



# *Tethys*: Enhancing the Understanding of Environmental Effects of Wind Energy

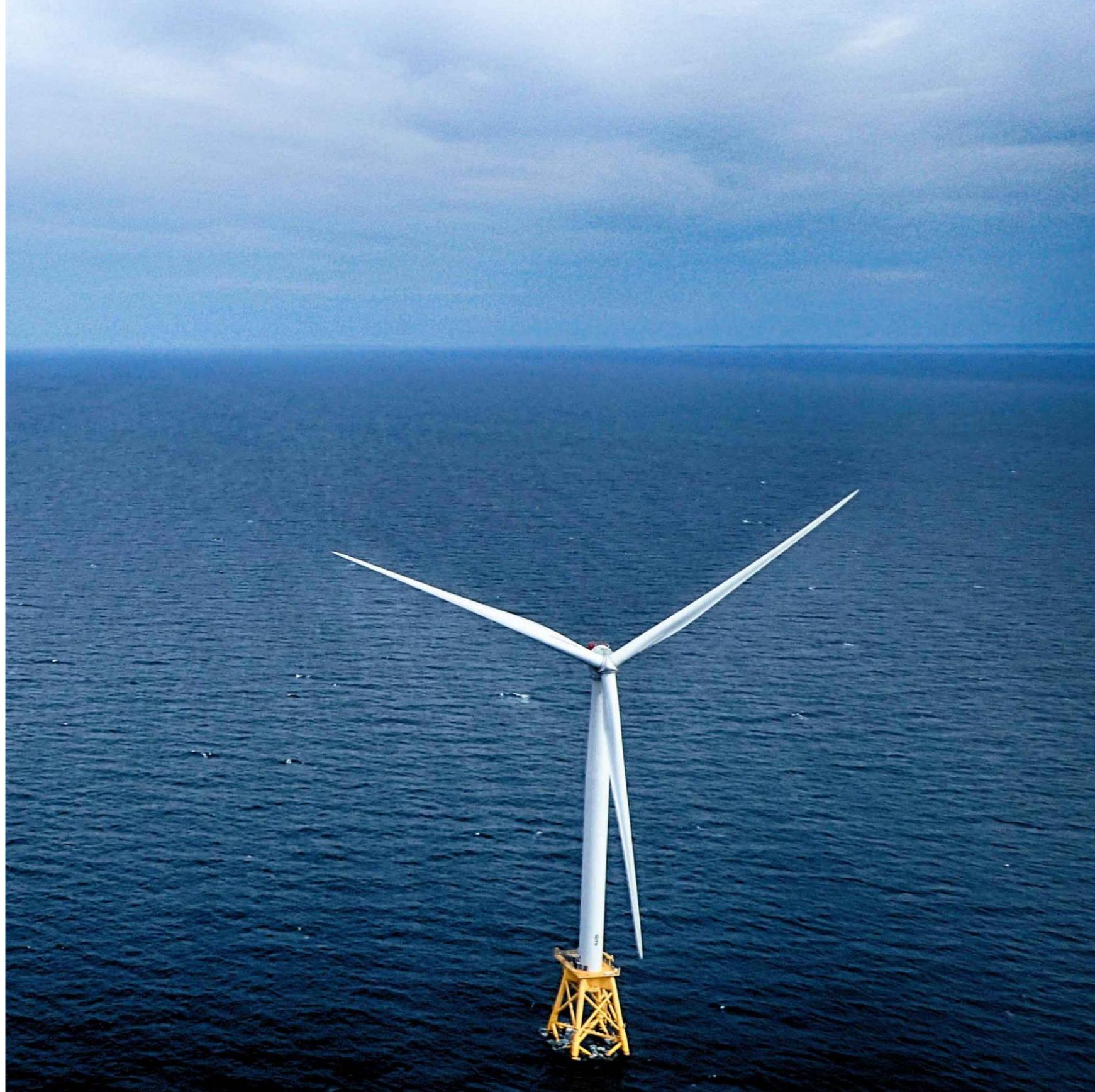
February 9, 2021

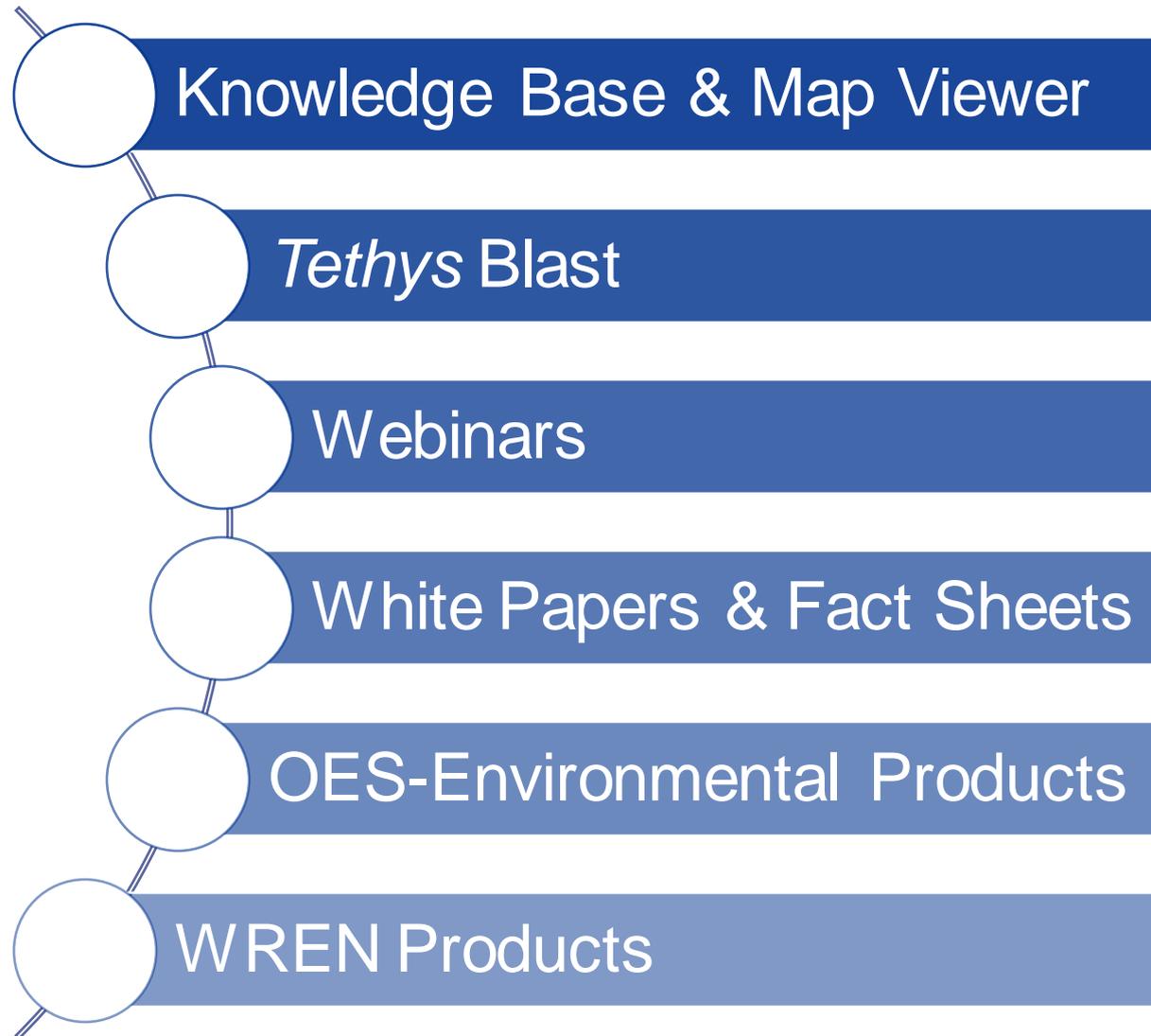
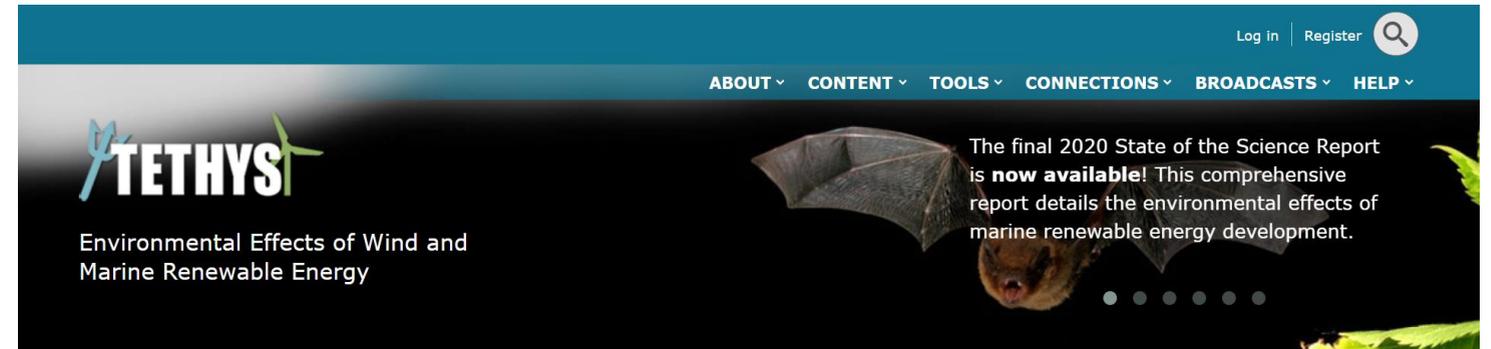
**Alicia M. Gorton, Ph.D., PMP**  
**Jonathan Whiting, P.E.**  
**Hayley Farr**

Pacific Northwest National Laboratory



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**TETHYS**

Environmental Effects of Wind and Marine Renewable Energy

The final 2020 State of the Science Report is **now available!** This comprehensive report details the environmental effects of marine renewable energy development.



**MARINE ENERGY**  
Generating electricity from the sea



**WIND ENERGY**  
Generating electricity from wind on land and at sea



**OES-ENVIRONMENTAL**  
Addressing environmental effects of marine energy internationally



**WREN**  
Resolving conflicts between wind and wildlife internationally

**GET STARTED**

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**KNOWLEDGE BASE**

Access thousands of publications and more, all in a searchable database.

Jan 2021 Today

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
			4:00 Supergen Offshore Renewable E	4:00 Floating		
24	25	26	27	28	29	30
			4:00 8th International	8:00 Marine E		
31						

**Recent Tethys Story**

**Environmental Effects of Marine Renewable Energy: the 2020 State of the Science Report**

The 2020 State of the Science Report was released on 8 June 2020 by Ocean Energy Systems (OES)-Environmental, supported by the International Energy Agency, and dedicated to examining the environmental effects of marine renewable energy (MRE) development. The 300-page report is the most comprehensive international analysis to date on the issue, based on studies and monitoring from publicly... [Read More](#)

Quickly locate content with the sitewide keyword search

Rotating announcements highlight notable products and events

**MARINE ENERGY**  
Generating electricity from the sea

**WIND ENERGY**  
Generating electricity from wind on land and at sea

**OES-ENVIRONMENTAL**  
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				5:00 Redesign		
				8:00 Marine E		
31						
11th Ok						

[Event Calendar](#) highlights conferences, workshops, and webinars from around the world

**Recent Tethys Story**

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[Tethys Stories](#) are contributed from individuals working in the field and are highlighted here

## Wind Energy

### Tethys: Enhancing the Understanding of Environmental Effects of Wind Energy

*Tethys* is a publicly accessible online knowledge base that facilitates the exchange and dissemination of information on environmental effects of **wind (land-based and offshore)** and **marine renewable energy**. *Tethys* supports the wind community by sharing the knowledge needed to advance wind energy development in an environmentally responsible manner.

*Tethys* provides land-based and offshore wind energy information and research findings that can support siting, permitting processes, management decisions, and operational strategies while minimizing risk to the environment, for use by researchers, regulators, device and project developers, and other stakeholders. *Tethys* hosts **scientific papers, reports, and other media**; creates a collaborative space for researchers, project developers, regulators, and other stakeholders; and provides a central location for **archived webinars, listing of events**, contacts for **individuals** and **organizations**, and links to **related databases**.

#### Tethys Knowledge Base & Map Viewer

*Tethys* hosts over 4,000 documents (peer-reviewed and grey literature) pertinent to the environmental effects of wind energy. There are several pathways by which users can find content to suit their needs. Documents available in the **Tethys Knowledge Base** can be filtered by content type (e.g., journal article, conference paper), technology type (land-based or offshore wind), or specific environmental effect (such as bat collisions). Documents that are geotagged can also be found by location on the **Tethys Map Viewer**. For more information on each of the tags used throughout *Tethys*, check out the **Glossary**.

#### Tethys Event Calendar

The **Event Calendar** highlights key events from around the world related to the development and environmental effects of wind and marine renewable energy, including conferences, workshops, webinars, and more. If you would like to recommend an event for the calendar, please email [tethys@pnnl.gov](mailto:tethys@pnnl.gov).

#### Tethys Blasts

**Tethys Blasts** are bi-weekly newsletters that highlight new documents on *Tethys*; relevant announcements, opportunities, and upcoming events; and news articles of international interest. **Sign up to join the mailing list here.**

#### Tethys Stories

**Tethys Stories** provide insight into advancing the wind and marine renewable energy industries in an environmentally responsible manner, contributed from individuals working in the field. The stories feature information on new projects, interesting research findings, and international collaborations relevant to wind and marine renewable energy development activities.

For more information on *Tethys*, visit the **About Tethys** page.

## WREN

WREN (Working Together to Resolve Environmental Effects of Wind Energy) is a collaborative initiative of 12 countries under the International Energy Agency Wind Committee. WREN was established in 2012 to address the environmental interactions of wind energy and wildlife. *Tethys* acts as a collaborative space for WREN, hosting white papers, short science summaries, and webinars.

### WREN Webinars

#### New to Tethys?

We recommend you start by checking out the **Knowledge Base** (our searchable database of publications and other content), subscribing to **Tethys Blasts** (our bi-weekly newsletter highlighting recently added publications, events, and industry news), and exploring more from there!

If you would like a bit of guidance, a **Tethys Wind One-Pager** and **Tethys Wind Webinar** are available that showcase the wind-related content and resources available on *Tethys*. Or, you can check out our **Tips for Tethys** page!

And don't forget to **register for a user account** to connect with others in the **wind energy community!**



#### Connections

The **Organizations** page lists the over 1,700 organizations, universities, and government agencies from around the world that are involved with wind and marine renewable energy. Each page highlights all of the documents in *Tethys* affiliated with an organization.

The **Databases** page lists external databases with information relevant to the development of wind and marine renewable energy around the world.

The **Tethys Community** page lists contact information for all of the researchers, regulators, developers, and other stakeholders who have registered an account on *Tethys* and provided consent to share their information.



Home » Content » Knowledge Base

# Knowledge Base

You are currently viewing:

Wind Energy Content ▾

The Knowledge Base provides access to documents and information about the environmental effects of wind energy, supporting the **WREN** initiative. Relevant documents from around the world are compiled into a user-friendly table that displays all content available in *Tethys*. Results can be narrowed using the keyword filters on the right, or with search terms entered in the text box. Content may also be sorted alphabetically by clicking on column headers. Some entries will appear on the next page.

As an alternative to the Knowledge Base, check out the **Map Viewer** to access geotagged content in a spatial view.

Search All:

Enter Search Term(s)

Apply

Enter terms to search for in all text fields

Title	Author	Date	Document Type	Category	Sub-category
Strategic Environmental Assessment and the precautionary principle in the spatial planning of wind farms: European experience in Serbia					
A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor				Wind	
What's love got to do with it? Understanding local cognitive and affective responses to wind power projects	Russell, A., Firestone, J.	January 2021	Journal Article	Wind Energy, Land-Based Wind	Human Dimensions, Social & Economic Data
An investigation into the potential for wind turbines to cause barotrauma in bats	Lawson, M., Jenne, D., Thresher, R.	December 2020	Journal Article	Wind Energy	Collision Bats
Changes in feeding behavior of longfin squid ( <i>Doryteuthis pealeii</i> ) during laboratory exposure to pile driving noise	Jones, I., Peyla, J., Clark, H.	December 2020	Journal Article	Wind Energy, Offshore Wind	Noise Invertebrates
The Effects of Offshore Wind Farms on Hydrodynamics and Implications for Fishes	van Berkel, J., Burchard, H., Christensen, A.	December 2020	Journal Article	Wind Energy, Offshore Wind	Changes in Flow Physical Environment, Sediment Transport, Fish
Setting the Context for Offshore Wind Development Effects on Fish and Fisheries	Gill, A., Degraer, S., Lipsky, A.	December 2020	Journal Article	Wind Energy, Offshore Wind	Changes in Flow, EMF, Habitat Change Human Dimensions, Fisheries, Stakeholder

Please select which content you are interested in viewing.

- Marine Energy Content 
- Wind Energy Content 
- All Content 

Clear All Filters

## Current Search

• 4547 results found

### Content Type

- Journal Article (2480)
- Report (1327)
- Book Chapter (207)
- Conference Paper (192)
- Thesis (122)
- Book (62)
- Presentation (58)
- Website (28)
- Magazine Article (26)
- Workshop Article (22)
- Summary (9)
- Guidance (7)
- Video (4)

### Technology

- Wind Energy (3658)
- Offshore Wind (1680)
- Land-Based Wind (1495)
- Marine Energy (477)
- Wave (83)
- Tidal (61)
- OTEC (12)
- Ocean Current (7)
- Riverine (5)
- Salinity Gradient (2)

### Stressor

- Collision (669)
- Habitat Change (560)
- Noise (527)
- Avoidance (245)
- Displacement (173)
- Attraction (170)

Home » Content » Knowledge Base

## Knowledge Base

You are currently viewing:

Wind Energy Content ▾

Easily switch to MRE Content

The Knowledge Base provides access to documents and information about the environmental effects of wind energy, supporting the **WREN** initiative. Relevant documents from around the world are compiled into a user-friendly table that displays all content available in *Tethys*. Results can be narrowed using the keyword filters on the right, or with search terms entered in the text box. Content may also be sorted alphabetically by clicking on column headers. Some entries will appear on the next page.

As an alternative to the Knowledge Base, check out the **Map Viewer** to access geotagged content in a spatial view.

Keyword search

Search All:

Enter Search Term(s)

Apply

Enter terms to search for in all text fields

Columns can be sorted alphabetically or by date

Title	Author	Date ▾	Content Type	Technology	Stressor	Receptor
<b>Strategic Environmental Assessment and the precautionary principle in the spatial planning of wind farms – European experience in Serbia</b>	Josimović, B., Cvjetić, A., Furundžić, D.	February 2021	Journal Article	Wind Energy, Land-Based Wind		Human Dimensions, Environmental Impact Assessment, Legal & Policy
<b>A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor</b>	Murgatroyd, M., Bouten, W., Amar, A.	January 2021	Journal Article	Wind Energy, Land-Based Wind	Collision	Birds, Raptors
<b>What's love got to do with it? Understanding local cognitive and affective responses to wind power projects</b>	Russell, A., Firestone, J.	January 2021	Journal Article	Wind Energy, Land-Based Wind		Human Dimensions, Social & Economic Data
<b>An investigation into the potential for wind turbines to cause barotrauma in bats</b>	Lawson, M., Jenne, D., Thresher, R.	December 2020	Journal Article	Wind Energy	Collision	Bats
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[Clear All Filters](#)

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Currently over 4,500 wind energy documents

Documents can be filtered by:

- Content Type
- Technology
- Stressor
- Receptor
- Year Published
- Attachment Available
- Country

# A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor

## Abstract

1. With the rapid growth of wind energy developments world-wide, it is critical that the negative impacts on wildlife are considered and mitigated. This includes minimising the number of large soaring raptors, which are killed when they collide with wind turbines.
2. To reduce the likelihood of raptor collisions, turbines should be placed at locations which are least used by sensitive species. For resident or breeding species, this is often delineated crudely through the use of circular buffers centred on nest sites, which assume uniform habitat use around a nest site.
3. Using GPS tracking data together with a digital elevation model we build and cross-validate a simple generalisable model, to classify the spatial likelihood of wind turbine collisions for resident adult Verreaux's eagles in any landscape where there are known nests. We apply our methods to operational developments in South Africa to validate the model and demonstrate its ability in predicting actual collision mortalities.
4. Our collision risk potential (CRP) model included the variables distance to nest, distance to conspecific nest, slope, distance to slope and elevation. Using our model, rather than a circular buffer, resulted in c. 4%–5% improvement in eagle protection while excluding development from the same amount (but not shape) of area. For an equal level of eagle protection, our model can make c. 20%–21% more area available for wind energy development compared to a circular buffer.
5. Exploring collisions at operational wind farms in South Africa we show that our CRP model correctly predicted 79% of known collisions, while circular buffers (5.2 km radius) only captured 50% of collisions.
6. *Synthesis and applications.* We show that by using predictive models to account for habitat use instead of simple buffers around a nest, a greater area of land can be made available for wind energy development without increased mortality risk to raptors. Our predictive model can be used to provide robust guidance on wind turbine placement in South Africa in a way which minimises the conflict between a vulnerable raptor species and the development of renewable energy.



Geotagged documents are also displayed in the [Map Viewer](#)

Journal Article	
<b>Title:</b>	A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor
<b>Author:</b>	<a href="#">Murgatroyd, M.</a> ; <a href="#">Bouten, W.</a> ; <a href="#">Amar, A.</a>
<b>Publication Date:</b>	January 5, 2021
<b>Journal:</b>	Journal of Applied Ecology
<b>Volume:</b>	In Press
<b>Pages:</b>	12
<b>Publisher:</b>	British Ecological Society
<b>Affiliation:</b>	<a href="#">University of Cape Town</a> , <a href="#">University of Amsterdam</a>
<b>Technology:</b>	<a href="#">Wind Energy, Land-Based Wind</a>
<b>Stressor:</b>	<a href="#">Collision</a>
<b>Receptor:</b>	<a href="#">Birds, Raptors</a>

Document Access	
<b>Website:</b>	<a href="#">External Link</a> 

Citation	
Murgatroyd, M.; Bouten, W.; Amar, A. (2021). A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor. <i>Journal of Applied Ecology</i> , In Press, 12. DOI: 10.1111/1365-2664.13799	

[Access File](#) 

When copyright allows, *Tethys* hosts a PDF of the document

Easily copy the automatically generated citation

# Map Viewer

You are currently viewing:

Wind Energy Content

Easily switch to MRE Content

The Map Viewer provides a spatial view of information about the environmental effects of wind energy, supporting the **WREN** initiative. Documents associated with a geographic location are compiled into an interactive map with panning, zooming, clustering, and filtering. Results can be narrowed using the keyword filters on the right, or with search terms entered in the text box. Content is clustered together but will break apart into smaller clusters or bubbles by zooming in or clicking on a cluster. Individual icons can be selected to open a dialog box with more information and link to the content page.

Not all content is geotagged. Check out the **Knowledge Base** for access to the full suite of information in *Tethys*.

Keyword search

Search All:

Search

Enter terms to search for in all text fields

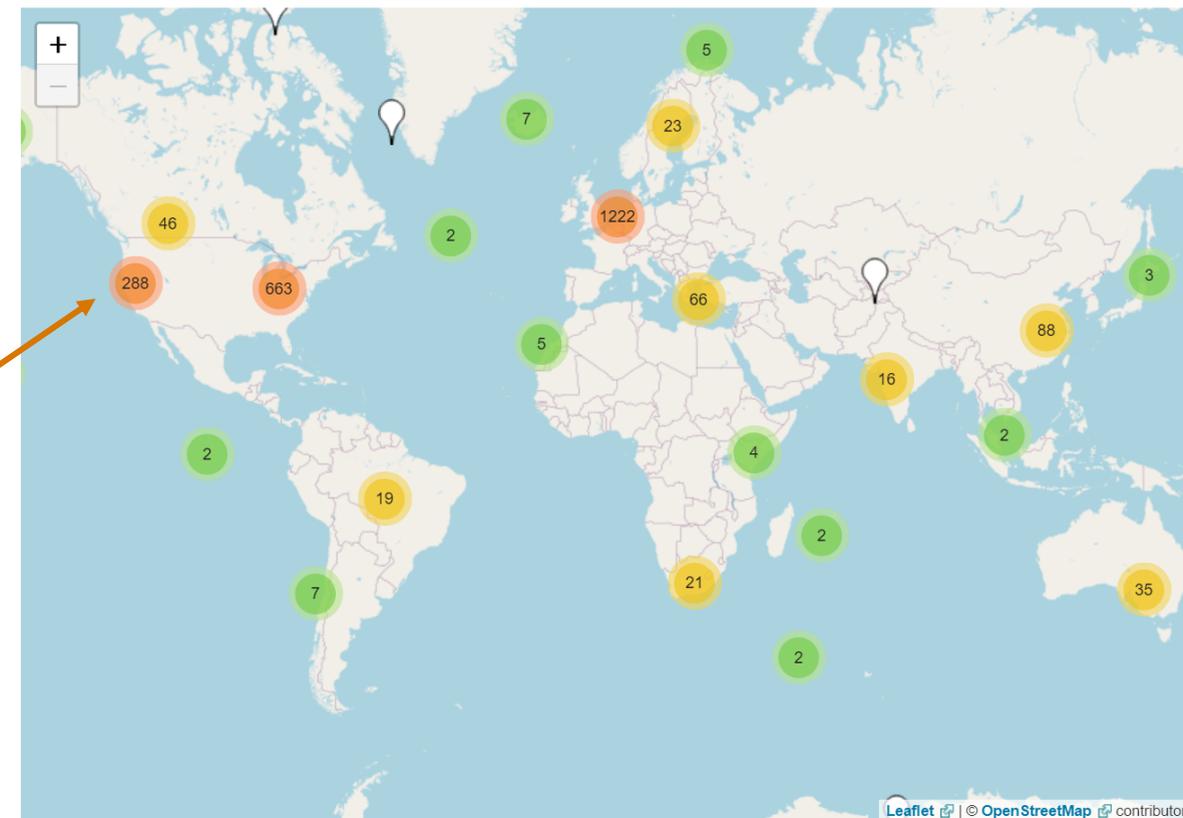
[Clear All Filters](#)

## Current Search

• 2579 results found

Currently over 2,500 geotagged wind energy documents

Zoom in or click on a cluster to expand and view documents



### Legend

Document (2579)

### Technology

- Wind Energy (2158)
  - Offshore Wind (991)
  - Land-Based Wind (983)
  - Marine Energy (191)
  - Wave (39)
  - Tidal (30)
  - OTEC (2)
  - Ocean Current (1)
  - Riverine (1)
- (Show more)

### Stressor

- Collision (397)
  - Habitat Change (365)
  - Noise (236)
- (Show more)

### Receptor

- Birds (872)
  - Human Dimensions (707)
  - Bats (422)
- (Show more)

Documents can be filtered by:

- Technology
- Stressor
- Receptor
- Country

## Glossary

### Technologies

- **Marine Energy:** The generation of renewable energy from tides, waves, currents, salinity, and temperature gradients in the oceans, seas, and rivers.
  - **Ocean Current Energy:** Capturing energy from ocean currents.
  - **Ocean Thermal Energy Conversion:** Capturing energy using temperature gradients across water depths.
  - **Riverine Energy:** Capturing energy from river currents.
  - **Salinity Gradient Energy:** Capturing energy from salinity gradients where freshwater meets seawater.
  - **Tidal Energy:** Capturing energy from tidal fluctuations.
  - **Wave Energy:** Capturing energy from waves.
- **Wind Energy:** The generation of renewable energy from the wind, either land-based or offshore.
  - **Land-Based Wind Energy:** Capturing energy from onshore wind.
  - **Offshore Wind Energy:** Capturing energy from offshore wind.

### Stressors & Interactions

- **Attraction:** Increased presence of organisms to a device.
- **Avoidance:** Temporary or permanent voluntary absence of organisms from the area surrounding a device.
- **Changes in Flow:** A device impeding or altering the flow of water or air.
- **Collision:** Direct contact between an animal and a device component.
- **Displacement:** Potential for the loss of habitat due to disturbance or barrier effects.
- **Electromagnetic Fields:** Physical fields generated by electrically charged objects.
- **Entrapment:** Large marine organisms feeling trapped by mooring lines, anchors, or cables.
- **Habitat Change:** Changes to the physical habitat around the device.
- **Lighting:** Artificial lighting added to devices for navigational safety.
- **Noise:** Sound generated during the construction or operation of a device.

### Receptors: Receptors include the marine animals, habitats, and ecosystems processes in which a device is deployed.

- **Bats:** Mammals with webbed wings capable of true flight.
- **Birds:** A broad term that applies to all species of birds.
  - **Ground-Nesting Birds:** Birds that nest and reside mostly on the ground.
  - **Passerines:** The most common type of birds, known for perching.
  - **Raptors:** Birds of prey that hunt and feed on large vertebrates compared to their size.
  - **Seabirds:** Birds that have adapted to life within the marine environment.
  - **Shorebirds:** Birds commonly found along shorelines, mudflats, and shallow water.
  - **Waterfowl:** Birds with webbed feet for aquatic environments.
- **Ecosystem Processes:** The physical, chemical, and biological processes that link organisms and their environment.
- **Fish:** Migratory fish passing through the area and resident fish living near a device.
  - **Demersal Fish:** Fish live and feed on or near the bottom of oceans and lakes.
  - **Pelagic Fish:** Fish that live in the pelagic zone of oceans or lakes.
- **Invertebrates:** A broad term that encompasses both marine and terrestrial animals lacking a backbone.
- **Marine Mammals:** A broad term that encompasses cetaceans, pinnipeds, and others.
  - **Cetaceans:** Whales, dolphins, and porpoises.
  - **Pinnipeds:** Seals, sea lions, and walruses.
- **Physical Environment:** The area surrounding a device.

Documents are tagged with relevant technology, stressor, and receptor tags

# Collision

## Direct contact between an animal and a device component.

Any part of a renewable energy device that moves has the potential to have a deleterious effect on both resident and migratory organisms. Collisions between animals and **tidal** or **wind** turbine blades could result in injury or death, either by direct contact with the device or by pressure changes created around the moving parts. The consequence of a collision with a blade may vary based on the rotational or mechanical speed of the moving parts, the presence and density of animals in the area, the time of day, weather conditions, and the ability of animals to sense and evade the device. Carcasses found around **land-based wind** turbines provide an estimate of **bird** and **bat** fatalities, while it is much more difficult to estimate the effect of collisions with **offshore wind** turbines. To date there have been no observed collisions of **marine mammals** or diving **seabirds** with tidal turbines. **Wave energy** devices also have moving parts such as heave plates, flaps, and other large heavy components that could potentially cause harm, although the likelihood is thought to be extremely small. Collisions resulting in injury and death of individual animals with moving parts of devices become particularly important if the loss of those individuals affect the stability and sustainability of the population in the area.



Terminology pages provide a description, photo, and table of all the documents tagged with the term

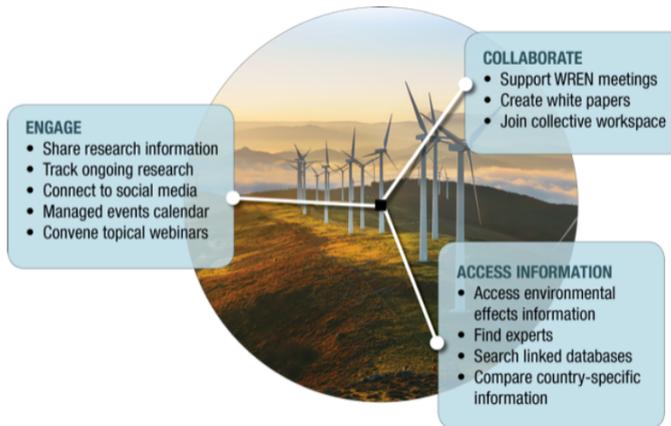
Total results: 836

Title	Author	Date ▾	Content Type	Technology	Stressor	Receptor
<a href="#">Collision risk modelling for tidal energy devices: A flexible simulation-based approach</a>	Horne, N., Culloch, R., Schmitt, P.	January 2021	Journal Article	Marine Energy, Tidal	Collision	Marine Mammals, Pinnipeds
<a href="#">A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor</a>	Murgatroyd, M., Bouten, W., Amar, A.	January 2021	Journal Article	Wind Energy, Land-Based Wind	Collision	Birds, Raptors
<a href="#">An investigation into the potential for wind turbines to cause barotrauma in bats</a>	Lawson, M., Jenne, D., Thresher, R.	December 2020	Journal Article	Wind Energy	Collision	Bats
<a href="#">Ocean energy and the environment: Research and strategic actions</a>	ETIP Ocean	December 2020	Report	Marine Energy, Tidal, Wave	Collision, EMF, Habitat Change, Noise	Physical Environment, Fish, Marine Mammals, Human Dimensions, Legal & Policy, Marine Spatial Planning
<a href="#">Vulnerability of northern gannets to offshore wind farms; seasonal and sex-specific collision risk and demographic consequences</a>	Lane, J., Jeavons, R., Deakin, Z.	December 2020	Journal Article	Wind Energy, Offshore Wind	Collision	Birds, Seabirds
<a href="#">Enabling Renewable Energy While Protecting Wildlife: An Ecological Risk-Based Approach to Wind Energy Development Using Ecosystem-Based Management Values</a>	Copping, A., Gorton, A., May, R.	November 2020	Journal Article	Wind Energy, Land-Based Wind, Offshore Wind	Collision, Habitat Change	Bats, Birds, Fish, Marine Mammals, Human Dimensions, Social & Economic Data, Stakeholder Engagement
<a href="#">Potential Environmental Effects of Marine Renewable Energy</a>	Copping, A., Hemery, J.	November	Journal	Marine Energy,	Changes in Flow, Collision, EMF,	Birds, Physical Environment, Fish, Invertebrates, Marine Mammals, Human

Similar pages available for:

- Glossary terms/tags
- Organizations
- Authors

## About WREN



### Knowledge Base

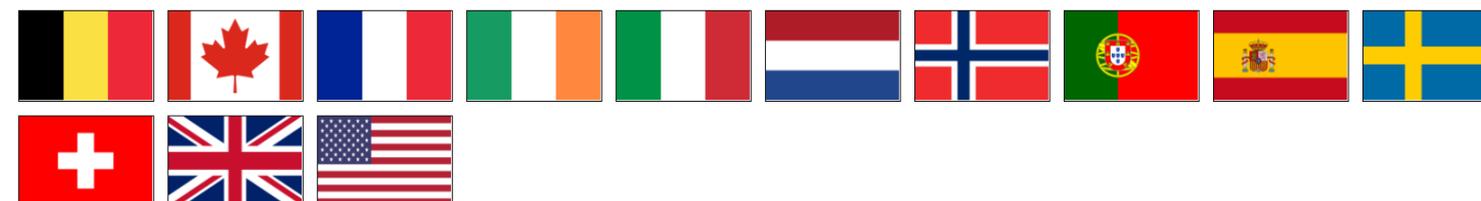
Access thousands of publications and more, all in a searchable database.

WREN (**W**orking Together to **R**esolve **E**nvironmental Effects of Wind Energy), also known as **Task 34**, was established by the **IEA Wind** Committee in October 2012 to address environmental issues associated with commercial development of land based and offshore wind energy projects. As the operating agent for WREN, the US leads this effort with support from the **National Renewable Energy Laboratory (NREL)**, the **Pacific Northwest National Laboratory (PNNL)**, and the **US Department of Energy's** Wind Energy Technologies Office (WETO).

The primary objective of WREN is to facilitate international collaboration and advance global understanding of potential environmental effects of wind energy. To support this effort, *Tethys* was expanded to serve as a collaborative outreach and engagement space, and to disseminate knowledge and information. While most WREN information and content is publicly accessible, some space is reserved for WREN member nations for collaborative work, under password-protection.

**To access member-only material, visit the [WREN Members Page](#).**

Countries Currently Involved in WREN (13):



### Contents

- [WREN White Papers](#)
- [WREN Short Science Summaries](#)
- [WREN Webinars](#)
- [Knowledge Base and Map Viewer](#)
- [WREN Meetings](#)
- [WREN Partners](#)
- [Contact Information](#)

WREN products include:

- White Papers
- Short Science Summaries
- Webinars

Access the [WREN Members page](#) here

## WREN White Papers

WREN is producing a series of white papers that address common problems facing wind and wildlife interactions, for which solutions are often elusive, and that do

[Home](#) » [About](#) » [About WREN](#)

## WREN White Papers

WREN is producing a series of white papers that address common problems facing wind and wildlife interactions, for which solutions are often elusive, and that do not fall within the purviews of industry, regulators, or researchers. The list of white papers is available below. As each paper is produced, it will be made available on *Tethys*. Each white paper is also summarized into a 2-page fact sheet, also available on *Tethys*. The summaries are translated into additional languages, representing the WREN network. The following are completed or planned:

- [2016 Adaptive Management \(Fact Sheet\)](#)
- [2019 Individual to Populations \(Fact Sheet\)](#)
- [2020 Risk-Based Management \(Fact Sheet\)](#)
- Cumulative Effects Assessment (In Progress)

## WREN Short Science Summaries

WREN seeks to summarize the current state of the science on interactions between wind energy development (land-based and offshore) and wildlife. A series of short science summaries are being prepared and made available for download on *Tethys*:



## WREN Webinars

WREN hosts quarterly webinars on the environmental concerns that are of importance to the land-based and offshore wind energy industries, as a means to effectively disseminate new information and research efforts to a large international audience of stakeholders. **You can sign up to receive invitations to live webinars here.**

Presentations from past wind energy webinars are hosted on *Tethys*, along with the associated video, as well as questions and answers. **Visit the archive.**

## Knowledge Base and Map Viewer

*Tethys* has collected over 3,600 documents related to the environmental effects of wind energy (land-based and offshore). All documents are available in a table format via the ***Tethys Knowledge Base***, which can be easily filtered to find documents relevant to specific searches such as document type, technology type, or environmental effect. Any documents related to a spatial location have been geotagged and made available on the ***Tethys Map Viewer*** (note: the Map Viewer contains only a subset of the documents available in the Knowledge Base).

## WREN Meetings

As an international initiative with 11 countries participating, in-person meetings among WREN country representatives are an important aspect as we work together to achieve the goals of WREN. These meetings occur twice a year, often in conjunction with related international conferences. The following is a list of all WREN

# Factsheet: A Risk-Based Approach for Addressing Wind and Wildlife Interactions using Ecosystem-Based Management Values



Factsheet and Short Science Summary pages provide access to the PDF and a table of documents relevant to the subject

In the context of **land-based** and **offshore wind energy** development, Risk Based Management (RBM) examines the potential negative effects on **birds, bats, terrestrial wildlife, marine mammals**, other marine organisms and the habitats or migratory pathways that support them. RBM has the potential to ensure that wildlife protection measures are focused on the factors that pose the highest risks, while maximizing the production of energy.

The risk-based approach that most closely addresses aspects of the complex ecosystems that make up the landscapes/seascapes of **wind energy** development is Ecosystem Based Management (EBM). EBM includes effects of human activities as well as environmental and ecological factors, using approaches that embrace holistic methods to include human needs and effects in an integrated view for managing resources sustainably.

Summary	
<b>Title:</b>	Factsheet: A Risk-Based Approach for Addressing Wind and Wildlife Interactions using Ecosystem-Based Management Values
<b>Author:</b>	<b>WREN</b>
<b>Publication Date:</b>	May 1, 2020
<b>Technology:</b>	<b>Wind Energy</b>

[Download the Risk-Based Management Factsheet](#)

The Risk-Based Management Factsheet was created to provide a broad summary of the [IEA Wind White Paper on A Risk-Based Approach for Addressing Wind and Wildlife Interactions Using Ecosystem-Based Management Values](#).

Access WREN's [Risk-Based Management White Paper](#) here

Title	Author	Date ▾	Content Type	Technology	Stressor	Receptor
<a href="#">Strategic Environmental Assessment and the precautionary principle in the spatial planning of wind farms – European experience in Serbia</a>	Josimović, B., Cvjetić, A., Furundžić, D.	February 2021	Journal Article	Wind Energy, Land-Based Wind		Human Dimensions, Environmental Impact Assessment, Legal & Policy
<a href="#">A predictive model for improving placement of wind turbines to minimise collision risk potential for a large soaring raptor</a>	Murgatroyd, M., Bouten, W., Amar, A.	January 2021	Journal Article	Wind Energy, Land-Based Wind	Collision	Birds, Raptors
<a href="#">What's love got to do with it? Understanding local cognitive and affective responses to wind power projects</a>	Russell, A., Firestone, J.	January 2021	Journal Article	Wind Energy, Land-Based Wind		Human Dimensions, Social & Economic Data
<a href="#">An investigation into the potential for wind turbines to cause barotrauma in bats</a>	Lawson, M., Jenne, D., Thresher, R., Houck, D., Wimsatt, J., Straw, B.	December 2020	Journal Article	Wind Energy	Collision	Bats



[Home](#) » [Broadcasts](#) » [Webinars for Marine and Wind Energy and the Environment](#)

## Webinars for Marine and Wind Energy and the Environment

Tethys hosts regular webinars pertaining to topic of environmental concern, as a means to effectively disseminate new information and research efforts to a large international audience of stakeholders. Anyone is welcome to attend these live webinars and participate in a live question and answer session with the presenters. Information for attending these live webinars is distributed to a public mailing list (separate lists for wind and water). Ongoing webinars on Tethys are sponsored by **OES-Environmental** and **WREN**.

You can sign up to receive invitations to live webinars here.

Below is a list of past webinars, containing video/audio files of the presentations and Q&A sessions when available.

Content Selection: - Any - Search Webinars:

Sponsored By	Title	Date	Description
WREN Webinar #18	<b>WREN/Tethys Webinar</b>	February 9, 2021	Join the National Renewable Energy Laboratory (NREL) and Pacific Northwest National Laboratory (PNNL) for a webinar discussing international efforts to address environmental issues associated with commercial development of land-based and offshore wind energy projects. NREL will discuss the new phase for Task 34 of the International Energy Agency's Wind Technical Collaborative Program, also known as <b>WREN (Working Together to Resolve the Environmental Effects of Wind Energy)</b> .
Wildlife & Wind Energy Webinar #9	<b>Wildlife &amp; Wind Energy Webinar Series: Future Priorities for Wildlife &amp; Wind Energy - Multi-stakeholder perspectives on challenges and opportunities</b>	December 8, 2020	Join us for the final webinar in a nine part webinar series titled Wildlife and Wind Energy: Considerations for monitoring and managing impacts. This dynamic series of training webinars has familiarized attendees with applied techniques for monitoring, permitting, reporting, and researching land-based wind energy and wildlife interactions. Experts from government agencies, private industry, academia, and NGOs have discussed important background information and address research and regulatory considerations related to early stages of prospecting potential projects to full operation.
Wildlife & Wind Energy Webinar #8	<b>Wildlife &amp; Wind Energy Webinar Series: Economics of Wind Energy: Understanding wildlife minimization in the context of development and financing</b>	November 10, 2020	Experts from Invenergy, DNV GL, and Pattern will provide an overview of the process of securing financing, budgeting, and contracting for wind development and operation. Additionally, our speakers will discuss how the financing process relates to the adoption of minimization strategies and conservation investments. This understanding can inform permitting and maximize conservation from wind energy assets.
New PRIMRE Developments: Part 2	<b>New PRIMRE Developments: Part 2 - New Features of Existing Knowledge Hubs</b>	October 28, 2020	Launched in 2019, the Portal and Repository for Information on Marine Renewable Energy (PRIMRE) was developed to serve as a centralized access point that enhances the accessibility and discoverability of information relevant to marine renewable energy (MRE) development and operations in the U.S. Part two of this two-part webinar series will highlight new features of existing PRIMRE Knowledge Hubs: Signature Projects, the Tethys Engineering Photo Library, and the PRIMRE aggregate search.
Wildlife & Wind Energy Webinar #7	<b>Wildlife &amp; Wind Energy Webinar Series: Impact Reduction Strategies for Eagles and Bats</b>	October 22, 2020	This webinar provided an overview of each including benefits, challenges, considerations, and species-specific applications. Representatives from industry and regulatory agencies shared perspectives on the role of these strategies in advancing wind energy and wildlife conservation. Attendees also heard about a publicly available technology database and an exciting new tool in development.
Wildlife & Wind	<b>Wildlife &amp; Wind Energy Webinar Series:</b>		Experts in field monitoring and statistical analysis reviewed the key considerations when planning a

Subscribe to receive webinar notifications

Easily switch between content selection and search for webinars

Find links to register for upcoming webinars, or view recordings and download presentations from past webinars

Home » Content » Event Calendar » Wildlife & Wind Energy Webinar Series: Future Priorities for Wildlife & Wind Energy - Multi-stakeholder perspectives on challenges and opportunities

## Wildlife & Wind Energy Webinar Series: Future Priorities for Wildlife & Wind Energy - Multi-stakeholder perspectives on challenges and opportunities

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Webinar #9: Future Priorities for Wildlife & Wind Energy: Multi-stakeholder perspectives on challenges and opportunities

The concluding webinar in this series will feature a multi-stakeholder panel with a forward looking focus: what does evolving turbine technology, advancing deployment, and the climate crisis mean for the wind-wildlife regulatory landscape? What are the biggest challenges and priorities for this work given changing costs, electrification of the grid, and more aggressive state renewable portfolio standards? How is each sector preparing for the future (federal and state regulators, industry, researchers, etc.) to enable wildlife-responsible wind energy development at the pace and scale needed to meet our climate goals? These questions will be informed by input from you, the attendees, provided throughout the webinar series and through interaction with the expert panel.

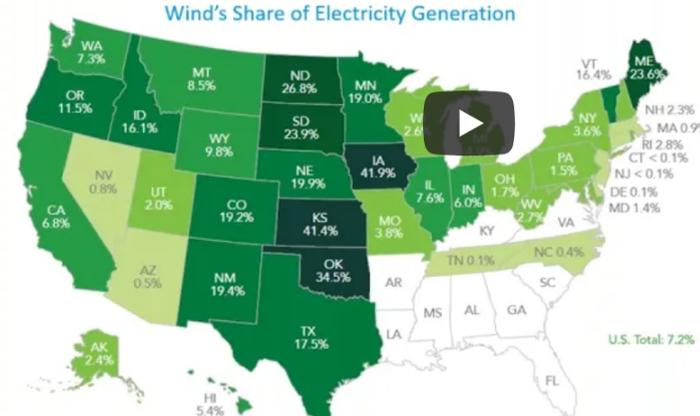
Webinar	
<b>Title:</b>	Wildlife & Wind Energy Webinar Series: Future Priorities for Wildlife & Wind Energy - Multi-stakeholder perspectives on challenges and opportunities
<b>Date:</b>	December 8, 2020 20:00–21:45 UTC
<b>Location:</b>	Online
<b>Website:</b>	<a href="#">External Link</a>
<b>Technology:</b>	<a href="#">Wind Energy</a> , <a href="#">Land-Based Wind</a>

TETHYS Wildlife & Wind Energy Webinar Series: Webinar #9 - Future Priorities for Wildlife & Wind Energy
Watch later Share



**Wind is now America's #1 renewable energy source**  
Generated 300 TWh of electricity—7.2% of 2019 generation

Wind's Share of Electricity Generation



State	Share (%)
VT	16.4%
ME	23.6%
NH	2.3%
MA	0.9%
RI	2.8%
CT	<0.1%
NJ	<0.1%
DE	0.1%
MD	1.4%
VA	2.7%
NC	0.4%
SC	0.1%
GA	0.1%
AL	0.1%
MS	0.1%
LA	0.1%
TX	17.5%
AK	2.4%
HI	5.4%
WV	2.7%
OH	1.7%
IN	6.0%
IL	7.6%
IA	41.9%
MO	3.8%
KS	41.4%
NE	19.9%
SD	23.9%
ND	26.8%
MN	19.0%
WI	2.6%
WY	9.8%
MT	8.5%
WV	2.7%
PA	1.5%
NY	3.6%
OR	11.5%
WA	7.3%
UT	2.0%
CO	19.2%
NM	19.4%
AZ	0.5%
NV	0.8%
CA	6.8%
U.S. Total	7.2%

Legend: >0% to <1% (lightest green), 1% to <5% (light green), 5% to <10% (medium green), 10% to <20% (dark green), 20% to <30% (darkest green), 30% and higher (black)

- Wind energy surpassed hydro in 2019 to become the largest source of renewable electricity in the country
- 6 states generated more than 20% of their electricity from wind power in 2019
- Iowa and Kansas generated more electricity from wind turbines than any other technology
- 21 states produced at least 5% of their generation from wind energy in 2019

Webinar recordings are hosted on *Tethys'* YouTube Channel

Links to related events or other webinars in a series are available below



## Subscribe to Tethys

You can sign up to receive emails from the Tethys and Tethys Engineering projects. You can pick your preferences on which content to receive, selecting from the following:

- Tethys Blast: Bi-weekly newsletter on the environmental effects of wind and MRE
- Tethys Engineering Blast: Bi-weekly newsletter on engineering aspects of MRE
- Marine Energy Content: Receive occasional notifications for upcoming opportunities and webinars about marine energy.
- Wind Energy Content: Receive occasional notifications for upcoming opportunities and webinars about wind energy.

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Register for an account to:

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Bi-weekly newsletter highlights:

- Announcements
- Upcoming Events
- New Documents on *Tethys*
- International News

You can contribute content by emailing [tethys@pnnl.gov](mailto:tethys@pnnl.gov)

# Tethys Development

- Content team locates, adds, and tags documents manually
- Developer team maintains and improves the website
- Very active in outreach (webinars, workshops, social media, SEO)



\*Drupal is a flexible, open-source framework used by over a million websites

# Analytics

Overview

Jan 1, 2020 - Dec 31, 2020

Users vs. Select a metric

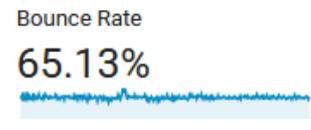
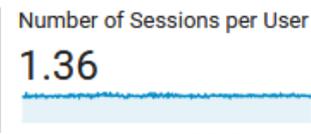
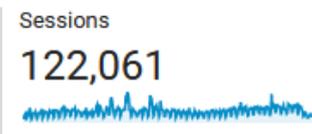
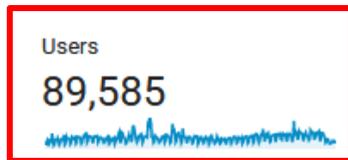
Hourly Day Week Month

Users

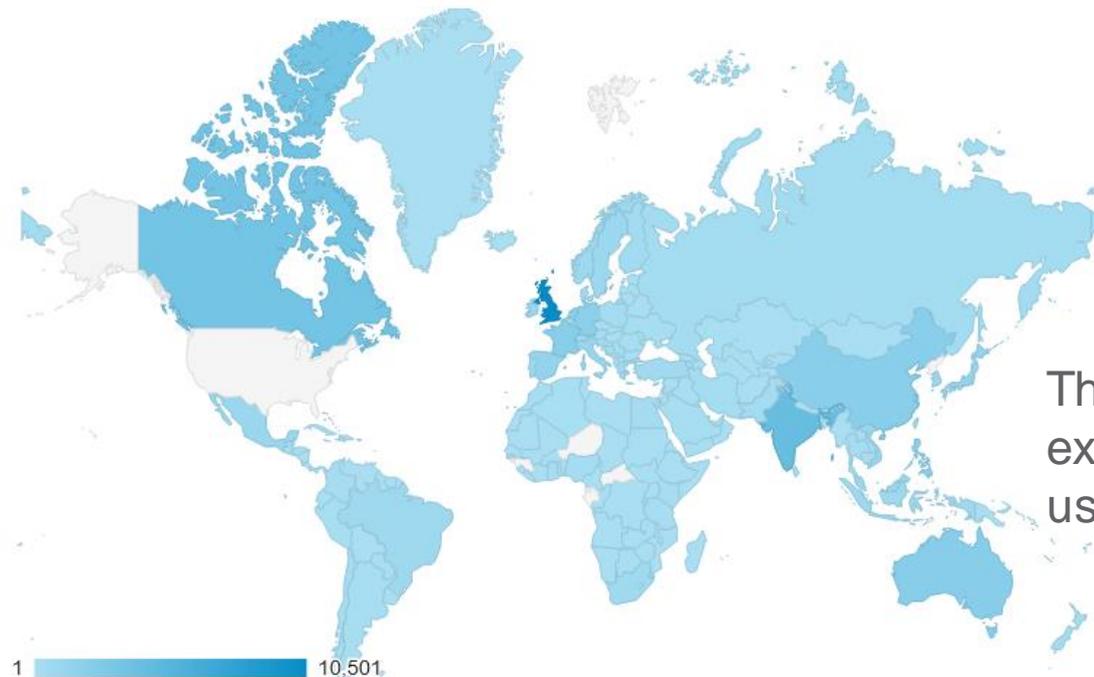
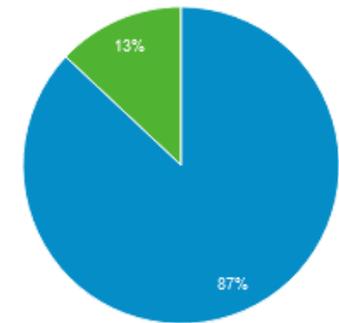
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February 2020 March 2020 April 2020 May 2020 June 2020 July 2020 August 2020 September 2020 October 2020 November 2020 December 2020



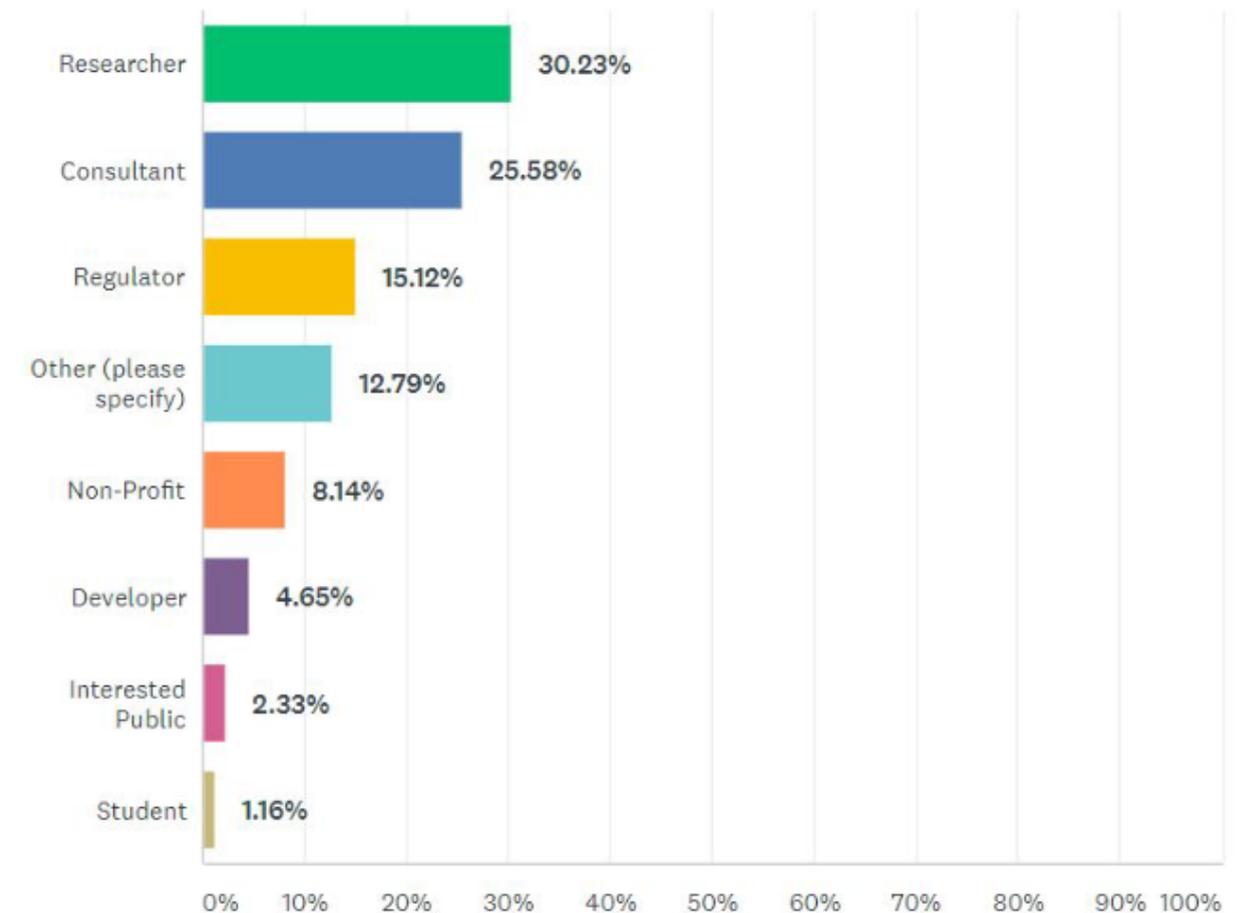
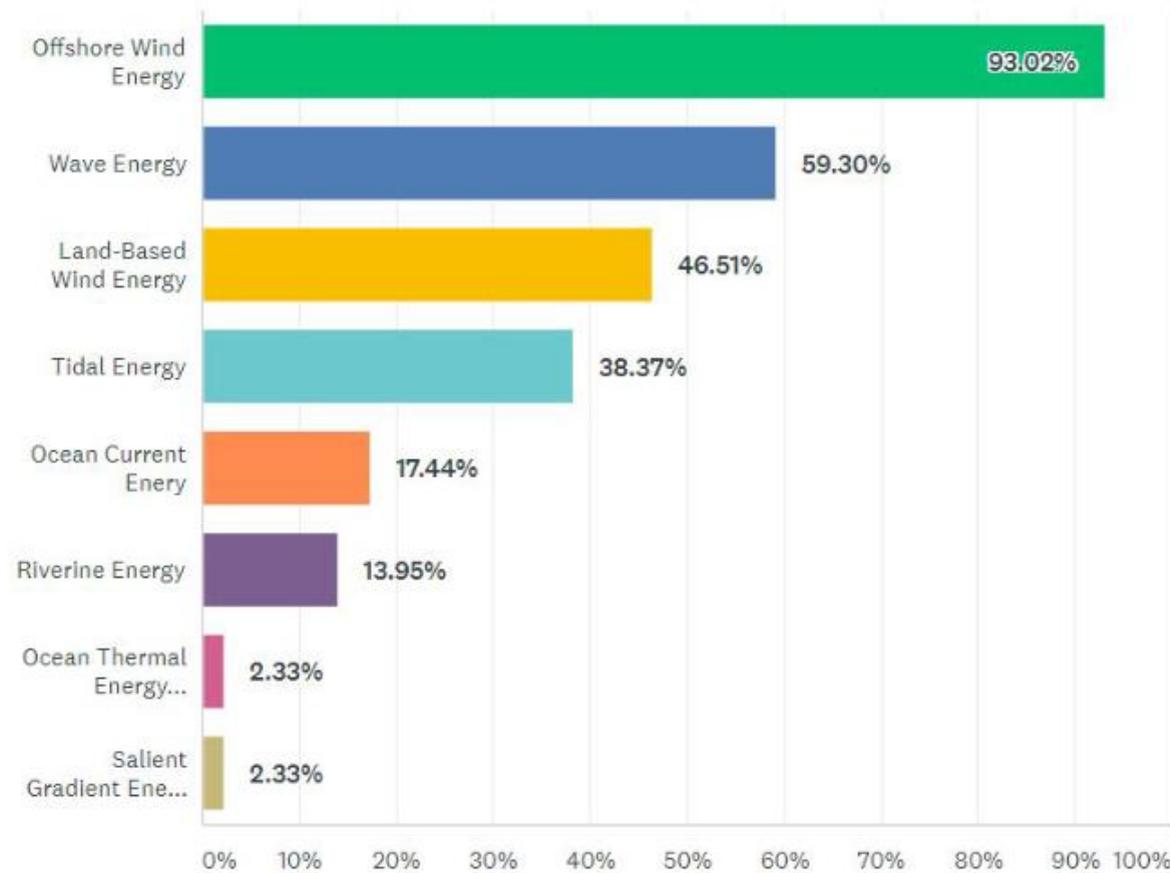
New Visitor Returning Visitor



This map excludes 30K users from U.S.

# Tethys Peer Review

- 12 questions sent to public *Tethys* mailing list
  - 86 responses



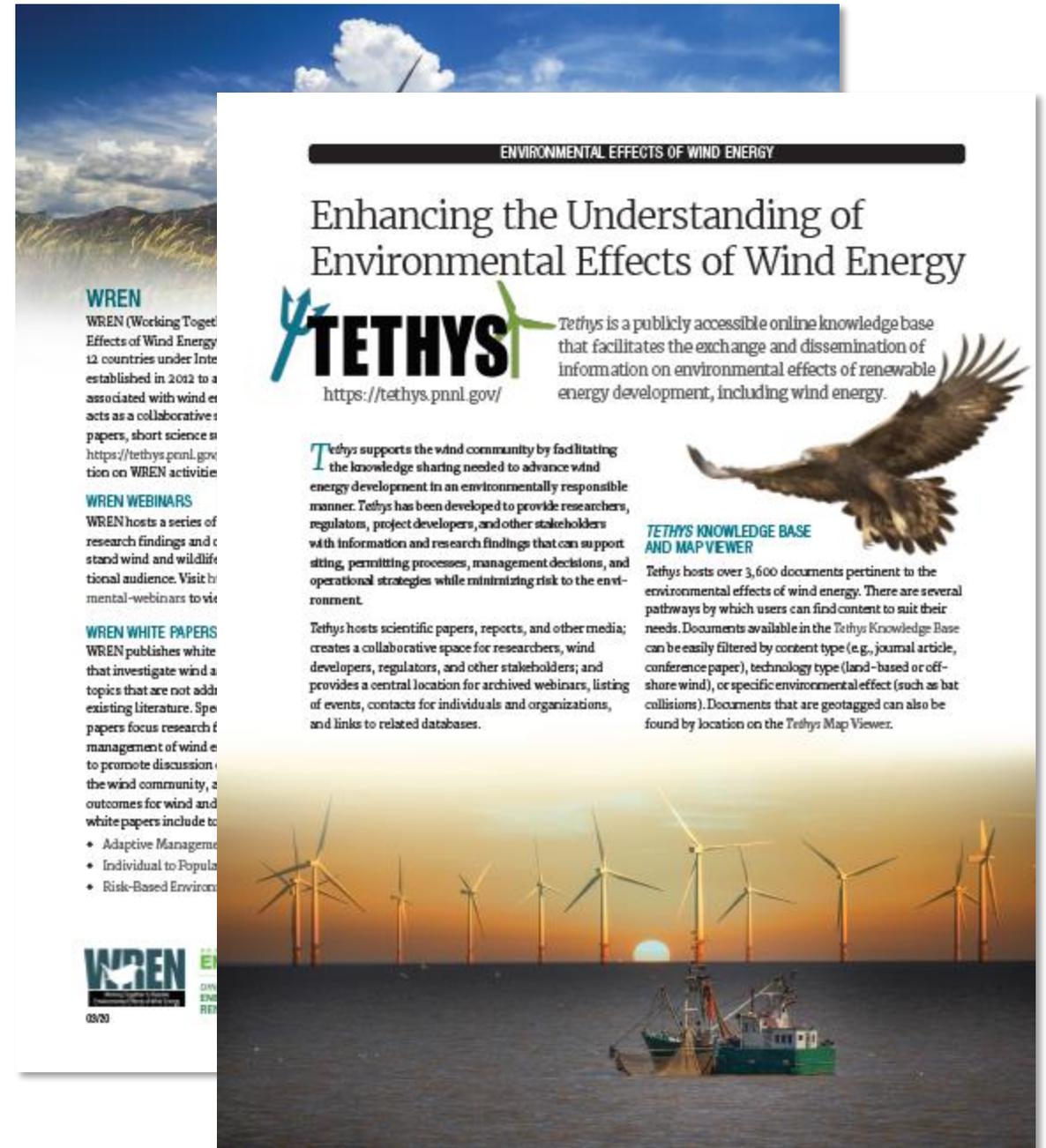
# Summary



Fosters international research and engagement to advance wind energy deployment through environmental



Facilitates data and information exchange on the environmental effects of wind energy to inform design, reduce environmental effects, and facilitate permitting



**ENVIRONMENTAL EFFECTS OF WIND ENERGY**

## Enhancing the Understanding of Environmental Effects of Wind Energy

**TETHYS** *Tethys is a publicly accessible online knowledge base that facilitates the exchange and dissemination of information on environmental effects of renewable energy development, including wind energy.*  
<https://tethys.pnnl.gov/>

**Tethys** supports the wind community by facilitating the knowledge sharing needed to advance wind energy development in an environmentally responsible manner. Tethys has been developed to provide researchers, regulators, project developers, and other stakeholders with information and research findings that can support siting, permitting processes, management decisions, and operational strategies while minimizing risk to the environment.

**TETHYS KNOWLEDGE BASE AND MAP VIEWER**  
 Tethys hosts over 3,600 documents pertinent to the environmental effects of wind energy. There are several pathways by which users can find content to suit their needs. Documents available in the Tethys Knowledge Base can be easily filtered by content type (e.g., journal article, conference paper), technology type (land-based or off-shore wind), or specific environmental effect (such as bat collisions). Documents that are geotagged can also be found by location on the Tethys Map Viewer.

**WREN**  
 WREN (Working Together to Resolve Environmental Effects of Wind Energy) is a collaborative effort established in 2012 to address the environmental effects associated with wind energy. WREN acts as a collaborative platform for sharing research findings and standard wind and wildlife mitigation measures. Visit <https://tethys.pnnl.gov/tethys/wren> for more information on WREN activities.

**WREN WEBINARS**  
 WREN hosts a series of research findings and standard wind and wildlife mitigation measures. Visit <https://tethys.pnnl.gov/tethys/wren/webinars> to view the recordings.

**WREN WHITE PAPERS**  
 WREN publishes white papers that investigate wind energy topics that are not addressed in existing literature. Special reports focus research findings to promote discussion in the wind community, and outcomes for wind energy development. White papers include:

- Adaptive Management
- Individual to Population
- Risk-Based Environmental



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**Thank you!**

