

TAKE IT FURTHER

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Redefining a Design Problem

- Learning from Design Failures
- Propose Your Own Path

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Wind is a renewable energy source because it is generated continually. Wind turbines use wind to produce electrical energy. In many places around the world, giant windmill-like turbines stand on top of ridges, in wide prairies, or offshore. In these fairly isolated places, the structures do not generally interfere with the lives of people. These large turbines are not designed for use in urban areas because they take up a lot of space and require strong winds to move their blades.

Adjustments for Societal and Environmental Needs

How could you use engineering design to develop a way to harness wind energy in a city while meeting the constraints of urban needs? One solution is the Wind Tree shown in the picture. This artificial tree has “leaves” that are lightweight wind turbines. Generators and cables are located inside the branches and trunk. The Wind Tree silently produces electric power even in a light breeze.

French entrepreneur Jérôme Michaud-Larivière developed the design after observing how even a very light wind rustled the leaves on trees. Michaud-Larivière wondered whether a wind-energy device based on several mini spinning turbines could generate enough energy to be useful in cities. The Wind Tree design has a relatively low power output of about 3.1 kW from light breezes when compared to the 2.5 to 3 mW output of traditional, large, land-based turbines. Michaud-Larivière suggested that a street lined with Wind Trees could power city streetlights or help offset the power use of nearby buildings.



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1. Explain, in terms of criteria and constraints, why the design of a traditional wind turbine might not be suitable for use in a city.

2. For the mini turbines to work properly, which of the following criteria are important in choosing the material for their construction?

- A. lightweight
- B. UV resistant
- C. recycled
- D. realistic leaf colors
- E. attracts insects
- F. rustproof



The “leaves” of Wind Trees are miniature turbines. They can move in light breezes.



3. Do the Math The kilowatt (kW) is a measure of power. Wind Tree turbines have a power output of 3.1 kW. The lightweight leaf turbines can move in light breezes. A traditional, large wind turbine can have a power output of up to 3 megawatts (mW), but strong winds are needed to move the large turbines. The large turbines are more powerful machines than the smaller Wind Trees because they can do the same amount of work over a shorter period of time.

How many Wind Trees would it take to match the power output of five large turbines? Remember that 1 megawatt equals 1000 kilowatts. Round your answer to the nearest whole number.

4. **Collaborate** As a team, learn about how changes to environmental and health laws and concerns have changed the definition of engineering problems that engineers of city infrastructure and energy-harnessing technologies deal with in the world today.