Hot Water Generation for Commercial and Industrial Applications

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Specification Sales Manager

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Baxi is part of the BDR Thermea Group, a global manufacturer and distributor of hot water & heating systems and services, with turnover in excess of €1.8bn.

BDR Thermea employs over 6,300 people in more than 70 countries worldwide.

The Group has a top market position in Western Europe and strong positions in rapidly growing markets.

other BDR Thermea brands
The UK’s No.1 Direct Fired Water Heater supplier
The UK’s No.1 Commercial Boiler supplier
The UK’s No.1 Mini-CHP supplier
Turnover circa £60m

A comprehensive portfolio of LZC technologies
The most comprehensive range of Hot Water, Heating and LZC solutions of any manufacturer within the UK
Agenda

1. Types of hot water generation
   - Indirect Calorifiers
   - Direct Cylinders
   - Plate heat exchangers
   - Electric point of use
   - Direct gas fired water heaters
     - Storage
     - Continuous flow
     - Low water content
2. LZC pre heat
3. System separation and decentralisation
   - Why direct gas fired hot water generation?
4. Emissions, efficiencies and running cost
5. Direct gas fired water heaters, principles of design
6. Andrews Condensing direct gas fired water heaters
Indirect Calorifiers
Types of Hot Water Generation

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Calorifiers

A Calorifier is an industry term for a storage vessel that has the capacity to generate heat within a mass of stored water

Capacities 400 litres plus

Pros
Existing boiler capacity
No flue required
Historical

Cons
Weight
Physical size
Recovery time
Stand by heat loss
Boilers need to operate at 80/60*

*For DHW generation
Direct Cylinders
Types of Hot Water Generation

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Cylinders

A **hot water cylinder** is a water tank that is used for storing hot water for space heating or domestic use.

**Capacities** 400 litres plus
**Immersion heater** 5 – 60 kW (single & 3-phase)

**Pros**
- Existing Boiler capacity
- No flue required
- Off mains gas
- Historical

**Cons**
- Weight
- Physical size
- Recovery time
- Stand by heat loss
Plate Heat Exchangers
Types of Hot Water Generation
Plate heat exchangers

A plate heat exchanger is a type of heat exchanger that uses metal plates to transfer heat between two fluids.

Capacities 30 kW plus

Pros
Existing Boiler capacity
Suited to refurbishment
No flue required
Compact

Cons
Higher boiler rating
Maintenance (plates)
Often used with cylinders (weight / recovery time)
Boilers need to operate at 80/60* 

* For DHW generation
Electric Point of Use

Types of Hot Water Generation
Electric point of use

Either **single point** (typically over a sink or basin) or **multipoint** (typically located beneath a sink or wall hung and serving a small number of outlets)

Capacities 10 - 100 litres
Heater elements 1 - 6 kW

**Pros**
Reduced pipework
Siting options
No flueing
Weight
No gas

**Cons**
Weight
Limited flow
Maintenance
Recovery rate
Water capacities
Direct gas fired water heaters

Either **storage**, **low water content** or **continuous flow** and with the burner assembly located within or adjacent to the water storage vessel

**Pros**
- Reduced storage
- Small footprint
- Fast recovery
- Low weight
- Flueing

**Cons**
- Flueing
- Gas pipework

Capacities 200 - 500 litres
Outputs 10 - 550kW
Direct gas fired water heaters

Storage Water Heater

Continuous Flow Water Heater

Low Water Content Water Heater
Water Quality and Treatment

Both Sediment and Limescale can impact upon the efficiency and lifecycle of **all** hot water generators.

We would advise always to use some form of water treatment when installing gas fired water heaters.

Seek advice from water treatment specialists.
Low Zero Carbon pre heat

Utilising low carbon / renewable technologies to pre heat the cold water supply to the buildings hot water system

Solar Thermal
Combined Heat and Power
Air source heat pump
Ground source heat pump
Low Zero Carbon pre heat

Pump on when delta T = or > 7°K
Pump off when delta T < or = 3°K

Single Coil Pre-Heat Solution with a Direct Gas Fired Water Heater
Low Zero Carbon pre heat

R-Gen 20/44 CHP c/w Buffer Vessel, Preheat Cylinders and MAXXflo Water Heaters
System separation and decentralisation

Heating Loads
Heating is a seasonal requirement, however when required there is a constant demand throughout the day

Typical Building Heating Profile
System separation and decentralisation

Hot water loads
Hot water is an annual requirement however required there are peaks and troughs in demand throughout the day
System separation and decentralisation

Therefore
It seems senseless to generate both of these differing loads from the same plant. Much better to have separate dedicated plant more closely matched to their specific requirements.
System separation and decentralisation

Specsavers, Southampton
### Efficiencies, emissions & running costs

#### Running cost comparison

<table>
<thead>
<tr>
<th>FUEL</th>
<th>PRICE/kW/h</th>
<th>METHOD OF HEATING</th>
<th>NOMINAL THERMAL EFFICIENCY</th>
<th>NOMINAL SYSTEM EFFICIENCY</th>
<th>UNITS REQUIRED</th>
<th>COST TO HEAT 500 LITRES @ 50°C TEMP RISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATURAL GAS</td>
<td>2.7 pence</td>
<td>Storage water heater</td>
<td>79%</td>
<td>62%</td>
<td>59.27</td>
<td>118.54 pence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non storage water heater</td>
<td>85%</td>
<td>65%</td>
<td>52.54</td>
<td>105.08 pence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condensing storage water heater</td>
<td>96%</td>
<td>62%</td>
<td>48.77</td>
<td>97.54 pence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Condensing non-storage water heater</td>
<td>98%</td>
<td>65%</td>
<td>45.57</td>
<td>91.14 pence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boiler/Heat exchanger</td>
<td>81%</td>
<td>56%</td>
<td>64.00</td>
<td>128.00 Pence</td>
</tr>
<tr>
<td>ELECTRICITY</td>
<td>9 pence</td>
<td>Storage/Immersion heater</td>
<td>90%</td>
<td>76%</td>
<td>42.44</td>
<td>424.42 pence</td>
</tr>
</tbody>
</table>

Based on the cost of heating 500 litres of water through a temperature rise of 50°C

Output (units) required: $4.18 \times 500 \times 50 / 3600 = 29.03\text{kW/h}$

- Natural Gas: Non-Domestic Consumer price of 2.7 pence per kWh
- Electricity: Non-Domestic Consumer price of 9 pence per kWh
- Source: Department of Energy and Climate Change Quarterly Energy Prices Qtr 4 2016 medium building
Efficiencies, emissions & running costs

Emissions

School hot water consumption profile (CIBSE Guide G)
## Efficiencies, emissions & running costs

### Emissions

<table>
<thead>
<tr>
<th></th>
<th>Direct gas fired water heaters</th>
<th>Gas fired boilers and calorifiers</th>
<th>Electric heaters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO₂ emissions / year</strong></td>
<td>4.89 tonnes</td>
<td>6.52 tonnes</td>
<td>7.31 tonnes</td>
</tr>
<tr>
<td><strong>CO₂ emissions / kW/h</strong></td>
<td>0.19 kg/kWh</td>
<td>0.19 kg/kWh</td>
<td>0.43 kg/kWh</td>
</tr>
<tr>
<td><strong>Consumption / year</strong></td>
<td>25,755 kWh</td>
<td>34,340 kWh</td>
<td>16,993 kWh</td>
</tr>
<tr>
<td><strong>System efficiency</strong></td>
<td>64%</td>
<td>60%</td>
<td>97%</td>
</tr>
<tr>
<td><strong>DHW temperature rise</strong></td>
<td>44 C</td>
<td>55 C</td>
<td>44 C</td>
</tr>
</tbody>
</table>

CO₂ emissions / kW/h = grid emission factor for natural gas and electricity

School hot water consumption profile (CIBSE Guide G)
Direct gas fired water heaters

Direct Gas Fired Water Heaters

Inputs 10 – 550 kW
Storage capacities 100 – 380 litres
Recovery rates* 0.3 – 2.6 litres/sec (130 – 9300 litres/hr)
Efficiencies* 74 – 99%

Stainless steel storage tank and heat exchanger options
High efficiency condensing and high efficiency options
Conventional and balanced flue options
Glass lined steel storage tank options
Copper heat exchanger options

* Recovery rate based on a 50° Celsius temperature rise
* Efficiency based on Gross CV
Direct gas fired water heaters

Direct Gas Fired Water Heaters

A traditional glass lined direct gas fired storage water heater
Condensing Direct Gas Fired Water Heaters

Principles of Design

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Condensing Water Heaters principles of design

Tank with internal flue tube/coil gives shorter condense time as whole tank gets warm when burner is firing

External heat exchanger gives maximum condense time due to cold return water enabling burners to remain on high fire longer thus giving quicker recovery
High efficiency condensing gas fired water heaters

Storage

MAXXflo

Stainless steel storage water heater

External heat exchange modules

Outputs 30 – 120 kW

Storage capacities 200 & 300 litres

Recovery rates 450 – 1920 litres/hr

30 kW heat exchanger module
High efficiency condensing gas fired water heaters

Storage

MAXXflo

Stainless steel storage water heater
External heat exchange modules

Outputs 31 – 122 kW
Storage capacities 200 & 300 litres
Recovery rates 450 – 1920 litres/hr
High efficiency condensing gas fired water heaters

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Stainless steel storage water heater
External heat exchange modules
Outputs 31 – 122 kW
Storage capacities 200 & 300 litres
Recovery rates 450 – 1920 litres/hr
High efficiency condensing gas fired water heaters

Storage

MAXXflo

**MASTER**
- adjustment tank setpoint
- monitors tank temperature
- sends to slaves:
  - call for heat
  - required flow temperature

**SLAVE**
- monitors:
  - flow temperature
  - return temperature
- controls:
  - output
  - pump speed
High efficiency condensing gas fired water heaters

Storage

ECOflo
Glass lined steel storage water heater
Downward firing burner
Outputs 35 – 111 kW
Storage capacities 230 & 380 litres
Recovery rates 600 - 1900 litres/hr
High efficiency condensing gas fired water heaters

Storage

ECOflo
Glass lined steel storage water heater
Downward firing burner
Outputs 35 - 111W
Storage capacities 230 & 380 litres
Recovery rates 600 - 1900 litres/hr

Unique triple pass heat exchange design maximises transfer of heat from combustion gas heat into the stored water
High efficiency condensing gas fired water heaters

Low water content

SUPAflo EVO

Stainless steel low water content water heater

Water cooled downward firing burner

Outputs 142 – 539 kW

Recovery rates 2430 – 9230 litres/hr

Buffer vessel options 300 – 747 litres
High efficiency condensing gas fired water heaters
Low water content

SUPAflo EVO
Stainless steel low water content water heater
Water cooled downward firing burner
Outputs 142 – 539 kW
Recovery rates 2430 – 9230 litres/hr
Buffer vessel options 300 – 747 litres
High efficiency condensing gas fired water heaters
Low water content

SUPAflo EVO
Stainless steel low water content water heater
Water cooled downward firing burner
Outputs 142 – 540 kW
Recovery rates 2434 – 9257 litres/hr
Buffer vessel options 300 – 500 litres

Unique patented combustion technology
NOx = > 38 mg/kWh (Class 6)
CO = > 14 mg/kWh
High efficiency condensing gas fired water heaters
Low water content
SUPAflo EVO c/w SFB Buffer Vessel
High efficiency condensing gas fired water heaters

FASTflo Plus

Finned copper tube continuous flow water heater
Stainless steel secondary heat exchanger
Wall hung

Outputs 42 & 56 kW
Recovery rates* 12 - 16 litres/min

* Recovery rate based on a 50° Celsius temperature rise
High efficiency condensing gas fired water heaters
Continuous flow

FASTflo Plus

Fig No.5
Andrews WH and WHX Multiple Water Heater Installation with Secondary Return

Gas rate for NG units
- WH42: 5.1 m³/hr
- WH56, WHX56: 6.5 m³/hr

Gas rate for Propane units
- LWH42: 1.9 m³/hr
- LWH56, LWX56: 2.5 m³/hr

Dynamic Pressure
- NG: 20 mbar
- Propane: 37 mbar

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High efficiency condensing gas fired water heaters
Continuous flow

FASTflo Plus

**Fig No.10**
Andrews WH and WHX Single Water Heater Installation with ST Range Storage Cylinder

- Stop cock
- Strainer
- Pressure reducing valve
- Non return valve
- Expansion vessel
- Expansion vessel + tambour
- Andrews bronze pump c/w ball valve unions (part no. B340)
- Combined temperature and pressure relief valve + tambour

Remote controller set to 70°C

Pump (see Fig. No. 12/13)

Gas Supply

Storage cylinder

Cold Supply

NB: Size mains pressure group to suit building design flow rate

Tank thermostat kit (part no. C927) set to 65°C

Gas rate for NG units
- WH42: 5.1 m³/hr
- WH56, WHX56: 6.5 m³/hr

Gas rate for Propane units
- LWH42: 1.9 m³/hr
- LWH56, LWX56: 2.5 m³/hr

Dynamic Pressure
- NG 20 mbar
- Propane 37 mbar

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Additional Support

• Now that the method of how to heat water has been determined, the next step is to calculate how much hot water is required

• **Size-it** (electronic web based water heater sizing program)
• 40 years experience – we know how buildings use hot water
• SBEM Benefits
• BIM Files, CAD Files