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WIND FARM PERMISSION & WILDLIFE PLANNING - A comparison of mitigation and compensation measures of EIAs for birds and bats in Austria and Sweden

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Figure 1: Wind turbine, Lichtenegg source: Claudia Andresek

I Preface

This is my thesis for my master's degree in Landscape Architecture and Planning at the Institute of Landscape Development, Recreation and Conservation Planning at the University of Natural Resources and Life Science in Vienna. At the beginning of my studies in 2010, I thought that I would start my career as a landscape architect. Note this, I'm now planning on a career as a specialist in environmental law and planning. There are two reasons for the change. The first is an increased understanding of the scale of this emerging scientific field. Secondly, during my two years of work experience in the field of agricultural and competition policies in the European Union, I learned how interconnected our world is. With a growing population and raising living standards across the globe worldwide, our energy consumption is rising, while we learn more and more about the negative impact of our traditional means of generating electricity. One of the most difficult questions for our generation is how to balance energy production with environmental protection. I will be looking into how wind energy development manages this balance of maximizing energy production while minimizing environmental damage. Wind turbines have fascinated me ever since my internship in the national park of Neusiedlersee in Austria. The national park "Neusiedler See- Seewinkel", which is famous for its species-rich bird life, coexists very closely to the largest wind farms of Austria at the Parndorf Platte. This coexistence of technology and wildlife led me to my research questions on the tradeoff between the new technology of wind energy development and environmental impact, as wind energy development is a new technology, requiring adequate tradeoffs with environmental issues. For the scientific and practical support, I would like to thank Prof. Ulrike Pröbstl from the University of Natural Resources and Life Sciences Vienna and Anders Larsson from the Swedish University of Agricultural Sciences. Furthermore, I would like to thank Johann Janker, managing director of Ecowind Austria and his authorized officer Matthäus Witek for their support and understanding. I would also like to thank Patrizia Cynuburk from the Austrian Environmental Agency and the staff of the county administrative boards of Skane, Kronoberg and Jönköping for the organizational support for the management and sending of data of all the EIA case studies from Austria and Sweden.

Figure 2: Foto Claudia Andresek, Raffael Kainersdorfer 2019

Finally, I would like to thank my family, especially my father for great support and experience, my boyfriend and friends for being helpful and supportive during my time studying Landscape Architecture and Planning at the University of Natural Resources and Life Sciences in Vienna and during my exchange year in 2015/16 at the Swedish University of Agricultural Sciences in Alnarp, Skane, Sweden.

I wish all readers of my master thesis an enriching experience and hope that I could give food for thought for how policies could develop in the field of wind energy permissions and wildlife planning.

II Abstract

The demand for wind energy in the European Union is increasing due to the 2020 targets set by the EU for renewable energy. The new technologies are facing bottlenecks due to concerns for nature conservation and a variety of European nature conservation laws, especially concerning birds and bats. There are significant differences in the mitigating measures of Environmental Impact Assessments (EIA) proposed for wind parks, even for EIAs concerning the same species or species with similar characteristics. This study compares the different measures advised in EIAs to offset, avoid or mitigate potential harm to birds and bats in proposed wind parks in Austria and Sweden. A literature review formed the basis of the research, underlining and discussing the differences in implementation of EU law into national law. In addition, I analyze 30 EIA's from two EU member states, Sweden and Austria, in regard to the measures mitigating and compensating for the development's impact on target species and the expected outcomes of the suggested measures. The analysis from this study outlines the possible opportunities, constraints and potential bottlenecks from the implementation of mitigation and compensation measures. The EIA methodology is still in its starting phase and is in need for further adjustments to find new solutions to support renewable energy while preserving European species at risk.

Keywords: EIA, ornithology, bats, wind energy

III Kurzfassung

Die Nachfrage für Windenergie steigt aufgrund der 2020-Ziele der EU für erneuerbare Energien in der gesamten EU stark an. Die neuen Technologien stehen vor Herausforderungen hinsichtlich der Bedenken des Naturschutzes, vor allem bei Vogel- und Fledermausfauna. Es gibt erhebliche Unterschiede in den Kompensations- und Ausgleichsmaßnahmen der UVP (Umweltverträglichkeitsprüfung), die für Windparks vorgeschlagen werden, auch bei gleichen oder verwandten Tierarten, welche die gleichen Lebensraumansprüche betreffen. Diese Arbeit vergleicht die verschiedenen Maßnahmen, die in den UVPs beschlossen werden, um potenzielle Schäden für Vögel und Fledermäuse in den geplanten Windparks in Österreich und Schweden auszugleichen. Eine Literaturrecherche bildet die Grundlage der Forschung, unterstreicht und diskutiert die Unterschiede bei der Umsetzung des EU-Rechts in nationales Recht. Die weitere Bewertung basiert auf den Analysen von 30 Fallstudien der UVP in den beiden Mitgliedstaaten Österreich und Schweden, welche die Ausgleichsmaßnahmen zu den Kriterien der Zielarten und der zu erwarteten Ergebnisse der vorgeschlagenen Maßnahmen beschreibt. Die Analyse dieser Studie skizziert die potenziellen Chancen, Beschränkungen und potenzielle Problemfaktoren der Umsetzung von Vermeidungs- und Kompensationsmaßnahmen. Die UVP-Methodik befindet sich noch in der Startphase und bedarf weiterer Anpassungen, um neue Lösungen zu finden, welche die erneuerbaren Energien unterstützen und gleichzeitig jene Arten, welche von hohem Risiko auszusterben betroffen sind, schützt.

Schlüsselwörter: UVP, Ornithologie, Fledermausfauna, Windenergie

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1 Introduction

1.1 Climate Change and its impact on wind energy policies in Europe, Austria and Sweden

Wind farms have been expanding during the last decades in Europe, as wind energy could play a significant role in meeting Europe's climate goals. However, birds and bats may be negatively affected by wind farms, a fact that has been well researched in the last ten years (Schuster et al., 2015, p. 300)
The Paris Agreement and several EU policy strategies will enforce the development of renewable energies. The Paris Agreement from 2015 lays out a plan to keep the global warming below 2°C. To translate this goal into action, at the 2018 Katowice, Poland climate conference, the Paris rulebook was adopted. This will be allowing tracking of the progress each country is making towards limiting global warming (European Commission, 2019). The „clean energy for all Europeans" package of the 30th of November 2016 will be the driving force for the expansion of the wind energy sector, onshore and offshore. The European Commission is the key driver for a clean energy transition of all EU countries and committed to cut CO2 emissions by at least 40% by 2030. The proposal of the „clean energy for all Europeans" package focuses on the three main targets: increasing energy efficiency, being a global leader in renewable energies and enabling clean and affordable energy for its citizens (European commission, 2016).
Meanwhile the EU's Renewable Energy Directive from 2009 has national targets with a 2020 deadline. For now, these national targets have been implemented in Austria and Sweden. As a result, Sweden and Austria have gone beyond the EU requirements. The Austrian Mission 2030 is a Austrian climate and energy strategy that aims to reduce greenhouse gas emissions by 36% by 2030, with 2005 as the baseline. The focus of the project is reducing of greenhouse gas emissions in the transport and building sector, as well increasing renewable energy as a percentage of gross final energy consumption to 45-50% by 2030. (Federal ministry of sustainability and tourism & the federal ministry of transport, innovation and technology, 2018, p. 21) Sweden's goal is to reduce domestic greenhouse gas emissions in all industries by 40% from 1990 levels during a 2021-2030 timeframe. (Ministry of the Environment and Energy, 2018, p. 8). In Sweden it is of special interest that renewable energy makes up 65% of the gross final consumption by 2030. (Ministry of the Environment and Energy, 2018, p. 10) This means that Sweden sets its own targets higher than the 40% of reduction asked for by the European Union and compared to Austria.

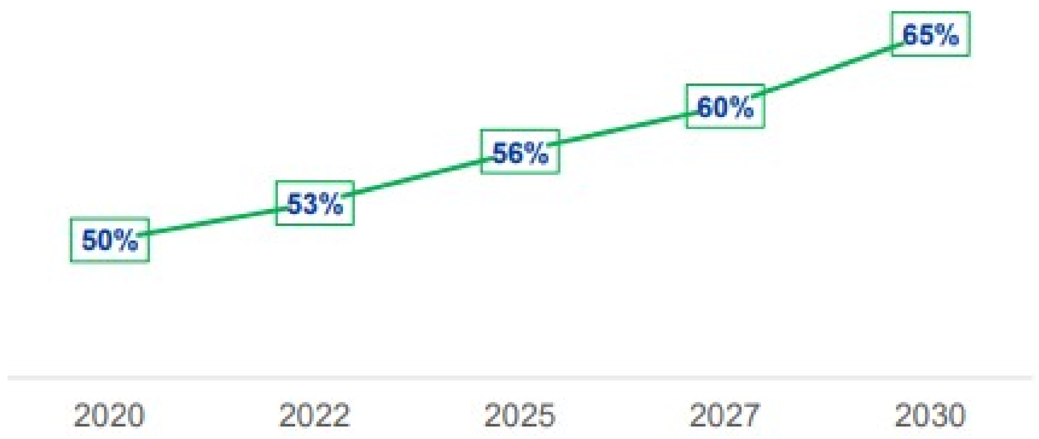


Table 1: Sweden's indicative trajectory for share of renewable energy sources in gross final consumption, Ministry of the Environment and Energy, 2018, p. 11

These goals have translated into real life accomplishments. Firstly, one need to look at what Austria has achieved so far in the use of wind energy. The country has exploited its potential and installed 2409 MW of wind power. This amount equals 9,1% of the Austrian energy consumption" (TORNER, Michael, 2017, p. 16). Most of the wind energy is produced in the federal state of Burgenland, which is energy self-sufficient since 2013 (Energie Burgenland, 2019). Secondly Sweden is EU's quickest growing country on wind power generation. In only the last two years Sweden has increased its wind energy capacity of 1660 MW. In total Sweden reached a capacity of 6024 MW produced by wind energy. (TORNER, Michael, 2017, p. 16)

1.2 Wind energy production and its impacts on Land Use and Environmental Policies

The shift to renewable energy typically requires change in land use. Wind turbines are seen in several different contexts, onshore, as well as offshore. These relatively new changes lead to conflicts within the land uses. Spatial planning tools like Energy Maps, as well as tools like the Environmental Impact Assessment (EIA), enhance the interdisciplinary of planning tools. Wind parks offshore take up room in the sea so there are possible conflicts with marine ecology, fishing or military uses. For onshore wind parks, conflicts between arable land, forest land and nature conservation can be seen.

In order to be able to manage environmental issues, Environmental Impact Assessments (EIAs) have been implemented world-wide since the enactment of the National Environmental Policy Act (NEPA) in the United States. EIAs are needed to identify, describe and assess the direct and indirect effects of a project on the environment. Some of the factors that are assessed through the EIA are human health, biodiversity, land, soil, water,

air, climate and others. The EIA also proves the interaction between those factors referred before. ("EUR-Lex - 32014L0052 - EN - EUR-Lex," 2011).
In Europe, the approval of the European Directive on EIA in 1985 stimulated the enactment of EIA legislation in many European countries in the late 1980s(GLASSON et al., 2012, p. 40). In addition, ever since theEuropean Council meeting in Cardiff in 1998, the issue of policy integration has been widely discussed in the EU. At this meeting the European council created strategies to address environmental concern in transport, energy and agriculture (Geerlings, 2003, p. 189). Currently all EU member states have to implement European guidelines on environmental impact assessment and strategic impact assessment and adapt their national legislation. This subsidiarity of the EIA directive creates a conflict between harmonization and subsidiarity of the legislation: Too strict laws will fail to allow room for local environmental conditions, too loose laws will create different economic conditions under which companies should work in the different EU member states (Mandl, 2010, p.5). Land use policies on building restrictions for wind energy development are often used to define requirements for the spatially compatible expansion of wind energy. The development program for wind energy in the national state of Styria, Austria is one example for using a land use policy tool in order to manage wind energy production in its least harmful way. The project "Spatial Planning and Energy for communities in all landscapes" is a cooperation of the department of spatial planning and building law. The department is the responsible institution for the spatial planning on the level of municipalities for the whole province of Styria. Their goal is to deal with the ongoing development of the planning law and its spatial planning instruments and is a European partnership programme (Kiaer, 2019).

This thesis will compare the differences in EIA policies and their application in Austria and Sweden, due to differing developments of Environmental Impact Assessments in the two European member countries. The study will discuss whether the precautionary principle, which is one of EU's most used environmental policy tools, performs as it is supposed to in the respective countries. The principle's idea is to prevent harm before a hazard has com existence.

2 State of knowledge

2.1 Legal bases of nature conservation law and protection requirements in the EU

The legal base of nature protection law in the EU is article 192 of the TFEU (Treaty on functioning of the European Union). Endangered species need protection from wind park development. Thus, one must investigate nature conservation laws of birds and bats. In this matter the EU and its member states share competence to tackle the issue of species extinction on a bigger scale. The respective directives are called the EU Flora-Fauna-Habitat directive, as well as the EU Birds directive. They aim to protect all about 500 wild bird species and a wide range of rare, threatened or endemic animal and plant species which are naturally occurring in the European Union, to ensure nature conservation and to achieve "no net loss" of species. The EU Flora-Fauna-Habitat directive and the EU Birds directive are the base of EU nature conservation law. The examination of the threatened species is implemented by the 9 Austrian federal nature conservation laws. In Sweden the Species Protection Ordinance (2007:845) contains the equivalent law. There are environmental testing obligations a stakeholder might face while constructing wind parks, or single wind turbines to ensure that all environmental impacts are analyzed. The strategic environmental assessment (SEA) applies in decision making processes and aims to ensure that environmental and possibly other sustainability aspects in policy, plan and programme making are considered (Fischer, 2007, p. 6.). All questions of species protection law for the approval of wind turbines shall be considered under these laws mentioned.

2.2 The impact of wind energy production from wind turbines on bird and bat fauna

Wind energy production has an influence on wildlife. Mostly birds and bats are affected by wind turbines in their natural habitat. The rotor blades of wind turbines are big obstacles for those species. Even indirect impacts of wind turbines can be seen, through forest cleaning, description of habitats and cutting of flyways for migrating species. Experts underline that fatality rates of bats can outnumber those of birds at most wind energy facilities" (Schuster et al., 2015, p. 301). Research on the impact of wind turbines on birds and bats have increased until today. The knowledge of impacts of wind turbines on bats is a rather new field in science and therefore knowledge in this field is still increasing into the possible. Birds show an average fatality rate of median "6,5 animals per wind turbine and year in Europe and median 1,6 animals per wind turbine and year in North America "(Rydell et al., 2012, p 28). Rydell explains that in North America most of the birds are located in various types of grassland usually at rather high elevation, while for Europe most estimates refer to sites in agricultural areas near wetlands or at the coast. Such areas usually harbor higher densities of birds than uplands. The development in the wind turbine sector designs even taller wind turbines with even longer rotor blades. In this height above 100m migratory birds are moving. "But analyses of larger wind turbines from the Netherlands, Belgium and Germany resulted in the same conclusion, namely that the danger to birds does not depend on the height or the sweep area of the turbines" (Rydell et al., 2012, p. 28). In general, it can be said that larger plants produce more electricity than smaller ones and in addition do not kill more birds. Spellman (2015) also states that motion smear, which happens when a bird is approaching a moving blade under high wind conditions is unable to see the blade, will be killed by the blade and noise of the turbines themselves which also leads to fatality rates of birds.

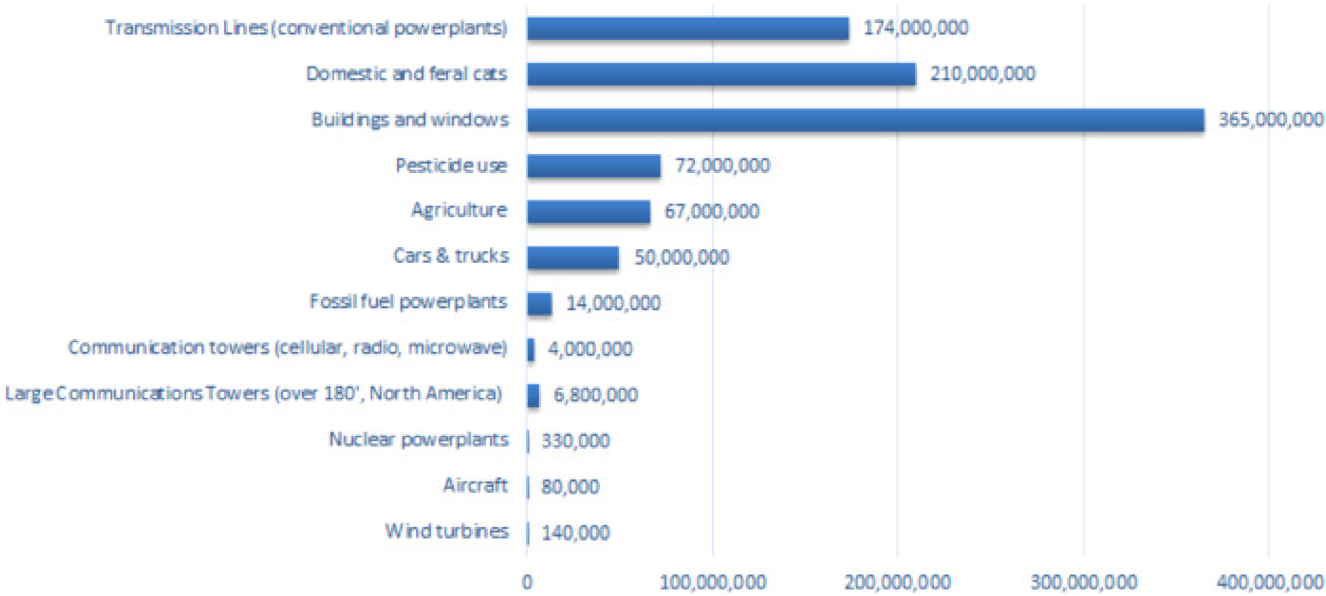


Figure 4: Annual avian mortality in the USA, Numbers show the lowest values when a range of estimates is given, Wang (2015)

Bats are vulnerable to wind turbines. They are facing a number of threats from wind turbines, "effects resulting from direct or indirect contact with moving turbine blades, causing lethal or sub-lethal injuries and barotrauma" (Schuster et al., 2015, p. 301). "Barotrauma involves tissue damage to air-containing structures caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation" (Baerwald et al., 2008). Bats are killed more frequently at wind farms located along coast lines or on tops of hills and mountains in forested areas. Rydell explains that analysis showed that bats fatality rates in forest areas in Northern Europe show 18 bats annually, but generally, the fatality rates in agricultural land are much lower with 1.8 bats per turbine annually. On average it is seen that 2,9 bats per year get killed by wind turbine. As soon as the agricultural areas shows more variation in topography and vegetation the fatality increases. Mortality rates of bats especially increase with the height as more insects for feed are available in this higher area.
Larger wind parks can show a significant influence on bird and bat populations. It is necessary to study possible impacts in detail. It is crucial to achieve the best possible solution to minimize the impact of wind turbines on bird and bat fauna (Baerwald et al., 2008, p. 1) "Unfortunately, the environmental policies which support renewable energy and those which protect wildlife are not coherently aligned. As climate mitigation efforts trigger renewable energy development, but then face substantial barriers from biodiversity protection instruments and practices" (Köppel et al., 2014, p. 1) ". The European environmental agency states that the number of bird species whose population are observed to be negatively impacted by climate change is three times larger than those observed to be positively affected looking at the number of widespread European land bird(European Environmental Agency, 2009). The effects of climate change for some migratory bird species may be most severe outside their European range and a comprehensive response would need to be effective beyond European territory. Therefore, all potential negative effects need to be assessed and effectively mitigated all based on our

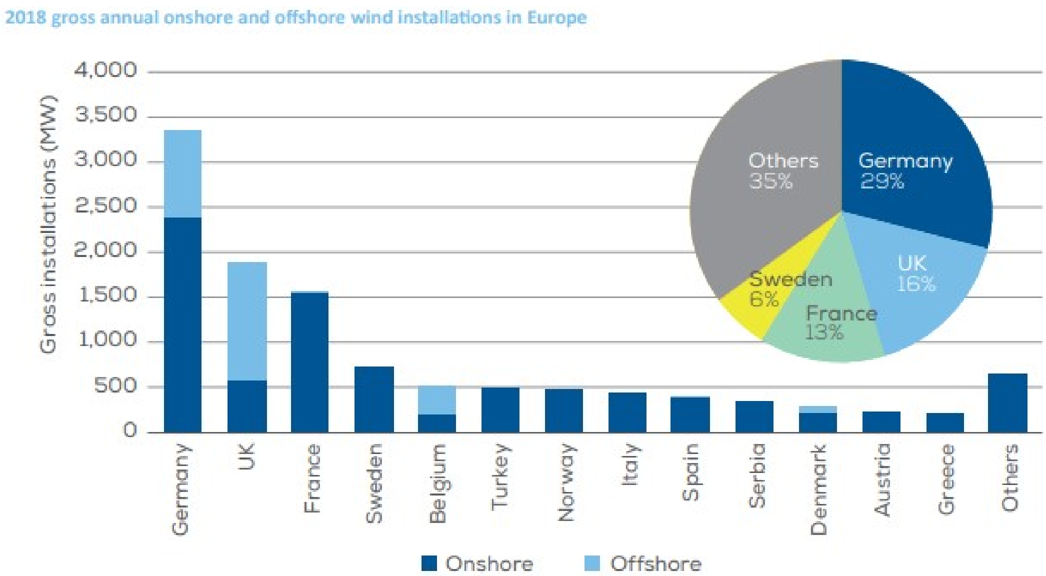
understanding of the cause and the influencing factors connected herewith "(Schuster et al., 2015, p. 321). In order to achieve similar standards in mitigation and compensation the study is analyzing how the respective countries are dealing with this challenging wildlife planning task.

2.3 Wind energy and its conflicts with nature conservation of bird-fauna and bat-fauna

Wind energy development faces conflicts often concerning flying animals, as birds, bats and insects. Those organisms could face disturbance and displacement from desirable habitat, barrier effects, collision risk as well as habitat loss or damage (Rydell 2012). As Marques et.al (2014) describes that is also the interaction that one has to look at. One need to compare the impacts of wind turbines and its cumulative effects on the wildlife of bird and bats through studies on compensation measurement of EIAs. This research aims on providing a qualitative analysis of the main effects of wind energy development onshore, focusing on frequently studied species groups as bats, breeding and resting birds, raptors and migratory birds. The literature research shows that the most important measures are avoidance measures, to avoid negative impacts on birds and bats from the beginning, as most accidents happen where birds concentrate, such as near wetlands and bodies of water, but sometimes also in elevated sites including peaks and ridges of hills and mountains.(Rydell, 2012, p. 4) Other areas of major interest for this thesis is looking into the differences of open and forested land as " in the light of experience from forestry, the risk of disturbance in forested land is considered to be very small for birds (Jönköping Län- County administrative Board, 2017). Studies described in Rydell et. al. (2012) demonstrate that from the largely forested Black Forest show that it is usually common pipistrelles and Leisler´s bats that are killed in the forested area. The difference in which species are being killed simply reflects local or regional differences in the occurrence of high-risk species. In general, as much as 98% of the bats killed by wind turbines in northern Europe belong to one of eight high risk species of Nyctalus, Pipistrellus, Vespertilio and to some extent also Eptesicus. On the other hand, Arnett (2015) states that "bats that regularly move and feed in less cluttered and more open air-space are most vulnerable to collisions with wind turbines, regardless of continent, habitat, migratory patterns, and roost preferences."
On the other hand, wind energy development supports the reduction of greenhouse gas emissions into the atmosphere, which prevents the fast progress of climate change. This is described as the green versus green dilemma. The green versus green dilemma points out that there are two distinct opinions. The proponents promote the benefits of wind energy development in reducing CO2 emissions to mitigate climate change, and opponents point to the costs involved for biodiversity and ecosystem services through land-/seascape changes (Köppel et al., 2014, p. 262). Therefore, the knowledge about the environmental impacts of wind turbines on nature conservation is constantly increasing. (see. p. 7 Miljökonsekvensbeskrivning för en vindbruksanläggning i Vaggeryds) The latest research looks at wind turbines influence on insects. The German Center for Aerospace calculates that every day from April till October millions of insects get killed through wind turbines. All in all, it sums of to 1,2 tons a year only in Germany (Trieb. F et. al, 2019).

2.2 State of knowledge: Onshore wind energy production in the EU

Windeurope (2018), who is Europe's biggest European association for the wind energy sector presents that "Europe installed 11.7 GW of new wind energy in 2018. 9 GW were onshore, and 2.65 GW were offshore. Europe decommissioned 0.4 GW of wind capacity, almost all of which was onshore wind "(WindEurope Annual Statistics, 2018, p. 8). China, the USA and Germany are the three world leading countries in wind energy development by installed capacity (Liu, 2015). This research only focuses on wind energy production with wind turbines used for onshore wind energy production. It looks into EIAs of wind turbines which need to be assessed in the EIA permit process. The study shows EIAs of wind turbines from 2003 till today. "Since the start the wind energy sector has developed, wind turbines got taller and the size of rotor blades have increased. The wind turbines built in years from 2003 till 2010 are 85m - 150m high, the wind turbines constructed from 2011 till 2018 are up to 250 m high. The higher turbines are, then those are mostly built in forested areas. 2018 has been the lowest year for new onshore installations since 2008" (WindEurope Annual Statistics, 2018, p. 8). The statistics show that Sweden is one of the countries installing the most onshore wind turbines and has a share of 6%. Germany shows the highest percentage of new wind turbine installations onshore as well as offshore. (see Figure 5: Gross annual onshore and offshore wind installations in Europe, Source: windeurope(2018))



Offshore	969	1,312	2	-	309	-	-	-	5	-	61	-	-	-
Onshore	2,402	589	1,563	717	204	497	480	452	392	356	220	230	207	706
Total	**3,371**	**1,901**	**1,565**	**717**	**513**	**497**	**480**	**452**	**397**	**356**	**281**	**230**	**207**	**706**

Source: WindEurope

Figure 5: Gross annual onshore and offshore wind installations in Europe, Source: windeurope(2018)

2.3 The impact of wind turbines on birds

Numerous effects of wind turbines are threatening the European wild bird population. A number of highly threatened species are listed in the EU- birds-directive (2009/147/EC**)** in Annex 1. The birds are disturbed by several threats, such as the risk of collision, the loss of habitat for foraging and as a mating area which can appear through direct loss of destruction of the area, as well as by causing disturbance, or effects of wind conditions and barrier effects of wind turbines which are seen especially for populations of migrating birds. Finally, it is to say that the less disturbed a natural habitat is, the higher the effects are on birds of wind farms.
For an easier evaluation of the threats that birds are facing I am going to divide the groups of birds as follows: Breeding and nesting birds, raptors, migratory birds and bats in the following chapter.

The impact on breeding and nesting birds

Breeding and nesting birds that roost around wind farms are in constant danger of the effects of wind turbines. They are affected during construction, as well as during the operational phase. Nesting species show avoidance behavior near turbines, and studies show that rather nesting birds than breeding birds are sensitive to the turbines (Schuster et al., 2015). As with other bird species, the collision risk is strongly species specific and the collision risk decreases for species that spend more time on the ground in particular Galliformes species. Land use change in the means of wind farm development has an impact on breeding birds, as their foraging areas are lost, or they can be disturbed at their mating grounds. The indirect habitat loss is mostly of greatest importance as human activity in the area increases during the construction phase, as well as afterwards. Species have to compete in a much smaller area with increased competition (Schuster at al. 2015). Schuster et. al. (2015) has reviewed more than 220 publications on effects of wind turbines on birds and bats. Therefore, Schuster et. al (2015) functions as the main source for this chapter, as they have gathered a great amount of information by several scientists in the field.

The impact on raptors

Raptors are of special collision risk due to their flight behavior and activity. Some species show a very high-risk flight behavior (e.g. circular flight, foraging, strategy,) that increases the chance of collision. Birds of prey have a high abundance on flight paths following areas with major wind currents, which are also most suitable for wind energy production, as you can find strong and steady winds in those corridors. This can lead to potential threats for raptors. Equally important it is to say that seasonal behavior and site characteristics of low flight altitude near summits and steep slopes, and low flight altitude with low air temperature influences flight activity. In a matter of fact raptors demonstrate inattentiveness during foraging and due to interaction behavior, which increases the risk of collision. There can be no difference seen between local populations and migrants in birds of prey (Schuster et al., 2015).

The impact on migratory birds

These species show differences in number of collisions with wind turbines due to migration peaks in spring and autumn. A decrease in flight altitude can be seen, if there is precipitation, headwinds and strong winds. Especially wind turbine patterns in the departure area trigger the migration activity, as tailwinds, cloud cover, low precipitation, atmospheric pressure. Temperature is an influencing factor that can be changing those other factors. Equally important is that migrating species are attracted by artificial light sources. Contradictions exist on the issue of lightning in red spectrum supporting the security for birds. Some species avoid the turbines and the areas more than others, very species-specific behavior can be observed (Schuster et al., 2015).

2.4 The impact of wind turbines for energy production on bats

All bat species are protected through the EU-Habitat Directive (92/43/EEC) as the European bat population is also strongly threatened by the fast industrial and technological development in the EU. Studies show that a wind turbine in Europe or North America kills on average 2.9 bats per year. These are median values, however, and the variation is large (0-60 birds and 0-70 bats) and the distribution uneven (bimodal). While most wind turbines actually kill none or very few birds and bats, some turbines kill many. The location of a wind park in relation to the local topography and surrounding habitat is the primary determinant of the number of birds and bats that will be killed (Rydell et al., 2012, p. 4). Several studies show that there are different groups of bats which show similar effects on wind turbines, it is rather the local differences that show different effects(Schuster et al., 2015).
With attention to bats, the mortality increases due to high flight activity with very low humidity, during late summer and autumn, during sunset and some hours after. The literature reviewed by Schuster et. al. (2015) does not see an effect of high bat mortality because of high bat activity in times of high air pressure. It is also ambiguous and not clear if the increase of temperature enhances bat activity/fatality (up to 21 degrees), that the decrease in wind speeds leads to a higher bat activity, as well as that there is a higher bat activity during moonlight nights.

Different from birds, bats have a higher risk of collision, due to their flight behavior. The flight technique of echolocation during the flight, produces an insufficient time of reaction. Bats are often active at turbine height while mating, feeding or swarming. They are so-called open foragers with narrow wings, which are more often exposed to collision. As a matter of fact, bats show an increased mortality due to attraction for prey, during the investigation of turbines as possible tree-roots and simply by the turbine structure itself, whereas it cannot be proven that bats are attracted by turbine lightning.
Moreover, there is also a lack of evidence that barotrauma, a rapid change in air pressure caused by moving blades can lead to internal injuries and accounts for the main cause of fatality, increases the risk of mortality (Schuster et al., 2015, p. 6).
The Barbastelle (*Barbastrella barbarstrellus*) belongs to the highly endangered bat species in Sweden and Austria. The Barbastelle (*Barbastrella barbarstrellus*) roosts behind loose bark and prefers mature deciduous forests. Therefore, there are often mitigation measures required for permits as the stop at low wind speeds, ≤ 5 m/s, during the most active period

of Barbastrelle (*Barbastrella barbarstrellus)* from July till September. In Austria there are also often implementations of compensation areas for Pipistrellus (*Pipistrellus pipistrellus*), Nyctalus (*Nyctalus nocturna*) and Myotis species.

Rydell et al. (2012) describes that as much as 98% of the bats killed trough wind turbines in northern Europe belong to one of eight high-risk species in the genera Nyctalus(*Nyctalus nocturna*), Pipistrellus (*Pipistrellus pipistrellus*), Vespertilio (*Vespertilio murinus*) and to some extent also Eptesicus (*Eptesicus serotinus*). And that the remaining 11 bat species which occur in Sweden comprise only 2% of the fatalities. This group includes all the species considered threatened at the European level or those listed in the Habitat Directive Annex II or IV. Much of this group consists of long eared bats (Plecotus spp.) and mouse eared bats (Myotis spp.). Some of these are among our commonest bats, while others are very rare. (Rydell et al, 2012, p. 105).

Species	Latin name	Number of dead bats			
		Sweden	Germany	Other	Total
High-risk species					
Common noctule	*Nyctalus noctula*	1	374	15	390
Leisler´s bat	*Nyctalus leisleri*	0	52	28	80
Nathusius´ pipistrelle	*Pipistrellus nathusii*	5	284	57	346
Common pipistrelle	*Pipistrellus pipistrellus*	1	230	139	370
Pygmy pipistrelle	*Pipistrellus pygmaeus*	1	21	14	36
Parti-colored bat	*Vespertilio murinus*	1	44	2	47
Northern bat	*Eptesicus nilssonii*	8	2	0	10
Serotine	*Eptesicus serotinus*	0	25	15	40
Other species					
Alcathoe whiskered bat	*Myotis alcathoe*	0	0	0	0
Greater mouse-eared bat	*Myotis myotis**	0	2	1	3
Pond bat	*Myotis dasycneme**	0	1	0	1
Daubenton´s bat	*Myotis daubentonii*	0	3	2	5
Brandt´s bat	*Myotis brandtii*	0	1	0	1
Whiskered bat	*Myotis mystacinus*	0	2	0	2
Natterer´s bat	*Myotis nattereri*	0	0	0	0
Bechstein´s bat	*Myotis bechsteinii**	0	0	1	1
Grey long-eared bat	*Plecotus austriacus*	0	6	1	7
Brown long-eared bat	*Plecotus auritus*	0	3	0	3
Barbastelle	*Barbastella barbastellus**	0	0	1	1
Unidentified		0	41	131	172
Total		**17**	**1091**	**407**	**1505**

Table 2:The distribution among species of bats found dead at wind turbines in Europe (Dürr 2009) Only species that occur in Sweden are included. It shows species that are considered threatened at the European level or listed in the Eu Habitat directive

To summarize it, there is more scientific lack of knowledge on the behavior of bats in the surrounding of wind turbines than we know about the behavior of birds in this new environment. We are lacking data on population from wind turbines. Yet we still do not know enough about the effectiveness of mitigation measures (Arnett 2015).

3 The Environmental Impact Assessment – a legal background

The environmental impact assessment is a new legal tool, which has started in the USA. “Since the enactment of the National Environmental Policy Act (NEPA) in the United States, Environmental Impact Assessment - systems have been established in various forms throughout the world. Also, in the European Union the approval of the European Directive on EIA in 1985 stimulated the enactment of EIA legislation in many European countries in the late 1980s” (GLASSON et al., 2012, p. 40). But already since “the meeting in Cardiff of the European Council 1998, the issue of policy integration has been discussed, where the European council called for specific strategies for the integration of environmental concerns into three areas of policy: transport, energy and agriculture. “(Geerlings, 2003, p. 189)

NEPA has been the first legislation to require EIAs. The policy consisted of two parts. The first one was for the protection and restoration of environmental quality and the second one to review environmental programs and its progress and to advice the president on matters of environmental protection. (GLASSON et al., 2012, p. 31 & 33)

Since that time EIA policy has spread all over the world. Glasson et al. (2012) states that by 1996 more than 100 countries worldwide have established EIA systems, first in developed countries and later also developing countries. Those EIA systems vary greatly, as in some countries EIAs only need to be applied for public projects and not to private projects, as well as some worldwide institution like the European Bank for Reconstruction and Development, UNEP, the World Bank and others set up their own guidelines for Environmental Impact Assessments.

Since the approval of an EIA directive in the EU in 1985 (GLASSON et al., 2012, p. 40), EIAs have been established in the whole European Union or, more specifically, the applicable law is to be applied to authorization procedures for certain environmentally relevant projects

3.1 The Environmental Impact Assessment in the EU – The EIA Directive (EU Directive 2011/92/EU)

The EU Directive 2011/92/EU of the European Parliament and of the Council has harmonized the principles for the environmental impact assessment of projects by introducing minimum requirements, with regard to the type of projects subject to assessment, the main obligations of developers, the content of the assessment and the participation of the competent authorities and the public, and it contributes to a high level of protection of the environment and human health. Glasson et al. (2012) raises awareness of urgent need of improvement of the EIA Directive in the matter of climate change, especially for the sectors energy and transport. In the current EIA Directive Member States are free to implement more compelling protective measures in accordance with the Treaty on the Functioning of the European Union (TFEU). (“EUR-Lex - 32014L0052 - EN - EUR-Lex,” 2011, p. 1)

3.2 Mitigation measures in the Environmental Impact Assessment

Marshall (2001) describes mitigation as any process, activity or action designed to avoid, reduce or compensate those significant adverse impacts likely to be caused by a development project. The EU EIA directive as well as NEPA have similar explanations of the term. (Marshall, 2001, p.195) In general the mitigation measures are following the mitigation hierarchy: (a) to avoid, (b) reduce/moderate/minimize, (c) to offset/ compensate. This hierarchy is followed to reach the best possible output, as a regulatory procedure in all international EIAs. Peste et. al, who has developed a methodology of comparing mitigation measures, describes that the hierarchy implies that avoidance strategies have priority over remedial ones and that those impacts that cannot be avoided or minimized need to be addressed through biodiversity offsets or compensatory measures. (Peste et al, 2014, p.11)

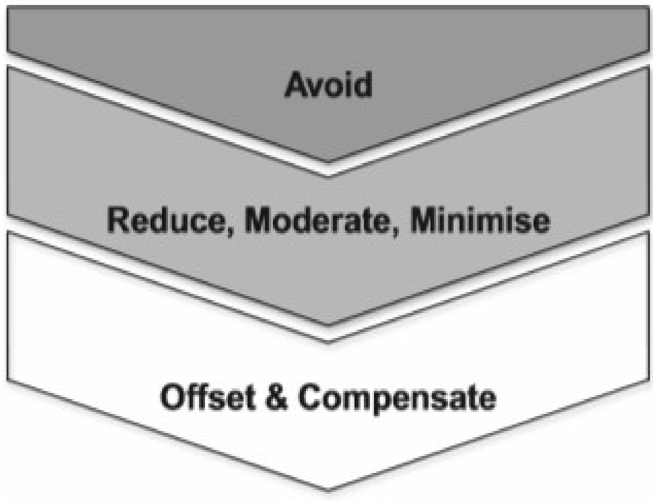


Fig 4: Peste et al, 2014, p.2, mitigation hierarchy (adapted from PricewaterhouseCoopers, 2010).

In the mitigation hierarchy compensation and offset measure are the last step of the mitigation process. If the destruction of unique habits, or irreversible loss would occur then mitigation measures could never be enough, and the project would have to be withdrawn. To describe this in more detail Glasson et. al (2012) refers to different levels of mitigation which could be: Alternatives (strategic, alternative locations and processes), physical design measures, project management measures and deferred mitigation.

3.3 Mitigation and compensation measures in the EIA Directive (EU Directive 2011/92/EU)

The EU Directive foresees mitigation in several steps of the EIA procedure. The EU Directive 2014/52/EU (35) reads as follows: “ Member States should ensure that mitigation and compensation measures are implemented, and that appropriate procedures are determined regarding the monitoring of significant adverse effects on the environment resulting from the construction and operation of a project, inter alia, to identify unforeseen significant adverse effects, in order to be able to undertake appropriate remedial action. Such monitoring should not duplicate or add to monitoring required pursuant to Union legislation other than this Directive and to national legislation.” (“EUR-Lex - 32014L0052 - EN - EUR-Lex,” 2011)
The EU legislator wants to ensure that mitigation and compensation measures are implemented and monitored but does not describe how it needs to be implemented. Therefore, the EU legislator gives the national legislation the opportunity to implement

compensation measures according to the conditions in the respective member state. Some more detailed descriptions of mitigation measures can be found in the current version of Directive 2011/92/EU in Article 5, which asks for a description of a mitigation measure and Article 9, whichs ensure that the public authority or authorities shall inform the public in accordance with the appropriate procedures. The Austrian Federal Ministry of sustainability divides the mitigation measures into three subgroups of mitigation and compensation measures:

Avoidance and mitigation measures (Vermeidung)
The aim of avoidance measures is to optimize a project in terms of its environmental impact. If adverse effects cannot be avoided, they must be reduced to an acceptable level by means of mitigation measures. Like the avoidance measures, they are primarily geared to the environmental optimization of a project. Mitigation measures usually start directly at the beginning of an impact.

Offset measures (Ausgleich)
Offset measures are intended to reduce significant impairments that remain despite avoidance and mitigation measures. The offset must be functionally, spatially and temporally related to the impaired object of protection (Federal Environment Agency, RVS Species Protection on Traffic Routes, RVS ...). The offset should be as similar as possible to the impaired functions and values or contribute to the improvement (e.g. in the case of loss of forest, substitute afforestation with locally suitable tree species) and restore the lost ecological functions at the site of the intervention.

Compensation measures (Ersatz)
Compensation measures should only be implemented when all possible avoidance, reduction and offset measures have been exhausted and considerable and lasting impairments still remain. In contrast to offset, compensation measures have a lighterfunctional, spatial and temporal reference. The effects of the intervention are compensated elsewhere (e.g. compensation for the loss of a wetland biotope by setting up a different type of biotope. The term "compensation measures" includes both compensatory and offset measures, also in this thesis, as the literature often talks about both and does not always clearly distinguish between them; they can be implemented through project measures and official requirements. Other legislators, as the US for example defines in its US Business and Biodiversity Offset Program Biodiversity offsets as “measurable conservation outcomes resulting from actions designed to compensate significant residual adverse impacts on biodiversity, after appropriate prevention and mitigation measures have been taken (Peste et al., 2014, p11).

3.4 Main Alternatives

Furthermore, the developer of a wind energy project which requires an EIA needs to provide, alternatives for the projects for which it intends to submit an application. In particular Art. 5 § 3 d of the EU Directive 2011/92/EU states that “an outline of the main alternatives studied by the developer and an indication of the main reason for his choice, taking into account the environmental effects;”.

In the case of wind energy development, Sweden established a well thought spatial planning scheme for wind energy development which helps the operator to decide on a site for the projects as well as for possible alternatives. Some Austrian federal States also implemented a spatial planning scheme for wind parks. This makes it sometimes easier to find possible locations for wind energy projects and alternative projects. Otherwise it is more difficult to argue for alternatives in the surrounding area, as they could be outside the special wind energy development zone.

3.5 The necessity of an EIA according to the EU directive

In accordance with Article 4 (1) of the EIA Directive, Annex I projects are in principle subject to an examination in accordance with Articles 5 to 10. For projects listed in Annex II, which wind farms are included in, Member States shall determine whether the project shall be made subject to an assessment in accordance with Articles 5 to 10. Member States shall make that determination through (a) case-by-case examination; or (b) thresholds or criteria set by the Member State. Member States may decide to apply both procedures referred to in points (a) and (b). Annex II 3. (i) thus, establishes the EIA requirement by case-by-case or thresholds or criteria set by the Member States at Installations for the harnessing of wind power for energy production (wind farms). Austria as well as Sweden sets thresholds and criteria for the installation of wind farms. Those criteria are set differently in those two Member States. The EU Directive 2011/92/EU is covered by the Federal Act on Environmental Impact Assessment (Environmental Impact Assessment Act 2000 – UVP-G 2000 (Federal Law Gazette No. 697/1993 in the current version Federal Law Gazette I. No. 80/2018) in Austria and the Swedish Environmental Code (SFS 1998:808) as well as the Ordinance on Environmental Impact Assessments (SFS 1998:905).

3.6 The implementation of EIAs in Austria: Federal Act on Environmental Impact Assessment (Environmental Impact Assessment Act 2000 – UVP-G 2000)

In Austria we have around 136 EIAs from the start till the year 2005, whereas 25% of the projects are handed in the energy sector. (Umweltbundesamt, 2006, p. 23) In the last years from 2009 till 2016 it has been 238 EIAs (Umweltbundesamt, 2017), which is a slight increase in the number of new EIA applications. The UVP-G 2000 states that the duration of the procedure until the approval in Article 7 of the EIA-2000, that itmust be done without undue delay, but as a matter of principle they should be completed in a simplified procedure after a maximum of 9 months or 6 months. In the year 2016, the median duration of the EIA procedure, was 17.9 months for all EIA procedures (EIA procedures and simplified procedures) from the introduction of the application for approval to the approval decision for 18.4 months: in simplified procedures 18.4 months. From the start of the public circulation (completion of the documents) to the approval decision, the average duration of the proceedings is reduced to approximately 9 months (8.8 months for EIA procedures and 8.9 months for simplified procedures) (Umweltbundesamt, 2017).

Almost all projects concerning Environmental Impact Assessments of wind turbines are located in the east of Austria, in the states of Burgenland, Lower Austria and Styria, as seen below. The Austrian Federal Act on Environmental Impact Assessment (Environmental Impact Assessment Act 2000 – UVP-G 2000) in the current version of the federal law gazette BGBl. I Nr. 80/2018 from 30/11/2018 is the regulatory framework for Environmental Impact Assessments in Austria. In Article 1. (1) UVP-G 2000 it states “the purpose of an environmental impact assessment (EIA) shall be, with public participation and on a basis of expertise,
1. to identify, describe and assess the direct and indirect effects that a project will or may have on a) human beings and biodiversity including, animals, plants and their habitats b) on surface and soil, water, air, and climate, c)on the landscape, and d)material assets and the cultural heritage, including interactions of several effects,
2. to examine measures that prevent or mitigate harmful, disturbing or adverse effects of a project on the environment or that enhance its beneficial effects,
3.to document the advantages and disadvantages of the alternatives examined by the project applicant as well as the environmentally relevant advantages and disadvantages of not proceeding with the project, and
4.to document the environmentally relevant advantages and disadvantages of the alternative sites or routes examined by the project applicant in case of projects for which the law foresees compulsory purchase. “
The protection of the fauna of birds and bats is therefore one of the goals of the UVP-G 2000 and measures that prevent or mitigate possible harmful, disturbing or adverse effects needs to be insured. In Article 6 (5) of the UVP-G 2000 a more detailed description of those measures envisaged to prevent, reduce or, where possible, offset any significant adverse effects of the project on the environment is described. Also, Article 17 (4) of the UVP-G 2000 specifies this condition as follows: “The decision shall take account of the results of the environmental impact assessment (in particular, environmental impact statement, environmental impact expertise or summary assessment, comments, including the comments and the results of the consultations according to Article 10 and, if applicable, the

results of a public hearing). The specification of suitable obligations, conditions, deadlines, project modifications, offsetting measures or other requirements in particular with regard to monitoring for significant adverse effects, measuring and reporting duties shall contribute to a high protection level for the environment in its entirety.”

In case the project does not reach all the requirements for approval (if the project fails to meet certain development consent requirements to such an extent that these deficiencies cannot be remedied by specifying obligations, conditions, deadlines, project modifications or offsetting measures, the application shall be rejected at any point in the procedure which is stipulated in Article 5 (6) of the UVP-G 2000.

Competent authority for the approval of projects with the duty of EIA in Austria in the first instance is the respective federal government (Landesregierung) of the affected federal state (Art 39 (3) UVP-G 2000). Their decisions can be challenged at the Federal Administrative Court (Art 40 UVP-G 2000). Thereafter there is basically the possibility of a further instance to the Constitutional and / or Administrative Court.

The UVP-G-2000 provides as the duration of the procedure until the approval in Article 7 of the EIA-2000, that this must be done without undue delay, but as a matter of principle they should be completed after a maximum of 9 months or in a simplified procedure after a maximum of 6 months.

The bird and bat fauna which is protected through the UVP-G is defined in detail by the 9 Austrian federal states nature conservation laws, by the Austrian legislator.

The nine Austrian state laws for Nature conservation

For a better understanding, it should be pointed out that the approval procedure under Article 3 (3) UVP-G 2000, the authority must apply all the other relevant material licensing provisions (eg water law, forestry law and, in particular, nature conservation regulations - “Concentrated Procedure” in the EIA).

Due to the nine-federal principles in Austria and the associated responsibility of the federal states there are 9 different nature conservation laws. On the one hand the Nature Conservation laws of Burgenland, Carinthia, Vorarlberg and Salzburg demand for compensatory measures if necessary. Only the Salzburger Naturschutzgesetz 1999 is also requesting for offset measurements. See in the Table 3 below how they are defined in the different states.

The approval provisions of the respective Nature Conservation Act must be into the concentrated approval procedure by the EIA.

The Styrian Nature Conservation Act

The Styrian Nature Conservation Act has been last changed in 2017 thus is one of the newest Nature Conservation laws in Austria. Its goals in Article 2 (1) are the protection of biodiversity of native flora and fauna and of fungi. If this biodiversity could be diminished Article 27 (4) gives the possibility to require compensation measures, if they lead to an improvement of the ecosystem. In Article 27 (5) the legislator as well gives the possibility of compensation payments to the federal state, which needs to be used for the achievement of the objectives of the nature conservation Act.

The Lower Austrian Nature Conservation Act

The Lower Austrian Nature Conservation Act has been last amended in 2017. Its goals in Article 1 (NÖ NSchG 2000) are the protection of nature in all its manifestations, to maintain and restore its ecological functions. Article 7 (NÖ NSchG 2000) describes the authorization requirements in which compensation and offset measurements are mentioned. Then Article 10 (7) relates to the authority which shall prescribe all necessary compensatory measures to ensure that the global coherence of Natura 2000 is protected. In detail the regional government may also compile a compensatory area register in which the data relating to compensatory areas are recorded and kept evident (see Article 32 (4) Lower Austrian Nature Conservation Act).

Burgenland Nature Conservation and Landscape Management Act

In spite of the last Nature Conservation Acts of Styria and Lower Austria, the Nature Conservation and Landscape Management Act of Burgenland from 1990 is rather old. Its goals set out in Article 1 of the Burgenland Nature Conservation and Landscape Management Act are the protection and maintenance of nature and landscapes in all forms. Moreover, it protects diversity, uniqueness, beauty and recreational value of nature and landscape, as well as the undisturbed structure of the life cycle of nature and the species richness of native flora and fauna and their natural habitats and bases of life. § 6a underlines compensatory measures, as more specified in § 51a, whereby provision is to be made for interventions - subject to availability and economic reasonableness - to be compensated in kind in the project area or, if possible, in spatial proximity in the same, similar or other manner. Furthermore Article 10 (2) describes the possibility of compensatory payments corresponding to the costs of obtaining a suitable replacement habitat. Article 10 (3) outlines that the amount of money shall be described by the authority and the money shall be used by the federal state government for projects concerned to improve the ecological infrastructure or in connection with near-natural forms of recreation, education or environmental education.

Nature Conservation Act	**Year**	**Goals**	**Compensation Measures**	**Compensation Payments**
Styrian Nature Conservation Act	2017	Protection of biodiversity of native flora and fauna and of fungi	yes	yes
Lower Austrian Nature Conservation Act	2017	Protection of nature in all its manifestations, to maintain and restore its ecological functions	yes	no
Burgenland Nature Conservation and Landscape Management Act	1990	Protection and maintenance of nature and landscapes in all forms	yes	yes
Vienna Nature Conservation Act	1998	Protection and maintenance of nature in all its manifestations and to ensure the sustainable functioning of urban ecology by setting the necessary conservation, supplemental and renewal measures.	yes	no
Upper Austrian Nature and Landscape Protection Act	2001	preservation, shape and maintenance of the life and appearance of native nature and the biodiversity of native flora, fauna and fungi and its natural habitat	yes	no
Carinthian Nature Conservation Act	2002	Protection of nature in its diversity, character and beauty and the biodiversity of native flora and fauna and their natural habitats, and sustain an undisturbed structure of the	yes	yes

		natural balance of life.		
Salzburg Nature Conservation Act	1999	Protection and the care of the native nature and the man-made cultural landscape and the biodiversity of the native flora and fauna and the performance and self-regulating capacity of nature	yes	yes
Tirol Nature Conservation Act	2005	protection of nature in its diversity, character and beauty, and its recreational value, and the biodiversity of native flora and fauna and their natural habitats, and a natural balance	yes	(yes)- due to environmental fees
Vorarlberg Nature Conservation and Landscape Development Act	1997	natural habitat, needs to be preserved and developed and, where necessary, restored in such a way ecosystem functions, and fauna and flora, including their habitats and habitats (biotopes) are protected as well as the diversity, uniqueness and beauty of nature and landscape are preserved	yes	yes

Table 3: The 9 Austrian nature conservation acts, 2019, Andresek

The Table shows the divers regulations on compensation in the respective laws of nature conservation in Austria. Some Acts are more focused on nature conservation and its biodiversity and some more on the recreational value for humans and its beauty. All Acts include a form of compensation measure, some only in spatially related areas, some in more distant areas and some allow implementation of compensational payments.

3.7 The EIA of wind parks in Austria

Not for all types of wind parks an EIA is required. Small wind turbines, depending on the affected federal state, only require permits in accordance with the building regulations, the electricity industry laws and, if applicable, nature conservation laws of the individual federal states or are only subject to a duty of disclosure. In the implementation of Article 4 (2) of the EIA Directive, Austria has in principle set thresholds and, in addition, has established a case-by-case assessment for an offense. According to UVP-G 2000 Annex 1 p 6 wind turbines with a total electrical power of at least 30 MW or with at least 20 converters with a nominal capacity of at least 0.5 MW each have to be subjected to an environmental impact assessment. (a.) Also wind turbines for the use of wind energy above an altitude of 1,000 m with a total electrical power of at least 15 MW or with at least 10 converters with a rated power of at least 0.5 MW each shall be subjected to an EIA. (b.) These two facts were thus implemented using a threshold concept.

It should be noted here that all procedures are to be carried out in the so-called “simplified procedure”, which means that according to Article 12a UVP-G 2000, in contrast to the "full" EIA, no environmental impact expertise has to be prepared, but only a summary assessment. It thus also eliminates the procedural step of the mandatory edition of the Environmental Impact Assessment for the public. The procedure should be completed without undue delay, no later than six months after the submission of the application, in accordance with Article 7 (3) UVP-G 2000.

Wind turbines in protected areas of category A with a total electrical power of at least 10 MW or with at least 10 converters with a nominal power of at least 0.5 MW each require a case-by-case check with regard to the EIA requirement. Special protection areas of category A are Pursuant to Council Directive 79/409/EEC on the conservation of wild birds (Birds Directive), OJ No. L 103/1, as last amended by Council Directive 94/24/EC of 8 June 1994, OJ No. L 164/9, as well as pursuant to Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitat Directive), OJ No. L 206/7; protection areas included in the list of sites of Community importance pursuant to Article 4 (2) of this Directive; forest reservations pursuant to Article 27 Forestry Act);

Specific areas designated national parks 1) under Land law, precisely delineated areas designated for nature conservation purposes by administrative act, similar small-scale protection areas designated by ordinance or designated unique natural phenomena;

UNESCO world heritage sites registered in the list pursuant to Article 11 (2) of the Convention Concerning the Protection of the World Cultural and Natural Heritage (BGBl. No. 60/1993).

The implementation of the case-by-case examination is governed by Article 3 (4) of the UVP-G 2000: “*In case of projects for which a threshold value is defined for certain protected areas in Column 3 of Annex 1 and, if this criterion is fulfilled, the authority shall decide on a case-by-case basis, taking into consideration the extent and lasting effects of the environmental impact, whether significant adverse effects are to be expected for the protected habitat (Category B of Annex 2) or the protection purpose for which the protected area has been established (Categories A, C, D and E of Annex 2). In this examination, protected areas of Category A, C, D or E of Annex 2 shall only be considered if they have already been designated or included in the list of sites of Community importance (Category A of Annex 2) on the day when the procedure is initiated. If such adverse effects are to be expected, an environmental impact assessment shall be performed. Paragraph 7 (Declaratory procedure)*

shall be applied. When taking the decision on a specific case, the authority shall take into consideration the following criteria:
1. Characteristics of the project (size of the project, cumulation with other projects, use of natural resources, production of waste, environmental pollution and nuisances, risk of accidents),
2. Location of the project (environmental sensitivity considering existing land use, abundance, quality and regenerative capacity of natural resources in the area, absorption capacity of the natural environment, historically, culturally or architecturally important landscapes),
3. Characteristics of the potential impact of the project on the environment (extent of the impact, transboundary nature of the impact, magnitude and complexity of the impact, probability of the impact, duration, frequency and reversibility of the impact) as well as the change in the environmental impact resulting from the implementation of the project as compared with the situation without the implementation of the project. In case of projects falling under Column 3 of Annex 1, the changed impact shall be assessed with regard to the protected area.
The case-by-case examination shall not be carried out if the project applicant requests that an environmental impact assessment be performed."

Amendments UVP-G 2000 in 2018

In the initial stage of the thesis the Case Studies are based on the UVP-G 2000 and before. During this phase of writing this research amendments have been made in December 2018 with Federal Law Gazette I No. 80/2018. This chapter explains some of the changes of the amendments to the UVP-G 2000 which are relevant for the construction of wind parks and compensation measures of birds and bats in case of those EIAs. The Austrian Parliament has published explanatory notes on the draft of the UVP-G Amendment 2018, which function as the main source of information for this chapter.

The now current facts for the EIA obligation (in particular new thresholds) were already considered in their description above - as were all legal citations in the version of the cited amendment.
Screening- Procedure
Firstly the Screening procedure should be made more transparent and criteria should be updated to be applied by the authority. The documents to be submitted by the project applicant will be described in more detail.

Extension of the area of assessment
Regarding Article 1 (1) a.) and b.): As a reaction to new environmental policy challenges, the areas of assessment in the EIA Amendment Directive were extended within the framework of the EIA procedure. Topics such as resource efficiency, climate change or disaster preparedness are to be given greater consideration in future. The impact of projects on biological diversity, and land use and - where relevant - on climate change must now be explicitly assessed and the disaster risks of a project taken into account. The new terminology for "flora and fauna" as a protective good focus now on "biodiversity" and is therefore broader, as biological diversity is the variability among all living organisms from all sources and the diversity of ecosystems.

“Lawyer of site”- “Site attorney”

Regarding Article (6) a “lawyer of site” needs to be granted party status in EIA proceedings. Therefore, a definition for a lawyer of site is inserted with the definitions analogous to the environmental lawyer and its party status is embodied in Article 19 (1) line 8 and (12).

Compensation measures and compensatory areas

Regarding Article 6 (1) und (2) During the time of the environmental impact declaration preparation, detailed information on compensation areas is often not possible, or only possible with difficulty, on parcels of land. Changes have been made, so that areas covered by measures and the impact objectives for the planned compensation areas are to be described. The municipalities in which only compensatory measures are carried out are not to be regarded as siting municipalities. Therefore, the project documents do not have to be published in these municipalities and no party positions of these municipalities are justified.

Aftercare

Article 6 (1) subparagraph (5) now also requires the follow-up phase to be described for most projects. It can be seen from the explanations that a description of the aftercare phase is necessary for projects with shorter lifetimes or predicted end of operation (e.g. tag structures, possibly wind turbines)

Completion of the preliminary proceedings on individual sub-areas

Regarding Article 16 (3).: In the explanations on the AVG (General Administrative Procedure Act 1991)-Amendment, it is clarified that the investigation procedure can be closed (separately) with regard to each case. Due to the complexity of EIA proceedings, the conclusion of the investigation procedure can be restricted to individual sub-areas of the case if those sub-areas are ready for decision.

Environmental Non- Governmental Organization (NGOs)

Regarding Article (9) all NGOs must submit suitable documents showing that the recognition criteria pursuant to (6) are still met, not only at the request of the Federal Minister for Sustainability and Tourism, but also every three years from the date of approval. This provision is intended to ensure ongoing transparency.

Responsibility for conduct of proceedings

Regarding Article (4) following the decision of the Administrative Court of 29.03.2017 it has decided that in view of the unity of the project, a competent authority must carry out the procedure under the EIA Act 2000, applying all the provisions governing this uniform project, over the Federal State Borders. The EIA authority in whose federal state the main part of the project is located is responsible. The Parliament explained the decision with an example for wind energy. “A wind energy project whose wind turbines are located in one federal state, while the grid line and feed into the grid take place in another federal state. Here, the wind turbines represent the main part of the project. If the wind turbines of a wind farm are located in both federal states, the main part of the project is located in the federal state in which the majority of the wind turbines are located. “(Parliament, explanatory notes Draft UVP-G Amendment 2018)

Climate protection targets

With regard to the climate protection goals, the expansion of renewable energy sources should be accelerated in Austria ((Government bill on the draft of the UVP-G amendment 2018, on Z 50, Z51 and Z 52 of Annex 1)

Regarding appendix 1.6: The expansion of renewable energy sources is to be accelerated. The wind turbines increased in capacity (the capacity of individual turbines is currently up to 3.3 MW and will continue to increase), the threshold values for the total electrical output will be increased. Since in recent years more and more wind power plants have also been erected at higher locations, a newly worded lit. b) now additionally refers to wind power plants at altitudes above 1,000 m above sea level. At these locations, a high degree of exposure and visibility of the turbines can be assumed, and effects on the habitats of endangered animal species and on bird migration can also be relevant.

<u>New thresholds for the EIA requirement of wind turbines</u>
The threshold values to be applied from Annex I Z 6 (a) of the UVP-G 2000 have already been mentioned above. Thus, in systems according to Annex I Z 6 (a) UVP-G 2000 instead of a total electrical capacity of 20 MW now perform only at a total output of 30 MW, an EIA now. New introduced were Annex I 6 (b) UVP-G 2000 with new installations for the use of wind energy above 1,000 m with a total electrical output of at least 15 MW or at least 10 converters with a nominal output of at least 0.5 MW each. The former subparagraph (b) has now become subparagraph (c), in which the total electric power threshold has been raised from at least 10 MW to 15 MW.

The law says to raise the thresholds:
"*With regard to the climate protection goals, the expansion of renewable energy sources should be accelerated. The situation for wind turbines was introduced in the year 2000. Due to the significantly increased capacity (the capacity of individual plants is currently up to 3.3 MW and will continue to increase), the thresholds for total electrical power will be increased. As in recent years, wind turbines are increasingly being built at higher elevations, is with a recast subparagraph (b) now additionally parked on wind turbines at altitudes above 1,000 m above sea level. At these locations is of a high level of exposure and Visibility of the installations and, in addition, impacts on the habitats of endangered species and bird migration may be relevant.*"

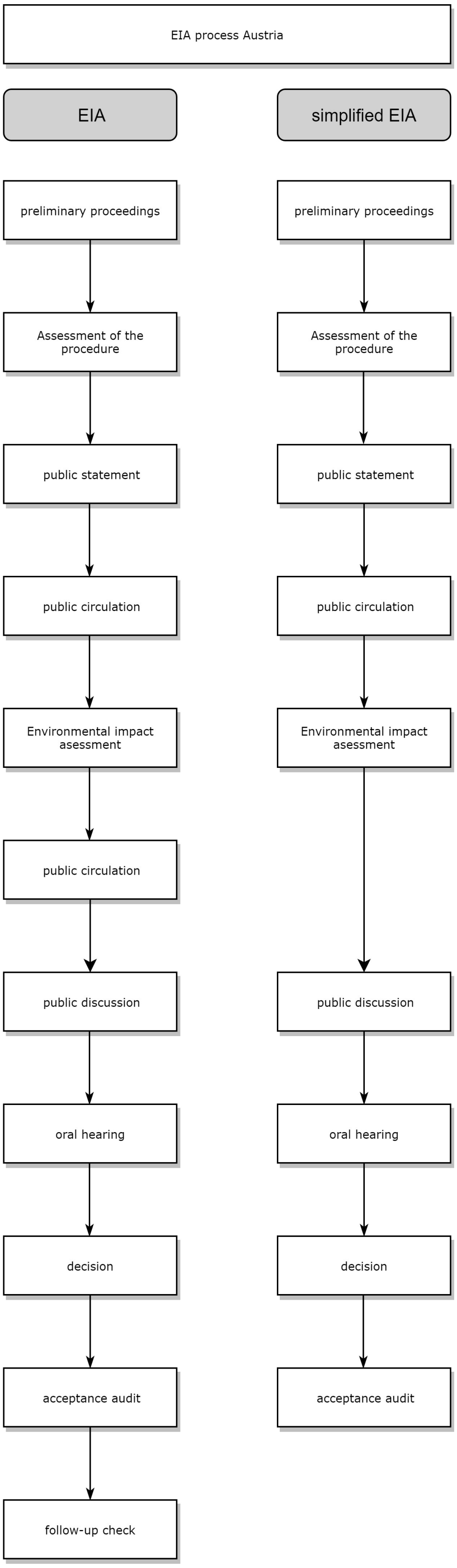


Figure 6:Process of EIA in Austria, source: Umweltbundesamt Austria(2019) Translation: Andresek (2019)

The process of EIA for Wind parks in Austria

In Austria the project developer for a wind energy project must apply with an environmental impact statement. This must describe the project, the most important alternatives examined, the effects of the project on the environment and the measures taken to avoid or reduce these effects. In the next steps the documents submitted will be made available for public inspection for at least six weeks in the local municipality and at the responsible EIA authority. The public must be informed of the public requirements. During this time, anyone can comment on the project. This will be evaluated by experts in all fields. The assessment has to be carried out with regard to the approval criteria of the UVP-G 2000 and results in the preparation of a comprehensive environmental impact assessment. When the assessment is done an oral hearing will be conducted, where parties can present their interests. Finally, the EIA decision authority, the state government for wind energy projects, decides on the application and the decision.

Most wind energy developments are going threw the simplified procedure. Those projects are facing the same ecological requirements than the normal procedure.

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3.8 The implementation in Sweden: Environmental Code (SFS 1998:808) and the Swedish Regulation (1998: 905) on environmental impact assessments.

There is no data available on how many EIAs in the energy sector have been successfully finished. A report from the Swedish federal ministry for environment gives more insight on the average duration of an EIA. 50. It is written that it is “almost impossible to state a meaningful average duration of transboundary EIA procedures. For the period 2006-2009 it is impossible because the main part of the cases is still pending, waiting for the final decision, even if the EIA-process is completed. The longest duration of procedure so far as was from 13 December 2005 until the decision in 2012. Usually the procedures as a whole, including the final decision, can be estimated to take between two and three years. But there are many examples when the duration is longer. (Sten Jerdenius, 2010, p.13)
The European EIA directive is mainly implemented by the Environmental Code (SFS 1998:808) and the Ordinance on Environmental Impact Assessments (SFS 1998:905). Those two acts give the legal base of the implementation of the EU- directive on EIA in Sweden. The acts set a framework for the implementation, as well as the Förordning (1998:905) om miljökonsekvensbeskrivningar (Ordinance on environmental impact assessments), which is the Swedish Regulation (1998: 905) on environmental impact assessments. Prior 1998 the Environmental Code was disseminated over 15 different laws for different industries.

The Environmental Code (SFS 1998:808)

The Swedish Environmental Code was adopted in 1998 and entered into force 1 January 1999.
The Objectives and area of application of the Environmental Code are explained in chapter 1. The purpose of this Code is to promote sustainable development which will assure a healthy and sound environment for present and future generations. Such development will be based on recognition of the fact that nature is worthy of protection and that our right to modify and exploit nature carries with it a responsibility for wise management of natural resources.
The Environmental Code explains that it “shall be applied in such a way as to ensure that:

- 1. human health and the environment are protected against damage and detriment, whether caused by pollutants or other impacts;
- 2. valuable natural and cultural environments are protected and preserved;
- 3. biological diversity is preserved;
- 4. the use of land, water and the physical environment in general is such as to secure a long-term good management in ecological, social, cultural and economic terms; and
- 5. reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles. “

The Environmental Impact Assessment is addressed in Chapter 6 of the Swedish Environmental Code. The first aspect to point out is the purpose of an EIA described in Section 3 that “it is to establish and describe the direct and indirect impact of a planned activity or measure on people, animals, plants, land, water, air, the climate, the landscape and the cultural environment, on the management of land, water and the physical environment in general, and on other management of materials, raw materials and energy. Another purpose is to enable an overall assessment to be made of this impact on human health and the environment. The purpose of an environmental impact assessment involving an activity covered by the Act (1999:381) on Measures to Prevent and Limit the Consequences of Serious Chemical Accidents, is also to identify and assess factors surrounding the activity that may affect its safety (Law 1999:385).

Courts
Regarding Chapter 20 of the Environmental Code of Sweden it is stated in Chapter 2 that the environmental courts shall be the first instance for the hearing of cases concerning compensation for environmental damage and others. The judgment granting a permit (Section 25) for an activity shall, where appropriate, include provisions concerning the liability for compensation or for implementing preventive measures and the manner of payment; as well as the obligation to pay charges or fees and set any conditions that are necessary to prevent or limit any harmful impact or other detriment. In addition, the code explains (Section 27) that if the effects of the activity cannot be predicted with sufficient certainty, the environmental court may, in granting permission for the activity, postpone the question of compensation or other conditions until information is available about the effects of the activity.

The Ordinance on Environmental Impact Assessments (SFS 1998:905)
The Swedish Regulation (1998: 905) on environmental impact assessments

Regarding Chapter 6 Section 3 of the Ordinances the purpose of the environmental impact assessment is to establish and describe the direct and indirect impact of a planned activity or measure on people, animals, plants, land, water, air, the climate, the landscape and the cultural environment, on the management of land, water and the physical environment in general, and on other management of materials, raw materials and energy. Another purpose is to enable an overall assessment to be made of this impact on human health and the environment.

3.9 The necessity of an EIA for wind parks in Sweden

According to Chapter 9, Section 1 of the Environmental Code (1998: 808), an activity is classified as dangerous for the environment if it causes: "Use of land, buildings or facilities in such a way as to cause detriment to the environment by noise, damage, light, ionizing or non-ionizing radiation or the like." Central to the thesis is that a wind farm is regarded as hazardous to the environment because it emits noise, shadows and causes visual impact. Shadows and visual effects are contained in the text "Other similar" in the above-mentioned provision (cf. Jönköping Län- County administrative Board, 2017, p. 6).
Equally relevant to the issue is that the Swedish Environmental Code describes the necessity of giving energy production and especially of renewable energy sources a stronger point in the legislation as it is written in:” Persons who pursue an activity or take a measure shall conserve raw materials and energy and reuse and recycle them wherever possible. Preference shall be given to renewable energy sources.” (Environmental Code, p.13)

Regarding Chapter 17 rules for permissibility in which wind farms consisting of clusters of three or more wind turbines with a total output of net loss than 10 MW (megawatt) need an EIA.

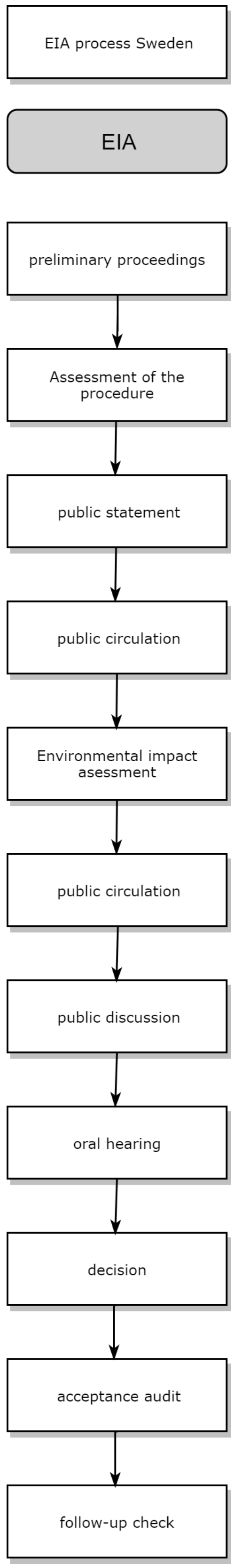


Figure 7: The EIA process in Sweden, Andresek (2019)

Furthermore Chapter 9 , sections 10-12 of the Ordinances set some rules of classification, depending on size, the facilities are divided into two types of license (B large facility and C medium sized facility) with three different business codes:

B For a wind power establishment for two or more turbines, where each turbines has a total height exceeding 150 meters, permission must be sought from the county administrative board (40.90)

B For a wind power installation of seven or more turbines, where each turbine has a total height greater than 120 meters, permission must be sought from the county administrative board (40.95)

C For a wind power establishment for one or more turbines, where each turbine exceeds 50 meters, a notification must be made in time to the municipal environmental committee (40,100). In this case no Environmental Impact Assessment is needed.

Large wind farms (business code 40.90 and 40.95) are subject to permission. The permit examination is carried out by the County Administrative Board's environmental assessment delegation, but the facility must also be approved by the municipality in accordance with Chapter 16. 4§ Environmental Code. The County Administrative Board may not take a decision in the trial before the municipality has given its approval. No building permit is required to construct a wind turbine if the work is covered by a permit under the Environmental Code, as the same test is usually carried out on a license application. A detailed plan may be required by the municipality if wind turbines are to be built in an area where there is a high demand for land (Jönköping Län- County administrative Board, 2017, p. 6).

3.10 The process of EIA for Wind parks in Sweden

In order to build a wind power plant in Sweden which corresponds to a permit of type B permits with the Environmental Code, which have the associated requirements for an EIA the operator makes an application including an EIA to the County Administrative Board. The content as already described before is explained in Chapter 6 of the Environmental Code as well as the Ordinances. The EIA must be able to read independently of the application of the operator, but it overlaps in some parts. It is decided on the scope of the individual case what the EIA needs to contain. The Länsstyrelsen from Kalmar and Kronoberg published a guide for developers who want to apply for a B-permit for wind power plants including an EIA, to describe the process. Firstly, in cases where an EIA-procedure is mandatory and the activity might cause significant transboundary impact all governmental authorities that are informed of the activity are required to notify the Swedish Environmental Protection Agency, the authority responsible for the application of the Convention. The Swedish Environmental Protection Agency then makes a case-by-case decision. The Swedish Environmental Protection Agency makes the assessment after consulting relevant expert authorities(https://www.unece.org/fileadmin/DAM/env/eia/documents/Review_2006_2009/Questionnaire2006_09_Sweden_en.pdf, p.4). The process starts with the application to the County Administrative Board, who can then request that the operator supplement the documents if necessary. When the application is complete, the county administrative board requests opinions from various commentators. The application is always referred to the municipality's environmental committee for opinion and to the county administrative board as representative of public interests. At the same time, the county administrative board in the local press announces that the application with the EIA has been received. In a consultation all opinions from the relevant authorities and the others must have been received from the County Administrative Board within the time specified in the announcement, usually within 3 - 6 weeks. The comments on the applied business from third persons to the county administrative board is sent for opinion to the operator, who then has the opportunity to respond to what has been expressed. In exceptional cases, a public meeting of the case may be held. The County Administrative Board's environmental protection unit, which has so far handled the case, submits a proposal for decision to the Environmental Review Delegation. The county administrative board, through the environmental review delegation, makes decisions on the matter. At the same time, it is decided if the EIA meets the requirements of the Environmental Code's 6th chapter. The decision is announced in the local press. Finally, the person affected by the decision (except the operator such as local residents and environmental organizations) has the right to within three weeks from the date stated in the decision and the announcement appeal the decision by the Environmental Court. Regarding environmental organizations, it is only non-profit associations whose purpose is to safeguard conservation and environmental interests who may appeal the decision. To get an appeal, the association must have been in it at least three years and have at least 100 members (Chapter 16, Section 13 of the Environmental Code).

4 Research objectives and Hypothesis

4.1 Problem statement

Within compensation measures of EIAs of wind parks significant differences can be seen over time and place on the same species or species with similar characteristics of birds and bats in Austria and in Sweden. The concern is that there are major differences seen in the different countries and federal states, due to differences in nature conservation laws and Environmental laws on Environmental Impact Assessments. Disparities can also be seen over time, as knowledge on the process of EIAs has been growing and legal obligations have changed during the past 25 years. Are there tools available which could improve the transparency and traceability (reproduction capacity) of compensation measures?

4.2 Research Objectives & Hypothesis

The aim of the thesis is to show the development and use of mitigation and compensation measures in the EIA of wind parks in the EU on the example of Austria and Sweden. The mitigation and compensation measures will focus on bird and bat fauna, as those animals show a significant effect on wind energy development. Since the EU directive (2011/92/EU) has been developed, every country was obligated to implement the directive into national law. This leads to different interpretations in national state law of the EU directive (2011/92/EU) on EIA. An analysis of applied mitigation and compensation measures for the bird and bat fauna will be conducted. This analysis gives a better understanding of the transformation of mitigation and compensation measures and will lead to greater clarity in the field to support experts in the field.

Hypothesis

- The EU directive (2011/92/EU) shows in-comprehensive disparities in the implementation of the directive concerning the mitigation and compensation measures of birds and bats by the national legislator of Austria and Sweden.
- Due to variances of legal processes of EIAs, mitigation and compensation measures can show differences in depth of the process between Austria and Sweden.
- The quantity of compensation measures for birds and bats are increasing over time in Austria and Sweden.
- A correlation between the size of a wind park and the amount of measures in can be observed in Austria and Sweden.

5 Methodological approach

In the first phase a literature review has been conducted. The review helps to understand and be able to compare the origin of EIA in the EU and its implementation into national law in its member states. The Austrian and the Swedish Law which are relevant for the EIA in the national laws have been studied in detail. The law and its implementation of this approach build the foundation. Secondly literature has been analyzed on the consequences of wind energy on bats and birds and the compensation measures already used. It is also essential to understand the technical background of how a wind turbine works, therefore a technical MOOC (massive open online course) offered by the Technical University of Denmark has been followed (DTU, Coursera, 2017) . The course offered an insight into the technical studies of wind turbines.

The implementation of the EIA law has been assessed through a survey of 30 Case Studies (see also Peste et. al 2014). The concept of working with Case Studies turned out to be suitable for this thesis. The methodology of Peste et. al. (2014) which can be adapted for bats and birds as well. The EIA's imply mitigation and compensation measures planned to avoid, reduce or compensate significant adverse impacts on the environment in order as written. The analysis of the Case Studies will show the legal base for the mitigation and compensation measures as well as the individual mitigation and compensation measures for birds and bats of each Case study in particular, as already used by Peste et al. (2014).

5.1 Selection of Case Studies

The selection of Case Studies took place in several steps. The first step included screening of existing EIAs in Austria and Sweden. The second step involved a selection of EIA case studies including the following criteria: Country, competent authority, project applicant, number of wind turbines, type of the wind turbine, performance, height of the turbine, rotor height, landscape, topography, year of project start. The EIA case studies have finally been chosen with the background knowledge from several stakeholders. I would like to mention especially Prof. Pröstl of the University of Natural resources and Life Sciences in Vienna, Patrizia Cyniburk from the Umweltbundesamt - the Austrian Environmental Agency and the expertise from Matthäus Witek from Ecowind, a wind project developer from Austria, to show insights into this field of knowledge from a wide range of stakeholders in an EIA process, as well es the expertise from the scientific background. The EIA Case studies show a variety of landscapes and topography. The list of Case Studies chosen can be found in Annex 1 for the Swedish case studies and Annex 2 for the Austrian case studies.

The Austrian EIA Case Studies are 17 in total, located in the federal States of Lower Austria, Burgenland and Styria. Burgenland has been the first state which has started wind energy development in Austria. It is a very flat and very little populated area in the east of the country. The area has high wind energy potential, due to its strong and regular winds. Secondly, Lower Austria has been developing wind parks as well, often in areas of agricultural production in hilly or flat areas. Nowadays Styria is also developing wind parks in its often very hilly and mountainous regions in the south of the country. The regions are also often forested and sometimes it requires felling of forest or standalone trees for the wind energy development.

The Swedish EIA Case Studies are 13 in total. The Swedish EIA Case Studies are located in the federal States of Jönjöping, Kronoberg and Skane on the south of Sweden. The areas are chosen due to their topology. Kronoberg and Jönköping are centrally located in Sweden and have hilly and forested landscape features. Skane is the most southern federal state of Sweden. It is known for its high wind speeds and it is very flat.
Since the regions show similar landscape and topography characteristics it is possible to show similarities and disparities between the two countries.

5.2 Criteria for the case study selection

The Case Studies have been selected based on the list as explained below:

- **Country**: The Case Studies must be located in Sweden or Austria. In those countries an EIA process has been developed according to EU law. The law has changed since its implementation, so it cannot for sure be said at what time which regulations have been in force during the time period of the EIAs referred to by the Case Studies. There is an explanation of the last change of the Austrian UVP-G 2000 law, which has been adopted in 2018 and therefore none of the EIA Case studies in this thesis have been developed under the new UVP-G 2000. Austria functions as the country of reference.

  Sweden as the country of comparison. Onshore wind development is very fast developing. The country strongly supports its development of renewable energies but is also known for its environmental standards.

  Competent authority: In Sweden and in Austria the regional authorities are responsible for the realization of an EIA of wind turbines. The competent Austrian authorities are in principle (for wind turbines always) the governments of the 9 federal states. In Sweden it is the County Administrative Board (CAB) who is the responsible authority in the matter of an EIA. 12 of the 21 County Administrative Boards are able to deal with EIAs in Sweden.
- **Project Applicant:** The project applicant shows the number of wind project developers in the field of large onshore wind parks. Mostly specialized companies are able to deal with such large projects. Some are already established energy suppliers but there are also some new players in the field.
- **Number of wind turbines:** The number of wind turbines shows the size of wind parks. The criteria are important due to the number defining the threshold of a possible EIA duty. The number of wind turbines differ between 3 up to 49 wind turbines.
- **Type/Name of the wind turbine:** The type and name of the wind turbine shows which wind turbine companies are active in Austria and Sweden.
- **Performance:** The data about the performance of each wind park is an estimation by the developer, reflecting data from the wind turbine producer. Therefore, it needs to be said that the data about the performance is only an estimation of the possible energy production with different types of wind turbines.

- **Height of turbine:** The height of wind turbines shows significant differences. Especially between open land and forested areas, as well as in flat land or at the edge of steep mountain slopes. For the developer it is of great importance that the wind turbine height is as tall as possible, to be able to generate more energy from the turbine, as winds are stronger in a height of more than 100m above ground.
- **Rotor Height:** The rotor height shows the height where the rotor is fixed. The recently built or repowered wind turbines usually have a higher wind turbine, as earlier built ones, as winds are stronger and more powerful about 100m above ground. The rotor height has also been chosen as a criterion to see the variations of the actual height of turbine and the rotor height.
- **Landscape:** Landscape features are influential parameters for the species composition and are relevant for the ecosystem. The criteria landscape shows if the wind park is located in an open landscape or in a forested area. Bird and bat species vary in these landscapes, so that the effect of the wind turbine on wildlife is different.
- **Topography:** Topography is one of the most influential parameters for wind production and flight behavior of birds and bats. Therefore, the wind parks have been chosen in flat, hilly and mountainous topography, to be able to see the differences on the influences on wildlife, as the fauna varies, between these three types of topography.
- **Year of project start:** The Case Studies are supposed to show the development of EIAs of wind parks over time, therefore the Case Studies are chosen with a wide range of years where the EIAs have been conducted.
- **Year of decision of EIA:** The Date of final decision making on the EIA is showing the required period of time to work through the EIA.

5.3 Research method to analyze mitigation and compensation in the EIA

The methodological approach uses advantages from the study by Peste et. al. (2014), which is called a review of potential conservation measures in the European context". The study compares offset/compensation measures in bat populations and has been published in 2014." Peste et. al. (2014) have used a broad range of monitoring reports and other official documents published between 2003 and 2013. They investigated a wide range of studies describing bat activity patterns, considering macro, - meso- and micro-scale features such as landscape characteristic, habitat, forestry/agricultural regime, vegetation structure, and water prey availability. The methodology by Peste et al. (2014) has been expanded including birds. Some EIAs have been proven by court and stricter mitigation measures have been asked for, but this has not been mentioned specifically in tables of Annex 1 and 2 and is simply included within the other mitigation and compensation measures

The criteria are:

- **Mitigation & Compensation measures:** The mitigation and compensation measures are emphasis of this thesis. As it has turned out to be complicated to distinct between different stages in the mitigation hierarchy through the analyses of the EIA case studies, this criterion shows a mixture of mitigation and compensation measures, which have been divided into two subcategories. Some EIA Case Studies also show zero mitigation/compensation measures for birds and bats. Peste et al.(2014) describe in their article about "how to mitigate impacts of wind farms on bats" that they have used a broad range of monitoring reports and other official documents published between 2003 and 2013. They have gathered information on the species, number of fatalities per species and seasonal trends in fatalities in European wind farms. (Peste et al., 2014, p.12) The criteria have been adjusted by some sub-criteria for this thesis, as it is necessary to reflect and analyses the mitigation and compensation measures and its effectiveness. Therefore, the following sub- criteria has been added:

    - **Mitigation**
        - **The constructional ban**: A constructional ban includes a measure that implies a constructional ban in the way that construction should be avoided in a vulnerable habitat.
        - **The constructional mitigation:** The measure should insure avoidance of construction at specific times of the year (e.g. during breeding season).
        - **The mitigation management:** The mitigation management manages certain mitigation measures under certain conditions (e.g. switching of WEA under certain conditions, as during the hours of sunset bats often feed insects at the same height as the wind turbine).

- **Compensation:** A compensational measure implies that something needs to be constructed in the means of the compensation measure. That could be the creation of a new habitat for birds and bats, as well as a conversion of cultivated land use to fallow land, if the measure would be of necessity for the affected species.
- **Monitoring:** The measure which implies monitoring ensures that the impact of wind turbines on birds and bats are monitored over a longer period of time, to understand and adapt future activities on the wind farm and other wind farms with similar conditions.
- **Most suitable area:** This criterion shows where the mitigation & compensation measure is used. It is often arable land or forest land (agricultural land) that is used for compensation measures. The suitable area for compensation needs to be situated nearby.
- **Target bat/bird species:** This criterion shows if the mitigation or compensation measure is focusing on a special targeted bat/bird species or bats in general. Especially raptors are often described as target species, but also migratory birds and others.
- **Expected outcomes:** The expected outcome is the aim of the mitigation and compensation measures. Those criteria have been chosen due to the outcome of the analyses of the EIA Case Studies and do not comply with the ones used by Peste et. al. (2014). The optimal solution would be no net loss or even net gain of endangered species. The expected outcomes which have been possible are:

    - optimize habitat
    - minimize risk of killing
    - avoid disturbance
    - create new habitat
    - less injuries
    - less ecological damage
    - conservation of habitat

- **Estimated time for visible effects:** This criterion looks into the estimated time until first compensation measures and their effects are likely to occur. Some measures have a short-term effect, some a medium-term effect and some might need some more time until effects are visible. Monitoring is determined a long-term measure, as it takes several years to be able to see effects or get results from it. Other measures like the establishment of a construction ban for a certain area, is classified as short-term measure, as effects are there immediately, even though it is a measure that has long term effects.

EIA	Definded Measues	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Steiermark										
Steinriegel	Switching off WEA below 3,0 m/s			x			wind turbine	all bats	minimize risk of killing	short term
Pretul	marking of potential trees for bats> will be cleared during active time of bats		x				forest land	all bats	minimize risk of killing	medium term
	switching off WEA, 15.5- 30.9 0,5ha before sunset till sunrise, <5m/a wind speed, > 10C, no rain			x			wind turbine(close to forest)	all bats	minimize risk of killing	short term
	switching off WEA, 1.8-30.9, 0,5h before sunset till sunrise, < 5m/s wind speed, >10C, no rain			x			wind turbine (open land)	all bats	minimize risk of killing	short term
	2 year Batmonitoring 01.05 till 15.10					x	on site	all bats	less ecological damage	long term
Handalm	switching off WEA, 1.8-30.9, 0,5h before sunset till sunrise, < 5m/s wind speed, >10C, no rain			x			wind turbine	all bats	minimize risk of killing	short term

Table 4: Example of table of mitigation and compensation measures, advancing the table by Peste et. al (2014), 2019, Andresek

F. Peste et. al. (2014) focused in their research on the offset/compensatory measures for bat populations affected by residual adverse effects of wind farms, including suitable areas for implementation, target species, expected outcomes, estimated time period for the outcomes to show visible effects (short-, medium, long term) and qualitative estimate of the implementation costs of each measure (low, medium, high). The assessment of this thesis is widened to the avian fauna and is following the same methodological approach with the adopted subcategories.

5.4 Differences between the Swedish and Austrian Procedure and legal base of the Environmental Impact Assessment

At first the EIA process of the two European member states look very similar. The permission procedure for wind turbines obliged for an EIA in Austria is a coordinated procedure, which means that all permits are given by one authority only. Also, Sweden applies the one-stop-shop principle, however there might be separate EIAs required. This is the case for example when certain kinds of infrastructural projects, like the construction of new roads or bridges are included (Rosengartden,2014). The choice if an EIA is necessary or not is made on a "case by case" analyses and respective thresholds. Despite the overall similar concepts, the thresholds in the two countries are rather different. In Sweden an EIA is necessary if an operator wants to build 7 or more wind turbines which are more than 150m high. The Austrian law rather uses the amount of energy generated for defining a threshold which says that turbines that generate at least 30 MW or that include at least 20 converters or produce 0,5MW each. This threshold has been changed recently during the renewal of the law in 2018.

The next difference is the legal base of environmental protection and planning, as Sweden sums up all environmental legal issues in the environmental code, which is applicable in the whole country. On the other hand, Austria developed nine different nature conservation laws which are applicable each in its own state only. Equally important is that in Sweden the public consultation before the public hearing is not as often used as a tool for participation, as it is in Austria. Lastly the Swedish authority often sets a time limit for wind energy EIA permits, which is not the case in Austria (Rosengardten,2014).

Table Similarities and differences:

Austria	Sweden
coordinated procedure - only EIA authority (“one stop shop) The EIA authority deals with all legal obligation’s ins one process.	coordinated procedure - (“one stop shop), but the Swedish legislation might however demand separate EIAs for separate parts of a project, due to different competent authorities.
choice made “case- by - case”	choice made “case- by - case”
voluntary public consultation before public hearing (often used)	voluntary public consultation before public hearing (less often)

Table 5: Similarities of EIAs in Austria and Sweden; 2019, Andresek

Austria	Sweden
9 state nature conservation laws	one environmental code for the whole country
turbines at least 30 MW or with at least 20 converters or 0,5 MW each	7 or more turbines higher than 150 meters
time limit, Decision without unnecessary delay, at the latest six months after application (Article 7 (3) UVP-G 2000)	no legally binding time limit for EIA processes, but a time limit is often used in wind energy projects

Table 6: Most common differences between EIA in Austria and Sweden; 2019, Andresek

The main process elements are the same in Austria and Sweden. The public consultation is rarely used as a tool for participation in Sweden. The authorities of both countries need to prove alternatives and usually have consultation phase of the developer with public authorities and the public. The permission processes show differences and so do the mitigation and compensation measures for birds and bats. On the other hand, some similarities can be found. The use of the construction of new compensation areas in the case of ecological damage on wildlife, or a construction ban during the mating period, especially for bird habitats is used in both countries very frequently as a mitigation measure. It has also been analyzed that switching off the wind turbine below a certain wind speed for the protection of bats is a common mitigation measure for bats used in both countries. Moreover, it can be stated that there are more mitigation and compensation measures for birds than for bats.

The mitigation hierarchy is a strong concept in EIA law. It is foreseen to be followed everywhere in Europe. The analyzed EIA Case Studies do not show this hierarchy. First avoidance is achieved by proof of alternatives, after this step the steps of avoidance, compensation and offset of the mitigation hierarchy are often spoken about in the same context. It cannot be assured where the ideas for these measures of avoidance, compensation and offset come from. Some of the mentioned measures are already mentioned in the EIS of the developer, others are required by the authority, others are required by court. The mitigation hierarchy is difficult to follow.

Due to difficulties of comparing the data of the EIA Case Studies it is important to mention how the data has been simplified in an understandable and comparable method. Mitigation, compensation measures of the EIA Case Studies were put into comparable tables. In this step more detailed information got lost, as information has been available in different stages of detail. The tables of Annex 1 and 2 present solely a summary of all measures found and do not state any information about the detail of the description in the EIA and the detail of description of several measures of avoidance, compensation or offset.

6 Results

The results of the EIA Case study analyses are structured in three parts. The first part focuses on the Austrian EIA Case Studies. The second one of the Swedish EIA Case Studies and the third part discusses similarities and contradictions between the Austrian and the Swedish Case Studies. The compensation measures for birds and bats are described in each section. The results present an insight into the permission process in wildlife mitigation and compensation planning in the two European member states.

6.1 The Austrian EIA Case Studies

The Lower Austrian EIA Case Studies

The wind energy permissions for the EIA Case Studies in Lower Austria have been finished between 2004 and 2017. The areas are located primarily in open land, which is mainly structured by flat and flat/hilly landscapes. The wind parks are mostly situated in arable crop land and mixed landscapes with managed forest land. Newly constructed compensation areas are mostly built in arable crop land.

In “Markgrafneusiedl” a compensation measure for birds allows also the change to early cultivation for arable fields, instead of the construction of newly fallow land. The peewit (*Vanellus vanellus*) needs those early cultivations during its breeding time, but usually changes its habitat after the breeding season again. Other target species of conservation are the imperial eagle (*Aquila heliaca*), red kite (*Milvus milvus*), sea eagle (*Haliaeetus albicilla*), black kite (*Milvus migrans*), peewit (*Vanellus vanellus*), corncrake (*Crex crex*) and black storck (*Ciconia nigra*). Most measures mostly consist of the construction of new compensation areas (constructional) and the ban of construction for certain ecological areas of importance on the respective site or nearby. The only longer measures are the “maintenance of scrub vegetation” which would take workforce over several years’ time. There are no monitoring measures planned which would look into the ecological effects of the built wind power project.

The compensation measures for bats include temporal switch off mechanisms as well as constructional measure, such as the construction of compensation areas. There are three Case Studies, at “Großengersdorf”, “Kreuzstetten” and “Marchefeld Nord” where no mitigation or compensation measures for bats were included.

The EIA Case Studies of Burgenland

As a result of the analysis, Burgenland started the earliest EIAs for wind power projects in Austria. The earliest EIAs are from around 2003 Kittsee and Parndorf (together 35 wind turbine’s) until the last in 2014, which is the wind park of Parma Süd (4 wind turbine’s). The landscape of Burgenland is flat and shaped by its arable land. Today it is well known for its landscape shaped by wind turbines. The whole country of Burgenland is energy- self-sufficient because of the wind energy development in the area (Energie Burgenland, 2019). According to the table of Annex 5 most compensation measures for birds are compensational measures and include the construction of meadows, wind breaks and fallow land. Construction bans can be found as well. Most measures aim to develop a more divers landscape with orchards, natural places along the river and hedges for windbreaks. The area with most of the wind turbines in Burgenland is primarily characterized by highly productive arable land in a very flat surrounding topography. The species which are specifically mentioned to be protected by compensation measures are the tawny pipit (*Anthus campestris)*, the red baked shrike (*Lanius collurio*), the common greenshank *(Tringa nebularia*) as well as all migratory species. The "Neusiedlersee area" which is located nearby has a worldwide relevance as a major migratory bird's resting zone during their migration periods. Therefore, it is of great importance for the wind power projects to leave corridors open for those birds. There are no measures of monitoring foreseen, to assure that the environmental measures show any effects and how the area develops over time. Likewise, it is to be noted, that none of the EIA Case Studies in Burgenland mention any compensation measures for bats. Especially in the older EIAs it is mentioned that there is not enough knowledge on the behavior of bats with wind turbines, therefore no measures have been applied.

The Styrian EIA Case Studies

In contrast to the wind farms in Burgenland and Lower Austria all wind parks power projects in Styria have been developed in mountainous areas. The earliest EIA of a wind energy project dates back to 2013, which is the wind power project of Steinriegel. The wind power project of Steinriegel includes 11 wind turbines and is built in a mountainous topography. All Case Studies are situated within a forested area with some alpine pastures. The mitigation measures consist of constructional bans and some temporal measures. In addition, compensation measures and monitoring measures are included. In fact, the Styrian EIA Case Studies show the largest number of compensation measures for birds and bats, compared to other Austrian Case Studies

The bird species which are specifically mentioned for certain mitigation and compensation measures are the snow grouse (*Lagopus lagopus*), the black grouse (*Tetrao tetrix)*, as well as migratory bird species in general. The snow grouse (*Lagopus lagopus*) and the black grouse (*Tetrao tetrix)* are typically hunted birds in those forested, mountain pasture areas and exist in only these types of landscapes. The black grouse (*Tetrao tetrix)* and the wood grouse (*Tetrao urogallus)* are two non-migratory species of the Galliformes family that are disturbed by wind turbines, during their mating period. The most serious threats for those species are habitat loss and fences with which the specimen collide. The capercaillie species are generally not threatened by the risk of killing through wind turbines, as they do not fly at the height of the rotor blades. But they are easily disturbed by humans who could use the area for recreational purposes or regular technical survey and the noise of the wind turbines. This is likely to happen in the Austrian grasslands, which are used for dairy production. The black grouse (*Tetrao tetrix)* cannot be found anymore in the Austrian lowlands. Therefore, the half open/ half forested area of the Alps gives the birds an important habitat.

Secondly the European nightjar (*Caprimulgus europaeus)* belongs to the endangered migratory bird species (breeding in Austria and Sweden) which show disturbance from wind turbines in Austria. As a mitigation measure it is often foreseen that a construction ban takes place during the time of the mating season, which usually takes place from May till the beginning of August, in order that successful breeding of the European nightjar (*Caprimulgus europaeus)* is more likely to happen. It is a bird of dry open areas with trees and bushes and likes moorland and forest clearings or fellow or newly planted woodland. Especially during the breeding time, it avoids treeless and heavy wooded areas and farmland.

The mitigation and compensation measures for bats are valid for all bat species. Most measures for bats include a temporal freeze of the wind turbine during the time of feeding, or during night time. Switching off the wind turbine is regulated under a certain wind speed (below 3m/s or 5m/s) half an hour before sunset till sunrise. At the area of Pretul it is mentioned that a 2-year bat monitoring is necessary for better understanding the bats behavior in the area, and to be able to adjust the measures to the new data available. There are no measures of creating a new habitat, but rather measures of minimizing the risk of killing and to reduce the ecological damage itself. In Schuster at. al (2015) it is explained that fatality rates of bats outnumber those of birds, though less mitigation and compensation measures are implemented than for birds.

Conclusion of the Austrian case studies

To conclude with the Austrian case studies, it is to say that the studied examples show significant differences. Some case studies show no compensation measures for bats and some show a significant number as many as 14 mitigation and compensation measures. Others have a very detailed wording of what needs to be achieved and some are very vague in their definition. For example, the EIA Case study of “Steinriegel” in Styria divides its mitigation measures into very detailed and specialized provisions, which have short term, medium term and long-term effects on the wind project area and its wildlife. Whereas the example of the EIA Case study “Weiden- Gols” in Burgenland only sets a construction ban for keeping a bird corridor open and does not proof the effects of this mitigation measure. All EIA’s have in common that there are compensation measures for birds in place. In the course of the EIA, the measures are a tool for wildlife planning.

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Steiermark										
Handalm	ecological oriented planning construction					x	on site	all birds	less ecologial damage	short term
	prohibit economic use of a swamp with spruces (27000m2)	x					swamp	all birds	create new habitat	long term
	Construction ban (Logging of 25 trees)	x					forest land	all birds	avoid disturbance	short term
	Construction ban (logging restrictions)	x					on site	all birds	avoid disturbance	medium term
	ecological construction supervision					x	on site	all birds	less ecological damage	short term
	construction ban before 7am, after 6pm		x				on site	all birds	avoid disturbance	short term
	Rising visibility of a fence				x		on site	Black Grouse(Tetrao tetrix)	less injuries	short term
	Visual design of the tower				x		wind turbine	Galliformes	less injuries	short term
	Monitoring of killed birds for the first 3 years					x	wind turbine	migrating birds	less injuries	medium term
	Birdscan- installation of birdradar to avoid collisition and monitor migrating birds			x		x	wind turbine	migrating birds	less injuries	short term
	Creation of resting area (100ha)				x		distant from site	snow grouse (Lagopus lagopus) and golden eagle	less ecological damage	short term
	Monitoring for snow grouse and black grouse					x	on site	snow grouse and black grouse (Lyrurus tetrix)	less ecological damage	long term

Table 7: Analysis of the mitigation and compensation measures for birds in Austria, Styria

Steinriegel	maintenance in october starting late morning				x		wind turbine	Black Grouse (Tetrao tetrix)	avoid disturbance	medium term
	replantation of trees				x		forest land	all birds	create new habitat	long term
Pretul	replantation of tress (1,3ha fir and maple)				x		forest land	grouse	create new habitat	long term
	creation of a quiet zone for deer of 90ha				x		distant from site	grouse	create new habitat	short term
	ecological oriented planning construction and supervision					x	on site	all birds	less ecological damage	short term
	contruction ban 1.4-20.5 to 9am till 5pm	x					on site	Black Grouse (Tetrao tetrix)	avoid disturbance	medium term
	protection of construction area during night and weekends	x					on site	all birds	less injuries	short term
	reconstruction of construction area				x		on site	all birds	less ecological damage	medium term
	maintenance of energy transmission only from 1.8 until 28.2	x					on site	all birds	less disturbance	medium term
	Conservation of swamp (Schwarzriegelmoores)	x					swamp	Black Grouse (Tetrao tetrix)	conservation of habitat	long term
	Minimization of paths post construction				x		Along paths	all birds	less ecological damage	medium term
	Rebuilding fences 200m Puffer + 1000m				x		fence	Black Grouse (Tetrao tetrix)	less injuries	medium term
	Maintaining old trees of 1,3ha for 1,3ha of clearcuttings	x					forest	all birds	less ecological damage	short term
	Creation of Compensation area (1 ha)				x		forest	capercaillie	avoid disturbance	short term
	Visitor steering concept					x	on sitte	grouse	avoid disturbance	long term
	Management concept of offset/compensation measures					x	all	all birds	less ecological damage	short term

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Burgenland										
Kittsee	creation of resticted zone	x					gravel pit	Tawny Pipit(*Anthus campestris)*	create new habitat	short term
	Construction ban of habitat and new creation	x					orchard	red baked shrike (Lanius collurio)	optimize habitat	medium term
	construction ban during 15.3 - 1.8		x				gravel pit	Tawny Pipit(Anthus campestris), red baked shrike(Lanius collurio)	avoid disturbance	medium term
	Creation of meadow				x		gravel pit	Tawny Pipit(Anthus campestris), red baked shrike*(Lanius collurio*)	create new habitat	short term
Weiden-Gols	construction ban for corridor	x					Along river	migrating birds	minimize risk of killing	short term
	construction ban for corridor	x					Along Road	migrating birds	minimize risk of killing	short term
Parndorf	Protection of windbreaks	x					windbreaks	all birds	avoid disturbance	short term
	Maintanance of windbreaks				x		windbreaks	all birds	improve habitat	short term
	Construction of windbreaks				x		on site	all birds	create new habitat	medium term
	Construction of fallow land (same size of destroyed fallow land)				x		on site	all birds	create new habitat	medium term
	Construction of new fallow land				x		wind turbine	all birds	create new habitat	medium term
	Create compensation area				x		distant from site	raptors	create new habitat	long term

Table 8:Analysis of the mitigation and compensation measures for birds in Austria, Burgenland

Römerstrasse	Ban of mowing	x					wind turbine	all birds	optimize habitat	short term
	construction of turbines close to each other			x			wind turbine	migratory species	avoid disturbance	short term
Parma Süd	ban of construction	x					on site	huntable bird species	avoid disturbance	short term
	Protection of wildlife	x					on site	huntable bird species	minimize risk of killing	short term
	Improve habitat				x		windbreaks	huntable bird species	optimize habitat	medium term
Parndorf Neudorf III	Creation of compensation area				x			huntable bird species	Create new habitat	medium term
	Create compensation area				x		wet area	common greenshank (Tringa nebularia)	Create new habitat	medium term
Neusiedl am See	Ban of contruction-corridor	x					wet area	migratory birds	avoid disturbance	short term
	Ban of construction corridor	x					Along road	migratory birds	avoid disturbance	short term

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Niederösterreich										
Marchfeld Nord	Construction of fallow land (9 ha)				x		arable land	all birds, especially raptors	create new habitat	short term
	creation of restricted corridor zone (4km)				x		along river	Imperial Eagle(*Aquila heliaca*)	minimize risk of killing	short term
	creation of restricted zone				x		along river	raptors	minimize risk of killing	short term
	maintenance against scrub vegetation				x		construction area	all birds	minimize risk of killing	short term
Dürnkrut-Götzendorf	construction of fallow land or meadow (25ha)				x		arable land	all birds	optimize habitat	medium term
	construction ban 1.3-30.5		x				wind turbine	Imperial eagle(*Aquila heliaca*), Red kite(*Milvus milvus*), White tailed eagle(Haliaeetus albicilla) , Black Kite (*Milvus migrans*)	minimize risk of killing	medium term
Großengersdorf	consruction of 5ha meadows				x		distant from site	Imperial eagle (Aquila heliaca)and other raptors	optimize habitat	medium term
	construction of fallow land (2ha)				x		distant from site	all birds	optimize habitat	short term
Kreuzstetten	leave corridors for migratory species	x					wind turbine	migratory species	less disturbance	short term
Markgrafneusiedl	construction of fallow land (10ha or 5ha of 10ha of early cultivations)				x		arable land	peewit (*Vanellus vanellus)*	create new habitat	medium term
Schildberg	construction of compensation areas				x		forest land	corncrake(*Crex crex*), Black storck(*Ciconia nigra*)	create new habitat	long term
Hohenruppersdorf III	construction of compensation area 1ha				x		fallow land	all	create new habitat	medium term

Table 9:Analysis of the mitigation and compensation measures for birds in Austria, Lower Austria

EIA	Definded Measues	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Steiermark										
Steinriegel	Switching off WEA below 3,0 m/s			x			wind turbine	all bats	minimize risk of killing	short term
Pretul	marking of potential trees for bats> will be cleared during active time of bats		x				forest land	all bats	minimize risk of killing	medium term
	switching off WEA, 15.5- 30.9 0,5ha before sunset till sunrise, <5m/a wind speed, > 10C, no rain			x			wind turbine(close to forest)	all bats	minimize risk of killing	short term
	switching off WEA, 1.8-30.9, 0,5h before sunset till sunrise, < 5m/s wind speed, >10C, no rain			x			wind turbine (open land)	all bats	minimize risk of killing	short term
	2 year Batmonitoring 01.05 till 15.10					x	on site	all bats	less ecological damage	long term
Handalm	switching off WEA, 1.8-30.9, 0,5h before sunset till sunrise, < 5m/s wind speed, >10C, no rain			x			wind turbine	all bats	minimize risk of killing	short term

Table 10:Analysis of the mitigation and compensation measures for bats in Styria, Austria

EIA	Defined measures	mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Burgenland										
Gols	no measures mentioned									
Kittssee	no measures mentioned									
Weiden-Gols	no measures mentioned									
Parndorf	no measures mentioned									
Parma Süd	no measures mentioned									
Neusiedl am See	no measures mentioned									

Table 11:Analysis of the mitigation and compensation measures for bats in Burgenland, Austria

Table 12:Analysis of the mitigation and compensation measures for bats in Lower Austria, *Austria*

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for effects
		constructional ban	constructional	management						
Niederösterreich										
Markgrafneusiedl	construction of fallow land (10ha or 5 ha of 10 of early cultivations)				x		crop land	bats	create new habitat	medium term
Schildberg	Creation of compeansation areas				x		forest land	Nyctalus (Nyctalus nocturna), Pipistrellus (Pipistrellus pipistrellus)	create new habitat	long term
	Conservation of trees that can be used for breeding	x					forest land	Myotis (Myotis spp.), Nyctalus (Nyctalus nocturna)	optimize habitat	long term
	Switch off time from (TRAXLER et al.2016 in prep.)			x			wind turbine	all	minimize risk of killing	short term
	monitoring					x	wind turbine	all	minimize risk of killing	short term
Hohenruppersdorf III	creation of compensation area				x		fallow land close to forest	all	create new habitat	medium term
Kreuzstetten	no measures mentioned									
Marchfeld Nord	no measures mentioned									
Großengersdorf	no measures mentioned									

6.2 The Swedish EIA Case Studies

The Kronoberg Län EIA Case Studies

There have been three Case Studies from Kronoberg Län, called “Ashult”, “Lyngsasa” and “Furuby”. “Ashult” does not consider any compensation measures, thus the other two do mention compensation measures for birds and bats. All areas are located in a forested area, which have a flat or hilly topography. With a height of 210m to 250m the wind turbines are very tall. This is due to the fact that the wind turbines are located in a forested area, as one can only achieve good wind speeds for energy production in higher areas. The higher wind turbines do have a higher energy production. Some compensation measures are required for especially threatened species like the European nightjar (*Caprimulgus europaeus)* and also for the black grouse (*Lyrurus tetrix*). These measures are rewarding measures, which should ensure the birds more calmness during their mating period. The EIA of “Ashult” has no measures related to birds.

The measures for bats only require temporary shutdowns. There are no measures foreseen which are compensating the impact or which are related to monitoring requirements.

The two wind energy projects of Berg and Vraneke in Kronobergs County, Sweden did not perceive a permit due to the occurrence of eagles in the project area.

The Jönköping Län EIA Case Studies

The outcome of the analyses of the EIA Case Studies from Jönjöping show mainly measures of monitoring. “Some of the wind farms in Jönköping county have control programs for bats or birds, especially the wind farms that have been built 2011-2018. Before that wind turbines were rather small and permission from the state was not required” (Lagerkvist N., 2019). Four Case Studies, each of them comprising 2 to 32 wind turbines, have been assessed. The topology of the area is hilly and mountainous and rather forested, with mainly harvested forests. All permissions are from the years of 2011 till 2013, as there have not been any EIAs necessary before.

The target species for bird measures in Jönköping are the wood grouse (*Tetrao urogallus)* and the black throated loon (*Gavia arctica)* at the lase in “Klämman”. This being the case two buffer zones are required to assure that these species are less disturbed by the wind turbines, as those could be sensible. The EIA of “Stensasa”, “Brahehus” and “Lemnhult” require a bird monitoring.

All EIAs include a bat monitoring with a control programme for a long-term period. The EIA of “Klämman” includes a switch off time during the most active period for bats from July till September. The” Brahehus” Case study requires collecting dead bats for monitoring purposes. Those findings are registered and examined. The number of compensation measures is very low. Nils Lagerquist from the Jönköping County Administrative Board’s department of Environment and Society Building (2019) states that “mostly mitigation measures are able to avoid building mills and roads in important habitats and applying buffer-zones to nesting-sites for example regarding wood-grouse (*Tetrao urogallus)*, birds of prey and ponds used by loon” (Lagerkvist, 2019).

The Skane Län EIA Case Studies

The county of Skane is located in the south of Sweden and has a flat topography which is dominated by agricultural land use. The county developed a strong wind energy sector onshore as well as offshore, as strong and lasting winds are typical for the area. “Assmasa” is the oldest EIA project which is included in this thesis and has started in 1998 and got the permission in 2000. The EIA does not include any measures for birds or bats.

An Osprey Action program has been implemented at the location of “Karsholm”. The Osprey *(Pandion haliaetus)* is designated by the EU Birds Directive. A large part of the European stock of osprey *(Pandion haliaetus)* breeds in Sweden and thus the country has a special responsibility to preserve this specie and therefore started this special program. The distance between the osprey *(Pandion haliaetus)* population and the nearest turbine is about 150m and might be a killing factor for the species. Therefore, a wind power expansion in Karsholm's forest may have a negative impact on the local population.

Special measures have been implemented and can be divided into three main points:

- Construction bans during the most sensitive times nesting and mating
- Compensation by developing mitigation by a new hatchery on site or by
- Construction of new hatcheries in the surrounding area

Compared to the EIA case study of “Karsholm” where the impact on bats shall be monitored. All other studied wind park project in Skane do not implies any measures.

Conclusions of the Swedish EIA case studies

To conclude with the Swedish EIA Case Studies, it is to say that differences can be seen in the terms of the amount of mitigation and compensation measures and what type they are using. All areas for wind parks in Sweden have a mainly forested and a smooth hilly landscape, even the mountainous areas show a smooth topology. A lot of ponds and lakes are stretching over the country and shape the nature of Sweden. The black throated loon *(Gavia arctica*) is one of those birds living in this water landscape and needs more protection. Particularly relevant is the analyses from the table of annex 1 which describes the types of wind turbines. In Sweden the description of the wind turbine type is always a term of reference and does not need to be the turbine type that will be finally built. It could be a similar type of wind turbine or a more recently developed type of wind turbine, which is more updated to the technical standards of today. Furthermore, it is more important to say that the start and end date has been difficult to investigate in the permits, as the EIA is only a part of the permission process and statistics about the duration of wind turbines EIA permit processes are not available.

The thesis shows that especially that the species of the golden eagle (*Aquila chrysaetos*), osprey *(Pandion haliaetus)*, imperial eagle (*Aquila heliaca*), sea eagle (*Haliaeetus albicilla*), red kite (*Milvus milvus*), black kite (Milvus migrans), the red baked shrike (Lanius collurio), tawny pipit (*Anthus campestris)*, peewit (*Vanellus vanellus*). The Swedish EIAs show that the species of Osprey *(Pandion haliaetus)*, black throated loon (*Gavia arctica*), wood grouse (*Tetrao urogallus)* and the European Nightjar (*Caprimulgus europaeus*) are the most disturbed by wind turbines.

EIA	Defined measures	Mitigation			Compens ation	Monit oring	Most suitable area	Target bird species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Jönköpings Län										
Lemnhult	500 m construction ban	x					on site	w ood grouse (Tetrao urogallus)	minimize risk of killing	short term
	bird monitorng					x	on site	all birds	minimize risk of killing	long term
Brahehus	Collecting of dead birds					x	w indturbine	all birds	monitoring deaths of threathened species	long term
Klämman	1km buffer zone	x					along lake	Black throated loon (Gavia arctica)	avoid disturbance	short term
Stensasa-Karstorp	bird monitoring + management plan					x	w indturbine	all birds	minimize risk of killing	long term term

Table 13: Analysis of the mitigation and compensation measures for birds in Jönköping, Sweden

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Skane										
Karsholm	Actionprogramm osprey					x	on site	Osprey (Pandion haliaetus)		
	stop of construction work march-may		x				on site	Osprey (Pandion haliaetus)	avoid disturbance	short term
	construction of a new hatchery on site				x		1km away from site	Osprey (Pandion haliaetus)	create new habitat	short term
	construction of a new hatcheries in surrounding areasby planting beeches				x		distant from site	Osprey (Pandion haliaetus)	create new habitat	medium term
	Evaluation after the action programm					x	everywhere	Osprey (Pandion haliaetus)	secure the area for Ospreys	medium term
Linderödsåsen	500 m buffer	x					wetlands	water birds	avoid disturbance	short term
Östra Herrestad	180 m buffer	x					beach	wading birds	avoid disturbance	short term
Fjelie	no measures mentioned									
Assmåsa	no measures mentioned									

Table 14:Analysis of the mitigation and compensation measures for birds in Skane, Sweden

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	Target bird species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Kronobergs Län										
Lyngsåsa	ban of construction from 1 March to 30 June		x				at the constrcution site	all birds	avoid disturbance	medium term
	Construction ban for wagering from 10:00 am from April 15 - May 5		x				around mating area	Black grouse (Tetrao tetrix)	avoid disturbance	short term
	500 m buffer zone for forest continuity	x					around mating area	Black grouse (Tetrao tetrix)	avoid disturbance	medium term
Furuby	Construction ban during april due to mating period		x				Ekekärret & Klerebohult	Black grouse (Tetrao tetrix)	avoid disturbance	short term
	Construction ban during mating season from late May -July		x				Ekekärret & Klerebohult	European Nightjar (Caprimulgus europaeus)	avoid disturbance	short term
	construction ban during the period 1 March to 30 June		x				windturbine 4, 8, 9, 10 and 7	all birds	avoid disturbance	short term
	Construction ban	x					coastal protection area	all birds	avoid disturbance	short term
Målajord	no measures mentioned									
Ashult	no measures mentioned									

Table 15:Analysis of the mitigation and compensation measures for birds in Kronoberg Län, Sweden

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	target bat species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Jönköpings Län										
Lemnhult	Batmonitoring after one third has been put into operation(August till Oktober)					x	wind turbine	all bats	minimize risk of killing	long term
Brahehus	Batmonitoring					x	windturbine	all bats	minimize risk of killing	long term
	Collecting dead bats					x	windturbine	all bats	monitoring deaths of threathened species	long term
Klämman	Batmonitoring + management plan					x	windturbine	all bats	minimize risk of killing	long term
	switching off WEA at windspeed < 5m/s during most active period, July till September			x			windturbine	all bats	minimize risk of killing	short term
Stensasa	Batmonitoring					x	windturbine	all bats	minimize risk of killing	long term

Table 16:Analysis of the mitigation and compensation measures for bats in Jönköping Län, Sweden

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	target bat species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Skane Län										
Assmåsa	no measures for bats									
Karsholm	impact on bats shall be reported					x	on site	all bats	improve knowledge	long term
Linderödsåsen	no measures for bats									
Fjelie	no measures for bats									
Östra Herrestad	no measures for bats									

Table 17:Analysis of the mitigation and compensation measures for bats in Skane Län, Sweden; Andresek (2019)

EIA	Defined measures	Mitigation			Compensation	Monitoring	Most suitable area	target bat species	Expected outcomes	Estimated time for visible effects
		constructional ban	constructional	management						
Kronobergs Län										
Ashult	no measures for bats									
Lyngsåsa	switching off WEA at windspeed < 5m/s during most active period, July till September			x			wind turbine	all bats	minimize risk of killing	short term
Furuby	switching off WEA at windspeed < 5m/s during most active period, July till September			x			wind turbine	all bats	minimize risk of killing	short term
Målajord	no measures for bats									

Table 18:Analysis of the mitigation and compensation measures for bats in Kronoberg Län, Sweden

6.3 A Comparison of compensation measures of birds and bats in Austria and Sweden

6.3.1 Mitigation measures

We saw in chapter 6.3 that three major aspects are characterizing mitigation measures:

- The constructional ban (avoidance of vulnerable habitat)
- The constructional mitigation (avoidance of construction at specific times of the year(e.g.) breeding)
- The mitigation management (e.g. switching off under certain conditions)

Constructional ban

The analyses show that mitigation measures and measures of avoidance are commonly used in Austria, in particular for birds and special bird species, like eagles, other raptors, the tawny pipit (*Anthus campestris)*, the red baked shrike (*Lanius collurio)* and migrating bird species. A ban of clearing of old trees is a measure of constructional ban commonly used in Austria to do less harm to bat populations nesting in old trees and to create a bigger habitat for those species.

Yet in Sweden construction bans are widely used measure. The buffer zones are described in detail like a distance of 500 m or 1 km and from where the buffer zone is supposed to start. The buffer zones shall avoid disturbance and reduce the risk of collision.

Other construction bans are the creation of buffer zones or buffer corridors. Especially migratory species need those zones. Also, areas along water are often restricted in Sweden, for the purpose of water bird species protection, like the endangered black throated loon (*Gavia arctica)*. In Sweden it is used as well to protect coastal areas. There are no examples in Sweden were this method is used for the protection of bats.

Constructional mitigation

Temporal construction bans are a widely used tool in Sweden. In Austria the tool of constructional mitigation is rarely used in the case studies analyzed.

Mitigation management

Temporal shutdowns of wind turbines for bat species during their most active time in summer from one hour before sunset till sunrise are very often used. This measure is nowadays used almost the same in Austria, as well as in Sweden. A switching off time is mandatory below wind speeds of 5m/s sometimes also 3m/s during the most active period of bats from July till September, one hour before sunset till sunrise. The shutdown times rarely differentiate from another, which leads to the assumption that this measure strongly impact the local bat populations. In Austria the temporal shutdown of the wind turbine has never been asked for in the early times of wind energy development in Burgenland, but since that it is commonly used. In Sweden the temporary shutdown for wind turbines for bats is used in all analyzed case studies.

Another temporal measure of avoidance is commonly used during the mating season of endangered bird populations, to avoid disturbance during the mating phase. Some of the bird species which are affected by this measure are the osprey *(Pandion haliaetus)*, the grouse, the European nightjar *(Caprimulgus europaeus)*, the tawny pipit (*Anthus campestris)*, the red baked shrike *(Lanius collurio)*, the imperial eagle *(Aquila heliaca)*, the red kite *(Milvus milvus)*, the sea eagle (*Haliaeetus albicilla*) and the black kite *(Milvus migrans)*. The mating season of those birds is during spring time often from March till May.

6.3.2 Compensational measures

In Austria mainly constructional measures are applied, mostly targeting bird species. The compensational measures mostly specify a size of the compensation area, which needs to be constructed. The size of the compensation area increases over time. The purchase of the required area for compensation is rather difficult in reality, especially for smaller project developers. Mostly arable land is considered for a compensation area in Austria. This could also be achieved by a combination of arable land as compensation area, like in the case of the construction of an orchard, the use of early cultivations on the field or taking out trees of the production forest, which could stay as a nesting area for bats.

Another example for a constructional measure is showing the visibility of a turbine like in the Case study of Handalm in Styria, Austria. The color green is standardly as color of wind turbine pillar, to rise the visibility for birds.

In Sweden on the other hand, compensation measures are rarely used for birds and not used for compensation of bats, as shown in the examples of EIA case Studies from Sweden. If a species is threatened, it is often the case that the permit is denied like in the Case of “Bordsjö”, “Vaggeryd”, “Berg” and “Vraneke”.

Thus, the construction of a new compensation area usually takes more time to evolve, the estimated time for visible effects have been chosen a medium-term effect.

6.3.3 Monitoring

Monitoring is not a direct mitigation or compensation measure but supports the development of mitigation management in the future. According to the outcomes of the table on birds and bats EIA Case Studies of Austria and Sweden, this category is mostly implemented in Sweden. Sweden has implemented a wide range of monitoring measures in their Environmental Impact Assessments. Bat monitoring is state of the art in nearly all case studies in Sweden.

Nevertheless, all recent case studies in Austria do involve mandatory bat monitoring as well. The EIA example of Pretul in Syria, Austria asks for a plan of ecological oriented construction to assure that species are not harmed throughout the whole phase. This a very outstanding example.

In general, it is unusual that the ecological influences of a specific project are monitored over the long term. There is data already available how bird species react to wind turbines, that Swedish and Austrian experts relate to. The EIA case study of "Brahehus", which got its permit in 2011 requires collecting dead birds and bats, as a monitoring measure, to gain experience on interaction of wind energy and fauna. In the Example of "Karsholm" in Sweden a special Action Program for ospreys *(Pandion haliaetus)* have been implemented. This Action program lays out special requirements for ospreys *(Pandion haliaetus)* and includes several actions of constructional ban, construction and temporal measures.

6.3.4 Construction of wind turbines in forest or in open land

Forested land is always described as a bottleneck in the Austrian literature (Federal ministry for sustainability and tourism, 2019). This can also be seen by the number of wind turbines which are built in forested areas. There is hardly any built in the early EIAs, nowadays the number increases. First Austria developed wind turbines only in the open and windy landscape of Burgenland. On the contrary the results of the Swedish EIAs, the wind turbines are mainly constructed in forested land, mainly production forest. The Swedish turbines are mostly taller due to that reason, so that the energy production can still be assured. The development of wind turbines in forested areas is wanted and supported by the Swedish government.

6.3.5 Mitigation and compensation measures for birds and bats in the federal states of Austria and Sweden

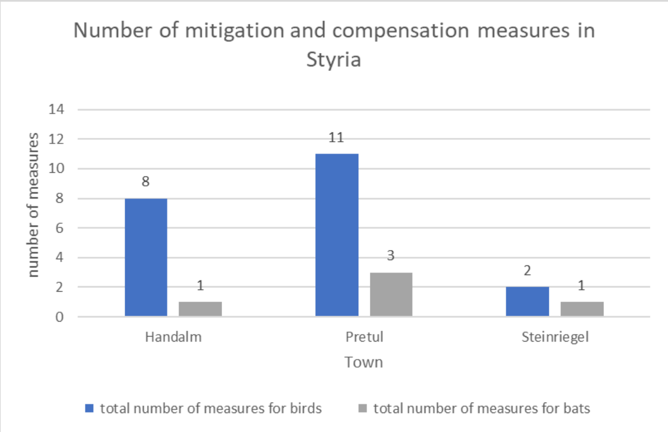
As a result of this research, both countries implemented a wide range of compensation measures for birds. The measures for birds are much more significant than the ones for bats. Especially the early EIA Case Studies do not include any mitigation or compensation measures for bats.

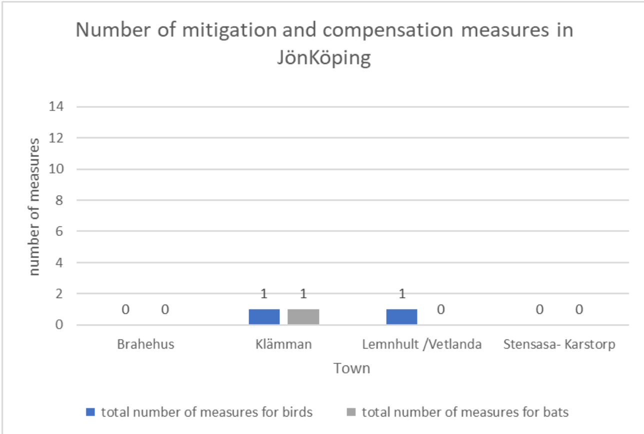
Later the number of mitigation and compensation measures for bats, especially monitoring and temporal measures increased. The awareness of the importance of bats is increasing. Sweden implements special monitoring programs for bats, as well as for ospreys *(Pandion haliaetus)*.

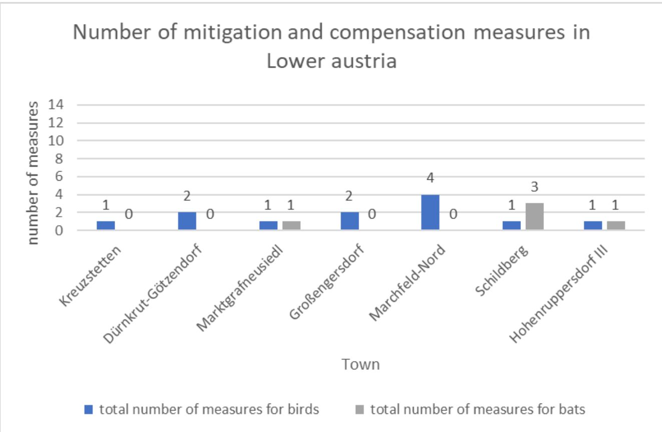
The followings table 19 shows the differences of numbers of mitigation measures in the federal states of Austria and Sweden. The project of Pretul with a total number of 14 mitigation and compensation measures, shows the highest number of measures. In total more measures are observed in Austria, than in Sweden through these 30 case studies. In Sweden is it often the case, that no measures are mentioned, then the number shows zero measures.

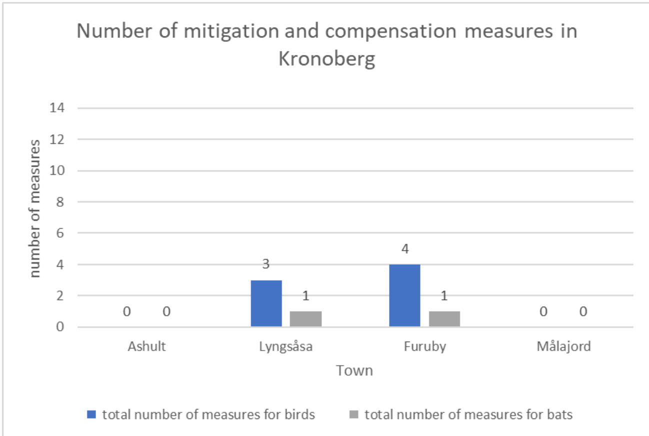
Table 19: Number of mitigation and compensation measures in the federal states of Austria and Sweden

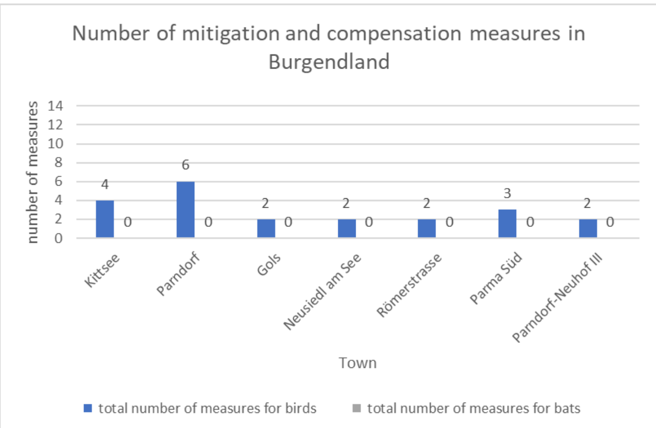
Austria (left side)	**Sweden (right side)**

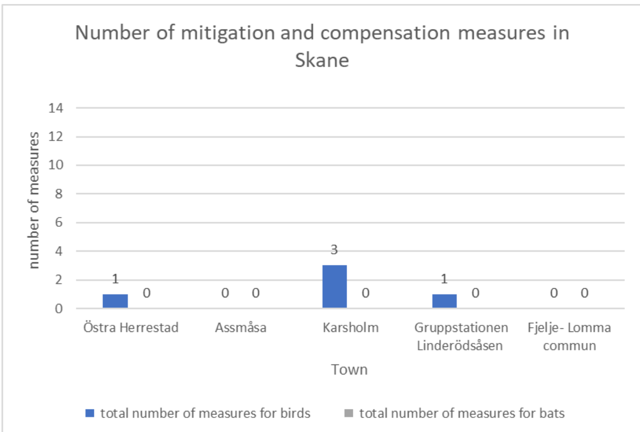












6.3.6 Correlation between size of wind park and measures in Sweden and Austria

Sweden

The correlation coefficient of the size of the wind park and the amount of measures for birds in the Sweden is 0,224. This coefficient is low; therefore, little correlation can be seen. Most studied EIA Case Studies in Sweden have 5 till 10 wind turbines. The correlation coefficient 0,006 for the studied EIA wind parks in number of wind turbines to the number of measures for bats is significantly low. Therefore, no correlation can be seen.

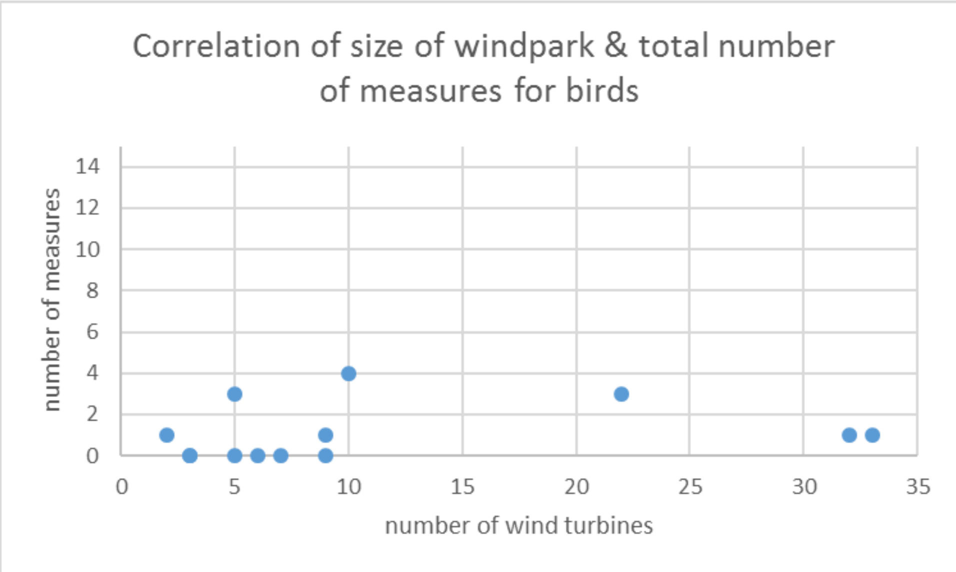


Figure 8:Correlation of size of wind park and total number of measures for birds in Sweden, Andresek, 2019

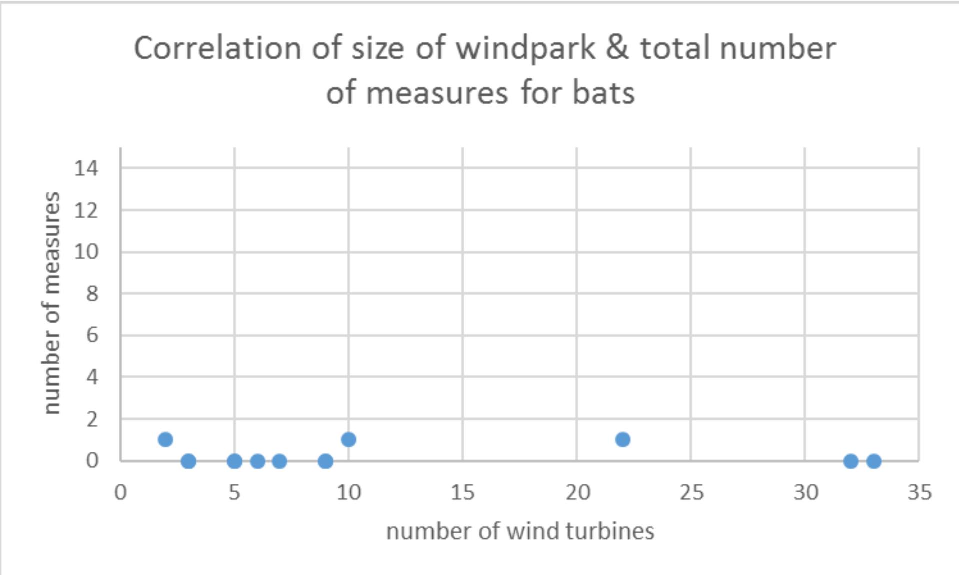


Figure 9:Correlation of size of wind park and total number of measures for bats in Sweden, Andresek, 2019

Austria

The correlation coefficient of the size of the wind park and the amount of measures for birds in the Austria is 0,171. This coefficient is low; therefore, little correlation can be seen. Most studied EIA Case Studies in Austria have 10 till 20 wind turbines. Therefore, the studied onshore wind parks in Austria are larger than the one sin Sweden. The correlation coefficient -0,265 for the studied EIA wind parks in number of wind turbines to the number of measures for bats is also low, but higher than the one for birds.

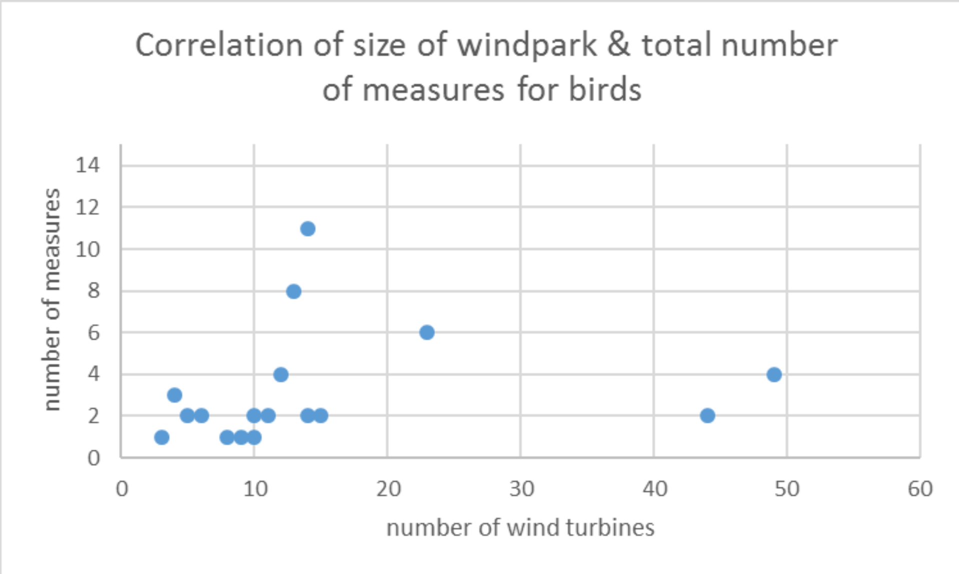


Figure 10:Correlation of size of wind park and total number of measures for birds in Austria, Andresek, 2019

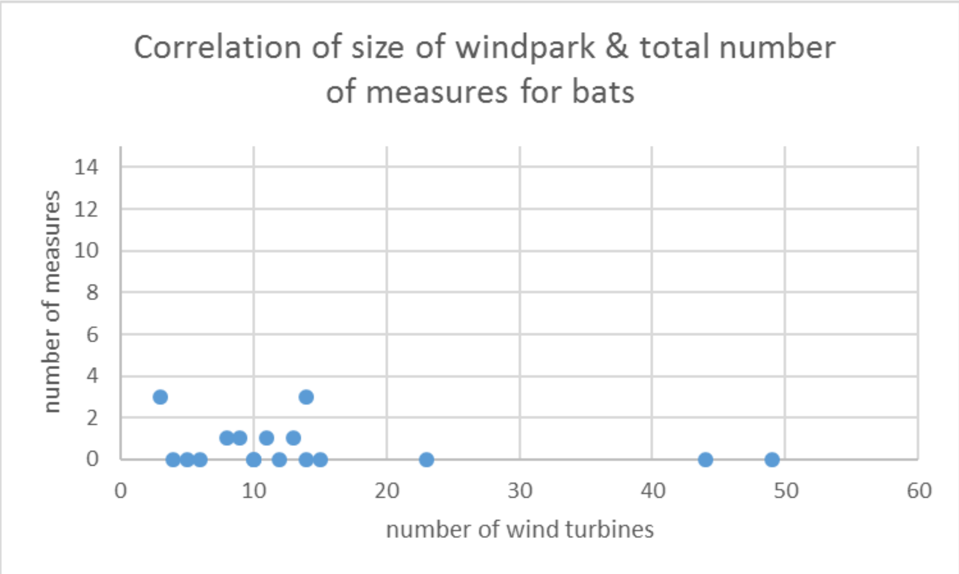


Figure 11:Correlation of size of wind park and total number of measures for bats in Austria, Andresek, 2019

6.3.7 Correlation between age and measures

The hypotheses stated that the quantity of compensation measures for birds and bats are rising over time in Austria as well as in Sweden. Monitoring measures have been excluded from this statistic, as the main concern of this thesis are the mitigation and compensation measures.

Sweden

The results show that there is very little relation between the year of decision of the EIA and the number of measures for birds, as the correlation coefficient 0,244 is low. The correlation coefficient for bats is slightly higher with 0,323. Figure 12 shows that the first measures for bats have been implemented in 2013 in Sweden.

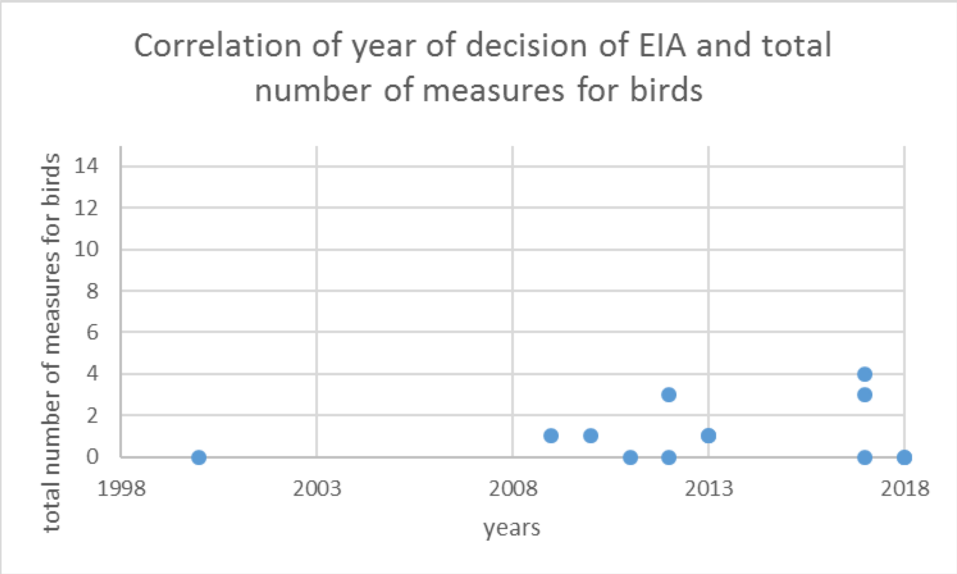


Figure 12: Correlation of year of decision of EIA and total number of measures for birds in Sweden, Andresek, 2019

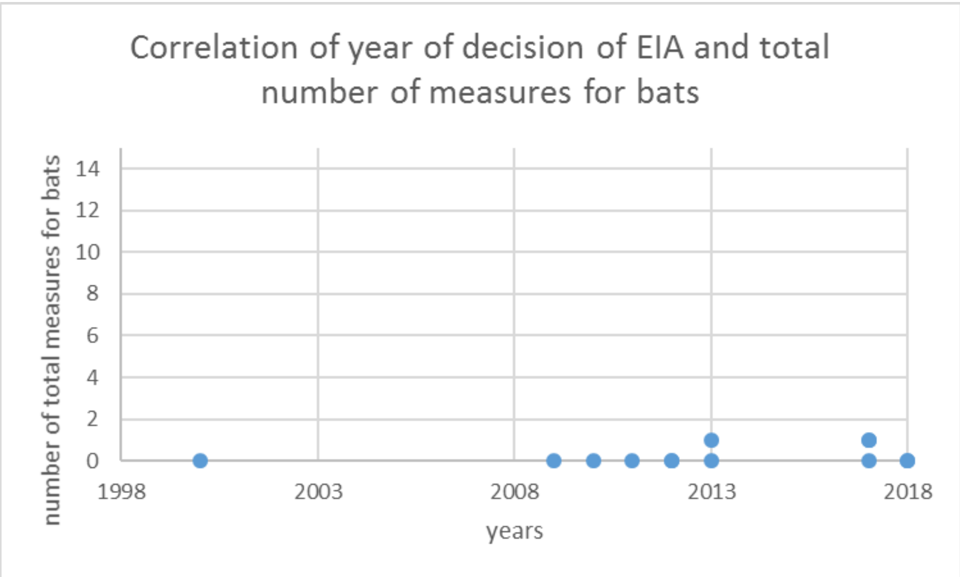


Figure 13:Correlation of year of decision of EIA and total number of measures for bats in Sweden, Andresek, 2019

Austria

The results show that there is very little relation between the year of decision of the EIA and the number of measures for birds, as the correlation coefficient 0,067 is very low. The correlation coefficient for bats is significantly higher than all others with 0,618.Figure 14 shows that the first measures for bats have been implemented in 2010 in Austria. Only 6 case studies show that it has been obligated to conduct compensation or mitigation measures.

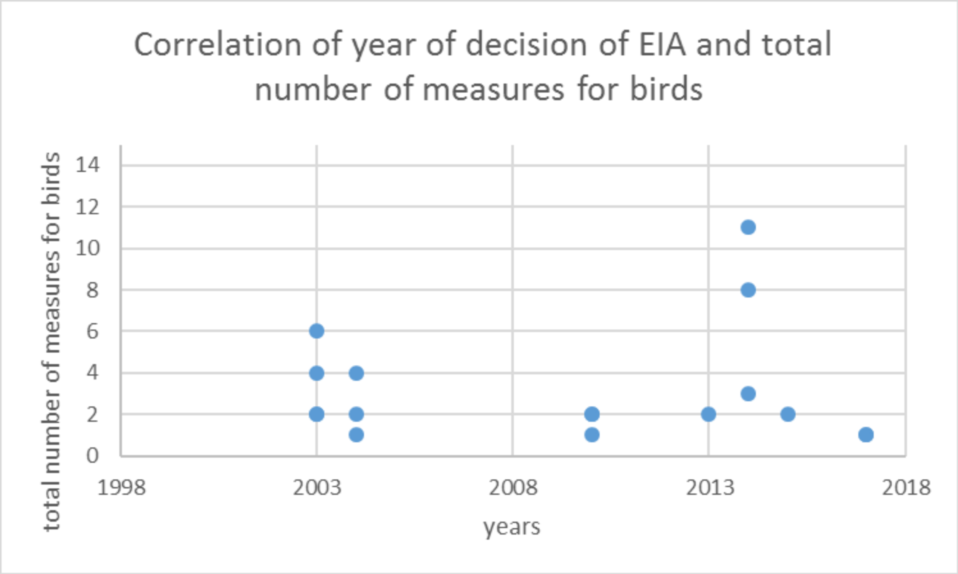


Figure 14:Correlation of year of decision of EIA and total number of measures for birds in Austria, Andresek, 2019

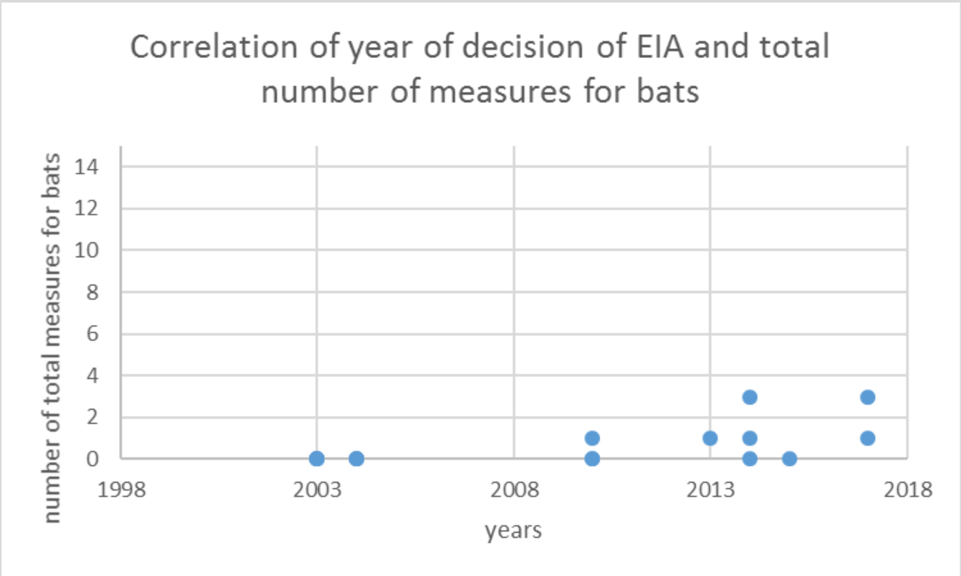


Figure 15:Correlation of year of decision of EIA and total number of measures for bats in Austria, Andresek, 2019

7 Discussion

7.1 Methodological criticism

Peste et al. show several measures that may be implemented to compensate the residual adverse effects of wind farms on bat populations. These measures are intended for the improvement of ecological conditions towards the increase of the carrying capacity for bat assemblages, specifically for breeding and roosting conditions and the increase of prey availability and accessibility (Peste at al., 2014, p. 4). They concluded that most of the measures they have analyzed are for the enhancement of habitat heterogeneity at the local, as well as at the landscape level. They have studied in their paper that "maintenance of native forests and the management of production forest should promote an increase in the availability of roosting and feeding grounds, including the improvement of foraging microhabitats. The creation of natural reserves, the establishment of agreements and partnerships with local owners, and the development of environmental education sessions for local communities may also contribute towards the achievement of no net loss and in some cases a net gain for bat populations" (Peste et al., 2014, p.10). The process of literature research has been of great importance to understand the topic and evaluate the complexity of wind farm permission and wildlife planning. To understand the effects of wind turbines on wildlife it matters to comprehend how wind turbines work in a technical sense, as wind streams and flows have an influence on wildlife.

Secondly the analysis of the legal background is the appropriate tool to elaborate on the similarities and differences of the process of EIAs of wind parks. Thus, in this step difficulties on the comparability of the national laws appeared. The implementation of the EU Directive 2011/92/EU displays differently in the two-member states. Sweden applies the same law on EIA and nature conservation in the whole country- Austria, on the other hand applies the EIA law in the whole country though applying different nature conservation law in each federal state. In the extent of this thesis, it has only been possible to show EIA case study examples in some of the federal states of Sweden and Austria. This leads to an incoherence of the methodology, as not all the studied legal background could have been proven through the empirical analysis of the EIA Case studies. As a result of the availability of data only three federal states of each of th two Member States have been chosen due to their history of wind energy planning and their comparability of topology and landscape. Thus, the outcome inevitably leads to inaccuracies in the analysis because the data only gives a brief glance on the implementation of wind energy planning in total.

The methodological approach could have been enhanced by interviews with stakeholders in both countries. Qualitative Interviews of experts and stakeholders in the field could have given more insight into the actual practice and planning process and decision making. Unfortunately, it has not been possible in the merits of the amount of workload of this thesis.

Reports by UNECE and the European Commission made it possible to get an insight into the current practice to see where similarities and problems appear during the permission process. The assessment of the case studies gives an insight into the used mitigation and compensation measures and whether they are monitored or not. The method proposed by Peste et. al (2014) is reasonable and could also study other species like insects.

7.2 Analyses of the hypothesis

7.2.1 Enforcement of the EU directive (2011/92/EU) on the assessment of the effects of certain public and private projects on the environment

- The EU directive (2011/92/EU) shows incomprehensive disparities in the implementation of the directive concerning the compensation measures of birds and bats by the national legislator of Austria and Sweden.

Having considered all issues, incomprehensive differences in the implementations of compensation measures can be seen. The analyses of the EIA case studies show that the application of the national legislation come to different results. The type of mitigation and compensation measures for birds vary widely between Austria and Sweden. On the other hand, the mitigation and compensation measures for bats are very comprehensive. The missing of compensation measures for bats when the EIA has been implemented in the two countries can be attributed to the lack of knowledge on bat behaviour in the area of wind turbines (Arnett, 2015). At a later stage, experts in Austria, as well as in Sweden, that looked into studies of Köppel, Schuster, Rydell and others requested for similar avoidance measures mainly.

Referring to birds, one concludes that the compensation measures for birds vary widely due to the species affected, as well as on the context of the nature conservation law applied. The measures are changing over a period of time. This could be partly due to changes in EIA law and nature conservation law but could also be caused by case studies which have given examples of how certain measures work and how certain measures shall not be applied anymore. Some of the examples are being given by court cases after the EIA permit process. Having considered all the studies that have been made on the behaviour of birds in general and certain bird species and their behaviour next to wind turbines seen in Schuster et. al who has summarized studies done worldwide, mitigation and compensation measures shall be comparable as all known effects have been studied.

In fact, the enforcement of the EU directive (2011792/EU) shows a very similar implementation into national law in the two chosen countries. The process varies in detail. According to the Austrian expert opinion of the report on “land use through compensation measures” (2019) by the federal ministry of sustainability and tourism, the current enforcement practice prefers compensation measures that have a high nature conservation effectiveness but place the least possible burden on agriculture. This includes, for example, measures on sites with a nature conservation value and i.e. sites that already have a certain nature conservation value (e.g. bushes of low-nutrient grassland). In this context, improvements in protected areas and implementation measures in Natura 2000 areas should also be considered to a greater extent than so far. It should be noted here that it is not only the planting of high-quality agricultural production areas that represents an upgrading (Federal ministry of sustainability and tourism, 2019). As stated by the Austrian experts, the most common areas used for compensation have been agricultural areas. This has not been proved by the analysis of the EIA Case Studies. The compensation areas are most likely on site. In the federal state of Styria, the most compensation areas are in forested areas. In Sweden one can see that most onshore wind turbines are being installed in forested areas, or around forested areas My opinion is that the policies are interpreted very differently. Because apart from the actual planning and permit process, Sweden has a very strong energy spatial planning in force. They have a strong political national agenda and strategy developing renewable energy, especially in forested areas. Most of Sweden's landscape is characterized by forests.

7.2.2 Differences in depth of detail in the mitigation and compensation measures

- Due to variances of the legal processes of EIAs, mitigation and compensation measures can show differences in depth of the process.

The results show different variations in warding of selected mitigation measures analysed. The precise formulation of mitigation measures shows major differences. Some are only stated by one simple sentence and room for interpretation is left for the developer. On the other hand, some mitigation measures are substantiated into every detail, which can be more often stated about the more recent EIA case studies, especially in Styria. As in Austria there is a lack of a national standard for a common ground in nature conservation law, it is seen in the results that there are differences in each state on the number of measures. Styria has the highest amount of mitigation and compensation measures in two of the three case studies conducted in the county of Styria, Austria. One observed that the literature studied does not give an answer to that question. Having listened to the experts in the field during the "Austrian Infrastrukturtag" on the 23rd of March 2019 in Vienna it is rather the outcome of the court cases that influences the making if the EIA in this way that it gets more detailed in the depth o the process.

The bird- and bat species inventories show very similar approaches nowadays and lead to comparable results. These results are interpreted in different depth of detail. In Sweden it is rather one exceptional species like the Osprey *(Pandion haliaetus)* that gets attention from the relevant testing authority. This result has also been seen in the study by Schuster et. al. who describe that raptors are of special risk of collision due to their flight behaviour. In Sweden all County Administrative Boards and consultants find it difficult to draw the line how well the species inventory must be done.

The Austrian Federal Ministry for Sustainability and Tourism has recently published a report on land consumption by compensation measures, as this is also seen as a struggle by different stakeholders. Likewise, the Swedish Government sees a lack of communication and understanding of compensation and the EIA as a whole and therefore also published a guideline called "Practical guidelines on strategic environmental assessment of plans and programmes".

The depth in detail gets more over time, as the experience on this topic is rising and more EIAs can be used for proving new EIS studies for the EIA of wind turbines. In short, the more information is available, the more the EIA information on compensation measures is explained in detail. The authority as well as the developer wants to make sure that all information is given, so that the permission can be given, and the construction is able to start. The developer is afraid that the permission might fail, and this could lead to even higher costs.

In general, in Austria it is very unlikely that a developer would apply for an EIA in a risky situation, therefore there are almost no rejections of permits in Austria, once the EIA permitting process has started. Thus, in Sweden it is more common that permits including an EIA get rejected. Some of the EIA case studies analysed in Sweden have still not been approved or have been rejected, some have been taken up by another developer some years later.

Increase of number of compensation measures over the last twenty years

- **The quantity of mitigation and compensation measures for birds and bats are increasing over time in Austria and Sweden.**

The Swedish EIA case studies have been analysed from the counties of Skane, Jönköping and Kronoberg. In conclusion, the study showed that differences in the EIAs can be seen in each county, although the Environmental Code is the only law which needs to be implemented concerning environmental impacts. The results illustrate that there are differences in Austria and Sweden and between birds and bats. The study could not proof that the quantity of mitigation and compensation measures for birds has been rising during the last years. But the quantity of measures for bats has been rising, as the first has been conducted in 2010 in Austria, as well as in 2013 in Sweden. The significance of the increase of mitigation and compensation measures for Austria is higher than the one for Sweden. Mostly monitoring measures are conducted by the authority, to gain more knowledge about the influence of wind turbines on bats, as this has been stated by Arnett (2015).

In Sweden most EIA reports cite Ashult (2016) who says that most consequences on the environment of wind turbines are small on bird and bat fauna. He is certain that wind energy production stops climate change, which he sees as a positive consequence for the natural environment (EIA, Ashult, 2016). Climate change is a major reason for Sweden's fast wind development and explains the positive effects of wind energy in the Swedish permissions as the draft Swedish integrated national energy and climate plans (2018) stresses out.

The data shows an increase of mitigation and compensation measures for bats in both countries over the last 10 years. The findings show that at the beginning no measures for bats have been made. Later as the knowledge of bat's interference with wind turbines has been rising, the number of measures for the protection of bats increased. It manifests that in the future it is likely that there will be measures for the protection of bats applied in the EIA more regularly. From my point of view, it is not likely anymore that the mitigation and compensation measures for bats will rise as much as it has been the last 10 years, as the knowledge about the behaviour of bats close by wind turbines has been investigated on. The point is though that if the techniques of wind turbines change, as for example developers build higher than before, new investigations need to be done. This could lead to new, even more efficient energy generation and less damage and disturbance for bat populations. The mitigation and compensation measures need to be adapted in the future.

The same results cannot be seen with bird species. There it states where the number of measures for birds decreases like in Lower Austria or in the federal state of Skane. In some states it increases like in the case of Styria. The correlation of a rising number of measures over time cannot be proofed. Therefore, I conclude that no clear trend can be expected from the analysis of the EIA case studies in this thesis. There is no explicit outcome manifested in the case of birds.

Having outlined the main arguments, it can be seen that the conservation of species needs to be seen in a more comprehensive way and that monitoring measures are increasing. This is shown by the osprey programme in Sweden, which require a whole set of comprehensive compensation measures as a package.

7.3 Current discourse in the field of Environmental Impact Assessments and relevance of the thesis

7.3.1 The threat of wind turbines for insects and other species

Currently the killing of insects through wind turbines is heavily discussed. The German Aerospace Center is inspirers with a model calculation which states that according to the model, wind turbines kill billions of insects - on every single summer day. Nevertheless, it is the transition from CO2 based energy to renewable energy which is the main saver of the biodiversity of species, through the stop of climate change. Experts from the field of nature conservation agree with the experts from the sector of wind energy production as they see this transition as the most important change before saving single animals, rather than save the whole species due to a more coherent change. Shall this apply also to other species like bats and birds? In fact, this is the green versus green dilemma that Köppel et. al (2014) describes, there are policies which support renewable energy and others to protect wildlife. Those need to be coherently aligned.

7.3.2 Monitoring of compensation areas after a certain period of time-reclassification

There is a public discourse in the field of Environmental Impact Assessments and nature conservation on the topic of compensation areas and a reclassification of the spatial use after a certain period of time. The Austrian report on land consumption by compensation measures questions the purpose of the compensation measure. Most of the Austrian compensation measures are foreseen in arable land (Bundesministerium für Nachhaltigkeit und Tourismus, 2019 p 43). Hence experts in the field in Austria request for less afforestation in highly productive agricultural land (Bundesministerium für Nachhaltigkeit und Tourismus, 2019 p 43).

It is rather recommended that industrial and commercial brownfield site shall be renatured. This is particularly useful if habitats for rare species can be secured or expanded. As a rule, a very high potential for upgrading is to be assumed, since impaired functions of the natural balance can be directly balanced and, beyond that, natural soil functions can be restored. Finally, there is no security on what happens with the compensation areas after the project is realized and finished. This leads to a lot of insecurity of compensational areas. For example Germany has started an eco-accounting system for offset and compensation measures (Ojowski, 2013). In this way the areas of high nature value can be accounted for a longer period of time and are formalised into a spatial plan. It is forbidden to impair the natural value of the area.

7.4 Recommendation for action

The awareness of climate change in the society is growing. The movement "Fridays for future" where students strike for a healthy climate for future generations has kept the attention of media worldwide. This is leading to wider acceptance of renewable energy and wind energy. There is continuously growing knowledge in the field of EIAs in the wind energy sector, due to the expansion of wind energy worldwide. The outcomes of knowledge of the practised EIAs and EISs shall be used for further wind turbine permissions.

Firstly, there is a need to strengthen energy spatial planning. Available energy spatial plans lower the entry barriers for potential developers to start a wind energy project and to request the authority for an EIA and a permission. Even after the construction, good designed landscape plans for integrated compensation measures, which are planned beforehand can help to faster find possible solutions for needed compensation measures. The use of local and supra-regional development concepts or comparable planning instruments for nature conservation aspects should therefore be presented and dealt with equivalent to agricultural aspects. In addition, the regional spatial and landscape planning prepares excellent possibilities for combinations of compensation and other uses of space. The earlier a developer knows where to possibly build a wind park and where he could possibly compensate potential damage on birds, bats and other the more likely it will be that he would start a project.

Secondly the authority shall make use of methodological guidelines. There are several methodological guidelines available on the process of EIA on a regional, national and European level. It would be interesting to know why certain guidelines are used and others are not.

Thirdly I would recommend a simplification of nature conservation law in Austria. After analysing the Swedish Environmental Code and studying how it is used in the whole country, it is seen that it is easily and commonly used in all regions of Sweden. Therefore, the EIAs are similar structured and the measures are required alike for the same species. Hence, I recommend a change of nature conservation laws in Austria. It is often the same species in all federal states that are endangered by wind turbines and would need the same amount of protection.

8. Summary

This thesis deals with the threats of bird and bat species due to wind energy. How does the EIA in the wind energy permission process deal with this issue? The examined countries are the two member states of the European Union Austria and Sweden, who actively promote the development of renewable energy through their policies.

Wind energy demand in the European Union is increasing due to the 2020 targets that the EU set for renewable energy. EU citizens consume more energy per citizen during the last decades while awareness of climate change is rising, as demonstrated for instance by the movement “Fridays for future”. New energy technologies like wind energy are facing bottlenecks in respect to concerns of nature conservation. The European Union and its Members States implemented a series of European nature conservation laws. The major law analyzed in this thesis concerns large wind parks. It is the EU directive on Environmental Impact Assessment “EU Directive 2011/92/EU”, which asks for minimum requirements for the level of protection of the environment and human health.

This study compares the different measures advised in Environmental impact assessments (EIA)to avoid or offset potential harm to birds and bats in proposed wind parks in Austria and Sweden. Firstly, a literature review formed the basis of the research, underlining and discussing the differences in implementation of EU law into national law. Secondly the assessment is based on the analyses of about 30 case studies of EIA’s in the two Member States utilizing the methodology by Peste et. al. (2014), who assesses the offset and compensation measures on the criteria of target species and expected of the suggested measures. The method has been adapted and includes the analyses of bird species. The analysis from this study outlines the potential opportunities, constraints and bottlenecks from the implementation of mitigation and compensation programs. The proper implementation of wildlife planning policies is in need for further adjustments. The analysis of the results and hypotheses leads to the following conclusions:

- The EU Directive 2011/92/EU has been sufficiently implemented into national law in both Member States and has been adjusted in both countries over time. The last change of the Austrian UVP-G, Austrian Law has been in 2018 and the last change of the Swedish Environmental Code has been applied in 2009. The process of the EIA is similarly implemented. The great difference in nature conservation law is that Sweden has one environmental code for the whole country, on the other hand Austria has nine different nature conservation laws for each federal state.

- The adopted method by Peste et. al (2014) shows difficulties in comparing mitigation and compensation measures with each other, as they are phrased very differently and had to be simplified to fit into the selected methodological approach. Incomprehensive disparities have been found between federal states, countries and over a period of time, which means that the number of mitigation and compensation measures varies. The number of mitigation and compensation measures in the Austrian counties is higher than in the Swedish counties.

Differences in the mitigation hierarchy have been observed, as Swedish wind energy projects get rejected more often. Sometimes the same or a different project developer retries to get a permit for a similar project. In Austria almost every wind energy project, requiring an EIA gets approved.

- Disparities in depth of detail in the description of mitigation and compensation measures have been found. Hence it is unclear for the developer how much freedom he/she will have for the implementation of the mitigation and compensation measures. It has also been observed that the depth in detail of mitigation and compensation measures increases over time in the case of bats. Less disparities over time in depth of details have been overserved in the case of birds. The differences of mitigation and compensation measures for birds are rather seen in different federal states and countries, as the measures might be very specific to certain species.

- An increase of number of mitigation and compensational measures for bats can be proved during the last decades. No higher quantity of mitigation and compensation measures have been observed for birds. The threat of bats being killed by wind turbines has been rarely studied before the year 2010. Since 2010 more measures are implemented than before, as the knowledge in bat behaviour around wind turbines has been growing. The number of measures for birds is differentiating in the countries and federal states. Measures that have been used in other EIA cases, are often used again by experts for more recent EIAs of wind turbines.

- There are disparities on where and how to implement compensation areas. In Sweden, there are practically no compensation areas in arable land. Instead they are located on forested land. It is therefore to ask whether Austria could also implement a greater number of compensation areas in forest land.

In a further research, it would be of great interest to analyze, how the measures are monitored and have changed since the end of the EIA until today. It is of great interest to see how the measures have changed or not changed the local biodiversity and number of individuals of birds and bats in the area of the wind turbines. One could ask, whether there should be a monetary refund of developers that rise the number of individuals of bird and bat species after the wind energy development.

The outcome could be enhanced by involving experts in the respective countries. Interviews would contribute to a more specific understanding of the bottlenecks in the field of wind energy permissions and wildlife planning.

In the future, more EIAs in the field of wind turbines will lead to greater knowledge. The knowledge about the interaction of fauna and wind turbines need to be implemented in mitigation, compensation and monitoring measures. This might lead to more stability in the EIA process and to advanced implementation of mitigation and compensation measures for birds and bats in the future.

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List of abbreviations

CAB	County Administrative Board (Sweden)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
SEPA	Swedish Environmental Protection Agency

Appendix

Appendix 1 shows an Overview of all Swedish EIA case studies:

Competent EIA authority	Project Applicant	Town	Number of turbines	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Jönköping Län-County Administrative Board	Brahehus Vind AB	Brahehus	9	Siemens SWT-101	2,3 MW	150		hilly/ mountainous	forest	2009	2011
	Klämman Vind AB	Klämman	2	Vestas V 112	3 MW	200	112	hilly/flat	forest	2011	2013
	Lemnhult Energi AB	Lemnhult /Vetlanda	32	Vestas V 112	3 MW	185	112	hilly/ mountainous	forest	2011	2013
	Eolus Vind AB	Stensasa- Karstorp	7	Vestas V90	2 MW	105	90	hilly	forest		2012

Figure 16:Analysis of mitigation and compensation measures in Jönköping,Sweden , 2019, Andresek

Competent EIA authority	Project Applicant	Town	Number of turbines	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Kronoberg Län-County Administrative Board	BayWa r.e. Scandinavia AB	Ashult	6	Siemens SWT-3.6-130	3,7MW	250	130	hilly/flat	forested	07.12.2016	2018
	BayWa r.e. Scandinavia AB	Lyngsåsa	22	Vestas V 136	3,45 MW	210	136	hilly/ flat	forested	08.05.2015	23.01-2017
	Furukraft AB	Furuby	10		3,45MW	220	130	flat	forested		2017
	Mångkraft AB, BayWa r.e.	Målajord	3		3,45MW	210	130	hilly/ flat	forested	2014	2017

Figure 17:Analysis of mitigation and compensation measures in Kronoberg Län,,Sweden , 2019, Andresek

Competent EIA authority	Project Applicant	Town	Number of turbines	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Skane Län- County Administrative Board	Östra Östra Herrestad Vind AB + Vattenfall	Östra Herrestad	9	Vestas V90	2 MW	86	83	flat	open land	2005	2006 + again 2010
	EURO WIND AB	Assmåsa	3	ENERCON E-66	1,5 MW	98	66	flat	open land	1998	2000
	BayWa. r.e. + HS Kraft AB	Karsholm	5	Enercon E82 + Nordex N90	2,3 MW	150	82	hilly/ flat	forested	2007	2012
	HS Kraft AB + BayWa. r.e.	Gruppstationen Linderödsåsen	33	Enercon E82 ,Siemens SWT-2.3-93,Vestas V90,Gamesa G87	2,3 MW	150	82	hilly/ flat	forested/open land	2007	2009
	Renewable Energy in Sweden AB	Fjelje- Lomma commun	5	Enercon E 70, Nordex N80	1,5 MW	85	83	flat	open land	2000	2002 + 2018 again

Figure 18:Analysis of mitigation and compensation measures in Skaneb Län,,Sweden , 2019, Andresek

Appendix 2 shows an Overview of all Austrian EIA case studies

Competent EIA authority	Project Applicant	Town	Number of turbines	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Styria	Energie Steiermark AG	Handalm	13	Enercon E-82 E4	3 MW * 13	119	82	mountainous	forest	20.12.2013	21.11.2014
	Verbund+ ÖBF	Pretul	14	ENERCON E-82-4	3MW * 14	119	82	mountainous	forest	13.9.2013	12/12/14
	ECOwind Windenergie Handels- und Wartungs GmbH	Steinriegel	11	ENERCON E70-E4	2,3MW*11	120	71	mountainous	forest	Feburar 2011	01.02.2013

Figure 19:Analysis of mitigation and compensation measures in Styria Austria, 2019, Andresek

Competent EIA authority	Project Applicant	Town	Number of turbines	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Lower Austria	Windkraft Simonsfeld GmbH & Co KG	Kreuzstetten	10	Vestas V80	2 MW*10	100	80	hilly	open land	28.8.2003	23.11.2004
	WEB Windenergie AG	Dürnkrut-Götzendorf	10	VESTAS V-90	20MW	150	90	hilly/flat	open land	06/08/09	12/10/10
	evn naturkraft Erzeugungs- und Verteilungs GmbH	Marktgrafneusiedl	9	REPOWER MM-92	2,05 MW *10	146,25	92,5	flat	open land	04/12/09	11/08/10
	Ökoenergie Projektentwicklung GmbH	Großengersdorf	5	ENERCON E-82	2MW*5	149,3	82	flat	open land	15.4.2008	10/12/15
	EVN Naturkraft GmbH & Co KG + WWS ÖKOENERGIE GmbH & Co KG+ WEB Windenergie AG	Marchfeld-Nord	49	Vestas & Enercon	98MW	100+105	80	flat	open land	30.6.2004	21.12.2004
	EVN Naturkraft Erzeugungsgesellschaft m.b.H.	Schildberg	3	Vestas V126, 3,3/3,45 MV	10,35MW	212	126	hilly	forested land	16.03.2016	25.04.2017
	Smart energy Betriebs GmbH	Hohenruppersdorf III	8	Enercon E-126 EP4	33,6MW	135	127	hilly	open land/forest		05.12.2017

Figure 20:Analysis of mitigation and compensation measures in Lower Austria, Austria, 2019, Andresek

Competent EIA authority	Project Applicant	Town	Number of turbine	Type	Performance	Height	Rotor	Topography	forest/ openland	Start EIA	Decision EIA
Burgenland	Austrian Windpower Betriebs GmbH & Co KG	Kittsee	12	Enercon E-66	43.6 MWh	85 +97	70	flat	open land		23.12.2003
	Austrian Windpower Betriebs GmbH & Co KG	Parndorf	23	ENERCON E-66	1,8MW*23	65+68	70	flat	open land	18.9.2003	17.12.2003
	Windpark Gols GmbH & Co. KEG	Gols	14	Vestas V80	2,0*14	152	80	flat	open land	14.4.2003	30.07.2003
	Austrian Windpower AG	Neusiedl am See	44	Enercon E-66	1,8MW*44	121	70	flat	open land	24.6.2003	13.08.2003
	Windpark Römerstrasse GmbH	Römerstrasse	6	Vestas V90	2,0*6	125	90	flat	open land	17.8.2004	30.11.2004
	Energie Burgendland Windkraft+ oekostrom Produktions GmbH	Parma Süd	4	Enercon E-101	12,20MW	135	101	flat	open land	20.12.2013	31.10.2014
	ImWind Elements GmbH	Parndorf-Neuhof III	15	Enercon E-101	45MW	135	101	flat	open land	15.10.2010	13.12.2010

Figure 21:Analysis of mitigation and compensation measures in Burgenland Austria, 2019, Andresek