

NO_x emissions for European gas turbine line and storage compressors

Per Kristensen, DGC

(pgk@dgc.dk)

Contents of the presentation

- **Characterize the machinery**
- **Investigate how the machines are operated**
- **Analyze NO_x emissions**
- **Conclusions and recommendations**

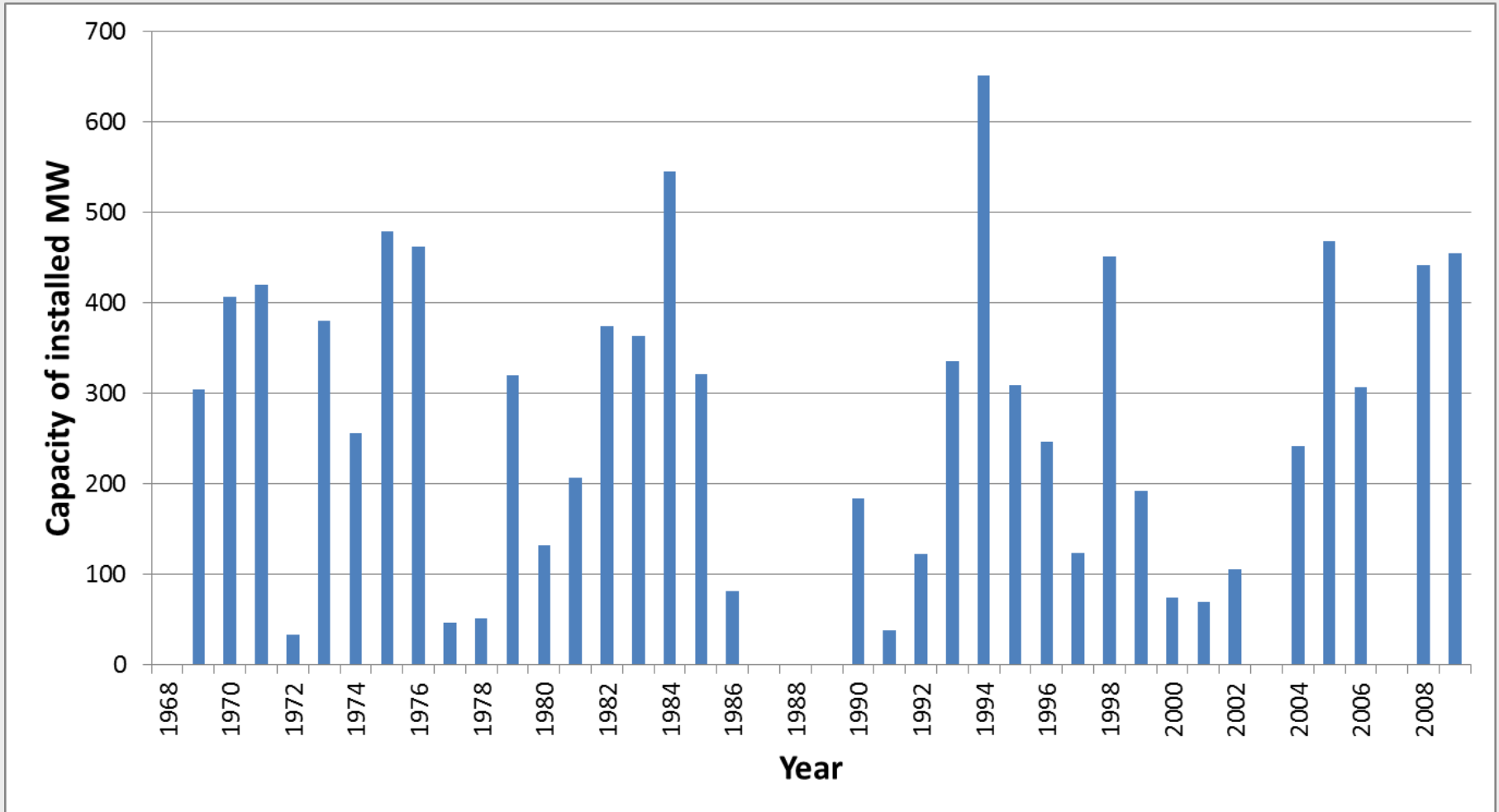
The survey – A large amount of data has been collected

- **Participation from 11 countries**
- **A total of 515 turbines in survey**
- **Total capacity is 18,800 MW**
- **Operational data from 2008 and 2009**
- **Average 2008/2009 data:
69,632 TJ of natural gas, 8837 tons of NO_x annually**
- **Quality assurance of data by comparison for identified outliers in dialogue with data providers**

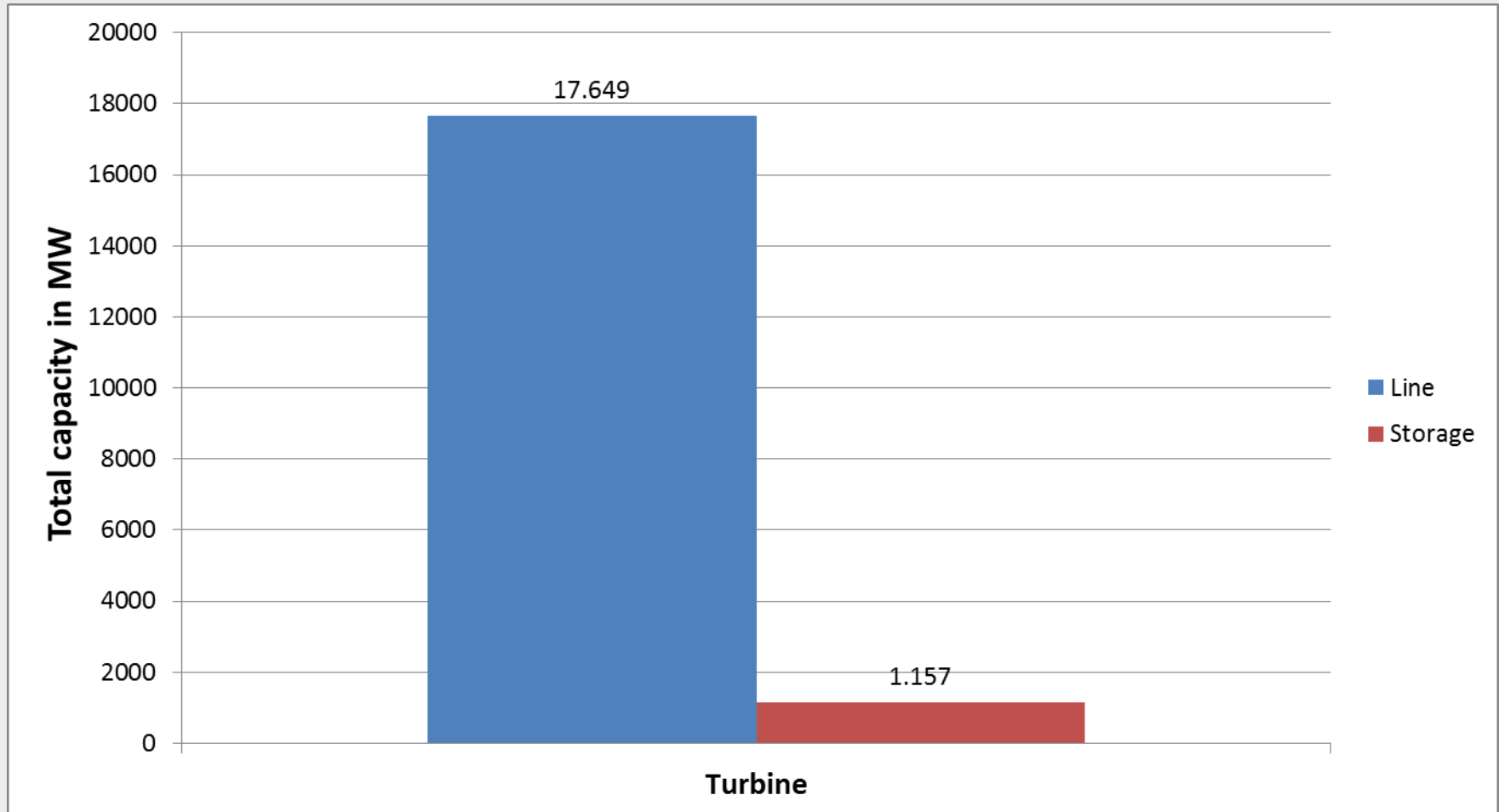
Characterization of machinery

RESULTS

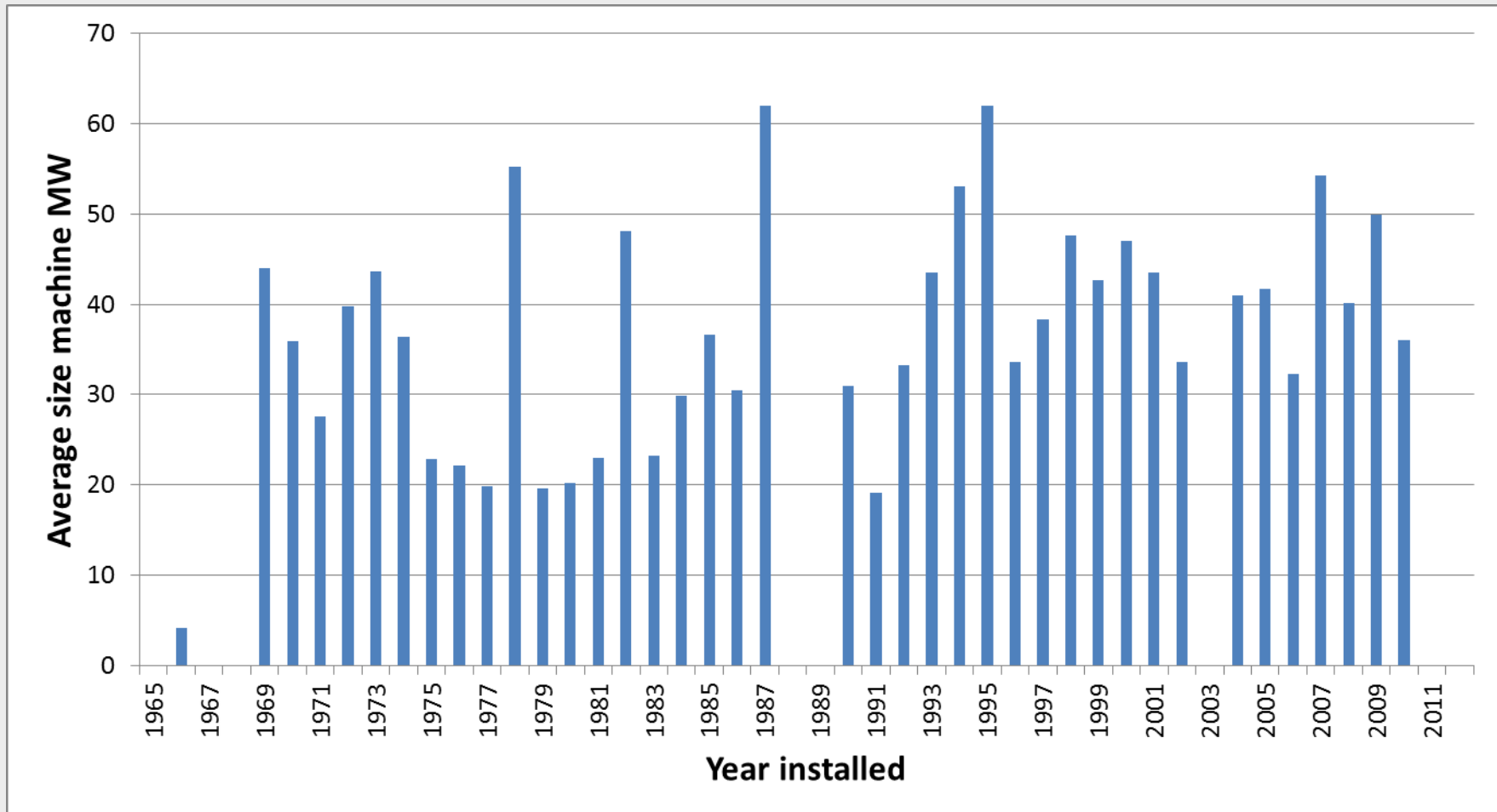
Age distribution for capacity



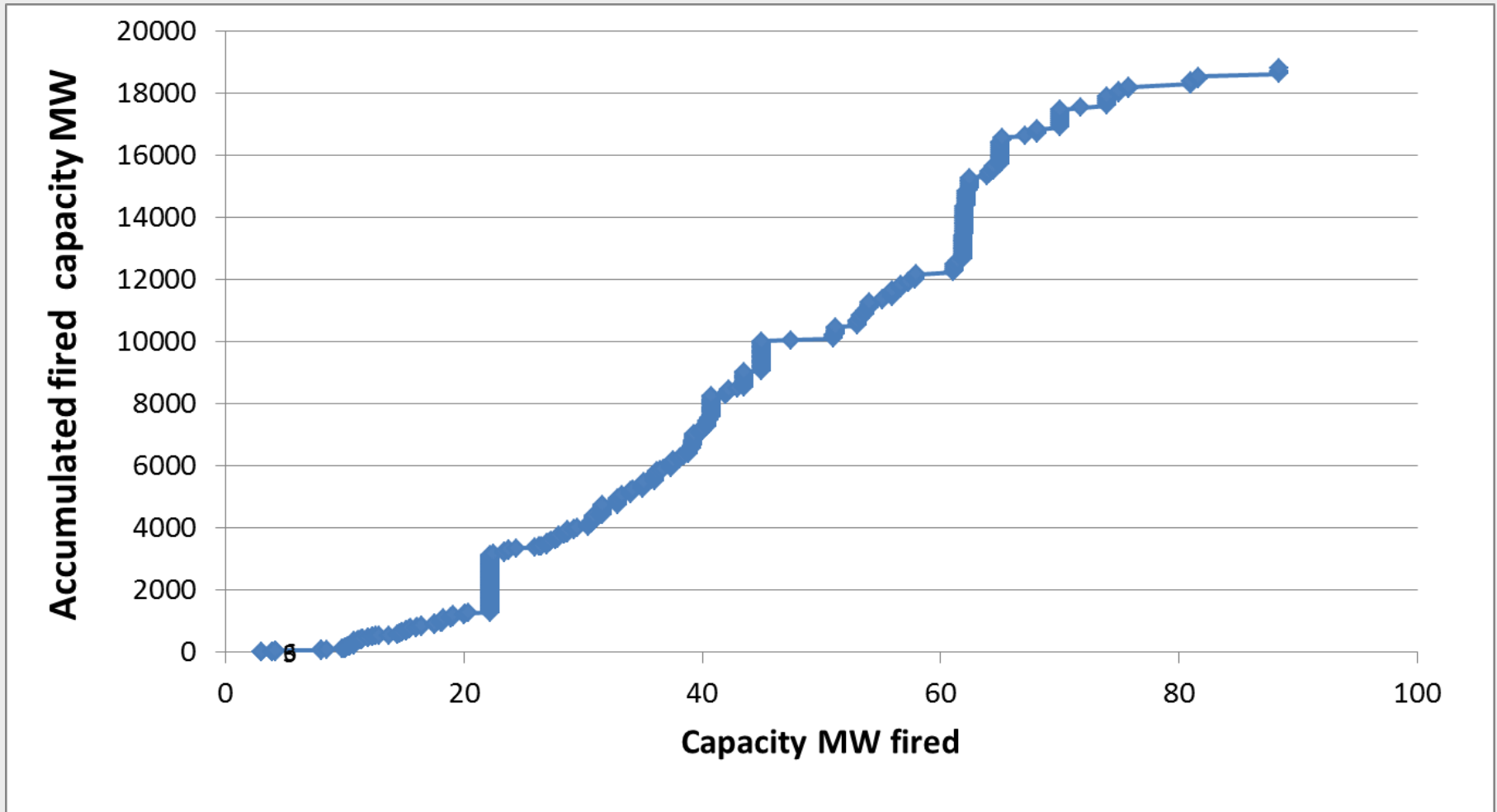
93 % of capacity is for transport



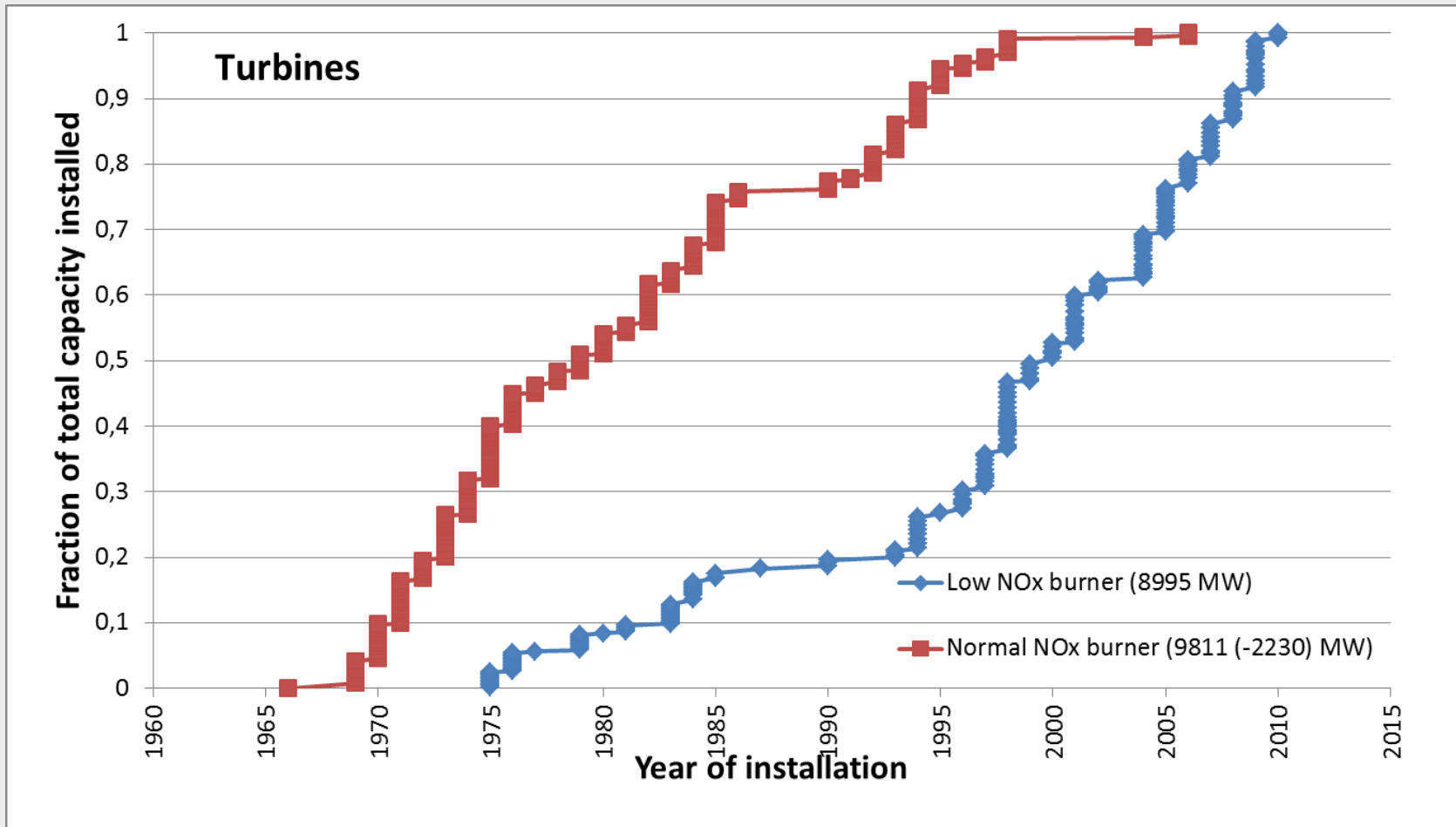
Average size of gas turbines by year of installation



Size distribution for line and storage turbines



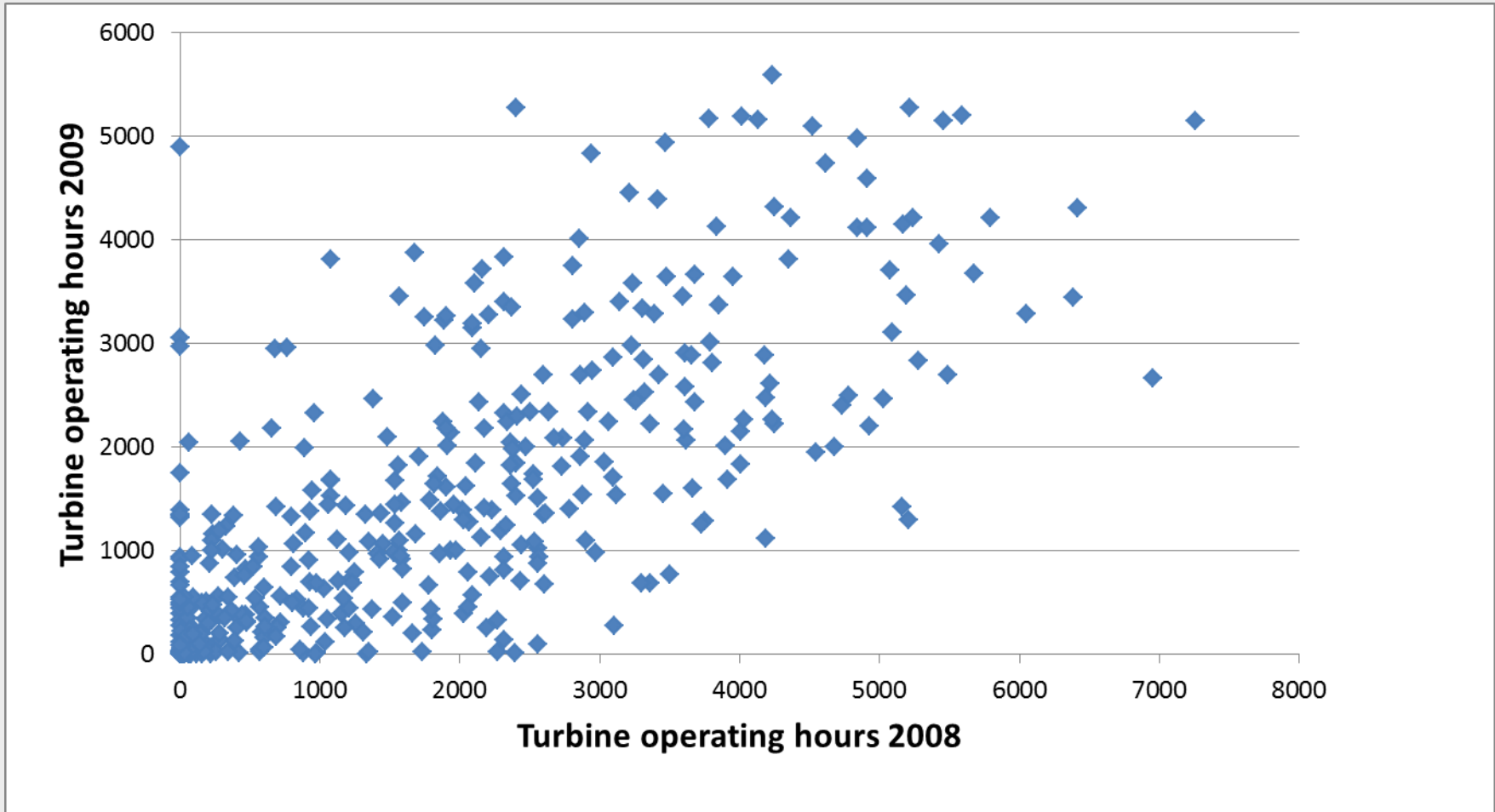
Normal burners on older turbines, low-NO_x on young turbines (some retrofitted)



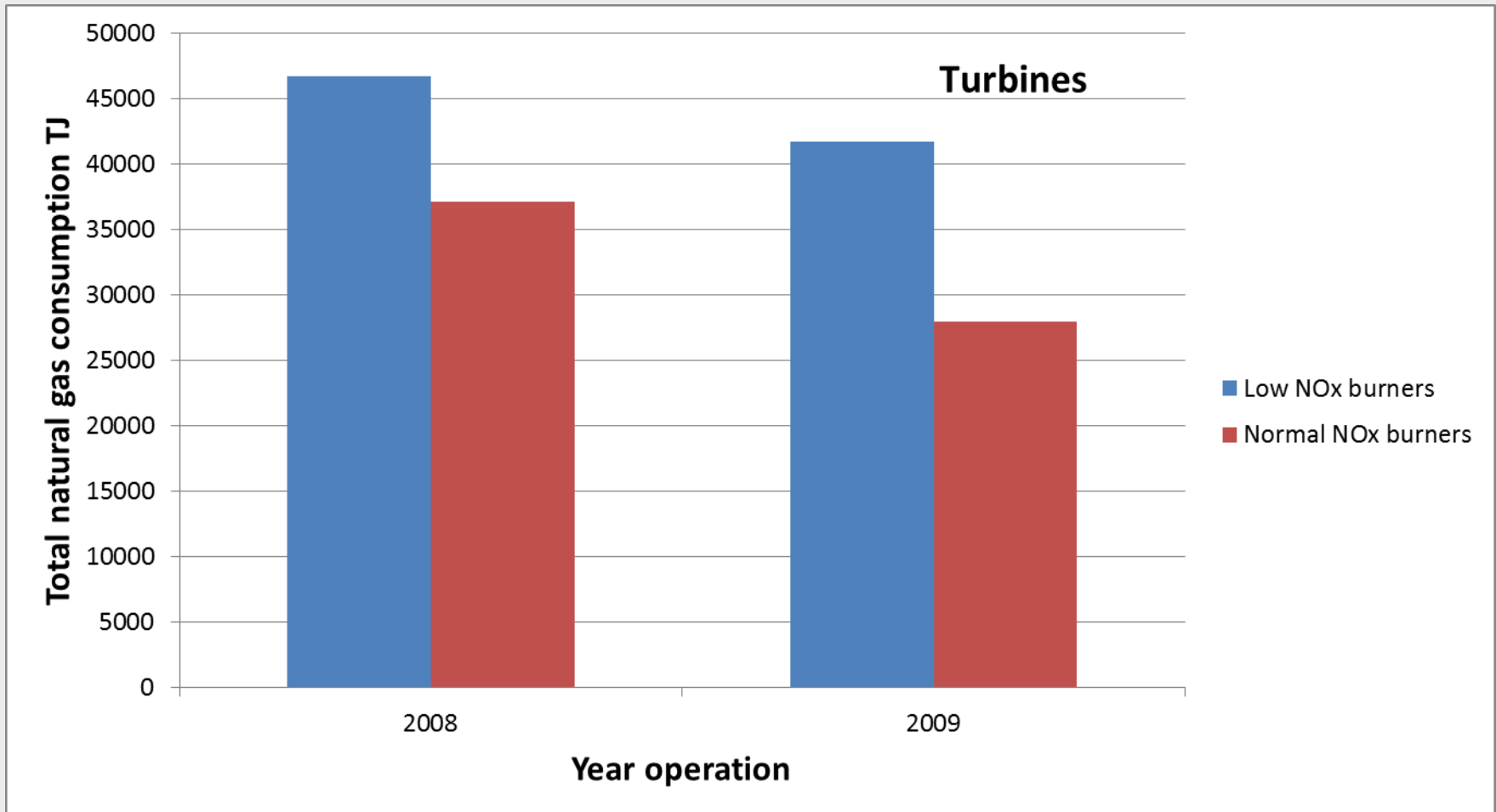
Characterization of operations

RESULTS

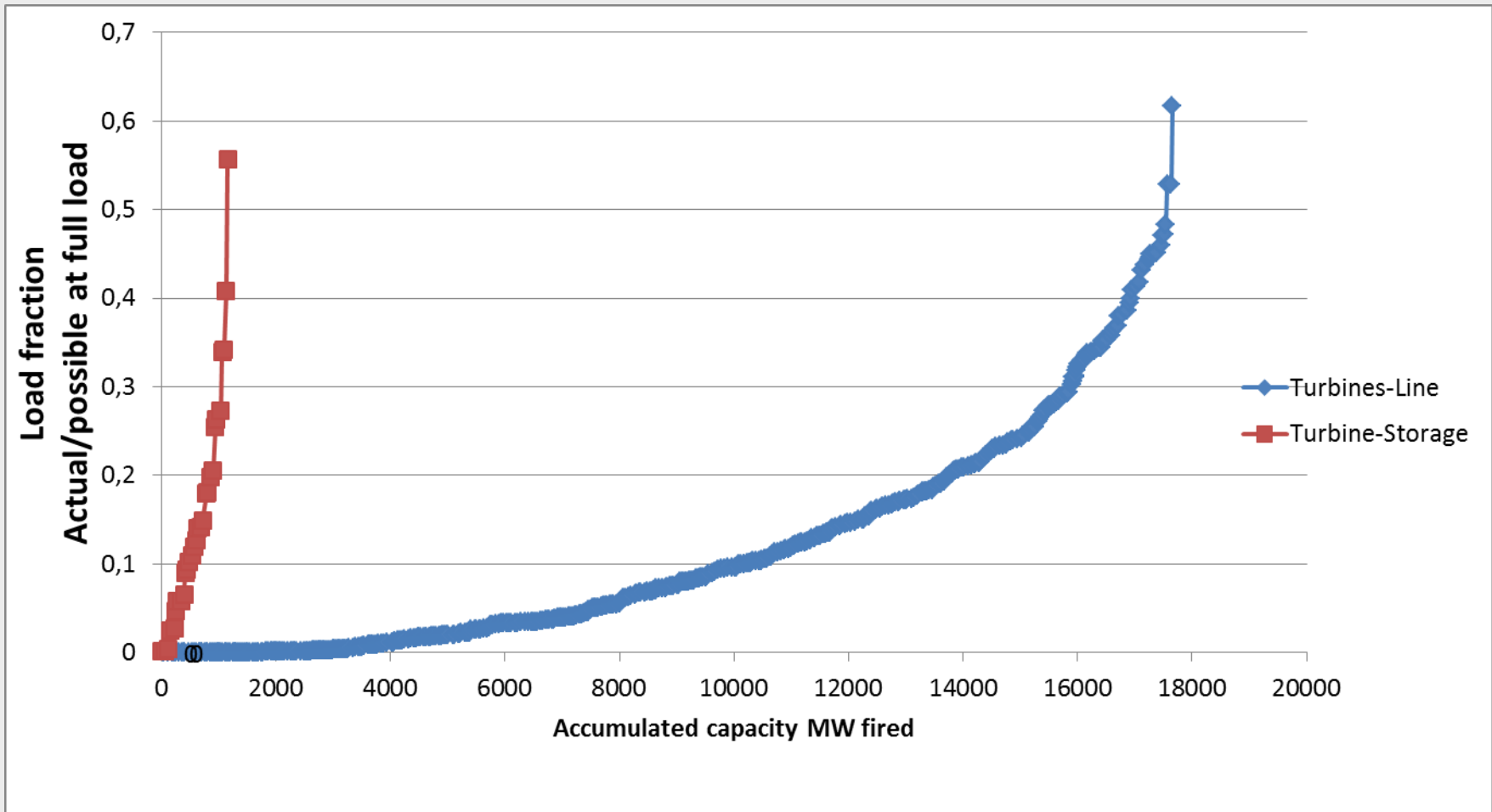
Natural gas consumption varies year/year



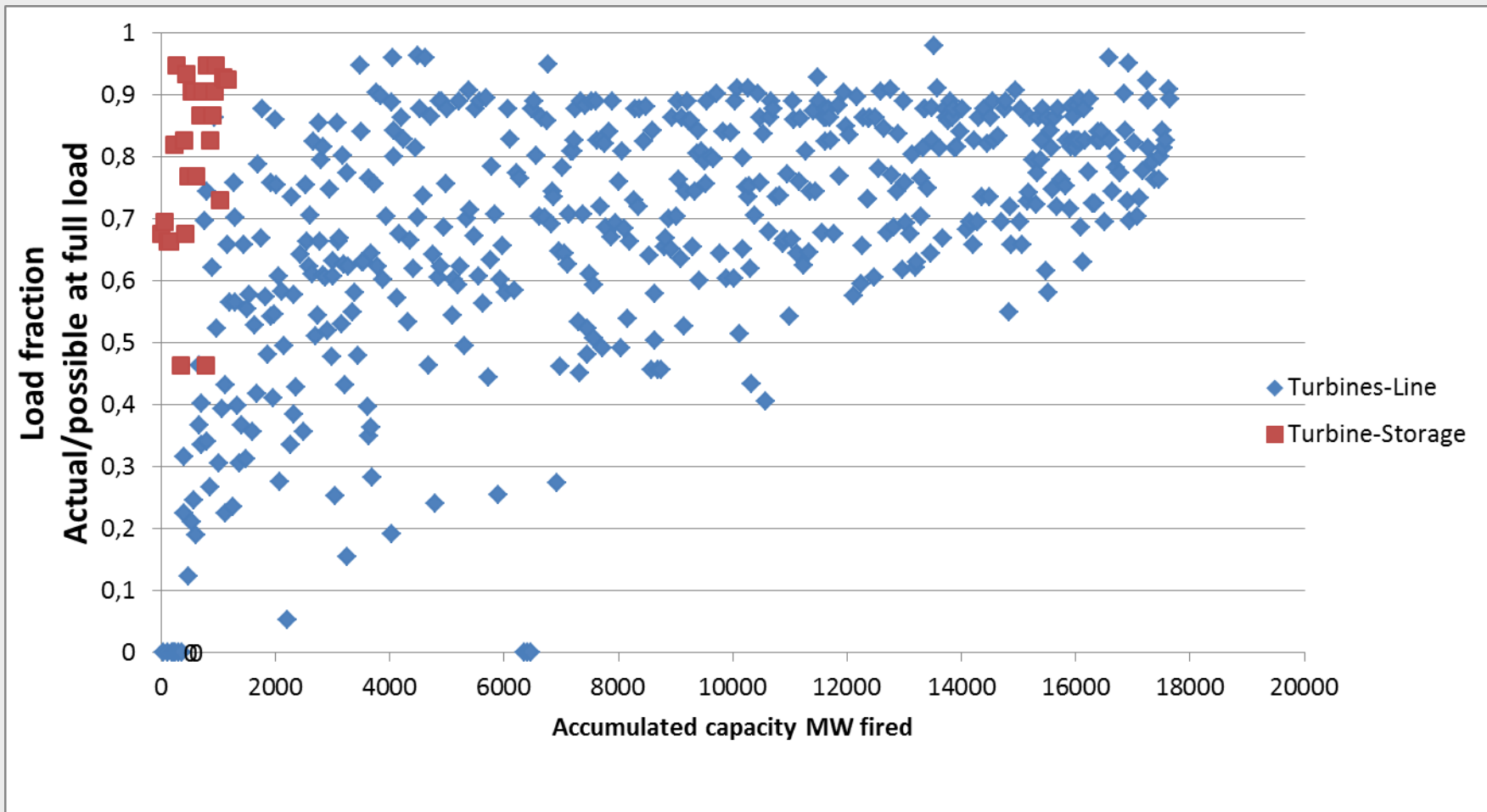
Low-NO_x burners dominate operation 58/42



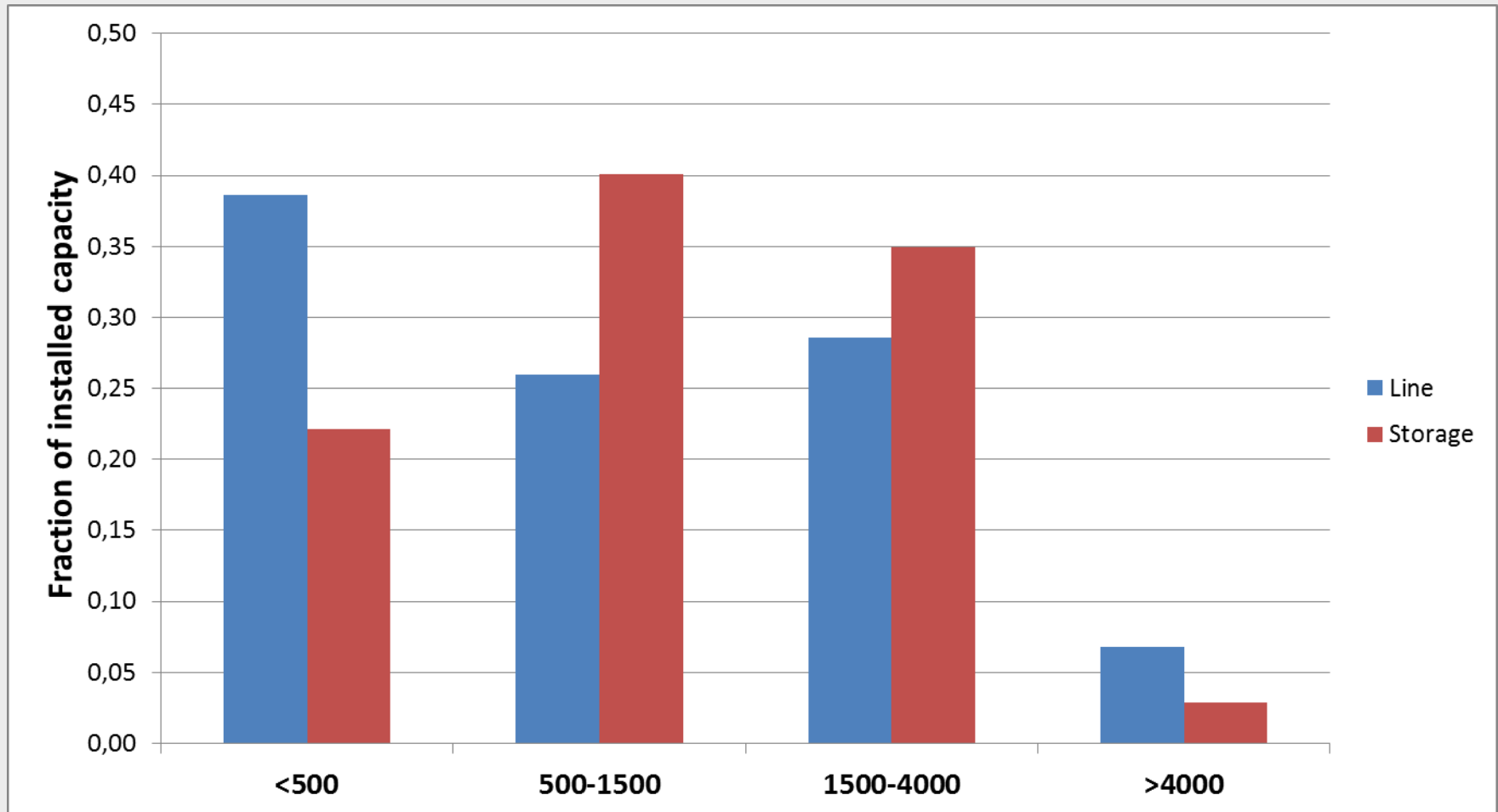
Annual load factor is very low for most turbines



Typical average annual load when rolling is 50-90 % of full load



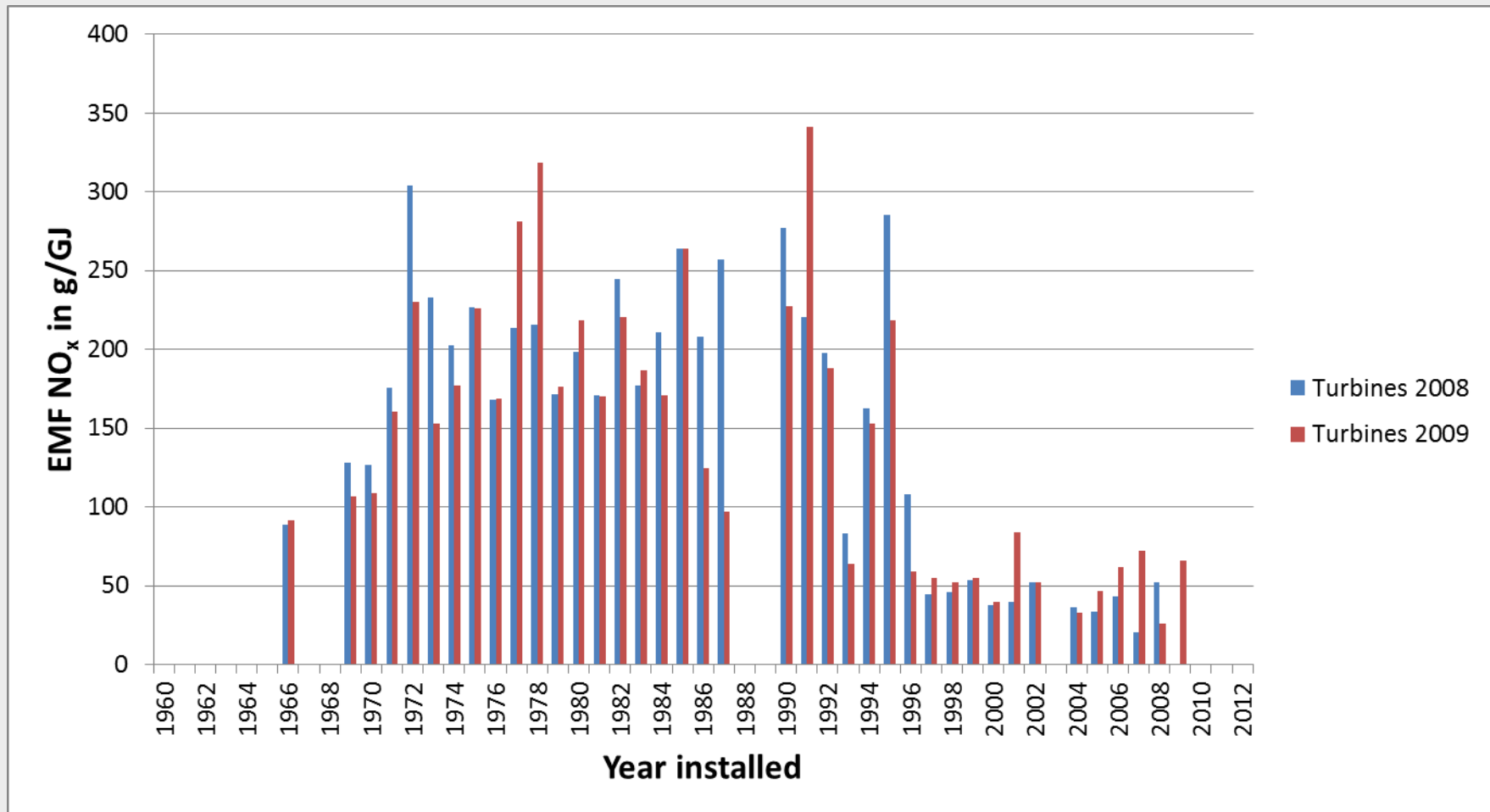
A large part of the capacity is operated a few hours



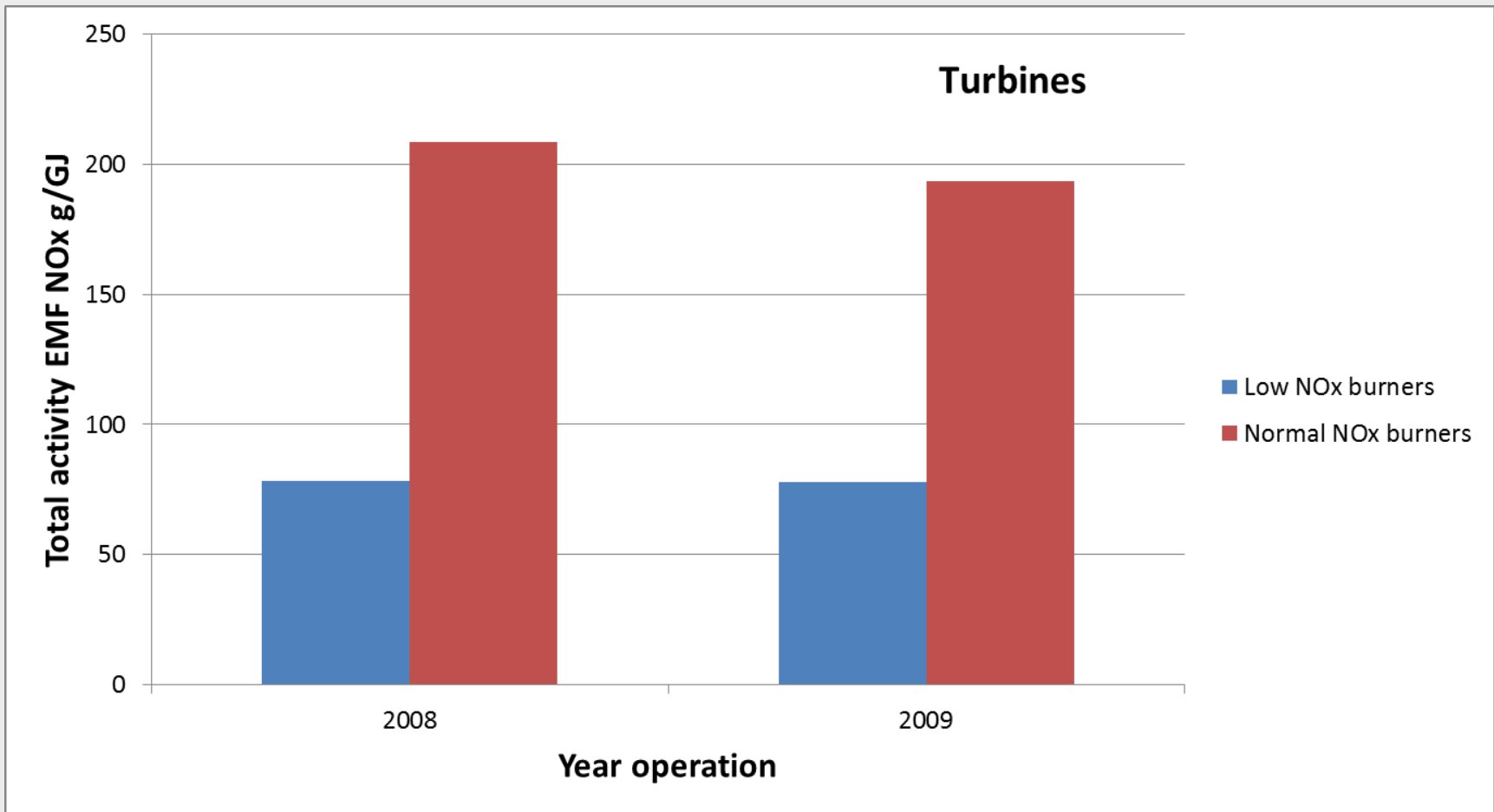
Investigation of NO_x emissions

RESULTS

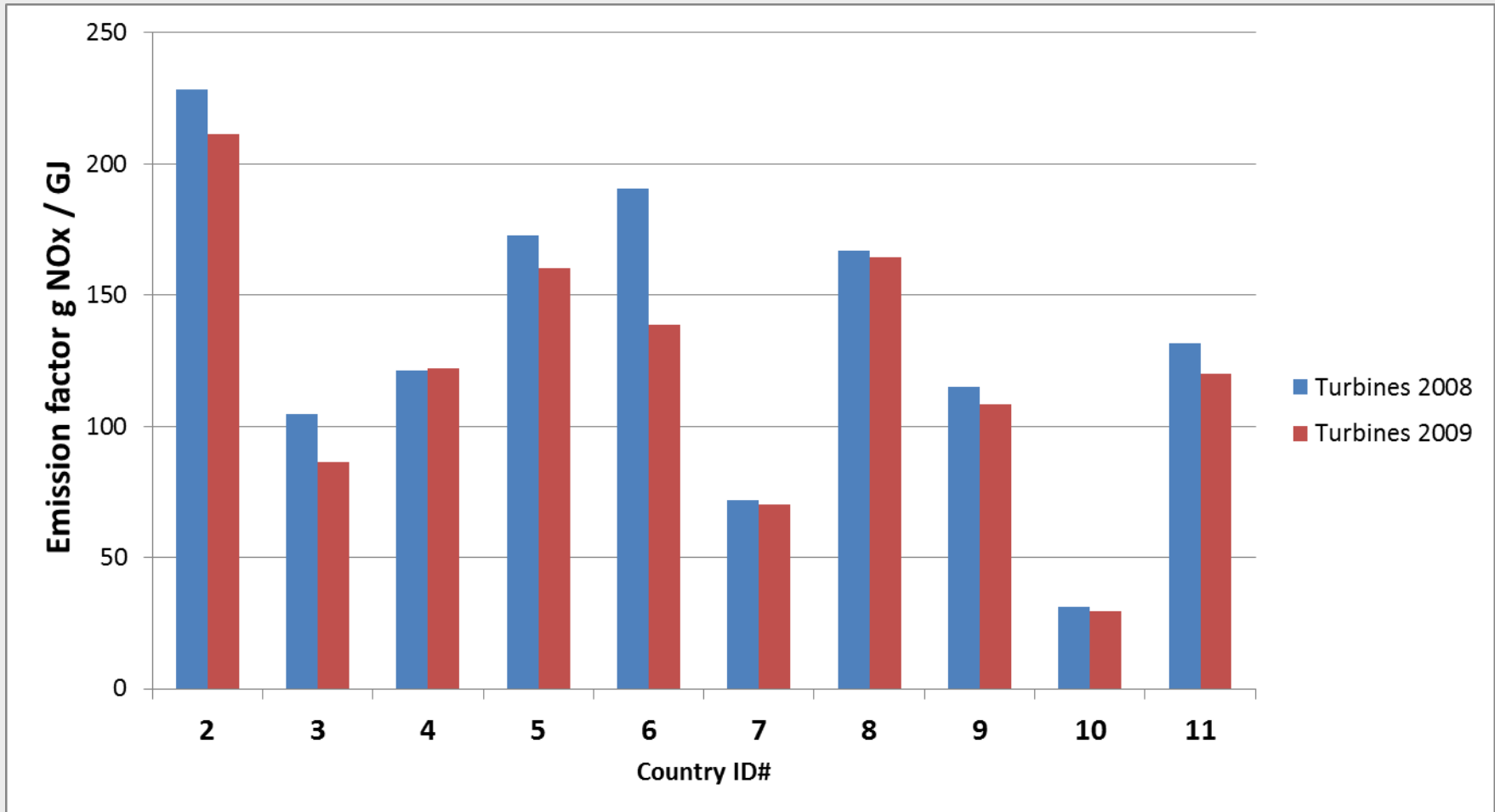
NO_x emission factor has a clear downward trend for turbines



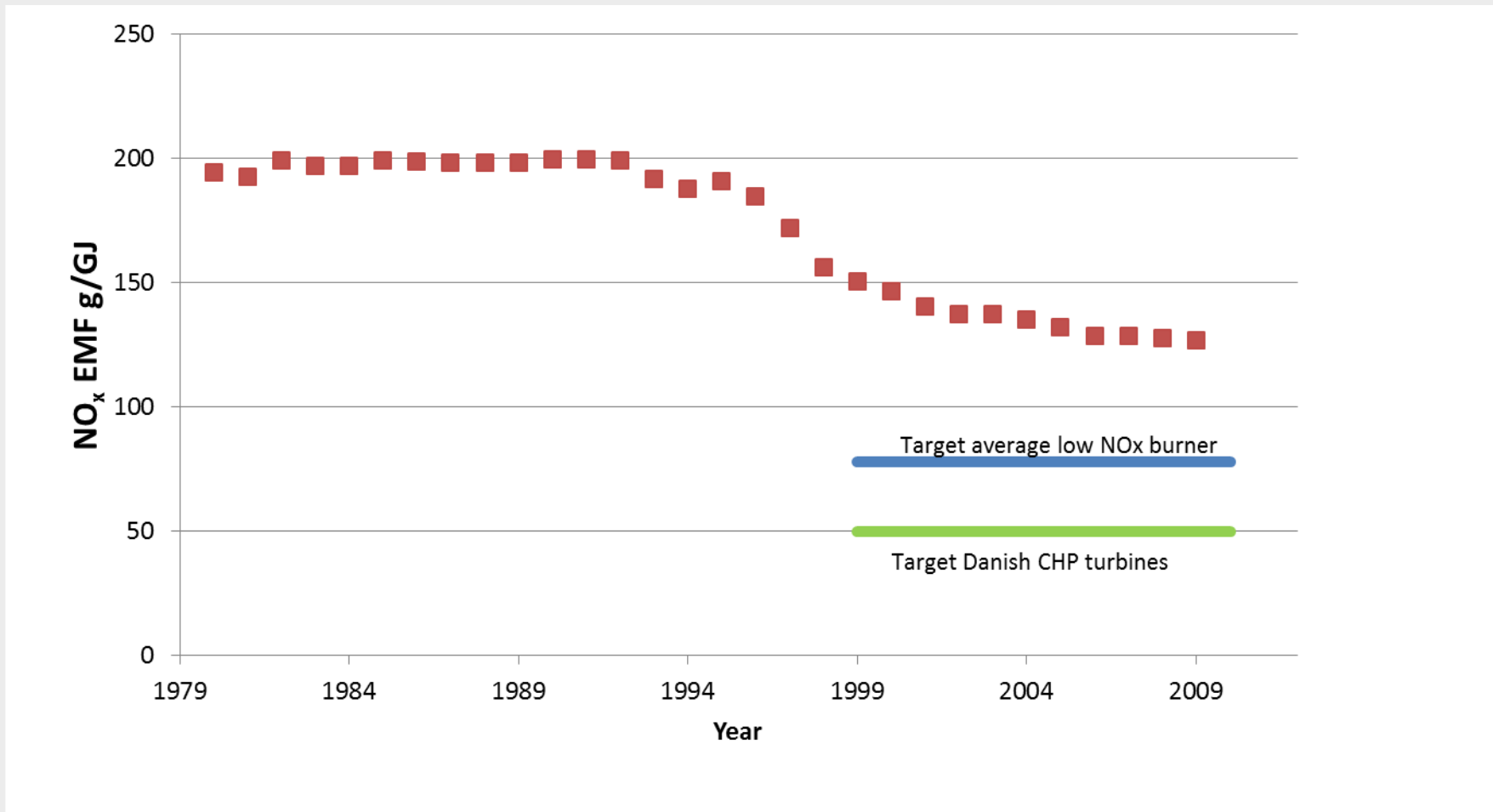
Low-NO_x burners do have lower NO_x emissions



Comparison by country



Emission factor development



Conclusions I

- **A large amount of data on line and storage gas turbine compressors has been collected**
- **Annual operational load factor is very low and when rolling, turbines have an average of 50-90 % load**
- **Large year over year changes in operation due to weather and changes in trade pattern**
- **Many turbines in operation were installed in the 1970s and 1980s**

Conclusions II

- **Low-NO_x burners provide lower NO_x by approximately a factor of two to three**
- **Emission factor for NO_x is steadily decreasing as gas companies choose low-NO_x technology when they install a new turbine**
- **Regulators must acknowledge that specific cost for NO_x reduction could be very high due to high investment costs and a low number of operation hours on many turbines**

Acknowledgment

The author wishes to acknowledge the work performed by the colleagues in the Marcogaz working group Air Emissions. Without their help in providing the data and fruitful discussions this work would not have been possible.

The logo for Marcogaz, featuring the word 'marcogaz' in a blue, lowercase, sans-serif font with a slight shadow effect, centered within a white rectangular box.