4. The Environmental Sustainability of the Music Industries

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4.1 Introduction

> An army of peaceful guerrillas … showed itself imminently ready to turn back on the already ravaged cities and their inoperable 'life-styles,' imminently prepared to move onto the mist-covered fields and into the cool, still woods.
>
> (Hodenfield 1969)

In his review of the Woodstock Music and Art Fair, which took place between 15 to 18 August 1969 and attracted an audience of more than 400,000 to the site of Max Yasgur's farm, *Rolling Stone* reporter Jan Hodenfield highlighted a paradox of post-industrial musical culture: people frequently participate in music as a means to *escape* the undesirable aspects of mass culture ('ravaged cities and their inoperable life-styles'), but popular music simultaneously *constitutes* a form of mass culture ('an army' of 400,000 in the case of the Woodstock audience). When we take part in the production and consumption of music, we are almost always interacting with broader social structures and material infrastructures - along with any environmental impacts arising from such interaction. Hodenfield's review of Woodstock, for example, goes on to describe some of the most visible environmental consequences of the festival:

> The sanitation facilities (600 portable toilets had been spotted across the farm) were breaking down and overflowing; the water from six wells and parked water tanks were proving to be an inadequate supply for the long lines that were forming, and the above-ground water pipes were being crushed by the humanity … Police reported a shortage of ambulances, and those that were available had difficulty getting back to local hospitals through the metal syrup of the traffic jam … In addition to the mountain shortages of food and water and overtaxed toilet facilities, a new problem was developing: mounting piles of garbage … At the end of the three-day event, festival officials estimated that the cleanup of the hillside, campsites and roads would take at least two weeks. (Ibid.)

Things have got both better and worse since Woodstock took place over fifty years ago. Whereas the Woodstock generation was making up the rules of large-scale amplified live music events as they went along, such mass gatherings are now a routine part of the global music economy. The music industries have become increasingly professionalized and efficient in delivering these events, but unfortunately it does not follow that their environmental impact has lessened.

What do the dynamics of the music industries look like from an environmental perspective? This is not a popular line of inquiry for those who advocate for music in the face of cuts to arts funding and education that routinely threaten access to musical opportunities, and when factors such as gentrification and property development threaten the existence of music venues and spaces for cultural performance. Against this backdrop, research into the environmental effects of the music industries can be at best unwelcome—and at worst met with open hostility. Drawing on previous work from the fields of ecomusicology (Allen and Dawe 2016; Pedelty 2012) and the political ecology of music (Devine 2015, 2019), as well as my own research, I aim to consider the question above.

As I have argued elsewhere, a world where music does not have an environmental impact is a world without music (Brennan 2020). It is not my intention to ruin one of life's great pleasures - the enjoyment of music - by pointing out its environmental cost. However, if we are to have any hope of addressing the challenge of climate change, we urgently need to become more mindful of the cost of the whole range of consumption behaviours that we usually take for granted, including our participation in music. The rest of this chapter therefore focuses on three of the most important components of the music industries – recorded music, live music, and musical instruments – and considers their current state from the perspective of environmental sustainability. It also offers a critique of the assumption that the growth of these industries is an unquestionable good.

4.2 The Live Music Industry

Live music is currently the most economically significant part of the music industries. It first outperformed the recording industry in 2008 (in the UK) and by some estimates will achieve a total global revenue of over $30 billion by 2022 (Sanchez 2018). In addition to offering a substantial stream of income for many musicians and businesses, the strength of the live music industry has also contributed to the renewal of urban areas, led to increases in tourism, bolstered national economies, and enhanced the musical lives and communities of many people (UK Music 2019, Webster et al 2018). Yet the cultural value and commercial successes of live music come with many hidden costs and consequences. Indeed, a live concert is only possible via all the infrastructural relations that underpin it, including transport and travel as well as energy consumption in performance spaces and waste management at festivals.

Given its increasing economic importance in recent years, it is perhaps no surprise that music tourism is being touted as a potential growth area. Karen Bradley (the UK government's Secretary of State for Culture, Media, and Sport at the time) welcomed a 2017 industry report on music tourism by noting that musicians 'drew more than 30 million people to live music concerts and festivals in the UK last year … Four out of ten people going to those events were music tourists … Music and the creative industries are central to our post-Brexit future. Live events in the UK draw visitors from across the globe to spend their money here' (Sanchez 2018, p. 8). Meanwhile, the Sound Diplomacy global music consultancy has also argued for a music tourism growth strategy in a co-authored white paper entitled 'Music is the New Gastronomy':

> Music tourism—as a specific sector of the tourism sector—is emerging, but not wholly understood. Unlike gastronomy or cultural tourism, music tourism is less defined, less organised and as a result, less lucrative. We believe this should change … [We need to] demonstrate the value of music to the tourism sector, and how it can be monetised to increase visitor numbers, hotel stays and other indicators. (Orozco, Jones and Shapiro. 2018, p.6)

Proponents making the case for growing the live music sector, and music tourism in particular, tend not to dwell on the environmental impact of the industry. But its impact is real enough: the environmental consultancy Julie's Bicycle once estimated that the UK music industries alone emit at least 540,000 tons of carbon dioxide equivalents (also known as greenhouse gas equivalents) into the atmosphere each year, and that the live music sector accounts for the vast majority—roughly 75 percent—of those emissions (Bottrill et al. 2018, p. 2).

In recent years, myself and other researchers have proposed the concept of a 'live music ecology' to make sense of the live music sector, subsequently noticing that 'ecology' has also become a commonplace term in music policy documents, replacing previous

correlative notions such as creative industry 'quarters' and 'clusters' (Behr et al. 2015, 2016; Holden 2015). However, the goal here is not merely to replace one buzzword with another. An ecological approach to live music should place an emphasis on different aspects of its production: 1) the *materiality* of the buildings in which live music happens and its surrounding infrastructures; 2) the *interdependence* between the actors and infrastructural materials who operate by intention within a music scene as well as those that operate outside of given music scenes (for example, regulators and licensing boards) but which nevertheless have a significant impact on live music; and 3) the *sustainability* of live music culture, where all the factors above contribute to the character and meet the needs of those living in a given musical ecosystem—ideally without, as the World Commission on Environment and Development (1987, p.16) once put it, 'compromising the ability of future generations to meet their own needs.'[1]

In the case of a concert, for example, audiences must choose how far they will travel to see their favourite artist in concert and what mode of transport they will use to get to the event—decisions that ultimately account for the majority of that event's carbon footprint. If the audience is camping at a festival or staying overnight in a city, their consumption choices, particularly accommodation and subsistence, create additional environmental impacts. The venue for a live music event is also an important factor, particularly whether it is a permanent or temporary space. In the former case, the venue will likely have access to electricity from a power grid. But in the latter case, it may have to install onsite infrastructures such as electricity as well as water and sewage. The venue's proximity to public transport and local residents, as well as its agreements with local authorities and councils on its environmental responsibilities and protocol, will also be important factors. The promoter will liaise with the venue (or in the case of a temporary site, facilitate the installation and demolition of the venue) and work with production suppliers to provide staging, lighting and sound equipment, and so on. In the case of greenfield sites for music, infrastructures such as tents, toilets, trackway, food, waste management, and generators will also have to be procured, each with a range of possible environmental effects that depend on the promoter's choices in sourcing suppliers. Meanwhile, the artist, manager, and agent will agree touring itineraries, where most often planning a route to mitigate environmental impact will lose out to other priorities such as securing the best fee for each performance. This situation is not helped by the fact that artists are generally able to command higher fees through 'exclusivity agreements' in their contract, which state they will not perform within an agreed geographical distance of the concert in question for a specified calendar period. For all of these reasons, the live music industry has clear environmental effects.

It would be unfair to say that the live music sector has completely ignored the issue of environmental sustainability. Indeed, 1960s free pop festivals were often wrapped up in ecological rhetoric (Brennan et al 2019, p.255), while in the contemporary era there are numerous agencies and organizations operating as part of the 'green events' sector dedicated

[1] Note that my approach to live music ecology stands in contrast to that of Huib Schippers and the Sustainable Futures for Music Cultures Project funded by the Australian Research Council. Schippers does not place a similar emphasis on materiality, interdependence, and sustainability in his theorization of musical ecosystems. He also uses the term 'sustainability' in a different sense, focusing on the sustainability of musical cultures as intangible cultural heritage rather than any concerns relating directly to environmental sustainability (see Schippers 2015).

to finding ways to reduce the environmental impact of large events of all kinds. In the case of music, the aforementioned British consultancy Julie's Bicycle was a pioneer in this respect and currently works to effect policy changes, encouraging sustainability through engagement between industry and the state as well as conducting 'data collection and research, workshops and training events, quality assurance, capacity building, and thought leadership.'[2] Outside the UK, there are a number of comparable organizations across Europe including the Green Music Initiative (Germany), Le Collectif des festivals (France), Green Events (Netherlands), Greener Events (Norway), and Energy Efficient Music Culture (with nine partners in twenty-one countries). Such firms are a quickly growing subsector within the events industry, as evidenced by the annual ADE Green conference, which brings together an average of 500 professionals each year to share best practice on environmental sustainability in the events sector.

4.3 The Recording Industry

As someone who teaches on a university music industries degree, I often have students asking me for advice on the most effective way to release recorded music. The truth is that there is no steadfast rule anymore, and any answer will depend on the genre in which an artist situates themselves and the type (and size) of audience they hope to reach. Releasing recorded music also raises both economic and environmental questions: if I press my album onto vinyl, would that be a disastrous financial decision? How concerned should I be about arguably unnecessary and inarguably hazardous PVC plastic waste that remains the core ingredient of vinyl records? Would cassette tapes (also plastic) be a good idea, now that they're making a comeback in indie circles? How many people still own tape decks? Is it still worth making (plastic) CDs? What would be the economic and environmental consequences of a digital-only release? Such questions demand an investigation into how the relationship between the economic and environmental costs of recorded music have changed across formats and over history.

The questions above provided the impetus for a collaboration between myself and Dr Kyle Devine on a research project called 'The Cost Of Music,' where I conducted archival research on how both the units produced and price consumers had been willing to pay for recorded music had changed over time, while Devine investigated the environmental impact of different recording formats.[3] The results were startling to us:

[2] Julie's Bicycle presentation slides for Fields of Green roundtable workshop, 16 October 2015.

[3] Economic costs were researched by Matt Brennan with assistance from Paul Archibald (methodology, sources, datasets published in Brennan and Archibald 2019). Environmental costs were researched by Kyle Devine (methodology, sources, and datasets published in Devine 2019).

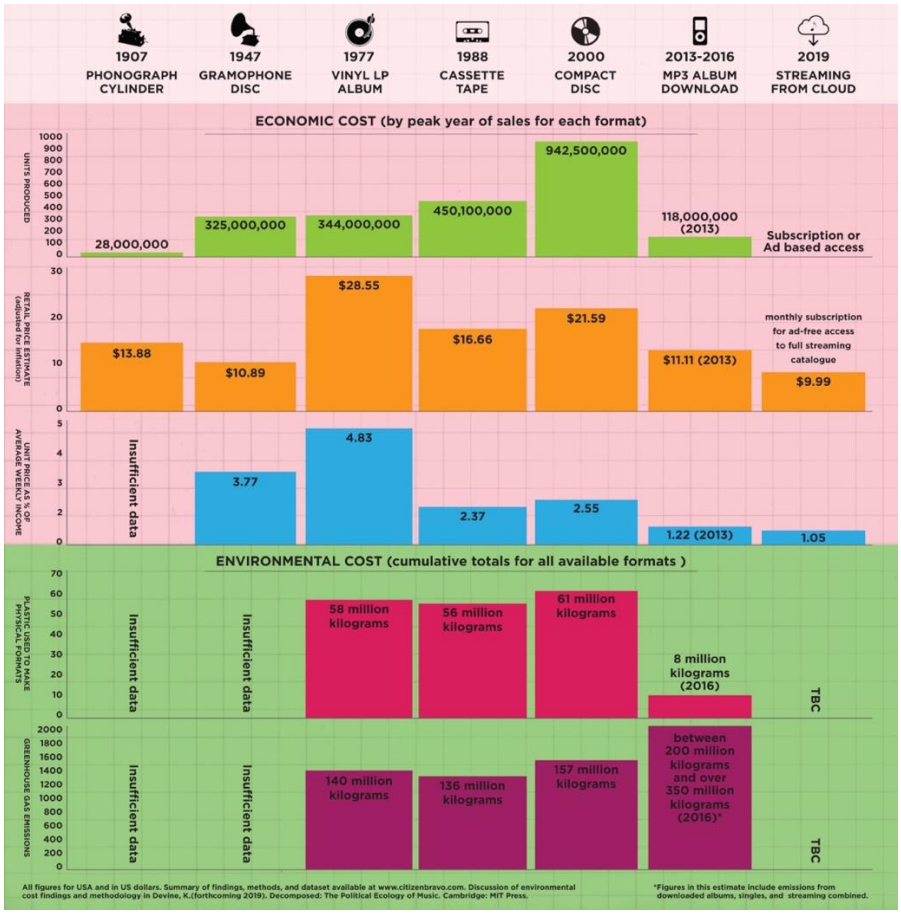


Figure 4.1: Diagram illustrating aspects of the economic and environmental costs of recording formats over time (for more details see Brennan and Devine 2020).

Using the United States as a case study, the infographic illustrates how five economic and environmental metrics have changed over type across seven recording formats: 1) the phonograph cylinder; 2) the 78 rpm disc; 3) the vinyl LP album; 4) the cassette tape; 5) the compact disc; 6) the digital album download; and 7) streaming music remotely from server farms (also known as 'the cloud'). Devine (2015) has previously mapped the history of recorded music into three material eras: shellac, plastic, and data.

The *shellac era* is something of a misnomer: the first viable sound recording and playback device was not the shellac disc, but the phonograph, invented by Thomas Edison in 1877. The cylinder format's peak year of production in the USA was 1907, when 28 million cylinders were manufactured. In today's money (adjusted for inflation), the illustrative price of a cylinder in that year was roughly $13.88. In the nineteenth century, cylinders were made of wax-like substances made from animal fats like beef tallow and processed paraffins like coal-based 'stench-wax'. As the phonograph industry evolved, cylinders were made from all kinds of things—from household tinfoil to whale spermaceti, and finally celluloid and a synthetic called condensate. The gramophone was invented by German-American immigrant Emile Berliner in 1887, and improved on the design of the phonograph by using flat round discs as a storage format instead of cylinders. Discs came in different sizes, but typically stored roughly three minutes of sound on each side. The 78 rpm disc format's peak year of production in the USA was 1947, when 325 million discs were sold. A key component of gramophone discs is shellac, a natural material produced by lac beetles in India. Once lac was harvested, processed washed, dried, and melted, it was shipped to a disc factory, where various ingredients for 78 rpm discs would be combined with shellac as an important but

minority component, while the majority ingredients for discs were locally sourced limestone and slate used as filler material (Brennan and Devine 2020).

The vinyl record moved recorded music away from the acoustic era (where most phonographs and gramophones operated without electricity) into the electrical analog era, but also the *plastic era*. To play music in this era consumers were not only now consuming electricity (an energy cost) but polyvinyl chloride (PVC) plastic. Columbia Records unveiled the 12-inch 33 1/3 LP in 1948, and in 1949 RCA-Victor introduced a rival format, the 7-inch 45 rpm single. The vinyl LP format's peak year of production in the USA was 1977, when 344 million albums were sold. In today's money (adjusted for inflation), the illustrative price of an album in that year was roughly $28.55, equivalent to 4.83% of a US citizen's average weekly salary at the time. The new plastic cost, along with the boom in recorded music manufacturing and sales, had obvious environmental implications. Roughly 58 million kilograms of plastic were used by the US record industry in 1977, the peak production year of the vinyl LP.

The plastic era of recorded music continued with the cassette tape and compact disc. The cassette tape format was developed in Belgium and introduced by the Philips Corporation in 1963. The cassette overtook other tape-based competitors (like the 8-track cartridge and reel-to-reel) thanks to its portability and sound quality. The cassette format's peak year of production in the USA was 1988, when over 450 million cassettes were sold. In today's money (adjusted for inflation), the illustrative price of an album on cassette in that year was roughly $16.66 US dollars. Meanwhile, the compact disc (CD) was a digital-optical data storage format co-developed by Philips and Sony and released in 1982. The compact disc format's peak year of production in the USA was 2000, when over 942.5 million albums on CD were sold. In today's money (adjusted for inflation), the illustrative price of an album on CD in that year was roughly $21.59 US dollars, with roughly 61 million kilograms of plastic used by the US record industry that year.

With the development of the MP3 coding format in 1993, Devine suggests that we enter the *data era* of recorded music. The small file size of MP3 files led to a boom in the distribution of music over the Internet in the mid to late 1990s, when bandwidth and storage were still very restricted. This created a market for MP3 players, and the most successful of these was the iPod, which was first released by Apple in 2001. The MP3 format's peak year of sales in the USA was 2012 for singles, when over 1.39 billion digital singles were legally sold; and 2013 for albums, when 118 million digital albums were legally sold. In today's money the illustrative price of a digital album in 2013 was roughly $11.11 US dollars – or roughly 1.22% of a US citizen's average weekly salary in that year. When downloading takes over, the amount of plastics used by the US drops dramatically to just 8 million kilograms by 2016.

The impact of the digital download market is difficult to separate from the impact of streaming, but it is fair to say that, with the advent of streaming, the business model of consuming recorded music gradually changed from being a *commodity industry* (buying copies to own) to a *service industry* (buying access to a temporary experience of music stored in the cloud). For just $9.99, or just over 1% of the current average weekly salary in the USA, consumers now have unlimited ad-free access to almost all recorded music ever released via platforms like Spotify, Apple Music, YouTube, Pandora, and Amazon. Streaming music took off in the mid-2000s, and the key company to make streaming commercially viable was Spotify, a Swedish company that launched in 2008. Streaming platforms use different digital encoding formats; Spotify, for instance, uses a compression format called Ogg Vorbis rather than MP3. We might initially assume that the rises of downloading and streaming are making music more environmentally friendly. But a very different picture emerges when we think about the energy used to power online music listening.

Storing and processing music online uses a tremendous amount of resources and energy – which have a high impact on the environment. (There is an equivalent point to make about waste resulting from playback devices with built in obscelence, of course, but our calculations were focused on recording format units as opposed to playback devices.) It is possible to demonstrate this by translating the production of plastics and the generation of electricity (for storing and transmitting digital audio files) into greenhouse gas equivalents (GHGs). Devine's research shows GHGs of 157 million kilograms in 2000, but by 2016 the generation of GHGs by storing and transmitting digital files for those listening to music online is estimated to be between 200 million kilograms and over 350 million kilograms in the USA alone. The transition towards streaming recorded music from internet-connected devices has resulted in significantly higher carbon emissions than at any previous point in history.

Obviously this is not the last word on the matter. To truly compare past and present, if it were even possible, you would have to factor in the emissions involved in making the devices on which we have listened to music in different eras. You would need to look at the fuel burned in distributing LPs or CDs to music stores, plus the costs of distributing music players then and now. There are the emissions from the recording studios and the emissions involved in making the musical instruments used in the recording process. You might even want to compare the emissions in live performances in the past and the present – it starts to look like an almost endless enquiry. Yet even if the comparison between different eras ultimately came out looking different, our overriding point would be the same: the price that consumers are willing to pay for listening to recorded music has never been lower than today, yet the hidden environmental impact of that experience is enormous.

The calculations in our project were made based on data from 2016, and it is important to note that the carbon impact of streaming would diminish significantly if all aspects of streaming were powered by renewable energy. But as one commenter pointed out in response to an article presenting our initial findings, even with corporations like Google and Apple moving to renewable energy supply, sorting out international energy production issues is a huge challenge:

> rich countries cannot simply press a button to turn on clean energy sources and leave fossil fuels behind. We use far too much energy to take even half of it from renewables. Unless we drastically change our economic systems and our energy-guzzling lifestyles, climate change will send us the way of the dinosaurs and there will be no more music to stream. (Brennan and Devine 2019)

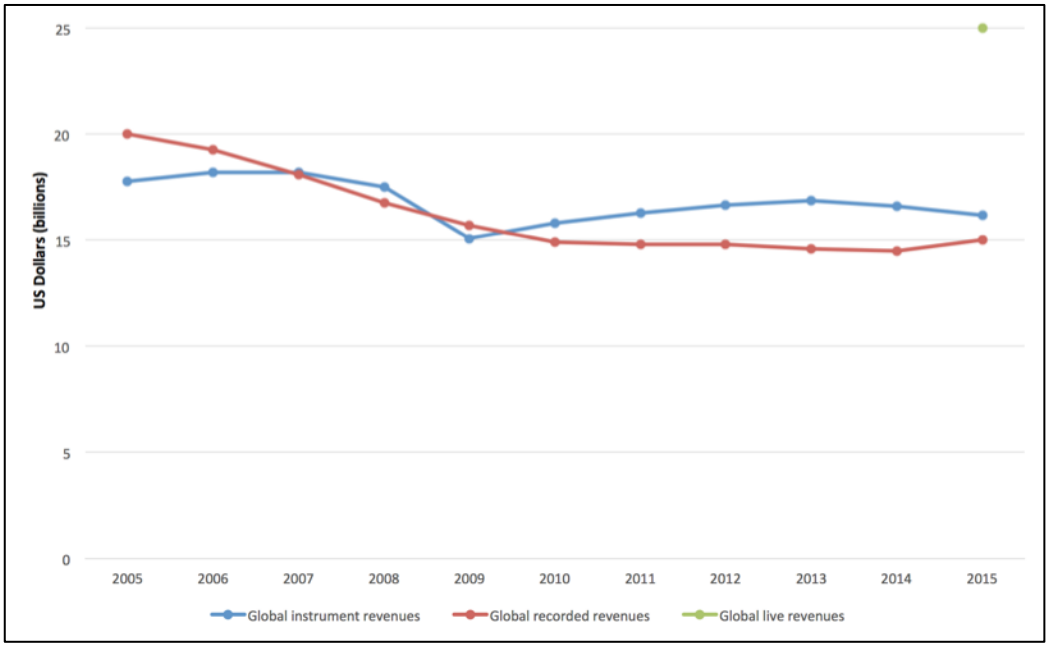
4.4 The Musical Instruments Industry

The musical instruments sector is not typically counted as part of the music industries. This is a strange state of affairs for two reasons. First, the musical instruments manufacturing sector was arguably the first component of the modern music industries to consciously self-identify as 'the music business' from at least the 1890s onward.[4] Second, the devaluation of the recording industry in the early 2000s coupled with the growth of the live music industry led to analysts pluralizing 'music industry' to 'music industries' to better reflect the multiple sectors of industry that monetized musical culture. Yet musical instruments have tended to be ignored even in accounts of the pluralized music industries, a situation made all the more

[4] This can be evidenced by reading through trade publications such as *Music Trades* from the turn of the twentieth century.

puzzling by the fact that as with live music, the value of the musical instruments industry *also* showed signs of overtaking the recording industry in the late in the first decade of the twenty-first century.

Figure 4.2: Diagram illustrating comparative global revenues from recorded music (International Federation of the Phonographic Industry 2016), 'music products' (i.e. instruments and music-making technologies, National Association of Music Merchants 2016), and live music (Price Waterhouse Cooper 2015).



In the graph, one line indicates global revenues from recorded music according to the International Federation of the Phonographic Industry (2016, p.9). This includes physical sales, digital sales, performance rights, and synchronization rights. We can see a gradual downward trend from 2007 to 2014 with a slight recovery in 2015. The live music industry is not represented by a globally operating trade association that publishes annual revenue figures, but the *green* dot in the top right corner of the graph represents a recent assessment by the accountancy firm Price Waterhouse Cooper of the value of the live music sector in 2015. It's well above both instruments and recorded music. Interestingly, however, the second line indicates revenues from music products according to the National Association of Music Merchants (2016, p.54). This includes both traditional instruments and new technologies for making music including the following areas: fretted instruments, pro audio and related products, school music, accessories, home pianos, printed music, recording products, percussion, electronic music products, portable keyboards, DJ products, organs, and karaoke devices. (There may be some debate whether all of the music-making commodities listed above should be grouped as 'instruments', but that argument is for another time). I don't know of a single piece of research that explains the music business in the way the graph suggests we should. Instead, accounts of the music industry have consistently ignored or underestimated the importance of musical instruments and tended to focus on the recorded sector, or more recently, the live sector. Overall it seems clear, however, that it doesn't make sense not to include musical instruments as a key component of the music industry as a whole.

There are several important implications that arise from the inclusion of instruments as a core part of the music industries, but for now I want to focus on what this means when considering the environmental sustainability of music. Inspired by recent work on the ecology of musical instrument making (Allen and Dawe 2016) and Kyle Devine's (2015, 2016) aforementioned record on the political ecology of recorded music, I want to propose a framework for making sense of the development of the contemporary musical instrument industry by dividing it into three overlapping historical eras grouped by the principal materials used to manufacture instruments: (1) *renewable and reusable materials (wood, metals)*; (2) *non-renewable materials (plastics and e-waste)*; and (3) *data*. I will use the drum kit as a case study to illustrate how this division works in practice, since tracing the history of drum kit manufacturing can reveal much about shifts in material resources used across the musical instrument industry as a whole.

As with other instruments, the drum kit's history is part of a larger narrative of the growth of the musical instrument manufacturing industry over the last two centuries from a small guild-based industry to a globalized mass production industry. From the invention of the drum kit as a modern instrument until the end of the Second World War, its production drew for the most part on *renewable and reusable materials.* In the nineteenth century, drums were mostly made from solid planks of timber wood – maple, mahogany, and walnut were all popular. These planks were then steam-bent into cylinders, after which reinforcing rings or glue rings were added so the shells kept their shape (Nicholls 2008, p. 16–17). Drum heads, usually made of calf skin, were tightened onto the shell using wooden hoops tensioned by ropes with leather fittings. Cymbals, meanwhile, were (and still are) made of a bronze alloy composed of 80% copper, 20% tin, and trace elements of silver which acted as a catalyst to bond the copper and tin together. The first drum hardware, such as bass drum pedals and snare drum stands, essentially transformed an otherwise disparate collection of drums and cymbals into new hybrid instrument - the early drum kit. By World War I drum manufacturers had started to produce more durable, standardized hardware out of iron and steel. By the end of the 1930s, drum manufacturers were tensioning drums with metal hoops, rods, and fittings, usually chrome-plated steel. They also begin to use laminated plywood instead of solid wood to construct their shells. The acoustic drum kit is still made of mostly wood and metal, and the odd bit of rubber, in the present day. Drum heads, however, are an important exception to this rule, and this brings me to the second overlapping era I want to discuss – the era of *non-renewable and e-waste materials*.

The first non-renewable components of the drum kit were its metal components: cymbals in the nineteenth century were followed in the twentieth century by metal fittings on and accompanying metal hardware typically made of iron, steel, or aluminium and plated in chrome or nickel. Metal snare drums - made of brass, steel, or aluminium - also become popular (especially from the 1960s onward). But most of these metals were also reasonably easy to reuse or recycle, not least because they were usually fairly easy to separate. A more complicated non-renewable material used in drum kits was plastic. As early as 1924, a type of petrochemical-based celluloid plastic known as pyralin was used as a decorative wrap around the shells of drums, and similar plastic wraps only became more popular from the 1930s onward (Brennan 2019). After the war, cheap durable, plastic compounds began to infiltrate most areas of consumer manufacturing, including a polyester film known as Mylar, which like many new postwar production materials had its origins in defense research and development. The dominant plastic drum head manufacturers, Evans and Remo, both began their business in the second half of the 1950s. According to Nicholls, plastic drum heads won over drummers almost completely in a few short years due to their numerous advantages: 'not only were plastic heads stronger than animal skin, they were also weather-proof, heat-proof, consistent, cheaper, and could be produced in vast quantities' (Nicholls 2008, p.29).

The biggest change in drum kit production during the 1960s and 1970s was without question the rapid rise of Japan as a key centre for drum kit design and manufacturing. Like Germany, Japan was forced to rebuild and rethink across all spheres of industry after the devastation of the Second World War. Non-Western drum manufacturers and, in particular, a trio of Japanese companies - Pearl, Tama, and Yamaha – all began trading in the postwar years. These companies aggressively expanded in the 1970s, not least due to their ability to manufacture drum kits at a cheaper price point thanks to the lower cost of labour in east Asia. The other key consequence, of course, was an increasingly global flow of instruments traveling from continent to continent, thus increasing the carbon footprint of consuming such instruments.

Perhaps the drum kit that best characterizes the non-renewable material era was the electronically synthesized drum kit of the 1980s. A pioneer in this regard was the Simmons SDSV, or Simmons Drum Synthesizer, developed by drummer and record producer Richard James Burgess and collaborators and commercially released in 1981. But electronic drum kits truly began widespread after Roland launched its first V-Drums kit – the TD10 – in 1997. As Roland's Product Manager for Drums in Europe, Jules Taberrer-Stewart observed:

> In today's market, we know that electronic drum sales are almost 1:1 for acoustic drums – in the [2015] German market, all acoustic drums and cymbals (excluding percussion) was worth 12.8m Euro, while electronic drum sales accounted for 10.6m Euro in the same year. The industry does not have that information available for all markets in Europe, but the German market is the largest single market in Europe and other countries will scale similarly (Personal interview, 7 June 2017).

One problem with this shift, of course, is that the majority of drum kits being made and sold today are now made from oil-based plastic and electronics which, like other consumer products, are having an increasingly detrimental effect on the planet.

Related to the rise of electronic drum kits, of course, are drum samples, drum programming and software, which brings us to the *data era* of the instrument. The roots of the data drum kit are in digital sampling. In 1979, Roger Linn created the Linn LM-1 Drum Computer, the first commercially released drum machine to use digital samples of acoustic drums. It was used on hits throughout the early 1980s. By the late 1980s, the replacement or augmentation of the acoustic drum kit by analog drum machines or digital samples of drums was commonplace in pop record production. By the twenty-first century we see the release of dedicated drum replacement software. Unlike streaming recorded music, these software programs do not tend to require the constant remote downloading of data from server farms to operate, but they do of course rely on the wider consumer electronics industry of portable computers, audio interfaces, and other hardware which is both difficult to renew and recycle, and which is characterized by built-in obsolescence and frequent software updates in order to sustain growth.

4.5 Conclusion

Unfortunately, there are no easy solutions to greening the music industries. So what can be done, and by who? Part of the answer to the first question must be a willingness to rethink the rationale for growth of the music industries (the same of course goes for the wider creative and global economy). The second question is equally important. Audiences and listeners clearly have a role to play in their consumption choices. But musicians, both amateur and professional, also shoulder some of the responsibility from their touring practices and travel to their equipment and distribution strategies. Manufacturers, promoters, labels, and technology companies that rely on musical content for their business model will need work

with governments to make a transition toward renewable energy supply combined with a reduction in overall energy use.

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