

Wind farms: Ecologically sensitive planning and design



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Decarbonising the world's energy systems via the deployment of renewable energy infrastructure is one of the most impactful things we can do to protect communities and the environment from the devastating impacts of unmitigated climate change.

While wind energy infrastructure remains essential to support the world's energy needs, a considered focus on avoiding and minimising impacts in the development and delivery is key to achieving the transition to renewable energy.

In many Asia Pacific countries it is already legislated that any proposed wind farm projects demonstrate where and how efforts have been made to avoid or minimise impacts through the planning and design process.

There is a complex challenge as countries work towards net zero and decarbonisation targets, while also avoiding and minimising impacts on communities and the environment.

This fact sheet compares some of the impacts associated with the technical aspects of wind farm projects, and explores ecologically sensitive design that can minimise and mitigate such impacts.

Two infographics are included that provide comparisons between the following scenarios:

- Scenario 1: Developing wind farms with a standard approach to environmental assessment
- Scenario 2: Developing wind farms with environment and community disturbance mitigation as a key focus



Wind farm projects: Four key areas to mitigate impacts

To reduce disturbance to the environment and communities, wind farm projects need to be developed with minimisation and mitigation in mind. If ecological values are determined early, routes and siting can be optimised and approvals can be obtained in a timely manner.

Actions that can be taken across key mitigation categories include:

 Biodiversity	 Technology	 Route planning and siting	 Approvals
• Micrositing access roads around ecologically sensitive areas, away from key habitats and individual vegetation • Minimising factors that may attract species to turbine locations • Blade marking to improve visibility to diurnal bird species • Acoustic deterrents to reduce the risk of collision for microbats • Implementing turbine-free buffers around areas that provide key breeding, roosting or foraging habitat for significant fauna species • Harmonise with the surrounding land used for agriculture	• Blade manipulator technology to raise turbine blades when navigating tight turns during transport, to reduce disturbance to vegetation • Raising the minimum turbine rotor swept area height to reduce the likelihood of turbine collision by avifauna, particularly microbats • Employing alternative crane technology such as tower cranes that are smaller and result in smaller hard stands and assembly areas, thereby reducing disturbance to vegetation • On demand shutdowns using smart technology to reduce potential impacts to raptors and other at-risk bird species • Low wind speed curtailment to reduce the risk of collision to microbats	• Planning alternative site logistics such as just-in-time delivery of turbine components such as blades, resulting in reduced laydown area construction, and overall ecological disturbance • Choosing development locations which balance great positive environmental and social outcomes (least impacts) with capital return • Possible optimisation of civil design and electrical design to minimise disturbance footprints, such as steepening earthwork batters and including retaining structures in steep terrain • Depending on geology, cabling may be installed underneath access roads, or within the access road corridor, therefore reducing earthworks	• Taking into account designation of natural assets for impact reduction or mitigation • Construction methodology: using energy-efficient machinery, reducing waste, and recycling materials, ongoing monitoring, and use of local materials • Layout planning that avoids native vegetation, prioritising retention of areas of highest ecological significance • Early engagement with communities to contribute to positive social value outcomes

Comparison of standard approach versus minimisation, mitigation and early investigations

Wind farm projects that focus on optimising routes, the accuracy of earthworks and maximising of siting will benefit from positive community and environmental outcomes.

Figure 1 – Scale of accuracy in approvals and planning

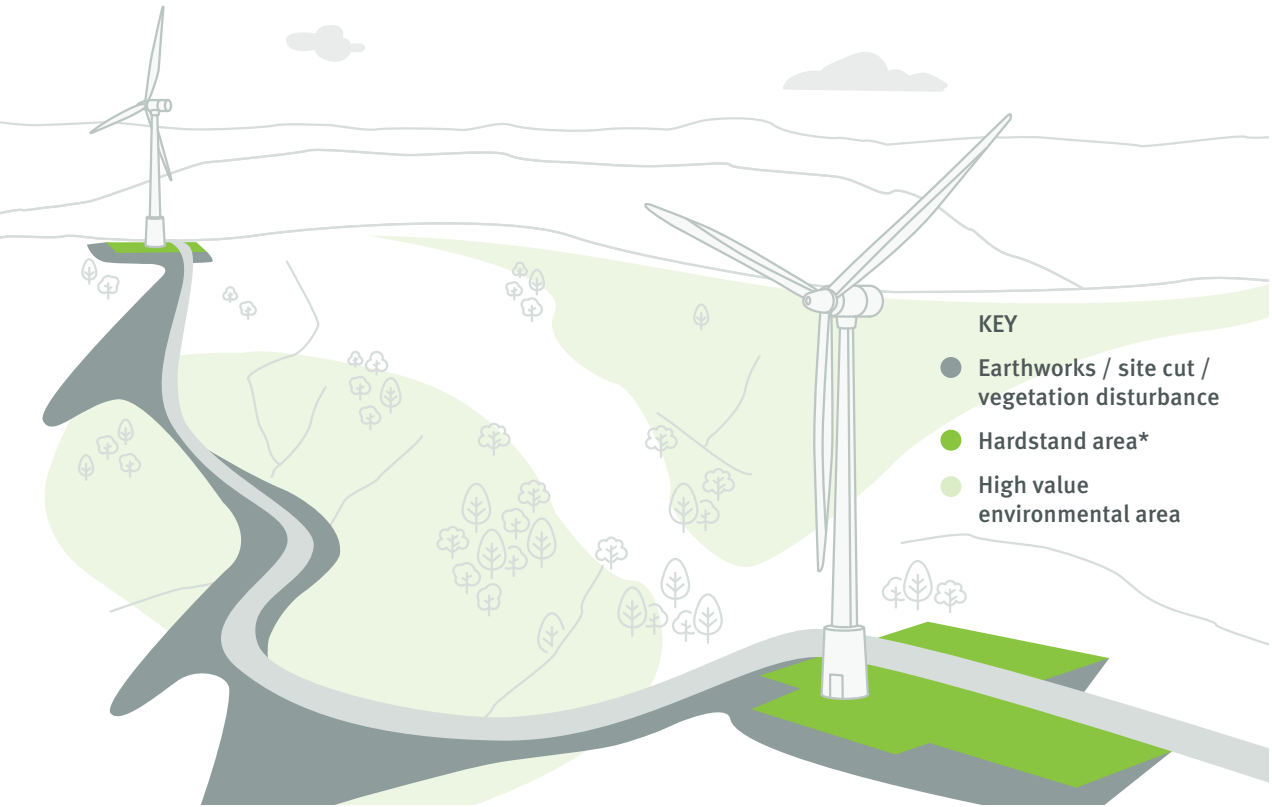
	SCENARIO 1: Standard approach	SCENARIO 2: With environmental assessments and values determined early
	Scale of accuracy (low to high)	
ROUTE PLANNING: Reduced impact of earthworks on high value environmental area Route optimised and accurate to minimise earthworks	●○○○	●●●●
SITING: Maximising siting for minimal environmental impacts	●○○○	●●●●
PLANNING AND ENVIRONMENTAL APPROVALS: Lessening the potential for delays and re-work	●○○○	●●●●

Figure 2 – Extent of positive outcomes for community and environment

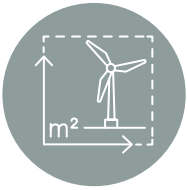
	SCENARIO 1: Standard approach	SCENARIO 2: Environment and community disturbance mitigation
	Extent of positive outcome for community and environment (low to high)	
COMMUNITY: Minimise disruption during construction	●○○○	●●○○
ENVIRONMENT: Minimise environmental impacts, and even achieve nature positive outcomes	●○○○	●●●●
STAKEHOLDERS: Design in consultation with stakeholders, landowners, and communities	●○○○	●●○○
PLANNING REGULATIONS: Identification on how to lessen the potential cumulative environmental and community impact	●○○○	●●●●



SCENARIO 1: Developing wind farms with a standard approach to environmental assessment



Impact of earthworks on high value environmental area



Hardstand area is large – up to 50 per cent more than scenario 2



Crews might be present for relatively **longer timeframes** during construction



Impacts on native vegetation, trees, geology and soils mostly connected with access roads and civil works

Environmental and community impact



Approvals: Protracted environmental and planning approvals



Timing: Extensive delay in approvals and project start

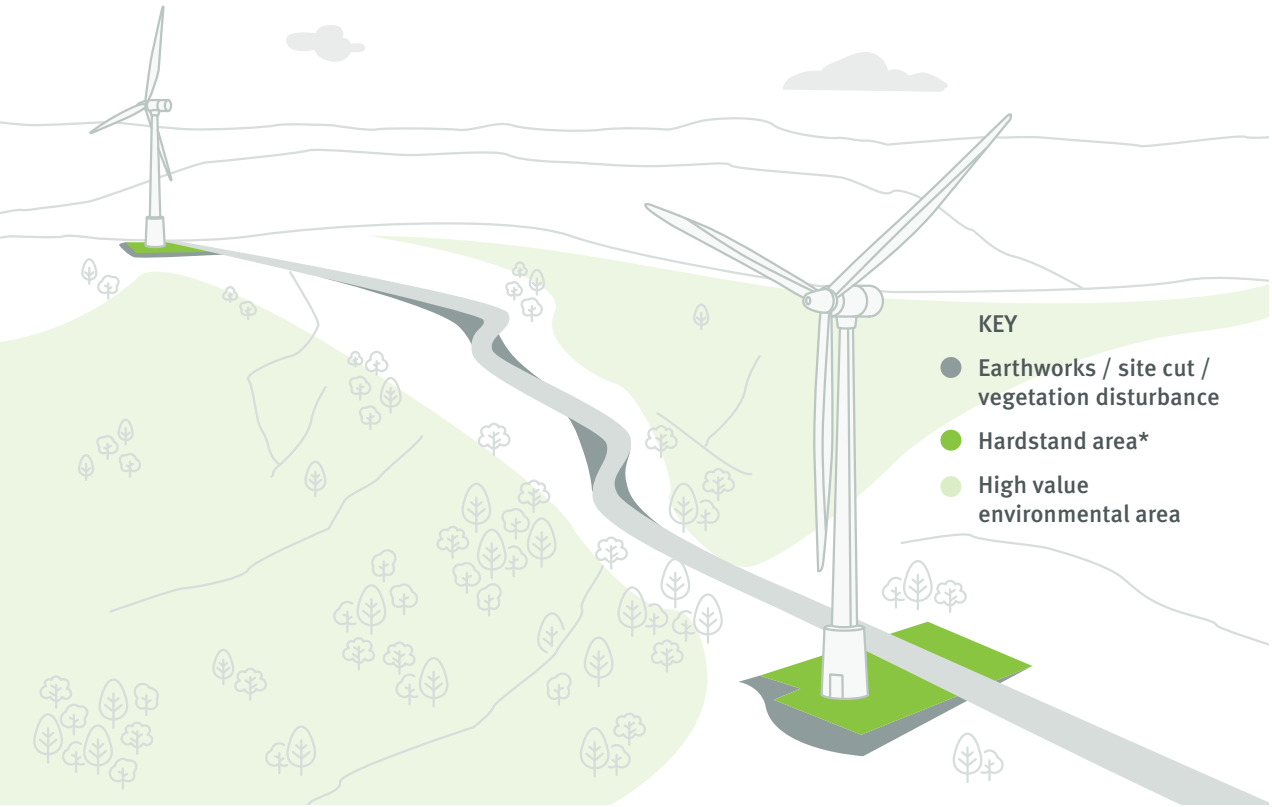


Costs: Increased offset costs

*Hardstand areas vary between projects, with some areas rehabilitated post-project, or different sizing depending on construction methodology.



SCENARIO 2: Developing wind farms with environment and community disturbance mitigation



Reduced energy use, waste, materials



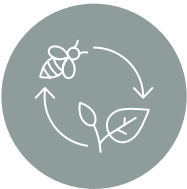
Less impacts on geology, soils and natural drainage than scenario 1



Avoidance or impact minimisation on vegetation and trees



Less impact on birds and bats using detection and operational technology applications



Improving biodiversity outcomes, even achieving nature positive

Environmental and community impact



Approvals: Streamlined environmental and planning approvals



Timing: Reduced delay in approvals and project start



Costs: Reduced offset costs



What does this mean for wind energy developments?

There are complex and sensitive considerations that investors and developers of wind energy projects need to work through to achieve approval. The design and construction for any individual project depends on multiple factors and needs to be done with sensitivity and empathy for the directly impacted landowners, communities, and the environment.

Aurecon, an Asia Pacific design, engineering and advisory company, specialises in delivering optimum design, community and environmental outcomes for challenging wind energy developments with complex requirements.



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