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PAUL WARDE & MAGNUS LINDMARK

Heat in a Cold Climate

Household Energy Choices in the Scandinavian North, 1890–1970

ABSTRACT This article examines the timing, scale and cause of transitions between different kinds of household energy use and especially heating in northern Sweden, with a focus on Norrbotten, between the late nineteenth century and 1970. It examines the related but separate histories of the adoption of new heating technologies, such as stoves and boilers, and the choice of fuels, such as firewood, coke, oil, and electricity, providing new data on the scale of consumption and timing of transition. The article demonstrates the important linkage between domestic fuel choice and labour markets, whether labour in farm and forest affecting stove use in the nineteenth century, or increased female labour participation outside the home and rising wages in the twentieth. The article goes beyond discussions of price and technology to consider the wider contexts of domestic use not only in terms of home life, but also industrial development and labour markets in northern Sweden.

KEYWORDS energy, labour, heating, coal, oil, electricity, environment, Sweden, Norrbotten

This paper examines the development of household fuel use in northern Sweden, with a particular focus on household heating in the country's northernmost county, Norrbotten. In this article we focus the role of energy for households with an emphasis on how new forms of ener-

gy became available for the household and how this both changed the way domestic work was organized, but was also adopted according to norms of household labor. More widely, although domestic heating is recognized as a significant aspect of the experience of home life, comfort, and domestic practices, there is surprisingly little historical literature on the topic. Most of that which exists treats it as an incidental aspect of histories of domestic comfort, seeking to explain norms of behavior rather than fuel choices (e.g. Brewer 2000). In turn, “practice theory,” influenced by sociology and anthropology, has used historical exemplars primarily with an eye to current policy and as a means of illustrating how transitions in domestic heating cannot be reduced to decisions over price or the inevitable consequence of technological advance (e.g. Shove *et al.* [eds.] 2012; Shove & Trentmann [eds.] 2018; Rinkinen *et al.* [eds.] 2019). The purpose of this article is not to test any particular theory or to develop arguments for use in current policy-making (although they may be inferred). Rather it is to empirically reconstruct patterns of heating use to demonstrate the eclectic ways through which change can be understood. An important finding is to recognize that households’ experience of energy transitions cannot be separated from the developments that are taking place in larger energy systems, governed by the state and business. It is well known, for example, that the drive towards electrification in northern Sweden was in part driven by the desire for regional industrial development, but other sectors also provided important spillovers into the domestic energy market (Warde 2019). At the same time, change may be driven by shifts in non-energy markets such as labor which impact on domestic energy practices and desired services. We do not present a history of the *experience* of heating, which may well have been rather more diverse than narrow data on fuel use and heating standards suggests. This would certainly be a desirable avenue for future research.

I

Norrbottnen has always been a periphery with rich natural resources, long distances and comparatively poor conditions for agriculture. Its northern location causes a short growing season, and cold temperatures. The population density has always been low compared to the rest of the country. From an energy point of view, the county is, however, an interesting case of an energy system created around a nexus of heavy industry, private capital, state intervention and the ordinary household. The industrialization of the county only came with the second industrial revolution, characterized by a large-scale use of electrical technologies, probably unrivalled in a Swedish perspective. The region’s industrial structure has for long been significantly divided between a small number of very large capital- and energy-inten-

sive export industries, combined with a relatively weak small industrial and service sector. The whole northern region of Sweden had relatively small urban areas such as Luleå and Umeå, with populations in the low tens of thousands for much of the twentieth century. The net effect is that Norrbotten has had a less industrial occupational structure than Sweden as a whole, whilst being more industrial than other northern counties.

Table 1. Urbanisation in Northern Sweden and the whole country.

	Norrbotten	Västerbotten	Sweden
1810	5%	3%	9%
1850	5%	2%	10%
1890	8%	4%	19%
1930	12%	8%	33%
1950	18%	13%	47%
1960	21%	19%	52%
1967	39%	47%	55%

Norrbotten towns: Luleå, Boden, Piteå, Kiruna and Haparanda.
 Västerbotten towns: Umeå and Skellefteå. Source: SCB 1969: 61 ff.

Although the agricultural population peaked around 1930 and fell thereafter, the industrial workforce only overtook the agricultural during the 1950s (Enflo *et al.* 2014). Investments in the county's industry were therefore characterized from an early date by international industrial capital and government involvement.

The county bears several of the characteristics of a latecomer in terms of industrial development as proposed by Alexander Gerschenkron: heavy investments and a leading role played by the state as an organizer and provider of capital, followed by high growth rates based on modern technology (Gerschenkron 1962). At the same time, Norrbotten also had the characteristics of a staple economy as the concept was discussed by Harold Innis, with an infrastructure and industrial structure designed for exporting staples, rather than refining products for final consumption (Innis 1930). This was particularly characteristic of forestry products and the rich deposits of iron ore. Although a major steel and pulp and papermaking industry expanded rapidly after the Second World War, much production was orientated towards intermediary rather than final products. The county's economy grew rapidly in periods of major infrastructural investment and the opening up of resources to external markets, notably in the 1890s, 1920s, and from the

late 1940s to the early 1960s (Hansson 2006). This story will be traced up until the 1970s, when the response to the oil crisis saw the development of district heating as a main source of energy for urban communities, which had now come to dominate a population that subsequently stagnated, removing the choice of heating technology from a majority of domestic households (Summerton 1992; Kaiserfeld 2005; Söderholm 2018).

With this general background in mind, we will examine how the energy distribution and consumption of households in Northern Sweden was shaped by these circumstances. This perspective implies, of course, that industrial activities, the large-scale of organization of energy flows and decisions made by large players such as the state, big companies and municipalities, as well as actors in households themselves must be taken into account. It is also necessary to recognize that the Norrbotten case cannot be separated from developments in other parts of the country, a consequence of energy technologies being universally available and since energy networks were not only becoming increasingly national, but also international. Finally, the cold climate would itself tend to increase the household energy consumption. A measure of this effect are the so-called “heating degree days,” the sum of the number of days with temperatures below 15 °C, times the degrees below 15. Heating degree days are shown in Table 2.

Table 2. Mean heating degree days after region 1980–2010.

District	Mean monthly heating degree days 1980–2010	Per cent of Stockholm
Sweden	449	130
Stockholm	345	100
Central Norrland	469	136
Northern Norrland	542	157
Southern Sweden	300	87
Western Sweden	329	96

The data refers to spatial dimensions only and is not weighted by population. The Swedish average is therefore dominated by Northern Sweden. Source: Created with the Konema database.

The table shows that the heating days in northern Norrland, which comprises Norrbotten, exceeds Stockholm by 57 per cent. This means that the basic household energy requirements were likely to be considerably higher in the north compared to the south, although as we will see that did not straightforwardly lead to higher fuel consumption.

II

Right up until the 1940s, wood provided the largest source of energy (measured simply by heat content) in Norrbotten (Warde 2019). During the nineteenth century household energy consumption was of a traditional kind, i.e. open stoves which after 1870 came to be replaced more and more by iron stoves. The wood barns for the larger farms give some idea of the wood consumption, which was probably around 20–40 cubic metres per year for larger households at big farms (see Fig. 1).



Fig. 1. Wood barn from a nineteenth-century Norrbotten farm at Hägnan out-door museum, Luleå (2004). Photo: Magnus Lindmark.

This is confirmed in surveys taken in different parts of northern Sweden between 1905 and the early 1950s (Ödman 1920; SOU 1924:42: 9–10; SOU 1948:32; SOU 1954:24). Normal practice was that the wood barn was large enough to accommodate two years of use. Recently-felled firewood dried on one side of the barn, while the other side was used for the present year's consumption. However investigations in the 1920s showed that the moisture content of firewood was still quite high, much higher than kiln-dried wood, and hence a proportion of the heat from combustion in the fireplace would have been lost to driving out that remaining moisture to make the

wood flammable. Birch was the preferred tree species, but this was partly determined by availability (SOU 1924:42: 26). It should be noted that the relatively slim dimensions of domestic firewood and the fact that birch was prioritized, meant that there was no competitive relationship with either charcoal for industrial use, which was made from small to medium dimension pine, nor the sawmill timber comprising old-grown and very large spruce. It may also be noticed that an important on-farm use of heat was boiling fodder for the livestock during the winter season to improve nutritional uptake. This practice is well known from several sources, while more detailed information was found in a most unexpected source material, children's stories from the early 1950s describing the history of their local communities. With fodder running out around April to mid-May, spruce branches and lichen were collected and chopped into small pieces. Subsequently, hot water was poured over them and after soaking for a couple of hours it was fed to the cows.¹

As late as the 1950s rural farm households overwhelmingly supplied firewood for themselves, in over 80 per cent of smallholdings with up to two hectares of arable, and universally in farms with over 10 hectares of cultivated land (SOU 1954:24). The children's stories also tell us that it was common to cut dry wood (Swedish *torrfuror*) for firewood in "the old days."² The practice was, according to one of the stories, that the firewood was collected during the winter, and that one man with a horse could bring home one big load of dry firewood in a day. The most common wood was pine. Dry spruce was used if a very high temperature was needed, for example when the so-called *rieska* bread was baked. Spruce was, however, never used in the open stove as it sparked extensively. Sometimes the timber for firewood was cut in spring. Here, we also learn about the superstition that wood should be cut at new moon, as such fuel was believed to dry better. When wood was cut in the spring it was called *baato*. When the autumn came, the trees were de-limbed (Swedish *kvistade*) and stacked in the forest. The firewood was only brought home during the winter.

A total fuel consumption of approximately 3.44 solid cubic metres per person per year was proposed in a survey concerning of 666 farm households in Värmland, a more southerly part of northern Sweden in the early 1920s, although this figure was a little higher in the colder parts of that region (SOU 1924:42: 28). The authors of the report thought that this was as much to do with the easier availability of wood in the north as the colder climate. The first survey of farms was not taken in Norrbotten until 1944, aiming to reconstruct pre-war levels of wood consumption. Although the sample for the whole of Norrland was 646, for the Norrbotten it was only 217 (SOU 1948:32). This provided an estimate of 7.65 cubic metres of stacked wood

per capita, which equates to around 5 cubic metres of solid wood—similar to that found for the larger and northernmost farms in Värmland in the 1920s. Consumption was higher inland, and it was suggested that this was the result of limited markets for labor, which was hence channeled into wood cutting. Later estimates for 1936, when coke probably still made up no more than 10 per cent of the market, reckoned that household consumption of firewood was around 6 cubic metres per person. These however derive from a rather uncertain origin in the estimates of “industry experts” in 1939 (SOU 1951:32). During the First World War authorities agreed in 1917 that 5 cubic metres per person was the amount required to cover essential household fuel needs in Norrbotten (SOU 1922:14: 209). If consumption had changed or not before these dates is very difficult to determine due to a lack of archival material, but the lack of information is itself perhaps an indication that firewood was not scarce. Customary law made it clear that farmers were free to log for household requirements even on forests owned by the Crown.³ Generalizing, one could say that the cost for firewood was the opportunity cost of labor. If one has ever attempted to fell a birch tree with a hand saw, split the log with a wedge, cut it to smaller pieces and then split the pieces again with an axe, one knows that it involves heavy work that most people would gladly avoid. The question is then if there was an alternative use of labor during the winter months or not. Dan Bäcklund claimed that there were alternative uses for labor and various jobs being done also during the winter, while Nils Gustav Lundgren argued that the winter was largely a period of idleness (Bäcklund 1988; Lundgren 1984).

The early industrialization of Norrbotten from the 1870s had implications for the use of domestic energy, not through new infrastructures for energy, but through new technologies and practices within the household. Chief among these was the iron stove, replacing older hearths or tile stoves. Our argument is that the rural economics of firewood changed as the sawmills’ demand for timber gave rise to a wage labor market for loggers in the late nineteenth century. At this time the rural population of Norrbotten was also expanding rapidly, with households combining a mix of agricultural work on small plots with forestry. Farm horses were also an essential element of forestry work for the removal of timber to water for log drives, and remained so until after the Second World War. The expanding wage labor market increased the opportunity cost for firewood. At the same time, rising incomes, in conjunction with falling iron prices made iron stoves more affordable. Still, it is worthy of note that a traditional open stove was a rather expensive piece of equipment but that the iron stove required new sets of pans and pots. This would have created an incentive to economize on firewood and, probably, the best way to do so was to invest in an iron

kitchen stove, since the iron stoves had a higher thermal efficiency than the traditional fireplaces.⁴

Nevertheless, this explanation for the timing of the dissemination of the stove remains informed guesswork and deductive reasoning. We do not know, for instance, to what degree the better thermal efficiency was used for saving wood or for creating a more pleasant indoor temperature, let alone creating a more comfortable working environment for women in the household. However warmth throughout the house did come to matter to women. A survey taken by Gallup of rural married women in 1943 as to the two changes that would most improve the quality of their lives, central heating ranked second after piped water and sewage disposal, with 24 per cent of respondents naming it (SOU 1947:46: 103). This was far ahead of other options, especially electric light and holidays which were named by only one per cent! Evidence based on interviews and oral history testimony points to the impact of the stove on everyday life as having been important (Sixtensson 2001).

The iron stove produced much more heat and one informant, interviewed in the 1950s about conditions around the turn of the century, noted:

the heat from the iron stove was several times more than open stoves, and the people started to mount double glazing, so that the ice disappeared from the window glass at winter.

The iron stove also burned wood at a slower rate than the open stove, heating the iron itself from which heat radiated. This also meant that much less oxygen was consumed, which during winter led rooms other than the kitchen to actually become colder, as the chimney lowered the air pressure in the whole building, causing outdoor air to be sucked into the house. It is worth noting that the iron stove came first, *followed* by insulation to utilize heat that with earlier types of stoves would have gone up the chimney. The much smaller air intake of the new stoves also meant that less air was sucked into the chimney. This informant continued that

the iron stoves were so hot so that the people started to walk around indoors more or less half dressed. And they tore down and threw away the bed-cabin and stated to sleep on the coach and in the imperial bed as the upper class. And the women had clean hands all day although they made fire and prepared the food. (Sixtensson 2001)

This statement tells us that there was indeed a considerable improvement in indoor temperature, and that the common practice before the iron stove must have been to wear “outdoor clothes” inside the house. Evidence on

this question is however rare and further research as to the impact of such change highly desirable. Furthermore, the bed-cabins, typical of northern Sweden, a bed design with closable doors, was abandoned. These beds have been identified as a means to conserve heat, but at the cost of facilitating the spread of contagious disease and providing literally a hotbed for lice. Obviously, the clean hands refer to soot and ashes, but also again points at the iron stove as a tool used primarily by women. The informant (in their particular style and dialect) noted,

And afraid of soot should the women now became. They became almost like the gentleman's house maid, when they slammed the iron stove shutter and baked bread and pastry. Yes, the iron stove showed for everyone who visited what kind of women that were in the household. (Sixtensson 2001)

These statements are more suggestive of an income effect than a fuel-saving aspect behind the spread of the iron stove. Furthermore the informant suggests that the final stages of the preparation of the firewood, for which smaller pieces were used in the iron stove, was work for boys, not men.

Many were the boys who sniffled and cried when they were forced to saw and split the firewood, when the bow saw was blunt and the birch wood was twisted like some kind of screw and too big and tough for the axe and full of large twigs. (Sixtensson 2001)

Although we cannot be sure how the total household energy consumption was affected, this suggests caution in the assumption often made in modelling that firewood consumption was higher the further one goes back in time because of the efficiency gains from improved models of stove.

We can however be certain that the introduction of the iron stove in northern Swedish households was directly related to an increased importance of paid work through attaining the capacity to purchase them. Nils Gustav Lundgren estimated that income from logging corresponded to at least 100 working days per year for a normal inland household at the turn of the century (Lundgren 1984). As income rose stoves became more affordable, at the same time it is likely, as we argued above, that the opportunity costs for domestic provision of firewood rose. It is also likely that this altered the opportunity cost of women's work. As argued by Dan Bäcklund, marginal activities at the farm, such as "outland farming," including harvesting of natural grown grass on mires, disappeared as paid forest work became more common (Bäcklund 1988). In short, Bäcklund argues that women's unpaid

domestic work became even harder, as men gave up some of the work at the farm for paid logging work. The female labor that could be saved with an iron stove may have been a motive for this investment. Without doubt, the iron stove provided additional utility in the form of an improved indoor environment and more comfortable women's work. It is therefore not surprising to find statements indicating that the iron stove was a marker of status among women. However Ruth Schwartz Cowan has argued that in America, the development of better stoves may have saved work for men, who spent less time cutting firewood, but increased expectations and hence the labor of cooking and cleanliness for women (Cowan 1984). It may have been the nature rather than the hours of female labor that changed.

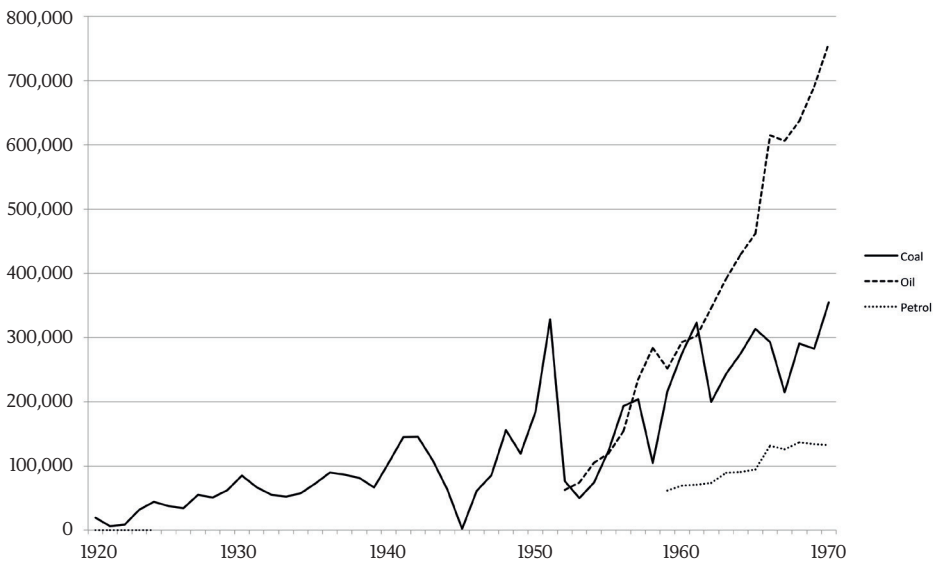
III

The first wave of change in domestic energy use in Norrbotten was related to the first industrial revolution, both in the provision of cheap iron and demand for forestry products. The use of wood fuel remained significant until after the Second World War, assisted by the scarcity of coal supplies during and in the immediate aftermath of the war.

But despite the dominance of firewood, there was a major expansion of coal imports (usually in the form of coke) from a minimal level in the early 1920s to reaching a third of Norrbotten's energy requirements by end of the 1940s (SOS Sjöfart 1911–1988). The small amount of coal arriving around 1900 was largely landed at Luleå and used by the iron industry or at Sunderbyn's brickworks (BiSOS 1900; Bergsten 2004: 100–111). Although some coal was used for metal-smelting, it remains a mystery—or at least a matter for investigation—where exactly the tens of thousands of tons arriving each year by the 1920s were used (see Fig. 2). When the Hushållningsällskapet investigated installed boilers in Norrbotten with a consumption of more than 500 hectolitres in 1932, no less than 82 boilers were reported in Luleå. These consumed reportedly 38,000 hl (c. 2,200 tons) of coke. The consumption by the boilers for which the specific annual consumption was not stated, we estimated at an additional 9,000 hl. We estimate the total consumption in Piteå at 3,600 hl, Boden 8,550 hl, Övertorneå 705 hl and Haparanda 3,900 hl, making for a grand total of 3,200 tons of coke for the purpose of space heating in larger buildings in these towns (AN: Enskilda arkiv 20 F5:4).⁵ It is likely that only Luleå had extensive use outside of public and commercial dwellings, as only around a quarter of the users fell into this category (presumably apartment blocks). Later estimates were that 22,000 tons of coke were used as household fuel in Norrbotten in 1936, a year in which nearly 90,000 tons of coal and coke were landed in ports from Skellefteå to Haparanda (SOU 1951:32; SOS Sjöfart 1911–1988). Many of the region's steam

engines were fueled with offcuts and waste from forestry, and the railways remained a mix of electrified line (going east-west and carrying ore from Kiruna and Gällivare) and steam (branch lines and the north-south route towards Stockholm). It seems likely that coal imports, that had long been the case in Sweden, were encouraged by their use as ballast in ships that were freighting timbers and iron ore, a spillover effect. This was especially the case in 1915, when 0.85 million tons of coal were offloaded in Luleå by German vessels seeking ore for the war effort. Anomalous years like this aside, the evidence is consistent with—but we can say no more than that—domestic coal use following roughly the same trend as imports to the region.

Fig. 2. Fossil fuels landed at ports from Skellefteå to Haparanda, 1920–1970 (tons).

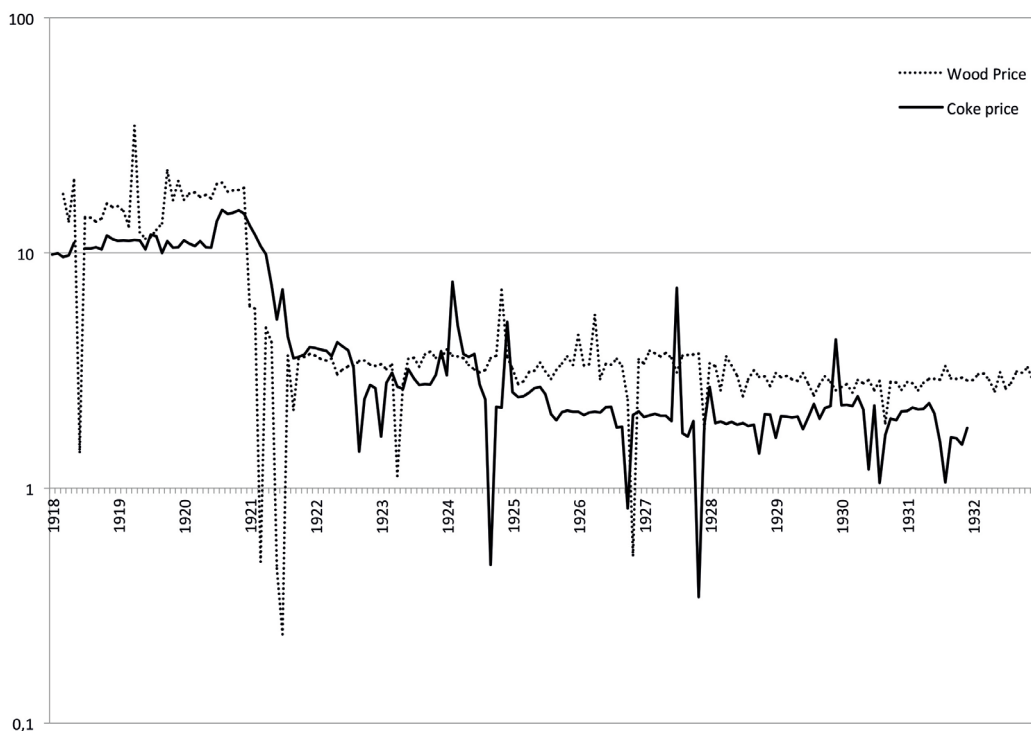


The graph includes fuel for all uses, not only households. From c. 1950 the great majority of coal and coke was for industrial use. Oil data is only recorded from 1952. Source: SOS Sjöfart 1911–1988.

Direct evidence of domestic coke use remains difficult to obtain. From the early 1920s, by which time coke was already the dominant household fuel in Stockholm, industrial censuses recorded fuel use, albeit rather unreliably (SOU 1922:56: 14). As these incorporated commercial premises such as newspaper offices and printers, cafés, bakers or butchers it is possible to see what the typical fuels for heating were. In 1925, twenty businesses in Luleå

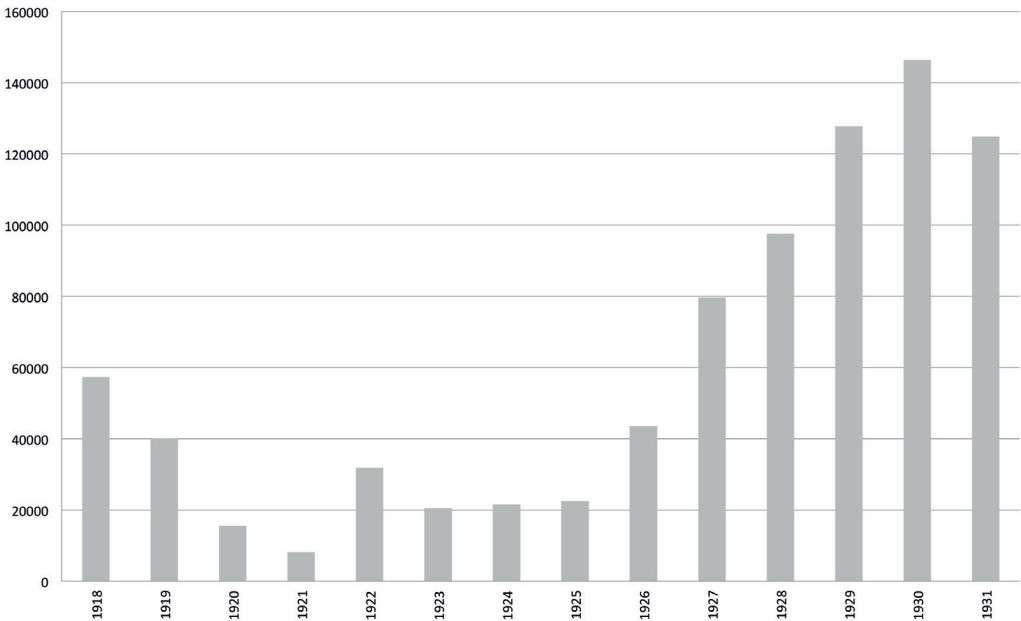
recorded fuel use, but only 7 listed coke or coal. By 1935, 25 businesses listed fuel consumption (out of 38), but only 10 recorded using coal or coke. The fuel economy, as is so often found, was mixed, but this result is still somewhat surprising (AN: Nbm 613 H:1–4). The account books of coal and fuel merchants show a clear price advantage for coke from 1925, presented in Fig. 3. This is matched in the quantities of fuel sold; before the middle of the decade most months saw greater sales of firewood from Luleå's main coal and building merchants, but after this date coke was dominant (see Fig. 4). These only provide a sample of the total number of consumers, but are indicative in terms of the scale and frequency of household purchases. By the late 1920s the company was selling over 10,000 tons of coke and coal each year, largely to household consumers, and must have dominated the Luleå market (AN: SE 534//1/G4–5).

Fig. 3. Average monthly price of wood and coke by estimated heating value sold by Luleå Kol & Materialaffär, 1918–1933 (SEK per hectolitre coke equivalent, log scale).



The wood series is a weighted average of birch and pine sales. The wood series has been adjusted to the heating equivalent in coke as estimated at the time. Source: AN: SE 534//1/G4–5.

Fig. 4. Annual sales of coal and coke from “Special account” of Luleå Kol & Materialaffär, 1918–1931 (hectolitres).



The “Special account” provides the most complete series of monthly data and made up the majority, but not all, of the company’s sales. Source: AN: SE 534//1/G4–5.

By 1932 the scale of market penetration by coke was sufficient that the county government commissioned a study of relative fuel costs because of fears that it would supplant firewood and prevent the possible expansion of local forestry. This may have followed debates in the Parliament and national interest on the same question since 1930 (AN: Enskilda arkiv 20 F5.4). The study’s conclusions draw our attention again to the significance of labor costs in choosing fuel. Officials checked the fuel use and boilers in a range of municipal offices, schools, banks, post offices, and commercial premises, and found coke use to be very widespread (often, again, in combination with firewood). The market prices for firewood and coke were by that date reckoned to be equivalent, regarding heat content (this may have been true more widely in the coastal region, but our own data suggests that in Luleå itself coke was already cheaper). Most boilers however could only take short pieces of wood, while coke could be shoveled in easily. Providing wood of suitable dimensions for the boilers required both higher processing costs in the forest, and also greater costs in transport and distribution. At the

same time, the volume of wood that could be fed into a boiler, and its lower energy density, meant that each fire lasted considerably less time than was the case with coke—according to the report, only around a quarter. The efficiency of wood-burning could vary considerably according to the type and moisture content of the wood.⁶ A wood fire needed considerably more labor and monitoring, and in some places, finding space for wood stores was a problem. This is indicated by a document of the Luleå Tenants' Association of 1946, which reckoned heating hot water for an apartment with a bathroom to require 6 cubic metres of *pannved* (wood for boilers), or 18 hectolitres (1.8 m³) of coke (AN: Enskilda arkiv 451.EV).

The county administration's study spent a considerable amount of time calculating, given the costs of tending the fire, the price to which firewood would have to fall to be competitive with coke in boilers of particular sizes. As it stood, the use of central heating in larger buildings or apartment blocks therefore favored coke. As shown in Table 3, the share of urban households dwelling in apartments with central heating was highest in Luleå and Boden in 1920, with around 5 and 8 per cent respectively, as compared to the national average around 4 per cent

Table 3. Share of apartments with certain amenities 1920.

Share of apartments with:	Bath	Central heating	Gas	Electricity
Luleå	3.4%	5.4%	0.0%	84%
Boden	1.6%	8.1%	0.0%	82%
Kiruna	1.1%	3.2%	0.0%	83%
Malmberget	0.6%	2.3%	0.0%	93%
All Swedish towns	4.2%	4.3%	31.6%	78%

Source: Kungl. Socialstyrelsen 1949.

The share of apartments with central heating was lower in the mining towns of Kiruna and Malmberget. This share had already risen to 40 per cent in Luleå by 1933, and 61 per cent by 1939, a similar share in Boden and above 30 per cent in Kiruna and Malmberget (Kungl. Socialstyrelsen 1949; Kungl. Socialstyrelsen 1952). Most northern towns expanded rapidly from the 1920s, but Kiruna had much of its housing stock completed by 1930, probably accounting for its slower expansion of amenities. Much of Boden's housing was built between 1936 and 1945 (Kungl. Socialstyrelsen 1952: 36–38, 211). However, construction of new dwellings cannot explain these trends entirely, as the rate of growth in central heating provision ex-

ceeded the provision of new housing stock and thus must involved some retro-fitting. In turn, this development has provided a major incentive towards switching fuel. What remained notable about Norrbotten was the absence of gasworks. By the 1940s this meant that every other urban residence in Norrland had an electric cooker, used at least in the summer, and in Norrbotten the proportion was probably higher. But a 1939 report still pointed to a “general lack of labour-saving devices for heating, water and waste” as a defining difference between rural and urban dwellings (SOU 1939:6: 76; SOU 1948:32).

By this time the beginnings of electrification, connected to the second industrial revolution, was already decades in the past. Norrbotten had in some regards been in the very forefront of this, even in an international perspective. In retrospect it is, however, clear that two energy and infrastructural systems developed in parallel: one large-scale system formed by the needs of the mining industry, and one being shaped by the more modest requirements of households. Still, the households in Norrbotten initially held an advantage in comparison to the rest of the country concerning the diffusion of electricity.

In the wake of the new ironmaking technologies of the late nineteenth century it became feasible to extract the phosphorous ores from the huge and rich orefields of Gällivare and Kiruna. However this would require transport links via either Luleå on the Gulf of Bothnia, or Narvik on the Norwegian coast. The major investment to achieve this came from the Swedish consortium Luossavaara-Kiirunavaara AB (LKAB) which was formed in 1890 for exploration and mining around Kiruna. Investments by the Swedish state would have an enormous influence on the fortune of the mines, in the long-run leading to the iron and steel sector being by far the most significant single industry in the region. The aspiration to develop the ore fields and industry more generally would also result in infrastructural development with major implications for the household use of energy. A large military installation was built at Boden to protect the ore fields from invasion from the east and in 1898 parliamentary agreement was reached in Sweden and Norway to extend the Gällivare–Kiruna railway to the west coast. In 1904, the large central Swedish mining company Grängesberg (TGO) became the main owner of both LKAB and AB Gällivare Malmfält, while at the same time a political dispute emerged between liberals and conservatives on whether the mines should be nationalized. After the conservative victory in the 1906 parliamentary election, it was decided, as a compromise, that half of LKAB's shares should be purchased by the state. Norrbotten's industrialization process was from an early date based on heavy investment, supported by nationalist ideas and optimism about profits, which equally applied to

the energy system (Hansson 2006; Viklund 2012).

The difficulty and expense of transporting loads on the “ore railway” and especially the Kiruna–Narvik line, along with difficulties in operating steam engines in the extreme Arctic conditions, lead to major investment in electrification of the railway and provision of power. This was achieved by the state-sponsored construction of the Porjus dam on Luleälven, completed in 1914 (Hansson 1994). At 55 MW this was then one of the largest hydropower projects in Sweden. The power plant was deliberately oversized to provide a basis for other industrial establishments in the area. Here we see another trait in the industrial development in Norrbotten, namely an active industrial policy, which would also be decisive both in the 1940s and 1970s. Roine Viklund has shown how the electrification of the railroad was part of wider nationalist industrial policy (Viklund 2012). The project made great demands on technological development, including the development of transmission lines and powerful electrical locomotives.

In the case of electrification, it is also important to remember that there were two parallel processes. At the same time as the Porjus plant was built, a number of smaller power plants for local power supply for lighting purposes were launched on municipal, private and co-operative initiative. Many were converted water mills equipped with a generator for local electricity supply. Porjus accounted for 88 per cent of the total installed hydroelectric power around 1923. About 10 per cent of the total electricity production was then based on steam in thermal plant. Staffan Hansson has called Porjus and the associated distribution system “Norrbotten’s mega system,” fully adapted to the needs of the mining industry. The established towns’ electricity supply was generally based on significantly smaller plants, but the towns that grew rapidly to provide a workforce for the mines, notably at Kiruna, were connected to the “mega system.” Concerted efforts at rationalization were led by the county government at the end of the 1910s to integrate local providers into the larger regional grid, and by the 1920s Norrbotten had a much greater presence of electrical motors than other regions of northern Scandinavia (Hansson 1991; Warde 2019).

Norrbotten’s households seem to have benefited from the early industrial electrification as the share of households with electrical light was somewhat higher in Norrbotten than in the country as a whole, as figures for 1920 previously shown in Table 3 reveal. By the end of the Second World War 99 percent of dwellings in urban Sweden were electrified (that is, had electric lighting), but coastal regions of Norrbotten were among the best connected rural regions nationally, also reaching around 99 percent. More remote inland areas had reached 85 percent, reaching 96 percent by 1950 (SOU 1947:3: 76; SOU 1951:32: 14). In combination with the increasingly

widespread installation of central heating, this made it easier to use multiple rooms in the house simultaneously and easily move between them, making in turn reliance on a central boiler more desirable. Such standards had also become the norm in the construction of especially urban housing. Indeed a report of 1947 articulated the expectation that the great majority of urban residences built after 1919 would have central heating (SOU 1947:3: 59).

IV

In the late 1940s domestic energy use remained very much a mixed energy regime. Firewood was still prevalent as we have seen, with many, especially rural households being dependent on the iron stove fueled with wood, as they had been for decades. In towns, stoves fueled by wood or coke provided both space heating and heat for cooking, although use of electrical hobs was becoming more widespread. By 1947 there was an electric cooker for every 3.5 inhabitants in 9 surveyed towns in northern Sweden, suggesting that they were now present in nearly every dwelling. Approximately a quarter of rural dwellings in the four northern counties (Norrländ) of Sweden had electric cookers (SOU 1947:3; SOU 1948:32). The greater prevalence of coal and coke in cities was probably driven by availability associated with its use as ballast and demand from locomotives and steam engines, although elec-



Fig. 5. Coke deliveries by A. Johnson & Co to apartments with central heating in Luleå, 1954. Photo: Espling Rune. Source: Luleå kommuns historiska bildarkiv.

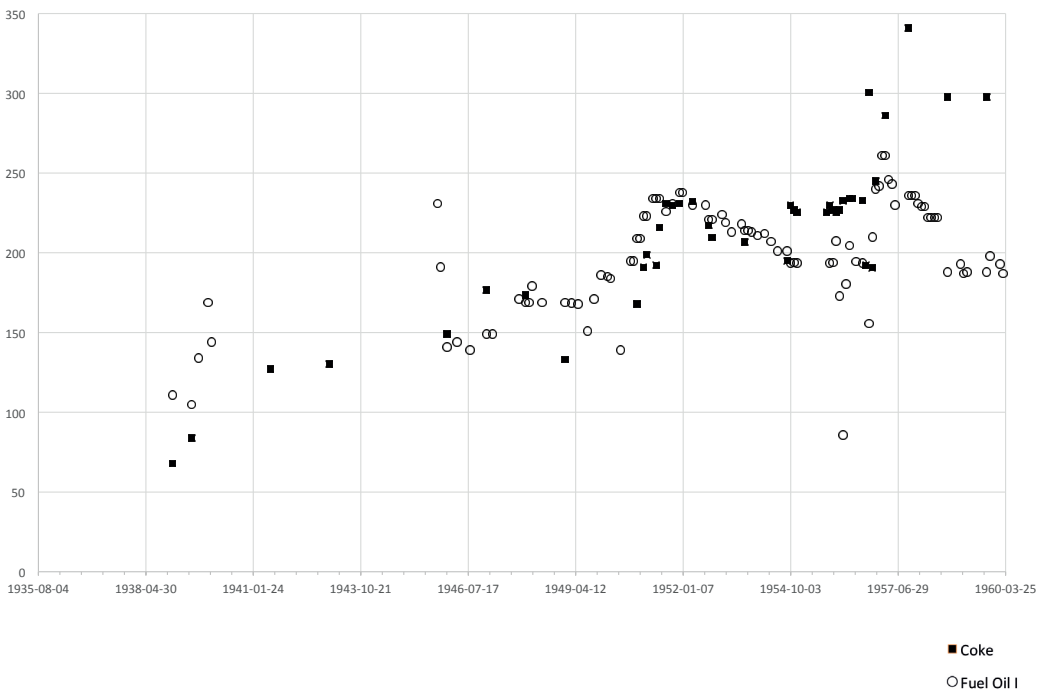
trical motors were the major source of stationary power. Given that purchases from coal merchants suggest that roughly 1.5 tons of coke (25 hectolitres) were consumed per household annually, this would have sufficed for 10,000 households if all the coke had been used for these purposes.⁷ Calculations by the Luleå Tenants' Association at this time of fuel use in a typical apartment block with 20 apartments and 4 shops came to 49 hl per unit, or around 3 tons of coke, 22 per cent of which was used for hot water and the rest for heating (Fig. 5).⁸ This in turn suggests that most households purchasing coke were not in fact using it as their sole fuel but mixing it with others, probably wood. However it may also have been the case that centralized boilers in apartment blocks were run for longer. In some blocks heating was arranged centrally, but in others individually by each tenant, indicating that they must also have had separate boilers. The transition to fossil fuel is sometimes observable in tenant contracts and purchases, as with a tenant's contract from 1921 that stated that, "to the apartment belongs space in the wood barn." However, by 1932, this property saw 417 SEK spent on coke and coal, but only 85 on firewood.⁹

However during the 1950s coke virtually disappeared as a household fuel in Sweden. This was a national trend, and the revolution also impacted the north, as all older fuels were replaced by oil (SOU 1957:4: 12, 19). Low oil prices after the war are a central part of this story. Falling prices were clearly seen by the oil industry itself as the main reason for the expansion of demand (SOU 1957:4: 13). Between 1952 (when navigation statistics first distinguish between fuel oil and other oil products) and 1960 oil imports rose fivefold in Norrbotten and tenfold by 1970 (SCB Sjöfart 1911–1988). Nevertheless, there are other aspects to this story aside from price. First, the ongoing electrification had supported the diffusion of electrical household equipment. Electric stoves increased at the expense of both the iron and the gas stove. As demand for gas dropped it was no longer profitable to produce the main by-product, namely coke whose supply began to fall nationally. By 1954 it is clear that the landing of coal in Norrbotten was predominantly directed to the NJA steelworks in Luleå. In 1955, NJA consumed around 190,000 tons of coke (Jonsson 1987: 276). By the late 1950s, the coal merchant Larson & Lind continued to sell between 1,000 and 2,000 tons each year to industrial users and steamships, but the household market had largely disappeared although apartment blocks still used small amounts of coke at this date (AN: Enskilda arkiv 17 AB Larson & Lind, 17 January 1963).

This transition is visible in business activity. Coke and coal merchants such as Larson & Lind and the Luleå Kol & Materialaffär also provided building materials or dealt with shipping, selling fuel inland to the consumer or property associations of Kiruna. They dealt generally with heavy material

arriving at the town’s wharves. Surviving account books suggest that domestic sales were geographically limited (AN: Enskilda arkiv 17 Larson & Lind G3; AN: SE/534//1/G4–6). But fuel suppliers large enough to be listed in the telephone books of the 1940s were restricted to Kiruna and Malmberget, and came in the category “wood and coal” rather than “coke and coal.” Inland in smaller settlements it is likely that households either self-supplied or could easily purchase firewood. By 1953, a rapid change was underway. Although more coal merchants in Haparanda and Kalix were now advertising in the telephone book, fewer businesses marketed firewood, and we can find firms selling heating oil equipment (including in Haparanda). Oil suppliers were however identical to the owners of petrol stations that had already proliferated throughout the region. Only a year later, the number of retailers advertising oil-burners leapt upwards, although many were still actually based in southern cities like Gothenburg. By the early 1960s, as well as coke merchants and petrol stations supplying heating oil, oil-burning equipment

Fig. 6. Price of coke and Fuel Oil No. 1 in Luleå, 1939–1961 (m³ oil equivalent).



Each marker denotes the price of a purchase by the Luleå Tenants’ Association or the Gradin family for their apartment blocks. Coke price has been set at the contemporary equivalent of heat content for a cubic metre of fuel oil, where 28.9 hectoliters of coke are reckoned to be equivalent to 1 cubic metre of oil. Sources: AN: Enskilda arkiv 451:1 E5; Enskilda arkiv 609, Bränslekostnader.

could be installed by a range of heating engineers based in the region's larger settlements: Kiruna, Kalix, Piteå, Boden, Haparanda, Gällivare, and of course Luleå, as well as southern suppliers being active.¹⁰

Fig. 6 shows price evidence from the tenants' association in Luleå. Seen purely in terms of the cost of the heat content, coke and fuel oil had roughly reached parity by the autumn of 1951, and oil become markedly cheaper from the autumn of 1955, the latter change driven by the rising price of coke. Even the oil price spike of the Suez crisis did not dent its price advantage. In between these dates there was no clear advantage, although oil was slightly more expensive, demonstrating that there was more to the transition already under way than just the contemporary market price. By the early 1960s, fuel oil was 20–25 per cent cheaper in nominal prices than had been a decade earlier, so home heating was becoming considerably cheaper in real terms.



Fig. 7. Oil cisterns in Luleå, Pontushammen, 1930s. Photo: Gustaf Holmström. Source: Luleå kommuns historiska bildarkiv.

Of course, in the countryside where four-fifths of the population still lived, things were different. Generally, the premium of fossil fuels over the Luleå price in nearby towns was low—no more than 5–7 per cent for fuel oil in the early 1960s in Boden, Piteå or Kalix, for example. However in more remote settlements, like Pajala, Vittangi or Arjeplog the premium was much higher,

at 20 per cent, and doubtless higher still at earlier dates when oil's penetration into the domestic market was not yet underway. In contrast, the price of firewood, driven largely by labor, was much less variable generally being within 5–10 per cent of the Luleå price if purchased on the market. Unless one had access to cheap firewood as a by-product of another activity, coke and oil were already cheaper fuels in the coastal region at the beginning of the 1950s, but far inland a price advantage for oil was probably established later in the decade. By the early 1960s, it was the cheapest fuel by far nearly everywhere (AN: Enskilda arkiv 20:1 F5:4).¹¹

Boilers used for residential heating could just as easily be fired with wood or coke. The Gradin family, who owned an apartment block on Storgatan in central Luleå built in the 1930s, had been pioneers in installing an oil-fired boiler for central heating but later in that decade added a wood kiln to this equipment as oil became increasingly expensive and hard to obtain during the war. Later in the 1940s this could be used to burn coke, which continued to be used alongside oil until 1958 (AN: Enskilda arkiv 609). However conversion to oil required considerable expense. In 1957, calculations obtained by the Luleå Tenants' Association shows that installing the smallest oil-burner viable for apartments to have cost around 3,200 SEK, a similar price to 300 hectolitres of coke. Given that this could be as much as ten times a household's annual consumption of coke, the capital investment was clearly very large for free-standing properties. However the marginal cost for buying larger burners was quite small, and ceased to rise once a consumption of 1,400 hectolitres was reached (probably the size of a large apartment block) (AN: Enskilda arkiv 451.EV). Based on the initial investment the incentives to switch to oil were thus much greater for those running collectively-managed blocks, a type of housing that expanded rapidly in the post-war years in urban areas. By 1965, 80 per cent of urban dwellings in Norrbotten had central heating with some kind of boiler, and in smaller settlements 65 per cent and nearly half of rural housing (SOU 1965:32: 60).

However we have already seen that the labor intensity of tending the boiler was a significant consideration in fuel choice (Fig. 8). Whilst coke had an advantage over firewood, oil-fired boilers required less attention than either. In 1932 it was reckoned that firewood required more labor in the form of stoking as compared to coke. As the boiler needed to be refueled every second or third hour there was an additional cost estimated at 1.56 SEK per corresponding hectolitres of coke (AN: Enskilda arkiv 20 F5:4). Thus, it was far from only the fuel price itself that determined the price of the heat service from coal and firewood, but also the trend of increasing wages. This is important because after the Second World War Sweden entered an unprecedentedly long period of high, unbroken real wage growth, with its highest

rates in the early 1950s. Interestingly, the early 1920s were also a period of very rapid growth.¹² An informant born in 1946 tells us that in his childhood home, a two-storey building built the year of his birth with central heating and with one apartment of three rooms and a kitchen on each floor, they would frequently alternate between using wood and coke depending on the season and the coke price. The boiler, however, required close su-

GÖTAVVERKENS
PANNOR
 OCH
RADIATORER




VÄRMELEDNINGSPANNOR:

GOTHIC
 V O
 VI & Å I
 VII & Å II
 UNDA VI & Å I
för underförbränning
 UNDA VI & Å I
för överförbränning
 UNDA V III & Å III

LEVERANS FRÅN LAGER

GÖTAVVERKEN · GÖTEBORG

Fig. 8. Advertisement for Götaverken boilers 1930. Source: *Affärsvärlden* 27 March 1930.

pervision and during the winter was filled with fuel morning, noon and evening. When the informant's mother started to work in the early 1960s, it was no longer possible to heat the boiler with solid fuels.¹³ The old boiler was therefore converted to oil by inserting a relatively cheap oil burner and installing an oil tank of 3–4 cubic metres in the basement where solid fuels had previously been stored.¹⁴ Government officials also noted that the low handling costs of an oil boiler were an incentive to switch (SOU 1957:4: 13).

Changing from solid fuels to oil was therefore not a major investment if a burner could be installed without the need for a new boiler. Much must have depended on the ease with which older boilers could be converted into oil-burners. When capital costs were still high, it suggests that labor market considerations must have been important to such a switch, which otherwise made little financial sense. Such considerations were evident from the Swedish Association of Creameries from the late 1940s to early 1960s, as their members considered the merits of switching to oil-burners. Around 1950 oil was still too expensive, despite the savings in wages, but near the coast creameries were using coal over the next decade. By the early 1960s coal was no longer considered an option, and oil had become very considerably cheaper. But a major incentive to switch was the fact, already demonstrated at Kalix's creamery, that an oil furnace required only 13 per cent of the labor-hours of wood in stoking (AN: Enskilda arkiv 20 F5).

Again, there were several lines of development converging at this point in time. The rise in the importance of women's work outside the household may have been a factor in this process. The opportunity cost of solid fuels rose as female wage labor became more frequent in the 1950s. By 1950 around 75–80 per cent of young unmarried women were working, but between 1950 and 1965 the proportion of married women of all ages working rose from 14 per cent to 30 per cent, a trend particularly marked among women aged 35–54, rising from around 15 to 37–38 per cent (SCB 1968: 22–23, 102–103). Although shares were lower in Norrbotten they understate the reality because married women working on farms were not included. Growing prosperity had led to a rapid diffusion of the private car after the war. This led to an induced demand for petrol produced in Swedish refineries. As a consequence, the supply of heavier fuel oils increased proportionally since the output mix of different oil grades in the refining process is basically constant, and supply of petrol necessarily meant the supply of fuel oil. The increased supply of fuel oil contributed to the low oil prices. Simultaneously, electrical household appliances, including the electric cooker, the washing machine and the refrigerator, along with an increased output of manufactured and semi-manufactured foodstuffs, helped to increase the productivity of household work. The increased efficiency of household labor as well as

growth in service sector employment outside the home increased the supply of female labor to the market. As the children of the post-war baby boom became teenagers around 1960s, switching from solid fuels to oil became one of the essentials, at least for families living in one-family houses. Oil use did give flexibility in that the boiler could be switched on and off with no loss of fuel. In contrast, once a solid fuel fire was lit, it had to be left to burn down. This meant that where equipment allowed switching, it was preferable to use more expensive solid fuels through the winter, but the more flexible oil outside of the coldest months—a strategy we can see was adopted by Luleå's apartment block owners (AN: Enskilda arkiv 609, 9 February 1940).

The choices faced were different, although related, for those owning individual houses, and those running apartment blocks with collective boilers. Price concerns, and the costs of installing new equipment were common to both, but labor costs were reflected differently through the opportunity cost of time, or the price of paying a wage for someone to keep the boiler running (probably in combination with other work as a janitor). However the increasing proportion of the population who lived in apartments would have had such choices made for them, and only had an opportunity to raise concerns through the tenants' association (Ivarsson & Tengling 1988). Fuel costs seem to have been generally subsumed into rents.¹⁵ The investigations undertaken by the Luleå Tenant's Association also show that a daytime indoor temperature of 18 °C and a night time temperature of 15 degrees were considered reasonable. The reports do, however, show that these were not always maintained, and that indoor temperatures slightly above 10 degrees were reported. In the private block owned by the Gradin family, with a generally well-to-do set of professional tenants, shops, and offices, a basic fuel charge included in the rent with a supplement added after the actual costs of fuel were calculated at the end of the heating year (in September). The supplement was scaled according to a set proportion for each apartment, so individual tenants had no control over the level of payment, nor any incentive to economize on use.¹⁶

V

It is clear that the organization of the household's energy supply became more connected to the large scale energy infrastructures after the 1930s. The evolution of household energy became more intertwined with developments in manufacturing industry as well as with wider energy policy, which up until the first oil crisis in 1973 and the growing environmental concerns during the late 1960s, was essentially part of the general industrial policy.

During this period there was one development that would have important repercussions for domestic energy use beyond 1970, namely the con-

struction of a steel plant in Luleå in 1939. Although by the 1970s economic problems led to the effective bankruptcy of both NJA and the wider Swedish steel industry, a rescue package from the state in 1979 saw all Swedish steel plants unified as Swedish Steel (SSAB). Under the new ownership an extensive modernization and restructuring program was initiated. In connection with this crisis, SSAB and Luleå municipality decided to form a co-owned power company, LuleKraft, to use process gas from the steel and coke plant for the generation of district heating. The plant was taken into operation in 1982, which was comparatively late compared to the provision of district heating in other Swedish municipalities which had started already in the 1950s, then fuelled by oil. The major expansion of district heating, today supplying around 50 per cent of the household heating demand in Sweden, had begun after the oil crisis in 1973. The Luleå district heating system, utilizing waste heat from the steel mill had its origins in the 1970s (Söderholm 2018). Sweden was at that time one of the world's most oil-dependent economies, and the incentives to quickly move away from oil were therefore strong among most economic actors. Government subsidy programs were directed to industry, municipalities and the households with the aim of phasing out oil from the heating systems in the second half of the 1970s. Strategies included the expansion of both district heating and direct electricity.

As the district heating systems were run by the municipality, the regulation at the time stipulated a “self-cost principle,” implying that the activity should not generate any profits exceeding the municipality's (low) capital costs. District heating was therefore competitive in terms of prices. Another forceful instrument was the municipal planning monopoly from 1947 which meant that the municipality determines how land is used in the municipality, including plans for every residential area. Municipalities could for instance in these detailed plans decide that if a property owner replaced an old boiler, the property should be connected to the district heating system. This planning monopoly was a significant instrument for expanding district heating. In previous decades consumers had responded to the availability and price of fuels that was often conditioned by wider industrial markets and state action. Now, that autonomy was receding for many urban households.

By 1996 Norrbotten had 16 district heating plants, of which Luleå's was by far the largest. Lesser plants in the urban districts of Kiruna and Piteå made extensive use of waste industrial heat as well as peat and wood. Outside of these operations, even quite small communities operated district heating plants but used the locally available fuels of peat and firewood (NCM 1998).

In the early twenty-first century, Norrbotten remains by far the highest

per capita consumer of energy in Sweden (five times higher than central Stockholm), but this is primarily driven by industrial use, above all in the SSAB plant in Luleå. The gap in household consumption is very much lower but still substantial, at 45 per cent in 2008, having risen from 16 per cent in 1990. One might expect that in the case of heating climate would provide a primary explanation, and is part of the story. However in recent decades Norrbotten has also enjoyed relatively cheap supply: although pricing is obviously a matter of policy on the part of the national distribution network retailers, by the 1980s Vattenfall, the main state-owned electricity supplier and owner of the national distribution company, was offering electricity in Norrbotten at 25 per cent below the average national price. The gap between Norrbotten and its southern neighbors is the cumulative effect of greater use of firewood, district heating and electricity. Rather than being related to labor regimes among rural households who work in their own lots of woodland or as loggers, increasing use of firewood and biofuel in district heating systems is permitted by the use of waste products from the region's now capital-intensive and very highly mechanized forestry industry. Here we see yet another spillover from what is effectively an industrial sector. We may hypothesize that part of the growing gap between Norrbotten and the rest of the country is a result of lock-in to an energy regime that makes extensive use of by-products and keeps prices low (Warde 2019).

We have seen how the domestication of household energy, seen here in a northern perspective, has evolved through various stages, gradually connecting the household to wider energy systems. The first significant moves from the open stove to the iron stove had profound effects on both female domestic work and indoor climate. We therefore argue that there was an important relationship between female work and the domestication of household energy. Simultaneously, the emergence of male paid work provided the means for buying the new energy equipment. As firewood remained the dominant fuel in the countryside, coal became more important in the towns, clearly exemplifying the close relationship between industrial energy demand, where coal was the preferred fuel especially for steam engines and locomotives, and that of the urban household. From the 1920s, electricity also became widespread, partly as a side effect of the industrial need for electricity and subsequent investment in power and grids. The 1950s and early 1960s saw a rapid diffusion of oil as the main fuel, a process driven by low oil prices, but also from the fact handling costs for attending an oil fueled boiler were low compared to coke, not to say firewood. This also had a connection to women's work, as oil liberated the single family household from frequent attention to the boiler. The next stage was set during the 1970s, with a rapid expansion of district heating and centralization of domestic energy systems through this and fur-

ther electrification. If possible future energy scenarios reverse this trend, they will have to take into account the overwhelming importance to people of how they spend their time.

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NOTES

¹ Arkivcentrum Norrbotten (henceforth AN) Gunhild Waara, *Klass 7 (1952)*, Bygdespegeln, uppsatser, Tändö socken, Niva, Storbyn. F 1:25.

² AN. Sten Juuso, *klass 7*, Bygdespegeln, uppsatser, Tändö socken, Niva, Storbyn. F 1:25.

³ This customary law only came in conflict with the state as farmers started to regard logging for selling saw-timber to forest companies as household requirements.

⁴ For an argument about this transition in America, see Cowan 1984: 57–61.

⁵ AN: Enskilda Arkiv 20 F5:4. Norrbottens hushållningsällskaps organisationskommitté.

⁶ On this problem, see SOU 1924:42: 26–27.

⁷ In 1950 the household sales by Larson & Lind were generally 25–30 hl. At a weight of 610 kg per cubic metre of coke, this would approximate to 1,525 to 1,830 kg of coke if the hl was “solid.” However, inevitably it was not, with higher grades of coke coming in larger pieces, and hence leaving more air in between them. Householders generally purchased the middle grade of coke with pieces of 40–60 mm in size. AN: Enskilda Arkiv 17, AB Larson & Lind, 17 January 1963.

⁸ These were fairly large apartments of 40 m². AN: Enskilda Arkiv 451.EV.

⁹ AN: Enskilda arkiv 252 Alida Granberg G1:1.

¹⁰ This is based on a survey of telephone books from 1944 to 1962, first of “district 9” covering most of Norrland, and later Luleå, covering Norrbotten county; and also the local Haparanda telephone book from 1951. Of course, given that advertising in the telephone book had a cost, not all suppliers or engineers would have been covered, but it is likely that those with any substantial business would be.

¹¹ These fuel costs are described in documents supplied in both typed reports and handwritten notes by various creameries around Norrbotten as part of discussions over investment in equipment and fuel within Norrbottens läns producentförening.

¹² Real wages are calculated from Prado 2010 and Edvinsson & Söderberg 2010.

¹³ Interview with man, born in central Umeå in 1946. Umeå 15 March 2016.

¹⁴ Instructions for ABSO boilers intended for coke states that oil burners may be installed in boilers larger than 1.5 m² by authorised personnel only. AB Skoglund och Olsson AB Trycksak nr 1149-B. AN: Arkiv Familjen Östlings arkiv 539 Ser L1:30.

¹⁵ AN: Bodens Hyresgästförening. Arkiv 1201:l: F containing Bränsleklausul för exklusiv-

kontrakt. Statens Hyresråds bränsleklausul, Eskilstuna 1941. See also SOU 1938:22: 208.

- ¹⁶ See AN: Enskilda Arkiv 609. Heating bills are preserved for most apartments from the mid-1940s to the early 1960s.

REFERENCES

Archives

- AN = Arkivcentrum Norrbotten
 Bodens Hyresgästförening. Arkiv 1201.
 Enskilda arkiv 17. AB Larson & Lind.
 Enskilda arkiv 20:1 F5. Norrbottens Läns Producentförening.
 Enskilda arkiv 252. Alida Granberg Gl.
 Enskilda arkiv 451.E. Luleå Hyresgästförening.
 Enskilda arkiv 609. Fastighets AB Forellen.
 F 1:25 Bygdespeglan, uppsatser.
 Familjen Östlings arkiv 539 Ser L1:30.
 Nbm 613, Staffan Hanson.
 SE 534//1, Luleå Kol & Materialaffär.
 Luleå kommuns historiska bildarkiv.

Literature

- Anselm, J. (1992). *Vattenkraft och naturskydd. En analys av opinionen mot vattenkraftutbyggnaden i Sverige 1950–1990* [Hydropower and nature protection. An analysis of opposition against hydropower development in Sweden, 1950–1990], Linköping: Linköping University.
- Bäcklund, D. (1988). *I industrisamhällets utkant. Småbrukens omvandling i Lappland 1870–1970* [On the outskirts of the industrial society. The transformation of small-scale farming in Lapland during the period 1870–1970] (Umeå Studies in Economic History 8), Umeå: Dept. of Economic History, Umeå University.
- Bergsten, J. (2004). "Tegelbruken" [The brickyards], in *Sunderbyn under 500 år*, eds. J. Bergsten, Y. Brander, L.E. Nilsson, N. Nyberg, R. Vikström & S.E. Vikström, Södra Sunderbyn: Jan Bergsten, pp. 101–111.
- BiSOS = Bidrag till Sveriges officiella Statistik (1900). L, *Statens Järnvägstrafik* [National rail traffic], Stockholm: Kongl. Jernvägsstyrelsen.
- Brewer, P.J. (2000). *From Fireplace to Cookstove. Technology and the Domestic Ideal in America*, Syracuse: Syracuse University Press.
- Cowan, R.S. (1984). *More Work for Mother. The Ironies of Household Technology from the Open Hearth to the Microwave*, New York: Basic Books.
- Edvinsson, R. & Söderberg, J. (2010). "The evolution of Swedish consumer prices 1290–2008," in *Historical Monetary and Financial Statistics for Sweden, Volume 1. Exchange Rates, Prices, and Wages, 1277–2008*, eds. R. Edvinsson, T. Jacobson & D. Waldenström, Stockholm: Ekerlid, pp. 412–452.
- Enflo, K., Henning, M. & Schön, L. (2014). "Swedish regional GDP 1855–2000. Estimations and general trends in the Swedish regional system," *Research in Economic History*, 30, pp. 47–89.
- Eriksson, M. (2015). "Beyond industrial policy. State intervention in the Swedish electrici-

ty supply industry, 1936–1946,” *Business History*, 57:6, pp. 1–16.

- Gerschenkron, A. (1962). *Economic Backwardness in Historical Perspective. A Book of Essays*, Cambridge, Massachusetts: Belknap Press of Harvard University Press.
- Hansson, S. (1994). *Porjus. En vision för industriell utveckling i övre Norrland* [‘Porjus. A vision of industrial development in upper Norrland’], Luleå: Luleå University of Technology.
- Hansson, S. (2006). “Gigantiska satsningar banade väg för norrbottnisk industrialisering och samhällsomvandling” [‘Gigantic investments paved way for industrialization and society transformation’], *Årsskrift 2004–2005 Norrbottensakademien*, Luleå: Norrbottensakademien, pp. 13–28.
- Innis, H.A. (1930). *The Fur Trade in Canada. An Introduction to Canadian Economic History*, London: Oxford University Press.
- Ivarsson, M. & Tengling, U. (1988). *Ett hem i folkhemmet. Berättelsen om en levande folkrörelse. Hyresgästernas riksförbund 65 år* [‘A home in the people’s home. The story of a living social movement. 65 Years of the National Tenants’ Association’], Stockholm: Hyresgästernas riksförbund.
- Johansson, N. (2006). “Atlantprojektet. En studie av planerna för det största projektet i svensk vattenkraftshistoria” [‘The Atlant project. A study of plans for the largest project in the history of Swedish hydropower’], bachelor’s thesis, Luleå University of Technology.
- Jonsson, S. (1987). *NJA – stålverket i norr. Förhistoria, bildande och första år* [‘NJA – the steelworks in the north. Pre-history, creation and first years’], Luleå: Norrbottens museum.
- Kaiserfeld, T. (2005). “Värme från när eller fjärran” [‘Heat from near or far’], *Historisk tidskrift*, 125:3, pp. 516–524.
- Kungl. Socialstyrelsen (1924). *Allmänna bostadsräkningen år 1920* [‘General housing census 1920’], Stockholm.
- Kungl. Socialstyrelsen (1949). *Allmänna bostadsräkningen år 1939* [‘General housing census 1939’], Stockholm.
- Kungl. Socialstyrelsen (1952). *Bostäder och Hushåll. Enligt allmänna bostadsräkningen 1945 och därtill anslutna undersökningar* [‘Housing and households according to the general housing census of 1945 and associated investigations’], Stockholm: Kungl. socialstyrelsen.
- Lundgren, N.G. (1984). *Skog för export. Skogsarbete, teknik och försörjning i Lule älvdal 1870–1970* [‘Forest for export. Forest work, technology and supply in the Lule valley, 1870–1970’] (Umeå Studies in Economic History 6), Umeå: Umeå University.
- NCM = Nordic Council of Ministers (1998). *Energy Report on the Nordic Parts of the Barents region*, Copenhagen: Nordic Council of Ministers.
- Ödman, P. (1920). “Några undersökningar rörande förbrukningen av virke till husbehov inom Västernorrlands landsbygd” [‘Some investigations concerning the use of firewood for household need in rural Västernorrland’], *Svenska skogsvärdssföreningens tidskrift*, 18:1–2, p. 1–47.
- Prado, S. (2010). “Nominal and real wages of manufacturing workers, 1860–2007,” in *Historical Monetary and Financial Statistics for Sweden, Volume I. Exchange Rates, Prices, and Wages, 1277–2008*, eds. R. Edvinsson, T. Jacobson & D. Waldenström, Stockholm: Ekerlid, pp. 479–527.
- Rinkinen, J., Shove, E. & Torriti, J. (eds.) (2019). *Energy Fables. Challenging Ideas in the Energy Sector*, London: Routledge.

- SCB = Statistiska centralbyrån (1968). *Folk- och Bostadsräkningen den 1 november 1965* [‘The population and housing census of 1 November 1965’], Stockholm: Statistiska centralbyrån.
- SCB (1969). *Historisk statistik för Sverige. D. 1. Befolkning 1720–1967* [‘Historical statistics for Sweden. Part 1. Population 1720–1967’], Örebro: SCB.
- Shove, E., Pantzar, M. & Watson, M. (eds.) (2012). *The Dynamics of Social Practice. Everyday Life and How it Changes*, Los Angeles: SAGE.
- Shove, E. & Trentmann, F. (eds.) (2018). *Infrastructures in Practice. The Dynamics of Demand in Networked Societies*, London: Routledge.
- Sixtensson, R. (2001). “Spisar och andra eldstäder” [‘Hearths and other fireplaces’], *Västerbotten*, 2001:1, pp. 2–11.
- Söderholm, K. (2018). “Pioneering industry/municipal district heating collaboration in Sweden in the 1970s,” *Energy Policy*, 112, pp. 328–333.
- SOS = Sveriges Officiella Statistik, Sjöfart 1911–1988 [‘Sea navigation 1911–1988’], Stockholm: Kommerskollegium; www.scb.se/hitta-statistik/aldre-statistik/innehall/sveriges-officiella-statistik-sos/sjofart-19111988/; access date 23 Oct. 2019.
- SOU = Statens offentliga utredningar (1922:14). *Statsmakterna och bränsleanskaffningen under krigsåren. Av Bränslekommissionen avgiven berättelse över dess verksamhet åren 1917–1921* [‘Government and fuel supply during the war. Report of the Fuel Commission on its activity 1917–1921’], Stockholm.
- SOU (1922:56). K. *Socialstyrelsens utlåtande med förslag till lag angående hyresregleringens avveckling m.m.* [‘The National Welfare Board’s opinion with suggestions on the law regarding the fixing of rents’], Stockholm.
- SOU (1924:42). *Förbrukningen av virke till husbehov på Värmlands läns landsbygd. Betänkande avgivet av de Sakkunniga för utredning om anordnande av skogsavverkningsstatistik och taxering av Sveriges samtliga skogar* [‘The use of wood for household needs in rural Värmland County. Report of the experts on the investigation of the organisation of wood-felling statistics and measurement of Swedish forests’], Stockholm.
- SOU (1938:22). *Betänkande med förslag till reformerad hyreslagstiftning* [‘Report with suggestions on the reformed rent laws’], Stockholm: Norstedt.
- SOU (1939:6). *Underlättandet av kvinnornas arbete i de mindre lanthemmen* [‘The facilitation of women’s work in smaller rural homes’], Stockholm.
- SOU (1947:3). *Redogörelse för detaljdistributörerna samt deras råkraftkostnader och priser vid distribution av elektrisk kraft* [‘Report on distributioners and their basic costs and prices in the distribution of electrical power’], Stockholm: Kommunikationsdepartementet.
- SOU (1947:46). *Betänkande angående Familjeliv och Hemarbete* [‘Report concerning family life and domestic work’], Stockholm.
- SOU (1948:32). *Utredning rörande skogstillgångarna och skogsindustriernas råvaruförsörjning i övre och mellersta Norrland m. m.* [‘Investigation into forest access and the supply of forest industry wares in upper and middle Norrland’], Stockholm.
- SOU (1951:32). *Bränsle och kraft. Orientering rörande Sveriges energiförsörjning* [‘Fuel and power: guide concerning Swedish energy supply and reports on investigations into fuel’], Stockholm: Nordiska bokhandeln.
- SOU (1954:24). *Klenvirke. Användningen av barrklenvirke, lövvirke och sågverksavfall. Betänkande* [‘Small-diameter wood. Use of small-diameter coniferous and deciduous wood and sawmill waste’], Stockholm: Nordiska bokhandeln.
- SOU (1957:4). *Oljelagring* [‘Oil storage’], Stockholm.

- SOU (1965:32). *Höjd bostadsstandard* ['Higher housing standards'], Stockholm.
- Summerton, J. (1992). *När fjärrvärmén kom till stan. Ett energisystem växer fram* ['When district heating came to town. Growth of an energy system'], Linköping: Linköping University.
- Trägårdh, K.F. (1940). "Kraftledningsbygget Porjus–Västerås" ['Power line construction Porjus–Västerås'], *Teknisk Tidskrift*, 1, pp. 1–7.
- Viklund, R. (2012). *Riksgränsbanans elektrifiering. Stat och företag i samverkan 1910–1917* ['Electrifying the border railway. The cooperation of state and private enterprise, 1910–1917'], diss., Luleå: Luleå University of Technology.
- Warde, P. (2019). "Energy regimes in the Fennoscandian north, c. 1900–2015," in *The Politics of Arctic Resources. Change and Continuity in the "Old North" of Northern Europe*, ed. E.C.H. Keskkitalo, London: Routledge, pp. 140–160.

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