Review Group 0251

Review of the Determination of Daily Calorific Values

Biomethane injection: Options for consideration

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Overview

- Background to this study
- Options considered
- Results of the study
  - Non-financial impacts (e.g. environment)
  - Estimate of costs (order of magnitude)
- Points for discussion

Background to the study

- Renewable gas supplies could contribute to UK's renewable energy and emissions reduction targets
- Decarbonising gas distribution networks helps position gas in low carbon economy
- Biomethane calorific value is low
- Typically 36 – 37 MJ/m^3 without enrichment
- Significant potential for FWACV cap
- Significant CV shrinkage costs

Options considered - 1

Option	Pros	Cons
1. Do nothing (Allow injection without target CV)	No change to regime	Significant CV Shrinkage caused by FWACV cap Customers billed for energy not consumed
2. Set target CV/enrich	No change to regime CV shrinkage avoided	Cost of gas enrichment Added propane is not renewable – dilutes environmental benefits (5% volume, 15% energy)

Options considered - 2

Option	Pros	Cons
3. Set target CV/blend: (a) Mix and measure CV (b) Inject and infer CV	No change to regime CV shrinkage avoided	Cost of blending Availability of sufficient blending gas limits capacity for injection
(c) IP inject	Availability of blending gas	Limited locations near to IP pipe Cost of compression
4. Shrink/change charging areas	CV shrinkage avoided? Minimise other shrinkage impacts	Additional CV determination Offtake…DG…consumer Reconciliation system change
5. Alter FWACV cap: (a) Abandon (b) Threshold on volume/energy	No or small change to regime CV shrinkage avoided or mitigated	Some consumers billed for energy not consumed

Quantification of financial impacts

- Model Britain:
  - 1000 TWh/y gas consumption
  - 350 TWh/y Power station users and NI
  - 650 TWh/y Distribution system (13 LDZs)
- Model LDZ:
  - 50,000 GWh/y gas consumption
    - 1.67 million domestic (18,000 kWh/y)
    - 32,000 C&I (634,000 kWh/y)

CV Shrinkage in Model LDZ

GCV of biomethane: GWh/y	GCV of LDZ: 38.5	39	39.5	40
36	1948	2564	3165	3750
36.5	1299	1922	2532	3125
37	649	1281	1899	2500
37.5	0	641	1266	1875
38	0	0	633	1250
38.5	0	0	0	625
39	0	0	0	0
39.5	0	0	0	0
40	0	0	0	0

Comparisons:

1. Potential impact in NE (NG, 26th June): 1000-1600 GWh/y
2. Annual UAG divided by 13: 280 GWh

Cost of CV Shrinkage in Model LDZ

		GCV of LDZ			
	£million	38.5	39	39.5	40
GCV of biomethane	36	18.5	24.4	30.1	35.6
	36.5	12.3	18.2	24.1	29.7
	37	6.2			23.8
	37.5	0.0	6.1	12.0	17.8
	38	0.0	0.0	6.0	11.9
	38.5	0.0	0.0	0.0	5.9
	39	0.0	0.0	0.0	0.0
	39.5	0.0	0.0	0.0	0.0
	40	0.0	0.0	0.0	0.0

Comparison:
Potential impact in NE (NG, 26th June): £10-14.7 million/y
- assuming SAP 0.95 p/kWh (28 p/therm)

Shrinkage gas cost per kWh of gas consumed: example cases

- Biomethane CV 36.0 MJ/m^3
- LDZ CV 39.5 MJ/m^3
  - 0.06 p/kWh (of LDZ gas consumed)
- Biomethane CV 37.0 MJ/m^3
- LDZ CV 39.5 MJ/m^3
  - 0.04 p/kWh (of LDZ gas consumed)

Comparisons:

1. UAG 0.005 p/kWh of UK gas consumed
2. UAG 0.004 p/kWh of LDZ gas consumed

Propane enrichment cost: example cases

- LDZ CV 39.5 MJ/m^3
- Biomethane 1% of LDZ energy
- Biomethane CV 37.0 MJ/m^3
  - 0.12 p/kWh (of biomethane)
  - 0.0012 p/kWh (o[redacted]d)
- Biomethane CV 38.5 MJ/m^3
  - 0.23 p/kWh (of biomethane)
  - 0.0023 p/kWh (o[redacted]d)

Because the consumer probably isn't the purchaser

Comparison of costs for options 1 (do nothing), 2 (enrich) and 5 (abandon cap)

	1	2a	2b	5a	5b	5c
CV of injected biomethane, MJ/m^3	36.0	37.0	38.5	36.0	37.0	38.5
CV of LDZ, MJ/m^3	39.5	39.5	39.5	39.5	39.5	39.5
CV Cap	Yes	Yes	Yes	No	No	No
CV Shrinkage cost, £million	30	18	-	-	-	-
Cost to all consumers, p/kWh:	0.060	0.037	0.002	-	0.001	0.002
shrinkage gas	0.060	0.036	-	-	-	-
propane enrichment	-	0.001	0.002	-	0.001	0.002
Under-billing of natural gas consumer, p/kWh*	0.696	0.418	-	-	-	-
Over-billing of biomethane consumer, p/kWh*	0.279	0.279	0.279	0.975	0.696	0.279

* arising from biomethane injection (capped CV – actual CV) = 1 MJ/m^3 for biomethane consumer; (FWACV-capped CV) for natural gas consumer

Cost of blending (option 3)

- Mix and measure
  - Assumptions:
    - Additional metering of natural gas feed
    - Two pipelines each 1km
    - Mid-size injection facility
    - Blending gas available at no charge
- Estimated additional cost
  - 0.11 p/kWh – 0.17 p/kWh (of biomethane consumed)
  - 0.0014 p/kWh (of LDZ gas consumed)

Cost of blending (option 3)

- Inject and infer
  - Assumptions:
    - Additional metering of natural gas feed
    - Single pipeline, 1km
    - Mid-size injection facility
    - Blending gas available at no charge
- Estimated additional cost
  - 0.02 p/kWh (of biomethane consumed)
  - 0.0002 p/kWh (of LDZ gas consumed)

Cost of blending (option 3)

- IP injection
  - Assumptions:
    - Additional metering of natural gas feed
    - Single pipeline, 1km
    - Mid-size injection facility
    - Blending gas available at no charge
    - Compression required
- Estimated additional cost
  - 0.13 p/kWh (of biomethane consumed)
  - 0.0013 p/kWh (of LDZ gas consumed

Summary of costs for option 3 (blending)
a/b: mix and measure; c/d: inject and infer; e/f: IP injection

	3a	3b	3c	3d	3e	3f
CV of NG/biomethane, MJ/m^3	37.0	38.5	37.0	38.5	37.0	38.5
CV of LDZ, MJ/m^3	39.5	39.5	39.5	39.5	39.5	39.5
CV Cap	Yes	Yes	Yes	Yes	Yes	Yes
CV Shrinkage cost, £million	18	-	18	-	18	-
Cost to all consumers, p/kWh:	0.0374	0.0014	0.0362	0.0002	0.0375	0.0015
shrinkage gas	0.0360	-	0.0360	-	0.0360	-
blending cost	0.0014	0.0014	0.0002	0.0002	0.0002	0.0002
compression cost	-	-	-	-	0.0013	0.0013
Under-billing of natural gas consumer, p/kWh*	0.418	-	0.418	-	0.418	-
Over-billing of biomethane consumer, p/kWh*	0.279	0.279	0.279	0.279	0.279	0.279

* arising from biomethane injection (capped CV – actual CV) = 1 MJ/m^3 for biomethane consumer; (FWACV-capped CV) for natural gas consumer

Cost of Option 4 (embedded charging zones)

- Like Wet Gas areas
  - SIS postcodes of areas receiving biomethane
  - CV information from injection point instrumentation
  - Lowest source CV assumed to operate (CV of biomethane)
  - Cap not triggered outside of embedded zone
  - Shrinkage in embedded zone – assumed 1% of option 1
- Required changes
  - No hardware changes assumed
  - System costs
    - Energy settlement – no change
    - Biomethane consumers reconciled as previously carried out for wet gas
    - Cost £0.5 million/y ? (0.001 p/kWh of LDZ gas consumed)
    - (Based on estimated Wet Gas Scheme costs)

Summary of costs for option 4 (embedded charging zones)

	4
CV Shrinkage cost, £million	3
CV hardware cost, £million	-
System hardware, £million	- ?
Cost to all consumers, p/kWh:	0.0016
system costs	0.0010
shrinkage gas	0.0006
Under-billing of natural gas consumer, p/kWh*	-
Under-billing of natural gas consumer in embedded zone, p/kWh*	0.696
Over-billing of biomethane consumer, p/kWh*	-

* arising from biomethane injection = zero for biomethane consumer; (natural gas CV-biomethane CV) for natural gas consumer

Summary of costs for all options

	1	2	3	4	5
Cost to all consumers, p/kWh:	0.06	0.002 – 0.04	0.001 – 0.04	0.0016	0 – 0.002
Under-billing of natural gas consumer, p/kWh*	0.696	0 – 0.418	0 – 0.418	-	-
Under-billing of natural gas consumer in embedded zone, p/kWh*	n/a	n/a	n/a	0.696	n/a
Over-billing of biomethane consumer, p/kWh*	0.279	0.279	0.279	-	0.279 - 0.975

Points for discussion

- Triggering of CV cap causes significant increase in shrinkage cost of biomethane injection
- Impact is disproportionate to the value of the biomethane injected
- Waiving the cap imposes additional cost on the biomethane consumer and probably not the biomethane purchaser
- Propane enrichment
  - Cost are small if shared by all consumers
  - Dilute the environmental /renewable benefits of biomethane
- Embedded charging zones
  - Potential to minimise over-billing of biomethane consumers
  - Can they be implemented pragmatically at low cost?