

ENERGY INFRASTRUCTURE TRENDS IN THE UNITED STATES

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Overview

The energy sector has been undergoing a variety of transitions as a result of demographic, economic, climatic, technological, and social forces that shift how we produce, transport and utilize energy. It is unclear, however, what infrastructure will be needed and how different transitions will impact existing energy infrastructure and the owners of those assets. This work provides an extensive look at existing domestic energy infrastructure owned by major oil and natural gas companies, and electric utilities throughout the United States. We focus on trends in physical and financial characteristics of infrastructure assets by region.

Data

We utilized three annual reports submitted by major oil and natural gas companies, and electric utilities to the Federal Energy Regulatory Commission, including Form 1 - Electric Utility Annual Report, Form 2/2A – Major/Non-Major Natural Gas Pipeline Annual Report, and Form 6 - Annual Report of Oil Pipeline Companies. We extracted physical and financial information of relevant energy infrastructure from annual reports between 1994 and 2016 (depending on availability of data).

Results¹

At this time we only have preliminary results. Shown in Figure 1 are highlights from FERC Form 1 that lists data for major (regulated) U.S. electric utilities. There are some interesting observations as data can be viewed in total for the U.S. or per region (Figure 1) and per customer. There is a small regional difference in per-customer asset values for transmission and distribution (T&D) (Figure 1(e)), which likely translates to similar regional annual customer costs, compensating for the rate of return to utility assets. Previous work indicates that, U.S.-wide, each customer pays for approximately 700-900 \$/year for annual T&D costs that include operations, maintenance, and annual capital spending (Fares and King, 2017).

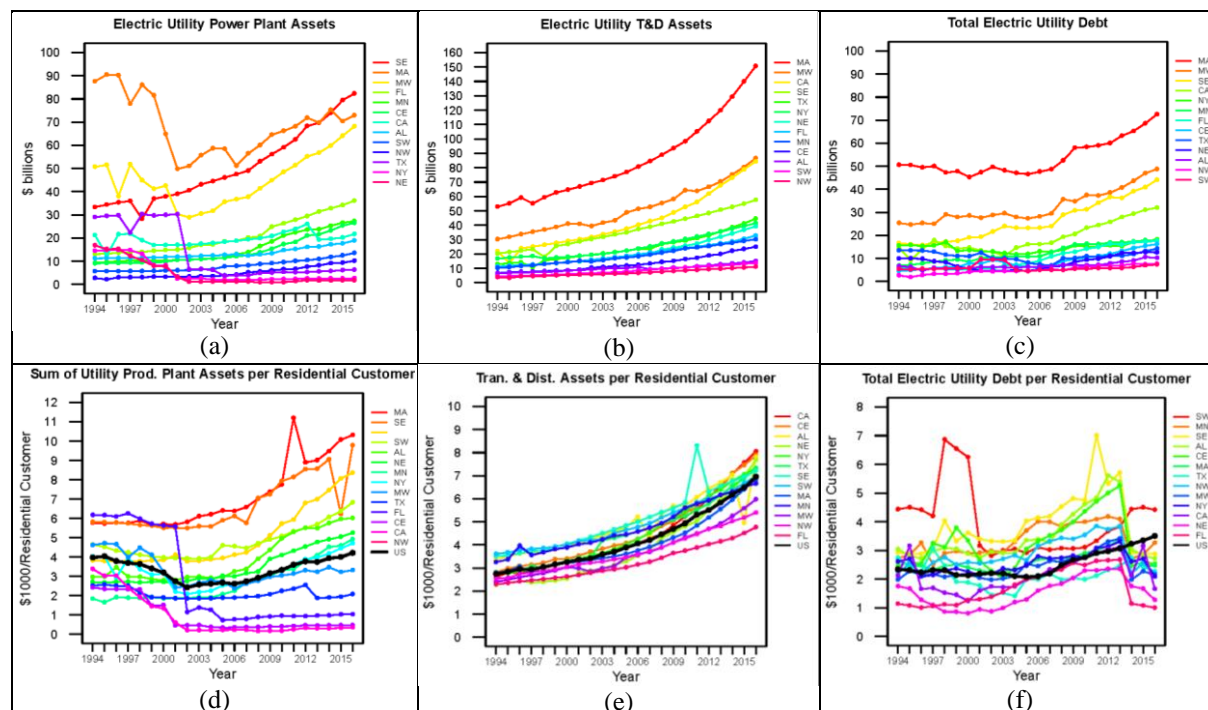


Figure 1. Data from FERC Form 1 that indicate significant differences between regions of the U.S. in terms of asset values and debts that are within regulated utilities. All data in nominal dollars. The legend represents regions for the continental U.S. that loosely relate to state boundaries and electric balancing regions.

¹ All results are preliminary pending further investigation.

Figure 2 provides highlights from FERC Form 2 that contains data for major U.S. natural gas pipeline companies. Total interstate natural gas pipeline mileage decreased since 2012 while increasing in some regions such as the southeast and mountain north (Figure 2(a)). The upward trend is also visible in terms of total asset values (Figure 2(b)). Increasing operating revenue on the other hand indicates higher utilization, which is potentially supported by increases in per-mile deliveries of natural gas. At first glance, these trends are consistent with recent developments in U.S. shale plays and gas-fired power plant construction trends, but a deeper investigation is warranted.

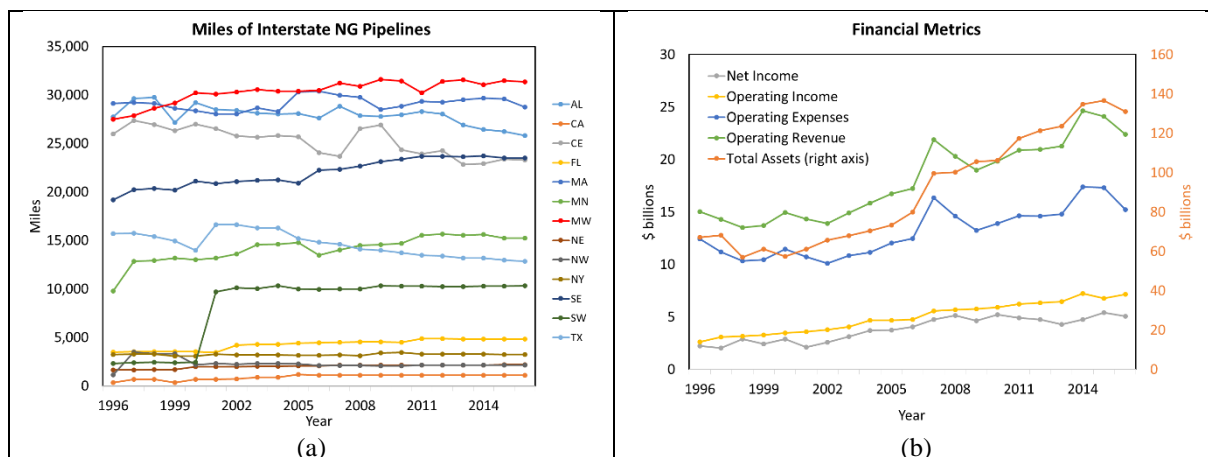


Figure 2. Data from FERC Form 2 on interstate natural gas pipelines. All data in nominal dollars. The regions for the continental U.S. loosely relate to state boundaries and electric balancing regions.

Figure 3 provides highlights from FERC Form 6 data, which includes some intrastate oil and products pipeline reporting. The increase in pipeline mileage is consistent with the increased drilling and production in unconventional oil and natural gas plays around the country (Figure 3(a)). In terms of asset value, trunk lines for crude oil and products constitute the largest portion (Figure 3(b)), which has increased significantly since the early 2010s when sizeable development of liquids-rich unconventional plays started. Figure 3(c) further shows that most of the asset value of trunk lines has been captured in pipeline construction.

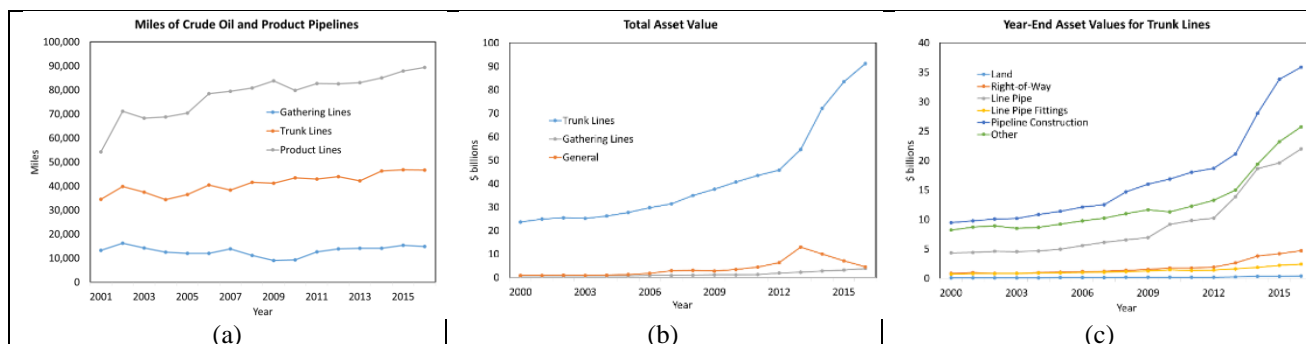


Figure 3. Data from FERC Form 6 on crude oil and products pipelines. All data in nominal dollars.

We anticipate additional results to discuss such as: (1) U.S.-wide assets and debt of interstate and other regulated natural gas (FERC Form 2) and oil pipelines (FERC Form 6); (2) estimate of asset values and debt of power plants in wholesale markets and municipal utilities that do not have data in FERC forms; and (3) relationship between peak MW and annual MWh to physical grid characteristics of the number of transformers and number of miles of T&D lines.

Conclusions

In recent years, retail electricity costs remained stubborn or even increased in some regions while wholesale electricity prices were declining. Increasing T&D investments as displayed in Figure 1 could partially explain this divergence. Data reported in Figures 2 and 3 are consistent with the unconventional oil and gas development across the U.S. Allocating the data across the regions will allow us to depict a more refined picture of what type of assets and where they are developed.

References

Fares, Robert L. and King, Carey W. 2017. Trends in transmission, distribution, and administration costs for U.S. investor-owned electric utilities, *Energy Policy*, 105, 354-362.