AFD Ep 422 - US Rural Electrification [Bill/Rachel] - Recording Apr 17, 2022

- Intro: This is our 3rd episode in a row on electrification in the United States. First we looked at the transition from electrochemical battery technology to electromagnetic power generators. Then we looked at urban electrification in the 1890s, tied in closely with streetcar electrification. The urban process happened almost overnight and then it spread to towns, but electrification kind of stalled in the most rural parts of the country for a few more decades. This was partly economics and partly technological. In the most rural areas, there was a low customer density, which posed financial hurdles, but also there were huge losses of power along transmission lines over long distances to serve those relatively few and far between potential customers). So this week we'll look at how the United States overcame that and then we'll compare that to the experience in a similar country in the same period.
- [Bill] Pre-New Deal:
    - Long-distance rail electrification (callback to episode 347, Feb 2021 leaning on "When The Steam Railroads Electrified" (1974, 2002 edition) by William D. Middleton): This era spanned the first decade of the 1900s through the 1930s. A 1936 Federal Power Commission report identified 20 railroads with some 12,000 miles of track that could be cost-effectively electrified. But US rail electrification peaked in 1938 at 6,300 miles. 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. We'll talk more about that era when we get to the New Deal in a few minutes.
    - Rural towns had by the end of the 1920s actually started to reach similar levels of proportional electrification as cities (i.e. around 90% of homes) because a modest local power plant could serve all the customers there in a compact area. The problem at this point really lay in the extremely rural and spread out smallholder farms and their lack of electricity access. High estimates put the rate of electrification at 10%. Other estimates put it far lower. By 1923, several years earlier, it was already clear to industry leaders and political leaders that American farms and their families would be measurably significantly more productive and happier if they had electricity access. But the private utilities estimated that the costs per mile might be as high as $2000 in contemporary money which would be tens of thousands per mile adjusted to 2020 inflation. There were simply no economies of scale and the retail electricity price to customers would be prohibitive as well.
    - [Rachel] https://www.cooperative.com/remagazine/articles/Pages/Flashbacks-The-First-Wind-Power-Boom.aspx (April 2017) *Between 1920 and 1935, farmers and ranchers purchased a million wind chargers—not the iconic windmills used since the 1850s to pump water for crops and livestock and still seen along rural back roads, but small, propeller-driven electricity generators.*
        - *The essential components were the propeller and tail, an attached generator, and wires leading indoors to a control panel and a battery.*
        - *The smallest wind chargers were ideal for charging radio batteries. At its peak, the Wincharger Corporation, the leading manufacturer, produced 2,000 of its 6-volt "DeLuxe" models each day at its factory in Sioux City, Iowa. The machines sold for $44 or, better yet, $15 when purchased with a Zenith radio and a 6-volt battery.*

        - *Another Iowa company, Parris-Dunn Corporation, made wind chargers ranging in size from 135 watts to 3,000 watts. Between 1934 and 1941, the company shipped 37,000 units to all 48 states and 93 foreign countries.*
        - *But none of this mechanical genius could stand up to the convenience and affordability of central-station power and the success that the federal Rural Electrification Administration had in making it available to farms, ranches, and small towns. Starting in the late 1930s, electric co-ops regularly lopped off county-size chunks of the wind-charger market, and this didn't let up until the early 1950s.*
- [Rachel] New Deal:
    - Callback to prior episode [#190 from Aug 2017] on FDR's 1932 campaign speeches against private power utilities… *I have spoken on several occasions of a "new deal" for the American people. I believe that the "new deal," as you and I know it, can be applied to a whole lot of things. It can be applied very definitely to the relationship between the electric utilities on the one side, and the consumer and the investor on the other.*
        - *True regulation is for the equal benefit of the consumer and the investor. The only man who will suffer from true regulation is the speculator, or the unscrupulous promoter who levies tribute equally from the man who buys the service and from the man who invests his savings in this great industry.*
        - ("Never shall the federal government part with its sovereignty or with its control of its power resources while I'm president of the United States." [Sept 21 1932 Portland OR speech])
        - *But these cold figures do not measure the human importance of the electric power in our present social order. Electricity is no longer a luxury. It is a definite necessity. It lights our homes, our places of work and our streets. It turns the wheels of most of our transportation and our factories. In our homes it serves not only for light, but it can become the willing servant of the family in countless ways. It can relieve the drudgery of the housewife and lift the great burden off the shoulders of the hardworking farmer. I say "can become" because we are most certainly backward in the use of electricity in our American homes and on our farms. In Canada the average home uses twice as much electric power per family as we do in the United States. What prevents our American people from taking full advantage of this great economic and human agency? The answer is simple. It is not because we lack undeveloped water power or unclaimed supplies of coal and oil. The reason is that we cannot take advantage of our own possibilities. The reason is frankly and definitely that many selfish interests in control of light and power industries have not been sufficiently far-sighted to establish rates low enough to encourage widespread public use.*
    - Executive Order 7037 / Rural Electrification Administration (May 1935): Full text https://en.wikisource.org/wiki/Executive_Order_7037 "To initiate, formulate, administer, and supervise a program of approved projects with respect to the generation, transmission, and distribution of electric energy in rural areas."
    - Rural Electrification Act of 1936 (May 1936) https://en.wikipedia.org/wiki/Rural_Electrification_Act
        - Texas Congressman and eventual US House Speaker Sam Rayburn, a New Dealer, was a champion of FDR's rural electrification initiatives and

said that the share of electrified farm homes in the US climbed from just 3% to 90% over the course of the 1930s, 40s, and 50s.

- Originally, *Congress set aside $100 million ($1.88 billion in 2020 dollars) for the new agency, enabling it to make loans to finance the construction of electricity generation and transmission to rural areas.* https://www.richmondfed.org/publications/research/econ_focus/2020/q1/economic_history The plan as first envisioned by Congress (not necessarily the FDR Administration with its natural skepticism verging on hostility to private utilities) was that the government would simply help private utilities with the funding and financing but it would still be a private endeavor. The Administration then imposed enough conditions on the proposed terms that most private utilities walked away from the table, clearing a path to do what FDR's people probably actually wanted to do all along, which was to structure the program like many other traditional agricultural region programs in the form of customer-owned and -governed local and regional co-ops to purchase power on the market and sell it to customers at prices as close to wholesale as possible, and also without deriving a profit margin. In 1930, as a benchmark comparison before the REA, there were only 33 power co-ops in the entire United States. The REA even distributed model legislation across the 48 states for legislatures to adopt authorizing and regulating such co-ops if they did not already have such a law on the books. Customers would pay a $5 fee to join the co-op. The REA also carefully structured the co-op arrangements so that any default on a federal loan (including to farm customers) would simply result in repossession of the electrical equipment and appliances with zero risk of the farm itself being seized. The co-ops themselves received very low-interest loans from the federal government to build their infrastructure out and the REA built a team of in-house engineering consultants to offer optimizations of grid design and implementation for specifically rural environments to get the most cost efficiencies possible. Generally the power that co-ops were buying actually came from existing private utility companies, who simply did not want to expand their distribution infrastructure, but the REA would finance brand-new co-op power generation if the private utilities refused to negotiate a fair contract with the co-ops.
    - As an aside, beginning in 1935, private power utilities had theoretically come under much more government regulation and mandatory reorganization, via the Wheeler-Rayburn Public Utility Holding Company Act of 1935, which broke up the power conglomerate holding companies into government-approved geographic monopolies where companies no longer competed for territory but also no longer operated everywhere as giant sprawling firms. That being said, these power conglomerates were still fighting this breakup policy tooth and nail in the courts at the time. https://en.wikipedia.org/wiki/Public_Utility_Holding_Company_Act_of_1935
- The REA didn't just build new power plants and put up transmission lines and grid connections but actually came to people's homes and installed basic wiring and light fixtures throughout houses and barns. This was partly a practical service, but also was meant to boost the demand per

farm to try to get a bit more economy of scale benefit to hooking up each individual small farm. The REA also offered low-interest financing for electrical appliances in farm homes, which few other countries in the world did as part of their rural electrification programs; this had the double effect of instantly boosting rural standards of living and again simply boosting the power demand per household to create more economies of scale. Small farmers were apparently willing to devote nearly a quarter of their annual incomes to electricity bills because of the benefits to their households and the productivity gains to the farm itself.
    - By the end of World War II, less than a decade after the Rural Electrification Act of 1936, half of American farms were electrified and the process of finishing electrifying the country took only about a quarter-century in all, from the mid-1930s. Less than 1% of all REA loans ended up in default.
- Tennessee Valley Authority https://en.wikipedia.org/wiki/Tennessee_Valley_Authority
    - Even before the Rural Electrification Administration and the comprehensive federal studies of the problem of rural electrification, FDR had come into office in the spring of 1933 with a ready-to-roll proposal for a government electrification and power production agency in the Tennessee River Valley that President Hoover had been blocking for years on ideological grounds. This was one of the poorest and most under-invested regions of the United States. While the TVA had many mandates on a range of rural matters, for this episode we will simply focus on the power projects, such as the hydroelectric dam construction that broke ground before 1933 had even come to a close. Between 1933 and 1942, 11 hydro power dams were built and enormous coal-fired steam turbine plants were also constructed, all of which proved critical for the war effort, both for materiel production and uranium enrichment. By the end of the war, the TVA was the largest electricity producing entity in the United States. Hydro remained its primary power source until 1955, when coal overtook it. (The TVA eventually also got into nuclear power a decade after that.) In 1966, the TVA began construction of its first nuclear power plant, Browns Ferry, in North Alabama.
    - The TVA Act gave the TVA the “power to acquire real estate for the construction of dams, reservoirs, transmission lines, power houses, and other structures, and navigation projects at any point along the Tennessee River, or any of its tributaries.” https://www.tva.com/about-tva/our-history/the-tva-act (lots of great pictures!)
    - Bad caveat: the TVA’s employment practices were quite racially exclusionary or hierarchical and women tended to be excluded as well
    - Norris Dam *required the displacement of more than 125,000 valley residents or roughly 15,000 families,[8] as well as some cemeteries and small towns, which caused some to oppose the projects, especially in rural areas.[9][25] The projects also inundated several Native American archaeological sites, and graves were reinterred at new locations, along with new tombstones.[26]*
- [Rachel] Post New Deal
    - The Rural Electrification Act of 1936 has been amended some 15 times beginning in the 1940s, eventually encompassing rural telephone, cable, and

internet service, which we will have to defer to another episode. https://en.wikipedia.org/wiki/Rural_Electrification_Act#Later_amendments However, because there are still almost 900 rural electric co-ops operating across the US, it is a model often floated for finally completing the long-stalled work of rural internet service provision that the private providers have endlessly dragged their heels on or produced the barest minimum levels of service well behind not only the rest of the country but much of the world. In 2018, during the Trump years remarkably enough, the FCC actually began offering financing to rural electric co-ops to become internet providers. https://www.richmondfed.org/publications/research/econ_focus/2020/q1/economic_history

- [Bill] Comparison to the Soviet Union in the same period
    - The United States of the early 20th century was not the only geographically massive agrarian economy with uneven population distribution trying to figure out how to electrify and modernize agriculture. The Communist Party in Soviet Russia and the USSR made country-wide electrification a major policy priority beginning in February 1920. The party leadership during the Civil War was already struggling immensely to bridge the cultural and economic divide between the Russian cities and the Russian countryside. Peasants who had supported the Communist Revolution for its promises of land reform didn't grasp why the central leadership wanted (and indeed needed) them to increase surplus grain production and yields, rather than engaging in autonomous subsistence farming, even as urban residents were on the brink of starvation because surplus grain was not being produced and delivered for the cities. Lenin said that electrification was critical to solving the problem, not just for its technological importance, but also for its political and economic implications in unifying the country: "...the organization of industry on the basis of modern, advanced technology, on electrification which will provide a link between town and country, will put an end to the division between town and country, will make it possible to raise the level of culture in the countryside and to overcome, even in the most remote corners of land, backwardness, ignorance, poverty, disease, and barbarism." In a December 1920 speech releasing the planning document, Lenin said "What we must now try is to convert every electric power station we build into a stronghold of enlightenment to be used to make the masses electricity-conscious, so to speak." Russia's steam railroads were also a disaster after World War I and the Russian Civil War, and in the cases where surplus grain was being produced, it often wasn't being moved to where it needed to go. Lenin again saw electrification as the solution by converting the entire Russian rail system to electric motive power, which was a transition under way in much of the United States by this point in the early 1920s. (See our Feb 2021 episode.) Lenin did not live to see Soviet rail electrification begin, but it did actually start in 1926, albeit fairly slowly and with significant assistance from General Electric in the US. Still, Lenin's dream of communist electrification was ambitious and got the ball rolling. Even the British science-fiction author H.G. Wells came away from a meeting with Lenin in 1920 feeling that his nationwide electrification vision was easily the least realistic and most utopian dream of the entire communist project in Russia, in no small part due to the massive geography and sparse population distributions. By 1934, Wells returned to the Soviet Union and admitted he was stunned by the progress being made on electrification. In 1913, the final year before World War I under Imperial Russia, the entire country had only created the capacity for 1.9 billion kWh of power generation as part of its ongoing state efforts to develop an urban

industrial base, and probably quite a bit of this was located in industrial zones that ended up outside the Soviet Union after the war. One of the many wartime negligences of the imperial government was a merely vague understanding of the state of crisis in the fledgling power sector and its negative effects in the war effort, and (as with every other logistical crisis) they did even less to fix it. In 1920, when the Communist plan launched, they could barely keep the lights on in Russian cities at all. By 1931, the USSR had developed 8.8 billion kWh of power capacity and by the following year had grown that again by another 50% to 13.5 billion kWh. In 1937, a year after the US Congress passed the Rural Electrification Act, the Soviet Union was now generating 36 billion kWh and added 12 billion more by 1940. All this power was developed out of the 1920 central planning – under the slogan "Communism is Soviet power plus the electrification of the whole country" – that envisioned 10 signature hydroelectric turbine power plants, various other types of regional power plants, and many other on-site power plants dedicated to major state enterprise factories. However, after Lenin's death, in many cases, the results diverged from the vision, by making electrification a supporting player to the overall push for industrial development, rather than a general goal with ordinary consumer benefits as a focus in its own right. This meant much of the power was quite consolidated and narrow in the pre-WWII period, largely focused on the biggest cities and the biggest factories. Notably, this was similar to the approach favored under the Tsarist regime, which just saw electrification as an industrial tool, not a social and political transformation. The main difference was that the Communist Party continued to keep the social and political goals in mind as something to get around to, which they eventually did. https://en.wikipedia.org/wiki/GOELRO https://www.jstor.org/stable/10.7591/j.ctt1g69x9s [Some of the info above is drawn from this book: "The Electrification of Russia, 1880-1926" by Jonathan Coopersmith, 1992, Cornell University Press – Chapters 6-8 but especially Chapter 8]

- Coda: In the aftermath of WW2, the Soviets eventually got back to work with electrification (later including nuclear power) and in the US it was also assumed that widespread railroad 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 by contrast had almost 20 times more electrified rail mileage by then. After the war, there was not enough private capital flowing to these American projects and the newly-proven diesel-electric technology seemed like a cheaper stepping stone to electrification at some future date. This never happened. The 1970s saw renewed interest in US 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.