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Analysis of the Impact of The Quantum - Trump Wall on U.S. Energy Prices

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March 2017

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G1 Quantum is a leading global consulting firm that offers economic, financial, and business management expertise to major law firms, utilities, industries, accounting firms, companies, and governments around the world.

Our consultants, many of whom are recognized as experts in their respective fields, provide a unique combination of functional capabilities and industry insight as well as analytical rigor. Our strengths in these areas help clients make important business and policy decisions and resolve critical disputes.

With years of industry experience and exceptional strength in our ability to consistently out innovate the competition with strong management and economic expertise in every phase of the electricity production cycle—from fuel procurement to retail strategy—as well as hands-on experience constructing our projects, helping clients manage market power, environmental policy, and regulatory issues.

We have pioneered techniques and models that have become industry standards, including competitive market designs, efficient bidding mechanisms, and methodologies to assess market power.

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March 2017

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TABLE OF CONTENTS

TABLE OF CONTENTS	III
1. SUMMARY.....	1
2. APPROACH.....	1
3. RESULTS	3
3.1. WHOLESALE PRICE IMPACT	3
3.2. ESTIMATED SAVINGS IN ELECTRICITY COSTS.....	4
3.3. CHANGE IN U.S. ENERGY	5
APPENDIX: KEY ASSUMPTIONS.....	7
A.1 FORECASTED DEMAND	7
A.2 FUEL PRICES AND CARBON POLICY.....	7
A.3 INFLATION ASSUMPTIONS	9
A.4 TOTAL COST	9

March 2017

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1. Summary

G1 Quantum (G1Q) has conducted an analysis of the impact of the Border Wall project on the U.S. wholesale electricity market. The Quantum - Trump Border Wall, depending upon the preferred height of the solar panels, will produce between \$87Billion dollars or 728 Billion kWh at 3ft up to \$291Billion dollars or 242Trillion kWh at 10ft. The population of the U.S. on average uses 10,812 kWh per year or just over 4Trillion kWh per year. This additional supply will reduce the need for generation from other power plants with higher pollutant emissions and operating costs, primarily fueled by natural gas, oil, and coal. Redirecting a small portion of the energy produced from the Quantum - Trump Border Wall to electrify the Quantum - Trump Border Wall will better defend the U.S. - Mexico Border meeting the Presidential Administrations strategic goals protecting U.S. National Security. G1Q has projected wholesale power prices over the period 2013-2037, for scenarios with and without the Quantum - Trump Border Wall in service, and quantified the expected reduction in wholesale power prices and wholesale electricity costs that would result from the power supplied by the project.

The principal findings of the analysis are:

- **Depending upon the size of the solar panel enhanced wall, the Quantum -Trump Border Wall would lead to a reduction in the wholesale cost of power averaging \$45Billion dollars annually over the 2017-2024 time period, resulting in an aggregate savings of \$550Billion dollars over the next 8 years.**
- **With the Quantum - Trump in service, over the 2017-2024 time period, the price of power in the U.S. wholesale market would be .2-.4 cents per kWh lower on average.**

2. Approach

Generally in the U.S electric power is bought and sold through a competitive wholesale market.¹ As a result of industry restructuring, U.S. utilities and other load serving entities own and operate almost no generating capacity, but rather make wholesale purchases from the competitive market, the costs of which are ultimately recovered through retail rates charged to end-use customers. Most U.S. customers pay a retail rate closely tied to prices set in periodic Standard Offer Service auctions, which in turn closely ties to expected wholesale power costs. Wholesale power costs are therefore a good measure of electricity costs for consumers in the U.S. G1Q has estimated the savings from Quantum - Trump Border Wall by comparing wholesale power costs for the region with and without the project in service.

Introducing the Quantum - Trump Border Wall's additional supply into the competitive wholesale power market will lower prices by displacing higher cost generation. Power in the U.S. is generally priced hourly.

¹ Power can be purchased through spot markets administered by various U.S. Operators, or through bilateral transactions and forward electricity markets. The power sold from the Quantum - Trump Border Wall will affect prices in all of these markets, regardless of whether the output is sold under contract or through the spot markets. In fact, all generation, even if under contract, must be scheduled through various U.S. spot markets. Power that is under contract for physical delivery is simply included at the bottom of the supply stack, therefore directly affecting the spot market. Likewise, expectations about prices in the spot market drive the pricing for forward transactions.

March 2017

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with the market price set by the offer from the highest-cost source of supply needed to meet demand. In each hour that the price is set by power plants with lower operating costs, rather than higher-cost units displaced by the supply from the Quantum - Trump Border Wall, the wholesale clearing price will be lower and electricity costs reduced. The variable operating cost of solar panels is almost zero, so electricity from the Quantum - Trump Border Wall will be offered at the bottom of the regional supply stack in every hour it is available. Hence, the Quantum - Trump Border Wall will displace higher-cost generation and the associated greenhouse gas emissions in almost every hour of every year, resulting in a reduction in the market price. G1Q has estimated these price decreases for each hour of each year from 2017 through 2024 and calculated the associated reduction in wholesale power costs.

The projections provided in this report cover the 2017 through 2024 time period and rely on the following key input assumptions:

- Natural gas and oil prices are based on the Energy Information Administration (EIA)² Annual Energy Outlook (AEO) 2016, as updated in April 2016 to account for the change in economic conditions in the prior year.
- Federal greenhouse gas program in place with prices of \$30/ton of carbon dioxide in 2013, escalating by 2030 to \$60/ton, scenarios that are consistent with those presented in ExxonMobil's Outlook for Energy, A View to 2030.
- Electricity demand growth as projected by U.S. Energy Information Administration in its most recent forecast, released in February 2017.

Additional detail about these assumptions is included in an appendix to this report.

G1Q used GE MAPS electricity market model to develop a fundamental forecast of market prices and generator dispatch for U.S. energy demand. The GE MAPS model is a security-constrained dispatch model that simulates the chronological, hourly operation of an electricity market. The model takes the specified, cost-based bids for each generator in the market, along with other generating unit operating assumptions and performs a least-cost dispatch subject to limits on the flow of power across power lines and other elements of the transmission system. The model finds the least-cost dispatch of power plants and calculates hourly prices for electricity for a specific location within the U.S. using the same basic approach that is applied in the actual operation of the power system and wholesale market.

G1Q's analysis relied on forecasted production patterns that provided for the project. The production profile includes, for each month of the year, an average value for each hour of the day. In reality, there will be day-to-day fluctuations not captured in these patterns. Test data for the project site indicate that the hourly fluctuations during the summer

² EIA, an administration with the US Department of Energy, provides data and forecast for the energy sector. The AEO provides a comprehensive, long-term view on energy supply, demand, and prices, based on fundamental modeling of the markets for each energy commodity. The 2016 AEO is available at: <https://www.eia.gov/>

months are coincident with warmer weather and higher electric demand. Hence, G1Q's estimates are likely to understate the potential benefits during summer peak hours.

3. Results

3.1. WHOLESALE PRICE IMPACT

Figure 2 shows G1Q's estimates of difference in the average U.S. wholesale power prices with and without the Quantum - Trump Border Wall in service. Over the 8 years covered by the analysis, prices would be an average of .12 cents / kWh lower with the project than without. As shown in Figure 3, the effect on wholesale electricity prices is even more pronounced for Southern U.S., where the project will be interconnected with the U.S. energy grid. The average price reduction for that zone is .11 1/2 cents / kWh.

Figure 1: Wholesale Price Reduction for the U.S.

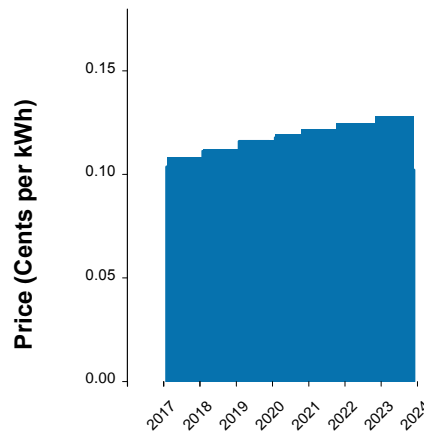
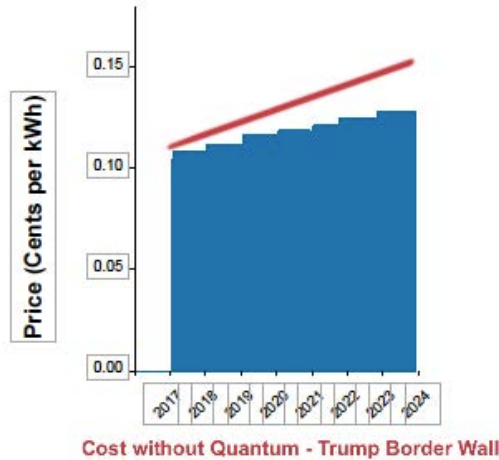


Figure 2: Wholesale Price Reduction for the United States

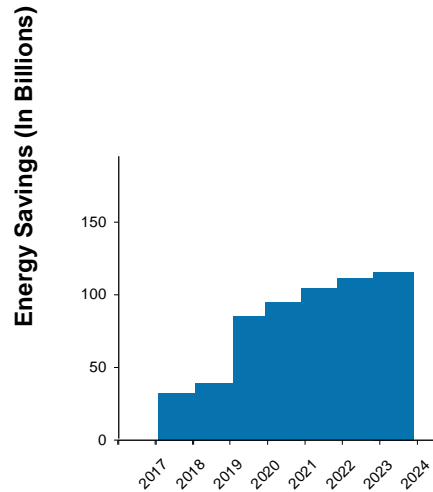


3.2. ESTIMATED SAVINGS IN ELECTRICITY COSTS

Figure 4 shows the expected savings in electricity costs associated with the forecasted reduction in wholesale market prices. The cost savings range between 2 to 4 cents per kWh which is \$50Billion dollars annually upon completion in late 2019, totaling \$555Billion over the 8 year period to 2024. The savings may fluctuate from year-to-year due primarily to the addition of new generating capacity added to meet regional demand growth. Because minimum efficient scale for new solar power is small the Quantum - Trump Border Wall creates an initial surplus, which depresses the 2017 electricity price, and prices then rise as the surplus is absorbed by demand growth reaching equilibrium domestically with excess solar energy increasing U.S. Net Exports .³

³ Additionally, the price impact and cost savings fluctuate from year-to-year based on the timing of forced outages for generating units, which are assigned randomly within G1Q model.

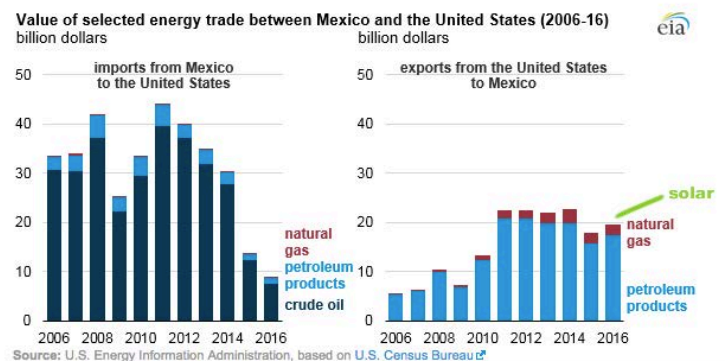
Figure 3: Projected Reduction in Wholesale Power Costs with the Quantum - Trump Border Wall



3.3. CHANGE IN U.S. GENERATION MIX

In order to illustrate how the Quantum - Trump Border Wall project would change the generation mix for U.S. Figure 5 shows the change in generation for non-wind resources for a representative year, 2017. As shown in Table 1, the expected pattern is very similar for other years. The output of the Quantum - Trump Border Wall will displace other generation from fossil fueled power plants, burning primarily gas, oil, and coal to an extent, but will find a healthy equilibrium domestically in the U.S. while helping to increase energy net exports to Mexico.

U.S. energy trade with Mexico: U.S. export value more than twice import value in 2016



Additionally, the Quantum - Trump Border Wall would be utilized slightly more in the Southern U.S. while in service, allowing some of the off-peak solar generation to be stored and used during peak periods. A large portion of the Quantum - Trump Border Wall could potentially drive U.S. solar energy exports from \$0USD to \$100B per year by 2019.

Figure 4: Change in Other U.S. Generation with Quantum - Trump Border Wall, 2019

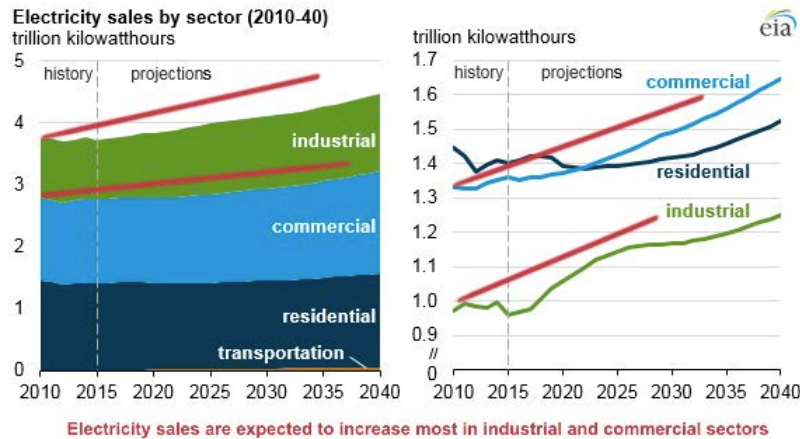
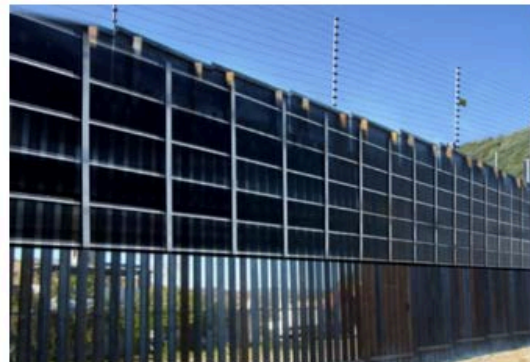
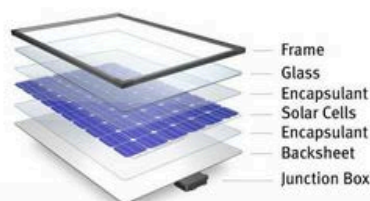


Figure 5: G1 Quantum Project Snapshot

The Quantum - Trump Border Wall will keep our borders safe generating 242Trillion kWh and pay for itself in its first year of operation



Assuming its 2000 miles each mile has 5280 ft so 5280 ft. x 2000 mi = 10,560,000.00 ft. times 10ft high solar wall = 105,600,000.00 sq. ft. So that's 105,600,000.00 sq. ft. of solar panels to cover a border wall 2000 miles long and panels 10 ft high. The panels are presumably 5 ft off the ground with the wall 15ft high total. So on average its around \$15,000USD for 3000 sq. ft. of solar panels so if you buy 105,600,000.00 sq. ft. I'm assuming you can get the panels for -\$1,000USD per every 3000 sq. ft. so 105,600,000.00 sq. ft. divided by 3000 sq. ft. = 35,200 times -\$1,000USD = \$35,200,000.00USD total for solar panels to cover 2,000 miles at 10 ft in height.



So without the solar panels the value metal mesh wall costs ~\$25MUSD per mile to build so lets add say \$10MUSD more per mile to include the solar panels so that's \$35MUSD times 2000 miles = \$70MUSD for the border wall. We can even go ahead and add say \$3MUSD for miscellaneous costs connecting the wall to the existing energy grid. So that's ~\$100MUSD total for a solar paneled border wall that's 15ft high and 2000 miles long.

Lets even add ~\$100MUSD of eminent domain costs to secure the border. So ~\$200MUSD total right? So assuming 105,600,000.00 sq. ft. times 9 watts per sq. ft. times 7 hrs a day times 365 = 242Trillion kWh

242Trillion kWh times .12 cents = \$291Billion dollars worth of energy year 1

APPENDIX: KEY ASSUMPTIONS

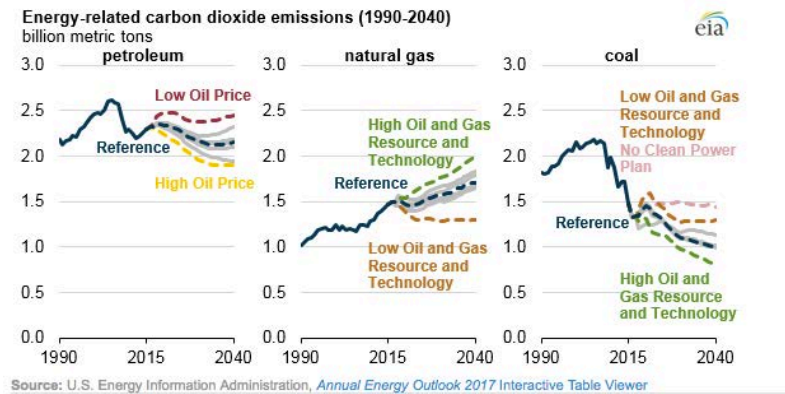
A.1 FORECASTED DEMAND

- Demand and peak loads for 2017-2024 are based on Exxon Mobil's report, the most recent regional forecast for the U.S.
- Quantum - Trump Border Wall projects hourly electricity demand by zone through 2024; these hourly demand forecasts were used in G1Q model runs, with the 2024 pattern used for all years thereafter, scaled appropriately to reflect demand growth.

Table 2: Carbon Emissions Driving Fossil Fuel Use

MARCH 2, 2017

Projected carbon dioxide emissions are sensitive to factors driving fossil fuel use



A.2 FUEL PRICES AND CARBON POLICY

The gas forecast is based on the US EIA Study March 2017 forecast.

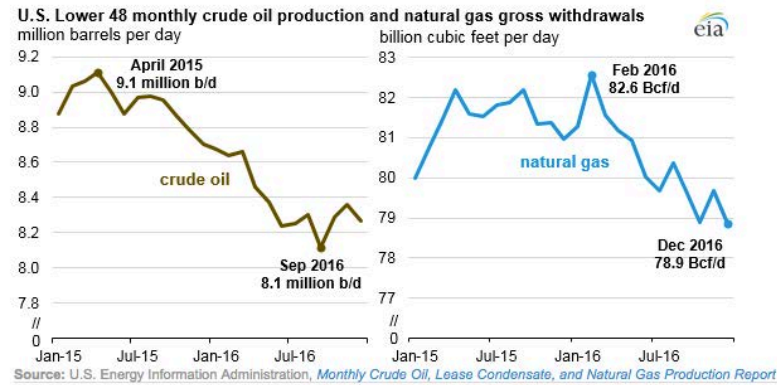
March 2017

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Table 3: Oil and Natural Gas Production

MARCH 8, 2017

U.S. crude oil and natural gas production both fell in 2016

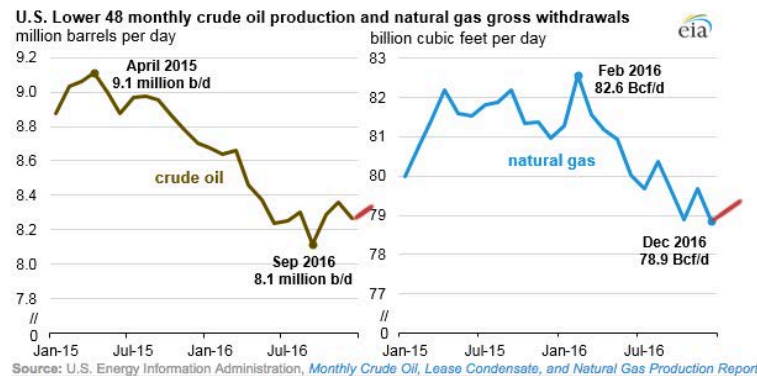


Oil and Natural Gas prices are based on the EIA price forecast March 2017. G1Q applied the most recent two-year Fox Business historical relationships between crude and product prices to derive oil product prices reaching similar conclusions as EIA.

Table 4: Oil and Natural Gas Production Normalizing

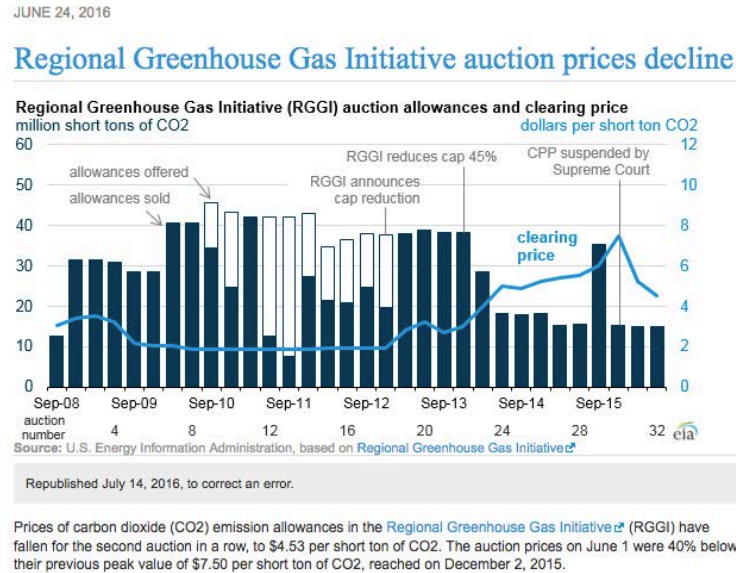
MARCH 8, 2017

U.S. crude oil and natural gas production both fell in 2016



Once the Quantum - Trump Border Wall reaches equilibrium with oil, natural gas, nuclear, and the energy sector prices are anticipated to normalize consistent with scenarios presented in ExxonMobil's Outlook.

Figure 7: CO₂ Allowance Prices Fluctuation Varies Month to Month



A.3 INFLATION ASSUMPTIONS

All values in this report are in nominal dollars, assuming an average inflation rate of 2.01 percent. The assumption is based on the inflation rates applied in the AEO 2016, shown in Table 3.

Table 3: Inflation Rates

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GDP Chain-type Price Index (2000=1.000)	1.237	1.243	1.258	1.274	1.297	1.324	1.354	1.385	1.417	1.450	1.484
Annual inflation rate	0.99%	0.55%	1.18%	1.25%	1.79%	2.12%	2.23%	2.29%	2.30%	2.37%	2.38%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GDP Chain-type Price Index (2000=1.000)	1.521	1.560	1.600	1.638	1.675	1.711	1.746	1.782	1.820	1.858	1.896
Annual inflation rate	2.49%	2.55%	2.54%	2.39%	2.26%	2.12%	2.08%	2.07%	2.11%	2.08%	2.07%

A.4 AVERAGE TOTAL COST OF QUANTUM - TRUMP BORDER WALL

On average the cost to build the Quantum - Trump Border Wall is expected to cost \$25Million dollars per mile. Adding \$10Million dollars per mile for the solar panels and installation bring the cost to \$35Million dollars per mile. \$35Million dollars per mile multiplied by 2000Miles equals \$7Billion dollars to build the Quantum Trump Border Wall. Lets add \$3Billion dollars for miscellaneous costs associate to grid restructuring, which bring the cost of the Quantum - Trump Border Wall to \$10Billion dollars. We can even include a high estimate of eminent domain costs of up to \$10Billion dollars bringin the total cost of the Quantum - Trump Border Wall to \$20Billion dollars. However, the total cost of the Quantum - Trump Border Wall is federally negligible because the Quantum - Trump Border Wall pays for itself in its first year of operation.