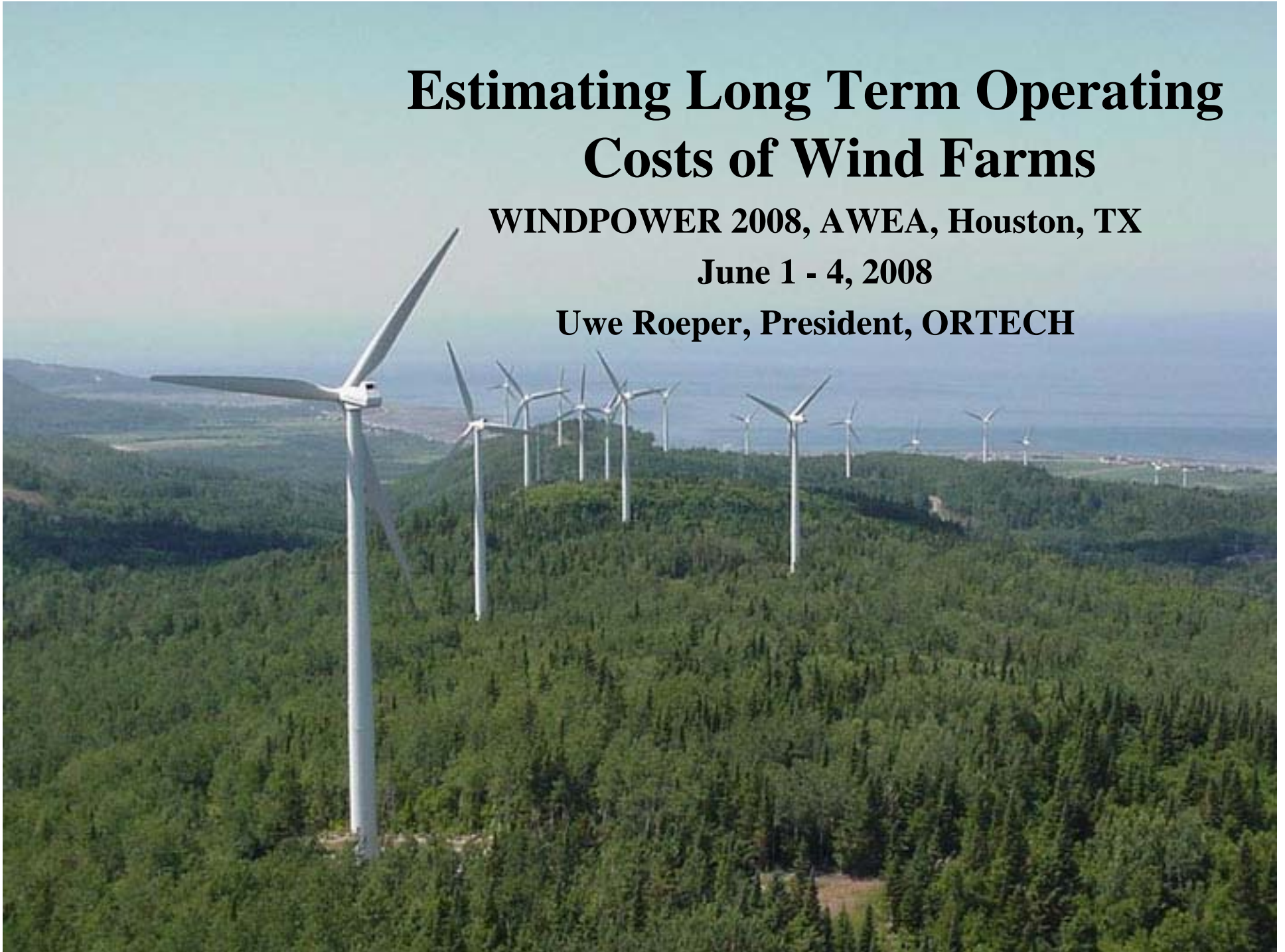


# **Estimating Long Term Operating Costs of Wind Farms**

**WINDPOWER 2008, AWEA, Houston, TX**

**June 1 - 4, 2008**

**Uwe Roeper, President, ORTECH**



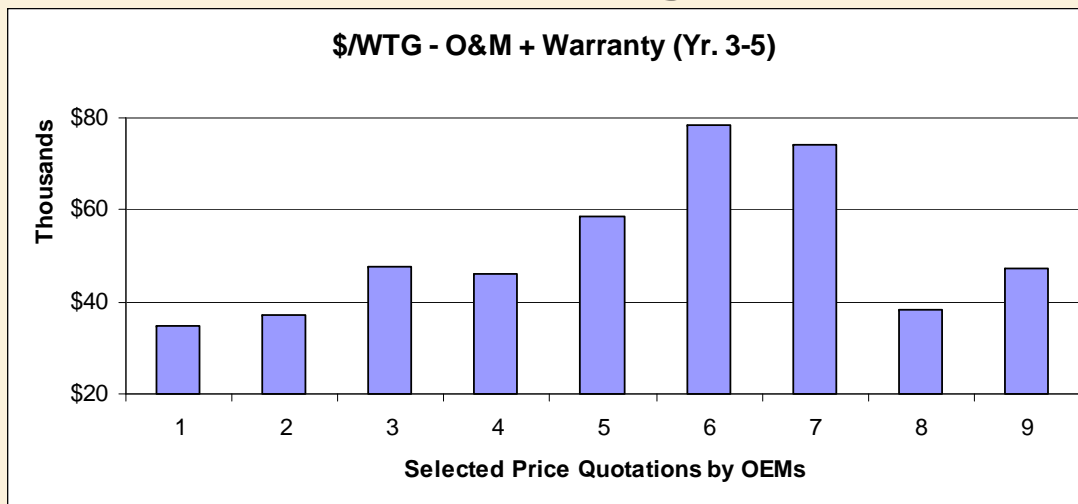
# ORTECH Power

- **Consulting (40 staff):**
  - **Wind Resource Assessment.**
  - **Operational Troubleshooting.**
  - **M&A Due Diligence.**
  - **Pet interest: long term repair costs for WTGs (5 years now).**

# Budgeting Challenge

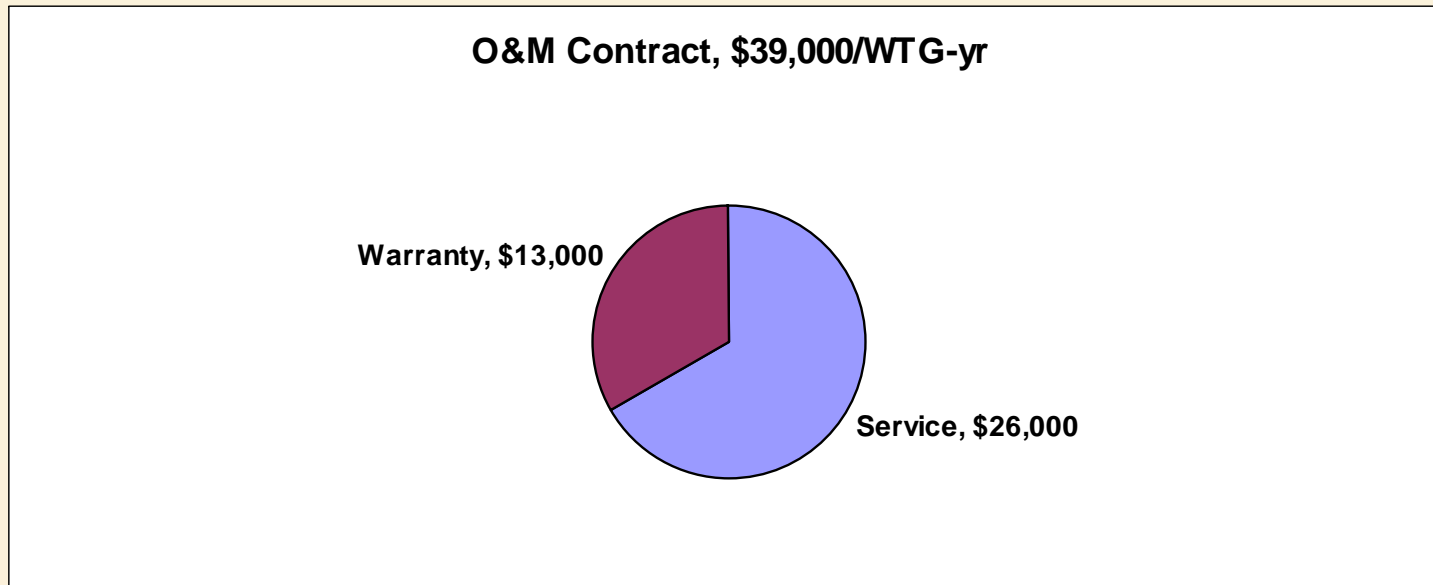
- **Turbine design life 20 years, op. experience < 10 years.**
- **Owners & manufacturers hesitant to share experience data.**
- **Few government statistics (except ISET in Europe; Sandia & NERC starting).**
- **O&M costs are site specific and model specific.**

# Cost of Warranty, Service Maintenance Contracts



- **Example of price variability in WMS contracts.**
- **In this presentation, we will use \$39,000/WTG-yr**

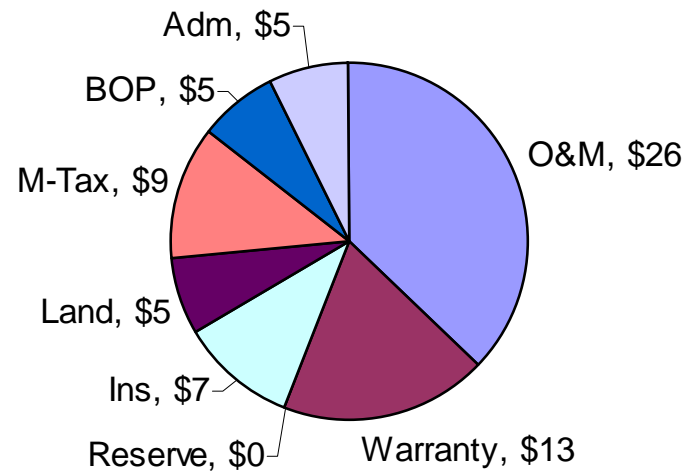
# Wty. Portion of WMS



- **WMS provides first benchmark for estimates**
- **Warranty cost often not broken out.**
- **Contractual exclusions vary.**
- **1/3 assumed as wty. portion of contracts.**

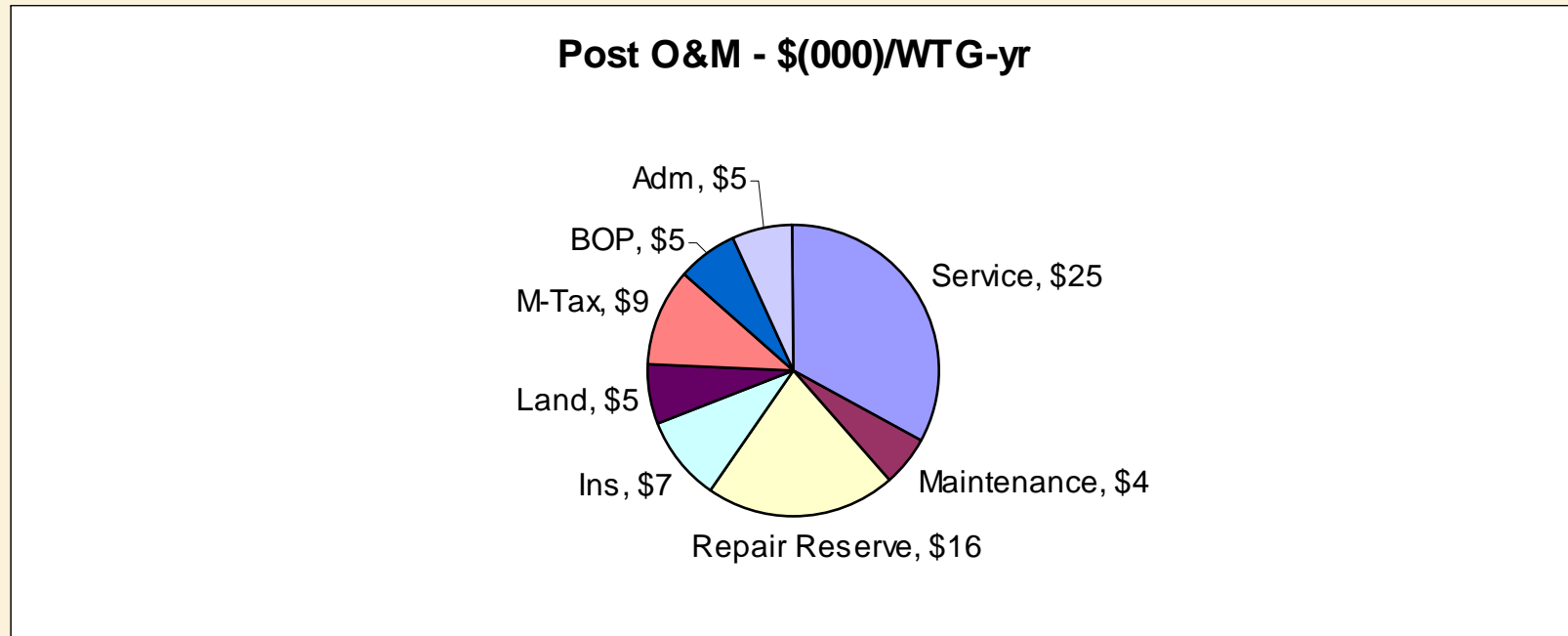
# WMS as Part of Total O&M

Warranty O&M - \$(000)/WTG-yr



- **WMS typically amounts to approx. 60%.**
- **Largely market based, not indicative of actual.**
- **Avail. only for early years (few repairs).**

# Post Wty. Service Costs

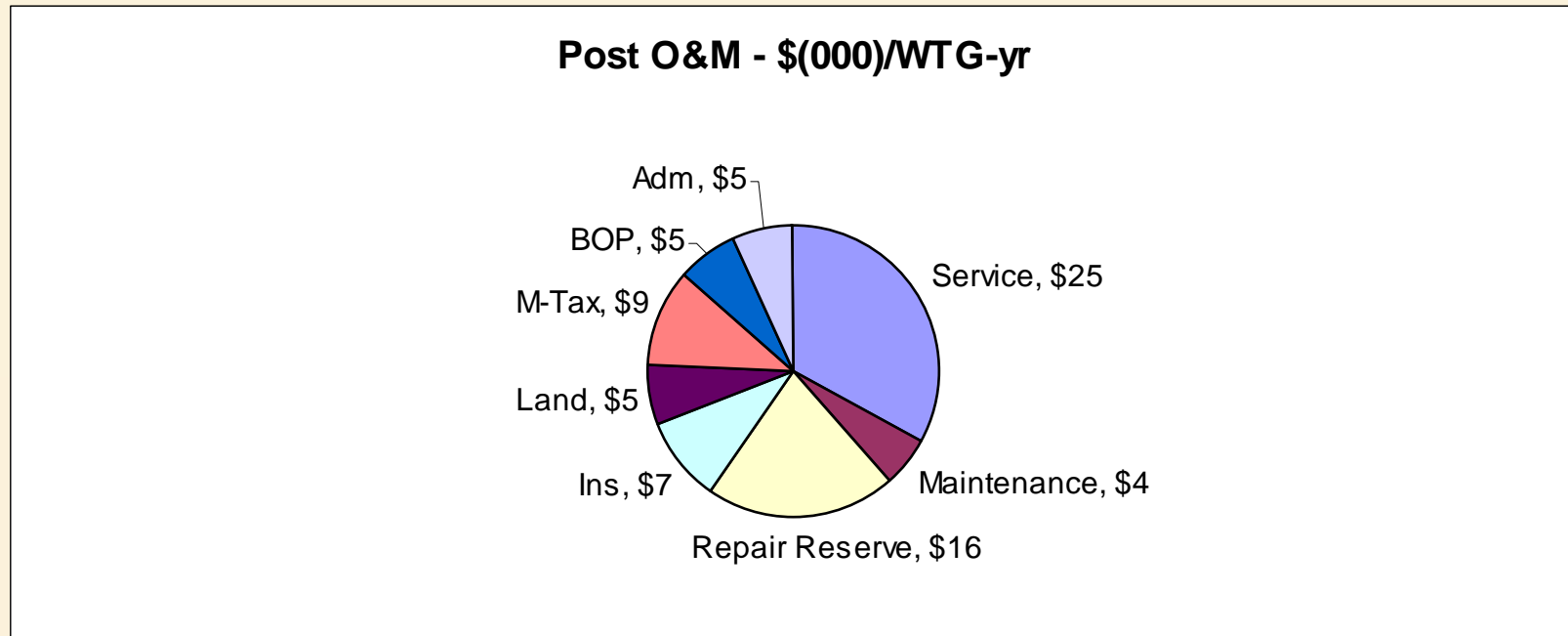


- **Service portion of WMS upper budget limit.**
  - 24/7 remote monitoring + scheduled mtnc. + basic on-site.
- **Budget varies by turbine model and site location.**

# Service Cost Control:

- **OEM**
  - **Pro:** familiar, meets specs, experienced, has parts.
  - **Con:** perhaps not least cost.
- **Independent Providers**
  - **Pro:** perhaps reduced cost, no training required.
  - **Con:** involves procurement process, performance contract set-up, change in process, parts.
- **Internalize**
  - **Pro:** potential for least cost.
  - **Con:** need to develop competence (training, SOPs, mgmt. system), parts.

# Post Wty. Maintenance Cost

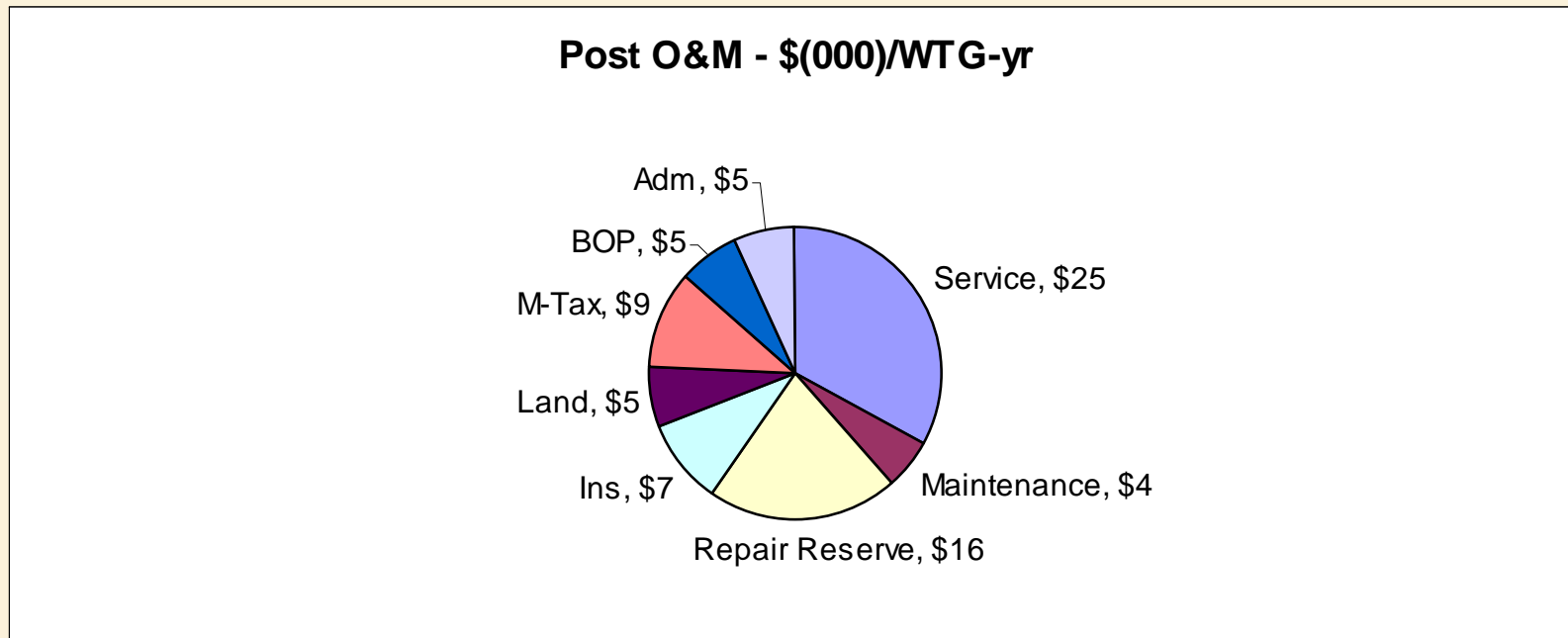


- **Unscheduled minor maintenance highly variable by site / model.**
- **Budget figure meant to refer to minor recurring small part replacement.**
- **Excludes major component repairs.**

# Maintenance Cost Control:

- **Increase parts inventory to reduce outage time (hidden cost / rev. loss).**
- **Improve parts supply chain & 24/7 fix.**
- **Track inventory statistics (items needed per year).**
- **Early & preventative replacement.**
- **Develop staff competence / train.**

# Post Wty. Repair Reserve

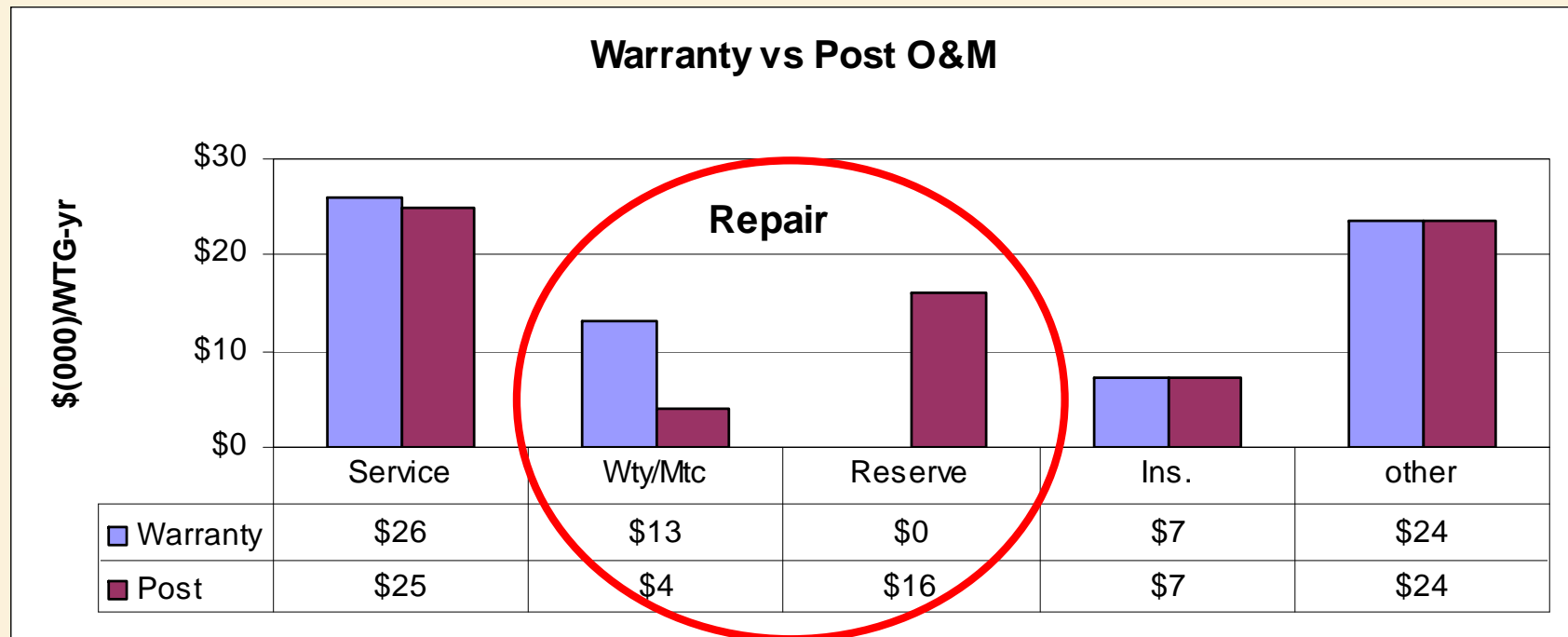


- **Planned or unplanned major repairs.**
- **Highly variable by site / model / age.**
- **Expected to occur only a few times during 20 year life.**

# **Repair Reserve Analysis:**

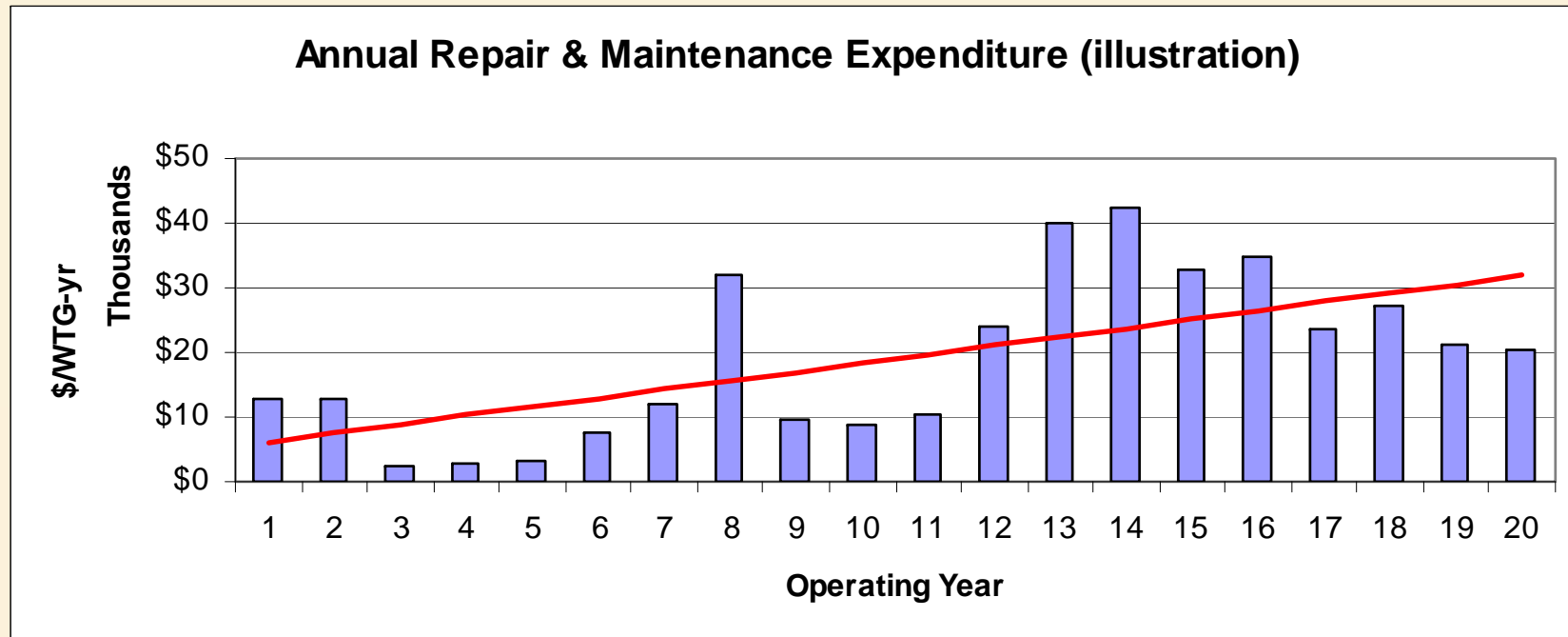
- **Depends greatly on site & model.**
- **Highly uncertain, little data available.**
- **May not know for many years what actual cost is for a specific site / model / age.**
- **Funds best held in a capital reserve, not in an annual operating expense account.**

# Wty. Vs. Post Comparison



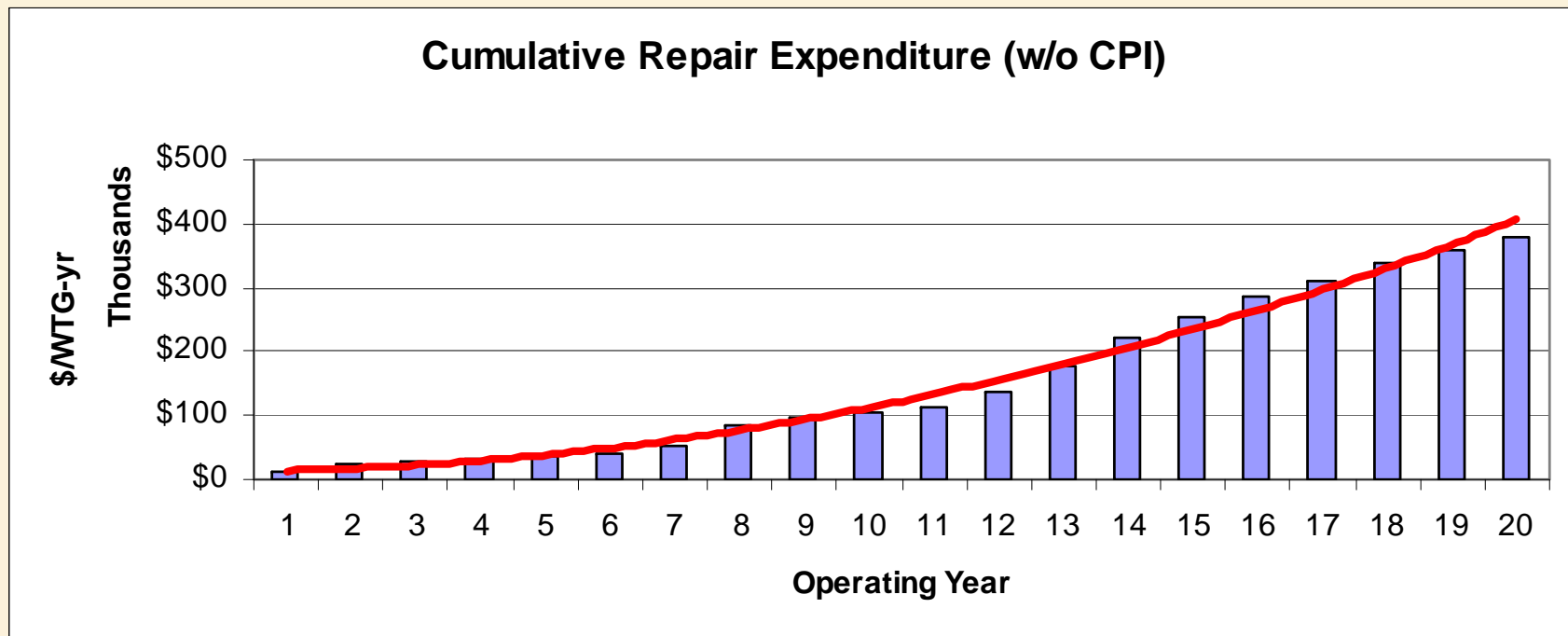
- **Maintenance is the expensed portion (recurring annually), reserve is the capital portion.**
- **Mtnc. + Reserve = \$20,000/WTG-yr.**

# Variable Annual Repair Costs



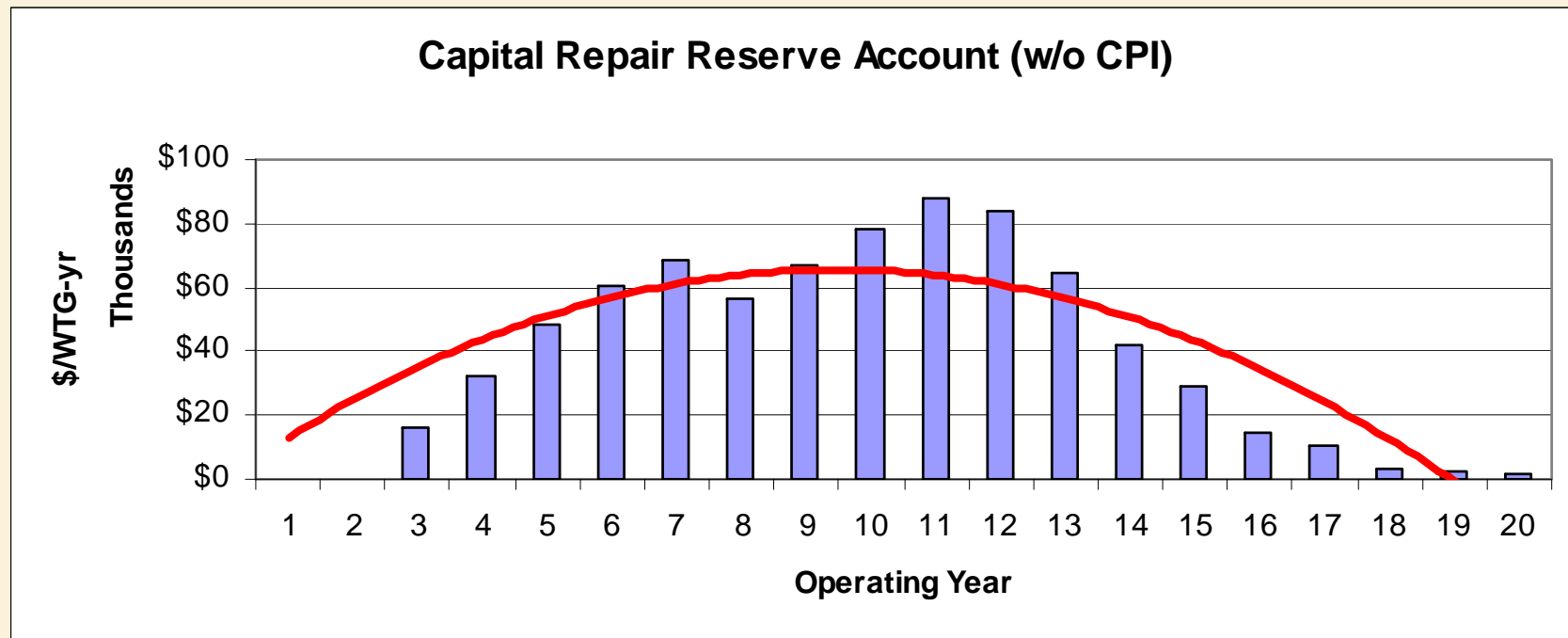
- While unscheduled minor maintenance is expected to remain fairly constant, major repair will occur in intervals and increase in cost with age.

# Total Life Cycle Cost



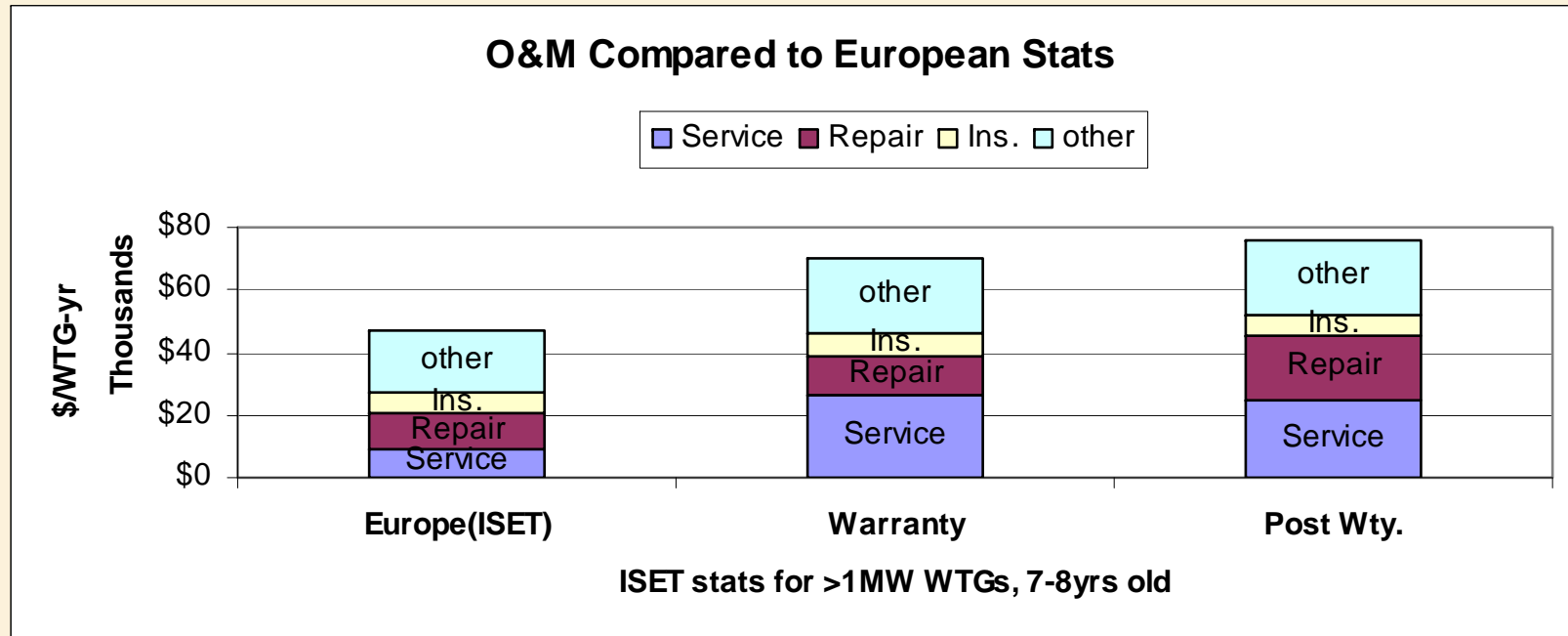
- **The operating goal is to minimize the cumulative total through preventative maintenance, early detection, reduction of outage times, etc.**
- **Small expenditure now may save big later.**

# Capital Account



- **Purpose of the capital account is to ensure that the cost has been budgeted and the funds are available, regardless of the year in which the repair occurs.**
- **In early years, repairs are less than \$16,000/WTG-yr, excess is saved. In later years, the reverse happens.**

# Repair Reserve Cost Check

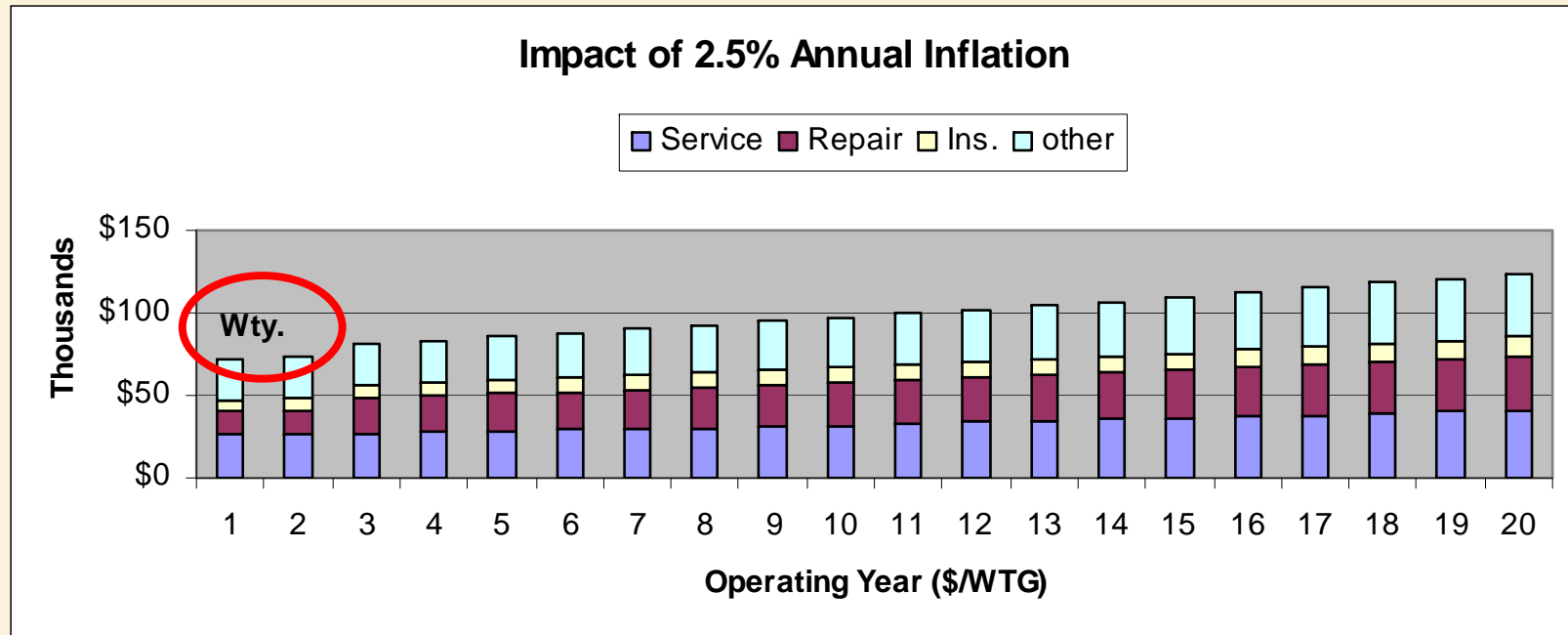


- **Budget costs can be reality checked against experience data and warranty quotes.**

# Sizing of Capital Reserve

- **Extremely difficult to validate.**
- **Should be done based on site characteristics (eg. turbulence, shear), model (eg. failure history, component analysis).**
- **Highly dependent on preventative maintenance and monitoring.**

# Accounting for Inflation



- **Budgets can be projected forward by assuming inflation rate.**
- **Parts and labour costs may move differently than inflation.**

# Conclusions

- **Limited data available for budgeting.**
- **Warranty / OEM quotes vary widely and may not be cost based.**
- **Conservative budget method outlined above.**
  - **Allows for cost savings in Service and Maintenance.**
- **Major repair best managed as life cycle capital cost.**
  - **Manage costs by preventative maintenance and condition monitoring.**
  - **Major repair cost difficult to est. / dep. on site/model/age.**
- **Use of capital reserve account is recommended for major and infrequent repairs.**
- **Inflation assumption can be used to project future years.**

# **Estimating Long Term Operating Costs of Wind Farms**

**WINDPOWER 2008, AWEA, Houston, TX**

**June 1 - 4, 2008**

**Uwe Roeper, President, ORTECH**

