

Volume #8: Lower Domestic Energy Prices Manifestations

Our previous Strategy Report discussed the manifestations arising from *Escalating Conflicts Globally* and how those manifestations are impacting 3RC’s approach when searching for and analyzing investment opportunities. This report examines the next Factor of Influence, *Lower Domestic Energy Prices*, and dives into the manifestations that are most relevant for 3RC and our investors.

The table below serves as an outline of the key manifestations that we will investigate throughout the following pages of this report. We are tracking several manifestations that will continue to shape 3RC’s thematic lens and will lead our search to uncover the most compelling investment opportunities for our investors.

As shown in the table below, the three major factual drivers that 3RC is in position to take advantage of related to lower domestic energy prices are the dawn of U.S. energy independence, the evolution of the U.S. energy grid, the use of energy harvesting technologies.

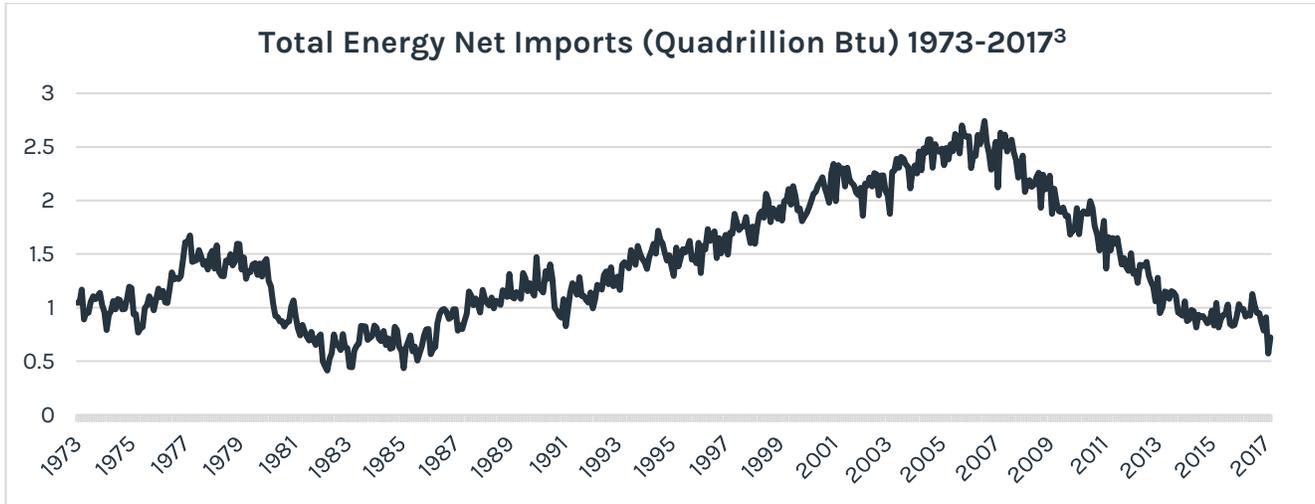
Factor of Influence	Factual Drivers	Manifestations
Lower Domestic Energy Prices	The dawn of United States energy independence	<ul style="list-style-type: none"> • Supply/demand imbalance • Increasing demand for energy storage systems • Reduction in coal as a primary power source <ul style="list-style-type: none"> ○ Increase in natural gas applications ○ The proliferation of oil and gas supply spawn ancillary business such as plastics and petrochemicals ○ Heightened use of renewable sources of energy • Increase in oil exports
	The evolution of the U.S. energy grid	<ul style="list-style-type: none"> • Increasing demand for energy storage systems to manage peak-demand • Rebuilding a “smart” efficient, secure energy grid • Mass decommissioning of aged and antiquated plants and grid infrastructure
	Energy harvesting technology	<ul style="list-style-type: none"> • Increasingly efficient charging processes and technology • Heightened demand for device charging components • Necessity for signage power protection and maintenance

U.S. Energy Independence

In Volume 4 of the 3RC strategy report series, it became clear that the United States was experiencing a burgeoning supply of energy resources while plateauing in demand, creating an imbalance that further reduced energy prices. This trend is only expected to continue as technology and consumption move forward, potentially placing further downward pressure on prices. While 3RC will not take a direct position on what level energy prices will be at in the future, this general dynamic has created new investment opportunities that 3RC will examine closely in the coming months.

This supply/demand imbalance has accelerated the United States’ transition to an increasingly energy independent nation. As renewables and natural gas grow to account for a higher portion of total energy production, the United States will not require the same amount of energy imports. While complete energy independence is still several years away, oil imports are projected to account for only 11% of daily demand

in 2020 – a shocking difference when compared to the 65% of demand oil imports accounted for in 2005.¹ Columbia University professor, Jason Bordoff, noted how drastic this change is, stating that “the U.S. will be a much smaller importer of oil in the future than anybody thought was possible a decade ago.”²



As this transition to energy independence continues, energy imports will steadily decline. Oil has already experienced a portion of this reduction, as exports doubled from 2016 to 2017 and reached one million barrels/day.⁴ While this is still small relative to the global supply (currently U.S. exports account for only 1% of global volume), it represents a noticeable shift toward a net export nation.

There has also been a push to increase natural gas exports with the goal of reducing European dependence on Russian oil. When the current administration visited Poland in early July, they highlighted the importance of the first natural gas purchase by a state-owned Polish company.⁵ Regardless of the potential implications and magnitude of these relationships, 3RC will place a heightened emphasis on the fuel transportation sector.

The reduction in energy imports has manifested itself by creating an opportunity within the storage marketplace, as producing and storing energy domestically has become more cost-effective than importing. Interestingly, this is a sector where 3RC has already explored through the purchase of PAT Tank. Applications of storage have expanded in recent years, opening up new end markets for investigation. Previously, energy storage solutions and energy prices were out of range for many potential end markets for storage solutions, though reduced prices have recently brought the opportunity within reach for many firms. A report by McKinsey & Co. showed that areas where storage is needed goes far beyond grid operators and power providers, but also extends to energy service companies and businesses that have strong relationships with potential customers.⁶

Energy storage has not yet shown strong signs of decreasing in the near future. Within the United States, crude oil stockpiles have been hovering near 500 million barrels, though there still could be upside for storage options.⁷ Moreover, as supply continues to outpace demand, domestic storage solutions will grow increasingly popular and valuable.

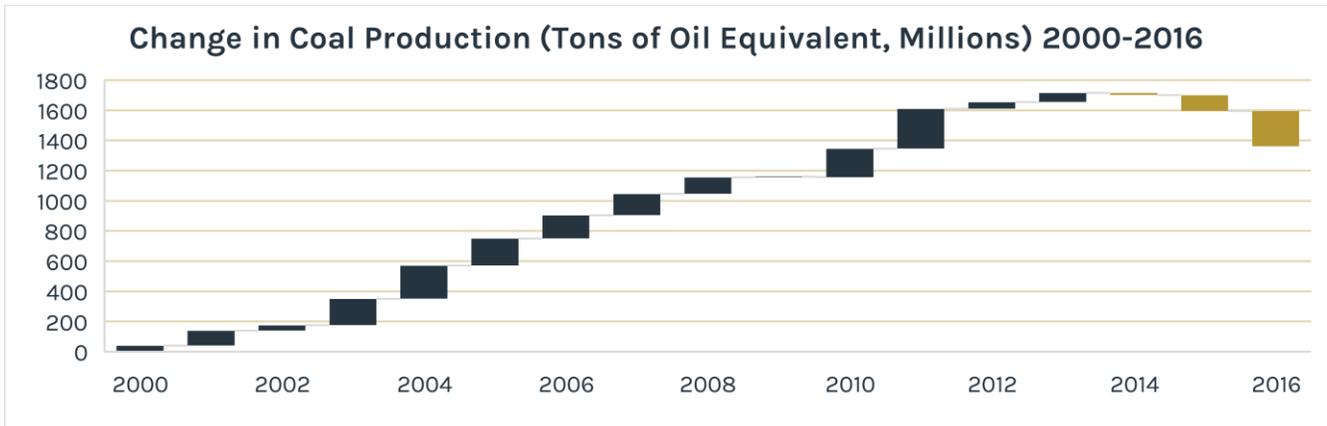
Demand has also grown for energy storage via batteries, and several technological advancements have developed as a result. By 2021, approximately 1,800 megawatts of new storage will be added to the United States, the majority of which will come in the form of lithium-ion batteries.⁸ The two major applications

of the new supply are for utilities and individuals, both of which will be discussed more in depth later in this report.

The increased use of energy storage solutions has also buoyed the tangential energy storage management industry. Back up supply, network management, time shifting, and energy arbitrage are examples of sub-verticals that will be utilized in tandem with energy storage.⁹ These areas will be emphasized as 3RC moves forward into investigating potential investment opportunities.

Changing Energy Sources

The energy source that is being hit the hardest as the U.S. transitions into a more energy independent nation is coal. Globally, coal consumption dropped 1.7% in 2016 despite the fact that from 2005-2015 it had increased by an average of 1.9% annually.¹⁰ This trend was also illustrated within the United States, as coal accounted for 39% of electricity generation in 2014 but only 34% in 2015.¹¹ Projections show how this trend will continue, eventually accounting for less than 15% of U.S. energy production by 2040.



This shift has also been enacted by energy companies as well. DTE Energy, an electric services company, plans to disconnect three coal plants between 2020 and 2030 and will completely eliminate coal plants by 2040.¹³ Instead, DTE plans to use a combination of 40% gas, 30% wind, 20% nuclear, and 10% solar for their energy sources.

Natural gas has seen a sharp increase in use and is projected to grow steadily in the near future as an alternate energy source to coal. Demand, however, won't necessarily be concentrated solely within the United States. Over the next five years, global natural gas usage is expected to increase by 1.6% annually, with developing nations driving the majority of new demand.¹⁴

The United States is already the largest producer of natural gas and growth will continue at 3% annually through 2022, accounting for over 20% of world production by that time. With production concentrated in the United States and demand growing from developing nations, exports of natural gas will increase. Of the total increase in production of natural gas from the United States through 2022, over 50% is expected to be exported to other nations.

The end market uses of natural gas are also shifting as technological advances in certain areas are limiting the value of natural gas. Chemical and fertilizer production, along with other industrial applications, will account for a large portion of overall natural gas growth.¹⁵ Power generation, on the other hand, will see less of an increase as renewables become more economically viable and the transition from coal to gas slows.

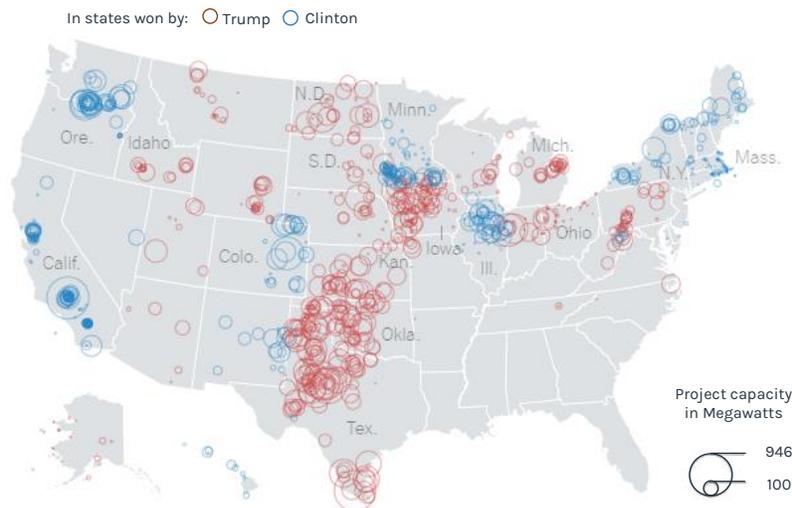
The increase in natural gas production has also opened tangential businesses for 3RC to consider. This has hit particularly close to home for 3RC as a new cracker plant is being built directly outside of Pittsburgh, bringing almost 6,000 workers to the region with 600 permanent positions.¹⁶ Moreover, construction of the cracker plant is also expected to bring companies within industry verticals that utilize polyethylene to the region as well, further increasing overall job count. Cracker plants produce one of the most common plastics, so plastics companies are expected to relocate to take advantage of the lower costs in the region. Lance Hummer, executive director of the Keystone Community Education Council, emphasized that the pull for companies will extend beyond Pittsburgh and into Lake Erie, West Virginia, and Ohio.¹⁷

Pennsylvania isn't the only state that has been experiencing the increase in cracker plants and tangential industries. An area in South Texas was recently chosen to be the location of the world's largest cracker plant, which is expected to bring over \$50 billion in economic benefits to the state for the first six years following completion and \$22 billion during construction alone. Jobs will also be brought to the region, 11,000 of which will take place during construction and 600 full-time. Moreover, it is important to note that this labor isn't cheap - the average salary of employees at the plant will be approximately \$90,000. The petrochemical market will also take root near the plant, as 1.8 million tons of ethylene will be produced annually as a byproduct which will fuel tangential industries.¹⁸

3RC is aware of this dynamic and has recognized the uniquely accessible petrochemical market due to the construction of the cracker plant nearby, and 3RC can use their geographical positioning and regional network as an exclusive value-add for potential new portfolio companies. In addition, 3RC will be shifting their investment lens toward companies that provide ancillary services to the energy transportation market supporting these trends.

Renewable energy sources have also grown with coal's decline. Wind energy now accounts for nearly 6% of the electricity for the United States and shows potential for supplying over a third.¹⁹ Wyoming, the state that produces the most coal in the entire United States, is exploring the opportunity to build one of the largest wind farms in the world.²⁰ The company that aims to build the farm, Goldwind Americas, is even offering a training program to ensure that ex-coal workers are equipped with the technical skills required of their new wind jobs.

Map of Wind Projects in the United States²¹



Solar has also experienced a rapid increase, with the amount installed expanding by 95% from 2015 to 2016.²² In specific cities, such as New York, this increase has been as large as 795% in five years.²³ This trend isn't expected to slow down, as offshore wind and solar costs could fall by 71% and 66% respectively by 2040.²⁴ For reference, the millionth solar installation was activated in February of 2017, 40 years after the first activated installation. The second millionth is expected to be activated in only two years, showing how rapid the adoption of solar technology will be.²⁵

This has propelled the solar energy storage market, which is expected to grow to \$19 billion in 2017 from a meager \$200 million in 2012.²⁶ Consumers are now more often entertaining the idea of making and using their own power via solar panels, which includes storing power when sunlight isn't present. Advancements in battery technology have enabled this trend, often referred to as partial grid defection, increasing implementation for residential customers who are early adopters. Storage arises again as the key limiting factor for increased adoption of residential solar use, and cheaper, more efficient storage will further disrupt utilities.²⁷

The potential applications of solar power have even extended to Trump's border wall concept. During a closed-door meeting in early June, Trump entertained the idea of solar panels covering the border wall which would help pay for the construction and maintenance costs of the wall itself.²⁸ Implementation of the concept is uncertain, of course, but the discussion and practicality shows the growth of solar power and rising amount of potential uses.

Changing Grid Regulations & Technology

In Volume 4 of the strategy report series, 3RC initially discussed lower domestic energy prices and specifically highlighted the emphasis that will be placed on modernizing grid infrastructure and transitioning from a hub-and-spoke model to a point-to-point model. Improved technology can enhance the capabilities of the grid and protect it from potential shutdowns, though it has not yet been implemented on a large scale. Regulations have served as a catalyst to accelerate the adoption of these key technological improvements and the shift to a point-to-point model.

California provides 3RC with a significant case study in how these changes will be implemented as regulations and cost efficiencies have combined to grow demand for energy storage. In an attempt to meet an ambitious goal of 33% renewable energy by 2020, California has run into voltage and demand issues due to the increasingly large quantity of renewables that are feeding into the grid.²⁹ From 2010 to 2015, solar grew from 0.3% to 6% of the state's overall power mix and wind has grown from 4.7% to 8.2%, which has increased the urgency and timeline for adoption of a resolution.³⁰

Energy storage has arisen as the solution to the demand management problem. This identification prompted a 2010 mandate by the California Public Utilities Commission which directed the three largest utilities in California to use 1,325 MW of storage by 2020. Electric Service Providers (ESPs) and Community Choice Aggregators (CCAs) were also instructed to generate energy storage solutions that are equivalent to 1% of peak annual load.³¹ While this may initially appear to be a marginal change, at the current state energy storage only accounts for under 2% of the U.S. peak demand, or 21,000 megawatts.³²

New grid regulations have even shown signs of quickly going national – New York has even followed suit by announcing \$15.5 million in funding to support adoption of energy storage solutions for the grid.³³ Secretary of Energy Rick Perry ordered a review of the grid in April to analyze the impacts of renewable energy on the grid and other energy sources.³⁴ In addition, the Department of Energy has studied grids with 30-80% renewable energy and determined that these systems work as consistently and with reduced costs and risks as arrangements with fewer renewables.³⁵ As the evidence builds for a heightened portion of renewables on the grid, legislators will push forward regulations in tandem.

Previously, the default solution for energy storage was pumped hydroelectric storage, which currently accounts for 96% of all storage.³⁶ These systems store energy, primarily from nuclear power plants, when demand is low and are quickly able to push more power through the grid when demand increases. In cases such as California, however, pumped hydro does not fall within the CPUC's legislation which will double non-pumped hydro energy storage for the entire U.S.³⁷

This projected increase in energy storage led the Bloomberg New Energy Finance outlook to predict that costs for batteries used for renewable energy sources will decrease 60% by 2030. Moreover, the general trend of increased energy storage is projected to lead to 10 times as much energy storage attached to the grid by 2020. The decrease in battery costs will reduce the upfront capital expenditure that is required to transform the grid system itself, further accelerating the adoption of and investment in improved grid infrastructure. Citibank analysts noted that the costs for battery storage will have to be within the range of \$150/kWh-\$230/kWh in order to see mass adoption of new battery technology, which is expected by 2030.³⁸

3RC is aware of these changes and is probing the energy storage services market for attractive investment opportunities. Security of storage systems is one market that should experience growth resulting from these shifts, as barriers will need to be built around each storage center to reduce the likelihood of accidents shutting down power. The servicing market will also grow which will open up a wide swath of companies for 3RC to consider.

Additionally, as the new grid model is ushered into place, there will be massive decommissioning costs that arise. Nuclear power plants show how large these expenses can grow with the cost of decommissioning a plant being approximately 10-15% of the initial cost of the plant itself.³⁹ Outside of the cost alone, other challenges can arise that increase the difficulty of the decommissioning process. One company, National Grid, decommissioned a liquefied natural gas storage location in 2013 and had to pay close attention to the project to ensure that environmental harm was reduced.⁴⁰ Service companies could potentially arise to facilitate this process, potentially creating an attractive investment opportunity for 3RC.

Energy Harvesting Technology

The potential for electrical generation and efficiency manifests itself in several different industry verticals. Of these verticals, the vehicle efficiency segment has shown some of the most promising initial developments, some of which were mentioned in the previous report. Despite how far off these advances may appear at first glance, implementation thus far highlights the potential impact of the technology.

One company that has particularly capitalized on these advances is Proterra, an electric bus manufacturer. Through the use of an overhead charger, Proterra's busses are capable of recharging in less than ten minutes, eliminating many of the potential issues related to underutilization and downtime of the busses themselves. This was facilitated by reduced battery costs, which have fallen by 80% since 2010.⁴¹ Adoption has been fairly quick, as many cities are looking to improve the efficiency of their public transportation fleets, making companies like Proterra a perfect solution.

An additional manifestation of this technology is that adoption of electric vehicles in general is accelerating, prompting major manufacturers to change their stance when it comes to production of those vehicles. Recently, Volvo announced that in 2019 every vehicle that it produces will have an electric motor.⁴² While the majority of vehicles produced are projected to still have some non-electric components, five car lines will be fully electric.

This shift has also been encouraged by government entities as well. The French government recently announced that they were considering a ban of all fossil fuel vehicles by 2040, an action which would definitively change market dynamics within the country.⁴³ These moves are not isolated to France, however, as the Netherlands and Germany are examining similar options to curb carbon pollution. Norway, a nation in which electric vehicles already account for 37% of their car market, is considering more radical measures to make the transition faster.⁴⁴ In 2016, the country announced that they will ban sales of fuel-based cars by 2025.⁴⁵

This, combined with the use of ecommerce, will cause a distinct shift in automotive aftermarket dynamics. The disruption both in parts and the supply chain in general will create areas which will hold attractive investment opportunities for 3RC.

An additional area of interest for 3RC is device charging, which has undergone a shift due to technological innovations. As seen with the Proterra bus example, the efficiency enabled through quick charging has helped encourage municipalities to transition to electric transportation options. Manifestations extend beyond industrial uses, however, and have expanded into devices such as cellphones. Wireless charging pads have offered up a convenient alternative to traditional wire chargers, and have extended to a variety of phone styles and aesthetic designs.

Digital signage is another market that has been burgeoning in recent years, with an approximation showing that \$1.2 billion is being spent on digital signage annually.⁴⁶ The signage itself is already quite pervasive in everyday life, with examples including retail P.O.S. displays and restaurant drive-thru menus. Protecting this equipment, then, is a crucial component of maintenance as 45% of computer data loss is a result of power failures and surges.⁴⁷ Moreover, power issues are not a minor problem, as the average computer is hit with 4 power-related problems each day – or 120 each month.⁴⁸

Interestingly, the maintenance of these systems does not always fall under the installer or the advertiser, creating a predicament for the owners of the equipment itself. Owners will not want to face a large cost if their equipment is damaged by a power failure, which opens up a new market for power maintenance of these systems. Surge protectors, uninterrupted power supply systems, and critical/emergency infrastructure will be crucial pieces in maintaining these technologies.

3RC has only started to examine the ramifications of lower domestic energy prices and what has been shown so far pushes 3RC to shift their investment lens toward areas that will receive outsized growth. The increase in domestic production has already reduced the quantity of energy that the United States imports, and the sources of energy itself is changing. This, combined with the changing grid and increased regulations, will catapult demand for energy storage solutions to new heights. Finally, the important impacts of energy harvesting on device charging and power solutions will be closely watched. As 3RC moves forward with the Strategy Report series and investment process, a close eye will be kept on the key manifestations of lower domestic energy prices.

SOURCES:

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- ¹⁸ Corpus-Christi Caller Times
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