

# Investigation, prediction and assessment of wind turbine noise and infrasound in Japan

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\*Low frequency noise: sounds **less than about 100Hz**



# Introduction

- Wind power is an important renewable source of energy in Japan.

Increasing of wind power generation



The Great East  
Japan Earthquake

Expectations to possibility of the wind power



Increasing of demands of Wind Power Station



Problems have occurred.

- Noise / Infrasound issues,
- Impacts on landscape,
- Bird strikes
- Shadow flickers



# Environment Impact Assessment (EIA) for Wind Power Stations in Japan

- National EIA systems have “positive list” of activities subject to EIA: Clarifying types and threshold sizes of development activities. Wind Power Station has not been in the positive list.
- EIAs for Wind Power Station were conducted voluntarily or following ad hoc requirement of local government so far.
- Wind Power Stations will be subject to the national-level EIA, base on the conclusion of special committee. (Oct. 2012...)
- Threshold size: Total power generation: 10,000 kW or above.

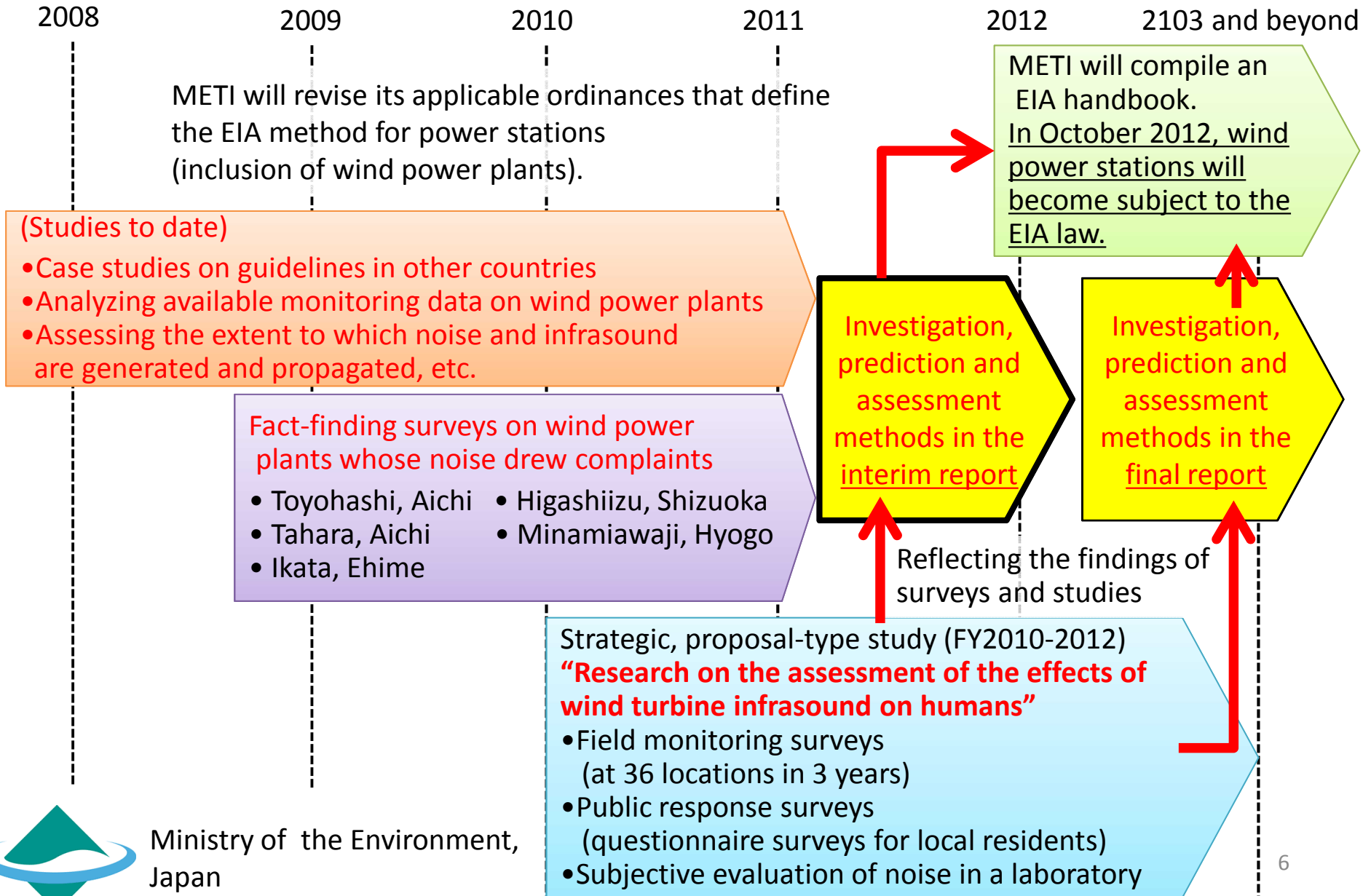


# Investigation, prediction and assessment Measures are essential to avoid Noise Problems

- MOEJ:
  - Need to prepare guidelines for appropriate methods to support proper EIA and design of wind power stations.
  - Measurement method of Noise and Low frequency noise.
  - Investigation, Prediction and Assessment method for Noise Impacts
- Taking into account unique characteristics of wind power noise and location of development.



# Examination of EIA for Wind Power Stations



# Overview of the interim report

- Literature Review
  - Studies by public organizations in the US, Canada, Australia and Japan
- Case Studies in Japan and Foreign Countries
  - 4 cases allowed non-statutory EIA complied by NEDO (New Energy and Industrial Technology Development Organization)
- Investigation, Prediction and Assessment methods



# Overview of the interim report

## Literature Review

- American Wind Energy Association and Canadian Wind Energy Association
  - *"There are **no direct pathological effects** from wind farms and that any potential impact on humans can be **minimized by following existing planning guidelines.**"*  
(Wind Turbine Sound and Health Effects An Expert Panel Review)
- The chair's summary of the Wind Turbine Noise 2011 conference
  - noise from wind power plants can have unfavorable health effects on local residents in the form of annoyance or sleep disorders
  - such effects may vary greatly depending on the individual since people's sensitivity to noise is more or less subjective





## Overview of the interim report

# Case Studies in Japan and Foreign Countries

- Some cases of non-statutory EIA which have largely been conducted by NEDO for a wind power station
- Problems of NEDO's EIA method
  - The criteria are unclear for selecting the survey area or location as well as for defining the survey period.
  - Prediction methods have not been adequately designed.
  - It is assumed that wind noise sporadically masks wind turbine noise.
  - The ex-post evaluations include interviews with local residents, but at times fail to measure the wind turbine noise.
- Characteristics of foreign EIA cases
  - The monitoring period is longer than in the Japanese cases.
  - The ISO 9613 series of standards is used for methods for predicting sound propagation.
  - Canada and the UK regulate noise in relative terms, while the US does so in absolute terms.



# Overview of the interim report

## Investigation Methods

- Sound source characteristics
  - gathering data on the overall values and frequency characteristics (octave band or 1/3 octave band) at particular sound power levels
  - gathering the manufacturer, the model number of the wind turbine and its basic specifications
- Sound propagation characteristics
  - Considering the topographic and climatic conditions of the area where the wind turbine is located since many wind turbines in Japan are located on mountain ridges
- Information about the sound receiving points
  - measuring or estimating the residual noise requires assessment of the area and layout of the buildings
  - the percentile level  $L_{A95}$  should be used for residual noise levels



# Overview of the interim report

## Prediction Methods

- ISO-standardized calculation method
  - focusing on the equivalent continuous A-weighted sound pressure levels for predicting the noise
  - the abstractness of the expression "conditions conducive to sound propagation" and the difficulty of calculating the reflection from a mountain ridge
- NEDO's method
  - Building on a model that considers a wind turbine as a point sound source and focuses on sound power levels provided by the manufacturer
  - using a constant for the coefficient of attenuation due to air absorption and fails to fully take into account the propagation characteristics of the noise when a wind turbine is mounted on a mountain ridge



# Overview of the interim report

## Assessment Methods

- EIA in Japan is built on two major approaches:
  - prevention and reduction of the environmental impact
  - consistency with standards or targets
- The following aspects should be examined to reduce the environmental impact of wind turbines, :
  - Location and layout
  - Scale and structure
  - Facility maintenance and the planting of surrounding vegetation
  - Operation and management



# Next Steps

- During FY2012, MOEJ will continue its efforts to improve on the investigation, prediction, and assessment methods
  - Establishing the EIA Methods
  - Coping with Offshore Wind Power Plants
  - Making Sound Power Levels and Other Data Available to the Public



## Next Steps

# Establishing the EIA Methods

- Prediction method
  - Examining the validity of methods for predicting how wind turbine noise is propagated
  - Improving and Accumulating measurement data that builds on clear measurement criteria and incorporate measures to control wind noise
- Assessment method
  - Required to consideration of how to handle swishing sounds and pure tone elements
    - It is necessary to assess how the acoustic characteristics of these sounds affect the auditory sense in humans
    - The characteristics of swishing and thumping sounds may affect the thinking behind penalties in the process of establishing assessment methods ...



## Next Steps

# Coping with Offshore Wind Power Stations

Offshore wind power generation has vast potential in Japan

Japan has a little substantial endowment of shallow waters around its coastline.

Wind Power Stations may be located in the vicinity of residential areas ...

Required to study noise from offshore wind turbines as well



Offshore Wind Turbine installed by MOEJ



## Next Steps

# Making Sound Power Levels and Other Data Available to the Public

Data on the sound power levels of wind turbines is required in order to make predictions for EIAs.



In Japan, wind turbine manufacturers don't generally provide data on sound power levels.

A mechanism whereby sound power level data is made readily available will provide an effective solution.

- The interim report proposes exploring ways to make it obligatory for wind turbine manufacturers to disclose data.
- e.g. the report suggests introducing a labeling system for wind turbines.





# Conclusions

The interim report proposed ...

- options for the investigation, prediction, and assessment methods and approaches in relation to wind turbine noise in light of the basic requirements of the EIA.
- both the requirements of assessment indicators and options for assessment methods in relation to the establishment of standards or targets for assessment methods



MOEJ is pursuing ...

- appropriate EIA methods while accumulating accurate data and reviewing the most recent studies
- the effects of wind turbine noise on humans

