Renewable energy essay sample

This project paper studies the potential of hydroelectric energy as a way to effectively generate, use and store renewable energy through the clean gravitational potential energy of stored water. Nuclear and coal fired plants could do change power output to achieve demand but at extremely high maintenance cost. Nuclear plants also being a good source of continuous energy has a high chance of posing hazard to the environment. Coal and fossil fuel fired power plants on the other hand cannot be depended on because the source will diminish someday. Therefore, alternative methods have to be explored in order to find a renewable and sustainable energy for the future generations. This project paper will study the benefits of hydroelectric energy as a potential and important energy source for a sustainable future.

INTRODUCTION

1. 0 Hydropower

Hydropower is a renewable energy source based on the natural water cycle. Hydropower is the most mature, reliable and cost-effective renewable power generation technology available. Hydropower schemes often have significant flexibility in their design and can be designed to meet base-load demands with relatively high capacity factors, or have higher installed capacities and a lower capacity factor, but meet a much larger share of peak demand. Hydropower is the largest renewable energy source, and it produces around 16 % of the world's electricity and over four-fifths of the world's renewable electricity. Currently, more than 25 countries in the world depend on hydropower for 90 % of their electricity supply (99. 3 % in Norway), and 12 countries are 100 % reliant on hydro. Hydro produces the bulk of electricity in 65 countries and plays some role in more than 150 countries. Canada, China and the United States are the countries which have the largest hydropower generation capacity. Hydropower is the most flexible source of power generation available and is capable of responding to demand fluctuations in minutes, delivering base-load power and, when a reservoir is present, storing electricity over weeks, months, seasons or even years.

One key advantage of hydropower is its unrivalled " load following" capability (i. e. it can meet load fluctuations minute-by-minute). Although other plants, notably conventional thermal power plants, can respond to load fluctuations, their response times are not as fast and often are not as flexible over their full output band. In addition to grid flexibility and security services (spinning reserve), hydropower dams with large reservoir storage be used to store energy over time to meet system peaks or demand decoupled from inflows. Storage can be over days, weeks, months, seasons or even years depending on the size of the reservoir.

As a result of this flexibility, hydropower is an ideal complement to variable renewables as, when the sun shines or the wind blows, reservoir levels can be allowed to increase for a time when there is no wind or sunshine. Similarly, when large ramping up or down of supply is needed due to increases or decreases in solar or wind generation, hydro can meet these demands. Hydroelectric generating units are able to start up quickly and operate efficiently almost instantly, even when used only for one or two hours. This is in contrast to thermal plant where start-up can take several hours or more, during which time efficiency is significantly below design levels. In addition, hydropower plants can operate efficiently at partial loads, which is not the case for many thermal plants. Reservoir and pumped storage hydropower can be used to reduce the frequency of start-ups and shutdowns of conventional thermal plants and maintain a balance between supply and demand, thereby reducing the load-following burden of thermal plants.

1. 1Hydropower Technologies

Hydropower has been used by mankind since ancient times. The energy of falling water was used by the Greeks to turn waterwheels that transferred their mechanical energy to a grinding stone to turn wheat into flour more than 2000 years ago. In the 1700s, mechanical hydropower was used extensively for milling and pumping. The modern era of hydropower development began in 1870 when the first hydroelectric power plant was installed in Cragside, England. The commercial use of hydropower started in 1880 in Grand Rapids, Michigan, where a dynamo driven by a water turbine was used to provide theatre and store front lighting. These early hydropower plants had small capacities by today’s standards but pioneered the development of the modern hydropower industry. Hydropower schemes range in size from just a few watts for pico-hydro to several GW or more for large-scale projects. Larger projects will usually contain a number of turbines, but smaller projects may rely on just one turbine. The two largest hydropower projects in the world are the 14 GW Itaipu project in Brazil and the Three Gorges project in China with 22. 4 GW. These two projects alone produce 80 to 100 TWh/year.

Large hydropower systems tend to be connected to centralised grids in order to ensure that there is enough demand to meet their generation capacity.

Small hydropower plants can be, and often are, used in isolated areas off-grid or in mini-grids. In isolated grid systems, if large reservoirs are not possible, natural seasonal flow variations might require that hydropower plants be combined with other generation sources in order to ensure continuous supply during dry periods. Hydropower transforms the potential energy of a mass of water flowing in a river or stream with a certain vertical fall (termed the " head"). The potential annual power generation of a hydropower project is proportional to the head and flow of water. Hydropower plants use a relatively simple concept to convert the energy potential of the flowing water to turn a turbine, which, in turn, provides the mechanical energy required to drive a generator and produce electricity.

1. 2 The main components of a conventional hydropower plant

1. 2. 1Dam Most hydropower plants rely on a dam that holds back water, creating a large water reservoir that can be used as storage. There may also be a de-silter to cope with sediment build-up behind the dam. 1. 2. 2Intake, penstock and surge chamber

Gates on the dam open and gravity conducts the water through the penstock (a cavity or pipeline) to the turbine. There is sometimes a head race before the penstock. A surge chamber or tank is used to reduce surges in water pressure that could potentially damage or lead to increased stresses on the turbine. 1. 2. 3Turbine

The water strikes the turbine blades and turns the turbine, which is attached to a generator by a shaft. There is a range of configurations possible with the generator above or next to the turbine. The most common type of turbine for hydropower plants in use today is the Francis Turbine, which allows a side-by-side configuration with the generator. 1. 2. 4Generators

As the turbine blades turn, the rotor inside the generator also turns and electric current is produced as magnets rotate inside the fixed-coil generator to produce alternating current (AC).

1. 2. 5 Transformer

The transformer inside the powerhouse takes the AC voltage and converts it into higher-voltage current for more efficient (lower losses) long-distance transport.

1. 2. 6Transmission lines

Send the electricity generated to a grid-connection point, or to a large industrial consumer directly, where the electricity is converted back to a lower voltage current and fed into the distribution network. In remote areas, new transmission lines can represent a considerable planning hurdle and expense. 1. 2. 7Outflow

Finally, the used water is carried out through pipelines, called tailraces, and re-enters the river downstream. The outflow system may also include " spillways" which allow the water to bypass the generation system and be " spilled" in times of flood or very high inflows and reservoir levels.

The water used to drive hydropower turbines is not " consumed" but is returned to the river system. This may not be immediately in front of the dam and can be several kilometres or further downstream, with a not insignificant impact on the river system in that area. However, in many cases, a hydropower system can facilitate the use of the water for other purposes or provide other services such as irrigation, flood control and/or more stable drinking water supplies. It can also improve conditions for navigation, fishing, tourism or leisure activities. The powerhouse contains most of the mechanical and electrical equipment and is made of conventional building materials although in some cases this maybe underground. The primary mechanical and electrical components of a small hydropower plant are the turbines and generators. Turbines are devices that convert the energy from falling water into rotating shaft power. There are two main turbine categories: “ reactionary” and “ impulse”. Impulse turbines extract the energy from the momentum of the flowing water, as opposed to the weight of the water. Reaction turbines extract energy from the pressure of the water head.

The most suitable and efficient turbine for a hydropower project will depend on the site and hydropower scheme design, with the key considerations being the head and flow rate. The Francis turbine is a reactionary turbine and is the most widely used hydropower turbine in existence. Francis turbines are highly efficient and can be used for a wide range of head and flow rates. The Kaplan reactionary turbine was derived from the Francis turbine but allows efficient hydropower production at heads between 10 and 70 metres, much lower than for a Francis turbine. Impulse turbines such as Pelton, Turgo and cross-flow (sometimes referred to as Banki-Michell or Ossberger) are also available. The Pelton turbine is the most commonly used turbine with high heads. Banki- Michell or Ossberger turbines have lower efficiencies but are less dependent on discharge and have lower maintenance requirements.

HYDROPOWER PLANT

2. 0Classification of Hydro Power Plants

Small hydropower, where a suitable site exists, is often a very cost-effective electric energy generation option. It will generally need to be located close to loads or existing transmission lines to make its exploitation economic. Small hydropower schemes typically take less time to

construct than large-scale ones although planning and approval processes are often similar. Large-scale hydropower plants with storage can largely de-couple the timing of hydropower generation from variable river flows. Large storage reservoirs may be sufficient to buffer seasonal or multi-seasonal changes in river flows, whereas smaller reservoirs may be able to buffer river flows on a daily or weekly basis.

Hydropower plants can be constructed in a variety of sizes and with different characteristics. In addition to the importance of the head and flow rate, hydropower schemes can be put into the following categories: 2. 1Run-of-river hydropower projects have no, or very little, storage capacity behind the dam and generation is dependent on the timing and size of river flows. 2. 1. 1Reservoir (storage) hydropower Reservoir (storage) hydropower schemes have the ability to store water behind the dam in a reservoir in order to de-couple generation from hydro inflows. Reservoir capacities can be small or very large, depending on the characteristics of the site and the economics of dam construction. 2. 1. 2 Pumped storage hydropower schemes use off-peak electricity to pump water from a reservoir located after the tailrace to the top of the reservoir, so that the pumped storage plant can generate at peak times and provide grid stability and flexibility services.

2. 2Environmental Impacts

Hydro-electric power plants have many environmental impacts, some of which are just beginning to be understood. These impacts, however, must be weighed against the environmental impacts of alternative sources of electricity. Until recently there was an almost universal belief that hydro power was a clean and environmentally safe method of producing electricity. Hydro-electric power plants do not emit any of the standard atmospheric pollutants such as carbon dioxide or sulphur dioxide given off by fossil fuel fired power plants. In this respect, hydro power is better than burning coal, oil or natural gas to produce electricity, as it does not contribute to global warming or acid rain. Similarly, hydro-electric power plants do not result in the risks of radioactive contamination associated with nuclear power plants.

A few recent studies of large reservoirs created behind hydro dams have suggested that decaying vegetation, submerged by flooding, may give off quantities of greenhouse gases equivalent to those from other sources of electricity. If this turns out to be true, hydro-electric facilities such as the James Bay project in Quebec that flood large areas of land might be significant contributors to global warming. Run of the river hydro plants without dams and reservoirs would not be a source of these greenhouse gases.

The most obvious impact of hydro-electric dams is the flooding of vast areas of land, much of it previously forested or used for agriculture. The size of reservoirs created can be extremely large. The La Grande project in the James Bay region of Quebec has already submerged over 10, 000 square kilometres of land; and if future plans are carried out, the eventual area of flooding in northern Quebec will be larger than the country of Switzerland. Reservoirs can be used for ensuring adequate water supplies, providing irrigation, and recreation; but in several cases they have flooded the homelands of native peoples, whose way of life has then been destroyed. Many rare ecosystems are also threatened by hydro-electric development.

2. 3Hydro-electric Power Plants

Hydro-electric power plants capture the energy released by water falling through a vertical distance, and transform this energy into useful electricity. In general, falling water is channelled through a turbine which converts the water’s energy into mechanical power. The rotation of the water turbines is transferred to a generator which produces electricity. The amount of electricity which can be generated at a hydro-electric plant is dependent upon two factors. These factors are (1) the vertical distance through which the water falls, called the “ head”, and (2) the flow rate, measured as volume per unit time. The electricity produced is proportional to the product of the head and the rate of flow. The following is an equation which may be used to roughly determine the amount of electricity which can be generated by a potential hydro-electric power site

POWER (kW) = 5. 9 x FLOW x HEAD

In this equation, FLOW is measured in cubic meters per second and HEAD is measured in meters.

Based on the facts presented above, hydro-electric power plants can generally be divided into two categories. “ High head” power plants are the most common and generally utilize a dam to store water at an increased elevation. The use of a dam to impound water also provides the capability of storing water during rainy periods and releasing it during dry periods. This results in the consistent and reliable production of electricity, able to meet demand. Heads for this type of power plant may be greater than 1000 m. Most large hydro-electric facilities are of the high head variety. High head plants with storage are very valuable to electric utilities because they can be quickly adjusted to meet the electrical demand on a distribution system.

“ Low head” hydro-electric plants are power plants which generally utilize heads of only a few meters or less. Power plants of this type may utilize a low dam or weir to channel water, or no dam and simply use the “ run of the river”. Run of the river generating stations cannot store water, thus their electric output varies with seasonal flows of water in a river. A large volume of water must pass through a low head hydro plant’s turbines in order to produce a useful amount of power. Hydro-electric facilities with a capacity of less than about 25 MW (1 MW = 1, 000, 000 Watts) are generally referred to as “ small hydro”, although hydro-electric technology is basically the same regardless of generating capacity.

2. 4Categories of Hydroelectric power plant

Hydroelectric plant have few type of categories which makes its different according to its specifications due to its capacity of water flow regulation or hydraulic characteristics, head under which they work, the basis of operation load supplied, storage and pondage, plant capacity, location and topography, and its turbine characteristics according to its specific speed. Based on their hydraulic characteristics or capacity foot water flow regulation, the hydro power plants may be categorised as run of river plants, storage plant, and pumped storage plant.

2. 4. 1Run of river plants

As the name suggests, these plants utilize the flow as it runs through the year, without any storage add the benefit thereof. During the rainy season high water flow is available and if the power plant is not able to use this large flow of water some quantity of water is allowed to flow over dam spillways as waste. On the other hand during dry season, the power produced by such plants will be less, due to low flow rates of water. Such plants may be further sub-divided into Run of river plants without pondage, and Run of river plants with pondage.

2. 4. 2Run of river plants without pondage

Such plants have absolutely no pondage available and use the water only as it comes in the stream. The dam constructed at the site may be for some purpose other than of hydro power development. For example it may bit required just to raise the water level for diverting it into an irrigation. Channel on the bank of simply to maintain a certain level for the navigation purpose, the development of hydro power being incidental. The flow may be considerable, through the head available is usually low and subject to the tail water conditions. Occasionally, high head plants may also belong to this category, like for example, a dam constructed for navigation or irrigationpurposes at the head of a water fall, creating practically no pondage. Thus, the power house located at the toe of the fall will be a " high head run-of-river plant." The well known Niagara Falls plant is a good example of this type.

The capacity of the run of river plant without pondage is fixed corresponding to the minimum flow available in the stream. Thus it is purely a base load plant with a high load factor (90-100%). In run of river plants, the dominant feature is that the normal run or flow of the river is not materially disturbed due to the construction of the plant. Such plants neither have a large reservoir nor do they have a diversion of the water away from the main channel. The power house is located along the main course of the river. Such plants are quite popular in Europe and all major rivers have a series of such plants along their course. In India on the other hand, very few classical run-of-river plants are constructed. The plants which come closet to be described as run-of-river plants are Obra (U. P.), Jawaharlal Sagar (Rajasthan) etc. A reason for the non availability ofrun of river plants in India is its typical monsoon climate which brings about the construction of flow only in a few months. European rivers, on the other hand have a more or less uniformly distributed flow a requirement eminently suitable for this category of hydel plants.

2. 4. 3Run of river plants with pondage.

Pondage usually refers to the collection of water behind a dam near the plant, and increases the stream capacity for short periods, storage means collection of water in reservoirs upstreams of the plant and this increases the capacity of the stream over an extended period of several months. Storage plants may work satisfactorily as base load and peak load stations. Some run of river plants have pondage facility available, which enables them to store water during off peak period and use it during the peak hours of the same day or week. Thus the plant has the flexibility to meet the hourly or daily fluctuations. The plant discharge may thus be many times more (3 to 8 times) than the minimum stream flow. Pondage increases the stream capacity for a short period, hours or week depending upon the capacity of the pond. This plant can be used as base load or peak load plants. Run-of-river plants are normally base load plants, but with some pondage available they may be able to operate both as peak load as well as base load plants, depending upon the flow available in the river. When a lot of flow is available in the river, they operate on the base of the 10ad curve. However with decreased stream flow, they may feasibly operate on the peak of the load curve.

2. 4. 4Storage plants (Reservoir plants).

in such plants, have reservoirs of fairly large size, which usually provide sufficient storage to carryover from wet season to dry season and sometimes even from one year to another. They can therefore supply water at a constant rate which is substantiallY higher than the minimum natural flow of the stream. The big dams, creating large lakes, usually provide relatively high heads for these power plants. The advantage of this plant is that the power generated by the plant during dry season will not be aff~cted. The storage takes care of fluctuations of the river supply or that of the load. In valley dam plants, a dam is dominant feature, creating a storage reservoir. Power house is located at the toe of the dam. No diversion of water away from the river is involved. The storage reservoir develops the necessary head for the power house. Water flows through penstocks embedded in the dam to the power house and joins the main ri ver course directly at the outlet of the power house. The valley dam plants are of medium to high heads. The artifidal head created will depend in the height of the dam. Main parts of a valley dam pi ant are: 1. The dam with its accessories like spillways etc.

2. The intake with trash racks, stop logs, gate and ancillaries. 3. The penstocks conveying water to the turbines with inlet valves and anchorages. 4. The main power house with its components.

2. 4. 5Pumped Storage Plants.

This type of plant in combination with hydro-electric power plant is used for supplying. the sudden peak load for short duration–a few hours in the year. These are special type of power plants which work as ordinary conventional hydropower stations for part of the time. The speciality of these power plants lies in the fact that when such plants are not producing power, they can be used as pumping stations which pump water from the tail race siJe to the high level reservoir. At such times these power stations utilise power available from elsewhere to run the pumping units. The working of the power stations can be distinguished as the generating phase when the turbines and generators are producing electrical power and the pumping phase when the pm” 1ps and motors are in operation. During the generating phase, therefore, water flows from the high level into the power house and thence to the tailrace side in the pumping phase it is vice versa.

This basic arrangement is schematically shown The fundamental arrangement consists in having two pools, one at a high level and the other at a low pool with the power house occupying an intermediate station. The water passages are from the higher level pool to the power house and then from the power house to the lower pool, which carry water in either direction depending upon the generating or the pumping phase. Figure shows the high altitude reservoir, the penstocks, the power house (containing reversible pump turbine and motor-generating units etc.) and the tail water pond of a typical such scheme. The tailwater may some times be a perennial (lasting through the year) river, or a natural lake. The capacity of the upper pond should be enough to meet atleast four to six hours of peak demand at the available head. Greater the available head, smaller the capacity of pond required for the given output.

2. 5Classification Based on Head

Most popular and conventional classification happens to be the one based on head. Types of plant

1- Low head plants less than 30 meters

2- Medium head plants 30 to 100 meters

3- High head plants Head above 100 meters.

2. 5. 1Low head plants

When the operating head is less than 30 meters, the plant is known as low head plant. These are also known as canal power plants. These are of two types which are run of river plants and diversion canal type A low head (canal water power plant) type is one type of plant. It stores water by the construction of a dam across a river and the power plant is installed near the base of the dam on the downstream side. The tailrace of the turbines is joined to the river on the downstream side. In this case no surge tank is required, as the power house is located near the dam itself and the dam is designed to take the pressure created due to the back flow under load conditions. This type of plant uses vertical shaft or Kaplan turbine.

2. 5. 2Medium head plants

The medium head plant is similar to the low head plant but works on a head of about 30 to 100 m. This type of plant uses Francis, propeller or kaplan turbine as prime mover. The forebay provided at the beginning of pen-stock serves as water reservoir. The forebaydraws water from main reservoir through a canal or tunnel. Forebay also stores the rejected water when then load on the turbine decreases. The Forebay itself works as a surge tank in the plant.

2. 5. 3High head plants

In the high head plants water is stored at high elevations due to rain etc. and can usually last throughout the year. the elevation of a high head plant. The main parts of such a plant are the dam, the intake or head works, the pressure tunnel, the surge tank, the pen stock, the power house and the tailrace

. At one end of the reservoir are provided outlets for water leading into forebays or surge tanks and from there to the turbines through penstocks. Trash racks are fitted at the inlets of the pressure tunnels to prevent the foreign matter from going into the tunnels. Since the tunnel carries the total head corresponding to actual reservoir level, the choice of the pressure tunnel should be given a very careful consideration. A pressure tunnel can be replaced either by a canal.

2. 6Selection of Site for Hydro-electric Power Plant

While selecting a suitable site, if a good system of natural storage lakes at high altitudes and with large catchment areas can be located, the plant will be comparatively economical. The essential characteristics for a good site are large catchment area, steep gradient to the area, high average rain fall and favourable sites for impounding reservoir. For this purpose, the geological, geographical, and meterological conditions of a site, need to be carefully investigated.

The most important factors which have to be considered in this selection are

1. Quantity of water available,
2. Storage of water,
3. Head of water which can be utilized,
4. Distance of power station site from power demand centres or load centre,
5. Accessibility of the site.

2. 7Spillways

A spillway acts as a safety valve for a dam. Spillways and gates help in the passage of flood water without any damage to the dam. They keep the reservoir level below the predetermined maximum level. Whatever may be the type of dam, it is absolutely necessary to provide a safe passage for the flood water down stream, so as to avoid the danger of the dam being over topped. The part of the dam which discharges the flood flow to the down stream side is called as ‘ spillway’. The spillway does not start discharging this the water reaches a predetermined level, called the Full R~serv()ir Level (FRI.). The highest level up to which the water is allowed to rise in the reservoir even during high floods is called as Maximum Water Level (MWL). The difference between MWL and FRL is called as the flood lift. The reservoir level will never cross MWL, at this level the discharging capacity of the spillway has to be such that the over flow over the spillway is at least equal to the instantaneous inflow. The spillway is an important part of the dam complex and is located either as a part of the main dam or separated at a suitable place near the dam.

2. 7. 1Types of Spillways

Depending upon the location of the site there are various types of spillways which may be suitably provided under prevailing circumstances. These can be listed as:

1. Over flow spillway
2. Chute or trough spillway
3. Side channel spillway
4. Shaft spillway
5. Siphon spillway’.

2. 7. 1. 1Over flow spillway (Ogee spillway).

An over flow spillway may have a control device, called a gate on the top of the crest or it may be without any such control. For an ungated spillway, the crest level forms the FRL and the height of the flood lift added over the crest level (FRL) corresponds to MWL as shown in Fig. 11•7•6. However, when the spillway is gated, the gates provide an additional storage up to their crests (top) during off-flood season.

2. 7. 1. 2Chute or Trough spillway.

The type of spillway is provided through the abutments of the dam when it is not possible to pass floods over the dam as in the case of earthern and rock fiU dams. The discharging water flows into a steep sloped open channel called chute. The channel is made of reinforced concrete slabs, The crest is usually wide and then the channel narrows for economy. The end is then again flared or widened for reducing the velocity. This type of spillway is suitable for earth dams because it is light. The chute spillways are simple in design and construction and are adoptable to almos: all foundation conditions.

2. 7. 1. 3Side channel spillways.

In a narrow valley, where the required crests length of the overflow spillway is not available, or, in a less wide stream where it is advantageous to leave the control portion of the stream for the power house, the side channel spillway is convenient. In this type, the flow being carried over the crest passes in a channel almost parallel to the crest. It implies, therefore, that the side channel spillways are applicable to narrow gorges. Another situation where side channel spillways can be given serious consideration is in the case of embankment dams. The design consideration~ require the side channels of sufficient capacity, so as to able to carry the maximum flood discharge without submerging the weir crest to an extended that the weir discharge capacity is restricted~The side channels are mostly of trapezoidal section.

2. 7. 1. 4Shaft spillway.

The shaft spillway, also some times known as ‘ morning glory’ spillway has shape of vertical funnel with a vertical through the dam or through the abutments conveying water past the dam. In a shaft spillway, the water drops through the vertical shaft and passes through a horizontal conduit passing through the dam at the bottom which conveys the water to the downward site of the damshaft which connects an L-shaped horizontal outlet conduct, extending. The shaft spillway is suitable for narrow gorges where other types of spillways do not find adequate space. In earthen dams where even a side channel or chute spillway is unsuitable for want of space, a shaft spillway may be excavated through the foundation or flanks of the river valley. The drawback of this spillway is the hazard of clogging with debries. Therefore, trash racks, floating booms and other protection debries should be used to prevent the debries from entering the spillway inlet.

2. 7. 1. 5Siphon spillways

The principle of operation of a siphon spillways is based on siphonic action. Such a spillway occupies less space and regulates the reservoir level with narrow limits. With this property, the siphon spillway also finds its use in canal foreway where the surges created by the change in turbine loads are to be equalised. It will be observed that initially the reservoir level is upto the crest of the spillway. A sheet of water starts travelling over the crest, if there is rise in water level of the reservoir due to flood. When all the air entrapped within the hood is drawn out and space gets filled with water (called primary) siphon action starts and water starts flowing over the crest.

HYDROPOWER PLANT IN MALAYSIA

3. 0Hydroelectric plant in Malaysia

400MW Kenyir Hydropower Station in Terengganu

The history of hydropower dam development in Peninsular Malaysia. The first major dam, the Chenderoh Dam, was constructed in 1939. There followed a long gap before construction recommenced after the Second WorldWar, starting with the Sultan Abu Bakar Dam (Cameron Highlands) in 1963. A temporary lull in construction activity occurred between the late 60s and early 70s when fuel oil was still very competitively priced as to offer a viable thermal alternative for power generation. The oil price increase in the mid 70s shifted attention back to hydropower in the overall energy development plan. This eventually led to the construction of four more dams between 1974 and 1984. These are Temengor (1974), Bersia (1980), Kenering (1980) and Kenyir

(1980).

3. 1Terengganu Hydroelectric Dam 400MW installed capacity

Sultan Mahmud Power Station 4X100MW

3. 2Cameron Highlands Dam 262MW installed capacity

1-Jor Dam 100MW

2-Woh Dam 150MW

3-Odak Dam 4. 2MW

4-Habu Dam 5. 5MW

5-Kampung Raja Dam 0. 8MW

6-Kampung Terla Dam 0. 5MW

7- Robinson Falls Dam 0. 9MW

3. 3Sungai Perak Hydroelectric Dam installed capacity

1-Bersia Dam 72MW

2-Chenderoh Power Station 40. 5MW

3- Kenering Power Station 120MW

4- Sungai Piah upper dam 14. 6MW

5-Sungai Piah lower dam 54MW

6-Temenggor Power Station 348MW

3. 4Future development in Malaysia

As for future hydro development in Peninsular Malaysia, several projects have been identified and studied at feasibility and pre-feasibility levels. These potential projects have to compete with alternative energy sources such as coal and gas in terms of economicviability. From the economic point of view, it is clear that hydropower requires substantial initial investment costs which can be a deterrent to potential developers. It has been proven in some countries of the inability of the private sector to undertake such investments. However, this should be balanced against the long life and low operating costs of hydro plants, and the fact that there is no consumption of fuel for energy generation. Globally, in comparison with other plants, and considering the quality of the energy produced, the balance shows a clear advantage for hydropower. At the 17th Congress of the World Energy Council in 1998, it was concluded that clear priority should be given to the development and use of appropriate renewable energies with the aim of limiting emissions resulting from the use of fossil fuels.

DISCUSSION

4. 0Advantages of hydroelectric

•Does not depend on costs of uranium, oil, or other fuels

•Pollution is rarely created

•It doesn’t require as many employees

•It can be set up in many sizes

•Stations can operate and run for long periods of time

•Reduces greenhouse emissions

•Relatively low maintenance costs

•Can be used throughout the world

•It is renewable

•Hydroelectricity produces no gas emissions or waste.

•Hydroelectric stations are inexpensive to operate.

•Makes barely any pollution compare to other ways of creating electricity

•Hydroelectric power is one of the most responsive (easy to start and stop) of any electric power generating source.

•The conversion of the forces of water to electric energy can be up to 90 percent efficient.

•Hydroelectric power produces no chemical or waste heat pollution.

•Hydroelectric power plants require little maintenance.

•Reservoir lakes can be used for recreation, and can provide considerable flood protection to downstream areas. •Groundwater reserves are increased by recharging from reservoirs. •Plants usually have an expected life span two to three times longer than conventional thermal power plants. •Hydroelectric installations can be used to breed fish and other aquatic products •It is more reliable than solar and wind power – because water can be stored and there is more of it, more often. Once a dam is constructed, electricity can be produced at a constant rate. •If electricity is not needed, the sluice gates can be shut, stopping electricity generation.

The water can be saved for use another time when electricity demand is high. The build up of water in the lake means that energy can be stored until needed, when the water is released to produce electricity. •Dams are designed to last many decades and so can contribute to the generation of electricity for many years / decades. •The lake that forms behind the dam can be used for water sports and leisure / pleasure activities. Often large dams become tourist attractions in their own right. •The lake’s water can be used for irrigation purposes.

•When in use, electricity produced by dam systems do not produce green house gases. They do not pollute the atmosphere. •Hydropower is a fueled by water, so it’s a clean fuel source. Hydropower doesn’t pollute the air like power plants that burn fossil fuels, such as coal, oil or natural gas. •Hydropower is a domestic source of energy, produced locally near where it is needed. •Hydropower relies on the water cycle, which is driven by the sun, thus it’s a renewable power source so long as the rain keeps falling on the dam catchment area. •Hydropower is generally available as needed;

engineers can control the flow of water through the turbines to produce electricity on demand. •Hydropower is not only a cleaner source of energy than oil but is it more cost effective as well. The most efficient coal burning plants are only able to convert around 50 percent of their energy into electricity, whereas modern day hydro power turbines convert up to 90 percent of their energy into electricity.

•Hydropower can cost less than a penny per kWh (Kilowatt Hour) compared to fossil fuel power plants at around 2 to 3 cents per kWh. That may not seem like a big difference, but when factored out over a year and the millions of kW hours Americans burn, it adds up to a huge savings. •Hydropower plants also have an added bonus as they create recreational opportunities for people as well as electricity. Hydro power dams provide not only water-based activities, but since much of the surrounding land is public they also encourage numerous other outdoor activities aside from boating, skiing, fishing, and hunting. •Hydropower plants provide benefits in addition to clean electricity. Hydro power plants create reservoirs that offer a variety of recreational opportunities, notably fishing, swimming, and boating. Most hydro power installations are required to provide some public access to the reservoir to allow the public to take advantage of these opportunities. Other benefits may include water supply and flood control. •Can help regulate river flows (flood prevention), stores water, creates recreational lake (though these uses often conflict).

4. 1Disadvantages of hydroelectric

•High investment costs

•Dependent on precipitation

•Sometimes messes up wildlife

•Loss of fish species

•Change in river or stream quality

•Cost for construction

•Hydroelectric power production require flooding of entire valleys and scenic areas. •Disrupts natural seasonal changes in he river, and ecosystems can be destroyed. •Ends flooding that help to clean out the silt in rivers, causing them to clog (Energy Laboratory). •The silt that usually flows down to the Beaches and Estuaries is block by the dam. •Studies show that the plant decay caused downstream of major dams produces as many greenhouse gasses as more conventional methods of producing electricity. •Dams are expensive to build, and due to drought may become useless, or produce much less power than originally planned. •A dam being build in Quebec will end up flooding an area as large as Switzerland (Energy Laboratory). •Dams can break in a massive flash flood

•Construction costs of large-scale hydroelectric projects are high. •Damming rivers causes changes in ecological cycles and surrounding landscapes; self-regulating ecosystems are changed into ones that must be managed. •Sedimentation can progressively curtail a dam’s ability to store water and generate energy. •There are a limited number of feasible sites for large dams. •Damming can cause loss of land suitable for agriculture and recreation. •Drought can affect power production.

•Dams are vulnerable to natural forces. There is a high direct death rate from the failure of dams. •River channels downstream from dams are more susceptible to erosion. •A disadvantage of hydroelectric power stations is that it destroys wildlife and habitats of any creatures living in the area. •Dams are extremely expensive to build and must be built to a very high standard. •The high cost of dam construction means that they must operate for many decades to become profitable. •The flooding of large areas of land means that the natural environment is destroyed. •People living in villages and towns that are in the valley to be flooded, must move out. This means that they lose their farms and businesses. In some countries, people are forcibly removed so that hydro-power schemes can go ahead. •The building of large dams can cause serious geological damage. For example, the building of the Hoover Dam in the USA triggered a number of earth quakes and has depressed the earth’s surface at its location. •Although modern planning and design of dams is good, in the past old dams have been known to be breached (the dam gives under the weight of water in the lake).

This has led to deaths and flooding. •Dams built blocking the progress of a river in one country usually means that the water supply from the same river in the following country is out of their control. This can lead to serious problems between neighboring countries. •Building a large dam alters the natural water table level. For example, the building of the Aswan Dam in Egypt has altered the level of the water table. This is slowly leading to damage of many of its ancient monuments as salts and destructive minerals are deposited in the stone work from ‘ rising damp’ caused by the changing water table level. •Hydro power dams can damage the surrounding environment and alter the quality of the water by creating low dissolved oxygen levels, which impacts fish and the surrounding ecosystems. They also take up a great deal of space and can impose on animal, plant, and even human environments. •Fish populations can be impacted if fish cannot migrate upstream past impoundment dams to spawning grounds or if they cannot migrate downstream to the ocean.

Upstream fish passage can be aided using fish ladders or elevators, or by trapping and hauling the fish upstream by truck. Downstream fish passage is aided by diverting fish from turbine intakes using screens or racks or even underwater lights and sounds, and by maintaining a minimum spill flow past the turbine. •Hydro power can impact water quality and flow. Hydro power plants can cause low dissolved oxygen levels in the water, a problem that is harmful to riparian (riverbank) habitats and is addressed using various aeration techniques, which oxygenate the water. Maintaining minimum flows of water downstream of a hydro power installation is also critical for the survival of riparian habitats. •Hydro power plants can be impacted by drought. When water is not available, the hydro power plants can’t produce electricity. •New hydro power facilities impact the local environment and may compete with other uses for the land. Those alternative uses may be more highly valued than electricity generation.

Humans, flora, and fauna may lose their natural habitat. Local cultures and historical sites may be flooded. Some older hydro power facilities may have historic value, so renovations of these facilities must also be sensitive to such preservation concerns and to impacts on plant and animal life. •By 2020, it is projected that the percentage of power obtained from hydro power dams will decrease to around four percent because no new plants are in the works, and because more money is being invested in other alternative energy sources such as solar power and wind power. •Dams usually flood large river valleys, covering a lot of native habitat with water, displacing animals and sometimes people. In China more than one million people were moved when they built their big “ Three Gorges” dam. Many archaeological sites are now unreachable under water and there is environmental damage along the banks of the many tributaries of the Yangtze Rive.