ANL 488 PROJECT PROPOSAL

Sentiment Analysis On Financial And Non-Financial Factors That Contribute To The Growth Of Renewable Energy Industry

Submitted by

JANINE NG YOU EN

School of Business Singapore University of Social Sciences

Presented to Singapore University of Social Sciences
In partial fulfillment of the requirements of the
Degree of Bachelor in Science in Business Analytics

2021

TABLE OF CONTENTS

Here are my main comments

1) ***Topic Formulation***: Very interesting topic, with a unique "non-material" appraoch to what is essentially a financial question. You have really thought about this topic I can see
2) ***Literature Review***: I found your literature review to be well written. Your arguments flowed from one to the other. Very good job
3) ***Data Understanding***: This section is very clearly, mishmashed and rushed. You only used Tableau, I noticed, but you have not shown me how you intend to do the sentiment analysis or if it even works on your sample data set at a very high level.
4) ***Proposed Modeling***: Too little detail. SPSS and that's it? Is that sufficient?
5) ***Overall Presentation***: You started strong but it kind of pittered out. You write well and with conviction, and your topic has me very interested. I am keen to see where you go with this.

CHAPTER ONE: INTRODUCTION

Since the Industrial Revolution, fossil fuels have been a driver of global economic development. Fossil fuels played a great role in industrialisation and energy systems, but the world is now experiencing its negative impacts. Over the years, the accumulation of carbon dioxide produced from burning fossil fuels has led to global climate change. Greenhouse gasses (carbon dioxide, nitrous oxide and methane) pollute the air and water, where rising temperatures and sea levels is evidence of the negative and lasting effects of burning fossil fuels (Sunseap, 2021).

As climate concerns increase, most countries are aiming to slow down the effects of global warming. International treaties such as the Kyoto Protocol and Paris Agreement are strategies that ensure countries participate in a goal to achieve a climate-neutral world by the mid-century (United Nations, 2021). Many countries are in a race to reduce their greenhouse gas emissions through energy transitions to renewable energies as renewables cause little to no little environmental damage and it is a low-carbon solution to fossil fuels and other non-renewable energies. Corporations and governments are seen making large investments in renewable energy technologies such as solar, wind, hydro and biomass. The demand for renewable technologies have even contributed to solar and wind energy production generating cheaper electricity than the cheapest new coal farms (Ambrose, 2021)

However, renewable energy outputs tend to be volatile due to their reliance on natural conditions. Solar energy cannot be produced at night and on cloudy days, while wind turbines will not move unless it is windy. Moody Investors Service found that India's renewable energy has grown by 20% in the past 5 years. However, close to 15-20% of wind and solar projects underperformed in 2019-2020. Low radiance was responsible for 68% of solar project underperformance while wind generation curtailments were responsible for 56% of underperformance (Jai, 2021). Thus, renewable energy projects end up underperforming from

Commented [MK1]: good

their initial forecasts and are not as reliable as fossil fuels that can be constantly burnt to produce electricity.

This raises an immediate response to generate energy when it is sunny or windy and store it for days when the weather is not optimal. However, storing energy is also an expensive and difficult process. Currently, the most common method of storing electricity is using batteries, but they have not reached the desired capacity to be used for electricity storage. Based on a United States household electricity usage study, an average household typically uses 210 kilowatt-hours of electricity per week, but best performing lithium-ion batteries can only store 0.2 kilowatt-hours of electricity per kilogram. Therefore, a battery must weigh 1050 kg (210kwh / 0.2) to power a house for an entire week, and that raises electricity bills by up 300% (Gates, 2021). This makes renewable energies less efficient than non-renewables due to the storage limitations and natural weather reliance.

Furthermore, renewables may not have the expected outcome of reducing electricity usage. Kealy (2015) conducted a study to analyse an embedded wind turbine's effectiveness in reducing their vicinity electricity bills in Ireland. They were disappointed with the finding that the turbine exceeded their maximum import capacity limit and even caused a deterioration of the power factor. Although the costs were offset by their energy policies, the addition of the wind turbine did not reduce their electricity bills nor yield notable benefits aside from aesthetics used for marketing content (Kealy, 2015).

Since renewable energies are not easily transported, nor do they produce the desired results and new energy farms are expensive to build implement, what helps relevant stakeholders provide support for renewable energy projects? This study aims to study this question and use a text mining analysis on factors that determine the success of renewable energy implementation.

Commented [MK2]: Well this is certainly an eye opene

Commented [MK3]: Good question; interesting you are taking a sentiment analysis approach here. It seems like yo argument is more that perception is more important that th almighty dollar. I will be very curious to see your results h

CHAPTER 2: LITERATURE REVIEW

Energy Investments On Economic Growth

There have been extensive environmental studies on the Renewable Energy (RE) industry and its impact on the economy. In the past, non-renewable energy sources drove the economy and fuelled the Industrial Revolution. Tugcu et al. (2012) compared renewable and non-renewable energy sources to rank their significance for economic growth in the G7 countries (United States, Canada, France, Germany, Italy, Japan and the United Kingdom) from 1980 to 2009. Using a classical production function, the team identified a bi-directional causality between non-renewable energy consumption and economic growth for each country (Tugcu et al., 2012). This reveals that non-renewables have had a strong historical track record of providing the necessary resources to drive industries.

Commented [MK4]: I don't understand what bi-directio causality means. Perhaps include a figure next time. You c actually reference figures as well, but of course you cant li all figures from a paper.

Recent shifts towards lowering carbon emissions through alternative energy sources have energized the RE industry. The growing demand for RE created an entirely new industry with economic opportunities that attracted investment and trading. A study by Ben Jebli & Ben Youssef (2013) explored a production modelling framework using stationary tests, cointegration tests, estimations and causality tests to identify causalities between RE and trade. They identified one-way causalities from RE to trade in the short-run, where a cause and effect relationship exists between RE to trade. While in the long run, a bidirectional causality will occur, whereby a mutual relationship exists between the two factors. Lastly, in the future, they predicted that increasing trade will contribute to increasing consumption of RE (Ben Jebli & Ben Youssef, 2013). Thus, when comparing RE and non-RE, aside from RE's environmental benefits, renewables have also generated economic benefits. Due to its many advantages, there is a need to better understand what leads to the success of RE investments.

Commented [MK5]: OK good summary

Financial factors that determine the RE investment decisions

Scholars in the RE field have mostly concentrated on the technical and economic characteristics of RE investments, and have typically utilized full rationality as the paradigmatic approach to explaining how stakeholders have made investment decisions. Usually, economic constraints are a barrier to RE development, this includes the high capital and maintenance cost of the technology (Jacobson & Johnson, 2000), limited experience RE technology (Jagadeesh, 2000) and under-valuing the benefits of environmental investments (Bradshaw& Brochers, 2000) (Mitchel & Connor, 2004).

Commented [MK6]: Correct, agree

The role of government policies is also often used to understand the capacity and predict the sector performance. This is seen from Shrimali et al., (2014) who explored India's state and federal policies in solving the financing challenges faced by their RE sector. The study used the support levels percentage of each available policy and projects developer cash flow analysis to identify the cost-effectiveness, subsidy-recovery and budget efficiency of each policy. It was identified that all policies (reduced costs, extended-tenor debts, interests subsidies) were effective in supporting RE and they have led to incentivize productions and meet viable gap findings. The study emphasised that any government interventions is useful to promote the usage of REs due to lack of resources businesses have to finance RE projects.

Commented [MK7]: ok

Financial attributes are also commonly used to determine investment decisions of RE projects. In the study on risk-return expectations of RE investors in Germany (Salm et al., 2016), a survey was conducted with over 1000 participants using an Adaptive Choice-Based Conjoint Analysis (ACBC) method. The study identified the ranking of average importance for energy projects. From most important to least important factors, return on investments, holding period technology preferences, project location and partnering investors. This shows that financial returns play a significant role in financial projects.

Commented [MK8]: interesting study

The main critique with using only financial drivers to determine investment or success RE projects is that attitudes and motivations of investors are not considered. This gap could be a great opportunity for research to better understand stakeholder motivations when investing in RE, which is deemed to be less reliable in both energy and financial perspectives but remains a booming sector.

Commented [MK9]: right you are!

Non-Financial factors that determine the RE investment decisions

Groups of research have found that traditionally used economic, financial and technical analyses of energy alternatives are not sufficient in explaining adoption barriers and diffusion of RE projects. This perspective suggests the inclusion of behavioural and social aspects of motivation using sociological and psychological methodologies to examine the views people have on RE (West et al., 2010) (Masini & Menichetti, 2012).

Commented [MK10]: Ok, I see where you are going wi this.

Perhaps for RE, the growth of the overall market is not only influenced by technological performance or market output. Rather, the perceived potential influence of RE also led to the expansion of the industry (Masini & Menichetti, 2012). Social science perspectives could contribute to the field of study of RE and provide deeper insights into motivations that affect the success of RE investments.

Masini and Menichetti (2012) explored an empirical analysis of the non-financial drivers behind investment decisions in the RE sector. Their study included measures such as:

Confidence in the effectiveness of existing policies and technological effectiveness; Attitudes toward radical technological adequacy; Investor's experience; Knowledge of RE; Institutional influence of peers, outside consultants and technical information.

Their data was collected from questionnaires given to 93 respondents from various sectors from venture capitalists, private equity managers, banks and energy companies. Using multiple

sources logistic regression methods, regression models to study the 93 respondents. They found that scientific beliefs towards technical adequacy for RE technologies had a greater relationship with driving investments than the effectiveness of RE policies. This implies that knowledge transfer or training for RE technologies is a more important element than providing the policies to incentivise RE adoption. Moreover, the study identified a group of investors who are extremely affected by institutional pressure from peers and consultants in their investment decisions. This reveals that investors are not solely affected by the numbers and outputs, more likely they are affected by societal motivations to adopt RE investments.

Commented [MK11]: good

Maqbool et al. (2018) further created a hypothesis and causal model to identify critical success factors behind renewable energy projects. Using questionnaires and a sampling technique, the responses from 272 firms working on RE projects in Pakistan were collected. A structural equation modelling method identified that all five factors (communication, team, technical, organizational and environmental) were significant towards the project success in their experience. It also found that environmental factors significantly mediates the connection between communication factors towards project success. This shows that there is a common motivation for the environment needed to facilitate communication for project success.

These papers imply that there are much more non-financial factors impacting RE sector success that is worth analysing. Due to resource constraints, the study is not able to create surveys for the stakeholders involved in adopting renewable energies. Rather, sentiment analysis will be conducted on 50 research papers on the topics of renewable energy research, energy policies and risk preferences. The study will collate the current findings in empirical evidence about factors affecting renewable energy adoption, with the aim to fill a scholarly gap of identifying both financial and non-financial factors that affect RE adoption.

Commented [MK12]: Good summary and a very respectable way to approach this topic

CHAPTER 3: DATA UNDERSTANDING AND PREPARATION

The aims of initial data understanding was to understand global renewable energy trends and identify Singapore's energy consumption patterns. This was done prior to the change in research direction. Previously, research topic was the reliability of Renewable Energy to replace oil and gas as our energy of choice using financial measures

Commented [MK13]: Since this is exploratory data analytics to firm up your topic, you could make it relevant your topic by saying that I want to first look at the "hard" quantitative data before looking at the "soft" qualitative da I also want to focus on Singapore because we have a well constrained market, good government policy and 2 forms energy generation for initial analysis namely power from LNG and power form solar.

Data Collection

Commented [MK14]: ok

Global data on energy consumption was found to understand current energy trends. Using tableau, exploratory data analysis was conducted on the percentage of renewables used in energy consumption of each country. Dataset was sourced from Ourworldindata.org, BP Statistical World of Energy and Singstat.

Data Preparation

A simple data preparation was conducted by deleting the unwanted texts using excel. As the time frame variable used is annual data, monthly data was categorised and sum into their respective years. The data also needed to be transposed to achieve the desired formatting for Tableau. On Tableau, two datasets were merged using the year field, the combined Singstat datasets were total annual electricity generation and consumption and total percentage of renewables used in energy consumption in Singapore. Datatypes were also changed accordingly to date and numeric values.

Commented [MK15]: ok

Theme: Industry
Subject: Energy and Utilities
Topic: Electricity Generation, Consumption and Tariffs
Table Title: Electricity Generation And Consumption, Monthly

Data last updated: 11/02/2020
Source: ENERGY MARKET AUTHORITY

Data Series	2019 Dec	2019 Nov	2019 Oct	2019 Sep	2019 Aug	2019 Jul	2019 Jun
Electricity Generation	4,429.9	4,424.2	4,565.1	4,585.6	4,694.4	4,658.5	4,437.8
Electricity Consumption	na	na	na	na	na	na	na
Industrial-related	na	na	na	na	na	na	na
Commerce And Service-related	na	na	na	na	na	na	na
Transport-related	na	na	na	na	na	na	na
Households	na	na	na	na	na	na	na
Others	na	na	na	na	na	na	na

Footnotes:
Data on industries are classified according to the Singapore Standard Industrial Classification 2015.
Electricity Generation (Gigawatt Hours):
Source: SP PowerAssets Ltd before 2003, Energy Market Authority wef 2003. Data reflect the gross generation in the system. From Jan 2016, data have incorporated output from solar generation.
Electricity Consumption (Gigawatt Hours):
Refers to the total electricity consumption by end users, including (embedded) consumption by autoproducers. From Jan 2016, data have incorporated consumption of output from solar generation.

Notation:
na not available or not applicablenec not elsewhere classifiednes not elsewhere specified- nil or negligible or not significant
NotesNumbers may not add up to the totals due to rounding.Data are the latest available at the time of access or download. Some statistics, particularly those for the most recent time periods, are provisional and may be subject to revision at a later date.
Values are shown in Singapoare dollars (unless otherwise specified)

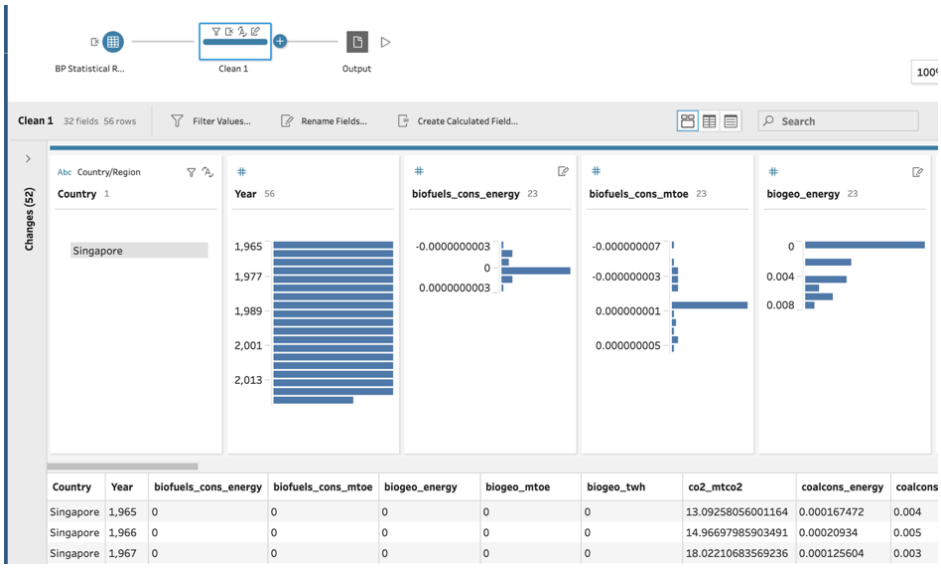
Generated by: SingStat Table Builder
Date generated: 16/08/2021
Contact: info@singstat.gov.sg

Figure 1: Raw excel sheet downloaded from Singstat

Commented [MK16]: Whe you talk about Fig 1, 2, 3 – must referenc it in the text. Otherwise its left hanging….

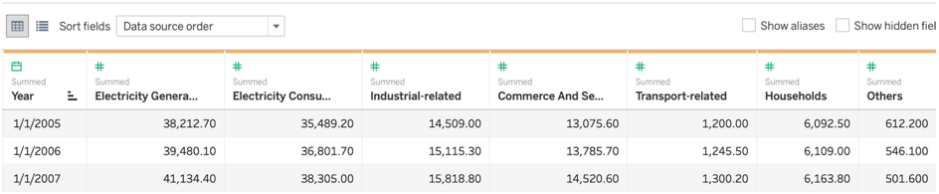
Year	Electricity Generation	Electricity Consumption	Industrial-related	Commerce And Service-related	Transport-related	Households	Others
2017	52225.80	49437.20	21034.30	18063.10	2767.90	7295.40	276.40
2016	51,587	48,627	20,421	17,698	2,638	7,590	280
2015	50,271.60	47,513.90	20,088.10	17,481.00	2,444.80	7,221.00	279.00
2014	49,309.70	46,403.10	19,753.20	17,046.50	2,441.10	6,924.50	237.70
2013	47,963.50	44,948.70	18,842.80	16,718.80	2,369.00	6,755.00	263.50
2012	46,936.20	44,200.80	18,572.40	16,365.80	2,328.50	6,629.50	304.10
2011	45,999.40	43,007.20	18,077.50	15,876.40	2,224.20	6,482.90	346.60
2010	45,367	42,252	17,662	15,470	2,098	6,636	385
2009	41,800.60	38,822.80	15,570.40	14,800.00	1,607.80	6,430.70	414.10
2008	41,669.60	38,987.10	16,030.50	15,004.90	1,399.80	6,094.00	457.60
2007	41,134.40	38,305.00	15,818.80	14,520.60	1,300.20	6,163.80	501.60
2006	39,480	36,802	15,115	13,786	1,246	6,109	546
2005	38,212.70	35,489.20	14,509.00	13,075.60	1,200.00	6,092.50	612.20

Figure 2: Cleaned and transposed excel sheet prepared for Tableau



Country	Year	biofuels_cons_energy	biofuels_cons_mtoe	biogeo_energy	biogeo_mtoe	biogeo_twh	co2_mtco2	coalcons_energy	coalcons
Singapore	1,965	0	0	0	0	0	13.09258056001164	0.000167472	0.004
Singapore	1,966	0	0	0	0	0	14.96697985903491	0.00020934	0.005
Singapore	1,967	0	0	0	0	0	18.02210683569236	0.000125604	0.003

Figure 3: Data cleaning using Tableau Prep Builder



Summed Year	Summed Electricity Genera...	Summed Electricity Consu...	Summed Industrial-related	Summed Commerce And Se...	Summed Transport-related	Summed Households	Summed Others
1/1/2005	38,212.70	35,489.20	14,509.00	13,075.60	1,200.00	6,092.50	612.200
1/1/2006	39,480.10	36,801.70	15,115.30	13,785.70	1,245.50	6,109.00	546.100
1/1/2007	41,134.40	38,305.00	15,818.80	14,520.60	1,300.20	6,163.80	501.600

Figure 4: Data merge using Tableau Desktop and data types of year were switched to date format.

Data exploration

Initial findings showed that in the year 2019, Iceland and Norway were the top two countries in usage of renewables, where Iceland uses 80% and Norway uses 66%.Big economies such as United States and China only uses 9% and 13% of renewables respectively, while well-developed Singapore uses 0.24%. Interestingly, developing countries such as Ecuador (30%) and Vietnam (15%) uses more renewables than their developed neighbours.

Singapore uses less than 1% of renewable energies in their total energy consumption. Comparing with its less developed neighbours, Singapore is very far behind in their adoption of REs for energy consumption.

Commented [MK17]: I am confused……now there is Norway? Not at all in line with what you said at the very s "The aims of initial data understanding was to understand global renewable energy trends and identify Singapore's energy consumption patterns"

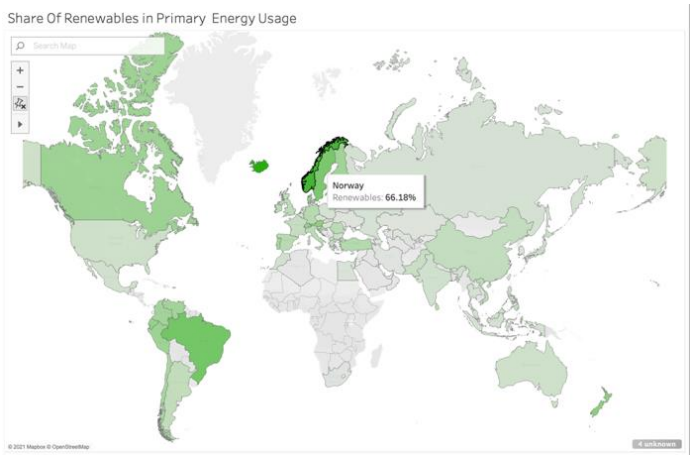


Figure 5: Norway uses 66.18% of renewable energies in their total energy usage in 2019

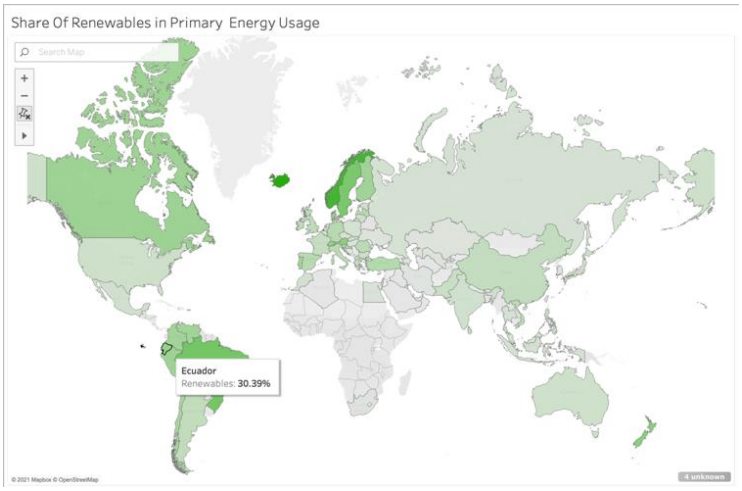


Figure 6: Ecuador uses 30.39% of renewable energies in their total energy usage in 2019

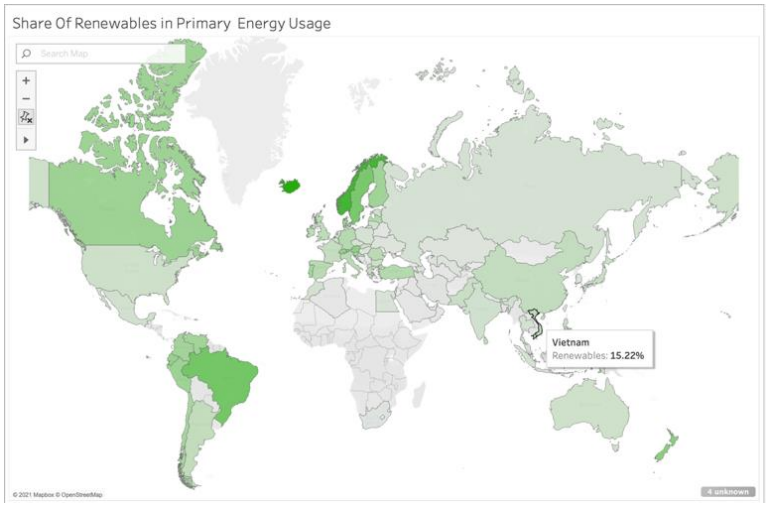


Figure 7: Vietnam uses 15.22% of renewable energies in their total energy usage in 2019

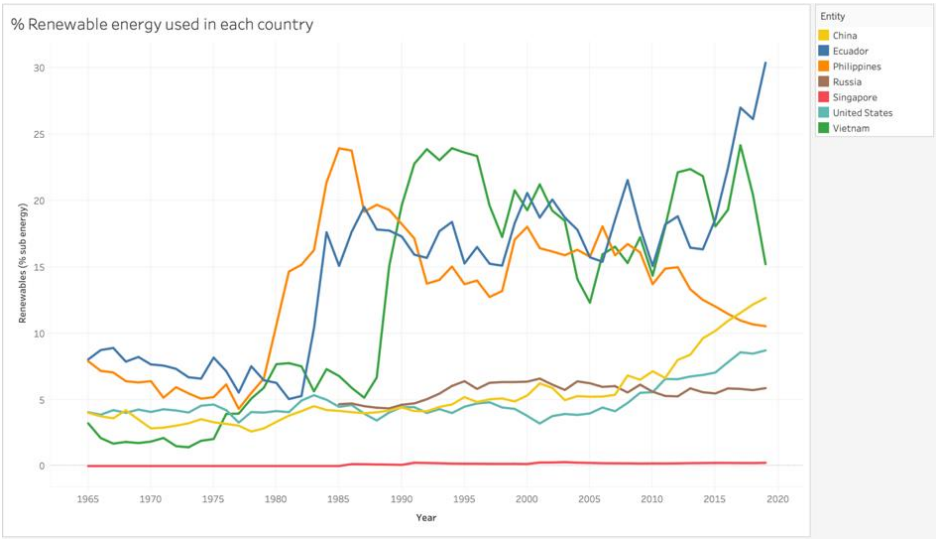


Figure 8: Share of renewable energies used in total energy usage in China, Ecuador, Philippines, Russia, Singapore, United States and Vietnam.

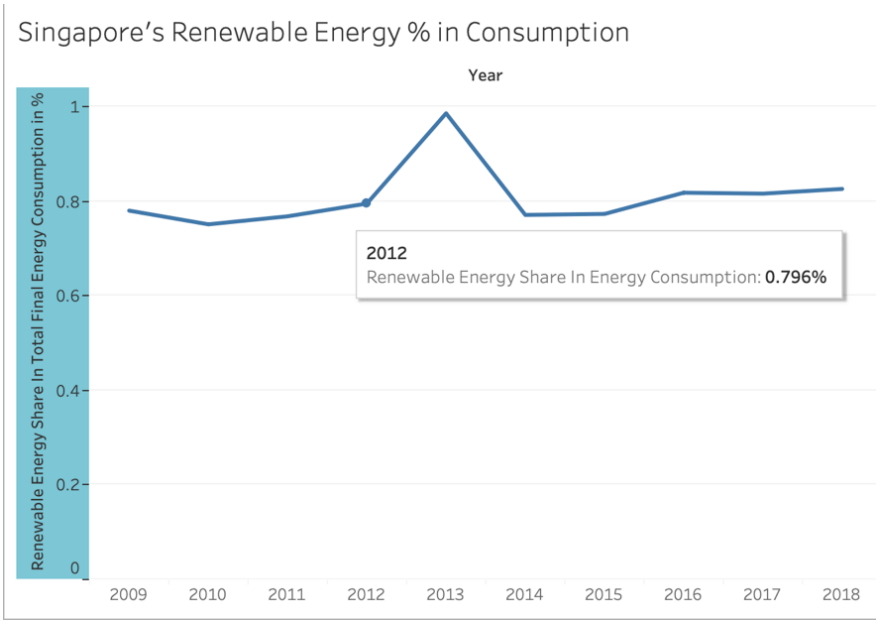


Figure 8: Singapore's renewable energy usage % trend

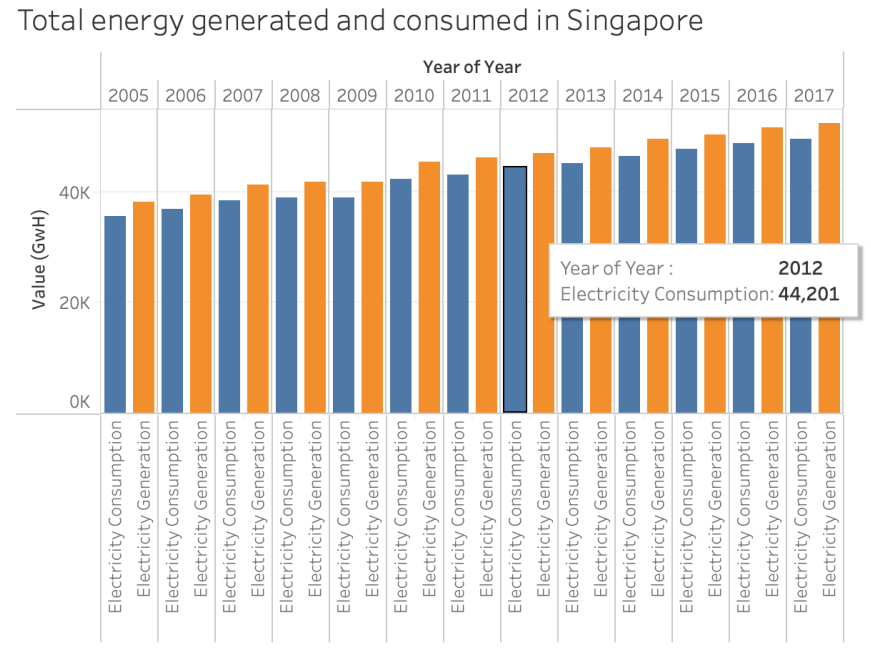


Figure 9: Singapore's total energy generation and consumption in Gigawatt hours (GwH)

CHAPTER 4: DATA PROPOSED MODELLING AND EVALUATION

The proposed model is to perform text mining 50 research papers on the topics of renewable energy research, energy policies and risk preferences. The aim is to collate the current findings in empirical evidence about factors affecting renewable energy adoption, and identify both financial and non-financial sentiments that affect RE adoption.

Using the SPSS modeler, text analysis will be used to transform unstructured data to identify the insights and common factors to successful renewable energy plans. The sentiments will be a learning point for future studies of RE projects and implementations, RE policy making and energy investments decision making

An interesting finding from data exploring is developing countries can adopt higher RE usage compared to developed countries. For example, Ecuador adopts 30% RE while Unites States only uses around 8%. This may be for the future research to identify the factors contributing to adopting sustainable energy in developing countries compared to developed countries. The point of comparison used could be the country's GDP and % share of RE adopted. The sentiments found would be a good learning point for all nations in both scales of development to increase their renewable energy usage.

Commented [MK18]: Interesting….

CHAPTER 2: PROPOSED SCHEDULE

Week 4	Submission of proposal Data preparation for text mining analysis, collecting the 50 journals
Week 5	Create the text mining model on SPSS
Week 6	Identify the accuracy of the model
Week 7	Rework on the model and gather feedback from peers, Report writing
Week 8	Prepare PowerPoint presentation
Week 9	Project Presentation
Week 10-15	Revise project based on feedback from Project Presentation. Work on Project Final Report and prepare for final submission.
Week 16	Submission of Project Final Report

References

Ambrose. (2021, June 23). *Most new wind and solar projects will be cheaper than coal, report finds.* the Guardian. https://www.theguardian.com/environment/2021/jun/23/most-new-wind-solar-projects-cheaper-than-coal-report

Ben Jebli, M., & Ben Youssef, S. (2013). Output, renewable and non-renewable energy consumption and international trade: Evidence from a panel of 69 countries. *Renewable Energy*, *83*, 799-808. https://doi.org/10.1016/j.renene.2015.04.061

Bradshaw, G. A., & Borchers, J. G. (2000). Uncertainty as information: Narrowing the science-policy gap. *Conservation Ecology*, *4*(1). https://doi.org/10.5751/es-00174-040107

Gates, B. (2016). *It is surprisingly hard to store energy*. gatesnotes.com. https://www.gatesnotes.com/energy/it-is-surprisingly-hard-to-store-energy

Jagadeesh, A. (2000). Wind energy development in Tamil Nadu and Andhra Pradesh, India institutional dynamics and barriers — A case study. *Energy Policy*, *28*(3), 157-168. https://doi.org/10.1016/s0301-4215(00)00007-0

Jai, S. (2021). *Indian renewable firms underperformed but credit quality intact: Moody's.* Business News, Finance News, India News, BSE/NSE News, Stock Markets News, Sensex NIFTY, Latest Breaking News Headlines. https://www.business-standard.com/article/companies/indian-renewable-firms-underperformed-but-credit-quality-intact-moody-s-121030901082_1.html#:~:text=%22About%2015%2D20%20per%20cent,the%20underperformance%20respectively%2C%E2%80%9D%20says%20Abhishek

Kealy, T. (2015). Does an embedded wind turbine reduce a company's electricity bill? Case study of a 300 kW wind turbine in Ireland. *Journal of Business Ethics*, *145*(2), 417-428. https://doi.org/10.1007/s10551-015-2837-4

MAQBOOL, R., RASHID, Y., SULTANA, S., & SUDONG, Y. (2018). Identifying the critical success factors and their relevant aspects for renewable energy projects; An empirical perspective. *Journal of Civil Engineering and Management*, *24*(3), 223-237. https://doi.org/10.3846/jcem.2018.1691

Masini, A., & Menichetti, E. (2012). Investment decisions in the renewable energy sector: An analysis of non-financial drivers. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2247461

Mitchell, C., & Connor, P. (2004). Renewable energy policy in the UK 1990–2003. *Energy Policy*, *32*(17), 1935-1947. https://doi.org/10.1016/j.enpol.2004.03.016

Salm, S., Hille, S. L., & Wüstenhagen, R. (2016). What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. *Energy Policy*, *97*, 310-320. https://doi.org/10.1016/j.enpol.2016.07.042

Schmid, G. (2012). The development of renewable energy power in India: Which policies have been effective? *Energy Policy*, *45*, 317-326. https://doi.org/10.1016/j.enpol.2012.02.039

Shrimali, G., Goel, S., Srinivasan, S., & Neslon, D. (2014, March 24). *Solving India's renewable energy financing challenge: Which federal policies can be most effective?* CPI. https://www.climatepolicyinitiative.org/publication/solving-indias-renewable-energy-financing-challenge-which-federal-policies-can-be-most-effective/

Sunseap. (2021). *Singapore's largest clean energy service provider*. Singapore's Largest Clean Energy Service Provider | Solar Systems & Solar Energy. https://www.sunseap.com/SG/

Tugcu, C. T., Ozturk, I., & Aslan, A. (2012). Renewable and non-renewable energy consumption and economic growth relationship revisited: Evidence from G7 countries. *Energy Economics*, *34*(6), 1942-1950. https://doi.org/10.1016/j.eneco.2012.08.021

United Nations. (2021). *The Paris Agreement | UNFCCC*. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement