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Solar and Wind Power Sector in Croatia: Are the Targets Realistic?

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1. Introduction

1.1. Background

Amid climate change threats and the scarcity of conventional energy sources many countries have started increasingly invest in alternative renewable energy resources, especially wind and solar power. Solar and wind power industry in recent years have shown that serve well not only in the fight against climate change, or as a way to increase energy security by using domestic energy sources but also as a mean of economic growth (New climate economy report 2014).

Croatian pathway towards renewable energy development started gradually evolving during EU accession negotiations when the large number of energy Directives was transposed into the national legislation. Together with other member states and in accordance with 2020 Strategy Croatia pledged to reach 20% of final energy consumption from renewable sources by 2020. Today Croatia is on the fast track of achieving more than 24 % of final energy consumptions coming from renewables. Such results leave often impression of a remarkable renewable energy deployment in Croatia (EIHP 2014). However Croatian renewable energy potential today significantly falls behind the actual utilization when it comes to its use in electricity (Runko Luttenberger 2015). Most of the produced electricity actually comes from large hydro power plants, while only 5.3 % comes from so called "new" renewables (EIHP 2014). In this share only 4% of gross electricity production comes from wind and less than 1% comes from solar energy (EIHP 2014).

Aim of this research is to analyse how realistic are the current wind and solar power targets in the context of renewable energy factors that are considered to influence renewable energy growth in Croatia. First, this paper will elaborate on the analysis of the energy market

development and renewable energy development in Croatia. Second, is elaboration of factors that are considered to influence renewable energy development and third evaluation of targets for wind and solar power in the context of renewable energy factors.

1.2. Research aim and objectives

The aim of this thesis is to analyse the how realistic are the current wind and solar power targets in the context of renewable energy factors that are considered to influence renewable energy growth in Croatia. The objectives used to achieve the aim are the following:

- Analysis of the energy market development and renewable energy development in Croatia
- Determining and elaboration of factors that are considered to influence renewable energy development
- Evaluation and elaboration of targets for wind and solar power in the context of RE factors

In order to assess the aforementioned objectives, we carried out a review of the literature on energy transitions, of factors influencing renewable energy growth and of renewable targets. Also, interviews were conducted with both renewable energy market players and non-governmental organizations in Croatia. A set of questions was designed for the purpose of the interviews.

Objectives	Method	Data Source
1. Analysis of the electricity market development and of the outset of renewables in Croatia	Review of the available data on energy market and renewable energy sector in Croatia	• research papers on energy transition • energy statistics (IEA, IRENA) • energy statistics in Croatia (EIHP)
2. Determination and elaboration of factors that are considered to influence renewable energy development	Literature review and interviews	• journals, papers, publications
3. Evaluation and elaboration of targets in the context of RE factors	Literature review and interviews with renewable energy market players	• legislation • zakon.hr

2. Literature Review

2.1. Energy transition towards renewable energy sources

Though research on historical energy transition shows slow transitional rates, we can nowadays observe a widespread and growing urgency for the next energy transition (Grubler 2012). Social, economic and environmental components of the current energy system are appraised as being fairly unsustainable (Global Energy Assessment 2012). Environmental protection is to be taken into particular consideration, given that it influences the formation of national energy policies, for example emission standards (Ciscar *et al*. 2013). Therefore, achieving sustainability in the energy sector presents one of the biggest challenges of modern development (Lior 2011).

History makes a great "observational space to draw lessons from and to inform policy models and makers of what it takes to initiate and to sustain much needed next energy transition towards sustainability" (Grubler 2012). Up to present day, all leading historical energy transitions happened primarily due to the unforeseen social, economic and environmental impacts in already congested systems (Grubler 2012). Even though the paradigm shift towards sustainable energy future will not happen automatically, some "patterns and dynamics of past changeovers" can be identified from history research (Hinrichs Rahlwes 2013; Grubler 2012). In recent years, policy framework on energy transition has been regarded as deviating from what was supposed to be the common belief how "energy transition policies and innovation efforts need to be persistent, continuous, aligned, as well as balanced in order to trigger next energy transition (Grubler 2012).

The breakthrough of the so called "new" renewables from laboratory experiments to actual deployment has indeed been an outcome of persistent efforts over the last couple of

decades. These efforts have enabled a gradual start of what Smil defines as "a change in the composition of primary energy supply or gradual shift from specific pattern of energy provision to a new state of energy system" in his book *Energy Transitions: History, Requirements, Prospects* (Smil 2010). "New" renewables include modern biomass, wind and solar (PV and solar heat) energy, small-scale hydropower, marine and geothermal energy (Glodemberg 2006). This new state of energy system has been recognized as having potential for future sustainable growth and has been considered to be a notable step forward from conventional energy sources. Although renewable energy transition might take the same amount of time as previous global transitions (50 to 60 years), the role of renewables in addressing many challenges of modern society has been acknowledged (Smil 2014; Hinrichs Rahlwes 2013). Renewables could not only provide energy security and sustainable energy supply for many developed and developing countries, but they could also help mitigate climate change with decentralized and large scale technologies (Hinrichs Rahlwes 2013).

It is expected that by 2050, renewable energy transition will reduce global greenhouse gas emissions by 50%, thus stimulating sustainable growth, decarbonisation of the energy sector, and expansion of 'green jobs' worldwide. (Hinrichs Rahlwes 2013; Renner *et al.* 2009). The Association of European Renewable Energy Research Centers (EUREC) predicts in its report that by the middle of the century, the European Union could cover 100% of its energy supply with renewable energy sources only, accompanied by "more than 6 million jobs and triggering cumulative investments of 2.8 trillion euros" (Hinrichs Rahlwes 2013).

Many scholars have agreed that *old renewables* such as hydroelectricity have already reached the full extent of their technological capacity, allowing the growth to come from *new renewables* such as wind, solar and biofuels (Smil 2014). For example, the U.S. hydro power has already been labelled as a limited source of energy to grow further, leaving space for *new*

renewables in the U.S. renewable supply (Smil 2014). Therefore, the greatest growth over the last couple of years in the electricity sector came from wind power, bio-energy use and photovoltaic (Hinrichs Rahlwes 2013).

Yet, *new renewables* face obstacles. "The scale and the intermittent nature of wind and solar energy, as well as prolonged shift in the size and cost of existing infrastructure makes transition to renewable energy particularly challenging" (Smil 2014). Current technology deficit of wind and PV photovoltaics does not meet the needs of modern societies for "reliable, uninterrupted supply of electricity with an increasing share demanded at night" (Smil 2014). As long as innovative solutions for such technology limitations are not found, wind and solar energy will be lacking in reliability, hindering renewable energy transition (Smil 2014).

Therefore, the implementation of different support mechanisms and policies is necessary in order to develop and deploy renewable energy technologies (Hinrichs Rahlwes 2013). However, these support mechanisms should only ease the market entrance for renewables and not substitute it (Hinrichs Rahlwes 2013). Moreover, such mechanisms should assure investment security in all renewable energy sectors as well as "provide incentives to reduce costs and accelerate learning curves in favour of renewables" (Hinrichs Rahlwes 2013). Investment security is particularly important for many new, small and medium enterprises that are just entering the market and often cannot afford loans (Hinrichs Rahlwes 2013).

Policies on the other hand should include: "funding research into many technologies, ending unneeded subsidies, making sure prices reflect the environmental and health cost imposed by energy sources, and improving energy efficiency worldwide" (Smil 2014). The example of Germany shows that accomplishing both the increased share of renewables and cost reductions is very likely if different state and civil society actors manage to reach a broad consensus (Hinrichs Rahlwes 2013). Del Rio and Unruh defined energy systems as "Techno-

Institutional Complexes" that combine "the large physical technologies themselves and the social organizations and institutions that build and manage them" (Del Rio and Unruh 2007). Hence, "well-designed support systems can trigger growth, cost decrease and progressive competitiveness of new technologies for a secure energy future" (Hinrichs Rahlwes 2013).

Although prevailing energy supply sources (oil and gas) and oligopolies still dominate energy markets, thus disobeying the level playing field principle, new renewable technologies are gradually growing and increasing their market share (Hinrichs Rahlwes 2013). However, setting up a level playing field in the following years will be of utmost importance in order to assist in the renewables' market progression (Hinrichs Rahlwes 2013). Without it, technologies that are already ready for a large scale development might go to waste in such distorted markets (Hinrichs Rahlwes 2013).

New technological inventions are usually small, imperfect and costly, but their continuing growth designates market penetration and transitional modifications on the macro level (Grubler 2012). This technological scaling up usually happens at two levels: "at the level of individual technologies and at the level of entire technologies" (Grubler 2012). "Scaling up in turn allows substantial cost improvements through economies of scale effects that further drive energy transitions" (Grubler 2012). There are several steps that need to be explained in order to understand how technologies change.

First step starts from individual technological components and the comprehension of their invention procedure, following undertaken improvements and finally their market entry (Hultman *et al.* 2011). However, these new energy technologies usually have to compete with already established systems (Del Rio and Unruh 2007). "Pre-existing infrastructure both physical and institutional, can create important constraints on the adaption patterns of new technologies, whereas failing to account for the path-dependent nature of technological

evolution can limit the potential success of new technological offerings" (Del Rio and Unruh 2007). Same case scenario can be found with wind energy and PV on the market today, both of which are adapting "in path-dependent ways to previous investment and policy decisions" (Del Rio and Unruh 2007).

"Understanding market forces that influence technology development and deployment is undoubtedly essential, but understanding long-term, large scale changes in the energy system requires a broader understanding of the relative influence of institutional, behavioural and social factors" (Hultman *et al.* 2011) "Changes can stem for example, from government regulation and policy differences in firm expertise and infrastructure" (Hultman *et al.* 2011) Grubler has conducted an interesting study on interrelations between potential adoption of new technologies and institutional and organizational changes. Results have shown that a dependence between these interrelations can be found "and that early technology adopters are the key kernels of learning, adaptation/modification of new energy technologies (Grubler 2012). Another study on technological diffusion by Montalvo and Hekkert has proven the importance of technological and social factors in comprehending principles of technological change (Hekkertn *et al.* 2007; Montalvo 2006)

Energy systems are generally complex systems whose functionality depends on a variety of factors. Much of mitigation efforts depends, inter alia, on established policies and their ability "to influence or accelerate the diffusion of climate change related technology" (Holdren 2006). In Germany, wind power expansion was triggered "by series of target oriented legislation, starting in 1991 with the first version of a feed-in-law, which started to really trigger wind power when it was combined with an amendment of the building code, granting priority to wind turbines in rural areas etc. while solar momentum was renewed by revision of the feed-in-law in 2004" (Hinrichs Rahlwes 2013).

All things considered, the so called "new" renewables have obviously become the cornerstone of what the world has already acknowledged as the latest global energy transition. Although many countries have already stepped into the new era, many more still need to follow the example. Renewables have created favourable circumstances not only for sustainable energy supply and energy security, but also for climate change mitigation, green job market formation, etc. Although not without obstacles and shortcomings, renewable sources offer a perspective for many dependent energy systems. Like any other system, renewable energy sector is driven by different factors. Markets, policies, regulations and technological settings all intervene in the process of RE deployment. Therefore, there is no "natural" superiority among the factors because success depends on countries themselves and their respective framework conditions and promotion models (Reiche and Bechberger 2004; Grubler 2012). However, nurturing the "persistence, continuity, alignment, and balance in innovation systems, policies and technological knowledge" will be crucial in all transitional systems around the world (Grubler 2012). Any consistency lacking or "stop-go policies" will result in a failing transition (Grubler 2012).

The following section will focus more on the dynamics of renewable energy sector, providing a summary of many diverse factors that stimulate renewable energy development globally.

2.1.1. Overview of the main factors that influence renewable energy development

While scholars have already proposed a number of explanatory independent variables driving diffusion and change during transitional period, the discussion continues nonetheless. Successful use of renewable energy sources, as pinpointed in Reiche's and Bechberger's analysis, depends on several factors such as: "long-term planning security for investors, technology-specific remuneration for green power, strong efforts in the field of power supply systems (grid extensions, fair access to the grid, etc.) and measures to reduce local resistance against RES projects" (Reiche and Bechberger 2004). Their comprehensive framework has introduced and identified five main factors (geography, economics, environment, politics, technology and cognitive environment) and their associated sub factors that influence renewable development (Reiche and Bechberger 2004).

Another set of eight categories was brought by Montalvo, arguing in favour of public policy, markets, economics, communities and social pressure, attitudes and social values, technological opportunities and capabilities as well as organizational abilities as crucial drivers (Montalvo 2008). Del Río González, on the other hand, suggests that there are three sets of factors supporting decisions on clean technology "firm exogenous and endogenous factors, conditions of the adopters and characteristics of the technology" (del Río González 2005). Jacobsson and Lauber, using the example of Germany, claimed that market formation, advocacy, institutional change and entry of firms are in fact crucial for this transformation (Jacobsson and Lauber 2006). A narrower approach was offered by Hongtao and Feiock, according to which regulatory institutions, party affiliations of the politicians and legislators, along with the professionalism of the legislature and various policy instruments predetermine the pathways of renewable development in different countries (Hongtao and Feiock 2014).

Grubler, on the other side, states a difference between factors that speed up transitions and factors that explain slow transitional rates. Factors that explain slow transitional rates are the following: "scale or market size, technological interrelatedness and infrastructure needs", while factors that accelerate transitions are: "preexistence of niche markets offering an early test bed for experimentation and scaling up novel technologies together with efficiency and costs – the higher relative advantage the faster the transition" (Grubler 2012). Investments in this scheme have the essential role of mechanisms "for increase and replacement of the capital stock of an economy" (Grubler 2012). Finally, "technological and linked institutional organizational transformations are fundamental drivers of energy transitions" (Grubler 2012).

Del Rio and Unruh discuss factors that could be both drivers and barriers to the diffusion of renewable energy transitions such as "techno economic characteristics of technology component, system-level infrastructure and institutional factors" (Del Rio and Unruh 2007). For example, wind power and solar photovoltaics are promising and in some cases proven energy technologies that offer attractive environmental performance characteristics. However, despite their apparent benefits, the diffusion of wind and PV technologies has often shown to be uneven on both national and international scales, displaying that the economic and institutional factors play a decisive role in fostering or inhibiting diffusion. (Del Rio and Unruh 2007).

Although the literature on factors cannot be easily generalized (Frantzeskaki and de Haan, 2009), one model proved to be prevailing in the technology transformation debate: Multi-level perspective (MLP) fuels transformation on the basis of "three fields of activity at different scales; niche innovations, sociotechnical regimes and sociotechnical landscape" (Hultman *et al.* 2012).

Table 2 Existing theories on factors in RE transformation

Scholars	The relevant variables
Montalvo, C. 2008 - classification of factors affecting innovations in cleaner technologies at firm level	(a) public policy, (b) markets, (c) economics, communities and social pressure, (d) attitudes and social values, (e) technological opportunities and capabilities (f) organizational capabilities
Reiche, D. and Bechberger, M. 2004 – factors influencing renewable energy development	(a) geography/starting position in energy policy - *amount of rainfall, sunshine intensity, wind speed, (non)availability of fossil resources, availability of nuclear power or government decision to phase it out* , (b) economic environment - *level of oil and gas prices, subsidies for fossil and uranium based energies, internalization of external costs*, (c) politics - *targets and definitions, administrative responsibility, green parties in power, permit procedures, international obligations, favourable regulation*, (d) technology - *technology development, grid capacity*, (e) cognitive environment - *public awareness, compatibility with the dominant belief in efficiency of large scale units.*
Del Río González, P. 2005 - factors supporting decisions on clean technology in the so-called 'triangular model'	(a) firm exogenous and (b) endogenous factors to the (c) conditions of the potential adopters, (d) characteristics of the environmental technology
Jacobsson, S. and Laube, V. 2006 – factors forming German regulatory framework in the 'battle over institutions'	(a) market formation, (b) advocacy, (c) institutional change and (d) entry of firms
Hongtao, Y. and Feiock, R.C. 2014 – role of politics, policies and prices	(a) Regulatory institutions, (b) party affiliations of the politicians and legislators, (c) professionalism of the legislature, (d) various policy instruments.
Grubler, A. 2012 – differentiation between factors that explain slow transitional rates and factors that speed up transitions	(a) Scale of market size, (b) technological interrelatedness, (c) infrastructure needs. (a) pre-existence of niche markets offering an early test bed for experimentation and scaling up (b) novel technologies together with (c) efficiency and costs, (d) technological and linked institutional organizational transformations
Del Rio and Unruh 2007 - both drivers and barriers to diffusion of renewable energy transitions	(a) techno economic characteristics of technology component, (b) system-level infrastructure, (c) institutional factors
Hultman et al. 2012 – model Multi-level perspective (MLP)	(a) niche innovations, (b) sociotechnical regimes (technical knowledge, institutions, infrastructure) and (c) sociotechnical landscape

2.2. Renewable energy transition in Croatia

In the seventies, Croatia was one of the most advanced countries in Europe when it comes to the development of infrastructure and to the expertise in the use of renewables, as well as in energy efficiency increase (Runko Luttenberger 2015). Together with fossil fuel facilities and big hydropower plants, Croatia had excellent foundation for future renewable breakthrough. However, the transition period from ex-socialist to market-based economy, followed by *Homeland war* and globalization, culminated in a sudden discontinuation of great designs and commenced pathways (Runko Luttenberger 2015). In the last twenty years, countries in South Eastern Europe, including Croatia, have gone through an economic, political and institutional change (Višković and Franki 2015). In the meantime, "strong centralization of power and resources together with, the centralization of spending through government ministries, agencies and funds rendered possible only the investments envisaged by strategy documents insufficiently discussed in public, but possibly largely influenced by lobbies fully aware that decentralized sources do not ensure concentration of large profits commonplace in fossil fuel sector and big investments projects in general" (Runko Luttenberger 2015).

Nowadays, the most important advocate of energy renewable transitions as well as of many national reforms in this country is undoubtedly the European Union (Višković and Franki 2015). The European Union itself has raised the bar high when it comes to the promotion of clean technology and sustainable future growth in European countries. Investments in renewables are seen as an opportunity to remove the shackles of fossil fuels (Višković and Franki 2015). Therefore, the academic community is united in the prioritizing of the deployment of renewable energy sources, including solar thermal and photovoltaic energy, wind, locally and sustainably-sourced biomass, biogas from agricultural waste and sewage sludge as well as geothermal energy (Runko Luttenberger 2015).

However, the actual utilization of Croatian renewable energy falls significantly behind its potential when it comes to its use in electricity (Runko Luttenberger 2015). Technically and economically, Croatia has a potential for achieving 100% renewables in energy consumption (Majandžić and Jerkić 2013). The most isolated parts of Croatia receive about 40% more energy than Central Europe and 60% more than Northern Europe (Runko Luttenberger 2015). Some of the reasons behind the stagnation are concentrated around different barriers or factors that in the case of Croatia still need to be resolved. Most of the existing literature on energy transition in Croatia and renewable energy development has been focusing on three dimensions that are used to explain the barriers to renewable energy deployment in Croatia: policy dimension, monopoly dimension of power utility companies and social dimension (Runko Luttenberger 2015).

Monopoly dimension is interesting from the perspective of deregulation and restructuration of energy industry in Croatia. Over the last few decades, the European Union has been actively committed in the processes of electricity market liberalization, focusing on the introduction of market-oriented structures instead of monopolistic utilities (Višković and Franki 2015). Many monopolistic companies have undergone different procedures of accounting and vertical unbundling, separating activities of production, transmission, distribution and supply (Višković and Franki 2015). As an EU Member State, Croatia went through the same pathway in order to create the competitive electricity market environment that provides equal conditions for everyone (Višković and Franki 2015). However, there years after the adoption of energy laws and the official opening, a complete functioning of the electricity market has not yet been established, due to an insufficient number of participants (Višković and Franki 2015). Besides that, the Croatian electricity market has been ranked 28th (out of 33 countries), as one of the least competitive electricity markets in Europe (Višković

and Franki 2015). Even though privately owned companies are considered to be more efficient frontiers that "desire higher profits in more competitive systems and thereby initiate positive changes", monopolistic utility companies still dominate the market, hindering possibilities for the acceptance of new market companies (Jamasb 2002; Arocena 2002; Višković and Franki 2015). "In the transformation to an open and liberal market, profitability, transparency, perception towards market entry and social benefits dominate investment decisions mechanisms, therefore in terms of these four criteria, the Croatian electricity market needs improvements despite considerable progress" (Grewal and Ipek 2009).

According to the existing literature, the policy dimension offers a fairly acceptable framework and legislation base for renewable energy sector development in Croatia. However, the existing framework was subject to frequent changes (Runko Luttenberger 2015). During the last ten years and the enactment of the national Energy Strategy, Croatia has lost its primary environmental focus (Runko Luttenberger 2015). The Energy Strategy that is currently in power has put a predominant emphasis on the use of fossil fuels and the expansion of nuclear power plants (Runko Luttenberger 2015). Therefore, Croatia is failing to ensure transparency and certainty for investments over the long run (Višković and Franki 2015). Any illustrations of the possibility of unacceptably high risks for foreign investors or financial institutions due to unstable framework will abolish "the much needed boost to the country's development" (Višković and Franki 2015). "Business needs to take decisions in terms of investment choices and cannot bare uncertainties" (Blyth 2007).

Support systems embedded in the policy framework have proved to have a crucial role in the deployment of diverse energy sources. For example, the existing fossil fuel subsidies create high barriers for RES deployment and are usually very hard to change (Kovačević 2011). Over the last six years, Southeastern Europe only has received "32 times more financing than

non-hydropower renewables from IFIs and IPA, although experts have estimated that it is between 1000 and 10,000 times more cost effective to save a unit of energy than to generate a new unit, and the regions suffer from massive energy wastage" (RunkoLuttenberger 2015). Competitiveness of the renewables is still rather low, taking into the account the significantly under-priced energy around the globe (Runko Luttenberger 2015). Even though financial institutions have the possibility of incentivizing this sector, this does not happen usually. Same case scenario is with the National Environment Protection and Energy Efficiency Fund in Croatia, where most of the funding is aimed at wasting management instead of developing RES (RunkoLuttenberger 2015). "Similarly problematic, the Fund does not provide money to individuals, that creating big obstacles- for small projects and private initiatives (RunkoLuttenberger 2015). In their study, Viškovic and Franki have described the "existing bilateral power trading mechanism as inapt for market development and transparent electric price setting" (Viškovic and Franki 2015). For this reason, they believe that Croatia does not attract enough foreign investments in only partially free market conditions and substantial state control (Viškovic and Franki 2015).

Problems of transparency, acting against public interest, influences and preferential treatments in what should be objective and independent studies (environmental impact assessments) are considered to be a significant burden for the Croatian renewable surrounding. "Croatia is tormented by pressure of the investor on authorized producer of environmental impact assessment study who in practice becomes dependent on interests of the profit of the one who selects him for collaboration and pays for the whole project and the study itself" (RunkoLuttenberger 2015). According to Boromiša, installed targets for the 2020 period are neither transparent nor consistent and result in dubious effects for general targets fulfilment (Boromiša 2011). "The quality of public governance is low: there is only a weak coordination

between different levels of government and little or over formalistic use of evidence-based-policy-making and assessment. There is no competitive selection procedure for supervisory board members and management, considerable amount of work has to be done in the effort to prevent corruption, risk assessment tools are not being systematically used and vulnerable sectors appear to be insufficiently prioritized and regulatory framework imposes a high burden on business, including lack of legal certainty, not transparent decision-making in particular at local level and numerous para-fiscal charges" (Višković and Franki 2015). Usually consultative processes with interested public (experts, civil society organizations, citizens) are never implemented (Runko Luttenberger 2015).

Moreover, "the phenomena of keeping on good terms, servility and ignorance has gripped decision-making on investing in energy sector in Croatia" (Runko Luttenberger 2015). Croatia not only lacks to provide alternative solutions to the revitalization of old projects, but it is also in need of a sustainable development vision (Runko Luttenberger 2015). Without a vision, there is no foundation for "forming public polices in energy sector and environmental protection as well as public access to credible data on potential economic, social and ecological effects of wider use of RES" (Runko Luttenberger 2015). Even though Croatian energy sector depends on actual big energy systems for stability and safety of electric power supply, "the investments and programs for the use of RES are left to citizens and foreign investors' initiatives, that being inappropriate for national interests" (FoE Croatia 2011). Therefore, many argue that Croatia has all the technical potential needed, but fails tremendously on the political field (Runko Luttenberger 2015) The infrastructure sector is yet another obstacle on the way towards more RES deployment, presenting crucial challenge for the energy sector reform (Višković and Franki 2015). Although Croatia has skilled workforce and has developed industrial collective memory for electronic and mechanical equipment and components

production, domestic manufacturing sectors fail to evolve into clean technology sectors (Runko Luttenberger 2015).

Unfortunately, social factors do not contribute to the diffusion of RES, even though Croatian people have a positive approach to clean technologies and renewables in general (Runko Luttenberger 2015). The educational pyramid in Croatia does not provide students with adequate background on universities and as a consequence results in a nonexistence of "systematic research, lack of experience of local companies in project organizations and general low level of knowledgeableness" (Runko Luttenberger 2015). In addition to that, the authorities in Croatia do not have a vision of curriculum reform and on top of that show biased patterns when supporting big centralized projects instead of more environmentally friendly and more beneficial ones (Deutsche Welle 2012). "However, Croatia is a typical part of the present global system in which decisions regarding what is consumed are not wholly made at the level of individual consumption, but largely in the boardrooms of corporations financed by the large banks and private equity capital. It is in the board rooms of large corporate public relations firms and advertising firms where the ideas are drawn up to create citizens-as-consumers" (Runko Luttenberger 2015).

Imposed solutions for renewable energy development revolve around framework transparency and stability, market and monopolistic nature of national electricity company, decentralized development, governance and investments. "A well-constructed, stable regulatory framework is one of the perquisites for achieving a transparent, competitive electricity market that is efficient, cost-reflective and able to attract foreign investment necessary for providing its development" (Višković and Franki 2015). "Regulatory reform involves three main aspects: form, progress, and the outcome of the regulation and key success is in the institutional and administrative capacity of the authorities" (Green *et al.* 2006; Pollitt

2009) Up to present day, Croatian government has not managed to establish a consensus around national energy strategy and support technologies that need substantial investment (Višković and Franki 2015). "Without major investments in generation and transmission capacities, consumers might suffer from future supply shortages" (Hooper and Medvedev 2009).

This would suggest that successful liberalization of economic activities also requires a certain amount of political acceptability (Višković and Franki 2015). Not only sunk investments in existing infrastructure need to be encouraged for rapid deployment, but also fossil fuel subsidies should be eliminated and grid expansion should be put into place. (Runko Luttenberger 2015). "Business climate and competition needs to be improved, administrative barriers need to be reduced, labour force participation needs to be fostered and restructuration and privatization of state-owned enterprises needs to be precipitated" (Višković and Franki 2015). Transparency of the electricity market should be primarily focused on reconsidering current power exchange through bilateral contracts (Runko Luttenberger 2015).

HEP should consider reforming its current structure, including investment projects that involve the use of RES. (Runko Luttenberger 2015). "People at local level should participate directly in energy supply. The revenues from energy industry remain in the region and can be reinvested there. Decentralized jobs are created locally, hence the entire project will promote domestic economy in the long term" (Runko Luttenberger 2015). Local authorities in Croatia hold a crucial role as well in promoting and disseminating the concept of solar energy use for electricity production and for heating – municipality has a tool to impose solar energy use through municipal regulations (Runko Luttenberger 2015). For the development of renewable energy, it is of bigger importance to ensure an active role of government at all levels and public sector utilities, than to provide expensive public subsidies for markets and private investors. All public institutions, state and municipal, should be obliged by law to fit solar systems on

their roofs. Also, purchasers of electricity can have significant impact on the mode of power that is produced through public procurement, which should give priority to energy generated by RES (Runko Luttenberger 2015). "The swift approval of laws often inadequately examined and discussed by the Parliament, increases the risk of legal loopholes". (Višković and Franki 2015). In order to achieve these goals, it is necessary to ensure a diversification of energy sources, to promote efficient energy systems and renewable energy sources, as well as to encourage an efficient price policy and environmental protection (Karasalinović Sedlar *et al.* 2011)

Existing literature review provides considerable information on different factors such as driving forces and barriers that influence renewable energy development in Croatia. However, literature fails on exploring the interrelations between contexts of target setting on factors that influence renewable energy growth. The importance of national level studies and energy transitions has already been proven through many pioneering in-depth country level studies (Schurr and Netschert 1960, Rosenberg 1994, Fouquet 2008). The goal of this case study is to show market development of the renewable sector in Croatia, as well as to help understand the factors behind the deployment of renewable energy. Therefore, this study will contribute in the sense of additional knowledge on interrelations between target setting and factors that influence renewable energy development in Croatia. While most of the existing literature focuses on detecting the barriers and driving forces, this research will focus on realistic targets and elaboration of how such target setting has influenced the context in which renewables are developing.

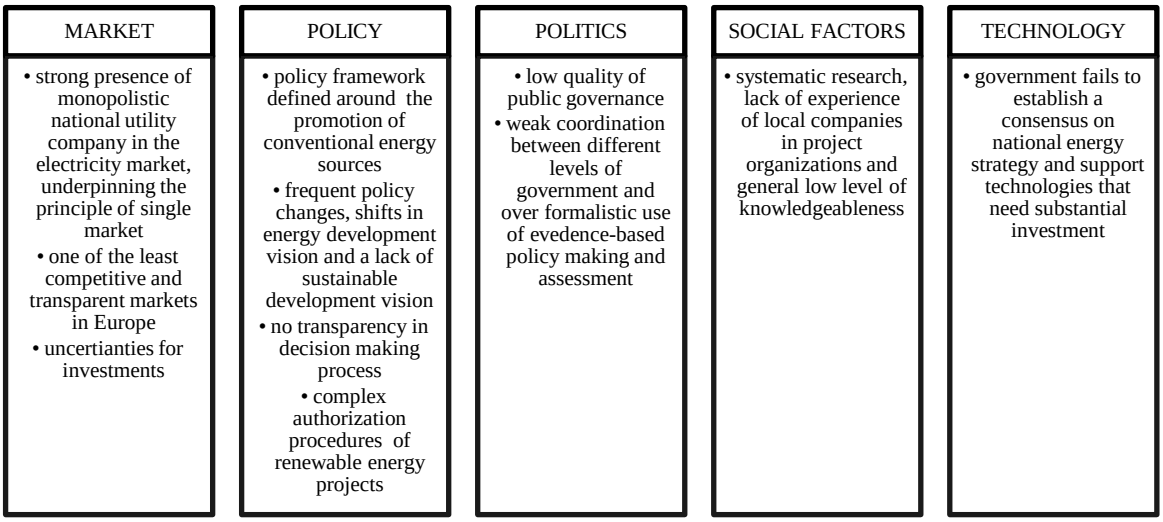

Figure 1 Overview of factors influencing RES development in Croatia

3. Theoretical Framework and Method

3.1. Elaboration of target framework and factors influencing renewable energy growth

The analytical framework constructed for the purpose of this research paper is based on two streams in renewable energy development study: factors that influence renewable energy development and target setting criteria. The core idea behind this approach is to integrate these two streams in order to elaborate and interrelate the insights between the current wind and solar power targets in Croatia and factors that are influencing renewable energy deployment.

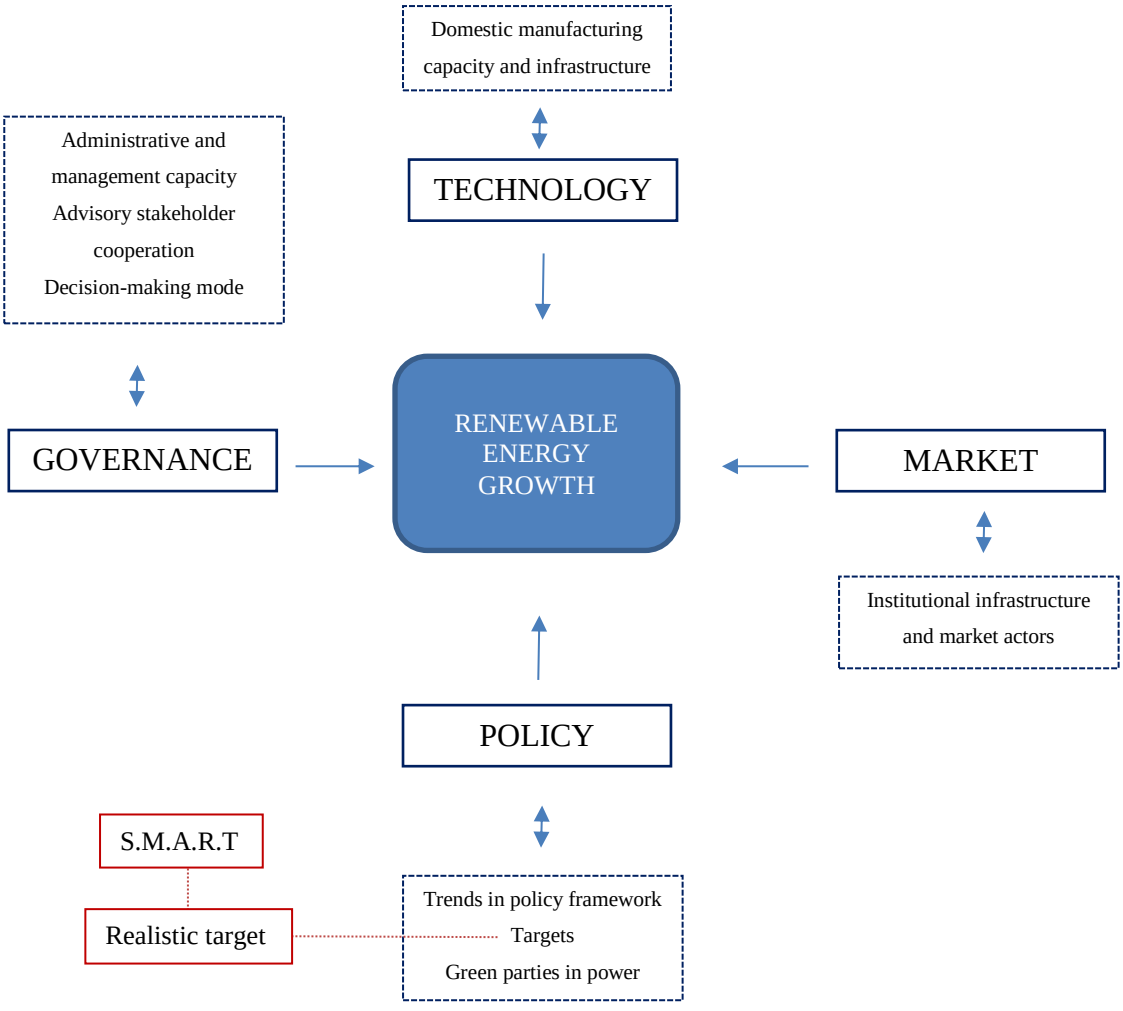

Figure 2 Analytical Framework

Over the last couple of years, "renewable energy targets have become the defining feature of global energy landscape, ranging from simple government announcements to legally binding obligations with clear, quantifiable metrics and specific compliance mechanisms" (IRENA 2015). First ever documented targets were established in 1974 by means of a presidential decree in Brazil's *ProAlcool Programme* in the context of the 1973 *Oil crisis* and raising awareness about energy security and energy policy issues (IRENA 2015). Since then, many prominent documents dealing with certain types of goals, targets and objectives have been appointed on political agendas worldwide such as UN's *The Millennium Development Goals*, IMF's *Poverty Reduction Strategy Papers*, or EU's *2020 Climate and Energy package* (Renard 2007; Lester and Neuhoff 2009; European Commission 2008).

Study on targets was first introduced in 1950 in the form of a theory known as Management by objectives (MBO), developed by Peter Drucker (Lester and Neuhoff 2009). Although the idea first emerged in the private business field, soon afterwards it was introduced in educational, health and environmental policies (Carol and Tosi 1973). The main assumption behind the theory is based on the belief that targets can "harness collective efforts and produce more efficient results" (IRENA 2015). Nowadays, they are used to improve the implementation of domestic and international actions, in national and international policy frameworks. (Lester and Neuhoff 2009). Therefore, target setting is a crucial factor in many decision-making processes (Edvardsson and Hansson 2005). The theory contains a set of conditions or properties, the so called SMART criteria that guide target settings (Edvardsson and Hanson 2005). The acronym SMART in this case stands for Specific, Measurable, Achievable, Realistic and Time-bound (Cintora 1999). Realistic criteria refer to the extent to which it is possible to reach the target in the sense of time horizon and the level of effort required to reach it (IRENA 2015). Many countries today are increasingly embracing targets

because of the "prospect of meeting multiple interconnected objectives such as energy security, environmental sustainability and socio-economic benefits" (IRENA 2015). The most important premise is the establishment of the energy targets on "a sound knowledge base, where metrics and design features are one dimension, and where decisive contextual factors such as political, institutional and economic aspects are considered" (IRENA 2015).

Therefore, for the purpose of analytical framework construction, two approaches will be used. First approach is based on a set of different *factors* that are considered to influence renewable energy development (Montalvo 2008; Reiche and Bechberger 2004; Del Río González 2005; Jacobsson and Laube 2006; Grubler 2012; Del Rio and Unruh 2007; Hultman et al. 2012) The second approach used in the framework is based on the *management by objectives* theory (Edvardsson and Hanson 2005). The graphic above displays the set of four independent variables and related sub factors; policy, technology, market and governance, as detrimental factors influencing renewable growth in Croatia. First, policy factor is used to addresses the trends in wind and solar policy framework, display the trends in target setting and explore the presence of green parties in decision making procedures. Within the second factor, study tends to analyse the existence of advisory stakeholder cooperation among market players and administrative and management capacity inside institutions responsible for renewable energy development, as well as to determine the decision-making mode of liable institutions. As part of the market scheme, the focus is on market formation, and institutional infrastructure. Technology factor is used in order to elaborate on domestic manufacturing capacity in Croatia.

While these factors will help us evaluate and understand the circumstances of the renewable energy environment in Croatia, using the target setting criteria will enable us to interrelate on target applicability in the context of developed factors in Croatia. Targets can be

used as indicators of political commitment, reassurance of positive and long term innovation trends as well as transparency enhancement (IRENA 2015). In theory, targets should stimulate stakeholders to go beyond the business-as-usual trajectories and should be based on a clear strategic vision for the future (Van Herten and Gunning-Schepers, 2000). Conversely, targets set too high can result in non-achievement, frustration or complacency (Van Herten and Gunning-Schepers, 2000). In reality, the level of ambition of targets is often the result of political decisions or negotiations and can change over time (IRENA 2015). In addition to that, involvement of different stakeholders is vital during the target design phase, along with a revision in order to achieve sense of balance between ambition and realism of targets (IRENA 2015). Once the target has been merged into the legislation, it evolves into a crucial component in "developing a clearer vision for the development of the sector enabling stakeholders to allocate resources more effectively" (IRENA 2015). Therefore, targets should be supported by well-defined strategies and policies (IRENA 2015). Based on these theoretical assumptions, we will develop a set of questions that will help us evaluate and interrelate the realistic target setting within the context of renewable energy factors in Croatia.

Analytical framework does not cover all the potentially important factors for renewable energy development in Croatia, for example, the role of social factors in green movements and public awareness of economic environment regarding price fluctuations, oil and gas prices, or fossil fuel subsidies. The goal of this research is to elaborate on the realistic targets applicability in the context of technology, policy, governance and market environment, leaving space for other factors to contribute with alternative explanations.

3.2. Method

This research is a qualitative study on the applicability of the current wind and solar power targets in the context of factors that influence renewable energy development in Croatia. The study offers an internal view on renewable energy development in Croatia from the perspective of market actors and different relevant stakeholders. In order to deploy previously discussed analytical framework, we used two levels of data analysis. First level was used to determine wheatear current targets are realistic and weather they are ambitious. For this purpose, categorization matrix was developed as part of deductive content analysis (Elo and Kyngas 2010). This allowed me to organize my data in pre-existing categories before analysis. The questions were raised to every research participant and required simple no/yes answer. Data was analysed on simple generalization based on the quantity of yes or no.

The second level of data analysis was based on assumptions extracted from the target literature. In order to evaluate and elaborate on wind and solar power targets in the context of renewable energy factors another categorization matrix was developed with the pre-existing categories.

3.2.1 Description of interview

In relation to the method data collection, this research was, among others, built on interviews as overriding data source. Samples for interviews were collected among state and private actors, i.e. government bodies, institutes, investors, project developers, consultants and NGOs related to Croatian wind and solar sector. The final sample was based on participants who were interested and willing to be part of the research. During the one week research trip to Croatia (June 25th – July 2nd) six interviews were conducted, with:

- 2 green non-governmental organizations
- 1 private company for design and construction of photovoltaic power plants

- 1 wind energy investor and project developer company
- 1 manufacturing company in wind sector
- 1 market operator

In each company/organization, the participant was interviewed in person, using a similar set of questions. Slight differences appeared in questions, depending whether the interview was conducted with companies involved in the solar or wind sector. The wording and the order of the questions, however, were different in each case as the interview unfolded. In this sense, the interviews followed a semi-structured pattern. Semi-structured interview allows participants to engage in the discussion freely and expanding the scope of the conversation. These fluctuations have enabled us to get an insight into the areas that we did not predicted in our questions, but that proved to be important for the research topic. Therefore, any potential lack of knowledge or experience in this field was not crucial for the investigation of the important points.

The list of questions was divided into four categories. The first category of questions referred to organizational or management capital of the company/NGO. Questions included an overview of activities, background, motives and goals behind the company or respective NGO. The second category of questions tried to get an insight into their view on renewable energy transitions globally and in Croatia, the most important actors, and finally their abilities to influence decision- making agenda. In addition, questions for investors in this category were more focused on motives to invest in certain sector and how the investments are driven. The third set of questions was about the main driving forces and barriers that influence renewable energy development in Croatia. The last set of questions was about targets in wind and solar sector. For that purpose, two structured questions were formed in order to get positive or negative answers about the feasibility of targets.

All research participants received *Information consent* that was used as a guarantee of anonymity. Therefore, their names are not given in the results section and they were instead categorized as “Interview 1, Interview2, 3, etc. This categorization was used in order to reference them appropriately. Anonymous interviews actually encouraged participants to be more forthcoming, especially about decision-making processes that happen behind closed doors.

3.2.2 Description of data sources

This study is built on interviews and documentary research. Papers used in this thesis include governmental and corporate documents, laws and strategies, energy statistics form IEA and IRENA, etc.

4. Results

4.1. Electricity market development and outset of renewables in Croatia

The earliest examples of electrification in Croatia date from the last decades of the nineteenth century, following patterns around the world (Kalea 2007). Since then, a growing market for electricity and an expanding network system have existed under different forms of governances. During the Yugoslavia epoch, (1945 – 1990) all energy assets in Croatia were nationalized and became people's property (Runko Luttenberger 2014). However, soon after the collapse of the Socialist Federal Republic of Yugoslavia in 1990s and the war that followed, Croatia's industry and infrastructure were devastated and the overall energy consumption experienced a substantial decline (Pukšec *et al.* 2014). It has been estimated that during the Independence War and the occupation in 1991/1992, a third of the existing Croatian electric transmission and distribution systems as well as a number of power plants were destroyed (Kalea 2007). In parallel, the process of vertical integration and merging of national power system took place. Shortly after the reintegration of the Croatian energy system and the reestablishment of the electricity market, the National Electricity Company became the single market player responsible for electricity production, distribution, transmission as well as heat supply and gas distribution.

Notwithstanding the wartime circumstances, Croatian energy reform was launched in the early nineties. Between 1994 and 1998, the Government has ratified several important international declarations, including Energy Charter Treaty, UNFCCC and the Protocol on Energy Efficiency and Related Environmental Aspects – PEEREA, while Kyoto Protocol was ratified later in 2007 (Karasalihović Sedlar*et al.* 2011). As a new independent country, Croatia was now obliged to create energy efficiency strategies and set policy aims, along with appropriate regulatory frameworks and specific programs for the promotion of efficient energy

use and for the reduction of adverse environmental effects from the energy sector such as greenhouse gases emissions (Karasalihović Sedlar*et al.* 2011). The pace of energy sector reform accelerated once it became obvious that Croatian internal and foreign priorities after state reintegration were shifting towards European integrations.

Early on in the energy reform, Croatia developed, among other National Energy Programs, five organized and systematic renewable programs; BIOEN, SUNEN, ENWIND, GEOEN, MAHE (Granić and Prebeg 2007). Entering the new millennium, a basic legal framework was established with Energy Law, Law on Regulation and Energy Activities, Law on Electricity Market, Law on Gas Market and the Law on Petroleum and Petroleum Products (Granic and Prebeg 2007).Until 2009, Croatian market based its future under three energy scenarios: the "business-as-usual" scenario (a scenario with no measures towards energy efficiency improvement and environmental standards adoption), the "most likely" scenario (a scenario with moderate measures) and the so called environmental scenario - a scenario with additional measures (Karasalihović Sedlar*et al.* 2011). However, the initiation of the European Union accession process placed serious requirements on Croatian electricity market. Therefore, the reform was directed towards a gradual restructuration of monopolistic environment in Croatia and towards an introduction to an open and competitive energy market (Bukša 2011). Integral national legislation was harmonized with the so called Third Package (EU's third internal energy market package; Eikeland 2011) with the purpose of competitiveness improvement as well as security and sustainability of energy supply (Karasalihović Sedlar*et al.* 2011).

Croatia finally joined the European Union in 2013, taking over commitments to meet the Europe 20-20-20 objectives. Today, the youngest EU member is also one of the smallest power systems in Europe with a total installed generation capacity of 4GW coming from 25

major power plants, mostly hydro or thermal, and one nuclear power plant, jointly owned with the Republic of Slovenia (EIHP 2014*)*. With a favourable hydrological situation and available fuel for thermal power plants, the total capacity of these plants could cover the demand. Nevertheless, this capacity does not provide acceptable supply security (Kalea 2007).

4.1.1. Trends in demand and supply

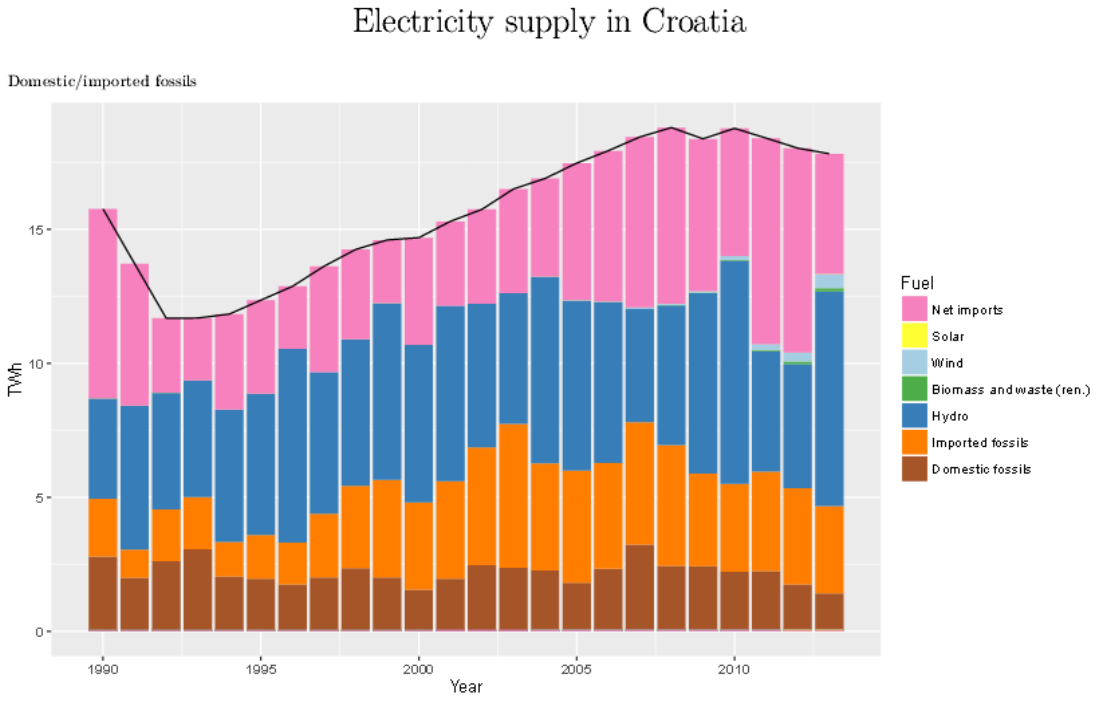

Figure 3 Electricity mix in Croatia, 1990 – 2013

Figure 3 shows the evolution of electricity generation in Croatia between 1990 and 2013. One obvious feature displayed on the figure is that, after years of successive growth, electricity demand has been modestly decreasing for the last four years. Ever since 1992, when Croatia recorded the lowest level of electricity consumption due to the war, gross electricity consumption and net consumption continuously increased until 2013. Final electricity consumption today shows decreasing trends, making Croatia one of the countries with lowest

consumption rates per capita in the European Union, with 36% below EU's average (EIHP 2014).

Electricity supply in Croatia has been dominated by hydropower, its share being 52%, followed by fossil-fuelled facilities with 40% share and about 8% of the total capacity installed in the nuclear power plant jointly owned by Croatia and Slovenia (EIHP 2014)[1]. Croatia currently imports more than 50 percent of its total electricity needs in form of both direct imports of electricity and import of fuels for generating electricity. Indicators for 2015 display the same trends. Namely, Croatia produced 39 % less net electricity and imported 56 % more electricity than in the same period last year (HGK, 2015). One of the reasons for such a high level of electricity imports is halted electricity delivery from power plants owned by the Croatian utility located in other former Yugoslav Republics (Vrhovčak*et al*. 2006).

Along with high electricity import, coal is the second highest imported energy source since 1992. In 1999, this fossil fuel was depleted, hence its production in Croatia ended (EIHP 2014). Over the last year, the import of electricity, coal, coke, crude oil and natural gas decreased, while the import of fuel wood, petroleum products and biomass increased (EIHP 2014). Such trends are mostly results of lower oil prices and increased economic activity (HGK, 2015).

Primary energy supply in Croatia is dominated by liquid fuels (31%), hydropower (21%), and natural gas (21%), which reflects in a significant share of domestic oil and natural gas production (Karasalihović Sedlar*et al.* 2011). When it comes to renewables in primary energy production with dominating hydropower share, "new" renewables recorded the highest growth, amounting to 36 percent. According to data from 2014, Croatia has already surpassed its 20-20-20 target because the share of renewables calculated by the EUROSTAT method in

[1]Shown on the figure as "electricity imports"

the total energy consumption amounts to 24.8 percent (EIHP 2014). Such results often leave the impression of a remarkable renewable energy deployment in Croatia, especially when numbers show that 57.4 percent of produced electricity in the gross electricity consumption came from renewable energy sources (EIHP 2014). In reality, however, most of the produced electricity came from large hydro power plants with the total share of 52.1 percent, and only 5.3 percent of produced electricity came from "new" renewables (EIHP 2014). Moreover if we look at the Figure 4 with shares for wind and solar energy among these 5.3 percent, we come to devastating results for the wind and solar sector in Croatia.

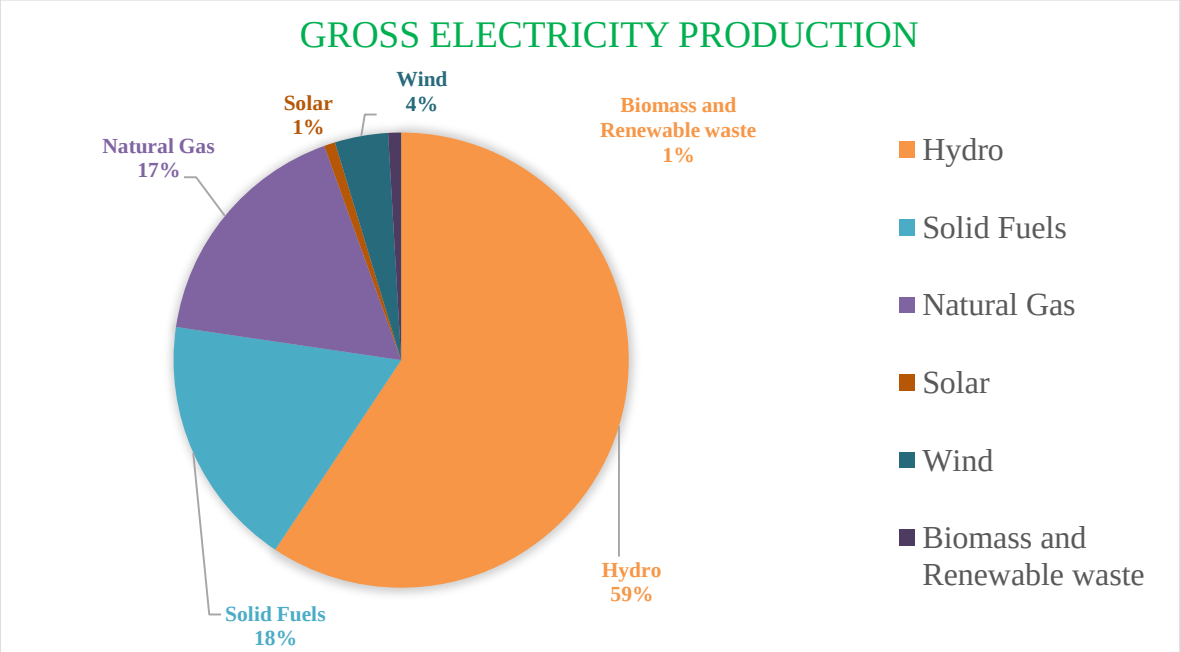

Figure 4 Share of 'new' renewables in gross electricity production (EIHP, 2014)

One can notice that only 4 percent of gross electricity production comes from wind and less than 1% comes from solar energy. Such development trends will most likely continue until 2020 and the development of the new Energy Strategy (Dorić*et al.* 2014).

4.2. Energy policy in Croatia

4.2.1. Trends in wind and solar policy framework

Promotion of wind and solar electricity production in Croatia and commitment towards it was first mentioned in the 1992 Declaration on Environmental Protection. Following the EU accession, electricity market was liberalized and the EU Renewable Energy Directive 2001/77/EC[2] was transposed into the national legislation, which encouraged the wind and solar power sector to gradually start evolving. Legal framework for renewables in Croatia is defined by the national Energy Strategy from 2009. Building a system that will provide supply security, competitiveness and sustainability is the core idea behind energy development in Croatia (CES, 2009).

In order to achieve previously mentioned objectives, it is necessary to diversify energy sources, promote energy efficiency and renewable energy, along with efficient price policy and environmental protection (KarasalihovićSedlar*et al.* 2011). Though this overarching document is much less environmental than the previous 2002 Strategy, the decision to encourage installation of clean-technologies was undisputable (RunkoLuttenberg 2015). According to the Strategy, it is expected that the installed capacity of wind power in the Republic of Croatia in 2020 will amount to 1,200 MW, while capacity for photovoltaic system will be 45 MW (CES 2009).

[2] https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive

TITLE	YEAR	POLICY STATUS	POLICY TYPE
Renewable Energy Sources and Highly Effective Cogeneration Act	January 2016	in force, not applicable	regulatory instrument>policy support
Electricity Market Act	February 2013	in force	policy support> strategic planning, regulatory instruments
Energy Act 2012	November 2012	in force	policy support> strategic planning, regulatory instruments
Tariff System for the Production of Electricity from RES and Cogeneration	May 2012	in force	economic instruments> fiscal/financial incentives> feed-in tariffs/premiums
National Energy Strategy	October 2009	in force	policy support> strategic planning, regulatory instruments
Ordinance on Acquiring the Status of Eligible Electricity Producer	2007	in force	regulatory instruments> codes and standards>sectoral standards, regulatory instruments
Environmental Protection Act	2007	in force	policy support> strategic planning
Regulation on the Minimum Share of Electricity Produced from RES and Cogeneration Whose Production is Incentivized	2007	in force	policy support, regulatory instruments>other mandatory requirements, regulatory instruments
Ordinance on the Use of Renewable Energy Sources and Cogeneration	2007	in force	regulatory instrument>policy support
Environment Protection and Energy Efficiency Fund	2003	in force	policy support>strategic planning, policy support, economic instruments>fiscal incentives>grants and subsidies, loans, taxes
Declaration on Environmental Protection	1992	in force	policy support> strategic planning

Table 2 Legislation Overview on Renewable Energy in Croatia, Source: IEA

In 2007, a stimulation system framework for production of electricity from renewable energy sources was introduced in the form of feed-in tariffs. Even though "renewable facilities were very capital intensive and the price of electricity produced was usually higher than the price of kWh from conventional facilities", the amount of the incentive fee was unreasonably

high and for some technologies even higher than in other European countries (Vrhovčak*et al.* 2006; Višković and Franki 2015). The system was operating in such a way that incentive fees that were paid from electricity buyers to electricity suppliers were collected and delivered to the market operator. Market operator would then forward collected fees to eligible producers now in form of incentive price (Raguzin*et al.* 2010). Electricity producers are granted the right of eligible producer for 25 years and the validity of the project contract for the purchase of electricity is 12-14 years (Simeunović 2015). After the adoption of new mechanisms, all legal, regulatory and market preconditions were established for systematic renewable energy growth in Croatia. However, what happened next was a rather perplexed and inconsistent solar and wind deployment.

Wind and solar power sector development in Croatia can be divided into three phases, following the policy and framework change pattern. In the first period from 2007 to 2010, the development pace was considered to be slow despite the existing legal framework, regulation and bylaws (Interview 3, 2016). Excessively complex legislative framework and lack of information among interested producers and investors between 2007 and 2010 resulted in a modest number of developed and constructed projects (Interview 3, 2016). By all odds, bewilderment of entrepreneurs that were faced with inefficiency and obscurity of the newest framework resulted with poor management, very often inverting the order of power plant development. Power plants were quite often constructed without the required paperwork and licensed electrical grid connection (Interview 3, 2016). The only activities at that time were focused on small-investments, for example in wind measurements, location search, environmental impact assessment studies, construction permits procedures, etc. (Interview 6, 2016). Indeed, that initial period required several years of adaptation, putting wind and solar development on hold (Interview 6, 2016).

Nonetheless, the second phase resulted in a boom for Croatian wind and solar sector. During the following three years, the rise of wind and solar sector was impressive mostly due to high incentive purchase prices and set targets (Interview 3, 2016). However, the growth was stopped in October 2013 when Government adopted National Action Plan for Renewable Energy Sources. Although the Action Plan followed the basic objectives outlined in the Energy Strategy, the fashion in which these guidelines were supposed to be achieved differed greatly (Simeunović 2015). National Action Plan virtually blocked all further wind power or solar power project development.

According to the new guidelines, Croatia is now turning towards the promotion of biomass plants and biogas, cogeneration and small hydro power plant (NAP, 2013). The reasoning behind halting further development of solely wind and solar energy can be found in the inability of Croatian manufacturing capacity to establish commercial production of wind turbines (NAP 2013). Furthermore, the fact that significant growth of wind sector has not yielded an increase in the employment rates was an additional reason to completely reverse direction of solar and wind power sector development. Instead, projects on biomass and biogas contribute significantly to job creation, therefore, their prioritization is considered to be reasonable.

PRODUCTION PLANT GROUP	**2007** (kn/kWh)	**2013** (kn/kWh)
a. solar power		
a.1. Integrated solar power plants with installed capacity amounting to 10 kW	3.40	1.91
a.2. Integrated solar power plants with installed capacity exceeding 10 kW and amounting to 30 kW	3.10	1.70
a.3. Integrated solar power plants with installed capacity exceeding 30 kW and amounting to 300 kW	2.10	1.54
b. wind power	0.72	0.64

Table 3 Overview of incentive prices for wind and solar energy in 2007 and 2013

However, with the reduction of incentive purchase prices and diminished targets in 2013, the development of solar and wind power sector began to stagnate and slowly decrease. From 2014 until the present day, there were no new project developments in terms of production or sale via the feed-in tariff system (Interview 3, 2016). The legal vacuum that existed in 2007 and limited power plants construction even for National Electricity Company, resembles very much the present situation (Interview 2, 2016).

The only projects currently in place for solar sector are the ones for private consumption purposes, supported by the Environmental Protection and Energy Efficiency Fund with a subsidy amounting up to 40 percent of the investment (Interview 3, 2016). The current stagnation might even be prolonged not only due to the absence of additional bylaws and programs but also as a direct result of the ongoing political instability in the country (Interview 3, 2016). Therefore, dysfunctional legal framework and ongoing political instability can be regarded as the biggest barrier for renewable sector in general. (Interview 3, 2016). Despite the undisputable interest for investment, frequent modification of "game rules" hinders any new investment (Interview 2, 2016).

Until two or three years ago, tariff system was based on fourteen-year contracts with fixed tariff purchase prices and already by 2014 the guidelines have changed (Interview 2, 2016). In January 2016, Croatia has finally enforced its first Law on Renewable Energy Sources and Highly Effective Cogeneration. The new law is based on a premium model. Instead of feed-in tariffs and guaranteed purchase prices, investors will now have to sell produced electricity on the market. (Ćenan 2015). This model is closer to market principles than it was hitherto the feed in tariff system but it is also riskier than the latter (Ćenan 2015). However, six months after the enforcement, the government has not yet adopted any related by-laws or regulations without which the law is completely useless (Interview 6, 2016).

4.2.3. Targets

Renewable energy targets today have become the "defining feature of global energy landscape" (IRENA 2015). The newest definition developed by the International Energy Agency defines targets as ″numerical goals established by governments or other actors (such as electric utilities) to achieve a specific amount of renewable energy production or consumption" in electricity, heating/cooling or transport sectors with inclusion of time period or date when targets need to be fulfilled (IRENA 2015). Croatia too has set up the targets for renewable energy technologies in accordance with the Europe 2020 Strategy.

RE TECHNOLOGIES	ENERGY STRATEGY (2009)	NACTIONAL ACTION PLAN (2013)	Target for contract conclusion (TARIFF SYSTEM 2015)	CEMO signed agreements (June 2016)
Wind	**1200 MW**	**400 MW**	**744 MW**	**743, 95 MW**
Solar	**45 MW**	**52 MW**	**-**	**54, 37 MW**
Small hydropower	100 MW	100 MW	35 MW	8,049 MW
Biomass	140 MW	85 MW	120 MW	119,927 MW
Biogas	110 MW	40 MW	70 MW	62,869 MW
Geothermal	20 MW	10 MW	30 MW	10,00 MW

Table 4 Renewable energy targets for 2020 set in Croatian Energy Development Strategy and the National action plan (www.hrote.hr)

Table 4 shows basic documents, laws and regulation acts that have defined the development of renewable energy in Croatia. Listed below are targets determined by these documents for each RE technology until 2020. What can be observed from the table is the obvious difference between these documents regarding the target setting within the same technology division. Due to target deviations, a major problem was caused on the electricity market, particularly within the wind sector. The National Energy Strategy in 2009 set a quite ambitious target with projections to develop wind market up to 1200 MW. However, in 2013, the National Action Plan for Renewable Energy Sources introduced a new and much lower

target (400 MW), but only after Croatian Energy Market Operator already signed the contracts to purchase electricity from eligible producers for a total of 750 MW. The institutions were obliged to follow targets consistent with the National Action Plan, bringing confusion and ambiguities into the electricity market.

Targets for the solar sector on the other hand were severely underestimated. Croatia has undoubtedly a tremendous insolation potential, but for unspecified reasons certain actors estimated that photovoltaic system is rather expensive and unprofitable for Croatian circumstances, which would be true in 2007 but not today (Interview 3, 2016). Only in 2014, the number of applicants in the solar sector exceeded the existing capacity for around 80 percent, which is about 1800 to 2000 denied candidates (Interview 5, 2016). This is why we can come to the conclusion that the method used to assign shares appears to be inadequate. "First come first served" principle proved to be especially misguiding, when knowing that many rejected candidates had to invest certain financial means into the licenses and administrative costs (Interview 5, 2016). In 2014, the target for solar energy was met in the first minutes of January 1st (Interview 5, 2016). Yet, with the adoption of the new law on renewables, the "first come first served" principle was replaced with public tenders. This was a very important step forward, not only in terms of market regularity, but also in terms of established criteria that will have to be fulfilled, such as project profitability, benefits for the local community, etc. (Interview 5, 2016).

Although all targets have been contracted and for the time being no further applications are possible, Croatia should definitely strive to higher targets, but not without actual studies that would include, among others, an analysis of transmission system capacity (Interview 6, 2016).

	In your opinion, do you consider targets within the wind sector realistic?	*Would you agree with the statement that targets within wind sector are ambitious enough?*	*In your opinion, do you consider targets within the sun sector realistic?*	*Would you agree with the statement that targets within sun sector are ambitious enough?*
Interview 1	-	-	-	-
Interview 2	Yes	Yes	-	-
Interview 3	-	-	Yes	No
Interview 4	No	Yes	Yes	No
Interview 5	Yes	No	Yes	No
Interview 6	Yes	No	Yes	No

Table 5 Views from research participants on realistic targets in wind and solar power sector

Target potential cannot be determined on the basis of nonperforming and scarce energy strategy (Interview 6, 2016). Additional knowledge and expertise needs to be invested in order to properly examine the complete integration of renewable energy systems into the existing one (Interview 5, 2016). Croatia lacks better predictive systems that many developed countries in the EU have heavily invested in. By obtaining and investing in such predictive systems for power plants operations, Croatia would avoid ignorant system planning with unreliable technology target installations (Interview 5, 2016). The world has gone very far with the integration of all these systems, with their control and management, while Croatia is only at an early stage, waiting to be supported by legislation (Interview 5, 2016). As long as target setting is not a part of controlled development, the pace of wind and solar deployment will continue to be disrupted in such a way that one year companies will achieve great results and the new two for example will be out of the business (Interview 53, 2016).

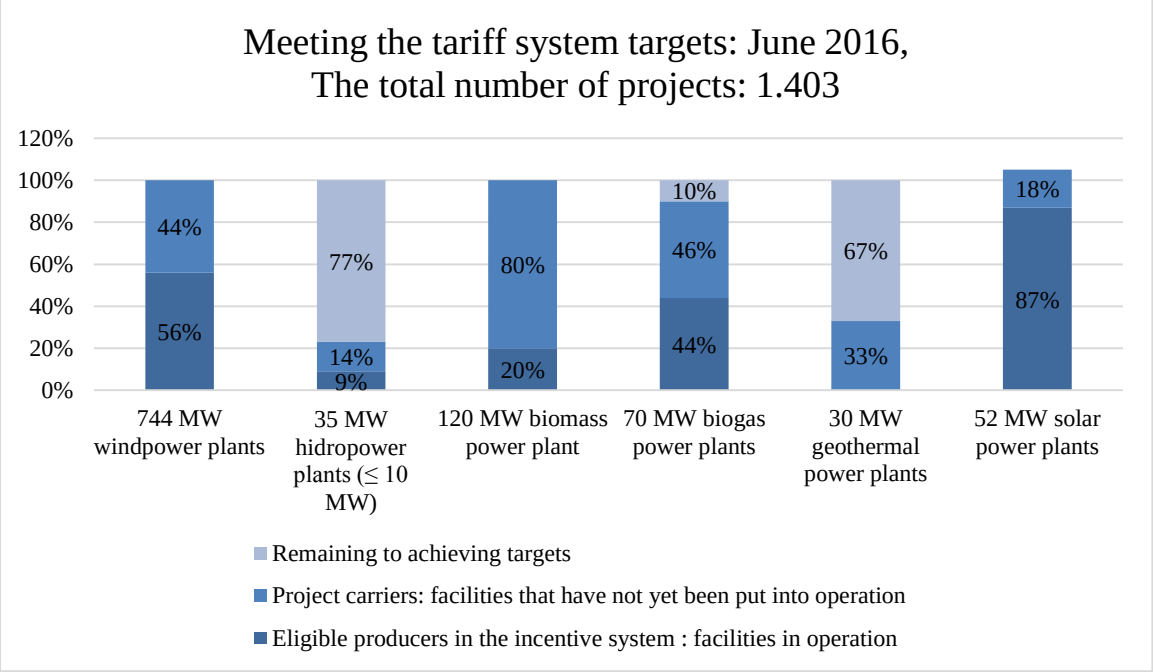

Table 6 Overview of tariff system targets until June 2016 (HROTE)

4.2.2. Green parties in power

Since the beginning of democratic changes in Croatia and the first parliamentary elections in 1990, Croatian political system records the emergence of *green parties*, but without any electoral success (Popovic 2015). European Green Coalition emerged at the first Croatian parliamentary elections in March 15th 1990 and consisted of political and extra-political options with 0, 4% of votes (Kasapović2001; izbori.hr). Over the next ten years, political parties and main political elites have not changed, withholding the emergence of any new parties or green ideas at the national level (Popovic2015). Another reason behind unsuccessful evolution of greens can be found within parties themselves: what is common to all green parties in Croatia is their political frivolity (Popovic2015). However, in 2005, the green movement in Croatia began to grow with strong advocacy campaigns against harmful environmental and energy projects (Interview 4, 2016). The recent successful venture of the green movement resulted with the suspension of oil drilling project in the Adriatic Sea and with the termination of the construction of thermal power plants operating on imported coal. Apart from the development of the green movement, the idea about green policies has also strengthened (Popovic2015).

	Parliamentary elections 2007	Parliamentary elections 2011	Parliamentary elections 2015	European Elections 2014
ZELENA LISTA	**0,59%**	**0,38%**		
ORaH			**2,06%**	**9,42%**

Table 7: Results of Croatian green parties in the parliamentary and European elections

The participation of green parties in governance is an important factor in terms of influence they could have on political agenda and agenda setting. For example, due to their voting power, green parties in Germany and Denmark have managed to promote and transfer policies on other parties and ultimately make direct political decisions (Popovic, 2015). Green parties in Croatia have never even crossed election threshold at the national Parliamentary elections. However, a surprising outcome arose at the 2014 European elections when ORaH won one MP seat in the

European Parliament. Although it seemed that this new green party might continue its electoral success, on the following Parliamentary elections that did not happen. Hence, Croatia still lacks a stakeholder that would promote green polices more proactively and accordingly influence the decision making agenda.

4.3. Governance

4.3.1. Administrative and management capacity

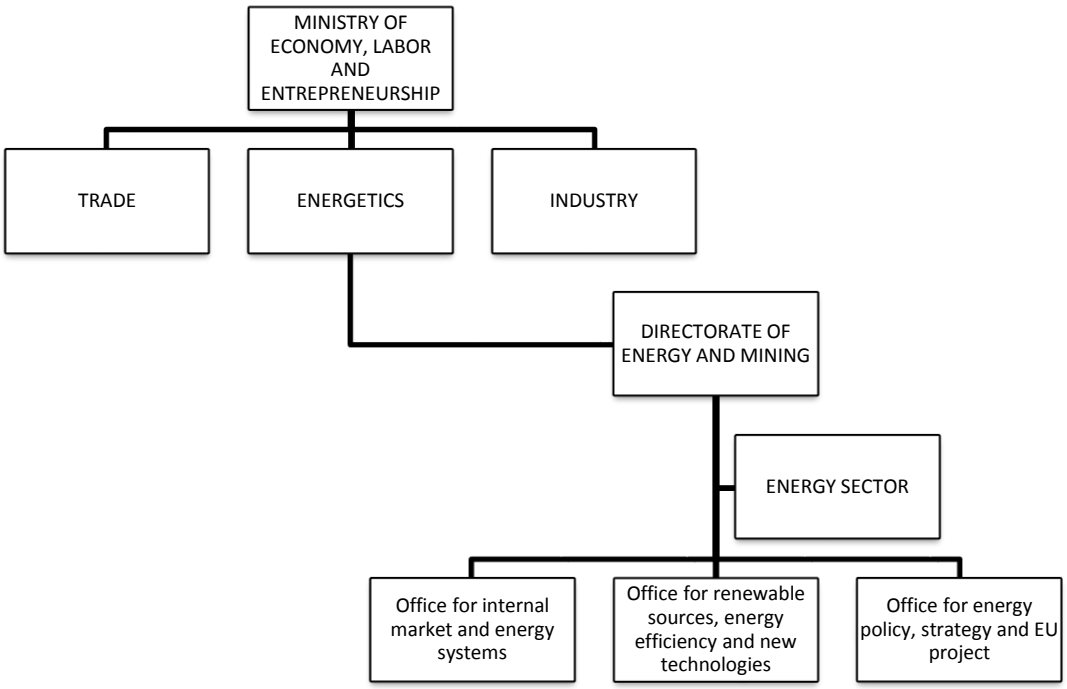

Figure 5 Structure of the Ministry of Economy in Croatia (www.mingo.hr)

Though the overall energy sector in Croatia is entirely under the jurisdiction of the Ministry of Economy, Labour and Entrepreneurship, there is still no serious understanding of the necessity of creating supportive conditions for renewable energy projects at the national level (Interview 4, 2016). The reason behind this is often the absence of a strong energy administration and management in public institutions. Moreover, the energy sector is driven by two monopolistic and influential energy companies, HEP[3] and INA[4], that have very strong internal administrations, responsible for companies' operational processes (Interview 4, 2016). Thus, there was no need to build up a strong Department of Energy that would develop energy

[3]Croatian National Electricity Company
[4] Main oil company in Croatia

polices in public and national interest when energy policies were result of disputes between HEP and INA as well as political and gas lobbying (Interview 4, 2016). Still, such policies have been set far away from representative National Energy Policy. The gas lobby in Croatia is extremely influential, which is evident from the existing gas infrastructure whose network is widespread in rural areas and supplies almost every rural household(Interview 4, 2016).The weak renewable energy sector lacks management and administration support for a similar policy or for the creation of such infrastructural preconditions and is instead represented by a handful of enthusiasts (Interview 4, 2016).

Figure 2 shows the structure of the Ministry of Economy. Before it became a part of the Directorate for Industry, Directorate of Energy existed independently (Interview 1, 2016). There are three offices within the Department of Energy: 1) office for internal market and energy; 2) office for renewable sources, energy efficiency, and new technologies; and 3) office for energy policy, strategy and EU projects. The department employs around 20 people, secretaries and support staff included (Interview 1, 2016). Besides the shortage of management personnel, which is very often cluttered with the paperwork, a professional competence deficiency arises in supranational level where EU membership requires active participations in negotiations and working bodies' sessions (Interview 1, 2016). Although Croatia is a rather small country that most probably will not influence the energy policy of the EU, the mere presence and presentation of opinions by the administrative body that is supposed to lead the Croatian national energy sector is crucial (Interview 1, 2016).

Hence, one of the biggest barriers in renewable energy deployment is the current Ministry of Economy, Labour and Entrepreneurship that has inadequate management and insufficient administrative capacities. In fact, Croatian governments for the last few years simply do not know what do to with renewables, other than that simply following led by

European guidelines. (Interview 4, 2016) As long as the Government does not take a long term stand on renewable energy development in Croatia, all the investor's efforts for systematic development of renewables will be in vain and energy strategies will continue to be formed with absolute market monopolists (Interview 1, 2016; Interview 4, 2016).

4.3.2. Decision – making mode

Parliament's support is often crucial in reassuring investor's ventures which in case of Croatia is left out (Interview 5, 2016). This is especially visible in the timeline and the mod laws are being enacted or altered inside the legislative institutions.Croatian government very often passes the laws without any timeline or adaptation period crucial for investors to adjust their projects and institutions to prepare their operational processes (Interview 5, 2016).Due to the time constraints and "last minute" law adoption during the EU accession period, most of the present legislation has been by-product of direct translation from EU directives instead of harmonization procedures. (Interview 1, 2016). Therefore Croatian legal framework is often evaluated as advanced by different Service Agencies when in reality is does not correspond to Croatian environment, existing market conditions, industry and labour capacity. (Interview 1, 2016). For example between 2008 and 2010 around 1200 laws were passed – which makes an average of almost three laws per day (Viskovic and Franki 2015). However such mode of decision making not only dismisses required consultations procedures but also risks authority abuse and lowers the quality of the laws (Viskovic and Franki 2015). Hence, in order to increase the level of secure investments, legislation and bylaws need to be enacted periodically, with the timeline, grace period and at least eight to nine months' adaptation period (Interview 5, 2016).

4.3.3. Advisory stakeholder cooperation

Although formal participation in public hearings and in policy making is possible for different stakeholders ranging from private to public sector, the participation of NGOs and citizens in Croatia is usually symbolic. Since the decision maker has no obligation to consider any given input, very often the motivation for partaking is lost (Interview 4, 2016). Although green non-governmental organizations are known for a relatively strong impact in preventing damaging projects to happen, no one seems to have any serious impact on the promotion of positive policies and actions (Interview 4, 2016). Successful campaigning against the construction of thermal coal power plants and oil-drilling in the Adriatic Sea gives a certain amount of influence to the bottom-up approach. However, frequent advocacy among a range of stakeholders does not seem to find an answer for the obvious dead-lock in the proactive polices, thus failing to provoke the change (Interview 4, 2016).

Solar and wind sector in Croatia require innovative and courageous policy efforts that might not be possible without the inclusion of various social actors (Interview 4, 2016). Important electricity market authorities are an indispensable part of the core team during the law drafting. In principle, relevant institutions are requested to take part and state their opinions along with their experiences with clients and investors, as well as to draw attention to the shortcomings in the system and to provide some recommendations for improvements (Interview 5, 2016). However, such efforts very often turn out to be useless (Interview 5, 2016). Croatian Chamber of Commerce often holds meetings with relevant actors of the Department for Renewable Energy Resources and maintains frequent correspondence with various ministries and government bodies. However, even when certain measures and arrangements are successfully negotiated, there is a tendency in the domestic political system that the moment the new government enters into power, a new set of rules is installed (Interview 6, 2016).

Industry players should at least be an equal participant in the market and at the decision-making table (Interview 6, 2016).

An open communication among experts, investors and investment banks during the preparation of regulation has proved to be crucial for the investment boost. If we assume that a certain regulation is very precisely and concretely crafted but holds one smallest defect that is unacceptable for investors and the overall investment will never be reached (Interview 2, 2016). A suitable example can be found in a neighbouring country, Serbia, where big wind projects (500 MW) have been prepared for realization for nearly three years already, but have to wait for a simple change of two clauses in the contract for the purchase of the electricity that banks do not approve (Interview 2, 2016). Not only that implementation of international commitments is being delayed, but also very bad signals are being sent to the whole business environment (Interview 2, 2016). Therefore, until the next Croatian government adopts the final version of regulations for the new Law on renewables, further investments are impossible. Every investment must have some kind of a justification and a strong foundation for investing, both of which are absent in the case of Croatia today (Interview 2, 2016).

Public discussions in Croatia are very often organized only to meet the form of the decision making process. In a six-month period, documents are being prepared and afterwards sent for a revision to all affected stakeholders (Interview 2, 2016). Within only four working days, all stakeholders are supposed to examine the whole document and manifest their opinions, observations and conclusions (Interview 2, 2016). There is usually no feedback on collected objectives. In other words, stakeholders withhold any information on adopted and non-adopted remarks and related clarifications (Interview 2, 2016). Probably the best example of a stakeholder cooperation gap happened during the National Action Plan for Renewable Energy Sources adoption in 2013.

Only few years after the National Energy Strategy laid the foundations for the wind and solar sector development, National Action Plan introduced a new binding set of rules that was entirely contradictory with regards to National Energy Strategy. At that point, the deployment of wind and solar sector was momentarily stopped with National Action Plan, a document that was never even discussed at a public hearing, Although fluctuations in stakeholder correspondence do sometimes appear, they are completely undesirable in moments of political and policy shifts (Interview 2, 2016). Generally, good and applicable documents without any objections cannot be designed only by policy makers, but they also need to include policy practitioners (Interview 2, 2016). Therefore, applicable, high quality documents that will allow great investment base need to be the result of an open and frequent correspondence as well as a coherence between different institutions.

4.4. Technology

4.4.1. Domestic manufacturing and infrastructure

The technological potential of a country is generally evaluated on the basis of comparison with countries in possession of a domestic manufacturing capacity and an already existing infrastructure (Interview 6, 2016). Croatia had a respectable industrial production during the socialist era along with all necessary resources, equipment, knowledge, market and basic industry, yet today this is severely neglected (Pavičević, 2016). Not only has the industry's infrastructure been destroyed in large part during the war, but also politics "consciously or unconsciously, turned its back on the Croatian industry" (Pavičević, 2016). Effects are evident even today in the sector of solar and especially wind energy, where domestic manufacturing reports very modest results. As table 2 shows, Croatia has 15 wind power plants and more than 190 installed wind turbines. Manufacturers whose turbines are currently on the market are German Siemens and Enercon, Danish Vestas, American General Electric, Spanish Acciona, Italian Leitwind and Croatian Koncar (Jerkić, 2015). Total installed capacity of 192 wind turbines is 345,850.00 kW, indicating an average of 1,979.42 kW per wind turbine. Initially, installed wind power was less than 1 MW until the last couple of years, when installed capacity of individual wind turbines increased to 2-3 MW, in line with market development in Croatia and Europe (Jerkić, 2015).

Manufacturer	Country	Total number of wind turbines	Installed capacity (kW)	Installed Capacity Share (%)
Enercon	Germany	60	101.300,00	26,65
Siemens	Germany	42	96.600,00	25,41
Vestas	Denmark	35	89.950,00	23,66
Acciona	Spain	20	30.000,00	7,89
Koncar	Croatia	16	17.500,00	4,60
General Electric	USA	12	34.200,00	8,99
Leitwind	Italy	7	10.500,00	2,76
Total		**190**	**380.050,00**	**100,00**

Table 8 List of wind turbine suppliers in Croatia with an installed capacity, Source: HROTE

Enercon currently holds the largest share of the market, the biggest number of wind turbines and the largest share of installed capacity, amounting to almost 30%. Siemens, Vestas (1st), Enercon, and General Electric (2nd) are among world's top ten wind turbine manufacturers (Jerkić, 2015). The future market presence of these manufactures is guaranteed, but the situation of the domestic manufacturer Končar who has not yet realized a serial production of wind turbines is uncertain and is yet to develop (Jerkić, 2015). The company holds almost 5% of the market with a total number of 16 wind turbines. The case of Croatian manufacturer is interesting because, in terms of operational capacities, Končar is more than just a wind turbine supplier. Unlike most of the listed companies above, this manufacturer does not only supply the market with wind turbines, but also co-exists with them (Interview 6, 2016). This means that the company remains involved in the maintenance, planning, servicing, further renovation investments and entire management over wind power plants (Interview 6, 2016). Even global companies that are financially very powerful do not have the tendency to develop a project from zero but rather take over the project off their ultimate acquisitions i.e. purchased firms that have already develop certain component (Interview 6, 2016).

In order to understand the circumstances of domestic manufacturing, it is essential to understand all procedures and processes that happen behind closed doors. The technical potential of manufacturing company can be observed from two aspects. One is the development aspect that prearranges the administrative foundation for new clean-technology generation by obtaining different range of permits, preparing feasibility studies or environment impact assessments, etc. The other aspect is the actual production (Interview 6, 2016). In order for new technology to be successfully marketed, cost planning structure needs to be determined, entailing environmental impact assessment studies, feasibility studies, shading emissions projections, the equipment prices, transportation price, construction work timeline, mechanical

and electrical installation, power plant testing and finally commissioning. Inputs given from the production aspect of the company can prove to be detrimental (Interview 6, 2016). Therefore, entering a market with complex technology like wind turbine requires serious cost planning structure (Interview 2, 2016). However, developing a project from scratch and ultimately manufacturing it requires substantial financial support. According to the research participants, the most problematic barrier of Croatian manufacturing capacity is financing. Not only that domestic industry has no support from governmental institutions, but very often financial institutions stand in their way (Interview 6, 2016). In the case of Končar, the lack of financial credibility makes it very hard to compete among companies like Enercon, General Electric, etc. Obtaining loans in European investment banks is very often a condition for the wind turbine manufacturer, which is why banks are frequently not prone to 'small' domestic producers (Interview 6, 2016).

Although Government tried to protect domestic industry through Tariff System in 2012 by introducing the local component into the electricity price purchase system, according to the EU guidelines such law clauses are deviating from the principles of an open market and therefore had to be repealed (Interview 5, 2016). Every eligible producer that had certain share of domestic components in power plants was qualified for higher electricity purchase price. Nevertheless, Croatian stimulation model for economy is clearly poor and has not yet managed to find more subtle, indirect ways of stimulation that are allowed and that other European countries are using (Interview 5, 2016). Therefore foreign investments are important driving force for current renewable energy growth in Croatia, especially in the wind sector. Local actors, those who had the enthusiasm to partake did not have the capacity and those who have had the capacity, likewise the National Electricity Company did not have the enthusiasm (Interview 4, 2016). Consequently, local actors have failed to push through in fact a single

major project leaving the market for foreign investors who have been very effective in lobbying favourable Feed-in tariffs (Interview 4, 2016). Most probably without such encouraging incentive system, the price drop in wind sector commerciality of wind sector would not happened that fast. (Interview 4, 2016)All in all, domestic industry seems to have enough capacity and determination to produce more, however, it lacks adequate support inside the system.

4.5. Market

4.5.1. Institutional infrastructure and market actors

The entire institutional infrastructure for greater use of renewable energy resources was more or less established in Croatia already in the end of the 80s, as part of the political effort to substitute the use of oil with new sources of energy (Interview 4, 2016). Taking that into consideration, it is crucial for any understanding of the development of renewable energy sources in Croatia to comprehend that at that time the country was one of the most advanced European countries when it comes to the use of renewable energy sources. In the late eighties, Croatia had Revolving Fund for financing projects in the renewable energy and energy efficiency that accumulated financial means from oil consumption tax (Interview 4, 2016).

There was a range of consulting and project developer offices working for industry on projects for solar energy and energy efficiency usage (Interview 4, 2016). Domestic manufacturers at that time built one of the first factories of photovoltaics cells in Europe with annual production capacity of 3.5 MW and there were three industrial plants for the production of solar collectors for thermal use (Interview 4, 2016). Unfortunately, the whole institutional infrastructure was systematically dissembled by the first Minister of Energy, using the war as pretext.

After a long period of restructuration and following the privatization of the energy sector, electricity market in Croatia was officially opened on July 1st 2008 (Interview 4, 2016). Although officially open, competition inside the market is still very limited with a growing need to improve investment climate and to create incentives for new entrants (EU Commission Report). There are two electricity markets in Croatia, one is focused on electricity trading and based on bilateral contracts and the other one is concentrated on power exchange (Interview 4, 2016). A very important component for the implementation of the project of renewable energy

deployment is the electricity market (Interview 4, 2016). This is so because it includes practical assistance and support of different market actors:

- HROTE – organization of the market
- Croatian Transmission System Operator – electricity transmission
- HEP – Distribution System Operator – electricity distribution[5]

Energy activity	Number of valid licences at the end of 2014	Company
Electricity generation	32	
Electricity transmission	1	HEP Transmission
Electricity distribution	1	HEP Distribution
Electricity supply	25	
Electricity market control	1	HROTE
Electricity trade	19	

Table 9 Subjects with valid licenses in the electricity sector (EIHP 2014)

The case of HEP, national electricity company is interesting in terms of its role in the market and its connection with the development of renewable energy. HEP has electricity generation capacity of 3 857.7 MW, none of which comes from "new" renewables. (EIHP 2014) HEP has simply not recognized the potential of RES or showed any kind of interest in investing in them other than investing in hydropower, and it focused instead on the construction of conventional power plants (Runko Luttenberger 2015). Also, HEP has a significant counter-interest in case of commercial use of photovoltaic system in Croatia (Interview 4, 2016). The only possible future for National Electricity Company would be its transformation from the current obsolete power industry into the steering wheel of hydropower plants (Interview 4, 2016).

[5] www.hrote.hr

5. Discussion

The following section elaborates on the targets within the context of renewable energy development in Croatia. Target setting implies certain assumptions that allow explaining observed processes within each factor and interrelation with current wind and solar targets.

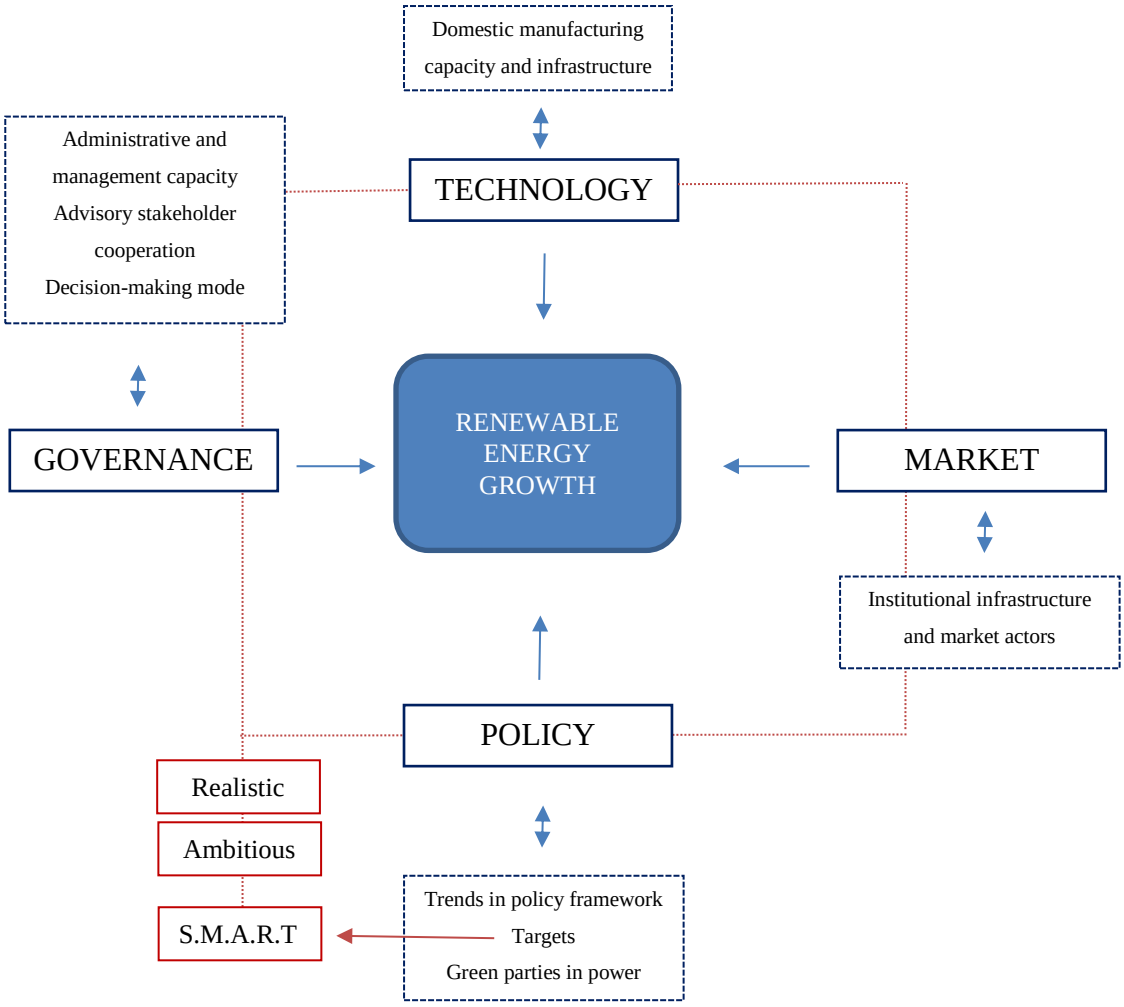

Figure 5 Explanatory structure on targets and factors in Croatia

5.1. Target as an indicator of political commitment, positive and long term innovation trends and clear strategic vision

Political commitment in the case of Croatia can be analyzed through the prism of integrated energy management system. Management capacity that leads renewable energy development in Croatia is very limited. First set of limitations are found in the absence of a separate Ministry of Energy. Energy sector instead is represented by the Ministry of Economy, Labor and Entrepreneurship. Therefore capacities to engage more on the national energy agenda in order to impose the necessity of renewable energy development are inadequate. Also within the energy sector itself existence of influential monopolistic companies render the possibility for renewable sector to growth.

Secondly, in order for system to evolve and build up it needs to be backed by relevant structures. An inclusion of all key stakeholders into the debate allows discussion to be more applicable. If political agreement is endorsed without any involvement of other stakeholders, the results are usually the erroneous decision with the opposite effect. For example the case of National Action Plan in 2013 when the document was introduced without even informal briefings. Such decision imposed enormous burden on the market and directly stooped further wind and solar deployment as well as the investments. Solar and wind policies require systematic development that is not possible without all relevant actors.

Such evaluation of different management and administrative capacities and its interrelations with the efficient and systematic cooperation between the factors actually reveal that there is no political commitment in Croatia towards the renewable energy development. Instead it could be argued that renewable energy deployment in Croatia is considered more as an obligation imposed by the European Union towards the 2020 objectives and the narratives of the European Union.

Positive and long term innovation trends in the renewable sector could be observed in terms of domestic manufacturing capacity within the wind power sector. Share of only 5% in the installed capacity is insignificant concerning the current potential and deployment. Seemingly, current targets in the context of technology factor prove there are positive and long term innovation trends however, Croatia seems not to recognize them. In 2013 with the introduction of new National Action Plan for renewable energy sources, Croatian national policy turned towards the promotion of biomass plants, biogas, cogeneration and small hydro power plant. The reasoning behind such dramatic shift was found in inability of Croatian manufacturing capacity to establish commercial production of wind turbines (NAP 2013). On the other hand, Koncar, the only manufacturing company in wind sector with innovation potential is unsuccessfully trying to gain credibility on the energy market. Thereby it seems rather obvious that Government is giving up on wind power development at the expense of employment increase that will yield biomass sector.

Ultimately, target as an indicator of clear strategic vision can be evaluated on the base of legislation and policy framework trends in the renewable energy sector. Reasons behind policy framework dysfunctionality can be understood from various perspectives. One of them is the timeline and modes how laws are being adopted in the Parliament. Creating a qualitative legal framework for renewable energy sector in Croatia cannot be based on so called-urgent procedures whereas draft law without procedural proofreading becomes the final law. In such cases law are being enforceable. Another perspective for poor policies framework is due to their nonperforming predictive systems.

All in all, elaboration on targets in the context of policy, market, technology and governance factors proves that there is no political commitment, positive and long term innovation trends nor clear strategic vision for renewable energy development in Croatia.

5.2. S.M.A.R.T. Targets

	In your opinion, do you consider targets within the wind sector realistic?	*Would you agree with the statement that targets within wind sector are ambitious enough?*	*In your opinion, do you consider targets within the solar sector realistic?*	*Would you agree with the statement that targets within solar sector are ambitious enough?*
Interview 1	-	-	-	-
Interview 2	Yes	Yes	-	-
Interview 3	-	-	Yes	No
Interview 4	No	No	Yes	No
Interview 5	Yes	No	Yes	No
Interview 6	Yes	No	Yes	No

Table 5 Views from research participants on realistic targets in wind and solar power sector

As shown in Table 5, views of different actors involved in the solar and wind power sector estimated, that both wind and solar power targets are realistic for current Croatian environment. The acronym SMART in this case stands for Specific, Measurable, Achievable, Realistic and Time-bound (Cintora 1999). Realistic criteria refer to the extent to which it is possible to reach the target in the sense of time horizon and the level of effort required to reach it (IRENA 2015). Based on these answers study can argue that current targets in the context of renewable energy development are realistic, however the targets are not ambitious enough. The fact that targets are not ambitious enough leaves the space for study to make assumptions and discuss how to create ways to develop further renewable energy development.

5.5. Solution for RE development in Croatia

Based on the present-day electricity mix, Croatia imports more than 50% of its total electricity needs (EIHP 2014). Under the assumption that ambitious targets are actually energy independent Croatia would be able to optimize the energy mix, increase the security of the energy supply, develop energy infrastructures and diversify energy sources and ultimately create a way towards renewable energy development.

Trends in demand and supply today show that electricity supply is dominated by hydro power, fossil fuel facilities and small share of nuclear power plants (EIHP 2014). Along with

the electricity, coal is the second highest imported energy source (EIHP 2014). Therefore in order to answer the growing energy demand Croatia needs to find solutions and create ways to develop further renewable energy sector.

The path way towards self-sufficiency needs to find answers in policy, governance, techno, and market perspective. Policy perspective in Croatia for so long has been based on short term goals. Trajectory towards more renewable energy deployment needs to be based on strategic goals long term. In case of policy framework changes and all other additional by-laws, change needs to be systematic.

Techno perspective is currently underdeveloped in Croatia. Manufacturing as well as Therefore country should focus in finding the ways how to support domestic industry and encourage their growth. Funding of research and development programs could focus new industries. Economic perspective on the other hand will enable market and green job growth.

6. Conclusion

This research explains how realistic are the current wind and solar targets in the context of factors that influence renewable energy development in Croatia. The main finding is that current targets are realistic in the context of renewable factors, however targets are not ambitious enough. Based on assumption that ambitious targets are indeed energy dependent this paper offers some solutions and creates a way toward better renewable energy development in Croatia.

First, this paper offers an analysis of electricity market and outset of renewables. Trends in demand and supply show that Croatia is very energy dependent. More than 50 percent of electricity has been imported. Electricity supply is dominated with hydropower plants, fossil fuels and nuclear power plant. Although Croatia has already reached the target of 20 percent share of renewables in the energy consumption, whereas the largest share belongs to hydropower plants, and only 1% solar and 4 % wind power plants. Indeed such indicators show stagnating sector of wind and solar power.

Secondly, based on the categorization matrix research participants gave their viewpoint on realistic targets. Pervasive number of research participants have agreed that targets for wind and solar power are indeed realistic, however they are not ambitious enough.

Thirdly, this papers offered elaboration of targets in the context of factors influencing renewable energy development. Based on set of questions targets were elaborated in the context of policy, market, technology, and governance factors. The elaboration shows that there is no political commitment, positive and long term innovation trend not clear strategic vision for renewable energy development in Croatia.

Finally I my view most problematic aspect of Croatian renewable energy sector today is unsystematic approach and lack strategic vision.

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Appendix 1.