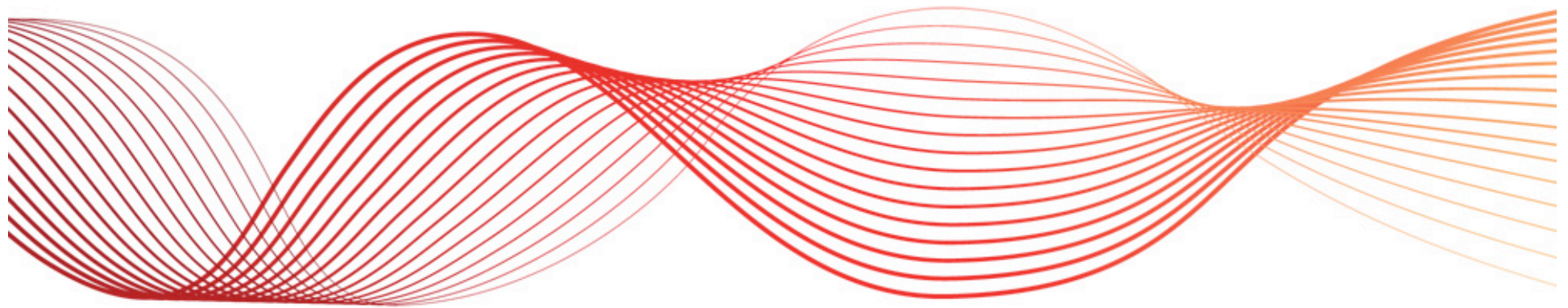


ELECTRIC VEHICLES AND THE ENERGY MARKET

April 2011



PRESENTED BY CRAIG OAKESHOTT
SENIOR MANAGER STRATEGY AND ECONOMICS

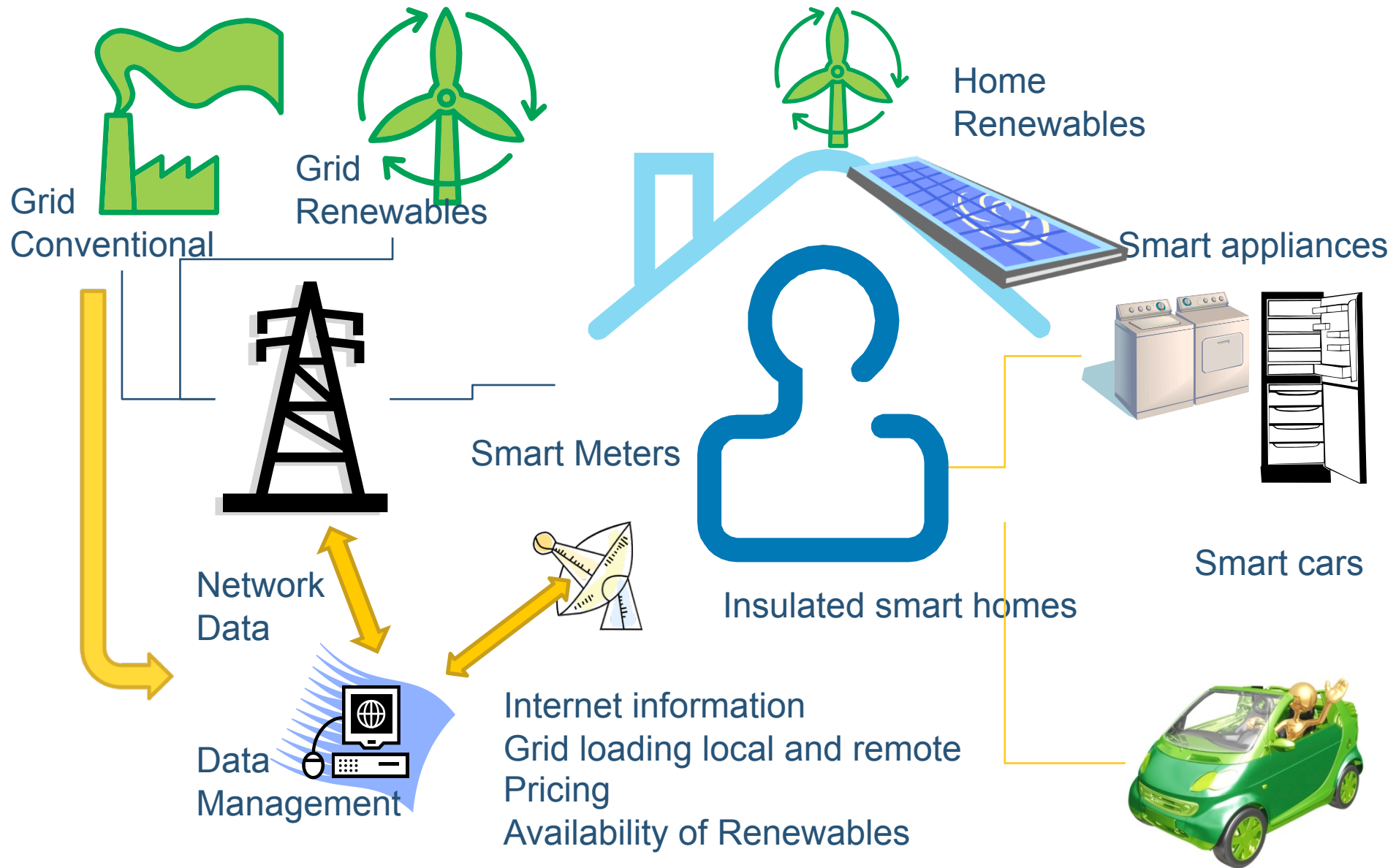


WHAT IS A SMART GRID?

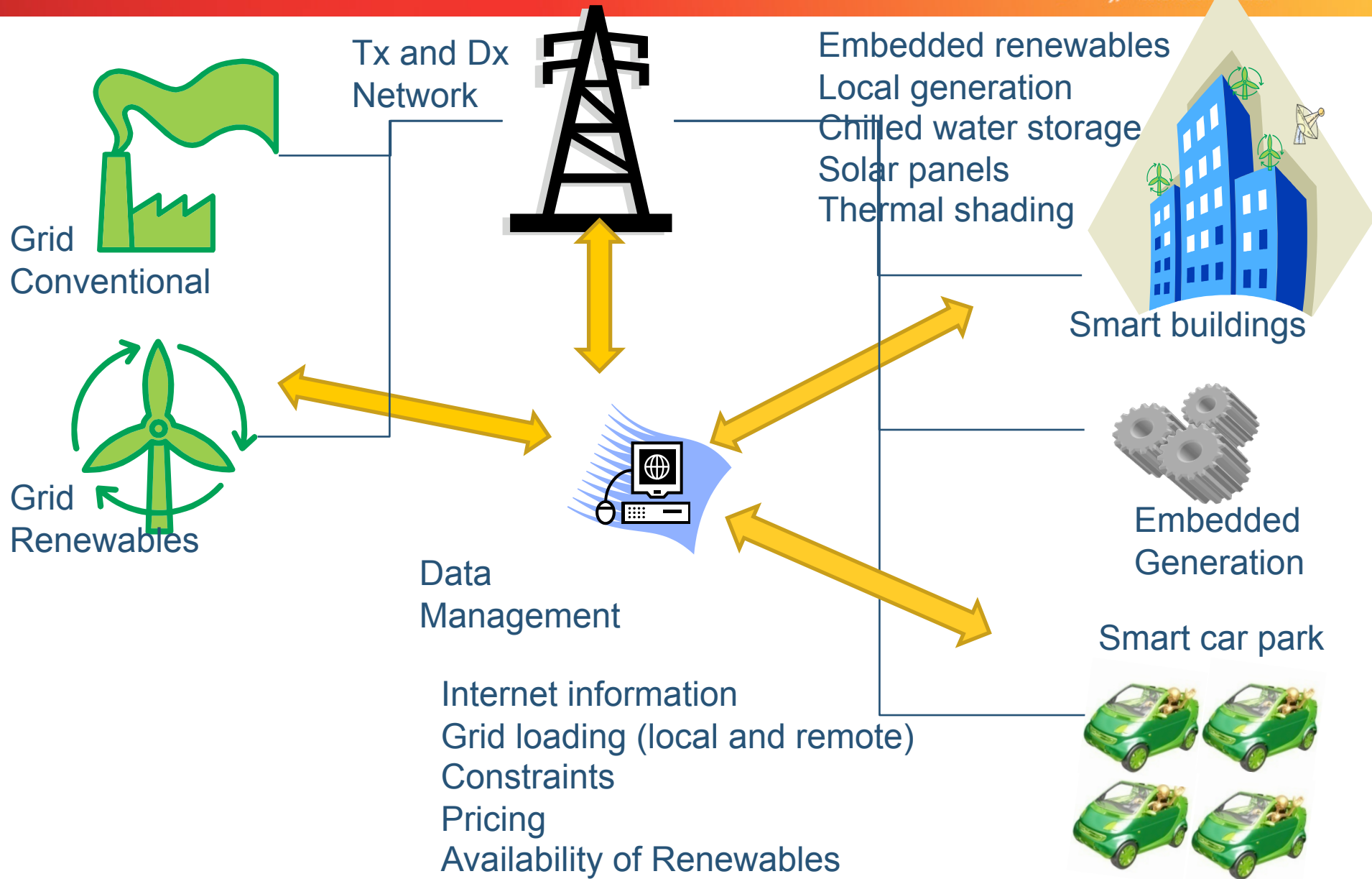


- Definition is becoming CLEARER with time.
 - A grid that uses
 - Communication, sensors, and analysis to improve flexibility security, safety and reliability
 - By
 - Facilitating user opportunities to consumption in response to
 - pricing signals
 - network utilisation
 - generation availability
 - While still delivering the anticipated utility to the consumer and benefit of the environment.
- CLEARER - BUT NOT MUCH CLEARER

WHAT IS A SMART GRID AT HOME



WHAT IS A SMART GRID IN THE CITY



EV'S COULD BE MORE THAN JUST CARS



- Smooth, Clean Quiet, good for the environment
- Thorny issue is : charging
 - How big a battery is necessary for the car – what about the grid?
 - Linked to renewable energy to get a low footprint
 - What renewable sources will it come from?
 - Solar
 - Hydro
 - Wind
 - others
 - 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 NATIONAL ELECTRICITY MARKET



- People are a mostly a mobile source of demand
- Industry is mostly a fixed source of demand
- EV's
 - are mobile demand
 - could be mobile supply
- 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

OPPORTUNITIES FOR SMART GRIDS AND EV'S



- Storage makes an intermittent source reliable
- For EV's
 - Managing some section of home demand
 - Contributing to home supply
- Massive potential to change existing paradigms
 - Old Paradigm
 - generate to match consumer demand
 - New Paradigm
 - consume when generation available
- What happens to the network if we do this?

OPPORTUNITIES FOR SMART GRIDS AND EV'S



- Significant intermittent renewable potentials (local and centralised)
- Energy storage potential, (local and centralised)
 - Hydro
 - Batteries (including potentially EV's)
 - Thermal
 - Other fuel sources, hydrogen, Methane, ammonia splitting
 - Flywheels
- Demand Growth
 - Trend is for bigger homes, more appliances
 - Peak demand growing faster than energy
 - Load factor worsening
 - Smart management has the potential to reduce the load factor by shifting demand and storing energy

- Manage network utilisation to avoid
 - Costly network expansion
 - Improve reliability
- Maintenance still needs to be performed
- Working all power stations very hard has issues
 - Base load generators are mostly coal – retiring them and going to gas is capital intensive
 - Intermittent and peaking generators are often gas but also less efficient and reliable.
- National market and national grid but not unconstrained transmission paths
- State based emissions figures are not very reliable

CHALLENGES IN DISPATCH TIMEFRAMES



- Dispatch time frames (5 minute)
 - Market systems currently dispatch scheduled generation to match customer demand
 - What is customer demand with a smart grid and how do we predict where it goes over short time intervals
 - Lots of small inputs – significant information transfers and processing for real time dispatch
 - Information from facilities not currently monitored
 - Local transformers,
 - street level demand and congestion
 - Who issues the signals AEMO, or the TNSP or the DNSP or the retailer or someone else?
 - Matching intermittency with other facilities
 - Local battery storage – cars, flywheels, home generation,
 - Grid connected – conventional and renewable generation

CHALLENGES LONGER TERM



- Demand forecasting
 - ½ hourly, pre-dispatch, STPASA, MTPASA time frames
 - Currently forecast at a native demand level
 - How much storage is installed, charged and where?
 - Need a reporting framework for new installations
 - Home installations are simple but (dude) where is the car?
 - How charged is the storage at the moment?
 - What is the intermittent forecast and its relationship to storages
 - How much to rely on at time of peak and where is it?
 - At the home level
 - In car parks in the CBD
 - How does it change the way the market is operated?
 - reserve margins and reliability standards

- **Communication challenge**
 - Large amounts of data
 - Short time frames
 - very variable locations and reactions
- **Possible safety and standards issues**
 - What happens in
 - a local fire or unit level local interruption
 - an isolated area district, suburb, peninsula
 - Emergency situations with emergency services
 - Communication reliability
 - What do you do if the signals fail

OTHER CHALLENGES



- Integration challenge
 - Standards for
 - Appliances lots of standards coming
 - Communication protocols
 - Charging locations (battery standards)

- Metering and charging arrangements
 - Retail bills
 - Information requirements on retailers and accounts
 - GHG reporting
 - Battery charge back arrangements or recharge costing
 - Multiple customers using a single charge point – same retailer?
 - Financing infrastructure
 - New transmission and distribution

FOUR TYPES OF CHARGING



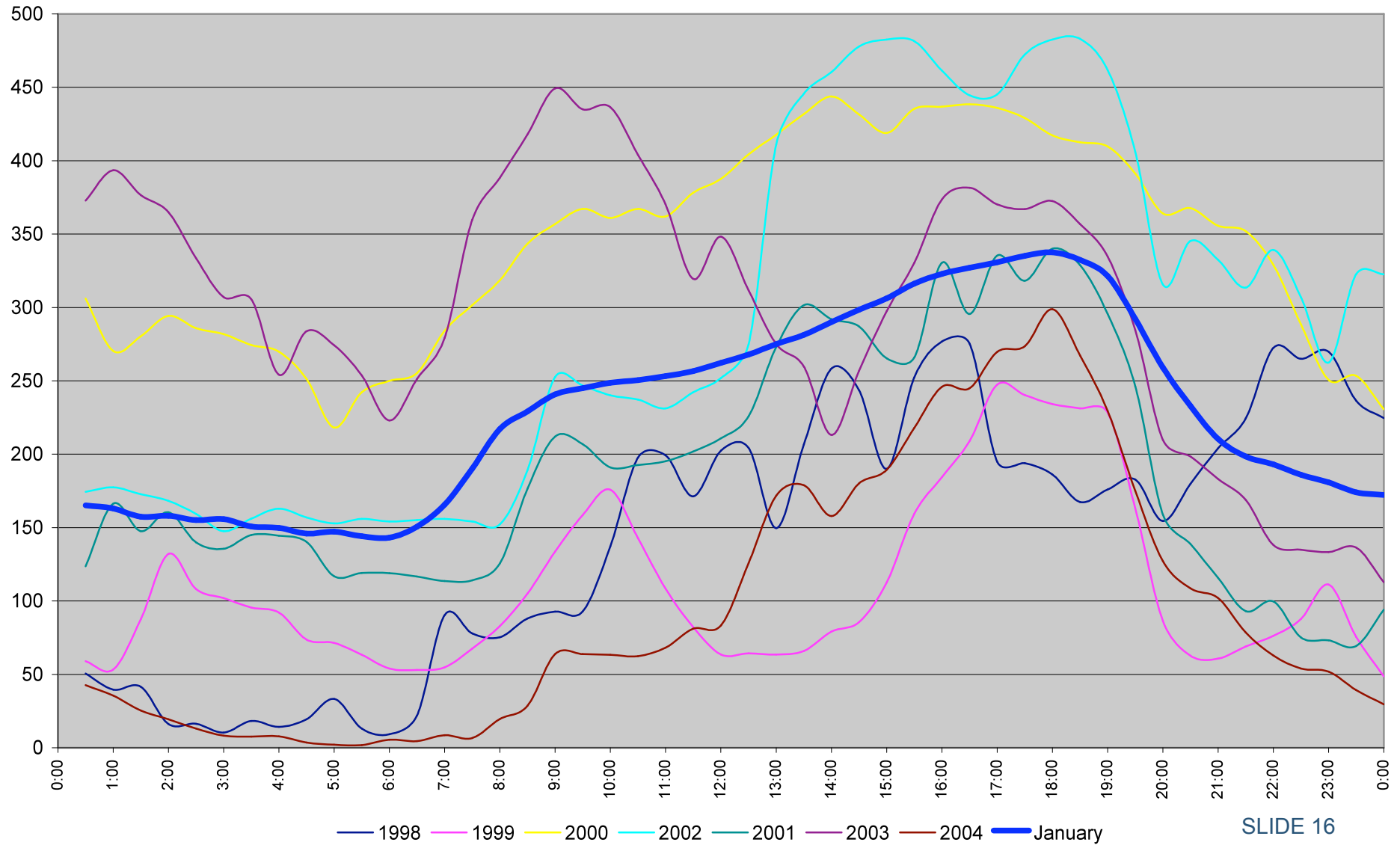
- Wide range of complexity of with respect to the charging regime:
 - Dumb / On demand
 - Off peak / scheduled to off peak low demand period
 - Smart triggered by price and network connectivity
 - Smart / Green triggered by availability of green power, price and network connectivity
- Load management, safety and security very important
- Communication is a key to success
- Don't underestimate the complexity of implementing standards

WHAT DO YOU KNOW ABOUT GREEN POWER

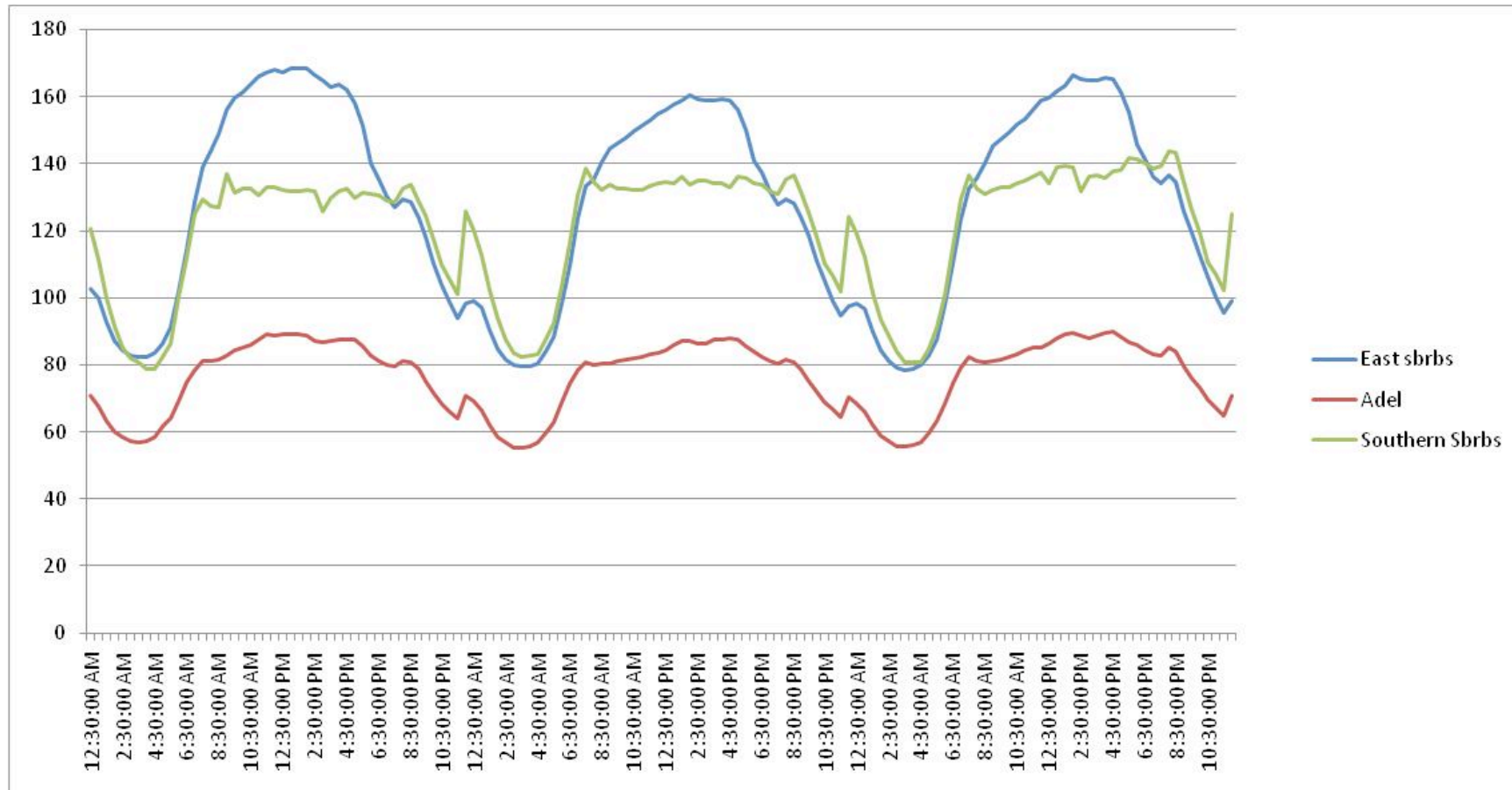


- Intermittent generation already has some challenges
 - Predictability - aided by forecasting systems but...
 - Typical capacity factor
 - Wind 30% - 40%
 - Solar up to 25%
 - On average generation follows a diurnal pattern
 - Best wind resources in SA and VIC but good sites in NSW
 - ~2000MW of wind operating
 - Wind ~\$100/MWh, solar ~\$300/MWh
 - Currently around +15,000MW of wind projects under consideration
 - Rooftop PV growing
 - Solar Flagships projects (PV and Solar Thermal)

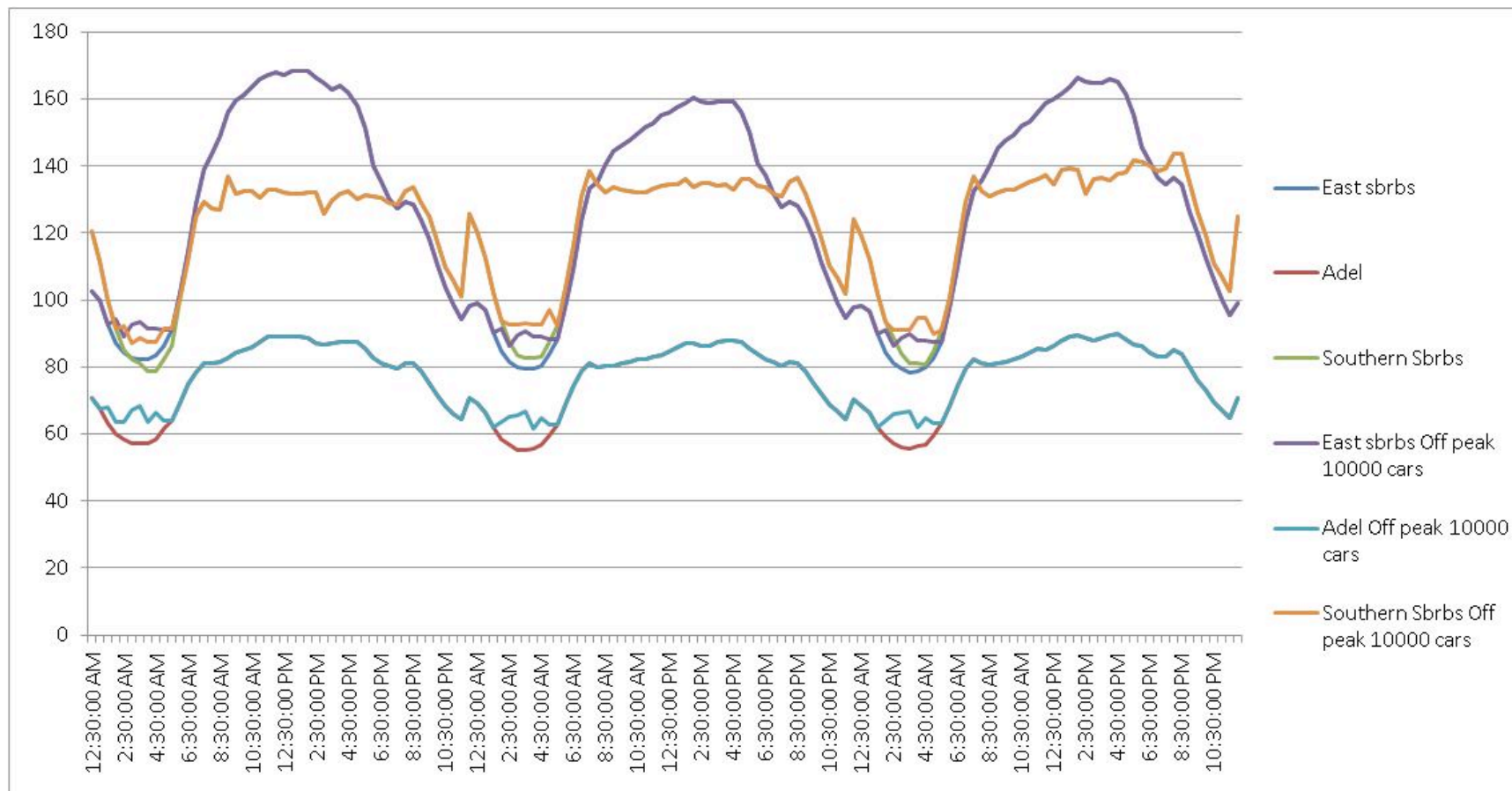
AVERAGE VS ACTUAL



TYPICAL DEMAND PROFILES



TYPICAL DEMAND PROFILES + OVERNIGHT CHARGING 10000 CARS.



LOTS OF CHALLENGES WITH EV'S



- While there is still a grid then there will need to be scheduling and forecasting
 - Instantaneous customer demand will be dramatically affected over the day and between days, depending on charging regime
- 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

