United Utilities' Structure of Charges Project

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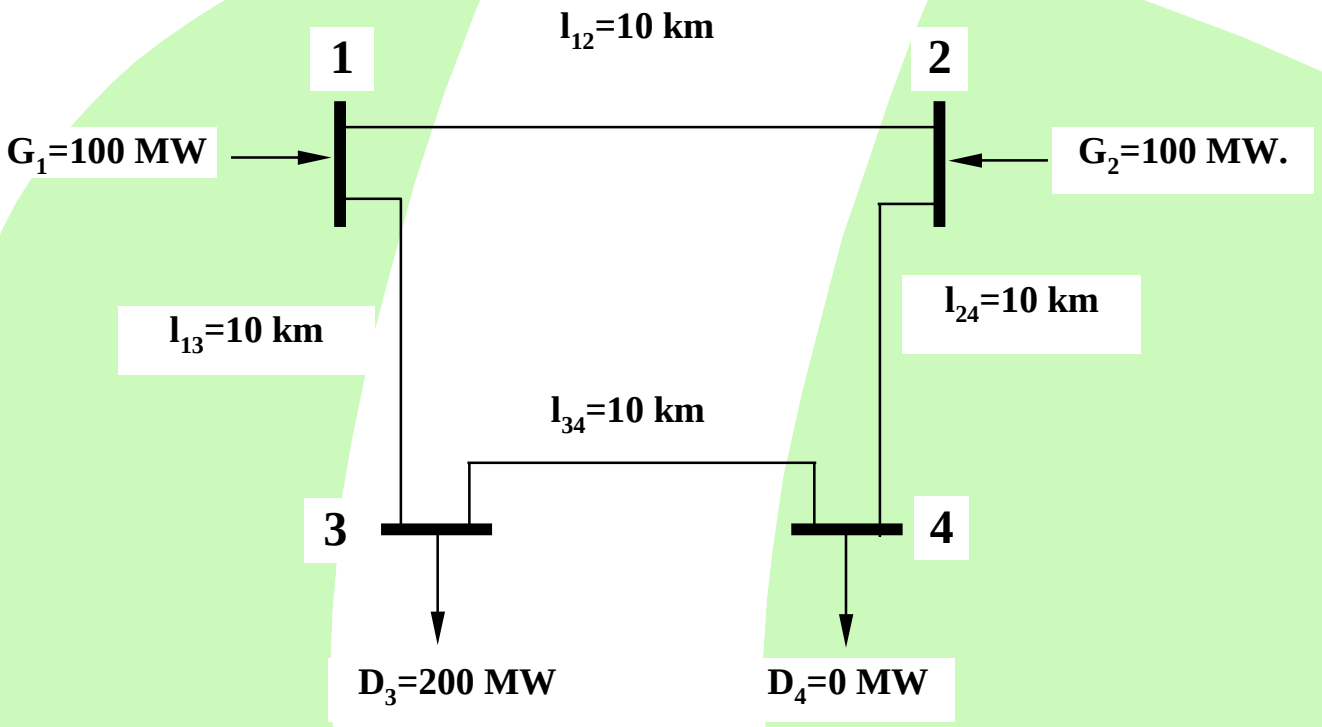
Outline of Study

- Literature review of pricing models and techniques
- Analysed ICRP and LRIC models
- Developed charging options
- Built test model/network:
  - Applying DCLF techniques and including contingency analysis
- Used test network to model a real United Utilities' network
- Evaluated charging options on real network

Cost Attribution

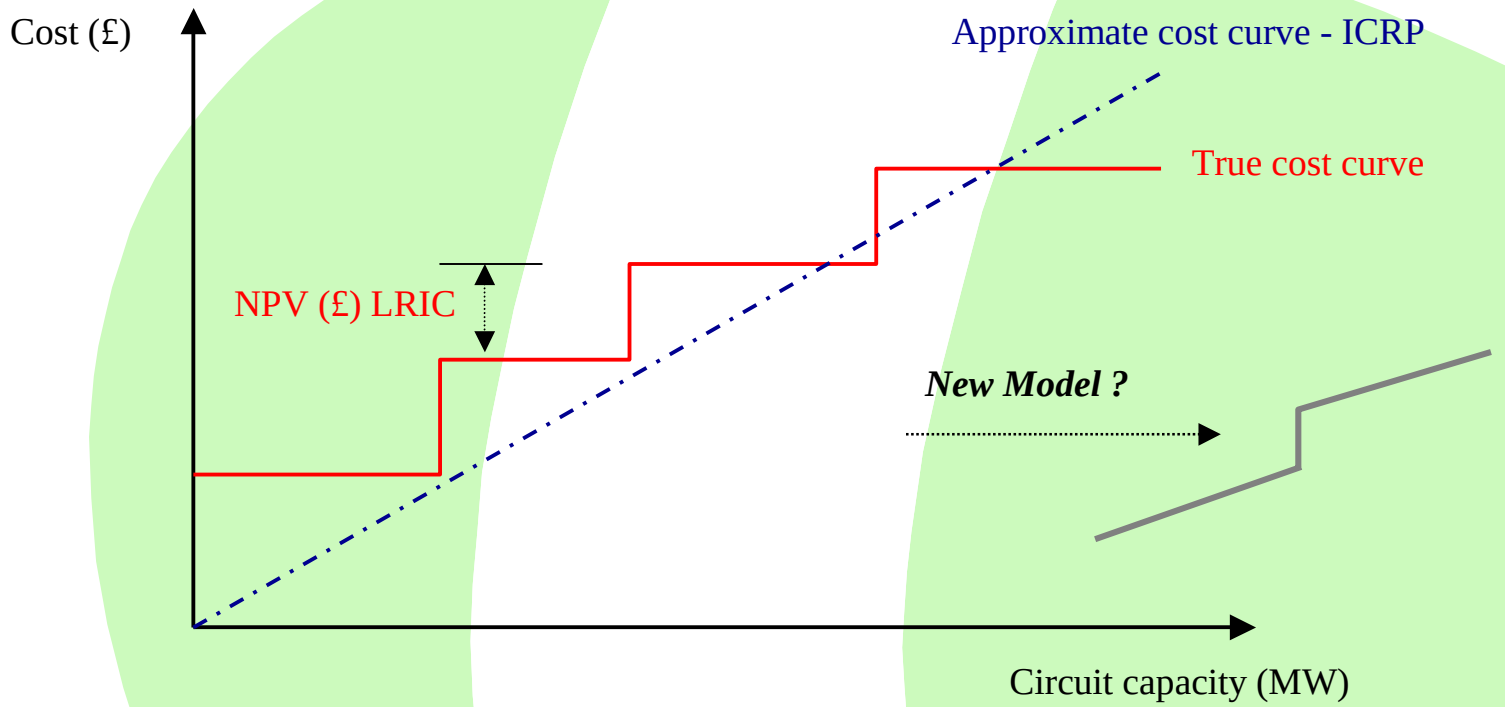
How to attribute network costs to customers?



Meshed network

Cost Modelling

How to model the pattern of “lumpy” investment in assets?



Cost Modelling

ICRP formula:

$$\text{Branch Cost} = A \times P/C$$

Where A = MEA cost, £
P = peak flow in the branch, MW
C = branch capacity, MW

LRIC formula:

$$\text{Branch Cost} = A / (1 + i)^T$$

Where A = MEA cost, £
i = discount rate
T = time to reinforcement

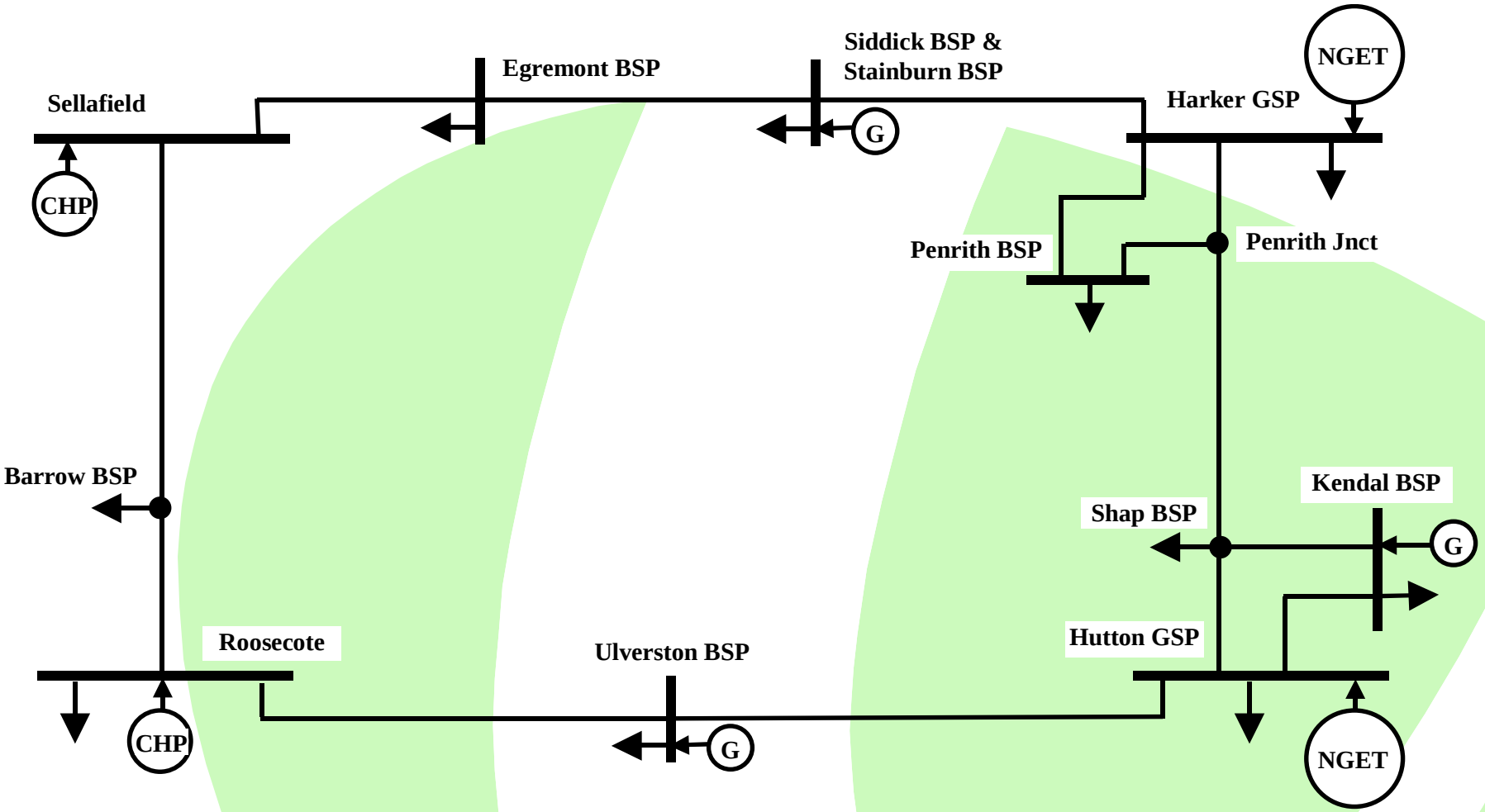
Cost Modelling - United Utilities' Development

General Cost Model Formula:

$$\text{General Branch Cost} = \{k * \text{LRIC}\} + \{(1-k) * \text{ICRP}\}$$

Where k = user defined factor that determines balance between terms

Cumbrian 132kV Network



Cumbrian Network Test Scenarios

We undertook three studies:

- Base case analysis of the Cumbrian Ring
- Connection of 20MW demand at Roosecote
- Connection of 200MW generation at Stainburn/Siddick

Cumbrian Network Study Results

Base case

	ICRP Nodal Cost	LRIC Nodal Cost	Total Nodal Cost
	(£/kW)	(£/kW)	(£/kW)
Harker GSP	0.0	0.0	0.0
Penrith Junction	0.35	1.46	1.81
Penrith BSP	-0.29	-1.30	-1.59
Shap BSP	1.33	5.48	6.81
Kendal BSP	1.34	5.48	6.82
Hutton GSP	1.68	6.75	8.44
Ulverston BSP	2.65	11.01	13.66
Roosecote	2.99	12.51	15.50
Barrow BSP	2.75	11.35	14.10
Sellafield	2.42	9.30	11.72
Egremont BSP	2.01	7.76	9.77
Siddick/Stainburn BSP	1.52	5.88	7.40
Annual Revenue (£k pa)			**£4,515**

Cumbrian Network Study Results

20MW demand at Roosecote

	ICRP Nodal Cost	LRIC Nodal Cost	Total Nodal Cost
	(£/kW)	(£/kW)	(£/kW)
Harker GSP	0.0	0.0	0.0
Penrith Junction	0.28	1.14	1.42
Penrith BSP	-0.31	-1.39	-1.70
Shap BSP	0.99	4.04	5.03
Kendal BSP	0.99	4.04	5.03
Hutton GSP	1.29	5.15	6.44
Ulverston BSP	2.10	8.81	10.91
Roosecote	2.38	10.08	12.46
Barrow BSP	2.23	9.27	11.50
Sellafield	2.13	8.38	10.51
Egremont BSP	1.77	6.98	8.74
Siddick/Stainburn BSP	1.34	5.29	6.63
Annual Revenue (£k pa)			**£3,657**

Cumbrian Network Study Results

200MW generation at Siddick/Stainburn

	ICRP Nodal Cost	LRIC Nodal Cost	Total Nodal Cost
	(£/kW)	(£/kW)	(£/kW)
Harker GSP	0.0	0.0	0.0
Penrith Junction	0.29	0.73	1.02
Penrith BSP	-0.33	-1.71	-2.04
Shap BSP	1.35	4.31	5.65
Kendal BSP	1.35	4.25	5.59
Hutton GSP	1.68	5.46	7.15
Ulverston BSP	3.00	10.48	13.48
Roosecote	3.48	12.31	15.79
Barrow BSP	3.48	12.18	15.65
Sellafield	3.59	12.22	15.81
Egremont BSP	3.34	11.16	14.50
Siddick/Stainburn BSP	3.06	9.94	13.00
Annual Revenue (£k pa)			**£7,746**

Results Summary

- Congested ‘generation dominated’ network
- New demand at Roosecote delays reinforcement
  - Decrease in annual cost of £858k
- New generation at Siddick/Stainburn brings forward reinforcement
  - Increase in annual cost of £3,231k

Next Steps

- Seek internal approval for full development and implementation at EHV network levels
- Contribute to and support work of ENA COG group
- Submit CIRED 2007 paper