Australian Wind Energy Forecasting System (AWEFS) overview

July 2010

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

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AGENDA / CONTENTS

1. Project background and timeline
2. System overview
3. Forecast Performance accuracy
4. Enhancements
5. Data access for Public Researchers

INCREASING WIND GENERATION

Queensland

12MW operating
300MW planned

New South Wales

170MW operating
2,200MW planned

South Australia

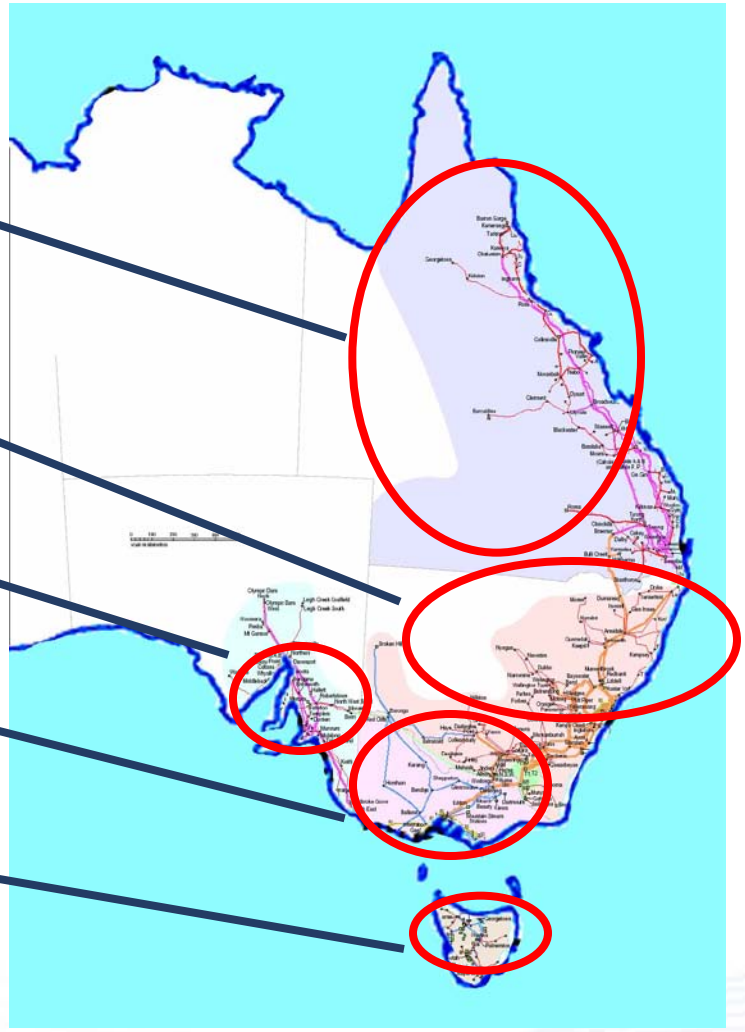
870MW operating
1,400MW planned

Victoria

430MW operating
2,500MW planned

Tasmania

140MW operating
420MW planned



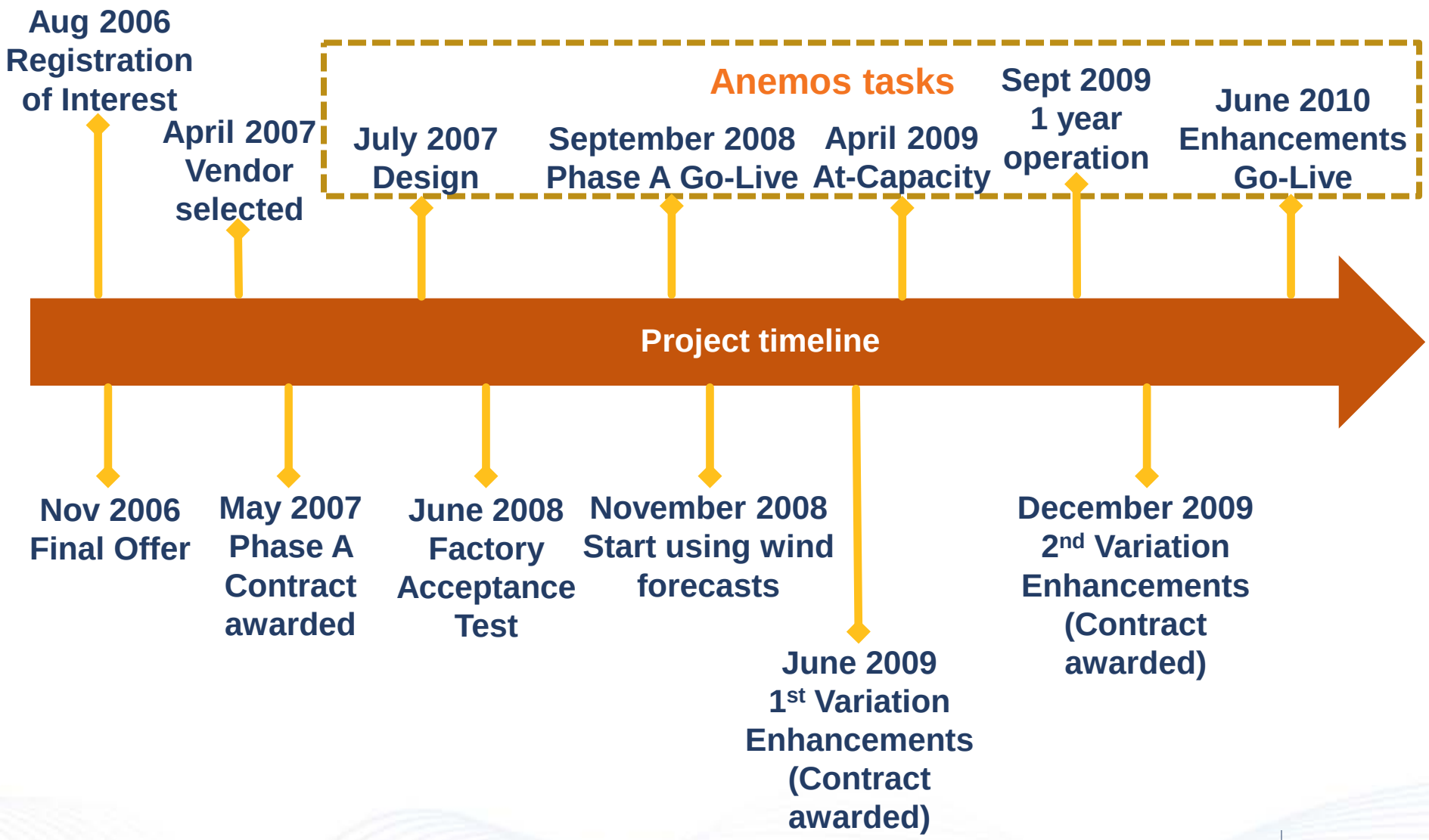
Operating: as of September 2009

Planned: 2009 to 2019

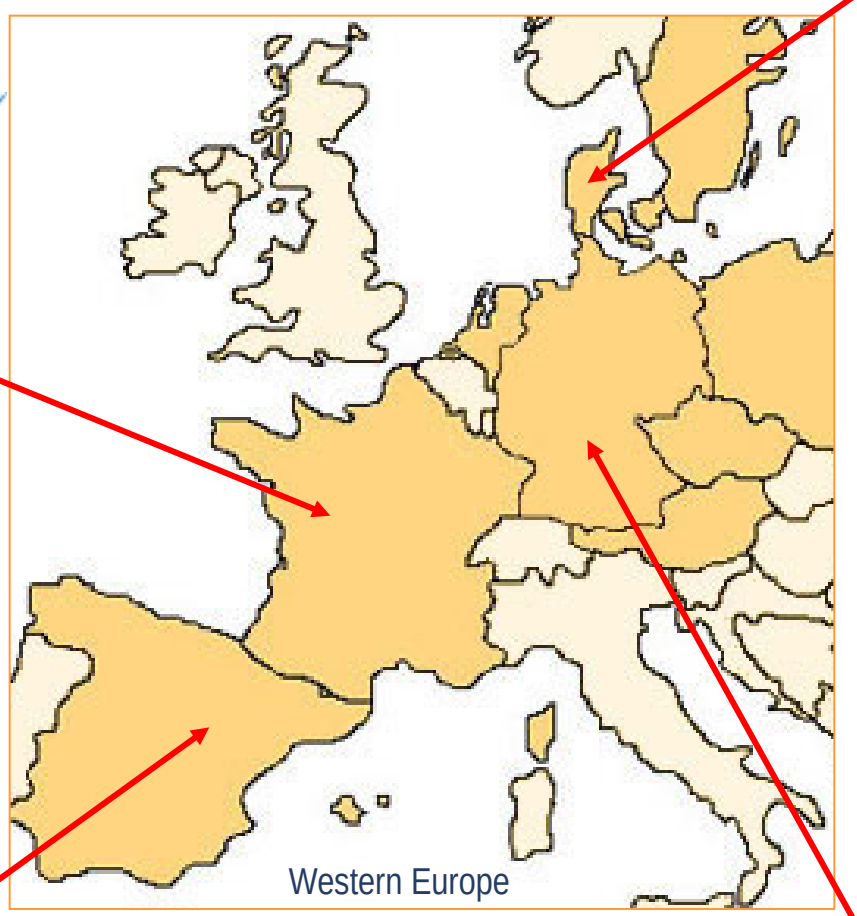
AWEFS PROJECT BACKGROUND

- Australian Federal government funded project
- Project objectives:
  - Tool to forecast wind generation
  - Collection and analysis of information to support public research organisations
- AEMO and Australian government engaged industry and the project was commenced in 2006
- Forecasting system established over a two year timeframe, operational in September 2008
- System sourced from Anemos consortium (EU)
- A “world first” approach
  - Integration with dispatch and in future supply/demand balancing related processes

AWEFS PROJECT TIMELINE



Anemos consortium



HOW DO WE FORECAST WIND GENERATION ?
ANEMOS DATA FLOWS

Inputs

- Historical Information
- Standing Data (wind farm details)
- Weather forecasts x 3
- Real time measurements
- Turbine Availability information

ANEMOS Forecasting system (Statistical, Physical, Combination models)

Output

For NEM Regions, aggregations, and wind farms: with uncertainty levels

Wind Generation forecasts

ANEMOS INTEGRATION INTO NEM SYSTEMS

Targets

Readings

Energy Management Systems

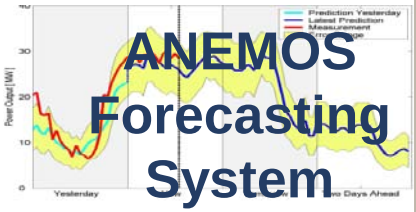
Market Management Systems

WEB Interface

Wind Manager

AEMO Operations

Future development



WEB Interface

Soap Interface

Researchers

European Weather Bureau

Australian Weather Bureau

USA Weather Bureau

FORECAST TIMEFRAMES

Anemos were engaged to develop a wind generation forecasting tool for the NEM Forecast timeframes, and are provided for real-time and day ahead time horizons:

Forecast timeframe	Resolution	Frequency
Dispatch	5 mins (5 min interval)	5 mins
5min Pre Dispatch	2 hours (5 min interval)	5 mins
Pre Dispatch	40 hours (30 min interval)	30 mins
6 day reserve forecast	6 days (30 min interval)	30 mins
2 years reserve forecast	2 years (peak 30 min interval)	Daily

Uncertainty forecasts: 10%, 50%, 90% Probability of Exceedance (POE) forecasts are also provided

INTEGRATION WITH DISPATCH & PASA PROCESSES

- The wind generation forecasts are used for
  - Load-forecasting: pre-dispatch (40 hrs ahead) and 7 days ahead
  - To adjust the native demand before input to 2 years ahead
- Significant wind generation (>=30MW) to be semi-dispatched (output controlled downwards), since March 2009
  - Limit output of wind generation at times when it would otherwise violate network capability
- Semi-scheduled Wind farms:
  - Submit dispatch offers and plant availability
  - Compete with other scheduled generation on the basis of offers – economic dispatch
  - Receive loading (dispatch) instructions from AEMO based on wind generation forecasts from Anemos system
  - Must comply with AEMO loading instructions

DATA REQUIREMENTS

- Standing data :
  - Wind farm location and terrain data: geographical coordinates, altitude, geometry and orography, mesoscale roughness coefficient and surrounding area roughness, meteorological mast height, air density
  - Wind turbine data: number and type in an identical unit cluster, hub height, rotor diameter, power curves, ambient temperature operating limits, cut-in and cut-out temperature, cut-out and cut-in wind speeds
- Turbine availability data:
  - Turbines unavailable or Scheduled Maintenance
  - Upper MW Limit or Down Regulation

DATA REQUIREMENTS

Remote monitoring requirements:

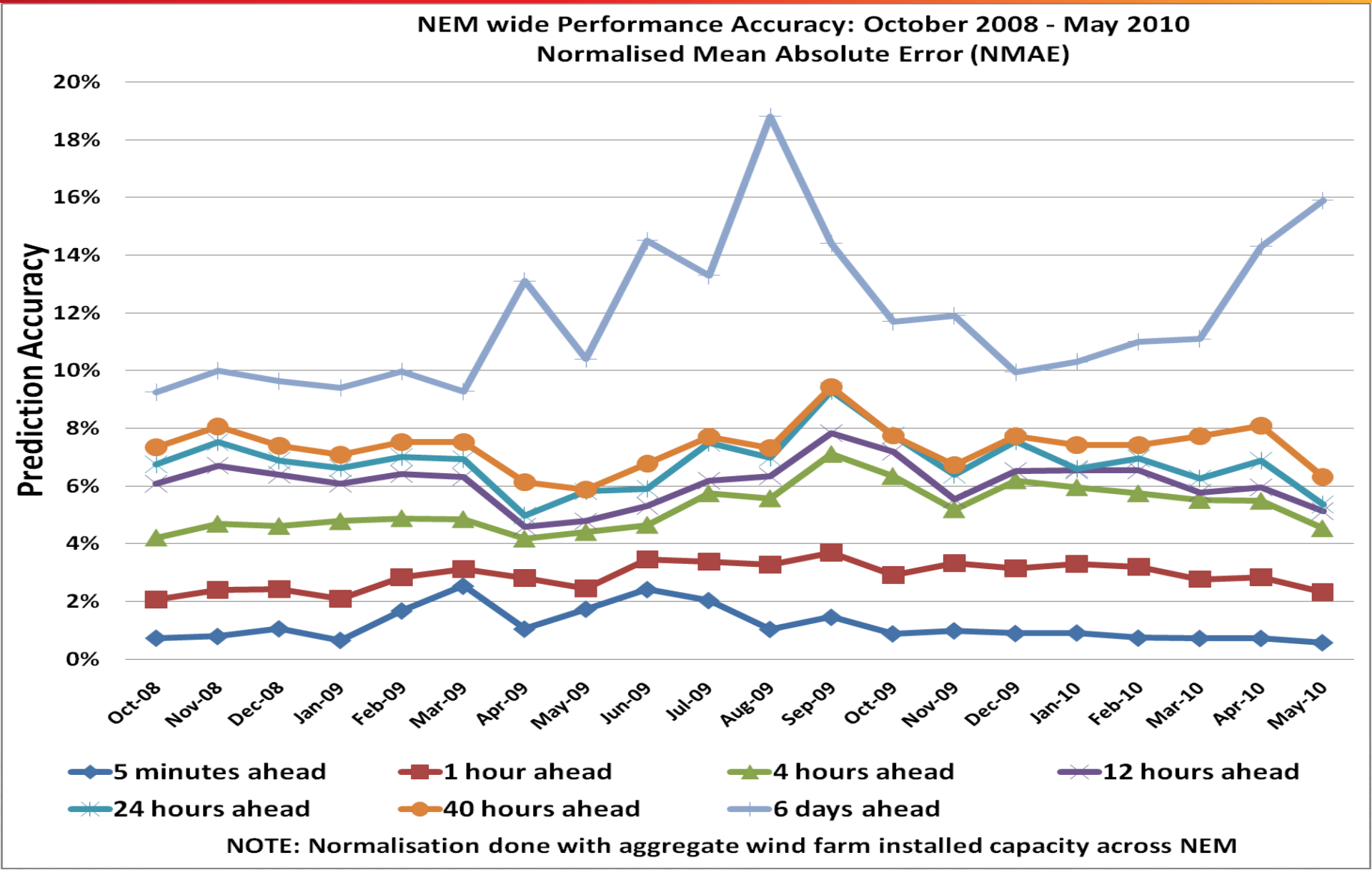
- Active power output (Wind Farm & cluster)
- Number of wind turbines available for generation, as the number of available generating units (Wind Farm & cluster)
- Number of wind turbines in operation, as the number of units generating power (Wind Farm & cluster)
- Wind speed (meters/sec) (cluster)
- Wind direction (degrees) (cluster)
- Temperature (cluster)
- Upper MW limit: Control scheme set points (Wind Farm)

MARKET PARTICIPANT INTERFACES

Interfaces are provided, that:

- Allow Participants to see their forecasts via '**View Wind Forecasts**' interface
- Enter turbine Availability information via '**Wind Energy Availability**' and '**Wind Energy 2 years Availability**' interfaces
  - Turbines unavailable: e.g. under maintenance, or to be commissioned in future
  - Upper MW Limit: e.g. when a Network Service Provider advises Wind Farm to restrict generation due to line outages, network congestion etc.
- Allow wind farms and AEMO Operators to input own forecasts via '**Forecast Override Interface**'; for all NEM timeframes (except Dispatch)

FORECAST PERFORMANCE ACCURACY – NORMALISED MEAN ABSOLUTE ERROR



AWEFS ENHANCEMENTS IMPLEMENTED JUNE 2010

System Improvements

- Redundancy, Scalability, SCADA based extreme events alarming, User rights Management, Improvements in system supervision

Models

- 2 year hourly forecast model, Daily pattern identification, Medium term model enhancement, Advanced SCADA up-scaling module

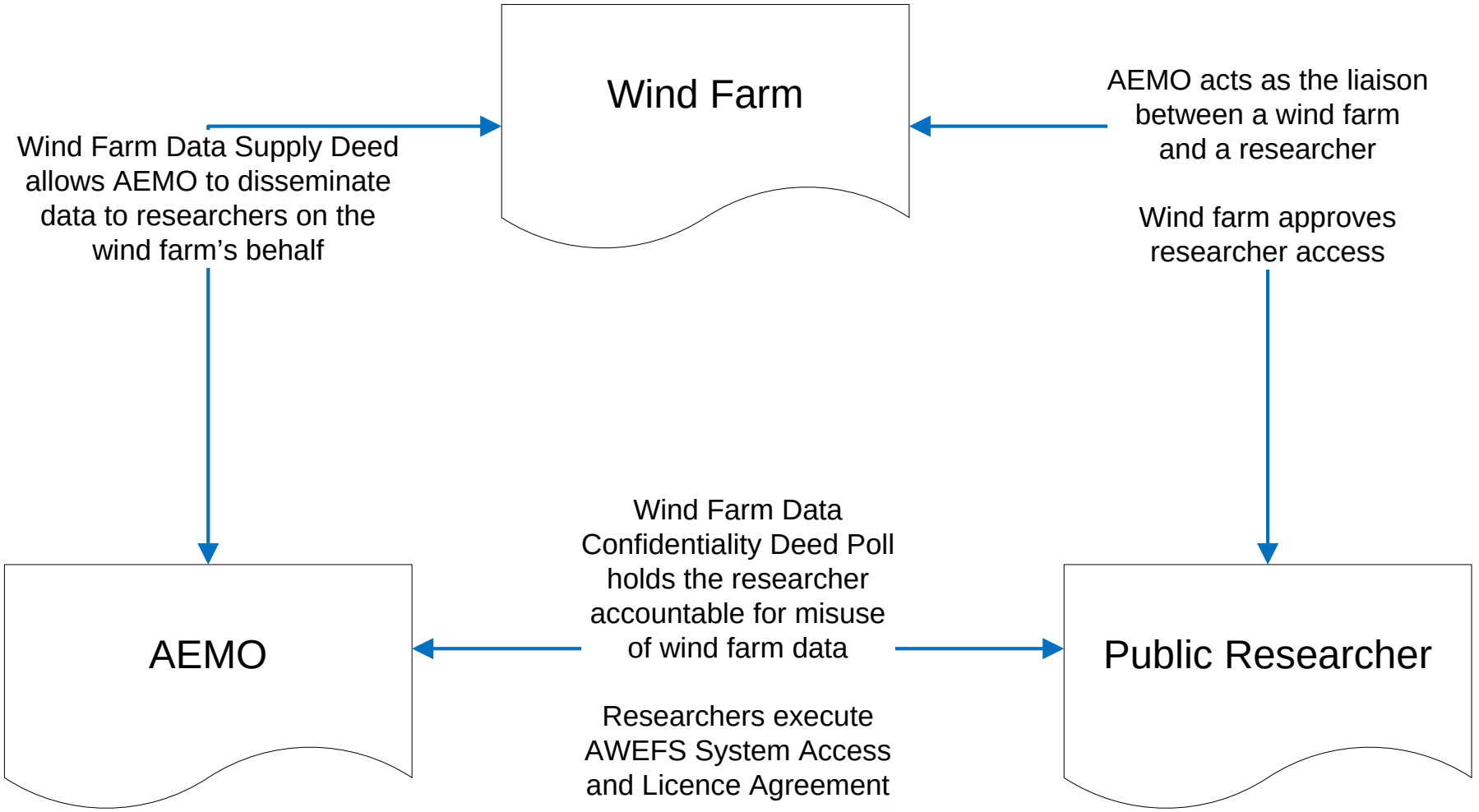
Research

- Researcher access server, Extreme events advanced alarming - evaluation study, and Study on utilisation of Ensemble Numerical Weather Predictions

WIND FARM DATA ACCESS FOR PUBLIC RESEARCHERS

- The AWEFS project implemented agreements to allow Australian public researchers to access wind farm data for studies aimed at improving wind generation forecasting techniques.
- Under these agreements, wind farm operators are able to allow release of confidential data on a voluntary basis for specific public research use. A page on the AEMO website for supply and access of this data is available at: **http://www.aemo.com.au/registration/researchers.html**

WIND FARM DATA ACCESS FOR PUBLIC RESEARCHERS



KEY REQUIREMENTS FOR SUCCESSFUL IMPLEMENTATION

- Solid commercial and regulatory framework for provision of data
- Industry wide consultations
  - Participation of wind farms in central dispatch processes
  - Development of new standards for collection of wind farm specific standing and SCADA data
  - Market interface development
- High degree of cooperation and collaboration between stakeholders: Government, industry, vendor
  - Training/ presentations for industry to build confidence
  - Engagement of industry working groups

KEY ACCOMPLISHMENTS AND CHALLENGES

- Integration of an effective operational system for the NEM
- Forecast performance accuracy targets being achieved with aim to further improve accuracy over time
- Significant proportion of total generation from wind farms in SA and VIC by 2020: AWEFS first step in tackling this increased wind generation
- Ongoing challenge: “Data Quality”
  - turbine commissioning schedules
  - turbine availability information
  - SCADA
  - Numerical Weather Predictions

Project information and updates available via AWEFS project page on AEMO website:
http://www.aemo.com.au/electricityops/awefs.html