

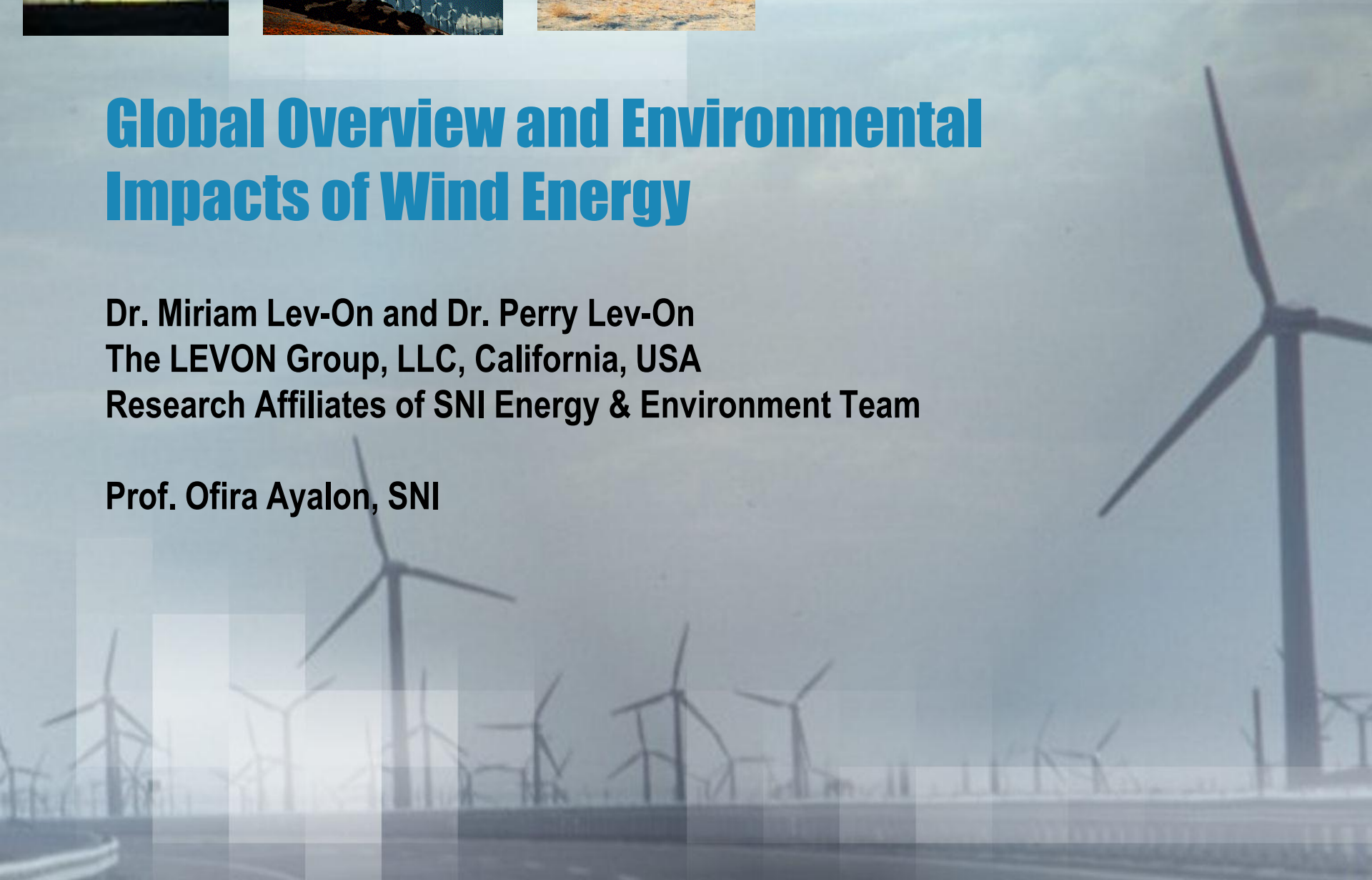


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Global Overview and Environmental Impacts of Wind Energy

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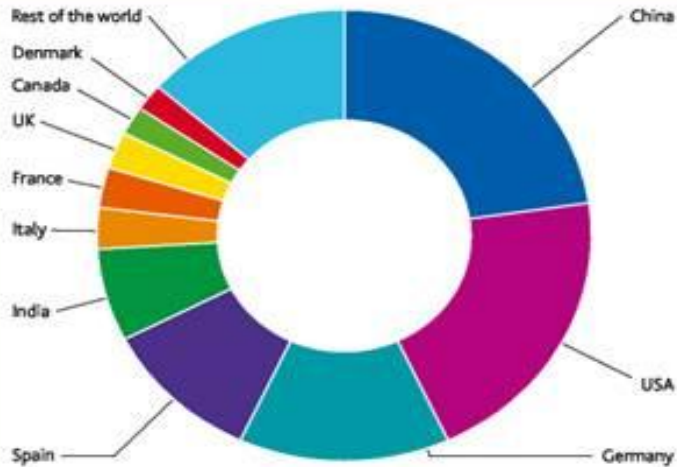
Outline

- ❖ **Global wind energy status**
- ❖ **Wind power in emerging economies**
- ❖ **Impact assessment**
- ❖ **Key Issues**
- ❖ **Case studies**
- ❖ **Recommendations**



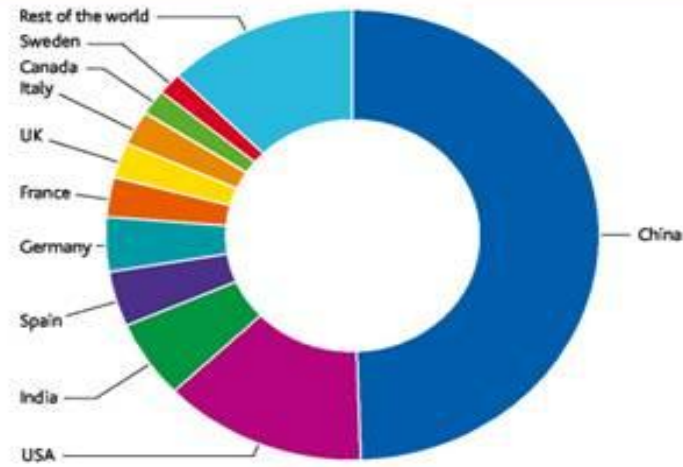
Global status of wind power in 2010

TOP 10 CUMULATIVE CAPACITY DEC 2010



Country	MW	%
China	44,733	22.7
USA	40,180	20.4
Germany	27,214	13.8
Spain	20,676	10.5
India	13,065	6.6
Italy	5,797	2.9
France	5,660	2.9
UK	5,204	2.6
Canada	4,009	2.0
Denmark	3,752	1.9
Rest of the world	26,749	13.6
Total TOP 10	170,290	86.4
World Total	197,039	100

TOP 10 NEW INSTALLED CAPACITY JAN-DEC 2010



Country	MW	%
China	18,928	49.5
USA	5,115	13.4
India	2,139	5.6
Spain	1,516	4.0
Germany	1,493	3.9
France	1,086	2.8
UK	962	2.5
Italy	948	2.5
Canada	690	1.8
Sweden	604	1.6
Rest of the world	4,785	12.5
Total TOP 10	33,480	87.5
World Total	38,265	100.0

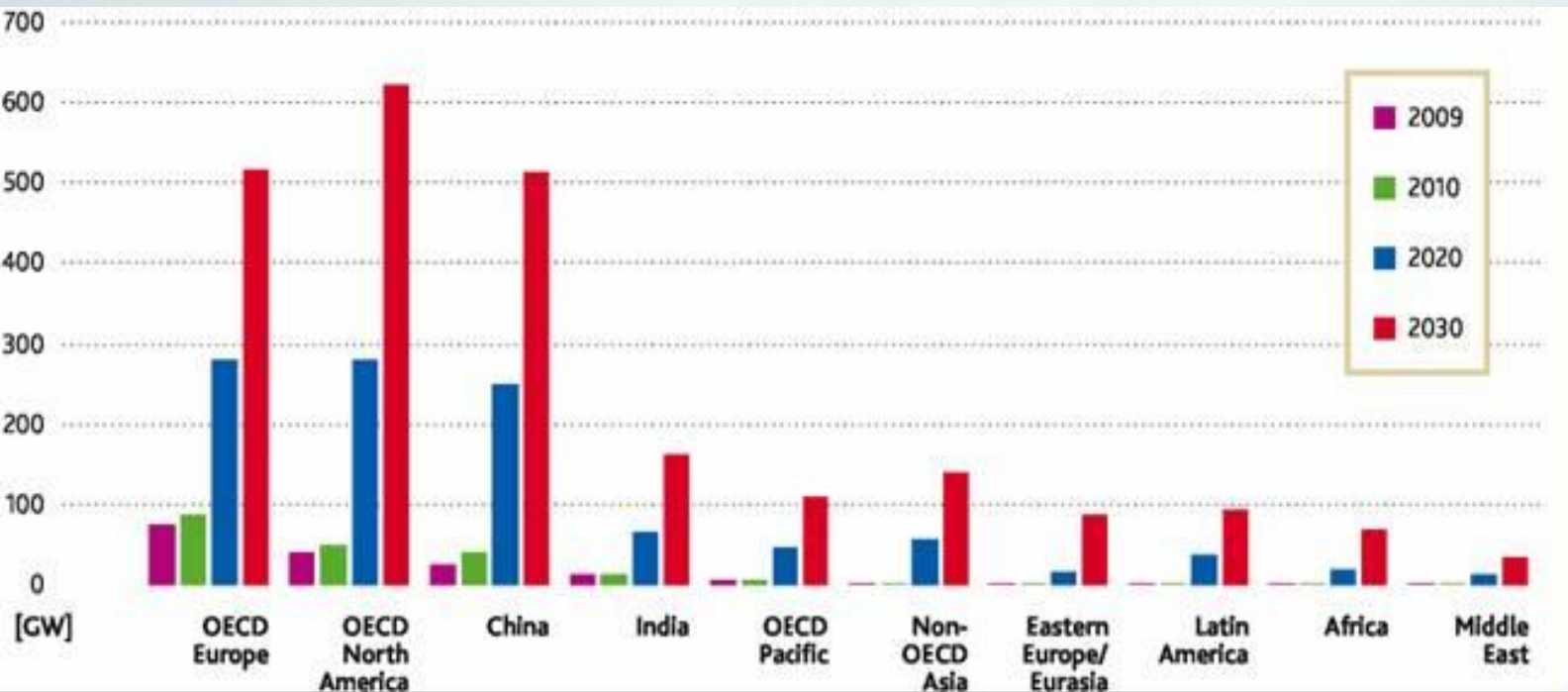
Source:
Global Wind
Report, 2010

Wind Power in Emerging Economies

- ❖ **In 2010, more new wind power capacity was installed in developing and emerging economies than in the OECD due to:**
 - Technology advances,
 - Increased knowledge about wind generation,
 - The role it can play for energy security and greenhouse gas emissions reductions from the power sector.
- ❖ **A few examples outside of the OECD:**
 - **China:** 18.9 GW added in 2010, to a total of 42.3 GW (largest incremental growth),
 - **India:** 17 companies are manufacturing wind power equipment, with a production capacity of 7.5 GW (expected to increase to 17 GW by 2013),
 - **Brazil:** capacity of 930 MW at the end of 2010 to increase to more than 4,000 MW by 2013.



Regional Breakdown: Advanced Scenario



Capacity in GW

	OECD Europe	OECD North America	China	India	OECD Pacific	Non-OECD Asia	Eastern Europe/Eurasia	Latin America	Africa	Middle East
2009	76	39	26	11	5	0.5	0.5	1	0.8	0.1
2010	87	50	41	13	6	0.7	0.9	2	1	0.1
2020	279	279	250	65	48	55	16	37	19	11
2030	515	622	513	16	109	140	87	93	67	34

Source: Global Wind Energy Council, Global Wind 2010 Report, Revised April 2011

Wind Power

Pros:

- ❖ Competitive **price**
- ❖ Possible **dual use of land**
- ❖ Has the potential to contribute to **cleaner energy** production
- ❖ Could reduce fossil fuel dependence
- ❖ Reduces (on average) **emissions of GHG and conventional pollutants**
- ❖ Meets government policies to **promote RE**

Requirements

- ❖ Gov. Policy to promote wind farm construction
- ❖ Utilities must buy all the wind power produced, when available

Cons:

- ❖ The actual power production rate might be overly optimistic due to **erroneous modeling** (~10%)
- ❖ The wind resource is **intermittent** and it might be necessary to 'top-off' electricity when sudden shortfalls occur
- ❖ Wind is typically 'embedded' in the distribution network **beyond the high voltage grid** so its dispatch would not affect base load generation
- ❖ Wind power requires careful planning to mitigate local impacts such as **noise, visual effects, environmental concerns, health and safety concerns**



Key Considerations for Wind-Energy Projects

- ❖ **The U.S. National Academy of Science (NAS) published guidance with recommendations for addressing a range of environmental, health and safety impacts of wind-energy projects (NAS, 2007)**
- ❖ **Focus areas to address regarding wind energy impacts:**
 1. Mechanisms to provide necessary information to interested and affected parties
 2. Requirement for developers to provide early notification of their intent to develop wind energy
 3. Publication of policies and regulations for evaluating the impacts of wind-energy projects
 4. Guidance regarding the kinds of information needed for review:
 - Degrees of adverse and beneficial effects of proposed wind-energy developments that are critical in evaluating a proposed project
 5. Regional planning documents with information on:
 - Quality of wind resources,
 - Capacity of transmission lines,
 - Major areas of concern, and
 - Tradeoffs that should be considered.

Wind Energy Development Environmental Concerns and Initial Recommendations

❖ Noise

- Design changes in wind turbines to reduce noise;
- Increase the efficiency of the turbines by assuring that more of the wind energy is converted into rotational torque and less into acoustic noise;
- Select proper siting and use insulating materials to minimize noise impacts.

❖ Visual Impacts

- Make proper siting decisions to avoid aesthetic impacts to the landscape;
- Install “appropriate” (fewer) number of turbines in any one location;
- Use larger and more efficient models of wind turbines.

❖ Avian/Bat Mortality

- Utilize mitigation measures, and study design protocols;
- Collect data through monitoring efforts at existing and proposed wind energy sites;
- Decide on site selection (following careful study) to minimize mortality;
- Continue on-going research addressing bird and bat impact issues.

❖ Other Concerns

- Consider blade movement and the presence of industrial equipment in the area as well as the potential accessibility of, and danger to, the public;
- Consider potential interference with radar and telecommunication facilities;
- Bear in mind that generators produce electric and magnetic fields.



Impact Assessment: Legal Issues

1. Do wind-energy guidelines and regulations exist?
2. Are rules and regulations issued by different agencies compatible?
3. Do the guidelines and regulations follow acceptable scientific principles when establishing data requirements ?
4. Does the review process include steps that explicitly address the cumulative impacts of wind-energy projects over time?
5. Does the regulatory framework include an evaluation option of “no project”?

Impact Assessment: Environmental Issues

1. What environmental mitigation measures will be taken and how will their effectiveness be measured?
2. Are there any legal requirements for such measures (e.g., habitat conservation plans)?
3. Are any listed species at risk from the proposed facility?
4. How and by whom will the environmental impacts be evaluated once the project is in operation?
5. If the evaluations indicate needed changes in the operation of the facility, how will such a decision be made and how will the changes' implementation be assured?
6. What pre-siting studies for site selection and pre-construction studies for impact assessment and mitigation planning are required?
7. What post-construction studies, with appropriate controls, are required to evaluate impacts, modify mitigation if needed, and improve future planning?
8. Would the studies assess the possibility of radio, television, and radar interference?

Impact Assessment: Health & Aesthetic Issues

1. Have pre-construction noise surveys been conducted to determine the background noise levels?
2. Will technical assessments of the operational noise levels be conducted?
3. Is there an established process to resolve complaints about the operation of the turbines?
4. Did the project planning involve a professional assessment of potential visual impacts, using established and acceptable methods?
5. How has the public, and particularly the locally affected inhabitants, been involved in evaluating the potential aesthetic and visual impacts?
6. Has there been expert consideration of the possible impacts of the project on recreational opportunities near the project site and on nearby historical, sacred, and/or archeological sites?



Impact Assessment: Economic and Cumulative Effects

1. Have the direct economic impacts of the project been accurately evaluated?
2. Does the evaluation account for, in addition to the revenues anticipated, the costs to the public?
3. Has there been a careful examination of the indirect economic costs and benefits?
4. Are the guarantees and mitigation measures designed to fit the project and address the interests of the community and the local jurisdictions?
5. How will the cumulative effects be assessed, and what will be included in that assessment?
 - Only the effects of the wind-energy installations, and/or
 - All other electricity generators, and/or
 - All other anthropogenic impacts on the area?
6. Have the spatial and temporal scales of the cumulative-effects assessment been specified?

Case Study: PEÑASCAL Wind Power Project (1)

❖ Project Overview

- Located in Kennedy County, on the **Texas coast south of Baffin Bay**
- 84 turbines with total capacity of 202 MW
- Project was developed to avoid or minimize environmental impacts on birds, wildlife and wetlands



❖ Key Environmental Issue: Protecting Wildlife

❖ Avian Risk

- Magnitude: 100 square miles
- 400 species potential
- Overland migration route
- Trans-Gulf migration events
- Wintering & resident species
- Flight and roosting patterns
- Unique habitats



❖ Steps Taken

- Extensive wildlife studies **before** construction began,
 - Annual migration patterns of raptors, passerines and other birds from throughout the central and eastern portions of North America.
- Wildlife biologists spent more than 4,000 hours (over 3 years) studying the site and avian patterns.
- **Information from the studies helped in final site design for minimal impact on the environment and wildlife**



Case Study: PEÑASCAL Wind Power Project (2)

❖ Data Collection & Analysis Strategies

- Boots-on-the-ground (24/7 coverage)
- Systematic point counts
- Monitoring and tracking methods
 - Radar, Infrared, Acoustic arrays
- Surveys
 - Ground surveys,
 - Flight path analyses
 - GIS mapping



❖ Bird-friendly turbine siting and risk mitigation strategies

- Buffer zones around sensitive habitat
- Avoid known flight corridors
- Carcass removal and/or relocation
- Turbine shutdown for **imminent migration events**

❖ Avian Radar System installed in 2008

- The system provides real-time bird mortality risk mitigation,
- “Early warning radar” detects approaching bird activity,
- Software is assessing mortality risk conditions, and,
- Automatically idling all or part of the turbines to reduce bird mortality risk.

Recommendations

- ❖ Conduct **reviews** of regional biological, aesthetic, cultural, and socioeconomic attributes
 - Including: species, habitats, recreational areas, or cultural sites that will be affected by the project
- ❖ Conduct proper **assessments** of the expected impacts of the proposed wind-energy project, in order to distinguish among potential sites
- ❖ Evaluate the key **information gaps** to get the project approved and conduct necessary studies to collect information before a project is approved
- ❖ Develop **operating and monitoring guidance** including mitigation measures for projects



Thank you for your attention

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