

# EEDAL'06

INTERNATIONAL ENERGY EFFICIENCY IN  
DOMESTIC APPLIANCES & LIGHTING CONFERENCE '06

Hot Water Load Control in South Africa

Johan Delpport & Nico Beute

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# Overview

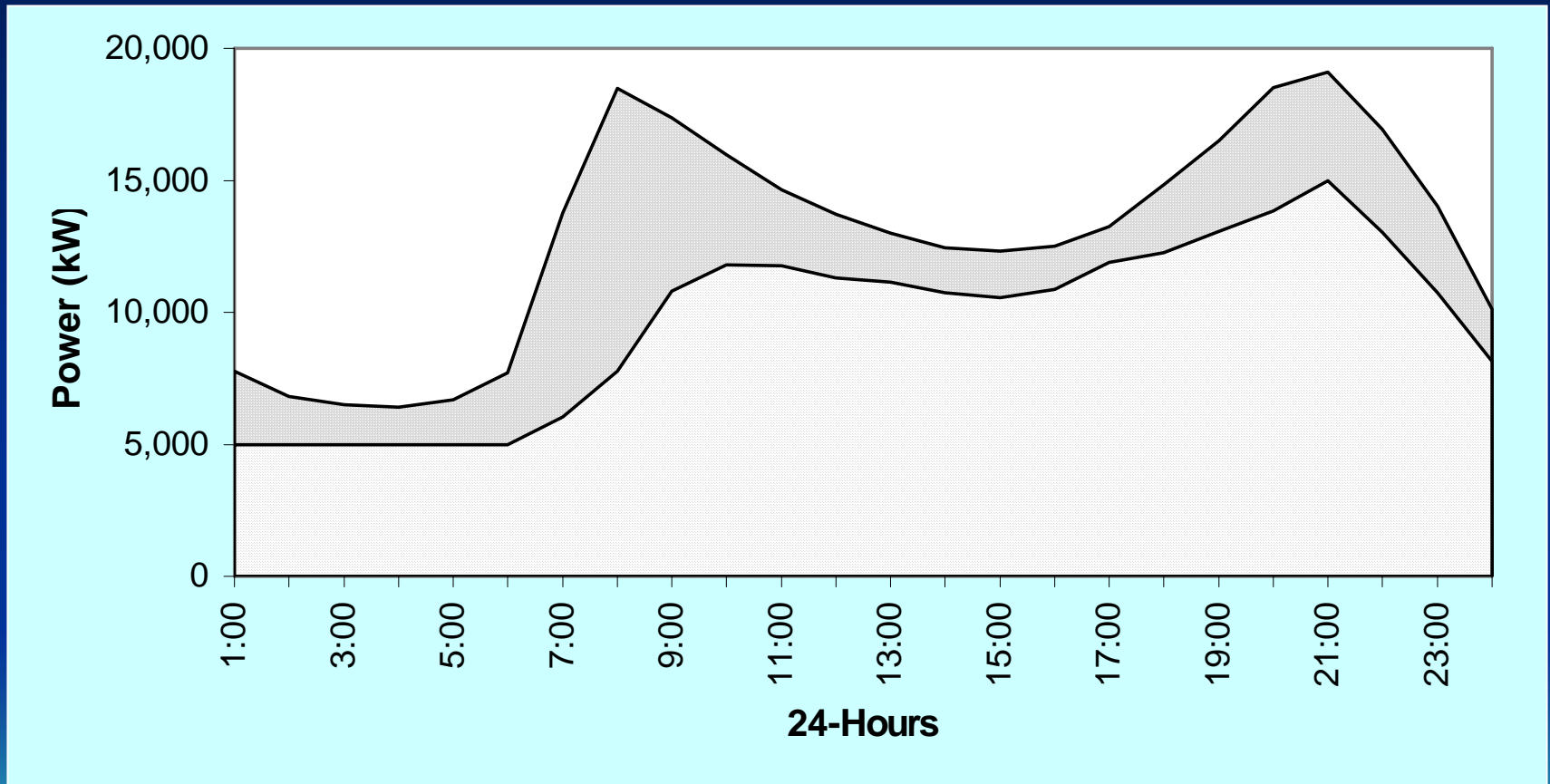
- The beginnings of ripple control
- Uses of controlling equipment
- Hot water load issues
- Current and new trends
- Algorithms for control
- Conclusions

# Introduction

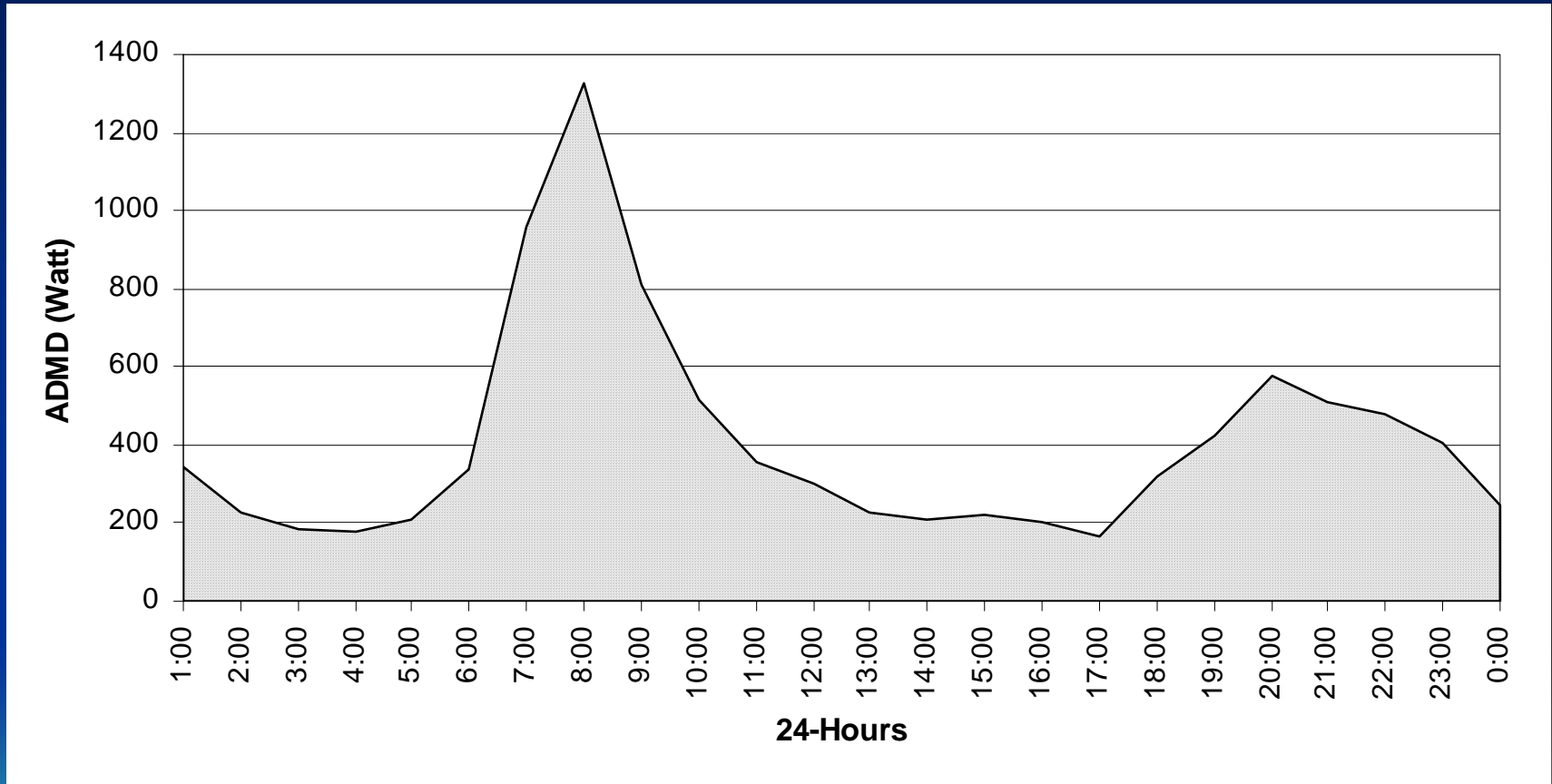
- The cost of electricity is greatly influenced by the peak load
- Hot water load in SA constitutes 25 to 40 of domestic load
- Domestic Load is a very peaky load during peak load time
- Water heating can be delayed during peak time without inconveniencing customers

# Hot water (Controllable) Load

in relation to the base load of a municipality



# The Hot water load (controllable)



# The beginning of ripple control

Year of publication	Authors	Principle
1897	Brown & Rouin (France)	Presence or absence of a d.c. between active and earth of an a.c. network (the inverse for d.c. networks)
1901	Turpain & Renous (France)	'Hertzian waves' generated by Ruhmkorff inductor. Detection by iron-fillings detector (branley's coherer)

# Commercial ripple control

<b>Year</b>	<b>Coding system</b>	<b>Coding system</b>	<b>Method of injection</b>
<b>1927</b>	<b>Cie des Compteurs (F) (Actadis)</b>	<b>One carrier frequency per command. Pulse duration 0.5 minute.</b>	<b>Sequential series injection into M.V. feeders.</b>
<b>1928</b>	<b>Durepaire-Perlat (F)</b>	<b>Rhythm of changing polarity impulses. 1 rhythm per command.</b>	<b>Injection between neutral and earth of L.V. networks.</b>

# Current technology used for HWLC

- Ripple
  - most common only one way communication
- Radio
  - use limited by mountainous terrain
- Power line communication
  - allows two way communication

# Algorithms used

- Grouping of customers
- Tariffs used
- Use notch tests to determine load
- Cold water come back load
- Reduce cost but not the supply of Hot Water
- Individualised switching

# Hot water load control issues in the early 1990's

- Reduce maximum load because of maximum demand tariff
- Pricing Policy
- Decentralised hot water load control using fuzzy logic
- Non intrusive load monitoring
- Modelling the Hot Water Load
- Solar, instant or hot water cylinders

# Hot water (controllable) load

Shape of load is dependent on: ...

- Location
- Type of consumers
- Element size
- Temperature

# Hot water load control examples of typical savings:

...

- On an account of R 900 000  
with a max demand and energy tariff:
  - Saving = R 75 000 per month
- Time of Use tariff:
  - Saving = R 200 per year per HWLC switch

# Generating Capacity in South Africa

- The South African Electrical Load is now critically near the generating capacity
- Power outages have occurred in the Western Cape because of Koeberg Nuclear Power Station malfunctioning
  - Koeberg has two 900 MVA units
  - Apart from Koeberg very limited generating capacity in the Western Cape
  - Load of the Western Cape is about 4000 MVA
  - Transmission line capacity about 3000 MVA

# Hot Water Load Control as a virtual Power Station

- Average rating of HWC is 2.5 kW
- Average load per HWC:
  - during morning peak: 1 kW
  - during evening peak: 0.6 kW
- Capital cost of:
  - controlling HWC € 350/kW
  - gas fired power station € 450/kW
  - coal fired power station € 1 200/kW
- Consider the effects of pollution

# New trends and the future of HWLC

- Two way communication
  - to give notification of temperature
  - to get on / off state
  - to report tampering
  - to improve algorithms
- Make the system more customer friendly
- Reward co-operative customers

# Conclusion

- Hot water load control is an excellent DSM measure
- Technology must improve -  
    2 way communication should be used