



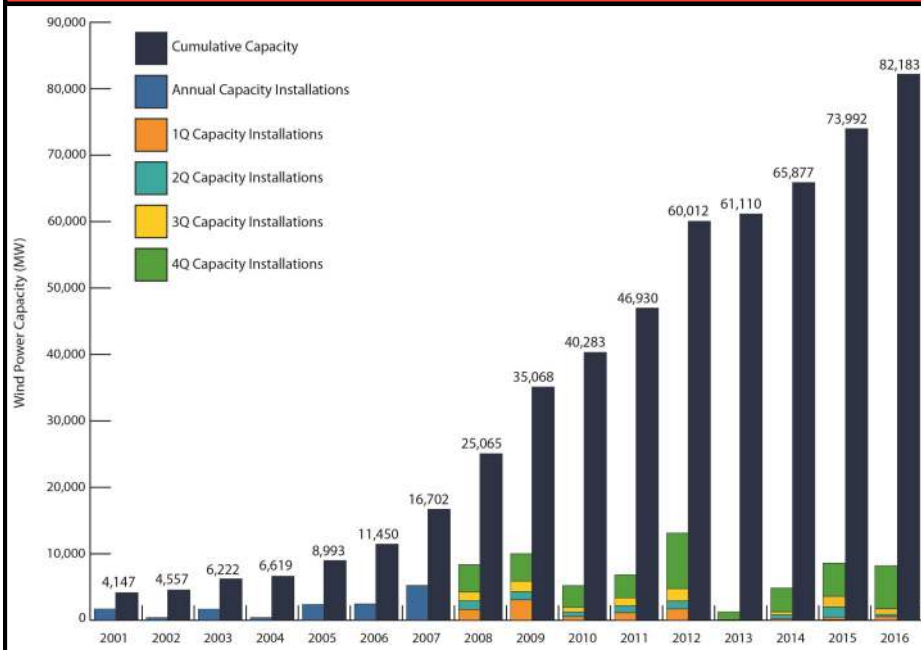
## Effects of Wind Energy Development on Wildlife

Wind energy has become an important source of renewable energy in North America. As of 2016, the United States has a total installed wind energy capacity of **82,183 Megawatts**; enough to power approximately **24 million homes** annually.<sup>1</sup> This represents an increase in capacity of over 70,000 Megawatts (**618% growth**) since 2006.<sup>1</sup>



Wind turbines in the U.S. produce over 82,000 Megawatts of energy every year<sup>1</sup> (Credit: Portland General Electric).

### U.S. Wind Energy Capacity



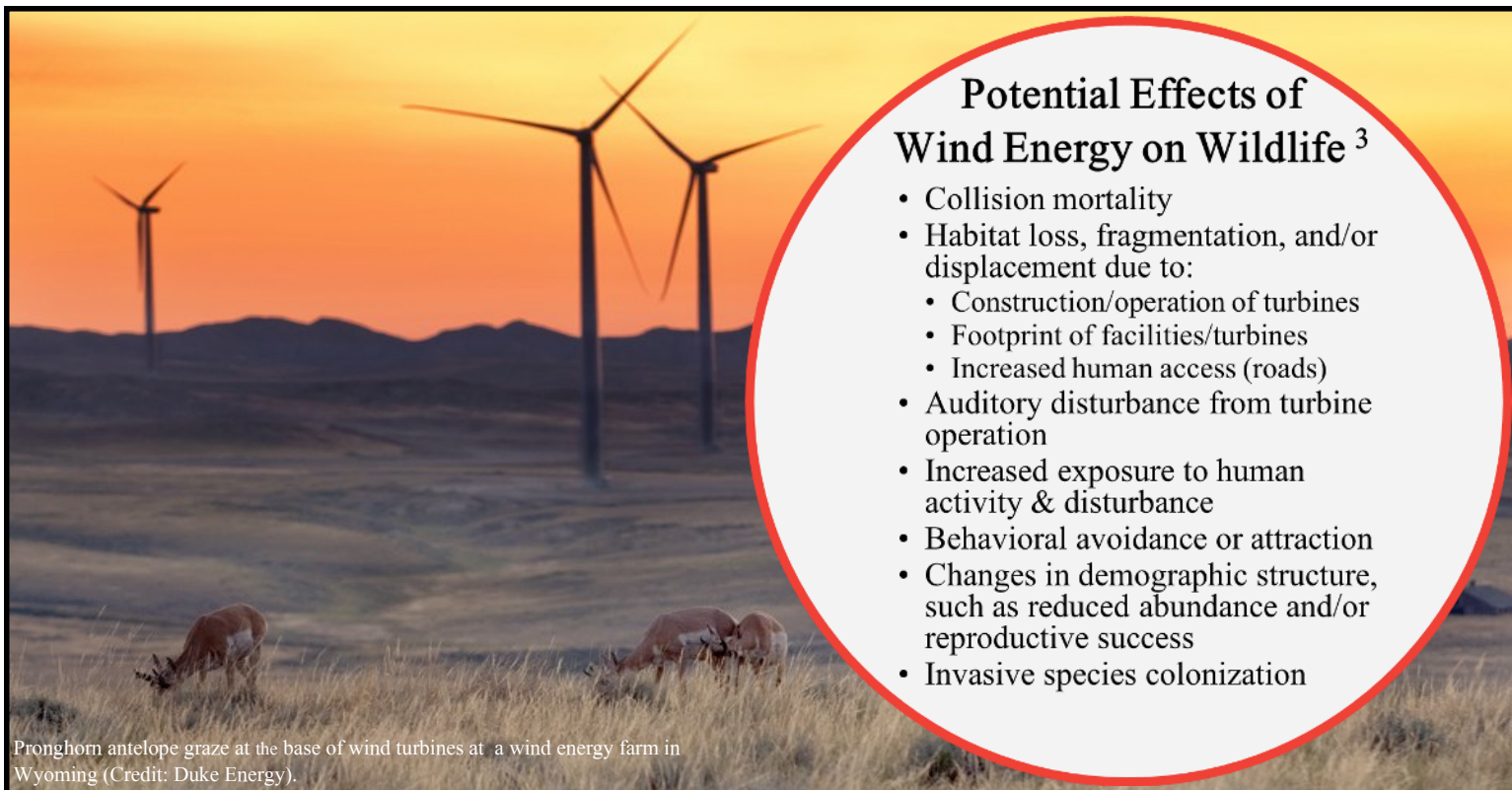
Over \$143 billion in new investments in the past decade has fueled remarkable growth in total wind energy capacity in the United States (Credit: American Wind Energy Association).<sup>1</sup>

### Not Environmentally Neutral

Atmospheric carbon dioxide (CO<sub>2</sub>) concentrations have increased from roughly 290 parts per million (ppm) at the start of the twentieth century to over **400 ppm** today.<sup>2</sup> As a well-documented **greenhouse gas** capable of altering global climate, this increase in atmospheric CO<sub>2</sub> will likely have **significant and far-reaching effects on all of Earth's biota**.<sup>3</sup>

Development of renewable energy sources, like wind power, offer promising opportunity to meet growing energy needs while simultaneously reducing carbon emissions. As a result, renewable resources are the **fastest growing energy source** in the world, with much of the growth coming from wind power.<sup>4</sup> However, **wind energy is not environmentally neutral**.<sup>3</sup>

Wind energy development and operation can pose **biologically significant, and potentially unrealized, cumulative threats to wildlife**.<sup>3</sup> When developing wind power as a source of "green energy," its effects to wildlife and habitats—both direct and indirect—should not be overlooked. Future wind energy development must take steps to **avoid, minimize, and mitigate** any harmful effects to wildlife by establishing a scientific basis for decision-making and by working closely with wildlife professionals when siting and operating turbines.<sup>5</sup>



Pronghorn antelope graze at the base of wind turbines at a wind energy farm in Wyoming (Credit: Duke Energy).

## Potential Effects of Wind Energy on Wildlife <sup>3</sup>

- Collision mortality
- Habitat loss, fragmentation, and/or displacement due to:
  - Construction/operation of turbines
  - Footprint of facilities/turbines
  - Increased human access (roads)
- Auditory disturbance from turbine operation
- Increased exposure to human activity & disturbance
- Behavioral avoidance or attraction
- Changes in demographic structure, such as reduced abundance and/or reproductive success
- Invasive species colonization

## Opportunities to Reduce Threats to Wildlife

### *Avoiding Wildlife Collisions*

Research has found that bat species most threatened by wind turbines tend to be active in low wind weather; before and after storms; and during fall migration.<sup>6</sup> One study found nearly **90% of fatalities** occur from mid-July to late-September during fall migration<sup>7</sup> and on low wind nights.<sup>8</sup> Bat mortality can be **substantially reduced** if wind turbines are turned off at these high risk times.<sup>9</sup> To reduce bird mortality, turbines can be placed in areas of lower abundance **outside migratory pathways**. Raptor mortality was much lower at certain wind farms with lower abundance of birds than at farms with large populations.<sup>10</sup> More consistent, longer-term pre- and post-construction studies are needed to further elucidate patterns of bird and bat fatality and test hypotheses regarding possible solutions and efficacy of mitigation measures.<sup>3</sup>

### *Avoiding Habitat Degradation*

**Strategic landscape level planning** is essential to reduce the effect of wind energy development on wildlife populations. Wind farms can be placed to avoid critical habitat such as sage grouse leks or migratory pathways.<sup>3</sup> Developers can also find ways to build turbines using the least amount of roads, transmission lines, and other infrastructure to reduce fragmentation effects.<sup>11</sup> The **best option** is often to site turbines on land that is already developed to make use of existing infrastructure and avoid disturbing intact habitat areas.<sup>11</sup> It is imperative that developers of wind energy, scientists, and natural resource agency specialists **cooperate** in developing and testing methods to minimize harm to wildlife.<sup>5</sup>

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