THE GLOBAL PETROLEUMSCAPE AND ITS IMPACT ON DESIGN PRACTICE

Carola Hein

ABSTRACT: Over the last century the petroleum industry's rapid growth has been accompanied by a steady flow of aggressively promoted petroleum-based products. The petroleumscape's spatial expansion and visual representation achieved widespread citizen buy-in. Following World War II the use of plastic materials in the building industry significantly increased through efforts from architects and industry leaders. The House of the Future, built by MIT architects, the Monsanto Chemical Company, and Disneyland exemplified a modern lifestyle: clean, functional, and fun. The architectural and technocratic dream of a mass-produced, fully plastic house that seemed possible in the post-war years did not survive the subsequent commercialisation of the plastics industry in the 1960s and 70s.

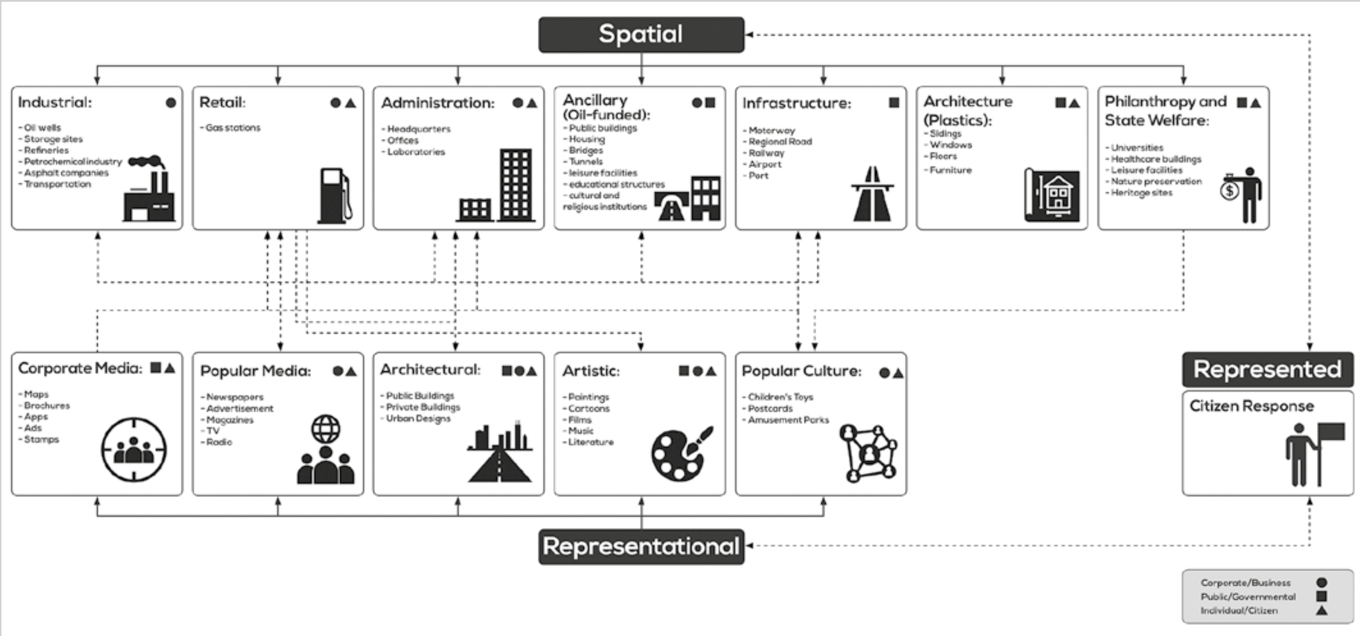
KEYWORDS: petroleum; synthetic materials; industry; architecture; plastics

INTRODUCTION: The expansive growth of the petroleum industry and its multitude of products - from lighting oil to fuel and plastics - has relied on the growth of a large consumer base. Citizens of different classes, races, cultures, genders, and ages around the world have embraced a multitude of petroleum products. They have benefitted from cheap energy for travel and heating, and they have taken advantage of easy-to-use plastic-based building materials. Extraction, production, transformation, transportation and consumption of petroleum have created a multifaceted spatial layer, a petroleumscape, that includes refineries and storage sites, office and research buildings, transportation infrastructure and gas stations.[1] All of these spaces are connected through their relation to a single commodity - petroleum - and its group of industrial players.

The petroleumscape emerged along with narratives and imagery that encouraged the use of petroleum products. Constant promotion helped reinforce widespread citizen buy-in, creating an energy culture that reinforces the spatial presence of the industry and further increases consumption in everyday life. Among the diverse industrial, administrative, retail and ancillary spaces, plastics in architecture play a particular role: plastic components related to building have a particularly wide range of applications and customers. They can be small in scale - from light switches to furniture - or part of architectural design and construction practice - from windows to walls. They can be marketed to professionals and builders as well as the everyday consumer.

This contribution provides an introduction to the early history of plastics, and explores how the vision of a plastic house developed after World War II, followed by the promotion of plastic materials in the building industry [FIGURE 01].

Petroleum naturally bubbles up from the ground, and humans used it for specialized purposes for millennia in ways that foreshadow our uses today. Incendiary weapons such as "Greek fire" anticipated our current use of oil for warfare, lighting, and warming. Bitumen, once used to make watertight pools and basins in Mesopotamia and to mummify bodies in Egypt, today appears in asphalt street surfaces, roofing materials, and waterproofing. And the historic use of petroleum as a medicine precedes more recent pharmaceutical and cosmetic uses; for some 150 years people have been applying Vaseline petroleum jelly to dry skin and minor wounds. Throughout the 18th century, inventors, businessmen, and chemists worked to create an efficient petroleum-fueled lamp to replace those that used more expensive natural oils[2]. By finding ways of transforming crude petroleum into useful products the oil



01 The Global Petroleumscape. © Author

industry was able to adapt to changing societal conditions and also to transform environments and lifestyles.

Industrial petroleum drilling started in 1859 and over the decades that followed, petroleum products became increasingly ubiquitous in industrial and daily use. In the early decades, petroleum was refined mostly into lighting fuel and grease. Engineers rapidly developed new uses for other petroleum products. Notably, the refining of crude oil to make kerosene also created gasoline. Long considered a waste product, gasoline's explosive qualities led Karl Benz (1844-1929) to use it in 1886 in the first practical internal combustion engine. Since the mid 19th century, chemists also began devising uses for petroleum that did not involve burning it. These uses include the production of new materials such as vinyl for paints, floors, or wall-covers; or petroleum-based fibres such as nylon, acrylic, polyester, and spandex, as well as microplastics, including the microbeads in some body scrubs and toothpastes.[3]

Plastic materials can be natural products, but it was only with the development of synthetic plastics that plastic could become so commonly used. Natural products such as rubber latex - made from plants - and shellac - made from the secretions of a beetle - are limited in amount. The synthetic production of easily mouldable products provided a broad range of new possibilities for different users. New plastic materials emerged in the mid-19th century, and were shown, for example at the 1862 International Exhibition, where Parkesine by Alexander Parkes (1812-1890) received a bronze medal. In the history of modern plastics Bakelite takes an important role. A lightweight and durable plastic, nonconductive of electricity and heat resistant, it served the emerging automotive and electrical industries at the turn of the 19th and 20th century. New products were made, including telephones, radios and electric sockets, but it was also used to replace existing products, such as toilet seats, ash trays, and jewellery. Plastic materials allowed for new organic or curved forms - in line with the predominant taste of the time - which were coveted by designers.[4]

Beginning in the 1920s, the American engineer Buckminster Fuller (1895-1983) imagined lightweight, prefabricated single-family houses that would allow for autonomous living and which showcased various uses of plastic products. There were many advantages to this structure, including the ability to prefabricate components in factories to be shipped and assembled, and adapted to local environments. Aluminum was Fuller's preferred material, which he combined with plastics, for example in the 4D Tower of 1928 and in a waterless toilet. In 1940 Fuller applied for a patent for a bathroom made of moulded plastic. Fuller would further develop these pre-war designs in his Wichita House of 1944, which used plastic windows. He then continued to further develop his building with the geodesic dome, a 1953 version of which was covered with DuPont's Mylar polyester film, creating a thin, clear, and very tough skin.[5]

Synthetic materials replaced limited natural ones and promised cheaper goods for a large group of new consumers among whom women played an important role. In the 1930s, the chemical company Du Pont invented two new products: nylon and neoprene. Nylon rapidly became a household item as it replaced the hairs of wild boar in toothbrushes. It was celebrated as it made stockings available for women at a much lower price than silk.[6] The development of synthetic plastics for insulators facilitated new amenities in the house and notably the electric kitchen. Heavily promoted by General Electric, the new kitchen -presented at the 1933 World's Fair with the "House of Magic" exhibit - featured an electric laundry, an iron, and a sewing machine, including numerous

02 General Electric's House of Magic, General Electric Range Advertisement. © Better Homes and Gardens June 1948, retrieved from https://www.flickr.com/photos/91591049@N00/15825470231

plastic components.[7] General Electric (and other companies) praised the advantages of plastic products for use in homes and marketed the innovative technologies and materials as part of a modern lifestyle - clean, functional, and fun. The presumed spaces of women - the kitchen - and their activities - cleaning, cooking, tending to the children - were of particular interest to the new industry [FIGURE 02].

Plastic materials were of great importance for the war effort, as the rapidly growing airplane and chemical industry needed lightweight composite materials and high strength plastics and plywood. Nylon replaced silk in parachutes,vinyl was used for tents and boots, and polyethylene was used for radar cables. The production of plastics during the war stimulated the creation of a new industry, which needed customers after the war ended. Plastic architecture appeared not just to be a way of using military technology in peace-time, but a way of solving the housing problem. As Beatriz Colomina points out, "The wartime accomplishments of the plastic industry were presented to the public in popular magazines as the great hope to ensure the financial future of an expanding, post-World War II economy."[8] The chemical company Monsanto was a key player in transitioning plastics from war to peace-time use. Monsanto worked closely with MIT in Boston. MIT's wide-ranging research foci at the time included "the fields of lighting, solar energy for house heating, plastics, zoning regulations as they affect the cost of residential building, the perceptual form of cities, and community costs and revenues involved in new industrial developments."[9]

MIT had contracts with several players from the chemical and plastic industry. Professor Albert Dietz (1908-1998), who was working on lightweight construction materials, was also the chair of the Society of the Plastics Industry (SPI) Committee on Plastics Education, which heavily promoted plastics. In 1950 he led the Plastics Materials Manufacturers' Association program which issued a "A Program for Plastics Education in Science and Engineering."[10] Dietz published multiple articles on plastics in 1954-1955 including a report funded by Monsanto.[11] MIT received various grants from Monsanto including one in 1955 for plastics in city planning.[12] By 1955 MIT developed studios with support from Monsanto along with "architectural evaluations of some of the typical building products that are either wholly or partially

03 The (all-white, all-male) participants of the Plastics in Building conference in 1955. © Building Research Institute, Plastics in Building, Washington, D.C.: National Academy of Sciences, National Research Council, 1955, p. 6

composed of plastics, and illustrations of present trends and future possibilities in the use of these materials." The goal was to "forecast possibilities that can be achieved when, in the future, we may take maximum advantage of the inherent properties of plastics as applied to house fabrication." A year later, MIT announced that:

The Division of Building Engineering and Construction, together with the Department of Architecture, is designing and constructing a plastics "House of Tomorrow" under the sponsorship of the Monsanto Chemical Company. Structural shape and architectural design have gone hand in hand, and a great deal of pioneering in structural design has been made necessary by the relatively new and untried structural properties of the materials.[13]

In the 1950s, for the professors at MIT, the goal of the collaboration was to develop an integrated, structural approach to plastics in construction.

The collaboration among industry, research and design grew as documented in a two-day workshop at the Chamber of Commerce in Washington in 1955. There, industry representatives, researchers, and architects studied the properties, uses, standards, codes, and future of plastic in building. Albert Dietz from MIT described the main characteristics of plastic as a building material. Following a number of presentations on the diverse uses of plastics in building, the structural engineer Johan A. Bjorksten (1907-1995) pointed out that "in looking to the future of building I believe that we should envision the use of plastics in primary structures" rather than as decorative or secondary building elements.[14] Robert K. Mueller, of the Plastics Division of Monsanto Chemical Company, pointed to the extreme increase of plastics over the last decades before 1955. He wrote:

the output of plastic materials has been expanding at an average rate of about 20 per cent per year since 1918. […] From 23 million pounds of plastics at the time of World War I output has jumped to three billion pounds estimated for this year. Output has doubled since 1949 and increased ten-fold over the amount of 1939. […]

We estimate total consumption of plastics in the building trades for 1954 will be over 400 million pounds.[15]

He further summarized the diverse possibilities of plastic materials in architecture and design: "the future of plastics in building is limited only by our imaginations and the public acceptance of new concepts in living".[16] [FIGURE 03]

Architects were eager to claim the new material for design purposes. In the roundtable of the 1955 event, the architect Robert Fitch Smith (1894-1964) from Miami presented a guest cottage that he had designed in Deerfield Beach, Florida, with 30% recycled plastics for Russell Reinforced Plastics Corporation. The building included 350 square feet of translucent fiberglass so that all spaces of the building could receive light at any time. Smith recognized both the opportunities and potential dangers of the plastic industry as they engaged the building sector:

Architects have always dreamed of a building material which is free from maintenance, termites, rust, discoloration, disintegration. Now, with the help of new mechanical engineers and industrialists, we may be well on the way to the development of this new material. We may even be on the way toward a new period of American architecture, a bright, new conception for the closed in spaces where people live—no dark corners, but a happy, sunny material clothed by a good structure. We may even be on the way to the golden age of American architecture. Only our misuse or our lack of appreciation of this glorious new material can slow our progress.[17]

And he warned presciently that architects needed detailed information from the plastics industry to make good buildings rather than let contractors and building owners choose from a broad range of plastic components: "To the architect, this detail is good and valuable information as to the parts of future buildings." [18]

Fitch-Smith continued:

These viewpoints must form a harmonious unit and must be so designed architecturally; therefore, a design background becomes necessary in the industrial phase of the work. If your materials, fine as they are, are misused, they will become of less value and will stop progress in its very path. I plead with you to hold to an architecturally-designed product as your goal, instead of a back-yard, do-it-yourself product. [19]

An important addition to the petroleumscape occurred in 1957 when MIT architects, Monsanto, and Disneyland formed a powerful collaboration with key players in design, research and education to show an integrated design approach towards the plastic building of the future. The "House of the Future" had to be modular and flexible in line with Fuller's designs, and offered a view of future living in a plastic-walled structure with new technologies including ultrasonic wave dishwashers, picture phones and atomic food preservation. The designers introduced new forms and technologies and, together with Monsanto and Disneyland, marketed it to millions of visitors as part of a modern lifestyle: clean, functional, and fun. The attraction imagined a possible mass-produced home of the future, but despite the inclusion of key collaborators, architect-designed houses in plastics did not become a trend. Soon after the House of the Future closed in 1967, the Finnish architect, Matti Suuronen (1933-2013) would design and build prefabricated single-family homes made of plastics, the Futuro (1968) and the Venturo (1971) [FIGURE 04].

By the mid-1960s, the opportunity for close collaboration between plastic and building industry seems to have passed. A 1965 conference in London entitled "Plastic in Building Structures" indicated the shift.[20] Architects pointed to the particularities of their profession. R. D. Gay wrote provocatively: "The architects are prevented by the established protocols and statutes of professionalism from developing their ideas on commercial lines. In spite of their ability to analyse and co-ordinate, the majority of architects shield themselves behind the facade of a dilettante club." And he continued: "The housing band-wagon is in motion and about 400 builders have already jumped on, each with his industrialized building system; 95 per cent of these systems are ill-conceived, unsuitable, based on ignorance of basic research and national requirement, and generally ugly."[21] The author still held out hope for collaboration between the building and plastic industries in view of post-war housing needs:

There exist major difficulties of communicating with the building industry. Whatever the problem, and its order of magnitude, it must be realized by both industries that there will be, in a few years, the absolute necessity for new materials, used in new ways. A large proportion of these must emanate from the organic-chemical industry, used alone or in conjunction with contemporary developments in the steel, aluminium and, perhaps, other industries." [22]

04 Some 20 million visitors saw the House of the Future, set in the year 1986, at Disneyland Anaheim, between 1957 and 1967. © Linda Peach Warner Collection. Acc#2014-57, Orange County Archives, retrieved from https://commons.wikimedia.org/wiki/File:Monsanto_Plastics_Home_of_the_Future,_Disneyland,_1958_(15364290924).jpg

He regretted that the "completely built plastic home seems to have disappeared." [23] He criticized a lack in leadership from MIT: "There are no 'codes of practice'; no text books are available for the design of building structures - for a decade we have been awaiting one from Dr. Dietz and his colleagues at the Massachusetts Institute of Technology." Dietz did not pick up this call, by 1979 a Plastic Design Structural Manual was still in the making.[24]

Some architects created unique structures with plastics materials. Kisho Kurokawa's (1934-2007) Nagakin building (1972) in Tokyo, which included a prefabricated plastic bathroom, offers an example. Plastic bathroom elements have since become a key feature in many Japanese houses, as they fit both the humid climate and the shower and bathing habits. The upheaval in the global petroleumscape in the 1970s meant that plastics could no longer be used by architects to create cheap, bespoke components. Instead of following comprehensive architect-led design for entire prefabricated and repeatable structures, the petrochemical and building industries collectively developed new materials and building elements including plastic bathroom units, insulation, windows, furniture, Lego toys, and doll houses. They turned towards the contracting sector and consumers instead of architects.

Professional magazines became one of the tools of the plastic industry to engage with the building sector. Numerous publications addressed themes such as "Plastics in Building" or "The Styron Story" and a journal titled "Plastics in Building Construction" (1975-) in the 1960s-1970s promoted the use of plastic building elements.[25] Advertisements for companies producing plastic building components spoke directly to consumers, cleverly connecting everyday objects with building materials. Women and young children were carefully targeted as consumers. Tupperware parties made plastics an integral part of a woman's experience, possibly reinforcing her preference for vinyl cladding or plastic windows. Girls encountered plastic Barbie dolls using plastic wardrobes, bathtubs or doll houses. Together with their brothers they may also have played with Legos or other plastic blocks.[26] The advertisement for Formica, "Too bad Dad," featured the Formica vanity, a must-have for women and girls, with a counter space around the wash bowl and drawers for towels, laundry and medicine.[27] Advertisements by Lamilux - a firm that produced components for ready-to-mount timber structures and grew to include fibre-reinforced composites - for corrugated sheathing and roof windows also aimed at engaging a new group of consumers, appealing notably to women apt to be in charge of the household.[28] The Styron advertisement for plastic wall tiles claimed a close collaboration with designers, but primarily addressed the client.[29] [FIGURE 05].

05 Publicity Too Bad Dad. © Unknown, retrieved from https://retrorenovation.com/wp-content/uploads/2008/03/1952-formica-lav343.jpg

Since the 1960s, plastic has been entering all parts of the home in a piecemeal fashion. Consumers have been buying plastic for everyday uses. Architects and builders have used the multitude of plastic products that have been developed for the construction industry. Much plastic building material regularly ends up in landfill sites. The current crisis of plastic waste seems to have brought the building industry back into the view of plastic producers and architects. Some recent projects feature buildings made of recycled plastics, such as the Plastic Bottle Village by Robert Bezeau (°1949) in Panama, built from a million plastic bottles, or Swansea-based Affresol's recycled plastic houses, composed of eight tons of trash each, and intended to solve housing and recycling problems simultaneously.[30]

DISCUSSION

By tracing the history of oil's impact on the built environment and its representations through the lens of plastic in architecture, the extent to which oil flows have affected society's physical spaces and ways of living from the smallest to the largest scale can be observed. The extent to which the consumer in general is now effectively part of the system is evident, and the critical need to comprehensively explore the relationship between architecture and plastic is clear.

CONCLUSION

The architectural and technocratic dream of a mass-produced, fully plastic house that seemed possible in the post-war years did not survive the subsequent commercialisation of the plastics industry in the 1960s and 70s. Designers lost any possible leadership role when technical design knowledge was concentrated in manufacturing and marketing corporations, rather than in the professions or academia. Over the same period, the early image of plastic as clean, functional and fun was to be tainted by the realisation that the cheap exploitation of plastics was beyond the control of Western economies, and later, that the consumption of mass-produced plastic would create intractable environmental consequences.

BIBLIOGRAPHY

BRITISH RESIN PRODUCTS LTD, The Styron Story: Everymans Guide to Polystyrene Plastics, British Resin Products Ltd., 1960.

BUILDING RESEARCH INSTITUTE, Plastics in Building, National Academy of Sciences, National Research Council, 1955.

COLOMINA, Beatriz, Annemarie BRENNAN, and Jeannie KIM, eds. Cold War Hothouses: Inventing Postwar Culture, from Cockpit to Playboy, Princeton Architectural Press, 2004.

DIETZ Albert G. H. "Practical Prospects for Plastics in Building Construction." *International Journal of Polymeric Materials* 8, no. 1 (1979).

FORBES, R. J. More Studies in Early Petroleum History 1860-1880, E.J.Brill, 1959.

HEIN, Carola. "Oil Spaces: The Global Petroleumscape in the Rotterdam/the Hague Area." *Journal of Urban History* 44, no. 5 (2018): 887–929.

INSTITUTE, THE PLASTICS, Plastics in Building Structures: Proceedings of a Conference Held in London, 14-16 June 1965, Pergamon Press, 1966.

Massachusetts Institute of Technology Bulletin President's Report. (October 1 1956).

Massachusetts Institute of Technology Bulletin President's Report. 91, no. 3 (November 1955).

Massachusetts Institute of Technology Bulletin President's Report 1949-1950. 86, no. 1 (1950).

ENDNOTES

1 Carola Hein, "Oil Spaces: The Global Petroleumscape in the Rotterdam/the Hague Area," *Journal of Urban History* 44, no. 5 (2018).

2 R. J. Forbes, *More Studies in Early Petroleum History 1860-1880* (Leiden: E.J.Brill, 1959).

3 The extent to which plastics are included in everyday objects is a subject of much public debate today. The company Polyplastics, for example, presents an account of the extent of plastics in our house: https://www.polyplastics.com/en/pavilion/life/index_t.html (accessed 17.9.2019)

4 The Bakelite Museum in London shows the diversity of objects made of the new material: https://www.bakelitemuseum.net/ (accessed 17.1.2019)

5 Gili Merin, AD Classics: The Dymaxion House / Buckminster Fuller, 12 July, 2013 https://www.archdaily.com/401528/ad-classics-the-dymaxion-house-buckminster-fuller (accessed 17.1.2019)

6 American Oil and Gas Historical Society: August 2, 1938 – Petroleum Product replaces Hog Bristles https://aoghs.org/this-week-in-petroleum-history/

7 General Electric at the World's Fair (1933) https://www.youtube.com/watch?v=wGyrFUA1DIs

8 Beatriz Colomina, Annemarie Brennan, and Jeannie Kim, eds., *Cold War Hothouses: Inventing Postwar Culture, from Cockpit to Playboy* (Princeton: Princeton Architectural Press, 2004).

9 "Massachusetts Institute of Technology Bulletin President's Report ", 91, no. 3 (1955), p. 34

10 'Massachusetts Institute of Technology Bulletin President's Report 1949-1950,'" 86, no. 1 (1950), p. 111

11 PLASTICS IN HOUSING, the report of a study sponsored by the Monsanto Chemical Company, edited by Richard W. Hamilton for the project staff. June, 1955. 'Massachusetts Institute of Technology Bulletin President's Report '", 91, no. 3 (1955), p. 450

12 "Massachusetts Institute of Technology Bulletin President's Report 1949-1950," 86, no. 1 (1950); "Massachusetts Institute of Technology Bulletin President's Report," 91, no. 3 (1955).

13 "Massachusetts Institute of Technology Bulletin President's Report," (1956).

14 Building Research Institute, *Plastics in Building* (Washington, D.C.: National Academy of Sciences, National Research Council, 1955), p. 107

15 Ibid. p. 129

16 Ibid. p. 129

17 Ibid. p. 115-116

18 Ibid. p. 113

19 Ibid. p. 113

20 The Plastics Institute, *Plastics in Building Structures: Proceedings of a Conference Held in London, 14-16 June 1965* (London: Pergamon Press, 1966).

21 Ibid. p. 1

22 Ibid. p. 2

23 Ibid. p. 2

24 Albert G. H. Dietz, "Practical Prospects for Plastics in Building Construction," *International Journal of Polymeric Materials* 8, no. 1 (1979).

25 British Resin Products Ltd., *The Styron Story: Everymans Guide to Polystyrene Plastics* (British Resin Products Ltd., 1960); Technomic Publishing Company (Lancaster - Pa.), "Plastics in Building Construction," (1975-). ICI, Plastics in Building

26 Ambricks http://www.architoys.net/toys/toypages/ambricks.html)

27 Too Bad Dad https://retrorenovation.com/wp-content/uploads/2008/03/1952-formica-lav343.jpg

28 Lamilux: http://www.lamilux.com/company/about-us/lamilux-history.html

29 https://corporate.dow.com/en-us/about/history/vintage-chemical-advertising/portfolio/styron

30 https://www.theatlantic.com/video/index/500036/plastic-bottle-village/
https://www.dailymail.co.uk/sciencetech/article-1253514/New-homes-built-18-tonnes-recycled-plastic.html

Carola Hein *(Germany, 1964) is Professor and Head, History of Architecture and Urban Planning Chair at Delft University of Technology. She has published widely in the field of architectural, urban and planning history. Among other major grants, she received a Guggenheim Fellowship to pursue research on The Global Architecture of Oil. Her books include: The Routledge Planning History Handbook (2017), Uz Nishiyama, Reflections on Urban, Regional and National Space (2017), History, Urbanism, Resilience, Proceedings of the 2016 IPHS conference (2016), Port Cities: Dynamic Landscapes and Global Networks (2011), Brussels: Perspectives on a European Capital (2007), European Brussels. Whose capital? Whose city? (2006), The Capital of Europe. Architecture and Urban Planning for the European Union (2004), Rebuilding Urban Japan after 1945 (2003), and Cities, Autonomy and Decentralisation in Japan. (2006), Hauptstadt Berlin 1957-58 (1991).*