The R&D Tax Credit Aspects of the Freight Rail Industry
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R&D tax credits provide excellent opportunities for companies innovating in the freight rail industry.

The freight rail industry in America is extensive and innovative. Demand for freight rail services has been outpacing infrastructure capacity year over year for the past decade. Each person in the U.S. requires the movement of approximately 40 tons of freight every year. In order to meet the needs of the growing urban population countrywide, engineers are developing innovative ways of transporting more goods, faster, safer, and cheaper than previous generations.

This has resulted in the most efficient freight rail industry in the world. Innovative sensors allow engineers to analyze a large amount of data that ultimately translates into smarter logistics which means reduced delivery time. Positive train control sends up-to-date visual and audible information to train crew members about areas where the train needs to be stopped or slowed down which means safer trains. Equipment upgrades reduce fuel consumption and ultimately translate into cost reductions for railroad companies.

Companies developing these and similar railroad technologies should be aware of federal and state R&D tax credits which are available to help stimulate innovation in the freight rail industry.

The Research & Development Tax Credit
Enacted in 1981, the Federal Research and Development (R&D) Tax Credit allows a credit of up to 13 percent of eligible spending for new and improved products and processes. Qualified research must meet the following four criteria:

- New or improved products, processes, or software
- Technological in nature
- Elimination of uncertainty
- Process of experimentation

Eligible costs include employee wages, cost of supplies, cost of testing, contract research expenses, and costs associated with developing a patent. On December 19, 2014, President Obama signed the bill extending the R&D Tax Credit for the 2014 tax year.

The Freight Rail Industry
The freight rail infrastructure in the U.S. is extensive. It consists of 28,000 locomotives, more than 1.4 million rail cars and over 140,000 miles of track. This infrastructure supports a $60 billion freight industry that is the largest in the world. In 2011, the American freight rail system transported 1,680 billion ton-miles of freight, about 25.4 percent of total global volume.
Compared with other freight moving industries within the U.S., freight by rail is the largest. The rail network accounts for approximately 40 percent of all freight movement in the country, as demonstrated in the chart below. However, such an extensive network requires enormous investments to maintain. Compared with other major industries, railroad companies invest one of the highest percentages of revenues to maintain their system. Managed as for-profit companies, freight rail movers routinely invest 15-20 percent of revenues back into their business. This has resulted in one of the most efficient freight rail systems in the world.

What’s more is that the amount of freight being moved throughout the country is still growing at a rapid pace. Since 2009, Union Pacific, the largest freight mover in the country increased weekly car loadings from 133,000 to 180,000. This uptick in operations is not unique to Union Pacific. The Federal Railroad Administration projects that the tonnage of freight shipped by the U.S. rail system will increase 22% industry wide by 2035.

This recent boom in the freight rail industry is leading industry players with extra cash to invest significantly in R&D. Railroads rely on advanced technologies to monitor the health of the country’s rail infrastructure. From ground-penetrating radar used to detect problems beneath tracks, to a vast network of wayside detectors used to identify equipment in need of repair, railroads are at the forefront of developing advanced technologies to further improve the freight rail equipment and infrastructure. Some recent technological developments are discussed below.

**Safer Tanker Cars**

The biggest growth area for the freight rail industry is in the transportation of oil and energy products. The recent glut of energy production in the country has created a huge demand for transportation of the product. Liquid transportation companies like BNSF have benefitted greatly. BNSF moves about 600,000 barrels of oil per day, up from 54,000 barrels per day in 2010. This type of drastic increase in services is typical in the energy transportation industry.

In 2009, more than 10,000 tank cars transported crude oil. In 2013, that number increased to nearly 500,000. However, the tank cars that were safe enough for the relatively light duty work demanded of them in 2010, simply cannot accommodate the exponential growth that the industry has recently experienced. To meet the demand for crude oil transportation, tank car manufacturers are stretching their capacity to keep pace. Tom Jackson, Vice President of Marketing for Greenbrier, one of America’s top train car manufacturers had this to say about tank car production “Tank Cars are taking precedent over everything. The box car is not a priority.” There were more than 52,000 orders for tank cars at the end of the first quarter this year, compared to just 4,363 orders for box cars.

The most common tankers in the industry are referred to as DOT-111 cars. The National Transportation Safety Board (NTSB) has identified a number of vulnerabilities in their design. Generally, these vulnerabilities are in respect to tank heads, shells, and fittings. These vulnerabilities create risk that flammable liquids such as crude oil and ethanol, could ignite and cause catastrophic damage during an accident. Incidents such as that have happened a number of times recently, causing catastrophic damage to property and resulting in a number of deaths and serious injuries.
The main challenge is that the DOT-111 shell is so thin that it is prone to puncture during an accident. If the shell is punctured, flammable cargo can spill, catch fire, and potentially explode. The response has been new recommendations from the NTSB that existing rail cars be retrofitted with new technology to prevent such catastrophes. These proposed improvements to the DOT-111 model are illustrated in the following link, [http://www.post-gazette.com/image/2015/02/18/tankerbig.png](http://www.post-gazette.com/image/2015/02/18/tankerbig.png).

Besides the upgrades to the tank cars, there are countless other innovations in the railroad industry. It would take a large novel to merely scratch the surface when discussing them. A few of them however, are discussed below along with some industry leaders in development. It is important to note that research and development is done by companies of all sizes from small mom and pop start-ups to large enterprises like Union Pacific and CSX.

**Union Pacific**

Union Pacific is one of America’s most recognized railroad companies. It links 23 states in the western two-thirds of the country by rail, providing a critical link in the global supply chain. From 2007-2012, Union Pacific invested $18 billion in its network and operations to support America’s transportation infrastructure, including a record $3.7 billion in 2012. The company is constantly discovering ways to improve technology used to move trains and run operations. Some of their most recent innovations are described below:

**Emissions Reducing Technologies**

Since 2000, Union Pacific has spent about $7.5 billion to purchase more than 4,100 fuel-efficient locomotives. They also invest significantly in Research and Development to discover other innovative ways of reducing their environmental footprint. Exploring new technologies is a hallmark that Union Pacific has pursued for decades. This focus on research and development serves as a catalyst for greater reductions in emissions.

Engineers at the company are currently testing the following three emissions-reducing technologies:

1. Exhaust gas recirculation (EGR)
2. Diesel oxidation catalysts (DOC)
3. Diesel particulate filters (DPF)

The company is using 25 locomotives to test various combinations of the above technologies. The locomotives are all UP9900 models. This signature unit is ideal for testing because it has a reduced engine size that creates the space needed to install all three technologies simultaneously.

Union Pacific is also working with the EPA, California Air Resources Board, and other local, state, and federal agencies to test and evaluate new emissions-reducing technologies which are described below:

- **Advanced Locomotive Emissions Control System:** reduces emissions by collecting exhaust gas from the smoke stack of locomotives and then treating the emissions rather than releasing them into the air.

- **Hybrid Electric Technology:** for locomotives hopes to achieve emissions reductions and fuel-efficiency improvements similar to those of hybrid electric cars without hindering normal yard operations. The eco-friendly ‘Green Goat’ locomotives, for example, use a conventional engine to charge a bank of batteries, which in turn power the train. However, the battery technology, safety, and performance limitations of currently prevents the Green Goat from achieving the anticipated and desired results. Still, lessons learned during these experiments helped guide the development of other new technologies. It is processes like these that drive the R&D tax credit.

- **Diesel Particulate Filter:** acts as filtration by utilizing high-temperature silicon carbide blocks to trap particulate matter in the exhaust.
As the gases containing the particles accumulate, the device periodically heats the carbon, causing it to ignite and burn off as water and carbon dioxide.

- **Intermediate Line-Haul Locomotive**: significantly reduces nitrogen oxide emissions by routing exhaust fumes through a selective catalytic reduction unit (SCR). This technology was not ideal for Union Pacific’s route structure, however, the company expects it to serve as a stepping stone for other innovative ways to reduce fuel usage and emissions.

### Norfolk Southern Corporation

Norfolk Southern operates one of the most extensive rail networks in the East. The Pennsylvania based company recently launched a $53 million energy conversion project at its Juniata Locomotive Shop that will substantially reduce carbon emissions and water usage at the 70-acre facility. "This project showcases Norfolk Southern’s commitment to sustainability and innovation," said CEO Wick Moorman. "The Juniata Locomotive Shop has a 125-year legacy of leading the rail industry in locomotive technology, and with our energy conversion project, this shop and its employees will remain an industry frontrunner in the 21st century."

U.S. Rep. Bill Shuster, chairman of the House Transportation and Infrastructure Committee praised the initiative, "I applaud Norfolk Southern’s commitment to innovation and growth for the rail industry in Blair County and across the country," "The Juniata Locomotive Shop has been operating for over 100 years in Central Pennsylvania, and this latest investment helps solidify its continued role in growing this nation through our railroads."

The project will replace the shop’s coal boilers with natural gas heaters and install a 1.2-megawatt capacity combined heat and power generator that will produce enough electricity to sustain the entire 16-building complex. When completed in late 2017, Norfolk Southern expects the improvements to save about $4 million in electricity costs, reduce water usage by 49.4 million gallons from steam-water recovery, and eliminate more than 29,000 tons of carbon emissions in Pennsylvania on an annual basis. This initiative will boost Norfolk Southern’s efficiency and help support further rail innovations.

### CSX Corporation

CSX Corporation is one of the nation’s leading transport suppliers. The Jacksonville, Florida based company’s network encompasses about 21,000 route miles of track in 23 states, the District of Columbia and Ontario and Quebec. Engineers at CSX are developing a broad range of technologies. Many which involve the development of technology to improve fuel efficiency and reduce greenhouse gas emissions. CSX has invested $1.5 billion over the last decade to improve its locomotive fuel efficiency and reduce corresponding emissions. One particular initiative involves real-time, energy management technology which uses GPS, track grade, and curvature data along with train information to identify the most fuel efficient throttle settings for each trip as the train moves across the railroad. In addition, various methods of rail lubrication are being explored to reduce rail-to-wheel friction and increase fuel efficiency.

### BNSF Railway Company

BNSF Railway, the second-largest freight railroad network in North America, covers most of the Midwest and Western regions of the country. BNSF is committed to growth and innovation. In 2014, the company spent a record $5.5 billion dollars to expand their railroad network. The company also spent $200 million last year on positive train control alone. Additional technologies BNSF utilizes to enhance safety include:

- **Wayside Detectors** – use laser, infrared and acoustic force technology.
- **Rail Detection** – uses ultrasonic shear waves to inspect rails.
- **Automatic Grades** – feature biometric driver identification, license plate recognition, tire inspection portals, and digital technology.
Like the other major freight delivery companies in the U.S., BNSF also invests significantly in the development of fuel efficiency technology and environmental footprint reduction. Some of these technologies are discussed below:

- **Idle Control**: installed on locomotives reduce air emissions and fuel consumption by automatically shutting down locomotives that aren't being used. BNSF has equipped more than 70% of their 6,600 locomotives with idle control technology. Similarly, all new locomotives they purchase are equipped with this technology.

- **Genset Locomotives**: a low emissions, EPA-certified diesel switch locomotive. Unlike conventional single engine locomotives, the Genset has three low horsepower engines that only operate when needed. This approach saves significant fuel and substantially reduces air emissions. BNSF operates 74 Genset locomotives in Texas and California.

- **New Hybrid Technology**: involves innovative ways to capture energy generated during braking and reuse it as needed for propulsion.

- **Wide-Span Electric Cranes**: BNSF was the first U.S. rail carrier to install wide-span cranes. These cranes produce zero emissions on site while generating power each time they lower a load. The wide stance design of these new cranes eliminates as many as six diesel trucks for shuttling containers within the intermodal facility.

**General Electric**

GE Transportation is a global technology leader and supplier to the railroad industry. For more than a century, GE has been building locomotives at their massive Erie, PA facility. The company has served as a pioneer in both passenger and freight locomotives. GE has also invested significantly in fuel efficiency technology and some of these technologies are discussed below:

- **Trip Optimizer**: an intelligent cruise control technology. Trains pulling long lines of cars up and down hills are somewhat like slinky toys, on the way up the cars pull apart; on the way down they crunch together. The trip optimizer is aware of those tendencies and uses them to control fuel usage. The computer actually scans the slope of oncoming hills, the length and weight of the train, its contents and its braking ability. It then automatically regulates the train’s speed to maximize its efficiency with the slinky tendencies in mind in order to consume the least amount of fuel.

- **Getting the Railcar on the Train Quicker**: GE is also piloting new technology that will help rail yard managers get the right railcar on the right train more quickly. Currently railcars sit idle in a rail yard about 40% of the time. When railcars come into loading yards they are often piled up in an unorganized manner. Having a computer that is smart enough to arrange cars so that they are loaded in an optimal order saves train usage time, employee salaries and fuel which all add up to substantial operating cost savings.

**Google Maps U.S. Rail Crossings**

Accidents at U.S. rail crossings have attracted widespread industry and media attention across the Northeast recently. So much so that Google Maps and the U.S. Federal Railroad Administration have agreed to use the agency’s data along with Google’s app to notify drivers about upcoming railroad crossings on Google Maps. The initiative will pinpoint every rail crossing in the country and send visual and audio alerts to a vast array of drivers who use the turn by turn navigation feature. Drivers are increasingly relying on this and similar technology when they drive. Most rail crossing accidents are caused by driver inattention and error. With the new app, a driver who is focused on...
navigation instead of the road will now have an increased awareness of the railroad crossings.

**Conclusion**

The freight rail industry in America is extensive and innovative. In order to meet the needs of the growing urban population countrywide, companies are developing innovative ways of transporting more people and goods, faster, safer, and cheaper than previous generations. Federal and state R&D tax credits are available to support these innovative freight rail efforts.