CBER
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# A Realistic View of Renewables

Christine Risch

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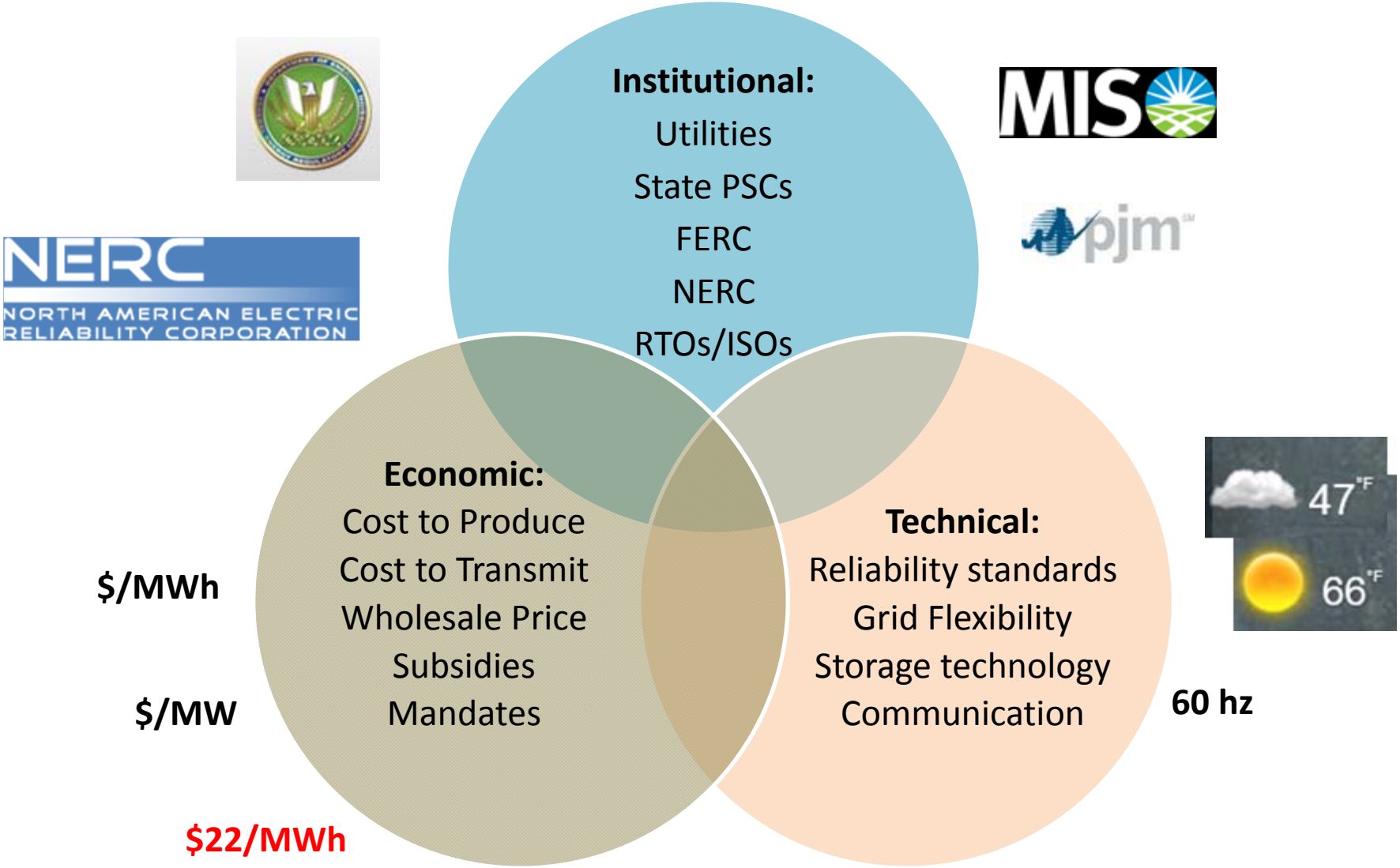
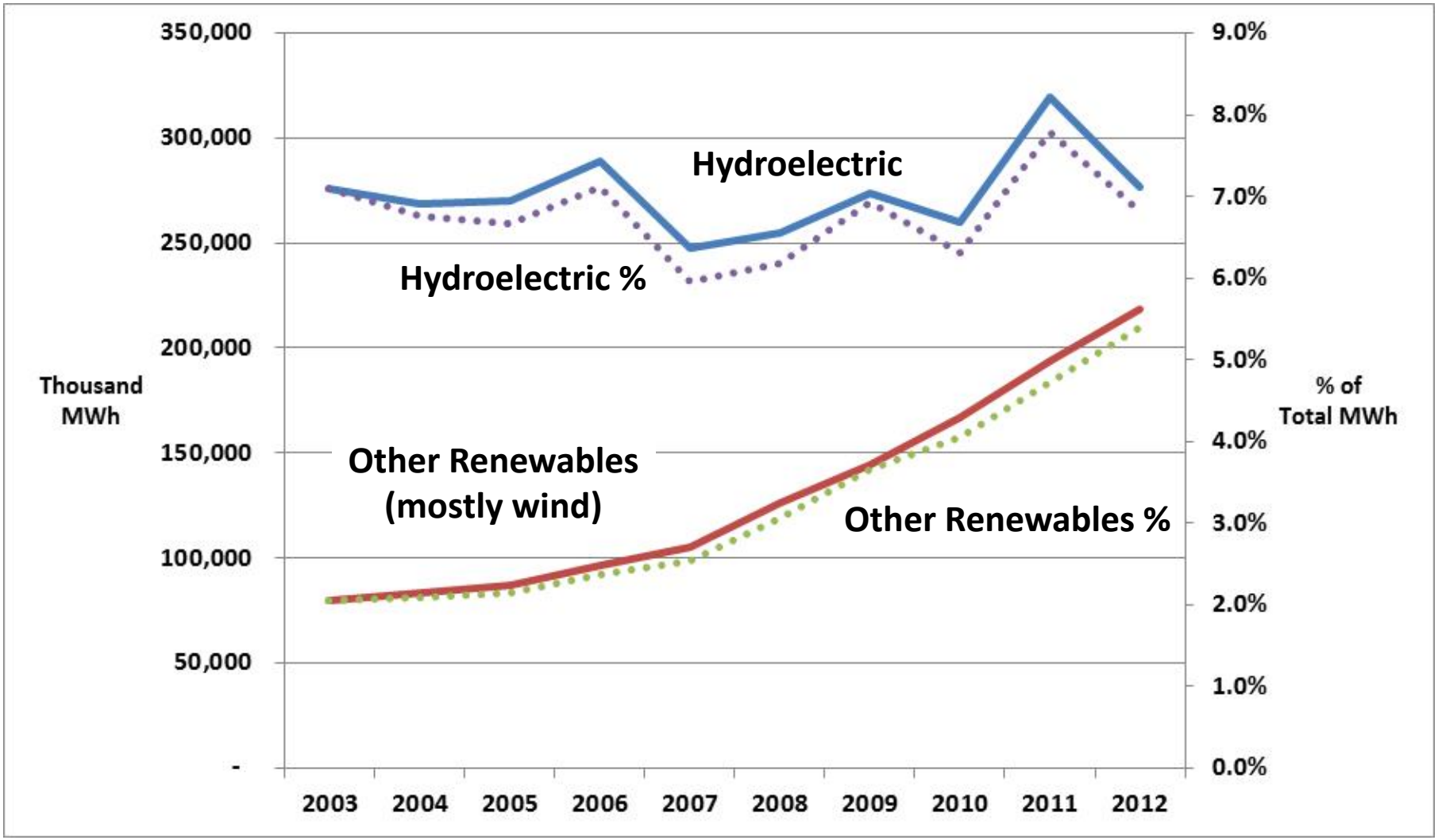
# Factors Affecting Utilization of Renewables



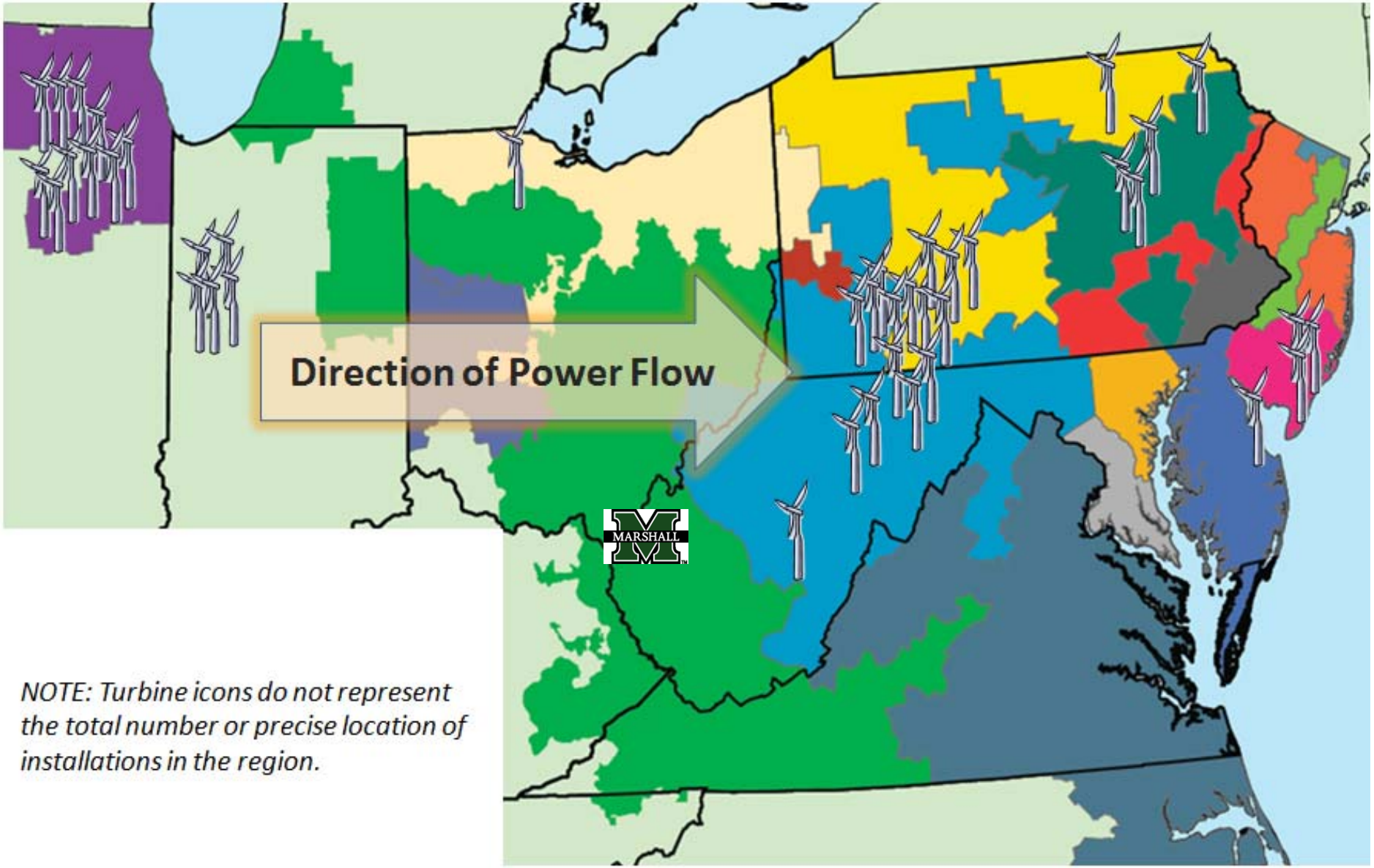
# Electricity Generated with Renewables - All U.S. in 2012: MWh & Share (12%)



# Technical Issues

- System Reliability – NERC says not much of an issue yet, but are concerned for expansion
- Enabling technology – DR, energy storage, PEVs, etc. that increase flexibility
- Managing Variability – forecasting output
- Increased need for reserves; not a major issue now, but will become bigger
- Increasing connectivity of balancing areas

# PJM Territory




*NOTE: Turbine icons do not represent the total number or precise location of installations in the region.*

# Institutional Issues

- Cost Allocation: ISO-level transmission costs are absorbed uniformly by all loads regardless of the benefits received
- Size of market: bigger is better, integrated markets share reserves and can better adjust for variability
- Enabling grid services: demand for new types of flexible reserves with correct sub-hourly price signals
- Market participation: supply of non-conventional services, e.g. DR, energy storage, PEVs
- Mandates/Incentives: RPSs; $22/MWh PTC

# Economic Issues

- Levelized cost of electricity ($/MWh) – renewables and fossil converging, but not only factor
- Cost to get to market: perhaps $40-$70 billion of transmission expansion cost to satisfy existing state-level RPSs through 2025 (Brattle Group)
- Integration Costs: are positive, possibly as low as $2 to $5/MWh for wind at up to 35% of MW
- Wholesale price distortion due to PTC

# Where We Are

- Renewable Energy is 12% of total annual electricity generated in the U.S. including hydro
- Wind already > 20% annual energy in places: IA, SD.
- Varies by region: Some utilities at >10% wind capacity as % of peak load, e.g. Xcel Energy
- In some time periods wind as much as 50% of energy produced: Ireland, BPA.
- NREL says can get to 80% renewables (w geothermal and biomass) if its suggestions are deployed
- Base load resources are necessary because they are dispatchable; allow integration of variable resources