Industry Presentation
SEM
Capacity Payment Mechanism

27 July 2007

John Parsonage

Agenda

- CPM Objectives
- CPM Design
- Annual Capacity Payment Sum
- Payments to Generators
- Charges to Suppliers
- Summary
- Parameters for 2007/2008

Agenda

- CPM Objectives
- CPM Design
- Annual Capacity Payment Sum
- Payments to Generators
- Charges to Suppliers
- Summary
- Parameters for 2007/2008

Objectives of the CPM[1]

- Capacity adequacy/reliability of system – new and existing plants
- Price Stability – take some volatility from energy market, help promote investment
- Simplicity
- Efficient signals for Long Term investments
- Susceptibility to gaming
- Fairness

1. CPM Options paper: May 2005

Agenda

- CPM Objectives
- CPM Design
- Annual Capacity Payment Sum
- Payments to Generators
- Charges to Suppliers
- Summary
- Parameters for 2007/2008

CPM Key Features

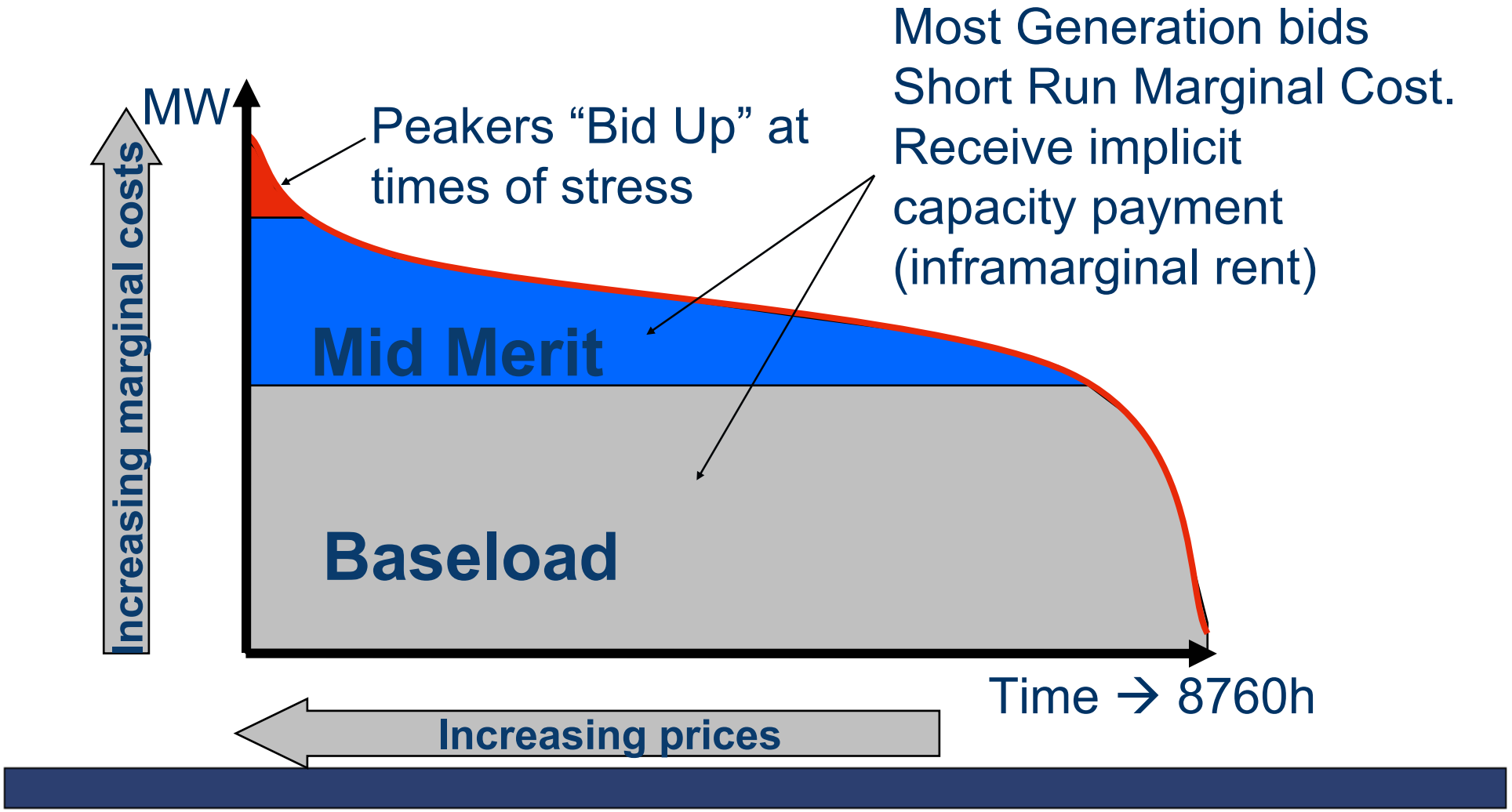
- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

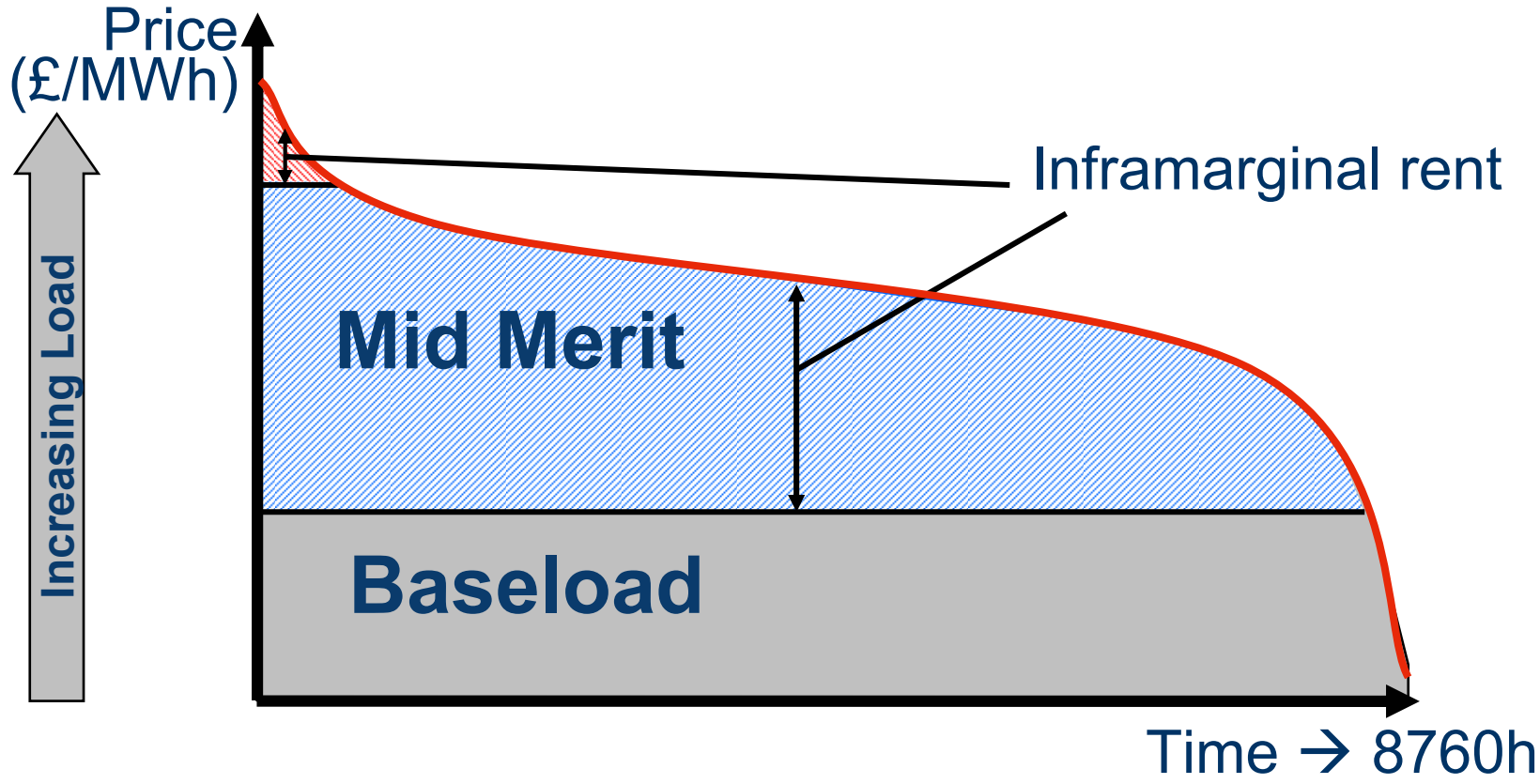
Pot Determination – Price Why Peaker Fixed Costs?

Energy Only Pool:

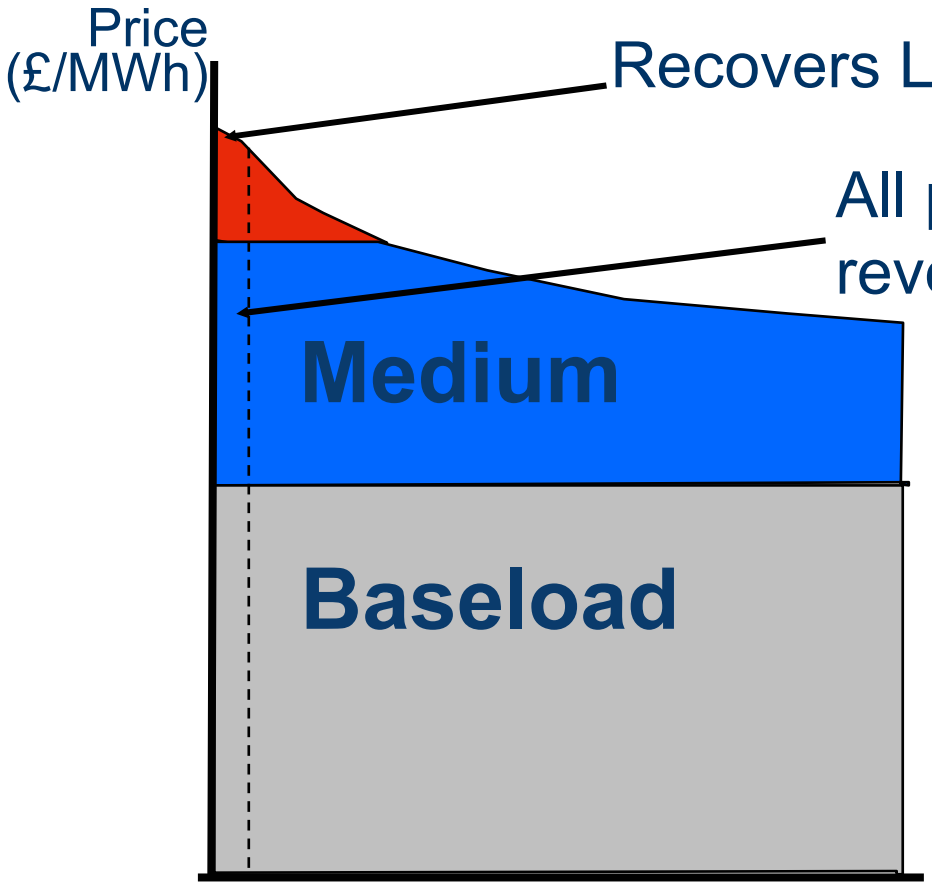


Pot Determination – Price Why Peaker Fixed Costs?

Energy Only Pool:



Pot Determination – Price
Why Peaker Fixed Costs?



- Remove Peaker Fixed Costs to CPM
- Peaker receives Fixed Costs through CPM
- Others receive Fixed Costs through CPM and inframarginal rent
- Allows SRMC bidding

BNE Peaker Fixed Costs

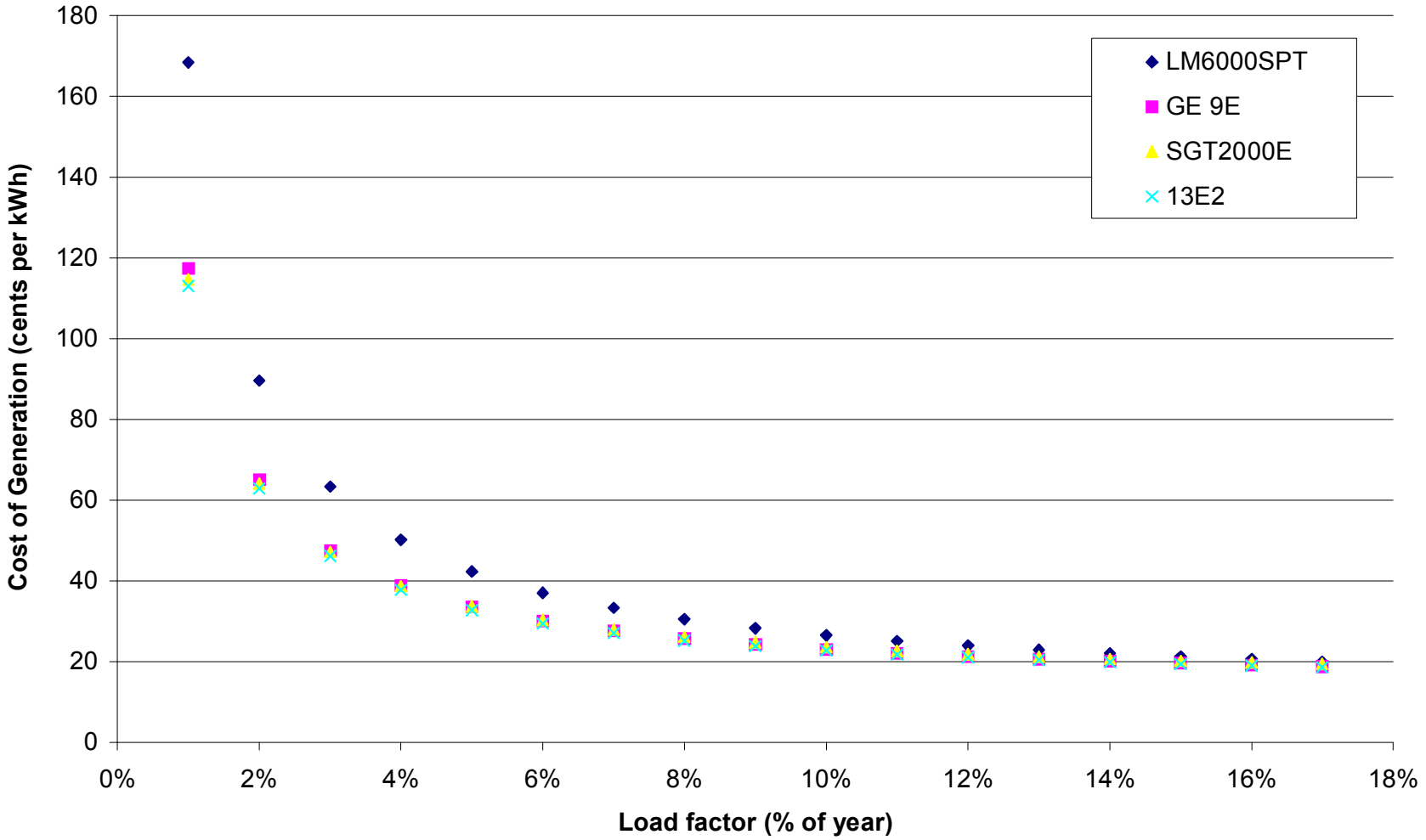
- Annualised fixed costs of a Best New Entrant Peaking Plant
- Methodology:
  - Identify appropriate technology for system
  - Estimate:
    - Financial costs (cost of capital over life)
    - Investment costs (site, equipment, etc.)
    - Operational costs (service agreement, Transmission charges, insurance etc.)
  - And deduct infra-marginal rents (if there are any)

BNE Peaker Fixed Costs

Technology	Output (MW)	Efficiency	Accessibility	Start Up	Plant Track Record	Screening Curve
LM6000SPT	44	39.0	√	√	√	
LMS100	92	43.6	√	√	X	
GE 6FA	74	33.9	√	X		
GE9E	124	32.9	√	√	√	
SGT2000E	159	34.0	√	√	√	
Alstom 13E2	187	36.9	√	√	√	

Aero Derivative
Heavy Duty Industrial Gas Turbine

BNE Peaker Fixed Costs



BNE Peaker Fixed Costs

Technology	Output (MW)	Efficiency	Accessibility	Start Up	Plant Track Record	Screening Curve
LM6000SPT	44	39.0	√	√	√	X
LMS100	92	43.6	√	√	X	
GE 6FA	74	33.9	√	X		
GE9E	124	32.9	√	√	√	√
SGT2000E	159	34.0	√	√	√	√
Alstom 13E2	187	36.9	√	√	√	√

Aero Derivative
Heavy Duty Industrial Gas Turbine

Integrated Pollution Prevention Control (IPPC) Best Available Technology (BAT) Directive – best efficiency

BNE Peaker Fixed Costs

- Original proposal fired the unit on Gas
- Responses indicated Gas Capacity Charge not tradeable
- Increased cost led to change to Distillate firing
  - Reduced capital cost (cf GCC) but reduced inframarginal rent too

BNE Peaker Fixed Costs

2007 Values[2]

Net Power Output (Lifetime)	182 MW
Capital Cost	€81 million
Amortisation Period	15 Years
WACC	7.83%
Annualised Capital Cost	€9.37 million
Fixed O&M Costs	€6.11 million
Annualised Cost of Capacity	€85.04/kW

2. Fixed Cost of New Entrant Peaking Plant for CPM – Final Decision paper: May 2007

BNE Peaker Fixed Costs

BNE Characteristics	
Minimum Stable Capacity	20MW
Incremental Heat Rate Slope	10.588GJ/MWh at MCR
Run Up Rate	10-20MW/min
Run Down Rate	10MW/min plus 6-8min Idle Time
Minimum Up Time	25 mins
Minimum Down Time	30 mins
Start-Up Energy	650GJ (LHV)
VOM Costs	1.39 cents/kWh

- Inframarginal rent:
  - Energy
    - Determined through multiple Plexos runs
    - Validated Plexos model and data
    - Determine SMPs without BNE
    - Determine running regime with BNE
  - Ancillary Service
    - Based on Eirgrid rates

2007 Values	
Energy Inframarginal Rent	€14.19/kW
Ancillary Service Revenue	€6.12/kW
Final BNE Cost	€64.73/kW

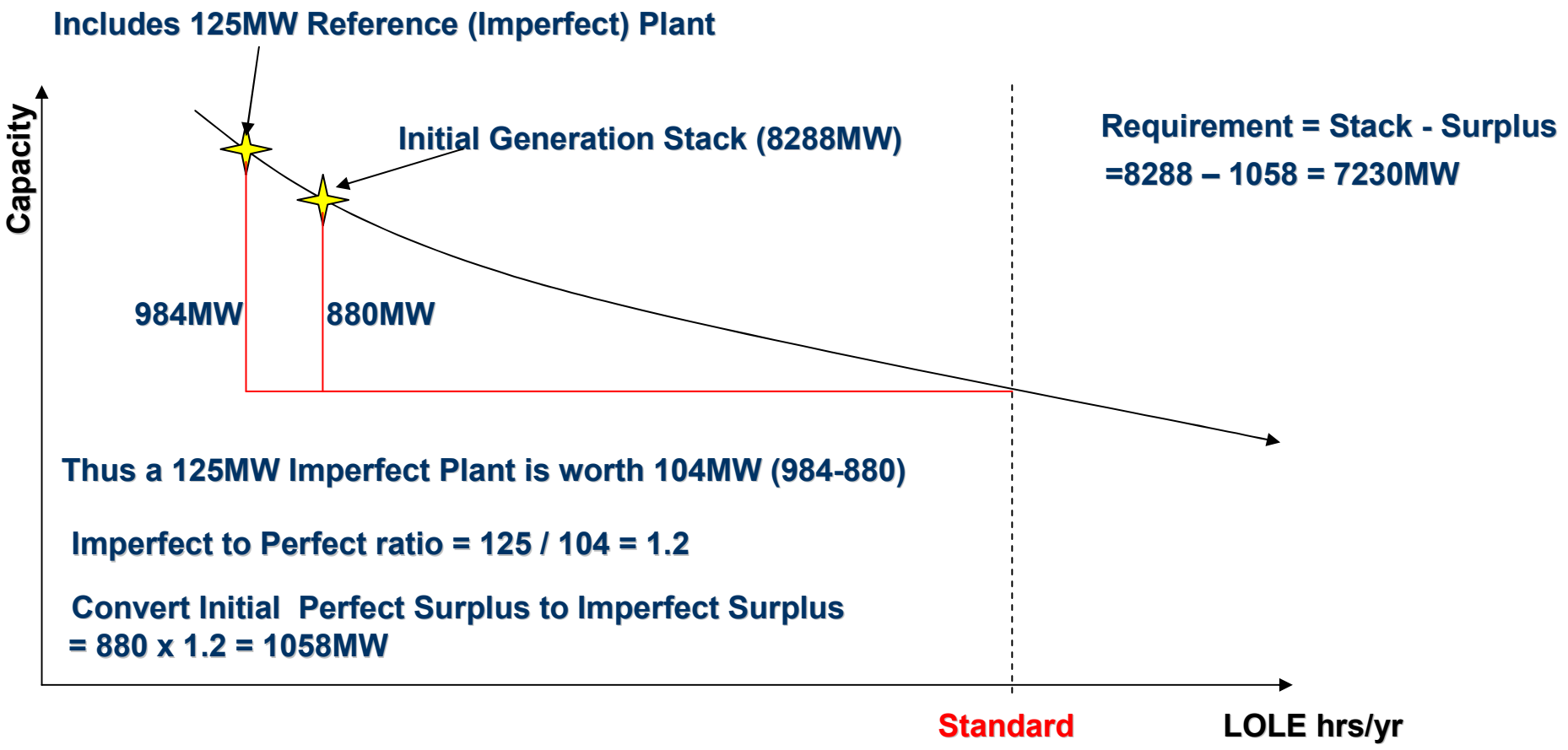
CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

Pot Determination – Volume

- Methodology:
  - Based on TSO Adequacy Assessment process
  - Create a demand forecast
  - Create generation probability distribution
  - Derive Loss of Load Probability (LOLP) per Trad. Period
  - Loss of Load Expectation$_{year}$ (LOLE) = $\sum_{year}$ LOLP
  - Compare LOLE to Security Standard ⇨ Deficit/Surplus
  - Requirement = Installed Capacity ± Deficit/Surplus

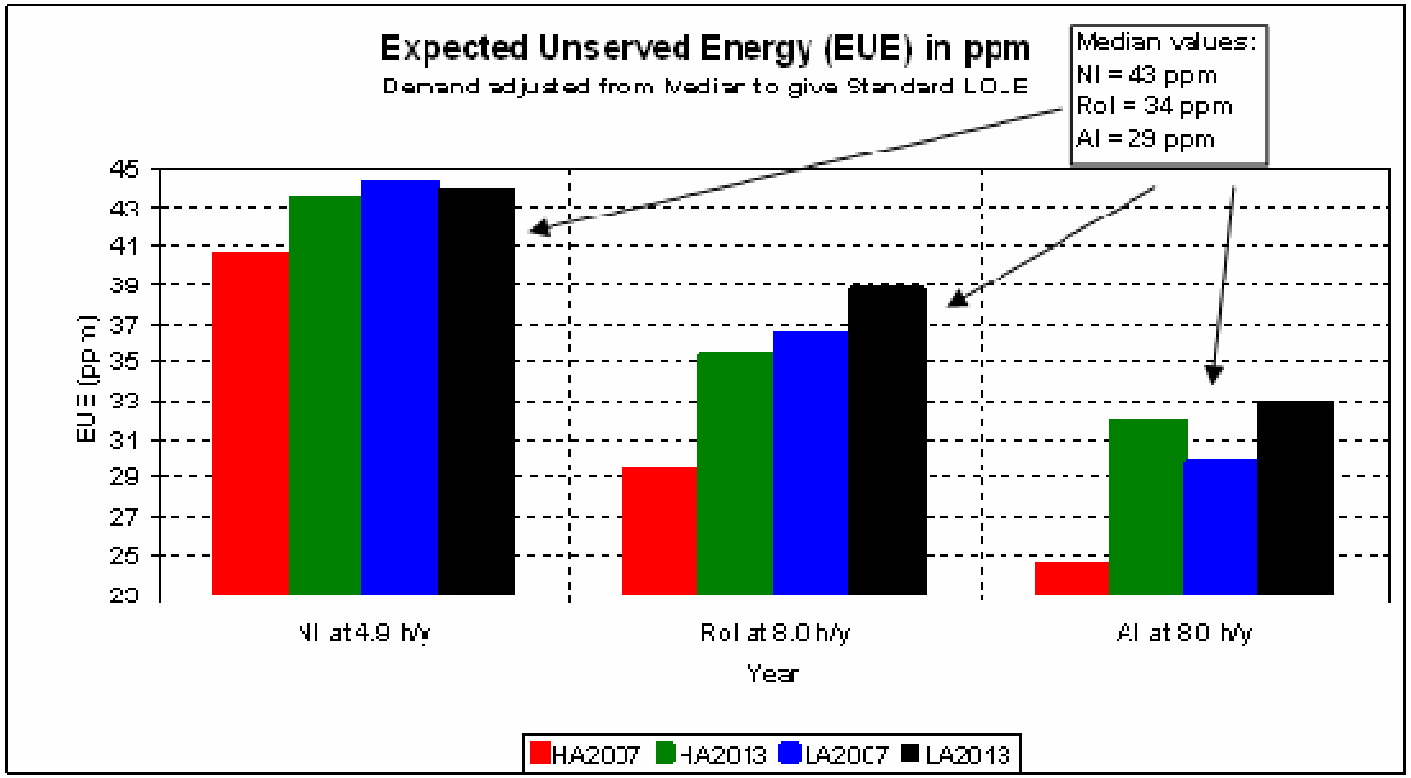
Capacity Requirement - Methodology



Capacity Requirement - Inputs

- Demand Forecast – From TSOs
- Unit Capacities – Direct from Generators
- Scheduled Outages – Historic Averages
- Adequacy Standard –
- Forced Outages –
- Wind Power –

Adequacy Standard



- Std > 8h/yr leads to greater EUE compared with current
- Select 8h/yr to give security/cost comparable with current

Forced Outage Probabilities

- Existing FOPs vary between NI and RoI
  - FOPs in NI ~ 4%
  - FOPs in RoI ~ 14%
- Incentivise Availability improvement (Objective)
- NI Average FOP - 4.23% - applied to all units*

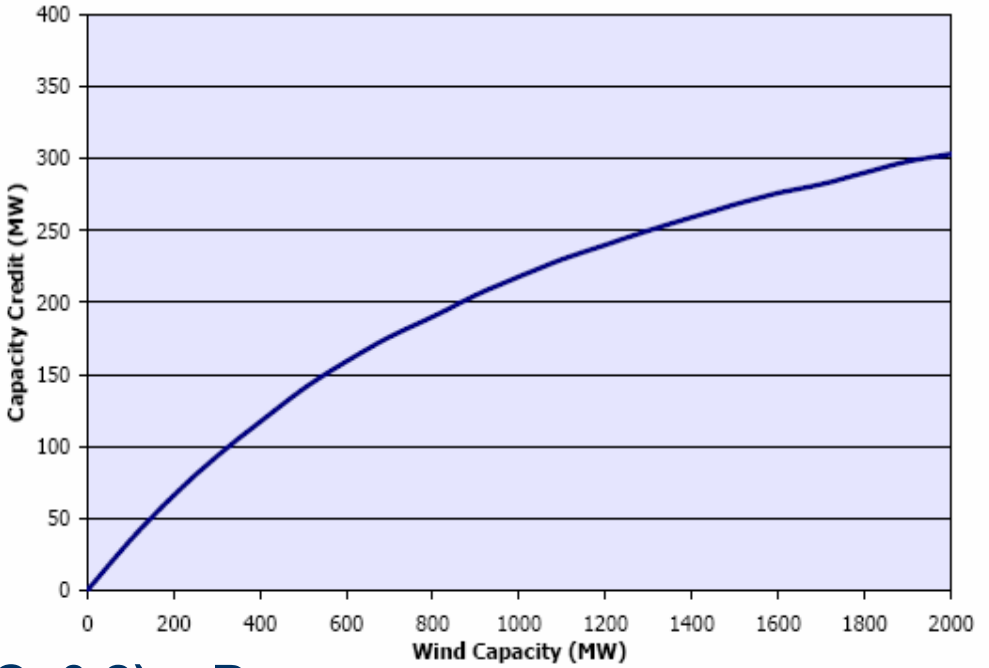
* Exception is Interconnectors – not a “true” generator

Treatment of Wind

- Wind generation reliant on fuel – very high FOPs
- Wind penetration set to grow
- Forecast output and adjust demand (i.e. not in generation “stack”)
- Apply Capacity Credit when calculating Capacity Requirement

Treatment of Wind

- All-island Wind 2007 ~1140MW
- Capacity Credit ~20%



Capacity Requirement = IC + (WICx0.2) + D

Where:

IC = Installed Capacity (market registered only) excluding Wind

WIC = Installed Capacity of Wind (market registered only)

D = Difference = Deficit or Surplus (where Surplus is negative)

Total Capacity Requirement for 2007 – 6960MW

Pot Determination – Monthly Values

- Annual Pot = BNE Price x Capacity Requirement
- For 2007 ~ €450.5 million
- Annual Pot split into Monthly Pots, weighted by peak to trough demand:

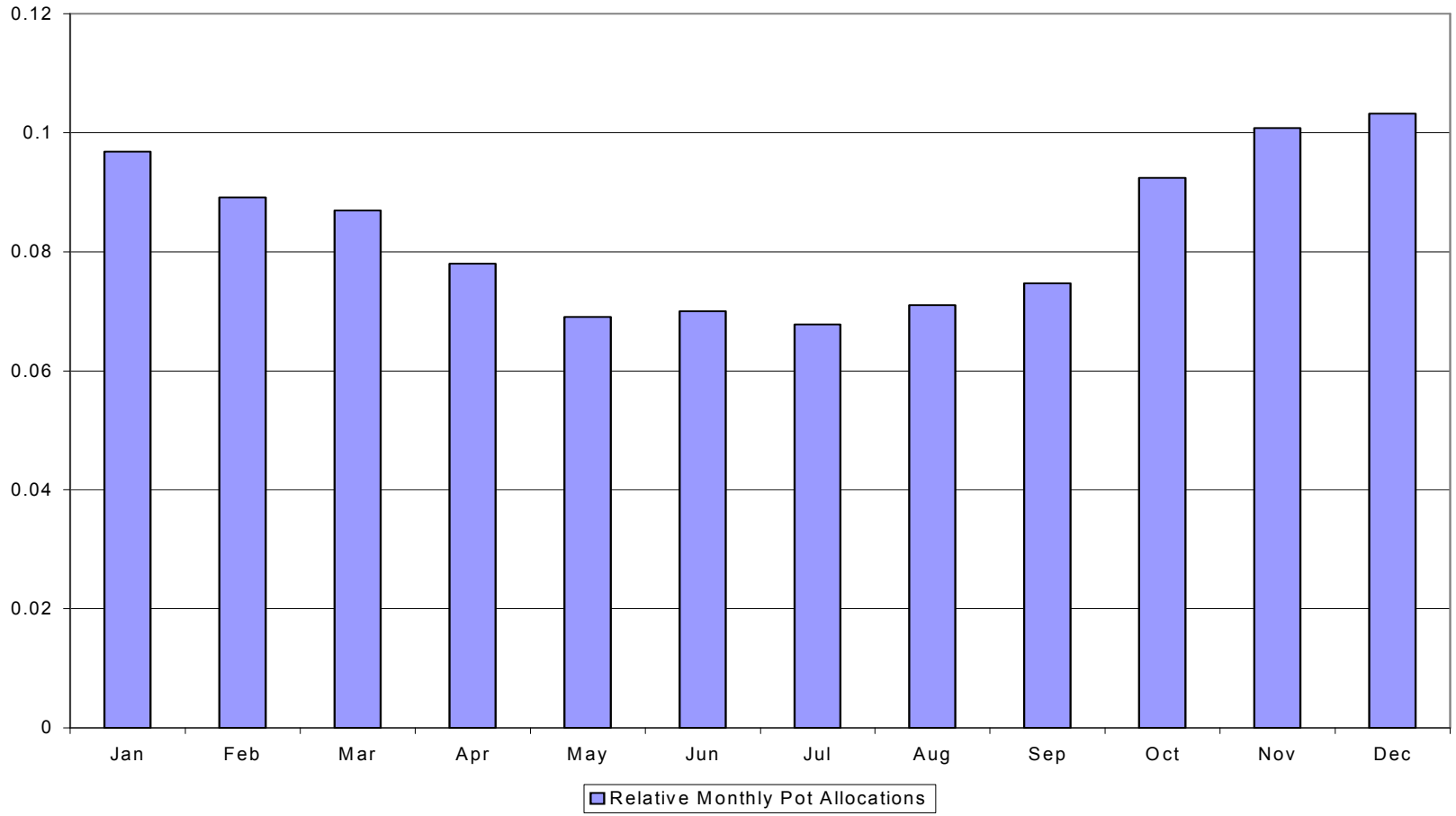
$$WF_c = \frac{P_c - MinFD_y}{\sum_{c\ in\ y}\left(P_c - MinFD_y\right)}$$ [3]

- Where:
  - WF_c is the Weighting Factor for the Capacity Period (Mth);
  - P_c is the peak demand in the Capacity Period; and
  - $MinFD_y$ is the minimum demand in the year

3. Capacity Factors Decisions Paper: December 2006

Pot Determination – Monthly Values

Majority of cash into high demand periods



CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

Why Have Three?

- Need to meet several Objectives
- Objectives sometimes conflicting
- Fixed: **30%**
  - Provides certainty to Generators, but
  - Weak incentives to respond to shortages
- Variable: **40%**
  - Still provides degree of certainty to Generators
  - Improves forecast of likely shortages, but
  - No response to un-forecast shortages
- Ex-Post: **30%**
  - Provides short-term response incentive, but
  - Payment incidence uncertain

A balance needs to be struck

How do the allocations work?

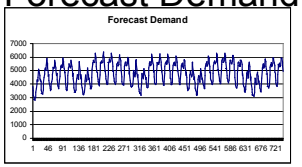
All Island Project

Fixed 30%

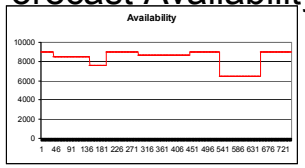
Variable 40%

Ex-Post 30%

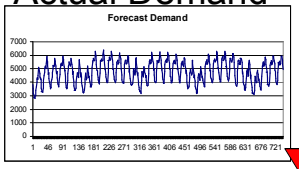
Forecast Demand



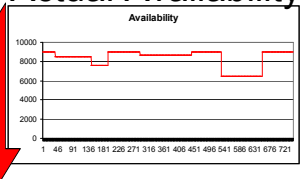
Forecast Availability



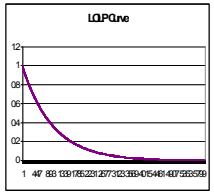
Actual Demand



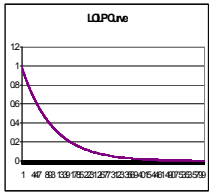
Actual Availability



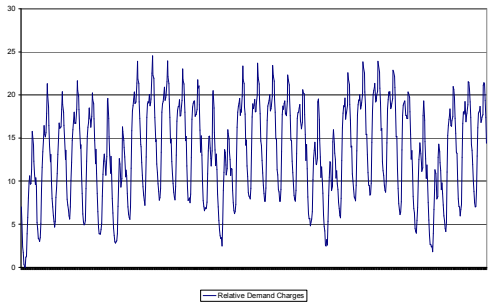
$$FCPWFh = \frac{FD_h - MinFD_c}{\sum_{h\ in\ c}(FD_h - MinFD_c)}$$

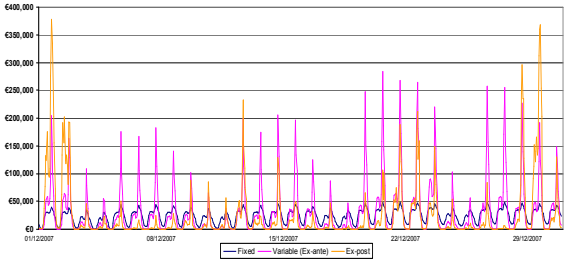


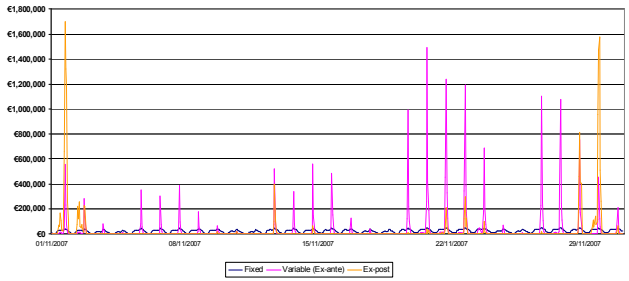
$$VCPWFh = \frac{\lambda_h}{\sum_{h\ in\ c}\lambda_h}$$



$$ECPWFh = \frac{\phi_h}{\sum_{h\ in\ c}\phi_h}$$







CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

Generator Payments

- Payments depend on available capacity* and price

TSC Version 2

4.123 $CPuh = CPGPFuh \times CPEALFuh \times (VCGPh + FCGPh + ECGPh)$

Where

1. *CPuh is the Capacity Payment for unit u in Trading Period h*
2. *CPGPFuh is the Capacity Payments Generation Price Factor for u in h*
3. *CPEALFuh is the Loss-Adjusted Capacity Payments Eligible Availability for u in h*
4. *VCGPh is the Variable Capacity Payments Generation Price in h*
5. *FCGPh is the Fixed Capacity Payments Generation Price in h*
6. *ECGPh is the Ex-Post Capacity Payments Generation Price in h*

- Availability
- Price
- Allocations (Variable / Fixed / Ex-Post)

* Based on production for some unit types (see later)

Generator Payments

- Capacity Payments depend on Price

TSC Version 2

4.115

$$CPGPFuh = \frac{\left((MSQuh \times CPPFh) + \sum_i \left(UCOQuhi \times Max\left\{ \frac{VOLL - UCOPuhi}{VOLL}, 0 \right\} \right) \right)}{MSQuh + \sum_i UCOQuhi}$$

Where

1. *CPGPFuh is the Capacity Payments Generation Price Factor for unit u in Trading Period h*
2. *MSQuh is the Market Schedule Quantity for u in h*
3. *CPPFh is the Capacity Payments Price Factor in h*
4. *UCOQuhi is the Unscheduled Capacity Offer Quantity for Price Quantity Pair i for u in h*
5. *VOLL is the Value of Lost Load*
6. *UCOPuhi is the Unscheduled Capacity Offer Price for i for u in h*

- A unit with Price > VOLL has no value
- A unit with Price ~ VOLL has little value
- As unit Price approaches VOLL, value decreases

Generator Payments

TSC Version 2
4.109

$$CPPFh = Max\left\{\left(\frac{(VOLL - SMPh)}{VOLL}\right), 0\right\}$$

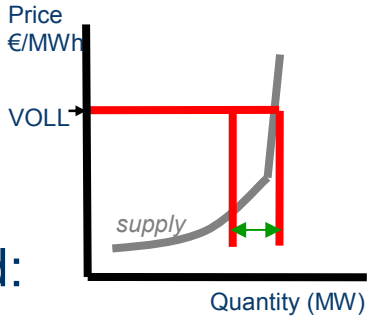
Where

1. *CPPFh is the Capacity Payments Price Factor for Trading Period h*
2. *VOLL is the Value of Lost Load*
3. *SMPh is the System Marginal Price for Trading Period h*

- Avoids payments to Generators exceeding VOLL

If Supply > Demand & Price < VOLL, Price = SMP

If Supply < Demand or Price > VOLL, Price = VOLL



Loss of Load Probability = Probability Supply < Demand:

Probability weighted Price = SMP x (1 – LOLP) + VOLL x LOLP

= SMP + LOLP x (VOLL – SMP)

Generator Payments

- Payments depend on available capacity* and price

TSC Version 2

4.123 $CPuh = CPGPFuh \times CPEALFuh \times (VCGPh + FCGPh + ECGPh)$

Where

1. *CPuh is the Capacity Payment for unit u in Trading Period h*
2. *CPGPFuh is the Capacity Payments Generation Price Factor for u in h*
3. *CPEALFuh is the Loss-Adjusted Capacity Payments Eligible Availability for u in h*
4. *VCGPh is the Variable Capacity Payments Generation Price in h*
5. *FCGPh is the Fixed Capacity Payments Generation Price in h*
6. *ECGPh is the Ex-Post Capacity Payments Generation Price in h*

- Availability
- Price
- Allocations (Variable / Fixed / Ex-Post)

* Based on production for some unit types (see later)

Generator Payments

- Generators paid against Loss-Adjusted Capacity Payments Eligible Availability (CPEALFuh)
- Mostly = APuh x TLAFuh x TPD
  - Where:
  - APuh is the Availability Profile of Unit u in Trading Period h
  - TLAFuh is the Transmission Loss Adjustment Factor of u in h
  - TPD is the Trading Period Duration
- But TSC Section 5 (Special Units) identifies other cases…

Generator Payments

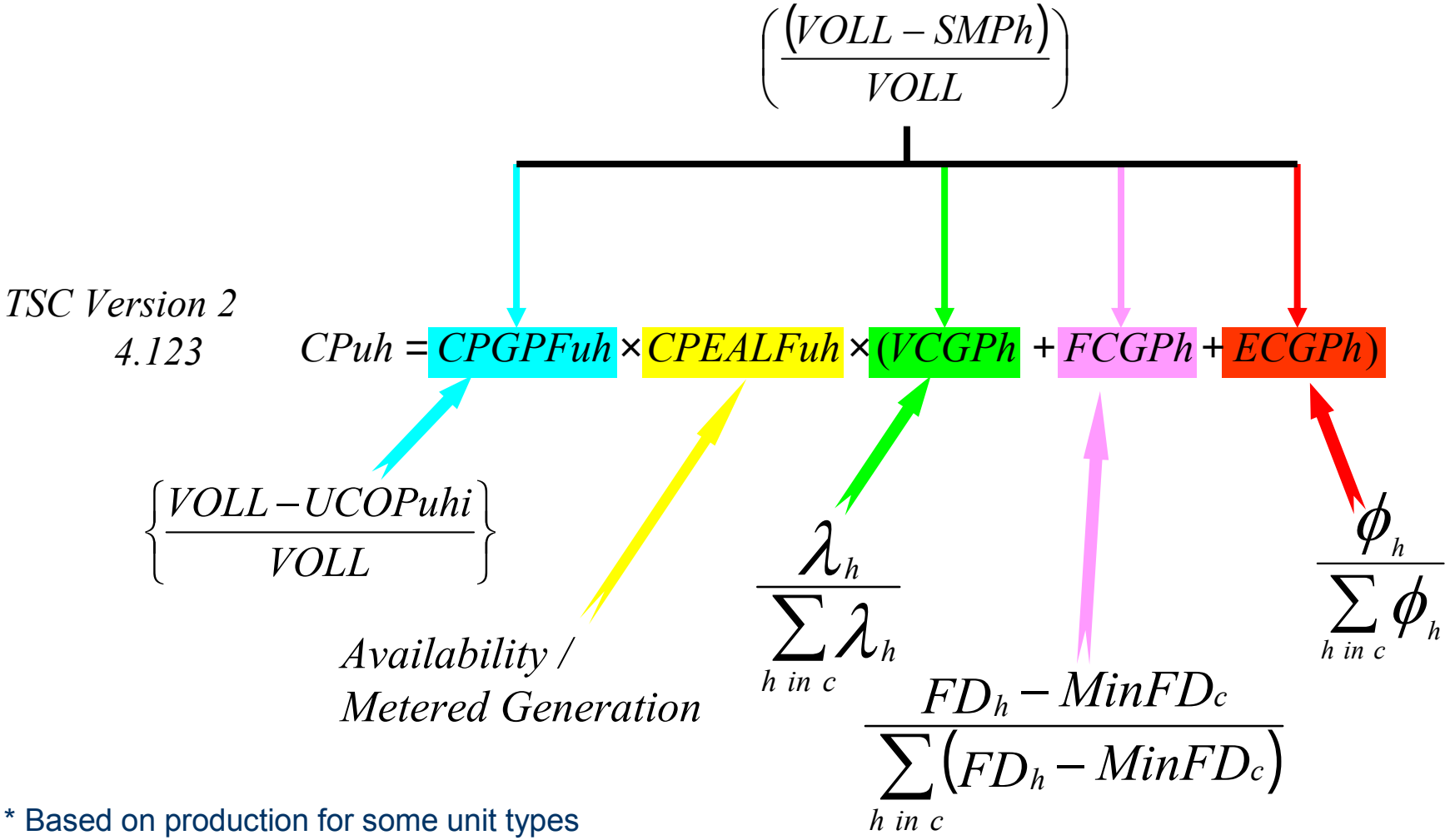
TSC Version 2, Table 5.1

Category	Form of Dispatch Instruction	Dispatch Quantity (DQuh)	Availability Profile (APuh)	Market Schedule Quantity (MSQuh)
Autonomous Generator Units	**N/A**	Actual Output (AOuh)	Actual Output (AOuh)	Actual Output (AOuh)
Variable Price Taker Generator Units	**Run**	Actual Output (AOuh)	Actual Output (AOuh)	Actual Output AOuh
Variable Price Taker Generator Units	**Unit constrained down in Dispatch Instructions to remain below a level of Output of X MW**	Time weighted average of (Outturn Availability when not constrained down below X MW, Min{X MW, Outturn Availability} when constrained down below X MW)	Max {Actual Output (AOuh), Time weighted average of Outturn Availability}	Max {Actual Output (AOuh), Time weighted average of Outturn Availability}
Variable Price Maker Generator Units	**Run**	Actual Output (AOuh)	Actual Output (AOuh)	Calculated by the MSP Software
Variable Price Maker Generator Units	**Unit constrained down in Dispatch Instructions to remain below a level of Output of X MW**	Time weighted average of (Outturn Availability when not constrained down below X MW, Min{X MW, Outturn Availability} when constrained down below X MW)	Max (Actual Output (AOuh), Time weighted average of Outturn Availability)	Calculated by the MSP Software
Predictable Price Taker Generator Units	**Any**	As set out in Section 4	As set out in Section 4	Minimum of Nominated Quantity (NQuh) and Availability Profile (APuh)

- Number of Special Cases
- Mainly Actual Output
- Interconnector Units:
  - Dispatch Quantity
  - Availability and price
- Energy Ltd./Pump. Stge:
  - Allocate “excess” to peak LOLP
- Demand Side Units:
  - Demand Reduction

Generator Payments – Summary

- Payments depend on available capacity* and price



* Based on production for some unit types

CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

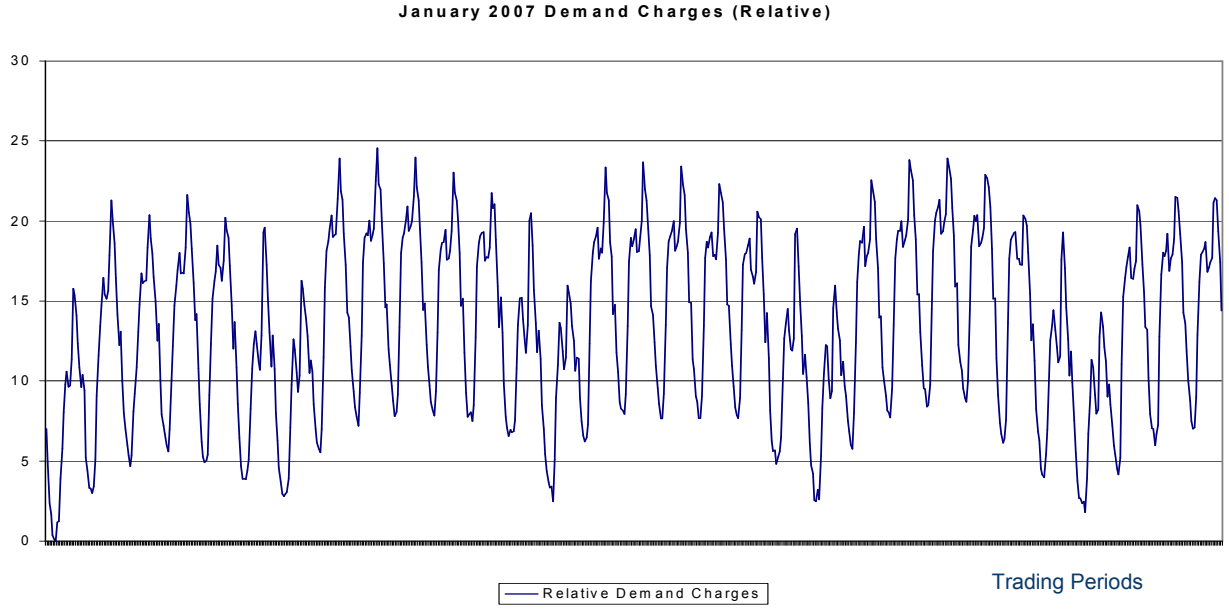
Allocation for Charges

- Allocated at start of year as for Fixed

TSC Version 2 4.105

$$FCPWFh = \frac{FD_h - MinFD_c}{\sum_{h\ in\ c}\left(FD_h - MinFD_c\right)}$$

- Capacity Period charge known – stability/certainty
- Incentivises reduction in consumption during peaks



CPM Key Features

- Fixed amount of cash (the Pot) per year
- Pot determined as Price x Volume
  - Price: Best New Entrant Peaking Plant fixed costs
  - Volume: Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption

Supplier Charges

- Trading Period allocations scaled in same way as for Generator payments

$$CPPFh = Max\left\{\left(\frac{(VOLL - SMPh)}{VOLL}\right), 0\right\}$$

- Suppliers charged based on consumption
- Charges reflect proportion of total consumption

Monthly Pot

$$NDLFvh \times FCPWFh \times CPPFh \times \left(\frac{CPPSc}{\sum_{v,h\ in\ c}(NDLFvh \times FCPWFh \times CPPFh)}\right)$$

Demand

"Fixed" Weighting Factor

Assimilation of TSC Version 2, 4.126 to 4.128

Agenda

- CPM Objectives
- CPM Design
- Annual Capacity Payment Sum
- Payments to Generators
- Charges to Suppliers
- Summary

Summary

- The CPM is designed to meet a number of Objectives:
  - Capacity Adequacy:
  - Efficient Long-Term Signals
  - Price Stability
  - Minimise Susceptibility to Gaming
  - Fairness
  - Simplicity
- Chosen mechanism is a Fixed Revenue mechanism……..

Summary - continued

- Fixed amount of cash per year
- Pot determined as Price x Volume
  - Best New Entrant Peaking Plant fixed costs
  - Capacity required to meet adequacy standard
- Pot allocated for Generator Payments:
  - Fixed (year ahead)
  - Variable (month ahead)
  - Ex-Post (month end)
- Generators paid when available: proportional
- Pot allocated for Supplier Charges:
  - Based on demand
- Suppliers charged on consumption: proportional

Agenda

- CPM Objectives
- CPM Design
- Annual Capacity Payment Sum
- Payments to Generators
- Charges to Suppliers
- Summary
- Parameters for 2007/2008

CPM Parameters and Timetable – "On-going"

- Regulatory Authorities determine (Y-4mths):
  - Annual Capacity Payment Sum ($ACPS_Y$)
  - Capacity Period Payment Sums ($CPPS_c$)
  - Fixed Capacity Payments Proportion ($FCCP_Y$)
  - Ex-Post Capacity Payments Proportion ($ECPP_Y$)
    - [and therefore the Variable Capacity Payments Proportion]
  - Value of Lost Load (VOLL)
  - Flattening Power Factor (FPF_Y)*
- Market Operator publishes above ~Y-2mths

Consultation on BNE technology in Spring

* SO recommends value to Regulatory Authorities at this time

CPM Parameters - 2007

- Capacity Requirement - 6960MW
- BNE Peaker Fixed Costs - €64.73/kW
- $ACPS_Y$ = €450,517,348
- $FCPP_Y$ = 0.3
- $ECPP_Y$ = 0.3 [VCPPY = 0.4]
- VOLL – Consultation
- FPF_Y = 0.35
- $CPPS_c$

Month	Amount
Jan	€42,277,947
Feb	€40,677,812
Mar	€40,532,345
Apr	€33,990,746
May	€32,088,658
Jun	€30,501,747
Jul	€30,722,151
Aug	€32,661,709
Sep	€32,685,953
Oct	€38,969,679
Nov	**€47,131,249**
Dec	**€48,277,352**

CPM Parameters – 2008

- Capacity Requirement - 7200MW*
- BNE Peaker Fixed Costs - €79.16/kW*
- $ACPS_Y$ = €569,952,000*
- $FCPP_Y$ = 0.3
- $ECPP_Y$ = 0.3 [VCPPY = 0.4]
- VOLL – Consultation
- FPF_Y = 0.35
- $CPPS^*_c$

Month	Amount
Jan	€53,344,047
Feb	€51,602,752
Mar	€51,019,670
Apr	€43,050,000
May	€40,598,406
Jun	€39,047,938
Jul	€39,591,264
Aug	€41,425,322
Sep	€41,255,698
Oct	€49,447,999
Nov	€59,143,062
Dec	€60,425,842

* Indicative Values. Final value to be published August 2007

End

Thank you for your attention

John Parsonage

Ledian House
45, Bedford Row
London
WC1R 4LN
Tel: +44 207 092 1795
Fax: +44 207 092 1770
Mob:+44 797 061 5309