WZI INC.

Jan 6, 2025

Attn.: U.S. Department of Energy (FE-34)
Office of Regulation, Analysis, and Engagement
Office of Fossil Energy and Carbon Management
https://fossil.energy.gov/app/docketindex/docket/index/30

Re: Response to DOE Study - 2024 LNG Export Study: Energy, Economic, and Environmental Assessment of U.S. LNG Exports

Summary

As an industry advisor, WZI respectfully submits these comments on the general issue of balance and prudence in the space occupied by the densely populated debate on the reduction of GHG - specifically LNG's methane emissions as opposed to critical adaptive measure in terms of global climate change. These comments are not targeted at specific elements of the study but rather are best summarized as an effort to expand the study's utility by distilling the impact of LNG into a prudent framework. LNG is simply an extension of the strategically vital and highly transportable methane molecule. Natural gas represents a key element of a nation's GDP; thus, it is not only essential to US domestic well-being but also it is of strategic interest to make US LNG available to allies and to curry strategic position in terms of the petro-dollar. The subject DOE study does not suffer from a flaw of analysis but rather a flaw of scope leading to narrowly constructed conclusions which could have been revealed in a robust technical peer review of the market impacts and LCA outcomes. Further, the success shown in fugitive methane mitigation in domestic regions of concern such as the Permian Basin should be factored in the analysis of the potential with regard to LNG. The models and studies should not ignore the balance between GHG reduction in terms of mitigation and both energy resiliency as an adaptive measure, as well as attraction of private sector investment. Therefore, we believe the Secretary of Energy should instruct DOE to provide a new study with a more encompassing scope and a substantive transparent peer review (possibly tapping into NPC's study process) and should incorporate the following—

Need for LNG:

The realities of natural gas and LNG as an energy source can be considered in terms of its relationship of energy from natural gas to the various final uses in the entire spectrum of the GDP specifically affected by natural gas (i.e., thermal energy for homes and factories, chemical feedstocks for products and textiles, as well as electrical energy for internet servers, LAN servers, cloud systems, WiFi and personal computers).

There is evidence of a long-term progression and shift at an exponential decay of energy use (i.e., efficiency increase) where the btu/$GDP decreased from 9,000 btu/$GDP in 1960 and crossed 5000 btu/$GDP in 2017. It now appears to be slowly approaching a value likely falling in the range of 4,000 btu/$ by 2030, indicating a rational limit based on all-in energy efficiency constraints. The same energy-to-efficiency approach extends to most industrialized countries. This underscores the strategic value of LNG exports on a global economic scale. And as no surprise, given the recent activity on the part of big-tech to support AI, the efficiency trend signals shifting to increased domestic nuclear power by 2050 as renewables reach a point of diminishing returns as far as contributing to baseload.

LNG export development helps domestically:

Reinforcement due to the expansion of LNG export capability is not incompatible with resiliency or price stability. It was erosion of resiliency due to California's failure to encourage building of capacity that caused system wide economic failure in 2000 and subsequent price spikes. And in ERCOT, during winter storm URI, the abrupt loss of policy-favored renewables and the rapid erosion of integrity in the unreinforced gas-fired assets led to the system failure.

Loss of marginal wells due to regulatory fiat (EPA fees, SEC reporting requirements, etc.) may be offset to some degree by new capacity with flexible dispatch, available in the margins of design capacity in the systems supporting export of LNG (i.e., wells, pipelines and storage).

Suggestion to mitigate price impact concerns:

A provision should be included in the gas tariffs and permits that interrupts export commitments for up to 20% of the peak domestic demand to cover emergency domestic demand based on determination by the Secretary of Energy or by Executive Order. The price would be tied to the seasonally adjusted Henry Hub price for the previous year. This provision would be known by both the domestic market as well as international markets and its effect would be factored into contracts, hedges and financial instruments. This swing capability is not unique and should be specifically considered in any meaningful policy study.

LNG facilities require committed gas paths and contracts to justify the capital investments that build capacity and resiliency. In this sense, producers of LNG will typically operate in a manner that on its face appear contrary to concepts of preserving strategic reserves, thus DOE's models are biased as if built around a zero-sum balance between domestic markets and export. However, the very complex nature of the natural gas market leaves a lot of head space to put in place additional capability needed to offset impacts of nature and poorly structured policies. Providing domestic stable market prices with the degree of reliability that is essential to the other non-export elements of the US Gross Domestic Product. One of the fundamental flaws in energy management is over-regulation limiting the ability of natural market forces to respond; this has been proven in recent history as shown in the discussions below. The existing natural gas market has been facilitated by the prudent application of long capacity-based contract instruments coupled with dynamic market instruments allowing deliveries of storage and just-in-time energy products; this is the nexus of a future contract framework built around flexible capacity allocations.

Need for LNG

One needs only to look at natural gas's impact on the historic relationships of heating, electricity and coal in the US to understand the dynamics of the natural gas market and its effect on the economy. The risk of price increases and a reduction of supply will be found again and again to be due to the failure to allow market forces to build in capacity, which appears to the antithesis of the current study's theme.

Natural Gas and its role in the GDP

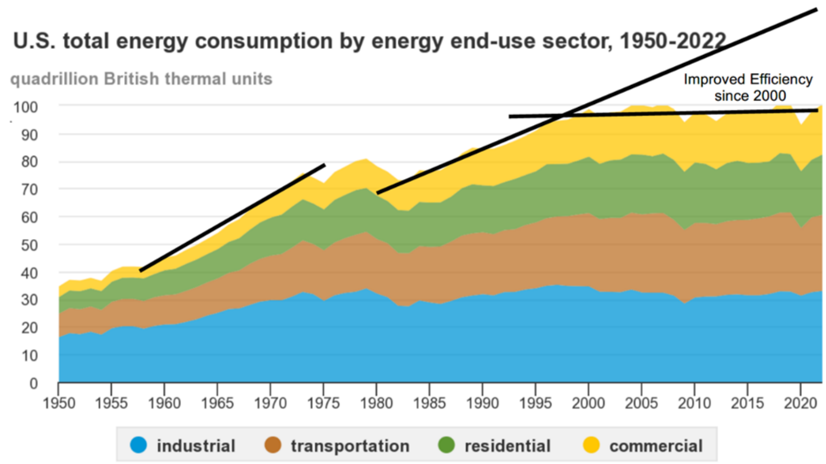
The realities of natural gas and LNG as an energy source can be considered in terms the energy from natural gas and its relationship to the various final uses in the entire spectrum of the GDP specifically affected by natural gas (i.e., thermal energy for homes and factories, chemical feedstocks for products and textiles, as well as electrical energy for internet servers, LAN servers, cloud systems, WiFi and personal computers). The table below provides a glimpse of the well-known fate of natural gas's energy as it relates to the GDP.

Table 1: Generalized Fate of Natural Gas in Terms of GDP

				GDP Sector			
Source		Commodity	Generalized Sector	**C** Consumer spending:	**I** Investment: business spending on fixed assets, plus investment in unsold inventory	**G** Government Spending by federal, state and local governments to provide goods and services.	**NX** Net Exports: United States.
Natural gas		Export	All below in Country of Destination				X
	Thermal	Heat	Industrial	X	X	X	
			Commercial	X	X	X	
			Residential	X		X	
		Electricity	Telecommunications	X	X	X	
			Electronics	X	X	X	
			Industrial	X	X	X	
			Commercial	X	X	X	
			Residential	X		X	
	Chemical	Fertilizer	Agriculture	X	X	X	
		Plastic	Industrial	X	X	X	
			Commercial	X	X	X	
			Residential	X		X	
		Biochem	Industrial	X	X	X	
			Commercial	X	X	X	
			Pharma/Medical	X	X	X	
		Textile	Industrial	X	X	X	
			Commercial	X	X	X	
			Residential	X		X	

Natural Gas and LNG and Economic Efficiency

The graph below shows energy consumption by sector. The heavy black lines emphasize the periods of relatively stable year-to-year demand periods (either steady growth or leveled growth in demand). Between 1950 to 1995, energy consumption in the US grew steadily except during the energy crisis in mid-1970s and in the early 1980's. After 1995, energy consumption began to level.



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 2.1, April 2023, preliminary data for 2022

Note: Total energy consumption includes primary energy and electrical energy; electrical energy includes electric system energy losses.

At the same time the economy as measured by GDP typically grew faster thus the dollar-based need for energy (on a btu/$GDP-basis) steadily decreased at varying rates. The question here is did the economy develop due to natural gas's impact or did natural gas capacity simply develop in a contango manner.

Since 1997, btu/$GDP (chained to 2012) has been tracked and reported by EIA. Over the course of the past twenty years, it appears to be relatively linear.[1] It shows a consistent trend in improving economic efficiency, (Energy Information Administration, 2022).

However, the greater trend extending back to 1950 using Federal Reserve Data (chained to 2017) along with reported energy consumption shows the data in a different light. (Federal Reserve Bank of St Louis)

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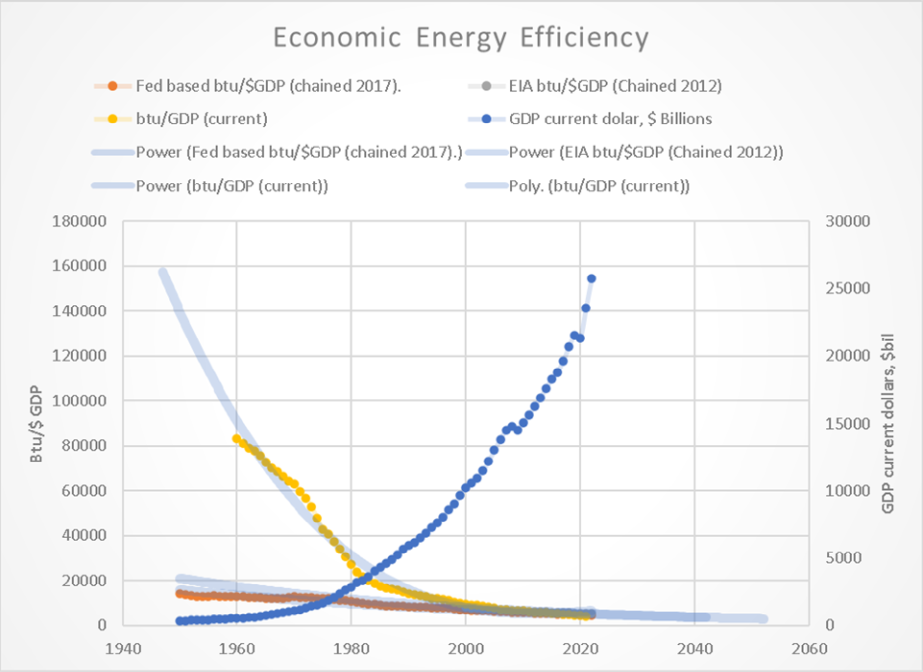
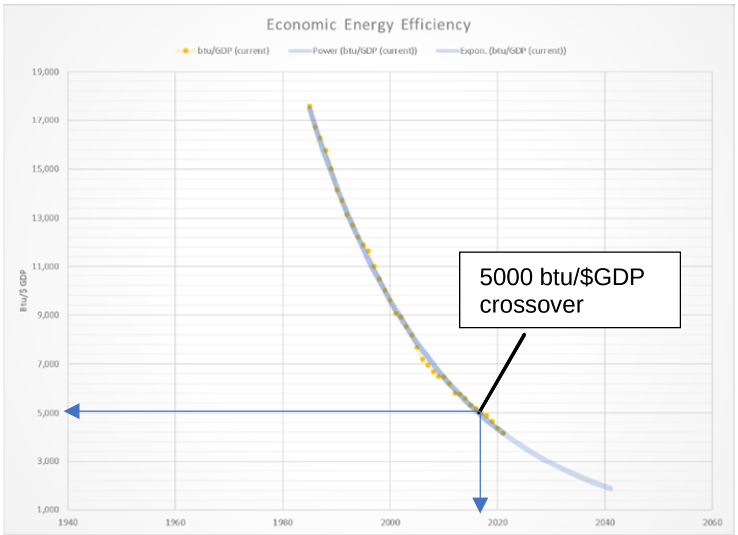
[1] EIA converts renewable electricity from kWh to btus using 3412.142 btu/kWh (an ideal conversion) as opposed to the use of "heat rates" which are different in that they account for inefficiency. Heat Rates are applied to fossil-based electricity which takes the entire cycle efficiency into account including losses due to heating converted water during combustion and the latent heat of vaporization, thus unless the water is condensed to liquid the latent heat of vaporization is an irretrievable energy loss. Other uses of Heat Rate include describing overall grid efficiency sometimes described as the System Average Heat Rate (SAHR). The inclusion of renewable energy drastically improves the SAHR since the energy addition assumes no other losses.



From: EIA - Energy in btu and GDP ($2012); Bureau of Economic Analysis- GDP ($2017) and GDP ($current)

One can see that high energy consumption was the prevailing model for the economy through the period from 1950 through the 1970's, then challenges brought energy to the forefront of policy. Efficiency mandates began to reduce energy wasted relative to then current GDP and the GDP itself typically grew year-to-year. After 1995, reductions in energy consumption on a btu/ $GDP basis have been steady in the past several decades.



Data from: EIA - Energy in btus, Bureau of Economic Analysis- GDP ($current)

What is more noteworthy for modelling the domestic and strategic need for LNG is the more historic view using a Fed-derived GDP (chained to 2017) applied to the EIA energy consumption for the same period. **There is evidence of a long-term progression and shift at an exponential decay where the**

btu/$GDP has crossed 5000 btu/$GDP (and assuming continued economic growth) appears to be slowly approaching a value likely falling in the range of 4,000 btu/$GDP by 2030, indicating a rational limit based on all-in energy efficiency constraints. The same energy-to-efficiency approach extends to most industrialized countries, underscoring the strategic value of LNG exports on a global economic scale.

In terms of the current GDP, one sees slight benefit of some of the renewables being brought on relative to the predictive exponential decline since 1985 (a period largely defined by natural gas policies and renewables) as well as the direct benefit of reductions in fugitive natural gas emissions. Are renewable-based energy replacements truly reliable, or a false crutch, how do they compare to the elimination of the fugitive natural gas emissions? Unfortunately, the all-or-nothing approach of GHG mitigation advocates will not be questioned as the test of time bears witnesses to planned policy outcomes running headlong into reality. As the pinch in btu/$ GDP is approached, the replacement energy (not to be confused with the avoided GHG emissions) should have a quality of reliability and resiliency equal or better than the policy-based displaced energy, regardless of GHG mitigation outcomes. **The impact due to the abrupt loss of the renewables and the rapid erosion of system integrity that follows will be at a greater scale than that impact felt during winter storm Uri; a risk of harm to the future domestic economy due to inadequate adaptive measures due to policy favoring mitigation measures.**

LNG export development helps domestically

Reinforcement is not incompatible with price moderation

In the current GHG mitigation paradigm, renewables have now placed high cost non-hydro renewable sources in a ***favored misalignment in terms of merit-based least-cost dispatch prioritization*** in response to normal utility rate-base demand curves. And if resource planning fails, the misalignment leads to out-of-synch pricing and shortages that can only be remedied by some combination of out-of-market purchases and rationing. See the discussion on the California electrical meltdown in 1999 to 2000.

Shifting allocations from reliable sources such as natural gas is a policy acceptance of a clear risk to reliability as witnessed in the winter storm Uri.

In the granular analysis of States as experimental laboratories, one gains an empirical sense of models, policy and outcomes and the importance of prudent reinforcement.

Looking at supply and demand on a utility scale requires a broad sense of systems. The first chart shows NERC's model for the normal diurnal demand and load following, (North American Electric Reliability Corporation, 2022). Note the grey bars for solar do not coincide with the demand.

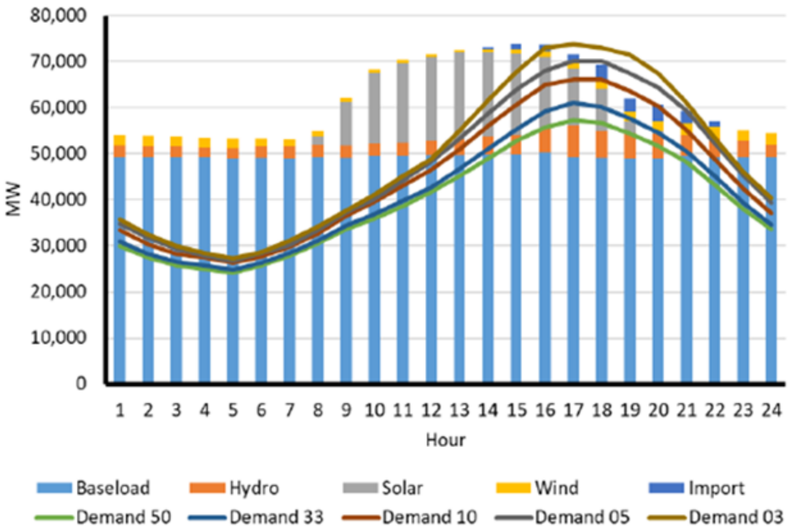


Figure 6: Hourly Demand and Resources for 2024 Summer Peak in WECC-CA/MX

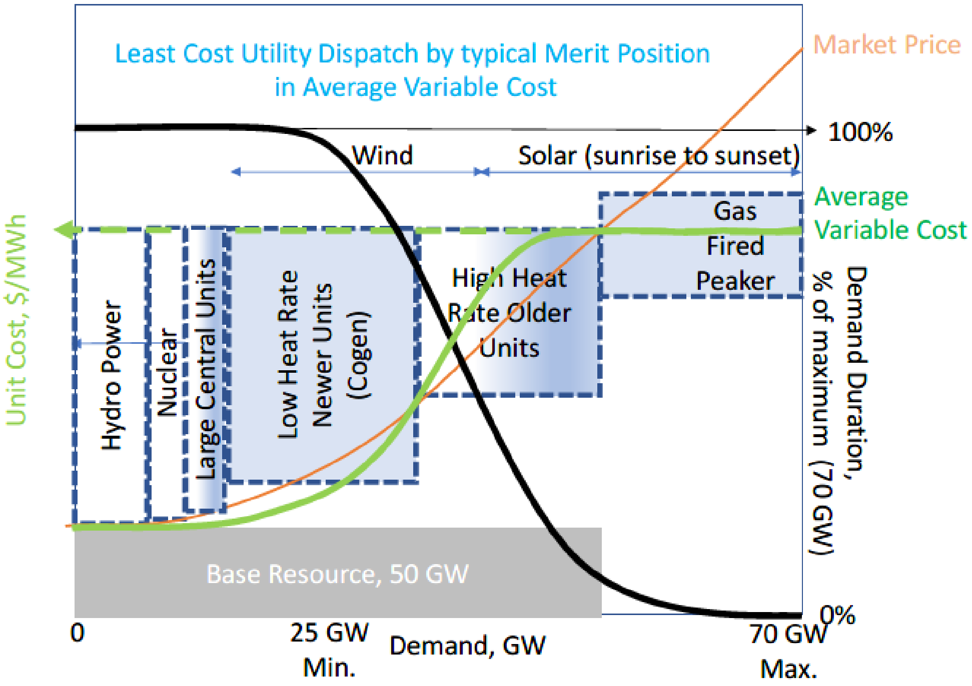
If you translate the same data into a supply and demand duration vs. demand curve one arrives at the and where the second chart has wholesale price (on the left) tied to demand duration (on the right). The orderly dispatch is stacked around "least-cost" dispatch and reliability with largely natural gas fired baseload coverage, nuclear power, and hydro covering the majority of the energy demand at any time of the day.

The chart plots **demand duration (heavy black line)** supply. The cumulative busbar Average Variable Cost at any given demand point is green. Both are plotted to the actual system demand instead of time, where:

- constant demand duration is 100% on the left side (largely industrial baseload);
- 100% duration extends to approximately 25 GW(largely industrial baseload);
- the peak demand (approximately 70 GW) logarithmically approaches 0% in duration (temporally this coincident peak is in the late afternoon and early evening) on the far right side,

The issue of the relationship to dispatch order can then be put together by either stacking the orderly dispatch (either by merit defined by generation agreements) or by preferential dispatch favoring renewables. Each dispatch call is based on some combination of temporal availability, least cost for utility baseload generation or long-term baseload contracts with private interests. As discussed later, this same load demand duration and following concept can be applied to natural gas.

Here one can assess the normal orderly dispatch relative to the generalized wholesale market price (as well as the Average Variable Cost) and the merit-based dispatch the order in which resources are allocated according to heat rates and contracts. Thus, underscoring the key role natural gas plays in maintaining the electric grid stability (as electricity priced at the gas-fired system average heat rate). The natural gas component of merit-order dispatch is shaded light blue. A white-blue gradient is provided in some dispatch areas to indicate sources which may include renewables coal, fuel oil as well as natural gas. The integral od the AVC curve represents the utility expense for energy less the additional ancillary service as well as transmission and distribution imbedded in rates.



Using this concept one can see that the complexity of the models in the 2024 LNG Export Study: Energy, Economic, and Environmental Assessment of U.S. LNG Exports report falls short in so far as it should scope in a piece of recent history – California's electrical restructuring in the late 1990's, and the impact of erosion of reliability and pricing.[2] It is difficult to accept that policy could be formulated based on narrowly scoped studies without substantive peer review or test against historic events; leading to a case of "fict" to be used to further the pursuit of foregone policy initiative.[3]

The need for natural gas's contribution to resiliency must be put into the proper planning context. In terms of policy, there are the known and potential risks; unknown risks are only realized upon failure to adapt. Some of these risks manifest themselves in the value chain such as, but not limited to, seismic events, severe weather, policy fiat, mitigation overreach, and infrastructure failures. **System-wide reinforcement to expand LNG capability is not incompatible with resiliency or price moderation.**

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[2] The effect of bringing technical findings to policy without a serious discussion of the accumulation of errors relative to the effective outcome of the policy affected by the "bad data" is policy dissembling, not tested until well after the impact of a poor policy decision is felt. In general, policy and design engineering share some important common factors in that they are intended to solve problems. The balance between mitigation and adaptation is always at risk of bad data and limitations on economic models. Design engineering delivers a solution that takes risk into account and balances risk mitigation against the overall efficiency of the design. Risk analysis embeds the issue of error, the assumption is made that deterministic elements are potentially wrong and thus imposed design margins are adjusted to compensate for the accumulation of errors.

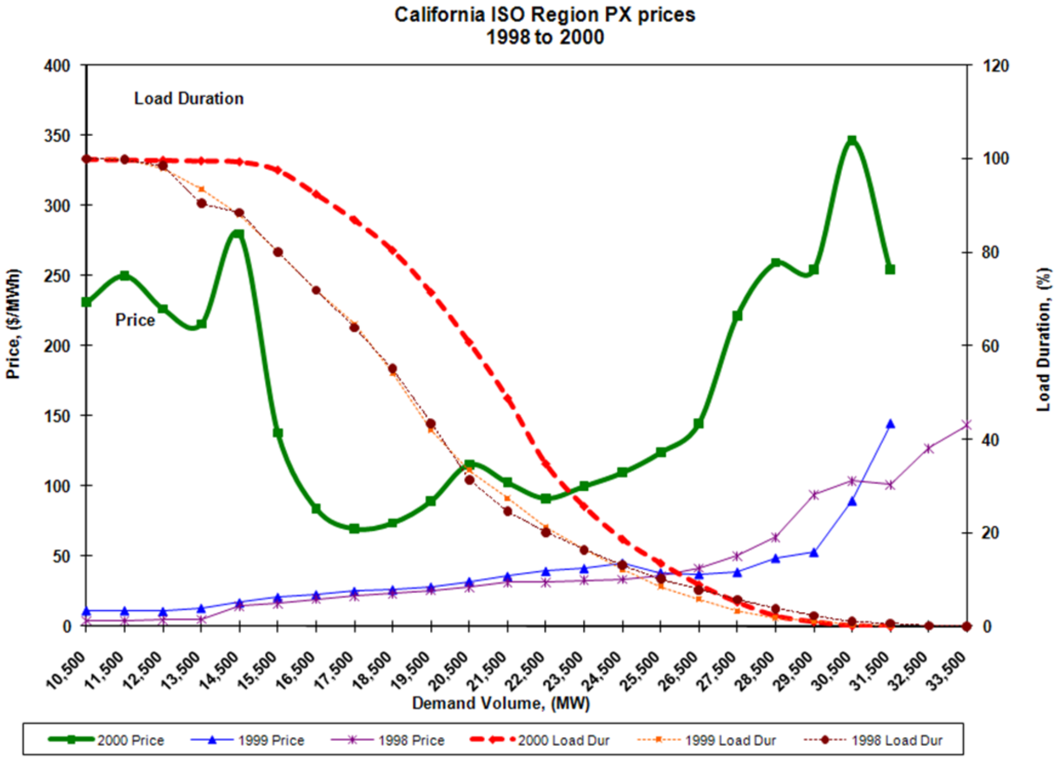
[3] "Fict" being a combination of fact and fiction defined by: I wouldn't have seen it if I hadn't believed it and I was right for the wrong reason.

California as an example of misaligned policy

In California as part of the planned restructuring, the older utility generation was sold off with Reliability Must Run contracts as an asset to the sale. Capacity requirements were to be matched by these older facilities or by new facilities built at-risk by Independent Power Producers (IPPs) taking bus-bar payments at dynamic PX time-based pricing and ancillary services payments paid by the California Independent System Operator (CAISO). However, the synthetic rate freeze built into AB1890 held market prices too low to encourage the IPPs to seek development, permits or funding for projects in California. Fortunately, the built-in capacity, previously fostered by PURPA lasted for several years.

The graph below shows first three years following the Electrical Restructuring in California up to the failure of the Power Exchange and the first PG&E bankruptcy. The data are sourced from Market Clearing Price - California Power Exchange California ISO Controlled Area, PX Market Clearing Price 1998 to 2000, Demand Volume – California ISO 1998 to 2000.

The load duration and pricing curve was consistent with the normal merit-based model through the first two full years of operation (1998 and 1999), market prices swung up and down diurnally over the load duration curve, reaching its peak price at the last instance of demand (far right side of the curve), but always keeping the Average Variable cost in alignment with the mandated rate freeze. Dispatch was still merit-based through the baseload and mid-portion of the load duration (using contracted base load facilities) with bid based and ancillary service dispatch covering any excess demand for energy over the last half of load duration.



In the historic 1999-2001 market meltdown in California, one sees a slight increase in average demand (due to frozen rates) but the coincident peak remained the same. The impact of the 1999 spring maintenance cycle (normally tied to historic spill-hydro prices and curtailment) coincided with the unseasonal drought in 1999-2000 (diminishing the capacity normally anticipated during the spring hydro event). This resulted in CAISO making calls for energy to backfill generation in the demand that is 100%

(left half of the load duration curve) that was neither contracted for nor available. The real cause of the meltdown is revealed in the price distortion due to unmet calls for Must-Run generation and the cost to bring on units that were on planned outages during the first 20% of the load duration curve (terminating at approximately 14,000 GW of demand) for the first three months of 2000. This effect led to grossly out-of-market wholesale prices in a rate-freeze environment leading to the power exchange (PX) collapse and PG&E bankruptcy. **Erosion of resiliency was due to failure to build-in capacity; this caused system wide economic failure.**

The point here is that the AB1890 synthetic-planned well-regulated market measures snowballed in a matter of days to the point where the Power Exchange and PG&E could not make payments for generation services leaving much of the market at risk due to non-recourse funding agreements. Most operating Independent Power Producer facilities were leveraged using various risk management instruments in their non-recourse financing structures including hedges which were subject to automatic calls tied their debt instruments. This led to the Enron collapse due to its inability to meet pounce calls on hedge products.

Winter storm Uri as an example of failed policy

Separate of the California market meltdown, in February 2021, Winter Storm Uri caused widespread blackouts in otherwise energy-rich Texas, affecting many millions of residents as well as businesses. Looking back to the common dispatch models above, one can see the difficulty in Renewable Portfolio Standards favoring wind (for all its LCA benefits) above classic thermal generation in the dispatch order.

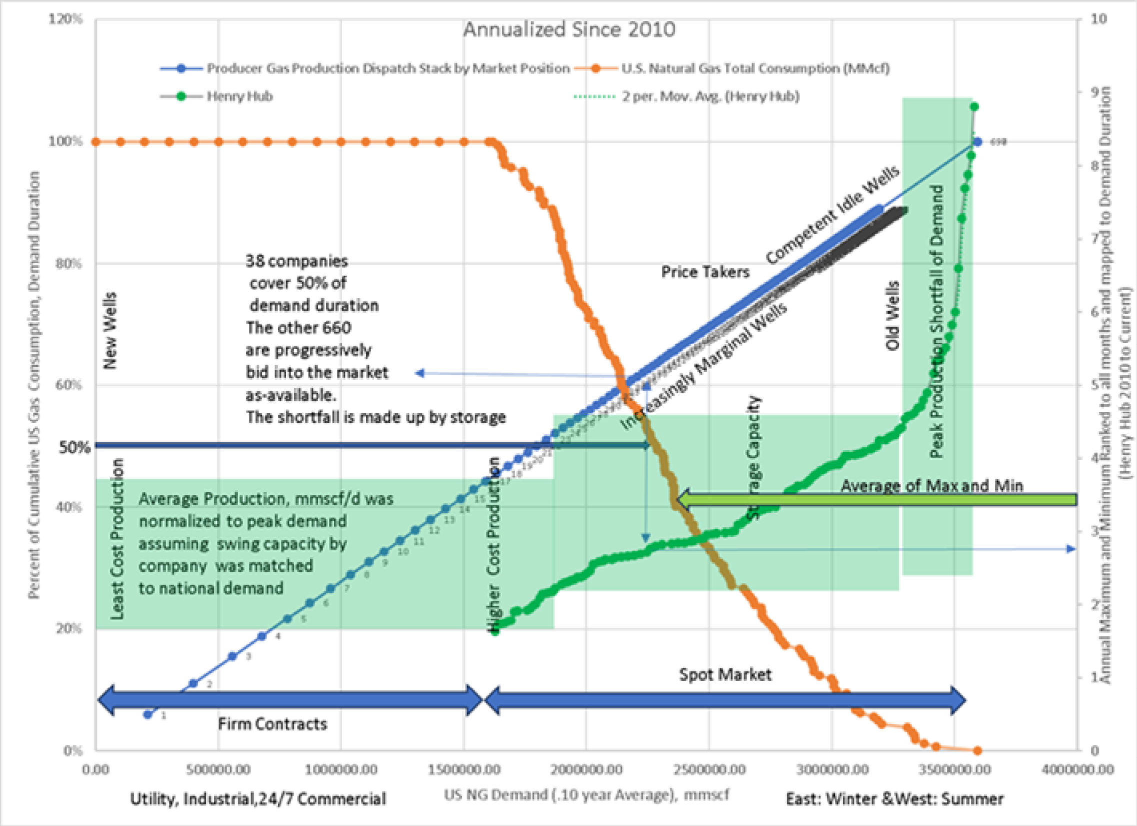
One of the common wintertime risks in southern power plants is associated with freezing instrumentation, particularly steam-sensing lines due to poor insulation and insufficient use of heat tracing. Couple this issue with the tremendous roll out of wind power in Texas and one sees a two-risk intersection during a peak demand period leading to grid failure. Had the TPUC simply ordered that all thermal power plants in Texas have sufficient heat trace to 20 degrees F and maintained a sufficient reserve of natural gas generation in the resource mix, there would have been no blackouts.

Winter Storm URI underscores the risks we accept in concept but must meet in reality. The National Petroleum Council (NPC) spoke to this concern in their December 2022 publication: “Petroleum Market Developments – Progress and Actions to Increase Supply and Improve Resiliency”, also citing ERCOT’s “Report on Causes of Generator Outages and Derates During the February 2021 Cold Weather Event”, (Federal Energy Regulatory Commission, 2021), (Electricity Reliability Council of Texas, 2021). The TGOA also noted in their study that the loss of power affected the deliverability of natural gas. The unavailability was largely due to the weather conditions affecting traditional power generation due to the common issue of ***freezing of un-heat traced lines*** but also due to ***wind turbine blade freezing*** and ***solar panels being snow covered***. NPC rightly noted, ”[g]iven the reliability of oil and gas systems and that the power generation sector are interconnected, communication and coordination between sectors are essential to bolster the reliability of both.” (National Petroleum Council, 2022). Concerning use of waivers during an emergency to compensate for erosion of resiliency, “[i]t can be difficult to “pre-write” waivers due to the individual nature of each emergency event”. Energy policy that fails to encourage contingency-based resiliency and reinforcement will expose the general population to the vagaries of future emergencies, (National Petroleum Council, 2022).

One needs only look to winter storm Uri and add this future scenario and its risks to the resource challenges due to insufficient allocation to competent capacity to see the potential for a collapse ***exceeding*** that of California in 2000/2001 with ramifications approaching or possibly exceeding that of the energy crises of 1974 and 1979.

Idle Wells, LNG and Market Price – (a case for avoided cost consideration)

Policy pressure is being put on the critical well population. **<u>The role of marginal and idle wells needs to be considered in the current proposed regulatory driven transition in the context of their critical service in the marketplace.</u>** The graph below shows a combination of relevant related information as a set of curves similar to that of electricity.



Again, like the electrical demand duration curve the load/demand duration (in orange) is the period for which the demand exceeds the minimum on a percentage basis. In other words, the annual average months swing since 2010 ranged from 1.6 billion scf per month to 3.59 billion scf per month, typically driven by the seasonal CONUS swing east to west depending on winter (heating) or summer (cooling) demands. So, the 100 percent line extends to 1.6 million and then begins to steadily drop as shorter periods of incremental demand progress until the peak which approaches (0%) of the time - a hard freeze or really hot summer days in many Metropolitan Statistical Areas (MSAs).

The other curve (blue) is the stack of producers ranked by their share of market as defined by the demand, (Energy Information Administration, 2022). All data are normalized on a pro rata basis to the EIA provided demand as if all parties had equal pro rata capacity to meet the normal annualized monthly demands with the same market position.

As one observes, the right side is the peak pricing and the lowest demand duration. What is interesting is that roughly 38 of the producers have sufficient capacity to follow the demand duration all the way to the 50% duration point. The other increment 50% to 0% demand duration is presumably followed by the rest of the stack (630 producers who are truly price-takers on a net back basis).

The long contracts maintain the floor price as they typically carry a limited burden (imbedded costs plus the incremental cost of capital plus returns). This floor price applies to the continuous demand and is levelized and frequently passed net-forward to the market. The remainder of the load duration is made up of market players that are positioned according to capability (to increasingly lesser capacity) shifting from sophisticated to marginal operators until all that are left are the “mom and pop” price takers that like other larger participants will idle their wells (and delay maintenance) if the price is below their breakeven or survival rate, the difference being for mom and pop operations those wells are all they have. These price takers set an avoided cost pressure on the peak demand price.

The objective here is to simply show the interrelationship of marginal and idle wells to the dispatch stack and how the marginal wells as price takers affect the market clearing mechanisms ultimately affecting the end user. **The inevitable loss of some or all of these wells due to decline or policy will require new capacity with flexible dispatch, this extra capacity can be found in rational provisions allowing increased export of LNG.**[4]

If the added capacity of marginal wells is not available, then the next logical backup supply is the local and regional fleet of Underground Natural Gas Storage Facilities (UNGSF). Once these are tapped out the market signal will continue to climb and potentially create a net-back that reallocates long capital to increase capacity by drilling new wells and adding facilities –limited by their roll-out capabilities. On the other hand, the LNG system including the storage can be assigned an emergency position (as a policy accommodation) to relieve the domestic stressor of unanticipated interruption –just in time.

Conclusion

The realization of both actual measured emissions and the reductions that can and will be achieved by command and control efforts should be established as a priority before engaging in policies that threaten the reliability of the energy infrastructure.

Investment in properly measuring and reducing methane emissions will be a prudent element to achieving domestic GHG mitigation while allowing the prudent development of the next wave of LNG infrastructure that will facilitate domestic well-being and provide strategic reduction of global GHG emissions.

Regards,

Jesse D. Frederick, VP WZI Inc.

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[4] Once lost, marginal wells and their spare capacity will not be available and may even become a social burden as orphan wells. Additional wells will be economically stimulated to support the LNG demand. These new wells and facilities will have intrinsic excess capacity that can be allocated by directive as part of the bargain to allow additional LNG.