LRMC Model results

Gas TCMF

25th May 2006

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Content

- Gas TCMF Progress and Summary of agreed analysis options
- Expansion factors applied for Transportation Models
- Summary of LRMC Modelling Results
- Explanation of differences in results between models

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Gas TCMF Progress

Summary of Options

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Alternate Transport Methodology Working Group Consensus

Issue	Working Group Consensus
1. S&D Scenarios: 1 Year or multiple Year?	Less than ten years to remove forecasting uncertainty & increase simplicity
2. How should incremental costs be modelled?	No opinion, although inclusion of spare capacity would indicate Transcost
3. How would spare capacity be treated?	Include “genuine spare capacity” within the Model
4. How would decrement (back flow) costs be treated?	Include within Model

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Alternate Tariff Methodology Working Group Consensus

Issue	Working Group Consensus
5. How should entry and exit costs be disaggregated?	Solver with 50: 50 constraint
6. How should negative costs be treated?	Removed as final step (Consider commoditisation of negative prices)
7. Should capacity charges be adjusted to 50:50 entry:exit and if so how?	Solver constraint
8. Are zones required?	Only if capacity is a zone based product
9. Are capacity charges adjusted to recover allowed revenue and if so how?	Where possible by adjustment, otherwise cost recovery via commodity based charges
10. Should year on year price changes be capped?	Retain: Potential to remove year-on-year capping but have capping based on forecast prices

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NTS Pricing Model Analysis Options

<table>
<tr><th>Option A (Status Quo)</th><th>Option B</th><th>Option C</th><th>Option D</th><th>Option F1</th><th>Option F2</th></tr>
<tr><td>10 year forecast</td><td colspan="5">1 to n (<=10) year forecast</td></tr>
<tr><td colspan="4">Transcost</td><td>Transportation Model + Single Expansion Factor</td><td>Transportation Model + Diameter Specific Expansion Factors</td></tr>
<tr><td colspan="3">Spare Capacity</td><td colspan="3">No spare capacity</td></tr>
<tr><td colspan="2">No Backhaul</td><td colspan="4">Backhaul benefit</td></tr>
<tr><td>Solver (non-negative)</td><td colspan="5">Solver 50: 50 Constraint remove negative prices as final step (Consider commoditisation of negative prices)</td></tr>
<tr><td colspan="6">Zoning, Capping and Revenue Recovery method depend on the capacity product</td></tr>
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Expansion Factors

Cost basis of Transportation Models

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Transportation Model Expansion Factors

- Expansion factors expressed in £/peak dayMWhkm.
  - Represents the capital cost of the transmission infrastructure required to transport 1 peak day MWh over 1 km.
  - Can be determined for each pipe diameter
    - Derived from the projected cost of steel pipeline projects (same data as Transcost)
    - Types weighted by recent NTS usage (900 to 1200mm) to produce the single factor.
  - Compression costs included
    - Full recompression to 85bar
- Transportation model calculated incremental flow distance (km) i.e. distance travelled by incremental peak day flow
  - Cost (£/MW)= Flow_Distance(km)*Expansion_Factor(£/MWkm)

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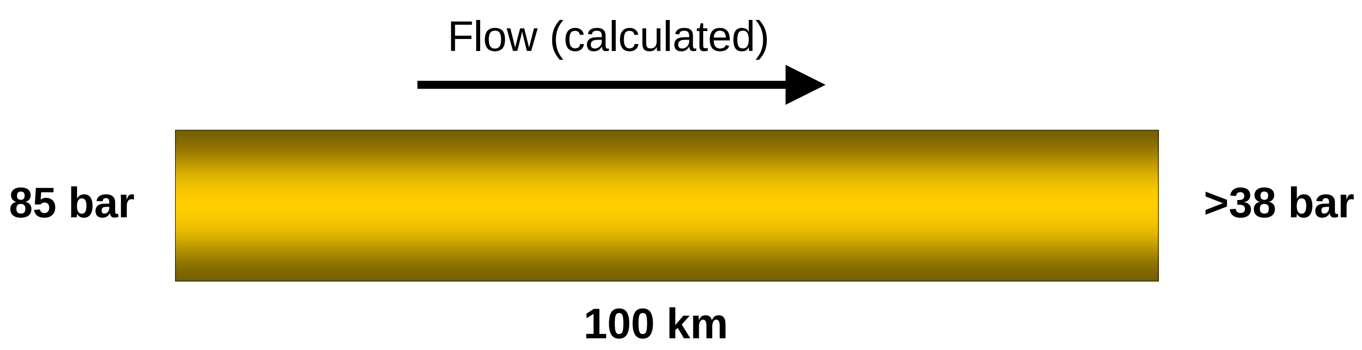
Expansion Factors: Pipe Costs



Consider effect on unit incremental flow costs arising from:

- Key modelling assumptions
  - 100km feeder duplication (parallel pipeline, same diameter)
  - Maximum inlet pressure 85bar
  - Optimum outlet pressure with minimum of 38 bar
  - Maximise flow

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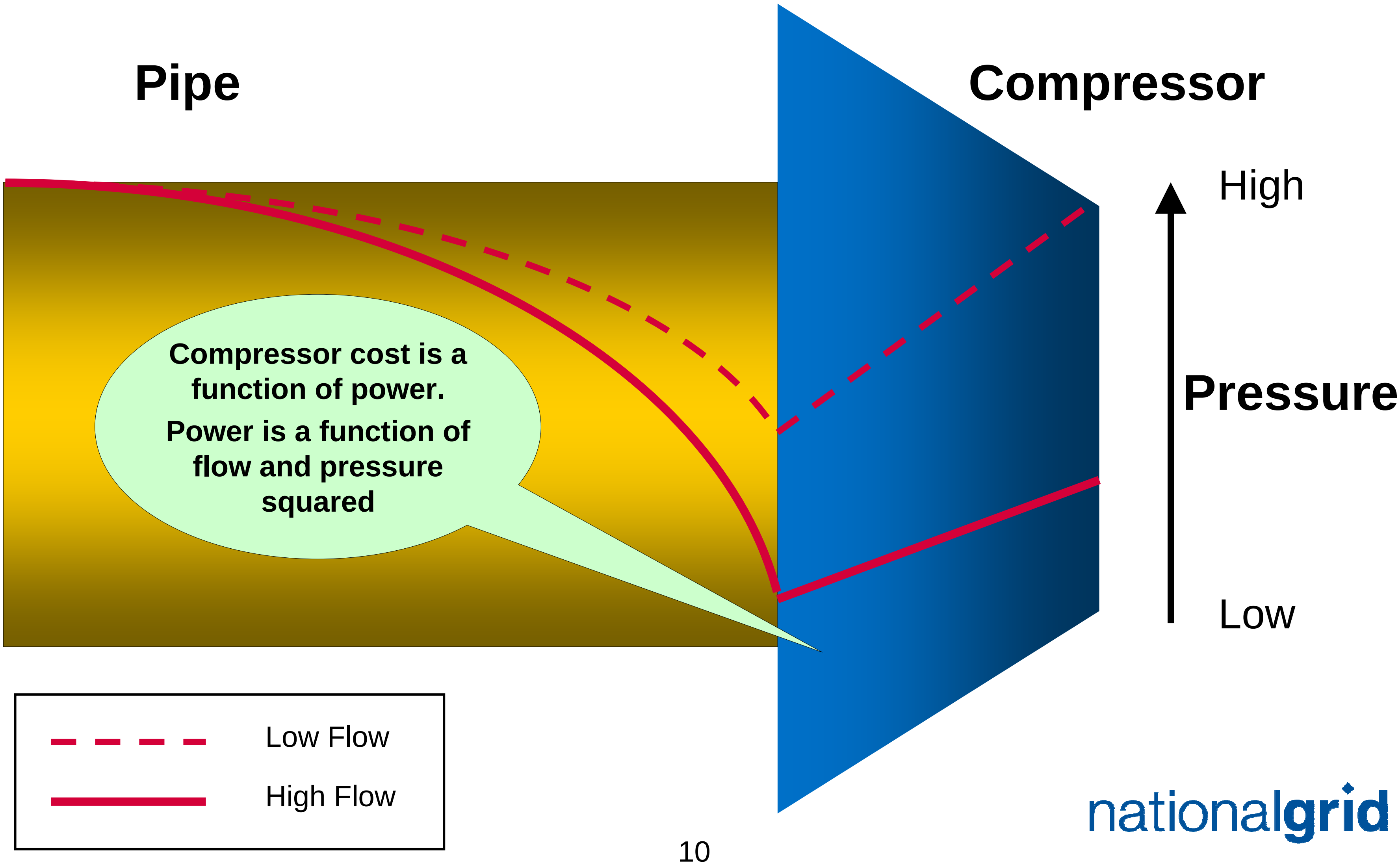
Expansion Factors: Compression Cost

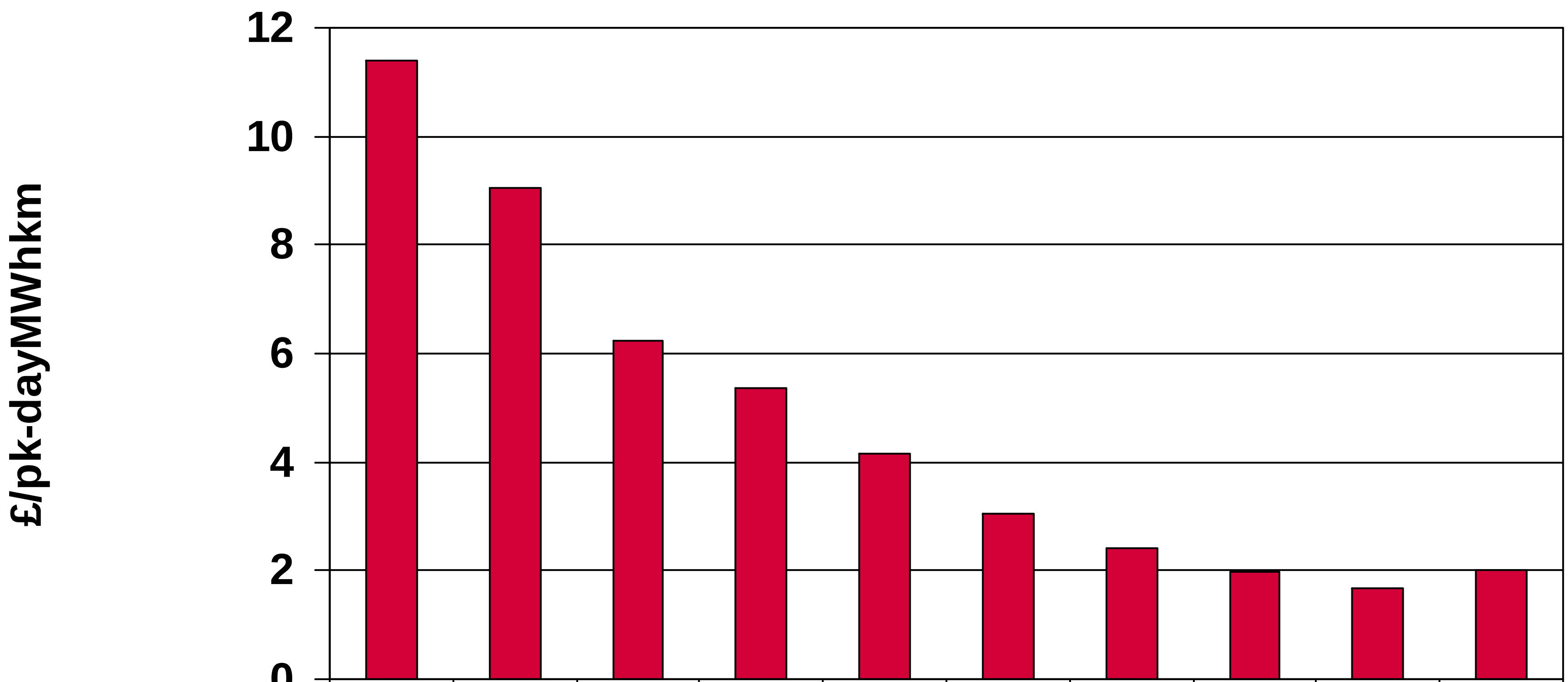


Expansion Factor Calculation (100km)

Pipe Diameter [mm]	A. Pipe Costs [£M]	B. Compressor Costs [£M]	C. Maximum Daily Flow [MWh]	Expansion Factor [£/MWkm] $=10^6x((A+B)/C)/100$
300	36.01	1.78	33,192	11.39
350	42.27	2.66	49,695	9.04
450	54.77	5.13	95,958	6.24
500	61.03	6.77	126,439	5.36
600	73.54	10.91	203,796	4.14
750	92.30	18.70	362,817	3.06
900	111.06	25.49	567,649	2.41
1050	129.82	32.84	825,379	1.97
1200	148.58	40.61	1,137,851	1.66

Expansion Factors

(Capital Costs)



	300	350	450	500	600	750	900	1050	1200	Average 900 to 1200
£/Pk-dayMWkm	11.385	9.04	6.243	5.362	4.143	3.059	2.406	1.971	1.663	2.013

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Gas TCMF LRMC Analysis

Modelling Process

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Modelling Process

	Transcost (Models A to D)	Transportation (Models F1 & F2)
S&D	Compile S&D Scenario	
Network Model	Pipe lengths/diameters Regulators Compressors Compressor parameters Regulator parameters Multi-junction Configurations	Pipe lengths/diameters
Costs	Pipe cost function Compressors costs	Expansion Factors
Base Reinforcement	Base reinforcement: Manually optimise Regulators for minimal base year costs	
Incremental costs	Incremental reinforcement for every combination of entry & exit point. Increment size 2.84 Mscm/d	Incremental reinforcement to reference node
Entry/Exit	Entry/Exit Solver, 50/50 constraint other than model A	Adjust to 50/50 Entry/Exit
Time to run & solve*	1/2 weeks	1 day

*Not including S&D compilation and building spreadsheet solver

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Modelling Results

- Raw Exit LRMCs
- Nodal Exit Prices
  - All model prices scaled to the revenue implied by the prevailing exit prices (April 2006)
- Exit Zone Prices
  - Flow weighted average of DN nodal prices
- Entry LRMCs
  - Non-negative: Analogous to UCAs

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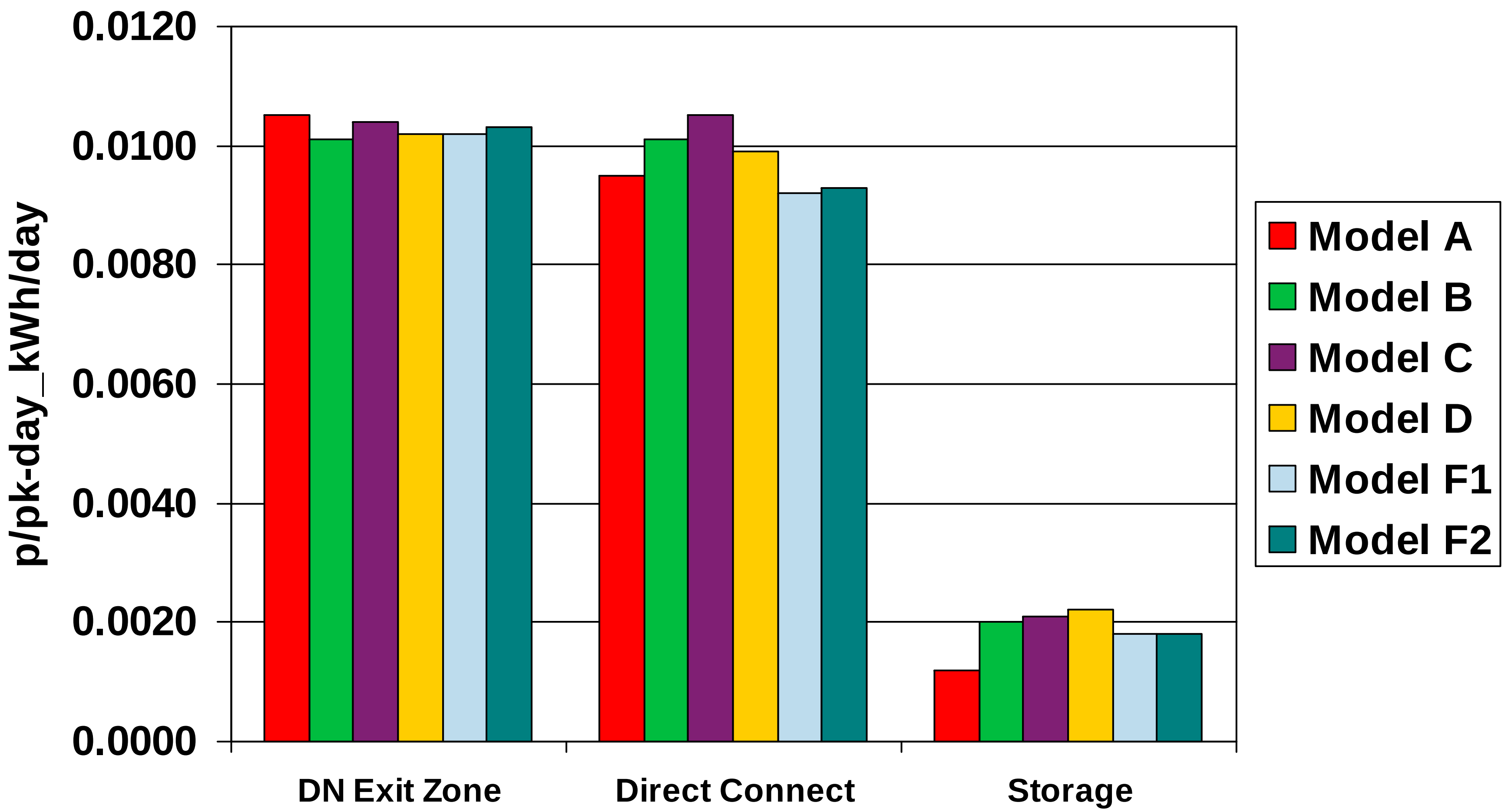
LRMC Model Analysis results

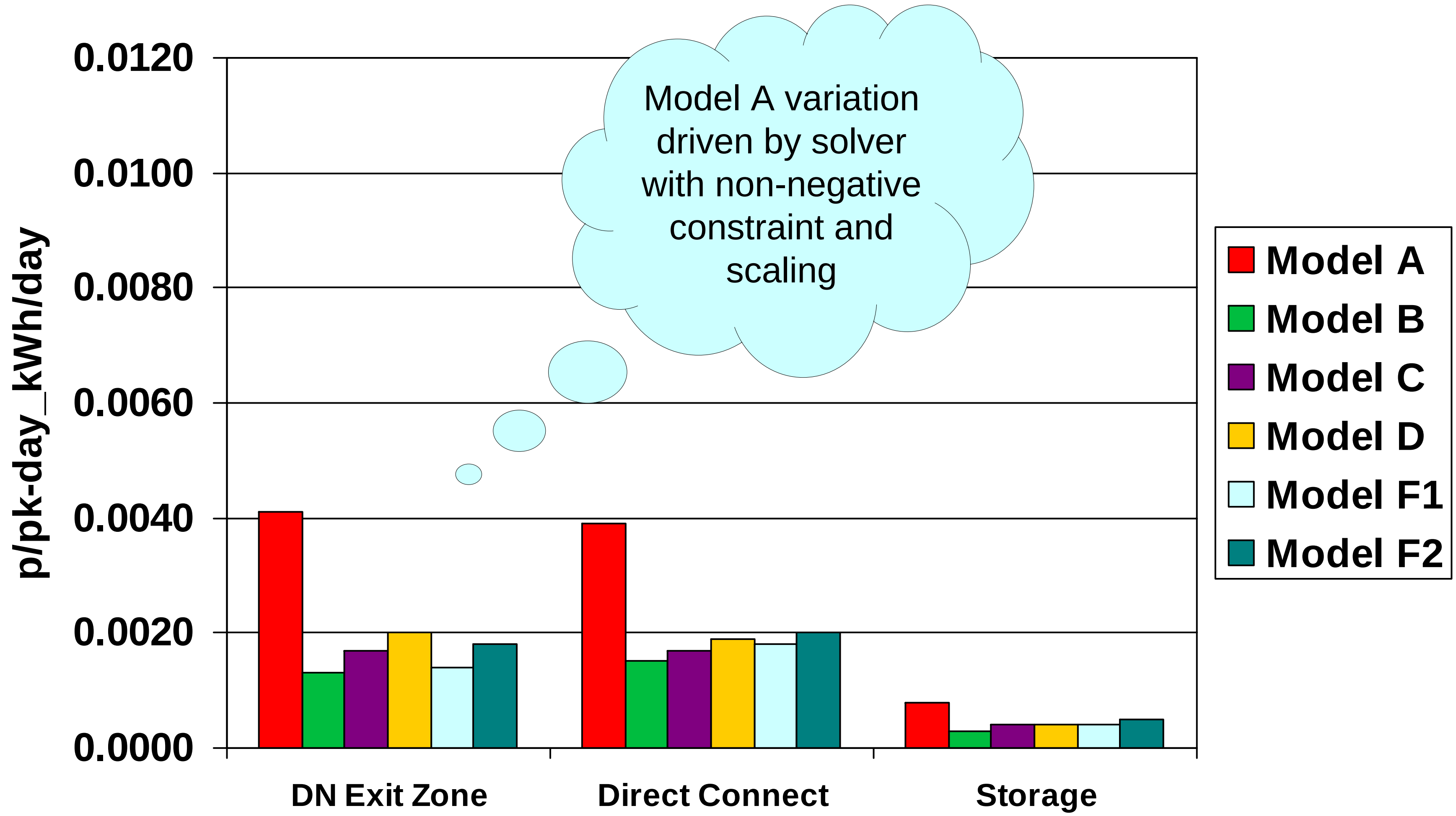
Exit

10 Year Average Exit Price

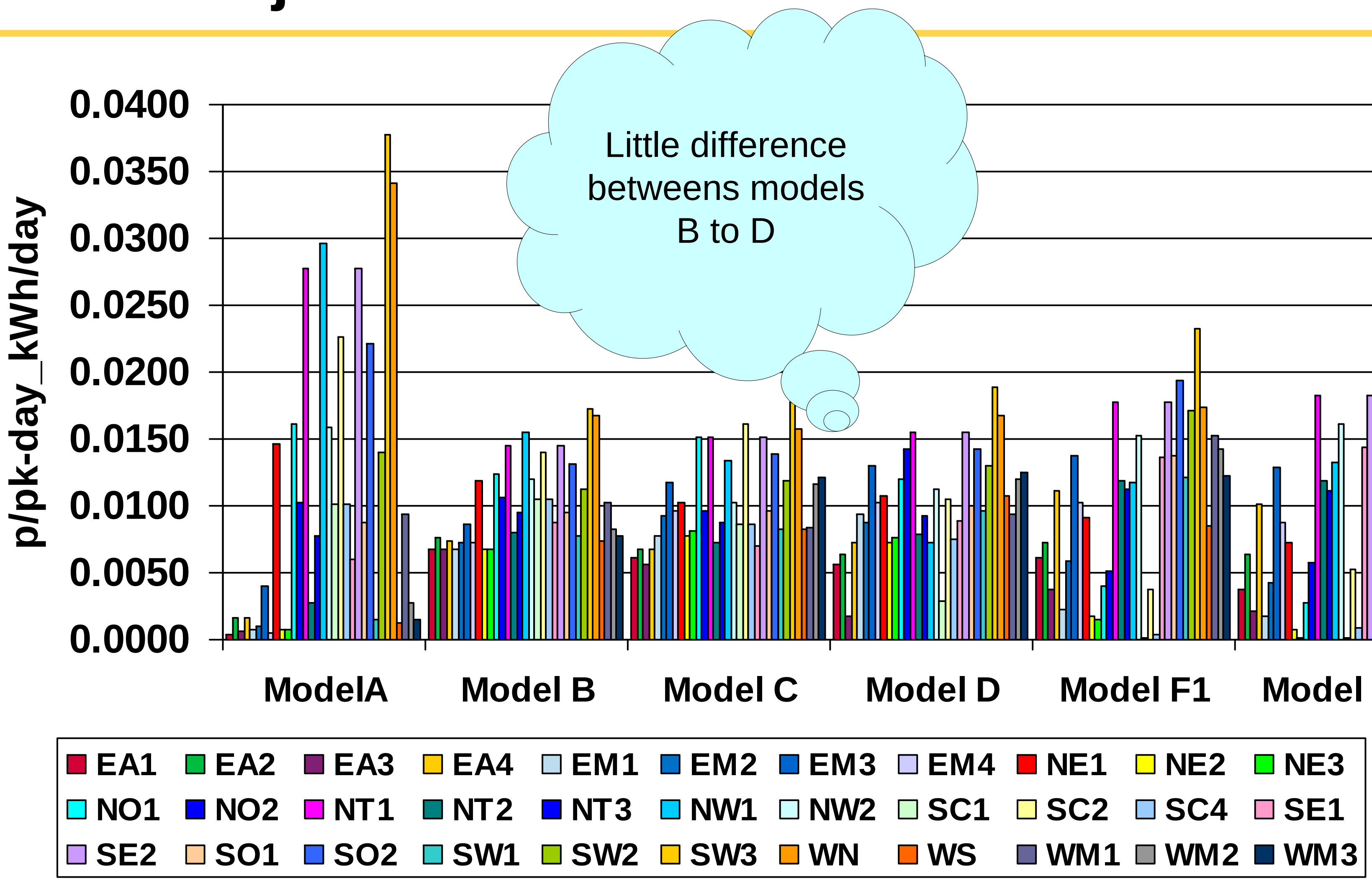
(Adjusted/Scaled to consistent allowed revenue)



Average Exit Standard Deviation (10 Year)



10 Year Average Exit Prices
Scaled/adjusted to recover allowed revenue



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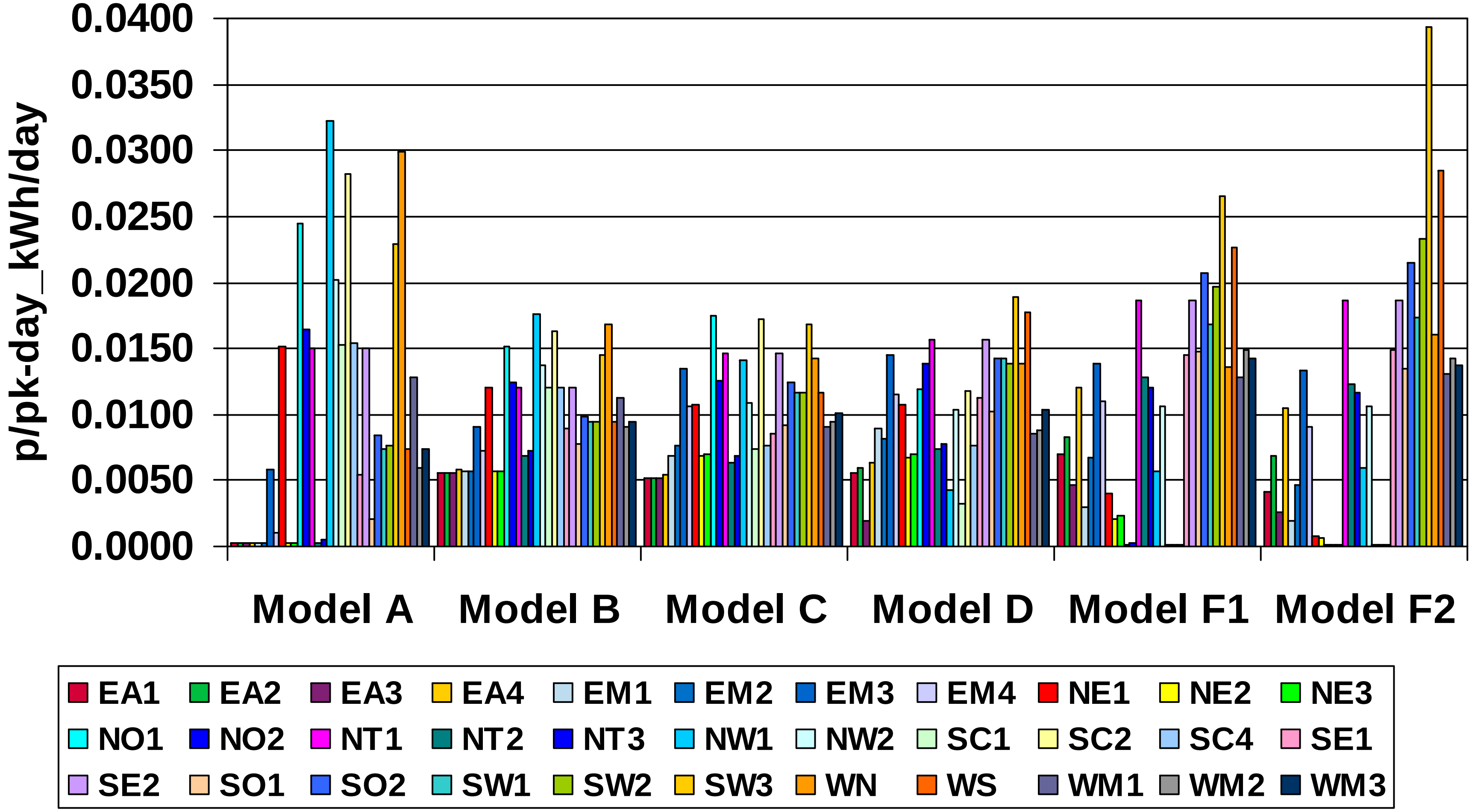
Year 1 (2006/7) Prices
Scaled/adjusted to recover allowed revenue



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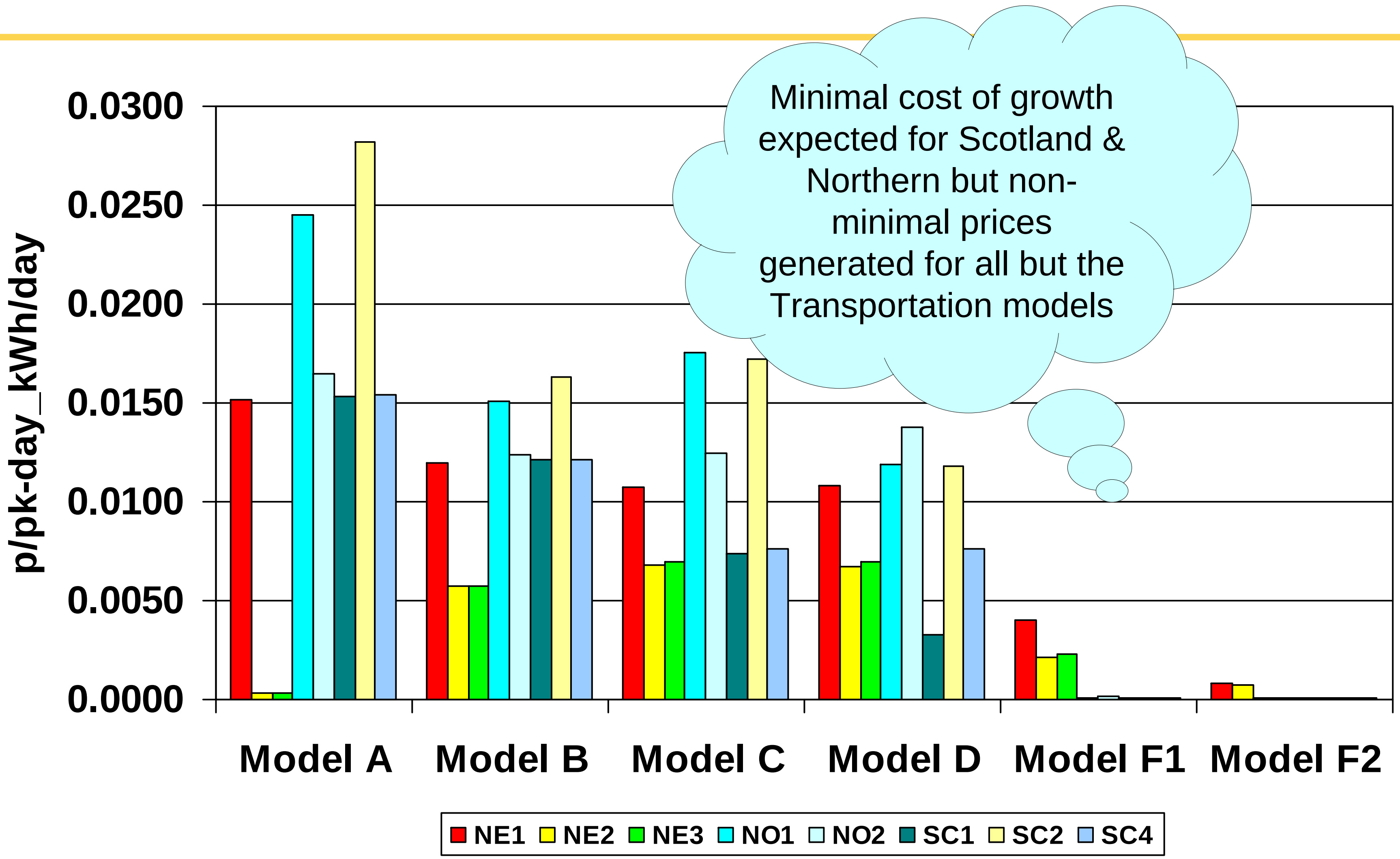
Year 1 (2006/7) Prices: Scotland & the North



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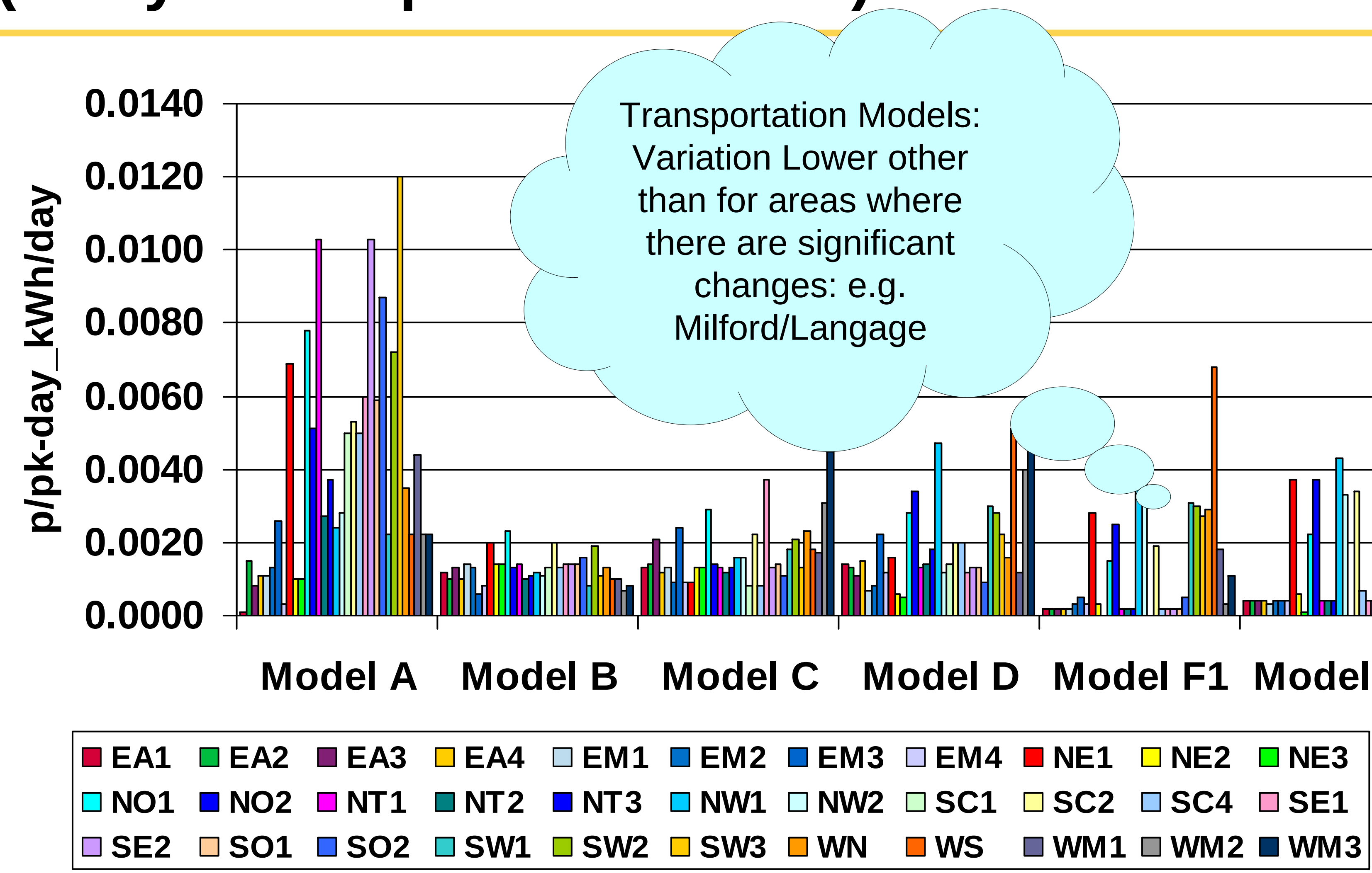
Exit Price Standard Deviation (Ten years of price estimates)



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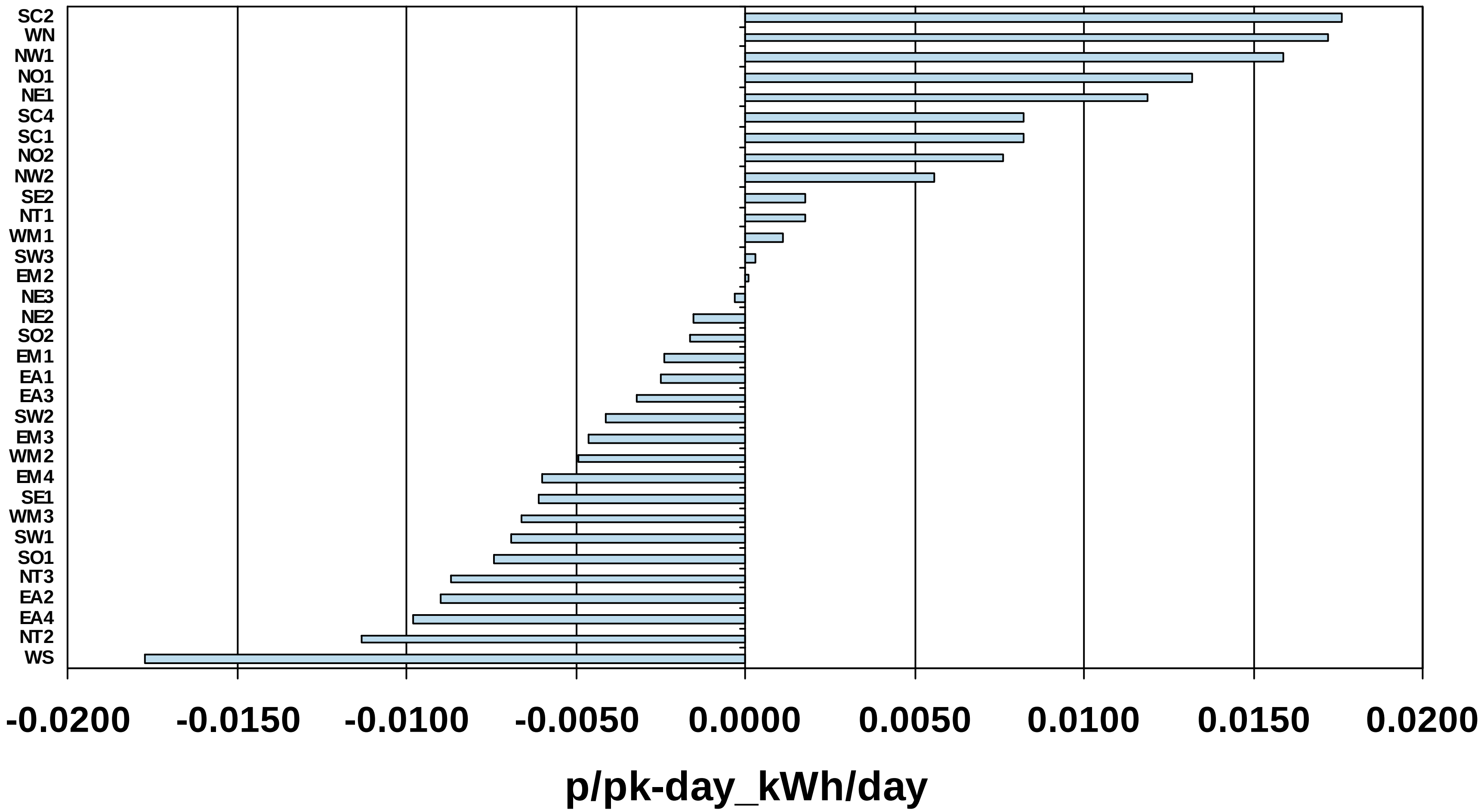
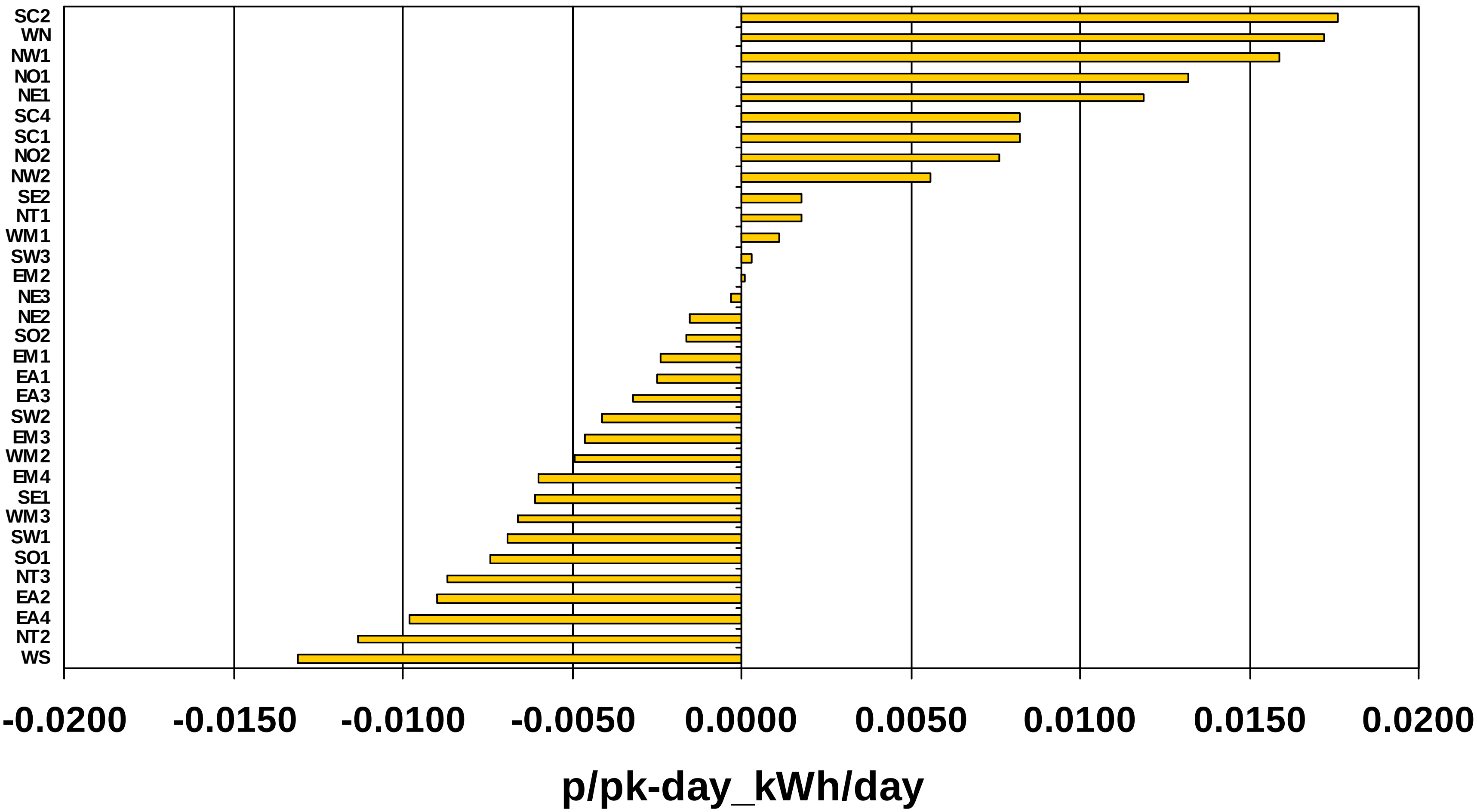
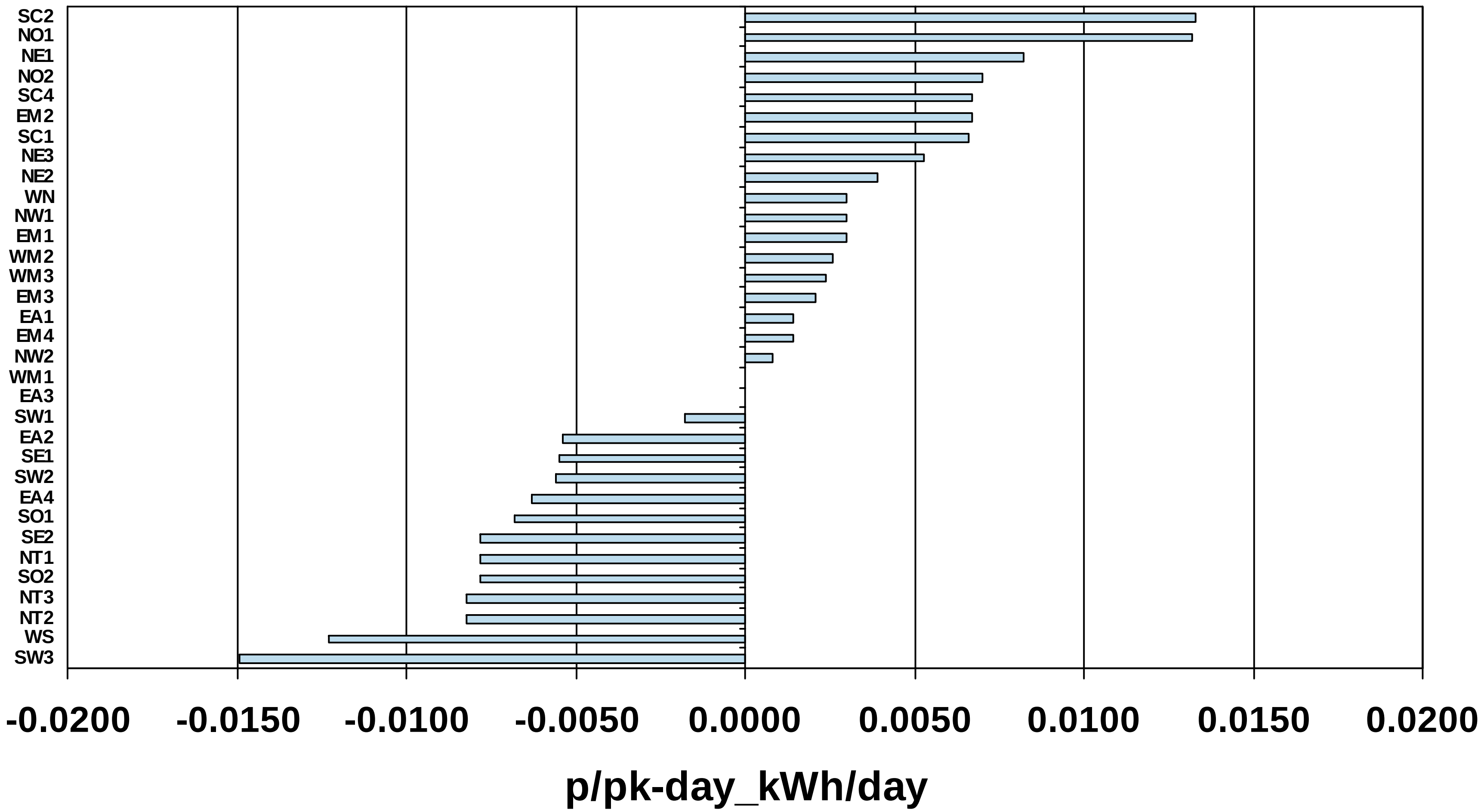
Model A (10 Year Average)– DN Impact



Model B (10 Year Average)– DN Impact



Model C (10 Year Average)– DN Impact



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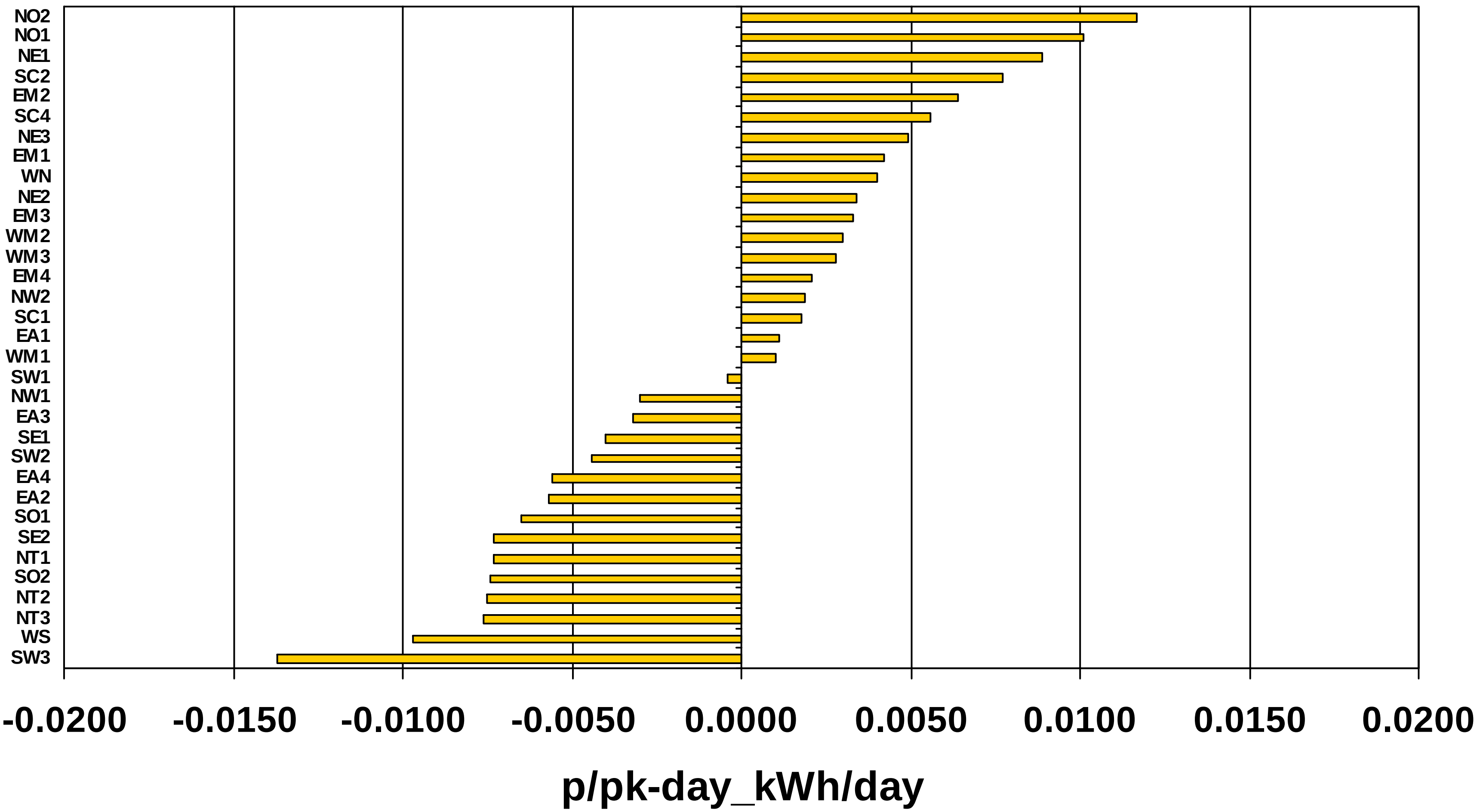
Model D (10 Year Average)– DN Impact



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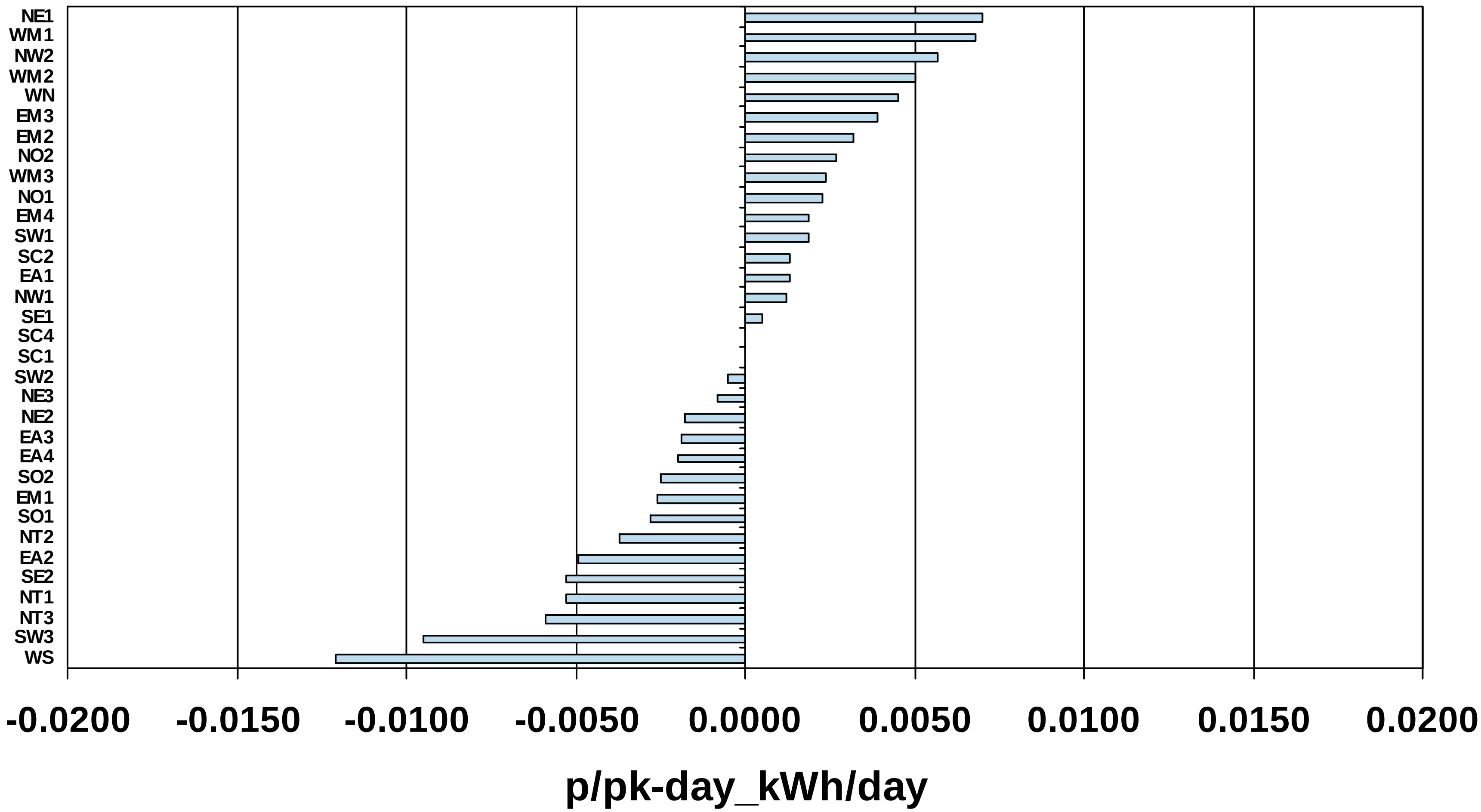
Model F1 (10 Year Average)– DN Impact



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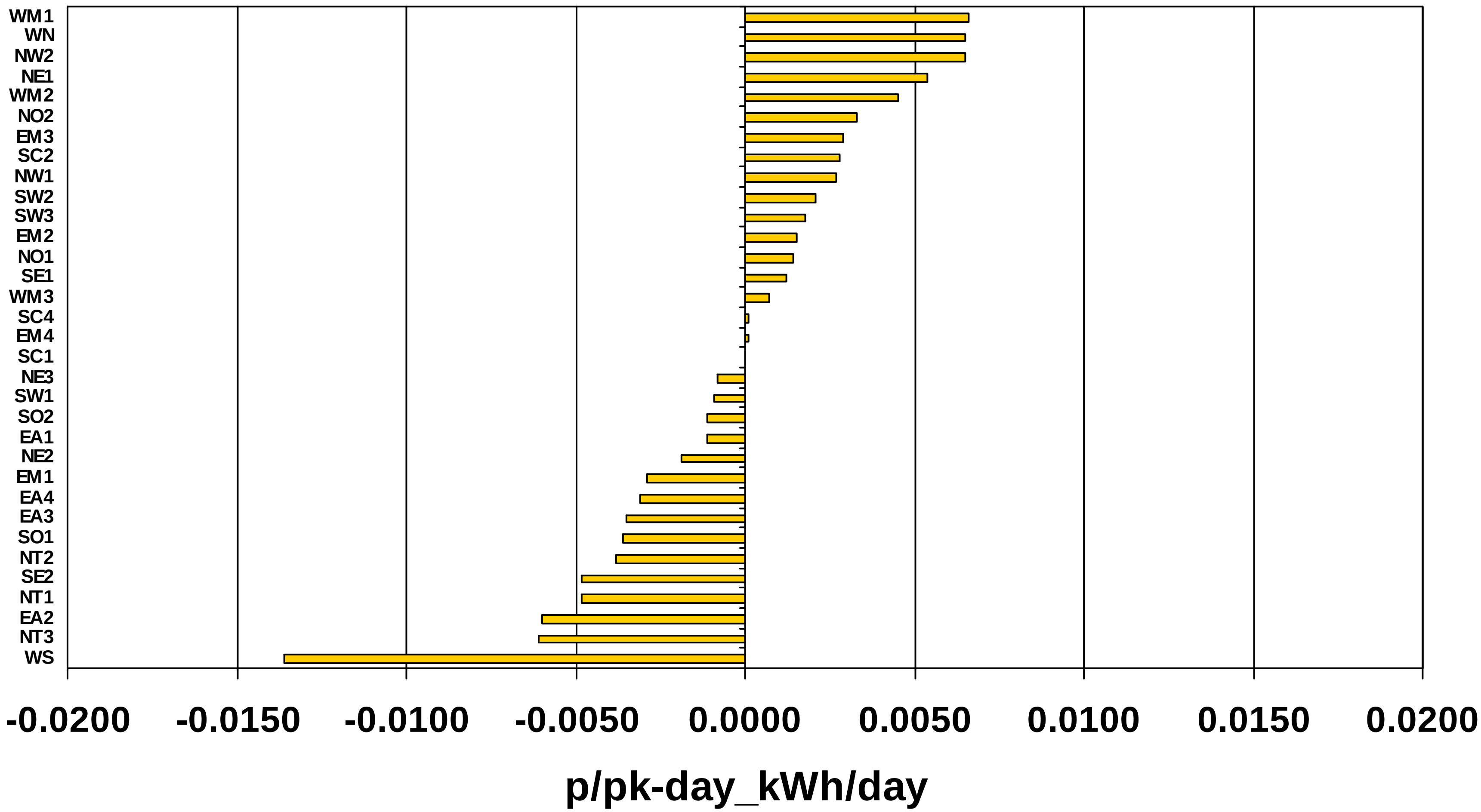
Model F2 (10 Year Average)– DN Impact



LRMC Model Analysis results

Entry

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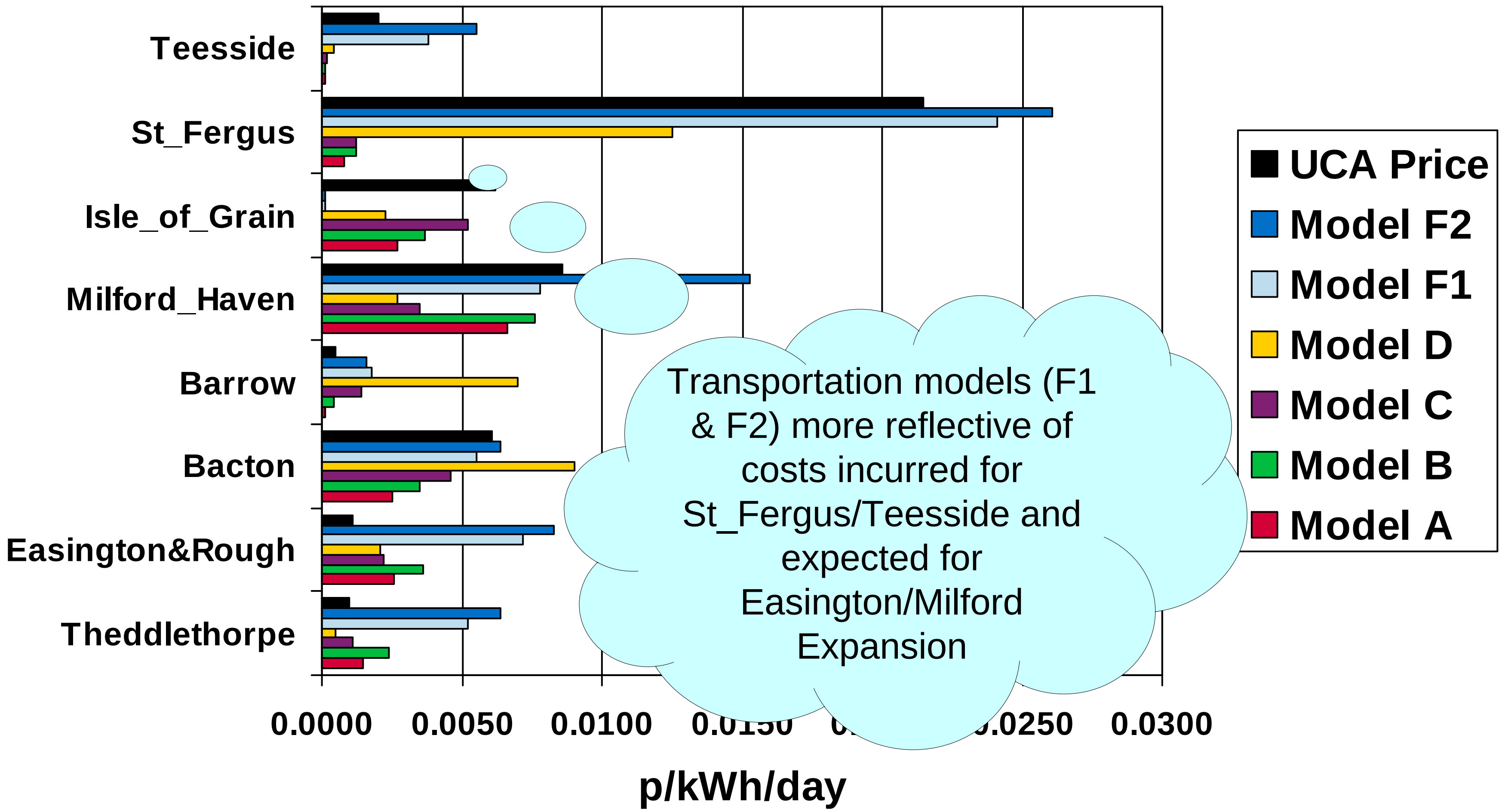
10 Year Average LRMCs – Large Entry Points



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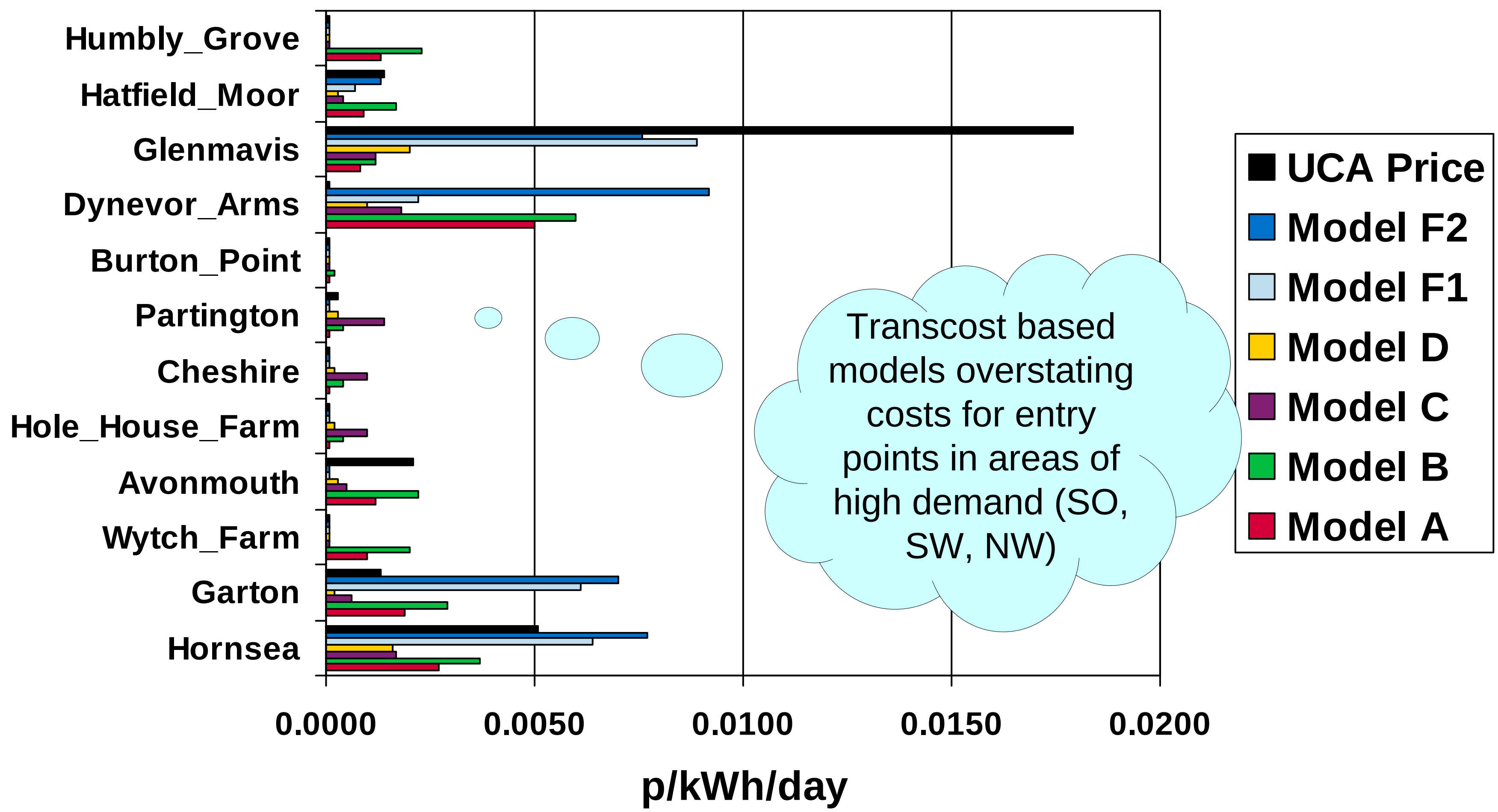
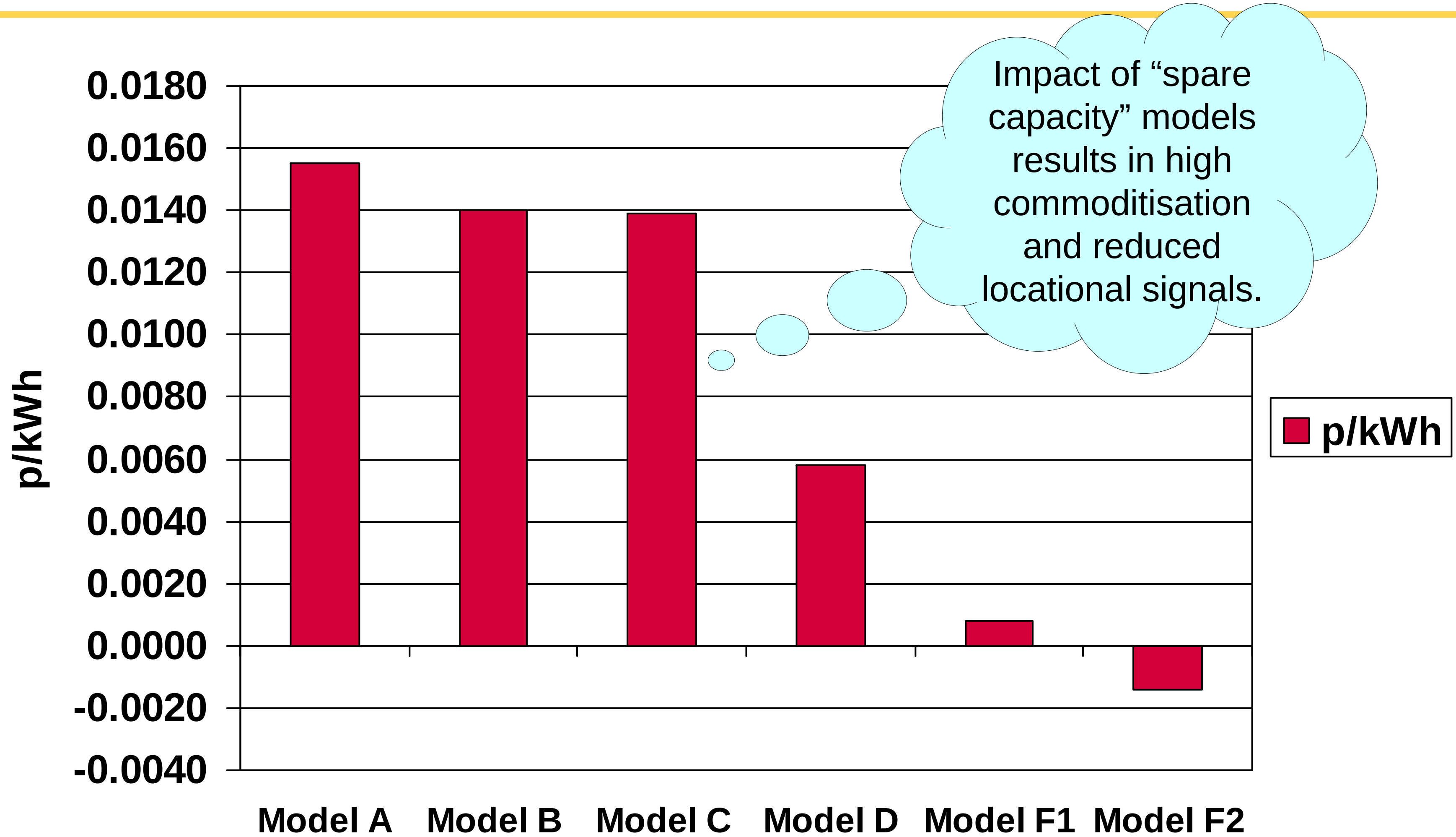
10 Year Average LRMCs – Small Entry Points



Entry TO Commodity-
Estimated rate to recover allowed revenue



NB Assumes 100% of capacity sold at reserve price

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Impact of S&D Scenario

"Central Case" v "Global LNG"

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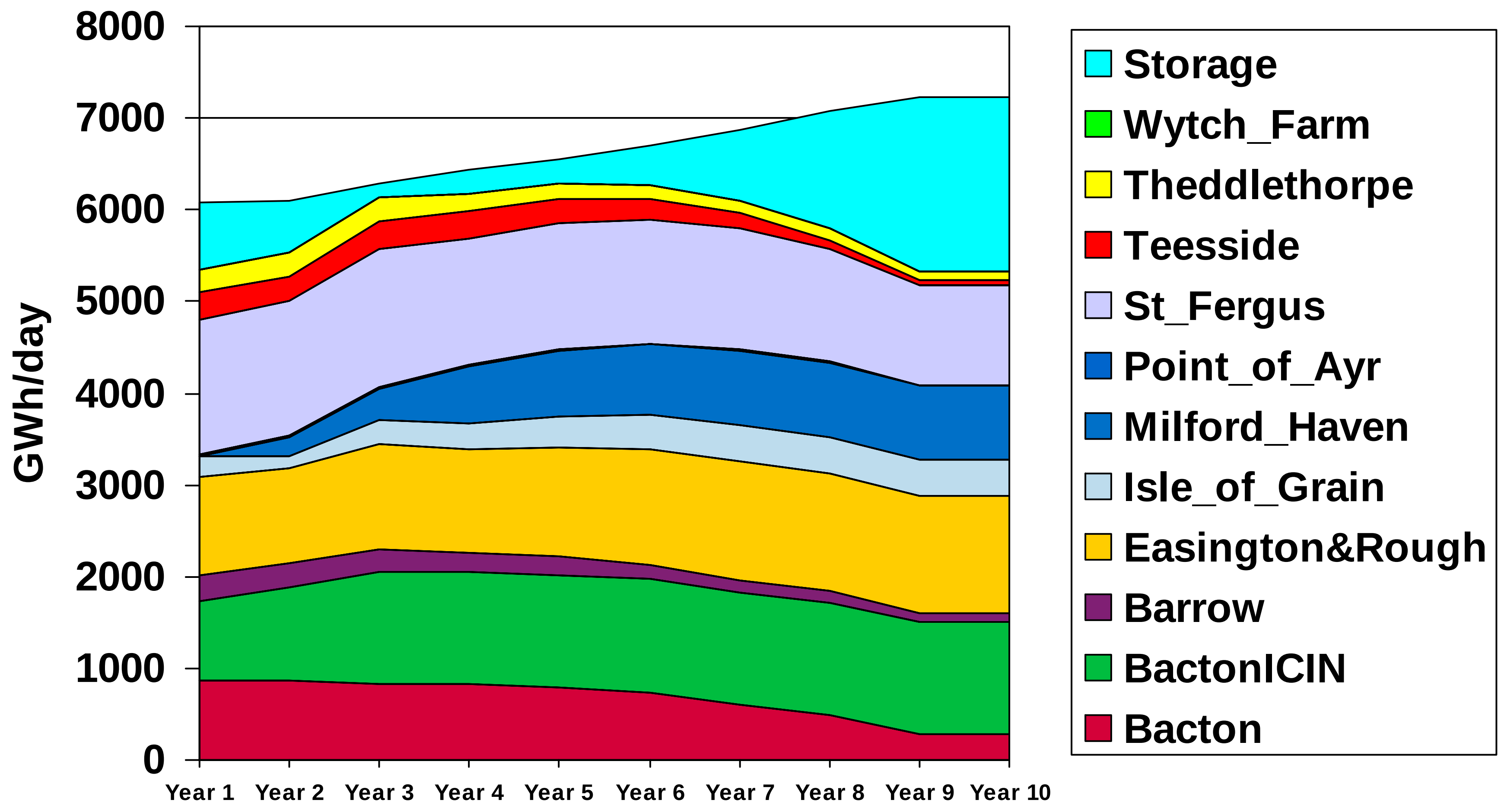
Central Case Supplies



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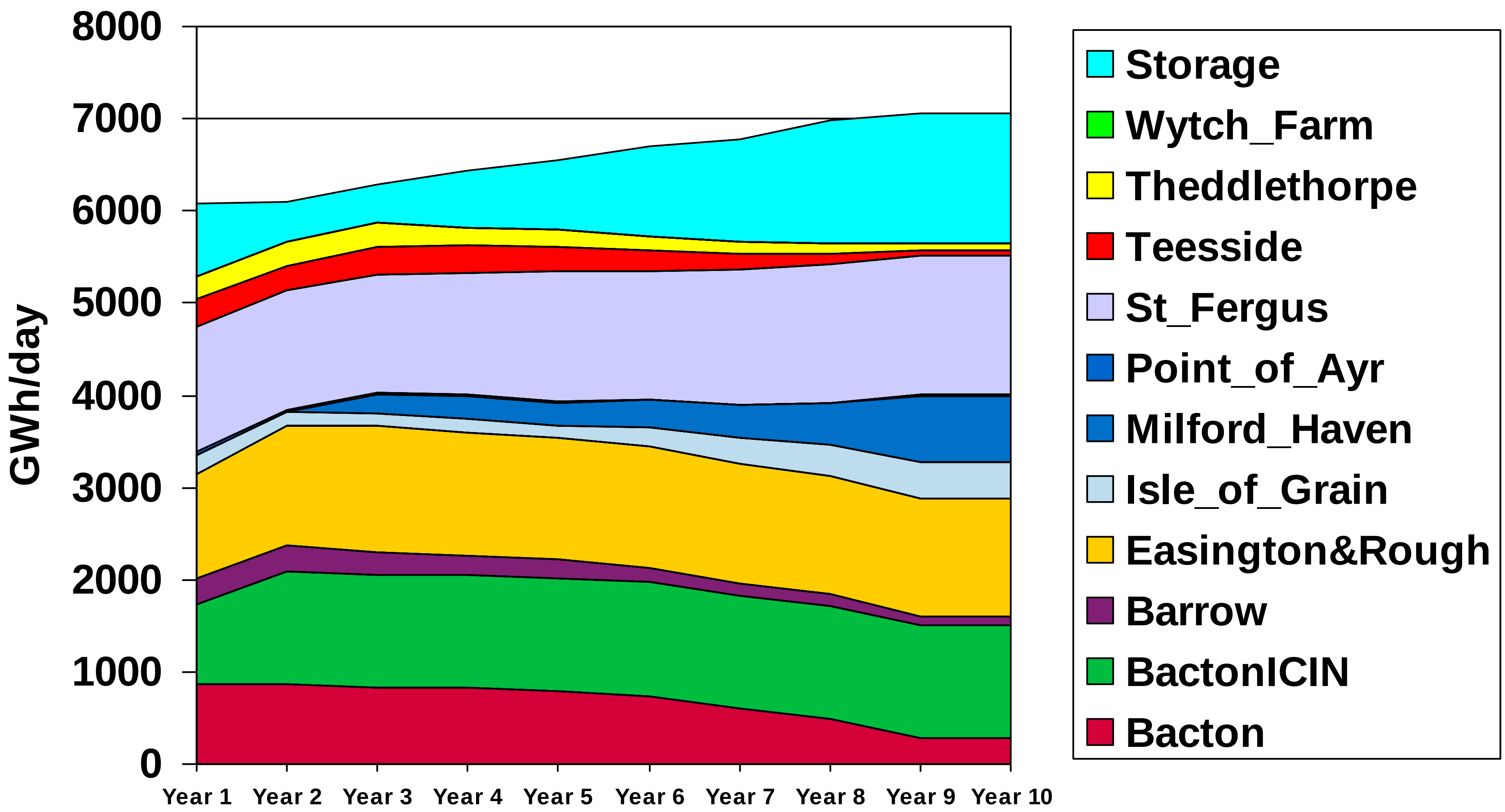
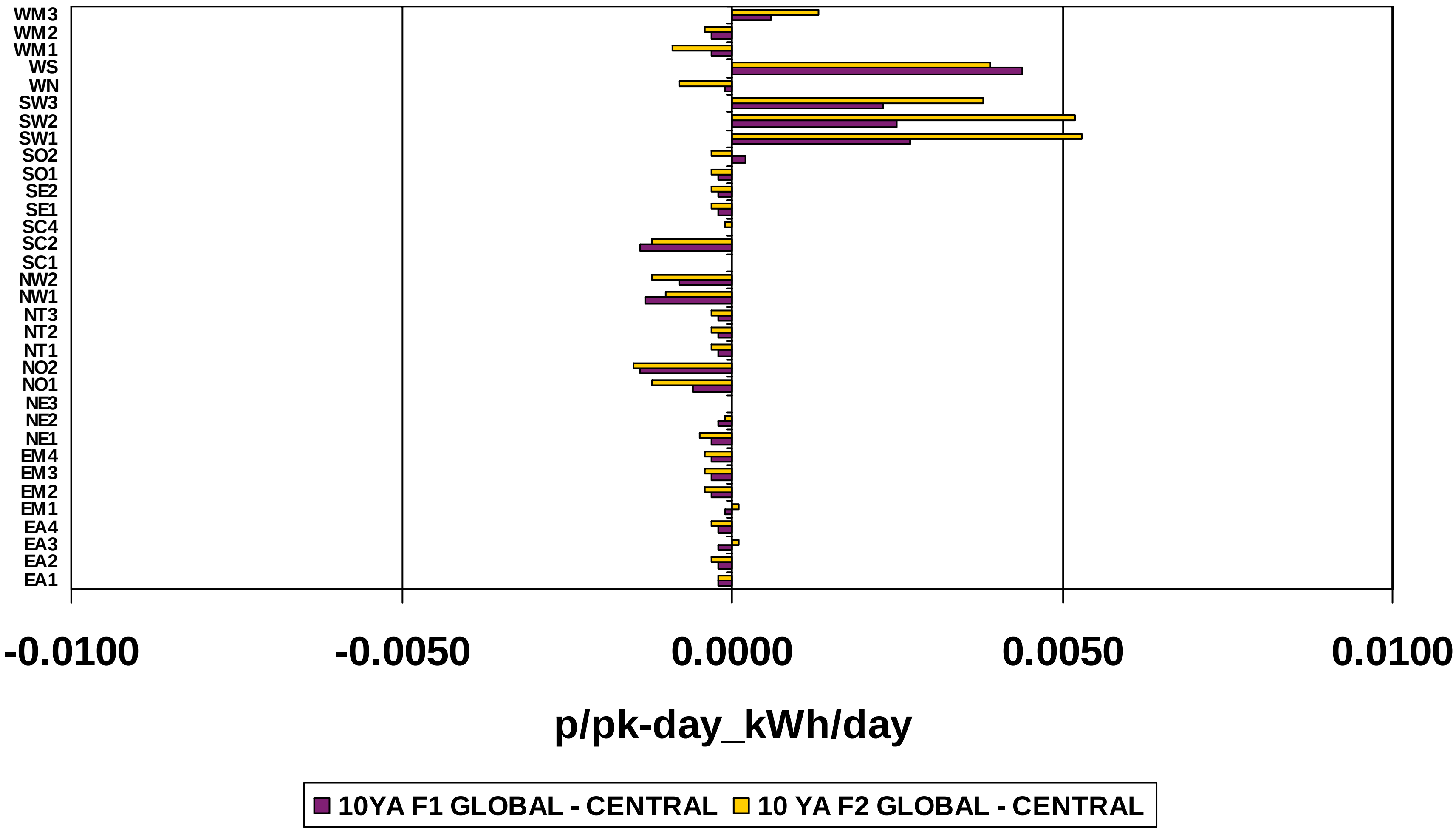
Global LNG Supplies



Impact of S&D Scenario (10 Year Average)



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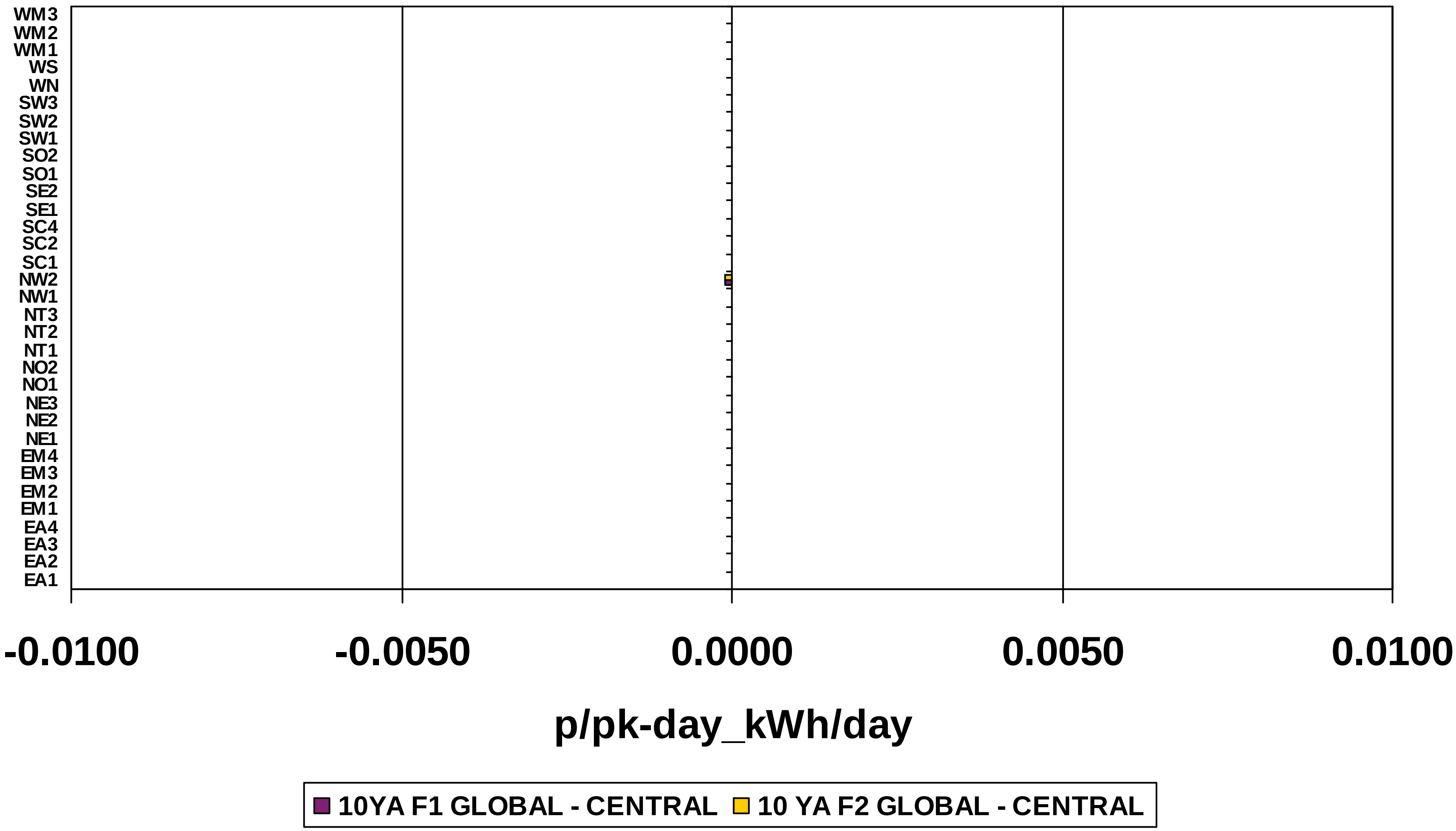
Impact of S&D Scenario (Year 1)



Summary of Model Results

Summary of Model Results(1)

- **Model A:** ***Year-on-year variation driven by solver with non-negative constraint only***
- **Model B:** ***Spare capacity reduces raw prices and results in counter intuitive prices when scaled (e.g. Scotland exit)***
- **Model C:** ***Considering backhaul by only considering forward flow routes has little impact when spare capacity is modeled.***
- **Model D:** ***Combination of forward flow and no spare capacity improves cost reflectivity (i.e. alignment with expected trend) but Transcost can only approximate removal of spare capacity.***

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Summary of Model Results(2)

- **Transportation Models (F1 & F2)** ***Closer than Transcost models to prevailing prices. Year-on-year variation can be linked directly to S&D changes.***

- **Model F1:** ***Most stable (year-on-year) yet retains cost reflectivity.***

- **Model F2:** ***Most cost reflective yet still more stable than Transcost models.***

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