

Smart Grid Opportunities & Risks

ATUG Regional Conference – Canberra, 20-21 May 2008



Robin Eckermann
Principal, Eckermann & Associates
Adjunct Professor, University of Canberra

Put yourself in the shoes of the average Australian Electricity Utility

- Monopoly life is pretty cosy
- Vast network assets
- Distributing electricity “radially”
- SCADA to zone substation (only)
- Limited “visibility” of your network

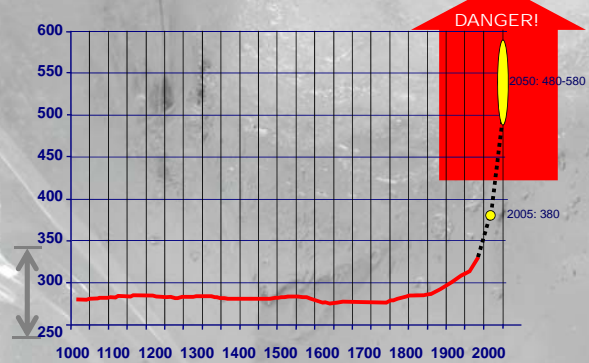


Business hasn't changed much for decades, but now there are new challenges on the horizon!

- Workforce is ageing
- Energy costs are rising
- You're the #1 culprit in GHG emissions



CO₂ Projections



The Environmental Challenge in Australia

559m tonnes CO₂ emissions in 2005
Worst per capita offenders in the world!
Climate change disaster scenarios looming
Electricity consumption accounts for 35%

A sliver of hope?
US EPRI estimate Smart Grids could deliver 13-25% GHG reduction

But what is a Smart Grid?

“A modernisation of the electricity distribution grid through the use of advanced sensor, communication, control and information technologies”

(US Department of Energy)

... but as with the term “broadband”, there is no singular, agreed definition of exactly what this entails

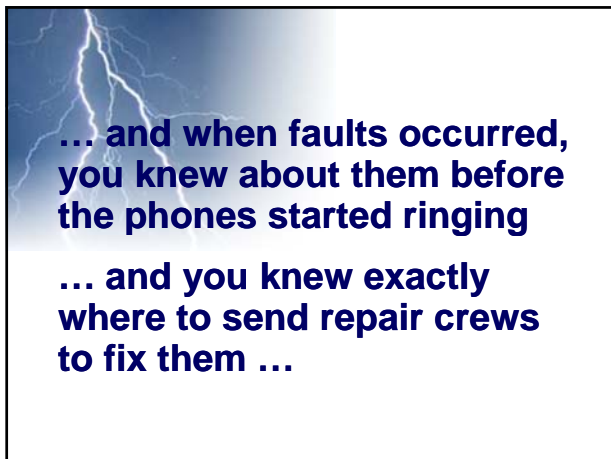
Imagine ...

... you could foresee problems looming long before equipment failed and services were disrupted ...



... and when faults occurred, you knew about them before the phones started ringing

... and you knew exactly where to send repair crews to fix them ...

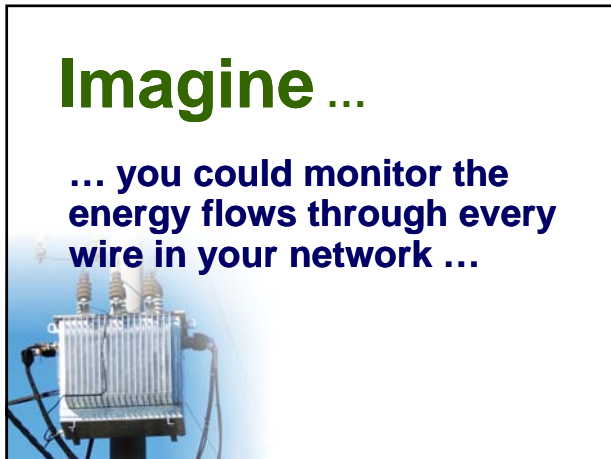


... and repair crews could confirm that *all* affected customers were back online before leaving the job



Imagine ...

... you could monitor the energy flows through every wire in your network ...

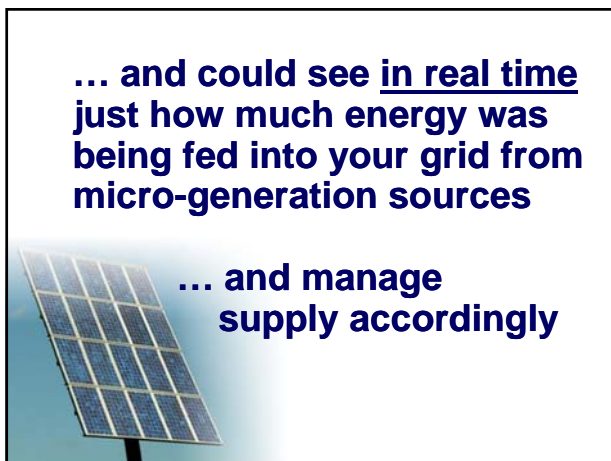



... and could extend the life of your assets by always operating them within their design tolerances ...



... and could see in real time just how much energy was being fed into your grid from micro-generation sources


... and manage supply accordingly






... and you could target load shedding measures with surgical accuracy to affect just the “hot spots” in your grid ...

... and know exactly what quality of power supply you were delivering to your customers




The graph plots Voltage (Y-axis, 118 to 126) against time (X-axis, 1:00 AM to 11:00 PM). It shows significant fluctuations, with a notable dip around 10:00 PM.



Imagine ...

... you could read any meter instantaneously ...

... or collect usage from hundreds of meters every second ...



... and could identify when and where more energy was being consumed that what was being billed ...

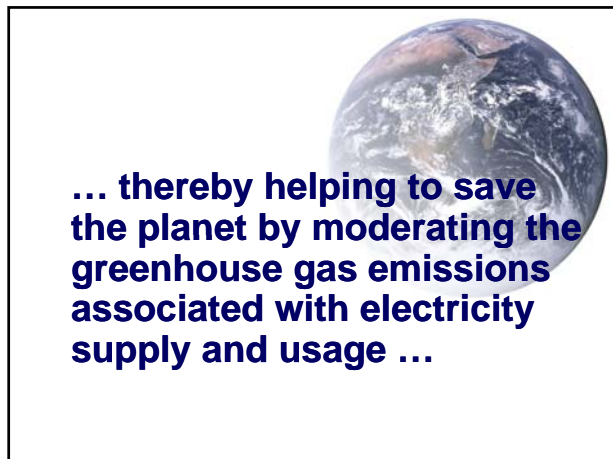


... and open a new channel of communication with all of your customers

Imagine ...



... you could reduce inefficiencies and losses in operating your grid ...



This is what Smart Grid is all about!

1989 BMW 535i	2007 BMW 525i
3.4 litres	2.5 litres
155 kW	160 kW
0-100 km/h in 8.6s	0-100 km/h in 7.9s
12.3 l/100km	9.4 l/100km

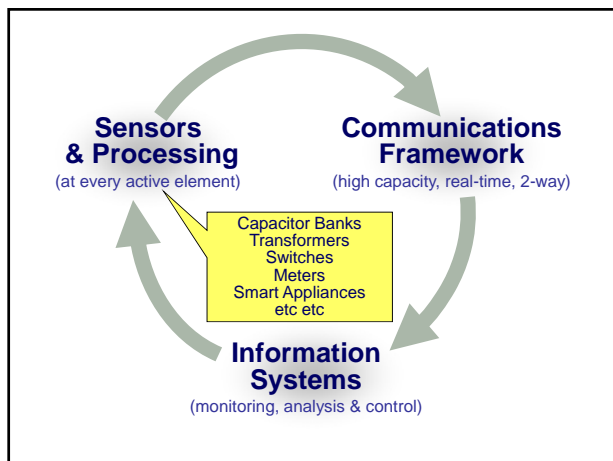
Smart engine technology (embedded micro-computers & communications) accounts for most of the improvement

Smart Grids

More effective management of electricity supply by distributed computing and communications technology

Potential? *Up to 25% reduction in energy use and CO₂ emissions ...*

... plus gains in efficiency and reliability!



So What's Australia Doing? (a simplified summary)

"Advanced Metering Infrastructure" (AMI) rollout initiated by Victoria – smart meters
 Record usage in half-hour intervals and use differential pricing to reduce peak usage
 Communication requirement: framed in terms of reading 48 x ½ hr readings once-a-day
 Triggered consideration of national approach (currently underway) led by COAG

AMI on its own delivers only a subset of full Smart Grid benefits

Communications Requirements

By introducing time-of-use (TOU) pricing, AMI starts a process with far-reaching consequences:

*"The end-user is not Mr. Smith or Ms. Jones ...
 ... the end-user is the washing machine!"*

Nicolas Arcauz, Metering Conference, Vienna, October 2007

Consider:

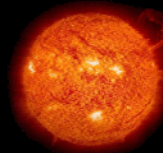
- real-time status information from every active element
- surgically targeted demand management commands
- keeping track of dynamically changing "non radial" energy flows

and of course:

- reading 48 (or more) energy usage figures

This is not a narrowband problem!

Smart Hot Water System



Using micros and communications:

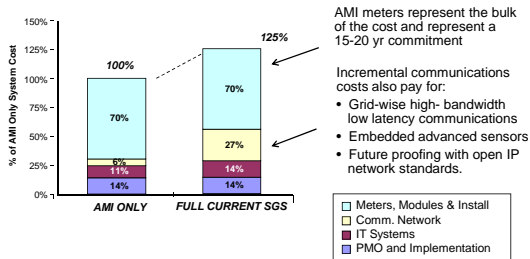
- learn usage patterns to predict demand
- obtain weather forecasts & energy prices
- anticipate what solar panels will deliver
- optimise supplementary energy usage

Based on Usage of 200 Litres/day & Canberra Prices	Electric *	Gas *	Solar +Gas	Smart Solar +Gas
Annual Energy Consumption (kWh)	4,600	6,400	1,900	1,150
Annual CO ₂ Emissions (kg)	4,800	3,000	1,100	700
Operating Annual Cost (\$)	462-623+	301	209	174

*Note that these figures do not take into account distribution losses – highest for electricity

Capital costs to deploy a full Smart Grid are ~25% higher than AMI

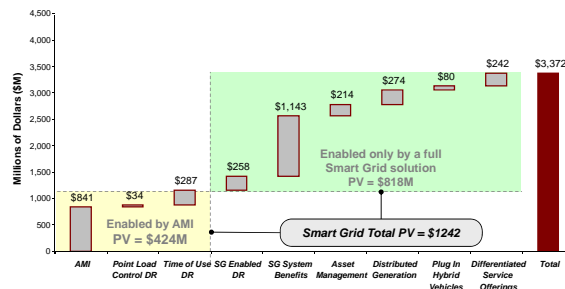
Total Cost of Deployment per Home Passed




*Note: Deployment costs only; additional operating costs and incremental ongoing CAPEX required for both cases

Benefits are ~190% higher!

Illustrative benefits analysis using model developed by Booz Allen Hamilton (US utility with 1 million meters, analysis over 17 years)



PV assumes 10% per year discount rate




One Efficient Communications Solution

Broadband over Power Lines (BPL)


Naturally aligned with grid
 High capacity
 Symmetrical
 Two-way
 Low-latency

Sufficient capacity to support future growth or value-add services



Another Smart-Grid Friendly Communications Approach

- Today's PLC & mesh radio not adequate
- Requirement can be solved by design and produced in low cost silicon chips
- Use Cenelec-A band for robust bi-directional performance (70 kbps) and 240v reach
- 54.5 million meters buying power
- Promises to be basis of a major international standard for AMI communication (OPEN)
- Deployments commencing from 2010



Here comes the Sting!

If the communication solution deployed for meters is not capable of supporting Smart Grid needs, utilities will be locked out of real grid modernisation for the life of the meters (~15 yrs)

Rather than rushing into AMI:

- Australia needs to take time out to understand the bigger Smart Grid opportunity
- Align with emerging international standards!



Why should you care?

You'll pay for it through increased electricity charges – so demand value for your money!

A vital industry operating below international best practice will affect Australia's competitiveness

You and your offspring have to live on this planet!

For the sake of our children and their children, lets take the time to get it right!



Thank You!

Grandchildren proudly produced by Robin Eckermann & family