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TECHNOLOGY WHITEPAPER

Innovation in Near-Ground Renewable Energy Harvesting

How naca.boost - a lift-and-drag hybrid rotor with an intelligent housing and integrated solar - makes turbulent near-ground wind economically usable for decentralised power.



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Executive Summary

The decentralised energy transition is not held back by technology for large installations. It is held back by economically viable technology at the small, distributed scale, where most off-grid and self-consumption demand actually sits.

Photovoltaics transformed distributed generation, but PV has a structural weakness: it delivers energy during the day and in summer, when demand is often lowest and the grid is already well supplied. In autumn and winter, at night, and under overcast skies a supply gap opens. Wind fills that gap, if it can be harvested where the demand is: near the ground, at installation heights of 3 to 8 metres, where airflow is turbulent, gusty, multi-directional, and significantly slower than at altitude. Conventional horizontal-axis turbines need free, laminar inflow and large hub heights and are unsuited to this environment. Conventional drag-only vertical-axis turbines (Savonius) tolerate turbulence but are structurally capped at a power coefficient of about 0.20.

naca.boost is a vertical-axis wind turbine engineered specifically for these near-ground, turbulent conditions, and delivered as a complete, integrated, rapidly deployable hybrid system. It harvests at least 75 per cent more energy from the same wind than a conventional near-ground turbine, and pairs that wind with solar for a steadier supply the whole year round.

- **A lift-and-drag hybrid rotor.** Aerofoil-profiled blades add powerful lift to simple drag, so the rotor captures far more of the wind while still self-starting and thriving in turbulence like a robust drag design. Its lift-driven character shows in a real-world tip-speed ratio of 2.1 - more than twice the wind speed, something a drag-only rotor simply cannot reach.
- **An intelligent airflow-guiding housing.** Its asymmetric shape speeds up the wind onto the working blade and shields the returning one, turning the housing into part of the engine.
- **A complete hybrid system, ready to run.** sky.boost adds modular solar, master.boost intelligently routes every kilowatt-hour, and the whole power station arrives on a trailer or ISO container and commissions in hours, not weeks.

2.1×	+75%	6,500	Hours
MEASURED TIP-SPEED RATIO	MORE ENERGY VS. CONVENTIONAL NEAR-GROUND VAWT	KWH ANNUAL YIELD AT 7 M/S AVG WIND	COMMISSIONING TIME, NOT WEEKS

The result is a turbine that is permit-light in many jurisdictions, quiet, and complementary to photovoltaics - a scalable building block for decentralised energy exactly where demand is greatest and existing wind technology performs worst.

1. The Near-Ground Wind Problem

The largest unmet demand for decentralised energy meets the largest technological gap in wind harvesting.

Wind power is the kinetic energy of moving air. The available power scales with the cube of wind velocity, $P = 0.5 \times \rho \times A \times v^3$, where ρ is air density (about 1.2 kg/m^3), A is the swept area, and v is wind velocity. Because of this cubic relationship, small increases in wind speed produce large increases in available power, and small losses of speed are equally punishing.

Wind is faster and more uniform at altitude. Closer to the ground it slows and becomes turbulent as it interacts with trees, buildings, and structures. Conventional large turbines respond to this in the only way their physics allows: they climb. Commercial horizontal-axis turbines (HAWT) run at 80 to 150 metre hub heights, where flow is fast and laminar. A 60 percent increase in wind speed yields roughly a fourfold increase in available power. For HAWT economics, altitude is not a preference. It is a physical requirement.

This creates the market gap. Off-grid and self-consumption demand - on commercial flat roofs, containers, construction sites, farms, remote industrial and telecoms sites - exists precisely at the heights and locations where HAWTs cannot operate economically. Towers add visual impact, planning resistance, and permitting complexity, and rooftop or container mounting is mechanically impossible. The sites with the greatest need for autonomous power are the sites existing wind technology handles worst.

Vertical-axis turbines (VAWT) work at ground level and remove the altitude constraint, but each classic design forces a trade-off. The Savonius drag rotor is rugged and self-starting yet captures barely a fifth of the wind; the Darrieus lift rotor is efficient but needs the clean, steady flow near-ground sites rarely provide. naca.boost resolves the trade-off: it keeps the self-starting, turbulence-tolerant Savonius base and adds Darrieus-like lift, so it draws far more energy while still thriving where the wind is messy. That is what naca.boost was built to do.

> **The market gap in one line:** demand for autonomous power is greatest exactly at the 3-8 m heights and cluttered sites where conventional wind technology performs worst.

2. Aerodynamic Fundamentals: Drag versus Lift

Vertical-axis turbines fall into two families whose operating principle differs fundamentally.

2.1 Drag rotors (Savonius type)

A Savonius rotor works on the drag principle: wind pushes against scoop-shaped blades. Such rotors are robust, self-starting, and direction-independent, but reach only low power coefficients (Cp about 0.12 to 0.20). The reason is physically unavoidable. One blade always moves against the wind and acts as a brake, and the tip-speed ratio TSR - the ratio of blade-tip speed to wind speed - stays structurally below 1.0. The blades cannot move faster than the wind that drives them. This ceiling is structural, not a manufacturing quality issue.

2.2 Lift rotors (Darrieus type)

A Darrieus rotor uses aerodynamic lift on profiled aerofoils, the same principle as an aircraft wing. Such rotors reach high power coefficients (Cp up to about 0.40) and tip-speed ratios (TSR) greater than 1. Their drawback: they need comparatively laminar inflow, are not reliably self-starting, and are sensitive to turbulence - so in near-ground, gusty conditions they lose performance sharply.

naca.boost is designed to combine the turbulence tolerance and self-starting of the drag rotor with the efficiency of the lift rotor.

Property	Drag (Savonius)	Lift (Darrieus)	naca.boost (hybrid)
Operating principle	Drag	Lift	**Lift-dominated, drag start**
Energy from the same wind	Baseline (low)	High (needs clean wind)	**At least +75% near-ground**
Tip-speed ratio TSR	< 1.0	> 1.0	**2.1 (measured)**
Self-starting	Yes	Weak	**Yes**
Turbulence tolerance	High	Low	**High**

Table 1. Positioning of the VAWT families. naca.boost unites the turbulence tolerance and self-starting of the drag rotor with the efficiency of the lift rotor.

3. The naca.boost Rotor: A Lift-Dominated Hybrid

It looks like a simple drag rotor. It performs like something far better.

From the outside, naca.boost resembles a familiar, robust drag rotor - the kind that shrugs off turbulence and starts itself in a light breeze. In operation, it behaves like a high-efficiency lift machine. That combination is what unlocks the extra energy.

3.1 Proven in the field: tip speed of 2.1

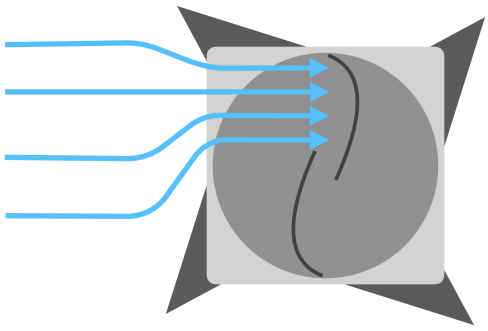
On real installations, naca.boost reaches a tip-speed ratio of 2.1: its blade tips move more than twice as fast as the wind. A simple drag rotor can never do that, because it cannot spin faster than the wind pushing it. That single number is the clearest sign that, behind its sturdy appearance, naca.boost is genuinely lift-driven - and lift is where the additional energy comes from.

3.2 The aerofoil rotor blade profile

Instead of simple Savonius scoops, naca.boost uses an elliptically profiled, aerofoil-shaped blade in a proprietary novventos configuration. During rotation the profile establishes an effective angle of attack to the inflow and therefore a significant lift component, while at start-up it retains the self-starting capability and robustness of a drag rotor. Lift forces are significantly stronger than drag at comparable wind speeds and enable tip speeds that exceed the incoming wind velocity - a condition drag-only designs cannot achieve.

3.3 Dual-bearing mechanical design

The rotor is mounted on ball bearings at both the top and the bottom of the shaft. This dual-bearing configuration handles flexural load under asymmetric wind loading much better, reduces mechanical vibration, and enables quiet operation across the full range of wind speeds.



naca.boost rotor - elliptically profiled aerofoil blades in proprietary novventos configuration.

4. The Asymmetric NACA Housing

The housing is the second principal innovation. Its patented asymmetric geometry, with an aerofoil (NACA) profile on both walls, performs two aerodynamic functions at once.

4.1 Accelerating the inflow

On the advancing side, the housing geometry converges the incoming airflow and accelerates it before it reaches the rotor swept area (nozzle effect). Because the power in the wind rises with the cube of velocity, even a moderate acceleration at the rotor face produces a disproportionate increase in extractable energy. This convergent acceleration is a primary contributor to the measured performance improvement over unhoused designs.

4.2 Shielding the returning blade

On the opposite side, the housing encloses the part of the rotor where the blade moves against the wind. It shields the returning blade from the inflow so it can no longer act as a brake, diverting that air into a protected internal slipstream and acting as a diffuser. Rather than opposing rotation, every revolution follows a cleaner, lower-drag path.

4.3 Unaffected by turbulence

The vertical-axis configuration accepts wind from any direction, with no mechanical yaw adjustment required. Conventional horizontal-axis turbines lose efficiency in the turbulent, multi-directional airflow typical of near-ground sites. The naca.boost rotor is designed to operate within these same conditions without loss of performance, so the turbulence that limits other turbines at low installation heights does not limit naca.boost.

4.4 Fixed, omnidirectional, low maintenance

The housing is a fixed, omnidirectional design with no moving tracking mechanism. It takes wind from any direction and needs no yaw motor to chase it. Fewer moving parts means less to wear out, less to service, and a design equally at home on a rooftop with shifting winds or on a trailer moved from site to site.

> **Turning a weakness into a strength:** Near-ground turbulence - the primary reason large horizontal-axis turbines cannot operate at low heights - becomes a functional advantage for naca.boost. The rotor's omnidirectional nature means variable wind direction actively increases excitation rather than degrading performance.

5. The Hybrid System: Wind plus Solar

naca.boost is not a competitor to photovoltaics. It is its ideal complement.

Wind and solar have naturally complementary profiles. Solar peaks in summer and during daylight; wind strengthens in autumn and winter, at night, and on overcast days - precisely when solar output falls towards zero. Managed together, each source fills the other's gaps and the combined output curve is significantly smoother than either source alone.

This matters most for storage. Required battery capacity is set by the depth and duration of worst-case production gaps. For solar alone in a northern winter, this can mean several days at full load with almost no generation, and the capital cost of that storage is prohibitive for most off-grid applications. Because the combined wind-plus-solar profile is smoothed, storage is sized against the residual variance rather than the worst-case single-source gap - which has a direct and roughly linear effect on required capacity, cost, weight, and logistics. novventos treats supply reliability, not peak generation, as the primary design objective.

5.1 sky.boost, master.boost, and integration

- **sky.boost - modular solar.** A photovoltaic array engineered for container and housing mounting. Panels sit on the same surfaces used to guide wind towards the rotor, so the same footprint harvests both sources.
- **master.boost - energy hub.** Manages all energy flows between naca.boost, sky.boost, storage, and loads - balancing both sources in real time. Full remote visibility through the novventos cloud with data.mine monitoring.
- **On-board turbine control.** Continuously adapts generator loading to hold optimal torque-to-rotation ratio. In storms it brakes the rotor.



sky.boost - modular solar panels for container and housing integration.



master.boost energy hub - real-time management of wind, solar, storage and load.

6. Mobility and Rapid Deployment

A defining property of the novventos solution is deployability. A complete mobile.energy unit integrates naca.boost, sky.boost, master.boost, and battery storage on a standard transport format - delivered on an ISO container and (as an option) mounted on a trailer. Structural loads stay within the tolerance of a standard container without reinforcement. There is no crane, no foundation work, and no specialist installation team. The unit arrives pre-balanced and pre-commissioned and generates power from the moment it is connected to the site load.

Capacity scales by unit addition. Each unit is a complete, independent power station, and adding units in parallel requires no site-specific engineering and no reconfiguration of existing units. Just as important, a mobile unit can be disconnected, loaded, and redeployed using the same logistics that delivered it. For temporary installations - construction sites, events, emergency response, and humanitarian deployments - the ability to recover and redeploy the capital investment is a significant advantage over any fixed renewable installation.



mobile.energy - complete power station on a standard ISO container, commissioning in hours.



mobile.energy trailer configuration - solar-clad, self-contained, ready to redeploy.

7. What It Delivers: Yield and Value

A single naca.boost unit generates around 6,500 kWh of energy per year at a good site (7 m/s average wind), with integrated solar on the housing adding output when the wind is calm. Because it starts generating in lighter winds and keeps working through the turbulence that stops other turbines, it produces across more hours of the year - not just on the best days - and it runs maintenance-free.

7.1 The real value: what it replaces

naca.boost's strongest case is off-grid. Where the alternative is a diesel generator, the real cost of a kilowatt-hour, once fuel, maintenance, and the logistics of getting fuel to a remote site are counted, can approach 1 EUR. Measured against that, a single unit's 6,500 kWh of annual output is worth on the order of 6,500 EUR per year, before even counting the noise, emissions, and refuelling trips that disappear with it. For remote industrial, construction, agricultural, and telecoms sites, this is the decisive argument.

On the grid, the case still stacks up. Self-consuming your own output avoids the full retail price of electricity: the raw energy cost, plus grid fees and taxes and levies, which together typically add around 60 percent on top. At a typical 0.25 EUR/kWh, that is worth roughly 1,600 EUR per unit per year, a figure that keeps climbing as grid fees rise.

~1,600
EUR/YEAR PER UNIT ON-GRID (SELF-CONSUMPTION)

~6,500
EUR/YEAR PER UNIT OFF-GRID VS. DIESEL

7.2 Cleaner, and more independent

Every kilowatt-hour generated on site is one less drawn from the grid - a substantial CO_2 saving against the grid mix over the year. Just as important, pairing wind with solar smooths generation across the day and the seasons and raises how much of your own demand you can cover, moving you closer to true energy independence.

8. Properties and Applications

8.1 Distinctive properties

- **Permit-light.** Build height under 3 metres and no mandatory foundation remove, in many regions, the permitting obligation and with it the largest market-entry barrier.
- **Quiet and unobtrusive.** Low sound emission (10 dB at 10 metres), no shadow flicker, no elevated bird-strike risk - suited to urban and commercial settings.
- **Recyclable and repairable.** Fully recyclable materials (steel, aluminium) and a modular build for repairability and circularity.
- **Scalable in clusters.** Multiple turbines couple under a shared energy management (master.boost).

8.2 Target applications

- **Commercial and industrial:** self-consumption optimisation on flat roofs.
- **Agriculture:** permit-light installation on farmland, combined with PV.
- **Off-grid and mobile:** construction sites, events, remote, telecoms, and humanitarian scenarios (mobile.energy).
- **Infrastructure:** integration into noise-barrier systems along transport routes and into urban development.



naca.boost double-stack installations - scalable by unit addition, no site-specific engineering required.

9. Technical Specification

Parameter	Value
Dimensions (L × W × D)	2,730 mm × 2,730 mm × 2,860 mm
Weight	600 kg
Rated power	2,500 W
Annual yield	6,500 kWh per year (at 7 m/s average wind speed)
Operating height	3 to 8 metres above ground
Rotor	Lift-and-drag hybrid; measured tip-speed ratio 2.1
Energy advantage	At least 75% more than a conventional near-ground VAWT
Integrated solar	Photovoltaic panels on the housing (sky.boost ready)
Noise level	10 dB at 10 metres
Maintenance	Maintenance-free
Installation	On rooftops, on containers, or in open terrain

Table 2. naca.boost technical specification. Technical changes reserved.



naca.boost - a complete near-ground hybrid turbine, installable on rooftops, containers, or open terrain.

10. Conclusion

naca.boost opens up a resource that has been out of reach: the turbulent, near-ground wind that sits exactly where decentralised energy is needed most. It does so through three ideas working together - a lift-and-drag hybrid rotor that pulls far more energy from the wind, with a real-world tip-speed ratio of 2.1 to prove it; an intelligent airflow-guiding housing that speeds the wind onto the working blade and shields the returning one; and a complete hybrid system that adds solar, manages every kilowatt-hour, and arrives ready to run.

Permit-light, quiet, and complementary to photovoltaics - delivered on a trailer or container and commissioning in hours rather than weeks - naca.boost is a scalable building block for the decentralised energy transition at the small scale, where demand is greatest and existing wind technology has delivered least.

2.1×
MEASURED TIP-SPEED RATIO

+75%
MORE ENERGY NEAR-GROUND

6,500
KWH PER YEAR PER UNIT

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Enquiries on technology partnerships, distribution, and deployment

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