

# Transmission Efficiency Initiative: Host Demonstration Project Energy Loss Savings with PATH Project



A 765-kV transmission line

## Project Scope

The objective of this project is to demonstrate the benefits of the Potomac-Appalachian transmission highline (PATH) project for improving transmission system efficiency and reducing carbon emissions. Actual savings realized by this project will be quantified by using a consistent measurement and verification (M&V) methodology that will be developed as part of EPRI's transmission efficiency research portfolio.

The PATH project, a joint venture of American Electric Power (AEP) and Allegheny Energy, consists of a 765-kV transmission line extending approximately 275 miles from southwestern West Virginia to central Maryland. This line will link AEP's Amos Station in Putnam County, WV, to the new Kemptown Station in Allegheny Energy's service area southeast of New Market, MD. The PATH project will strengthen grid reliability and provide economic benefits to the region. This goal will be realized by using advanced transmission technologies to achieve the full potential of the project, with a key benefit (among others) being a significant reduction in power and energy losses. Energy savings attributable to the PATH project are considerable and build on industry's continual efforts to enhance the efficiency of electric power transmission.

- Evaluate savings from deploying Potomac-Appalachian transmission highline (PATH).
- Monitor before and after energy losses and utilization and document the results.
- Benefits include increased capacity, reduced losses, and reduced carbon footprint.

The savings in the PATH project derive from two main components: the innovative transmission line design, and the unloading of the underlying, lower-voltage transmission systems (extrahigh-voltage overlay concept). The savings from the new line design include the following:

- Conductor selection. Conductor with trapezoidal aluminum strands and steel core (aluminum-conductor, steel-reinforced trapezoidal wire [ACSR/TW]) has been selected for the PATH project. These conductors are stronger and more compact and have lower resistance than conventional conductors of the same diameter, offering more efficient transmission of electric energy. With the 2300-MW loading projected for the PATH, line loss savings relative to standard round wire conductors can exceed 40 GWh annually.
- Bundled phase conductor design. Until recently, four conductors per phase had been used for 765-kV construction in North America. Although the audible noise performance of such lines generally has been acceptable, use of a six-conductor bundle developed for AEP's newest 765-kV line in West Virginia and Virginia further limits noise, particularly at higher elevations. The improved design offers added benefits of reduced levels of radio and television interference and substantially lower line losses than AEP's original design. In fact, loss reductions due to this improvement, also planned in PATH, approach 20% (resistive losses) and 60% (corona losses) relative to a similarly situated, early 765-kV line.

- Phase and shield wire transposition. Plans have been developed to transpose (that is, rotate) phases of the PATH line. Phase transposition will moderate system unbalance and reduce line losses; additional loss reduction will be achieved by also transposing the shield wires. A total loss reduction in PATH due to phase and shield wire transposition is estimated at about 5%, yielding another 2 GWh in annual energy savings.
- Switchable shunt reactors. Advanced circuit breakers will be used as part of the PATH project to permit de-energization and energization of five shunt reactor banks automatically or by remote control, without taking the line out of service. When energized, these shunt reactors will incur a total of 2.5 MW in losses. It is estimated that shunt reactors will be required only 20–30% of the time. Hence, de-energizing them when not required for voltage control allows additional energy loss savings of at least 1.5 GWh annually.

Apart from the savings achieved with the advanced line design, the mere presence of the PATH, when placed in service, will help to unload the underlying, lower-voltage transmission systems (extrahigh voltage overlay concept). These systems are characterized by a substantially higher resistance and, thus, higher losses. Studies show that, with PATH carrying 2300 MW, system losses will decline by 200 MW or more, resulting in energy savings of at least 600 GWh annually. In total, at least 660 GWh of energy will be saved annually by implementing the PATH project. As a result, an estimated 340,000 tons (308,000 metric tonnes) of CO<sub>2</sub> emissions can be avoided annually.

### Expected Benefits

One or more of the following benefits will be realized through the implementation of this project:

- Reduced transmission system losses
- Increased transmission capacity
- Reduced overall carbon footprint by reducing the energy lost on the transmission wires and permitting greater integration of non-emitting, renewable resources

### Approach for Measurement and Verification

The detailed methodology of M&V will be developed during the course of the project using the following general approach:

- Demand, energy and CO<sub>2</sub> savings will be determined based on transmission load flow simulations for the studied system.
- Line load and losses will be evaluated over a one-year period based on observed loading and compared to the estimated savings. This will lead to an industry-accepted methodology for projecting savings from advanced conductor applications.
- A life cycle carbon footprint methodology will be developed for the various loss saving applications.

### Project Schedule

The schedule of the project tasks is as follows:

1. Collect data. AEP will provide EPRI with the information required for the study, including the following:
  - Detailed descriptions of the PATH project
  - Power flow model and selected scenario
  - Data over the study period for 1) power flow for the PATH line, 2) line availability, and 3) system dispatch and load flow
2. Evaluate line losses from monitored power flow.
3. Evaluate overall system losses based on a consolidated load evaluation methodology.
4. Evaluate CO<sub>2</sub> savings.
5. Document results using EPRI demonstration protocol.
6. Prepare final project report.