



In addition to yield, mix, and cost considerations, overall network fluidity also impacts profitability. To this point we note that the major railroads report performance measures weekly such as average train speed and terminal dwell.

- **Speed/Velocity:** Train speed measures the linehaul movement between terminals. The average speed is calculated by dividing train-miles by total hours operated. In general the higher the average train speed the better the network is being run, with high frequency and stop duration translating to lower average speeds and in turn less efficiency (all else equal).
- **Dwell:** Terminal dwell is the average time a car resides at the specified terminal location expressed in hours. Dwell has averaged 24.5 hours YTD industry-wide, which is slightly above historical levels (23.9 hours in 2014).

The underlying geographical characteristics of a rail footprint can have a major impact on the aforementioned profitability and service elements. Both CNI and CP are transcontinental railroads accounting for 75% of Canada's railway tracks, while the United States railroad system is more fragmented, with over 610 total freight railroads operating across roughly 140,000 miles of track. The U.S. is also more densely populated on the East Coast with seven of the largest metropolitan areas located east of the Mississippi River. This not only results in a shorter length of haul for both NSC and CSX, but introduces truck as an intermodal competitor as well. Conversely, Canada has a lower population density (4 people per square kilometer vs. 35 in the United States according the world bank) and major population centers that are more spread out on both the east and west coast.

While the distance between major population hubs may improve length of haul for certain commodities for the Canadian rails, there are certain other geographical challenges imposed by the unique terrain and climate of Canada compared to the U.S. The Canadian prairies, which stretch across much of the three of the Western provinces (Alberta, Saskatchewan, and Manitoba), which make up a significant portion of the transcontinental route, are relatively flat and as such have been converted into cropland. However, there are still pockets of difficult route portions, such as Field Hill and formerly Big Hill for CP, which has now been converted into the Spiral Tunnels. For railroads, a wider variation in gradient and curvature of tracks can result in higher maintenance and fuel costs. To this point, a study by Oliver Wyman in 2012 found that Canadian Pacific's network has steeper grades and more track curvature than CNI, which the consulting group concluded would require an additional 203 main line AC locomotives than CNI, resulting in increased depreciation, fuel, and maintenance costs (though this did not actually turn out to be the case).

Cash flow and balance sheet discussion

The very strong return profile allows railroad companies to generate significant operating cash flows. A disproportionate amount of this needed to be allocated to significant capex investments for network upgrades and expansion, new locomotives to meet stricter emission standards, as well as other regulations (particular in the U.S.). To these points we note that the Class I railroads under our coverage universe generated nearly \$170B in operating cash flow cumulatively over the last ten years (2006-2016), compared to \$235B in ebitda over the same period. Free cash flow totaled \$65B (62% of net income), as capex totaled \$103B and averaged 17.2% of sales. Capex as a % of sales has averaged closer to 20% of