Synergies between Demand Side Management and Tariff Design: Residential time-of-use tariff (Homeflex) Project

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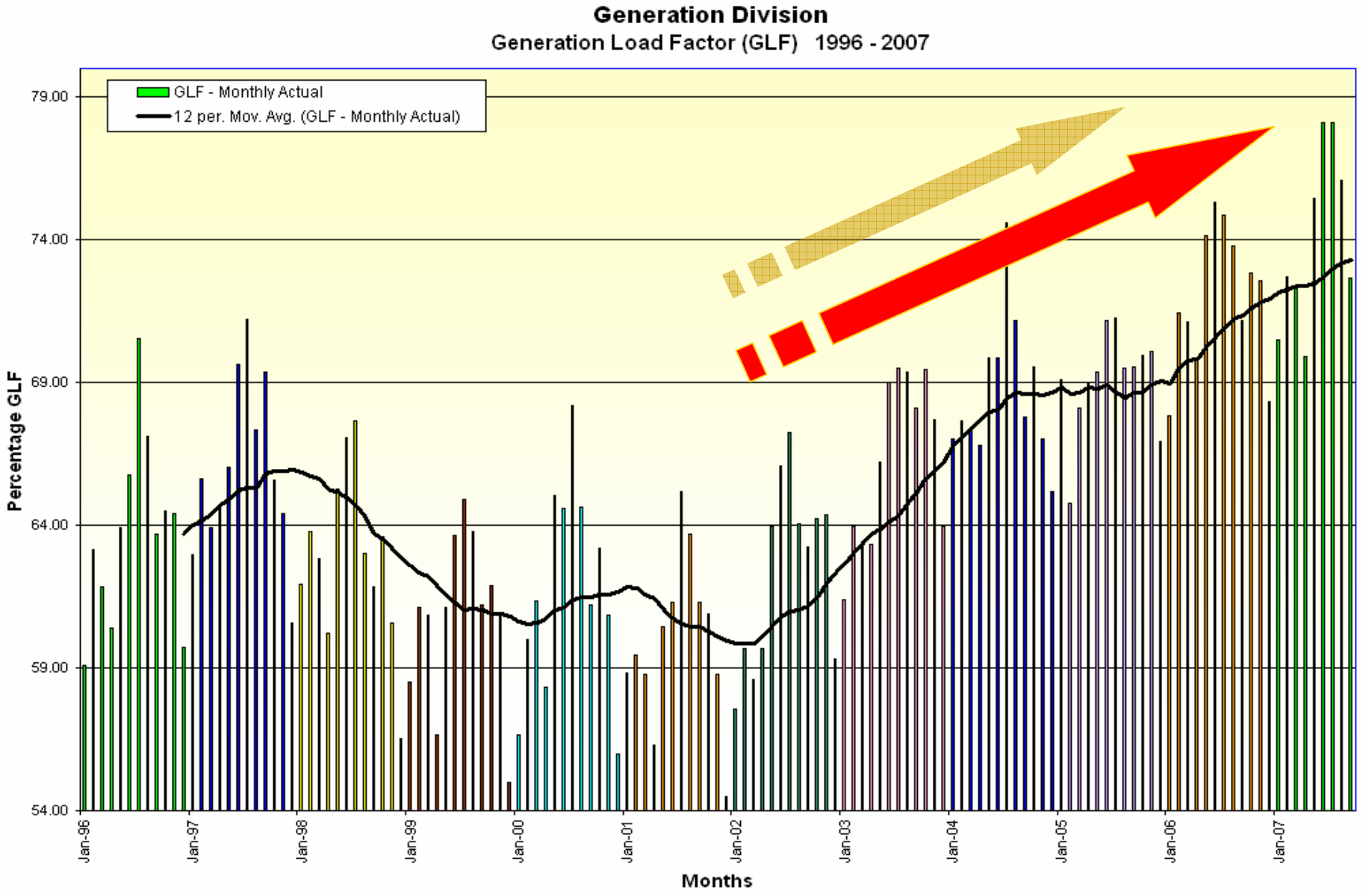
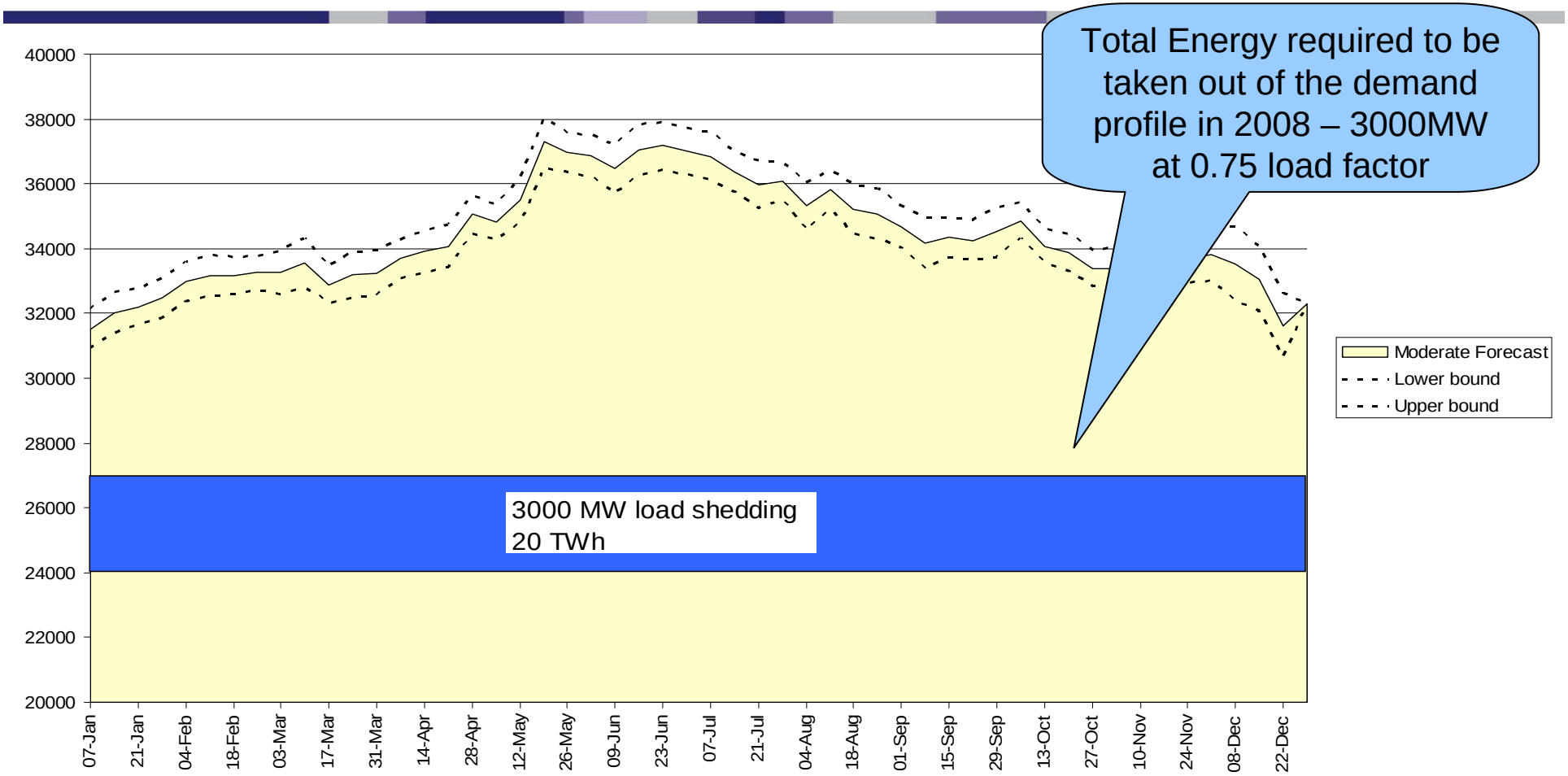


The reserve margin is currently 8–10%, against an aspiration of 15%

Increased probability of power interruptions and load shedding

Overall need to reduce 20TWH or 3000MW off the Demand Profile



- **Eskom's system is tight and the requirements are to reduce demand by 10% to achieve 20TWh or 3 000MW load reduction.**
- **This will continue for the next 5 to 8 years.**

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The First Pilot Objective

The initial objective of the Homeflex Pilot Project was:

- to develop and introduce a residential time-of-use tariff,
- that will penetrate the market, and
- provide incentives and benefits to customers,
- which will ultimately result in the optimization of the country's peak demand curve profile.

First pilot test conclusions

- A tariff (Homeflex) was developed, various pilots were run with **tariff only** - less than 5% demand response noted.
- Pricing ratios was not high enough to convey adequate pricing signal.
- Was in an era of low costs of electricity and affordability as national driver vs. customer lifestyle change (electricity was too cheap).
- Various other load management & efficiency strategies were studied during this period - not integrated with the tariff.
- Changing environment - WEPS, ISEP, ESI, EDI - tariff become outdated.
- A revised Business Case - recommended piloting of revised tariff together with load management technologies.

Second Round - Pilot Objectives

- Primary aim: to determine whether a **TOU pricing signal combined with enabling technologies** would encourage customers to shift their electricity consumption during system constrained periods.
- Other aspects tested:
  1. Customer's acceptance of and response to the tariff and load management technologies.
  2. The Distributor's support structures required for the implementation of Homeflex e.g. Metering, Billing, Contact Centre, Field Services.

Second Round - Pilot Testing

- Pilots funded by Eskom's DSM - Research.
- Revised pilots were re-launched at Sandton, Tableview with load management device.
- Three pilots were run - Tableview, Sandton and eThekweni Electricity (Durban).
- Each Pilot sample was made up of:
  - Test group customer on 2 Part Homeflex tariff,
  - Test group customers on 3 Part Homeflex tariff,
  - Control group customers (on Homepower- flat rate residential tariff).
- Load research installed at each together with current domestic meter.

10 Key conclusions from Eskom pilot tests

1. Customers **do respond** to a TOU price signal, even if the price signal is not significant, however…
2. Greater demand response occurs with enabling technologies.
3. **Maximum** demand response was achieved when TOU tariff was combined with an automated load management device.
   - Significantly more than stand-alone load management.
4. Need to get the tariff & rate design right for effective economic signalling!

10 Key conclusions from Eskom pilot tests

5. Tariff is the constant & continuous economic signal that is the "active" DSM driver for behaviour changes (to be more energy efficient & conserve power).
6. Tariff ensured that the load shedding devices is kept in place, **operating normally and untampered.**
7. To make a load management strategy successful, customer must see **tangible direct benefits**.
   - Time-of-use tariff is an extremely effective strategy that provides **immediate** incentives to customers.

10 Key conclusions from Eskom pilot tests

8. The passing on of the benefits to the customer increased the customer's active participation & increased customer service – optimal win/win situation.
9. Requirements for :
   - a load limiting device with metering technology to support TOU tariff.
   - To be targeted at customers who have non-essential appliances, including hot water load (geysers) that can be load curtailed during system constraint periods.
   - the **most cost-effective** enabling technology is a smart meter (TOU billing+ load reduction, tamper detect etc.)

10 Key conclusions from pilot tests

10. The tariff and smart meter strategy is the most cost-effective, sustainable, customer incentivised medium to long-term demand response solution.

International TOU tariff findings

World Bank Primer on DSM[1]:

1. Dynamic pricing, especially when combined with enabling technologies, can produce much larger reductions in peak demand than TOU tariffs on its own or non-technology enabled tariffs.
2. Rebates are not a cost-effective and sustainable way for implementing DSM programs. A much better way is to change energy prices so they reflect the true scarcity value of electricity by time of day.
3. Smart meters, combined with more flexible pricing, would provide an economic incentive for consumers to reduce energy consumption during the peak hours.
4. Customers are likely to respond to higher peak prices by reducing peak usage.

- The above was confirmed in Eskom's pilot study conducted between 2001 and 2005.

[1] ***Primer on Demand-Side Management prepared for*** **The World Bank by Charles River Associates**

Enabling technology: The smart meter

Intelligent staggered come-back load

Two-way Wireless Communication

Prepayment or Credit meter

Dynamic customer messaging

Remote disconnect & reconnect

Load Limiting/Reduction at supply point

Outage & Fault Notification

Power Quality (Voltage) Monitoring

Time-of-Use ENABLED

Remote Electricity/Water Meter Reading and load management

Administer Free Basic Services

Detection of Tampering and Load Shed Bypassing

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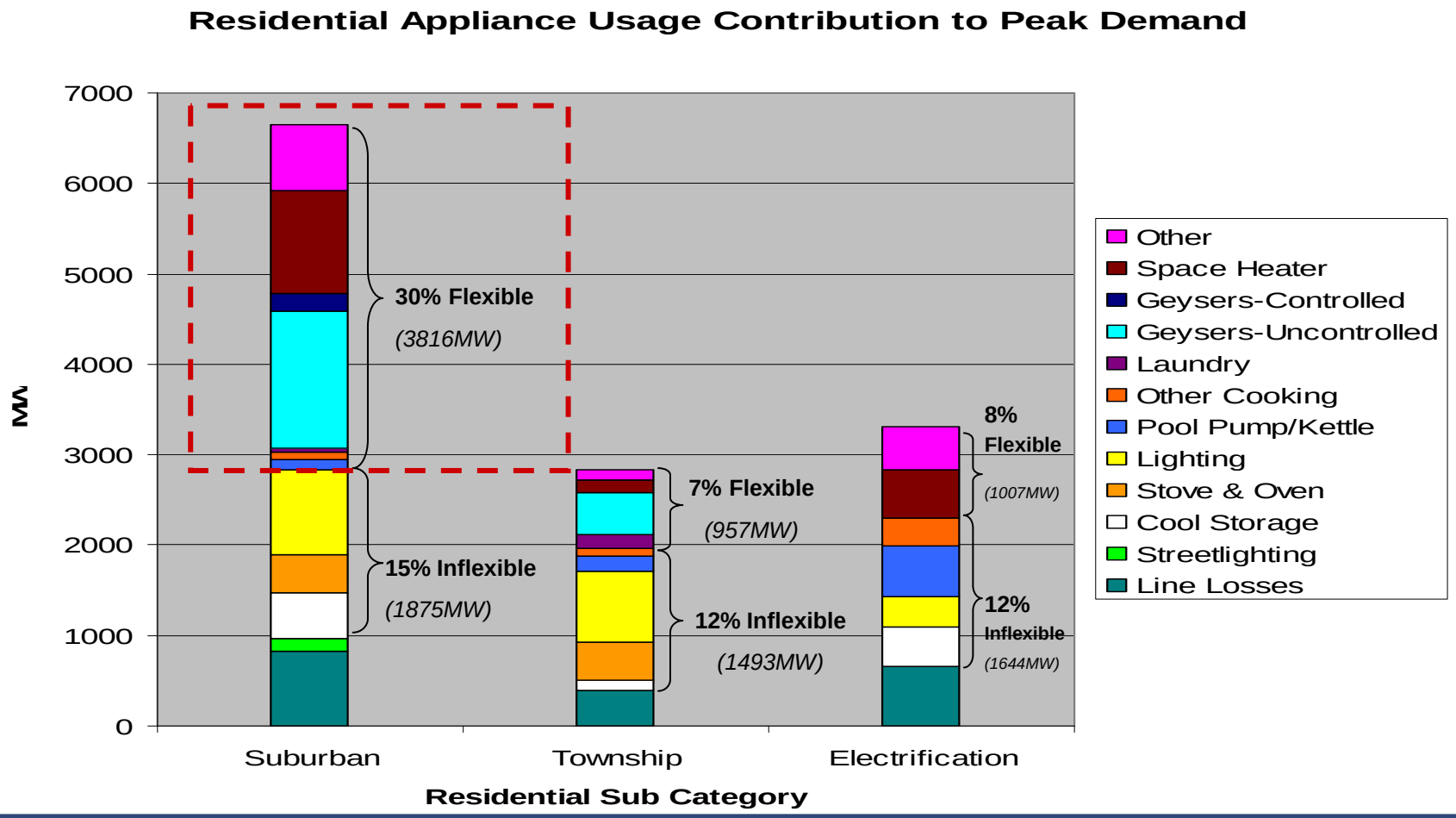
Initial Target Market[2]



Consumers will be urged to change usage behaviour on flexible appliances (power conservation/load reduction)
and to select energy efficient versions of inflexible appliances

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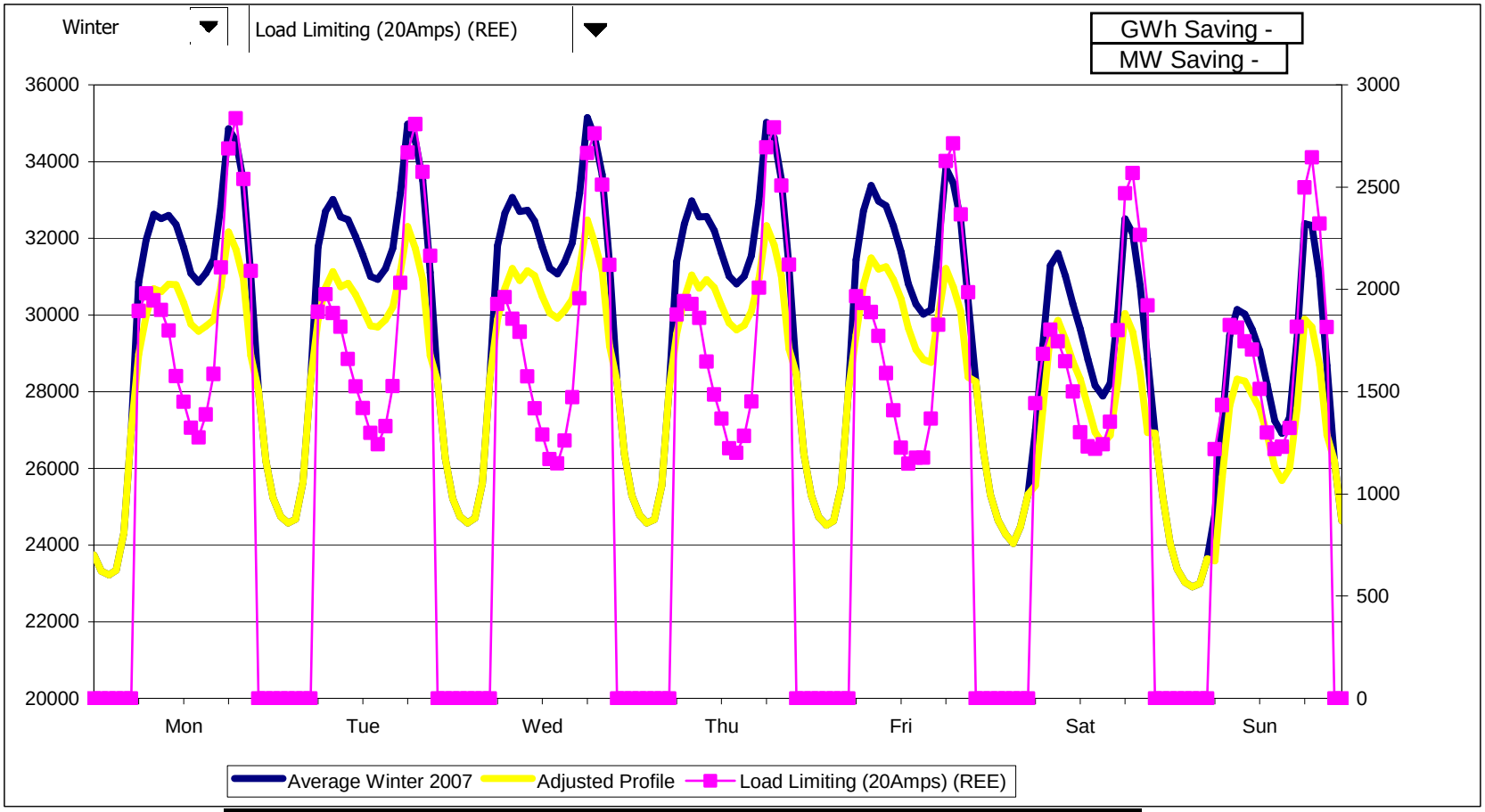
South African Benefits

Projected impact modeling against national system profile – Average winter weekday, 80% market penetration[2]



Smart Meter Load Limiting (20Amps)	GWh Saving	MW Saving	Utilisation Factor	MW	Load Factor
Pre-Winter	2709	1607	41.6%	1761	
Winter	2616	2694	42.2%	2836	
Post-Winter	2093	1607	41.6%	1761	
Total	7,419 GWh	2,694 MW	31.5%	2836	29.9%

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South African Benefits

1. Execute scheduled & system emergency load reducing/limiting functionality & power conservation:
   - Approx. 3000MW[2] of total SA suburban consumption can be reduced by smart meter load limiting device;
     - reduce/limit customer's supply capacity e.g. from 60A to 20A via single wireless broadcast, and
     - restore individually or in a group via a staggered comeback approach with advanced, intelligent master station.
   - Customer has electricity for a few essential appliances (lights, TV, microwave, security), but will not be completely load shed.

South African Benefits

2. DSM energy efficiency (tariff drives and incentivises the efficient use of electricity, power conservation, promotes changes in lifestyle behaviour).
3. Savings to economy (avoid key industrial customer load shedding).
4. Contributes to restoring a workable reserve margin to alleviate strain on generation assets.
5. Avoided Generation costs.
6. More cost reflective recovery of costs.

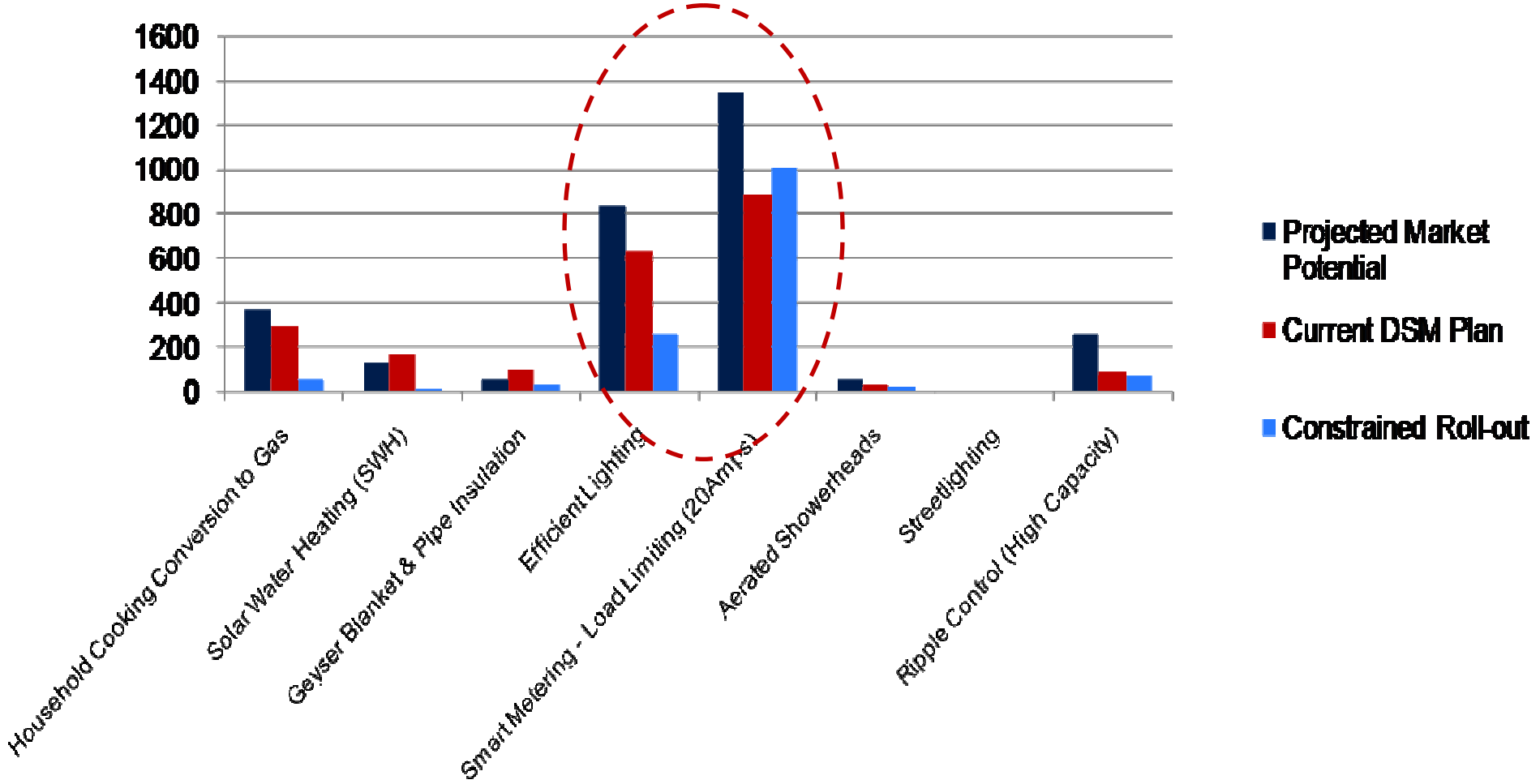
South African Benefits

7. More accurate reflection of the purchasing structures, reducing trading risk in retail tariff.
8. Improved business efficiency
   - Installation of integrated load management smart meter devices:
   - yields additional benefits to business (bi-directional, real-time communications to meter, tamper-detect, remote connect/disconnect).

South African Benefits

9. Improved, dynamic customer messaging.
10. Effective implementation of Power Conservation Programme to residential and commercial customers
    - currently inaccurate metering estimations is not effective measurements for the implementation of tariffs incentives or penalty.

Amongst other DSM strategies
(based on current 3-Year Plan)



DSM projected potential market penetration, current plan & constrained roll out[2]

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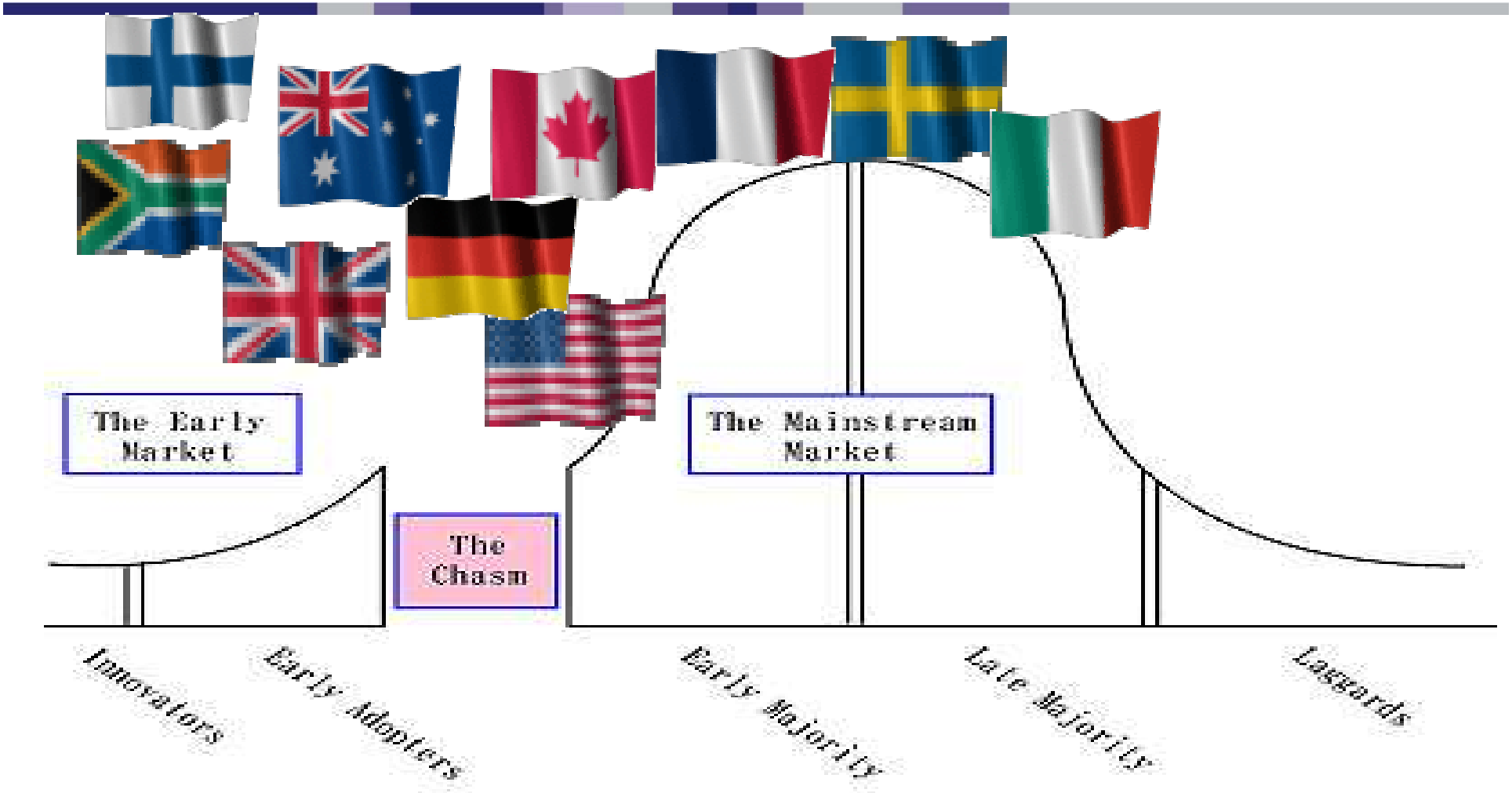
International Best Practices: smart meter*



*Includes AMR, Intelligent metering and AMI developments

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International Regulations

- International energy regulators have mandated the accurate meter reading (AMR) and smart metering (USA, Sweden, Italy, France, Spain, Netherlands, UK)[3].
- South Africa to join the market leaders
  - Cabinet Lekgotla mandated smart metering as one of the interventions to address electricity shortages (25 January 2008)[4].
  - Proposed amendments to the Electricity Regulation Act - call for end user or customer with a monthly consumption of 500kWh and above, must be on a time-of-use tariff not later than 2010.

Global Findings

- Smart meters for demand response makes economic, customer and technological sense[5].
- Smart metering has a positive net value based only on demand response, however the qualititative benefits can add another 10-20% of the business case benefits[6].
- It is relevant to consider a smart meter roll out that is achieved at the least cost, whilst still delivering on business efficiencies[6].
- A combination of best practices, proper integration and timing will lead to a successful AMI deployment, which will not only comply with any government or regulatory requirements, but provide the utility with overall operational and customer benefits.[7]
- Smart meter increasingly becomes a key part of the new energy landscape[5,8].

Conclusion

- The mechanism of time-of-use tariffs as medium to convey an economic price signal to the customer is one of the most effective and sustainable strategies to illicit demand response.
- The price signal contained in the TOU tariffs continuously reflects the scarcity value of electricity by time of day and continuously entrenches the need for efficiency message.
- Coupled with the enabling technology of a smart meter, an optimal load reduction is certainly achievable.
- The combined strategy of TOU tariffs and smart meters is an exceptional breakthrough in the equity sharing of the benefits from generator, distributor to the customer (benefits shared in the value chain).

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References

[1] Primer on Demand-Side Management prepared for The World Bank by Charles River Associates

[2] DSM End Use Study & Statistics South Africa, General Household Survey 2006

[3] Smart Meter Project Map, Engage Consulting, UK

[4] DPE Minister – Cabinet Lekgotla National Electricity Emergency Programme, 25 January 2008

[5] Demand Response Makes Sense Report, Gerald A. Ducey, Landis+Gyr, DRAM Board member

[6] Report for the Ministerial Council on Energy Smart Meter Working Group, NERA Consulting

[7] Report for the Ministerial Council on Energy Smart Meter Working Group, NERA Consulting

[8] Australian Broadcasting Corporation, M Peacock

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