Michigan Great Lakes Wind Council

Balancing the Use of Great Lakes Resources

Excerpts from Executive Order 2009-1, Creating the Great Lakes Wind Council

- The Great Lakes are Michigan's most precious natural resource and the government of this state has a solemn, perpetual, fiduciary responsibility to protect and preserve the waters of the Great Lakes in public trust for the citizens of Michigan.
- The Great Lakes provide tremendous economic value to the citizens of Michigan in the tourism, recreation, fishing, and shipping industries.
- The availability, consistency, and velocity of wind in the Great Lakes makes their waters uniquely attractive to wind energy developers seeking to build offshore wind energy systems.
- If developed properly, offshore wind energy systems in a very small portion of Michigan's vast share of the Great Lakes could provide a significant portion of Michigan's and the Midwest's electricity needs, improve Michigan's economy, and create jobs in this state.

www.michiganglowcouncil.org
June 2010

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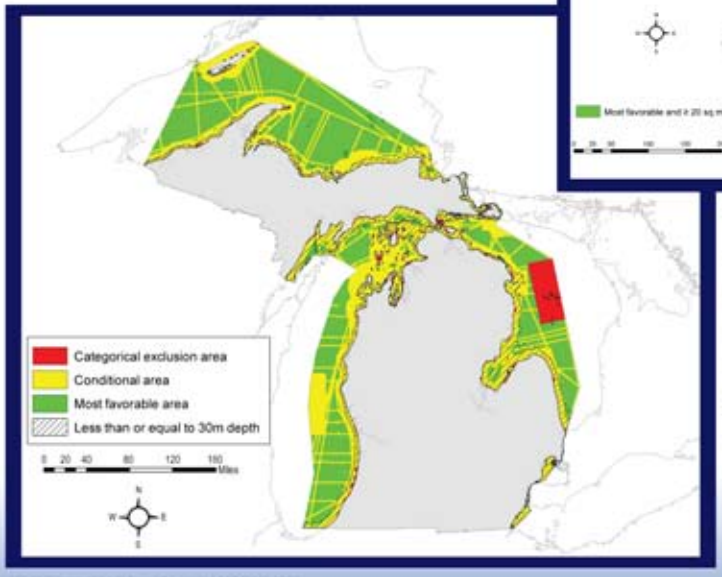
Where Should Offshore Wind Energy Be Developed?

Anticipating the development of Michigan's world-class offshore wind resources, a council comprised of 29 stakeholders and state agency representatives used GIS mapping tools to identify the "least" and "most" favorable areas for development of offshore wind energy on state-owned bottomlands.

Three designations were developed using various screening criteria:

- **Categorical exclusion areas:** Bottomlands that are not suitable for development due to existing uses and/or state or federal laws that provide for other exclusive uses (for example, navigation channels, coastal airport setbacks, etc.)
- **Conditional areas:** Bottomlands that may have potential for development but contain one or more potentially competing value such as wildlife habitat, harbors, commercial fishing, shoreline, shipwrecks, etc.
- **Most favorable areas:** Bottomlands outside of categorical exclusion areas and conditional areas that do not contain any features defined by the screening criteria



The map to the left shows the three types of areas. For example, the red rectangle in Lake Huron is a military operation area. The bright yellow strip along the shore indicates a "conditional" 6-mile-wide visual buffer.

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Habitat Protection Buffers for Offshore Wind Energy Development

The Great Lakes Wind Council uses the best available field surveys and studies to identify habitats of special concern on the Great Lakes so they can be given special consideration before wind energy development is allowed.

Biological screening criteria include:

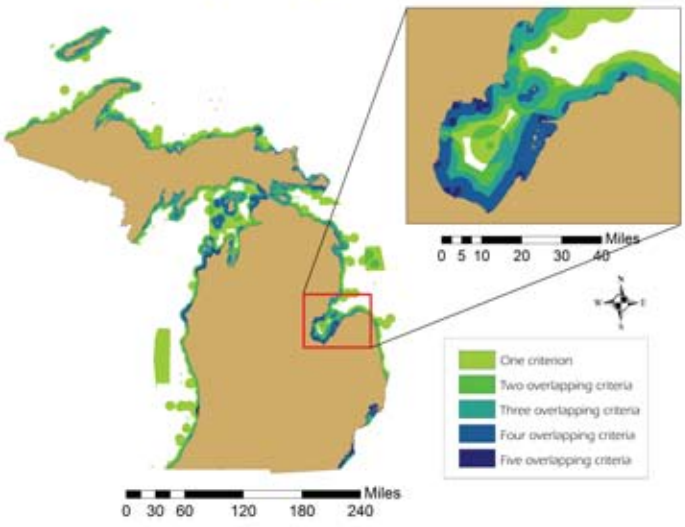
- Fish spawning areas
- Threatened or endangered species
- High bird or bat concentrations
- Sensitive bird or bat species
- Nearshore habitats

The council applied a one-mile buffer around fish spawning areas, which are shown on the map to the right. The map below applies the various biological criteria used by the council and illustrates the high concentration of sensitive habitat and species close to shore. The shading illustrates how these sensitive species or habitats overlap.

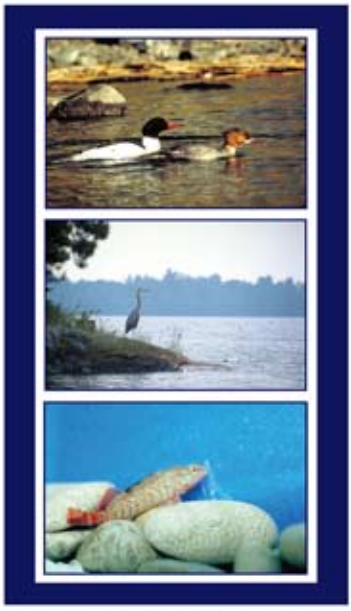
The council recommended avoiding these areas for wind energy development.

Fish Spawning Areas

Nearshore Areas with Sensitive Species or High Biological Productivity



Maps courtesy of Institute for Fisheries Research/MDNR, 2010



Photos courtesy Great Lakes National Program Office/U.S. EPA

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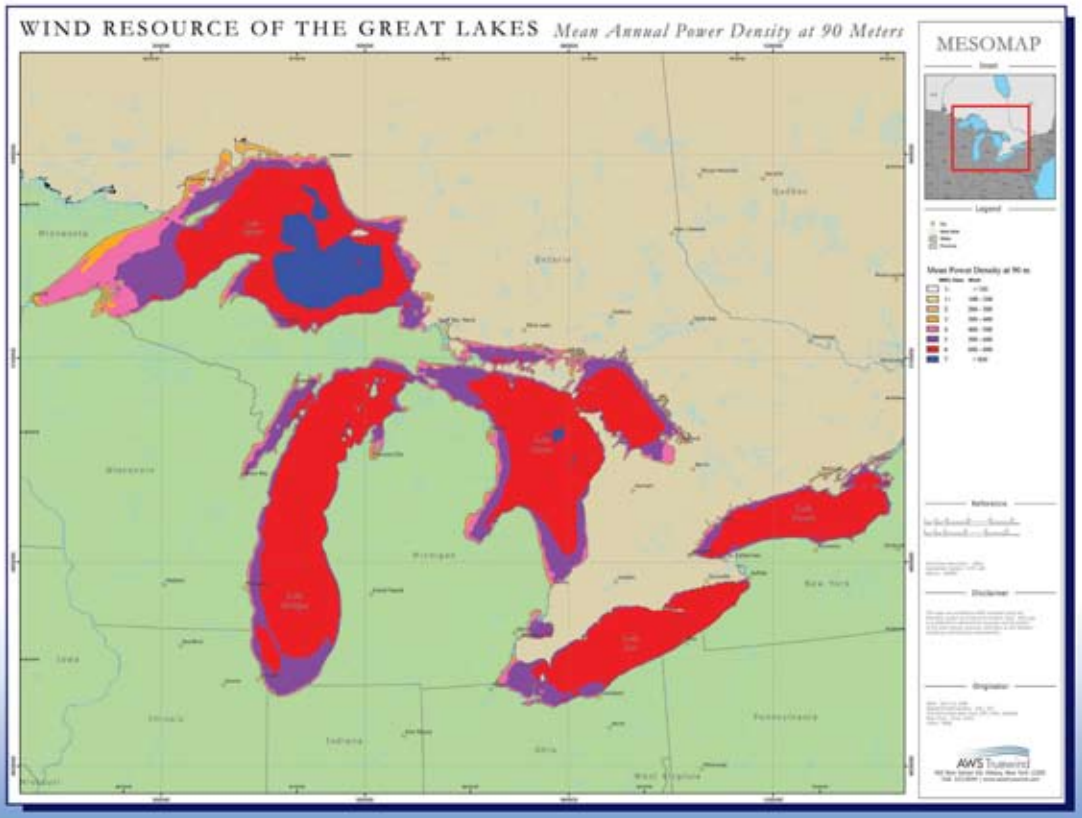
Great Lakes: World Class Wind Resources

Michigan's Great Lakes have some of the best wind resources in the world. Maps prepared for the U.S. Department of Energy (DOE) classify Great Lakes wind resources as "excellent" (purple), "outstanding" (red), and "superb" (blue area).

Wind Energy Potential

The Great Lakes could produce a significant amount of electricity from offshore wind farms, even if only a fraction of the lakes is used for this purpose. For example, developing only *2 percent* of "conditional" and "most favorable" areas identified by the council (no depth restrictions) would provide roughly *30 percent* of the electrical energy needed for the entire state of Michigan.

The DOE forecasts that 1,000 megawatts of wind energy in Michigan (the approximate output of two large offshore wind projects) would result in annual CO_2 reductions of 2.9 million tons. This is equivalent to the CO_2 emissions from the electricity used by approximately 340,000 homes each year, according to U.S. Environmental Protection Agency estimates.



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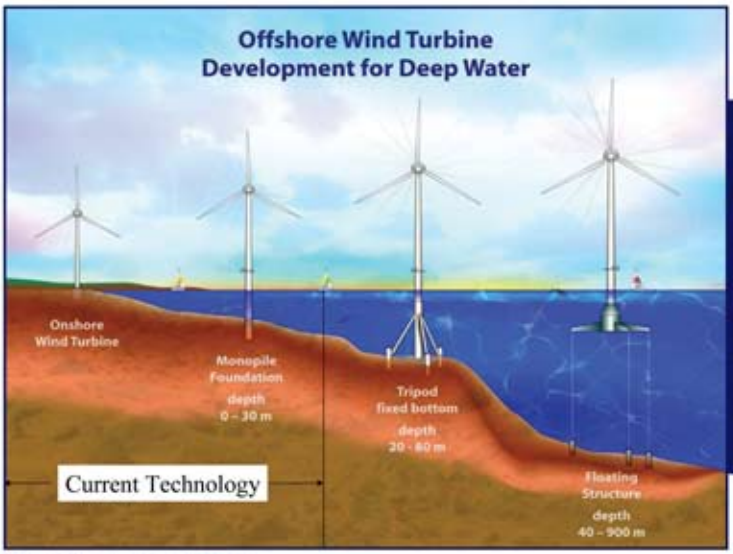
Offshore Wind Energy Technology and Trends



Source: U.S. Department of Energy (DOE) 2008

As technology continues to improve, it will be possible to place wind turbines at greater depths, where winds are stronger and more consistent. Great Lakes ice conditions will present additional engineering challenges before deep water systems can be built.

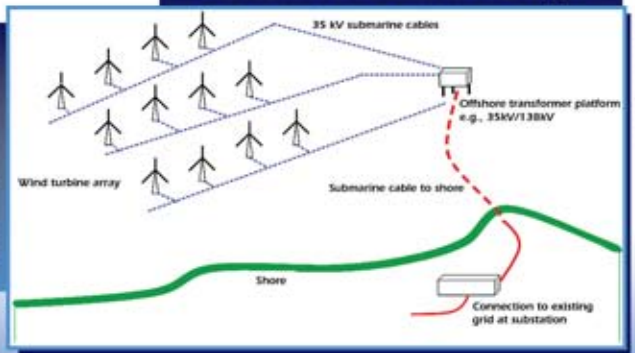
Quick Facts about Offshore Wind Energy Systems

- Offshore turbines are typically larger and have greater energy production potential than onshore systems.
- The installed cost is approximately twice the cost of onshore systems but this does not mean that the wholesale or retail prices for electricity from offshore wind energy would be twice as high.
- Higher costs of offshore wind systems may be offset by the greater amounts of wind available over the water.
- Offshore systems also require more maintenance than onshore systems over the life of the project.
- Worldwide, offshore wind energy generating capacity totals over 2,000 megawatts (MW), with none in the United States. Europe's offshore wind capacity is expected to skyrocket by 2015 to over 37,000 MW, enough to provide electrical power to roughly 11 million homes.

Turbine Installation

Photo credit: Bluewater Wind

Offshore Electrical Design



Source: Bluewater Wind

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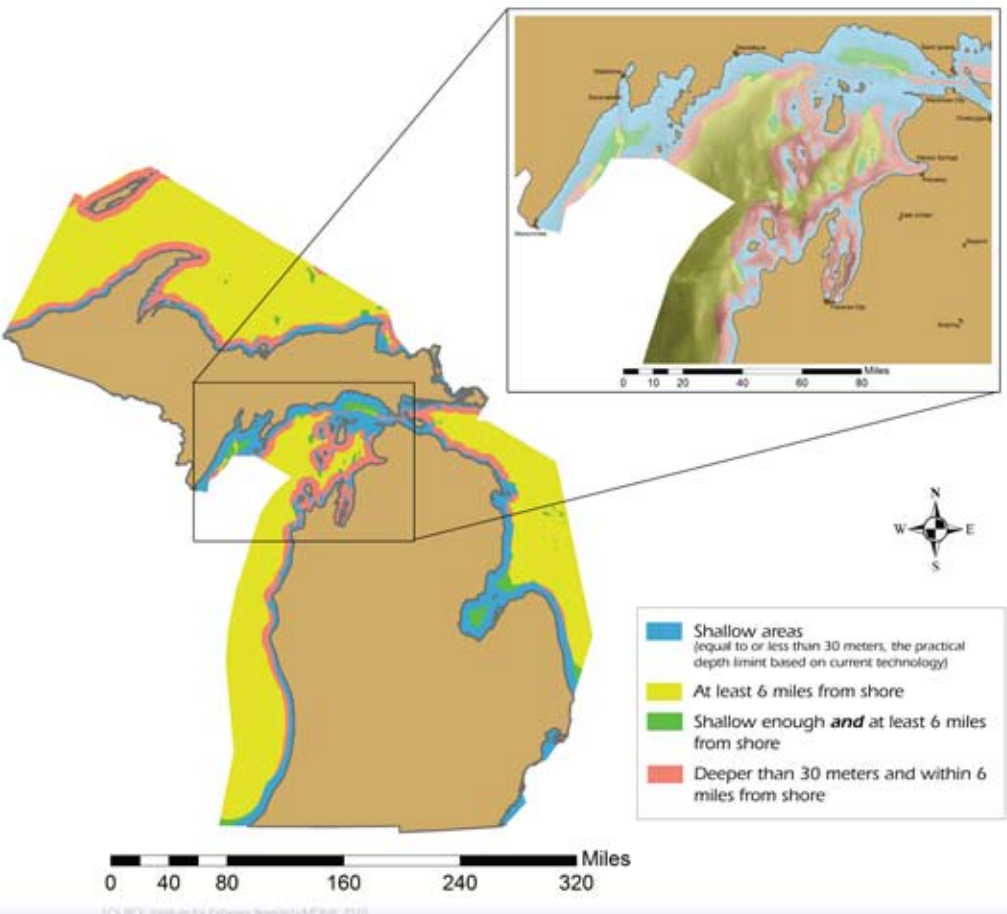
Water Depths for Offshore Wind Energy Development

Water depth is an important factor for siting an offshore wind energy system. Depths of less than 30 meters (about 100 feet) are most attractive to developers. The map below illustrates areas that are less than 30 meters deep and beyond the six-mile shoreline buffer recommended by the Great Lakes Wind Council.

As technology changes, turbines can be located in deeper waters and farther from shore. Prototype foundations and towers are being tested in European ocean depths of approximately 150 feet and floating wind energy platforms are being tested.



SOURCE: Institute for Fisheries Research/MDNR, 2010

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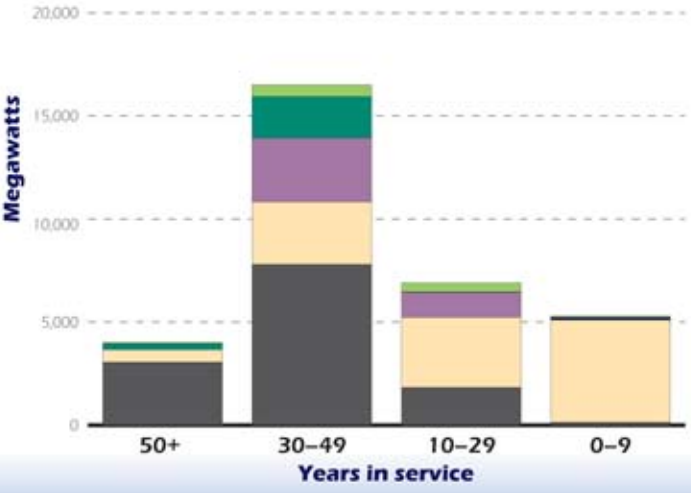
Supplying Michigan's Electricity Needs

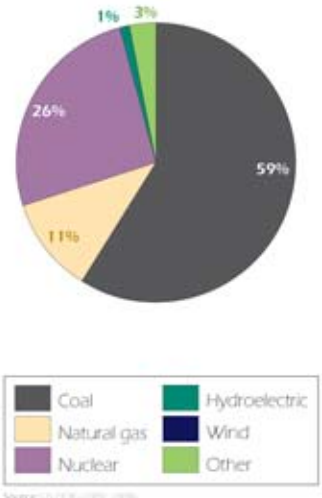
Now and in the Future

Michigan has an aging fleet of power plants; about two-thirds of the total generating capacity is at least 30 years old. How will Michigan meet its electricity needs in the future? Michigan's new renewable energy law requires that at least 10% of electricity sold in the state must come from renewable sources by 2015. Michigan currently has 144 megawatts of installed onshore wind capacity, amounting to less than 1% of the state's total electricity sales. Federal climate change legislation and other policies could accelerate the demand for renewable energy and/or accelerate the retirement of older, fossil-fuel plants.

Current Electricity Generators in Michigan by Years in Service, 2008



Electricity Generation in Michigan by Source, 2007



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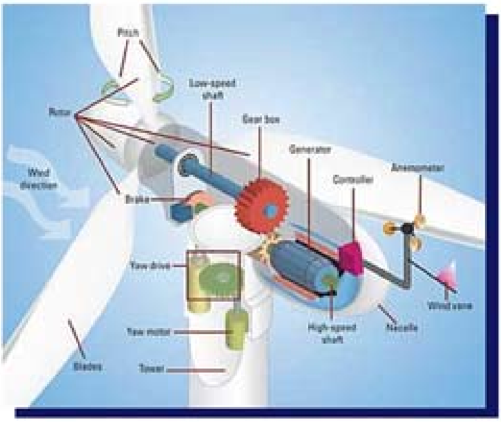
Business Opportunities in the Wind Energy Industry



Turbines have lots of moving parts that could mean jobs for Michigan

8,000+ components in each utility-scale wind turbine

Wind Turbine Component	Investment Potential through 2020, US (US$ billion)*	Investment Potential through 2020, Global (US$ billion)*
Rotor Blades	$23 – $27	$121 – $139
Gearbox	$13 – $16	$66 – $85
Generator	$3.5 – $5	$18 – $30
Bearings (Pitch, Yaw)	$2.5 – $5	$12 – $24
Tower	$29 – $33	$151 – $169
Power Converter	$4.5 – $7	$24 – $36

Current and Anticipated Supply Chain Needs to Meet Expected Wind Energy Demand

- Industrial gearboxes
- Large bearings
- Generators/generator components
- Large castings and machining
- Quality control and reliability issues
- Crane availability
- Domestic transport capacity and permitting
- Qualified/affordable personnel

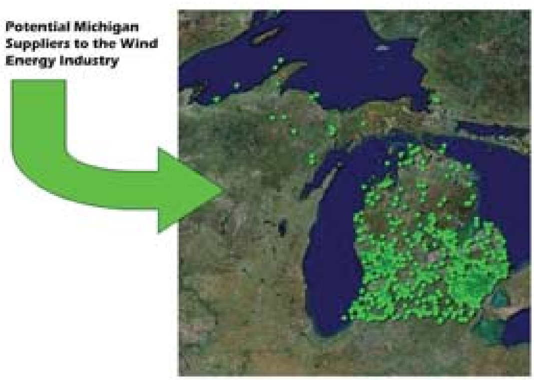
MICHIGAN

Poised to Succeed with Strengths in Manufacturing, Engineering Design, and Research

- 66 existing manufacturers and suppliers; 1,000 more have potential
- 30,000+ jobs anticipated if state realizes potential to be wind energy component manufacturing hub of Midwest
- Michigan ranks second in the nation for total annual R&D investment
- Michigan is home to world-class research universities and more than 330 R&D tech centers
- Highly trained workforce is ready and available

Michigan Leading in Wind Turbine Innovation

- Permanent magnet generators/direct drive systems
- Advanced wind powertrain systems
- New wind blade designs, materials, and processing
- Breakthrough LIDAR wind turbine control and siting tools
- Automation methods for wind blades and hub machining
- Next generation wind energy capturing systems



Images and data provided by Michigan Economic Development Corporation (2010)

Offshore Wind Energy Photo Simulations

Photo A

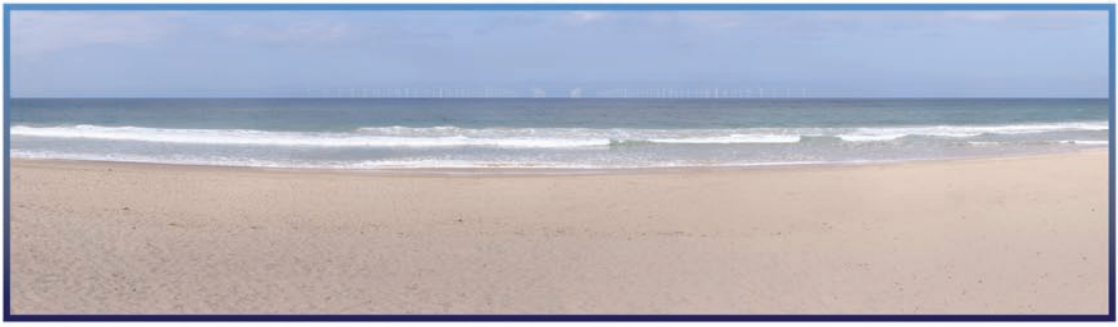


Photo B

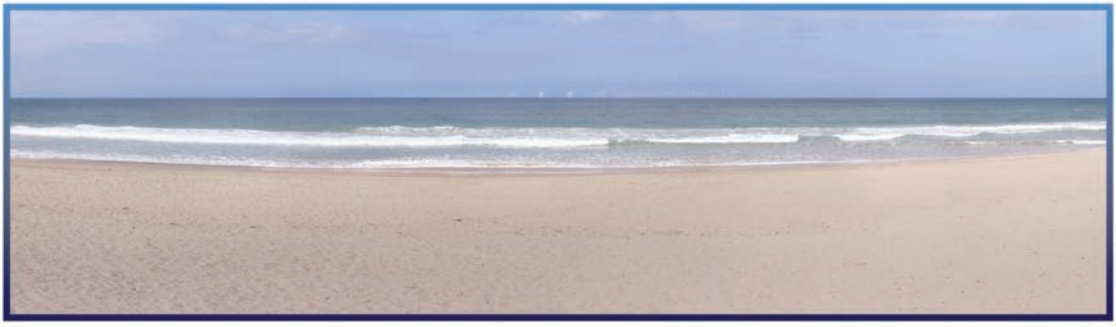
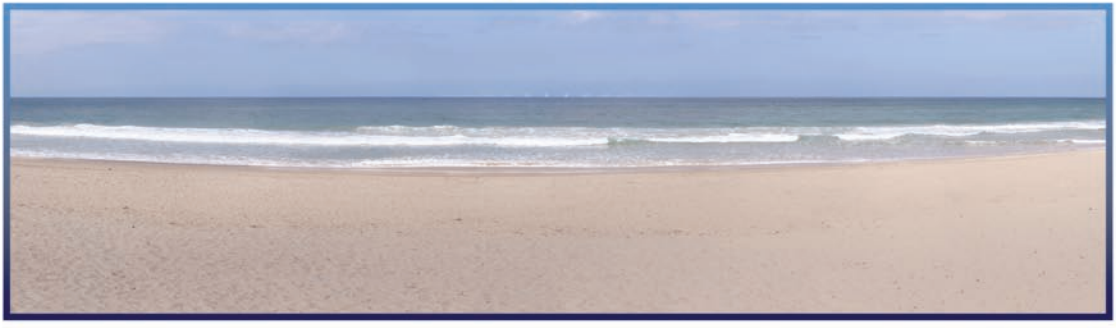


Photo C



Images courtesy of the University of Delaware.