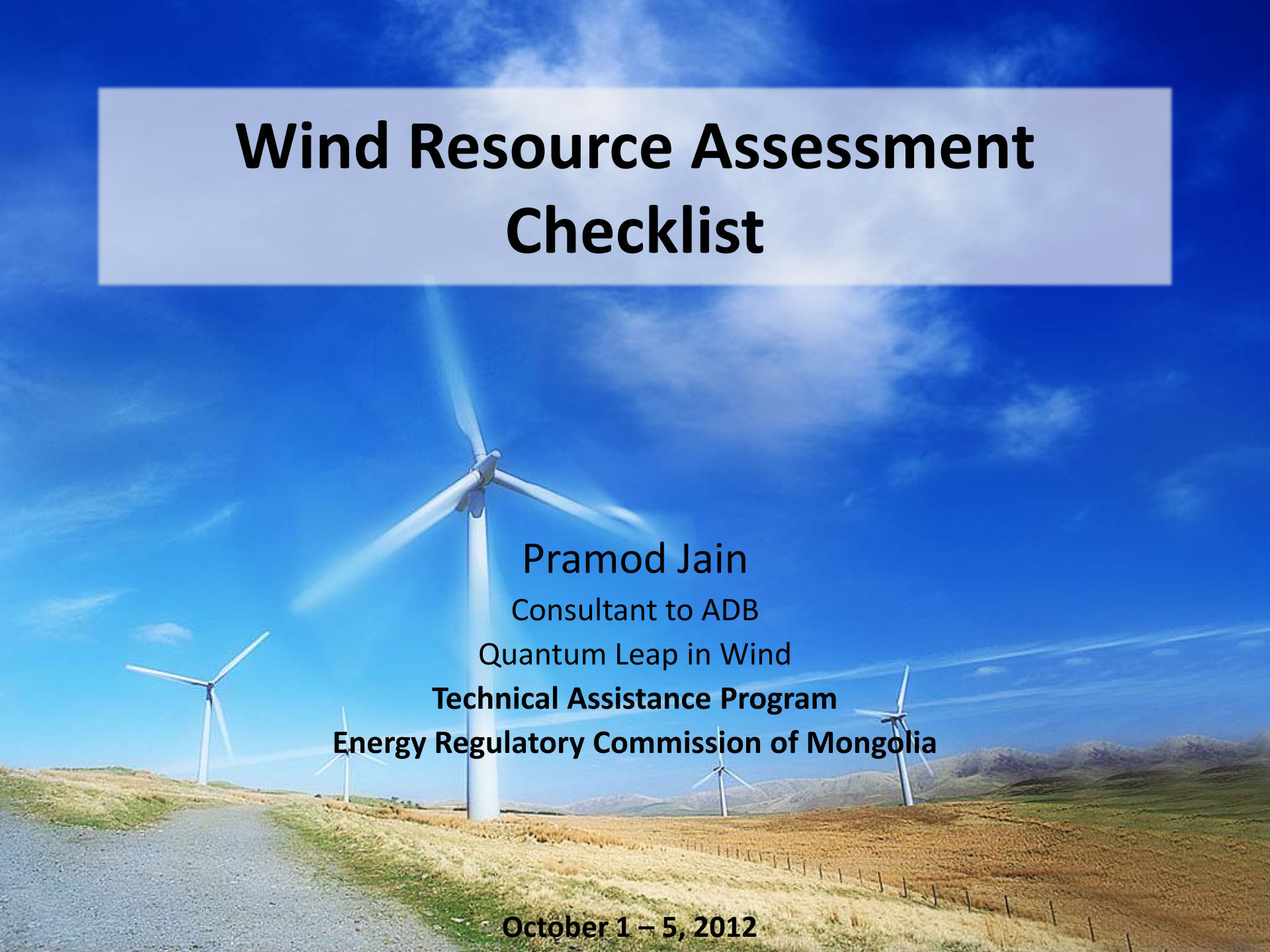
Wind Resource Assessment Checklist



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Technical Assistance Program

Energy Regulatory Commission of Mongolia

October 1 – 5, 2012

Checklist for Bankable WRA

Properties of Bankable Wind Resource Assessment

- Wind measurement at 60m height and at multiple heights
- Duration of measurement is one year or more
- Wind measurement is done within acceptable distance of site
- Proper location and configuration of met-towers
- Average, max, min and standard deviation of wind speed are recorded every 10 minutes
- Quality and calibrated wind measurement instruments
- Auditable wind data management
- Processing wind speed data is documented

Checklist for Bankable WRA

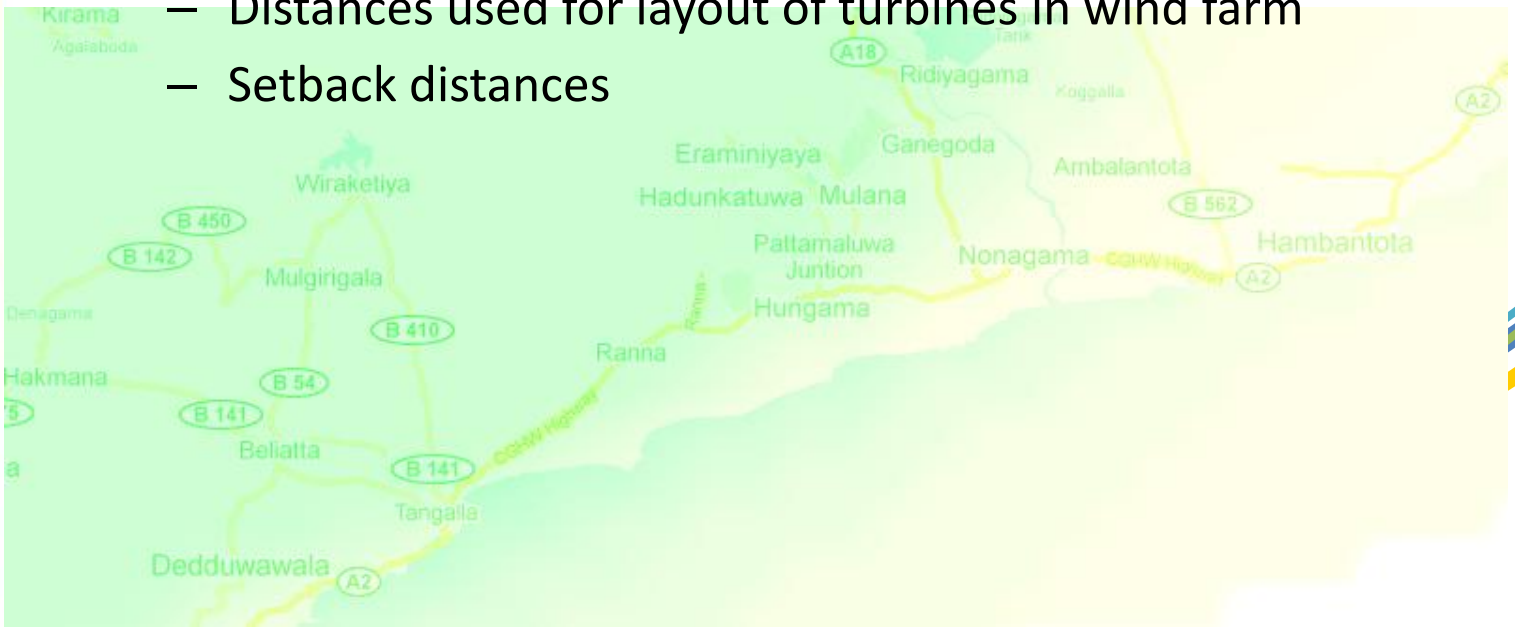
Properties of Bankable Wind Resource Assessment

- Long-term correction is applied
- Wind farm layout is provided
- Losses are quantified
- Uncertainty is quantified
- Average Annual Energy Production is computed along with P50, P95, P99, and others
- Appropriate class of wind turbine is chosen based on:
  - Extreme wind speed analysis, performed with long-term data in order to pick class of turbine
  - Turbulence of wind flow and wake, computed with measured data and layout of turbines

Checklist for Bankable WRA

Properties of Bankable Wind Resource Assessment

- List of modeling assumptions are provided:
  - Roughness model
  - Shear model
  - Statistical model for temporal extrapolation
  - Model for spatial extrapolation
  - Model for computing wake
  - Distances used for layout of turbines in wind farm
  - Setback distances



Losses: Typical losses

Loss category	Loss estimate	Comments
Wake losses	5 – 15%	WindPRO and WindFarmer have tools to compute wake losses
Plant availability	2 – 5%	Turbine related, BPO related, Grid unavailability
Electrical losses	2 – 4%	Transformer losses, Transmission losses, Internal power consumption
Turbine performance	1.5 – 5%	Power curve loss, High wind hysteresis, Wind modeling
Environmental	1 –3%	Outside operating range, Icing, Wildlife, Lightning, Roughness change
Curtailment	1 – 3%	Grid , Wind sector
Others		Earthquake: Seismic database may be used estimate frequency

Source: P. Jain, Wind Energy Engineering, 2010

Typical Values of Uncertainty

Component of Uncertainty	Sensitivity Factor	Amount of Uncertainty (%)	Net Uncertainty of AEP Because of Component (%)
Wind speed measurement	1.5	5	7.5
Wind speed spatial extrapolation	1.5	3	4.5
Wind speed long-term correction	1.5	3	4.5
Wind shear, height extrapolation	1.5	2	3
Air density	1	0.3	0.3
Power curve	1	0.6	0.6
Wake losses in wind farm	1	1.7	1.7
Unaccounted for Loss	1	1	1
Total uncertainty of AEP assuming components are uncorrelated is square root of sum of squares			**10.5%**

Source: P. Jain, Wind Energy Engineering, 2010

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