Mitigating Supply Shortfalls in the Developing World

SAVING ELECTRICITY IN A HURRY

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Agenda

- Power Crisis – more often than you think
- Typology of Power Crisis
- How a power crisis becomes a financial crisis
- Energy efficiency quick fixes – more is needed
- The idea behind market-based TECCs
- Examples of market-based approaches in the power sector – Brazil, California, South Africa
- Lessons Learned
- Where to learn more?

Capacity scarcity becoming widespread – with a weeping wave in 2001-2002 (just a sample)

System	Year
Argentina	1988
Indonesia	1991
Malaysia	1992
Colombia	1992
Ivory Coast, Ghana, Togo and Benin	1998
Chile	1998-1999
Philippines	1999
Tanzania, Kenya	2000
Yugoslavia	2000-2001
California	2000-2001
Russia	2001
New Zealand	2001
Brazil	2001-2002
Venezuela	2002
Marahashtra – India	2002
Norway	2001 and 2003
Dominican Republic	2002-present

Snapshot – five years after

2005

Nicaraguans have faced power outages of up to eight hours (09/20)
Taipower kicks off 4th edition of power rationing program (09/28)
Bangladesh: Emergency meet fails to make rationing decisions (10/14)
DR threatened by energy crisis that could doom recent years of economic growth and democratic development (12/27)

2006

Severe Power Rationing in Haiti (01/16)
Tanzania – Power Rationing Starts Today (02/02)
Power shortages and black-outs continue to plague India's major cities (02/03)
South Africa must "race to avert energy crisis" (02/28)
Vietnam may face power crisis (03/02)
Uganda – Kampala – Power Struggle in a Powerless City (03/06)
French Polynesia – Power Rationing Causing Problems, Protests (03/0 8)
Zanzibar starts partial power rationing (03/09)
Zimbabwe – Massive Power Rationing in the Horizon (3/20)

What about 10 years later?

The ongoing power shortage has hit dairy milk collections resulting in a loss of billions of shillings by processors and farmers, and the gradual collapse of the industry. “If we cannot meet the demands of Dar es Salaam alone, how can satisfy the country’s demand?” (Tanzania, March 2011)

Power shortage costing economy $2.5 billion annually - "The loss of over 400,000 employments and decline of one billion dollar in our exports was also seen due to power crisis in the country," (Pakistan, January 2011)

The Electricity of Vietnam Group Monday asked the government for VND13 trillion (US$666.8 million) so that it can operate oil-fueled thermal plants to overcome the serious power shortage expected this year. The power shortage estimated at 6 billion kilowatt- hours in 2010, partly caused by dry weather during the year that resulted in low wat levels at rivers and reduced hydropower output. (Vietnam, January 2011)

The electricity deficit of 90-95MW has led to increased load shedding reminiscent of the power crisis in 2006. (Uganda, March 20

Bangladesh's development efforts were being "stymied" by power shortage while Bhutan had huge untapped potentials of hydropower.... (Bangladesh, January 2011)

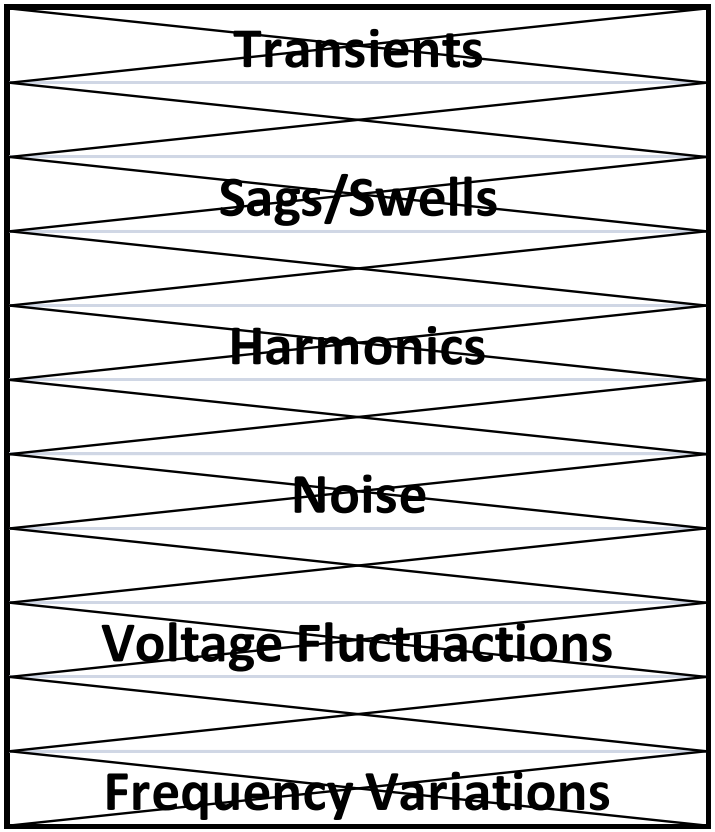
Scrambling to keep in reach its goal of reducing energy use per unit of GDP during the period of the 2006-10 five-ye plan, China resorted to increasingly desperate measures such as rationing power to households and industry. A seve diesel shortage developed. (China, January 2011)

For the second time in only four years, a drought has put Chile at risk of power rationing. The possible power short in central Chile and the impact it has already had on electricity prices underline the urgency of investment in generation capacity and transmission infrastructure. (Chile, February 2011)

Coal shortage is likely to hit all the three thermal power plants in Haryana. While the thermal plants are required to keep a stock for 25 days, the coal stock is sufficient only one to two days. (India, March 2011)

In the last decade, the Dominican Republic has been affected by a power crisis nationwide. In 2008, the crisis reached a deficit o 40% in the generation (Dominican Republic, March 2011)

Not even talking about quality of supply, but simply outages (black-outs)



Types of shortages and causes

Energy Constrained Systems – lack of MWh

- Poor rainfall – Brazil, Norway, New Zealand (2001), East Africa (2006)
- Poor operations planning & reservoir management – Tanzania, Brazil
- Conflicting uses for the water – Uganda and neighbors - Lake Victoria
- Not always in hydro dominated systems
  - No money to buy fuel, despite abundant thermal capacity (DR)
  - Curtailment in fuel supply (e.g. Chile, importing gas from Argentina)
- As a result – frequent, often erratic rotating black-outs, any time of the day or week

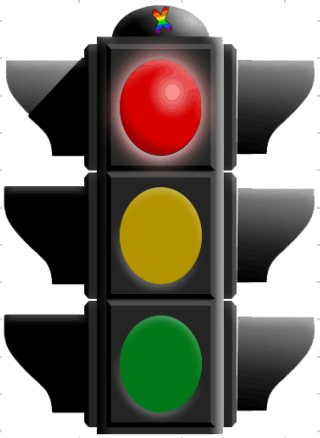
Capacity Constrained Systems – lack of MW (peaking capacity)

- Not sufficient generation capacity to meet peak load (or fuel) (Kenya)
- Low reserve margins and-or unreliable system, high LOLP (SA)
- G cartelization to reduce available capacity (California)
- Poor pricing leading to peaks, low load factors (MENA countries)
- Energy constrained systems where reservoirs have been over depleted (loss of head) – both energy and capacity constrained (Tanzania)

How a power crisis becomes a financial crisis

Avatar Power Company - Supply Demand Crunch

Normal Operating Conditions						
1000 MW	Average Energy	500 MWh/h	Annual Production		4380	GWh
			Losses		876	GWh
	Load Factor = 50%		Sales		3504	GWh
	Average Tariff = US4.5 cents/kWh		Annual Revenues		175	US$ Million
Poor Hydrology - Power Crisis						
	New Average Energy	400 MWh/h				
If 6 months	Shortfall	100 MWh/h				
	Lease		133 MW	Generation factor = 75%		
Rule of 6 = 60 MW for 6 months cost US$60 million, 2/6 capacity, 4/6 fuel, at US$60/barrel, generation factor = 60%						
Cost of Emergency Generation	@ US$ 60/barrel	US$ million	125	Cost per kWh (US cents)	14	% of Annual Revenues 71%
(For 9 months)	@ US$100/barrel	US$ million	175	Cost per kWh (US cents)	20	% of Annual Revenues 100%

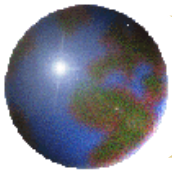


Why does it happen so often?

- Focusing on supply-side only solutions, by preparing and relying on optimistic expansion plants that will never materialize?
- Not doing enough to rationalize consumption – e.g. energy efficiency (MWh), demand side management (MW)?
- Lack of a regulatory mechanism to properly allocate a very scarce good - noting that days of "cheap and abundant" energy are gone?
- Or lack of proper metering technology to enable time of use metering, critical peak pricing, seasonal rates?
- All of the above?

Quick interventions on the demand side have proved to be extremely effective – but not sufficient

- The most common – efficient lighting (e.g. CFL, street lighting)
- A compelling case, in particular in time of crisis
- In a nutshell – savings of 75%
  - 800,000 units (US$1 each), 30 MW peak savings
  - Payback of 15 days, if country is using emergency generation
  - In Ethiopia, 5 million units saved almost US$100 million in a hurry
- Most of our WB Group utility clients have embraced CFLs and similar DSM approaches
- WB Group has provided expertise and funded such initiatives
- Just the tip of the iceberg though – how to unveil more efficiency?
- A wide menu – this presentation focuses on some market-based approaches



What else is needed to better allocate constrained supply in a more effective way – Increase tariffs? TECCs?

- In a nutshell, TECCs are a different pricing mechanism
- Assign end-users a consumption entitlement (e.g. 90% of historic consumption) – administrative allocation (or auction)
- Price entitlement (or quota) at regulated tariffs – shortfall and surpluses at SRMC (or best proxy thereof) – the customer "sees" the real cost of scarcity
- Design effective safety nets and fall back positions
- Allow end-users to trade entitlements
  - With the utility, for smaller users
  - In the market (s) for larger ones
- Utility billing and collection systems can be easily accommodated

What is the rationale behind TECCs?

- First – acknowledgement that there is a binding constraint that cannot be revoked by a law or decree
- How to allocate a scarce good? Increasing price for all kWh, but …
  - Will put poor customers out of business
  - Given wide range and uncertain price elasticity among customer groups, effectiveness is not guaranteed
  - Economic distribution effects may be devastating
- Or imposing the binding constraints via quotas
  - Price quota at regulated tariffs (cost-reflective)
  - Settle differences at short run marginal costs and allow trading
  - Linkage between wholesale and retail markets enables customers to see price of scarcity
  - Penalties for non-compliance
  - If does not work, increase price, reduce quotas
  - If everything else fails – rolling black-outs (the default solution)
  - At least customer was given an option

Can TECC help in every crisis?

	Expected Duration			
	Short (few days)	**Medium (< than one year)**	**Long (> one rainy season)**	**Chronic (>3 years)**
Notice				
Short (or no)	* Typical massive Blackouts - US 1965, 2007, Italy 2006, Brazil 2009 - Reliability	* Sudden increase in oil prices (e.g 2008), no resources to buy fuel	* Disruption in physical structure - war, terrorism * Defficient maintenance or modernization (Cuba, 2009)	N/A
Antecipated	* Some natural disasters - e.g. Katrina * Sudden incrase in demand - World Cup	* Low Rainfall for consecutive years, overdepletion of reservoirs (Brazil, 2001), Venezuela (2010)	* Supply or Demand Shocks 2-3 years - lack of generation - (Uganda, 2006) * South Africa - until Medupi comes on line * Angola (exponential growth)	Lack of capacity, system adequacy, Nigeria, India, Pakistan, many SSA countries
Effectiveness of TECC	Depends on regulatory system already in place and enabling technology	Likely to be effective, but requires fast government actions	Likely to be effective	May be effective, if government able to persuade about the benefits

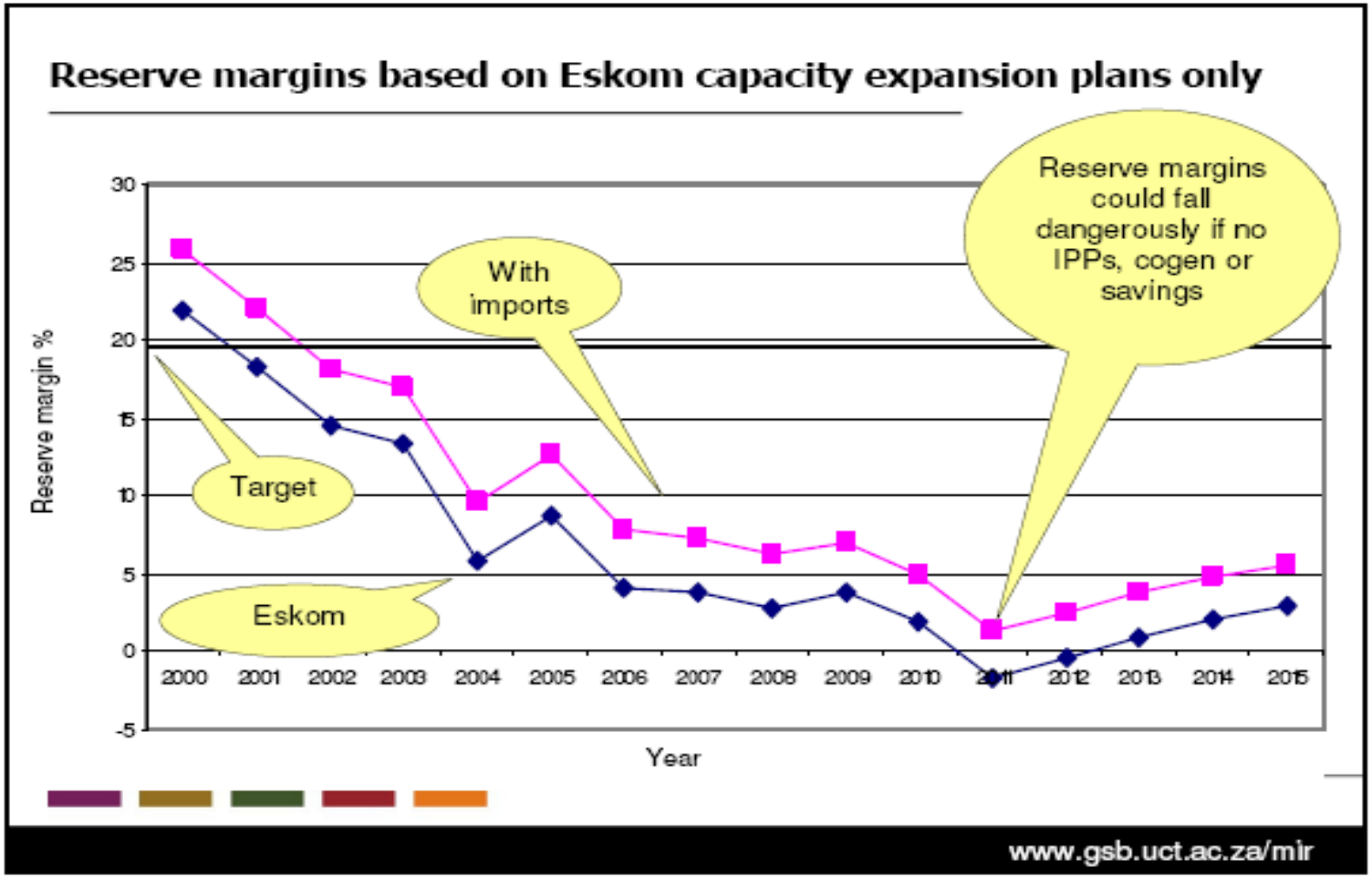
Other market-based ideas

- India - Perform, Achieve and Trade Mechanism (PAT), under implementation - 2011
  - Sets energy consumption reduction targets for 714 energy-intensive industries
  - Issuance of Energy Savings Certificates for users who exceed their targets (tradable instruments)
- UK – Tradable Energy Quotas (TEQ) – for peak oil and climate change (under discussion)
- In the power sector per se – Brazil, California, South Africa
- Cap and trade of CO_2– multiple variations

Examples in the Power Sector

- Brazil – 2001-2002 (next session)
- California -2000-2001 (Alan)
- South Africa - 2008

In 2008 South Africa realized that supply problems would go beyond 2010 World Cup

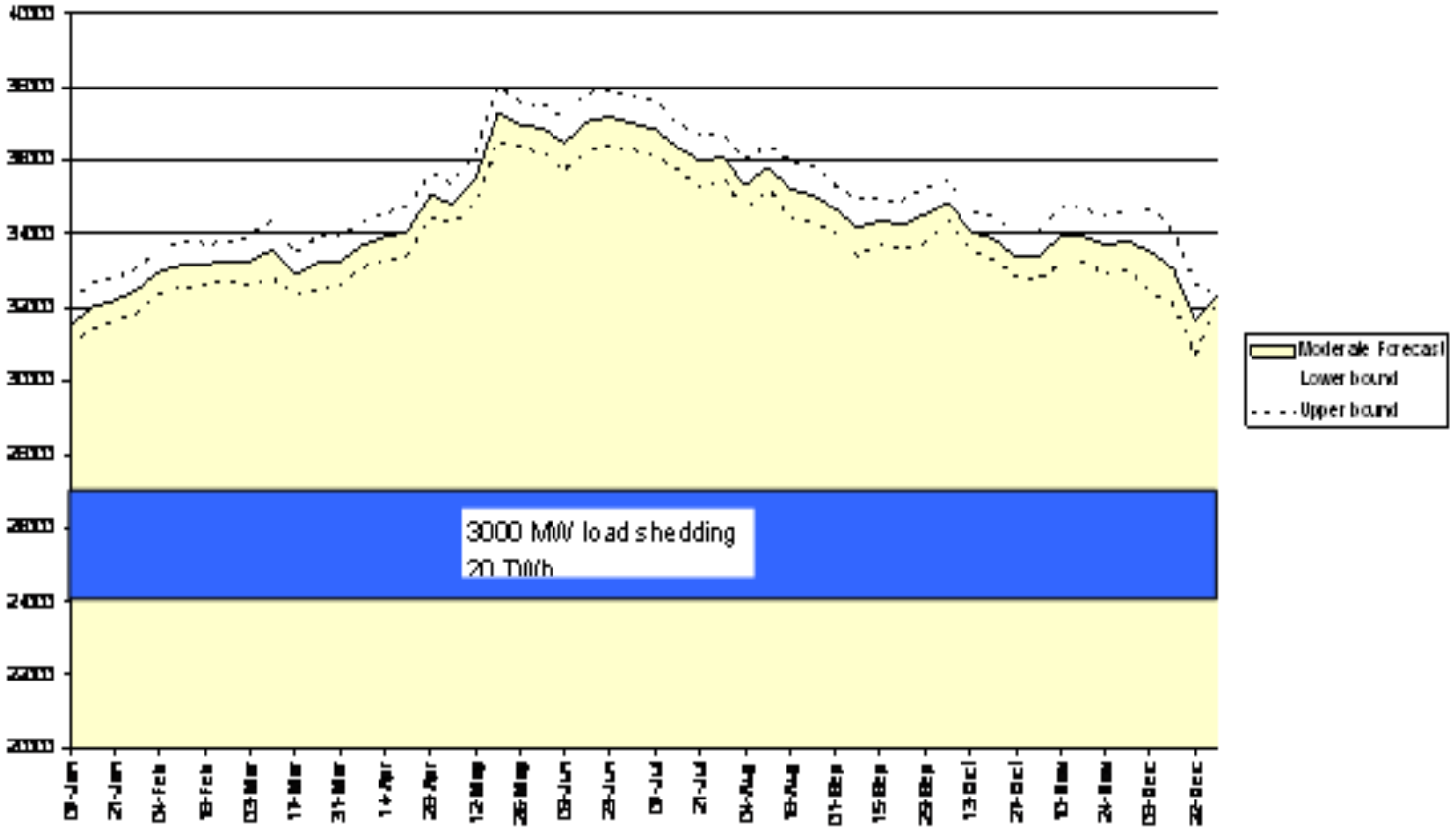


With such low reserve margins, in 2008 black-outs became unavoidable

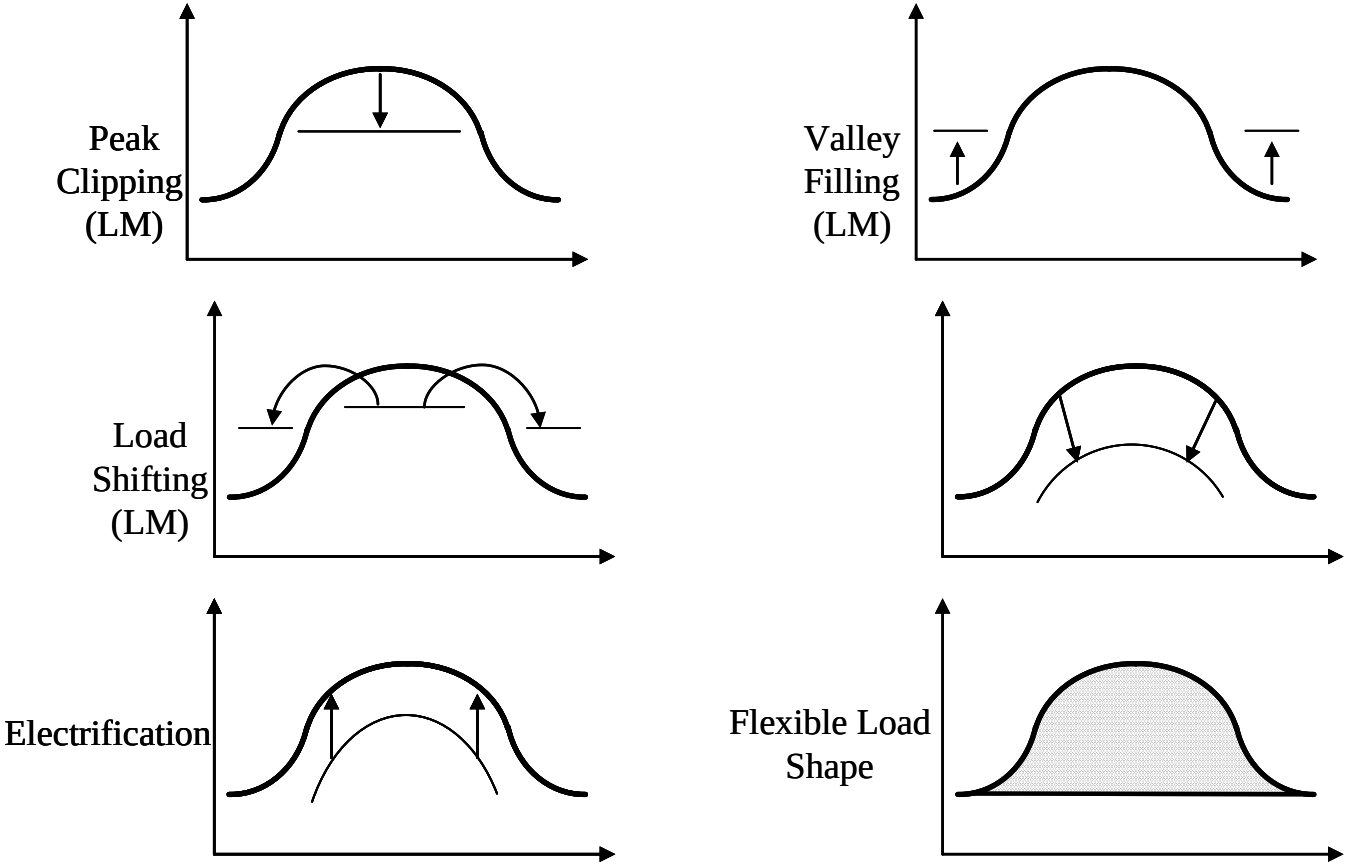
Example: 28 January 2008	**MW**
Eskom capacity+imports	39 855
Operating reserves	1 800
Planned maintenance	3 715
Breakdowns (e.g boiler tube ruptures, etc)	4 235
Reduction in capacity (e.g. wet or insuff coal)	2 694
Total capacity unavailable for supply	31%

Consequence: massive load-shedding

South Africa was both capacity and energy constrained – a "flat" load curve

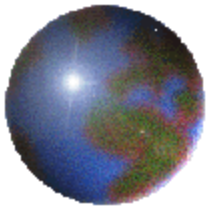


Which requires both energy efficiency and DSM interventions



RSA put together a demand response package which included a TECC-equivalent mechanism

- Component 1 – scale up ESKOM funded investments in EE and DSM, channeling additional funds and using a "standard offer" approach (a mirror image of FiT)
- Component 2 – demand response program and protocols with large users
- Component 3 – quotas to end users (TECC like)
  - Inspired in the Brazilian model
  - Adapted to RSA reality (e.g. 7 million pre-paid meters)
  - Phased-in implementation – starting with a target of 10% for large users
  - After September 2008 crisis, operating margins restored – no need to extend to smaller customers



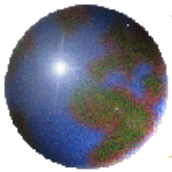
Lessons Learned

Lessons learned 1

- Shortages are not accidents in high growth, financially constrained power systems
- Usual approaches have focused primarily on the supply side – but managing shortages requires interventions on the demand side, innovative tariff schemes and enabling metering
- The issue is not ideological – "to ration or not" – but how to do it sensibly
  - Energy at 20 cents/kWh, and oil at US 100/barrel is one form of rationing
  - Ditto for rolling black-outs, brown-outs, or pent-up demand
- Black-outs – worst way to ration
- Shortages are very diverse in nature and duration - rationing program has to be tailored
- Planning in advance is needed, well before need to ration

Lessons Learned 2

- TECCs - Market-based, quota-like tariff systems have proved to be effective rationing mechanisms
- However, they require commercial discipline
- It is a "social pact" – conserve energy and as *quid-pro-quo* supply will be 24x7
- Many countries have been reluctant to implement it
- Poor needs to be protected with a safety net that encourages efficiency
- Do not socialize gains and losses
- Honor contracts
- Put someone in full control to deal with crisis



Where to learn more?

Implementing Power Rationing in a Sensible Way:

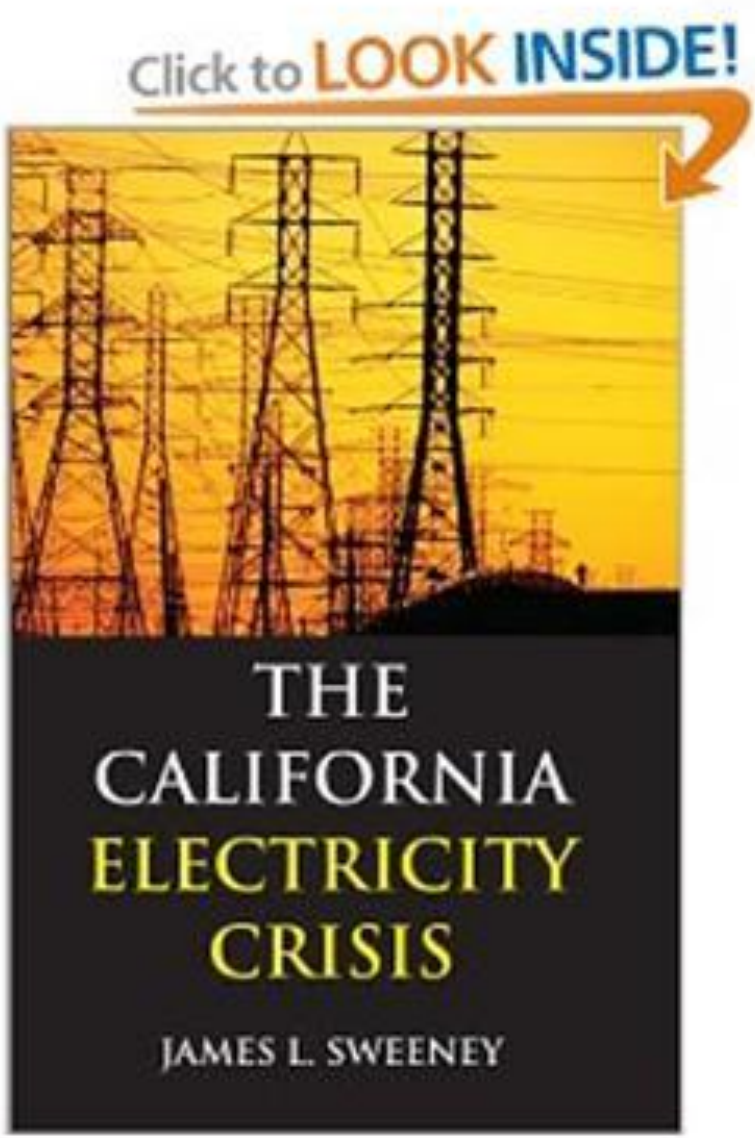
Lessons Learned and International Best Practices

Energy Sector Management Assistance Program

ESMAP

Report 305/05

August 2005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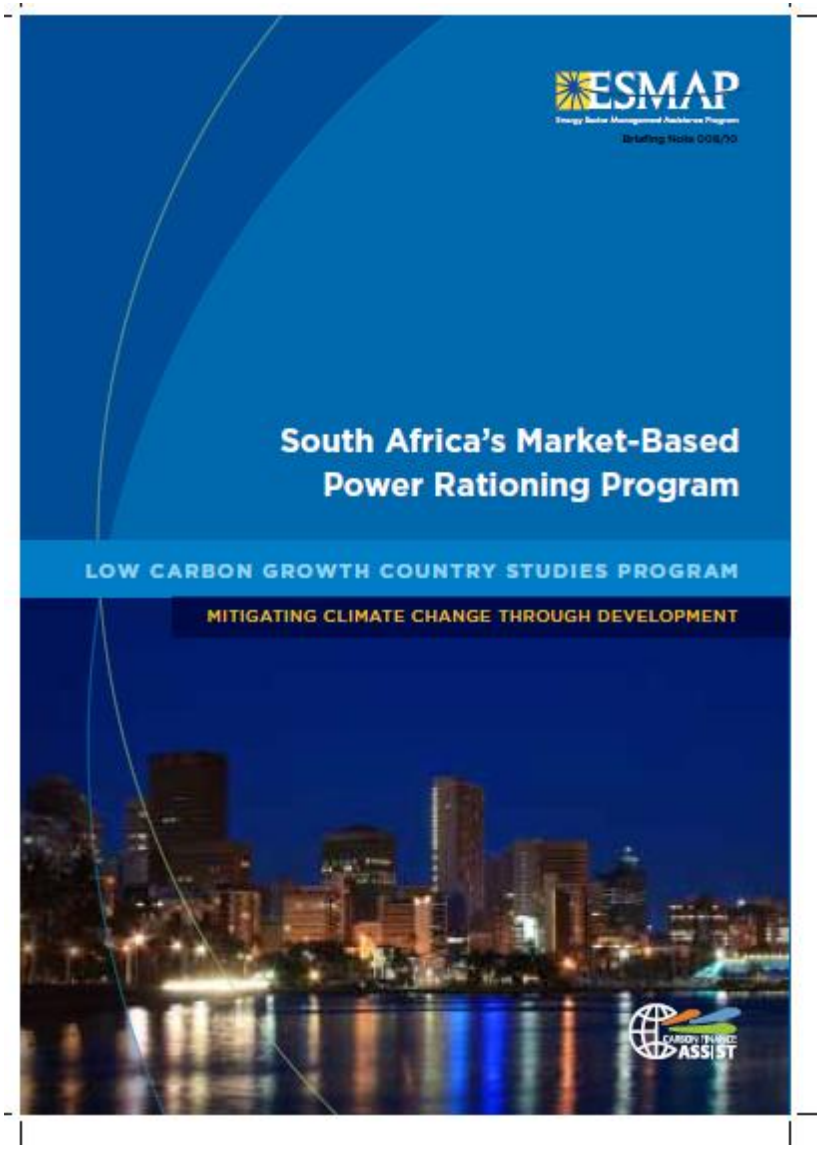
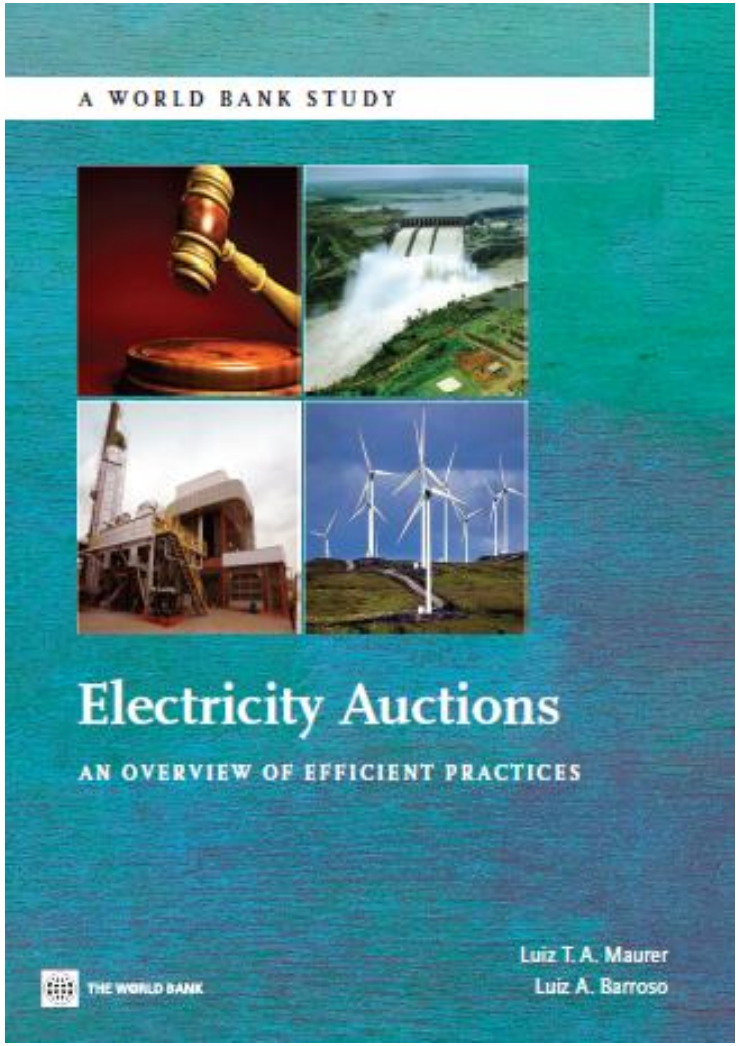

ESMAP
South Africa's Market-Based
Power Rationing Program
LOW CARBON GROWTH COUNTRY STUDIES PROGRAM
MITIGATING CLIMATE CHANGE THROUGH DEVELOPMENT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