

Report on M2G Pilots for IMechE (Institution of Mechanical Engineers)

Pilot Site: [IMechE, 1 Birdcage Walk, London SW1H 9JJ](#)

Pilot period: [26th February 2009 to 16th April 2009](#)

Report Date: 30th April 2009



Title Report on M2G Pilot for IMechE

Customer Institution of Mechanical Engineers

Customer reference IME001

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Executive Summary

Sabien was asked by IMechE to demonstrate the energy consumption and CO₂ savings by installing Sabien's M2G technology to six boilers at the IMechE office in London.

Sabien project managed the M2G pilot, collected the measured data and produced this report with its findings.

M2G technology delivered a 17% reduction in consumption at the site. Savings for the site are illustrated in the Savings & Payback Table below. Savings were calculated using energy consumption data supplied by IMechE.

In order to measure savings during the pilot period, the M2G is switched into a toggle mode where it functions alternately between save and bypass modes. This is done for comparison purposes and therefore only half of the potential savings are being delivered whilst in toggle mode. At the completion of the pilot period, M2G is re-set to continuous Save mode, delivering 100% of savings.

At the current gas price of 3.0p/kWh, payback for the six M2G units fitted at the site is forecast within 2.7 years. M2G delivered realistic savings considering that the building has low gas consumption for a building with multiple boilers. This should be considered as the lower expectation and with higher gas cost in the future the payback period would be reduced.

Payback period & CO₂ Reduction

	Payback	%Savings
Overall for the site	2.7 years	17%

In conclusion

- ▣ M2G delivered a 17% saving over the pilot period.
- ▣ Payback is forecast within 2.7 years.
- ▣ 25 tonnes of CO₂ are forecast to be reduced per annum, delivering a forecast 125 tonnes of CO₂ savings over 5 years.
- ▣ There were no reports from the site FM of ambient room and hot water temperatures being affected during the pilot.
- ▣ Paybacks exclude VAT and Enhanced Capital Allowance.
- ▣ Sabien delivered significant energy savings and reduction of CO₂ emissions, making the M2G a commercially viable and proven energy efficiency technology for IMechE to use in its estate.



About Sabien Technology Limited

Sabien Technology Limited, a subsidiary of Sabien Technology Group Plc an AIM listed company, targets large multi-site companies that are tasked by shareholders and management to reduce and manage their carbon footprint and energy consumption. Sabien markets and sells energy saving technology. Our M2G product is proven to reduce energy consumption and carbon emissions, typically up to 25%.

M2G explained:

The M2G is an intelligent boiler load optimisation controller that improves the efficiency of each individual boiler. It monitors the temperature of the water in the flow and return every 10 seconds and the data is recorded with heat transfer rates at the first and second stage firings. When a loading demand is made, the system automatically checks the latest data it has stored and decides whether it is more economical to retain first stage firing or to introduce a second stage firing. The result is a substantial fuel reduction during less demanding situations while ensuring maximum capacity during heavy load periods.

The M2G is Carbon Trust approved and qualifies for the Enhanced Capital Allowance Scheme.

M2G Unique specification technology

(VTR) Variable Temperature Response

The M2G digitally measures and responds to separate boiler flow and return temperatures on each of the boilers, enabling boiler load profile indexing. The software is fully adaptive to changes in variable boiler set point control such as BMS or direct weather compensation control.

(SFC) Staged Firing Control

The M2G has two fail safe control relays, enabling direct control on high/low burners. The M2G has two separate “Save” modes enabling optimisation of a two stage burner, maximising boiler thermal efficiency for changes in load patterns.

(BCT) Boiler Control Terminal

The M2G RS232 interface enables full Data Acquisition and Control; this enables the M2G to be configured to “Toggle” modes for piloting and validation. The M2G software is fully configurable, via Options and Parameters for changes in system applications and requirements.



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1 Project Aims

Sabien Technology was asked by IMechE to demonstrate the energy consumption and CO₂ savings by installing Sabien’s M2G technology to six boilers at the IMechE office in London. The pilot started in February 2009 and ended in April 2009.

Sabien's objectives for the pilot were as follows:-

- ▣ Install M2G on all six boilers at the IMechE site.
- ▣ Measure and calculate the indicative gas consumption (using kWh) and the CO₂ savings produced by M2G over the pilot period, for all the sites.
- ▣ Calculate the payback for the M2G pilot using annual energy consumption figures and p/kWh provided by IMechE.

This report presents the findings of the savings produced by M2G and demonstrates the payback on M2Gs used in the pilot. The findings in the report are indicative of potential savings if M2G is fitted throughout the IMechE estate.

2 Our Findings

Please note that during the pilot period that Boiler no.4 was inoperable due to a faulty air pressure switch which was unrelated to M2G. Therefore the results in this report are based on five of the six boilers.

We would expect M2G to make an even higher percentage saving when all six boilers are in operation. M2G performed extremely well for a building with a low gas consumption.

Table 1 provides an overview of the M2G pilot findings.

Table 1 - Summary of findings

	Overall
Consumption Savings (%) for the site	17%
Payback	2.7 years
Average Price (p/kWh)	3.0p
Annual Energy Bill (£s) – Natural Gas	£24,210
Annual Saving (£'s)	£4,116
Energy Consumption(kWh)	807,000
Annual Savings (kWh)	137,190
Number of M2G units fitted	6
M2G cost (£'s) – 6 units	£11,100
Annual CO ₂ savings (tonnes)	25

During the pilot period, M2G is configured to toggle between ‘Save’ (i.e. days when the M2G is operational and makes savings) and ‘Bypass’ (i.e. days when the M2G is bypassed and makes no savings) modes. A comparison of the boiler firing periods is then made between save and bypass days. Variations in outside temperature are accommodated using industry standard degree day calculation (see section 3.1.3 on page 11).



N.B. When the M2G is functioning in save and bypass modes, only half of the potential savings are being delivered. At the end of the pilot period, M2G is re-set to continuous Save mode, delivering 100% of savings (please see section 3.1 for further details).

The measurement methodology is explained in detail in Section 3.1 on page 9.

2.1 Boiler Saving

Method 1, as outlined in Section 3.1.1 on page 9, was used to measure and analyse the pilot site. Table 2 shows hours run and degree day measurements and percentage savings for the site. Please see section 3.1.3 on page 11 for degree day calculation.

Table 2 - Savings derived from pilot period

IMEchE, Birdcage Walk		
Mode	Hours Run	Degree Days
Save	17.3	101.4
Bypass	18.0	87.5
Saving	17%	

2.2 Payback Period

Table 3 shows the payback period for 6 x M2G units. Table 4 shows the annual and cumulative financial and CO₂ savings over 5 years.

Hence,

$$\text{Savings}(\%) = 1 - \left(\frac{\frac{\text{Hours_Run}_{\text{Save}}}{\text{Degree_Days}_{\text{Save}}}}{\frac{\text{Hours_Run}_{\text{Bypass}}}{\text{Degree_Days}_{\text{Bypass}}}} \right) \times 100$$

$$\text{Savings}(\%) = 1 - \left(\frac{\frac{17.3}{101.4}}{\frac{18.0}{87.5}} \right) \times 100 = 17\%$$



Table 3 – Savings & Payback

Site	Average % Savings
IMechE, Birdcage Walk	17%
Overall Payback	2.7 years

The gas consumption data and gas price in pence/kWh were supplied by IMechE. The energy cost for the site was averaged at 3.0p/kWh. Savings were calculated using annual gas consumption data supplied by IMechE.

Table 4 - Overall CO₂ and Cost Savings

	Estimated CO ₂ Savings (tonnes)		Cost Savings (£s)	
	Yr by Yr	Cumulative	Yr by Yr	Cumulative
Year 1	25	25	£4,116	£4,116
Year 2	25	50	£4,116	£8,231
Year 3	25	75	£4,116	£12,437
Year 4	25	100	£4,116	£16,463
Year 5	25	125	£4,116	£20,579

2.3 Data Collection

During the data collection, there were no reported problems or loss of services. Services were not compromised in any way. All data was recorded and sent to Sabien's Watford office for analysis.

2.4 Conclusion

- ▣ M2G delivered a 17% saving over the pilot period.
- ▣ Payback is forecast within 2.7 years.
- ▣ 25 tonnes of CO₂ are forecast to be reduced per annum, delivering a forecast 125 tonnes of CO₂ savings over 5 years.
- ▣ There were no reports from the site FM of ambient room and hot water temperatures being affected during the pilot.
- ▣ Paybacks exclude VAT and Enhanced Capital Allowances.
- ▣ Sabien delivered significant energy savings and reduction of CO₂ emissions, making the M2G a commercially viable and proven energy efficiency technology for IMechE to use in its estate.



3 Appendix

3.1 Pilot Details

Sabien uses external data logging equipment on the M2G to record daily save and bypass data from the boilers and a temperature data logger to measure outside ambient temperature. There are two methods used to measure the hours run, outlined below. The difference between the two methodologies is that **Methodology I** aggregates the hours run on a daily basis, whereas **Methodology II** produces hours run for the period of the trial (save days and bypass days).

Sabien reserves the right to use either methodology, dependant on site conditions and external factors.

During the pilot period, M2G is configured to toggle between ‘Save’ (i.e. days when the M2G is operational and makes savings) and ‘Bypass’ (i.e. days when the M2G is bypassed and makes no savings) modes. A comparison of the boiler firing periods is then made between save and bypass days. Variations in outside temperature are accommodated using industry standard degree day calculation.

N.B. When the M2G is functioning in save and bypass modes (i.e. toggle mode, used during the pilot), only half of the potential gas consumption savings are being delivered. There is no visible correlation between the gas meter readings and the savings recorded by our measurement equipment as the gas meter readings are not synchronised to the M2G measurement of save and bypass days. However, to make this correlation possible, half hourly gas meters would need to be installed and the data recorded and analysed. The gas meter savings would then need to be compared to the savings from Sabien’s measurement equipment for savings confirmation.

At the completion of the pilot period, M2G is re-set to continuous Save mode, delivering 100% of savings.

3.1.1 Methodology I

1. (a) Data loggers record:

Date	Run Time	Finish Time
-	-	-

(b) Temperature logger records:

Date	Time in hours	Temperature
-----	1 – 24	°C



2. Sabien converts the temperature data into degree day data, i.e. temperature specific to the site, using the Degree Day Calculation formulae shown below.

3. Percentage savings are calculated as follows:

$$\text{Savings(\%)} = 1 - \left(\frac{\frac{\text{Hours_Run}_{\text{Save}}}{\text{Degree_Days}_{\text{Save}}}}{\frac{\text{Hours_Run}_{\text{Bypass}}}{\text{Degree_Days}_{\text{Bypass}}}} \right) \times 100$$

4. All pilot equipment is collected at the end of the pilot.



3.1.2 Methodology II

1. (a) Hour Run meters record:

- Save Day Hours Run**
- Bypass Day Hours Run**

(b) Temperature logger records:

Date	Time in hours	Temperature
-----	1 – 24	°C

2. Sabien converts the temperature data into degree day data, i.e. temperature specific to the site, using the Degree Day Calculation formulae shown below.

3. Percentage savings are calculated as follows:

$$\text{Savings(\%)} = 1 - \left(\frac{\frac{\text{Hours_Run}_{\text{Save}}}{\text{Degree_Days}_{\text{Save}}}}{\frac{\text{Hours_Run}_{\text{Bypass}}}{\text{Degree_Days}_{\text{Bypass}}}} \right) \times 100$$

4. All pilot equipment is collected at the end of the pilot.

3.1.3 Degree Day Calculation Method

Heating degree days are a measure of the severity and duration of cold weather: the colder the weather, the larger the number of degree days. Degree days are a summation of the difference between actual outside temperature and a nominal base temperature (in the UK, this is taken to be 15.5°C). The industry equations for the calculation of degree days are shown below.

Degree days can be used to ‘normalise’ energy consumption data, thus allowing fair comparisons between months or years. For example, if a building were to show a drop in heating energy consumption of 5%, that would seem to be good. But if it were subsequently shown that over that timescale the degree days were 20% below normal, the figures may actually constitute a rise in energy consumption.



Industry equations for the calculation of degree days

T = Temperature

T_{base} = 15.5°C

DD = Degree Days

When T_{min} and T_{max} have been found for each day, the calculation is then one of the following:

If T_{min} > T_{base}, DD = 0

If (T_{max}+T_{min})/2 > T_{base}, DD = (T_{base} - T_{min})/4

If T_{max} >= T_{base}, DD = ((T_{base}-T_{min})/2)-((T_{max}-T_{base})/4)

If T_{max} < T_{base}, DD = T_{base} - ((T_{max}+T_{min})/2)

3.1.4 Payback Calculation

The simple payback calculation used was:

$$Payback = \frac{Cost}{Savings} \times 52$$

where payback is shown in weeks.



3.2 Pilot History Log & Detailed Findings

3.2.1 IMechE, 1 Birdcage Walk, London SW1H 9JJ

Boiler information

Boiler #: 1,2,3,4,5,6
 Location: Basement
 Boiler Type(s): Roca NG100 124
 Burner Type : N/A – Atmospheric boilers
 Boiler Application: LTHW Heating & Hot Water Services
 Boiler Capacity: 124 kW x 6
 Other: Trend

Table 5 – IMechE Site Log

Date	Status	Notes
26.02.09	M2G units commissioned for pilot	Noted fault on Boiler no.4 – boiler inoperable.
30.03.09	Data Collection visit	Boiler no.4 still inoperable. Data collected and sent to Sabien for analysis
30.04.09	Data Collection visit	Boiler no.4 repaired. Data collected and sent to Sabien for analysis

Technical Findings

It was noted at the point of commissioning the pilot that Boiler no.4 was inoperable due to a faulty air pressure switch.


On the first data collection visit on 30th March 2009, boiler no.4 had not been repaired.

When our technician made a final collection of data on 30th April 2009, boiler no.4 had been repaired. However, it was noted that boiler no.5 was also inoperable – the site FM was aware that this was not M2G related. During the visit, the site FM informed the Sabien Technician that boiler no.4 had been repaired on or around 16th April 2009. Hence, to avoid using data that would not reflect the performance of the boilers and the M2G, data after 16th April 2009 has been excluded from this report.

During the data collection, there were no reported problems or loss of services. Services were not compromised in any way.



Appendix - Customer Information Sheet, Pilot Methodology & Degree Days Chart



Customer information sheet - Outright Purchase Proposal

Customer Name:

Site ref:

Inputs:

Energy - boiler information

No of boilers

Type of fuel

* Annual consumption (Kwh)

Price per/Kwh (in pence)

M2G Cost

Estimated annual % savings

Estimated annual % increase in fuel costs


Outputs:

Current annual CO2 output based on your annual kWh consumption 149 tonnes

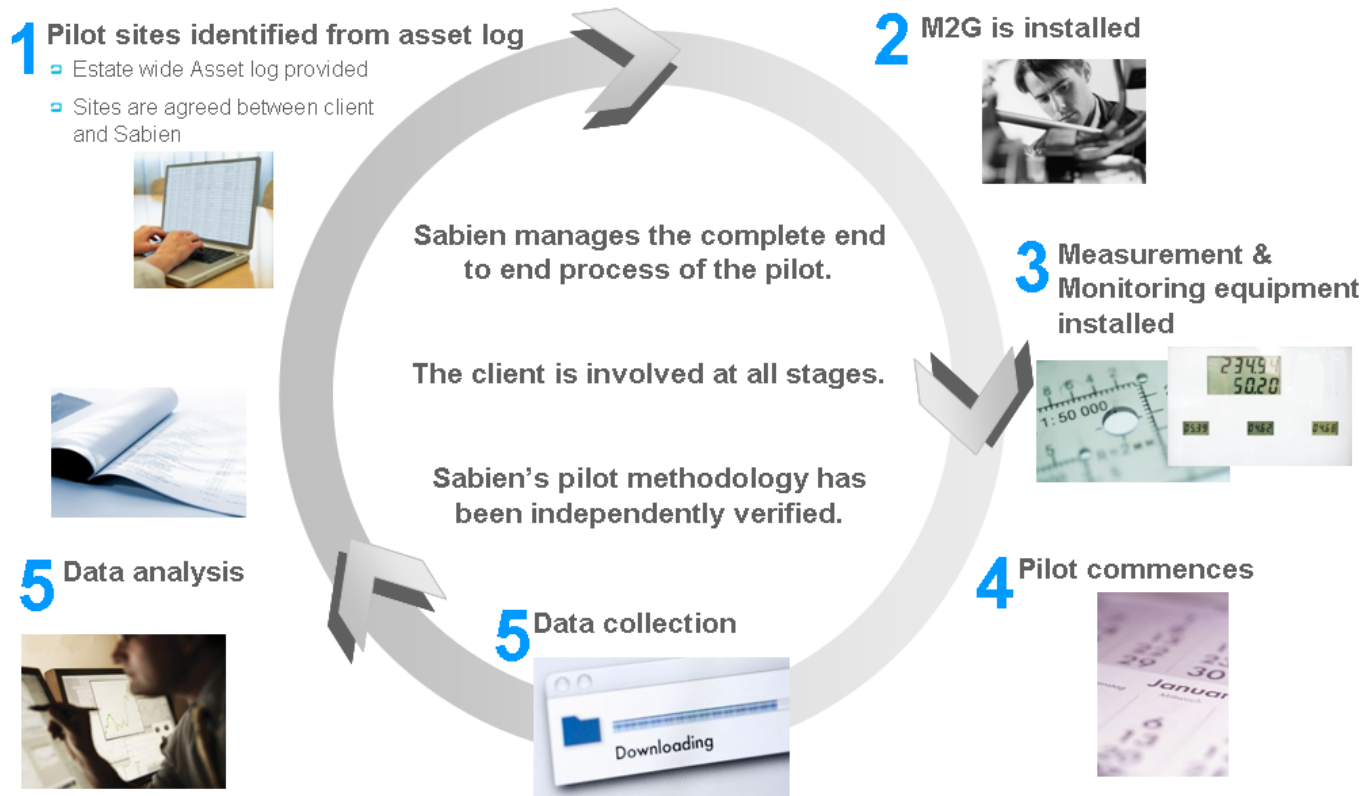
Payback:

2.7 years
32.4 months
140.4 weeks

Estimated CO2 savings tonnes			Cost savings £s		
Year	Yr by Yr	Cumulative	Yr by Yr	Cumulative	
1	25	25	£ 4,116	£ 4,116	
2	25	50	£ 4,116	£ 8,231	
3	25	75	£ 4,116	£ 12,347	
4	25	100	£ 4,116	£ 16,463	
5	25	125	£ 4,116	£ 20,579	



Piloting M2G. Customer journey





Notes

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