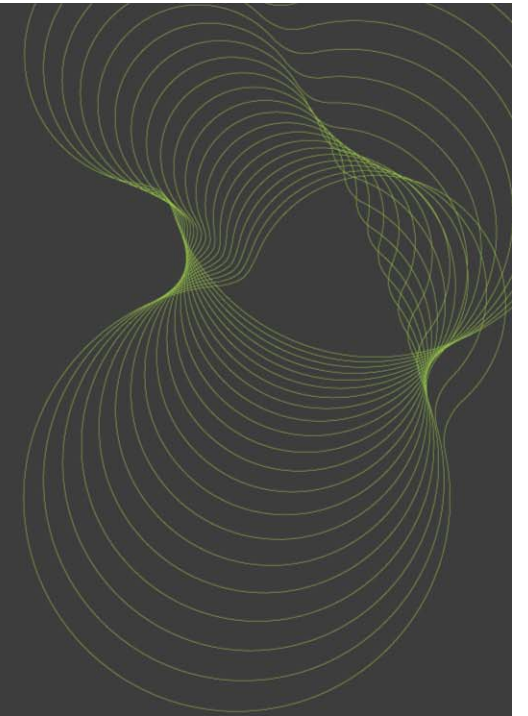


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Savings from a Shower Flow Regulator

Peter Iles

Aim of project

- **To evaluate average CO₂ emission savings from an EAGA shower regulator**

- EAGA requested evaluation for the CERT scheme
(Carbon Emission Reduction Target)
- CERT (2008-11) sets targets for domestic gas & electricity suppliers

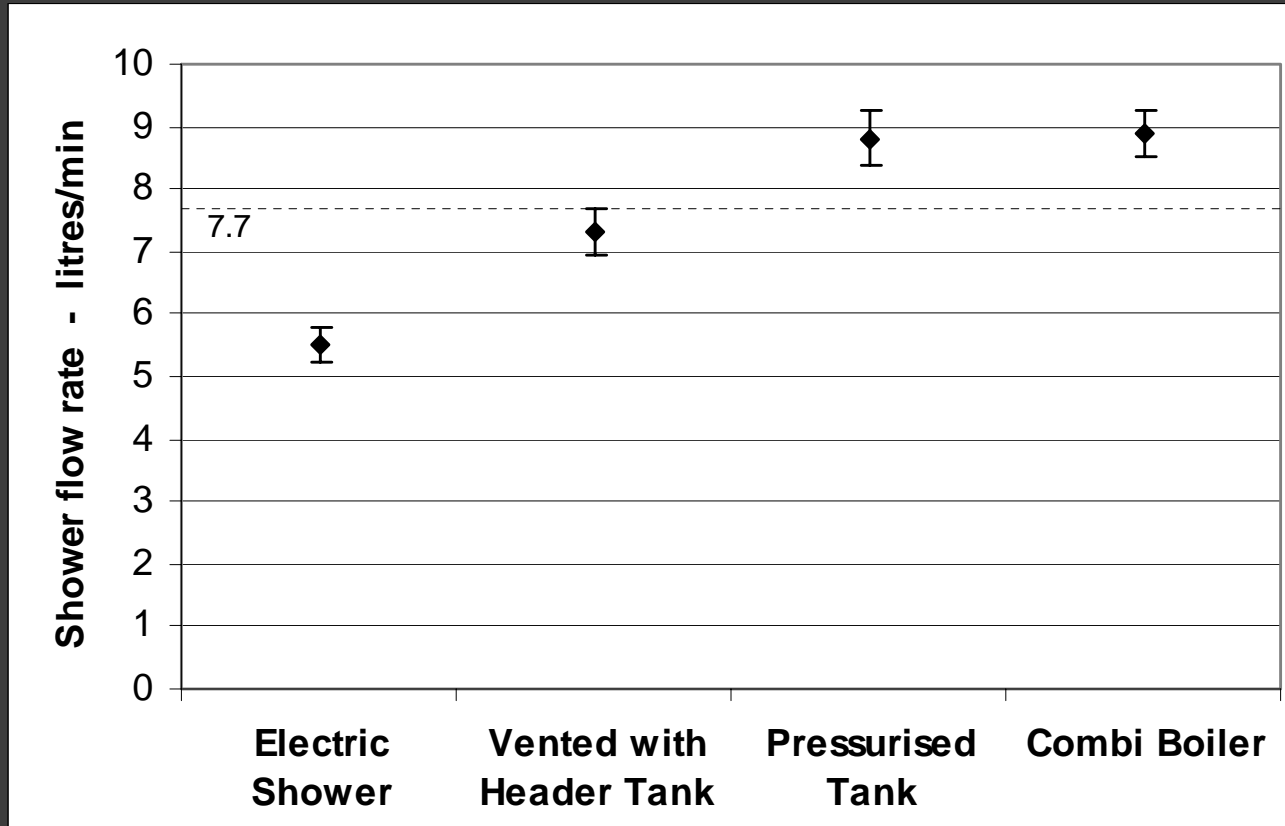
CERT targets mostly met through insulation, electrical appliances, heating.
New products may be introduced if acceptable evidence presented to Ofgem.

EAGA Shower Flow Regulator

- Reduces a flow above 7.7 litres/min to about this value



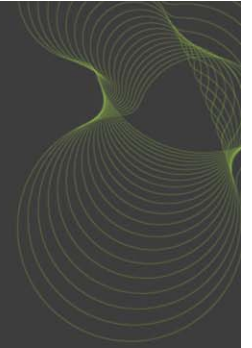
Suitable Shower / Hot Water Systems



Average flow rates, survey of 1168 homes (bars show 95% C.I. of mean)
(Durham University)

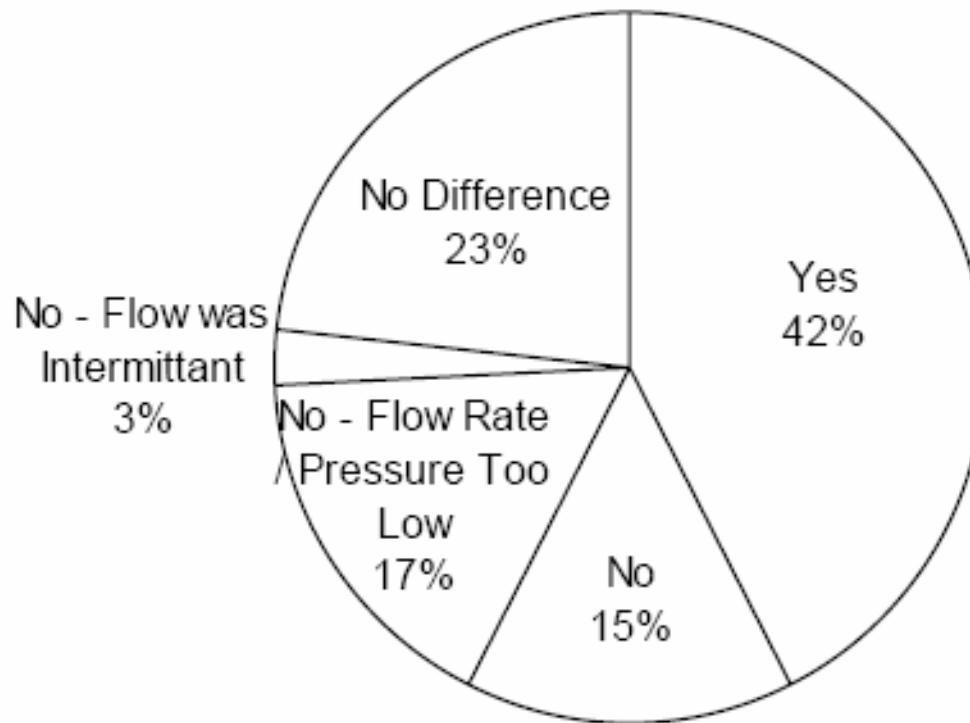
Acceptability to recipients

- To be offered with bag to check flow > 7.7 litres/min
- Trial or return basis
 - To check adequate flow, and acceptable shower experience
- 204 homes asked questions after a week of usage
 - 91% would recommend it to a friend if supplied free
 - 86% if it cost £10
 - 88% chose to keep the Shower Regulator
 - *Of 20, 8 did not notice a reduction in flow rate*
 - *Of 20, 4 felt that slightly reduced pressure was not a problem*
 - *several welcomed savings, particularly 7 of 20 who had a water meter*
(Durham University)



Acceptability to recipients

Did you enjoy showering more with the device fitted?



- 65% responded 'Yes' or 'No difference' (*Durham University*)

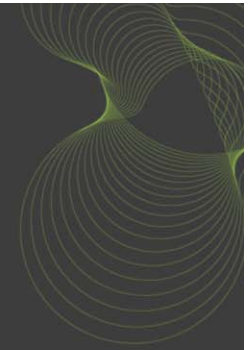
CO₂ emission savings evaluated from:

a) Reduction in hot water used for showering

- Flow rate, frequency of showering, time taken during shower
- Shower temperature and thus % of flow which is hot water
- Before, and after installation of shower regulator

b) CO₂ saving, per litre reduction of shower hot water

- BREDEM (BRE Domestic Energy Model) used to consider heat demands and gains



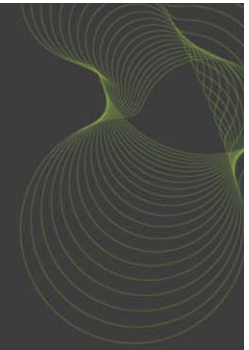
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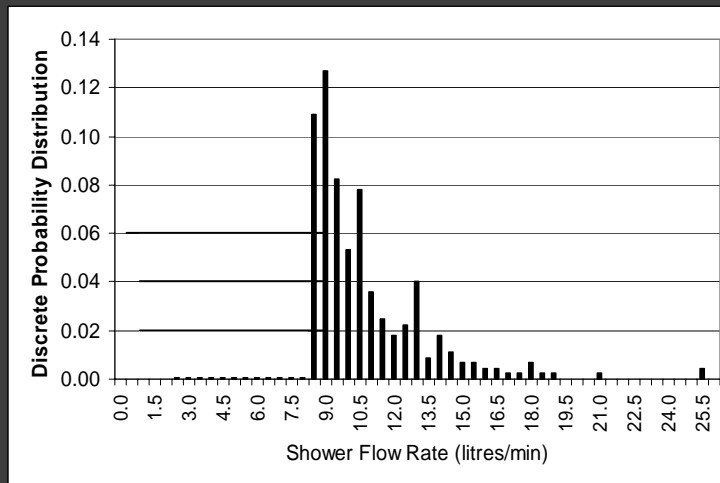
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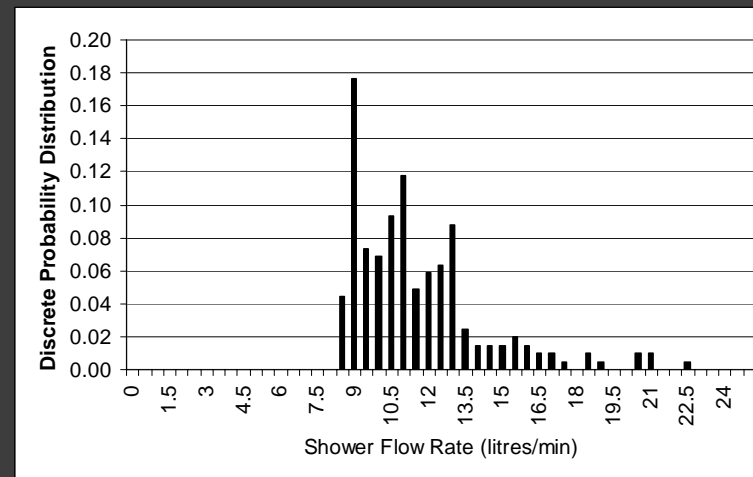
a) Reduction in hot water used for showering

- **Flow rate before installing regulator**

- mains pressure or pumped (combi, mains pressure tank, pumped shower)
- very variable: depends on pressure, pipework, shower rose
- timed filling of calibrated bucket



EAGA: 302 results, mean 11.28



SMS: 204 results, mean 10.48

(Durham University)

Weighted mean: 10.8 litres/min

a) Reduction in hot water used for showering

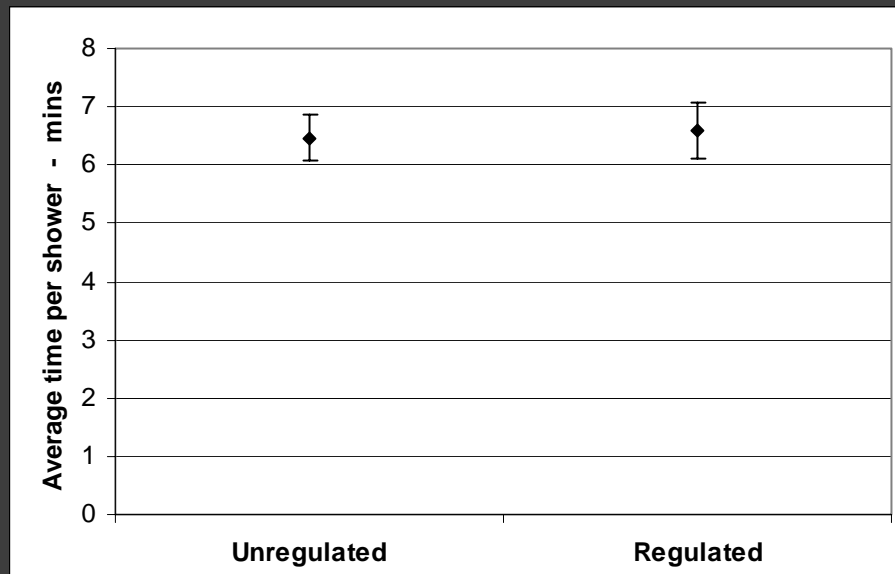
- Flow rate after installing regulator

- 204 homes with mains pressure showers (*Durham University*)
 - Average 7.57 litres/min (90% C.I. of mean 0.21)
- KIWA laboratory tests
 - 7.7 litres/min at 350, 400, 450 kPa pressure
 - 7.8 litres/min at 500 kPa
 - Reducing to 7.6 litres/min as pressure increased to 1000 kPa

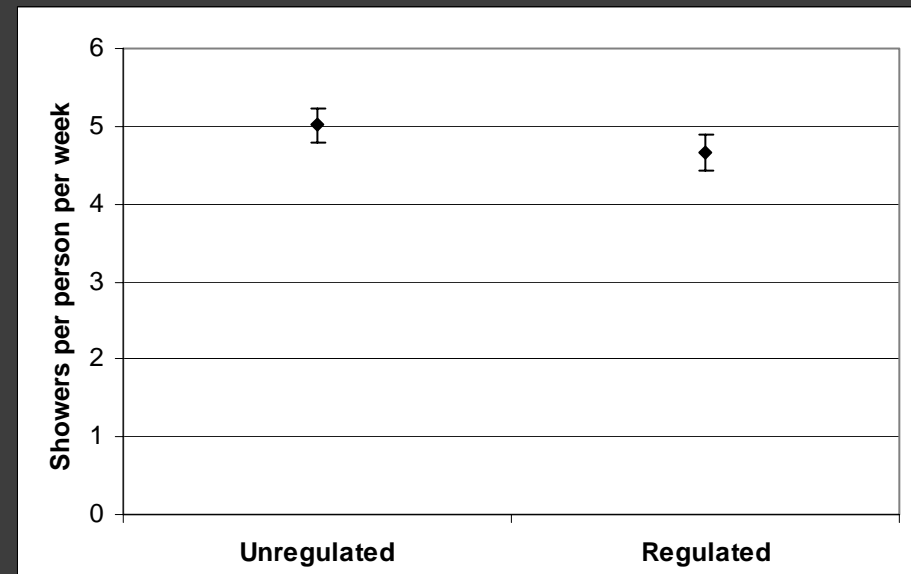
7.6 litres/min considered representative of actual usage

a) Reduction in hot water used for showering

- Effect of shower regulator:



time spent showering



frequency of showering

204 households, 378 people (bars show 95% C.I. of the mean)

(Durham University)

a) Reduction in hot water used for showering

- Time taken during shower

- 204 people self recorded, entering to leaving shower (*Durham University*)
 - 6.53 mins mean
mains pressure showers
- 1941 people self recorded, shower running time, include warm up (AMA)
 - 8.00 mins mean, ranging from <3 to >15 (1% >25 mins)
 - 7.88 mins mean if children excluded
all shower types, including electric and gravity fed

6.53 minutes considered representative

a) Reduction in hot water used for showering

- **Frequency of showering**

- 204 households, 378 people, recorded frequency during two weeks, mains pressure showers (*Durham University*)
 - *0.69 /person /day (95% C.I. of mean 0.24)*
 - Information from water utilities & shower manufacturers (AMA)
 - *0.6 /person /day for pressurised & pumped showers*
 - *0.48 /person /day electric & gravity fed showers*
- Indications from other data that frequency may relate to shower type

0.69 /person /day considered representative

GB mean is 2.33 person /household

giving 1.61 showers /household /day

a) Reduction in hot water used for showering

- Water temperature & hot/cold water blend

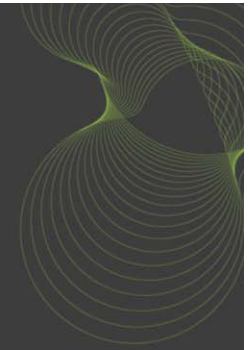
- Volunteers free to adjust temperature (BRE), mean : 39.5 °C
- TMVA recommended safe hot water for shower and washbasin : 41 °C
- BS 6340-1 'Shower Units' requires 50 litres at 40 °C at the shower head

Indicates ~ 39 °C at the shower head (blood temp. 37 °C)

Temperature at mixing point 40 °C

Cold feed 10 °C, hot feed 60 °C,

Requires 60%:40% hot:cold water



a) Reduction in hot water used for showering

- **Summary**

- Average flow rate before installation : 10.8 litres/min
- Flow rate after installation : 7.6 litres/min

- Average time spent showering : 6.53 mins
- Average frequency 1.61 showers /household /day

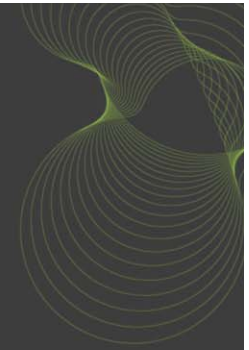
- Shower temperature 40 °C, water blend 60%:40% hot:cold water

Water saving 12,288 litres/yr

Hot water saving 7,373 litres/year

(71% of BREDEM total hot water use)

CO₂ emission savings evaluated from:



a) Reduction in hot water used for showering

- Flow rate, frequency of showering, time taken during shower
- Shower temperature and thus % of flow which is hot water
- Before, and after installation of shower regulator

b) CO₂ saving, per litre reduction of shower hot water

- BREDEM (BRE Domestic Energy Model) to consider heat demands and gains

b) CO₂ saving, per litre reduction of shower hot water

- Hot water system heat flows

- Hot water cylinder losses
- Distribution pipework losses

Unaffected by reduction in hot water use – may be neglected

- Heat content of water
- Primary pipework (boiler to cylinder) losses

Affected by reduction in hot water use – must be considered

b) CO₂ saving, per litre reduction of shower hot water

- Primary pipework (boiler to cylinder) losses

- Using BREDEM, each L litres reduction in demand

gives saving of $+ L \times 0.0152$ kWh

- Gains: using BREDEM model & assumption

gives 'saving' of $- L \times 0.0119$ kWh

b) CO₂ saving, per litre reduction of shower hot water

- Heat content of water

- Each L litres reduction in demand, assuming 50°C temp. rise
gives saving of $+ L \times 0.0581$ kWh
- Gains: using BREDEM model & assumption of 25% to 50% contribution
gives 'saving' of $- L \times 0.0122$ to $- L \times 0.0244$ kWh

If extract fan present then gains considered negligible
gives 'saving' of zero kWh

Weighting by no. of houses with / without extract fan
gives 'saving' of $- L \times 0.0083$ to $- L \times 0.0166$ kWh

b) CO₂ saving, per litre reduction of shower hot water

- Conversion to CO₂ saving

Central Heating	Seasonal efficiency	Households	kgCO ₂ /kWh
Gas	78%	19049	0.1899
Oil	82%	1135	0.2493

CO₂ coefficients and typical heating efficiencies, are those used in CERT

Weighted average : 0.2469 kgCO₂/kWh (useful energy)

b) CO₂ saving, per litre reduction of shower hot water

- **Summary**

a) Heat content	+ 14.34	gCO ₂ /litre
b) Gains from shower	- 2.05 to - 4.10	gCO ₂ /litre
c) Primary pipework losses	+ 3.75	gCO ₂ /litre
d) Primary pipework gains	- 2.94	gCO ₂ /litre
– Combi boiler :	a) b)	10.2 to 12.3 gCO ₂ /litre
– Boiler & cylinder :	a) b) c) d)	11.1 to 13.1 gCO ₂ /litre

majority of mains pressure heating systems are combi boilers so:

11.5 gCO₂/litre reduction in shower hot water

CO₂ emission savings evaluated from:

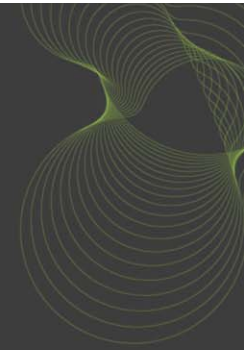
a) Reduction in hot water used for showering
average 7,373 litres/year

b) CO₂ saving, per litre reduction of shower hot water
average 11.5 gCO₂/litre

Average CO₂ emission savings from Shower Regulator
84.8 kg CO₂ /year

or 440 kWh/year delivered energy for a typical boiler
(of 78% seasonal efficiency)

Sensitivity of result



- Saving is proportional to:
 - showering time, and frequency
 - difference in flow rate before and after installation

- Sensitivity to flow rate before installation:

	litres/min	saving kgCO ₂ /yr	% difference
wtd ave used >	10.80	84.8	
EAGA data	10.48	76.3	- 10%
SMS data	11.28	97.5	+ 15%

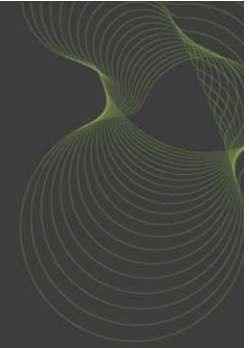
- Sensitivity to other parameters $\pm 5\%$ to $\pm 10\%$

Maintenance and lifetime of Shower Regulator

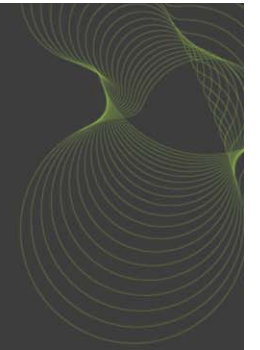


- Limescale deposition
 - permanently in water so no evaporation and deposition
 - smooth surfaces so any deposition washed away by flow
 - no active reaction with materials
- Mesh filter
 - clean if required
 - new build: clean after taps are first run to clear sand and grit
- Lifetime estimate
 - 12.2 years based on ONS data and AMA Research reports

Summary of savings from Shower Regulator



- 12,288 litres/year water
 - around £18/year for a metered supply
- 7,373 litres/year hot water
- 84.8 kg CO₂/year
 - Cavity wall insulation: 634 kg CO₂/year in CERT
 - 6.8 gCO₂/year at the Utility Company
- 440 kWh/year delivered energy (for a typical boiler)
 - around £9/year for gas



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Display set-up

- You should be able to see white through to black in 7 boxes below and the fractal should be visible.

