Chapter 6
Addressing Resistance to a Fact-Based Approach

Abstract  Facts are critical to making informed decisions but are often not enough to convince people to change their priorities. Scientific approaches like LCA presents obstacles and opportunities to non-specialists, including designers.

The self-preservation instinct is typically hardwired into each individual. This genetic predisposition to avoid certain risks that loom large in our consciousness both safeguards the continuation of our species and blinds us to less visible and possibly much greater threats. Media outlets play to the natural human reliance on heuristics and implicit biases. The confusion a “post-fact” world creates serves to maintain the status quo by perpetually calling into question well-established facts and stalling fruitful debate. Spectacular headlines provoke irrational fears that distract from other, more statistically likely threats.

Rhetorical techniques frame facts. Denialism is intended to create paralysis. More information is not necessarily better, if it is derived from sources that only confirm sociopolitical biases rather than challenging them. It is important to acknowledge contextual headwinds operating at the largest scales in society before blithely applying a targeted set of analytical techniques to measure environmental impacts in a design project.

Before presenting the “how-to” of integrating a data-driven approach to sustainable design decisions, however, it is important to recognize that facts in one domain are not always enough to persuade a decision-maker. Attributional LCA may improve process-based decisions without requiring wholesale recanting of firmly held world views. Non-geometric data serves designers as a foundation to a fact-based and measured approach.

6.1 Fast and Slow Decisions

Every day, we decide on whether to buy this or that, to drive faster or slower, or to vote for one candidate over another. We make certain decisions instantaneously, like running from a snarling dog, stepping out of the way of a speeding bus, or picking a favorite toothpaste from a grocery shelf full of competing products. These decisions leverage what psychologists refer to System 1 thinking. We reach them quickly and automatically, and they require little effort or concentration. Other decisions or activities require careful evaluation and calculation. Deliberating over which
healthcare plan to enroll our family in, for example, requires System 2 thinking to take over. System 2 engages when reaching a conclusion requires analytical processes (Kahneman 2013). Material decisions based in patient and technically detailed life cycle assessment activities reside primarily in the System 2 domain.

Sometimes the perceived importance of the decision and the weight of making the correct decision are so great that we freeze. We fall victim to the “paralysis of analysis.” Out of the fear of making the wrong choice, we get stuck in an endless loop of comparing the relative costs and benefits of each option. As the number of options rises, or the decision-making process identifies conflicting criteria, the time spent trying to decide also increases.

At some point we might conclude that making no decision is a choice and either walk away from the weighty responsibility or arbitrarily pick one option from an array of choices. Complicated choices, however, do not make up the majority of daily decision-making. Most of the choices we make every day seem relatively trivial, but taken together, the effects can add up. What we feel is risky behavior can have a lot to do with how we perceive it will impact our lives and, perhaps most importantly, when the effects will manifest.

6.1.1 Sustainable Choices

Behavioral economists study the way people make decisions. By observing people’s habits and the outcomes of their decisions in multiple settings, they collect and interpret data in order to more accurately predict the odds that most people will make one choice over another. The insights they uncover about our natural inclinations are based on observations of subjects in controlled experiments or pointed surveys that measure not the way we ought to behave but how we actually do behave when given the chance to decide between two or more options. Studies have shown that what we want is dependent on how close to now we are going to get it. We tend to make choices that conform to what we have been told is good for us. The healthy choice, the one that promises to bring about a state of well-being and long-term benefits, is what we tend to choose when we are planning for the future. The farther off “the future” is, the more likely we are to choose the rational, the healthy, and the “good” options, when focused on that which directly affects our own well-being.

Our natural inclinations are focused primarily on what is closest to us in time and space. Anything that might indirectly affect us is on the perceptual back burner. Harvard behavioral economist, David Laibson, speaks about “intertemporal choice” and how our actions or purchasing decisions can positively or negatively affect us in the future:

There’s a fundamental tension, in humans and other animals, between seizing available rewards in the present, and being patient for rewards in the future,” he says. “It’s radically important. People very robustly want instant gratification right now, and want to be patient in the future. If you ask people, ‘Which do you want right now, fruit or chocolate?’ they say, ‘Chocolate!’ But if you ask, ‘Which one a week from now?’ they will say, ‘Fruit.’ Now we
want chocolate, cigarettes, and a trashy movie. In the future, we want to eat fruit, to quit smoking, and to watch Bergman films. (Lambert 2006)

This decision-making dynamic holds in the considerations that dominate the commercial design world as well, where short-term risks of financial failure outweigh long-term environmental or social concerns. Clients responsible for the financial performance of individual projects and initiatives may make aspirational statements that embrace a sustainable design ethos, but meaningful actions are not likely to follow if they require any real change in business behavior or priorities.

Heuristics are used to substitute complex questions with simpler ones to break the cycle of decision-making paralysis and arrive at an answer. Designers may reframe an inherently complex problem using only a subset of criteria they feel most comfortable with to define acceptable parameters. When faced with complexity, or a threat to the financial bottom line, it is common to retreat to the traditional metrics of success.

Sustainable design and production is a multifaceted domain that ideally would include triple-bottom-line accounting considerations (Elkington 1998). To remain in business, however, mainstream design practices continue to hew closely to a client’s primary concerns which are often financial. A design firm that consistently and completely ignores financial, single-bottom-line issues is not viable in the marketplace for long.

Even designers able to successfully expand a single-bottom-line focus to include a project’s environmental impact often simplify the issues under consideration. To avoid the complexity that a multivariable matrix of weighted and qualified environmental impact categories introduces, they may optimize a single performance criterion such as energy efficiency, carbon footprint, or waste reduction. Attempting to treat all impact categories equally would require time and effort that are currently too resource intensive to integrate into the design process. The next three chapters, however, present workflow options to realistically consider a wider subset of material environmental impacts using purpose-built tools to do so.

### 6.1.2 Biases

Cognitive biases are constantly at work in the evaluation of relative threats or benefits. Availability biases work to convince that an event is less likely to occur if there are no examples available in recent memory; tomorrow’s world will be a lot like yesterday’s world based on easily retrieved memories (Schwartz et al. 1991). Confirmation biases promote the searching and accepting of only that information that supports personal view, beliefs, or values (Nickerson 1998). Hyperbolic discounting is at work in the earlier “fruit or chocolate” example when making more virtuous or health choices later but take immediate payoffs now. People make choices today that their future selves would prefer not to have made, despite using the same reasoning (Laibson 1997). Normalcy biases lead people to minimize or
completely disbelieve threat warnings. “The initial response to a disaster warning is disbelief” (Drabek 1986). Biases are the lenses we all filter information through when making decisions, and they warp perception when assessing likely threats and opportunities.

In his book, Global Catastrophes and Trends, the Next 50 Years, Vaclav Smil presents a measured and thoroughly researched evaluation of an array of possible mid-twenty-first-century threats. His approach systematically considers the odds that various natural and cultural/technological risks have to negatively affect the lives of individual human beings or wipe out the entire human civilization. Smil shows, for example, how relatively unlikely people were to die from a volcanic eruption, airline accident, or terrorist attack compared to car accidents or medical errors which were between three and four orders of magnitude more likely to take a life (Smil 2008). People tend to not focus on and guard against less spectacular but more likely risk events.¹

6.2 Climate Change Story

Directly explaining climate change to the public is like telling a story about rust. The pace and technical details of the story make capturing the imagination a challenge. No matter how certain the science is about what drives it, the facts and phenomena play out over a time scale to which most people have trouble relating or caring about. Even the most committed designers will likely not change the hearts and minds of clients who are not already convinced that there is a problem that their design addresses.

Stories of calamity and destruction are best told when the action happens suddenly. Unlike a nuclear explosion, a plane crash, or a house fire, the story about the incremental changes in the ratio of certain harmful chemical elements and compounds in air and water, measured in parts per billion, does not immediately captivate. Even when it concerns all the air and water we have, the slow pace and amorphous, invisible action tend to lose people’s attention. In today’s 24-hour news cycle, large and spectacular short-term changes that directly affect human life for the worse make better stories. They are fixed in the imagination more effectively than long, drawn out, “boring” processes that indirectly cause harm. The steadily warming environmental conditions that contribute to storm intensity (Murakami et al. 2017) don’t generate the same interest or audience ratings as the sensational coverage of a hurricane (Grabe et al. 2001). Because the violent effects of such a storm are clearly tragic, they focus attention and immediate action to respond to the crisis.

¹In the 2008 book, Smil concludes that we should be preparing for a nearly 100% chance of a novel strain of influenza to produce a global pandemic. He also calls for government programs to simultaneously increase energy efficiency and decrease overall use to benefit the environment.
Energy use, as discussed in Chap. 2, underpins every climate change story. Generating and using increasing amounts of the energy required to maintain the consumption/production status quo is directly linked to a network of complex environmental issues slowly playing out in the ecosphere (US EPA 2016). Attachment to habits are the root cause of increased energy consumption. In order to avoid modifying behavior born out of ideas of what we want, need, and deserve, now and in the future, some engage in endless debate to stall action (Oreskes and Conway 2011). While we wait, mean global temperatures continue to rise.

For those who wish to stall, what is said in these opposing narratives is not as important as how it is said in order to keep the debate going. If there are a hundred steps needed to effectively address the actual crisis, the debate functions to keep a long pause on the first step. While everyone is frozen, arguing the fundamentals, concerted large-scale action is impossible. Democratically elected governments wait, hedge bets for political and short-term economic reasons, and stall. Agencies, tasked with studying the problem further, make incremental policy changes and write regulations that may or may not be enforceable. Effective action to address this problem is hindered, while the fundamental cause of the problem is endlessly debated. Despite the majority of international scientists reporting overwhelming evidence to support the view that human activity is causing global temperature to rise, the debate continues.

Although gradual and incremental, sea-level rise may be the most visible of all the effects, as higher seas directly impact coastal cities. Buildings and entire regions, flooded or washed away by ever-costlier storms, make headlines. Rather than spurring action to address root causes, threats from large storm surges mobilize governments who have the means to “harden” infrastructure with steel and concrete barriers against hurricane force winds and waves. Wealthy nations fund resiliency initiatives to protect life and property in vulnerable areas where they have economic or political interest all over the world.

Other effects, while even less evident, are no less real and even more dangerous to life on earth. Subtle but irreversible changes to the chemical composition of the same seawater that inundates shore communities have farther-reaching implications. These subtle changes extend beyond the shore to the air we breathe and the soil we depend on to feed ourselves. They affect everyone, not only coastal dwellers. No matter how high up or how far inland we move from flood-prone cities, we still need clean air, potable water, and healthy food to live.

6.2.1  The False Debate over Fundamental Causes of Climate Change

Some people, with the potential to influence policy decisions, do not or will not believe human activity has any significant impact on the overall environment. Some may acknowledge the connection between the two but will not act. Many of the
same lawmakers who pass funding initiatives to build higher seawalls against rising sea levels, and even agree to fortify natural estuary buffers to address a threat whose effects they can see, lack the vision or political will to tackle the root causes of the threat (Nawaguna 2020). They may not fully subscribe to a maximum fossil fuel extraction agenda powering established production and consumption patterns. Nevertheless, the economic imperative to maintain and support existing carbon-based energy production systems are often too politically expedient and compelling to argue against publically. The net effect is that they do not publicly accept climate change as a dilemma. They remain unconcerned with the consequences of increasing the extraction and burning of fossil fuels, so long as the economy in their district grows enough to get them reelected. This attitude forms one pole of the debate, and it elicits an equally strong opposite reaction from those who disagree (Tyson and Kennedy 2020).

Still, most people, irrespective of which opinion they hold, simply do not know for sure. From time to time, they may tune in to the climate change debate to see who is prevailing. Ideally, the debate would be rooted in hard science and the consensus findings of the great majority of researchers. The enormous short-term political and economic outcomes at stake, however, often trump rational serious consideration of scientific facts. Specious arguments and denialism attempt to obfuscate decades of sound and patient global climate research founded on centuries of fundamental and uncontroversial science.

These two opposing views are not represented equally among people in the scientific community. An overwhelming majority of the world’s climate research scientists (97%) have concluded that the rise in global temperatures and the resultant change in our climate systems are caused by human activity (Cook et al. 2013; Cook et al. 2016; NASA 2020). Still, denialist fringe groups persist in formulating messages intended to maximize doubt in debates carried by both conservative and liberal media outlets. Such false skepticism, promoted to create the net perception that we still do not know for sure what is causing the rise in global temperatures, side-steps the scientific debate. Climate denialists regularly use pseudoscience to directly confront genuine climate science (Hannson 2017).

Conservative media backs status-quo industry interests and regularly parades unqualified “experts” to opine on the debate and cast doubt on the scientific consensus in order to keep advertising funding flowing. Some of their chosen spokespeople have science credentials (not necessarily climate science), but many are chosen primarily for their considerable rhetorical, debate, and presentation skills. In the name of fair and balanced coverage, even mainstream media outlets may turn to the same people when reporting on climate change issues.

Denialists use a set of common rhetorical techniques in the media that leverage normal human biases to challenge scientific facts. John Cook is a research assistant professor at George Mason University’s Center for Climate Change Communication. He has developed the mnemonic acronym, FLICC, to help people clearly remember which ones are being used to frame arguments to refute scientific facts. His FLICC taxonomy uses a series of subtitled icons to show and reinforce the array of techniques used (see Fig. 6.1)
Instead of proceeding to fruitful discussions about what specific corrective actions to take to improve our ecological fortunes, we allow ourselves to become mired in conversations about fundamental science. The physical causes of a rise in atmospheric temperatures have been known for over a century, ever since Svante Arrhenius published his quantification of carbon dioxide’s contribution to the greenhouse effect (Arrhenius 1896).

The reason the debate can continue at all, though, is that most people do not know anything about fundamental climate science. This is broadly true of anyone outside the scientific community and includes policymakers, corporate leaders, consumers, and designers. Figure 6.2 clearly shows the climate science milestone
Fig. 6.2 Timeline of major events in the history of climate science, 1820 to present. From “The History of Climate Science” on Skeptical Science: http://sks.to/history (Cook et al. 2016). (Used under Creative Commons Attribution-Share Alike 4.0 International)
discoveries that for nearly 200 years have established clear evidence linking increasing CO₂ levels to global warming.

The protracted debates, however, do not continue due to a lack of information or knowledge. It may not even come down to a denial that a crisis exists. Rather, ecological concerns may simply be significantly lower priorities than economic ones. Hyperbolic discounting, operating at industrial scale, needs to be acknowledged and addressed. If both ecologically and economically acceptable product and project options are available, then the need for a tradeoff between them disappears. This is applicable not only to design but to all industrial disciplines. Environmental LCA can play a part by providing midpoint indicators of environmental performance. But there are further considerations to deal with before committing to building LCA into a design workflow.

6.3 Taking Issue with Life Cycle Assessment

Many critics have pointed to the basic problem of data reliability and the effort it takes to properly collect and use it as LCA’s Achilles heel. In her overview treatment of the subject as it relates to building design and building products, Kathrina Simonen correctly identifies barriers to fundamental accuracy, usefulness, and cost-effectiveness the results issuing from study documents. She points out the arguable pessimists’ view that LCA is being oversold and that broad extrapolations can be consistently drawn and used from existing expensive and detailed LCA studies:

A huge effort is required to conduct an LCA and the results can be of questionable value: uncertain with limited value to conduct change. One can argue that even in the relatively certain field of operational energy use (with meters to track consumption), we find our ability to predict actual energy use has limited precision. How can we expect to develop credible data throughout a complex and changing supply chain and the uncertainty of building life cycle stages?...Unless LCA can become cost-effective and integrated within existing design and manufacturing processes, the effort of conducting an LCA can often outweigh the benefits. (Simonen 2014)

This pointed criticism regarding the inherent complexity, uncertainty, and great expense in time and money to conduct a full life cycle assessment is shared across disciplines and will most likely not be solved by any single industry, profession, or field. LCA conclusions also have the disadvantage of being applicable or valid only to the specific product or service it studied. Change one materially important process or boundary condition in the defined life cycle and the whole profile can change, rendering the formal LCA no longer valid to describe what it originally assessed.

The first iterative LCA “goal and scope” phase anticipates and foreshadows the next three. Before proceeding with a discussion and demonstration of beneficial applications of subsequent LCA phases, it may help to pause and address the questions and concerns raised by this overall approach to evaluating what and how to satisfy the demands of a market. Since the majority of both designers and clients are
not steeped in the technical ins and outs of ecologically responsible evaluations, some may hesitate to embrace an additional process that seems to demand:

1. Extra expense.
2. A faith in a set of detailed and qualified facts and study conclusions expressed in scientific terms.
3. Willingness to expand focus and attention beyond a single ecologically important impact category such as global warming.
4. A willingness at the end of it all to accept a level of uncertainty that decisions will actually yield ecologically superior decisions across multiple impact categories.
5. Acceptance that LCA focusses primarily on environmental impacts and does not take other important considerations such as cost and societal impacts into consideration.
6. Cannot effect an order of magnitude change through available options.
7. That there may be no truly “good” decisions and “less bad” ones will only delay the inevitable.
8. Acceptance of results that are not comparable with any other study document of a similar product system.
9. Faith in imperfect models that are abstract and that cannot fully capture reality.
10. Comfort with nonintuitive, nonvisual, data-driven processes to provide insight.

These are all legitimate concerns that, if ignored, will hamper efforts to expand the use of LCA and the design tools that it supports. New tools used to integrate LCA data into the design process can mitigate some of the concerns but until there is a fully automated and seamless interface, challenges to broad acceptance will continue to persist. Yale University’s Phillip Bernstein predicts that as workflows shift to more cloud-based integrated data-centric models with a constellation of tools accessing a common data feed, a greater number of firms will be able to directly integrate LCA into architectural projects (Cays 2017).

### 6.3.1 The Attributional LCA Time Scale

Life cycle assessment provides foundational information leading to better predictions within a clearly defined time horizon and potential impacts within that temporal window. While nearly impossible to directly compare and evaluate all aggregate risks associated with industrial product environmental impacts, it is possible to at least see and compare two or more options in a study before deciding on which of them to choose. Two different but legitimate approaches are available but serve different purposes. The ILCD handbook states that:

The attributional LCI model describes its actual or forecasted specific or average supply chain plus its use and end-of-life value chain, all embedded into a static technosphere.
The consequential LCI model describes the supply chain as it is theoretically expected in consequence of the analyzed decision, embedded in a dynamic technosphere that reacts to a change in the demand for different products (EUR 24708 EN 2010).

Potential impacts to midpoint impact categories are calculated from life cycle inventory data. Midpoint categories include:

- Climate change.
- Ozone depletion.
- Human toxicity.
- Respiratory inorganics.
- Ionizing radiation.
- Ground-level photochemical ozone formation.
- Acidification.
- Eutrophication.
- Ecotoxicity.
- Land use.
- Resource depletion.

These midpoint categories can then be extended further out on the impact pathway to broad endpoint categories such as damage to human health, damage to ecosystem diversity, and resource scarcity. The farther into the future, the wider the spatial boundaries, and the greater the quantity of interacting variables in the system being studied, the less certain any attempt will be to accurately calculate the probability of any specific consequence coming to pass. It is likely that consequential LCA will continue to be challenged by technical limits, complexity, and inherent uncertainty that surround making large-scale predictions. For designers, the tools available primarily use attributional methodologies that focus on potential midpoint impacts inferred from LCI data.

### 6.4 An Appeal to Reason

When doubt and confusion reign, decision-making suffers. As we struggle to define and delineate the boundaries of such a large and complex problem as climate change, there can be an enormous delay before we even start developing effective approaches to its solution. Before we decide on even the first steps, the problem itself must be firmly established and understood. Questioning the causes is where most of us get stuck, paralyzed by the conflicting messages we hear from the “experts.” Neither of the dominant opposing views refutes the fact that the average temperature on the planet is rising. However, global warming is alternately referred to as a human-caused “crisis” demanding immediate action or as part of a natural process over which we have absolutely no control.

Effective appeals to consider alternatives to operational status quo often fail to convince. Emotionally charged positions based solely on firmly held personal
beliefs rarely change when confronted with facts (Björnberg et al. 2017). This is especially true when there is a perceived potential for immediate or short-term financial loss. There is no better illustration of this dysfunctional dynamic between ideology and facts than the variety of politically motivated COVID-19 global pandemic responses and the results playing out in 2019, 2020, and probably well into 2021 even as life-saving vaccinations are made widely available.

World views, immune to evidence-based arguments, are built over a lifetime shaped by experience that supports counterfactual reasoning (Van Hoeck et al. 2015). While fact-based approaches offer limited success in prompting a change in the behavior of the most strident climate and environmental science denialists, they, nevertheless, provide a foundation to support rational action. The LCA framework provides a stable structure to present detailed evidence of the environmental effects attached to any product system. Framed by the formally established goal and scope phase, subsequent LCA phases provide more detail and reach qualified conclusions about the impacts of the assessed goods and services.

The parallels between LCA and design praxis in establishing a well-defined project goal and scope don’t hold for the critical LCI and LCIA phases. Designers presenting evidence-based sustainable options to clients are not typically involved in these detailed technical phases but, as discussed in the next three chapters, can employ tools and techniques supported by the mounting evidence and growing data-set continuously generated by experienced LCA practitioners and the industries they study closely.

Deliberative thought, predicated on trustworthy facts, requires time. The practices and language we have developed for thinking, reasoning, and collectively deciding are methodical and thorough. In a post-fact media landscape, however, we are encouraged to do nothing. But, as established in Chap. 1, that is an impossibility. While we allow business to go on as usual, each living breathing human being on the planet continues to take in and give back, and our technologically amplified actions are increasingly unsustainable.

### 6.4.1 Impossible to Do Nothing

With that in mind, it is worth noting that there are two meanings to the phrase “impossible to do nothing.” The first is a biological fact of being alive here and now. The second is a call to act, to first understand the scope and consequences of our thoughts and actions, and then to make the necessary and appropriate changes that will ensure our own and future generations’ ability to thrive. Effective changes take place at different rates through individual daily decisions on what and how we will consume and also through collective political action.

It is also a fact that, whatever the causes, inaction at the individual and collective level is a decision with consequences. The status quo has inertia on its side to maintain deeply engrained habits and practices just as they are. Any change in direction to the system, even a small one, requires a force to move it. Therefore, before we...
design anything, we must first understand the key elements that define and influence the system we wish to improve; then we must improve it through decisive action informed by trustworthy data.

### 6.4.2 Inventory Analysis (LCI)

Data is at the heart of all LCA activities. LCA experts define life cycle inventory (LCI) as “a methodology for estimating the consumption of resources and the quantities of waste flows and emissions caused by or otherwise attributable to a product’s life cycle. Consumption of resources and generation of waste/emissions are likely to occur at multiple sites and regions of the world, as different fractions of the total emissions at any one site (the fraction required to provide the specified functional unit; allocation amongst related and nonrelated co-products in a facility such as a refinery, etc.), at different times (e.g. use phase of a car compared to its disposal), and over different time periods (multiple generations in some cases, e.g. for landfilling)” (Rebitzer et al. 2004). ISO 14040 and ISO 14044 provide guidance in how to carry out LCI activities.

LCA practitioners have, since the 1990s, taken data quality into consideration. Established data pedigree matrices qualify individual bits of information that flow into the models that describe product systems. Pedigree typically includes indicators such as source reliability, completeness, temporal correlation, geographical correlation, and technological correlation (Weidema 1998; Frischknecht et al. 2005). Chap. 7 will further discuss the essential LCI data foundations and how they support design workflows tools.

### 6.5 Dominance of Geometric Data Models in Design Education

Even when there is general sympathy with integrating new and better data-driven approaches, established visual cultural practices may resist change. Just as the single financial bottom line can dominate all other concerns in professional design practices, the aesthetic bottom line typically reigns in schools of design where financial constraints can be disregarded.

There are both challenges and opportunities in the wider adoption of LCA in professional architectural education. In an Architectural Design article on LCA data and design workflows, I noted that “Life Cycle Assessment is fundamentally abstract and technical, as opposed to visual and intuitive, which may account for its slow adoption by most architecture firms” (Cays 2017). This observation continues to be reinforced by the conversations I have with designers and design students today.
Models of architecture and design projects in both the academy and in professional practice focus overwhelmingly on the geometric relationships of proposed design elements. Final presentation diagrams, technical drawings, and renderings in design critiques focus on the physical dimensions, programmatic arrangements, and functions supporting a design concept. Students learn early to focus primarily on the visual aspects of their projects as a matter of course.

The largely qualitative academic and professional design discussions contrast starkly with LCA’s dry quantitative technical language and heavily qualified statements. Interpretive data visualization tools and dashboards make LCA, non-geometric, tabular data more accessible. However, the physically large-scale, but essentially invisible, environmental phenomena these data describe rarely turn heads in a design critique. Juries discuss the formal merits of a design project. Asking panelists to focus on the “eutrophication potential” or even the more recognized and accepted categorical threat “global warming potential” of different design alternatives is a hard sell. What to do with environmental impact assessment statements, even when based on trustworthy data, is not immediately evident.

6.5.1 Aesthetic/Technical Split in the Academy

Professional design schools teach important technical subjects, but, in the end, these are often relegated to relatively minor roles in holistic design assessment. In architectural education, building science courses in construction, structures, and environmental control systems supports the design studio where a two and a half to one lion’s share of credits in design curricula are distributed. Design programs typically attract students who want to manifest their creative impulses at various scales in the physical world. Technical analysis is typically tolerated but less valued than formal synthesis. This is the main challenge to integrate LCA into design curricula.

The tension between the technical and aesthetic reflects the bifurcated origins of the design academy. Today’s design schools are rooted in and modeled on two parallel academic traditions: the polytechnic and the beaux arts. In today’s siloed academic environment, integrating the “Arts and Sciences” as a set of complementary approaches to explore physical phenomena is still more of a wish than a practical reality. This is true even in amalgamated and applied disciplines like design.

There is a growing student and faculty interest in “life cycle thinking.” But when faced with the requirements of conducting proper studies as defined in the ISO 14040, 14,044, and other data-driven standards, the conversation quickly turns away from rigorous quantitative analysis back to the familiar comfort and safety of formal synthesis. This is, in no way, intended to diminish the necessity of serious qualitative design critique. Rather, it is an observation of primary drivers of academic design decisions that present a challenge for LCA adoption.
6.5.2 Bridging the Divide

In the 2012 Life Cycle Assessment Handbook’s final chapter titled “Life Cycle Knowledge Informs Greener Products,” James Fava identifies the emergence of software interfaces that will promote wider LCA adoption by the design disciplines and “go a long way toward ensuring that life cycle environmental information is used in product commercialization” (Fava 2012). This practical approach recognizes that it is unrealistic to expect non-specialists to embrace the rigors and statistical subtleties involved in formal LCA goal and scope definition, data inventory collection, impact assessment, and iterative interpretation exercises. Fortunately, software interfaces that marry digital geometric models with non-geometric data and provide impact assessments over multiple environmental impact categories are becoming increasingly available. Additionally, CPU and GPU hardware processing power continues its steady climb, setting the groundwork for a new generation of real-time interactive dashboards. These new interfaces will potentially be able to draw LCI data in and integrate it directly into the material libraries in designers’ geometric models.

6.5.3 One Country’s Call to Measure and Assess

Calls are growing louder by both the design professions and the academy to have sustainability data-drive design. The American Institute of Architects’ 2019 Framework for Design Excellence and the National Architectural Accrediting Board’s 2020 Conditions for Accreditation both promote actionable sustainability standards. The AIA Framework’s Design for Resources provides useful links to LCA software resources and the International EPD Database. These voices are added to numerous other professional academic, professional, and third sector groups that have, for many years, been advocating for a science- and data-driven approach to a more sustainably designed built environment.

In the summer of 2019, over 100 representative academic, professional, regulator, and student stakeholders gathered in Chicago. During a 3-day multilateral forum. They finalized the main points driving the Conditions of Architectural Accreditation, and a writing team of seven condensed the stakeholder findings into the final 2020 Conditions for Accreditation. Six shared overarching values were defined. One of which is environmental stewardship and professional responsibility. It says that:

Architects are responsible for the impact of their work on the natural world and on public health, safety, and welfare. As professionals and designers of the built environment, we embrace these responsibilities and act ethically to accomplish them.

A fine statement but in order to be actionable, two more criteria, to be met by all architecture programs, were included in the 2020 conditions:
1. **PC.3 Ecological Knowledge and Responsibility which States that**

A program must demonstrate how its curriculum, structure, and other experiences address(es … how it] instills in students a holistic understanding of the dynamic between built and natural environments, enabling future architects to mitigate climate change responsibly by leveraging ecological, advanced building performance, adaptation, and resilience principles in their work and advocacy activities.

2. **SC.5 Design Synthesis**

[A program must demonstrate how it ensures, through program curricula and other experiences, with an emphasis on the articulation of learning objectives and assessment] that students develop the ability to make design decisions within architectural projects while demonstrating synthesis of user requirements, regulatory requirements, site conditions and accessible design and consideration of measurable environmental impacts of their design decisions. (NAAB 2020)

This last criterion must be demonstrated in the passing design work of *all* students preparing to enter practice. My introduction of the phrase measurable environmental impacts was resisted by some at the time since it did not mention carbon foot-printing by name and also because it was unclear how design students would measure the broad environmental impacts of design alternatives since they had never had to before. It was finally agreed that quantification of environmental impacts would be included as a student requirement. If the two preceding accreditation conditions that centered on environmental stewardship, ecological knowledge, and professional responsibility were to *actually* support public health, safety, and welfare, then each and every student about to enter the profession had to prove how his or her design decisions consider and act on the insights the non-geometric environmental impact category data can reveal.

James Fava ended his chapter in 2012 saying that “the jury was still out on whether this trend will continue” but that he predicted that LCA information would be used more and more to inform decision-making in both government and private sectors. It seems that he, and all who have been optimistic about LCA’s ability to augment many other fields, was right. They predicted wider operationalizing of LCA data through new visualization tools (Fig. 6.3).

The last three chapters of this book focus on a student-centric approach to build broader awareness and encourage the use of several LCA/LCIA data interfaces. Several approaches were evaluated, from semiautomatic processes that leverage building or product information models such as Tally, One Click LCA, and Solidworks Sustainability to spreadsheet processes that work off of the Athena Impact Estimator for Buildings. Much of this work came out of a close collaboration with an independent study undergraduate architecture student, Erin Heidelberber. The work is primarily focused on the building scale due to the majority of design tools that can interface with building centric data. Putting these practical approaches into practice, designers of every stripe can augment their creative impulses and improve judgment with a growing number of effective LCIA tools that eliminate much of the painstaking work required in a proper quantitative life cycle approach to design.
Fig. 6.3 A growing number of LCA/LCIA tools are available to designers to reduce friction in sustainable design decision-making

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