate Change Process?", International Scientific Conference "Accounting and Finance – The Global Languages in Business" 1st Edition, Constantin Brâncoveanu University of Piteşti Faculty of Finance-Accounting of Piteşti, Pitesti (ROMANIA)

Nasalciuc I., (2016)a, "The externalities approach in the context of conventional energy markets. The assessment review on evaluation methodologies and policies for internalization", 1st Annual Conference of the Financial Studies Department " Financial Perspectives and Challenges", "Victor Slăvescu" Centre for Financial and Monetary Research, Bucharest (Romania)

Negro S.O., Alkemade F. and Hekkert M.P., (2012), "Why does renewable energy diffuse so slowly? A review of innovation system problems", Renewable and Sustainable Energy Reviews 16, pp. 3836– 3846

Nordhaus W.D., (2010), "Economic Aspects of global Warming in a Post-Copenhagen Environment", Department of Economics, Yale University, CT 06520, New Haven

Paul N., De Jager D., Tesniere L., Roijen S., etc., (2016), "The impact of risks in renewable energy investments and the role of smart policies", http://diacore.eu/results/item/enhancing-res-investments-final-report (accessed June 7th 2016)

Schmidt, T.S., Born, R., Schneider, M. (2012), “Assessing the Costs of Photovoltaic and Wind Power in Six, Developing Countries”, Nature Climate Change 2, pp. 548-553.

Stenzel T, Frenzel A. (2008),”Regulating technological change – the strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets”, Energy Policy 36, pp.2645–57

Sundqvist T., (2004), What causes the disparity of electricity externality estimates?, Energy Policy 32, p.1753–1766

Trumper S.C., Gerhard S, Staatmann S, Weinmann O.,(2014), ”Qualitative analysis of strategies for the integration of renewable energies in the electricity grid”, Energy Procedia 46, pp.161–170.

Turner, G., Roots, S., Wiltshire, M., Trueb, J., Brown, S., Benz, G., Hegelbach, M. (2013): Profiling the Risks in Solar and Wind, Bloomberg and Swiss Re, http://about.bnef.com/, accessed on 15.05.2016

Waissbein, O., Glemarec, Y., Bayraktar, H., & Schmidt, T.S., (2013), “Derisking Renewable Energy Investment. A Framework to Support Policymakers in Selecting Public Instruments to Promote Renewable Energy Investment in Developing Countries.”, New York, NY: United Nations Development Program

Watts, C. (2011): Managing the Risk in Renewable Energy, A Report from the Economist Intelligence Unit Sponsored by Swiss Re, www.economistinsights.com, accessed 03.05.2016.

Wing L.C. and Jin Z., (2015), “ Risk Management Methods Applied to Renewable and Sustainable Energy: A Review.” Journal of Electrical and Electronic Engineering. Special Issue: Sustainable and Renewable Energies and Systems. Vol. 3, No. 1-1, pp. 1-12. doi: 10.11648/j.jeee.s.2015030101.11

Wolsink, M., (2007), “Planning of renewables schemes. Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation” Energy Policy 35 (5), pp. 2692-2704

Wustenhagen R.,Wolsink M. and Jean Burer M., (2007) “Social acceptance of renewable energy innovation: An introduction to the concept”, Energy Policy 35, pp. 2683–2691

* * *, IAWG (2010), Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Guvernul SUA, Washington, p.9

* * *, IPCC (2007), ”Climate Change 2007. Synthesis Report”, Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, ISBN 92-9169-122-4, Geneva

* * *, IRENA (2016), ‘Unlocking Renewable Energy Investment: The Role of Risk Mitigation and Structured Finance,’ IRENA, Abu Dhabi

* * *, UNEP, (2004), “Financial Risk Management Instruments for Renewable Energy Projects”, United Nations Environment Programme Division of Technology, Industry and Economics, ISBN: 92-807-2445-2