

**DESIGN OF WATER CURRENT TURBINE FOR
ELECTRICITY GENERATION FROM TIDAL ENERGY**

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UNIVERSITI MALAYSIA SARAWAK

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DESIGN OF WATER CURRENT TURBINE FOR ELECTRICITY GENERATION FROM TIDAL ENERGY

MOHAMAD SATIM BIN SELBI

**This report is submitted in partial fulfillment of the requirement for the degree of
Bachelor in Engineering (Hons) in Mechanical Engineering and Manufacturing
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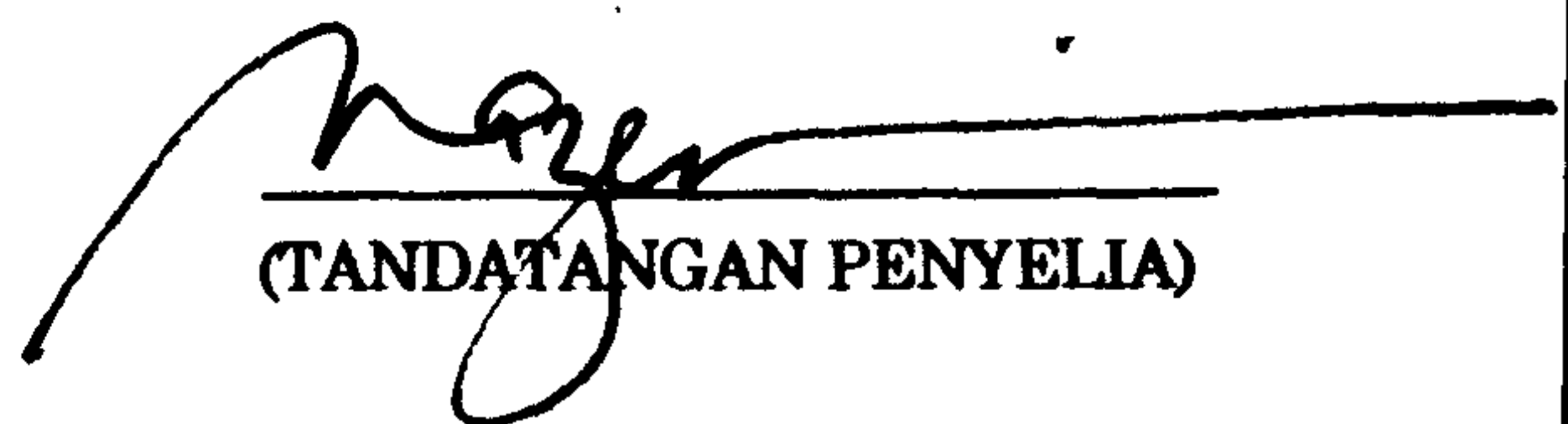
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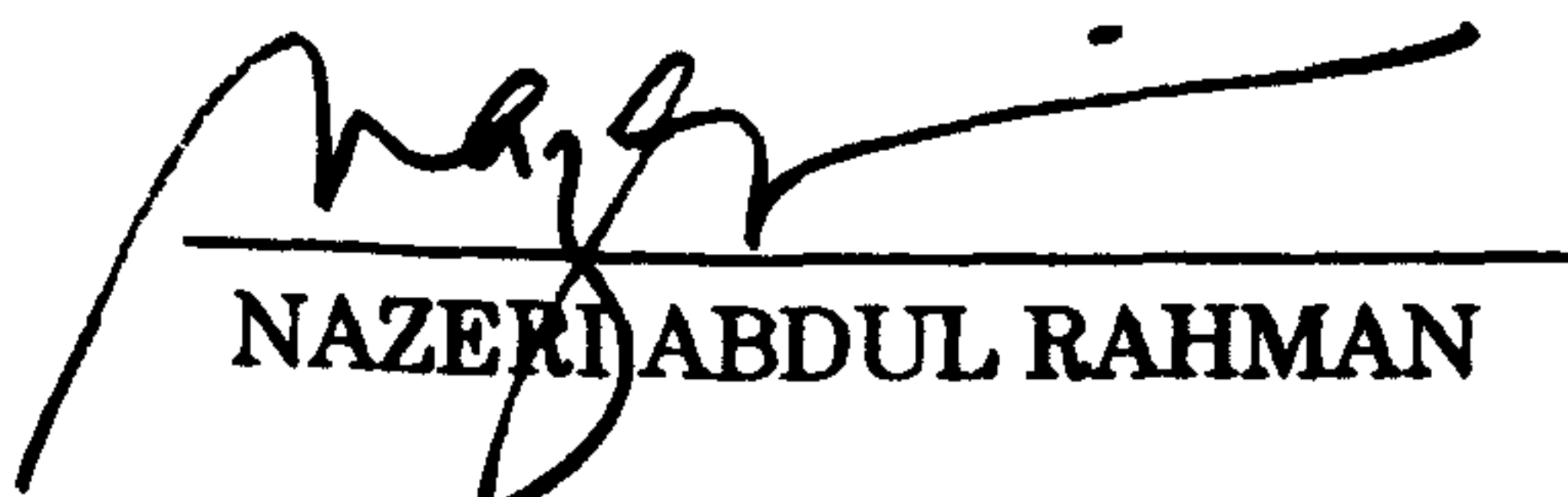
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BISMILLAHIRRAHMANIRRAHIM

“By The Name Of Allah, Most Gracious and Most Merciful ”

*This Project is Dedicated to
My Parent; Ayahanda Selbi bin Hj. Seman and Bonda Fatimah
bt. Matair, & My Family . .*

ACKNOWLEDGEMENT

BISMILLAHIRRAHMANIRRAHIM

“ IN THE NAME OF ALLAH MOST GRACIOUS AND MOST MERCIFUL ”

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ABSTRACT

Tidal energy is one of inexhaustible energy source available. Tide is phenomenon that is related to the different in ocean level, which is the effect from gravitational attraction between earth, moon and sun. Water current turbine is utilized for electricity generation from tidal energy. This project involved in designing water current turbine and turbine prototype making. Material availability and fabrication facility must be considered for the prototype construction. The final prototype is obtained after modification from the two early designs. The prototype performance is carried out through the experiment conducted. Result is depicted in voltages versus the water flow velocity. It is found that the voltage increase as the velocity of the water increased. This conclude that the design is capable to produce electricity as projected. However the prototype needs some improvement to make it more reliable as an electricity generation turbine.

ABSTRAK

Tenaga pasang surut sungai merupakan salah satu daripada tenaga yang boleh diperbaharui. Penomena pasang surut adalah disebabkan oleh perbezaan paras air sungai. Perbezaan ini disebabkan oleh daya tarikan graviti antara bumi, bulan dan matahari. Turbin air telah lama digunakan sebagai janakuasa elektrik daripada tenaga pasang surut air sungai. Projek ini melibatkan aktiviti merekabentuk turbin air dan juga membuat modelnya. Semasa membuat model turbin air, terdapat dua perkara yang perlu dititikberatkan iaitu, kemudahan untuk mendapatkan kompenan model dan kemudahan untuk membuat model turbin air. Rekabentuk model yang terakhir terhasil apabila telah membuat beberapa siri pengubahsuaian pada model turbin air yang pertama dan model yang kedua. Eksperimen telah dilakukan untuk mendapat keputusan mengenai keupayaan model turbin air. Keputusan diambil berdasarkan hubung kait nilai voltase dan laju arus air. Didapati, nilai voltase meningkat apabila laju air meningkat. Kesimpulannya, model turbine air dalam projek ini berupaya untuk menjanakan kuasa elektrik daripada tenaga pasang surut. Walau bagaimanapun, model turbin air perlu beberapa pengubahsuaian untuk mencapai keupayaan sebenar dan relevan untuk digunakan untuk menjana kuasa elektrik daripada kuasa pasang surut sungai.

CONTENTS

ACKNOWLEDGEMENT.....	i
ABSTRACT.....	ii
ABSTRAK.....	iii
CONTENTS.....	iv
LIST OF FIGURES.....	viii
LIST OF TABLES.....	xi
CHAPTER 1-INTRODUCTION TO ENERGY.....	1
1.1 Types Of Energy.....	1
1.1.1 Exhaustible Energy Sources.....	1
1.1.2 Renewable Energy Sources.....	1
1.1.3 Inexhaustible Energy Sources.....	2
1.2 The Use And Availability Of Energy.....	2
1.3 Energy Crisis.....	4
1.3.1 Pollution From Exhaustible Energy.....	5
1.3.2 Increase In Energy Prices.....	5
1.3.3 Energy Difficulties At Rural Places.....	5
1.3.4 Environmental Impact.....	6
1.4 Energy From Ocean.....	6
1.4.1 Tides Energy.....	6
1.4.2 Wave Energy.....	8

1.4.3	Ocean Thermal Energy.....	9
1.5	Turbines.....	11
1.5.1	Turbine Design History.....	12
1.6	Application From The Water Turbine.....	15
1.7	Objective Of Designing Efficient Water Current Turbine For Electricity Generation.....	16
1.7.a	Design Low Water Current Turbine.....	16
1.7.b	Low Maintenance Desired And Easy To Maintain.....	16
1.7.c	The Design Is Suitable For Low Velocity Water Current.....	16
1.7.d	Design For Rural Places.....	17
CHAPTER 2 - LITERATURE REVIEW.....		18
2.1	Introduction.....	18
2.2	Types Of Turbines.....	18
2.3	Turbine Generator Efficiency.....	20
2.4	New Technology Turbine Design.....	21
2.4.1	Series I Proto Types 5 kW Unit.....	21
2.4.2	PowerPal AC Mini Hydroelectric Generator.....	22
2.4.3	Nautilus Turbine.....	24
2.4.4	Helical Turbine.....	27
2.4.5	Tyson Turbine.....	29
a	Advantages From Tyson Turbine.....	29
b	Tyson Turbine Basic Operation.....	30
c	Water Pumping.....	30

d	Electrical Power Generation.....	30
CHAPTER 3 - METHODOLOGY.....		33
3.1	Project Planning And Activity Scheduling.....	33
3.2	Methods Of Collecting Data.....	33
3.2.1	Experiment Procedure.....	33
3.2.2	Fabricating Prototype.....	34
3.3	Drawing Sketching.....	34
3.4	Material Selection.....	34
3.5	Fabrication Facility.....	34
3.6	Applying The Computer Aided Software.....	34
CHAPTER 4 - WATER CURRENT TURBINE DESIGN.....		36
4.1	Design Consideration.....	36
4.2	First Design Of Water Current Turbine.....	37
4.2.1	First Design Specification.....	39
4.2.2	First Design Material Selection.....	39
4.3	Second Design Specification.....	41
4.4	Third Design Specification.....	44
4.4.1	Dimension Of The Water Current Turbine As The Final Design..	47
CHAPTER 5 - EXPERIMENTAL PROCEDURE.....		54
5.1	Experimental Procedure.....	54
5.2	List Of Activity Planned For The Experiment.....	54

CONTENTS

5.3	Experiment Precautions.....	55
CHAPTER 6 – RESULT AND DISCUSSION.....		57
6.1	Experiment Result.....	57
6.2	Discussion.....	60
CHAPTER 7 – CONCLUSION AND RECOMMENDATION.....		62
7.1	Conclusion.....	62
7.2	Recommendation.....	63
7.2.1	Use A Higher Performance Of Dynamo.....	63
7.2.2	Appropriate Attack Angle For Propeller.....	63
7.2.3	Improve The Fundamental Experiment Procedure.....	63
7.2.4	Cover The Bevel Gear.....	63
7.2.5	Cover The Exposed Shaft.....	64
7.2.6	Platform Utilization To The Water Current Turbine.....	64
BIBLIOGRAPHY.....		65
APPENDIX 1		68
APPENDIX 2.....		69
BACK COVER: Engineering Drawing Of Water Current Turbine [The Final Design]- Compact Disk.		

LIST OF FIGURES

Figure 1.1	Energy Usage In United State Of America.....	2
Figure 1.2	Worldwide Energy Usage.....	3
Figure 1.3	Energy Sources Reservation For United State Of America.....	3
Figure 1.4	Worldwide Energy Reservation.....	4
Figure 1.5	Tidal Power Plant Across The Rance River in France.....	7
Figure 1.6	Flowing water drives the blades of the water turbine. The turbine rotates the generator shaft to produces electricity.....	8
Figure 1.7	Kinetic energy from the waves used to impact the turbine and then, the turbine spin the generator to generate electricity.....	9
Figure 1.8	This Mini-OTEC research facility, which successful generated 50,000 watts of electricity energy.....	10
Figure 1.9	Simplified diagram of an OTEC plant in operation.....	11
Figure 1.10	Illustration Fourneyron radial-outflow hydraulic turbine.....	14
Figure 2.1	Application ranges of various types of water turbine, plotted as Q vs H with lines showing constant power determined assuming $n_o=0.8$	20
Figure 2.2	Series I Proto Types 5 kW unit.....	22
Figure 2.3	Two different locations to install the 200W type, PowerPal generator.	23
Figure 2.4	Part Of the PowerPal generator.....	24
Figure 2.5	The Nautilus Turbine.....	25

LIST OF FIGURES

Figure 2.6	Runner: Discharge side with top cover and alternator buckets attached.....	26
Figure 2.7	The Nautilus Turbine' s installation diagram.....	26
Figure 2.8	Alexander Gorlov's helical turbine gets a testing in the tidal currents of Cape Cod Canal in1997.....	28
Figure 2.9	The Helical turbine set up.....	29
Figure 2.10	Shows power output as a function of water speed for both sizes of the turbine.....	31
Figure 2.11	Illustrates The Tyson turbine model.....	31
Figure 2.12	Illustrates front view of Tyson turbine	32
Figure 2.13	Illustrates the side vies of Tyson turbine.....	32
Figure 3.1	Design displayed in four views from AutoCAD 2000.....	35
Figure 4.1	Shows the first prototype design specification.....	37
Figure 4.2	Shows the total rotation of the first prototype by the 1:2 bevel gear.....	38
Figure 4.3	Show cross section and front view of the design.....	39
Figure 4.4	Second water current turbine prototype.....	41
Figure 4.5	Second turbine prototype design cross section.....	42
Figure 4.6	The bevel gear position in 90 ^o and L clip is to ensure the joining between two casings is at an angle of 90 ^o	43
Figure 4.7	Shows new L clip of the third prototype design.....	44
Figure 4.8	Final water turbine prototype design	45
Figure 4.9	Final prototype design in side view.....	45
Figure 4.10	Final prototype design in front view.....	45

LIST OF FIGURES

Figure 4.11	Final prototype design in back view.....	45
Figure 4.12	Final prototype design in different angle view.....	46
Figure 4.13	Final prototype design in wire frame display.....	46
Figure 4.14	Shows the prototype dimension at bottom part of final water current turbine design [dimension is in mm unit].....	47
Figure 4.15	Shows the dimension of upper part of the final design [dimension in mm unit].....	48
Figure 4.16	Shows dimension of the main body [dimension in mm unit].....	49
Figure 4.17	Shows the dimension of the propeller [dimension in mm unit]....	50
Figure 4.18	Show the final design part assembly.....	51
Figure 4.19	Picture of final design side view [photograph]	53
Figure 4.20	Another side view of final design picture [photograph].....	53
Figure 5.1	The experiment apparatus setup.....	56
Figure 6.1	Data from the first experiment.....	58
Figure 6.2	Data from the second experiment.....	58
Figure 6.3	Data from the third experiment.....	59
Figure 6.4	Average data from all experiments.....	59
Figure 6.5	Conversion of Hz unit into cm s^{-1}	60

LIST OF TABLES

Table 1.2	Distribution of harnessed and harnessable potential of hydraulic power.....	19
Table 2.2	Additional information to select turbine type for plant capability efficiency	21
Table 2.3	Data detailed for MHG-200W, MHG- 500W and MHG – 1000W types of characteristic	23
Table 4.1	First water current design material selection and material specification	40
Table 4.2	Material selections and specification of final design	52
Table 5.1	Experiment devices and its purpose.....	54
Table 5.2	Water current turbine model prototype experiment procedure.....	55
Table 6.1	Result between voltage produces by the turbine and velocity of water flow in ten different experiments.....	57

CHAPTER 1

INTRODUCTION TO ENERGY

1.1 Types of Energy Sources

All energy available on earth derived from the sun. Plants capture radiant energy, which is produced by the sun, and the energy is used to convert the CO_2 and H_2 in carbohydrate [in form of sugar]. Energy sources can be categorized into three types; exhaustible, renewable energy and inexhaustible energy sources

1.1.1 Exhaustible Energy Sources

Exhaustible energy sources cannot be replaced once they are used up. Exhaustible energy sources are found under ground, in high-pressure condition and special task is required to find them. Examples of exhaustible energy sources are fossil fuel such as petroleum, natural gas, uranium and coal. Nowadays, the most used exhaustible energy source is oil and about 90 percent of world populations use this energy for transportation, and heat generation. Combustion residue from fossil fuel burning is the main air polluter especially from the petrol and diesel engine used in transportation. [Bohn., et. al., 1986]

1.1.2 Renewable Energy Sources

Renewable energy can be used indefinitely if they are properly managed, woods and plants are some of example for renewable energy. However, this energy can also be classified as exhaustible energy when if this sources are not well managed. For

example, when cutting too many trees and no action to replant, it will be depleted. Other examples of renewable energy sources are gasohol, methanol and bioconversion.

1.1.3 Inexhaustible Energy Sources

Inexhaustible energy is an energy source, which will always be available. Examples of this type of energy are solar energy, hydroelectric, wind, tides, ocean thermal, solar salt ponds, hydrogen and geothermal energy.

1.2 The Use and Availability of Energy

Over 90 percent of energy used in United States Of America is based on three fuels such as oil, coal and natural gas. [Bohn., et. al., 1986]

Figure 1.1 and Figure 1.2 show the usage of these fuels for United States Of America and worldwide respectively.

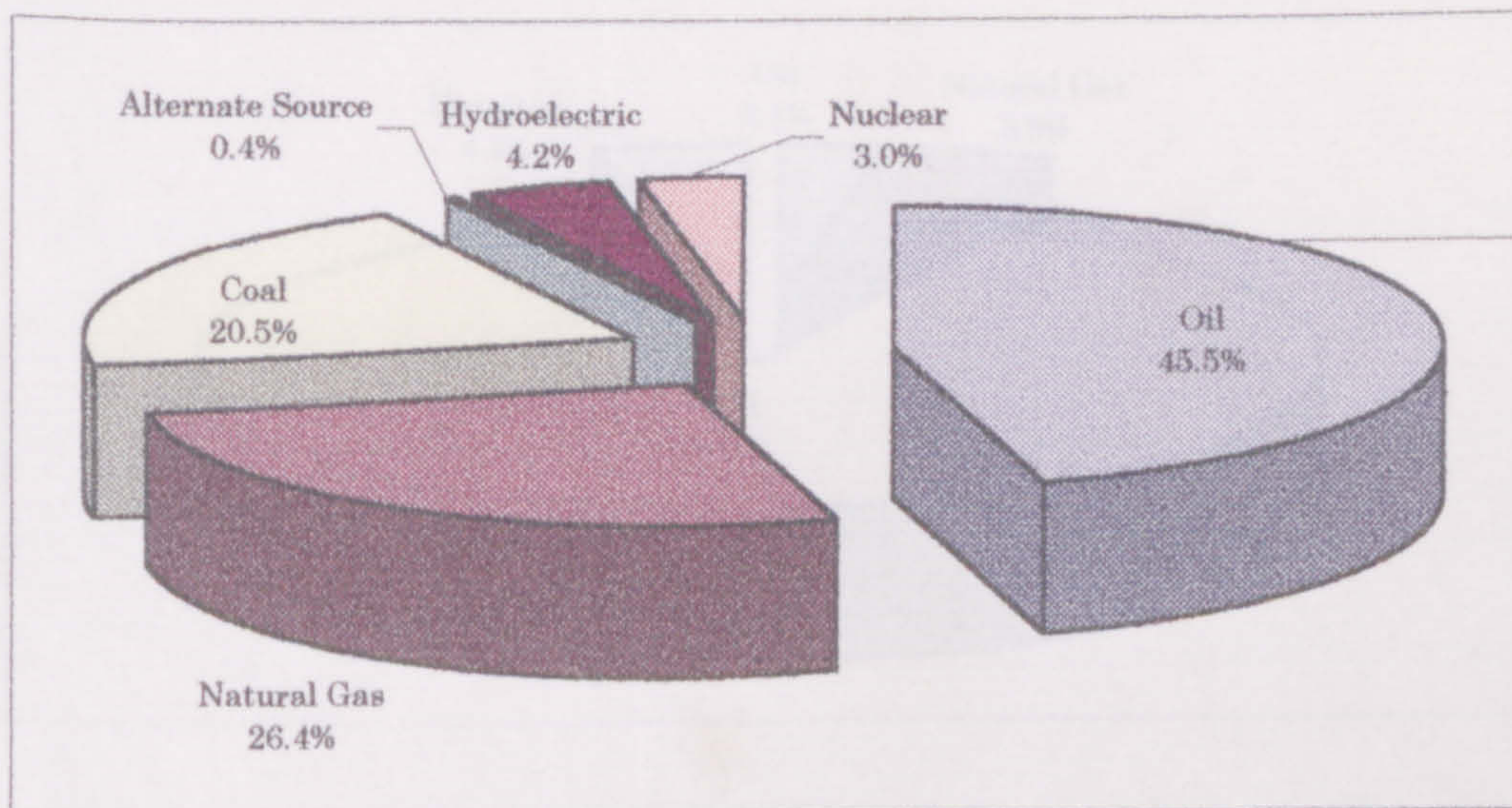


Figure 1.1: Energy usage in United States Of America. [Bohn, et. al., 1986]

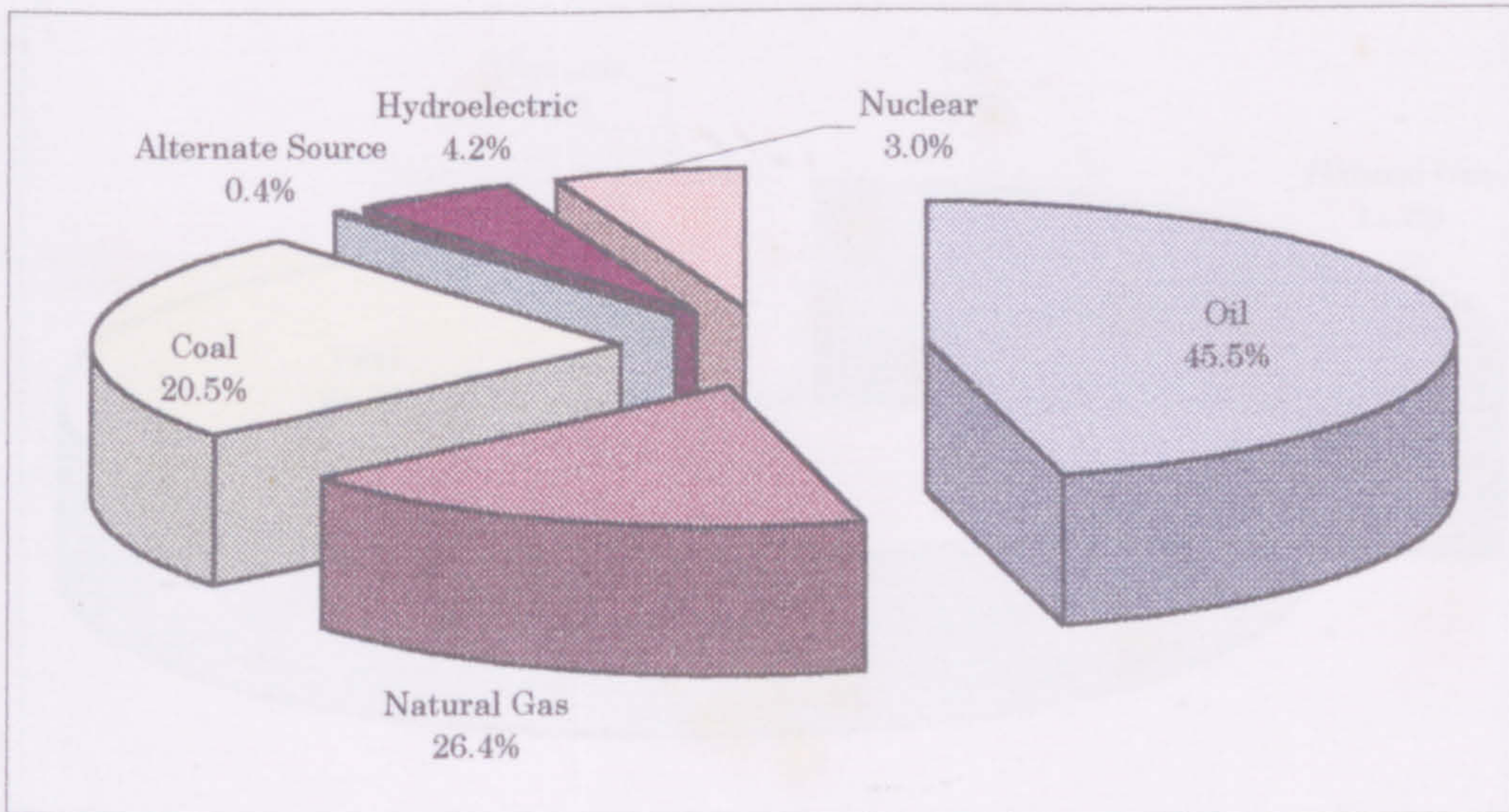


Figure 1.2: Worldwide energy usages. [Bohn., et. al., 1986]

Figure 1.1 and Figure 1.2, show three most important energy sources. Coal, oil and natural gas which, are fossil fuel. About 45% of total energy consumption, both in United States Of America and worldwide derived from oil. The remaining energy sources are hydroelectric and nuclear energy. Alternate source, which include solar energy is contributing less than one percent of current energy usage.

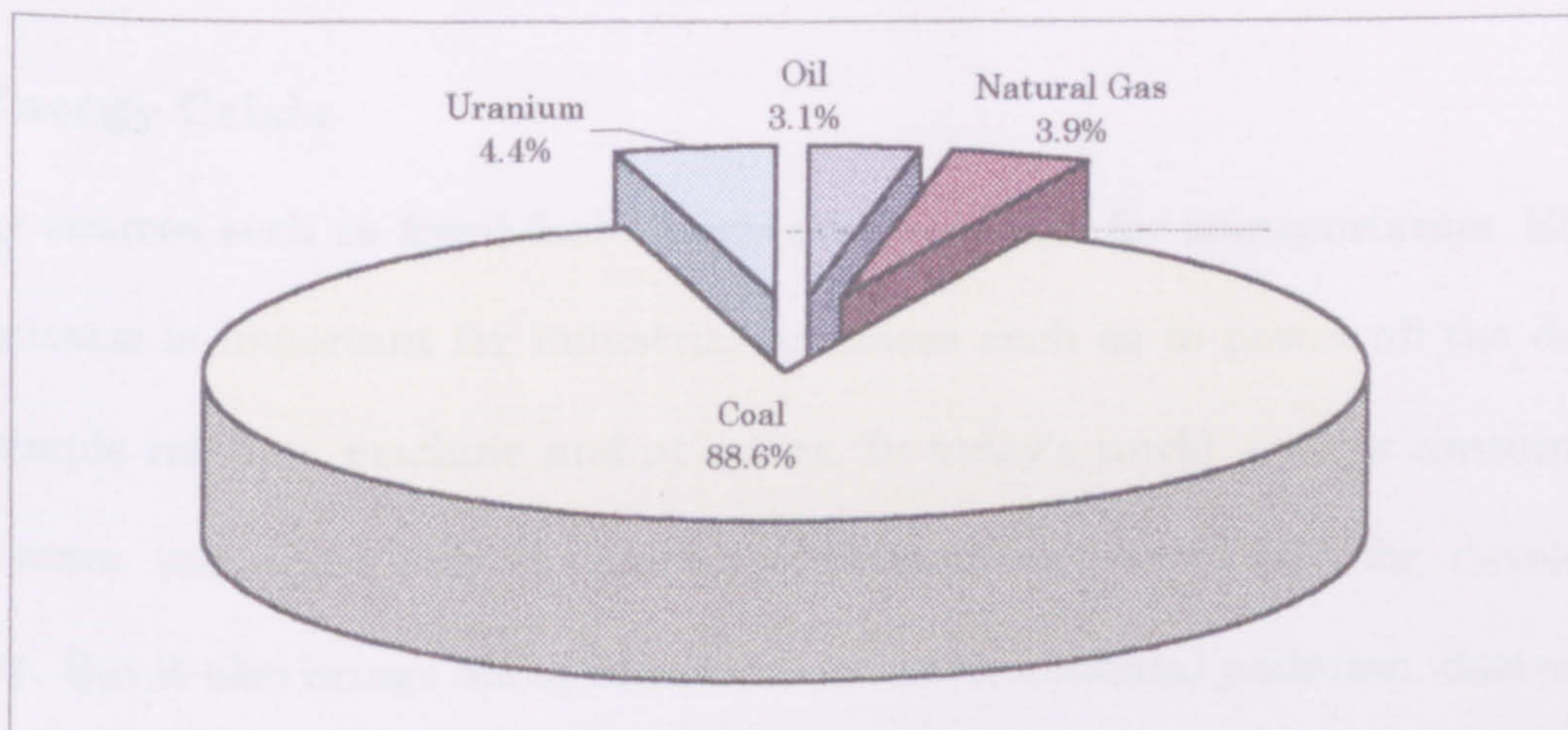


Figure 1.3: Energy source reservation for United State of America.[Bohn., et. al., 1986]

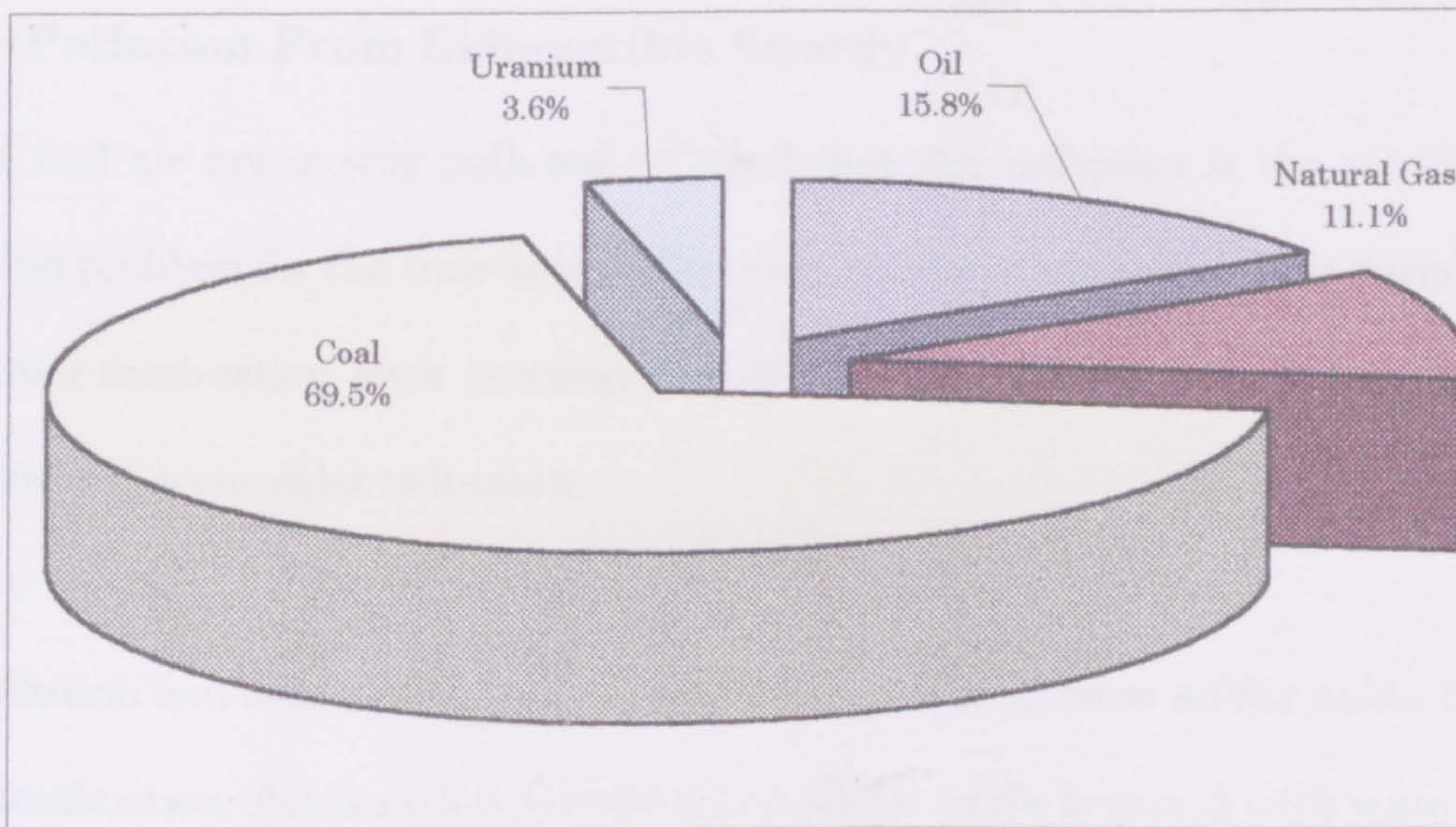


Figure 1.4: Worldwide energy reservation. [Bohn., et. al., 1986]

From the **Figure 1.3** and **Figure 1.4** show that oil reserves storage in both United States of America and worldwide are limited but it, is the most consumed fuel. In order to avoid the energy supplies shortage, the development of new technologies for inexhaustible or renewable energy for utilization should be improved.

1.3 Energy Crisis

Energy sources such as fossil fuel energy are important for transportation. Electric transmission is important for industrial processes such as to power all the devices for example robotics, machine and et cetera. In today's world, energy consumption plays main important role in economic development especially for developing country. But it also brings along crisis such as environmental pollution, destruction of natural environmental and higher demand energy.

1.3.1 Pollution From Exhaustible Energy

Water and air are mostly polluted by fossil fuel. Air pollution is the world's main pollution problem for the time being. The main source of air pollution is derived from fossil fuel combustion such as smog and carbon monoxide and these two elements are toxic and hazardous to human.

Air pollution can cause acid rain. Acids rain is produced from sulfur oxide through fossil combustion. Acids rain is formed when sulfur oxide is mixed with water vapor in the sky and it can destroy all living things.

1.3.2 Increase In Energy Prices

Currently, there is an increase in demand for hydrocarbons especially, oil and natural gas, as these the sources are convenient to be used [Bansal., et.al., 1990]

The price of fossil fuels such as petroleum and diesel escalated due to high demand in the transportation industry and power generation

1.3.3 Energy Difficulties At Rural Places

Many developing countries have energy distribution or supply problem especially for electricity generation. To solve this problem, petrol or diesel fuel engine is used to generate electricity by the mean of generator. The cost of fuel use is elevated tremendously due to transportation purposes. This can be reduced if fuel can be obtained within close vicinity to the demand.

1.3.4 Environment Impact

Inexhaustible energy is the best replacement for exhaustible energy. But a part of that, it also causes several problems. Conventional way to harvest electricity from river tidal energy is to build water dam for hydroelectric plant station. However, to build hydroelectric power station high cost is needed for engineering services, infrastructure and high cost operation. The water dam can change the water current flow pattern. This will destruct the marine habitat.

Nowadays, Bakun Hydroelectric claimed to be the second world largest world water dam. Bakun hydroelectric will generate 2, 400 M of electricity. [Allison, 2001]. However, Bakun hydroelectric is can be the hazardous structure when the water is leaking. The dam destruction could cause big flood to the surrounding area, especially at low elevation land.

1.4 Energy From Ocean

The world's ocean can provide three types of inexhaustible energies, namely wave energy, tidal energy and thermal energy. All of these energies are air pollution free and they have potential as major energy sources.

1.4.1 Tides Energy

Water raises and falls in a regular sequence everyday. The change of water level height is called tidal activity and this tide phenomenon is affected by the pull of the moon gravity. This occurs when the earth spins on its axis and the moon gravity pulls on part of earth. Raised water surface is called high tide, while the lower water

is called low tide. Both high and low tides are about six hours each. Thus, the water level changes its height four times per day. The different height of the water could be utilized for electricity generation. To get this ocean's inexhaustible energy a bay area with potential tide energy to be bounded with a dam.

Dam is closed when high tide approaches. But once the tide is at highest level, the water is allowed to go through the bay. Turbine is used to generate electricity when the water flows into the dam.

When the tide retreats, the dam is closed again and this will trap the high tide water behind the dam in the bay. When the ocean level is at its lowest, the dam is opened to allow water flowing back to the ocean and once again turn the turbine.

Figure 1.5 shows the huge water dam for hydroelectric power plant located at Rance River in France. **Figure 1.6** portrays the components for the tidal hydroelectric power plant.

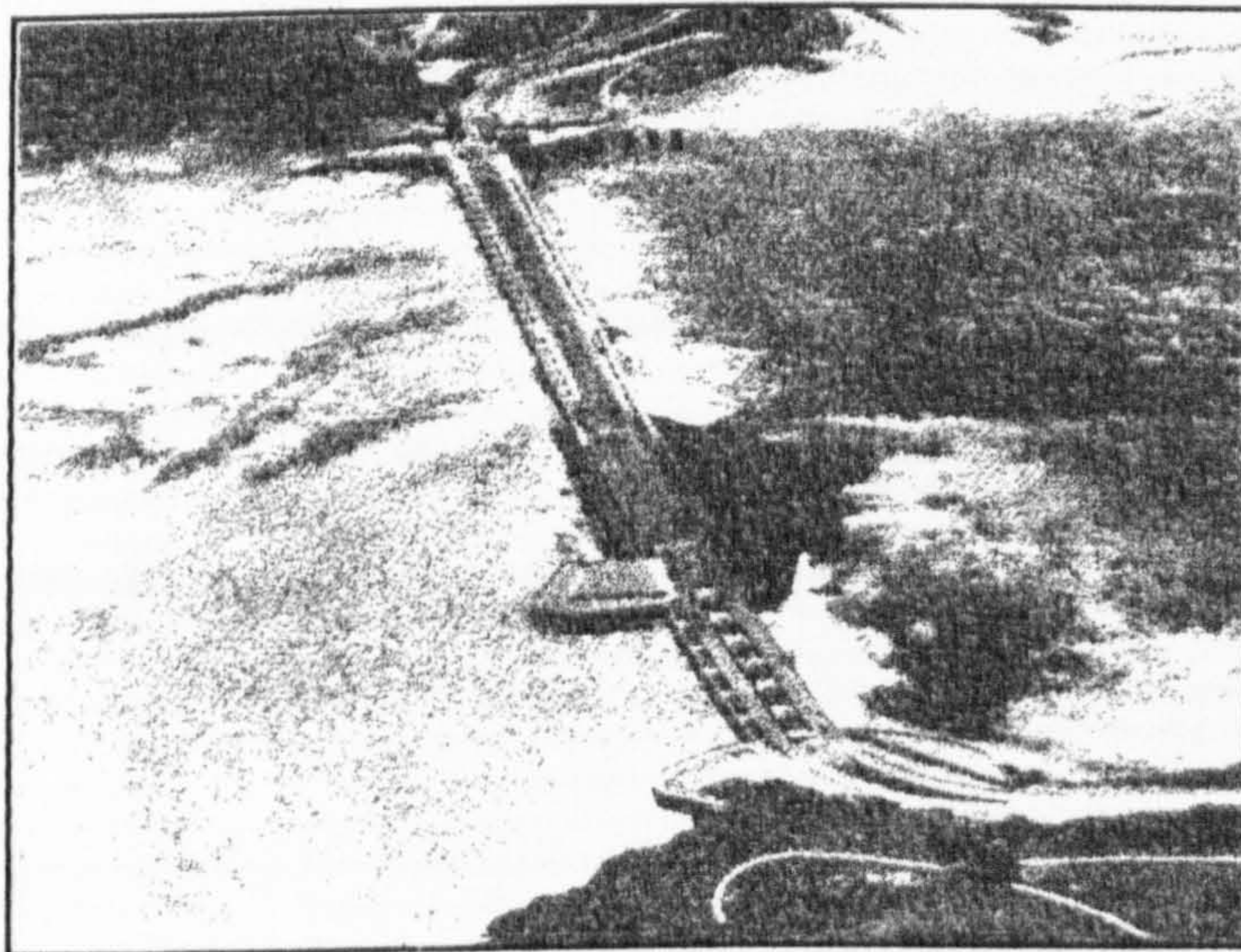


Figure 1.5: Tidal power plant across the Rance River in France, which can produce 10 megawatt of electrical power. [Bohn., et., al., 1986]

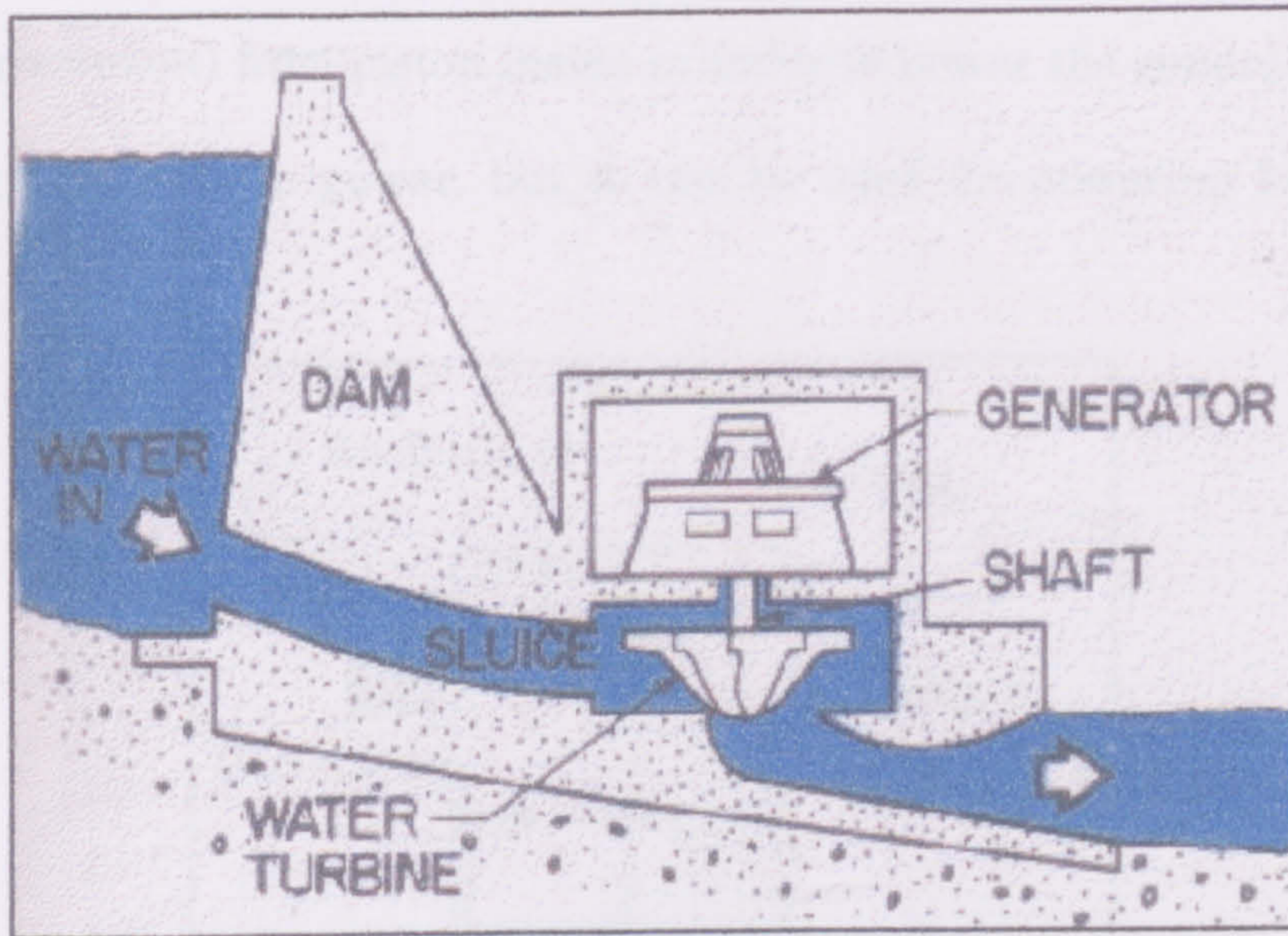


Figure 1.6: Flowing water drives the blade of the water turbine. The turbine rotates the generator shaft to produce electricity. [Bohn., et., al., 1986]

1.4.2 Wave Energy

The ocean waves highly consist of kinetic energy, which can be invested to generate electric energy with the utilization of turbine. A generator is connected to the turbine is used to produce electricity.

As the waves rise into a chamber, the rising water level forces the air out of the chamber. This compressed air spins a turbine, which then turn the generator.

Figure 1.7 portrays that generation of the kinetic energy from waves for electricity generation.

When the wave retreat, air flows through the turbine and back into the chamber through doors that normally closed. Another method is by applying movement (up