

AWARENESS ON RENEWABLE ENERGY AMONG GENERAL POPULATION - A SURVEY

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ABSTRACT :

Heavy dependence of fossil fuels among people contributes to GHG emissions and air pollution. This survey assesses the awareness of renewable energy sources among the general population. Various factors and benefits of switching back to renewable energy sources includes reduction in atmospheric pollution and saving from monthly energy bills can be done if solar energy was used instead of electrical energy. With the advancement of smart technologies conversion of renewable energy from one source to another became easier, This study consists of structured questionnaires administered to participants through online google forms link. The data was collected and statistically analysed using SPSS software. The people were aware of the benefits of renewable energy, they needed to educate the society regarding the prevention of environment pollution by switching to renewable energy sources consumption. The association between groups was assessed by Chi Square test where $p < 0.05$ was considered statistically significant. This study concludes that there is awareness upto a certain extent among people on renewable energy sources. Even though not significant, the majority of the 15 to 20 years aged study population knows better about renewable energy than the other age groups. The awareness about the benefits of renewable energy is required for a better future.

KEYWORDS: Geothermal energy, renewable energy, sustainable, solar energy, online survey.

INTRODUCTION:

Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves and geothermal heat(Houri, 2006; Aliyu, Dada and Adam, 2015). Renewable energy often provides energy in four important areas like electricity generation, air and water and rural energy services. This is completely in contrast to non renewable sources such as fossil fuels(Ellabban, Abu-Rub and Blaabjerg, 2014). Prior to the development of coal in the mid 19th century, nearly all energy used was that of a renewable source. Almost without a

doubt the oldest known use of renewable energy-dates to more than a million years ago(Rodríguez-Urrego and Rodríguez-Urrego, 2018).

Many studies and surveys have been conducted on this topic over the years, with aims like to understand public opinion on renewable energy is derived directly or indirectly from the sun. Sunlight can be captured directly using solar technologies, the sun's heat drives winds, whose energy is captured with turbines. Plants also rely on the sun to grow and their stored energy can be utilised for bioenergy(Heinloth, no date; Kohl and Dürrschmidt, 2013) as demonstrated by studies done on this topic.

Studies on topics like In Silico analysis(Ponnulakshmi *et al.*, 2019)(Surapaneni and Jainu, 2014), gold nanoparticles(Ke *et al.*, 2019; Wu *et al.*, 2019), apoptosis(Ma *et al.*, 2019; Li *et al.*, 2020), constituents of ginger(Chen *et al.*, 2019), zinc oxide nanoparticles((Chen *et al.*, 2019; Wang *et al.*, 2019), zingerone(Gan *et al.*, 2019), myristica fragrans houtt(Rengasamy *et al.*, 2018; Gan *et al.*, 2019), cytotoxicity in strawberry extract(G *et al.*, 2018), purification of alkaline protease(Rengasamy *et al.*, 2016; Shukri *et al.*, 2016), cytotoxicity in pineapple extract(Menon, V and Gayathri, 2016), Garcinia mangostana(Jainu, Priya and Mohan, 2018), steatohepatitis (Mohan, Veeraraghavan and Jainu, 2015) and awareness on child obesity(Shukri *et al.*, 2016) enriched my knowledge. This epidemiology study is stemmed out for the current use of our community.

Not all renewable energy sources rely on the sun, for example: geothermal energy utilizes the earth's internal heat, tidal energy relies on the gravitational pull of the moon and hydropower relies on the flow of water. While renewable energy systems are better for the environment and produce less emissions than conventional energy sources, many of these sources still face difficulties in being deployed at a large scale including, but not limited to, technological barriers, high start-up capital cost and intermitteray challenges(Zakarya, 2018), In today's world the demand for non-renewable energy sources increases as people use less renewable energy(Dileep, 2020). Thus the aim of this survey is to assess the awareness among general population on renewable energy

MATERIALS AND METHODS:

This survey is prospective observational study, the advantages of this study were it was economical, easy to create and believed to have a wide reach, gathers large data, quick interpretation and involves a heterogeneous population. This survey has been approved by the scientific review board, Saveetha Dental College, Chennai. The sample size of this survey includes 100 adults in the age group of 25-50 years old and this survey was administered from March - May 2020.

Previous literature on this topic includes a survey on public awareness towards renewable energy in turkey, where a survey dependent on gender, age was conducted(Irmak *et al.*, 2014), with this study according to education politics, environment and energy factors, assessments are made trying to uncover the relationship between these factors(Kacan, 2015). In another study the questions were focused on sustainable energy and its management and the benefits of renewable energy usage in sustaining many important resources(Mishra, 2016). The sampling method for survey conducted by Erdal(Irmak *et al.*, 2014; Mishra, 2016) is a non-probability convenient method, its sample size includes 332 people from various universities in Turkey aged below 28 years and above 18 years.

A self structured questionnaire, comprising 15 questions, was administered by an online survey planet link which contains outputs such as demographic information, application, advantages, method of representing each output variable including pie charts and bar diagrams.

Data was statistically analysed and the chi square test was done by SPSS software and results were represented by pie charts. The association between groups was assessed by Chi Square test where $p < 0.05$ was considered statistically significant.

RESULT AND DISCUSSION:

In figure 1 the pie chart represents the age group where 66.99% of the respondents belonged to the age group of 15-20 years and 20.39% belonged to the age group of 21-29 years and 12.62% were from the age group of 30 years and above. In figure 2, the pie chart represents the gender of the respondents in which it shows 63.11% were male, 35.92% were female and 0.97% were others. In Figure 3, the pie chart represents whether renewable energy is naturally replenishable or not for which 81.55% said yes and 18.45% said no. In figure 4, the pie chart represents the types of renewable energy and 43.69% said one type, 33.98% said 2 types, 18.45% said 3 types, 1.94% said 4 types and 1.94% said 5 types. In figure 5, the question was to name renewable energy sources and 74.76% said sun and wind and 25.24% chose coal and petroleum.

In figure 6 the pie chart represents the responses on A.C. Becquerel found which type of renewable energy, 82.52% said solar energy and 17.48% said wind energy. In figure 7, the question was how much renewable energy we use, and 66.02% said more than 30% energy is used and 33.98% said less than 30% is used. In figure 8, the question was about how geothermal energy is derived, 63.11% said its heat derived and 36.89% said electricity derived. In figure 9, the question was about which source produces the most pollution and 60.19% said solar and 39.81% said geothermal. In figure 10 the question was about which source of energy is more expensive and 73.79% said renewable and 26.21% said non renewable. In figure 11, the question was which source of energy is more efficient, 60.14% said biomass and 37.86% said solar energy. In figure 12, the question asked was can renewable energy reduce pollution, 29.13% said agree, 38.83% said strongly disagree, 18.45% said disagree, 7.77% said strongly agree and 5.83% said neutral. In figure 13, the question was about the percentage of available renewable energy in the world, 71.84% said more than 70% and 28.16% said less than 70%. In figure 14, the question was whether renewable energy does any good for the environment, 49.51% said yes and 37.86% said no and 12.62% said maybe. In figure 15 the pie chart represents the percentage distribution of who is leading in renewable energy consumption, where 59.22% said India and 40.78% said Germany. In figure 16, the pie chart represents disadvantages of renewable energy sources, 73.79% said conversion of its form and 26.21% said availability. In figure 17 the pie chart represents percentage distribution of where does India rank among top 10 countries in the world in renewable energy consumption, where 81.55% said among top 10 and 18.45% said among top 10 countries.

In figure 18, the bar graph shows the association between age and responses to awareness on renewable energy. 61% of people aged 15-20 years, 12% of people aged 20-30 years, 11% of people aged more than 30 years have answered that energy is naturally replenished. Majority of 15 to 20 years knows about renewable energy than the others but on analysis there was no statistical significance between different age groups and responses to awareness on renewable energy (p -value >0.05). In figure 19 shows the association between age and responses on types of renewable energy. 35% of people aged 15-20 years, 6% of people aged more than 30 years have answered that renewable energy is only 1 type, whereas 8% of people aged 20-30 years have answered 3 types. Majority of the 15 to 20 years aged population knows the types of renewable energy than the other age group but on analysis there was no statistical significance between age groups and responses on types of renewable energy (p -value >0.05). In figure 20, the bar graph shows the association between age and responses on the name of renewable sources used. 55% of

people aged 15-20 years, 15% of people of age group 20-30 years and 7% of people aged more than 30 years have answered sun and wind. Majority of the 15 to 20 years aged study population knows about the sources of renewable energy than other age groups, but on analysis there was no statistical significance between age group and responses on the name of renewable sources used(p -value >0.05). In figure 21, the bar graph shows the association between age and responses on what A.E Becquerel found. 62% of people aged 15-20 years, 14% people aged 20-30 years and 9% of people aged more than 30 years have answered energy he found solar energy. Majority of the 15 to 20 years aged study population knows correctly that Becquerel found the solar energy more than the other age groups, but on analysis there was no statistical significance between age group and responses(p -value >0.05). In figure 22, the bar graph shows the association between age and responses on percentage of energy obtained from renewable sources.51% of people aged 15-20 years and 14% of people aged 20-30 years have answered $>30\%$, whereas 10% of people aged more than 30 years have answered $<30\%$. Majority of the 15 to 20 years aged population knows the level of energy obtained from renewable sources than the other age groups, but on analysis there was no statistical significance between age group and responses on percentage of energy obtained from renewable sources(p -value >0.05). In figure 23, the bar graph shows the association between age and responses on how geothermal energy is derived. 51% of people aged 15-20 years, 11% of people aged 20-30 years have answered heat derived, whereas 10% of people aged more than 30 years old have answered electricity derived. Majority of the 15 to 20 years aged population knows how the geothermal energy is derived than the other age groups. However, the difference is not statistically significant(p -value >0.05).

In figure 24, the bar graph shows the association between age and responses on which renewable energy produces most pollution.48% of people aged 15-20 years have answered solar, whereas 12% of people aged 20-30 years and 8% of people aged above 30 years have answered Geothermal.Majority of the 15 to 20 years aged population knows the type of renewable energy produces more pollution than the other age groups. However, the difference is not statistically significant($p>0.05$). In figure 25,the bar graph shows the association between age and responses on the source of energy that is more expensive.55% of people aged 15-20 years, 13% of people aged 20-30 years and 8% of people aged more than 30 years old have answered renewable.Majority of the 15 to 20 years aged population knows renewable energy is more expensive than the other age groups. However, the difference is not statistically significant($p>0.05$).In figure 26, the bar graph shows the association between age and responses on renewable sources that is more efficient. 51% of people aged 15-20 years and 11% of people aged 20-30 years old have answered biomass, whereas 11% of people aged more than 30 years old have answered Solar, Majority of the 15 to 20 years aged population knows that biomass is more efficient than the other age groups. However, the difference is not statistically significant(p - value >0.05).In figure 27, the bar graph shows the association between age and responses on will switching to renewable energy sources reduce pollution. 35% of people aged 15-20 years have answered strongly agree, whereas 7% of people aged 20-30 years and 9% of people aged more than 30 years have answered Agree, Majority of the 15 to 20 years aged population strongly agreed to switching to renewable energy sources to reduce pollution than the other age groups. However, the difference is not statistically significant.

In figure 28, the bar graph shows the association between age and responses on the percentage of renewable energy available. 13% of people aged 20-30 years have answered more than 70%, whereas 8% of people aged more than 30 years old have answered less than 70%. Majority of the 15 to 20 years aged population knows that more than 70% of renewable energy available than the other age groups. However, the difference is not statistically significant(p -value >0.05). In figure 29, the bar graph shows the association between age and responses on whether renewable energy sources do any good for environmental pollution. 35% of people aged 15-20 years have answered no, whereas 13% of people aged

20-30 years and 12 % of people aged more than 30 years have answered yes, Majority of the 15 to 20

years aged population knows that renewable energy sources are also good for environmental pollution than the other age groups. However, the difference is not statistically significant(p -value >0.05). In figure 30, the bar graph shows the association between age and responses on who is leading in renewable energy sources consumption. 44% of people aged 15-20 years and 8% of people aged more than 30 years have answered India, whereas 12% of people aged 20-30 years have answered Germany, Majority of the 15 to 20 years aged population knows that India is leading in renewable energy sources consumption than the other age groups. However, the difference is not statistically significant($p > 0.05$). In figure 31, the bar graph shows the association between age and responses on the number of participants and their view over disadvantages of renewable energy sources. 58% of people aged 15-20 years and 12% of people aged 20-30 years have answered Conversion of forms, whereas 7% of people aged more than 30 years have answered availability, Majority of the 15 to 20 years aged population knows the disadvantages of renewable energy sources than the other age groups. However, the difference is not statistically significant(p -value >0.05). In figure 32, the bar graph shows the association between age and responses on where India stands in renewable energy consumption. 61% of people aged 15-20 years, 13% of people aged 20-30 years and 10% of people aged more than 30 years have answered among the top 10 countries. Majority of the 15 to 20 years aged population knows where India stands in renewable energy consumption than the other age groups. However, the difference is not statistically significant(p -value >0.05).

In a similar survey conducted on beneficial factors of renewable energy in the UK out of 1056 participants 49% felt there is benefit for the environment(Çelikler, 2013), thus in both these surveys public opinion remains positive. A study conducted in the UK 73% of respondents used renewable energy for day to day work. A survey conducted in Canada by majority of the respondents stated that non-renewable energy caused more pollution(Vassileva and Campillo, 2014). Increase in sample size and inclusion of more criteria are the limitations of this survey. Various steps can be taken to conserve non renewable resources and enable the use of renewable resources.

CONCLUSION:

This study concludes that there is awareness upto a certain extent among people on renewable energy sources. Even though not significant, the majority of the 15 to 20 years aged study population knows better about renewable energy than the other age groups. Many measures like usage of more renewable energy sources can be done to reduce the risk of energy source depletion and pollution and increasing the awareness about the pros and usage of renewable energy sources may reduce pollution. However more research on this topic is warranted for a better understanding.

CONFLICT OF INTEREST: No conflict of interest declared.

AUTHOR CONTRIBUTIONS:

Sachin Aditya B: Literature search, data collection, analysis

V. Vishnupriya: Data verification, manuscript drafting

R. Gayathri: Data verification, manuscript drafting

Kavitha S: Data verification, manuscript drafting.

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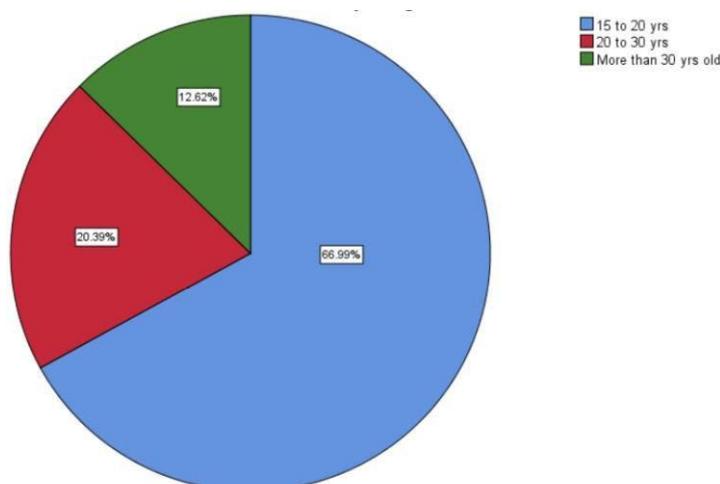


Figure 1: Pie chart represents the percentage distribution of age group of participants. 66.99% responded are aged 15-20 years(blue), 20.39% responded are 20-30 years(red) and 12.62% responded are 30years and above(green).

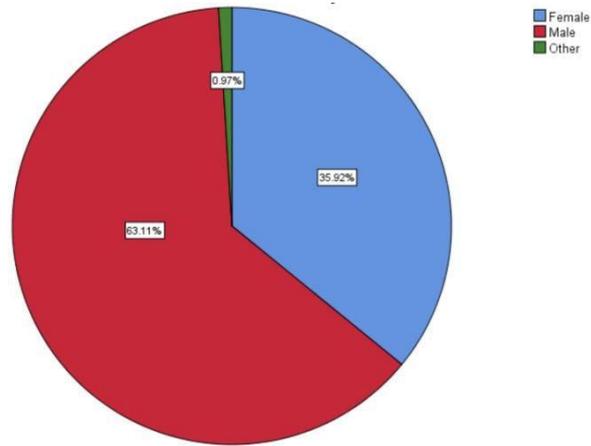


Figure 2: Pie chart representing the percentage distribution of gender of respondents. 63.11% are male(blue) and 35.92% responded are females(red) and 0.97% responded are other(green).

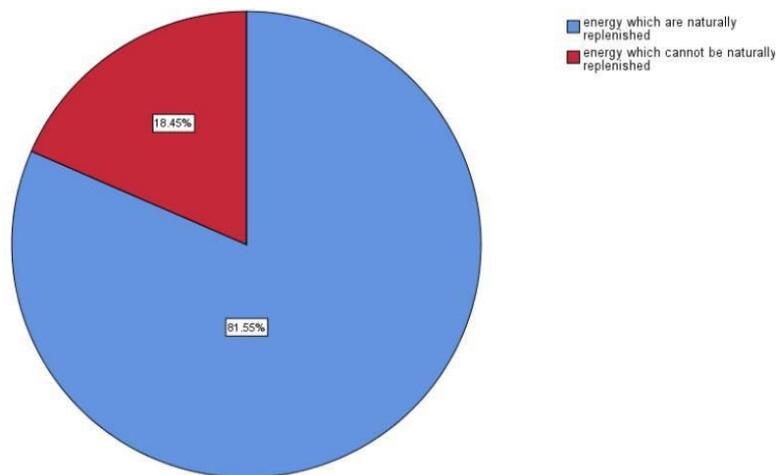


Figure 3: Pie chart representing the percentage distribution of responses about awareness on renewable energy. 81.5% of the study population agreed that it can be naturally replenished (blue), 18.45% of the participants agreed that it cannot be naturally replenished(red).

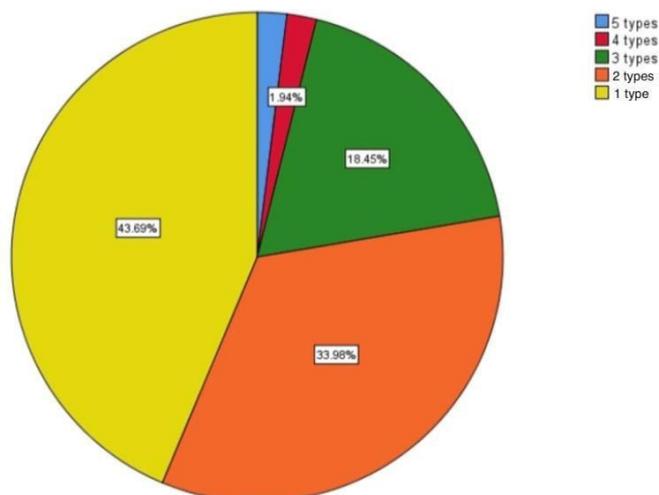


Figure 4: Pie chart representing the percentage distribution of responses about awareness on different types of renewable energy, 43.69% responded for 1 type(yellow), 33.98% responded for 2 types(orange), 18.45% responded for 3 types(green), 1.94% responded for 4 types(red) and 1.94% responded for 5

types(blue).

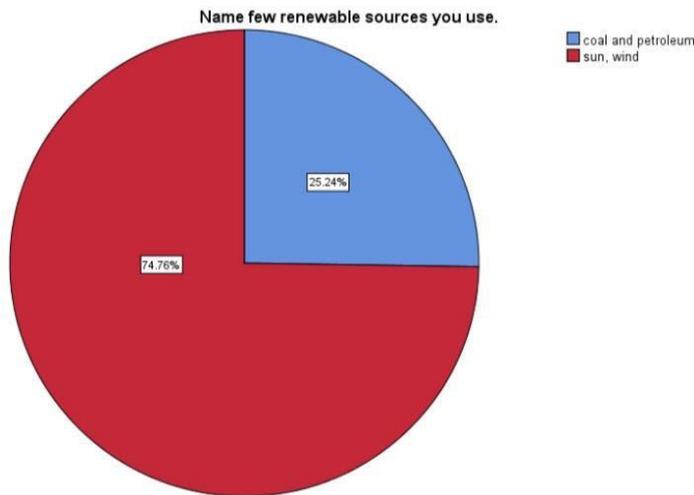


Figure 5: Pie chart representing the percentage distribution of responses about awareness on the sources of renewable energy. 74.76% responded to the sun, wind(red) 25.24% responded to coal and petroleum(blue).

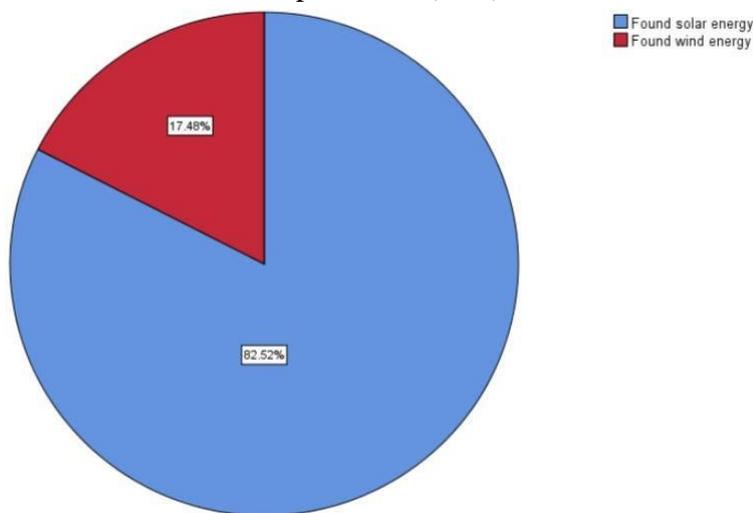


Figure 6: Pie chart representing the percentage distribution of responses about awareness on AE Becquerel found wind energy or solar energy, 82.52%(blue), responded to solar energy and 17.48% responded to wind energy (red).

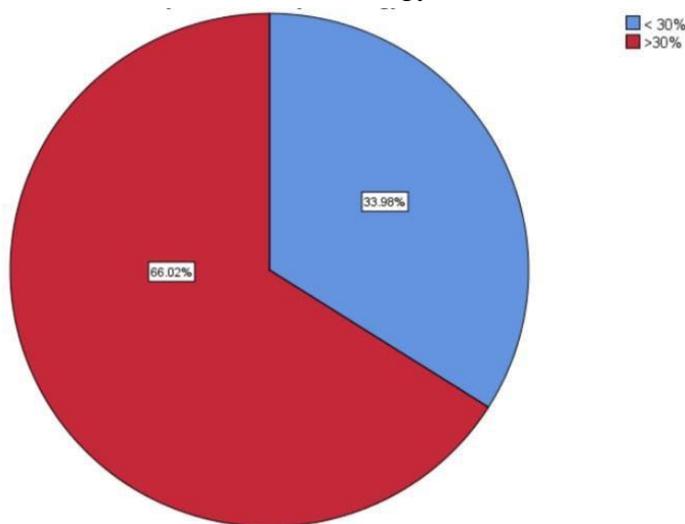


Figure 7: Pie chart representing the percentage distribution of responses about awareness on energy that is obtained from renewable sources, 33.98% responded to <30%(blue) and 66.02% responded to >30%(red).

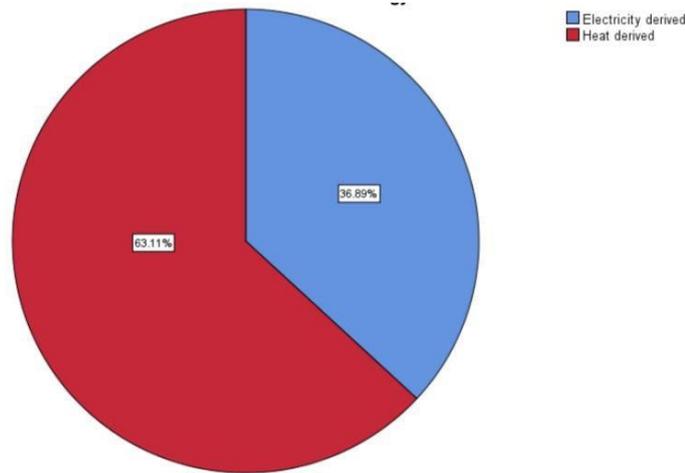


Figure 8: Pie chart representing the percentage distribution of responses about awareness on how geothermal energy is derived, 63.11% responded to Heat derived (red) and 36.89% responded to Electricity derived (blue).

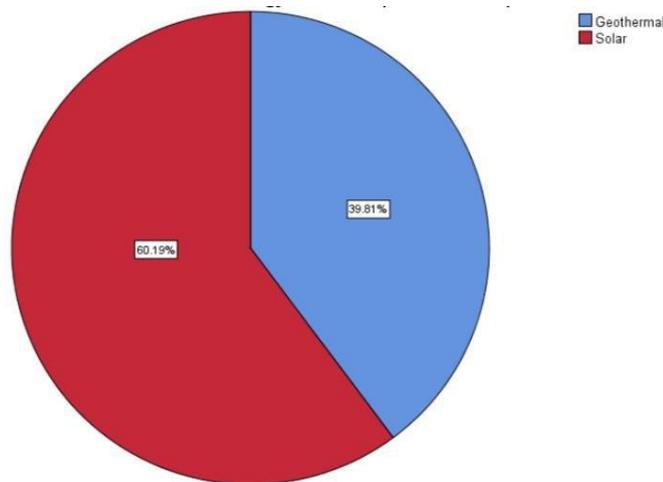


Figure 9: Pie chart representing the percentage distribution of responses about awareness on types of renewable energy which produces pollution, 60.19% responded Solar (red) and 39.81% responded Geothermal (blue).

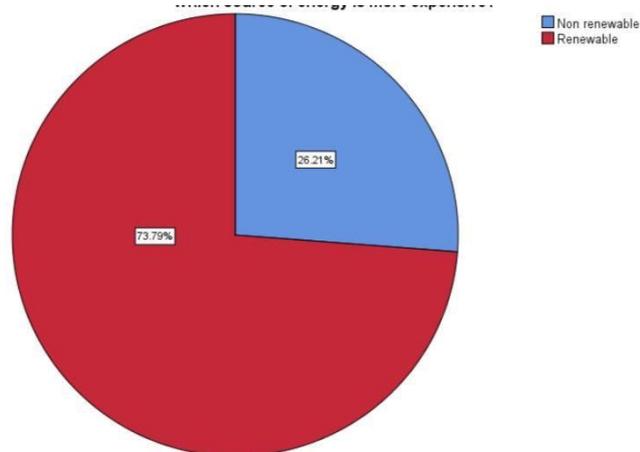


Figure 10: Pie chart representing the percentage distribution of responses about awareness on source of energy which is more expensive. 73.79% responded to renewable (red) and 26.21% responded to non renewable (blue).

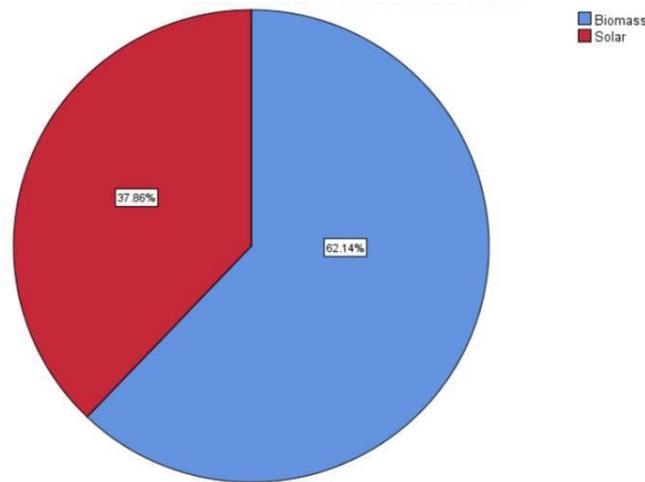


Figure 11: Pie chart representing the percentage distribution of responses about awareness on source of energy which is more efficient. 62.14% responded to biomass(blue) and 39.86% responded to solar(red).

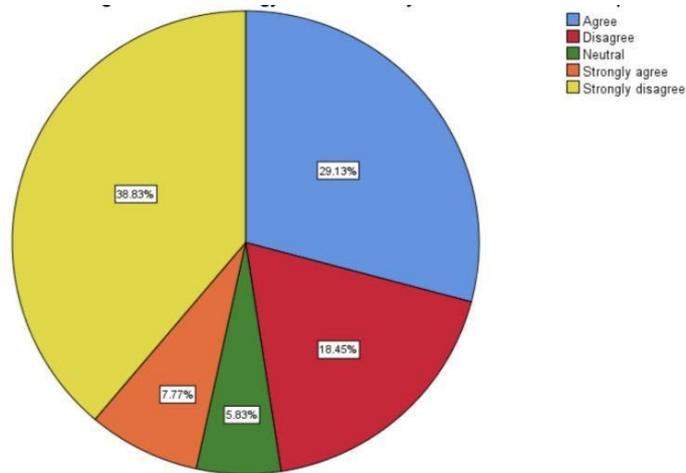


Figure 12: Pie chart representing the percentage distribution of whether people agree on reduction of pollution on switching to renewable sources from non renewable, 18.45% responded Disagree(red), 5.83% responded neutral(green), 38.83% responded strongly disagree(yellow), 7.77% responded strongly agree (orange) and 29.1% responded agree(blue).

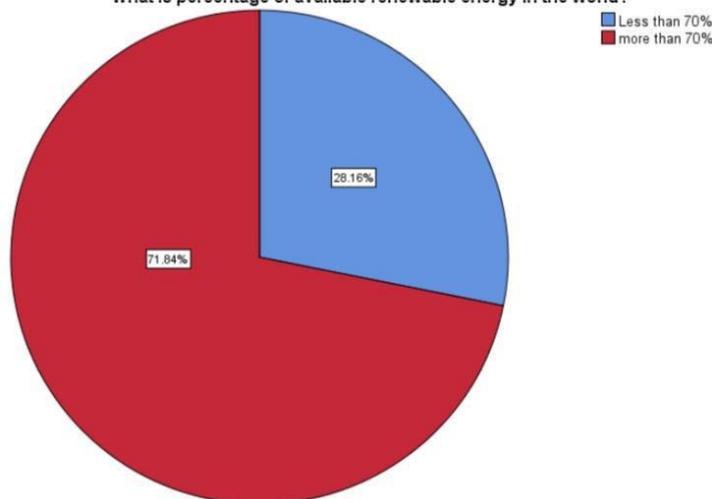


Figure 13: Pie chart representing the percentage distribution of responses about awareness on available renewable energy in the world, 71.84% responded more than 70%(red)and 28.16% responded less than 70%(blue).

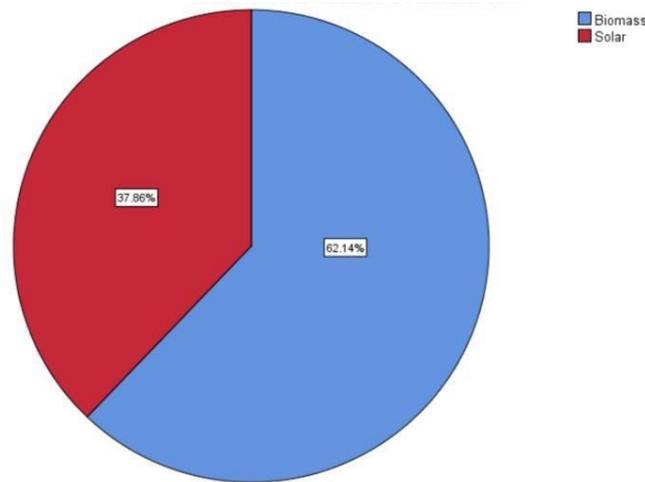


Figure 14: Pie chart representing the percentage distribution of responses about awareness on renewable energy consumption does any good for the environment, 49.51% responded yes(green), 37.86% responded no(red) and 12.62% responded may be(blue).

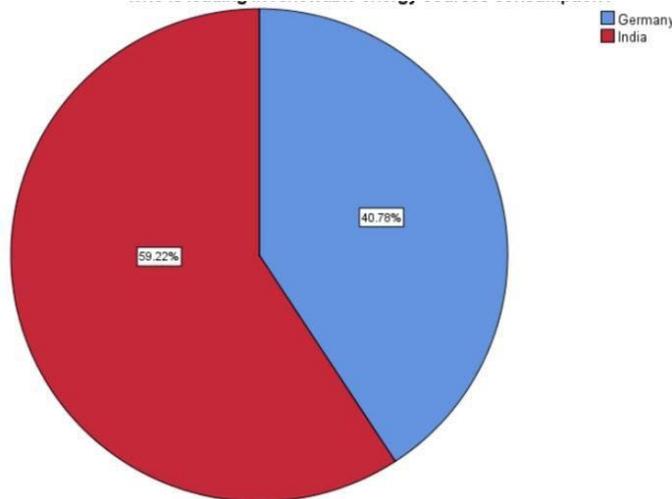


Figure 15: Pie chart representing the percentage distribution of responses about awareness on leading players in renewable energy consumption, 59.22% responded India (red) and 40.78% responded Germany(blue).

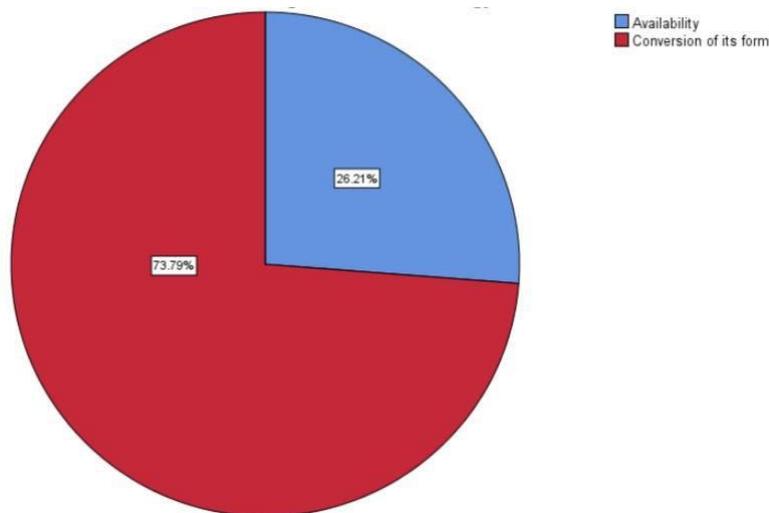


Figure 16: Pie chart representing the percentage distribution of the disadvantages of renewable energy sources, 73.79% responded to conversion of its form(red) and 26.21% responded to availability(blue).

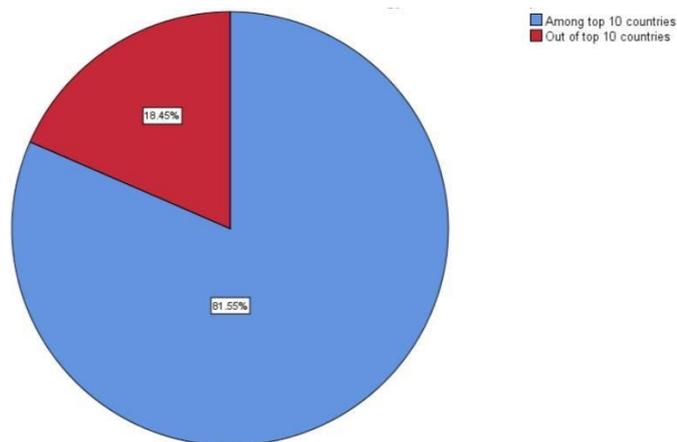


Figure 17: Pie chart representing the percentage distribution of responses about awareness on India's rank in renewable energy source consumption. 81.55% responded among top 10 countries(blue) and 18.45% responded out of top 10 countries(red).

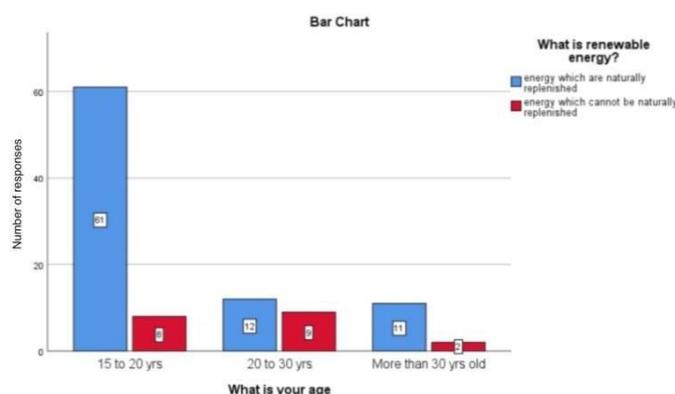


Figure 18: Bar graph representing the association between age(X axis) and responses on awareness on renewable energy(Y axis). Majority of 15 to 20 years knows about renewable energy than the others but on analysis there was no statistical significance between different age groups and responses to awareness on renewable energy. Pearson's Chi square test value=10.553, p value = 0.236 ($p > 0.05$ statistically not significant).

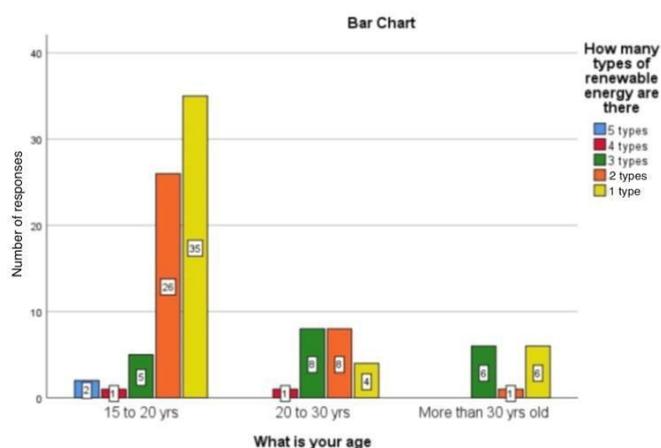


Figure 19: Bar graph representing the association between age (X axis) and responses on types of renewable energy (Y axis). Majority of the 15 to 20 years aged population knows the types of renewable energy than the other age group but on analysis there was no statistical significance between age groups and responses on types of renewable energy. Pearson's Chi square test value = 22.079, p value = 0.116 (> 0.05) hence statistically not significant.

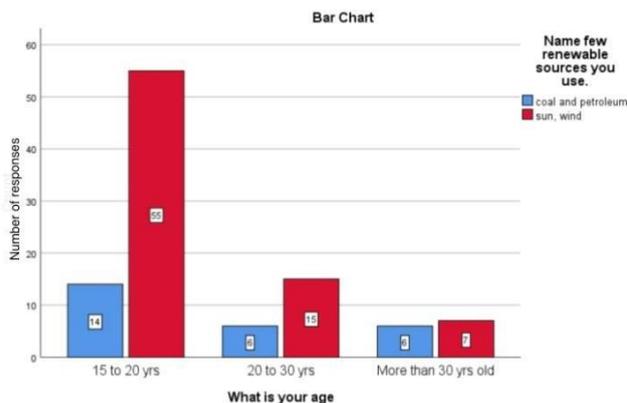


Figure 20: Bar graph representing the association between age(X axis) and responses on name of renewable sources used (Y axis). Majority of the 15 to 20 years aged study population knows about the sources of renewable energy than other age groups, but on analysis there was no statistical significance between age group and responses on the name of renewable sources used. Pearson's Chi square test value= 4.033 , p value = 0.133 (>0.05) hence statistically not significant.

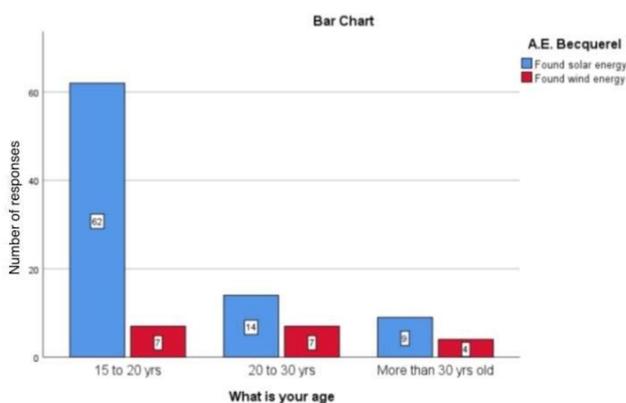


Figure 21: Bar graph representing the association between age(X axis) and responses on what AE Becquerel found(Y axis). Majority of the 15 to 20 years aged study population knows correctly that Becquerel found the solar energy than the other age groups, but on analysis there was no statistical significance between age group and responses. Pearson's Chi square test value= 7.826 , p value = 0.430(>0.05) hence statistically not significant.

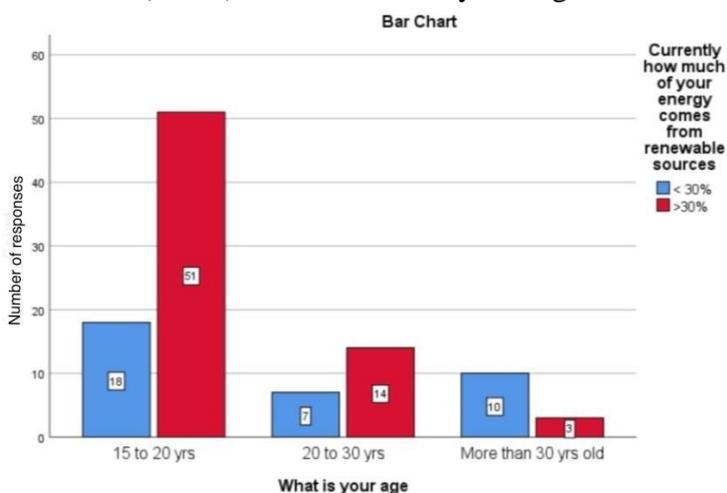


Figure 22: Bar graph representing the association between age (X axis) and responses on percentage of energy obtained from renewable sources(Y axis). Majority of the 15 to 20 years aged population knows the level of energy obtained from renewable sources than the other age groups, but on analysis there was no statistical significance between age group and responses on percentage of energy obtained from renewable sources. Pearson's Chi square test value=12.606, p value =0.327 (>0.05) hence statistically not

significant.

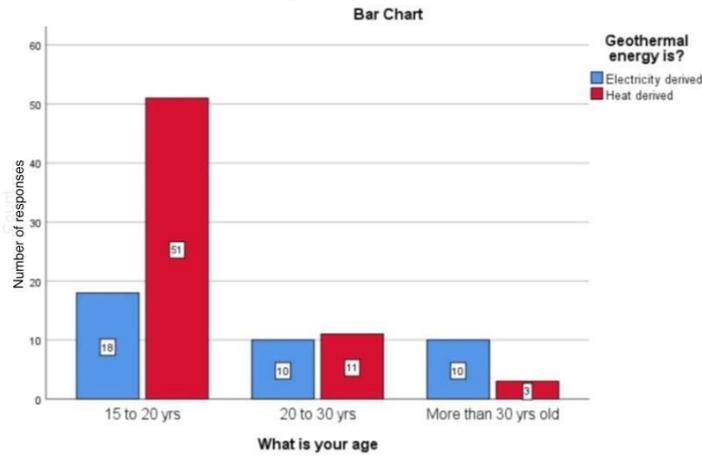


Figure 23: Bar graph representing the association between age(X axis) and responses on how geothermal energy is derived(Y axis). Majority of the 15 to 20 years aged population knows how the geothermal energy is derived than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value= 3.793 , p value = 0.150(>0.05) hence statistically not significant.

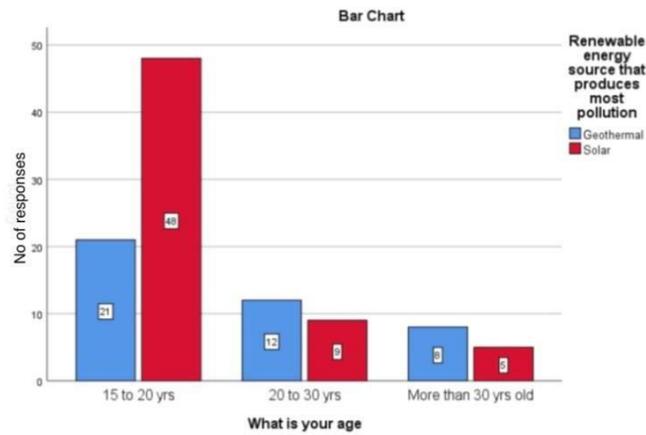


Figure 24: Bar graph representing the association between age(X axis) and responses on which renewable energy produces most pollution(Y axis). Majority of the 15 to 20 years aged population knows the type of renewable energy produces more pollution than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value=16.994,p value = 0.221 (>0.05) hence statistically not significant.

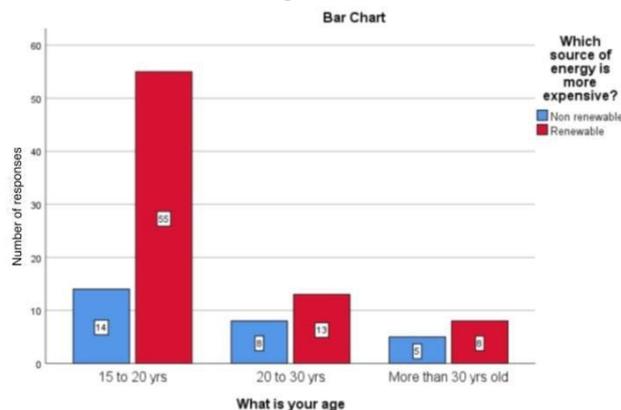


Figure 25: Bar graph representing the association between age(X axis) and responses on the source of energy that is more expensive(Y axis). Majority of the 15 to 20 years aged population knows renewable energy is more expensive than the other age groups. However, the difference is not statistically significant. , Pearson's Chi square test value= 20.211 , p value =0.321 (>0.05) hence statistically not significant.

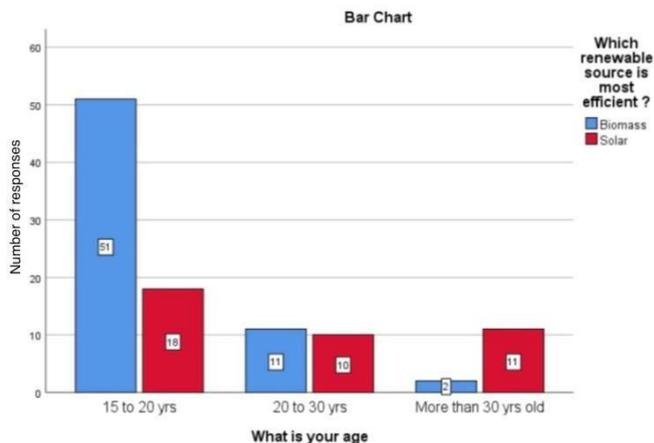


Figure 26: Bar graph representing the association between age(X axis) and responses on renewable sources that is more efficient(Y axis). Majority of the 15 to 20 years aged population knows that biomass is more efficient than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value=18.305 , p value = 0.113 (>0.05) hence statistically not significant.

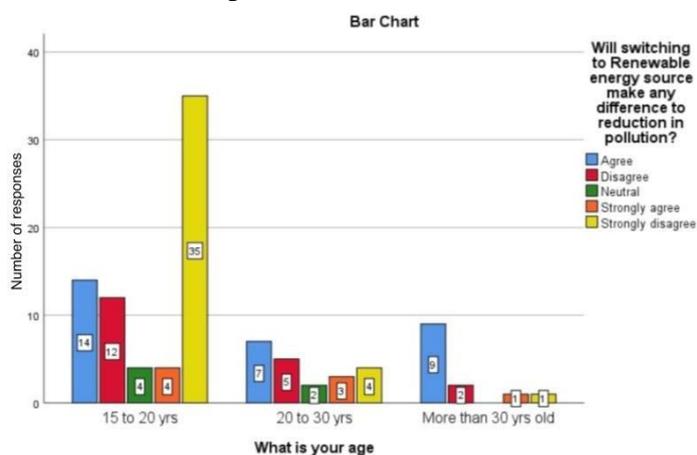


Figure 27: Bar graph representing the association between age(X axis) and responses on will switching to renewable energy sources reduce pollution(Y axis). Majority of the 15 to 20 years aged population strongly agreed to switching to renewable energy sources reduce pollution than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value= 2.948 , p value = 0.229 (>0.05) hence statistically not significant.

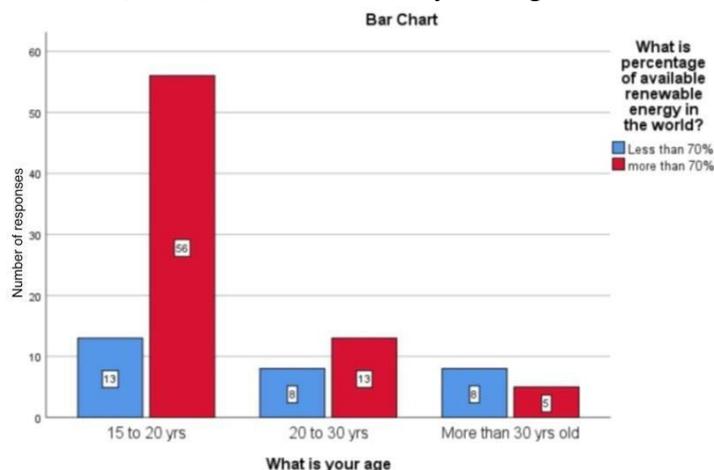


Figure 28: Bar graph representing the association between age(X axis) and responses on the percentage of renewable energy available(Y axis). Majority of the 15 to 20 years aged population knows that more than 70% of renewable energy available than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value=20.211 , p value = 0.112 (>0.05) hence statistically not significant.

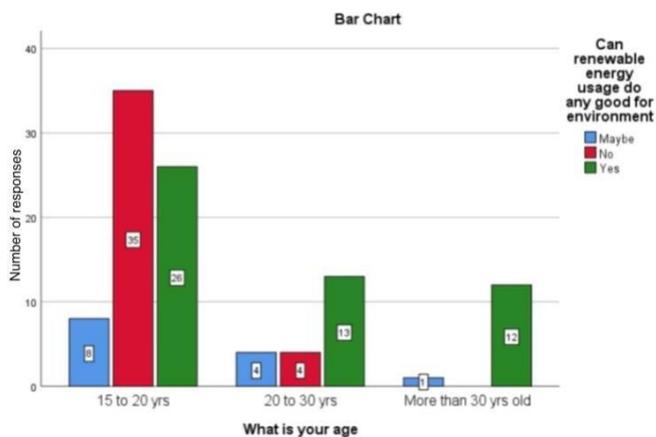


Figure 29: Bar graph representing the association between age(X axis) and responses on whether renewable energy sources do any good for environmental pollution(Y axis). Majority of the 15 to 20 years aged population knows that renewable energy sources are also good for environmental pollution than the other age groups. However, the difference is not statistically significant. Pearson’s Chi square test value= 20.211 , p value = 0.110 (>0.05) hence statistically not significant.

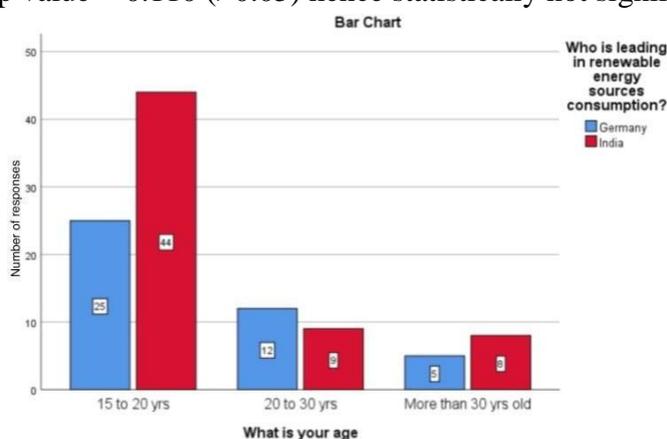


Figure 30: Bar graph representing the association between age(X axis) and responses on who is leading in renewable energy sources consumption(Y axis). Majority of the 15 to 20 years aged population knows that India is leading in renewable energy sources consumption than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value=7.728 , p value = 0.092 (>0.05) hence statistically not significant.

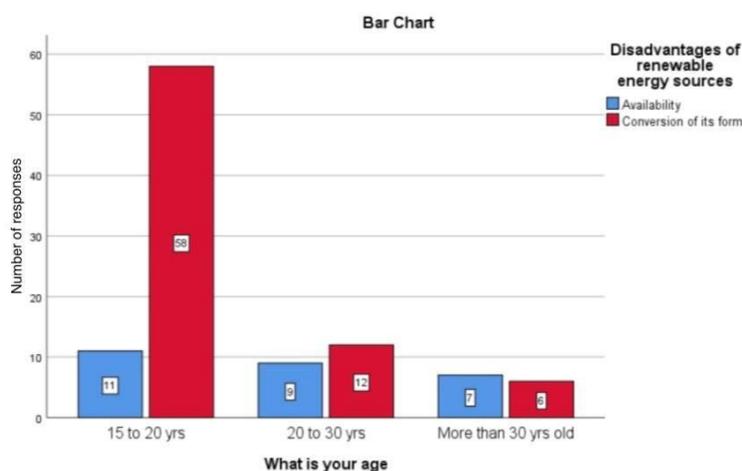


Figure 31: Bar graph representing the association between age(X axis) and responses on number of participants and their view over the disadvantages of renewable energy sources(Y axis). Majority of the 15

to 20 years aged population knows the disadvantages of renewable energy sources than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value = 11.903, p value = 0.130 (>0.05) hence statistically not significant.

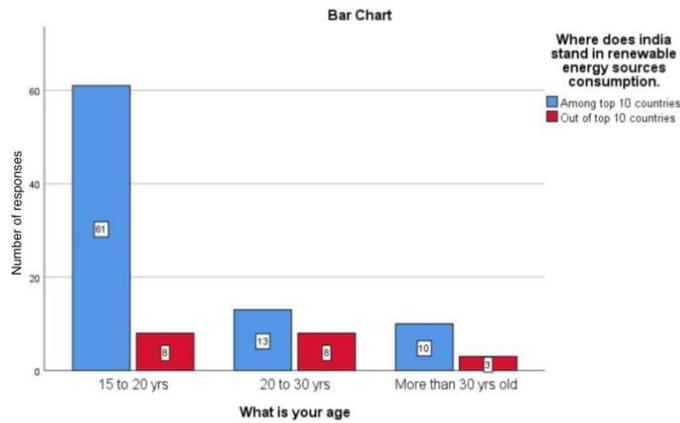


Figure 32: Bar graph representing the association between age(X axis) and responses on where India stands in renewable energy consumption(Y axis). Majority of the 15 to 20 years aged population knows where India stands in renewable energy consumption than the other age groups. However, the difference is not statistically significant. Pearson's Chi square test value =11.903, p value = 0.160 (>0.05) hence statistically not significant.