Overhead Power Transmission Lines and Forests: An ill-regulated Relationship?

by Dr D. Pylarinos

Transmission lines are essential for providing us with electricity in our homes. Setting up these networks can be especially vital, yet, challenging in remote locations. How these power transmission lines are constructed in the natural environment is essential for engineers to consider, to not only minimise environmental impacts, but maintain the functionality of the power lines.

Trees pose problems to transmission lines, as fallen branches and trees can cause damage. Dr. Pylarinos is an engineer who explains more on this subject, suggesting improvements for the regulation of transmission lines with forests.
A power system is an electricity network that consists of three basic elements: generation, transmission and distribution.

A transmission network may include underground cables, but it is usually mostly consisted of overhead transmission lines. The term “overhead transmission line” includes both the high voltage conductors that carry the electricity and the structures that support them (towers or poles equipped with various equipment e.g. insulators, ground conductors etc).

Line routes are designed following a techno-economic approach that aims to ensure the lowest possible cost while maintaining safety standards. The actual construction cost is not the critical issue, being relatively stable. The key factor is the cost of land that, along with public pressure related to visual pollution and various safety and health risks, leads power lines to follow routes along remote areas.

The “pass-through-remote-areas” rule is generally followed worldwide, but the actual legislation varies between different countries and this makes a significant difference in the case of forests. When a transmission line is constructed, a small area, around each tower, is purchased, leased or expropriated. The optimal technical approach is to fully prohibit any activity in proximity to the whole line’s length by owning the land. This, however, is highly impractical as the cost would rise enormously.

A partial expropriation is usually enforced that regulates or prohibits activities within certain distances from the line. In Greece, for example, the owner of the land under the line may be allowed to build but only to a certain height when in a certain distance from the line.

But what happens, and what should happen, when a transmission line goes through a forest?

The first answer that pops in mind and that is often followed is to allow them to grow but only to a certain height (and to a certain length if they approach the line sideways). The matter becomes more complicated in countries where forests are property of the state and are heavily protected under law, such as in Greece, which means that you are only allowed to trim a tree in order to keep just the right distance from the line throughout the year, always under the supervision of the Forest Service to ensure that the trimming is just right (and not at all excessive). The Forest Service is expected to create and maintain firebreak zones, but the need of firebreak zones and the existence of transmission lines are not combined in any way, at least in Greece and several other countries.

This myopic approach leads to a series of unfortunate results, some obvious and some not so obvious. Maintaining the trees under a certain height actually poses an unnecessary safety risk for workers, with the use of heavy machinery, or the climbing of trees to reach the right height, while being exposed to falling tree parts. Trimming trees under or near lines may also require switching off the line for safety reasons (which could mean a higher operation cost and also a stability risk of the system). The repetitive trimming also creates a high yearly cost for the transmission line operator and for the Forest Service that also has to supervise the works.

There is always the risk of misjudging the growth rate of a certain tree or the distance between the tree and the line. This would allow the tree to grow closer to the line between the trimmings, potentially creating a transmission line fault and thus a fire hazard.

Neighboring trees may pose a threat to the line even when trimmed correctly. In the case of strong winds, a tree branch, or even a whole tree, may be carried onto the line. Such a fault may lead to heavy complications that include outages and black-outs.
The inspection and maintenance cost for the transmission line also rises. Moving through a forest may require moving on foot, which means less time efficiency and higher costs. Even when vehicles are used, the surrounding environment may pose threats for the personnel, and bring a risk of damage risks for the vehicles (for example ill-maintained roads, falling trees and branches etc). Problems in navigation are also to be expected.

Further, more recent techniques such as aerial inspection (with the use of drones or planes equipped with cameras) provide significant technological breakthroughs which could be cost-cutting and more efficient. For example, trees approaching lines from a sideways direction may be spotted using vertical aerial images, cutting the costs of inspections regarding the distance between trees and lines, if trees were not allowed to grow under the line. However, a policy that allows trees to grow under transmission lines nullifies such advancements.

It should also be noted that fire products (heat, smoke, flame etc) are well known to cause faults when a fire passes under (or near) a transmission line.

For all the above reasons, it is highly likely that most transmission line operators would prefer to have the responsibility and bear the costs of maintaining a fire break zone under their transmission lines, rather than the tree-trimming policy. This approach would mean improved safety and lower costs for both forests and lines.

Overhead transmission lines and forests often have an ill-regulated relationship, associated with unnecessary costs and risks. This has been the result of pre-established views that should be reconsidered to achieve optimal safety and costs for both power systems and forests.

Bio

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He is the Editor-In-Chief of “Engineering, Technology & Applied Science Research”. He has authored over 60 published works (papers, chapters, books etc).

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