

# **WIND ENERGY & AIR EMISSIONS REDUCTION**

Presentation to Virginia Wind Symposium

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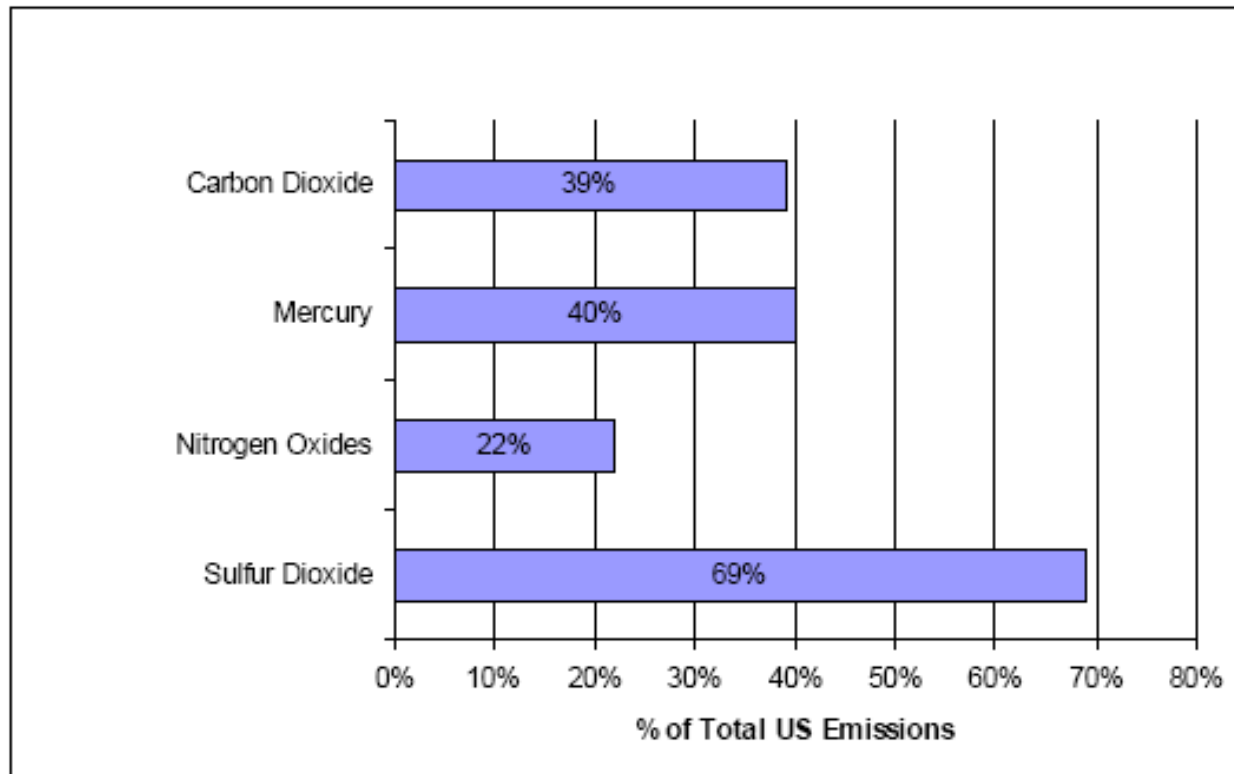
# OVERVIEW

- **Air emissions from fossil fuel-fired generation:**
  - Versus zero-emission wind;
  - Contribution to total U.S. air emissions;
  - Health & environmental effects.
- **Overview of wind & the electric grid;**
- **Wind energy & the climate challenge;**
- **Emissions trading & wind energy;**
- **Summary;**
- **Resources.**

# ZERO-EMISSION WIND VERSUS FOSSIL FUELS

- **Wind energy** - zero emissions of greenhouse gases and other air pollutants
- **Fossil fuel-fired electric generation** from coal, oil, and natural gas - substantial direct emissions of numerous air pollutants that have adverse impacts on public health and the environment
  - Conventional pollutants (e.g., nitrogen oxides)
  - Hazardous pollutants (e.g., mercury, dioxin)
  - Greenhouse gases (e.g., carbon dioxide)

# CONTRIBUTION OF FOSSIL FUEL-FIRED GENERATION TO TOTAL U.S. EMISSIONS OF SPECIFIC POLLUTANTS



Source: Miller, P.J. et al., N.American  
Power Plant Emissions

# HEALTH & ENVIRONMENTAL EFFECTS OF AIR EMISSIONS FROM FOSSIL FUEL- FIRED POWER PLANTS

- **Carbon dioxide** – principal greenhouse gas causing global warming;
- **Mercury** – Fetal exposure from maternal fish consumption may lead to neurobehavioral and learning problems;
- **Nitrogen oxides** – causes adverse respiratory effects and precursor to ground-level ozone;
- **Sulfur dioxide** – exacerbates heart and chronic lung disease & major contributor to acid rain;

# HEALTH & ENVIRONMENTAL EFFECTS OF AIR EMISSIONS FROM FOSSIL FUEL- FIRED POWER PLANTS

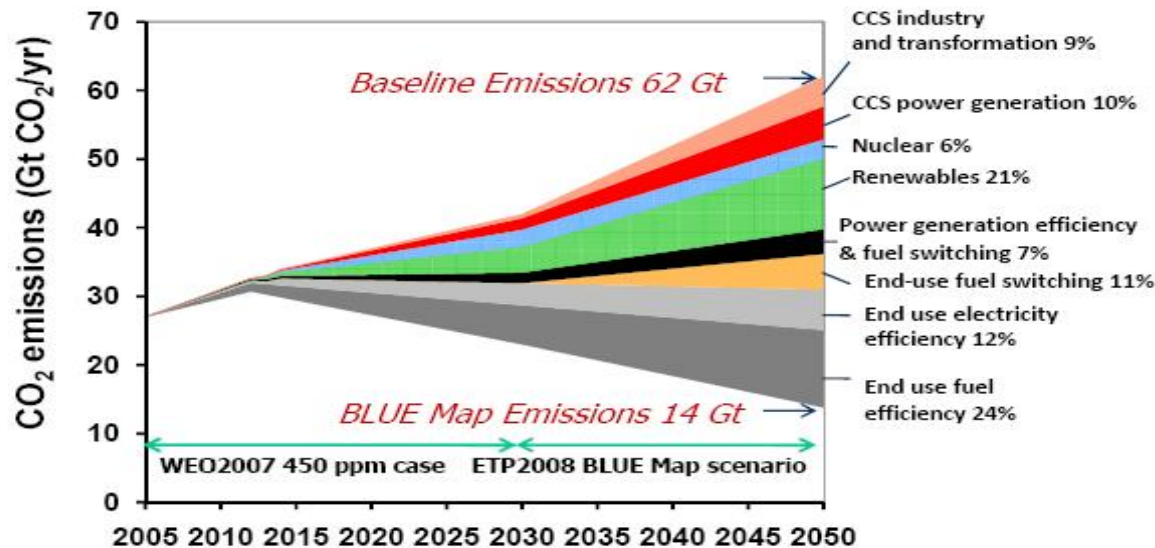
- **Particulate matter** – can cause or aggravate heart and lung diseases and causes regional haze;
- **Volatile organic compounds** – include dioxins, furans , formaldehyde and benzene – known carcinogens and toxins;
- **Trace heavy metals** – include arsenic, cadmium, lead, antimony, manganese, nickel, beryllium, and cobalt – human carcinogens and/or toxins.

# WIND & THE ELECTRIC GRID

- Wind projects displace fossil fuel generation and reduce emissions at individual power plants;
- Economically preferred power source because of zero fuel costs and low operating costs;
- When wind turbines are producing power, they will generally “back down” fossil fuel-fired generation.

# WIND ENERGY & THE CLIMATE CHALLENGE

## A New Energy Revolution: Cutting Energy Related CO<sub>2</sub> Emissions

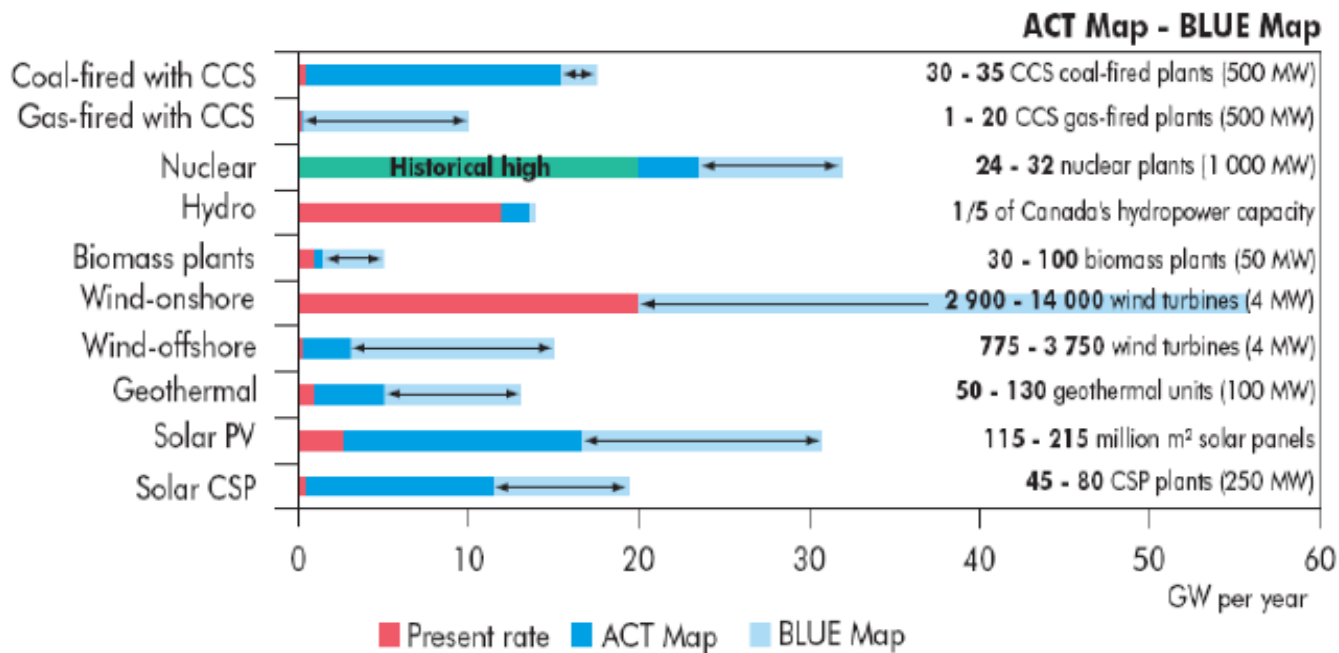


In support of the G8 Plan of Action

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# WIND ENERGY & THE CLIMATE CHALLENGE

## Average Annual Power Generation Capacity Additions, 2010 – 2050 *An Energy Revolution*

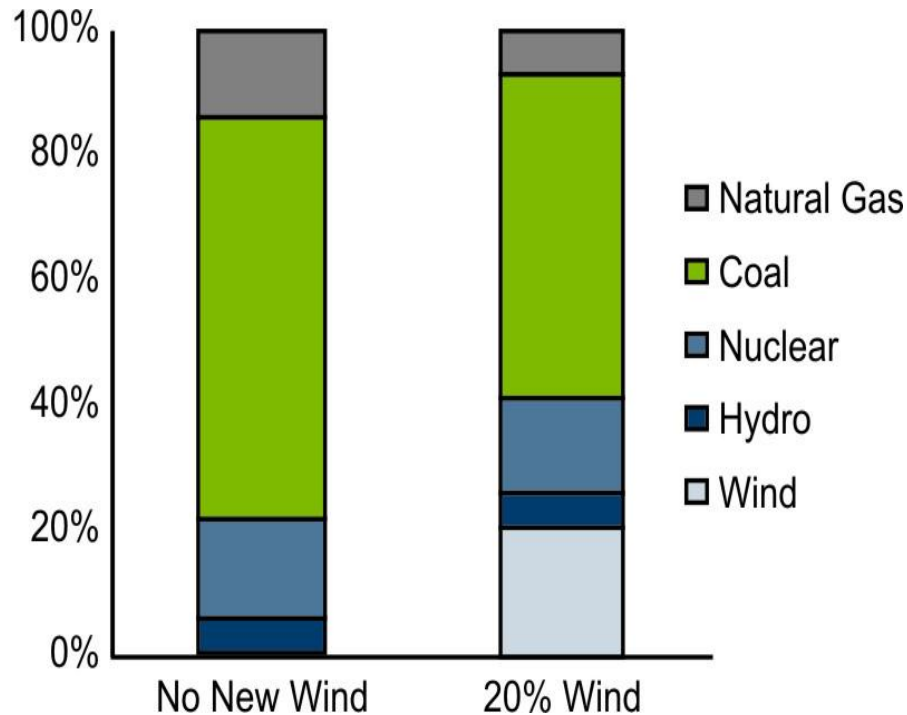


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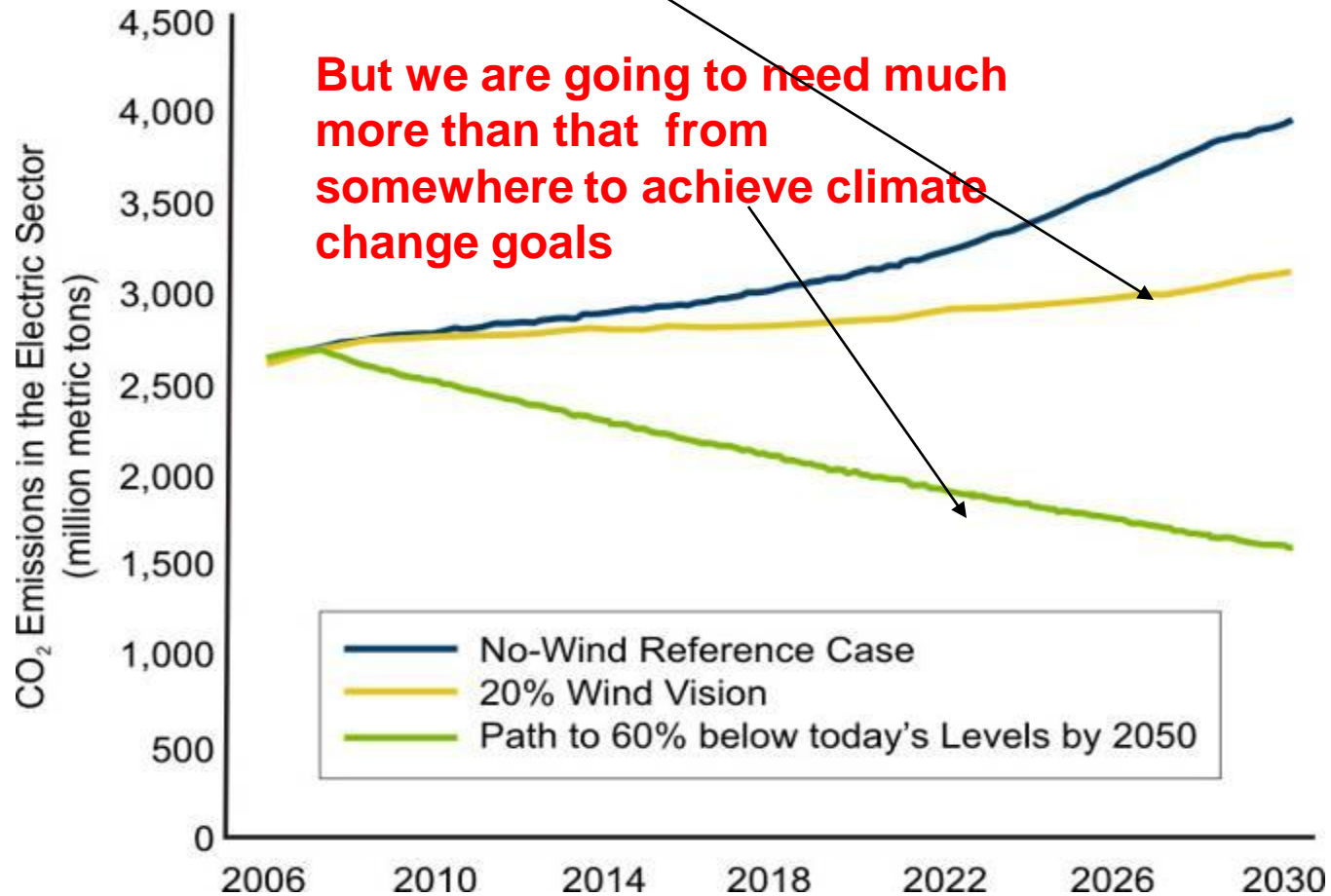
Source: IEA - June 2008 Report

# WIND ENERGY & THE CLIMATE CHALLENGE



The 20% Wind Scenario would decrease generation from natural gas by 50% and generation from coal by 18% by 2030.

# 20% WIND FLATTENS ELECTRIC CO<sub>2</sub> EMISSIONS



# EMISSIONS TRADING BASICS

- **Regulator – EPA, State, or Regional Entity:**
  - Sets an emission cap (in tons) for particular pollutant (e.g., SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>) for a specific sector (e.g. electric generation)
  - Distributes allowances that permit emissions of a specified amount of a pollutant in a particular year or season
- **Fossil Fuel Generators** meet requirements by:
  - Reducing emissions;
  - Buying or selling allowances (trading); or
  - Purchasing offsets (under certain CO<sub>2</sub> trading programs).

# EMISSIONS TRADING & WIND ENERGY

- **Wind Energy Helps to Meet Air Quality and Climate Change Goals (Caps)**
  - Wind energy is a crucial technology available today to help meet greenhouse gas emission reduction goals (caps).
  - Wind energy also contributes to meeting air quality goals.
- **Challenges in Emissions Trading (Cap-and-Trade) Programs**
  - Total emissions will not be reduced below the level of the emissions cap when wind projects come on line unless the cap-and-trade rules are designed to allow this outcome.

# SUMMARY

- In contrast to conventional fossil fuel-fired electric generation, wind energy:
  - Does not degrade air quality; and
  - Will make an important contribution to meeting climate change and air quality goals.

# RESOURCES AND CONTACT INFORMATION

- **Resources:**

- Wind Energy and Air Emission Reduction Benefits: A Primer –

[http://www.eere.energy.gov/windandhydro/windpoweringaamerica/pdfs/policy/wind\\_air\\_emissions.pdf](http://www.eere.energy.gov/windandhydro/windpoweringaamerica/pdfs/policy/wind_air_emissions.pdf)

- 20% US Wind Energy Vision by 2030 –

<http://www1.eere.energy.gov/windandhydro/>

- International Energy Agency – Energy Technology Perspectives 2008 -

<http://www.iea.org/Textbase/techno/etp/index.asp>

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