



LAB^{TQ} - MARCOGAZ
Workshop
mCHP - the UK experience
on behalf of Mark Crowther

3rd May 2012



Overall efficiency measurement

- In the UK, we test mCHP according to BSI PAS 67
- This tests all mCHP, boilers etc to a 24 hour schedule - similar to DHW draw off patterns
- Three measurement points (% of heat output)
 - 100% at 60°C to 80°C
 - 30% at 30°C to 37°C
 - 10% at 30°C to 33°C
- Plus
 - Standby
 - DHW only (to M324 tapping patterns - typically 100l/day)



Overall efficiency measurement

- **Under 3 possible heating regimes:-**
 - 06:00 to 09:00 and 16:00 to 23:00 BIMODAL
 - 06:00 to 23:00 UNIMODAL
 - 00:00 to 24:00 CONTINUOUS
- **Under a control system typical of that installed in a UK house**
- **This gives manufacturers the chance of testing appliances in their 'recommended' operating regime**



Overall efficiency measurement

- This 24 hour technique is always accompanied by Energy Balance Validation (EBV) - typically to +/-2%
- This requires balance of:-

$$\begin{aligned} & \text{Energy In} \\ & \text{(Fuel, Electricity)} \\ & = \\ & \text{Energy Out} \\ & \text{(Heat, Electricity, Case Loss, Flue Loss, Condensate)} \end{aligned}$$

- EBV ensures the validity of complex tests



Overall efficiency measurement

■ Applicable to:-

- IC engines
- Stirling engines
- Organic Rankine Cycle
- High temp Fuel Cell
- PEM Fuel Cell
- Any 'hybrid' units - eg Boiler + mCHP



Overall efficiency measurement

■ Why this 24 hour approach ?

- UK authorities do not believe the results calculated for such complex units with their very varied shut down and start up regimes and widely varying efficiencies
- Anecdotally, there is considerable variation in the efficiencies reported for production of DHW. In principle, this could be calculated by adding together start-up, operational and shut down values. However, this does not agree with reality.



Overall efficiency measurement

- **We see similar issues with mCHP where start up and shut down periods can be 15 minutes!**
 - This can be a very serious problem on a warm day when the continuous heating might only need to produce 10% of its theoretical load (ie 2 hours 24 mins/day)
 - This is equivalent to 6 minutes in every hour
- **We suggest that trying to accurately project efficiency performance for such an appliance taking 15 minutes to start, 6 minutes to run and 5 minutes to shut down is practically impossible!**



Overall efficiency measurement

■ The PAS 67 Test

- Fully automated test creating 'a level playing field'
- Whilst conceptually complex, it does reflect reality
- Energy balance validation guarantees good quality results
- The method has been validated by Field Trials
- Typical cost €10,000–15,000 for full suite of tests
- Rewards good quality, well controlled units



Example scenarios (1)

■ Typical cold day - mCHP operates for long periods

Cold day		
% Load	60%	
Hours/day	14.4	hrs
Typical ON period	1	hrs
Typical OFF period	0.2	hrs
Cycles/day	14	
Electricity %	Very Good	
Householder	Happy	



Example scenarios (2)

- **Typical cool day - mCHP operates for long periods BUT only twice per day**

OPTION 1		
% Load	10%	
Hours/day	2.4	hrs
Typical ON period	1	hrs
Typical OFF period	0.2	hrs
Cycles/day	2	
Electricity %	Good	
Householder	Cold	



Example scenarios (3)

- **Typical cool day - mCHP operates 24 times/day BUT for very short periods**

OPTION 2		
% Load	10%	
Hours/day	2.4	hrs
Typical ON period	0.1	hrs
Typical OFF period	0.9	hrs
Cycles/day	24	
Electricity %	VERY POOR	
Householder	Warm	



Example scenarios (4)

- **Typical cool day - mCHP operates 8 times/day giving reasonable operating periods + electricity**

OPTION 3		
% Load	10%	
Hours/day	2.4	hrs
Typical ON period	0.3	hrs
Typical OFF period	1.7	hrs
Cycles/day	8	Over 16 hours
Electricity %	Satisfactory	
Householder	Happy	



Conclusions

- **Only a continuous 24-hour test like PAS67 can distinguish between the available options and thus indicate which machine is going to give the best performance to the householder**
- **If we do nothing, the theoretical models will prevail and there is a real risk that the technologies will fall into disrepute with large numbers of unhappy customers**



Where can I get it?

Standard Number	PAS 67:2008
Title	Laboratory tests to determine the heating and electrical performance of heat-led micro-cogeneration packages primarily intended for heating dwellings
Status	Current
Publication Date	31 October 2008
Cross References	BS 845-1:1987 , BS 845-2:1987 , BS 1566-1:2002 , BS EN 13203-2:2006 , BS EN 304:1992 , BS EN 437:2003 , BS EN 60751:1996 , 2004/8/EC , 2004/108/EC , Engineering Recommendation G83-1 , UKAS M3003:2007 , 92/42/EEC , BS EN ISO 9001 , 90/396/EEC , BS EN 483:2000 , PD CEN/TR 1749:2005
Descriptors	Heaters, Heating equipment, Space-heating systems, Cogeneration systems, Gas-powered devices, Boilers, Domestic facilities, Electric power generation, Electricity, Electric generators, Thermal efficiency, Heat, Thermal output, Performance testing, Laboratory testing, Energy consumption, Solid-fuelled devices, Liquid fuel appliances
ICS	97.100.99 (Heaters using other sources of energy)
Committee	ZZ/1
ISBN	978 0 580 64480 1
Publisher	BSI
Format	A4
Delivery	YES
Pages	64
File Size	838 KB
Price	£ 65.00



Thank you!

Paul Balmer – Commercial Director, Kiwa Ltd
Board Member LAB^{TQ}