Limitations of Environmental Success Without Successful Environmental Policy

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After the Second World War, Helsinki experienced decades of modernization and rising living standards, but also the adverse consequences of modern urban life. Air pollution from energy generation, industries, waste incineration and traffic became increasingly obvious from the late 1950s onward. Scientific uncertainty about the nature and severity of the problem, together with a lack of appropriate legal tools to combat air pollution, resulted in the failure of city officials' attempts to deal effectively with polluters. Hegemonic attitudes concerning the nation's economic future led to reluctance to demand costly air-protection measures – pollution was partly accepted as the price to pay for higher living standards. Paradoxically, in spite of this, the air quality in Helsinki eventually improved remarkably, after having been at its worst in the late 1960s. The main causes of this development– the transition to district heating and the relocation of polluting industries away from Helsinki – were a consequence of economic calculations in the context of an energy supply crisis and the specific geographic limitations of the city. The city's improved air quality was a result of partial problem displacement combined with economically motivated structural changes. This paper examines the reasons for this environmentally advantageous outcome, which was achieved in the absence of a particularly successful environmental policy.

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Urban environmental history from the 19th century onward abounds with stories about cities where rapid urban growth combined with heavy industrialization and intensive use of coal as an energy source caused smoky skies and increasing air pollution. The history of political and cultural responses to urban air pollution problems has been widely studied.[2] As in

many other cities, air pollution emerged in Helsinki as a new urban nuisance at the turn of the 19th century. Nevertheless, it never attained levels comparable to those of the heavily industrialized metropolises of central Europe and North America.

In Helsinki, smoke first began to be perceived as a problem in the early 20th century. Under the influence of the new emphasis on hygiene of the period, a smoke inspector was employed for three years to work on the most serious cases of pollution in the city.[3] However, by the 1910s at the latest general interest in the smoke problem began to wane, and it was not until the post World War II years that urban air pollution gained momentum again in Helsinki's public agenda.

[1] Acknowledgements: An earlier version of this paper was presented at the 5th Roundtable on Urban Environmental History in Berlin 2008. Comments from the audience are gratefully acknowledged, as well as valuable suggestions for revision provided by two anonymous reviewers of this article.

[2] See, among others, P. Brimblecombe, *The Big Smoke: A History of Air Pollution in London since Medieval Times,* Routledge, London 1987. A. Andersen, F.-J. Brüggemeier, "Gase, Rauch und Saurer Regen", in *Besiegte Natur. Geschichte der Umwelt im 19. und 20. Jahrhundert*, F.-J. Brüggemeier, T. Rommelspacher (eds), Beck'sche Reihe 345, Beck, München 1987, pp. 64-85. C. Bowler, P. Brimblecombe, "Control of Air Pollution in Manchester prior to the Public Health Act, 1875", in *Environment and History*, 6, 1, 2000, pp. 71-98. D. Stradling, *Smokestacks and Progressives. Environmentalists, Engineers and Air Quality in America 1881-1951*, John Hopkins University Press, Baltimore 1999. S.H. Dewey, *Don't Breathe the Air. Air Pollution and U.S. Environmental Politics 1945-1970,* Environmental History Series 16, A&M University Press, Texas 2000. M. Jacobson, *Atmospheric Pollution: History, Science and Regulation,* Cambridge University Press, Cambridge 2002. F. Uekötter, *Von der Rauchplage zur ökologischen Revolution. Eine Geschichte der Luftverschmutzung in Deutschland und den USA 1880-1970,* Veröffentlichungen des Instituts für soziale Bewegungen, Schriftenreihe A: Darstellungen, Band 26, Klartextverlag, Essen 2003. B. Luckin " 'The Heart and Home of Horror': The Great London Fogs of the Late Nineteenth Century", in *Social History* 28, 1, 2003, pp. 31-48. P. Thorsheim, *Inventing Pollution. Coal Smoke and Culture in Britain since 1800,* Series in Ecology and History, Ohio University Press, Ohio 2006.

[3] M. Kruut, *Kivihiilisavua vastaan. Helsingin ilman epäpuhtaudet sekä ilman pilaantumisesta käyty yleinen keskustelu 1880-luvulta 1920-luvulle,* Master's Thesis, Department of Finnish History, University of Helsinki, Helsinki 1998.

After the reconstruction period immediately following World War II, Finland, and Helsinki in particular, experienced several decades of economic prosperity, rapid modernization, improving standards of living, and changing consumer habits. The adverse consequences of the modern life style soon became evident as urban environmental problems escalated. Air pollution problems caused by energy generation, industries, waste management, and traffic became increasingly obvious from the late 1950s onwards. Early air protection efforts were beset by many failures. Paradoxically, in spite of this the air quality in Helsinki eventually improved significantly after being at its worst in the late 1960s.

This paper aims to examine the reasons for this environmental success, achieved without a particularly successful environmental policy. How was it possible that the struggle of officials to combat air pollution failed in Helsinki, and yet the air quality of the city improved? My study concentrates on municipal-level policies, since in Finland municipalities have a high degree of autonomy and economic independence, and manage much of the state welfare sector, which they finance with state subsidies and by collecting taxes. Before the gradual institutionalization of environmental administration during the 1970s and the passing of the Air Protection Act in 1982, air pollution questions were dealt with mainly at the local level.

My research material consists of documents produced by the main administrative actor in the environmental field, the city Health Board and Office, during the period 1945-1982. I studied air protection policies by analyzing the discussions, arguments and decisions of the Health Board related to citizens' written complaints about smoke problems. The material includes preparatory documents of committees dealing with air quality issues as well as related administrative documents from the City Council and City Government. The documents concerning the energy question in Helsinki belong to the Helsinki Electric Utility (Helsingin Energia).[4] I have com-

[4] These committees include Helsingin ympäristönsuojelun neuvottelukunta HYT (the Helsinki Environmental Committee; documents stored in the Helsinki City Archives) and the Ilmansuojelun ja meluntorjunnan neuvottelukunta ISMET (National Air Protection and Noise Abatement Committee; documents

plemented the information derived from this archive material with newspaper articles from the period .

Air pollution in post-war Helsinki

Helsinki was a backward and small village until 1812, when, as part of a more general geopolitical strategy, it was designated as the capital of the autonomous Grand Principality of Finland, part of the Russian Empire. The city grew rapidly, evolving by the latter half of the 19th century into a bustling town and the administrative and economic center of the country. Industrialization accelerated, especially during the last decades of the century.

The city center of Helsinki is located on the southern tip of a peninsula surrounded on three sides by the Baltic Sea (Map 1). The city grew fastest northwards, along the main railways.

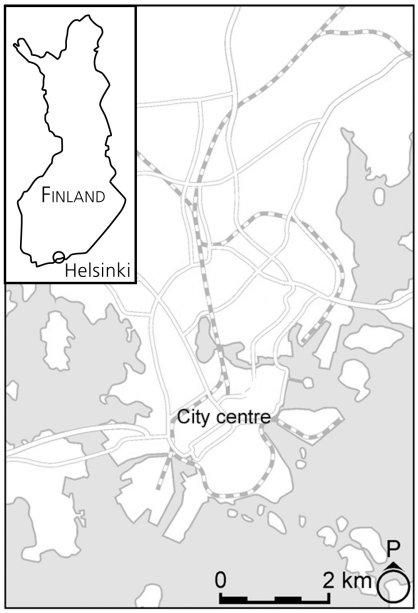
Ever since early descriptions of the city, scholars emphasized its excellent natural conditions and good ventilation. Fresh sea air diffused the detrimental urban smoke and helped to maintain healthy living conditions.[5] The geographical location of the city center, however, was also disadvantageous. As I will demonstrate later, the limited available space on the peninsula had an effect on the pollution history of the city.

Despite this good ventilation, there is plenty of evidence for pollution issues in the city after its industrialization. Citizens complained to authorities about poor environmental conditions and demanded improvements. Smoke problems were mostly very local, affecting neighbors and people in the vicinity of the pollution source. Until the first scientific study of air quality was conducted in 1959, the recognition of air pollution problems in Helsinki was based on

stored in the archives of the Finnish Council of State). The Health Board, City Council and City Government documents are in the Helsinki City Archives; energy-related documents in the archives of the Helsinki Energy Utility.

[5] H. Waris, *Työläisyhteiskunnan syntyminen Helsingin Pitkänsillan pohjoispuolelle*, Weilin + Göös, Helsinki 1973 [1932]. S.-E. Åström, "Samhällets omdaning" in *Helsingfors stads historia*. Perioden 1875-1918, Helsingfors stad, Helsingfors 1956, p. 210.

Map 1. Central Helsinki with railways and the main roads around 1970



direct sensory impressions that were immediate and localized.[6] The general perception of air quality in the city was based on lay people's descriptions and occasional scientific studies.[7] It can be assumed that only the most striking cases were brought up in the public debate. Especially during the immediate post-war years, in the late 1940s and early 1950s, the country suffered from massive social and economic problems, including shortages of food and other essentials. These circumstances raised the threshold for complaints about less urgent problems, such as smoke.[8]

[6] Compare J. Dunsby, "Localizing Smog: Transgressions in the Therapeutic Landscape", in *Smoke and Mirrors. The Politics and Culture of Air Pollution*, E.M. DuPuis (ed.), New York University Press, New York 2004, p. 175.

[7] Minutes of the Health Board meetings 1945-1982.

[8] T. Lahtinen, R. Vuorisalo, "' It's War and Everyone Can Do As They Please!' An Environmental History of a Finnish City in Wartime", in *Environmental History* 9, 4, 2004, pp. 679-700.

According to the complaints, the sources of air pollution in Helsinki after World War II were manifold. Central heating chimneys puffed out coke and oil smoke, especially in the long and cold winters. In many cases the smoke was recognized as problematic, but since heating was a crucial necessity, there were hardly any complaints about it. Public saunas, mainly heated with firewood, also caused smoke in courtyards, but were usually not prohibited since the sauna culture was considered an essential part of human well-being.[9] Most of the complaints were targeted at smoke from industries. Even though it was never considered a predominantly industrial city, Helsinki was the leading industrial city of the country, with activity peaking in the mid-to-late 1960s. The three main industrial branches were metal, food and printing. Until the 1950s, more than half the industry in Helsinki was located in the central districts and the main peninsula.[10] Small workshops of various types – including metal workshops, bakeries and roasting factories – were the most important sources of local air pollution in the city. These shops were often located in the foundations of dwelling houses, and their smoke was hence an everyday nuisance for citizens.[11] The harbors around the peninsula were the most trafficked in Finland, and the ships and trains operating there added to the emissions.

Despite occasional economic recessions, the decades following World War II were more prosperous than ever before. As the only metropolis of the country, Helsinki was the forerunner of a boom in modernization and increasing affluence. The population of the city grew rapidly. Its new, modern lifestyle was characterized by ris-

[9] P. Schönach, *Kaupungin savut ja käryt. Helsingin ilmansuojelu 1945-1982,* Doctoral thesis, Yhteiskuntapolitiikan laitoksen tutkimuksia 1/2008, University of Helsinki, Helsinki 2008. Also available online at http://urn.fi/URN:ISBN:978-952-10-5010-7, pp. 165-166.

[10] K. Hoffmann, "Elinkeinot", in *Helsingin historia vuodesta 1945,* O. Turpeinen, T. Herranen, K. Hoffmann (eds), Helsingin kaupunki, Helsinki 1997, pp. 276-282. H. Schulman "Helsingin kasvu suurkaupungiksi", in *Näkökulmia Helsingin ympäristöhistoriaan. Kaupungin ja ympäristön muutos 1800- ja 1900-luvuilla,* S. Laakkonen, S. Laurila, P. Kansanen, H. Schulman (eds), Helsingin kaupungin tietokeskus, Helsinki 2001, pp. 22-26.

[11] Minutes of the Health Board meetings.

Pic. 1. Porcelain factory smokestack northeast of central Helsinki[12]

ing consumerism, with increasing expenditure on household appliances, leisure and luxury.[13] Reflecting this transition, the quantity and quality of household waste changed rapidly. More solid waste of diverse material, not suitable for composting or recycling, was produced than ever before. At the same time it became more and more difficult to find remote enough landfills that were at the same time accessible with reasonable transportation costs. The city thus faced a constant garbage crisis. As an affordable and quick solution,

[12] Picture taken 23 February 1973. Photographer unknown, Pertti Forss' private collection.

[13] A. Perrels, "Private Consumption in Economic and Environmental Policy Context", in *Kulutuksen pitkä kaari. Niukkuudesta yksilöllisiin valintoihin*, K. Ahlqvist, A. Raijas, A. Perrels, J. Simpura, L. Uusitalo (eds), Gaudeamus Helsinki University Press, Helsinki 2008, pp. 100-101. V. Heinonen, "Näin alkoi kulutusjuhla. Suomalaisen kulutusyhteiskunnan rakenteistuminen", in *Hyvää elämää. 90 vuotta suomalaista kuluttajatutkimusta*, K. Hyvönen, A. Juntto, P. Laaksonen, P. Timonen (eds), Kuluttajatutkimuskeskus, Helsinki 2000, pp. 14 ff.

small-scale backyard incinerators were constructed for densely populated districts. Soon smoke and unpleasant smells from thousands of insufficiently burning furnaces became familiar components of the city air. Small-scale incineration was the most complained about source of annoyance. People suffered from soot dirtying furniture, windows and laundry, and smells making indoor ventilation impossible. A large municipal incinerator eight kilometers northeast of the city center started operations in 1961. Later investigations have shown that the incineration of waste here, besides producing smoke and smells, caused considerable pollution from heavy metals such as cadmium and mercury.[14]

A further source of air pollution was added to these in the decades following World War II, which saw, as in many other cities, the rise of the private car "from exclusivity to autocracy."[15] After the import of private cars was liberalized in Finland in 1960, their numbers rose dramatically. In 1950 there were only 6000 private cars in the city; twenty years later they numbered 87,000.[16] With a road infrastructure built for much fewer cars and the geographical limitations of the city center, huge traffic problems soon became evident. Constant congestions caused bottlenecks on bridges leading to the central peninsula. Traffic and its exhaust fumes were speedily becoming a new, serious source of air pollution.[17]

Helsinki's air quality was precisely measured for the first times in 1958 and 1959. Several investigations, although not systematic, followed during the 1960s.[18] The results of the late 1950s already

[14] K. Leminen, R. Pyrylä, "Teollisuuden muisto. Helsingin maaperän saastuminen ja kunnostus", in *Näkökulmia Helsingin ympäristöhistoriaan* cit., p. 82. R. Mattsson, T. Jaakkola, "An Analysis of Helsinki Air 1962 to 1977 Based on Trace Metals and Radionuclides", in *Geophysica*, 16, 1, 1979, p. 24.

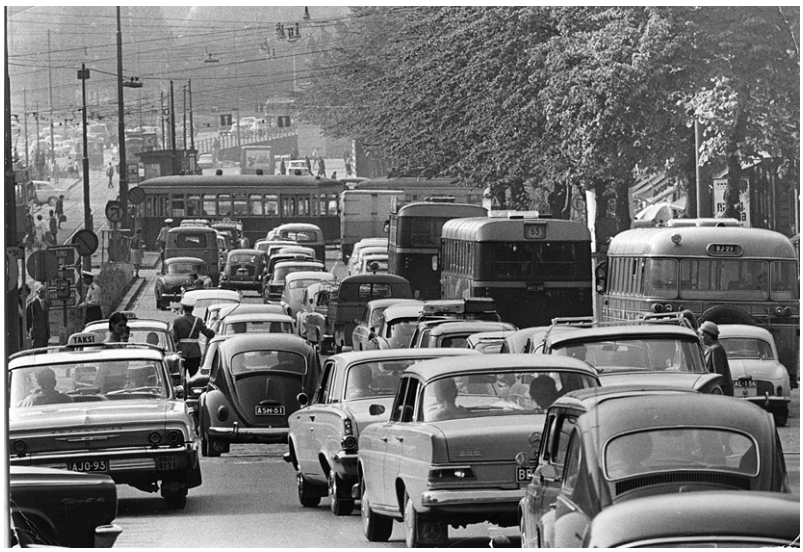
[15] L. Virrankoski, "Auto ympäristökysymyksenä ennen ja nyt", in *Viettelyksen vaunu. Autoilukulttuurin muutos Suomessa,* K. Toiskallio (ed.), SKS Toimituksia 841, Suomalaisen kirjallisuuden Seura, Helsinki 2001, p. 236 (translation of the Finnish phrase "ylellisyydestä yksinvaltaan" by the author).

[16] Helsinki City Statistical Yearbooks.

[17] Schönach, *Kaupungin savut ja käryt* cit., pp. 64-65, 168 ff.

[18] A. Laamanen, "*Leijuvat epäpuhtaudet Helsingin ilmassa",* Työterveyslaitoksen tutkimuksia 19, Työterveyslaitos, Helsinki, 1966. A. Laamanen, "*Helsingin*

Pic. 2. Central Helsinki traffic, probably in the late 1960s[19]



showed surprisingly high pollution levels. Later studies indicate that the air quality in Helsinki worsened considerably after 1959. Sulphur dioxide concentrations and particulate matter exceeded both international recommendations and Finnish (at that time still unofficial) guidelines for acceptable air quality in housing areas.[20] Citizens'

ilman laskeutuvat ainekset. Katsaus v:lta 1959 ... 1965" Työterveyslaitoksen tutkimuksia 33,Työterveyslaitos, Helsinki 1967. A. Laamanen, L. Noro, *"Helsingin ilman leijuvat ainekset. Katsaus vuosilta 1959 ...1965",* Työterveyslaitoksen tutkimuksia 30, Työterveyslaitos, Helsinki 1967. A. Laamanen, L. Noro, *"Helsingin ilman saasteen lähdeyhtymäkatsaus ja siihen liittyvät kaupunkikohtaiset ilmasuojelunäkymät",* Työterveyslaitoksen tutkimuksia 34, Työterveyslaitos, Helsinki 1967. A. Laamanen, Y. Rautanen, *"Helsingin ilman saasteisuustutkimus v. 1967-1968",* Työterveyslaitoksen tutkimuksia 51, Työterveyslaitos, Helsinki 1969.

[19] Photographer and date unknown, Pertti Forss' private collection.

[20] P. Kajanne, S. Laiho, "A Preliminary Investigation of Air Pollution in Helsinki with Particular Attention to Diesel Smoke", in *Suomen Kemistilehti* (B-part) 31, 4, 1958, pp. 193-198. L. Noro, A. Laamanen, "Über den Charakter und die

written complaints about smoke problems peaked during the 1960s. Normally health officials received 100-200 complaints annually, but in 1966 there were 280 complaints about smoke and soot.[21] Media attention also peaked during the 1960s, even though articles about environmental issues in Finnish newspapers were more numerous later, during the 1970s.[22] The alarming findings were discussed several times by the Health Board, and the City Council and several committees and working groups tried to deal with the pollution issue. There was increasing insistence among the general public on the need for concrete action to combat the deterioration of air quality.

As I mentioned above, the air quality in Helsinki did eventually improve from the 1970s onwards. It has been estimated that it was at its worst in the late 1960s, after which air filter samples reveal a continuous reduction in particulate matter (Fig. 1).

Air pollution-sensitive lichens, which declined between 1933 and the 1960s, were observed to recover from the mid-1970s on.[23] In the 1970s regular air quality measurements were started, and these studies showed declining levels of pollutants such as sulphur dioxide. Complaints from the public about smoke problems also decreased during those years.[24]

In sum, both scientific results and the subjective experiences of citizens indicate that the air quality deteriorated rather quickly in Helsinki in the post-war years. This was due to industrial activities, the

gesundheitlichen Auswirkungen der Luftverunreinigung in Helsinki", in *Staub* 22, 5, 1962, pp. 191-192. A. Laamanen, *Leijuvat epäpuhtaudet Helsingin ilmassa,* Työterveyslaitoksen tutkimuksia, 19, Työterveyslaitos, Helsinki 1966. A. Laamanen, L. Noro,"The Settleable Impurities of Outdoor Air", in *Work, Environment, Health* 2, 1, 1966, pp. 64-65.

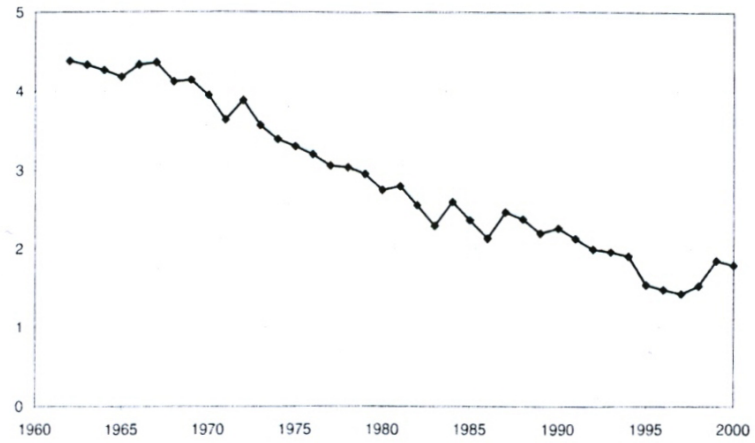
[21] Schönach, *Kaupungin savut ja käryt* cit., p. 182.

[22] P. Suhonen, *Mediat me ja ympäristö*, Vastapaino, Tampere 1994, p. 98.

[23] V. Hosiaisluoma, *Puiden jäkälät Helsingin kantakaupungin ilmanlaadun kuvaajina vuonna 2000* Ympäristökeskuksen julkaisu 14, Helsingin kaupungin ympäristökeskus, Helsinki 2001. V. Hokkanen, L. Oksanen, E. Rantakrans, *Helsingin ilman rikki*, Helsingin Energia, Helsinki 1977. Pääkaupunkiseudun ilmansuojelu tavoiteohjelma 1981, Pääkaupunkiseudun julkaisusarja A, YTV, Helsinki 1981.

[24] Hufvudstadsbladet (Hbl) [the main Swedish language newspaper in Finland] 11 August 1976. Minutes of the Health Board 1945-1980.

Fig 1. The relative darkness of air filter samples, 1962-2000 [25]



introduction of incineration as a waste management procedure, and the dramatic growth of motor vehicle traffic in the limited geographical area of the city center. However, within a relatively short period of time this trend was reversed, and after the late 1960s the air quality in the city center began to improve considerably. Was this success story a result of efficient smoke abatement and air protection policy?

The failure of air protection policy in post-war Helsinki

The purpose of environmental policy can be defined as regulating pollution, preventing the deterioration of the environment, and maintaining or improving the quality of the natural environment.[26] I will argue that the improving of air quality in central Helsinki was the outcome, not of intentional attempts to reduce air pollution,

[25] R. Mattsson, "Nokea ja pienhiukkasia. Ilman fysikaalis-kemiallisen tutkimuksen kehitys", in *Näkökulmia Helsingin ympäristöhistoriaan* cit., pp. 182-195.

[26] L. Lundqvist, "Environmental Politics in the Nordic Countries: Policy, Or-

but of processes motivated by reasons other than environmental concern. Indeed, the authorities were reluctant to act proactively on the issue and their few attempts to tackle pollution problems largely failed. One could easily argue that the air quality in Helsinki has improved despite failures in air protection policy. These failures can be regarded as depending on a variety of factors or incidents, from ideological and institutional-juridical barriers to the influential personal opinion of a single official. The following paragraphs look further into this question and provide examples of how and why air protection policies in Helsinki failed.[27]

Scientific uncertainty and administrative reluctance

Very similarly to what Frank Uekötter affirms about car exhausts in pre-World War II Germany, the reaction of scientists in post-war Helsinki to air pollution emissions in general was indefinite or "lukewarm."[28] Pollution problems were obvious and increasingly addressed as more serious than a mere nuisance, but at the same time dismissive statements were articulated that no real health hazards were imminent. The Finnish air pollution experts at the Technical-Hygienic Department of the Institute for Occupational Health were the key figures in the committees formed to deal with the issue. In public they gave rather contradictory messages on the topic. On the one hand, they stressed the worsening of the situation and drew nearly horrific scenarios about future air quality; on the other, they

ganisation and Capacity", in *Governing the Environment: Politics, Policy and Organisation in the Nordic Countries*, P. Christiansen (ed.), Nord 5, Nordic Council, Copenhagen 1996, p. 16.

[27] Urban environmental historians have described several examples of failures in air protection policies. Some of them have features similar to the case of Helsinki – though they mostly occurred decades earlier than in Finland. For American examples of failures in air protection policies, see Dewey, *Don't Breathe the Air* cit., p. 113 ff. F. Uekötter, "The Merits of the Precautionary Principle", in *Smoke and Mirrors. The Politics and Culture of Air Pollution*, E.M. DuPuis (ed.), New York University Press, New York 2004, pp. 137ff.

[28] Ibid., p. 126.

instantly added that this could be avoided by sufficient funding for further research – although hardly any proposals for concrete measures were put forward[29] –, and reassured the worrying public by stating that pollution was under control. They were possibly underestimating the problem,[30] and certainly giving it only marginal and occasional attention, when compared with that it was receiving in other urbanities in, for instance, central Europe. It must also be said that the available scientific results left room for very different interpretations of the severity of the air pollution question in Helsinki.[31]

In 1960 and 1966, two different committees were set up by the authorities to investigate the pollution issue. The authorities were reluctant to take proactive action on the pollution issue with any programmatic measures before they received precise instructions from the expert committees. However, the committees' results were only ready much later, after four and seven years, respectively, because their members mainly participated in the committees in addition to their main duties, and the secretary, the leading air protection expert in the country, was busy with several other studies at the Department of Occupational Health. In the end, their final reports offered very few concrete suggestions for smoke abatement.

Thus, for more than a decade the authorities waited for scientific justification and expert opinions on how to conduct effective air protection and ended up intervening only in extreme individual cases of smokestack pollution with technological fixes or arrangements to stagger times of smoke production. Pollution issues were easily understated, and overshadowed by more urgent problems.

The will to invest in smoke abatement was very weak. The municipality was caught in the contradiction between its efforts to offer

[29] Health Board 5 February 1964, 112§, App. 2; 16 June 1965, 539§, App.8; Hbl 2 July 1960. *Helsingin Sanomat* (HS) [major Finnish newspaper] 9 July 1960. HS 2 March 1960. ISMET (National committee for air protection and noise abatement) statement 20 January 1971. For more on the strategy of "more research" in environmental policy, see J. A. Hannigan, *Environmental Sociology: A Social Constructivist Perspective,* Routledge, London 1995, pp. 77–79.

[30] T. Launis, *Ympäristösuojelun esiselvitykset, yleiskaavaehdotus 1972*, Yleiskaavaosasto 11 June 1971, Kaupunkisuunnitteluvirasto, Helsinki 1971, p. 37.

[31] Schönach, *Kaupungin savut ja käryt* cit., pp. 190-191.

citizens a healthy and pleasant living environment and those to encourage industrial activity for economic prosperity.[32] Creating jobs, especially in the industry, and raising tax money were crucial aims for postwar Finland's welfare project, and a top priority in Helsinki's communal policies.[33] Environmental concern was often thwarted by the ideas behind the modernizing project of post-war Finland, with the hegemonic ideology of economic growth at its core.[34]

The discourse of economic hegemony was widely accepted. Citizens complaining about smoke problems often specified that they did not "intend to create unemployment" with their complaints.[35] Thus, smoke was not perceived merely as pollution, or at least a severe nuisance, but also as a symbol of prosperity and progress. An urban variant of the phrase "money smells,"[36] familiar among Finnish communities with pulp and paper industries, was evolving: smoke was an essential part of the city, and rural air quality could not be demanded in a lively urban environment. Real urbanity and its modern amenities involved certain nuisances which could not be avoided without returning to backward, undeveloped times. Some even mused about the disappearance of industrial romanticism with its smoke.[37] Cars, fumes and smoke were the symbols of a modern

[32] This parallels what Martin Jänicke has written about state failure in environmental policy, only transferred to the local level. M. Jänicke, *State Failure. The Impotence of Politics in Industrial Society,* Polity Press, Cambridge 1990.

[33] I. Massa, *Pohjoinen luonnonvalloitus. Suunnistus ympäristöhistoriaan Lapissa ja Suomessa,* Gaudeamus, Helsinki 1994, p. 119.

[34] M. Laine, L. Peltonen, *Ympäristökysymys ja aseveliakseli. Ympäristön politisoituminen Tampereella vuosina 1950-1995*, Tampere University Press, Tampere 2003, p. 137.

[35] Health Board 4 September1968, 834§, App. 2. See also Laine, Peltonen, *Ympäristökysymys ja aseveliakseli* cit., p. 137.

[36] I. Massa, *Toinen ympäristötiede. Kirjoituksia yhteiskuntatieteellisestä ympäristötutkimuksesta*, Gaudeamus, Helsinki 1998, p. 145. Compare also with the slogan "smoke puts bread on my table," which workers of the American Steel and Wire Co. used to repeat in infamous Donora, Pennsylvania, where air pollution killed 20 people in 1948. See: http://www.portal.state.pa.us/portal/server.pt/community/events_that_shaped_our_environment/13894/donora_smog_/588401 (viewed 18 September 2010).

[37] Schönach, *Kaupungin savut ja käryt* cit., p. 164.

era in Finnish urbanism, and as such they should be appreciated or at least tolerated, rather than grumbled about.[38]

Smoke problems were the cost to be paid for improved living standards and the everyday amenities that the nation desired: pollution was the by-product of prosperity.[39] The demand for healthy living conditions was easy to ignore because smoke pollution was often local and occasional. Since no definite danger was proven to exist, serious intentions to limit industrial activity or the increase of traffic were not voiced, nor would have been widely accepted.

Lack of appropriate legal tools

The immediate post-war decades in Finland have been described as a phase of legalistic administrative culture. Civil servants had considerable power in municipal decision-making,[40] and the citizens themselves placed great trust in the action of the authorities. The public thus mainly turned to the authorities to demand improvements in local air quality. Pollution issues were also brought up by the elected municipal representatives, after which the cases were transferred to the appropriate bureau for processing.[41] The lack of specific juridical-administrative tools was a key obstacle to effective air protection. Civil servants are guided in their work by laws and statutes. They work on concrete cases that are within their area of responsibility.[42] Even when there was general concern about increasing air pollution problems, the practical work of abating pollution was done reactively, case by

[38] Suomen Sosiaalidemokraatti [newspaper] 13 February 1963. Hermanni-Vallila [district newspaper] 2, 1980.

[39] A. Laamanen, "Raitista ulkoilmaa", in *Työterveysuutiset* 4, 1962, p. 13.

[40] R. Sairinen, *Regulatory Reform of Finnish Environmental Policy*, Helsinki University of Technology, Espoo 2000, p. 250. L. Kolbe, "Helsinki kasvaa suurkaupungiksi. Julkisuus, politiikka, hallinto ja kansalaiset 1945-2000", in *Helsingin historia vuodesta 1945, Osa 3,* L. Kolbe, H. Helin (eds), City of Helsinki, Helsinki 2002, pp. 24, 61.

[41] Schönach, *Kaupungin savut ja käryt* cit., pp. 111-113.

[42] M. Hajer, H. Wagenaar, *Deliberative Policy Analysis. Understanding Governance in the Network Society. Theories of Institutional Design,* Cambridge University Press, Cambridge 2003, p. 19.

case, normally only after a complaint had been received concerning smoke, soot or other pollutants. Air pollution problems could be addressed only under the Health Care Act, which prohibited activity causing health damage.[43] Proof of health damage was necessary, however, before the law could be invoked. In the case of air pollution this was extremely difficult to do, and the burden of proof was on the damaged parties.[44] Although the scientific know-how to provide evidence of health damage would have been theoretically available, the health authorities, let alone ordinary citizens, lacked the instruments and finances to conduct the necessary research. As a consequence of this cognitive uncertainty, smoke and fumes were often treated as a mere nuisance, inconvenience, or hygienic problem, not as a health hazard.[45] Lack of proof was also used as an argument by the owners of polluting industries. The sole guilt of an individual facility could not be proved, especially in areas with many industrial sites. The authorities were also advised to concentrate on more severe problems.[46] A case in the district of Lauttasaari exemplifies this dilemma. The Health Board received a complaint about a company using strong chemicals for wood processing. The complaint came from the employees of the neighboring company, among whom yellow smoke from their neighbor was causing nausea and other symptoms of poisoning. Since the cause for the sickness could not be unambiguously traced to this smoke, they were simply advised to get treatment. No restrictions were imposed on the industry.[47]

In the case of small-scale incineration, the demonstration of health damage required an absurdly involved procedure. The many smoking in-situ incinerators were unanimously disapproved by the

[43] National Health Care Act (192/1927) revised (469/1965). There was an Adjoining Properties Act (NaapL 26/20), but it was mostly applied to large-scale environmental hazards causing considerable damage, such as the pollution of water courses by the pulp industry. It applied to civil law and was not within the jurisdiction of the city authorities.

[44] See also e.g. Hannigan, *Environmental Sociology* cit., p. 99.

[45] Schönach, *Kaupungin savut ja käryt* cit., p. 96.

[46] E.g. Health Board, 30 May 1956, 403§; 8 June 1966, 528§ App2; 18 September 1968, 879, App 7.

[47] Health Board 21 September 1949, 1026§.

so called "smell-nuisance-committee" set up in 1960 to deal with the pollution problem in Helsinki.[48] However, the judicial interpretation of building restrictions did not consider the possibility of prohibiting small-scale incineration altogether. Health officials had no other means to try to decrease the smoke emitted daily from more than a thousand of incinerators than to give proof of health damage in a highly laborious and ineffective way. They referred to studies stating that smoke from waste combustion at temperatures lower than 800 °C would cause negative health effects. The incinerators in town were inspected one by one, and their combustion temperature was measured. One case required at least three visits by the health inspector and two readings at the health board. One sanitary inspector was occupied full-time with incineration measurements for more than a decade. All this while new in-situ incinerators were being installed, throughout the 1960s, in new, quickly built suburbs, and were even recommended by the Engineering Office of the Union of Property Owners and the City Inspectors of Property.[49] The process of closing down an incinerator was laborious and the city health department, with its constant shortage of personnel, could react only very slowly to the significant local pollution problems caused by incinerators. The closure of the small incinerators operating in Helsinki took more than twenty years.[50]

In cases where smoke was declared a health risk, the company or owner could delay the execution of the required measures by appealing to higher authorities. It was not unexceptional for smoke-containment measures solicited by the Health Board to be postponed up to five years due to continued considerations of the case in the regional courts and finally at the highest court levels.[51] A polluting company was usually given six months' time to carry out the tech-

[48] Hajukiusakomitea (Smoke Nuisance Committee), City Government 23 September 1966, 2506§, App. 1.

[49] Health Board 16 September 1959, 783§ App. 1; 24 February 1965, 153§, App.4.

[50] The last backyard incinerator was closed in 1980, Health Board 25 March 1980, 197§, App.6.

[51] See e.g. Health Board 3 April 1968, 332§, App 3 and 4; 10 February 1971, 206§; 24 March 1971, 396§, 19 May 1971, 713§.

Pic 3. Health inspector Pauli Lindfors measuring the combustion temperature of a backyard incinerator in Helsinki in the 1960s [52]

nical improvements required for smoke reduction, after which the enforcement procedure could begin if the measures had not been taken. Appeals were often filed merely to delay the enforcement of the Health Board decisions, since the higher instances practically never changed the original resolutions in favor of the appealing party.[53] And the health authorities had no means to stop the pollution

[52] Photographer unknown; Pertti Forss' private collection.

[53] A. Rautanen, "Terveydellinen haitta ja jätteenpolttouunin aiheuttamat il-

before this long-drawn judicial process was over. The institutional setting thus acted as a constraint on the successful inhibition of urban air pollution. The legal apparatus was not prepared for questions related to air pollution and, as a consequence, the problem of pollution and its health hazard was understated as a mere nuisance, and dismissed with the argument that air pollution was an unfortunate but inevitable consequence of prosperous, modern urban life, in Finland as elsewhere.

Institutional inflexibility

Post-war air protection in Finland can be described as an institutionalization process. Societies respond to new emerging issues with ad hoc solutions case by case, but since some problems occur repeatedly, they call for institutionalized and standardized procedures. While, on the one hand, these guarantee predictability and effectiveness,[54] on the other they restrict the possibility of creative responses to new issues. Standardized policies are not easily converted in order to face new challenges.[55] In Helsinki, institutional inflexibility is exemplified by the attempts to ban idling of motor vehicles.

During the 1960s the city authorities were indecisive about the problem of rapidly increasing personal motor vehicle traffic. For some it was a positive sign of modernization and necessary for the future prosperity of the country, while others were worried about the development, but nevertheless saw it as inevitable. City planners were strongly in favor of increasing car circulation in the city center. Green areas were sacrificed for new space for cars in the form of parking lots, broader lanes and new roads.[56]

man epäpuhtaudet", in *Ympäristö ja terveys*, 5, 1970, pp. 353-355. Health Board 19 May 1971, 713§.

[54] K. Shepsle, M. Bonchek, *Analyzing Politics. Rationality, Behaviour and Institutions*, W.W. Norton & Company Inc, New York 1997, pp. 299-300.

[55] J. Connelly, G. Smith, *Politics and the Environment. From Theory to Practice*, 2nd edition, Routledge, London 2003, p. 135.

[56] See T. Herranen, *Hevosomnibusseista metroon. Vuosisata Helsingin joukkoliikennettä,* Helsingin kaupungin julkaisuja 39, Helsingin kaupungin liikennelaitos, Helsinki 1988, p. 126.

While unwilling to take concrete action to stop cars from taking over the streets of Helsinki, its city officials responded to criticism about the contribution of exhaust fumes to air pollution by turning their attention to idling. In the cold winters especially, cars were kept warm by leaving the motor running – sometimes through the whole night.[57] At depots, buses idled for several hours every morning. Idling was soon publically proclaimed as unnecessary and an indication of indifference towards fellow citizens. Offenders were branded as inconsiderate drivers, and driving schools were accused of teaching new drivers irresponsible habits. As in Sweden, a maximum time-limit of three minutes of idling was proposed. This was also the recommendation of a working group of the Council of Europe.[58]

However, even though idling was clearly disapproved in Helsinki by all actors, a ban was not achieved, despite several attempts. This was due to the juridical interpretations of the County Administrative Board and the Association of Finnish Cities, according to which no individual city had executive power over such an issue – a ban of idling could only be enacted through national legislation. It was actually planned in a revision of the Road Traffic Act, but for unknown reasons it did not make it into the law.[59] The city authorities had to confine themselves to a non-binding recommendation to avoid idling, which was given to professional drivers as well as those of the city transport services. For a more general ban on idling the authorities had to wait for national legislation.[60] Thus, there was a strong consensus in Helsinki on the necessity to ban idling because of the air pollution it caused, but inflexible legal and institutional structures inhibited this desired change. Though the ban would probably not have significantly reduced traffic-induced air

[57] HS 20 January 1968.

[58] ISMET 9/1967, 3§ and 6§.

[59] S. Nienstedt, *Ympäristöpolitiikan alku. Ympäristönsuojelun tulo Suomen valtakunnalliseen politiikkaan 1960-1970-luvun vaihteessa,* Poliittisen historian tutkimuksia 9, Turun yliopisto, Turku 1997, p. 109. Personal disclosure from the archives of the Finnish Parliament.

[60] Hbl 21 September 1970. HYT 6/1972, 5§, 3/1974, 27§ and 10/1976, 87.5§. National legislation banning idling was enacted as late as 1982, and even then its formulation was problematic: it banned "unnecessary" idling.

pollution, this case exemplifies the difficulty of authorities to take concrete steps towards effective air protection policies. The following is another example of the same problem.

Deficiency in the decision-making process

Another example of the failure of air protection measures in Helsinki concerns trolley buses. Among the most criticized polluting vehicles in Helsinki were buses with diesel engines. In acceleration and uphill driving, they left behind dense, black smoke. At bus stations people waited for their buses surrounded by thick fumes. On the contrary, trolley buses, which had operated in Helsinki since 1949, were a non-smoky and noiseless means of transport, appreciated by citizens and recommended by the health authorities.[61]

For arguably purely personal reasons, the managers of the transport services did not favor trolley buses. Their operation was planned to cease by the 1970s.[62] Investments in new trolley buses were frozen. The argumentation against trolley buses was not convincing, and several initiatives to keep them in service were taken in the City Council. The Council voted for the continuation of trolley bus traffic in Helsinki and funds for new procurements were reserved.[63] However, because the allowance was not clearly earmarked for trolley buses, the managers of the transport services waved aside the results of the City Council vote and abandoned trolley bus operation for good in 1985.[64] A loophole in the democratic decision-making process thus allowed an environmentally sound urban public transportation system to be discontinued on rather arbitrary grounds.

This and the previous example show how intentions to improve air quality in Helsinki failed at different levels of administration, or

[61] T. Herranen, *Hevosomnibusseista metroon* cit., p. 206.

[62] O. Ampuja, *Melun sieto kaupunkielämän välttämättömyytenä Melu ympäristöongelmana ja sen synnyttämien reaktioiden kulttuurinen käsittely Helsingissä*, Bibliotheka historica 100, Suomalaisen kirjallisuuden seura, Helsinki 2007, pp. 74-75.

[63] City Council 7 January 1970, 41§, 27 May 1970, 405§, 28 October 1970, 799§.

[64] Herranen, *Hevosomnibusseista metroon* cit., pp. 279-280.

were at the least considerably ineffective. Successful air protection policy was hindered by flaws in the prevailing legal apparatus and the contradicting goals of the different sectors within local administration. The inflexibility of the institutional and judicial structures in handling newly emerging issues, including air pollution, led to failures, even in cases of strong public and political support for air protection measures. In one case, the personal preference of the civil servants and a loophole in the democratic decision-making process made unfavorable development possible. Despite much supportive talk, concrete steps towards air protection seemed to be difficult to take. But if these were the premises, how did the significant improvement in air quality that actually took place in Helsinki come about?

Environmental improvements through problem displacement

The main reasons for this local environmental success were the change in the heating infrastructure of the city and the relocation of polluting industries outside the central districts. The motives behind these developments were mainly economic. The expanding industry needed to break free from the geographic constraints of the city.

District heating in Helsinki

Until World War II, Helsinki relied heavily for its electric energy supply on hydro power from several rivers throughout the country. The coal burning electric plant in Helsinki delivered less than 10% of the rapidly increasing demand. Engineers were influenced by the German experiences in the field of energy production. The co-production of electricity and heat was actively debated as early as the 1930s;[65] at the time, however, it was considered unnecessary,

[65] Since industrialization, the Finnish engineering profession had had close connections with Germany, where many professionals received their training and gained their work experience. See P. Tulkki, *Valtion virka vai teollinen työ? Insinöörityö sosiaalisena ilmiönä 1802-1939,* Koulutussosiologian tutkimuskeskus, 38, Turun yliopisto, Turku 1996, pp. 172, 256.

since the available hydro power was seen as amply sufficient even for future needs. The bitter peace treaty with the Soviet Union at the end of the war changed the situation; more than 30% of the hydro power capacity was on territory that had been assigned to the USSR. The city had only a few hydro power shares left, and untapped sources for new hydroelectric power plants were becoming limited in the country. The years 1946 and 1947 were much drier than normal, which reduced the electricity supply even more, and Helsinki struggled with serious electricity shortages until the late 1940s.[66] In this new situation, hydro power appeared both insufficient to meet prospective energy demand and unreliable due to its dependence on weather conditions.

Energy officials soon decided to invest heavily in coal-dependent power plant capacity within the city. The efficiency rate of imported coal, used for coke production for central heating purposes, could be raised from approximately 45% to 75% if power plants supplied densely populated districts with waste heat. Given the strict exchange control regulations of the post-war economy, any effort to save foreign currency through increased efficiency was more than welcome. In 1948 the electric utility of Helsinki began investigations and preparations for the co-generation of electricity and heating in a new power plant. In the new geopolitical situation, all calculations strongly supported the viability of district heating. The main arguments were purely economic, although district heating was also encouraged for the additional advantages it had to offer: savings for homeowners through space freed up from coke storage, cleaner courtyards, and lighter workloads for building caretakers responsible for fuel in central heating houses. Furthermore, infrastructure previously needed for fuel distribution would become redundant, fire safety would improve since combustion would no longer take place in houses, and the reduction of smoke would result in collective hygienic benefits to the city.[67] District heating started in 1957 and expanded steadily. Nearly all buildings were converted to the new heating system, at the latest

[66] Helsinki Electric Utility Yearbooks 1945-1955. Kaukolämpötutkimus, Helsinki Electric Utility 1953 (District heating study), pp. 10, 29-30.

[67] Kaukolämpötutkimus cit.

when their central heating equipment was due for renewal, since at that point the cost of joining the district heating network was low enough to be profitable for housing companies and businesses. The price for district heating, produced by the city-owned electric utility, was guaranteed to be kept at most at the same level as that of central heating, thus making district heating even more attractive.[68] Heating was increasingly outsourced to a competitive supplier. Soon all new housing areas were planned from the beginning to be included into the district heating network, and coke smoke from house chimneys began to disappear from the Helsinki skyline. Map 2 illustrates the expansion of district heating in central Helsinki.

The shift to district heating was the single most important development towards the improvement of air quality in Helsinki. In central Helsinki, sulphur concentrations, which in the 1960s had still exceeded international recommendations, fell in line with them as district heating expanded.[69] It was a lot easier to control and decrease emissions from large combustion units run by professionally trained personnel than from the thousands of central-heating furnaces in the city. The emissions from a few, large power plants with high smoke stacks were diluted by the high-chimney method, which for decades had been the main tool for combating air pollution, in Finland as elsewhere.[70]

Industrial flight from central Helsinki

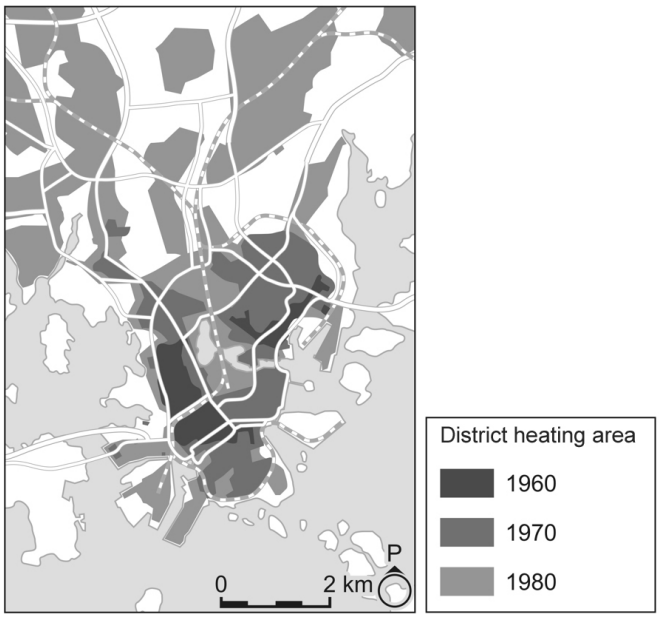
The other major change in air pollution sources in Helsinki concerned industrial emissions. Starting from the 1960s, industries originally located in central Helsinki began moving away from it. The densely built center did not allow entrepreneurs to expand their activities as much as they needed in a situation of increasing competition and economic growth. Nor could the city of Helsinki offer

[68] U. Kilpinen, "Fjärruppvärmningen i Helsingfors", in *Finsk Kommunaltidskrift,* 3, 1955, p. 85.

[69] V. Hokkanen, L. Oksanen, E. Rantakrans, *Helsingin ilman rikki*, Helsingin sähkölaitos, Helsinki 1977.

[70] See Jänicke, S*tate Failure* cit., pp. 47-51. Andersen, Brüggemeier, *Gase, Rauch und Saurer Regen* cit., pp. 67 ff. Sairinen, *Regulatory Reform of Finnish* cit., pp. 73-74.

Map 2. The expansion of district heating in Helsinki, 1960-1980[71]



more spacious sites in its downtown districts. It thus became attractive for companies to move further away from the city center, where enough space was available and new storage halls could be built. Large scale transportation was also becoming more and more complicated in the narrow streets of the center, where increasing motor vehicle traffic jammed the streets. The transportation infrastructure could be better organized in more peripheral areas.[72]

The growth of the city, combined with its inconvenient geography, led to the more or less voluntary relocation of smoky industries. Thus, in many cases air pollution problems caused by industrial smoke basically solved themselves without pressure from the city authorities. The tendency of the industry to move to outer districts was welcomed and encouraged by the health authorities, but only after

[71] Helsinki Electric Utility Yearbooks cit.
[72] Hoffman, *Elinkeinot* cit., pp. 336-337.

the decision had already been made by the entrepreneurs. Health concerns were not the reason for the relocation: The decline in pollution was only an additional asset to purely economic considerations.

Both the material relocation of smoke-producing industrial facilities and the dispersal of emissions from energy generation through high smokestacks to a larger area are basically a form of spatial displacement of a problem. This was by no means a new idea in air protection policies. Throughout the history of the industrial era, authorities have solved the problem of air pollution by decreasing, not the emissions themselves, but their impact on human beings.[73] Displacement of the pollution source was often a quick and easy fix to a problem whose dismissal would have easily caused controversies. In the case of Helsinki, though, both the absolute amount of pollutants and the number of humans whose health was affected by emissions were reduced by this development. Increased energy efficiency absolutely lessened emissions, and the relocation of industries often also entailed investments in new, better technology and processes with fewer emissions. Likewise, the production of district heating in large plants gave out fewer emissions per unit than central heating. Industrial facilities in more remote areas with less population were advantageous also as regards the impact on citizens' health. Clearly, the problem of industries being located on the small and hemmed-in central peninsula was the vicinity of homes to smokestacks. The new, more remote locations for industries were planned as industrial areas with no residential areas close by, even later, when the city expanded in the direction of those areas. Although relocation of emitting sources is never the perfect solution, only a very local one, in Helsinki it unquestionably led to good results on all sides.

Conclusion: the limits of success

Was air protection policy in Helsinki a success or not? In terms of political decisions and measures taken by the authorities to improve air

[73] Compare Thorsheim, *Inventing Pollution* cit., pp. 132 ff. T. LeCain, "When Everybody Wins Does the Environment Lose? The Environmental Techno-Fix in Twentieth Century American Mining", in *The Technological Fix. How People Use Technology to*

quality, in many aspects it was a failure. Intentional action to prevent the increase of pollution in the city was only marginally successful. Despite much talk, concrete action was rarely taken. First, the lack of scientific evidence, combined with the absence of cooperation between science and the administration, undermined the very basis for effective air protection. Furthermore, the inflexible institutional-juridical system was not prepared to handle issues of this nature. One example described above shows how an accidental loophole in the decision-making process made it possible for just one influential opponent to impede the taking of environmentally beneficial decisions. The prevailing mindset considered the hegemony of economic growth as the core of the grand national welfare project, and was hence reluctant to force costly interventions on businesses to prevent smoke and fumes.

The four main sources of air pollution in Helsinki: energy generation, industries, waste incineration, and motor vehicle traffic, developed in the post-war decades in different ways. The eventual improvement of air quality was the result of declining pollution levels from energy generation and industries, and the termination of small-scale waste incineration.[74] Pollution from energy generation decreased following a technological shift combined with the dispersal of emissions through higher smokestacks. Industrial pollution was largely eliminated through relocation. These developments were economically and geographically motivated, independent of environmental considerations. Fortunately, to a certain degree it was a win-win proposition. Economically advantageous measures turned out to have the additional benefit of being, to some degree, environmentally sound.

Even though relocation of pollution is merely an instance of problem displacement, and hence cannot be judged as an environmentally optimal solution, in the case of Helsinki emissions also decreased in absolute terms. This was due to simultaneously implemented technological improvements and improved possibilities for effective smoke control. The

Create and Solve Problems, L. Rosner (ed.), Routledge, New York 2004, pp. 137-153. M.S. Andersen, *Governance by Green Taxes. Making Pollution Prevention Pay*, Issues in Environmental Politics, Manchester University Press, Manchester 1994, p. 11.

[74] A large, communal incineration plant was in operation in Helsinki until 1982, when it was closed due to pollution. For reasons of space, I have not discussed this case here.

relocation of polluting industry was determined by the natural limits of the city. Geography can be seen as advantageous or disadvantageous, depending on one's viewpoint. On the other hand, the increase in energy efficiency through district heating fits the idea of a successful combination of environmental and economic progress. District heating can be seen as one good example of a new environmentally benign technology in which, as Joseph Huber suggests, the end user experiences no difference, but the huge environmental benefit is formed "upstream", in production.[75]

Waste incineration was the only pollution source in the case of which purposeful measures led to positive achievements. However, because of institutional and legal inflexibility, this happened painfully, slowly, and inefficiently. The current persisting motor vehicle pollution in the city shows that, in the absence of environmental policies, actions not directly motivated by environmental concern will reduce pollution only to a limited extent. Vehicle exhaust and, indirectly, high concentrations of particles by effect of sanding have been the main source of urban air pollution in Helsinki since the 1970s.[76] Even gradual improvements in public transportation did little to diminish traffic-induced pollution, and this situation has endured to the present day. Helsinki regularly exceeds EU air-quality thresholds. A new air protection program implemented by the EU to address such cases of threshold surpassing does not appear to have produced any significant, structural changes.[77] The current problems of air quality in Helsinki bear witness to the enduring inability of authorities to curb traffic-induced pollution, which was already evident 30 years ago. We have seen that earlier on economically attractive solutions resulted in significant improvements in air quality. Any further reductions, however, will require, instead, a forceful and successful environmental policy. This seems to be politically difficult to achieve.

[75] J. Huber, *New Technologies and Environmental Innovation*, Cheltenham, Edward Elgar, Northhampton 2004, p. 226.

[76] Similarly, e.g. Thorsheim, *Inventing Pollution* cit., p. 192, has highlighted how the concentration of air protection policies on coal smoke has led to overlooking pollution from other sources, such as motor vehicle exhaust, which was and still is a considerable problem in Britain.

[77] Helsinki City Air Protection Programme 2008-2016, available at: http://www.hel2.fi/ymk/julkaisut/Julkaisut2008/Julkaisu10_08net.pdf.