International Markets for Advanced Gas Turbine Systems

Barry J. Davidson (barry.davidson@natpower.com; +44 1793 896260)
National Power PLC
Windmill Hill Business Park
Swindon SN5 6PB
UK

INTRODUCTION

Slide 1

The perspective provided is that from a large International IPP, the focus being global markets for advanced gas turbine based plant. Projections suggest that world annual demand for capacity additions are up to 100 GW p.a. by the end of yr 2000, with capacity growth in the US at 8-10 GW p.a. The opening remarks refer to targets and prospects for the IPP and OEM for development of large central generation and interconnected methods.

The second part of this paper covers markets for mid size gas fired systems. As a benchmark, UK experience is cited covering regulatory issues that prevail to potentially underpin this market. Systems can be viewed as either central generation or embedded distributed generation.

Slide 2

Rapid technology advances have led to optimal combined cycle operation and cash flow. However, when plant has proven to be reliable, it is invariably obsolete. For the operator who needs returns on substantial investments, predictable availability and cash flows are as important as thermal performance. The dilemma has been that high performance has equated with increased risk in the form of uncertain reliability. The IPP drivers have been lower avoided costs than a Utility alternative; bids made with razor thin margins; and the desire to maintain or maximise profit margins. The outcome has been tighter design allowances from OEMs; aggressive O&M programmes to maximise revenue; less flexibility for operators; and little functional redundancy in the designs.

STEPPING FORWARD

Slide 3

The macro view is change in ownership and finance driven. 20% new worldwide equipment sales go to IPPs. By 2005, this could be 65%. Alot of these developers have little or no Electric Utility background. There may be a trend to use smarter technology with perhaps reduced number of components and simplified systems equally suited to base load, mid range and daily start operation, remaining competitive at full and part load. Equally there are the demands of insurability and financeability requirements of a moving market and the need to avoid being locked into an unprofitable market segment. A power station can now be usefully compared with a refinery with inputs of gas and backup fuels converted to products for electricity markets e.g. energy, capacity, ancillary services, transmission constraints or sold into short term gas markets. By analysing these markets, the power producer can formulate an output "slate" to maximise profit. It is worth recalling the quote from St. Thomas Aquinas that " not everything that is more difficult is more meritorious" but Company objectives of income and profit must be satisfied.

Slide 4

The OEM post-sales support for equipment life cycle cost reduction embraces performance and operations guarantees, maintenance contracts, emissions guarantees etc. Product differentiation is becoming an issue and additional elements needed for the future from OEMs to enhance project value or aid project development are typically equity, local manufacturing capability, in-country experience and finding projects. From the finance perspective, short term debt will need to track short term power purchase committments and movement of time of day pricing.

REGULATORY STRUCTURES

Slide 5

There are typically three regulatory regimes for IPPs. Negotiated deals are characterised by the need for superior technical support for unfamiliar local markets with emphasis on relationships and government contacts. In competitive bidding, cost is all important so there is intense pressure on equipment life cycle cost and OEM/IPP collaboration to target several projects is desirable. Merchant/ Pool markets are characterised by high revenue uncertainty and the aim must be to identify and capture value. The OEM needs to provide low through life cost equipment and in addition, where possible, identify innovative project development opportunities that add value.

Slide 6

Post 1998 in the UK, Regional Electricity Companies (REC), who are generators in their own right, will lose their guaranteed domestic market and cannot pass risk to their regulated customers. The stage is thus set across the board for new deals with risk spread more evenly e.g. merchant plant. Features are

- no long term power sales
- only recover pool price extant at time of generation
- indexation and net back pricing where price of gas rises/falls with pool electricity price
- tolling arrangements where the gas supplier is the electricity marketer
- fixed cost largely unhedged
- forward pricing of electricity

As markets exist in gas, power generation and retail sales, market players can exploit opportunities for arbitrage and move from risk minimisation to opportunity maximisation strategies. With the development of truly liquid and transparent markets for both inputs and outputs, the financial derivative tools of other commodity markets can come into play.

For merchant plant, outage avoidance at peak pool prices may be essential and hardware reliability very important. AES experience in the UK at the Barry gas fired plant would suggest that a project running on a merchant basis would have been difficult to sell to banks with a more advanced turbine than the Siemens V94.2 that was chosen. If pool price is non-optimum, opportunities may exist to move away from maximum continuous rating at such times and increase plant life. Creating value is not always synonymous with cost reduction and a "must run" attitude does not always prevail. OEMs need to review designs with potential owners at an early stage to integrate user requirements for operational performance and quantify risks.

Slide 7

To stress the importance of availability in the market place, particularly a pooled market, there are a number of key performance measures notably unconstrained and capacity loss indices. Day ahead unconstrained loss is effectively the plant replacement cost. Current day loss is the lost income at system marginal price (SMP). In the UK market a 1% loss of availability for NP can equate to ten of millions $ in lost earnings. The capacity loss index is a measure of plant declared unavailable ahead of scheduling, again with potential lost earnings.

Station operating costs and thermal performance are other obvious targetted performance measures. Advanced technology gas turbine replacement costs can total $1.5-2M per stage. Advanced technology component repair techniques are still in the developmental stage. It is currently replacement rather than repair - repair costs could ultimately be 2-3 times current levels.

Slide 8

To summarise the first part of this paper, competitive power supply will drive further developments. Some countries will favour leading edge gas technology, others, for example, may adopt a "CO2 neutral" plant strategy. From active management of the supply market and collaboration with OEMs solutions will be obtained to deliver superior business performance. For strategically important and high value transactions, issues such as criticality, through life costing and value engineering are as important as headline prices. Optimal commercial advantage will be through a redefined risk/reward relationship which seeks to avoid traditional adversarial approaches. High expectations for RAM will be met through a better understanding of technology uniqueness. Advanced gas plant product attributes will have different market value depending whether interest is from a new entrant or an experienced player viz the extent of strategic focus, opportunism, global strength (alliance/partnering) etc.

<u>PROJECT SIZE</u>

Slide 9

A customer is strongly influenced by project size. Small projects with unique constraints and needs have particular technical requirements which can point to certain vendors. Suitability is an overiding requirement and niche equipment suppliers can have more flexibility.

Slide 10

The growth of embedded generation in the UK was initially driven by increased recognition of environmental benefits of renewable energy and combined heat and power (CHP) or cogeneration schemes. Plant in the UK are still predominantly centrally despatched above the grid supply point (GSP) but we are now seeing the emergence of non-centrally despatched flexible mid size gas units e.g. on-site generation with overspill export and purpose built mid-merit plant. Examples are Southern Electric (UK) with LM6000 gas turbines under 50 MWe; Rolls Royce Trents at Fort Dunlop (just under 100 MWe) and potentially elsewhere; Teeside Power 50-100 MWe open cycle units / CHP for black start and peaking. Prospects for embedded generation differ substantially between different sectors of the market and this arises from regulatory impact. In parallel with this current trend, conversion of existing large assets to dual firing is a cheap means of mid - merit expansion.

Slide 11/12

In the UK, payments received to centrally or non-centrally despatched plant are multivarious and the methodology is summarised on slide 12. Regarding contractual arrangements with respect to output, there are two break points of note particularly in the context of the penetration of aeroderivatives in the UK market:

- it is an absolute requirement that if the project is over 100 MWe then it must be centrally despatched and the associated pool rules apply. This is principally a technical breakpoint since at the time of deregulation, practically all of UK generation was over 100 MWe.

- As an on-site generator, regulations allow export of surplus electricity up to 50 MWe without a generation licence. This breakpoint is essentially administrative to minimise bureaucracy. The significance of the licence is that if you hold one, pool membership is mandatory and generator exports onto the REC system must go into the pool and therefore are subject to pool rules and payment.

Savings from reductions in triad charges and system losses are significant for an embedded generator and host and where these occur in conjunction with a genarator operating efficiently in CHP mode, the environment can also benefit. For example, Europe wants to cap carbon emissions at 15% below 1990 levels within 12 years. A triad charge is levied related to electricity imported from the transmission system. This is based on demand at the GSP at the time of three peak demands - the Triad. These features are quantified next.

Slide 13

For markets in the US, it may be difficult to formulate a similar breakdown as shown here - in this UK case from pool purchase price to the total price three catagories of customer typically pay. With embedded generation, where can savings be made to the generator and / or host?

For an EG non-centrally despatched and electing to be non-pooled, then:

(a) the host REC can avoid paying pool system support payments or "uplift" on the purchase. Uplift covers for payments to generators for ancillary services (frequency response, reactive power, transmission constraints); demand forecast errors; and out of merit generation. It is operated as a profit/risk sharing scheme and is mainly system support, maintaining the security and stability of the transmission system. Of course the EG misses out on payments from the pool for system support and has to strike a deal with the host REC the commercial value of which is set by the suppliers avoided cost.

(b) there is no transmission charge on generators, the so called Use of System (UoS) generation charge.

(c) there is avoidance of some of the losses on the host REC system e.g. dynamic losses but more notably as materially it is quite significant, if the EG runs at the triad, then the UoS demand charge is lower for the REC or second tier supplier trading behind the same grid supply point.

(d) there is avoidance of energy losses (recovered from all suppliers on an equal basis).

(e) If the non-pooled generator is non-fossil, then the electricity sale to the host REC avoids the fossil fuel levy. The non-fossil fuel obligation (NFFO) is a mechanism by which renewable generating technologies are helped through the difficult period between being a proven technology and being an economic one.

The penetration of EG into the UK market reflects the accrued system advantages discussed e.g. triad benefits. The EG can elect to be pooled (see slide 12), the pool paying the pool purchase price (PPP = Energy + Availability) only for the exports (i.e. not including uplift as not centrally despatched). This essentially only covers short run costs. Generally speaking uplift, which is determined by market competition, is a mechanism to cover all costs and give a reasonable return on investment. Without uplift, the owner can aim to exploit high pool prices in winter months and operate plant as mid merit. The risk here is fluctuations in pool price but the owner can hedge the risk by entering contracts for differences (CFD) with any willing party. (In the UK it may be recalled that if you are a licensed generator then pool membership is mandatory).

The EG can also elect to be centrally despatched. This gives access to a greater range of payments from the pool through uplift but the EG would then have to pay UoS charges and confers no triad benefits.

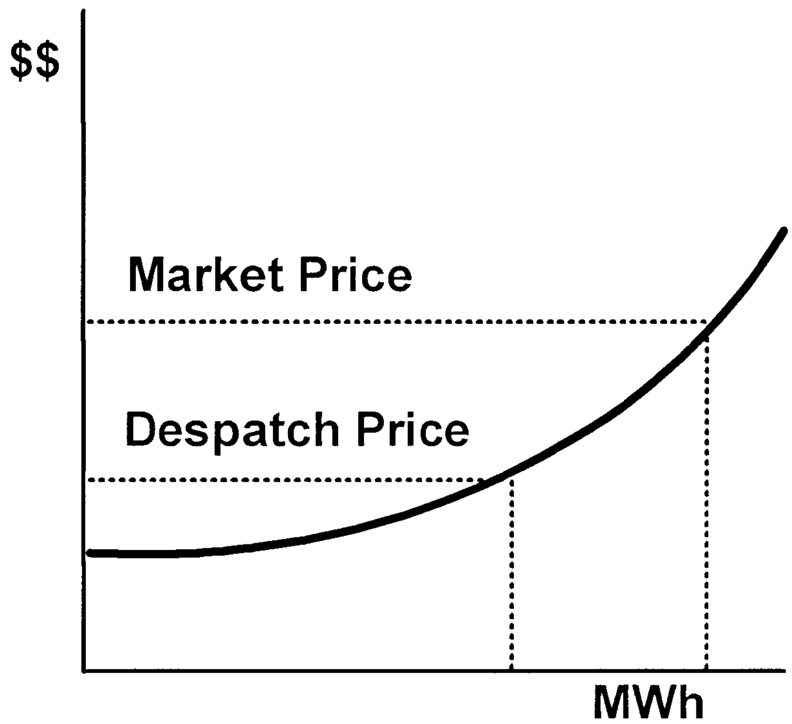
Within this regulatory framework, there is scope for flexible embedded cash generation machines. To end on a reflective note, if regulatory ground rules change, and already in the UK there have been revisions from the Secretary of State for Energy, will EG benefits be curtailed or will new opportunities manifest? Such changes might be a lowering of the 100 MWe limit or the EG required to contribute to uplift for security of supply reasons on the supergrid. It might be perceived that although pool prices have not fallen significantly over the last few years in the UK, there is a discernable trend and early EG entry is necessary to maximise returns. Outside the UK, small power projects are clearly attractive particularly in developing regions of SE Asia. Thailand and Indonesia have Small Power Programmes (SPPs) with renewable emphasis currently. Governments want local capital markets to develop.

ACKNOWLEDGEMENTS

National Power makes no warranty or representation whatsoever that the information is accurate or can be used for any particular purpose. Any person intending to use the information should satisfy himself as to the accuracy thereof and the suitability for the purpose for which he intends to use it.

INTERNATIONAL MARKETS FOR ADVANCED TURBINE SYSTEMS

BARRY J DAVIDSON
NATIONAL POWER PLC



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ATS Annual Program
Review Meeting
October 28-29, 1997

BACKCLOTH

- Rapid technology advances and large increases in efficiency and output
- OEMs have not generally had the opportunity to fully prove a new machine as reliable
- Numerous (and large) losses relating to testing / operation of gas turbines in recent years. Sometimes difficult to determine precise cause

FUTURE BACKCLOTH

- OEM customer base shifting more to IPP's
- OEM products less differentiated with respect to price and performance

- IPP equipment selection criteria more complex and varied
- IPP needs not so much related to equipment as on market and project demand
  - E.g. regulatory structures

IMPACT ON OEMs

- OEMs need to be additional Service Providers
- OEM threshold skills necessary to compete taken as read
  - Product Related Services
- OEMs need to offer non-product related services and give
  - Value Chain diversification

MARKET EVOLUTION FOR IPPs
Regulatory structures

- Negotiated Deals
- Competitive Bidding
- Merchant or Pool Markets
  - Capture value

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OWNER NEEDS

- Reliable long term operation
  - Cash generation device to deliver value
  - Customer has high expectations for RAM
- Process to quantify risks
  - Risk analysis tells us how to optimise or create value
- Need OEM committment

POOL MARKET
Performance measures

- Unconstrained Loss Index
  - Lost earnings from inability to deliver declared day-ahead or in-day availability
- Capacity Loss Index
  - Lost availability payments from plant declared unavailable ahead of scheduling

AN INFORMED CUSTOMER IS A GOOD PARTNER

Operator view into OEM reference plant design

Supplier pespective in generator functional specification

Low first cost platform

Common Targets : Modify performance, RAM, O&M, Cost data

Compliance World Bank environmental standards

Low life cycle cost solution

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PROJECT SIZE
Customer needs

- Large projects, any market
  - Low through life costs
  - Reliable equipment
- Small Projects
  - Equipment suitability

Size, MWe	No. of Units	$M value
20-50	742	8.2
50-125	819	17.0
125+	1316	52.5

Future orders by size 1997-2006
Forecast International 1997

Commoditisation (power,gas)
Consolidation (cost,market,scale)
Convergence of services
Competitiveness (customer)

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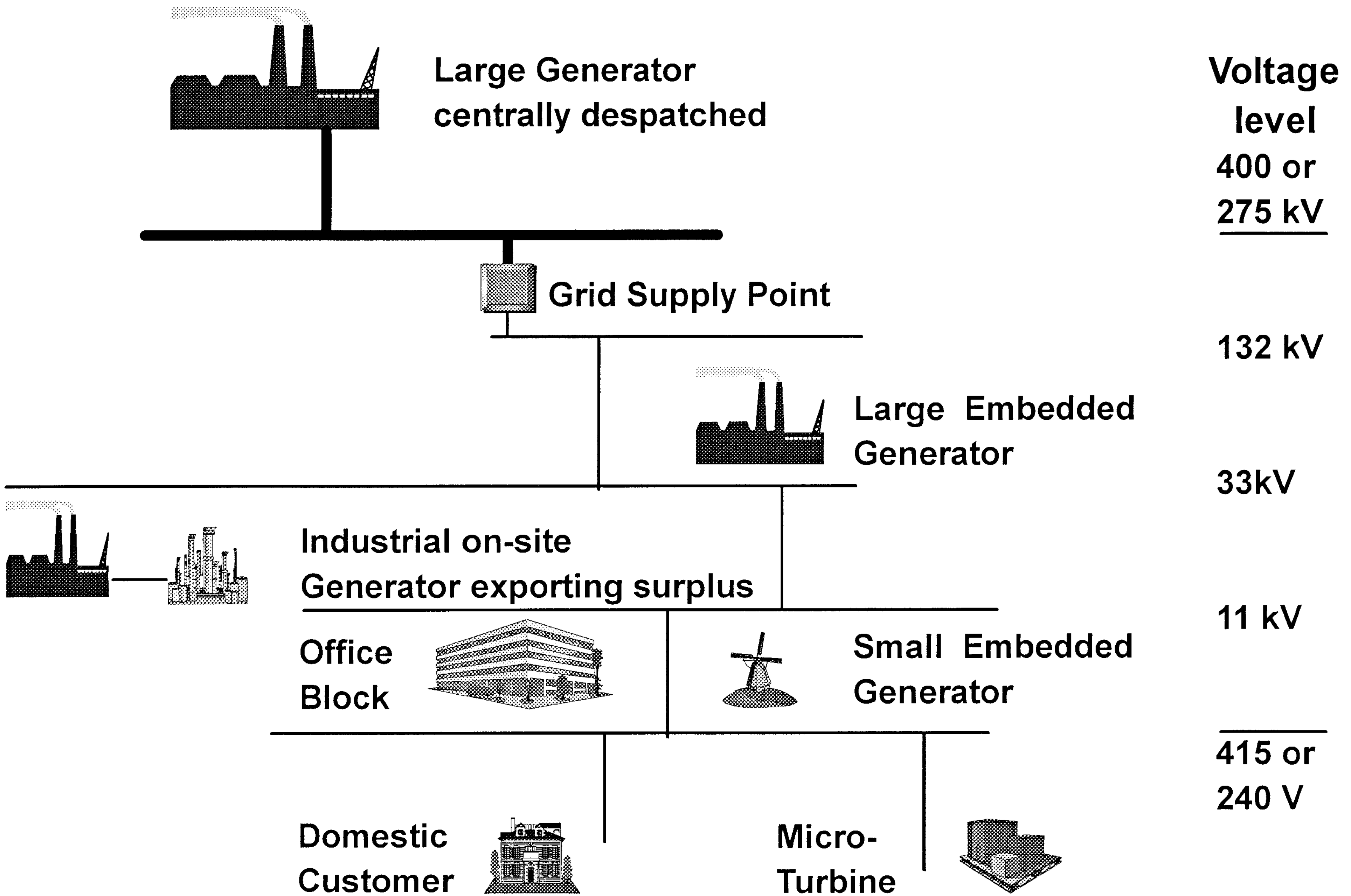
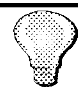
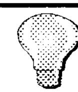
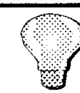
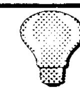
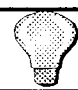
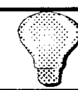
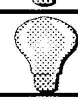
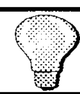
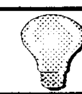
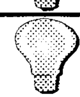
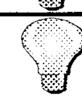

Large Generator
centrally despatched
Voltage
level
400 or
275 kV
Grid Supply Point
132 kV
Large Embedded
Generator
33kV
Industrial on-site
Generator exporting surplus
11 kV
Office
Block
Small Embedded
Generator
415 or
240 V
Domestic
Customer
Micro-
Turbine

EMBEDDED GENERATOR (EG)

- Payments a Generator receives depend on whether
  - EG is non-centrally despatched or elects to be centrally despatched
  - EG elects to be pooled or non-pooled
- Wide range of contractual arrangements are possible with respect to output
- Savings can be made through reductions in triad charges and in system losses

SUMMARY OF PAYMENTS

	Available	Unconstrained Schedule	Running	Payments
Central Despatch:				
Pooled				Energy + Availability + System support
Pooled				Bid price + Availability + System support
Pooled				Energy + Availability - Bid price
Pooled				Availability
Non-central despatch:				
Pool election				Energy + Availability
Non-pooled election				Strike a deal.

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UK ELECTRICITY PRICES
Typical p/kWh (c/kWh) prices seen by:

	Domestic Customer	Typical Industrial	Energy Intensive Industry
Pool Purchase Price, PPP	3.70 (5.9)	2.71 (4.3)	2.50 (4.0)
Uplift	0.23 (0.4)	0.23 (0.4)	0.23 (0.4)
Transmission UoS charge on generator	0.38 (0.6)	0.25 (0.4)	0.11 (0.2)
UoS demand charge on distribution	3.08 (4.9)	0.88 (1.4)	0.22 (0.35)
Losses (energy)	0.5 (0.8)	0.15 (0.2)	0.08 (0.1)
Levy	0.79 (1.3)	0.42 (0.7)	0.31 (0.5
TOTAL	8.68 (13.9)	4.64 (7.4)	3.45 (5.5)

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