GMIT
GALWAY-MAYO INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA NA GAILLIMHE-MAIGH EO

Content for Energy App GMIT

For the competition for the android computer

Introduction

This document provides information about the design of an Energy App for the competition for the android computer in GMIT.

Please read carefully the document to understand the structure of the app, the content and the instructions. Notes (in red) are inserted where necessary. These are only notes/instructions for the app developer, they will not appear as text in the app.

You are suggested to follow the following steps in the development of the application:

1. Set up the structure according to the present document (slightly changed in comparison to the original version you received earlier)
2. Populate with content the first three pages: **Home**, **About Energy Lab** and **Solar Panels** – deadline: 31 July 2011
3. Review the above-mentioned pages with Aurora and John
4. Continue with the rest of the pages
5. Complete the application – deadline: 30 Sep 2011

For any inquiries during the development phase please email Aurora Dimache: aurora.dimache@gmit.ie and John Healy: john.healy@gmit.ie

Structure

Note: There are small changes in the structure:

1. **Home** is 'Level 0'. It is just an introduction to the app.
2. **About Energy lab** is Level 1. This is where all the icons for various technologies that are described at Level 2 are.
3. Level 3 Heat pump **Energy calculator** is renamed: **Efficiency and cost of ownership.**
4. Level 2 **Heat transfer** is renamed: **Heat Transfer through underfloor and/or radiator systems.**

Please see below the revised structure.

Level 0	Level 1	Level 2	Level 3
Home Text , image and link to Energy degree courses on GMIT web site	**About Energy lab** Text, video of energy lab and icons for all the technologies described at Level 2		
		Solar Panels Description with image(s)/link to Youtube video	**System Overview** Display image containing points that show text when clicked
		Heat Pump Description with image(s)/link to Youtube video	**System Overview and operation** Image showing moving arrows showing flow ofair/water. Image contains points that show text when clicked.
			Efficiency and cost of ownership Allows price comparison with traditional systems. Equations for calculations will be provided
		Biomass Boiler Description with image(s)/link to Youtube video. Buttons to allow navigation to Level 3	**Wood Gasification** Display image containing points that show text when clicked
			Wood Pellet Display image containing points that show text when clicked
		Gas Boiler Description with	**System Overview** Display image containing points that

		image(s)/link to Youtube video	show text when clicked
		Heat Transfer through underfloor and/or radiator systems Description with image(s)/link to Youtube video. Buttons to allow navigation to Level 3	**Radiator System** Display image containing points that show text when clicked
			Under Floor Heating Systems Display image containing points that show text when clicked
		Home Button to return to home screen	
		Quit Button to exit application gracefully	

Level 0. Home

This app provides an introduction to the renewable energy technologies available in the Energy Lab in the Mechanical Engineering Department in GMIT. You can visit the lab and interact with state-of-the-art energy technology and/or you can find out more about the Department and what we can offer to our students.

Mechanical Engineering Department GMIT

Note: When click this button, the following link will open:
http://www.gmit.ie/engineering/mechanical-industrial/index.html

Go to Energy Lab

Note: When click this button, Level 1 **About the GMIT Energy lab** screen will open.

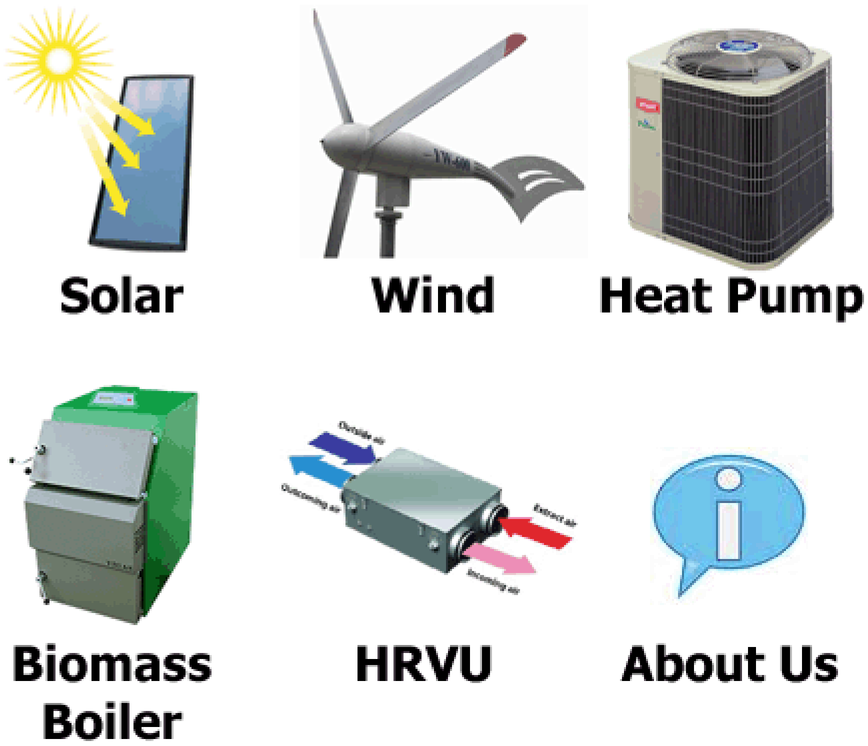
Level 1. About the GMIT Energy lab

Note: This is a new name for the tab 'About us'. This screen appears when click on **Go to Energy lab** button at Level 0.

The Energy Lab in GMIT is equipped with state-of-the-art sustainable energy technologies: solar, biomass, heat pumps, and wind. Sensors monitor and track the performance of all these systems. Students can view the technologies and analyse their performance on the Energy lab website.

See video of Energy lab

Note: When click this button, a video that presents the energy lab will appear on the screen. Video will be provided later.



Note: All icons of all Level 2 technologies will appear on this screen as above (check the **Structure** chapter for all Level 2 technologies).

Level 2. Solar panels

Note: This screen appears when click on the **Solar panels** button at Level 1.

Solar panels transfer the sun's energy, which is in the form of electromagnetic radiation, into thermal energy to heat water for domestic and industrial purposes.

See video of solar panels

Note: When click this button, the following link will open (YouTube video):
http://www.youtube.com/watch?v=sqTGm60wP4g

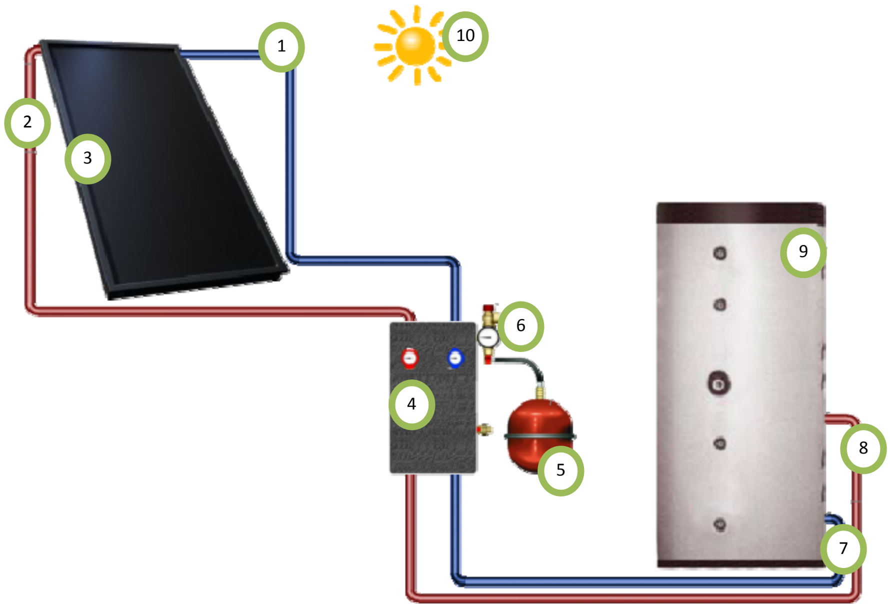
System overview

Note: When click this button, Level 3 **Solar panels. System overview** screen will open.

Level 3. Solar panels. System overview

Note: This screen appears when click on the **System overview** button at Level 2 **Solar panels**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



1	Inlet temperature	The inlet temperature sensor measures the temperature of the incoming (cold) water to the collector. It is only needed during testing and is not a standard part of a domestic solar thermal system.
2	Outlet temperature	The outlet temperature sensor measures the temperature of the outgoing (heated) water from the collector. When the outgoing water temperature reaches a set temperature compared with that pre-set at the top of the storage tank, the circulation pump is activated. When the temperature difference goes below a pre-set value, the pump de-activates.
3	Solar thermal flat plate	The best place to put a solar thermal collector is on a south-facing roof. This is where it will get most sun. The solar panels act like a window. They let in the sun's energy and it is taken up by the solar thermal system. The typical domestic home uses either flat plate or evacuated tube collectors. The diagram presents the flat plate collector in GMIT Energy lab.
4	System controller + pump	The system controller turns on/off the circulating pump, based on the reading from the solar collector outlet temperature.
5	Expansion vessel	The expansion tank allows the water in the system to expand due to water temperature rise.

6	Pressure gauge	The pressure gauge shows the pressure of the fluid in the pipes of the solar collector system.
7	Solar return temperature	This is the temperature of the water coming from the coil in the multi-energy tank. The hot water in the pipe coming from the solar panels is transferred from the inlet pipe to heat the water in the tank.
8	Solar flow temperature	This is the temperature of the water coming from the solar panel minus the temperature losses occurring in the pipework between the solar panel and the tank. To reduce these losses, use 'class 0' high temperature insulation.
9	Hot water storage tank	The basic solar thermal system has a dual coil cylinder as the storage tank. A dual coil cylinder basically has two coils: a coil for the solar thermal system and a coil for the auxiliary heating system. The circulating pump for the solar system sends the hot water from the solar panels through the lower coil. The heat from the solar collector is transferred into the tank, ready for use. On a dull day, when there is not much sun, the second coil is used to heat the tank, via an auxiliary heating system, typically an oil, gas or biomass fuelled boiler.
10	Solar radiation	The sun provides energy in the form of electromagnetic radiation. The average direct solar radiation in Ireland is 2.6kWh/m^2/day, which is quite good considering the large number of cloudy, overcast days. Solar panels can provide on average 60% of domestic hot water in winter and usually 100% in summer.

Level 2. Heat Pump

Note: This screen appears when click on the **Heat pump** button at Level 1.

An air source heat pump extracts heat from the surrounding air. A fan draws the air over a heat exchanger coil known as an Evaporator. The coil is filled with a cold refrigerant liquid. As the air flows over this coil, the cool liquid inside the coil draws heat from the air, and begins to heat up. This heat is later passed into a hot water storage tank located within the building, via a second heat exchanger known as a Condenser.

See video of heat pumps

Note: When click this button, the following link will open (YouTube video): http://www.youtube.com/watch?v=g9U1xtW-TEo&playnext=1&list=PL4F286D120FAD18B1

System overview and operation

Note: When click this button, Level 3 **Heat pump. System overview and operation** screen will open.

Efficiency and cost of ownership

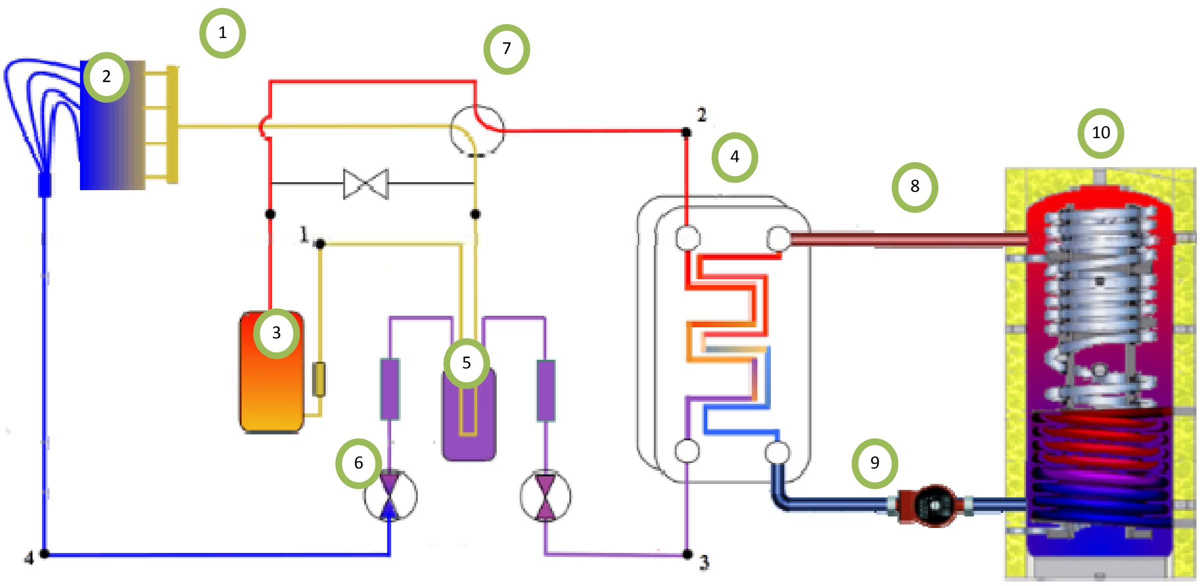
Note: When click this button, Level 3 **Heat pump. Efficiency and cost of ownership** screen will open.

Level 3. Heat Pump. System overview and operation

Note: This screen appears when click on the **System overview and operation** button at Level 2 **Heat pump**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.

Note: Arrows are not represented in this picture. They should be in the app.



1	Ambient air	The air outside the building. The heat pump in the GMIT Energy Lab draws heat energy from a large volume of air outside and transforms it into a lower volume of hot water inside.
2	Evaporator	The evaporator uses a fan to draw air from the surroundings over tubes containing refrigerant. Since the air is warmer than the refrigerant in the tubes, heat is transferred from the 'warm' air (even at or below 0°C) to the colder refrigerant. This causes the cold refrigerant liquid to evaporate, and turn into a gas.
3	Compressor	The compressor, driven by an electric motor, acts like a pump, pushing the refrigerant about the circuit. It also increases both the temperature and pressure of the refrigerant vapour.
4	Condenser	The hot vapour from the compressor now enters the condenser and, as it condenses from a vapour to a liquid, gives off heat to the water from the water storage tank. The heated water flows back into the multi-energy tank where it is stored for domestic use.
5	Receiver vessel	Receiver tank for temporary storage of the refrigerant.
6	Throttle valve (expansion valve)	The refrigerant moves on from the condenser to a receiver tank for temporary storage, before demand draws it through the expansion valve, where its temperature and pressure both decrease. It then returns to the

		evaporator and the cycle is repeated.
7	Heat/cool mode switch	Switch for heat/cool mode. The heat pump can work also in air conditioning mode (providing cool air). This switch makes the system work in reverse mode (transfers heat from water to air).
8	Hot water flow	The hot water supply to the multi-energy tank.
9	Cold return flow	Cold water return from the multi-energy tank.
10	Multi-energy tank	Thermal store (water storage tank).

Level 3. Heat Pump. Efficiency and cost of ownership

Note: This screen appears when click on the **System overview and operation** button at Level 2 **Heat pump**.

Note: This is a calculator. The user will input some parameters and he will see the result. The calculation will be delivered in an Excel format later.

Level 2. Biomass Boiler

Note: This screen appears when click on the **Biomass boiler** button at Level 1.

Biomass is a term used to identify fuels used in the renewable energy sector. These fuels include agricultural residues, energy crops and wood based crops.

A wood pellet boiler (see left image from the GMIT Energy Lab) is fired on biological material (wood pellets) and is used to heat water. A gasification boiler (see right image from the GMIT Energy Lab) uses a syngas which is generated through the chemical reaction of burning wood and is also used to heat water.

See video of biomass boiler

Note: When click this button, the following link will open (YouTube video):
http://www.youtube.com/watch?v=B-pmbUSZsK4&feature=related

Wood gasification

Note: When click this button, Level 3 **Biomass boiler. Wood gasification** screen will open.

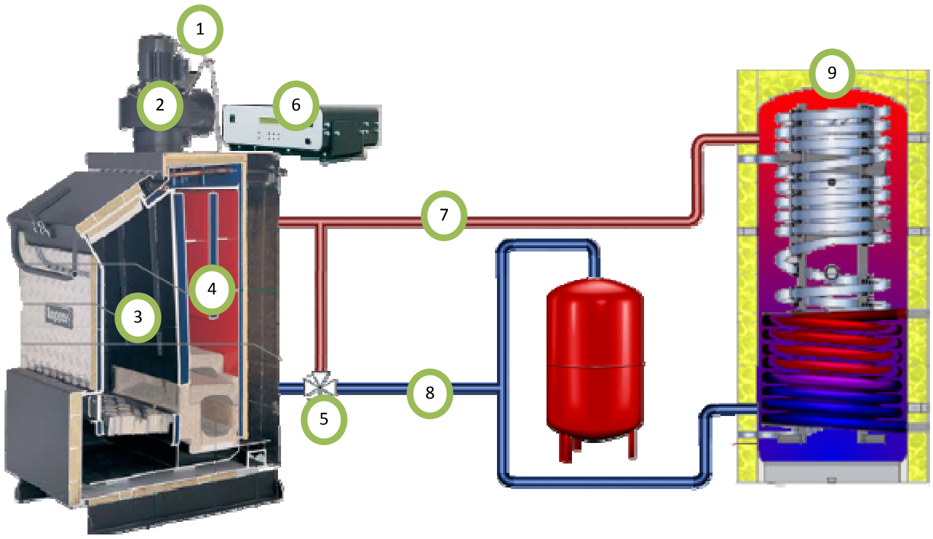
Wood pellet

Note: When click this button, Level 3 **Biomass boiler. Wood pellet** screen will open.

Level 3. Biomass Boiler. Wood Gasification

Note: This screen appears when click on the **Wood gasification** button at Level 2 **Biomass boiler**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



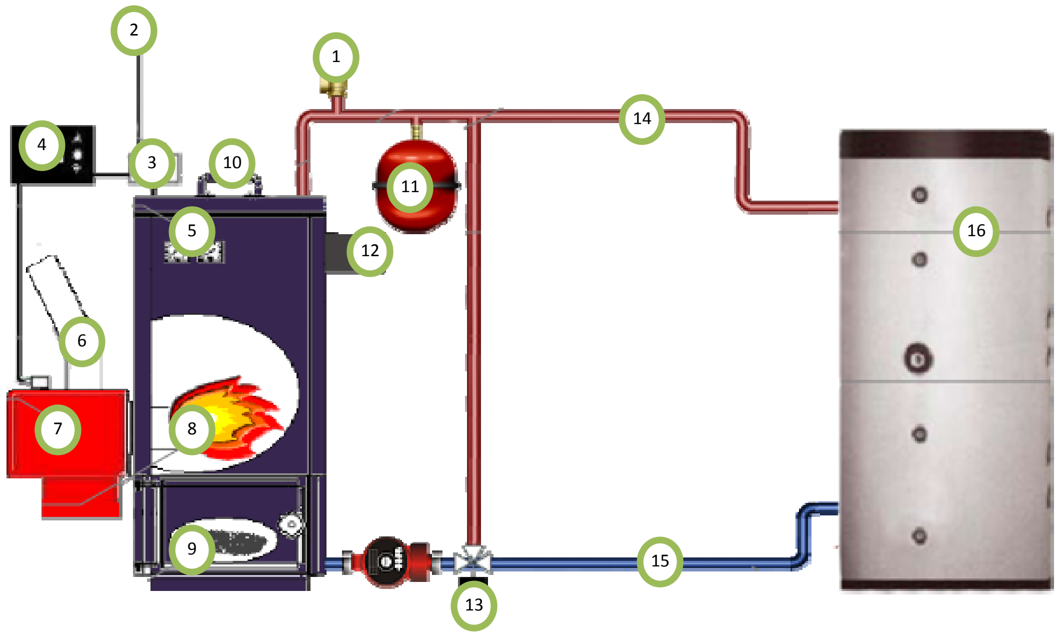
1	Lambda sensor	The oxygen sensor measures the difference between exhaust gas mixture and the external air. The lambda sensor is extremely important, as it is used to control the air inlet valve, thereby achieving an optimum environment for combustion.
2	Induced draft fan	The induced draft ventilator is fitted to the flue gas connection and operates via an electric motor. The boiler needs the fan to draw the gases generated in the first combustion chamber into the secondary combustion chamber, where they are burned at a very high temperature. 
3	Primary combustion chamber	This is the main chamber in the boiler where the boiler is filled with logs, the logs are ignited, and initial combustion of the wood takes place. Depending on the type of wood used, the boiler can hold between 36-55kg of wood.
4	Flue gas turbulators	Small baffles are inserted into the boiler heat exchanger to agitate the air providing better heat transfer to the boiler hence increasing the efficiency of the boiler.
5	Mixing valve	A mixing valve is connected to the flow and return pipe work. This ensures

	(by-pass)	that water temperature in the pipe going back to the boiler is high enough to prevent condensation of flue gases in the boiler. This keeps the boiler running more efficiently. A three-way valve permits flow and return water to be mixed in the proportions necessary to keep the water going back to the boiler at the desired temperature.
6	Control panel	The boiler's control panel is fixed to the top surface of the boiler. It allows the user to set key performance values for the efficient operation of the boiler.
7	Flow	The hot water supply to the multi-energy tank.
8	Return	Cold water return from the multi-energy tank.
9	Multi-energy tank	Thermal store (water storage tank).

Level 3. Biomass Boiler. Wood Pellet

Note: This screen appears when click on the **Wood pellet** button at Level 2 **Biomass boiler**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



1	Safety valve	Exhausts to atmosphere in the event of an over pressure. 
2	Power supply	Electricity from the grid.
3	Safety cut-off	In the event of the boiler over heating, the safety cut off will turn off the boiler fan and auger.
4	Control box	Control panel.
5	Pressure/ temperature display	Displays pressure and temperature.
6	Pellet feed tube	Receives pellets from the auger/hopper. The boiler requires wood pellets with a diameter of between 6-8mm. The use of any other pellets in the boiler may cause loss in combustion efficiency.

		
7	Burner unit	Contains the ignition elements, photo cell, internal auger, and fan. The burner unit receives pellets from the external auger. The burner is fed pellets by connecting the thermoplastic hose to the top of the combustion unit and the other side to the external auger.
8	Combustion flame	Ignites the pellets.
9	Ash chamber	Ashes fall into an ash pan located in this chamber. This ash can be used for composting purposes.
10	Boiler access hatch	Permits access to the boiler.
11	Expansion vessel	Allows water to expand when heated.
12	Flue	The purpose of the flue is to generate a draught that will transport smoke and fumes away from the point of combustion. The draught in the flue is determined by outside temperature, boiler capacity, exhaust gas temperature, chimney height and outside wind conditions. As conditions change, the draught can easily vary from 0 to 100Pa. Wood pellet boilers are most efficient when the negative pressure in the flue ranges from 0 to 20Pa. A motorised flue fan has been installed in the Energy Lab to assist in maintaining this pressure differential.
13	Mixing valve	The 3-way thermostatic mixing valve ensures the return temperature to the boiler is hot enough to prevent condensation of the flue gases in the boiler chamber.
14	Flow	The hot water supply to the multi-energy tank.
15	Return	Cold water return from the multi-energy tank.
16	Multi-energy tank	Thermal store (water storage tank).

Level 2. Condensing Gas Boiler

Note: This screen appears when click on the **Gas boiler** button at Level 1.

Condensing gas boilers use less fuel and have lower running costs than other boilers. Higher efficiency levels are made possible by extracting heat contained in the combustion gases, which would otherwise have been lost to the atmosphere.

See video of gas boiler

Note: When click this button, the following link will open (YouTube video):

http://www.youtube.com/watch?v=MFzYIpXEjDU

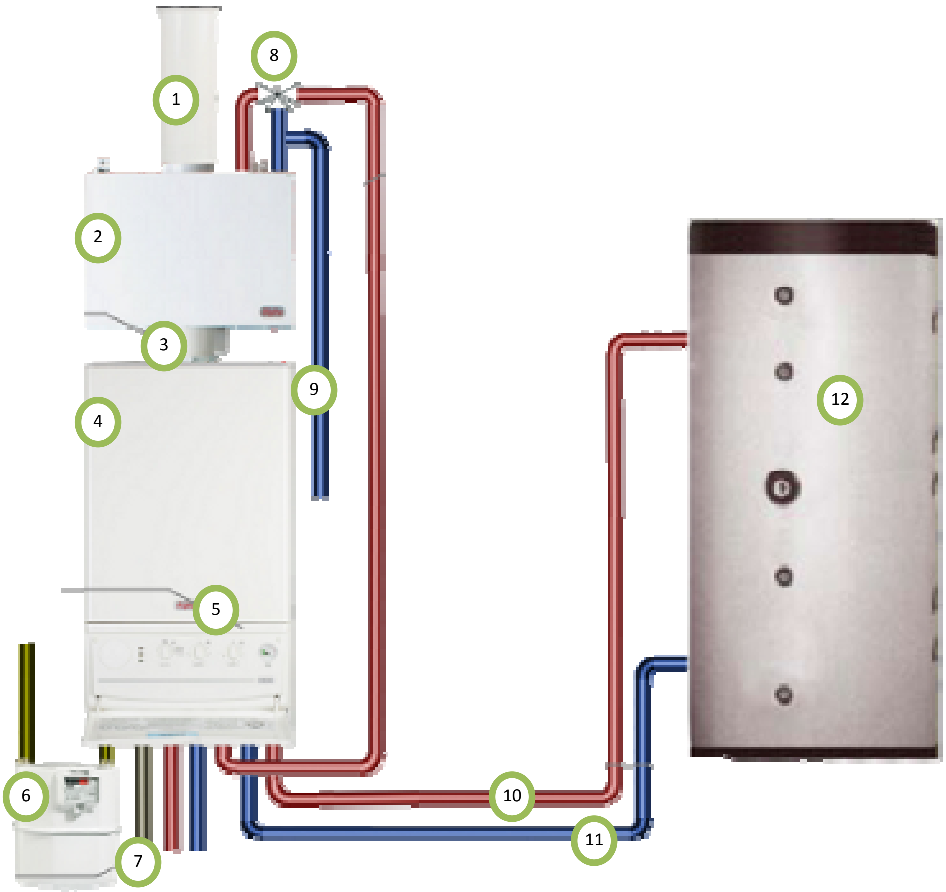
System overview

Note: When click this button, Level 3 **Condensing gas boiler. System overview** screen will open.

Level 3. Condensing Gas Boiler. System overview

Note: This screen appears when click on the **System overview** button at Level 2 **Condensing gas boiler**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



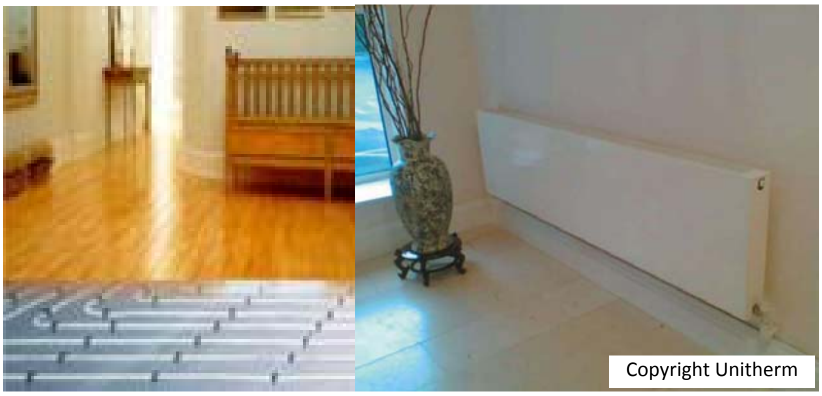
1	Flue	The boiler is a room sealed boiler. A fan draws out the combustion fumes, and discharges them directly outside through the central core of a circular, concentric flue, around which air is drawn in and passed to the combustion chamber of the boiler.
2	Gas saver	This is a passive flue gas heat recovery device. The gas saver is easily installed between the boiler and flue. It stores the condensate (5.5L) normally expelled into the atmosphere through the boiler flue. The heat from this condensate is used to pre-heat water coming into the boiler base from the cold mains supply. This significantly increases efficiency of the condensing boiler to greater than 91%.
3	Boiler flue outlet	Gas boiler air inlet and exhaust gas outlet.
4	Condensing gas	The gas boiler installed in the Energy Lab is an Alpha CD25C high efficiency,

	boiler	condensing, combination boiler designed to use propane gas only. The boiler has an efficiency of 91.9%. As it is a ‘combi’ boiler, it is therefore capable of providing both central heating and domestic hot water at mains pressure.
5	Boiler controls	This controls the operational efficiency of the boiler by allowing the user to adjust key performance parameters.
6	Gas meter	In order to determine the efficiency of the boiler, the rate of propane being consumed is monitored using a gas meter.
7	Condensation drain	The condensate produced by the boiler is usually acidic, and has to be piped to a drain. The heat exchanger of the boiler must be of very high quality to prevent corrosion by the acid.
8	Blending valve	A 3-way valve mixes some cold water with hot water on the return, thus preventing thermal shock and condensation on the outside of the boiler plate.
9	Mains water supply	Supplies cold water for domestic hot water heating at mains pressure.
10	Flow	The hot water supply to the multi-energy tank.
11	Return	Cold water return from the multi-energy tank.
12	Multi-energy tank	Thermal store (water storage tank).

Level 2. Heat Transfer through underfloor and/or radiator systems

Note: This screen appears when click on the **Heat transfer** button at Level 1.

The radiator system and the underfloor heating systems represent an excellent example of heat transfer. Heat transfer can occur through conduction, convection and radiation. All three systems are represented in the GMIT Energy lab. Heat transfer only occurs when there is a temperature gradient, i.e. heat energy flows from a high temperature region to a low temperature region.



See video of heat transfer through underfloor heating

Note: When click this button, the following link will open (YouTube video):
http://www.youtube.com/watch?v=2AzgljdNNN4&feature=related

Radiator system

Note: When click this button, Level 3 **Heat transfer. Radiator system** screen will open.

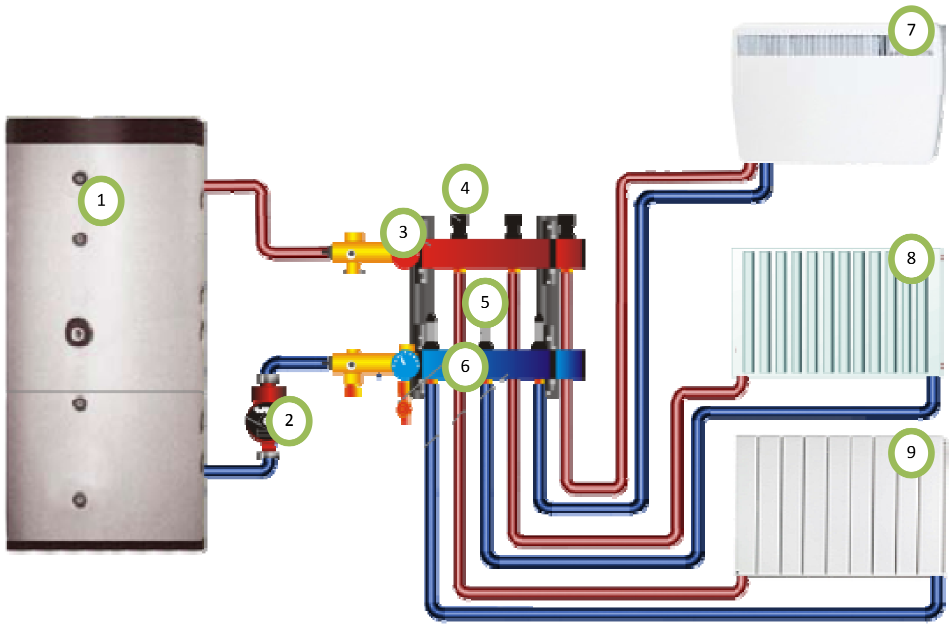
Underfloor heating system

Note: When click this button, Level 3 **Heat transfer. Underfloor heating system** screen will open.

Level 3. Heat Transfer. Radiator System

Note: This screen appears when click on the **Radiator system** button at Level 2 **Heat transfer through undefloor and/or radiator system**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



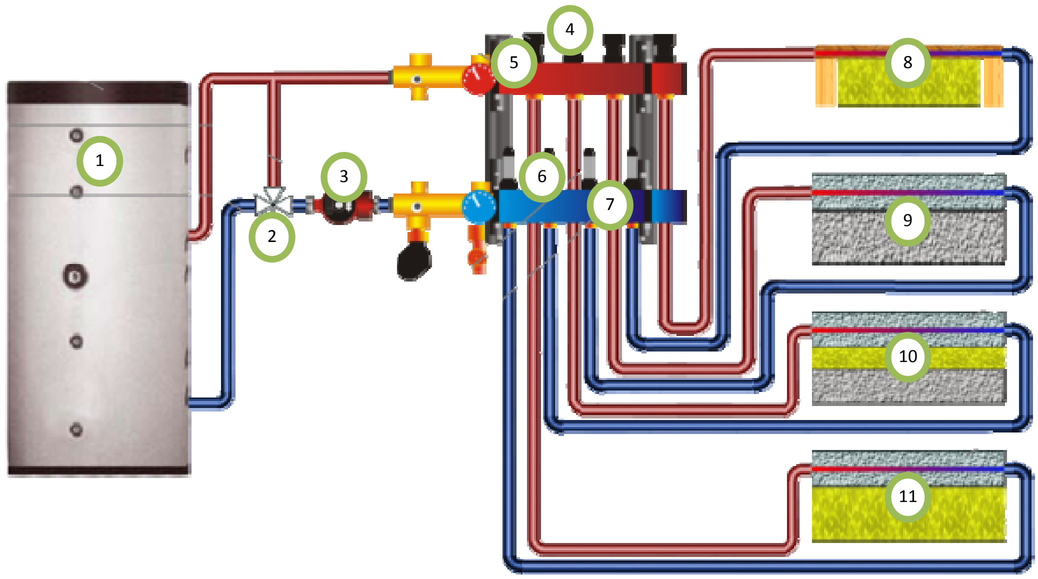
1	Multi-energy tank	The basic solar thermal system incorporates a dual coil cylinder as the storage tank. A dual coil cylinder basically has two coils: a coil for the solar thermal system and a coil for the auxiliary heating system. The circulating pump circulates the heat transfer fluid through the lower coil. In turn, the heat from the solar collector is transferred into the tank, ready for use. On a day of low incoming solar radiation, the second coil is used to heat the tank, via an auxiliary heating system, typically an oil, gas or biomass fuelled boiler.
2	Circulation pump	The circulation pump circulates water through the manifolds to the individual radiators. The pump has three speed settings.
3	Radiator supply manifold	Makes it possible to control the hot water flow to individual radiators and to set the temperature in any room so as to automatically control each circuit using a thermostat.
4	Manifold flow valves	Electrically operated flow valves to allow the user to activate each radiator using the control system. These solenoid-operated valves are used to control zones in a domestic installation where a temperature controller (room stat) activates the solenoid.
5	Flow indicators	Flow control valves and visual flow meters on the return manifold to balance the flow to each circuit.

6	Radiator return manifold	Makes it possible to control the cold water flow from individual radiators.
7	Fan assisted radiator	The Energy Lab has three different types of radiator attached to the heat pump, to compare performance. This one is an electronic fan assisted radiator.
8	Steel radiator	Steel natural convection radiator. The Energy Lab has three different types of radiator attached to the heat pump, to compare performance.
9	Aluminium radiator	The Energy Lab has three different types of radiator attached to the heat pump, to compare performance. This one is an aluminium natural convection radiator.

Level 3. Heat Transfer. Underflloor Heating Systems

Note: This screen appears when click on the **Underfloor heating system** button at Level 2 **Heat transfer through undefloor and/or radiator system**.

Note: The components are numbered (see figure below) just to be easy to be followed by the app developer. On the app screen there should be pins (or similar). When a pin is clicked, the name of the component and the corresponding text (as in the table below) should appear at the bottom of the page.



1	Multi-energy tank	The basic solar thermal system incorporates a dual-coil cylinder as the storage tank. A dual coil cylinder basically has two coils: a coil for the solar thermal system and a coil for the auxiliary heating system. The circulating pump circulates the heat transfer fluid through the lower coil. In turn, the heat from the solar collector is transferred into the tank, ready for use. On a day of low incoming solar radiation, the second coil is used to heat the tank, via an auxiliary heating system, typically an oil, gas or biomass fuelled boiler.
2	Mixing valve	Temperature-controlled 3-port mixing valve. The temperature needed for underfloor heating in standard domestic installations is 35-40^{0}C. Water returns to the bottom of the multi-energy tank only when the temperature drops below this value (pre-set). Alternately, the water circulates to the supply manifold.
3	Circulation pump	The circulation pump circulates water through the manifolds to the individual underfloor heating system. The pump has three speed settings.
4	Manifold flow valves	Electrically (solenoid) operated flow valves to allow the user to activate each underfloor loop using the control system. These solenoid-operated valves would be used to control zones in a domestic installation where a temperature controller (room stat) would activate the solenoid.
5	Underfloor supply manifold	Supply manifold for four-zone underfloor heating system.

6	Flow indicators	Flow control valves and visual flow meters on the return manifold to balance the flow to each circuit (underfloor loop).
7	Underfloor return manifold	Return manifold for four-zone underfloor heating system.
8	Timber floor	The Energy Lab has four different floor types, to compare performance of the underfloor heating system. This one is timber floor construction with underfloor heating panel.
9	Concrete no insulation	Concrete floor with no insulation. This is one of four different floor types in the Energy Lab, so we can compare how the underfloor heating works with different floors.
10	Concrete 80mm insulation	Concrete floor with 80mm polyurethane foam with double foil layered insulation laid under the underfloor heating pipe. One of four different floor types in the Energy Lab to allow comparison of underfloor heating system performance for different floor types.
11	Concrete 250mm insulation	Concrete floor with 250mm polyurethane foam with double foil layered insulation laid under the underfloor heating pipe. One of four different floor types in the Energy Lab to allow comparison of underfloor heating system performance for different floor types.