[Bonus] AFD Ep 347 Links and Notes - Early US Rail Electrification (feat. Justin from WTYPP) - Recording Feb 2

- Book - "When The Steam Railroads Electrified" (1974, 2002 edition) by William D. Middleton
- Today's guest is Justin Roczniak from "Well There's Your Problem" (a colorful comedy podcast & slideshow series on engineering disasters) as well as the content creator behind the "donoteat01" YouTube series that uses the city-building simulator "Cities: Skylines" to talk about urban policy & urban history from a leftist perspective. We've referred to episodes of these shows on our show previously and I often will hear a passing sentence from Justin in one of his videos that inspires me to do a bunch of research to produce a whole episode or multiple episodes on some industrial history topic. For this episode, we needed to get someone with a scientific engineering background, a history interest, and a leftist worldview on the program, so Justin welcome to Arsenal For Democracy.
- Today we're climbing into our time machines and traveling to the far-distant technologically-advanced electro-steampunk futurism of the United States in the year 1938 and before – an era when this country was the global leader in electrification of railroads, when electricity-powered trains were running side by side with steam trains, and when companies would compete to brag in advertising to the general public about the wonders of their electrified train equipment. [cite Book title]
- It's important to emphasize that electrification of American railroads wasn't some kind of failure we had to walk back -- Book quote, p. 397: "In almost every instance, U.S. electrification was a huge success. Running times were reduced. Tonnage capacities were increased. Electric locomotives delivered transportation at much lower fuel costs. Electric locomotive maintenance costs were a fraction of those for steam power, their availability was two or three times greater, and their effective service lives promised to be twice as long as those of steam locomotives. In many cases, the savings resulting from electric operation were sufficient to repay the cost of electrification in as little as five years."
- **[Discussion about the early development]** The 1938 US peak was a century after the first experiments with electromagnetism in motive power and 59 years after the first successful demonstrations of electrified third-rail trains in 1879 in Germany and then again in 1880 in the US. Electrification of existing rail service began in 1885 in Baltimore. Initially the electrification focus was around urban street railways, but as early as 1887 in Pennsylvania a coal freight line was electrified. By the time of the Columbian Exposition in 1893, the same year as overhead wire rail service was beginning, General Electric was making grandiose proclamations (p.25) of the dawn of a thousand-year reign for electrified rail service.
- **[DISCUSSION ABOUT WHAT HAPPENED AFTER THE 1890s UNTIL THE LATE 1930s]**
- **Trust-Busting**: Did the halting of the **New Haven Railroad's** regional monopolization by Louis Brandeis and the federal government stop electrification that would otherwise have happened, or did the financial problems of the company related to its expensive mergers & acquisitions stop electrification? (see p.79 for description of NYNHHRR electrification plans -- the book seems to blame it on the debt load from mergers)
    - I remember in the late 90s when they finally extended electrification on Amtrak from New Haven CT to Boston, which had never previously happened because of the New Haven RR's problems in the early 20th century when it was working on electrifying that line. Those extra 156 route miles to Boston took 90 years to get done and that was one of maybe two expansions to rail electrification in the US between the late 1930s and the year 2000.

- **Pennsylvania RR:** Electrification was the key to unlocking capacity without building more trackage by speeding up trains on main lines and in switching yards and stations or by pulling longer trains. Pennsylvania Railroad electrification also ended up being one of the big private industry projects of the Great Depression (though they received federal assistance too).
    - They managed to put up some pretty blistering service speeds on their electrified trains especially with the GG1 locomotives in the mid-1930s. How fast were these electrified trains typically going almost a century ago compared to steam alternatives at the time and compared to typical trains today?
    - Setting aside electrification of urban streetcars and the effects that had on urban electrification for a different episode … One interesting point that the PRR proved on the US east coast was that rail electrification could by itself generate a huge amount of new business for power utility companies (p.318), which means they can expand their own operations and do more things. I think it was speculated at the time (but mostly never came to pass) that if the US had electrified railroads through much of its more rural areas it might have sped up the electrification for the general population in those regions.
    - If time, anecdote on the PRR *Federal* accident in 1953, which WTYPP did an episode on: *Despite the seriousness of the wreck of the Federal, passengers traveling in cars toward the back of the train were not all badly shaken up. The father of a friend of Bill's Dad, on his way to a business meeting in D.C. on this train, was surprised when informed later that it had crashed, as he had noticed only an unusually rough stop at Union Station.*
    - Also if time, the book mentions two freak engineering problems with the GG1 locomotive including tiny snowflakes and clouds of mayflies (p.338)
- **Freight electrification & mountain electrification:**
    - Northern Pacific looked to electrification of the Cascades both for its climbing power and its lack of smoke and heat in the long mountain tunnels, which almost asphyxiated train crews and passengers. By 1909, they had electrified a section. Once this was proven, it allowed them to build other electrified tunnels to save distance and climbing in the late 1920s.
    - Not long after, the Milwaukee Road at the beginning of the 20th century built a route over the Rocky Mountains and Cascades to connect their midwest core operations with west coast seaport access and they were interested in electrifying it, partly because of their ties to a copper mining interest that would stand to gain from all the copper needed for electrification (over 17 tons a mile; p. 217) and partly because the tractive power of electric locomotives would help with the mountains. Also they were less likely than steam engines to have cold weather problems (p.222). Electrification of the Milwaukee Road's mountain route began in the 1910s and the power companies they contracted with began significantly expanding capacity. There was a lot of testing with this and other projects on the possibilities of cycling back downhill braking force into tractive power, kind of like a hybrid car today.
        - After WW2, Milwaukee Road also ended up acquiring GE's "Little Joe" electric locomotives that were intended for sale to the USSR until the US government banned it for Cold War reasons (p.238 &: https://en.wikipedia.org/wiki/Little_Joe_(electric_locomotive)#Milwaukee_Road)
        - They never actually finished linking up Milwaukee Road's electrified sections, leaving a gap in Idaho served by more conventional means

    - Norfolk & Western electrified Appalachian rail routes beginning in the early 1910s. The improved speed and reduced need for locomotives with electrification over the mountains meant they were practically printing money relative to their old costs by the early 1920s. But after WW2, they tunneled to shorten the route and decided it was so much shorter and easier that they didn't need to electrify the new route, in contrast with what Northern Pacific had done a couple decades before in the west. In the 1960s, mergers made retaining electrified service through Appalachia even less desirable.
- Previously on your videos, you've talked about how the design of specific locomotives was often explicitly done with labor costs and hostility to unions in mind. For example, I think I recall you or your guests talking about how some steam locomotives were designed with an objective of not needing as large an operating crew or changing the boiler fuel shoveling design to try to break the fireman's union. **What were the Labor implications of electrification in the early days before dieselization?**
- **Science and the implications for the future of transportation, economically and ecologically --**
- In the first few decades of the 20th century, there was a lot of bold talk about how much rail electrification was just around the corner, but most of it never came to be. A 1936 Federal Power Commission report identified 20 railroads with some 12,000 miles of track that could be cost-effectively electrified. But electrification peaked in 1938 at 6,300 miles (p. 412).
- **P. 414: Lack of industry standardization on currents, voltages, equipment, catenary, third rail, etc. all inhibited electrification**
- P. 416: Although the cost savings for operations were huge after electrification, the upfront capital investments required to install electrification and buy new equipment was another huge hurdle. The Great Depression hit revenues hard enough that further electrification was dependent on federal government loans. The war also slowed things, despite big surges in freight traffic related to the war effort.
- P. 417: Postwar diesel-electric locomotives are basically electric trains except that the power is generated onboard with diesel fuel instead of remotely.
- Pp. 419-421: In the aftermath of WW2, it was assumed that widespread electrification would resume almost immediately and many projects were identified as possibilities, but none of them ever got built and the US was in 17th place in rail electrification by the early 1970s. The Soviet Union had almost 20 times more electrified rail mileage. After the war, there was not enough private capital flowing to these projects and the newly-proven diesel-electric technology seemed like a cheaper stepping stone to electrification at some future date.
- Pp. 421-422: Dieselization also allowed railroads to actually start rolling back previous electrification, especially in places where it had been undertaken to avoid the smoke from steam power rather than for financial reasons. Corporate mergers between companies where one was electrified and one was not generally led to taking away the electrified service in favor of standardization across the combined new systems.
- Pp. 424-428: The 1970s saw renewed interest in rail electrification between the rising traffic and the oil shock but by the time the studies were done at the start of the 1980s, the price pressures against diesel had subsided again, and nothing came of any of this.
- Here are some episodes of Justin's shows that we talked about today:
    - 1953 Federal Wreck: https://www.youtube.com/watch?v=38-MKEap0AQ
    - Print media: https://www.youtube.com/watch?v=qW48CIGuvZE
    - Septa trackless trolleys: https://www.youtube.com/watch?v=zcxezjtw1Ak
    - Steam locomotives and labor politics: https://www.youtube.com/watch?v=gifz9IcwrPs

- Hyperloop is bad: https://www.youtube.com/watch?v=4dn6ZVpJLxs
- Power Politics & Planning series episode 1: https://www.youtube.com/watch?v=0lvUByM-fZk