US and Global Energy Security: Where We Are Falling Short

Thomas N. Russo

As the United States and nations around the world seek to transition to a low-carbon economy and increase our energy security, our current energy technology and regulatory tools appear woefully inadequate. In their current state, these tools won't expedite the planning, building, and operating of our future energy infrastructures. Rather than creating a policy toolbox capable of successfully aiding the transition, the tools leveraged in the United States are creating a circular self-propagating system that only painstakingly "moves the needle" forward to achieve energy security and long-term sustainability **(Figure 1).**

This author believes that the following policies and actions miss the mark and will not improve energy security nor slow or reduce the impacts of climate change:

1. Blind faith in renewables and tax credits to incentivize investments in clean energy.
2. Over-reliance on regulatory fixes to reduce carbon emissions to mitigate operational performance gaps of fossil fuel and nuclear power.
3. Federal government research and development (R&D) investments that favor incremental efficiency improvements to existing energy technologies.
4. Equating reform of environmental regulations and expeditious environmental reviews of energy projects as code for reduced levels of environmental protection.
5. Over-emphasizing the environmental impact review process (producing paper), regardless of significant project delays.
6. Ignoring the lessons learned over the last 50 years in environmental impact assessment and mitigation strategies.
7. Allowing the US Courts to determine whether National Environmental Policy Act (NEPA) environmental reviews are adequate and not promoting administrative dispute resolution and alternative approaches.

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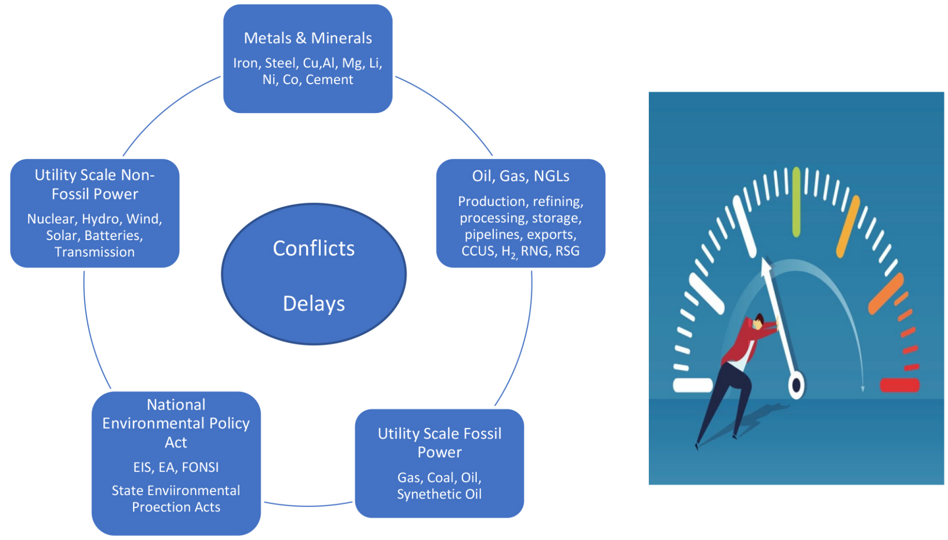
INTRODUCTION

The United States, the United Kingdom, the European Union, and China have all promoted fossil and non-fossil energy investments via feed-in tariffs, tax incentives, and related policies. However, policy-makers and non-government organizations such as trade associations and environmental groups often ignore the efficiencies of these technologies and their operating characteristics. The latter has traditionally been the domain of scientists and engineers, but these professions are notably absent at policy-making meetings. At this time, global inflation, the possibility of a recession, energy security, and supply chain bottlenecks

Figure 1. Circular System of Conflict Regarding Energy Security and Sustainability



Source: Russo on Energy LLC.

have taken center stage. However, the United States, Europe, China, India, and emerging economies demand timely energy infrastructure investments to improve energy security and meet decarbonization goals no later than 2050, and possibly earlier as promulgated goals.

Sustainable energy development does not happen in a vacuum. Societies must make hard choices and tradeoffs when determining what types of energy generation projects to develop. Only in rare circumstances are countries blessed with relatively small populations and abundant renewable energy (Norway's hydropower and Iceland's geothermal and hydropower). In contrast, the remaining nations of the world must parse through numerous fossil and non-fossil energy technologies to determine what is in the public interest of their citizens and economies. Many countries have relied on environmental laws and implemented regulatory reviews of new projects and, in some cases, existing projects[1] after several decades to ensure that they are still in the public interest.

Societies must make hard choices and tradeoffs when determining what types of energy generation projects to develop.

In the United States, the Forest Service (USFS) and Bureau of Land Management (BLM) have oversight of energy infrastructure projects on lands they administer. Other federal agencies designated by Congress regulate specific types of energy and infrastructure projects proposed on public and private land. Good examples include the Federal Energy Regulatory Commission (FERC), which regulates non-federal hydropower and interstate natural gas facilities. The Nuclear Regulatory Commission (NRC) regulates nuclear power plants, while the Bureau of Ocean Energy Management regulates offshore oil, gas, solar, and wind projects in the outer continental shelf. All the projects above are subject to environmental reviews required by NEPA. In many cases, the individual states affected by such schemes have

[1] For example, hydropower and nuclear projects in the United States that are licensed by the Federal Energy Regulatory Commission and Nuclear Energy Regulatory Commission, respectively.

veto power over whether any approved projects are ever constructed under section 401 of the Clean Water Act (CWA) and the Coastal Zone Management Act (CZMA).

While NEPA, CWS, and the CZMA may appear to be rational approaches to determining the public interest, they have become duplicative and more suited for an era when "time is not of the essence." These regulatory processes ignore the rich experience of more than 40 years of environmental impact assessment in the United States, the United Kingdom, and Europe, and the World Bank Group and the lessons learned regarding mitigating environmental and social impacts of energy projects. For these reasons, this author firmly believes that the United States, in particular, has suboptimal policies in place to achieve energy security and sustainable energy development in the face of growing challenges from climate change. The remainder of this article explains why and recommends improvements to refocus efforts and accelerate decision-making.

WHERE WE ARE FALLING SHORT

Zero to One and Other Metrics

Legislators and policy-makers believe tax incentives are crucial to achieving energy security and clean energy goals. The private sector welcomes such changes in the tax code. In reality, incentives are not a substitute for new energy technologies and improvements that transition a society from what Peter Thiel called "Zero to One."[2] Some examples of "Zero to One" improvement are replacing a manual typewriter with a word processor, replacing physical commercial payment systems with electronic payments (e-commerce), and replacing landline phones with wireless phones. A recent Zero to One example was developing Messenger RNA (mRNA) vaccines to fight the Covid-19 pandemic in less than a year, rather than the typical timeframe of 10 to 15 years. This author believes that the United States should significantly increase its R&D investments in energy technologies that hold the promise of "Zero to One" benefit, instead of being content with incremental improvements in heat rates, energy efficiency conversion, and capacity factors for current technologies.

A cursory look at the efficiency and capacity factors of primary fossil and non-fossil power technologies clearly shows that our power fleet is long overdue for some breakthrough improvements (**Figure 2).**

> **In reality, incentives are not a substitute for new energy technologies and improvements that transition a society from what Peter Thiel called "Zero to One."**

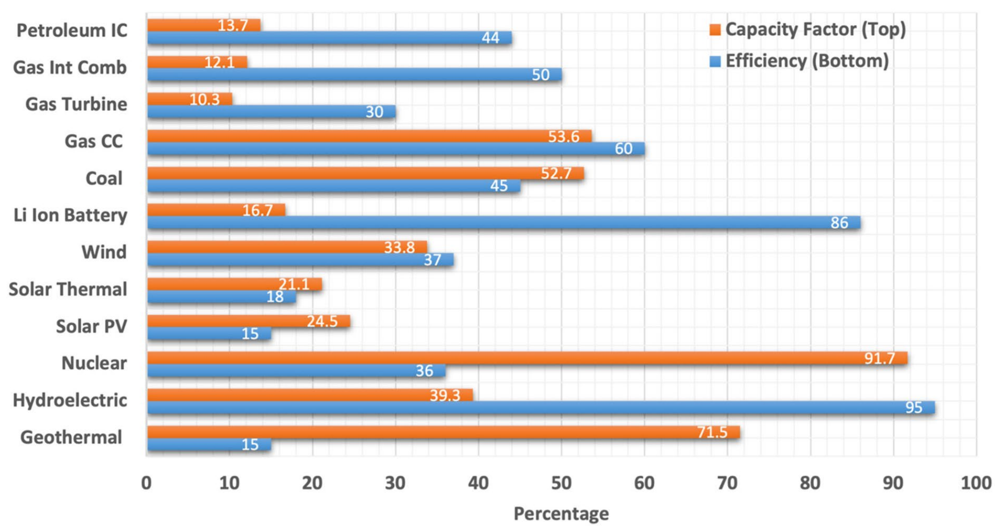
Figure 1 clearly shows that every power technology has its challenges for policymakers to consider regarding their energy conversion efficiency and capacity factor. The latter is the percentage of time a project operates in a year. These two metrics are essential and should humble the most ardent advocates of specific technologies. All power technology and associated fuel delivery infrastructure are subject to operational and supply chain constraints in the markets where they operate. In reality, the physical environment is seldom ideal, and every type of project must be maintained to operate efficiently.

Some examples will help illustrate how efficiency and capacity factors affect actual electric energy production. Hydropower is one of the most efficient renewable technologies. It converts 95 percent of the mechanical energy of falling water to electrical energy. However, hydropower is subject to the amount of precipitation, droughts, and floods, and requires routine safety and operational maintenance. Hence, the average capacity is only 39 percent of the time in a year when projects can operate (Figure 2).

Solar and wind energy projects, despite their growing popularity, have energy conversion

[2] Thiel, P., & Masters, B. (2021). *Zero to One: Notes on Startups, or How to Build the Future.* Virgin Books.

Figure 2. Average Capacity Factors and Efficiency of Fossil and Non-Fossil Fuel Utility-Scale Power Generators



Source: EIA Table 6.07.B. Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels and Non-Fossil Fuels. Retrieved from https://bit.ly/3zYaw3q and https://bit.ly/3xKkrH8. Wärtsilä Combustion Engine vs. Gas Turbine: Pulse Load Efficiency and Profitability. Retrieved from https://bit.ly/3bc0wsX. Eurelectric. Retrieved from https://bit.ly/3yhD1rM. National Renewable Energy Laboratory (2022). Annual Technology Baseline. Retrieved from https://bit.ly/3NhK0VM.

efficiencies between 15–18 percent and capacity factors between 14–24.5 percent, respectively. The particulate matter from wildfires and extreme weather events can also negatively affect energy conversion. Acres of solar panels are required to produce the electric energy equivalent to a nuclear power plant.[3] The latter plant has an efficiency of 36 percent, but it can operate on average 96 percent of the time in a year when properly maintained and affect a much smaller area.

Developers are adding lithium-ion battery storage projects to the electric grid. These storage projects are characterized by high efficiency capacity of 86 percent, assuming a two-cycle day of approximately one cycle per day. The National Renewable Energy Laboratory (NREL) uses a 4-hour device with an expected capacity factor of 16.7 percent as most typical, although 2-hour devices with 8.3 percent capacity factors are also in operation.

While today's energy debates highlight the intermittency of renewable energy, the actual heat rates illustrate just how poor the efficiency of baseload fossil fuel utility-scale power plants is (**Table 1**). Heat rates measure the efficiency of coal, natural gas, petroleum, and nuclear power plants in producing electrical energy. The heat rate of a conventional fossil fuel-fired power plant represents the amount of heat, typically in British Thermal Units (Btus), needed to generate 1 kilowatt-hour (kWh) of electric energy.

Theoretically, a power plant that uses only 3,412 Btu of thermal energy from a fuel to produce 1 kWh of electric energy would be 100 percent efficient.[4] As shown in Table 1, the heat rates and overall efficiency of fossil and non-fossil fuels vary. Natural gas-fired power plants have lower heat rates and are more efficient in converting the energy content of the natural gas

[3] Bryce, R. (2020). *A Question of Power: Electricity and the Wealth of Nations.* United States: Public Affairs.

[4] US Energy Information Administration. (n.d.). *What is the efficiency of different types of power plants?* Retrieved from https://bit.ly/3N5sqEk.

Table 1. Average Tested Heat Rates by Type of Unit, Efficiency, and Energy Source, 2020 in Btu per Kilowatt-Hour and Percentage

Type of Unit	Coal		Petroleum		Natural Gas		Nuclear	
	Heat Rate	Efficiency	Heat Rate	Efficiency	Heat Rate	Efficiency	Heat Rate	Efficiency
Steam Generator	9,997	34%	10,339	33.0%	10,368	32.9%	10,446	32.7%
Gas Turbine	—		13,223	25.8%	11,069	30.8%	—	
Internal Combustion	—		10,334	33.0%	8,832	38.6%	—	
Combined Cycle			9,208	37.1%	7,604	44.9%	—	

Source: EIA. Retrieved from https://bit.ly/3QK499U.

into electric energy. Manufacturers of combustion turbines and reciprocating engines are constantly trying to achieve lower heat rates for their unit offerings. They often illustrate how specific units will operate during morning and evening ramping, or can cycle more easily to follow load in electricity markets, adding more renewable energy. When fossil-fuel power plants are retired, plant owners replace them with more efficient units with lower heat rates or battery technologies.

Heat rates, energy efficiency, and capacity factors give us a general idea of what power plants are best suited for in an electricity market. However, they are oversimplified. All of the above technologies are subject to weather variations, fuel, and materials availability (i.e., metals, steel, gas, coal, uranium), grid dispatch orders, and climate-induced weather events that make it challenging to maintain a stable grid. The existing power grid is essential to advanced and emerging economies, but is not as efficient as it needs to be. The grid requires innovation and technological improvements on the order of a "Zero to One" scale to meet net-zero energy (NØEnergy) goals.

NØEnergy Research and Development

R&D in energy, and specifically in NØEnergy research, is an essential factor to determine whether current efforts will achieve NØ reductions in greenhouse gases. Net funding for the US Department of Energy (DOE)'s applied energy R&D programs increased by roughly 10 percent in 2022, well short of the Biden Administration's request. However, the Infrastructure Investment and Jobs Act provides billions in additional funding for clean energy technology[5] (**Figure 3).** Unfortunately, these investments will not improve clean energy efficiency or capacity factors, but will cause more land-use conflicts and NEPA disputes for many projects.

The fruits of some of those R&D efforts are beginning to pay off. Engineers at the Massachusetts Institute of Technology (MIT) and NREL have designed a heat engine with no moving parts. Their new demonstrations show that it converts heat to electricity with over 40 percent efficiency—a performance better than that of traditional steam turbines.[6]

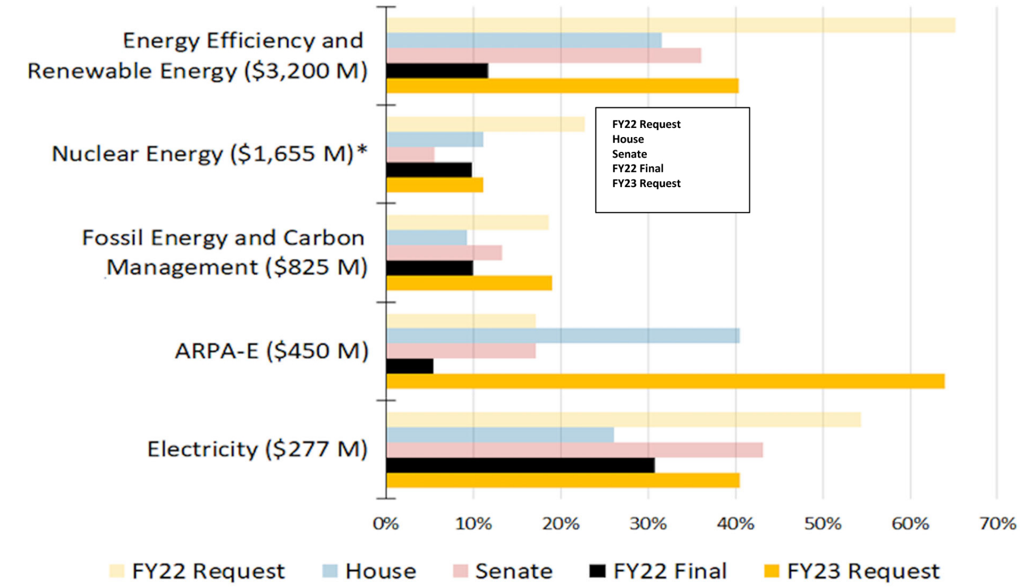
As published in *Nature,*[7] thermophotovoltaics (TPVs) convert predominantly infrared-wavelength light to electricity via the photovoltaic effect and can enable approaches to energy and conversion that use higher-temperature heat sources than the turbines that are ubiquitous in electricity production today. Reaching 40 percent efficiency with TPVs is significant because it means that TPVs, as a heat engine technology, can compete with turbines. However, TPVs could

[5] American Institute of Physics. (2022, June 3). *DOE Applied Energy Budget: FY22 Outcomes and FY23 Request.* Retrieved from https://bit.ly/3xWPFLc.

[6] Massachusetts Institute of Technology. (2022, April 13). A new heat engine with no moving parts is as efficient as a steam turbine. *ScienceDaily.* Retrieved from https://bit.ly/3P0lfPu.

[7] LaPotin, A., Schulte, K.L., Steiner, M.A., et al. (2022, April 13). Thermophotovoltaic efficiency of 40%. *Nature,* 604, pp. 287–291. https://doi.org/10.1038/s41586-022-04473-y.

Figure 3. FY22 Appropriations: DOE Applied Energy R&D (all percentages relative to FY21; $ amounts in brackets are FY22)



Source: See note 6.

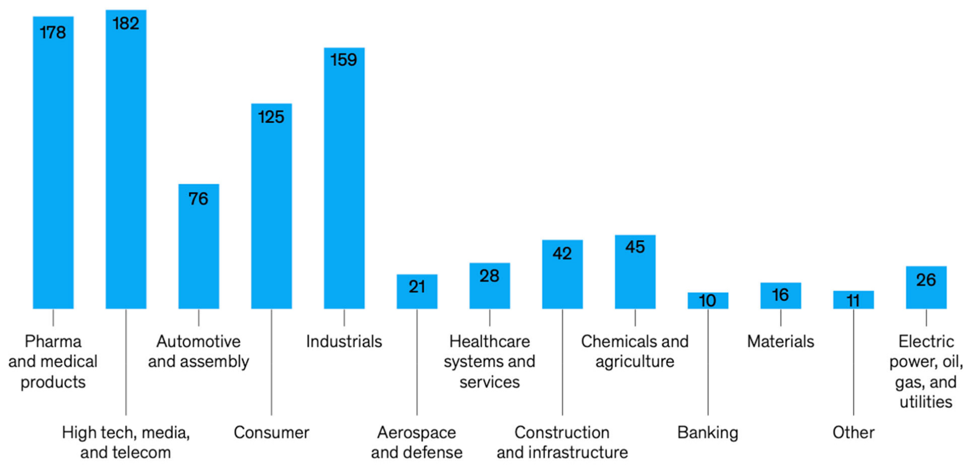
be even more attractive than a turbine given the potential of lower costs (< $0.25 per watt), faster response times, lower maintenance, ease of integration with external heat sources, and fuel flexibility. This is noteworthy because turbine costs and performance have already reached full maturity, so there are limited prospects for future improvement, as they are at the end of their development curve.

TPVs, on the other hand, are very early in their progress down a fundamentally different development curve according to the MIT and NREL researchers. Consequently, TPVs have numerous prospects for both improved efficiency (e.g., by improving reflectivity and lowering series resistance) and lowering cost (e.g., by reusing substrates and cheaper feedstocks). Thus, the demonstration of 40 percent efficiency represents an important step towards realizing the higher potential that can be achieved with increased attention and funding in the coming years, as commercial applications emerge and become profitable.

The work at MIT and NREL is noteworthy, but also emphasizes the significant roles of the federal government and universities in funding new technologies and additional improvements. One would think the electric power and related energy sectors would be heavily vested in R&D, given their reliance on technologies. That is not the case. While Big Pharma, automotive and technology industries are in the headlines, global private-sector investments by the energy sector are very low. Energy companies in 2008 invested only $28 billion, which is 14 and 15 percent of what Big Pharma and high tech, media and telecon invested (**Figure 4**). Also, the energy sector invested only 3 percent of its profits in R&D compared with 40–50 percent for Big Pharma, automotive and technology companies.[8]

[8] Brennan, T., Ernst, P., Katz, J., & Roth, E. (2022, November 3). *Building an R&D strategy for modern times.* McKinsey & Company. https://mck.co/3yVI3dD.

Figure 4. Total Global Private-Sector R&D Investment by Industry ($ billion)



[1]Earnings before interest, taxes, depreciation, and amortization.
[2]Nominal US $, 2018.
Source: S&P Capital IQ

Source: See note 8.

The above information clearly shows that R&D investments by energy companies alone will not be able to address climate change and energy security challenges. Global success in meeting these two challenges rests with funding new technologies, like TPVs to replace existing technologies that have reached full maturity. This author believes that governments and universities must provide the bulk of new R&D funding and foster new startup companies in the electric power sector and oil and gas industry.

Publications in NØEnergy Research and Development

According to a 2021 R&D report entitled "Pathways to Net Zero: The Impact of Clean Energy Research" (Elsevier),[9] China leads the way with the largest number of publications in NØEnergy research, followed by the United States, with India, Germany, and Japan trailing. However, Saudi Arabia, India, and Russia have shown the most significant growth since 2011.

The Elsevier report also shows that Chinese and US research focused on lithium alloys, secondary batteries, and electric batteries, with the United States publishing more in this area than on any other topic. China was also three times more specialized in this area than the global average.

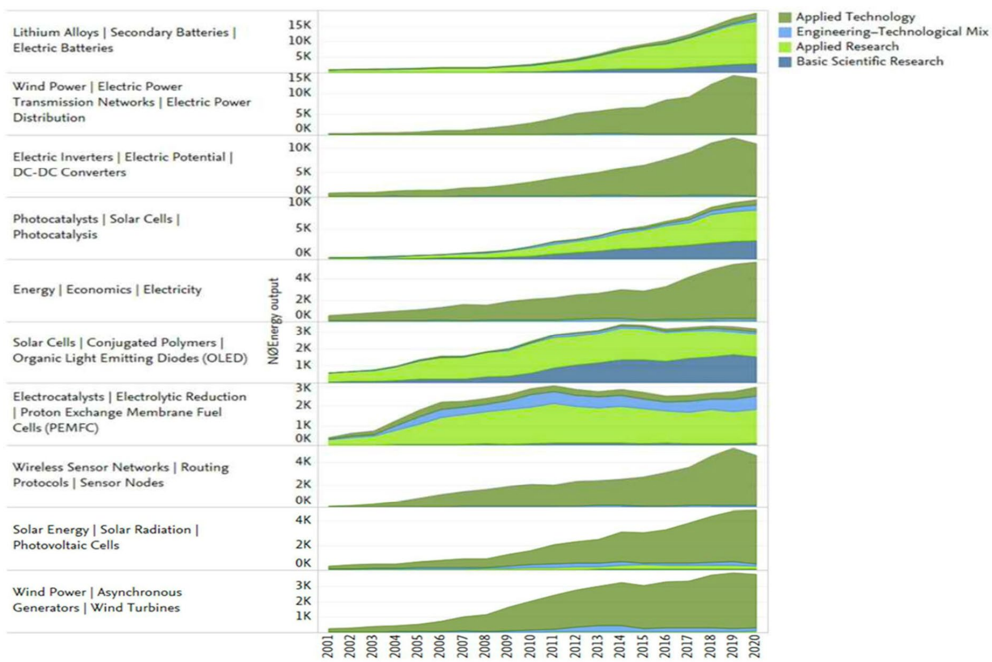
China is also a leading funder of NØEnergy research. The country's National Natural Science Foundation funded 117,992 publications, nearly three times the number of publications of all US funding institutions and four times as many publications as funded by European Union institutions.

The global share of basic research in NØEnergy remained stable at 8 to 9 percent over the 2001–2020 period. Most NØEnergy research is applied R&D in wind and solar power, electric inverters, and energy/electricity economics. The share of applied technology increased by more than 20 percent (**Figure 5).**

For the 2011–2020 period, Singapore had the highest share of basic research, followed by Switzerland, Russia, and Japan. South Korea and Japan

[9] Elsevier. (2021, October 28). *Report: How can research help the world hit net zero by 2050?* Retrieved from https://bit.ly/3ngTdTG.

Figure 5. Distribution of Output Across Research Levels for the Top 10 Most Published Topic Clusters in NØEnergy, 2001–2020.



Source: See note 7.

had notably higher shares of applied research than other countries. Denmark, Iran, and Malaysia had the highest percentages of applied technology (66 percent each).

The high levels of applied R&D publications generally reflect the maturity of the topic or subject. There were relatively low numbers of basic R&D publications for solar and wind energy. However, this author believes that solar and wind energy's low energy efficiency warrants more basic research to improve energy efficiency significantly. The lack of NØEnergy research needed to improve energy conversion rates in solar PV (15 percent), solar thermal (18 percent), and wind (37 percent) is troubling. It would appear that governments, funding institutions, and researchers alike are satisfied with the current low levels of energy conversion efficiency, and research in solar and wind technologies has plateaued. Little efficiency improvements have dire consequences, especially since solar, wind, and other clean energy technologies require extensive quantities of metals, steel, and concrete, which have environmental implications on land use and environmental sustainability (**Table 2).**

One key finding of the Elsevier report was the low number of NØEnergy research publications of an interdisciplinary nature. This finding is highly problematic given the relatively poor levels of energy efficiency conversion of existing and preferred clean energy technologies being used to achieve NØEnergy goals by 2050 or 2060. Increased levels of energy R&D of an interdisciplinary nature are needed to help governments and industry resolve land-use conflicts via dispute resolution, especially in siting projects in environmental justice (EJ) communities and landowners. Conflicts onshore and offshore will be increasing as the United States, Canada, the European Union, Russia, China, and emerging economies of Asia extract the metals needed to support the expansion of electric vehicles and other clean energy

Table 2. Mineral Needs Vary Across Clean Energy Technologies

Critical mineral needs for clean energy technologies

	Copper	Cobalt	Nickel	Lithium	REEs	Chromium	Zinc	PGMs	Aluminium*
Solar PV	Dark	Open	Open	Open	Open	Open	Open	Open	Dark
Wind	Dark	Open	Grey	Open	Dark	Grey	Dark	Open	Grey
Hydro	Grey	Open	Open	Open	Open	Grey	Grey	Open	Grey
CSP	Grey	Open	Grey	Open	Open	Dark	Grey	Open	Dark
Bioenergy	Dark	Open	Open	Open	Open	Open	Grey	Open	Grey
Geothermal	Open	Open	Dark	Open	Open	Dark	Open	Open	Open
Nuclear	Grey	Open	Grey	Open	Open	Grey	Open	Open	Open
Electricity networks	Dark	Open	Open	Open	Open	Open	Open	Open	Dark
EVs and battery storage	Dark	Dark	Dark	Dark	Dark	Open	Open	Open	Dark
Hydrogen	Open	Open	Dark	Open	Grey	Open	Open	Dark	Grey

Shading of circle indicates relative importance of mineral to clean energy:
Dark = high
Grey = moderate
Open = low

CSP = concentrating solar power; PGM = platinum group metals; REE = rare earth elements

Source: International Energy Agency.

and continue to use fossil and nuclear power technologies. As discussed in the next section, R&D must focus on ways to expedite the reviews of energy projects and identify and manage environmental mitigation required during construction and the life of an energy project.

THE RUSH BEHIND THE IMPLEMENTATION OF NEPA

This author believes that the length of time and costs to complete NEPA reviews is excessive, and the process is wasteful. Environmental impact assessments of energy projects have remained virtually unchanged since the President's Council on Environmental Quality (CEQ) issued regulations implementing NEPA in 1978. Most federal agencies require project developers to consult with the public and other stakeholders before filing a formal application. Environmental consultants do most NEPA analyses.

While preparation of NEPA documents has benefited from advances in word processing (typewriters to word processors), electronic filing of comments, and electronic distribution of comments, the overall process is unwieldy. A few examples of exceptions have included computer modeling of air temperature, air quality, hydraulic and water quality effects to support an overall NEPA process. While the modeling is impressive, NEPA reviews have resisted automation. The result is a detailed slow process that produces a great deal of paper that decision-makers and their staff must review before deciding on potential impacts of a proposed project.

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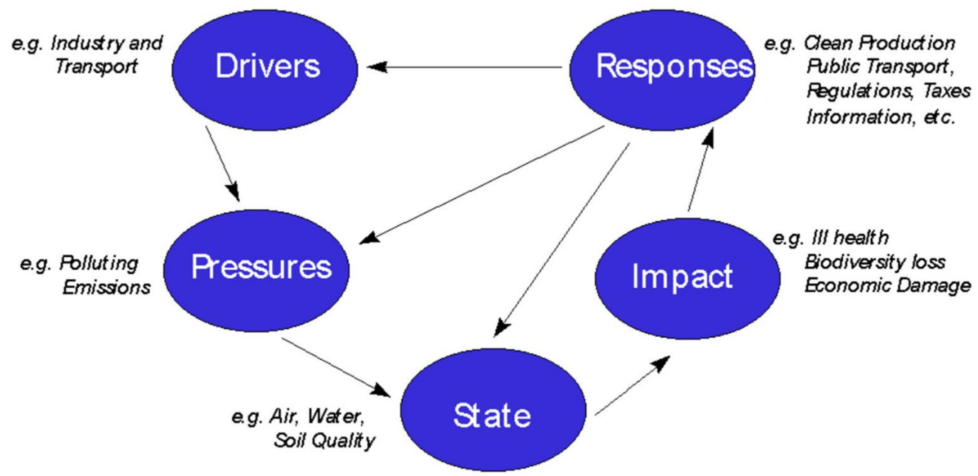
A report produced for the European Environmental Agency in 1998[10] indicates that decision-makers should be assessing the environmental and social impacts of an energy project using a DPSIR framework that identifies Drivers, Pressures, State of the environment, and Impact. From the impact, decision-makers must determine appropriate Responses, to direct the final impact in the desired direction (a reduction in environmental harm). These responses will influence the drivers, pressures, and states, thus completing a feedback loop **(Figure 6).**

[10] Peirce, M. (1998, February). *Technical Report No 14: Computer-Based Models in Integrated Environmental Assessment.* A report produced for the European Environment Agency. Retrieved from https://bit.ly/3a0Kli5.

Figure 6. Analyzing Impact Using a DPSIR Framework



Source: See note 10.

In contrast, many controversial projects become driven by a desire to spend inordinate amounts of time and effort on one or more of the elements of the DPSIR framework. In part, this may be tactical, to delay the NEPA process and decision-making. However, this results in a significant disservice to the NEPA process because it obfuscates regulatory responses, such as mitigation actions, that could significantly reduce project impacts during the construction and operation of the project. This author questions whether the time, cost, and effort to prepare EIS documents actually results in better decisions than NEPA originally intended, or if it's being done purely for compliance purposes. Suppose time is of the essence in achieving reductions in greenhouse gas (GHG) emissions to fight climate change and ensure energy security. In that case, we cannot afford a "business as usual" approach to NEPA reviews. A simplified and more direct analysis that is thorough but focuses on mitigation is needed.

NEPA supporters consistently argue that NEPA compliance is necessary to protect the environment, including impacts on landowners and EJ communities affected by projects. This author believes this would be true if we had little or no knowledge of a power and energy infrastructure's impacts on the environment and EJ communities. In reality, federal and state agencies understand the environmental impacts of numerous energy technologies. These entities know how to mitigate potential impacts since they have reviewed, in some cases, hundreds of projects over the last 40 years. The more important issue to resolve is how that knowledge is being applied today, and whether there is a sense of urgency given the increasing effects of climate change.

In 2020, federal agencies prepared 254 environmental impact statements (EISs).[11] Agencies like the BLM, Army Corps of Engineers, USFS, DOE, FERC, and NRC prepared most of the EISs related to energy projects.

This author contends that most federal and state agencies, and the energy developers who propose energy projects, should by now understand what is needed to mitigate negative impacts from these kinds of projects. Also, the lead federal

[11] National Association of Environmental Professionals. (2021, November 23). *NEAP Annual NEPA Report.* Retrieved from https://bit.ly/3Ra0UZN.

Table 3. White House CEQ's Five-Point Plan to Expedite NEPA Permitting

	White House CEQ Plan	Author's Comment
1.	Consolidating decision-making among agencies to reduce the number of federal permits a project would need. The White House will also create teams of sector-specific experts in an effort to streamline permitting applications from various industries.	Is this legal? Most permit requirements are related to specific laws. CEQ should be promoting industry sector-specific expert talks with environmental groups to find common ground and identify what types of projects warrant expeditious NEPA reviews. See agreement and reforms before Congress advocated by dam owners and environmentalists.*
2.	Establishing timeline goals and tracking project information.	FAST-41 Fixing America's Surface Transportation Act passed in 2015 tried to do this, but it has not resulted in significant improvements.
3.	Engaging in "meaningful outreach and communication" with states, tribes, and local governments to gain support and input from projects' starting points.	Every federal agency currently requires meaningful outreach. Instead of just collecting input, change the goal to determining how best to develop and mitigate a proposed project.
4.	Improving technical assistance and support to non-federal partners.	Not a bad idea if you want to fund dispute resolution experts, but not good if you are financing groups in opposition to everything.
5.	Using existing agency resources to prioritize permitting review.	Act on projects that are ready to move forward and are more environmentally acceptable after being mitigated rather than on a "first-in, first-out" basis.

*Penrod, E. (2022, May 13). Congress, stakeholders find consensus around hydropower license reform. *Utility Dive.* Retrieved from https://bit.ly/3yrSKob; Plumer, B. (2020, October 13). Environmentalists and dam operators, at war for years, start making peace. *New York Times.* Retrieved from https://nyti.ms/3fUp4Fm.

agency and interested stakeholders should also, by now, be able to determine that mitigative measures are needed for various energy projects. There is no need for a voluminous NEPA document that takes years to write to arrive at a decision that has been determined hundreds of times before with adequate mitigation measures to protect the environment. New energy technologies such as offshore wind may warrant such reviews, but they are exceptions to the rule. After gaining experience with a few windfarm projects, the Bureau of Ocean Energy Management (BOEM) and stakeholders should not have to prepare voluminous EISs on the projects and could develop a standard permit.

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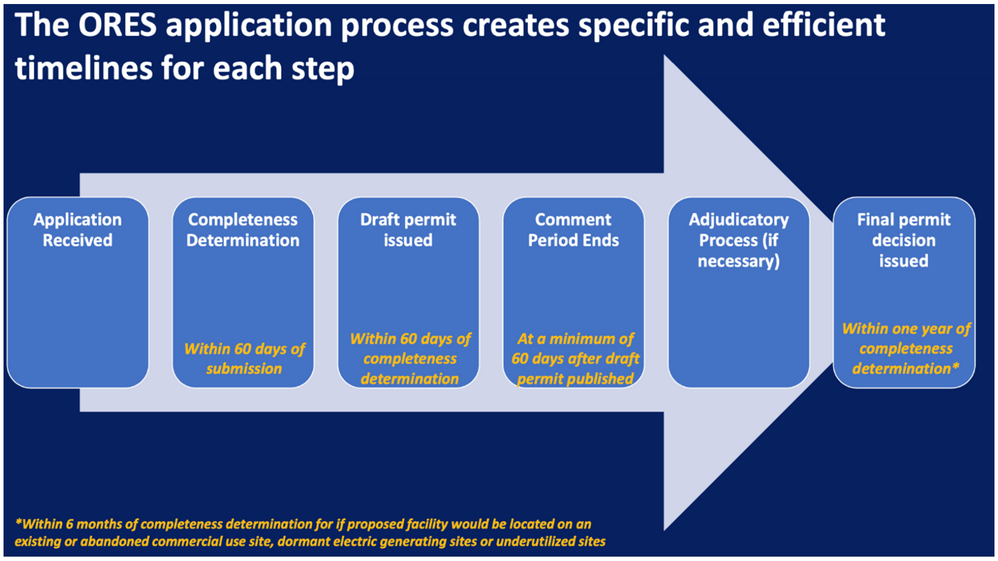
The Biden Administration's CEQ Chair, Brenda Mallory, appears to recognize this challenge and has recently presented a five-point plan to expedite permitting (**Table 3**). This author believes this plan will not be sufficient to overcome inherent tradeoffs between permitting efficiency and best outcomes for communities and the environment. However, it has elements worth exploring, namely dispute resolution and consensus-building, that could lead to regulatory reform (see author's comment in item 1).

STANDARDIZING PERMITS—PUTTING MITIGATION BEFORE THE NEPA PROCESS

This author believes that the key to making progress in achieving US and global energy security and environmental sustainability is the standardization of permits.[12] Before this can be achieved, developers of specific energy technologies and environmental groups must literally "make peace with each other." It also requires federal agencies to refrain from tweaking an already complicated NEPA process and begin relying on the decades of staff and stakeholder experience in siting and mitigating impacts associated with specific energy technologies. Instead of making

[12] Depending on the federal agency, permits are called different names such as licenses, certificates of public convenience and necessity, orders, records of decisions, etc.

Figure 7. Overview of New York's Office of Renewable Energy Siting Process for Large-Scale Renewable Energy Projects



Source: ORES.

every condition in the permit "site-specific" and relying on an EIS to create the condition, most permit conditions should be standardized.[13] To enable standardization, energy project developers must also refrain from gaming the system and be sufficiently capitalized to conduct studies and develop an adequate record for regulators to understand the project and its environmental impacts.

To enable standardization, energy project developers must also refrain from gaming the system and be sufficiently capitalized to conduct studies and develop an adequate record for regulators to understand the project and its environmental impacts.

The practice of standardizing permits with respect to NEPA is no different than what many industrial standards organizations do when building projects. Standards organizations like the International Code Council (ICC), American Society of Mechanical Engineers (ASME), National Fire Protection Association (NFPA), and International Society of Automation (ISA) develop and approve their standards and make them available to industry. They seldom rely on site-specific standards. If they did, nothing would be built and completed on time and within budget. These standards organizations also amend their standards as new research dictates.

Standard permits containing USCs are at the heart of New York State's Office of Renewable Energy Siting (ORES) program.

Standardizing permits is not a novel undertaking. Many regulatory agencies have permits containing Uniform Standard Conditions (USCs), which FERC calls Standard L, P, and E Form Articles.[14]

[13] Depending on the federal agency, permits are called different names such as licenses, certificates of public convenience and necessity, orders, records of decisions, etc.

[14] Federal Energy Regulatory Commission. (n.d.). *Standard Articles for energy projects.* Retrieved from https://bit.ly/3I26dGq.

Usually, a regulatory agency would add site-specific conditions when issuing a final permit. However, this author advocates federal agencies issue rule-making to develop new permits containing USCs with the provision for a limited number of site-specific conditions. Thereafter, when a developer files a complete application, the agency would examine the project and issue a standard permit with the appropriate USC conditions and any site-specific conditions within 6 months. After notice and opportunity for comment, the agency would issue the final permit within 1 year of the filing date of a complete application.

Standard permits containing USCs are at the heart of New York State's Office of Renewable Energy Siting (ORES) program. The new office handles siting large-scale solar and wind projects and issues a permit containing all state approvals within 1 year of filing a complete application (**Figure 7**). The latter is determined by ORES and assumes a good faith effort by the developer to meet the application requirements.

There has been significant backlash from communities, since the ability for local involvement has been significantly reduced.

ORES issues a draft permit within 60 days of determining it has a complete application. The clock for issuing the final permit begins on the date the agency determines it has a complete application. New York has also implemented a "Build Ready" program through the New York State Energy Research and Development Authority (NYSERDA). The program identifies previously disturbed and under-utilized sites (i.e., landfills, abandoned generation sites, and brownfields to name a few) which are determined to be appropriate to site large-scale projects and are made available to developers through a competitive process. In these instances, a final permit is issued 6 months after an application is deemed complete. Other sites not within the Build Ready program have a 12-month window after a complete application is filed. After issuance of the draft permit with USC and site-specific conditions, ORES seeks comments within 60 days and allows an adjudicatory process if necessary. Comments are minimized from New York state and local agencies since they have participated in developing the permits with USC for large-scale solar and wind energy during the previous rule-making. However, there has been significant backlash from communities, since the ability for local involvement has been significantly reduced; the law creating ORES gives the Office the ability to over-ride local laws which are considered to be over-burdensome or an obstacle to developing large-scale projects. And the onus is on the local municipality, not the developer, to ensure the project is meeting all local zoning laws, etc. At the time of this column, ORES was reviewing 12 solar projects and had permitted two solar projects.[15]

This author believes a similar process would apply to FERC's hydropower program, since dam owners and environmental groups have made peace and recommended legislative reforms to Congress.[16] Hydropower projects undergoing relicensing, adding power to nonpower dams, and closed-loop pumped storage hydropower projects should benefit from standardization of permits with USCs similar to what New York is doing.

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FERC's controversial natural gas pipeline and LNG terminals are also good candidates for a standardized permitting approach, since there is a great deal of knowledge of these facilities. While finding common ground between natural gas companies and environmental groups has been elusive, the CEQ and FERC, along with the natural gas industry and environmental groups,

[15] NYS Office of Renewable Energy. (n.d.). *Siting pending and permitted projects.* Retrieved from https://on.ny.gov/3ALE1G7.
[16] See note 12.

should explore matters just as the hydropower industry and environmental groups have done. Despite the polarization and the recent Supreme Court ruling in West Virginia v. EPA (2022),[17] the natural gas industry is working with EPA and environmental groups to reduce Carbon Dioxide (CO_2) and methane emissions and—using new technologies—to prevent blowdowns and methane emissions during the maintenance of natural gas facilities.

Alternatives to the current NEPA process that are most promising include the development of Standardized Permits with USCs for specific categories of technologies.

Small Modular Reactors (SMRs) would likely benefit from the standardization of permits when these come before the NRC. SMRs warrant a more efficient review process and may be better candidates for developing an SMR permit with USCs, given their smaller size and modular construction.

CONCLUSION

The United States and most other countries are pursuing more traditional technologies and processes to meet their energy security and NØEnergy goals by 2060. However, baseload combustion turbine costs and performance have already reached full maturity, so there are limited prospects for future improvement. Even if these countries could increase the percentage of renewable energy and deploy carbon capture technologies, the relatively poor energy conversion efficiencies, heat rates, and capacity factors would result in increased land-use conflicts. While advocates of clean energy technologies tout their zero-emission attributes, they ignore the land-use conflicts from mining metals and minerals to sustain the level of clean energy investments.

Governments and universities must spearhead NØEnergy R&D as the electric power, and oil and natural gas industries significantly lag behind R&D investments by Big Pharma, automotive and technology industries. More basic and applied research is needed to create new technologies to deliver Zero to One benefits. Low numbers of NØEnergy research publications of an interdisciplinary nature are symptomatic of how stovepiped the energy industry is concerning dealing with the impacts of technologies on the environment and communities over the economic life of projects.

Countries like the United States, the United Kingdom, and also the European Union, with a long history of robust environmental impact assessment, will be challenged to site projects promptly. The United States, in particular, will be affected by NEPA compliance issues and the Biden Administration's desire to expedite reviews and give more consideration to GHG emissions and EJ communities. The current strategies implemented by the White House CEQ are insufficient to make a significant difference in how quickly projects can be built.

It will require refocusing federal agencies' efforts on defining necessary mitigation with stakeholders and then shifting efforts to implement it during construction and for the rest of the project's economic life.

Alternatives to the current NEPA process that are most promising include the development of Standardized Permits with USCs for specific categories of technologies. So far, this process has been fruitful under New York's ORES, which expedites siting of large wind, solar, and battery projects. However, conflicts with local governments may affect the projects actually permitted. Other government agencies can apply the lessons learned by ORES to other energy technologies. However, it will require refocusing federal agencies' efforts on defining necessary mitigation with stakeholders and then shifting efforts to implement it during construction and for the rest of the project's economic life.

[17] SCOTUS Blog. (n.d.). *West Virginia v. Environmental Protection Agency.* Retrieved from https://bit.ly/3ygK7eW.

