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Innovative green technologies enhancing the comfort of HVAC world- A review

Jayaprakash Vytla
jayaprakash1991994@gmail.com
School of Engineering and Technology, Jain University, Bangalore, Karnataka

Dr. Alok Kumar Rohit
alokrohit2007@gmail.com
School of Engineering and Technology, Jain University, Bangalore, Karnataka

C. Sasikumar
sasikumar1234@gmail.com
School of Engineering and Technology, Jain University, Bangalore, Karnataka

ABSTRACT

New properties and new technologies in HVAC systems are invented nowadays which were rudimentary in today's world. Most of the people are looking for smarter and more comfortable with less cost in energy in air conditioning. They deliver energy efficient improvement to enhance the quality of their buildings. The new innovative technologies transmogrify the day to day life with many more comfortable designs efficient to their life. This paper explains, what the new green technologies are which changes the HVAC systems. As per the world is running with green technologies it is reliance on renewable energy which has no effect on the environmental. There are several leverages of using the green energy, which includes the capability to produce energy as nature's footprint on the earth.

Keywords— *New green technologies, HVAC, Solar power, Heat pump*

1. INTRODUCTION

With the new green technologies, the economic growth has a huge trend with many changes in HVAC. New technologies worldwide have started the research to create enormous energy–efficient designs. Design of heating ventilation and air conditioning system (HVAC) is based on the Japanese Industrial Standard (JIS) for hanging the support systems conforming to (SMACNA) standards for high comfort. Many experts in green technologies have revolutionized the entries in the HVAC industries in the past few years. Technicians have designed for green HVAC technologies to promote sustainability and cleanliness of environment which augment comfort and diminish the monthly energy cost. Designers of green technology systems play a flagship role in HVAC systems. The design of HVAC systems should not alter the environmental systems, also they have many conditions to follow while designing the system. Many of the HVAC designers have discerned the new ways to get the green HVAC with full satisfaction by their performance of systems with ephemeral. The companies succor to select the green systems and people also have some avaricious to live in a society with a congenial life and they have swanky look to their life. Each technology has idiosyncrasy with their designs and they tremor the current world. As we look at past we have many problems with HVAC systems and uses of HVAC is flagging with huge damage to the environment, but at present, we can see the contradistinction in HVAC systems with diminishing the ambient and nature and is easily accessible to everyone with less cost. Nowadays HVAC is omnipresent in malls, industries, and etc. While designing the green HVAC the designers faced the hindrances in their technologies, they have shown their work to laborites and got better repercussion with more meticulous and ultimately they give more efficient and less cost green technologies used in HVAC systems.

2. THE ROLE OF HVAC SYSTEMS

Heat ventilation and air conditioning system is responsible to keep the room in hot condition (winter season) and in cold condition (summer season) respectively. These systems have a huge network in the HVAC systems like air filters, dampers, compressors, and other equipment to make sure that air in the conditioning room is clean and comfortable. But to run all the equipment, a lot of power is used by the system. The components in the systems will be wear and tear like car parts such as air filters it may be replaced or repair. Fortunately, there are people who devote the necessary time and resources to monitor the performances of the HVAC systems that can minimize their repair and maintenance. By using HVAC technicians those who understand the in and out of the system has the most flagship. The air quality improved by the HVAC unit is maintained properly and as we know to maintain the system in good condition, it is important to control the temperature and humidity in the air for comfort in the conditioning room. To run the HVAC system in proper condition several regular maintenance and care must be taken and repairs of HVAC in regular interval of time should be done in order to run the system smoothly, which can keep your energy bills low. The technicians of HVAC systems have also found out the ways to keep the energy efficiency and cost–effectiveness of the system. Using of HVAC systems shows a great impact on the environmental damage by using the non-renewable energy resources like fuels for the use in generation of electricity. Which can contribute to pollution, this system makes a huge noise, contaminate the water and air by chemicals, oils, and heat transfer etc. which shows a great

effect on the green buildings, HVAC engineer plays a key role in the design of the system. They should have made a certain plan to keep in the process which should not have any effect to the environment with fewer tools in the systems and less cost to the life cycle of the HVAC systems. Instead of using the fuels and oils lubricants in the HVAC, motivate the public to choose the green technologies used in HVAC. According to the Energy Department in the U.S as per the data, in the abode, about 46% of energy is being used and in an apartment, about 40% to 60% of energy is used. If it is not running effectively, these systems immediately drain wallets and devour environmental resources, which makes the atmosphere squalid.

The HVAC factories have come a long way since the days of sending the fuel into the furnaces to keep the abode scalding. Recent step forward in renewable power and tidy technologies are making these systems good in comfortable conditions and easier than ever before and use of power will also be diminished.

3. WHAT IS GREEN HVAC

Green building points out those green HVAC systems which consist of smaller less costly and less complicated heating and cooling equipment. It also notes that the systems are using energy–efficient designs that can reduce the size of the heating and cooling of the systems by 30% to 50%.

According to many experts, green technologies has revolutionized its entry to the HVAC industries in the past few years. Technicians of green HVAC technologies have to promote sustain and cleanliness of the environment while augments the comfort and diminishes the monthly energy cost. Mostly new innovated technologies have transmogrified the heating ventilation and air conditioning. As to improve the efficiency of the system to make them more economical, green HVAC requires technicians to rethink and modify the design of the system to check performance and installation of the system maintenances in past and present and implement the solutions that consume less energy to be used by systems and energy need for future.

As we know there are three main reasons why the green technology is zenith in the world:

- The complexity of higher efficiency.
- Evolving Environmental Protection Agency (EPA) regulations.
- Increasing in green buildings codes.

In the future green HVAC, technology promises to bring eco-friendly systems as manufactures as an attempt to develop the systems which meet the new (EPS).

4. DISCOVERY OF NEW GREEN TECHNOLOGIES USING IN HVAC SYSTEMS

- Dual fuel heat pump
- Ice energy (or) ice –powered an air conditioner
- Smart thermostats
- Solar power
- Geothermal heat pump
- Quiet- duct wrap
- On command hot water re-circulator
- Thermally driven air condition
- Radiant floor heating
- Energy analysis software
- Chromasun micro-concentrator

These are the new technologies which trend in the present world. By using these technologies green HVAC systems help for malls, industries, etc to protect the natural resources by using the most efficient and environmentally friendly technology.

5. METHODOLOGY

New technologies in the above list transmogrify the current HVAC systems.

5.1 Dual fuel heat pump

It is one of the special application is used in the HVAC systems to control the temperature where the outside temperature can go way below the freezing point. Dual fuel heat pump consists of a normal heat pump where cooling can be done during the summer in the abode and heating in the winter. The dual fuel heat pump system is designed by the manufacturer of HVAC, where the oil or gas furnace is incorporated into the heat pump system as shown in figure 1. When the outside temperature drops below 32°C the heat pump becomes ineffective, the system may do it automatically using certain criteria. When it happens the heat pump stops its operation.

Fig. 1: Dual fuel heat pump system using in HVAC

By using both gas furnace and electric heat pump as shown in figure 2, it can play a linchpin role in the comfortable and efficient type of warming for different temperatures. Above 40 degrees the pump will use the power to warm the abode. But at low temperature, the pump uses the gas heat to provide better efficiency.

The compressor will not do any more compression work. The gas furnace is used for heating the house by the using a heat exchanger. The fan will blow the air over the heat exchanger and it will transfer the hot air into the room.

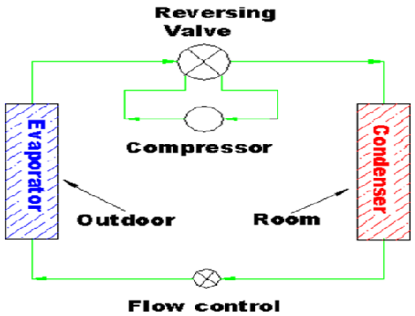

Fig. 2: Line diagram of a heat pump

While selecting the dual fuel heat pump it is always a good idea to calculate the return investment. It is more costly compared to the normal heat pump. Compared to the cost we are using the electrical heater during the same number of days that you will be using the gas furnace.

5.2 Smart thermostats

A smart thermostat is a device which is used to control the temperature of the room by using the mobile app (or) remote. It is the next generation of temperature control systems.

The smart thermostats save the energy by allowing the home to control the temperature of the home where ever we go. It is really smart and it can identify that when nobody is present in the room and control the system accordingly. Just in the market, the users are interested in smart thermostats technologies which are shown in figure 3.

Fig. 3: Smart thermostat using in HVAC

As we can see in the graph shown in figure 4, the users of the smart thermostats are augmented day by day. It predicts the annual global revenue from smart thermostats which grew from $146.9 million in 2014 to $2.3 billion in 2023.

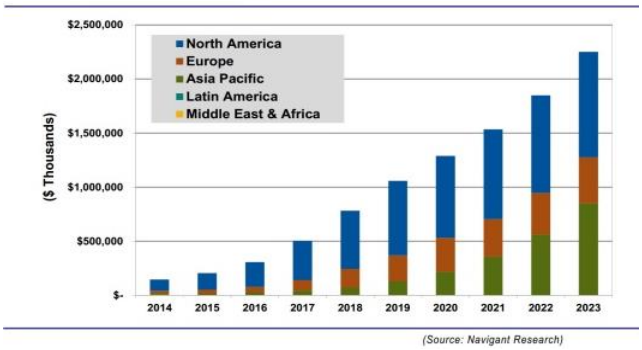

Fig. 4: Communicating/smart thermostat device and software and services revenue by region world markets: 2014-2023

5.3 Energy from ice

Ice energy is based on the Glendale calf by applying an ice-powered air conditioning unit which is known as ice bear. It is used to manipulate the building's cooling conditions but in the more cases, it will diminish the total net energy consumption of a building. The working of ice bear is done by the chilling of 450 gallons of water in a tank in all-night and makes it possible to available for next day for the cooling process. When the ice charging is switched, it can allow the cooling up to six hours. When the ice starts to melt, the job of cooling is reversed back to the building's conventional commercial A/C unit.

Fig. 5: Ice energy using in HVAC

The Ice Bear is a thermal battery it can change the existing air conditioners into cost-effective freezing machines. When the power grid is less burdened Ice bear fills with the water and are formed into ice blocks during the night as shown in figure 5. During daytime it allows an affordable air conditioning to the building, the ice is used without running the air conditioners energy-guzzling compressor. But in repercussion, about 90% of less energy is using during the hottest hours of the days. We can see drastically diminishing fall in both electric bills and emissions from carbon.

Ice energy has been successful in the past few years. It considers some of the following key stats:

- 1000 units installed
- 95 % peak load reduction
- 2000lbs of saved per unit per year

Moreover, ice energy introduced ice bear 20 in February it serves a smaller–capacity and is an initial ice battery.

5.4 Geothermal heat pumps

It is also called ground sources of the heat pump. It is used for heating or cooling system which can transfer heat from the ground. Geothermal HVAC uses the earth's temperatures below of the ground and deep underwater to heat and cool the house. The underground pipes it contains water, it transfers heat in the house in cold weather and outside when the weather is warmed. These systems do not produce any pollution and have no effect on nature as shown in Figure 6. The pipes which are used in the underground can last for up to 100 years.

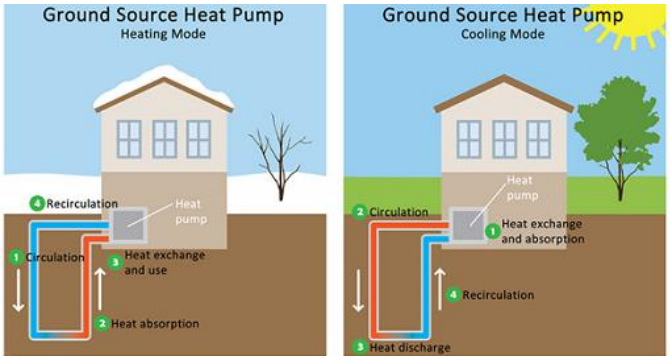

Fig. 6: Use of ground heat pump

Since the 1940's these types of pumps has been used in some areas. The green energy experts are taking a new look with super-efficient geo-exchange pumps 4 times as efficient as conventional HVAC systems but the installation is a little bit expensive than traditional systems. The uses of the geothermal heat pump are burgeoning in the HVAC market and recently it is used due to the current green movement. By using the looped piping placed under the ground, it can transfer the heat from the earth. During the cold season, the water in the pipe absorbs the heat transfer which is carried back into the indoor heating is.

These pumps can deliver the efficiencies between 300% and 600% can be used even on the cold winter nights. Compared to traditional pumps it can provide 175% to 250% in cold weather condition. They are many types of geothermal heat pump

- Closed-loop
- Horizontal
- Vertical
- Pond/lake

Compared to the air–source heat pumps, (geothermal and water-source heat pumps) are quit quieter, lasts longer, but it needs little maintenances, and it does not depend on the temperature of the outside of air. It is used to diminish the energy cost and consumption of power now and in the future.

5.5 SOLAR POWER

Everyone nowadays is about solar energy and how it's important for your life. 30% of the energy which comes from the solar power. Solar energy means it can absorb the heat from the sun transferred to your uses it is used in home industries.

Fig. 7: Using solar power for HVAC

We can generate the power by using the solar energy for our needs. At first, the installation cost is high and maintenances are low. Solar panels provide energy even on the cloudy days and there are different types of solar panels as per the applications. Some of the solar panels can move automatically as they follow the direction of the sun. Solar shingles and roof tiles are available in different variety of colors and styles to blend in with your existing roof. We can also add a solar water heater to our homes. This present use of solar energy is increasing without any effect of nature.

5.6 Software used for energy analysis

By using this software we can protect the energy efficiency and price saving of HVAC systems for space before actually installing and making it useful for such equipment. Heating of air conditioning system this software is more used by engineers and architects who always look for the equipment and tools to be used in their design. This software can be used to project the lifespan, energy use, and its consideration of the impact of the nation–HVAC techniques. Green Building studio and Energy Gauge are some of the analytical software which is used for HVAC systems.

5.7 On command hot water re-circulator

The on–command hot water recirculation is a device which is used in the homeowner's systems. By using this we can get hot water as quickly as possible and there is no better choice than the on command hot water recirculation from the taco comfort solutions. It immediately delivers hot water at any time we need it. Then how does hot water recirculation works? By using the on–command and cool water it runs down the drain. The water is circulated into the heater through the cold water line, taco says the pump over the hot water from the water heater and put back the cooled water via the cold water line it result when the hot water reduces the faucet the on command heater sensor and control board stop the pump entirely. Thus it stops the risk of pushing hot water into the cold water line and it can provide hot water at any time 24 hours a day. Taco also used for notes that say the average homeowners may waste over the 12,000 gallons of water per year. While they wait for hot water from a faucet. But with on–command the homeowners are able to reduce water and energy consumptions as shown in figure 8. The working and uses of this device are very simple.

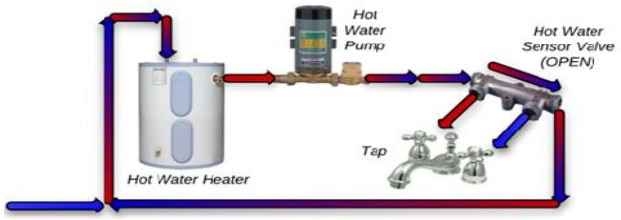

Fig. 8: On-command hot water recirculation

The re-circulation system can also save 10,000-15,000 gallons of water each year.

5.8 Quiet – Duct wrap

The quiet–duct wrap product is nothing new but the product developed by the green products company. Finding the duct trap made from durable natural was impossible until now. A quiet–duct wrap delivers a wide range of benefits. It is light in weight and is made up of natural cotton fiber construction. There is no fiberglass in the wrap. Due to the softness of fiber, there is no irritation and VOCs like conventional duct wrap. It protects from the unwanted air duct, radiant heat, the cooling effect is put and it decreases landfill waste at the same time.

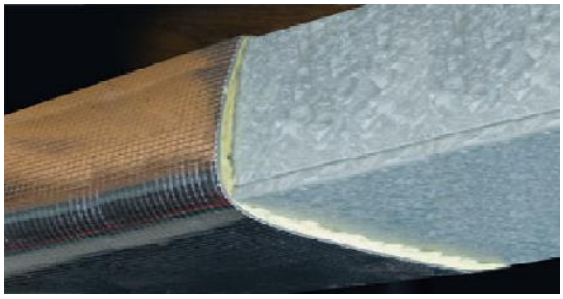

Fig. 9: Diagram of quite-duct wrap

It helps in thermal and acoustic insulation product which is almost similar to the traditional duct trap. This product is treated with the U.S Environmental Protection Agency (EPA). It is also used for fire resistant. Quite–duct wrap is shown in figure 9. Which is mostly used in HVAC technicians and property owners. It will improve the enhanced protection and durability. It also used for maintaining energy-efficient buildings.

5.9 Thermally driven air conditioning

It can provide a cheap in cost to naturally air–conditioning units which they are driven electrically.

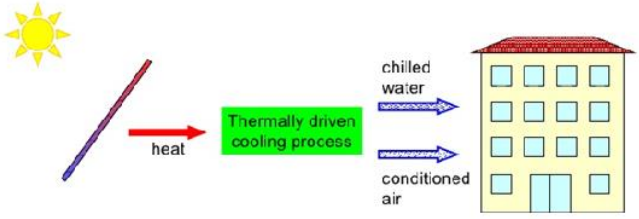

Fig. 10: Diagram of solar thermally driven A/C

In the thermally driven Chillers as shown in figure 10, by using the solar energy it can run a short time by the supply of natural gas. But some of the company's make their own solar panels it can provide huge temperature to drive double-effect chillers it gives more effectiveness to the systems. But double chiller system provides more cooling effect than comparative photovoltaic systems which can chop off the electricity costs.

5.10 Chromasun micro-concentrator

It is the next generation of solar collection. The chromasun micro-concentrator has high performance in the solar collector and is shown in figure 11. For the scale solar systems, we can use the same technology but it has a smaller package. Which is mainly designed for the rooftop of the building's integration.

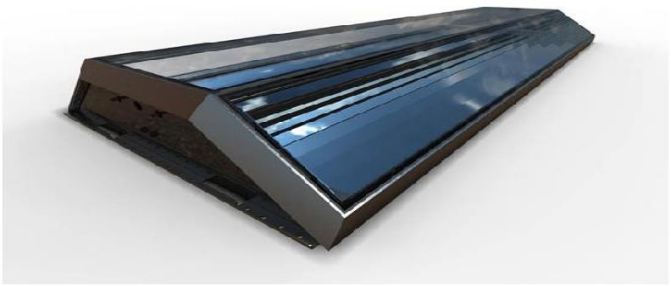

Fig. 11: Diagram of chromasun micro-concentrator

When the scalding sun is beating down on a building it will not diminish the air conditioning bill but by using the Chromasun's Micro-Concentrator it is possible to diminish the power bills. These make your life simple and the rooftop is safe, which is integrated at top of the abode panels. It contains special lenses arranged in mirrors which can automatically rotate around the sun's path concentrating and collecting solar energy. This energy can be used for the building's HVAC system, converting peak sun loads into spotless efficient air conditioning. Its working is shown in figure 12.

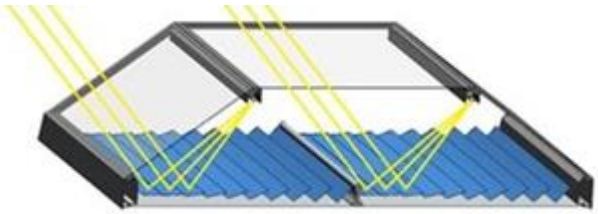

Fig. 12: Working of MCT panel

By using mirror strips we can collect the sunlight which goes in MCT panel through the glazing as shown in Figure 12. The sunlight is concentrated and focused on the receiver. The receiver contains a coated stainless steel pipe which is used to absorb the concentrated sunlight not for losing the heat. The pipe can receive up to 25 time's concentrated sunlight and which is simple to work at a temperature of up to 400°F (205°C).

Heat transfer fluid can be circulated at any conditions and heated in the receiver pipe. Some of the common fluids used are pressurized water up to 40 bar water-glycol mixtures at ambient pressure and thermal transfer oils. In addition, fluids such as potable liquids sludge and slurries may be heated. The collection of efficiencies is done by MCT panel that exceeds traditional flat panel collectors once the fluid temperatures augment beyond 55°C (124°F). MCT uses huge energy from sunlight than any other flat panel collector in these conditions. Collecting the better efficiency means more energy from the rooftop and carrying out with higher output temperatures without penalty. To get the higher efficiency performances to use more complex concentrating systems can be done. Now Chromasun MCT brings that performance to the rooftop with far less complexity and the convenience of a flat panel.

At 176°C and (350°F) test temperature constant heat is achieved and the highest temperature rating is tested under the SRCC standard. 600 test methods and minimum standards for concentrating collectors. Chromasun MCT is certified under OG-100 which is the principal rating for all so collectors in the United States as shown in figure 13.

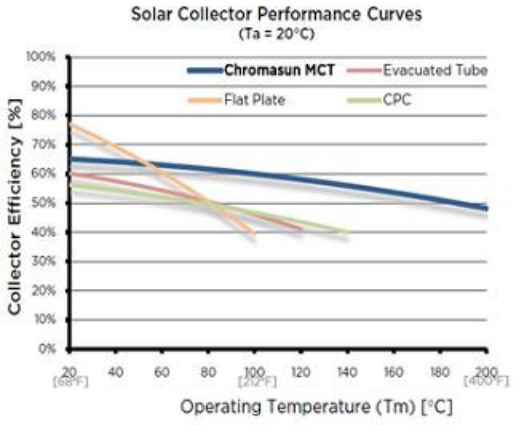

Fig. 13: Comparison with traditional flat panel collectors

5.11 Radiant floor heating

Radiant floor heating keeps rooms warm doesn't make any noise and is energy efficient. It can warm your entire house or supplement just only a room or two. With a radiant heat floor, the warmth rises evenly from below so the temperature of the room is uniform from top to bottom and your tootsies never get cold. It's an especially nice feature in bathrooms. Also, there's no blowing air like with forced air systems. That means less stirred up dust and allergens.

Radiant floor heating is more expensive than conventional forced air systems but over time saves money due to better efficiency also there aren't any ducts to leak air and waste energy. When the weather becomes so hot the air conditioning system required a separate system. By using the radiant heat it is not possible to cool a house.

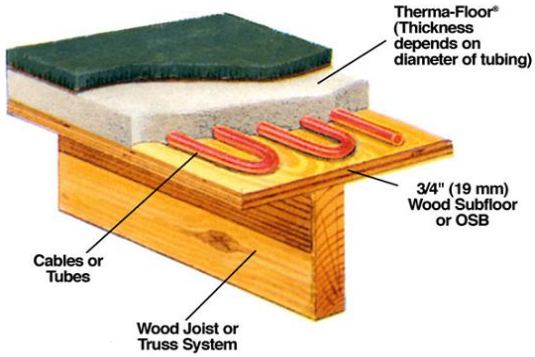

Fig. 14: Radiant floor heating system

There are two basic types of radiant floor heating systems electric and hot water.

(1) Electric radiant floor heating
(2) Electric single wire installations
(3) Hot water radiant systems

From hot-water tubes or electric wires, heat will carry out from the underground of the floor by using the radiant setup as shown in figure 14. Where the invisible waves of thermal radiation increase from below point and heat up at any objects that it strikes with, which radiate the captured heat in turn. But the temperature remains constant. We can stay comfortable because of ambient surfaces stealing the warmth from your body.

A conventional forced-air heating system is seen almost in all American abodes. When Air flows out of the registers at a well-baked of 120 degrees augment to the top of the room where it

quickly sheds heat then drops it back to cool. Then the air in the room becomes uncomfortably stratified. Your head can be bathed in warmth while your toes lie in the frozen zone. Then there's the problem of cycling, you turn on the furnace it quickly takes you to 68 or 70 and then shuts off. The repercussion is excellent, it calls the cold 70 which is what you feel right after the warm air prevents pumping from the registers. By using jarring ups and downs are absent with radiant floors it may reach 80 degrees top on a frigid day. The hot air still augments and the entire floor so cooled as air always stays up at the ceiling.

6. CONCLUSION

With the help of this paper, anyone can understand the concept of the HVAC system to make our life more comfortable. By looking at such technologies now 15% of nature is free from pollution. Where 85% is still remaining with pollution, let us join the hand to make the world with the green environment but it will certainly take time to do it. As recently as December 2013 president of U.S has said by 2020 its reliance on renewable energy. Which means 25% of energy will come from the renewable energy. By using the renewable energy we have several advantages and ability to diminish the atmosphere's footprint on the earth. With the growth in population, HVAC technologies have done many transformations over time. Not only in U.S. but worldwide are joined in research to create new enormous energy efficient systems, as well as new types of systems which can run the engines such as solar or geothermal. The new green technologies are a purple patch in the world.

7. FUTURE SCOPE

In future new technologies can be expected from companies to transform this world against fuels.

8. REFERENCES

[1] "Born in controversy— Representing interests (1904 to 1929)". Modern Building Services. 1 June 2004. Retrieved 3 February 2016.

[2] Judd Bane (1 March 2012). "Building for the future" Modern Building Services. Retrieved 3 Feb. 2016.

[3] "National College for Heating, Ventilating, Refrigeration, and Fan Engineering".Archives Hub. Retrieved 3 Feb 2016.

[4] "HVCA Membership approves name change". Heating, Ventilation & Plumbing Magazine. 14 Dec. 2011. Retrieved 2015

[5] "Written evidence submitted by the Heating and Ventilating Contractors' Association (HVCA), 10 February 2012". Parliament.uk. Retrieved 3 February 2016.

[6] "Engineering: turning ideas into reality - Innovation, Universities, Science and Skills Committee - Memorandum 61 Submission from the Heating and Ventilating Contractors' Association (HVCA)". Parliament UK. Retrieved 3 February 2016.

[7] "B&ES release DW/144". RAC (Refrigeration and Air Conditioning) Magazine. 2 December 2014. Retrieved 2016-02-02.

