



The market is changing, and C6 Infrastructure Partners is in a fantastic position to capitalize. Our queue for new hydroelectric assets continues to grow, with another three packages coming across our desks in the last few weeks. The time to act on purchasing power assets is NOW. The only way we can truly deliver on our thesis is with investor support. We now have a proven track record of success, and C6 is ready to capitalize on this opportunity!

How can C6 purchase assets at steep discounts to current power markets and replacement costs?

1. Assets are being deemed non-core by companies.
 - o Paper and pulp mills, textiles, and other firms that own power plants are experiencing rising costs with unions and can't access net metering or other renewable power incentives. The beneficial pricing is only available to power companies, which we have through Artesian Asset Management.
 - o Large utility companies are focusing on upgrading bigger assets. They recognize the ability to generate 20%+ returns on these small-scale projects, but it may only increase total power generation of 500KW. Their goal is to produce more electricity even though yields are closer to 10%.
2. Privately owned hydroelectric assets are coming to market.
 - o Their owners can't afford to deal with FERC relicensing
 - o They are looking to retire and sell the assets
 - Many of these assets were purchased in the 1970's & 80's, and they are looking to take an exit
3. Companies are looking to invest in large scale projects or are over-levered after getting stuck in solar/wind projects.

What's the Best Way to Create Long-Term Value for Investors?

C6 Infrastructure Partners is addressing energy shortfalls by acquiring power-generating assets in the Northeast, Midwest, and Southeast. The C6 team has been dealing with power since 2006, and we saw an opportune time to strike in 2019. Many of the large investment houses that laughed at our thesis are now clambering to find ways to invest. We've already made significant headway, and we are in advanced negotiations with multiple power packages.

The big firms are now chasing because they are so far behind the market. BlackRock is the most recent to dive headfirst into the "Critical Infrastructure" market. "BlackRock is in talks with various governments over ways to fund critical investments to support artificial intelligence (AI), including increasing the power supply, the CEO of the world's largest asset manager said on Friday. AI is seen as a major boost to global productivity, but it

requires data centres and semiconductor plants that require huge amounts of electricity.”¹ While we disagree with Mr. Fink’s opinion that we need pervasive subsidies, we do believe there is a huge opportunity, and this is a generational type of investment: [“Investments to build the data centres and chip factories backing AI technologies and power them, which BlackRock estimates ‘in the trillions of dollars,’ require the participation of private investors and could be a great opportunity for pension funds and insurers, Fink said.”](#)

Fink believes this can only happen with another round of 100s of billions of subsidies being thrown at the market—but he is wrong. This has only resulted in a misallocation of capital, chasing projects that were NOT truly SUSTAINABLE! They went after projects that were tax havens and ONLY made money with subsidies. [A fundamental view of C6 is the importance of sustainability being completely achieved when a project generates free cash flow.](#) We need all forms of power/energy over the next few decades to meet the growing demand, but this can only come on the back of realistic deployment.

The power markets have moved further in C6’s favor as more companies announce investment plans to high-grade the grid. National Grid is the latest to tap into the markets, raising £7B (about \$8.95B). “National Grid said the fund would be spent on ‘critical energy infrastructure in the UK and US in support of the energy transition and economic growth objectives’ but did not identify which projects it would invest in.”² National Grid’s CEO, Pettigrew, said: “As economies become increasingly digital, electrified and decarbonized, the need for energy infrastructure has rarely been more pressing.” National Grid is planning to spend about \$77B between 2024 and 2029, which is almost double what was spent over the last five years. “Earlier this year, the group’s electricity system operator estimated that £54bn would need to be spent between now and 2030, and a further £58bn in the following five years, to meet government decarbonization targets.” They are estimating this will add about \$25–\$38 to customer bills, but this is assuming projects are built on time and on budget.

Over the past five to seven years, budgets have ballooned. This has been driven by equipment shortages, increases in labor and raw material costs, long lead times, and an increase in other pivotal input expenses. The below chart shows the level of spending that must occur to hit the “Energy Transition” targets. It’s nearly impossible to see only a “small bump” in power bills given this level of spending. Whether this happens

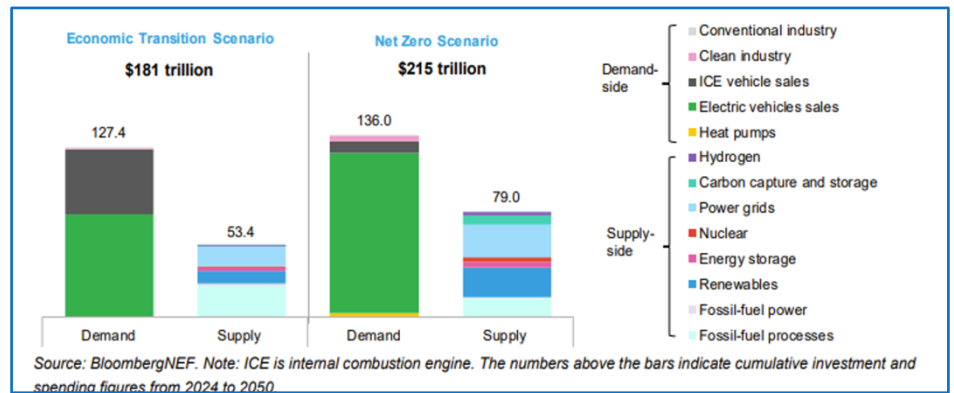
¹ <https://www.reuters.com/technology/blackrock-ceo-sees-giant-issue-europe-due-ai-power-needs-2024-05-17/>

² <https://amp.theguardian.com/business/article/2024/may/23/national-grid-taps-shareholders-to-help-fund-60bn-low-carbon-energy-switch>

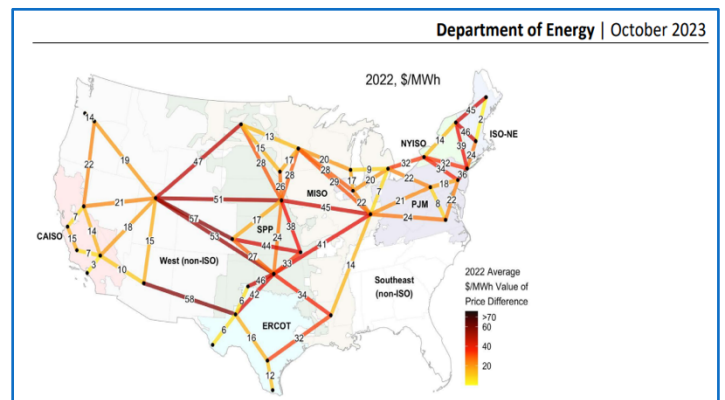
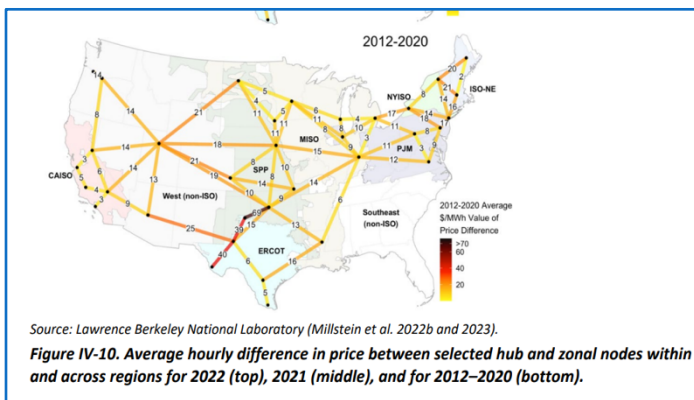
through the private sector (as it should) or backed by subsidies, the consumer is paying. The market has to be realistic about our power mix because being cash-flow positive is paramount to truly being “Sustainable.”

C6 has successfully answered the call for a sustainable future with well-timed investments in hydroelectric and sustainable/renewable fertilizer. We knew that interconnects were going to be hard to obtain—filled with price hikes and shortages. C6 was able to get in front of this by purchasing assets that were already connected and delivering solutions to a struggling grid. This has enabled us to generate cash immediately instead of waiting years for grid access.

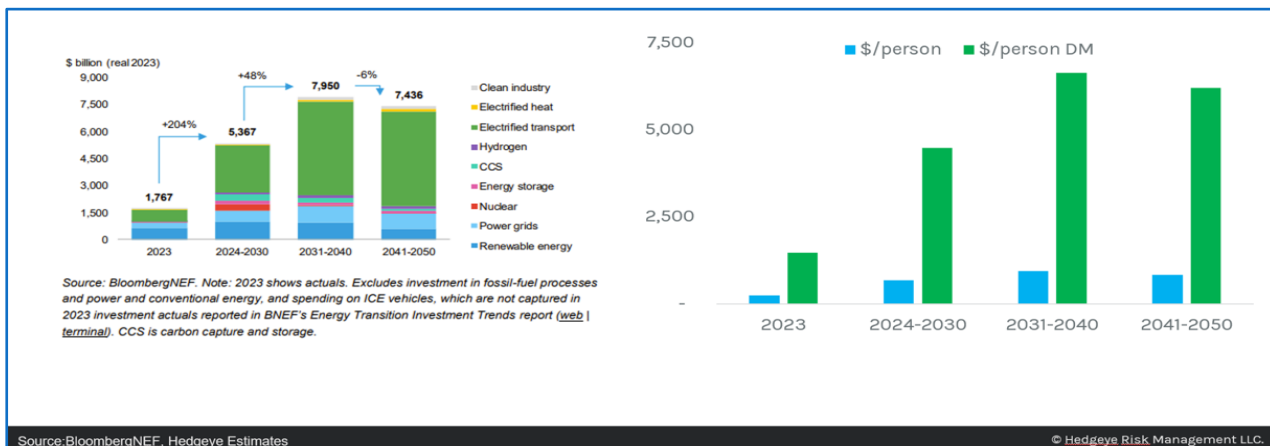
There are two ways to cover rising costs: raise power prices or increase subsidies. The end result is the same—the consumer is going to pay more (by way of more expensive bills or a rise in taxes to cover the additional government spending). Mr. Fink (CEO of



BlackRock) has pushed the view of additional subsidies, but we’ve seen how the funding has been misappropriated time and time again. We’ve been told for over a decade that more solar and wind installation will mean lower prices for consumers. Instead, the data tells a very different story when you compare 2012–2020 averages to 2023. The average cost per MW has only been moving higher . . . and still rising to cover increased costs and demand. These are HUGE opportunities for C6 because we can still buy assets well below replacement and current price levels.

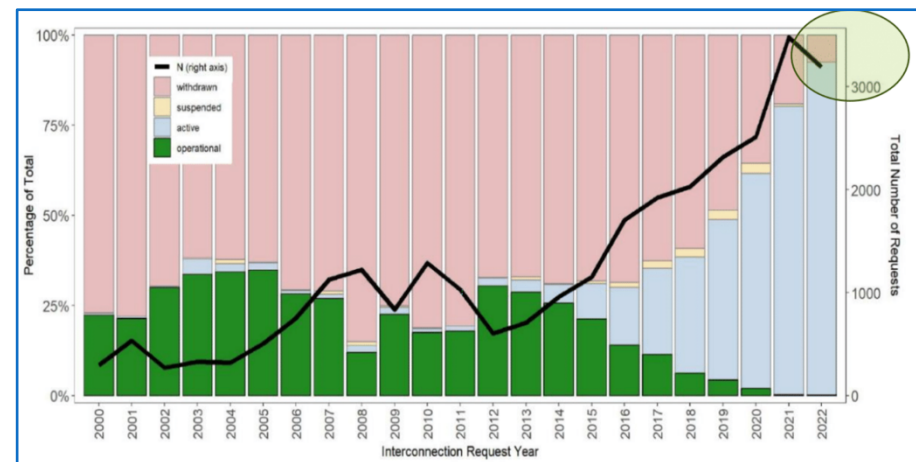


Government has chased solar and wind, but this has failed to deliver meaningful solutions because their limitations were ignored. C6’s fundamental view on sustainability is driven by revenue generation and free cash flow. When a company, fund, or project is perpetually losing money, it cannot be considered sustainable! We can’t shy away from spending on infrastructure—especially because it’s been ignored for decades. But it also doesn’t mean we should burn money for a “righteous cause.” There are legitimate sustainable solutions that allow for growth and expansion while making healthy returns for all parties involved.



The above chart shows that there is still a lot of money being spent on solar over the next few years. As we discussed in our last update, those numbers have fallen throughout 2023–24 with more project cancellations coming over the next three years. Cancellations have picked up as interest rates rose, interconnection queues got longer, and subsidies are no longer able to carry the costs of a project.

This chart only shows 2022, and we know there have been a slew of additional cancellations in '23, and accelerating (again) in '24. Silicon Valley Bank (one of the largest providers of solar projects) didn't go bankrupt until March 10, 2023, which canceled a significant amount of loan guarantees. The Fed also didn't start raising rates until March 2022—so 2022 started the year at .25% and ended it closer to 4%. The total

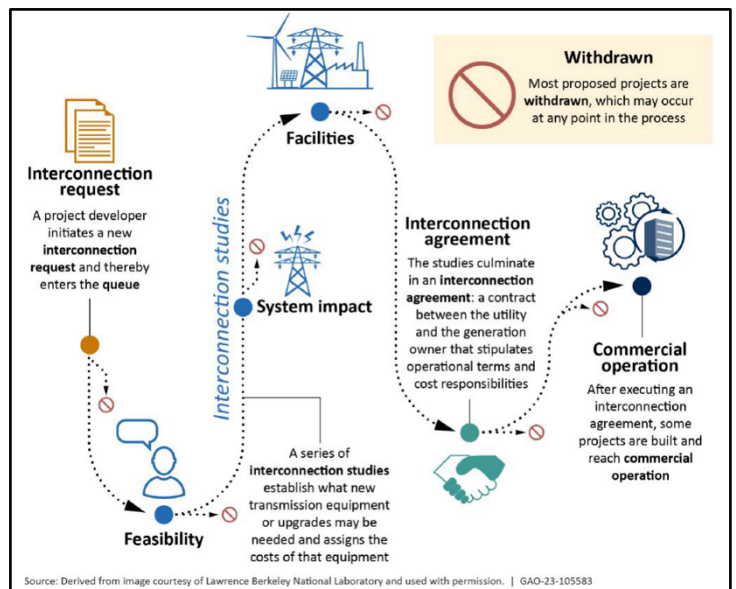


rate rising cycle was 11 times from March 2022 to July 2023, so many of these solar projects that lost support had to refinance at much higher rates. Now, a huge number of projects are no longer viable because they don't reach the most basic economics (even with subsidies).

The Importance of Interconnects

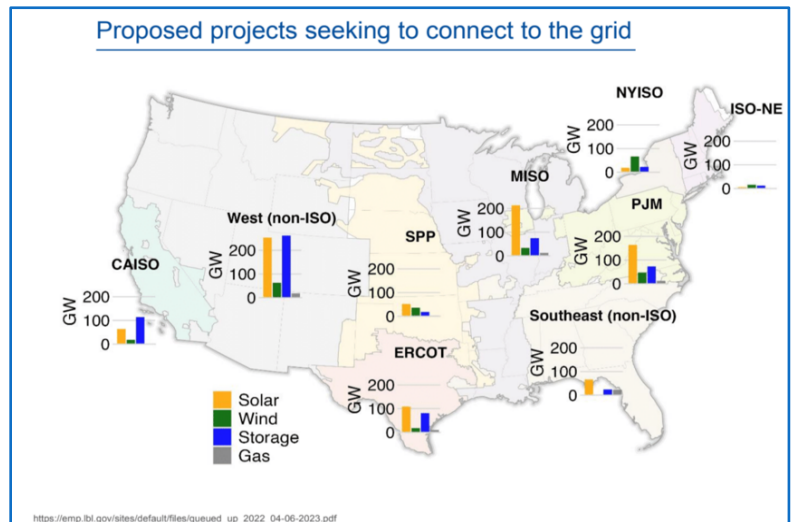
How does the interconnection process work for a new power project?

- A project developer initiates a new interconnection request (IR) and thereby enters the queue
- A series of interconnection studies establish what new transmission equipment, or upgrades may be needed and assigns the costs of that equipment
- The studies culminate in an interconnection agreement (IA): a contract between the ISO or utility and the generation owner that stipulates operational terms and cost responsibilities
- Most proposed projects are withdrawn, which may occur at any point in the process
- After executing an IA, some projects are built and reach commercial operation



When it comes to connecting new power to the grid, a facility can drop out of the queue at any time, but the ISOs/Utility companies also have the right to adjust their connection ability. The “System Impact” is where we are seeing a major issue because the grid has to manage the intermittency of solar/wind. Some projects will address this with natural gas generators, but they are struck with “interruptible contracts.” This means that the natural gas providers can cut their flow at any time, and as we saw in Texas during Storm Uri, it can happen rapidly and create a cascading failure. ISOs must account for this impact, and this has slowed many of these new connections. The carrying costs of the projects are also rising, which is why we’ve seen cancellations become exponential in 2023/2024.

It will only get worse as we move through the next three years. This chart from April 2022 gives you an idea of just how much solar was expected.

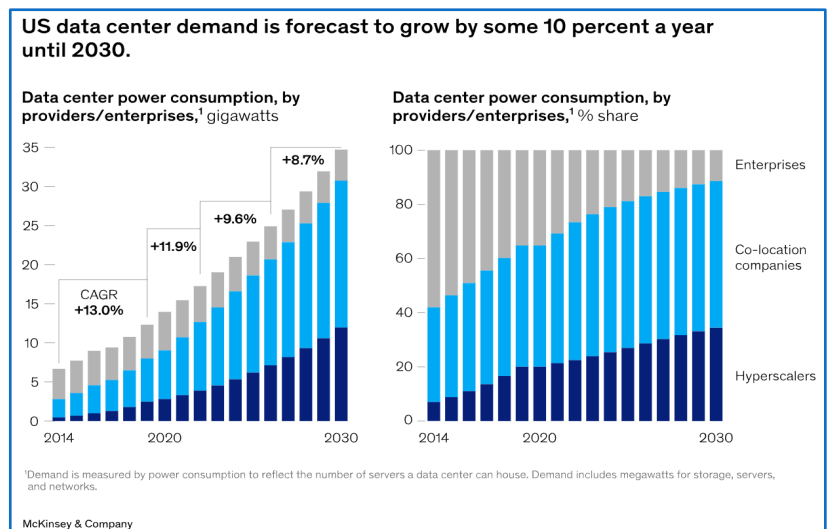


There have been a large number of failed projects over last few years, and this will only get worse as lead times increase:

- Only ~21% of projects (14% of capacity) requesting interconnection from 2000–2017 reached commercial operations by the end of 2022.
 - This was also when rates were VERY low and subsidies were being thrown at all projects
- Completion rates are even lower for wind (20%) and solar (14%)
 - In “supportive” years, the completion rate was 14%, and now that the market has shifted, the cancellation rates have moved much higher
- There has been a marked increase in the average time projects spend in the queue before being built. The typical project built in 2015 took 3 years from interconnection request to commercial operation, compared to 5 years in 2022. Given the ISO intermittent issues and growing power demand, these delays are only getting longer.

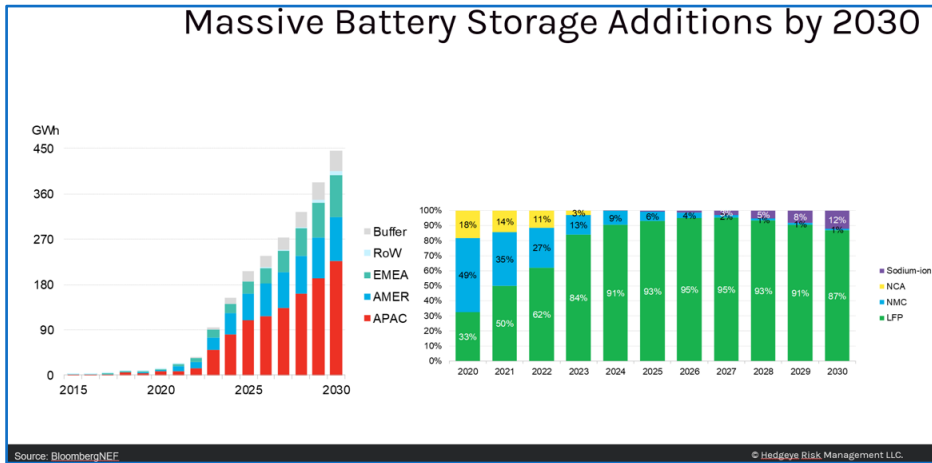
McKinsey estimates that energy demand from data centers will explode from 17GW in 2022 to 35GW by 2030 (growth of 10% a year). This chart is from Jan 2023: Have we seen demand go up or down from that point? U.S. grid planners had been forecasting a mere .5% annual growth rate over the last decade, so the catch-up must be rapid. ALL solutions must be used to meet the demand.

C6 does not have any of these interconnect problems because we are purchasing existing assets that are already generating power with interconnects.



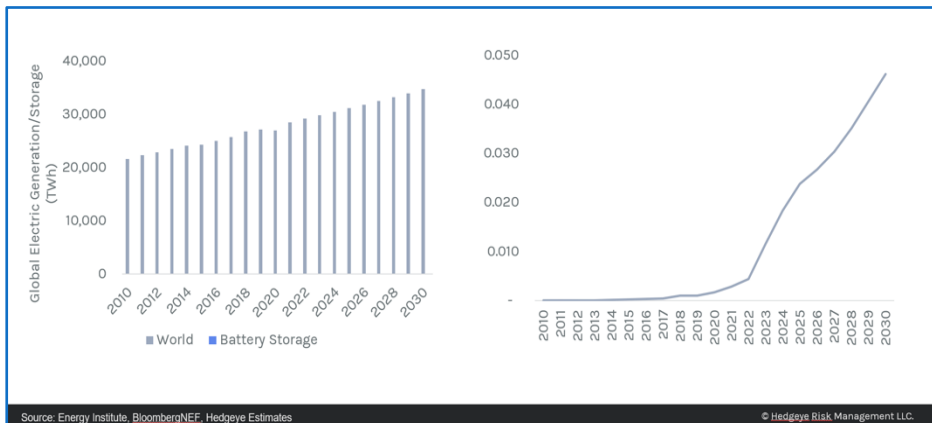
We Can't Rely on Batteries Alone

There is a pervasive view that costs will fall for green energy, especially batteries. But given the broader rise in commodity and labor, it's difficult to see how that comes to pass.

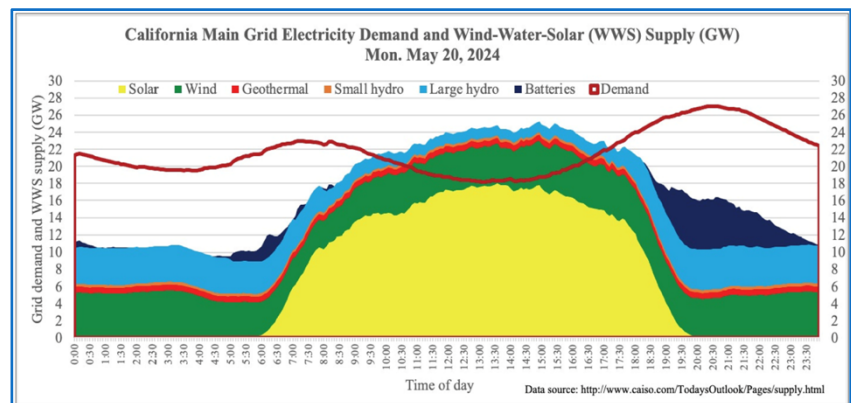


Let's say everything lines up and battery costs collapse, allowing for a massive deployment of capacity. This would put about 450GW into the power mix.

The battery buildup projections of 450GW wouldn't even begin to scratch the surface for the demand required around the world. When you measure 450GW against the global consumption of power, you can see in the second chart that battery storage doesn't even show up. And this doesn't capture the HUGE surge in demand that has come to market since the end of 2022.

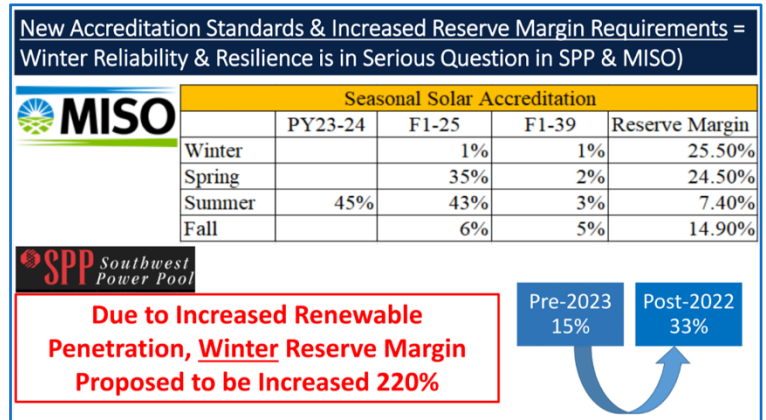


If we look at California as an example, it will take 10–12GW per night and morning to cover current demand levels. And this is assuming that batteries can last that long . . . when most can only hold a three-hour charge. By factoring in limitations, it would require about double or triple the installed back-up to at least 20GW. The additional batteries would also increase demand during the peak periods to recharge prior to the nightly and morning discharge. These numbers don't include any power demand



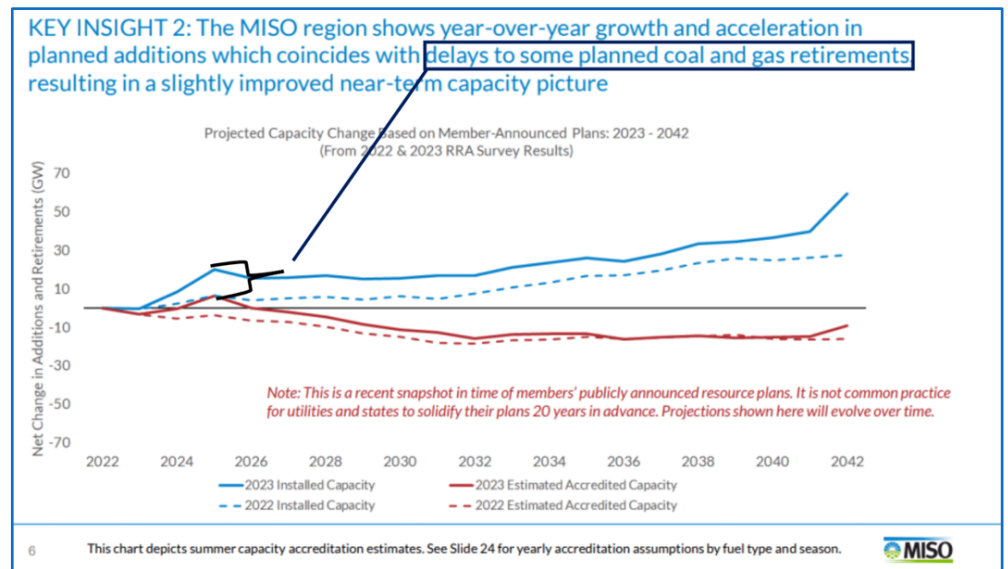
increases, which continue to grow around the world. Batteries are a great product to have in small doses, but you can see how batteries are drawn down during the night with little available in the morning. We also have to factor in battery degradation, and the limitations battery deployment has due to seasonality.

When we look at how things have changed after 2022, MISO and SPP have significantly adjusted their winter reserve requirements because of the intermittent issues. Here you can see the shift in the reserve margin, and how it has only moved higher since 2023. ISOs have been getting more realistic about the fragility of wind/solar, which is another reason they've been slow steaming interconnects.



There has been some slowdown in coal and natural gas retirements to help bridge near-term shortfalls.

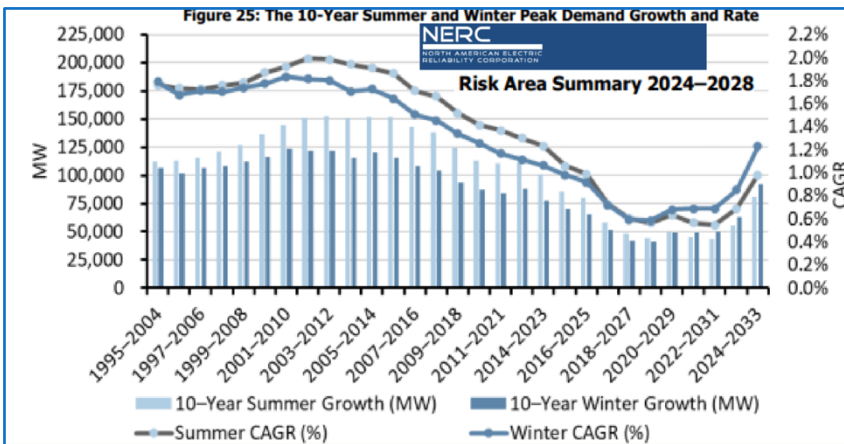
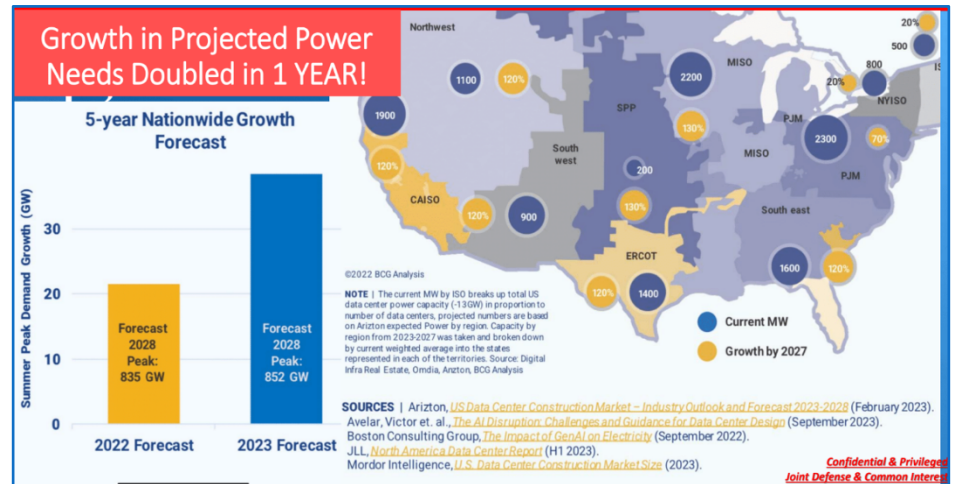
But what are we going to replace that with?



We're Facing Exponential Power Growth

Growth estimates for power are shifting higher since 2023. It's important to appreciate that these estimates don't even include the shift higher in AI expectations.

There has been another step up in forecasted demand, and we see this moving higher once again with the new data on AI.



Winter growth has shifted much higher, which is when hydroelectric capacity shines. C6's facilities are in a perfect position to capitalize on these demand cycles. Winter demand will continue to outpace as natural gas heat is reduced, with more reliance on electric heat / heat pumps.

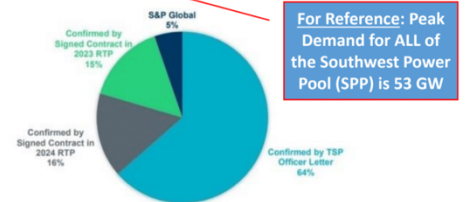
When we look at "Large Load Requests," ERCOT gives a great snapshot of demand coming into the market. ERCOT is fielding requests that would essentially double the size of peak demand over the next six years.

Potential Range of Increased Demand in ERCOT Alone is Breathtaking

2023 Peak Demand = 85 GW vs. New Large Load Requests for 2024-2030 = 30-62 GW !!

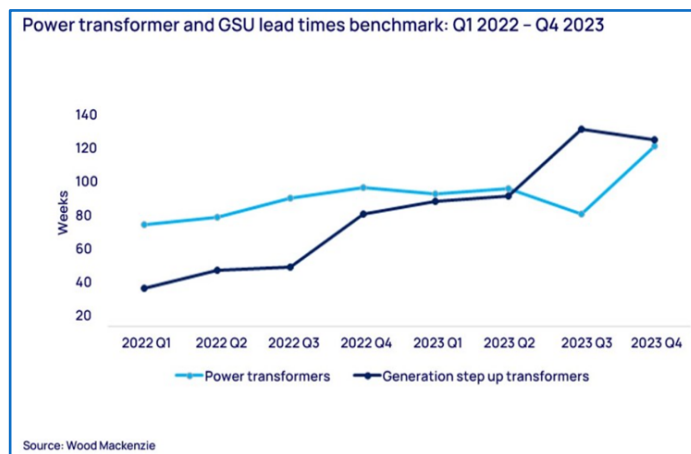
2024 RTP Load Review Results - 2030

- Approximately **62 GW** of additional load will be added on top of the 2024 RTP bounded load level for study year 2030 with the breakdown as follows



The Full Supply Chain of the Grid is Getting More Expensive

We could talk about how crazy all of the costs have gotten, but it's better to hone in on two key aspects: copper and transformers. These items are critical in moving power around the world. "Transformer lead times have been increasing for the last 2 years - from around 50 weeks in 2021, to 120 weeks on average in 2024. Large transformers, both substation power, and generator step-up (GSU) transformers, have lead times ranging from 80 to 210 weeks, and some manufacturers have already announced plans to expand capacity to meet growing demand."³

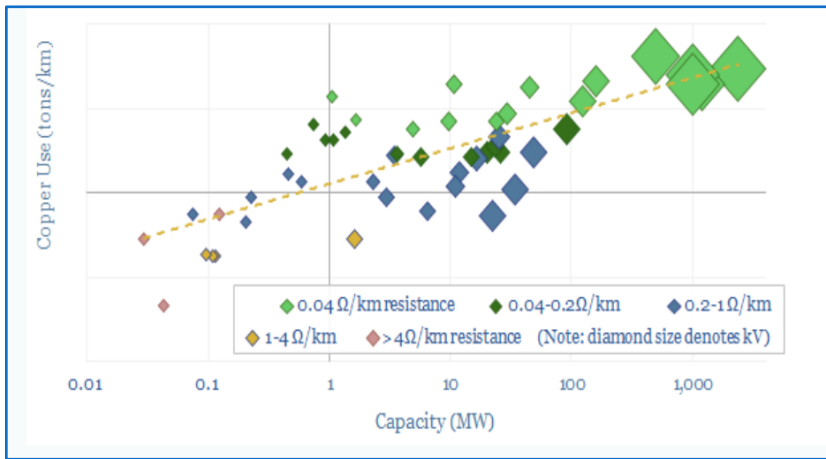


There are multiple issues impacting the lead times of transformers:

- Installed transformers are approaching their 35–40-year design life. There has been a program in place for almost a decade to replace assets.
- Expanding transformer manufacturing is a very costly endeavor, and there hasn't been the drive or margin to expand operations.
 - "The same manufacturers that acquired the technology and financial capital in the 1980s are enjoying full production slots and higher margins because of increased global demand. In turn, this limits their motivation to expand and risk financial instability."⁴
- OEMs (Original Equipment Manufacturers) are still experiencing material, equipment, and personnel shortages, causing long lead times.
- The U.S. can only meet 20% of our domestic demand. This means we are competing with the rest of the world for the other 80% of our supply. Power shortages and aging infrastructure isn't just a U.S. issue.

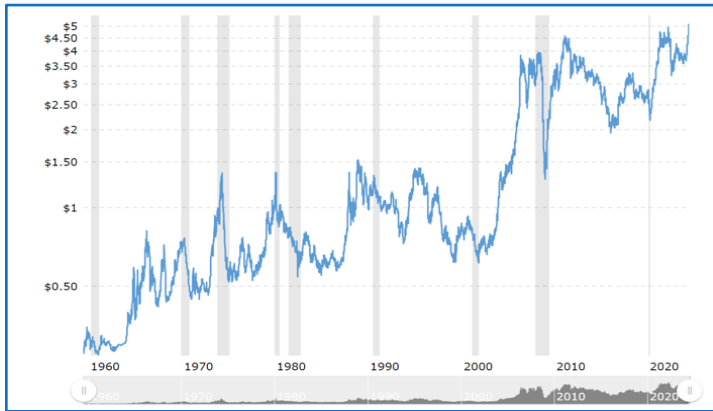
³ <https://www.woodmac.com/news/opinion/supply-shortages-and-an-inflexible-market-give-rise-to-high-power-transformer-lead-times/>

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Transmission wire also consumes a significant amount of copper. The bigger the gauge of wire, the more copper it requires. This chart gives a rough estimate of the tons per kilometer of copper.

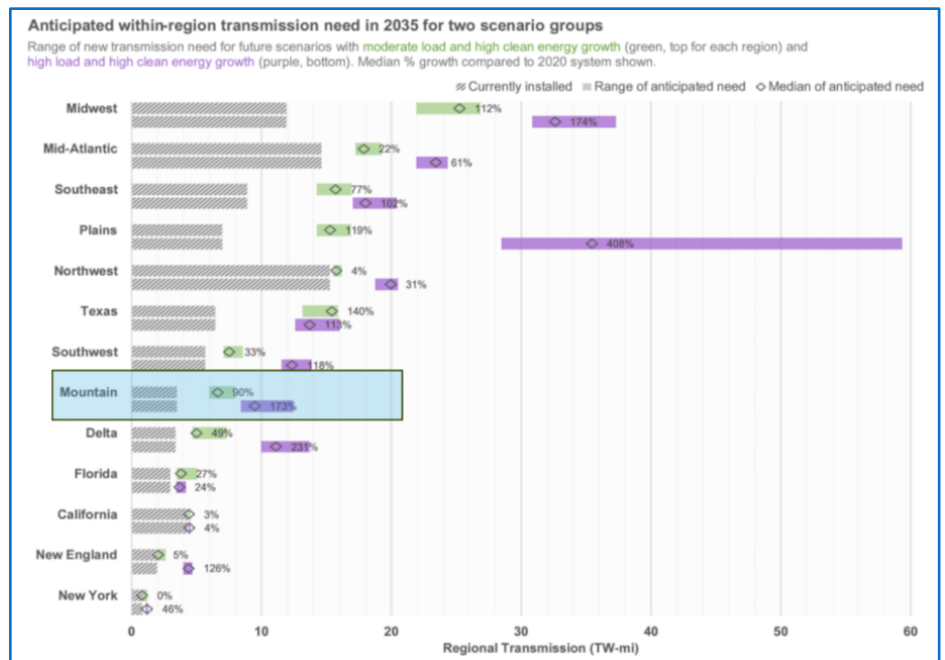
This is important because of the massive amount of wireline that needs to be constructed in this country to deliver the growing demand of power.



This chart puts into perspective just how elevated copper prices currently are against previous decades.

Here are some key findings from the DOE National Transmission Needs Study (2023):

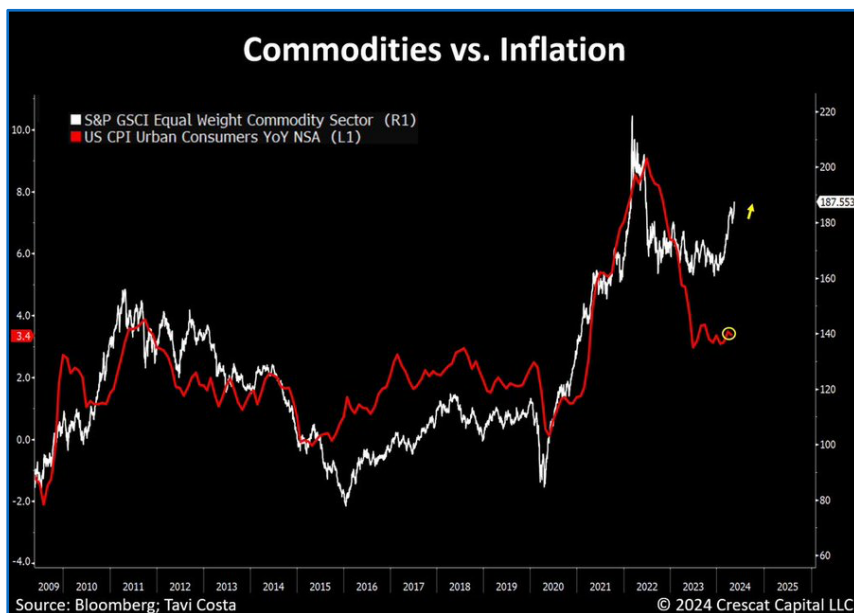
- Today's grid cannot adequately support 21st century challenges—including the integration of new clean energy sources and growing transportation and building electrification—while remaining resilient in the face of extreme weather exacerbated by climate change.



- Several regions endure consistently high prices, most notably in the Plains, Midwest, Mid-Atlantic, New York, and California. Additional transmission to bring cost-effective generation to demand in these high-priced locations would help lower prices.

Commodity prices have surged, increasing the input costs to build transformers as well as distribution networks. “Transformer prices have risen 60% to 80% on average since January 2020. Commodity prices for raw materials such as Grain Oriented Electrical Steel (GOES) have doubled since January 2020, while copper prices have increased approximately 50% over the same time frame. GOES prices have surged by almost 100% since January 2020, driven by a significant market deficit and key manufacturers curtailing production.”

When we look broadly at commodities, there has been another move higher over the last six months. Even when commodity prices “fell,” they stagnated at the highs from the early 2010’s. We are now facing a surge in new demand while supply and production remains slow or unable to catch up to the current levels of required raw materials.

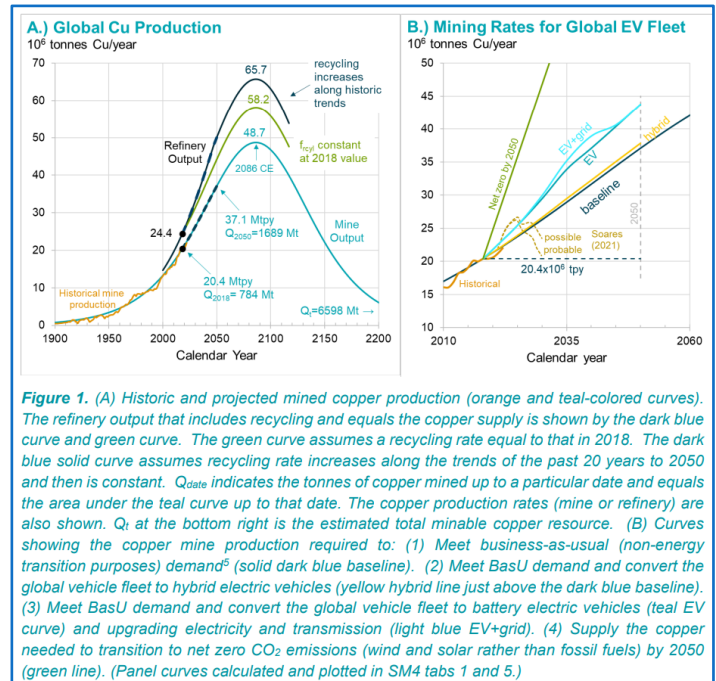


Current and Expected Mining Capacity Falls Short of Covering Demand Increases

When we look at basic supply and demand economics for copper, there physically won't be enough product to carry out the current U.S. policies "to transition the country's electricity and vehicle infrastructure to renewable energy, according to a University of Michigan study."⁵

It's important to put into perspective the level of demand required: "...an electric vehicle requires three to five times as much copper as an internal combustion engine vehicle—not to mention the copper required for upgrades to the electric grid. 'A normal Honda Accord needs about 40 pounds of copper. The same battery electric Honda Accord needs almost 200 pounds of copper. Onshore wind turbines require about 10 tons of copper, and in offshore wind turbines, that amount can more than double,' said Adam Simon, U-M professor of earth and environmental studies. 'We show in the paper that the amount of copper needed is essentially impossible for mining companies to produce.' The study examined 120 years of global data from copper mining companies, and calculated how much copper the U.S. electricity infrastructure and fleet of cars would need to upgrade to renewable energy. It found that renewable energy's copper needs would outstrip what copper mines can produce at the current rate. The study, led by Simon and Cornell University researcher Lawrence Cathles, was published by the International Energy Forum and discussed in a webinar, 'Copper mining and vehicle electrification.'"

The report continues by highlighting the level of mining that must occur over the next 30 years: **The researchers found that between 2018 and 2050, the world will need to mine 115% more copper than has been mined in all of human history up until 2018 just to meet "business as usual."**



⁵ <https://news.umich.edu/copper-cant-be-mined-fast-enough-to-electrify-the-us/>

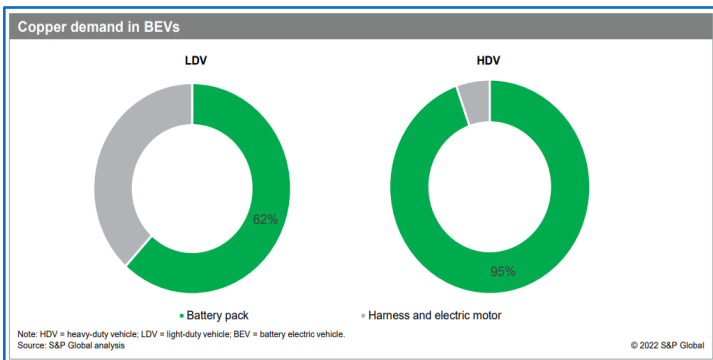
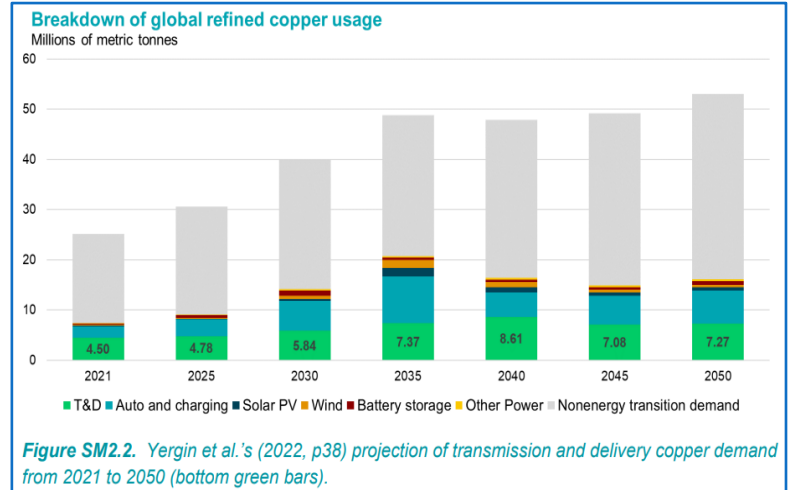
Table 1. Extra copper (relative to 2018) mined between 2018 and 2050 and number of mines that must be put into operation each year over this period to meet electrification demands (see SM4 tab 5).

	Mt mined above 2018 line	New mine production in 2050 in Mtpy	New mines* in 2050	New mines* per year
baseline	260	16.3	35	1.1
Hybrid	275	17.2	37	1.2
EV+grid	404	25.2	54	1.7
net zero	1460†	91.3	194	6.0

†Assumes that net zero requires mining 1200 Mt additional (above baseline) copper^{13,14}. Mines* indicates the number new mines with a production rate of 0.472 Mtpy, the average production rate of the top 10 mines producing today (SM3.2).

This does not even consider the green energy transition. The same U-M study states: “To meet the copper needs of electrifying the global vehicle fleet, as many as six new large copper mines must be brought online annually over the next several decades. About 40% of the production from new mines will be required for electric vehicle-related grid upgrades.”

The grid and energy transition demand must still contend with other copper usage. This breakdown chart doesn’t even include a more aggressive (exponential) adoption of AI, which is becoming more of a base case by the month. This would shift the “T&D” demand levels higher and increase the competition for supply. Many of these charts and estimates were created in 2022, and in only two years, the expansion of AI has outpaced even the most bullish estimates.



An interesting, overlooked point is what it would look like if Class 8 Trucks electrify. “The copper required for the collectors inside the battery packs of BEVs, as well as the e-motor itself, are the main drivers of increased copper demand. More BEVs mean more battery packs and e-motors. This is magnified in medium-duty and heavy-duty vehicles where the size of the battery pack required is much larger to maintain a sufficient range. For instance, a Class 8 truck (a typical 18-wheeler) will require a battery about 11 times the size of a personal car battery. As a result, the battery pack is responsible for over 90% of copper demand in larger vehicles. The above figure illustrates the copper demand by component in a light-duty versus a heavy-duty vehicle.”⁶

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⁶ https://ororesourcecorp.com/_resources/blog/Future-of-Copper.pdf

If we look at the chart to the right, 25 class 8 trucks would consume a total of 9MW, or equivalent to the Empire State Building. There are 3.91M Class 8 trucks in operation throughout the U.S., which equates to another 1,407GW of demand if they all converted. The nameplate capacity for the U.S. electrical grid is 1,213GW as of 2021.

So essentially, if all class 8 trucks convert, we would have to more than double our grid to meet the new demand. This doesn't include EVs, AI, data centers, electrification mandates at the home, industrial expansion, or any other growth capacity.

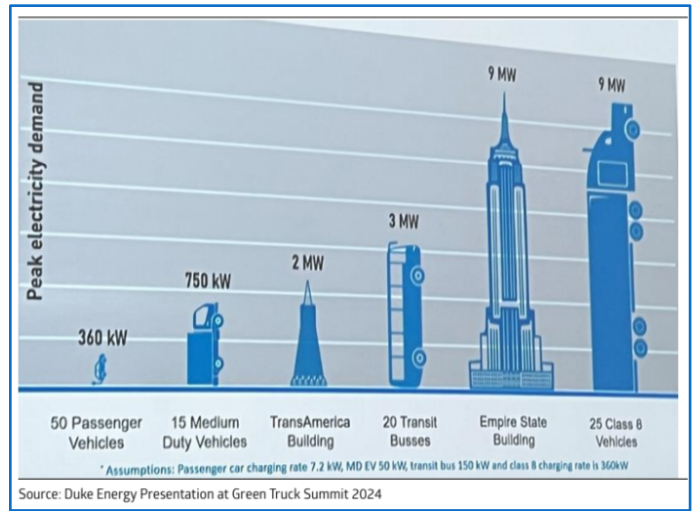
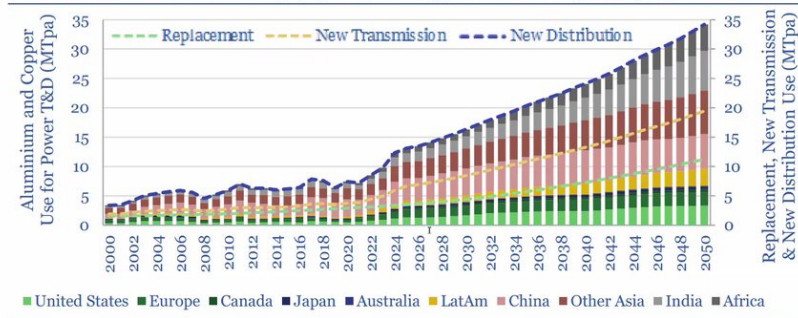


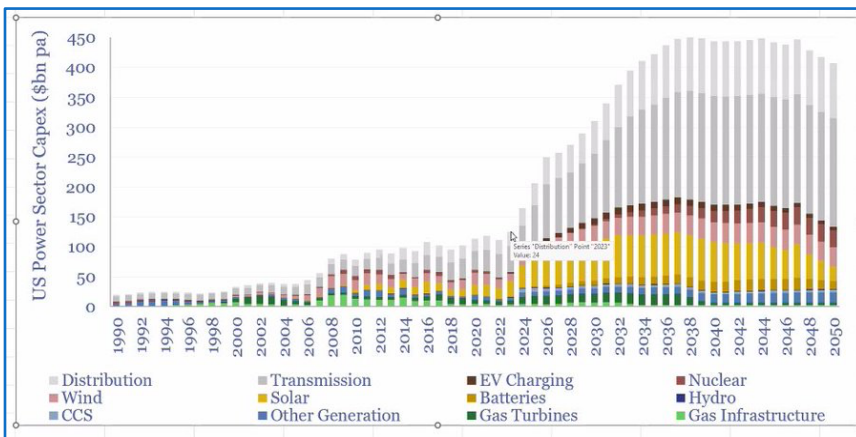
Fig 20. Today's power grids use 5-6MTpa of aluminium and 3MTpa of copper; these numbers need to rise by 4x for the energy transition's grid infrastructure?



Source: Technical Papers, Company Reports, TSE [Download the data?](#)

This chart Fig 20. does a great job of highlighting the significant requirements for data centers, power generation, and transmission. The world will need almost 4x the available amount of copper and aluminum to meet the growing demand of data centers and energy transition by 2050.

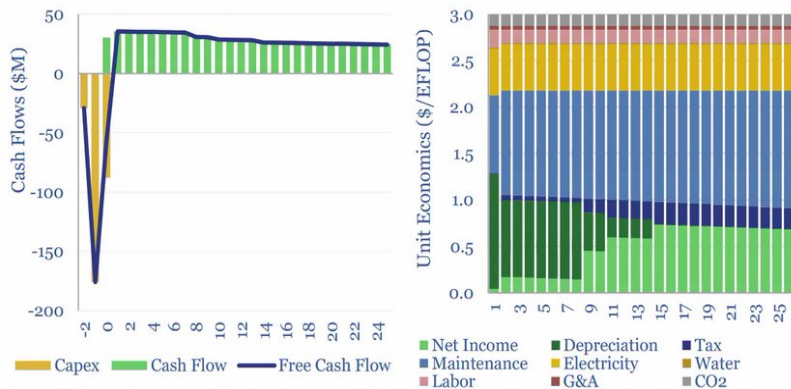
Similar to comments from National Grid highlighted earlier, these estimates are putting the U.S. power sector's CapEx needs from \$150B in 2024 up to about \$450B in 2034.



This Global Energy Crisis Presents a Huge Opportunity for Funds Like C6

It's pivotal to understand that other parts of the world are facing similar energy problems, which creates global scarcity of required equipment and commodities.

Fig 6. A 30MW data-center costing \$300M needs to earn \$100M pa in revenues? At 7.5 c/kWh delivered, energy would absorb 17% of the revenue of this data-center



Power is a huge cost to a data center so the opportunity to co-locate provides several key advantages. By co-locating assets, we take the transmission to a negligible number, as well as offer behind-the-meter pricing that helps offset some of our labor costs.

There are different costs when moving an object, whether it be data, electron, or

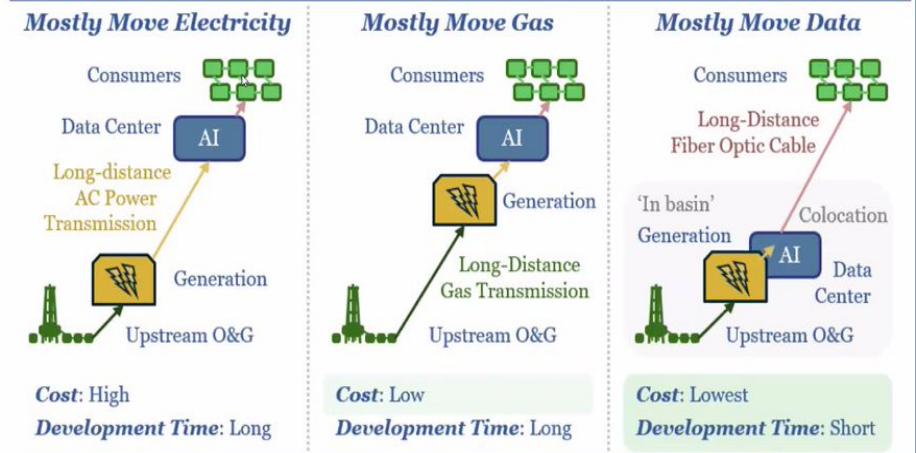
methane. The cost of moving data is 30% less than natural gas and a whopping 90% less than moving power.

At C6, we appreciate the importance of being close to the power source. This is why we are working with data centers to co-locate them at our hydroelectric facilities.

- 1) They are behind the meter. Power price is a huge component of their cost, so structuring a PPA (power purchase agreement) is a huge benefit for their underlying economics.

- 2) The servers are right next to the power source. This shortens transmission to an insignificant level, optimizing their operation.
- 3) Optimal cooling options driven by asset location, as well as ample water that can be cycled for cooling.
- 4) Electricians, operators, and staff onsite that can help manage the facilities.

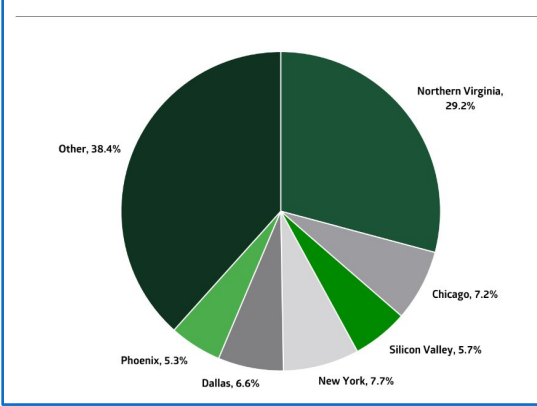
Fig 1. Moving data costs 30% less than gas; both cost 90% less than moving power.



Source: Technical Papers, Company Reports, TSE

[Download the data?](#)

Figure 8 Market Share Of Top 6 U.S. Data Center Markets By Net UPS Power



5) Many of the hydroelectric assets are in more rural areas that have direct access to Tier 3/ 4 cities or close proximity to universities. These regions pay a premium for data because many of the data centers are near Tier 1 cities and D.C.

All of this will result in higher prices for power across the board. This is pivotal to provide a rate of return and incentivize the deployment of efficient capital. The introduction of subsidies and tax plans skewed the deployment of capital over the last decade. It

drove excess money into projects that weren't profitable or effective at generating the level of power promised. Instead, projects were financed with questionable arithmetic, leaving the ISOs struggling to close the intermittent issues.

C6 is focused on baseload power, optimizing pre-existing capacity, and adding new generation.

We need a basket of solutions to address our shortfalls, and we agree fully with this perspective on natural gas: "Natural gas generation is the best, most cost-effective, and most reliable way to manage the variability of other energy resources." Jim Robb, President and CEO of North American Electric Reliability Corporation.

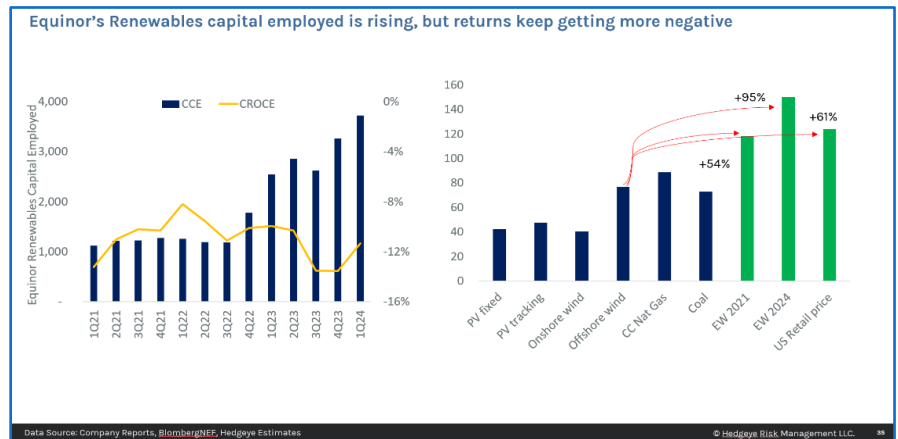
\$ mm	Capex			BP Plan*			Implied ROCE		
	2023A	2025E	2030E	2023A	2025E	2030E	2023A	2025E	2030E
Resilient Hydrocarbons	11.1	10.0	9.0	39.2	41.0	42.5	15%	16%	17%
Oil Production	6.3	5.2	4.5	18.9	27.0	28.5	17%	24%	26%
Natural Gas	3.0	3.0	3.0	14.8	14.0	14.0	14%	13%	15%
Products	1.8	1.8	1.5	5.6	4.5	4.3	12%	10%	10%
Convenience and Mobility	3.1	2.5	3.5	4.4	7.0	10.0	17%	25%	25%
Low-Carbon	1.3	4.0	4.0			2.5	0%	0%	9%
Group	15.5	16.5	16.5	43.6	52.5	59.3	15%	17%	19%

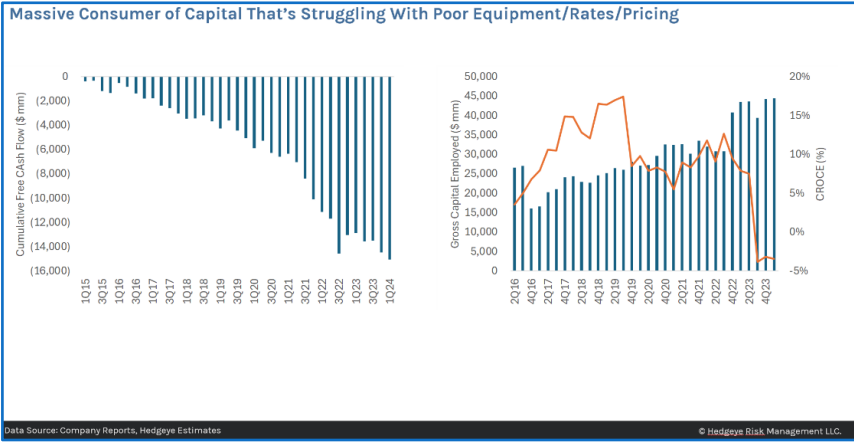
* at midpoint of guidance, implied ROCE, Resilient Hydrocarbons breakdown are Hedgeye estimates

When we look at how capital is being deployed, we find that even projects with subsidies are steeply negative, failing to reach even the lowest internal hurdle rates. BP is just one example that is pushing hard down

the "Low-Carbon" path but struggles to even touch the internal hurdle rates.

When looking at other companies that have pivoted to green initiatives, such as Equinor, we see how their return on capital deployed only gets further negative. Prices will be forced higher if companies expect even a semblance of returns.





Many companies have taken advantage of the “grift” created through low rates and huge subsidies. Orsted is another company that has failed to reach any level of free cash flow capacity.

The ISOs and utility companies are now struggling to meet the rising demand, and it’s about time we get serious about how we address the next few decades.

Orsted, BP, and Equinor are just a few examples of firms that have shifted but can’t generate cash flow in the current market because they have relied on subsidies.

The demand pivot across the grid is real, and power prices will have to rise to incentivize new supply. We are currently in a huge paradigm shift as electricity prices begin a relentless march higher. The solutions will come from new power generation, optimized wire line, additional distribution, and advances in power flow control.

The future is not going to be a “one size fits all.” The shifting market will require a basket approach and that is where C6 looks to capitalize!