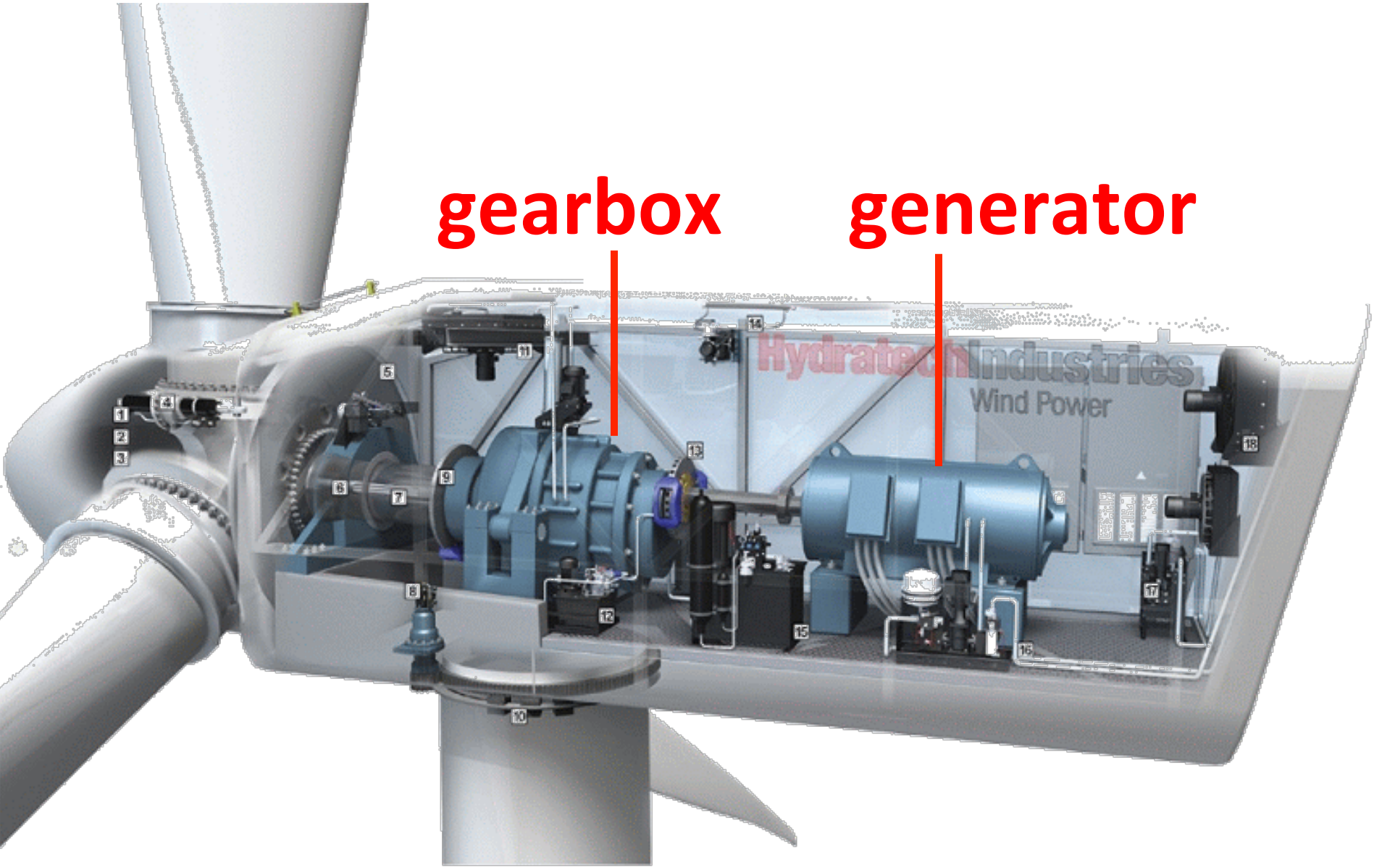
Twistact: The Key to Proliferation of Wind Power

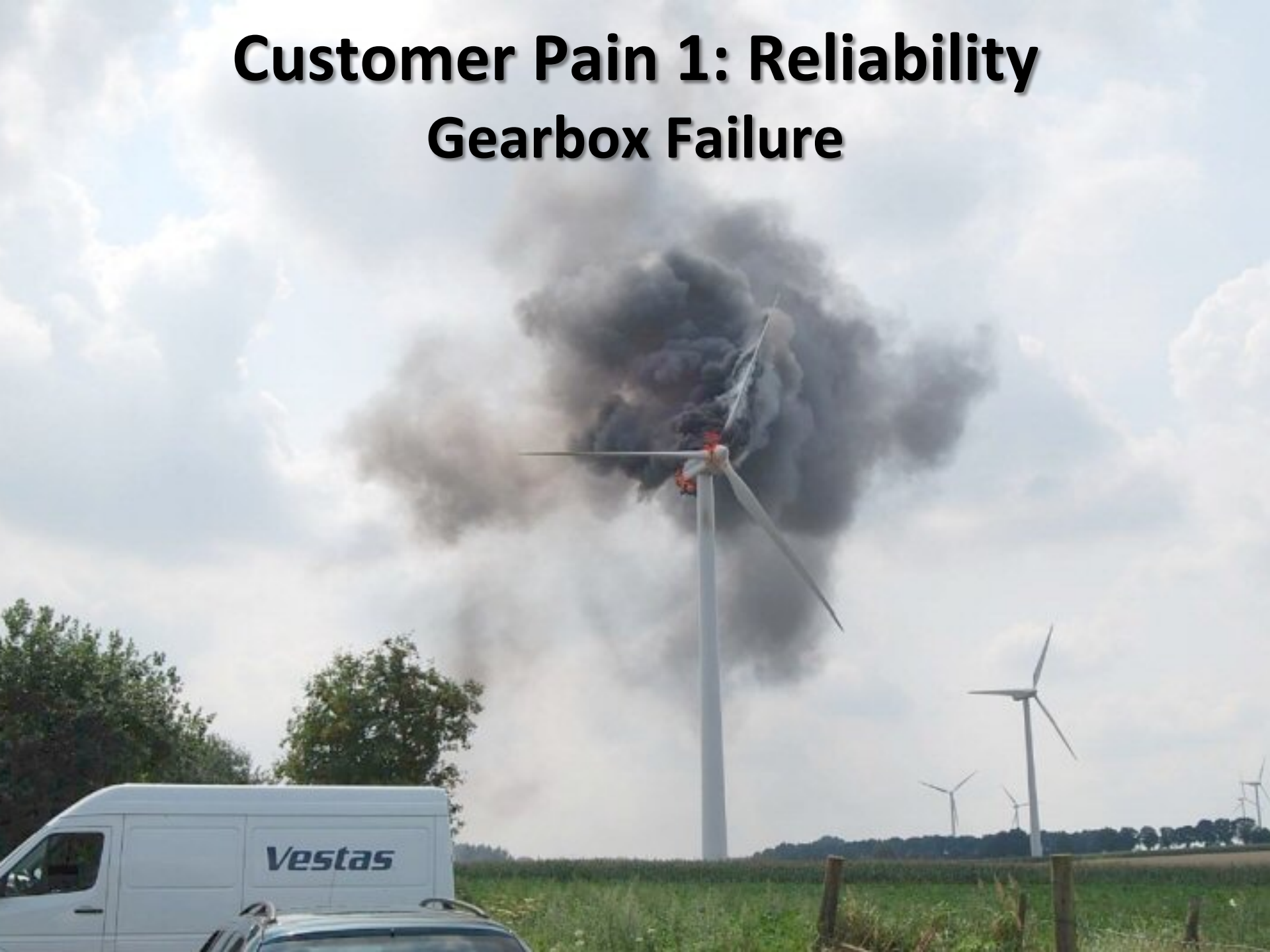
SAND2015-2233PE

Jeff Koplow (Principal Investigator)
Wayne Staats (Entrepreneurial Lead)
Jim Presley (Industry Mentor)
Justin Vanness (Core Team Member)
Arthur Kariya (Core Team Member)

Inside an Old School Wind Turbine

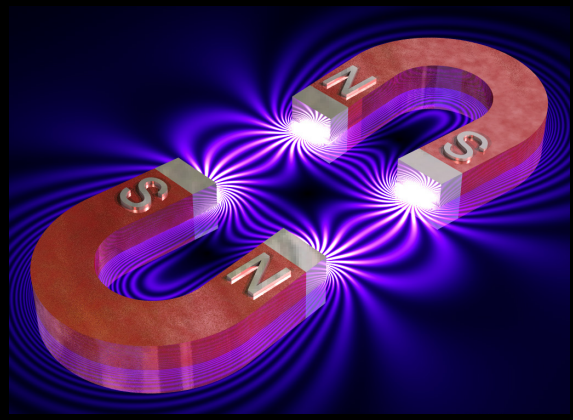


Customer Pain 1: Reliability
Gearbox Failure



Customer Pain 2: Market Scalability

Not Enough Rare Earth Magnets to Grow the Market



The Atlantic

ENVIRONMENT MAY 2009

Clean Energy's Dirty Little Secret

Hybrid cars and wind turbines need rare-earth minerals that come with their own hefty environmental price tag.

LISA MARGONELLI | MAY 1 2009, 12:00 PM ET

PHOTO BY GREG VOJTKO/THE PRESS ENTER

THE UNINCORPORATED COM
to recommend it to tourists. A scr
alongside Route 15, it has no kits
thermometer that nearby Baker,
no casinos like Las Vegas has an
colored industrial gate lies an att
created by a 21st-century gold rus

WIRED.CO.UK BUSINESS RARE EARTH MINERALS MINING CHINA

China warns that its rare earth minerals are running out

BUSINESS / 22 JUNE 12 / by IAN STEA

environment360

Reporting, Analysis, Opinion & Debate

18 NOV 2013: **REPORT**

A Scarcity of Rare Metals Is Hindering Green Technologies

A shortage of "rare earth" metals, used in everything from electric car batteries to solar panels to wind turbines, is hampering the growth of renewable energy technologies. Researchers are now working to find alternatives to these critical elements or better ways to recycle them.

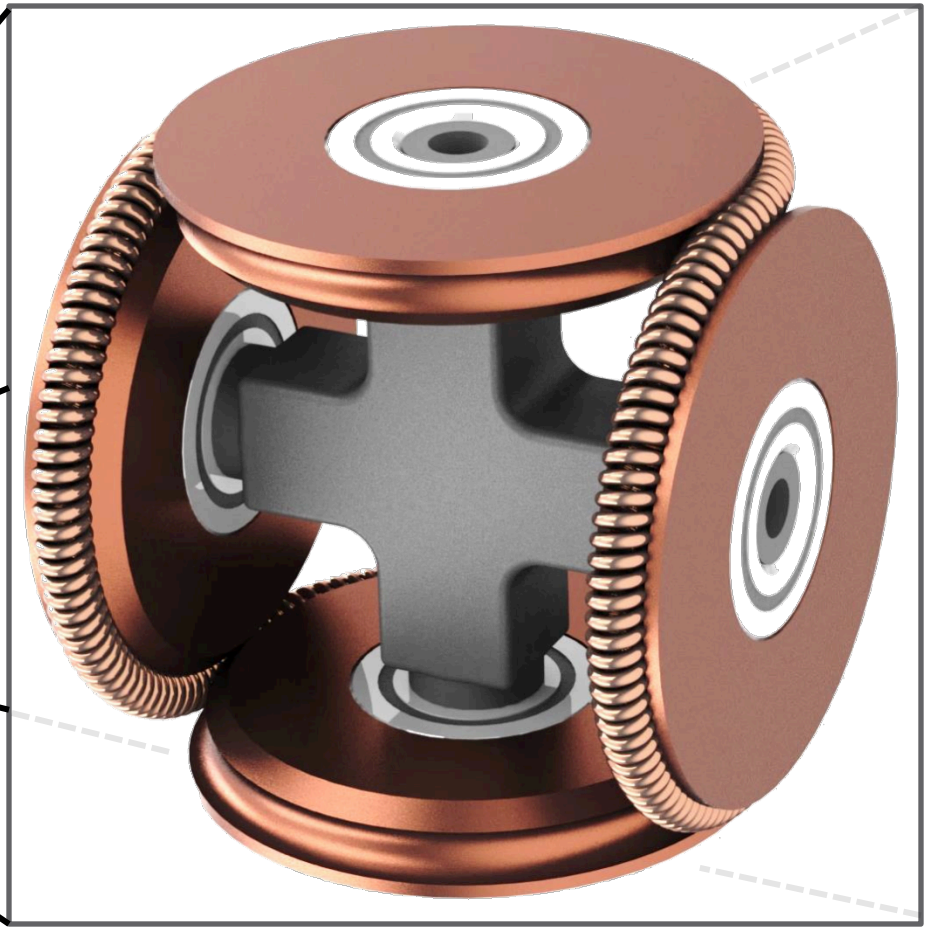
What About Direct-Drive + Electromagnets?

Enercon E-126

- No gearbox
- No rare earth magnets
- Fatal flaw – sliding electrical contacts

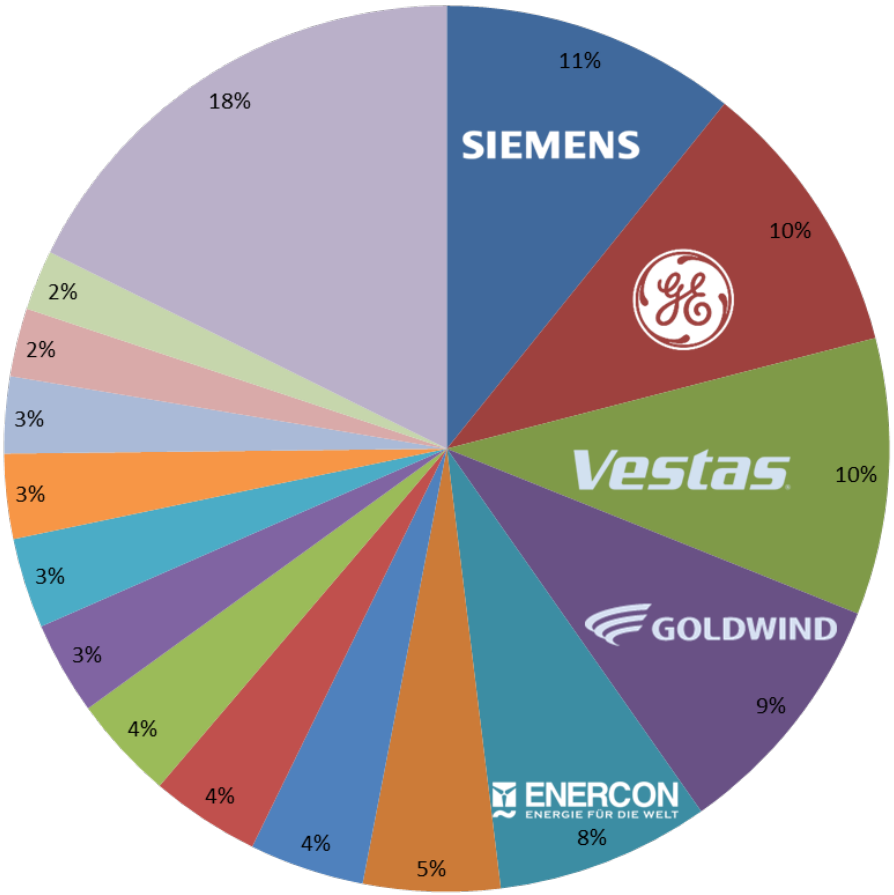
The Last Piece of the Puzzle: Twistact Technology

- Enables direct-drive + electromagnet approach
- Maintenance free
  - No sliding contacts
  - No electrical arcing



Commercial Product: Drop-in electrical generator solution for next-generation wind turbines

Profile of an Early Adopter



- Siemens
- GE
- Vestas
- Goldwind
- Enercon
- United Power
- Gamesa
- Mingyang
- Envision
- XEMC
- Sewind
- Nordex
- Senvion
- DEC
- CSIC
- Others

2nd Tier

- **Capable** (adequate resources)
- **Agile** (responsive to opportunity)
- **Hungry** (to become top-tier)

The Twistact Value Proposition

Finally, reliability *and* scalability

- No gear boxes
- No rare earths
- No sliding electrical contacts

Modular drop-in

Steep market growth

New market reality:
How will you survive if your competitors have Twistact technology and you don't?

Patent protection
- U.S. Patent 8,585,413 (Koplow)
- Completely distinct from prior art

The Twistact Team

- Jeff Koplow (PI)
- Wayne Staats (EL)
- Justin Vanness
- Arthur Kariya

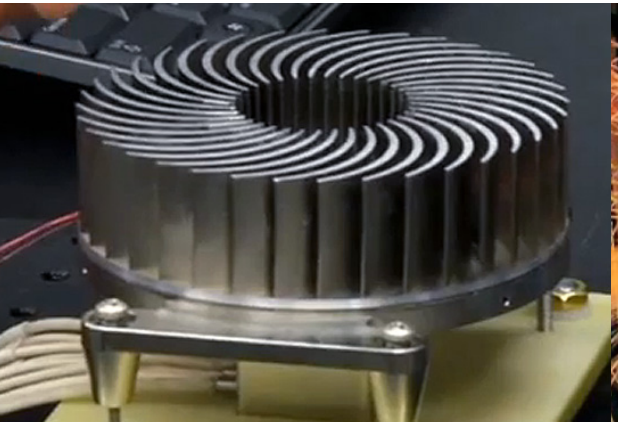
- Four R&D 100 Awards
- Track record of practical innovation
- Experience engaging industry
- 10 licenses on inventions to date

- Jim Presley – LabCorp Industry Mentor

Massachusetts Institute of Technology

HARVARD UNIVERSITY

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Sandia Cooler
(now being commercialized)

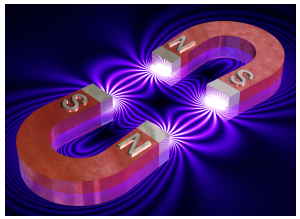
Mode Filtered Fiber Laser
(de facto standard worldwide)

Rotary-Cooled
Solid-State Lighting

PROBLEM

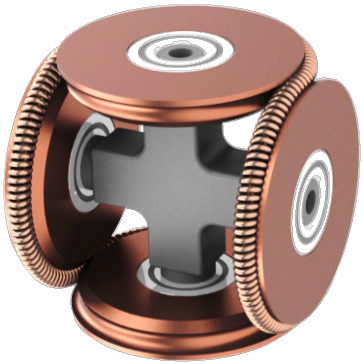
Customer Pain 1:
Reliability/maintenance (gearbox failure)

Customer Pain 2:
Scalability (insufficient rare earth magnet supply)



Alternative: direct-drive + electromagnets (sliding electrical contact failure)


SOLUTION



Twistact Technology

KEY METRICS

Market penetration:
- 20% in 5 years
- 80% in 15 years

Wind power provides 50% of electricity by 2030

UNIQUE VALUE PROP

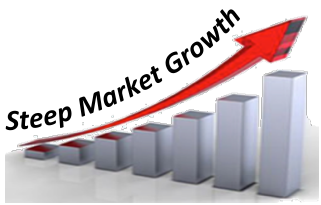
Reliability

No gearboxes

No sliding electrical contacts

Market Scalability

No rare earth magnets



UNFAIR ADVANTAGE

Patented technology

Very distinct from prior art

Infringement easy to detect

CHANNELS

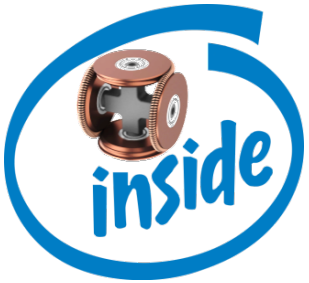
Direct sales to OEMs

Strategic Partnerships

CUSTOMER SEGMENTS

Early adopters: 2nd tier wind turbine OEMs
- Capable
- Agile
- Hungry

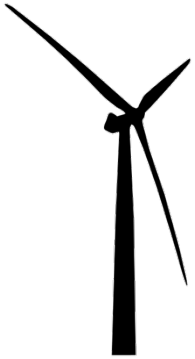
Customers:
- Vertically integrated wind turbine OEMs
- Generator OEMs



COST STRUCTURE

Fixed costs
- Capital equipment
- Labor
- Overhead

Variable costs
- Raw materials
- Manufacturing
- COTS components



REVENUE

Wind turbine/generator OEM partners

Hardware customization/NRE

Discrete sales

Service contracts

SBIR grants