

The Wind Engineering Energy and Environment (WindEEE) Dome

CFI Project 21166

Total Value: \$23.7M

CFI Contribution: \$9.48M



Horia Hangan
Professor - Western
Director – BLWTL
Lead Investigator - WindEEE



Slide 1

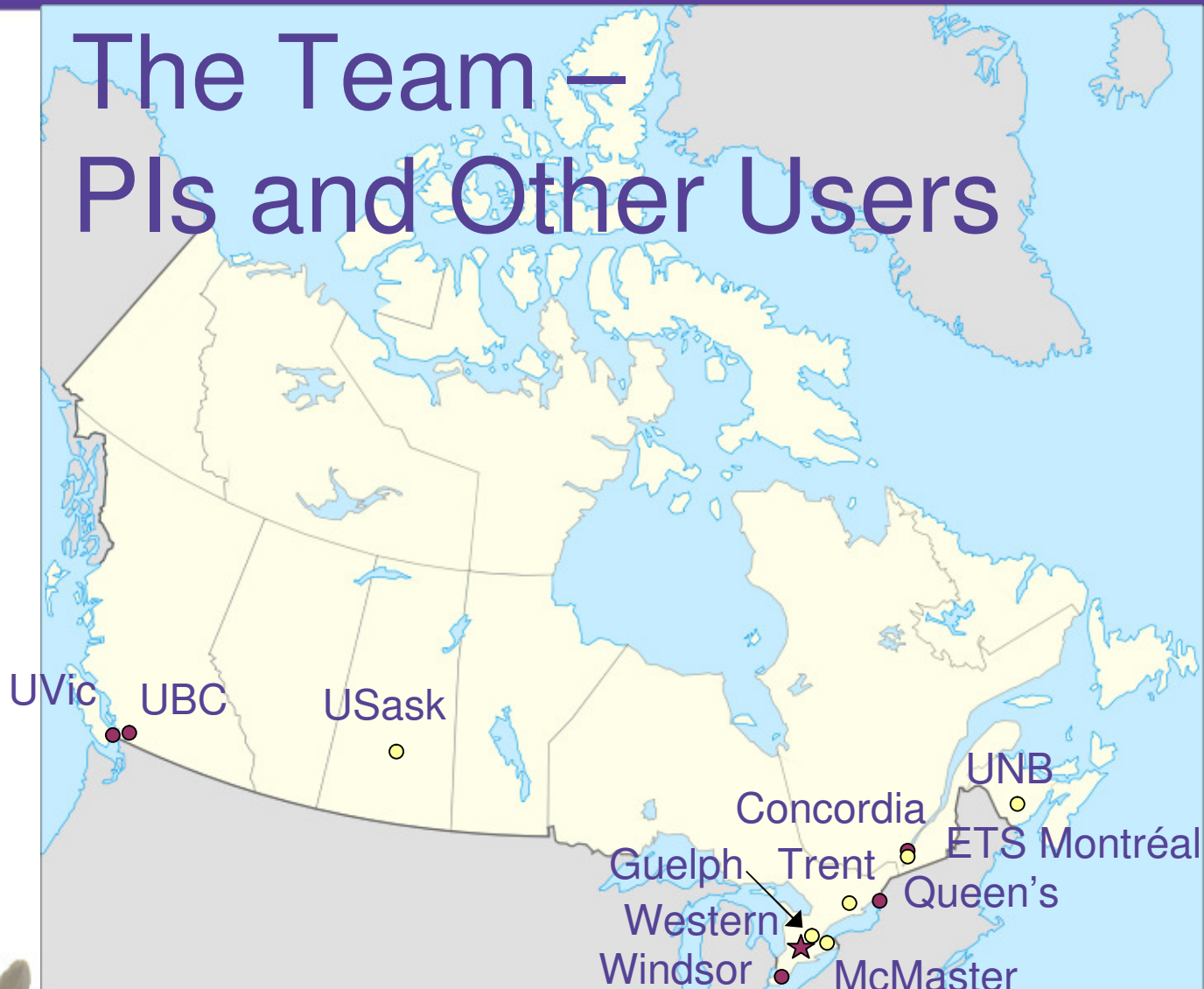
H6

Thank you for accepting to be part of this pannel to examine the Wind Eng., Energy and Environment (WindEEE) Dome Project. This is a Canada Foundation for Innovation Proposal of a total value of 23.7M with a CFI contribution of 9.5M.

Let me introduce the "defending" team today: I am HH, the Project Leader. My colleague Dr. Greg Kopp Canada Reserach Chair Tier II in WE, Dr. Ugo Piomelli CRC Tier I in Computational Turbulence and Dr. Paul Davenport our President and Vice-Chancelor

Horia_user, 2/2/2009

The Team – PIs and Other Users



The Team - Partners



WindEEE -The Vision:

- **Wind damage** → **Local Storms**
account for > 60% of wind damage
and \$200M annual losses in Canada
- **Wind Farms** → 20% Energy Losses
in Canada due to model uncertainty
related to **Wind Farm Siting, Terrain
effects and Wake and Array Effects**
- Need of a novel wind testing facility
- The WindEEE Dome



Slide 4

H3

The Vision of the WindEEE dome is based on our collective experience in wind research and applications for more than 45 years.

In the last couple of years we came to the understanding that more than 60%...

Also, wind farms in Canada show Energy Losses of the order of 20% due to....

In order to improve the meso and microscale wind modeling and predictions we need a novel wind testing facility: the WindEEE dome.

Horia_user, 2/2/2009

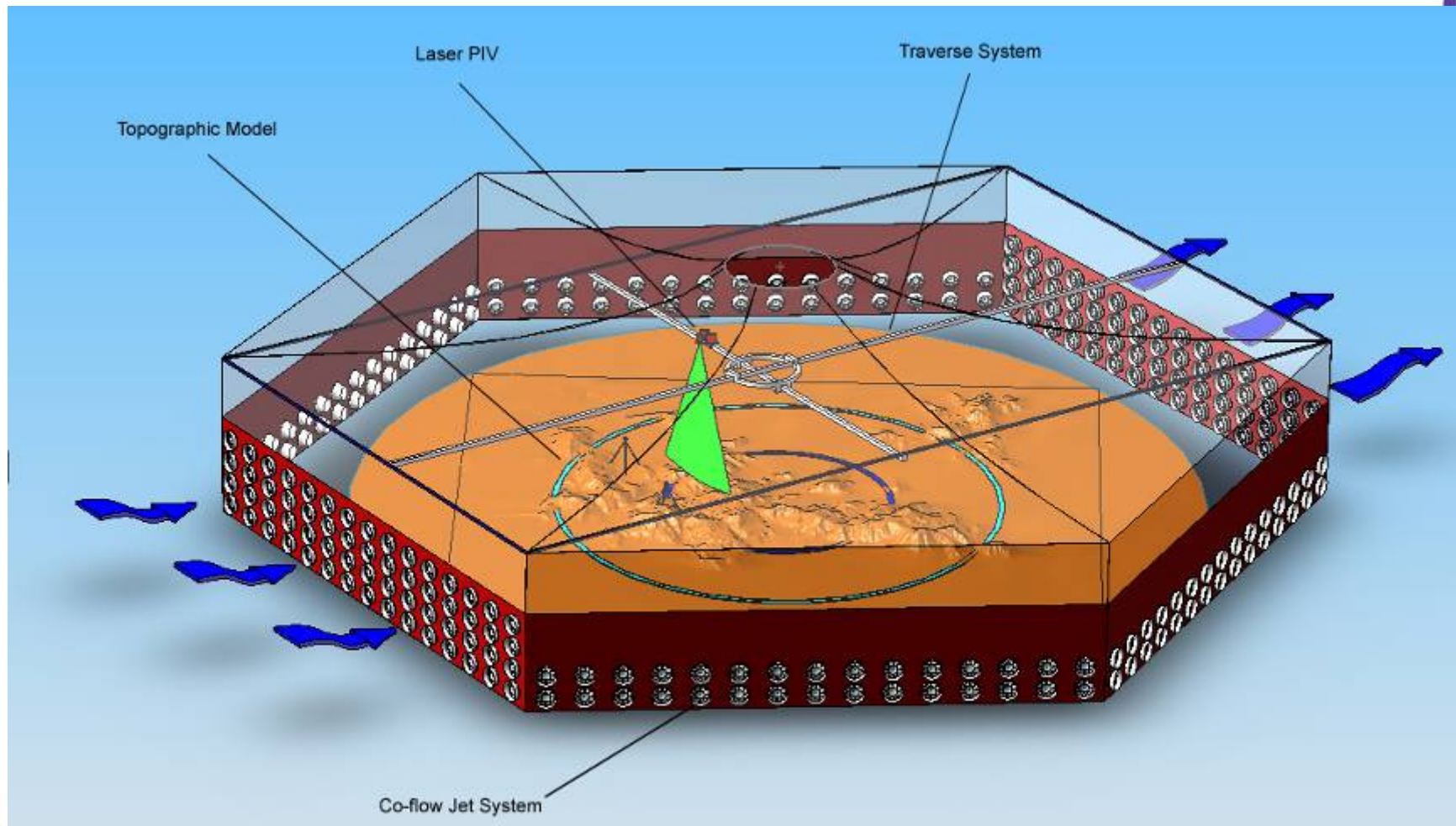
The Need for WindEEE:



- BLWTL and 3LP facility have established our track record in wind research
- But they can't do what WindEEE will do:
 - Local storms: tornado, downburst, gust fronts, low level currents
 - Large scale simulations
- WindEEE + 3LP + BLWTL = Unparalleled Wind Research Capability



The Infrastructure:



Slide 6

H4

WindEEE is conceived as a hexagonal space of 25 m in diameter.

On the peripheric walls a matrix of reversible fans coupled with a louvre system can produce a large variety of wind fields: TORNADOS, DOWNBURSTS or STRAIGHT but SHEARED WINDS

An active ground floor capability can reproduce complex topographic terrains in short time intervals.

A PIV system coupled with a Traverse system situated at the top measures high resolution wind velocity fields in both horizontal and vertical planes.

Finally a feed-back control system coupling numerical predictions and PIV measurements with the fan system will ensure that the desired wind field is simulated.

Horia_user, 2/4/2009

The Capabilities:

- Certain:
 - Tornados and Downbursts at 1/100 scale
 - Tornados up to S=1.2 or F3 (90% of events)
 - Wind farms siting and array effects at 1/500 to 1/1000 scale with 10 m (full scale) resolution
- Expected:
 - Rotating wake effects at 1/100 scale
 - Full Scale Blade Aerodynamics at $Re=2 \times 10^6$



The Research:

1. Physical simulation of complex wind fields
2. Surface wind fields over complex terrains
3. Improve performance of wind turbines and wind farms
4. Risk, Smart Grid connectivity, Economics, Policy and Decision making models



WindEEE: Economic and public policy research on wind energy

- Economic and commercial opportunities for wind energy
 - Energy produced by current wind farm technology is higher cost per MWh than fossil fuel generated energy
 - Optimizing turbine scale and farm location – using WindEEE test model facilities – will improve capacity utilization and energy output, reducing wind energy unit costs
 - Improving wind farm performance will drive greater investment in the sector

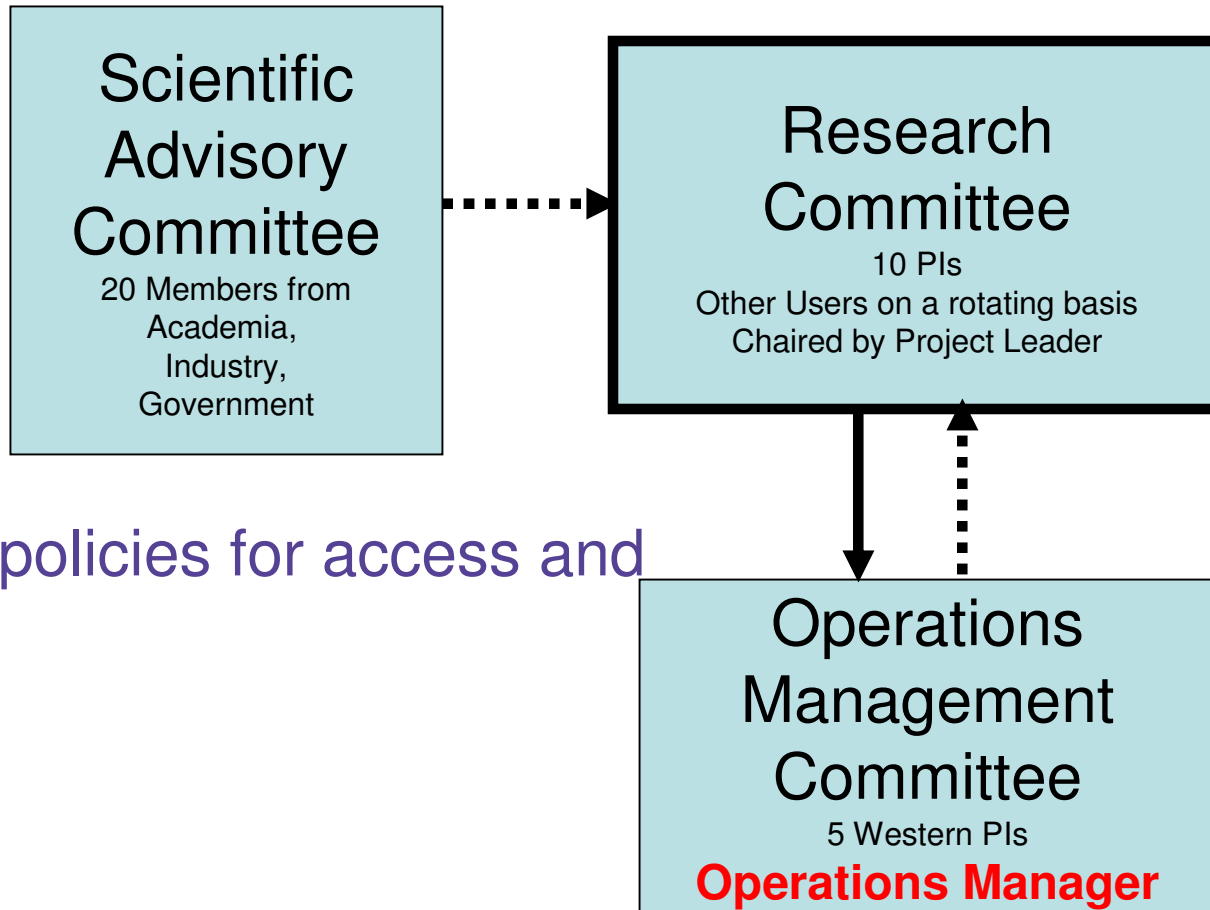


WindEEE: Economic and public policy research on wind energy (ii)

- Public policy environment for wind energy
 - Governments provide subsidies to private sector to encourage wind investment (e.g. through dedicated wind energy tariffs as in Ontario)
 - Policy decision: what are the optimal subsidies / tariffs? How should they change over time?
 - WindEEE facilities can model the *costs* of producing wind energy under varying turbine technologies and environmental conditions



Operational Management Structure



-RC will set policies for access and operations



Sustainability

- Based on experience with BLWTL and 3LP's
- Strong understanding of operating costs
- Established partnerships and collaborations
- Develop new, international partnerships



Benefits to Canada

- WindEEE: paradigm shift in wind research
- A globally unique facility: international impact
- Attract and train Highly Qualified Personnel
- Rational wind design of large structures
- 20% wind energy grid penetration by 2025



CONCLUSIONS

- Western: BLWTL historically dominated wind engineering research since 1964
- Western: Recently 3 LP's Facility adds full scale testing
- Western: NOW WindEEE Dome adds the "Weather Machine"
- **WESTERN = WIND !!!**

