Unsustainable "Sustainability Energy" – Wind Turbines, What are the true costs….

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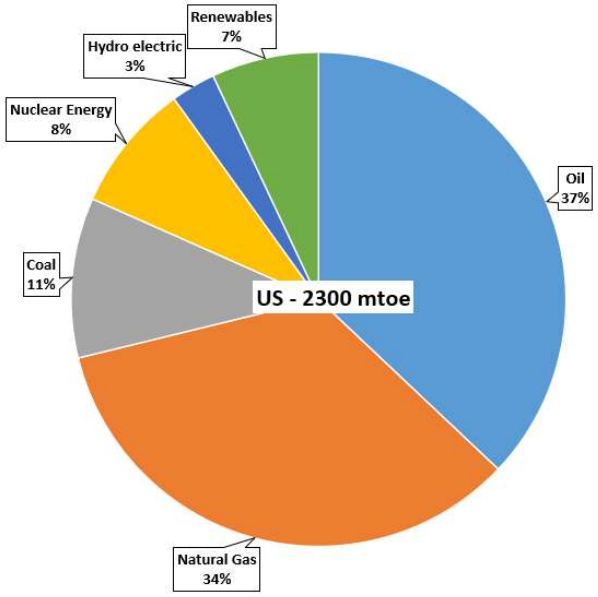
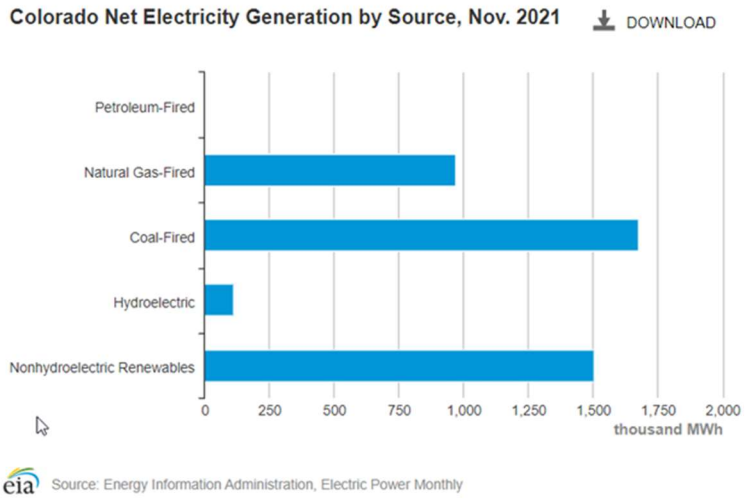
Taking a higher-level view of energy security and power generation, given the current war in Ukraine and sanctions on Russia, the commodity pricing for everything from crude oil, natural gas, and rare earth metals have been increasing exponentially.

Inflation is at a level was over 40 years ago. This has significant implications to the population and to our energy policy, especially at the State level. This has serious implications for our cost of energy in the United States, and in Colorado. Especially considering what the PUC and Xcel Energy are proposing. Their Clean Energy Plan will be devastating to the local Colorado economy due to the number of materials required to build out, and the instability that it will inherently build into the grid.

Now before we go on to discuss this issue, it is important to put the overall energy usage in the U.S. and Colorado into perspective. **The energy consumption in the U.S. in 2020 was roughly 82% hydrocarbon based, only 10% renewables (including hydro-electric)[1]. To get to "Net Zero" by 2030 in the U.S. would require that 82% of our energy consumption be replaced with wind, solar, hydro, possibly geothermal, etc.. The physical reality of achieving these goals without impacting our energy security at a global scale is not possible.**

In 2021, Colorado electricity production from Hydrocarbon Generation sources was 2,956 MWh (reference below in the figure)





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The current proposed Xcel Energy Power Pathway, and their Clean Energy Plan proposes to install **2,300 MW** of wind power generation[2]. **The intermittent wind generation that they are proposing (in addition to the early retirements of these reliable generators) will replace this electricty source. Wind generation only has 36-44% capacity factor (think the amount of time it is actually producing power) thus requires reliable backup generation (which is NOT included in Xcel's current Clean Energy Plan).**

To produce 2,300 MW of wind power generation would require four hundred and sixty (460) 5 MW Turbines, roughly 500 ft tall, and requiring roughly 60 acres per turbine to install[3]. Based on their plan they will need to find roughly 138,000 acres to place wind farms on the eastern plains (215 square miles).

To many, including the Colorado PUC, this seems like a reasonable path to their "net zero" goals, however, there is no accounting of cradle to grave emissions, nor environmental implications of the installation of this many wind turbines on the eastern plains.

What is the cradle to grave emissions of Wind Turbines, and what does it take to construct one?

Among the challenges facing the Xcel Energy's Clean Energy Plan, is the fact that a LOT of stuff will need to be prodcued, fabricated, transported, and constructed to replace our current reliable hydrocarbon-based power generation sources that are currently operating in the State that Xcel would like to retire early due to their CO_2 emissions.

The crucial factor that needs to be considered is that a significant volume of metals, minerals, and construction materials are required to produce a wind turbine.

Let's do a comparison between a modern gas-fired power plant and a wind turbine to put things into perspective.

A 100 MW power generation facility will power 75,000 homes[4].

Table 1 below provides a comparison of the materials required to build a 100 MW gas-fired generator vs. a wind turbine facility.

Table 1 Conventional Power Generation Materials compared to Wind Turbine Materials[4]

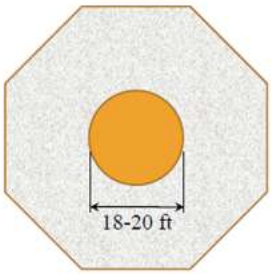
Materials Required	Natural Gas Co-Gen 100 MW Turbine	Wind Turbine Generation	
QTY - 1	100 MW Gas Turbine - Roughly the size of a house	**QTY - 40***	**5 MW Wind Turbines**
Iron Ore	300 tons	**Iron Ore**	**60,000 tons**
Concrete	2000 tons	**Concrete**	**100,000 tons**
Specialty Metals	100 tons	**Specialty Metals**	**2,000 tons**
		Polymer Resin (blades)	**2,000 tons**
Land Use	**Depending upon facility 30 -60 acres**	**Land Use**	**138,000 acres**
	Materials Required for the Wells to produce the natural gas required:		
Natural Gas	17 MMscfd (3 wells in the Haynesville Basin)		
Iron Ore	400 tons		
Concrete	1500 tons		
CO2 Production	325,000 metric tonnes	Not reported because they do not report the	
* Assuming a 50% capacity generation factor which is unlikely, typical capacity factors range from 32 - 44% (time that the turbine is actually producing electricty)			

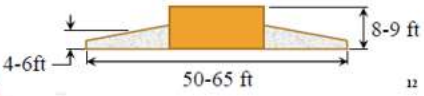
The mining and processing of the materials required to produce the wind turbine require significant amounts of energy. Producing just the concrete and steel alone will result in 200,000 tons of CO_2 production[4].

To put this into perspective, this is an example of the foundation that would be required for each wind turbine[5]:

Foundations

- SLAB.
  - Formwork is set up in foundation pit, rebar is installed before concrete is poured.
  - ➔Footing
    - –•width: 50-65 ft
    - –•avg. depth: 4-6 ft
  - ➔Pedestal
    - –•diameter: 18-20 ft
    - –•height: 8-9 ft
- PILE
  - If soil is weak
  - Bedplate rest on 20 or more pole-shaped piles, extending into the earth.





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Xcel Energy claims that they are not in control of the bid proposals that they are reviewing for their Clean Energy Pathway, which is not true. Unfortunately, there have been ZERO renewable developments that required the wind generators to do full reclaimation of the land after the project is done. To put this into perspective, there would be one of these foundations for roughly every 60 acres of wind turbine contracted land. They will not be required to remove these structures, nor the roads to construct and service the turbines, and the power lines that will be put in place.

If these projects are approved to go ahead, the county commisionners, citizens and landowners should require that, at a minimum, a $500,000 bond per wind turbine installation is put into place to ensure the high plains prairies are made whole after the turbine project servicable life.

References:

1. Statistical Review of World Energy 2021© BP p.l.c. 2021
2. https://www.xcelenergy.com/company/rates_and_regulations/resource_plans/clean_energy_plan (Refer to Volume 1 Plan Overview PDF)
3. *https://www.landmarkdividend.com/wind-turbine-lease-rates-2/#:~:text=Quantity%20of%20Land%20Available,turbines%20and%20other%20supporting%20infrastructure.*
4. *Tell It Like It Is – Unseen Costs of the Energy Transition: Minerals, Metals and Construction Materials", Mark Mills, Renewable Energy Analytics, Feb. 28, 2022.*
5. *Renewable Energy, PetroSkills, 2022.*