

CRANE CONSIDERATIONS RELATED TO MAINTAINING WIND TURBINES

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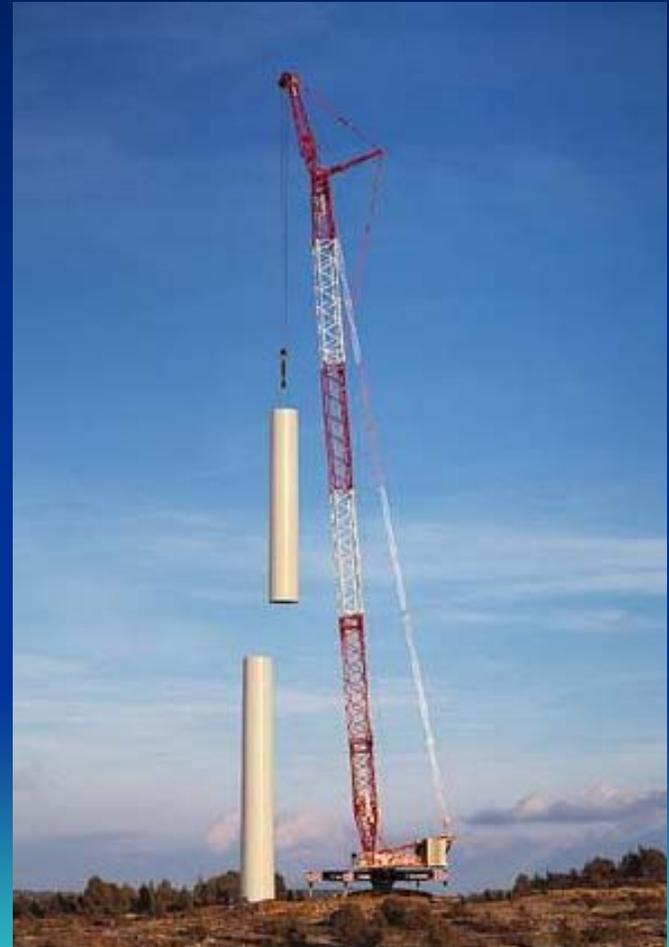
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MAJOR NEED FOR CRANES

- Nacelle Lift or Removal – Big Crane
- Gearbox Replacement – Medium crane
 - Note: High-speed bearings can often be replaced uptower
- Blades – Medium crane (or rig from nacelle)
- Generator – Small crane for whole generator
 - Note: If only bearings, can do job uptower
- Tower damage (rare) – Big crane

LARGE CRANE FEATURES

- Liebherr Model 1400/2 - W
 - Crawler, 4.5-m chassis
 - Narrow track, special for wind farms
- Capacity: 400 T at 4.5 m
- Height to 119 m
- Cost: varies (ht., wt, distance)
 - Mob/demob: 50k\$ - 100k\$
 - 4-day rate: 130K\$ - 200k\$+



Crane Use for Heavy Maintenance

- Large hydraulic crane
- Typical Lift
 - Large Gearbox
- Mobilization
 - Over road
 - Cost, varies greatly
- Cost: \$400 - \$500 per hour
- Extra boom costs - add to mobe/demobe + hrly



Liebherr LTM 1400, 400 T, 130-m pick

Crane Use for Medium-Weight Lift

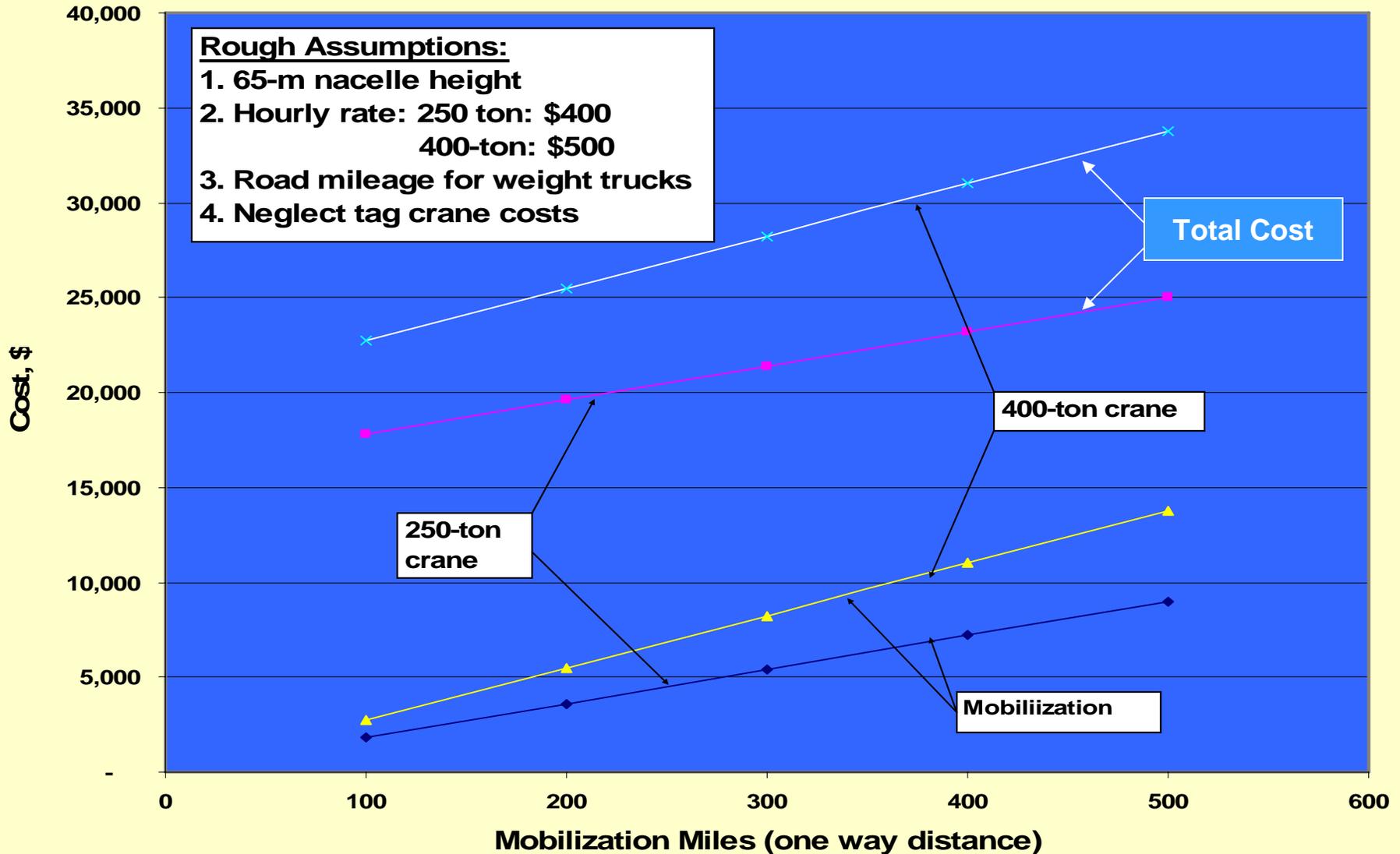
- Medium hydraulic crane
- Typical Lift
 - Medium-Weight Gearbox
- Mobilization
 - Over road
 - Cost, varies greatly
- Cost: \$300 - \$400/hour
- Extra boom costs – add to mobe/demobe + hrly



Liebherr LTM 1250, 250-ton, 101-m pick

Example of Crane Costs and Variation with Mobilization Distance (4-days of work + one day down due to wind)

Note: Estimates are approx. 50th percentile of range



SUMMARY

- **Hydraulic cranes easier/cheaper/quicker to mobilize**
- **Costs vary widely by geographic area and with industry work load**
- **Large operators could justify ownership vs lease**
- **Nacelle lift increases costs dramatically**
- **If possible, plan use of cranes to lump jobs and avoid WTG downtime**
- **Anticipate needs (condition monitoring helps)**
- **Cranes can be a costly portion of O&M costs – especially in later years**