

# PAYING DG TO PROVIDE POWER When Power is Needed

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## Two Views of Capacity Payments

- Pay for the promise to produce power when the power is needed
- Pay for having produced power when the power was needed

Can't finance new power plants under latter concept

But might be able to get existing "junk" to operate occasionally under latter concept

## Total Numbers of Domestic Gensets

### Distributions by State

Range (KW) State	50-70	71-150	151-300	301-700	701-1200	1201-2000	2001+	Total
California	22,405	23,558	14,373	7,062	5,259	5,257	1,968	79,882
Washington	3,699	3,553	4,060	1,400	916	812	304	14,744
Arizona	2,961	1,421	2,708	1,120	220	650	230	9,310
Oregon	2,143	2,058	1,960	811	530	470	176	8,148
Nevada	1,072	1,029	980	406	266	236	83	4,072
Colorado	2,556	2,700	3,273	967	506	561	201	10,764
Utah	1,337	1,284	978	506	332	294	110	4,841
New Mexico	1,145	1,100	1,047	433	283	251	94	4,353
Montana	547	621	538	222	146	129	48	2,251
Wyoming	321	494	323	122	80	71	27	1,438
<b>Total</b>	<b>38,186</b>	<b>37,818</b>	<b>30,240</b>	<b>13,049</b>	<b>8,538</b>	<b>8,731</b>	<b>3,241</b>	<b>139,803</b>

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## Total Capacity (MW) of Domestic Gensets

### Distributions by State

Range (KW) Nominal (KW) State	50-70 60	71-150 110	151-300 220	301-700 500	701-1200 950	1201-2000 1600	2001+ 3000	Total
California	1,344	2,591	3,162	3,531	4,996	8,411	5,904	29,940
Washington	222	391	893	700	870	1,299	912	5,287
Arizona	178	156	596	560	209	1,040	690	3,429
Oregon	129	226	431	406	504	752	528	2,975
Nevada	64	113	216	203	253	378	249	1,475
Colorado	153	297	720	484	481	898	603	3,635
Utah	80	141	215	253	315	470	330	1,805
New Mexico	69	121	230	217	269	402	282	1,589
Montana	33	68	118	111	139	206	144	820
Wyoming	19	54	71	61	76	114	81	476
<b>Total</b>	<b>2,291</b>	<b>4,160</b>	<b>6,653</b>	<b>6,525</b>	<b>8,111</b>	<b>13,970</b>	<b>9,723</b>	<b>51,432</b>

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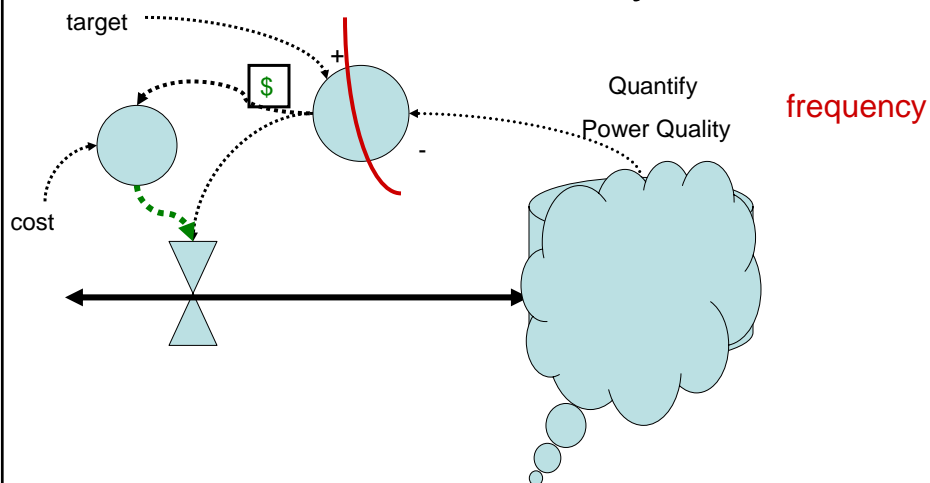
## Wide Open Load Following WOLF

- Short run marginal cost
- Negative feedback using system physics
- Active power priced globally/regionally
- Geographic differentiation
  - Line Losses
  - Constraints
- Reactive power priced locally

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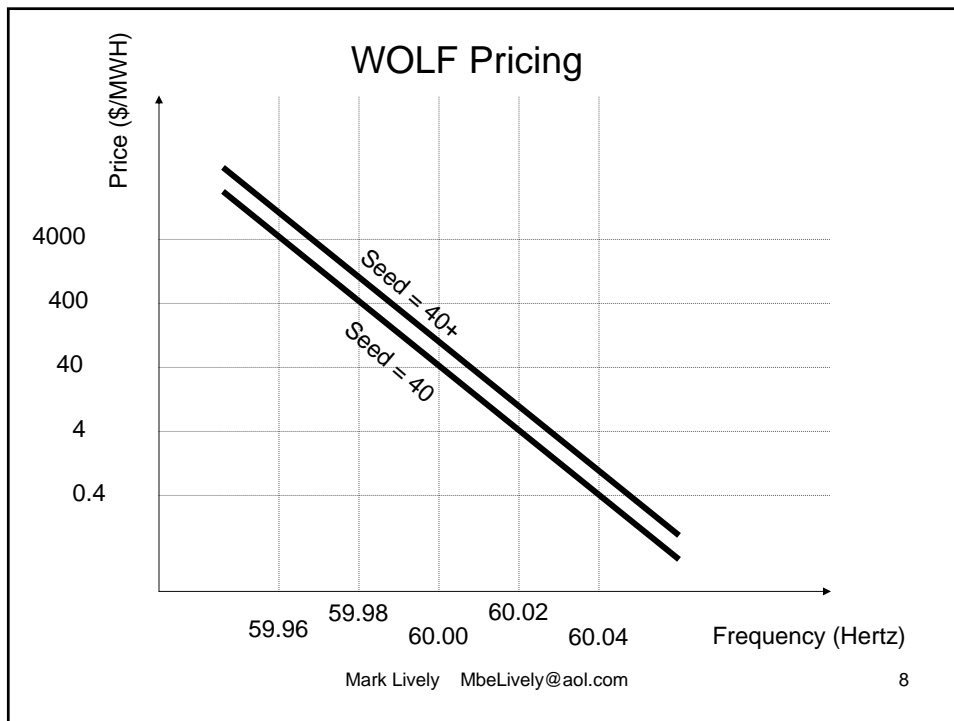
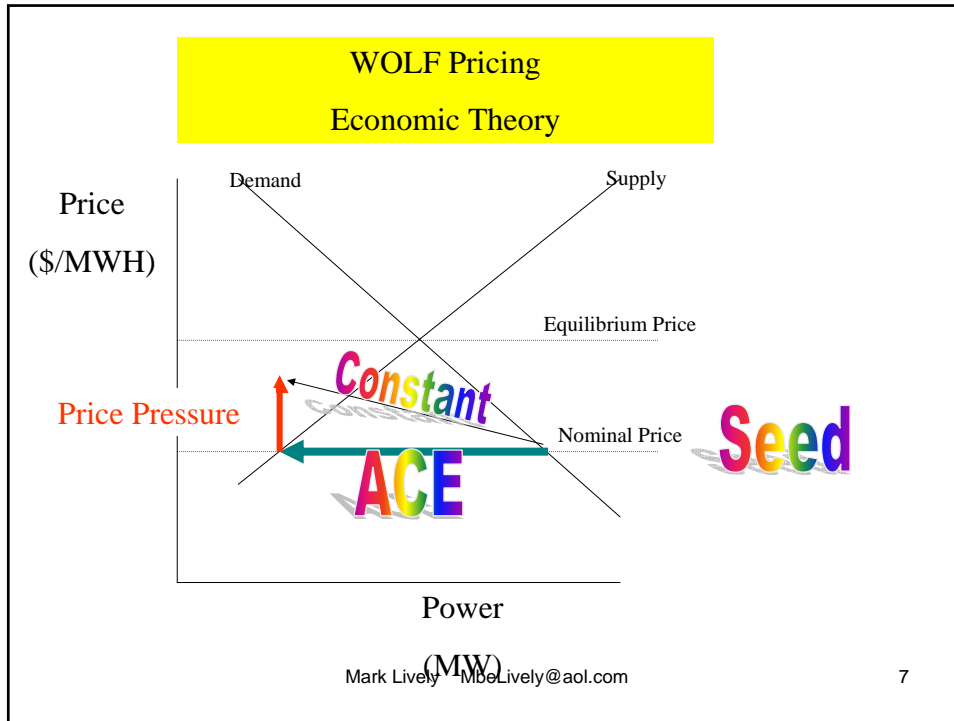
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## Wide Open Load Following Control Theory

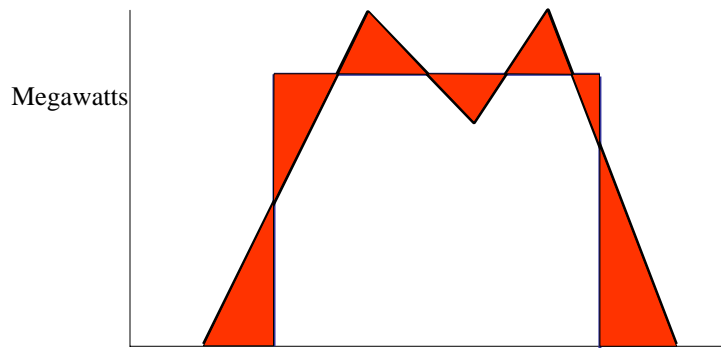


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# Delivering Active Power

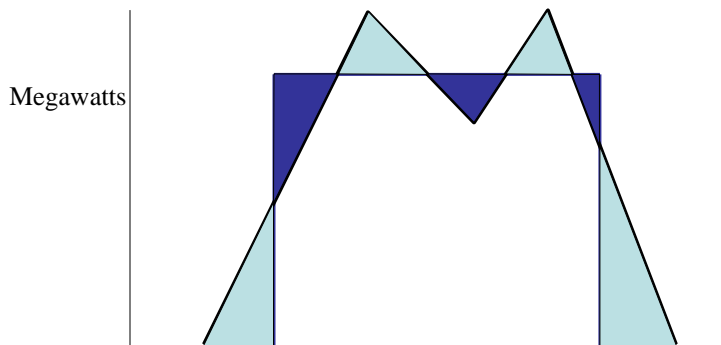


Duration of Transaction

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# Delivering Active Power

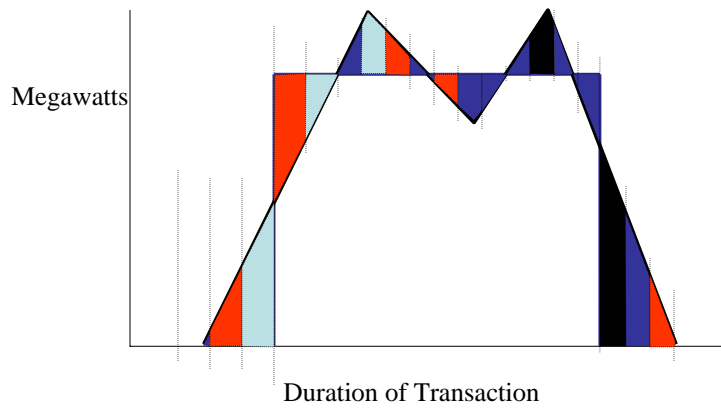


Duration of Transaction

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# Delivering Active Power

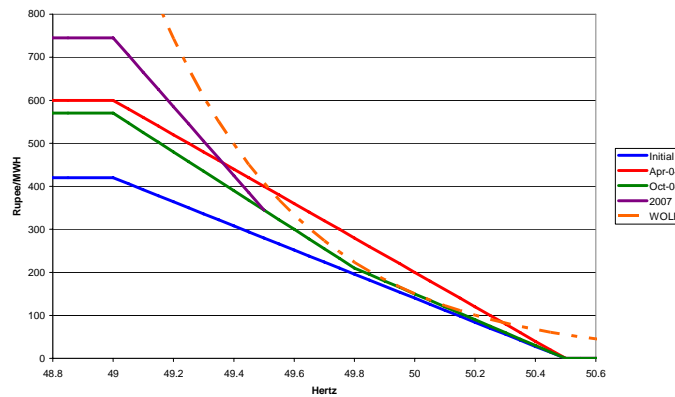


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# Formulary Auction India vs WOLF

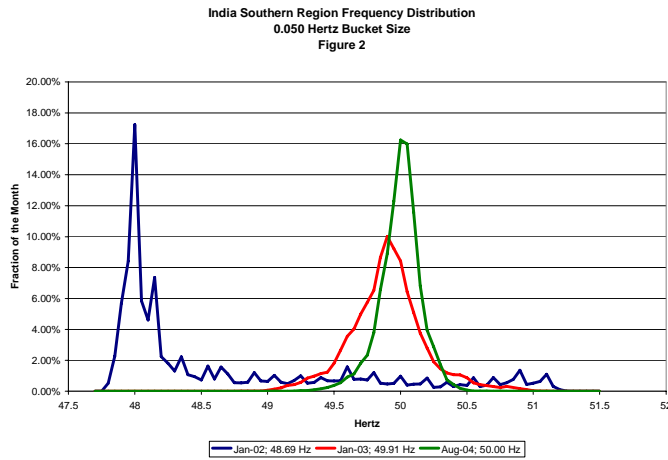
ABT UI Pricing Chart  
Figure 1



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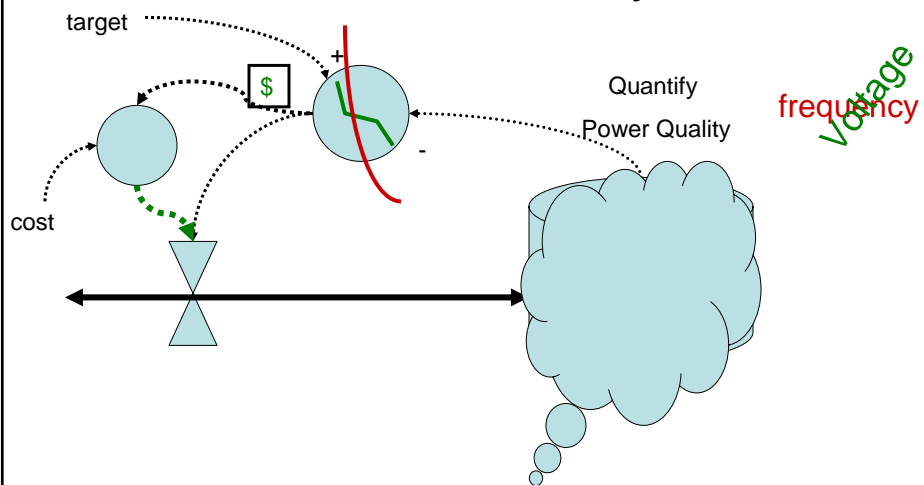
# Indian Price Responsiveness



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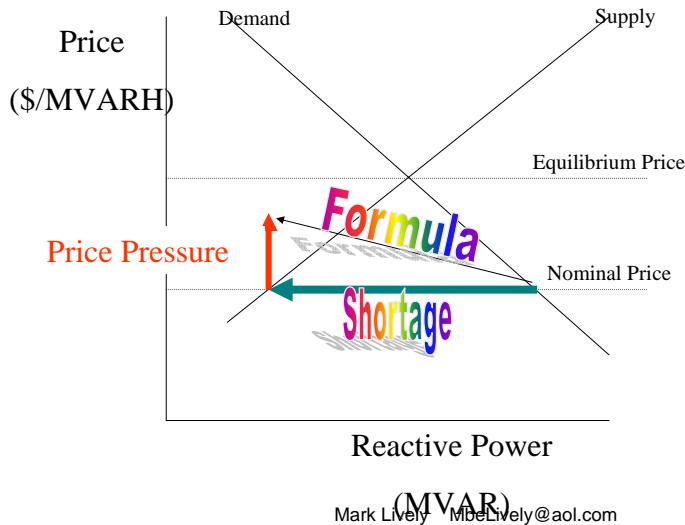
## Wide Open Load Following Control Theory



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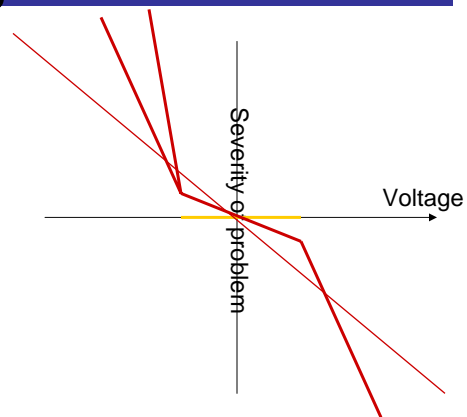
## Wide Open Load Following Dynamic Economic Theory



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## Wide Open Load Following Adjusting the Curve

- For small voltage excursions, no harm, no foul
- Low voltage excursions are more serious than high voltage excursions



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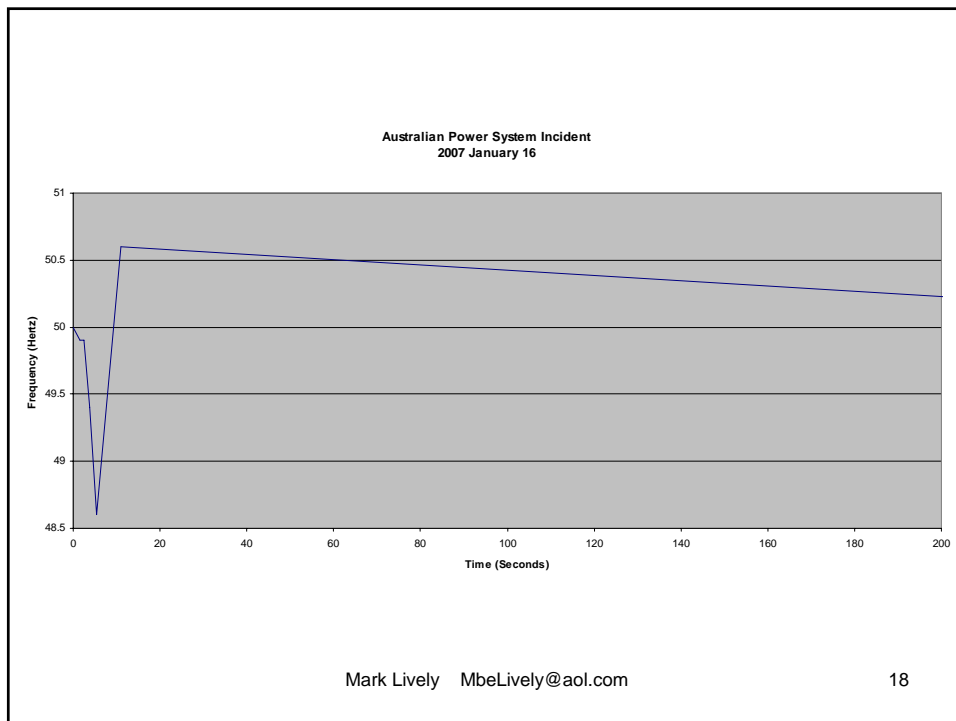


## Applying WOLF to Load Control

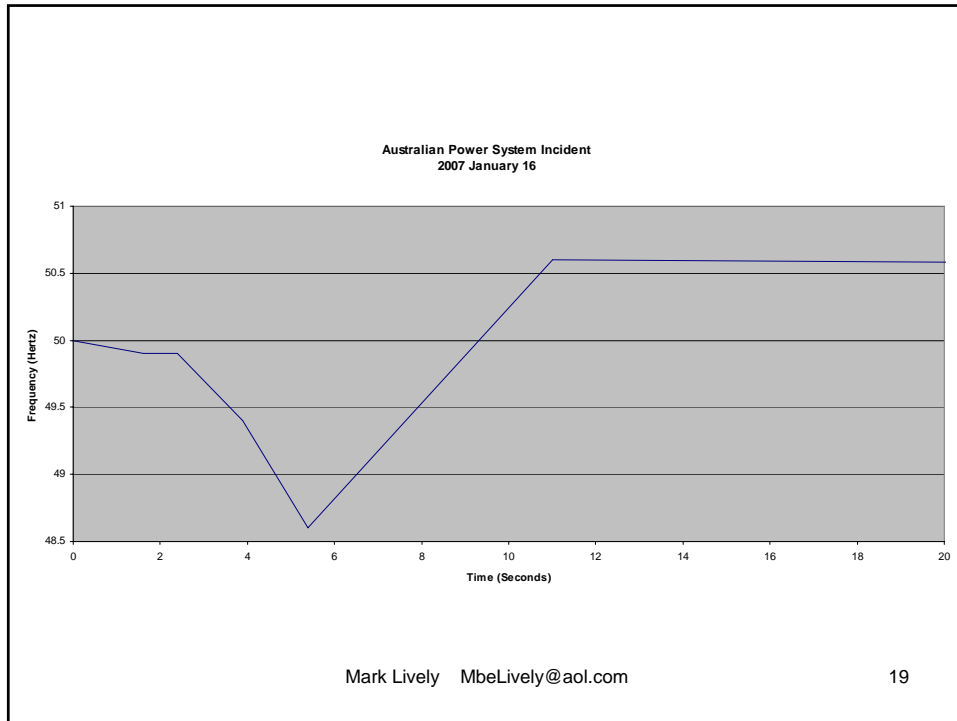
- ESKOM rule—Don't start combustion turbines until frequency is expected to be below 49.5 Hertz for 2 hours or more
- What to do with intermittent shortage, such as system separation with severe frequency sag

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## WOLF UFR Example

- Value set every 1/10 second
- \$50/MWH Base
- Price Doubles
  - 100 Millihertz
  - 90 Millihertz
  - 80 Millihertz
  - 70 Millihertz
  - 60 Millihertz

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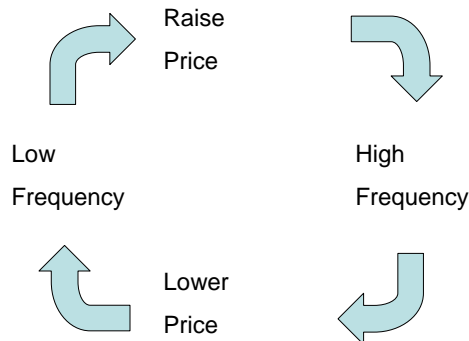
WOLF Evaluation of Load Control  
During 2007 January 16 Incident  
In Australia

Value of Energy = \$50/MWH  
Value Doubles With Frequency Base (m/hz)

Frequency Base	Value of Interruption	Value of Excess
60	\$58,780.48	\$(2.74)
70	\$6,823.13	\$(2.67)
80	\$1,381.12	\$(2.59)
90	\$404.24	\$(2.52)
100	\$152.95	\$(2.45)

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## WOLF Pricing Control Theory



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