Third Party Access to Infrastructure and The Future Recovery of Oil And Gas Reserves In The UKCS

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Work in Progress

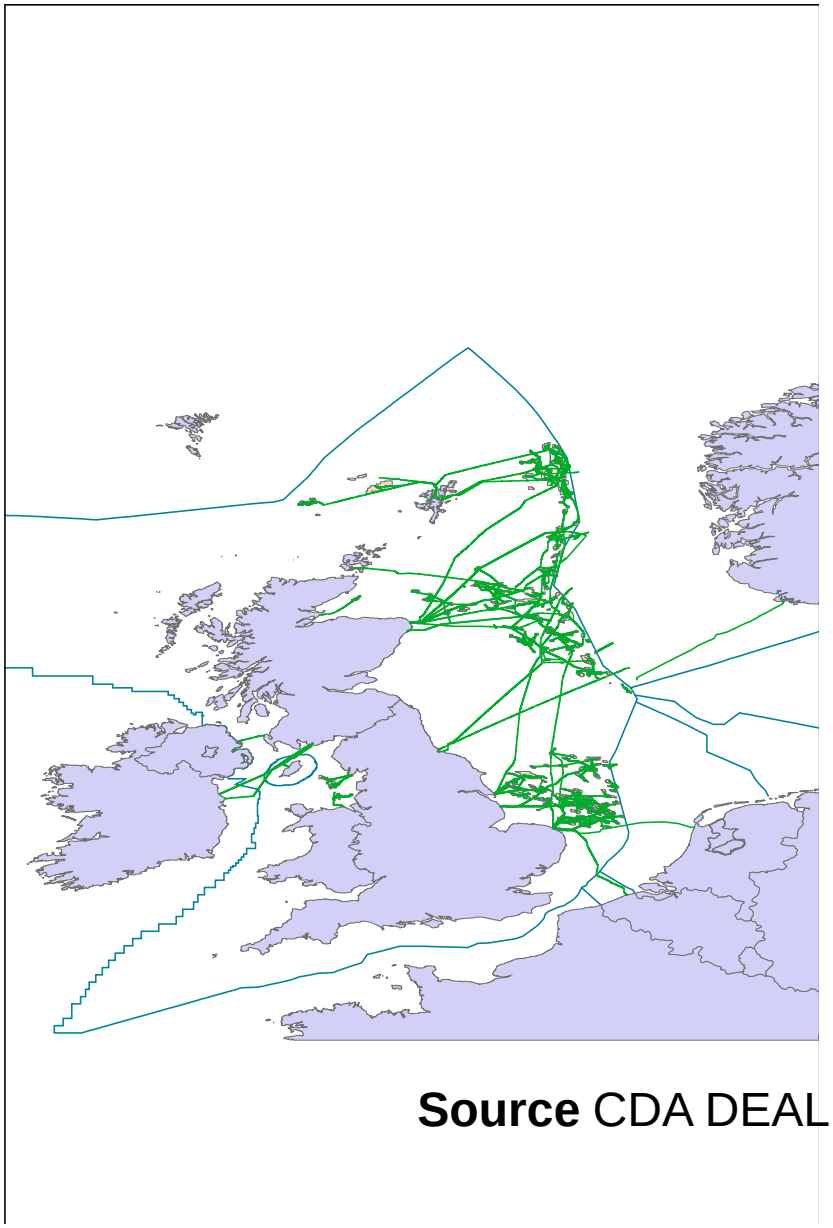
UK Continental Shelf

Mature Province
Typical Remaining Fields Small

Operator structure changed
New Developments
Small/Medium E&P Companies

Access to Existing Infrastructure
•Transport System
•Hubs - Processing

Existing Infrastructure Ageing
Industry
Key Access to Hubs Processing



Source CDA DEAL

Third Party Access - Regulatory framework

Negotiations - Field Developers & Infrastructure Owners

- Industry's Infrastructure Code of Practice (ICoP)
- If negotiations fail - DECC can intervene - "Determination".

Current Industry Review – Oil & Gas UK

Field Developers

- Delays – Infrastructure owners prioritize own developments
- Terms - Extraction of Field Rents

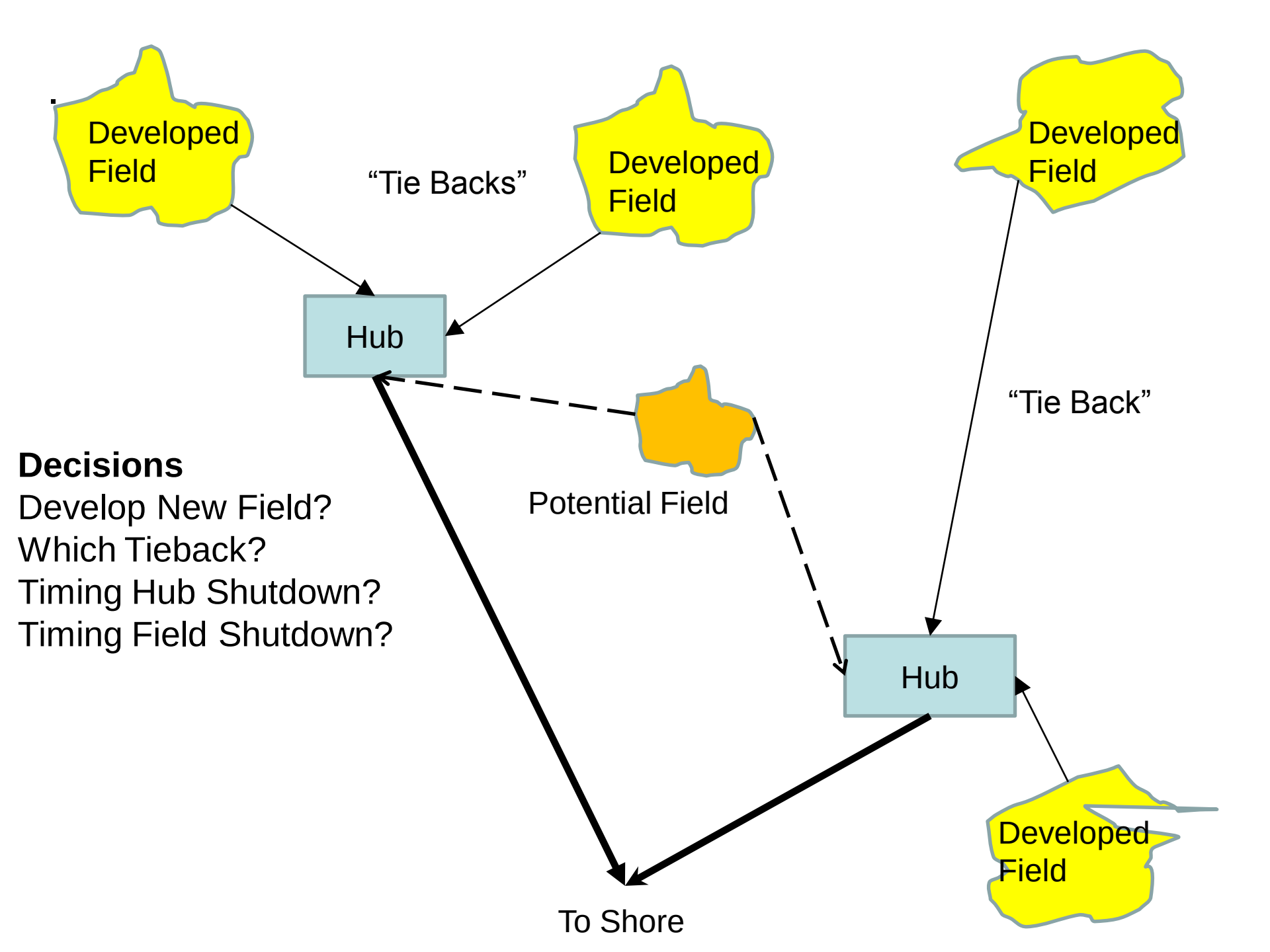
Infrastructure Owners – emphasise access costs

Two referrals to DECC - No Determinations

Improvements to Infrastructure Code of Practice

Full Unbundling & Regulation (Onshore electricity/gas network)

Could changes affect exploitation remaining UKCS resources ?


Developed Field
"Tie Backs"
Developed Field
Developed Field
Hub
"Tie Back"
Potential Field
Decisions
Develop New Field?
Which Tieback?
Timing Hub Shutdown?
Timing Field Shutdown?
Hub
Developed Field
To Shore

Potential Market Failures: Hub Access & Access Pricing

Ownership Structure

Local Monopoly Power

Indivisibilities (Ginsburgh & Keyzer, 1997)

Vertically Integrated Hub Owners (Armstrong, Doyle & Vickers, 1996) – Prioritizing Own Production

Information asymmetries

Modelling Aim Impact of Ownership Structure & Indivisibilities

Mixed Integer Programming Model

Maximizes the Post Tax NPV of area production

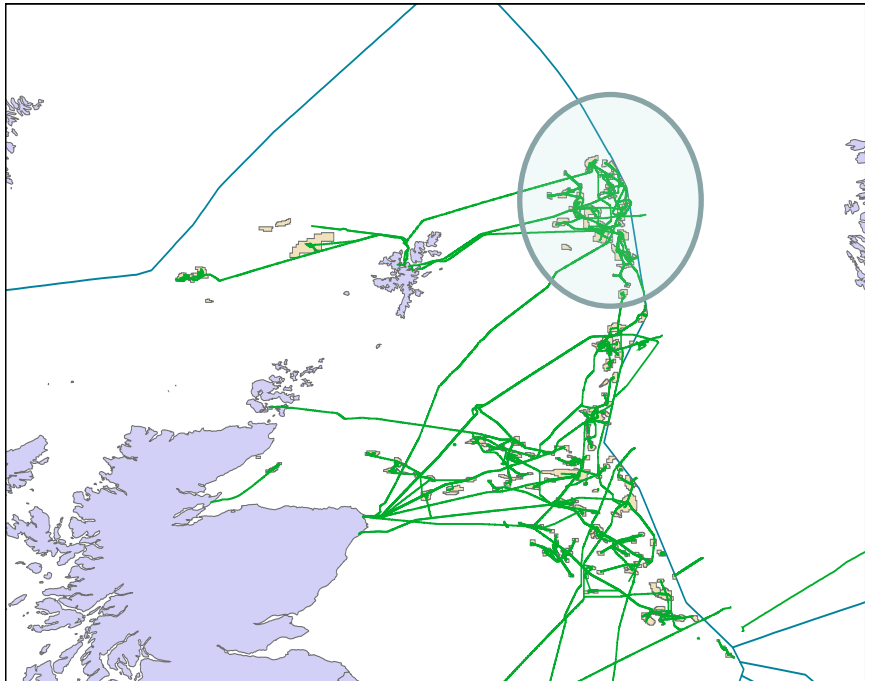
Finding optimal set of new developments
Tiebacks from fields to hubs
Timings of hub and field shutdown

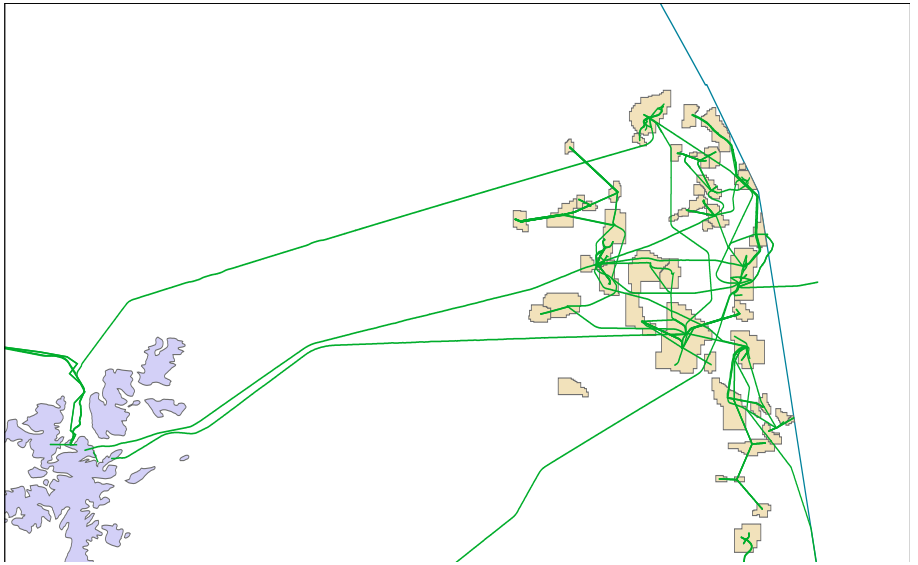
Hubs Treated as Entry Point to Transportation System

Basic Tax Corporation Tax + Supplementary Charge + Allowances

Explore
Single Ownership - First best solution
Impact separation of infrastructure and field ownership
Negotiation Delays
Unbundling + Non Discriminatory Pricing

Case Study Area: Northern North Sea





Source CDA DEAL

70 fields and potential developments

34 “sanctioned”/existing fields, 36 probable/possible/technical.

12 hubs (and sub-hubs) identified

Data

Hub & field location - GIS data available from DECC and CDA
DEAL + Assumptions.

Field database based on OGUK data (Kemp & Stephen)
Each (potential) development) profiles 2010-2050
Expected oil and gas production
Real capital expenditure
Operating and abandonment costs, and pre-tax revenues

Values exclude tariff revenue.
Assumed prices: Oil - $90/bbl , Gas - 60p/therm.

Base Model - *"as if"* single operator for NNS
Standard MIP Approach, e.g.

Production at Hub = Sum Field Production Tie-backed to Hub

$$yo_{ht} = \sum_{i \in D} \overline{tiep}_{ih} . to_{iht}$$

Tieback Production to Hub Forces Tieback Active

$$to_{iht} + tg_{iht} \leq M . tb_{iht}$$

$$tb_{iht}(binary) = 1 \text{ if Tieback Field to Hub Active}$$

Activate New Tieback

$$tbs_{iht} \geq tb_{iht} - tb_{iht-1}$$

$$tbs_{iht}(binary) = 1 \text{ Tieback Activated (Fixed Cost Incurred)}$$

Similar Constraints Hub & field shutdown/Decom Cost

Hubcfr – Base + individual financial constraints field/hub

Split ownership structure across fields/hubs implies basic economic viability individual elements.

Cost Shares introduced Contributions by Fields to Hubs Opex

Hub - Sum of *Cost Shares* paid by Tie in Field = Hub Opex

Field – NPV of future net cash flow (*ncf*) non-negative each year

$$\sum_{\tau \in T} \frac{1}{(1+r)^{\tau - t}} . ncf_{i\tau} \geq 0,$$

Hubcfr 3 year delay – Hubcfr with 3 year delay all potential developments.

Ad hoc Potential costs of negotiation delays

Unitpr- Hubcfr with implicit price paid per boe at each hub same for all tiebacks

Extreme Non-discriminatory pricing with Hubs unbundled?

Restrictions on Cost Shares

cs_{iht} Cost Share Field to Hub Operating Costs Period t

uch_{iht} Unit Cost Contribution by Field to Hub Operating Costs

$$cs_{iht} = uch_{iht}.(\text{TieBack Volume in BOE})$$

Integer Constraints ensure

$uch_{iht} = 0$ if TieBack Not active

$uch_{iht} = up_{ht}$ if TieBack Active

For Each Active Hub

Cost Share paid each Tie back = HubPrice*Volume

Single HubPrice for Each Hub (different prices across hubs and time)

Indivisibilities Impact

HubPrice – Dependent on which Fields Tie-backs.

Which Fields Tie-backs – Dependent on HubPrice

Model Results

	Base	*Hubcfr*	*Hubcfr 3 year delay*	*Unitpr*
Post Tax NNS NPV £m	7982.4	7889.8	6662.6	3261.4
Tax NPV £m	6861.1	7321.5	6776.0	5496.7
No New Developments (out of possible 36)	29	30	30	23
Total Number of Production Periods	663	682	676	471

Model Results

	Base	*Hubcfr*	*Hubcfr 3 year delay*	*Unitpr*
Year Hub Decommissioned*				
Cormorant	2014	2020	2025	2017
Alwyn North	2031	2031	2031	2013
Brent	2022	2020	2011	2011
Eider	2016	2016	2011	2011
Dunlin	2042	2042	2045	2034
Tern	2023	2023	2023	2021
Dunbar	2027	2025	2025	2016
Thistle	2032	2031	2031	2031
Ninian	2034	2034	2033	2011
Heather	2038	2038	2041	2020
Magnus	2026	2026	2026	2013
Murchison	2017	2017	2017	2016

*Note these are simulated model outcomes only.

Figure 1 NNS Oil Production Thousand Barrels per Day (tb/d)

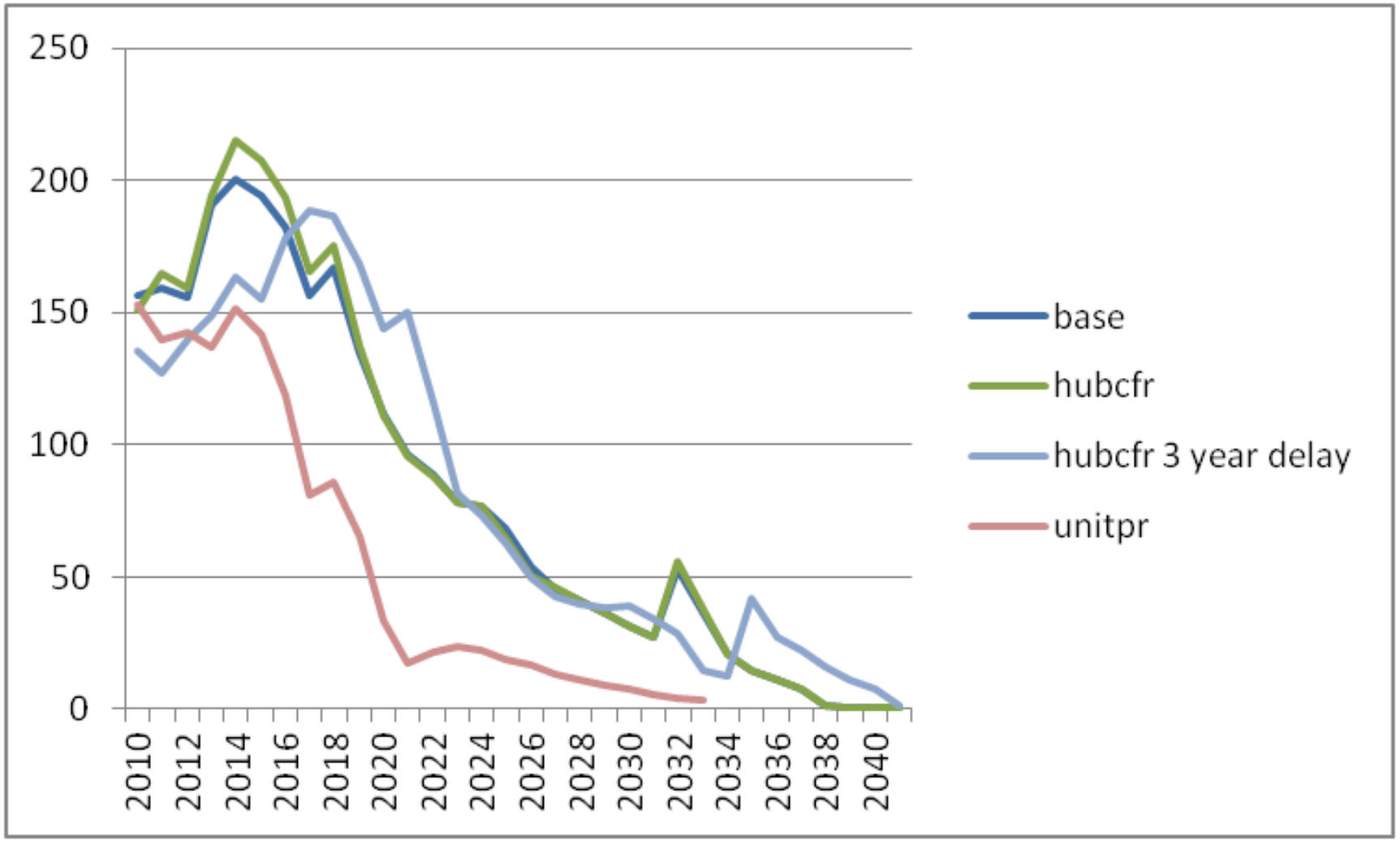


Figure 2: NNS Gas Production Million Cubic Feet per Day (mmcfd)

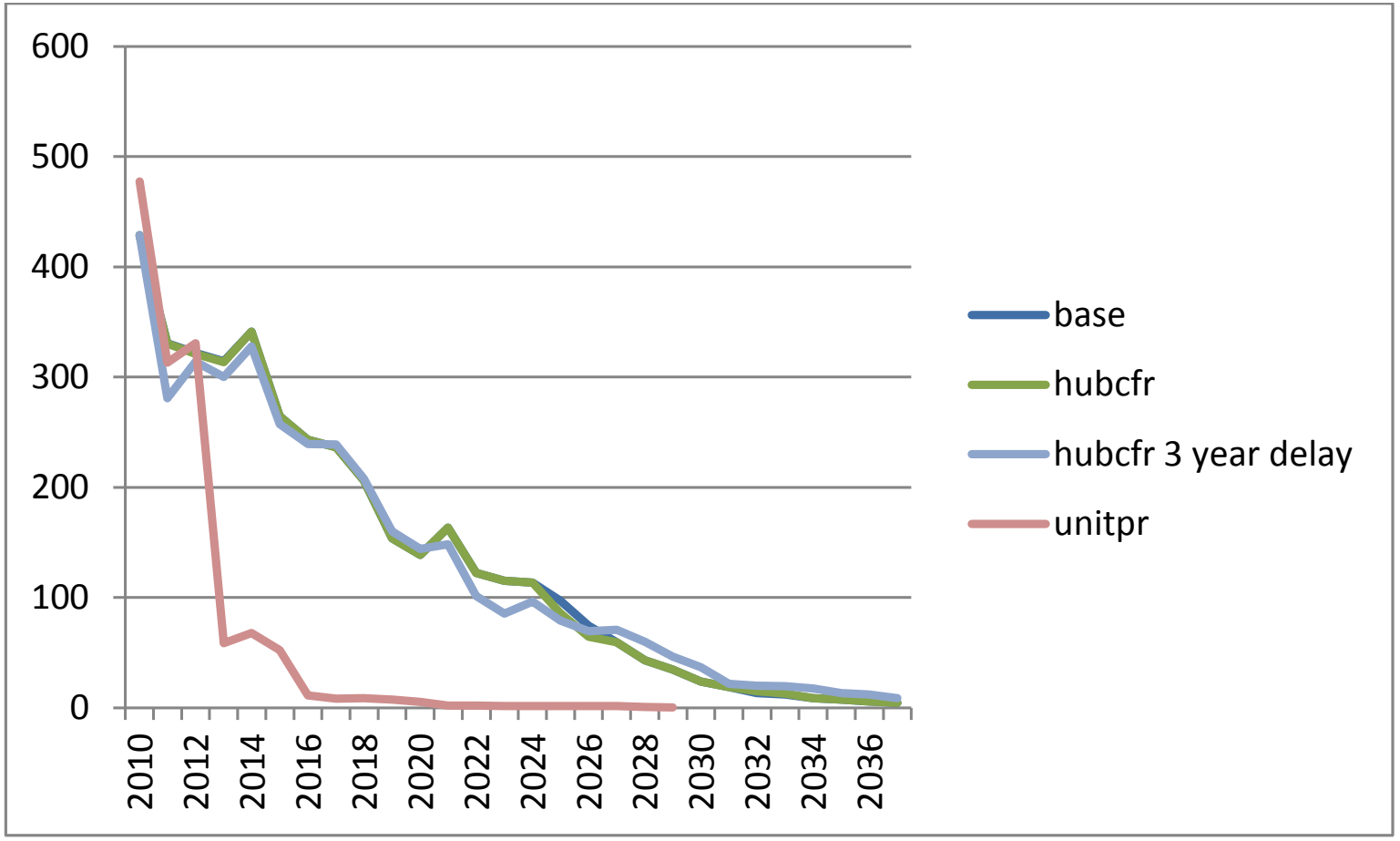


Figure 3 Non-Discriminatory Pricing Scenario (*Unitpr*): Unit Hub Prices 2011 £/boe

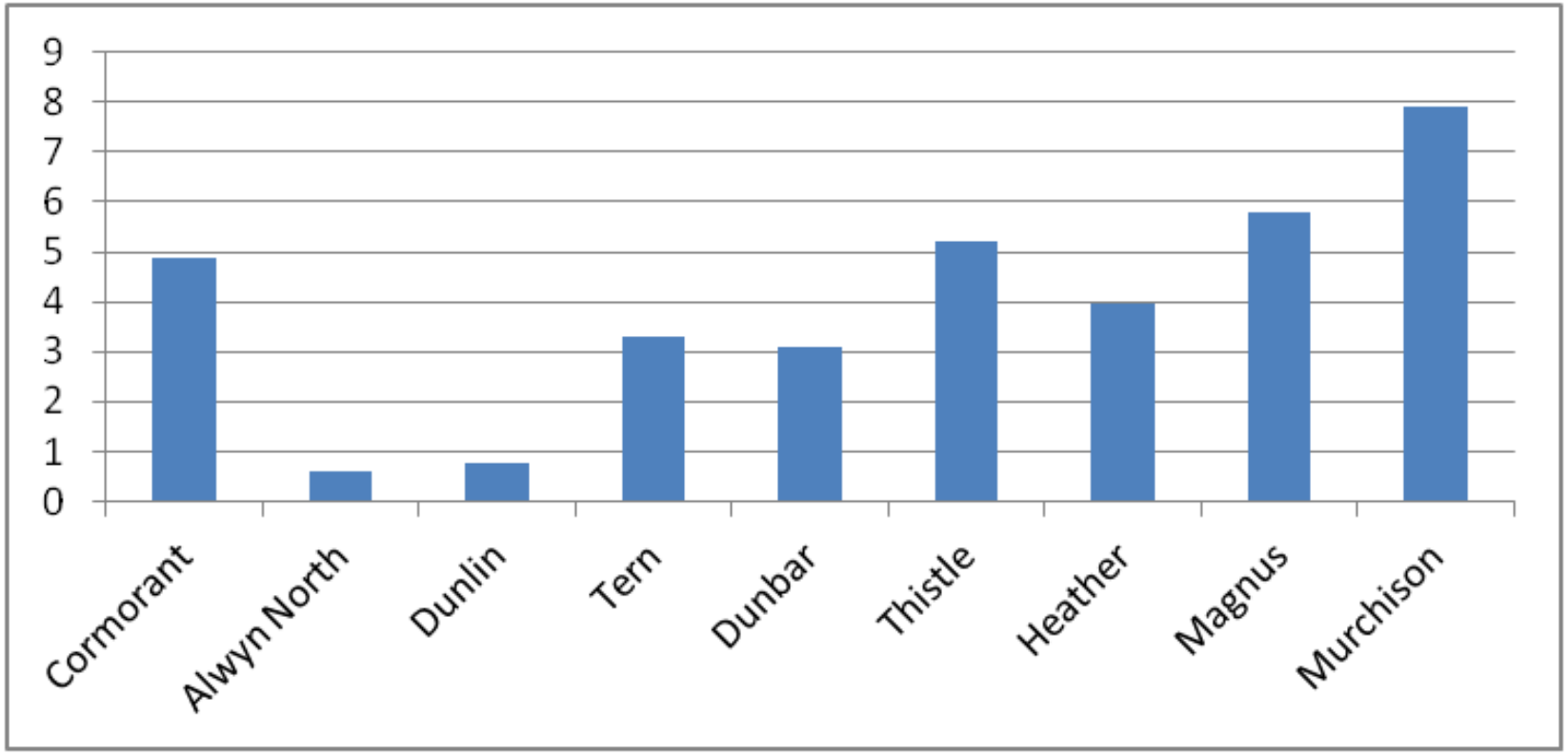
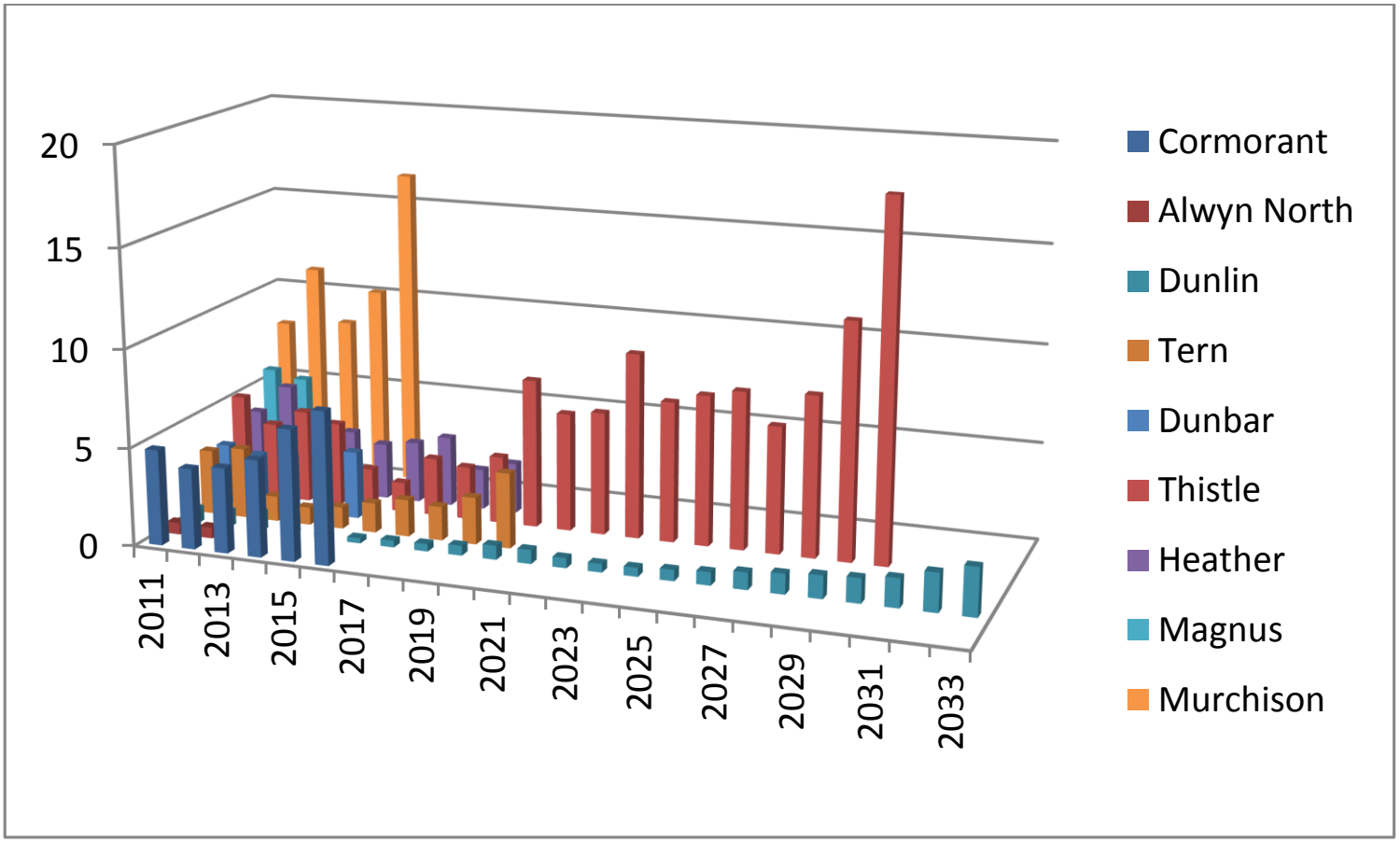


Figure 4 Non-Discriminatory Pricing Scenario (Unitpr): Unit Hub Prices by Year



Summary & Conclusions

Ownership differences some reduction Province NPV.
Hub viability constraints – Mixed Impact shutdown date
Cost of delay is high - mostly postponement
Difficulty applying “extreme” non-discriminatory pricing regime – variable field costs.

Caveats

No modelling individual firms behaviour/bilateral bargaining
No risk and uncertainty
Timing of new field developments
Multipart Tariffs

Should UK Government
Enhance negotiated settlements efficiency
or
Instigate full regulation?

Thank you for your attention