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Abstract: This environmental history paper explores the development of the wood-paper commodity chain and its environment between 1945 and 1955. This commodity chain is embedded in its environment through its dependency on natural resources (e. g. wood, water) and energy (e. g. rivers, human and animal workforce). Two phases are identified within this timeframe: reconstruction (1945–1950) and transformation (1950–55). During the first five years, before joining the ERP, both forestry as well as the paper industry had to deal with acute shortages of raw materials and energy. The paper industry came up with several schemes to get access to raw materials and work force and nearly achieved 1937 production levels by 1950. The second part of the paper analyses the impact of the ERP investment programs on the wood-paper commodity chain. It was transformed by the ERP investments on all levels. This transformation loosened the embeddedness of the wood-paper commodity chain in its environments, strengthened its internal integration and created new dependencies.

Keywords: ERP, Marshall Plan, forestry, pulp and paper production, Austria

JEL Codes: N54, N74, Q23

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Reconstruction and Transformation of the Austrian Wood-Paper Commodity Chain 1945–1955

Introduction

The European Recovery Program (ERP) was an extensive aid program that facilitated financial as well as technology and knowledge transfer. Austria was among the sixteen countries that were included in this program. While many aspects of the ERP have already been researched, Günter Bischof, one of the most active ERP researchers in Austria, states in his 2017 book that forestry and the paper industries (from now on, the system of paper production will only be addressed as the paper industry for simplification) is still a desideratum of ERP research (Bischof and Petschar 2017, 133).

In this article, I will show that restoring the paper industry to its pre-war production levels had already been achieved before the start of the ERP. However, the measures financed and enabled by the ERP actively changed the wood-paper commodity chain on many levels. This comprised change in raw materials, technologies, energy supply, and other aspects that have implications for the environment, which merits an environmental history perspective.

Related Work

ERP Research in Austria

According to Günter Bischof, Austrian ERP research proceeded in three phases. The first phase of research dealt mostly with the aid programs that preceded the ERP as well as the negotiations and the early phase of the ERP. The ERP was mostly viewed in a very positive light and was not critically challenged (Bischof and Petschar 2017, 17).

A second phase, which Bischof calls the revisionist phase, represents the first critical analyses of the ERP. When archive material became available, a more critical view on the ERP was developing, and that view dominated ERP scholarship until the 1990s. In this phase, many scientists viewed the ERP as a tool of US imperialism (Sensenig 1987; Bischof and Petschar 2017, 17).

The third phase of the ERP research is the current, post-revisionist phase. In this phase, critical analyses of the impact and success of the ERP are being conducted

in a different way. International ERP research was incorporated into Austrian ERP research. Starting with Alan S. Milward's *The Reconstruction of Western Europe, 1945–51*, this new research concluded that, considering the whole program, its impact on Europe was most likely less profound than previous research had assumed. Milward's study was also the first attempt to analyze the ERP quantitatively. He showed that the ERP was most likely not the turning point in European economic development, but rather that it boosted an existing trend. He argues that the ERP has helped to increase private investments and widen (material) bottlenecks (Milward 1984, 107); similarly, Long and Eichengreen dub the ERP a "large highly successful structural adjustment program" (Long and Eichengreen 1991).

Very often, Austria is seen as a special case, since it was one of the best-funded countries within the ERP. Austria was also in a special situation because of the minimization of its Soviet occupation zone, with companies in this zone nevertheless receiving ERP-funds (Bischof and Petschar 2017, 108–109). This was also acknowledged in Milward's studies (Milward 1984, 92).

Environmental History Research

If natural circumstances are to be taken into account, but a culture/nature dichotomy is to be avoided to give due credit to hybridity, (for example, a forest planted by humans), the concept of socio-natural sites is particularly helpful. Socio-natural sites are nexuses of co-evolutionary interaction of practices and biophysical arrangements via four modes: perception, representation, programs, and work (Winiwarter and Schmid 2008, 158–173). These modes can be identified in the ERP. On the political level, representations were negotiated (containment of communism through economic growth and a better standard of living, for example), and then experts and professionals translated these representations into programs (strengthening exporting industries like the paper industry). The applicants drafted programs that had to be approved by foreign experts and were often modified by these experts. These programs were translated into practices (application of new technology, resource extraction, and so on) by companies and econom-

ic actors and interacted with material arrangements in many ways (Mähr 1989, 208–209).

Most ERP research has focused on two of the four modes: representations and programs. Only a few post-revisionist studies have gone beyond and looked at the material interactions involved in these programs through their practices and touched on the material aspect of the ERP. Since environmental history is dealing with the material implications, it can offer a constructive addition to the post-revisionist view on the ERP.

An Environmental History of the ERP

Environmental histories of the ERP in Austria are scarce. Robert Groß has accomplished an analysis of the ERP's impact on winter tourism in Vorarlberg, and Georg Rigele gives an account of the impact of the ERP on Austrian hydroelectricity focusing on the power plant Kaprun (Rigele 2000; Groß 2017).

Several environmental history studies that deal with forestry and the paper industry as well as research from other scientific fields can be used in developing an environmental history of the paper industry in Austria. These include economic studies of the reconstruction of the paper industry after the Second World War (Bubik 1958; Hromatka 1971), the forest history of Austria during the twentieth century (Weigl 2002), and technical studies that deal with technology in forestry as well as in the paper industry (Cohen 1984; Pröll [n.d.]).

Although it deals with the paper industry in the United States, *The Slain Wood* by William Boyd gives a good example of aspects and dynamics to be considered when researching the paper industry. In his book, Boyd traces how the paper industry managed to thrive in the United States' South. He shows how technological inventions (the sulphate process that allowed the use of loblolly pine, for instance), in combination with a very specific economic situation (cheap land) and ecological conditions, (decline of cotton and introduction of forest management), on top of social conditions favoring the paper industry and discriminating against forest workers, created special incentives for the paper industry. He also shows how the 'nature' of technologies plays an important role and describes the intrinsic problems that the sheer size of the machines creates for the paper industry. The machines of the paper industry are among the biggest in all industries and are quite often custom-made for the specific site. This causes a low mobility for factories and a huge part of the company capital fixed in the machines (Boyd 2015).

The Wood-Based Paper Industry in Austria

Producing paper from wood began in the early nineteenth century. When the capacities for paper production grew with the invention of the paper machine in

1799, the collected amount of the original resource – textile fiber – could not keep up with the growing demand. The innovation of using wood for the production of paper offered a unique opportunity for the Austrian part of the Habsburg Empire. During the nineteenth century, a thriving paper industry developed (Hromatka 1971, 7, 18). Austria's geography (specially the region of today's Austria) provided good conditions for the development of the wood-based paper industry because of its extensive forest areas as well as accessibility to rivers. The regional concentration became a problem when close to forty percent of the Austrian-Hungarian paper manufacturing companies remained within the new Austrian borders in 1918 (Melichar 2004, 282). The separation from its customers after the First World War forced the Austrian paper industry to focus on exporting their products (Hromatka 1971, 20–22).

It can be safely assumed that new technology (faster and wider paper machines or the burning of spent lye, for instance) and infrastructure (new forest roads, for example) introduced after the Second World War changed the energy supply, production capacities, and the raw materials that were used by the paper industry. This strengthened the wood-paper commodity chain and loosened its embeddedness in its environment.

While many aspects of the wood-paper commodity chain have changed during the twentieth century, the next paragraph will show its main features and its embeddedness in its environment.

The wood-paper commodity chain is dominated by water and energy. Water serves multiple functions in the paper production process. It is not only a raw material but also a means of (wood) transportation (Hafner and Trzesniowski 1994, 345), used in several stages of the paper production process, (in the process of grinding wood and the production of steam, for instance), and is used to flush effluents into rivers (Vogel 1989, 1; Baumann and Herberg-Liedtke 1993, 25). In the past, water was also used to generate energy for the production process. This made paper production dependent on the region's seasonal climate. The paper industry had to deal with changing amounts of water flow due to seasonal changes as well as with frozen water during the winter months (Heidl 1948, 87). Other energy sources throughout the production process were the human body as well as fossil fuels such as coal (Hromatka 1971, 25).

When the paper industry based its production on wood, it became dependent on an economic sector with its own set of rules. Since wood is a slowly growing 'crop' that needs decades to mature, the forest sector cannot easily react to short-term business cycles. To secure the long-term supply of wood, forests have to be managed sustainably and ecological factors have to be considered. This includes restricting harvests to secure usable timber for coming years as well as regular management to

keep the forests healthy (Johann ²1994, 208). Short-term events like storms and forest pests interfered with long-term forest plans. Before the 1950s, the harvest cycle was strongly connected to the seasons, with harvest taking place in spring and the transportation of the wood in the following winter (Handel-Mazzetti and Elsässer 1950, 21). Because of the heavy mechanical work, originally without the aid of machines other than early chainsaws, the physical abilities of workers' bodies was a necessity.

The next link in the wood-paper commodity chain was the pulp producers, which can be divided into mechanical and chemical pulp producers. The mechanical pulping process uses mostly mechanical energy and water to make the wood fibers available for cardboard and low-quality paper production. The chemical pulping process additionally needs large amounts of heat as well as chemical energy to produce lignin-free pulp that is used for high quality paper (Baumann and Herberg-Liedtke 1993, 24–33).

In the next step, the pulp was transformed into various forms of paper and cardboard on huge paper machines. In this process, more water, as well as chemical and thermal energy, were needed (Baumann and Herberg-Liedtke 1993, 55–57). All these steps of the wood-paper commodity chain are connected through transport, also dependent on energy from human bodies, animal muscles, as well as fossil fuels.

The First Half of the Twentieth Century

The impact of the ERP must be evaluated in context. Many events had a bearing on the paper industry during the first half of the twentieth century. After the First World War, new borders and a much smaller country area forced the paper industry to focus on export; the economic depression was also the start of a concentration process that still continues today. Although short, Austria's integration into the German Reich had a profound impact on Austrian industry, and the paper industry was no exception (Melichar 2004, 282, 466–468).

Although there were few investments in the paper industry between 1938 and 1945, the ongoing concentration accelerated. A 1951 study from WIFO (also known as the Austrian Institute of Economic Research) sees the reason for this concentration process not only in the excess capacities after the First World War but also in technological reasons. They found that many companies were too small and that mixed/integrated companies had an advantage. The biggest concentration happened in the cardboard and wood grinding sector; the sector shrunk to 67 companies in 1949, down from 184 companies in 1925 (WIFO 1951, 4).

Forestry and the Paper Industry after the Second World War

After the Second World War, both forestry and the paper industry faced a dire situation. Austrian forestry faced

the overuse of easily accessible forest stands and a lack of management due to a shortage of workers (Weigl 2002, 643–644). In the paper industry, problems included the lack of raw materials as well as a lack of modernisation and streamlining of company structures. After the war, paper industry officials believed that the Austrian companies were not able to compete on the world market (WIFO 1951, 4).

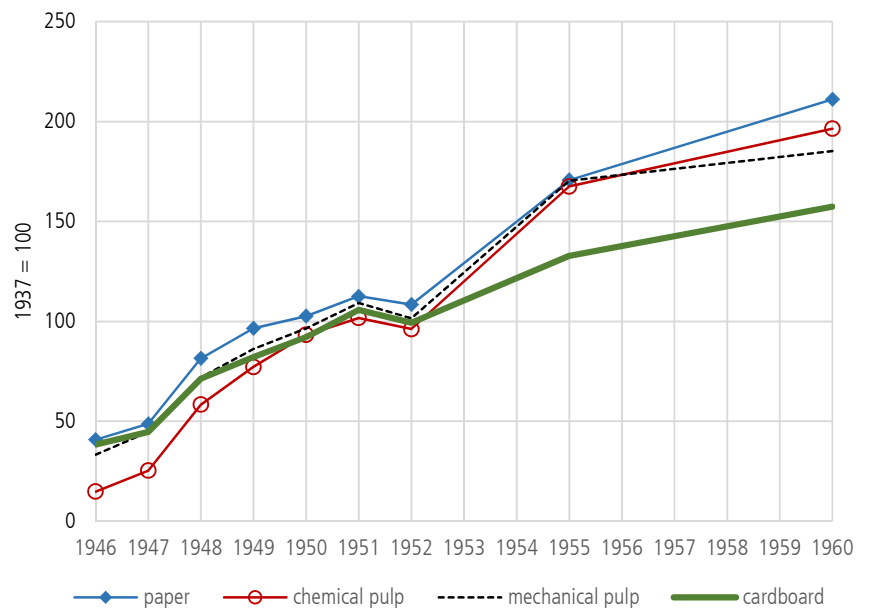
Changes Between 1945 and 1950

The paper industry joined the ERP as late as 1950; therefore, it is important to take a closer look at the preceding five-year period in order to get a better understanding of the impact of the ERP. Although further research is needed, some of the measures that were taken before 1950 can be documented using the yearly reports of the paper industry. The paper industry faced multiple problems: the newly enforced borders of the occupation zones cut them off from important administrative and trade connections, and the industry suffered from significant wood and energy shortages. Additionally, forestry workers were, like many other Austrians, suffering from undernutrition and a lack of basic equipment (Pickl 1963, 63). The dire nutrition situation after the war made physical human strength a 'bottleneck' for paper production (Fachverband 1948, 2). To deal with the interruption of formal structures, the paper industry quickly formed new administrative organisations (for instance, a local organisation 'Gebietsverband' for the British occupation zone) (Pickl 1963, 62).

The following examples show the active role of the paper industry in restoring and securing their resources. To improve the raw material supply, the paper industry devised the Pa-Ko¹ campaign to gain access to wood. One of the reasons for the wood shortages after the war was the reluctance of owners of small forests to sell their wood due to currency instabilities. This was important because of the structure of forest ownership in Austria. A large part of the forest area was made up of smaller forests, mostly owned by farmers.² To deal with this problem, the paper industry bought coal with foreign currency and offered this coal in exchange for wood (at an exchange rate of one tonne of coal to four cubic meters of wood) (Fachverband 1948, 1). In 1948, about one quarter³ of the wood supply to the paper industry originated from the Pa-Ko campaign (Fachverband 1948, 3).

Archive material shows the industry's efforts to improve the situation of forestry workers. Negotiators from the paper industry played an active role in providing forestry workers with more calories during the period of rationing after the war.⁴ To provide forestry workers with shoes, the paper industry devised a scheme similar to the Pa-Ko campaign, using foreign currency from paper export to buy raw hides for the production of shoes. The paper industry also recruited forestry workers from

Figure 1: Yearly production of the Austrian paper industry (1937=100). Production 1937: paper: 232,130 tonnes, chemical pulp: 268,000 tonnes, mechanical pulp: 96,760 tonnes, cardboard: 64,100 tonnes. Data: Fachverband 1952, 5; Melichar 2004, 470.



Italy to supplement their workforce (Fachverband 1948, 1).

The measures implemented by the paper industry show the important role of the human body in the wood-paper commodity chain. The well-being of the forestry workers was essential to maintain their productivity. The workers were undernourished, and, because of a shortage of raw hides, not enough shoes were available for the heavy work in the forests. Therefore, many of the forestry workers, who were often recruited from nearby farms, preferred to stay home.⁵

The production numbers show significant improvements between 1945 and 1950 (Melichar 2004, 470–471). ‘Reconstruction’ to pre-war values had been nearly achieved in all areas of production (see Figure 1).

The European Recovery Program

Between 1948 and 1953, the US transported goods with a value of approximately one billion dollars to Austria, which were sold at domestic prices. The proceeds were put into a special account that was called the ‘ERP-Sonderkonto.’ From this ERP-Sonderkonto, low-interest loans were granted to Austrian businesses, which had to be repaid into the same account (Tinhof et al. 1958, 54; Lacina 2000, 11–12). Applicants had to cover part of their investments with own capital. This account, now called the ERP-Fonds, still exists and is managed by the Austrian Wirtschaftsservice. It was handed over to Austria in 1962 (AWS-Historie. [n.d.]).

While the aid programs launched immediately after the war offered mainly short-term relief, the ERP was inspired by the New Deal of the 1930s. It aimed at short- and long-term transformation of the economies that were

involved. Although the impact, motivations, and benefits of the ERP are still discussed, it can be said that the program aimed at stabilizing European markets through productivity, economic growth, and the stabilisation of local currencies. On a European level, it encouraged free trade and political integration (Bischof and Petschar 2017, 13, 55–59).

While the Marshall Plan undoubtedly had political goals like the containment of communism, its economic goals like closing the dollar gap and economic growth are of more immediate importance here, because they translate directly into resource questions. Charles S. Maier was the first to discuss the “American foreign productivity policy” (Boel 2003, 12): “Washington’s effort [...] was to ensure the primacy of economics over politics, to de-ideologize issues of political economy into questions of output and efficiency” (Maier 1977, 629).

In Austria, the ERP evolved in three phases. In the first phase, 1948–49, direct aid was delivered to the Austrian people in the form of food and raw materials. In the years 1950–51, aid went into the reconstruction and modernisation of ‘basic industries,’ including pulp & paper. During the third phase, 1952–53, ERP measures targeted finished products as well as export goods. The restoration and enhancement of Austrian infrastructure such as railways, roads, agriculture, and forestry was a main target for investments (Lacina 2000, 11–12). To achieve economic stabilisation, the ERP grants and the investments should help to generate foreign currency to close the ‘dollar gap’ that was viewed as an important threat during this time (Seidel 2005, 281–282). This explains the generous grants that were awarded to the paper industries. Figure 2 shows that the paper industry and the wood industries constituted an important part of the

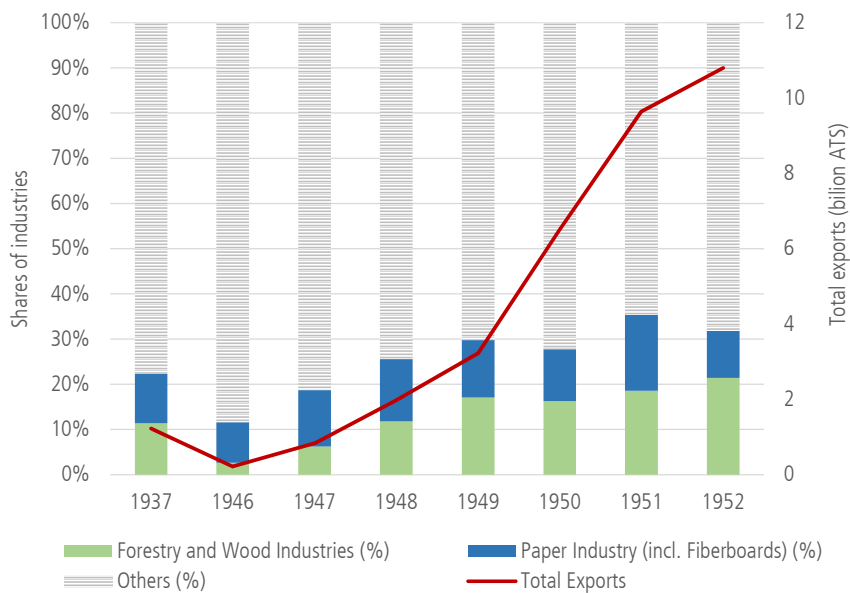


Figure 2: Export value of the wood and paper industries in per cent and value of total export in billion ATS. Data: Memorandum 1953, 32.

Austrian export value before and after the Second World War and especially after the effect of the ERP kicked in after 1950.

To achieve an increase in productivity, several organisations and programs were founded.

The OEEC (Organization for European Economic Cooperation, the predecessor of the OECD) and the ECA (Economic Cooperation Administration) oversaw the economic coordination of the ERP. The OEEC was founded in 1948 by the sixteen European countries that participated in the ERP (with the US and Canada acting as observers) (Schmelzer 2016, 40). Its purpose was to distribute ERP aid and to “implement an economic recovery program for the western European countries” (OECD 1996, 11). It targeted industry, energy, agriculture, and technology. It also worked to improve trade liberalisation and currency convertibility after the war (OECD 1996, 11).

The US Congress founded the ECA in 1948. Its purpose was to administer ERP aid. The ECA was important because it dealt with applications for investment programs and granted loans and aid. It employed experts to assess applications and suggest changes and modifications to the investment programs. These experts had a big influence on the development of the paper industry (WIFO 1951, 26; Statistics and Report Division 1953, 22–23).

The Foreign Assistance Act of 1948 installed the Technical Assistance Program (TAP) as one of the management tools of the ERP. The money invested in the TAP rose from two million dollars in 1948 to twenty million dollars in 1952. The TAP’s mandate was to “transfer U.S. production and management techniques and know-how to Europe,” but it was also about exporting the “American productivity spirit” (Boel 2003, 28). The TAP was maybe minor in financial terms, but it constitutes an impor-

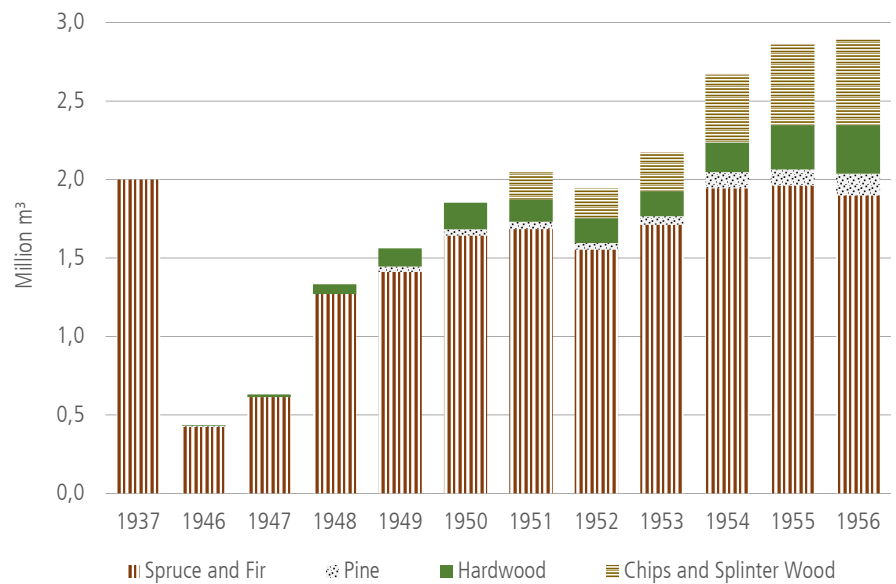
tant part of the ERP in terms of transforming business practices on all levels. Employees from all levels within the participating companies were encouraged to go on study trips (mostly to the United States and northern countries). There they saw and learned about new technologies and work organisation. Back home, these people would act as multipliers, as several reports, written by participants, show (Silberman et al. 1996, 444–445). These travel reports were published by the ÖPZ (Austrian Productivity Center), another organisation that aimed at increasing productivity (OPWZ-Geschichte. [n.d.]).

The Investment Programs

To understand how the investment programs changed the wood-paper commodity chain, it is important to understand their goals, the processes that influenced the planners while drafting these programs, and the changes that were applied to them in the ECA application process. Although further research is needed to answer these questions fully, a short overview is possible.

The Investment Program for the Austrian Paper Industry
The Austrian paper industry joined the ERP late because industry officials were afraid to lose their independence when entering into such a large investment program. The investment proposals had to be written by Austrian entities but were reviewed by the ECA and their experts (WIFO 1951, 26; Hromatka 1971, 32). Thirty-one companies finally participated in the program. Major changes were applied to the investment proposals by the ECA experts. They were convinced that Austrian companies did not think big enough and so suggested larger proposals (WIFO 1951, 26).

Figure 3: Wood used by the Austrian paper industry 1937, 1946–1956. Data: Bubik 1958, 201.



As has been shown previously, the pre-war production levels were restored by 1950 (see Figure 1). In line with the goals of the ERP, the goals of the investment program for the paper industry were an increase in capacities and productivity as well as export. The investment program that was approved and implemented transformed the Austrian paper industry on many levels. These included changes in energy use, raw materials, efficiency, and technology. By June 1953, 771 million ATS in ERP loans had been released to the Austrian paper industry (which represents close to 8 % of all counterpart releases). Additionally, the industry was using 326 million ATS of their own capital by this time (WIFO 1953; Vereinigung österreichischer Papier-, Zellulose-, Holzstoff- und Pappenindustrieller 1953, 11–12).

Two options for increasing the capacity of the paper industry exist: increasing the speed of the machines and their width. Both changes needed expertise to avoid technical problems in conjunction with faster speeds and bigger—and therefore heavier—parts of the machinery (Cohen 1984, 780). Comparisons concerning the speed and width of Austrian paper machines with the paper machines used in Canada and Sweden showed that Austria was not able to compete on the world market. While the largest paper machine in Austria had a width of 3.5 meters in 1950, the largest machine in Sweden reached six meters and the largest machine in Canada reached even seven meters (WIFO 1951, 8). The machines used in the paper production process were among the biggest machines in industry. They were often custom-built for specific sites and were therefore very expensive (Boyd 2015, 117). This may explain why Austrian company owners were at first cautious in their investment plans.

The paper industry depended on a raw material: wood. Using this raw material efficiently was important for both financial and ecological reasons. Several technological changes that affected the material efficiency were introduced during the investment program. New technologies for bark removal, both in the groundwood process as well as in the pulping process, had the potential to decrease wood losses by about ten percent. Further losses occurred when the wood was chipped for pulp production. American experts assessed the chipping machines and concluded that they lacked the proper maintenance. Edgeless blades caused too much sawdust, which could not be used in the process. Losses also occurred during cooking and bleaching in the pulping process; these factors could also be reduced with new machines. New technological solutions were also found and developed to use the waste and by-products of the ground wood and pulping processes. These included burning of the spent lye, the production of spirit, and the production of glue (WIFO 1951, 13–14). Another measure to reduce the necessary amount of raw material was the building of thirty-three machines for fiber recovery (Bubik 1958, 156).

Another suggestion from the American experts was to increase sulphate pulp production and the construction of new sulphate pulp factories. The sulphate process allowed higher pulp yields and offered the possibility of using a wider range of woods. It also allowed the use of pine, hardwood, and waste wood from the sawmill industry (see Figure 3). Since there were few other uses for the waste products of the sawmill industry, this presented a significant advantage for these factories (WIFO 1951, 14). A new sulphate factory in Nettingsdorf was added to the existing sulphate pulp factory in Frantschach Carinthia (Bubik 1958, 154). WIFO criticised the process

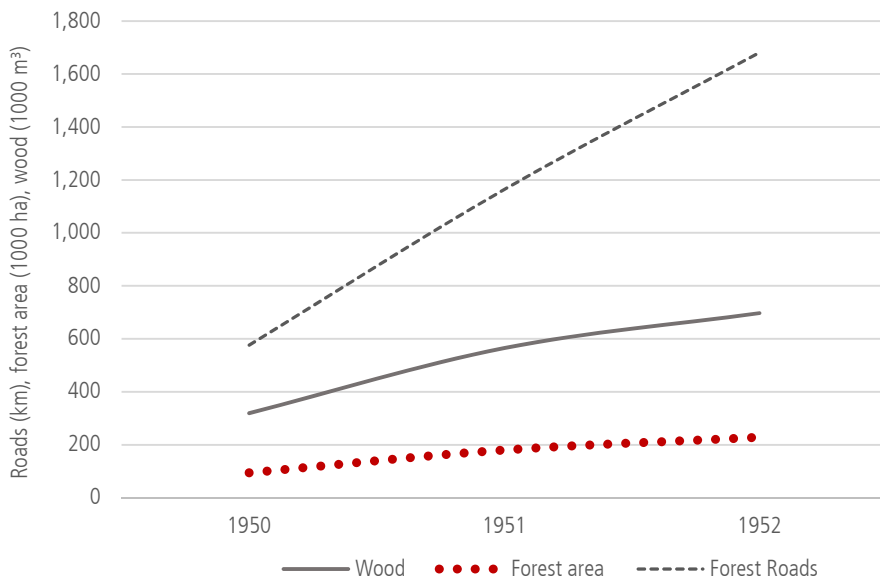


Figure 4: Increase in forest roads, accessible forest area, and available wood in Austria through ERP measures. Data: Memorandum 1953, 51.

in 1951, stating that technologies to produce new kinds of fibers were not considered in the investment program.

In the energy sector, there was also a large potential for improvement. The WIFO report states that, in most pulp factories, the spent lye was not burned for energy production because the new technology for using the chemical energy from the lye was not available in Austria. The method of reusing the spent lye was already common in countries like Sweden (WIFO 1951, 17–18). The investment program of the paper industry shows that new machines that allowed the reuse of spent lye were planned and installed. New boiler systems were installed that allowed to reuse the thermic energy that was saved in the spent lye. The energy basis of the paper industry was also changed through the installation of new water power (2,940 kW) and caloric power equipment (15,000 kW). This allowed the industry to save fuel as well as use different kinds of fuels like coal dust and oil. This enabled the Austrian paper industry to use mainly Austrian fuels by 1952 (Bubik 1958, 154).

After 1952, production grew significantly (see Figure 1). Although the number of production sites continued to decline during the second half of the twentieth century, the production of paper rose throughout this time. Given the changes described above, it is likely that ERP investments laid the foundation for one of the strongest sectors of the economy today. In 2015, twenty-one companies were producing approximately five million tonnes of paper products on twenty-four sites (Austropapier 2016, 2).

Long-Term Investment Program for Forestry 1950–1952

Forestry and agricultural entities, in addition to industries, were allowed and encouraged to apply for ERP grants. As it was for industries, forestry officials also had

to draft an investment program. The original program was designed by the Austrian Ministry for Agriculture and Forestry and submitted to the ECA late because of a lack of staff. The program included (sorted according to financial volume) logging, reforestation, and plant production; a forest survey, research and education, forest protection, thinning, and stock tending (Memorandum 1953, 11, 16; Weigl 2002, 648). As with the investment program for the paper industry, the ECA also played an important role in the design of the investment program. A FAO forest mission reviewed and improved the program and facilitated coordination with the wood processing industries (Weigl 2002, 648). Financial priority was given to logging, reforestation, and a forest survey. Logging aid included the construction of forest roads, aimed at providing access to previously inaccessible forest stands, and the acquisition of new machines for harvesting and wood transport. This reflected the rising industrial demand for wood. Forestry officials were afraid of a wood shortage. In his very detailed overview on Austrian forestry in the twentieth century, Norbert Weigl shows that the ERP was important for Austrian forestry. He concludes that modernisation, an increase in productivity, and mechanisation only started after the beginning of the ERP (Weigl 2002, 663).

A report from 1953 shows the short-term effects of the investment program. Between 1950 and 1952 (see Figure 4), the amount of forest roads increased by 1,681 kilometers. Through the increase of forest roads, the amount of available wood increased by 697,000 cubic meters and the accessible forest area increased by 228,000 hectares (Memorandum 1953, 51). At that time, the estimated sustainable harvest per year was around seven million cubic meters of wood (Weigl 2002, 675).

The TAP offered a study exchange to train forestry workers in the use of newly available machines such as power chainsaws. These trainings proved to be very effective (Dutz and Silberman 1994, 8).

Afforestation was another important part of the program; The official reports, as well as the research by Norbert Weigl, show that experiments were conducted with new tree species, especially fast-growing trees like poplars (Memorandum 1953, 27–28; Weigl 2002, 654). This was also reflected in the TAP program, which included one study visit focusing on poplars (Wettstein 1951).

Although not funded as generously as logging and afforestation, the forest survey was an important part of the “long-term investment program for forestry” it allowed the assessment of acute needs for wood. Part of the anxiety among both forestry and industry officials resulted from not knowing how much wood was available and what condition the Austrian forests were in. The biggest insecurity concerned small, privately-owned forests. The last Austrian forest survey dated back to 1935; it had been based on records from large forest estates and did not include information on small forests (Memorandum 1953, 24). The ERP-funded forest survey was conducted from 1952 until 1956. It introduced many new techniques and technologies. Personnel was especially trained and sent into the forests, aerial pictures were taken, and new machine-based technology was used to process the data (BMLF 1960). The survey not only included wood reserves but also the condition of vegetation and soils. It changed the view on the Austrian forests literally as well as figuratively. According to Norbert Weigl, the survey served as an important input in the debate on sustainability within the forestry community (Weigl 2002, 649–650).

How Did These Programs Change the Wood-Paper Commodity Chain?

In the following paragraphs, the programs’ effects on the wood-paper commodity chain that have been identified, starting with the production of raw material in forestry, will be summarised. Through the construction of new forest roads, the commodity chain extended its access into Austrian forests. The new forest roads transformed the forests to meet the needs of motorised vehicles, which became more important after the war due to changes in rural structures, a lack of horses, and the quest for increased productivity (Weigl 2002, 652). This increased the available amount of wood by approximately ten percent according to contemporary estimates (see Figure 4). The mountainous Austrian terrain proved to be a challenge to this process and special vehicles, like the ‘Motormuli’ had to be developed. These new infrastructure facilities and machines also offered the possibility of reducing forest work’s dependency on the seasonal

cycle (Handel-Mazzetti and Elsässer 1950, 20–21; Weigl 2002, 652).

The reforestation experiments with trees that allowed shorter rotation, like poplars, shows that forest management tried to shorten the production cycles to increase productivity. The active involvement of the paper industry in poplar research and planting is an example of their engagement in securing resources (Bubik 1958, 123–125). The study of the challenges the poplar program faced, as well as its ecological and economical outcome, promises to be a rewarding research question for the future.

The second step of the wood-paper commodity chain is pulp production. While the Austrian paper industry before the late 1940s had used mostly spruce, in the form of logs, the introduction of new technologies allowed the use of by-products of the sawmill industry. This development added sawmills as a new component to the wood-paper commodity chain. Another development was the rise in the use of the sulphate process to produce chemical pulp. This allowed the paper industry to use a wider variety of tree species. This had several implications: it widened the resource base and allowed the paper industry to use trees with less market competition (WIFO 1951, 14). As Figure 3 shows, the increased wood demand was mostly covered with this new source for raw material.

The pulping sector of the industry was also a key factor in using wood more efficiently. The debarking process was transferred from the wood to the factories (Weigl 2002, 667). New machines reduced losses in the debarking and grinding process and enabled a more efficient use of energy in the production of chemical pulp (WIFO 1951, 13).

The next step in the commodity chain is the cardboard and paper production factories. Here the capacities were increased through the installation of new machines and adaption of old machines to become wider and faster. This increased production capacities and therefore the demand for raw material and energy. The previous paragraphs showed that the technological improvements in other parts of the commodity chain made this increase of capacities possible.

We will go one step further to discuss the use of waste paper as a raw material. Especially in times of crisis, reusing material became an important source for raw materials. After the Second World War, the paper industry organised waste paper collections to supplement their needs. Coal from the Pa-Ko campaign was used as trading material (four kilograms of waste paper could be traded against one kilogram of coal) (Fachverband 1948, 12). The installation of new machines that improved the recycling process, and sometimes even the demand of one single machine, (for example, a new cardboard machine at Mayr-Melnhof in 1951), was reflected in the amounts of recycled waste paper (Fachverband 1955, 27).

Some aspects become obvious only when we look at the whole commodity chain. While the production of energy within the factories had been partly based on fossil fuels for a long time, forestry became increasingly based on fossil fuels with the introduction of motorised vehicles for forest work and transportation and fossil-fuel-powered machines like the chainsaw (Pröll [n.d.]). The investment programs also literally changed insiders' views of the Austrian forests by providing the first attempt at a thorough assessment of the Austrian forests using aerial pictures (Bundesministerium für Land- und Forstwirtschaft et al. 1960, 16).

Continuing our journey to the paper factories, a look into the investment program also shows that the production sites themselves had to adapt to the technological changes. In eight factories, rails for transport were built or adapted, and thirty-four new houses for employees of the factories were provided (Vereinigung österreichischer Papier-, Zellulose-, Holzstoff- und Papierindustrieller 1953, Table 6).

On the consumer side, the demand for paper increased significantly, from fourteen kilograms per person in 1947 to thirty-three kilograms per person in 1955 (Fachverband 1955, 6).

Conclusion

This article presents the first results of research in progress. It aims at showing how a program that, in the cases of the paper industry and forestry, only lasted two to three years, changed basic structures of all parts of the wood-paper commodity chain. In 2015, the Austrian paper industry produced close to five million tonnes of paper and around 1.8 million tonnes of chemical and mechanical pulp. In quantitative terms, the developments after the 1960s overshadow the developments that can be observed between 1945 and 1955, but many of the trends that were set and introduced at that time are still visible today. This includes the growing utilisation rate of waste paper (close to fifty percent in 2015), the increasing amount of sawmill by-products (more than fifty percent of the wood that was used in 2015 belonged in this category), and the growing energy efficiency that today even allows some of the pulp factories to supply energy to the national electricity grid (Austropapier 2016, 2; 33; 38).

Effluents, however, are not mentioned in this article. In the sources used for this article, which mainly include reports and research conducted shortly after the implementation of these programs, this topic is mostly absent, and therefore the sources did not allow for a conclusive statement on this issue. It can be said that effluent and its effects were not part of a broader discourse at the time, but hints in the sources show that stream pollution caused local conflicts between factories and their neighbours nearby and downstream (Dinklge 1954, 126). The

yearly report of the paper industry, as well as a dissertation from the late 1950s, also hints at the existence of a working group that dealt with questions of how to deal with the spent lye (Bubik 1958, 91; Fachverband 1954, 41).

Viewing the interface of nature and society in the paper industry provides a basis for future environmental history research. Such research will have to take a closer look at the specific links of the wood-paper commodity chain and the socio-natural sites created by the reconstruction between 1945 and 1950 and their development during the time of transformation from 1950 onward.

1. PaKo is short for Papier und Kohle (paper and coal).
2. Waldstandsaufnahme 1952/56: 40% private forest below 50 ha.
3. In 1948 1,337.034 m³ of the total of 351.719 m³ wood used by the paper industry were supplied by the Pa-Ko campaign.
4. KLA, Österr. Wirtschaftskomitee, Schachtel 1, Mappe 4, 26.5.1946.
5. KLA, Österr. Wirtschaftskomitee, Schachtel 1, Mappe 4, 26.4.1946.

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