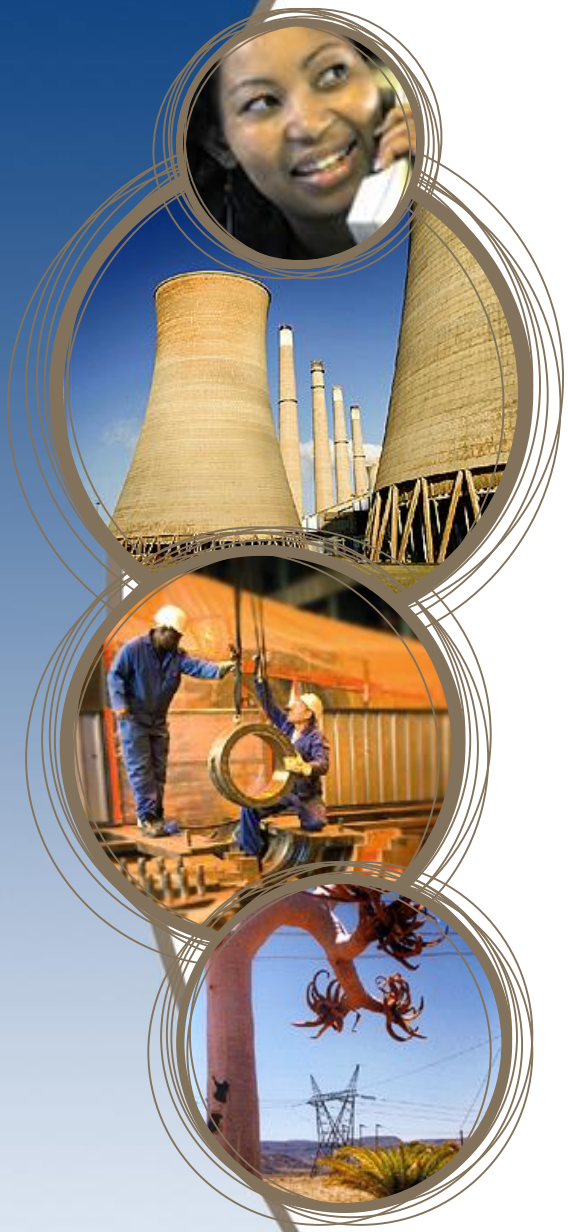


# Integrated Resource Plan for Electricity

27 September 2013, Cape Town

Ntokozo Sigwebela
*Energy Planning, Eskom*

# Contents

# The Electricity Regulation on New Generation Capacity

**The Electricity Regulation on New Generation Capacity (2011) states that:**

**(1) The integrated resource plan shall**

- (a) be developed by the Minister after consultation with the Regulator; and
- (b) be published in the *Government Gazette* by the Minister.

**(2) The system operator, the NTC and the Regulator shall timeously provide such assistance as the Minister may require for purposes of developing and monitoring the implementation of an integrated resource plan.**

**(3) The Regulator shall, after consultation with the Minister, the system operator and the NTC, make rules relating to the keeping of relevant information, the submission of such information and the rendering of returns by licensees, as required in order to facilitate integrated resource planning.**

# The IRP 2010 is the medium- to long-term roadmap for power-capacity expansion in RSA

- **IRP is the Integrated Resource Plan as described in Electricity Regulation Act (2006) – promulgated in March 2011 to cover the period 2010-2030**
- **It is a medium- to long-term plan that will help direct expansion of electricity supply including private and own generation and power purchases from regional projects**
- **The IRP plan determines the timing and mix of the projects and will form the basis by which NERSA will license such projects**
- **The IRP does not consider who builds projects or where they are build**
- **The IRP plans for both capacity additions and operating regimes of these capacities**

# The IRP needs to answer the following questions

- **What are the electrical energy requirements for South Africa to achieve the aspiration of sustainable economic growth?**
- **By when is the capacity needed?**
- **What is the appropriate mix of technologies to meet these needs that ensures South Africa can:**
  - **meet its commitments to climate change initiatives,**
  - **ensures adequacy of supply,**
  - **creates a local manufacturing base,**
  - **maintains a competitive position in the global arena and**
  - **ensures sustainable use of local and regional resources?**

# The IRP process is output focused

- **The IRP process does not start with an end in mind**
- **The IRP process uses a fact base to determine the most COST EFFECTIVE mix of generation options given the constraints imposed (nationally and internationally)**
- **Scenarios are produced to allow the decision makers to manipulate options to produce a policy ad risk adjusted plan**

# Scenarios vs. Plans

- **Scenarios are not likely plans.**
- **They are the output of the model's attempt to optimise the mix given the scenario objectives at the least cost.**
- **From the scenarios a risk adjusted (Balanced) scenario developed by tweaking the major parameters to achieve a realistic balance.**

# IRP Critical Dimensions

- **Electricity Prices / Tariffs**
- **Carbon and Emissions**
- **Regional Development**
- **Generation Mix**
- **Implementation timeframes and costs**

# Key Scenarios

- **Key scenarios investigated**
  - **Demand scenarios**
  - **Supply option scenarios**
  - **Economic impact scenarios**
  - **Climate change scenarios**
  - **Regional development scenarios (electricity import & export scenarios)**

# Contents

# Process to derive the IRP 2010-30 involved consultation with stakeholders

1. **Consultation on input parameters to the IRP 2010 modelling, where:**
   - a) Registered stakeholders received the stakeholder information pack;
   - b) Stakeholders provided written input on the proposed planning assumptions;
   - c) A workshop was held with stakeholders on the feedback received and the final agreed parameter values

**The final input parameter values that were used in the modelling of the scenarios were based on a consolidation of both government and broader stakeholder feedback and approved by the governance structure set up by government for this purpose.**

2. **Consultation on the Revised Balanced Scenario and draft IRP 2010, where:**
   - a) Stakeholders received the modelling outputs (based on the input parameters) and the draft IRP;
   - b) The DoE hosted a series of workshops on the draft IRP with stakeholders; and
   - c) Stakeholders provided final written comments.

**The Revised Balanced Scenario was developed based on the balancing of Government policy objectives such as including objectives for a diverse generation mix, carbon mitigation objectives, localisation and regional development.**

# Consultation Analysis

| IRP Parameter | Total |
|---|---|
| Renewable Generation | 200 |
| The IRP2010 Consultation Process | 111 |
| Demand Response | 94 |
| Economic factors | 92 |
| Climate Change | 78 |
| Non Eskom Generation | 68 |
| Security of Supply | 52 |
| Demand Forecast | 32 |
| Price Elasticity | 29 |
| Cost of Generation Options | 28 |
| Non IRP Related | 25 |
| Water | 22 |

# Dealing with Input Comments

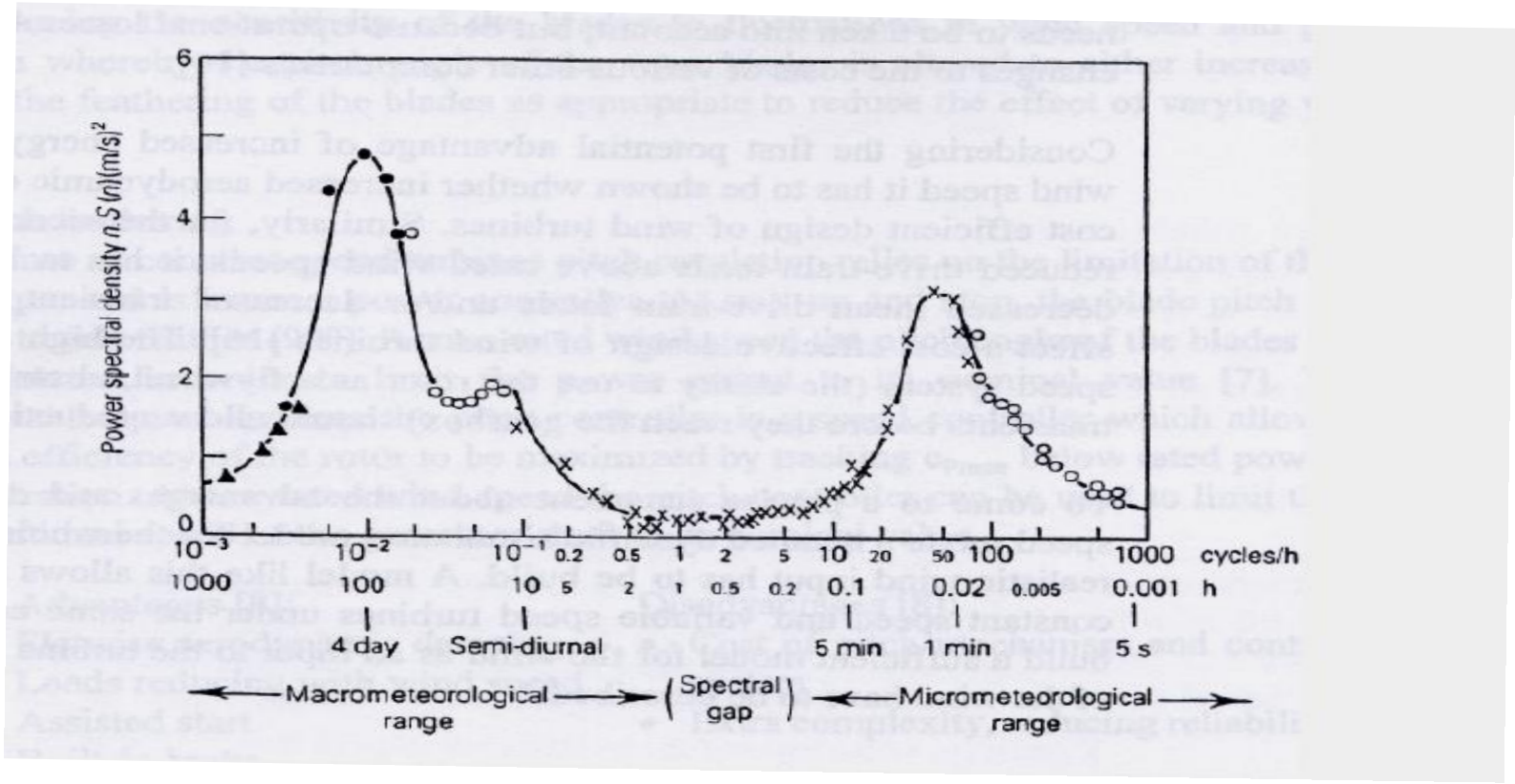
- **Each of the comments incorporated into the analysis for each parameter – the reasons for the final parameter range also updated and included in the published pack on the Web.**
- **For each of the parameters the inputs given were analysed and a response provided on the update input parameters.**
- **Several critically important aspects of Technology costs and viability (e.g. Biomass) were very helpful and provided fantastic insight**
- **The public relished the participation process and its continued use in long-term planning must be ensured.**

# Contents

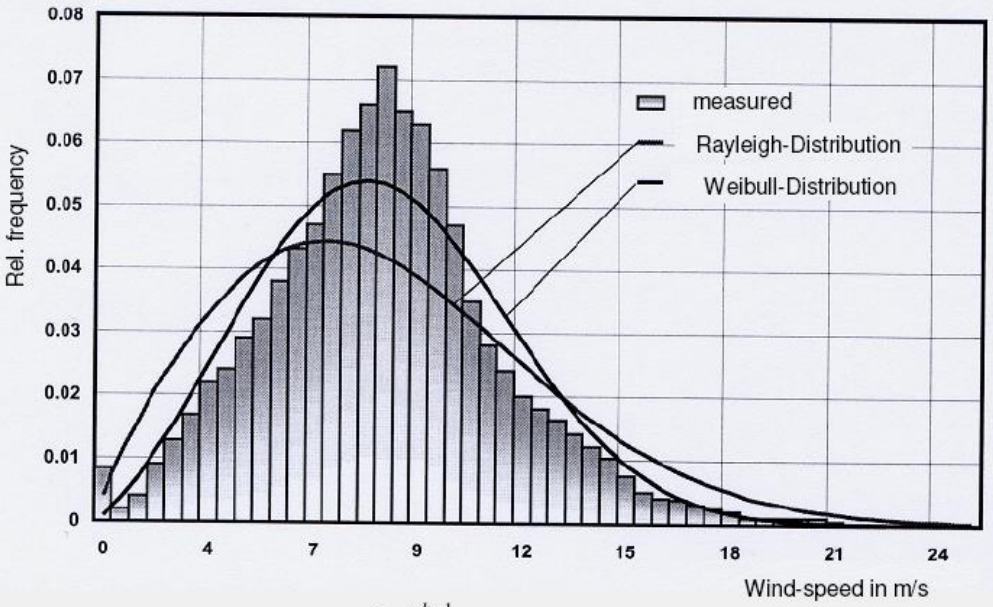
# Wind model

- **Wind data was not generally available when the studies for IRP 2010 started**
- **Conflicting claims from various quarters made it difficult to know what the true situation is**
- **Thus international data regarding wind was deemed to be the most reliable for the purposes of IRP 2010**
- **From the Capacity Credit Workshop in March 2010 a number of important principles were used to generate wind profiles for the studies**

# Wind Speed Distribution



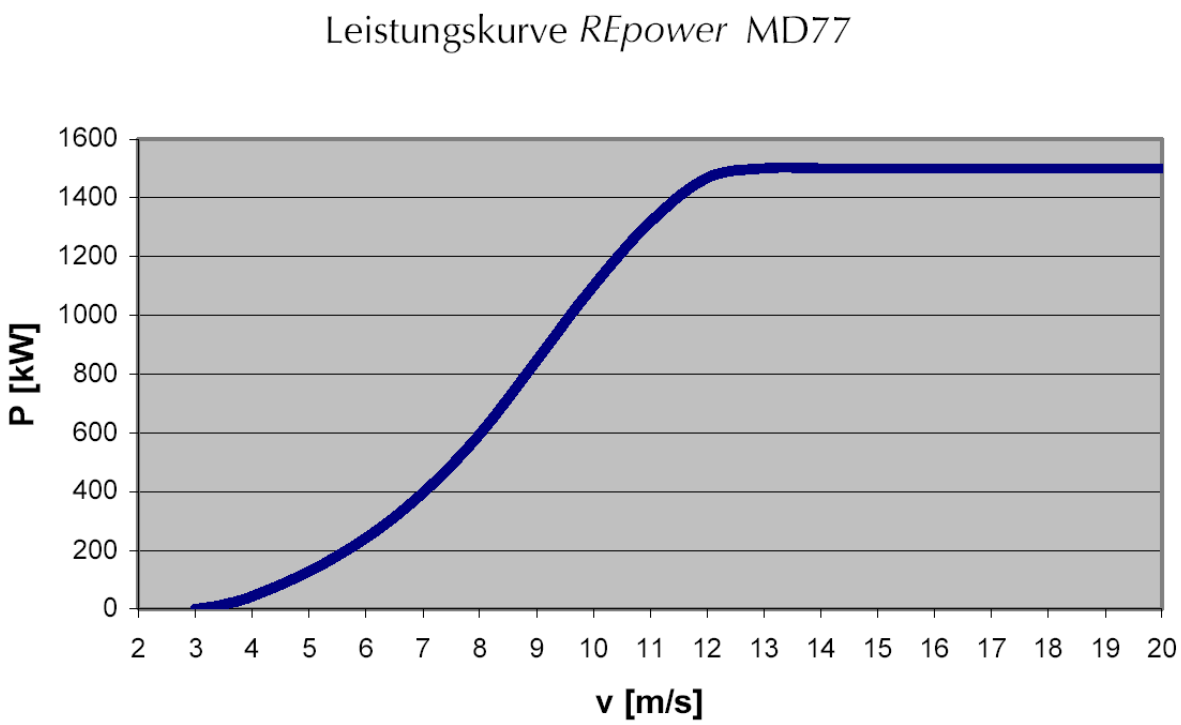
# Wind Speed Distribution




Weibull-Distribution: $f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} e^{-\left(\frac{v}{c}\right)^{k}}$

Rayleigh-Distribution: k=2

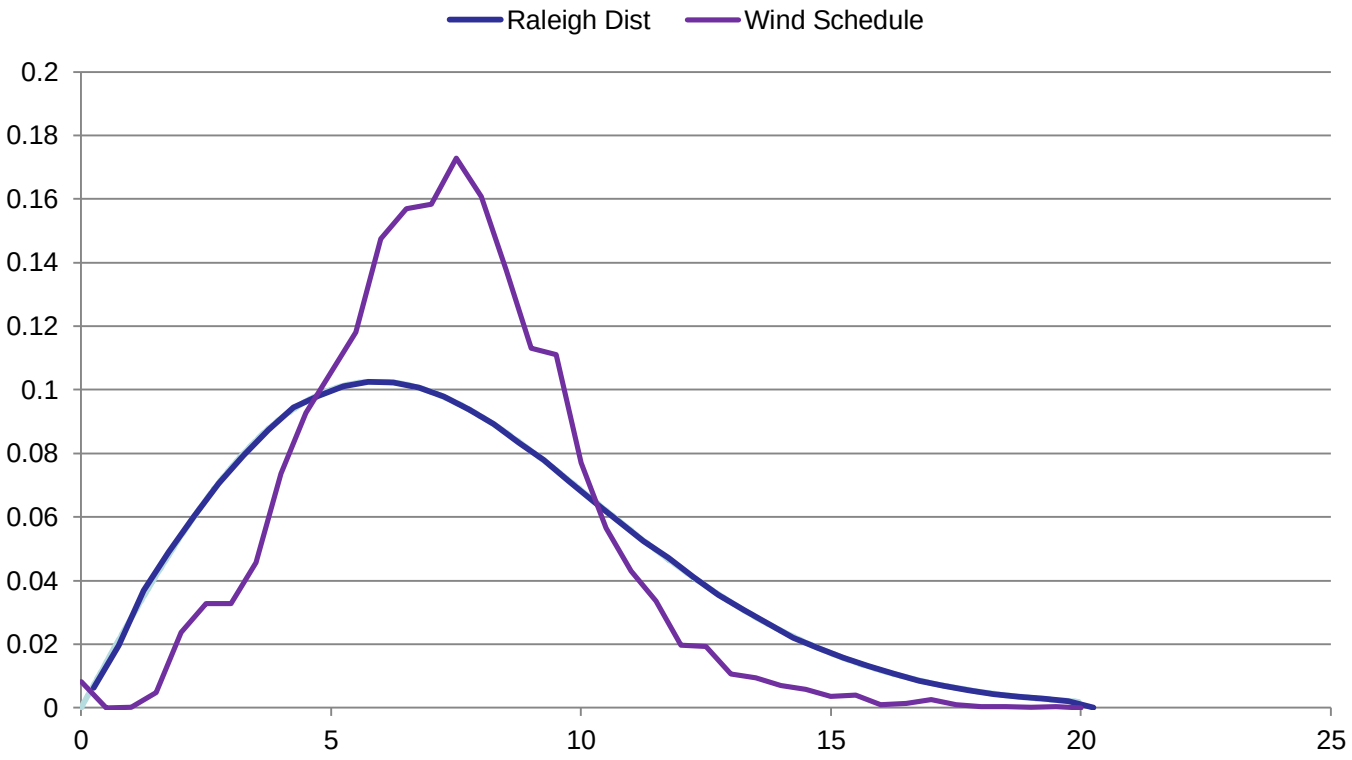
# Wind Speed vs. Power Delivered



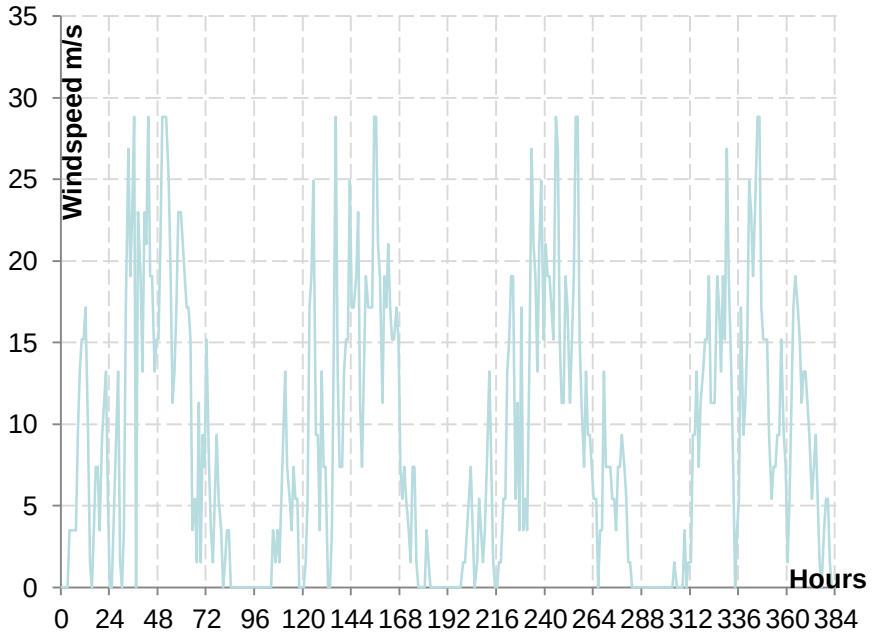
# Wind Energy Schedules

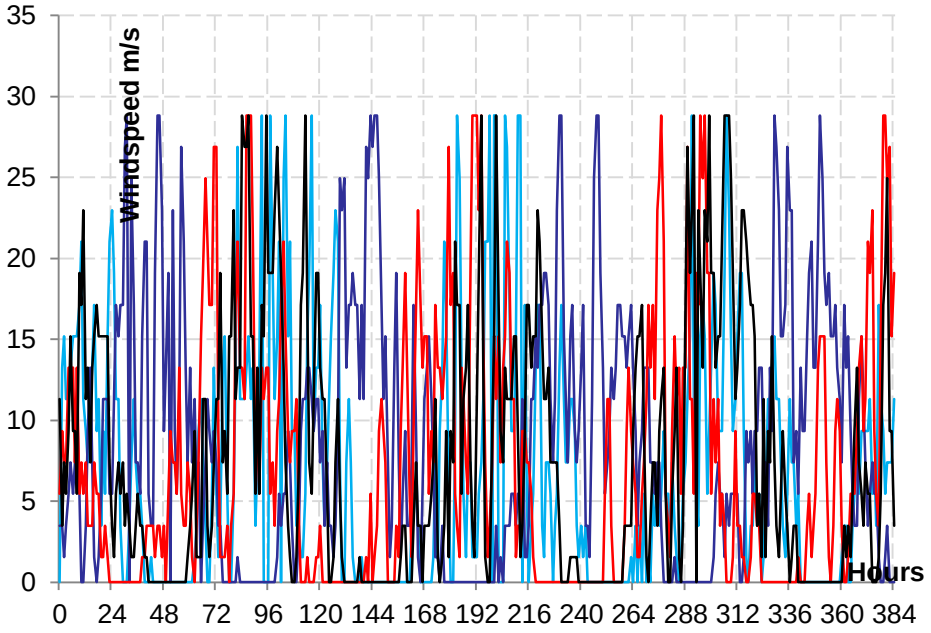
- **Since wind speed varies unpredictably, the process started with a random set of numbers**
- **This was converted into a variation that peaked every 100 hours (~ 4 day cycle)**
- **Used a three hour moving average to reduce wind speed variation from hour to hour**
- **The resulting schedule was tested against the Raleigh distribution for wind speed, as is shown in the next slide**

# Calculated Wind Schedule



# At Least Four Sites

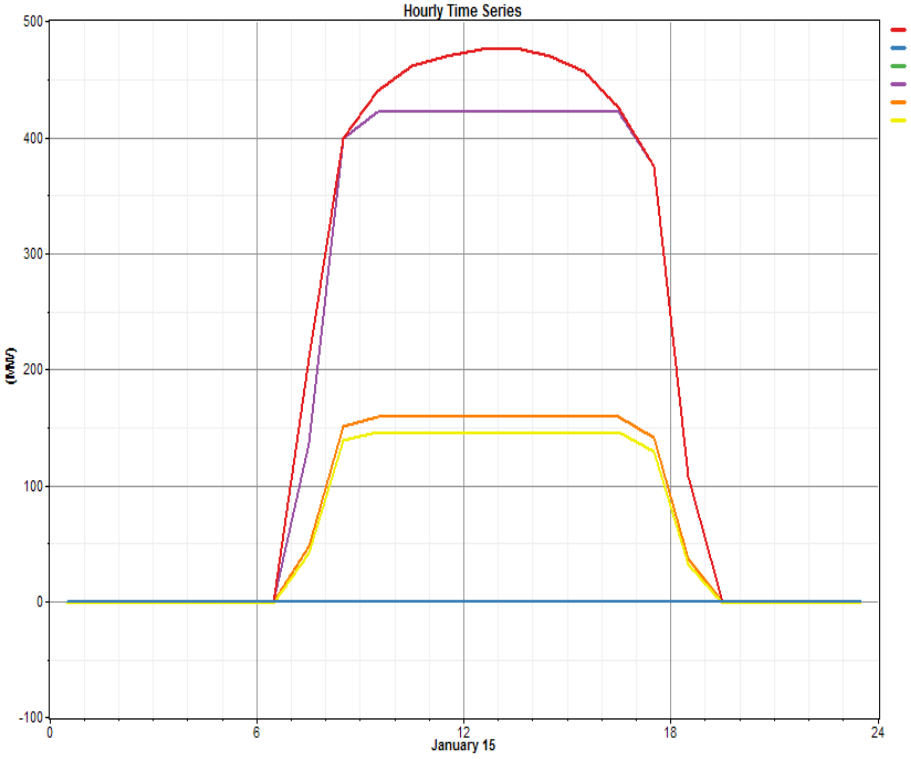


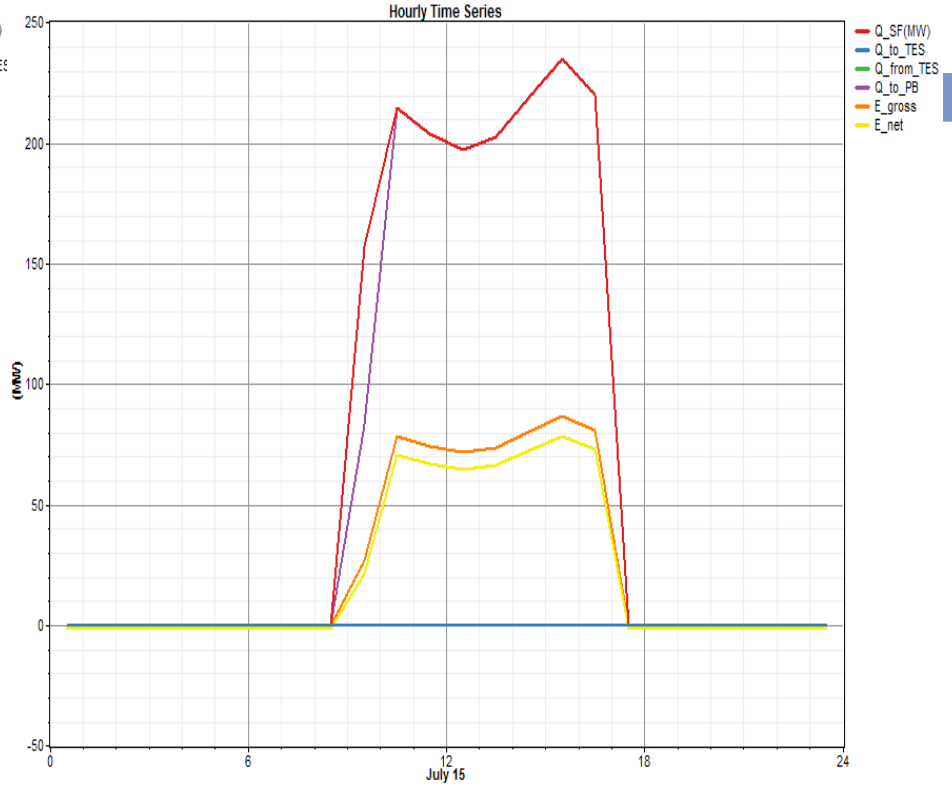



# Wind model: Conclusion

- **Wind is an unknown production factor in SA**
- **Worldwide it is an almost mature technology**
- **By using information from other parts of the world, it was possible to generate wind generation schedules that comply with requirements:**
  - **Realistic wind speed distribution**
  - **Required load factor**
  - **Realistic relationship between wind speed and generation**
- **Measured data for SA should become available in future**

# Solar model:
# No storage gen profile

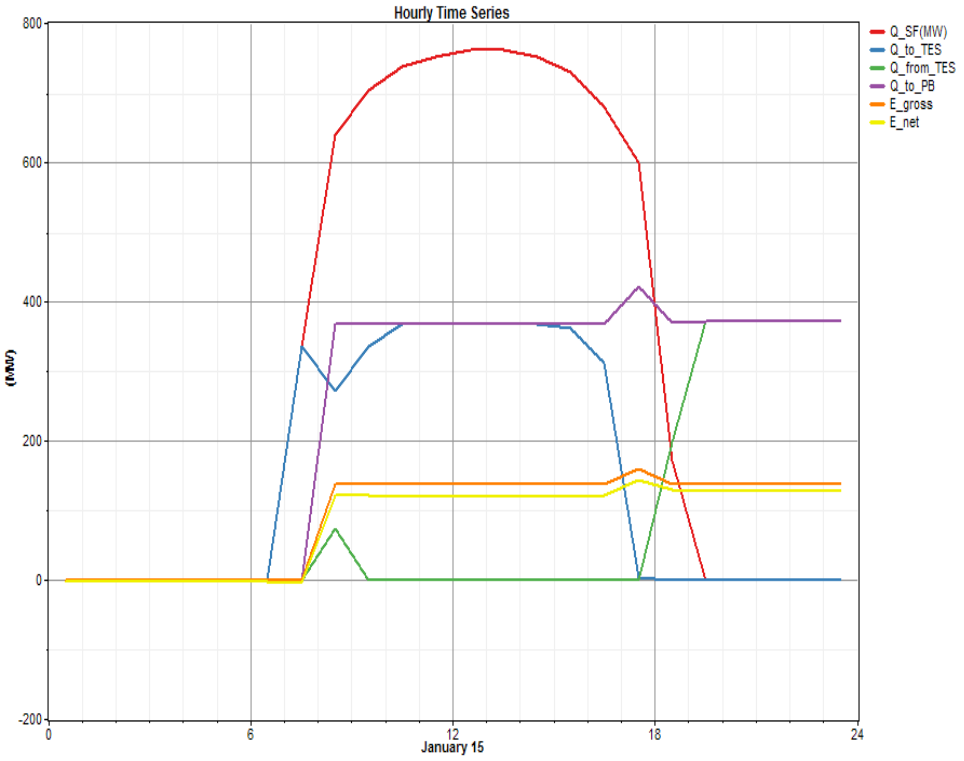


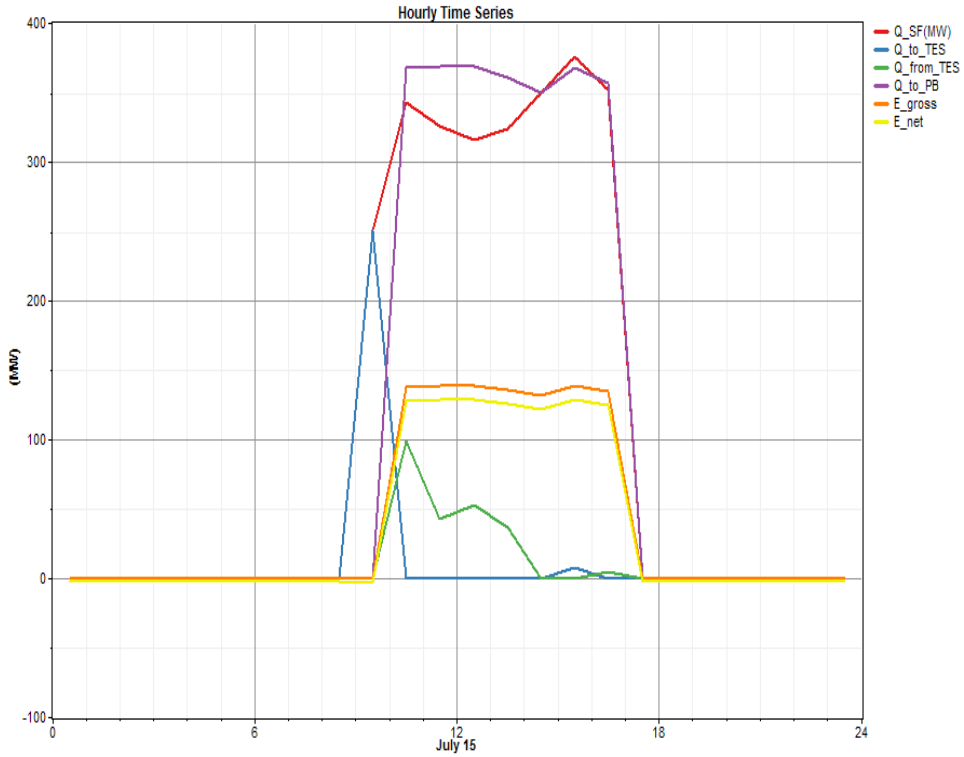






24

# Solar model:
## 9hrs storage gen profile




SOURCE: EPRI Report for IRP 2010



25

# Solar model

- **Reproduce profile for other 10 months of the year for a 100 MW unit**

- **Randomize cloud cover over a day of the month**
  - **If random variable > that a preset probability of cloud cover, then generate**
    - **Probability is a function a of the EPRI load factor for the unit (over the planning horizon).**
  - **Else, the unit cannot generate**
  - **Replicate for each month of the year**
  - **For each year over the period 2010-2030 (planning horizon)**
  - **Be sure to account for LEAP years**

- **This provides a solar trough generation profile,**
  - **for 24 hours a day**
  - **over the appropriate number of days for the month**
  - **Over 20 years**

- **Load solar generation profile into PLEXOS models**

# Contents

# IRP2010 UPDATE

## IRP 2010-30 is a living Strategy

- To be revised regularly preferably every 2 years
- Focus in 2012 on Integrated Energy Plan; critical input into next round of IRP
- Proposal to have a review instead of a full iteration, including new scenarios and some changes in inputs and assumptions to assess impact on IRP outcomes

# Thank you