

Children's Carbon Cultures

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Abstract

In this article, we examine the connection between how we imagine carbon, energy and energy futures, and carbon use. We argue that to act on climate change we must reframe our cultural understanding carbon. Where children have often been left out of discussions of carbon use, we bring children into these conversations about carbon consumption and imaginaries through examining contemporary perspectives on posthumanism and energy cultures. We demonstrate that children's imaginative renderings of possible climate change solutions offer an effectively very different way of connecting with climate change, perhaps a more motivating and inspiring means of relating to the more than human world and reworking our entanglements with energy cultures.

Keywords

carbon, children, energy cultures, climate change, posthumanism

We examine some new ways of imagining carbon, energy, and energy futures as a possible option for motivating public desire to stop climate change. We argue that reframing how we see carbon is core to the project of stopping climate change. Carbon is central to life, and indeed to human beings. The human body is a complex mixture of six elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Approximately 18% of our bodies are carbon. Our children are partially composed of carbon and carbon consumption is a part of children's lives, although their voices are not often considered in debates about climate change. The worlds into which children are born rely on industrial and commercial carbon consumption. However, until the recent rise of global protests about climate change, children's voices and agency have largely been omitted from discussions of carbon consumption. In this article, we bring children into discussions about carbon consumption and carbon imaginaries through examining contemporary perspectives on posthumanism and energy cultures. We bring these together with data from three research projects that each begins to map children's perspectives on carbon production and consumption. In some respects this work is long overdue, as children stand to inherit a precarious global climate that rests significantly on cultural practices, values, and understandings of carbon and energy cultures.

Any approach to thinking about carbon and energy cultures is necessarily a posthuman inquiry, because we are all entangled with carbon and carbon imaginaries. We are attached to systems run on carbon, enmeshed with places

geared to produce coal, enamored with carbon heavy or “carbon neutral” objects and profoundly entangled with the more-than-human world:

... phenomena do not merely mark the epistemological inseparability of observer and observed; rather, *phenomena are the ontological inseparability of agentially intra-acting “components.”* ... phenomena are the ontological entanglement of objects and agencies of observation. Hence it is the ontological inseparability or entanglement of the object and the agencies of observation that is the basis for complementarity. (Barad, 2007, pp. 308–309)

Karen Barad's concept of quantum entanglement helps to show the relational and responsive nature of how and where we are attached. Quantum entanglement is considered a “posthuman” concept because it shows how fundamentally the human is composed of and by the more than human. We use the word posthuman to express criticism of the individual subject, the age of enlightenment, and associated beliefs that predominantly White, male, European men and knowledges are the center of our world and knowledge systems. If the White, male, European man can be seen as the model of the human—or as “humanism,”

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then *posthumanism is the story of us other humans*: BIPOC, women, children, the disabled, LGBTQIA+, and our relational becomings with animals, lands, atmospheres, ideas, and things.

Posthumanism is a philosophy of and for the people: it makes space for everyday, material and unconscious ways of knowing, it believes we are entangled, dependent, and messy. It does not profess to have all the answers—indeed, it believes in the liveness of matter and co-construction of anything that might be considered to be “an answer.” Recent analysis in childhood studies identifies that researchers have identified a need to develop a posthuman understanding of childhood (Malone, 2016; Murris, 2016) to better understand children’s relationships with the environments they co-habit. More than this, we argue that a posthuman perspective draws attention to the impact of children on the environment and the agency that environments have. For example, global warming is an example of environmental agency that demonstrates the power the non-human world has over humans: climate change will lead to mass extinction if we do not work to stop it. Rosi Braidotti describes this more than human focus through saying that: “the challenge of the posthuman condition consists in grabbing the opportunities offered by the decline of the unitary subject position upheld by humanism, which has mutated in a number of complex directions” (Braidotti, 2013, p. 50).

People become through carbon consumption, children’s practices of carbon consumption, and specific carbon imaginaries are entangled in their lives. We have all been enmeshed with children’s imaginative reconfigurations of carbon cultures through our fieldwork, which generates art by and with children reconfiguring the carbon cultures into which they are born. The data in what follows explores findings from three research grants, Anna Hickey-Moody’s ARC future fellowship project *Interfaith Childhoods*, Amy Cutter-Mackenzie-Knowles and David Rousell’s *Climate Change and Me* project, and David Rousell’s *Local Alternatives* project.

In the arts-based methods for Anna Hickey-Moody’s ARC future fellowship project *Interfaith Childhoods*, she asked children to express their values through making artwork about “what really matters” (Hickey-Moody & Willcox, 2019). Many of the perspectives children presented foreground knowledges about carbon that are not part of popular discourses and are omitted from parent cultures of carbon production and consumption. These subjugated knowledges present children’s subcultural perspectives on this critical environmental resource. While the specific art-based methods employed to create various examples given are different, each employs a creative opportunity for children to reflect on, and express their perspectives about the world, and children typically wanted to make work about the environment and carbon consumption.

Arts-based ethnographic workshops with children were designed for the *Interfaith Childhoods* project as a primary source of empirical data collection with children. The project uses a new materialist approach which, when developed into a set of community arts practices and pedagogies, understands children’s perspectives on the topics of community, belonging, faith, and identity. Since 2016, the project has run across 12 sites in London, Manchester, Sydney, Adelaide, Melbourne, and Canberra. Anna Hickey-Moody works with children, their parents, carers, and teachers to facilitate arts-based methods of exploring faith and community, to produce a broader narrative about how people feel they belong. At the time of writing, the research has over 400 participants and is ongoing. The arts workshops which we specifically discuss in this article are considered a method of community engagement and a means of making data *with* children, as children’s experiences and worldviews articulate through their art. Over the 3 years of research, the children are engaged in a set of three multi-day workshops, followed by community focus group discussions with the children’s parents and carers. The art making and the focus group discussions explore themes of identity, community, belonging, social values, and religious beliefs. Such methods offer safe spaces for children to build resilience and confidence, exercise their agency, and express themselves through acts of art making. It is in this material agency that we see children’s diverse beliefs, hopes, and aspirations emerge (Hickey-Moody, 2017, 2018, 2019a,b). Broadly speaking, sharing this information can facilitate a better understanding of intercultural relations and in this article we can see insights into children’s environmental and future imaginaries.

The workshops are centered on various forms of visual art, but also incorporate three dimensional art, digital animation, music and they are a way that Hickey-Moody advances a performative reading of the child’s body in space. The arts workshops occur in a location that is already embedded in the children’s worlds, namely, their school, their religious institution, or a local community service provider. So, the children are familiar with these contexts. The workshops are designed to support children in thinking about, and expressing their opinions and experiences individually, and then to move on to develop collective visions of the future and community life through working together. Scaffolded collaboration and reflection are embedded in the workshop structures.

In most instances, the workshops employ the same materials and media in all the research sites and follow the same order of events in all the research sites. Each workshop is prefaced by a plenary discussion in which Hickey-Moody leads the children through an exploration of their responses to, and existing knowledge of, the subject of the day’s workshop. The topics range from identity, belonging, and values to “what really matters,” “imagining the future,”

among other collaborative tasks. These discussions and collaborations result in the children's main ideas being written on a white board and then drawn on as a resource for art making across the course of the workshop. The workshops are broken into sections, with each section having a specific focus. The remakes of energy cultures and practices of carbon consumption that feature in the children's work are striking. So too are their responses to questions about value, and this data about the environment and climate change is not a result of being directly asked about the subject, its children's responses to the question "what really matters."

In a primary school in South East London in 2017, when children were asked to show a future that is made up of "everything that really matters," they created a collaborative painting featuring the environment, nature, and animals. The children's first few unprompted responses to the question of "what really matters" were flowers, rain and water, bees, insects, sticks, and our bodies. They expressed their own enmeshment in energy cultures through focusing on water, the sun, and rivers.

In Figure 1, children create a possible future environment that explicitly centers care for the environment, featuring a zoo to "care for animals," a forest to "care for plants," an airport because "we understand differences from other countries," a Mosque, and a Church. It's interesting that carbon sinks (forests) and carbon emissions (airports) sit side by side in this visualization of carbon cultures. Rather unexpectedly, this project presented a myriad of inventive ways through which children visualized carbon and carbon cultures. Jennifer Gabrys (2014) argues that we need to be able to visualize energy "beyond tactics of awareness, [in order] to give rise to speculative energy practices" (p. 2101). And this is exactly what the children's art does. While attempts to visualize energy have often been limited to tracking consumption through numeric representation (e.g., through smart meters, home appliances, or energy foot-print web tools), Gabrys argues that we may do better to visualize the materiality of energy as a "political scene." She explains,

. . . materiality is arguably more than objects, things, or evidently tangible material, but also includes relations, processes, and infrastructures (Gabrys, 2011), which exceed the participatory space of the consumer-citizen who might judiciously act on energy use. (Gabrys, 2014, p. 2107)

Here, the onus is taken off the individual consumer-citizen to visualize their relationships with energy from the cosmopolitical perspective of "collective becomings" (Gabrys, 2014, p. 2106). This is important, Gabrys argues, because energy is usually not invisible by accident or happenstance, rather, the act of *hiding energy* is a successful "design strategy" that has masked our unsustainable practices of energy consumption for decades (Gabrys, 2014, p. 2098).



Figure 1. Future city with a zoo, a forest, a church, a mosque and an airport. London 2017.

By including relations and processes in her conception of the materiality of energy, Gabrys shortens the distance between energy and culture. In many respects, children's art performs the same task of bringing energy and culture together through presenting visual maps of human-energy culture relations.

The children involved with Interfaith Childhoods in London, Manchester, Sydney, Melbourne, Adelaide, and Canberra shortened the distance between energy and culture through drawing invented energy saving devices, drawing water cycles flowing in and across parks, flowers, and the earth in almost all of their art about "what really matters." In discussions about the climate for the future that children had created they noted that "the sky is normally blue . . . but this one has green, blue, red, purple, and black"—this observation echoes the paper mâché worlds they created, which featured mingled colors, and fantastic possible planetary compositions. It is not just children's imagining of energy and visualizing carbon neutral inventions that might save the world, their practices of being in the world can also be seen as significant forms of enmeshment.

Here, we see children making a community in the bush (Figure 2), and this particular community was populated by the children and also imagined dragons and water creatures, roads made of water—populated with fish, crustaceans, and people in submarines. Other future cities that children made had flying carbon neutral trains, mobile carbon neutral hospitals, a rainbow road, flying carbon neutral cars, a magic carpet to reduce emissions, and people were shown diving out of the cars and flying carpets with parachutes strapped on their backs, opening as they filled with air.

The children connected energy production and consumption to offer new ways of saving energy that align with their cultural values. Such imaginative cultural readings of energy possibilities have broadly been overlooked in scholarship on



Figure 2. A community in the bush.

energy cultures and climate change. However, exactly such a reading is essential to addressing the climate crisis and indeed, to understanding the posthuman condition. As Strauss, Rupp, and Love establish—energy production and consumption do not always follow logical economic or environmental principles—instead our relationships to energy are equally determined by our cultural values, and “people tend to switch frames of reference among technical, economic, and cultural logics when considering their uses of energy” (Strauss et al., 2013, p. 10).

Therefore, assuming that liberal economic principles or technological innovation alone will provide the necessary solutions to the climate crisis ignores the ways our uses of energy do not fall neatly along economically or environmentally logical lines, and the distinct role that cultural processes play in forming the values and beliefs that structure our energy practices. One canvass the children made of greens and blues blended sea and land across 4 m, another depicted an earth encircled by humans: an earth encircled by humans caring for it and for one another. One of the children made this poem, which presents breath and animals as central to human life and to the energy culture of the world:

“LIFE your

Heart.

Animals.

Breathing.

Air.”

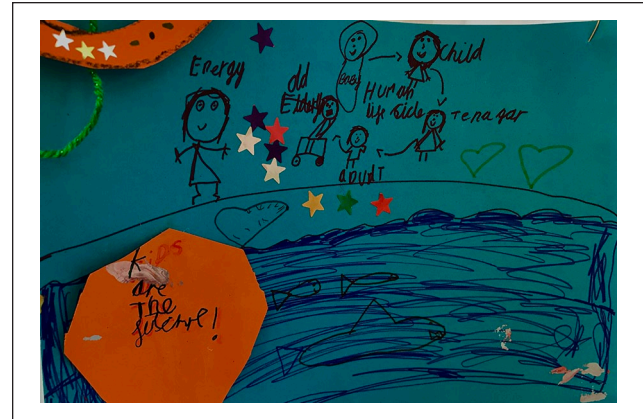


Figure 3. Human life cycle (kids are the future!), London 2018.

Another participant drew a “life cycle” of a person transitioning from a baby, to adulthood, and to old age (Figure 3). This cycle was a circular diagram that hovered above an ocean, which was full of fish and hearts and stars. It also featured the words “kids are the future”—this image is a collage of a range of different ideas of time, family, life, and energy movements which shows how connected these things are. Energy is presented as a person who is part of this diagram of relationality.

As Adrian Ivakhiv (2018, p. 202) reminds us, all cultural movements, political and material formations are essentially comprised of energy:

All life on this planet is the product of one or another permutation of the interaction between energy originating from the sun (light and heat) and the surface of the Earth that it strikes. Everything we know is an evolved permutation of that endlessly differentiating process. (Ivakhiv, 2018, p. 201)

Children are particularly aware of this expanded sense of energy, which is not only made tangible by units of measurement, but through cultural practices, speculative imaginings, and political becomings of all kinds. Energy as a concept moves through all forms and modalities of life.

This child-lens into energy cultures radically reframes capitalist configurations of energy as carbon. In her previous work on carbon cultures, Hickey-Moody (2019) has argued that “carbon production, consumption and trading mobilise masculinist energy tropes of competition, performance and frontier politics” (p. 149). David Tyfield also traces the rise of carbon through coal, to show how it is tied to, and mirrored by, the trajectory of different stages of liberalism. Tyfield (2014) argues that energy as a concept is “conceived as social, cultural and political socio-technical systems” and therefore “must be explored as a key explanatory factor in accounts of social change and, in particular of the *power* that executes and is itself formed by such change” (p. 61).

What we see from Tyfield (2014), and our own analyses, is that our sources of energy are not coincidental or distinct from our socioeconomic systems—rather, these systems and energy sources give meaning to one another (p. 61). Any attempt to convert or alter the course of these energy practices is impossible without also addressing the cultural values, practices, and systems that underpin them. Energy cultures are an acknowledgment of the way that modes of energy production and consumption are not coincidental, but are intricately linked to our cultural systems.

The materiality of energy is essential to its position within energy cultures. While it permeates our day-to-day lives, it is often difficult to make energy visual or tangible. The specific means by which we might understand the materiality of energy, therefore, directs our actions in vastly different ways. Children offer us new ways of understanding the materialization of energy, such as flying recycling factories, flying cars, and streets of water that stop the need for carbon emissions and create spaces for marine life to thrive. These inventions and urban re-designs are just a few of many that appeared across the course of Hickey-Moody's fieldwork and are obvious responses to climate change. These inventions show just how worried children are about climate change and how their enmeshment with the more than human world informs their imaginations.

As Sheena Wilson (2018) shows, our ability to respond to the climate crisis is essentially linked to our ability to imagine creative alternatives to our current energy systems (p. 379). Our ability to open the concept of energy beyond carbon cultures of consumption and capital is, therefore, crucial. Where Western minority worldviews “inevitably define the contours of our systems, social realities, and, therefore, in many cases, the limits of our imaginaries,” our ability to envisage creative energy solutions are stifled (Wilson, 2018, p. 379). Energy cultures can be repressive and capitalist, locking us into certain practices and ideals that appear normative and even insurmountable, however, when enacted through diverse values-sets, speculative practices such as children's art, can open up new realities of energy consumption.

Current scholarly understandings of energy cultures demonstrate how social practices are materialized through our energy systems and infrastructures. Energy cultures are not isolated systems, but are in constant states of interaction and influence with each other. In his discussion of the effects of mining on Indigenous communities, Tony Birch demonstrates what we may see as a very different energy culture than those described by Sheller, Tyfield, and Hickey-Moody's work, for example. While he does not articulate this through the concept of energy cultures, Birch's analysis of mining and traditional Indigenous knowledge in Australia offers an insight into how the consequences of our energy practices are rarely, if ever, felt equally. He states,

Indigenous people, particularly those living outside major urban centers, will additionally face the consequence of sickness to country itself. The ability to adequately engage with Country, to nurture and maintain cultural ceremony for both Elders and the young (Green et al., 2009) will become increasingly difficult. Indigenous communities live interdependently with country. Sickness, in its holistic cultural, physical and psychological sense will be acutely felt. (Birch, 2016, p. 94)

There are two key points that make Birch's analysis pertinent to an understanding of energy cultures. First, cultural values produce affective experiences that mean that the consequences of our energy practices are not experienced equally.

Second, energy cultures themselves cannot be neatly demarcated. Instead, there are often multiple, complexly connected energy cultures that form around and through particular material embodiments of energy. Through the mining industry's extractive practices, we see the embodiment of the cultural values and practices that are integral to Hickey-Moody's (2015, 2019) earlier studies of masculinist carbon cultures. However, within this same space exists the vastly different energy cultures of which Tony Birch speaks.

It is not possible to clearly delimit these cultures around specific practices either. As Birch demonstrates, the decision to allow mining leases on traditional lands is often positioned within complex and competing responsibilities:

When Indigenous traditional owners make important decisions regarding protection and maintenance of Country, they do so under duress, considering that their people are often suffering immediate and endemic social and economic disadvantage. The extraction of fossil fuels from Indigenous land ultimately becomes a major contributor to global warming. (Birch, 2016, p. 96)

When analyzing energy cultures, it is clear that values do not neatly predetermine practices or choices. There are entanglements of power, matter, and historical context that people cannot ever effectively unravel, meaning that collective and individual choices around energy extraction, production, and consumption are complex and are shaped by the more than human: by the composition of land, soil, fossils, by historical animals, and ecosystems: by deaths accumulated in earth.

Analysis of these systems thus needs to include an understanding of how energy cultures have been enacted and disrupted by colonization. As Birch demonstrates, “The history of colonial expansion is a key contributor to climate change . . . producing catastrophic economic and social impacts on Indigenous communities” (Birch, 2016, p. 92). Colonization and environmental exploitation are inextricably linked, and as such, contemporary energy cultures are also often constructed either through, or in opposition to, colonial values.

The activist groups that form around such values set out specifically to disrupt the prevailing energy cultures of colonial expansion and extraction. For Birch, “Combined concerns over climate change and the inequities embedded in historical relationships between Indigenous communities and mining companies has mobilized a new generation of Indigenous activists” (Birch, 2016, p. 95). Similar concerns have mobilized thousands of school children marching against climate change across the world.

Rahul Mukherjee (2020) depicts the distinct energy cultures (or what he calls “radiant infrastructures”) that form around environmental controversies in India: nuclear reactors in rural communities, and mobile phone towers in urban centers. Similarly, young people around the world are engaging in a form of climate activism that is attentive to the impacts of colonial histories. Within Australia, “Seed” is the first Indigenous youth climate network that actively connects issues of climate change to land rights for First Nations people. Seed is one of a number of new youth-focused activist groups which reflect the fact that environmental publics are forming across multiple localities, calling audiences to attention to question the future of energy production and consumption, and at the same time, often highlighting the links between these practices and wider cultural, historical, and economic systems. How, then, might we understand, visualize, and interact with energy if we are not limited by frameworks of consumption and capital? What of frameworks of energy that are not based on environmental control and exploitation, but on an enmeshed ecology of humans and nonhumans alike?

David Rousell and Amy Cutter-Mackenzie’s work on climate change and children has demonstrated how children and young people conceive of alternative ways of valuing nature, not as a passive resource for human use, but as active and as site of agential relations of energy (Cutter-Mackenzie & Rousell, 2019; Rousell et al., 2017). We discuss this work in greater detail below.

In *The Mushroom at the End of the World*, Anna Tsing also develops an understanding of humans as a part of, not apart from, nature. Tsing reminds us that

Humans, too, have always been involved in multispecies world making. Fire was a tool for early humans not just to cook but also to burn the landscape, encouraging edible bulbs and grasses that attracted animals for hunting. Humans shape multispecies worlds when our living arrangements make room for other species . . . (Tsing, 2015, p. 22)

Furthermore, she explains that

Pines, with their associated fungal partners, often flourish in landscapes burned by humans; pines and fungi work together to take advantage of bright open spaces and exposed mineral soils. Humans, pines, and fungi make living arrangements simultaneously for themselves and for others: multispecies worlds. (Tsing, 2015, p. 22)

The ecological processes of multispecies energy ecosystems show us the outside of the human. We are enmeshed with fungi, pine, fire, water, and atmosphere and we rely on matter and liquid in ways that can be viewed as cultural processes, and thus are equally a part of contemporary energy cultures, but are also part of science. Air and water keep us alive. As in Donna Haraway’s “naturecultures” and Samantha Frost’s “biocultural” creatures, energy cultures are formed through more-than-human encounters (Frost, 2016, p. 4). Tsing, as well as the young co-researchers within Cutter-Mackenzie and Rousell’s work in *Climate Change and Me*, demonstrates a cultural framework of energy consumption and production that makes room for and facilitates alternative, more than human modes of world-building. Such a framework is distinctly at odds with the cultures of speed and lightness enacted by the capitalist aluminum energy culture so insightfully articulated by Mimi Sheller (2014).

Our point here is that cultural understandings of energy shape, and are shaped by, wider systems and practices of consumption; but also that energy cultures include speculative practices, practices that can allow us to open up cultural spaces to imagine alternative futures (Rousell et al., 2017). Tsing’s analysis of the Matsutake mushroom, the child-researchers within *Climate Change and Me*, and the *Interfaith Childhoods* project, along with the practices of climate activists, especially children’s recent public large-scale climate activism, open the window to alternative energy cultures and imaginaries, ones in which energy is not the product of environmental control and exploitation, but the material embodiment of the relationship between humans and nonhumans alike. However, changing prevailing energy cultures is not a simple task. Reaching such a state requires not just a shift in imaginaries and values, but a material change in our relationships to energy.

The entanglement of humans with the materiality of energy leads to the enactment of distinct practices, values, and systems of energy consumption. This materiality is not simply the tangible representation of energy, but an assemblage of relations, infrastructures, practices, and movements (Berlant, 2016; Gabrys, 2014; McCormack, 2017). Just as energy itself cannot be created or destroyed, only transferred or transformed, energy cultures are, too, in constant, speculative states of becoming (Gabrys, 2014, p. 2106). To increase the potential of speculative energy cultures, we want to suggest that we should better understand children’s carbon cultures—through inquiring into how children’s understandings of and values around carbon affect their practices of energy consumption. We do so with an openness to the perspectives detailed above, and an awareness that energy is not confined to the numbers on our electricity bills or the readings on a smart meter, or even to the prevailing economic system of the time. Children’s conceptions of and speculative practices around energy and carbon are likely to move beyond these restric-



Figure 4. Photographs of fungi in her local rainforest taken by Grace, a 13-year-old co-researcher in the Climate Change and Me project.

tive frameworks. Listening to these perspectives is essential if we are to address the climate crisis.

Climate Change and Me (CC+Me) 1.0

The Climate Change and Me international Research Program (see <http://climatechangeandme.com.au>) consists of a series of research projects focused on climate change and children (Figure 4). The inaugural project, entitled Climate Change + Me 1.0 (2014–2017), took place over a period of 4 years in the Northern region of New South Wales, Australia. The project was funded by the NSW Environmental Trust, which is an independent statutory body established by the NSW government to fund a broad range of organizations to undertake projects that respond to environmental concerns across NSW. The CC+Me project 1.0 aimed to strengthen relationships between local environments and communities by increasing opportunities for children and young people (age 9–14) to collectively develop a new vision for climate change education. Cutter-Mackenzie-Knowles and Rousell worked with 135 children and young people as co-researchers exploring creative and affective responses to climate change through participatory ethnography and socially engaged arts practices across five phases of research. Four primary schools and two high

schools joined the project as community partners, and students elected to participate based on their experience in research workshops, either in the school or at Southern Cross University. The research workshops were set in motion through the project's emergent research design and child-framed methodology, which allowed us to work collaboratively with children and young people within a “co-research playspace” (Cutter-Mackenzie & Rousell, 2019). Initially, this involved hosting research training workshops in local schools, where students were introduced to scientific and social understandings of climate change, explored the concepts of the Anthropocene epoch and deep time, learned to conduct ethnographic research, take field notes, and use creative practices such as drawing, photography, and video as creative research methods. The research team also developed a customized and secure social media interface that enabled the young researchers to post and comment on each other's research blogs and images, as well as initiate their own small projects, discussions, and games within a blogspace called the “CC + Me Hangout.”

Throughout these research activities, children and young people had the freedom to develop their own research practices and trajectories, and they were supported with material, discussions, analytic approaches, and collective development of creative lines of inquiry. The artworks,

essays, videos, photographs, poems, and fictional works created through this research were assembled into a public touring exhibition called *Past Now Future*, which was viewed by over 8,000 members of the public over an 8-week period. This material also provided the resources for a trans-disciplinary climate change curriculum co-developed with young people, and which is being implemented in 20 primary and secondary schools across Australia (see www.climatechangeandme.com.au). David Rousell extended the work of *Climate Change and me* project through his work in the *Local Alternatives* project, which also offers ways of visually mapping young people's relationships to energy cultures and also builds new possibilities for relationships to energy cultures.

Shifting Carbon Imaginaries in the Local Alternatives Project

Throughout the varied conceptual and creative experiments that have taken place over the life of the *Local Alternatives* project, carbon has often come to feature in discussions of extraction, transmutation, contamination, enslavement, and wonder. Rather than taking a simplistic stance against carbon as the source or reason for climate change, children and young people have often been fascinated with the visceral, sensuous, and imaginative potentials of carbon as an element that is never pure or neutral. This fascination with what might be termed a "carbon imaginary" began to emerge in the very first workshops with a group of children (aged 9–11) at the Z-Arts community arts center in Manchester, UK.¹ These initial workshops focused on developing artistic techniques for sensing and responding to the impacts of climate change across multiple material and affective levels. The group initially focused on two concepts as tools for opening and activating children's creative processes: the concept of "strata" and the concept of "climate." These workshops combined engagement with contemporary artworks, scientific models and diagrams, philosophical discussions, creative writing, and practice-based experiments with artistic materials and media.

In experiments with the concept of strata, the group began by engaging with notions of deep time as materialized in the Earth's geologic layers. This involved an engagement with stratigraphic models that illustrate the complex temporalities and flows of the Earth's carbon cycles and energy systems. The group explored how carbon has been captured and stored in the Earth's layers across the geologic time scale, while also studying the irreversible effects of unearthing and dredging carbon from the Earth through coal mining and fracking (see Figure 5). This geologic engagement with carbon was expanded to consider layers of human transport and communications strata, biological and genetic strata, socio-cultural strata, digital strata, as well as mental, unconscious, and affective strata that are



Figure 5. A material flow of black India ink which one of the children described as "erupting" like crude oil and contaminating the layers of colored strata she had created with watercolors.



Figure 6. Another example of how black India ink effected an irreversible transmutation of a child's strata painting. She described the ink as acting "like oil" dredged from the Earth that was leaching into, smudging, and contaminating all the other layers (Participant artwork from the *Local Alternatives* project).

entangled with contemporary processes of carbon extraction and energy provision. The group also looked at the works of several contemporary artists who employ concepts of strata and the carbon cycle as source material, including Jarod Charzewski's discarded textile installations and Laura Moriarty's encaustic wax sculptures.

These varied perspectives on the stratigraphy of carbon served as inspiration for children's artistic experiments with creating "strata paintings" using a range of inks, watercolors, and reactive materials on paper. The process of creating strata paintings functioned both as a material experiment with how media might perform different stratifications on paper and as a conceptual experiment with how different carbon imaginaries might emerge through the creative process. Because the children were working



Figure 7. Blurring the mixed milieus of Earthly carbonscapes and imaginaries (Participant artwork from the Local Alternatives project).

with the media while it was still wet on the surface of the paper, the process created a dynamic and immediate interplay of materials and activity. Many of the children's strata paintings began with a process of layering bands of watercolor that bled into one another at the edges, but preserved a structural integrity as discrete layers of color. This arrangement was then disrupted by the addition of black India ink using a dropper or spray bottle, along with the use of salt and other chemical agents to create zones of resistance between different viscosities and flows of material on the surface of the paper.

As this experimental process unfolded, the children began to describe the material agency of the Black India ink as being "unearthed," "spreading," and "contaminating" other strata in the painting, just like crude oil or coal being mined from deep underground (see Figure 2). One of the aspects of this process that the children found both fascinating and disturbing was that the black ink seemed to erupt and take over the strata painting very quickly, making it nearly impossible to mitigate or control its effects in disrupting the careful integrity of the watercolor layers they had previously laid down (see Figure 3). Once the ink had begun to saturate the strata painting, there was no way of "going back" to the careful layers they had previously created. This led to a series of provocative discussions around the irreversibility of large-scale mining processes that unearth carbon sinks that have been safely stored in the Earth's layers for millions of years, as well as the absurdity of geo-engineering projects aimed at recapturing and storing carbon unleashed by these processes.²

These associations with carbon as having agency carried over into the next series of creative experiments. Shifting focus from layers of geologic strata to the various "spheres" of the Earth's climate system, the next workshops began with an engagement with the energetic relationships between the biosphere, geosphere, atmosphere, hydrosphere, and cryosphere. This included scientific modellings of the flow of carbon across these spheres, as well as creative renderings and experimentations with climate spheres

in contemporary art, such as the Cloud Cities installations by artist and architect Tomas Saraceno. What emerged from this process was a sense of how children's cultural images and imaginings of the Earth itself were being altered by the play of carbon across these multiple spheres. Children were fascinated with an image showing the "blue marble" photograph of the Earth from space, widely popularized since the 1960s, contrasted with two other more recent images, one of the Earth's electricity grid from the International Space station and another that documents NASA's global modeling of carbon flows across the Earth over an entire year. In the Local Alternatives workshops, these contrasting images of the Earth's "carbonscapes" led to discussions of how cultural perceptions and imaginings of the Earth are being reshaped by climate science data, as well as children's critical engagement with climate activism and discourse in the public domain. Emerging from these discussions was a sense that children no longer viewed the Earth as something "whole," "pure," or "natural," but rather as something "scarred," "gridded," "technologised," "contaminated," "mixed up," and "chaotic."

As a way of exploring these ideas further, Rousell invited children to use different colors of clay to express their shifting cultural images of the Earth through its various spheres and carbonscapes. Many of them chose to create a series of multilayered spheres, but interestingly, when the spheres were cut into cross sections, each of the layers was composed of a mixture of different colors. A number of children described how they were trying to mix together the clay to produce a new color, a color that didn't exist "in nature." They were not interested in preserving the boundaries between spheres, exploring instead the possibilities of "unnatural" mixtures within and between layers. Visually, the cross sections of these clay sculptures were almost impossible to focus upon, appearing like a blurry, pixelated image even when holding it right up to your eye level. They conveyed a loss of resolution and separability of elements, achieving a mixture of milieus that, for many of the children, spoke to their sense of human culture, technology, politics,

and value becoming indistinguishable from the ecologies of the Earth's biosphere, carbon cycles, and climate systems.

These creative engagements with carbon map children's feelings and imaginaries in relation to climate change and carbon production. They also offer an original perspective on climate change that presents the situation from the child's perspective.

Conclusion

In this article, we have presented some initial creative, methodological routes into re-organizing relationships with carbon and energy cultures through arts-based research with children. Existing empirical research has focused on children and young people's scientific understandings of carbon, particularly in the broader context of climate change or global warming (Cutter-Mackenzie & Rousell, 2019; Rousell & Cutter-Mackenzie-Knowles, 2020). Such research can risk positioning children as limited, erroneous, and highly influenced by the media in their understanding of carbon and climate change more broadly. A number of recent studies, however, reveal that scientific knowledge-based approaches have been largely ineffective in altering the attitudes and behavior of children and young people toward climate change (Brownlee et al., 2013; Dijkstra & Goedhart, 2012).

Cognitive increases in knowledge about climate change show little to no correlation with pro-environmental attitudes or behavior in the wider population (Dijkstra & Goedhart, 2012). Indeed, Selby and Kagawa (2010) observed trends toward climate change skepticism in mainstream education programs where climate change is framed "as an issue calling for a scientific or technical fix rather than as a pathology of an ethically numb, inequitable and denatured human condition" (p. 42).

Perhaps affective attachments to climates and children's creative reconfigurations of environmental futures offer us new ways forward? While science has told us for a long time that the climate is changing, people repeatedly ignore and forget this fact, remaining largely unmoved. Children's imaginative renderings of possible climate change solutions offer an affectively very different way of connecting with climate change, perhaps a more motivating and inspiring means of relating to the more than human world and reworking our entanglements with energy cultures.

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Notes

1. For over 25 years, Z-Arts has occupied a repurposed Victorian era theater in the multiethnic neighborhood of Hulme. Offering a café, multiple exhibition spaces, theaters, and workshop spaces for the visual and performing arts, Z-Arts has become a community hub for children and young people to engage with cutting-edge arts education that addresses critical social and environmental concerns.
2. While the workshops allowed children to continuously engage with artistic processes as part of this inquiry into strata, their conceptual movements were also documented and mapped diagrammatically on the project website (see www.localalternatives.org/strata).

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