Red Sea Wind Energy Wind (RSWE) 650MW Power Plant (500 MW + 150 MW extension) at the Gulf of Suez

Cumulative Effects Analysis

15 February, 2024

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Red Sea Wind Energy S.A.E. (RSWE) and its sponsors: Toyota Tsusho Corporation (TTC), Eurus Energy Holdings Corporation (EEH), ENGIE Energie Services S.A. (ENGIE) and Orascom Construction S.A.E (OC)

Issue and Revision Record:

Version	Date	Description	Prepared by	Checked & Approved by
Rev 0	15 February, 2024	Cumulative Effects Analysis	Alvaro Camina, ECOConsult	RCREEE/RSWE/EBRD
FINAL	8 April, 2024	Cumulative Effects Analysis	Alvaro Camina, ECOConsult	RCREEE/RSWE/EBRD

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Executive Summary

This report presents the findings of a rapid analysis of the potential cumulative effects on biodiversity of wind farms in development by Red Sea Wind Energy Project on the Gulf of Suez, Egypt. The report builds on the findings of the Cumulative Effects Analysis that was undertaken for the Lekela, Amunet, NIAT, and Infinity Wind Farms, all located in the vicinity of the RSWE project or within the same Flyway area to the south. The analysis identifies priority bird Valued Environmental Components (VECs) (IFC 2013) and a preliminary list of other VECs. High-level mitigation and monitoring actions that will be adopted by RSWE are presented.

Additional actions that RSWE and other developers in the study area will undertake or support to address their contribution to the cumulative effects of their developments together with others in the region are also presented.

To determine priority bird VECs for the Projects, the approach that was followed was originally modelled on the Tafila Region Wind Power Projects Cumulative Impact Assessment (IFC 2017), and has been modified to the local conditions and data available through a previous Cumulative Effects Analysis that was undertaken for the Lekela 250 MW wind project (TBC, 2018), Amunet 500 MW (2022), Infinity I 200 MW (2023), Infinity II 320 MW (2023), and NIAT 500 MW (2023). Similar to them, a staged screening of the list of preliminary bird species was undertaken, to develop a final list of priority bird VECs that were likely to be at greatest overall risk from the Projects. The data used in the process included all the data that was originally available for the Lekela CEA in addition to all recent data collected in the study area including RSWE's on-site assessments that were carried out in the autumns 2019 and 2020, and springs of 2020 and 2021.

This CEA incorporates and reflects the potential cumulative effects of RSWE's GoSII 500MW Wind Farm layout and its 150 MW extension (GoSII 150MW layout), which received governmental approval in 2024.

The process has identified 11 species, which had an Overall Risk of Major or Moderate, are considered priority bird VECs for the Projects.

Step 4 of the Tafila approach, identifying fatality thresholds for priority bird VECs, has not yet been undertaken as part of this process, but is planned to be undertaken in the near future and will be included in an updated version of the report.

In step 5, mitigation measures and monitoring actions are proposed, to be adopted by the RSWE project, and others that are proposed to be undertaken collectively and collaboratively by all wind energy developers across the study area. This mitigation and monitoring actions focus on the potential impacts to the 11 priority VECs are based on industry good practice while building on the already existing experience of adaptive management at operational wind farms along the Gulf of Suez.

1 INTRODUCTION

1.1 Scope and objectives

A Cumulative Effects Analysis (CEA) is a multi-layered analysis approach that aims at identifying and analysing the impacts of a set of projects on a pre-defined set of ecological elements; habitats and species. The CEA comes into context for the RSWE project since it is located in an area that includes multiple wind farms while being also located along a major bird migratory flyway, namely the Rift Valley Red Sea flyway. Although the impact of wind power project infrastructure on Migratory Soaring Birds (MSBs) is well documented, it should be highlighted that the CEA will not be limited to this context and will also take into consideration other ecological elements, including habitats and volant mammals (bats).

The CEA follows a series of multi-layered steps that would eventually identify the potential cumulative impacts of the projects of concern in order to eventually provide monitoring and mitigation measures that would be applied through an adaptive management approach. These steps would follow the approach that was developed under the Cumulative Effects Assessment for the Tafila Region Wind Power Projects in Jordan (IFC, 2017).

This analysis represents the initial steps in understanding potential cumulative effects to biodiversity of wind farm developments by RSWE S.A.E. and other operations in the Gulf of Suez, Egypt. It aims to identify priority Valued Environmental Components (VECs) which are most at risk from the combined impacts of all the existing and potential wind developments identified within the study area, building on the first CEA in the GOS, which was undertaken by Lekela Power Ltd. For Lekela 250MW Wind Farm, located to the south of RSWE Project. Most importantly, this CEA integrates the avifaunal in-flight monitoring assessments that were undertaken at RSWE 500MW project and its 150 MW extension (GoSII 500MW + 150MW) during the autumns of 2019 and 2020, and the springs of 2020 and 2021 migration seasons. This analysis also proposes mitigation, monitoring and other management actions for projects operating within the study area to address potential impacts to the identified priority VECs.

1.2 The Geographic Boundaries

The Project is located in the Red Sea Governorate of Egypt, around 200km to the southeast of the capital city of Cairo. More specifically, the Project is located near the Red Sea shoreline and within the Ras Ghareb Local Governmental Unit of the Red Sea Governorate, where the closest residential areas include Ras Ghareb city (located 40km to the southeast) and Zaafarana village (45km to the north). The Project is located within a 1,200km^2 area that has been allocated by the Government of Egypt to NREA for development of wind farms, (presented in red in Figure 1 below), which is the area for assessing potential cumulative effects on biodiversity covers the area targeted for potential wind farm development in the Ras Gharib – Gebel El Zeit area, Red Sea Governorate, Egypt. Within this, a land area of approximately 75.8km^2 (presented in blue in Figure 1 below) has been allocated to the Developer by NREA for the development of this Project.

Being located by the western coastline of the Gulf of Suez, the project site is located along the Red Sea/Rift Valley flyway, which is one of the most important migration flyways for migratory soaring birds in the world with over 1.5 million soaring birds migrating through it twice a year (Birdlife, 2020). The flyway links the European breeding grounds with the African wintering areas of for a total of 37 migratory soaring birds. Regular migration monitoring along the western coast of the Gulf of Suez where the project is located has shown that there is a significant difference in the level of use of the area during migration seasons. Research has shown that this part of the flyway is used by much larger numbers of birds during spring migration in comparison with autumn migration seasons.

Figure 1: Project Site (Red) as Part of the National-Decree Area Allocated for Wind Farm Developments.

Figure 2. Main routes used by migratory soaring birds as part of the Red Sea/Rift Valley Flyway (BirdLife, 2020)

The key projects considered within the area include the following:

1. Red Sea Wind Energy (RSWE) 500MW + 150MW Wind Farm (under development)

2. Ras Gharib Wind Energy (RGWE) 262.5MW Wind Farm (operational)

3. Lekela 250MW Wind Farm (operational)

4. AMUNET 500MW Wind Farm (under development)

5. NIAT 500MW Wind Farm (under development)

6. IPH 200MW Wind Farm (under development)

7. IPH 320 MW Wind Farm (under development)

8. Suez Wind Energy 1.1 GW overall project, which include the Plot 1 and Plot 2 subprojects (under development).

9. NOTE: See the full list of additional references from other projects and studies from which data have been used. All these were used and cited in the Step 2-see Appendix- when required.

1.3   The Temporal Scope

The different wind farms in the study area are in varying stages of development. Some have been operational for a few years while others have started operating less than a year while others are in the pre-construction preparation phase.

2   IDENTIFICATION AND SCREENING OF VECS

VECs are defined as attributes, both environmental and social, that are considered important in assessing the risks that a project or suite of projects poses to the environment. Identification of VECs was restricted to flora and fauna species (biodiversity), physical features and habitat via a desk-based exercise using published and grey literature.

Priority VECs were selected through an iterative process in consultation with the stakeholders. For each VEC group and/or potential impact, the following elements were discussed and were reviewed in the literature:

▪   Sensitivities

▪   Available data sources

▪   Activities and/or drivers other than wind projects

▪   Data ownership and access

3   THE APPROACH

The framework is based on internationally accepted approaches to risk assessment practices to identify priority VECs and aligns with the EBRD Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources Guidance Note 2022, and International Finance Corporation's (IFC's) Guidance Note 6 (GN6) applicable to other lenders. This framework for birds has two objectives: to identify those species at highest risk from the potential impacts of developments in the study area, and to propose mitigation, monitoring and other management activities to address risks to those species. This framework follows a five-step process, as follows.

- **Step 1**: develop a preliminary list of potential VECs, comprising species potentially at risk from developments in the study area, because they are either known or predicted to occur in the study area.

- **Step 2**: determine the relative 'Sensitivity' of the species, being a combination of the vulnerability of the species and Importance of the population recorded in the study area relative to the appropriate Unit of Analysis (UoA), i.e. the flyway population or global distribution. Species which were determined to have negligible sensitivity were dropped from analysis before proceeding to Step 3. Species where the flyway population comprised <1% of the global population, and for which any impact would be negligible for the species at a global level, were also dropped at this stage.

- **Step 3**: determine the Overall Risk to the species from the cumulative effects of wind farm developments within the study area, being a combination of the sensitivity, as identified in Step 2; and cumulative Likelihood of Effect (LoE) rating for each species. Those species with an Overall Risk of Major or Moderate are considered to be priority bird VECs for the project.

- **Step 4**: identify thresholds for fatalities for each priority bird VECs, by setting the point at which further loss is considered a risk to long-term viability of the population. Threshold setting takes into account species-specific biological and demographic parameters, the cumulative risk associated with WPPs, and the likely effects of external stressors on the population defined by the UoA. This step has not been undertaken and is planned to be undertaken at a later stage and will be included in a reviewed version of this report.

- **Step 5**: proposes a range of mitigation, monitoring and management actions, to avoid fatalities of priority bird VECs, and to accurately estimate priority bird VEC fatalities to facilitate compliance with thresholds and inform adaptive management responses.

Error! Reference source not found.**: Process for the identification of the priority VECs**

4   THE APPLICATION

4.1   Step1: Develop Species Population List and Identify Unit of Analysis

The purpose of step 1 is to identify all bird species or populations that could potentially be at risk from the cumulative effects within the study area and to determine a relevant UoA by which any effects on each species or population should be measured. A species population list of all bird species known or likely to be present in the study area was compiled from:

- Infinity IPH 200MW spring and autumn 2021, and spring 2023 avifaunal and biodiversity assessments, a total of three seasons,

- Infinity IPH 320MW spring and autumn 2022 avifaunal and biodiversity assessments, a total of 2 seasons,

- NIAT 500MW spring and autumn 2021 and 2022 avifaunal and biodiversity assessments, a total of four seasons,

- AMUNET 500MW spring and autumn avifaunal and biodiversity assessments (2020 – 2021), and spring 2022, a total of five seasons,

- RSWE 500 MW spring and autumn avifaunal and biodiversity assessments (2019 – 2021), and spring 2021, a total of four seasons,

- Lekela 250MW Wind Farm (2015 – 2021) avifaunal assessment, a total of 8 seasons,

- RGWE 262.5MW Wind Farm (2018 – 2021) avifaunal assessment, a total of 7 seasons.

The CEA's for the above-mentioned projects:

- CEA for Lekela Wind Farm (2015-2018)

- CEA for RSWE Wind Farm (2019-2021)

- CEA for AMUNET Wind Farm (2020-2022)

- CEA for IPH 200 MW (2023)

- CEA for IPH 320MW (2023)

- CEA for NIAT 500MW (2023)

And:

- RCREEE Strategic and Cumulative Environmental and Social Assessment Active Turbine Management Program (ATMP) for Wind Power Projects in the Gulf of Suez (RCREEE 2018);

- ACWA Power 1.1 GW projects in the Plots #1 and #2 north and south to Ras Gharib.

- The Migratory Soaring Bird Database (BirdLife International 2018b), is not operational by the time this update of the CEA is produced (February 2024).

- The lists of bird and bat species included in the assessment of global vulnerability to wind power development compiled by Thaxter et al. (2017), filtered by species mapped in IBAT as occurring in the project area as.

NOTE: See the entire list of additional projects under the reference section and in the Appendix Excel file.

These species were then allocated to one of three categories, and an appropriate Unit of Analysis (UoA) determined for each category:

- Category 1: Migratory Soaring Birds (as per BirdLife International 2018b), with the UoA being the Rift Valley / Red Sea flyway population. Data on populations of these species were sourced from Grontmij (2009), supplemented with information from Porter (2006) as needed;

- Category 2: Breeding and resident raptors, including species that were recorded at the study area and are known from literature to be breeding in the study area and its vicinity;

- Category 3: Other migrants and wintering species, with the UoA being the global breeding range extent (taken from BirdLife International 2017) as no national, regional or flyway-level estimates were available to allow a definition of a smaller UoA;

- Category 4: Other resident species, with the UoA being the same as for Category 2 species.

Step 1 produced a species population list of 193 bird species, see Table 1.

Table 1: Species population list of potential bird VECs

Order	Number of Potential VECs
Accipitriformes (diurnal birds of prey)	30
Anseriformes (waterfowls)	8
Apodiformes (swifts, treeswifts and hummingbirds)	3
Bucerotiformes (hornbills, hoopoe, wood-hoopoe)	1
Charadriiformes (shorebirds)	43
Ciconiiformes (storks)	4
Columbiformes (pigeons and doves)	3
Coraciiformes (kingfishers and allies)	5
Falconiformes (falcons and caracaras)	10
Galliformes (ground-feeding birds)	2
Gruiformes (cranes, crakes and rails)	5
Passeriformes (perching birds)	60
Pelecaniformes (ibis, herons and pelicans)	14
Podicipediformes (grebes)	1
Pteroclidiformes (sandgrouses)	2
Strigiformes (nocturnal birds of prey)	1
Suliformes (cormorants, gannets and boobies)	1

4.2 Step 2 – Identify species sensitivity

The purpose of Step 2 is to determine the sensitivity of each species or population identified in Step 1 based on its vulnerability at a national, regional, or international scale, depending on the UoA, and the

relative importance of the study area to the population. Sensitivity as considered here relates to the species population present in the study area, and combines two components:

- Relative Importance for each MSB species population was defined as an estimate of the proportion of the Rift Valley/Red Sea flyway population migrating through wind power projects within the study area. Owing to the practical difficulties of monitoring the entire Flyway, the population estimate for a species is given as the maximum seasonal count recorded at any of the Middle East bottleneck sites during the period of documented migration monitoring (Porter, 2006) recorded in the study area, and for other migrants and for resident species the global breeding range (sourced from Birdlife International species accounts), with ratings as per Table 2 and Table 3 respectively. For the population recorded in the study area, we have taken this number to be the maximum count recorded in any season for any survey.

- Vulnerability, for each species population, was scored using international and/or regional guidance on conservation status appropriate to its UoA and evidence of its vulnerability to wind farms. International guidance was applied to migrant and wintering species populations (categories 1 and 3) and regional guidance to the resident and summer breeding species populations (categories 2 and 4), see Table 4.

These two factors are combined in a matrix to determine to overall species sensitivity, see Table 5. Species with a negligible sensitivity were not progressed to Step 3. Additionally, we discounted species where the estimated flyway population was <1% of the total estimated global population to reflect the very low importance of the Rift Valley / Red Sea flyway population at a global level: this removed five additional species that were rated above a negligible sensitivity (White-tailed Sea Eagle *Haliaeetus albicilla*, Griffon Vulture *Gyps fulvus*, Cinereous Vulture *Aegypius monachus,* Hen Harrier *Circus cyaneus* and Red Kite *Milvus milvus*).

Table 2. Relative importance scoring for migratory soaring birds

Relative Importance	Maximum total count for a species within a single season from any one project in the study area as a percentage of flyway population
Negligible	≤ 1%
Low	>1% and ≤ 5%
Moderate	>5% and ≤10%
High	>10%

Table 3. Relative importance scoring for other migrants and resident species

Relative Importance	Global resident or breeding range (km^2) – extent of occurrence
Negligible	> 10,000,000
Low	> 100,000 and < 10,000,000
Moderate	> 50,000 and < 100,000
High	< 50,000

Table 4. Vulnerability scoring criteria

Vulnerability rating	Migratory soaring birds (and other species where an SVI has been designated)	Other migrants and resident species
Negligible	LC on IUCN Global Red List, and SVI of 6 or below	LC on IUCN Global Red List
Low	VU or NT on IUCN Global Red List and SVI 6 or below; LC on IUCN Global Red List and SVI of 7 or 8; or CMS Category 2 Species and SVI of 6 or below	NT on IUCN Global Red List
Moderate	VU or NT on IUCN "Global" Red List and SVI of 7 or 8; LC on IUCN Global Red List and SVI of 9 or 10; or CMS Category 2 Species and SVI of 7 or 8	VU on IUCN Global Red List
High	CR or EN on IUCN Global Red List; VU or NT on the IUCN Global Red List and SVI of 9 or 10; or CMS Category 2 Species and SVI 9 or 10	CR or EN on IUCN Global Red List

Table 5. Sensitivity matrix

Sensitivity		Relative Importance			
		Negligible	**Low**	**Moderate**	**High**
Vulnerability	**Negligible**	Negligible	Negligible	Low	Low
	Low	Negligible	Low	Low	Medium
	Moderate	Low	Low	Medium	High
	High	Low	Medium	High	High

Step 2 produced a list of 35 avian species with their sensitivity being low or above, which means 159 species populations were scoped out as a result, see Table 6.

Table 6. Scoring at step 2 for species sensitivity rates as Low, Moderate and High

Species	Vulnerability	Relative Importance	Sensitivity
European Turtle-dove *Streptopelia turtur*	Negligible	Moderate	Low
Bar-tailed Godwit *Limoa lapponica*	Low	Low	Low
Curlew Sandpiper *Calidris ferruginea*	Low	Low	Low
Great Snipe *Gallinago media*	Low	Low	Low
Yellow-billed Stork *Mycteria ibis*	Moderate	Negligible	Low
White-eyed Gul *Larus leucophthalmus*	Low	Low	Low
Black-winged Pratincole *Glareola nordmanni*	Low	Low	Low
Black Stork *Ciconia nigra*	Moderate	High	High
White Stork *Ciconia ciconia*	Moderate	High	High
Common Crane *Grus grus*	Moderate	High	High
Dalmatian Pelican *Pelecanus crispus*	High	Negligible	Low
Great White Pelican *Pelecanus onocrotalus*	Moderate	High	High
European Honey-buzzard *Pernis apivorus*	Moderate	Low	Low
Bateleur *Terathopius ecaudatus*	Moderate	Negligible	Low
Egyptian Vulture *Neophron percnopterus*	High	Low	Moderate
Cinereous Vulture *Aegypius monachus*	High	Negligible	Low
Lappet-faced Vulture *Torgos tracheliotos*	High	Negligible	Low
Black Kite *Milvus migrans*	Low	Moderate	Low
Bonelli's Eagle *Aquila fasciata*	Moderate	Negligible	Low
Tawny Eagle *Aquila rapax*	High	Negligible	Low
Steppe Eagle *Aquila nipalensis*	High	High	High
Eastern Imperial Eagle *Aquila heliacal*	High	Low	Moderate
Golden Eagle *Aquila chrysaetos*	Moderate	Negligible	Low
Verreaux's Eagle *Aquila verreauxii*	Moderate	Negligible	Low
Greater Spotted Eagle *Clanga clanga*	High	High	High
Lesser Spotted Eagle *Clanga pomarina*	Moderate	Moderate	Moderate
Booted Eagle *Hieraaetus pennatus*	Moderate	High	High
Short-toed Snake-eagle *Circaetus gallicus*	Low	Moderate	Low
Eurasian Buzzard *Buteo buteo*	Low	Moderate	Low
Long-legged Buzzard *Buteo rufinus*	Low	Moderate	Low
Levant Sparrowhawk *Accipiter brevipes*	Negligible	High	Low
Montagu's Harrier *Circus pygargus*	Moderate	Negligible	Low
Pallid Harrier *Circus macrourus*	Moderate	Moderate	Moderate
Saker Falcon *Falco cherrug*	High	Negligible	Low
Cyprus Warbler *Sylvia melanothorax*	Negligible	High	Low

4.3   Step 3 – Ecological risk assessment and identification of priority bird VECs

Step 3 aims to identify priority bird VECs from the 35 sensitive species remaining from Step 2. This is done by combining each species' sensitivity rating with an estimated of site-specific risk (the Likelihood of effect: LoE) to identify the species which are most at risk of significant impacts from wind farm developments in the study area.

The reasons to repeat the CEA are:

1) To update the first one from 2020 (EcoConsult 2020) produced in August 2020 and not considering the autumn 2020 and spring 2021 migratory seasons and,

2) Consider the turbines for the 500MW project (GoSII 500MW), which has a tip height of 180m, and the extension of 150MW (additional 20 WTGs) having a 200 m tip height (GoSII 150MW). In addition, for the purpose of the CEA, as done for the CRM, it has been assumed all the turbines have the same characteristics and a tip height of 200 m, which would be the worst scenario.

Based on the baseline bird data available, Likelihood of Effect comprised of three components:

- **Component 1.** A score for the combined effect of the percent of individuals recorded flying below 200 m and mean flock size, see Table 7. These are birds which are potentially at risk of collision with turbines or could collide with transmission lines. We took the weighted mean percent of individuals recorded flying below 200 m (i.e. sum total of individuals <200 m divided by the sum total individuals for all seasons) for all seasons where this value was reported. For species with no data for the percent of records <200 m, we scored these as having 50% of records <200 m. Mean flock size was derived from the average flock sizes reported during each survey period: no weighting was applied as not all surveys covered the full migration period for all species, and flocking behaviour might vary throughout this period. Larger flocks were considered to be at greater risk of multiple fatalities due to the higher numbers present and the reduced ability for individuals in the flock to see and avoid turbines or power lines. For species with no data on mean flock size, we conservatively scored these as having a maximum flock size equal to the maximum count recorded in a season (as per Component 2, below: i.e. equivalent to all individuals passing in a single flock). For species with values for both variables, the resulting matrix score was increased by one if the variability (taken as the standard deviation of all reported values for that species) of the percentage of flights <200 m was in the top two quartiles (i.e. the top 50% of values). We added this additional step to account for situations where flight height behaviour was very variable and the average value was less valid as a risk predictor;

- **Component 2**. The maximum total count for a species within a single season from any one project in the study area to reflect the fact that species with higher counts in the study area are more likely to be affected by wind developments, see ; and,

- **Component 3**. Whether or not that species had been recorded on the ground within the study area, irrespective of the numbers of individuals involved (species with records of landing scored 1, those without 0). Those species recorded on the ground must pass through the collision risk zone, and hence are at greater risk of collision than those species for which landing on the ground has not been recorded.

These three components were summed to arrive at a final LoE score for each species (theoretical range 2-10), which was separated into quartiles to derive a LoE rating for that species, see Table 9. This LoE rating was then combined with the Sensitivity rating from Step 3 to derive an Overall Risk rating from the project, see Table 10. Species which had an Overall Risk of Major or Moderate were considered Priority bird VECs for the study area

Table 7. Matrix for scoring mean flock size and percentage of flights less than 200m for each species

Mean flock size	Percentage of flights < 200m			
	0-25	26-50	51-75	76-100
< 10	1	1	2	2
10–50	1	2	2	3
51-100	2	2	3	4
> 100	2	3	4	4

Table 8. Score categories for the maximum seasonal counts for a species in the study area

Maximum season count	
Range	Score
0-10	1
11-1,000	2
1,001-10,000	3
> 10,000	4

Table 9. Likelihood of Effect rating based on overall score for each species evaluated at Step 3

Likelihood of Effect (LoE)	
Overall Score (based on quartiles)	Level of Effect
≤2	Negligible
>2 and ≤3	Low
>3 and ≤6	Medium
>6	High

Table 10. Overall risk matrix

Overall risk		Likelihood of Effect (LoE)			
		Negligible	Low	Medium	High
Sensitivity	Low	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

Step 3 identified 11 species with an Overall Risk of Major or Moderate from the project, and these species considered priority VECs for this analysis, see Table 11.

Table 11. Scoring and rating details for the 11 species identified as priority VECs

Species	IUCN Red List Status	SVI	Vulnerability	Highest Count	Flyway Population	% of UoA	Relative Importance	Sensitivity	% flights <200m	Mean flock size	Landing in Area	LoE	Overall Risk
Black Stork *Ciconia nigra*	LC	10	Moderate	6,738	19,500	34.6	High	High	59.03	55	Yes	High	Major
White Stork *Ciconia ciconia*	LC	10	Moderate	212,030	450,000	47.1	High	High	71.35	755	Yes	High	Major
Common Crane *Grus grus*	LC	10	Moderate	12,004	35,000	34.3	High	High	48.28	5	Yes	High	Major
Great White Pelican *Pelecanus onocrotalus*	LC	10	Moderate	31,001	70,000	44.3	High	High	21.6	55	Yes	High	Major
European Honey-buzzard *Pernis apivorus*	LC	7	Moderate	35,423	1,000,000	3.5	Low	Low	65.9	75	Yes	High	Moderate
Egyptian Vulture *Neophron percnopterus*	EN	10	High	395	4,335	8.7	Low	Moderate	37.85	2	No	Medium	Moderate
Black Kite *Milvus migrans*	LC	8	Low	16,229	132,700	12.2	Moderate	Moderate	40.9	8	Yes	High	Moderate
Steppe Eagle *Aquila nipalensis*	EN	9	High	17,152	37,500	45.7	High	High	44.75	7	Yes	Medium	Major
Booted Eagle *Hieraaetus pennatus*	LC	9	Moderate	858	3,169	27.1	High	High	27.85	1	No	Medium	Major
Eurasian Buzzard *Buteo buteo*	LC	7	Low	86,740	1,250,000	6.9	Moderate	Low	43.89	48	Yes	High	Moderate
Pallid Harrier *Circus macrourus*	NT	8	Moderate	100	1,505	6.6	Moderate	Moderate	72.09	1	Yes	Medium	Moderate

4.4   Step 4 – Identification of thresholds for fatalities for each priority bird VECs

Step 4 aims to identify thresholds for fatalities for each priority bird VECs for the study area, by setting the point at which further loss is considered a risk to long-term viability of the population. Threshold setting takes into account species-specific biological and demographic parameters, the cumulative risk associated with WPPs, and the likely effects of external stressors on the population defined by the UoA.

Step 4 has two parts: Part 1 identifies, for each priority bird VEC, a threshold number of fatalities appropriate in the study area for maintaining or attaining the long-term viability of the population. Part 2 explains the threshold system and the actions triggered as a consequence of passing thresholds. These actions are summarized as a decision tree in Figure 4. The decision tree forms the basis of the adaptive management framework, described in detail in step 5.

4.4.1   Part 1: Threshold-Setting Process

The Tafila approach was followed in the threshold-setting process, which was originally guided by related concepts within European and U.S. legal frameworks, specifically criteria underpinning "*Favorable Conservation Status*" (EC Habitats Directive, Council Directive 92/43/EEC, and the Birds Directive 2009/149 EC) and "Optimal Sustainable Population" (pursuant to 16 USCS § 1362). Thresholds were assessed for each priority bird VEC relative to the population size determined by their UoA.

For each priority bird VEC, the annual number of fatalities that could be sustained without compromising long-term viability was determined using a simple "Potential Biological Removal" (PBR) analysis, see below. This annual fatality estimate was then compared with the annual number of fatalities predicted from the effects of principal external stressors on the population, in particular illegal killing, power-line electrocution, and the taking of live birds[1]. When this fatality estimate exceeded the PBR level, an annual threshold of zero fatality threshold targets was applied. When the PBR level was not exceeded, the expertise of the authors of the conservation status of the population was used to assess whether the results was (a) sufficiently close to the PBR to imply no WPP-related mortality was possible without an adverse effect on the population or (b) sufficiently below the PBR level to indicate that some WPP-related mortality was possible without an effect on population viability.

The PBR is calculated as:

$$PBR = \frac{1}{2} R_{max} N_{min} f$$

Where:

R_{max} is the annual recruitment rate, which can be calculated from the maximum annual population growth rate via $R_{max} = Y_{max} - 1$. Y_{max} is calculated as:

$$Y_{max} = \frac{(sa - s + a + 1) + \sqrt{(s - sa - a - 1)^2 - 4sa^2}}{2a}$$

with s as the mean annual adult survival and a as the mean age at first breeding (Niel & Lebreton 2005). Information on s and a were sought for each bird VEC, however where this was not available, parameters from a closely-related surrogate species were used. PBR analysis is a simple, robust, and precautionary test

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[1] Information on the number of fatalities from external stressors is scarce for both the study area and Egypt as a whole, and typically relates to "incidental" reports of fatalities and their apparent causes. To address this information gap and make it possible to incorporate external stressors into an assessment of the viability of each population, the ERP identified principal stressors for the priority bird VECs and then gave approximate range estimates of the annual number of fatalities attributable to each stressor individually and all external stressors combined. Range estimates for annual fatalities were < 1, ≥ 1 and < 5, ≥ 5 and < 10, > 10 < 100, > 100 < 1000, > 1000 < 10000.

developed for situations in which information on species population biology is limited (see Wade, 1998; Neil and Lebreton, 2005; Dillingham and Fletcher, 2011).

It uses species-specific biological and demographic parameters, specifically adult survival rate and year of first breeding, to calculate an annual rate of human-caused mortality that if realized would likely result in a non-viable population in the long term. It should be highlighted that no cumulative collision risk estimate could be obtained since not all wind farm projects in the study area have performed a Collision Risk Modelling and the SESA has indicated that such modelling is difficult to provide valid estimates in the geographical area of the Gulf of Suez.

However, information has been gathered from the existing operational WPPs and OHTLs in the region. In addition to performing a CRM, and the lack of a peer-review of the reports, results of the post-construction fatality monitoring (PCFM) may highlight about the current extent (species) and impact (number of fatalities) within the region. Thus, we have only considered qualitative information about fatalities in the region. One of the representative papers is that from Riad[2] (2022) which collated data from March 2019 to May 2022 form wind farms in the NREA area, recording fifty nine fatalities with wind turbines. The most affected species in order of importance were the White stork, followed by a second group formed by the Black kite *Milvus migrans,* Steppe Buzzard and Honey Buzzard, and all the remaining species: Lesser Spotted *Clanga pomarina* and Steppe eagles, Eurasian Sparrowhawk *Accipiter nisus*, Montagu´s and Marsh harriers (*Circus pygargus* and *C. aeruginosus*), and Common Kestrel *Falco tinnunculus*. We cannot forget the lack of systematic fatality searches and corrections for potential biases, nor the systematic review of those species not considered migratory soaring birds.

4.4.2   Primary Threshold Targets

Priority bird VEC populations that were assigned a zero-fatality threshold target are subject to monitoring, mitigation plans and adaptive management designed to minimize the contact of these species with WPPs in the study area, and conservation actions designed to reduce the number of fatalities from other stressors. For these priority bird VECs, an adaptive management response is triggered when there is an elevated-risk situation or a near-miss incident or if a fatality occurs.

Annual Fatality Threshold Targets

Priority bird VECS assigned to an annual fatality threshold target is subject to the same monitoring and mitigation plans and adaptive management as zero fatality threshold populations. For these priority bird VECs, an adaptive management response is triggered when periodic review of the results of post-construction carcass searches shows that the annual fatality threshold target has been exceeded.

Other Threshold Targets: Extreme Events Threshold Targets

In addition to thresholds set for priority bird VECs, thresholds are required to alleviate the risk of multi- fatality events to a small number of populations that are not priority bird VECs. This is particularly relevant to WPPs in the study area because of the potential for flocks of specific nonpriority MSBs to occur in the area. For practical reasons, such as the need for a quick decision in the field to avoid this type of extreme event, thresholds should be set to a standard flock size (regardless of species) and should be broadly informed by PBR levels of flocking species and estimates of external stressor fatality rates.

1.1.1   Adaptive Management

Adaptive management is triggered when target thresholds are exceeded and when new evidence acquired over time shows an increased or decreased risk to a priority bird VEC or an increased risk to a non-priority population. Increased risk to priority birds requires that mitigation and management measures be revised to

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[2] Riad, S. 2022. Egypt. Acad. J. Biolog. Sci., 14(2): 19-33 (2022)

uphold thresholds and promote the long-term viability of the population. For priority bird VECs that exhibit a decreased risk over time, their primary threshold target may be reassessed, and revised or reassigned to reflect the reduced risk to their long-term population viability. Non-priority populations that exhibit evidence of increased risk may be assigned as priority bird VECs, may have an appropriate threshold determined and may be subject to associated adaptive management response strategies. Adaptive management is a key component of threshold setting within the CEA as it provides a mechanism for dealing with the uncertainty associated with determining priority bird populations and with predicting thresholdsfor priority bird VECs.

This process is iterative, and the breaching of successive thresholds should be matched by an increase in the measures to protect and promote the viability of priority bird VEC populations.

Adaptive management responses are not limited to exceeded thresholds. Adaptive management may also be triggered in response to other events:

- Evidence of an increased risk to a population from other unrelated sources that indirectly affects the threshold for fatalities related to the study area. For example, evidence of increased persecution during the operational phase of the WPPs may lead to re-assigning a priority bird VEC with an *annual fatality threshold target* to a *zero fatality threshold target.*

- A near-miss incident, in which no fatality occurred but monitoring and mitigation protocols failed to alleviate the risk of collision; for example, where a request to shut down a turbine in response to an approaching priority bird was not completed before the bird flew through the rotor-swept area, leading to a review and revision of monitoring and mitigation protocols.

1.1.2   Decision Tree for Thresholds

The decision tree explains the threshold system and actions triggered if passing a threshold see figure below. In addition, the decision tree and proposed thresholds from step 4 provide the basis for developing mitigation and monitoring protocols, the adaptive management framework, and joint management and action plans for developers and other stakeholders (see step 5).
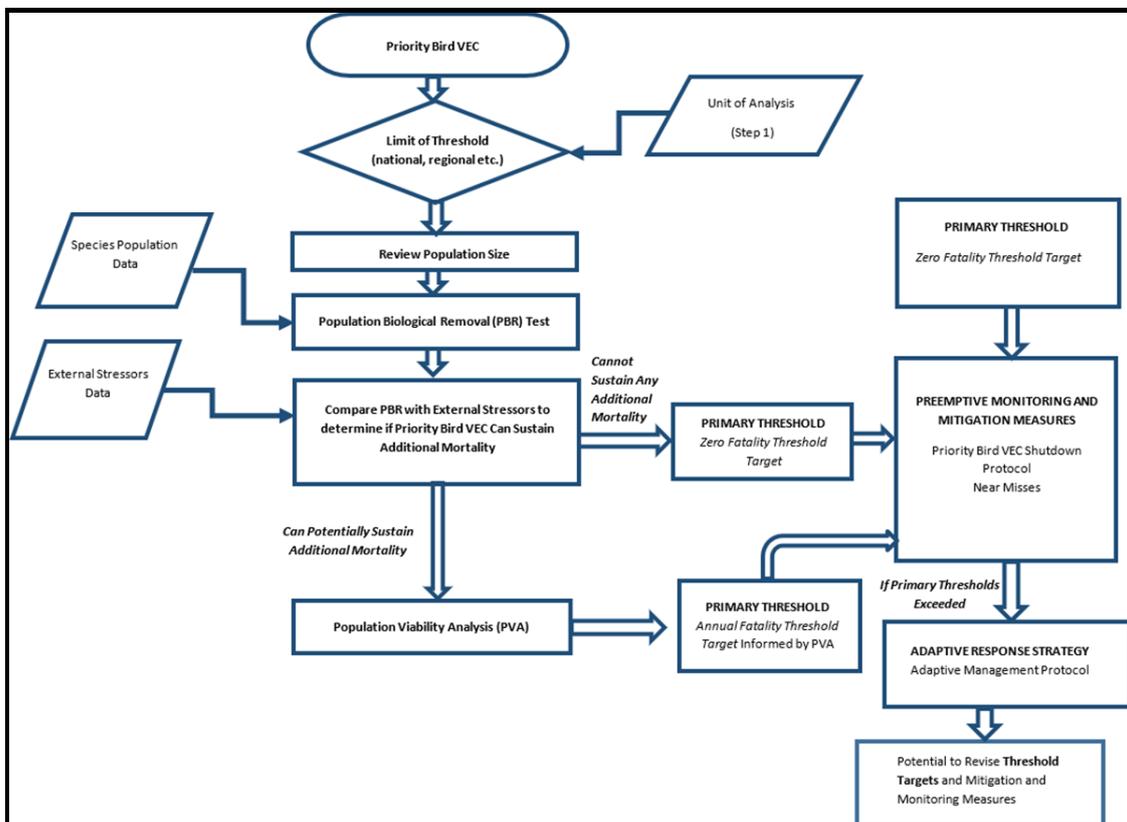

Figure 3: Decision Tree for Priority Bird VECs

Out of the 11 species, three species were assigned to a zero fatality threshold target as a result of applying the threshold-setting protocol in step 4, while the other three species were given a threshold ranging from 7 to 10 individuals per species, see tables below.

Biological and demographic parameters required to conduct threshold-setting analyses were taken from existing species-specific studies for each priority bird VEC. Parameters derived from studies of populations within the Middle East region were used where they existed; otherwise the results of studies from the most appropriate population outside the region were used. Using surrogate parameters from different populations of the same species should provide reasonably similar parameter values, as was the case here. The two populations are similar in other aspects of their biology, e.g., migratory, no migratory populations. For some of the species were no species-specific parameters were available, typical values for raptors of similar mass were used to give an indication of a likely threshold. Adult survival and age of first breeding are related to body mass in raptors (Newton, 1979; Newton et al. 2016); therefore, using surrogate species with similar mass should allow approximate predictions about the amount of mortality these priority bird VEC populations can sustain.

Table 12: Potential Biological Removal Analysis Input Data and Results for Priority VECs

Species	IUCN Red List Status	Unit of Analysis	Flyway Population	Demographic Parameters			
				Age at First Breeding	Annual Adult Survival (%)	Recovery Factor Used in PBR	PBR Level Estimate, Annual No. of Fatalities
Black Stork *Ciconia nigra*	LC	Flyway Population	19,500	3	80%	0.1	102
White Stork *Ciconia ciconia*	LC	Flyway Population	450,000	3	78%	0.1	2,353
Common Crane *Grus grus*	LC	Flyway Population	35,000	4	89%	0.1	183
Great White Pelican *Pelecanus onocrotalus*[1]	LC	Flyway Population	70,000	3	80%	0.1	366
Steppe Buzzard *Buteo buteo*	LC	Flyway Population	1,250,000	3	90%	1	93,750
Egyptian Vulture *Neophron percnopterus*	EN	Flyway Population	4,335	5	93%	0.1	10
Steppe Eagle *Aquila nipalensis*[4]	EN	Flyway Population	37,500	4	92%	0.1	197
Greater Spotted Eagle *Clanga clanga*[4]	VU	Flyway Population	2,180	4	92%	0.1	11
Booted Eagle *Hieraaetus pennatus*[3]	LC	Flyway Population	3,169	4	96%	1	125
Black kite *Milvus migrans*[3]	LC	Flyway Population	132,700	3	90%	1	9,953
Pallid Harrier *Circus macrourus*	NT	Flyway Population	1,505	3	74%	1	59

1. No species-specific biological or demographic parameters available. Analysis uses an estimate of adult survival rate and age of first breeding for the American White Pelican (Johnson and Sloan, 1978).

2. No species-specific biological or demographic parameters available. Analysis uses an estimate of adult survival rate and age of first breeding for Eurasian Buzzard *Buteo buteo* (Kenward et al., 2000)

3. No species-specific biological or demographic parameters available. Analysis uses an estimate of adult survival rate and age of first breeding for the red kite *Milvus milvus*) (Newton, Davis, and Davis, 1989)

4. No species-specific biological or demographic parameters available. Analysis uses an estimate of adult survival rate and age of first breeding for the Eastern imperial eagle *Aquila heliaca* (Katzner et al., 2006)

5. No species-specific biological or demographic parameters available. Analysis uses an estimate of adult survival rate and age of first breeding for the Eurasian Sparrowhawk *Accipiter nisus* (Newton, 1975)

Table 13: Priority VECs – Review of Steps 1-3 and Results of Step 4 Identifying thresholds

Species	IUCN Red List Status	SVI	Vulnerability	Relative Importance	Sensitivity	LoE	Overall Risk	PBR Level (annualfatality estimate)	Non-wind farm fatality estimate			Primary Threshold Target
									Electrocution	Illegal killing	Collection of live birds	
Black Stork *Ciconia nigra*	LC	10	Moderate	High	High	High	Major	102	≥1 and <5	≥1 and <5	≥1 and <5	Zero fatality
White Stork *Ciconia ciconia*	LC	10	Moderate	High	High	High	Major	2,353	> 10 < 100	> 100 < 1000	> 10 < 100	7
Common Crane *Grus grus*	LC	10	Moderate	High	High	High	Major	183	> 10 < 100	> 10 < 100	> 10 < 100	Zero fatality
Great White Pelican *Pelecanus onocrotalus*	LC	10	Moderate	High	High	High	Major	366	> 10 < 100	> 10 < 100	> 10 < 100	Zero fatality
Egyptian Vulture *Neophron percnopterus*	EN	10	High	Low	Medium	Medium	Moderate	10	≥1 and <5	≥1 and <5	≥1 and <5	Zero fatality
Steppe Eagle *Aquila nipalensis*	EN	9	High	High	High	Medium	Major	197	> 10 < 100	> 10 < 100	> 10 < 100	Zero fatality
Black Kite *Milvus migrans*	VU	8	Low	Moderate	Medium	High	Moderate	9,953	≥ 10 < 5	>10 and 100	≥1 and <5	10
Booted Eagle *Hieraaetus pennatus*	LC	9	Moderate	High	High	Medium	Major	125.2	> 10 < 100	≥1 and <5	≥1 and <5	Zero fatality
Honey Buzzard *Pernis apivorus*	LC	7	Moderate	High	Low	High	Moderate	5250	> 10 < 100	≥1 and <5	≥1 and <5	Zero fatality
Pallid Harrier *Circus macrourus*	NT	8	Moderate	Moderate	Medium	Medium	Moderate	59	> 10 < 100	≥1 and <5	≥1 and <5	Zero fatality
Steppe/Common Buzzard *Buteo buteo*	LC	7	Low	Moderate	Low	High	Moderate	93,750	>10 and <100	> 10 < 100	≥1 and <5	10

4.5   Step 5 – Identify mitigation and monitoring

This section follows the broad mitigation and monitoring actions that were proposed by the Cumulative Effects Analysis that was undertaken for Lekela project. Following the same approach and building on the results of that analysis while adding to it more analysis by the more recent field assessments and literature, the actions follow the same approach and broad lines. These mitigation and monitoring actions focus on the 11-priority bird VECs, as identified in this document, but will, even if indirectly, will provide benefits for other bird species passing through the area of all wind farms. In all cases, mitigation and monitoring actions are based on industry good practice, adapted to be locally-relevant. Mitigation and monitoring actions focus on two areas:

- On-site mitigation and monitoring methods, to minimize collision risk, validate the effectiveness of proposed mitigation methods, allow estimation of residual impacts, and provide information to adapt monitoring and mitigation to prevailing conditions; and,

- Collaborative efforts with other wind farm developers, to minimize the cumulative effects of all the proposed wind farm developments in the study area.

Since these measures and will be included in the project's ESIA, which will be submitted for approval and they have also been adopted by existing developers in the study area, such as Lekela, Amunet and RSWE, this will ensure the conservation of the VECs all across the area and would consequently help in protecting the species across a critical part of the flyway. By adopting best-practice mitigation measures and monitoring actions, Masdar IPH will be able to reduce its impact for the identified VECs (see Table 12).

Table 12: Proposed Mitigation Measures and Monitoring Actions for the Project and the Study Area

Action	Measure	Description	Key objective	Responsible entity	Timeframe
		Site-specific mitigation actions			
1	Development of appropriate protocols	All actions require clear and detailed protocols that can be followed by all survey teams: this information should be included in the relevant Project documents. Protocols should align with industry good-practice guidelines. The Post-construction fatality monitoring will be designed by an ornithologist experienced in assessing bird risk at wind farm developments. This can build on the already available protocols prepared for the implementation of the ATMP that is already being implemented at the operational wind farms along the Gulf of Suez	Ensure that all actions are undertaken in a consistent manner, and collect appropriate data to make decisions.	Consultant / RCREEE	Approved protocols at least three months prior to commencement of operation
2	Shutdown On-demand	Shutdown on-demand' is an already established method to mitigate the risk to birds of colliding with wind turbine rotors. It involves a coordinated team of field observers identifying situations when birds are at risk of colliding with turbines as they move within the wind farm, and initiating a temporary shut-down of one or more turbines.	To minimize the number of collisions between priority bird VECs and wind turbines.	Consultant / RCREEE	Protocols and tested system in place prior to commencement of operation
3	Installation of bird flight diverters on Project power lines	Many bird species are known to collide with power lines (particularly high-voltage lines), and installing bird flight diverters has been shown to lessen this risk. The OHL configuration (type and frequency) of bird flight diverters should be based on industry Good-practice, relying on local examples of successful installation if available.	Minimization of collisions to priority bird VECs with Project power lines	EETC	During power line erection
4	Adaptive action	Immediate review of process in the event of a recorded mortality for a priority bird VEC, to determine if additional actions could be implemented to further reduce Collision risk.	Minimization of collisions to priority bird VECs	Consultant / RCREEE/RSWE	On-going from commencement of operation

Table 13: Proposed monitoring actions for the project and the study area

Action	Measure	Description	Key objective	Responsible entity	Timeframe
		Site-specific monitoring actions			
1	Monitoring of priority VECS in-flight monitoring	'In-flight monitoring' is a bird surveillance program and method that is designed to monitor activity and track the flight paths of Priority Birds[1] and flocks of non-priority Migratory Soaring Birds (MSBs) relative to operational wind turbines. The principal aim of in-flight monitoring is to inform turbine shutdown decisions and to identify 'Elevated Risk Situations'. Similar to shut down on-demand, in-flight monitoring of priority birds follows a protocol that can be developed following the protocols developed as part of the ATMP that is being implemented as part of the operational monitoring of wind farms along the Gulf of Suez	To ensure that shut-down on demand protocols can be initiated with sufficient time to minimize bird collisions	Consultant / RCREEE	Prior to commencement of operation
2	Carcass search surveys	This involves regular surveys of the area beneath turbines to detect carcasses from individual birds that have collided with turbine blades. Similar surveys are being already implemented, according to best-practice guidelines, in operational wind farms along the Gulf of Suez as part of the ATMP and can be applied similarly at the project site. The Post-construction fatality monitoring will produce seasonal separate fatality estimates for spring and autumn accounting for area searched, carcass search frequency, bias corrections for searcher efficiency and carcass removal, also using GenEst as a fatality estimator. Fatalities will be estimated separately for the WTGs and the OHTL	To determine the level of observed fatalities due to collisions with turbines and power lines at the wind farm site.	Consultant / RCREEE	On-going for at least the first three years of operation, then reassessment
3	Carcass bias-correction trials	Bias-correction trials aim to convert the observed carcasses to an actual estimate of mortalities, as some carcasses will be removed prior to carcass surveys occurring (carcass removal bias), and searchers will not detect all carcasses present (searcher efficiency bias). Such trials are being already implemented, according to best-practice guidelines, in operational wind farms along the Gulf of Suez as part of the ATMP and can be applied similarly at the project site.	To determine the correction factor to apply to detected carcasses to estimate true project-related mortality.	Consultant / RCREEE	Annually for three years, then reassessment. Can begin prior to commencement of operation.
4	Review to improve monitoring	Periodic reviews of Actions 1, 2, and 4-8 will be undertaken to improve the effectiveness of monitoring and mitigation actions. This will include:	Adaptive management to reduce risk	GOS2	On-going from start of construction

Action	Measure	Description	Key objective	Responsible entity	Timeframe
		Actions to be implemented on the level of the study area			
5	Data sharing	All developers to make annual summaries of their respective monitoring and mitigation efforts publicly available to support baseline knowledge, increase Transparency and understanding of the work being undertaken.	Maximize the knowledge base in the region.	All developers	Variable, depending on the data released

6	Joint training of observers	All developers to contribute to the joint training of a pool of skilled bird observers who are able to carry out baseline and monitoring surveys throughout the study area, and adjacent Important Bird Area	Ensure comparable observer standards are maintained across all project sites.	All developers	On-going, with establishment prior to commencement of operation
7	Coordination of observer networks	All developers to co-ordinate in the Project area to site observer networks where these can be of greatest benefit	Maximize the benefits from an extended observer network	All developers	On-going, with establishment prior to commencement of operation
8	Discussion forum	Facilitate / support an annual biodiversity workshop / conference for all wind farms in the Project area, to facilitate knowledge exchange, share experiences and plan cumulative actions….	Improve regional knowledge of priority avian VECs and improve wind farm operations	All developers	Annually

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