PO.016

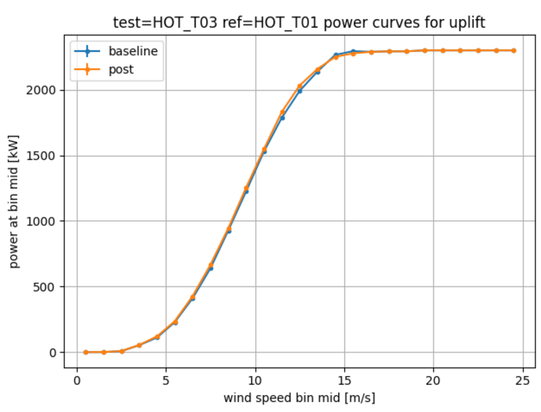
Achieving Measurable AEP Uplift Through Adaptive Control: Open-Source Data and Methods

Alex Clerc, Tommy Berg, Aleix Torner, Christopher Warnock, Kevin Watts

RES

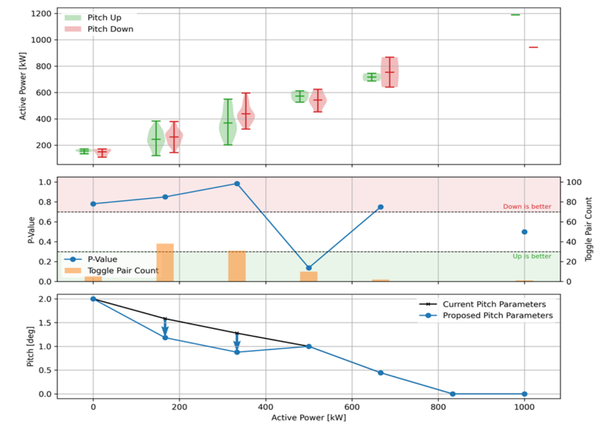
We can increase AEP by >1% using adaptive control

Phase 1: Pitch Curve Initial Enhancement



Validated gain for test turbines: **1.0% uplift**

Phase 2: Adaptive Pitch Curve Optimisation



Initial results for test turbines: **2.0%+ uplift**

2024: Initial success

TuneUp [1] deployed and validated at Hill of Towie SWT 2.3-82 site in Scotland utilizing one-time pitch curve optimisation. Measured AEP result: 1.0% uplift. Released as open case study (thank you to TRIG, the site owner) [2].

Challenges

How to further adapt to short-term changes in inflow (e.g. shear, turbulence, stability, etc.) and long-term effects like blade condition to further increase AEP?

How to ensure pitch remains optimal over time with a scalable solution?

2025-26: Meeting the challenges

Turbine performance was optimised at another test site (Altahullion) using a real-time controller continuously evaluating small changes in pitch setpoints, which provides the basis for a continuous and adaptive optimisation strategy.

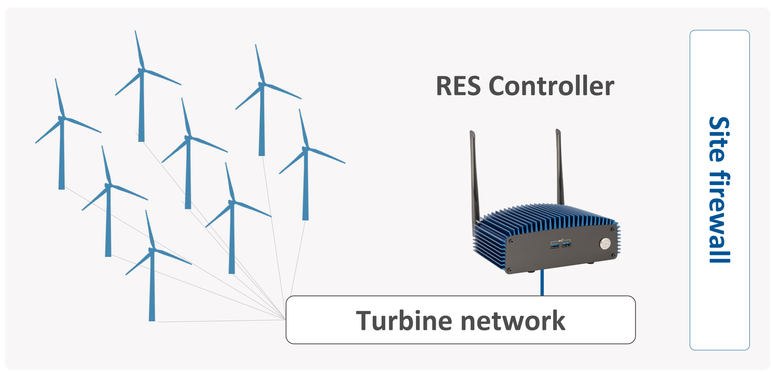
Altahullion Case Study

An open dataset for the Adaptive TuneUp trials at Altahullion has been published on Zenodo in May 2026 [3]. Open analysis of this and further trials will be released later.

Safe and scalable technology without third party or individual turbine hardware

All turbine commands were managed by a single RES-developed controller sitting on the wind site network, thus avoiding the need to equip each individual turbine with additional hardware.

The controller leveraged **Anemo** technology [4] to safely send commands to individual turbines through their native control protocol:



Validation methods

The open Python tool **wind-up** [5] is used to process the SCADA to measure uplift and uncertainty.

Visit RES GitHub repo

References:

1. https://res-group.com/digital-solutions/tuneup/
2. https://github.com/resgroup/hill-of-towie-open-source-analysis
3. https://zenodo.org/records/19948235
4. https://res-group.com/digital-solutions/anemo/
5. https://github.com/resgroup/wind-up

Watch this presentation

Download the poster

Wind EUROPE TECHNOLOGY WORKSHOP 2026 11-12 JUNE ROTTERDAM

windeurope.org/tech2026
#WindTech26