ELECTRIC VEHICLES AND THE ENERGY MARKET

April 2010

PRESENTED BY CRAIG OAKESHOTT
SENIOR MANAGER STRATEGY AND ECONOMICS

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

EV'S ARE MORE THAN CARS

- Smooth, Clean Quiet, good for the environment
- Big issue is : charging
  - How big a battery is necessary for the car – what about the grid?
  - Linked to renewable energy – Very low footprint
    - What renewable sources will it come from?
      - Solar
      - Hydro
      - Wind
      - Geothermal
  - How is it delivered to the car
    - Local generation
    - Centralised / Decentralised Via the Grid
  - What else can that power do
    - Grid Support
    - Grid augmentation and expansion
    - Other storage

WHAT DOES AN EV HAVE TO DO WITH THE NEM

- People are a mobile source of demand
- EV's could be either mobile supply or demand
- Charging of EV's comes from many potential sources
  - Local generation
    - Solar panels
    - Wind turbines
    - Small generation units that are part of a smart home
  - The Grid
    - Centralised power stations
    - Decentralised power stations
    - Smart Grids
- Currently in the NEM
  - Wholesale prices reflect supply scarcity
  - Little or no energy storage

HOW MUCH POWER FOR EV'S

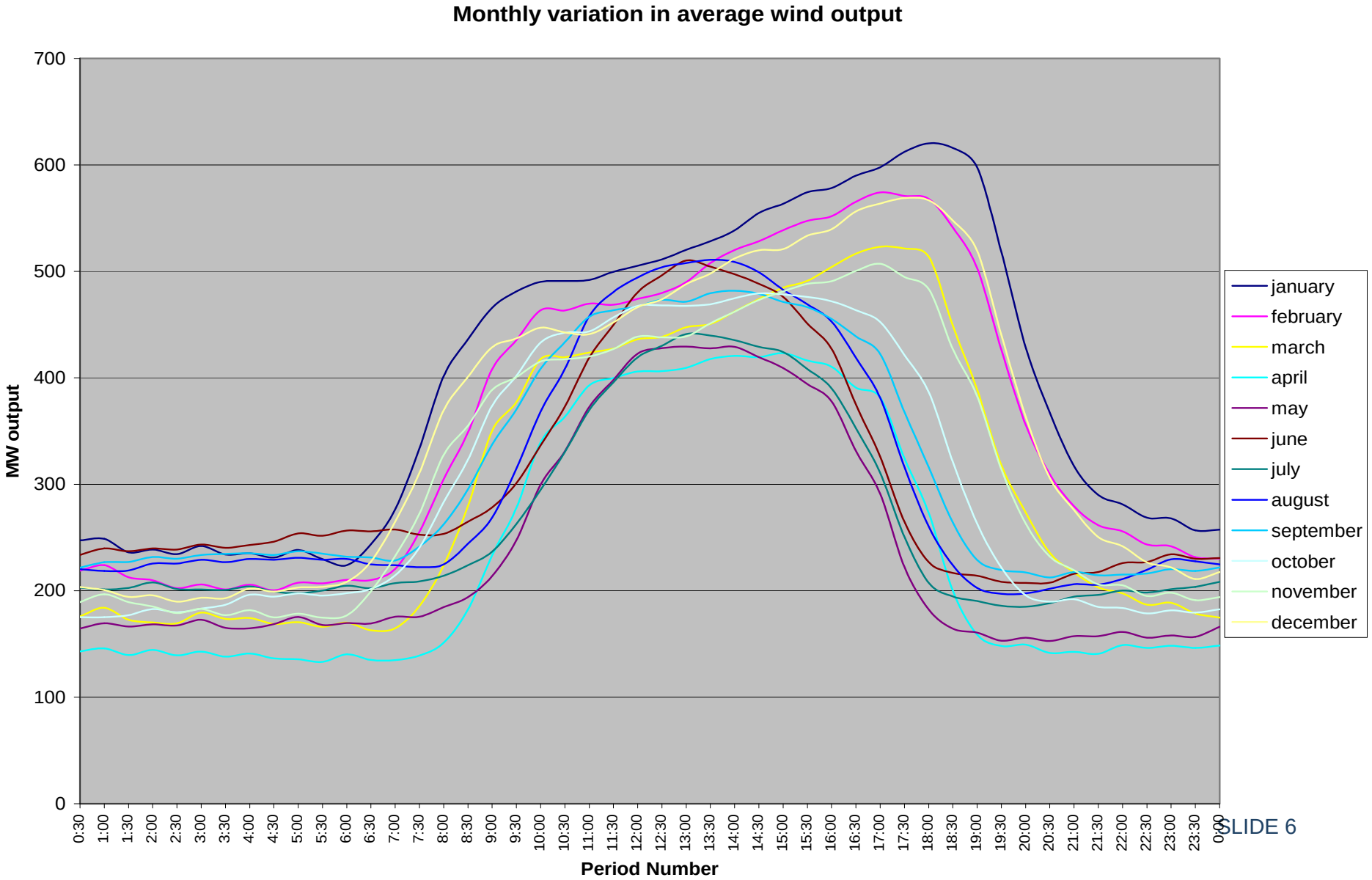
- Calculations from AutoCRC - 20,000GWh
  - About half the size of the expanded MRET scheme
  - Hydro
    - Snowy Hydro is ~3,700 MW installed, producing ~4,500 GWh annually
    - Tasmania has ~2,600 MW installed ,producing ~10,000 GWh annually
    - But what about future droughts?
    - What other hydro resources can we get?
  - Wind turbines
    - ~1,780 MW currently installed delivering about 5,000 GWh annually
    - So around 7-8000 MW of wind turbines
  - Solar
    - ~120MW ~50,000 homes
    - So around 11-12,000 MW of Solar panels
  - Geothermal
    - Currently no commercial scale plant operating
    - Massive potential once technical issues resolved
  - Obviously the solution is a combination of these and other sources
- Better Place: 6 million vehicles by 2030 is around 13-14,000 GWh

WHAT DO YOU KNOW ABOUT WIND POWER

- Intermittent resource
  - Predictability aided by forecasting systems but...
  - Typical capacity factor between 30% and 40%
  - Contribution during current peak demand periods
    - 3% in SA , 8% in Vic, 0% in Tas
  - On average generation follows a diurnal pattern
  - Best Resources in SA and VIC but good sites in NSW
  - ~1780MW operating
  - Cost typically ~$100/MWh
  - Currently around +15,000MW of projects under consideration

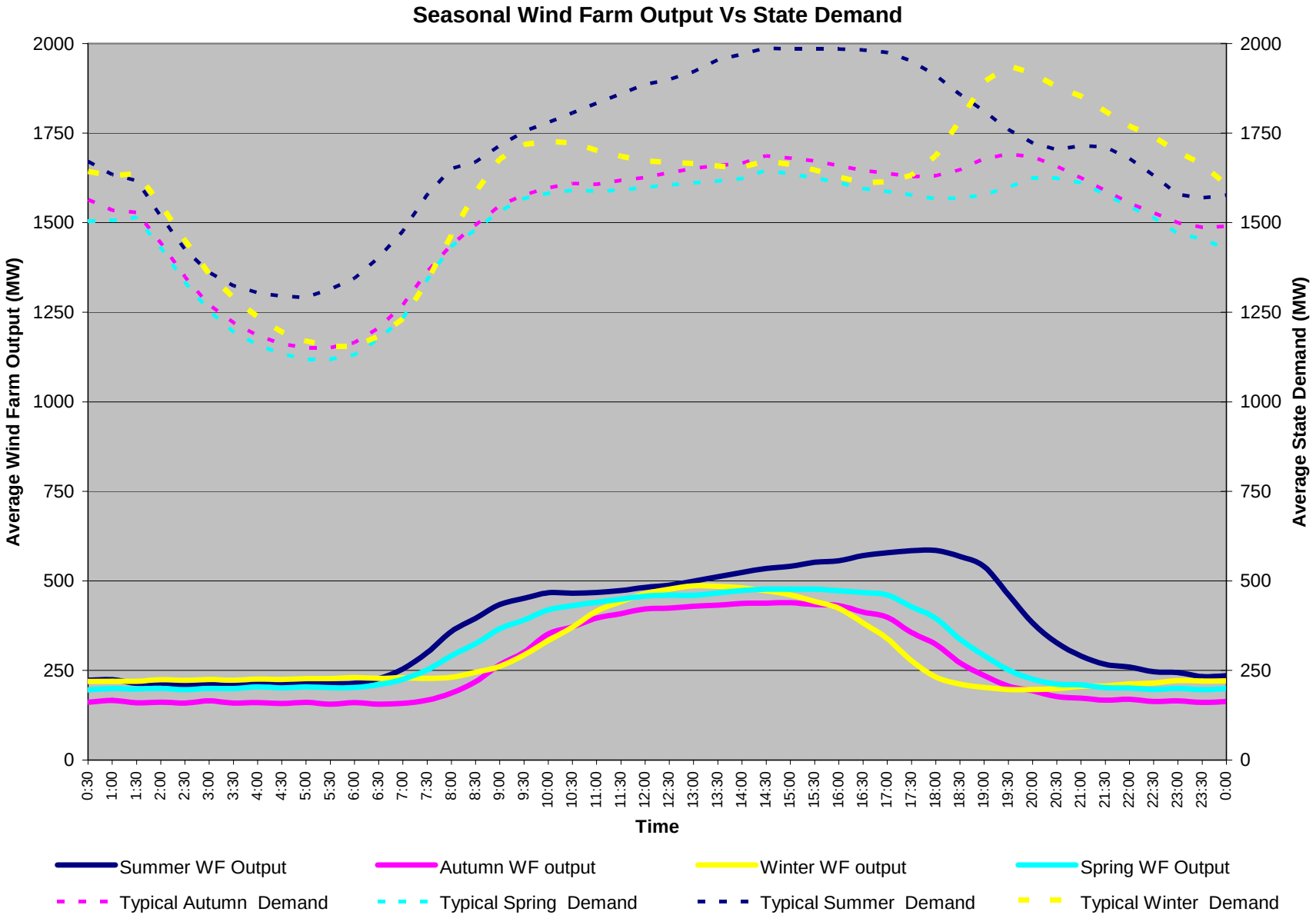
DAILY AVERAGE GENERATION BY MONTH

1000MW INSTALLED

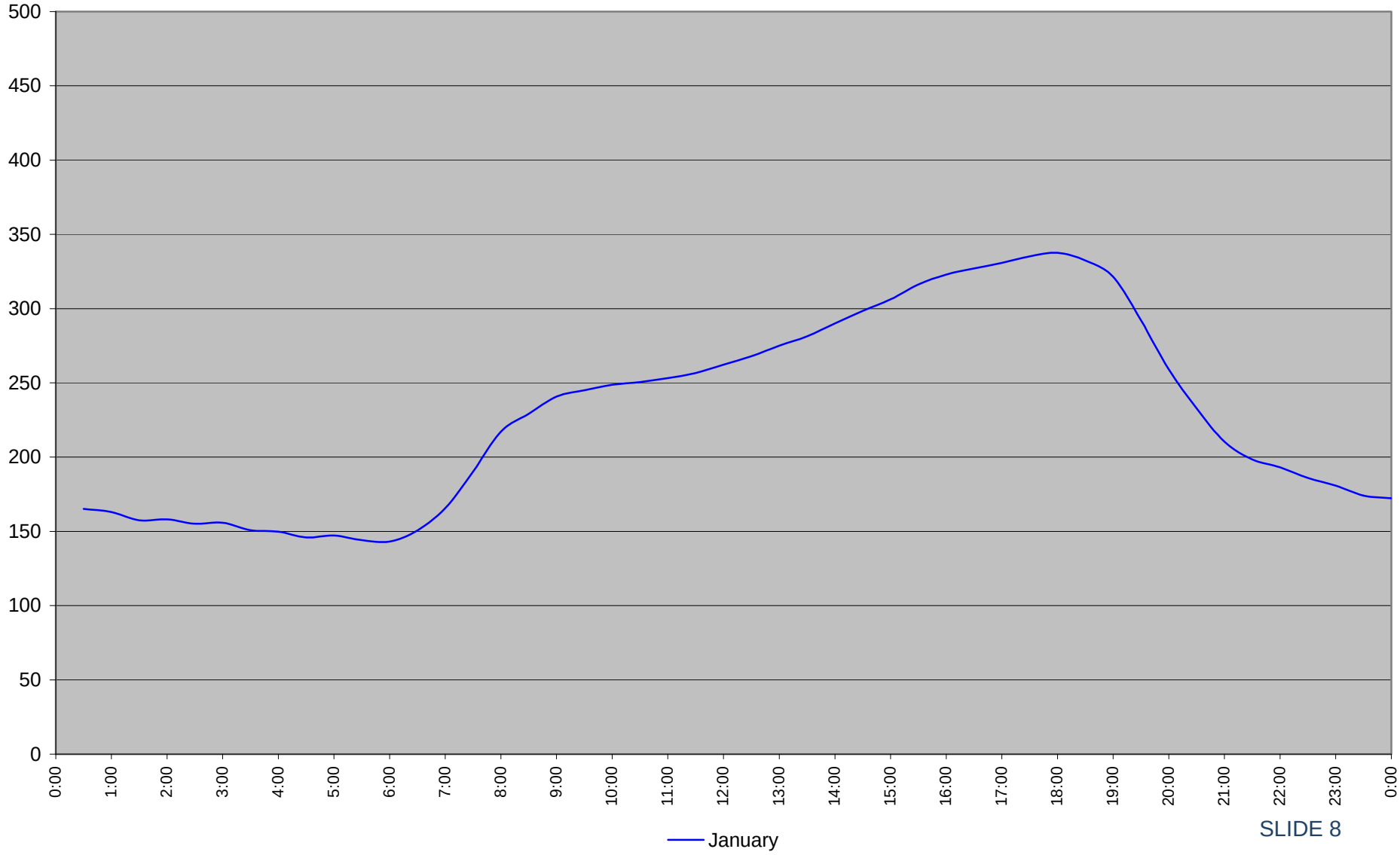


RELATIVE TO DEMAND

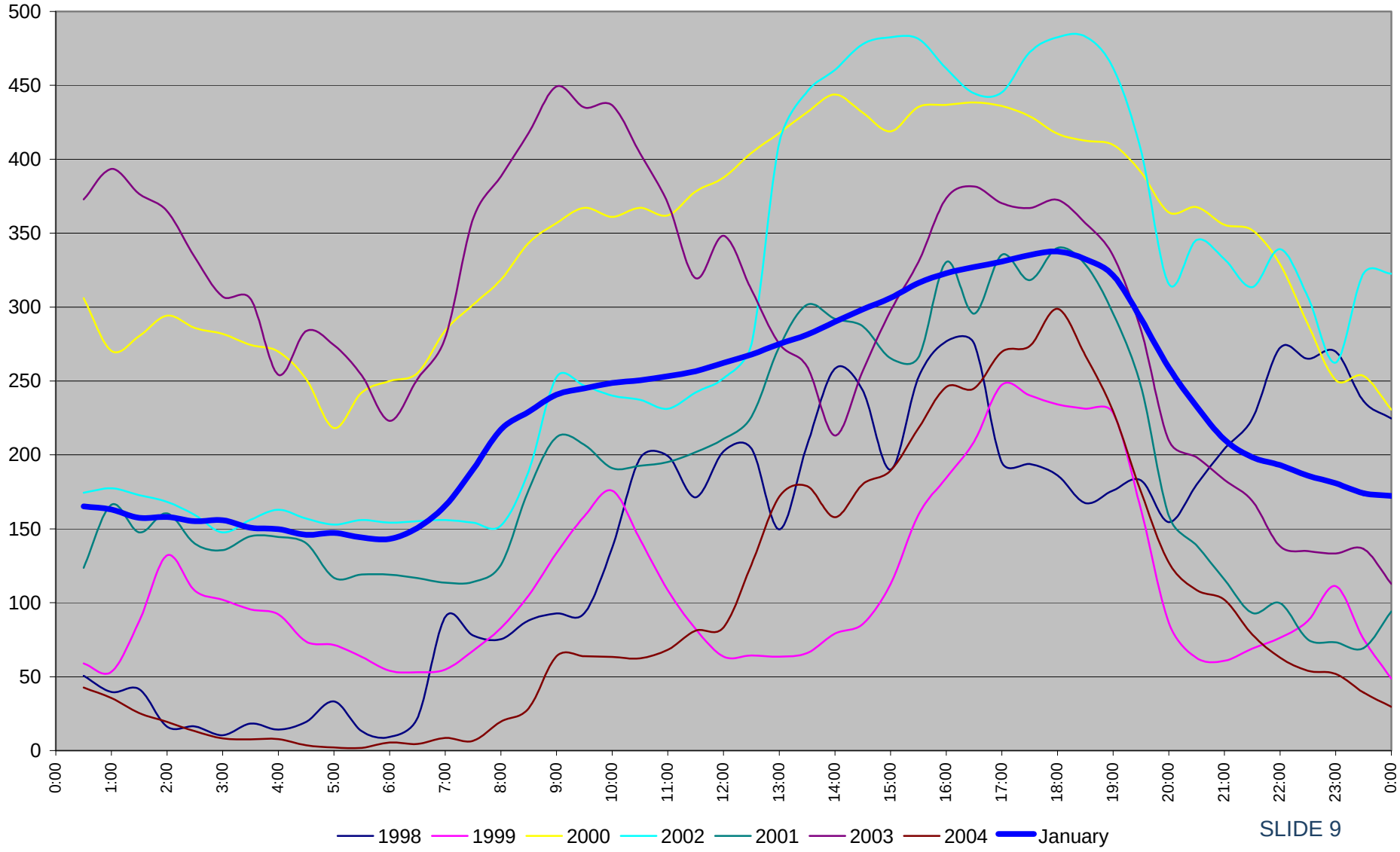
1000MW INSTALLED



AVERAGE VS ACTUAL



AVERAGE VS ACTUAL



WHAT DO YOU KNOW ABOUT SOLAR POWER

- Intermittent resource
  - No forecasting systems available at the moment
  - Typical capacity factor between 16% and 20% for rooftops slightly better for other systems
  - Contribution during current peak demand periods
    - 50% in SA unknown in other states
  - generation pattern may match travel / charging in summer
  - ~120MW operating
  - Cost typically $200-300/MWh
  - Large potential but implementation is slow

WHAT DO YOU KNOW ABOUT GEOTHERMAL POWER

- Potentially a base load resource
- Two main types Hot Saturated Aquifers and Hot Dry Rock
  - Drilling to depth is feasible
  - On ground generation technology is feasible
    - Low temperatures (<300C) low thermodynamic efficiency but..?
  - Currently not commercial
    - Targets for +500MW by 2020
  - Initially ~$120MWh dropping to $80/MWh in time
  - Currently best resources a long way from the load centres.
  - Massive potential- estimated +7000 years of supply of all of Australia's energy needs

HOW DO YOU CHARGE A CAR?

- Dumb Charge
  - Plug it in when ever and where ever you stop
  - Charge it up as soon as it is plugged in
  - Very simple!
    - No communication overhead
  - Can't be seen as "green" - no link to renewable generation
  - Really bad for the grid and peak demand management
    - Mobile transient loads
      - the CBD in the morning with your office loads
      - The suburbs in the afternoon with your home loads
  - Adding to demand in peak periods pushes up prices

HOW DO YOU CHARGE A CAR?

- Smart Charge
  - Plug it in when ever and where ever you stop
  - Charge it up only as much as is necessary
    - Car records data on trips, locations, potential future destination ie tell the car you are going to grandma's house next, or to the office tomorrow
    - When demand at the location drops to match network capability -> charge
    - Limit load on network from all devices to a maximum, use the car to supply some of that charge
  - Minimal additional grid infrastructure
  - Holding prices up by maintaining demand or lifting demand in off peak
  - Greater time to coincide with renewable generation

HOW DO YOU CHARGE A CAR?

- Green Charge
  - Plug it in when ever and where ever you stop
  - Charge it up only as much as is necessary but only if there is green power available to you in your area
    - Car records data on trips, locations, potential future destination ie tell the car you are going to grandma's house next, or to the office tomorrow
    - Grid tells the charger what green power is available
      - How much green power is going in
      - Can you get it here
  - BIG communication overhead.
  - What happens if the car battery is low or flat and renewable energy isn't available?
    - Can you select black power?
    - Bigger battery – more opportunity to charge

HOW DO YOU CHARGE A CAR?

- Smart Green Charge
  - Plug it in when ever and where ever you stop
  - Charge it up only as much as is necessary but only if there is green power available to you in your area
    - Car records data on trips, locations, potential future destination ie tell the car you are going to grandma's house next, or to the office tomorrow
    - Grid tells the charger what green power is available
      - How much green power is going in
      - Can you get it here
    - Car tells the Grid how much power is stored an available to offset customer demand
  - BIGGER communication overhead.
  - What happens if the car battery is low or flat and renewable energy isn't available?
    - Can you select black power?
    - Bigger battery – more opportunity to charge when renewable available

LOTS OF CHALLENGES WITH EV'S

- Forecasting Demand
  - Instantaneous customer demand will be dramatically affected over the day and between days
- Operational
  - What visibility to the market operator
  - Matching requirements
- Regulatory and Settlement
  - NER has retailer obligations
    - Does the charge post belong to one retailer or many are they like ATM's
    - GHG reporting
  - Connection and grid performance standards and costs
  - Safety
    - Supply back to the grid
    - Emergencies and maintenance

YOUR ATTENTION IS APPRECIATED

And so are your questions

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR