

# Synergistic Partnership of Standards and Design Process: But What's Next

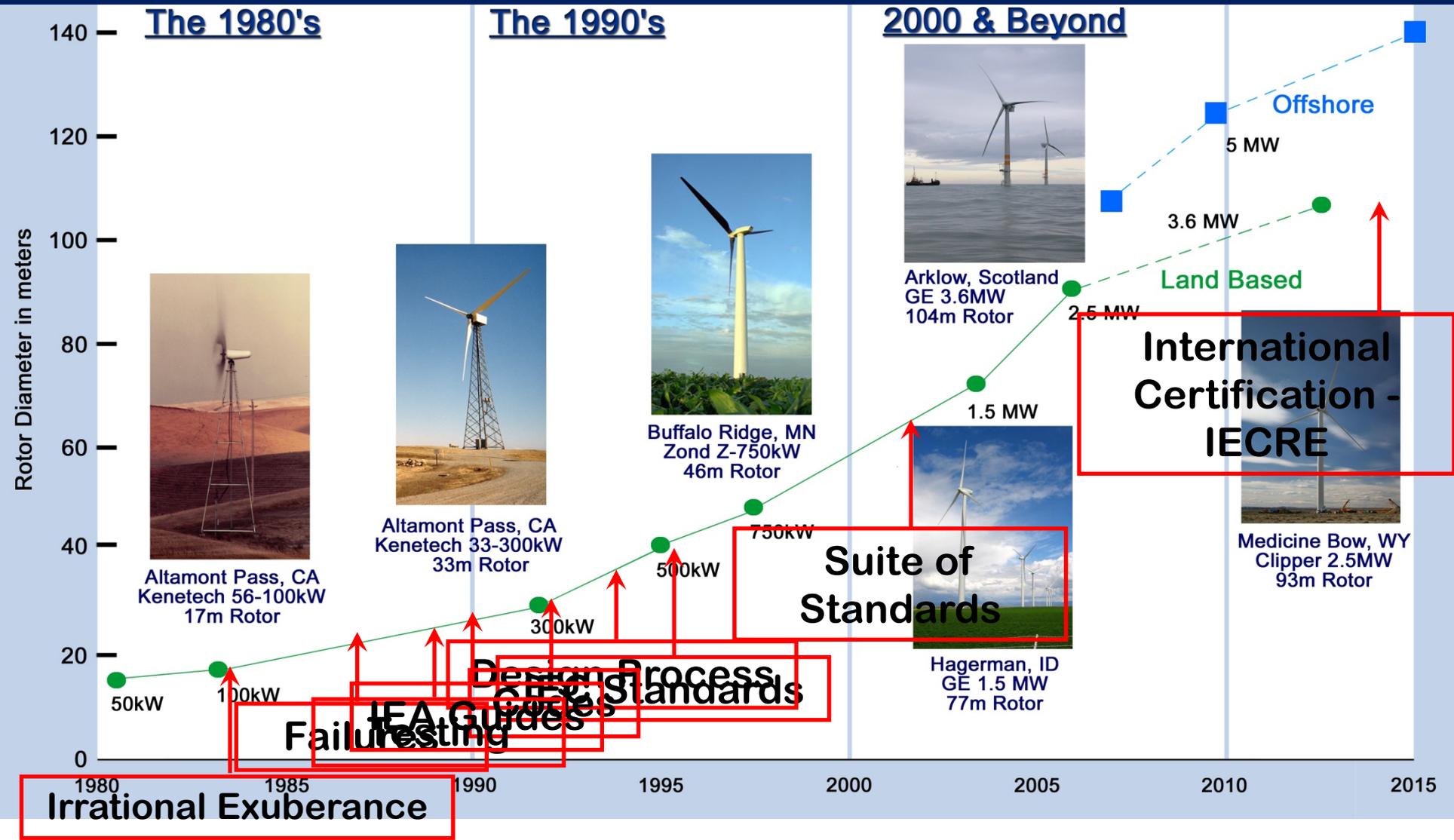
## 2015 Wind Energy Systems Engineering Workshop

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# Standards History: Defining the Path to Turbine Reliability



# Standards Successes / Failures



- Blades experience few failures (due to design process and testing required by IEC standards)
- Gears no longer fail (because of implementation of AGMA 6006 standard - DOE/NREL supported)
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Bearings still fail (Design Process?)  
Some blade series failures (Mfg. QA?)  
Still many gaps in the suite of standards  
Standards needed to help End Users?  
Certification not trusted by Owner/Operators  
(broader participation?)



# Turbine Centric vs Plant

## What's working

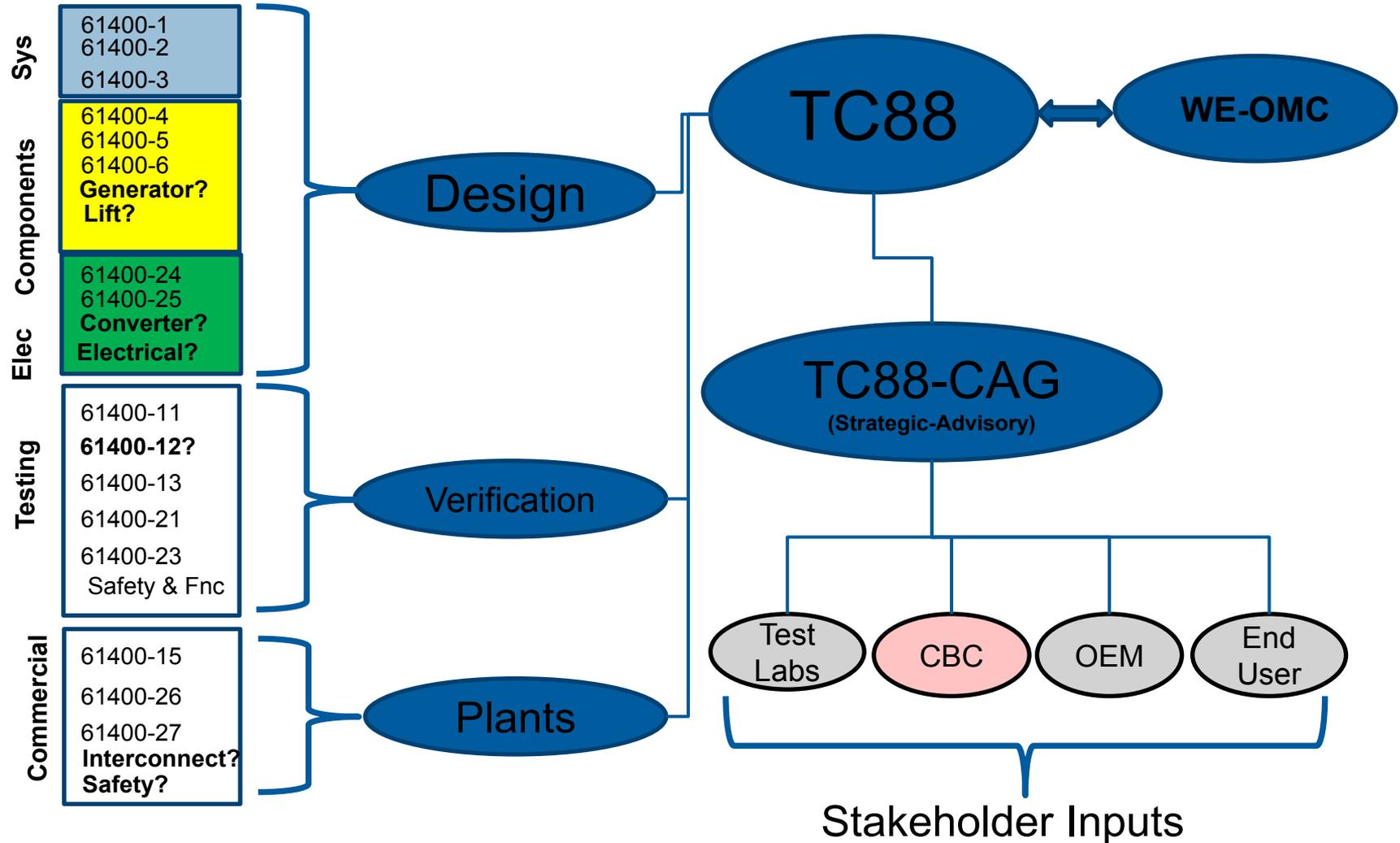
- Turbine design Framework
  - Fatigue?
  - Uncertainty?
- Coupled turbine aeroelastic analysis reasonable(?)
- Turbine test standards
  - Design support
  - Validation for End Users (?)
- Major component design
  - Blades
  - Drive Train
  - “Minor” components?

## What's Not

- Broad stakeholder engagement
- Need standards for:
  - facilitate wind plant design
  - Operations
  - Plant performance benchmarking
  - Integration requirements
- Wind specific component standards (“minor” components)
- Little formal collaboration between R&D and standards committees to solve technical challenges.

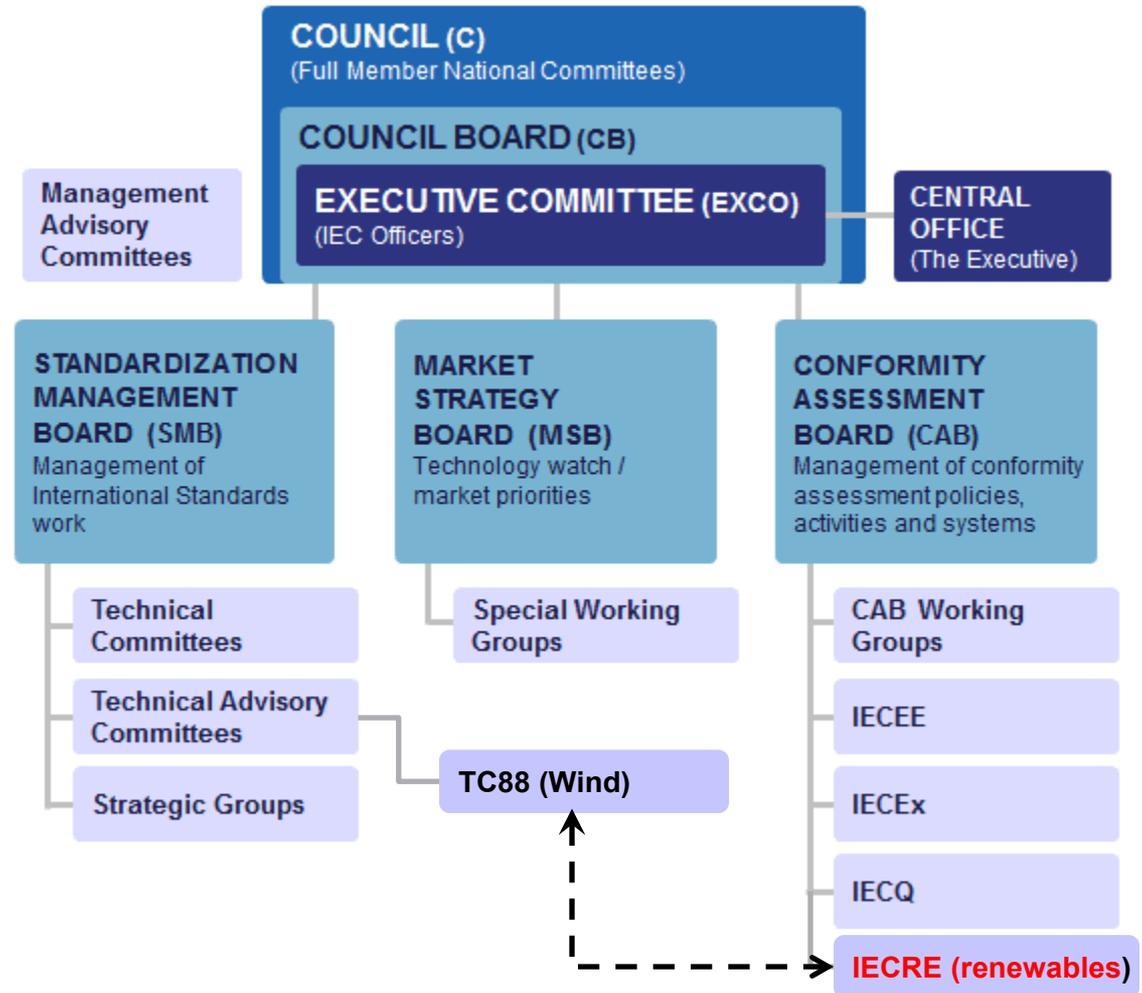
# Possible TC88 New Framework

- Logical vertically organized groupings?
- Reduced scope standards for responsive revision time
- Managed & maintained by groups with common interest/expertise?
- Meeting broad industry sector needs (system compatibility framework)?



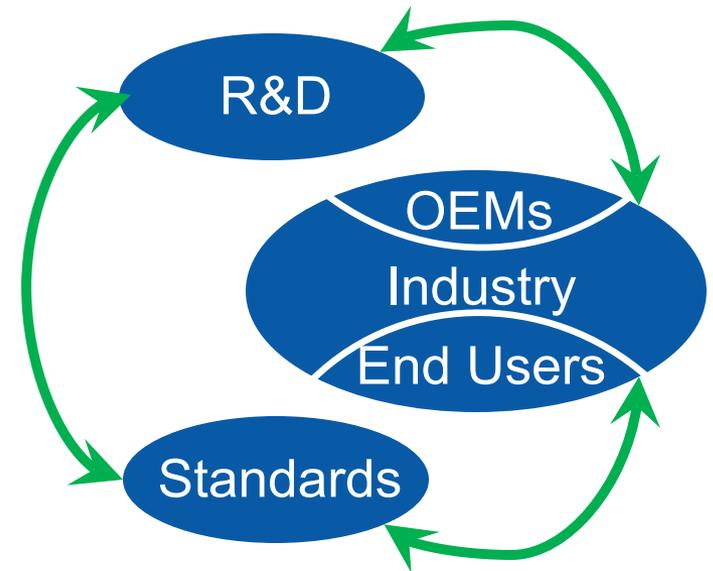
## International Electrotechnical Commission (IEC)

- IEC leads international standards for wind plants
- Multiple national standards.
- Multiple independent certification organization “rules”
- **Harmonization is needed**



# What is needed from R&D

- More formal relationship that is informed by and informs standards.
- Broader stakeholder relevance
- Long-term (examples):
  - Accurate comprehensive flow understanding (inflow, plant and local atmospheric coupling)
  - Validated system design tools
  - Methods for quantifying uncertainties
  - Reference data sets
- Short-term (examples):
  - Robust fatigue design process
  - Reference models
  - System oriented design framework
  - More accurate wake models
  - Accurate benchmarking of performance
    - Turbines within a wind plant
    - Full wind plant (“wind plant  $C_p$ ”)



# Role of Standards and Certification in Wind Industry Maturation

- Public / investor confidence
  - Design safety requirements (implied reliability)
  - Credible performance verification
  - Permitting requirements clarity (international harmonization)
  - Credible community impact measures (noise)
- Technology development
  - Standardized (accurate / consistent) testing techniques
  - Defined design process
  - Design verification testing
  - Common definition of external conditions
  - Design goals (20 year life, redundant safety systems, etc)
  - Level playing field in international market
  - Common design vocabulary (design load cases, coordinate systems, safety factors, etc)