6CER - 50 Year Energy Plan

Unit 6

Name: Student Example

Period: 4

Date: 6/14/18

You are tasked to write an essay communicating the problem you are trying to solve with the 50 Year Energy Plan and evaluate your design solution against others.

There will be four (4) sections of your essay:

1. Exploring Our Engineering Challenge (Claim)
    a. Introduce the problem you are trying to solve.
    b. Describe what requirements must be met (the constraints) in order to successfully meet your goal.
    c. Describe the criteria that will be used to judge the created solution.
    d. Make a claim as to what you think is most important of the criteria and explain why.
    e. Detail what may happen if a plan is not implemented
2. Evaluating Competing 50 Year Plans (Evidence)
    a. Your plan
        i. Screenshot of your plan with a title
        ii. Describe the strategy of your plan
        iii. Describe the strengths and weaknesses of your plan
    b. Competing plan
        i. Screenshot of a competing plan
        ii. Describe the strategy of the competing plan
        iii. Describe the strengths and weaknesses of the comp
3. Reasoning about the Best Design (Reasoning)
    a. Restate which criteria you found most important and state which plan best fulfills that priority.
    b. Describe the differences between your plan and the competitor's plan in terms of the criteria and strategy.
    c. Conclude which plan you find better and ex
4. Limitations of your Plan
    a. What challenges do you envision in implementing your solution? Have you made any assumptions?
    b. What problems may still remain if your proposed plan is implemented?
    c. What technological breakthroughs might change your plan design? How might it change?

We as the Energy Plan Commision seek to establish an effective 50 Year Energy Plan that will satisfy the requirements of the "Clean Electricity and Coal Transition Plan" to meet the needs of all Oregonians each decade. In order to evaluate a successful energy plan, our constraints must be to produce reliable energy to respond to the needs of Oregonians; fulfill the Oregon Law "Clean Electricity and Coal Transition Plan" with removal of coal power by 2035; stay within projected growth for each decade; and consider the economic aspects of energy usage. We will evaluate the energy sources based upon environmental impact and land use, such as waste production; climate and air quality impact, such as undesirable greenhouse gas emissions; and lifetime cost criteria. Keeping in mind that global warming caused by CO_2 leads to extreme weather events, worsens human health, and may lower crop production with irregular temperature patterns, our highest priority is to mitigate the negative climate and air quality impact from energy sources like coal. Otherwise, if we do not implement a successful plan, harmful effects on the environment, climate change, and air quality will be detrimental to the health and economic stability of future generations in and outside of Oregon.

My overall strategy for my 50 Year Energy Plan was to eliminate the use of coal and natural gas early on in order to reduce the negative effects of these sources on climate and air quality due to carbon dioxide emissions. In addition, I focused on maximizing my percent growth by investing in environmentally responsible and reliable resources like geothermal energy early on in order to fulfill Oregon's requirements in the long run. As a result of my strategy, one strength of my plan was that the climate and air quality impact consistently improved over time and the environmental and land use impact was excellent all throughout because I primarily invested in geothermal, wind, wave, and biomass energy. Another strength was that my plan removed the use of natural gas and its negative consequences due to possible leaks. On the other hand, one weakness was that my plan became more costly over time at 2.7 and also slightly less reliable at 3.8 in the end, which was a tradeoff for more environmentally responsible energy sources.

The main strategy of the competing 50 Year Energy Plan was to minimize the environmental and land use impact by investing in sources like geothermal and wind energy. It appears that the competing plan also emphasized staying cost effective because it invested in most of the cheaper energy sources. Some of the strengths of the competing plan was that environmental and land use impact stayed excellent and the reliability was at 4.0 in the end. However, one weakness was that in the 2010s and 2020s, the climate and air quality was extremely poor and that the climate and air quality did not improve past the 2040s, but stayed constant. Another weakness in this plan was that its third most used resource was natural gas, which disturbs land because it requires drilling wells and pipelines that may leak, explode, and release toxic chemicals into communities.

As mentioned before, reducing negative climate and air quality impact was my top priority because many energy sources emit greenhouse gases that contribute to global warming. After carefully comparing the designs, I claim that my 50 Year Energy Plan accomplished the number one priority with the most amount of success. To support this, my plan did a better job addressing climate and air quality impact, which is shown with my better rating starting in the 2020s and continuing until the 2060s with a 1.4 versus the competing 1.6. I achieved this difference by eliminating natural gas early on and investing in more wave and biomass energy when compared to the competing plan. Another difference is that my plan more successfully executed the environmental and land use criterion with a 2.6 when compared to the competing plan's 2.7 because I invested in biomass, smart grid technology, and energy storage. It's important to notice that the strategy I used to reduce climate impact was interconnected with the environmental and land use criteria as most of the sources with less land use had less CO_2 emissions. Furthermore, even though the resulting startup and maintenance cost for my 50 Year Energy Plan and the competing plan were 2.7 and 2.5 respectively, it must be understood that the tradeoff for lower cost was between using cheap natural gas instead of more environmentally sustainable sources like biomass and wave energy. Ultimately, after thorough investigation, I conclude that my design successfully achieves our goal of a more environmentally and budget friendly and reliable energy plan for all Oregonians.

By analyzing my chosen 50 Year Energy Plan, I predict that it will be difficult to gain Oregon's public and legal approval for the huge shift from using coal and natural gas to geothermal and wave energy instead. For

example, according to the Oregon Department of Energy, Oregon has high marine energy potential, but must follow regulations in the Part 5 Territorial Sea Plan, as well as get a lease from the Bureau of Ocean Energy Management for federal waters. As a result, it may take a lot of time for the government to allow implementation of a new wave energy project that is fundamental to my plan; but, I trust that it will be worthwhile. It will also be challenging to get approval for more nuclear energy since its radioactive waste can damage health. In addition, it may be challenging to find open land to build more wind farms in Oregon as the population grows. If we overcome these public and legal challenges, one key problem that may remain is that the expenses may continue to rise; however, it is critical to understand that the money saved by using more renewable and sustainable energy sources typically exceeds the initial startup and maintenance cost as time goes on. Another possible problem is that if it is used irresponsibly, geothermal energy may interfere with tectonically active plates and lower ground temperature. In addition, the overdue Cascadia earthquake would also present serious damage to all of Oregon's energy planning if it were to occur. Moreover, if technological breakthroughs lead to a reliable and cost effective way to store solar energy so more harvested sunlight can go to use throughout the day, my plan could invest in more solar energy and less geothermal energy in order to diversify my sources. Similarly, if scientists discover a way to eliminate the radioactive waste by-product from nuclear sources, my plan could also invest in more nuclear energy to boost its reliability. Additionally, if engineers find a way to improve the smart grid technology, my plan would be even more reliable due to its ability to reduce energy transmission loss.

As the Energy Plan Commision, it is our responsibility to find a solution to meet human energy demands while protecting the Earth and its inhabitants in the long run. After careful analysis, my 50 Year Energy Plan would satisfy the requirements of the "Clean Electricity and Coal Transition Plan" to meet the needs of all Oregonians each decade.

My 50 Year Energy Plan

My 50 Year Energy Plan

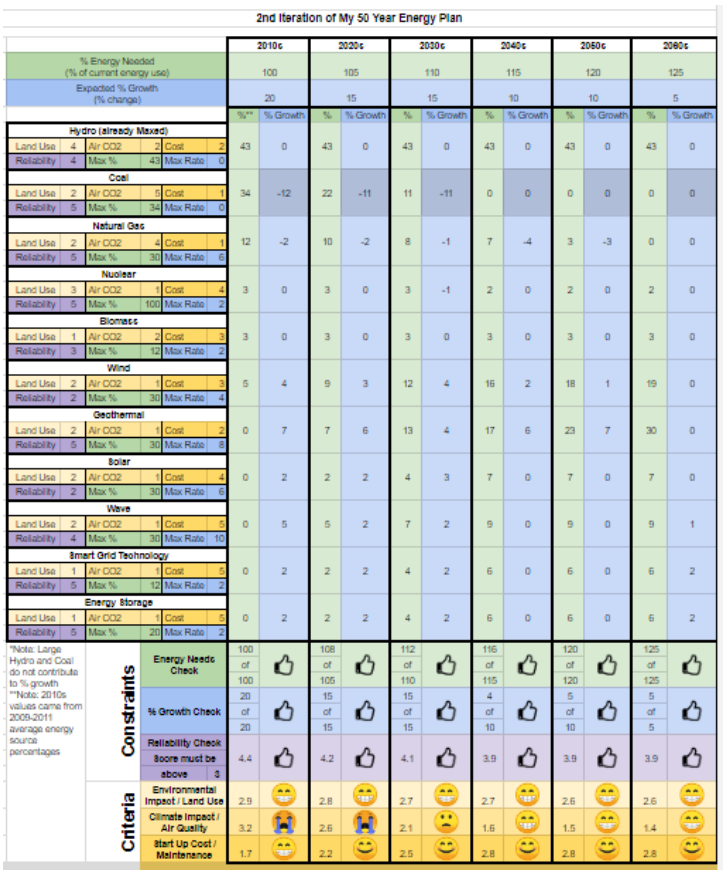
							2010s		2020s		2030s		2040s		2050s		2060s	
% Energy Needed (% of current energy use)							100		105		110		115		120		125	
Expected % Growth (% change)							20		15		15		10		10		5	
							%**	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth
Hydro (already Maxed)																		
Land Use	4	Air CO2	2	Cost	2		43	0	43	0	43	0	43	0	43	0	43	0
Reliability	4	Max %	43	Max Ratio	0													
Coal																		
Land Use	2	Air CO2	5	Cost	1		34	-13	21	-11	10	-10	0	0	0	0	0	0
Reliability	5	Max %	34	Max Ratio	0													
Natural Gas																		
Land Use	2	Air CO2	4	Cost	1		12	-9	3	-3	0	0	0	0	0	0	0	0
Reliability	5	Max %	30	Max Ratio	6													
Nuclear																		
Land Use	3	Air CO2	1	Cost	4		3	-2	1	2	3	0	3	0	3	0	3	0
Reliability	5	Max %	100	Max Ratio	2													
Biomass																		
Land Use	1	Air CO2	2	Cost	3		3	2	5	2	7	2	9	0	9	0	9	0
Reliability	3	Max %	12	Max Ratio	2													
Wind																		
Land Use	2	Air CO2	1	Cost	3		5	4	9	4	13	3	16	0	16	4	20	0
Reliability	2	Max %	30	Max Ratio	4													
Geothermal																		
Land Use	2	Air CO2	1	Cost	2		0	8	8	8	16	8	24	5	29	1	30	0
Reliability	5	Max %	30	Max Ratio	8													
Solar																		
Land Use	2	Air CO2	1	Cost	4		0	4	4	1	5	0	5	0	5	0	5	0
Reliability	2	Max %	30	Max Ratio	6													
Wave																		
Land Use	2	Air CO2	1	Cost	5		0	10	10	0	10	0	10	0	10	0	10	1
Reliability	4	Max %	30	Max Ratio	10													
Smart Grid Technology																		
Land Use	1	Air CO2	1	Cost	5		0	2	2	1	3	0	3	0	3	0	3	2
Reliability	5	Max %	12	Max Ratio	2													
Energy Storage																		
Land Use	1	Air CO2	1	Cost	5		0	1	1	0	1	1	2	0	2	0	2	2
Reliability	5	Max %	20	Max Ratio	2													
*Note: Large Hydro and Coal do not contribute to % growth **Note: 2010s values came from 2009-2011 average energy source percentages																		
Constraints						**Energy Needs Check**	100 of 100		107 of 105		111 of 110		115 of 115		120 of 120		125 of 125	
						% Growth Check	20 of 20		15 of 15		14 of 15		5 of 10		5 of 10		5 of 5	
						Reliability Check	4.4		4.0		3.9		3.8		3.9		3.8	
						Score must be above	3											
Criteria						**Environmental Impact / Land Use**	2.9		2.8		2.7		2.7		2.6		2.6	
						Climate Impact / Air Quality	3.2		2.4		1.8		1.5		1.4		1.4	
						Start Up Cost / Maintenance	1.7		2.4		2.6		2.7		2.7		2.7	

Competing 50 Year Energy Plan

Competing 50 Year Energy Plan

						2010s		2020s		2030s		2040s		2050s		2060s	
% Energy Needed (% of current energy use)						100		105		110		115		120		125	
Expected % Growth (% change)						20		15		15		10		10		5	
						%**	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth
Hydro (already Maxed)																	
Land Use	4	Air CO2	2	Cost	2	43	0	43	0	43	0	43	0	43	0	43	0
Reliability	4	Max %	43	Max Ratio	0												
Coal																	
Land Use	2	Air CO2	5	Cost	1	34	-12	22	-12	10	-10	0	0	0	0	0	0
Reliability	5	Max %	34	Max Ratio	0												
Natural Gas																	
Land Use	2	Air CO2	4	Cost	1	12	-3	9	0	9	0	9	1	10	0	10	0
Reliability	5	Max %	30	Max Ratio	6												
Nuclear																	
Land Use	3	Air CO2	1	Cost	4	3	2	5	2	7	0	7	0	7	1	8	0
Reliability	5	Max %	100	Max Ratio	2												
Biomass																	
Land Use	1	Air CO2	2	Cost	3	3	0	3	0	3	0	3	0	3	0	3	0
Reliability	3	Max %	12	Max Ratio	2												
Wind																	
Land Use	2	Air CO2	1	Cost	3	5	4	9	4	13	3	16	0	16	2	18	0
Reliability	2	Max %	30	Max Ratio	4												
Geothermal																	
Land Use	2	Air CO2	1	Cost	2	0	8	8	8	16	8	24	4	28	2	30	0
Reliability	5	Max %	30	Max Ratio	8												
Solar																	
Land Use	2	Air CO2	1	Cost	4	0	6	6	0	6	1	7	0	7	0	7	0
Reliability	2	Max %	30	Max Ratio	6												
Wave																	
Land Use	2	Air CO2	1	Cost	5	0	3	3	0	3	0	3	0	3	0	3	0
Reliability	4	Max %	30	Max Ratio	10												
Smart Grid Technology																	
Land Use	1	Air CO2	1	Cost	5	0	0	0	0	0	1	1	0	1	0	1	0
Reliability	5	Max %	12	Max Ratio	2												
Energy Storage																	
Land Use	1	Air CO2	1	Cost	5	0	0	0	0	0	2	2	0	2	0	2	0
Reliability	5	Max %	20	Max Ratio	2												
*Note: Large Hydro and Coal do not contribute to % growth **Note: 2010s values came from 2009-2011 average energy source percentages	Constraints	Energy Needs Check				100 of 100		108 of 105		110 of 110		115 of 115		120 of 120		125 of 125	
		% Growth Check				20 of 20		14 of 15		15 of 15		5 of 10		5 of 10		0 of 5	
		Reliability Check				4.4		4.1		4.0		3.9		4.0		4.0	
		Score must be above			3												
	Criteria	Environmental Impact / Land Use				2.9		2.9		2.8		2.8		2.7		2.7	
		Climate Impact / Air Quality				3.2		2.6		2.0		1.6		1.6		1.6	
		Start Up Cost / Maintenance				1.7		2.2		2.3		2.5		2.5		2.5	

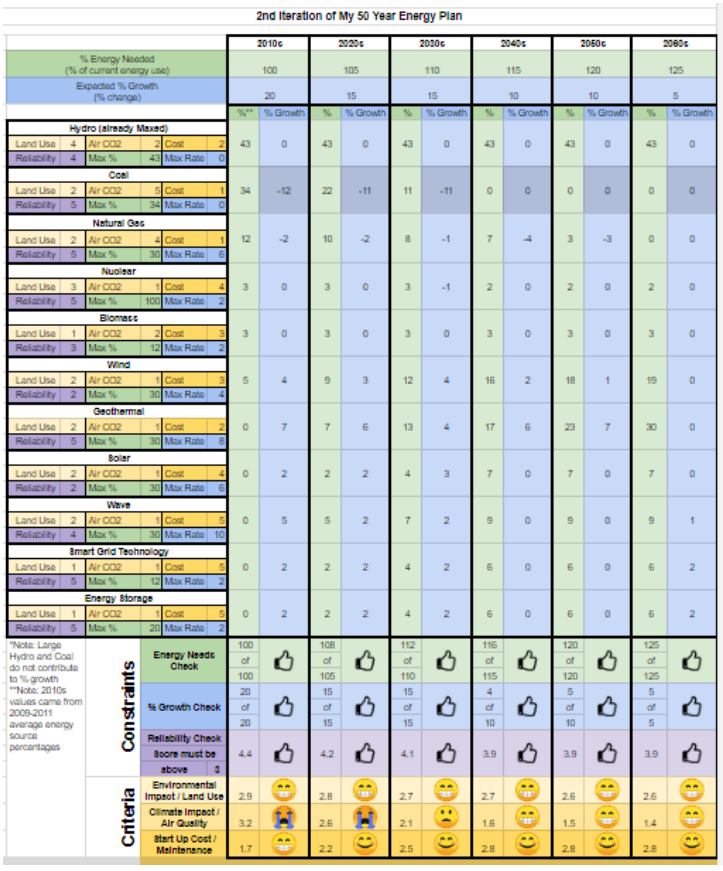
1st Iteration of My 50 Year Energy Plan



2nd Iteration of My 50 Year Energy Plan

		2010s		2020s		2030s		2040s		2050s		2060s	
% Energy Needed (% of current energy use)		100		105		110		115		120		125	
Expected % Growth (% change)		20		15		15		10		10		5	
		%**	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth
Hydro (already Maxed)	Land Use 4, Air CO2 2, Cost 2; Reliability 4, Max % 43, Max Rate 0	43	0	43	0	43	0	43	0	43	0	43	0
Coal	Land Use 2, Air CO2 5, Cost 1; Reliability 5, Max % 34, Max Rate 0	34	-12	22	-11	11	-11	0	0	0	0	0	0
Natural Gas	Land Use 2, Air CO2 4, Cost 1; Reliability 5, Max % 30, Max Rate 6	12	-2	10	-2	8	-1	7	-4	3	-3	0	0
Nuclear	Land Use 3, Air CO2 1, Cost 4; Reliability 5, Max % 100, Max Rate 2	3	0	3	0	3	-1	2	0	2	0	2	0
Biomass	Land Use 1, Air CO2 2, Cost 3; Reliability 3, Max % 12, Max Rate 2	3	0	3	0	3	0	3	0	3	0	3	0
Wind	Land Use 2, Air CO2 1, Cost 3; Reliability 2, Max % 30, Max Rate 4	5	4	9	3	12	4	16	2	18	1	19	0
Geothermal	Land Use 2, Air CO2 1, Cost 2; Reliability 5, Max % 30, Max Rate 8	0	7	7	6	13	4	17	6	23	7	30	0
Solar	Land Use 2, Air CO2 1, Cost 4; Reliability 2, Max % 30, Max Rate 6	0	2	2	2	4	3	7	0	7	0	7	0
Wave	Land Use 2, Air CO2 1, Cost 5; Reliability 4, Max % 30, Max Rate 10	0	5	5	2	7	2	9	0	9	0	9	1
Smart Grid Technology	Land Use 1, Air CO2 1, Cost 5; Reliability 5, Max % 12, Max Rate 2	0	2	2	2	4	2	6	0	6	0	6	2
Energy Storage	Land Use 1, Air CO2 1, Cost 5; Reliability 5, Max % 20, Max Rate 2	0	2	2	2	4	2	6	0	6	0	6	2
*Note: Large Hydro and Coal do not contribute to % growth **Note: 2010s values came from 2005-2011 average energy source percentages	Constraints: Energy Needs Check	100 of 100	👍	108 of 105	👍	112 of 110	👍	116 of 115	👍	120 of 120	👍	125 of 125	👍
	Constraints: % Growth Check	20 of 20	👍	15 of 15	👍	15 of 15	👍	4 of 10	👍	5 of 10	👍	5 of 5	👍
	Constraints: Reliability Check (score must be above 3)	4.4	👍	4.2	👍	4.1	👍	3.9	👍	3.9	👍	3.9	👍
	Criteria: Environmental Impact / Land Use	2.9	😁	2.8	😁	2.7	😁	2.7	😁	2.6	😁	2.6	😁
	Criteria: Climate Impact / Air Quality	3.2	😭	2.6	😭	2.1	😕	1.6	😁	1.5	😁	1.4	😁
	Criteria: Start Up Cost / Maintenance	1.7	😁	2.2	😊	2.5	😊	2.8	😊	2.8	😊	2.8	😊

2nd Iteration of My 50 Year Energy Plan



2nd Iteration of My 50 Year Energy Plan

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Expected % Growth (% change)		20		15		15		10		10		5	
		%**	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth
Hydro (already Maxed)	Land Use 4, Air CO2 2, Cost 2; Reliability 4, Max % 43, Max Rate 0	43	0	43	0	43	0	43	0	43	0	43	0
Coal	Land Use 2, Air CO2 5, Cost 1; Reliability 5, Max % 34, Max Rate 0	34	-12	22	-11	11	-11	0	0	0	0	0	0
Natural Gas	Land Use 2, Air CO2 4, Cost 1; Reliability 5, Max % 30, Max Rate 6	12	-2	10	-2	8	-1	7	-4	3	-3	0	0
Nuclear	Land Use 3, Air CO2 1, Cost 4; Reliability 5, Max % 100, Max Rate 2	3	0	3	0	3	-1	2	0	2	0	2	0
Biomass	Land Use 1, Air CO2 2, Cost 3; Reliability 3, Max % 12, Max Rate 2	3	0	3	0	3	0	3	0	3	0	3	0
Wind	Land Use 2, Air CO2 1, Cost 3; Reliability 2, Max % 30, Max Rate 4	5	4	9	3	12	4	16	2	18	1	19	0
Geothermal	Land Use 2, Air CO2 1, Cost 2; Reliability 5, Max % 30, Max Rate 8	0	7	7	6	13	4	17	6	23	7	30	0
Solar	Land Use 2, Air CO2 1, Cost 4; Reliability 2, Max % 30, Max Rate 6	0	2	2	2	4	3	7	0	7	0	7	0
Wave	Land Use 2, Air CO2 1, Cost 5; Reliability 4, Max % 30, Max Rate 10	0	5	5	2	7	2	9	0	9	0	9	1
Smart Grid Technology	Land Use 1, Air CO2 1, Cost 5; Reliability 5, Max % 12, Max Rate 2	0	2	2	2	4	2	6	0	6	0	6	2
Energy Storage	Land Use 1, Air CO2 1, Cost 5; Reliability 5, Max % 20, Max Rate 2	0	2	2	2	4	2	6	0	6	0	6	2
*Note: Large Hydro and Coal do not contribute to % growth **Note: 2010s values came from 2005-2011 average energy source percentages	Constraints: Energy Needs Check	100 of 100	👍	108 of 105	👍	112 of 110	👍	116 of 115	👍	120 of 120	👍	125 of 125	👍
	Constraints: % Growth Check	20 of 20	👍	15 of 15	👍	15 of 15	👍	4 of 10	👍	5 of 10	👍	5 of 5	👍
	Constraints: Reliability Check (score must be above 3)	4.4	👍	4.2	👍	4.1	👍	3.9	👍	3.9	👍	3.9	👍
	Criteria: Environmental Impact / Land Use	2.9	😁	2.8	😁	2.7	😁	2.7	😁	2.6	😁	2.6	😁
	Criteria: Climate Impact / Air Quality	3.2	😭	2.6	😭	2.1	😕	1.6	😁	1.5	😁	1.4	😁
	Criteria: Start Up Cost / Maintenance	1.7	😁	2.2	😊	2.5	😊	2.8	😊	2.8	😊	2.8	😊