

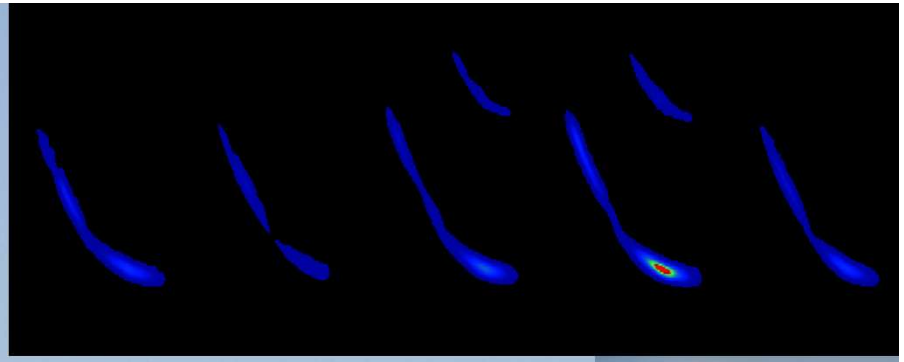

Offshore Wind Wildlife Studies: current challenges and emerging solutions

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Principal Ornithologist, Normandeau Associates (formerly Pandion Systems)

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Giant Cuisinart: How does wind power negatively impact birds?

US Annual average bird mortality from collisions with wind turbines (from NAS 2007)

4.27 birds per turbine

2.96 birds per megawatt

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Bird Threat-down: Where does wind power rank among anthropogenic threats to birds?

US annual bird mortality estimates (from NAS 2007 except for vehicles)

1.	Buildings/windows	97-976 million
2.	High-tension lines	130-1000 million
3.	Communication towers	5-50 million
4.	Pesticides	>72 million
5.	Domestic cats	“hundreds of millions”
6.	Vehicles	(hundreds of millions)
7.	Wind turbines	20-37 thousand

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Bird Threat-down: Where does wind power rank among anthropogenic threats to birds?

Conservation groups are virtually unanimous: the biggest threats currently facing bird populations are not direct mortality-causing factors

1. climate change
2. habitat loss/destruction

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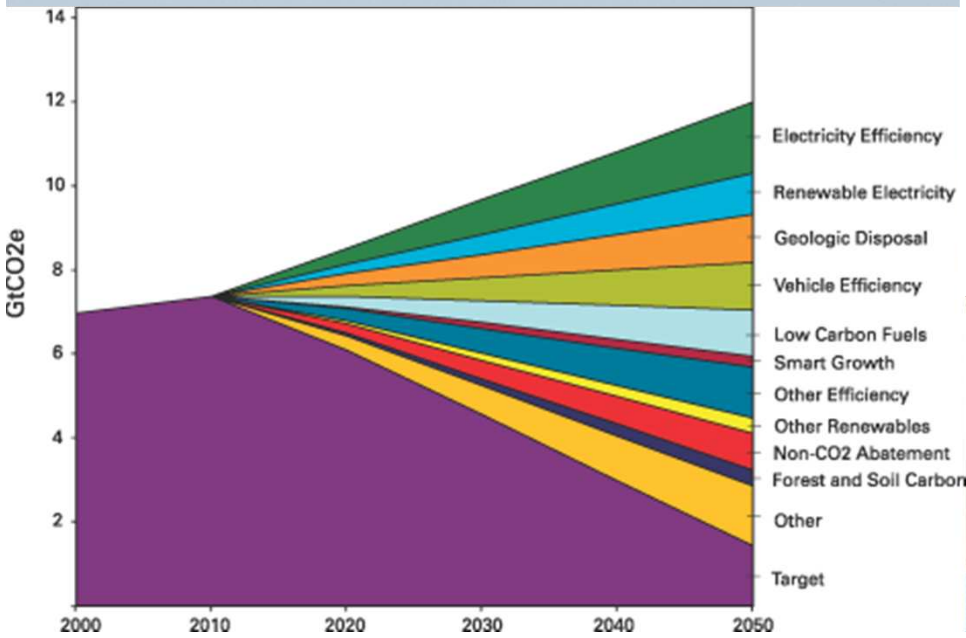
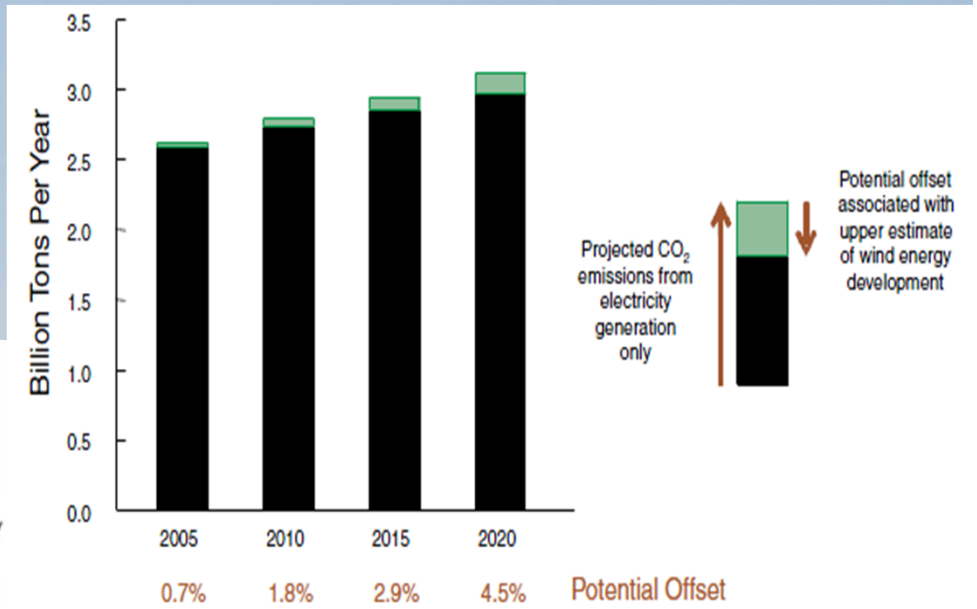
Wind, Warming, and Wedges: Positive impacts of wind power generation on birds

http://www.nrdc.org/globalwarming/blueprint/Images/methodology_wedges.gif





From NAS 2007

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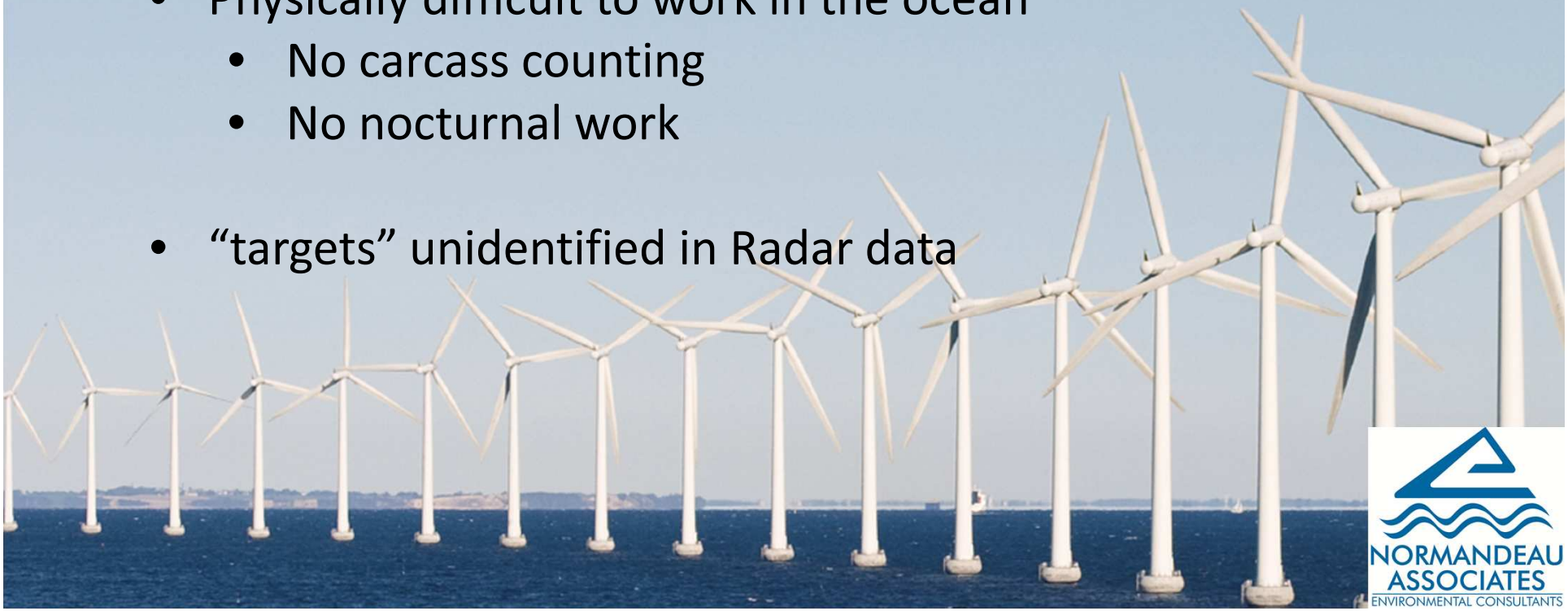
Offshore Wind Wildlife Study Challenges

- Limited background knowledge of marine ecology
- Expensive to work in the ocean
  - Plane or boat needed for field surveys
- Physically difficult to work in the ocean
  - No carcass counting
  - No nocturnal work
- “targets” unidentified in Radar data



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Emerging Technology Offers Solutions

- Expensive to work in the ocean
  - Plane or boat needed for field surveys

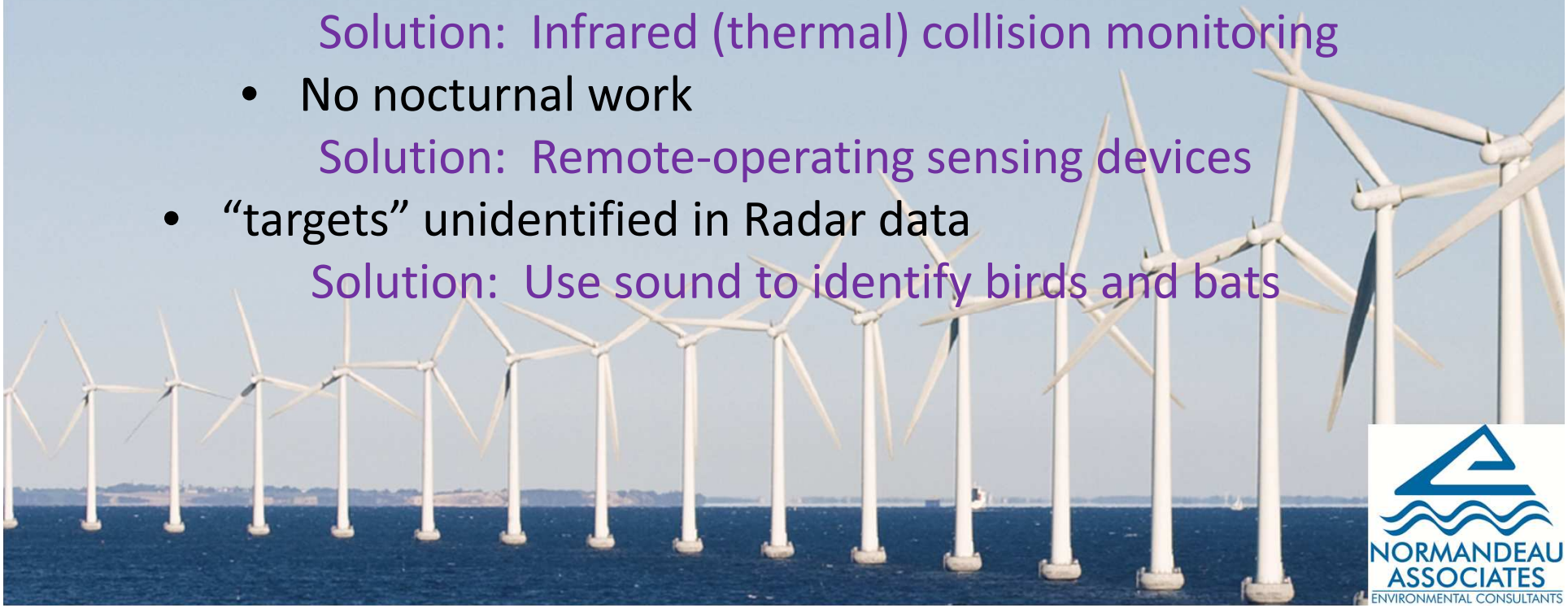
    Solution: Remote-operating sensing devices

    Solution: Large-area surveys for cost-effectiveness
- Physically difficult to work in the ocean
  - No carcass counting

    Solution: Infrared (thermal) collision monitoring
  - No nocturnal work

    Solution: Remote-operating sensing devices
- "targets" unidentified in Radar data

  Solution: Use sound to identify birds and bats



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Two US Federal Government Initiatives to Advance Offshore Wildlife Sensing Technology

Current research and development projects by Normandeau Associates for the Bureau of Ocean Energy Management, Regulation, and Enforcement (USDOI-BOEMRE)

1. Acoustic/Thermographic Offshore Monitoring System

2. Aerial High-definition Imaging Pilot Study

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Acoustic/Thermographic Offshore Monitoring System (ATOM)

- **Objective**

  Gather species-specific data on birds and bats flying at rotor swept altitudes at proposed offshore wind facility locations

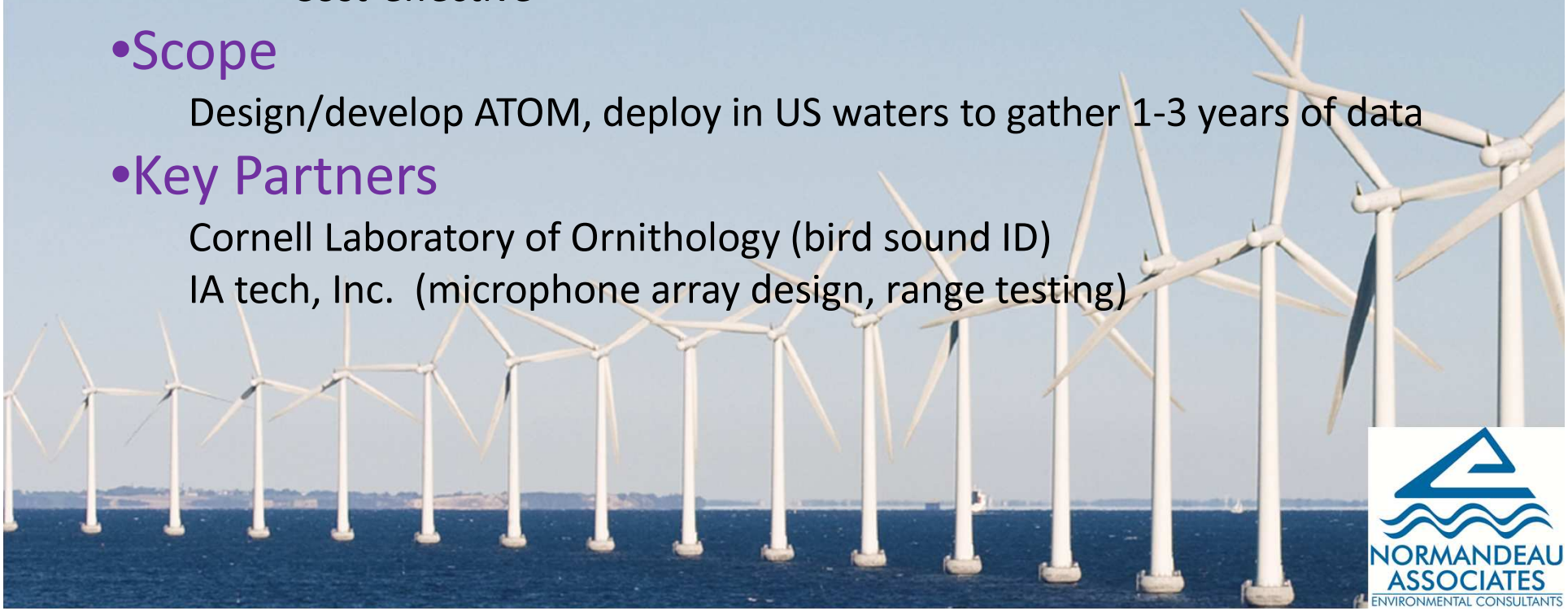
  - Day and night
  - Throughout the seasons
  - Cost-effective

- **Scope**

  Design/develop ATOM, deploy in US waters to gather 1-3 years of data

- **Key Partners**

  Cornell Laboratory of Ornithology (bird sound ID)
  IA tech, Inc. (microphone array design, range testing)



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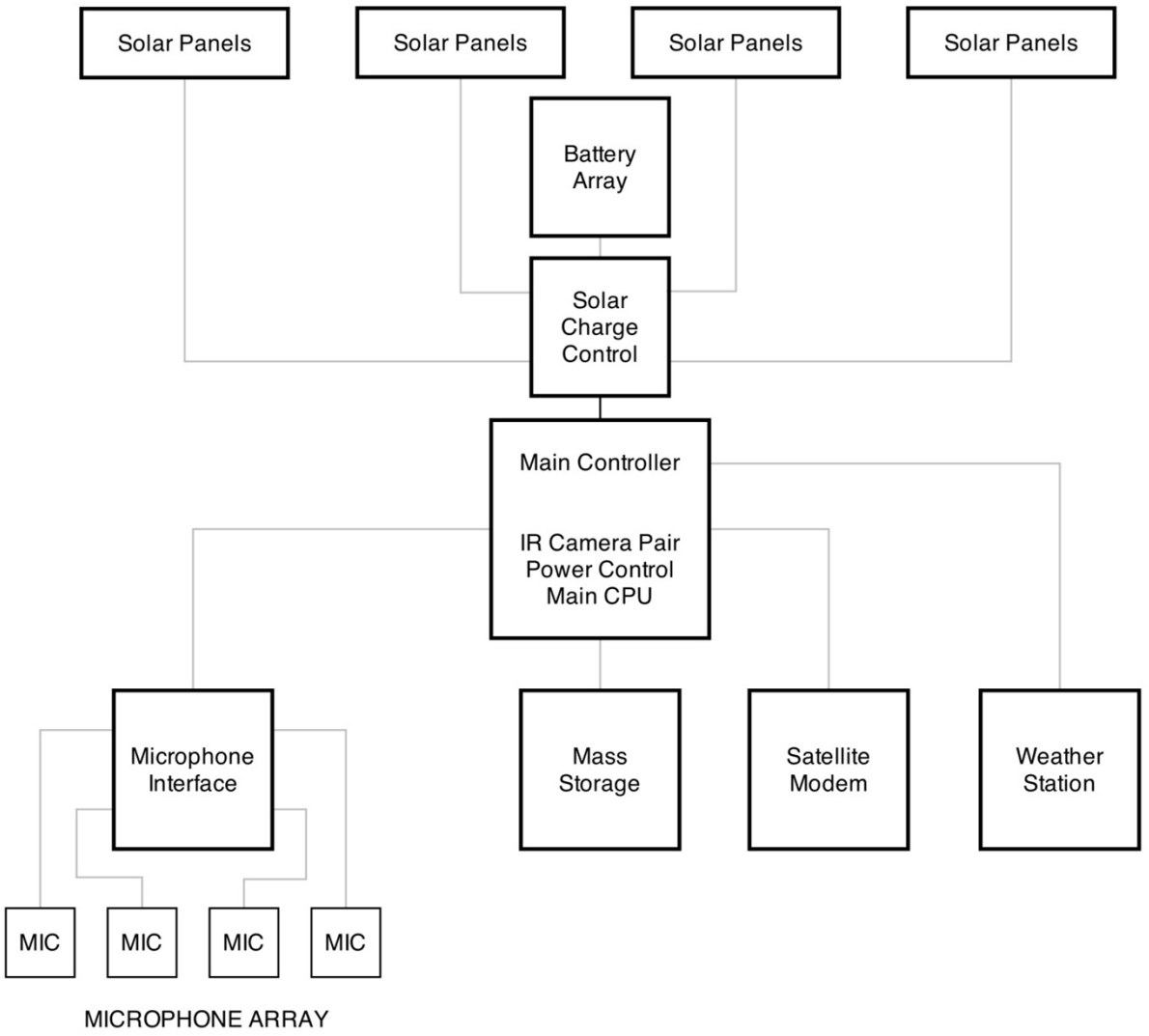
Acoustic/Thermographic Offshore Monitoring System (ATOM)



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Acoustic/Thermographic Offshore Monitoring System (ATOM)


Data storage system (64TB)


Thermal cameras, beam, and controller


Mike node computer


Weather- and bird-proof mikes

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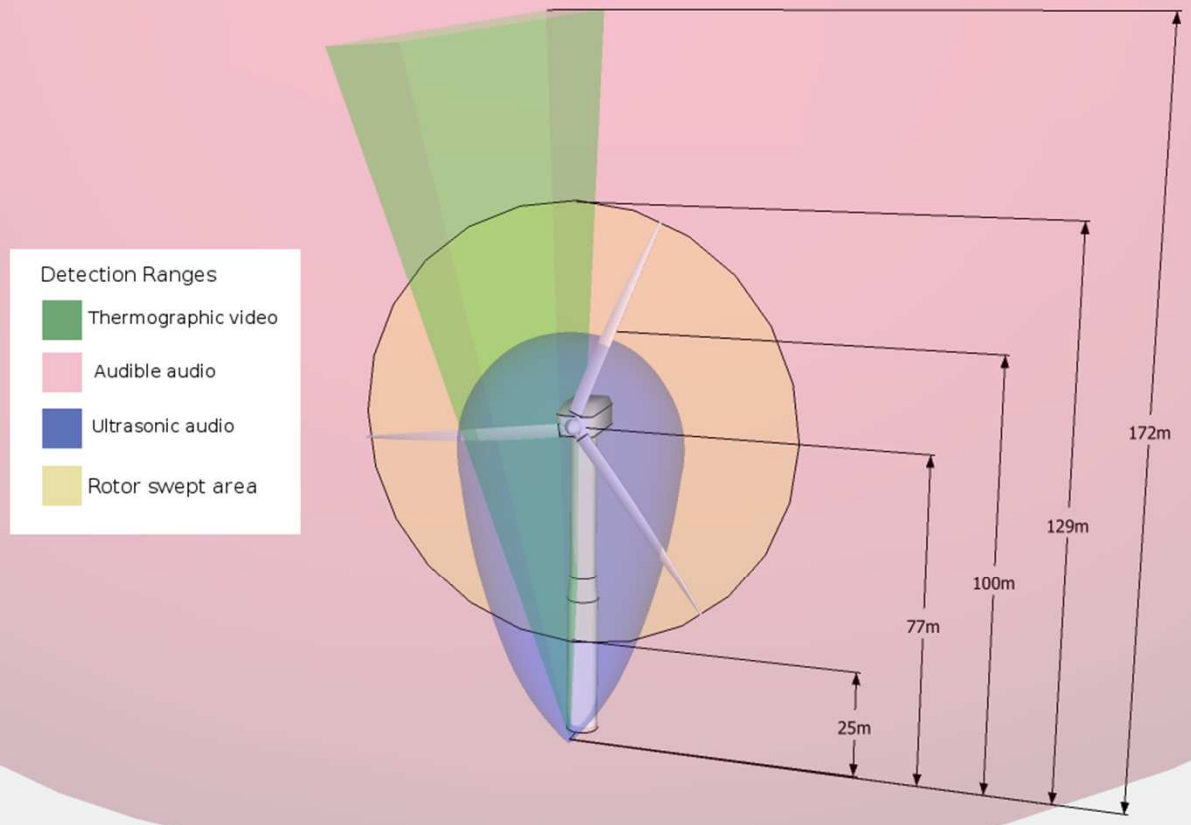
Acoustic/Thermographic Offshore Monitoring System (ATOM)

AOM Predicted Detection Beams



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Acoustic/Thermographic Offshore Monitoring System (ATOM)

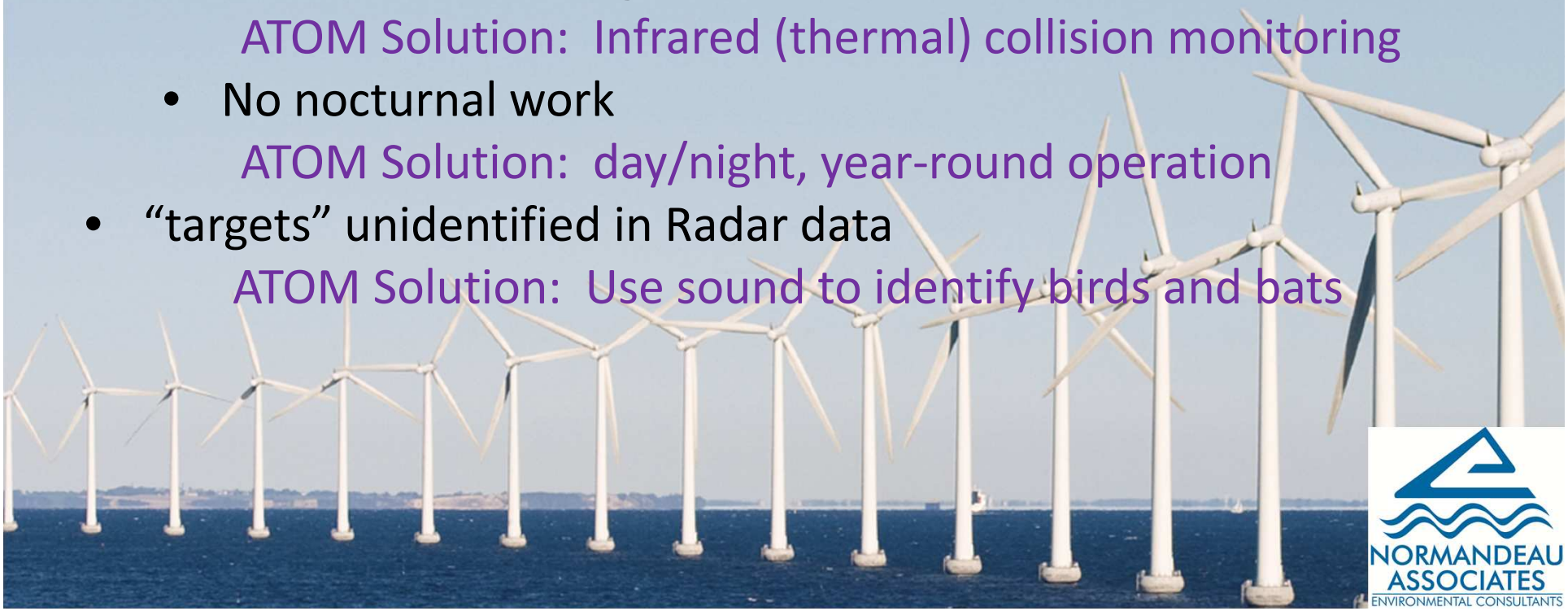
- Expensive to work in the ocean
  - Plane or boat needed for field surveys

    ATOM Solution: Remote-unmanned operation
- Physically difficult to work in the ocean
  - No carcass counting

    ATOM Solution: Infrared (thermal) collision monitoring
  - No nocturnal work

    ATOM Solution: day/night, year-round operation
- "targets" unidentified in Radar data

  ATOM Solution: Use sound to identify birds and bats



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Aerial High-definition Imaging Pilot Study

•Objective

Determine optimal technology and methodology for conducting high-definition aerial ocean wildlife surveys in the U.S.

- Birds, marine mammals, and sea turtles
- Cover a very large area in a very short time
- Cost-effective and safe

•Scope

Conduct pilot studies, evaluate image-gathering tech. configurations, develop large area survey protocol

•Key Partners

Boulder Imaging
IA tech, Inc. (unmanned aircraft)
Gemini Renewables
British Trust for Ornithology
AIS observers
ECOES, inc.
Pinnacle 1 Aviation

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Aerial High-definition Imaging Pilot Study

Pioneering European studies show that this can work

Lesser Black-backed Gull
Resolution = 2cm

European Shag
Resolution ≈3cm

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Aerial High-definition Imaging Pilot Study

Biology dictates need for “snapshot” surveys

- Birds fly
  - Seabirds and migrating coastal and pelagic birds move many miles per day
- Turtles and marine mammals swim
  - These taxa may also cover many miles in a day
- Survey implication
  - Surveys conducted in adjoining areas on successive days may either miss, or double count large numbers of individuals, particularly in N-S movements (e.g. migration)

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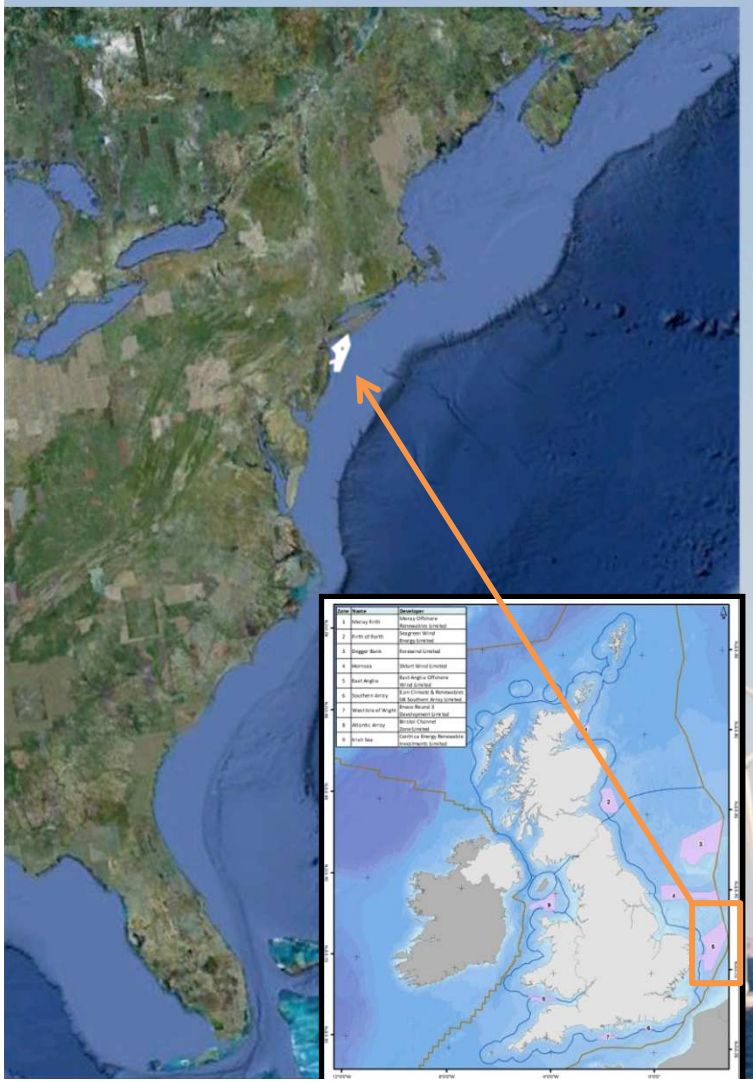
Aerial High-definition Imaging Pilot Study



- COWRIE zone 5 (East Anglia), July 2009, survey area shown transposed onto AOCS (in white) (HiDef Aerial Surveying Ltd, 2009)

- 40 m image width
- 10% sampling ⇨ 400m transect separation
- 2316 mi^2 survey area
- 610 meter flight altitude
- 174 mph airspeed

- Survey time: 3 days

←Crown Estate Round 3 Zones

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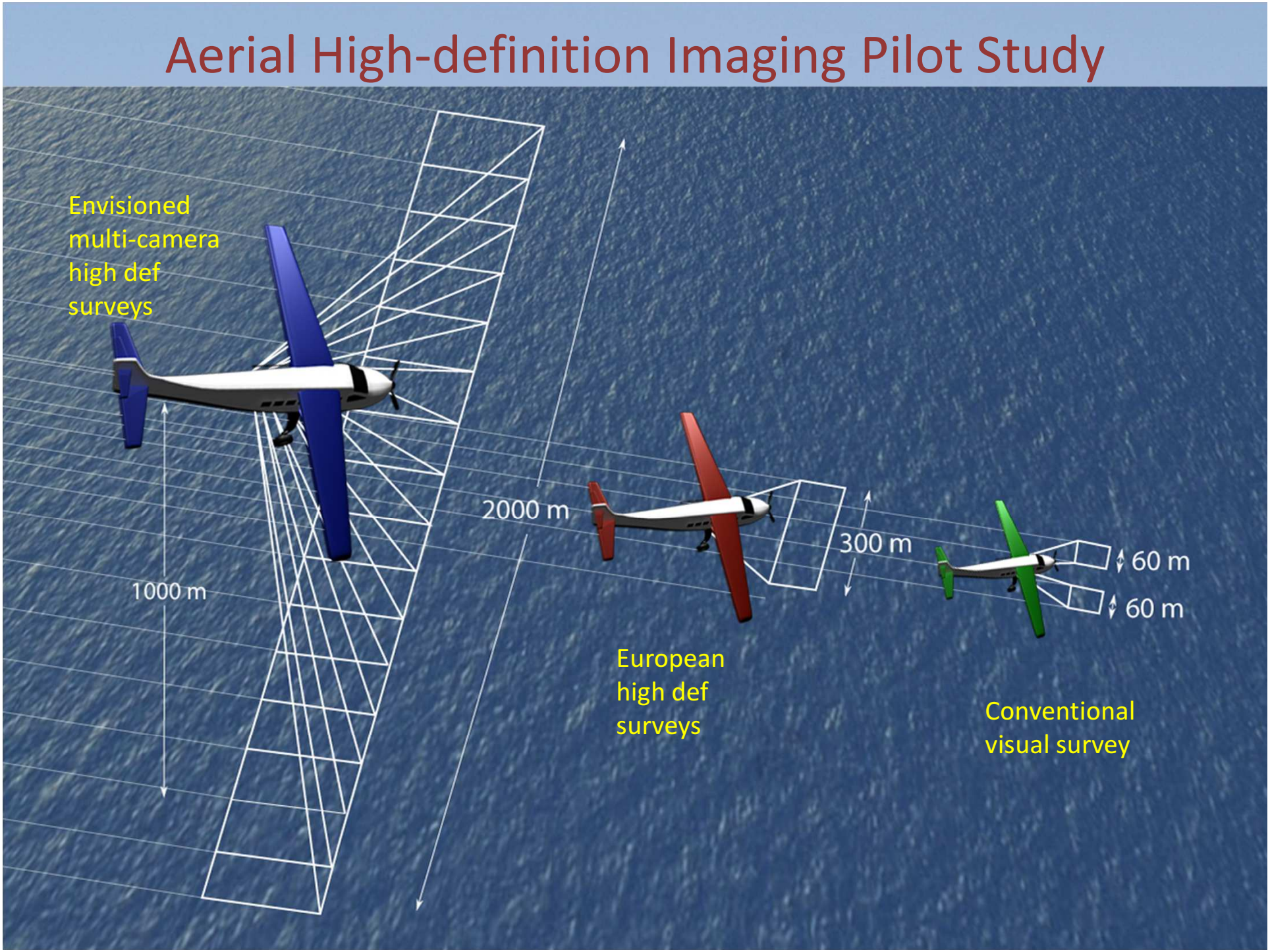
Aerial High-definition Imaging Pilot Study



Aerial High-definition Imaging Pilot Study

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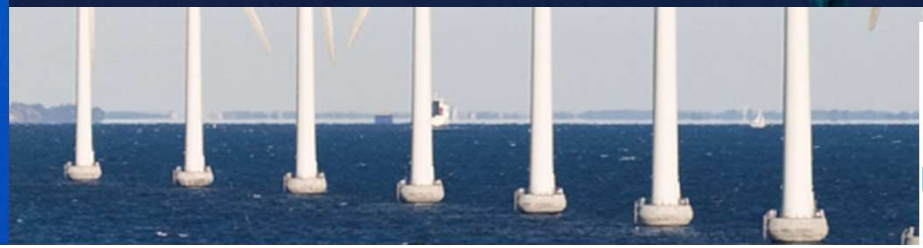
Aerial High-definition Imaging Pilot Study

Applying high-definition technique to mammals and turtles



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Aerial High-definition Imaging Pilot Study

Advantages of high definition imaging relative to visual observer surveys

- Images archived, data are “repeatable”, not subject to unknown observer bias
- Higher altitude flight doesn’t alter results by disturbing wildlife
- Higher altitude flight is safer (safer still with unmanned system)
- Faster flight, larger survey beam allow more cost-effective sampling of large areas

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Emerging Technology Offers Solutions

- Expensive to work in the ocean
  - Plane or boat needed for field surveys

    Solution: Remote-operating sensing device (ATOM)

    Solution: Large-area high-definition aerial surveys for cost-effective collection of high-quality data
- Physically difficult to work in the ocean
  - No carcass counting

    Solution: Infrared collision monitoring (ATOM)
  - No nocturnal work

    Solution: Remote-operating sensing device (ATOM)
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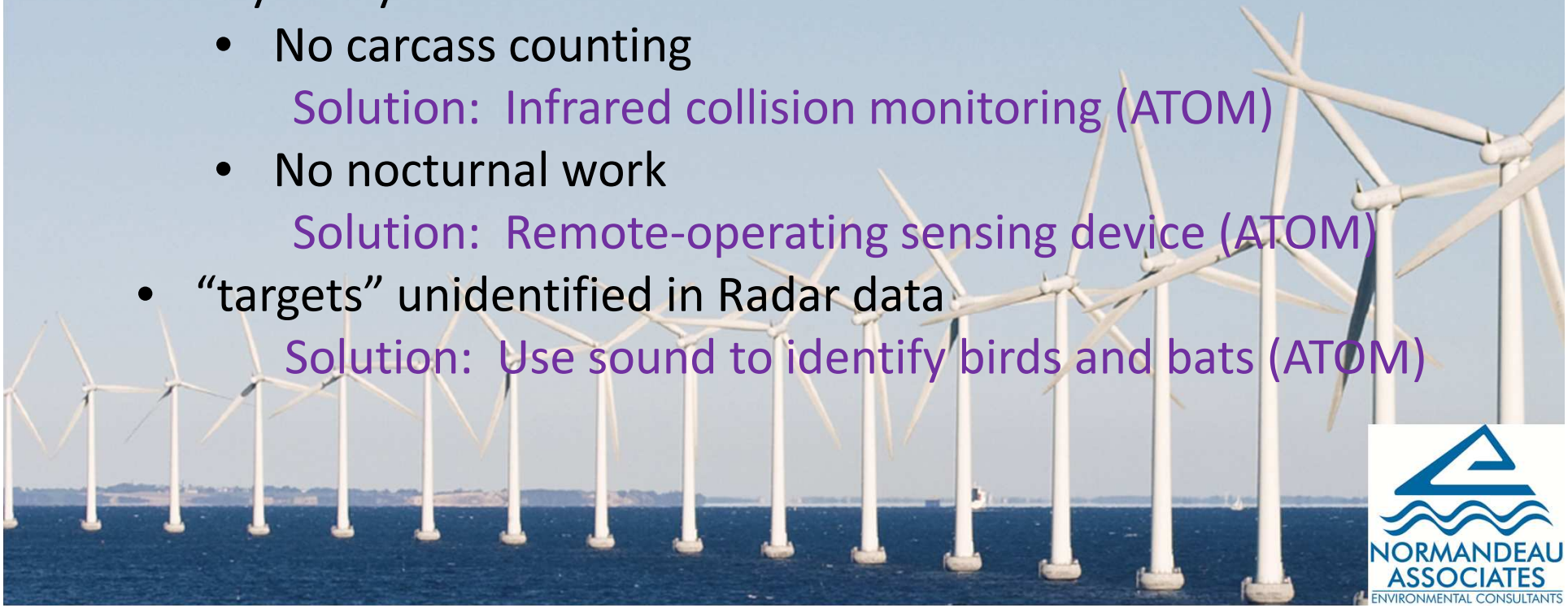
  Solution: Use sound to identify birds and bats (ATOM)



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Thanks