Part I: Why Wind Turbines Catch Fire

Meet the Panel

JP Conkwright - Panelist
Professor of Fire Protection and Safety Engineering Technology
Eastern Kentucky University

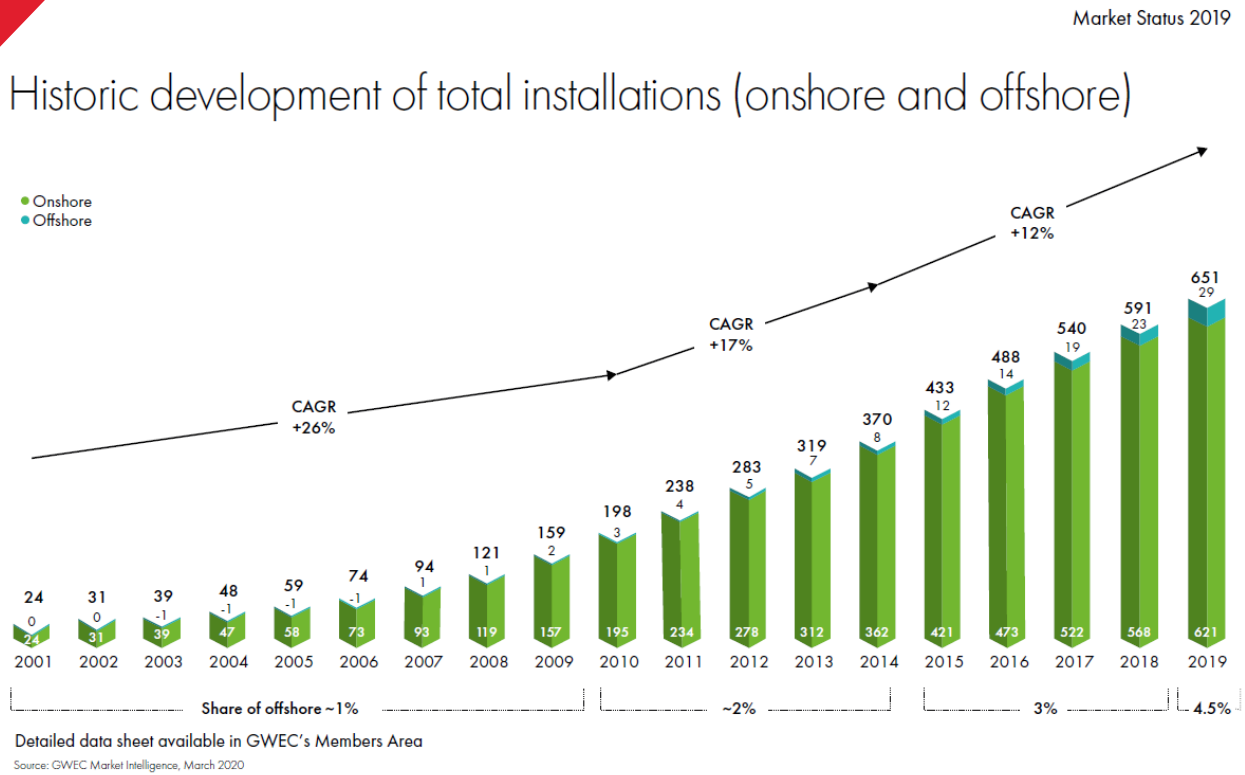
Angela Krcmar - Panelist
Global Sales Manager - Wind
Firetrace

Sally Wright - Panelist
Principal Wind Turbine Engineer
DNV GL - Renewables

Steve Mulhall - Moderator
Business Development Manager - Wind
Firetrace

Context:

Global Wind Industry & Market

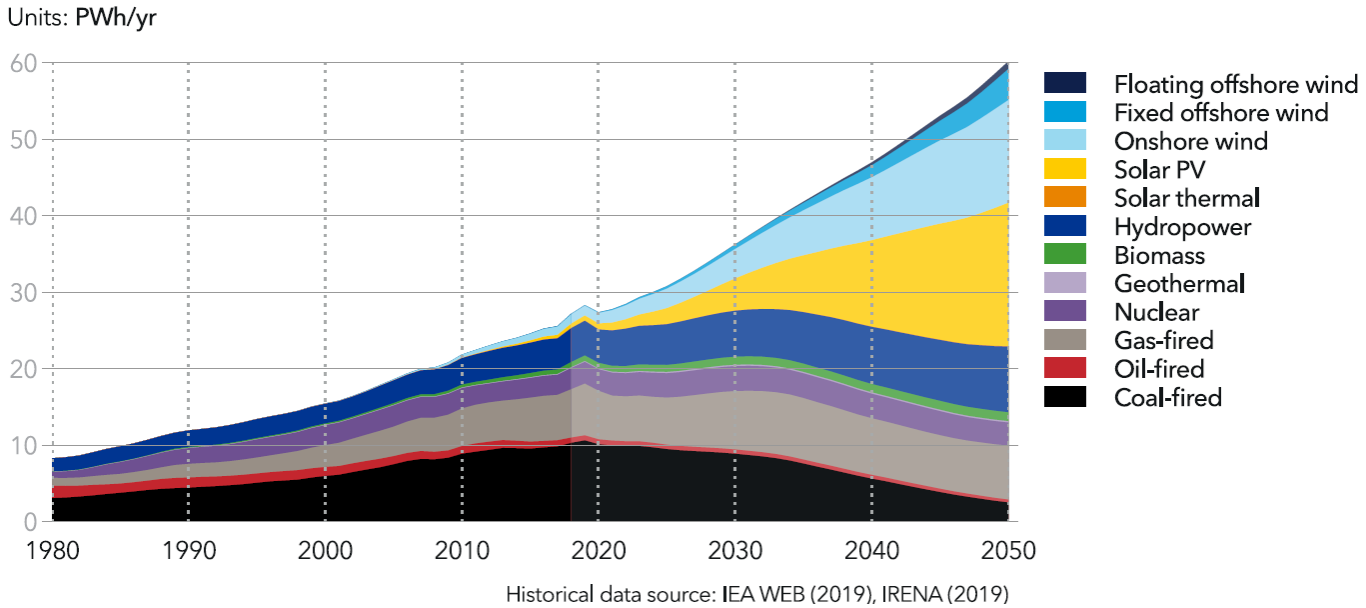


Source: Global Wind Report 2019, Global Wind Energy Council gwec.net

Context:

Global Wind Industry & Market

World electricity generation by power station type



Historical data source: IEA WEB (2019), IRENA (2019)

Renewable share of electricity generation. Non-fossil sources will dominate electricity generation by 2050, with 62% of power supplied by variable renewables, half each from wind and solar PV. Considerable investment in grids and flexibility will be needed but will be aided by plunging battery costs and widespread use of vehicle-to-grid storage.

Source: DNV GL Energy Transition Outlook 2020 eto.dnvgl.com

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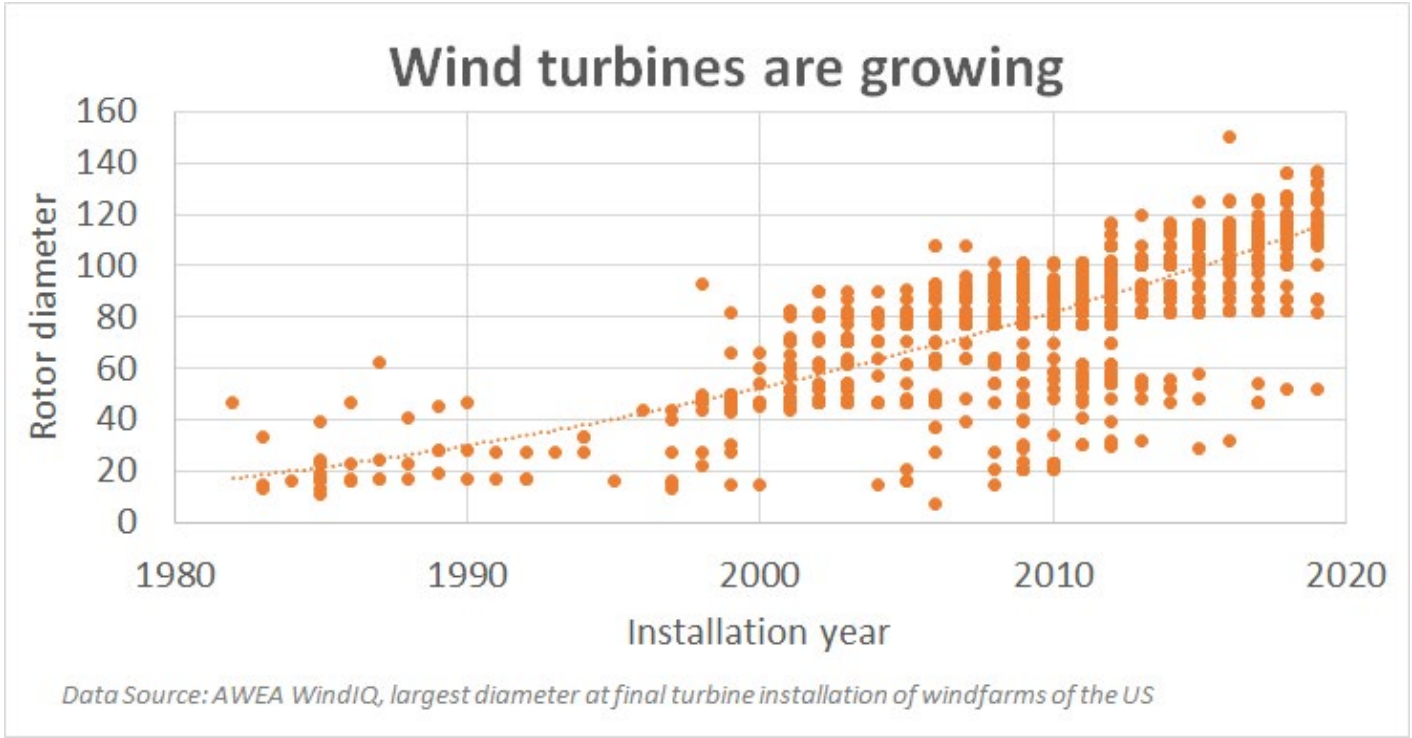
Global Wind Industry & Market



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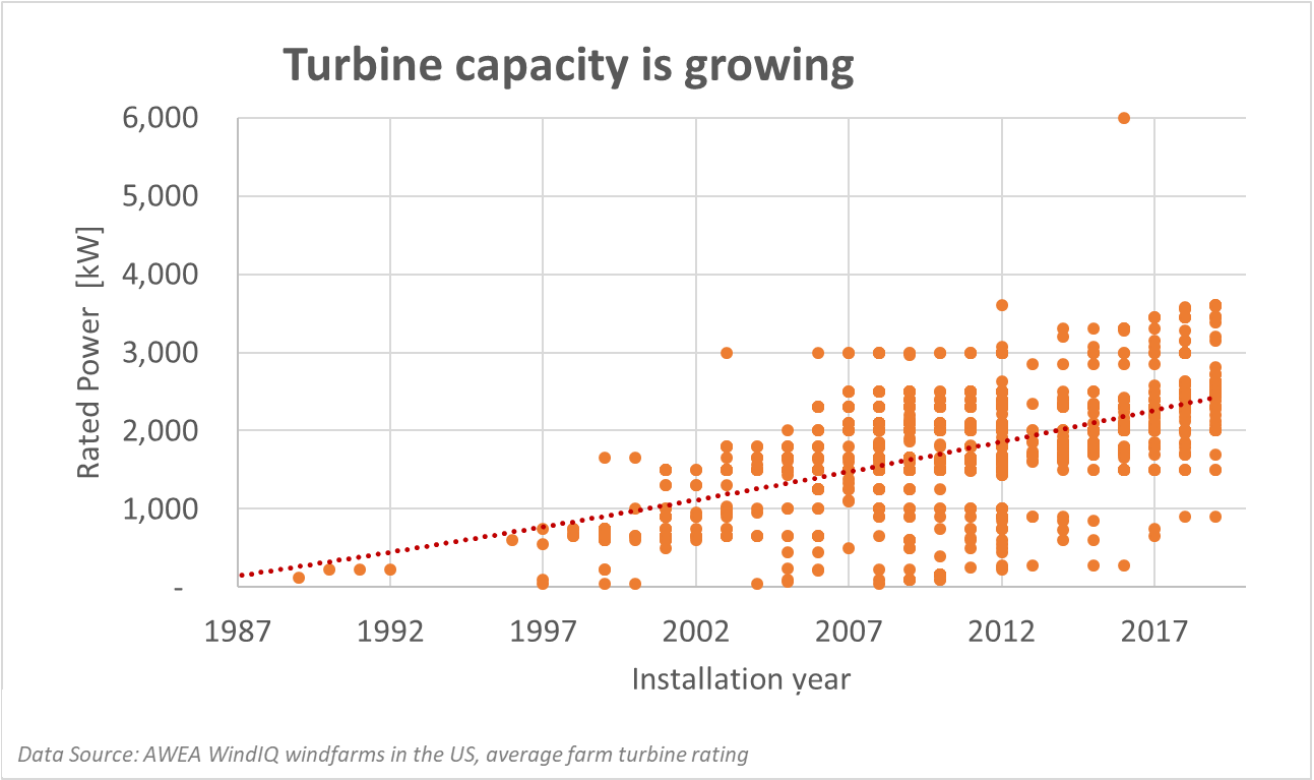
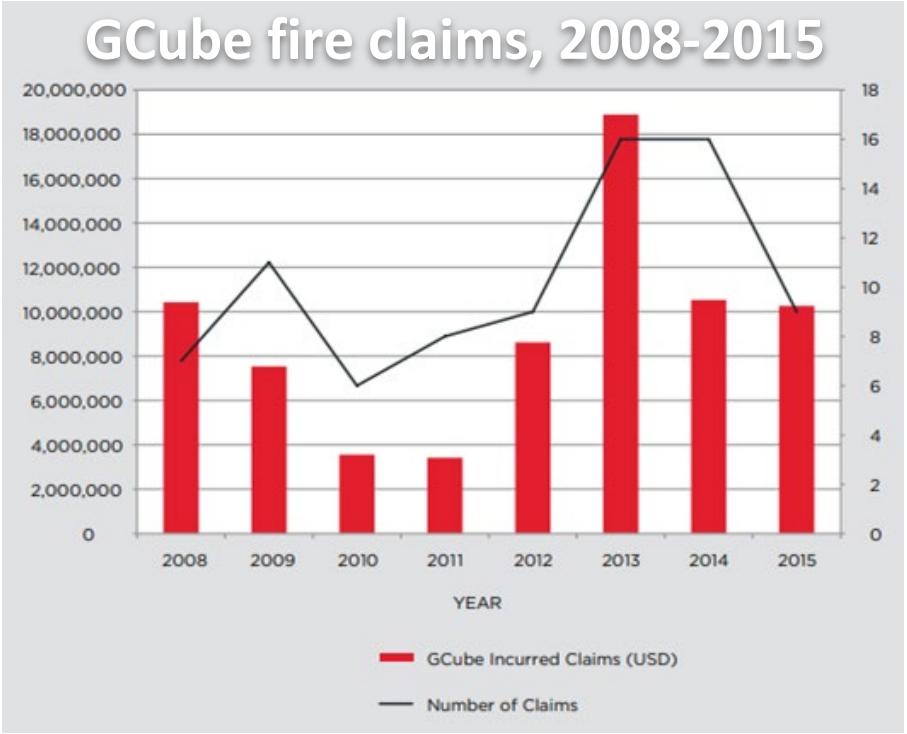


Data Source: AWEA WindIQ windfarms in the US, average farm turbine rating

How prevalent are turbine fires?

How prevalent are turbine fires?

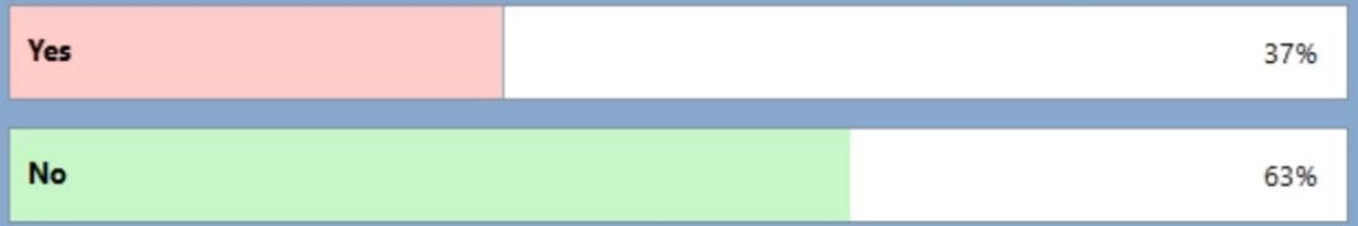
- Statistics vary from 1 in 2,000 to 1 in 10,000 will have a fire
- Limited data sources:
  - No central repository
  - Wind opposition organizations:
    - News
    - especially catastrophic & wildfires
  - Insurance companies (GCube 2015)
- Anecdotal



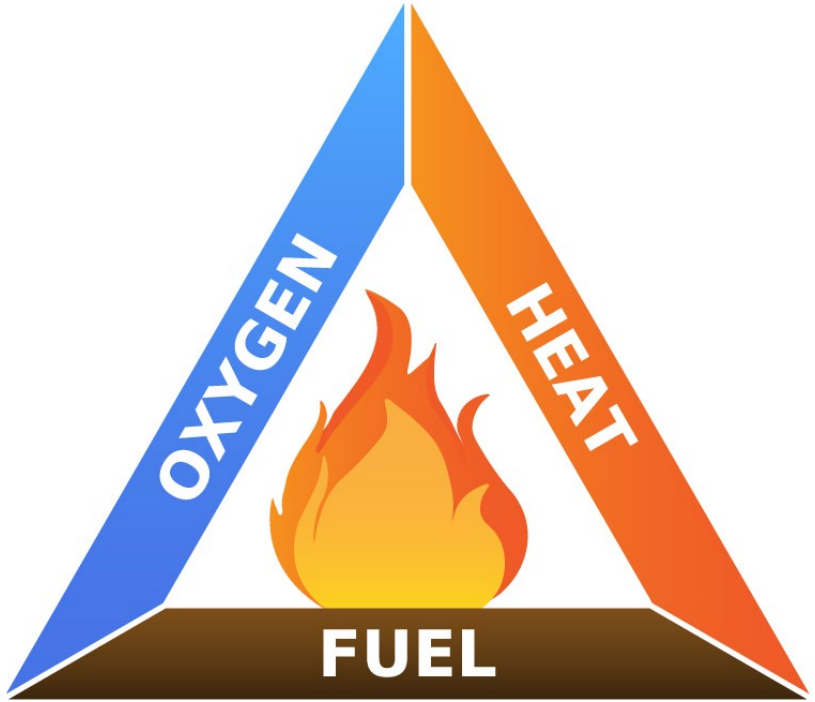
QUICKPOLL

Have you ever experienced or been part of the aftermath of a wind turbine fire?

Poll Results (single answer required):

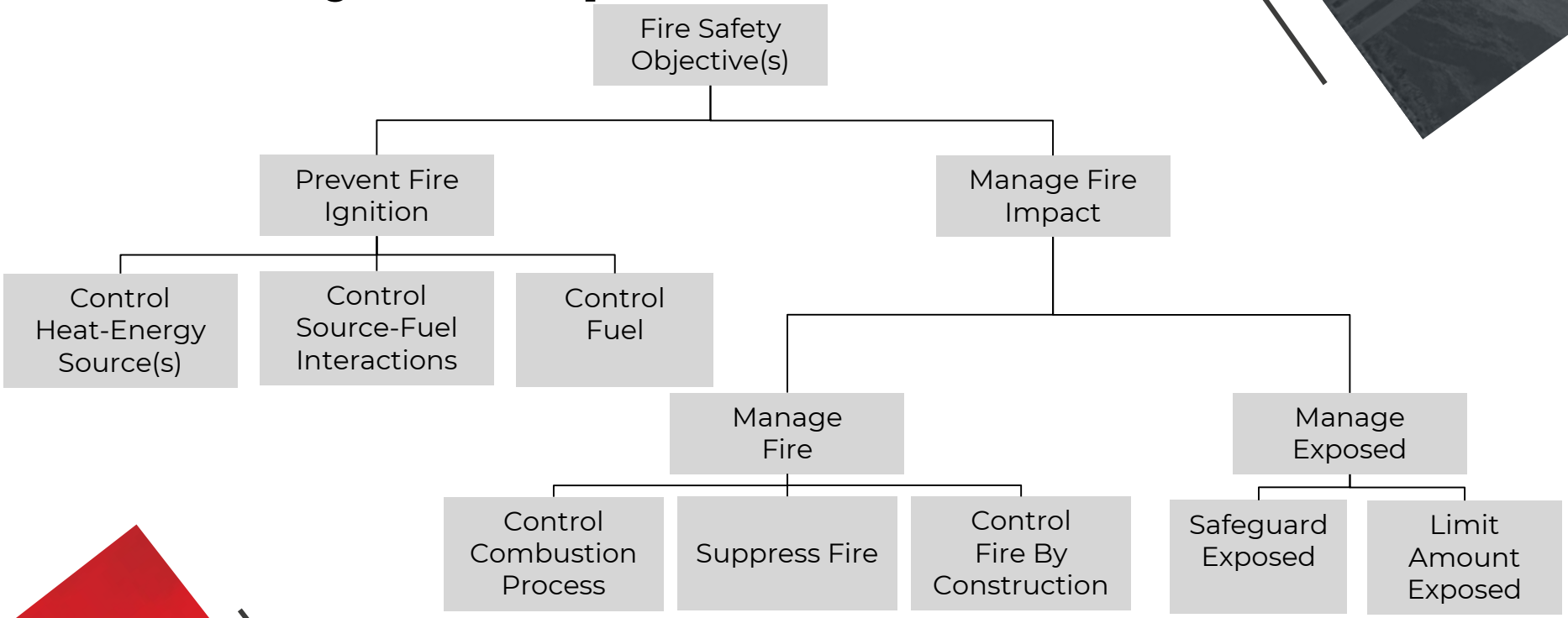


Context: How does a fire start?



Oxygen + Fuel + Ignition Source

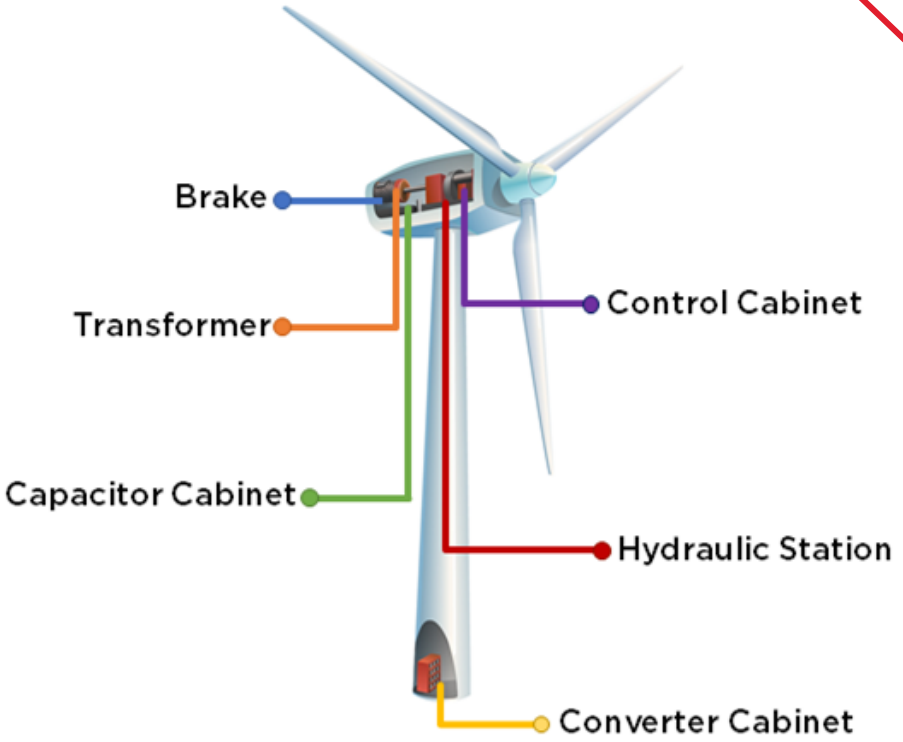
Fire Safety Concept Tree - NFPA 550



Source: NFPA 550

What are the Ignition Sources in Turbine Fires?

Typical Ignition Sources



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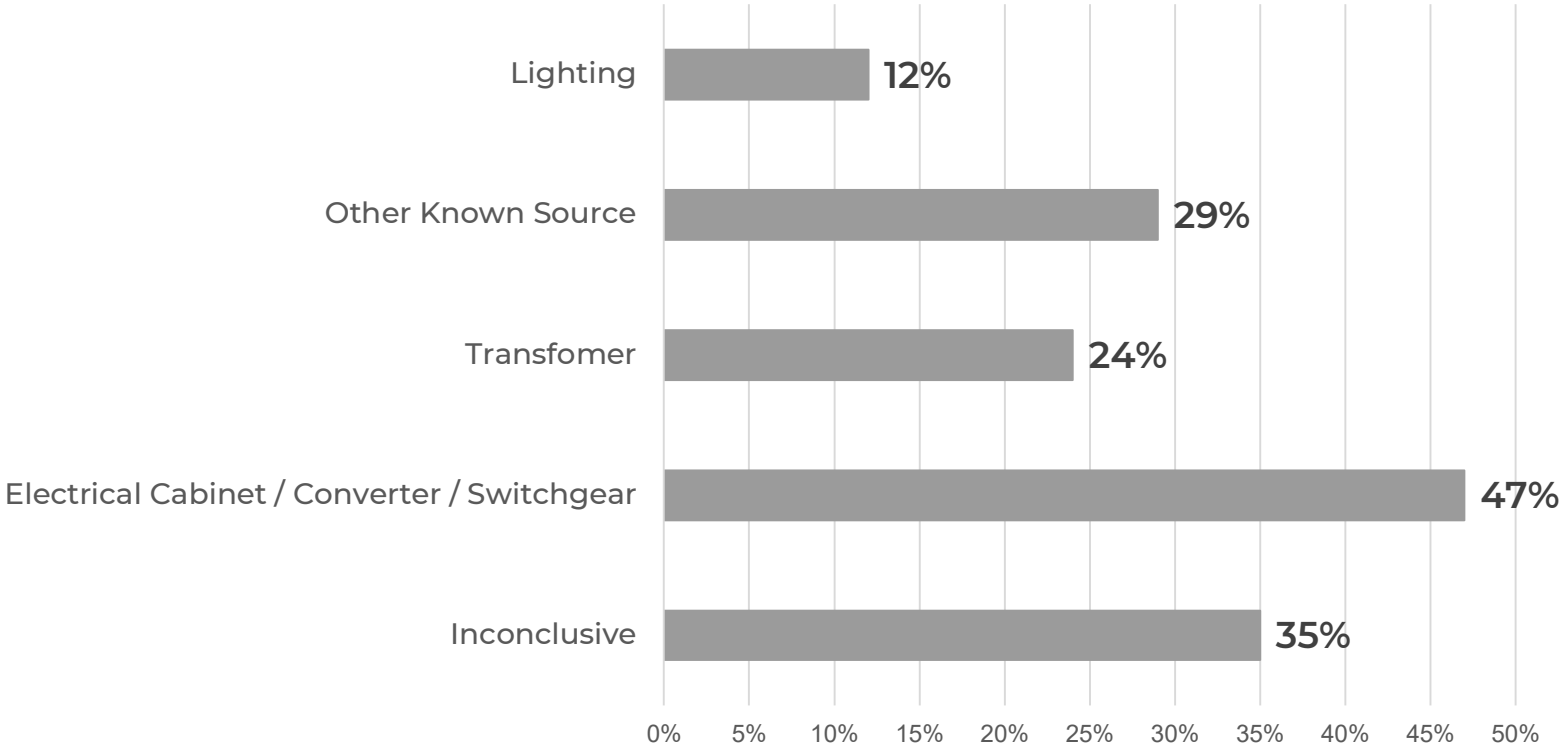
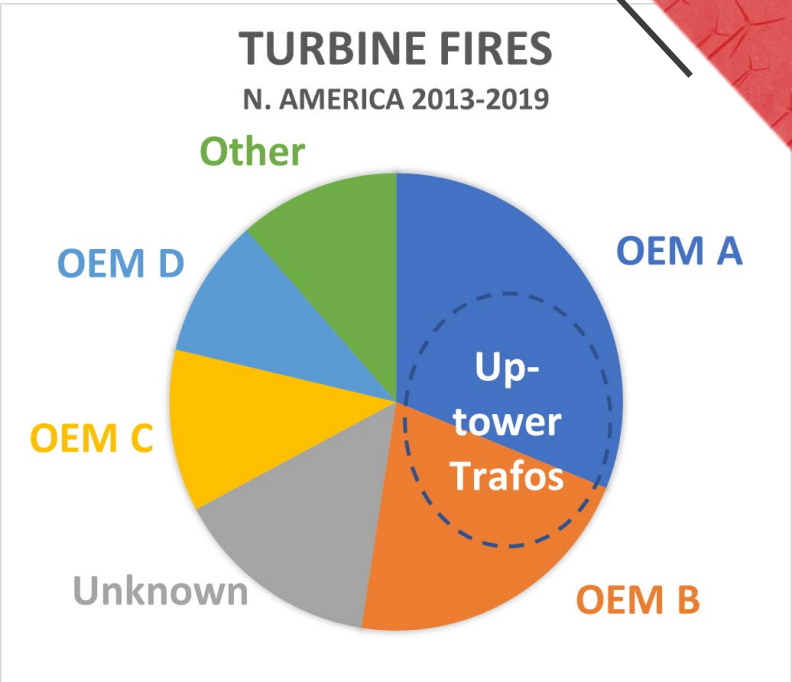


Turbine Design Affects Fire Risk

- Up-tower transformers
  - Arc fault detectors
- Bearing Temp monitoring
- Quality control
- Lightning protection



N=61. DNV GL data. Likely not comprehensive. Includes a few non-catastrophic fires. Modern turbine designs only.

DNV·GL

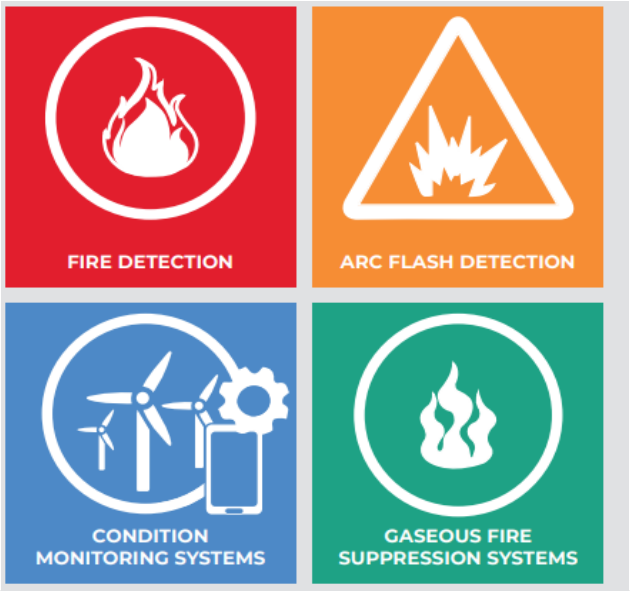
Turbine Design Affects Fire Risk

Is it getting better?

- **Industry improvements:**
  - Arc fault protection
    - More sensors, better placement, better monitoring
  - Condition monitoring (e.g. bearing temp)
- **On the down-side of larger turbines:**
  - Lightning protection
    - Longer blades
    - Carbon
  - Higher ratings - higher losses
  - Faster design cycle, less testing

Types of Mitigation

- Passive and active protection
- Protection options
- Monitoring, detection and suppression



Questions?

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Question slide

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